DOE/OR/21548-158
CONTRACT NO. DE-AC05-86OR21548

WSSRAP CHEMICAL PLANT GEOTECHNICAL INVESTIGATIONS

For the
Weldon Spring Site Remedial Action Project
Weldon Spring, Missouri

Prepared by MK-Ferguson Company and Jacobs Engineering Group

DECEMBER 1990 **REV. 0**

U.S. Department of Energy
Oak Ridge Operations Office
Weldon Spring Site Remedial Action Project

121090

DOE/ORO/21548-158

Weldon Spring Site Remedial Action Project

WSSRAP Chemical Plant
Geotechnical Investigations

December 1990

Revision 0

Prepared by

MK-FERGUSON COMPANY
and
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Prepared for

U.S. DEPARTMENT OF ENERGY
Oak Ridge Operations Office
Under Contract DE-AC05-86OR21548

georpt.cp/ccp/jof

121090

Printed in the United States of America. Available from the National Technical Information Service, NTIS, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161

NTIS Price Codes - Printed copy: A99
Microfiche: A01

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1 INTRODUCTION

1.1 General

This document has been prepared for the United States Department of Energy (DOE) Weldon Spring Site Remedial Action Project (WSSRAP) by the Project Management Contractor (PMC), which consists of MK-Ferguson Company (MKF) and Morrison Knudsen Corporation Environmental Services Group (MKES) with Jacobs Engineering Group (JEG) as MKF's predesignated subcontractor. MKES provided most of the field and technical support to the PMC for the geotechnical investigations and for the preparation of this document. Since MKF and MKES are both subsidiaries of the Morrison Knudsen Corporation, the distinction between the activities of each organization is not always specified in this document.

This report presents the results of site geotechnical investigations conducted by the PMC in the vicinity of the Weldon Spring chemical plant and raffinate pits (WSCP/RP) and in potential on-site and off-site clayey material borrow sources. The WSCP/RP is the proposed disposal cell (DC) site.

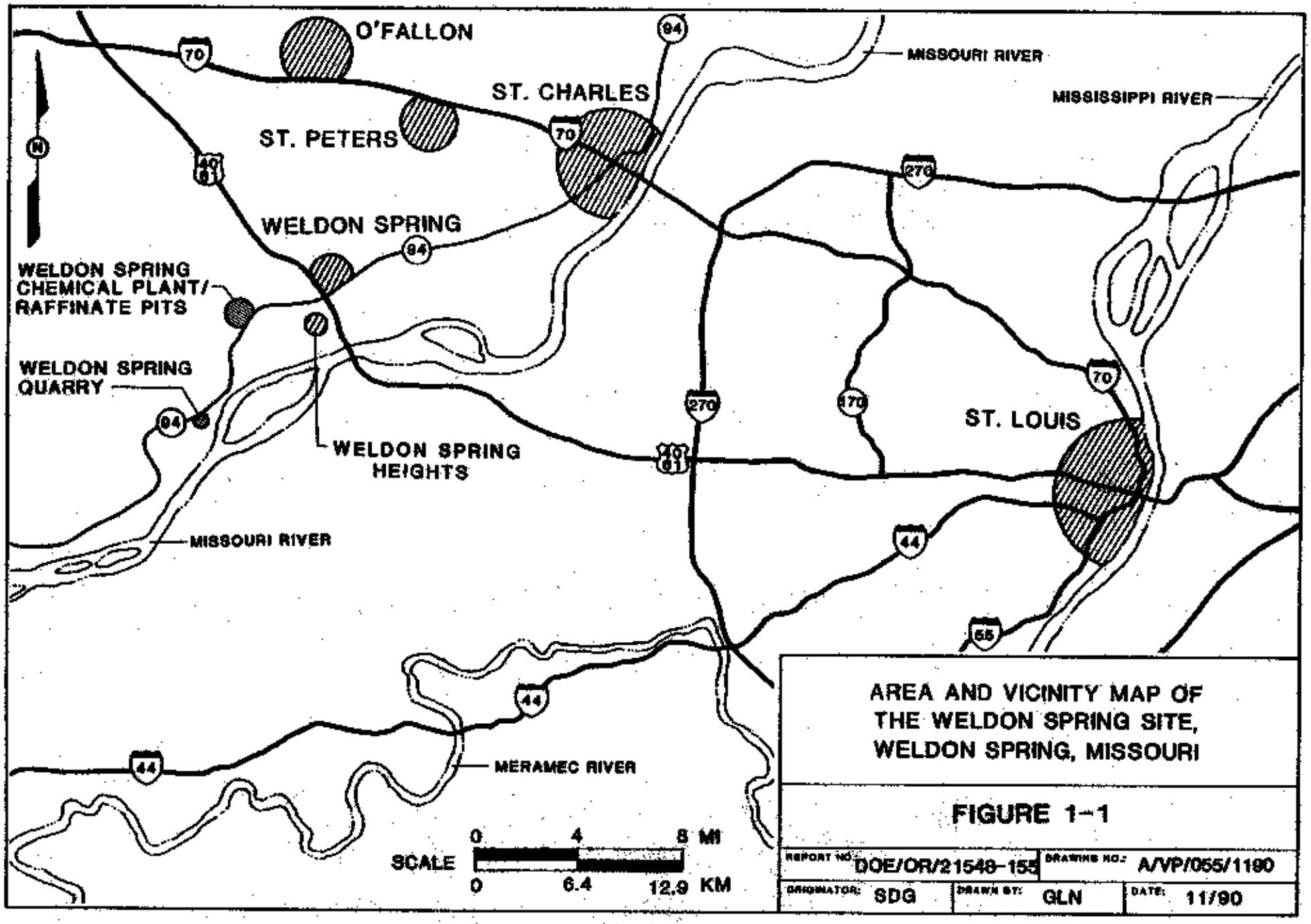
The proposed disposal cell will be used for long-term storage of contaminated waste materials generated from clean up of the Weldon Spring site. The geotechnical investigations were part of the field data collection for the remedial investigation/feasibility study (RI/FS) process. This process is specified by the National Contingency Plan (NCP) which requires investigation and evaluation of waste sites. The data will also be used to support RI documentation (MKF and JEG 1990c), the site suitability study (MKF and JEG 1990b), and the design of the proposed disposal cell, including temporary facilities. The

investigation program generally followed the rationale and procedures identified in the Geophysical/ Geotechnical Investigation Sampling Plan (MKF and JEG 1988b). Results of previous geotechnical investigations of the site and in-progress PMC RI efforts were reviewed and are discussed in sections on geologic and site characterization of the subsurface materials.

As illustrated in Figure 1-1, the Weldon Spring site is located approximately 30 miles west of St. Louis, Missouri, near the town of Weldon Spring in southwestern St. Charles County. The proposed disposal cell site lies just west of Missouri State Highway 94, approximately 2 miles southwest of its junction with U.S. Highway 40 (Interstate 64) near the communities of Weldon Spring and Weldon Spring Heights. The Weldon Spring site also includes the Weldon Spring quarry (QY) located approximately 4 miles south-southwest of the proposed disposal cell site. The geotechnical investigations at the quarry site, which were conducted in conjunction with investigations at the proposed DC site, are addressed in a separate report (MKF and JEG 1990c). Figure 1-2 shows the existing facilities at the site.

The investigations were conducted in two phases. Phase I began in June 1988 and concluded in August 1988. These investigations included drilling in the west dike of raffinate pit No. 4, in the proposed administration building footprint (now constructed), and in the proposed disposal cell area. On-site test pits from which clay or fill material might be borrowed were excavated by a backhoe. Surface geophysical surveys were also performed.

Phase II investigations began in January 1989 and were completed in August 1990. These investigations included drilling angled boreholes in the proposed disposal cell area, drilling



AREA AND VICINITY MAP OF THE WELDON SPRING SITE, WELDON SPRING, MISSOURI

FIGURE 1-1

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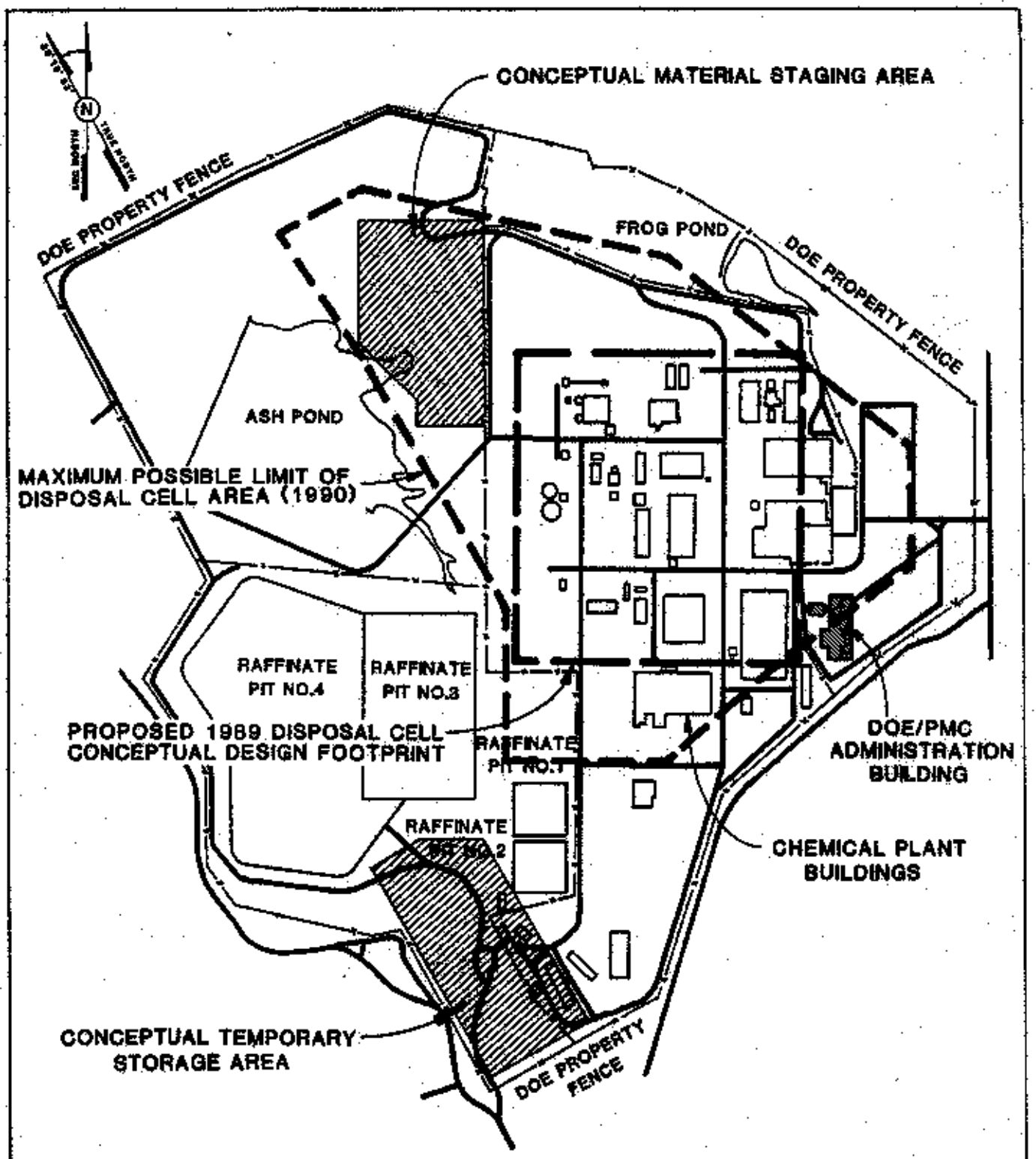


NOTE: FACILITIES SHOWN ARE EXISTING AS OF 1986 UNLESS AS INDICATED

SOURCE: MK-F & JEG, 1990

SCALE 0 500 1000 FT
0 152.4 304.8 M

WELDON SPRING CHEMICAL PLANT/ RAFFINATE PIT SITE PLAN

FIGURE 1-2

REPORT NO.: DOE/OR/21548-155	DRAWING NO.: A/CP/099/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90

boreholes and installing piezometers within and adjacent to the proposed disposal cell area, drilling in the proposed temporary storage area (TSA), and excavating test pits in two potential off-site areas for clay borrow sources. Additional work in Phase II consisted of excavating test pits in the material staging area (MSA) in August 1990.

A summary of these investigations is listed in Table 1-1. Locations of boreholes, piezometers, wells, pits, and geophysical survey lines for Phase I are shown in Figure 1-3; those for Phase II and the additional MSA investigations are shown in Figure 1-4. Off-site borrow test pit locations are shown in Figure 1.5.

In addition to the above activities, the geotechnical site investigations included the relogging of rock cores from boreholes drilled during previous investigations.

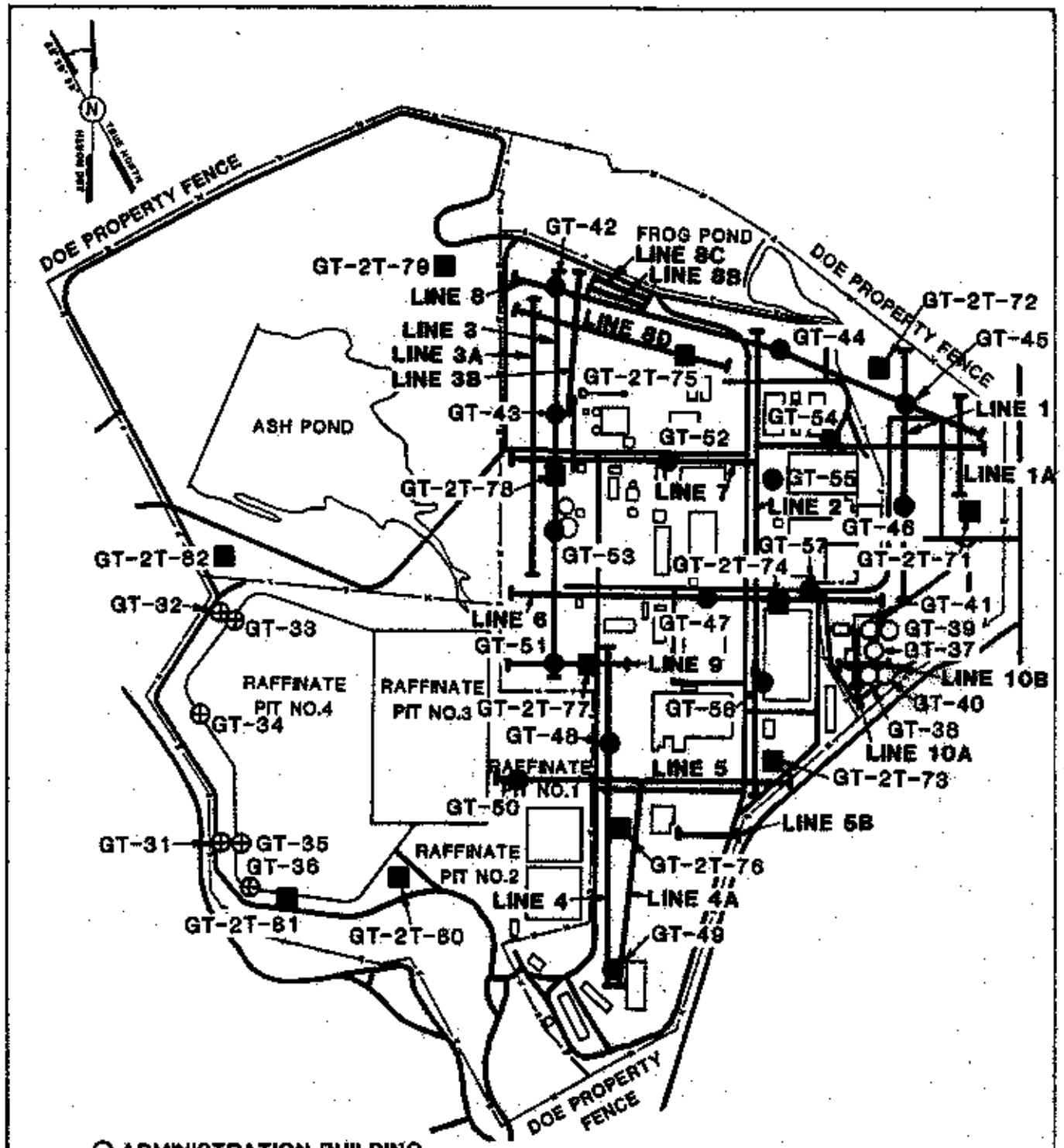
1.2 Purpose and Scope

The purpose of this document is to present the geotechnical field and laboratory data that were obtained to characterize the overburden materials in support of proposed remedial action activities for the disposal cell. Engineering parameters, analyses, and recommendations regarding the subsurface soils and foundation are not part of this report, but will be prepared during a separate special study. The site plan in Figure 1-2 shows the maximum limits and the proposed 1989 conceptual footprint of the disposal cell and related facilities. The footprint shown represents its planned location at the time of planning and execution of the field investigation program (1988-1989). The maximum possible limit shown represents the maximum size of a disposal cell at this site as determined by the PMC in 1990.

TABLE 1-1 Summary of PMC Geotechnical Field Investigations at the Weldon Spring Site

Location	Data Sources	Text References	Purpose
PHASE I (June - Aug, 1988)			
Raffinate pit No. 4	Borings and Piezometers GT-31 to GT-36	Figure 1-3 & Appendix A-1	Dike stability; groundwater monitoring.
Proposed administration building	Borings GT-37 to GT-41	Figure 1-3 & Appendix A-2	Foundation soil parameters.
Proposed disposal cell	Borings GT-42 to GT-57	Figure 1-3 & Appendix A-3	Soil and bedrock parameters; corroborate geophysical survey results.
Various, on site	Test pits GT-2T71 to GT 2T82	Figure 1-3 & Appendix A-4	On-site clay borrow materials.
Proposed disposal cell	Geophysical survey lines #1 to 10	Figure 1-3 *See Note	Subsurface geophysical model.
PHASE II (Jan - Sept, 1989)			
Proposed disposal cell	Angle borings AH-1, AH-2	Figure 1-4 Appendix B-1	Bedrock structure and hydraulic conductivity.
Proposed temporary storage area	Borings GTS-1 to GTS-7	Figure 1-4 Appendix B-2	Foundation soil parameters.
Proposed disposal site perimeter	Borings and piezometers GT-58 to GT-67	Figure 1-4 Appendix B-3	Soil and bedrock parameters; groundwater monitoring.
Potential off-site clayey borrow source (SSE of DC site)	Test pits TPBS-1 to PBS-30	Figure 1-5 Appendix B-4	Off-site clay borrow materials suitability.
ADDITIONAL WORK TO PHASE II (Aug 1990)			
Proposed materials staging area	Test pits TPMS-1 to TPMS-9	Figure 1-4	Soil parameters.

NOTE * Geophysical survey conducted by Geotechnology Services, Inc., 1988. See reference report.



○ ADMINISTRATION BUILDING BOREHOLE (LOCATION APPROXIMATE)

⊕ RAFFINATE PIT NO.4 DIKE BOREHOLE

● DISPOSAL CELL BOREHOLE/ COREHOLE

■ PLANT SITE TEST PITS

GEOPHYSICAL SURVEY LINE

SCALE 0 500 1000 FT
0 152.4 304.8 M

PHASE I FIELD INVESTIGATIONS
LOCATION MAP

FIGURE 1-3

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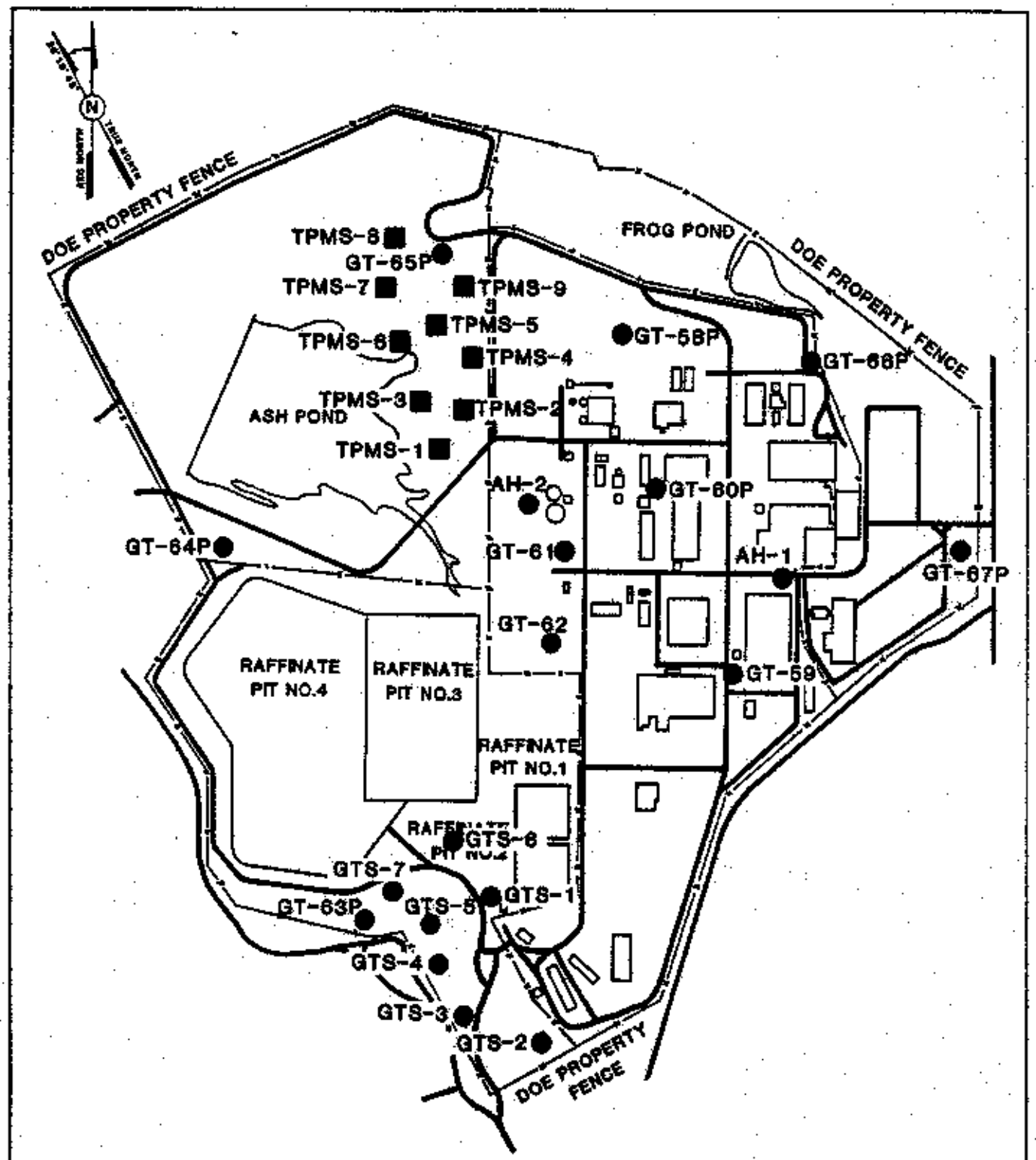

● -DRILL SITE

■ -TEST PIT

SCALE 0 500 1000 FT
0 152.4 304.8 M

PHASE II FIELD INVESTIGATIONS AND ADDITIONAL MSA TEST PITS LOCATION MAP

FIGURE 1-4

REPORT NO.: DOE/OR/21548-155	DRAWING NO.: A/CP/101/1190	
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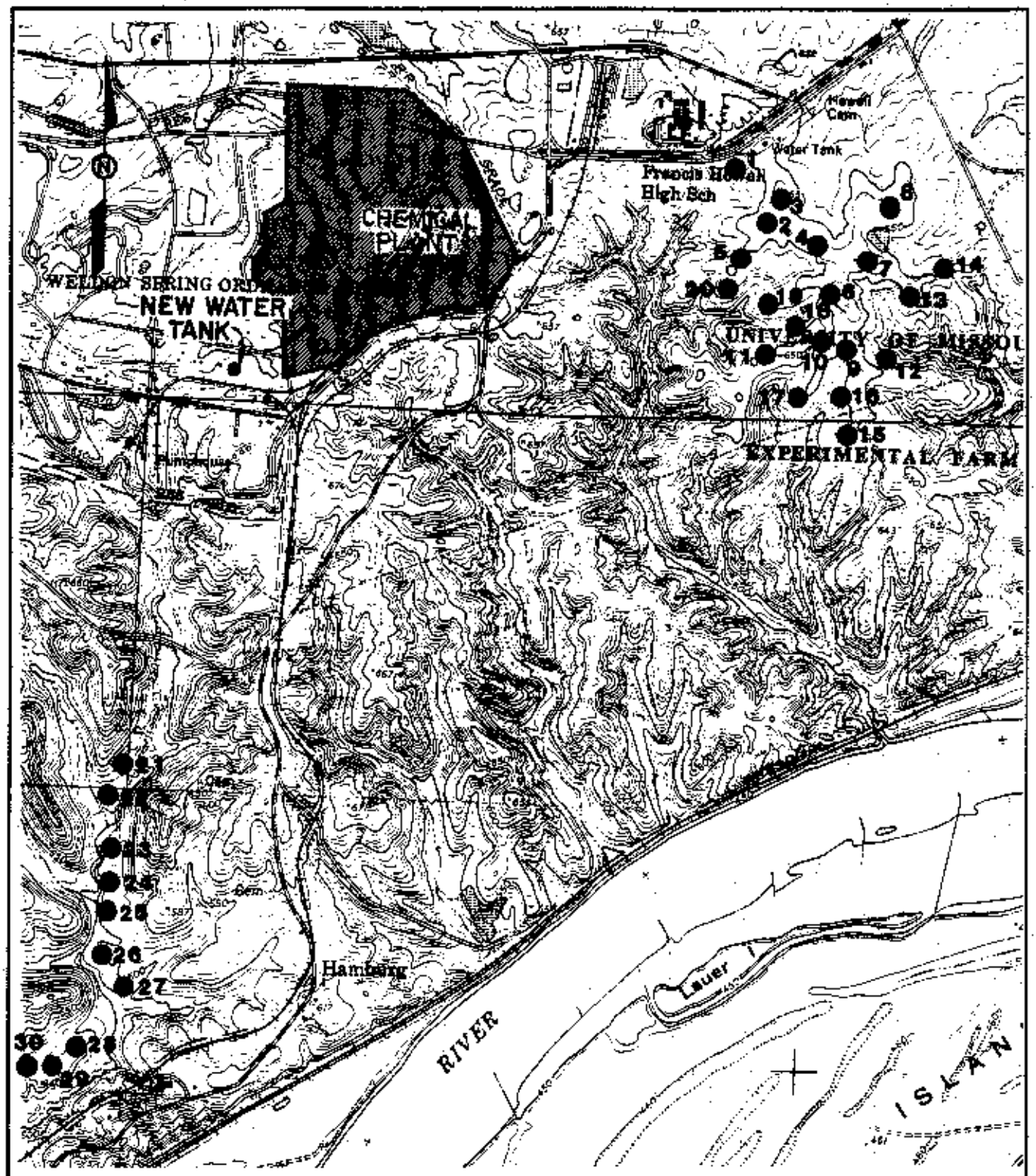

8● TEST PIT LOCATION (TPBS-8)

0 2000 4000 FT

0 609.6 1219.2 M

SCALE

SOURCE MAP: USGS QUAD MAP

OFF-SITE CLAY BORROWS SOURCES TEST PIT LOCATION MAP

FIGURE 1-5

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Geotechnical field investigations conducted by the PMC began in June 1988 and were completed in August 1990. Field activities included overseeing borehole drilling, piezometer installation, test pit excavation, and geophysical survey. Soil samples collected during field investigations were sent to subcontractor laboratories for testing under the direction of the PMC. Laboratory testing began in June 1988 and was completed in October 1990.

The PMC geotechnical investigation program provided data for the following items:

- Foundation engineering parameters for the design of the administration building.
- Subsurface characterization and engineering parameters for the site suitability study and design of the disposal cell (1989 version).
- Foundation engineering parameters for temporary storage area design.
- Foundation engineering parameters for material staging area design.
- Dike stability assessment of raffinate pit Nos. 3 and 4.
- Potential off-site borrow sources for clayey material.
- Potential utilization of uncontaminated on-site soils for construction materials.
- Groundwater elevations.

- Relogging of selected core samples from previous investigations.

A description of the purpose and the number of boreholes or test pits investigated for each item is included in later sections. The original scope has been modified several times to support the changing needs of the RI/FS and RA process as work progresses. With the exception of the preparation of this report, the execution of the material staging area investigation program, and the reduction of laboratory test data and results, most work on the above items was performed between June 1988 and December 1989.

This document was prepared at various stages concurrently, and occasionally in conjunction with, the site RI report (MKF and JEG 1990c) and the site suitability study (MKF and JEG 1990b). Parts of this document may duplicate parts of these two reports. In such cases, references to these reports are not cited.

The geotechnical data and discussions included in this report may be used to support further remedial investigations and design activities at the Weldon Spring site.

1.3 Background and Proposed Construction

The Weldon Spring site contains abandoned buildings, equipment, facilities, and ground surfaces that were used at different times by various organizations to produce or process trinitrotoluene (TNT), dinitrotoluene (DNT), uranium feed materials, and scrap metals. The site has been under DOE custody since 1969 when responsibility for the raffinate pits was first transferred to the DOE. Since then, the DOE has been given management responsibilities for the quarry (in 1981) and for the

chemical plant (in 1985). Table 1-2 is a summary chronology of the WSS.

The proposed remedial actions for the WSSRAP include dismantling buildings and facilities; clean up and disposal of wastes from the quarry, raffinate pits, chemical plant, and vicinity properties; and closure of the site. The exact disposal method or methods will not be finalized until the feasibility study report and Record of Decision (ROD) are issued. The geotechnical investigation was planned on the basis of the conceptual design of the disposal cell, which is currently in progress. A brief description of the proposed disposal cell and major temporary facilities (see Figure 1-2) follows to provide readers with background information.

- Disposal Cell - The proposed disposal cell will be designed to receive all solid wastes from the Weldon Spring site, quarry, and vicinity properties, and to isolate them from the environment in compliance with State and Federal requirements. Estimated waste volume in the 1989 conceptual design amounts to approximately 900,000 cubic yards. This estimate will most likely be revised as the RI/FS effort continues. The features of the disposal cell will include bottom liners (earth and synthetic), a leachate collection and detection system, and cover components including a low permeability/radon barrier layer, a bio barrier, a filter layer, and a erosion protection layer. The cell will be designed to have a top slope of approximately 2% to 4% and a side slope of approximately 20%. The cell will be located in the northern part of the chemical plant area.

TABLE 1-2 Summary Chronology of Weldon Spring Site (Sheet 1 of 4)

DATE	SITE STATUS	
1941 to 1945	Property (17,232 acres) acquired by U.S. Department of the Army (USDA), 1941. Atlas Powder Company operates the plant known as Weldon Spring Ordnance Works (WSOW), 1941 - 1944.	Production of explosives TNT and DNT during World War II. Temporary waste storage in seven lagoons; four lagoons drained and filled, three others drained; wastewater treatment plans constructed and product sludges incinerated, 1941-1943.
1946	WSOW declared surplus property; first attempts at decontamination by Atlas Powder Company and by U.S. Army Corps of Engineers (USCOE) Kansas City District.	Processing equipment declared contaminated. USCOE removes over 3,500 cy dirt, burns more than 113,000 lbs TNT and more than 80,000 lbs TNT residues; some buildings removed or destroyed; location of disposed waste material not known.
1947 to 1956	WSOW property disposed of as follows: 1947-1949: - University of Missouri (U of M): 7,920 acres. - Missouri Department of Conservation: 7,200 acres from U of M for Weldon Spring Wildlife Area; 6,944 acres for Busch Wildlife Area	No recorded waste disposal activities (1947-1955). Land transferred to AEC partially decontaminated; WSUFMP land to revert to USDA at end of AEC operations. WSUFMP operations lasted until 1966.

TABLE 1-2 Summary Chronology of Weldon Spring Site (Continued)
(Sheet 2 of 4)

DATE	SITE STATUS	
1957 to 1965	- St. Charles County Public Schools: 38 acres for Francis Howell High School. - General Services Administration transfers 2,063 acres to USDA 1950; 205 acres of this transferred to Atomic Energy Commission (AEC) for Weldon Spring Uranium Feed Materials Plant (WSUFMP), 1955. AEC acquires abandoned quarry (WSQ) from USDA for use as low-level radioactive waste disposal site, 1958. After transfer to AEC, the remaining 1,860 acres designated as Weldon Spring U.S. Army Reserve Training Area, 1959.	Mallinckrodt Chemical Works operates WSUFMP producing uranium metal from ore; plant contains numerous buildings and two waste (raffinate) pits, 1957-1966. Third raffinate pit constructed, 1958. Waste from dismantling of Mallinckrodt Destrehan Street Plant disposed of in quarry, 1960-1963. USDA disposes of uranium- and thorium-contaminated wastes from Granite City arsenal until waste purchased for reprocessing and removed, 1963-1965. Fourth raffinate pit constructed on land transferred to AEC, 1964.
1965 to 1966	AEC closes WSUFMP (end of 1966).	Thorium oxide processed at WSUFMP; wastes deposited in raffinate pit No. 4. Thorium residues from Cincinnati (approximately 556 cy) disposed of at site; wastes covered by TNT-contaminated material disposed of by USDA. WSUFMP cleanup wastes disposed of in raffinate pit No. 4.

TABLE 1-2 Summary Chronology of Weldon Spring Site (Continued)
(Sheet 3 of 4)

DATE	SITE STATUS	
1967 to 1970	AEC transfer 205 acres of WSUFMP to USDA. AEC maintains control of Building 438 and 51 acre tract with raffinate pits. In 1967 USCOE contracts for design and construction of herbicide facility known as Weldon Spring Chemical Plant (WSCP) 1967. The plant remained under control of USDA; the raffinate pits (WSRP) declared excess property in 1970.	USDA prepares for production of herbicides. Thompson-Stearns-Roger Corporation designs herbicide plant; in 1968 former WSUFMP facilities to be decontaminated and removed. Approximately 5,560 cy of contaminated wastes dumped at the quarry, 1968-1969. WSCP herbicide project canceled, 1969.
1972	St. Charles County purchases well field previously used for WSOW. Well field is located south of the quarry.	No recorded waste disposal activities.
1975 to 1979	AEC contracts National Lead company of Ohio to do environmental monitoring and maintenance of WSCP and quarry.	Preliminary assessment of environmental impacts at WSCP, 1975. Additional characterization deemed necessary. Phase I - Phase III: Installation Restoration Assessment study by Ryckman, Edgerly, Tomlinson and Associates, 1977-1979.
1981 to 1985	Department of Energy (DOE, successor to AEC) contracts Bechtel National, Inc., for management and maintenance of WSRP and quarry, 1981. DOE assumes custody and accountability of the WSCP from USDA, 1984-1985. DOE designates WSCP and WSRP decontamination as major project, 1985.	No recorded waste disposal activities. Site remedial investigations by Bechtel, Berkeley Geoscience Associates.

TABLE 1-2 Summary Chronology of Weldon Spring Site (Continued)
(Sheet 4 of 4)

DATE	SITE STATUS	
1986 to 1989	MK-Ferguson Company selected as Project Management Contractor for Weldon Spring Remedial Action Project, 1986. DOE project office established on site, 1986. Quarry site included in National Priorities (Superfund) List 1987; WSCP and WSRP added to list and all areas redesignated as Weldon Spring Site, 1989. Source: MK-Ferguson and Jacobs Engineering Group, 1989.	MK-Ferguson assumes control of Weldon Spring site; remedial investigations and characterization started, 1986. Site characterization to be completed in 1989.

- Temporary Storage Area - The proposed temporary storage area (TSA) will be constructed to stockpile wastes and rubble from the quarry until they are placed in the disposal cell. The TSA will be located south of the raffinate pits as shown in Figure 1-2. A low permeability foundation and liner are desirable features for the design of the TSA.

- Material Staging Area - A material staging area (MSA) is proposed near the northern part of the site (Figure 1-2). The MSA will be used for segregating and classifying materials from building dismantlement pending a decision on their ultimate disposition.

- Administration Building - The administration building (constructed in 1989) was designed to house the DOE and PMC site offices. The building is a steel-framed one story building and is located near the eastern part of the site.

- Other pertinent facilities will include a sludge treatment plant, a water treatment plant, holding ponds, and decontamination facilities. The exact locations of these facilities had not been identified at the time of the field investigations.

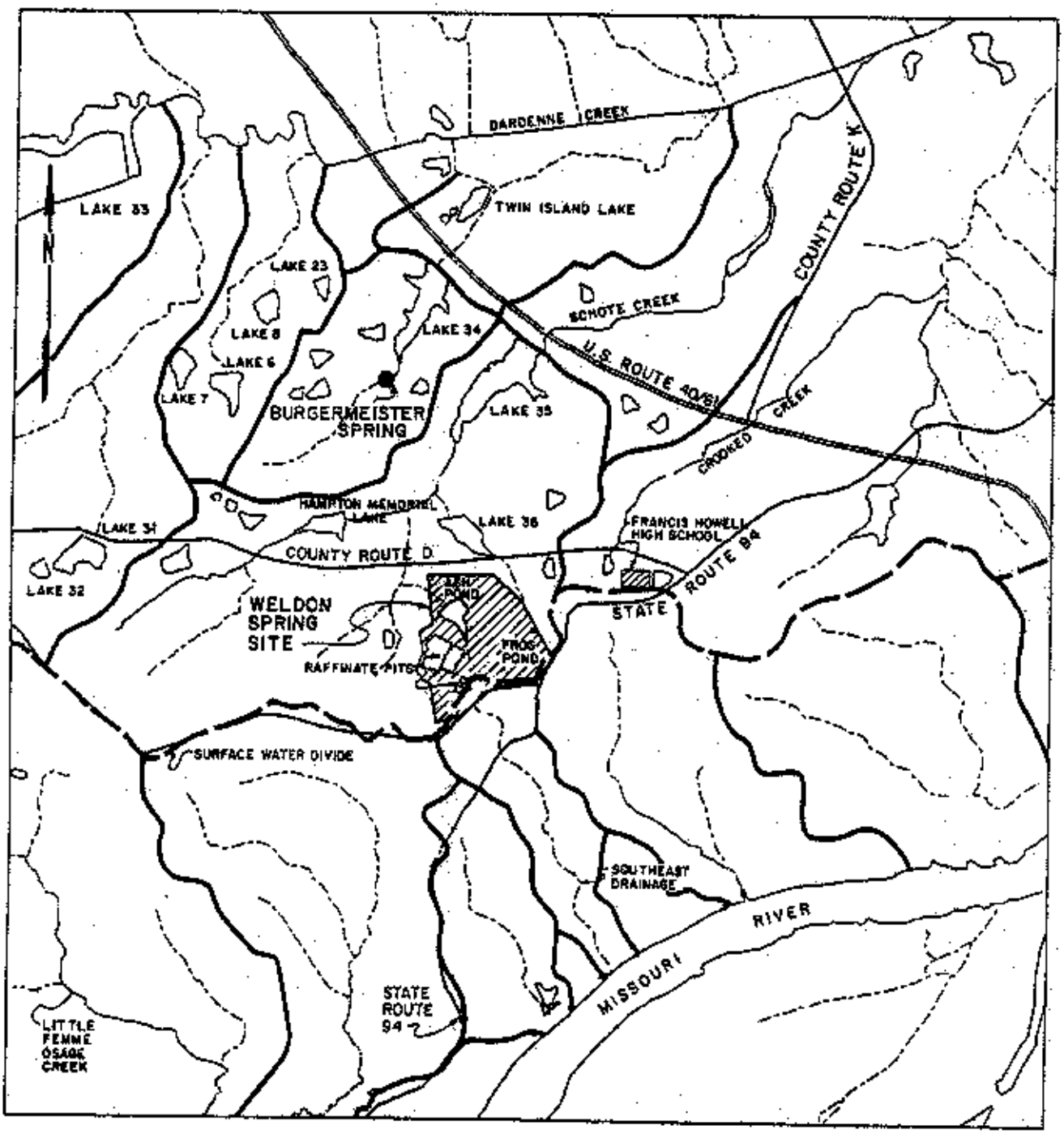
2 SITE CONDITIONS

2.1 Surface Features

The Weldon Spring site is located in southwestern St. Charles County, Missouri, which is a roughly triangular area bounded by the Mississippi River on the north and east and the Missouri River on the south. The uplands in the southwestern half of the county and the area south of the Weldon Spring site (WSS) are rugged and crossed by steep sided, narrow streams (MGS 1977). Figure 2-1 shows the major drainages in the vicinity of the WSS.

The WSS lies on an upland ridge of low relief, with gentle rolling terrain shaped by late Pleistocene (Wisconsinan Stage) glaciation. The furthest advance of these glaciers reached the south edge of the site near the drainage divide between the Mississippi and Missouri Rivers (Figure 2-1). The site straddles this surface drainage divide. Most of the site is drained by Schote Creek and its tributaries, which flow north through a series of lakes into Dardenne Creek, a tributary of the Mississippi River. The Dardenne Creek drainage is characterized by broad floodplains draining gently rolling topography (MGS 1977). The southeastern portion of the site drains southward through several unnamed tributaries to the Missouri River, approximately 1.5 miles to the southeast.

The site topography is generally flat, sloping gently from the higher elevations of about 672 feet mean sea level (MSL) along the south edge of the site to lower elevations of about 608 feet MSL on the north end of the site. Abrupt changes in surface elevation occur in the areas that were disturbed during



LEGEND:

- SURFACE WATER DIVIDE BETWEEN MISSISSIPPI RIVER AND MISSOURI RIVER
- DRAINAGE BOUNDARY
- CREEK OR SURFACE DRAINAGE
- POND OR LAKE

0 3200 6400 FT

0 975.4 1950.7 M

SCALE

SURFACE WATER DRAINAGES NEAR THE WSS

FIGURE 2-1

REPORT NO.: DOE/OR/21548-155		EXHIBIT NO.: A/VP/067/1190	
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construction of the raffinate pits and the Ash Pond dikes. The dikes rise up to 20 feet above the surrounding ground surface. The major existing and proposed site features are shown in Figure 1-2.

No natural drainages traverse the site, except for remnants of a filled channel through the Ash Pond area (MKF and JEG 1988a). However, three man-made structures influence site drainage. Ash Pond was formed by construction of a dike across the northwest side of a topographic depression. In 1989, a diversion channel was constructed around the pond to prevent surface water from flowing into it and mixing with contaminated soil and water. When water draining the northern portion of the site reaches the spillway elevation of the Ash Pond collection basin, it flows into the diversion channel and off the WSS via a tributary to Schote Creek. Also, along the north side of the chemical plant area a sloped embankment was built to provide a level area for coal storage and a basin for runoff in the area of the steam plant (BNI 1987). Finally, Frog Pond is a settling basin located near the eastern edge of the site. Overflow water from this pond flows off site to the north into the August A. Bush Memorial Wildlife Area, and eventually into the Schote Creek drainage system (Figures 1-2 and 2-1).

Other man-made features at the WSS consist chiefly of buildings and associated structures used in the chemical plant operations. Many buildings and facilities were destroyed after the completion of each phase of operations at the site, especially those associated with the Weldon Spring Ordinance Works (WSOW). Currently, there are approximately 13 major buildings, 30 support structures, and other miscellaneous facilities and equipment at the WSS. Most of these facilities have been abandoned. The facilities currently in use include

office trailers and the newly constructed administration building. Portions of the site other than the buildings, pits, and ponds are generally covered with gravel, asphalt, pavement, grass, or natural vegetation. The wildlife areas surrounding the WSS are predominantly covered with brush, grasses, and trees. The agricultural areas to the east and southeast are open fields with stands of trees and brush generally found along steams.

Flooding at the WSS by heavy spring and early summer rains is unlikely because the site is at the headwaters of most of the small tributary streams that either flow north to Schote Creek and the Mississippi River or south to the Missouri River. Although the Mississippi and Missouri Rivers have in the past often reached flood stage from April through July of each year, the potential for these rivers flooding the site is extremely low because the site elevation rises from 608 feet MSL at its lowest point. The maximum recorded flood on the Missouri River occurred during June 1844 and reached a peak water surface elevation of 473 feet MSL in the stretch of river immediately south and east of the site (MK-Engineers 1988). Since the Missouri River now has numerous flood control facilities, the possibility of a flood of a similar magnitude is remote.

2.2 Geology and Hydrogeology

The materials presented in this section have been compiled and summarized from various references and previous investigations including recent PMC investigations for the RI/FS process.

2.2.1 Regional Setting

The Weldon Spring Site lies on the south edge of the dissected till plains of the Central Lowland Physiographic Province. The site is on an east-west trending low ridge that forms a drainage divide between the Missouri and Mississippi Rivers. This ridge forms the approximate boundary between the glaciated region to the north and the Salem Plateau Physiographic Province to the south. These dissected till plains are broad, flat to gently rolling upland areas. They were eroded nearly flat by glacial scouring and filling during the late Pleistocene (Wisconsinan Stage) glaciation. The Salem Plateau to the south was not glaciated and is characterized by steep, rugged uplands and heavily wooded hills and ridges dissected by narrow streams with steep, rocky slopes (MGS 1977).

2.2.2 Stratigraphy

The stratigraphy of the Weldon Spring site is composed of approximately 2,000 to 3,000 feet of Paleozoic Era marine limestone, dolomite, sandstone, and shale. It has been described in detail in the draft Remedial Investigation Report (MKF and JEG 1990c). Other detailed descriptions are available in the literature (Kleeschulte and Emmett 1986, BNI 1987). This document describes only those soil and bedrock units encountered in the geotechnical investigations because the lower rock units have little or no effect on the proposed remedial action. The reader is directed to the referenced reports for more information on regional site stratigraphy. For immediate reference, Figure 2-2 shows a generalized stratigraphic column for the region. A summary of stratigraphic units discussed here is presented in Table 2-1. The stratigraphic units mentioned on this table are

SYSTEM	SERIES	STRATIGRAPHIC UNIT	TYPICAL THICKNESS (FT)*	LITHOLOGY	PHYSICAL CHARACTERISTICS	AQUIFER DESIG.	HYDROSTRATIGRAPHIC UNIT
QUATERNARY	HOLOCENE	Alluvium	0.5-4		Gravelly, silty loam.		ALLUVIAL AQUIFER
	PLEISTOCENE	Loess and Glacial Drift	15-55	Variable	Silty clay, gravelly clay, silty loam, clay, or loam over residuum from weathered bedrock.		(unsaturated)
MISSISSIPPIAN	MERAMECIAN	Salem Formation	0-15		Limestone, limey dolomite, finely to coarsely crystalline, massively bedded, and thin bedded shale.	*	(unsaturated)
		Warsaw Formation	60-80		Shale and thin to medium bedded finely crystalline limestone with interbedded chert.		
	OSAGEAN	Burlington and Keokuk Limestones	100-200		Cherty limestone, very fine to very coarsely crystalline, fossiliferous, thickly bedded to massive.	SHALLOW BEDROCK AQUIFER	SHALLOW BEDROCK AQUIFER
		Fern Glen Limestone	45-70		Cherty limestone, dolomitic in part, very fine to very coarsely crystalline, medium to thickly bedded.		MISSISSIPPIAN-DEVONIAN AQUIFER SYSTEM
	KINDERHOOKIAN	Chouteau Limestone	20-50		Dolomitic, argillaceous limestone; finely crystalline; thin to medium bedded.		
		Bushberg Sandstone	40-55		Quartz arenite, fine to medium grained, friable.		
DEVONIAN	UPPER	Lower Part of Sulfur Spring Group undifferentiated			Calcareous siltstone, sandstone, oolitic limestone, and hard carbonaceous shale.		
ORDOVICIAN	CINCINNATIAN	Maquoketa Shale	10-30		Calcareous to dolomitic silty shale and mudstone, thinly laminated to massive.	LEAKY CONFINING LAYER	ORDOVICIAN LEAKY CONFINING UNIT
	CHAMPLAINIAN	Kimmswick Limestone	70-100		Limestone, coarsely crystalline, medium to thickly bedded, fossiliferous and cherty near base.		
		Decorah Formation	30-60		Shale with thin interbeds of very finely crystalline limestone.		
		Plattin Limestone	100-130		Dolomitic limestone, very finely crystalline, fossiliferous, thinly bedded.		
		Joachim Dolomite	80-105		Interbedded very finely crystalline, thinly bedded dolomite; limestone; and shale. Sandy at base.		
		St. Peter Sandstone	120-150		Quartz arenite, fine to medium grained, massive.	DEEP BEDROCK AQUIFER	DEEP BEDROCK AQUIFER
	CANADIAN	Powell Dolomite	50-60		Sandy dolomite, medium to finely crystalline, minor chert and shale.		
		Cotter Dolomite	200-250		Argillaceous, cherty dolomite; fine to medium crystalline, interbedded with shale.		
		Jefferson City Dolomite	160-180		Dolomite, fine to medium crystalline.		
		Roubidoux Formation	150-170		Dolomitic sandstone.		ORDOVICIAN-CAMBRIAN AQUIFER SYSTEM
		Gasconade Dolomite	250		Cherty dolomite and arenaceous dolomite (Gunter Member).		
CAMBRIAN	UPPER	Eminence Dolomite	200		Dolomite, medium to coarsely crystalline, medium bedded to massive.		
		Potosi Dolomite	100		Dolomite, fine to medium crystalline, thickly bedded to massive. Drusy quartz common.		

*Thickness data sources vary. Quaternary unit thicknesses based on on-site drilling and trenching. Burlington and Keokuk through Joachim Dolomite based on USGS wells MW-GS02 and GS06. St. Peter Sandstone and below from Kleeschulte and Emmett (1987). Warsaw and Salem Formations from Missouri DNR-DGLS Geologic Map OFM-90-252-GI (1990).

*The Warsaw and Salem Formations are not believed to be saturated in the WSS vicinity.

GENERALIZED STRATIGRAPHY AND HYDROSTRATIGRAPHY

FIGURE 2-2

REPORT NO.: DOE/OR/21548-155		EXHIBIT NO.: A/PI/078/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	

TABLE 2-1 Stratigraphic Units at the Weldon Spring Site

Stratigraphic Unit		Unit Characteristics	
Age	Name	Thickness Range(ft)[a]	Typical Description
QUATERNARY			
Holocene	Top Soil	0-4	Organic clayey silt to silty clay.
	Fill	0-30	Variable: primarily clayey silt.
Pleistocene	Loess	0-10	Silt to clayey silt, minor sand; low plasticity.
	Ferrelview Formation	0-22	Silty clay to clayey silt, minor sand and fine gravel; stiff and moderately to highly plastic.
	Clay Till	0-30	Silty clay and clayey silt, with sand and gravel (rounded chert, igneous and metamorphic); massive, very stiff, moderately plastic.
	Basal Till	0-10	Sandy, clayey, silty gravel to gravelly silt (angular chert).
(Pre-Pleistocene?)	Residuum	0-26	Gravelly clay to gravelly silt, with weathered chert and limestone fragments
MISSISSIPPIAN			
	Burlington-Keokuk Limestones	9 to >50	Weathered limestone: argillaceous limestone, with abundant chert as nodules or interbeds; very finely to very coarsely crystalline; fossiliferous; solution features common. Competent limestone: thin to massive; finely to coarsely crystalline; less cherty; stylolitic; fossiliferous.

(a) Thickness data based on-site drilling and trenching.

discussed from the geotechnical engineering perspective in Section 4.

Burlington-Keokuk Limestone (Mississippian) formations comprise the uppermost bedrock stratigraphic unit at the WSS. These formations are undifferentiated at the site and are therefore designated as the Burlington-Keokuk Limestone. Because the Burlington-Keokuk Limestone was the only bedrock unit encountered during the MK-Ferguson investigation, it is the only unit discussed here. This unit is a thin to thick bedded, argillaceous, fine to coarsely crystalline limestone containing abundant chert as nodules and beds. On the basis of borehole stratigraphic data, the formation has been divided into two sub-units primarily according to weathering characteristics. The upper sub-unit is referred to as the weathered limestone; the lower one is referred to as the competent limestone.

The weathered limestone is typically grayish orange to yellowish gray, and argillaceous. It contains up to 60% chert as nodules and interbeds. It is fossiliferous, moderately to highly fractured, and slightly to severely weathered. Solution features are common, ranging from small voids to 5-foot cavities (BNI 1987). Solution features are typically parallel to bedding.

The competent limestone is light gray, finely to coarsely crystalline, stylolitic, and fossiliferous, with less (20-40%) chert than the weathered limestone. This unit is much less fractured than the weathered limestone.

Unconsolidated soil units overlying the limestone bedrock in the WSS area are typically Pleistocene to Holocene glacial and periglacial sediments capped by a layer of organic top soil. At the base of the sequence is the residuum, which has been

interpreted as resulting from pre-Quaternary weathering of the youngest bedrock formation (BNI 1987). The residuum is generally a reddish brown gravelly clay to clayey gravel. Thickness and areal extent are variable.

The basal till (early Pleistocene) overlies the residuum. This unit is a yellowish brown, sandy, clayey, silty gravel with angular chert pebbles in a loosely bound matrix. The thinness or absence of this unit in areas of highest bedrock elevations suggests that the deposition of this unit may have been affected by bedrock topography. The basal till is found in the western and north central areas of the site.

The clay till unit overlies the basal till. This early Pleistocene deposit is composed of yellowish brown silty clay to clayey silt. Clay till sediments are massive, very stiff, and moderately to highly plastic. Pebbles in the till are subrounded chert and igneous and metamorphic detritus in contrast with the coarse fraction of the basal till. This may indicate a different source area for the unit. The clay till is widely spread beneath the site.

Overlying the clay till is the Ferrelview Formation, a mid-Pleistocene glacial till plain sediment. This unit is a mottled gray and dark yellowish orange silty clay to clayey silt. It is usually very stiff and plastic. This unit is also found throughout the site subsurface.

Overlying the Ferrelview Formation is a loess unit (late Pleistocene) that occurs sporadically across the site. The spotty distribution may be due to predepositional topography, post depositional erosion, and/or extensive reworking of the upper soils during site construction activities. The loess is

primarily silt to clayey silt, with very minor amounts of sand, and has a low plasticity.

The uppermost soil unit is the combined topsoil/fill unit. The topsoil is generally a black, organically rich clayey silt to silty clay. The fill fraction varies in thickness and composition across the site, but is primarily a clayey silt.

2.2.3 Structure and Seismicity

The rocks in the region around the WSS were deformed during the Paleozoic Era vertical crustal movements. These movements resulted in the formation of broad bedrock basins and arches (Eardley 1951). The bedrock flexure nearest to the WSS is the House Springs-Eureka anticline, located approximately 4 miles southwest of the site. This fold trends northwest-southeast (Kleeschulte and Emmett 1986). The bedrock on the northeast limb of the anticline, where the WSS is located, generally strikes in a N60°W direction with gentle dips of 0.5° to 1° to the northeast (Krummel 1956).

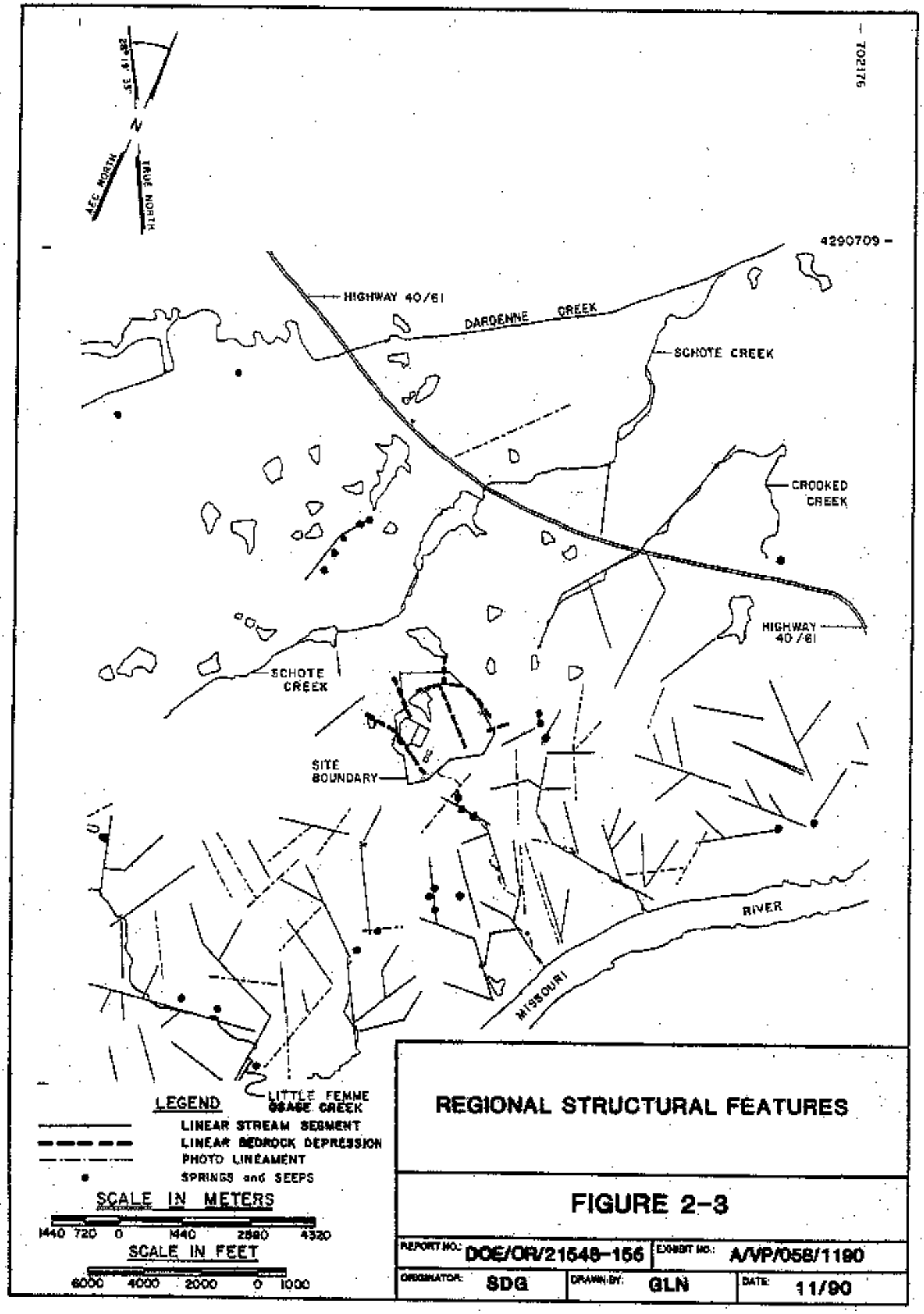
Jointing in the bedrock of the WSS area consists of two major sets. One set trends between N30°W and N65°W; the other between N30°E and N72°E (Roberts 1951). The joints at the WSS and the nearby Weldon Spring quarry dip vertically to nearly vertically (Berkeley Geosciences Associates 1984).

Regional structural features are shown in Figure 2-3. This map reflects a compilation of field measurements of jointing near the WSS and evaluation of the regional topographic features such as linear stream segments and photolineaments. The map is based on review of topographic maps and infrared aerial photographs of the WSS area. The linearity of the streams and features shown in

Figure 2-3 suggests that these valley orientations are structurally controlled along joints. Structural orientations are to the northwest and northeast with a minor northerly trend. The predominant trend of the streams in the unglaciated southern half of the mapped area is a strong orientation to the northwest with a mean bearing of N65°W. A second set of linear stream segments trends N38°E while a third, minor set trends N10°W.

The WSS lies in a tectonically inactive region of the North American continent near the boundary of the Mississippi Embayment (BNI 1983a). No faults are known to cross the site, but geologic mapping of the Weldon Spring 7-1/2 minute quadrangle by the Missouri Department of Natural Resource Division of Geology and Land Survey shows an east-west trending normal fault with up to 60 feet of vertical displacement passing 1 mile to the north of the site. The displacement terminates near Lake 35 of the Busch Wildlife area (Figure 2-1). The fault trends toward Burgermeister Spring which is 1 mile farther to the west. This fault does not show recurrent movement within the last 35,000 years, thus is not considered capable of producing the maximum credible earthquake at the site (JEG 1988).

The nearest seismic source to the WSS is the New Madrid Seismic Zone which is centered approximately 175 miles southeast of the WSS in the extreme southeastern corner of Missouri. This seismic zone has been the locus of some of the largest earthquakes on record for the United States. Between 1811 and 1812 earthquakes with estimated Richter magnitudes of 7.2 to 8.0 occurred there. These quakes rang church bells as far away as Boston. Locally, they reversed the flow of the Mississippi River (McKeown 1982).



REGIONAL STRUCTURAL FEATURES

FIGURE 2-3

REPORT NO.: DOE/OR/21548-156		EXHIBIT NO.: A/VP/058/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	

On the basis of a seismicity evaluation of this source area, Jacobs Engineering Group (JEG 1988) has estimated that the maximum credible earthquake in the New Madrid Seismic Zone would produced Modified Mercalli (MM) intensities in the range of 8.6 to 9.7 (equivalent to a magnitude of 6.1 to 6.6 on the Richter scale). Peak on-site acceleration (bedrock acceleration) from such an earthquake would be 0.26 g.

2.2.4 Hydrogeology

Three principal aquifer systems have been identified in the Weldon Spring area. These are the alluvial aquifers, the shallow bedrock aquifer system, and the deep bedrock aquifer system. In addition, a leaky confining layer is found below the shallow bedrock aquifer system. Individual zones from this layer may also be classified as low yielding aquifers (Kleeschulte and Emmett 1986 and 1987).

The alluvial aquifers include the saturated sands, gravels, and silts that compose the alluvium of the Missouri and Mississippi rivers. Yields from these aquifers along the major rivers range up to 2,600 gallons per minute (gpm) (BNI 1987). Alluvial aquifers are not present beneath the WSS. Some perched groundwater is scattered throughout the vadose zone, which may be a local recharge pathway to the shallow bedrock aquifer system.

The shallow bedrock aquifer system is made up of the saturated Mississippian- and Devonian-age rocks. It ranges in thickness from 250 to 650 feet. This aquifer system includes the Burlington-Keokuk Limestone beneath the Weldon Spring area down through the lower part of the Sulfur Springs Group (Figure 2-2). Reported yields of wells completed in this aquifer range from less than 1 gpm to 50 gpm (BNI 1987). The more productive wells

are those that intercept zones of extensive secondary porosity such as joints, fractures, and solution openings.

The deep bedrock aquifer is within Ordovician and Upper Cambrian formations, which include the St. Peter Sandstone through the Potosi Dolomite (Figure 2-2). This aquifer is approximately 1,000 feet thick. Its yields range from 10 gpm to 500 gpm (BNI 1987).

Between the deep and shallow bedrock aquifers is a leaky confining layer from the top of the Maquoketa Shale down through the Joachim Dolomite. These formations correspond to the Ordovician leaky confining unit as depicted in Figure 2-2. Some low yielding aquifers within the leaky confining layer do occur and may produce 10 gpm to 50 gpm of potable water on a local basis. The confining sequence is approximately 400 feet thick (Kleeschulte and Emmett 1986).

3 FIELD INVESTIGATIONS

3.1 Previous Geotechnical Investigations

The PMC has reviewed and evaluated in depth the geotechnical and geophysical investigations conducted at the site before 1988. The findings are summarized and presented in the Geophysical/ Geotechnical Investigation Sampling Plan Report (MKF and JEG 1988b). Previous investigations by various organizations and the years when they were performed are listed below. Numbers in parentheses represent the year in which each report was published.

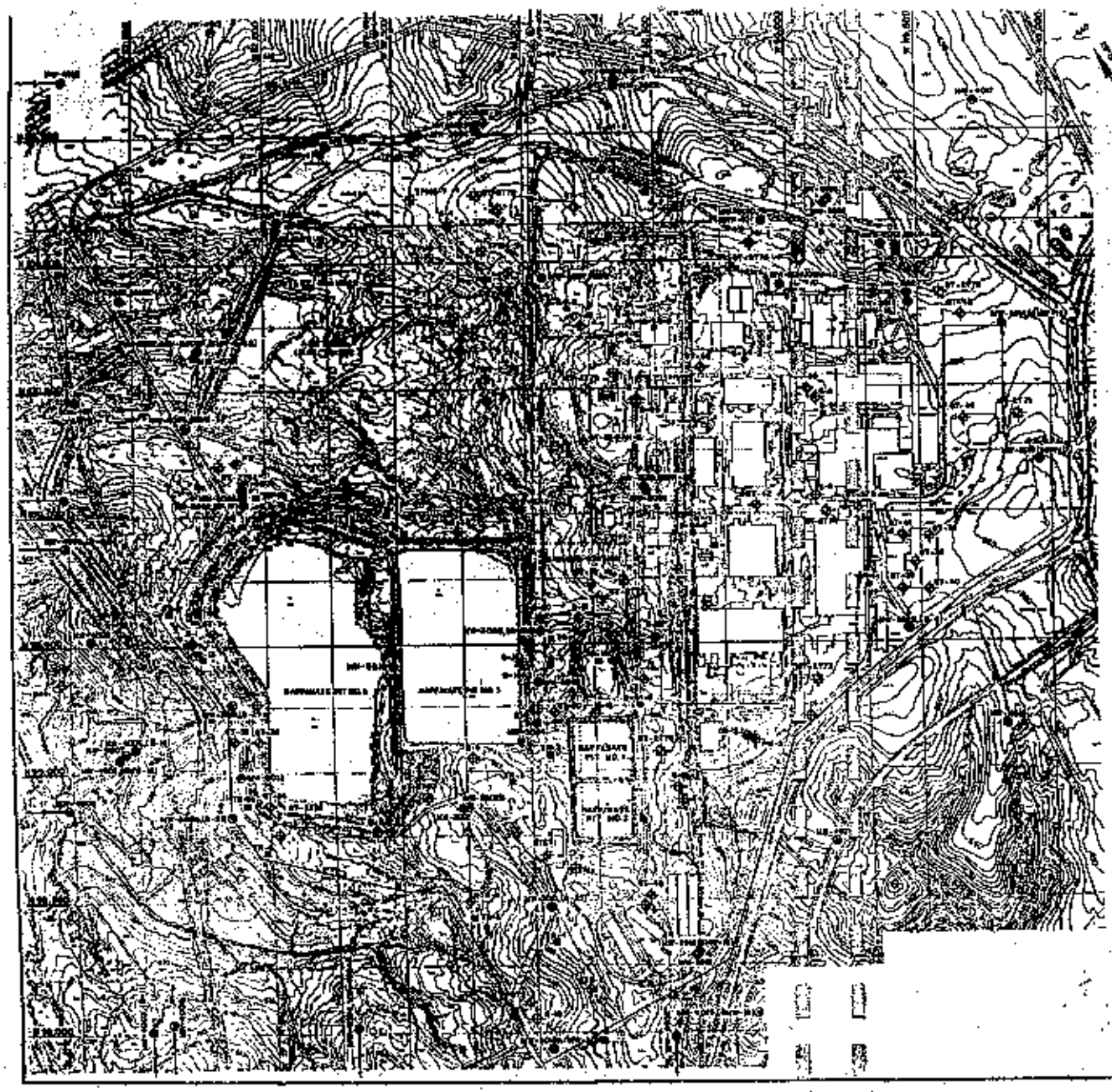
- Geotechnical

  - U.S. Army Corps of Engineers - 1954 (1955, 1970)
  - Henry M. Reitz Consulting Engineers - 1963 (1964)
  - Bechtel National, Inc. - 1982-1984 (1984)
  - Bechtel National, Inc. - 1986 (1987)

- Geophysical

  - Weston Geophysical Corporation - 1982 and 1984 (1983)
  - Detection Science, Inc. - 1986 (1987)
  - Missouri Dept of Natural Resources - 1988-1989 (1988)

Overall, more than 150 boreholes and monitoring wells have been drilled or installed, and more than 70 test pits and trenches have been excavated in the vicinity of the chemical plant and raffinate pits. Locations of the holes, wells, and test pits resulting from previous investigations, as well as those resulting from the present investigations are shown in Figure 3-1. Table 3-1 shows the numbering system for identifying



LEGEND:

SCALE FEET

TEST PITS, MONITOR WELLS AND BOREHOLES LOCATION MAP

FIGURE 3-1

the various borings and test pits. Coordinates and depths of boreholes, monitoring wells, and test pits used in the remedial investigations (RI) database are presented in Appendix C-1. The earliest studies (COE 1955, Henry M. Reitz 1964, Moylan and Elser 1967) obtained soil and rock geotechnical data for construction of site facilities. Later studies (BNI 1983a and 1987) characterized the site geology and hydrogeology and provided long-term groundwater monitoring. On-site geophysical studies prior to 1988 were conducted mainly in the raffinate pits area to refine geologic models of the site subsurface (Weston Geophysical 1983, Detection Science 1987). An off-site geophysical study (Hoffman 1988) was conducted to determine possible sources of water and conduits leading to the Burgermeister Spring.

3.2 PMC Geotechnical Investigations

The geotechnical investigations at the Weldon Spring site by the PMC were based on findings from the Geophysical/Geotechnical Investigation Sampling Plan (MKF and JEG 1988b). These investigations were conducted in phases. Phase I field activities began in June 1988 and were completed in August 1988. Phase II field activities began in January 1989 and were completed in September 1989. Additional Phase II test pit investigations were conducted by MK-Ferguson in August 1990. Table 1-2 summarizes these investigations. Locations of boreholes, test pits, and geophysical surveys are shown in Figures 1-3, 1-4, and 1-5. Individual activities and their purposes are discussed below. Boring and test pit logs are provided in Appendixes (shown in parentheses following each activity). Table 3-2 is a list of all relogged boreholes.

TABLE 3-1 Borehole and Test Pit Numbering System

LETTER DESIGNATION	NUMBER SYSTEM	FIRM/AGENCY	YEAR
B-1, etc.	Borehole number - raffinate pit area	Bechtel National Inc.	1983
B-15A, etc.	Replacement hole for B-15		
G-1	Borehole number - chemical plant area - geotechnical investigations	Bechtel National, Inc.	1986
GMW-3	Borehole completed as a monitoring well	Bechtel National Inc.	1986
G-54-1	Borehole number - chemical plant area	Corps of Engineers	1954
GT-2T-71	Test pit number - geotechnical investigations chemical plant area	PMC	1988
GT-31 to GT-36	Borehole number - geotechnical investigations raffinate pit No. 4	PMC	1988
GT-37 to GT-41	Borehole number - geotechnical investigations Admin. Bldg. area	PMC	1988
GT-42 to GT-57	Borehole number - geotechnical investigations chemical plant area	PMC	1988
AB-1	Angled borehole number - chemical plant area	PMC	1989
GTS-1	Borehole number - temporary storage area	PMC	1989
GT-58P to GT-67P	Borehole number - chemical plant area - P added if hole completed as piezometer	PMC	1989
MW-2001	Monitoring well number - within chemical plant area	PMC	1988-1989
MW-3001	Monitoring well number - wells completed adjacent to the Chemical Plant area	PMC	1988-1889
MW-4001	Monitoring well number - wells completed outside WES area	PMC	1988-1989
PW-1	Pumping well number	PMC	1989
OB-2j	Observation well adjacent to pumping well	PMC	1989
T-1	Backhoe trench number	Bechtel National, Inc.	1986
TR-1	Trench number	Bechtel National, Inc.	1983
TPBS-1	Test pit number - borrow source area	PMC	1989
TPMS-1	Test pit number - materials storage area	PMC	1990

TABLE 3-2 List of Boreholes with Relogged Rock Cores

BOREHOLE NUMBERS		
B-3 (MW-2016)	GMW-2 (MW-2002)	MW-3002B
B-4 (MW-2020)	GMW-2A (MW-2002A)	MW-3006
B-9 (MW-4002)	GMW-3 (MW-2003)	MW-3019A
B-11 (MW-4003	GMW-4 (MW-2004)	MW-3019B
B-17 (MW-3007)	GMW-5 (MW-2005)	MW-4004
B-19A (MW-3008)	GMW-6 (MW-2006)	MW-4004B
B-21 (MW-3009)	GMW-7 (MW-2007)	MW-4005
B-23 (MW-3010)	GMW-8 (MW-2008)	MW-4007
G-1	GMW-9 (MW-2009)	MW-4008
G-2	GMW-10 (MW-2010)	MW-4009
G-2A	GMW-11 (MW-2011)	MW-4010
G-3	GMW-12 (MW-2012)	MW-4011
G-4	GMW-13 (MW-2013)	MW-4012
G-5	GMW-14 (MW-2014)	MW-4013
G-6	GMW-15 (MW-2015)	MW-4014
G-7	GMW-16 (MW-4001)	MW-4015
G-8	GMW-17 (MW-2017)	MW-4016
G-9	GMW-18 (MW-2018)	MW-4017
G-13	GMW-19 (MW-4019)	MW-4018
G-14	MW-2019	MW-4020
G-15	MW-2021	MW-4021
G-16	MW-2022	MW-4022
G-18	MW-2025	MW-4023
G-19	MW-2026	PW-1
G-20	MW-2027	PW-2
G-21	MW-2028	PW-3
GMW-1 (MW-2001)	MW-3001	OB2j

NOTE: Boreholes B-3 through GMW-19 were drilled by BMI during earlier studies at NNS. Boreholes MW-2019 through MW-4023 and PW-1 through OB2j were drilled as part of the extended monitoring well program by the PMC.

Phase I field activities consisted of the following:

- Six boreholes completed as piezometers (GT-31 to GT-36) along the dike of raffinate pit No. 4. [Appx. A-1]

- Five boreholes (GT-37 to GT-41) in the area of the administration building. [Appx. A-2]

- Sixteen exploratory boreholes (GT-42 to GT-57) in the area of the proposed disposal cell. [Appx. A-3]

- Twelve on-site test pits (GT-2T71 to GT-2T82) for potential on-site clay material sources. [Appx. A-4]

- Relogging of 35 monitoring well logs (MW-2019 to MW-4023, PW-1 to PW-3, and OB2]) using stored rock cores from earlier PMC investigations. [Appx. A-5]

- Surface geophysical survey of the proposed disposal cell site (performed by Geotechnology Services, Inc.). [See GSI 1988]

Phase II field activities consisted of the following:

- Two angled exploratory boreholes (AH-1 and AH-2) in the bedrock beneath the proposed disposal cell. Downhole geophysical surveys were made in these two boreholes. [Appx. B-1]

- Seven exploratory boreholes (GTS-1 to GTS-7) at the site of the proposed temporary storage area (TSA). [Appx. B-2]

- Ten boreholes and piezometers (GT-58P to GT-67P) within, and adjacent to, the proposed disposal cell. [Appx. B-3]

- Thirty test pits (TPBS-1 to TPBS-30) at two potential off-site sources for clay borrow material. [Appx. B-4]

- Relogging of 46 boreholes (B,G, and GMW series) using stored rock cores from previous BNI investigations. [Appx. B-5]

Additional work in Phase II in August 1990 consisted of digging and logging nine test pits (TPMS-1 to TPMS-9) at the proposed Materials Staging Area (MSA). [Appx. B-6]

Appendixes A and B contain brief field reports describing the work, including health and safety precautions taken to protect field personnel.

3.3 Phase I Investigations

Phase I geotechnical investigations began in June 1988 and were completed in August 1988. This section summarizes the purpose, equipment, exploration method, and sampling procedure of each activity in this phase. All explored locations, with the exception of relogged holes, are shown in Figure 1-3. Soil drilling and rock coring were performed by Hannibal Testing Laboratories and logged by MK-Environmental Services Group (MKES) geologists and engineers, except as noted. All drilling was accomplished using a Central Mining Equipment CME-55 drill rig. Drilling was advanced in soil using 6-5/8 inch outside diameter (OD) and 3-1/4 inch inside diameter (ID) hollow-stem augers to auger refusal. In rock, NQ wireline coring (3-inch diameter hole, 1-7/8 inch ID) core bits were used. Soil samples were

obtained by using either a standard penetration test (SPT) split spoon sampler (ASTM D1586) or a California modified split-barrel sampler. The SPT sampler had an outside diameter (OD) of 2.0 inches and an inside diameter (ID) of 1.5 inches. The California split-barrel sampler had an OD of 3 inches and an ID of 2.5 inches. The samplers were driven 18 inches into the substratum. The samplers were advanced using a 140-pound safety hammer free-falling 30 inches. The number of blows required to drive each 6-inch advancement was recorded, and the blows for the final two 6-inch drives were summed and expressed as blows per foot. This blow count correlates roughly to various soil properties such as relative density of granular soils and the consistency of cohesive soils. The test is also useful in estimating other soil parameters such as unit weight, angle of internal friction, and unconfined compressive strength. Undisturbed samples were obtained by hydraulically pushing a 3-inch OD, 36-inch long Shelby tube approximately 30 inches. The test pits were excavated by a Caterpillar Company CAT 416 extendable backhoe. All soil samples were described according to the Unified Soil Classification System (USCS). Detailed sampling procedures and edited field logs may be found in Appendixes A-1 through A-4. The soil classifications in the logs were field classified and may not have incorporated laboratory classification results.

3.3.1 Raffinate Pit No. 4 Dike

Boreholes GT-31 through GT-36 were drilled and piezometers installed June 1 and 16, 1988. The holes were drilled to define subsurface conditions and to obtain samples for testing. The testing was needed to determine engineering parameters for dike stability analysis. All boreholes were completed as piezometers to monitor the phreatic surface, if any, within the dike and at the downstream toe. These data were used in stability model

analyses. Boreholes GT-31 and GT-32 are located in the western downstream toe of the dike; all others are located on the dike crest (see Figure 1-3). Boreholes GT-31 and GT-32 were sampled every 5 feet or at major lithologic changes. Boreholes GT-33 through GT-36 were sampled continuously throughout the dike material and at every 5 feet within the native soils until auger refusal at the top of bedrock. Screen lengths of piezometers varied depending on the total depth of exposed dike material. Boring dimensions and logs and piezometer construction details are shown in Appendix A-1. All piezometers installed on the pit dike were found to be dry when last observed on August 29, 1988.

3.3.2 Administration Building

Five boreholes (GT-37 through GT-41) were drilled at the proposed location of the new administration building (Figure 1-3) between June 2 and 9, 1988. These holes were drilled to obtain soil samples to be used to determine geotechnical design parameters for the building foundation and to locate the groundwater level in the area. Boreholes were sampled continuously to 15 feet, and every 5 feet thereafter to auger refusal (inferred top of bedrock). All holes were left open to measure the groundwater level. However, the walls of these holes collapsed within a few days to within 8 to 10 feet of the ground surface. Subsequently, on June 17, 1989, all holes were redrilled to the original depth and backfilled with Volclay grout. Detailed drilling procedures and boring logs are shown in Appendix A-2.

3.3.3 Disposal Cell

Sixteen boreholes (GT-41 to GT-47) were drilled in the vicinity of the proposed disposal cell conceptual footprint (1988

and 1989 versions) between June 21 and August 29, 1988. These holes were drilled to obtain soil samples for laboratory testing. The results of these tests were used to determine geotechnical engineering parameters, to characterize the site subsurface in the vicinity of the disposal cell, and to correlate borehole data with the geophysical surveys. Accordingly, several of the boreholes were located along seismic lines or at the intersections of such lines. Locations of borings and seismic survey lines are shown in Figure 1-3. All boreholes were sampled every 2.5 feet in soil until auger refusal at the top of bedrock. Boreholes were typically cored 20 feet into the bedrock, except for boreholes GT-53 and GT-57 (located respectively adjacent to angled boreholes AH-1 and AH-2) and GT-49 (location of another boring previously drilled into bedrock). All boreholes were backfilled with Volclay grout upon completion. Detailed drilling procedures and boring logs are shown in Appendix A-3.

3.3.4 On-Site Test Pits

Twelve test pits (GT-2T71 through GT-2T82) were excavated at the site between July 12 and 15, 1988. These pits provided bulk samples of uncontaminated clayey material from within the site boundaries. This material could be used for the clay cover (radon barrier) and clay liner of the proposed disposal cell and for other backfill purposes. Figure 1-3 shows the locations of the pits. The pits were excavated using a CAT 416 backhoe. Pit dimensions were approximately 2 ft x 8 ft x 12 ft. Bulk samples were stored in 5 mil plastic bags before laboratory testing. Personnel access into the test pits below 5 feet was not permitted because of site safety procedures. Therefore, logging was done during excavation by examination of disturbed samples and visual observation of pit walls. Test pit logs, shown in Appendix A-4, describe soils and the types and locations of soil

samples. During pit excavation, contaminated soils were separated from other soil. The pits were backfilled by replacing excavated soils in the reverse order from which they were removed. Backfill in test pit GT-2T81, which is located on top of the raffinate pit No. 1, dike was more thoroughly compacted. The lifts of backfill soil were 6 to 8 inches thick between compactions.

3.3.5 Geophysical Site Investigation

In 1988, an extensive geophysical survey of the proposed disposal cell footprint site was conducted by Geotechnology Services, Inc. (GSI 1988). This investigation was done in conjunction with the Phase I geotechnical program to provide geophysical information for refining the geological model of the site subsurface. Data acquired by the survey are delineated in the Geophysical/Geotechnical Investigation Sampling Plan (MKF and JEG 1988b). They include:

- Shallow and deep electromagnetic induction (EM)
- Gradient magnetometry
- Very Low Frequency (VLF) magnetometry
- Seismic refraction
- Seismic reflection
- Spontaneous potential (SP)
- Direct current vertical electric soundings (VES)

These methods were applied along geophysical survey lines to ensure that data acquired were representative of the site (Figure 1-3). With the exception of seismic refraction, consistent or usable results were generally obtained only where the survey lines were not close to buildings and other sources of interference. A summary of the results is presented in Section

4.1.5. Table 3-3 summarizes each geophysical survey method and the equipment used. Detailed survey data and results are presented in the report by Geotechnology Services, Inc. (GSI 1988).

3.3.6 Relogging of Rock Cores from Previous Investigations

The boreholes drilled in 1988, when the PMC installed monitoring wells, were relogged from September 1988 through January 1989 by a PMC geologist at the site. The purpose of the relogging was to obtain additional data on the physical properties of the overburden soil and bedrock, and to interpret the borehole stratigraphy for the RI effort. Photographs of the cores were taken for archival purposes. The boreholes relogged during this phase are numbered with the prefix MW, PW, or OB and are listed in Table 3-2. The relogged logs are presented in Appendix A-5.

3.4 Phase II Investigations

Phase II geotechnical investigations were conducted from January through September 1989. This section summarizes the work procedures and purpose of each activity conducted. All locations discussed are shown in Figure 1-4. Borehole and test pit logs may be found in Appendix B-1 through B-4.

The subcontractor for drilling vertical boreholes (at the temporary storage area, the disposal cell, and perimeter locations) and for excavating test pits (off-site borrow) was Hannibal Testing Laboratory. Angled boreholes were drilled by Brotcke Engineering. MKES geologists logged all boreholes and test pits. They also supervised the installation of piezometers.

TABLE 3-3 Summary of Geophysical Surveys

GEOPHYSICAL METHOD	PURPOSE	EQUIPMENT USED	SURVEY LOCATIONS	EVALUATION
Shallow Electromagnetic Induction (EM) and Gradient Magnetometry	Locate areas prone to conductive interference. Develop a "layered earth" model of the site subsurface.	Geonics EM-31-DL, Geonics EM-34-3 terrain conductivity meters EDA, OMNI IV magnetometer	Various, on site and site perimeter	On-site results erratic because of buildings, pipes, and/or buried conductors. Perimeter results consistent.
Vary Low Frequency (VLF) Magnetometry and Deep Electromagnetic Induction (EM)	Detect deeper conductive features and determine their orientation in the subsurface. Develop "layered earth" model of the site subsurface.	ABEM, VLF/EM Wadi System Geonics EM-34-3 terrain conductivity meter. Measurements at 50-ft intervals; coil spacing: 10,20,10 meters.	Various on site and site perimeter.	On-site results erratic near buildings pipes, and/or buried conductors. Perimeter results consistent.
Seismic Refraction	Detect and delineate subsurface seismic velocity horizons.	Geometrics ES1225 and ES1210 signal enhancement seismographs. Geophone spread length: 220-260 ft.	Various, on site.	On-site results relatively consistent. Perimeter results consistent.
Seismic Reflection	Define subsurface reflecting horizons.	Same as seismic refraction equipment listed above.	Various, on site.	High frequency "noise"; reflection survey discontinued.
Vertical Electric Soundings (VES) and Spontaneous Potential (SP)	Depict resisting layering, depth to bedrock, fractures, and fluid movement. Determine lateral changes in conductivity.	Wenner array with stainless steel and porous pot electrode ABEM, SAS 300B meter.	North of coal storage area. VES soundings based on high anomalies in SP data.	VES and SP on-site results erratic; possibly charts subsurface material and moisture conditions.

Source: Geotechnology Services, Inc. 1988.

Vertical boreholes in the disposal cell and temporary storage areas were drilled using a CME-55 drill rig. Drilling was advanced using 6-5/8 inch OD, 3-1/4 inch ID hollow stem augers in soil to auger refusal. Where appropriate, bedrock was cored using the NQ wireline coring method. Soil samples were obtained either by driving a standard penetration test (SPT) split spoon sampler or a California modified split-barrel sampler 18 inches into the substructure, or by pushing a Shelby tube approximately 30 inches into the substructure. The dimensions of the sampler and the sampling techniques for vertical boreholes are the same as those described in the discussion of Phase I investigations (Section 3.3). Other sampling methods are described where appropriate. Drilling and sampling of angled boreholes are described below.

3.4.1 Angled Boreholes

Two angled exploratory boreholes, AH-1 and AH-2, were drilled between January 16 and March 14, 1989. These boreholes were drilled to characterize bedrock structure, fracturing, and hydraulic conductivity, and to perform downhole geophysical surveys. Drilling was done by Brotcke Engineering. Figure 1-4 shows the borehole locations. Detailed descriptions of drilling, boring logs, and geophysical logs are presented in Appendix B-1.

The angled boreholes were oriented normal to major regional joint sets trending between N30°-72°E and N30°-65°W in order to intersect these joint sets. Borehole AH-1 was oriented at N42°E and AH-2 was oriented at N39°W. Both holes were drilled approximately 60° from horizontal. Drilling through the soil was accomplished with an Acker Mark IV skid-mounted drill rig equipped with an 8-inch diameter tri-cone bit. The soil portion of the borehole was cased. Coring in bedrock was advanced with a

Longyear 38 wireline rig equipped with a 5-foot NQ-wireline triple tube core barrel. MKES geologists tested bedrock hydraulic conductivity (permeability) at 10-foot intervals in the first 30 feet below top of rock, and after that, at 20-foot intervals. The test methods and results are presented in Appendix B-1. Table 3-4 is a summary of field tested permeability (hydraulic conductivity) values.

Both boreholes were geophysically logged by Wooddell Geophysical Services (Wooddell 1989) at the completion of the drilling. Geophysical logging included the following:

- Caliper
- Deviation
- Temperature
- Natural gamma
- Density
- Resistivity
- Neutron
- Sonic
- Spontaneous potential

Casing of the total depth in borehole AH-1 with 2-inch (ID) PVC pipe was necessary after minor caving occurred during logging. Borehole AH-2 was cased in a similar fashion after the caliper tool was successfully run. Both holes were abandoned after geophysical logging by pumping Volclay grout through the PVC pipe as the pipe was withdrawn from the hole. In borehole AH-1 a portion of the pipe remained stuck and was grouted in place.

TABLE 3-4 Summary of In Situ Permeability Test Results

BOREHOLE NUMBER	TEST INTERVAL OR DEPTH (FEET)[1]	STRATIGRAPHIC UNIT	CALCULATED HYDRAULIC CONDUCTIVITY (cm/sec)[2]
AH-1	3.8 - 12.6	Bedrock	9.3×10^{-4}
	12.4 - 21.3	Weathered limestone	6.1×10^{-4}
	20.6 - 29.5		ND[3]
	29.2 - 46.8		$<1.16 \times 10^{-5}$*
	46.7 - 64.1		$<3.6 \times 10^{-7}$*
	64.0 - 81.5	Competent limestone	8.4×10^{-6}
	79.7 - 100.6		$<6.6 \times 10^{-8}$*
AH-2	4.2 - 12.7	Bedrock	8.7×10^{-4}
	11.5 - 21.4	Weathered limestone	1.7×10^{-4}
	21.0 - 30.0		4.0×10^{-7}
	29.9 - 47.3		$<8.4 \times 10^{-8}$*
	47.2 - 74.7		$<1.9 \times 10^{-6}$*
	64.6 - 82.0	Competent limestone	1.0×10^{-6}
	81.8 - 100.7		2.1×10^{-5}
GTS-1	36.5	Residuum (CL)	ND
GTS-2	10.0	Ferrelview (CL)	ND
	25.0	Clay Till (CL)	ND
GTS-3	7.5	Ferrelview (CH)	ND
	17.5	Clay Till (CL)	ND
	22.5	Residuum (CL)	ND
GTS-4	5.0	Ferrelview (CL)	ND
	24.0	Basal Till (CL)	ND
GTS-5	15.0	Ferrelview (CH)	1.25×10^{-7}*
GT-59	22.5	Clay Till (CH)	4.94×10^{-7}*
GT-61	51.5	Basal Till (ML)	8.56×10^{-5}

NOTES:

1 Hydraulic conductivity tests in bedrock were packer tests under applied water pressure. In soil, tests were constant head permeability tests. For AH-1 and AH-2 the test interval shown is below top of bedrock; for all others, the depth shown is below ground level.

2 Hydraulic conductivity values for AH-1 and AH-2 calculated from Table 1 and 2 in Appendix B-1; for GTS-1 through GTS-5, Appendix B-2; for GT-59 and GT-61, Appendix B-3. Calculated values in bedrock are average of at least three tests; values marked by asterisk are results of single test.

3 ND = results below detection limit (10^{-8} cm/sec).

3.4.2 Temporary Storage Area

Seven boreholes, GTS-1 through GTS-7, were drilled in the temporary storage area between May 5 and June 8, 1989. Drilling was conducted to obtain soil samples for geotechnical laboratory testing, to field test the hydraulic conductivity of in situ soilunits, and to study the physical characteristics of the soil. In addition, bulk samples were taken in the top 5 feet and stored in 5-gallon buckets for laboratory moisture-density (compaction) tests. Boring logs and details of field procedures are shown in Appendix B-2.

The boreholes were drilled through soil by hollow-stem auger until auger refusal at the top of bedrock. Soil samples were obtained during auger drilling every 2.5 feet by driving an SPT sampler or pushing a Shelby tube into the substratum. A constant-head permeability test was performed in boreholes GTS-1 through GTS-5 after each Shelby tube sample was taken. The tests were made by pushing NQ (2-3/8 inch ID) rods through the hollow stem augers 4 inches into the substratum (to provide a seal). The rods were filled with water and water was added as needed to maintain the level. The volume of water added was recorded at typical 10-minute test periods. Table 3-2 summarizes field test soil hydraulic conductivity values. All boreholes were backfilled with Volclay grout after completion of drilling and field testing.

3.4.3 Disposal Cell and Perimeter

Ten boreholes, GT-58P through GT-67P, were drilled June 15 to 30, and July 10 to August 15, 1989. Of these 10, seven were completed as piezometers. In the documentation, these holes are designated by a "P" following the borehole number. These

boreholes were drilled to obtain soil samples to be used in determining engineering parameters. These holes were also used in the hydrogeologic investigation program. They provided additional piezometers for monitoring water levels in the shallow bedrock aquifer in the proposed disposal cell area.

The boreholes without piezometers were drilled using 6-7/8 inch OD, 3-1/4 inch ID hollow-stem augers. They were drilled through the overburden to refusal at the top of bedrock. The holes with piezometers were drilled using 7-1/4 inch OD, 4-1/4 inch ID hollow-stem augers. They were drilled through overburden soils. Then NQ-wireline coring was used to core through bedrock to a depth 8 to 10 feet below the projected groundwater table. Borings were sampled 2.5 foot intervals, using an SPT split spoon sampler and/or Shelby tube. Constant-head permeability tests were also conducted in boreholes GT-59 and GT-61 after each Shelby tube sampling.

The piezometers were constructed using 2-inch ID Schedule 40 PVC pipe. Since the water level was typically within the cored bedrock, the piezometers were installed without a sandpack. A 10-foot segment of the pipe straddling the water level encountered during drilling was screened with 0.01 inch slots. In most cases the screen was isolated by using a packer or reduction coupler and sealing off the annular space above it. Piezometers were developed by Hannibal Testing Laboratories between August 21 and September 11, 1989. Development was accomplished using Teflon bailers and a Triloc 1.7-inch PVC hand pump.

Borehole and piezometer locations are shown in Figure 1-4. Boring logs and piezometer development summary data, a field report, and a summary of piezometer completion data may be found

in Appendix B-3. Water level elevation data for these and other wells on site are shown in Appendix C.

3.4.4 Off-Site Borrow Test Pits

Thirty test pits, TPBS-1 through TPBS-30, were excavated in two potential clay borrow source areas south and southeast of the WSS site on March 28-30 and April 17-20, 1989. Borrow source No. 1 is located in the experimental farm area owned by the University of Missouri. Borrow source No. 2 is located approximately 0.4 miles west of the town of Hamburg. The locations of the test pits are shown in Figure 1-5. The pits were excavated to provide bulk samples of clayey soils from borrow sources that may be used during the construction of the proposed disposal cell. Samples were tested for engineering characteristics to determine the suitability of the soil for construction and design purposes. In addition to bulk samples, relatively undisturbed samples were obtained from 14 pits by driving a Corps of Engineers sampler approximately 5-foot depths in clays. These undisturbed samples were used to determine in situ dry density and moisture content of the soil. The pits were excavated by Bleigh Construction using a CAT 416 backhoe with an extendable boom and a 24-inch bucket. Pit dimensions were approximately 2 x 8 x 12 feet. MKES geologists logged the test pits and supervised excavation procedures. Test pit logs are presented in Appendix B-4.

3.4.5 Relogging of Rock Cores from Previous Investigations

MKES geologists relogged rock cores from BNI investigations in 1984 and 1986. This relogging took place at the site from October 2 through November 22, 1989. The purpose of the relogging was to (1) obtain geotechnical parameters not recorded

by BNI during their drilling programs, (2) identify depths of core loss zones for possible correlation among boreholes, (3) provide detailed lithologic descriptions not provided in the original BNI logs for stratigraphic correlation in the bedrock, and (4) photograph the cores for archival purposes. The boreholes with relogged cores, numbered with prefixes B, G, or GMW, are listed in Table 3-2. The relogged logs are presented in Appendix B-5. Photographs of rock cores are kept in the project archives at the WSS.

3.4.6 Materials Staging Area Investigation

Additional investigations were conducted in August 1990 in the materials staging area (see Figure 1-4). Nine test pits, TPMS-1 through TPMS-9, were excavated on August 6, 1990 using a Ford 755 backhoe furnished by Dave Kolb Excavating. The pits were excavated to provide bulk samples for laboratory testing of soils that may be used during the construction of the material staging area. The pits were approximately 2 x 15 feet wide and up to 15 feet deep. A PMC geologist logged the test pits and supervised excavation procedures. Test pit logs are presented in Appendix B-5.

4 SUBSURFACE CONDITIONS

4.1 General

This section discusses the geotechnical subsurface conditions of the site, including the chemical plant, raffinate pit, temporary storage, and materials storage areas. Accordingly, descriptions of overburden soil material and material thickness and permeability (hydraulic conductivity); bedrock surface depths, fracturing, and hydraulic conductivity; and groundwater flow patterns are included. The conclusions of the geophysical surveys are summarized to provide a verifying model of the site subsurface. All of this information is based on the results of the geotechnical field investigation program conducted by MK-Ferguson from 1988 through 1990, and on the results of previous site characterizations and geologic and geophysical site studies by Bechtel National, Inc. (BNI 1984 and 1987) and Geotechnology Services, Inc. (1988).

4.2 Soil

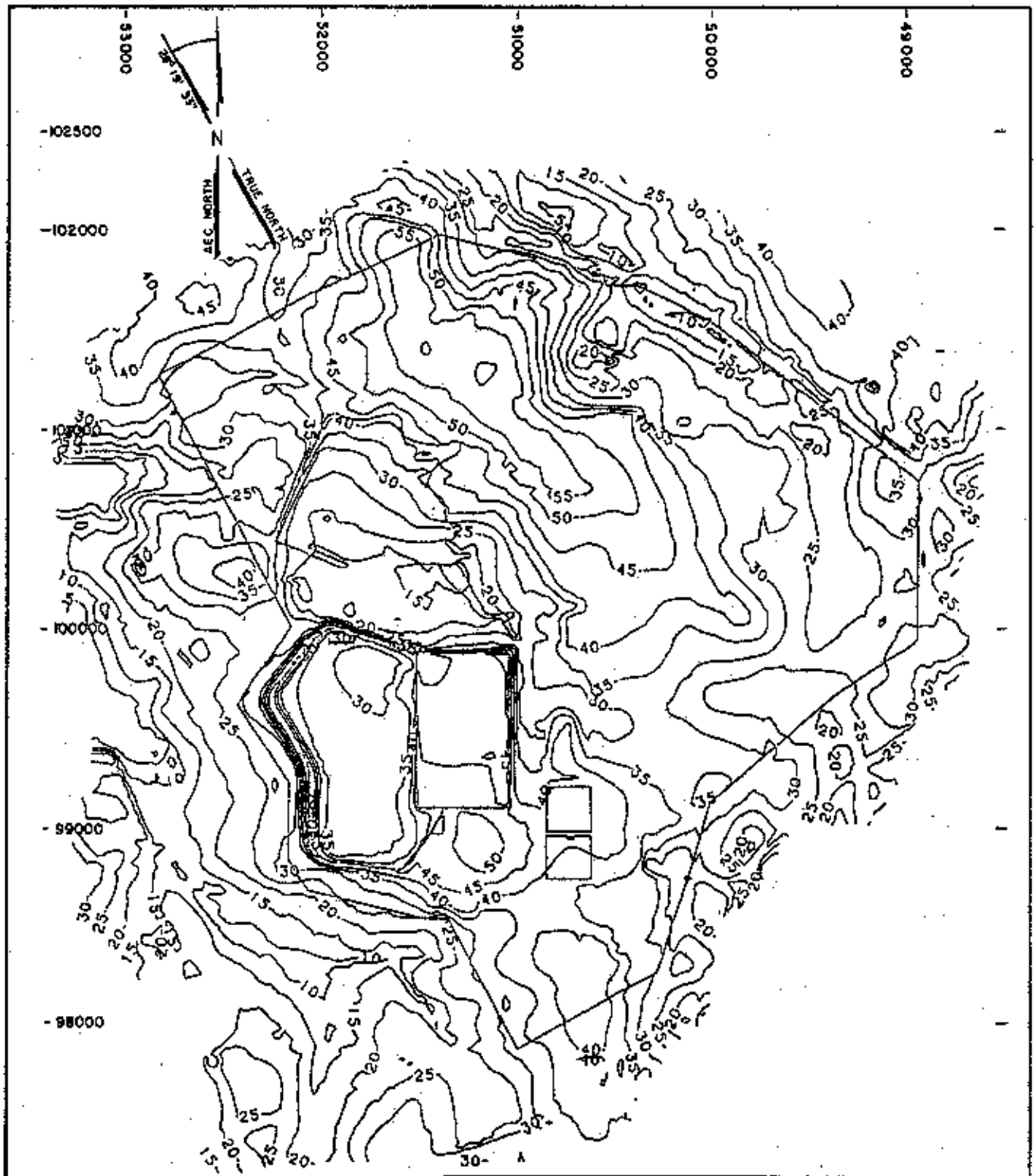
General geologic characteristics of the soil units at the Weldon Spring site (WSS) are described in Section 2.2. The physical and geotechnical properties of the soil units are listed in Table 2-1. Averaged geotechnical engineering properties, based on selected test results, have been summarized during remedial investigation (RI) studies performed from 1988 through 1990 (MKF and JEG 1990c) in conjunction with the geotechnical field investigation programs. Results of geotechnical laboratory testing for this study are presented in Section 5.

Following the geotechnical field investigations and the installation of monitoring wells in the chemical plant area, the

geologic data from each of the borehole and test pit logs were evaluated. Isopach and contour maps and geologic cross sections were generated by computer using the geological database.

Isopach maps of the various soil units and contour maps of the bedrock units (Figures 4-1 through 4-8) and geologic cross sections (Figures 4-10 through 4-14) were developed during RI documentation efforts (MKF and JEG 1990c). Figure 4-9 is a plan map of all the borehole, test pit, and cross section locations. Geologic cross-sections A-A' through E-E' are shown in Figures 4-10 through 4-14, respectively. In the cross sections, each of the soil units and the two bedrock units described below can be seen in their relative positions. These figures indicate the thickness distribution of each unit, particularly the fill. Information from test pits for the material staging area are not included in these figures.

Overall soil (overburden) thickness at the WSS ranges from 15 to 60 feet, and is apparently controlled by both surface erosion and bedrock topography. Figure 4-1 is a soil thickness isopach map. Soil is thickest in the north-central portion of the site and thinnest in the eastern portion. By contrast, the bedrock surface elevation is lowest in the western portion of the site and highest in the eastern portion. This combination of greater soil thickness over areas of lower bedrock surface and vice versa has resulted in a relatively level ground surface across most of the site (Geotechnology 1988, BNI 1987). This corresponds well to eroding of pre-glacial topographic highs and the filling of lower elevations with glacial drift.



LEGEND

10 THICKNESS CONTOUR

SCALE IN METERS

120 60 0 120 240 360

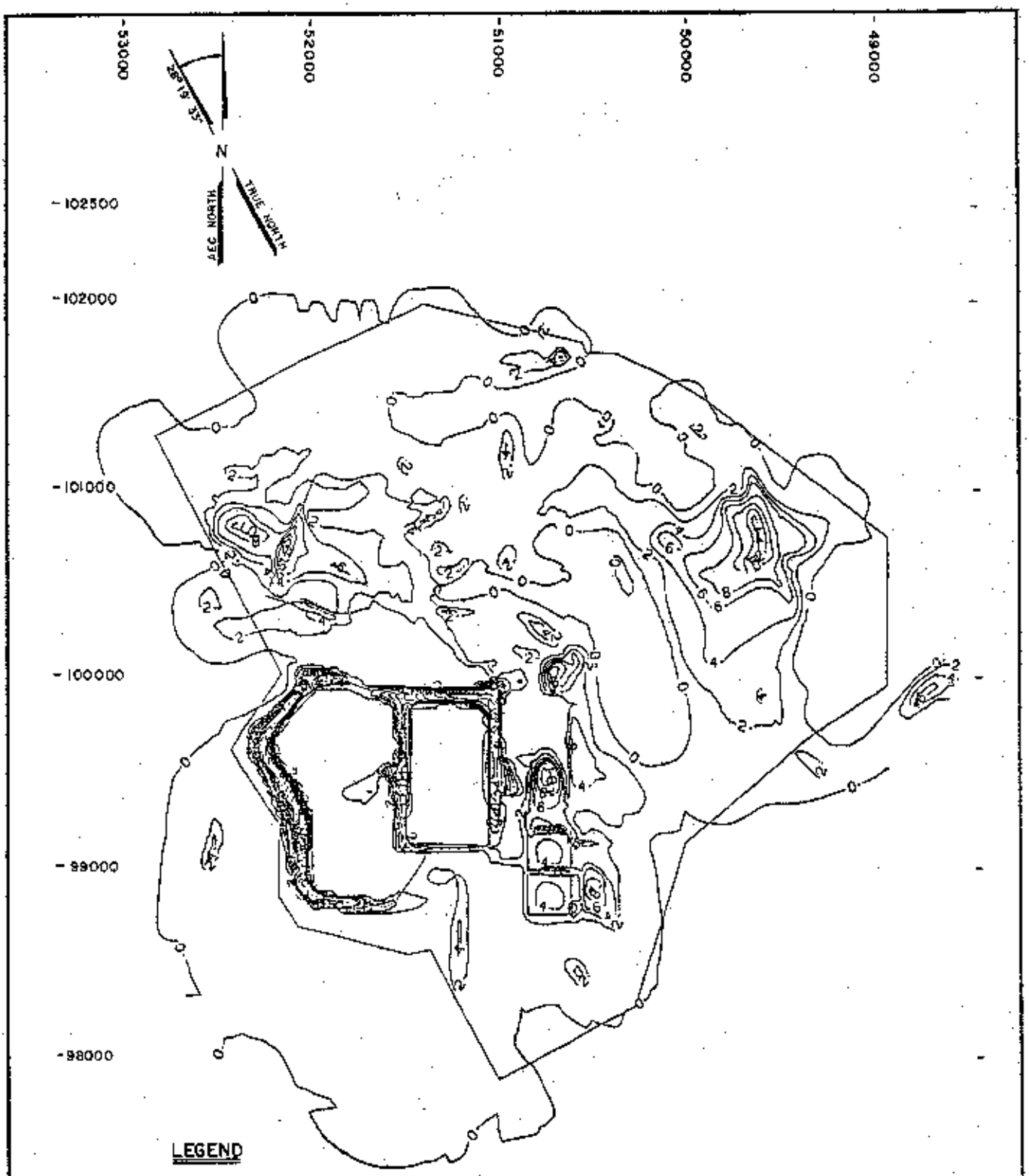
SCALE IN FEET

500 250 0 500 1000

ISOPACH MAP OF TOTAL OVERBURDEN

FIGURE 4-1

REPORT NO. DOE/OR/21548-155		DRAWING NO.: A/CP/102/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	



LEGEND

—4— THICKNESS CONTOUR of TOPSOIL / FILL

CONTOUR INTERVAL 2.0 FT.

SCALE IN METERS

120 60 0 120 240 360

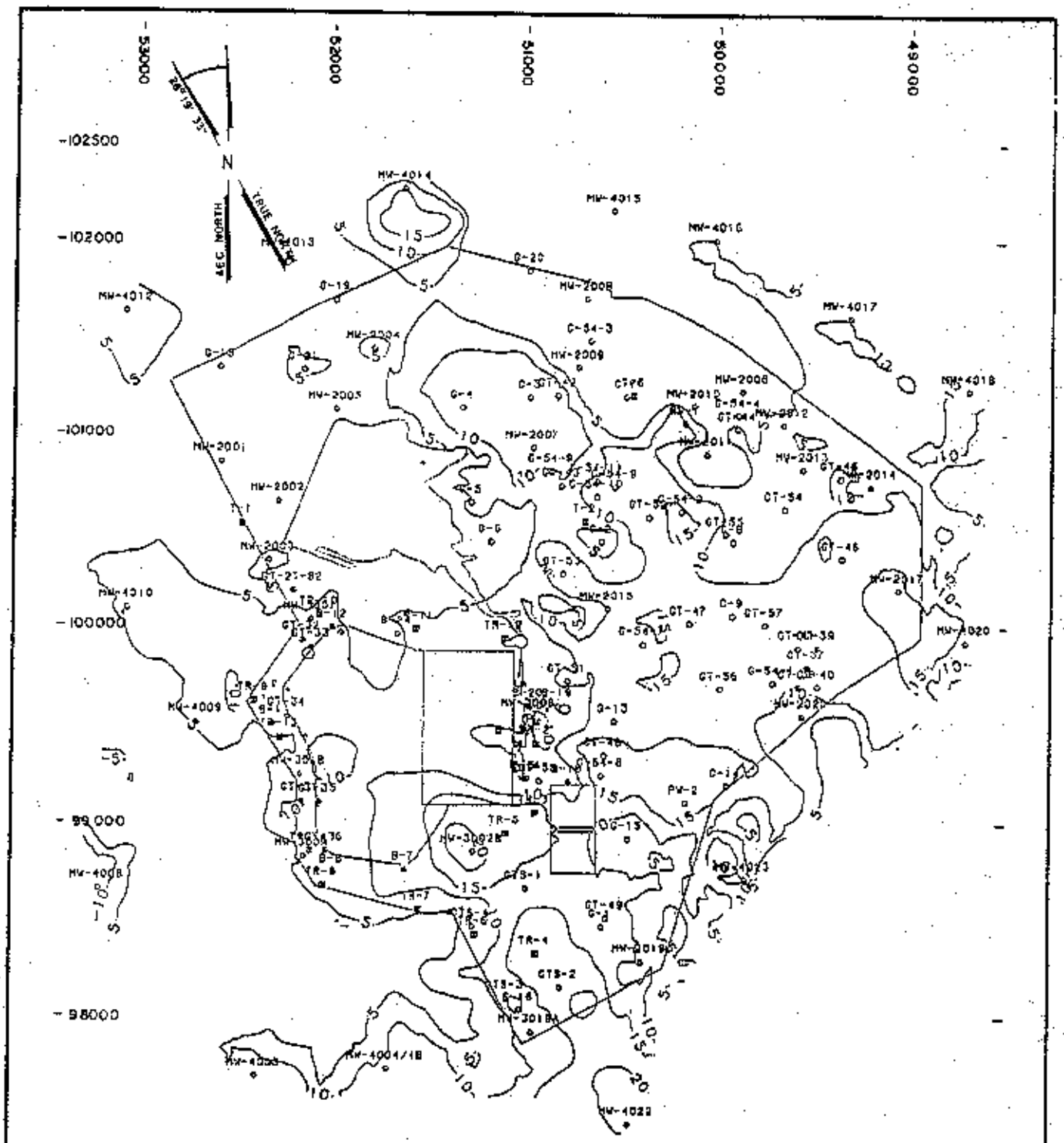
SCALE IN FEET

500 250 0 500 1000

ISOPACH MAP OF TOPSOIL/FILL

FIGURE 4-2

REPORT NO.: DOE/OR/21548-155		SHEET NO.: A/CP/103/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	



LEGEND

—10— THICKNESS CONTOUR of FERRELVIEW FORMATION

CONTOUR INTERVAL 5.0 FT.

SCALE IN METERS

120 60 0 120 240 360

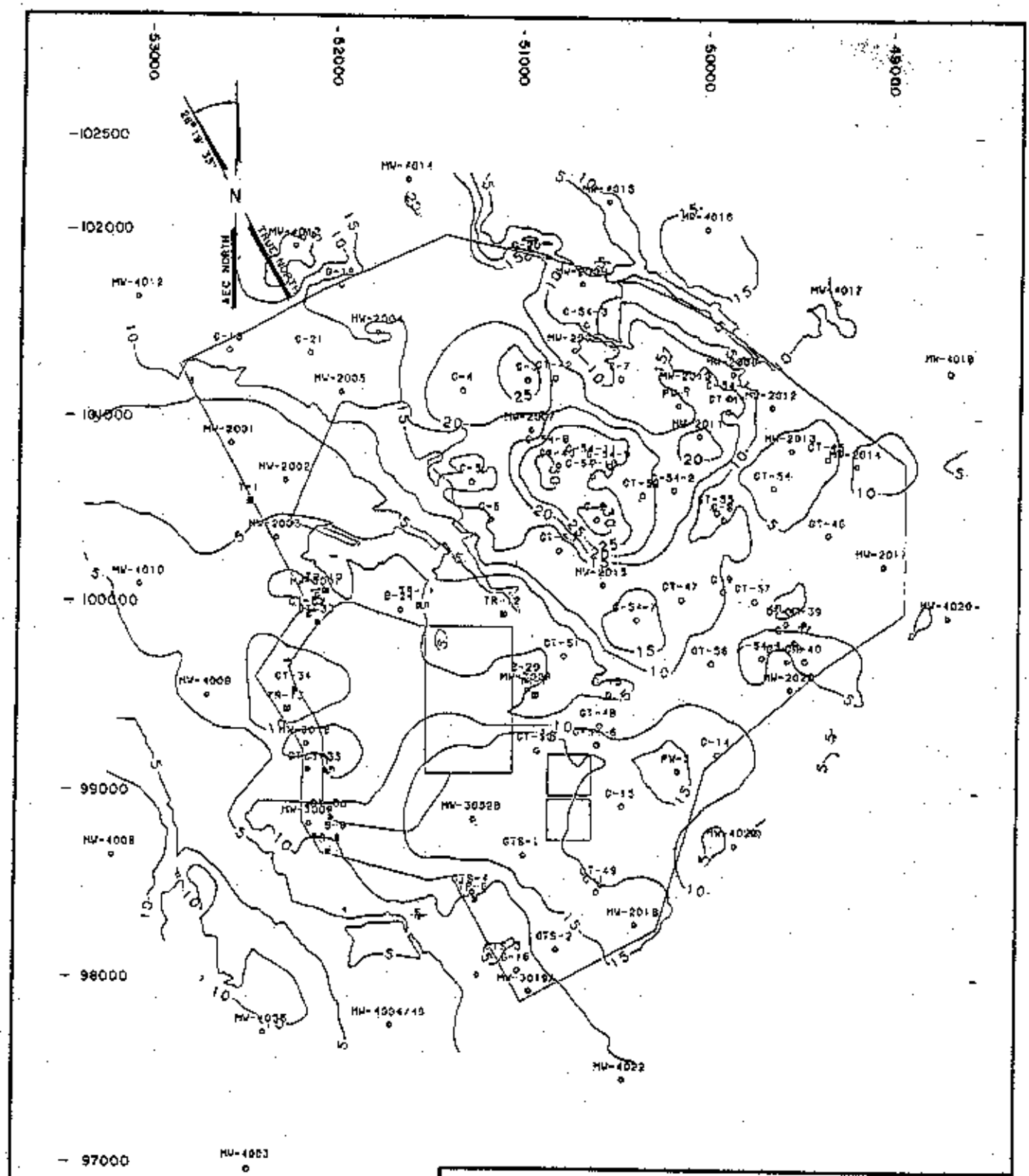
SCALE IN FEET

500 250 0 500 1000

ISOPACH MAP OF FERRELVIEW FORMATION

FIGURE 4-3

REPORT NO.: DOE/OR/21548-155		EXHIBIT NO.: A/CP/104/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	



LEGEND

—10— THICKNESS CONTOUR of CLAY TILL

CONTOUR INTERVAL 5.0 FT.

SCALE IN METERS

120 60 0 120 240 360

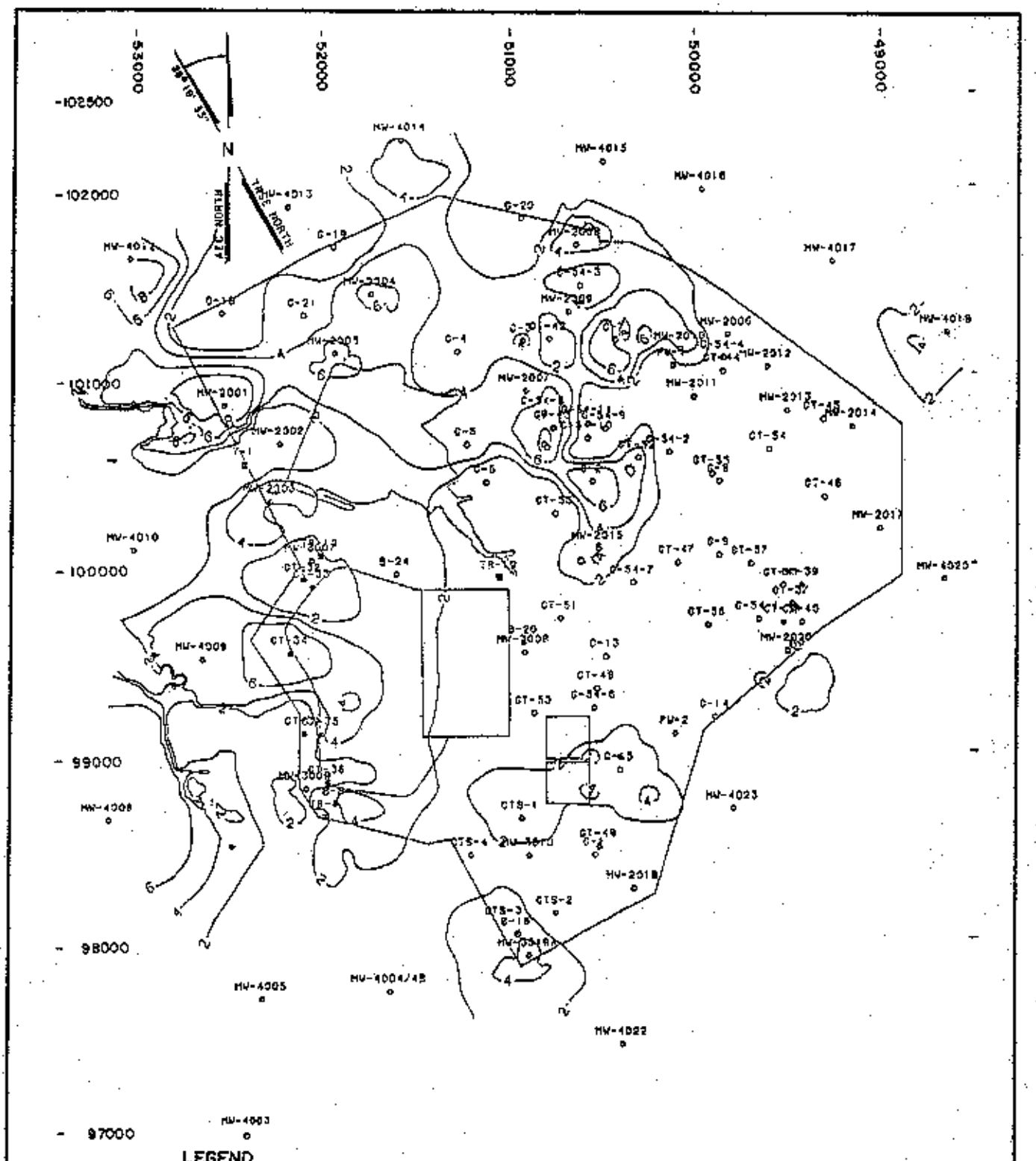
SCALE IN FEET

500 250 0 500 1000

ISOPACH MAP OF CLAY TILL

FIGURE 4-4

REPORT NO.: DOE/OR/21548-155		EXHIBIT NO.: A/CP/105/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	



LEGEND

—6— THICKNESS CONTOUR of BASAL TILL

CONTOUR INTERVAL 2.0 FT.

SCALE IN METERS

120 60 0 120 240 360

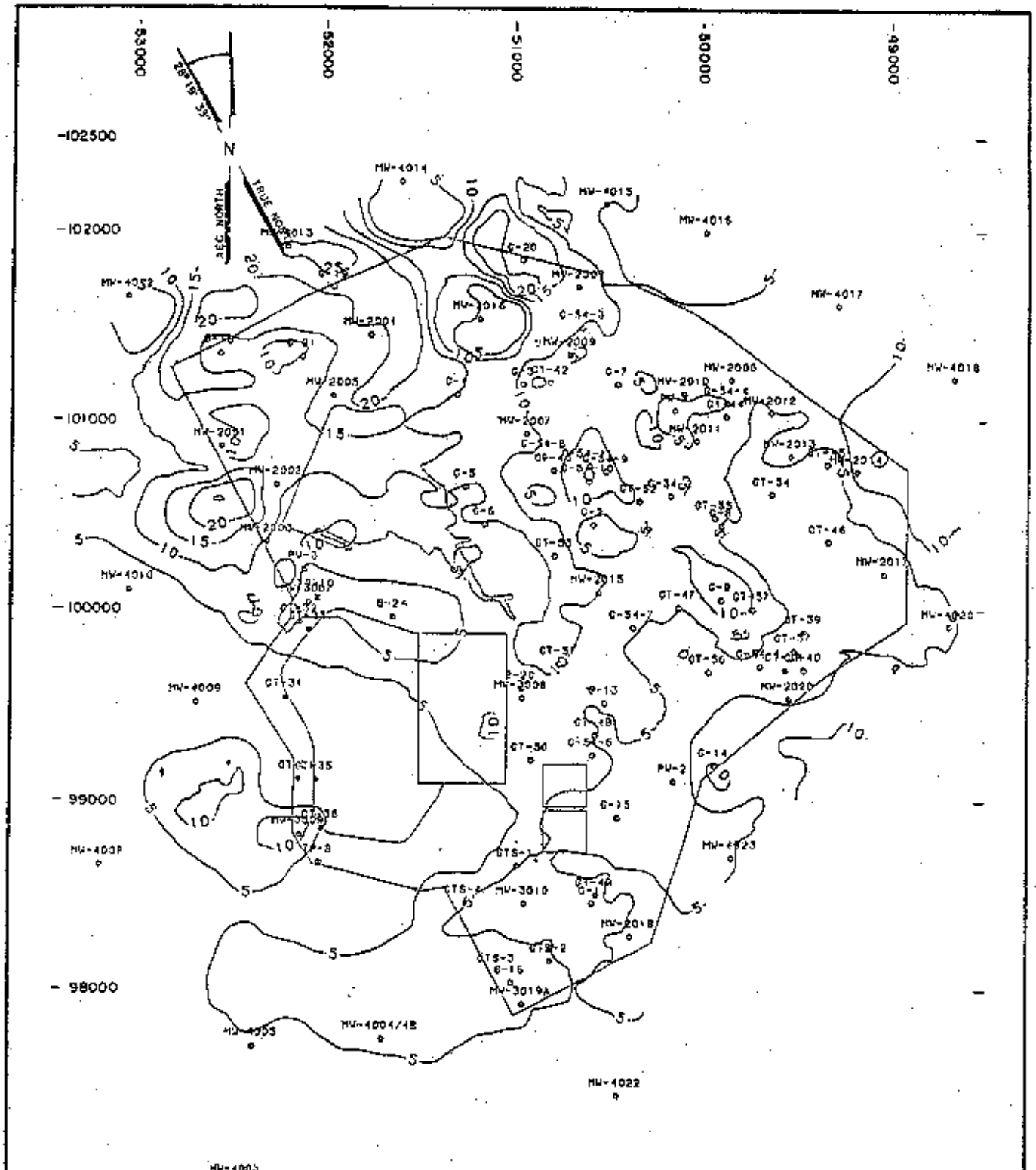
SCALE IN FEET

500 250 0 500 1000

ISOPACH MAP OF BASAL TILL

FIGURE 4-5

REPORT NO.: DOE/OR/21548-155		EXHIBIT NO.: A/CP/106/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	



LEGEND

—10— THICKNESS CONTOUR of RESIDUUM

CONTOUR INTERVAL 2.0 FT.

SCALE IN METERS

120 60 0 120 240 360

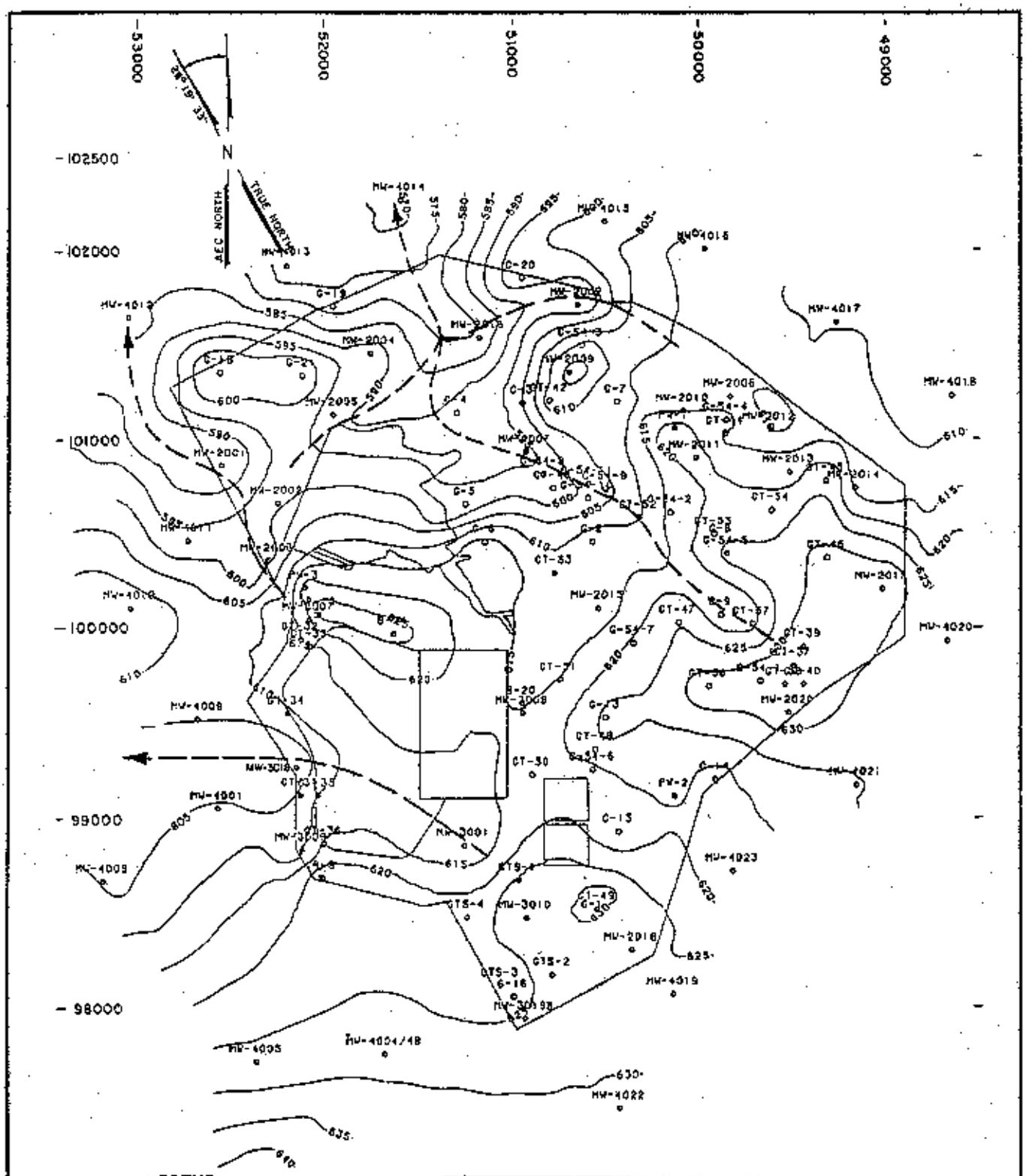
SCALE IN FEET

500 250 0 500 1000

ISOPACH MAP OF RESIDUUM

FIGURE 4-6

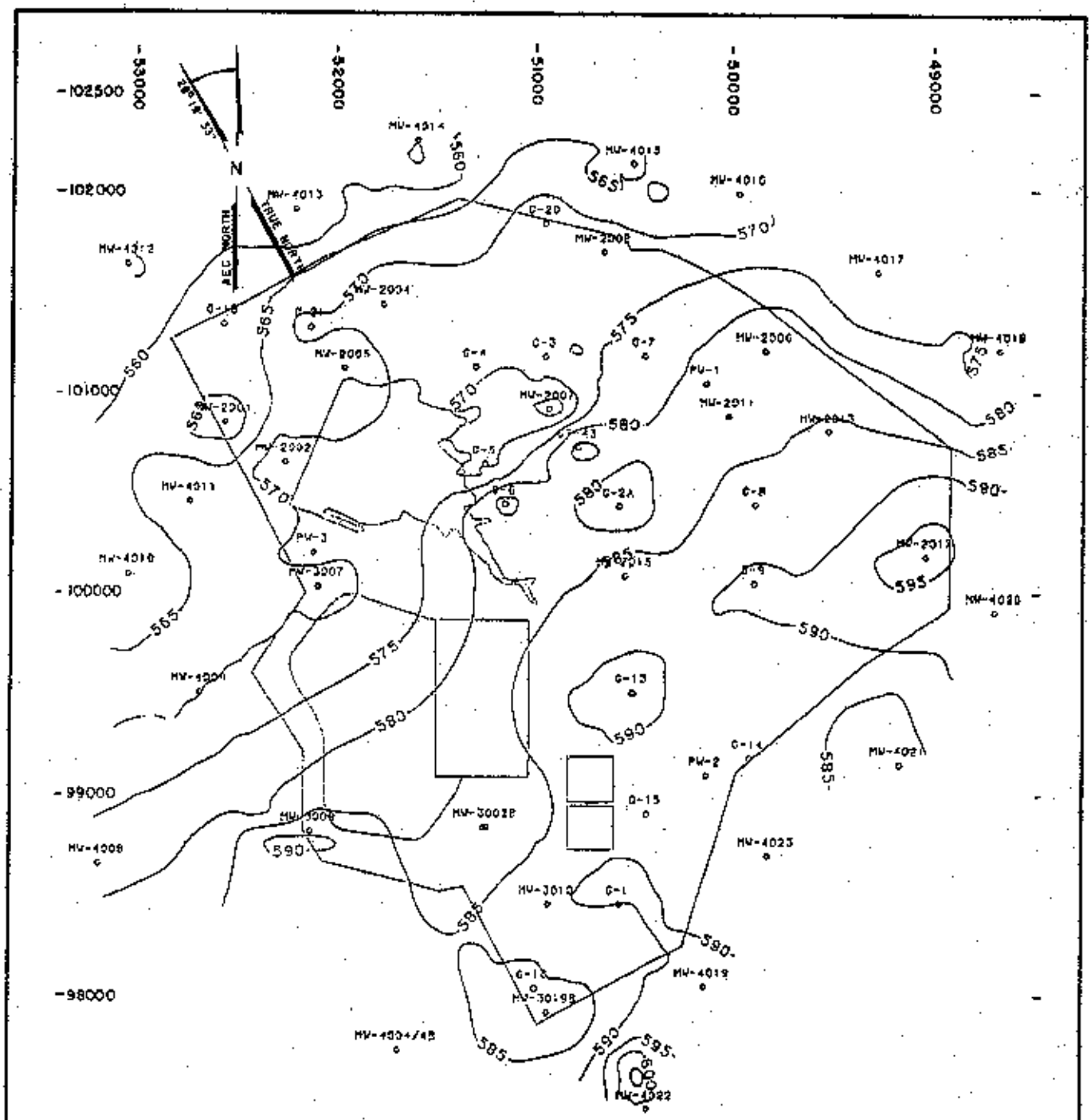
REPORT NO.: DOE/OR/21548-165		EXHIBIT NO.: A/CP/107/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	



CONTOUR MAP OF TOP OF WEATHERED LIMESTONE

FIGURE 4-7

REPORT NO.: DOE/OR/21548-155		EXHIBIT NO.: A/CP/108/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	



LEGEND

590 — CONTOUR OF TOP OF COMPETENT LIMESTONE

CONTOUR INTERVAL 5.0 FT.

SCALE IN METERS

120 60 0 120 240 360

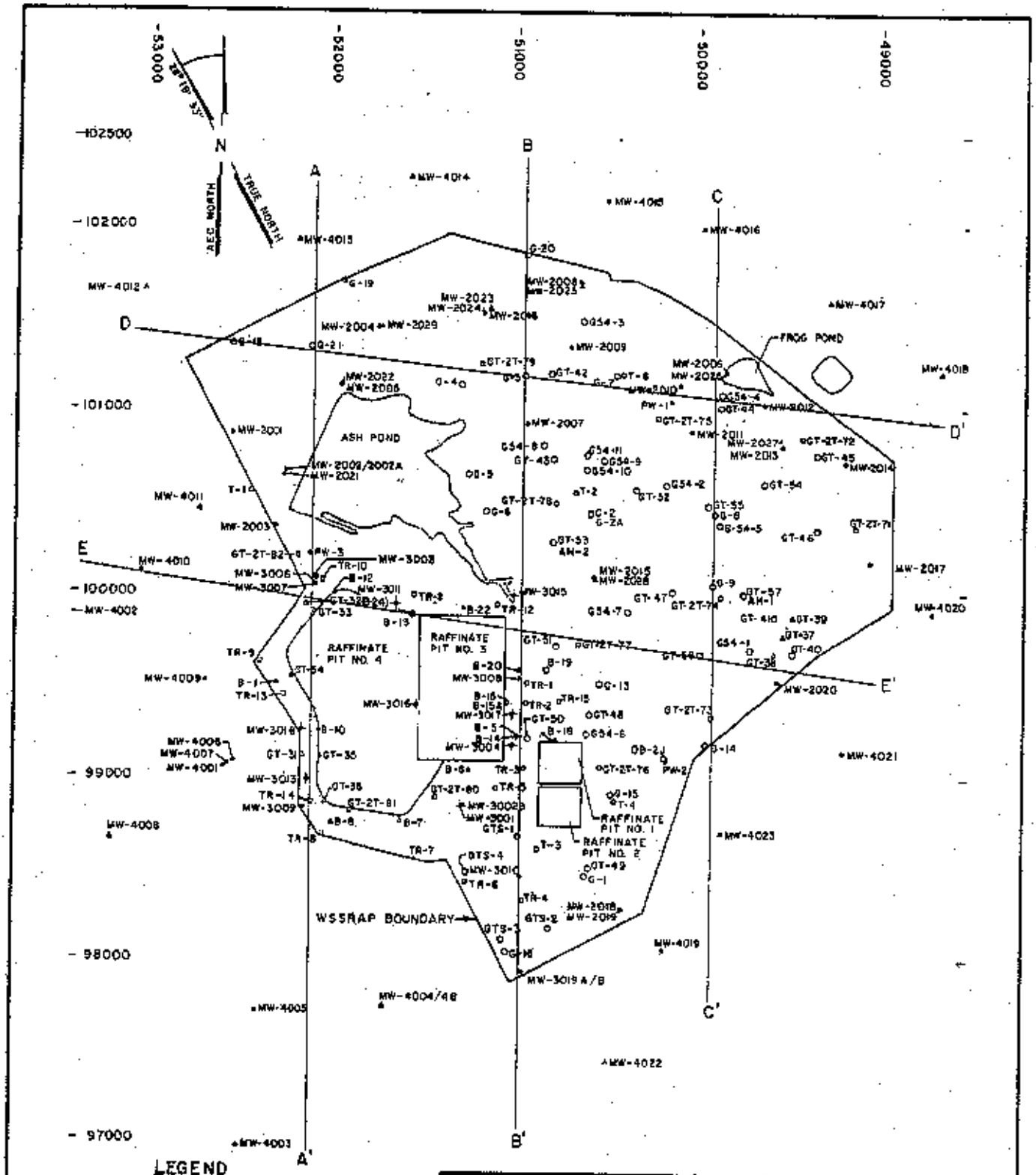
SCALE IN FEET

500 250 0 500 1000

CONTOUR MAP OF TOP OF COMPETENT LIMESTONE

FIGURE 4-8

REPORT NO.: DOE/OR/21548-155		EXHIBIT NO.: A/CP/109/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	



LEGEND

- MONITOR WELL (WEATHERED BEDROCK)
- MONITOR WELL (COMPETENT BEDROCK)
- BOREHOLE
- PIEZOMETER
- OVERBURDEN WELL
- TRENCH
- A-A' CROSS SECTION LOCATION

SCALE IN METERS

120 60 0 120 240 360

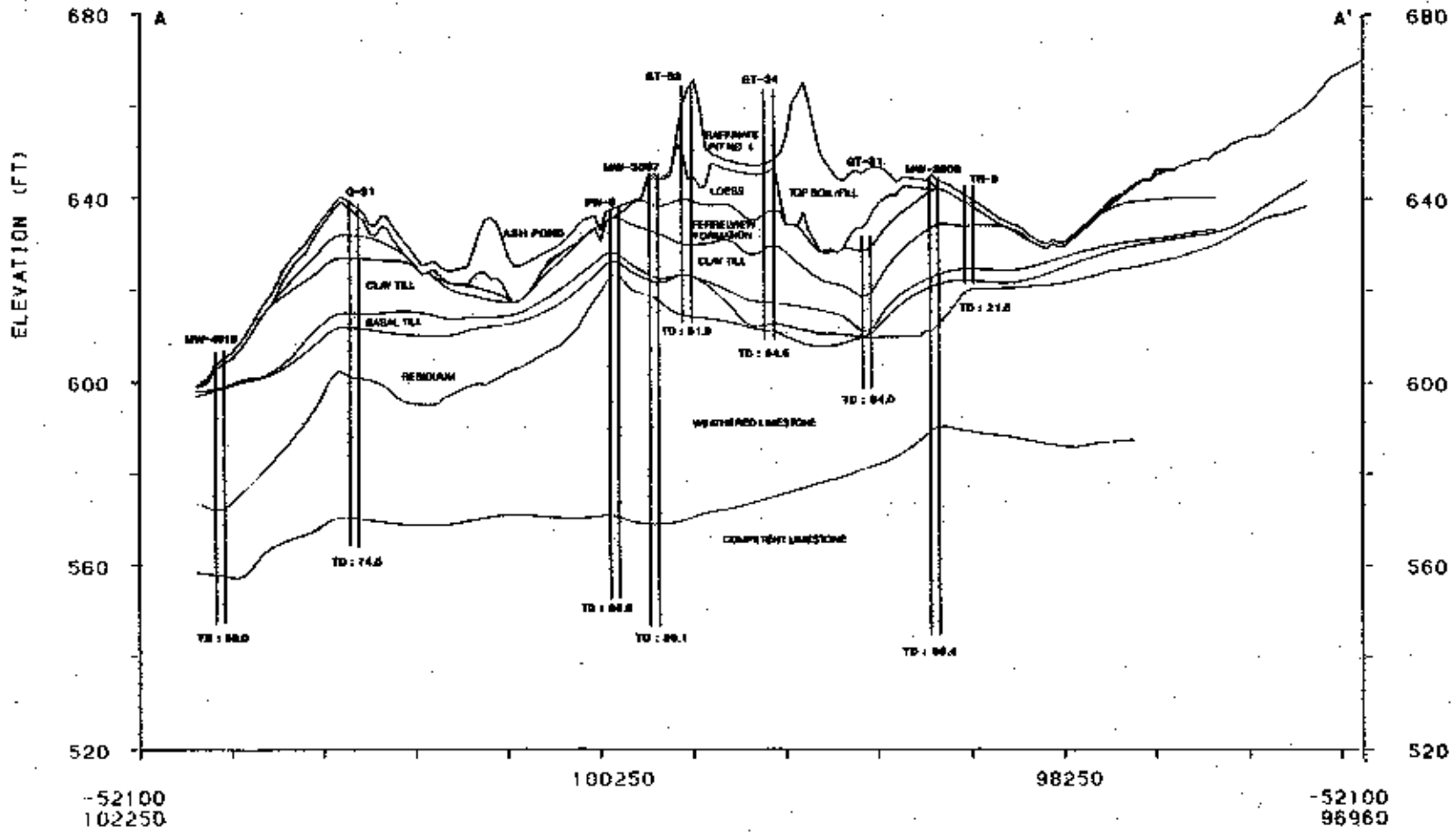
SCALE IN FEET

500 250 0 500 1000

BOREHOLE AND TEST PIT LOCATION MAP WITH CROSS SECTIONS

FIGURE 4-9

REPORT NO.: DOE/OR/21548-166		EXHIBIT NO.: A/CP/110/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	



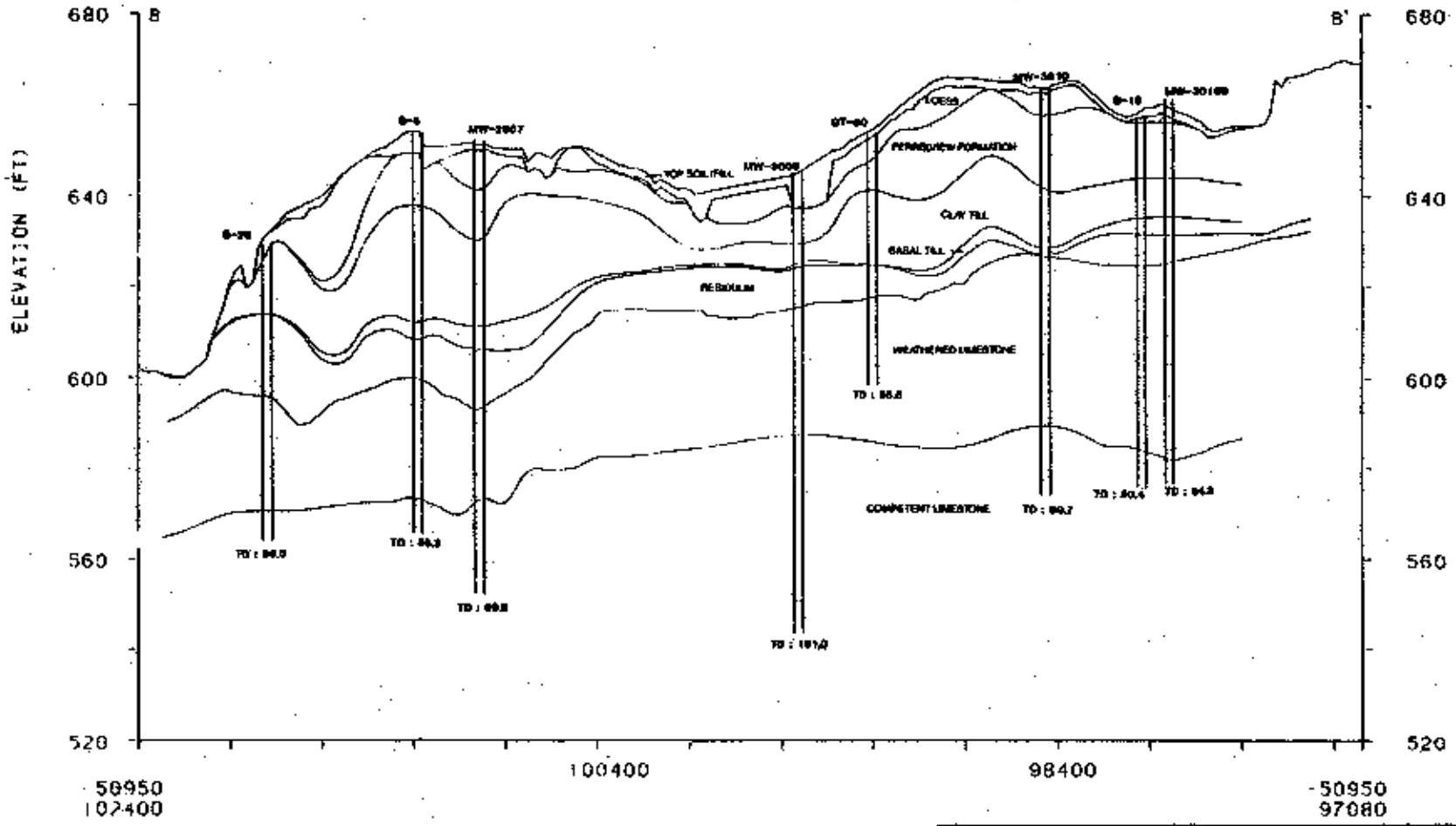
Scale

Horz. Scale 1 unit = 122 M (400 ft.)
Vert. Scale 1 unit = 6.1 M (20 ft.)

GEOLOGIC CROSS SECTION A–A'

FIGURE 4–10

REPORT NO: DOE/OR/21548-155		DRAWING NO.: A/CP/111/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	



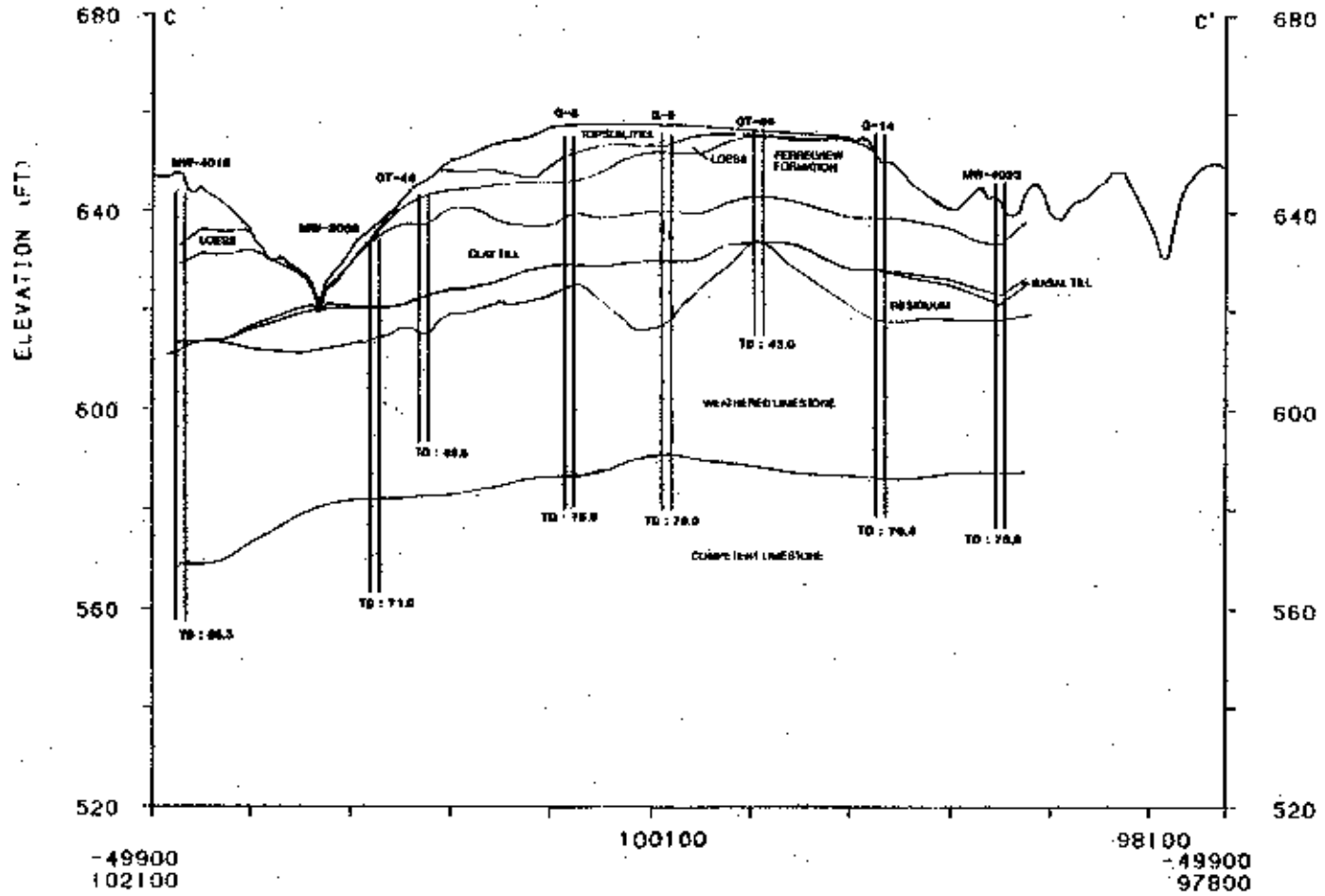
Scale

Horz. Scale 1 unit = 122 M (400 ft.)
Vert. Scale 1 unit = 6.1 M (20 ft.)

GEOLOGIC CROSS SECTION B-B'

FIGURE 4-11

REPORT NO.: DOE/OR/21548-155		DRAWING NO.: A/CP/112/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	



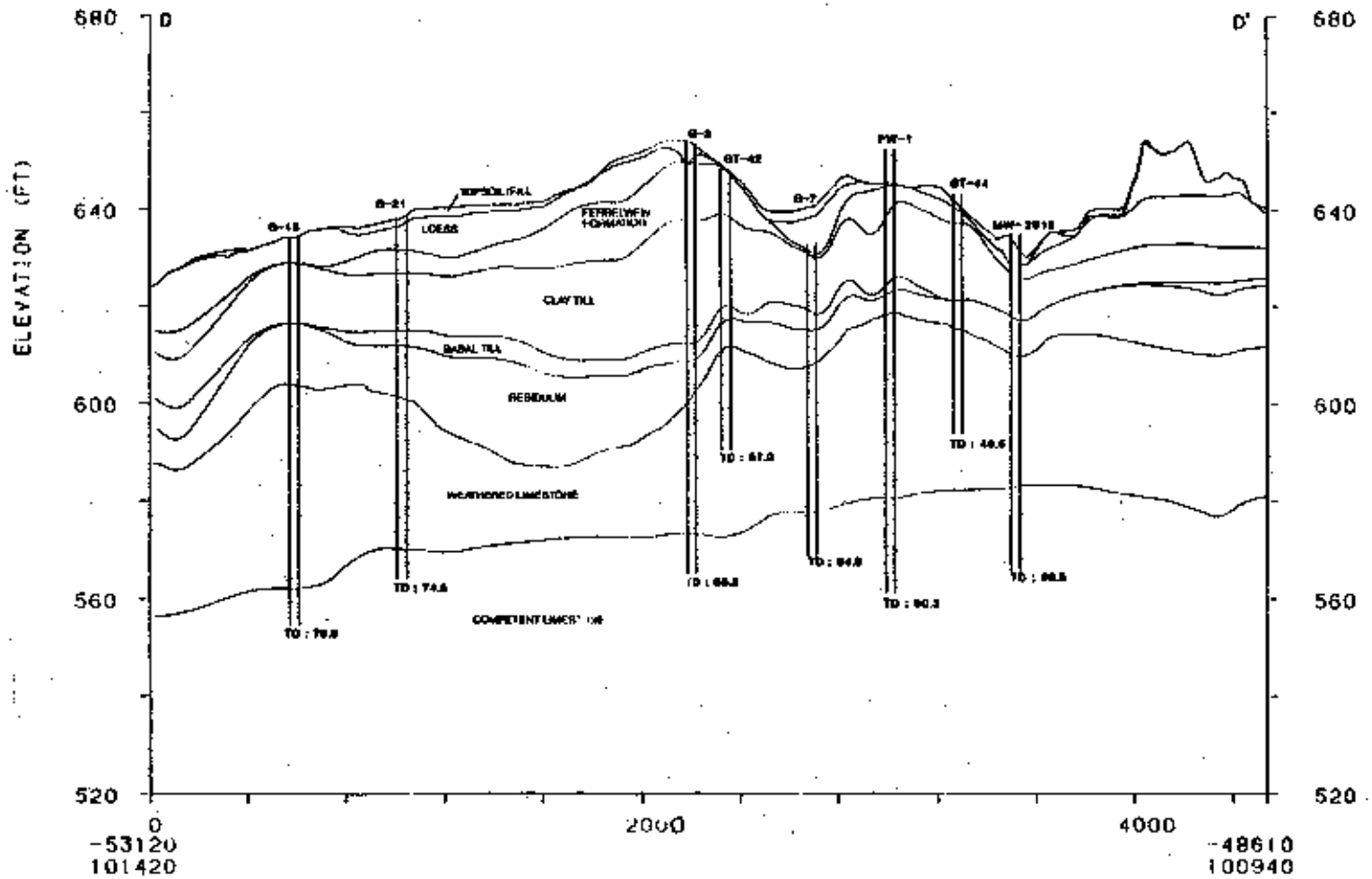
Scale

Horz. Scale 1 unit = 122 M (400 ft.)
Vert. Scale 1 unit = 6.1 M (20 ft.)

GEOLOGIC CROSS SECTION C-C'

FIGURE 4-12

REPORT NO. DOE/OR/21548-155		DRAWING NO.: A/CP/113/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	



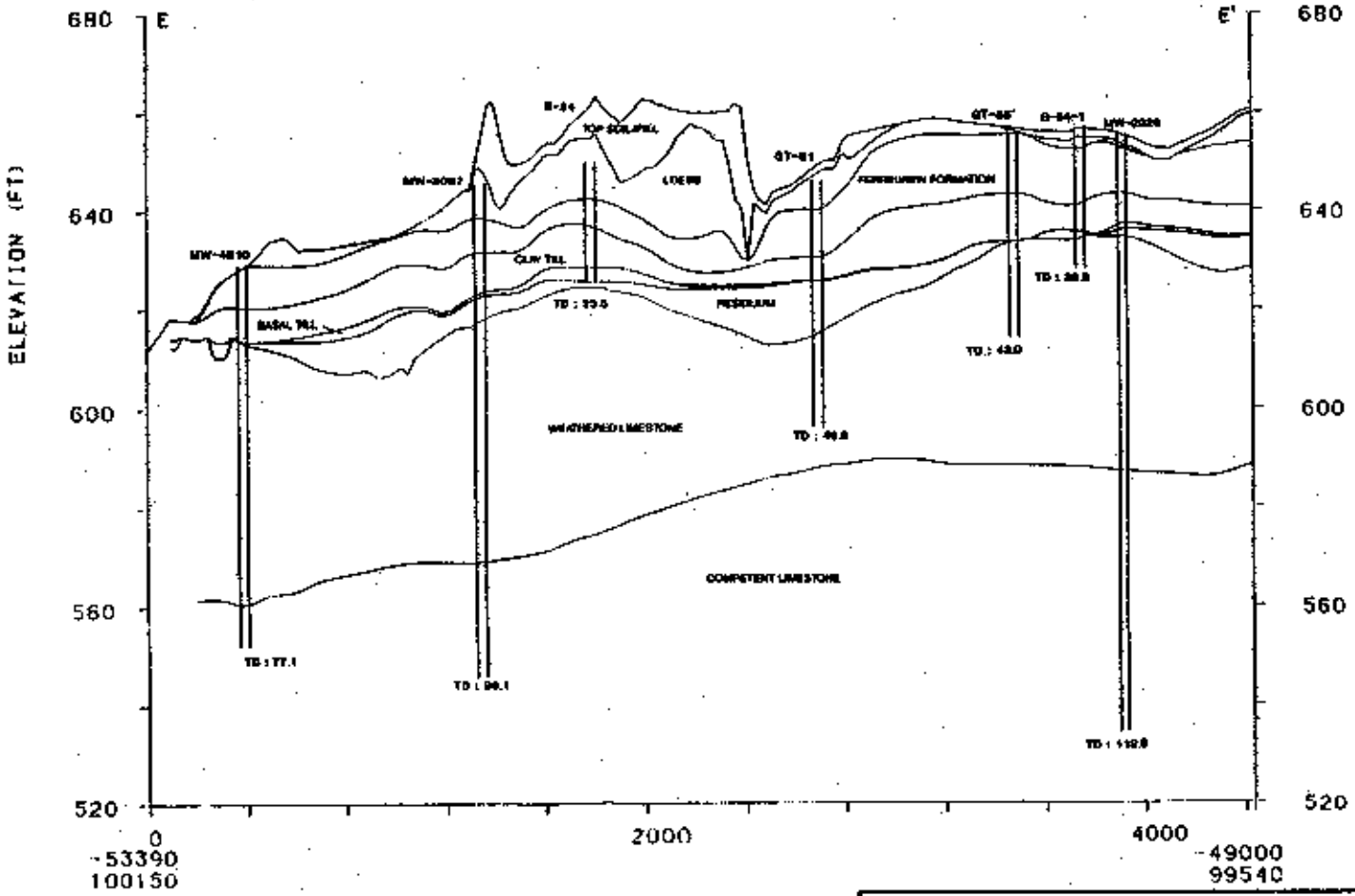
Scale

Horz. Scale 1 unit 122 M (400 ft.)
Vert. Scale 1 unit = 6.1 M (20 ft.)

GEOLOGIC CROSS SECTION D-D'

FIGURE 4-13

REPORT NO. DOE/OR/21548-155	DRAWING NO.: A/CP/114/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90



Scale

Horz. Scale 1 unit = 122 M (400 ft.)
Vert. Scale 1 unit = 6.1 M (20 ft.)

GEOLOGIC CROSS SECTION E-E'

FIGURE 4-14

REPORT NO.: DOE/OR/21548-155		DRAWING NO.: A/CP/115/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	

Topsoil/Fill - The uppermost soil unit at the site consists of large areas of disturbed fill and a thin veneer of top soil. Fill is highly variable in thickness and composition (Table 2-1). Figure 4-2 is an isopach map of the topsoil/fill. Thickness ranges from 0 to 14 feet, except in the raffinate pit and Ash Pond areas where engineered fills of up to 20 feet are encountered. Large volumes of fill were used in constructing the dikes for the raffinate pits and Ash Pond, where the thickest accumulations were found (BNI 1987). Fill was also used for general site embankment construction, site grading, and drainage control prior to the construction of the chemical plant structures.

The fill material comprising the raffinate pit dikes is unsaturated. Laboratory test results for this material indicate that the moisture content ranges between 15% and 24%, and the dry unit weight is approximately 100 pounds per cubic foot (pcf). Fines content (minus No. 200 sieve) ranges from 78% to 96% and the plasticity index (PI) ranges from 24% to 41%. Permeabilities of the dike fill have been reported at 1.4×10^{-7} cm/sec to 1.6×10^{-9} cm/sec. Piezometers installed in the raffinate pit No. 4 dike during these field investigations have remained dry (Appendix A-1).

Loess - The loess unit underlying the topsoil/fill is randomly scattered across the site, possibly because it is a wind blown deposit (MGS 1977). Loess distribution may also have been affected by extensive reworking of the upper subsurface during site preparation and construction. Loess thicknesses of 10.5 feet were found during these field investigations. Materials from this unit consist primarily of a mottled gray silt to dark yellowish-orange, clayey silt or silty clay. The loess exhibits low plasticity with a PI ranging from 10 to 30. It does

not collapse when wet like other wind deposited soils that are commonly called loess and are typically found in this part of the country. The moisture content of this loess ranges from 15% to 30%; the dry unit weight ranges from 90 to 105 pcf. Fine content usually ranges from 95% to 99%.

Ferrelview - The Ferrelview Formation, which underlies the loess unit is one of the more extensive soil units within the site overburden. This unit is important from the design perspective because it will provide the first natural barrier to contaminant migration below the engineered impermeable liner of the proposed disposal cell. Unit thickness ranges from 0 to 22 feet (Table 2-1 and Figure 4-3). Where encountered in boreholes it is typically dark yellowish-orange to brown with gray mottling. Material composition ranges from a silty clay to a clayey silt, which is often very stiff and exhibits high plasticity (PI from 20 to 50). Laboratory sieve analyses show that most of the material is silt and clay with minor sand. The percent of fines generally ranges from 85% to 98%. The moisture content generally ranges from 15% to 30% and the dry unit weight from 90 pcf to 114 pcf.

The Ferrelview contains a high percentage of silt which may be derived from the underlying clay till. Samples of clay from this formation have a characteristic conchoidal fracture and often exhibit slickensides which may be caused by consolidation and compaction. Permeability test results for the clay portion range between 3.2×10^{-6} and 1.0×10^{-8} cm/sec. In situ permeability tests in boreholes at the proposed temporary storage area have yielded hydraulic conductivities (permeability) less than 1.0×10^{-8} cm/sec within the more clayey zones (Appendix B-2).

Clay Till - The clay till underlying the Ferralview Formation is the most horizontally extensive soil unit at the WSS. It has been encountered in almost all of the boreholes and test pits on the site. The thickness of this unit ranges up to 30 feet (Figure 4-4). The clay till consists of massive and very stiff yellowish brown silty clay and clayey silt, and has a medium to high plasticity. It contains minor amounts of sand and rounded to subrounded gravel. The PI generally ranges from 25 to 45. The percent of fines (minus No. 200 sieve) ranges from 70% to 95%. The water content ranges from 12% to 35%, and the dry unit weight from 82 pcf to 120 pcf.

Permeability values in the clay till range from 3.0×10^{-6} to 1.4×10^{-8} cm/sec. The unit has a high effective cation exchange ratio.

Basal Till - The basal till unit is found mostly in the western and north-central portions of the site. The unit ranges in thickness from 0 to 8 feet as shown on the isopach map in Figure 4-5. It is typically a yellowish brown, sandy-silty-gravelly clay to clayey gravel. The basal till is the most gravelly soil unit within the site overburden. Therefore, it may have higher permeability than the other overlying soil units. Limited test results (fewer than five tests) show that the PI is generally between 12 and 28, the fines from 28% to 84%, the moisture content approximately 18%, and the dry unit weight from 102 pcf to 120 pcf.

Residuum - The residuum is found immediately above the bedrock throughout the site region. It is laterally extensive on the site. This soil unit is interpreted to be a pre-Pleistocene weathering horizon of the underlying bedrock (BNI 1984). Its thickness varies from 0 to approximately 25 feet as shown in

Figure 4-6. Thicker deposits correspond to bedrock lows; thinner areas are found over bedrock highs. Residuum materials are a distinctive red to yellow. They consist of gravelly clay to gravelly silt, clayey sand, and gravel. The gravel consists of angular, weathered chert or limestone rock fragments. The interstitial clay is often highly plastic and forms a tight matrix around the gravel-sized rock fragments. Samples obtained for testing probably represent residuum with higher fines content because of poor sample recovery from residuum with higher gravel content. Based on the limited test results, the PI for the interstitial clay portion ranges from 28 to 50. Fines in the tested samples range from 35% to 80%. The moisture content and the dry unit weight range from 10% to 25% and 100 pcf to 117 pcf, respectively.

Laboratory testing of a sample from near the top of the residuum yielded a permeability of 5.0×10^{-8} cm/sec. In situ permeability, as measured at the soil bedrock interface (base of the residuum), ranges from 6.3×10^{-4} cm/sec (BNI 1987). These results most likely reflect hydraulic conductivity values at the residuum/bedrock interface and may not truly represent the residuum unit. Because these permeabilities are much higher than other soil units tested, the residuum is a potential pathway for lateral migration of contaminants. Such migration is possible particularly where abundant rock fragments lie on the bedrock.

4.3 Bedrock

The Burlington-Keokuk Limestone is the first bedrock unit encountered below the unconsolidated overburden materials on the site and is the only bedrock unit discussed in this section. The other bedrock units are not significant from an engineering standpoint because of their great depth. The Burlington-Keokuk

Limestone formation has been sub divided into a weathered limestone horizon and a competent limestone horizon. Information discussed below is presented in Appendixes A-3, B-1, and B-3, and summarized in Table 2-1.

An early investigation (Roberts 1951) reported two major joint sets within the exposed bedrock in the Weldon Spring area: one trends between N30°W and N65°W, and the other trends between N30°E and N72°E. Subsequent regional and site-specific studies have generally confirmed these orientations. Bedrock topography exhibits erosional features interpreted as paleochannels. This interpretation coincides with observed joint set orientations. The joint sets are discussed in more detail in Section 2.

Weathered Limestone - This geotechnical bedrock horizon is highly to moderately weathered and well fractured. The materials are yellowish brown, yellowish gray, grayish orange, and/or white. The limestone contains 40% to 60% chert occurring as distinct interbeds or nodules. It is finely crystalline to coarse grained, thinly to massively bedded, and argillaceous with iron oxide stains in the rock matrix and along fractures. The weathered limestone is characteristically more fractured. It contains numerous solution features. The smaller openings are often lined with calcite and drusy to euhedral quartz, while the larger cavities are often filled with clay or a silt/clay/chert gravel mixture (BNI 1987). These cavities are generally reported as core loss in the boring logs.

The top-of-bedrock contour map (top of weathered limestone, Figure 4-7) shows several depressions. These features are interpreted as pre-glacial, fluvial paleochannels. Their trend is approximately parallel to the regional structure orientations (Figure 2-1) and their location may be structurally controlled.

Bechtel (1983a) identified the largest paleochannel in the subsurface near the power plant (Building No. 401) and the drainage east of Ash Pond. These features were confirmed by geophysical surveys of the area (Geotechnology Services, Inc. 1988).

Core drilling in the weathered limestone for Phase II geotechnical investigations indicated that fracturing is predominantly horizontal and closely spaced. It occurs along the shaley interbeds, bedding planes, and chert interbeds. Fractures are commonly clay filled or mineralized. Rock quality designations (RQD) in boreholes penetrating the weathered limestone show that approximately 73% (see Table 4-1) of this bedrock horizon has very poor to poor RQD values (i.e., it is highly fractured). By contrast about 79% of the rock of the competent limestone bedrock horizon can be classified as having fair to excellent RQD and only 9% as having very poor RQD.

Data from angled borings, cored to intersect the regional northeasterly and northwesterly vertical joint sets, indicate sporadic joints in the weathered limestone immediately below the proposed disposal cell area. Spacing between vertical joints ranges from 2.5 to 18 feet with an average of one every 10 feet. Vertical joints near the weathered bedrock surface are enlarged and often clay filled. Both fracture and joint density in the highly fractured weathered limestone decreases rapidly with depth, and the character of the rock grades into the less fractured competent limestone bedrock horizon.

<u>Competent Limestone</u> - The competent limestone is found 10 to 50 feet beneath the weathered limestone horizon. Figure 4-8 is a contour map of the competent limestone. This fresher rock is gray to light gray, finely to coarsely crystalline, and bedded.

TABLE 4-1 Summary of Rock Quality Designation (RQD) From Coring in Boreholes

STRATIGRAPHIC UNIT	(PERCENTAGE OF CORE RUNS IN GIVEN RANGE) VERY POOR	POOR	FAIR	GOOD	EXCELLENT
Weathered Limestone	41	32	21	5	1
Competent Limestone	9	12	44	25	10

Note: *RQD designations are defined as follows:

Very Poor	0-25%
Poor	26-50%
Fair	51-75%
Good	76-90%
Excellent	91-100%

The competent limestone rock is stylolitic and fossilferous, with 20% to 40% chert nodules and chert beds. Only slightly weathered, if at all, the competent limestone has very little iron oxide staining, and contains fresh pyrite along some fracture surfaces. About 79% of the RQD values can be described as fair to excellent. Solution features are not common in this unit.

Lithologic logging indicates that the surface of the competent limestone is much flatter than that of the weathered limestone. It exhibits fewer weathering effects and more structural jointing control. Although the surfaces are gentler than the top of bedrock, more frequent vertical fractures may exist in the competent limestone in the areas directly beneath the paleochannels identified in the weathered limestone. These areas may also be the focus of groundwater migration in the shallow bedrock aquifer.

4.4 Groundwater

Groundwater at the WSS is found mainly in the shallow bedrock aquifer comprising an upper zone (weathered limestone) and a lower zone (competent limestone). The groundwater system also includes two important compounds: an unsaturated vadose zone and localized areas of perched groundwater.

Vadose Zone and Soil - The vadose zone is the unsaturated zone of soil and rock between the ground surface and the groundwater table. Because of local and seasonal variations in recharge and discharge, the thickness of the vadose zone at the site varies locally, seasonally, and from year to year. The variation ranges from less than 35 feet to more than 65 feet. Seasonal variations of groundwater at the site are discussed in

more detail in the site Remedial Investigation Report (MKF and JEG 1990a, 1990c).

Water infiltrates from the ground surface through the soil. Since there are no sources of surface water, the chief source of water infiltrating through the vadose zone is precipitation. The quantity of water from this source reaching the vadose zone depends on precipitation intensity and type, the conditions of the soil surface, vegetation, and the physical properties of the soil. Direct infiltration occurs in vegetated areas such as those near Frog Pond, the western portion of the site near Ash Pond and the raffinate pits, and most of the area surrounding the site. The eastern portion of the site is generally paved and/or covered with buildings, which prevents direct infiltration through the surface. Infiltration in this portion is limited to discrete areas such as drainage ditches, deteriorated underground sewer lines, and small exposed areas. Standing bodies of water, such as Ash Pond, Frog Pond, and the raffinate pits may also act as sources for infiltration. The amount of recharge to the subsurface through infiltration is a function of the hydraulic conductivities of the underlying materials.

Perched Groundwater Zones - Areas of perched groundwater are encountered in localized areas. Shallow monitoring wells installed in the chemical plant area have delineated these zones. Perched conditions occur where leakage or infiltration accumulates over low permeability, clay-rich horizons and in discrete permeable lenses. Unsaturated flow is present locally as a result of direct infiltration; leakage from on-site storm water, sewer, and water lines; and leakage from the raffinate pits. Mounded conditions resulting from leakage have been detected beneath the raffinate pits.

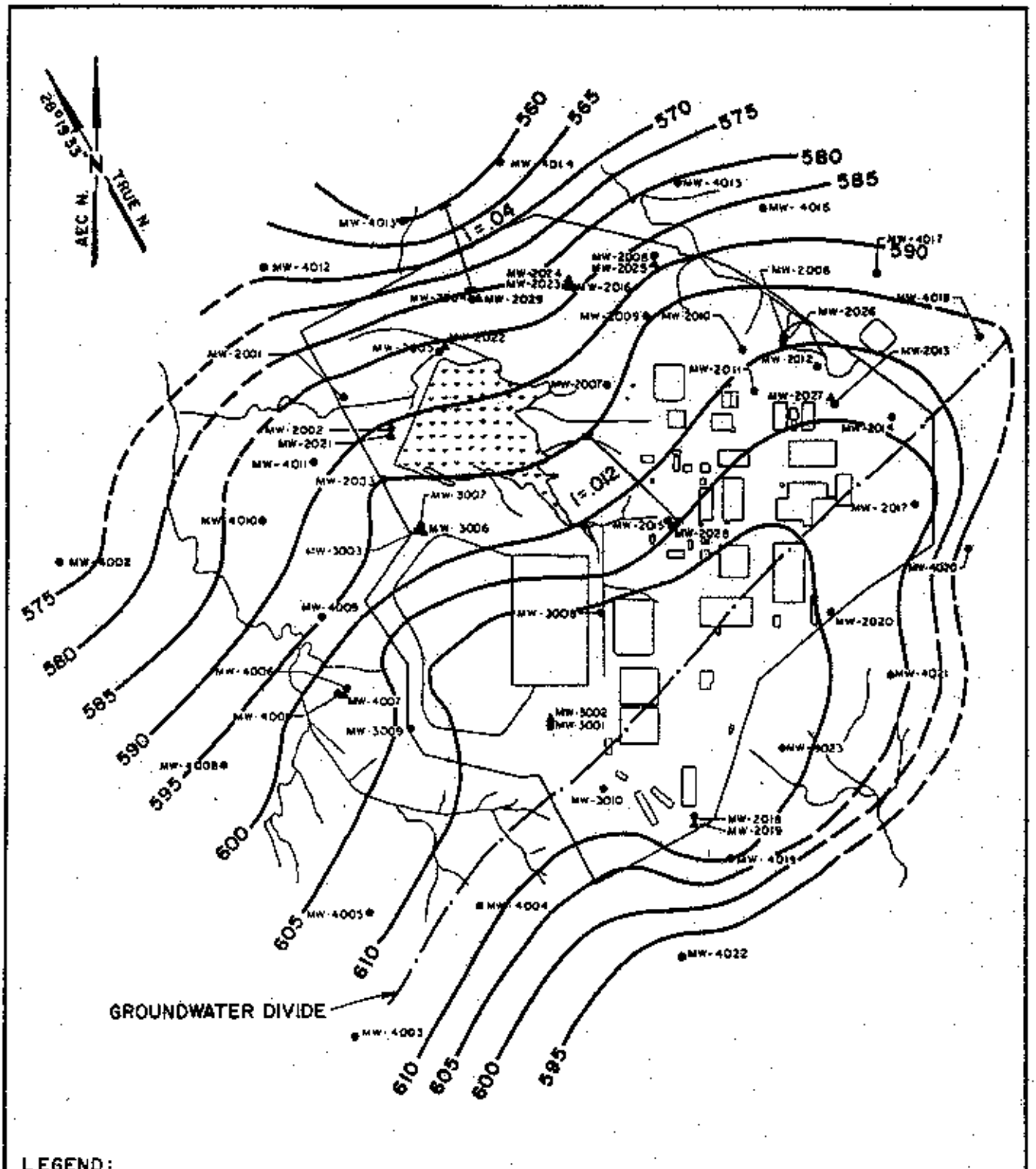
Water-level monitoring from 1986 through June 1990 indicated perched groundwater zones below raffinate pits No. 3 and No. 4 (MKF and JEG 1990a).

Seismic anomalies detected during the geophysical survey in 1984 indicated the possible presence of perched water zones south of raffinate pit No. 3. Geophysical data indicated that the central portion of raffinate pit No. 3 was saturated, and that saturated conditions also existed beneath the unsaturated sludges and soil on the east, west, and south sides of raffinate pit No. 3 (MKF and JEG 1990a).

Perched water was also encountered in boreholes drilled in June 1988 near the administration building. This water originated from a leaking water line. It is stored near the surface, possibly in the pipe trench backfill.

Shallow Bedrock Aquifer - The shallow bedrock aquifer at the WSS is contained within the Burlington-Keokuk bedrock unit. Groundwater elevation (potentiometric surface) contours for the shallow bedrock are shown in Figure 4-15. Potentiometric contours for other aquifers are presented in the site Remedial Investigation Report (MKF and JEG 1990c). Groundwater elevation data for the period August 1989 to August 1990, including piezometers installed for this investigation, are listed in Appendix C.

The potentiometric contour maps show fluctuations in groundwater elevation. The changes may be due to seasonal changes in precipitation and infiltration at the site. In general, precipitation is lowest and evaporation highest in summer (July), and vice versa in winter (December). This is



LEGEND:

- ● SHALLOW MONITORING WELL
- ▲ DEEP MONITORING WELL
- —600— POTENTIOMETRIC CONTOUR (FT-MSL)

0 500 1500 FT
0 243.8 487.7 M
SCALE

POTENTIOMETRIC SURFACE OF SHALLOW AQUIFER

FIGURE 4-15

REPORT NO.: DOE/OR/21548-155		DOBBIT NO.: A/CP/116/1190	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 11/90	

reflected in lower summer groundwater levels for a given location and higher winter levels. In either case, the level of the piezometric surface appears to be below planned excavation depths.

The potentiometric surface elevation for deep wells is generally lower than that for shallow wells. This indicates a net downward vertical gradient within the shallow bedrock aquifer. Another feature of this aquifer is the groundwater divide passing through the eastern portion of the site. Groundwater to the east of this divide flows east-southeast toward the Missouri River. Groundwater to the west of this divide flows north-northwest. The groundwater divide essentially mimics the regional surface water divide. Surface water on the eastern part of the site flows toward the Missouri River; that on the western part flows toward a network of streams and lakes north of the site. Eventually this portion flows into the Mississippi River.

A detailed hydrogeologic study by the PMC is presented in the Draft Aquifer Characterization Data Report (MKF and JEG 1990a).

4.5 Geophysical Model

Results of the geophysical investigation (not including geophysical logging of angled holes) are summarized below and shown in Table 3-1. With the exception of seismic refraction, results of the geophysical surveys are generally restricted to the site perimeter. Despite their limitations, the geophysical surveys indicates a model of the site subsurface that generally corresponds to the geology encountered in boreholes (Geotechnology Services, Inc. 1988).

Generally, three seismic layers were defined by the refraction data. The top (surface) seismic layer ranges in thickness between 1.5 and 15 feet; its velocity varies between 50 and 1,920 feet per second (fps). The second seismic layer ranges in thickness from 22 to 60 feet and has a velocity between 2,220 fpc and 5,880 fpc. This layer may correspond to an increase in moisture content near the top of the Ferrelview Formation. The deepest seismic layer has a seismic velocity of 11,600 fpc to 18,200 fpc and generally corresponds to the top of moderately weathered to fresh limestone. However, this layer may also include basal till and residuum at some locations. This layer dips generally toward the north-northeast and undulates. Local relief of 15 feet is commonly observed along the seismic lines. The higher velocities are thought to indicate zones of dense competent limestone.

The electromagnetic (EM) resistivity data generally indicate four layers. The surface layer ranges in thickness from 5.5 to 18 feet and has resistivities ranging from 8 to 45 ohm-meter (ohm-m). This layer is composed of fill, loess, and/or the Ferrelview Formation. The second layer is 4.5 to 16.5 feet thick and ranges from 2 to 170 ohm-m in resistivity. It usually corresponds to zones in the clay till, but may also indicate areas of higher clay content in the Ferrelview Formation. The bottom of this layer may correspond to a decrease in clay content. The third EM layer ranges in thickness from 3.5 to 33 feet and in resistivity from 13 to 24 ohm-m.

The only area where usable spontaneous potential (SP) data were collected is near the north corner of the site. The SP data contain numerous anomalies which may be the result of varying soil thicknesses, conductivity, moisture content, and/or features

in the limestone bedrock such as clay filled fractures. The anomalies generally range in magnitude from 4 to 12 volts.

Models based on the results of the four vertical direct current electrical sounding (VES) surveys show five (sometimes six) layers. The surface resistivity layer varies both in resistivity and thickness due to the moisture content, type of soil, and the vegetation present on the surface. The resistivities of the second and third layer range, from 20 to 35 ohm-m and 3 to 20 ohm-m, respectively. Both of these layers may include the clay till. Variations in resistivity are probably due to changes in clay and/or moisture content. The fourth layer ranges in resistivity from 22 to 120 ohm-m. This layer may correspond to the basal till or highly weathered limestone. Moderately weathered limestone may be indicated by the fifth layer which ranges in resistivity from 480 to 1,000 ohm-m.

4.6 On-Site Borrow Sources

Overburden soils from the ground surface to shallow depths (approximately 12 feet) were investigated as possible sources of borrow material. These soils are representative of the upper soil units such as fill, loess, and Ferrelview clay that are generally found on the site. The soils encountered consist of silty clays and gravelly clays (fill) with medium to high plasticity and a consistency from medium stiff to very stiff. The soils are generally classified as CL and CH according to the Unified Soil Classification System. The moisture content ranges from 14% to 28% and the specific gravity from 2.51 to 2.74. The plasticity index is between 6 and 56. The proportion of fines ranges from 89% to 99%. Compaction test results using the Standard Proctor (ASTM D 698) method show an optimum moisture content ranging from 12% to 21% and a maximum dry unit weight

ranging from 102 pcf to 116 pcf. If these soils are uncontaminated they are, with few exceptions, suitable for use as earth fill materials.

4.7 Off-Site Borrow Sources

Except for the 1-foot thick topsoil layer, the soils encountered at borrow source No. 1 are mainly silty clay and clayey silt with occasional thin layers (1 to 2 feet) of gravelly clay. The clays and silts are yellowish brown to yellow mottled with gray and brown colorings, stiff to hard, and low to highly plastic. The plasticity index from laboratory test results, with the exception of one non-plastic sample, ranges from 10 to 44. The moisture content usually ranges from 11% to 28% and the specific gravity from 2.55 to 2.74. The percent of fines passing the No. 200 sieve ranges from 62% to 98%. Standard Proctor compaction test (ASTM D 698) results show that the optimum moisture content and the maximum dry unit weight range from 15% to 21% and 100 pcf to 116 pcf, respectively. Preliminary evaluation suggests that this is a good source for clayey materials for disposal cell construction. It is tentatively estimated that the amount of clayey soils available for construction exceeds the required design volume required by the 1989 conceptual design.

The soils encountered at borrow source No. 2 contain a high percentage of sands and gravels. The soils generally consisted of clayey silt; gravelly, clayey silt; and silty, sandy gravel. Due to the high proportion of coarse grained particles, this source is considered to be unsuitable for clayey soil borrow. However, the upper clayey silts may be utilized as a source of material to be used with vegetative cover or as general backfill material. Limited test results on this layer show the soil is

classified as CL or ML according to the Unified Soil Classification System with a PI of 12 to 21. The moisture content ranges from 23% to 28% and specific gravity from 2.62 to 2.71. The proportion of fines ranges from 90% to 97%. Standard Proctor compaction tests show that the optimum moisture content ranges from 15% to 18% and the maximum dry unit weight from 105 pcf to 110 pcf.

5 GEOTECHNICAL LABORATORY TESTING

5.1 Testing Programs

Geotechnical laboratory tests were used to determine the engineering properties of the overburden units within the chemical plant and raffinate pit areas, and at potential on-site and off-site clayey borrow sources. These data are needed for design studies of the proposed disposal cell and related facilities. In addition, geotechnical data including the engineering properties of the soil units were necessary for the site suitability study (MKF and JEG 1990b) which will lead to a decision on the location of the disposal cell at the Weldon Spring site.

Since the start of the MKF geotechnical field investigations in May 1988, a total of 11 laboratory testing programs have been implemented. These programs were planned in stages to facilitate laboratory testing as samples were obtained during the field investigations. Each test program specified which soil samples would be tested, the types of tests, the standard testing methods, and special testing instructions. Table 5-1 summarizes these programs, including the designated testing laboratories and the dates the programs were transmitted for testing. Three of these testing programs were prepared for soil samples from the staging and water treatment facility areas at the quarry. Detailed information concerning these programs is presented in the Quarry Geotechnical Investigations Report (MKF and JEG 1990c).

TABLE 5-1 Summary of Soil Testing Programs

TEST PROGRAM #	REQUEST NO.	DATE REQUESTED	PURPOSE	LABORATORY
1	1	06/23/88	Administration building	Chen-Northern, Inc.
2	2	07/27/88	Raffinate pit No. 4	Chen-Northern, Inc.
3	3	10/14/88	Disposal cell	Chen-Northern, Inc.
4	4	05/11/89	Quarry staging area	Geotechnology Services, Inc.
5	2A	05/26/89	Disposal cell	Geotechnology/metaTRACE/Chen-Northern
6	3A	06/26/89	Borrow sources	Geotechnology/metaTRACE/Chen-Northern/ Hannibal Testing
7	2B	08/25/89	Disposal cell	Geotechnology Services, Inc.
8	5	10/11/89	Temporary storage area	Geotechnology Services, Inc.
9	6	05/07/90	Quarry staging area	Geotechnology Services, Inc.
10	7	06/26/90	Quarry staging area	Geotechnology Services, Inc.
11	8	08/03/90	Material staging area	Geotechnology Services, Inc.

The four laboratories utilized for the testing were:

- Chen-Northern, Inc., Denver, CO
- Geotechnology Engineering and Environmental Services Inc., St. Louis, MO (Geotechnology).
- MetaTRACE, Inc., Earth City, MO
- Hannibal Testing Laboratories, Inc., Hannibal, MO

Chen-Northern was retained to perform the first three programs in 1988. Geotechnology was awarded the contract for laboratory testing in 1989 and 1990. Because of limited ability to perform some tests, Geotechnology subcontracted cation exchange capacity tests to metaTRACE, Inc., and the capillary moisture tests to Chen-Northern, Inc.

Soil samples were shipped in specially constructed wooden boxes to Chen-Northern in Denver by overnight air freight. All samples tested by Chen-Northern were discarded following the testing.

Samples designated for Geotechnology were transported to their St. Louis location in site vehicles. The samples from the materials staging area were returned to the site for storage for possible future testing. The rest were discarded after testing.

Fourteen in situ samples taken by drive tube methods from the vertical walls of off-site clay borrow test pits by Hannibal Testing Laboratory were tested at their laboratory for moisture content and density.

Most of the laboratory soil tests were performed in accordance with the American Society for Testing and Materials (ASTM) standard test procedures (ASTM 1990). The triaxial shear tests, which included the consolidated undrained compression tests with pore pressure measurements (R tests); the unconsolidated undrained compression tests (Q tests); and the triaxial constant-head permeability tests were all performed in accordance with the methods described in U.S. Army Corps of Engineers Manual EM 1110-2-1906 (COE 1970). The cation exchange capacity test was performed in accordance with Soil Conservation Service Method 5A3A.

Special instructions for slight modifications to the standard test methods were included in the test program. These modifications usually included specified confining pressures for triaxial shear and consolidation tests, consolidation loading increments, and density for remolded specimens.

Requested laboratory tests and methods used in the testing programs included (ASTM 1990, COE 1970, SCS 1967):

- Sieve Analysis - ASTM C136
- Sieve Analysis with Hydrometer - ASTM D422
- Atterberg Limits - ASTM D4318
- Shrinkage Limit - ASTM D427
- Unit Weight/Void Ratio - ASTM C29
- Specific Gravity - ASTM D854
- Moisture Content - ASTM D2216
- Dry Density - ASTM D2937
- One Dimensional Consolidation Test - ASTM D2435
- Triaxial (R) Shear Strength Test - EM 1906
- Triaxial (Q) Shear Strength Test - EM 1906
- Triaxial Permeability - EM 1906

- Capillary-Moisture Relationships - ASTM D2325 and D3152
- Moisture-Density Relationships - ASTM D698
- Cation Exchange Capacity - SCS 5A3A

Table 5-2 shows the number of tests by each test method on samples from the administration building area, the material staging area, the raffinate pit No. 4 dike, the clay borrow sources, and the chemical plant area including the TSA. A brief discussion of the significance and applicability of each type of test follows:

- Gradation Test (Sieve Analysis) with or without Hydrometer - The gradation test, or sieve analysis, determines the distribution of the various particle sizes in soil. Standard sieves are used to separate particles of all sizes except silts and clays, for which a hydrometer analysis is used. Particle size distribution is used to classify soils, estimate permeability (using empirical correlations), and analyze the potential for particle migration at the interface of two soils.

- Atterberg Limits and Shrinkage Limit Tests - Atterberg limits are index properties, and include liquid limit, plastic limit, and plasticity index. These properties are used in classifying soils and estimating relative plasticity, consistency, and activity. In some cases, these properties also correlate with compressibility, permeability, compactability, shrink-swell, and shear-strength characteristics.

  The shrinkage limit is typically assumed to be the amount of water required to fill the voids of a cohesive soil at

TABLE 5-2 Summary of Laboratory Tests

LABORATORY SOIL TEST	CHEMICAL PLANT	MATERIALS STAGING AREA	RAFFINATE PIT #4 DIKE	BORROW SOURCES	ADMINISTRATION BUILDING
Sieve Analysis, ASTM C136	12	-	1	0	-
Sieve Analysis with Hydrometer, ASTM D422	51	17	15	18	6
Atterberg Limits, ASTM D4318	60	16	14	20	10
Shrinkage Limit, ASTM D427	4	-	-	4	7
Specific Gravity, ASTM D854	35	-	3	13	3
Moisture Content, ASTM D2216	91	-	16	20	11
Dry Density, ASTM D2937	57	-	10	0	8
1-D Consolidation, ASTM D2435	21	-	-	3	3
Triaxial (R) Test, EM 1906	11	-	5	6	-
Triaxial (Q) Test, EM 1906	17	-	-	6	2
Triaxial Permeability, EM 1906	35	17	1	13	-
Capillary Moisture, ASTM D2325 & D3152	8		-	12	-
Moisture-Density, ASTM D698	-	16	-	12	1
Cation Exchange Capacity, SCS 5A3A	8	-	-	6	-

the minimum void ratio obtained by drying. It is used todetermine the shrinkage potential or possibility of development of cracks in cohesive soils.

- Specific Gravity Test - Specific gravity is used to determine the unit weight of the solid particles of a soil with respect to the unit weight of water. This factor is used in many equations expressing relationships among air, water, and soil solids.

- Moisture Content Test - The moisture content test determines the pore water content (% of dry soil weight) of a soil-water mixture. It is used extensively in determining soil index properties, soil behavior correlations, and soil consistency. It is used in most equations expressing relationships among air, water, and solids in a soil. When used with Atterberg limits, moisture content can indicate whether a soil is preconsolidated.

- Dry Density Test - The dry density test is used to determine the dry unit weight of a soil. It is the basis for determining overburden stresses and other soil properties useful in settlement calculations. In situ density can also be used as an indicator of past stresses and loadings on the soil. It also helps to determine soil horizons and volume-weight relationships.

- One-Dimensional Consolidation Test - The one-dimensional consolidation test determines consolidation characteristics for a soil. A sample is axially loaded and allowed to drain while being restrained laterally. The decrease in void ratio is measured as a function of

loading and time. The consolidation characteristics obtained are used to estimate the rate and magnitude of consolidation under actual loading conditions. It is also used to estimate the permeability of the soil.

- Unconsolidated, Undrained Triaxial Compression (UU or Q) Test - The UU triaxial compression or Q test determines the total shear strength parameters and stress/strain characteristics of a soil. The test simulates short-term or end-of-construction conditions by not allowing excess pore pressures resulting from confining and axial stresses to dissipate. A series of samples of a soil are tested at different confining pressures to develop the parameters and characteristics.

- Consolidated, Undrained Triaxial Compression (CU or R) Test - The CU triaxial compression or R test determines total and effective shear strength parameters and stress/strain characteristics of a soil. The test simulates long-term conditions by allowing consolidation of the soil sample before uniaxial loading is applied. A series of samples of a soil are tested at different consolidation/confining pressures to develop the parameters and characteristics.

- Constant-Head Triaxial Permeability Test - The constant-head triaxial permeability test measures the permeability, or hydraulic conductivity, of a saturated soil that is subjected to a constant head and hydraulic gradient. The tests are performed at different confining pressures to simulate in situ loading conditions. The hydraulic conductivity of a soil is used to determine

seepage and groundwater flow rates. It is also used as a measure of relative imperviousness.

- Capillary-Moisture Relationships - The capillary-moisture relationship test determines the moisture content retained in the soil subjected to a given soil-water tension. The tensions applied usually range from 1 to 15 atmospheres (atm). The test results are used to estimate the long-term moisture content of the soil, for radon barrier design, and for correlating unsaturated hydraulic conductivities with soil saturation.

- Moisture-Density Relationships (Compaction Test) - The compaction test develops moisture-density characteristics for a soil that is compacted at a specified energy level. Each soil has unique moisture-density characteristics. The test utilizes a standard compaction mold and a hammer to compact the soil. A series of tests at varying moisture contents yields a compaction curve from which the maximum dry density and the optimum moisture content (OMC) can be determined. The minimum density and range of water content to be used in the field can then be specified.

- Capillary-Moisture Relationships - The capillary-moisture relationship test determines the moisture content retained in the soil subjected to a given soil-water tension. The tensions applied usually range from 1 to 15 atm. The test results are used to estimate the long-term moisture content of the soil for radon barrier design and for correlating unsaturated hydraulic conductivities with soil saturation.

- Cation Exchange Capacity - The cation exchange capacity (CEC) is the charge or electrical attraction for cations per unit mass as measured in milequivalents per 100 grams of soil. The CEC indicates various clay minerals such as kaolinite, illite, or montmorillinite in the soil. The clay mineral types are used in evaluating the expansiveness of a soil.

5.2 Soil Test Results

The first group of soil test results were received by the PMC from Chen-Northern, Inc., in August 1988. These were for samples taken during investigations regarding the foundation of the administration building. Additional test results were received from Chem-Northern, Inc., in October 1988 and again in January 1989. These were from the tests of soil samples from the raffinate pit No. 4 dike and the chemical plant site boreholes drilled in 1988.

During 1989 and into 1990 the soil samples selected for testing were sent to Geotechnology, Inc., in St. Louis. Results were transmitted periodically to the PMC until October 1990. These results have been filed by the PMC, and the number of tests per method has been entered into a database which can be sorted by sample location and sample number, and by test method.

The results of tests for physical soil characteristics are presented in Table 5-3. These characteristics include sieve analysis, Atterberg limit, shrinkage limit, specific gravity, natural moisture content, and dry unit weight. Properties such as optimum moisture content and dry unit weight, which are the results of compaction tests, and coefficient of permeability are also listed in the table. Soil test data sheets, including

TABLE 5-3 Average Values of Laboratory Test Results of Overburden Soil Samples (Based on test results from Oct. 88 to May 89)

Overburden Unit	% of Grain Size				Atterberg Limit		Unified Soil Classif.	Specific Gravity	Unit Weight (pcf)		Moisture Content (%)
	Gravel	Sand	Silt	Clay	Liquid Limit (%)	Plasticity Index (%)			Dry	Wet	
Loess	0	2	68	30	41	22	CL	2.71	100	113	22.5
Ferrelview	0	5	60	35	48	31	CL-CH	2.68	101	124	23.0
Clay Till	1	19	40	40	52	36	CL-CH	2.71	108	128	19.8
Basal Till/ Clay Till	0*	26	39	35	37	20	CL	2.61	106	125	18.3
Residuum	28	24		48	72	50	GC	2.79	88	118	22.9
Raffinate Pit Dike Fill	0	12	48	40	49	31	CL	2.63	102	125	20.8

NOTES: 1. Values in table are average values based on available laboratory test results as of May 1989. (--) denotes result not available yet or no test was performed. Average values from additional testing subsequent to May 1989 will be published in addendum or separate report.

2. Average values were calculated using arithmetic mean method unless otherwise noted.

3. All tests are performed on disturbed or undisturbed samples.

* Gravel portions of the basal till usually not obtainable from conventional sampling methods used. Therefore, gradation values are for the non-gravel size particles.

TABLE 5-3 Summary of Laboratory Testing Soil Samples (Based on test results from October 88 to May 89) (Continued)

Overburden Unit	Hydraulic Conductivity (Permeability) (cm/sec)	Consolidation	Coeff. of Consolidation (cm^2/sec)	Shear Strength Total (from UU test)	Shear Strength Effective (from CU test)
Loess	6.2×10^{-6}	C_c = 0.144[a] C_r = 0.022[b]	4.1×10^{-4}	c = 1160 psf ø = 0	c' = 240 psf ø' = 35°
Ferrelview Formation	8.9×10^{-8}	C_c = 0.173 C_r = 0.033	6.0×10^{-4}	c = 1380 psf ø = 0	c' = 250 psf ø' = 19°
Clay Till	2.6×10^{-8}	C_c = 0.153 C_r = 0.042	1.4×10^{-4}	c = 1140 psf ø = 0	c' = 110 psf ø' = 26°
Basal Till/Clay Till	3.8×10^{-8}	-- --	--	c = 1060 psf ø = 0	-- --
Residuum	5.0×10^{-8}	C_c = 0.142 C_r = 0.052	1.0×10^{-4}	--	c' = 260 psf ø' = 15°
Raffinate Pit Dike Fill	--	-- --	--	--	c' = 310 psf ø' = 17°

NOTE: See also notes shown on Page 1 of Table

C_c = virgin compression ratio
C_r = recompression ratio
Values averaged using geometric mean method.

results from triaxial-shear strength and consolidation tests, are presented in Appendix D. Minor corrections such as typographical errors, mislabelling, and laboratory originated revision values, have been incorporated into the data sheets for the sake of consistency and are noted accordingly on the revised data sheets. A summary of permeability test result corrections is included in Appendix D-1.

Test results from the Phase I investigation program (tests performed by Chen-Northern) were evaluated for conceptual design of the disposal cell in 1989. Average values for each overburden soil unit were calculated for each test type and are shown in Table 5-4.

Test results for the Phase II investigation program will be evaluated in detail 1991.

TABLE 5-4 Summary of Soil Test Results
(10 Sheets)

SUMMARY OF SOIL TEST RESULTS

(sheet 1 of 10)

Hole or Trench Number	Sample Number	Depth (ft) From	Depth (ft) To	Laboratory Classification USCS	Mechanical Analysis (%) Gravel	Sand	Fines	Atterberg Limits (%) LL	PI	Shrinkage Limit (%)	Specific Gravity G	Natural w (%)	Natural γ_d (PCF)	Std. Proctor Compaction (ASTM D698) Optimum w (%)	Optimum γ_d (PCF)	Triaxial Permeability γ_d (PCF)	(conf. pressure) (KSF)	k cm/sec	Consolidation C_c	C_r	P_c (KSF)	Soil Unit
BT-31	BT-02	4.0	6.5	CL	0	10	90	36	20		2.68	20.9	103.1									F
	BT-06	18.0	20.5		0	4	96					20.1	104.6									F
BT-32	BT-01	1.0	3.5	CL	0	4	96	32	13			20.1	101.4									L
	BT-02	9.0	10.5	CH	0	15	85	64	46			28.4	90.5									F
	BT-05	16.5	21.0		3	8	89					36.3	82.9									C
BT-33	BT-04	5.0	7.5	CL	0	6	94	43	27													DP
	BT-14	22.0	24.5	CL	0	6	94	38	10			15.7	100.7			90.4	1×10^{-7}					L
BT-34	BB-05	7.0	8.5	CH	0	20	80	55	38			20.8										BF
	BB-17	27.0	28.5	CL	0	7	93	40	25			18.4	111.8									F
BT-35	BB-02	3.0	4.5	CH	0	10	90	59	41			22.5										BF
	BB-08	13.0	14.5	CL	0	14	86	49	31		2.63	18.9										BF
	BB-11	17.5	19.0									16.0										BF
	BB-15	25.0	26.5	CL	0	5	95	42	25			20.8	104.6									DF
	BB-20	31.0	32.5	CL	0	1	99	43	25			19.8										L
BT-36	BT-04	8.5	11.0	CL	0	22	78	48	32			22.6	100.2									BF
	BB-09	14.0	15.5	CL	0	5	95	43	24			23.8										DF
	BT-12	18.5	21.0	CL	0	1	99	44	29		2.70	21.5	97.8									L
BT-37	BB-01	1.5	3.0	CH				58	34	8.3												L
	BT-03	5.0	7.5	CL	0	3	97	43	29	11.3	2.69	24.4	101.2									L
	BB-05	9.0	10.5									20.7										F
	BT-06	10.5	13.0	CH	0	3	97	55	39			25.1	100.3									F
BT-38	BB-02	3.0	4.5	CL	0	2	98	37	18	19.6		21.8										L
	BT-05	4.5	7.0	CL	0	1	99	48	29	18.4		27.3	96.8									L
BT-39	BB-02	4.0	5.5	CL	0	1	99	38	19	15.9		26.8	105.0									L
	BT-05	5.5	8.0								2.66	23.2	100.4	17.9	107.5							F
	BT-06	9.5	12.0																			F

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SUMMARY OF SOIL TEST RESULTS

(sheet 2 of 10)

Hole or Trench Number	Sample Number	Depth (ft) From	Depth (ft) To	Laboratory Classification USCS	Mechanical Analysis (%) Gravel	Mechanical Analysis (%) Sand	Mechanical Analysis (%) Fines	Atterberg Limits (%) LL	Atterberg Limits (%) PI	Shrinkage Limit (%)	Specific Gravity G	Natural W (%)	Natural γ_d (PCF)	Std. Proctor Compaction (ASTM D698) Optimum W (%)	Std. Proctor Compaction (ASTM D698) Optimum γ_d (PCF)	Triaxial Permeability γ_d (PCF)	Triaxial Permeability (conf. pressure) (KSF)	Triaxial Permeability x (cm/sec)	Consolidation C_c	Consolidation C_r	Consolidation P_c' (KSF)	Soil Unit
GT-39	ST-05	12.0	14.5	CH	0	6	94	65	48		2.68	25.1	99.4									F
GT-41	SS-02	3.5	4.0	CL				48	28	11.8		27.9	94.4									
	SS-02	4.0	4.5	CL				48	28	12.8		28.6	95.1									
	SS-04	6.0	7.5	CL				48	23			24.5										F
GT-42	ST-08	9.5	12.0									16.9	113.3									F
	SS-08	17.0	18.5									12.4	119.4									C
GT-43	SS-02	1.5	3.0									14.5										L
	ST-04	6.0	8.5					48	32		2.66	24.4	98.6			95.7 to 91.6	(0.07) < 9 x 10^{-4}** (0.29) < 7 x 10^{-8}**					F
	ST-10	21.5	23.75	CL	0	26	74	47	32		2.71	18.6	106.3									C
	SS-17	40.0	41.5					31	12		2.59	17.6	109.9			104.3 to 106.8	(0.43) < 6 x 10^{-8}** (0.72) < 4 x 10^{-8}**					B
	SS-19	30.0	31.0		29	46	25					28.4										R
GT-44	ST-03	5.0	7.5									17.6	106.2									C
	SS-10	22.5	24.0									45.0	76.5									R
GT-45	SS-01	1.0	2.5									18.1										
	ST-04	7.5	10.0									21.3	103.3									F
	ST-07	15.0	17.5									22.1	104.5			106.5 to 102.8	(0.21) < 8 x 10^{-5}** (0.58) < 2 x 10^{-8}**					C
GT-46	ST-03	5.0	7.5									22.1	99.6			103.7 to 103	(0.07) < 9 x 10^{-4}** ((0.43) < 3 x 10^{-6}**		0.282	0.027	6.6	F
GT-47	ST-05	10.0	12.5	CL	0	2	98	45	28		2.69	22.9	99.5						0.216	0.06	6.5	F
	SS-09	20.0	21.5					51	36			20.5	72.4									C
	SS-14	32.5	34.0									14.8										R

B = Basal Till
F = Farrelview Clay
C = Clay Till
L = Loess/Fill
DF = Dike Fill
R = Residuum

SUMMARY OF SOIL TEST RESULTS

(sheet 3 of 10)

Hole or Trench Number	Sample Number	Depth (ft) From	Depth (ft) To	Laboratory Classification USCS	Mechanical Analysis (%) Gravel	Mechanical Analysis (%) Sand	Mechanical Analysis (%) Fines	Atterberg Limits (%) LL	Atterberg Limits (%) PL	Shrinkage Limit (%)	Specific Gravity G	Natural W (%)	Natural γ_d (PCF)	Std. Proctor Compaction (ASTM D698) Optimum W (%)	Std. Proctor Compaction (ASTM D698) Optimum γ_d (PCF)	Triaxial Permeability γ_d (PCF)	Triaxial Permeability (conf. pressure) (KSF)	Triaxial Permeability k (cm/sec)	Consolidation C_c	Consolidation C_r	Consolidation P'_o (KSF)	Soil Unit
GT-48	ST-03	7.5	10.0	CL	0	3	97	41	23			27.7	90.3									F
	ST-05	12.5	15.0									22.6	101.3			101.3 to 99.2	(0.14) < 6 x 10^{-4}** (0.50) < 1 x 10^{-8}**					F
	ST-07	17.5	20.0	CH	0	2	98	60	43		2.67	27.8	95.9						0.335	0.086	6.1	F
	SS-12	30.0	31.5									18.5										R
GT-50	ST-02	2.5	5.0	CL	0	1	99	47	29		2.72	21.1	104.7			107.7 to 98.2	(0.07) < 3 x 10^{-4}** (0.43) < 2 x 10^{-5}**		0.25	0.032	30.0	L
	ST-06	12.5	15.0	CH	0	5	95	63	45		2.74	26.9	95.8						0.26	0.075	15.0	C
	SS-08	17.5	19.0									14.0	114.5			115.8 to 100	(0.22) < 2 x 10^{-7}** (0.58) < 7 x 10^{-8}**					C
	SS-14	32.5	34.0									18.0										R
GT-51	SS-01	0.0	1.5					33	11			22.9										L
	ST-05	5.0	7.5	CL	0	2	98	44	28		2.63	21.4	101.6									F
	ST-07	15.0	17.5	CL	0	30	70	39	25		2.68	17.5	112.6			113.2 to 108.6	(0.22) < 3 x 10^{-6}** (0.38) < 2 x 10^{-8}**					C
	SS-09	20.0	21.5	CH	4	15	81	76	50		2.79	33.7	88.7			92.7 to 87.7	(0.29) < 3 x 10^{-7}** (0.65) < 5 x 10^{-8}**		0.265	0.097	5.0	R
	SS-11	25.0	26.5									10.1										R
GT-52	ST-04	10.0	12.5					61	44			25.9	101.3									F
	ST-06	15.0	17.5								2.79	23.8	100.5			100.1 to 91.7	(0.22) < 3 x 10^{-6}**					C
	SS-09	22.5	24.0									18.2										C
	SS-11	27.5	29.0									15.6	115.0									C
	SS-14	35.0	36.5	CL	0	26	74	42	28		2.68	19.0	101.6									B
	SS-17	42.5	44.0									25.7										R
GT-53	ST-02	2.5	4.0									21.4	102.3									L
	ST-04	7.5	10.0	CH	0	3	97	54	38		2.73	22.3	103.8									F
	ST-08	17.5	20.0	CH	0	16	84	58	41		2.70	21.6	104.8									C
	SS-15	35.0	36.5		22	25	53					23.1										R
GT-54	ST-03	4.5	7.0	CL	0	3	97	42	25			21.8	100.1									L
	SS-08	17.0	18.5									21.8										L

B = Basal Till
F = Ferralview Clay
C = Clay Till
L = Loess/Fill
DF = Dike Fill
R = Residuum

**Unreliable results due to extremely low confining pressure used in testing.

SUMMARY OF SOIL TEST RESULTS

(sheet 4 of 10)

Hole or Trench Number	Sample Number	Depth (ft) From	Depth (ft) To	Laboratory Classification USCS	Mechanical Analysis (%) Gravel	Sand	Fines	Atterberg Limits (%) LL	PI	Shrinkage Limit (%)	Specific Gravity G	Natural w (%)	γ_d (PCF)	Std. Proctor Compaction (ASTM D698) Optimum w (%)	γ_d (PCF)	Triaxial Permeability γ_d (PCF)	(conf. pressure) (KSF)	k (cm/sec)	Consolidation E_s	C_r	P_c (KSF)	Soil Unit
GT-55	ST-02	2.5	5.0									22.8	96.0									L
	ST-04	7.5	10.0	CL/CH	0	1	99	50	29		2.75	30.7	89.4			94.8 to 92.8	(0.14)	$< 1 \times 10^{-5}$	0.26	0.041	6.7	L
																	(0.50)	$< 2 \times 10^{-6}$				
	ST-06	12.5	15.0	CH	0	1	99	51	33		2.82	22.8	103.7						0.462	0.062	18.5	F
	ST-08	17.5	20.0					62	27			22.5	103.0									F
	08-12	27.5	29.0					70	50			25.2	99.6						0.268	0.006	7.4	R
GT-56	ST-02	5.0	7.5	CL	8	2	90	38	12		2.62	20.6	101.1						0.380	0.033	9.9	F
	ST-04	10.0	12.5									26.5	90.1			96.2 to 92.6	(0.14)	$< 2 \times 10^{-7}$				F
																	(0.50)	$< 3 \times 10^{-8}$				
	ST-06	15.0	17.0	CL	0	26	74	44	20			19.0	109.9						0.248	0.061	30.8	C
	08-08	19.5	21.0		0	19	81	42	27		2.66	21.6	105.6									C
	SS-09	22.0	23.5	CH	4	6	90	71	50			27.1										C
GT-57	SS-02	5.0	6.5									26.5										L
	ST-03	7.5	10.0					42	25			27.4	93.5									F
	ST-06	15.0	16.5									22.7										F
	08-11	27.5	29.0		55	10	35					17.1										R
GT-58P	ST-01	2.5	5.0	CH	0	4	96	54	23			1 19.8 2 26.0					(1) (3)	2×10^{-7} 6×10^{-7}				L
	ST-03	7.5	10.0	CH	0	5	95	66	46		2.69	1 21.5 2 11.7				104.8	(1) (3)	6×10^{-8} $< 1 \times 10^{-9}$				F
	ST-09	22.5	24.0								2.65						(2) (4)	4×10^{-8} $< 1 \times 10^{-9}$				C
	08-11	28.5	29.0	GC	50	10	40					1.3	117.4									B
GT-59	ST-02	5.0	7.5													102.4	(1) (3)	4×10^{-7} 2×10^{-7}				F
	ST-06	15.0	17.5													110.5	(2)	$< 1 \times 10^{-9}$				C
GT-60P	ST-04	12.5	15.0								2.72											F
	ST-10	27.5	30.0	CL	0	21	79	44	27		2.70					109.1	(3) (6)	5×10^{-8} $< 1 \times 10^{-9}$				C
	08-15	41.0	41.5	CL	7	16	77	35	13							109.8 105.1	(4) (7)	9×10^{-8} 2×10^{-7}				C

B = Basal Till
F = Farralview Clay
C = Clay Till
L = Loess/Fill
DF = Dike Fill
R = Residuum

**Unreliable results due to extremely low confining pressure used in testing.

SUMMARY OF SOIL TEST RESULTS

(sheet 5 of 10)

Hole or Trench Number	Sample Number	Depth (ft) From	Depth (ft) To	Laboratory Classification USCS	Mechanical Analysis (%) Gravel	Mechanical Analysis (%) Sand	Mechanical Analysis (%) Fines	Atterberg Limits (%) LL	Atterberg Limits (%) PI	Shrinkage Limit (%)	Specific Gravity G	Natural W (%)	Natural γ_d (PCF)	Std. Proctor Compaction (ASTM D698) Optimum W (%)	Std. Proctor Compaction (ASTM D698) Optimum γ_d (PCF)	Triaxial Permeability γ_d (PCF)	Triaxial Permeability (conf. pressure) (KSF)	Triaxial Permeability K (cm/sec)	Consolidation C_c	Consolidation C_r	Consolidation P'_o (KSF)	Soil Unit
GT-60P	SS-16	45.0	46.5	SC	33	37	30															B
	SB-17	48.5	49.0	SC	22	52	28									105.1	(4) 3×10^{-7} (7) 2×10^{-7}					B
GT-61	SS-13	32.5	34.0	CB	0	27	73															C
	SB-18	50.5	51.5	SC	36	34	30					11.0	118.9									B
GT-62	ST-07	17.5	20.0									T 30.9 B 25.0				100.3	(2) 5×10^{-8} (4) $<1 \times 10^{-9}$					F
	SB-13	32.8	33.3													100.1	(3) 3×10^{-5} (3) 6×10^{-8}					B
	SB-15	38.0	39.0	GC	43	17	40				2.76											B
GT-63P	ST-01	2.5	5.0	CB	6	7	87	56	32							100.4	(1) 7×10^{-9}					F
	ST-09	22.5	25.0	CL	0	25	75	45	28		2.75	16.4	113.9			110.0	(2) 9×10^{-9}					C
	SB-15	38.0	38.5	SC-GC	40	45	15															C
GT-65P	SB-16	40.0	41.5	GC	42	24	34									81.3	(4) 8×10^{-7} (7) 4×10^{-7}					R
GT-67P	ST-04	10.0	12.5																			F
	ST-08	20.0	22.5													110.2	(2) 1×10^{-7}					T

B = Metal Fill
F = Ferrelview Clay
C = Clay Till
L = Loess/Fill
DF = Dike Fill
R = Residuum

**Unreliable results due to extremely low confining pressure used in testing.

SUMMARY OF SOIL TEST RESULTS

(sheet 6 of 10)

Hole or Trench Number	Sample Number	Depth (ft) From	Depth (ft) To	Laboratory Classification USCS	Mechanical Analysis (%) Gravel	Mechanical Analysis (%) Sand	Mechanical Analysis (%) Fines	Atterberg Limits (%) LL	Atterberg Limits (%) PL	Shrinkage Limit (%)	Specific Gravity G	Natural W (%)	Natural T_d (PCF)	Std. Proctor Compaction (ASTM D698) Optimum W (%)	Std. Proctor Compaction (ASTM D698) Optimum T_d (PCF)	Triaxial Permeability T_d (PCF)	Triaxial Permeability (conf. pressure) (KSF)	Triaxial Permeability k (cm/sec)	Consolidation C_c	Consolidation C_r	Consolidation P'_c (KSF)	Soil Unit
GTS-1	ST-03	5.0	7.5	CL	0	3	97	40	20			T 26.7 M 23.3 B 22.8	97.5	17.5 (comp. GTS-3,	102.8 with ST-02)		(1) 2 x 10^{-7} (composite with GTS-3, ST-02)					F
GTS-2	ST-02	2.5	5.0									T 29.2 M 25.5 B 26.6	95.0	18.5 (comp. GTS-4,	103.0 with ST-04)		(1) 8 x 10^{-8} (composite with GTS-4, ST-04)					F
	ST-04	7.5	10.0									T 20.5 B 20.7	103.8 102.1									F
	COMP.	2.5	10.0	CL	0	3	97	44	24													
GTS-3	ST-02	5.0	7.5	CH	1	3	96	53	34			T 28.9 M 29.6 B 37.4	89.9	(composite see GTS-1, ST-03)			(composite see GTS-1, ST-03)					F
GTS-4	ST-02	2.5	5.0	CH	8	4	88	51	28			T 28.2 M 28.4 B 28.1	92.3	17.7 (comp.)	105.3		(1) 2 x 10^{-7} (composite)					F
	ST-04	7.5	10.0	CL	0	6	94	41	21			T 26.7 M 21.5 B 21.5	102.9									F
GTS-5	BULK	0.0	5.0	CH	1	7	92	53	35			21.7		17.5	106.4		(1) 2 x 10^{-8}					DF
GTS-6	BULK	0.0	5.0	CL	0	1	99	43	21			19.7		18.3	104.6		(1) 1 x 10^{-7}					F
GTS-7	BULK	0.0	5.0	CH	0	5	95	59	35			23.8		19.2	102.7		(1) 5 x 10^{-8}					DF

B = Basal Till C = Clay Till DF = Dike Fill

SUMMARY OF SOIL TEST RESULTS

(sheet 7 of 10)

Hole or Trench Number	Sample Number	Depth (ft) From	Depth (ft) To	Laboratory Classificatn USCS	Mechanical Analysis (%) Gravel	Mechanical Analysis (%) Sand	Mechanical Analysis (%) Fines	Atterberg Limits (%) LL	Atterberg Limits (%) Pt	Shrinkage Limit (%)	Specific Gravity G	Natural W (%)	Natural γ_d (PCF)	Std. Proctor Compaction (ASTM D698) Optimum W (%)	Std. Proctor Compaction (ASTM D698) Optimum γ_d (PCF)	Triaxial Permeability γ_d (PCF)	Triaxial Permeability (conf. pressure) (KSF)	Triaxial Permeability k (cm/sec)	Consolidation C_c	Consolidation C_r	Consolidation P'_o (KSF)	Soil Unit
GT-2T71	BU-01A	3.5	6.5	CL	0	2	98	39	17		2.69	28.3		15.4	108.8							
	BU-02A	6.5	12	CH	0	3	97	52	37	8.3	2.51	17.3		18.5	106.9	106.4	(1)	2×10^{-8}				
GT-2T72	BU-01A	7.5	10.5	CL-ML	0	5	95	27	6		2.68	22.1		12.5	116.1							
GT-2T74	BU-01A	7.8	10.5								2.74											
	BU-01A	4.0	8.5	CL	0	3	97	42	24			25.9		16.1	106.3							
GT-2T75	BU-01A	2.5	6.5								2.69	20.8										
	BU-02B	6.5	12.0	CH	0	3	97	77	56	7.3	2.73	23.1		20.1	102.3	97.5	(1)	$<1 \times 10^{-9}$				
	BU-01A	4	8.5	CL	0	1	99	39	17					17.6	108.8							
GT-2T77	BU-01B	1.5	4.0	CH	0	1	99	58	33		2.55	16.6		16.6	104.3							
	BU-02A	7.0	10.5	CL	0	3	97	49	26		2.66	24.4		19.2	104.4	103.0	(1)	2×10^{-8}				
GT-2T78	BU-01A	4.0	6.5	CL	0	2	98	30 28	11 18		2.71	14.7		11.7	114.9							
	BU-02B	6.5	12.0	CH	0	3	97	58	39		2.69	20.1		14.6 21.3	115.6 104.2	99.2	(1)	4×10^{-8}				
GT-2T79	BU-01A	1.8	6.5	CL	0	2	98	49	26	10.7	2.72	16.0										
	BU-02A	6.5	12.0	CH	0	3	97	62	43			23.1										
GT-2T80	BU-01A	0.5	8.0	CL	0	4	96	38	18			18.1										
GT-2T81	BU-01A	0.5	6.5	CL	1	10	89	36	18	17.5		20.4										
	BU-02A	6.5	12.0	CL	0	4	96	48	23			24.0										
GT-2T82	BU-01A	0.5	3.5	CL	0	4	96	42	23			13.8										
	BU-02A	3.5	6.0	CH	0	3	97	53	31			25.2										
	BU-03A	6.0	10.0	CL	2	21	77	48	27			16.2										

B = Basal Till
F = Farrelview Clay
*Visual Classification

C = Clay Till
L = Loess/Fill

DF = Dike Fill
R = Residuum

**Unreliable results due to extremely low confining pressure used in testing.

SUMMARY OF SOIL TEST RESULTS

(sheet 8 of 10)

Hole or Trench Number	Sample Number	Depth (ft) From	Depth (ft) To	Laboratory Classificatn USCS	Mechanical Analysis (%) Gravel	Mechanical Analysis (%) Sand	Mechanical Analysis (%) Fines	Atterberg Limits (%) LL	Atterberg Limits (%) PI	Shrinkage Limit (%)	Specific Gravity G	Natural W (%)	Natural γ_d (PCF)	Std. Proctor Compaction (ASTM D698) Optimum W (%)	Std. Proctor Compaction (ASTM D698) Optimum γ_d (PCF)	Triaxial Permeability γ_d (PCF)	Triaxial Permeability (conf. pressure) (KSF)	Triaxial Permeability k (cm/sec)	Consolidation C_c	Consolidation C_r	Consolidation P'_o (KSF)	Soil Unit
TPMS-1	BU-01	0.0	6.0	CH	0	7	93	51	32			20.0		17.4	103.0	98.6	(1)	7×10^{-8}				
TPMS-2	BU-01	0.0	2.0	CL	0	6	94	49	29			18.5		18.7	104.3		(1)	2×10^{-8}				
	BU-02	2.0	6.0	CH	0	20	80	67	46			21.9		21.0	100.6		(1)	$< 1 \times 10^{-9}$				
TPMS-3	BU-01	1.0	6.0	CL	0	16	84	39	19			22.4		17.1	104.0	99.5	(1)	3×10^{-7}				
TPMS-4	BU-01	1.0	3.5	CL	0	10	90	49	29			20.0		18.6	105.4		(1)	9×10^{-9}				
	BU-02	4.0	6.5	CH	0	14	86	73	49			27.5		22.8	95.5		(1)	$< 1 \times 10^{-9}$				
TPMS-5	BU-01	1.0	7.0	CL	0	4	96	37	20			19.8		15.9	108.1		(1)	2×10^{-8}				
	BU-02	8.0	10.0	CH	0	2	98	73	49			26.6		21.7	97.8		(1)	9×10^{-9}				
TPMS-6	BU-01	1.0	5.0	CL	0	2	98	40	22			15.7		16.4	106.0		(1)	3×10^{-7}				
	BU-02	5.5	7.5	CH	0	4	96	72	47			19.4		21.3	100.4		(1)	$< 1 \times 10^{-9}$				
TPMS-7	BU-01	1.0	7.0	CL	0	4	96	37	20			19.7		17.4	107.2		(1)	1×10^{-7}				
	BU-02	7.0	9.5	CH	0	3	97	82	58			20.3		21.1	94.7		(1)	1×10^{-7}				
TPMS-8	BU-01	1.0	5.0	CL	0	3	97	30	11			9.9		16.3	108.0		(1)	6×10^{-8}				
	BU-02	5.0	10.5	CH	0	6	94	63	44			25.1		21.6	98.6		(1)	$< 1 \times 10^{-9}$				
	BU-03	12.0	14.0		0	45	55					11.1										
TPMS-9	BU-01	1.0	7.0	CL	0	3	97	38	18			16.5		15.4	104.9							
	BU-02	8.0	15.0	CH	0	5	95	69	45			15.1		24.1	95.0							

B = Basal Till
E = Ferrovision Clay
Visual Classification

C = Clay Till
L = Loess/Fill

DF = Dike Fill
R = Residuum

**Unreliable results due to extremely low confining pressure used in testing.

SUMMARY OF SOIL TEST RESULTS

(sheet 9 of 10)

Hole or Trench Number	Sample Number	Depth (ft) From	Depth (ft) To	Laboratory Classification USCS	Mechanical Analysis (%) Gravel	Mechanical Analysis (%) Sand	Mechanical Analysis (%) Fines	Atterberg Limits (%) LL	Atterberg Limits (%) PI	Shrinkage Limit (%)	Specific Gravity G	Natural W (%)	Natural T_d (PCF)	Std. Proctor Compaction (ASTM D698) Optimum W (%)	Std. Proctor Compaction (ASTM D698) Optimum T_d (PCF)	Triaxial Permeability T_d (PCF)	Triaxial Permeability (conf. pressure) (KSF)	Triaxial Permeability k (cm/sec)	Consolidation C_c	Consolidation C_r	Consolidation P'_o (KSF)	Soil Unit
TPBS-1	2A	2.4	7.1	CL	0	9	91	31	13		2.65	11.1		15.6	110.4	108.2	(1)	3×10^{-7}				
	3A	7.1	9.2	MH				60	21		2.70	26.4		20.1	105.6							
	4A	9.2	14.1	CL	1	37	62	42	18	22.2	2.59	20.5		14.6	116.1	111.0	(1)	4×10^{-8}				
TPBS-6	1A	0.6	9.1	ML	0	3	97	36	11		2.64	24.6		19.3	102.0	99.9	(1)	2×10^{-8}				
	2A	9.1	12.6	CH				64	44		2.74	24.9		20.9	100.3	94.6	(1)	1×10^{-8}				
TPBS-8	1A	0.6	4.3	CL	0	2	98	34	16		2.73	21.8		17.4	108.0	102.9	(1)	3×10^{-8}				
	2A	4.3	8.5	CL	0	2	98	34	12	15.9	2.64	13.3		15.6	109.4	106.0	(1)	2×10^{-7}				
	3A	8.5	11.9	CL-CH	0	2	98	50	30		2.59	21.0		20.5	101.9	97.3	(1)	5×10^{-9}				
TPBS-10	1A	0.5	6.1	ML				40	17			23.5				102.1	(1)	1×10^{-7}				
	2A	8.2	10.9	ML	0	3	97	43	11			20.1				101.7	(1)	2×10^{-8}				
	3A	10.9	13.4	CH	0	5	95	61	43	8.5		23.1				97.0	(1)	$<1 \times 10^{-9}$				
TPBS-11	1A	0.6	10.4	CL	0	3	97	35	12		2.72	25.3				99.5	(1)	3×10^{-8}				
	2A	10.4	12.3	CH	0	2	98	57	27	11.3	2.60	27.4				98.5	(1)	3×10^{-8}				
TPBS-14	2A	2.9	8.4	CL	0	2	98	35	15			25.2										
	3A	8.4	11.8	ML	0	2	98		NP			22.4										
TPBS-15	1A	2.4	10.8	ML	0	3	97	41	9			25.5										
	2A	10.8	12.9	CH	2	4	94	71	50			28.1										
	3A	7.1	9.2		1	13	86															
TPBS-23	1A	0.7	13.1	CL	0	3	97	37	21		2.71	26.2		18.2	106.3	102.8	(1)	4×10^{-7}				
TPBS-28	1A	0.7	9.9	CL	0	5	95	38	10		2.65	23.2		14.9	109.8							
TPBS-30	1A	1.8	12.4	ML	0	10	90	37	12		2.62	28.0		18.3	106.6							

S = Basal Till
F = Ferralvium Clay
NP = nonplastic

C = Clay Till
L = Loess/Fill

DF = Dike Fill
R = Rockham

**Unreliable results due to extremely low confining pressure used in testing.

SUMMARY OF SOIL TEST RESULTS

(sheet 10 of 10)

Hole or Trench Number	Sample Number (Test No.)	Depth (ft) From	Depth (ft) To	Laboratory Classificatn USCS	Mechanical Analysis (%) Gravel	Mechanical Analysis (%) Sand	Mechanical Analysis (%) Fines	Atterberg Limits (%) LL	Atterberg Limits (%) PI	Shrinkage Limit (%)	Specific Gravity G	Natural W (%)	Natural γ_d (PCF)	Std. Proctor Compaction (ASTM D698) Optimum W (%)	Std. Proctor Compaction (ASTM D698) Optimum γ_d (PCF)
TPBS-13	1	4.6	5.0	CL*								27.7	92.2		
TPBS-14	2	4.9	5.3	CL*								25.9	93.6		
TPBS-15	3	5.9	6.3	CL*								23.8	89.1		
TPBS-16	4	5.4	5.8	CL*								24.3	98.7		
TPBS-17	5	6.0	6.4	CL*								24.8	96.8		
TPBS-18	6	4.8	5.2	CL*								19.9	97.5		
TPBS-19	7	4.9	5.3	CL*								24.0	99.0		
TPBS-20	8	5.4	5.8	CL*								25.6	96.7		
TPBS-23	9	5.7	6.1	CL*								28.3	91.8		
TPBS-26	10	4.9	5.3	CL*								24.8	98.9		
TPBS-25	11	4.1	4.5	CL*								23.5	100.1		
TPBS-28	12	3.8	4.2	CL*								26.4	95.2		
TPBS-29	13	4.8	5.2	CL*								28.0	96.1		
TPBS-38	14	4.9	5.3	CL*								26.4	95.3		

B = Basal Till C = Clay Till OF = Dike Fill
E = Ferrelview Clay L = Loess/Fill R = Residuum

6 REFERENCES

ASTM, see American Society for Testing and Materials

American Society for Testing and Materials, 1990. Annual Book of ASTM Standards. Philadelphia.

Bechtel National, Inc., 1983a, Weldon Spring Storage Site 1982 - 1983, Geologic Characterization. July.

Bechtel National, Inc., 1983b. Weldon Spring Storage Site, Site Seismicity and Design Earthquake Considerations. San Francisco, California. July.

Bechtel National, Inc., 1984. Geologic Report, Weldon Spring Raffinate Pits Site. Prepared for U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tennessee. DOR/OR/20722-6. November.

Bechtel National, Inc., 1987, Hydrogeological Characterization Report for Weldon Spring Chemical Plant, Weldon Spring, Missouri. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tennessee. DOE/OR/20722-137. July 1987.

Berkeley Geoscience Associates, 1984. Characterization and Assessment for the Weldon Spring Quarry Low-Level Radioactive Waste Storage Site. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tennessee. DOE/OR/853. September.

BNI, See Bechtel National, Inc.

COE, see U.S. Army Corps of Engineers.

Detection Science, Inc., 1987, Seismic Refraction Survey - Weldon Spring Chemical Plant, Weldon Spring, Missouri; and BNI, 1987, Appendix E: Electromagnetic Terrain Conductivity Survey of the Weldon Spring Chemical Plant Grounds.

Eardley, A.J., 1951. Structural Geology of North America, Second Edition. Harper and Row, New York City.

Geotechnology Services, Inc., 1988, Final Report, Volumes I and II Geophysical Investigation Specification 3589-SC-WP028, Weldon Spring Chemical Plant. Prepared for MK-Ferguson Company. December 1988.

GSI, see Geotechnology Services, Inc.

Henry M. Reitz, Consulting Engineers, 1964, Design Memorandum for 12M.Cubic Feet. Raffinate Pit, Atomic Energy Commission Plant, Weldon Spring, Missouri. January 1964.

Hoffman, David, 1988, Status Report, Shallow Groundwater Investigations at Weldon Spring. Missouri Department of Natural Resources.

Jacobs Engineering Group, 1988. Determination of Maximum Earthquake for Weldon Spring Disposal Facility. April.

JEG, see Jacobs Engineering Group.

Kleeschulte, M.J., and L.F. Emmett, 1986. Compilation and Preliminary Interpretation of Hydrologic Data for the Weldon Spring Radioactive Waste Disposal Sites, St. Charles County, Missouri. A Progress Report. U.S. Geological Survey, Water Resources Investigation Report 85-4272.

Kleeschulte, M.J., and L.F. Emmett, 1987. Hydrology and Water Quality at the Weldon Spring Radioactive Waste Disposal Sites, St. Charles County, Missouri. U.S. Geological Survey Water Resources Investigations Report 87-4169.

Krummel, W.J., 1956. The Geology of a Portion of the Weldon Spring Quadrangle. Unpublished Masters Thesis, Washington University, St. Louis, Missouri. June.

McKeown, F.A., 1982. Overview and Discussion, in McKeown, F.A. and L.C. Pakiser, editors. Investigations of the New Madrid, Missouri, Earthquake Region. U.S. Geological Survey Professional Paper 1236.

MGS, See Missouri Geological Survey.

Missouri Geological Survey, 1977. The Resources of St. Charles County, Missouri: Land, Water and Minerals. Missouri Department of Natural Resources, Rolla, Missouri. April.

MKF and JEG, see MK-Ferguson Company and Jacobs Engineering Group.

MK-Ferguson Company and Jacobs Engineering Group, 1988a. Hydrogeologic Investigations Work Plan. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tennessee. DOE/OR/21548-020. April.

MK-Ferguson and Jacobs Engineering Group, 1988b. Geophysical/ Geotechnical Investigation Sampling Plan, Weldon Spring Site Remedial Action Project. Prepared for the U.S. Department of Energy, Oak Ridge Operation Office, Oak Ridge, Tennessee. DOE/OR/21548-014. July 1988.

MK-Ferguson and Jacobs Engineering Group, 1988c. Hydrogeologic Investigations Sampling Plan. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tennessee. DOE/OR/21548-020. November.

MK-Ferguson and Jacobs Engineering Group, 1990a. Draft Aquifer Characteristics Data Report for the Weldon Spring Site Chemical Plant/Raffinate Pits and Vicinity Properties. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tennessee. DOE/OR/21548-122. June.

MK-Ferguson and Jacobs Engineering Group, 1990b. Suitability of the Weldon Spring Site for Potential Location of a Disposal Facility for the Weldon Spring Site Remediation Action Project, Weldon Spring, Missouri. DOE/OR/21548-102 Revision 0. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tennessee. September.

MK-Ferguson and Jacobs Engineering Group, 1990c. WSSRAP Quarry Geotechnical Investigations. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tennessee. November.

Morrison-Knudsen Engineers, Inc., 1988. WSSRAP Quarry Remedial Investigations for Bulk Waste Removal. Draft Report. San Francisco, CA. August.

Moylan, J. E. and L. G. Elser, 1967. Geologic Appraisal of Settlement Pits, Weldon Spring Ordinance Works. Prepared for the Department of the Army, Kansas City District Corps of Engineers, Kansas City, Missouri. October.

Roberts, C.M., 1951. Preliminary Investigation of Groundwater Occurrences in the Weldon Spring Area, St. Charles County, Missouri. U.S. Geological Survey Open-File Report 82-1008. December.

SCS, see U.S. Soil Conservation Service.

U.S. Army Corps of Engineers, Office of the District Engineer, St. Louis District, 1955. Report of Foundation Investigation, United States Atomic Energy Commission,Weldon Spring, Missouri. February 1955.

U.S. Army Corps of Engineers, 1970. Engineering Manual, Engineering Design Stability of Earth and Rockfill Dams. EM 1110-2-1902. April.

U.S. Soil Conservation Service, 1967. Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples. Soil Survey Investigations Report No. 1. U.S. Department of Agriculture. Washington, DC.

Weston Geophysical, 1983. Geophysical Measurements/DOE Raffinate Pit Site. Prepared for Bechtel National, Inc. March.

Woodell Lugging, Inc., 1989. Report of Geophysical Logging. Mattoon, Il.

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APPENDIX A

PHASE I BOREHOLE, PIEZOMETER AND TEST PIT LOGS

Appendix A

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APPENDIX A-1

RAFFINATE PIT 4 DIKE PIEZOMETER LOGS
(GT-31 THROUGH GT-36)

A-1

WSSRAP RAFFINATE PIT 4 DIKE
GEOTECHNICAL DRILLING

This report presents the procedures performed during the drilling, soil sampling, and piezometer construction made at raffinate pit 4 at the Weldon Spring Site Remedial Action Project (WSSRAP). Six borings (GT-31 to GT-36) were made along the west side of the pit, four borings were placed on the dike crest (GT-33 to GT-36), and two (GT-31 and GT-32) were located at the western toe of the dike. Boring locations are shown on the accompanying Boring Location Plan. All six borings were completed as piezometers.

Drilling was accomplished between June 1, 1988 and June 16, 1988 by Hannibal Testing Laboratories (HTL), Hannibal, Missouri under subcontract number 3589-SC-WP024. HTL employees Tom Clay and Terry Hemme performed as driller and driller's helper, respectively. Sample logging, documentation, and drilling supervision was performed by Alan Benfer, geologist employed by Morrison-Knudsen Engineers (MKE), Boise. Direction for subsurface soil sampling techniques and intervals was provided by Ed Tom, MKE geotechnical engineer, San Francisco and Bill Knight, Jacobs Engineering civil engineer, Weldon Spring.

Upon mobilization to the site, the drill rig and all drilling tools were decontaminated with a high pressure water wash. Additionally, the rear of the rig and drilling tools were decontaminated between borings. Personal protective clothing consisted of cloth coveralls, gloves, safety boots with rubber boot covers, and hard hats. A Ludlum model 44 radiation detector was present at the boring location and was used to scan all soil samples for radiation. No soil samples displayed radiation above background levels.

All drilling personnel received the OSHA 40-hour hazardous waste safety training (29CFR 1910.120) plus site-specific WSSRAP radiation safety

instruction conducted by a site health physicist. All personnel wore thermoluminescent dosimitry (TLD) badges and provided entrance and exit urine samples.

Drilling was accomplished with a CME-55 drill rig using continuous flight hollow stem augers having an outside (O.D.) diameter of 6-5/8 inches and an inside (I.D.) diameter of 3-1/4 inches.

Continuous soil sampling was performed through the fill comprising the dike, and at least every five feet thereafter to auger refusal, assumed to be limestone bedrock. Borings GT-31 and GT-32, located at the toe of the dike, were sampled at least every five feet or change in material to auger refusal.

Disturbed soil samples were obtained using a 2.0-inch O.D., 1.5-inch I.D. Standard Penetration (SPT) sampler. SPT samples were placed in capped plastic jars. Relatively undisturbed samples were obtained using a California split-barrel sampler having an O.D. of 3.0 inches and I.D. of 2.5 inches. Four, 6-inch long, 2.5-inch I.D. brass liners were placed inside the California sampler. Each retrieved 6-inch liner was capped and taped. Both the SPT and California samplers were driven a depth of 18 inches using a 140-pound safety hammer free-falling 30 inches. The number of blows required to drive each 6-inch interval was recorded and the final two 6-inch drives were summed and expressed as blows per foot. Undisturbed samples were obtained by hydraulically pushing 3.0-inch diameter, 36-inch long steel shelby tubes to a depth of 30 inches. Upon retrieval, both ends of the tube were sealed with molten bee's wax, capped, and taped. Care was taken to maintain the tubes in a vertical position at all times.

Geotechnical boring logs accompany this report and show soils encountered, samplers used as defined on the cover sheet, sampling intervals, and piezometer construction. Photographs of SPT samples collected and photos of various drilling activities also accompany this report.

A daily diary was maintained documenting all drilling activities. Chain-of-custody forms were completed for all samples collected. Samples were stored on-site in building 404 and arranged in order for easy retrieval. Copies of field logs were sent to Ed Tom, San Fransicso, on a weekly basis.

All six borings at the dike were completed as piezometers to detect seepage from the adjacent pond. Once total depth was achieved, the augers were backed out about six feet. Typically, 5 feet of 1/2-inch pelletized bentonite was poured through the augers to the bottom five feet of the hole to form a bottom-hole seal. The bentonite was then hydrated using five gallons of clear water. The piezometer string was assembled and lowered through the augers to the top of the bentonite.

Piezometers consisted of 2.0-inch (I.D.), schedule 40, flush-threaded PVC pipe manufactured by TriLoc. The piezometer was machine slotted 0.010 inch from 1.0 foot above the bentonite seal to approximately five feet below ground surface. A cap was threaded on the bottom of the screen and a slip cap was placed on the top of the casing which extended about two feet above ground level.

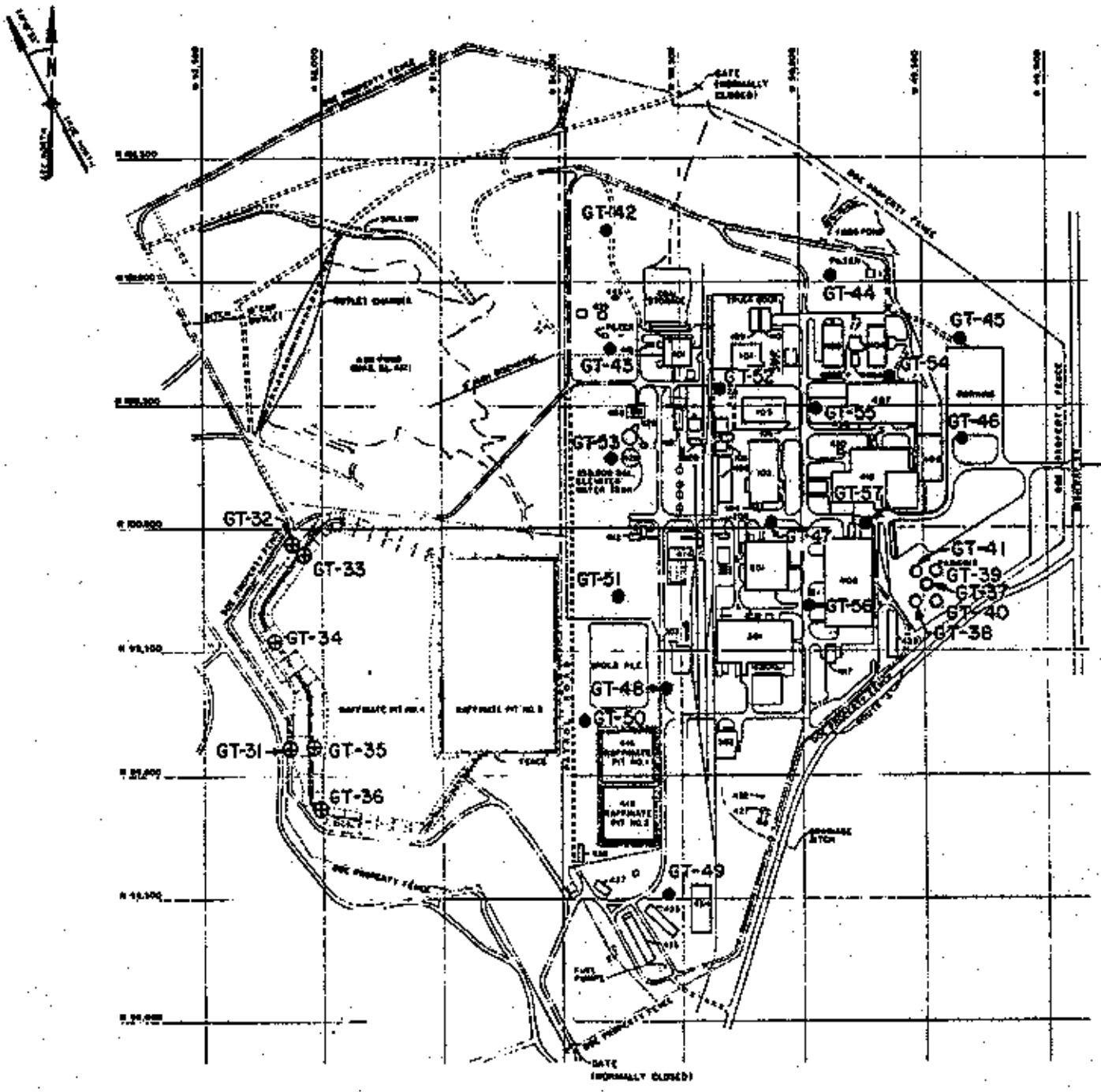
Once the piezometer string was installed, the augers were withdrawn from the hole. A sand pack was then placed, consisting of U.S. Silica flint shot blasting sand. The sand pack extended from the bottom-hole bentonite to one foot above the top of screen; typically four feet below ground surface. Pelletized bentonite was placed above the sand pack to ground level and hydrated to form a surface seal.

On August 29, 1988, all piezometers were checked for water and all were dry.

HSSRAP GEOTECHNICAL DRILLING PROGRAM
BOREHOLE SUMMARY

Boring Number	North	West	Elevation	Started	Completed	Total Depth (ft)
GT-31*	99119.33	52130.81	634.5	06/01/88	06/02/88	34.0
GT-32*	99939.82	52126.54	643.7	06/06/88	06/06/88	24.0
GT-33*	99901.55	52078.99	665.4	06/07/88	06/08/88	50.5
GT-34*	99546.25	52202.09	665.0	06/10/88	06/13/88	54.5
GT-35*	99115.06	52039.30	665.6	06/13/88	06/15/88	54.0
GT-36*	98864.37	52006.51	664.5	06/15/88	06/16/88	47.75
GT-37*	--	--	657.0	06/02/88	06/03/88	24.0
GT-38*	--	--	657.7	06/03/88	06/03/88	26.5
GT-39*	--	--	656.7	06/03/88	06/06/88	22.5
GT-40*	--	--	657.4	06/09/88	06/09/88	23.0
GT-41*	--	--	655.9	06/09/88	06/09/88	21.5
GT-42	101205.99	50804.63	648.0	06/21/88	06/24/88	57.0
GT-43	100736.60	50786.06	654.2	06/24/88	06/30/88	78.5
GT-44	101030.75	49875.58	643.3	06/30/88	07/06/88	49.5
GT-45	100775.15	49344.17	645.0	07/06/88	07/08/88	41.5
GT-46	100364.80	49339.95	651.8	07/08/88	07/13/88	40.5
GT-47	100024.84	50128.92	660.3	07/13/88	07/15/88	55.5
GT-48	99353.04	50568.09	657.7	07/15/88	07/21/88	53.6
GT-49*	98517.34	50560.76	665.3	07/21/88	07/22/88	29.5
GT-50	99223	50905	653.8	07/22/88	07/27/88	55.5
GT-51	99725.91	50758.54	646.1	07/27/88	08/08/88	49.9
GT-52	100577	50335	658.8	08/09/88	08/12/88	70.2
GT-53*	100284	50781	655.5	08/12/88	08/16/88	42.5
GT-54	100618	49635	652.4	08/16/88	08/19/88	50.0
GT-55	100490	49937	655.6	08/19/88	08/24/88	53.0
GT-56	99689	49971	657.1	08/24/88	08/26/88	43.0
GT-57*	10017	49739	654.7	08/26/88	08/29/88	36.5

*Augered and sampled to bedrock; others cored 20 feet



LEGEND:

- PAVED ROAD (ASPHALT OR CONCRETE)
- GRAVELED ROAD
- OLD ROADBED
- FENCE
- ELECTRICAL SUBSTATION
- ADMINISTRATION BUILDING BOREHOLE (LOCATION APPROXIMATE)
- RAFFINATE PIT NO.4 DIKE BOREHOLE
- DISPOSAL CELL BOREHOLE / CORENOLE

200 0 200 400
SCALE FEET

MKE DOCUMENT NO. 5121-C-DW-D-D1-0278-A

U. S. DEPARTMENT OF ENERGY
OAK RIDGE, TENNESSEE

CHEMICAL PLANT
CONSTRUCTION DRAWINGS

BORING LOCATION PLAN
GEOTECHNICAL DRILLING PROGRAM

WESTON-KNUDSEN ENGINEERS, INC
WESTON PROJECT

DE-AC05-86OR21548

GEOTECHNICAL BORING LOG LEGEND

SYMBOLIC LOG

CLAY

SILT

SAND

GRAVEL

SILTY CLAY

CLAYEY SILT

GRAVELLY CLAY

CLAYEY GRAVEL

SANDY CLAY

TOPSOIL

SHALE

CHERTY LIMESTONE

SAMPLER DESIGNATIONS

SS = STANDARD PENETRATION SAMPLER (2.0" SPLIT SPOON)

SB = CALIFORNIA SAMPLER (3.0" SPLIT BARREL)
X = LINERS COLLECTED

ST = 3.0" SHELBY TUBE
P.P.= POCKET PENETROMETER ,UNCONFINED COMPRESSIVE STRENGTH (Tons/Sq.Ft.)

GROUNDWATER MEASUREMENTS

6.5'; 6/9 ▽ = DEPTH & DATE OF INITIAL WATER LEVEL MEASUREMENT

2.9'; 6/16 ▼ = DEPTH & DATE OF STABILIZED WATER LEVEL MEASUREMENT

COLORS

SOIL & ROCK COLORS FROM MUNSELL SOIL COLOR CHARTS

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 2

Project Number: MKE-9423

Hole Number: GT-31 (GT-3B31)

Project: WSSRAP RP 4 Dike	Location: at toe of dike - N. end
Coordinates: (AEC) 99119.3N 52130.8W	Drilling Contractor: Hannibal Testing Labs

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME 55 Cont. Flt. H.S. auger 7" OD., 3½" ID	29.0'	---	7"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
634.5 ft. Top PVC Casing	Vertical	34.0'

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
24.0' 6/2/88	None	1:00 6/1/88	2:40 6/2/88	A. Benfer

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
							Limestone gravel, angalar, light gray FILL
		2.0 3.5	SS 01	1"	8.5.7 12		Silty clay, plastic, mottled moderate brown (10YR 4/2) and olive gray (5Y 4/1), moist, stiff. CL
	5	4.0 6.5	ST 02	31"			P.P. = 2.5, very stiff, with MnOx (black)
		6.5 8.0	SS 03	18"	3.5.6 11		P.P. = 3.5 FERRELVIEW
	10	9.0 11.5	ST 04	32"			P.P. = 3.25
		11.5 13.0	SS 05	18"	3.8.10 18		P.P. = 3.25 trace fine gravel (< 5%) mottled light brown (5YR 5/6) and light olive gray (5Y 6/1)
	15						
	20	18.0 20.5	ST 06	33½"			Silty clay with trace of gravel, moderate brown (5YR 4/4) and pinkish gray, plastic, moist, very stiff. CH P.P. = 2.75
		20.5 22.0	SS 07	17"	8.13.50/4" 63+		P.P. = 3.0 gravelly at 23'
24' 6/2	25	24.0 24.75	SS08	12"	22 50/3"		

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 2 of 2
Project Number: MKE-9423
Hole Number: GT-31 (GT-3831)

Project: WSSRAP RP 4 Dike
Location: at toe of dike - N. end

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE & NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
25							
							Probable weathered limestone, cherty, grayish orange (10YR 7/4) and medium light gray (N5-chert) - moist, hard
	30						Weathered limestone
	35						T.D. 34' 4:10 6/1/88 Installed piezometer Boring backfilled to 20.0' with ½" bentonite pellets. 2" I.D. PVC screen, 0.010" slots extends from 20.0' to 5.0'. Sand filter extends from 20.0' to 4.0'. Bentonite 4.0' to ground surface. All bentonite was hydrated with clean water after placement.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 1 of 2

GEOTECHNICAL BORING LOG

Project Number: MKE-9423

Hole Number: GT-32 (GT-3B32)

Project: WSSRAP - RP 4 Dike	Location: at toe of RP #4 dike - N. end
Coordinates: (AEC) 99939.8N 52126.5W	Drilling Contractor: Hannibal Testing Labs
Drill Make and Model: CME-55 Cont. Flt. H.S. Auger 7" OD, 3½" ID	Depth Top of Rock: 24.0'
Depth Casing & Size: None	Hole Size: 7"
Elevation: 643.2 ft. Top PVC Casing	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 24.0'	
Water Level: 3:20 6/6 No water	Fluid & Additives: None
Date Start: 11:10 6/6/88	Date Finish: 5:00 6/6/88
Logger: A. Benfer	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		1.0 – 3.5	ST 01	31½"	Pushed 30"		Clayey silt, mottled, yellowish brown (10YR 5/4) and gray (5Y 6/1) with minor black stringers MnOx, moist, hard (4.5) ML
							LOESS
	5						stiff drilling
	10	9.0 – 11.5	ST 02	28"			Clay with some sand (10%) and fine gravel (5%) mottled brown (7.5YR 5/6) and gray (10YR 6/1), moist, stiff to very stiff (2.0), CH
		11.5 – 13.0	SS 03	20"	3.5.10 15		- P.P. = 2.25 very stiff, with black MnOx
							FERRELVIEW
	15						gravelly at 14.5'
		17.0 – 18.5	SS 04	18"	4.15.19 34		Silty clay with sand and fine gravel (15%), yellowish brown (10YR 5/4), moist, very stiff to hard (2.25 - 4.0), igneous gravel clast in shoe. CL-CH
		18.5 – 21.0	ST 05	21½"			CLAY TILL
	20						Clay, slightly sandy (10-20%) with fine gravel, 5% Red (2.5YR 4/6) moist, very stiff (3.0) CH igneous rock fragments (1") very stiff (2.2)
		21.0 – 23.3	ST 06	18"	Pushed 16"		RESIDUUM
		23.8	SS 07	6"	5.13.30 43		Weathered limestone and chert with clay, yellow (10YR 7/8) moist
	25						T.D. 24.0' auger refusal 2:45 6/6/88

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 2 of 2

Project Number: MKE-9423

Hole Number: GT-32 (GT-3B32)

Project: WSSRAP - RP 4 Dike

Location: at toe of RP #4 dike - N. end

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	30						Installed piezometer, backfilled with bentonite pellets to 19.0', screen set from 19' (18') to 4', sand pack to 3'. Bentonite pellet surface seal. All bentonite hydrated.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 1 of 2

GEOTECHNICAL BORING LOG

Project Number: MKE-9423

Hole Number: GT-33 (GT-3B33)

Project: WSSRAP - RP #4 Dike	Location: RP #4 dike crest - N. end
Coordinates: (AEC) 99901.6N 52079.0W	Drilling Contractor: Hannibal Testing Labs
Drill Make and Model: CME-55 Cont Flt. H.S. Auger-7" OD 3½" ID	Depth Top of Rock: 50.5'
Depth Casing & Size: None	Hole Size: 7"
Elevation: 665.4 ft. Top PVC Casing	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 50.5'	
Water Level: None	Fluid & Additives: None
Date Start: 10:10 6/7/88	Date Finish: 2:30 6/8/88
Logger: A. Benfer	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		0.5 2.0	SS 01	11"	3.5.9 14		Silty clay, slightly sandy (15%), yellowish red (5YR 5/6) damp, hard (74.5). CL
		2.0 3.5	SS 02	5"	5.10.8 18		dark brown (10YR 3/3), very stiff (3.75)
		3.5 5.0	SS 03	9½"	4.5.7 12		- P.P. = 3.75 less sand
	5	5.0 7.5	ST 04	28"			yellowish brown (10YR 5/4), moist, stiff (1.8), bottom of tube is loose and disturbed-possibly entire sample
		7.5 9.0	SS 05	20"	3.4.5 9		- P.P. = 1.6 very little sand - CL
	10	9.0 10.5	SS 06	13"	2.2.3 5		- P.P. = 2.0 stiff-very stiff
		10.5 12.0	SS 07	14"	2.2.4 6		- P.P. = 1.3 stiff, ~10% sand
		12.0 14.5	ST 08	32"			- P.P. = 1.75
	15	16.0	SS 09	13"	3.3.6 9		- P.P. = 2.5 very stiff
		16.0 17.5	SS 10	13"	3.5.5 10		- P.P. = 1.75 stiff
		17.5 19.0	SS 11	12"	1.2.5 7		- P.P. = 2.5 very stiff
	20	19.0 20.5	SS 12	15"	1.5.6 11		FILL
		20.5 22.0	SS 13	9"	1.3.8 11		20.0 Silty clay, mottled dark gray (10YR 4/1) and yellowish brown (10YR 5/4), very stiff (2.5), trace (5%) fine gravel, CL
		22.0 24.5	ST 14	29"	Pushed Hard		mottled yellowish brown (10YR 5/4) and minor gray with black MNOX module, damp, hard (4.5+) hard drilling LOESS
	25						

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 2 of 2

GEOTECHNICAL BORING LOG

Project Number: MKE-9423

Hole Number: GT-33 (GT-3B33)

Project: WSSRAP - RP #4 Dike

Location: RP #4 dike crest - N. end

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
25							Clay, sandy (15%) mottled red (2.5YR 4/8) and gray (2.5YR 6/0), moist, very stiff (3.0) CH
							FERRELVIEW
	30	29.0 30.5	SB 15	12"	5.9.12 21		Clay with trace of sand and fine gravel (10%) mottled red (2.5YR 4/8) and gray (2.5YR 6/0) moist, very stiff (3.0) CH
							FERRELVIEW
	35	34.0 35.5	SB 16	18"	4.10.20 30		34.5 Silty clay, with sand and gravel (20%), gravel ¼"-½", subrounded, mottled yellowish brown (10YR 5/6) and black (MnOx) and gray (7.5YR 8/0), moist, hard (4.25) CL
							gravelly at 37'
							CLAY TILL
	40	40.0 41.5	SS 17	17"	8.11.15 26		41.0 Clayey gravel, clay (yellow red 5YR 5/8) gravel (chert gray 10YR 6/1). Clay moist CH., medium dense GC.
	45	44.5 46.0	SS 18	8"	20.18.30 48		dense
							46.5 Silty clay, gravelly (up to ¼", 5%) sandy (5%), mottled yellow brown (10YR 6/6) and black (MnOx), moist, very stiff (2.5) CL; igneous rock & chert fgmts
		47.5 49.0	SS 19	10"	7.15.22 47		49.5 BASAL TILL
	50	49.5 51.0	SB 20	12"	7.27.50/6" 77+		Gravel (chert), clayey (25%), yellowish brown (10YR 6/6), chert (light gray) moist, dense, clay (1.5) GC - samples disturbed RESIDUUM

T.D. 50.5' auger refusal, 11:15 6/8/88

Piezometer installed. Backfilled to 45.7' with bentonite pellets. Set 2" PVC screen (0.01"), bottom of screen at 44.7'; top at 5.2'. sand 45.7-4.0', bentonite pellets to surface - hydrated.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 3

Project Number: MKE-9423

Hole Number: GT-34 (GT-3B34)

Project: WSSRAP-RP#4 DIKE	Location: RP#4 DIKE CREST
Coordinates: (AEC) 99546.3N 52202.1W	Drilling Contractor: HANNIBAL TESTING LABS
Drill Make and Model: CME-55 Cont. Flt. H.S. Auger	Depth Top of Rock: 54.0' / Depth Casing & Size: --- / Hole Size: 7"
Elevation: 665.0 ft. Top PVC Casing	Angle from Vert. and Bearing: Vertical / Depth Bottom of Hole: 54.0'
Water Level: None	Fluid & Additives: None / Date Start: 8:30 6/10/88 / Date Finish: 3:15 6/13/88 / Logger: A. Benfer

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
							gravel road surface
		1.0 2.5	SS 01	4"	3.4.4 8		Silty clay, light yellow brown (10YR 6/4), damp, hard (4.5+) CL
		2.5 4.0	SS 02	3"	3.2.3 5		10% fine to coarse sand
	5	4.0 5.5	SS 03	12"	2.2.3 5		P.P. = 2.5 very stiff, moist
		5.5 7.0	SS 04	13"	1.3.3 6		P.P. = 2.5
		7.0 8.5	SS 05	15"	1.2.4 6		P.P. = 2.5 mottled brownish yellow (10YR 6/6) and gray (10YR 6/1) localized MnOx (black)
		8.5 11.0	ST 06	22"			
	10						P.P. = 2.2 CH, 20% sand possibly disturbed
		11.0 12.5	SS 07	12"	2.4.5 9		P.P. = 3.0, Localized fine gravel (3/8") 20%
		12.5 14.0	SS 08	12"	2.6.12 18		P.P. = 2.2 P.P. = 4.5+ dark yellow brown (10YR 4/2), very stiff to hard.
	15	14.0 15.5	SS 09	13"	3.6.8 14		P.P. = 3.5
		15.5 17.0	SS 10	11"	2.5.10 15		P.P. = 4.3 hard drilling
		17.0 19.5	ST 11	27"	hard push		P.P. = 4.5+ hard, mottled yellow brown (10YR 5/4) and black, (MnOx)
	20	19.5 21.0	SS 12	8½"	5.8.11 19		P.P. = 4.0 very stiff damp
		21.0 22.5	SS 13	12"	3.5.10 15		P.P. = 2.5
		22.5 24.0	SS 14	10"	3.6.9 15		P.P. = 3.7 - 4.5, hard FILL 24.0
	25	24.0 25.5	SS 15	12"	3.5.7 12		Silty clay, mottled yellow brown (10YR 5/6) and light gray (10YR 7/1) moist, very stiff (2.3) CL

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 2 of 3
Project Number: MKE-9423
Hole Number: GT-34 (GT-3B34)

Project: WSSRAP-RP#4 DIKE
Location: RP#4 DIKE CREST

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		25.5 27.0	SS 16	11"	3.4.9 13		- P.P. = 3.0, localized MnOx (black)
		27.0 28.5	SB 17	12"	4.12.21 33		- P.P. = 4.5+, hard
	30						FERRELVIEW
		33.0 34.5	SB 18	12"	7.11.15 26		Silty clay with fine to coarse sand (15%) and fine gravel (5%) mottled yellow brown (10YR 5/6) and light gray (10YR 7/1) and black (MnOx), moist, hard (4.5+) CL - CH
	35						CLAY TILL
		38.0 39.5	SS 19	20"	5.8.13 21		39.0
	40						Silty clay, gravely, mottled yellow brown, (10YR 5/6) and light gray (10YR 7/1) and black (MnOx) damp, hard (4.5+) CL
		43.0 44.5	SB 20	12"	4.10.20 30		Very silty clay to clayey silt, mottled yellow brown (10YR 5/6) and light gray (10YR 7/1) and black, moist, hard (4.5+). CL - ML
	45						
		48.0 49.5	SS 21	20"	5.13.37 50		Gravelly, very silty clay to gravelly (40%) clayey silt, mottled yellow brown (10YR 5/6) and light gray (10YR 7/1) and black (MnOx), moist, hard (4.5+) CL - ML. gravel angular chert
	50						
		53.0 54.5	SB 22	12"	8.38.50/5" 88+		Silty clay, mottled yellow brown (10YR 5/6) and light gray (10YR 7/2), and black (MnOx) moist, stiff to very stiff, (2.0) CL. cherty at 53.7' 54.0
							Weathered limestone with chert, damp, white (5YR 8/1), hard.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 3 of 3

Project Number: MKE-9423

Hole Number: GT-34 (GT-3B34)

GEOTECHNICAL BORING LOG

Project: WSSRAP-RP #4 DIKE

Location: RP#4 DIKE CREST

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE & NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	55						T.D. 54.5' 10:30 6/13/88 Set Piezometer at 50.0. Bentonite pellet backfill 54.5 to 50.0. Bottom of screen at 49.0'; top at 5.5'. Sand filter 50.0 to 4.0. Bentonite pellet surface seal 0-4'.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 3

Project Number: MKE-9423

Hole Number: GT-35 (GT-3B35)

Project: WSSRAP-RP4 DIKE	Location: RP#4 DIKE CREST
Coordinates: (AEC) 99115.1N 52039.3W	Drilling Contractor: HANNIBAL TESTING LABS
Drill Make and Model: CME - 55 Cont. Flt. H.S. Auger	Depth Top of Rock: 54.0 / Depth Casing & Size: / Hole Size: 7"
Elevation: 665.6 ft. Top PVC Casing	Angle from Vert. and Bearing: Vertical / Depth Bottom of Hole: 54.0
Water Level: None	Fluid & Additives: None / Date Start: 4:15 6/13/88 / Date Finish: 11:00 6/15/88 / Logger: A. Benfer

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
							6" limestone gravel - white
		1.5 3.0	SS 01	9"	2.2.2 4		Silty clay, mottled brownish yellow (10YR 6/6) and very dark brown, (10YR 3/1) moist, stiff, (1.5) CL FILL
		3.0 4.5	SS 02	13"	2.2.4 6		P.P. = 2.75, very stiff, yellow brown (10YR 5/4) trace fine gravel (5%).
	5	4.5 6.0	SS 03	11"	3.3.5		P.P. = 2.5
6/13/88		6.0 7.5	SS 04	14"	3.3.5 8		P.P. = 2.75 CL - CH
6/14/88		7.5 10.0	ST 05	29"			P.P. = 4.5+, hard, dark yellow brown (10YR 4/4) damp
	10	10.0 11.5	SS 06	11"	4.6.8 14		P.P. = 4.5+, mottled dark yellow brown (10YR 4/4) and yellow brown (10YR 5/4) slightly sandy (10%). discing
		11.5 13.0	SS 07	12"	3.4.7 11		P.P. = 4.5+, very silty
		13.0 14.5	SS 08	12"	3.7.9 16		P.P. = 2.5 - 4.0, very stiff to hard, moist
	15	14.5 16.0	SS 09	9½"	3.6.10 16		P.P. = 4.5+, hard
		16.0 17.5	SB 10	12"	6.11.15 26		P.P. = 4.5+
		17.5 19.0	SS 11	12"	3.6.9 15		P.P. = 4.0, very stiff-hard, locally sandy (15%) with fine gravel (5%).
	20	19.0 20.5	SS 12	11"	3.4.7 11		P.P. = 2.5 - 3.0
		20.5 22.0	SS 13	13"	2.3.6 9		P.P. = 2.0 stiff to very stiff mottled yellow brown (10YR 5/6) and light gray (10YR 7/1) and black, moist.
		22.0 23.5	SS 14	20"	2.3.4 7		P.P. = 2.5, very stiff
		23.5 25.0	SB 15	6"	7.7.9 16		P.P. = 2.75

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 2 of 3
Project Number: MKE-9423
Hole Number: GT-35 (GT-3B35)

Project: WSSRAP-RP4 DIKE
Location: RP#4 DIKE CREST

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25	25.0 26.5	SS 16	14"	1.3.6 9		- P.P. = 3.5
		26.5 28.0	SS 17	12"	3.4.6 10		- P.P. = 2.6
		28.0 29.5	SS 18	16"	3.5.5 10		- P.P. = 2.0 - 4.0 stiff to hard
	30	31.0	SS 19	13"	3.5.10 15		FILL Silty clay, various colors, dark gray (5Y 3/1), mottled yellow brown (10YR 5/6) light gray (10YR 7/1) moist, very stiff to hard (3.5 - 74.5) CL
		31.0 32.5	SS 20	18"	7.9.14 23		30.8' Silty clay, dark gray (10YR 4/1), damp, hard (4.5+) CL root fragments at 32.2'
	35						LOESS
		35.5 38.0	ST 21	27"			Clay, mottled brownish yellow (10YR 6/6) and light gray (10YR 7/1), moist, very stiff (2.3), CH 10% coarse angular sand, slickensided
		38.0 39.5	SS 22	18"	4.5.8 13		- P.P. = 3.25 FERRELVIEW
	40						hard drilling
	45	45.0 46.5	SB 23	12"	6.10.15 25		- P.P. = 2.5 - 4.5 very stiff stringers of MnOx (black) 10% coarse sand & 5% fine gravel CL - CH CLAY TILL
							48.5
	50	50.0 51.5	SS 24	18"	1.7.30 37		Sandy gravel clay to clayey sandy gravel, igneous rock & chert fragments, mottled yellow brown (10YR 5/6) and light gray (10YR 7/1), moist, stiff (1.5) to dense, CL - GP BASAL TILL?
							weathered limestone?
							T.D. 54.0' Auger refusal 3:10 6/14/88

APPENDIX A-2

WSSRAP ADMINISTRATION BUILDING BOREHOLE LOGS
(GT-37 THROUGH GT-41)

GEOTECHNICAL FOUNDATION INVESTIGATION
WSSRAP ADMINISTRATION BUILDING

A-2

This report presents the procedures performed during the drilling - soil sampling of five exploratory borings made at the location of the proposed administration building at the Weldon Spring Site Remedial Action Project (WSSRAP).

Drilling was accomplished on June 2, 3, 6 and 9, 1988. Borings GT-37 through GT-41 were placed at the approximate four corners and center of the proposed building at locations previously marked by surveyors. The building will be sited on an existing paved parking area outside the chemical plant within an uncontaminated area, thus personal protective clothing was not required for drilling personnel, nor was decontamination of drill tools required between borings. The drill rig and tools were decontaminated by steam cleaning prior to initiating the drilling.

Drilling was subcontracted to Hannibal Testing Laboratories (HTL), Hannibal, Missouri. HTL employees Tom Clay and Terry Hemme performed as driller and drillers' helper, respectively. Sample logging, documentation and drilling supervision was performed by Alan Benfer, geologist employed by Morrison-Knudsen Engineers (MKE), Boise. Direction for subsurface sampling techniques and intervals was provided by Ed Tom, geotechnical engineer employed by MKE, San Francisco.

Drilling was accomplished with a CME-55 drill rig using continuous flight hollow stem augers having an outside (O.D.) diameter of 6-5/8 inches and an inside (I.D.) diameter of 3-1/4 inches.

Continuous soil sampling was performed to a depth of approximately 15 feet and every 5 feet or less, thereafter. Disturbed soil samples were obtained using a 2.0-inch O.D., 1.5-inch I.D. standard penetration (SPT) sampler. SPT samples were placed in plastic jars. Relatively

undisturbed samples were obtained using a California split-barrel sampler having an O.D. of 3.0 inches and I.D. of 2.5 inches. Four, 6-inch long, 2.5-inch I.D. brass liners were placed inside the California sampler. Each retrieved 6-inch liner was capped and taped. Both the SPT and California samplers were driven a depth of 18 inches using a 140-pound safety hammer free-falling 30 inches. The number of blows required to drive each 6 inch interval was recorded and the final two 6-inch drives were summed and expressed as blows per foot. Undisturbed samples were obtained by hydraulically pushing 3.0-inch diameter, 36-inch long steel shelby tubes to a depth of 30 inches. Upon retrieval, both ends of the tube were sealed with molten bee's wax, capped and taped. Care was taken to maintain the tubes in a vertical position at all times. All samples were stored on-site in building 404 and arranged in order for easy retrieval.

Drilling was terminated at auger refusal assumed to be the top of limestone bedrock. Attached to this report are the geotechnical boring logs showing samplers used as defined on the cover sheet, sampling intervals, soil encountered and water levels. Field logs were provided to Ed Tom on a daily basis.

All borings were covered and left open to allow encountered groundwater to stabilize. On June 16, 1988 groundwater levels were measured and it was determined that all borings had collapsed at a depth of 8 to 10 feet. On June 17, all borings were drilled out to the original depth prior to abandonment.

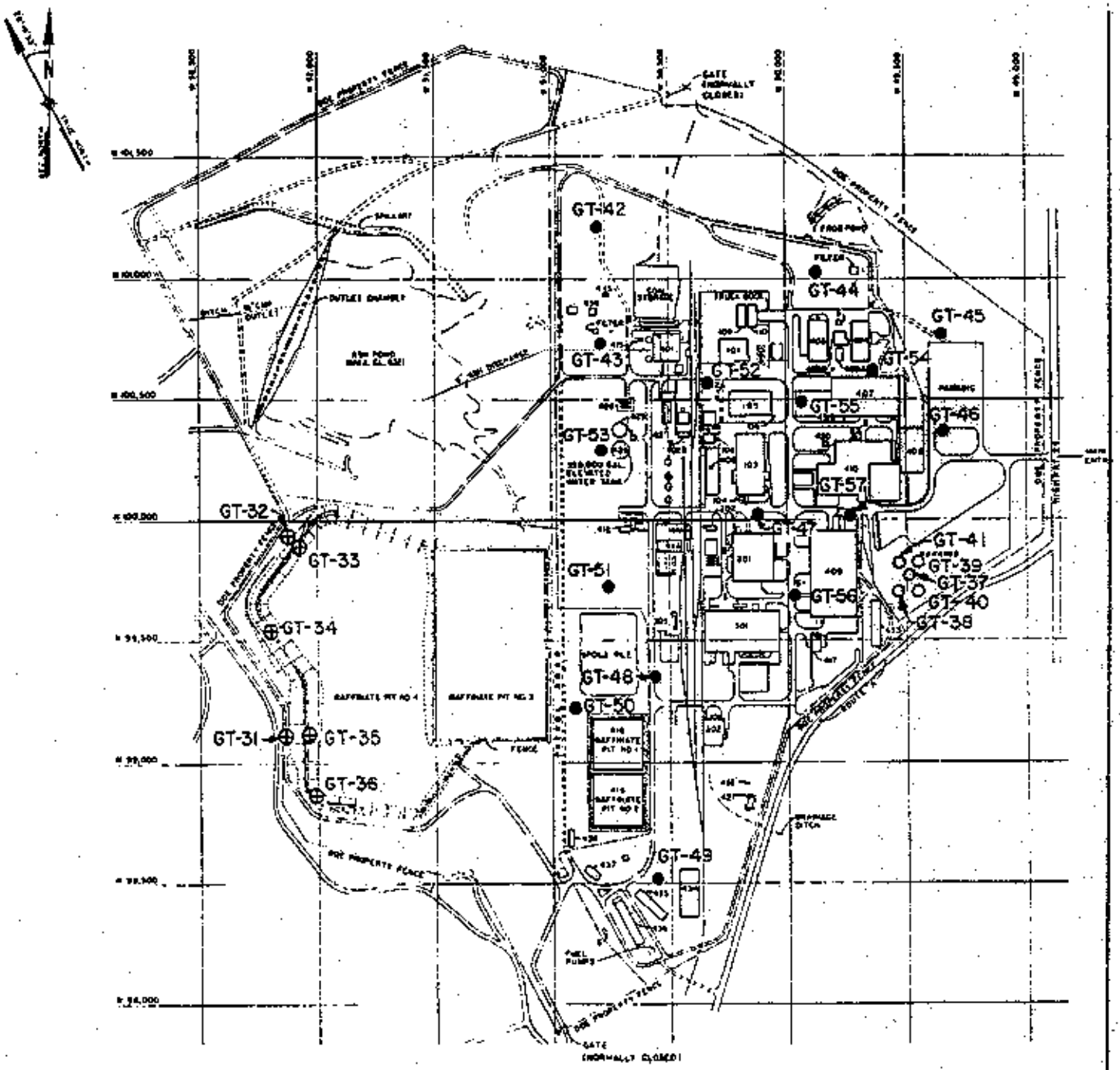
All borings were abandoned by plugging with Volclay Grout manufactured by American Colloid Company. Volclay consists of a high-solids bentonite clay powder with a 4% added initiator which causes the grout to set up to a plastic consistency. Each 50-pound bag of Volclay was mixed with 23 gallons of clear water. The Volclay powder was jetted through a hopper into a tub and thoroughly mixed by circulating through the rig mud pump. Two pounds of initiator were added per 50-pound bag of Volclay. Once mixed, the grout slurry was pumped through the hollow stem augers, the augers were retrieved and the hole topped-off.

WSSRAP GEOTECHNICAL DRILLING PROGRAM

BOREHOLE SUMMARY

Boring Number	North	West	Elevation	Started	Completed	Total Depth (ft)
GT-31*	99119.33	52130.81	634.5	06/01/88	06/02/88	34.0
GT-32*	99939.82	52126.54	643.7	06/06/88	06/06/88	24.0
GT-33*	99901.55	52078.99	665.4	06/07/88	06/08/88	50.5
GT-34*	99546.25	52202.09	665.0	06/10/88	06/13/88	54.5
GT-35*	99115.06	52039.30	665.6	06/13/88	06/15/88	54.0
GT-36*	98864.37	52006.51	664.5	06/15/88	06/16/88	47.75
GT-37*	--	--	657.0	06/02/88	06/03/88	24.0
GT-38*	--	--	657.7	06/03/88	06/03/88	26.5
GT-39*	--	--	656.7	06/03/88	06/06/88	22.5
GT-40*	--	--	657.4	06/09/88	06/09/88	23.0
GT-41*	--	--	655.9	06/09/88	06/09/88	21.5
GT-42	101205.99	50804.63	648.0	06/21/88	06/24/88	57.0
GT-43	100736.60	50786.06	654.2	06/24/88	06/30/88	78.5
GT-44	101030.75	49875.58	643.3	06/30/88	07/06/88	49.5
GT-45	100775.15	49344.17	645.0	07/06/88	07/08/88	41.5
GT-46	100364.80	49339.95	651.8	07/08/88	07/13/88	40.5
GT-47	100024.84	50128.92	660.3	07/13/88	07/15/88	55.5
GT-48	99353.04	50568.09	657.7	07/15/88	07/21/88	53.6
GT-49*	98517.34	50560.76	665.3	07/21/88	07/22/88	29.5
GT-50	99223	50905	653.8	07/22/88	07/27/88	55.5
GT-51	99725.91	50758.54	646.1	07/27/88	08/08/88	49.9
GT-52	100577	50335	658.8	08/09/88	08/12/88	70.2
GT-53*	100284	50781	655.5	08/12/88	08/16/88	42.5
GT-54	100618	49635	652.4	08/16/88	08/19/88	50.0
GT-55	100490	49937	655.6	08/19/88	08/24/88	53.0
GT-56	99689	49971	657.1	08/24/88	08/26/88	43.0
GT-57*	10017	49739	654.7	08/26/88	08/29/88	36.5

*Augered and sampled to bedrock; others cored 20 feet



LEGEND:

- PAVED ROAD (ASPHALT OR CONCRETE)
- GRAVELED ROAD
- OLD ROADBED
- FENCE
- ELECTRICAL SUBSTATION
- ADMINISTRATION BUILDING BOREHOLE (LOCATION APPROXIMATE)
- RAFFINATE PIT NO. 4 DIKE BOREHOLE
- DISPOSAL CELL BOREHOLE / COREHOLE

200 0 200 400
SCALE FEET

MKE DOCUMENT NO. 5121-C-04-0-01-0878-4

U. S. DEPARTMENT OF ENERGY
OAK RIDGE, TENNESSEE

CHEMICAL PLANT
CONSTRUCTION DRAWINGS
BORING LOCATION PLAN
GEOTECHNICAL DRILLING PROGRAM

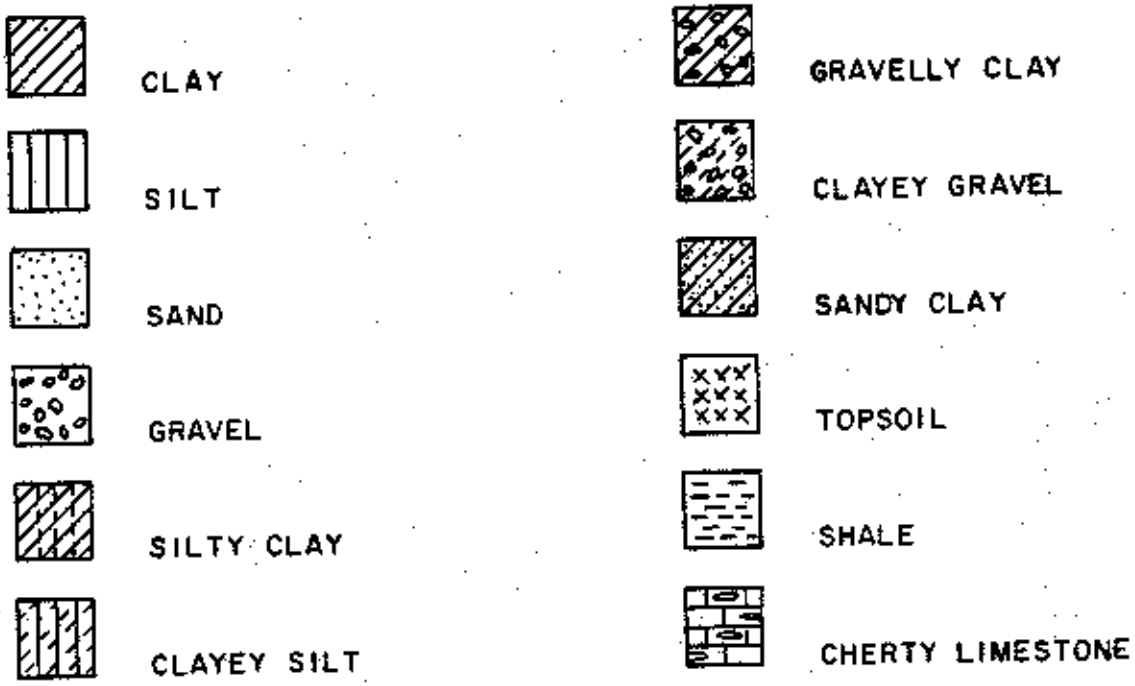
MORRISON KNUDSEN ENGINEERS, INC.
WESTON PROJECT

DE-AC05-86OR21548

5121E-CP-501

GEOTECHNICAL BORING LOG LEGEND

SYMBOLIC LOG



SAMPLER DESIGNATIONS

SS = STANDARD PENETRATION SAMPLER (2.0" SPLIT SPOON)

SB = CALIFORNIA SAMPLER (3.0" SPLIT BARREL)
x/x = LINERS COLLECTED

ST = 3.0" SHELBY TUBE
P.P. = POCKET PENETROMETER, UNCONFINED COMPRESSIVE STRENGTH (Tons/Sq.Ft.)

GROUNDWATER MEASUREMENTS

6.5'; 6/9 ▽ = DEPTH & DATE OF INITIAL WATER LEVEL MEASUREMENT

2.9'; 6/16 ▼ = DEPTH & DATE OF STABILIZED WATER LEVEL MEASUREMENT

COLORS

SOIL & ROCK COLORS FROM MUNSELL SOIL COLOR CHARTS

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 1

Project Number: MKE - 9423

Hole Number: GT-37 (GT-2B37)

Project: WSSRAP GT DRILLING	Location: ADMINISTRATION BUILDING (CENTER)
Coordinates: Not Available	Drilling Contractor: HANNIBAL TESTING LABORATORIES

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55 HOLLOW STEM CONT. FLT. AUGER - 7" OD, 3½" ID	24.0	---	7"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
657.0 ft.	Vertical	24.0'

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
10.5' 6/3,3.6 6/6	None	4:15 6/2/88	10:10 6/3/88	A. BENFER

Elevation	Depth Below Surface	Sample Interval	Sample Type & Number	Sample Recovery	Standard Penetration Test Results 6"-6"-6" (N)	Symbolic Log	Soil Description (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
							Asphalt and base rock 1.5'
		1.5 3.0	SS 01	18"	1.2.4 6		Topsoil - Clayey Silt, black, moist, stiff (1.0) ML
3.6' 6/6		5.0	ST 02	4"			Silty Clay, mottled olive gray (5Y 4/1) and light brown (5YR 5/6), moist, stiff (1.25) CL weathered iron nodules.
	5	5.0 7.5	ST 03	30½"			Clayey Silt, olive gray (5Y 4/1) moist, stiff, ML LOESS
		7.5 9.0	SS 04	19"	1.4.5 9		Silty Clay, mottled, pale yellowish brown (10YR 6/2) and moderate reddish brown (10R 4/6), moist, stiff (1.6) - CL. Contains weathered FeOx nodules. FERRELVIEW
10.5' 6/2	10	9.0 10.5	SS 05	18"	2.4.6 10		- P.P. = 2.3 very stiff, Wet
		10.5 13.0	ST 06	33½"			- P.P. = 2.1, very stiff, moist
		13.0 14.5	SS 07	20"	2.2.5 7		- P.P. = 1.8, stiff
	15	14.5 16.0	SS 08	19"	1.3.4 7		Light olive gray (5Y 6/1) and medium reddish brown (10R 4/6) - less FeOx, stiff (1.5)
	20	20.0 21.5	SS 09	21"	2.4.9 13		21.0 Silty Clay with trace of gravel, mottled light olive gray (5Y 6/1) and moderate reddish brown (10R 4/6) and black (MnOx), moist, very stiff (3.75) CL.
	25						T.D. 24.0 9:50, 6/3/88 Auger refusal Hole grouted with volclay

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 2

Project Number: MKE - 9423

Hole Number: GT-38 (GT-2B38)

Project: WSSRAP GT DRILLING	Location: SOUTHWEST CORNER ADMINISTRATION BUILDING
Coordinates: Not Available	Drilling Contractor: HANNIBAL TESTING LABORATORIES

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55 HOLLOW STEM CONT. FLT. AUGER - 7" OD, 3½" ID	25.0'	---	7"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
657.7 ft.	Vertical	26.5'

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
11' 6/3, 4.3 6/6	None	11:00 6/3/88	2:55 6/3/88	A. BENFER

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
							Asphalt (1½") and base rock
		1.5 3.0	SS 01	19½"	Pushed 18"		Silty Clay, with angular gravel (½"), mottled grayish olive (10Y 4/2) and light olive brown (5Y 5/6) moist, stiff to very stiff (2.0) CL - gravel possible fill. Tube tip slightly bent. No gravel 3.5; stiff (1.75)
4.3' 6/6		3.0 4.5	SS 02	3½	7.5.4 9		
	5	4.5 7.0	ST 03	26"			Grading LOESS
		7.0 8.5	SS 04	19"	1.2.3 5		Very silty clay to clayey silt, with trace of fine gravel (~5%), mottled light olive gray (5Y 5/2) and moderate yellow brown (10YR 5/4)(FeOx), moist stiff (2.0). CL-ML FERRELVIEW
	10	8.5	ST 05	29"			Silty Clay, mottled, greenish gray (5GY 6/1) and light brown (5YR 5/6), moist, stiff (1.5) CL - grading light olive gray (5Y 6/1) trace angular gravel at 11.0'; Wet
11' 6/3		11.0 12.5	SS 06	18"	3.5.6 11		- Trace coarse sand, P.P. = 1.5, stiff, moist
		12.5 15.0	ST 07	33½"			- P.P. = 1.2, stiff FERRELVIEW
	15						
	20	20.0 21.5	SS 08	19"	3.5.9 14		20.5 Silty Clay, with some subrounded chert gravel (~10%), mottled light olive gray (5Y 6/1) and moderate reddish brown (10R 4/6) and localized black MnOx, moist, very stiff (3.2) CH
		21.5 23.5	ST 09	18"	Pushed 24"		As above, stiff (1.5), igneous rock fragments and minor coarse sand
	25						25.0 CLAY TILL

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 2 of 2
Project Number: MKE - 9423
Hole Number: GT-38

Project: W5SRAP GT DRILLING
Location: SOUTHWEST CORNER ADMINISTRATION BUILDING

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		25.0 26.5	SS 10	8"	6.16.9 25		Weathered limestone and chert with clay, pinkish gray (5YR 8/1), moist, medium dense. RESIDUUM Sample very disturbed
							T.D. 26.5' auger refusal 2:30 6/3/88 Hole grouted with volclay
	30						

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 1

Project Number: MKE - 9423

Hole Number: GT-39 (GT-2B39)

Project: WSSRAP GT DRILLING	Location: NORTHEAST CORNER ADMINISTRATION BUILDING
Coordinates: Not Available	Drilling Contractor: HANNIBAL TESTING LABORATORIES
Drill Make and Model: CME-55 HOLLOW STEM CONT. FLT. AUGER 7"OD, 3¼" ID	Depth Top of Rock: 22.5' / Depth Casing & Size: --- / Hole Size: 7"
Elevation: 656.7 ft.	Angle from Vert. and Bearing: Vertical / Depth Bottom of Hole: 22.5'
Water Level: 4.25' 6/9, 2.1 6/16	Fluid & Additives: None / Date Start: 3:20 6/3/88 / Date Finish: 10:15 6/6/88 / Logger: A. BENFER

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
							Grass and topsoil overlying gravelly clay fill, moderate brown (5YR 4/4) moist, stiff, CL 1.5
2.1' 6/16		1.5 4.0	ST 01	30"	Pushed Hard		Clayey Silt, mottled light olive gray (5YR 5/2) and moderate reddish brown (10R 4/6), moist, medium stiff to stiff (1.0) ML Grading LOESS ?
	5	4.0 5.5	SS 02	18"	1.2.3 5		Very silty clay light olive gray (5Y 6/1) and moderate reddish brown (10R 4/6) moist, medium stiff to stiff (1.0) CL
		5.5 8.0	ST 03	29"			Stiff (1.75) FERRELVIEW
		9.5	SS 04	18"	1.3.5 8		- P.P. = 1.5 - 2.0 less silt
	10	9.5 12.0	ST 04	25½"			- Stiff to very stiff (2.0)
		12.0 14.5	ST 05	31"			Clay, mottled, light olive gray (5Y 6/1) and moderately reddish brown (10R 4/6), moist, very stiff (2.25) CH
	15	14.5 16.0	SS 06	17"	4.6.7 13		- P.P. = 2.25, trace coarse sand, trace fine gravel (<¼",<5%) CL-CH - possibly wet
							17.0
	20	19.0 20.5	ST 07	23"	Pushed 18"		Silty Clay with some sand and gravel, (25%) mottled light brown (5YR 5/6) and pale yellowish brown (10YR 6/2) and black, moist, very stiff (3.2) CL CLAY TILL
		20.5 22.0	SS 08	0	3.8.11 19"		- Angular chert clast in tip, CL-CH. P.P. = 3.2
	25						T.D. 22.5' auger refusal 9:50, 6/6/88 Hole grouted with volclay

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 1
Project Number: MKE - 9423
Hole Number: GT-40 (GT-2B40)

Project: WSSRAP GT DRILLING	Location: PARKING LOT - ADMINISTRATION BLDG. S.E.CORNER
Coordinates: Not Available	Drilling Contractor: HANNIBAL TESTING LABORATORIES
Drill Make and Model: CME-55 CONT. FLT. HOLLOW STEM AUGER 7"ID, 3½" ID	Depth Top of Rock: 23.0 / Depth Casing & Size: --- / Hole Size: 7"
Elevation: 657.4 ft.	Angle from Vert. and Bearing: Vertical / Depth Bottom of Hole: 23.0
Water Level: 11' 6/9, dry 6/16	Fluid & Additives: None / Date Start: 8:00 6/9/88 / Date Finish: 10:30 6/9/88 / Logger: A. BENFER

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
							Asphalt 1", base 8"
		1.5					Silty Clay with gravel (40%), dark gray (2.5YR 4/0), moist, soft to stiff CL — FILL
		2.8	ST 01	16"	Hard Push 16"		- P.P. = 3.2 - Very stiff, angular gravel up to 2"
3.5' 6/9		3.0 4.5	SB 02	10"	2.12.10 22		- P.P. = 3.0
	5	4.5 6.0	SS 03	0	4.6.6 12		Clayey Silt, dark gray (10YR 4/1), moist, very stiff (3.0) ML — LOESS
		6.0 8.5	ST 04	22½"			Silty Clay, light gray (10YR 7/1) and strong brown (7.5YR 5/8) moist, very stiff (2.5), CL
		8.5 10.0	SS 05	18"	2.5.7 12		Trace gravel (< 5%) - P.P. = 3.5 — FERRELVIEW
	10	10.0 11.5	SS 06	20"	3.4.7 11		- P.P. = 3.0, wet at 11.0', moist at 11.5'
11' 6/9		11.5 13.0	SB 07	14"	3.4.7 11		Grading CH, P.P. = 2.6
		13.0 14.5	SS 08	20"	2.4.6 10		- P.P. = 1.75, stiff.
	15						? — CLAY TILL
							Trace of coarse sand and fine gravel (10%) 20.0
	20	19.0 20.5	SS 09	18"	5.8.13 21		Gravel, clayey (40%) mottled dark brown (7.5YR 3/4), and very pale brown (10YR 7/4) moist, medium dense. (Clay very stiff (2.5). GC gravel is chert. — RESIDUUM
	25						T.D. 23.0 auger refusal. 10:30 a.m., 6/9/88 Water cascading into hole at ~ 3½' Hole grouted with volclay.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 1
Project Number: MKE - 9423
Hole Number: GT-41 (GT-2B41)

Project: WSSRAP GT DRILLING	Location: NORTHWEST CORNER ADMINISTRATION BLDG. PARKING ARE
Coordinates: Not Available	Drilling Contractor: HANNIBAL TESTING LABORATORIES

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55 CONF. FLT. HOLLOW STEM AUGER 7" OD, 3½" ID	~22	---	7"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
655.9 ft.	Vertical	21.5'

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
2.85' 6/16/88	None	1:30 6/9/88	4:10 6/9/88	A. BENFER

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
							Asphalt 1", clayey gravel - angular 2" limestone
2.9' 6/16		1.5 3.0	SS 01	6"	4.3.4 7		Silty Gravelly Clay, very dark gray (5Y 3/1), moist, stiff (1.75), CL FILL
		3.0 4.5	SB 02	12"	3.4.8 12		4.5
	5	4.5 6.0	SS 03	14"	2.2.4 6		Silty Clay, yellowish red (5YR 5/6 - FeOx) and gray (10YR 5/1) moist, stiff to very stiff (2.0), black MnOx nodules. CL LOESS
.5' 6/9		6.0 7.5	SS 04	12"	1.2.2 4		Very silty, medium stiff to stiff (1.0)
		7.5 10.0	ST 05	33"			Silty Clay, gray (10YR 5/1) and minor yellowish red (5YR 5/6) Wet, medium stiff (.5-1.0) CL soft zone 6.5-7.0. Wet @ 6.5'
	10	10.0 11.5	SS 06	20"	1.3.4 7		- P.P. = 2.0 - stiff to very stiff, moist - 1.0-1.6 - Stiff
		11.5 14.0	ST 07	27"			FERRELVIEW Clay, mottled yellow brown (10YR 5/6) and gray (10YR 6/1), moist, very stiff (2.6) CH
	15						
	20	19.0 20.5	SS 08	12"	2.4.8 12		20.0 Silty Clay, sandy fine to coarse (15%), mottled yellow brown (10YR 5/6) and light gray (10YR 7/1) and black (MnOx) moist, very stiff (3.25) CL CLAY TILL Gravelly at 21.5. Residuum?
	25						T.D. 21.5 Auger refusal. 3:50 p.m. 6/9/88 Hole grouted with volclay

APPENDIX A-3

WSSRAP DISPOSAL CELL BOREHOLE LOGS
(GT-42 THROUGH GT-57)

A.3

WSSRAP DISPOSAL CELL
GEOTECHNICAL DRILLING

This report presents the procedures performed during the drilling, soil sampling, and coring of 16 exploratory borings made at the location of the proposed disposal cell, Weldon Spring Remedial Action Project (WSSRAP). Boring locations are shown on the accompanying Boring Location Plan. The investigation will provide geotechnical design parameters and help evaluate the suitability of the site for construction of a waste disposal facility. Direction for the drilling program was provided by the Department of Energy (DOE) document, Geophysical/Geotechnical Investigation Sampling Plan. The borings were placed along seismic refraction survey lines.

Drilling was conducted between June 21, 1988 and August 29, 1988 by Hannibal Testing Laboratories (HTL) under subcontracts WP024 (auger) and WP091 (coring). HTL employees Tom Clay and Terry Hemme performed as driller and driller's helper, respectively. Sample logging, documentation and drilling supervision was performed by Alan Benfer and Paul Patchin, alternately, both geologists employed by Morrison-Knudsen Engineers (MKE), Boise.

Prior to initiating the drilling, the drill rig and all drilling tools were thoroughly decontaminated with high pressure steam. Additionally, the rear of the rig and drilling tools were decontaminated between borings. Personal protective clothing consisted of cloth coveralls, gloves, safety boots with rubber boot covers, and hard hats. A Ludlum model 44 radiation detector was present at the boring location and was used to scan all soil samples and core for radiation. No samples displayed radiation above background levels.

All drilling personnel received the OSHA 40-hour hazardous waste safety training (29CFR 1910.120) plus site-specific WSSRAP radiation safety

instruction conducted by a site health physicist. All personnel wore thermoluminescent dosimitry (TLD) badges and provided entrance and exit urine samples.

Overburden (soil) drilling was accomplished with a CME-55 drill rig using continuous flight hollow-stem augers having an outside (O.D.) diameter of 6-5/8 inches and an inside (I.D.) diameter of 3-1/4 inches. The same rig performed coring of the bedrock.

Soil sampling was performed on 2-1/2 foot centers through the overburden. Disturbed soil samples were obtained using a 2.0-inch O.D., 1.5-inch I.D. Standard Penetration (SPT) sampler. SPT samples were placed in capped plastic jars. Relatively undisturbed samples were obtained using a California split-barrel sampler having an O.D. of 3.0 inches and I.D. of 2.5 inches. Four, 6-inch long, 2.5-inch I.D. brass liners were placed inside the California sampler. Each retrieved 6-inch liner was capped and taped. Both the SPT and California samplers were driven a depth of 18 inches beyond the lead auger using a 140-pound safety hammer free-falling 30 inches. The number of blows required to drive each 6-inch interval was recorded and the final two 6-inch drives were summed and expressed as blows per foot. Undisturbed samples were obtained by hydraulically pushing 3.0-inch diameter, 36-inch long steel shelby tubes to a depth of 30 inches. Upon retrieval, both ends of the tube were sealed with molten bee's wax, capped, and taped. Care was taken to maintain the tubes in a vertical position at all times.

Soils encountered were described in accordance with the Unified Soil Classification System. SPT and other selected samples were photographed. These photos, as well as the boring logs, accompany this report. Copies of field logs were sent to Ed Tom, San Francisco, on a weekly basis.

A daily diary was maintained documenting all drilling activities. Chain-of-custody forms were completed showing soil samples collected. All samples were stored on-site in building 404 and arranged in order collected to provide easy retrieval.

Soil sampling was continued to auger refusal at the top of bedrock. The hollow-stem augers were left in the hole to serve as casing and the boring was continued using a 10-foot NQ wireline corebarrel having a 2.98-inch diameter diamond impregnated bit, providing 1.875-inch diameter core. A split inner-barrel was used within the core barrel to maintain core integrity. Borings were typically cored 20 feet using clear water only. Water was transported from the site decontamination pad using a 750-gallon water truck.

Borings GT-53 and GT-57 were not cored, as deep core holes are proposed at these locations. GT-49 was not cored because rock information was available from a nearby corehole drilled by others.

The core was striped to maintain orientation and the footage was marked on the core. Selective portions of the core were photographed. Discontinuities were graphically recorded on the log and described. Penetration rate, water return, recovery, and RQD were recorded. Wooden blocks, marking core runs and estimated loss zones were placed within the core as it was boxed. Photographs were taken of the boxed core and accompany this report, as well as core logs.

All borings were abandoned by plugging with Volclay Grout manufactured by American Colloid Company. Volclay consists of a high-solids bentonite clay powder with a 4% added initiator which causes the grout to set up to a plastic consistency. Each 50-pound bag of Volclay was mixed with 23 gallons of clear water. The Volclay powder was jetted through a hopper into a tub and thoroughly mixed by circulating through the rig mud pump. Two pounds of initiator were added per 50-pound bag of Volclay. Once mixed, the grout slurry was pumped through the hollow stem augers, the augers were retrieved, and the hole topped-off.

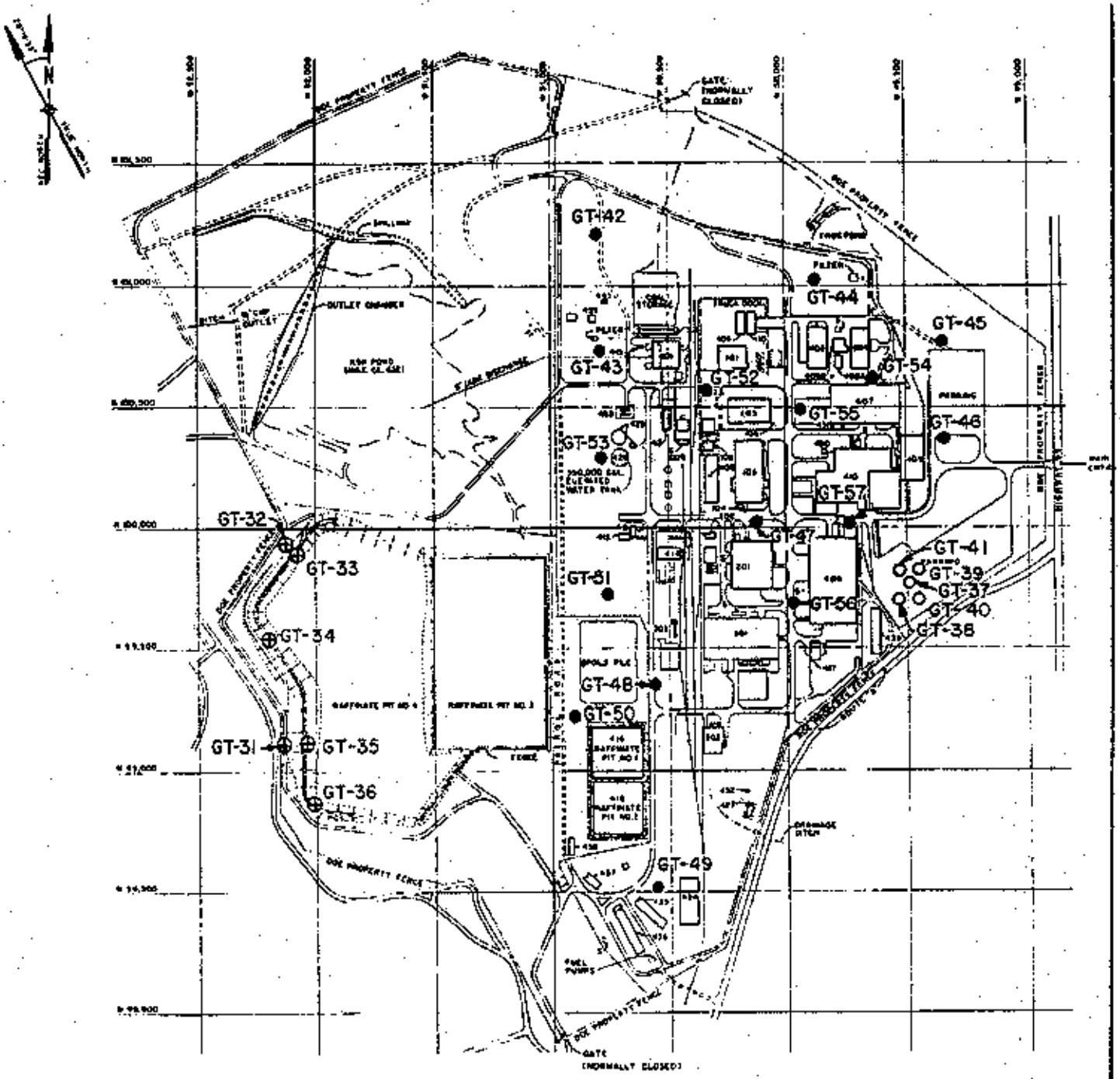
The cored holes took excessive grout into the fractured formation. To minimize takes, normally two bags were mixed and pumped into the hole and allowed to set overnight to seal the rock fractures. Grouting was typically completed the next day.

Upon completion of the disposal cell drilling, the drill rig, all drilling tools, and the water truck were decontaminated with high pressure wash prior to demobilizing the site.

HSSRAP GEOTECHNICAL DRILLING PROGRAM
BOREHOLE SUMMARY

Boring Number	North	West	Elevation	Started	Completed	Total Depth (ft)
GT-31*	99119.33	52130.81	634.5	06/01/88	06/02/88	34.0
GT-32*	99939.82	52126.54	643.7	06/06/88	06/06/88	24.0
GT-33*	99901.55	52078.99	665.4	06/07/88	06/08/88	50.5
GT-34*	99546.25	52202.09	665.0	06/10/88	06/13/88	54.5
GT-35*	99115.06	52039.30	665.6	06/13/88	06/15/88	54.0
GT-36*	98864.37	52006.51	664.5	06/15/88	06/16/88	47.75
GT-37*	--	--	657.0	06/02/88	06/03/88	24.0
GT-38*	--	--	657.7	06/03/88	06/03/88	26.5
GT-39*	--	--	656.7	06/03/88	06/06/88	22.5
GT-40*	--	--	657.4	06/09/88	06/09/88	23.0
GT-41*	--	--	655.9	06/09/88	06/09/88	21.5
GT-42	101205.99	50804.63	648.0	06/21/88	06/24/88	57.0
GT-43	100736.60	50786.06	654.2	06/24/88	06/30/88	78.5
GT-44	101030.75	49875.58	643.3	06/30/88	07/06/88	49.5
GT-45	100775.15	49344.17	645.0	07/06/88	07/08/88	41.5
GT-46	100364.80	49339.95	651.8	07/08/88	07/13/88	40.5
GT-47	100024.84	50128.92	660.3	07/13/88	07/15/88	55.5
GT-48	99353.04	50568.09	657.7	07/15/88	07/21/88	53.6
GT-49*	98517.34	50560.76	665.3	07/21/88	07/22/88	29.5
GT-50	99223	50905	653.8	07/22/88	07/27/88	55.5
GT-51	99725.91	50758.54	646.1	07/27/88	08/08/88	49.9
GT-52	100577	50335	658.8	08/09/88	08/12/88	70.2
GT-53*	100284	50781	655.5	08/12/88	08/16/88	42.5
GT-54	100618	49635	652.4	08/16/88	08/19/88	50.0
GT-55	100490	49937	655.6	08/19/88	08/24/88	53.0
GT-56	99689	49971	657.1	08/24/88	08/26/88	43.0
GT-57*	10017	49739	654.7	08/26/88	08/29/88	36.5

*Augered and sampled to bedrock; others cored 20 feet



LEGEND:

- PAVED ROAD (ASPHALT OR CONCRETE)
- GRAVELLED ROAD
- OLD ROADBED
- FENCE
- ELECTRICAL SUBSTATION
- ADMINISTRATION BUILDING BOREHOLE (LOCATION APPROXIMATE)
- RAFFINATE PIT NO. 4 DIKE BOREHOLE
- DISPOSAL CELL BOREHOLE / COREHOLE

200 0 200 400
SCALE FEET

MKE DOCUMENT NO 5121-C DW-D-01-0278-4

U. S. DEPARTMENT OF ENERGY
OAK RIDGE, TENNESSEE

CHEMICAL PLANT
CONSTRUCTION DRAWINGS

BORING LOCATION PLAN
GEOTECHNICAL DRILLING PROGRAM

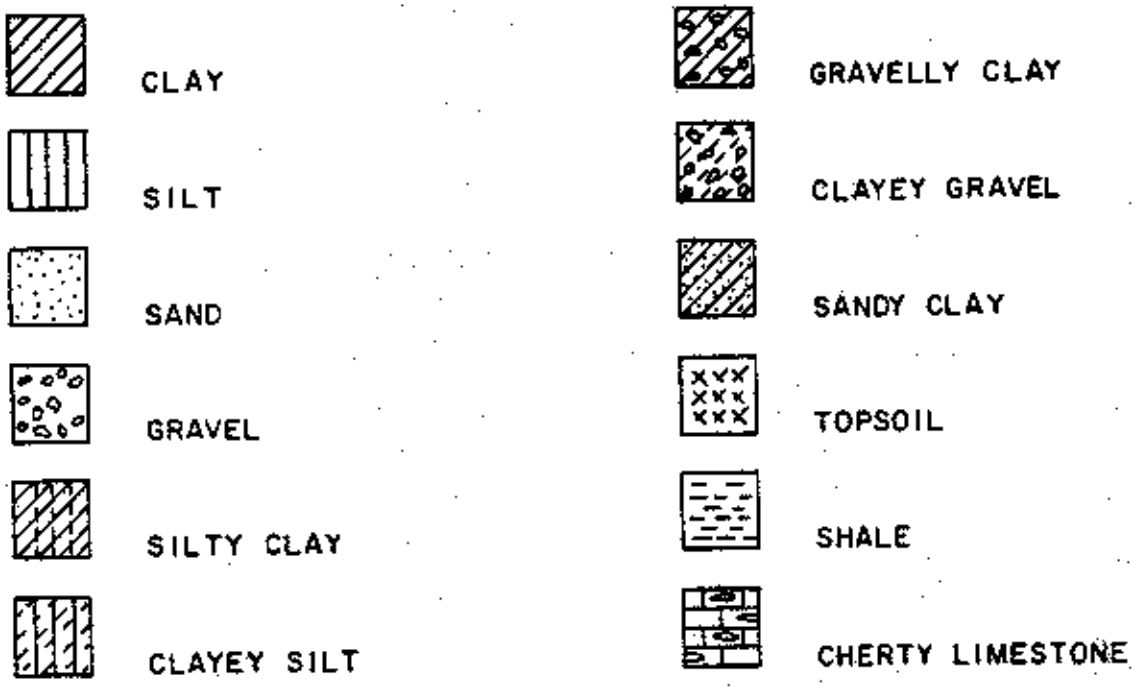
MORRISON-KNUDSEN ENGINEERS, INC.
WEBRA PROJECT

DE-AC05-86OR21548

5121E-CP-50E

GEOTECHNICAL BORING LOG LEGEND

SYMBOLIC LOG



SAMPLER DESIGNATIONS

SS = STANDARD PENETRATION SAMPLER (2.0" SPLIT SPOON)

SB = CALIFORNIA SAMPLER (3.0" SPLIT BARREL)
X = LINERS COLLECTED

ST = 3.0" SHELBY TUBE
P.P = POCKET PENETROMETER, UNCONFINED COMPRESSIVE STRENGTH (Tons/Sq.Ft.)

GROUNDWATER MEASUREMENTS

6.5'; 6/9 ▽ = DEPTH & DATE OF INITIAL WATER LEVEL MEASUREMENT

2.9'; 6/16 ▼ = DEPTH & DATE OF STABILIZED WATER LEVEL MEASUREMENT

COLORS

SOIL & ROCK COLORS FROM MUNSELL SOIL COLOR CHARTS

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 5
Project Number: MKE 9423
Hole Number: GT - 42 (GT-2B42)

Project: WSSRAP GT DRILLING	Location: INTERSECTION SEISMIC LINES 3 & 8
Coordinates: (AEC) 101206.0N 50804.6W	Drilling Contractor: HANNIBAL TESTING LABS
Drill Make and Model: CME-55, 7" HOLLOW STEM AUGER; CORE NO WIRELINE	Depth Top of Rock: 37.0
Depth Casing & Size: 7" AUGER 35.0	Hole Size: 7"/2.98"
Elevation: 648.0 ft.	Angle from Vert. and Bearing: VERTICAL
Depth Bottom of Hole: 57.0 FT.	
Water Level: NONE	Fluid & Additives: CLEAR WATER
Date Start: 8:20 6/21/88	Date Finish: 7:20 6/24/88
Logger: A. BENFER	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		.5 2.0	SS 01	1"	5.8.12 20		Silty Clay, pinkish gray (7.5YR 6/2) dry, hard (4.5+) CL contains roots
		2.0 3.5	SS 02	12"	8.10.13 23		Mottled brownish yellow (10YR 6/6) and light gray (10YR 7/1). P.P. = 4.5+
	5	4.5 6.0	SS 03	1"	5.8.7 15		FERRELVIEW
		7.0 8.5	SS 04	6"	4.5.6 11		Very silty Silty Clay, mottled yellow brown (10 YR 5/6) and light gray (10YR 7/1) moist, stiff (1.8) with trace of gravel (5%)
							CLAY TILL
	10	9.5 12.0	ST 05	28"			-P.P. = 4.5+ hard, with MnOx (black) and sandstone cobble
		12.0 13.5	SS 06	12"	3.6.11 17		-P.P. = 4.5+ with sand (10%) and fine gravel (15%)
	15	14.5 16.0	SS 07	10"	3.6.9 15		-P.P. = 3.7 very stiff
		17.0 18.5	SB 08	12"	10.23.25 37		-P.P. = 4.5+, hard
	20	19.5 21.0	SS 09	2"	5.15.23 38		-P.P. = 4.5+ Silty Clay, sandy (fine 20%), gravelly, weathered limestone (2.5Y 7/6) dry, hard.
		22.0 23.5	SS 10	13"	7.7.11 18		-P.P. = 4.0 very stiff, yellow brown (10YR 6/6) subrounded sand (20%) and fine gravel (5%) MnOx (black)
	25	24.5	SB		13.23.25		

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 2 of 5
Project Number: MKE 9423
Hole Number: GT - 42 (GT-2B42)

Project: WSSRAP GT DRILLING
Location: INTERSECTION SEISMIC LINES 3 & 8

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
		26.0	11	12"	37		- P.P. = 4.0
		27.0 28.5	SS 12	20"	4.5.9 14		- P.P. = 2.5 - 3.5 with stringers of $CaCO_3$ (white), subrounded gravel
	30	29.5 31.0	SS 13	0	3.20.27 47		Silty Clay, Sandy & gravelly (20%) hard lt. yellow brown (2.5Y 6/4) CL
							Gravel (Chert), clayey (20%), red (10R 5/6), and light gray, (10YR 7/1), dry, dense. GC. RESIDUUM
							Chert - heavy gravel 33.5' softer at 34' - layered
							auger refusal at 35.0'. Switched to 3" roller bit with water. Chert, red clay and minor limestone
							Boring continued with NQ core, 37.0' to 57.0', pages 3-5.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 3 of 5

Project Number: MKE 9423

Hole Number: GT - 42 (GT-2B42)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT DRILLING

Location: INTERSECTION SEISMIC LINES 3 & 8

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
37	Smooth No fluid return	NQ-1 1.1 1.3 85%		1	0	7	Loose, planar Rough recrystallized $CaCO_3$ horizonta Minor FeOx Staining		Limestone & 25% chert, light gray (10YR 7/2), medium grained, fossiliferous Very slight weathering, hard
38	1-1/3 hrs/8" 0 return	38.3 NQ-2 7.75		1	4.9 10	3 0	Joints mostly loose, non		Chert, gray (7.5YR 5/0) and light reddish brown (5YR 6/4)
39	28 mins/ft. 0 return	10.0 77.5%			49 %		Planar, rough same pyritic Mostly horizonta some slight		Cherty limestone, brownish yellow (10YR 6/8 - limestone) and white (5YR 8/1 - chert) with gray (7.5 YR 5/0 - MnOx)
40	7-1/3 mins/ft 0 return						angle. styolite, weak styolite tight		scattered pyrite, both fresh and oxidized. Hard, slightly weathered medium grained
41	10 Mins/ft 0 return					2	Tight		
42	4.5 mins/ft 0 return					2			
43	9 mins/ft 0 return					1			

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 4 of 5

Project Number: MKE 9423

Hole Number: GT - 42 (GT-2B42)

Project: WSSRAP GT DRILLING

Location: INTERSECTION SEISMIC LINES 3 & 8

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
	0 return					4+	Granulated zones crushed to sand to fine gravel size open 1"			
46										
						4+	"			
47	17 1/2 mins/ft						"			
	0 return					1				
48							+			
49	11 mins/ft	48.3 NO-3		2		3				
	0 return	7.75/8.7			7.35/8.7	0				
	3 mins/ft									
50	0 return	89%			84 %					
	2-1/2 mins/ft					2				
51	0 return									
	2-3/4 mins/ft					1				

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 5 of 5
Project Number: MKE 9423
Hole Number: GT - 42 (GT-2842)

Project: WSSRAP GT DRILLING
Location: INTERSECTION SEISMIC LINES 3 & 8

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
	0 return 4-1/2 mins/ft					0	1/2" granulated zone		
53									
	0 return					0			
54									
	0 return					0			Styolite 54.6'
55									Chert - 55.0 - 55.5
56									
	9 mins/ft								
57									
									T.D. 57.0 9:00 6/23
58									Grouted hole with 6 bags volclay grout

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 6
Project Number: MKE 9423
Hole Number: GT-43(GT-2B43)

Project: WSSRAP GT DRILLING	Location: Seismic line #3, Sta. 1+60
Coordinates: (AEC) 100736.6N 50786.1W	Drilling Contractor: Hannibal Testing Labs
Drill Make and Model: CME-55 7" hollow stem auger; core NQ wireline	Depth Top of Rock: 58.5
Depth Casing & Size: 7" auger 57.5	Hole Size: 7"/2.98"
Elevation: 654.2 ft.	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 78.5	
Water Level: None	Fluid & Additives: Clear water
Date Start: 8:20 6/24/88	Date Finish: 8:45 6/30/88
Logger: A. Benfer	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		0 1.5	SS 01	1"	5-5-6 11		Silty clay, very pale brown (10YR 7/4), dry, hard (4.5+) CL FeOx nodules
		1.5 3.0	SS 02	9"	4-7-5 12		-pp = 4.5+ Mottled, very pale brown (10YR 7/4) and dark gray (10YR 4/1)
							LOESS - ?
		4.0 5.5	SS 03	11"	2-4-5 8		5.5' very silty
		6.0 8.5	ST 04	31"			Silty clay, mottled yellowish brown (10YR 5/6) and light gray (10YR 7/1) and black (MnOx), moist, very stiff (3.0) CL FERRELVIEW
							Clay, highly plastic, mottled, brownish yellow (10YR 6/6) and light gray (10YR 7/1), moist, stiff (1.75) CH
	10	9.0 10.5	SS 05	15"	2-3-4 7		-pp = 2.2, very stiff, minor MnOx (black) FERRELVIEW
		11.5 13.0	SS 06	14"	2-3-5 8		Silty clay, w/10% fine to coarse sand and 5% fine rounded gravel (3/8"), mottled light yellowish brown (10YR 6/4) and light gray (10YR 7/1), moist, very stiff (2.2) CL-CH CLAY TILL
	15	14.0 15.5	SB 07	12"	2-7-11 18		-pp = 2.7 MnOx stringers, FeOx nodules
		16.5 18.0	SS 08	14"	3-5-6 11		-pp = 2.5 - 3.5
	20	19.0 20.5	SS 09	13"	2-4-8 12		-pp = 3.0-4.0, increase in fine gravel (15%) angular
		21.5 23.75	ST 10	31½"	Pushed 27"		-pp = 3.5
	25						

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 2 of 6
Project Number: MKE 9423
Hole Number: GT-43 (GT-2B43)

Project: WSSRAP GT DRILLING
Location: Seismic line #3, Sta. 1+60

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25	25.0 26.5	SS 11	17"	4-6-8 14		-pp = 2.7 gravel up to 3/4"
		27.5 29.0	SS 12	15"	4-7-9 16		-pp = 3.75-4.0 increase in coarse sand and fine gravel; approx. 25% igneous rock fragments, less MnOx
	30	30.0 31.5	SB 13	12"	4-10-18 28		Silty clay, sandy, fine to coarse (20% and fine gravel (10%), light yellowish brown (10YR 6/4), minor light gray (10YR 7/2) and black (MnOx), damp, hard (4.5+) CL-CH
		32.5 34.0	SS 14	12"	8-9-10 19		Cherty gravel at 32.5 -pp = 3.5, very stiff
	35	35.0 36.5	SS 15	16"	6-8-12 20		-pp = 3.5-4.0 - mostly light gray with small weathered FeOx nodules (yellowish brown), very silty
		37.5 39.0	SS 16	15"	5-9-9 18		-pp = 3.25 mottled yellowish brown (10YR 5/6) and light yellowish brown (10YR 6/4) and black (MnOx), angular chert gravel in tip
	40	40.0 41.5	SB 17	12"	4-8-21 29		very pale brown (10YR 7/3), stiff (1.0) with angular chert gravel (30%) very moist.
							41.0 gravel, angular chert (white) with silty clay, (40%) yellowish brown (10YR 5/6), moist, dense, GC. bottom 6" possibly disturbed. BASAL TILL - ?
	45	45.0	SS	1"	50/3"		Chert (8") yellowish brown (10YR 5/6), gravelly clay, layered BASAL TILL gravelly (chert) clay to clayey gravel
	50	50.0 51.0	SS 19	10"	13-30		Chert, highly fractured with clay (light red 2.5YR 6/8), moist, dense, GC -pp = 2.5 RESIDUUM
	55						

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 3 of 6

Project Number: MKE 9423

Hole Number: GT-43 (GT-2B43)

Project: WSSRAP GT DRILLING

Location: Seismic line #3, Sta. 1+60

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
		55.0	SS		8-6-4		Weathered chert highly fractured, clayey, yellow (10YR 7/6), very moist.
		56.5	20	10"	10		(lag gravel - ?)
							Auger refusal 57.5 10:50 6/27/88 hole continued with 3" roller bit
	60						Boring continued with NQ core 58.5' to 78.5', pages 4-6

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 4 of 6
Project Number: MKE 9423
Hole Number: GT-43 (GT-2B43)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT DRILLING
Location: Seismic line #3, Sta. 1+60

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
	Begin NQ Core	58.5							Limestone with chert
		NQ-1		1		3	Open (~¼") wide		Limestone, moderately weathered very pale brown (10YR 7/4)
59	0 water return smooth 6½ mins./ft.	3.6/4.5			1.75/4.5	5	Planar rough Minor calcite filling		Dissimated weathered pyrite 59.3-60.1 with 40% chert 60.1-60.7 - chert, fresh, hard light gray (10YR 7/1)
60	50% water return 13½ min./ft.	80%			39 %	3+	horizontal bedding		Loss estimated at 60.7-61.1 probably severely weathered limestone
61	50+% return 15 mins./ft.	LP = 6½"				2			61.6-62.3 - limestone as above, minor chert
62	31 mins./ft. 50+% return	63.0				3+	1" wide highly broken, severe weathering, sugary open, rough		62.3-66 - chert (as above)
63	50+% return 2+ hrs/ft	NQ-2 5.5/5.0 105%			4.3/5.5 78 %	1	Open (¼") rough, horizontal		Minor (15%) irregular lenses of very pale brown (10YR 8/3) limestone 63.0-64.0' - moderately severely weathered
64	50% return 1 3/4 hrs/ft					4	tight minor FeOx		
65									

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 5 of 6
Project Number: MKE 9423
Hole Number: GT-43 (GT-2B43)

Project: WSSRAP GT DRILLING
Location: Seismic line #3, Sta. 1+60

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
65	0 return 9 mins./ft.					3	vuggy, filled		65.5-66.0 - vugs in chert filled with limestone up to 1"
66	4 mins./ft.					1	tight tight		66.1-66.8 - interbedded chert, light gray and limestone very pale brown (10YR 7/4) 66.8-67.3 - very pale brown limestone
67	5½ mins./ft. 40% water	68.0				2	mechanical		67.3-68.0 - interbedded chert and limestone with disseminated FeOx
68	--	NQ-3 10.0/10.0	0	2	9.5/10.0	0			68.0-70.2 - marbled limestone (40%) very pale brown (10YR 7/4) and chert (60%), light gray (10 YR 7/1).
69	8 mins./ft.	100%			95%	0	both tight,		LS - slight weathering, disseminated oxidized pyrite grains. Marble structure to 78'
70	7 mins./ft.				LPs 46"	1	Planar, rough, horizontal		70.2-71.7 - Limestone, light brownish gray
71	7 mins./ft. 0 return					0			71.0-72.0 - Mostly chert 72.0-78 - 50% chert/limestone 71.7-78.0 - limestone, light gray (10YR 7/1),
72									

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project Number: MKE 9423

Hole Number: GT-43 (GT-2B43)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT DRILLING

Location: Seismic line #3, Sta. 1+60

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
72	7 mins./ft. 0 return					3	styolite, tight shaley		chert - light gray (10YR 7/0)
73	3½ mins./ft. 0 return					1	tight, rough, thin green clay film		73.6-73.8 - secondary calcite
74	2 mins./ft.					0			74.5 - ½" vug ringed with calcite X/S
75	1-3/4 mins./ft. 0 return					0			
76	2¼ mins./ft. 50% return					0			76.4-77.3 - mostly chert (bluish)
77	2½ mins./ft.					1	open (1/8"), rough, thin clay film mechanical		
78									78.0-78.5 - local calcite, strongly marbled
79									T.D. 78.5 7:17 6/29/88 78.0-78.5 - core bagged. No room in box.

Boring backfilled with 4½ bags volclay grout mixed with 23 gals. water per bag.

MORRISON-KNUDSEN ENGINEERS, INC.
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GEOTECHNICAL BORING LOG

Sheet 1 of 5

Project Number: MKE 9423

Hole Number: GT-44 (GT-2B44)

Project: WSSRAP GT Drilling	Location: Seismic Line #8, Sta. 10+20
Coordinates: (AEC) 101030.8N 49875.6W	Drilling Contractor: Hannibal Testing Labs

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55 7" hollow stem auger; core NQ wireline	29.5	7" auger 29.0	7"/2.98"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
643.3 ft.	Vertical	49.5

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
None	Clear Water	10:00 6/30/88	9:10 7/6/88	A. Benfer

Elevation	Depth Below Surface	Sample Interval	Sample Type & Number	Recovery	Standard Penetration Test Results 6"-6"-6" (N)	Symbolic Log	Soil Description (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		0 / 1.5	55 / 01	6"	2-5-8 / 13		Silty clay strong brown (7.5 yr 4/6', 5/8) and very pale brown (10 yr 8/3), damp, hard (4.5+) CL contains roots
		2.5 / 4.0	55 / 02	16"	2-4-6 / 10		--pp = 2.5, very stiff, moffled light gray (10 yr 7/1) and brownish yellow (10 yr 6/6), moist
	5	5.0 / 7.5	ST / 03	31"			FERRELVIEW
		7.5 / 9.0	55 / 04	13"	2-4-6 / 10		Silty clay w/20% sand, mottled strong brown (7.5 yr 5/8) and light gray (10 yr 7/1) moist, very stiff (3.5) CL-CH, FeOx --pp = 2.2
	10	10.0 / 11.5	55 / 05	14"	2-5-7 / 12		Silty clay w/40% sand, mostly coarse, trace gravel at 10'. Very sandy at 11.0 --pp = 3.6, 10% sand, MnOx stringer at 11.5 CLAY TILL
		12.5 / 14.0	SB / 06	12"	6-6-10 / 16		--pp = 1.0 - 2.0, stiff, 5% fine gravel (up to 1/2")
	15	15.0 / 16.5	55 / 07	13"	3-4-7 / 11		--pp = 2.5 - 2.75, very stiff, 10% sand, 5% angular gravel.
		17.5 / 19.0	55 / 08	15"	2-5-7 / 12		--pp = 3.2 igneous rock fragments CLAY TILL
	20	20.0 / 21.5	55 / 09	12"	4-28-40 / 68		20.5
		22.5 / 24.0	SB / 10	12"	17-28-14		Clayey angular chert gravel - clay brownish yellow (10 yr 6/6) to red 10R 5/6) chert - white (10 yr 8/1), moist, dense GC --pp = 3.0, predominantly clay - CH - very stiff (undisturbed samples) RESIDUUM
	25						

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 2 of 5

Project Number: MKE 9423

Hole Number: GT-44 (GT-2B44)

Project: ESSRAP GT Drilling

Location: Seismic Line #8, Sta. 10+20

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
		25.0	55	10"	11-15-18		Predominantly gravel (angular chert)
		26.5	11		33		
		27.5	55		7-14-13		As above
		29.0	12		27		29.0' auger refusal. Tricone bit at 29.0'
	30						Cuttings - weathered limestone with minor clay.
							Boring continued with NQ core 29.5' to 49.5', pages 3-5

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 3 of 5
Project Number: MKE 9423
Hole Number: GT-44 (GT-2B44)

Project: WSSRAP GT Drilling
Location: Seismic Line #8, Sta. 10+20

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
	Begin Core	29.5							
		NQ-1		1		3	Open (1/2") Rounded		
30	2-1/2 mins/ft	8.0 / 8.5			6.5 / 8.5	4	Open, gravel, all horizontal		Chert & limestone, approx. 50% each throughout run.
	0 return	94%			76%		Open (1/4") styolite, heated		
31	3-1/2 mins.					3	Open (1/4")		Limestone - white (5 yr 8/1) to very pale brown (10 yr 7/4)
	0 return								
32	3-1/2 mins					1	Tight		Chert - white (5 yr 8/1) to pale Red (10R 6/4). Limestone moderately weathered.
	0 return						Tight		
33	3-1/2 mins					2	Tight		
	0 return						Open		
34	3-1/4 mins					1			
	0 return						Tight		
35	3-1/2 mins					2	Tight Tight		35.9 - 36.1 Chert, open jugs (1/2") from 35.0 - 36.0 appears brecciated (healed), pinkish color
	0 return								

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 4 of 5
Project Number: MKE 9423
Hole Number: GT-44 (GT-2B44)

Project: WSSRAP GT Drilling
Location: Seismic Line #8, Sta. 10+20

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
	4-1/2 mins					3	Tight		
							Open, Shaley		
	0 return						Broken (1/2")		
37									37.4 - 37.7 - chert vuggy
							Open (1/8")		
							Mechanical		
	0 return	38.0							
38	3-1/4 mins.	NQ-2		2	6.7/10	5/0	Open		50% chert, 50% limestone
							Broken		Colors as above
	0 return						Broken		Limestone generally moderatel
39	3-1/2 mins	7.85/10.0			67%	0			Severely weathered 38.8 - 39.8 vuggy chert
	0 return								
40	Rod slap	79%				2	Calcite Filling, Open		Vuggy chert 41.3 - 41.8
	0 return								
41	2 mins.					2			
	0 return						Open, Soft		41.5 at loss. Limestone severely weathered, soft
42	1-3/4 mins			2					
	0 return								
43									

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 5 of 5
Project Number: MKE 9423
Hole Number: GT-44 (GT-2B44)

Project: WSSRAP GT Drilling
Location: Seismic Line #8, Sta. 10+20

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
	3-1/2 mins 0 return								43.7 - 44.6 - vuggy chert
44	4 mins 0 return					1	1-1/2" broken		
45	0 return					0			
46	0 return					0			46.4 - 46.6 - Weak, shaley Ls.
47	0 return	48.0				1	Tight		47.4 - 47.8 vuggy chert & severely weathered limestone, sandy
48	4 mins 0 return	NQ-3 1.45 1.50 97%		2	1.0 1.5 67%	0			48.0 - 49.0 Limestone, slight weathering 49.0 - 49.3 cherty Ls.
49							Tight Open, gray clay film		49.3 - 49.5 - vuggy chert T.D. 49.5 9:00 7/1/88 Hole grouted with 3 bags of volclay grout.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 4

Project Number: MKE 9423

Hole Number: GT-45 (GT-2B45)

Project: WSSRAP GT DRILLING	Location: SEISMIC LINE #1, STATION 7 + 70
Coordinates: (AEC) 100775.2N 49344.2W	Drilling Contractor: HANNIBEL TESTING LABS

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55, 7" HOLLOW STEM AUGER; CORE NQ WIRELINE	21.0	7" AUGER 21.0	7"/2.98"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
645.0 Ft.	VERTICAL	41.5

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
12', PERCHED	CLEAR WATER	10:20 7/6/88	9:00 7/8/88	A. BENFER

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		1.0 2.5	SS 01	1"	5.6.7 13		Silty Clay, mottled gray (10YR 6/1) and light yellow brown (10YR 6/3), minor MnOx (black), dry, hard (4.5+) CL Fill gravelly.
		3.5 5.0	SS 02	1"	3.5.5 10		P.P. = 4.5+
	5	5.0 6.5	SS 03	10"	3.5.6 11		6.0 Silty Clay, mottled gray (7.5YR 6/0) and light yellow brown (10YR 6/4), moist, stiff to very stiff CL Ferrelview?
		7.5	ST 04	21½"			CH - ?
	10	10.0 10.0 11.5	SS 05	13"	2.3.6. 9		P.P. = 2.75, very stiff, mostly light gray (10YR 7/1) minor FeOx, brownish yellow (10YR 6/6)
		12.5 14.0	SS 06	17"	2.2.4 6		P.P. = 2.2 CH, moist
	15	15.0 17.5	ST 07	31½"			FERRELVIEW Silty Clay, sandy (30%), fine to coarse trace fine rounded gravel, mottled light gray (10YR, 7/1) and yellow brown (10YR5/6) moist, very stiff (3.25), CH
		17.5 19.0	SS 08	18"	3.6.6 12		P.P. = 2.75, increase fine gravel gravel(15%) up to 3/4 rounded to angular considerable MnOx.
	20	20.0 21.0	SS 09	1"	15.36 51		CLAY TILL Limestone, fresh, white, hard
	25						Auger refusal @ 21.0' switched to 3" roller bit Limestone with some light brown clay. Rotary to 21.5' Switched to NQ core at 21.5', to 41.5', pages 2-4

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 2 of 4

Project Number: MKE 9423

Hole Number: GT-45 (GT-2B45)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT DRILLING

Location: SEISMIC LINE #1, STATION 7 + 70

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
	Begin Core	21.5							
22		NQ-1		1					Limestone, fresh, hard, crystalline, white
	4½ mins/ft 50% return	1.3/2.5			.55 2.5	3	Open, planar, rough, unweathered, vertical-weathered, eroded, rough.		
23									23.2 - 24.2 chert white (10YR 8/1) and light yellow brown (10YR 6/4).
	17½ mins/ft	52% LP=.55'			22 %	5+	Shattered		
24		24.0							
	5½ mins 75% return	NQ-2 2.1/4.0		1	0	3+	Open (1/8") Open (1/2") Broken (1")loose		24.2 - 25.1 Limestone, white slightly weathered, several ¼" vugs, weathered pyrite. 25.1 - 25.4 - limestone light
25									
	3 mins 0 return	53%			LP= 3.5"	4+	Broken, loose Broken, loose Broken, loose, (1/2") open		Yellow brown (10YR 6/4) moderate severe weathering, eroded. 25.4 - 25.6 white, moderate weathering 25.6 - 26.0 Limestone, white with 30% chert-yellow brown
26									
27									
		28.0							

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 3 of 4

Project Number: MKE 9423

Hole Number: GT-45 (GT-2B45)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT DRILLING

Location: SEISMIC LINE #1, STATION 7 + 70

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
28	3 mins/ft 0 return	NQ-3		1	2.6/10.0	4	Broken - Vertical Open (1/2")		28-29.15- chert, white (10YR 8/1), 1" vug
29	8 mins 0 return	5.5/10.0			26 %	4	Highly broken		29.6 - 30.0- chert & limestone moderate severely weathered.
30	8 mins 0	55%					Styolite, weak		30.55 - 31.0 - chert & limestone 1/2" shaley seam. Limestone very pale brown (10YR 7/4)
31	5 1/2 mins 0								31.75 - 32.0 Limestone very pale brown, fossiliferous.
32	4 mins 0								
33	3 mins 0	dropped							
34	7 1/4 mins 0			1		1+	Broken (1")		34.85 - 35.3 - Limestone, while slightly weathered. Disseminated MnOx

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 4 of 4
Project Number: MKE 9423
Hole Number: GT-45 (GT-2B45)

Project: WSSRAP GT DRILLING
Location: SEISMIC LINE #1, STATION 7 + 70

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
35	4 1/4 mins 0	55%			26 %	3	Open Open		35.3 - 36.3 - Limestone & chert. wavy structure. Limestone weathered 1/8" deep, 1" long
36	13 mins 0				LP= .75"	1	Open (½")broken Tight, thin FeOx		36.3 - 37.2 chert, white, bluish, pinkish.
37	19 mins 0					3	Open (1/16"), all		37.2 - 38.0 Limestone & chert interbedded.
38	6 mins 0	38.0 NQ-4 1.5/3.5		1	0 LP= .35	3	Open, rough, All planar		38.0 - 41.5 Limestone predominantly very pale brown (10YR 8/4) with
39	5 mins 0	43%				2	Open rough Open rough		Interbedded chert (@ 30%), gray (10YR 6/1). Limestone moderate severely weathered.
40	9 mins 0					4	Open rough		Vuggy Limestone (½") at 41.0
41							Open rough Open rough		T.D. 41.5' 1:45 7/7/88 Hole grouted with 4+ bags volclay

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 4

Project Number: NKE - 9423

Hole Number: GT-46 (GT-2B46)

Project: WSSRAP GT DRILLING	Location: SEISMIC LINE #1, STA. 3 + 55
Coordinates: (AEC) 100364.8N 49340.0W	Drilling Contractor: HANNIBAL TESTING LABORATORIES
Drill Make and Model: CME-55 7" HOLLOW STEM AUGER; CORE NQ WIRELINE	Depth Top of Rock: 20.0
Depth Casing & Size: 7" AUGER 20.5	Hole Size: 7"/2.98"
Elevation: 651.8 ft.	Angle from Vert. and Bearing: VERTICAL
Depth Bottom of Hole: 40.5	
Water Level: NONE	Fluid & Additives: CLEAR WATER
Date Start: 9:25 7/8/88	Date Finish: 8:00 7/13/88
Logger: A. BENFER	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		1.0 2.5	SS 01	3"	8.9.9 18		Silty Clay, mottled brownish yellow (10YR 6/6) and light gray (10YR 7/1), dry to moist hard (4.5+) CL, MnOx (black)
		2.5 4.0	SS 02	8"	5.6.7 13		- P.P. = 2.0, stiff to very stiff, moist, very silty
	5	5.0 7.5	ST 03	17½"			FERRELVIEW
		7.5 9.0	SS 04	16"	2.3.4 7		- P.P. = 2.2, very stiff, mostly light gray
	10	10.0 11.5	SS 05	18"	2.4.5 9		Clay, mottled, light gray (10YR 7/1) and yellow brown (10YR 5/6) and black (MnOx) moist, very stiff (3.3) CH
		12.5 15.0	ST 06	24½"			FERRELVIEW
	15	15.0 16.5	SS 07	18"	2.4.7 11		Silty Clay, with sand & fine gravel (5-10%) mottled yellow brown (10YR) and black (MnOx), minor light gray (10YR 7/1) moist, very stiff (2.8) CH
							- P.P. = 3.75, increase sand & gravel (20%)
		17.5 19.0	SS 08	14"	5.8.9 17		- P.P. = 4.5+ hard CLAY TILL
	20	20.0			Bouncing		Weathered Limestone Refusal 20.5' 1:10 7/8 Switched to NQ core at 20.5', to 40.5', pages 2-4
	25						

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 2 of 4
Project Number: MKE - 9423
Hole Number: GT-46 (GT-2B46)

Project: WSSRAP GT DRILLING
Location: SEISMIC LINE #1, STA. 3 + 55

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
20	Begin Core	20.5'							20.5-23.8
	75% return	NQ-1				1	All appear bedding open, rough, loose		Limestone, pinkish gray, (5YR 7/2) with thin (1/8") wavy
21	2" drop 0 water return	7.33 8.3		1	4.0 8.3	5	Open, rough, loose		Brownish yellow (10YR 6/6)
									Spaced 1/2" apart bedding, fossiliferous
22	9½ mins/ft.						Open (¼") rough		
7/8	8 mins/ft	88%			48 %	1	Open (¼") rough, shaley		Medium grained, slight weathering, 1" chert at 21.9
23	0 return						Open, rough, loose		1" soft mudstone at 22.4'
	10 mins/ft.				LP 0.6	2	Shaley		
	0 return						Open, rough, loose		23.8 - 28.8 - Limestone as above with disseminated
24	9 mins						Tight, shaley		oxidized phrite. Several
						5	Tight, shaley		thin mud seams (1/8" - ½")
	0 return						Tight, shaley		between 24.0 - 25.5
25	8 mins								Chert 24.8 - 25.0
						3	Tight, shaley		
	0 return						Tight		
26	7 mins					3	Both tight, shaley		26.4 - 1/4" mud seam
	0 return						All tight, shaley		

MORRISON-KNUDSEN ENGINEERS, INC.
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GEOTECHNICAL BORING LOG

Sheet 3 of 4
Project Number: MKE - 9423
Hole Number: GT-46 (GT-2B46)

Project: WSSRAP GT DRILLING
Location: SEISMIC LINE #1, STA. 3 + 55

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
27	17 mins 0 return					5	All tight, shaley		27.7 - 27.9 - chert
28	19 mins 0 return	28.8				2			28.4 - 1/2" soft mud seam
29	10 mins 0 return	NQ-2 9.7/9.7		1	8.0/9.7	2	Open (⅛") loose Open (1/8") loose		Mostly limestone, very pale brown (10YR 7/4) & (10YR 8/3) 50% chert 28.5 - 29.3 light gray (10YR 7/1)
30	10 mins 0 return	100%		30.8	82% LP=	1	30.2 - 31.5 - several styolites weak, some vertical Open (3/16")loose		29.3 - 31.4 - Limestone bedding 1/2" - 2" with several styolites.
31	24 mins 0 return			2	1.55' 10 > 4"	2	Tight, styolite Open (½") loose		31.5 - 33.7 - 40% chert
32	23 mins 0 return					1	Rough Broken (½")		32.4 - 33.2 - Disseminated oxidized pyrite. Thicker bedding up to 8".
33	22 mins/ft 0 return					3	Tight Tight shaley (1/16")		Thin, shaley partings (1/8") at 33.2, 33.8.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 4 of 4

Project Number: MKE - 9423

Hole Number: GT-46 (GT-2B46)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT DRILLING

Location: SEISMIC LINE #1, STA. 3 + 55

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
34 7/11	26 mins/ft 0 return	NQ-2				4	all open, 1/8" - 1/4", loose		Pyritic 34.2'; 34.4-styolites 34.7 - 35.0 - chert
35 7/8	4½ Mins/ft 0 return					1	Open, (¼") loose rough 35.5 - 36.5 styolites, weak, not broken		35.4 - 36.3 - 60% chert
36	5 mins/ft 0 return					1	Shaley (1/2") eroded		36.2 - 38.1 - more massive bedding, up to 8" 36.8 - 1/2" shaley seam
37	10½ mins 0 return					1	Tight, styolite		37.6 - 37.9 chert 38.1 - 38.4 - chert
38	60 mins 0 return	38.5		2		3	Tight, clayey(1/8") Tight Mechanical Open,loose,rough Open,loose,rough		Limestone throughout run is hard & slight weathering
39	10 mins 0 return	NQ-3 1.85/2.0			1.0/2.0	3	Sty,1/16" rough Open(¼") loose, rough Open(¼") loose, clay film		38.5-39.1 predominantly chert gray (7.5YR 6/0) 39.1-40.5 - predominantly limestone, hard Slight weathering, fossilferous
40		93%			50%	0			30% chert
4.									T.D. 40.5 9:45 7/12/88

LP= .5'
2 > 4"

Hole grouted 4+ bags volclay

MORRISON-KNUDSEN ENGINEERS, INC.
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GEOTECHNICAL BORING LOG

Sheet 1 of 5
Project Number: MKE 9423
Hole Number: GT - 47 (GT-2B47)

Project: WSSRAP - GT DRILLING	Location: SEISMIC LINE #6, STA. 1 + 35
Coordinates: (AEC) 100024.8N 50128.9W	Drilling Contractor: HANNIBAL TESTING LABORATORIES

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55, CONT. FLT. HOLLOW STEM AUGER; CORE DRILLING: NQ WIRELINE	35.3 FEET	35.5FT 3¼" I.D.	AUGER: 7" CORE: 2.98"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
660.3 FT	VERTICAL	55.5 FEET

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
	CLEAR WATER	9:20 7/13/88	1:35 7/15/88	A. BENFER P. PATCHIN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		0	SS	7"	7.13.15		Silty Clay with angular gravel and fine to coarse sand, predominantly pale brown (10YR 6/3), dry, hard CL, contains roots
		1.5	01		28		FILL
		2.5	SS	7"	7.7.6		Clayey Silt, mottled, light yellow brown (10YR 6/4), moist, very stiff (2.25), ML
		4.0	02		13		LOESS
	5	5.0	ST	27"			
		7.5	03				Silty Clay, mottled yellow brown (10YR 5/6), very silty and light gray (10YR 7/1) very plastic, moist, stiff (1.75), CL-CH
		7.5	SS	10"	1.3.5		-P.P.=2.0-2.75 - very stiff
		9.0	04		8		
	10	10.0	ST	6"	Pushed		-P.P.=2.75 - CH
		12.5	05		30"		FERRELVIEW
		12.5	SS	17"	2.3.5		-P.P.=2.25, mostly light gray, trace fine gravel to coarse sand, CH
		14.0	06		8		
	15	15.0	ST	0"	Pushed		-P.P.=2.5 very stiff
		17.0	07		24"		
		17.0	SB	12"	7.12.17		-P.P.=4.1, hard, 10% sand: grading
		19.0	08		29		
	20	20.0	SB	12"	3.9.16		Silty Clay with 25% sand, fine to coarse, mottled light gray (10YR 7/1) and light yellow brown (10YR 6/4) moist, hard (4.0-4.2), CH with MnOx (black)
		21.5	09		25		
		22.5	SS	15"	4.7.11		-P.P.=4.54, hard, trace fine gravel
		24.0	10		18		CLAY TILL
	25						

MORRISON-KNUDSEN ENGINEERS, INC.
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Sheet 2 of 5

Project Number: MKE 9423

Hole Number: GT - 47 (GT-2B47)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT DRILLING

Location: SEISMIC LINE #6, STA. 1 + 35

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		25.0 26.5	SB 11	18"	5.12.15 27		-P.P.=4.0-4.5, hard, increasing fine gravel (15%) subrounded
		27.5 29.0	SS 12	18"	4.5.9 14		-P.P.=4.2, hard, FeOx nodules, slickensides, fine gravel (angular chert) CLAY TILL
	30	30.0 31.5	SB 13	6"	3.11.20 31		Gravelly -P.P.=3.0-4.5 very stiff to hard with slickensides
		32.5 34.0	SS 14	15"	21.30.20 50		Clayey Gravel, mostly angular chert up to 1½", clay (30%) strong brown (7.5YR 5/6) CH, moist, medium dense, GC 33.0-34.0 mostly angular limestone ½" to 1" white (7.5YR 8/) RESIDUUM?
7/13 7/14	35	35.5	SB-15	0"	7.50		35.5' Drove 6" to refusal. Auger refusal @ 35.5'. GC as above with 3" chert gravel, sub-rounded with minor strong brown clay (7.5YR 5/6). Refusal at 6:30 a.m. 7/14/88.
	40						Hole continued with NQ core barrel. Cored from 35.5' to 55.5'. Core description on sheets 3 through 5.

MORRISON-KNUDSEN ENGINEERS, INC.
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GEOTECHNICAL BORING LOG

Sheet 3 of 5
Project Number: MKE-9423
Hole Number (GT-2847) GT-47

Project: WSSRAP Geotech Drilling
Location: Seismic Line #6, Sta. 1 + 35

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
35	Begin NQ Core	35.5							
36	75% water return	NQ-1		1			Completely fractured (vertical) rubbly		Limestone, light yellowish brn. (10YR 6/4) fine grained, wavy bedding.
37	13 minutes / ft. 50% return	2.8 / 8.3			1.8 / 8.3	3	Open rough, loose; Slightly weatherd; Open rough, loose		Slight weathering, fossiliferous, hard, cherty nodules and interbedded chert, very pale brown (10YR 8/3) throughout.
38	9 minutes / ft. 50% return	34%			22%	2	Mechanical; Tight, styolite; Tight, styolite		Laminar MnOx staining throughout, disseminated oxidized pyrite @ 36-36.5'& 37.3-37.5'
39	19 minutes / ft. 50% return		38.3		LP= L8'				Vertical MnOx dendrites
40	7 minutes / ft. -10% return 0% return				1 > 4"				
41	5 minutes / ft. 0 return								Lost water possible voids from 40.0-43.8
42	7 minutes / ft. 0 return								

MORRISON-KNUDSEN ENGINEERS, INC.
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GEOTECHNICAL BORING LOG

Sheet 4 of 5
Project Number: MKE-9423
Hole Number (GT-2B47) GT-47

Project: WSSRAP Geotech Drilling
Location: Seismic Line #7, Sta. 1 + 35

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
42–43	9 minutes / ft. 0 return								Soft
43–44	4 minutes / ft. 0 return	43.8	44.0						43.8-44.0? Chert, white (10YR) with limonite staining, hard, fossiliferous w/ vugs, minor $CaCO_3$
44–45	15 minutes / ft. solid 0 return	NQ-2 1.3/4.7	44.5 45.0	1	.5/4.7	3	vertical, tight		44.5-45.0? Chert, as above, slightly vuggy
45–46	4 minutes / ft. 0 return	28%			11%				45.0-46.0? soft possible voids
46–47	13 minutes / ft. 0 return		46.5		1 > 4"	1	tight, smooth		46.0-46.5? Chert, w/ weathered vugs, and minor clay infilling. Vug w/ re-crystallization at 46.3 (1")
47–48	5 minutes / ft. 0 return				L.P. .5'				46.2-46.5 rubbly, broken Soft
48–49	5 minutes / ft. 0 return	48.5 NQ-3		1					

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 5 of 5

Project Number: MKE-9423

Hole Number (GT-2847) GT-47

GEOTECHNICAL BORING LOG

Project: WSSRAP Geotech Drilling

Location: Seismic Line #6, Sta. 1 + 35

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
49	6 minutes / ft. 0 return	6.2'/7.0'			5.1'/7.0'	1	Open, rough, FeOx		Chert, white (10YR 8/2) 50% interbedded with Limestone (50%), brnsh yllw (10YR 6/6) to light yllwsh brn (10YR 6/4), altered and vuggy throughout. Limonite staining in joints and vugs. Chert is hard, L.S. is weathered and soft. Weathered pyrite blebs @ 49.8' and 52.3', vugs are elongated along bedding plane up to 1" long and 1/2" thick.
50									
51	7 minutes / ft. 0 return	89%	50.1 50.4		73%	2	Open, rough, loose minor FeOx staining; Open, ½ weathrd		
52	6 minutes / ft. 0 return				LP= 1.1'	3	Tight, weathered FeOx; Open rough, FeOx styolite, weak		MnOx @ 51.5' and 52.6'
53	6 minutes / ft. 0 return				7 > 4"				-- 52.5-55.0 Very weathered
54	5 minutes / ft. 0 return					1	Open, weathered, ¼"		Crumbly
55	7 minutes / ft. 0 return			54.9		3	Open, weathered, vuggy FeOx bleb 1"; Open, ½" weathrd; Tight, smooth		
	55.5			BAG 55.5		1	styolite, weak		
56									T.D. 55.5' @ 2:00 p.m. 7/14 Hole grouted with 7 bags volclay.

MORRISON-KNUDSEN ENGINEERS, INC.
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GEOTECHNICAL BORING LOG

Sheet 1 of 5

Project Number: MKE - 9423

Hole Number: GT - 48 (GT-2B48)

Project: WSSRAP GT DRILLING	Location: SEISMIC LINE #4, STATION 3 + 73
Coordinates: (AEC) 99353.0N 50568.1W	Drilling Contractor: HANNIBAL TESTING LABORATORIES
Drill Make and Model: CHE-55, 7" HOLLOW STEM AUGER; CORING: NQ WIRELINE	Depth Top of Rock: 33.6 FT.
Depth Casing & Size: 33.6 FT 3½"I.D.	Hole Size: 7" AUGER 2.98" CORE
Elevation: 657.7 FT	Angle from Vert. and Bearing: VERTICAL
Depth Bottom of Hole: 53.6 FT.	
Water Level:	Fluid & Additives: CLEAR WATER
Date Start: 7/18/88	Date Finish: 7/21/88
Logger: P. PATCHIN	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
					Auger		Augered to 2.5'. Dark gray silt with angular gravel, damp, ML FILL
		2.5 / 5.0	ST 01	25"			Silt, clayey, very dark gray (5Y 3/1), moist, stiff (1.5), ML
	5	5.0 / 6.5	SS 02	10"	2.3.4 7		Silty Clay, dark olive gray (5Y 3/2), very stiff (2.5) FeOx nodules, moist, CL FILL
		7.5 / 10.0	ST 03	28"			Silty Clay, gray (5Y 5/1) soft (.5) very moist, FeOx blebs, minor sand, 5%, very plastic, CH
	10	10.0 / 11.5	SS 04	14"	1.2.3 5		-P.P. = .75 moist, CH FERRELVIEW
		12.5 / 15.0	ST 05	25"			Silty Clay, mottled yellowish brown (10YR 5/6) and gray (10YR 6/1), gray fraction approx. 50%; comprised of silt, stiff (1.8), very moist to saturated, CL-CH
	15	15.0 / 16.5	SS 06	15"	2.3.4 7		-P.P.=2.1 very stiff, moist, CL-CH
		17.5 / 20.0	ST 07	30"			-P.P. = 2.75 moist, CL-CH FERRELVIEW
	20	20.0 / 21.5	SS 08	17"	2.3.6 9		-P.P. = 2.5 - 3.0 CL-CH. Driller felt gravel at 21.0 feet. Sampler did not retrieve any.
		22.5 / 25.0	ST 09	30"			Gravelly Clay, brownish yellow (10YR 6/6), with 10% fine gravel. igneous rock, some chert, very stiff, (3.0), silty, damp, CL CLAY TILL
	25						

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project Number: MKE - 9423

Hole Number: GT - 48 (GT-2848)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT DRILLING

Location: SEISMIC LINE #4, STATION 3 + 73

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		25.0 26.5	SS 10	14"	3.6.15 21		P.P. 3.5, silty, FeOx nodules. 26.0-26.5 sandy, very fine (40%), light gray (10YR 7/1), FeOx nodules and MnOx stringers CLAY TILL
		27.5 29.0	SB 11	6"	9.17.24 41		Clay, strong brown (7.5YR 4/6), FeOx nodules (5%), and MnOx veins, very stiff (3.5), CL
	30	30.0 31.5	SS 12	13"	7.17.13 30		Clayey Gravel, 50%, angular chert up to 1", and 50% clay, strong brown (7.5YR 4/6), abundant MnOx nodules (1/8"), and veins, hard (4.5-5.0), minor sandy pockets moist, GC RESIDUUM?
		32.5 33.6	SB 13	0"	7.15.50 75		As above, large angular chert and minor L.S., 70% angular chert up to 2", fossilferous. Drove 14"
	35						Auger refusal at 33.6' @ 1:15 p.m., 7/18/88. Begin NQ coring.
							Cored rock from 33.6' to 53.6'. Core descriptions on pages 3 through 5.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 3 of 5

Project Number: MKE 9423

Hole Number (GT-2B48) GT-48

GEOTECHNICAL BORING LOG

Project: WSSRAP GT Drilling

Location: Seismic line #4, Sta. 3 + 73

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
	Begin Coring 33.6'									
34	75% H_2O return	NQ-1	33.7	1					33.6-33.7 Chert, white (7.5 YR 8/) granular, broken	
35	5 minutes / ft. 50% H_2O return	2.8/8.4 33%			1.4/8.4 16%					
36	4 min. / ft. 50% H_2O return		35.4						35.0-35.4 Chert, pink (7.5 YR 7/4) varigated, pinkish-white (7.5YR 8/2) minor alteration, hard, MnOx veinlets	
37	7 min. / ft. 50% H_2O return		36.2 36.7			3	vertical, tight		36.0-36.2 As above, slightly altered and vuggy with $CaCO_3$ filling 36.7-37.0 L.S. light gray (10 YR 7/2) crystalline with chert from 36.8-36.9)	
38	5 min. / ft. 25% H_2O return		37.7				mechanical		37.7-38.0 Chert, light gray 10YR 7/1) rubblized, FeOx stain in fractures	
39	7 min. / ft. 50% H_2O return									
40	4 min. / ft. 25% H_2O return									

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 4 of 5
Project Number: MKE 9423
Hole Number (GT-2848) GT-48

Project: WSSRAP GT-Drilling
Location: Seismic line #4, Sta. 3 + 73

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
40	4 min. / ft.								40.5-51.1 Limestone, light gray (10YR 7/2), hard with weathered pyrite blebs & some chert, fossiliferous
	25% H_2O return		40.5			2	Tight, rough, cly Styolite.		
41									
	11 min. / ft.						Open, rough (½") with clay & FeOx		
	25% H_2O return					3			41.7-41.9 altered with FeOx and MnOx
42	Blocked off	42.0					Open ½" weatherd styolite		41.9-42.0 Chert, weathered
	5 min. / ft.	NQ-2		1	1.2/2.0		Healed		
	50% H_2O return	2.0/2.0			60%	3	Open, rough, cly weathered ½" vertical, healed		42.7-43.1 Chert, pinkish-gray (7.5YR 7/2), fractured —weathered 1" pyrite nodule
43									
	90 min. / ft.	100%			LP = .6' 3> 4"		Open, rough — vertical, healed		43.2-45.7 Chert, light gray (7.5YR 7/), fossiliferous, very hard, fractured, with minor limestone interbedded (20%)
	50% H_2O return					6	Open, rough — Open, smooth — Open, rubble, FeOx (2) vertical healed		
44		44.0							
	55 min. / ft.	NQ-3		1	2.3/4.1				
	50% H_2O	4.0/4.1			56%	2			- Fresh pyrite vug filling (1") at 44.6'
45									
	28 min. / ft.	98%			LP = 1.2' 4> 4"		Open, rough 1/8"		
	50% H_2O return					3	Open, smooth Open, rough, FeOx		45.7-48.4 mottled white (10YR 8/2) with FeOx nodules
46									
	7 min. / ft.						Open, rough, cly styolites (2)		46.0-48.0 brownish-yellow (10YR 6/8) mottled with 20% gray chert & FeOx blebs
	50% H_2O return					5	Rubble & clay 46.4-46.7 Tight, rough		46.4-46.7 Rubblized limestone & chert and light gray clay (5 YR 7/1) stiff, Cl
47									

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

Sheet 5 of 5

Project Number: MKE 9423

Hole Number (GT-2B48) GT-48

GEOTECHNICAL BORING LOG

Project: WSSRAP GT Drilling

Location: Seismic line #4, Sta. 3 + 73

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
48	15 min. / ft. 50% return					1	Open, rubblized Mechanical, rubblized		47.3-47.7 Fractured, & weathered, with FeOx staining and clay filling.
		48.1							
49	7 min. / ft. 50% return	NQ-4 2.7/3.0	48.8	1 2	1.8/3.0 60%	3	Open, 1/8" rough Styolites		48.4-50.4 Brownish-yellow (10YR 6/6) slightly weathered and vuggy. Interbedded with light gray (10YR 7/1) chert (30%)
50	10 min. / ft. 50% return	90%			LP = .8'	5	Open 1" weathered Styolites (3) weak Tight, rough		
51	37 min. / ft. 50% return				3 > 4"	6	Styolite, weak Open rough 2 Horiz. sealed 2 Vert. sealed Rubble		50.4-50.7 Chert grayish-brown (2.5YR 5/2) with FeOx blebs & stringers
		51.1							
52	25 min. / ft. 50% return	NQ-5 2.5/2.5		2	1.4/2.5 56%	5	Tight, smooth Vertical sealed Tight, rough		51.1-51.5 Marlstone, silty yellow (10YR 7/6) with 30% interbedded chert 51.5-52.1 Chert, very pale brown (10YR 7/3) with 20% marlstone
53	10 min. / ft. 50% return	100%			LP = .8' 2 > 4"	1	Open, rough		52.1-53.6 Marlstone as above, slightly calcareous with 20% interbedded chert, abundant MnOx specks?, silty
	53.6					1	Mechanical Open, rough		
									T.D. @ 53.6 3:05 p.m. 7/20 Hole grouted with 6 bags volclay.

MORRISON-KNUDSEN ENGINEERS, INC.
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GEOTECHNICAL BORING LOG

Sheet 1 of 2

Project Number: MKE 9423

Hole Number: GT - 49 (GT-2B49)

Project: WSSRAP GT DRILLING	Location: SEISMIC LINE #4, STA. 12 + 11
Coordinates: (AEC) 98517.3N 50560.8W	Drilling Contractor: HANNIBAL TESTING LABORATORIES
Drill Make and Model: CME-55 CONT. FLT. HOLLOW STEM AUGERS; CORING: NQ WIRELINE	Depth Top of Rock: 29.5 FT
Depth Casing & Size: 29.5FT. 3⅛"I.D.	Hole Size: 7"
Elevation: 665.3 FT	Angle from Vert. and Bearing: VERTICAL
Depth Bottom of Hole: 29.5 FT	
Water Level:	Fluid & Additives: CLEAR WATER
Date Start: 1:15 7/21/88	Date Finish: 12:30 7/22/88
Logger: P. PATCHIN	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		0.0 1.5	SS 01	11"	4.9.5 14		0-.3' Topsoil w/roots and gravel, clayey, Clayey Silt dark brown (10YR 3/3), dry,hard (4.5). FeOx blebs, brittle,ML
		2.5 4.0	SS 02	9"	3.6.9 14		-P.P.=4.5 yellowish brown (10YR 5/4) mottled, minor sand, damp, ML
	5	5.0 7.5	ST 03	23"			-P.P.-4.0 with light brownish gray, fine sand (25%) mottled, ML
		7.5 9.0	SS 04	15"	2.3.4 7		Clay, plastic, gray (10YR 6/1) slightly mottled, some slickensides, moist, stiff to very stiff (1.5-2.5), MnOx stringers, CH
	10	10.0 12.5	ST 05	19"			- P.P. = 2.5 less plastic, 5% very fine gravel (angular) minor sand-less than 5%, CL-CH
		12.5 14.0	SS 06	10"	2.4.6 10		-P.P.=3.0 CL FERRELVIEW
	15	15.0 16.8	ST 07	21"	Pushed 22"		Gravel at 16.0'
		17.5 19.0	SS 08	11"	4.8.11 19		Gravelly Clay, mottled, yellowish brown (10YR 5/8) and light gray (2.5Y 7/2) moist, silty, very stiff (3.0) gravel (Approx. 20%) up to ½" subrounded and angular, igneous, mafic, &quartz rock, MnOx, FeOx, CL
	20	20.0 21.5	SB 09	6"	12.20.28 37		Clayey Sand, brownish yellow (10YR 6/8), approx. 60% very fine sand, approx. 30% clay, 5% fine angular gravel, moist, hard (less than 5.0) MnOx blebs and stringers, SC
		22.5 24.0	SS 10	15"	7.11.13 24		-P.P.=3.5 abund. MnOx (black) 5% gravel, moist -P.P.=(3.5) Sandy Clay, FeOx nodules, with limestone gravel (weathered) and rounded chert gravel (5% total) MnOx, CL CLAY TILL
	25						

MORRISON-KNUDSEN ENGINEERS, INC.
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Sheet 2 of 2

Project Number: MKE 9423

Hole Number: GT-49 (GT-2849)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT DRILLING

Location: SEISMIC LINE #4, STA. 12 + 11

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
		25.0 26.5	SB 11	12"	5.14.21 28		Sandy Silty Clay - yellowish brown (10YR 5/6), dry, mottled, 5% sand, 5% L.S and chert gravel, hard (4.5) MnOx dendrites, CL
		27.5 29.0	SS 12	12"	4.9.12 21		-P.P.=4.5 - Damp, 20% sand, lignite blebs, silt, 10% fine gravel 29.5' T.D.
	30						Auger refusal at 29.5' at 7:30 a.m., 7/22/88 Hole grouted with 2+ bags volclay.

MORRISON-KNUDSEN ENGINEERS, INC.
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GEOTECHNICAL BORING LOG

Sheet 1 of 5
Project Number: MKE - 9423
Hole Number: GT-50 (GT-2B50)

Project: WSSRAP GT DRILLING	Location: SEISMIC LINE #5, STA. 2 + 91
Coordinates: (AEC) 99223N 50905W	Drilling Contractor: HANNIBAL TESTING LABORATORIES
Drill Make and Model: CME-55 7" HOLLOW STEM AUGER; CORE NQ WIRELINE	Depth Top of Rock: 35.5
Depth Casing & Size: 7" AUGER 35.5	Hole Size: 7"/2.98"
Elevation: 653.8 ft.	Angle from Vert. and Bearing: VERTICAL
Depth Bottom of Hole: 55.5	
Water Level: NONE	Fluid & Additives: CLEAR WATER
Date Start: 12:45 7/22/88	Date Finish: 9:20 7/27/88
Logger: A. BENFER	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		0.0 1.5	SS 01	11"	3.6.6 12		Clayey Silt, very dark grayish brown (10YR 3/2) roots ML
		2.5 5.0	ST 02	16"			Clayey Silt, light brownish gray (2.5Y 6/2) slightly mottled, moist, very stiff (2.75) ML
	5	5.0 6.5	SS 03	16"	2.5.7 12		- P.P. = 2.75 gray, light gray (10YR 6/1) FeOx blebs, sandy, moist LOESS
		7.5 10.0	ST 04	25"			Silty Clay, mottled gray (10YR 6/1) and yellowish brown (10YR 5/8) minor sand Moist, FeOx, blebs, very stiff (2.5) CL
	10	10.0 11.5	SS 05	14"	1.3.3 6		- P.P. = 2.0 - moist FERRELVIEW
		12.5 15.0	ST 06	27"			Gravelly Clay, yellowish brown (10YR 5/8) 10% fine angular and rounded chert gravel, very stiff (2.75) CL CLAY TILL
7/22 7/25	15	15.0 16.5	SS 07	16"	3.6.9 15		- P.P. = 3.5, 25% sand, MnOx, mottled yellow brown (10YR 5/8) and light gray (10YR 7/1)
		17.5 19.0	SB 08	12"	5.12.17 29		- 4.0 - 40% sand, minor gravel Grading
	20	20.0 21.5	SS 09	12"	7.7.8 15		Clayey (20%) Sand, non plastic, fine to coarse, 10% fine gravel, yellow (10YR 7/6) moist, medium dense (PP = 3.5) SC CLAY TILL
		22.5 24.0	SB 10	0	7.19.16		No recovery, medium dense Gravelly at 24'
	25						

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 2 of 5

Project Number: MKE - 9423

Hole Number: GT-50 (GT-2B50)

Project: WSSRAP GT DRILLING

Location: SEISMIC LINE #5, STA. 2 + 91

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		25.0 26.5	SB 11	6"	8.16.29 45		SB11 Sample disturbed, Placed in jar Clayey Silt, light gray (10YR 7/1) with yellow brown (10YR 5/8) moist, medium stiff to stiff, ML with MnOx, black
		27.5 29.0	SS 12	0	7.19.38		
	30						RESIDUUM
		30.25	SB 13	3"	50/3"		Gravel, angular chert, yellow brown (10YR 5/8), clayey (10%), red (2.5YR 4/8) moist, dense GC. Disturbed, Placed in jar.
		32.5 34.0	SS 14	6"	9.21.50 71		Clay matrix brownish yellow (10YR 6/6)
	35						
		35.0 36.0	SS 15	5"	3.50/5" 53+		Auger refusal 35.5' 11:20 7/25/88

Continued boring with NQ core 35.5' to 55.5', pages 3-5.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 3 of 5

Project Number: MKE - 9423

Hole Number: GT-50 (GT-2B50)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT DRILLING

Location: SEISMIC LINE #5, STA. 2 + 91

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
	Begin core	35.5							
	Lost water temp.	NQ-1				3+	Tight, smooth		35.5 - 36.2 - chert, brownish yellow (10YR 6/8) and light gray (10YR 7/1)
36	75% return 27 mins/ft.	3.70 / 8.0		1	1.7 / 8.0	3	Minor FeOx		
	75% return	46%			21%		Open (1") rough		36.2 - 37.35 - cherty (50%)
37	4-1/3 mins/ft. 75% return				LP= .56	1	pitted, eroded rough, weathered		Limestone, brownish yellow (10YR 6/8), light gray (10YR 7/1) and dark gray (10YR 4/1)
38 7/25	3½ mins/ft.					0			Moderate weathered, styolites one weathered 1/8" deep at 37.3 hard
7/26	75% return								
39	5½ mins 75%					1+	Highly broken		39.3 - 40.1 - Cherty (50%) Limestone (Yellow - 10YR 7/3)
40	3½ mins 75%					0			Chert light gray. Limestone vuggy - 1/4" deep; 1/2" wide moderately severely weathered
41	5 mins 75%					1	open (¼")		hard 41.75 - 43.5 - cherty (25%) Limestone (yellow 10YR 7/8)

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 4 of 5

Project Number: MKE - 9423

Hole Number: GT-50 (GT-2B50)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT DRILLING

Location: SEISMIC LINE #5, STA. 2 + 91

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
	4 mins						All open ¼" Rough, severely weathered, granular		Chert - white (10YR 8/1) Limestone moderate severely weathered. Vuggy ⅛" x ½"
43	75%					3			
	7 mins	43.5					Tight, styolite		1" dark brown chert nodule at 42.2' in vug.
	75%	NQ-2		1		2	Vugs ¼" - ½"Open rough		43.5 - 44.0 cherty (50%)
44	7½ mins	9.2/10.0			7.6/10.0				Limestone, vuggy (½"), moderately severe weathering. 44.0 - 53.5 - cherty (50%)
	75%					1	Open 1/16" rough		
45	9 mins	92%			76%	3	Tight		Limestone (brownish yellow 10YR 6/8), chert light gray.
	75%						Open ¼", rough		
46	12½ mins	LP= 2.0'				1	Open ¼"-1.0", rough		10YR 7/1) slight weathering
	13 mins						Open rough		Scattered pyrite. ½" oxidized pyrite nodules at 48.6.
47	75%					1			
	7 mins						Tight		
48	75%			1		1			49.8', 51.7' Chert & Limestone inter-bedded displaying a marble texture.
	5½ mins						Open ¼" rough		

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 5 of 5
Project Number: MKE - 9423
Hole Number: GT-50 (GT-2B50)

Project: WSSRAP GT DRILLING
Location: SEISMIC LINE #5, STA. 2 + 91

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
	75 + %			49.3 / 2			Open 1/8-1/4" Rough		Marble texture Overall rock quality fair to good
	11½ mins								
50	75 + %						Tight		
	8 mins					1	Styolite, weak		
51	75%								
	7 mins					0	Styolite, weak		
52	75%								
	16½ mins					2	Open ½", weathered, rough, granular Open 3/4", weathered, rough granular		
53	75%	53.5				1	Mechanical		53.5-54.6 - chert, light gray
	20 mins	NQ-3					3 - open ¼-½", rough		
54	75%	2.0 / 2.0			.55 / 2.0	4	3 - open ¼", smooth		54.6 - 55.5 - Limestone, minor chert. Yellowish brown. Moderate weathering. Finely disseminated pyrite!
	3½ mins				28 %		Open 1/8", rough		
55	75%	100%					Open ¼", rough		T.D. 55.5' 1:15 7/26/88 Hole abandoned with 3 bags of volclay grout.
56									

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 5
Project Number: MKE - 9423
Hole Number: GT-51 (GT-2B51)

Project: WSSRAP GT DRILLING	Location: 100' NORTH SPOIL PILE-SEISMIC LINE #9,STA.0+20
Coordinates: (AEC) 99725.91N 50758.54W	Drilling Contractor: HANNIBAL TESTING LABORATORIES

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55 7" HOLLOW STEM AUGER; CORE NO WIRELINE	31.0	7" AUGER 31.0	7"/2.98"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
646.1 ft.	VERTICAL	49.9

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
NONE	CLEAR WATER	9:30 7/27/88	12:00 8/8/88	A. BENFER

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		0 1.5	SS 01	6"	2.2.3 5		Clayey Silt, dark gray (10YR 4/1), moist, stiff to very stiff (2.0), ML. Upper 4' contains roots. LOESS
		2.5 4.0	SS 02	9"	3.6.7 13		Silty Clay, mottled, pale brown (10YR 6/3), yellow brown (10YR 5/8) and gray (10YR 5/1), damp, very stiff (3.5) CL. Some FeOx nodules.
	5	5.0 7.5	ST 03	30"			Slightly Silty Clay, mottled light gray (10YR 7/1) and yellow brown (10YR 5/6), moist, very stiff (2.75) CH.
		7.5 9.0	SS 04	14"	2.3.5 8		P.P. = 1.5
							P.P. = 2.7 stiff to very stiff
	10	10.0 12.5	ST 05	2"	Placed in Jar		P.P. = 1.5 - 2.5 FERRELVIEW
		12.5 14.0	SS 06	18"	2.5.6 11		P.P. = 2.75 - 3.0 with MnOx (black), slickensided very plastic. No silt, Trace of sand.
	15	15.0 17.5	ST 07	30"			Sandy (15%), silty clay, with 5% angular chert gravel (½"), mottled gray (10YR 6/1) and yellow brown (10YR 5/6) and black (MnOx), moist, hard (4.5) CH.
		17.5 19.0	ST 08	18"	2.6.9 15		P.P. = 3.0 very stiff - 15% chert gravel.
	20	20.0 21.5	SB 09	12"	4.10.14 24		20.5 CLAY TILL Gravelly Sandy Clay, chert gravel (white) clay red (2.5YR 4/6), moist, very stiff (3.3) CH grading to clayey gravel at 24'
		22.5 24.0	SS 10	12"	6.9.14 23		Clayey Gravel, angular chert (white) clay yellow brown (10YR 6/8), moist, medium dense, GC. RESIDUUM
	25						

MORRISON-KNUDSEN ENGINEERS, INC.
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GEOTECHNICAL BORING LOG

Sheet 2 of 5

Project Number: MKE - 9423

Hole Number: GT-51 (GT-2B51)

Project: WSSRAP GT DRILLING

Location: 100' NORTH SPOIL PILE-SEISMIC LINE #9,STA.0+2

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		25.0 26.5	SS 11	8"	13.18.7 25		As Above RESIDUUM
		27.5	SS 12	8"	2.5.11		P.P. = Mostly clay, less gravel, sandy FeOx nodules, stiff
	30	30.0 31.0	SB 13	6"	8,10 18		Silty, Gravelly (25% chert) Clay, mottled very pale brown (10YR 8/3) and yellow brown (10YR 5/8), moist, stiff (1.2) CL. Maybe highly weathered limestone. 1/4" lens of silty medium to coarse rounded sand at tip of shoe.
	35						Auger refusal 31.0 3:10 7/27/88 Boring continued with NQ core 31.0' to 49.9', pages 3-5

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 3 of 5
Project Number: MKE - 9423
Hole Number: GT-51 (GT-2B51)

Project: WSSRAP GT DRILLING
Location: 100' NORTH SPOIL PILE-SEISMIC LINE #9,STA.0+20

DEPTH	COMMENTS (TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION)	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION)	GRAPHIC LOG	LITHOLOGY (MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION; CEMENTATION HARDNESS WEATHERED STATE)
31	25 mins/ft.	31.0 / NQ-1		1	1.8 / 4.4				
32	100% return 23 mins/ft.	3.1 / 4.4			41 %	1	Open, rough Styolites, weak		32.0-32.1 chert, white (7.5YR 8/0) 32.1 - 33.8, cherty (25% limestone, chert white, limestone, yellow (10YR 8/6), slight weathering, hard
33	100% return 19 mins	70%			LP= 1.3	3	Styolite open 1/8", clay film Open ½", rough		33.4 - 33.8 1/4" oxidized pyrite nodules
34	100% return 26 mins					1			34.1 - 35.4 - chert, light gray (2.5Y 7/0). 34.3-34.55 shale, clayey, slickensided, gray (10YR 6/1)
35	100% return 38 mins	35.4 NQ-2		1			Open ½", rough vertical		35.1 - 35.2 gray clay 20° dip.
36	100% return 15 mins	0.5' / 8.0			0%				Chert, light gray (2.5Y 7/0) 6" recovered)
37	100% return 20 mins	6%							Loss zones unknown
38									

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 4 of 5

Project Number: MKE - 9423

Hole Number: GT-51 (GT-2B51)

Project: WSSRAP GT DRILLING

Location: 100' NORTH SPOIL PILE-SEISMIC LINE #9,STA.0+20

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
	100% return 25 mins									
39										
	100% return 14 mins									
40										
7/28	100% return 12 mins									
41										
7/29	100% return 50 mins									
42										
	100% return 18 mins									
43										
	100% return	43.5								
	15 mins	NQ-3		1						
44										
	100% return	0.18'/6.0		1	0%					
	8 mins	3%							Limestone cuttings at 45.5	
45										

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 5 of 5

Project Number: MKE - 9423

Hole Number: GT-51 (GT-2851)

Project: WSSRAP GT DRILLING

Location: 100' NORTH SPOIL PILE-SEISMIC LINE #9,STA.0+20

DEPTH	COMMENTS (TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION)	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION)	GRAPHIC LOG	LITHOLOGY (MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE)
	100% return 5 mins								Cherty (50%) limestone, marble texture.
46	Lost water @ 46' 7½ mins								Chert light gray (2.5Y 7/0) Limestone brownish yellow (10YR 6/8) slight weathering, hard.
47	0 return 8-3/4 mins								2" recovered - loss unknown
48	0 return 13 mins								NOTE: Approximately 2.2 feet of limy chert fragments recovered from core barrel. Depth anywhere from 35.4 to 49.9. Boxed, but not labeled.
49	0	49.5							
		NQ-4 0%		1	0				
50									T.D. 49.9 1:30 7/29/88 Hole grouted with volclay
51									

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 6

Project Number: MKE 9423

Hole Number: GT-52 (GT-2B52)

Project: WSSRAP Geotech Drilling	Location: Seismic Line #7, Sta. 3+59
Coordinates: (AEC) 100577N 50335W	Drilling Contractor: Hannibal Testing Laboratories

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55 7" Hollow Stem Auger; Coring: NQ Wireline	49.5'	49.5' 3¼ I.D.	Auger 7" Core: 2.98"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
658.8 ft.	Vertical	70.2 ft.

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
@ 27.5' @ 11:00am 8/9/88	Clear Water	6:25 8/9/88	10:30 8/12/88	P. Patchin

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	TYPE & NUMBER	RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		0.0 – 2.5			Auger		Augered through 1' of concrete, 6" of base rock, then 1' of very dark gray (10YR 3/1) clayey silt. ML FILL
		2.5 – 4.0	SS 01	3"	3.2.2 4		- P.P. = 2.5 dry, ML
	5	5.0 – 7.5	ST 02	12"			Clayey Gravel, up to 1" chert, angular, clay approx. 40%, gray (5Y 6/1), saturated, plastic GC
		7.5 – 9.0	SS 03	15"	1.3.4 7		Clay, light gray (5Y 7/1) plastic with FeOx nodules and MnOx dendrites, saturated, slickensides, stiff (1.75), CH
	10	10.0 – 12.5	ST 04	28"			- P.P. = 3.0 as above, mottled with brownish yellow (10YR 6/8) moist, CH FERRELVIEW
		12.5 – 14.0	SS 05	12"	2.4.6 10		- P.P. = 2.5 moist, mottled as above, slickensides CH
	15	15.0 – 17.5	ST 06	26"			Gravelly Clay, mottled brownish yellow (10YR 6/8) and light gray (5Y 7/1) gravel up to 3/8", angular chert, 5% sand, damp, hard (4.0) CH-CL
		17.5 – 19.0	SS 07	13"	5.8.10 18		- P.P. = 3.75 yellowish brown (10YR 5/8), 10% subrounded fine gravel (mafic, igneous), increased MnOx stringers, CL-CH
	20	20.0 – 21.5	SB 08	6"	8.13.16		- P.P. = 4.5 siltier, CL CLAY TILL
		22.5 – 24.0	SS 09	14"	3.6.10 16		- P.P. = 3.5, only slight mottling, sandy
	25						

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project Number: MKE-9423

Hole Number: GT-52 (GT-2B52)

GEOTECHNICAL BORING LOG

Project: WSSRAP Geotech Drilling

Location: Seismic Line #7 Sta. 3+59

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		25.0 26.5	SB 10	12"	8.16.20		- P.P. > 4.5, sandy (10%), silty (10%) limestone gravel up to 1½", damp, CL
Water @ 11:00 8/9/88		27.5 29.0	SS 11	16"	4.10.13 23		- P.P. = 4.5, light yellowish brown (10YR 6/4) horizontal and vertical partings and joints with heavy MnOx staining, sandy, damp to dry, CL
	30	30.0 31.5	SB 12	12"	5.13.20		- P.P. > 4.5 CL as above, some mottling CLAY TILL
		32.5 34.0	SS 13	17"	10.12.15 27		- P.P. = 2.25, chert gravel (10%), FeOx nodules
	35	35.0 36.5	SB 14	12"	6.22.31		Gravelly Clay, light brownish gray (2.5Y 6/2), with white (10YR 8/1) limestone nodules (30%) interbedded in matrix. Nodules very angular and cryptocrystalline. Very wavy bedding in clay. Disseminated $CaCO_3$ also, dry, hard (4.5), CL
		37.5 39.0	SS 15	0"	9.18.20 38		
	40	40.0 41.4	SB 16	9"	6.11.50 Drove 16		Gravelly Clay, 40% gravel, 60% clay, mottled dark yellowish brown (10YR 4/6) and red (2.5YR 4/6), large angular chert and weathered siltstone fragments up to 2", small to fine fragments also present, CL
		42.5 44.0	SS 17	16"	13.21.29 50		- P.P. = 2.0, fine gravel from 43.1-43.8 reddish yellow (7.5YR 8/6) oxidized
	45	45.0 46.5	SB 18	12"	1.40.35		- P.P. = 3.25, yellowish red (5YR 5/6), no L.S., MnOx stringers RESIDUUM 49.5'
	50						Auger refusal @ 49.5' at 2:45p.m. 8/9/88. Cored from 52.0' to 70.2'. Core description on pages 3 through 6.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 3 of 6

Project Number: MKE-9423

Hole Number: GT-52 (GT-2B52)

GEOTECHNICAL BORING LOG

Project: WSSRAP Geotech Drilling

Location: Seismic Line #7 Sta. 3+59

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
	No H_2O in hole @ start of tri-cone drilling								49.5'
50	100% H_2O return								Drilled with tri-cone bit. Cuttings were limestone very pale brown (10YR 3/3) and chert, white (10YR 8/1). Approx, 50% of each rock type.
51	100% return								
52	100% return								Begin NQ Coring
53	5 minutes/ft. 100% return	NQ-1 6.3/6.5 97%	52.2	1	5.0/6.3 79%	1	Rubble Tight, rough		52.2-52.4 Rubbly chert white (2.5Y N8/), weathered. 52.4-52.7 Limestone, very pale brown (10YR 7/4) to light gray (10YR 7/2) interbedded with 20% chert, white (2.5Y N8/), chert as nodules also.
54	6 minutes/ft. 100% return				7 > 4" LP = 2.0'	1	Styolite Tight, rough 25° Styolite		
55	10 minutes/ft. 100% return					3	Open, rough (2) rubble Open, smooth		54.7-57.4 Limestone and chert as above, 50/50
56	5 minutes/ft. 100% return					1	Open, rough		55.5-56.0 weathered and vuggy (limestone)

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 4 of 6

Project Number: MKE-9423

Hole Number: GT-52 (GT-2B52)

GEOTECHNICAL BORING LOG

Project: WSSRAP Geotech Drilling

Location: Seismic Line #7 Sta. 3+59

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
56		NQ-1		1			Open, ½" rubbly		
							Tight, rough		
	- Water return 50%	con't.							
						4	Styolite, weak		
	36 minutes/ft.						Tight, rough		
57							Tight, rough		--56.9-57.3 90% chert fossiliferous
	25% return								
						1	Open 3/4", rough		--57.4-61.6 Predominantly Limestone, as above with 10% chert, slightly weathered and silty, slightly vuggy, minor MxOx specks.
58	28 minutes/ft.								
	50% return						Open, rough		
		58.5							
		NQ-2		1		2			
59	12 minutes/ft.						Open, rough		
							Open, rough		
		4.2 / 4.5			.5 / 4.2		Tight, rough		
	50% return					3			
60	5 minutes/ft.	93%			12%		Styolite, weak		
							Open 3/4",clay		
							Open 1",clay		Clay seams, light brownish gray (2.54 6/1), silty, very stiff CL
	50% return				L.P		Open 3/4",clay		
					.5	>	Tight, rough		
					1	6	Tight, rough		60.6-63.0 Chert, light gray (7.5YR N7/) weathered and fractured with clay infilling of fractures, 10% limestone as above.
	6 minutes/ft.				>		Highly fractured w/clay filling		
61					4"				
							Rubblized		
	25% return						Tight, rough, cly		
							Tight, rough, cly		
			61.7			4	Rubble		
				2					
62	6 minutes/ft.								
	25% return		62.4				Tight,rough,cly		
						3			
	22 minutes/ft.								
63	blocked off		62.7				Rubble, clay		

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 5 of 6

Project Number: MKE-9423

Hole Number: GT-52 (GT-2B52)

GEOTECHNICAL BORING LOG

Project: WSSRAP Geotech Drilling

Location: Seismic Line #7 Sta. 3+59

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
63	75% return 11 minutes/ft.	NQ-3 1.0/1.0 100%		2	.3/1.0 30%	2	Open, rough Open, rough		63.0-64.0 Silty Limestone, yellow (10YR 7/6) slightly weathered with 10% interbedded chert as above. Abundant MnOx specks?
64	blocked off			LP 3					64.0-65.2 Chert (90%) light gray (7.5YR N7/), weathered limestone (10%) with clay infilling fractures.
65	75% return 8 minutes/ft.	NQ-4 2.5/2.5 100%		2	2.2/2.5 88%	3	Healed Tight, rough Open, rubbly weathered		
66	75% return 10 minutes/ft.					2	Tight, healed Tight, rough		65.2-66.0 Limestone, light gray (2.5Y 7/2)(60%) chert as above (40%) interbedded, only slightly weathered, slightly fossiliferous.
67	50% return 39 minutes/ft.	66.5 NQ-5 1.0/1.0 100%		2	0/1.0	2	Tight, smooth Rubble, fractured		66.0-66.7 Chert, hard mottled white (2.5Y N8/) and pale yellow (2.5Y 8/4). Healed fractures present, MnOx stringers, fossiliferous.
68	50% return blocked off 35 minutes/ft.	67.4 NQ-6 2.4/2.4		2	0% 0/2.4	3	Mechanical Open, rough Open, rough Open rough		66.7-69.4 Silty limestone, yellow (10YR 7/6) interbedded with white chert (20%) as above, abundant MnOx specks? Slightly weathered.
69	75% return 22 minutes/ft.	100%			0%	4	Open, smooth Open, smooth Tight, rough Open, rough		
70	75% return 42 minutes/ft.	69.8 NQ-7 100%		2	n/a	n/a	Tight, rough Rough, rubblized Tight, rough Tight, rough		69.4-70.2 Chert, light gray (7.5YR N7/), hard, minor limestone (10%) some clay in fractures.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 6 of 6
Project Number: MKE-9423
Hole Number: GT-52 (GT-2B52)

Project: WSSRAP Geotech Drilling
Location: Seismic Line #7 Sta. 3+59

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
70	75% return Bit wore out	NQ-8 100% 70.2		2	n/a				Chert as above	70.2
71									Total Depth 70.2' at 2:55 p.m. 8/11/88	

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 1 of 2

GEOTECHNICAL BORING LOG

Project Number: MKE-9423

Hole Number: GT-53 (GT-2B53)

Project: WSSRAP GEOTECH Drilling	Location: Seismic Line #3 Sta. 2+88
Coordinates: (AEC) 100284N 50781W	Drilling Contractor: Hannibal Testing Laboratories
Drill Make and Model: CME-55 7" Hollow Stem Auger; Coring: NQ Wireline	Depth Top of Rock: 42.5'
Depth Casing & Size: 42.5', 3¼' I.D.	Hole Size: Auger: 7" Core: 2.98"
Elevation: 655.5 ft.	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 42.5'	
Water Level:	Fluid & Additives: None
Date Start: 12:30 8/12/88	Date Finish: 8:35 8/16/88
Logger: P. Patchin	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0	0 1.5	SS 01	5"	4.3.2 5		Clayey Silt, dark grayish brown (10YR 5/2), with ang. gravel, roots to .3', very stiff (2.25) damp, ML
		2.5 4.6	ST 02	16"	Pushed 25"		Silty Clay, light brnsh gry (2.5Y 6/2) with ang. L.S. gravel to 2½", vry stiff (3.5), CL (Gravel at 4.6' for approx. .5') FILL
	5	5.0 6.5	SS 03	15"	3.3.5 8		Clay, yellowish brn (10YR 5/4) slightly silty, moist, plastic, very stiff (2.25), no gravel, minor MnOx strings and FeOx blebs. CL-CH
		7.5 10.0	ST 04	19"			Silty Clay, mottled light brnsh gray (2.5Y 6/2) and brnsh yellow (10YR 6/6), MnOx stringers and FeOx blebs abundant, moist, very stiff (2.25) CH
	10	10.0 11.5	SS 05	16"	3.4.6 10		-- P.P. = 2.25 CL-CH FERRELVIEW
		12.5 15.0	ST 06	22"			Clay, mottled lt gry (2.5Y 7/2) and strng brn (7.5YR 5/6), fine ang. grvl and sand (5%), plastic, moist, CH
/12/88 /15/88	15	15.0 16.5	SS 07	16"	6.9.10 19		-- Silty Clay, mottled lt gry (10YR 7/1) and brnsh yllw (10YR 6/6) slty (40%) very fine ang. grvl (3%) FeOx blebs and MnOx stringers, damp, CL-CH
		17.5 20.0	ST 08	21"			
	20	20.0 21.5	SS 09	13"	5.10.12 22		Gravelly Clay, brnsh yllw (10YR 6/8) damp with 10% sub-rnded to ang. grvl includ. igneous rx, minor lt gry sandy parts, vry stiff (4.0), CL -- P.P. 4.5 sandy (30%) fine, abund. MnOx, brnsh yllw (10YR 6/6)
		22.5 24.0	SB 10	12"	7.11.16 27		-- P.P. = 4.25 2" ang. chert and rounded mafic gravel, 20% fine sand CLAY TILL
	25						

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 2 of 2

Project Number: MKE-9423

Hole Number: GT-53 (GT-2B53)

GEOTECHNICAL BORING LOG

Project: WSSRAP Geotech Drilling

Location: Seismic Line #3 Sta. 2+88

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25.0	25.0 26.5	SS 11	14"	3.5.6 11		-- P.P. = 3.25 Sandy, CL CLAY TILL
		27.5 29.0	SB 12	12"	6.13.30		Silt, mottled light brnsh gry (10YR 6/2) and brnsh yllw (10YR 6/8) slightly clyey, no grvl, dry, stiff, (1.75) minor MnOx and FeOx blebs, ML
	30	30.0 31.5	SS 13	13"	8.12.12 24		Silty Clay, mottled yllwsh red (5YR 5/6) and light yllwsh brn (10YR 6/4), 30% silt, 5% fine grvl, FeOx blebs and MnOx stringers (minor), damp, hard (4.5) ML
		32.5 33.3	SB 14	6"	25.50 for 4"		32.5 - Clayey Gravel, grvl up to 2", chert, angular white, clay (30%) red (2.5YR 4/6) GC
	35	35.0 36.5	SS 15	12"	9.12.12 24		-- As above, clay is yllwsh brn (10YR 5/8) and red (2.5YR 4/6) silty, GC
		37.5 39.0	SB 16	12"	8.13.25		-- As above, approx. 50% clay, very stiff (3.0) moist, GC RESIDUUM
	40	40.0 41.5	SS 17	14"	12.20.17 37		-- As above, 30% clay some angular limestone, chert is white (2.5Y 8/) T.D. 42.5'

Auger Refusal at 42.5'
@ 1:20 p.m. 8/15/88

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

Sheet 1 of 5

Project Number: NKE-9423

Hole Number: GT-54 (GT-2B54)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT Drilling	Location: Thirteen Feet East of Seismic Line #7, Sta. 3+38
Coordinates: (AEC) 100618N 49635W	Drilling Contractor: Hannibal Testing Laboratories
Drill Make and Model: CME-55 7" Hollow Stem Auger; Coring: NQ Wireline	Depth Top of Rock: 30.0'
Depth Casing & Size: 30.0' 3¼" I.D.	Hole Size: 7" Auger 2.98" Core
Elevation: 652.4 ft.	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 50.0'	Water Level:
Fluid & Additives: Clear Water	Date Start: 8:55 8/16/88
Date Finish: 10:25 8/19/88	Logger: P. Patchin

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		0.0 1.5	SS 01	10"	10.8.4 12		Clayey Silt, with limestone gravel, yellowish brown (10YR 5/4), dry, hard (>4.0) roots, ML
		2.5 4.0	SS 02	12"	2.2.3 5		Clay, slightly silty, yllwsh brn (10YR 5/4) with L.S. grvl, very stiff (2.5) plastic, damp, CL-CH
	5	4.5 7.0	ST 03	19"			Silt, slightly clayey, olive gry (5Y 4/2), damp, hard,(>4.5) ML
		7.0 8.5	SS 04	9"	1.3.4 7		-- P.P. = 2.25 more clay (40%) ML FILL?
	10	9.5 12.0	ST 05	24"			-- P.P. 4.5 dark gray (5Y 4/1) roots, moist, (clay 10%) ML
		12.0 13.5	SS 06	12"	1.3.5 8		-- P.P. = 1.75 moist, ½" limestone gravel, moist, ML
	15	14.5 17.0	ST 07	26"			? ? ? Clayey Silt, olive gry (5Y 4/2) slightly mottled with yllwsh brn (10YR 5/8), FeOx blebs, damp, vry stiff (2.5), minor fine snd (3%) ML
		17.0 18.5	SS 08	11"	2.2.3 5		-- P.P. = 2.0 dark gry (5Y 4/1) chert gravel, angular, ML
	20	19.5 22.0	ST 09	13"			Silty Clay, olive gray (5Y 4/2) moist, soft (.5) some FeOx stain, 30% silt, CL-CH
		22.0 23.5	SS 10	10"	18" by rod wt.		-- Clayey Silt, dark gray (5Y 4/1), saturated, very soft (0.0), ML
							-- 23.8 Driller felt gravel
	25	24.5	SB 11		2.3.5		-----see next page----

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project Number: MKE-9423

Hole Number: GT-54 (GT-2854)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT Drilling

Location: Thirteen Feet East of Seismic Line #7, Sta. 3+38

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25	26.0	SB 11	12"	2.3.5		Silty Clay, very wet to saturated, olive gry (5Y 5/2) mottled with lt. gry (2.5Y 7/), 5% grvl up to ¼" and sandy pockets (3%), very fine, very soft (< .25) CH
		27.0	SS	14"	3.4.2		
		28.5	12		6		Clayey Silt, lt olive gry (5Y 6/2) with grvl (chert) up to 2", sndy, moist, ML
		29.5					30.0'
	30	30.2	SB 13	0"	5.50 for 3"		

Auger Refusal at 30.0' at 2:15 p.m. 8/16/88

Cored from 30.0' to 50.0'
Core description on pages 3 through 5

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 3 of 5

Project Number: MKE-9423

Hole Number: GT-54 (GT-2B54)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT Drilling

Location: Thirteen feet east of Seismic Line #7, Sta. 3+38

	DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
8/16 8/17	30	100% H_2O return	NQ-1 7.8/7.8		1	4.6/7.8	5	Rubble Open, rough		30.0-30.4 Chert, white banded, (5YR 8/1) very hard fossiliferous
	31	8 min./ft.				59%		Open, smooth Tight, rough Tight, rough		30.4-37.4 Limestone, very pale brn (10YR 7/4) bedded mod. hard, fossiliferous, with scattered slightly weathered pyrite blebs throughout; interbedded with banded chert and chert nodules (5%), white (10YR 8/), hard, fossiliferous
	32	100% return 9 min./ft.	100%			L.P = 1.1'	6	Tight, rough Tight, rough(2) Styolite,vry wk Open, rough Open, rough Tight, rough		
	33	100% return 12 min./ft.				9/4"	3	Tight, rough Styolites, (3) Tight, smooth Tight, smooth		Fractures generally have clay filling and/or are shaley
	34	75% return 14 min./ft.					2	Open, rough Open, rough		33.3-33.4 Very fossiliferous
	35	75% return 26 min./ft.					1	Styloites, (2) Styolite, weak Styolite, weak Open, rough		
	36	75% return 12 min./ft.					7	Styolite, weak Open, shaly Tight, shaly(3) Open, shaly Open, rough Tight, rough		Shaley 35.1-35.5
	37	75% return 34 min./ft.					3	Tight, rough Styolites,wk(2) Styolite, weak Open ¼" rough Open, rough Styolites (2)		

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 4 of 5

Project Number: MKE-9423

Hole Number: GT-54 (GT-2B54)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT Drilling

Location: Thirteen feet east of Seismic Line #7, Sta. 3+38

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
38	75% return 28 min./ft.	37.8 NQ-2		1		1	Tight, rough Open ½" smooth		37.4-38.1 Chert, white (10YR 8/1) with brnsh yllw (10YR 6/6) stylolites, very hard, fossiliferous, minor pyrite
39	75% return 20 min./ft.	4.0/4.7 85%			2.6/4.7 55%	2	Open, rough		38.1-38.7 Limestone, as before, very fossiliferous (crinoids) slightly bedded 38.7-39.1 Limestone, lt gry (2.5Y 7/2) hard, fossiliferous, (brachiopods?), massive, with sparse weathered pyrite specks
40	75% return 30 min./ft.			39.2/2	L.P = .85' >	4	Tight, smooth horiz. (3) Tight, smooth, vertical (1)		39.1-39.4 Chert, white (2.5Y N8/) very hard, very fossiliferous (brachs)
41	50% return 32 min./ft.				4"	4	Open, rubbly Multiple, rubble weathered		39.4-40.2 Limestone, as before 40.2-40.7 Chert, as before, fractured 40.7-41.8 Limestone, as before
42	75% return 11 min./ft.		41.8			1	Open, rough rubble		
43	75% return 17 min./ft.	42.5 NQ-3		2					
44		1.4/2.0 70%	43.1		1.0/2.0 50% 2 > 4"	2	Tight, rough Tight, rough		43.1-43.2 Chert, rubble, white (10YR 8/1) 43.2-43.4 Limestone, very pale brn (10YR 7/3), fossiliferous, with "coral-like" structure 43.4-46.6 Limestone (con't)

8/17
8/18

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 5 of 5

Project Number: MKE-9423

Hole Number: GT-54(GT-2B54)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT Drilling

Location: Thirteen feet east of Seismic Line #7, Sta. 3+38

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
44	75% return	44.5		2	L.P. .7	1			yellow (10YR 7/6) slightly bedded mod. hard, fossiliferous, slightly weathered, interbedded with 20% chert nodules, white (7.5YR N8/), fossiliferous, fractured, MnOx in fractures
45	15 min./ft.	NQ-4 3.7 / 3.7			2.4 / 3.7		Open 1/8" rough		
46	75% return 6 min./ft.	100%			65%	3	Styolites, weak Tight (3) weathered		--Soft
47	75% return 7 min./ft.					2	Tight, rough, shly Styolite, weak Tight, rough weathered		--46.6-50.0 Chert (60%) and Limestone, very weathered (40%) interbedded. L.S. is very vuggy and argillaceous
48	75% return 11 min./ft.					4	Open ¼", rough Open ¼", rough Tight, rough Open, rough Open, rough		
49	10% return 8 min./ft.	48.2 NQ-5 1.7 / 1.8	48.3	2	0%	4	Open, rough Tight, rough Open ½", rough weathered		As above only slightly weathered from 48.3-49.0 --48.6 Lost water circulation --49.0-50.0 Very weathered altered, rubbly, yellow (10YR 7/8)
50	50% return 4 min./ft.	94%				4	Open ½", rough weathered Open (3) rough, weathered		Regained water circulation at 49.1' 50.0'
									Total Depth 50.0' at 8:55 a.m. 8/18/88

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 5

Project Number: MKE 9423

Hole Number: GT-55 (GT-2B55)

Project: WSSRAP GEOTECH DRILLING	Location: Approx. 33' E. seismic line #2, Sta. 4+67
Coordinates: (AEC) 100490N 49937W	Drilling Contractor: Hannibal Testing Laboratories

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55 7" Hollow Stem Auger; Core: NO Wireline	33.0	3½" I.D.	7" Auger 2.98" Core

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
655.6 ft.	Vertical	53.0

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
	Clear Water	08/19/88	12:00 08/24/88	P. Patchin A. Benfer

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	TYPE & NUMBER	RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		0.0 1.5	SS 01	5"	3.7.11 18		Silt, very dark grayish brown, (10YR 3/2) with angular limestone gravel, roots 0.0-0.2'. Pale yellow (10YR 7/4)) at 1.4', dry. ML
		2.5 5.0	ST 02	20"			Silt, brown (10YR 5/3), slightly clayey, mottled with gray (10YR 6/1), damp to dry, hard (4.5) ML
	5	5.0 6.5	SS 03	12"	1.3.3 6		Clayey silt, yellowish brn (10YR 5/6), stiff (1:5), damp, ML LOESS
8/19 8/22		7.5 10.0	ST 04	19"			Silty clay, olive gray (5Y 5/2), moist, stiff (2.0) silt (40%) CL LOESS
	10	10.0 11.5	SS 05	12"	3.6.9 15		- P.P. = 2.0, less silt - P.P. = 3.0, very stiff, gray (5Y 6/1) and brnsh yellow (10YR 6/8), minor MnOx
		12.5 15.0	ST 06	25"			Clay, mottled light gray (10YR 7/1) and brownish yellow (10YR 6/6), moist - tip wet, very stiff (2.5), CH. FERRELVIEW
	15	15.0 16.5	SS 07	14"	2.4.5 9		- P.P. = 2.2, trace sand (< 5%), moist
		17.5 20.0	ST 08	20"			- P.P. = 2.75, mottled brownish yellow (10YR 6/6) and light gray (10YR 7/1) and black (MnOx). 10% sand and fine gravel.
	20	20.0 21.5	SS 09	18"	4.8.11 19		Silty clay, sandy (20%) and fine gravel (5%), mottled brownish yellow (10YR 6/6), light gray (10YR 7/1) and black (MnOx), moist, hard (4.5+). CL-CH
		22.5 24.0	SB 10	12"	5.9.12 21		- P.P. = 3.0, very stiff, 20% sand CLAY TILL
	25						

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 2 of 5

Project Number: MKE 9423

Hole Number: GT-55 (GT-2B55)

Project: WSSRAP GT Drilling

Location: Approx. 33' E. seismic line #2, Sta. 4+67

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		25.0 26.5	SS 11	18"	3.5.8 13		Silty Clay, sandy (15%), fine gravel 1/8-1/4" (15%), mottled brownish yellow (10YR 7/6), light gray (10YR 7/1) and black MnOx stringers, moist, very stiff (3.3). CH. FeOx nodules.
		27.5 29.0	SB 12	12"	4.11.16 27		Clay, 15% fine gravel (1/8" chert), mottled, red (10R 5/6), light gray (10YR 7/1) and minor black, moist, very stiff (3.5). CH
	30	30.0 31.5	SS 13	7"	4.31.30 61		- Gravel, (chert), clay matrix (25%) red brown (5YR 5/4), dense. GC. RESIDUUM
		32.5	SS 14	0	Rods Bouncing		T.D. 33.0 auger refusal 1:40 8/22/88
	35						Switched to NQ core at 33.0', to 53.0', pages 3-5
	40						

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 3 of 5

Project Number: MKE 9423

Hole Number: GT-55

GEOTECHNICAL BORING LOG

Project: WSSRAP GT Drilling

Location: Approx. 33' E. Seismic Line #2, Sta. 4+67

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
33	15 mins/ft 75% water return	33.0 NQ-1 4.25 5.75		1	3.2 5.75				
34	14 mins/ft 75% return	74%			LP 1.4 66%		Fragments		Fossiliferous throughout, calcite replaced 34.4-35.9, cherty limestone (50% chert). Limestone reddish yellow (7.5YR 7/6), chert pinkish white (7.5YR 8/2) thgoughout
35	8 1/2 mins/ft. 75% return					1	Slight angle, planar, tight Stylolite, tight clay film		
36	4 1/2 mins/ft 75% return					2	Stylolite, weak Stylolite, open 1/8", clay film Stylolite, tight		35.9-36-6 - Several stylolites; limestone 36.6-38. 75, cherty limestone, 40% chert
37	2 mins/ft Lost water at 37.3'					1	Stylolite, weak Stylolite, weak Open ½", rough, clay film		Chert purplish at 37' 37.6-38.4 - scattered oxidized pyrite nodules 1/8".
38	8 mins/ft 0 return	33.75 NQ-2				2	Stylolites, tight Open ½"		Overall rock quality good slight weathering, hard
39	5 mins/ft 0 return	5.5 9.25 59%		3.5 9.25 1	38%	1	Open 1/8", rough		39.0-40.3' Limestone, light brown (7.5YR 6/4) slight weathering, hard, minor oxidixed pyrite. 40.3-40.8 Chert, white (10YR 8/1)

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 4 of 5
Project Number: MKE 9423
Hole Number: GT-55 (GT-2B55)

Project: WSSRAP GT DRILLING
Location: Approx. 33' E. Seismic Line #2, Sta. 4+67

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
40	4½ mins/ft 0 return				LP 1.1'	2	Tight Open 1/8"		40.8-41.1 - Limestone
41	7 mins/ft 0 return					3			41.5-41.75 - White chert, fossiliferous
42	7½ mins/ft 0 return					3	Open 1/8", rough Tight		42.5-43.1 - Limestone, medium course grained, moderate weathering
43	5 mins/ft 0 return					4			43.35-43.5 - White chert 43.9 - 44.2 - White chert
44	4 mins/ft 0 return very fast from 44.5-45.5					1			44.6-44.75 - Course limestone
45	2½ mins/ft 0 return					3			45.1-45.2 - Course limestone moderate weathering 45.7-48.0 - Cherty, limestone, vuggy (½")
46	5½ mins/ft 0 return					4	Open 1/8", rough Open ¼", rough		Spaced 1-3"
47									

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 5 of 5
Project Number: MKE 9423
Hole Number: GT-55 (GT-2B55)

Project: WSSRAP GT DRILLING
Location: Approx. 33' E. Seismic Line #2, Sta. 4+67

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
47	4 mins/ft 0 return	48.0		1 2		1	Open ¼", rough		Overall rock quality fair NQ-2
48	7 mins/ft 0 return	NQ-3 4.6/5.0		2	3.5 5.0 70%	2	Open ½", rough		48.4-50.3 - Cherty limestone, minor chert, joints weathered 48.4-48.75 - vuggy ½"
49	6 mins/ft 0 return	92%			LP .8'	4	Tight Open ½", wthrd, rough Open ¼", rough, weathered		
50	4 mins/ft 0 return					3	Open ½", wthrd, rough Open ½", rough Open 1/8" Open 1", vug		50.3-51.1 - White chert 51.1-53.0 - Cherty limestone, minor chert
51	5 mins/ft 0 return					3	Tight Open ½", rough Tight		Overall rock quality 48.4-51.9 - Fair 51.9-53.0 - Good
52						1	Open 1/8"		Less fossiliferous than NQ-1, NQ-2
53									T.D. 53.0' 11:55 8/23/88 Grouted hole with 9 bags volclay.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 4

Project Number: MKE 9423

Hole Number: GT-56 (GT-2B56)

Project: WSSRAP GT DRILLING	Location: Seismic Line #2, Sta. 3+33
Coordinates: (AEC) 99689N 49971W	Drilling Contractor: Hannibal Testing Laboratories

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55 7" Hollow Stem Auger; Coring: NQ Wireline	23.5'	7" Auger	7"/2.98"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
657.1 ft.	Vertical	43.0

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
None	Clear Water	12:15 8/24/88	9:00 8/26/88	A. Benfer

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
							8" concrete, 12" base rock
		2.5 4.0	SS 01	14"	3.3.4 7		Clayey Silt, mottled gray (2.5YR 6/0) and reddish yellow (7.5YR 6/8), moist, stiff to very stiff (2.0), ML. Minor organics
	5	5.0 7.5	ST 02	29"			LOESS - P.P.=2.3, very stiff, reddish yellow and brownish yellow (10YR 6/6).
		7.5 9.0	SS 03	14"	1.3.5 8		8.0 Silty Clay, mottled brownish yellow (10YR 6/6) and light gray (10YR 7/1), moist, very stiff (2.75), FeOx nodules. CL CH at 8.5', minor black MnOx.
	10	10.0 12.5	ST 04	24"			FERRELVIEW - P.P.=2.2, CH
		12.5 14.0	SS 05	18"	2.4.6 10		Clay, mottled light gray (10YR 7/1) and brownish yellow (10YR 6/6), moist, very stiff (2.2), very plastic, MnOx, trace angular ¼" gravel. CH
	15	15.0 17.0	ST 06	22"	Pushed 24"		- P.P.=4.0, hard, 15% sand, 5% angular fine gravel, MnOx stringers
		17.0 18.5	SS 07	17"	4.5.7 12		- P.P.=3.5, very stiff, 15% gravel CLAY TILL
	20	19.5 21.0	SB 08	12"	6.7.13 20		20.75 Clay, very plastic, mottled brownish yellow (10YR 6/6) and light gray (5Y 7/1) with black MnOx stringers, moist, very stiff (3.75), CH
		22.0 23.5	SS 09	11"	2.3.10 13		22.0 Silty Clay, sandy (20%), fine gravel (15%) brownish yellow (10YR 6/6) and black with MnOx nodules, moist very stiff (2.5), CH. Chert gravel in shoe.
	25						

T.D. 23.5' Auger refusal 2:45 8/24/88
Boring continued with NQ core 23.5' to 43.0', pages 2-4

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 2 of 4
Project Number: MKE 9423
Hole Number: GT-56 (GT-2B56)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT DRILLING
Location: Seismic Line #2, Sta. 3+33

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
	Begin core	23.5 NQ-1		1					
24	3¼ mins/ft 75% water return	5.9/10.0 59%			4.0/10.0 40%				24.95-25.15 - Limestone, light gray (10YR 7/1), slight weathering, hard
25	4½ mins/ft 75% return				LP 1.7'	3+	Open 1", rough Rough		25.9-26.2 - Leimstone, moderate weathering, limonite stain
26	4 mins/ft 75% return					3+	Rough 1" fragments, weathered Rough		26.9-28.55 - Limestone, yellow (10R 7/6), some styolites, slight weathering, hard 26.9-27.7 - Up to 1" vugs
27	15½ mins/ft Lost water at 26.5'					3	Open ½", rough, eroded Styolite, weak Open 1/8", shaley both tight		27.9-28.1 - Strong limonitic stain
28	5¼ mins/ft o return					3	Rough		
29	4½ mins/ft o return						Open 3/4", rough		29.7-33.4 - Limestone, white (10YR 8/2), styolites, scattered oxidized pyrite, (con't)
30									

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 3 of 4
Project Number: MKE-9423
Hole Number: GT-56 (GT-2B56)

Project: WSSRAP GT DRILLING
Location: Seismic Line #2, Sta. 3+33

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
30	5½ mins/ft 0 return					0	Styolites, weak		crystalline. Rock quality good, slight weathering, hard
31	8¼ mins/ft 0 return					1	Tight, shaley		31.15 - ½" limonitic shaley zone, also at 31.9
32	7½ mins/ft 0 return					1	Styolite, weak		Calcite fossils scattered throughout run
33	13 mins/ft 0 return	33.5 NQ-2 3.0		1	1.5 9.5		Open ½", shaley clayey Open ¼", clayey rough, clayey		
34	8½ mins/ft o return	9.5 32%			16% LP .55'				
35	6 mins/ft 0 return								
36	6 mins/ft 0 return								
37									

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 4 of 4

Project Number: MKE 9423

Hole Number: GT 56 (GT-2B56)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT DRILLING

Location: Seismic Line #2, Sta. 3+33

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
37	15 mins/ft 0 return								37.8-38.25 - Limestone fragments-1". Limestone throughout NQ-2 is white (10YR 8/2).
38							Styolite, weak ½" clay seam 3" clay seam		Scattered oxidized pyrite throughout NQ-2 Clay seams are light gray (10YR 7/1) clay shale, very weak
39									Styolites at 39.6 and 40.8
40	10 mins/ft 0 return						Styolite, weak		Overall rock quality NQ-2 is fair. Moderately weathered.
41	5½ mins/ft 0 return								
42	19 mons/ft 0 return								42.2-43.0 - Limestone fragments 1-2"
43									T.D. 43.0' 2:00 8/25/88 Hole grouted with 4 bags volclay
44									

MORRISON-KNUDSEN ENGINEERS, INC.
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GEOTECHNICAL BORING LOG

Sheet 1 of 2

Project Number: MKE 9423

Hole Number: GT-57 (GT-2857)

Project: WSSRAP GT DRILLING	Location: Seismic Line #6, Sta. 2+61
Coordinates: (AEC) 100017N 49739W	Drilling Contractor: Hannibal Testing Laboratories

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55 Hollow Stem Auger	35.0	None	7"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
654.7 ft.	Vertical	36.5

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
None	None	9:40 8/26/88	9:30 8/29/88	A. Benfer

Elevation	Depth Below Surface	Sample Interval	Sample Type & Number	Recovery	Standard Penetration Test Results 6"-6"-6" (N)	Symbolic Log	Soil Description (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
							Asphalt and base rock 1.0'
							Silty Clay with fine gravel, dark olive gray (5Y 3/2), moist (stiff), CL FILL
		2.5 5.0	ST 01	26"			Clayey Silt, mottled gray (5Y 5/1) and yellow brown (10YR 5/6), moist, very stiff (2.75), ML LOESS
	5	5.0 6.5	SS 02	14"	2.3.3 6		6.0 Silty Clay, gray (5Y 6/1) and dark gray (5Y 4/1), very moist, medium stiff (0.75), CL LOESS
		7.5 10.0	ST 03	25"			- P.P.=2.75 Light brownish gray (10YR 6/2), very stiff
	10	10.0 11.5	SS 04	15"	3.4.7 11		- P.P.=2.2 Mottled light brownish gray (10YR 6/2) and yellow brown (10YR 5/6), no MnOx, CL-CH. LOESS-?
		12.5	ST 05	30"			Silty Clay, mottled brownish yellow (10YR 6/6) and gray (10YR 6/1), moist, very stiff (2.5), no MnOx, CH
	15	15.0 15.0 16.5	SS 06	15"	2.4.7 11		- P.P.=3.2
		17.5 19.0	SB 07	12"	5.11.15 26		- P.P.=3.5, 10-15% sand, MnOx FERRELVIEW
	20	20.0 21.5	SS 08	14"	2.4.5 9		Silty Clay, 10% sand, mottled brownish yellow (10YR 6/8) and light gray (10YR 7/1) with black MnOx stringers, moist, very stiff (3.0), CH FERRELVIEW-?
		22.5 24.0	SB 09	12"	4.8.16 24		- P.P.=4.5+, hard no sand, slickensided
	25						

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 2 of 2
Project Number: MKE 9423
Hole Number: GT-57 (GT-2B57)

Project: WSSRAP GT DRILLING
Location: Seismic Line #6, Sta. 2+61

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25	25.0 26.5	SS 10	16"	4.6.11 17		- P.P.=3.75, very stiff, no sand, angular chert gravel on tip 26.5
		27.5 29.0	SB 11	4"	7.16.24 40		Gravel of angular chert with clay matrix, yellowish brown (10YR 5/6) and black, MnOx, CH, moist, dense, GC. One partial liner
	30	30.0 31.5	SB	6"	15.25.27 52		- P.P.=3.0 - P.P.=2.75, angular chert gravel as above. One partial liner.
		32.5 34.0	SB 13	12"	12.13.50/3" 63+		- P.P.=2.25, clay matrix RESIDUUM 35.0
	35	35.0 36.5	SS 14	12"	7.34.50/5" 84+		Clay Shale, highly fissile, light gray (10YR 7/1), dry, hard. Some FeOx and MnOx staining.
							T.D. 36.5' 1:55 8/26/88 Hole grouted with 3 bags volclay.

APPENDIX A-4

ON-SITE TEST PIT LOGS
(GT-2T71 THROUGH GT-2T82)

LOG OF TEST PIT GT-2T71

A-4

- Location: 50 feet plan east of southeast corner of parking lot east of building 409
- Type of excavator: Cat 416 extendable backhoe (new)
- Start excavation: 12:35 p.m. 07/12/88
- Finish excavation: 1:05 p.m.
- Finish backfilling: 2:00 p.m.
- Finish decontamination: 2:30 p.m.

Depth, Feet		Description
0-0.5	CL	Silty Clay: Dark yellowish-brown (10YR4/6); 10-15% fine sand; moist; medium plasticity; medium stiff. Some organics upper 4".
0.5-3.5	CL-CH	Silty Clay: Dark yellowish-brown (10YR4/6) becoming brownish yellow mottled with light gray (10YR7/1); moist; medium to high plasticity; stiff to very stiff (similar to GT-2T73, BU-01).
3.5-6.5	CH	Silty Clay: As above, but light gray (10YR7/1) mottled with brownish-yellow (10YR6/8) and very stiff.
6.5-12.0	CH	Silty Clay: Gray (10YR6/1) mottled with brownish-yellow (10YR6/8) and some yellowish-red (5YR5/8); moist becoming wet; high plasticity; very stiff.

Samples Collected

GT-2T71: BU-01A, 3.5'-6.5'
GT-2T71: BU-01B, 3.5'-6.5'

GT-2T71: BU-02A, 6.5'-12.0'
GT-2T71: BU-02B, 6.5'-12.0'

Logged By. W. A. Gale

LOG OF TEST PIT GT-2T72

- Location: 135 feet north of parking lot on line with east side of building 409
- Type of excavator: Cat 416 extendable backhoe (new)
- Start excavation: 2:30 p.m. 07/12/88
- Finish excavation: 3:05 p.m.
- Finish backfilling: 3:40 p.m.
- Finish decontamination: 4:05 p.m.

Depth, Feet		Description
0-0.5	CL	Fill: Silty clay; dark yellowish-brown (10YR4/4); some fine sand; moist, low to medium plasticity; medium stiff. Some organics.
0.5-3.5	CL	Fill: Gravelly clay; yellowish-brown (10YR5/8); 40-45% fine to coarse gravel (1/2" to 2" diameter); moist; medium plasticity; stiff. (Unsuitable for use as impermeable clay cap; very localized in old draw area.)
3.5-7.5	CH	Silty Clay: Light brownish-gray (10YR6/2) and brownish-yellow (10YR6/8); moist to wet; high plasticity; stiff (similar to GT-2T71, BU-01).
7.5-10.5	CL	Silty Clay: Gray (10YR6/1); wet becoming very wet with thin saturated zones; low to medium plasticity; medium stiff to stiff.
10.5-12.0	CH	Silty Clay: Gray (10YR6/1) mottled with brownish-yellow (10YR6/8); wet; high plasticity; stiff (similar to GT-2T71, BU-02).

Samples Collected

GT-2T72: BU-01A, 7.5'-10.5'
GT-2T72: BU-01B, 7.5'-10.5'

GT-2T72: GS-02A, 10.5'-12.0' (grab sample)
GT-2T72: GS-02B, 10.5'-12.0' (grab sample)

Logged By. W. A. Gale

LOG OF TEST PIT GT-2T73

- Location: 100 feet plan south of southwest corner of building 417
- Type of excavator: Cat 416 extendable backhoe (new)
- Start excavation: 4:35 p.m. 07/12/88
- Finish excavation: 5:00 p.m.
- Finish backfilling: 8:10 a.m. 07/13/88
- Finish decontamination: 8:25 a.m.

Depth, Feet		Description
0-1.5	CL	Fill: Gravelly clay; yellowish-brown (10YR5/6); 40-45% gravel (1/2" to 2"); moist; medium plasticity; stiff. Some organics upper 3".
1.5-5.5	CL-CH	Silty Clay: Yellowish-brown (10YR5/6) and brownish-yellow (10YR6/8) mottled with light brownish-gray (10YR6/2); moist; medium to high plasticity; very stiff.
5.5-6.5	CH	Silty Clay: Brownish-yellow (10YR6/8) and gray (10YR6/1); wet; high plasticity; stiff.
6.5-12.0	CH	Silty Clay: Gray (10YR6/1) mottled with some yellowish-brown (10YR5/8); wet with very wet zones; high plasticity; stiff.

Samples Collected

GT-2T73: BU-01A, 1.5'-5.5'
GT-2T73: BU-01B, 1.5'-5.5'

GT-2T73: BU-02A, 6.5'-12.0'
GT-2T73: BU-02B, 6.5'-12.0'

Logged By. W. A. Gale

LOG OF TEST PIT GT-2T74

- Location: 40 feet plan east and 40 feet plan north of northwest corner of building 408
- Type of excavator: Cat 416 extendable backhoe (new)
- Start excavation: 8:27 a.m. 07/13/88
- Finish excavation: 9:15 a.m.
- Finish backfilling: 9:45 a.m.
- Finish decontamination: 10:10 a.m.

Depth, feet		Description
0-2.0	CL	Fill: Silty clay; dark brown (10YR4/3) and dark yellowish-brown (10YR4/6); some gravel; moist; medium plasticity; medium stiff.
2.0-4.0	CL & CH	Fill: As above but mottled with some brownish-yellow (10YR6/8), high plasticity, silty clay.
4.0-8.5	CL	Silty Clay: Gray (10YR6/1) lightly mottled with some yellowish-red (5YR5/8) becoming gray (10YR6/1) and yellowish-red (5YR5/8) at 6.0 feet; some fine sand (5-10%); wet to very wet; medium plasticity; medium stiff. (Possible loess and reworked loess.)
8.5-12.0	CH	Silty Clay: Gray (10YR6/1) and brownish-yellow (10YR6/8) mottled with yellowish-red (5YR5/8); wet; high plasticity; stiff (similar to GT-2T73, BU-01).

Samples Collected

GT-2T74: BU-01A, 4.0'-8.5'
GT-2T74: BU-01B, 4.0'-8.5'

GT-2T74: GS-02A, 8.5'-12.0'
GT-2T74: GS-02B, 8.5'-12.0'

Logged By: W. A. Gale

LOG OF TEST PIT GT-2T75

- Location: 30 feet plan north of concrete loading dock area, on line with west edge of loading dock building 109
- Type of excavator: Cat 416 extendable backhoe (new)
- Start excavation: 12:30 p.m. 07/13/88
- Finish excavation: 1:20 p.m.
- Finish backfilling: 2:05 p.m.
- Finish decontamination: 2:45 p.m.

Depth, Feet		Description
0-2.5	CL	Fill and Possible Fill: Silty clay; brown (10YR5/3); some fine sand (up to 10%); moist; medium plasticity; medium stiff to stiff. Organics and contaminated soil upper 4" (meter reading up to 100-110 counts per minute).
2.5-6.5	CL	Silty Clay: Light brownish-gray (10YR6/2) and brownish-yellow (10YR6/8); moist becoming wet; medium plasticity; stiff.
6.5-12.0	CH	Silty Clay: Grayish-brown (10YR5/2), gray (10YR6/1), and brownish-yellow (10YR6/8); wet; high plasticity; stiff to very stiff.

Samples Collected

GT-2T75: BU-01A, 2.5'-6.5'
GT-2T75: BU-01B, 2.5'-6.5'

GT-2T75: BU-02A, 6.5'-12.0'
GT-2T75: BU-02B, 6.5'-12.0'

Logged By. W. A. Gale

LOG OF TEST PIT GT-2T76

- Location: 150 feet plan west of southwest corner of building 302
- Type of excavator: Cat 416 extendable backhoe (new)
- Start excavation: 9:05 a.m. 07/14/88
- Finish excavation: 9:50 a.m.
- Finish backfilling: 10:30 a.m.
- Finish decontamination: 11:25 a.m.

Depth, Feet		Description
0-1.5	CL	Fill: Silty clay; yellowish-brown (10YR5/8); 15-20% gravel (1/2" to 2"); moist; medium plasticity; medium stiff. Organics upper 4" and contaminated soil with (meter reading = 80 counts/minute) depth of 1.5'.
1.5-2.5	CL	Silty Clay: Dark brown (10YR4/3); moist; medium plasticity; stiff. Trace of organics.
2.5-8.5	CL w/CH	Silty Clay: Brownish-yellow (10YR6/8) mottled with light brownish-gray (10YR6/2) and yellowish-red (5YR5/8); moist becoming wet at 4.5 feet; medium plasticity; stiff becoming medium stiff. Zones of high plasticity silty clay.
8.5-12.0	CH	Silty Clay: Brownish-yellow (10YR6/8) and gray (10YR6/1); wet; high plasticity; stiff.

Samples Collected

GT-2T76: BU-01A, 2.5'-8.5'
GT-2T76: BU-01B, 2.5'-8.5'

GT-2T76: BU-02A, 8.5'-12.0'
GT-2T76: BU-02B, 8.5'-12.0'

Logged By. W. A. Gale

LOG OF TEST PIT GT-2T77

- Location: 130 feet plan south of southwest corner of building 414 and 75 feet west of same building corner
- Type of excavator: Cat 416 extendable backhoe (new)
- Start excavation: 3:05 p.m. 07/13/88
- Finish excavation: 3:50 p.m.
- Finish backfilling: 4:05 p.m.
- Finish decontamination: 4:25 p.m.

Depth, Feet		Description
0-1.5	CL	Silty Clay: Dark grayish-brown (10YR4/2); moist; medium plasticity; stiff. Organics and contaminated soil (meter reading = 80-90 counts per minute) upper 8".
1.5-4.0	CL-CH	Silty Clay: Yellowish-brown (10YR5/8) becoming brownish-brownish-yellow (10YR6/8) and light brownish-gray (10YR6/2); moist to wet; medium to high plasticity; stiff.
4.0-5.0	CL	Silty Clay: Gray (10YR6/1) mottled with some brownish-yellow (10YR6/8); wet; medium plasticity; medium stiff to stiff.
5.0-7.0	CH	Silty Clay: Gray (10YR6/1) mottled with brownish-yellow (10YR6/8); wet; high plasticity; stiff to very stiff.
7.0-10.5	CH	Silty Clay: As above but brownish-yellow (10YR6/8) mottled with gray (10YR6/1); wet; high plasticity; stiff to very stiff.
10.5-12.0	CH	Silty Clay: As before, from 5.0-7.0.

Samples Collected

GT-2T77: BU-01A, 1.5'-4.0'
GT-2T77: BU-01B, 1.5'-4.0'

GT-2T77: BU-02A, 7.0'-10.5'
GT-2T77: BU-02B, 7.0'-10.5'

Logged By: W. A. Gale

LOG OF TEST PIT GT-2T78

- Location: 50 feet plan west of northwest corner of fence around facility 428
- Type of excavator: Cat 416 extendable backhoe (new)
- Start excavation: 4:30 p.m. 07/13/88
- Finish excavation: 5:05 p.m.
- Finish backfilling: 8:05 a.m. 07/14/88
- Finish decontamination: 9:05 a.m.

Depth, Feet		Description
0-1.0	CL	Fill: Silty clay; dark yellowish-brown (10YR4/6); some gravel (1/2" to 2"); dry; medium plasticity; medium stiff.
1.0-4.0	CL	Silty Clay: Yellowish-brown (10YR6/8) and light brownish- gray (10YR6/2); dry; medium plasticity; very stiff.
4.0-6.5	CL	Silty Clay: As above but moist to wet and stiff (possible reworked loess).
6.5-12.0	CH	Silty Clay: Yellowish-brown (10YR5/8) mottled with light brownish-gray (10YR6/2) and brownish-yellow (10YR6/8); wet; high plasticity; very stiff.

Samples Collected

GT-2T78: BU-01A, 4.0'-6.5'
GT-2T78: BU-01B, 4.0'-6.5'

GT-2T78: BU-02A, 6.5'-12'0'
GT-2T78: BU-02B, 6.5'-12'0'

Logged By. W. A. Gale

LOG OF TEST PIT GT-2T79

- Location: 150 feet plan south of point of curvature of south side of loop in road located near station W15,000 & N101,500
- Type of excavator: Cat 416 extendable backhoe (new)
- Start excavation: 12:35 p.m. 07/14/88
- Finish excavation: 1:20 p.m.
- Finish backfilling: 1:50 p.m.
- Finish decontamination: 2:15 p.m.

Depth, Feet		Description
0-1.0	CL	Silty Clay: Dark grayish-brown (10YR4/2) becoming brown (10YR5/3); moist; medium plasticity; stiff. Organics upper 6"; contaminated soil to depth of 1.0' (meter reading = 90 counts/minute).
1.0-6.5	CL	Silty Clay: Yellowish-brown (10YR5/8) mottled with light brownish-gray (10YR6/2) and yellowish-red (5YR5/8); moist becoming wet at 4.5 feet; medium plasticity; stiff.
6.5-12.0	CH	Silty Clay: Yellowish-brown (10YR5/8) mottled with gray (10YR6/1); wet; high plasticity; stiff.

Samples Collected

GT-2T79: BU-01A, 1.0'-6.5'
GT-2T79: BU-01B, 1.0'-6.5'

GT-2T79: BU-02A, 6.5'-12.0'
GT-2T79: BU-02B, 6.5'-12.0'

Logged By. W. A. Gale

LOG OF TEST PIT GT-2T80

- Location: 100 feet plan south of intersection of dike access road and centerline of east side of raffinate pit dike number 4; 40 feet to centerline of road that parallels the pit dike.
- Type of excavator: Cat 416 extendable backhoe (new)
- Start excavation: 2:35 p.m. 07/14/88
- Finish excavation: 3:20 p.m.
- Finish backfilling: 4:15 p.m.
- Finish decontamination: 4:40 p.m.

Depth, Feet		Description
0-0.5	CL	Silty Clay: Dark yellowish-brown (10YR4/6); moist; medium plasticity; medium stiff. Some organics (possible fill).
0.5-8.0	CL	Silty Clay: Brownish-yellow (10YR6/8) mottled with light brownish-gray (10YR6/2) and yellowish-red (5YR5/8); moist becoming wet at 4.0 feet; medium plasticity; stiff.
8.0-12.0	CH	Silty Clay: Brownish-yellow (10YR6/8) mottled with gray (10YR6/1); wet; high plasticity; stiff.

Samples Collected

GT-2T80: BU-01A, 0.5'-8.0'
GT-2T80: BU-01B, 0.5'-8.0'

GT-2T80: BU-02A, 8.0'-12.0'
GT-2T80: BU-02B, 8.0'-12.0'

Four samples (5-gallon buckets) for Rick Ferguson/Bill Knight (Jacobs) for vitrification tests
2 @ 8-10'
2 @ 10-12'

Logged By. H. A. Gale

LOG OF TEST PIT GT-2T81

- Location: On top of dike, 150 feet plan eastward from point of intersection of centerline of top of dike road at southwest corner of raffinate pit no. 4
- Type of excavator: Cat 416 extendable backhoe (new)
- Start excavation: 9:05 a.m. 07/15/88
- Finish excavation: 9:45 a.m.
- Finish backfilling: 10:40 a.m. (carefully backfilled and tamped in thin lifts with backhoe bucket)
- Finish decontamination: 11:10 a.m.

Depth, Feet		Description
0-0.5	CL	Fill: Silty clay; dark brown (10YR4/3); moist; medium plasticity; medium stiff. Some organics.
0.5-6.5	CL & CH	Fill: Silty clay; yellowish-brown (10YR5/8), reddish-brown (5YR5/4), and grayish-brown (10YR5/2); moist; medium and high plasticity; stiff. Some zones of dark brown, medium plasticity silty clay from 4.0-6.0 feet.
6.5-12.0	CL & CH	Fill: Silty clay; yellowish-brown (10YR5/8) mottled with dark brownish-gray (10YR4/2) and brownish-yellow; moist becoming wet at 8.0 feet; medium and high plasticity; stiff.

Note: Possible old top of dike surface at 4.0 feet depth?

Samples Collected

GT-2T81: BU-01A, 0.5'-6.5'
GT-2T81: BU-01B, 0.5'-6.5'

GT-2T81: BU-02A, 6.5'-12.0'
GT-2T81: BU-02B, 6.5'-12.0'

Logged By, W. A. Gale

LOG OF TEST PIT GT-2T82

- Location: Plan north of northwest corner of raffinate pit dike No. 4; 150 feet plan southeast from road intersection and 50 feet plan northeast of fence
- Type of excavator: Cat 416 extendable backhoe (new)
- Start excavation: 12:50 p.m. 07/15/88
- Finish excavation: 2:05 p.m.
- Finish backfilling: 2:50 p.m.
- Finish decontamination: 3:20 p.m.

Depth, Feet		Description
0-0.5	CL	Silty Clay: Dark yellowish-brown (10YR4/6); moist; medium plasticity; stiff. Some organics (meter reading = 25 counts/minute).
0.5-3.5	CL	Silty Clay: Pale brown (10YR6/3) mottled with light brownish-gray (10YR6/2); moist; medium plasticity; stiff.
3.5-6.0	CH	Silty Clay: Reddish-brown (5YR5/4) mottled with light brownish-gray (10YR6/2); moist to becoming wet; high plasticity; stiff.
6.0-8.5	CL	Silty Clay: Brownish-yellow (10YR68) mottled with gray (10YR6/1); wet; high plasticity; stiff to very stiff.
8.5-10.0	CH	Silty Clay: As above but black (10YR2/1) mottling and infilling in possible old shrinkage cracks.
10.0-11.0	CH	Silty Clay: As above but 15-25% chert gravels (#4 sieve to nominal 3").
11.0		Backhoe refusal in possible residuum.

Samples Collected

GT-2T82: BU-01A, 0.5'-3.5'
GT-2T82: BU-01B, 0.5'-3.5'

GT-2T82: BU-02A, 3.5'-6.0'
GT-2T82: BU-02B, 3.5'-6.0'

GT-2T82, BU-03A, 6.0'-10.0'
GT-2T82, BU-03B, 6.0'-10.0'

Logged By. W. A. Gale

APPENDIX A-5

RELOGGED MONITOR WELL LOGS
(MW-2019 THROUGH MW-4023 AND PW-1, PW-2, PW-3 AND OB2j)

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

INTER-OFFICE CORRESPONDENCE

DATE: August 11, 1989

TO: [redacted]

FROM: P.C. Patchin P.C. Patchin

LOCATION: Weldon Spring Project

LOCATION: BHO/PL IV - 6

SUBJECT: GEOTECHNICAL LOGS FROM THE 1988 EXTENDED MONITOR WELL PROGRAM - WSSRAP

Subsequent to completion of the 1988 Extended Monitor Well Program, personnel from MKE-BHO received direction from the WSS office to log soil and core samples obtained during the drilling of the monitor wells. The goal was to obtain additional data on the physical properties of the overburden and bedrock, and to interpret the borehole stratigraphy for the upcoming RI Report.

Commencing in September 1988 and continuing through January 1989, a total of 171 boxes of core representing over 3190 ft. of drilling were logged at the WSS. The core was logged and photographed using the same procedures as the disposal cell geotechnical drilling completed in August 1989. The soil samples were described, re-bagged, and labelled with sample identification numbers corresponding to the borehole log. Chain of Custody forms were also completed for all soil samples. Stratigraphic units were delineated in the soil and core samples based on the physical characteristics recognized in previous drilling programs. These interpretations were noted directly on the borehole log.

During the logging effort, the completed field logs were finalized and typed. Photos were developed and photo logs were prepared. Enclosed are two volumes: Volume 1 contains the completed borehole logs and Volume 2 contains 3x5" color photos of the core with accompanying photo logs. Monitor well logs and photos included in these volumes are listed below:

MW-2019	MW-3001	MW-4005	MW-4013	MW-4021
MW-2021	MW-3002B	MW-4007	MW-4014	MW-4022
MW-2022	MW-3006	MW-4008	MW-4015	MW-4023
MW-2025	MW-3019A	MW-4009	MW-4016	PW-1
MW-2026	MW-3019B	MW-4010	MW-4017	PW-2
MW-2027	MW-4004	MW-4011	MW-4018	PW-3
MW-2028	MW-4004B	MW-4012	MW-4020	OB2j

If you have any questions, please contact me.

PP/hew
Enclosure
cc: K. Johnson-w/o att.
L. Gonzales-w/o att.
B. Knight-w/o att.
C. Payton-w/o att.
E.C. Tom-w/att.
D. Dahlstrom-w/o att.
Reading File

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WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 6

Project Number:

Hole Number: MW-2019

Project: WSSRAP Monitor Well Drilling	Location: South edge of Chemical Plant next to RR gate
Coordinates: N.98287.4 W.50391.3 (AEC)	Drilling Contractor: Layne-Western
Drill Make and Model: CME 55/75, NQ Wireline	Depth Top of Rock:
Depth Casing & Size: 80'; 10"	Hole Size: 12" to 80' then 8.5"
Elevation: 661.5, 663.2 TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 116.0'; reamed to 116.3'	
Water Level:	Fluid & Additives: Water
Date Start: 05/24/88	Date Finish: 05/25/88
Logger: Original* K. Erickson	

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of soils and upper bedrock, see log of MW-2018 (Bechtel GMW-18, 1986)
81									Begin Core 81.0'
82	Competent Limestone ↓	RUN1 9.0/9.0 100%		1	6.3/9.0 70%	1	Open, rough		81.0-84.7 LIMESTONE light gray to very light gray (N7-N8) mealy texture, hard, fresh crystalline, microfossils and fossil fragments, horn coral, crinoids, styolitic with black organics? on styolite surfaces, hairline fracture-open-dipping 86°, chert 83.3-83.6 white with light blue specks, no visible porosity in limestone
83					LP = 1.3'	3	Tight, rough Tight, rough Tight,rough,MnOx		
84					9/4"	3	Open, rough Open, rough Open,rough,MnOx Stylolite		

*Geotechnical Information by: P. Patchin/ D. Reynolds

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 2 of 6

BOREHOLE LOG

Project Number:

Hole Number MW-2019

Project: WSSRAP MW DRILLING

Location: N.98287 W.50391

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION · CORING RATE AND SMOOTHNESS · CORING FLUID LOSS · CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS · PLANARITY · SMOOTHNESS · FILLING, STAINING · ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY · CLASSIFICATION · COLOR · GRAIN SIZE · ALTERATION · CEMENTATION · HARDNESS · WEATHERED STATE
84		RUN1 con't		1		4	Open,rough, stylolitic,MnOx?		Limestone, as above
85							Open,rough,MnOx Open,rough,MnOx Tight,rough		84.7-85.6 CHERT light bluish gray (5B 7/1) very hard, fresh, nodular
86						3	Tight,rough Tight,rough Open,rough		85.6-88.1 LIMESTONE light gray (N7) microcrystalline, dense, interbedded chert and chert nodules at 86.1-86.2, 86.7, 87.3-87.4, very thin stylolites, hairline fractures, hard, fresh
87						3	Tight,rough Tight,rough Tight,rough		
88						1	Open,rough, stylolitic,MnOx?		
89						3	Tight,rough,MnOx stylolite Tight,rough Tight,rough		88.1-89.0 CHERT mottled light bluish gray to white, very hard, fresh
90						0	stylolite		89.0-93.7 LIMESTONE light gray (N7) finely crystalline, fossil fragments, crinoids, stylolitic, dense, hard, fresh, chert nodule 92.6-93.1 light bluish gray (5B 7/1), fracture from 91.8-92.9 86° dip, healed with calcite
91		RUN2 3.7/3.7 100%		2	3.7/3.7 100%	0	stylolite (5)		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 6

Project Number:

Hole Number: MW 2019

Project: WSSRAP MW DRILLING

Location: N.98287 W.50391

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
91		RUN2 con't		2	LP = 1.1'	1	Tight, rough, stylolitic, MnOx		Limestone, as above
					4 > 4"		Stylolites		
92									
						1	Stylolite		
93							Open, rough		
		93.7			93.7	1	Mechanical		93.7-94.4 CHERT light bluish gray (5B 7/1) crinoidal, very hard and dense, fresh
94		RUN3			.8 / 6.3		Tight, smooth		
		6.3 / 6.3			13%		Tight, smooth		94.4-97.6 LIMESTONE light gray (N7) flaggy, broken into wafers "poker chips" along bedding planes ¼" to 2" fossiliferous, stylolitic, weathering along wafer planes, crinoidal moderately wthrd 94.4-95.2; severely wthrd 96.0-97.3, visible porosity along solutioned bedding planes
		100%			LP = 0.4'	8	Rubblized wafered section		
95							Open, rough		
					2 > 4"		Open, rough		
							Open, rough		
						10	Open, rough		
96							Open, rough		
						> 30	Multiple laminar fractures, rock wafers w/re-crystallization, very weathered		
97									
						> 6	Rubble		97.6-108.7 LIMESTONE light gray (N7) massive, finely crystalline, crinoidal,
98									(con't)

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 6

Project Number:

Hole Number: MW-2019

Project: WSSRAP MW DRILLING

Location: N. 98287 W.50391 (AEC)

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
98		RUN 3 con't		2		4	Open, rough Open, rough Tight, smooth		bryozoans, large stylolites chert nodules at 98.5-99.0, 99.5-99.8, 102.2-102.9, 107.7-108.3, very hard and dense, fresh, no visible porosity.
99							Tight, smooth 20°		
						4	Open, rough Open, rough Open, rough Rubble		
100		100.0					Open, rough		
		RUN4 10.0/10.0 100%		3	7.0/10.0 70%	2	Tight, rough Stylolite Tight, rough Stylolite		
101									
					LP = 1.7' Wg 4"	6	Open, rough Open, rough Rubble Open, rough		
102									
						3	Tight, rough 15°		
103									
						0	Stylolites		
104									
						1	Stylolite, weak Tight, rough		
105									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 6

Project Number:

Hole Number MW 2019

Project: WSSRAP MW DRILLING

Location: N.92827 W.50391 (AEC)

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
105–106		RUN4 con't.		3		1	Stylolite Stylolite Tight, rough, stylolitic, MnOx		Limestone, as above
106–107						0			
107–108						3	Open, rough Stylolite Stylolite Open, smooth, 10° Open, smooth, 30° MnOx		
108–109						7	Open, smooth 10°		
109–110						6	Open, rough Open, rough Rubble Open, rough		108.7-109.7 LIMESTONE light gray (N7) flaggy, broken into ¼" to 1½" wafers along bedding planes, finely crystalline, crinoidal, sub-chalky, breaks easily along bedding planes-poorly cemented, slightly wthrd.
110–111		110.0 RUN5 6.0/6.0 100%		4	2.9 6.0 = 48%	3	Open, rough Open, rough Stylolite		109.7-110.8 LIMESTONE very light gray (N8), micro-crystalline, dense, very thin stylolites, hard, fresh
111–112					LP = 0.85 > 4"	2	Open, rough Rubble Open, rough		110.8-112.1 LIMESTONE medium light gray (N6) crinoid fragments 1m to 25mm, fine to coarse crystalline, stylolitic, hard, fresh, visible vuggy porosity 1-3mm.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 6

Project Number:

Hole Number: MW 2019

Project: WSSRAP MW DRILLING

Location: (AEC) N. 98287 W.50391

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
112		RUN5 con't		4			Stylolite Tight, rough		112.1-113.2 LIMESTONE very light gray (N8) coarse crystalline with large crinoid and bryozoan fragments, more porous. Good visable porosity 15 to 20% inter-crystalline and vuggy porosity moderately hard, slightly weathered.
						5	Open, rough		
113									
						2	Tight, rough		
114									113.2-115.6 LIMESTONE light gray (N7) medium to fine crystalline, scattered vugs, est.5-10% porosity Chert nodules at 113.5-113.6, 114.1-114.4, 114.5-114.8, 115.1-115.2, 115.4,115.7 to 116.0. Chert is very light blue (5B 7/1) modular to chicken wire hard, fresh, fracture from 115.7'-116.0' dipping 70°±3°, cemented with calcite.
							Open, rough Open, rough(2) Tight,smooth,MnOx 15°		
						5	Open, rough Rubble		
115									
							Open, rough Open, rough Tight, rough Tight, rough		
						4	Tight, smooth		
116									
									T.D. 116.0' Reamed to 116.3'. Installed well consisting of 4" dia. stainless steel. Screen 116.0' to 106.0', 0.010" slots. Sand pack to 103.0'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 5

Project Number:

Hole Number: MW 2021

Project: WSSRAP MONITOR WELL DRILLING	Location: West end of ash pond
Coordinates: (AEC) 100634.9N 52263.2W	Drilling Contractor: Layne-Western
Drill Make and Model: CME-55/75, NQ Wireline	Depth Top of Rock:
Depth Casing & Size: 80.0'; 10"	Hole Size: 12" to 80.0' then 8.5"
Elevation: 624.6' 626.1 TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 110.7', reamed to 111.0'	
Water Level:	Fluid & Additives: Water
Date Start: 6/13/88	Date Finish: 6/13/88
Logger: Original* E. Gorove	

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of soils and upper bedrock, see log of MW-2002 (Bechtel, GMW-2, 1986)
81									
									Begin Core 81.5'
82	Competent Limestone	RUN1		1	5.3/7.9	2	Open, rough,MnOx Open, rough,MnOx		Limestone, gray and light tan (N 7/0) fossiliferous, massive bedding, hard, fresh, slightly stylolitic, MnOx staining on fractures, some course crystalline. No cavities, fresh, partially recrystallized.
83	↓	7.9/7.9 100%			57%	2	Open, rough to smooth Open, rough Open, rough,MnOx		
84					LP = .8'	6	Vert., open,rough Open, rough Open, rough Healed Open, rough		
85					11 > 4"	2	Open, rough,MnOx Open, rough		

*Geotechnical Information by: P. Patchin/D. Reynolds

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 5

Project Number:

Hole Number MW 2021

Project: WSSRAP MW DRILLING

Location: 100635N 52263W

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
85		RUN1 con't.		1		3	Stylolite,open rough, MnOx		Limestone, as above
							Open, rough		
86							Open, rough		
						3	Open, rough Open, rough		
87							Open, rough		
						3	Stylolite,tight Open,rough,MnOx Open,rough,MnOx Stylolite,tight		
88									
						1	Open, rough		
89									
							Open, rough,MnOx		89.4-110.7 Limestone, as above interbedded with chert; limestone is alternately layers of original sediment and subsequent recrystalized layers, moderately hard, fresh Chert is light bluish gray (5B 7/1), is found bedded, as nodules, or interbeds with L.S., very hard, fresh, fractured. Chert at 89.6-90.3 and 91.7-92.0. Some solution cavities in L.S., pinpoint to 3cm.
		89.5							
		RUN2		2	6.0/9.0	>3	Open,smooth,MnOx Vert,tight,smooth Open, rough, rubblized		
90									
		9.0/9.0			67%	>4	Tight, rough Tight, rough Tight, rough		
91		100%							
					LP = .1' 11 > 4"	2	Tight, rough		
92							Tight,rough,MnOx		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 5

Project Number:

Hole Number: MW 2021

Project: WSSRAP MW DRILLING

Location: 100635N 52263W

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
92		RUN2 con.t				0	Stylolite,tight		
93									
						1	Tight, smooth		93.5-93.7 Chert as above
94									
						1	Open, rough		94.6-95.3 Interbedded chert, as above
95									95.0 1/2" solution cavity with calcite xls.
						2	Tight,rough,MnOx Stylolite, open, rough,MnOx		
96									
				96.6 / 3		7	Tight, rough Vert,tight,smooth Tight,rough Open, rough Open, rough Vertical, tight, rough		96.1-96.4 Chert, as before, fractured 96.6-96.9 Chert as above
97									
						4	Stylolite, open rough, MnOx Tight,rough,MnOx Open,rough Open,rough Open,rough		97.8-98.1 Very vuggy with solution cavities partially filled with calcite xls. 98.8 Solution cavities with calcite xls.
98									
		98.4							
		RUN3		3		3	Vert,recemented Open,rough		
99									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 5

Project Number:

Hole Number MW 2021

Project: WSSRAP MW DRILLING

Location: 100635N 52263W

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
99	Note: From 104.6 to 105.4 there is only rock rubble.	RUN3 con't 10.0 / 10.0		3	7.3 / 10.0 / 73%	3	Open, rough Open, rough Open, rough		Limestone, as above. Solution cavities at 105', very fine grained possibly micrite at 99.2-100.6, fresh, some fossils throughout 100.4-100.9. Chert as before, very hard.
100	Probably some core loss in this section.	100%			LP = 1.5'	> 4	Open, rough Open, rough Rubblized Open, rough		
101							Open, smooth FeOx (possibly from core barrel)		
102					12 > 4"	1	Stylolite, open rough MnOx		
103						4	Open, rough Open, rough Open, rough, MnOx Open, rough		102.0-102.8 Very fine grained, interbedded with chert.
104						1	Open, rough		
105				4		> 2	Open, rough Rubble Zone		104.0-104.4 Very fine grained (micrite) 104.4-104.6 Chert, rubblized 105.4-105.6 Vuggy with calcite.
106						> 1	Stylolite tight		105.7-106.0 Very fine grained (micrite)

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 5

Project Number:

Hole Number: MW 2021

Project: WSSRAP MW DRILLING

Location: 100635N 52263W

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
106							Open, rough Open, smooth Stylolite,tight		Limestone (con't.) as above, fresh, chert from 106.0-107.5'. Pyrite deposit at 108.7; some fossils from 108.7-109.0'.
107									
108							Stylolite,open rough, MnOx		
		108.4				1	Open, rough		
109		RUN4		4	2.1/2.3				
110		2.3/2.3 100%			91% LP = .9'	1	Stylolite, open rough, MnOx		
					3 > 4"	1	Stylolite rough, MnOx		
									T.D. 110.7' Reamed to 111.0'. Installed well consisting of 4" dia. stainless steel. Screen 110.7' to 101.0' 0.010" slots. Sand pack to 96.2'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 5

Project Number:

Hole Number: MW 2022

Project: WSSRAP Monitoring Well Drilling	Location: NE Corner of Ash Pond
Coordinates: N.101154.8 W.51945.6 (AEC)	Drilling Contractor: Layne-Western
Drill Make and Model: CME-55/75, NQ Wireline	Depth Top of Rock:
Depth Casing & Size: 100.0'; 10"	Hole Size: 12" to 100' then 8.5"
Elevation: 636.1', 637.3' TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 128.0'	
Water Level:	Fluid & Additives: Water
Date Start: 06-07-88	Date Finish:
Logger: Original* N. Bingert	

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of soils and upper bedrock, see log MW-2005 (GMW-5).
		100.5							Begin Core 100.5'
101	Competent Limestone	RUN1 2.2/2.2		1	1.5/2.2	1	Open, smooth		100.5-102.7 LIMESTONE very light gray (N8) fossiliferous, massive, coarse grained, fossils are crinoid pieces and shell fragments fresh, hard.
102	↓	100%			68% LP = 1.0'	2	Open, smooth Open, rough		
		102.7			2 > 4"	3	Open, rough Open, rough Open, rough Mechanical		102.7-105.7 LIMESTONE same as above with stylolites and chert nodules. Chert is very light gray with silicified fossil fragments. LIMESTONE is hard with very slight weathering.
103		RUN2		1	3.9/5.0				
104		4.9/5.0 98%			78% LP = 1.0' 5 > 4"		Open, rough w/ FeOx? stain and recrystlization Stylolite Tight, smooth		

*Geotechnical Information by: P. Patchin/ D. Reynolds

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 5

Project Number:

Hole Number MW 2022

Project: WSSRAP MW DRILLING

Location: N.101154 W. 51946

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
104		RUN2 con't.		1		1	Tight, rough		Chert 103.8-104.0'
105									
106						1	Tight, rough MnOx?		105.7-107.7' LIMESTONE light gray (N7) massive, medium to fine crystalline, tight, trace stylolites with carbonaceous coatings, fresh.
107						1	Open, rough		
		107.7				1	Stylolite, open rough, MnOx?		107.7-117.7' LIMESTONE alternating coarse grained fossiliferous and medium to fine crystalline as above, hard, fresh, coarse grained, fossiliferous between 107.7-109.7', 112.5-115.5', medium to fine crystalline between 109.7-112.5', 115.7-117.7', vuggy-pinpoint to 0.1" at 111.2-112.1', some bedded chert and chert nodules, beds to 4", very light gray (N8) with silicified fossil frags, trace stylolites, chert at 108.7-108.8'.
108		RUN3		1	8.9/10.0				
109		10.0/10.0 100%			89% LP = 1.8'	4	Open, rough; Rubble; Open, rough; Open, smooth; Open, smooth		
110					12 >4"	0			
			110.7/2			2	Tight, rough; Stylolite, open rough, MnOx		110.7-110.8' Chert

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 3 of 5

Project Number:

BOREHOLE LOG

Hole Number: MW 2022

Project: WSSRAP MW DRILLING

Location: N.101154 W.51946 (AEC)

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
111		RUN3 con't		2		1	Tight, rough		LIMESTONE, as above	
112						3	Tight, rough Tight, smooth 40°		112.2-112.4 Chert	
113						0	Open, rough			
114						1	Tight, rough			
115						2	Stylolite Open, rough Open, rough Dark clay filling		115.3-115.7 Chert	
116						3	Open, rough Open, rough		116.2-116.6 Chert	
117						1	Tight, smooth, 20° MnOx? stain		117.0-117.1 Chert	
		117.7 RUN4		2			Mechanical		117.7-128 LIMESTONE, alternating coarse-grained (con't)	

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 5

Project Number:

Hole Number: MW 2022

Project: WSSRAP MW DRILLING

Location: N.101154 W.51946

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
118		RUN4		2	8.4 / 10.3	1	Stylolite		hard, fresh, fossiliferous, and medium to fine crystalline as above with some nodular and bedded chert and trace stylolites, vuggy porosity, chert at 119.6-120.0
119		10.3 / 10.3 = 100%			82%		Stylolite, tight rough, MnOx?		
120					LP = 1.3' 10 > 4"	1	Open, rough 17°		Vugs-pinpoint to 0.1" between 118-118.8' and at 127.9-128.0'.
121				3		1	Tight, rough		
122						3	Open, rough, MnOx? Open, rough Open, rough, MnOx		
123						0			
124						3	Tight, rough Tight, rough Open, rough Tight, healed		123.8-124.3 Chert, with banding
125						0			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 5

Project Number:

Hole Number: HW 2022

Project: WSSRAP MW DRILLING

Location: N.101154 W.51946

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
125		RUN4 con't		3			Styolite Styolite, open rough, MnOx? Tight, rough 15°		Limestone, as before
126							Open,wthrd,rough w/rexlization Tight,smooth 15° MnOx? Tight,smooth 20°		
127									
128									T.D. 128.0' Installed well consisting of 4" dia. stainless steel. Screen 125.9' to 115.9', 0.010" slots. Sand pack to 112.0'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 6

Project Number:

Hole Number: MW-2025

Project: WSSRAP MONITOR WELL DRILLING	Location: S. Side of Road, 100' W. of N.E. Gate in Chem. Plant Fence
Coordinates: 101688.3N . 50648.9W (AEC)	Drilling Contractor: Layne-Western
Drill Make and Model: CME-55/75, NQ Wireline	Depth Top of Rock:
Depth Casing & Size: 80.0'; 10"	Hole Size: 12" to 80' then 8.5"
Elevation: 622.3'; 624.1 TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 108.6'	
Water Level:	Fluid & Additives: Water
Date Start: 5/31/88	Date Finish: 6/1/88
Logger: Original* Erickson	

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
70									For soil descriptions and upper bedrock, see log of MW 2008 (Bechtel BMW-8, 1986)
									Begin Core 70.5'
71	Competent Limestone	RUN1		1	3.2 / 4.0	0	Stylolite -weak Open,rough		70.5-74.9 LIMESTONE light gray (N7) crystalline fresh, dense, hard, fossiliferous,stylolitic, interbedded with chert, light bluish gray (5B7/1) nodular, fossiliferous. Chert at 71.8-72.0', 72.4-72.6', 73.2-73.4', 73.5-73.7', and 74.5-74.7'.
72	↓	4.0 / 4.0 100%			80% LP = 7'	2	Open,rough		
73					6 > 4"	4	Open,rough,MnOX Vertical,tight, smooth Tight, rough		
74						2	Open,rough,MnOx Tight,rough Open,smooth		
		74.5				3	Open,rough,MnOX		
75		RUN2		1	7.9 / 8.7		Open,rough,MnOX Open,smooth		74.9-87.3' LIMESTONE (con't)

*Geotechnical Information by: P. Patchin/ D. Reynolds

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 6

Project Number:

Hole Number MW-2025

Project: WSSRAP MW DRILLING

Location: 101688 N 50649W

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
75		8.7/8.7 100%		1	91%	4	Open,rough Rubblized Open,rough Rubblized Open, rough		Light gray (N7) as above w/ scattered deposition of MnOX? on fractures and stylolites; interbedded with CHERT, light bluish-gray, nodular, fossiliferous, very hard, fresh, brittle. Chert @ 75.1-75.4', 75.7-75.8', 77.6-77.9', 81.5-81.6', 83.5-83.7'
76									
77					LP = .1	1	Tight,rough		
78					12 > 4"	2	Open,rough,MnOX Open, smooth		
79						0			
80						2	Tight,rough Open, rough		
81				80.5/2		2	Stylolite, tight Open,rough,MnOX		
						3	Open,rough Rubblized Open,rough Stylolite,open rough, MnOx		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 6

Project Number:

Hole Number MW-2025

Project: WSSRAP MW DRILLING

Location: 10168BN 50649W

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
82									Limestone, as above
						1	Stylolite, tight		
83							Tight,rough,MnOX		
		83.2							
		RUN3		2			Tight, rough		
		6.3/6.3			5.4/6.3	2	Open,rough,MnOX		
84									
		100%			86%		Stylolite, tight		
					LP = 1.2'	0	Stylolite, tight Stylolite,opn,rgh MnOX(hammer mark)		
85									
					9 > 4"	1	Open,rough		
86									
						2	Stylolite,tight,rgh Stylolite,tight,rgh MnOx(hammer) Tight,rough		
87									
						1	Styloliteopn,rough MnOx Vertical fracture Healed cemented		87.3-108.6' LIMESTONE, light gray (N7), slightly dolomitic, moderately, hard, fresh, crinodal,stylolitic, two crinoid columnals included in stylolite @ 88.7', brachiopods, dense.
88									
						2	Tight,rough Stylolite, tight		
89									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 4 of 6

Project Number:

BOREHOLE LOG

Hole Number: MW-2025

Project: WSSRAP MW DRILLING

Location: 101688N 50649W

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
89				2					Limestone, as above
		89.5				2	Tight,rough		
		RUN4			91%				
90							Tight,rough		
		10.0 / 10.0							
				3		0			
91		100%							
							Tight,rough		
						2			
92							Open,rough		91.7-92.2' CHERT, light bluish-gray, (5B7/1), nodular, crinoidal, very hard, brittle
							Open, smooth		
						1			
93									
							Tight,smooth		
						3	Open,rough		93.5-94.0' Chert as above
							Open,rough		
94									
						1			
95							Tight,smooth		
									95.0-95.2' CHERT as above
						1			
96							Tight,rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 6

Project Number:

Hole Number MW-2025

Project: WSSRAP MW DRILLING

Location: 101688N 50649W

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
96									Limestone, as above
						0			
97									
							Open,rough,MnOx		97.4-98.2' Chert as above
						1			
98									
							Tight,rough,MnOx		
							Stylolite, right, rough		
						3			
99							Tight, rough		
		99.5				1	Open, rough		99.6-102.6' Vuggy with solution cavities at 99.6' and 100.0' partially filled with sparry calcite and dogtooth spar. Vugs are 1 to 10mm diameter with drusy quartz.
		RUN5		4	6.6 / 9.1				
100							Open, rough		
		9.1 / 9.1	100.4	5	73%	3	Open, rough		
		100%			LP = 1.2'				
101							Open, rough		
					9 > 4"	2	Open, rough		
							Open, rough		
102									
							Open, rough		
						3	Open, rough		
							Tight, smooth		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 6

Project Number:

Hole Number MW-2025

Project: WSSRAP MW DRILLING

Location: 101688N 50649W

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS / CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
103		RUN5 con't		4			Open, rough		Limestone, as above	
							Vert. rubblized			
						4	Open, rough			
							Stylolite, tight			
104							Open, smooth			
							Open, rough			
						1				
105										
							Open, rough			
						1	Stylolite, tight			
106										
							Stylolite, tight			
						1	Stylolite, tight, rough			
107										
							Styolite, weak			
						1	Stylolite, opn,rgh			
108							Stylolite, tight			
							Healed,cemented			
							Tight, rough			
	108.6'						Stylolites		T.D. 108.6'	

Completed 6/1/88

Installed well consisting of 4" dia. stainless steel. Screen from 106.9' to 96.9' 0.010" slots. Sand pack to 94.0'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 6

Project Number:

Hole Number: MW-2026

Project: WSSRAP MONITOR WELL DRILLING	Location: West End of Frog Pond Dam
Coordinates: N.101215.3 W.49861.1 (AEC)	Drilling Contractor: Layne-Western
Drill Make and Model: CME-55/75, NQ Wireline	Depth Top of Rock:
Depth Casing & Size: 80.0'; 10"	Hole Size: 12" to 80.0' then reamed 8.5"
Elevation: 631.04';633.44' TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 118.0'	
Water Level:	Fluid & Additives: Water
Date Start: 05/26/88	Date Finish: 05/27/88
Logger: Original* K. Erickson	

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of soils and upper bedrock see log of MW-2006 (GMW-6)
81									Begin Core 81.0'
82	Competent Limestone ↓	RUN1 8.5/8.5 100%		1	5.9/8.5	2	Void Open, rough		81.0-81.3' Limestone grayish orange (10YR 7/4), hard, fresh, flecked with dark brn siderite crystals, crystalline, crinoidal, orange limonite stain, stylolitic
83					69% LP = 1.2'	2	Open, rough Mechanical,tight Open, rough		81.3-81.7' Void space 81.7-83.5' Limestone, siliceous olive gray (5Y 4/1) inter-bedded with chert nodules 1-4cm
84					11 >4"	2	Open, rough Open, rough Tight, smooth		83.5-100.4' Limestone light gray (N7) crystalline, hard, fresh, fossiliferous-crinoids horn coral, chain coral, brachiopods, dense, chert nodules-light bluish gray (5B 7/1) with fossils as above (84.4-85.2', 86.0-86.4', 88.5 and scattered throughout 89.6-100.4'),stylolitic
85						2	Tight, smooth 20° Tight, healed, vertical		

*Geotechnical Information by: P. Patchin
D. Reynolds

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 6

Project Number:

Hole Number: MW 2026

Project: WSSRAP MW DRILLING

Location: N.101215 W.49861

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
85		RUN1 con't.		1					Limestone, as above	
						2	Open, rough Open, rough			
86							Open, smooth			
						2	Open, smooth			
87										
						1				
88							Stylolite, open, MnOx & FeOx			
							Stylolite Stylolite			
						1	Tight, smooth Stylolite			
89							Open, rough			
		89.5				4	Tight, smooth Tight, smooth			
		RUN2		1	5.6/10.0		Tight, rough, vertical			
90							Tight, rough			
		9.8/10.0 98%	90.5 90.7		66% LP = 1.1	1	Tight, rough			
91				91.0						
				2	12 > 4"	6	Open, smooth (3) Tight, rough Open, rough			
92							Open, rough			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 6

Project Number:

Hole Number: MW-2026

Project: WSSRAP MW Drilling

Location: N.101215 W.49861

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
92		RUN2 con't		2			Open, rough, stylolitic, MnOx		Limestone, as above	
						1	Tight, healed			
93							Tight, healed			
							Open, rough			
							Stylolite			
						4	Tight, rough			
							Tight,healed			
94							Tight, rough			
							Open,rubbly,MnOx			
						2	Tight, rough			
95							Open, smooth			
						1				
96							Stylolite			
							Open,rough,stylo			
							Open, rough			
						3	Open, smooth			
97										
							Tight, smooth			
						1	Tight, healed			
98										
							Tight, rough			
							Stylolite			
						3				
							Tight, rough			
99							Open, rough			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 6

Project Number:

Hole Number MW-2026

Project: WSSRAP MW DRILLING

Location: N.101215 W.49861

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
99		RUN2		2			Open, rough		
		99.5				3	Tight, rough		
		RUN3			6.4		Mechanical		
100					10.0		Tight, rough		
		10.0 / 10.0			64% LP= 1.2'	2	Stylolite		100.4-101.7' Limestone yellowish gray (5Y 8/1), moderately hard, very slight weathering, crystalline, calcarenite, byrozoan, crinoids, horn coral 99.8-99.9 and 101.6-101.1. Possible brachiopod at 94.6, intercrystalline porosity throughout.
							Open, rough, wthrd		
							Open, rough, wthrd		
101		100%		101.0			Open, rough		
				3	12 > 4"	1	Stylolite		101.7-109.6' Limestone light gray (N7) fossiliferous, hard, fresh, crinoids, bryozoans, horn corals interbedded chert-light bluish gray (5B 7/1) nodular and fossiliferous 101.2-102.7', 103.7-104.0', 104.4-104.8', 105.9-106.8', 107.6-107.8' and 108.4-108.6'. Fossil cast at 103.9' possible crinoid head.
							Vertical(>3)healed		
102							Tight, rough		
							Rubble		
						3	Tight, smooth		
103							Open, vuggy		
						3			
104							Tight, smooth		
							Tight, rough		
						2	Tight, rough		
							Open, rough		
105									
						1			
106							Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 6

Project Number:

Hole Number: MW 2026

Project: WSSRAP MW DRILLING

Location: N.101215 W.49861

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
106		RUN3		3		>5	Highly fractured >4		Limestone, as above
							Tight, smooth		
							Vertical,healed(2)		
107							Tight, rough		
						4	Tight, rough		
							Tight, smooth		
							Tight, smooth(2)		
108							Tight,smooth,MnOx		
							Stylolite		
						1	Stylolite		
							Tight, rough		
109									
						>3	Tight, rough		
		109.5							109.6-110.0 Limestone rubble and possibly caving that fell in hole overnight.
		RUN4			1.1/4.5				
110							Rubble		110.0-111.4 Limestone very light gray (N8) fresh, granular, crinoid fragments, hard, vuggy and intercrystalline porosity with che light bluish gray (5B 7/1) 110.2-110.3 and 111.1-111.4.
		4.5/4.5			24%	4	Open, rough		
111		100%	111.0		LP = .7'				111.4-113.4 Limestone light gray (N7) "poker chip weathering", core breaks into wafers 2mm to 9cm thick along bedding planes, soft, weathering moderate to moderately severe with no discoloration. Shows intercrystalline and bedding plane porosity, approx. 15 to 25%.
							Tight, smooth		
					2 > 4"	12	Open, rough w/ recrystallization		
112									
							Open, rough w/ recrystallization		
						11	Stylolite		
							Tight, rough		
							Open, rough w/ recrystallization		
113									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 6

Project Number:

Hole Number MW2026

Project: WSSRAP MW DRILLING

Location: N.101215 W.49861

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
113		RUN4		4			Open, rough w/ recrystallizatio		113.4-118.0 Limestone light gray (N7) to very light gray (N8) mealy texture, hard, fresh, fossiliferous, (crinoid and bryozoans), dense, crystalline, with interbedded chert (5B 7/1) at 114.6-114.9 and 115.0-115.2.
114		114.0				6	Stylolite		
115		RUN5 4.0/4.0			3.1/4.0 78%	> 4	Mechanical Tight, rough Rubble		
116		100%			LP = 1.4'	1	Stylolite, tight		
117					5 > 4"	2	Tight, rough stylolitic Open, smooth		
118						1	Stylolite Stylolite, weak, MnOx Stylolite, open, MnOx		

T.D. 118.0'

Installed well consisting of 4" diameter stainless steel. Screen 117.9' to 107.9', 0.010" slots. Sand pack to 105.5'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 7

Project Number:

Hole Number: MW-2027

Project: WSSRAP MONITOR WELL DRILLING	Location: East of Bldg. 404, just outside fence
Coordinates: N.100858.0 W.49546.5 (AEC)	Drilling Contractor: Layne-Western
Drill Make and Model: CME-55/75, NQ wireline	Depth Top of Rock:
Depth Casing & Size: 10" to 79.5'	Hole Size: Reamed 12"
Elevation: 646.6', 646.8' TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 120.5' Reamed to 121.5'	
Water Level:	Fluid & Additives: Water
Date Start: 05/20/88	Date Finish:
Logger: Original* L. Ehrhard	

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of soils and upper bedrock, see logs of MW-2013 and GT2T72
80									
		80.2							Begin Core 80.2'
81	Competent Limestone ↓	RUN1 6.4/6.4		1	5.4/6.4 84%	3	Open, rough Tight, rough Stylolite,tight rough MnOx		80.2-86.4 Limestone, with interbedded chert, light olive gray (5Y 6/1) to medium dark gray (N4) massive, hard,medium to finely and coarsely crystalline, no vugs, some stylolites,fresh; chert at 80.2-80.9 and 86.1-86.4, fossiliferous, hexacoral, crinoids, fresh, very hard
82		100%			LP = 1.8'	1	Tight, rough		
83					7 > 4"	1	Tight, rough		
84						3	Stylolite,rough rough, MnOx Tight, rough Tight, rough MnOx		

*Geotechnical Information by: P. Patchin/ D. Reynolds

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 7

Project Number:

Hole Number MW-2027

Project: WSSRAP MW Drilling

Location: N.100858 W.49546

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
84		RUN1 con't		1		0			
85							Stylolite, tight		
86						1	Tight, rough 10° Stylolite, tight		
							Open, rough MnOx		
		86.4					Open, rough		86.4-90.6 Limestone, light gray (N7) to medium light gray (N6), with interbedded chert, massive medium crystalline, no vugs, few stylolites, hard, fresh; chert at 86.4-86.9 and 89.1-89.5, very hard, fresh
87		RUN2 4.2/4.2		2	2.0/4.2	> 6	Rubble Zone Open, rough MnOx		
88		100%			48% LP = .5'	3	Open, rough Open, rough MnOx Stylolite, Open rough MnOx		
89					5 > 4"	4	Tight, rough 30° Tight, rough 15°		
90						3	Tight, smooth 30° Stylolite, open rough MnOx Tight, rough		
		90.6				2	Tight, rough 40° Tight, rough		90.6-93.9 Limestone, cherty, light gray, very fossiliferous crystalline, hard, fresh, (con't)
91		RUN3		3					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 7

Project Number:

Hole Number: MW-2027

Project: WSSRAP MW Drilling

Location: (AEC) N.100858 W.49546

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
91		9.4 / 9.4 100%		3	5.5 / 9.4 59%	3	Open, rough (3)		dense, chertbands at 91.5-91.7, chert at 92.3-92.7 and 93.1-93.7
92									
93					LP = 1.5'	3	Open, rough (3)		
94					6 > 4"	5	Open, rough Tight, smooth Open, rough "POKER CHIPS" Open, rough		93.9-95.4 Limestone, as above with partings or bedding planes, core broken into wafers 1cm to 5cm thick, moderately weathered, medium hard, very fossiliferous
95						15			
96						7	Open, rough Open, rough Vertical healed Tight, rough		95.4-96.0 chert nodular, medium bluish gray (5B 5/1) with limestone inclusions 96.0-100.0 Limestone, as above
97						1			
98						1	Stylolite, open rough, Mnox		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 7

Project Number:

Hole Number: MW-2027

Project: WSSRAP MW Drilling

Location: (AEC) N.100858 W.49546

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
98		RUN3 con't		3		1			
99							Stylolite,open rough, MnOx		
						0			
100		100.0							100.0-104.7 Limestone as above, moderately weathered with recrystallization from 100.0-102.3. Chert at 100.9-101.0 and 101.3-101.5
		RUN4 9.3/9.3		4	8.5/9.3		Open, rough		
						3	Open, rough		
101		100%			91%		Open, rough		
							Open, rough		
					LP = 2.9'	2	Open, smooth		
102									
					10 > 4"	0			
103									
							Stylolite,tight (2)		
						0			
104									
							Tight, rough		
						1			104.7-107.5 Limestone, medium light gray, dense, no vugs. (con't)
105									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 7

Project Number:

Hole Number MW-2027

Project: WSSRAP MW Drilling

Location: (AEC) N.100858 W.49546

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
105		RUN4 con't		4		1	Stylolite,tight		fossiliferous, stylolitic granular, crinoids
106							Open, rough Open. rough MnOx		
107						4	Stylolite, tight Open, rough Tight, smooth 20° Tight, rough 40° MnOX		106.4-107.0 Chert
108						1	Stylolite,tight Open, rough		107.5-109.3 Limestone, as above, fossil fragments, hard fresh, stylolites, intergranular porosity.
109						1	Open, rough Stylolite,tight Open, rough MnOx		109.0-109.3 Chert
		109.3							109.3-110.0 Limestone as above
110		RUN5 5.5/5.5			3.3/5.5 55%	3	Open, rough Stylolite,tight Open, rough MnOx		
111		100%		5	LP = 1.1	5	Open, rough (4) Tight, rough		110.0-120.0 Limestone, light gray (N7) fossiliferous, stylolitic, dense, hard, fresh moderately weathered and medium hard 110.0-112.4; chert at 110.5-110.7 and 110.9-111.1, medium bluish gray (5B 5/1) very hard, brittle sharp fragments.
112					5 > 4"	4	Open, rough (4)		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 7

Project Number:

Hole Number MW-2027

Project: WSSRAP MW Drilling

Location: (AEC) N.100858 W.49546

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
112		RUN5 con't.		5					Limestone, as above
						4	Open, rough (4)		
113									
						1	Stylolite,tight Open, rough		
114							Tight, rough		
							Vertical, tight, smooth		114.1-114.2 Chert as above
						6	Open, rough Stylolite,tight		114.8-115.3 Chert as above
		114.8					Open, rough		
115		RUN6		6			Open, rough		
		5.2 / 5.2			3.3 / 5.2		Verticals tight, smooth Open, rough		
						4	Open, rough, MnOx		
		100%			63%				
116							Stylolite tight		
					LP = 1.2'				116.6-117.1 Chert as above
						3	Open, rough Healed		
117					4 / 4"		Vertical tight, smooth		
							Healed (4)		
							Stylolite, tight		
						2			
118							Open, rough		
							Stylolite,tight		118.6-118.8 Chert as above
						2	Open, rough Tight, smooth,25% MnOx		
119									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 7

Project Number

Hole Number MW-2027

Project: WSSRAP MW Drilling

Location: (AEC) N.100858 W.49546

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
119		RUN6 con't.		5						
						3	Open, rough Open, rough		119.7-120.2	Chert as above
120	Core ends at 120.0						Mechanical			
						?				
121									T.D. 120.5	
									Reamed hole to 122.0' Installed well consisting of 4" diameter stainless steel. Screen 121.6' to 111.6', 0.010" slots. Sand pack to 107.0'	

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 7

Project Number:

Hole Number: MW 2028

Project: WSSRAP Monitoring Well Drilling	Location: West of Building 406 at NE Corner of Roads
Coordinates: N.100092.5 W.50543.0 (AEC)	Drilling Contractor: Layne-Western
Drill Make and Model: CME-55/75, NQ wireline	Depth Top of Rock: Elev.613.5
Depth Casing & Size: 10" to 90.0'	Hole Size: Reamed 12"
Elevation: 557.8', 659.7' TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 131.2' Reamed to 131.5'	
Water Level:	Fluid & Additives: Water
Date Start: 05/18/88	Date Finish: 05/18/88
Logger: Original* L. Ehrhard	

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
91									For soils descriptions and upper bedrock, see log of MW-2015 (GMW-15).
		91.6							Begin core 91.6'
92	Competent Limestone	RUN1		1	5.0 / 7.8	1	Open, rough		91.6-99.4' Limestone light olive gray (5Y 6/1), cherty, massive, medium to finely crystalline, no vugs, occasional stylolites, fresh, hard, fossiliferous, chert nodules at 92.0-92.2.
93	↓	7.8 / 7.8 100%			64% LP = 0.8'	4	Open, rough Open, smooth Open, smooth Stylolite		
94					10 > 4"	3	Open, rough		93.7-93.8 Chert, bluish gray
95						4	Open, rough		
96						2	Open, rough Stylolite Open, rough Stylolite		

*Geotechnical Information by: P. Patchin/ D. Reynolds

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 7

Project Number:

Hole Number: MW 2028

Project: WSSRAP MW DRILLING

Location: N.100092 W.50543 (AEC)

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
96		RUN1 con't.		1		2	Stylolite, open, rough, MnOx Open, smooth		Limestone, as above
97							Open, rough		
98						1	Stylolites		98.0-98.1 Chert
99						4	Open, rough Open, rough, MnOx		98.5-98.7 Chert
100		99.4 RUN2		2	3.8/10.0	3	Open, rough		99.4-109.4 Limestone, massive light olive gray (5Y 6/1), cherty, medium to finely crystalline, moderately hard, few vugs at 100.6' 1-2cm in diameter, few stylolites, fossiliferous, brachiopods and crinoids, fresh, with chert beds and nodules. Chert at 100.6-100.8; 101.0-101.5 (nodules)
101		10.0/10.0 100%			38% LP = 0.7	5	Open, rough Open, rough Open, rough		
102					9 > 4"	4	Open, rough Open, rough		101.8-102.4 Chert nodules
103						4	Open, rough Rubble Open, rough, MnOx Open, rough Rubble Open, rough		102.5-102.6 Chert nodule

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 7

Project Number:

Hole Number MW 2028

Project: WSSRAP MW DRILLING

Location: N.100092 W. 50543

DEPTH	COMMENTS (TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION)	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION (TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION)	GRAPHIC LOG	LITHOLOGY (MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE)
103		RUN2		2			Open, rough Rubble		103.1-103.2 Chert nodule
						4	Open, rough Stylolite Open, rough		
104									
							Open, rough Open, rough		104.6-105.2 Chert, banded fractured
						5	Open, rough Rubble Open, rough		
105									
						4	Open, rough		
106									
						2	Open, rough Open, rough		
107									
							Open, rough		107.1-107.9 Chert with concentric nodular bands, very hard
						2	Tight, smooth		
108									
							Stylolite, open, rough, MnOx		
						4	Open, rough		
109							Tight, rough		
		109.4					Rubble Open, rough		109.1-109.2 Chert nodule, banded, fractured
		RUN3		3		4			109.4-119.4 LIMESTONE Light olive gray (5Y 6/1) - as above, occasional (con't)
110							Open, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 7

Project Number:

Hole Number: MW 2028

Project: WSSRAP MW DRILLING

Location: N.100092 W.50543

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
110		10.0/10.0 100%		3	7.8 10.0 78%	1	Stylolite, tight Open, rough		Stylolites and fossil hash.
111							Tight, rough		
					LP * 0.7'	2	Open, rough		
112							Stylolite, tight, Filled Tight, rough Open, rough, MnOx Healed Open, rough		112.2-112.4 Chert nodules
					16 > 4"	4	Stylolite, tight Tight, rough		
113									
							Open, rough, MnOx Tight, rough Healed		113.7-114.2 Chert, fractured banded, MnOx?
						4	Smooth, tight Rubble		
114							Open, rough		
							Stylolite, tight Filled Tight, rough		
						2	Stylolite, tight		
115									
						1	Tight, rough		
116									
							Tight, rough		
						2			
117							Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 7

Project Number:

Hole Number: MW 2028

Project: WSSRAP MW DRILLING

Location: N.100092 W.50543 (AEC)

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
117		RUN3 con't		3					LIMESTONE, as above
						3	Open, rough Tight, rough		
118							Tight,smooth clay		118.0-118.4 Chert, fractured
						4	Vert,smooth,tight Tight, smooth Healed Stylolite, open-rough, MnOx Healed w/calcite		
119							Tight,rough Stylolite,tight		
		119.4					Open, rough		119.4-128.4 LIMESTONE light olive gray (5Y 6/1) as above, few stylolites, fresh, vuggy from 125-128'.
		RUN4		4	4.4/9.0	3	Tight, rough		
120							Tight, smooth		
		9.0/9.0 100%			49% LP =	2	Tight, rough Open,rough,MnOx Healed		120.6-120.8 Chert, hard
121									
					1.0' 7 > 4"	3	Open, rough		121.8-122.0 Chert, hard fractured
122							Open, rough Open, rough		
							Tight, rough 10° Tight,rough,MnOx 30°		122.3-122.5 Chert
123						3	Stylolite,tight Stylolite,tight Tight, rough		
							Open,rough,MnOx		
124						2			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 7

Project Number:

Hole Number MW 2028

Project: WSSRAP MW DRILLING

Location: N.100092 W.50543

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
124		RUN4 con't		4			Open, rough,MnOx		LIMESTONE, as above 124.3-124.6 Chert,fractured
						3	Open, rough		124.6 3/4" vug with calcite crystals
125							Open, rough Open,rough,MnOx		124.9-125.0 Chert
						1			
126							Open,rough,MnOx		126.0-126.6 Chert, bluish gray, vuggy, possible FeOx specks.
						5	Vert. tight, smooth 70°		126.8-127.0 Chert
127							Open, rough Tight,rough,MnOx		
						4	Tight, rough Tight,rough xtals pocket calcite Tight, rough		127.3 Vug (1½") mostly filled with calcite xls up to ½". 127.9-128.4 Chert, dark bluish gray, fractured, very hard, slightly vuggy.
128							Tight, rough		
		128.4					Tight, rough Tight, smooth		128.4-131.2 LIMESTONE light olive gray (5Y 6/1) as above, chert 128.4-128.6.
		RUN5		5	2.4/2.8	5	Tight, rough		
129							Open, rough Stylolite, tight		
		2.8/2.8			79%	2	Open, rough		
130		100%			LP *				
					.5'		Open, rough		130.5-130.7 Chert, vuggy (1/8") with calcite infilling.
					5 > 4"	4	Tight, rough Open, rough		
131									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 7

Project Number:

Hole Number: MW 2028

Project: WSSRAP MW DRILLING

Location: N.100092 W.50543

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
131										
									T.D. 131.2' Reamed to 131.5' Installed well consisting of 4" diameter stainless steel. Screen 131.0' to 121.0', 0.010" slots. Sand pack to 116.0'.	

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 6

Project Number:

Hole Number: MW 3001

Project: WSSRAP Monitoring Well Drilling

Location: 200'. South of Raffinate Pit 3

Coordinates: N.98852.6W.51262.4(AEC)

Drilling Contractor: Layne-Western

Drill Make and Model: CME-55/75, NQ wireline

Depth Top of Rock:

Depth Casing & Size:

Hole Size: Reamed 8.5"

Elevation: 664.3',666.45 TOC

Angle from Vert. and Bearing: Vertical

Depth Bottom of Hole: 90.0'

Water Level:

Fluid & Additives: Water

Date Start: 06/14/88

Date Finish: 06/15/88

Logger: Original* N. Bingert

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For soils descriptions and upper bedrock, see log of MW 3002. Augered to 51.5'.
.5									
	Split Spoon	10%		1					51.5-51.7' Split Spoon 40 blows to go 2" Chert Breccia and clay, chert is white (N9) to iron stained light brown (5YR 5/6) angular coarse sand to fine gravel; clay is very pale brown (8/4)
52									
							Residuum?		
53									51.7 to 53.5? No sample available
	53.5	Run1							53.5' Begin Core
	Top of bedrock?	.45/.50 90%		0/.5 0%	L.P =0 0>4"	4	Open, rough Open, rough		53.5-54.0' Chert very light gray (N8) to iron-stained dark ylwish orange (10YR 6/6) hairline fractures, vugs pinpoint to 0.5', druzy quartz in larger vugs, fossiliferous including solution cavity or crinoid stem.
54									
	Split Spoon 54.8								
55									
	Split Spoon								54.0-54.8' Split Spoon 100 blows to go 0.8' Chert Breccia and clay, same as 51.5-51.7', unconsolidated, water bearing according to driller
56									

54.8-56.0' No sample available

*Geotechnical Information by: P. Patchin/ D. Reynolds

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 2 of 6

BOREHOLE LOG

Project Number:

Hole Number MW-3001

Project: WSSRAP MW Drilling

Location: (AEC) N.98853 W.51262

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN: LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
56		RUN2 2.0/2.5		1	1.5/2.0 60%	1	Open, rough Healed		56.0-58.5 Chert Breccia, rehealed with sparry calcite and clay; chert is mostly light gray (N7) to iron-stained dark yellowish orange (10YR 6/6); one large (1") oxidized pyrite nodule in vug at 56.7', moderately weathered bedded chert from 57.8-58.0.
57		80%			LP=.8'		Open, rough brecciated, recemented		
					2 > 4"	4	Open, rough(4)		
58							Open, rough		
		58.5							
59		RUN3 1.1/4.5			0/4.5 =0%				58.5-63.0 Chert Breccia unconsolidated. Same as 54.0-54.8. Bottom 0.2' of interval may be back into weathered bedded chert. Only 1.1' of sample recovered.
60		25%			LP =0		Core loss 3.4'		
					0 > 4"		Location Unknown		
61									Location of core loss on RUN3 is unknown.
62									
			61.9			3	Rubble or unconsolidated		
63							All open, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 6

Project Number:

Hole Number MW-3001

Project: WSSRAP MW Drilling

Location: (AEC) N.98853 W.51262

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
63		RUN4 .45/3.0 15%	63.2	1	0		Open, rough		63.0-66.0 Chert
					3.0 =0%		Open, rough		Only 0.5' of fractured rock recovered, similar to 53.5-54.0 but less weathered
64					LP =0				
65							Core Loss 2.5' Location unknown		
66		66.0	65.7				Rubble Zone		66.0-73.8 LIMESTONE
		RUN5 7.0/7.8 90%			0.9/7.8 = 12%	>3	Open, rough		Dark yellowish orange (10YR 6/6) thick bedded to massive with chert nodules and beds to 1.5' thick. Limestone contains trace pyrite, oxidized, in medium sand sized grains. MnOx? specks throughout, moderate to moderately severely weathered, chert is mottled, light olive gray (5Y 6/1) to grayish orange (10YR 7/4); contains some vugs. chert from 68.0' to 69.5' and contains vugs pinpoint to 1.3' partially filled with quartz and drusy quartz.
							Open, rough		
67							Open, rough		
					LP = 0.5		Open, rough		
							Open, rough		
						5	Open, rough		
68							Open, rough MnOx		
							Open, rough		
						3	Tight, rough		
69									
						6	Open, rough		
70									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 6

Project Number:

Hole Number MW-3001

Project: WSSRAP MW Drilling

Location: (AEC) N.98853 W.51262

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
70		RUN5 con't		2		5	Open, rough		Limestone, as above
71									
							Rubble Zone Open, rough Open, rough		
72							Rubble Zone Open, rough Open, rough Rubble Zone		
73									
							CORE LOSS 0.8' location unknown		
		73.8							73.8-81.5 LIMESTONE mottled light gray (N7) to grayish orange (10YR 7/4), thick bedded to massive with nodules and interbeds of chert to .7' thick, vugs pinpoint to .1", 10% at most, trace pyrite. Chert is light gray (N7) to medium gray (N5) with some silicified fossils (shell frags). Severely weathered to 77.0', remainder slightly to moderately weathered, trace stylolites.
74		RUN6							
		6.16/7.7 80%					CORE LOSS 1.2' location unknown		
75									
							Rubble Zone		
76									
77									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 6

Project Number:

Hole Number MW-3001

Project: WSSRAP MW Drilling

Location: (AEC) N. 98853 W.51262

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
77		RUN6 con't		2		6			Limestone, as above
78							Open, rough		
79			79.0			>6	Rubble Zone		78.4-79.0 Chert
			79.3						79.1-79.3 Chert
80						>6	Rubble Zone		
81						3	Tight, rough Tight, rough Stylolite, open rough MnOx		
		81.5				4	Tight, rough Tight, rough Open, rough		81.5-83.5 LIMESTONE same slightly weathered limestone and chert interval as 73.8-81.5
82		RUN7		3			Open, rough		
83		8.1/8.5 95%				3	Stylolite, open rough MnOx Tight, rough Tight, rough		
						1	Tight, rough		83.5-90.0 LIMESTONE light gray (N7); massive, course grained to medium grained, chert mostly very light gray (N8) in nodules

(con't)

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 6

Project Number:

Hole Number MW-3001

Project: WSSRAP MW Drilling

Location: (AEC) N.98853 W.51262

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
84	↑ Weathered Limestone	RUN7 con't.			3		Tight, rough Open, rough		and beds to 0.3' thick, trace styolites, fossils are shell frags, crinoid pieces and brachiopods, fresh, hard.
						5	Tight, rough Open, rough Open, rough, MnOx		
85									
	Competent Limestone					1	Tight, rough		
86	↓								
			86.7			1	Open, rough		Core Loss 0.4' Location unknown
87									
			87.1				Tight, rough		
						3	Open, rough Open, rough		
88									
							Tight, rough Tight, rough		
						3			
89							Tight, rough		
						5	Open, rough		
90									

T.D. 90.0'
Installed well consistino of 2" diameter stainless steel. Screen 75.0' to 50.0', 0.010" slots. Sand pack to 52.7'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 16

Project Number:

Hole Number: MW-3002 B

Project: WSSRAP - Monitor Well Drilling	Location: 150' S of SW corner Raffinate Pit 3
Coordinates: N.98856.6 W.51245.6 (AEC)	Drilling Contractor: Layne Western
Drill Make and Model: CME 55/75, 7" Hollow Stem Auger, NQ Wireline Core	Depth Top of Rock: 65.0
Depth Casing & Size: 100'; 10"	Hole Size: 12" to 100" then 8.5"
Elevation: 664.7; 666.7 TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 150'	
Water Level:	Fluid & Additives: Water
Date Start: 06/03/88	Date Finish: 06/06/88
Logger: * Original Erickson	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						LOESS
		3.5 5.0	SS 01	2"	11-19-18 37		SILTY CLAY-CLAYEY SILT, low plasticity, yellowish brown (10YR 5/4), very dry, very stiff, crumbly, CL to ML.
	5						6.8
		8.5 10.0	SS 02	18"	2-6-8 14		SILTY CLAY, mottled, low plasticity, dark brown (10YR 4/3) to grey, slightly damp, stiff, limonite staining, CL.
	10						
		13.5 15.0	SS 03	18"	2-4-6 10		SILTY CLAY, as above, medium plasticity, olive brown (2.5Y 4/4), moist, Mn, CL.
	15						FERRELVIEW
		18.5 20.0	SS 04	18"	3-7-8 15		SILTY CLAY, as above, trace of medium sand, very stiff, Mn specks and streaks, Fe nodules, CL.
	20						
		12.5 25.0	SS 05	18"	5-8-10 18		SILTY CLAY, as above, trace medium to coarse sand and gravel, yellowish brown (10YR 5/8), slightly moist, CL.
	25						

* Geotechnical Information by: R. Parsons
M. Schauer

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 16

Project Number:

Hole Number: 3002 B

Project: WSSRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25						27.0
	30	28.5 30.0	SS 06	18"	5-10-11 21		SILTY CLAY, as above, light olive brown (2.5Y 5/4), occasional limonite and Fe, Mn bands (fracture-like crosscut), CL.
	35	33.5 35.0	SS 07	18"	5-8-10 18		SILTY CLAY, as above, very slight to low plasticity, vertical fracture with Mn surfaces, CL.
							CLAY TILL
	40	38.5 40.0	SS 08	18"	7-10-11 21		SILTY CLAY, as above.
	45	43.5 45.0	SS 09	18"	2-4-6 10		SILTY CLAY, slight to low plasticity, trace fine gravel, light yellowish brown (2.5Y 6/2), slightly moist, stiff, limonite stain, Mn, CL.
							46.8
	50	48.5 50.0	SS 10	6"	17-21-46 67		CLAYEY GRAVEL, low to medium plasticity, fine to coarse gravel, yellow (2.5Y 8/6), slightly moist, stiff, angular to subangular chert and LS gravel, some weathered chert, clay has limonite stain, Mn, GC.
							BASAL TILL
							Begin Core (53.5-57.5)
							53.5
	55			Run1		54.0	53.5-57.5 CHERT, light bluish gray (5B 5/1) microcrystalline, mostly core loss
							RESIDUUM

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 16

Project Number:

Hole Number 3002 B

Project: WSSRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	55			RUN 1 cont'd .2/4.0	RQD: 0/4.0		Core loss - As Above RESIDUUM
				5%	0% LP=0.2' 0 > 4"		Auger? 57.5-65.0
	60	60.0 60.9	SS II	2"	3/18"/5 / 0/0		SILTY SAND to CLAYEY SAND, non-plastic to low plasticity, reddish yellow (7.5YR 6/8), wet, loose, coarse, angular chert fragments 1 to 7 mm, SM to SC 61.
							? ? ?
							Top of Bedrock?
	65						Sampler refusal at 60.9' Cored from 53.5-57.5' 65.0-100.0' Core descriptions on pages 4 through 10.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Project Number:

Hole Number 3002 B

Project: WSSRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Resume NQ Coring 65.0
65		Run2 9.5 / 9.5 100%		2	6.1 / 9.5 64% LP = 1.2'	2	Open, rough Open, rough Open, rough		65.0-74.5 LIMESTONE; argillaceous; dark yellowish orange (10YR 6/6); med. bedded with chert; lt. grey (N7); thin interbeds and rubble zones to .5' thick; vugs in chert interbeds; irregular shape to .8" in length; druzy quartz in vugs; pinpoint Fe stains in LS to 10%; limestone mod. weathered and mod. hard.
66					12 > 4	1			
67						3	Open, rough Open, rough Open, rough		
68						4	Open, rough (4)		
69						2	Open, rough Open, rough		
70						3	Open, rough (2)		
				2			Open, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 16

Project Number:

Hole Number 3002 B

Project: WSSRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
71		Run2 Cont.		2		4	Open, rough Open, smooth, MnOx Open, rough, MnOx Open, rough, MnOx		As Above
72						1			
73						0	Open, smooth, MnOx		
74									
		74.5		2		6	Open, rough (6)		74.5-80.5 LIMESTONE; cherty, dusky yellow (5Y 6/4) to lt. grey (N7); med. bedded, chert nodules in brecciated zones and thin beds; chert very lt. grey (N8) to med. grey (N5); irregular vugs 20% in cherty zone to 1.0"; lined w/druzy quartz; trace of pyrite; mod. to slight weathering and mod. hard. Argillaceous 74.5 to 78.2.
75		Run3 5.4 6.0 90%		3	1.4 6.0 = 23% LP * 0.4'	4	Open, rough (4)		
76					4 >4"	4	Open, rough (4)		
77						4	Open, rough Open, rough Open, rough Open, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 16

Project Number:

Hole Number 3002 B

Project: WSSRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
78		Run3 Cont.	78.3				Rubblized zone		As Above	
79			78.9				Open, rough			
						4	Open, rough (2)			
							Open, rough			
80	Upper weathered limestone						Open, rough			
		80.5				3	Open, rough		80.5-90.0 LIMESTONE; fossiliferous; yellowish gray (5Y 7/2) to lt. gray (N7); thick bedded to massive; med. to coarse xtln; some chert lt. grey (N7) to med. grey (N5) in nodules and beds to 0.5' thick; fossils are shell fragments and crinoids; trace stylolites; fresh to slightly weathered and hard.	
	Lower competent limestone	Run4 9.5/9.5 100%			6.0/9.5 = 63% LP = 0.9'					
81							Open, rough			
						2				
							Open, rough, MnOx			
82					10 > 4"					
						2	Open, rough			
							Open, rough, MnOx			
83										
						2	Open, rough			
							Open, rough			
84				3						
				4			Open, rough			
						2	Open, rough			
				4			Rubblized zone			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 16

Project Number:

Hole Number 3002 B

Project: WSSRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
85		Run4 Cont.		4		2	Open, rough Open, smooth		As Above
86						2	Open, rough, MnOx Tight, MnOx		
87						1	Open, rough		
88						7	Open, rough, MnOx Open, rough (2) Open, rough (4)		
89						2	Open, rough Open, rough		
90		90.0 Run5 10.0 10.0 100%			7.9 10.0 = 79% LP =	2	Open, rough Rubblized zone Open, rough		90.0-100.0 LIMESTONE; fossiliferous and interbedded chert; yellowish grey (5Y 7/2) to lt. grey (N7); thick bedded to mass; med. to coarse xtln; chert lt. grey (N7) to med. (N5) grey; nodules and beds to 0.5'; fossils are shell fragments and crinoids; trace stylolites fresh to slightly weathered and hard.
91					1.1' 12 >4"	2	Open, rough Tight, stylolite		
				4					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 16

Project Number:

Hole Number 3002 B

Project: WSSRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
92		Run5 Cont.		4		1	Open, rough		As Above	
93						2	Open, rough, MnOx Tight, MnOx			
94				4 5		4	Open, rough Open, rough (3)			
95						2	Rubblized zone Open, rough Open, rough			
96						3	Tight,stylolite Open, rough Open, rough			
97						2	Tight,stylolite Open, rough			
98						1				
9				5			Open,stylolite			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 9 of 16

Project Number:

BOREHOLE LOG

Hole Number 3002 B

Project: WSSRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
99		Run5 Cont.		5		4	Open, smooth Tight, stylolite Open, smooth Open, smooth		As Above
				5					100.0-101.4 Rotary drilled
100									
101									
		101.4							101.4-150.0 LIMESTONE; lt. grey (N7); thick bedded; fine to med. xtln; occ. chert nodules; occ. fossils; fresh and hard.
		Run6 7.8/7.8 100%		1*	5.4/7.8 69% LP 1.0' 9 > 4"	6	Rubblized zone		
102						5	Open, rough (5)		
103						1	Rubblized zone		
							Open, rough		
104						2	Tight		
							Open, smooth		
105						3	Open, rough		
106				1			Open, rough (2)		

*Box numbers correspond to additional core boxes for interval from 101.4' to 150.0'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 10 of 16

Project Number:

Hole Number 3002 B

Project: WSSRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
106		Run6 Cont.		1			Open,stylolite MnOx		As Above	
						4	Open, ro gh			
							Open, rough, MnOx			
107						1	Open, rough			
108						1	Open, rough			
109		109.2					Open, rough, MnOx			
		Run7 5.5 / 5.5 100%			4.7 / 5.5 85% LP * 0.9'	3	Open, rough, MnOx (2)			
110						2	Open, rough, MnOx			
				1 / 2	9 > 4"		Open, rough			
111						3	Open, rough, MnOx			
							Open, rough (2)			
112						2	Open, rough, MnOx			
							Open, rough			
.3										

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 11 of 16

Project Number:

Hole Number 3002 B

Project: WSSRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
113		Run7 Cont.		2		1	Open, stylolite, MnOx		As Above
114						3	Open, rough, MnOx		
		114.7					Open, rough		
		Run8			5.3		Open, rough		
115		6.3 / 6.3 100%			6.3 84% LP = 1.2'	3	Open, stylolite MnOx		
							Open, rough, MnOx		
							Open, rough, MnOx		
116					9 > 4"	1	Open, rough		
117						2	Open, rough (2)		
118						2	Open, rough, MnOx		
							Open, rough		
119			2			3	Open, smooth(3)		
			3						
0			3						

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 12 of 16

Project Number:

Hole Number: 3002 B

Project: WSSRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
120		Run8 Cont.		3		2	Open, rough, MnOx Open, smooth		As Above	
		121.0								
121		Run9 8.0 / 8.0 100%			7.0 / 8.0 88% LP = 1.5'	5	Open, smooth (4) Open, rough, MnOx			
122					9 > 4"	1	Open, rough			
123						0				
124						2	Open, rough Open, smooth			
125						3	Open, rough Tight Open, rough			
126						0				
127				3						

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 13 of 16

Project Number:

Hole Number: 3002 B

Project: WSSRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
127		Run9 Cont.		3		2	Tight		As Above	
							Tight,stylolite(2)			
128				3 4		3	Open, rough (2)			
		129.0					Open,stylolite			
129		Run10 10.0 / 10.0 100%			6.0 / 10.0 60% LP = 0.8'	3	Open, smooth (3)			
130					11 > 4"	3	Open,stylolite MnOx			
							Open, spun			
131						3	Open, rough (3)			
							Rubblized zone			
132						1	Open, rough			
133						3	Open, rough			
							Tight, stylolite (2)			
134				4						

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 14 of 16

Project Number:

Hole Number 3002 B

Project: MZZRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
134		Run10 Cont.		4					As Above	
							Open rough (5)			
135							Tight, stylolite			
							Open, rough (3)			
							Tight, stylolite			
							Open, rough			
136							Tight			
							Tight, stylolite			
							Open, rough, MnOx			
							Open, smooth (2)			
137							Open, smooth			
							Tight, stylolite			
				4			Open, smooth (3)			
				5						
138							Open, rough			
		139.0								
139		Run11 10.0/10.0 100%			6.3 10.0 63% LP = 1.5'		Open, rough (2)			
140					10 > 4"		Open, rough, MnOx			
141				5						

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Project Number:

Hole Number: 3002 B

Project: WSSRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
141		Run11 Cont.		5		4	Open, rough (4)		As Above	
142						0				
143						3	Open, smooth			
144						1	Tight, stylolite MnOx			
145						2				
146						6	Open, rough (6)			
147						2	Open, rough (3)			
148			5 6 6				Tight,stylolite			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 16 of 16

Project Number:

Hole Number: 3002 B

Project: WSSRAP - Monitor Well Drilling

Location: 150' S of SW corner Raffinate Pit 3

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
148		Run11 Cont.				6	Open, rough (3) Open, rough, MnOx Open, rough Open, rough		As Above
		149.0							
149		Run12 0.5 1.9 50%			1.0 0% LP= 0.2' 0 >4"		Rubblized zone		
150									Total Depth 150' Installed well consisting of 4" diameter stainless steel. Screen 147.5 to 137.5', 0.010" slots. Sand pack to 134.0'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 6

Project Number:

Hole Number: MW-3006

Project: WSSRAP - Monitor Well Drilling	Location: N. side of Raffinate Pit 4
Coordinates: N.100048.7 W.52070.6 (AEC)	Drilling Contractor: Layne Western
Drill Make and Model: CME-55/75, NQ Wireline	Depth Top of Rock:
Depth Casing & Size: None	Hole Size: Reamed to 12"
Elevation: G.S. 645.9 ; TOC 647.1	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 135.3 ; Reamed to 135.5'	
Water Level:	Fluid & Additives: Water
Date Start: 05/02/88	Date Finish: 05/12/88
Logger: L. Ehrhard, K. Erickson *Original	

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
98	Competent Limestone ↓	Run1 9.4/9.4 100%		1	6.5 9.4 69% LP = 0.8'	3	Open, rough (3)		98.0-107.5 LIMESTONE; fossiliferous; lt. grey (N7); styolites; dense; pinpoint vugs in LS; fresh and hard chert nodules; lt. grey (N7) at 99.0-99.4 and 100.6-100.7; slightly limey; fossiliferous; nodular
99					12 > 4"		Open, rough (2)		
							Open, rough, MnOx		
100							Open, rough		
						4	Tight, stylolite		
							Tight		
							Open, spun		
101							Tight		
						3	Open, rough		
							Open, rough, MnOx		
102							Open, rough, MnOx (3)		
						6	Tight, stylolite (2)		
							Open, rough, MnOx		
103							Open, smooth		
						3	Open, rough, MnOx		
104				1			Open, spun		

*Geotechnical Information by: R. Parsons
M. Schauer

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 6

Project Number:

Hole Number 3006

Project: WSSRAP - Monitor Well Drilling

Location: N. side of Raffinate Pit 4

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
104		Run1 Cont.		1		2	Open, rough, calcite		
105						4	Open, rough Open, rough, MnOx Open, rough Open, rough		
106						3	Open, rough (3)		
107		107.4		1		1	Open, rough, MnOx		107.5-115.2 LIMESTONE; lt. grey (N7); fossiliferous; stylolites; dense; vugs very low porosity; fresh weathered and hard; chert nodules (5B 7/1) lt. bluish grey at 108.8-108.9 109.0-109.2 110.4-110.7
108		Run2 10.0/10.0 100%		2	6.1/10.0 61% LP 1.9'	5	Open, rough (5)		
109					8 > 4"	5	Open, smooth Open, spun Open, rough (3)		
110						2	Tight, stylolite Open, rough		
111				2					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 6

Project Number:

Hole Number: 3006

Project: WSSRAP - Monitor Well Drilling

Location: N. side of Raffinate Pit 4

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
111		Run2 Cont.		2					As Above	
						5	Open, rough (5)			
112										
							Open, smooth			
						3	Open, spun			
							Tight			
113							Open, rough, MnOx			
						3				
							Tight, stylolite (4)			
114										
						3				
							Open, rough			
115										
							Open, rough, MnOx		115.2-121.3 LIMESTONE and CHERT; limestone; lt. grey (N7); fossiliferous; styolites; dense; fresh weathered and hard chert; lt. bluish grey (5B 7/4); very hard.	
						2				
							Open, rough (2)			
116										
						5	Open, smooth			
							Open, rough (3)			
117										
		117.4		2						
		Run3 8.0/10.0 80%		3	RQD ↓	3	Open, rough (3)			
8				3						

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 6

Project Number:

Hole Number 3006

Project: WSSRAP - Monitor Well Drilling

Location: N. side of Raffinate Pit 4

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
118		Run3 Cont.	118.4	3	6.3 10.0 63% LP 1.2'		Rubblized zone		As Above
119			119.4		11 > 4"	X			
120			120.4			X			
121			121.4			X			121.3-127.4 LIMESTONE; lt. grey (N7); styolites; fossiliferous, crystaline; chert nodules (5B 7/1) lt. bluish grey at 127.9-127.1, 10 mm vug in nodule; LS fresh weathered and hard.
						2	Open, rough Tight,stylolite		
122						3	Open, rough Open, smooth Tight,stylolite		
123						2	Open, rough (2)		
124						3	Open, rough, MnOx Tight stylolite MnOx		
125				3			Open, smooth		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 6

Project Number:

Hole Number 3006

Project: WSSRAP - Monitor Well Drilling

Location: N. side of Raffinate Pit 4

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
125		Run3 Cont.		3		2	Tight, stylolite Open, rough		
126						2	Tight, stylolite Open, rough		
127		127.4		3		2	Open, rough, MnOx		127.4-135.3 LIMESTONE; cherty; grey (N8 to 5Y 6/1); massive; fine to med. grained; vugs 10% @ 130.7-133.0; 1 mm to 40 mm contain calcite xtals; pyrite; fossiliferous; brachiopods and bryozoa in med. grained zones, stylolites; chert nodules; 5 cm; LS fresh and hard.
128		Run4 7.1/7.9 90%		4	3.3/7.9 46% LP 0.6'	2	Open, stylolite Open, rough		
					7 > 4"	1	Rubblized zone		
129			129 129.8			X	Core loss - Possibly ground up by broken bit. Small piece in core box.		
130						2	Open, smooth Open, rough		
131						1	Open, rough		
2				4			Rubblized zone		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 6 of 6

Project Number:

BOREHOLE LOG

Hole Number 3006

Project: WSSRAP - Monitor Well Drilling

Location: N. side of Raffinate Pit 4

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
132				4			Tight		As Above
							Open, rough (2)		
						3	Rubblized zone		
133							Open, rough (2)		
						3	Tight, MnOx		
134							Open, rough		
							Open, smooth		
							Open, spun		
						4			
							Open, rough		
135									
				4		0			Total Depth 135.3'

Installed well consisting of 4" diameter stainless steel. Screen 135.0-124.0', 0.010" slots. Sand pack to 120.0'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 5

Project Number:

Hole Number: MW-3019 A

Project: WSSRAP - Monitor Well Drilling	Location: Adjacent to road 30' N of S fence
Coordinates: N.97937.0 W.50946.0 (AEC)	Drilling Contractor: Layne Western
Drill Make and Model: CME 55/75, 7" Hollow Stem Auger; NQ Wireline Core	Depth Top of Rock: 35.0'
Depth Casing & Size:	Hole Size:
Elevation: G.S. 660.1	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 44.2 * Original	
Water Level:	Fluid & Additives: Water
Date Start: 03/15/88	Date Finish: abandoned 3/17/88
Logger: K. Erickson, A. Harrington	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						TOPSOIL
		3.5 5.0	SS 01	17"	3-5-9 14		3.5-3.7 SILTY CLAY, slightly plastic, dark brown (5Y2 5/1), soft, roots and organics, noncalcareous, topsoil, CL. 3.7'
	5						3.5-5.0 SILTY CLAY, low to medium plasticity, brown (10 YR 5/3), orange mottling, moist, stiff, Fe nodules and specks, noncalcareous, CL.
		8.5 10.0	SS 02	18"	3-4-6 10		SILTY CLAY, medium to highly plastic, grey (7.5YR 7/0) with orange (7.5YR 5/6) mottling in upper 1.1 feet, damp, very stiff, some FeOx nodules, occasional Mn blebs, noncalcareous, CL-CH.
	10						FERRELVIEW
		13.5 15.0	SS 03	11"	4-6-7 13		SILTY CLAY, medium to highly plastic, grey (10YR 6/1) with orange (10YR 5/8) limonite mottling, damp, hard, occasional Fe nodules, Mn stringers, CL-CH. 16.0'
	15						CLAY TILL
		18.5 20.0	SS 04	18"	Not listed		SILTY CLAY, as above, trace medium to fine sand, very stiff, Fe stains, Mn dendrites, CL-CH.
	20						SILTY CLAY and CLAYEY GRAVEL, clay as above, no sand, dense; gravel is fine to coarse, subangular to subrounded LS and chert; 23.7-24.2 black pyrolusite stain and Mn surface (fracture like)
		23.5 25.0	SS 05	18"	6-8-16 24		24.6-24.8 coarse gravel and coarse sand 24.5' 24.8-25.0 calcareous, CL-GC.
	25						

*Geotechnical Information by: R. Parsons, M. Schauer

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 5

Project Number:

Hole Number 3019 A

Project: WSSRAP - Monitor Well Drilling

Location: Adjacent to road 30' N of S fence

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25						BASAL TILL
		28.5					28.5-29.2 CLAYEY GRAVEL, clay slightly to medium plastic at bottom, fine at top to coarse at bottom of sample subangular to subrounded chert and LS gravel, grey (10YR 7/8), slightly damp, soft near top to stiff at bottom, calcareous with Fe stain, GC
		29.2	SS06	5"	40/5"		
	30						Sampler refusal at 29.2'
							Cored from 29.2 to 44.2'
							Core descriptions on pages 3 through 5

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 5

Project Number:

Hole Number: 3019 A

Project: WSSRAP - Monitor Well Drilling

Location: Adjacent to road 30' N of S fence

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Begin NQ coring 29.0'
29		Run1 4.0/7.5 55%		2	0/7.5 = 0% LP = 0.3'	X	Rubblized zone		29.0-33.0 CHERT/CLAY Breccia; very lt. grey (N8) to brown (5YR 4/4); fine to coarse gravel size chert fragments; fine xtln; with CLAY matrix; slt plastic; stiff; moist; noncalcareous; highly rubblized; Fe stain (5YR 4/4) brown on fracture faces and in scattered pinpoints to 3 mm in diameter. Chert nodules at 30.4-30.7, 31.0-31.4, 31.6-32.1. Severely weathered and soft.
30					0 > 4'	X			
31						X			
32						X			RESIDUUM?
33			33.0						Core loss 33.9-36.5 (core ground up by broken core catcher blocking mouth of core barrel)
34				2					35.0' Top of bedrock, correlated with 3019B.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 5

Project Number:

Hole Number 3019 A

Project: WSSRAP - Monitor Well Drilling

Location: Adjacent to road 30' N of S fence

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
35		Run1 Cont.		2	0. .2 0% LP = 0.1'				As Above
36	Run2 .1/.2 50%	36.5 36.6			0 > 4"				36.5-37.7 CHERT; lt. grey (N7) med. lt. grey (N6); finely xtln; vugs pinpoint to 4 mm; limonite stain on fractures; slt weathered and very hard; fracture 37.0-37.5.
37		Run3 1.0/7.5 15%	36.7 37.7		0.6/7.5 8% LP = 0.6	1	Open, smooth, FeOx Rubblized zone		Core loss 37.7-44.2 Core loss due to broken core barrel.
38					1 > 4"				
39									
40									
41				2					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 5

Project Number: —

Hole Number 3019 A

Project: WSSRAP - Monitor Well Drilling

Location: Adjacent to road 30' N of S fence

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
42		Run3 Cont.		2						
43										
44				2					Total Depth 44.2'	
									Hole Abandoned (broken core barrel left in hole)	
45										

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 8

Project Number:

Hole Number: MW-3019 B

Project: WSSRAP - Monitor well drilling	Location: 5' South of 3019 A
Coordinates: N.97932.6 W.50945.5	Drilling Contractor: Layne Western
Drill Make and Model: CME 55/75; 7" Hollow Stem - Auger; NQ Wireline Core	Depth Top of Rock: 35.0
Depth Casing & Size:	Hole Size: Reamed 8"
Elevation: 660.14'G.S.; 661.9'TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 84.3'	
Water Level:	Fluid & Additives: Water
Date Start: 03/17/88	Date Finish: 03/21/88
Logger: Original* N. Bingert	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	30						For description of soils, see log 3019A
		34.5	SS 01	5"	40/5"		34.5-34.9 CLAYEY GRAVEL, low plasticity, silty greenish gray (5Y 7/3), moist, dense, fine to coarse subangular chert gravel lt. blue grey (5B 7/1) to light brown (5YR 5/6), Fe staining and Mn, GC.
	35	34.9					Top of bedrock @ 35.0'
							Cored from 35.5 to 84.3
							Core descriptions on pages 2 through 8

Geotechnical information by: M. Schauer
R. Parsons

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 8

Project Number:

Hole Number 3019 B

Project: WSSRAP - Monitor Well Drilling

Location: 5' South of 3019 A

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
35									35.0-35.5 No log available
		35.5							Begin coring 35.5'
36		Run1 3.8 / 8.5 45%		1	0.5 / 8.5 6% LP = 0.5'				4.7' core loss exact location unknown 35.5-52.0 CHERT RUBBLE lt. grey (N7) to lt. brown (5Y 5/6), gravel to cobble size, clay filling in fracs and vugs, mod. brown (5YR 4/4) to very pale orange (10YR 8/2), vugs in chert, pinpoint to .5", druzy quartz lining; fossil frags (crinoids) in chert; mod. severe weathering and soft overall (chert hard)
37					1 > 4"				
38									
39									
40									
				1					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 8

Project Number:

Hole Number 3019 B

Project: WSSRAP - Monitor Well Drilling

Location: 5' South of 3019 A

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
41		Run1 Cont.		1					As Above	
42										
43										
		44.0								
44		Run2 4.0 / 8.0 50%			1.2 / 8.0 15% LP = 0.4'				4.0' core loss exact location unknown	
45					3 > 4"					
46										
47										
48				1						

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 8

Project Number

Hole Number 3019 B

Project: WSSRAP - Monitor Well Drilling

Location: 5' South of 3019 A

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
49		Run2 Cont.		1					Chert rubble, as above
50									
51									
		52.0		1					
52		Run3 1.5/2.0 75%		2	0.5/2.0 25% LP = 0.5'				0.5' core loss exact location unknown 52.0-63.7 ARGILLACEOUS LIMESTONE; grey orange (10YR 7/4) to mod. yellow brown (10YR 5/4), finely xtln, cherty, numerous vugs pinpoint to .5", secondary calcite filling vugs and fractures, mod. weathered and soft to med. hard.
53					1 > 4"				
		54.0							
54		Run4 10.0/10.0 100%		2	4.8/10.0 48% LP = 1.1'	0	fracs.		
55					10 > 4"	3	Open, rough (3)		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 8

Project Number:

Hole Number 3019 B

Project: WSSRAP - Monitor Well Drilling

Location: 5' South of 3019 A

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
56		Run4 Cont.		3		7	Open, rough (7)		As Above	
57						4	Open, rough (4)			
58						4	Open, rough (4)			
59						2	Open, rough			
60							Open, rough (2)			
						3	Open, rough (3)			
61						4	Open, rough (3)			
62				2 3		2	Open, rough (2)			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 8

Project Number:

Hole Number: 3019 B

Project: WSSRAP - Monitor Well Drilling

Location: 5' South of 3019 A

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
63		Run4 Cont.		3		4	Open, rough (4)		63.7-64.0 LIMESTONE; lt. grey (N7); fossiliferous; med. xtln; abundant crinoid frags; fresh and hard.
		64.0					Open, rough, MnOx		
64		Run5 .8/.8 100%			0.3/0.8 38% LP= 0.3 (>4")	2	Open, rough (2)		64.0-64.8 LIMESTONE; lt. olive grey (5Y 6/1); med. bedded; fine to med. xtln; trace fossils; fresh and hard. 64.5-64.7 chert nodule, lt. grey (N7), rounded, surrounded by dark yellowish-orange (10YR 6/6) clay.
	64.8								
65		Run6 9.5/9.5 100%			6.8/9.5 72% LP = 1.4"	1	Open, smooth		64.8-67.6 LIMESTONE; fossiliferous; lt. grey (N7) to yellowish grey (5Y 7/2); massive; med. to coarse xtln; no vugs; fossils; crinoids; brachiopods; bryzoans; fresh and hard, trace glauconite.
66					11 > 4"		Open, smooth, MnOx		
						2	Tight, stylolite		
67							Open, smooth		
						2	Open, rough		67.6-70.6 CHERT and LIMESTONE INTERMIXED; chert; very lt. grey (N8) to med. grey (N5); micro xtln; vugs pinpoint to .2" x 1", some druzy quartz in vugs; trace pyrite in fractures; trace fossil fragments; limestone; same as above 64.8 to 67.6 except occ. Fe staining; fresh to slightly weathered and hard.
68						3	Open, rough (3)		
69							Open, rough, MnOx		
						3	Open, rough, MnOx		
				3			Open, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 8

Project Number:

Hole Number 3019 B

Project: WSSRAP - Monitor Well Drilling

Location: 5' South of 3019 A

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
70		Run6 Cont.		3		3	Open, rough (3)		As Above 70.6-72.4 LIMESTONE; lt. grey (N7) to yellowish grey (5Y 7/2); massive; med. to coarse xtln; no vugs; Fe staining; slightly weathered and mod. hard to hard.
71				3 4		1	Open, rough		
72						4	Tight Open, rough, FeOx Rubblized zone Open, smooth (2)		72.4-74.3 CHERT and LIMESTONE INTERMIXED; same as section 67.6-70.6.
73						3	Open, rough (3) Rubblized zone		
74		74.3 Run7 10.0 10.0 100%			5.9 10.0 59% LP 1.0'	2	Open, rough (2) Open, smooth		74.3-77.0 LIMESTONE; fossiliferous; lt. grey (N7); massive; med. to coarse xtln; chert nodules; fossils are crinoids; slightly weathered and mod. hard to hard.
75					10 > 4"	4	Open, rough (2) Open, rough (2)		
76				4		3	Open, stylolite MnOx Open, rough chlorite lined Open, rough, MnOx		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 8

Project Number:

Hole Number: 3019 B

Project: WSSRAP - Monitor Well Drilling

Location: 5' South of 3019 A

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
77		Run7 Cont.		4		4	Open, rough (4)		77.0-78.3 CHERT and LIMESTONE INTERMIXED; same as section 67.6 to 70.6.
78	78.3 lower competent bedrock					1	Open, rough, MnOx		78.3-84.3 LIMESTONE; fossiliferous; lt. grey (N7); massive; med. to coarse xtln; chert nodules; fossils are crinoids; slightly weathered and mod. hard to hard.
79				4		3	Open, rough Open, smooth, MnOx (2)		
80				5		2	Open, stylolite, MnOx Open, smooth		
81						2	Open, smooth (2)		
82						4	Tight Open, rough, MnOx Open, rough Open, stylolite		
83						3	Tight Open, rough Tight, stylolite		
				5		2	Open, rough Tight, stylolite		Total Depth 84.3'

Installed well consisting of 2" dia. stainless steel. Screen 83.7-73.7', 0.010" slots. Sand pack to 70.0'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 7

Project Number:

Hole Number: MW-4004

Project: WSSRAP MONITOR WELL DRILLING	Location: Open field southwest of fence
Coordinates: N.97749 E.51689	Drilling Contractor: Layne-Western
Drill Make and Model: CME 55/75, 7" Hollow Stem Auger; NQ Wireline Core	Depth Top of Rock: 23.5'
Depth Casing & Size: 23.5'/7" Auger	Hole Size: 7"/2.98"
Elevation: G.S.651.0	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 64.0'	Water Level:
Fluid & Additives: Water	Date Start: 03-22-88
Date Finish: Abandoned 03-24-88	Logger: Original* Neal Bingert

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
					Auger to 3.5'	XXX	TOPSOIL/FILL 1.0'
	5	3.5 5.0	SS 01	16.2"	7.16.17 33		CLAYEY SILT, light gray (2.5Y 7/2) with yellowish brown (10YR 5/8) FeOx mottling, dry, slightly plastic, hard, root structures in top 3", ML.
	10	8.5 10.0	SS 02	1.3"	3.4.5 9		CLAYEY SILT, light gray (2.5Y 7/2) as above with some topsoil with roots (probably sluff), soft, medium plastic, ML.
							FERRELVIEW
	15	13.5 15.0	SS 03	16.2"	2.4.8 12		SILTY CLAY, mottled light gray (2.5Y 7/2) and strong brown (7.5YR 5/6), 40% silt, dry minor fine angular chert gravel, (<5%) medium plastic, very stiff, increasing MnOx staining and gravel by depth, CL. 14.5'
							CLAY TILL 17.5'
	20	18.5 20.0	SS 04	7.2"	8.18.14 32		GRAVELLY CLAY, strong brown (7.5YR 5/6) to yellowish red (5YR 5/6) 40% very angular chert and weathered chert gravel, hard, CL.
		20.0					RESIDUUM
		23.5	SS 05	0"	---		No recovery 23.5'
	25						Top of Bedrock @ 23.5' Cored from 23.5-64.0'. Core descriptions on pages 2 through 7.

*Geotechnical Information by: P. Patchin/M. Schauer

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 7

Project Number:

Hole Number MW-4004

Project: WSSRAP MW DRILLING

Location: N.97749 E.51689

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
23		23.5							Begin Coring 23.5'
		Run1 .2/.5 33%	23.7	1	--	1	Open, smooth		23.5-23.7' CHERT, light gray (N7), massive, trace fossils (crinoids) minor FeOx staining, very hard, fresh.
24		Run2 2.1/7.1 30%		1	.4/7.1 5%	4	Open, rough Tight, smooth (2) Open, rough		24.0-24.7' CHERT, light gray (N7) to medium gray (N5) massive, minor fossils (crinoids) very hard, very slightly weathered. 1.4' of CHERT/CLAY BRECCIA, light gray (N7) to FeOx stained mod. brown (5YR 4/4); chert fraction is severely weathered and fractured with pieces up to 1½", vugs pinpoint to .5", clay in vugs and voids bluish white (5B 9/1) to dark yellowish orange (10YR 6/6), non-calcareous. The recovered chert/clay breccia most likely represents entire interval from 24.7-31.1'.
25					LP = .4		5.0' CORE LOSS; location in run unknown		
26					1 > 4"				
27									
28									
29									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 7

Project Number:

Hole Number MW-4004

Project: WSSRAP MW DRILLING

Location: N.97749 E.51689

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
30		Run2 con't		1						
31		31.1							31.1'-34.0' CHERT/CLAY BRECCIA as above, chert up to 2", severely weathered. Recovered 1.9' of 3.9' core run. Most likely entire run is CHERT/ CLAY BRECCIA or gravelly clay.	
		Run3 2.0/2.9 69%		1	0%					
32							1.0' of CORE LOSS, location in section unknown. 1.9' of rubble, location in section unknown.			
33										
34		Run4 2.0/4.0 50%		1	0%				34.0-37.5' CHERT/CLAY BRECCIA as above.	
35										
36										

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 7

Project Number:

Hole Number MW-4004

Project: WSSRAP MW DRILLING

Location: N.97749 E.51689

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
37		Run4 con't		1		V 6	Rubble		37.5-44.0' LIMESTONE argillaceous, yellowish orange (10YR 6/6) thick bedded to massive fine to medium crystalline, soft to medium hard, moderately severely weathered, with MnOx and FeOx staining; chert as lenses, nodules and beds to .4' thick, very light gray (N8) to pinkish gray (5YR 8/1), vugs in chert to 1" filled with euhedral calcite and drusy quartz.
38		Run5 9.9/11.0? 90%		2	2.1/11.0 19%	6	Open, rough; Tight, rough; Opn,rgh,FeOx; Spun (3)		
39					LP = .5'	6	Spun (2); Open, rough; Tight, rough		
40					5 > 4"		Tight, rough		
						6	Tight, rough; Tight, smooth; Tight, rough; Open,rough,½"		
41						3	Open, rough; Tight,rough,25°		
42						6	Open, smooth; Tight,rough (3); Tight, rough		
43						5	Opn,smooth,clay; Open, rough; Open, vuggy		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 7

Project Number:

Hole Number MW-4004

Project: WSSRAP MW DRILLING

Location: N.97749 E.51689

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
44		Run5 con't		2			Opn,rgh,wthrd		44-47.1 LIMESTONE, argillaceous as above with nodular chert and chert clasts, dark yellowish orange (10YR 6/6) @ 46.5 laminated with .5cm to 1.5cm chert clasts, soft, severely weathered, core breaks in hand.
						3	Tight, rough		
45							Opn,smth,clay		
							Open, rough		
						4	Open, rough		
46							Opn,rgh,rubbly, weathered (4)		
						5	Tgt,shaley,smth Tight,rough		
47							Open, rough		
						>6	Rubble (clay & silt)		47.1-47.9 CLAY, calcareous, dark yellowish orange (10YR 6/6), massive, some chert nodules (cavern fill?), stiff, friable.
48			47.9						47.9-49.6 CORE LOSS
49		Run6 7.4'/8.0 93%	49.6	3	1.8/8.0 23% LP = .6'				49.6-54.6 LIMESTONE, argillaceous, dark yellowish orange (10YR 6/6), with interbedded chert nodules and beds, occasional vugs in chert. Soft, moderately severely weathered.
							Open, rough		
50							Open, rough		
					4 > 4"		Open,rgh,32°		
							Rubble		
							Open, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 7

Project Number:

Hole Number MW-4004

Project: WSSRAP MW DRILLING

Location: N.97749 E.51689

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
51		Run6 con't		3			Open, rough		LIMESTONE, as above
							Opn,rgh,vuggy		
							Tgt,rgh,vuggy		
52							Tight, rough		
							Tight, rough		
							Tight,rough,45°		
							Tight,rough,20°		
53									
							Tight,rough,25°		
							Tight, rough		
							Opn,rgh,vuggy		
54							Open,rough		
							Rubble		
							Opn,rgh,vuggy, FeOx		
							Tight,rough		54.6-57.0 LIMESTONE, fossiliferous, pinkish gray (5YR 8/1) to dark yellowish orange (10YR 6/6), thick bedded to massive, coarse crystalline, some chert in nodules and beds (to 14cm thick), medium gray (N5) to pinkish gray (5YR 8/1) with some FeOx staining. Medium hard, moderately weathered, crinoids.
55							Tgt,rgh,stylolitic FeOx		
							Tight, rough		
56							Open, rough		
							Rubble		
57							Open,smooth,FeOx		57.0-60.0 LIMESTONE, as above.
		Run7 6.7/7.0 96%		3	2.0/7.0 29%		Spun		
							Open, rough		
58							Open, shaley		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 7

Project Number:

Hole Number MW-4004

Project: WSSRAP MW DRILLING

Location: N.97749 E.51689

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
58		Run7 con't		3	LP = .6'	6	Tight, rough (4) Spun		LIMESTONE, as above
59				4	5 > 4"		Opn,rgh,vuggy		
						3	Tight, rough		
60							Stylolite Tgt,rgh,stylolite MnOx? Stylolite		60.0-64.0 LIMESTONE, medium light gray (N6) to grayish orange (10YR 7/4) fine to medium crystalline with some highly fossiliferous coarse grained zones, 5% vugs pinpoint to .7' mostly concentrated in grayish orange zones, (also argillaceous), moderately hard, moderately weathered, trace pyrite, trace glauconite; interbedded with nodules and lenses of chert to .8' (@ 62.9-63.7'), chert is very light gray (N8) mottled with dark gray (N3), trace pinpoint vugs, trace silicified fossils, trace vertical fractures with calcite filling, irregular patches of selective silicification where groundmass is replaced by chert.
						4	Tight, rough Opn,smth,clay Tight,rough,25°		
61							Tight,rgh,20° MnOx		
						4	Tight, rough		
62							Tight, rough		
							Tight, rough		
						5	Tight, rough Open,rough,40°		
	Upper Wthrd Limestone						Tight,rgh,vuggy		
63	Lower Competent Limestone						Tight, smooth		
			63.7			3	Tight, rough Open, smooth		
64									64.0' T.D. 64.0'. Hole abandoned after losing bit in hole. Drilled MW-4004B adjacent to this drillhole.
65									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 2
Project Number:
Hole Number MW-4004B

Project: WSSRAP MW DRILLING	Location: Adjacent to Drillhole MW-4004
Coordinates: N.97749.0 W.51689.0	Drilling Contractor: Layne-Western
Drill Make and Model: CME-55/75; 7" Hollow Stem Auger; NQ Wireline Core	Depth Top of Rock: 23.5 Elev: 628.2
Depth Casing & Size: 23.5':7"Auger	Hole Size 12" to 25' then 8.5"
Elevation: 651.7'; 653.1 T.O.C.	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 74.0'; Reamed to 75.0'	
Water Level:	Fluid & Additives: Water
Date Start: 3/28/88	Date Finish: 3/30/88
Logger: *Original Neal Bingert	

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
63									Drilled from surface to core point with tri-cone bit. See MW-4004 log for soil and core description 0-64.0'. Begin Core 64.0'
64	Competent Limestone	Run1 9.5/10.0	64.5	1	6.1/10.0 61%		Open, rough; Tight, rough		64.0-74.0' LIMESTONE light gray (N7) to light olive gray (5Y 6/1), finely crystalline, very hard, fresh, fossiliferous, stylolitic with 10% chert (very light gray (N8)) as lenses and nodules. Chert is hard, fossiliferous, very slightly weathered with minor vugs.
65					LP = .9'		Stylolites; Tight, rough		
66					12 > 4"		Spun		
							Tight, rough, stylolite, MnOx; Spun		
67							Spun, MnOx; Spun		
68							Spun		

*Geotechnical Information by: P. Patchin

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 2

Project Number:

Hole Number MW-4004B

Project: WSSRAP MW DRILLING

Location: N.97749.0 W.51689.0

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
69		Run1 con't					Spun Tgt,stylolitic Stylolite MnOx		LIMESTONE, as above
						5	Spun Tight,rough Spun Stylolite		
70							Spun		
						2	Spun,stylolitic		
71							Stylolite Spun Spun,stylolitic		
						3	Spun		
72							Spun Tight, rough		
						4	Spun		
73									
						3	Spun (3')		
74									74.0'
									T.D. 74.0' Reamed to 75.0' Installed well consisting of 2" diameter stainless steel. Screen 65.0-75.0', 0.010" slots. Sand pack to 63.0'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 10

Project Number:

Hole Number: MW-4005

Project: WSSRAP MONITOR WELL DRILLING	Location: 40' East of Pavilion at Army Base
Coordinates: N.97709.9 W.52371.9 (AEC)	Drilling Contractor: REACT/Layne-Western
Drill Make and Model: CME 55/75; 7" Hollow Stem Auger; NQ Wireline Core	Depth Top of Rock: 30.0'
Depth Casing & Size:	Hole Size: 8.5"
Elevation: 656.4 ; 657.3' TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 78.8'	
Water Level:	Fluid & Additives: Water
Date Start: 04/04/88	Date Finish: 04/05/88
Logger: *Original L. Ehrhard	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
					Auger to 3.5'		
	5	3.5 5.0	SS 01	18"	8.14.24 38		CLAY, brown (10YR 7/4) mottled with gray (10YR 8/3), dry, stiff
							FERRELVIEW ?
	10	8.5 10.0	SS 02	18"	4.7.10 17		CLAY, brown (10YR 4/6), slightly moist, dense, hard, iron oxide nodules.
	15	13.5 15.0	SS 03	0"	4.8.8 16		13.5-15.0 No sample 15.0'
							CLAY TILL?
	20	18.5 20.0	SS 04	16.2"	5.8.9 17		SANDY CLAY, brown (10YR 5/6) to gray (10YR 7/2), slightly moist, stiff, iron oxide nodules, chert-quartz sand <5mm increasing percentage with depth, organics.
	25	23.5 25.0	SS 05	18"	3.7.10 17		SANDY CLAY, same as above

*Geotechnical Information by M. Schauer (bedrock only)

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 10

Project Number:

Hole Number MW-4005

Project: WSSRAP MW DRILLING

Location: N.97710 W.52372

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25						26.0' RESIDUUM
		28.5 29.1	SS06	7"	31-40/1"		CHERTY CLAY, gray (10YR 8/2) to brown (10YR 6/6), 50% angular chert<1.5cm, decomposed limestone present.
	30						30.0'

Top of Bedrock @ 30.0'

Cored from 30.0-78.8'. Core descriptions on pages 3 through 10.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 10

Project Number:

Hole Number MW-4005

Project: WSSRAP MW DRILLING

Location: N.97710 W.52372

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
29										
30		30.0							Begin Coring	30.0'
31		Run1 0.8/8.8 10%		1	0/8.8 0% LP = 0.2'				0.8' of CHERT, calcareous, gray (N8-N5), 0.5-2" pieces, a few vugs (<0.5cm) with white to tan decomposed limestone and weathered chert, FeOx stain in rock and on fractures, hard, moderately weathered.	
32					0 > 4"		8.0' of Core Loss, Location in run unknown		Core recovered is 60% rubble (<0.1', FeOx) and 40% very closely fractured pieces with open, rough fractures.	
33										
34										
35										
36										

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 10

Project Number:

Hole Number MW-4005

Project: WSSRAP MW DRILLING

Location: N.97710 W.52372

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
36		Run1 con't		1						
37										
38										
		38.8								
39		Run2 1.8/7.2 25%		1	0/7.2 0% LP = 0.3'				1.8' of CHERT, calcareous, gray (N7), massive; below 39.8 has 10% vugs < 1cm, is moderately solutionized, and contains intermixed brown argillaceous limestone (and as vug fillings). FeOx stain. Moderately hard to medium hardness, moderately severely weathered.	
40					0 > 4"		5.4' of core loss, location in run unknown			
41									Core recovered is 50% rubble (≤0.1', FeOx, including 90° fracture cut into pieces) and 50% very closely to closely fractured pieces with open, rough fractures.	
42										

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 10

Project Number:

Hole Number MW-4005

Project: WSSRAP MW DRILLING

Location: N.97710 W.52372

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
43		Run2 con't		1						
44										
45										
46		46.0								
		Run3 5.0/7.2 70%		1	1.3/7.2 18% LP = 0.5'				3.3' of CHERT/LIMESTONE/CLAY BRECCIA. Chert is gray (N8), vuggy, highly solutionized, hard. Limestone is argillaceous, brown (10YR 6/6), soft to medium hardness. Clay matrix is brown (10YR 6/6), soft to firm. Unit is severely weathered.		
47										
48					3 > 4"		2.2' of core loss, location between 46.0-51.5 unknown		Core recovered is 60% rubble (0.2-0.3' pieces are 50%, 30% is < 0.1', 20% is extremely small, clay on surfaces) and 40% closely to very closely fractured pieces with open, rough fractures.	
49										

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 10

Project Number:

Hole Number MW-4005

Project: WSSRAP MW DRILLING

Location: N.97710 W.52372

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
50		Run3 con't		1					
51						2	Spun		51.5-53.2' LIMESTONE, gray (N8), massive, medium crystalline, hard, fresh
52						>6	Tight, rough		
53		53.2					Rubble (angular, incl. 90° fracs.) Rough, spun		
		Run4 10.0/10.0 100%		2	4.5/10.0 45% LP = 0.8' 10 > 4"	5	Tight, rough, MnOx, sol'n, stylolitic Rough, spun		53.2-63.2' LIMESTONE, argillaceous (highly to 60.7), cherty, brown (5YR 5/6) to gray (N7), massive, fine to medium crystalline, occasional chert nodules < 2", MnOx speckles in brown limestone, a few crinoid fossils, occasional stylolites, medium hardness to hard, moderately to slightly weathered.
54						6	Open, rough Rough, spun Open, rough Rough, spun		
55						5	Tight, smooth Open, rough		
56							Open, rough Opn, rgh, MnOx Opn, rgh, MnOx		
						4	Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 10

Project Number:

Hole Number MW-4005

Project: WSSRAP MW DRILLING

Location: N.97710 W.52372

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
57		Run4 con't		2			Rough, spun		LIMESTONE, as above
						3	Rough, solution, stylolitic,spun		
58							Tight, rough		
						3	Open, rough		
59							Rough, spun		
						3	Rough,sl. FeOx, spun		
							Opn,rgh to smth, sl. FeOx		
							Tight, rough		
60							Tgt,rgh, sl.FeOx		
						4	Opn,rgh,sl.FeOx		
							Smth,FeOx,spun		
							Rgh,sl.FeOx,spun		
61							Rgh,sol'n, large stylolite, spun		
						3	Rough, spun		
							Rgh,vuggy,spun		
62							Rough,sol'n, clay,spun		
						3	Rough, spun		
							Rgh,sl. sol'n, clay, spun		
63							Tight, rough		
		63.2							
		Run5 2.1/2.1 100%		3	1.7/2.1 81%	2	Rough, MnOx, spun		63.2-65.3' LIMESTONE, argillaceous, brown (5YR 6/4) to gray (N8), massive, fine to medium crystalline, occasional chert nodules<2",

(con't)

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 10

Project Number:

Hole Number MW-4005

Project: WSSRAP MW DRILLING

Location: N.97710 W.52372

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
64		Run5 con't		3	LP = 0.7'	2	Rough, spun		MnOx speckles in brown limestone, a few crinoid fossils, occasional stylolites, moderately hard, slightly weathered.
65		65.3			3 > 4"		Rough, spun Open, rough		LIMESTONE, as above. 65.3-73.8' No sample
		Run6		3	0	1			
		0 / 8.5			8.5				
66		0%			0%				
67									
68									
69									
70									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 9 of 10

Project Number:

Hole Number MW-4005

Project: WSSRAP MW DRILLING

Location: N.97710 W.52372

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
71		Run6 con't		3						
72										
73										
		73.8							73.8-78.8' No sample	
74		Run7 0/5.0 0%		3	0/5.0 0%					
75										
76										
77										

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 10 of 10

Project Number

Hole Number MW-4005

Project: WSSRAP MW DRILLING

Location: N.97710 W.52372

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
78		Run7 con't		3						78.8
79									T.D. 78.8' Installed well consisting of 2" diameter stainless steel. Screen 68.4-78.4', 0.010" slots. Sand pack to 63.9'.	

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 6

Project Number:

Hole Number: MW-4007

Project: WSSRAP MONITOR WELL DRILLING

Location: Army property SW of WSSRAP, adjacent to road

Coordinates: N.99069.4 W.52545.4 (AEC)

Drilling Contractor: Layne-Western

Drill Make and Model: CME 55/75; NQ Wireline Core

Depth Top of Rock: --

Depth Casing & Size: 40.0'; 10"

Hole Size: 12" to 40' then 8.5"

Elevation: G.S.621.5 ; 624.1' TOC

Angle from Vert. and Bearing: Vertical

Depth Bottom of Hole: 90.0'

Water Level:

Fluid & Additives: Water

Date Start: 5/13/88

Date Finish: 5/14/88

Logger: Original* A. Harrington/T. Ruby

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
49									
50									Begin Coring 50.0'
51	Lower Competent Limestone ↓	Run1 8.0/8.0 100%		1	5.7/8.0 71% LP = 0.8'	1	Opn,rgh,solution, MnOx		50.0-53.7 LIMESTONE, light gray (N7) to light olive gray (5Y 6/1), medium to coarse crystalline, occasional stylolites and brachiopod fossil fragments, hard, fresh.
52					10 > 4"	2	Tight, rough		
53						3	Tight, rough, stylolitic Open, rough, fossils Open, rough Spun		
54						3	Open, rough, solution, MnOx Opn,rgh,MnOx		53.7-55.0 LIMESTONE, light gray (N7) to light olive gray (5Y 6/1), medium to coarse crystalline, with chert nodules (up to 0.2'), stylolites, occasional fossils, hard, fresh.
55						1	Spun Tight, rough		

*Geotechnical Information by: M. Schauer

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 6

Project Number

Hole Number MW-4007

Project: WSSRAP MONITOR WELL DRILLING

Location: N.99069 W.52545

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
55		Run1 con't		1			Tight, rough Open, rough		55.0-57.0 CHERT, light gray (N7), microcrystalline, with argillaceous limestone fillings (light olive gray 5Y 6/1), vugs pinpoint to 2mm, rehealed fractures, stylolites, hard, fresh.
						3	Opn,rgh, sl. solution, MnOx Opn,rgh, solution, MnOx,stylolitic		
56							Open, rough Opn,rgh,vuggy		
						5	Open, rough Spun		
57									57.0-62.45 LIMESTONE, yellowish gray (5Y 8/1), going from fine to coarse crystalline with depth, with chert nodules (0.1-0.2', very light gray N8 and light bluish gray 5B 7/1), pinpoint vugs<5%, occasional stylolites and fossils, rehealed fractures, hard, fresh.
						2	Open, rough (2)		
		58.0							
58		Run2		2	8.8/10.0		Open, rough		
		10.0/10.0			88%	3	Open, rough		
		100%							
59					LP = 0.9'		Spun		
						3			
					16 > 4'		Open, rough		
60									
						1	Opn,rgh, MnOx, stylolitic		
61							Open, rough		
						2	Spun		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 6

Project Number:

Hole Number MW-4007

Project: WSSRAP MONITOR WELL DRILLING

Location: N.99069 W.52545

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
62		Run2 con't		2		2	Spun		LIMESTONE, as above. 62.4 -63.5 LIMESTONE, yellowish gray (5Y 8/1), with abundant chert (light bluish gray 5B 7/1), calcite-filled fractures in chert, occasional stylolites, crinoids, hard, fresh.
63						2	Tight, rough Opn,rgh,vuggy w/calcite xls		63.5-65.5 LIMESTONE, yellowish gray (5Y 8/1), fine to medium crystalline, with calcite crystals in vugs (0.1-0.3') and calcite infilling, occasional chert nodules (0.1-0.2', light bluish gray 5B 7/1 to bluish white 5B 9/1), few fossils, hard, fresh.
64						2	Open, rough		
65						4	Tight, rough Open, rough		65.5-68.0 LIMESTONE, yellowish gray (5Y 8/1), fine to medium crystalline, occasional chert nodules (0.2-0.3'), few fossils and stylolites,hard, fresh.
66						1	Tight, rough Opn,rgh,solution MnOx (2)		
67				67.4 / 3		2	Tight, rough(3)		
68		68.0					Rgh,solution, MnOx, stylolitic		68.0-72.3 LIMESTONE, yellowish gray (5Y 8/1) to light olive gray (5Y 6/1), medium to coarse crystalline, with abundant calcite, stylolites,fossils including crinoids, hard, fresh.
.9		Run3 4.5 / 4.5 100%		3	3.2 / 4.5 71% LP = 1.5	3	Spun,MnOx, stylolitic Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 6

Project Number:

Hole Number MW-4007

Project: WSSRAP MONITOR WELL DRILLING

Location: N.99069 W.52545

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
69		Run3 con't		3	4 > 4"	3	Tight, rough, stylolitic, MnOx Tight, rough Open, rough, MnOx wthrd, stylolitic		LIMESTONE, as above.
70						0			
							Spun		
71						3	Tight, rough, MnOx Tight, rough		
72		72.5				> 6	Opn, rgh, fossils Open, rough Rubble (angular chert, incl. vert frac)		72.3-72.7 CHERT, light bluish gray (5B 7/1), microcrystalline, fine sprinkle of pyrite from 72.3-72.4, broken chips and pieces, very hard, fresh.
		Run4		3	7.7 / 11.0				
73		11.0 / 11.0 100%			70% LP = 0.8'	3	Spun Tight, rough		72.7-76.4 LIMESTONE, argillaceous, light olive gray (5Y 6/1), fine crystalline, occasional chert nodules (0.05-0.1') and fossil hashes and stylolites hard, fresh.
					14 > 4"		Open, rough Open, rough		
74						1	Open, rough		
75						2	Open, rough Open, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 6

Project Number:

Hole Number MW-4007

Project: WSSRAP MONITOR WELL DRILLING

Location: N.99069 W.52545

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
76		Run4 con't		3		2	Open, rough, MnOx, solution Open, rough		LIMESTONE, as above. 76.4-81.5 LIMESTONE, light olive gray (5Y 6/1) to yellowish gray (5Y 8/1), medium to coarse crystalline, with calcite and occasional chert nodules (0.1'), increasing fossil hash and crinoids with depth, stylolites, hard, fresh.
77				77.3 4		3	Open, rough, fossils (3)		
78						2	Open, rough Spun		
79						2	Tight, rough		
80						3	Open, rough Opn,rgh,MnOx wthrd,stylolitic Tight, rough		
81						6	Spun Tight,rgh,75° Open, rough (4)		81.5-82.3 LIMESTONE, light gray (N7), fine to medium crystalline, with occasional chert lenses (0.2-0.4', light bluish gray 5B 7/1),stylolites, hard, fresh.
82						5	Opn,rgh,MnOx, sol'n,stylolitic Tgt,smth,90° Tight, smooth Open, smooth		82.3-83.1 CHERT, light bluish gray (5B 7/1), vugs pinpoint to 0.1' filled with quartz crystals, quartz veins, very hard, fresh.
83									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 6

Project Number:

Hole Number MW-4007

Project: WSSRAP MONITOR WELL DRILLING

Location: N.99069 W.52545

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
83		Run4 con't		4		3	Open, smooth Open,rgh,MnOx		CHERT, as above 83.1-85.7 LIMESTONE, argillaceous, light olive gray (5Y 6/1), fine crystalline, vugs pinpoint to 0.07' filled with calcite or quartz, rehealed fractures filled with calcite, chert nodules (0.05-0.35'), layer of MnOx - possible stylolite, hard, fresh.
	83.5	Run5 6.5/6.5 100%		4	5.4/6.5 83% LP = 1.0 9 > 4"		Spun		
84						2	Open, rough		
85						1			
86							Tight, rough		85.7-87.5 CHERT, light bluish gray (5B 7/1), microcrystalline, with limestone lenses (0.1-0.2'), vugs pinpoint to 0.2', MnOx staining - possible stylolite, limestone fizzes readily with HCl, chert contains occasional calcite veins, hard, fresh.
				86/5	7	5	Open, rough Opn,rgh,solution MnOx Opn,rgh,MnOx		
87						4	Open, rough		87.5-90.0 LIMESTONE, very light gray (N8) to pinkish gray (5YR 8/1), medium crystalline, with calcite, pinpoint vugs <5%, fossiliferous hash, stylolites, hard, fresh.
88						2	Opn,rgh,solution MnOx, stylolitic Tight to opn,rgh, solution,MnOx, stylolitic		
89						2	Tgt,rgh,solution, sl. MnOx, stylolitic Rgh,solution, MnOx		90.0'

T.D. 90.0'

Installed well consisting of 4" diameter stainless steel. Screen 79.6-89.6', 0.010" slots. Sand pack to 77.0'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 10

Project Number:

Hole Number MW-4008

Project: WSSRAP MONITOR WELL DRILLING

Location: ---

Coordinates: N.98668.7 W.53180.5

Drilling Contractor: Layne-Western

Drill Make and Model: CME 55/75; 7" Hollow Stem Auger; Core NQ Wireline

Depth Top of Rock: 32.4'

Depth Casing & Size: ---

Hole Size: 12" to 44', then 8.5"

Elevation: 635.5' GS, 637.3' T.O.C.

Angle from Vert. and Bearing: Vertical

Depth Bottom of Hole: 82.4' Reamed to 83.0'

Water Level:

Fluid & Additives: Water

Date Start: 03/10/88

Date Finish: 03/21/88

Logger: Original* C.Allen/B.Fieselman

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						
		3.5 5.0	SS 01	18"	3.7.7 14		SILTY CLAY, brownish yellow (10YR 6/6) mottled with yellowish brown (10YR 5/4), ~30% silt, slightly plastic, slightly moist, stiff, 5% MnOx blebs and stringers, minor FeOx staining, slightly sandy, CL.
	5						FERRELVIEW
		8.5 10.0	SS 02	9.7"	2.4.5 9		CLAY, mottled light gray (7.5YR N7/) and reddish yellow (7.5YR 6/8), highly plastic, moist, stiff, abundant FeOx nodules(5%) to 1/4", <2% sand to fine gravel size chert, CH.
	10						13.0'
		13.5 15.0	SS 03	18"	4.7.8 15		CLAY, slightly mottled brownish yellow (10YR 6/8) and minor light gray (10YR 7/1) with approx. 5% coarse sand to fine angular gravel including some subrounded igneous rocks, med. plasticity, slightly moist, stiff, minor silt, abundant MnOx, with some FeOx blebs, CL.
	15						CLAY TILL
		18.5 20.0	SS 04	18"	4.7.7 14		CLAY, silty, light yellowish brown, (10YR 6/4), med. plastic, slightly moist, approx. 15% fine gravel as above, slightly sandy, occasional FeOx blebs and MnOx. CL.
	20						
		23.5 25.0	SS 05	18"	10.24.16 40		23.5-24.5' SILTY CLAY brownish yellow (10YR 6/8) mottled with light gray (10YR 7/1), with abundant limestone concretions up to 24.5 (con't)
	25						

*Geotechnical Information by: R. Parsons/ P. Patchin

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 10

Project Number:

Hole Number MW-4008

Project: WSSRAP MW DRILLING

Location: N.98668.7 W.53180.4

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25						1", very stiff, med. plasticity. CL. 24.5-25.0' SANDY SILT, slightly clayey (10%) light gray (10YR 7/1) mottled with light yellowish brown (10YR 6/4) hard, dry, 25% fine to coarse calcareous sand, minor fine gravel size chert, non-plastic, ML. BASAL TILL
		28.5 30.0	SS 06	18"	7.6.14 20		SILT, clayey, light yellowish brown (10YR 6/4) with FeOx staining, 10% clay, non-plastic, dry-slightly moist, very stiff, minor coarse sand to gravel size chert (<5%), ML.
	30						Bedrock at 32.4'. Cored from 32.4' to 82.4'. Core descriptions on pages 3 through 10.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 10

Project Number:

Hole Number MW-4008

Project: WSSRAP MW DRILLING

Location: N.98668.7 W.53810.4

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
31										
32		32.4							Begin NQ Coring	32.4'
33		Run1 1.5/10.0 15%		2	0% LP = .15'		Rubblized Zone		Core Run1 cut 10 ft. 32.4'-42.4'. Only 1.5' recovered. Unable to tell what interval the 1.5' of core came from. 1.5' sample consists of fine to coarse gravel size chert fragments.	
34										
35										
36										
37										
38										

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 10

Project Number:

Hole Number MW-4008

Project: WSSRAP MW DRILLING

Location: N.98668.7 W.53180.4

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
38				2			Rubblized Zone		
39									39.0-42.4' Soft according to driller
40									
41									
42		42.4					Rubblized Zone		42.4-45.2' LIMESTONE argillaceous with interbedded chert. LS yellowish orange (10YR 8/6). Chert light bluish gray (5B 7/1), micro to finely xtln, vugs 10% pinpoint, thick bedded, chert beds to 0.4' thick, moderately weathered and moderately hard.
43		Run2 10.0/10.6 94%		2	6.8/10.6 = 64% LP = .9'	5	Open, rough (5)		
44					9 > 4"	4	Open, rough Open, rough		
45							Open, rough (2)		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 10

Project Number:

Hole Number MW-4008

Project: WSSRAP MW DRILLING

Location: N.98668.7 W.53180.4

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
45		Run2 con't		2		3	Opn,rgh,MnOx Tight Open, rough		45.2-49.1 LIMESTONE with chert clusters and beds; light gray (N7), massive to thickly bedded, finely to coarsely xtln, vugs <5% pinpoint, minor fossils @ 47.1-47.3', lg crinoid @ 47.4', slightly weathered and hard.
46						3	Open, stylolite Tight, stylolite Open, smooth		
47						1	Open, rough		
48						3	Open, rough		
49				49.6 / 3		1	Open, rough		49.1-50.8 LIMESTONE argillaceous dk yellowish orange (10YR 6/6), thick bedded, finely xtln, vugs 10% pinpoint, Mn filled, no fossils, slightly weathered and hard.
50						3	Opn,rgh,MnOx Open,rough (2)		50.8-54.7 LIMESTONE w/chert clusters, light gray (N7) fine to coarse xtln, no vugs, chert clusters, <10% up to 2" dia., slightly weathered and hard.
51			51.4			3	Open, rough (3)		
52									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 10

Project Number:

Hole Number MW-4008

Project: WSSRAP MW DRILLING

Location: N.98668.7 W.53180.4

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
52				3			Rubblized Zone		
						1	Open, rough		
		53.0							
53		Run3		3	7.5				
		9.4/9.4			9.4 = 80%	4	Open,rough (3)		
		100%					Open, rough		
54					LP = 1.2'				
					12 > 4"	1	Opn,rgh,MnOx		54.7-57.2 LIMESTONE w/chert nodules, light gray (N7) to light brownish gray (5YR 6/1) massive, fine to coarse xtln, vugs <2% pinpoint, chert nodules to 1.5" and interbeds to .25' thick, minor fossils, slight weathering and hard.
55							Open, rough		
						3	Open, rough		
56							Opn, stylolite, MnOx		
						3	Open, rough (2)		
							Open,rough,FeOx		
57	Upper Weathered Limestone					3	Open,rough(2)		57.2-62.4 LIMESTONE, very light gray (N8) to med. light gray (N6) massive, fine to coarse xtln, vugs 2% pin-point, minor chert, Mn staining, stylolites, slightly weathered and hard.
	Lower Competent Limestone	57.4'					Open, rough		
58							Open, rough,MnOx		
						2	Open, spun		
59									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 10

Project Number:

Hole Number MW-4008

Project: WSSRAP MW DRILLING

Location: N.98668.7 W.53180.4

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
59		Run3 con't		4			Opn,rgh,MnOx		
						2	Open, rough		
60							Stylolite,tight (2)		
						3	Stylolite,open MnOx		
61							Stylolite, tight		
						3	Opn,rgh,MnOx		
							Stylolite, tight		
62		62.4					Open, rough (2)		62.4-72.4 LIMESTONE, very light gray (N8) to medium light gray (N6), massive to thick bedded, fine to coarse xtln, vugs 2% pinpoint, occ chert nodules to 0.2' thick, minor stylolites,slightly fossiliferous, lg. crinoid at 69.6, fresh and hard.
		Run4 10.0/10.0 100%		4	6.5/10.0 = 65%	3			
63							Stylolite,tight (2)		
					LP = 1.8'	1			
64					10 > 4"		Open, rough		
						4	Open, rough (3)		
65						1			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 10

Project Number:

Hole Number MW-4008

Project: WSSRAP MW DRILLING

Location: N.98668.7 W.53180.4

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
66		Run4 con't					Open, rough		LIMESTONE, as above
						1			
67							Open, rough		
						1			
							Rubblized Zone		
68				68.2 / 5			Open, rough (3)		
						4			
							Stylolite, tight, MnOx		
69									
						2			
							Opn,rgh,MnOx Tight		
70									
							Open, rough		
						5	Open, rough (3)		
71									
						3	Open, rough (4)		
							Rubble		
72							Open, rough		
		72.4					Open,rgh,MnOx		72.4-82.4 Description on next page.
		Run5 10.0 / 10.0		5	RDQ ↓	5	Open, rough (2)		
3							Open,rough,MnOx		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 9 of 10

Project Number:

Hole Number MW-4008

Project: WSSRAP MW DRILLING

Location: N.98668.7 W.53180.4

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
73		Run5 con't		5	6.9 10.0 = 69%	1	Open, spun		72.4-82.4 LIMESTONE, very light gray (N8) to medium light gray (N6) massive, fine to coarse xtln, vugs <2% pinpoint to 3mm, occ. chert lens to 0.8' thick, abundant stylolites, slightly fossiliferous, jointing in chert lens with siliceous infilling, MnOx stain, fresh and hard.
74					LP = 2.0'		Open, spun		
						4	Stylolite, opn, MnOx		
					9 > 4"		Open, smooth		
75							Open, rough		
						2	Tight, healed		
76							Stylolite, tight(2)		
						3	Open, rough		
							Stylolite, tight		
77				77.1 / 6			Stylolite, opn, MnOx		
						7	Open, rough Open, spun Open, smooth Opn, rgh, MnOx Stylolite, tight		
78							Stylolite, tight		
						3	Open, rough (2)		
79							Open, rough Stylolite, tight		
						5	Open, rgh, MnOx		
80							Open, rgh, MnOx		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 10 of 10

Project Number:

Hole Number MW-4008

Project: WSSRAP MW DRILLING

Location: N.98668.7 W.53180.4

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
80		Run5 con't		6		3	Open, rough (3)			
81						1	Stylolite,tight			
82										
	82.4								T.D. 82.4'. Installed 2" stainless steel well, screen from 72.8' to 82.8', 0.010 slots, filter pack at 70.0'.	

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 10

Project Number:

Hole Number: MW-4009

Project: WSSRAP MONITOR WELL DRILLING

Location: Missouri National Guard Training Area

Coordinates: N.99516.7 W.52671.9 (AEC)

Drilling Contractor: Layne-Western/React

Drill Make and Model: CME 55/75; 7" Hollow Stem Auger; NO Wireline Core

Depth Top of Rock: 19.0'

Depth Casing & Size: None

Hole Size: Reamed 8.5"

Elevation: 624.2G.S.; 625.8 TOC

Angle from Vert. and Bearing: Vertical

Depth Bottom of Hole: 76.5'; Reamed to 76.8'

Water Level:

Fluid & Additives: Water

Date Start: 4/11/88

Date Finish: 4/13/88

Logger: Original* Fieselman/Allen

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						TOPSOIL/FILL 1.0'
							3.5-3.7 CLAYEY SILT, plastic, dark reddish brown (5YR 2.5/2), moist, stiff, roots-20% organics OH
		3.5 5.0	SS 01	18"	3.5.7 12		3.7-5.0' CLAYEY SILT, plastic, light olive brown (2.5Y 5/4) with orange - light gray (2.5Y N7) mottling & Mn staining, CL.
	5						FERRELVIEW 8.0'
		8.5 10.0	SS 02	18"	7.10.14 24		SILTY CLAY, highly plastic; <5% fine (non-calcareous) sand, light olive brown with minor Mn staining and gray mottling (2.5Y 5/4); slightly moist, very stiff, CH.
	10						CLAY TILL 13.5'-13.6' same as above 13.6'
		13.5 15.0	SS 03	18"	26.29.31 60		SILTY CLAYEY GRAVEL, non-plastic; 50% coarse sand to gravel, 50% silt and clay; brownish yellow (10YR 6/6), dry to slightly moist, hard, sub-angular to sub-rounded chert gravel; GC.
	15						BASAL TILL
		18.5	SS 04	6"	40/6"		18.5-19.0' same as above 19.0'
	20	19.0					Top of Bedrock @ 19.0' Cored from 19.0' to 76.5'. Core descriptions on pages 2 through 10.

* Geotechnical Information by: P. Patchin/D. Dahlstrom/R. Parsons

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 10

Project Number:

Hole Number MW-4009

Project: WSSRAP MW DRILLING

Location: N.99517 W.52672

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
18									
19									Begin Coring 19.0'
		Run1 2.9/8.5 34%		2	0/8.5 0% LP = .2' 0 > 4"		5.6' of Core loss, location unknown		2.9' of core recovered from a 8.5' core run. Recovered core includes 1.7' of angular CHERT GRAVEL, very light gray (N8) with some pale yellowish orange (10YR 8/6) microcrystalline <5% vugs (pinpoint to 4mm) <2% fossils, moderately weathered and moderately hard. Also includes 1.2' of highly weathered and fractured CHERT, very light gray (N8), pale yellowish orange (10YR 8/6) FeOx staining, very leached with interstitial clay, microcrystalline, no bedding, very friable.
20									
21									
22									
23									
24									
25									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 10

Project Number:

Hole Number MW-4009

Project: WSSRAP MW DRILLING

Location: N.99517 W.52672

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
25		Run1 con't		2					
26									
27									
		27.5							
		Run2		2	0.0 / 10.0 0%				27.5'-37.5' 3.2' of core recovered from a 10.0' run. 1.0' of CHERT as above except less weathered. 2.2' of LIMESTONE, argillaceous, dark yellowish orange (10YR 6/6), massive, micro to finely crystalline, moderately severely weathered, <5% vugs (pinpoint), no fossils, medium hard to soft, bottom .5" grades to chert gravel.
28		3.2 / 10.0 32%			LP = .3		6.8' of Core Loss, location in run unknown		
29					0 >4"				
30									
31									
32									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 10

Project Number:

Hole Number MW-4009

Project: WSSRAP MW DRILLING

Location: N.99517 W.52672

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
32		Run2 con't		2						
33										
34										
35										
36										
37										
		37.5								
		Run3		2	9.4 / 10.0		Rough, open		37.5'-38.1' CHERT, light gray (N7), massive, micro-crystalline, fractured, vuggy (10%) and solution features, no fossils, minor calcite in joints and vugs.	
38		10.0 / 10.0 100%			94% LP = .9 14 > 4"		Rough, open Rough, tight		38.1'-41.2' LIMESTONE argillacrous, grayish-orange (10YR 7/4), massive, micro- to finely crystalline: (con't)	

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 10

Project Number:

Hole Number MW-4009

Project: WSSRAP MW DRILLING

Location: N.99517 W.52672

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
39		Run3 con't					Tight,rgh,vuggy		≤20% vugs pinpoint to 10mm, calcite infilling in some vugs, ≤5% chert nodules up to 1" in diameter, shaley partings medium dark gray (N4) no fossils, moderately severely weathered, moderately hard.
				2/3		2	Tight,rgh,wthrd		
40							Open,rgh,clay		
						1			
41							Opn,smooth,clay		41.2'-47.5' LIMESTONE, very light gray (N8) to light gray (N7), medium bedded with 20% chert as nodules and lenses, slightly weathered, finely crystalline, hard, slightly argillaceous, 1½" soultion cavity at 41.9' in chert lens, partially filled with quartz and calcite crystals, occasional fractures with limey clay filling, fossiliferous.
						2	Opn vug, calcite quartz crystal		
42									
						4	Opn,rgh,clay (2)		
43							Opn,rgh,clay (2)		
						0	Stylolites (2)		
44									
						0			
45									
						1	Opn,smooth,clay		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 10

Project Number:

Hole Number: MW-4009

Project: WSSRAP MW DRILLING

Location: N.99517 W.52672

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
46		Run3 con't				1	Opn, stylolite, MnOx, clay		LIMESTONE, as above
47		47.5		3		>			
		Run4		4	4.7 / 10.0	6	Rubble Open, rough		47.5'-57.5' LIMESTONE, pale yellowish brown (10YR 6/2) to very light gray (N8), medium bedded, slightly to moderately weathered, microcrystalline to finely crystalline, 15% chert as lenses and nodules, fossiliferous with some weathered and vuggy sections; minor stylolites in lower portion, minor joints and fractures with limey clay filling, some MnOx staining near stylolites.
48		8.5 / 10.0 85%	? 48.5		47% LP .9' 8 > 4"	3	Open, rgh, FeOx Spun Open, rgh, vuggy		
49			49.0 ?			5	Open, rgh, wthrd (3) Spun		
50			? 50.5			6	Spun Rubble		
51			51.5 ?			3	Open, spun		
52						6	Open, rough (3) Tight, rough (3) Open, rough Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 10

Project Number:

Hole Number MW 4009

Project: WSSRAP MW DRILLING

Location: N.99517 W.52672

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
53		Run4 con't		4			Tight, rough		LIMESTONE, as above
						4	Open, rough		
							Open, rough (2)		
54	Upper wthrd Limestone								
						3	Open, rough		
54.6	Lower competent Limestone						Spun (2)		
55									
						2	Spun		
							Stylolite,weak, MnOx		
56									
						2	Tight,rgh,wthrd		
							Opn,rgh clay 15°		
57									
		57.5		4		3	Opn,smooth,clay 15°		
		Run5		5	0.8 / 5.0 16% LP = .8 1 > 4"		Open, smooth Spun		57.5'-58.7' LIMESTONE, light gray (N7) to light olive gray (5Y 6/1); massive, micro to finely crystalline minor fossils, fresh.
58		1.2 / 5.0 24%	? 58.7			> 6	Open, rough Rubble		58.7'-62.5' Core Loss
59									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 10

Project Number:

Hole Number: MW 4009

Project: WSSRAP MW DRILLING

Location: N.99517 W.52672

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
60		Run5 con't		5					
61									
62									
		62.5							62.5'-66.5' LIMESTONE, very light gray (N3) massive bedding, fine to medium crystalline, vugs < 5% pinpoint; occasional chert nodules in upper portion of interval up to 1" in diameter; minor fossils < 5%; occasional stylolites, some Mn stain; hard, fresh.
		Run6		5	2.6				
					10.0				
63					26%		Spun		
		4.0			LP		Stylolite		
		10.0			.6		Spun		
						4	Stylolite		
		40%			4		Spun		
64					> 4"		Spun		
						2			
							Spun		
65							Stylolite		
							Spun		
							Tight, rough		
							Spun		
						6	Tight, smooth, metallic, xls, 55°		
							Open, rough		
66							Spun		
			66.5				Spun		66.5'-72.5' Core Loss

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 9 of 10

Project Number:

Hole Number MW 4009

Project: WSSRAP MW DRILLING

Location: N.99517 W.52672

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY, SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
67		Run6 Con't		5					CORE LOSS	
68										
69										
70										
71										
72										
		72.5 Run7		5	0.4/4.0				72.5'-75.2' CORE LOSS?	
73		1.3/4.0 32%			10% LP .4 1 > 4"					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 10 of 10

Project Number:

Hole Number MW-4009

Project: WSSRAP MW DRILLING

Location: N.99517 W.52672

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
74		Run7 con't		5						
75			75.2 ?				Rubble		75.2'-76.5' LIMESTONE as above except no chert nodules.	
						6	Spun Tight,rough Spun			
76						2	Stylolite,weak Spun			
77									T.D. 76.5' Installed well consisting of 2" diameter stainless steel. Screen from 66.6' to 76.6', 0.010 slots. Sand pack to 64.0'.	

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 10

Project Number:

Hole Number: MW-4010

Project: WSSRAP MONITOR WELL DRILLING

Location: West of roadway at top of borrow-pit at edge of woods

Coordinates: N.100102.7 W.53029.8

Drilling Contractor: Layne-Western

Drill Make and Model: CME 55/75; 7" hollow stem auger; NW wireline core

Depth Top of Rock: 15.7'

Depth Casing & Size:

Hole Size: Reamed 12" to 19'.

Elevation: 629.1 ; 630.7 TOC

Angle from Vert. and Bearing: Vertical

Depth Bottom of Hole: 77.0'; Reamed to 77.1'

Water Level:

Fluid & Additives: Water

Date Start: 3/11/88

Date Finish: 3/14/88

Logger: Original* C. Allen/B. Fieselman

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
							3.5'-3.7' ORGANIC CLAY, dark gray (10YR 3/1), slightly plastic, moist, soft, highly organic, OL.
	5	3.5 5.0	SS 01	18"	3.4.4 8		3.7'-5.0' SILTY CLAY, yellowish brown (10YR 5/4) with gray mottling, low to medium plasticity, moist, stiff, manganese dendrites, rootlets throughout, pyrolusite, CL.
							8.5'-8.7' SILTY CLAY, as above, some topsoil slough, CL.
							FERRELVIEW FM 8.7'
	10	8.5 10.0	SS 02	18"	10.12.10 22		8.7'-9.85' CLAYEY GRAVEL, fine to coarse, angular and weathered subrounded chert gravel with silty clay matrix, dark yellowish brown (10YR 4/6), medium to high plasticity, dry to slightly moist, very stiff, GC.
							9.85' to 10.0' SILTY CLAY as immediately above with less chert gravel, dry, hard, CL-CH.
	15	13.5 15.0	SS 03	18"	8.16.12 28		CLAY TILL 13.5'-15.0' SILTY CLAY, dark yellowish brown (10YR 4/6), medium plasticity, dry to slightly moist, medium stiff, minor manganese, dendrites, fine to coarse, angular chert gravel, slightly calcareous, sandy, CL. 15.7'
							Bedrock @ 15.7' Cored from 15.7' to 77.0'. Core descriptions on pages 2 through 10.

*Geotechnical information by: P. Patchin/ M. Schauer

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 10

Project Number:

Hole Number MW-4010

Project: WSSRAP MW DRILLING

Location: N.100103 W.53030

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
15									Begin Coring 15.7'
16		Run1		2	2.2 / 4.0		Open, smooth		15.7'-19.7' LIMESTONE, slightly argillaceous, pale yellowish orange (10YR 8/6) to yellowish gray (5Y 8/1), ≈5% interbedded chert. Limestone massive, hard, slightly to moderately weathered, with FeOx staining; clay in fractures, finely xln. Chert as nodules or lenses to .4' thick, fractured, very hard, slightly weathered with limonite staining.
		3.8 / 4.0			55%	4	Opn,rgh,sl. spinning		
		95%			LP * .4		Opn,rgh,spun Opn,rgh,clay		
17					6 4"	4	Opn,rgh,spun Spun		
18						3	Open,rgh,spun		
							Open,rough,clay coating		
19			19.5			5	Opn,rgh,clay Opn,rgh,cly,spun Spun		
		19.7							
20		Run2		2	2.4 / 5.0		Open,rough,MnOx, spun		19.7'-24.2' LIMESTONE, grayish orange (10YR 7/4) to dark yellowish orange (10YR 6/6), finely xln, slightly fossiliferous, slightly argillaceous, mod. hard, slightly to mod. wthrd, slightly vuggy, severely weathered, 22.2'-22.7', chert from 19.9'-20.7', very light gray (N8) mottled, very hard, fractured, slightly fossiliferous (con't)
		4.0 / 5.0			48%	4	Tgt,rgh,MnOx,50°		
		80%			LP * .6'		Opn,rgh,FeOx, sl. spinning Opn,rgh,FeOx Opn,rgh,FeOx,spun		
21					5 > 4"	4	Opn,rgh Spun Open,rgh,FeOx		
22									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 10

Project Number:

Hole Number MW-4010

Project: WSSRAP MW DRILLING

Location: N.100103 W.53030

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
22		Run2 con't		2			Open, rough Rubble (FeOx,sl. MnOx)		with pyrolusite stringers and fracture filling.
			22.7			>6	Opn,rgh,FeOx		
23									
						1	Opn,rgh,FeOx, spun		
			23.7						
24							Opn,rgh,clay		
		24.7				1			24.7'-25.1' CHERT, light bluish gray (5B 7/1) to yellowish gray (5Y 8/1) very hard, microcrystalline, very slightly weathered, < 5% pin-point to 2mm vugs, fracture with 76° dip, healed.
25		Run3		3					
		10.0 / 10.0			7.7 / 10.0				
					77%	1			
		100%					Open, rough		25.1'-26.6' LIMESTONE, argillaceous; grayish orange (10YR 7/4) mottled with very pale orange (10YR 8/2) interbedded with 50% nodular and lensitic chert, v. light gray (N8) and grayish orange (10YR 8/2). Limestone is moderately hard to med. hard, moderately weathered, stylolitic, FeOx stained. CHERT is hard to very hard, slightly weathered, vuggy (pinpoint to 2mm, MnOx dendrites abundant.
26					LP = 1.2'				
							Opn,rgh,spun		
					14 > 4"	4	Open,rgh,clay Tgt,smooth,MnOx FeOx		
27							Tgt,smooth,MnOx, FeOx, 70°		
							Tight,smooth		
						3	Opn,rgh,clay		
28							Tight,smooth, MnOx,FeOx,30°		
						1			
29							Open, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 10

Project Number:

Hole Number MW-4010

Project: WSSRAP MW DRILLING

Location: N.100103 W.53030

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
29		Run3 con't		3		2	Opn,rgh Opn,rgh,spun		26.6'-30.0' CHERT (70%) as above, interbedded with L.S. 30%, solution cavities, pinpoint to 24mm filled with FeOx clay.
30						3	Opn,rgh,FeOx, solution,vuggy Tight,rough,sl. vuggy Opn,rgh,vuggy, spun		30.0'-32.6' LIMESTONE, as before, grayish orange (10YR 7/4) moderately severely weathered and solutioned, abundant FeOx, vuggy, w/20% interbedded CHERT as above, vuggy.
31						2	Opn,rgh (2)		
32						3	Opn,rgh (2) Opn,rgh,spun		32.6'-34.3' CHERT as above very light gray (N8) and grayish orange (10YR 7/4), slightly vuggy.
33						3	Opn,rgh,clay, sol'n,stylolitic Opn,rgh,sol'n.		
34		34.7				3	Opn,rgh, lt.gry clay Claylens(lt.gry)		34.3'-34.7' CLAY AND CHERT clay is yellowish gray (5Y 8/1), highly plastic, hard, moist, silty. Chert (30%) as above, severely weathered and rubblized.
35		Run4 10.0/10.0 100%		4	4.0/10.0 40% LP = 1.1	1	Opn,rgh Opn,rgh,FeOx		34.7'-39.6' CHERT as before, grayish orange (con't)

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 10

Project Number:

Hole Number MW-4010

Project: WSSRAP MW DRILLING

Location: N.100103 W.53030

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
36		Run4 con't		4	8		Opn,rgh,clay		(10YR 7/4) vugs, lime and clay filled, pinpoint to 25mm, styolitic, MnOx dendrites, with 10% interbedded limestone as above, clay (.1') at 38.5'.
					>4"		Opn,rgh,FeOx		
						4	Opn,rgh,FeOx,vgy		
							Opn,rough		
37							Opn,rgh, sol'n, styolitic		
						2	Opn,rgh,sl. FeOx		
							Opn,rough		
38							Opn,rgh,clay		
						5	Opn,rgh,lt.gray clay		
							Opn,rgh,clay, friable		
39							Opn,smooth		
						>6	Opn,rgh		
							Rubble (clayey)		
							Opn,rgh,clay		39.6'-44.3' LIMESTONE, argillaceous, as before, grayish orange (10YR 7/4) to dark yellowish orange (10YR 6/6), medium hard, slightly to moderately weathered, stylolitic, w/abundant MnOx specks throughout rock. 30% clay (light olive gray 5Y 6/1) common in fracture filling and partings, 2" vug with clay fill at 42.1', chert (30%) as nodules and lenses, as above, very light gray (N7) to grayish orange (10YR 7/4), fractured and healed.
							Opn,rough (4)		
40									
						5			
							Opn,rgh,FeOx		
41									
							Open, rough (4)		
						4			
							Opn,smooth, green clay		
42							Opn,rgh,thick med. gry clay		
							Rubble & Clay		
						6	Open,rgh,clay		
							Open, rough		
43									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 10

Project Number:

Hole Number MW-4010

Project: WSSRAP MW DRILLING

Location: N.100103 W.53030

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
43		Run4 con't		4		4	Open, rough Open, rough, sl. solution Open, rough		
44							Opn,rgh,clay, spun		44.3'-44.7' CHERT, as above light gray (N7)
		44.7				1			44.7'-45.7' LIMESTONE, as before, with 40% nodular chert as above minor microfossils, MnOx specks.
45		Run5 1.0/10.0 10%	45.7	5	1.0/10.0 10%	2	Open, rough, clay, MnOx Rough		45.7'-54.7' CORE LOSS - Retrieved silty sand cuttings from mud tank for interval (possible void?). Sand is mod. yellowish brown, well sorted, very fine, limey.
46					LP = .5'				
47					2 > 4"				
48									
49									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 10

Project Number:

Hole Number: MW-4010

Project: WSSRAP MW DRILLING

Location: N.100103 W.53030

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
50		Run5 con't		5		-			CORE LOSS, as above.
51						-			
52						-			
53						-			
54						-			
		54.7				-			54.7'-55.4' LIMESTONE argillaceous, as before, abundant MnOx, mod. weathered, grayish orange (10YR 7/4) with 30% chert, as before.
55		Run6 .8/10.0 8%	55.5	6	.8/10.0 8% LP = .8' 1 > 4"	1	Rough		55.4'-69.7' CORE LOSS. Retrieved silty sand cuttings from mud tank (void?). Sand is very fine (con't)
56						-			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 10

Project Number:

Hole Number MW-4010

Project: WSSRAP MW DRILLING

Location: N.100103 W.53030

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
57		Run6 Con't		5					to fine, with minor coarse grains, poorly sorted trimodal.	
58										
59										
60										
61										
62										
63										

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 9 of 10

Project Number:

Hole Number MW-4010

Project: WSSRAP MW DRILLING

Location: N.100103 W.53030

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
64		Run6 con't		5					CORE LOSS, as above
		64.7							
		Run7		5					
65		0			0%				
		5.0							
		0%							
66									
67									
68									
69									
		69.7							69.7'-77.0' LIMESTONE, light gray, with chert nodules at 73.8-74.0', 75.1-75.3, 75.6-75.8, 76.7-76.9, pale blue (5PB 7/2). Limestone is finely crystalline, hard, very slightly weathered (con't)
70	Upper Wthrd Limestone	Run8		5	4.6 / 7.3		Spun		
		7.3 / 7.3			63%		Opn,rgh,spun		
					LP = .7'	>6	Rgh,sl. spinning Rubble (some FeOx) Spun		
	70.8	100%							
	Lower Competent Limestone								

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 10 of 10

Project Number:

Hole Number MW-4010

Project: WSSRAP MW DRILLING

Location: N.100103 W.53030

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
71		Run8 con't		5	10 > 4"	2	Tight, rough(z)		to fresh, stylolite with clay in stylolites, fossiliferous, thickly bedded
72						2	Opn,rgh,stylolitic		
73						3	Open, rough, sl. stylolitic Opn,rgh,stylolitic Open, rough		
74						3	Tight, rough Open, rough		
75							Tight, rough		
				75.3/6		6	Open, rough(7)		
76						4	Opn,rgh,dark gry clay,solution Tight, smooth		77.0'
77									T.D. 77.0' Installed well consisting of 2" diameter stainless steel. Screen from 66.9' to 76.9', 0.010" slots. Sand pack to 64.6'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 9

Project Number:

Hole Number: MW - 4011

Project: WSSRAP - Monitor Well Drilling

Location:

Coordinates: N100457.6 W52720.5

Drilling Contractor: React/Layne Western

Drill Make and Model: CME 55/75; 7" Hollow Stem Auger; Core NQ wireline

Depth Top of Rock: 30.0

Depth Casing & Size: --

Hole Size: Reamed 8.5"

Elevation: Ground 626.9 ; 628.1 TOC

Angle from Vert. and Bearing: Vertical

Depth Bottom of Hole: 76.2 Reamed to 78.7'

Water Level:

Fluid & Additives: Water

Date Start: 03/08/88

Date Finish: 03/15/88

Logger: *Original C. Allen

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						3.5-4.6 SILTY CLAY, low plasticity, yellowish brown (10YR 5/6), moist, medium stiffness, minor grey mottling, some organics, some Fe and Mn staining, CL. 4.6-5.0 SILTY CLAY, moderate plasticity, very dark greyish brown (10YR 3/2), very moist, medium stiffness, Fe and Mn staining, CL.
		3.5 5.0	SS 01	18"	3-3-6 9		
	5						
		8.5 10.0	SS 02	18"	10-26-25 >50		CLAYEY GRAVEL, subangular chert bluish white (5B 7/1), 20 to 50% clay, high plasticity, brown (7.5YR 5/8) hard, slightly moist, pyrolusite, GC.
	10						
		13.5 15.0	SS 03	18"	12-40		CLAYEY GRAVEL, as above, gravel from coarse sand to fine gravel, 60% clay, GC.
	15						
		18.5 20.0	SS 04	14"	11-16-8 24		CLAYEY GRAVEL, gravel as above, low plasticity, reddish yellow (7.5YR 6/8) slightly moist, loose, Fe stained, GC.
	20						
		23.5 25.0	SS 05	11"	6-14-1 15		CLAYEY GRAVEL, as above, angular gravel, moist.
	25						

*Geotechnical information by: R. Parsons
P. Patchin

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 9

Project Number:

Hole Number MW - 4011

Project: WSSRAP - Monitor Well Drilling -

Location:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol.
	25						
							CLAYEY GRAVEL, as above, GC.
		28.5 30.0	SS 06	6"	1-40 for 6"		Begin NQ coring 30'
	30						Bedrock at 30.0'
							Cored from 30.0 to 76.2'.
							Core descriptions on pages 3 through 9

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 9

Project Number:

Hole Number: MW - 4011

Project: WSSRAP - Monitor Well Drilling

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
30		Run1 3.2/4.0 81%	30.4	2	1.5/4.0 = 38% LP= 0.5'		Rubblized zone		30.0-30.5 CHERT; bluish white (5B 9/1) to lt. bluish grey (5B 7/1); thick bedded; microcrystalline; vugs <5% pinpoint to 5 mm; siliceous in filling of joints; minor fossils (<5%); Fe stains; fresh and hard.
31			31.2		3 > 4"	4			30.5-37.1 LIMESTONE WITH CHERT; greyish orange pink (5YR 7/2); micro to coarse xtln; thick bedded; vugs <5% pinpoint to 2"; CHERT; bluish white (5B 9/1) to greenish grey (5G 6/1); thick bedded; micro xtln; vugs <5% pinpoint to 1 mm; <2% fossils; fresh and hard @ 33.8 to 34.0, @ 36.2 to 37.1
							Open, rough, FeOx (4)		
32							Open, spun		
							Open, rough		
						4	Open, spun		
							Tight		
33							Open, rough, spun		Solutionized LS with clay in filling @ 31.0 to 31.4
						3	Open, rough		
							Tight, stylolite		
34		34.0							
		Run2 1.9/2.2 85%			.4/2.2 = 18% LP= 0.4		Open, rough, Fe and MnOx		
						4	Open, rough		
							Open, rough (2)		
35			35.3		1 > 4"	X			
			35.6			X			
36		36.2							
		Run3			RQD		Open, rough (2)		
							Rubblized zone		
				2					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 9

Project Number:

Hole Number MW - 4011

Project: WSSRAP - Monitor Well Drilling

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
37		Run3 10.0/10.0 100%		2	5.7/10.0 = 57% LP= 0.7	4	Open, rough (3)		37.1-52.0 LIMESTONE ARGILLACEOUS WITH CHERT; LS greyish orange (10YR 7/4); massive; micro to fine xtln; vugs < 5% pinpoint to 2 mm; moderately weathered and mod. hard. Solution features @ 38.0-38.1, 38.5-38.7, 39.5-39.7. Chert nodules to 0.2' thick, <5% fossils fresh and hard.
							Open, rough		
38							Open, rough		
					13				
					4"	3	Open, rough		
							Open, rough, FeOx		
39									
						2	Open, rough		
				2			Open, rough		
				3					
40									
						4	Open, rough (4)		
41									
						3	Open, rough (4)		
42									
						2	Open, stylolite, MnOx		
43							Open, rough		
						3	Open, smooth FeOx		
				3			Open, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 9

Project Number:

Hole Number MW - 4011

Project: WSSRAP - Monitor Well Drilling

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
44		Run3 Cont.		3			Open, rough		As Above
						3	Open, rough		
45							Open, rough		
						2	Open, rough		
							Open, rough		
46		46.2					Open, rough		
		Run4 10.0 / 10.0 100%			6.6 / 10.0 = 66% LP= 0.9	4	Open, rough (3)		Solution Features @ 46.2-46.4 47.6-48.7 49.8-50.5
47					12 > 4"		Open, rough (3)		
						4	Open, rough		
48						1	Open, rough		
49				3			Open, rough (2)		
				4		3	Open, rough		
50							Open, rough (2)		
				4		2			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 9

Project Number:

Hole Number: MW - 4011

Project: WSSRAP - Monitor Well Drilling

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
51		Run4 Cont.		4		5	Open, rough Open, smooth Open, rough Open, rough Tight, MnOx		As Above
52						3	Tight, stylolite Open, rough, MnOx (2)		52.0-54.4 LIMESTONE; dark yellowish orange (10YR 6/6) thick bedded; micro to fine xtln; vugs <5% pinpoint; minor Mn filling; chert nodules to 0.6' thick fresh and hard
53						2	Open, rough		
54						1	Open, stylolite Open, stylolite		54.5-55.5 LIMESTONE ARGILLACEOUS WITH CHERT; grayish orange (10YR 7/4); massive; micro to fine xtln; vugs <5% pinpoint to 2 mm; chert nodules to 0.1' thick; fresh and hard.
55						2	Open, rough (2)		55.5-56.2 CHERT; lt. bluish gray (5B 7/1); thick bedded; micro xtln; vugs <5% pinpoint; fresh and hard
56		56.2 Run5 10.0 10.0 100%			5.4 10.0 = 54% LP= 0.7	4	Open, smooth Tight, stylolite Open, rough, MnOx Tight, stylolite MnOx		56.2-57.5 LIMESTONE; mod. orange pink (10YR 7/4) thin bedded; micro to fine xtln; <5% pinpoint vugs; fresh & hard
57					12 >4"	2	Open, rough Open, rough, FeOx		57.5-58.7 CHERT; lt. bluish grey (5B 7/1); mod. bedded; micro xtln; vugs <5%; argillaceous LS lens @ 58.3 to 58.5; fresh and hard
				4					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 9

Project Number:

Hole Number MW - 4011

Project: WSSRAP - Monitor Well Drilling

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
58	Upper weathered limestone	Run5 Cont.		4		4	Open, rough (2)		As Above
	Lower Competent bedrock	58.7							58.7-76.2 LIMESTONE; mod. orange pink (IOR 7/4) to grayish orange pink (5YR 7/2); thick bedded; micro to fine xtln; vugs <5% pinpoint; fossiliferous; chert nodules to .2'; chert bands @ 59.2-59.6 62.1-62.6 63.3-63.6 Fresh and hard
59				4			Open, rough (3)		
				5		2	Open, rough		
60							Open, rough		
						2	Open, rough, MnOx		
61							Open, stylolite, MnOx		
						3	Open, smooth		
62							Open, rough (2)		
						3	Tight		
							Open, rough		
							Rubblized zone		
63							Open, rough (3)		63.3-64.7 LIMESTONE; argillaceous; grayish orange pink (5YR 7/2); mod. bedded; micro xtln; <5% pinpoint vugs; no fossils; moderately weathered and moderately hard
						6	Open, smooth		
							Open, rough		
64							Open, spun		
							Open, rough (2)		
						5	Open, rough (3)		
				5					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 9

Project Number:

Hole Number MW - 4011

Project: WSSRAP - Monitor Well Drilling

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
65		Run5 Cont.		5		2	Open, rough (2)		As Above LS Same as Interval 58.7-76.2	
66		66.2								
		Run6 10.0 / 10.0 100%			8.9 / 10.0 = 89% LP= 1.5	1	Open, rough			
67					12 > 4"	2	Open, rough, MnOx Open, rough			
68						3	Open, rough Open, rough (2)			
				5						
69				6		2	Open, rough (2)			
70						2	Tight, stylolite Tight, stylolite MnOx			
71						3	Open, stylolite Open, rough, MnOx Tight, stylolite			
				6						

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 9 of 9

Project Number: —

Hole Number MW - 4011

Project: WSSRAP - Monitor Well Drilling

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
72		Run6 Cont.		6		2	Open, rough Tight, stylolite		As Above LS Same as Interval 58.7-76.2
73						4	Open, stylolite Open, rough Open, stylolite (2)		
74						2	Open, stylolite Open, rough		
75						2	Open, rough Open, rough, MnOx		
76				6					TD 76.2'

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 10

Project Number:

Hole Number: MW-4012

Project: WSSRAP MONITOR WELL DRILLING	Location: Open field west of service road in Bush reserve 25 yards N. or Hwy D.
Coordinates: N.101642.0 W.53034.3 (AEC)	Drilling Contractor: Layne-Western
Drill Make and Model: CME 55/75, 7" Hollow Stem Auger; NO Wireline Core	Depth Top of Rock: 33.0'
Depth Casing & Size: None	Hole Size: Reamed 8.5"
Elevation: 615.4 G.S.; 617.3 TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 80.2'	Water Level:
Fluid & Additives: Water	Date Start: 04/14/88
Date Finish: 04/19/88	Logger: *Original C.Allen/B.Fieselman

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0				Auger to 3.5'	XXX	TOPSOIL 1.0'
		3.5 5.0	SS 01	18"	3.3.3 6		SILTY CLAY, yellowish brown (10YR 5/8) slightly plastic, moist, medium stiff, with upper 3" containing rootlets, upper 9" very silty with abundant FeOx nodules, mottled gray (10YR 7/1). CL
	5						FERRELVIEW
		8.5 10.0	SS 02	18"	4.8.10 18		SILTY CLAY, mottled yellowish brown (10YR 5/8) and gray (10YR 7/1) plastic, moist, very stiff, with fine to coarse sand size chert fragments (10%) throughout. Increased MnOx staining going deeper, chert gravel to 3/4" from 9.2'-10.0', rounded igneous gravel also present. CH 9.0'
	10						CLAY TILL
		13.5 15.0	SS 03	18"	6.6.8 14		GRAVELLY CLAY, slightly silty, light olive brown (2.5Y 5/4), moist, stiff, 20% gravel sand size to 1". Limestone and chert gravel from 13.8'-14.0', MnOx and FeOx staining. CH
	15						
		18.5 20.0	SS 04	18"	3.4.4 8		SILTY CLAY, yellowish brown (10YR 5/6) moist, stiff with some minor chert and limestone fine gravel (5%). Limestone concretions? angular from 18.6-18.8, FeOx and MnOx staining grades to sandy clayey silt, pale brown (10YR 6/3) last 6" of interval. CL 19.5'
	20						BASAL TILL
		23.5 25.0	SS 05	18"	26.17.12 29		CLAYEY SILT, sandy, yellowish brown (10YR 5/6) to light gray (2.5Y 7/N7), very stiff, (con't)
	25						

*Geotechnical Information by: P. Patchin

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 10

Project Number:

Hole Number MW-4012

Project: WSSRAP MW DRILLING

Location: N.101642 W.53034

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25						slightly plastic, dry to damp, with abundant broken angular chert gravel to 1" throughout shattered angular chert lense @ 23.7-23.9'. ML
							BASAL TILL 28.0
		28.5 30.0	SS 06	18"	7.7.5 12		GRAVELLY LCLAY, (40% angular chert gravel) very moist to wet (bottom 6"), clay fraction very sticky to plastic, brownish yellow (10YR 6/8). CL.
	30						RESIDUUM 30.5'
							Cored from 30.5' to 80.2'. Core descriptions on pages 2 through 10. Driller called bedrock at 30.0' but while coring from 31-33', core cut very easily (soil); FTR determined bedrock at approx. 33' below ground surface.
	35						(RESIDUUM 30.5-33.0')

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 10

Project Number:

Hole Number: MW-4012

Project: WSSRAP MW DRILLING

Location: N.101642 W.53034

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
30		30.5							Begin Coring 30.5'
	RESIDUUM	Run1 2.0/7.5 27%		2	0/7.5 0%				Recovered 2.0' of broken weathered CHERT GRAVEL, very light gray (N8) to light bluish gray (5B 7/1), microcrystalline, slightly vuggy (10%) pinpoint to 5mm, no fossils, minor limestone interbedding near 38.0'. Upper section contains .9' of silty clay, red (2.5YR 4/6) with angular chert gravel (RESIDUUM).
31									
32									
33	Top of bedrock	33.0					5.5' of CORE LOSS Location unknown		
34									
35									
36									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 10

Project Number:

Hole Number MW-4012

Project: WSSRAP MW DRILLING

Location: N.101642 W.53034

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
37		Run1 con't		2					CHERT, as above
		38.0							
38		Run2		2	2.4/10.0		Open, smooth		38.0-41.0' - LIMESTONE, argillaceous, very pale orange, (10YR 8/2) to grayish orange (10YR 7/4) medium bedded finely crystalline, slightly vuggy (<5%) pinpoint, occasional chert nodules to 1.5" dia., slightly to moderately weathered, medium hard, FeOx specks, clay filling in some fractures.
		10.0/10.0				6	Open, rough (5)		
					24% LP = .9'				
39							Opn,rgh,calcite		
		100%					Opn,rgh ½"		
						>	Opn, rough		
							Open, spun		
						6	Open, rough ½"		
40					5 > 4"		Open, spun		
							Open, rough		
							Opn,smooth,FeOx		
						5	Opn,rgh,clay		
							Opn,smooth,clay		41.0-47.1' - LIMESTONE argillaceous, very pale orange (10YR 8/2) to grayish orange (10YR 7/4) medium bedding, finely xln, severely weathered and solutioned, vugs (25%) pinpoint to 1" with calcite and drusy quartz filling, interbedded and modular chert (20%) to 3" thick, minor shaley fractures, minor FeOx staining, clay filling (greenish) in some fractures.
41							Tight, rough		
						4	Tight, rough		
							Opn,rgh, 40°		
42							Open, rough		
						3			
							Open, rough		
43							Open, rough(2)		
						5	Opn,rgh,vuggy		
							Open, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 10

Project Number:

Hole Number MW-4012

Project: WSSRAP MW DRILLING

Location: N.101642 W.53034

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
44		Run2 con't		2			Tight, rough Open, rough		LIMESTONE, as above
				44.6		4	Open, rough 35% FeOx?		
				3			Tight,rough,clay		
45							Opn,rgh, clay Tight, rough Open, rough		
						5	Open, rough 30°, clay		
46							Tight,rgh,vugs calcite, qtz		
						1			
47							Open, shaley, green clay Open, stylolite clay Tight,rgh,vert		47.1-57.0' - LIMESTONE with interbedded and nodulous chert (15%) light gray (N8) to grayish orange (10YR 9/4) finely to coarsely crystalline, slightly to moderately wthrd, moderately hard, vugs <10% pinpoint to 10mm, minor recrystallization in weathered zones, fossiliferous, occasional solutioning.
						> 6	Open, smooth Rubble Open, rough		
48		Run3							
		10.0 / 10.0		3	3.8 / 10.0	2			
					38% LP = .8'		Open,rgh,FeOx?		
49		100%				> 6	Open, rough Open, spun Tight,smooth, FeOx?		
50					7 > 4"				
						6	Open, spun (7)		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 10

Project Number:

Hole Number MW-4012

Project: WSSRAP MW DRILLING

Location: N.101642 W.53034

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
51		Run3 con't		3			Open, rough (2)		LIMESTONE, as above
						3			
							Tight, rough		
52									
							Opn,rgh, FeOx		
						5	Open, rough (3)		
							Tight, rough		
53									
							Open, rough (3)		
						4	Opn,rgh, 10°		
							Stylolite		
54									
							Opn,rgh, FeOx		
				54	7	4	opn,rgh,wthrd (3)		
				4					
55									
							Tight, rough		
						3	Open, rough		
							Tight,rgh,30°		
56									
						1	Tight, rough		
57									57.0-58.0 CHERT, very light gray (N8) microcrystalline fresh, very hard with 2" limestone band grayish orange (10YR 7/4) (con't)
							Open, smooth (2)		
							Tight, smooth (2)		
						>	Tight, rough		
						6	Open, rough,FeOx		
							Open, smooth		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 10

Project Number:

Hole Number MW-4012

Project: WSSRAP MW DRILLING

Location: N.101642 W.53034

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
58		Run4		4	0		Open, rough		fossiliferous, fractured.
		1.0 / 1.0			1.0	>	Open, spun		
		100%			0%	6	Open, rough		
							Rubble w/clay		
59									59.0-68.3 LIMESTONE, slightly argillaceous, grayish orange (10YR 7/4) to bluish white (5B 9/1) medium bedded, micro to coarsely crystalline, with chert lenses and nodules up to 2" diameter, fossiliferous, abundant fossils 65.2-65.7 abundant styolites in lower portion with MnOx? deposition, some fractures with clay, 59.0-62.7 slightly weathered, 62.7-68.3 very slightly weathered. Shaley partings 63.0-63.5'.
		Run5		4	6.7 / 9.3		Tight,rgh,FeOx		
		9.3 / 9.3			72%	4	Open,rgh,clay(3)		
60	UPPER WTHRD LIMESTONE	100%			LP = 3.0'	>	Open, rough Rubble with abundant clay		
	60.7					6	Open, rough		
	LOWER COMPETENT				7 > 4"				
61	LIMESTONE								
						2	Stylolites(2)		
							Tight,smooth Stylolite, weak		
62									
						> 6	Open, rough		
							Rubble		
63							Open, rough		
							Stylolites (2)		
						1	Opn, stylolite MnOx?		
64									
						0			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 10

Project Number:

Hole Number MW-4012

Project: WSSRAP MW DRILLING

Location: N.101642 W.53034

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
65		Run5 con't		5		1	Stylolite, weak Stylolite		LIMESTONE, as above
66							Stylolite		
						1	Stylolites(3) Opn,rgh,MnOx		
67						2	Tight, rough (2)		
68							Opn,rgh,MnOx		
		68.3				3	Opn,rgh,clay & recrystalization Stylolite, weak		68.3-78.3 LIMESTONE, very light gray (N8) to bluish white (5B 9/1), medium bedded, finely to coarsely crystalline, vugs < 5%, pinpoint to 1½" with calcite and drusy quartz filling, hard, very slightly weathered, chert nodules and beds ½" to 2", interbeds of chert with minor L.S. from 69.9-79.9' (bluish white 5B 9/1), slightly fossiliferous, calcite xls up to 3/4" in solution area at 72.8' and 75.6', styolitic.
69		Run6 10.0/10.0 100%		5	6.7/10.0 67% LP = 1.1'	6	Open,rough Rubble Open, rough (2) Open, rough		
70					12 > 4"	3	Open, rough Opn,smooth,clay Stylolite Open,½" rgh, MnOx?		
71						2	Open, smooth Opn,smooth,clay MnOx?		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 9 of 10

Project Number:

Hole Number MW-4012

Project: WSSRAP MW DRILLING

Location: N.101642 W. 53034

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
72		Run6 con't		5			Opn,rgh,MnOx?		LIMESTONE, as above
						4	Open, rough Open cavity w/ calcite xls		
73							Open, rough		
						2	Open, rough,MnOx		
74				6			Tight, rough		
						3	Open, smooth black clay Tight, rough		
75						2	Tight,rgh,15°		
76						2	Stylolite Tight,rough Opn,rgh,MnOx StyloTitic		
77						3	Stylolite,weak Open, rough Healed, weak Stylolites(2) Tight, smooth		
78		78.3							78.3-80.2 LIMESTONE very light gray (N8) to bluish white (5B 9/1) as above, with chert nodules to 1/2" diameter, (con't)
		Run7 1.9/1.9		6	1.9/1.9 100%	1	Stylolites (2)		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 10 of 10

Project Number:

Hole Number MW-4012

Project: WSSRAP MW DRILLING

Location: N.101642 W.53034

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
79		RUN7 con't		6	LP = 1.9'	0	Stylolite		vugs, < 2% pinpoint, fresh very hard.
		100%					Stylolite		
80					1 > 4"	1	Stylolite, weak		
									T.D. 80.2'
									Installed well consisting of 2" diameter stainless steel. Screen 65.3' to 75.3', 0.010" slots. Sand pack to 62.7'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 6

Project Number:

Hole Number: MW-4013

Project: WSSRAP Monitor Well Drilling	Location: Approx. 1 mile north on Hwy. D from Hwy. 94
Coordinates: N.101916.0 W.52193.0 (AEC)	Drilling Contractor: Layne-Western
Drill Make and Model: CME-55/75 7" Hollow Stem Auger; NQ Wireline Core	Depth Top of Rock: 35.1'
Depth Casing & Size: 10" to 21.0'	Hole Size: 12" to 21.0' then 8"
Elevation: 606.8 G.S.; 608.7 TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 60.0'	Water Level:
Fluid & Additives: Water	Date Start: 5/31/88
Date Finish: 6/1/88	Logger: Original* T. Ruby/A. Harrington

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0				Auger to 3.5'	XXX	TOPSOIL/FILL 1.0'
							3.5'-3.9' SILTY CLAY, dark brown (10YR 3/3), moist, medium stiff, with topsoil, CL. LOESS 3.9'
		3.5 5.0	SS 01	16.2"	2.3.5 8		3.9'-5.0' CLAY, slightly silty, mottled yellowish red (5YR 4/6) and light gray (5Y 6/1) moist, medium stiff, slightly plastic, with roots, CL.
	5						FERRELVIEW 8.5'
		8.5 10.0	SS 02	10"	15.16.51 >50		8.5'-10.0' GRAVELLY CLAY, yellowish red (5YR 4/6), 45% very angular chert gravel (white) up to 1" size, damp, hard, slightly sandy, clay fraction highly plastic, CL.
	10						
		13.5 15.0	SS 03	16.2"	12.13.11 24		13.5'-15.0' GRAVELLY CLAY, dark red (2.5YR 3/6), 30% angular chert, sand size to 1", moist, very stiff, minor silt, clay fraction highly plastic, CL.
	15						RESIDUUM
		18.5 20.0	SS 04	13.5"	6.8.7 15		18.5'-20.0' GRAVELLY CLAY, reddish brown (2.5YR 4/4) Mottled with reddish yellow (7.5YR 6/8), 40% angular chert up to 1", moist, slightly plastic with some silt, stiff, CL.
	20						
		23.5 25.0	SS 05	15.3"	6.7.40 47		23.5'-24.0' GRAVELLY CLAY, yellowish brown, (10YR 5/8) moist, 25% angular weathered chert gravel to 1" , trace fine sand, hard, CL.
	25						

*Geotechnical Information by: P. Patchin

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 6

Project Number:

Hole Number MW-4013

Project: WSSRAP MW DRILLING

Location: N.101916 W.52193

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25						24.0'-25.0' GRAVELLY CLAY, silty, brown (10YR 5/3) to dark btown (10YR 3/3), angular chert gravel, moist, soft, trace fine sand, CL.
		28.5 30.0	SS 06	8.1"	3.4.4 8		28.5'-30.0' GRAVELLY CLAY, sandy, silty, 20% angular chert up to 1.2", dark yellowish brown (10YR 4/6), moist-wet, hard, minor sand, CL.
	30						RESIDUUM?
		33.5 35.0	SS 07	0"	40/0"		35.1'
	35						Top of bedrock @ 35.1' Cored from 35.1' to 60.0'. Core description on pages 3 through 6.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 6

Project Number:

Hole Number MW-4013

Project: WSSRAP MW DRILLING

Location: N.101916 W.52193

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
							Begin Core 35.1		
35	35.1'	Run1 7.2/8.6 84%		1	1.5/8.6 17%	5	Open, rough Open, smooth Open, rough Open, smooth Open, rough		35.1'-40.1' INTERBEDDED ARGILLACEOUS LIMESTONE AND CHERT, grayish orange (10YR 7/4) to yellowish gray (5Y 7/2) with approx. 30% chert, light gray to white (N8 to N9). L.S. is massive, finely xln, moderately hard, moderately weathered, solutioned, minor stylolites vuggy (≈40%) pin-point to .1', vugs partially filled with calcite or drusy quartz. Less weathered with depth.
36					LP = .4' 4 > 4"	6	Open, rough Open, rough (4)		
37									
38			38.3			3	Open, rough Opn,rgh, clay		
39						5	Open, rough Open, rough Open, rough (4)		
40						6	Stylolite,clay Opn,smooth,clay Opn,rgh,clay Fractured,healed w/calcite Rubble		40.1'-45.0' LIMESTONE, argillaceous grayish orange (10YR 7/4) and yellowish gray (5Y 7/2) massive, moderately hard, moderately weathered, finely crystalline, slightly vuggy (≈10%) with approximately 30% chert as nodules and interbeds, light gray (N7).
41						3	Open, rough Stylolite Open, rough Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 6

Project Number:

Hole Number MW-4013

Project: WSSRAP MW DRILLING

Location: N.101916 W.52193

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
42		Run1 con't					Tight,rgh,20°		LIMESTONE, as above
				42.3 / 2		3	Open,rgh,40°		
43							Tight, smooth		
			43.5			5	Open, rough (3)		
		43.7							
		Run2		2			Open, rough		
44							Opn,smooth,25°		
		6.4 / 8.0			2.2 / 8.0		Tight, rough		44.3'-45.0' CHERT, light gray (N7) with argillaceous limestone (40%) interbedded as above.
							Open, smooth		
		80%			28%	7	Tight, rough		
							Open, smooth		45.0'-47.3' CHERT, light gray (N7) hard, very slightly weathered with 20% argillaceous limestone lenses from 45.4-46.1, chert has fossil hashes and crinoid stems up to 1", with occasional healed fractures.
45					LP = .6'		Healed		
						1	Open, rough		
46					5 > 4"				
							Open, smooth		
						2			
47							Open, rough		47.3'-50.8' LIMESTONE, grayish orange (10YR 7/4) to medium light gray (N7) fine to medium crystalline, slightly weathered with pinpoint vugs, fossiliferous stylolites, with FeOx specks and chert nodules (10%).
							Tight, rough		
						5	Open, rough		
							Open, smooth		
48									
							Tight, rough		
						4	Open, rough		
							Open,rgh,stylolite		
49							Open, smooth		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 6

Project Number:

Hole Number MW-4013

Project: WSSRAP MW DRILLING

Location: N.101916 W.52193

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
49		Run2 con't	49.5			2	Open, smooth (2)		LIMESTONE, as above
50			50.2				Open, smooth Rubble		
						>	Open, smooth		
			50.3			6	Open, rough		50.8'-51.7' CORE LOSS
51	Upper weathered Limestone?								
		51.7				2	Open, spun		51.7'-60.0' LIMESTONE with chert lenses and nodules (15%), very pale orange (10YR) to light olive gray (N7), slightly vuggy with quartz, slightly weathered, hard, stylolitic MnOx clay? coating on fractures, calcite xls in fractures, fossiliferous, crinoid stems.
52	Lower Competent Limestone?	Run3		3	5.6		Open, rough		
		7.9/8.3 95%			8.3 67%	2	Open,smooth,20° Tight, smooth		
53					LP = 1.2'	3	Tight, rough Tight, smooth		
54					10 > 4"		Tight, rough		
						3	Open,rgh,clay Open, smooth(2)		
55						3	Opn ¼",smth cly Opn,smth,blk cly Stylolite Tight,rgh,clay		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 6

Project Number:

Hole Number: MW-4013

Project: WSSRAP MW DRILLING

Location: N.101916 W.52193

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
56		Run3 con't							LIMESTONE, as above	
						0				
57							Tight,rgh,calcite			
						2	Tight,rgh,MnOx clay?			
58										
						3	Tight, smooth			
							Open,rough			
59							Open, spun			
							Opn,spun,MnOx?			
			59.6			3	Open, rough			
60										60.0'
									T.D. 60.0'	
61									Installed well consisting of 2" diameter stainless steel. Screen 39.5' to 59.5', 0.010" slots. Sand pack to 37.5'.	
62										

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 6

Project Number:

Hole Number: MW 4014

Project: WSSRAP Monitoring Well Drilling	Location: West side of Highway D, one mile north of Highway 94.
Coordinates: N.102267.3 W.51592.4 (AEC)	Drilling Contractor: Layne-Western
Drill Make and Model: CME 55/75, 7" Hollow Stem Auger; NO Wireline, Core	Depth Top of Rock: 54.2'
Depth Casing & Size: 10" to 42.0"	Hole Size: 12" to 42'; Reamed to 8.5"
Elevation: 607.5'; 609.1' TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 66.4'	
Water Level:	Fluid & Additives: Water
Date Start: 05/25/88	Date Finish: 05/26/88
Logged: Original* T. Ruby	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						Silty Clay, medium plastic with organics, yellow brown (10YR 5/4,4/4), mottled gray and black, dry to moist, stiff, CL.
		3.5 5.0	SS 01	15"	3.4.7 11		
	5						FERRELVIEW?
							Silty Clay, highly plastic, some organics, light yellow to olive brown (2.5Y 6/4, 5/4), moist, very stiff, CH. Black zone at 9.7'.
		8.5 10.0	SS 02	14"	4.7.14 21		
	10						FERRELVIEW?
		13.5 15.0	SS 03	15"	5.7.21 28		Mottled with gray and black, dry
	15						Clayey Silt, highly plastic, light yellow brown (10YR 6/4), dry, very stiff, discing MH
							FERRELVIEW? 17.0'
		18.5 20.0	SS 04	17"	12.18.30 48		Silty Clay, highly plastic, with chert pebbles, mottled brownish yellow (10YR 6/6), strong brown (7.5YR 5/6) and dark red (2.5YR 3/6), dry, hard, CH.
	20						CLAY TILL?
		23.5 25.0	SS 05	14"	26.21.40 61		Clay, slightly plastic, with chert fragments, dark red (2.5YR 3/4), moist, hard, CL.
	25						CLAY TILL?

*Geotechnical Information by: P. Patchin/D. Reynolds

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 6

Project Number:

Hole Number: MW 4014

Project: WSSRAP MW DRILLING

Location: N.102267 W.51592

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25						
	30	28.5 30.0	SS 06	18"	15.15.15 30		Clay, slightly plastic with chert fragments, dark red (2.5YR 3/4); moist, very stiff, CL.
							CLAY TILL?
	35	33.5 35.0	SS 07	2"	40-2"		Hard
							37.0
	40	38.5 40.0	SS 08	7"	4.5.12 17		Silty Clay, slightly plastic, trace fine sand with weathered chert and limestone fragments, yellow (2.5YR 7/4) and yellowish brown (10YR 5/4), moist, very stiff, CL.
							BASAL TILL? 42.0'
							Top of bedrock @ 42.0' Cored from 42.0' to 66.4. Core descriptions on page 3 through page 6.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 6

Project Number:

Hole Number MW 4014

Project: WSSRAP MW DRILLING

Location: N.102267 W.51592

DEPTH	COMMENTS (TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION)	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION)	GRAPHIC LOG	LITHOLOGY (MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION; CEMENTATION HARDNESS WEATHERED STATE)
42		RUN1 1.0/5.8 17%	42.5	1	0/5.8 = 0%	> 4	Open, rough		42.0-42.5 LIMESTONE argillaceous, pale yellowish orange, (10YR 8/6), finely crystalline, chert nodules, voids-pinpoint to 1" solution cavities, hard, moderate weathering
43									42.5-45.5 CORE LOSS Location uncertain.
44					LP = .2 VO 4"	-			
45						-			
46			45.5 46.0			-	Rubble zone		45.4-46.0 As above rubblized; 46.0-47.8 CORE LOSS VOID, high water loss
47						-			
48		47.8 RUN2				-			47.8-48.3 CHERT white (N9) weathered with clay, rubblized hard, moderate weathering
49		0.5/3.0 17%	48.3		0/3.0 *0% LP = 0	-	Rubble zone		48.3-50.8 CORE LOSS Location uncertain

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 6

Project Number:

Hole Number MW 4014

Project: WSSRAP MW DRILLING

Location: N.102267 W.51592

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
49		RUN2 con't		1	0 > 4"	-			
50									
		50.8				-			Auger (Split Spoon Sample) 50.8-51.3 CHERT FRAGMENTS most of matrix material washed out by drilling, contains some silt and clay (7.5 4/6) medium brown, calcareous, very wet
51		RUN3							
		0.45 / 0.90 50% 51.7	51.3		0 / 0.9 = 0%	-	Rubble Zone		51.3-51.7 CORE LOSS LOCATION UNCERTAIN
52		RUN4		2					
		6.1 / 6.1 100%			3.4 / 6.1 = 56%	>1	Rubble Zone		51.7-52.6 CHERT FRAGMENTS white (N9) and light gray (N8) rubblized
53							Open, rough		52.6-55.0 LIMESTONE light olive gray (5Y 6/1), massive, finely crystalline, white chert nodules up to 2", fossilized, hard, very slight weathering.
							Tight, rough		
							Open, rough		
							Open, rough		
							Rubble Zone		
54	Upper Weathered				LP = 1.3' 6 > 4"	>5	Open, rough		
							Rubble Zone		
	Limestone	54.2					Open, rough		
	Lower Competent Limestone					3	Tight, rough		
55							Tight, rough		55.0-57.7 INTERBEDDED LIMESTONE AND CHERT light olive gray (5Y 6/1) with light gray chert (N7) mottled, few vugs-pinpoint .1', fossils in chert (con't)
							Part. Healed		
							Tight, rough		
							Tight, rough		
						3			
							Healed		
56							Tight, rough, stylolite, MnOx		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 6

Project Number:

Hole Number: MW 4014

Project: WSSRAP MW DRILLING

Location: N. 102267 W.51592

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
56				2		0			hard, very slight weathering
57									
		57.8				3	Tight, rough Open, rough		57.8-66.4 LIMESTONE very light gray (N8) to yellowish gray (5Y 7/2). Section 57.8-58.4 is medium gray (N5); 58.4-59.1 very dark possible manganese staining. Core is massive, medium to coarsely crystalline, occasional chert nodules, few vugs-pinpoint stylolites, hard, very slight weathering.
58		RUN5					Open, rough		
		8.6 / 8.6 100%			7.2 / 8.6 = 84%	1	Open, rough, stylolite, MnOx		
59									
					LP = 1.29' 4"	2	Open, rough, stylolite, MnOx Stylolite, tight Open, rough		
60									
						0	Stylolite, tight		
61									
				61.4 / 3		2	Tight, rough Open, rough Stylolite		
62									
						7	Open, rough Tight, rough		
63							Open, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 6

Project Number:

Hole Number MW 4014

Project: WSSRAP MW. DRILLING

Location: N.102267 W.51592

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
63		RUN5 con't		3			Open, rough Open, rough		LIMESTONE as above
						4	Tight,rough 35°		
64									
							Open, rough		
						3			
65							Open, rough		
							Stylolites,tight		
						1	Open,rough,MnOx		
66									
							Stylolite, tight		
									T.D. 66.4' Installed well consisting of 2" diameter stainless steel. Screen 65.0' to 45.0', 0.010" slots. Sand pack to 43.0'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 8

Project Number:

Hole Number: MW 4015

Project: WSSRAP Monitoring Well Drilling	Location: Vicinity property north of site
Coordinates: N.102150.1 W.50509.5 (AEC)	Drilling Contractor: Layne-Western
Drill Make and Model: CME 55/75 7" Hollow Stem Auger; NO Wireline Core	Depth Top of Rock: 13.0'
Depth Casing & Size:	Hole Size: Reamed 8.5"
Elevation: 617.9; 619.6 TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 60.1', Reamed to 63.2'	
Water Level:	Fluid & Additives: Clear Water
Date Start: 05/18/88	Date Finish: 05/19/88
Logger: Original* T. Ruby	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						
		3.5 5.0	SS 01	18"	3.6.11 17		Slightly silty clay, medium plasticity, 5% fine gravel, MnOx staining, mottled yellow brown (10YR 5/6), gray and black (5Y 2.5/1), moist, very stiff, CL. root structures.
	5						Clay, highly plastic, 10% fine gravel, 5% sand, organics, MnOx stringers, brownish yellow (10YR 6/6), moist, hard, CH, root structures.
		8.5 10.0	SS 02	14.4"	8.15.16 31		CLAY TILL 9.3'
	10						Clay with chert gravel to 2", subrounded, yellowish red (5YR 4/6), moist, hard, CL. MnOx staining.
							RESIDUUM 13.0'
	15						Bedrock @ 13.0' Cored from 13.0 to 60.1'. Core description pages 2 to 8.

*Geotechnical Information by: P. Patchin/D. Reynolds

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 8

Project Number:

Hole Number: MW 4015

Project: WSSRAP MW DRILLING

Location: N.102150 W.50509

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
13	Core Loss 13.0-15.3	RUN1 2.0/4.3		1	0.4 4.3 = 9%				
14									
	Bit dropped	47%			LP = .4'				
15					1				
			15.3		>4"	4	Open, rough; Tight, smooth, 90° (vertical)		15.3-32.1 Interbedded chert and limestone. Very light gray (N8) to pinkish gray (5YR 8/1). Predominantly chert (70%) to limestone (30%) microcrystalline, hard, vuggy (10%) pinpoint to 0.1', fracturing, solutioned, fossiliferous-occasional crinoids. Limestone very light gray (N8) pinkish gray (5YR 8/1) coarsely crystalline section at 26.3-27.3, 30.5-30.9, 31.8-32.1. Chert at 15.3-16.5, 19.4-19.6, 27.9-28.2, 30.1-30.4. Percentage of limestone increases at ≈24.5' to 50% L.S. 50% chert. Entire interval is slightly to moderately weathered.
16							Open, rough		
							Rubble		
						3			
17							Open, rough		
		17.25							
		RUN2 5.0/7.0			2.9 7.0 = 41%	2	Rubble; Open, rough		
18							Open, rough, FeOx		
		71%			LP = 0.7'	2	Open, rough		
19					6 >4"		Open, rough		
							Stylolite		
						2	Tight, smooth		
20							Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 8

Project Number:

Hole Number: MW 4015

Project: WSSRAP MW DRILLING

Location: N.102150 W.50509

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
20		RUN2 con't		1					Interbedded chert and limestone as above 20.5-22.5 CORE LOSS
			20.5			1	Open, rough		
21									
22									
			22.5			1	Open, rough		
23									
							Open, rough weathered		
							Open,rough,FeOx		
24						4	Tight, rough vertical		
		24.3	24.3						
		RUN3		2	3.4		Rubble		
		7.8 / 7.8			7.8 = 44%	2	Open, rough		
25							Open, rough		
		100%			LP = 0.7'	2	Open, rough Rubble		
26							Open, rough		
					7 > 4"	3	Open, rough, Stylolitic		
							Open, rough		
27									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 8

Project Number:

Hole Number MW 4015

Project: WSSRAP MW DRILLING

Location: N.102150 W.50509

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
27		RUN3 con't		2			Tight, rough Open,rough,FeOx Rubble		Interbedded chert and limestone as above
						4	Open,rough,40°		
28							Open,rough,vgy		
						3	Open, rough		
29							Tight,rough,FeOx Open,rough,FeOx		29.1-29.6 Moderately severe weathering with elongate vugs parallel to bedding up to 1½" long.
						4	Open, rough,FeOx		
30									
						3	Open, rough Healed,vertical Open, rough, Stylolitic		
31							Open, rough, shaley Stylolite		
						2	Open, rough		
32							Mechanical		32.1-34.9 LIMESTONE very pale orange (10YR 8/2) to very light gray (N8) argillaceous massive, mod. hard, very slightly to slightly wthrd, coarse crystalline, vugs pinpoint to 0.1', chert nodules throughout up to .15', few fossils zone 33.6-33.7 limestone, very argillaceous, fine grained, grayish orange (10YR 7/4).
		32.1							
		RUN4 10.0/10.0 100%		2	3.0/10.0 = 30%	5	Tight, rough Open, rough		
33							Open, rough		
					LP = 0.6'	5	Tight, rough Open, rough Rubble		
34					6 >4"		Open,rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 8

Project Number:

Hole Number: MW 4015

Project: WSSRAP MW DRILLING

Location: N.102150 W.50509

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	DISCONTINUITIES: FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
34		RUN4 con't		34.1 / 3			Open, rough		
						3			
35									34.9-36.2 CHERT mottled ranges from light gray (N8) to yellowish gray (5Y 5/2) to light olive gray (5Y 5/2) microcrystalline, very slightly weathered, hard, minor vugs-pinpoint to 0.5'; fossiliferous crinoid stems, 5% intermixed limestone .
							Tight, smooth Open, rough Open, rough		
						4	Open,smooth,25° w/FeOx		
36							Open, rough		
							Open, rough		
						3			36.2-45.2 LIMESTONE grayish orange (10YR 7/4) argillaceous, massive, slightly to moderately weathered, hard, finely crystalline, vugs pinpoint to 0.1'? chert nodules throughout-pinpoint to .50' few fossils solutioned, 36.2-37.9 severely weathered and rubbly.
37									
							Rubble		
						1			
38									
							Open, rough		
							Tight,rough,FeOx		
						4			
							Open, smooth		
39									39.0-39.4 very argillaceous
							Open, rough		
						3			
40									
							Open, rough		
						3			
41							Open,rough,w/cly		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 8

Project Number:

Hole Number MW 4015

Project: WSSRAP MW DRILLING

Location: N.102150 - W.50509

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
41		RUN4 con't		3					Limestone, as above
						1	Open, rough		
							Stylolite		
42									
		42.1					Open,smooth,40°		
		RUN5 10.0/10.0 100%			6.7/10.0 = 67%	2	Open, rough		
43									
					LP = 1.1' 15 V 4"		Open, rough		
						2	Open, rough		
44									
				44.1/4			Open, rough, cly		
							Open, rough		
						4	Open, smooth		
45							Open, rough		
									45.2-50.4 LIMESTONE yellowish gray (5Y 7/2) to light olive gray (5Y 6/1), argillaceous. Chert nodules at 45.7' from 0.1' to 0.35'. Chert is very light gray to medium gray (N8) vugs pinpoint to 0.15', slightly weathered, hard to moderately hard.
						1	Open, rough		
46									
							Tight, smooth		
							Open, rough		
							Rubble		
						4	Open, rough		
47							Open, rough		
							Open, rough		
						3			
48									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 8

Project Number:

Hole Number MW 4015

Project: WSSRAP MW DRILLING

Location: N. 102150 W. 50509

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
48		RUN5 con't		4			Open, rough		
						3	Open, rough		
49							Open,smooth,20°		
						0			
50									
							Open, rough,FeOx & clay filling		50.4-51.0' LIMESTONE very light gray (N8) to light gray (N7) coarsely crystalline, massive, stylolitic, hard to moderately hard, very slightly to slightly wthrd.
							Open,rough,clay		
							Stylolite		
51							Tight, rough		
							Opn,rough,$CaCO_3$		51.0-52.7' LIMESTONE grayish orange (10YR 7/4) argillaceous, massive, finely crystalline, stylolites, manganese specs, increasing % of chert nodules and manganese specs, hard to moderately hard, very slightly to slightly wthrd.
							Tight, rough		
52							Open, rough		
		52.1							
		RUN6			3.8		Mechanical		
		8.0 / 8.0			3.0 =		Open, rough		
53		100%			48%		Tight, rough		52.7-53.8' LIMESTONE very pale orange (10YR 8/2) to light gray (N7), massive, coarsely crystalline, chert nodules, fossils, stylolites, hard, very slightly to slightly weathered.
					LP = 0.7'		Tight,healed,vert		
							Opn,rgh,calcite		
							Open, rough		
			53.8 / 5		8 / 4"		Open, rough		53.8-56.5' LIMESTONE grayish orange (10YR 7/4) argillaceous, massive, finely crystalline, interbedded chert nodules, manganese specs, solutioned, hard to moderately hard, vugs pinpoint to 0.1'.
54									
							Open, rough		
							Open, rough		
							Tight, rough		
55									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 8

Project Number:

Hole Number MW 4015

Project: WSSRAP MW DRILLING

Location: N.102150 W.50509

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
55		RUN5 con't		5			Tight,vgy,rough		slight to moderate weathering
							Open, rough		
							Tight, smooth		
56							Open, rough		
							Rubble		
	Upper Weathered Limestone						Open, rough		
		56.5'					Tight, smooth		56.5-60.1 LIMESTONE
57	Lower Competent Limestone								very pale orange (10YR 8/2) to very light gray (N8) fine to medium crystalline, vugs-
							Open, rough		0.05-0.50', few fossils,
							Tight,smooth,15°		stylolite,manganese oxide,
							Tight, rough		fresh, chert at 59.8-59.9',
									60.0-60.1', 59.1-59.4',
58							Stylolite		57.6-57.8' and 57.0-57.1'.
									Core hard to moderately hard,
							Tight, rough		very slight weathering.
							Open,rough,MnOx $CaCO_3$		
59							Tight, rough		
							Tight, rough		
							Tight, smooth		
							Tight, rough		
60							Open, rough		
									T.D. 60.1'
									Reamed to 63.2'. Installed well consisting of 2" dia. stainless steel. Screen from 63.05' to 43.05', 0.010" slots. Sand pack to 40.0'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 10

Project Number:

Hole Number: MW 4016

Project: WSSRAP Monitoring Well Drilling	Location: North of Site
Coordinates: N.102002.9 W.49981.7	Drilling Contractor: Layne Western
Drill Make and Model: CME-55/75, 7" Hollow Stem Auger; NQ Wireline Core	Depth Top of Rock: 30.0'
Depth Casing & Size: None	Hole Size: Reamed 8.5"
Elevation: 643.1'; 644.0' TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 85.3'	Water Level:
Fluid & Additives: Clear Water	Date Start: 3/2/88
Date Finish: 3/7/88	Logger: Original* C. Allen/B. Fieselman

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						
		3.5 5.0	SS 01	18"	4.8.6 14		3.5-5.0 Clayey silt, yellowish brown (10YR 5/4) with orange mottling, medium stiff, FeOx, nodules wet, Mn staining, root particles ML.
	5						LOESS 7.0'
							FERRELVIEW? 8.5-10.0 CLAY silty, yellowish brown (10YR 5/4) orange mottling, medium stiff, high plasticity, very moist, minor iron staining, root particles at top of sample, mottling fades towards bottom of sample, < 5% chert gravel to 1/8", angular stiff, CL.
		8.5 10.0	SS 02	18"	3.6.7 13		
	10						12.0'
							13.5-15.0 CLAY silty, yellowish brown (10YR 5/4) gray mottling, stiff, high plasticity, moist, Mn and Fe staining more abundant than previous sample, occasional fine to coarse sand and fine gravel composed of chert and rounded igneous rock, CH.
		13.5 15.0	SS 03	18"	4.6.7 13		
	15						CLAY TILL
							18.5-19.2 Gravelly clay, yellowish brown (10YR 5/4) gray mottling, very stiff, high plasticity, moist, Mn staining, fine to coarse sand size chert and limestone fragments (10%) very stiff, CH
		18.5 20.0	SS 04	18"	6.11.14 25		19.2-20.0 As above with (20%) gravel size chert, up to 1", moist, more abundant Mn and Fe staining, very stiff, CL.
	20						23.5-25.0 Gravelly clay, silty, yellowish brown (10YR 5/4) very stiff, high plasticity, moist, Mn staining, minor Fe staining, coarse sand to fine gravel size limestone and chert fragments, and rounded mafic gravel, total (10%), CL.
		23.5 25.0	SS 05	18"	3.6.9 15		
	25						

*Geotechnical Information by: P. Patchin/D. Reynolds

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 2 of 10

Project Number:

BOREHOLE LOG

Hole Number: MW 4016

Project: WSSRAP MW DRILLING

Location: N.102003 W.49982

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25						28.5-30.0 Gravelly Clay, silty, yellowish brown (10YR 5/4) very stiff, high plasticity, moist, abundant Mn staining, minor Fe nodules, coarse sand to fine gravel size limestone and chert fragments, some small calcite grains, interbedded clay-light gray (2.5YR 7/2). CL
		28.5 30.0	SS 06	18"	6.9.13 22		
	30						30.0'
							Bedrock at 30.0' Cored from 30.6' to 85.3'. Core description on pages 3 through 10.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 10

Project Number:

Hole Number: MW 4016

Project: WSSRAP MW DRILLING

Location: N.102003 W.49982

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
30									Interval 30.0 to 30.6--No log available
30.6	Begin Core	30.6							
31		RUN1		2	0.5/0.0				Location of core loss unknown, possible voids throughout. Entire run encountered intermittant voids up to 2" about every 4"-6".
32		2.8/10.0 = 28%			5% LP = 0.5'				
33					1 > 4"				
34									
35									
36									
37									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 10

Project Number:

Hole Number MW 4016

Project: WSSRAP MW Drilling

Location: N.102003 W.49982

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
37		RUN1 con't		2					Location of core loss unknown, possible voids
38			37.8						37.8-40.6? Chert Gravel with clay, chert is white (N9) moderately hard, MnOx, moderately weathered, sub-angular, from 1/16" to 2-1/2" in size, vuggy; clay is dark reddish brown (10YR 3/2) makes up approximately 10%. Bedded chert from 39.7-40.2? light bluish gray (5B 7/1) massive, minor vugs, (< 2%) up to 2mm, fossiliferous (30%).
39							Gravel Zone		
40						>1	Open,rough,FeOx		40.6-41.6 CHERT, grayish orange (10YR 7/4), vuggy, clay filling of vugs and fractures (20%) fossiliferous, microcrystalline.
		40.6				>2	Open,rough,FeOx Rubble Zone Open,rough,FeOx		
41		RUN2		2	2.9 / 10.0				
42		5.5 / 10.0 = 55%			29% LP = 18	>2	Open,rough,FeOx Rubble Zone Open,rough,FeOx		41.6-41.9 CHERT, white (N9) to very light gray (N8) vugs up to 1 cm, fossiliferous as above.
43					6 > 4"	>3	Open,rough,FeOx Rubble Zone Open,rough,FeOx		42.0-42.4 LIMESTONE very pale orange (10YR 8/2) solutionized and fractured, moderately weathered, hard, vugs to 1cm, interbedded chert (20%).
44						>3	Open,rough,FeOx Rubble Zone Open,rough,FeOx		42.4-43.0 As above but with 30% chert. 43.0-45.1 Limestone, with interbedded chert, section (cont'd)

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 10

Project Number:

Hole Number MW 4016

Project: WSSRAP MW DRILLING

Location: N.102003 W.49982

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
44		RUN2 con't		2			Tight, rough Open,rough,FeOx		43.0-45.1? LIMESTONE, with interbedded chert, section of core is rubblized (44.3-44.9) with vuggy chert pieces; limestone is very pale orange (10YR 8/2) finely crystalline with vugs up to 4mm, silicious and MnOx infilling of vugs, fossiliferous occurring in 1" bands, slightly weathered, moderately hard.
45						>3	Rubble Zone Open,rough,FeOx		
			45.1				Open, rough		
46						>1			
47									
48									
49									49.6-50.6 LIMESTONE, CHERTY as above with stylolites
50			49.6			>2	Open, rough Open, rough, stylolitic		
		50.6				2	Stylolite, tight Open, rough		
51		RUN3		3			Open, rough		50.6-61.4 LIMESTONE, with interbedded chert (con't)

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 10

Project Number:

Hole Number MW 4016

Project: WSSRAP MW DRILLING

Location: N.102003 W.49982

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
51		10.3/10.0		3	5.4/10.3 = 52%	5	Open, rough (5)		Limestone is very pale orange (10YR 8/2) marly, slightly to moderately weathered, moderately hard; vuggy, microcrystalline. Chert is very light gray (N8) fossiliferous, MnOx and FeOx staining in vugs and fractures, solution features up to 1cm, @ 51.3'-51.8' and 60.1-60.4. Approximately 60% limestone, 40% chert.
52		103%							
53					LP 1.2' 9 > 4"	3	Open, rough Tight, rough		
54						2	Open, rough Tight, rough		
55						4	Open, rough(4)		
56						6	Tight, rough(3) Tight, rough Open, rough		
57						2	Tight, rough Tight, rough		
58						1	Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 10

Project Number:

Hole Number: MW 4016

Project: WSSRAP MW DRILLING

Location: N.102003 W.49982

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
58		RUN3		3			Tight, rough		LIMESTONE, as above
						3	Open, rough Tight, rough		
59									
							Healed Tight, rough Stylolite, tight		
				59.8		4	Open, rough		
60									
				4			Open, rough Rubble Zone Open, rough		
						>4			
		60.9							
61							Open, rough		
		RUN4 10.0 10.0 100%		10.0	5.4 10.0 = 54%	>4	Rubble Zone Tight, smooth		61.4-62.3 LIMESTONE as above, pale orange (10YR 8/6) argillaceous, finely crystalline, very fine sand size calcite grains
62									
					LP = 2.1 4 >4"	5	Open, rough (4)		62.3-64.3 Limestone with interbedded chert as in 50.6-61.1. Vuggy with solution features throughout.
63									
						4	Tight, rough Open, rough		
64									
						2	Tight, rough		64.3-65.0 LIMESTONE same argillaceous L.S. as 61.4-62.3
65									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 10

Project Number:

Hole Number MW 4016

Project: WSSRAP MW DRILLING

Location: N.102003 W.49982

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
65		RUN4 con't		4		0			65.0-67.6 Interbedded chert (~50%), and argillaceous limestone (~50%) as in 62.3-64.3, finely crystalline, slightly weathered, hard.
66									
67						1	Tight, rough, Stylolite		
68						1	Tight, rough, Stylolite, MnOx Stylolites, tight		67.6-72.2 CHERT (60%) interbedded with marlstone (40%), chert is light bluish gray (5B 7/1), marlstone is very pale orange (10YR 8/2), massive, micro to coarse crystalline, moderately weathered, moderately hard to hard, vuggy pinpoint to 2cm, slightly fossiliferous.
69						3	Tight, rough Open, rough		
70				69.8 / 5		0			
71		70.9				4	Tight, rough Open, rough		
72		RUN5 10.0 / 10.0 100%		5	4.7 / 10.0 = 47%	7	Open, rough Tight, rough Open, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 9 of 10

Project Number:

Hole Number MW 4016

Project: WSSRAP MW DRILLING

Location: N.102003 W.49982

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
72		RUN5		5	LP = 0.8' 7 > 4"	2	Open, rough Tight, rough		72.2-73.7 LIMESTONE argillaceous, minor chert, (20%) slightly weathered and vuggy
73									73.7-74.6 CHERT, bluish white (5B 9/1) to light bluish gray (5B 7/1) massive, fractured, minor limestone, fossiliferous, moderately weathered.
74	↑ Upper Weathered					6	Open, rough, MnOx (6)		
75	Limestone 74.2 Lower Competent Limestone ↓					4	Open, rough Open, rough, MnOx Tight, rough, Stylolite, MnOx Healed		74.6-80.9 LIMESTONE with chert lenses. Limestone (80%) is very light gray (N8) to light gray (N7), massive, thickly bedded, micro to coarsely crystalline, minor vugs near fractures and chert contacts, fossiliferous, very slightly weathered, hard. Chert is bluish white (5B 9/1) to light bluish gray (5B 7/1), very hard, bedded and nodular, fractured. Chert at 75.5-75.6, 75.7-75.8, 77.0-77.6, 78.1-78.4, 79.0-79.4, 80.0-80.2, 80.5-80.9.
76						3	Stylolite, tight Open, rough Vert, tight, rgh Tight, rough		
77						3	Vert, tight, rgh Tight, rough Vertical healed		
78						3	Open, rough Open, rough Healed		
79						3	Tight, rough Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 10 of 10

Project Number:

Hole Number: MW 4016

Project: WSSRAP MW DRILLING

Location: N. 102003 W.49982

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	DISCONTINUITIES: FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
79		RUN5 con't		5			Open, rough		Limestone, as above
				79.4					
				6		4	Open, rough		
80							Healed		
						6	Tight, rough Open, rough Healed		
		80.9					Open, rough		80.9-81.4 CHERT, light greenish gray (5G 8/1) to light bluish gray (5B 7/1) fossiliferous, very hard.
81							Opn,rgh, vert		
		RUN6		6	3.2		Vert,tight,rgh		
		4.4 / 4.4			4.4 = 73%	5	Open, rough		81.4-35.3 LIMESTONE light gray (N7) to very light gray (N8) massive,coarsely crystalline, minor vugs with calcite filling, minor FeOx and MnOx filling in vugs and fractures, very slightly weathered.
82		100%							
					LP = 1.4	0			
83					3 > 4"		Tight,rough, stylolite, MnOx		
							Stylolite,tight		82.3-82.4 Argillaceous L.S. Tense
						1			
84									
						4	Open, rough		84.5-84.8 Chert, fossiliferous, very hard.
85							Vert, tight, smooth,MnOx		
							Open, rough		
						0			T.D. 85.3'
									Installed well consisting of 2" dia. stainless steel. Screen from 83.7-73.7, 0.010" slots. Sand pack to 71.6'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 9

Project Number:

Hole Number: MW 4017

Project: WSSRAP MONITOR WELL DRILLING	Location: ≈ 250 ft. Northwest of County Maintenance Building
Coordinates: (AEC) N.101611.9 W.49287.3	Drilling Contractor: Layne Western
Drill Make and Model: CME 55/75 7" Hollow Stem Auger; Core; NQ Wireline	Depth Top of Rock: 40.0'
Depth Casing & Size:	Hole Size: Reamed 8.5"
Elevation: 649.5; 650.0 TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 85.1'	
Water Level:	Fluid & Additives: Water
Date Start: 06/08/88	Date Finish: 06/10/88
Logger: Original* E. Gorove	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	5	3.5 5.0	SS 01	9"	2.9.15 24		Clayey Silt, dark yellowish brown (10YR 4/4) dry, trace organic nodules, FeOx stain, roots, very stiff, ML.
							LOESS
	10	8.5 10.0	SS 02	4"	6.10.8 18		Clayey Silt, brown (10YR 4/3) dry, very stiff, FeOx nodules, trace organics and roots, ML.
							12.0'
							FERRELVIEW
	15	13.5 15.0	SS 03	7"	7.13.15 28		Silty Clay, gray (10YR 7/1) dry, very stiff, FeOx stringers and nodules, trace organics, slight mottling with yellow (10YR 6/8), CL.
							FERRELVIEW
	20	18.5 20.0	SS 04	14"	4.7.10 17		Clay, mottled gray (10YR 5/1) and brownish yellow (10YR 6/8), slightly sandy (5%), very stiff, damp, plastic, FeOx, minor MnOx. CH.
							22.0'
	25	23.5 25.0	SS 05	18"	4.7.9 16		Sandy Clay, mottled gray (10YR 6/1) and yellowish brown (10YR 5/8), 15% very fine sand, minor v. fine gravel, moist, plastic, very stiff, CH.
							CLAY TILL

*Geotechnical Information by: P. Patchin/

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 9

Project Number:

Hole Number: MW-4017

Project: WSSRAP MW DRILLING

Location: N.101612 W.49287

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25						CLAY TILL
		28.5 30.0	SS 06		5.10.11 22		Gravelly Clay, mottled, yellowish orange (10YR 5/8) and gray (10YR 5/1) angular chert gravel up to 1/4", abundant MnOx, very stiff, FeOx, damp, CL.
	30						32.0'
		33.5 35.0	SS 07	4"	12.15.17 32		Clayey Gravel, reddish brown (2.5YR 4/4) clay (30%) and white angular chert gravel (70%) up to 1". Clay is moist, very stiff to hard, minor sand, GC.
	35						RESIDUUM
		38.5 40.0	SS 08	4"	13.10.50 >60		As above, 80% chert, 20% clay
	40						40.0'
							Top of bedrock at 40.0'
							Cored from 40.0' to 85.1'. Core descriptions on Pages 3 through 9.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 9

Project Number:

Hole Number MW 4017

Project: WSSRAP MW DRILLING

Location: N.101612 W.49287

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
40									Begin NX Coring 40.0'
41		RUN1 2.3/5.2	? 40.8	1	.4/5.2 8%	4	Open, rough; Open, smooth, 20°; Open, rough; Rubble Zone; Open, rough		40.0-40.7 CHERT, very light gray (N8) to white (N9), very hard, FeOx staining, fractured, vuggy, slightly to moderately weathered, fossiliferous. 40.7-44.2 LIMESTONE with 30% interbedded chert, grayish orange (10YR 7/4) moderately weathered, vuggy, hard, finely crystalline with reddish brown (2.5YR 4/4) clay partings starting at 40.7 and most likely continued through the section of core loss at 44.2-45.2'.
42		44%			LP = .4"	--			
43			42.7		1 > 4"	3	Open, rough		
44			?			4	Open, rough; Open, rough		
45			44.2			1			44.2-45.2' CORE LOSS, probable void.
		45.2							
46		RUN2 2.3/3.8	45.5	2	.4/3.8 37%	2	Open, rough		45.2-62.9 LIMESTONE, as above grayish orange (10YR 7/4) vuggy with abundant solution features, moderately

(con't)

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 9

Project Number:

Hole Number MW-4017

Project: WSSRAP MW DRILLING

Location: N.101612 W.49287

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
46		RUN2 con't 60%		2	LP = .4" 4 >4"	--			to severely weathered, FeOx staining, argillaceous, in weathered zones, hard to moderately hard, fossiliferous, chert (30%) is interbedded and nodular and occasionally vuggy.
47									
48			?			>2	Rubble Zone Open, rough		
49		49.0				3	Open, rough Open, rough		
50		RUN3 2.2'/3.6'	49.4	2	.4 3.6 11%	>2	Open, rough		
51		60%	50.8		LP = .4" 1 >4"	>1	Open, rough stylolite, tight Open, rough		
52						>2	Rubble Zone Open, rough		
53		52.6 RUN4		2	1.6/4.7	>4	Open, rough		LIMESTONE as above
54		3.4/4.7 72%			= 34% LP = 2				

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 9

Project Number:

Hole Number: MW 4017

Project: W5SRAP MW DRILLING

Location: N.101612 W.49287

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
54				2	2 >4"	2	Rubble Zone Open, rough		LIMESTONE, as above
55							Stylolite, tight		
56						2			
57						.4	Open, rough (5) Healed Open, rough Rubble Zone		
		57.3							
58		RUN5		2	3.5/5.6	3	Open, rough Open, rough		LIMESTONE, interbedded with chert, as above
59		4.8/5.6 86%			63% LP = .9'	2	Tight, rough		
60				3	6 >4"	3	Open, rough Healed Open, rough Tight, rough		
61						2	Open, rough Open, rough		60.6-61.5 Severely weathered and argillaceous, rubbly, vuggy.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 6 of 9

BOREHOLE LOG

Project Number:

Hole Number MW-4017

Project: WSSRAP MW DRILLING

Location: N.101612 W.49287

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
61		RUN5 con't		3			Open, rough (4)		61.5-66.5 ARGILLACEOUS LIMESTONE (60%) interbedded with chert (40%). Limestone is grayish orange, earthy, moderately hard, solution cavities and vugs common, wthrd, fractured; chert is mottled very pale orange (10YR 8/2) and pale yellowish brown (10YR 6/2), very hard, slightly vuggy, with healed fractures.
			61.5?			>4			
62									
							Open, rough		
			?			>3			
		62.9					Open, rough		
63									
		RUN6		3	3.2 / 6.1				
		5.0' / 6.1'			52%	>2			
64			63.8				Open, rough		
		82%	?		LP = .5'	3	Open, rough		
65									
							Open, rough		
					7 > 4"	6	Open, rough		
66							Tight, rough Open, rough		
						2	Open, rough		66.5-69.2 CHERT, fossiliferous mottled light brownish gray (5YR 6/1) and very light gray (N8), very hard, moderately vuggy, slightly weathered, finely crystalline with 20% interbedded argillaceous limestone as above with solution cavities up to 3/4", moderately weathered.
67							Open, rough		
						2	Open, rough		
68									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Project Number:

Hole Number: MW 4017

Project: WSSRAP MW DRILLING

Location: N. 101612 W.49287

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
68				3					CHERT, as above
						1	Open, rough		
69		69.0					Open, rough		
		RUN7		4	5.8		Stylolite, tight		69.2-72.6 ARGILLACEOUS LIMESTONE, grayish orange (10YR 7/4), fine to medium grained, porous, moderately hard, thinly bedded with minor chert nodules and lenses (10%). Calcite vug-filling (1") in chert at 70.4'.
		9.0 / 9.0			9.0	2			
70					76%		Tight, rough		
		85%			LP = 2.4'		Stylolite, tight		
						2	Tight, rough		
71							Stylolite, tight Open, rough		
							Tight, rough, MnOx 30°		
					9 > 4"	3	Open, rough, MnOx		
72							Open, rough, MnOx		
							Tight, rough, MnOx		72.6-76.0 ARGILLACEOUS to SILTY LIMESTONE, as above with less $CaCO_3$, with interbedded nodular vuggy chert (30%), vugs up to 1/2" with calcite infilling.
						1			
73									
						0			
74									
							Tight, rough		
						1			
75									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 9

Project Number:

Hole Number MW-4017

Project: WSSRAP MW DRILLING

Location: N.101612 W.49287

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
75		RUN7 con't		4		2	Tight, rough Stylolite, tight		
76							Tight, rough Stylolite, tight		76.0-80.0 ARGILLACEOUS SILTY LIMESTONE as above with 20% interbedded chert lenses and nodules. Chert is not vuggy as before.
77	↑			5		4	Open, rough, MnOx Tight, rough, MnOx Open, rough		
78	Upper Weathered Limestone Lower Competent	77.8 78.0				4	Tight, rough Tight, rough Stylolite, tight Open, rough		
79	Limestone ↓	RUN8 7.0/7.0		5	5.5/7.0 79%	2	Open, rough, Stylolite, MnOx Stylolite, tight Open, rough		
80		100%			LP = 1.2	3	Open, rough Stylolite, tight Tight, rough Tight, rough, MnOx		
81					8 > 4"	1	Open, rough Stylolite, tight		80.0-85.0 LIMESTONE, light gray (N7), hard, fresh, slightly argillaceous, with chert lenses (10%) average 2" thick with minor vugs, also some chert nodules. Limestone is fine grained, slightly stylolitic. Chert is fossiliferous. Trace pyrite.
82						2	Open, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 9 of 9

Project Number:

Hole Number MW-4017

Project: WSSRAP MW DRILLING

Location: N.101612 W.49287

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
82		RUN8 con't		5			Open, rough		Limestone, as above	
							Stylolites tight			
						2	Open, rough			
83							Stylolite, MnOx			
							Open, rough			
							Rubble Zone			
							Open, rough			
						2				
84										
				6			Open, rough			
						1				
85										85.1'
									T.D. @ 85.1' on 6/10/88 Installed well consisting of 2" dia. stainless steel. Screen from 84.5' to 64.5', 0.010" slots. Sand pack to 62.3'.	

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 7

Project Number:

Hole Number: MW 4018

Project: WSSRAP Monitoring Well Drilling	Location: Approximately 500 feet east of Highway Maintenance Facility
Coordinates: N.101233.4 W.48677.0 (AEC)	Drilling Contractor: Layne-Western
Drill Make and Model: CME 55/75, 7" Hollow Stem Auger; NQ wireline core	Depth Top of Rock: 44.0'
Depth Casing & Size:	Hole Size: 12" to 50' then reamed 8.5
Elevation: 648.0', 649.9' TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 78.5', reamed to 82.5'	
Water Level: 7/23/88 597.70' Elev.	Fluid & Additives: Clear Water
Date Start: 02/17/88	Date Finish: 02/26/88
Logger: Original* L. Ehrhard	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	5	3.5 5.0	SS 01	18"	2.2.4 6		3.5-5.0 SILTY CLAY, medium brown-orange mottled (10YR 4/3), medium plasticity, very moist, trace organic nodules, Fe-staining, very silty (45%), CL
							LOESS 7.0'
	10	8.5 10.0	SS 02	18"	3.4.6 10		8.5-10.0 CLAY, light brown-red mottled (10YR 5/4) stiff, moderate plasticity, moist, Fe-staining, slightly silty, CH
	15	13.5 15.0	SS 03	18"	5.8.10 18		13.5-15.0 CLAY, light brown-olive gray mottled (10YR 5/3-10YR 6/1) moderate plasticity, moist, trace organics, Fe-staining and nodules, MnOx, very stiff, CL
							FERRELVIEW 17.0'
							CLAY TILL
	20	18.5 20.0	SS 04	1.8"	5.8.11 19		18.5-20.0 SANDY SILT yellowish brn mottled (10YR 5/4) moist, Fe-staining, minor clay, ML
		20.0 21.5	SS 05	18"	7.10.11 21		20.0-21.5 SILTY CLAY, yellow orange (10YR 5/6) slightly moist, 10% sand and chert gravel (fine), Section 20.1-20.3 is light gray (10YR 7/1), very stiff, CL.
							23.5-24.0 SILTY CLAY, yellow-brn (10YR 6/6) and gray, Fe-staining, trace sand and gravel grades into next section, hard, MnOx abundant, CL. 24.0'
	25	23.5 25.0	SS 06	13.5"	6.9.42 51		24.0-24.3 Gravelly Clay, gray-orange-brown mottled

*Geotechnical Information by: P. Patchin/D. Reynold

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 7

Project Number:

Hole Number MW 4018

Project: WSSRAP Monitoring Well Drilling

Location: N.101233 W.48677

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25						(10YR 7/1-10YR 6/6) Fe-staining, sand and angular chert gravel, MnOx, CL BASAL TILL 24.3-24.5 GRAVEL, clayey, chert, Fe-staining, moist clay, 20% clay, gravel to 1", hard, GC 28.0'
	30	28.5 30.0	SS 07	18"	4.10.11 21		28.5-29.5 CLAYEY GRAVEL, weathered chert gravel with some limestone, dark yellowish brown (10YR 4/6) Fe-staining, MnOx, very stiff, GC 29.5-30.0 CLAY, gravelly, strong brown (7.5YR 4/6), medium plasticity, moist, Mn-Oxide on limestone and chert gravel CL 33.5-35.0 CLAY, gravelly, orange-red mottled (10YR 4/6), Fe-staining, Mn-Oxide on decomposed limestone gravel, 40% gravel, angular, stiff, CL.
	35	33.5 35.0	SS 08	12.6"	11.9.7 16		RESIDUUM
	40	38.5 40.0	SS 09	9"	6.6.6 12		38.5-40.0 CLAY, gravelly, brown-orange (10YR 5/6) medium plasticity, moist, Fe-staining, chert and decomposed limestone with minor Mn-Oxide, sandy, silty, stiff, CL 40.0-44.0 No sample recovery, water level at 40.5' (2/26/88), bedrock at 43'. 44.0'
	45						Bedrock at 44.0'. Cored from 44.0' to 78.5'. Core description on pages 3 through 7.
	50						
	55						

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 3 of 7

BOREHOLE LOG

Project Number:

Hole Number MW 4018

Project: WSSRAP MW Drilling

Location: N.101233 W. 48677

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Begin Core 44.0
44		RUN1 6.0/7.5 80%		1	2.9/7.5 39%	4	Open, rough		44.0-50.0 LIMESTONE with chert nodules, white to very pale orange (10YR 8/2) finely crystalline, voids-pinpoint to >1" (core loss areas), minor Mn staining, moderate solution feature (voids) Core argillaceous Fe staining, hard to moderately hard, weathering slight to moderately severe at vuggy areas. Core very vuggy 46.0-46.5' and 48.0-49.8'.
45									
					LP = .8'	2			
46							Open, rough, FeOx		
			46.5		5 > 4"	3	Open, rough, vuggy, FeOx		
47									
48									
			48.0				Open, rough Rubble		
						5	Open, rough Solution vugs		
49							Open, rough, vgy Solution vug		
							Open, rough		
							Open, rough		
50						5	Open, rough, vuggy		50.0-51.5' LIMESTONE cherty, dark yellow orange (10YR 6/6) to moderately yellow brown (10YR 5/4), finely crystallized, solution features. Interbedded chert, hard to (con't)
51						0			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 7

Project Number:

Hole Number MW 4018

Project: WSSRAP MW DRILLING

Location: N.101233 W.48677

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
51		RUN1 con't 51.5		1			Tight, rough		moderately hard, slightly weathered.
		RUN2		2	4.3	6	Open, rough		51.5-58.5 As above, interbedded chert throughout
52					7.0		Rubble Open, rough		
53		7.0/7.0 100%			51% LP = 8'	2	Open, rough, vgy		
							Open, rough		
54					10 > 4"	3	Tight, rough Open,rough,vug		
55						1	Tight,rough,25°		54.8-55.8 Pinpoint to 10mm solution features in limestone
56						4	Tight,rough,vgy Stylolite Open,rough,vgy Rubble Open,rough,vgy Tight,rough,vgy 15°		
57						2	Open, rough		56.5-57.0 Pinpoint in 10mm solution features in limestone
58						3	Open,rough,wthrd vgy, FeOx Open, rough Rubble Open, rough		57.0-58.1 Chert lenses

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 7

Project Number:

Hole Number MW 4018

Project: WSSRAP MW DRILLING

Location: N.101233 W.48677

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
58		RUN2 con't 58.5		2			Open, rough		58.5-68.5 LIMESTONE with interbedded chert, grayish orange (10YR 7/4), intermittant voids from 1mm to 2cm, some quartz recrystallization associated with chert vugs. 66.5-68.5' is tannish gray (5Y 7/2), argillaceous with minor chert, fine to very fine crystallized, 58.5-62.0' solution features. Core is hard at chert area to moderately hard at limestone area. Weathering is slight. Some iron staining.
59		RUN3		3	6.0/10.0	2			
60		10.0/10.0 100%			50% LP = 1.5'	9	Open, rough, weathered; Tight, rough; Open,rough,vgy; Open,rough,FeOx; Open,rough,vgy		
61					6 > 4"	4	Tight, rough; Tight,smooth,25°; Open,rough,25°; Open,rough		
62						4	Rubble; Open, smooth; Open, rough		
63						3	Open, rouch stylolitic; Open, rough; Open, rough		
64						2	Open, rough; Tight, rough		
65						1	Open,smooth,clay		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 7

Project Number:

Hole Number: MW 4018

Project: WSSRAP MW DRILLING

Location: N.101233 W.48677

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
65				3			Stylolite		Limestone, as above
						0			
66									
							Open, rough, clay		
						2			
67							Open, rough		
							Rubble		
						4	Open, rough		
							Rubble		
68				68.0			Open, rough		
				4					
		68.5				4			68.5-78.5 LIMESTONE interbedded cherty, brownish yellow (10YR 8/2) to grayish white (N 8/0) finely crystallized, trace of void spaces from 1mm to 5mm, trace fossils from 73.0-74.0', trace stylolites from 75.0 to 76.0', solution features 69.0' to 72.0' pinpoint to .01', some infilling to vugs with quartz. Core argillaceous, hard to moderately hard, slight to moderate weathering.
		RUN4			3.9		Open, rough		
69				10.0			Tight, rough		
		10.0 / 10.0			39%				
					P =	5	Open, rough (5)		
70		100%			1.1'				
					7 > 4"		Open, rough (7)		
						7			
71									
							Open, rough (5)		
						5			
72									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 7
Project Number:
Hole Number MW 4018

Project: WSSRAP MW DRILLING
Location: N.101233 W.48677

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
72	↑ Upper Weathered Limestone 73.0'	RUN4 con't		4		3	Open, rough		Limestone, as above
73	Lower Competent Limestone ↓					5	Open, rough		
74						3	Tight, rough Open, rough Healed		
75						2	Open, rough, stylolitic, MnOx Stylolites tight		
76				76.0 5		0	Open, rough, Stylolitic, MnOx		
77						3	Open, rough Tight, rough		
78						1	Open, rough Tight, rough		T.D. 2/26/88 78.5'

Reamed to 82.5'. Installed well consisting of 2" dia. stainless steel. Screen from 74.5' to 64.5', 0.010" slots. Sand pack to 61.5'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 9

Project Number:

Hole Number: NW 4020

Project: WSSRAP - Monitor Well Drilling	Location:
Coordinates: N 99932.8 W.48704.2	Drilling Contractor: React/Layne Western
Drill Make and Model: CME 55/75; 7" Hollow Stem Auger; Core NQ wireline	Depth Top of Rock: 35.0
Depth Casing & Size: None	Hole Size: Reamed 8.5"
Elevation: 657.9' G.S.; 659.2 TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 81.3	
Water Level:	Fluid & Additives: Water
Date Start: 02/24/88	Date Finish: 03/01/88
Logger: * B. Fieselman	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						TOPSOIL/FILL 2.0'
		3.5 5.0	SS 01	18"	6-8-8 16		SILTY CLAY; dk brn (10YR 5/2) w/grey mottling; med. plastic; hard; very moist; Fe stain; some organics. CL.
	5						
		8.5 10.0	SS 02	9"	3-5-6 11		SILTY CLAY; reddish brn (10YR 5/4) med. plastic; moist; stiff; CL
	10						FERRELVIEW
		13.5 15.0	SS 03	18"	4-6-10 16		SILTY CLAY; light brownish grey (10YR 6/4) med. plastic; damp; stiff; Fe nods; fine chert, CL.
	15						
		18.5 20.0	SS 04	18"	5-6-9 15		SILTY CLAY; reddish brn (10 YR 5/6) w/grey mottling; med. plastic; damp; very stiff; some Fe (orange) mottling; fine chert. CL. 20.0'
	20						
		23.5 25.0	SS 05	18"	4-12-16 28		SILTY CLAY; greyish brown (10YR 5/3) with grey and orange mottling; med. plastic; moist; very stiff; pyrolusite stringers; chert gravel at 24.7. CL.
	25						

*Geotechnical Information by: R. Parsons

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 9

Project Number:

Hole Number MW 4020

Project: WSSRAP - Monitor Well Drilling

Location:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25						CLAY TILL
		28.5 30.0	SS 06	6"	12-13-30 43		CLAYEY GRAVEL; greenish grey (5YR 6/2); med. plastic; slightly moist; very stiff; minor silt; abundant chert gravel. GC. 30.0'
	30						RESIDUUM
		33.5 35.0	SS 07	6"	7-4-3 7		CLAYEY GRAVEL; greenish grey (5YR 6/2) to yellowish orange (10YR 5/6); med. plastic; moist; med. stiff; abundant chert gravel. GC.
	35						Begin NQ Coring Cored from 36.6 to 81.3. Core descriptions on pages 3-9. Top of bedrock at 36.0 ft.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 9

Project Number:

Hole Number: MW 4020

Project: WSSRAP - Monitor Well Drilling

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
36									Begin Core 36.6
37	.9 CL	Run1 5.8/6.7 87%	37.3	2	1.9/6.7 = 28% LP = 0.5'		Rubblized zone		36.6-38.2 CHERT; gravel; pale yellowish brown (10YR 6/2)
38			38.2		4 > 4"	> 6	Highly fractured		38.2-43.3 LIMESTONE; yellowish grey (5Y 7/2); massive; fine xtln; vugs 20%; pinpoint to 2mm; vugs Fe & Mn filled; micro fossils 10%; replaced w/siliceous material; chert nodules; very light gray (N7) to light grey (N8); fresh and hard.
							Open, rough		
39						2	Open, rough		
40							Open, rough		
						3	Open, rough		
							Open, spun		
							Open, rough, FeOx		
41							Open, spun		
							Open, rough		
						4	Rubblized zone		
				2			Open, smooth (2)		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 9

Project Number:

Hole Number MW 4020

Project: WSSRAP - Monitor Well Drilling

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
42		Run1 Cont.		2		4	Open, smooth Open, smooth, Fe Open, rough Open, spun		As Above
43			43.3	2					
		Run2 1.0/4.0 25%		3	0.0/4.0 0% LP = 0.2' 0 > 4"				43.3-47.3 LIMESTONE WITH CHERT GRAVEL; LS wht (N9) to lt.grey (N8); thick bedded; coarse xtln; vugs; pinpoint to 1cm; Fe & Mn stain; chert gravel lt.grey (N6) to med. dark gray (N8); fine xtln; LS moderate weathered and hard; chert fresh and hard.
44	3.0 CL								
45									
46			46.3						
47							Rubblized zone		
		47.3							47.3-50.5 LIMESTONE and CHERT INTERBEDDED; LS greyish orange (10YR 7/4) massive; micro to coarse xtln; Fe clasts; fossiliferous fresh and hard; chert very lt. grey (N7) to lt. grey (N8); fine xtln; solution features; fresh and hard.
		Run3 9.4/9.8 96%			6.8/9.8 69% LP = 1.2' 11 > 4	0			
48	.4 CL					3	Open, rough, clay Open, rough, clay solution features Open, rough, clay		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 9

Project Number:

Hole Number MW 4020

Project: WSSRAP - Monitor Well Drilling

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
49		Run3 Cont.		3					As Above
			49.4			1	Open, rough, clay		
50							Open, rough		
						3	Open, rough		50.5-51.8 LIMESTONE ARGILLACEOUS; dark yellow orange (10YR 6/6) massive; micro xtln; vugs pinpoint w/Mn filling; up to 20% chert; fresh and hard.
							Open, rough		
51							Open, rough		
							Open, rough		
							Open, rough, clay (2)		
						4			51.8-57.1 LIMESTONE WITH CHERT INTERBEDDED: LS greyish orange (10 YR 7/4) massive; micro to coarse xtln; vugs pinpoint to 1 mm; Mn filled; chert lt. bluish grey (5B 7/1) to very pale orange (10YR 8/2) massive; micro xtln; fossiliferous; fresh and hard.
52									
							Open, rough (3)		
						4			
							Open, rough, MnOx		
53							Open, rough		
				3					
				4		1			
54									
							Open, rough		
						1			
55									
							Open, rough		
						2	Open, rough		
5				4					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 9

Project Number

Hole Number MW 4020

Project: WSSRAP - Monitor Well Drilling

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
56		Run3 Cont.		4		0			As Above
57		57.1							57.1-57.9 CHERT; very lt. grey (N8) massive; micro xtln; vugs pinpoint Mn filled; fresh and hard.
		Run4 7.4/8.0 93%			3.7/8.0 46% LP = 0.8'	3	Open, smooth Open, rough, MnOx Open, rough		
58	2.0 CL				7 4"	3	Open, rough (3)		57.9-73.4 LIMESTONE ARGILLACEOUS WITH CHERT; LS greyish orange (10YR 7/4); chert lt. bluish grey (5B 7/1) massive; micro xtln; vugs pinpoint to 6 mm; solution features clay filled, 1/8" wide; moderately weathered and hard.
59						4	Open, rough (2) Open, rough Open, rough		
60			60.6	4			Rubblized zone		
				5					
61			61.0				Rubblized zone		
62						3	Open, rough (3) Open, rough Open, styolite		
				5		3	Open, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 9

Project Number:

Hole Number MW 4020

Project: WSSRAP - Monitor Well Drilling

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
63		Run4 Cont.		5		2	Tight, stylolite Open, rough		As Above	
64						2	Rubblized zone Open, rough			
65		65.1				4	Open, rough Open, stylolite			
		Run5 8.6 / 8.6 100%					Open, rough (3)			
66						3	Open, rough			
67	Weathered Limestone						Open, rough, MnOx Tight, MnOx			
		67.5				3	Open, rough (3)			
68	Comptetent LImestone					5	Open, rough (5)			
69						3	Open, rough (2) Open, rough			
				5						

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 9

Project Number:

Hole Number MW 4020

Project: WSSRAP - Monitor Well Drilling

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
70		Run5 Cont.		6		2	Open, rough		As Above	
							Open, rough, MnOx			
71							Open, smooth			
						2	Open, rough			
72							Open, rough			
						2	Open, smooth			
73							Open, rough (2)			
						4	Open, rough		73.4-81.3 LIMESTONE WITH CHERT; LS lt. grey (N7) to pinkish grey (5Y 8/1); thick bedded; micro xtln; fossiliferous; pinpoint vugs, fresh and hard; chert, very lt. grey (N8); thick bedded; micro xtln; minor vugs; fossiliferous; fresh and hard.	
		73.7					Open, rough, MnOx			
74		Run6 7.6 / 7.6 100%				2	Open, rough, MnOx			
							Open, smooth			
75							Open, rough			
						5	Tight, stylolite			
							Open, rough (3)			
76						1				
77				6			Open, rough			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 9 of 9

Project Number:

Hole Number MW 4020

Project: WSSRAP - Monitor Well Drilling

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
77		Run6 Cont.		6		1	Open, rough		As Above	
78						3	Tight,stylolite Open, rough (2)			
				6 7						
79						3	Open, rough (3)			
80						1	Open, rough			
81				7						
									TD 81.3' Installed well consisting of 2" diameter stainless steel. Screen from 76.8' to 66.8', 0.010" slots. Sand pack to 65.0'.	

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 9

Project Number:

Hole Number: MW-4021

Project: WSSRAP MONITOR WELL DRILLING	Location: S.E. of WSSRAP site on vicinity property adjacent to Army Depot
Coordinates: N.99169.9 W.49187.6 (AEC)	Drilling Contractor: Layne-Western
Drill Make and Model: CME 55/75 7" Hollow Stem Auger; NQ Wireline	Depth Top of Rock: 26.5'
Depth Casing & Size:	Hole Size: 8.5"
Elevation: 650.1; 651.9 TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 69.65' Reamed to 71.0'	
Water Level:	Fluid & Additives: Water
Date Start: 05/16/88	Date Finish: 05/17/88
Logger: *Original A.Herrington/T.Ruby	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						
		3.5 5.0	SS 01	18"	2.3.7 10		SILTY CLAY, mottled dark yellowish brown (10YR 4/6) and grayish brown (10YR 5/2) 20-40% silt, slightly plastic, stiff, CL. LOESS? 6.0
	5						
		8.5 10.0	SS 02	1.5"	3.5.6 11		SILT, sandy, light yellowish brown (10YR 6/4) to yellowish brown (10YR 5/6), minor clay, damp, med. plasticity, stiff, ML. FERRELVIEW?
	10						
		13.5 15.0	SS 03	18"	3.7.8 15		CLAY, light gray (5Y 7/2) with yellow (10YR 7/8) FeOx stained mottling, moist, highly plastic, stiff, blocky fracturing, abundant MnOx stringers, CH.
	15						
		18.5 20.0	SS 04	18"	10.19.36 >50		CLAY, light gray (5Y 7/2) minor FeOx mottling as above, highly plastic, damp-dry, slickensided, abundant MnOx on partings, calcite stringers, hard, *100 counts/min gamma radiation, CL 23.0'
	20						
		23.5 25.0	SS 05	11"	17.40/4		CLAY, light gray (5Y 7/1) to white (5Y 8/1) with minor FeOx staining, limey, damp to dry, hard, high plasticity, with 20% weathered (con't)
	25						

*Geotechnical Information by: P. Patchin

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 2 of 9

BOREHOLE LOG

Project Number:

Hole Number MW-4021

Project: WSSRAP MW DRILLING

Location: N.99170 W.49188

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25						chert fragments to 3/8" at bottom of sample, CL. CLAY TILL? 26.5'
							Top of bedrock 26.5'. Cored from 26.5' to 69.65'. Core descriptions on pages 3 through 9.
	30						

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 9

Project Number

Hole Number MW-4021

Project: WSSRAP MW DRILLING

Location: N.99170 W.49188

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
25									
26									Begin Coring 26.5'
27		Run1 4.2/6.5 65%		2	.8/6.5 12% LP = .4'		2.2' CORE LOSS Location in section unknown		26.5-32.5' LIMESTONE slightly argillaceous, light olive gray (5Y 6/1) to very pale orange (10YR 8/2), finely crystalline, slightly to moderately weathered, moderately hard, with clay partings from 3/8" to .2' thick (light greenish gray (5GY 8/1)) abundant FeOx & MnOx specks, vugs pinpoint to 1/2" with oxidized pyrite and MnOx infilling, 5% chert as nodules, core is rubbly.
28					2 > 4"		Unable to determine location of fractures for run.		
29									
30									
31									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 9

Project Number:

Hole Number MW-4021

Project: WSSRAP MW DRILLING

Location: N.99170 W.49188

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
32		32.5							32.5-33.0' CHERT, light olive gray (5Y 6/1) micro-crystalline, very hard, fresh.
	Bit dropped 4", 6",2",4" during run according to driller.	Run2 5.0' 10.0' 50%		2	0% LP = .3' 0 > 4"		5.0' of CORE LOSS, location in section unknown.		33.0-34.1' LIMESTONE, as before, occasional fossils and a complete crinoid stem, moderately solutioned.
33									
34									34.1-43.0' CHERT, rubblized, very light gray (N8) to dark yellowish orange (10YR 6/6) to dusky red (5R 3/4), micro-crystalline, moderately weathered, hard, with MnOx and FeOx staining, clay filling in fractures and solutioned area ranging from light greenish gray (5GY 8/1) to very dark red (5R 2/6) near bottom of run, limonite and hematite in fractures, occasional fossil hashes, rehealed fractures and remnant limestone last .4' of run.
35							Unable to determine location of fractures for run.		
36									
37									
38									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 9

Project Number:

Hole Number MW-4021

Project: WSSRAP MW DRILLING

Location: N.99170 W.49188

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
39		Run2 con't		2					CHERT, as above.
40									
41									
42									
43		43.0					Open, rough		43.0-47.0 LIMESTONE argillaceous, dark yellowish orange (10YR 6/6), finely crystalline, moderately severely weathered, med. hard, stylolitic and solution with FeOx blebs, calcite fracture filling, abundant MnOx specks, fossiliferous, 30% interbedded chert, very light gray (N8), hard, moderately weathered.
		Run3		3	6.0 / 10.0	> 6	Open, rough, FeOx, solutioned		
		10.0 / 10.0			60% LP = .8'		Open, rough (4)		
44		100%							
					11 > 4"	2	Open, rough (2)		
45							Tight, rough, FeOx, calcite		
							Stylolite		
						2	Tight, rough, FeOx calcite		
46									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 9

Project Number:

Hole Number: MW-4021

Project: WSSRAP MW DRILLING

Location: N.99170 W.49188

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
46		Run3 con't		3		2	Tight, stylolitic clay, FeOx		LIMESTONE, as above
47							Open, rough, FeOx calcite		47.0-51.6' LIMESTONE with chert nodules, pale yellow orange (10YR 8/6) grading to light olive gray (5Y 6/1), finely crystalline, moderately hard and weathered, stylolitic with MnOx, minor FeOx and calcite in fractures, slightly argillaceous and fossiliferous, 30% interbedded chert (light bluish gray 5B 7/1).
							Spun, FeOx		
						2			
48							Tight, stylolitic		
							Stylolite		
						2	Tight, rough		
							Stylolites (3)		
							Vertical, healed, MnOx, FeOx		
49							Tight, rough		
						5	Opn, stylolitic FeOx calcite		
							Opn, rough, FeOx		
							Tgt, stylolitic FeOx		
50							Opn, stylolitic FeOx, MnOx		
						2	Tight, stylolitic MnOx		
51							Open, rough, FeOx calcite		51.6-53.0' CHERT, med. light gray (N6) highly fractured and solutioned with olive gray (5Y 4/1) clay infilling of fractures and stylolites, minor limestone (20%) mod. weathered.
						3			
							Stylolites		
52							Open, rough, clay stylolitic		
						3			
53							Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 9

Project Number:

Hole Number MW-4021

Project: WSSRAP MW DRILLING

Location: N.99170 W.49188

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
53		Run4 2.0/9.7 21%		4	0% LP * .2' 0 > 4"				53.0-59.7' CORE LOSS chewed up by bit due to unseated core barrel.
54									
55									
56									
57									
58									
59									
60			59.7						59.7-62.7' CHERT, with clay, pale blue (5PB 7/2), microcrystalline (con't)

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 9

Project Number:

Hole Number MW-4021

Project: WSSRAP MW DRILLING

Location: N.99170 W.49188

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
60		Run4 con't		4			1.0' of additional CORE LOSS, location in run unknown.		vugs from pinpoint to .1', solution features common, 20% argillaceous limestone (light olive gray 5Y 6/1), minor MnOx on fractures.
61							Unable to determine location of fractures in run.		
62									
		62.7							62.7-69.65' Alternating CHERT & LIMESTONE - the core was mixed up when the box and the table were knocked to the ground by water truck.
63		Run5 6.95/6.95 100%		4	5.0 6.95 72% LP = 1.2'		Unable to determine location of fractures for run due to dropped core box.		1.5' LIMESTONE, yellowish gray (5Y 7/2) med. to coarsely crystalline, occasional fossil, fresh.
64									5.45' CHERT pale blue (5PB 7/2) microcrystalline, vugs from pinpoint to 3mm, fresh to mod. weathered with 25% interbedded argillaceous limestone (light olive gray (5Y 6/1)) stylolitic w/MnOx in stylolites.
65									
66									
67									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 9 of 9

Project Number:

Hole Number MW-4021

Project: WSSRAP MW DRILLING

Location: N.99170 W.49188

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
67	↑ Weathered Limestone?	Run5 con't		4					CHERT, as above.	
68	Competent Limestone? ↓									
69									Total Depth 69.65'	
70									Installed 2" stainless steel well. Screen from 50.8 to 70.8', 0.010" slots, filter pack at 49.0'.	

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 11

Project Number:

Hole Number: MW-4022

Project: WSSRAP MONITOR WELL DRILLING	Location: Near Army property entrance SE of site
Coordinates: N.97459.7 W.50447.4 (AEC)	Drilling Contractor: Layne-Western
Drill Make and Model: CME 55/75; 7" Hollow Stem Auger; NQ Wireline Core	Depth Top of Rock: 35.0'
Depth Casing & Size: 31'; 10"	Hole Size: 12" to 31' Then 8.5"
Elevation: 663.3'; 667.9' TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 90.9'	Water Level:
Fluid & Additives: Water	Date Start: 5/19/88
Date Finish: 5/23/88	Logger: *Original T. Ruby

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
					Auger to 3.5'		
	5	3.5 5.0	SS 01	15.3"	3.4.7 11		SILTY CLAY - CLAYEY SILT, light brown (10YR 5/4), low to medium plasticity, top 0.3' dry, moist below, stiff, mottled with gray and black specks, with some roots, CL-ML.
	10	8.5 10.0	SS 02	18"	2.3.4 7		SILTY CLAY, light brown (10YR 5/3) and light gray (10YR 7/1), mottled, medium plasticity, moist, medium stiff, iron oxide staining, with some organics, with some iron oxide nodules, occasional large manganese oxide specks, CL.
	15	13.5 15.0	SS 03	1.8"	2.4.5 9		SILTY CLAY - CLAYEY SILT, light brown (10YR 5/4) to medium brown (10YR 4/4), slightly plastic, moist, stiff, may have been cave-in, CL-ML.
							FERRELVIEW
	20	18.5 20.0	SS 04	15.3"	6.6.7 13		SILTY CLAY, orangish brown (10YR 5/8) with light gray mottling, medium plasticity, moist, stiff, manganese oxide streaks, iron oxide nodules, sandy, occasional fine gravel (chert), CL.
		23.5 25.0	SS 05	18"	4.6.7 13		22.0' SILTY CLAY, light orangish brown (10YR 6/6) with gray, red and black mottling, medium plasticity, moist, stiff, with some organics, iron oxide nodules, manganese oxide streaks, sandy, fine gravel (chert and limestone), CL.

*Geotechnical Information by M. Schauer

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 11

Project Number:

Hole Number MW-4022

Project: WSSRAP MW DRILLING

Location: N.97460 W.50447

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25						CLAY TILL SILTY CLAY-GRAVELLY CLAY, medium brown (10YR 3/3), medium plastic, moist, stiff, with some black organics, 0.2' light gray chert gravel at bottom, gravel is fine to coarse chert and limestone, sandy, CL.
	30	28.5 30.0	SS 06	7.2"	6.2.12 14		
							CLAYEY GRAVEL, fine to coarse, angular to weathered subrounded chert gravel with manganese oxide dendrites in silty clay matrix, orangish brown (10YR 5/8) and light greenish gray (5Y 8/2), mottled, medium plasticity, moist, hard, sandy, gravel increasing with depth; GC. 32.
	35	33.5 34.8	SS 07	13.6"	16.20.40/4"		35.0' RESIDUUM
							Top of bedrock @ 35.0' Cored from 35.0-90.9'. Core descriptions on pages 3 through 11.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 11

Project Number:

Hole Number MW-4022

Project: WSSRAP MW DRILLING

Location: N.97460 W.50447

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
34										
		35.0							Begin Coring @35.0'	35.0'
35		Run1		1	0.4/7.7 5%				35.0-51.5' CHERT/CLAY BRECCIA AND RUBBLE. Chert is dark yellowish orange (10YR 6/6), dusky blue (5PB 3/2), very light gray (N8), and dark reddish brown (10R 3/4), mottled, microcrystalline, vugs ≈10% pinpoint to 1/2", has been solutionized, hard. Clay matrix is light gray (5Y 8/1) and reddish brown (10YR 6/6), soft to stiff. Unit is very severely to severely weathered. 50% of recovered core consists of pieces 0.1-0.4' long)very closely to closely fractured), rest is rubble pieces <0.1' long (extremely closely fractured).			
		3.1/7.7 40%			LP = 0.4'					
36							4.6' of core loss, location in run unknown			
					1 > 4"					
37										
38										
39										
40										
41										

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 4 of 11

BOREHOLE LOG

Project Number:

Hole Number MW-4022

Project: WSSRAP MW DRILLING

Location: N.97460 W.50447

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
41		Run1 con't		1						
42										
		42.7								
43		Run2 5.0/5.0 100%		1	0/5.0 0% LP = 0.3 0 4"				CHERT/CLAY BRECCIA AND RUBBLE, as above.	
44				44.7 / 2						
45										
46										
47										
		47.7								
48		Run3		2	1.8/10.0					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 11

Project Number:

Hole Number MW-4022

Project: WSSRAP MW DRILLING

Location: N.97460 W.50447

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
48		Run3 con't		2	18%				CHERT/CLAY BRECCIA AND RUBBLE, as above.
		8.0/10.0			LP = .5'				
49		80%			4 > 4"				
50									
51									
						> 6	Open,rgh,clay, friable		51.5-59.5' LIMESTONE, very argillaceous, dark yellowish orange (10YR 6/6), massive, fine crystalline, vugs ≈5% pinpoint to 1/2", occasional light gray chert nodules 1/4-5", MnOx specks, fossils, solutioned, soft to moderately hard, moderately severely to moderately weathered.
52							Open, rough Rubble		
						> 6	Open, rough Opn,rgh,clay		
53							Opn,rgh-smooth Opn,rgh,clay (green)		
						3	Opn,rgh,clay 0.01-0.02' thick (green) Opn,rgh,clay		
54							Opn,rgh,clay 0.03' thick		
						> 6	Open, rough Rubble (clay on surfaces)		
				54/3	7		Opn,rgh,clay		
55									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 11

Project Number:

Hole Number MW-4022

Project: WSSRAP MW DRILLING

Location: N.97460 W.50447

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
55		Run3 con't		3		>6	Opn,rgh,clay Rubble (clay on surfaces) Opn,rgh,clay		LIMESTONE, as above
			55.7						
56									
57									
		57.7							
58		Run4 9.6/9.6 100%		3	4.6/9.6 48%	6	Spun Open, rough Opn,rgh,MnOx, solution Opn,rgh,clay Open, rough		
59					LP = 1.0' 8 >4"		Open, rough (4)		
60	Upper Weathered Limestone / Lower Competent Limestone	60.2				4 / 3	Opn,rgh,MnOx, soltn,stylolitic Opn,rgh,MnOx, soltn, large stylolite		59.5-67.4' LIMESTONE, very light gray (N8), massive, medium to coarse crystalline, chert nodules 1/2-2", fossils, stylolites, hard, fresh. With some lenses (≈15-20%) of LIMESTONE, grayish orange (10YR 7/4) to dark yellowish orange (10YR 6/6), with MnOx specks.
61						1	Tight, rough (3) Tgt,rgh,fossils		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 11

Project Number:

Hole Number MW-4022

Project: WSSRAP MW DRILLING

Location: N.97460 W.50447

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION CEMENTATION HARDNESS WEATHERED STATE
62		Run4 con't		3		3	Tight,rgh,fossils Tgt,rgh,MnOx, soltn,stylolitic Tight, rough		LIMESTONE, as above.
63						4	Open, rough Opn,rgh,FeOx, sl. solution Tight, rough		
64						3	Tgt,rgh,MnOx, solution Open, rough Tight,smooth,FeOx, well developed MnOx dendrites (pyrolusite)		
65						2	Tgt,rgh,FeOx, MnOx dendrites Tight, rough Tight,rough,FeOx		
66				4		1	Tight,rough,MnOx, FeOx,solution, stylolitic		
67		67.3				>6	FeOx,fossils,spun FeOx,spun Rubble (some FeOx & fossils)		
68		Run5 0.1/2.5 4%	67.4	4	0/2.5 0% LP = 0.1' 0/4"		Recovered 0.1' chert nodule (rubble) 2.4' core loss due to poor drill bit		
69									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 8 of 11

Project Number:

BOREHOLE LOG

Hole Number MW-4022

Project: WSSRAP MW DRILLING

Location: N.97460 W.50447

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
69		Run5 con't		4					
		69.8					Opn,rgh,FeOx		69.8-70.8' LIMESTONE, grayish orange (10YR 7/4) grading to light gray (N7), massive, medium to coarse crystalline, vugs ≈10% pinpoint to 0.1', occasional chert nodules, stylolites, fossils-crinoid stems, hard, fresh.
70	69.0-78.0 Core spring left spiral marks in core	Run6 8.2 / 8.2 100%		4	4.6 / 8.2 56%		Opn,rgh,wthrd		
						4	Tight, rough		
					LP = 0.9		Opn,rgh,MnOx, solution,clay 0.3' thick		
71					9 > 4"				
						2	Tight, rough		70.8-90.9' LIMESTONE, light gray (N7) to light olive gray (5Y 6/1), massive, medium to coarse crystalline, vugs 10% pinpoint to 0.1', occasional chert nodules 0.1-0.7', stylolites, fossils-crinoid stems, hard, fresh.
72							Opn,rgh,MnOx, solution,wthrd, clay		
						4	Opn,rgh,MnOx, solution,wthrd		
							Spun		
73							Open, rough		
							Tight, smooth		
						5	Tgt,rgh,wthrd		
							Tgt,rgh,MnOx, solution-stylolitic		
74							Tight, rough		
							Weathered,spun		
						2			
75									
						2	Open, rough		
							Tight,rough,MnOx solution, stylolitic		
76							Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Project Number:

Hole Number: MW-4022

Project: WSSRAP MW DRILLING

Location: N.97460 W.50447

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
76	69.8-78.0 Core spring left spiral marks on core.	Run6 con't		4		2	Tight, rough		LIMESTONE, as above
							Open,rgh,MnOx, soltn,stylolitic		
77						3	Tight,rgh,MnOx, solution		
							Tight, rough		
		78.0					Opn,rgh,wthrd		
78							Opn,rgh,clay 0.005-0.01'thick		
		Run7 9.9/9.9 100%		5	5.7/9.9 58% LP = 0.6' 14 > 4"	5	Opn,smooth		
							Opn,rough		
							Opn,rgh,solution		
79							Open, rough		
						3	Opn,rgh,MnOx sl. solution		
							Tight, rough		
80							Spun		
						3	MnOx,sl.solution, sl.stylolitic,spun		
							Open, smooth		
81							Opn,rgh,sl.MnOx, sl. stylolitic		
						4	Opn,rgh,solutn, sll stylolitic		
							Open, rough		
82	81.9-87.9' Core spring left spinal marks on core.						Tight, rough		
							Opn, rough, MnOx, solution		
						4	Tight, rough		
83							Tight,rough,MnOx, solutn,stylolitic		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 10 of 11

Project Number:

Hole Number MW-4022

Project: WSSRAP MW DRILLING

Location: N.97460 W.50447

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
83	81.9-87.9 Core spring left spiral marks on core.	Run7 con't		5			Tight, rough		LIMESTONE, as above
						3	Tight, rough		
84							Tight, rough		
							Tight, rough		
						3	Open, rough		
85							Opn,rgh,sl.MnOx, weathered		
						3	Opn,rgh,wthrd		
							Tight,rgh,MnOx, soltn,stylolitic		
86							Open, rough		
						3	Tgt,rgh,solutn, stylolitic		
							Tight, rough		
87							Tight,rgh,MnOx, soltn,stylolitic		
							Tight,rgh,MnOx, solution		
				87.7		3	Tight,rgh,MnOx,		87.9-88.7' Large rounded concretionary-looking structure, very light gray (N8), semi-hard (knife leaves mark, yet powders), non-calcareous. CHERT?
		87.9		6					
88		Run8 3.0/3.0 100%		6	2.1/3.0 70% LP 0.6' 5 > 4"		Tgt,rgh,fossils		
						2	Open, rough		
89							Tight, rough MnOx, solution, stylolitic,spun		
						3			
							Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 11 of 11

BOREHOLE LOG

Project Number:

Hole Number MW-4022

Project: WSSRAP MW DRILLING

Location: N.97460 W.50447

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
90		Run8 con't		6		2	MnOx,solutn,spun Tgt,rgh,weathered fossils		LIMESTONE, as above 90.5-90.6' Small nodule, very light gray (N8), soft, non-calcareous, chalky-like, porous. WEATHERED CHERT? 90.9
91									T.D. 90.9' Installed well consisting of 2" diameter stainless steel. Screen 68.8-88.8', 0.010" slots. Sand pack to 67.0'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 8

Project Number:

Hole Number: MW-4023

Project: WSSRAP Monitor Well Drilling	Location: North edge of old R.R. grade near sanitary sewer outfall-chemical plant
Coordinates: N.98718.5 W.49845.1	Drilling Contractor: Layne-Western
Drill Make and Model: CME-55/75; 7" Hollow Stem Auger; NQ wireline core (NX to 33.2')	Depth Top of Rock: 28.9'
Depth Casing & Size: 28.0'; 10"	Hole Size: 12" to 28' then 8.5"
Elevation: 646.5'; 648.5 TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 70.0'	Water Level: ---
Fluid & Additives: Water	Date Start: 7/5/88
Date Finish: 7/6/88	Logger: *Original K. Erickson

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
					Auger to 3.5'		SILTY CLAY - CLAYEY SILT, dark yellowish brown (10YR 4/4), non-plastic to slightly plastic, dry in upper section, slightly damp at bottom, very stiff, small roots, few scattered limestone pebbles, CL-ML.
	5	3.5 5.0	SS 01	5.4"	5.18.12 30		OLD RAILROAD EMBANKMENT-FILL 7.0'
	10	8.5 10.0	SS 02	5.9"	6.12.13 25		SILTY CLAY - CLAYEY SILT, light gray (2.5Y 7.2) and strong brown (7.5YR 4/4), slightly plastic, damp, stiff to very stiff, massive - no visible bedding, sandy, pebbly (limestone), occasional iron oxide nodules, CL-ML. No recovery first try, used catcher on second try.
	15	13.5 15.0	SS 03	10.8"	3.8.11 19		SILTY CLAY, light gray (2.5Y 7.2) and strong brown (7.5YR 4/4), low plasticity, damp, very stiff, massive - no visible bedding, sandy, scattered pebbles, limonite stain, some manganese dendrites, CL.
	20	18.5 20.0	SS 04	18"	3.9.11 20		SILTY CLAY, light gray (2.5Y 7.2) and strong brown (7.5YR 4/4), mottled, low plasticity, damp, very stiff, massive - no visible bedding, sandy, scattered pebbles, limonite stain, manganese dendrites, occasional iron oxide nodules, CL.
							FERRELVIEW FM 22.0'
	25	23.5 25.0	SS 05	12.1"	8.9.13 22		SILTY CLAY, dark brown (7.5YR 3/4), low plasticity, damp, stiff to very stiff, sandy, limestone and abundant, angular to sub-rounded chert pebbles, limonite stain, manganese dendrites, 1" chert fragment at bottom blocking opening, CL. CLAY TILL

*Geotechnical Information by: P. Patchin/ M. Schauer

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 8

Project Number:

Hole Number MW-4023

Project: WSSRAP MW DRILLING

Location: N.98718 W.49845

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25						CLAY TILL 27.0'
		28.5	SS06	1"	50/4.5"		CLAYEY GRAVEL, medium gray (N5), broken, sharp edged, angular chert gravel in brown, sandy, silty clay matrix with limonite staining, non-plastic, very slightly damp, loose, GC. BASAL TILL 28.9'
		28.9					
	30						Sampler refusal @ 28.9'. Cored from 28.9-70.0'. Core descriptions on pages 3 through 8.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 8

Project Number:

Hole Number MW-4023

Project: WSSRAP MW DRILLING

Location: N.98718 W.49845

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
28		28.9							Begin Coring @ 28.9' 28.9'
29		Run1 0.8/0.8 100%		1	0/0.8 = 0%	4	Open, smooth Opn,rgh,FeOx Opn,rgh,FeOx		28.9-30.0' CHERT, light gray (N7) mottled, with minor argillaceous limestone, limonite stained, fractured, moderately weathered, vuggy, solutioned from 29.2-29.5', rubble from 29.7-30.0'.
29.7		Run2 0.3/0.3 100%	30.0	1	0%		Rubble		
30		Run3 2.8/3.2 88%	30.4	1	2.5/3.2 78%	1			30.4-37.1' CHERT (70%) mottled light gray (N7) and dark yellowish orange (10YR 6/6), 30% interbedded argillaceous limestone, dark yellowish orange (10YR 6/6). Chert is hard to very hard, microcrystalline, slightly weathered, slightly vuggy, limonite stained in fractures, nodular. Limestone is moderately-severely weathered, medium hard, with MnOx specs abundant.
31					LP = .8' 4 > 4"	2	Open, rough, FeOx, stained clay (4)		
32						1			
33	NX Core NQ Core	33.2							
		Run4 2.8/2.8 100%		2	1.1/2.8 39%	2	Rubble (w/FeOx, clay) Slightly smooth, FeOx. Opn,rgh,FeOx solution		
34					LP = .7' 2 > 4"	4	Opn,rgh,FeOx Opn,rgh,FeOx clay		
35									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 8

Project Number:

Hole Number MW-4023

Project: WSSRAP MW DRILLING

Location: N.98718 W.49845

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
35		Run4 con't		2			Opn,rgh,thick FeOx clay		CHERT, as above
						2	Opn,rgh,FeOx clay		
36		Run5 4.6/4.6 100%		2	3.1/4.6 67% LP = 0.8' 5 > 4"	1			
37						4	Opn,rgh,FeOx,vgy, solutioned; Opn,rgh,FeOx; Tight,rgh,FeOx		37.1-44.6' LIMESTONE as above but is 70% of rock, interbedded with 30% CHERT as above.
38						2	Open,rough,FeOx clay; Tight,rough,FeOx stain		
39						1	Open,rough,FeOx stained clay, solution		
40		40.6				2			
41		Run6 4.1/4.1 100%		2	2.2/4.1 54% LP = 0.6' 4 > 4"	4	Opn,rgh,FeOx; Opn,rgh,FeOx cly; Opn,rgh,FeOx		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 8

Project Number:

Hole Number MW-4023

Project: WSSRAP MW DRILLING

Location: N.98718 W.49845

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
42		Run6 con't		2		> 6	Tight, rough, FeOx Open, rough Rubble Open, rough, stylolitic		LIMESTONE, as above
43			43.2 / 3			2	Tight, rough		
44							Tight, rough, 30°, FeOx		
		44.7				> 6	Opn, rgh, clay, FeOx Stylolite Opn, rgh, stylolitic FeOx, MnOx		44.6-45.6' CHERT, mottled light gray (N7) to light bluish gray (5B 7/1), very hard, microcrystalline, slightly to moderately weathered, fractured with clay in weathered intervals.
45		Run7 6.9 / 8.3 83%	45.6	3	3.2 / 8.3 39% LP = 0.7'	> 6	Open, rough Rubble Open, rough Tight, smth (3) Rubble w/clay		
46					7 > 4"				
47			47.0			6	Open, rough Tight, rough (4)		47.0-52.0' LIMESTONE argillaceous, as before, grayish orange (10YR 7/4) with abundant MnOx specs; interbedded with 20% CHERT, as before, very light gray (N8) to light gray (N7), slightly vuggy.
48							Tight, rough		
49						2	Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 8

Project Number:

Hole Number MW-4023

Project: WSSRAP MW DRILLING

Location: N.98718 W.49845

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
49		Run7 con't		3			Tight, rough Mechanical		
						2	Tgt,rgh,FeOx		
50									
							Tight, rough		
						4	Tight, rough		
							Tight, rough		
51							Opn,rgh,clay 20°		
							Opn,rgh,clay		
						3			
							Tight, rough		52.0-53.5' CHERT, light gray (N7) brecciated, rubbly, 10% interbedded limestone, light olive gray (5Y 6/1). Chert is hard to very hard, slightly weathered, fossiliferous, w/FeOx staining w/grayish green (10GY 5/2) clay in fractures.
52									
						> 6	Tight,rgh,FeOx		
							Opn,rgh,cly(grn)		
		53.0					Rubble w/clay		
53		Run8 7.0/7.0 100%		4	4.6/7.0 66% LP = 0.9'	> 6	Open, rough		53.5-59.2' LIMESTONE argillaceous, yellowish gray (5Y 7/2) with 20% interbedded and nodular CHERT, very light gray (N8) to light bluish gray (5B 7/1). Limestone is finely crystalline, moderately hard, massive, stylolitic slightly weathered. Chert is hard to very hard, vugs to 7mm. Trace pyrite.
							Tgt,rgh,stylolitic		
54							Styolite		
					> 8 4"	2	Tight, rough		
							Open,rough		
55							Opn,rgh,stylolitic MnOx		
							Tight,rgh,MnOx		
						2			
56									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 8

Project Number:

Hole Number MW-4023

Project: WSSRAP MW DRILLING

Location: N.98718 W.49845

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
56		Run8 con't		4			Tight, rough		
						2	Tight,rgh,wthrd		
57									
						5	Tight, rough Opn,smth,clay		
58									
	Upper Weathered Limestone					1	Tight, rough		
59							Opn,smth,shaley clay(grn), 20°		59.2-70.0' LIMESTONE, yellowish gray (5Y 7/2) to very light gray (N8); interbedded with 25% CHERT very light gray (N8) to light gray (N7). Limestone is moderately hard, very slightly argillaceous, medium crystalline, massive, very slightly weathered to fresh, fossiliferous with bryozoans, stylolitic. Chert is very hard, moderately fractured w/minor FeOx, moderately vuggy, with concretionary banding.
	Lower Competent Limestone					2	opn,stylolite,cly MnOx Stylolite		
		60.0							
60		Run9 10.0/10.0 100%		4	5.9/10.0 59%		Tight, smooth		
						5	Tight, smooth Opn,stylolitic MnOx		
61					LP = 1.8'		Stylolitic, weak, MnOx Stylolite Opn,smth,20°		
					9 > 4"	3	Tight, rough		
62									
						0			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 8

Project Number:

Hole Number MW-4023

Project: WSSRAP MW DRILLING

Location: N.98718 W.49845

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
63		Run9 con't		5					LIMESTONE, as above	
						1	Tight, smooth, MnOx			
64										
						> 6	Open, smooth Rubble			
							Open, smooth			
							Open, rough			
65							Tight, rough			
							Open, rgh, 10°			
						2	Tight, rough			
66										
						3	Opn, smth, shly cly			
							Open, rgh, vuggy			
67							Open, rough			
						4	Tight, rough			
							Opn, rgh, MnOx			
							Opn, rgh, shaley			
68										
						3	Open, rough			
							Tight, rough			
69										
							Tight, rough			
						4	Open, smooth			
							Tight, rough, FeOx shaley			
70							Tight, rough			70.0'

T.D. 70.0'

Installed well consisting of 2" diameter stainless steel. Screen 33.0-53.0', 0.01" slots. Sand pack to 30.5'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 12

Project Number:

Hole Number: PW-1

Project: WSSRAP - Pump Well	Location: Northeast of Chemical Plant
Coordinates: N.101061.0 W.50145.2	Drilling Contractor: Brotcke
Drill Make and Model: CME 55/75, 7" Hollow Stem Auger; NQ Wireline Core	Depth Top of Rock: 27.7
Depth Casing & Size:	Hole Size: 10"
Elevation: 647.2 G.S., 650.5 TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 90.2 Reamed to 90.3'	
Water Level:	Fluid & Additives: Water
Date Start: 07/05/88	Date Finish: 07/07/89
Logger: Original* T. Ruby	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						
	5	4.5 6.0	SS 01	13.1"	3/3/6 9		SILTY CLAY, medium plasticity, light greenish gray (10 YR 7/2), moist, stiff, FeOx mottling with occasional nodules, CL. FERRELVIEW
	10	9.5 11.0	SS 02	18"	6/9/11 20		SILTY CLAY, medium to high plasticity, light gray (10 YR 7/1) with orangish gray (10 YR 6/8) mottling, moist, very stiff, FeOx mottling and Mn blebs, CL-CH. ? ? ? ? 12.0
	15	14.5 16.0	SS 03	18"	4/10/15 25		SILTY CLAY, as above, light orangish brown ( ) with traces of sand, organics, and fine gravel, occasional Mn streaks. CLAY TILL
	20	19.5 21.0	SS 04	18"	5/11/13 24		SILTY CLAY, as above, no Mn.
							? ? ? ? 23.0
	25	24.5 26.0	SS 05	4.9"	12/21/24 45		CLAYEY GRAVEL, medium plastic, light brown (7.5 YR 4/6), moist, hard, with some organics and weathered chert fragments, GC. RESIDUUM

*Geotechnical information by: R. Parsons
M. Schauer

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Project Number:

Hole Number: PW-1

Project: WSSRAP - Pump Well

Location: Northeast of Chemical Plant

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE & NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25						RESIDUUM
	27.7						Bedrock @ 27.7'

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 12

Project Number:

Hole Number PW-1

Project: WSSRAP - Pump Well

Location: Northeast of Chemical Plant

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Begin core 27.7'
28		Run 1 3.2/5.1 63%		I	1.4/5.1 27%	0	Tight, rough		27.7-30.9 LIMESTONE; (5Y 7/2, 5Y 8/4, NB) yellowish gray, grayish yellow and very light gray; thick bedded, fine xln, chert nodules - pinpoint to 2"; stylolites; slightly weathered; hard.
					LP= 0.5"	2	Rough, spun		
29					3 > 4"		Open,rough,MnOx		
						3	Tight, rough, MnOx		
							Open,rough,MnOx solution		
30							Rough, spun		
						>6	Tight, rough to smooth		
							Open,rough,MnOx reddish brown clay		
31							Rubble (0.1-0.2'pieces of limestone & chert mixed with reddish brown clay)		
32						1			
33		32.8 Run2					Rough spun		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 12

Project Number:

Hole Number: PW-1

Project: WSSRAP - Pump Well

Location: Northeast of Chemical Plant

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
33		Run2 9.7 / 9.7 100%			5.1 / 9.7 53% LP	1	Tight, rough, sl. solution		32.8-36.7 LIMESTONE;(N7, 5YR 8/11) light gray + pinkish gray; thick bedded; coarse xln, stylolites; fossiliferous chert nodules 1/4"-6"; slightly weathered, 35.0-35.5 is extremely weathered; hard, extremely weathered zone mod. hard
					1.0'		Tight, rough		
34				1	10	3	Rough, spun		
				2	> 4		Open, rough, MnOx		
35							Open, rough		
						6	Open, rough, MnOx, FeOx, solution		
							Tight, rough		
36							Open, rough, vuggy		
						4	Open, smooth, MnOx, FeOx		
							Open, rough		36.7-47.7 CHERT AND LIMESTONE INTERMIXED;(10YR 7/4) grayish orange - LS (N7) - light gray chert, thick bedded; med xln; fossiliferous chert; moderately weathered, moderately hard.
37						4	Tight, rough		
38							Open, rough, clay		
						3			
39							Open, rough		
						4	Open, rough, FeOx		
40							Open, rough, FeOx, vuggy		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 12

Project Number:

Hole Number PW-1

Project: WSSRAP - Pump Well

Location: Northeast of Chemical Plant

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
40		Run2 cont.		2		3	Tight, rough Open, rough		As Above
							Tight, rough		
41						4	Open, rough, FeOx Open, rough Tight, rough, MnOx		
42						5	Open, rough Rough, clay Rough		
		42.5							
		Run3 8.6 / 10.0 86%			3.9 / 10.0 39% LP = 0.6'				
43				2		2	Open, rough (4)		
				3	8 > 4				
44						2	Tight, rough (2)		
45							Open, rough (2)		45.0-47.7 As Above. Extremely weathered.
			45.4			3	Rough, clay		
46									
			46.6			2	Open, rough, clay (2)		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 12

Project Number:

Hole Number PW-1

Project: WSSRAP - Pump Well

Location: Northeast of Chemical Plant

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
47		Run3 Cont.		3			Open, rough, clay (4)		As Above
						6	Rough, spun		
							Tight, smooth, MnOx, FeOx		47.7-60.8 ARGILLACEOUS LIMESTONE AND CHERT INTERMIXED; (10YR 7/4) grayish orange and (N7) light gray; thick bedded; fine-med. xln; slight-moderate weathering; fossilferous chert; moderately hard.
48							Rough, spun		
						2	Tight, rough		
49									
						5	Tight, rough (6)		
50									
						2			
51									
						4	Open, rough (2)		
							Tight, rough(2)		
52									
		52.5	52.3				Rough (2)		
		Run4 9.3 / 10.0 93%	52.5		7.1 / 10.0 71% LP = 0.8' 12 > 4	3	Tight, rough		
53				3			Rough, spun		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 12

Project Number:

Hole Number PW-1

Project: WSSRAP - Pump Well

Location: Northeast of Chemical Plant

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
53		Run4 Cont.		3			Rough, spun		As Above	
							Tight			
						4	Open, rough, FeOx			
							Tight			
54							Open, rough, FeOx			
				4		2	Open, smooth			
55										
							Open, rough, FeOx			
						3				
							Open, rough			
56			56.0				Open, rough, FeOx			
						1				
			56.5							
							Open, rough			
57										
						2	Open, rough			
							Open, rough, MnOx			
58										
							Open, rough, FeOx			
						2	Open, smooth			
59										
							Tight			
						2				
							Open, rough, FeOx			
				4						

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 8 of 12

Project Number:

BOREHOLE LOG

Hole Number: PW-1

Project: WSSRAP - Pump Well

Location: Northeast of Chemical Plant

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
60		Run4 Cont.		4		2	Open, rough, FeOx		As Above
							Open, rough		
61						2	Open, smooth		60.8-65.8 LIMESTONE; argillaceous; (10YR 8/6 + 5Y 2/1) pale yellowish orange + yellowish gray; thick bedded; fine xln; chert nodules throughout 1/4"-8"; moderately weathered; moderately hard to hard.
							Tight		
62			62.3						
		62.5				1			
		Run5 9.0 / 9.9 91%			6.7 / 9.9 68% LP = 1.1' 12 > 4"		Open, smooth		
63						1	Open, rough		
64							Open, rough		
						3	Open, smooth, FeOx		
				4			Open, smooth		
65				5			Open, rough		65.8-71.3 LIMESTONE Details Below
						2	Open, rough		
66							Tight		
			66.8			1			

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 9 of 12

Project Number:

Hole Number PW-1

Project: WSSRAP - Pump Well

Location: Northeast of Chemical Plant

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
67		Run5 Cont.	67.7	5		0			65.8-71.3 LIMESTONE; argillaceous; (10YR 8/6) pale yellowish orange; thick bedded; fine xln; occ. fossilferous chert nodules; vugs 20%; pinpoint to 3/4"; moderately weathered; qtz filling in some vugs; moderately hard to hard.
68						2	Open, rough Open, rough		
69						4	Open, rough Open, smooth (3)		
70						1	Open, rough		
71	Upper Weathered Limestone Lower Competent Limestone	71.3'				4	Open, rough Open, rough Tight Open, rough, MnOx		71.3-80.8 LIMESTONE, CHERT and ARGILLACEOUS LIMESTONE INTERMIXED; (N8) light gray; LS & arg. LS (5B 7/1) light bluish gray - chert; thick bedded; finely xln; vugs 10%; pinpoint to 1"; stylolites; fossils; slightly weathered hard.
72		72.4				2	Open, smooth		
		Run6 10.0 / 10.0 100%			5.7 / 10.0 57% LP = 0.8 13 > 4				
73							Open, smooth Open, smooth Open, smooth		
				5		4	Open, rough (2)		
74									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 10 of 12

BOREHOLE LOG

Project Number:

Hole Number PW-1

Project: WSSRAP - Pump Well

Location: Northeast of Chemical Plant

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
74		Run6 Cont.		5			Open, rough		As Above	
						3	Open, rough			
							Open, rough			
75				5			Open, rough (3)			
				6						
						3				
76							Open, rough			
						3	Open, smooth			
							Open, smooth			
77										
							Open, rough (4)			
						5				
78							Tight			
							Open, rough rubble			
						4	Tight			
79										
							Open, rough			
						2	Tight, stylolite			
80				6						

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 11 of 12

Project Number:

Hole Number PW-1

Project: WSSRAP - Pump Well

Location: Northeast of Chemical Plant

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
80		Run6 Cont.		6		4	Open, rough Tight Open, smooth Open, rough		80.8-90.2 LIMESTONE (N8, N7, + 5B 5/1) very light gray, light gray + medium bluish gray; thick bedded; medium xln, vugs 5%; pinpoint to 3/4"; chert nodules < 35% 1/2"-5"; stylolites; slightly weathered to fresh; hard to very hard.
81						5	Open, rough (5)		
82		82.4				2	Open, smooth Open, rough		
		Run7 7.8/7.8 100%			5.3/7.8 68% LP = 1.4'				
83						2	Open, rough, FeOx		
					10 > 4		Open, rough		
84				6 / 7		2	Open, smooth Open, smooth		
85						3	Open, rough Open, rough (2)		
86						1	Tight, stylolite		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 12 of 12

Project Number:

Hole Number PW-1

Project: WSSRAP - Pump Well

Location: Northeast of Chemical Plant

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
87		Run 7 Cont.		7			Open, rough		As Above	
						3	Open, rough			
							Open, rough			
88							Open, rough			
						2				
							Open, rough			
89										
						1	Tight, stylolite			
90										
									Total Depth 90.2' Reamed to 90.3'. Installed well consisting of 6" dia. PVC. Screen from 89.5' to 49.8', 0.020" slots. Sand pack to 46.4'.	

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 10

Project Number:

Hole Number: PW-2

Project: WSSRAP Pumpwell	Location: In front of Building 302
Coordinates: N.99112.6 W.50150.8 (AEC)	Drilling Contractor: Brotcke
Drill Make and Model: CME 55/75, NX Wireline Core	Depth Top of Rock: 36.5' / Depth Casing & Size: / Hole Size: 10"
Elevation: 657.0 G.S., 659.8 TOC	Angle from Vert. and Bearing: Vertical / Depth Bottom of Hole: 92.1'
Water Level: 45.0' 7/7/88	Fluid & Additives: Clear Water / Date Start: 06-29-88 / Date Finish: 07-01-88 / Logger: *Original T. Ruby

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0					XXX	
	5	4.5 6.0	SS 01	18"	4.6.7 13		SILTY CLAY, low plasticity, trace very fine sand, light brown (10YR 5.4) with gray and orange mottling, moist, stiff, MnOx specks, CL.
	10	9.5 11.0	SS 02	18"	3.4.6 10		SILTY CLAY, as above, light brown (10YR 5/6), mottled gray (10YR 7/1) and orange, medium plasticity.
	15	14.5 16.0	SS 03	18"	4.5.8 13		SILTY CLAY, as above. FERRELVIEW 19.0'
	20	19.5 21.0	SS 04	18"	5.9.12 21		19.5-20.5 SILTY CLAY with trace fine gravel and some medium sand, medium to high plasticity, light brown (10YR 5/8) mottled with gray (10YR 7/1) and orange, moist, very stiff. CL-CH, MnOx stringers. 20.5-CH. CLAY TILL 20.5-21.0 CLAY, medium to high plasticity, light gray (5Y 6/2), moist, stiff, some Mn stringers, CL-CH.
	25	24.5 26.0	SS 05	18"	6.7.12 19		

*Geotechnical Information by: R. Parsons/M. Schauer

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 10

Project Number:

Hole Number PW-2

Project: WSSRAP - Pumpwell

Location: In front of Building 302

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25						24.5-25.0 SILTY CLAY, medium to high plasticity, medium brown (10YR 4/6), mottled with light gray, moist, stiff, CL-CH.
							25.0-25.5 SANDY SILT, low plasticity, light tan (2.5Y 7/2) and gray, moist, soft. ML.
							CLAY TILL
	30	29.5 31.0	SS 06	18"	4.8.10 18		25.5-26.0 SILTY CLAY, medium plasticity, trace fine sand, reddish brown (10YR 5/8) with gray and black (MnOx) stringers, moist, stiff. CL
							29.5-31.0 CLAY, medium to high plasticity, 32.5'
							some silt, reddish brown (10YR 5/8) mottled with light gray, moist, very stiff, Mn stringers, CL-CH
							RESIDUUM
	35	34.5 36.0	SS 07	12"	8.13.36 49		34.5-36.0 CLAYEY GRAVEL, medium to high plasticity, trace of fine to coarse chert, light greenish gray (5Y 7/2), moist, hard, GC
							Top of bedrock @ 36.5'
							Cored from 36.5-38.2'
							Augered from 38.2-44.0'
							Cored from 44.0-92.1'
							Core descriptions on pages 2 through 10.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 10

Project Number:

Hole Number PW-2

Project: WSSRAP Pumpwell

Location: In front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
36									Begin NQ Core 36.5'
37		Run1 1.2/1.7 71%							36.5-37.7 CHERT and LIMESTONE rubble with trace of clay at base, light gray, pink and tan.
			37.7						37.7-38.2 Core loss
38			38.2						
39									
40	39.5 40.0 SS 08 SPT 50/6"	6"							39.5-40.0 SILTY CLAY to CLAYEY GRAVEL, highly plastic with fine angular limestone and chert fragments, light greenish tan (5Y 7/2), moist, soft, CH-GC.
41									
42									
43									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 10

Project Number:

Hole Number PW-2

Project: WSSRAP - Pumpwell

Location: In Front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
44		44.0 Run2 5.0/10.0 50%		1					44.0-51.0' CLAY matrix with chert rubble (residuum) pink (10YR 6/4) and tan (5Y 7/3) clay with light blue chert. 44.0-50.9 Core loss of 5.0'. Exact location in run unknown.	
45										
							Highly rubblized zone.			
46										
47										
48										
49										
50										

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 5 of 10

Project Number:

BOREHOLE LOG

Hole Number PW-2

Project: WSSRAP - Pumpwell

Location: In Front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
50				1			Rubblized		As Above
				1/2					
51					1.2/3.0 40% LP = 0.4'	4	Open, rough (4)		51.0-54.0' LIMESTONE, argillaceous dark yellowish orange (10YR 6/6); thick bedded; finely xln; occ. vug; occ. fossil; some solutioning; calcareous variations; manganese OX specks throughout. Moderately to slightly weathered and moderately hard to hard.
52					3 > 4"	4	Open, rough (4)		
53							Open, rough (2)		51.6-52.3' Very argillaceous
						5	Opn,rgh,clay		
							Opn,rgh, MnOx		
54		54.0					Open, rough		54.0-57.2' CHERT rubble, chewed up by slipped shoe. Hard, slightly weathered.
		Run3 0.9/3.2 28%			0/3.2 0% LP = 0.1		2.3' Core loss in Run #3 location unknown		
55					0 > 4"		Highly rubblized frac? mechanical		
56									
57				2					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 10

Project Number:

Hole Number PW-2

Project: WSSRAP - Pumpwell

Location: In Front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
57		57.2		2					57.2-69.8' ARGILLACEOUS LIMESTONE with abundant chert, dark yellowish orange-gray (10YR 6/6) chert: thick bedded; finely xln; vugs 20% solutioned; calcite rehealing up to 2" (@ 60') MnOx specks throughout; fractured chert very solutioned - 63-65' moderate hard and moderate weathering.
		Run4 3.7/5.3 70%			0.7/5.3 13%		Core Loss 1.6' in Run #4		
58					LP = 0.4'		location unknown		
					2 > 4"		8 fractures and 3 rubblized zones in this run.		
59									
60									
61									
62									
		62.5					Open, rough		
		Run5 3.8/5.0 76%			0.7/5.0 14%	1			
63					LP = 0.4'	5	Open, rough (5)		
					2 > 4"				
64				2					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 10

Project Number:

Hole Number PW-2

Project: WSSRAP - Pumpwell

Location: In Front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
64				3			Core loss 1.2' between 64.0-67.5 location unknown		
						1			
65							14 frac. between 64.0 & 67.5' Open, rough		
						1			
66									
						1			
67									
		67.5							
		Run6 5.1/5.1 100%			0.8/5.1 16%	2			
68							Open, rough (5)		
					LP = 0.4'	3			
					2 > 4"				
69							Open, rough (2)		
	Upper Weathered Limestone					4	Tight		
							Open, rough (2)		69.8-88.4' LIMESTONE very light gray (N8) to light olive gray (5Y 6/1); thick bedded; medium xln; vugs <5% pinpoint to 1/4"; stylolites w/MnOx; occ. chert nodules 1/4"-6" (con't)
70	Lower Competent Limestone						Open, smooth		
							Open, rough		
						3	Tight		
				3					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 10

Project Number:

Hole Number PW-2

Project: WSSRAP Pumpwell

Location: In Front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
71				3			Open, rough Tight Open, rough (2)		(con't) light bluish gray (5B 7/1) w/fossils; slightly weathered and hard.
						10	Rubble Zone(6)		
72							Opn,rgh,MnOx		
		72.6							
		Run7 6.8/6.8 100%			4.7/6.8 69% LP = 0.98 > 4"	3	Open, smooth		
73						1	Open, rough		
74							Open, smooth		
						2			
75				3/4			Open, smooth		
						1	Open, rough, MnOx		
76							Open, rough		
						4	Open, smooth(2)		
77							Tight		
						2	Opn,rgh,FeOx		
78							Open, smooth		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 9 of 10

Project Number:

Hole Number PW-2

Project: WSSRAP Pumpwell

Location: In Front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
78				4			Open, rough		LIMESTONE, as above.
						7	Open, smooth(5)		
							Open, rough		
79									
		79.4					Open, rough		
		Run8					Tight		
		1.8/1.8			0.4/1.8 22%	4	Open, smooth		
80		100%					Open, spun (2)		
					LP = 0.4'	4			
					1 > 4"		Open, smooth (4)		
81		81.2							
		Run9					Open, rough		
		1.5/1.5			0.4/1.5 27%	4			
		100%					Open, smooth (2)		
82					LP = 0.4'				
							Open, smooth(3)		
		82.7			1/4"	4			
		Run10			4.4/9.4 47%		Tight, stylolite		
83		9.4/9.4					Open, MnOx		
		100%			LP = 0.9'	9	Open, smooth / Tight		
							Open, rough (5)		
84				4	9 > 4"		Opn,rgh,MnOx(2)		
				5					
						7	Open, smooth (6)		
85				5					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 10 of 10

Project Number:

BOREHOLE LOG

Hole Number PW-2

Project: WSSRAP Pumpwell

Location: In Front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
85				5		3	Open, rough Tight, stylolite Open, rough		LIMESTONE, as above.
86						10	Open, rough (4) Open, spun Open, rough (5)		86.3-87.4' Thin horizontal frac. zones; fossils.
87						5	Open, rough (3) Open, rough		
88						3	Open, rough (4) Open, rough, MnOx		88.4-92.1' LIMESTONE very light gray (N8) to light gray (N9); thick bedded; medium xln; stylolites; fossils; fresh and hard.
89						2	Open, smooth Tight		
90						3	Open, rough Open, smooth Tight		
91						3	Stylolite, tight		
92							Open, rough (2)		Total Depth 92.1'

Installed well consisting of 6" PVC. Screen from 85.0' to 45.0', 0.020" slots. Sand pack to 42.5'.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 11

Project Number:

Hole Number: PW-3

Project: WSSRAP - Pump Well	Location: Near Ash Pond
Coordinates: N.100208.6 W.52104.2 (AEC)	Drilling Contractor: Brotcke
Drill Make and Model: CME 55/75, 7" Hollow Stem Auger;NO Wireline Core	Depth Top of Rock: 16.0'
Depth Casing & Size: None	Hole Size: 10"
Elevation: 638.6' G.S.; 640.8' TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 85.1'; Reamed to 86.0'	
Water Level:	Fluid & Additives: Water
Date Start: 07/07/88	Date Finish: 07/15/88
Logger: * Original T. Ruby	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						FILL 2.0
							LOESS 5.0
	5	5.0 6.5	SS 01	13"	4-5-7 12		SILTY CLAY, medium to highly plastic, medium brown (10YR 4/6); mottled with light grey (10YR 6/1); moist; stiff; occasional FeOx nodules, CL-CH.
							FERRELVIEW
	10	10.0 11.5	SS 02	17"	3-8-10 18		SILTY CLAY, as above, medium orange (10YR 5/8); some medium to coarse grained sand, MnOx streaks, CL-CH. ? 12.0
							RESIDUUM
	15	15.0 16.0	SS 03	6"	3-10-50 60		SILTY CLAY-CLAYEY GRAVEL, medium plasticity, LS and chert fragments (fine to coarse), crinoid fossil fragments, med. brown (10YR 5/6), moist, hard, CL-GC.
							Bedrock @ 16.0'
							Cored from 16.0 to 32.8'
							Augered from 32.8 to 35.9' (sample description, pg 4)
							Cored from 35.9 to 85.1'
							Core descriptions on pages 2 through 11

*Geotechnical Information by: R. Parsons
M. Schauer

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 2 of 11

BOREHOLE LOG

Project Number:

Hole Number PW-3

Project: WSSRAP - Pump Well

Location: Near Ash Pond

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Begin coring 16.0'
16		Run1 1.8/1.8 100%			1.2/1.8 67% LP= 0.6'	3	Open, rough Open, rough Tight		16.0-22.8 LIMESTONE; (10YR 8/6) pale yellowish orange and (5YR 8/4) mod. orange pink; thick bedded; finely xtln to med. xln; vugs <10% to 1/2"; occ. chert nodules 1/2-2"; w/hairline fractures; stylolites; few fossils; MnOx dendrites; pyrite; slt to mod. weathering; hard
17					2 > 4"	2	Open, rough Tight		CLAY zones, brown, rubble @ 17.8-19.2 21.0-21.8
			17.8						
18		Run2 2.8/7.6 37%		1	1.2/7.6 16% LP= 0.9'	X			
19			19.2		2 > 4"	X	Rubblized zone		
20						2	Open, rough (2)		
21			21.0			X			21.9-22.6 CLAY, brown
22			21.8	1					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 11

Project Number:

Hole Number PW-3

Project: WSSRAP - Pump Well

Location: Near Ash Pond

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
22		Run2 Cont.		1		X			
			22.8						22.8-25.4 Core Loss.
23						X			
24						X			
25									
		25.4							
		Run3 2.5 / 7.4 34%	25.4		1.2 / 7.4 16% LP= 0.8'	X	Core loss 4.9' exact location in zone unknown (multiple clay zones) 25.4-32.8		25.4-32.8 CHERT and LIMESTONE INTERMIXED with clay (washed out); (10YR 7/4) grayish orange and (N7) lt. gray; thick bedded; fine to coarsely crystalline, MnOx dendrites; slightly to moderately weathered; hard
26									
					2 > 4"	X			
27						X			
28						X			
9				1					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 11

Project Number:

Hole Number PW-3

Project: WSSRAP - Pump Well

Location: Near Ash Pond

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
29		Run3 Cont.		1						
30										
31										
32										
		32.8							32.8-35.3 Augered	
33		AUGER								
34										
35									35.3-35.9, split spoon sample SS04: CLAYEY-SILTY SAND, well graded, med. plasticity, with coarse grained angular gravel, light orangish brown (10YR 6/8), moist, loose, SM-SC	
	35.3 SPT: 4/50 2"	SS 04 8"								
36	35.9			2						
		Run4								

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 11

Project Number:

Hole Number PW-3

Project: WSSRAP - Pump Well

Location: Near Ash Pond

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
36		Run4 Cont. 6.5/6.9 94%	36.3 ▼ ▲ 36.7	2	4.0 6.9 58% LP= 0.6'		36.3-36.7 Washout LS/sand zone of potential flow		35.9-36.7 CHERT, pale yellowish orange (10YR 8/6) and very lt. grey (N8), microcrystalline, hairline fractures, with solutioned LS, moderately hard, weathered
37					>9 4"	2	Open, rough Open, rough		36.7-44.8 LIMESTONE with CHERT interbedded, LS is pale yellowish orange (10YR 8/6) to greyish orange (10YR 7/4), chert is very light grey (N8), thick bedded, finely crystalline, vugs pinpoint to 1/4" <15%, moderately hard and moderately weathered
38						2	Open, rough (2)		
39						5	Open, rough (2) Tight Open, rough (2)		
40						2	Open, rough (2)		
41						2	Open, rough (2)		
42						2	Open, rough (2)		42.0 solutioned zone
		42.8 Run5		2					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 6 of 11

BOREHOLE LOG

Project Number:

Hole Number: PW-3

Project: WSSRAP - Pump Well

Location: Near Ash Pond

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
43		Run5 Cont. 9.2/10.0 92%			6.4/10.0 64% LP= 1.0'	4	Open, rough (4)		As Above
							Open, rough		
44					11 > 4"	3	Open, rough Open, spun		
				2/3					44.8-46.3 CHERT, lt. grey (N7), lt. olive grey (5Y 6/1), and lt. bluish grey (5B 7/1), micro xtln, vugs <5% up to 1/2", some calcite filled, fossils, some jointing, hard, slightly weathered to fresh.
45						2	Open, rough Open, spun		
46			46	3					46.3-47.1 Possible clay lens with LS/ chert fragments washed out.
47			47	1					47.1-47.4 CLAY, medium grey (N5) to dark grey (N3) with subangular chert fragments and some LS fragments
48						2	Open, smooth Open, smooth		47.4-53.5 LIMESTONE and CHERT interbedded, LS is greyish orange (10YR 7/4) chert is very lt. gray (N8), thick bedded, finely crystalline, chert has hairline fractures, hard, slightly to moderately weathered
49						1	Open, rough		
J				3					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 11

Project Number:

Hole Number PW-3

Project: WSSRAP - Pump Well

Location: Near Ash Pond

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
50		Run5 Cont.		3		2	Open, rough		As Above
							Open, rough		
51							Open, rough		
						3	Tight Open, rough		
									51.8 CLAY layer
52						2	Open, rough		
							Open, rough, FeOx		
		52.8							
53		Run6 3.5 / 3.5 100%			2.5 / 3.5 71% LP= 0.5'	5	Open, rough (3)		53.5-56.7 LIMESTONE; argillaceous; (10YR 7/4) (5Y 8/4) grayish orange to grayish yellow; thick bedded; fine xtln; occ. chert nodule pinpoint -1"; MnOx; moderate weathering and modearately hard
							Open, rough (2)		
54					6 > 4"	3	Open, smooth		
							Open, rough		
				3 / 4			Open, rough		
55							Open, rough		
						2	Rubblized zone		55.4-56.0 SILT LENS; (10YR 7/3) tan, calcareous
							Open, rough		
							Rubblized zone		
56							Open, rough		
		56.3 Run7 1.6 / 1.6 100%			1.5 / 1.6 94%	3	Open, rough (2)		56.7-60.7 ARGILLACEOUS LIMESTONE and CHERT

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 11

Project Number:

Hole Number PW-3

Project: WSSRAP - Pump Well

Location: Near Ash Pond

DEPTH	COMMENTS: TEST/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
57		Run7 Cont. 57.9		4	LP= 0.9 2 > 4"	2	Open, rough Open, rough		(Cont'd) (5Y 7/2-5Y 6/4) yellowish grey, chert lt. grey to dusky yellow; thick bedded; finely xtln; vugs; 40% pinpoint to 1/2"; moderately weathering and moderately hard
58		Run8 5.0/5.0 100%			2.1/5.0 42% LP= 0.7' 5 > 4"	5	Open, rough (5)		
59							Open, rough Open, rough Open, rough		
60						3	Open, rough (4)		
						6	Chlorite stain on (2) Open, rough, MnOx (2)		60.7-64.1 LIMESTONE, very lt. grey (N8) to lt. grey (N7), thick bedded, finely crystalline, occasional chert nodules 1-4", white (N9) to lt. bluish gray (5B 7/1), hard and fresh
61						4	Open, rough Open, smooth Open, stylolite, MnOx		
62		62.9				2	Open, rough Tight, stylolite Open, smooth		
63		Run9 4.8/4.8 100%		4 5	4.0/4.8 83% LP= 0.8'	1	Tight, stylolite		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 9 of 11

Project Number:

Hole Number PW-3

Project: WSSRAP - Pump Well

Location: Near Ash Pond

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
64		Run9 Cont.		5	6 > 4"	2	Open, rough		64.1-67.2 ARGILLACEOUS LS and CHERT INTERMIXED; (5Y 6/1) lt. grey to lt. olive grey LS; (5B 7/1) lt. bluish grey chert; thick bedded, finely xtln; vugs < 15% pinpoint to 1/4"; fresh and hard
							Open, rough		
65							Open, smooth		
						2	Open, rough		
66						1	Open, rough		
	↑ Upper Weathered								
67	Limestone	67.2				4	Open, rough, MnOx (2)		67.2-85.1 LIMESTONE; (N8-N7) very lt. grey-lt. grey; thick bedded; fine to med. xtln; occ. chert nodule 1" to 5"; stylolites w/MnOx staining; fossils; fresh and hard to very hard
	Lower Competent Limestone	67.7					Open, rough		
		Run10 2.7/2.7 100%			0 / 2.7 0% LP= 0.3'		Open, rough, MnOx		
68	↓						Tight, stylolite		
						3	Open, rough (3)		
					0 > 4"				
69						7	Open, rough, FeOx (7)		
70									
		70.4				5	Open, rough (4)		
		Run11							
1				5					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 10 of 11

Project Number:

Hole Number PW-3

Project: WSSRAP - Pump Well

Location: Near Ash Pond

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
71		Run11 2.4/2.4 100%		5	1.5/2.4 63% LP= 0.6'				As above
72				5	3 > 4"	1	Open, rough (2)		72.4-72.8 (N5) dark grey MnOx staining
				6					
		72.8							
73		Run12 2.8/5.0 56%			1.6/5.0 32% LP= 0.4'	2	Rubblized zone		
							Open, rough, MnOx (2)		
74					4 > 4"	1	Open, smooth		
							Rubblized zone		
75			75.2			X			
76						X			
77						X			
			77.4			X			
		77.8 Run13		6					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 11 of 11

Project Number:

Hole Number PW-3

Project: WSSRAP - Pump Well

Location: Near Ash Pond

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
78		Run13 2.6/2.8 93%		6	2.2/2.8 79% LP= 0.9'	4	Tight		As Above	
							Open, stylolite			
							Tight, MnOx			
							Open, rough			
79					4 > 4"	1	Tight, stylolite			
80						7	Open, smooth (7)			
		80.6	80.4							
		Run14 4.5/4.5 100%	80.6		4.1/4.5 91% LP= 1.5'	2	Tight, stylolite			
							Open, rough			
81					6 > 4"	1	Tight			
82						3	Tight, MnOx (2)			
							Open, rough			
83				6		2	Tight, stylolite			
				7			Open, rough			
84							Rubblized zone		83.9-84.2 Very fractured zone	
						2	Open, rough			
85				7			Open, rough		Total Depth 85.1'	

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 8

Project Number:

Hole Number: OB2j

Project: WSSRAP - Pump Observation Well	Location: In Front of Building 302
Coordinates: N.99129.6 W.50159.7	Drilling Contractor: Brotcke
Drill Make and Model: CME 55/75, NQ Wireline	Depth Top of Rock: 90.1
Depth Casing & Size:	Hole Size:
Elevation: Ground: 657.0; 659.5 TOC	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 140.3	
Water Level:	Fluid & Additives: Water
Date Start: 09-12-88	Date Finish: 09-21-88
Logger: Original* D. Scholtzhauer	

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
90		40.1 Run1 2.6/2.6 100%		1	2.2/2.6 85% LP = 0.6' 5 > 4"		Open, rough		St. Coring in Lower Competent Bedrock
						2	Open, rough		90.1-96.7 LIMESTONE light gray (N7) to very light gray (N8), thickly bedded, medium to coarse crystals, few vugs, few fossils, few chert nodules 0.1'-0.3', fresh and hard.
91							Open, rough		
						2	Open, rough		
92							Open, rough		
		92.7				1			
		Run2 5.2/5.2 100%			2.6/5.2 50% LP = 0.6' 6 > 4"		Open, rough		
93						6	Tight, stylolite		
							Open, rough		
							Tight, stylolite		
							Open, rough		
							Open, rough, MnOx		
94									
						3	Open, rough		
95							Open, stylolite MnOx		
						4	Open, rough		
							Open, stylolite		
							Open, rough		
96							Open, rough		

*Geotechnical Information by: R. Parsons/ M. Schauer

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 8

Project Number:

Hole Number OB2j

Project: WSSRAP Pump Observation Well

Location: In Front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
96		Run2 con't				3	Open, rough (3)		As Above
									96.7-98.5 LIMESTONE AND CHERT INTERBEDDED, yellowish gray (5Y 7/2) to light gray (N7), thick bedding, medium LS crystals, crinoid stems in chert, fresh to slightly weathered, chert fractures calcite filled, hard.
97							Open, rough (2)		
						2	Open, rough		
		97.9					Rubblized Zone		
98		Run3 5.1/5.1 100%			3.2/5.1 63% LP = 0.7		Rubblized Zone		98.5-103.0 LIMESTONE very light gray (N8), thickly bedded, medium to coarse crystals, few fossils, fresh, stylolites, hard.
						2	Open, rough (2)		
							Open, rough		
99					7 > 4"		Tight, stylolite		
						3	Open, smooth		
100				1/2					
							Open, smooth		
						3	Tight, stylolite		
							Open, rough		
101							Open, smooth		
						3	Open, rough		
							Tight, stylolite		
102							Open, rough		
						3	Open, rough, MnOx (2)		
103				2					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 8

Project Number:

Hole Number 0B2j

Project: WSSRAP Pump Observation Well

Location: In Front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
103		Run4 1.6/1.6 100%		2	0.7/1.6 44% LP = 0.4'	5	Tight,stylolite Open, smooth Open,smooth,MnOx Open, rough (2)		103.0-111.6 LIMESTONE lt.gry (N7) to very light gray (N8), thick bedding, medium crystals, few vugs, pinpoint to 0.1', few fossils, few chert nodules, 0.1' dia, fresh, stylolites, hard.
104		104.7			>2 4"	2	Open, rough (2)		
		Run5 3.0/3.0 100%			2.4/3.0 80% LP = 0.5'	4	Tight,stylo,MnOx Tight, MnOx Open,rough,MnOx Open, smooth		
105					>6 4"				
106						3	Tight Open, smooth Open, rough		
107		107.7				2	Open,stylo, MnOx Open, smooth, MnOx		
		Run6 4.8/4.8 100%		2/3	3.5/4.8 73% LP = 0.7'	5	Tight,stylolite Tight Open, smooth (2)		
108					>7 4"	3	Tight Open, rough Tight Open, rough		
109				3					
110									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 4 of 8

BOREHOLE LOG

Project Number:

Hole Number 0B2j

Project: WSSRAP Pump Observation Well

Location: In Front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
110		Run6 con't		3			Tight Open, rough		As Above.
						3	Tight,stylolite		
							Open, rough		
111							Open,rough,MnOx		
						2	Rubblized Zone		111.6-114.1 LIMESTONE light olive gray (5Y 6/1) to pale yellowish green (10GY 7/2), small to medium grains, some fossils, some chert nodules, 0.01-0.2' dia, fresh, hard.
112									
		112.5							
		Run7 1.7/1.7 100%			0.4/1.7 24% LP * 0.4' 1 > 4"	5	Open, rough(5)		
113							Open, rough Tight,stylolite		
						6	Open, rough(4)		
114		114.2							114.1-124.7 LIMESTONE light gray (N7) to pinkish gray (5YR 8/1) LS, thick bedded, small to medium xtals, few fossils, many chert nodules 0.1-0.3' dia, fresh, hard, chert is light bluish gray (5B 7/1), bands of light olive gray LS - 114.5-115.1 121.8-123.2 many fossils - 119.1-119.2 123.2-124.7
		Run8 3.6/3.6 100%			3.0/3.6 83% LP * 0.5' 7 > 4"		Open,stylolite		
						3	Open,rough,MnOx		
							Open, rough		
115							Open,smooth(3) Open, rough		
						5			
							Open, rough		
116							Tight,stylolite MnOx		
						2			
							Open, rough		
117				3					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 8

Project Number:

Hole Number 0B2J

Project: WSSRAP Pump Observation Well

Location: In Front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
117		Run8 con't		3		3	Tight,stylolite		As Above.	
		117.8		3			Open, rough Open,rough			
		Run9		4	3.9					
118		4.7/4.7			4.7		Open, rough			
		100%			83%	4	Open, rough			
					LP = 1.2		Opn,rgh,MnOx (2)			
119					6 > 4"		Open, rough			
						1				
120						2	Open, smooth			
							Tight,stylolite			
121						2	Open, rough Tight,stylolite MnOx			
122										
		122.5				2	Open, smooth(2)			
		Run10			2.7					
		4.9/4.9			4.9					
123		100%			55%					
					LP = 0.8'	5	Open,rough(4)			
				4	5 > 4"		Tight,stylolite			
124										

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 8

Project Number:

Hole Number 0821

Project: WSSRAP Pump Observation Well

Location: In Front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
124		Run10 con't		4			Open, rough (2)		
						4	Open, rough		124.7-127.3 LIMESTONE, very light gray (N8), thick bedded, medium xtals, many large fossils, fresh, hard.
							Open, rough		
125							Open, rough		
						3			
							Open, rough (2)		
126							Open, rough		
						3	Tight,stylolite		
							Open, smooth		
127							Open, smooth		
		127.3		4					
		Run11 4.8/4.8 100%		5	3.3/4.8 69% LP = 0.6'	3	Open, rough		127.3-130.3 LIMESTONE, very light gray (N8) to pinkish gray (5YR 8/1), thick bedded, small to medium grain, pinpoint to .02' vugs, many fossils, few chert nodules 0.2', fresh, stylolites, hard.
128							Tight,stylolite		
						5	Open, rough(3)		
					7 > 4"		Tight,stylolite		
129							Open, rough		
						4	Open, rough (4)		
130									130.3-132.1 LIMESTONE very light gray (N8) to light greenish gray (5GY 8/1), thick, small to medium xtals, pinpoint vugs, chert nodules 0.1' dia, fresh, stylolites, hard.
						1	Open, rough		
131				5					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 8

Project Number:

Hole Number: OB2j

Project: WSSRAP Pump Observation Well

Location: In Front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
131		Run11 con't		5		3	Open, rough Open, smooth Open, rough		
132		132.1							
		Run12 1.9/1.9 100%			1.5/1.9 79% LP = 0.6'	2	Open, rough Tight, stylolite MnOx		132.3-133.6 LIMESTONE, very light gray (N8) to grayish pink (5R 8/2), thick, small to medium xtals, pinpoint vugs, many fossils, fresh, hard.
133									
					3 > 4"	6	Open,rough(6)		133.6-134.5 CHERT, pale blue (5PB 7/2), medium bedded, cryptocrystalline, fresh, very hard.
134		134.0							
		Run13 3.8/3.8 100%			3.1/3.8 82% LP = 0.7'	2	Open, smooth Open, rough		134.5-137.4 LIMESTONE, yellowish gray (5Y 8/1) and light olive gray (5Y 6/1), medium bedded, small crystals, many pinpoint vugs, many fossils in LS, fresh, stylolites, hard.
135					6 > 4"	3	Open, rough Open, stylolite MnOx		
136				5/6		5	Tight (2) Open, rough Tight Open, rough		
137						4	Tight Tight Open, rough (3)		137.4-140.3 CHERT and LS INTERBEDDED, (con't)
		137.8							
138		Run14		6					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

Sheet 8 of 8

Project Number:

BOREHOLE LOG

Hole Number: OB2j

Project: WSSRAP Pump Observation Well

Location: In Front of Building 302

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
138		Run14 2.5 / 2.5 100%		6	2.3 / 2.5 92% LP = 0.7'	2	Open, rough		pale blue (5PB 7/2) to yellowish gray (5Y 8/1), med bedded, small crystals, many fossils in LS, fresh, stylolites, hard to very hard.
							Tight, stylolite		
139					4 > 4"	3	Open, smooth(3)		
140						1	Tight, stylolite		
									Total Depth 140.3'
141									

APPENDIX B

PHASE II BOREHOLE, PIEZOMETER AND TEST PIT LOGS

Appendix B

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APPENDIX B-1

ANGLE BOREHOLE DRILLING AND GEOPHYSICAL LOGS (AH-1, AH-2)

WSSRAP DISPOSAL CELL

GEOTECHNICAL ANGLE HOLE DRILLING

B-1

This report describes the procedures performed during the drilling, coring, and pressure testing of two angled exploratory core holes located within the area of the proposed disposal cell, Weldon Spring Remedial Action Project (WSSRAP). The objective of the drilling was to characterize the bedrock structure, fracturing, hydraulic conductivity, and to perform downhole geophysical surveys. The angle hole locations were determined during the Geotechnical Investigations Phase I program completed in August 1988, and are shown on Figure 1.

In previous studies the major regional joint sets were identified. C.M. Roberts (USGS, 1951) reported two major sets, one trending between N30W and N65W, and the other set oriented between N30E and N72E. All joints were determined to be near-vertical to vertical. To intersect these joint sets, the angle holes were drilled at bearings perpendicular to the average joint trends. Hole AH-1 was drilled at N42°E and hole AH-2 was drilled at N39°W.

Drilling was conducted from January 16 through March 14, 1989 by Brotcke Engineering under subcontract WP059. Various Brotcke employees performed the drilling and water pressure testing. Drilling and testing supervision, documentation, and core logging were performed by Paul Patchin, Ray Parsons, and Charles Payton, all employed by MK-Ferguson, Environmental Services Division.

Before drilling commenced the drill rigs, drill pipe, and all drilling tools were thoroughly decontaminated with high pressure steam. In addition, the rear of the drill rigs, all tools, and drill pipe were decontaminated between drill holes. Because the drill sites were outside of restricted, contaminated areas, personal protective clothing was not required, although all personnel wore safety rubber boots, gloves, and

hard hats. A Ludlum model 44 scintillometer was present at the drill site at all times and was used to scan all core samples for radiation. No sample displayed radiation above background levels.

All drilling or supervision personnel received OSHA approved 40-hour hazardous waste safety training (29 CFR 1910.120). In addition, site specific WSSRAP radiation safety instruction was given by a site health physicist. All personnel wore thermoluminescent dosimitry (TLD) badges to monitor radiation exposure, and provided entrance and exit urine samples for medical surveillance.

Overburden drilling was accomplished using an Acker Mark IV skid-mounted drill rig. Two vertical boreholes had previously been drilled and sampled to the top of bedrock at both angle hole sites. Therefore, overburden sampling in the angle holes was not performed. An 8-inch diameter tri-cone bit mounted on a 10-ft stabilizing tool was used to drill through the overburden. The holes were drilled at an angle of 60° from horizontal to the top of bedrock. Pressurized air and water were used to lift cuttings to the surface. The overburden was then cased with 4-inch pipe down to the bedrock surface. At the completion of overburden drilling, the skid rig was moved off and a Longyear 38 wireline coring rig was moved onto the hole. This rig then core-drilled on the angle from the top of bedrock to total depth in both holes.

Continuous coring was accomplished using a 5-foot NQ-wireline triple-tube core barrel having a 2.98-inch OD diamond impregnated bit, which provided 1.75 inch diameter core. A split inner barrel was used to maintain core integrity and borings were cored using water only. Water was transported from the site decontamination pad and also from a hydrant adjacent to the administration building using a 300-gallon water truck.

As the core was retrieved, it was striped to maintain orientation and down-hole footage was marked on the core. Physical characteristics and discontinuities were recorded on the log and described. Penetration rate, water return/loss, core recovery, and RQD were also recorded.

Wooden blocks marking core runs and estimated loss zones were placed within the core as it was boxed. Photographs were taken of the boxed core and the drilling operation. These, as well as the core logs, accompany this report.

Water pressure (packer) tests were performed in each drillhole at 10-ft intervals for the first 30 feet below the top of bedrock, then at 20-ft intervals to total depth. The tests were accomplished using a single inflatable packer connected to 3/4-inch galvanized steel water pipe. A Bean Royal water pump with two in-line surge chambers provided water pressure for the testing. Water flow and pressure were measured with a flow meter and pressure gauge, respectively.

Generally, three tests of five minute duration were performed at each test interval. Once the test section had been cored, the hole was briefly flushed with water and the core barrel removed. The drill pipe was pulled to where the bit was just above the desired top of the test interval. The packer assembly was then lowered with the water pipe, set into the bit, and inflated with compressed gas. After the packer was securely seated, the hole was pressurized to the desired water pressure, stabilized, and testing started. The initial test was generally a low pressure test, then proceeded to a higher pressure test, then back to the low pressure. For each test the inflow pressure, average flow, length of test interval, and total head were recorded on test logs. Periodic water table measurements were also taken and recorded. The hydraulic conductivity for each test in the interval was then calculated and recorded on the test logs which are included with this report. Tables 1 and 2 summarize the packer testing results for both drill holes.

Both angle holes were geophysically logged at the completion of the drilling. During the logging of hole AH-1 some of the tools wedged in the hole because of minor caving. This necessitated the installation of 2-inch ID PVC pipe to total depth. The tools were then lowered through the PVC pipe. This was also done in hole AH-2 after the caliper tool was successfully run. Each drill hole was surveyed using the following

geophysical methods: natural gamma ray; density; resistivity; neutron; sonic; spontaneous potential; temperature; deviation; and caliper. The logs for these surveys accompany this report.

Both drill holes were abandoned following the geophysical logging. The 2-inch PVC pipe already in place was used to tremie Volclay bentonite grout to the bottom of the hole and was gradually pulled out as the hole filled with grout. The 4-inch overburden casing was also pulled during grouting. In hole AH-1, the 2-inch PVC pipe became wedged as it was being pulled out. After repeated tries, it was determined that further pulling would break the pipe. The pipe was then grouted into the hole and later pulled until breakage. Approximately 20 feet of PVC pipe was removed from the hole with the remainder being grouted in place. Careful attention was made to insure complete grouting inside and outside of the PVC pipe.

A daily diary was kept during all drilling activities documenting the fieldwork progress. Upon completion of the angle hole drilling, the drill rig, boom truck, water truck, and all drilling tools were decontaminated with high pressure steam wash prior to leaving the site.

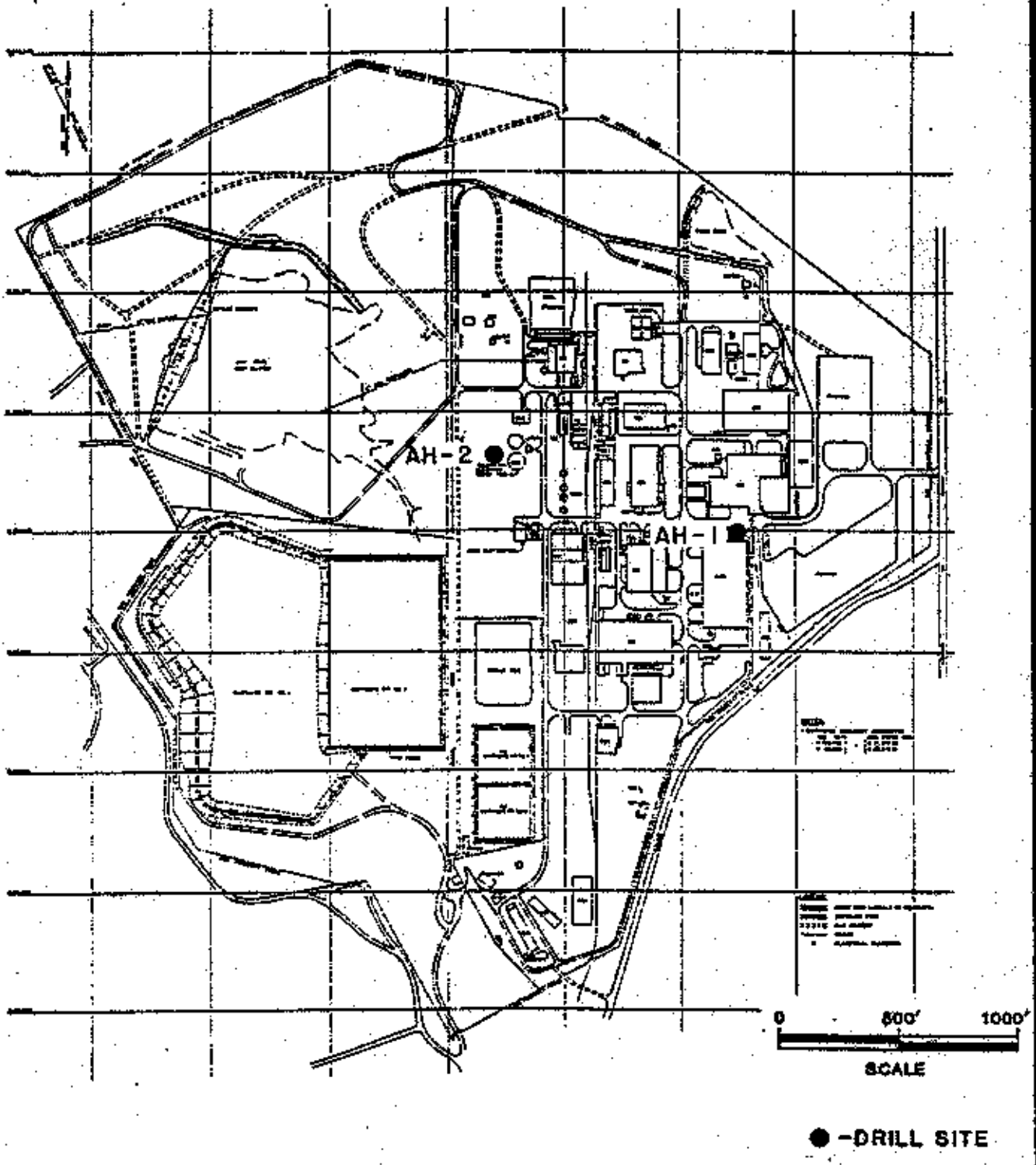

FIGURE I

DRILL HOLE LOCATIONS

TABLE 1

HYDRAULIC CONDUCTIVITY IN BEDROCK

PACKER TESTING RESULTS

DRILL HOLE AH-1

TEST NO.	TEST SECTION (angle depth-ft)	PRESSURE (psi)	AVERAGE* FLOW (gpm)	HYDRAULIC CONDUCTIVITY (cm/sec)
1-1	39.8 - 50.0	5	11.24	1.00×10^{-3}
1-2		10	12.9	9.44×10^{-4}
1-3		20	15.3	8.26×10^{-4}
1-4		10	12.98	9.50×10^{-4}
2-1	49.8 - 60.0	20	12.63	6.30×10^{-4}
2-2		40	16.82	5.65×10^{-4}
2-3		20	12.75	6.36×10^{-4}
3-1	59.2 - 69.5	20	0	0
3-2		40	0	0
3-3		20	0	0
4-1	69.2 - 89.5	35	0	0
4-2		70	0.88	1.16×10^{-5}
4-3		35	0	0
5-1	89.4 - 109.5	40	0	0
5-2		80	0.03	3.60×10^{-7}
5-3		40	0	0
6-1	109.4 - 129.5	45	0.02	3.63×10^{-7}
6-2		90	2.3	2.49×10^{-5}
6-3		45	0	0
7-1	127.5 - 151.6	40	0	0
7-2		90	0.0071	6.60×10^{-8}
7-3		40	0	0

* Flow rate averaged over 5 to 9 minute testing period.

TABLE 2

HYDRAULIC CONDUCTIVITY IN BEDROCK

PACKER TESTING RESULTS

DRILL HOLE AH-2

TEST NO.	TEST SECTION (angle depth-ft)	PRESSURE (psi)	AVERAGE* FLOW (gpm)	HYDRAULIC CONDUCTIVITY (cm/sec)
1-1	53.6 - 63.4	10	14.13	9.02×10^{-4}
1-2		20	16.38	8.04×10^{-4}
1-3		10	14.30	9.13×10^{-4}
2-1	62.0 - 73.4	20	4.21	1.79×10^{-4}
2-2		40	6.02	1.77×10^{-4}
2-3		20	3.84	1.64×10^{-4}
3-1	73.0 - 83.4	30	0.01	3.74×10^{-7}
3-2		60	0.04	9.63×10^{-7}
3-3		30	0	0
4-1	83.2 - 103.4	40	0	0
4-2		80	0.73	8.41×10^{-6}
4-3		40	0	0
5-1	103.2 - 123.4	60	0	0
5-2		90	0.18	1.89×10^{-6}
5-3		60	0	0
6-1	123.2 - 143.4	60	0.04	5.70×10^{-7}
6-2		90	0.20	2.10×10^{-6}
6-3		60	0.05	7.12×10^{-7}
7-1	143.2 - 165.0	60	1.66	2.21×10^{-5}
7-2		90	2.11	2.08×10^{-5}
7-3		60	1.44	1.92×10^{-5}

* Flow rate averaged over 5 to 9 minute testing period.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 17

Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling	Location: At borehole GT-57, adjacent to the south of access control.
Coordinates: (AEC) N.100017 W.49739W	Drilling Contractor: Brotcke Engineering
Drill Make and Model: Rotary: Acker Mark IV Coring: Longyear 38	Depth Top of Rock: ~ 35.5'
Depth Casing & Size: 4" to 36.4'	Hole Size: 8" to 36.7' then 2.98"
Elevation: 654.7 (Ground)	Angle from Vert. and Bearing: 30° on N 42° E
Depth Bottom of Hole: 151.6' on angle; 131.2' Vert.	
Water Level: Vertical 46.1' 2/2/89	Fluid & Additives: Water
Date Start: 01/24/89	Date Finish: 02/14/89
Logger: R. Parsons, P.Patchin, C.Payton	

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
34									Drilled from surface to 36.7' with tri-cone bit. Encountered probable bedrock at 35.5' (driller said it was very solid). Continued to drill with tri-cone bit to 36.7' to confirm bedrock surface. Set 4" casing through overburden. (See log for borehole GT-57 for description of overburden.)
35	Bedrock at 35.5'								
36									Begin NQ Coring 36.7'
37	4 min/ft 0% return	NQ-1 3.4'/3.4' 100%		1	1.2' 3.4' 35% LP = .4'	>6	Open, rough Open, rough Open ⅛", FeOx clay Rubble		36.7-44.6' LIMESTONE, grayish orange (10YR 7/4) to pale yellowish brown (10YR 6/2), slightly argillaceous, finely crystalline, moderately weathered, mod. hard, fossiliferous with <2% weathered pyrite blebs, 5% chert nodules (very pale orange (10YR 8/2)), with MnOx stringers, clay and MnOx in partings.
38	4 min/ft 0% return				3 > 4"	5	Open, smoth, clay Open, rgh, clay(2) Styolite		
39	3 min/ft					>6	Open, rgh, clay(4) Rubble		
40	39.8 Top of Pressure Test #1								

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 17

Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling

Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
40	3 min/ft	40.1 / NQ-2		1			Rubble		LIMESTONE, as above.
		2.3' / 4.5'			1.5' / 4.5' 33%				40.4-40.8' CHERT, white (N9) fossiliferous, crinoids.
	0% return						Open, rough		
41	3 min/ft	51%			LP = .6'		Open,rgh,clay		
							Open,rgh,FeOx clay		
	0% return				> 3 4"				
42	3 min/ft						Open, rough		42.0-42.3' Coarsely crystalline, crinoid stem at 42.0'.
			42.4				Rubble		42.4-44.6' CORE LOSS
	0% return								
43	3 min/ft								
	0% return								
44	2 min/ft								
		44.6' / NQ-3 .4/.4 100%		1					44.6-45.0' CHERT, medium light gray (N5), microcrystalline, very hard, fractured and rubblized.
	0% return								
45	3 min/ft	NQ-4			1.3' / 5.0' 26%				45.0-48.2' CORE LOSS, possible solution cavity with clay. Driller said was soft.
		1.8' / 5.0' 36%							
	0% return				LP = .8'				
46	3 min/ft								
					> 2 4"				
47	0% return								

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 17

Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling

Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
47	3 min/ft -Driller said rock soft and taking water 0% return	NQ-4 con't		1		> 6			CORE LOSS, con't.
48	3 min/ft 0% return		48.2			2	Opn,rgh,clay Opn,rgh,clay, FeOx (2)		48.2-48.5' CLAY, yellowish gray (5Y 7/2), moist, plastic slightly silty with chert gravel.
49	3 min/ft 0% return					2	Tight,rough, FeOx calcite		48.5-52.0' LIMESTONE dark yellowish orange (10YR 6/6) mottled with chert (50%) very pale orange (10YR 8/2). Limestone is argillaceous, mod. severely weathered, finely crystalline with FeOx staining, and mod. hard. Chert is hard, fractured with MnOx and FeOx stringers. Some solution features in L.S. from 50.0'-52.0'.
Top of Test #2 2/2/89 50	-49.8 Bottom of Test #1 3 min/ft Soft 0% return	NQ-5 1.4'/2.0' 70%		1	.5/2.0 25%	> 6	Tight, smooth Rubble		
51	3 min/ft 0% return Blocked off		51.0 51.6		LP = .5 1 > 4"	> 6	Open, rough, FeOx, clay		51.0-51.6' CORE LOSS
52	1 min/ft very soft	NQ-6 0.3'/3.0' 10%			0%				52.0-54.7' CORE LOSS Driller said it was very soft. Most likely clay and chert gravel-filled solution cavity. Recovered some very weathered and vuggy chert gravel with heavy FeOx deposition.
53	1 min/ft								
54									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 17

Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling

Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
54	3 min/ft			2					CORE LOSS con't.
	0% return		54.7'						54.7-60.5' ARGILLACEOUS LIMESTONE (60%) grayish orange (10YR 7/4) interbedded with CHERT (40%), very light gray (N8) as nodules and lenses. Limestone is mod. severely weathered with abundant FeOx stain, mod. hard, finely crystalline, vuggy, with clay filling in fractures. Chert is hard, slightly weathered, fractured with MnOx blebs and stringers, fossiliferous.
55	4 min/ft	NQ-7 4.9'/5.0' 98%			4.9'/5.0' 98% LP = 2.5'	1	Open, rough		
	0% return								
56	3 min/ft				5 > 4"	2	Open, rough Open, rough		
	0% return								
57	5 min/ft					0			
	0% return								
58	3 min/ft					0			
	0% return								
59	--59.2 Top of Test #3 3 min/ft 0% return Bottom of Test #2					1	Open,rough,clay		
60	2 min/ft	NQ-8 3.4'/5.0' 68%	60.5'		1.7'/5.0' 34% LP = .7'	>6	Open, rough (2) Rubble		60.5-61.1' CORE LOSS. Possible solution feature. Residual chert gravel and clay present.
61	0% return			2					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 17

Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling

Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
61	2 min/ft	NQ-8 con't	61.1	2	3 > 4"				61.1-62.2' ARGILLACEOUS LIMESTONE and CHERT as before. Brecciated with clay 61.8-62.2'. 62.2-63.2' CORE LOSS
						6	Open,rgh,clay, MnOx		
							Tight,rough,clay		
	0% return						Open,rough,clay		
62	2 min/ft		62.2				Open,rough,clay		
						2			
	0% return								
63	5 min/ft		63.2				Open,rough,clay Rubble		63.2-63.4' Chert rubble, with clay. 63.4-68.0' CHERT (60%), ARGILLACEOUS LIMESTONE (40%) as before, chert nodule med. dark gray (N4) with abundant MnOx and fossils at 64.7-64.9'
						6	Open 1/8" rgh, clay		
	0% return								
64	4 min/ft						Tight,rough,FeOx clay		
						1			
2/3/89 2/7/89 65	0% return								
	6 min/ft	NQ-9 4.5'/4.5' 100%		2/3	2.5'/4.5' 56% LP = .7'	1	Tight,rough,FeOx		
66							Open,smooth		66.0-66.4' CHERT nodule, medium dark gray (N4).
	8 min/ft				5 > 4"	6	Open,rough (3)		
							Opn,rgh,clay		
67							Opn,rgh,clay		
	7 min/ft					5	Open,rough (4)		
68				3					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 17

Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling

Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
68	4.0 min/ft	NQ-9		3		1			68.0-71.5' ARGILLACEOUS LIMESTONE. As before, moderately weathered and hard.
69	-69.2' Top of Test #4								
2/8	-69.5' Bottom of Test #3	69.5							
		NQ-10 5.0' 5.0' 100%		3	4.7' 5.0' 94%	2	Open, rough		
							Open, rough		
70	5 min/ft						Open, rough		
					>6 4"	1			
71	3 min/ft						Styolite,tight		
						2	Open, rough		71.5-79.5' LIMESTONE and CHERT, intermixed, med. lt. gray (N6); fossiliferous, vugs<5% pinpoint to 5mm; occ. solution feature. Fresh and hard LS; grayish orange (10YR 7/4) LS 60% - Chert 40%.
72	3 min/ft						Open, rough		
						2			
							Open, rough		
73	3 min/ft								
						1	Open,rough,MnOx		
74	3 min/ft								
		74.5'				1	Open, rough		
		NQ-11 5.0' 5.0'		3	RQD				
75									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 17

Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling

Location: N.100017 W.49379

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
75	3 min/ft	100%		4	4.9'/5.0' 98% LP = 3.5	2	Open, rough Open, rough		LIMESTONE and CHERT, as above.
76	2 min/ft				4 > 4"	0			76.7-78.0' Solutions features and vugs pinpoint to 1/4".
77	2 min/ft					0			
78	2 min/ft					0			
79	2 min/ft	79.5				1	Open, rough		
		NQ-12 5.0'/5.0'		4	4.0'/5.0' 80%				79.5-84.5' LIMESTONE and CHERT, intermixed, L.S. is grayish orange (10YR 7/4); thick bedded; vugs pinpoint: chert med light gray (N6). Fresh and hard.
80	2 min/ft Wthrd Limestone Competent Limestone	100%			LP = 1.0	5	Open, smooth Open, rough Open,rgh,clay Open, rough (2)		
81	2 min/ft				6 > 4"	3	Open,rgh,clay Open,rough (2)		
82									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 17

Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling

Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
82	2 min/ft	NQ-12 con't		4					As above.
						1	Open, rough		
							Styolite, tight		
83	2 min/ft						Open, rough		
						3	Tight		
84	2 min/ft						Open, rough		
		84.5'				1			84.5-89.5' L.S. and CHERT as above
		NQ-13 5.0'/5.0' 100%		4/5	4.5/5.0' 90% LP = 1.7'				
85							Open,rgh,MnOx		
						1			
					5 > 4"				
86							Styolite,tight		
							Open, smooth		86.4-86.6' Solution features.
						3	Oprn, rough		
87									
						0			
88							Open, rough		
						3	Open, rough (2)		
89									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 9 of 17

Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling

Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
89	4 min/ft Top of Test #5 -Bottom of Test #4	NQ-13 89.5		5		5	Open, rough (2) Open, smooth (2)		89.5-94.5' LIMESTONE light gray (N7) thick bedded; vugs pinpoint; occ. fossil; chert nodules at 89.5-89.9' and 92.9-93.2'. Fresh and hard.
90	4 min/ft	NQ-14 5.0'/5.0' 100%		5	3.2/5.0 64% LP = 1.9'	3	Open, rough Open, rough (2)		
91	5 min/ft				>3 4"	4	Open, rough (2) Styolite, tight (3)		
92	7 min/ft					1	Open, smooth		
93	6 min/ft					5	Open, smooth (2) Open, rough (2) Open, rough		
94	4 min/ft	94.5				>6	Rubblized Zone		94.5-99.5' LIMESTONE as above
2/8 2/9		NQ-15 5.0'/5.0' 100%		5 6	4.6/5.0 94% LP = 1.9				
95	4 min/ft					1	Styolite, tight		
96					>3 4"				

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 10 of 17

Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling

Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
96	4 min/ft	NQ-15 con't		6			Open,rough,clay		As above
						3	Open, rough		
							Styolite, tight		CHERT BANDS, medium light gray (N6), fossiliferous, at: 96.4-96.6' 97.0-97.2' 97.7-97.8' 98.0-98.2'
97	4 min/ft					2	Open, rough,clay		
							Open, rough		
98	4 min/ft					0			
99	4 min/ft								
		99.5					Open, rough		99.5-104.5' LIMESTONE, light gray (N7); thick bedded; vugs pinpoint; occasional fossil; styolites, fresh and hard.
		NQ-16 5.0'/5.0' 100%		6	4.9'/5.0' 98% LP = 2.9'	2	Styolite, tight		CHERT nodules as before at: 99.5-99.7' 100.3-100.5' 101.3-101.7' 102.5-102.7'
100	3 min/ft				3 > 4"	0			
101	3 min/ft					0			
102	3 min/ft						Styolite, tight		
						7	Open,rough(6)		
103									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 11 of 17
Project Number 5121
Hole Number AH-1

Project: WSSRAP Angle Hole Drilling
Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
103	3 min/ft	NQ-16 con't		6		1	Open, rough		As above
104	4 min/ft	104.5				1	Open, rough		104.5-109.5' LIMESTONE as above.
		NQ-17 5.0' / 5.0' 100%		6	5.0 / 5.0 100%				
105	4 min/ft	100%		7	LP = 3.1'	2	Styolite, tight, MnOx		CHERT nodules as before at: 106.4-106.5' 106.7-107.0' 107.3-107.8'
							Styolite, tight		
106	4 min/ft				> 4"	2	Open, rough, MnOx Styolite, tight		
107	3 min/ft					1	Open, rough		
108	3 min/ft					1	Open, spun		
109	Top of Test #6 Bottom of Test #5	109.5				2	Open, rough		109.5-113.0' (Description next page)
		NQ-18		7	RQD		Open, rough, fossil		
110									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 12 of 17

Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling

Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
110	10 min/ft No drill water return NW casing at 38.0'	NQ-18 3.5'/3.5' 100%		7	83% 2.9'/3.5'	0			109.5-113.0' LIMESTONE light gray (N7), thick bedded with scattered CHERT nodules, unweathered, hard to very hard, scattered fossils.
111	9 min/ft				LP = 1.1' 6 > 4"	1	Fractures, tight irregular-opened by drilling		Chert unweathered, very hard, light bluish gray (5B 7/1). Chert nodules at: 110.0-110.3' 111.4' 112.0-112.2' 112.4' 112.8' 113.0-113.2'
112	23 min/ft					2	Core broken by drilling thru chert nodules. Smooth, tight joint 66° Mechanical(2)		
113	25 min/ft	NQ-19 1.5'/1.5' 100%			1.0'/1.5' 66% LP = 1.0	1	Styolite, open irregular		Void - Open 10-15mm, partially filled with calcite crystals. Small irregular chert nodules at 113.8-114.3'.
114	18 min/ft	114.5		7 8	1 > 4"	0	Styolite, tight Mechanical		
115	18 min/ft	NQ-20 2.2'/2.2' 100%			2.0/2.2 91% LP = 1.2 2 > 4"	1	Styolites, tight Open, irregular Styolite, tight		115.2 - Increase in density. Chert interbedded up to 80% of rock, chert nodule at 115.5'.
116	28 min/ft Changed to a new bit	116.7				2	Mechanical Open, irregular		Thinly interbedded chert and limestone - very irregular sharp contacts.
117		NQ-21			RQD ↓				

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 13 of 17
Project Number: 5121
Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling
Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
117	8 min/ft No drill water return	2.8'/2.8' 100%		8	2.6/2.8 93% LP = .07'	2	Open, irreg. Calcite filled irreg. void		LIMESTONE, interbedded with thin irregular chert, unweathered, hard to very hard. Light gray (N7) to light bluish gray (5B 7/1).
118	6 min/ft				4 > 4"	1	Open, irreg. mg. oxide Open, irreg.void Open, irreg.		
119	35 min/ft bit not cutting well-pulled core bbl.	119.5 NQ-22 0.7'/0.7' 100%		8	71% LP = 0.5 1>4"	0	Tight, irreg. fracture-opened during drilling	57°	--Mixed Limestone and Chert-marble texture breccia-like, hard to very hard, some calcite healed fractures. --Mottled light greenish gray (5G 8/1), light bluish gray (5B 7/1) to greenish gray (5G 6/1).
120	Sharpened bit 5 min/ft	NQ-23 4.3'/4.3' 100%			3.8/4.3 88% LP = 3.0	1	Irreg. open mg. oxide		- Decrease in amount of chert. - Limestone unweathered, hard, light greenish gray (5G 8/1)
121	5 min/ft				2 > 4"	1	Irreg,open,MnOx		
122	4 min/ft no drill water return			8 9		0	Styolite, tight Styolite, tight		- Mod. hard brecciated zone. - Opened by hand pressure.
123	3 min/ft					0	Styolites, all tight		
124									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

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Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling

Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
124	3 min/ft	NQ-23 124.5					Drill breaks		--Limestone, light-greenish gray (5G 8/1) to light bluish gray (5B 7/1), unweathered, hard, bedded.
		NQ-24 5.0' / 5.0' 100%		9	4.3' / 5.0' 86%	2			
125	3 min/ft				LP = 1.6'	0	Water pressure test 109.4 to 129.5		
126	3 min/ft coring smooth; bit cutting very well				5 > 4"	2	Open, irreg. Styolite, tight Open, irreg.		
127	3 min/ft no drill water return -Top of Test #7					2	Styolite, tight		--Thin beds of limestone, very light gray (N8), mod . hard, thin white mineral coating fractures, breaks with hand pressure.
128	3 min/ft					3	Core broken during drilling		
129	3 min/ft -Bottom of Test #6					3	Styolite - opened during drilling		
130	5 min/ft	NQ-25 4.8' / 5.0' 95%			4.0' / 5.0' 80% LP = 1.0'	5	Fractures sl. irreg, sharp edges	75	Chert bed-light bluish gray (5B 7/1, very hard . Unweathered-fractured Limestone, light greenish gray (5G 8/1), coarse sand texture.
131									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

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Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling

Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
131	5 min/ft	NQ-25 con't			80%	1			LIMESTONE, unweathered, hard, sandy texture, greenish gray (5GY 6/1) with some interbedded chert, very hard, unweathered light bluish gray (5B 7/1).
				9	7 > 4"		Tight, smooth(2)		
132	2.5 min/ft			10		3	Hairline fractures in chert-opened during drilling, sharp edges.		
133	2.5 min/ft					1	Core tends to break during drilling along chert/limestone contacts.		
134	3 min/ft					2	Tight, rough		
		134.5					Tight, rough		
		NQ-26 4.4'/4.6' 96%		10	98%				
135	3 min/ft				LP = 1.9' 4 > 4"	0			
136	3 min/ft					2	Core broken open during drilling along chert/limestone contact.		
137	3 min/ft					1			
138				10					

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 16 of 17

Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling

Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
138	9 min/ft Decrease in drilling rate	96%		10	99%	1	Rubblized zone		LIMESTONE, as above
139		139.1							139.1-144.1' LIMESTONE greenish gray (5GY 6/1); vugs, pinpoint to 1/16"; fresh and hard; chert nodules; light bluish gray (5B 7/1); fresh and very hard at: 139.1-139.3' 139.5-139.8' 140.0-140.2' 141.2-141.4' 142.5-143.0'
2/14	10 min/ft	NQ-27 5.0'/5.0' 100%			4.2/5.0 84%	3	Open, rough; Open, smooth(2)		
140	3 min/ft				LP = 3.2	3	Open, smooth; Open, rough; Tight		
141	3 min/ft				2 > 4"	3	Styolite, tight; Tight; Styolite, tight		
142	3 min/ft			10/11		2	Styolite, tight; Tight		
143	3 min/ft					1	Open, rough, MnOx		
144	3 min/ft	144.1 NQ-28 5.0'/5.0' 100%		11	RQD	2			144.1-151.6' Description on next page...
145									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 17 of 17

Project Number: 5121

Hole Number: AH-1

Project: WSSRAP Angle Hole Drilling

Location: N.100017 W.49739

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (IN)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
145	3 min/ft			11	4.9'/5.0' 98%	2	Styolite, tight Styolite, tight		144.1-151.6' LIMESTONE greenish gray (5GY 6/1); vugs pinpoint; styolites and occ. fossils. Fresh and hard; chert nodules; light bluish gray (5B 7/1); fresh and very hard at: 149.5-149.7' 150.5-150.6'
146	3 min/ft				LP = 3.1' 2 > 4"	2	Styolite, tight Styolite, tight		
147	3 min/ft					3	Open, smooth Open, rough (2)		
148	3 min/ft					0			
149	4 min/ft	149.1 NQ-29 2.5'/2.5' 100%		11	1.8'/2.5' 72%	3	Open, rough Open, spun		
150	3 min/ft				LP = .5' 4 > 4"	4	Open, rough Open, rough (2) Styolite, tight Open, rough		
151	Bottom of Test #7 151.6'					1	Open, rough		T.D. 151.6' 11:00a.m. 2/14/89
152									

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD)

Test # 1

Project: WSSRAP Angle Hole Drilling	Job Number: 5121	Test Section: 39.8 to 50.0	Bore Hole: AH-1
Test Equipment Identification: Tigre Tierra Packer, Neptune Trident Water Meter, Bean Royal Piston Pump	BORE HOLE Orientation: 60° from Horz.	Size: NQ	Test By: P. Patchin; Date: Feb. 1, 1989
Packers: On Casing; Single/Double; Hydraulic/Inflatable	Groundwater Depth: — Ft.	Gauge Height Above Ground: 3 Ft.	Gravity Head: 41.9 Ft.

TEST 1-1 Inflow pressure (Hp) 5 psi x 2.31 = 11.5 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	22 55.0	66.3	77.3	88.4	99.5	23 11.9	22.2	33.7				11.24 GPM / CFM
Take Per Min.	11.3	11.0	11.1	11.1	12.4	10.3	11.5					CFM x 7.48 = GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (Hp) − Head Losses (H_L)

53.4 FT. = 41.9 FT. + 11.5 FT. − 0 FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln \frac{L\ (ft)}{r\ (ft)} = \frac{11.24}{53.4 \times 10.2} \times .011 \ln \frac{10.2}{.124} = 1.00 \times 10^{-3}\ \text{CM/SEC}$$

TEST 1-2 Inflow pressure (Hp) 10 psi x 2.31 = 23.1 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	395.0	407.9	420.9	433.7	446.6	459.7	472.4					12.9 GPM / CFM
Take Per Min.	12.9	13.0	12.8	12.9	13.1	12.7						

H_T 65.0 FT. = H_G 41.9 FT. + Hp 23.1 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln \frac{L}{r} = \frac{12.9}{65.0 \times 10.2} \times .011 \ln \frac{10.2}{.124} = 9.44 \times 10^{-4}\ \text{CM/SEC}$$

TEST 1-3 Inflow pressure (Hp) 20 psi x 2.31 = 46.2 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	525.0	540.6	556.0	571.3	586.8	602.0	617.1					15.3 GPM / CFM
Take Per Min.	15.6	15.4	15.3	15.5	15.2	15.1						

H_T 88.1 FT. = H_G 41.9 FT. + Hp 46.2 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln \frac{L}{r} = \frac{15.3}{88.1 \times 10.2} \times .011 \ln \frac{10.2}{.124} = 8.26 \times 10^{-4}\ \text{CM/SEC}$$

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD) Test #1 Cont.

Project: WSSRAP Angle Hole Drilling	Job Number: 5121	Test Section: 39.8 to 50.0	Bore Hole: AH-1
Test Equipment Identification: Tigre Tierra Packer, Neptune Trident Water Meter, Bean Royal Piston Pump	BORE HOLE Orientation: 60° from Horiz.	Size: NQ	Test By: P. Patchin; Date: Feb. 1, 1989
Packers: On Casing; Single/Double; Hydraulic/Inflatable	Groundwater Depth: — Ft.	Gauge Height Above Ground: 3 Ft.	Gravity Head: 41.9 Ft.

TEST 1-4 Inflow pressure (Hp) 10 psi × 2.31 = 23.1 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	631.0	644.1	657.1	669.9	682.9	695.9						12.98 GPM
												CFM
Take Per Min.		13.1	13.0	12.8	13.0	13.0						CFM × 7.48 = GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (Hp) − Head Losses (H_L)

65.0 FT. = 41.9 FT. + 23.1 FT. − 0 FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln \frac{L\ (ft)}{r\ (ft)} = \frac{12.98}{65.0 \times 10.2} \times .011 \ln \frac{10.2}{.124} = 9.50 \times 10^{-4}\ \text{K, CM/SEC}$$

TEST Inflow pressure (Hp) _____ psi × 2.31 = _____ feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.												GPM
												CFM
Take Per Min.												

H_T ____ FT. = H_G ____ FT. + Hp ____ FT. − H_L ____ FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln \frac{L}{r} = \frac{\quad}{\quad \times \quad} \times \quad = \text{K, CM/SEC}$$

TEST Inflow pressure (Hp) _____ psi × 2.31 = _____ feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.												GPM
												CFM
Take Per Min.												

H_T ____ FT. = H_G ____ FT. + Hp ____ FT. − H_L ____ FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln \frac{L}{r} = \frac{\quad}{\quad \times \quad} \times \quad = \text{K, CM/SEC}$$

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD)

Test # 2.

Project: WSSRAP Angle Hole Drilling	Job Number: 5121	Test Section: 49.8 to 60.0	Bore Hole: AH-1
Test Equipment Identification: Tigre Tierra Packer, Neptune Trident Water Meter, Bean Royal Piston Pump	BORE HOLE — Orientation: 60° from Horiz.	Size: NQ	Test By: P. Patchin, C. Payton — Date: Feb. 2, 1989
Packers: On Casing, (Single/Double), Hydraulic/(Inflatable)	Groundwater Depth: Angle: 53.2, Vert.: 46.07 Ft.	Gauge Height Above Ground: 3 Ft.	Gravity Head: 49.07 Ft.

TEST 2.1 Inflow pressure (Hp) 20 psi × 2.31 = 46.2 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	745.7	757.8	770.6	783.3	795.8	808.4	820.8					12.63 GPM
												CFM
Take Per Min.		12.8	12.8	12.7	12.5	12.6	12.4					CFM × 7.48 = GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (Hp) − Head Losses (H_L)

95.27 FT. = 49.07 FT. + 46.2 FT. − 0 FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln \frac{L\ (ft)}{r\ (ft)} = \frac{12.63}{95.27 \times 10.2} \times .011 \ln \frac{10.2}{.124} = 6.30 \times 10^{-4}\ \text{K, CM/SEC}$$

TEST 2-2 Inflow pressure (Hp) 40 psi × 2.31 = 92.4 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	860.0	877.1	893.7	910.6	927.4	944.1						16.82 GPM
												CFM
Take Per Min.		17.1	16.6	16.9	16.8	16.7						

H_T 141.47 FT. = H_G 49.07 FT. + Hp 92.4 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln \frac{L}{r} = \frac{16.82}{141.47 \times 10.2} \times .011 \ln \frac{10.2}{.124} = 5.65 \times 10^{-4}\ \text{K, CM/SEC}$$

TEST 2.3 Inflow pressure (Hp) 20 psi × 2.31 = 46.2 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	29 83.0	96.8	30 08.7	21.4	34.2	47.0	59.5					12.75 GPM
												CFM
Take Per Min.		13.8	11.9	12.7	12.8	12.8	12.5					

H_T 95.27 FT. = H_G 49.07 FT. + Hp 46.2 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln \frac{L}{r} = \frac{12.75}{95.27 \times 10.2} \times .011 \ln \frac{10.2}{.124} = 6.36 \times 10^{-4}\ \text{K, CM/SEC}$$

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD) Test # 3

Project: WSSRAP Angle Hole Drilling	Job Number: 5121	Test Section: 59.2 to 69.5	Bore Hole: AH-1
Test Equipment Identification: Tigre Tierra Packer, Neptune Trident water meter, Bean Royal Piston Pump	BORE HOLE Orientation: 60° from Horiz.	Size: NQ	Test By: R. Parsons; Date: Feb. 7, 1989
Packers: On Casing, Single/Double, Hydraulic/Inflatable	Groundwater Depth: Angle: 51.7, Vert.: 44.8 Ft.	Gauge Height Above Ground: 3 Ft.	Gravity Head: 47.8 Ft.

TEST 3-1 Inflow pressure (Hp) 20 psi x 2.31 = _____ feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading 30 Gallons or Cu. Ft.	72.1	72.1	72.1	72.1	72.1	72.1	72.1					0 GPM
												CFM
Take Per Min.	0	0	0	0	0	0						CFM x 7.48 = GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (Hp) − Head Losses (H_L)

FT. = FT. + FT. − FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln. \frac{L\ (ft)}{r\ (ft)} = \frac{\quad}{\times} \times \quad = \text{K, CM/SEC}$$

TEST 3-2 Inflow pressure (Hp) 40 psi x 2.31 = _____ feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading 30 Gallons or Cu. Ft.	72.1	72.1	72.1	72.1	72.1	72.1	72.1					0 GPM
												CFM
Take Per Min.	0	0	0	0	0	0						

H_T FT. = H_G FT. + Hp FT. − H_L FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{\quad}{\times} \times \quad = \text{K, CM/SEC}$$

TEST 3-3 Inflow pressure (Hp) 20 psi x 2.31 = _____ feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading 30 Gallons or Cu. Ft.	72.1	72.1	72.1	72.1	72.1	72.1	72.1					0 GPM
												CFM
Take Per Min.	0	0	0	0	0	0						

H_T FT. = H_G FT. + Hp FT. − H_L FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{\quad}{\times} \times \quad = \text{K, CM/SEC}$$

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD) Test # 4

Project: WSSRAP Angle Hole Drilling	Job Number: 5121	Test Section: 69.2 to 89.5	Bore Hole: AH-1
Test Equipment Identification: Tigre Tierra Packer, Neptune Trident water meter, Bean Royal Piston Pump	BORE HOLE Orientation: 60° from Horiz.	Size: NQ	Test By: R. Parsons; Date: Feb. 8, 1989
Packers: On Casing; Single/Double; Hydraulic/Inflatable	Groundwater Depth: Angle: 51.7 Vert.: 44.8 Ft.	Gauge Height Above Ground: 3 Ft.	Gravity Head: 47.8 Ft.

TEST 4 - 1 Inflow pressure (Hp) 35 psi x 2.31 = _____ feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading 30 Gallons or Cu. Ft.	86.5	86.5	86.5	86.5	86.5	86.5	86.5					0 GPM
												CFM
Take Per Min.		0	0	0	0	0	0					CFM x 7.48 = GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (H_P) − Head Losses (H_L)

FT. = FT. + FT. − FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln. \frac{L\ (ft)}{r\ (ft)} = \frac{\quad}{\times} \times \quad = \text{K, CM/SEC}$$

TEST 4 - 2 Inflow pressure (Hp) 70 psi x 2.31 = 161.7 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading 30 Gallons or Cu. Ft.	89.5	90.3	91.3	92.2	93.0	93.8	94.6					.88 GPM
												CFM
Take Per Min.		1.0	1.0	0.9	0.8	0.8	0.8					

H_T 209.5 FT. = H_G 47.8 FT. + H_P 161.7 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{.88}{209.5 \times 20.3} \times .011 \ln \frac{20.3}{.124} = 1.16 \times 10^{-5} \text{ K, CM/SEC}$$

TEST 4 - 3 Inflow pressure (Hp) 35 psi x 2.31 = _____ feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading 30 Gallons or Cu. Ft.	94.6	94.6	94.6	94.6	94.6	94.6	94.6					0 GPM
												CFM
Take Per Min.		0	0	0	0	0	0					

H_T FT. = H_G FT. + H_P FT. − H_L FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{\quad}{\times} \times \quad = \text{K, CM/SEC}$$

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD) Test #5

Project: WSSRAP Angle Hole Drilling	Job Number: 5121	Test Section: 89.4 to 109.5	Bore Hole: AH-1
Test Equipment Identification: Tigre Tierra Packer, Neptune Trident water meter, Bean Royal Piston Pump	BORE HOLE Orientation: 60° from Horiz.	Size: NQ	Test By: R. Parsons; Date: Feb. 9, 1989
Packers: On Casing; Single/Double; Hydraulic/Inflatable	Groundwater Depth: Angle: 51.7; Vert.: 44.8 Ft.	Gauge Height Above Ground: 3 Ft.	Gravity Head: 47.8 Ft.

TEST 5-1 Inflow pressure (H_P) 40 psi × 2.31 = _____ feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading 30	96.2	96.2	96.2	96.2	96.2	96.2	96.2					0 GPM
Gallons or Cu. Ft.												CFM
Take Per Min.	0	0	0	0	0	0						CFM × 7.48 = GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (H_P) − Head Losses (H_L)

[ ] FT. = [ ] FT. + [ ] FT. − [ ] FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln. \frac{L\ (ft)}{r\ (ft)} = \frac{\quad}{\times} \times \quad = \text{K, CM/SEC}$$

TEST 5-2 Inflow pressure (H_P) 80 psi × 2.31 = 184.8 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading 30	96.4	96.4	96.4	96.5	96.5	96.6	96.6	96.7	96.7	96.7		.03 GPM
Gallons or Cu. Ft.												CFM
Take Per Min.	0	0	0.1	0	0.1	0	0.1	0	0			

H_T 232.6 FT. = H_G 47.8 FT. + H_P 184.8 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{.03}{232.6 \times 20.1} \times .011 \ln \frac{20.1}{.124} = \text{K, CM/SEC } 3.60 \times 10^{-7}$$

TEST 5-3 Inflow pressure (H_P) 40 psi × 2.31 = _____ feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading 30	96.7	96.7	96.7	96.7	96.7	96.7	96.7					0 GPM
Gallons or Cu. Ft.												CFM
Take Per Min.	0	0	0	0	0	0						

H_T [ ] FT. = H_G [ ] FT. + H_P [ ] FT. − H_L [ ] FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{\quad}{\times} \times \quad = \text{K, CM/SEC}$$

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD)

Test #6

Project: WSSRAP Angle Hole Drilling	Job Number: 5121	Test Section: 109.4 to 129.5	Bore Hole: AH-1
Test Equipment Identification: Tiger Tierra Packer, Neptune Trident water meter, Bean Royal Piston Pump	BORE HOLE Orientation: 60° from Horiz.	Size: NQ	Test By: C. Payton; Date: Feb. 13, 1989
Packers: On Casing; Single/Double; Hydraulic/Inflatable	Groundwater Depth: Angle: 53.3; Vert.: 46.2 Ft.	Gauge Height Above Ground: 3 Ft.	Gravity Head: 49.2 Ft.

TEST 6-1 Inflow pressure (Hp) 45 psi x 2.31 = 104 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	0.30	0.32	0.35	0.36	0.38	0.39						0.02 GPM
												CFM
Take Per Min.		0.02	0.01	0.03	0.02	0.01						CFM x 7.48 = GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (Hp) − Head Losses (H_L)

153.2 FT. = 49.2 FT. + 104 FT. − 0 FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln. \frac{L\ (ft)}{r\ (ft)} = \frac{0.02}{153.2 \times 20.1} \times .011 \ln \frac{20.1}{.124} = K,\ CM/SEC\ 3.63 \times 10^{-7}$$

TEST 6-2 Inflow pressure (Hp) 90 psi x 2.31 = 207.9 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	3.00	4.51	6.38	8.42	10.62	13.07	15.65	18.32	21.18			2.3 GPM
												CFM
Take Per Min.		1.51	1.87	2.04	2.20	2.45	2.58	2.67	2.86			

H_T 257.1 FT. = H_G 49.2 FT. + Hp 207.9 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{2.3}{257.1 \times 20.1} \times .011 \ln \frac{20.1}{.124} = K,\ CM/SEC\ 2.49 \times 10^{-5}$$

TEST 6-3 Inflow pressure (Hp) _____ psi x 2.31 = _____ feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	22.3	22.3	22.3	22.3	22.3	22.3						0 GPM
												CFM
Take Per Min.		0	0	0	0	0						

H_T _____ FT. = H_G _____ FT. + Hp _____ FT. − H_L _____ FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{\quad}{\quad \times \quad} \times \quad = K,\ CM/SEC$$

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD) Test # 7

Project: WSSRAP	Job Number:	Test Section:	Bore Hole:
Angle Hole Drilling	5121	127.5 to 151.6	AH-1

Test Equipment Identification	BORE HOLE		Test By: R. Parsons
Tigre Tierra Packer Neptune Trident water meter Bean Royal Piston Pump	Orientation: 60° from Horiz.	Size: NQ	Date: Feb. 14, 1989

Packers: On Casing (Single) Double Hydraulic Inflatable	Groundwater Depth: Angle: 53.3 Vert.: 46.2 FL	Gauge Height Above Ground: 3 FL	Gravity Head: 49.2 FL

TEST 7-1 Inflow pressure (Hp) 40 psi x 2.31 = _____ feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	29.7	29.7	29.7	29.7	29.7	29.7	29.7					0 GPM CFM
Take Per Min.		0	0	0	0	0	0					CFM x 7.48 = GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (Hp) − Head Losses (H_L)

FT. = FT. + FT. − FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln. \frac{L\ (ft)}{r\ (ft)} = \frac{\quad}{\quad \times \quad} \times \quad = \text{K, CM/SEC}$$

TEST 7-2 Inflow pressure (Hp) 90 psi x 2.31 = 207.9 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	30.7	30.7	30.7	30.7	30.75	30.75	30.75	30.75				.0071 GPM CFM
Take Per Min.		0	0	0	0.05	0	0	0				

H_T 257.1 FT. = H_G 49.2 FT. + Hp 207.9 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{.0071}{257.1 \times 24.1} \times .011 \ln \frac{24.1}{.124} = \text{K, CM/SEC } 6.60 \times 10^{-8}$$

TEST 7-3 Inflow pressure (Hp) 40 psi x 2.31 = _____ feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	30.75	30.75	30.75	30.75	30.75	30.75	30.75					0 GPM CFM
Take Per Min.		0	0	0	0	0	0					

H_T FT. = H_G FT. + Hp FT. − H_L FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{\quad}{\quad \times \quad} \times \quad = \text{K, CM/SEC}$$

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 17

Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling	Location: At drillhole GT-53 location west of water tower
Coordinates: (AEC) N.100284 W.50781	Drilling Contractor: Brotcke Engineering

Drill Make and Model: Overburden: Acker Mark IV; Coring: Longyear 38	Depth Top of Rock: Angle 48.7'; Vert. 42.2'	Depth Casing & Size: 4" to 51.0'	Hole Size: 8" to 51.0', then 2.98"
Elevation: 655.5 ft. (ground)	Angle from Vert. and Bearing: 30° on N39°W	Depth Bottom of Hole: Angle:165.0' Vertical:142.9'	
Water Level: 2/22/89 Vertical:52.9'	Fluid & Additives: Water	Date Start: 01-27-89	Date Finish: 03-03-89
Logger: P. Patchin			

Depth	Comments: Tests/Monitoring, Instrumentation, Coring Rate and Smoothness, Coring Fluid Loss, Contamination	Core Run Length and Recovery (%)	Core Loss Zone	Box Number	Discontinuities: RQD	Fractures per Foot	Description: Tightness, Planarity, Smoothness, Filling, Staining, Orientation	Graphic Log	Lithology: Mineralogy, Classification, Color, Grain Size, Alteration; Cementation, Hardness, Weathered State
48									Roller-bit drilled to 51.0'. Encountered probable bedrock at 48.7' (very soft). Set 4" casing through overburden to 51.0'. (See log for borehole GT-53 for description of overburden)
	Top of Bedrock 48.7								
49									
50									
	4" casing								
51									Begin NQ Coring
2/21	3 min/ft	NQ-1 .7' / 2.4' 29%		1	0%				51.0-52.7' CORE LOSS
52	0% return								
	2.5 min/ft					>6			
53	0% return		52.7				Rubble Open		52.7-53.4' CHERT, very pale orange (10YR 8/2), mod. wthrd, vuggy, v. hard abundant MnOx stringers, minor yellowish gray (5Y 7/2) mottling.
	2 min/ft	53.4'					Open, rough, vuggy FeOx		53.4-55.4' CORE LOSS, likely solution cavity, soft drilling
	53.6 Pressure Test #1	NQ-2 3.0' / 5.0'		1	1.4' / 5.0				
54	25% return				28%				

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 17

Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN: LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
54	2 min/ft	60%		I	LP = .6'				CORE LOSS, con't.
55	20% return 3 min/ft				3 > 4"				
			55.4			>6	Gravel rubble		55.4-56.0' CHERT GRAVEL, as before, possible filling from core loss zones above, FeOx stained.
56	15% return 2 min/ft					1	Open,rough,shaly FeOx		56.0-62.1' CHERT, varies from light bluish gray (5B 7/1) to grayish orange (10YR 7/4), with 10% interbedded limestone from 56.0-57.7' and 20% from 57.7 to 62-1'. Chert is moderately weathered, very hard, fossiliferous, solutioned where limestone interbeds, with abundant MnOx stringers and blebs, abundant FeOx on fractures and solution cavities. Clay also in cavities and fractures. LIMESTONE is argillaceous grayish orange (10YR 7/4) finely crystalline, mod. hard and weathered.
57	15% return 3 min/ft	lost water 57.4				4	Open,rough, clay,FeOx, vuggy (3)		
58	0% return 3 min/ft	58.4					Open,rough,FeOx, vuggy,clay (2)		
		NQ-3 5.0/5.0 100%			3.2/5.0	1			
59	0% return 3 min/ft				64% LP = 1.0	1	Open,rough, FeOx, clay		
60	0% return 3 min/ft				5 > 4"		Open,solutioned		
						5	FeOx, clay (2)		
61	0% return						Open, rough (2) FeOx, clay		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 17

Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
61	4 min/ft	NQ-3 con't		1					CHERT, as above
	Top of pressure test #2					2	Open, rough, vuggy, clay, FeOx (2)		
62	0% return								62.1-69.4' LIMESTONE, slightly to argillaceous, finely crystalline, grayish orange (10YR 7/4), fossiliferous with 40% chert as beds and nodules, L.S. is bedded, hard, moderately weathered. *Vertical fracture from 62.9-63.4' (adjusted for hole angle) with abundant limonite on fracture surfaces. Vugs with calcite and drusy quartz filling from 66.7-67.8'. Chert is light bluish gray (5B 7/1), very hard, vuggy.
	5 min/ft					2	Tight, smooth FeOx		
	0% return						Open, rgh, FeOx		
63	3 min/ft						Open, rgh, vertical FeOx		
2/21 2/22	Bottom of pressure test #1	63.4 NQ-4		1	4.7/5.0	1			
	0% return	5.0/5.0			94%				
64	13 min/ft	100%		2	LP = .9'		Tight, rough		
	0% return				7 > 4"	2			
65	3 min/ft						Tight, smooth		
	0% return					1			
66	4 min/ft						Open, rough		
	0% return					1	Tight, smooth		
67	4 min/ft						Open, rough		
						2			
68	0% return						Opn, rgh, FeOx, cly		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 17

Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
68	3 min/ft	NQ-4 con't 68.4		2			Open,smooth,FeOx		68.4-68.7' CORE LOSS
	0% return	NQ-5 2.2/2.5 88%	68.7	2	1.2/2.5 48% LP = .8'	>6	Rubble		68.7-69.4' LIMESTONE, as above.
69	10 min/ft				2 > 4"	2	Open,rough,clay Open,rough,FeOx		69.4-70.6' LIMESTONE, siliceous, massive, finely to med. crystalline, very light gray (N8), fossiliferous slightly weathered, mod. hard, with 10% interbedded chert.
70	0% return 18 min/ft					4	Open, spun (2)		70.6-71.5' CHERT, mottled yellowish gray (5Y 7/2) and light olive gray (5Y 5/2 minor) very hard, fractured (many healed) nodular, fossiliferous slightly weathered.
2/22 2/23 71	Stopped coring, no progress, changed bit	70.9					Tight, smooth		
	5 min/ft	NQ-6 2.5/2.5 100%		2	.7'/2.5 28% LP = .7'	3	Tight, smooth		71.5-72.5' LIMESTONE (70%) and CHERT (30%) as above.
72	0% return						Tight, rough (2)		
	3 min/ft				1 > 4"	2	Open, rough Styolite		72.5-79.5' CHERT (60%) and ARGILLACEOUS LIMESTONE (40%) interbedded. Chert is light bluish gray (5B 7/1) slightly weathered, hard with MnOx stringers. Limestone is very argillaceous, grayish orange (10YR 7/4) finely crystalline, mod. hard with MnOx specks in matrix.
	Top of pressure test #3 0% return								
73	3 min/ft	73.4					Tight,rough, FeOx,clay Open, rough Rubble		
	Bottom of #2 pressure test 0% return	NQ-7 5.0/5.0 100%		3	4.5/5.0 90% LP = 1.1'	4	Open, rough		
74	2 min/ft					3	Open,smooth,cly Spun		
75	0% return						Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

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Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
75	2 min/ft	NQ-7 con't.		3	6 > 4"	1	Tight, rough		LIMESTONE, as above.
76	0% return						Styolite		
	2 min/ft					1	Tight, rough Styolite		
77	0% return								
	3 min/ft					1	Open, shaley		
78	0% return								
	2 min/ft	78.4				2			
		NQ-8		3	3.2/5.0		Open, rough		
79	0% return	4.8/5.0			64% LP = .9'		Open,rough,clay		
	2 min/ft	96%				2	Open, rough		79.5-89.2' CHERT as above (RQ%), fossiliferous, very hard, nodular and vuggy. 20% LIMEY SILTSTONE, light olive gray (5Y 6/1), medium hard to soft, vuggy, no FeOx 50% chert and 50% siltstone from 82.0-89.2'.
80	0% return				5 > 4"		Open,rough,FeOx MnOx, clay (2)		
	2 min/ft					2			
81	0% return						Spun		
	2 min/ft					3	Open,rough,MnOx		
82	0% return		81.8				Open, rough (2)		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 17

Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
82	2 min/ft	NQ-8 con't		3					CHERT, as above
			82.5/4			1	Spun		
	0% return								
83	3 min/ft								
	Bottom of H_2O pressure test #1	83.4					Open, rough		
2/23 2/24	Weathered L.S.	NQ-9 5.0/5.0		4	4.5/5.0	4	Spun (2)		
	Competent L.S.						Open, rough		
84	3 min/ft	100%			90%				
					LP = 1.9	1			
	0% return						Open, rough		
85	2 min/ft				4 > 4"		Open, rough		
						1			
	0% return								
86	4 min/ft								
						1			
	0% return						Open,smth,shaley olive gray clay		
87	3 min/ft								
						1			
	0% return						Tight, rough		
88	4 min/ft								
		88.4					Open, rough		
		NQ-10 5.0/5.0		4	4.3/5.0	2	Open, rough		
89	0% return								

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 17

Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
89	7 min/ft	NQ-10 con't		4	86%		Open, smooth w/ green clay,shaley		89.2-89.8' CHERT, very light gray (N8) with medium dark gray (N4) bands and concretions, very hard, fresh, MnOx stringers.
		100%			LP = 1.8	>6	Rubble		
	0% return								
90	5 min/ft				6 > 4"	2	Open,stylolite, black clay Stylolite, weak		89.8-91.9' LIMESTONE, massive light gray (N7), hard, fresh, stylolitic, fossiliferous.
	0% return								
91	5 min/ft					1	Stylolite		
				91/5	6				
	0% return								91.9-96.2' SILTSTONE, limey (70%) interbedded with 30% nodular CHERT, as before.
92	5 min/ft						Tight, rough		
						>6	Rubble		
	0% return						Open, rough		
93	4 min/ft								
2/24 2/27		93.4					Healed		
		NQ-11		5	4.6/5.0	2	Open, rough		
		5.0'/5.0'			92%				
94	3 min/ft -New Bit	100%			LP = 1.9'	3	Open, smooth MnOx Mechanical		
95	2 min/ft				5 > 4"		Open, rough		
						1	Tight, rough		
96									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 8 of 17

Project Number: 5151

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
96	2 min/ft	NQ-11 con't		5		0			96.2-102.5' LIMESTONE light olive gray (5Y 6/1) medium to coarsely xln, hard, fresh, fossiliferous with 10% nodular chert (very light gray (N8)). LS is slightly styolitic with argillaceous zones up to .5'.
97	2 min/ft					2	Tight, rough Styolite, weak		
98	2 min/ft	98.4'							
		NQ-12		5	4.0/5.0 80%	1	Tight, smooth		
99	2 min/ft	5.0'/5.0' 100%			LP = 2.2'	>6	Rubblized Tight, mechanical vertical		
100	4 min/ft				4 > 4"	1	Tight, rough, FeX 80°		
101	3 min/ft			101/6	6	1	Open, rough		
102	4 min/ft					1	Styolite, weak w/black clay		102.5-105.1' LIMESTONE argillaceous, light olive gray (5Y 6/1) finely crystalline, (con't)
103									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

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Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
103	3 min/ft Top of Test #5 Bottom of Test #4	NQ-12 con't 103.4		6			Open, rough, clay		fossiliferous, hard, fresh, slightly vuggy at 105.0', with 5% chert nodules.
		NQ-13		6	3.9/5.0	3	Open, rough (2)		
104	3 min/ft	5.0/5.0 100%			78% LP = 1.2	1	Tight, rough		
105	3 min/ft				6 > 4"		Rubble		105.1-105.8' CHERT, pale blue (5PB 7/2) very hard, fresh, nodular with interbedded argillaceous L.S. as above.
						>6	Tight, rough		
106	3 min/ft								105.8-107.0' LIMESTONE, argillaceous, as before.
						1	Open, rough stylolitic		
107	42 min/ft hard						Open, smooth		107.0-107.8' CHERT, light gray (N7) with medium dark gray (N4) concretionary banding, very hard, fossiliferous, fresh with minor MnOx stringers.
						3	Tight, smooth		
							Tight, rough		
108	5 min/ft	108.4					Styolites		107.8-119.5' LIMESTONE, fine to coarsely crystalline, fresh, occasional argillaceous zones to .4', hard, stylolitic, with chert nodules (10%) pale blue (5PB 7/2) very hard, slightly vuggy.
		NQ-14		6	4.4/5.0	1	Open, rough, black clay		
109	3 min/ft	5.0/5.0 100%			88% LP = 1.4'	1	Open, rough, MnOx		
110									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

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Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
110	2 min/ft	NQ-14 con't		6	6				LIMESTONE, as above. Solution cavity at 110.4; Chert nodules at: 110.7-110.9' 112.8-112.9' 114.6-114.9' 115.4-115.7' 116.5-116.7'
			110	7	>4"	>6	Rubble		
	0% return								
111	2 min/ft					1	Tight, rough, vertical		
112	2 min/ft					2	Tight, rough (2)		
113	3 min/ft	113.4							
2/27 2/28		NQ-15 5.0/5.0 100%		7	4.3/5.0 86%	0			
114	2 min/ft				LP = 1.9'	1	Styolite		
115	4 min/ft				3 > 4"		Open, smooth		
							Tight, rough		
	hard					2	Tight, smooth		
116	3 min/ft					1	Tight, rough		
117									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 11 of 17

Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
117	3 min/ft	NQ-15 con't		7			Styolite		LIMESTONE, as above
						0			
118	0% return 2 min/ft	118.4					Styolite		
		NQ-16		7	4.3/5.0 86%	0			
119	3 min/ft	5.0/5.0 100%			LP = 2.8'		Tight, rough, styolitic Open, styolitic, MnOx		119.5-120.1' CHERT, very light gray (N8), very hard, fresh, fractured, with pyrite deposition on vertical fracture, fossiliferous.
				119.8/8	4 > 4"	5	Tight, smooth		
120	3 min/ft						Open, rough		120.1-122.8' LIMESTONE, light gray (N7), finely to microcrystalline, massive to thick bedded, fresh, hard, slightly styolitic with occasional chert nodules or bands to .3'.
						1			
121	2 min/ft					0			
122	4 min/ft						Styolite, weak		
						1			122.8-123.9' CHERT, medium light gray (N6) very hard fractured (most healed) with dark calcite on fractures, slightly vuggy.
123	4 min/ft Top of Test #6 Bottom of Test #5	123.4					Open, rough MnOx brecciated		
		NQ-17 5.0/5.0		8	4.1/5.0	1	Open, rough Open, smooth, black clay		123.9-143.1' LIMESTONE,
124									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 12 of 17

Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
124	3 min/ft	NQ-17 con't 100%		8	82% LP = 2.3'	0			massive, finely crystalline, hard, fossiliferous, styolitic with occasional chert band or nodule up to .1'.
125	3 min/ft				> 3 4"	0	Styolite		
126	2 min/ft					3	Styolite, weak black clay Styolite, weak Open, rough		
127	--hard 3 min/ft					0			
128	2 min/ft	128.4					Open, styolite, black clay		
129	2 min/ft	NQ-18 5.0/5.0 100%	129.2	8 9	4.9/5.0 98% LP = 2.3'	1			
130	2 min/ft				> 3 4"	1	Styolite, weak		
131						1	Tight, rough		

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 13 of 17

Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
131	2 min/ft	NQ-18 con't		9		0			LIMESTONE, as above, massive, finely to coarsely crystalline. Porous zones (finely xln) from: 134.7-135.2; 135.8-136.9; 137.6-138.4. Chert at: 135.6-135.8; 136.9-137.3; 137.5-137.6
132	2 min/ft					1	Open, rough, black clay		
133	1.5 min/ft	133.4					Tight, smooth(2)		
		NQ-19		9	3.9/5.0	1			
134	1.5 min/ft	5.0/5.0 100%			78% LP = 2.2'	1	Styolite, weak		
135	1.5 min/ft				3 > 4"	2	Tight, smooth		
136	1 min/ft					2	Tight, rough vertical		
137	1 min/ft					4	Tight, rough; Open, rough; Tight, smooth; Tight, rough		
138									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 14 of 17

Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
138	1.5 min/ft	NQ-19 con't 138.4		9					LIMESTONE, as above, massive. Chert beds or nodules: 138.4-138.8, 139.0-139.2, 141.1-141.2, 142.8-143.1
		NQ-20	138.7	10	3.4/5.0	>6	Rubble, drill break		
		5.0/5.0 100%			68%		Open, rough (2)		
139	1.5 min/ft				LP = 1.5'	1	Open, smooth black clay		
140	2 min/ft				4 > 4"	3	Open, smooth black clay		
							Tight, smooth vertical		
141	2 min/ft						Styolite, weak Fractured zone		
						>6			
142	2 min/ft					1			
143	2 min/ft						Tight, smooth		143.1-148.9' SILTSTONE light olive gray (5Y 6/1) almost no HCL reaction; mod. hard, massive, with pinpoint to 1/2" vugs. 10% nodular chert, two rounded solution cavities @ 145.5-145.7 and 145.8-145.9 with large euhedral quartz crystals. Vuggy (con't)
2/28 3/01	Top of Test #7	143.4					Opn,smooth,clay (black)		
	Bottom of Test 3¢	NQ-21 5.0/5.0 100%		10	4.5/5.0 90%	2	Tight, rough		
144	2 min/ft				LP = 2.1'	0			
145									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 15 of 17

Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
145	2 min/ft	NQ-21 con't		10	>3 4"	1	Tight, rough solution cavity		from 146.3-146.7'.
146	1 min/ft					2	Tight, rough Open, rough		
147	1 min/ft					0			
			147.9	11					
148	2 min/ft	148.4				3	Tight, rough Tight, smooth		
		NQ-22 5.0/5.0		11	3.6/5.0		Tight,smth,MnOx?		148.9-149.3' CHERT, pale blue (5PB 7/2) fractured to rubble by drill, very hard.
149	2 min/ft	100%			72% LP = 1.2	>6	Drill Rubble Tgt,rgh,vertical Open, rough Styolite, weak		149.3-155.0' LIMESTONE, light gray (N7) to (N6) fine to coarse crystalline, hard, massive, very fossiliferous, very minor chert nodules, styolitic, fresh.
150	2 min/ft				>3 4"	0			
151	2 min/ft					1	Open, styolite black clay		
152									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 16 of 17

Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.56781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
152	2 min/ft	NQ-22 con't		11		0			LIMESTONE, as above.
153	2.5 min/ft	153.4							
		NQ-23 5.0/5.0 100%		11	4.2/5.0 84%	0	Styolite		
154	2.5 min/ft				LP = 1.2'	3	Open, rough, vert 80° Open, smooth Open, rough		
155	2 min/ft				4 > 4"	>6	Styolite, weak Open, smooth Rubble Open, smooth		155.0-157.1' SILTSTONE (70%) and LIMESTONE as above interbedded minor chert nodules.
156	2 min/ft					1	Tight, styolite		
157	2 min/ft		157.3	12		2	Styolite, weak Styolite, weak		157.1-159.9' LIMESTONE finely crystalline as before, styolitic.
158	2 min/ft	158.4							
		NQ-24 5.0/5.0		12	2.9/5.0 58%	0			
159									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 17 of 17

Project Number: 5121

Hole Number: AH-2

Project: WSSRAP Angle Hole Drilling

Location: N.100284 W.50781

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
159	2 min/ft	NQ-24 con't 100%		12	LP = 1.3	1			
					3 > 4"		Open, rough		159.9-160.8' CHERT as before, highly fractured
160	3 min/ft					>6	Tight, smooth High fractured to rubble		160.8-162.2' LIMEY SILTSTONE, as before, vuggy.
							Open, smooth		
161	3 min/ft					2	Open, rough Tight, rough vug with drusy quartz		
162	3 min/ft					>6	Rubble		162.2-165.0' LIMESTONE course crystalline, as before.
163	2 min/ft	163.4					Tight, rough		
		NQ-25 1.6/1.6 100%		12	1.6/1.6 100%	1			
164	Bottom of Test #7				LP = 1.6'	0			T.D. 165.0'
165									11:15a.m. 3/1/89
166									

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD) Test # 1

Project: WSSRAP Angle Hole Drilling	Job Number: 5121	Test Section: 53.6 to 63.4	Bore Hole: AH-2
Test Equipment Identification: Tigre Tierra Packer, Neptune Trident water meter, Bean Royal Piston Pump	BORE HOLE Orientation: 60° from Horiz.	Size: NQ	Test By: P. Patchin; Date: Feb. 22, 1989
Packers: On Casing; Single/Double; Hydraulic/Inflatable	Groundwater Depth: Angle: 61.1; Vert.: 52.9 Ft.	Gauge Height Above Ground: 3 Ft.	Gravity Head: 53.7 Ft.

TEST 1-1 Inflow pressure (Hp) 10 psi x 2.31 = 23.1 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	180.0	194.2	208.4	222.7	237.7	250.8	264.8					14.13 GPM
												CFM
Take Per Min.		14.2	14.2	14.3	15.0	13.1	14.0					CFM x 7.48 = GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (Hp) − Head Losses (H_L)

76.8 FT. = 53.7 FT. + 23.1 FT. − 0 FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln. \frac{L\ (ft)}{r\ (ft)} = \frac{14.13}{76.8 \times 9.8} \times .011 \ln \frac{9.8}{.124} = 9.02 \times 10^{-4}\ \text{K, CM/SEC}$$

TEST 1-2 Inflow pressure (Hp) 20 psi x 2.31 = 46.2 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	340.0	356.6	372.9	389.4	405.6	421.9						16.38 GPM
												CFM
Take Per Min.		16.6	16.3	16.5	16.2	16.3						

H_T 99.9 FT. = H_G 53.7 FT. + Hp 46.2 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{16.38}{99.9 \times 9.8} \times .011 \ln \frac{9.8}{.124} = 8.04 \times 10^{-4}\ \text{K, CM/SEC}$$

TEST 1-3 Inflow pressure (Hp) 10 psi x 2.31 = 23.1 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	450.0	464.4	478.8	493.1	507.4	520.9	535.8					14.30 GPM
												CFM
Take Per Min.		14.4	14.4	14.3	14.3	13.5	14.9					

H_T 76.8 FT. = H_G 53.7 FT. + Hp 23.1 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{14.3}{76.8 \times 9.8} \times .011 \ln \frac{9.8}{.124} = 9.13 \times 10^{-4}\ \text{K, CM/SEC}$$

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD) Test # 2

Project: WSSRAP Angle Hole Drilling	Job Number: 5121	Test Section: 62.0 to 73.4	Bore Hole: AH-2
Test Equipment Identification: Tigre Tierra Packer, Neptune Trident Water Meter, Beam Royal Piston Pump	BORE HOLE Orientation: 60° from Horiz.	Size: NQ	Test By: P. Patchin; Date: Feb. 23, 1989
Packers: On Casing; (Single/Double); Hydraulic/(Inflatable)	Groundwater Depth: Angle: 61.4; Vert.: 53.2 Ft.	Gauge Height Above Ground: 3 Ft.	Gravity Head: 56.2 Ft.

TEST 2 - 1 Inflow pressure (Hp) 20 psi × 2.31 = 46.2 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	675.0	679.5	684.8	688.2	692.2	696.4	700.5	704.5				4.21 GPM
												CFM
Take Per Min.		4.5	5.3	3.4	4.0	4.2	4.1	4.0				CFM × 7.48 – GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (Hp) – Head Losses (H_L)

102.4 FT. = 56.2 FT. + 46.2 FT. – 0 FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln \frac{L\ (ft)}{r\ (ft)} = \frac{4.21}{102.4 \times 11.4} \times .011 \ln \frac{11.4}{.124} = K,\ CM/SEC\ 1.79 \times 10^{-4}$$

TEST 2 - 2 Inflow pressure (Hp) 40 psi × 2.31 = 92.4 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	713.0	719.2	725.2	731.2	737.2	743.1						6.02 GPM
												CFM
Take Per Min.		6.2	6.0	6.0	6.0	5.9						

H_T 148.6 FT. = H_G 56.2 FT. + Hp 92.4 FT. – H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln \frac{L}{r} = \frac{6.02}{148.6 \times 11.4} \times .011 \ln \frac{11.4}{.124} = K,\ CM/SEC\ 1.77 \times 10^{-4}$$

TEST 2 - 3 Inflow pressure (Hp) 20 psi × 2.31 = 46.2 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	749.0	752.8	756.7	760.5	764.3	768.2						3.84 GPM
												CFM
Take Per Min.		3.8	3.9	3.8	3.8	3.9						

H_T 102.4 FT. = H_G 56.2 FT. + Hp 46.2 FT. – H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln \frac{L}{r} = \frac{3.84}{102.4 \times 11.4} \times .011 \ln \frac{11.4}{.124} = K,\ CM/SEC\ 1.64 \times 10^{-4}$$

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD) Test # 3

Project: WSSRAP Angle Hole Drilling	Job Number: 5121	Test Section: 73.0 to 83.4	Bore Hole: AH-2
Test Equipment Identification: Tigre Tierra Packer, Neptune Trident Water meter, Bean Royal Piston Pump	BORE HOLE Orientation: 60° from Horiz.	Size: NQ	Test By: P. Patchin; Date: Feb. 24, 1989
Packers: On Casing, Single/Double, Hydraulic/Inflatable	Groundwater Depth: Angle: 61.1 Vert.: 52.9 FL	Gauge Height Above Ground: 3 FL	Gravity Head: 55.9 FL

TEST 3-1 Inflow pressure (Hp) 30 psi x 2.31 = 69.3 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	2.54	2.56	2.57	2.58	2.58	2.60	2.60					.01 GPM
												CFM
Take Per Min.		.02	.01	.01	.00	.02	.00					CFM x 7.48 = GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (H_P) − Head Losses (H_L)

125.2 FT. = 55.9 FT. + 69.3 FT. − 0 FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln. \frac{L\ (ft)}{r\ (ft)} = \frac{.01}{125.2 \times 10.4} \times .011 \ln \frac{10.4}{.124} = K,\ CM/SEC\ 3.74 \times 10^{-7}$$

TEST 3-2 Inflow pressure (Hp) 60 psi x 2.31 = 138.6 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	4.00	4.04	4.10	4.14	4.19	4.22	4.26					.04 GPM
												CFM
Take Per Min.		.04	.06	.04	.05	.03	.04					

H_T 194.5 FT. = H_G 55.9 FT. + H_P 138.6 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{.04}{194.5 \times 10.4} \times .011 \ln \frac{10.4}{.124} = K,\ CM/SEC\ 9.63 \times 10^{-7}$$

TEST 3-3 Inflow pressure (Hp) 30 psi x 2.31 = 69.3 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	7.25	7.25	7.25	7.26	7.26	7.26	7.26					0 GPM
												CFM
Take Per Min.		0	0	.01	0	0	0					

H_T FT. = H_G FT. + H_P FT. − H_L FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{\quad}{\quad \times \quad} \times \quad = K,\ CM/SEC$$

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD) Test # 4

Project: WSSRAP Angle Hole Drilling	Job Number: 5121	Test Section: 83.2 to 103.4	Bore Hole: AH-2
Test Equipment Identification: Tigre Tierra Packer, Neptune Trident water meter, Bean Royal Piston Pump	BORE HOLE — Orientation: 60° From Horiz.	Size: NQ	Test By: P. Patchin; Date: Feb. 27, 1989
Packers: On Casing; Single/Double; Hydraulic/Inflatable	Groundwater Depth: Angle: 61.2; Vert.: 53.0 ft.	Gauge Height Above Ground: 3 ft.	Gravity Head: 56.0 ft.

TEST 4-1 Inflow pressure (Hp) 40 psi x 2.31 = 92.4 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	7.43	7.43	7.43	7.43	7.43	7.43						0 GPM
												CFM
Take Per Min.	0	0	0	0	0							CFM x 7.48 = GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (H_P) − Head Losses (H_L)

[ ] FT. = [ ] FT. + [ ] FT. − [ ] FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln. \frac{L\ (ft)}{r\ (ft)} = \frac{\quad}{\times} \times \quad = \text{K, CM/SEC}$$

TEST 4-2 Inflow pressure (Hp) 80 psi x 2.31 = 184.8 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	5.00	5.73	6.47	7.20	7.93							.73 GPM
												CFM
Take Per Min.	.73	.74	.73	.73								

H_T 240.8 FT. = H_G 56.0 FT. + H_P 184.8 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{.73}{240.8 \times 20.2} \times .011 \ln \frac{20.2}{.124} = \text{K, CM/SEC } 8.41 \times 10^{-6}$$

TEST 4-3 Inflow pressure (Hp) 40 psi x 2.31 = 92.4 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	9.49	9.49	9.49	9.49	9.49	9.49						0 GPM
												CFM
Take Per Min.	0	0	0	0	0							

H_T [ ] FT. = H_G [ ] FT. + H_P [ ] FT. − H_L [ ] FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{\quad}{\times} \times \quad = \text{K, CM/SEC}$$

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD) Test #5

Project: WSSRAP Angle Hole Drilling	Job Number: 5121	Test Section: 103.2 to 123.4	Bore Hole: AH-2
Test Equipment Identification: Tigre Tierra Packer, Neptune Trident water meter, Bean Royal Piston Pump	BORE HOLE Orientation: 60° from Horiz.	Size: NQ	Test By: P. Patchin; Date: Feb. 28, 1989
Packers: On Casing; (Single)/Double; Hydraulic/(Inflatable)	Groundwater Depth: Angle: 61.2; Vert.: 53.0 Ft.	Gauge Height Above Ground: 3 Ft.	Gravity Head: 56.0 Ft.

TEST 5-1 Inflow pressure (Hp) 60 psi × 2.31 = 138.6 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	8.29	8.29	8.29	8.29	8.29	8.29						0 GPM; CFM
Take Per Min.		0	0	0	0	0						CFM × 7.48 = GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (Hp) − Head Losses (H_L)

[ ] FT. = [ ] FT. + [ ] FT. − [ ] FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln \frac{L\ (ft)}{r\ (ft)} = \frac{\quad}{\times} \times \quad = \text{K, CM/SEC}$$

TEST 5-2 Inflow pressure (Hp) 90 psi × 2.31 = 207.9 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	8.35	8.49	8.68	8.90	9.07	9.25						.18 GPM; CFM
Take Per Min.		.14	.19	.22	.17	.18						

H_T 263.9 FT. = H_G 56.0 FT. + Hp 207.9 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln \frac{L}{r} = \frac{.18}{263.9 \times 20.2} \times .011 \ln \frac{20.2}{.124} = \text{K, CM/SEC } 1.89 \times 10^{-6}$$

TEST 5-3 Inflow pressure (Hp) 60 psi × 2.31 = 138.6 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	9.31	9.31	9.31	9.31	9.31	9.31						0 GPM; CFM
Take Per Min.		0	0	0	0	0						

H_T [ ] FT. = H_G [ ] FT. + Hp [ ] FT. − H_L [ ] FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln \frac{L}{r} = \frac{\quad}{\times} \times \quad = \text{K, CM/SEC}$$

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD) Test #6

Project: WSSRAP Angle Hole Drilling	Job Number: 5121	Test Section: 123.2 to 143.4	Bore Hole: AH-2
Test Equipment Identification: Tigre Tierra Packer, Neptune Trident water meter, Bean Royal Piston Pump	BORE HOLE Orientation: 60° from Horiz.	Size: NQ	Test By: P. Patchin; Date: Feb. 28, 1989
Packers: On Casing; Single/Double; Hydraulic/Inflatable	Groundwater Depth: Angle : 61.2; Vert. : 53.0 Ft.	Gauge Height Above Ground: 3 Ft.	Gravity Head: 56.0 Ft.

TEST 6-1 Inflow pressure (Hp) 60 psi × 2.31 = 138.6 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	7.10	7.10	7.12	7.18	7.23	7.29	7.35					.04 GPM
												CFM
Take Per Min.		0	.02	.06	.05	.06	.06					CFM × 7.48 = GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (H_P) − Head Losses (H_L)

194.6 FT. = 56.0 FT. + 138.6 FT. − 0 FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln. \frac{L\ (ft)}{r\ (ft)} = \frac{.04}{194.6 \times 20.2} \times .011 \ln \frac{20.2}{.124} = 5.70 \times 10^{-7}\ \text{K, CM/SEC}$$

TEST 6-2 Inflow pressure (Hp) 90 psi × 2.31 = 207.9 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	7.45	7.64	7.85	8.06	8.26	8.47						.20 GPM
												CFM
Take Per Min.		.19	.21	.21	.20	.21						

H_T 263.9 FT. = H_G 56.0 FT. + H_P 207.9 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{.20}{263.9 \times 20.2} \times .011 \ln \frac{20.2}{.124} = 2.10 \times 10^{-6}\ \text{K, CM/SEC}$$

TEST 6-3 Inflow pressure (Hp) 60 psi × 2.31 = 138.6 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	8.55	8.59	8.64	8.70	8.76	8.82						.05 GPM
												CFM
Take Per Min.		.04	.05	.06	.06	.06						

H_T 194.6 FT. = H_G 56.0 FT. + H_P 138.6 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{.05}{194.6 \times 20.2} \times .011 \ln \frac{20.2}{.124} = 7.12 \times 10^{-7}\ \text{K, CM/SEC}$$

MORRISON-KNUDSEN ENGINEERS, INC.

PRESSURE TEST RESULTS (FIELD) Test #7

Project: WSSRAP Angle Hole Drilling	Job Number: 5121	Test Section: 143.2 to 165.0	Bore Hole: AH-2
Test Equipment Identification: Tigre Tierra Packer, Neptune Trident water meter, Bean Royal Piston Pump	BORE HOLE — Orientation: 60° from Horiz.	Size: NQ	Test By: P. Patchin; Date: March 1, 1989
Packers: On Casing; Single/Double; Hydraulic/Inflatable	Groundwater Depth: Angle: 62.6; Vert.: 54.2 Ft.	Gauge Height Above Ground: 3 Ft.	Gravity Head: 57.2 Ft.

TEST 7-1 Inflow pressure (Hp) 60 psi x 2.31 = 138.6 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	9.00	10.79	12.49	14.13	15.75	17.32						1.66 GPM
												CFM
Take Per Min.		1.79	1.70	1.64	1.62	1.57						CFM x 7.48 = GPM

Total Head (H_T) = Gravity Head (H_G) + Pressure Head (Hp) − Head Losses (H_L)

195.8 FT. = 57.2 FT. + 138.6 FT. − 0 FT.

$$K = \frac{Q\ (gpm)}{H_T\ (ft) \times L\ (ft)} \times .011 \ln. \frac{L\ (ft)}{r\ (ft)} = \frac{1.66}{195.8 \times 21.8} \times .011 \ln \frac{21.8}{.124} = K,\ CM/SEC\ 2.21 \times 10^{-5}$$

TEST 7-2 Inflow pressure (Hp) 90 psi x 2.31 = 207.9 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	1.00	3.20	5.36	7.49	9.61	11.65	13.68					2.11 GPM
												CFM
Take Per Min.		2.20	2.16	2.13	2.12	2.04	2.03					

H_T 265.1 FT. = H_G 57.2 FT. + Hp 207.9 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{2.11}{265.1 \times 21.8} \times .011 \ln \frac{21.8}{.124} = K,\ CM/SEC\ 2.08 \times 10^{-5}$$

TEST 7-3 Inflow pressure (Hp) 60 psi x 2.31 = 138.6 feet

TIME, MIN.	0	1	2	3	4	5	6	7	8	9	10	Q AVERAGE FLOW
Meter Reading Gallons or Cu. Ft.	8.50	10.01	11.67	12.93	14.33	15.70						1.44 GPM
												CFM
Take Per Min.												

H_T 195.8 FT. = H_G 57.2 FT. + Hp 138.6 FT. − H_L 0 FT.

$$K = \frac{Q}{H_T \times L} \times .011 \ln. \frac{L}{r} = \frac{1.44}{195.8 \times 21.8} \times .011 \ln \frac{21.8}{.124} = K,\ CM/SEC\ 1.92 \times 10^{-5}$$

LOGGING TOOLS UTILIZED

NATURAL GAMMA RAY

All of the wells were logged with a Comprobe, Inc. model 1804 Scintillation Gamma Ray tool. This 1 5/8" OD tool houses a 7/8" by 2 1/2" Sodium Iodide crystal detector. This tool carries the Wooddell ID # WL-GRS1.

NEUTRON - NEUTRON

The 1 5/8" Neutron tool utilized for the thermal Neutron logging is a mate to the 1 5/8" Gamma Ray tool and the 1 5/8" Casing Collar tool. These tools can be stacked and run simultaneously if desired. The Neutron detector is a proportional HE3 type which measures 1" by 6". The Comprobe model is # 1805 and the Wooddell designation is WL-GRN2. This tool was activated with a 2.8 Ci. Am241Be source spaced 14" below the detector.

CASING COLLAR TOOL

The Comprobe model 1801 magnetic Casing Collar Locator measuring 1 5/8" was utilized. Since this log was not required and since there is not any specific method of operation of this tool then we are not presenting any other information.

Gamma - Gamma

Two types of Gamma - Gamma (Density) tools were utilized. Both tools were activated with the same 125 mCi. Cs137 source. The source to detector spacing was the same for both tools at 12" with the same style 1/2" by 1/2" crystals.

The smaller wells were logged with a Comprobe, Inc. 1 1/4" tool designated as model #1204. The Wooddell number is WL-SD4. This tool is referred to as a 4 PI tool since there is only shielding above and below the detector. The source can radiate in all 360 deg. around the wellbore while the detector is affected by all sides of the borehole. It was necessary to use this tool in wells #2027, #2028 and #4019 since they were completed in 2" pipe.

The larger tool manufactured by Gearhart Owen, Inc. as model 06-9242-000 measures 1 11/16". Wooddell's number is WL-GRD4. This tool is decentralized to the side of the casing with the use of a bow spring assembly. By virtue of its larger size the crystal can be shielded with more heavy metal. Both the detector and source are shielded on all sides with only windows present on the side of the tool exposed to the borehole wall. This arrangement is utilized to provide sensitivity by minimizing back scatter.

TEMPERATURE

The Comprobe 1 5/8" model 1813 tool was chosen for the temperature surveys. The fast response solid-state sensor is calibrated for direct surface readout of 0 to 350 deg. F. Wooddell's tool number is WL-TF32.

CALIPER

Borehole size measurements were accomplished with a Gearhart Owen, Inc. model 06-9380-100 three arm caliper tool. The Wooddell designation is tool #WL-3AC. Arm lengths were chosen to provide a 1 1/4" to 8" reading area.

SONIC CEMENT BOND

The Gearhart Owen, Inc. model 06-1030-001, 2" Sonic tool was used to provide the Cement Bond Log. This tool is manufactured with a 3' transmitter to receiver spacing. The presence of cement is determined by the amplitude of the first arrival. In the open hole, the formation travel time can be determined by measuring the time elapse from the transmitted signal to the first arrival.

SONIC DELTA TIME

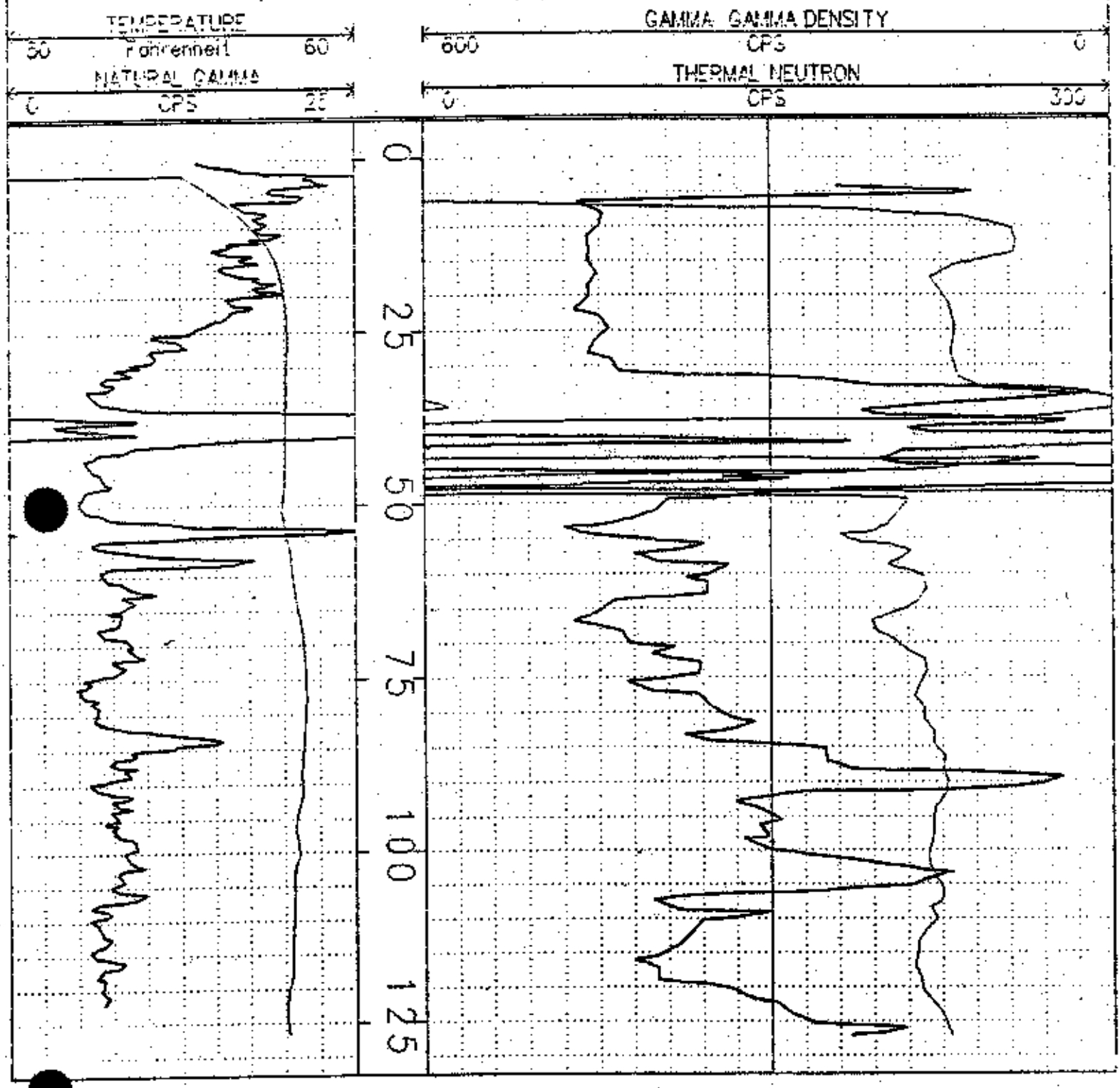
The Delta Time Sonic logs were run on the two open hole angle holes. Since these holes were drilled with a 2.98" bit and since there was chipped crumbling rock formation falling off the sides of the wellbore and since the smaller tools experienced difficulty in being pulled from the well and since the caliper tool became hung in well AH-1, it was determined that a smaller Sonic tool should be utilized and run inside 2" PVC pipe. The same reasoning existed for running the Gamma - Gamma (density) and Neutron - Neutron logs inside the 2" PVC.

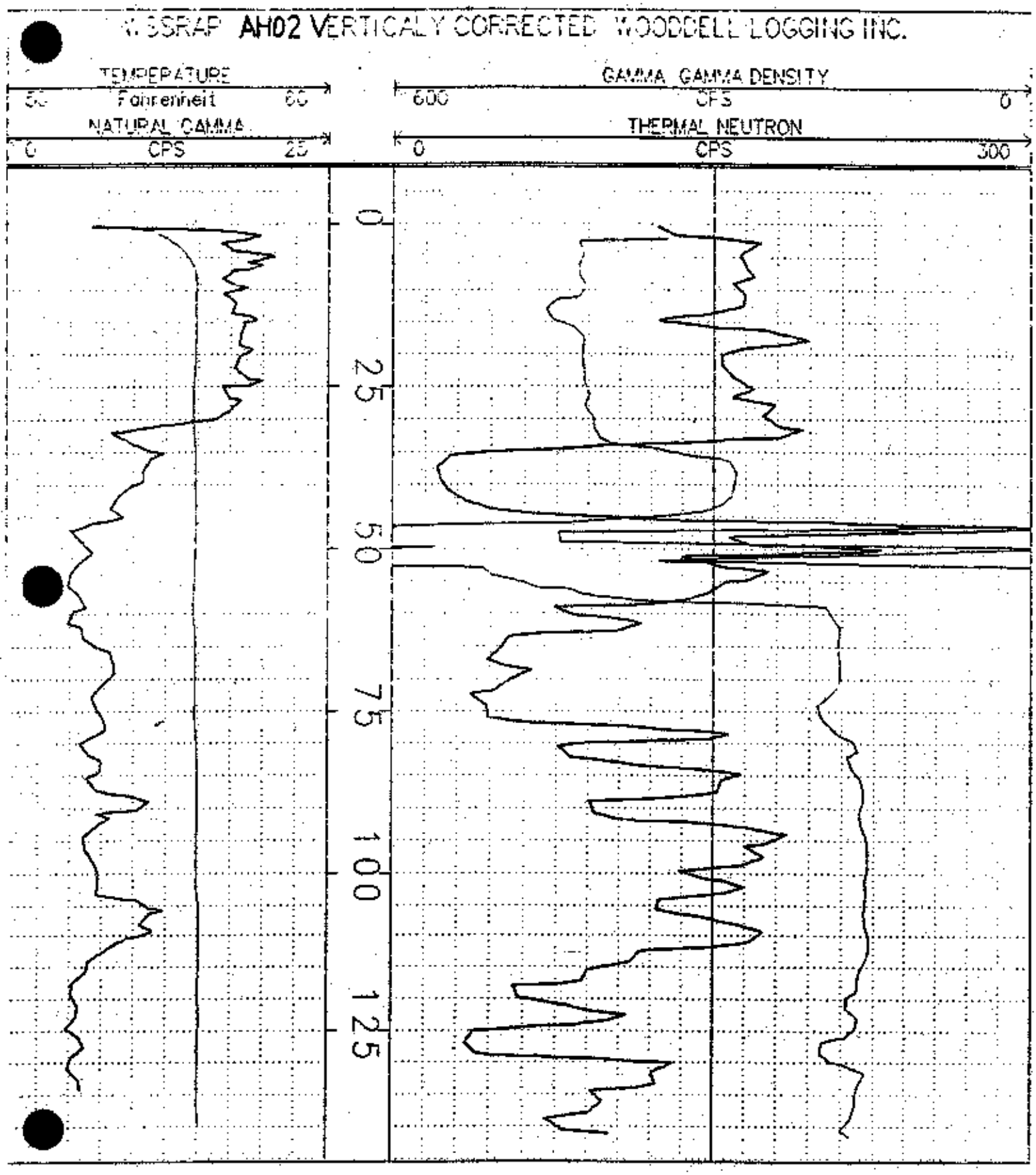
The Bell Petroleum model 3600, 1 3/4" Sonic tool was chosen to replace the Gearhart tool for the open hole logs. This tool likewise measures the sonic travel time from the transmits signal to the first arrival. The times represented on the logs represent the total travel times in milliseconds.

Resistivity and SP

The Comprobe model 1245 downhole electrode sub was utilized with the Gearhart Owen model 06-9825-004 Resistivity SP module to provide the respective logs.

WSSRAP AH01 VERTICALY CORRECTED WOODDELL LOGGING INC.




W.SSRAP AH02 VERTICALY CORRECTED WOODDELL LOGGING INC.
TEMPERATURE
Fahrenheit
NATURAL GAMMA
CPS
25
GAMMA GAMMA DENSITY
600
CPS
0
THERMAL NEUTRON
0
CPS
300
0
25
50
75
100
125

APPENDIX B-2

TEMPORARY STORAGE AREA BOREHOLE LOGS
(GTS-1 THROUGH GTS-7)

GEOTECHNICAL INVESTIGATIONS PHASE II
TEMPORARY STORAGE AREA

B-2

INTRODUCTION

The Phase II geotechnical investigations program performed at the Weldon Spring Site Remedial Action Project (WSSRAP) consisted of several tasks. These included drilling at the Weldon Spring Quarry (WSQ) staging area; drilling at the temporary storage and disposal cell areas of the Weldon Spring Site (WSS); installation of piezometers at WSS and WSQ; and test pit excavation for clay borrow sources located near the WSS. This report presents the procedures used for characterizing the subsurface conditions at the temporary storage area. Included in with this report are drill logs, boring location plan, photographs, borehole summary table and borehole constant head permeability measurements.

LOCATION

The temporary storage area is located at the southern end of the WSS and immediately southwest of raffinate pit #3. The area is oriented in a north-south direction and consists of approximately ten acres. Figure 1, Boring Location Plan, shows the location of the area and boreholes.

PURPOSE

The subsurface investigation was performed to provide geotechnical design parameters for a temporary disposal cell. It is planned to place waste removed from the quarry in the cell temporarily until completion of the larger WSS disposal cell. The investigation included drilling, soil sampling, in-situ permeability testing, and hole abandonment. Table 1 provides a summary of the borings.

TABLE 1

BOREHOLE SUMMARY

BORING	COORDINATES NORTH	EAST	ELEVATION	TOTAL DEPTH	DATE COMPLETED
GTS-1	98657.06	50964.40	665.35	39.8	5/12/89
GTS-2	98100.43	50751.90	668.17	37.3	5/10/89
GTS-3	98118.63	51076.87	654.97	31.5	5/08/89
GTS-4	98488.62	51237.15	652.20	27.5	5/11/89
GTS-5	98607.71	51245.77	662.64	37.0	6/06/89
GTS-6	98932.02	51035.66	665.28	47.0	6/07/89
GTS-7	98771.04	51381.75	662.64	44.5	6/08/89

PROJECT PERSONNEL

Subcontract WP117 was awarded to Hannibal Testing Laboratories (HTL), Hannibal, Missouri for drilling. HTL employees Tom Clay and Terry Hemme performed as driller and driller's helper, respectively. MK-Environmental Services geologists Paul Patchin and Alan Benfer alternated for logging documentation and supervision of the drilling and site activities. Charles Payton, WSSRAP geologist provided project direction.

HEALTH/SAFETY AND DECONTAMINATION

Drilling was not performed within any restricted areas. Two localized areas of radioactive contamination lie within the temporary storage area, but field activities avoided these areas.

TLD badges and entrance urine samples were required for site personnel. Exit urine samples were not required as site disposal cell drilling was following immediately. Hard hats and sturdy work boots were worn by all workers.

A Ludlum Model 44-9 scintillometer was used to scan all samples for radioactivity and to scan personnel hands prior to drinking water near the drill sites. An

initial 1/2-hour safety meeting was presented and attended by all project personnel. The driller, Tom Clay, was required to attend a weekly, one-hour subcontractor safety meeting. A weekly subcontractor safety meeting was also held and documented.

The drill rig and all drilling tools were decontaminated by steam cleaning upon arrival at the site and were decontaminated between borings and upon completion of the storage area drilling.

DRILLING AND SAMPLING

Seven Borings, GTS-1 through GTS-7 were drilled at the temporary storage area. Figure 1 shows the boring locations. The GTS designation for borings implies geotechnical temporary storage.

The temporary storage area investigation was performed between May 5 and June 8, 1989. Drilling was accomplished using a CME Model 55 truck-mounted drill rig. Six and 7/8 inch outside diameter (O.D.); 3-1/4 inch inside diameter (I.D.) continuous flight hollow stem augers drilled the overburden to auger refusal at the top of the bedrock.

SOIL SAMPLING

Soil sampling was performed on 2-1/2 foot centers through the overburden. Disturbed soil samples were obtained using a 2.0-inch O.D., 1.5-inch I.D. Standard Penetration (SPT) sampler. SPT samples were placed in capped plastic jars. Relatively undisturbed samples were obtained using a California split-barrel sampler having an O.D. of 3.0 inches and I.D. of 2.5 inches. Four, 6-inch long, 2.56-inch I.D. brass liners were placed inside the California sampler. Each retrieved 6-inch liner was capped and taped. Both the SPT and California samplers were driven a depth of 18 inches beyond the lead auger using an automatic 140-pound hammer free-falling 30-inches. The number of blows required to drive each 6-inch interval was recorded and final two 6-inch drives were summed and expressed as blows per foot. Undisturbed samples were obtained by

hydraulically pushing 3.0-inch diameter, 36-inch long steel Shelby tubes to a depth of 30 inches. Upon retrieval, both ends of the tube were sealed with molten bee's wax, capped, and taped. Care was taken to maintain the tubes in a vertical position at all times.

Soils encountered were described in accordance with the Unified Soil Classification. Soil colors were described according to Munsell Color Charts. SPT and other selected samples were photographed. These photos, as well a the boring logs, accompany this report.

Bulk cuttings samples were taken for the first five feet in all boreholes except GTS-3 for compaction testing. These samples were placed into a 5-gallon bucket, covered with a lid, then securely taped with duct tape and labeled.

Duplicate soil samples were taken when possible, in all borings except GTS-3 for mineralogical analysis by the U.S. Geological Survey. A duplicate sample was taken when enough sample was available in a split spoon, partial brass liner, or the end of a shelby tube. These samples were placed in plastic zip-lock bags and labeled by borehole, depth, sample number, and stratigraphic horizon. They were then stored with the other samples until retrieval by a USGS representative for analysis.

All samples were labeled and chain-of-custody forms were completed showing samples collected. All soil samples were stored in Building 410 in a heated room to prevent sample freezing. A daily field diary was maintained documenting all drilling activities. A daily record of work progress was submitted to Charles Payton as well as a weekly summary of pay items. Copies of field logs were sent weekly to Edward Tom, Geotechnical Engineer, MK-Environmental Services, San Francisco.

GTS Borings were not cored and were abandoned upon encountering auger refusal.

PERMEABILITY TESTING

Constant head borehole permeability testing was performed in borings GTS-1 through GTS-5 at varying depths. Testing and calculations followed the procedures outlined in the U.S. Bureau of Reclamation Earth Manual, Appendix E-18 (open-end gravity flow tests). All tests were performed within the unsaturated zone above the water table. The permeability testing procedures consisted of lowering threaded NQ (2.375-inch diameter, I.D.) drill rods through the hollow stem augers to the hole bottom. Testing followed the retrieval of a Shelby tube or California sample. The rods were pushed into undisturbed soil approximately 4-inches to provide a seal. Clear water was used to completely fill the inside of the rods and a full level was maintained by adding water as the water level dropped. The volume of water added after initial filling was recorded for the testing period of typically ten minutes. Table 2 below presents a summary of these results.

TABLE 2

CONSTANT HEAD PERMEABILITY TESTS

BORING	TEST DEPTH	SOIL CLASS	TAKE	CALCULATED PERMEABILITY (cm/sec.)
GTS-1	36.5	CL	0	0.0
GTS-2	10.0	CL	0	0.0
	25.0	CL	0	0.0
GTS-3	7.5	CH	0	0.0
	17.5	CL	0	0.0
	22.5	CL	0	0.0
GTS-4	5.0	CL	0	0.0
	24.0	CL-CH	0	0.0
GTS-5	15.0	CH	0.25 oz.	1.25×10^{-6}

BOREHOLE ABANDONMENT

All GTS borings were abandoned by plugging with Volclay grout manufactured by American Colloid Company. Volclay consists of a high-solids bentonite clay powder with a 4% added initiator which causes the grout to set up to a plastic consistency. Each 50-pound bag of Volclay was mixed with 23-gallons of clear water. The Volclay powder was jetted through a hopper into a tub and thoroughly mixed by circulating through the rig mud pump. Two pounds of initiator were added per 50-pound bag of Volclay. Once mixed, the grout slurry was pumped through the hollow stem augers, the augers were retrieved, and the hole topped-off. The borehole was then staked and later surveyed for location and elevation.

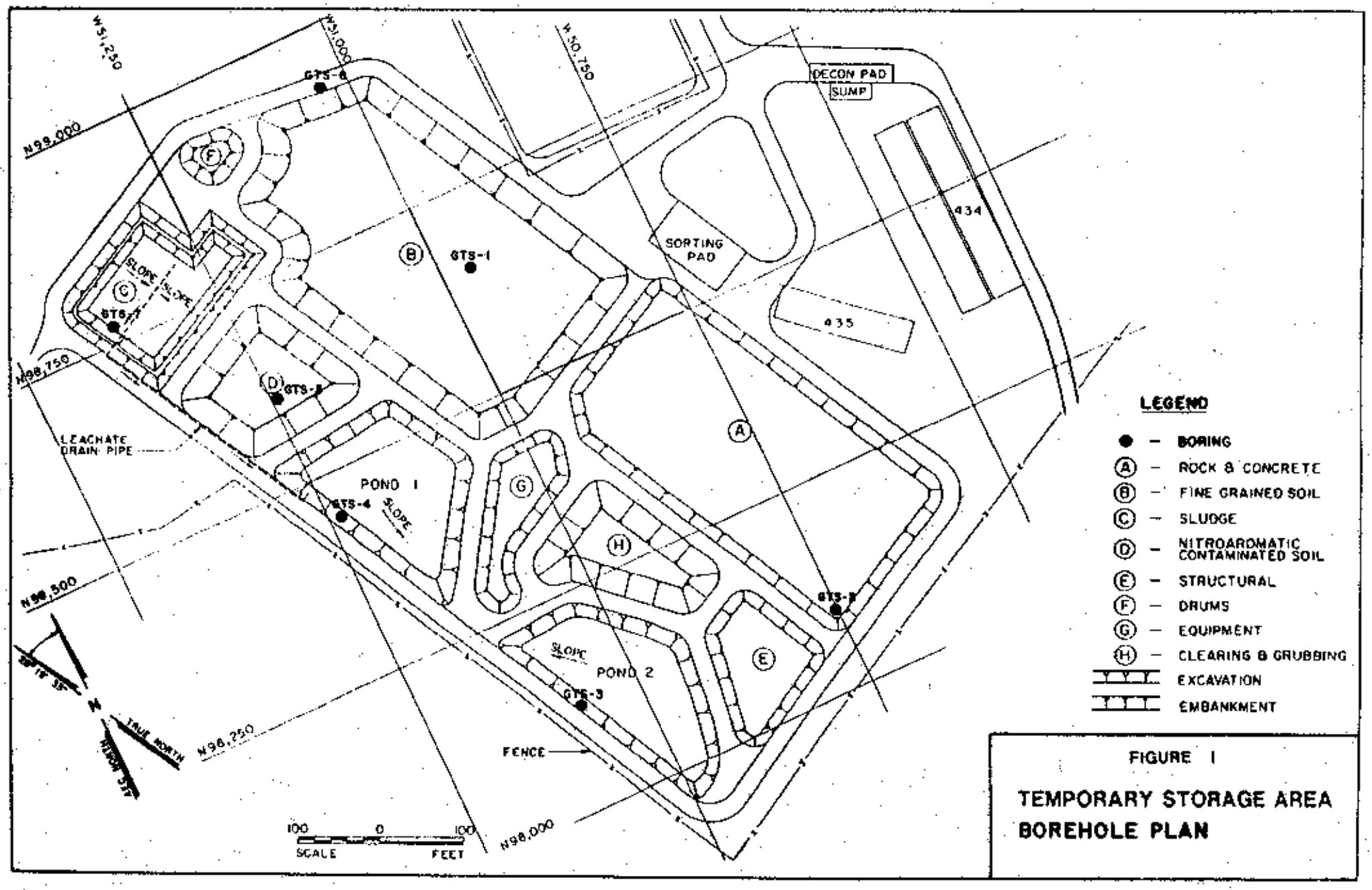


FIGURE 1

TEMPORARY STORAGE AREA BOREHOLE PLAN

GEOTECHNICAL BORING LOG LEGEND

SYMBOLIC LOG

	CLAY		GRAVELLY CLAY
	SILT		CLAYEY GRAVEL
	SAND		SANDY CLAY
	GRAVEL		TOPSOIL
	SILTY CLAY		SHALE
	CLAYEY SILT		CHERTY LIMESTONE

SAMPLER DESIGNATIONS

SS = STANDARD PENETRATION SAMPLER (2.0" SPLIT SPOON)

SB = CALIFORNIA SAMPLER (3.0" SPLIT BARREL)
X = LINERS COLLECTED

ST = 3.0" SHELBY TUBE
P.P. = POCKET PENETROMETER, UNCONFINED COMPRESSIVE STRENGTH (Tons/Sq.Ft.)

GROUNDWATER MEASUREMENTS

6.5'; 6/9 ▽ = DEPTH & DATE OF INITIAL WATER LEVEL MEASUREMENT

2.9'; 6/16 ▼ = DEPTH & DATE OF STABILIZED WATER LEVEL MEASUREMENT

COLORS

SOIL & ROCK COLORS FROM MUNSELL SOIL AND GSA ROCK COLOR CHARTS

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 2

Project Number: 5121

Hole Number: GTS-1

Project: Geotechnical Investigation - Phase II	Location: Temporary Storage Area
Coordinates: (AEC) N. 98657.1 W. 50964.4	Drilling Contractor: Hannibal Testing Labs.
Drill Make and Model: CME 55; 6 7/8" Hollow Stem Auger, 3¼", I.D.	Depth Top of Rock: 39.8'
Depth Casing & Size: none	Hole Size: 6 7/8"
Elevation: 665.35 ft. G.S.	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 39.8'	
Water Level: none	Fluid & Additives: none
Date Start: 5/11/89	Date Finish: 5/12/89
Logger: P. Patchin	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						CLAYEY SILT, nonplastic, brown (10YR 4/3) w/roots, organics, FeOx nodules, v. stiff (2.75) last 1" 1.8
		1.0 2.5	SS 01	7"	2-3-4 7		mottled lt. yellowish brown (2.5Y 6/4) and yellowish brown (10Y 5/8), damp to dry. ML.
		2.5 4.0	SS 02	11"	2-4-5 9		CLAYEY SILT (40% clay) slightly plastic, mottled lt. brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/8) FeOx) damp to dry, MnOx blebs, FeOx stain, ML-CL
	5	5.0 7.5	ST 03	12"			as above, damp, pp=2.5, non-plastic, ML FERRELVIEW 7.8
		7.5 9.0	SS 04	18"	2-3-5 8		SILTY CLAY, mottled as above, damp FeOx nodules (20% silt), slight to mod. plasticity. V. stiff 2.25 CL
	10	10.0 12.5	ST 05	20"			CLAY med. to high plasticity, mottled lt. yellowish brown (2.5Y 6/4) and yellowish brown (10Y 5/8), damp, v. little silt, FeOx nodules, no MnOx, v. stiff (2.5) CL-CH.
		12.5 14.0	SS 06	18"	2-3-4 7		CLAY as above, with white non-calcareous soft inclusions, pp=3.0 CH FERRELVIEW
	15	15.0 17.5	ST 07	28"			CLAY, gravelly (10%) mod. plasticity, mottled as above, slightly damp, abundant MnOx streaks, 16.3
		17.5 19.0	SS 08	17"	2-8-9 17		FeOx nodules. Gravel is subrounded igneous and metamorphics, very stiff (3.25) CL-CH CLAY TILL Clay gravelly as above, increased MnOx stringers and FeOx blebs to 7mm, igneous gravel to 2cm (15%) damp to dry. Sandy (5%) coarse, very stiff (3.75) CL
	20	20.0 21.5	ST 09	29"			CLAY as above, sandy, predominantly yellowish brown (10YR 5/8) moist, pp=2.75 CL CLAY TILL
		22.5 24.0	SS 10	18"	3-9-10 19		CLAY as above, no mottling; with hard L.S. gravel, vert. fractures w/MnOx, pp=3.75, sandy, dry to damp, CL
	25						See next page for sample ST11

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 2

Project Number: 5121

Hole Number: GTS-1

Project: Geotechnical Investigation - Phase II

Location: Temporary Storage Area

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25	25.0	ST 11	16"			Sampler drove rock & caved last 8" of Shelby tube. Cut offtube 8" from bottom. Rock was calcareous. Gravelly-CLAY as above, dry pp=3.5 CL
Sampler refusal		27.2					
		27.5 29.0	SS 12	18"	4-10-11 21		CLAY as above, abundant MnOx & fractures with leaching pp=4.5 dry CLAY TILL
	30	30.0 31.5	SB 13	5"	8-19-20 39		Pushed a large (7cm) rock at end of sampler. CLAY as above, damp pp=3. 31.8
		32.5 34.0	SS 14	17"	6-14-17 31		CLAYEY SAND to SILT (v. fine)(20% clay)lt.gray (10YR 7/2) nonplastic, dry to damp, abundant FeOx nodules to 3mm. Hard (> 4.0) no gravel mottled with lt.yellowish brn. (10YR 6/4) SC-ML BASAL TILL? 34.9
	35	35.0 36.5	SB 15	12"	6-12-13 25		GRAVELLY CLAY, slight plasticity, yellowish red, no silt (5YR 5/6) mottled with pinkish gray (5YR 6/2) 5% chert gravel to 12mm, minor finely xln L.S. (dark); damp, blocky, w/minor MnOx; FeOx blebs, hard (4.5) CL Residuum
		37.5 39.0	SS 16	3"	7-11-20 31		Pushed rock, (lithographic limestone, gray 10YR 6/1) GRAVELLY CLAY, as above, pp=4.5, dry 39.8
	40						Auger refusal @39.8' @8:40a.m. 5/12/89

Note: In end of clean-out tube before grouting was large chert gravel (7cm) with weathering rinds and pyrite (fresh) inclusions. Also more leached looking clay.

Collected bulk sample from 0-5.0' from auger cuttings.

Grouted hole to surface with Volclay grout.

Performed a constant head test at 36.5'. No take.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 2

Project Number: 5121

Hole Number: GTS-2

Project: Geotechnical Investigation - Phase II	Location: Temporary Storage Area
Coordinates: N.98100.4 W.50751.9 (AEC)	Drilling Contractor: Hannibal Testing Labs

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55, 6 7/8" Hollow Stem Auger; 3¼" I.D.	37.3'	none	6 7/8"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
668.17 ft. G.S.	Vertical	37.3'

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
None	None	5/9/89	5/10/89	P. Patchin

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0	0 1.5	SS 01	12"	2-6-7 13		SILTY CLAY, mod. plasticity, mottled light gray (10YR 7/1) and yellow (10YR 7/6), moist, roots, organics. CL. Bottom 6" is clayey silt, dk grayish brown (10YR 4/2) non-plastic, v. stiff (2.25) ML
		2.5 5.0	ST 02	18"			SILTY CLAY, low plasticity, mottled light brownish gray (2.5Y 6/2) and brownish yellow (10YR 6/6) very stiff (2.25) damp, CL. FeOx blebs, MnOx stringers. Silt ~30-40%.
	5	5.0 6.5	SS 03	18"	3-5-8 13		As above pp=2.0 CL FERRELVIEW
		7.5 10.0	ST 04	28"			As above, pp=2.25 minor fine gravel, CL
	10	10.0 11.5	SS 05	18"	7-9-10 19		As above, pp=2.0 2" soft saturated zone at 10.8', overall moist CL.
		12.5 15.0	ST 06				CLAY, as above, less silty (10%) high plasticity, moist, CH pp=2.5
	15	15.0 16.5	SS 07	18"	2-5-10 15		CLAY as above, pp=2.75, high plasticity, damp, with slickensides, CL-CH FERRELVIEW
		17.5 20.0	ST 08	0"	Sample fell out no recovery		Shelby tube sampler empty. Drove split barrel sampler to pick up sample. At end of split barrel was SILTY CLAY as above, dry, increase MnOx streaks, minor fine gravel, CL
	20	20.0 21.5	SS 09	18"	2-4-6 10		CLAY, as above, dry, pp=3.25, minor gravel, CL-CH 22.0
		22.5 25.0	ST 10	26"			CLAY, as above but with increased (10%) fine gravel/coarse sand, dry, low plasticity, hard (3.75) CL CLAY TILL
	25						

See next page for SS11 sample description

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 2

Project Number: 5121

Hole Number: GTS-2

Project: Geotechnical Investigation - Phase II

Location: Temporary Storage Area

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25	25.0 26.5	SS 11	18"	3-7-8 15		SILTY CLAY, gravelly (15%) low plasticity, dry, hard (4.25), gravel fraction subround igneous, mafic, possible metamorphic rock, sandy (10%), predominantly yellowish brown (10YR 5/8) CL
		27.5 29.0	SB 12	12"	4-7-14 21		as above pp=4.5 dry
							CLAY TILL
	30	30.0 31.5	SS 13	18"	5-7-12		as above, less sand and silt, more plastic pp=4.0 gravel up to 3cm (chert).
		32.5 34.0	SB 14	0"	4-11-12		No sample, pushed rock. At end of split barrel is white (5Y 8/1) clay with decomposed L.S. CL 34.2
							RESIDUUM?
	35	35.0 36.5	SB 15	12"	13-39-30 >50 37.3'		CLAYEY GRAVEL, nonplastic, dry, gravel up to 5cm, white (5Y 8/1), weathered limestone and chert (90%) minor clay, white (5Y 8/2) and MnOx and FeOx staining; last 4" is light gray (5Y 7/2) clay, "soapy", dry.
	40						Auger Refusal at 37.3' at 3:40pm 5/9/89

Note: Constant head tests at 10.0' and 25.0'. No take on both. Attempted test at 36.5' but could not seat NW drill rod due to rock.

Took bulk sample from 0-5' from auger cuttings.

Grouted hole to surface with Volclay grout.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 2

Project Number: 5121

Hole Number: GTS-3

Project: Geotechnical Investigation - Phase II	Location: Temporary Storage Area
Coordinates: N.98118.6- W.51076.9 (AEC)	Drilling Contractor: Hannibal Testing Labs

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55, 6 7/8" Hollow Stem Auger with 3¼" I.D.	31.5'	none	6 7/8"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
654.97 ft. G.S.	Vertical	31.5'

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
None	None	5/5/89	5/8/89	P. Patchin

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						Augered to 2.5'
							FERRELVIEW
		2.5 4.0	SS 01	5"	2-1-1 2		SILTY CLAY, low plasticity, dark yllwsh brn(10YR 3/4) mottled with yellowish red (10YR 4/6), moist, soft (.75) CL
	5	5.0 7.5	ST 02	17"			CLAY, high plasticity, mottled red (2.5YR 4/8) and brn (10YR 5/3), minor black (MnOx) streaks, moist, med. stiff (1.0) CH
		8.0 9.5	SS 03	11"	2-7-8 15		CLAY, as above, light gray (10YR 7/1), slightly silty, no mottling, moist, stiff (1.5), CH
	10	10.0 12.5	ST 04	28"			SILTY CLAY, 15% silt, low to med plasticity, mottled yellowish brown (10YR 5/6) and light gray (10YR 7/1) with abundant FeOx nodules and MnOx streaks, damp, very stiff (4.0), CL FERRELVIEW
		12.5 14.0	SS 05	18"	1-8-9 17		As above, grading to siltier (~30%) minor fine sand and gravel at bottom, v. stiff (3.0) CL 13.5
							CLAY TILL
	15	15.0 17.5	ST 06	29"			SILTY CLAY, low plasticity, yellowish brown (10YR 5/6) mottled with light gray (5Y 7/2), damp very stiff (4.0) approx. 15% fine gravel (igneous & metamorphic)subrnd abundant FeOx blebs & MnOx stringers. CH
		17.5 19.0	SS 07	10"	3-12-18 30		SANDY GRAVEL, nonplastic, white (10YR 8/1) 60% large angular chert gravel, (gray 10YR 6/1) up to 2cm, minor clay (5%), minor FeOx stain; dry. GM 18.5
							BASAL TILL
	20	20.0 22.5	ST 08	16"			CLAY, low to med plasticity, white, (5Y 8/1), damp, blocky, stiff, (2.0) with FeOx and MnOx stringers, "soapy", with approx. 25% decomposed limestone? (high reaction to HCL) CL. 21.3
		22.5 24.0	SS 09	12"	9-10-15 25		As above, increase in FeOx stain, with very angular pale blue chert, pp=2.0 RESIDUUM?
	25						

See next page for SB11 Sample description.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 2

Project Number: 5121

Hole Number: GTS-3

Project: Geotechnical Investigation - Phase II

Location: Temporary Storage Area

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25	25.0	SB	6"	13-14-15		CLAY, gravelly, light brownish gray (2.5Y 6/2), mod. to high plasticity, with FeOx staining (10YR 6/6) & MnOx stringers; stiff (1.23) 25% subangular chert gravel to 4cm, no limestone, CL RESIDUUM?
		26.5	10		29		
		27.5	SS	10"	10-22-23		GRAVEL, with minor clay, nonplastic, dry 10% clay, gravel is cherty limestone to 3cm, also sand size decomposed rock, all stained with FeOx, GC.
5/5 5/8		29.0	11		45		
		30.0					As above w/50% clay to 30.2', gravel (cont'd below)
	30		SB12	6"	50; >50		
		30.5			refusal		AUGER REFUSAL RESIDUUM? 31.5

@8:50 am 5/8/89

is predominantly chert gravel. At 30.2 is weathered bedrock with mainly chert and clay (brownish yellow 10YR 6/6), chert pieces to 4cm. Also white clay (5Y 8/1) with MnOx stringers. FeOx stain throughout with minor weathered limestone and limey clay.

Grouted hole to surface with Volclay grout.

Note: Performed constant head test at 7.5', 17.5', and 22.5'. No take on all tests.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 2

Project Number: 5121

Hole Number: GTS-4

Project: Geotechnical Investigation - Phase II	Location: Temporary Storage Area
Coordinates: N.98448.6 W.51237.2 (AEC)	Drilling Contractor: Hannibal Testing Labs
Drill Make and Model: CME 55, 6 7/8" Hollow Stem Auger: 3¼" I.D.	Depth Top of Rock: 27.3
Depth Casing & Size: none	Hole Size: 6 7/8"
Elevation: 652.20 ft. G.S.	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 27.5	
Water Level: None	Fluid & Additives: None
Date Start: 5/10/89	Date Finish: 5/11/89
Logger: P. Patchin	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0	00 1.5	SS 01	9"	3-7-6 13		CLAYEY SILT, non-plastic, dark brn (10YR 3/3) abund. roots & organics, moist. Last 3" brn (10Y 5/3) w/med. gravel & dry ML. TOPSOIL/FILL 2.0
		2.5 5.0	ST 02	27"			SILTY CLAY, slight plasticity, mottled brn (10YR 5/3) & strong brn (7.5YR 5/6), dry to damp, abund. FeOx stn, 25% silt, occasional blkorganic? blebs, v. stiff (2.25) CL
	5	5.0 6.5	SS 03	16"	2-3-6 9		CLAYEY SILT (~30% clay) non-plastic, mottled lt. grnsh gray (10YR 6/2) & brnsh yellow (10YR 6/8), dry to damp, w/bl organic? blebs (prob. FeOx), v. stiff (2.25) ML FERRELVIEW
		7.5 10.0	ST 04	30"			As above, increased SILT (80-90%) w/FeOx blebs, more lt. brnsh gray (10YR 6/2), damp, stiff (1.75) ML 10.3
	10	10.0 11.5	SS 05	18"	2-5-7 12		CLAY, gravelly, mod. plasticity, mottled yellowish brn (10YR 6/8) and lt. gray (minor) (10YR 7/1), chert gravel (subrnd) fine to 1cm (10%) minor sand, abund FeOx nods & MnOx stringers, v/stiff (2.25). CL-CH
		12.5 15.0	ST 06	30"			As above, sandier, less mottling, pp=3.25, w/vert & horiz. fractures w/MnOx staining and leaching, dry-damp CL.
	15	15.0 16.5	SS 07	16"			As above, pp=3.5, no mottling; slight to mod. plasticity. CL-CH CLAY TILL
	6"						
		17.5 20.0	ST 08	26"			CLAY, mod. plasticity, lt. yellowish brn (10YR 6/4), hard (4.25) abund FeOx blebs 5% rounded gravel, v. little sand, dry to damp, no fractures, CL-CH
	20	20.0 21.5	SS 09	15"	4-8-7 15		As above, pp=3.75, abund angular chert gravel @20.5 for 4" yellowish brown (10YR 5/7) abund. MnOx streaks; damp, no L.S. CL-CH 22.8
		22.5 24.0	SB 10	6"	8-15-5 20		CLAYEY GRAVEL, w/angular chert gravel up to 6cm in diam. (possible silicified L.S.) BASAL TILL? 23.7
	25						GRAVELLY CLAY, slt. plasticity, wh. (5Y 8/2) mottled w/brnsh ylw (10YR 6/8) mottling, 20% chert (ang) gravel (pieces) up to 5cm long, vuggy w/wthring rinds, clay is moist and talc-like, no L.S., CL-CH RESIDUUM

See next page for sample SB11

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 2

Project Number: 5121

Hole Number: GTS-4

Project: Geotechnical Investigation - Phase II

Location: Temporary Storage Area

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25	25.0 26.5	SB 11	6"	17-19-12		CLAYEY GRAVEL, nonplastic 20% clay is "talc like", lt olive yellow (10YR 6/6), damp, w/ abund. FeOx, also decomposed L.S (HCL reaction), angular chert gravel 27.5
							loose silty matrix, GC RESIDUUM?
							Auger refusal @ 27.5'
							@ 3:50pm 5/10/89
	30						

Note: GTS-4 Bulk Sample taken from 0-5.0' from auger cuttings.

Grouted hole to surface with Volclay grout.

Constant head test at 5.0' and 24.0'.
No take on both.

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 2

Project Number: 5121
Contract WP117

Hole Number: GTS-5

Project: Geotechnical Investigation Phase II	Location: Temporary Storage Area
Coordinates: N.98607.7 W.51245.8 (AEC)	Drilling Contractor: Hannibal Testing Laboratories

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55 H.S. Augers 6-7/8", 3 1/4"	37.0	None	6-7/8"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
G.S. 662.64 ft.	Vertical	37.0

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
Dry	None	12:50 6/5/89	11:10 6/6/89	A. Benfer

Elevation	Depth Below Surface	Sample Interval	Sample Type & Number	Sample Recovery	Standard Penetration Test Results 6"-6"-6" (N)	Symbolic Log	Soil Description (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	GTS-5 Bulk	2.5					(Bulk sample of cuttings, GTS-5, collected from 0 to 5.0 feet).
	5	2.5–5.0	ST 01	29"			CLAY, highly plastic, mottled brownish yellow (10YR 6/6) and dark gray (10YR 4/1), moist, minor black, stiff to very stiff (2.0), CH, contains minor rounded limestone gravel (¼"), possible fill.
		5.0–6.5	SS 02	13"	2.2.2 4		As above, bottom 2" mottled blue and olive gray (5Y 5/2) with decomposed grass.
							FILL 7.5
	10	7.5–10.0	ST 03	19"			SILTY CLAY, low plasticity, mottled yellowish brown (10YR 5/6) and light gray (10YR 7/1), moist very stiff (2.25), CL, minor FeOx.
		10.0–11.5	SS 04	17"	2.4.4 8		As above, mostly light yellowish brown (10YR 6/4), with ~20% black FeOx, pp=2.2
							FERRELVIEW 12.5
	15	12.5–15.0	ST 05	20"			CLAY, highly plastic, mottled yellowish brown (10YR 5/6) and gray (10YR 6/1), moist, stiff (1.5), CH. Contains ~10% FeOx and <5% spherical nodules (1/8"), trace limestone sand.
		15.0–16.5	SS 06	18"	2.1.3 4		As above, pp=2.2, 16.0-16.5, 5% sand.
	20	17.5–20.0	ST 07	23"			Disturbed
							FERRELVIEW 20.5
		20.0–21.5	SS 08	18"	2.2.5 7		SILTY CLAY, medium plasticity, 10% sand, 10% fine subrounded gravel, brownish yellow (10YR 6/6) with black MnOx stringers, moist, very stiff (3.0), CH.
	25	22.5–24.5	ST 09	32"	Pushed 24"		As above, mottled with light gray (10YR 7/1), less sand and gravel, pp=3.0. CLAY TILL

5/5/89
6/6/89

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 2

Project Number: 5121
Contract WP117

Hole Number
GTS-5

Project: Geotechnical Investigation Phase II

Location: Temporary Storage Area

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25						
5/5/89 6/6/89		25.0 26.5	SS 10	18"	2.6.3 19		26.0-28.0 as above, increase in gravel >50%, predominantly chert, up to 2", subrounded, pp(clay)=3.5.
		27.5 29.0	SB 11	12"	7.12.16 28		As above, pp=4.5+, hard, 15% fine to coarse sand, trace gravel (1/4"), MnOx stringers.
	30						CLAY TILL
		30.0 31.5	SS 12	18"	4.7.11 18		SILTY CLAY, medium plasticity, ~15% sand, mottled brownish yellow (10YR 6/6) and light gray (10YR 7/1), damp, hard, (>4.5), CL-CH, spherical FeOx, MnOx stringers and blebs.
		32.5 35.0	ST 13	34			As above, pp=3.0, very stiff, CH.
	35						36.0
		35.0 36.5	SS 14	18"	3.9.50 59		GRAVEL fragments, chert, 10% clay, chert-yellowish brown (10YR 5/6), also clay with black MnOx, clay moist, hard, GC. RESIDUUM

Auger refusal at 37.0, T.D. 11:10 6/6/89
Apparent bedrock
Grouted hole with 2 bags of Volclay

Constant head test at 15.0'. Take = .25 oz. in 10 minutes.

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 2
Project Number: 5121
Contract WP117
Hole Number: GTS-6

Project: Geotechnical Investigation Phase II	Location: Temporary Storage Area
Coordinates: N.98933.0 W.51035.7 (AEC)	Drilling Contractor: Hannibal Testing Laboratories
Drill Make and Model: CME-55 H.S. Auger 6 7/8", 3 1/4"	Depth Top of Rock: 47.0 / Depth Casing & Size: None / Hole Size: 6 - 7/8"
Elevation: G.S. 665.28 ft.	Angle from Vert. and Bearing: Vertical / Depth Bottom of Hole: 47.0
Water Level: Dry	Fluid & Additives: None / Date Start: 3:00 6/6/89 / Date Finish: 1:25 6/7/89 / Logger: A. Benfer

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	GTS-6 Bulk						(Bulk sample of cuttings, GTS-6, collected from 0 to 5.0 feet).
		2.5 4.0	SS 01	9"	3.6.8		SILT, nonplastic, mottled yellowish brown (10YR 5/6) and light gray (10YR 7/2), damp, hard (4.5+), ML.
	5						
		5.0 7.5	ST 02	24"			FERRELVIEW As above, pp=4.5+, hard, light yellowish brown (10YR 6/4)
		7.5 9.0	SS 03	18"	3.5.7 12		SILTY CLAY, low to medium plasticity, mostly light yellowish brown (10YR 6/4) with yellowish brown (10YR 5/6), moist, very stiff to hard (4.0), CL. Up to 1/8" blebs MnOx.
	10						
		10.0 12.5	ST 04	-			FERRELVIEW As above, pp=4.1, hard, mottled yellowish brown (10YR 5/6) and lt. gray (10YR 7/1), abundant FeOx. 12.5
		12.5 14.0	SS 05	12"	2.3.5 8		CLAY, highly plastic, mottled yellowish brown (10YR 5/6) and light gray (10YR 7/1), moist, very stiff (2.5), CH. Slickensided, contains MnOx and FeOx.
'6/89 '7/89	15						
		15.0 17.5	ST 06	26"			As above, pp=3.1 FERRELVIEW
		17.5 19.0	SS 07	18	3.4.6 10		As above, pp=2.5, very stiff, slickensided with stringers and blebs of MnOx and spherical FeOx nodules.
	20						
		20.0 22.5	ST 08	30"			As above, pp=3.75, 5% white angular sand 22.5
		22.5 24.0	SS 09	18"	4.6.10 16		SILTY CLAY, highly plastic, 15% sand, 10% subrounded fine gravel, spherical FeOx, reddish yellow (7.5YR 6/6) with light gray (10YR 7/1), damp, hard (4.5+) CL-CH. Minor MnOx. CLAY TILL

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 2
Project Number: 5121
Contract WP117
Hole Number: GTS-6

Project: Geotechnical Investigation Phase II
Location: Temporary Storage Area

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25	25.0 27.5	ST 10	28"			As above, pp=4.5+, increase in MnOx
		27.5 29.0	SS 11	18"	4.6.8 14		As above, pp=3.0, very stiff, less sand and gravel
	30	30.0 31.5	SB 12	12"	3.8.10.13 23		SILTY CLAY, medium plasticity, 10% sand, 10% fine gravel, brownish yellow (10YR 6/6) with minor light gray (10YR 7/1), damp, very stiff (3.25), CL. FeOx and MnOx stringers.
		32.5 34.0	SS 13	15"	5.7.10 17		As above, pp=4.5+, hard, slickensided with MnOx
	35	35.0 36.5	SB 14	12"	9.18.24 42		As above, pp=4.3 CLAY TILL
		37.5 39.0	SS 15	18"	5.7.10 17		Hard drilling As above, pp=3.75, spherical FeOx, granitic rock fragments, some well rounded fine gravel.
	40	40.0 41.5	SB 16	12"	11.22.35 57		As above, at 40.5', mottled red (2.5YR 5/8) and light gray (10YR 7/1), moist, hard (4.5+).
	45	45.0 46.5	SS 17	18"	5.15.43 58		GRAVEL, 30% clay, predominantly chert, brownish yellow (10YR 6/6) and black (MnOx), damp, hard (4.5+) GC, bottom 2" chert, highly fractured. RESIDUUM

Auger refusal 47.', T.D. 1:25 6/7/89
Probably bedrock
Grouted hole with 2 bags Volclay

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 2

Project Number: 5121 Contract WP117

Hole Number: GTS-7

Project: Geotechnical Investigation Phase II	Location: Temporary Storage Area
Coordinates: N.98771.0 W.51381.8 (AEC)	Drilling Contractor: Hannibal Testing Laboratories
Drill Make and Model: CME-55 H.S Auger 6-7/8", 3-1/4"	Depth Top of Rock: 44.5 / Depth Casing & Size: None / Hole Size: 6-7/8"
Elevation: G.S. 662.07 ft.	Angle from Vert. and Bearing: Vertical / Depth Bottom of Hole: 44.5
Water Level: Dry	Fluid & Additives: None / Date Start: 8:45 6/8/89 / Date Finish: 2:00 6/8/89 / Logger: A. Benfer

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	GTS-Bulk						(Bulk sample of cuttings GTS-7 Bulk, collected from 0 to 5.0 feet). FILL
		2.5 4.0	SS 01	4"	3.3.5 8		SILTY CLAY, low plasticity, dk yellowish brn (10YR 4/2) dry, hard (4.5+), CL, localized angular gravel. 3.5
5		5.0 7.5	ST 02	32"			SILTY CLAY, medium plasticity, mottled strong brown (7.5YR 5/6) and yellow (10 YR 7/3), moist, stiff to very stiff (2.0), CL. Contains black MnOx. FERRELVIEW
		7.5 9.0	SS 03	14"	1.3.5 8		CLAY, low plasticity, very silty, yellow (10YR 7/4) very stiff (3.0), CL. MnOx and FeOx blebs. 9.0
10		10.0 12.5	ST 04	20"			CLAY, highly plastic, mottled yellowish red (5YR 6/6) and light gray (7.5YR 7/0). moist, very stiff (2.25), CH.
		12.5 14.0	SS 05	18"	3.4.5 9		As above, mostly light gray (10YR 7/1) with strong brown (7.5 YR 5/6) (FeOx), pp=2.75. As above, minor MnOx, spherical FeOx, pp=3.5.
15		15.0 17.5	ST 06	22"			FERRELVIEW As above, trace sand and fine gravel, pp=2.75. 17.5
		17.5 19.0	SS 07	18"	3.5.10		SILTY CLAY, 20% sand, mottled brownish yellow (10YR 6/6) and light gray (10YR 7/1), damp, hard (4.5+), CL-CH. Slickensided, MnOx blebs.
20		20.0 22.5	ST 08	20"			CLAY TILL
		22.5 24.0	SS 09	16"	3.5.6 11		As above, 15% sand, 5% subrounded gravel, pp=3.7, CH. As Above, pp=4.5+, MnOx stringers, trace gravel up to ½".

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 2
Project Number: 5121
Contract WP117
Hole Number
GTS-7

Project: Geotechnical Investigation Phase II
Location: Temporary Storage Area

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
		25.0 26.5	SB 10	18"	7.15.27 42		As above, stiff (1.5), moist, CL, stringers of CaCO3 and MnOx, some well rounded coarse sand.
		27.5 29.0	SS 11	18"	4.7.9 16		As above, pp=4.5+, 10% fine gravel, vertical light gray clay stringers. CLAY TILL
		30.0 31.5	SB 12	12"	17.38.28 66		CLAY, silty, 10% sand, 10% gravel up to 1", brownish yellow (10YR 6/6) with light gray (10YR 6/6) stringers, spherical FeOx, damp hard (4.5), CL.
		32.5 34.0	SS 13	18"	4.7.11 18		As above, reddiwh yellow (7.5YR 6/8) at 33.5, pp=4.5, slickensided some with MnOx film.
	35	35.0 36.5	SB 14	12"	11.15.26 41		As above, yellowish brown (10YR 6/6) 37.0
		37.5 39.0	SS 15	18"	7.11.8 19		37.5-38.0 SAND, fine to coarse, 20% clay, strong brown (7.5YR 5/6), damp, medium dense, SC. 38.0-39.0 CLAY, medium plasticity, light gray (10YR 7/1) moist, medium stiff to stiff (1.0), CL-CH, with white lithographic limestone fragments.
	40	40.0 41.5	SB 16	12"	5.9.2 11		40.0-41.5 CLAY, low plasticity, speckled yellowish brown (10YR 7/1), moist, very stiff (2.5), CL, minor MnOx, abundant FeOx up to 1/4" nodules. CLAY TILL
							Auger refusal 44.5', T.D., 2:00 6/8/89 Probable bedrock Hole grouted with 2 bags Volclay.

APPENDIX B-3

DISPOSAL CELL AND PERIMETER AREA BOREHOLE AND PIEZOMETER AREA (GT-58P THROUGH GT-67P)

GEOTECHNICAL INVESTIGATIONS PHASE II
DISPOSAL CELL AND PERIMETER AREA

INTRODUCTION

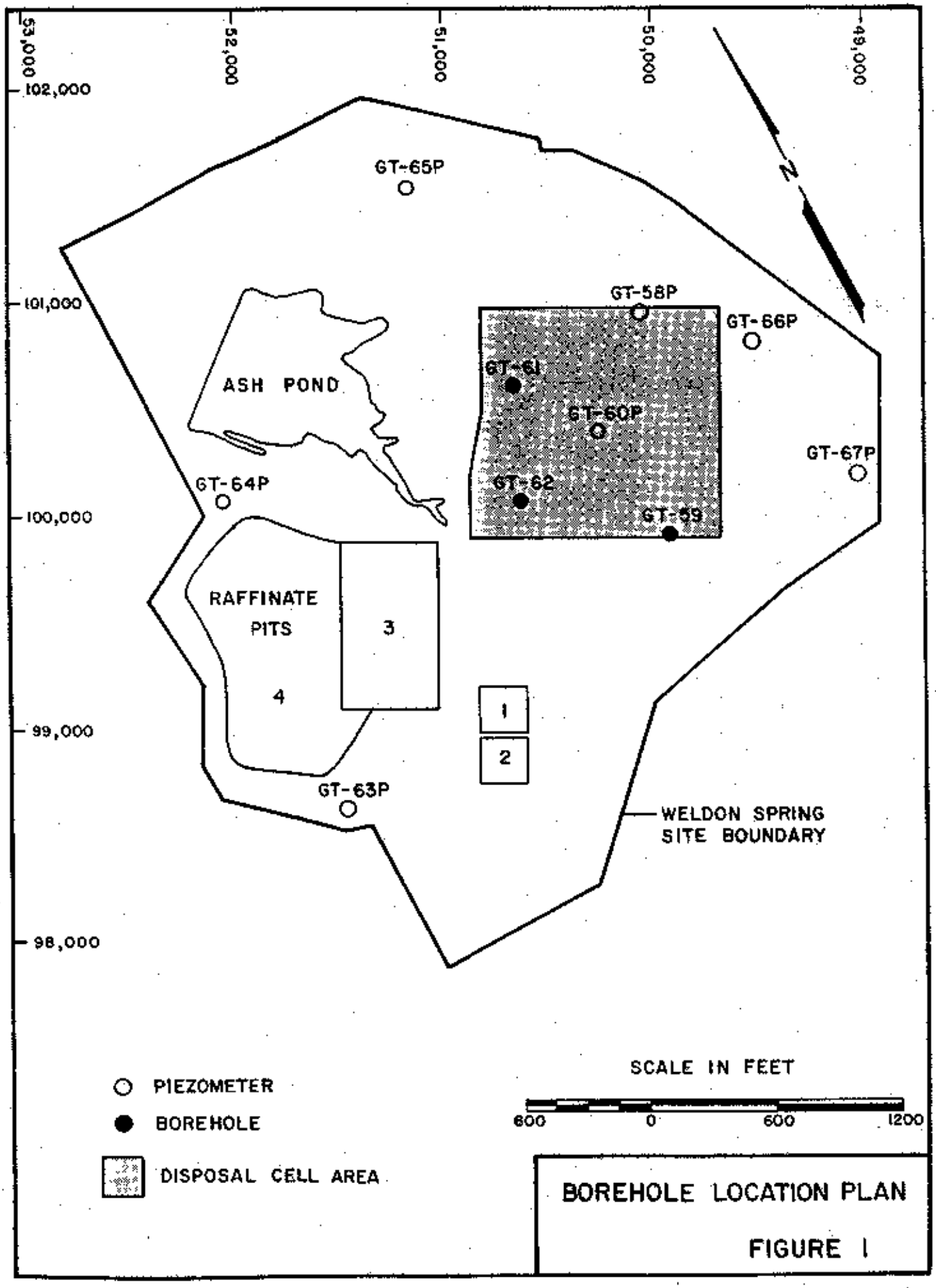
This report presents the procedures used for characterizing the subsurface conditions at the disposal cell and perimeter areas of the Weldon Spring Site (WSS). Included in this report are drill logs, well completion drawings, boring location plan, photographs, and borehole summary table. The subsurface investigation in the disposal cell area was performed to adequately characterize the average hydraulic conductivity of each of the overburden soil units, and to obtain additional geotechnical data for these units. The installation of piezometers both in the disposal cell and perimeter areas was done to characterize the uppermost portion of the shallow bedrock aquifer, with respect to the nature, extent, fate, and transport of contamination from the site. This data will be used to evaluate groundwater remediation requirements in Phase II of the feasibility study.

LOCATION

The proposed disposal cell area is located in the east-central portion of the WSS (Figure 1). Five geotechnical boreholes were drilled within the cell outline. Two of the five boreholes were completed as shallow aquifer piezometers; the remaining three were grouted to the surface after sampling to auger refusal. An additional five boreholes were drilled at selected locations near the perimeter of the WSS (Figure 1). These were all completed as shallow aquifer piezometers. All piezometers are denoted by a "P" in the borehole designation (example GT-60P). Table I summarizes the boreholes and piezometers drilled during this program.

HEALTH/SAFETY AND DECONTAMINATION

Drilling was not performed in any restricted areas. Two borehole locations, GT-62 and GT-60, were in areas where the ground surface and upper soil exhibited higher-than-background radiation levels. In these areas, rubber boot covers,



BOREHOLE LOCATION PLAN

FIGURE 1

TABLE 1

BOREHOLE/PIEZOMETER SUMMARY

Boring Number	Coordinates (PEC) North	West	Elevation TOC[1]	Ground	Top of Rock	Total Depth	Date Completed	Monitoring Interval[2]	Initial Groundwater Elevation	Remarks
GT-58P	100952.32	50055.19	652.79	653.01	29.5	60.9	07/11/89	30.5-60.9	600.95 06/30/89	Packer used; no sand pack
GT-59	99905.72	49963.81		657.00	27.0	27.0	06/16/89	--	None encountered	Grouted, no piezometer
GT-60P	100388.44	50260.36	662.11	660.60	48.7	67.5	07/21/89	58.2-67.5	603.59 07/24/89	Packer used; no sand pack
GT-61	100609.25	50679.21		658.13	59.5	59.5	06/21/89	--	None encountered	Grouted, no piezometer
GT-62	100062.40	50630.89		657.33	43.5	43.5	06/20/89	--	None encountered	Grouted, no piezometer
GT-63P	98626.12	51471.98	658.92	656.86	45.5	51.0	07/28/89	35.2-51.0	615.32 07/28/89	Reamed with sand pack
GT-64P	100053.12	52053.34	643.09	640.85	22.0	57.0	08/04/89	22.0-57.0	600.59 08/04/89	Packer used, no sand pack
GT-65P	101532.99	51161.08	636.71	634.92	48.5	60.0	08/15/89	48.0-60.0	582.72 08/16/89	Packer used, no sand pack
GT-66P	100814.69	49527.91	647.47	644.68	23.0	47.5	08/08/89	23.1-47.5	606.88 08/10/89	Packer used, no sand pack
GT-67P	100196.80	49036.75	660.34	657.70	32.5	60.0	08/11/89	34.5-60.0	617.04 08/18/89	Packer used, no sand pack

NOTE: All dimensions in feet and all depths below ground surface.

[1] TOC = Top of casing

[2] Top and bottom of sand pack or depth of packer to bottom of borehole (no sand pack)

rubber gloves, and in the case of GT-60, Tyvek suits were used temporarily until health physics personnel determined the contamination was not significant and did not extend below the first few feet of soil. TLD badges, hard hats, and sturdy work boots were worn by all personnel at the remaining drill sites.

A Ludlum Model 44-9 GM scintillometer was used to scan all samples and core for radioactivity and to scan personnel prior to any drinking of water near the drill site. The subcontractor held a weekly safety training meeting for the crew which was documented on weekly safety meeting forms and submitted to operations.

Upon completion of drilling in the temporary storage area and prior to drilling in the disposal cell area, the drilling tools and back of the drill rig were decontaminated with a portable steam cleaner. This was also done between borings. After drilling GT-62, contaminated mud was discovered on both the drill rig and water truck, so both were thoroughly decontaminated at the decontamination pad prior to moving to the next borehole. Upon completion of the drilling, the drill rig and all tools were thoroughly decontaminated prior to demobilization from the site.

DRILLING AND SAMPLING

Drilling, sampling, and piezometer installation were performed from June 15 through June 30, and July 10 through August 15, 1989. Installation of protective casing, protective posts, and well development were performed from August 15 through September 11, 1989. Drilling was accomplished using a CME Model 55 truck-mounted drill rig. Geotechnical borings utilized 6-7/8-inch outside diameter (O.D.), 3-1/4-inch inside diameter (I.D.) continuous flight hollow-stem augers to drill through the overburden to auger refusal at the top of bedrock.

Piezometers were drilled with a 7-1/4-inch (O.D.) by 4-1/4-inch (I.D.) augers to bedrock, then cored to approximately 8 to 10 feet below the projected water table depth. This was performed using a NQ wireline core barrel, and the holes were cored to a depth that straddled the piezometer screen across the water table.

SOIL SAMPLING

Soil sampling was performed in an identical manner to the sampling carried out in the temporary storage area investigation, with the exception that no bulk cuttings samples were taken for compaction testing. When possible, duplicate samples were again retrieved from each soil sample for mineralogical analysis by the USGS. These samples were bagged and labeled with the approximate stratigraphic soil unit intercepted in the sample. A USGS representative periodically gathered all samples from storage in building 410.

PERMEABILITY TESTING

Constant head permeability testing was performed in two boreholes in the disposal cell area at varying depths. Testing and calculations followed the same procedures used during the temporary storage area drilling and testing. Testing results and locations are given below.

Boring	Test Depth	Soil Class	Take	Calculated Permeability (cm/sec.)
GT-59	22.5′	CH	1.5 oz	4.94×10^{-7}
GT-61	51.5′	ML	48 oz	8.56×10^{-5}*

* Large gravel most likely prevented seating of NQ rod at test depth as evidenced by bent rod end. Calculated permeability is probably higher than actual.

ROCK CORING

In the piezometer borings, coring commenced at auger refusal. The hollow-stem augers were left in the hole to serve as casing, and the boring was continued using a 10-ft NQ wireline core barrel having a 2.98-inch diameter diamond-impregnated bit. This provided 1.875-inch diameter core. Because of the use of the larger 4-1/4-inch I.D. augers, the drill rods would usually slap the inside of the augers during drilling. Severe rod slap in some borings

necessitated installation of NW-size flush-jointed casing inside the augers to bedrock. This stabilized the drill rods and increased coring efficiency.

Piezometers were cored to a depth where the screen would straddle the water table. This will allow sampling of the uppermost portion of the shallow bedrock aquifer. Coring rates were often very slow due to abundant chert in the bedrock, which also made reaming of the coreholes to 4 inches impossible in all but one piezometer (GT-63P).

During the coring of GT-64P, it was noted that significant bit drops occurred in the upper 19 feet of bedrock. Severe core loss also occurred in this section (see Core Log). Just prior to installation of the piezometer, the driller noticed cold air venting from the borehole. ES&H was immediately notified who in turn, requested evacuation of the area immediately adjacent to the borehole until the venting air could be tested. This was done and upon monitoring, the air was determined to have elevated gamma and alpha radiation levels. These levels were not high enough though, to prevent further work at the drill site. After overnight monitoring, piezometer installation continued and was completed shortly afterward.

The core was striped red and blue to maintain orientation and the footage was marked on the core. Wooden blocks marking core runs and estimated loss zones were placed within the core as it was boxed. Penetration rate, water return, soft zones, core recovery, lithology and RQD were all recorded. Discontinuities were graphically recorded on the log and described. All of the core was then photographed. Core logs, photos and photo logs arranged by borehole accompany this report.

PIEZOMETER INSTALLATION

Piezometers were installed in all boreholes except GT-59, GT-61, and GT-62. Piezometers were constructed of 2-inch (I.D.) flush-threaded PVC pipe. Screens had 0.010-inch slots with a length of 10 feet to limit the monitoring interval to the top of the water table.

In all piezometers except GT-63P, a packer consisting of a 2-3/4-inch to 4-inch PVC reducer was placed at the top of bedrock because of the difficulty in reaming the corehole from 2.98 inches to 4 inches. The reducer was slipped over the piezometer casing and allowed to catch in the corehole at the top of bedrock as the piezometer was being lowered. The piezometer casing slipped though while the reducer remained stationary at the top of the bedrock. Once the piezometer was on bottom, the reducer was tapped and seated into the corehole using 3/4-inch PVC pipe. A minimum of 3 feet of bentonite pellets were placed directly on top of the reducer to provide a seal, followed by Volclay grout to the ground surface. No sand pack was used because of the small annulus (0.3") between the piezometer casing and corehole. Soft rock conditions in GT-63P were such that allowed reaming of the corehole. Merimac Warrior WB-30 silica sand was used as a filter pack in this piezometer, followed by a 3-ft seal of 1/2-inch bentonite pellets, then Volclay grout to the surface.

Later, a protective lockable casing was cemented in place over all piezometer casings. Three protective concrete-filled posts were then installed 120° apart and approximately 4 feet from each piezometer to prevent inadvertent damage.

PIEZOMETER DEVELOPMENT

All piezometers were developed between August 21 and September 11, 1989 by HTL and supervised by Neal Allday (WSSRAP environemntal engineer). Development was accomplished using Teflon bailers and a Triloc 1.7-inch PVC hand pump. The piezometers were developed by purging water to remove sediment and to promote aquifer flow. All bailers and pumps were decontaminated prior to placing in a piezometer.

Project specifications required the purging of five casing and annular space volumes of water for development of each piezometer. Table 2 presents a summary of well plus annulus volumes and water purged from each piezometer.

Table 2

Piezometer	Casing + Annulus Volume[1] (Water Column = Gal.)	Volume Removed	Water Condition	Water Parameters[2] Temperature (°C)	pH	Conductivity (umhos)
GT-58-P	6.75' = 2.43 gal.	30.0	Slightly cloudy	18.4	7.2	850
GT-60P	9.71' = 3.49 gal.	29.0	Cloudy	17.0	7.4	520
GT-63P	4.78' = 1.72 gal.	7.5	Very cloudy	18.0	7.0	590
GT-64P	4.38' = 1.57 gal.	7.5	Very cloudy	16.1	7.0	1800
GT-65P	6.29' = 2.26 gal.	20.7	Cloudy	17.0	7.4	1200
GT-66P	4.48' = 1.61 gal.	13.5	Relatively clear	18.4	7.2	900
GT-67P	12.10' = 4.35 gal.	41.0	Clear	17.0	6.9	850

[1]2.98" hole (casing + annulus) has volume of approx. 0.36 gal/ft.
[2]Water parameters from last measurment during three consecutive measurement practice.

Water evacuated during piezometer development was placed into 55-gallon barrels, sealed, and placed in building 434 awaiting disposal.

GEOTECHNICAL BORING LOG LEGEND

SYMBOLIC LOG

	CLAY		GRAVELLY CLAY
	SILT		CLAYEY GRAVEL
	SAND		SANDY CLAY
	GRAVEL		TOPSOIL
	SILTY CLAY		SHALE
	CLAYEY SILT		CHERTY LIMESTONE

SAMPLER DESIGNATIONS

SS = STANDARD PENETRATION SAMPLER (2.0" SPLIT SPOON)

SB = CALIFORNIA SAMPLER (3.0" SPLIT BARREL)
x = LINERS COLLECTED

ST = 3.0" SHELBY TUBE
P.P = POCKET PENETROMETER, UNCONFINED COMPRESSIVE STRENGTH (Tons/Sq.Ft.)

GROUNDWATER MEASUREMENTS

6.5'; 6/9 ▽ = DEPTH & DATE OF INITIAL WATER LEVEL MEASUREMENT

2.9'; 6/16 ▼ = DEPTH & DATE OF STABILIZED WATER LEVEL MEASUREMENT

COLORS

SOIL & ROCK COLORS FROM MUNSELL SOIL AND GSA ROCK COLOR CHARTS

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 7

Project Number: WP-117

Hole Number: GT-58P

Project: Geotechnical Investigation Phase II	Location: 60 ft N8°E from well MW-2011
Coordinates: N.100952.32 W. 50055.19 (AEC)	Drilling Contractor: Hannibal Testing Labs

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME 55, 7" H.S. Auger 7-1/4" O.D., 4-1/4" I.D.	29.5'	29.5', 7¼" O.D.	7½" ovbd.,4"rock

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
G.S. 653.01'; T.O.C. 654.79'	Vertical	60.9'

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
6/30/89 @52.06' b.g.s.	Clear water	6/22/89	7/11/89	P. Patchin

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
					Augered		CLAYEY SILT, dark yellowish brown (10YR 4/4), topsoil and roots, ML. TOPSOIL/LOESS
		2.5 – 5.0	ST 01	24"			CLAYEY SILT, slightly plastic, mottled light brownish gray (2.5Y 6/2) and brownish yellow (10YR 6/8), damp - moist, stiff (1.5), very clayey, FeOx blebs, ML. LOESS
	5	5.0 – 6.5	SS 02	17"	1.3.5 8		As above, pp=2.0 7.0
		7.5 – 10.0	ST 03	26"			SILTY CLAY, moderate plasticity, mottled light brownish gray (2.5Y 6/2) and brownish yellow (10YR 6/8), damp - moist, very stiff (2.5), FeOx blebs, blocky minor MnOx stringers, CL-CH.
	10	10.0 – 11.5	SS 04	12"	2.2.4 6		As above, high plasticity, less silt, pp=2.0, CH. FERRELVIEW
		12.5 – 15.0	ST 05	30"			SILTY CLAY, slightly plastic, gravelly (fine 5%) possible igneous and chert, mottled yellowish brown (10YR 5/8) and light gray (2.5Y 7/2), damp, hard (4.0) abundant MnOx, CL. 13.5
	15	15.0 – 16.5	SS 06	15"	2.4.6 10		As above, with 10% sand pockets, vertical fractures, pp=3.0. CLAY TILL
		17.5 – 20.0	ST 07	29"			As above, increased FeOx color yellowish brown (10YR 5/8), damp to dry, vertical fractures, pp=4.5, CL.
	20	20.0 – 21.5	SS 08	18"	5.6.7 13		As above, little mottling, predominantly brownish yellow (10YR 6/6), abundant MnOx on vertical and horizontal fractures, sandy pockets, CL
		22.5 – 24.8	ST 09	28"	Pushed 28"		As above with subrounded mafic gravel to 1 cm., pp>4.5, CL 25.2
	25						

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 7

Project Number: WP-117

Hole Number: GT-58P

Project: Geotechnical Investigation Phase II

Location:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25	25.0 26.5	SS 10	0"	7.9.10 19		Pushed rock, no sample
		27.5 29.0	SB 11	6"	13.29.18 47		RESIDUUM GRAVELLY CLAY with 50% subang. white chert gravel to 1 cm with weathering rinds and MnOx veins. Interstitial clay is strong brown (7.5YR 5/6), slightly plastic, very stiff, damp to dry, with MnOx blebs. CL 29.5'
	30						AUGER REFUSAL at 11:30 A.M. 6/22/89. See next page for core description from 29.5'-60.9'

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 7
Project Number WP-117
Hole Number GT-58P

Project: Geotechnical Investigation Phase II
Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
29									Begin Coring 29.5
	11 min/ft	NQ-1 2.0/5.2	?	1	.7/5.2		Open, Spun		29.5-41.6 LIMESTONE, slightly to moderately argillaceous, very pale brown (10YR 7/3) with occasional chert nodules (white) and minor interbedded chert. Limestone is medium crystalline, slightly to moderately weathered, hard, slightly stylolitic and fossiliferous with FeOx pseudomorphs in matrix. Also is thinly bedded with occasional MnOx dendrites. Chert is very hard, fossiliferous, fractured with MnOx and FeOx stain.
30	100% return		30.0				Tight, Spun		
	8 min/ft	38%			13%		Open, rough		
					2 > 4 L.P. = 4"				
31	100% return								
	12 min/ft								
32	Lost Water 31.8'						Rubble		
	10 min/ft		32.0 ? ? 32.7			> 6	Stylolite Open, Spun		
							Open, Spun		
33	0 return								
	19 min/ft						Open, Spun		
			33.2 ?			> 6	Open,rough Rubble		
34	0 return		34.0						Void from 34.0'-35.0'.
	Drilled very soft 1 min/ft					> 6			
6/22 6/23 35		35.2							
	Not advancing, pull core barrel	NQ-2 2.3/3.0		1	1.1/3.0				
36	24 min/ft		35.7		37%		Rubble		

*Munsell Color Chart for all colors.

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 7

Project Number: WP-117

Hole Number: GT-58P

Project: Geotechnical Investigation Phase II

Location:

Depth	Comments: Tests/Monitoring, Instrumentation, Coring Rate and Smoothness, Coring Fluid Loss, Contamination	Core Run Length and Recovery (%)	Core Loss Zone	Box Number	RQD	Fractures Per Foot	Discontinuities: Description, Tightness, Planarity, Smoothness, Filling, Staining, Orientation	Graphic Log	Lithology: Mineralogy, Classification, Color, Grain Size, Alteration; Cementation, Hardness, Weathered State
36	17 min/ft	64%	36.2	1	3 > 4 L.P. = .4	5	Open, Spun Open, Rough Open, Spun (2)		LIMESTONE, as above, 40% chert (white) as nodules from 36.4'-38.2'. Chert has abundant pyrite blebs oriented along bedding with oxidation halos.
37	0% return						Open, Rough Stylolitic, FeOx clay		
	11 min/ft					4	Open, Spun		
38	0% return						Open, Stylolitic Spun		
	17 min/ft	38.2 NQ-3 .8/.8		1	.5/.8 62% L.P. = .5'	> 6	Open, Spun Rubble		38.2' LIMESTONE, becomes more massive, slightly weathered, recrystallized, hard to very hard.
39	Blocked off	100%					Open, Spun		
	31 min/ft	NQ-4 .9/1.0	39.5	1	.5/1.0 50% L.P. = .5'	> 6	Open, Spun Open, Rough (2)		
6/23 6/26	Pulled bit and changed		39.7						
6/26 6/27	Roller-bit drilled to →	90% 40.3							
41	Very slow coring	NQ-5 1.9/1.9 100%			.6/1.9 32% L.P. = .6	3	Tight, Rough Open, Rough, FeOx clay (3)		Interbedding of chert 40.8'-41.3'.
	16 min/ft					4			
42					1 > 4"		Open, Rough, FeOx clay Open, Smooth (2)		41.6-42.6 CHERT, mottled white (10YR 8/1) and light yellowish brown (10YR 6/4). Very hard, fractured (healed) minor MnOx stringers, very slightly weathered, vuggy at contact with limestone (FeOx).
	54 min/ft	42.2 NQ-6 1.4/1.8 77%	42.7	1	.7/1.8 39%	> 6	Open, Rough FeOx vuggy Open, Rough, vuggy (2) Open, Rough, FeOx (2)		
43									42.6-43.2 LIMESTONE, as above.

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 7

Project Number: WP-117

Hole Number: GT-58P

Project: Geotechnical Investigation Phase II

Location:

Date	Depth	Comments: Tests/Monitoring, Instrumentation, Coring Rate and Smoothness, Coring Fluid Loss, Contamination	Core Run Length and Recovery (%)	Core Loss Zone	Box Number	RQD	Fractures Per Foot	Discontinuities: Description, Tightness, Planarity, Smoothness, Filling, Staining, Orientation	Graphic Log	Lithology: Mineralogy, Classification, Color, Grain Size, Alteration; Cementation, Hardness, Weathered State
6/27	43	32 min/ft	NQ-6 cont'd 4.32		1 2	L.P. = .4 2 > 4"	> 6	Open, rough, FeOx Open, rough, FeOx spun Open, rough, FeOx		43.2-44.0 CHERT, as above with interbedded limestone (as above) from 43.4-43.6.
6/28	44	0 return								44.0-60.9 CHERT (65%) and ARGILLACEOUS LIMESTONE (35%) INTERBEDDED, chert is mottled white (7.5YR N8/) grading to very pale brown (10YR 8/3), cryptocrystalline, very slightly weathered, very hard, fractured (healed) nodular to lenticular, with FeOx stain and MnOx fracture filling. Limestone is argillaceous, very pale brown (10YR 7/4) slightly to severely weathered, soft to hard, vuggy and solutioned vugs pinpoint to .5' (53.0-53.5), with abundant MnOx specks in matrix and FeOx staining (abundant on fractures and vugs). Calcite filling in small vertical fractures at 51.5'. Limestone more competent at 52.0'.
		32 min/ft	NQ-7 9.5/10.0 95%		2	6.8/10.0 68%	2	Open, rough, FeOx		
	45	23 min/ft				L.P. = 1.2 12 > 4"	6	Open, rough, FeOx weathered Open, spun Open, rough, FeOx clay, rubbly (3) Open, rough, FeOx		
	46	24 min/ft					3	Open 2mm, rough, vuggy FeOx clay Tight, rough, FeOx vuggy		
	47	17 min/ft					3	Tight, rough, FeOx Tight, smooth, FeOx Open, rough, FeOx clay (2)		
	48	18 min/ft					2	Open, rough, vuggy, FeOx (2)		
	49	21 min/ft					2	Open(3mm) rough FeOx clay, vuggy		
	50									

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 7
Project Number: WP-117
Hole Number: GT-58P

Project: Geotechnical Investigation Phase II
Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
50	21 min/ft	NQ-7 contd				2	Open, rough, FeOx vuggy Open 11mm, rough vuggy, FeOx clay		CHERT AND LIMESTONE, as above; 50% chert, 50% argillaceous limestone.
51	32 min/ft					3	Open 3mm, rough, FeOx vuggy Open 3mm, rough, FeOx, calc. veins Tight, rough, FeOx clay, vuggy		
52	31 min/ft					1	Open, rough, vuggy FeOx clay		
53	Dropped 5" 18 min/ft		530 535			>6	Open, rough, FeOx Cavity Open, rough, vuggy FeOx		Possible void from 53.0' to 53.5'.
54	34 min/ft	NQ-8 5.4/6.9 78%			2.9/6.9 42%	1	Open, rough vuggy		
55	22 min/ft		551		L.P. = .7		Open, spun		
56	20 min/ft		566		>6 .4"		Chert rubble		56.6'-58.3' Very weathered and solutioned.
57									

6/28
6/29

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 7
Project Number: WP-117
Hole Number: GT-58P

Project: Geotechnical Investigation Phase II
Location:

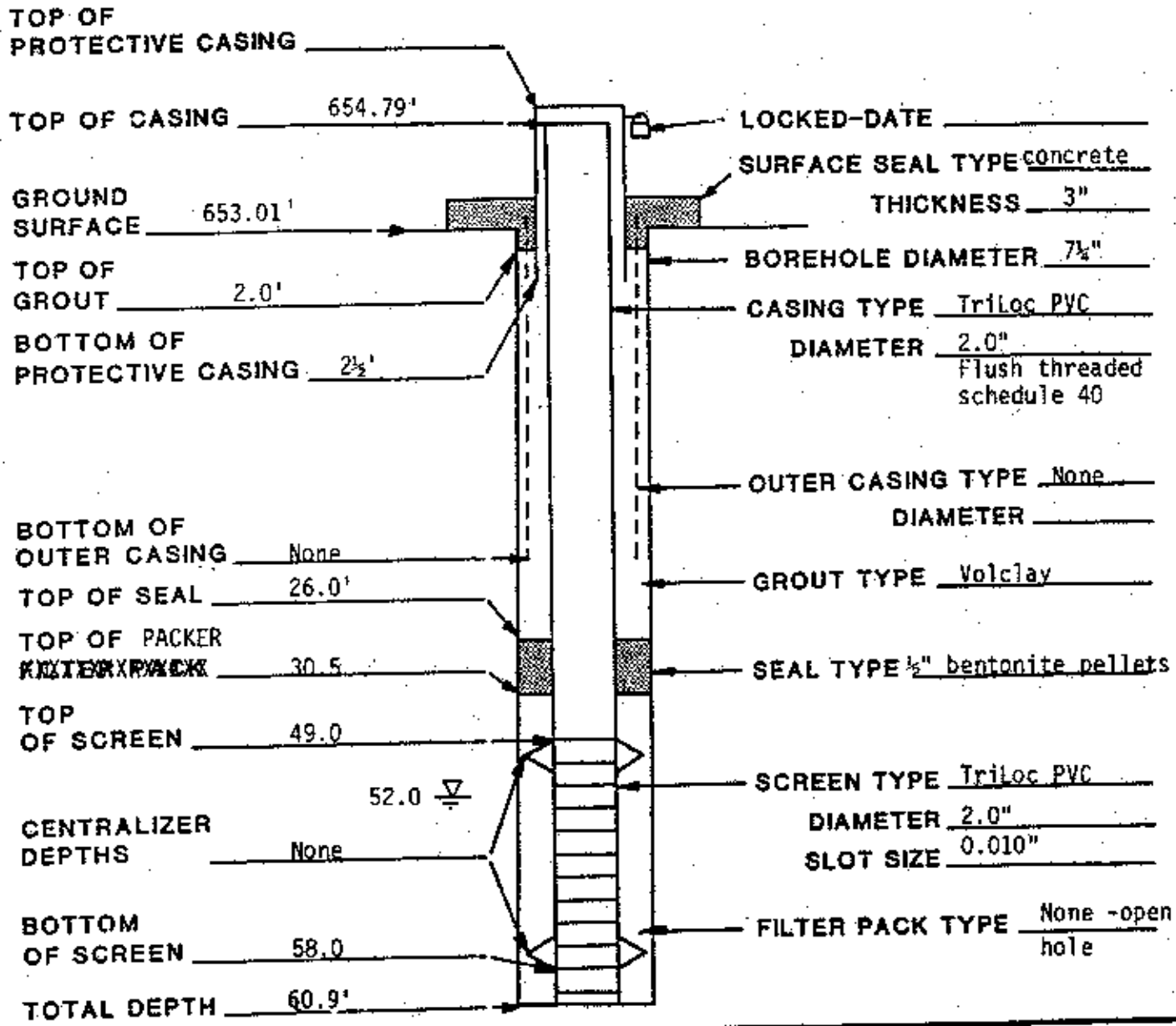
DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
57	18 min/ft					4	Open, rough, rubbly FeOx clay (2) Open,rough, FeOx (2)		CHERT AND LIMESTONE, as above.
6/29 6/30 58	38 min/ft					2	Tight, rough Tight,rough,vuggy Open, rough		
59	17 min/ft					> 6	Rubble with clay FeOx		59.3'-59.8' Rubblized, very weathered.
60						4	Tight,rough,FeOx Open, rough, FeOx clay Tight,rough Mechanical		60.9
61									T.D. at 11:20 A.M. 6/30/89 Installed piezometer consisting of 2" PVC screened from 49.0-58.0', with 0.01" slots.
62									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

XXWELL COMPLETION RECORD (PIEZOMETER)

WELL NUMBER GT-58P DATE INSTALLED 7/11/89

PMC REPRESENTATIVE Alan Benfer DRILLER Tom Clay, Hannibal



COMMENTS All depths below ground surface 2-5/8" - 4". PVC reducer placed at top of core hole at 30.5' to serve as packer. Hole diameter 7¾" 0-29.5'; 2.98" (NO) 29.5' to 60.9' (T.D.) Cuttings from 59.0' to 60.9'.

PMC REPRESENTATIVE SIGNATURE J. Alan Benfer DATE 7/11/89

J. Alan Benfer

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 2
Project Number: 5121 WP-117
Hole Number: GT-59

Project: Geotechnical Investigation Phase II	Location: Disposal Cell, NW(AEC) Cor. Bldg. 408
Coordinates: N. 99905.72 W.49963.81 (AEC)	Drilling Contractor: Hannibal Testing Labs
Drill Make and Model: CME-55, H.S. Auger, 6-7/8" O.D.; 3¼" I.D.	Depth Top of Rock: 27.0' / Depth Casing & Size: none / Hole Size: 6-7/8"
Elevation: G.S. 657.00'	Angle from Vert. and Bearing: Vertical / Depth Bottom of Hole: 27.0'
Water Level: none	Fluid & Additives: none / Date Start: 2:00 6/15/89 / Date Finish: 6/16/89 / Logger: A. Benfer

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	0						SILTY CLAY, low plasticity, yellowish brown(10YR 5/6), moist(stiff), CL. Contains angular limestone fragments. FILL
		2.5 4.0	SS 01	17"	2-3-4 7		SILTY CLAY, medium plasticity, mottled strong brown (7.5YR 5/6) and light gray(10YR 7/1), moist, stiff (1.5) CL. Strong FeOx, minor MnOx. FERRELVIEW
	5	5.0 7.5	ST 02	29"			As above, pp=1.5, very moist.
		7.5 9.0	SS 03	18"	1-3-5 8		As above, pp=2.0, stiff to very stiff, increased MnOx.
	10	10.0 12.5	ST 04	24"			CLAY, highly plastic, mottled yellowish brown (10YR 6/6) and light gray(10YR 7/1), moist, stiff to very stiff(2.0), CH, at 12.5' contains 5% white fine to coarse sand and trace fine gravel, minor MnOx. 13.0
		12.5 14.0	SS 05	18"	2-3-5 8		CLAY, high plasticity, 10% sand, 5% fine angular to subrounded gravel, mottled yellowish brown(10YR 6/8) and light gray(10YR 7/1), moist, very stiff(3.0) CH. Slickensided, MnOx stringers, minor FeOx. CLAY TILL
	15	15.0 17.5	ST 06	31"			As above, pp=3.5, gravel up to ½".
		17.5 19.0	SS 07	16"	3-4-6 10		As above, pp=3.5, minor spherical FeOx nodules.
	20	20.0 22.5	ST 08	28"			As above, pp=4.5+, hard, mottled yellowish red(5YR 5/8) and light gray(10YR 7/1), fractured, open 1/16", MnOx coated, 10% sand, CH.
		22.5 24.0	SS 09	18"	3-6-9 15		As above, pp=3.5, very stiff, slickensides coated with MnOx and light gray clay, 1/16" spherical FeOx.
	25						

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 2

Project Number: 5121 WP-117

Hole Number: GT-59

Project: Geotechnical Investigation Phase II

Location:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol	
	25	25.0 26.5	SB 10		11-32-26 58		26.0 As above, spherical MnOx nodules.	26.0
							GRAVEL, CHERT, light gray(10YR 7/1) with yellowish brown(10YR 5/6) weathering rind; 20% clay, yellowish brown(10YR 6/6), very plastic, moist, dense. GC, 2" chert clast in tip. RESIDUUM	

T.D. 27.0' Auger refusal at 9:45, 6/16/89. Hole grouted with Volclay.

Note: Constant head test at 22.5'.
Take = 1.5 oz. in 10 minutes.

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 5
Project Number: 5121 WP-117
Hole Number: GT-60P

Project: Geotechnical Investigation Phase II	Location: SW Corner Building 105
Coordinates: N.100388.44 W.50260.36 (AEC)	Drilling Contractor: Hannibal Testing Labs

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55, H.S. Auger 7-1/4 O.D.; 4¼" I.D.; NO Wireline Core	48.75'	Augers to 58'	7-1/4/2.98"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
G.S. 660.60'; T.O.C. 662.11'	Vertical	67.5'

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
7/24/89 57.01' b.g.s.	Clear Water	8:35 7/12/89	3:30 7/19/89	A. Benfer

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0				Auger		8" Concrete
							SILTY CLAY, medium plasticity, yellowish brown (10YR 5/4), moist, stiff, CL
	5	5.0 6.5	SS 01	10"	1-2-2 4		CLAY, highly plastic, mottled yellowish brown(10YR 6/6) and light gray(10YR 7/1), moist, medium stiff to stiff(1.0), CH. Contains minor MnOx and trace fine gravel.
		7.5 10.0	ST 02	24"			FERRELVIEW CLAY, as above, very stiff(2.5), considerable FeOx, no gravel, CH, sampler wet.
	10	10.0 11.5	SS 03	17"	2-4-5 9		CLAY, as above, (3.0), CH. Perched water from leaking utilities.
		12.5 15.0	ST 04	33"			CLAY, as above, (2.2), MnOx stringers along slickensides. Mostly yellow(10YR 7/2), CH.
	15	15.0 16.5	SS 05	18"	2-4-6 10		CLAY, as above, (2.5), yellow(2.5Y 7/2), minor yellowish brown(10YR 5/6), minor MnOx, slickensided, CH.
		17.5 20.0	ST 06	29"			CLAY, as above, (3.75), CH.
	20	20.0 21.5	SS 07	12"	1-2-5 7		CLAY, as above, (3.75), CH, one ½" granite rock fragment, minor FeOx. ~23.0'
	25	22.5 25.0	ST 08	25"			CLAY, high plasticity, 15% sand, mottled yellowish brown(10YR 5/8) and light gray(10YR 7/1), damp, very stiff(3.5), CH, minor MnOx, trace fine gravel.

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 5
Project Number: 5121 WP-117
Hole Number: GT-60P

Project: Geotechnical Investigation Phase II
Location:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25	25.0 26.5	SS 09	18"	6-6-9 15		CLAY, as above (3.5).
							CLAY TILL
		27.5 30.0	ST 10	30"			CLAY, as above (3.25), slight increase in gravel. Tube tip slightly bent.
	30	30.0 31.5	SS 11	18"	3-5-6 11		CLAY, medium plasticity, 20% sand, minor gravel, some decomposed, yellowish brown(10YR 5/6) with light gray(10YR 7/1) stringers, moist, very stiff(2.2), CL-CH, MnOx stringers and FeOx.
		32.5 34.0	SB 12	12"	5-12-21 33		CLAY, as above, hard (4.0), increase in gravel at 34.0'
	35	35.0 36.5	SS 13	18"	4-7-10 17		CLAY, as above, very stiff (3.0), minor subrounded gravel up to ¼".
7/12 7/13							37.5
		37.5 39.0	SS 14	18"	5-8-10 18		SILT, low plasticity, gray(10YR 6/2), minor FeOx, moist, stiff to very stiff (2.0), ML.
	40						CLAY TILL?
		40.0 41.5	SB 15	12"	9-13-19 32		SILT, as above, with MnOx (black) and spherical FeOx weathered nodules (yellowish brown), very stiff (3.0).
	45						
		45.0 46.5	SS 16	12"	20-17-15 32		GRAVEL, 30% clay, up to 1", predominately chert, brownish yellow(10YR 6/6) with MnOx, moist, dense, GC.
		47.5 49.0	SB 17	6"	21-29-24		BASAL TILL?
							48.75
	50						Weathered CHERT and LIMESTONE, clayey, highly fractured, brownish yellow(10YR 6/6) and light gray (10YR 7/1), moist, dense.
		52.5 54.0	SS 18	8"	5-9-23		Weathered bedrock as above.
	55						

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 5

Project Number: 5121 WP-117

Hole Number: GT-60P

Project: Geotechnical Investigation Phase II

Location:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	55						
							Auger refusal at 58.0' at 11:20, 7/13/89. Cored from 58.0-67.5'. Core description, pages 4-5.

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 5
Project Number: 5121 WP-117
Hole Number: GT-60P

Project: Geotechnical Investigation Phase II
Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
58		58.0							Begin Coring 58.0
	14 min/ft	NQ-1 1.0/1.0 100%		1	.63/1.0 63%	5	Rough,open,spun; Tight (2)		58.0-61.6 Approximately 50% LIMESTONE, 50% CHERT, limestone grayish orange(10YR 7/4) to moderate yellowish brown (10YR 5/4).
59	75% water return		59.0		2 > 4"				58.8-59.0, 59.7 Oxidized pyrite.
	12 min/ft	NQ-2 1.9/2.1	59.1		1.1/2.1 52%	4	Rough, open ¼" (2); Rough, open ½", spun		59.4-59.8 CHERT, very light gray(N8).
60	100% water return	100%			L.P. = 0.65	3	Rough, open 1"; Rough, open ½"; Mechanical (2)		60.4-61.1 Argillaceous LIMESTONE with CHERT NQ-1, NQ-2 slightly weathered, no vugs, joints weathered, recut core 59' to 60.4'.
	24 min/ft				2 > 4"				
61	100% water return	61.1							61.1-62.0 Mostly CHERT with MARBLY LIMESTONE which is eroded 1/8" deep, dark yellowish orange(10YR 6/6), weathered, CHERT medium light gray (N6).
	34 min/ft	NQ-3 6.5/6.4			4.8/6.5 74%	4	Rough, open 1/8"; Rough, open ¼", (2)		
62	100% water return	101%			L.P. = 1.2		Rough, open ½", (2)		62.0-62.4 Predominately CHERT.
	22 min/ft				6 > 4"	2			62.4-63.3 Mostly LIMESTONE, maybe dolomitic, low HCL react, slightly weathered.
63	100% water return								62.9 Stylolite

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 5
Project Number: 5121 WP-117
Hole Number: GT-60P

Project: Geotechnical Investigation Phase II
Location:

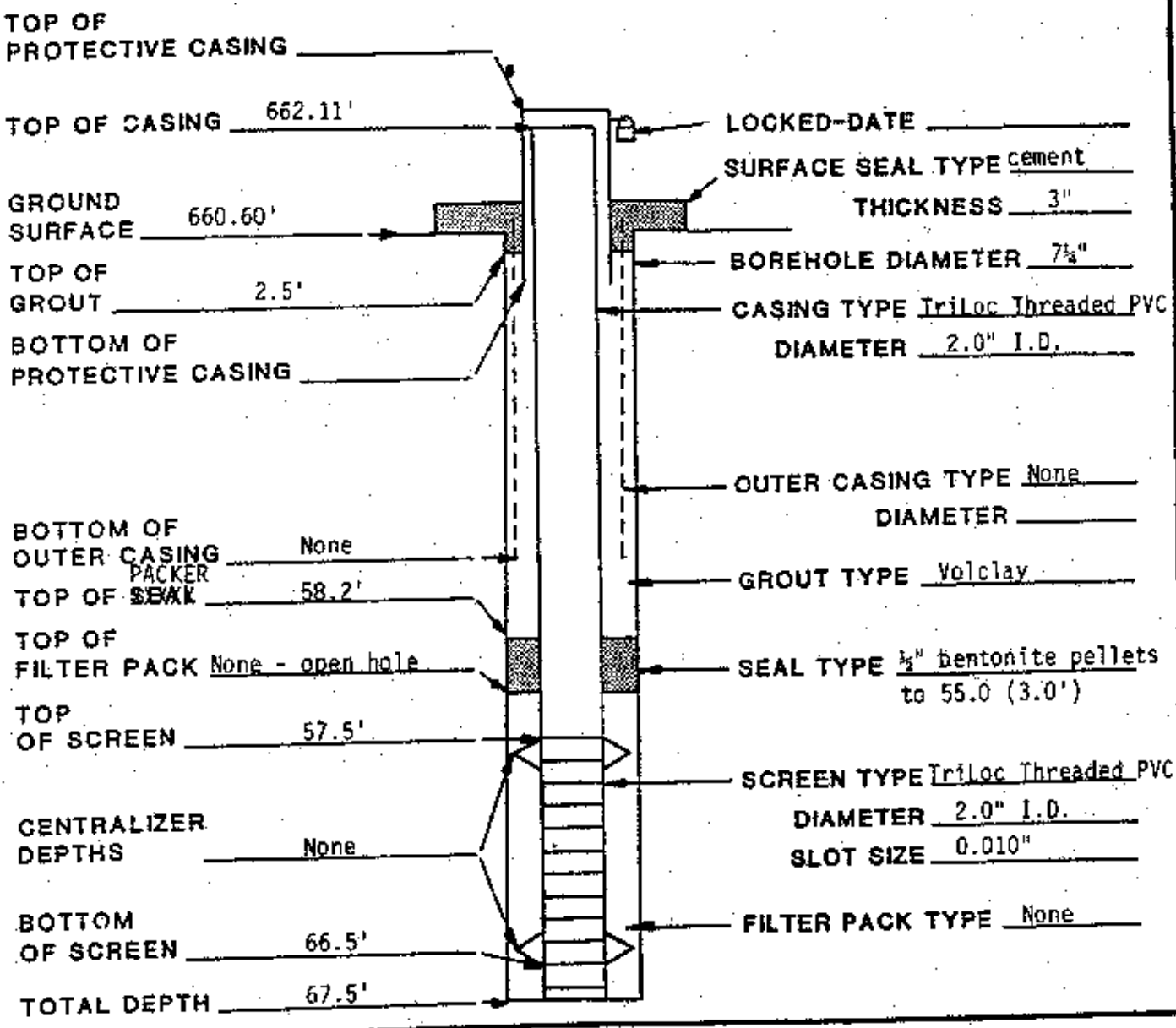
DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
63	27 min/ft					4	Vertical in chert tight to open 1/8", smooth		63.3-64.5 Bluish CHERT, fossiliferous, fresh.
64	100% return						Rough, open 1/8"		
	29 min/ft					4	Tight, mechanical (2)		64.2 Pyritic
							Rough, open 1/8"		64.5-67.5 Approximately 50% CHERT, medium light gray(N6) and 50% dolomitic LIMESTONE, grayish orange(10YR 7/4), intermixed.
65	100% return						Tight, mechanical		
	25 min/ft					1	Rough, open ¼"		
66	100% return						Tight		
	20 min/ft					2	Rough, open ¼"		LIMESTONE solution 1/8" deep at 66.8 and 67.1 to 67.4.
67	100% return								
	17 min/ft 100% return								Overall rock quality NQ-3 fairly good.
68									T.D. 67.5' at 3:30, 7/19/89. Installed piezometer, see attached completion record.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

PIEZOMETER ~~WELL~~ COMPLETION RECORD

WELL NUMBER GT-60P DATE INSTALLED 7/20/89, 7/21/89

PMC REPRESENTATIVE Alan Benfer DRILLER Tom Clay, Hannibal Testing



COMMENTS All depths below ground surface. 2-5/8"-4" PVC reducer placed 58.2' to 58.5' to serve as packer in top of core hole. Hole diameter 7¼" 0-58.0'; 2.98" (NQ) 58.0-67.5'.

PMC REPRESENTATIVE SIGNATURE J. Alan Benfer DATE 7/21/89

J. Alan Benfer

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 3

Project Number: WP-117

Hole Number: GT-61

Project: Geotechnical Investigation Phase II	Location: Chemical Plant Area, approximately 100' west of building 401
Coordinates: N.100609.25 W.50679.21 (AEC)	Drilling Contractor: Hannibal Testing Labs

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME 55, 6 7/8" O.D. H.S. Auger, 3½" I.D.	59.5	59.5 7" Auger	7¼"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
G.S. 658.13'	Vertical	59.5

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
None	None	6/20/89	6/21/89	P. Patchin

Elevation	Depth Below Surface	Sample Interval	Sample Type & Number	Recovery	Standard Penetration Test Results 6"-6"-6" (N)	Symbolic Log	Soil Description (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0				Augered		0-2.0 Road base rockfill (limestone gravel) FILL 2.0
		2.5 4.0	SS 01	17"	3-3-4 7		CLAYEY SILT, nonplastic, mottled yellowish brown (10YR 5/4) and very dark grayish brown (10YR 3/2), damp, FeOx and MnOx blebs abundant, (20% clay), siltier at top, stiff (1.75), ML LOESS 5.0
	5	5.0 7.5	ST 02	17"			CLAY, highly plastic, mottled yellowish brown (10YR 5/4) and light gray (10YR 7/2), damp to moist, minor FeOx blebs, stiff (1.5), CH FERRELVIEW
		7.5 9.0	SS 03	18"	2-3-3 6		CLAY, as above, slightly siltier, pp=1.5, CH with whitish concretion (1cm), no HCl reaction 10.5
	10	10.0 12.5	ST 04	29"			CLAY, as above, increased light gray (10YR 7/2), MnOx stringers and FeOx blebs, pp=2.0, minor fractures, CH FERRELVIEW
		12.5 14.0	SS 05	18"	2-3-5 8		CLAY, as above, minor very fine gravel <5% slickensides, increased yellowish brown color, pp=2.5, CH
	15	15.0 17.5	ST 06	29"			SILTY CLAY, slightly plastic, sandy(5%) very fine, mottled yellowish brown (10YR 5/8) and minor light gray (10YR 7/2)(sand), dry to damp, fine gravel(quartz and chert) subangular to subrounded, MnOx stringers abundant, FeOx blebs, hard (4.25), CL
		17.5 19.0	SS 07	18"	3-6-8 14		SILTY CLAY, as above with predominant yellowish brown (10YR 5/8), 10% gravel fine to 1 cm, dry, subrounded mafic gravel, hard (>4.5), 5 mm FeOx blebs, CL
	20	20.0 22.5	ST 08	26"			SILTY CLAY, as above, pp=4.5 CLAY TILL
		22.5 24.0	SS 09	18"	3-5-9 14		SILTY CLAY, as above, some vertical fractures with leaching, damp to dry, abundant MnOx, some mottling, pp=4.5
	25						Sample ST10 on next page

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 3

Project Number: WP-117

Hole Number: GT-61

Project: Geotechnical Investigation Phase II

Location:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25	25.0 27.5	ST 10	30"			SILTY CLAY, as above, increased sand (very fine)(20%), minor gravel fine to very fine, dry, pp > 4.5, non-plastic, vertical fractures with leaching, CL
		27.5 29.0	SS 11	18"	4-8-11 19		SILTY CLAY, as above, very silty and sandy (40%), grading to CLAYEY SILT at bottom, vertical fractures leached to light olive gray (5Y 6/2), pp=4.5, dry CL-ML CLAY TILL 30.0
	30	30.0 31.6	ST 12	20"	20		SILTY SAND, very fine grained, brownish yellow (10YR 6/8) dry, hard(>4.5) MnOx streaks, no gravel, SM. CLAY TILL?
6/20		32.5 34.0	SS 13	16"	4-7-7 14		SILTY SANDY CLAY with 10% fine gravel, slightly plastic, damp to moist, yellowish brown(10YR 5/8), with abundant vertical fractures stained with MnOx and leached, very stiff(3.75) CL CLAY TILL
	35	35.0 36.5	SB 14	6"	36-50-45 50		GRAVELLY SAND fine grained, dry to damp, brownish yellow(10YR 6/8). Gravel is coarse grained($CaCO_3$ cemented SS(10%)), very dense, SW. CLAY TILL(BASAL TILL?)
		37.5 39.0	SS 15	18"	4-6-7 17		Interbedded CLAY, SILT and SAND, mottled yellowish brown(10YR 5/8) and light gray(5Y 7/1). 60% clay is dry to damp slightly plastic with abundant MnOx stringers, vertical fractures, sand is in pockets fine to medium grained(gray), only minor very fine gravel, FeOx nodules, CL
	40	40.0 41.5	SB 16	12"	7-10-18 28		As above, more clay(75%), abundant FeOx nodules, damp to dry, minor fine gravel, CL CLAY TILL 42.5
							CLAY TILL?
	45	45.0 46.5	SS 17	18"	8-10-11 21		CLAYEY SILT, mottled light gray(2.5Y 7/2)and yellowish brown(10YR 5/8) with 3cm microcrystalline, angular limestone gravel piece at 42.7'. Silt is nonplastic, damp, with abundant MnOx stringers and FeOx stain, very clayey at top, very stiff(2.5) CL
							BASAL TILL?
	50	50.0 51.5	SB 18	12"	3-36-40 50		GRAVELLY SILT, as above with 30% subangular chert gravel, silt is clayey, light gray(10YR 7/2) with FeOx mottling, damp to dry, dense ML
	*						RESIDUUM
							See next page for sample SS19 description.

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 3

Project Number: WP-117

Hole Number: GT-61

Project: Geotechnical Investigation Phase II

Location:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	55	55.0 56.5	SS 19	7"	6-7-8 15		CLAYEY GRAVEL, brownish yellow(10YR 6/8) with poorly sorted subangular chert gravel, fine to 4 cm with MnOx dendrites, some very coarse sand (fine gravel) and minor silt, damp to moist, GC RESIDUUM Auger refusal 59.5
	60						Top of bedrock at 12:55 p.m. 6/21/89 Borehole grouted to surface with Volclay bentonite grout. *Falling Head Test at 51.5', take = 48 oz/10 min After pulling drill pipe determined rock piece at end of pipe. Pipe may have not been seated properly.

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 2

Project Number: WP-117

Hole Number: GT-62

Project: Geotechnical Investigation Phase II	Location: Disposal Cell: Adjacent to the N.E. of Building 412
Coordinates: N.10062.40 W. 50630.89 (AEC)	Drilling Contractor: Hannibal Testing Labs
Drill Make and Model: CME 55; 6 7/8" O.D. Hollow Stem Auger; 3¼" I.D.	Depth Top of Rock: 43.5' / Depth Casing & Size: none / Hole Size: 6-7/8"
Elevation: G. S. 657.33'	Angle from Vert. and Bearing: Vertical / Depth Bottom of Hole: 43.5'
Water Level: 12.7' 10:32a.m. 6/19/89	Fluid & Additives: None / Date Start: 6/19/89 / Date Finish: 6/20/89 / Logger: P. Patchin

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0				Augered		CLAYEY SILT, upper 1' topsoil with roots, organics. Very dark grayish orange (10YR 3/2) then dark yellowish brown (10YR 4/4), damp, nonplastic, 20% clay, ML.
		2.5 5.0	ST 01	24"			SILTY CLAY, slightly plastic, mottled olive gray (5YR 5/2) and dark grayish brown (2.5YR 5/2), with 10% limestone gravel, damp, very stiff, CL FILL
	5	5.0 6.5	SS 02	12"	2-4-4 8		SILTY CLAY, as above, minor FeOx, pp=2.0, CL
		7.5 10.0	ST 03	12"			SILTY CLAY, as above, moderate plasticity, increased clay, moist, pp=1.0, CL FILL
	10	10.0 11.5	SS 04	18"	1-2-2 4		SILTY CLAY, as above, increased silt (30%), dark gray (5Y 4/1), moist to wet, minor FeOx nodule, pp=.25
12.7	▽	12.5 15.0	ST 05	25"			CLAYEY SILT, slightly plastic, mottled dark gray with minor olive gray (5Y 5/2), wet, loose, soft (.5) ML FILL
	15	15.0 16.5	SS 06	7"	1-1-4 5		CLAYEY SILT, as above, pp=.25
		17.5 20.0	ST 07	26"			SILTY CLAY, moderate plasticity, ~25% silt, minor fine gravel < 5%, mottled light gray (5Y 7/2) with minor brownish yellow (10YR 6/8), damp, very stiff (2.0), minor MnOx streaks, CL-CH FERRELVIEW
	20	20.0 21.5	SS 08	18"	1-2-4 6		SILTY CLAY, as above, pp=2.5, with slickensides, CH, with large chert piece (2cm) subrounded
	25	22.5 25.0	ST 09	25"			SILTY CLAY, as above, with 15% fine to coarse (2cm) chert gravel, minor sand, pp=3.75, gravel subangular, damp, CL-CH, only minor FeOx, minor mafic gravel CLAY TILL?

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 2

Project Number: WP-117

Hole Number: GT-62

Project: Geotechnical Investigation Phase II

Location:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25	25.0 26.5	SS 10	17"	2-3-11 14		SILTY CLAY, as above, 15-20% fine gravel, sandy (coarse), increased MnOx streak, slight plasticity, damp, CL-CH CLAY TILL
		27.5 29.5	ST 11	Push 24" 24"			CLAY, gravelly, 10% fine chert gravel, slight plasticity, mottled yellowish brown (10YR 5/8) with minor light gray (10YR 7/2), damp, hard(4.5), abundant MnOx streaks and FeOx blebs, CL. CLAY TILL
	30	30.0 31.5	SS 12	8"	4-6-9 15		CLAY, as above, with slickensides, and vertical fractures with MnOx deposition, pp=3.5, blocky, CL 32.6
		32.5 33.3	SB 13	6"	24-76 74.5"		CLAYEY GRAVEL, dry to damp, gravel very fractured and angular, dark yellowish brown (10YR 4/4), interstitial clay (15%) is reddish brown (10YR 4/3), blocky, damp, w/silty highly FeOx stnd dcompsd rock, GC BASAL TILL?
	35	35.0 36.5	SS 14	12"	25-37-13 50		SILTY GRAVEL, white(10YR 8/2), very angular chert gravel (chards) with "rock flour silt" (30%), very dry, very minor clay, GM BASAL TILL 37.0
		37.5 39.0	SB 15	12"	17-21-25 47		CLAYEY GRAVEL, strong brown (7.5YR 5/6) grading to mottled yellowish brown (10YR 5/8) and light gray (2/5Y 7/2), gravel is white chert with MnOx staining & wthrng rinds, subangular to 3cm, clay(30%) is slightly to mod. plastic w/ abund MnOx, damp, GC RESIDUUM
	40	40.0 41.5	SS 16	13"	8-15-22 37		CLAYEY GRAVEL, as above, increased gravel (90%), clay as above, some rock flour with very minor HCL reaction, clay is moist, GC RESIDUUM
		43.5					Auger Refusal 43.5

at 3:35 p.m. 6/19/89

Hole grouted to surface with Volclay bentonite grout

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 4

Project Number: WP-117

Hole Number: GT-63P

Project: Geotechnical Investigation Phase II	Location: Approx. 200' S. of Raffinate pit #4
Coordinates: N. 98626.12 W. 51471.98	Drilling Contractor: Hannibal Testing Labs
Drill Make and Model: CME-55, 7-1/4" O.D. 4½" I.D. H.S. Auger, 2.98" core bit	Depth Top of Rock: 45.5'
Depth Casing & Size: 45.5', 4½" I.D.	Hole Size: 7¼" to 38.5 then 4.0"
Elevation: G.S. 656.86'; T.O.C. 658.92'	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 51.0'	
Water Level: 7/28/89 41.54' b.g.s.	Fluid & Additives: Water
Date Start: 7/24/89	Date Finish: 7/28/89
Logger: P. Patchin	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0				Auger		0-1.0 TOPSOIL, dark brown (10YR 3/3), with roots organics. 1.0-2.5 CLAYEY SILT, brown (10YR 5/3), ML
		2.5 5.0	ST 01	29"			CLAYEY SILT, ~30% clay, slightly to non-plastic, mottled dark grayish brown (10YR 4/2) and yellowish red (5YR 5/6), damp, MnOx blebs (black), stiff, ML
	5	5.0 6.5	SS 02	12"	3-4-4 8		FERRELVIEW SILTY CLAY, slightly plastic, mottled light brownish gray (2.5YR 6/2) and yellowish brown (10YR 5/6), ~40% silt, damp, very stiff (2.75), FeOx blebs, CL
		7.5 10.0	ST 03	27"			FERRELVIEW SILT, slightly clayey, nonplastic, brownish yellow (10YR 6/6), damp to dry, ~10% clay, minor FeOx, very stiff (3.25), ML
	10	10.0 11.5	SS 04	17"	3-4-6 10		FERRELVIEW CLAYEY SILT, as above with increased clay (~30%), very abundant, FeOx (strong brown-7.5YR 5/8) MnOx, large FeOx nodules (2mm), damp, very stiff (2.0), ML-CL
		12.5 15.0	ST 05	28"			CLAY, highly plastic, mottled light gray (2.5YR 7/2) and brownish yellow (10YR 6/8), with ~5% subrounded fine gravel to 3mm, damp to moist, MnOx streaks and FeOx blebs (sporadic), very stiff (2.5), CL 15.5
	15	15.0 16.5	SS 06	18"	3-4-6 10		As above with increase in fine gravel (some mafic) 5-10%, silt, and MnOx fracture filling, damp, pp=2.75, CL-CH
		17.5 20.0	ST 07	30"			CLAY TILL As above, dry to damp, less mottling, sandy (fine) pockets (5%), horizontal and vertical fractures with MnOx and FeOx blebs abundant, pp=3.75, CL
	20	20.0 21.5	SS 08	18"	4-6-7 13		As above, gravel to 1 cm, fractures with leaching, pp=3.0, CL
		22.5 25.0	ST 09	27.5"			As above, yellowish brown (10YR 5/6) no mottling, sandy, dry, abundant fractures with leaching, slightly plastic, pp=4.5, CL
	25						

FERRELVIEW

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 4

Project Number: WP-117

Hole Number: GT-63P

Project: Geotechnical Investigation Phase II

Location:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25	25.0 26.5	SS 10	14"	6-12-12 24		SILTY CLAY, as above, lithographic limestone gravel to 2 cm from 25.8' to 26.0', increased FeOx stain, pp=3.75, dry, mottled, CL CLAY TILL
		27.5 29.0	SB 11	12"	5-9-12 21		CLAYEY SILT, Light gray (10YR 7/2) non-plastic, moist, no gravel, very stiff (2.25) minor FeOx blebs, ML
	30	30.0 31.5	SS 12	18"	4-7-7 14		As above with minor MnOx bleb, pp=3.0 CLAY TILL?
		32.5 34.0	SB 13	12"	5-12-14 26		SILTY CLAY, mottled, light yellowish brown (10YR 6/4) and strong brown (7.5YR 5/6) slightly plastic, dry to damp, very abundant FeOx blebs, very stiff (4.0) CL CLAY TILL
	35	35.0 36.5	SS 14	18"	10-15-17 32		35.0-36.5 GRAVELLY CLAY, ~40% angular chert gravel, silty, (rock flour), very abundant FeOx blebs, damp to dry, minor decomposed rock, clay is slightly plastic as above, minor red(2.5YR 4/6) angular chert gravel, predominately gray to white with MnOx inclusions, hard (4.0),CL RESIDUUM
		37.5 38.5	SB 15		10-68 refusal		37.5-38.5 As above, more leached light gray (2.5YR 7/2), pp>4.5, "soapy" clay. 39.0
	40						Auger refusal at 8:30 a.m. 7/25/89
							Cored from 38.0' to 51.0'. Description on pages 3 and 4.

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 4

Project Number: WP-117

Hole Number: GT-63P

Project: Geotechnical Investigation Phase II

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
39									Begin Coring 39.0'
	9 min/ft	NQ-1 .6 / 6.5'	39.31		0%				Determined top of rock was actually at 45.5'. Had false auger refusal at 39.0.' Auger drilled to 45.5' and resumed coring.
40	100% return	9%							
	16 min/ft								39.0-39.3' CHERT, mottled light gray (N7) and pale yellowish orange (10YR 8/6) hard, vuggy with MnOx streaks.
41	80% return								
	5 min/ft								
42	80% return								RESIDUUM?
	8 min/ft Bad rod slap								
43	90% return								
	18 min/ft								
44	90% return								44.4-45.3 SOFT
	4 min/ft Lost Water Soft								
45									

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 4

Project Number: WP-117

Hole Number: GT-63P

Project: Geotechnical Investigation Phase II

Location:

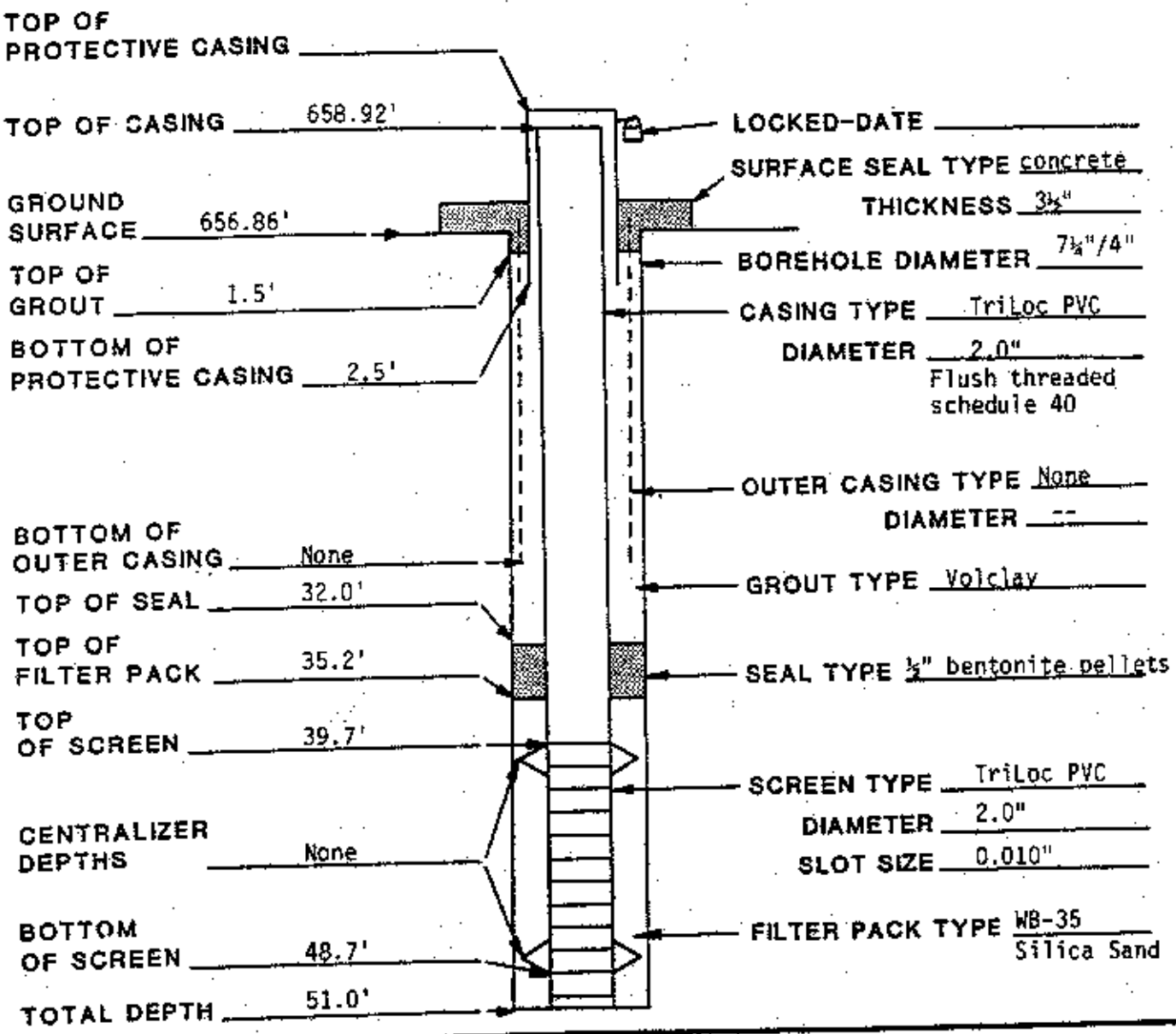
DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
VOID	22 min/ft			1					45.3-45.5' CHERT, highly fractured, very light gray(N8),very hard,slt. wthrd,FeOx on frac45.5
7/25	Regained water		45.3						
7/26									Auger Refusal at 45.5
		NQ-3		1	4.4/5.5				
46	80% return						Open,rough, FeOx		45.5-51.0' ARGILLACEOUS LIMESTONE, dark yellowish orange (10YR 6/6), silty, moderately weathered, medium to moderately hard, with abundant MnOx specks in matrix, occasionally vuggy, interbedded with 40-50% CHERT, very light gray (N8) to grayish orange (10YR 7/4), hard, fractured, (healed), with abundant MnOx infilling of fractures, fossiliferous, with minor hematite specks.
	12 min/ft	5.1/5.5			80%				
		93%			L.P. = .78 > 4"	2	Open,rough 1cm FeOx,minor clay		
47	90% return								
	14 min/ft						Open,rough,FeOx		
						3	Tight,rough,FeOx		
48	90% return						Open,rough,minor clay		
	14 min/ft								48.8-50.0' 60% CHERT
						3	Open,rough,minor clay		
							Open,rough,vuggy, rubbly		
49	95% return								
	9 min/ft						Tight,rough,30°		
						2			
50	95% return						Tight,smooth		
	6 min/ft								
			51.6			2	Open,rough (2)		51.3-51.6' Vuggy
51	95% return								T.D. 51.0'
									11:30 a.m. 7/26/89 Installed piezometer, see attached completion diagram.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

WELL COMPLETION RECORD

WELL NUMBER GT-63P DATE INSTALLED 7/27/89 - 7/28/89

PMC REPRESENTATIVE Paul Patchin DRILLER Tom Clay - Hannibal



COMMENTS All depths below ground surface. Reamed hole to 4" from top of rock at 45.5' to 51.0' T.D. prior to well installation. Sand pack from 51.0' to piezometer bottom at 49.7'.

PMC REPRESENTATIVE SIGNATURE Paul Patchin DATE 7/28/89

Paul Patchin

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 7

Project Number: WP-117

Hole Number: GT-64P

Project: Geotechnical Investigation Phase II	Location: 18 feet Southeast of MW-3006
Coordinates: N.100053.12 W.52053.34	Drilling Contractor: Hannibal Testing Labs
Drill Make and Model: CME-55, 7¼" O.D. 4½ I.D. H.S. Auger; 2.98" core bit	Depth Top of Rock: 22.0'
Depth Casing & Size: NW 22.2'	Hole Size: OVBD 7¼"/2.98"
Elevation: G.S. 640.85'; T.O.C. 643.09'	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 57.0'	Water Level:
Fluid & Additives: Water	Date Start: 7/28/89
Date Finish: 8/4/89	Logger: P. Patchin

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0				Auger		SILTY CLAY, very dark grayish brown(10YR 3/2) damp, with organics roots first .5" CL-ML FILL
		2.5 4.0	SS 01	8"	2-7-9 16		CLAYEY SILT, nonplastic, mottled light gray(2.5Y 7/2) and yellowish brown(10YR 5/6) dry, 10% clay, hard (>4.5) ML LOESS?
	5	5.0 7.5	ST 02	30"			SILTY CLAY, very silty, yellowish brown(10YR 5/4), nonplastic dry to damp, very stiff(4.0), with abundant FeOx(black) nodules to 4mm,CL FERRELVIEW
		7.5 9.0	SS 03	14"	3-5-6 11		CLAY, moderate to high plasticity, dark brown(10YR 4/3) damp, very stiff(3.25) minor FeOx nodules CL-CH FERRELVIEW
	10	10.0 12.5	ST 04	28"			CLAY, slightly silty, moderate plasticity with ~5% fine gravel to 3mm, mottled light brownish gray (2.5Y 5/2) and minor brownish yellow(10YR 6/6) mafic and chert subrounded gravel, very stiff(3.0), blocky dry CL-CH
		12.5 14.0	SS 05	18"	3-7-9 16		CLAY, as above, increased sand(5%) and silt(20%) and gravel(5-10%), vertical fractures with MnOx infilling, less blocky, pp=4.0, dry CL. CLAY TILL
	15	15.0 17.5	ST 06	27"			As above, no mottling, increased MnOx in fractures, gravel to 3cm (angular chert), pp=3.25, damp, CL
		17.5 19.0	SS 07	10"	7-12-11 23		SILTY CLAYEY GRAVEL, angular chert gravel to 2 cm, with weathering rinds, 5% clay (yellowish brown 10YR 5/6) and silt (rock flour) white (2.5Y 8/2) sandy loose matrix. BASAL TILL/RESIDUUM?
	20	20.0 21.5	SB 08		7-14-20 34		CLAYEY GRAVEL, lithographic L.S. to 6cm with wthrd chert 20% clay, lt brnsh gry(2.5Y 6.2) and strong brn (7.5YR 5/6) slightly plastic with MnOx and FeOx, GC. RESIDUUM 22.0
	25						Auger refusal at 22 ft, 3:25 p.m. 7/18/89 Cored from 22.0' to 57.0'. Core descriptions on pages 2 through 7.

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 7

Project Number: WP-117

Hole Number: GT-64P

Project: Geotechnical Investigation Phase II

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
21									
22									Begin Coring 22.0'
	8 min/ft	NQ-1		1	4.6/7.0	> 6	Rubble Open,rough,spun		22.0-26.5 ARGILLACEOUS LIMESTONE WITH CHERT, limestone is finely to coarsely xln, grayish orange(10YR 7/4) moderately weathered, moderately hard to hard, fossiliferous, stylolitic with FeOx pseudomorphs throughout, FeOx and MnOx stain on fractures, vuggy at 23.7'. CHERT as nodules, interbeds and beds, is white(10YR 8/2) to yellow(10YR 8/6), very hard, slightly weathered, fractured (healed) with MnOx fracture lining.
		5.7/7.0			66%				
23	100% return	81%			L.P. = 1.2				
	4 min/ft 23.6 lost water 23.6'-24.1' Possible void		23.7		5 > 4"	> 6	Stylolite, weak Open,rough,FeOx Open,rough,vuggy with $CaCO_3$ xls		
24	11 min/ft					> 6			23.7-24.8 Core loss
25	0 return		24.8				Open, spun (3)		
	14 min/ft					2	Stylolite Tight,rough,FeOx		
26	0 return						Stylolite, weak Open,rough,lt gr (2.5Y 7/2)clay,FeOx		
	13 min/ft 26.3' - hard					1	Stylolite		26.5-27.7 CHERT, as above
27	0 return								
	10 min/ft					1	Stylolite Open 8mm, stylolite,clay		27.2-28.8 LIMESTONE and CHERT, as above.
28	0 return								

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 7

Project Number: WP-117

Hole Number: GT-64P

Project: Geotechnical Investigation Phase II

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
28	3 min/ft SOFT			1		3	Stylolite, tight clay, weak Stylolite Open, smooth, 1cm glauconitic clay Open, rough		LIMESTONE and CHERT, as above 28.8-37.4 CORE LOSS, very soft drilling. Encountered probable cavities throughout section with minor rock thickness between voids. Probable voids from approximately: 30.4'-32.2' 32.6'-33.0' 33.2'-33.5' 33.6'-34.0' 34.5'-34.8' 35.4'-35.8' 36.5'-37.5' All probable voids evidenced by bit drop. Driller says "no rock" encountered in these sections.
			28.8						
29	0 return								
	2 min/ft	NQ-2 1.3'/10.0 13%		1	1.0'/10.0 10% L.P. = .5' 2 >4"				
30	0 return								
	2 min/ft								
31	0 return						Core Loss		
	1 min/ft								
32	0 return								
	<2 min/ft								
33									
	<2 min/ft								
34									
	4 min/ft								
35									

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 7
Project Number: WP-117
Hole Number: GT-64P

Project: Geotechnical Investigation Phase II
Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
35	4 min/ft			1		>6			Core Loss
36	0 return								
	2 min/ft					>6			
37	0 return								
	15 min/ft		37.4			>6	Rubble		37.4-37.7 CHERT RUBBLE 37.7-38.7 CHERT, as above, very hard with minor interbedded limestone as above.
38	0 return								
	11 min/ft					>6	Tight, smooth, $CaCO_3$		
	38.7'-39.8' very soft (VOID)		38.7				Open, vuggy		38.7-40.0 Core Loss, probable void from approximately 38.7' to 39.8'.
39									
7/31 8/01	3 min/ft	NQ-3 8.3'/10.0' 83%		1	7.1'/10.0' 71%				
40			40.0		L.P. = 1.4'		Rubble		40.0-40.5 CHERT, rubblized, hard, fractured
	5 min/ft 40.0'-40.5' very soft		40.5		9 > 4"	>6	Rubble		40.5-41.2 Core Loss, probable void
41	0 return						Open, rough, vuggy FeOx		
	11 min/ft		41.2			4	Tight, smooth vertical, FeOx Tight, rough, FeOx (2)		41.2-57.0 CHERT(65%) Interbedded with ARGILLACEOUS SILTY LIMESTONE. CHERT is very pale orange(10YR 8/2) to light gray (N7) slightly to moderately (cont'd)
42	0 return								

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 7

Project Number: WP-117

Hole Number: GT-64P

Project: Geotechnical Investigation Phase II

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
42	11 min/ft	NQ-3 contd		1		1	Open,rough,clay		weathered, vuggy; fractured (healed with MnOx) $CaCO_3$ lining some fractures, hard, as nodules and interbeds, increasing chert approximately 75% from 50.0-54.0 and 55.0-57.0. Moderately to severely weathered here. LIMESTONE is silty, argillaceous, grayish orange(10YR 7/4) to pale yellowish orange (10YR 8/6), moderate to moderately severe weathered, vuggy with vugs to 2cm, some very silty areas that absorb water readily with little HCl reaction, moderately hard to soft, slightly stylolitic, very solutioned from 42.5-47.3. Grades to limey siltstone at 54.0'. Some euhedral quartz infilling of small vugs in limestone and chert throughout. FeOx stain on fractures in chert at 41.2-41.7 and at 53.0.
43	0 return								
	8 min/ft			43.2		2	Open,rough,30° FeOx		
				2			Tight,rough,clay		
44	12 min/ft					1	Tight,rough,clay		
45	10 min/ft					1	Tight,rough, vuggy		
46	6 min/ft					0			
47	5 min/ft					1	Open, rough, vuggy		
48							Tight, smooth		
	5 min/ft					> 6	Rubble		
49									

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 7

Project Number: WP-117

Hole Number: GT-64P

Project: Geotechnical Investigation Phase II

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
49	4 min/ft	NQ-4		2	3.7'/4.3				CHERT and SILTY LIMESTONE interbedded, as above.
		4.3'/4.3'			86%	1	Tight, rough, vuggy		
50		100%			L.P. = 1.5'				
	10 min/ft				4 > 4"	1	Tight, rough, vuggy		
51									
	7 min/ft					1	Tight, smooth, FeOx		
52									
	14 min/ft			2/3		0			
53									
	18 min/ft	53.3					Rubble		
		NQ-5		3	2.5'/3.7'	> 6	Tight, 80°, smooth, $CaCO_3$		
		3.7'/3.7'					Rubble		
54					L.P. = 1.4'		Tight, stylolitic dark clay		
	10 min/ft	100%			3 > 4"	2			
55							Tight, rough, stylolitic		
	14 min/ft					0			
56									

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 7 of 7

Project Number: WP-117

Hole Number: GT-64P

Project: Geotechnical Investigation Phase II

Location:

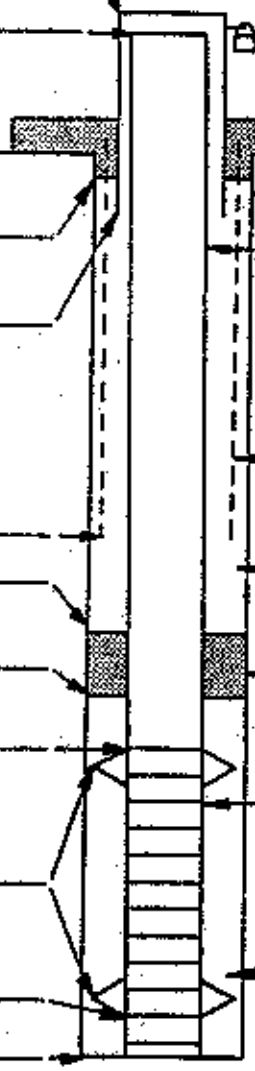
DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
56	18 min/ft	NQ-5 cont'd		3		1	Tight, rough		CHERT and LIMESTONE, as above.
57									T.D. 57.0' at 4:20 p.m. 8/1/89 Installed piezometer, see attached completion record.
58									
59									
60									
61									

WELDON SPRING SITE REMEDIAL ACTION PROJECT

WELL COMPLETION RECORD (PIEZOMETER)

WELL NUMBER GT-64P DATE INSTALLED 8/4/89

PMC REPRESENTATIVE Paul Patchin DRILLER Tom Clay - Hannibal



TOP OF PROTECTIVE CASING

TOP OF CASING 643.09'

GROUND SURFACE 640.85'

TOP OF GROUT 1.0'

BOTTOM OF PROTECTIVE CASING 2.0'

BOTTOM OF OUTER CASING None

TOP OF ~~SEAL~~ PACKER 22.0'

TOP OF FILTER PACK None

TOP OF SCREEN 38.0'

CENTRALIZER DEPTHS None

BOTTOM OF SCREEN 47.0'

TOTAL DEPTH 57.0'

LOCKED-DATE

SURFACE SEAL TYPE concrete

THICKNESS 3"

BOREHOLE DIAMETER 8" to 22'

CASING TYPE TriLoc PVC

DIAMETER 2.0"

Flush threaded Schedule 40

OUTER CASING TYPE None

DIAMETER --

GROUT TYPE Volclay

SEAL TYPE ½" bentonite pellets pellets to 19.0' (3.0')

SCREEN TYPE TriLoc PVC

DIAMETER 2.0"

SLOT SIZE 0.010"

FILTER PACK TYPE None

* Cuttings filled borehole to 48.0', could not evacuate.

COMMENTS All depths below ground surface. 2-5/8" to 4" PVC reducer placed from 22.0 to ~22.2' to serve as packer at top of rock. Bentonite seal placed directly above reducer to 19.0'.

PMC REPRESENTATIVE SIGNATURE Paul C. Patchin DATE 8/4/89

Paul C. Patchin

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 4
Project Number: 5121 WP-117
Hole Number: GT-65P

Project: Geotechnical Investigation Phase II	Location: 27' SW of MW-2023, 30' SE of MW-2024 (AEC)
Coordinates: N.101532.99 W.51161.08 (AEC)	Drilling Contractor: Hannibal Testing Labs
Drill Make and Model: CME-55 H.S. Auger 7¼" O.D.; 4¼" I.D.; NQ wireline core	Depth Top of Rock: 48.5'
Depth Casing & Size: Augers to 48.5'	Hole Size: Ovbd 7½" Core 2.98"
Elevation: G.S. 634.92'; T.O.C. 636.71'	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 60.0'	
Water Level: 8/16/89 52.2' b.g.s.	Fluid & Additives:
Date Start: 1:05 8/11/89	Date Finish: 3:20 8/15/89
Logger: A. Benfer	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						
		2.5 4.0	SS 01	4"	2-3-4 7		CLAYEY SILT, low plasticity, dark gray(10YR 4/1) to brownish yellow(10YR 6/6), damp, medium stiff to stiff (1.0) ML. Contains MnOx and FeOx.
	5						FERRELVIEW? 5.0
		5.0 7.5	ST 02	27"			SILTY CLAY, medium plasticity, 20% sand, trace rounded gravel, brownish yellow(10YR 6/8), moist very stiff (2.5) CL.
		7.5 9.0	SS 03	15"	2-4-6 10		As above, pp=3.3, mottled with light gray(10YR 7/1) with MnOx.
	10						CLAY TILL (atypical)
		10.0 12.5	ST 04	26"			As above, pp=1.25, stiff.
		12.5 14.0	SS 05	16"	2-4-5 9		As above, light yellow brown(2.5Y 6/4), with caliche, very stiff (3.2), with silt pockets.
	15						
		15.0 17.5	ST 06	27"			As above, pp=2.5 with caliche.
		17.5 19.0	SS 07	18"	3-6-8 14		SILTY CLAY, medium plasticity, 10% sand, 10% fine rounded gravel, brownish yellow(10YR 6/8) with minor light gray(10YR 7/1) stringers and MnOx stringers, damp, hard (4.1), CL. Typical clay till.
	20						
		20.0 22.5	ST 08	31"			As above, pp=4.5+.
		22.5 24.0	SS 09	18"	4-6-10 16		As above, very stiff(3.25), highly plastic, CH.
							CLAY TILL
	25						

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 4

Project Number: 5121 WP-117

Hole Number GT-65P

Project: Geotechnical Investigation Phase II

Location:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25	25.0 26.0	ST 10	9"	Tip Bent		SILT, nonplastic, to SILTY CLAY, medium plasticity, light brownish gray (2.5Y 6/2) to light yellowish brown(10YR 6/4), moist, very stiff(2.0-3.0), ML to CL. Clay contains minor sand.
		27.5 29.0	SS 11	18"	3-6-7 13		27.5-29.0 CLAY, highly plastic, brownish yellow(10YR 6/8), moist, very stiff(2.75), CH, contains 5% sand, 15% fine gravel and MnOx.
	30	30.0 31.5	SB 12	12"	11-15-19 34		As above, minor angular gravel up to 1½", pp=3.75. CLAY TILL
		32.5 34.0	SS 13	13"	8-8-10 18		As above, stiff(1.75) with yellow(10YR 7/6) limestone fragments.
	35	35.0 36.5	SB 14	12"	10-9-24 33		SILT, low plasticity, reddish yellow(5YR 7/4), abundant FeOx, minor gravel, very stiff(2.1) 36.3
		37.5 39.0	SS 15	16"	10-11-13 24		GRAVEL, angular chert, white(10YR 8/1), 25% clay, yellowish red(5YR 4/6), plastic, moist, dense, GC. As above, pp=4.0, hard. RESIDUUM
	40	40.0 41.5	SB 16	12"	17-18-26		As above, highly fractured and weathered chert with 25% clay, red(2.5YR 4/8), very moist, CH.
	45	45.0 46.5	SS 17	18"	5-7-8 15		As above, stiff(1.5).
	50						Auger refusal 48.5, T.D. 11:15 8/14/89. Cored from 48.5' to 60.0'. Core descriptions on pages 3 and 4.

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 4
Project Number: 5121 WP-117
Hole Number: GT-65P

Project: Geotechnical Investigation Phase II
Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
			?						Begin Coring 48.5
	3 min/ft	NQ-1		1	0%				
49									
	50% water return	0.6 / 4.5			L.P. = 0.15	6	Only fragments recovered.		49.4-50.0? CHERT, white(10YR 8/1), weathered, minor MnOx and FeOx.
		13%	?						
50	6½ min/ft		?						
	50% return Void 50.5'								
51	1½ min/ft								
	Lost water at 51'								
52	1 min/ft								
	0% return								
53	5 min/ft	53.0					Rubble		53.0-53.2 CHERT fragments.
	0% return	NQ-2	?		3.5 / 5.5		Rough, open 1/16" (3)		53.2-54.3 SILTY LIMESTONE, yellow(10YR 7/4), moderately weathered. Contains finely (cont'd)
		5.5 / 5.5			64%	3+			
54	5 min/ft	100%							

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 4
Project Number: 5121 WP-117
Hole Number: GT-65P

Project: Geotechnical Investigation Phase II
Location:

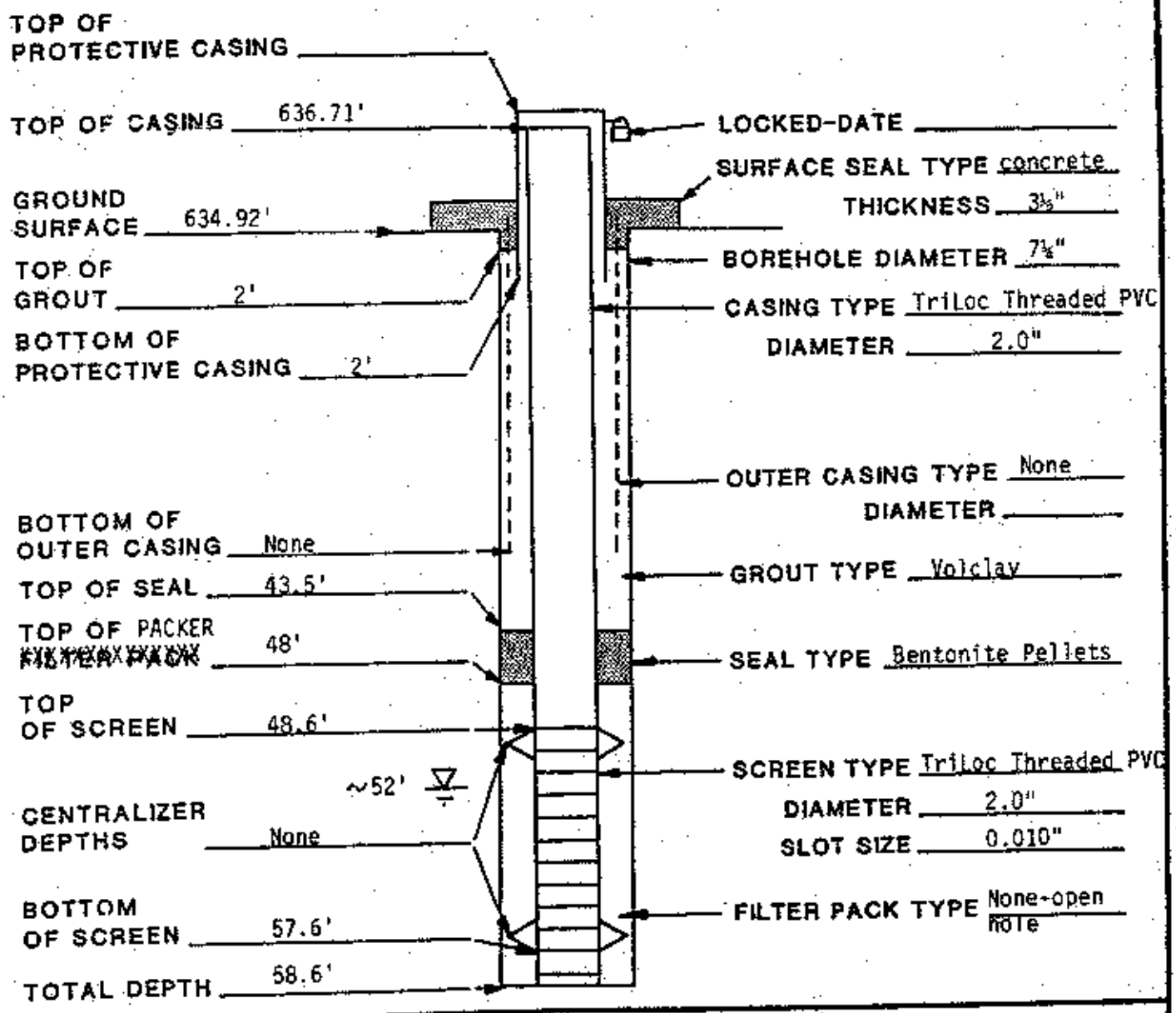
DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
54	10% water return				L.P.= 1.25 4	2	Rough, open 1/16", gray clay coating.		disseminated oxidized pyrite. 54.3-54.95 CHERT, fresh white (10YR 8/1)
55	4½ min/ft				4"		Rough, open 1/16", bedding		54.95-57.95 SILTY LIMESTONE, as above, with 50% chert distributed throughout, providing a breccia appearance. Chert white to bluish to pinkish.
	10% return					0	Stylolite, weak, closed		
56	3¼ min/ft						Stylolite, tight		
	0% return					1			
57	4¼ min/ft								
	0% return					4	Tight (4)		
58	4¼ min/ft								57.95-58.4 Massive calcite.
	0% return	58.5				2	Rough, open ¼" Mechanical		58.4-60.0 Intermixed weathered CHERT 50% white(10YR 8/1) and silty LIMESTONE, weathered, pale brown(10YR 6/3).
		NQ-3			0.85				
59	2 min/ft	1.5			1.5 57%		Rough, open 1"		
	0% return	1.5			L.P.= 0.5' 2	2	Rough, open 1/8" Rough, open ½"		59.25-60.0 CHERT, bluish gray (7.5YR 6/0).
		100%							
60					4"				
									T.D. 60.0', 10:45 8/15/89, Installed piezometer. See attached completion record.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

WELL COMPLETION RECORD (PIEZOMETER)

WELL NUMBER GT-65P DATE INSTALLED 8/15/89

PMC REPRESENTATIVE Alan Benfer DRILLER Tom Clay - Hannibal



COMMENTS T.D. 60.0 feet, slough to 58.6'. Hole diameter 7¾" 0' to 48.5'; 2.98" (NQ) 48.5' to 60.0'. All depths below ground surface. 2-5/8 - 4" PVC reducer placed as packer at 48.0'.

PMC REPRESENTATIVE SIGNATURE J. Alan Benfer DATE 8/15/89

J. Alan Benfer

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 5

Project Number: 5121 WP-117

Hole Number: GT-66P

Project: Geotechnical Investigation Phase II	Location: 12' SE(AEC) MW-2013
Coordinates: N.100814.69 W. 49527.91	Drilling Contractor: Hannibal Testing Labs

Drill Make and Model	Depth Top of Rock	Depth Casing & Size	Hole Size
CME-55, H.S. Auger 7¼" O.D. 4¼" I.D.; NQ Wireline Core	23.0'	NW to 23.5'	7-1/4/2.98"

Elevation	Angle from Vert. and Bearing	Depth Bottom of Hole
G.S. 644.68'; T.O.C. 647.47'	Vertical	47.5'

Water Level	Fluid & Additives	Date Start	Date Finish	Logger
8/10/89 37.8 b.g.s.	Water	9:15 8/7/89	10:55 8/8/89	A. Benfer

Elevation	Depth Below Surface	Sample Interval	Sample Type & Number	Recovery	Standard Penetration Test Results 6"-6"-6" (N)	Symbolic Log	Soil Description (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0						
		2.5 4.0	SS 01	10"	2-3-3 6		SILTY CLAY, medium plasticity, yellowish brown(10YR 6/3), moist, stiff(1.25), CL. Contains minor roots. FILL
	5						
		5.0 7.5	ST 02	19"			Minor gravel up to 3/4", very soft(<.25), very moist.
		7.5 9.0	SS 03	14"	1-3-6 9		SILT, nonplastic, dark gray(10YR 4/1), damp, to SILTY CLAY, very stiff(3.5), ML/CL. Minor organics, trace gravel. FILL
	10						
		10.0 12.5	ST 04	20"			CLAY, highly plastic, mottled light gray(10YR 7/1) and yellowish brown(10YR 5/6), moist, very stiff(2.5). CL. Considerable FeOx.
		12.5 14.0	SS 05	17"	2-4-5 9		12.5-14.0 As above, very silty, disseminated FeOx, pp=3.75, CL.
	15						FERRELVIEW
		15.0 17.5	ST 06	27"			As above, pp=2.25, fractures with FeOx, CL-CH 17.5
		17.5 19.0	SS 07	18"	2-4-6 10		SANDY SILTY CLAY, medium plasticity, 20% fine sand, trace fine gravel, light gray(10YR 7/1), moist very stiff(3.5), CL. CLAY TILL
	20						
		21.0 22.5	SB 08	6"	7-7-8		GRAVELLY CLAY, highly plastic, 40% angular limestone gravel up to 1½", mottled light gray(10YR 7/1) and brownish yellow(10YR 6/8), moist, very stiff(2.75), CH. Slickensided. FeOx, minor MnOx. CLAY TILL 22.8
			SS09	2"	50/6"		
		23.0					As above, highly fractured chert, yellow(10YR 7/4), MnOx
	25						Auger Refusal 23.0' 11:30 8/7/89. Cored from 23.2' to 47.5'. Core descriptions on pages 2 through 5.

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 5

Project Number: 5121 WP-117

Hole Number: GT-66P

Project: Geotechnical Investigation Phase II

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
23		23.2							Begin Coring 23.2
	4 min/ft	NQ-1		1		2	Gravel		LIMESTONE, yellow(10YR 7/6), coarsely crystalline (fossiliferous).
24	75% water return		23.8				Rough, open ⅛"		
	8 min/ft lost water-24.5'	8.25 / 10.3 80%			5.2 / 8.25 63%	4	Rough, open ¼" Stylolite, tight		24.5-24.8 Several stylolites 24.9 1/8" oxidized pyrite, some weathered out forming pits.
25							Rough, stained, open 1/8"		25.0-25.7 Pinkish chert nodules.
	13 min/ft					1	Rough, open ½"		25.4-28.3 Several stylolites
26	10% return-25.5'								28.8-27.0 Scattered oxidized pyrite.
	lost water-26.0' 7½ min/ft						Shaley, tight		27.6 Chert nodule
27			27.0						NQ-1 Slightly weathered, overall rock quality good.
	Void 27.0-27.8' 3 3/4 min/ft								
28	0% water return								

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 5
Project Number: 5121 WP-117
Hole Number: GT-66P

Project: Geotechnical Investigation Phase II
Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
28	Void 27.0-27.3' 2 min/ft to 27.5' 10½ min/ft		28.1						
29	0% return						Rubble, rough, open 1.0"		29.1-29.5 Pinkish chert
	Void 28.9-30.75 2 min 4 min/ft		29.6			1+			
30	0% return								
	Soft-29.9-30.1 6 3/4 min/ft		30.0			1+	Rubble, rough open 1.0"		30.8-31.0 Highly fossiliferous
31	0% return								31.7-31.9 Whitish chert
	3½ min/ft					0			
32	0% return						Healed (2)		
	2½ min/ft					1+	Healed		32.7-32.9 Hard clay seam
33	0% return						Rubble, clayey		32.8-33.0 Cherty
	10 min/ft								33.2-33.5 Cherty
8/7/89 8/8/89		33.5				1			
		NQ-2							
34	0% return	9.1 / 10.0			7.2 / 9.1				NQ-2 LIMESTONE yellowish brown(10YR 6/8) with 25% chert, white(10YR 8/1) to yellow(10YR 8/6), throughout. Limestone coarsely crystalline.
	3 min/ft	91%	34.4		79%	1	Rough, stained vertical fracture		
35	0% return								

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 5
Project Number: 5121 WP-117
Hole Number: GT-66P

Project: Geotechnical Investigation Phase II
Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
35	5¼ min/ft		34.3		L.P. = 2.2'	3+	Rough, open 1"		
				35.8	6		Rough, open ¼"		35.8-35.9 Tan claystone, fractured, weak, slickensided.
36	0% return			2	> 4"		Claystone seam		
	5½ min/ft						Eroded ½" (2)		36.2 Highly weathered joints
						3+	Tight		36.4 Stylolite
37	0% return								
	4½ min/ft					0			
10/89 37.8									
38	0% return								
	5 min/ft					1			38.0-39.0 Thin argillaceous zones.
39	0% return						Rough, open 1/8"		
	7½ min/ft					6+	Highly fractured and weathered chert and limestone		39.2-39.6 Highly weathered limestone with fractured residual chert.
40	0% return								39.7 LIMESTONE solutnd. out to ½" deep.
	8½ min/ft					1			
41	0% return						Rough, eroded, open ⅛-½" (3)		
	4 3/4 min/ft					2			41.3-42.0 LIMESTONE solutioned to ¼" deep.
42	0% return								

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 5
Project Number: 5121 WP-117
Hole Number: GT-66P

Project: Geotechnical Investigation Phase II
Location:

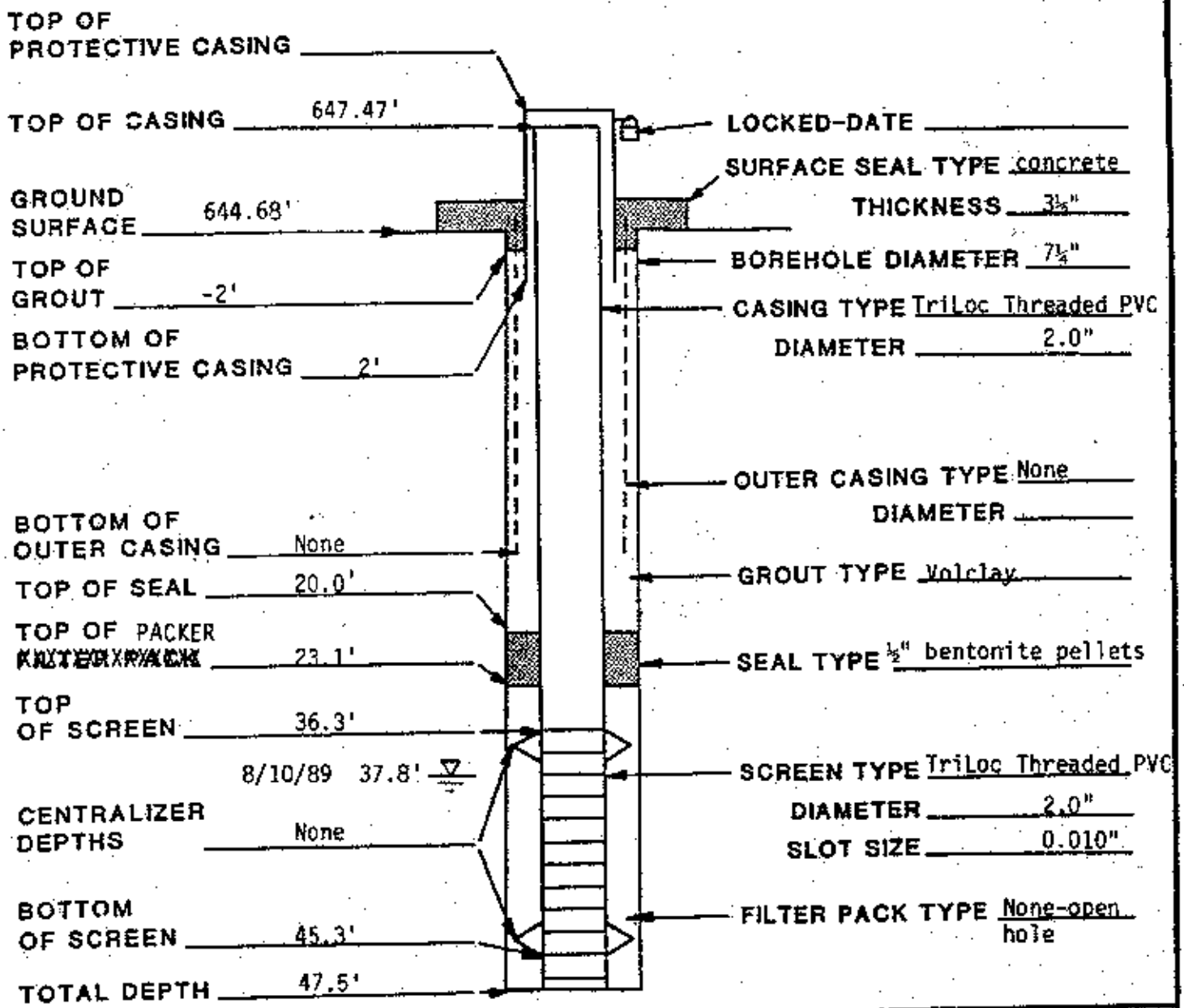
DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
42	8½ min/ft					1	Rough, open ¼"		Overall rock quality NQ-2 fair, slight to moderately severe weathering.
43	0% return								
	4½ min/ft	43.5				1			
		NQ-3			3.5 / 4.0				NQ-3 moderately weathered, rock quality good. Limestone and chert and color as above, argillaceous.
44	0% return	4.0 / 4.0			88%				
	3¼ min/ft	100%			L.P. = 1.9	1	Tight		
45	0% return			50 3	5 > 4"				Coarsely crystalline.
	6 3/4 min/ft					0			43.7 Limestone weathered ¼" deep.
46	0% return								
	4 min/ft					4	Tight Stylolite, tight Tight		
47							Tight		
									T.D. 47.5' 10:55 8/8/89 Installed piezometer, see attached completion record.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

PIEZOMETER ~~WELL~~ COMPLETION RECORD

WELL NUMBER GT-66P DATE INSTALLED 8/8/89

PMC REPRESENTATIVE Alan Benfer DRILLER Tom Clay, Hannibal



COMMENTS T.D. 47.5', minor slough to 46.3'. Hole diameter 23.3' - 47.5' 2.98" (NQ core). 2-5/8" - 4" PVC reducer used as packer. All depths below ground surface.

PMC REPRESENTATIVE SIGNATURE J. Alan Benfer DATE 8/8/89

J. Alan Benfer

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 6

Project Number: 5121 WP-117

Hole Number: GT-67P

Project: Geotechnical Investigation Phase II	Location: 14' SE (AEC) of MW 2017
Coordinates: N.100196.80 W. 49036.75	Drilling Contractor: Hannibal Testing Labs
Drill Make and Model: CME-55 H.S. Auger, 7¼"O.D., 4¼"I.D., NQ Wireline Core	Depth Top of Rock: 32.5'
Depth Casing & Size: NW 34.75'	Hole Size: 7¼"/2.98"
Elevation: G.S. 657.70'; T.O.C. 660.34'	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 60.0'	
Water Level: 8/18/89 40.3' b.g.s.	Fluid & Additives: Clear Water
Date Start: 8:25; 8/9/89	Date Finish: 11:15; 8/11/89
Logger: A. Benfer	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	0				Auger		SILTY CLAY, medium plasticity, yellowish brown (10YR 5/8), moist (stiff) CL
		2.5 4.0	SS 01	18"	3-5-6 11		CLAY, highly plastic, yellowish brown (10YR 6/8) with minor light gray(10YR 7/1), moist, hard(4.5+), CH. Contains spherical FeOx concretions. FERRELVIEW
	5	5.0 7.5	ST 02	19"			As above, pp=4.5+, clay as above, CH, minor MnOx
		7.5 9.0	SS 03	16"	3-4-6 10		As above, very stiff(3.75), CH as above, slickensided, some MnOx stringers.
	10	10.0 12.5	ST 04	13"			As above, pp=2.75, mottled red(2.5YR 5/6)and light gray(10YR 7/1), black (MnOx), highly slickensided.
		12.5 14.0	SS 05	18"	3-5-7 12		As above, very stiff to hard(4.0), mottled strong brown(7.5YR 5/8) and light gray(10YR 7/1), 5% fine sand, trace fine gravel. CH
	15	15.0 17.5	ST 06	5"			As above, pp=4.0, lightly slickensided, glassy, CH 18.0
		17.5 19.0	SS 07	16"	3-6-7 13		CLAY, 15% fine to medium sand, 10% fine gravel, highly plastic, mottled, yellowish brown(10YR 5/8)and light gray(10YR 7/1)and black(MnOx stringers) from 18.0', moist, very stiff(3.5), CH. Conspicuous white sand grains. CLAY TILL
	20	20.0 22.5	ST 08	28"			As above, pp=3.75, less sand, CH.
		22.5 24.0	SS 09	13"	3-4-9 13		22.5' Angular gravel up to 3/4". 23.5-23.8' Slightly silty medium to coarse grained sand, yellow(10YR 8/4) damp, granitic, SW.
	25						

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 2 of 6
Project Number: 5121 WP-117
Hole Number GT-67P

Project: Geotechnical Investigation Phase II
Location:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	25	25.0 26.5	SB 10	6"	50-60-25 85		GRAVEL, 25% clay, sandy, brownish yellow(10YR 6/6) and black(MnOx), moist, very dense, GC clasts up to 2"
		27.5 29.0	SS 11	10"	2-3-4 7		CLAY, highly plastic, mottled strong brown(7.5YR 5/6) and light gray(10YR 7/1) and black(MnOx), minor white weathered chert gravel, moist, very stiff(3.2), CH, colors mixed. CLAY TILL
	30	30.0 31.5	SS 12	0"	6-9-16 25		No recovery.
		32.5					32.5
		33.0	SS13	6"	30-37/1"		Weathered limestone and claystone, light gray(10YR 7/1), damp, hard.
	35						Auger refusal 34.5', at 12:45, 8/9/89.
							Cored from 34.5' to 60.0'. Core descriptions on pages 3 through 6.

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 3 of 6
Project Number: 5121 WP117
Hole Number: GT-67P

Project: Geotechnical Investigation Phase II
Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Begin Coring 34.5
	4½ min/ft	NQ-1		1	4.8 / 9.0				
35		7.75							
	75% water return	9.0			53%				
		86%			L.P. =				
			356		0.95'		Chert gravel		CHERT and LIMESTONE fragments with disseminated oxidized pyrite.
36	8½ min/ft				6 > 4"				
	75% water return					2	Rough, open ¼"		36.0-38.1 SILTY LIMESTONE, fine grained, yellow(10YR 7/8), moderately weathered
37	7 min/ft								
	75% return					2	Rough, open 1/8"-1/4" Rough, open 1/8"		37.35-37.55 CHERT, whitish to purplish
38	5½ min/ft						Rough, open ¼"		
	75% return					3	Rough, open ¼" eroded		38.1-43.3 LIMESTONE, medium grained, white(10YR 8/1), slightly weathered 38.2-39.5 disseminated oxidized pyrite, stylolitic
39	10½ min/ft						Shaley parting open 1/8"		38.3-38.5 whitish chert
	75% return					2	½" clay seam. eroded Rough, open 1/16"		38.9-39.0 shaley 39.2 ½" gray clay seam 39.45 1/8" shale 39.65 ½" shaley seam 39.7 1" chert nodule
40	7 min/ft								

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 4 of 6

Project Number: 5121 WP-117

Hole Number: GT-67P

Project: Geotechnical Investigation Phase II

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
40	100% return	NQ-1 cont'd		1		1			40.0; 40.4 ½" shaley zone 40.2-40.35 chert nodule 40.5-40.8 cherty
41	7 3/4 min/ft						Thin shale parting-tight (3)		41.0-41.3 cherty
	75% return					4	1/8" clay seam, eroded 1" wide, broken		41.55-41.85 stylolitic, eroded
42	6 ¼ min/ft								42.0-42.3 cherty
	75% return					1	Shale parting, rough, open ¼"		
43	10 min/ft						Rough, open ½", clay coating		43.3-43.5 cherty
	75% return	43.5				2	Rough, 3/4" clay seam		43.4 3/4" gray clay seam 43.5-45.2 LIMESTONE, coarsely crystalline, white(10YR 8/1) with 25% chert, whitish, slightly weathered, 4 stylolites stained brown, fossiliferous.
44	9½ min/ft	NQ-2 10.0 10.0		1	9.1 10.0 91%		Rough, stained, tight		
	75% return	100%			L.P. = 3.6'	0			
45	9 min/ft		45.1	2	7 > 4"				45.2-48.7 Mostly SILTY LIMESTONE, yellow(10YR 7/4), finely disseminated oxidized pyrite, 25% chert
	75% return					0	Mechanical		
46	15 min/ft								46.5-47.15 Massive chert
	75% return					0			
47	16½ min/ft								

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 5 of 6
Project Number: 5121 WP-117
Hole Number: GT-67P

Project: Geotechnical Investigation Phase II
Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
47	75% return	NQ-2 cont'd		2					
	12½ min/ft					1	Stylolite, tight		
48									
	75% return					0			48.7-50.0 white CHERT
49	12½ min/ft						Rough, open ½", eroded		
	75" return					4	Rough, open ¼", eroded; 3/4" shale seam, weak; Tight		49.5 3/4" gray shale seam; 49.8 1/8" gray shale seam; 49.9 1/8" gray shale seam
50	11 min/ft								
	75% return					0			50.0-52.2 50% LIMESTONE and CHERT, closely intermixed. Limestone yellowish brown (10YR 6/6), chert bluish white (10YR 8/1), limestone solutioned up to ¼" deep.
51	9¼ min/ft								
	75% return					2	Rough, open ½", eroded, clay film (2)		
52	13½ min/ft								
	75% return					2	Rough, open ¼", eroded; Stylolite, tight; Mechanical		52.2-53.5 Predominantly chert, bluish
53	7 min/ft								
	75% return	53.5				1	Rough, tight		53.5-54.7 Medium grained LIMESTONE, white (10YE 8/2) with 50% chert, bluish, light gray (7.5 YR 7/0).
54	10½ min/ft	NQ-3		2					

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 6
Project Number: 5121 WP-117
Hole Number: GT-67P

Project: Geotechnical Investigation Phase II
Location:

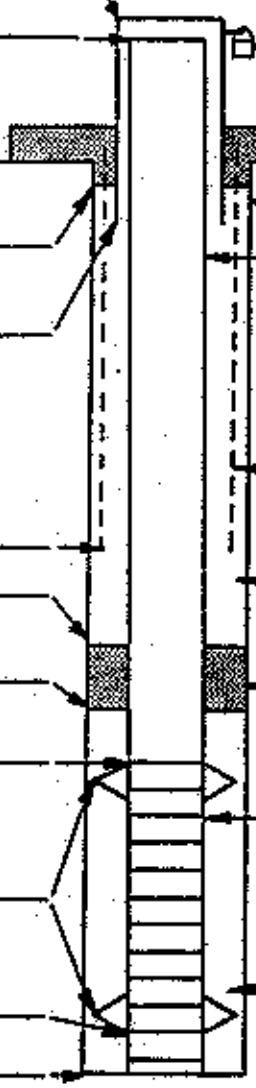
DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
54	75% return	NQ-3		2	5.5/6.0				
		6.6/6.5		54.7	92%	2	Tight, clay film		54.7-55.95 50% CHERT, 50% LIMESTONE, colors as above, limestone solutioned to 1/8" deep.
55	12 min/ft	101%		3			Rough, tight, clay film		
	75% return				L.P. = 2.2'	1			55.6-55.95 minor dark gray mudstone seams 55.95-56.2 white CHERT
56	9 min/ft				>5 4"		Tight		56.2-57.1 SILTY LIMESTONE, yellowish brown(10YR 6/8), minor chert, moderately weathered.
	75% return					3	Highly fractured		
57	5½ min/ft						Tight		
	75% return					0			57.1-58.1 White LIMESTONE with 40% bluish chert.
58	6 min/ft								
	75% return								58.1-58.8 Bluish CHERT (40%), and yellowish brown limestone. 58.8-59.5 Yellowish brown LIMESTONE, moderately to severely weathered.
59	6 min/ft						Tight		
	75% return						Rough, open 3/4" eroded Tight (2)		59.5-60.0 Whitish LIMESTONE.
60									
									T.D. 60.0' 1:15 8/10/89 Installed piezometer, see attached completion record.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

PIEZOMETER ~~WELL~~ COMPLETION RECORD

WELL NUMBER GT-67P DATE INSTALLED 8/11/89

PMC REPRESENTATIVE Alan Benfer DRILLER Tom Clay, Hannibal



TOP OF PROTECTIVE CASING

TOP OF CASING 660.34'

GROUND SURFACE 657.34'

TOP OF GROUT 2'

BOTTOM OF PROTECTIVE CASING 3'

BOTTOM OF OUTER CASING None

TOP OF SEAL 28.7'

TOP OF PACKER 34.5'

TOP OF SCREEN 49.5'

CENTRALIZER DEPTHS None

BOTTOM OF SCREEN 58.5'

TOTAL DEPTH 60.0'

LOCKED-DATE

SURFACE SEAL TYPE concrete

THICKNESS 3"

BOREHOLE DIAMETER 7¼"

CASING TYPE TriLoc threaded PVC

DIAMETER 2.0"

OUTER CASING TYPE None

DIAMETER

GROUT TYPE Volclay

SEAL TYPE ½" bentonite pellets

SCREEN TYPE TriLoc threaded PVC

DIAMETER 2.0"

SLOT SIZE 0.010"

FILTER PACK TYPE None

COMMENTS Hole diameter 7¼" to 34.5'; 2.98" (NQ) 34.5' to 60.0' (T.D.). 2-5/8" to 4" PVC reducer placed at 34.5' to serve as packer at top of rock. All depths below ground surface. Cuttings from 59.5' to 60.0'.

PMC REPRESENTATIVE SIGNATURE J. Alan Benfer DATE 8/11/89

J. Alan Benfer

APPENDIX B-4

OFF-SITE TEST PIT LOGS
(TPBS-1 THROUGH TPBS-30)

B-4

GEOTECHNICAL INVESTIGATIONS PHASE II
CLAY BORROW INVESTIGATION

INTRODUCTION

This report describes the procedures performed during the excavation of 30 test pits located within the Weldon Spring Wildlife Area. The objective of the test pits were to determine soil type, thickness, and extent, for locating possible clay borrow sources for use as construction material in the proposed disposal cell at the Weldon Spring Remedial Action Project (WSSRAP).

LOCATION

Two areas were chosen within the Weldon Spring Wildlife Area. The larger area contains 20 test pits, and is located approximately 1 mile due east of the site, in section 32, T 46 N, R 3 E, (Figure 1). The smaller area contains 10 test pits, and is located approximately 1-1/2 miles southwest of the site, in sections 1 and 12 of T 45 N, R 2 E.

Pit locations were determined by WSSRAP geologist Charles Payton, and Mark Cantrell geologist, M-K Environmental, Boise.

PERSONNEL/HEALTH SAFETY

Excavation was conducted from March 28th through March 30th, and April 17th through April 20th, by Bleigh Construction under subcontract to Hannibal Testing Laboratories. The excavation supervision, soil logging, testing, and sampling were performed by Mark Cantrell. The backhoe operator was Nick McNew of Bleigh Construction. Because of the uncontaminated off-site location of the work, personal protective equipment was limited to hard hats and steel-toed boots.

EXCAVATING AND SAMPLING

Excavation of the test pits was conducted by removing soil in thin layers, so as to aid in identifying soil boundaries. A Caterpillar 416 extendable boom backhoe with a 24-inch bucket was used for all excavations. Pits were logged during excavation by examination of

disturbed samples and visual observation of the pit walls. Geotechnical logs contained herein describe the nature and extent of the soils encountered in the investigation in accordance with the Unified Soil Classification System and Munsell soil color notation. Pit locations were identified by TPBS-1 through TPBS-30 (Test Pit Borrow Site 1 through Test Pit Borrow Site 30).

For safety reasons personnel access into the test pits was not permitted after depths of five feet, so soils were logged and sampled as they were excavated and deposited on the ground surface by the backhoe. Representative samples were taken of "possible" clay borrow zones. Samples were placed in double garbage bags, then into five gallon plastic buckets. Sample ID tags were placed inside the bags and the buckets. The bucket lids were then sealed, duct taped, and labeled with permanent markers. All bucket samples were taken in duplicate, and stored at the WSS in Building 410.

Sample identification consists of the pit number and sample depth. Duplicate samples were labeled the same as the original. The samples collected are recorded at the bottom of the test pit logs.

Relatively undisturbed samples were taken with a Corps of Engineers soil sampler in 14 pits. These samples consist of 4" x 4" thin-walled cylinders driven into the soil at approximately 5' depths. Sample numbers and blow counts were recorded on the test pit logs. The cylinders were encased in duct tape and sent to Hannibal Testing Laboratories for physical testing. No duplicate undisturbed samples were taken. All samples were identified on chain-of-custody forms.

After all information was gathered, back-filling was performed using excavated material in the reverse order in which it was excavated. All test pits are identified in the field by flagged and labeled lath, then later surveyed for location and elevation. This information is contained on each test pit log. Photographs were taken of selected samples and test pits. These photos and accompanying photo log are contained herein.

LEGEND

8 TEST PIT LOCATION (TPBS-8)

FIGURE 1

TEST PIT LOCATIONS

LOG OF TEST PIT TPBS-1

- Coordinates (MSPC): Northing: 1044071.34 Easting: 439552.68
- Elevation: 641.33 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 8:50 a.m. 03/28/89
- Finish backfilling: 10:20 a.m.

Depth, Feet	Description
0.0-0.8	TOPSOIL: Silt, medium-low plasticity, dark yellowish brown (10YR 4/4), moist, medium stiff, roots, ML.
0.8-2.6	SILTY CLAY: Dark yellowish brown (10YR 4/6), mottled with light gray (10YR 7/1), moist, medium plasticity, pp = 2.0, stiff to very stiff, roots, CL/ML.
2.6-7.1	CLAYEY SILT: Pale yellow (2.5Y 7/4) mottled with light gray (2.5Y 7/2), dry, hard, crumbly, pyrolusite veins, ML.
7.1-9.2	GRAVELLY CLAY: Light gray (5Y 7/2) mottled with brownish yellow (10YR 6/6), some coarse sand (<5%) and <5% gravel, moist, medium to high plasticity, pp = 3.0, very stiff, CH.
9.2-14.1	SILTY CLAY: Brownish yellow (10YR 6/6) mottled with light gray (2.5Y 7/2), <10% sand and <5% gravel, moist, pp = >4.5, hard, pyrolusite veins, CH.

Samples Collected

TPBS-1: 0.8'-2.6'
TPBS-1: 2.6'-7.1'
TPBS-1: 7.1'-9.2'
TPBS-1: 9.2'-14.1'

NOTE: All samples were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-2

- Coordinates (MSPC): Northing: 1043432.46 Easting: 439939.85
- Elevation: 655.71 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 10:29 a.m. 03/28/89
- Finish backfilling: 12:05 p.m.

Depth, Feet	Description
0.0-0.7	TOPSOIL: Silt, very dark grayish brown (10 YR 3/2), <3% fine sand, moist, pp = 1.25, medium stiff to stiff, low-medium plasticity, roots, ML.
0.7-3.5	CLAY: Very pale brown (10YR 7/4) mottled with strong brown (7.5YR 5/8), moist, medium plasticity, pp = 1.5, stiff, roots, pyrolusite, CL/CH.
3.5-8.2	SILTY CLAY: Light gray (10YR 7/2) mottled with dark yellow brown (10YR 4/6), moist, medium plasticity, soft, minor pyrolusite, CL/CH.
8.2-12.1	CLAY: Light gray (10YR 7/1) mottled with yellowish brown (10YR 5/6), moist, medium plasticity, minor pyrolusite, CL/CH.

Samples Collected

TPBS-2: 0.7'-3.5'
TPBS-2: 3.5'-8.2'
TPBS-2: 8.2'-12.1'

NOTE: All samples were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-3

- Coordinates (MSPC): Northing: 1044587.08 Easting: 438279.85
- Elevation: 657.30 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 1:10 p.m. 03/28/89
- Finish backfilling: 2:20 p.m.

Depth, Feet	Description
0.0-0.9	TOPSOIL: Silt, very dark grayish brown (10YR 3/2), <3% fine sand, moist, low plasticity, pp = 0.75, medium stiff, roots, ML.
0.9-9.8	SILTY CLAY/CLAYEY SILT: Light yellowish brown (10YR 6/4) mottled with yellowish brown (10YR 5/6), moist, pp = 2.25, very stiff, roots, some pyrolusite, low to medium plasticity, ML/CL.
9.8-12.2	SILTY CLAY: Brown (7.5YR 5/4) mottled with pale brown (10YR 6/3), moist, pp = 2.75, very stiff, pyrolusite veins, medium plasticity, CL.

Samples Collected

TPBS-3: 0.9'-9.8'
TPBS-3: 9.8'-12.2'

NOTE: All samples were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-4

- Coordinates (MSPC): Northing: 1043097.65 Easting: 440349.64
- Elevation: 660.21 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 2:27 p.m. 03/28/89
- Finish backfilling: 3:47 p.m.

Depth, Feet	Description
0.0-0.7	TOPSOIL: Silt, very dark grayish brown (10YR 3/2), with <3% fine sand, moist, pp = 1.0, medium stiff to stiff, low plasticity, roots, ML.
0.7-5.1	SILTY CLAY: Light gray (10YR 7/2) mottled with yellowish brown (10YR 5/8), moist, low to medium plasticity, pp = 1.75, stiff, roots, minor pyrolusite, CL.
5.1-8.6	CLAYEY SILT: Light gray (10YR 7/2) mottled with yellowish brown (10YR 5/8), moist, low plasticity, pp = 2.75, very stiff, minor pyrolusite, ML.
8.6-12.0	SILTY CLAY: Light brownish gray (10YR 6/2) mottled with yellowish brown (10YR 5/6), moist, pp = 3.75, very stiff, low plasticity, CL.

Samples Collected

TPBS-4: 0.7'-5.1'
TPBS-4: 5.1'-8.6'
TPBS-4: 8.6'-12.0'

NOTE: All samples were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-5

- Coordinates (MSPC): Northing: 1042961.89 Easting: 439583.15
- Elevation: 646.26 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 8:22 a.m. 03/29/89
- Finish backfilling: 9:51 a.m.

Depth, Feet	Description
0.0-0.5	TOPSOIL: Silt, grayish brown (10YR 5/2), with <3% fine sand, wet, pp = 0.25, soft to very soft, low plasticity, roots, ML.
0.5-9.3	SILTY CLAY/CLAYEY SILT: Dark yellowish brown (10YR 4/6) mottled with gray (10YR 5/1), moist, medium plasticity, pp = 1.25, stiff, roots, pyrolusite, CL/ML.
9.3-10.5	CLAY: Gray (5Y 6/1), with <5% coarse sand, moist, high plasticity, pp = 2.0, stiff to very stiff, minor pyrolusite, CH.
10.5-12.3	SILTY CLAY: Yellowish brown (10YR 5/8) mottled with light gray (10YR 6/1), with <15% very fine to coarse sand, moist, medium plasticity, pp = 2.25, very stiff, minor fine gravel, CL.

Samples Collected

TPBS-5: 0.5'-9.3'
TPBS-5: 9.3'-10.5'
TPBS-5: 10.5'-12.3'

NOTE: All samples were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-6

- Coordinates (MSPC): Northing: 1042369.08 Easting: 440854.60
- Elevation: 661.18 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 12:41 p.m. 03/29/89
- Finish backfilling: 1:49 p.m.

Depth, Feet	Description
0.0-0.6	TOPSOIL: Silt, brown (10YR 4/3), with <3% fine sand, wet, very soft, low plasticity, roots, ML.
0.6-9.1	SILTY CLAY/CLAYEY SILT: Dark yellowish brown (10YR 4/6) mottled with gray (10YR 5/1), with <3% fine sand, moist, low to medium plasticity, CL/ML.
9.1-12.6	CLAY: Gray (5Y 6/1), moist, highly plastic, pp = 2.25, very stiff, <10% coarse sand and fine gravel, minor organics, CH.

Samples Collected

TPBS-6: 0.6'-9.1'
TPBS-6: 9.1'-12.6'

NOTE: All samples were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-7

- Coordinates (MSPC): Northing: 1042865.88 Easting: 441172.71
- Elevation: 672.01 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 2:01 p.m. 03/29/89
- Finish backfilling: 2:55 p.m.

Depth, Feet	Description
0.0-0.5	TOPSOIL: Silt, brown (10YR 4/3), with <3% fine sand, moist, very soft, low plasticity, roots, ML.
0.5-7.7	SILTY CLAY/CLAYEY SILT: Dark yellowish brown (10YR 4/6) mottled with gray (10YR 5/1), (upper 1' of unit strong brown silty clay [7.5YR 4/6]), moist, pp = 1.5, stiff, medium to low plasticity, CL/ML.
7.7-12.5	CLAYEY SILT: Light gray (10YR 7/2) mottled with yellowish brown (10YR 5/8), moist, low to medium plasticity, = 2.25, very stiff, ML.

Samples Collected

TPBS-7: 0.5'-7.7'
TPBS-7: 7.7'-12.5'

NOTE: All samples were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-8

- Coordinates (MSPC): Northing: 1043578.58 Easting: 441516.23
- Elevation: 662.58 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 3:01 a.m. 03/29/89
- Finish backfilling: 4:15 p.m.

Depth, Feet	Description
0.0-0.6	TOPSOIL: Silt, brown (10YR 4/3), with <3% fine sand, moist, pp = 0.75, medium stiff, low plasticity, roots, ML.
0.6-4.3	SILTY CLAY: Varies from yellowish brown (10YR 5/4) to yellowish red (5YR 5/6) in upper 1.5', then is mottled light olive gray (5Y 6/2) with strong brown (7.5 YR 5/6), moist, pp = 1.0, medium stiff to stiff, medium plasticity, pyrolusite, CL/CH.
4.3-8.5	CLAYEY SILT: Light gray (10YR 7/2) mottled with yellow (10YR 7/6), dry, pp = >4.5, hard, ML.
8.5-11.9	CLAY: Light olive brown (2.5Y 5/6), slickensides gray (10YR 6/1), pp = >4.5, hard, moist, CH.

Samples Collected

TPBS-8: 0.6'-4.3'
TPBS-8: 4.3'-8.5'
TPBS-8: 8.5'-11.9'

NOTE: All samples were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-9

- Coordinates (MSPC): Northing: 1041564.83 Easting: 441008.67
- Elevation: 661.11 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 8:15 a.m. 03/30/89
- Finish backfilling: 9:20 a.m.

Depth, Feet	Description
0.0-0.7	TOPSOIL: Silt, dark yellowish brown (10YR 4/4), with <3% sand, moist, pp = 0.5, soft to medium stiff, low plasticity, roots, ML.
0.7-6.5	SILTY CLAY: Yellowish brown (10YR 5/4) mottled with dark yellowish brown (10YR 4/6), moist, medium plasticity, pp = 1.25, stiff, roots, pyrolusite veins, CH/CL.
6.5-8.5	CLAYEY SILT: Light brownish gray (10YR 6/2) mottled with dark yellowish brown (10YR 4/6), moist, low plasticity, pp = >4.5, hard, roots, pyrolusite, ML.
8.5-12.2	CLAY: Light olive gray (5Y 6/2), moist, highly plastic, pp = 3.5, very stiff, minor chert gravel <2%, CH.

Samples Collected

TPBS-9: 0.7'-6.5'
TPBS-9: 8.5'-12.2'

NOTE: All samples were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-10

- Coordinates (MSPC): Northing: 1041550.27 Easting: 440675.85
- Elevation: 661.94 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 9:26 a.m. 03/30/89
- Finish backfilling: 10:41 a.m.

Depth, Feet	Description
0.0-0.5	TOPSOIL: Silt, dark brown (10YR 4/3) moist, low plasticity, pp = 0.25, soft to very soft, minor fine sand, roots, ML.
0.5-6.1	SILTY CLAY: Light brownish gray (10 YR 6/2) mottled with yellowish brown (10YR 5/6), moist, medium plasticity, pp = 1.5, stiff, CH.
6.1-8.2	SILT: Dark yellowish brown (10YR 4/6) mottled with light brownish gray (10YR 6/2), moist, low plasticity, pp = >4.5, hard, ML.
8.2-10.9	CLAY: Yellowish brown (10YR 5/6), moist, highly plastic, pp = >4.5, hard, pyrolusite veins, CH.
10.9-13.4	CLAY: Light olive gray (5Y 6/2), moist, highly plastic, pp = 3.25, very stiff, <1% chert gravel, pyrolusite, CH.
13.4-15.2	GRAVELLY CLAY: Brownish yellow (10YR 6/8), moist, highly plastic, pp = 3.25, very stiff, approx. 15% chert gravel and coarse sand, CH.

Samples Collected

TPBS-10: 0.5'-6.1'
TPBS-10: 8.2'-10.9'
TPBS-10: 10.9'-13.4'

NOTE: All samples were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-11

- Coordinates (MSPC): Northing: 1041626.32 Easting: 439988.35
- Elevation: 652.75 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 11:45 a.m. 03/30/89
- Finish backfilling: 1:05 p.m.

Depth, Feet	Description
0.0-0.6	TOPSOIL: Silty, brown (10YR 4/3), with <3% fine sand, moist, low plasticity, pp = 0.25, soft, roots, ML.
0.6-10.4	SILTY CLAYS/CLAYEY SILTS: Dark yellowish brown (10YR 4/6) mottled with light brownish gray (10YR 6/2), moist, medium plasticity, pp = 1.5, stiff, CL & ML.
10.4-12.3	CLAY: Strong brown (7.5YR 4/6), moist, medium to high plasticity, pp = 3.5, very stiff, CL/CH.
12.3-13.2	GRAVELLY CLAY: Brownish yellow (10YR 6/8) mottled with light gray (10YR 7/1), moist, low to medium plasticity, pp = 3.0, very stiff, <10% coarse sand, <5% gravel (chert and limestone), CL.

Samples Collected

TPBS-11: 0.6'-10.4'
TPBS-11: 10.4'-12.3'

NOTE: All samples were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-12

- Coordinates (MSPC): Northing: 1041260.03 Easting: 4411332.71
- Elevation: 656.71 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 1:20 p.m. 03/30/89
- Finish backfilling: 2:30 p.m.

Depth, Feet	Description
0.0-0.5	TOPSOIL: Silt, brown (10YR 4/3), moist, low plasticity, pp = 0.25, soft, roots, ML.
0.5-7.4	SILTY CLAY: Dark yellowish brown (10YR 4/6) mottled with light brownish gray (10YR 6/2), moist, medium plasticity, pp = 2.25, very stiff, zones of clayey silt, some pyrolusite, CL.
7.4-9.1	CLAY: Dark yellowish brown (10YR 4/4), minor very coarse sand (<5%), moist, highly plastic, pp = 2.5, very stiff, organics, pyrolusite, CH.
9.1-12.1	SILTY CLAY/CLAYEY SILT: Brownish yellow (10YR 6/8) mottled with pale brown (10YR 6/3), moist, medium plasticity, pp = 2.0-3.5, very stiff, minor gravel <1%, pyrolusite, CL/ML.

Samples Collected

TPBS-12: 0.5'-7.4'
TPBS-12: 7.4'-9.1'
TPBS-12: 9.1'-12.1'

NOTE: All samples were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-13

- Coordinates (MSPC): Northing: 1042507.63 Easting: 441939.54
- Elevation: 655.44 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 9:00 a.m. 04/17/89
- Finish backfilling: 10:20 a.m.

Depth, Feet	Description
0.0-0.9	TOPSOIL: Silt, brown (10YR 4/3), with minor fine sand, moist, medium stiff to stiff, pp = 1.0, low plasticity, roots, ML.
0.9-1.8	CLAY: Yellowish brown (10YR 5/8), moist, medium to high plasticity, pp = 1.75, stiff, CH.
1.8-8.4	SILTY CLAY: Dark yellowish brown (10YR 4/6) mottled with gray (10YR 5/1), moist, pp = 1.5, stiff, low plasticity, pyrolusite (minor), CL.
8.4-13.5	CLAY: Gray (10YR 7/1) mottled with brownish yellow (10YR 6/6), moist, pp = 2.25, very stiff, high plasticity, minor pyrolusite veins, CH.

Samples Collected

TPBS-13: 1.8'-8.4'
TPBS-13: 8.4'-13.5'
TPBS-13: 4.6'-4.9' (Thin-walled cylinder sample; blow count = 30)

NOTE: Above samples except TPBS-13: 4.6'-4.9' were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-14

- Coordinates (MSPC): Northing: 1042733.86 Easting: 442161.38
- Elevation: 649.56 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 10:30 a.m. 04/17/89
- Finish backfilling: 11:51 a.m.

Depth, Feet	Description
0.0-0.9	TOPSOIL: Silt, dark yellowish brown (10YR 4/4), with minor fine sand, moist, pp = (range <0.25-1.0), mainly soft, roots, ML.
0.9-2.9	CLAY: (Some silty clay), yellowish brown (10YR 5/6) mottled with light yellowish brown (10YR 6/4), moist, pp = 1.5, stiff, highly plastic, some medium plastic, CH.
2.9-8.4	SILTY CLAY: (Some clayey silt), dark yellowish brown (10YR 4/6) mottled with gray (10YR 5/1), moist, pp = 1.5, stiff, low plasticity, minor pyrolusite, CL.
8.4-11.8	CLAY: Gray (10YR 7/1) mottled with brownish yellow (10YR 6/6), moist, pp = 2.5, very stiff, minor pyrolusite veins, highly plastic, minor coarse-grained sand and fine gravel, CH.

Samples Collected

TPBS-14: 0.9'-2.9'
TPBS-14: 2.9'-8.4'
TPBS-14: 8.4'-11.8'
TPBS-14: 4.9'-5.2' (Thin-walled cylinder sample; blow count = 25)

NOTE: Above samples except TPBS-14: 4.9'-5.2' were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-15

- Coordinates (MSPC): Northing: 1040527.57 Easting: 441017.88
- Elevation: 650.44 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 12:55 p.m. 04/17/89
- Finish backfilling: 2:25 p.m.

Depth, Feet	Description
0.0-0.9	TOPSOIL: Silt, very dark grayish brown (10YR 3/2), moist, minor fine sand, pp = 0.25 to 0.75, moistly soft, roots, ML.
0.9-2.4	SILTY CLAY: Yellowish brown 9(10YR 5/6), wet, medium plasticity, pp = 0.50, soft to medium stiff, CL.
2.4-10.8	SILTY CLAY: Some clayey silt, light gray (10YR 7/1) mottled with yellowish brown (10YR 5/8), moist, pp = 1.5, stiff, low plasticity, minor pyrolusite, CL.
10.8-12.9	CLAY: Very pale brown (10YR 7/4), slickensides gray (10YR 6/1), moist, pp = 2.25, very stiff, pyrolusite veins on slickensides, minor coarse sand and fine gravel, CH.

Samples Collected

TPBS-15: 2.4'-10.8'
TPBS-15: 10.8'-12.9'
TPBS-15: 5.9'-6.2' (Thin-walled cylinder sample; blow count = 11)

NOTE: Above samples except TPBS-15: 5.9'-6.2' were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-16

- Coordinates (MSPC): Northing: 1041033.52 Easting: 441024.16
- Elevation: 652.46 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 2:31 p.m. 04/17/89
- Finish backfilling: 3:41 p.m.

Depth, Feet	Description
0.0-1.0	TOPSOIL: Silt, brown (10YR 4/3), moist, minor fine sand, soft, low plasticity, roots, ML.
1.0-2.1	SILTY CLAY: Yellowish brown (10YR 5/6), wet, contains minor fine sand, medium plasticity, pp = 0.75, medium stiff, CL.
2.1-10.5	SILTY CLAY: Yellowish brown (10YR 5/8) mottled with light gray (10YR 7/1), moist, pp = 1.75, stiff, medium plasticity, CL.
12.5-13.1	GRAVELLY CLAY: Brownish yellow mottled with light brown, and very light gray, some white, approx. 20% coarse sand and <10% gravel up to 3", pp = 2.5, very stiff, medium plasticity, CL.

Samples Collected

TPBS-16: 2.1'-10.5'
TPBS-16: 5.4'-5.7' (Thin-walled cylinder sample; blow count = 55)

NOTE: Above samples except TPBS-16: 2.1-'10.5' taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-17

- Coordinates (MSPC): Northing: 1041050.72 Easting: 440432.89
- Elevation: 646.59 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 3:48 p.m. 04/17/89
- Finish backfilling:

Depth, Feet	Description
0.0-0.7	TOPSOIL: Silt, brown (10YR 4/3), moist, minor fine sand, soft, pp = 1.0, medium stiff to stiff, low plasticity, roots, ML.
0.7-10.2	SILTY CLAY: Yellowish brown (10YR 5/8) mottled with light gray (10YR 7/1), moist, pp = 1.5, stiff, medium plasticity, CL.
10.2-12.4	CLAY: Yellowish red (5YR 4/6) and brownish yellow (10YR 6/8), with light gray (2.5Y 6/0) slickensides, moist, contains minor gravel and minor coarse sand, pp = 2.25, very stiff, highly plastic, organics (roots), CH.

Samples Collected

TPBS-17: 0.7'-10.2'
TPBS-17: 10.2'-12.4'
TPBS-17: 6.0'-6.3' (Thin-walled cylinder sample; blow count = 35)

NOTE: Above samples except TPBS-17: 6.0'-6.3' were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-18

- Coordinates (MSPC): Northing: 1041845.98 Easting: 440354.26
- Elevation: 645.75 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 8:27 a.m. 04/18/89
- Finish backfilling: 9:43 a.m.

Depth, Feet	Description
0.0-0.7	TOPSOIL: Silt, minor fine sand, dark yellowish brown (10YR 4/4), moist, pp = 1.25, stiff, low plasticity, roots, ML.
0.7-5.1	SILTY CLAY: Dark yellowish brown (10YR 4/6) mottled with light gray (10YR 7/2), moist, medium plasticity, pp = 1.25, stiff, roots, pyrolusite, CL.
5.1-8.9	CLAYEY SILT: Yellowish brown (10YR 5/4) mottled with light gray (10YR 7/3), moist, low plasticity, pp = >4.0, hard, pyrolusite, ML.
8.9-12.2	CLAY: Yellowish brown (10YR 5/4) mottled with light gray (10YR 7/2), slickensides also light gray, moist, pp = 2.5, very stiff, high plasticity, pyrolusite veins on slickensides, minor 1/2" minus gravel, CH.

Samples Collected

TPBS-18: 0.7'-5.1'
TPBS-18: 8.9'-12.2'
TPBS-18: 4.8'-5.1' (Thin-walled cylinder sample; blow count = 59)

NOTE: Above samples except TPBS-18: 4.8'-5.1' were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-19

- Coordinates (MSPC): Northing: 104226.30 Easting: 439982.02
- Elevation: 645.01 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 9:49 a.m. 04/18/89
- Finish backfilling: 11:25 a.m.

Depth, Feet	Description
0.0-0.7	TOPSOIL: Silt, dark yellowish brown (10YR 4/4), moist, low plasticity, very soft, roots, ML.
0.7-9.5	SILTY CLAY: Yellowish brown (10YR 5/6) mottled with light gray (10YR 7/2), moist, medium plasticity, pp = 1.5, stiff, pyrolusite, roots in upper 2', some zones of high plasticity, CL/CH.
9.5-11.8	CLAY: Yellowish brown (10YR 5/4) mottled with light gray (10YR 7/2), increasing to brownish yellow (10YR 6/6) with depth, moist, highly plastic, pp = 2.75, very stiff, pyrolusite, slickensides, minor coarse sand and 1" minus gravel, CH.

Samples Collected

TPBS-19: 0.7'-9.5'
TPBS-19: 9.5'-11.8'
TPBS-19: 4.9'-5.2' (Thin-walled cylinder sample; blow count = 63)

NOTE: Above samples except TPBS-19: 4.9'-5.2' were taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-20

- Coordinates (MSPC): Northing: 1042302.05 Easting: 439212.97
- Elevation: 630.75 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 12:20 p.m. 04/18/89
- Finish backfilling: 1:29 p.m.

Depth, Feet	Description
0.0-0.7	TOPSOIL: Silt, dark yellowish brown (10YR 4/4), moist, low plasticity, pp = 1.25, stiff, roots, ML.
0.7-7.1	SILTY CLAY: Yellowish brown (10YR 5/6) mottled with light gray (10YR 7/2), moist, low to medium plasticity, pp = 1.5, stiff, pyrolusite, CL.
7.1-8.9	SILTY CLAY: Strong brown (7.5YR 5/6), medium plasticity, pp = 1.0, medium stiff to stiff, moist, pyrolusite, CL.

Samples Collected

TPBS-20: 0.7'-7.1'
TPBS-20: 5.4'-5.7' (Thin-walled cylinder sample; blow count = 51)

NOTE: Hit refusal (bedrock) at 8.9'.

NOTE: Above sample TPBS-20: 0.7'-7.1' taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-21

- Coordinates (MSPC): Northing: 1035776.04 Easting: 431284.04
- Elevation: 529.50 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 2:15 p.m. 04/18/89
- Finish backfilling: 3:24 p.m.

Depth, Feet	Description
0.0-0.9	TOPSOIL: Silt, dark yellowish brown (10YR 4/4), moist, low plasticity, soft, roots, ML.
0.9-5.4	CLAYEY SILT: Dark yellowish brown (10YR 4/4), moist, low to medium plasticity, pp = 0.5, soft, ML.
5.4-12.3	GRAVELLY CLAYEY SILT: Dark yellowish brown (10YR 4/4) changing to mottled dark yellowish brown (10YR 4/6) and gray (10YR 6/1) at 8.4'. At 5.4-6.5' and 8.4-9.8' are gravel lenses with approx. 30% gravel and approx. 10% sand, with minor cobbles, ML.

Samples Collected

TPBS-21: 0.9'-5.4'

NOTE: Water level at approx. 11'.
Above sample taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-22

- Coordinates (MSPC): Northing: 1035319.11 Easting: 431048.26
- Elevation: 517.27 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 8:45 a.m. 04/19/89
- Finish backfilling: 9:25 a.m.

Depth, Feet	Description
0.0-2.4	SILT: Dark yellowish brown (10YR 3/3), moist, low plasticity, soft, roots in upper 1', ML.
2.4-5.6	SILTY SANDY GRAVEL: Well graded, approx 60% gravel, approx. 5% cobbles, approx. 25% sand, approx. 10% fines (sands and gravels were very angular), GW.

NOTE: Constant caving of pit walls due to gravels and shallow water table; no samples taken. Water table at approx. 3'.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-23

- Coordinates (MSPC): Northing: 1034664.71 Easting: 431132.27
- Elevation: 515.23 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 9:31 a.m. 04/19/89
- Finish backfilling: 10:31 a.m.

Depth, Feet	Description
0.0-0.7	TOPSOIL: Silt, brown (10YR 4/3), moist, low plasticity, pp = 1.0, medium stiff, minor fine sand, roots, ML.
0.7-13.1	CLAYEY SILT: Dark yellowish brown (10YR 4/6) mottled with light gray (10YR 7/1), moist to wet to saturated at approx. 5.5', upper zone (moist), pp = 2.5, very stiff, lower zones soft, low plasticity, pyrolusite, ML.

Samples Collected

TPBS-23: 0.7'-13.1'
TPBS-23: 5.7'-6.0' (Thin-walled cylinder sample; blow count = 21)

NOTE: Water table at approx. 5.5'.

NOTE: Above sample TPBS-23: 0.7'-13.1' taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-24

- Coordinates (MSPC): Northing: 1034026.52 Easting: 431092.62
- Elevation: 504.01 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 10:33 a.m. 04/19/89
- Finish backfilling: 11:14 a.m.

Depth, Feet	Description
0.0-1.9	SILT: Brown (10YR 4/3), moist, soft, low plasticity, roots upper 1', few cobbles, ML.
1.9-2.8	GRAVELLY SILTS: Brown (10YR 4/3), moist, medium stiff, low plasticity, approx. 15% gravels, coarse grained, few cobbles, ML.
2.8-4.1	SILT: Brown (10YR 4/3), moist, soft, low plasticity, ML.
4.1-9.8	SILTY GRAVELS: Dark yellowish brown (10YR 4/4), fine-grained gravels approx. 65%, coarse-grained sands approx. 10%, fines approx. 25%, moist near top to saturated with depth, gravels poorly graded, GM.
9.8-11.6	SILT: Very dark gray (5Y 3/1), saturated, very soft, low plasticity, ML.

NOTE: No samples taken, pit sides caved constantly.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-25

- Coordinates (MSPC): Northing: 1033430.83 Easting: 431094.89
- Elevation: 503.25 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 11:17 a.m. 04/19/89
- Finish backfilling: 12:14 p.m.

Depth, Feet	Description
0.0-0.6	TOPSOIL: Silt, dark brown (10YR 3/3), moist, soft, low plasticity, roots, ML.
0.6-7.9	SILT: Dark yellowish brown (10YR 4/4) mottled with gray (10YR 6/1), moist at top to wet with depth, saturated at approx. 6', pp = 0.75 to 1.25, medium stiff to stiff, low plasticity, ML.
7.9-12.5	SANDY SILTY GRAVEL: Dark brown (10YR 3/6) mottled with gray (10YR 6/1), also mottled with yellowish brown (10YR 5/8), saturated, low plasticity, approx. 55% gravel (fine), approx. 10% sand, coarse grained, and approx. 35% silt, GM.

Samples Collected

TPBS-25: 0.6'-7.9'
TPBS-25: 4.1'-4.4' (Thin-walled cylinder sample; blow count = 30)

NOTE: Water table at approx. 6'.
Above sample TPBS-25: 0.6'-7.9' taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-26

- Coordinates (MSPC): Northing: 1032969.38 Easting: 431062.84
- Elevation: 497.67 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 1:05 p.m. 04/19/89
- Finish backfilling: 1:58 p.m.

Depth, Feet	Description
0.0-0.5	TOPSOIL: Dark yellowish brown (10YR 4/4), moist, soft, low plasticity, minor fine sand, roots, ML.
0.5-13.4	CLAYEY SILT: Yellowish brown (10YR 5/4) mottled with light brownish gray (10YR 6/2), moist to wet to approx. 8', then saturated, low plasticity, pp = 1.5 in upper 3', then 3.0 until saturated then soft, range soft to very stiff, ML.

Samples Collected

TPBS-26: 0.5'-13.4'
TPBS-26: 4.9'-5.2' (Thin-walled cylinder sample; blow count = 30)

NOTE: Water table at approx. 8'.

NOTE: Above sample TPBS-26: 0.5'-13.4' taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-27

- Coordinates (MSPC): Northing: 1032350.81 Easting: 431030.41
- Elevation: 488.74 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 2:02 p.m. 04/19/89
- Finish backfilling: 2:42 p.m.

Depth, Feet	Description
0.0-0.9	TOPSOIL: Silt, minor fine sand, dark yellowish brown (10YR 3/6), moist, soft, low plasticity, ML.
0.9-4.9	CLAYEY SILT: Dark brown (10YR 3/3), moist to saturated at approx. 3', soft to medium stiff, low plasticity, Fe Ox staining, ML.
4.9-10.4	SILTY SANDY GRAVEL: Generally a dark grayish brown (10YR 4/2), saturated, approx. 15% coarse gravel, 40% fine gravel, 35% coarse-grained sand, 10% silt, few cobbles, GW.
10.4-12.5	CLAYEY SILT: Dark gray (2.5Y 4/0), saturated, soft, low plasticity, ML.

Samples Collected

TPBS-27: 0.9'-4.9'

NOTE: Water table at approx. 3', pit walls badly caving.
Above sample taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-28

- Coordinates (MSPC): Northing: 1031686.41 Easting: 430597.94
- Elevation: 510.53 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 3:00 p.m. 04/19/89
- Finish backfilling: 3:54 p.m.

Depth, Feet	Description
0.0-0.7	TOPSOIL: Silt, brown (10YR 4/3), moist, low plasticity, pp = 1.0, medium stiff to stiff, roots, ML.
0.7-9.9	CLAYEY SILT: Brown (10YR 4/3) mottled with gray (10YR 6/1), moist, medium plasticity, pp = 1.5, stiff, pyrolusite, ML.
9.9-12.4	SAND: Fine grained, yellowish brown (10YR 5/4), wet, loose, SP.

Samples Collected

TPBS-28: 0.7'-9.9'
TPBS-28: 3.8'-4.1' (Thin-walled cylinder sample; blow count = 35)

NOTE: Above sample TPBS-28: 0.7'-9.9' taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-29

- Coordinates (MSPC): Northing: 1031532.02 Easting: 430195.37
- Elevation: 511.85
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 8:35 a.m. 04/20/89
- Finish backfilling: 9:59 a.m.

Depth, Feet	Description
0.0-0.5	TOPSOIL: Silt, dark brown (10YR 3/3), moist, low plasticity, pp = 1.25, stiff, roots, ML.
0.5-12.0	CLAYEY SILT: Yellowish brown (10YR 5/4) mottled with light gray (10YR 6/1), changing to gray (10YR 6/1) mottled with strong brown (7.5YR 5/8) at approx. 10', moist, low to medium plasticity, pp = 1.75 first few feet, 2.25 next couple of feet, then 1.0 at depth, medium stiff to very stiff, pyrolusite, strong brown color is iron oxide, ML.

Samples Collected

TPBS-29: 0.5'-12.0'
TPBS-29: 4.8'-5.2' (Thin-walled cylinder sample; blow count = 70)

NOTE: Above sample TPBS-29: 0.5'-12.0' taken in duplicate.

Logged by Mark Cantrell

LOG OF TEST PIT TPBS-30

- Coordinates (MSPC): Northing: 1031340.46 Easting: 429726.51
- Elevation: 514.30 ft
- Type of excavator: Cat 416 extendable backhoe
- Start excavation: 10:01 a.m. 04/20/89
- Finish backfilling: 11:06 a.m.

Depth, Feet	Description
0.0-1.0	TOPSOIL: Silt, minor fine sand, brown (10YR 4/3), moist, low plasticity, pp - 1.25, stiff, roots, ML.
1.0-1.8	SILT: Minor fine sand, light gray (10YR 7/2), moist, low plasticity, pp = >4, hard, minor pyrolusite, ML.
1.8-12.4	CLAYEY SILT: Dark yellowish brown (10YR 4/6) mottled with light brownish gray (10YR 6/2), moist to wet at depth, medium plasticity, pyrolusite, small seam (2") of fine sand at depth, pp = 2.5, very stiff to soft at depth, medium plasticity to high plasticity at depth (small amount of ML/MH), ML.

Samples Collected

TPBS-30: 1.8'-12.4'
TPBS-30: 4.9'-5.2' (Thin-walled cylinder sample; blow count = 39)

NOTE: Above sample TPBS-30: 1.8'-12.4' taken in duplicate.

Logged by Mark Cantrell

APPENDIX B-5

MATERIAL STAGING AREA TEST PIT LOGS
(TPMS-1 THROUGH TPMS-9)

TEST PIT LOG

OJECT	SITE	LOCATION	JOB NO.	TEST PIT NO.
Weldon Spring	MSA		3589	TPMS-1

NTRACTOR	EXCAVATION METHOD	SIZE	BEGUN	COMPLETED	GROUND ELEV.	GR. WATER DEPTH	LOGGED BY:
ave Kolb	Ford 755 backhoe	1 yd³	3 Aug 90	3 Aug 90	—	—	C. C. Payton

PTH	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	REMARKS PHOTOGRAPH
5	BU-01 0.0 to 6.0		SILTY CLAY, CL yellowish brown to reddish brown mottled, damp, non plastic at natural moisture, stiff – becomes plastic w/ added moisture. Some organics in the upper 0.5 ft. grass and weed roots. slight increase in moisture w/ depth	Bulk sample from 0.0 to 6.0 ft recompacted to 95% of max. dry density at optimum moisture and tested for permeability $K = 5.0 \times 10^{-8}$ cm/sec
2			SILTY CLAY, CL-CH, yellowish brown to reddish brown mottled, moist, very stiff, plastic	
3			BOTTOM OF PIT. Depth 6.5 Elev.	
4				
5				

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SHEET	TEST PIT NO.
1 OF 1	TPMS-1

H420

TEST PIT LOG

PROJECT	SITE	LOCATION	JOB NO.	TEST PIT NO.
Weldon Spring Chemical Plant	MSA		3589	TPMS-2

CONTRACTOR	EXCAVATION METHOD	SIZE	BEGUN	COMPLETED	GROUND ELEV.	GR. WATER DEPTH	LOGGED BY:
Dave Kolb	Ford 755 Backhoe		3 AUG 90	3 AUG 90	–	–	C. C. Payton

DEPTH	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	REMARKS PHOTOGRAPH
0				
1	BU-01 0' to 2'		SILTY CLAY - CL - yellowish brown, mottled, very stiff, damp; plastic at natural moisture but very difficult to mold with hand pressure. Loess ?	
2				
3	BU-02 2' to 6'		CLAY - CH - light yellowish brown and bluish gray, mottled, stiff, plastic, easily molded with hand pressure. slickensides present in the gray colored clay; some scattered open fractures - may be due to the stress applied by the backhoe bucket. Slight increase in moisture w/ depth. Ferrelview	
4				
5				
6			BOTTOM OF PIT Depth 6' Elev.	

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SHEET	TEST PIT NO.
1 OF 1	TPMS-2

H420

TEST PIT LOG

OJECT	SITE	LOCATION	JOB NO.	PIT NO.
Weld[illegible] Spring Chemical Plant Site	MSA		3589	TPMS-3.

NTRACTOR	EXCAVATION METHOD	SIZE	BEGUN	COMPLETED	GROUND ELEV.	GR. WATER DEPTH	LOGGED BY:
Dave Kolb	Ford 755 Backhoe	2 X 20	3 AUG 90	3 AUG 90	–	–	C. C. Payton

PTH	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	REMARKS ~~PHOTOGRAPH~~
0			SILTY CLAY - brownish gray, loose, roots damp - non plastic	
1			SILTY CLAY, yellowish and reddish brown, very stiff, damp, not plastic at natural moisture	
2				
3	BU-01 1º to 6º		SILT - light gray, loose, dry to damp - non plastic	Bulk sample taken from a depth of 1º ft. to 6º ft. Sample compacted to 95% of maximum dry density at optimum moisture and tested for permeability. $K = 2.0 \times 10^{-7}$ cm/sec.
4			SILTY CLAY - yellowish to reddish brown - mottled, damp to moist, very stiff barely plastic at natural moisture	
5				
6			– Increase in moisture, plastic, stiff	
7				
			BOTTOM OF PIT Depth 7º ft. Elev.	

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SHEET	TEST PIT NO.
1 OF 1	TPMS-3

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TEST PIT LOG

PROJECT	SITE	LOCATION	JOB NO.	TEST PIT NO.
Weldon Spring Chemical Plant site	MSA		3589	TPMS-4

CONTRACTOR	EXCAVATION METHOD	SIZE	BEGUN	COMPLETED	GROUND ELEV.	GR. WATER DEPTH	LOGGED BY:
Dave Kolb	Ford 755 Backhoe	2 X 15	3 AUG. '90	3 AUG. '90	—	—	C. C. Payton

DEPTH	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	REMARKS PHOTOGRAPH
0			SILTY CLAY - CL - mottled gray to reddish brown, stiff to very stiff. Some black MnOx on thin layers on linear features irregular shapes slightly plastic at natural moisture Difficult to mold with finger press. Loess	
1	BU-01 1' to 3'			
2				
3				
4			CLAY - CH - yellowish brown - gray to light bluish gray, stiff, moist, plastic w/ scattered - gravel sized sub-rounded rock fragments. slickensides and some open stress fractures, irregular. - some wet spots	
5	BU-02 4' to 6'			
6				
			BOTTOM OF PIT Depth 6' ft. Elev.	

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SHEET	TEST PIT NO.
1 OF 1	TPMS-4

EH420

TEST PIT LOG

PROJECT	SITE	LOCATION	JOB NO.	TEST PIT NO.
Weldon Spring Chemical Plant site	MSA		3589	TPMS-5

CONTRACTOR	EXCAVATION METHOD	SIZE	BEGUN	COMPLETED	GROUND ELEV.	GR. WATER DEPTH	LOGGED BY:
Dave Kolb	Ford 755 backhoe	2 x 16	3 Aug 90	3 Aug. 90	—	—	C. C. Payton

DEPTH	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	REMARKS PHOTOGRAPH
0			SILT. brownish gray, loose, damp. roots non plastic top soil - becomes plastic with added moisture	
1				
2			SILTY CLAY- CL- or a clayey silt, reddish brown, stiff to very stiff. moist, slightly plastic at natural moisture. some black MnO_x stringers and blebs of FeOx.	
3	BU-01			
4	1' to 7'			
5			Loess	
6				
7				
8			CLAY - CH: light gray. brownish reddish gray. stiff, moist to wet. plastic	
9	BU-02 8' to 10'		Ferrelview	
10			BOTTOM OF PIT Depth 10' ft. Elev.	

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SHEET	TEST PIT NO.
1 OF 1	TPMS-5

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TEST PIT LOG

PROJECT	SITE	LOCATION	JOB NO.	TEST PIT NO.
Weldon Spring Chemical Plant Site	MSA		3589	TPMS-6

CONTRACTOR	EXCAVATION METHOD	SIZE	BEGUN	COMPLETED	GROUND ELEV.	GR. WATER DEPTH	LOGGED BY:
Dave Kolb	Ford 577 backhoe	2 X 15	3 Aug 90	3 Aug 90	—	—	C. C. Payton

DEPTH	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	REMARKS PHOTOGRAPH
0			SILT - brownish gray, loose, dry, non plastic. Top Soil / roots	
1			CLAYEY SILT - ML - light reddish brown to gray, mottled, very stiff, dry to damp, non plastic at natural moisture, low dry strength. Difficult to dig with backhoe bucket. Loess	
2	BU-01			
3	1± to 5±			
4				
5				
6	BU-02 5± to 7±		CLAY - CH - light brown to light gray, very stiff, moist, plastic, high dry strength. Difficult to excavate with backhoe bucket.	
7				
			BOTTOM OF PIT Depth 7± ft. Elev.	

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SHEET	TEST PIT NO.
1 OF 1	TPMS-6

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TEST PIT LOG

PROJECT	SITE	LOCATION	JOB NO.	TEST PIT NO.
Weldon Spring Chemical Plant Site	MSA		3589	TPMS-7.

CONTRACTOR	EXCAVATION METHOD	SIZE	BEGUN	COMPLETED	GROUND ELEV.	GR. WATER DEPTH	LOGGED BY:
Dave Kolb	Ford 755 Backhoe	2 x 15	3 Aug. 90	3 Aug 90	—	—	C. C. Payton

DEPTH	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	REMARKS PHOTOGRAPH
0			CLAYEY SILT, gray, loose, dry, non plastic at natural moisture - plastic with added moisture. Top soil, roots	
1			SILTY CLAY - CL - reddish brown, dry to damp, very stiff, non plastic at natural moisture, difficult to excavate with backhoe - Clods can be broken apart with hand pressure. crumbles in hand with effort. Some MnOx stringers, black Loess	
2				
3	BU-01			
4	1° to 7°			
5				
6				
7				
8	BU-02 7° to 9°		CLAY - CH - light brown to light bluish gray, very stiff, damp, plastic - some slickensides - difficult to remold with hand pressure. Ferrelview Fm.	
9				
			BOTTOM OF PIT Depth 9 ft. Elev.	

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SHEET	TEST PIT NO.
1 OF 1	TPMS-7

CH420

PROJECT	SITE	LOCATION	JOB NO.	TEST PIT NO.
Weldon [illegible]ng Chemical Plant site	MS[illegible]		3589	TPMS-8

CONTRACTOR	EXCAVATION METHOD	SIZE	BEGUN	COMPLETED	GROUND ELEV.	GR. WATER DEPTH	LOGGED BY:
Dave Kolb	Ford 577 Backhoe	2 x 20	3 Aug 90	3 Aug 90	—	—	C. C. Payton

DEPTH	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	REMARKS PHOTOGRAPH
0			CLAYEY SILT, reddish brown, loose, dry, Top soil roots.	
1			CLAYEY SILT. ML - light reddish brown to light gray, mottled; dry to damp, stiff. non-plastic at natural moisture. becomes plastic with added moisture.	
2	BU-01 1° to 5°		Clods crumble with hand pressure.	
3			Loess	
4				
5			CLAY- CH - light bluish gray, light brown very stiff, damp to moist. plastic. scattered subrounded gravel sized rock fragments	
6				
7	BU-02 5° to 10°		some irregular open fractures and slickensides easily seen in material excavated from pit.	
8				
9			Ferrelview Fm	
10				
11			SANDY CLAY - light yellowish brown, very stiff, moist	

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SHEET	TEST PIT NO.
1 OF 2	TPMS-8

H420

TEST PIT LOG

PROJECT	SITE	LOCATION	JOB NO.	TEST PIT NO.
Weldon Spring Chemical Plant Site	MSA		3589	TPMS-8

CONTRACTOR	EXCAVATION METHOD	SIZE	BEGUN	COMPLETED	GROUND ELEV.	GR. WATER DEPTH	LOGGED BY:
Dave Kolb	Ford 577 Backhoe	2 x 20	3 Aug 90	3 Aug 90	—	—	C. C. Payton

DEPTH	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	REMARKS PHOTOGRAPH
			CLAY - CH	
11			SANDY CLAY, light yellowish brown, very stiff, moist - gritty appearance plastic	
12	BU-03 12± to 14±		SILTY SAND, reddish brown to red, damp, dense, non plastic, cohesive with some clayey sand	
13				
14			CLAY TILL	
			BOTTOM OF PIT Depth 14± ft. Elev.	

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SHEET	TEST PIT NO.
2 OF 2	TPMS-8

EH420

TEST PIT LOG

PROJECT	SITE	LOCATION	JOB NO.	TEST PIT NO.
Weldon Spring Chemical Plant Site	MSA		3589	TPMS-9.

CONTRACTOR	EXCAVATION METHOD	SIZE	BEGUN	COMPLETED	GROUND ELEV.	GR. WATER DEPTH	LOGGED BY:
Dave Kolb	Ford 577 Backhoe	2 x 20	3 Aug. 90	3 Aug. 90	—	—	C. C. Payton

DEPTH	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	REMARKS PHOTOGRAPH
0			CLAYEY SILT - gray, loose dry - top soil, roots	
1			CLAYEY SILT - ML - light reddish brown. light gray to yellowish brown - mottled. black MnO_2 stringers, stiff, damp, non-plastic at natural moisture. becomes plastic with additional moisture. low to medium dry strength. Loess.	
2				
3	BU-01 1° to 7°			
4				
5				
6				
7				
8			SILTY CLAY. CH - light reddish brown and bluish gray, very stiff damp to moist remolds with difficultly with fingers - plastic. some gravel sized rock fragments. Ferrelview Fm.	
9	BU-02 8° to 15°			
10				
11				

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SHEET	TEST PIT NO.
1 OF 2	TPMS-9

EH420

TEST PIT LOG

PROJECT	SITE	LOCATION	JOB NO.	TEST PIT NO.
Weldon Spring Chemical Plant site	MSA		3589	TPMS-9

CONTRACTOR	EXCAVATION METHOD	SIZE	BEGUN	COMPLETED	GROUND ELEV.	GR. WATER DEPTH	LOGGED BY:
Dave Kolb	Ford 577 Backhoe	2 X 20	3Aug90	3Aug.90	—	—	C. C. Payton

DEPTH	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	REMARKS PHOTOGRAPH
10			CLAY - CH - light reddish brown to light bluish gray - very stiff, damp to moist, remolds with difficulty w/ fingers - plastic - scattered gravel sized rock fragments.	
11	BU-02 8° to 15°			
12				
13			Ferrelview Fm.	
14				
15			BOTTOM OF PIT Depth 15° ft. Elev.	Test pit back filled with excavated material - no compaction - marked with a wooden stake.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

SHEET	TEST PIT NO.
2 OF 2	TPMS-9

HEH420

APPENDIX B-6

RELOGGED BECHTEL BOREHOLE LOGS
(B-3 THROUGH GMW-19)

Summary of Boreholes Relogged

B-3	(MW-2016)	GMW-1	(MW-2001)
B-4	(MW-2020)	GMW-2	(MW-2002)
B-9	(MW-4002)	GMW-2A	(MW-2002A)
B-11	(MW-4003)	GMW-3	(MW-2003)
B-17	(MW-3007)	GMW-4	(MW-2004)
B-19A	(MW-3008)	GMW-5	(MW-2005)
B-21	(MW-3009)	GMW-6	(MW-2006)
B-23	(MW-3010)	GMW-7	(MW-2007)
G-1		GMW-8	(MW-2008)
G-2		GMW-9	(MW-2009)
G-2A		GMW-10	(MW-2010)
G-3		GMW-11	(MW-2011)
G-4		GMW-12	(MW-2012)
G-5		GMW-13	(MW-2013)
G-6		GMW-14	(MW-2014)
G-7		GMW-15	(MW-2015)
G-8		GMW-16	(MW-4001)
G-9		GMW-17	(MW-2017)
G-13		GMW-18	(MW-2018)
G-14		GMW-19	(MW-4019)
G-15			
G-16			
G-18			
G-19			
G-20			
G-21			

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 15

Project Number: 5121

GEOTECHNICAL ATTACHMENT

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location: N.101532.6 W.51176.7 G.S.Elev. 635.71

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
46									Augered without sampling from 0-48.0'. For description of cuttings see original B-3 log.	
47										
48	AUGER REFUSAL								Begin Coring	48.0'
		Run 1			0%				Probable core loss for entire run; no core found for this interval. See original log for description of this interval.	
49		0 / 6.8' 0%								
50										
51										
52										
53										

Geotechnical Information by
Paul Patchin 11/1/89

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 15

Project Number: 5121

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location: North of Disposal Cell Area

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
53		Run 1 cont.							Core Loss, as above.
54									54.8'
55									Drilled from 54.8' to 57.7' with 6" roller bit.
56									
57									
58									Resume Coring 57.7'
58		Run 2 4.7'/4.7' 100%		1	1.7'/4.7' 36% L.P. = .5'	5	Rubble Open, rough Tight, rough Open, smooth cly Open, stylolitic FeOx, MnOx		57.7-63.2' LIMEY SILTSTONE (50%) and CHERT (50%) intermixed & finely divided. Siltstone is permeable, grayish orange (10YR 7/4) to approx. 58.9' then is light olive gry. (5Y 6/1); minor reaction to HCL solid or powdered, med. hard, no fossils, slightly to mod. wthrd, no MnOx specks, FeOx stain to 59.0'. CHERT is white (N9) to light bluish gray (5B 7/1), vuggy, v. hard,
59					4 >		Tight, rough (2) FeOx		
					4"	3	Tight, rough Open, rough		
60									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 15

Project Number: 5121

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
60		Run 2 cont		1		5	Open, rough Tight, rough Open, rubbly Vert., tight, rough		slightly to mod. wthrd. (bone-marrow texture), fossiliferous, siltstone is also slightly argillaceous.
61						4	Open, rough Open, rough 28° glauc. cly Tight, rough (2) Tight, rough 32°		
62							Open, rough		
		62.4							
		Run 3		1	1.7'/3.5'	2			
63	WEATHERED LIMESTONE ↑ ↓ COMPETENT LIMESTONE	3.5'/3.5' 100%			49% L.P. = .7'	3	Open, rough, contact Open, rough Tight, rough, rubbly Tight, smooth, 28°		63.2-64.4' LIMEY SILTSTONE & CHERT as above but less wthrd. (slightly wthrd.), no vugs, hard.
64					3 > 4"	5	Open, rough, glauc. cly (2) Open, spun, glauc. (3)		64.4-143.9' LIMESTONE with approx. 30% CHERT as nodules and minor intermixing. Limestone is yellowish gray (5Y 8/1) to light olive gray (5Y 6/1) with minor med. gray (N5) zones; finely to coarse crystalline w/minor silty zones, slightly weathered to fresh, fossiliferous (brachs, crinoids, bryozoa) stylolitic with carb. cly filling; occas. pyrite (oxidized) replacement in fossils, minor solutioned zones with vugs pinpoint to 3cm.
65							Rubble (chert)		
		65.9'				6	Open, rough Tight, smooth Open, stylolitic		
66		Run 4 4.5'/4.5' 100%		1	1.5'/4.5 33% L.P. = .6'	2	Stylolite Tight, smooth		
67									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 15

Project Number: 5121

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
67		Run 4 cont.		1	3 > 4"	6	Open, spun Open, rough Open, spun Open, rough Open, smooth 18°		CHERT is white (N9) with mottled light bluish gray (5B 7/1), v. hard, fractured (many healed w/calcite), occasionally vuggy with euhedral calcite & quartz filling, fossilferous, slightly weathered to fresh, minor FeOx and MnOx staining. Some concretionary banding. (Also see original Bechtel B-3 log for additional description of limestone).
68							Open, spun		
						> 6	Spun Spun		
69							Chert rubble		
						> 6	Open, rough, FeOx minor cly Open, stylolitic rough calcite xls		
70							Tight, rough Open, rough		
		70.4				2	Open, rough, rubbly		
		Run 5		1	1.5'/2.8'		Tight, healed, vert		
71		2.8'/2.8'			54%		Open, stylolitic Stylolite		71.7'-72.8' Chert, mottled, fractured, rubblized.
					L.P. = .6'	> 6	Vert, tight, healed Open, rough (2)		
		100%							
72					3 > 4"		Chert rubble Open, rough (2) Rubble		
						> 6	Open, smooth (5)		
73							Open, rough, vuggy, contact		
		73.2'							
		Run 6 .8'/.8' 100%		1	.8'/.8' 100% L.P. = .8'	0			
74									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 15

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
74		Run 7 3.7'/3.7' 100%		1	1.9'/3.7' 51% L.P. = .6'	> 6	Chert rubble		LIMESTONE & CHERT as above.
							Open, stylolitic carb. cly		74.7-75.5' Silty Limestone & Chert intermixed, vuggy, permeable.
75							Open, rough		
					4 > 4"	4	Tight, rough		75.5'-96.6' Approximately 20% Chert.
							Open, smooth		
76							Open, rubbly, rough		
						2	Open, stylolitic glauc, carb cly		
							Tight, smooth		
77						2	Open, stylolitic carb. cly		
		77.7'							
78		Run 8 5.0'/5.0' 100%		2	2.8'/5.0' 56% L.P. = 1.2'		Tight, smooth		
						5	Tight, smooth		
							Open, rough, rubbly FeOx (2)		
79							Open, rough (3) rubbly		79.0'-79.9' Silty Limestone & chert, as before, rubblized.
					5 > 4"	> 6	Rubble		
			? 79.9				Open, rough		
80						2	Open, spun		
			80.3 ?				Open, rough, FeOx		
81									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 15

Project Number: 5121

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
81		Run 8 cont.		2		1	Tight, rough, FeOx		LIMESTONE & CHERT, as above.
82						1	Open, stylolitic blk. carb. cly (abund) Stylolite		82.2-82.8' Dark, carbonac. (med. gray (N5) very fossiliferous with abund. crinoid stem pieces. Bordered at top & bottom by stylolites.
		82.7							
83		Run 9 3.9'/3.9' 100%		2	2.3'/3.9' 59%	2	Spun Stylolite		
84						1	Open, spun, stylolitic Stylolite		
85							Open, stylolitic carb. cly		
							Open, stylolitic spun		
86						> 6	Chert rubble		
		86.6				3	Tight, rough (2)		
87		Run 10 2.8'/2.8' 100%		2	.9'/2.8 32% L.P. = .9	> 6	Open, rough (2) Open, spun Open, rough Open, smooth, bryozoa Tight, rough Open, rough Tight, rough Open, smooth (2)		
88									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 7 of 15

Project Number: 5121

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
88		Run 10 cont.		2	1 > 4"	5	Open, rough (2) Open, smooth Open, rough Tight, rough		LIMESTONE & CHERT, as above Abund. healed fracts.
89		89.4				4	Open, smooth (2)		
		Run 11 1.5' / 1.5' 100%		2	.5' / 1.5' 33% L.P. = .5'		Open, rough Tight, smooth 40° Calcite xls, 5mm		
90						3	Open, rough		
		90.9					Open, rough Tight, rough		
91		Run 12 5.0' / 5.0'		2	3.7' / 5.0' 74% L.P. = .7'	2	Open, stylolitic		91.3-92.5' Silty Limestone with vuggy chert.
92						4	Open, rough, rubble Tight, rough (2)		
					8 > 4"		Open, spun, stylolitic, carb. cly		
93						2	Open, spun Tight, smooth		
94							Open, stylolitic blk carb cly		
						3	Open, rough (3)		
95									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 8 of 15

Project Number: 5121

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
95		Run 12 cont.		2		2	Open, rough Tight, smooth		LIMESTONE & CHERT, as above
96		95.9							
		Run 13	96.5	2	3.5/5.0	1	Tight, rough		96.6-148.6' Approx. 10% CHERT as nodules. No intermixing
		5.0'/5.0'		3	70% L.P. = .9'				
97		100%					Stylolite		
					5 > 4"	3	Tight, rough Open, rough		
98							Tight, rough		
						2	Open, rough, contact 26° Stylolite		
99							Tight stylolitic glauc. Stylolites (2)		99.0-102.0' Abundant crinoid stems (fossil hash)
						1	Tight, rough, stylolitic		
100									100.3' - Pyrite replacement of fossil on fracture.
						3	Open, rough, stylolite FeOx Vert. tight, smooth, calcite		
101		100.9					Open, stylolite, carb cly Stylolite		
		Run 14 5.0'/5.0' 100%		3	3.9/5.0 78% L.P. = .9'	1	Open, stylolitic		
102									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 9 of 15

Project Number: 5121

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
102		Run 14 cont.		3	7 > 4"	2	Spun		LIMESTONE & CHERT, as above
							Open, stylolitic carb. cly		
103									
						> 6	Open, spun fossil		
104									
						> 6	Open, smooth		
105							Tight, rough		
						3	Open, rough		
		105.9							
106							Spun, stylolitic		
		Run 15 5.0'/5.0' 100%		3	2.6'/5.0' 52%		Open, smooth Open, spun (2)		
107					L.P. = 1.2'		Open, spun Open, rough Spun		106.9-107.9' Slightly argillaceous. 107.3'-Circular chert nodule 4cm diameter.
					4 > 4"		Open, smooth, MnOx		
108							Vert tight, smooth Open rough (2)		
109									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 10 of 15

Project Number: 5121

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
109		Run 15 cont		3		6	Open rough		LIMESTONE & CHERT, as above.
110							Spun (8)		
		110.9				4	Tight, rough		
111		Run 16 1.1'/1.1' 100%		3	1.1'/1.1' 100% L.P. = .6'	1	Stylolite Open, smooth 30°		
112									
		Run 17 5.0'/5.0' 100%		3					Note: Run 17 has approx. .9' MORE CORE than it should. Unable to determine why. Core before and after Run 17 measures out correctly. Cannot determine fracture locations or RQD in this run.
113									
114				4					
115									
116									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 11 of 15

Project Number: 5121

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
116		Run 17 cont.		4					LIMESTONE & CHERT, as above.
117									
		Run 18 5.0'/5.0'		4	3.6'/5.0' 72% L.P. = .7'	> 6	Open, smooth (2)		
							Open, spun		
118									
					6 > 4"	2	Open, rough		
							Open, spun, stylolitic		
119									
						2	Open, spun Stylolitic, weak		
120							Open, stylolitc, glauc. cly		
						2	Open, stylolitic		
121									
						1	Open, stylolitic Stylolite		
122									
		Run 19 1.1'/1.1' 100%		4	.7'/1.1' 64% L.P. = .7'	> 6	Open, spun Rubble		122.7'-123.5' Chert nodule, fractures, v. hard with (cont'd)
123									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 12 of 15

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
123	123.1'	Run 20 3.9'/3.9' 100%		4	2.5'/3.9' 64% L.P. = 1.1'	> 6	Rubble cont. Tight, smooth		concretionary banding.
124					3 > 4"	2	Open, smooth Open, rough		
125						3			
126						> 6	Open, rough, stylolitic carb cly FeOx Open, spun (8) Vert.,tight,smooth Tight, smooth Open, spun (2)		
127		Run 21 2.3'/2.3' 100%		4	.9'/2.3 39% L.P. = .5'	> 6	Tight, rough Open, rough Tight, rough Rubble		127.8'-129.4' Vuggy dolomitic ? limestone (slow HCL reaction but low permeability), & rubblized chert band (.3'). Abund. drusy quartz vug filling at 128.8'. Vugs pinpoint to 1cm.
128						> 6	Open, smooth (2) Open, rough Rubble Open, rough, vuggy drusy qtz		
129		129.3' Run 22 4.9'/4.9'		4	2.0'/4.9' 41%	2	Tight, smooth Open, rough		
130									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 13 of 15

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
130		Run 22 cont.		4	4 > 4"				LIMESTONE & CHERT, as above
							Tight, smooth, 22°, carb cly		
							Chert rubble		
131							Open, spun		
							Tight, smooth		
							Open, spun Stylolite		
132									
							Open, smooth Vert. tight, rough FeOx bleb		
133				133.1 5			Tight, rough		
							Tight, rough (2)		
134		134.2					Tight, rough		
		Run 23 4.8'/4.8' 100%		5	3.9'/4.8' 81% L.P. = 1.6'		Tight, smooth		
135							Stylolite		
					4 > 4"		Stylolite, weak		
136							Tight,smooth (2)		
							Stylolites (2)		
137									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 14 of 15

Project Number: 5121

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
137		Run 23 cont.		5						
							Tight, rough 8°			
138							Open, smooth 15°			
							Stylolite			
							Open, rough			
139							Chert, rubble			
		Run 24 4.9' / 4.9' 100%		5	3.7 / 4.9 76%		Open, rough			
							Stylolites (2)			
					L.P. = 1.5'		Tight, rough			
140							Open, smooth (2)			
					6 > 4		Open, 4mm, stylolitic, carb. cly			
141							Stylolites (3)			
142							Tight, smooth			
									Brachiopods	
							Open, stylolitic carb. cly			
143							Open, stylolitic carb. cly		143.5-143.7' Solution cavity with euhedral quartz & calcite infilling. Also drusy qtz.	
		143.9'					Rubble			
144										

Rubble

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 15 of 15

Project Number: 5121

Hole Number: B-3 (MW-2016)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
144		Run 25		5	1.6'/4.7'		Rubble		143.9-148.6' SILTY LIMESTONE vuggy, pinpoint to 5mm. Approx. 30% CHERT which is occasionally weathered, and brecciated with light blue gray clasts in white groundmass.
							Tight, smooth		
		4.7'/4.7'			34%		Tight, rough, vuggy		
145		100%			L.P. = .5'		Open, smooth, contact		
							Open, rough, rubbly		
					4 > 4"		Tight, smooth, 23°		
146							Open, rough rubbly		
							Open, rough MnOx		
							Rubble		
147							Open, rough, stylolitic carb. cly		
							Tight, rough 15°		
							Open, stylolitic carb. cly		
148							Open, smooth		
							Vert, smooth		
						6	Chert Rubble		Stop Coring at 148.6'.
149									Roller-bit? drilled to 150.5 T.D.
150									Total Depth 150.5'

Note: RQD % determined on boxed core. Actual RQD as retrieved from core-barrel may be higher.

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 13

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-4 (MW-2020)

Project: BECHTEL Geotechnical Logging

Location: N.99548.3 W.49549.1 G.S.ELEV. 655.46

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Rotary drilled from surface to 36.5'. Estimated top of rock at 23.7'. For cuttings descriptions of 0-36.5' see original B-3 log.
36									
	36.5								BEGIN CORING AT 36.5'.
37		Run 1 2.3'/2.5' 92%		1	1.0/2.5 40% L.P. = .6'	3	Tight, rough FeOx 30° Open, FeOx, rough 48°		36.5'-37.0' CHERT, yellowish gray (5Y 7/2) to dark yellowish orange (10YR 6/6), v. hard fractured (healed), moderately wthrd., FeOx stn. and specks and MnOx fract. filling. 37.0'-38.0' LIMESTONE, very pale orange (10YR 8/2) coarsely crystalline, hard, mod. wthrd, fossiliferous, abund. hematite after pyrite replacement of fossils, FeOx stained. 38.0'-42.2' INTERBEDDED & RUBBLIZED LIMESTONE, CHERT & SHALE. L.S. & Chert finely divided together (40% total) L.S. is severely wthrd, pale yellowish orange (10YR 8/6) soft, argillaceous. Chert is light gray (N7) hard, mod. wthrd. SHALE is light olive gray (5Y 5/2), broken to thin plates 1cm long, fissile, soft, mod. wthrd. Glauconitic clay filling in L.S. & possible void at approx. 41.2'
38					2 > 4"	> 6	Spun, FeOx Rubble Open (1mm) rough FeOx, MnOx Rubble Fissile Clay		
39			? 38.8						
40		Run 2 3.8'/5.0' 92%	?	1	.4'/5.0 8% L.P. = .4'	> 6	1.2' of core loss in 39.1 - 41.7' interval. Probably in 40.0-41.2' interval described as "void, losing all circulation". Entire interval is chert and fissile (cont.)		
41					1 > 4"	> 6			

Geotechnical Information by
Paul Patchin 11/9/89

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 13

Project Number: 5121

GEOTECHNICAL ATTACHMENT

Hole Number: B-4 (MW-2020)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
41		Run 2 cont		1		> 6	Shale rubble w/ minor glauc. cly		
42							Open (3mm) rough FeOx cly.		42.2-44.0' ARGILLACEOUS LIMESTONE (65%) & CHERT (35%) finely divided together. L.S. is dark yellowish orange, (10YR 6/6), severely wthrd. & solutioned, vuggy, abund. FeOx stain, medium hard to soft rubbly with clay fract. filling. CHERT is light gray (N7) to grayish orange (10YR 7/4) hard, mod. wthrd., fractured with MnOx infilling.
						> 6	Open, rough, vuggy (2cm) abund. FeOx Rubble w/clay		
43						4	Open (1cm) rough vuggy, abund FeOx Open (2cm) rough vuggy, abund FeOx Open (1cm) rough vuggy, abund FeOx (2)		
44		Run 3 4.9'/4.9' 100%		1	4.4'/4.9' 90% L.P. = .8' 8 > 4"	2	Open, spun, vuggy w/marcasite to 1cm, abund. FeOx		44.0-47.5' ARGILLACEOUS LIMESTONE & CHERT, as above but only mod. weathered and occasionally solutioned. L.S. has MnOx specks throughout matrix & stringers. CHERT is finely divided and nodular to .2', fossiliferous. Vug in L.S. at 44.5' with marcasite xls to 1cm. L.S. is fossiliferous. Approx. 50% chert from 45.6' to 47.5'.
45							Tight, rough, FeOx, MnOx		
						2	Open, smooth, 18° FeOx, MnOx Stylolite, weak		
46						> 6	Tight, rough, FeOx, MnOx (3)		
47							Vuggy Rubble		
	Weathered Limestone 47.5					1	Open (4mm) stylolitic FeOx, clay		47.5-55.5' LIMESTONE (60%) & CHERT (40%) intermixed. L.S. is yellowish gray (5Y 7/2) (predominant) to occasionally
	Competent Limestone								
48									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 13

Project Number: 5121

Hole Number: B-4 (MW-2020)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
48		Run 3 cont. 48.9		1		2	Tight, rough, MnOx Stylolite, weak		grayish orange (10YR 7/4) (FeOx), thickly bedded, fossiliferous, slightly argillaceous & silty, slightly to mod. weathered, hard, slightly stylolitic. Medium light gray (N6) and very fossiliferous from 51.3'-51.5' finely to coarsely srystalline CHERT is predominantly finely divided with limestone, also nodular to .3', fractured, mottled light bluish gray (5B 7/1) to med. light gray (N6), very weathered and rubblized from 51.5' - 51.8' with FeOx stain.
49		Run 4 2.7'/2.7' 100%		1	2.1'/2.4' 87% L.P. = 1.1'	2	Spun, FeOx Stylolite		
50					3 > 4"	1	Open, 12°, rough FeOx, MnOx		
51		51.6'				> 6	Open, spun, FeOx Stylolite Open, stylolitic carb. cly (2) Open, rough, FeOx		
52		Run 5 2.4'/2.4' 100%		1	1.7'/2.4' 71% L.P. = .9'		Chert Rubble		
53					3 > 4	3	Open, spun Open, spun, FeOx Cly Tight, rough, Stylolite Open, stylolitic FeOx broken Stylolites (2)		
54						1			
55		Run 6 4.7'/4.7' 100%		1	1.8'/4.7' 38%	1	Tight, smooth, 35° MnOx		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 13

Project Number: 5121

Hole Number: B-4 (MW-2020)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
55		Run 6 cont.		1	L.P. = .9'	4	Tight, rough Open(2mm) stylolitic carb. cly Stylolite weak		55.5'-67.8' CALCAREOUS SILTSTONE (50%) & CHERT (50%). SILTSTONE is light olive gray (5Y 5/2), permeable, slightly weathered, mod. hard to hard. Stylolitic with carb. & glauc. clay infilling, minor fossils (darker). CHERT is light bluish gray (5B 7/1) to light olive gray (5Y 6/1) to white. Finely divided & nodular, fossiliferous. Nodule (bed) from 56.8' - 59.4' with minor interbedded siltstone, brecciated with angular pieces at 61.0-61.3', vuggy and weathered from 62.5'-65.1' with quartz infilling in vugs. Rubblized from 60.0-60.8', weathered and abundant glauconitic (green) and light gray (N7) clay.
56				56.2	3 > 4"	5	Open, stylolitic carb cly (2) Open (1cm) fissle cly, stylolitic Open, stylolitic carb cly (2)		
57						> 6	Open (1cm) stylolitic carb & FeOx cly Open, spun Tight, rough, carb & fissle clay		
58		58.7				5	Rubblized Chert Tight, smooth Open, smooth Open, rough (2)		
59		Run 7 4.9'/4.9' 100%		2	3.1'/4.9' 63% L.P. = 1.0'	5	Open, rough Open, smooth Open (2mm) stylolitic carb cly (2) Open, spun, stylolitic		
60					4 > 4"	> 6	Open, spun, stylolitic carb cly abund. FeOx Rubble with Glauconitic cly		
61						1	Open (1mm) stylolitic carb. cly.		
62									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 13

Project Number: 5121

Hole Number: B-4 (MW-2020)

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
62		Run 7 cont.		2		1	Tight, rough, vuggy		CALCAREOUS SILTSTONE and CHERT as above
63									
		63.6				1	Tight, rough		
64		Run 8		2	3.8'/4.8'		Tight, smooth		
		4.8'/4.8' 100%			79% L.P. = .8'	3	Spun		
65					8 > 4"		Open, rough (3)		
						5	Tight, rough		
66							Open, smooth		
						2	Open (2mm) stylolitic carb cly		
							Tight, smooth		
							Soln cavity with $CaCO_3$ & Qtz		
67							Tight, smooth		
						2	Open, smooth (1mm) glauc.		67.8'-80.0' LIMESTONE (80%) and CHERT (20%) (nodular). L.S. is yellowish gray (5Y 7/2), finely to coarsely (fossiliferous) crystalline, hard, v. slightly weathered to fresh, stylolitic, thickly bedded, CHERT is nodular to .6', white
68							Open, smooth, 12°, carb. cly.		
		68.4				> 6	CHERT Rubble		
		Run 9 4.8'/4.8'		2	2.7'/4.8' 56%		Vert. tight		
69									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 6 of 13

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-4 (MW-2020)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
69		100%		2	L.P. = .8'	3	Open, rough (2) Stylolite		(N9) to light bluish gray (5B 7/1), fossiliferous, very hard, slightly wthrd to fresh, fractured with MnOx.
					4 > 4"		Tight, rough		
70						2			
							Open, rough, rubbly (2) Tight, rough		
71						3	Stylolite, weak Tight, rough		
72									
						> 6	Open, vert, smooth Open, rough		
73		73.2					Chert Rubble		
		Run 10		3	3.7' / 4.9'	> 6	Tight, rough		
74		4.9' / 4.9'			75%				
		100%			L.P. = 1.4'	2	Tight, rough		
75					5 > 4"		Tight, rough Vert, tight		
						3	Tight, rough, contact Stylolite, weak		
76									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 7 of 13

Project Number: 5121

Hole Number: B-4 (MW-2020)

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
76		Run 10		3		2			Limestone and Chert, as above.
77							Spun (2)		
						> 6	Spun (2)		
78		78.1'					Rubble		
		Run 11		3	3.6' / 4.9'	> 6	Open, smooth		
		4.9' / 4.9'			73%				
79		100%			L.P. = 1.0'		Tight, smooth		
						3	Open, spun		
							Tight, rough, rubbly		
					5		Vert., tight smooth MnOx		
80					4"		Open (1mm) stylolitic carb. & gray clay, Rubble		80.1-83.0' SILTY LIMESTONE (70%) & CHERT (30%) finely divided together. L.S. is light olive gray (5Y 5/2) hard, slightly permeable. CHERT is light bluish gray (5B 7/1) to white, slightly vuggy (pinpoint). Rubblized from 82.8-83.0'.
						> 6			
81							Vert, tight, rough		
						3	Open (1mm) stylolitic carb. clay		
82							Open, stylolitic carb. cly.		
						> 6			
83							Rubble		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 8 of 13

Project Number: 5121

Hole Number: B-4 (MW-2020)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
83		Run 12 4.8'/4.8'		3	4.4'/4.8' 92% L.P. = 1.9' 3 > 4"	2	Open, rubbly, spun Spun, stylolitic Stylolite		83.0-119.6' LIMESTONE (90%) with nodular CHERT (10%). Limestone is light gray (N7) to minor medium light gray (N6), hard to very hard, fresh to minor slightly weathered, stylolitic with carbonaceous clay, finely to coarsely crystalline, locally very fossiliferous, massive, locally recrystallized? and slightly weathered at 109.6-113.1' CHERT is light gray (N7) to white (N9), nodular, v. hard, fresh, fossiliferous, fractured, locally banded (concretionary). Nodules to .6' thick.
84						0			
85						2	Open, smooth, 8° Stylolitic, weak Stylolite		
86						2	Stylolite Tight, stylolitic, carb cly. Stylolite, weak		NOTE: See also description of bedrock on original B-4 log.
87		87.8				1	Tight, stylolite		
88		Run 13 5.0'/5.0'		3	4.6'/5.0' 92% L.P. = 1.6' 6 > 4"	1	Stylolite Open, stylolitic broken Stylolite		
89						3	Open, stylolite carb, cly. Stylolite Tight, stylolitic Stylolite, weak		
90									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 9 of 13

Project Number: 5121

Hole Number: B-4 (MW-2020)

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
90		Run 13 cont		3		2	Tight, stylolite Stylolite Tight, rough		LIMESTONE, as above
91						0			
92				4		5	Vertical, tight rough Open, stylolitic carb. cly. Stylolite Tight, rough Spun Spun		
		92.8							
93		Run 14		4	4.2'/4.8'	1	Stylolite Tight, smooth		
		4.8'/4.8'			87%				
94		100%			L.P. = 1.1'	1			
					6 > 4"		Spun, 5°		
95						1	Spun		
96						2	Spun Tight, rough 12°		
97									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 10 of 13

Project Number: 5121

Hole Number: B-4 (MW-2020)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
97		Run 14 cont 97.6		4		2	Tight, rough		LIMESTONE, as above
98		Run 15 4.9' / 4.9' 100%		4	4.6' / 4.9' 94% L.P. = .7'	2	Open, spun, stylolitic, carb. cly. Tight, contact		
99					8 > 4"	> 6	Open, solution cavity, calcite xls Tight, rough		
100						> 6			
101						2	Open, stylolitic carb. cly. Spun, rubbly		
102		102.5				3	Open, smooth		
103		Run 16 4.6' / 4.8' 96%		4	3.6' / 4.6' 75% L.P. = 1.5'	1	Tight, stylolitic Stylolite, weak, open carb. cly Spun 8° Tight, rough		
104									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 11 of 13

Project Number: 5121

Hole Number: B-4 (MW-2020)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
104		Run 16 cont.		4	4 > 4"	1	Stylolite, weak Spun, stylolitic carb. cly.		LIMESTONE, as above	
105						0	Stylolite			
106			106.1 – 106.3			4	Open, rough Open, rubbly, stylolitic Vert., tight, smooth			
107		107.3				1	Open, stylolitic carb. cly			
		Run 17 4.4'/4.4'		4	4.2'/4.4' 95%	1	Open, stylolitic carb. cly.			
108					L.P. = 2.0'	0				
109					4 > 4"	2	Stylolite, open weak, carb. cly Tight, rough			
110						1	Open, rubblized			
111				5						

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 12 of 13

Project Number: 5121

Hole Number: B-4 (MW-2020)

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
111		Run 17 cont. 111.7		5		1	Tight, rough		LIMESTONE, as above
112		Run 18 2.1'/2.1' 100%		5	1.1'/2.1' 52% L.P. = .7'	6	Tight, smooth, contact; Spun, contact; Spun (5)		
113		113.8			2 > 4"	3	Tight, rough		
114		Run 19 4.7'/4.7' 100%		5	2.8'/4.7' 59% L.P. = 1.4'	> 6	Spun, contact; Rubble (possible soln. cavity w/ drusy qtz)		
115					4 > 4"	> 6	Tight, smooth shaley (3) coral fossil; Spun; Tight, rough (2)		
116						3	Open, rough, rubbly (2); Tight, rough; Spun, stylolitic carb. cly		
117						2	Spun; Open, rough, 10°		
118							Open, (2mm) stylolitic, carb cly		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 13 of 13

Project Number: 5121

Hole Number: B-4 (MW-2020)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
118		Run 19 cont.		5		1			LIMESTONE, as above
	118.5	Run 20 1.1'/1.1' 100%		5	.6/1.1 54% L.P. =.6 1 >4"		Tight, rough		
119							Tight, rough		Total Depth 119.6'

NOTE: RQD measured on boxed core. Actual RQD values may be higher.

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 7

Project Number: 5121

Hole Number: B-9 (MW-4002)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION / CEMENTATION, HARDNESS, WEATHERED STATE
									0-41' drilled with 6" rock bit and compressed air. For a description of the cuttings see original log.
		41.6'	41.0'						Begin Coring @ 41'
41		Run 1. 1.6'/3.0' 50%		1	0.4'/3.0' 13% LP= 0.4'	7 6			41.0'-56.2' silty, argillaceous limestone and chert. LIMESTONE: massive to medium bedded (0.05' thick). moderate yellowish brown (10YR 5/4) to grayish orange (10YR 7/4) Medium hard, moderate to moderately severe weathering. Chert: light gray (N7) to dark yellowish orange (10YR 4/6) very hard to medium hard. Slight to severe weathering. Chert occurs as discrete layers up to 1.5' thick and as finely divided masses within limestone. Ratio of limestone : chert 42.8'-44.0' 0 : 100 44.0-56.2 60 : 40
42			42.5			7 6	chert + ls nubble open, rough, MnOx blebs open (0-3cm), rough open (0-1cm), rough MnOx dendrites		
43		44.0'		1		7 6	open (0-4cm), rough FeOx stain, chert nubble tight, smooth, MnOx staining (2) open (0-3cm), rough (2)		
44		Run 2. 4.6'/4.6' 100%		1 1	1.0'/4.6' 22% LP= 0.4'	7 6	open (0-5mm) rough open (0-2cm) rough stylolite? open (0-5mm), rough (4)		
45									

Geotechnical Information by D. Dahlstrom 5/10/90

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 7

Project Number: 5171

Hole Number: B-9 (MW-4002)

Project: Bechtel Geotechical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
45		Run 2 (cont)		1		7 6	open (0-5mm), rough MnOx blebs (2) spun; open (0-5mm) rough MnOx blebs (4)		silty, argillaceous limestone and chert as above
46						4	open (0-1cm), rough; open, rough, 90° dip, MnOx blebs spun; open, rough		
47						4	tight, rough, silica coated; open, rough, 20° dip; open, rough (4)		
48		48.6'	48.6'	1		7 6	10° dip		
		Run 3 3.6'/4.8' 75%	49.2'	1	0.4'/4.8' 8% LP= 0.4'		rubble		
49						7 6	open, rough spun; open, rough (2)		
50						6	tight, smooth, FeOx stain (2); open, rough, stylolite? stylolite - strong; tight, rough; open (0-5mm), rough		
							open, rough; open (0-1cm), rough, clay lined		50.9 - 53.4' "bone marrow" chert
51						7 6	open (0-5mm) rough (3); open, rough (2); rubble		
52				1			open (0-2cm), rough		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 7

Project Number: 5121

Hole Number: B-9 (MW-4002)

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
52		Run 3 (cont)		1		7	open, rough (4) rubble		silty, argillaceous limestone and chert as above.
			52.8			6	rubble		
53		53.4'		1					
		Run 4 4.0'/4.1' 98%	53.5	1	Q'/4.1' 0%	7 6	open, rough open (0-2cm), rough open, rough (4)		
							open, rough rubble open (0-1cm), rough (6)		
54						7 6	open (0-5mm) spun, rough (6)		
55							open (0-1cm), rough (3)		
							spun (2)		
56							open (0-1cm), rough, clay-lined (2)		56.2-71.6 micritic to very coarsely crystalline, fossiliferous, stylolitic limestone and chert, with minor argillaceous limestone beds to 66.8'.
							open, smooth, FeO2 stain open (1cm), rough, rubble		
							open, rough, 15° dip		stylolite?
							open, rough, clay-lined open (0-2cm), rough		
57							open (0-1cm) rough (2)		Limestone: crystalline layers light gray (N7) to medium light gray (N6). micritic portions grayish orange (10YR 7/4). Mottled layers range from matrix to grain supported. Medium hardness.
		57.5'	57.5	1			open, rough rubble		
		Run 5' 4.3'/4.7' 91%	57.9	1	2.1'/4.7' 49% LP= 0.65'		open, rough		
58							stylolite - broken (3)		← tooth plunge @ ~65° (see 71.7') moderate to moderately severe weathering
59				1			stylolite - strong		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 7

Project Number: 5121

Hole Number: B-9 (MW-4002)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	DISCONTINUITIES: FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
59		Run 5 (cont)		1		1	spun (4)		56.2 – 71.6 (continued) Chert: white (N9) to light gray (N7) to dark yellowish orange (10YR 6/6). Very hard to hard. Very slight to moderate weathering. Chert generally highly fractured. Chert occurs as discrete layers and irregularly-shaped modules.
60						6	fossiliferous; open, rough 80° dip; open, rough spun		
61						5	open (0-5mm), rough; open, rough 80° dip; open, rough (3)		Ratio of limestone: chert 56.2 – 57.3 70 : 30 57.9 – 64.4 100 : 0 64.4 – 71.6 80 : 20 very coarsely xtlin – fossiliferous
62		62.2' Run 6 3.8'/4.3' 88%		1 1 1 2	1.1'/4.3' 26% LP = 0.4'	>6	open (0-2cm), rough; open (0-1cm), rough; open, rough; open (0-5mm), rough (4); open, rough; stylolite		
63						3	open (0-5mm), rough (2); open, rough		
64						>6	open (0-1cm), rough; spun; open, rough; open (0-1cm), rough; open, rough (2); chert rubble		highly fractured chert – numerous mechanical fractures – FeOx stained
65			65.0' 65.5'			>6	open, rough		
66				2			open (0-1cm), rough		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 7

Project Number: 5121

Hole Number: B-9 (MW-4002)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
66		Run 6 (cont)		2			open, rough (4) rubble		micritic to crystalline limestone and chert as above	
		66.5'		2		>6				
		Run 7		2	1.8'		open (>1cm), rough			
		4.9' / 4.4'			4.4'		open (0-1cm), rough			
67					41%		open, rough open (0-1cm), rough			
		44%			LP= 0.8'	>6	open, rough (4) rubble			
						>6	rubble			
							open, rough, 80° dip			
69							tight, rough (2)		clay parting	
						>6	open, rough (2) clay-lined rubble			
70						6	open, rough, clay-lined (4)			
		70.9'		2			open (0-8mm), rough			
		Run 8		2	3.2'		open, rough			
71	weathered limestone 71.6'	4.4' / 4.4'			4.4'	>6	light, rough, MnOx stain open (0-5mm), rough, MnOx stain (4) open, smooth 90° dip		71.6-84.8' micritic to very coarsely crystalline, fossiliferous, stylolitic limestone and chert.	
	competent limestone	100%			75% LP= 1.9'		chert rubble			
							open, rough 30° dip		Limestone: massive bedded. Light gray (N7) to medium gray (N5). Moderately hard fresh weathering.	
72						2	numerous healed fractures in limestone			
73				2			light, rough, MnOx stain			

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 7

Project Number: 5121

Hole Number: B-9 (MW-4002)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
73		Run 8 (cont)		2		1	stylolite (7) (6 strong) broken		shelly partings 73.1 – 73.5. no fractures along partings 74.6 – 84.8 (continued) chert: white (N9) to light gray (N7). very hard to hard. Fresh to very slight weathering. Generally highly fractured.
74						0			Teeth have non-vertical plunge
75		75.3'		2					Chert occurs as discrete layers, many terminate against stylolites, fractures occur along most contacts.
		Run 9 4.0'/4.0' 100%		2	3.1'/4.0' 78% LP= 1.1'	1	light, rough stylolite-strong (3)		
76						7	(mechanical fracture)		
						6	open, smooth (2) chert rubble		
							stylolite-strong (2)		
77						2	open (0-1cm), rough		
							open, rough		
78						2	open, rough (2)		
79		79.3'		2					
		Run 10 2.9'/2.9' 100%		2	1.2'/2.9' 41% LP= 0.6'	1	open, rough stylolite strong		
80									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 7 of 7

Project Number: 5121

Hole Number: B-9 (MW-4002)

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
80		Run 10 (cont)		2		> 6	stylolite - open open, rough, fossiliferous open, rough, silica coated (3) 85° dip open (0-5mm) rough (6)		micritic to very coarsely crystalline limestone and chert, as above.
81						2	fossiliferous		
		82.2'							
		Run 11 1.5'/2.6' 58%			1.2'/2.6' 46% LP= 0.65'	1			
83							stylolite - mechanically fractured		
			83.7'			> 6			
84						> 6			
		84.8'							Total Depth = 84.8'
			84.2'						

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 8

Project Number: 5121

Hole Number: B-11 (MW-4003)

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
		52.0'							0-51' advanced with 6" rock bit and compressed air. For description of cuttings, see original log. One ft dis-crepancy between drilled depth and coring start. Begin coring at 52.0'
52		Run 1 4.0'/4.0' 100%		1	3.65'/4.0' 91% LP = 0.8'	2	open stylolite(2) mechanical fracture? strong open (0-5mm), rough		52.0 – 105.9 micritic to very coarsely crystalline, massively bedded, fossiliferous stylolitic limestone and chert, with minor silty, argillaceous limestone.
53						1	tight, rough, brachiopod stylolite-strong (3)		Limestone: light gray (N7) and grayish orange (10YR 7/4) to dark yellowish orange (10YR 6/6). Moderately hard. Slight to moderate weathering.
54						2	open, rough stylolite-strong stylolite(3) broken strong(2)		color variations generally sharp, generally related to permeability: less permeable layers gray, more permeable orange (Fe-stained).
55						2	tight, rough stylolite (3) strong broken strong open (0-5mm), rough, FeOx stained		RQD generally high for limestone – only multiple gone from 95.1 to 96.2 in in limestone.
		56.0'		1					
56		Run 2 4.5'/4.5' 100%		1	3.05'/4.5' 68% LP = 0.7'	3	stylolite-strong (2) open, rough, brachiopod stylolite-broken		Chert: generally white (N9) to medium light gray (N6), with minor pale yellowish brown (10YR 6/2)
57						2	open (0-1cm), rough stylolite? open, rough		
58				1					

Geotechnical Information by:
D. Dahlstrom 5/14/90

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 8

Project Number: 5121

Hole Number: B-11 (MW-4003)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
58		Run 2 (cont)		1		3	open		52.0–105.9 continued FeOx staining generally limited to fracture surfaces. Very hard to hard, very slight to slight weathering. Chert layers generally highly fractured. Most fractures extremely weak or chert rubblized during coring. Chert occurs as discrete layers up to 1.6' thick and as irregularly shaped nodules. Finely divided texture and "bone-marrow" texture virtually absent in this core.
							open (0-5mm), rough; tight, rough 90° dip; stylolite - strong (2)		
59						5	tight, rough, 80° dip; open, rough, FeOx stain; tight, rough, 90° dip; tight, rough; open, rough, FeOx stain; stylolite - strong		
60		60.5'		1		1	open, rough, FeOx stain; stylolite - strong		
		Run 3 5.0'/5.0' 100%		1	2.15'/50' 43% UP= 0.65'				
61						7 6	open, rough (2); tight, rough, 80° dip; open, rough; stylolite - broken; open, rough, FeOx blebs (2); open (0-5mm), rough (3)		wavy limestone; highly fractured chert; numerous healed fractures in chert
62						7 6	open, rough, very sty chert rubble; open, smooth; open (0-2mm), rough (2); FeOx stain, MnOx blebs; calcite - lined		Ratios of limestone: chert 52.0-59.3' 100:0 59.5-68.9 80:20 68.9-73.7 99:1 73.7-105.9 80:20
63						7 6	open, rough, 40° dip; open, rough (2)		
64						7 6	stylolite - strong; open, rough; rubble; stylolite - broken		highly fractured chert
65				1					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 8

Project Number: 5121

Hole Number: B-11 (MW-4003)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
65		Run 3 (cont.) 65.3'		1		3	stylolite - broken open, smooth		limestone and chert as above
		Run 4 3.8'/3.8' 103%		1	3.1'/3.8' 82% LP= 0.7'	1	stylolite - broken open, rough		
66									
67						2	tight, rough stylolite - strong (3) open, rough		
68						3	stylolite - (2) strong broken tight, rough open, rough, FeOx stain		
69		69.3'		1			stylolite - strong (3)		
		Run 5 4.6'/4.7' 98%		1	3.35'/4.7' 71% LP= 1.1'	0			
70				1 2		1	stylolite - broken		
71						4	open, rough open (0-5mm), rough (3)		
72				2					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 8

Project Number: 5121

Hole Number: B-11 (MW-4003)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
72		Run 5 (cont)		2					limestone and chert as above
									72.7–75.6 silty, argillaceous limestone layer – color, hardness, weathering characteristics same as above.
73							open (0-5mm), rough, MnOx blebs		
							open, rough, MnOx blebs (2)		
							bryozoans		
		74.0'		2					74.0–74.2 vuggy chert
		Run 6 3.6'/3.7' 97%	74.9' 75.0	2	1.2'/3.7' 32% LP= 0.6'		open (0-1cm), rough, MnOx blebs (3)		
							open, rough		
							hubble		
75							open, rough		
							stylolite – strong		
							open, rough		
							healed fracture in limestone, 90° dip		
76							open, rough, MnOx blebs		
							open (0-1cm), rough (3)		
							tight, rough 90° dip, FeOx stain		
77							open, rough, FeOx stain		
		77.7'		2			open (0-1cm), rough, MnOx specks		
		Run 7 4.8'/4.8' 100%			1.3'/4.8' 27% LP= 0.9'		stylolite – broken		
78									
							open (0-1cm), rough		
79				2			open (0-5mm), rough (2)		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 8

Project Number: 5121

Hole Number: B-11 (MW-4003)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
79		Run 7 (cont)		2			open, rough (3)		limestone and chert as above
						5	chert pebble		
							open, rough		
80							open (0-2cm), rough		
						3	open, rough, 80° dip, FeOx blebs		
							tight, rough		
							open, rough		
81						3	tight, rough, FeOx blebs		highly fractured chert
							open, rough		
82							open (0-5mm) rough (2)		
		82.5'		2		3			
		Run 8 4.2'/4.2' 100%		2	2.6'/4.2' 62% LP= 1.35'		open, rough, FeOx stain		
							stylolite-strong		
83							open, rough (2)		
						2	stylolite-strong		
84						1			
							open, rough, FeOx stain (2)		highly fractured chert
85						>6	open, rough		
86				2					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 8

Project Number: 5121

Hole Number: B-11 (MW-4003)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	DISCONTINUITIES: FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
86				2			stylolite-broken		limestone and chert as above
						1			
		86.7'							
		Run 9		2	3.95'/4.6'				
87		4.7'/4.6'			86%				
		102%			LP= 1.4'	1	stylolite-strong		
							open, smooth		
							stylolite (3) strong (2)		
						0			
89							broken		
				2		1			
				3					
90									
						1	open, rough rubble at fracture		
							stylolite-strong		
							open, rough, MnOx blebs		
91		91.3		3			stylolite-strong		
							open, rough		
		Run 10.		3	2.9'/4.9'	2			
		4.9'/4.9'			59%		stylolite-strong		
					LP=				
92		100%			1.9'		open, smooth		
							chert rubble		
						>	open, rough		
							tight, rough, 90° dip		
						6	open (0-1cm), rough		
							healed fracture, 90° dip		
93				3					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 7 of 8

Project Number: 5121

Hole Number: B-11 (MW-4003)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
93		Run 10 (cont.)		3		7 6	open, smooth chert rubble open, rough		limestone and chert as above
94						0	stylolite-strong		
95						7 6	open, rough limestone rubble		
96		96.2'		3			open, rough		
		Run 11 4.9'/4.9' 100%		3	1.95'/4.9' 40%	7 6	open (0-5mm), rough open, rough, 10° dip		
97					0.85'	7 6	open (0-5mm), rough tight, smooth (2) chert rubble open, rough tight, smooth (3)		97.5 – 98.9 highly fractured chert
98						7 6	open, smooth (3) open (0-5mm), smooth open, rough, fossiferous open, smooth		98.9 – 100.5 silty, argillaceous limestone. Same color, hardness, and weathering characteristics as above.
99						1	tight, rough, Mn, blebs		
100				3					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 8 of 8

Project Number: 5121

Hole Number: B-11 (MW-4003)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
100		Run 11 (cont)		3		4	open (2-5 mm) rough tight, rough, 90° dip open, rough, rubble stylolite - broken		limestone and chert as above.
		101.1'							
101		Run 12 4.8' 5.1' 94%		3	3.25' 5.1' 64% LP= 0.65'	7 6	open, rough chert, rubble open, smooth open, rough (?)		
102						2	stylolite - strong open (0-1cm), rough		
103						2	open, rough stylolite - strong stylolite - broken		
104						7 6	open, rough (?) chert rubble open, rough, silica coated		
105			105.9			7 6	tight, rough mechanical fracture		Total Depth = 106.2'
106		106.2'	106.2	3					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 9

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-17 (MW-3007)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
			? 39.0						Drilled with 6" roller bit and mud to 39.0'. For description of samples 0-39', see original log. Begin Coring @ 39.0'
39		Run 1 1.0'/4.3' 23%		1	0.'/4.3' 0%	>6			39.0'-67.3' Silty, argillaceous limestone and chert. Limestone: massive, bedded, pale yellowish orange (10YR 8/6) to dark yellowish orange (10YR 6/6). In places, speckled with MnOx. Medium hard to soft. Moderate to moderately severe weathering.
40						>6			
41						>6			Chert: mottled medium gray (N5) and grayish orange (10YR 7/4), and very light gray (N8) to light bluish gray (5B 7/1). Very hard to moderately hard. Slight to moderately severe weathering.
42			42.3 ?			>6	cherty rubble		Chert occurs as discrete layers up to 0.4' thick, as lenses, and as finely detached masses within limestone.
							open, rough		
43		43.3	? 43.3	1			open (0-1cm), rough, clay-lined; open, rough, vuggy		
		Run 2 3.0'/4.3' 70%		1	1.8'/4.3' 42% LP= 0.7'	>6			Limestone and portions of chert highly water-permeable. Ratio of limestone: chert 39.0-57.4 50:50; 57.4-67.3 70:30
44						>6	open, rough (2); open (0-5mm), rough (3)		vuggy
			44.6	1					
45									

Geotechnical Information by D. Lahstrom 5/8/90

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 9

Project Number: 5121

Hole Number: B-17 (MW-3007)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
45		Run 2 (cont)		1		5	open (0-1cm), rough (3) open, rough open (0-1cm), rough (2)		silty, argillaceous limestone and chert as above
46						1	dip 15°		vuggy
47		47.6'	47.6	1		>6	open (0-2cm), rough open, rough (2)		
		Run 3 2.5/3.1 81%	48.2	1	1.2'/3.1' 39% LP = 0.45'				
48						>6	rubble open, rough (7)		
49						3			
50		50.7'		1		>6	open, rough, FeOx stain open (>5mm), rough (2)		vuggy
		Run 4 2.0/2.0 100%		1	0.1'/2.0' 0%		open, smooth (2) dip 30° open, rough (3)		rubble
51						6	open (0-1cm), rough (2)		
52				1			open, rough		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 9

Project Number: 5121

Hole Number: B-17 (MW-3007)

Project: Bechtel Geotechnical logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
52		Run 4 (cont)		1		7	rubble open, rough calcite-lined, 90° dip; open, rough (2)		silty, argillaceous limestone and chert as above
						6	open (0-1cm) rough; open, rough; rubble		
		52.7'		1					
		Run 5		1	2.8'/9.7'		open, rough (2) dip 30°; open (0-1cm), rough		
53		4.7'/4.7' 100%			60% LP= 0.7'	3	open (0-2cm), rough (2); open, rough		
54						2	open (0-1cm), rough; stylolite-sharp; open, rough (2)		
55						2	stylolite-broken		
56						5	open, rough (6); MnOx blebs (3)		
57		57.4'	57.1	1		7			
		Run 6 3.7'/4.6' 80%		1	2.7'/4.6' 59% LP= 1.5'	6			
58			58.3			7	open, rough (3) (MnOx blebs)		
59				1		6	clay-lined		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 9

Project Number: 5121

Hole Number: B-17 (MW-3007)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
59		Run 6 (cont)		1		2	open, rough MnOx specks (4) 12° dip		silty, argillaceous limestone and chert as above	
60						2	silica coated			
61						1				
		62.0'		1			open (0-1cm), shaley sty/dlite-strong			
62		Run 7 4.3'/4.0' 108%		1	2.0'/8.0' 50% LP= 1.0'	0				
63				1 / 2		>6	open, rough (6) rubble		62.9 – 65.0' "bone-marrow" chert	
64						>6	shaley			
65						>6	open, rough tight, rough open, rough			
66				2						

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 9

Project Number: 5121

Hole Number: B-17 (MW-3007)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
66		Run 8 4.8' / 4.8' 100%		2	3.0' / 4.8' 63% LP= 1.9'	> 6	tight, rough (2) MnOx specks, 10° dip		silty argillaceous limestone and chert as above
67						> 6	open, rough clay-filled void; open, rough stylolite-strong (2); tight, smooth, FeOx stain (3)		67.3 – 71.7 fossiliferous, stylolitic, micritic to coarsely crystalline limestone and nodular chert. Limestone: massively bedded, very light gray (N8) to medium light gray (N6). Moderately hard to medium hard. Very slight weathering. Chert: white (N9) to light bluish gray (5B 7/1), very hard. Fresh to very slight weathering. Highly fractured. Rock is of lower permeability than surrounding siltier units.
68						4	stylolite-broken; stylolite-strong		
69						0	stylolite-strong		
70		70.8'		2		> 6	tight, smooth (5); open, smooth, bryozoan		
71		Run 9 5.0' / 5.0' 100%		2	3.6' / 5.0' 72% LP= 0.9'	> 6	open, rubble, rough; tight, rough 90° dip; stylolite-broken		71.7' to 78.0' silty, argillaceous limestone and chert. See description for 39.0 – 67.3' above.
72						1	open, rough		
73				2					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 9

Project Number: 5121

Hole Number: B-17 (MW-3009)

Project: Bechtel Geotechnical logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
73		Run 9 (cont)		2		7 6	open, rough (4)		silty argillaceous limestone and chert as above.
74						4	tight, rough (3)		
75						3	open, rough stylolite-strong		75.1 – 78.5 fractures generally along lithologic contacts
		75.8		2			open, rough		healed fractures 90° dip - in chert
		Run 10		2	2.4'		open, smooth		
76		4.8' / 4.8' 100%			4.8' 50% LP= 0.5'	4	open (0-1cm), rough open open, rough (2) bryozoan		
77	weathered limestone 78.0'					6	open, rough tight, rough (5) open (0-1cm) rough		90° dip healed fractures in chert
78	competent limestone					3	open, smooth open, rough tight, rough, fossiliferous		78.0 – 99.1 fossiliferous, stylolitic, micritic to coarsely crystalline limestone and chert. See descript for 63.7 to 71.5 healed sub-vertical fracture in limestone
79				2 / 3		4	open, rough weak chip tight, rough, MnOx blebs, silica coated		compared to crystalline limestone in other core, this unit is more micritic and has higher permeability.
80				3			open, rough, shaley		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 7 of 9

Project Number: 5121

Hole Number: B-17 (MW-3007)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (ft)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
80		Run 10 (cont)		3					micritic to crystalline limestone and chert as above
						3	stylolite - broken		
		80.6'		3					
		Run 11		3	2.1 / 4.0		open (0-3mm), clay lined		
							stylolite?		
							stylolite - broken		
81		4.1 / 4.0			53%				
		103%			LP= 0.8'	1			
							open, rough		
							open (0-5mm), rough		
82							stylolite - broken		
							open (0-5mm) rough		
						6	open, rough - (3)		chert highly fractured
83							tight, rough (3)		
						1			
84									chert lense - fractures on contact with limestone
						2			
		84.6'		3					
		Run 12		3	3.7' / 4.8'		stylolites - strong		
85		4.8' / 4.8'			77%				
		100%			LP= 1.2'	1			
							stylolite broken		
86						0			
87				3					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 8 of 9

Project Number: 5121

Hole Number: B-17 (MW-3007)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION, TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
87		Run 12 (cont)		3			stylolite - mechanical fracture open, smooth highly fractured chert open, rough stylolite - strong		micritic to crystalline limestone and chert as above chert with numerous healed fractures
88							open (0-5mm), rough stylolite (2) - broken - strong		
89		89.4'		3			tight, rough highly fractured chert open, rough, FeOx specks		
		Run 13 4.9' 4.9' 100%		3	2.25' 4.9' 46% LP = 1.05'		open, rough, fossiliferous (3) 15° dip		
90							tight, rough, fossil. open, rough, fossil (2)		
91							stylolite - strong tight, rough open, rough		
92							open (0-1cm) rough open, rough 90° dip		
93							open (0-1cm) rough tight, rough, mechanical? (2)		
94							open (0-2cm) rough tight, rough		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 9 of 9

Project Number: 5121

Hole Number: B-17 (MW-3007)

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION)	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
94		Run 13 (cont) 94.3'		3			open, rough (4)		micritic to crystalline limestone and chert as above
		Run 14 4.8' / 4.8' 100%		3	2.6' / 4.8' 54% LP = 4.1'		silica coated		
95							stylolite - broken; open, rough		
96							tight, rough (3); brownish open, rough, silica coated; stylolite - (2) strong		
97							tight, rough; open, rough; tight, rough		
98				3 / 4			highly fractured chert; tight, rough; open, rough		
		99.1'		4					TD = 99.1'
99									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 10

Project Number: 5121

Hole Number: B-19A (MW-3008)

Project: BECHTEL Geotechnical Logging

Location: N. 99546.41 W. 50954.29

G.L. ELEV. 645.17
T.O.C. 648.28

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0-39.0', see original log for B-19A.
39									BEGIN CORING AT 39.0'.
		Run 1		1		2			39.0-48.7' ARGILLACEOUS LIMESTONE (60%) and CHERT. LS: Grayish orange (10YR 7/4) silty, very permeable, medium to mod. hard, mod. weathered, MnOx flakes throughout quickly reactive to HCL. CHERT: White (N9) to pale blue (5PB 7/2) finely divided with LS, very hard, fresh, fragment slightly weathered MnOx healed fractures, fossiliferous zones at contact with LS. Large (9mm x 17mm) crinoid stem at 39.8'.
		4.8'/5.0'			4.1'/5.0'		Crinoid stem, 9mm dia.		
40		96%			82% L.P. = 0.7'	2	Open, rough (5)		
41									
			? 41.6			4	Open, rough, glauc. clay, FeOx, vuggy (3)		
42			41.8 ?				Open, rough, carbon. clay, stylolitic		
						3	Tight, rough		
43							Open, rough, clay		
						2	Tight, rough		
							Open, rough		
44				1					

Geotechnical Information
by R. McClure, 11/15/89

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 10

Project Number: 5121

Hole Number: B-19A (MW-3008)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
44		Run 2		1		2			Argillaceous Limestone and Chert, as above.
		4.7'/4.7'			3.7'/4.7'		Open, rough (2)		
45		100%			79%	3	Open, rough, glauc. clay, FeOx, stylolitic (2)		
					L.P. = 1.0'		Open, spun, Open, rough,clay		
46						3	Tight, rough Open,rough,clay		
47						1	Tight, smooth		
48						2	Open, rough, pyrite, FeOx Open, tight,FeOx clay,bryozoan		
		48.7							48.7-56.8' ARGILLACEOUS LIMESTONE (55%) and CHERT. LS: As in section 39.0-48.7'. CHERT: As above, except percent chert increases and chert becomes nodular.
49		Run 3							
		4.8'/4.8'			2.9'/4.8'	>6			
		100%			60%		Open,rough, stylolitic, glauc. clay		48.7-49.7', cored chert and fissile clay, light gray (N7) with some angular, chert fragment/rubble.
50					L.P. = 0.8'	2	Stylolite, weak Open, rough, stylolitic, carbon. clay, FeOx		50.4-50.9', chert nodule.
51				1			Open,smooth, clay		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 10

Project Number: 5121

Hole Number: B-19A (MW-3008)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
51		Run 3 cont		1		2	Open, smooth, carb. clay, pin-point vugs		Argillaceous Limestone and Chert, as above.
							Open, rough		51.1-52.3' Banded chert.
52						2	Tight, rough		
							Open, smooth		
53						3	Open, smooth 30°		53.0-53.5' Chert nodule.
		53.5							
		Run 4					Open, rough (2)		
54			?						
		4.8' / 4.9'	54.3		2.9' / 4.9'	>6	Rough, stylolitic FeOx Void		
			54.4				Rough, glauc. cly.		
		98%	?		59%		Open, rough, stylolitic carb. clay		
55					L.P. = 0.9'	1	Open, rough (2)		
56						3	Open, rough, stylolitic		
							Open, rough, stylolite carbon. clay (3) Rubble		56.8-71.0' ARGILLACEOUS LIMESTONE (60% 70%) and CHERT. LS: Yellowish gray (5Y 7/2) to light olive gray (5Y 6/1), silty, very permeable, medium hard, moderate severely weathered, slowly reactive to HCL, some hematite from pyrite
57						2			
							Open, rough, vuggy		
58				1					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet -4 of 10

Project Number: 5121

Hole Number: B-19A (MW-300B)

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
58		Run 4 cont. 58.4'		1		0			From 56.8-62.5' extremely vuggy, "Bone-marrow" type texture, finely divided with chert. From 62.5-71.0' chert is nodular; limestone moderately weathered, not vuggy. CHERT: White (N9) to grayish blue (5PB 5/2), very hard to hard, slightly permeable and slightly weathered where hard, MnOx replacement in vuggy zone, calcite-lined vugs, abundant healed vertical fractures.
		Run 5	?	2					
59		4.9' / 5.0'	59.2 / 59.3		3.3' / 5.0'	>6	Rough, vuggy Void Rubble		
		98%	?		66%		Rough, vuggy		
60					L.P. = 0.7'	3	Calcite-lined vug		
61						3	Open, rough, vuggy (6)		
62						3	Open, rough		
							Open, spun		
63							Open, rough, carbon and glac. clay		
		63.4'				3	Stylolite		
		Run 6					Open, rough, carbon clay (2)		
64		4.7' / 4.7'			3.0' / 4.7'		Open, rough		
		100%			64% L.P. = 0.9'	3	Tight, rough		
65				2			Open, smooth, glauc. clay (2)		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 10

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-19A (MW-3008)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
65		Run 6 cont.		2		4	Open, rough, stylolite, glauc. cly.		Argillaceous Limestone and Chert, as above.
							Open, rough		
							Tight, smooth		
66						1	Open, rough, stylolitic, carbon. clay		
							Open, smooth Stylolite (3)		66.5-67.2' Limestone, light gray (N7), microcrystalline, fossiliferous, stylolites, hard, very slightly weathered, very active response to HCL.
67						3	Open, smooth, MnOx (3)		
							Rubble		
68		68.1'							
		Run 7				1			68.2-68.8' Limestone, as from 66.5-67.2', coarsely crystalline, abundant crinoid stems near fracture at 68.6'.
							Open, smooth 10°		
		4.8'/4.8'			4.5'/4.8'		Stylolite		
69		100%			94%	1			
					L.P. = 1.1'		Open, spun		
70									
						2	Tight, rough		
							Open, spun		
71									71.0-77.5' LIMESTONE (80%) and CHERT.
						3	Open, smooth		LS: Very light gray (N8) to light gray (N7), microcrystalline to coarsely crystalline, silty and slightly permeable,
							Open, stylolite		
72				2			Open, spun		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 6 of 10

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-19A (MW-3008)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
72		Run 7 cont. 72.9		2		>6	Rubble		hard, slightly weathered, fossiliferous where micro-crystalline. CHERT: Light gray (N7) to dusky blue (PB 3/2), nodular, abundant healed fractures, some MnOx replacement
73		Run 8 4.8'/4.8' 100%			3.9'/4.8' 81% L.P. = 0.8'	1	Open, rough (2)		73.7-76.5' Coarsely crystalline, silty, slightly permeable limestone.
74						2			
75						>6	Open, spun (10)		
76						3	Open, stylolite, carbon. clay		
77		77.7'		2		2	Open, rough, stylolitic, glauc. clay; Stylolite; Open, rough, carbon. clay		77.5-101.0' LIMESTONE, light gray (N7) to med. bluish gray (5B 5/1), fine to coarsely crystalline, hard, very slightly weathered to fresh, abundant stylolites, massively bedded with small-scale localized bedding, thick (to 1.1') fossiliferous zones of predominantly crinoid stems.
78		Run 9 4.7'/4.7' 100%		3	4.5'/4.7' 96% L.P. = 2.0'	2	Open, smooth		
79							Open, spun		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 7 of 10

Project Number: 5121

GEOTECHNICAL ATTACHMENT

Hole Number: B-19A (MW-3008)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
79		Run 9 cont.		3		0	Stylolite		Limestone contains lenses and stringers of coarsely crystalline, slightly permeable white limestone above 91.2'. Also has some zones of nodular chert, as described in section from 71.0-77.5'.
80						1	Stylolite		
							Open, rough, stylolitic, carbon. clay		
81						0	Stylolite		
							Stylolite		
82						2	Tight, smooth		
		82.4'							
		Run 10							82.9-83.8' Fossiliferous zone.
83		4.7'/5.0' 94%			4.7'/5.0' 94%	1	Stylolites (4)		NOTE: Also see description of Limestone bedrock on original B-19A log.
84					L.P. = 3.4'	0	Stylolite, weak		
85						1	Stylolites (5)		
86				3			Tight, 3 pelecypods		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 8 of 10

Project Number: 5121

Hole Number: B-19A (MW-3008)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
86		Run 10 cont.		3		2	Tight, rough, stylolitic, carb. clay		Limestone, as above.
			?				Tight, rough		
87			87.1			>6	Rough, stylolitic Void?		
		Run 11	87.4 ?				Rubblized		
88		4.9'/4.9' 100%			4.1'/4.9' 84%	0	Stylolite		
89					L.P = 1.7'	2	Open, stylolite, carbon. clay		
							Stylolite		89.7-90.5' Chert nodule.
90						1	Tight, rough (2)		
91						4	Open, rough		
							Open, stylolite, carb. clay		
							Open, smooth, rubblized		
92		92.1'					Tight, rough		
		Run 12 4.9'/4.9'			3.8'/4.9'	2	Open, stylolite, carb. clay		92.1-92.7' Chert nodule.
93				3	78%		Tight, rough		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 9 of 10

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-19A (MW-3008)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
93		Run 12 cont 100%		3	L.P. = 1.0'	2	Stylolites (2) Open, stylolite, carb. clay		Limestone, as above.
94						2	Open, spun Stylolite Tight, rough (2)		
95						>6	Rubble, fresh Stylolite, weak		
96				3 4		1	Tight, rough		96.6-97.7' Finely divided, coarsely crystalline, slightly permeable limestone and chert, as described above.
97		Run 13 4.0'/4.0' 100%			3.8'/4.0' 95% L.P. = 1.1'	2	Open, spun (2)		97.7-99.1' Fossiliferous zone.
98						1	Stylolites (2) Open, stylolite, carb. clay		
99						1	Open, smooth		99.7-99.8' Fossiliferous zone.
100				4					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 10 of 10

Project Number: 5121

Hole Number: B-19A (MW-3008)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
100		Run 13 cont.		4		2	Tight, rough Tight, stylolite carbon. clay Stylolite		Limestone, as above. 100.5-101.0' Fossiliferous zone.
101									Total Depth 101.0' Note: RQD determined from boxed core. Actual RQD values may be higher.

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 9

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-21 (MW-3009)

Project: BECHTEL Geotechnical Logging

Location: N. 98832.52 W. 52123.23 G.S.Elev. 644.30

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0-45.0', see original B-21 log.
45									BEGIN CORING AT 45.0'.
		Run 1		1		>6			45.0-55.6' ARGILLACEOUS LIMESTONE (80%) and CHERT. LS: Grayish orange (10YR 7/4) to dark yellowish orange (10YR 6/6), medium hard to soft, moderately to very severely weathered, silty, very permeable, slowly reactive to HCl, MnOx flakes throughout. CHERT: Finely divided, white (N9) rinds to light bluish gray (5B 7/1), hard to very hard, rinds are moderately weathered, abundant dendritic healed fractures, some calcite lined vugs.
		2.8'/2.8'			1.2'/2.8'		Open, rough, vuggy, rubbly (8)		
46		100%			43%		Open, rough, vuggy Open, smooth		
					L.P. = 0.4'	4	Open, spun (2)		
47									
						1	Open, smooth		
		47.8'							
48		Run 2					Open, spun		
		4.4'/4.4'			2.1'/4.4'	3	Open, vuggy, spun (2)		
49		100%			48%				
					L.P. = 0.5'	5	Open, spun (5)		
50				1					

Geotechnical Information
by R. McClure 11/22/89

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 9

Project Number: 5121

Hole Number: B-21 (MW-3009)

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
50		Run 2 cont		1		4	Open, rough, vuggy		Argillaceous Limestone and Chert, as above.
							Open, vuggy, spun (3)		
51						2	Open, rough, slightly vuggy		
52		52.2'							
		Run 3				4	Open, vuggy, spun (5)		
53		4.4'/4.6' 96%	? 53.4 53.5 53.6 53.7 ?		2.6'/4.6' 57% L.P. = 1.1'		Rough, vuggy (4)		
54						2	Open, rough, vuggy; Open, smooth; Open, rough		
55						1	Open, smooth		55.6-71.5' ARGILLACEOUS LIMESTONE (80%) and CHERT. LS: Yellowish gray (5Y 7/2) to light gray (N7), mod. hard to hard, slightly weathered, silty, permeable, very small specks of MnOx throughout, few crinoid stems at contacts with chert, stylolites.
56						4	Open, smooth, glauc. clay (2)		
		56.8'					Open, rough glauc. clay		
57		Run 4		1					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 9

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-21 (MW-3009)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
57		Run 4		1		>6	Shaley clay		Argillaceous Limestone and Chert (cont.)
		5.1'/5.1'			2.2'/5.1'		Open, stylolite Stylolite		CHERT: Light gray (N7) to light bluish gray (5B 7/1) to medium gray (N5), very hard, fresh, nodular, abundant healed dendritic cts fractures, some open fractures. Shaley clay, layer from 56.9-57.2', greenish black (5G 2/1) soft, fissile.
58		100%			43%	>6	Chert fragments, fresh		
					L.P. * 0.9'				
59							Open, rough		
						2	Open, smooth		
							Open, spun		
60						>6	Tight, rough		
61							Chert fragments, fresh		
						>6			
62		61.9'					Tight, rough (2)		
		Run 5				2	Stylolite		
		4.2'/4.2'			2.1'/4.2'		Open, stylolite		
63		100%		1	50%	4	Open, smooth, vert; open, smooth		
				2	L.P. * 0.6'		Open, spun		
							Open, rough		
64							Open, spun (2)		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 9

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-21 (MW-3009)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
64		Run 5 cont		2		4	Tight, rough Open, smooth, spun (2) Open, rough		Argillaceous Limestone and Chert, as above.
65						4	Open, spun Open, smooth		
66		66.1'					Open, smooth (2) vert; open, smooth, MnOx		
		Run 6				>6	Chert fragments, fresh		
67		4.7'/4.7'			2.4'/4.7'		Open spun Open, smooth (2) vert; open, smooth, MnOx		
		100%			51%	>6			
68					L.P. = 0.8'		Stylolite Chert fragments, fresh		
						>6			
69							Open, rough		
						2	Open, smooth Open, spun		
70							Tight, rough		
						2	Open, rough		
		70.8'							
71		Run 7		2					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 9

Project Number: 5121

Hole Number: B-21 (MW-3009)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
71		Run 7 cont. 4.8'/4.8' 100%		2	4.6'/4.8' 96% L.P. = 1.4'	2	Open, spun		Argillaceous Limestone and Chert, as above.
							Open, stylolite, carbon. clay		71.5-99.4' LIMESTONE (95%) and CHERT. LS: Light gray (N7) to light bluish gray (5B 7/1), fine to coarsely crystalline, hard, fresh with slightly weathered zones, abundant crinoid stems, bryozoa and a few brachiopods, abundant stylolites, massively bedded with local planar laminations. CHERT: As in section 55.6-71.5'. NOTE: Also see description of limestone bedrock on original B-21 log.
72						3	Open, spun (2) Vert; tight, smooth, MnOx		
							Open, rough, stylolitic, glauc. clay		
73						1	Open, rough, stylolitic, brachiopod		
74						0	Stylolites (3)		
75		75.6'				1	Open, rough Stylolite		
76		Run 8 4.7'/4.7' 100%			4.3'/4.7' 91% L.P. = 1.4'	1	Stylolites (2)		
							Open, stylolite, carbon. clay		
77						1	Stylolite, weak		
							Open, spun		
78				2					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 9

Project Number: 5121

Hole Number: B-21 (MW-3009)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
78		Run 8 cont.		2		1			Limestone and Chert, as above.
79						0	Open, stylolite, carbon. clay		
80							Stylolite, weak		
		80.3' Run 9				1			
81		4.7'/4.7' 100%			3.5'/4.7' 74% L.P. = 0.8'	1	Open, rough, Vert; tight, healed; Open, spun		
82				2 3		>6	Tight, smooth Vert; tight, smooth MnOx; Open, rough		
83						>6	Chert fragments, fresh; Chert fragments, fresh; Open, smooth		
84						2	Tight, rough		
85		Run 9 end		3			Open, stylolitic carbon. clay		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 7 of 9

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-21 (MW-3009)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
85		Run 10		3		3	Open, rough		Limestone and Chert, as above.
		5.0'/5.0'			3.8'/5.0'		Open, stylolitic glauc. clay (2)		
86		100%			76%	>6			
					L.P. = 1.9'		Open, spun		
							Chert fragments, fresh		
87						>6	Open, stylolite, carbon. clay		
88							Chert fragments, fresh		
						>6			
							Stylolite		
89						0	Stylolite, weak		
90		Run 11				1	Open, spun (1)		
		4.8'/4.8'			4.1'/4.8'		Stylolite		
91		100%			85%	0			
					L.P. = 1.9'				
92				3					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 9 of 9

Project Number: 5121

Hole Number: B-21 (MW-3009)

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
92		Run 11 cont.		3		1	Open, spun vert; tight, rough		Limestone and Chert, as above.	
93						6	Tight, rough, slightly vuggy			92.7-93.3' Coarsely crystalline, slightly weathered, slightly vuggy limestone.
							Chert fragments, fresh			
94						1	Tight, rough (1)			
		94.8'								
95		Run 12				0				
		4.2'/4.6'			3.2'/4.6'					
96		91%	? 96.4		70%		Stylolite			
					L.P. = 1.6'		Smooth Void?			
			96.8 ?				Rough, white and smokey quartz crystals			
97						3	Open, rough, bryozoa			97.6-99.2' Coarsely crystalline limestone as in 92.7-93.3'.
							Open, rough, slightly vuggy (2)			
98						3	Open, smooth, contact			
							Tight, smooth, vert, tight, smooth			
99				3			Open, rough, slightly vuggy			

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 9 of 9

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-21 (MW-3009)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
99		Run 12 end		3					Limestone and Chert, as above.
									Total Depth 99.4'.
100									Note: RQD determined on boxed core. Actual RQD values may be higher.

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 6

Project Number: 5121

Hole Number: B-23 (MW-3010)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
									Drilled with 6" roller bit to 52.5'. For description of cuttings see original log.
		52.5'	52.5						Begin coring at 52.5'
		Run 1	52.6	1	1.7' / 5.1'	> 6	open, rough, MnOx blebs		52.5' – 75.8' silty, argillaceous limestone and chert with minor very fine to very coarsely crystalline limestone and chert (54.4 – 56.2')
53		5.0' / 5.1'			33%		open (0-5mm), rough, MnOx blebs (4)		Limestone: massively bedded, grayish orange (10YR 7/4) to dark yellowish orange (10YR 6/6) with MnOx blebs from 52.5' to 71.5'. Medium hard to soft. Moderate to severe weathering.
		98%			LP= 0.9'	2			
54						> 6	open, rough, MnOx blebs; spun limestone rubble; open, rough; open (0-5mm), rough		Chert: very light gray (N8) to medium gray (N5) and pinkish gray (5YR 8/1), very hard to hard, slight to moderate weathering.
55						> 6	open, rough; chert rubble; open, smooth, MnOx spots		Chert occurs as discrete layers up to 0.65' thick, as irregularly shaped nodules up to 0.5' thick, and as finely divided masses in limestone.
56						> 6	open, rough; stylolite - strong open, rough; tight, rough, FeOx stain, good dip		
57						3	tight, rough; open, rough		
		57.6'		1					
58		Run 2		1					

Geotechnical Information by:
D. Dahlstrom 5/17/90

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 6

Project Number: 5121

Hole Number: B-23 (MW-3010)

Project: Bechtel Geotechnical logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
58		Run 2 (cont) 4.9'/4.9' 100%		1	0.55'/4.9' 11% LP= 0.55	>6	open, rough (2) clayey gravel open, rough, clay lined open (0-1cm), rough, MnOx blebs (2)		silty, argillaceous limestone and chert as above vuggy
59						6	open, rough, clay lined open (0-3mm), rough open, rough, MnOx blebs (2) open (0-1cm), rough, MnOx blebs (3)		
60						>6	open, rough, MnOx blebs (4) open (0-1cm), rough, MnOx blebs (2)		
61						>6	open, rough, MnOx blebs limestone rubble open, rough (4) MnOx blebs 90° dip		
62		62.5'		1		>6	limestone rubble open, rough, MnOx blebs (4) 90° dip open, rough, MnOx blebs open (0-3mm), rough, MnOx blebs (3)		
63		Run 3 5.0'/5.2' 96%		1	2.7'/5.2' 52% LP= 0.75'	2	tight, rough, MnOx blebs (2) 25° dip		vuggy chert
64						2	open, rough, MnOx blebs tight, rough, MnOx blebs		
65				1					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 6

Project Number: 5121

Hole Number: B-23 (MW-3010)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
65		Run 3 (cont)		1		1	open, rough, MnOx blebs		silty, argillaceous limestone and chert as above
							open (0-1cm), rough, MnOx blebs		
66						7	open, rough, MnOx blebs, 25° dip		vugs
			66.6			6	open rough		
			66.8				limestone rubble		
67						7	open, rough, MnOx blebs		
		67.7'		1		6	open (0-1cm), rough, MnOx blebs (2)		
		Run 4		1	1.3' / 4.0'				
68		4.0' / 4.0' 100%			33% LP= 0.55'	7	open (0-5mm), rough, vuggy, MnOx blebs		
						6	open, rough, MnOx blebs (2)		
							chert rubble		
							open, rough (2)		
69						4	open (0-5mm), rough		
							open, rough (3)		
70						2			70.3 - 71.4 "bone-marrow" chert
							open (0-5mm), rough (2)		
71						5	open, rough		numerous weak fractures in limestone
							open (0-2cm), rough		
		71.7'		1			open, rough, MnOx blebs		
72		Run 5		2			open (0-3cm), rough		extremely vuggy chert

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 6

Project Number: 5121

Hole Number: B-23 (MW-3010)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
72		Run 5 (cont) 4.7'/4.6' 103%		2	2.85'/4.6' 62% LP= 0.7'	2	open (0-3mm), rough, MnOx specks; open, rough (7)		silty, argillaceous limestone and chert as above
73						3			
74						2	15° dip; glauconite, 15° dip		
75	weathered limestone 75.8					4	open (0-5mm), rough, shaley stylolite - broken; open, rough, shaley stylolite - strong (8)		75.4 – 75.9' numerous shaley seams and partings; 75.8 – 90.7 very finely to very coarsely crystalline limestone and chert with minor silty, argillaceous limestone.
	competent limestone								
76		76.3'		2					
		Run 6 4.8'/4.8' 100%		2	4.2'/4.8' 88% LP= 2.05'	0			limestone: fossiliferous, stylolitic, massively bedded, very light gray (N8) to medium gray (N5), moderately hard, fresh to slight weathering. chert: white (N9) to medium light gray (N6), very hard to moderately hard, slight to moderate weathering. chert generally highly fractured, in some zones vuggy. chert occurs as nodules generally terminating
77						0			
78						1	stylolite - broken, teeth plunge ~30°		
79				2					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 6

Project Number: 5121

Hole Number: B-23 (MW-3010)

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
79				2		3	stylolite-broken tight, rough open, rough (3)		against stylolites, and as finely divided masses within silty, argillaceous limestone (e.g. 79.0 to 80.1')
80						2			
		81.1'		2			open (0-2cm), rough		
81		Run 7 4.9'/4.9' 100%		2	2.7'/4.9' 55% LP= 0.7'	7	open, rough, vuggy		vuggy chert
							open (rubblized), rough		
82						1	open, rough		
83						1	stylolite-broken		
84						7	open, rough open (rubblized) rough open, rough chert rubble		highly fractured chert
85						4	open, rough (5)		
86				2					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 6 of 6

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: B-23 (MW-3010)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
86		Run 8 4.7'/4.7' 100%		2	3.3'/4.7' 70% LP= 0.8'	>6	open, rough (?)		limestone and chert as above.	
							chert rubble			
							open (0-5mm), rough			
87						2	tight, rough stylolite-strong			
							open (0-1cm) rough, shaley partings			
							stylolite-strong			
88							open (0-5mm) rough			
							stylolite-strong (?)			
						2	stylolite-broken			
89						>6	open (rubblized) rough			
90							open, rough (stylolite?)			
		90.7'		2					TD = 90.7'	

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 6

Project Number: 5121

Hole Number: G-1

Project: BECHTEL GEOTECHNICAL LOGGING

Location: SOUTH OF DISPOSAL CELL,

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
									For description of overburden from 0-45.3', see original G-1 log.
45	45.3'								BEGIN CORING AT 45.3'
		Run 1		1					
46		5.0'/8.5' 59%			3.3/8.5' 39%				
47					L.P. = 0.85'				
					7 > 4"				
48									49.0-49.3 clay + chert gravel (clasts to 3cm) + clasts of chert and argillaceous limestone - (poor recovery of unconsolidated material)
49						> 6	open, rough, FeOx vert: 4 healed, strong 1 tight, smooth FeOx open, smooth, FeOx		49.3 - 50.2 chert - white gray (N8) to dk yellowish or (10 YR 6/6), very hard, slightly weathered, highly fractured
50				1					

Geotechnical info by R. McClure & D. Dahlstrom 2/8/90

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 6

Project Number: 5121

Hole Number: G-1

Project:

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
50		Run 1 cont.		1		5	open, smooth, FeOx open, rough, clay, FeOx open, rough, clay, FeOx open open (2cm) rough		50.2 - 79.5 silty, argillaceous limestone + chert (lug 5mm aperture) 3mm trace limestone: dark yellowish orange (10 YR 6/6) with MnO_x specks & blebs medium to soft, moderate to moderately severe weathering FeO_x staining throughout rock, highly permeable
51						2	tight, rough, MnO_x specks open, rough, MnO_x specks (2cm)		
52						3	open, rough, clay open, rough, clay tight, rough		chert: mottled dark yellowish orange (10 YR 6/6) and light bluish gray (5 B 7/1) to light bluish gray, very hard to moderately hard, very slight to moderate weathering chert finely divided within limestone, to massive beds 0.4' thick - (e.g. 51.6 - 52.0') ratios: LS : chert 50.2 - 58' 50:50 58 - 59' lo 100% 59 - 60.4 ~100% chert 60.4 - 79.5 50:50
53						1	open, rough		
53.8'									
54		Run 2		1			open, rough (2)		
		10.0' 10.0' 100%			6.3 10.0' 63%	5	open, open (2)		
55							open, rough (2)		
					L.P.= .75'	4	open, open (2) stylolite - strong		
56					12 7 4"		tight, rough, MnO_x bleb		
						1	open, rough, MnO_x bleb		
57				1					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 6

Project Number: 5121

Hole Number: G-1

Project:

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
57		Run 2 cont.		1			open, rough, MnO_x blebs		silty, argillaceous ls + chert (as above)
						6	open, smooth, MnO_x blebs		
							open, rough, MnO_x blebs		
				2			open (1cm), rough, MnO_x blebs		
58							open, rough, MnO_x blebs		
						2	open (5cm), rough, MnO_x blebs		
59									58.7-59.1 relatively pure, fossiliferous limestone
							chert nubble		
						> 6			
60									
							tight, rough		
						2	stylolite, broken		
61									
							open, rough, MnO_x blebs, pitted		
						2	tight, rough, MnO_x blebs		
62							open, rough (2)		
						3	tight, rough, hammer?		
63									
						4	tight, rough, FeO_x		
		Run #2 End		2			open, rough, clay		
64							open, smooth (in chert)		
							open, rough		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 6

Project Number: 5121

Hole Number: G-1

GEOTECHNICAL ATTACHMENT

Project:

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
64		Run 3		2			open, rough		silty, argillaceous limestone + chert (as above)
						5	open		
		9.6 / 10.0'			5.4 / 10.0'		open, smooth, clay		
							open, rough (2)		
65							open		
		96%			54%		open, rough, MnOx blebs (2)		
					L.P.= 0.8'	> 6			
66									
					11 > 4"				
						> 6	vert-open, rough, MnOx blebs		
							open, rough, MnOx blebs		
							tight, rough, pitted		
67				2 / 3			open, rough, pitted		
						2	stylolite-strong		
							open, rough		
68									
						2	open, rough, MnOx blebs (2)		
69									
							tight, rough, MnOx specks		
						> 6	vert-open, rough, clay		
							open, rough, MnOx specs		
							clay coating, weak, mech.		
70							open, rough, MnOx blebs (2)		
						3			
							tight, rough, MnOx blebs chert-filled fracture		
71				3					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 6

Project Number: 5121

Hole Number: G-1

Project:

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
71		Run 3 cont.		3			open, rough, MnO_2 blebs (3)		silty, argillaceous limestone + chert (as above)
						3			
72							tight, rough, MnO_2 blebs		euhedral calcite in vug
							open, rough, MnO_2 blebs		
						4	open, rough, clay lined		
							open, smooth, clay		
73									
						2	tight, rough, vuggy		73.6–76.5' "bone marrow" chert – ~60% argill limestone, 40% chert – rock vuggy, extremely permeable minor associated hematite after pyrite (?)
74		Run 3 End		3			open, rough		
				3			tight, rough		
		Run 4				2			
							open, rough		
75		10.0' / 10.0'			7.6 / 10.0'		open, rough, clay lined (2)		75.0–75.8' mix of oxid/unox argillaceous limestone (unoxidized color: Pale Olive (10 Y 6/2)) –
		100%		3	76%	2			75.8'–78.8' oxidized (weathered)
				4	L.P.=				
76					1.5'		open, rough, MnO_2 blebs (4)		
					13 > 4"	4			
77							open, smooth		
						4	tight, rough, MnO_2, FeO_2 (2)		
78				4			tight, smooth, glauconite		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 6

Project Number: 5121

Hole Number: G-1

Project:

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
78		Run 4 Cont'		4		3	open, rough, MnO_x spec open, rough, black clay stylolite, strong open (1cm) rough, glauconitic		silty, argillaceous limestone + chert (as above)
79						2	open, rough, FeO_x spec open, rough, black clay stylolite, strong		78.5 - 84.0 (TD) LIMESTONE very light to light grey (N8, N7) moderate to medium hardness, fresh very fine to very coarsely crystalline, stylolitic, fossiliferous minor chert (~5%)
80						1	open, rough, broken stylolite		
81						1	tight, rough, broken stylolite		
82						1	tight, rough stylolite, strong →		
83						2	open (5mm) rough lithologic contact, weak		
84		End Run 4		4			open (5mm) rough		Total Depth 84.0
85		84.0							Note: RQDs measured on boxed core, actual values may have been higher

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 3

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-2

Project: Bechtel Geotechnical Logging

Location: N. 100449.9 W. 50577.3 G.S.Elev. 657.90

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
	Auger and split spoon sampled to 45.0'.								See original log of G-2 for description of overburden 0-45.0'.
45									Begin Coring 45.0'
		Run 1 .4/1.0 40%		1	0%		0.6' core loss, location unknown.		45.0-55.5' CHERT and CHERT FRAGMENTS, hard, very light gray(N9) to pale yellowish orange(10YR 8/6), slightly to severely weathered (fragments) vuggy, FeOx stained, MnOx, fracture filling, fossiliferous. All rubble to 54.8'. (Probable void gravel fill). Reddish brn cly with chert pieces near 53.0'
46									
		Run 2 .9/7.0 13%		1	0%		6.1' core loss throughout core run.		
47									
48									
49									
50									
51									

Geotechnical Information by: P. Patchin 10/5/89.

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 3

Project Number: 5121

Hole Number: G-2

Project: Bechtel Geotechnical Logging

Location: Disposal Cell Footprint

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
51		Run 2		1			6.1' Core loss throughout run.		CHERT, as above.
52									
53									
		Run 3		1	1.15'/5.0'				
		3.2'/5.0'			23%				
54		64%			L.P. = .5'				
							Rubble		
55			54.8 ?				Open,rough		
							Open,smooth		
						6	Open,rough,FeOx (6)		55.5-56.5' CHERT(60%) and ARGILLACEOUS LIMESTONE(40%) intermixed. Chert is as above but not vuggy, finely divided with the limestone. L.S. is grayish orange(10YR 6/6), argillaceous and silty, hard, mod. weathered, FeOx stained.
56									
						3	Tight,rough		
57							Tight,smooth		56.5-58.3' LIMESTONE med. xln, slightly argillaceous, massive, fossiliferous, yellowish gray (5Y 7/2), FeOx cly on partings, slightly to mod. wthrd, hard.
						5	Open,rough,FeOx (3)		
							Tight,rough,FeOx, cly		
58							Spun		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 3

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-2

Project: Bechtel Geotechnical Logging

Location: Disposal Cell Footprint

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
58		Run 4		1	1.35'/6.0'	> 6	Open,rough Rubble Open,rough,FeOx (5)		58.3-64.0' ARGILLACEOUS LIMESTONE(70%) and CHERT(30%) as above. Limestone shows bands to .4' of med. xln slightly argillaceous. Other sections are siltier with increased weathering and vugs.
		5.4'/6.0'			23%				
59		90%			L.P. = .6'		Open,rough (4)		
						> 6	Tight,rough Open,spun Open,rough		
60							Tight,rough Open,rough		
						> 6	Tight,rough Open, rough (4)		
			? 61.0						
61						> 6			
			61.6 ?				Rubble		
62							Tight,rough		
				2		2	Open,smooth		
63							Tight,rough,cly		
						> 6	Open,rough (4)		
64	Weathered L.S.								T.D. 64.0'

Boring abandoned.

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 5

Project Number: 5121

Hole Number: G-2A

Project: Bechtel Geotechnical Logging

Location: N. 100440.0 W. 50578.1 G.S.Elev. 658.0

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Auger drilled from 0-53.0' without sampling.
53									Begin Coring 53.0'
		Run 1		1	2.2'/6.5'	> 6	Rubble Open,rough (2)		53.0-71.7' CHERT - mottled: med. light gray(N6) to very light gray(N8)(60-70%) + (30-40%) silty, argillaceous limestone: grayish orange (10YR 7/4). Chert layered to finely divided in limestone, very hard, l.s. medium; mod. to mod. severe weathering.
		4.3'/6.5'			34%		Rubble Open,rough (2)		
54		66%			L.P. = .4'	3	Open,rough,FeOx, cly Open,spun Open,rough		
55						5	Tight,rough (2) Open,rough,FeOx, cly Open,rough		55.0-56.0' Med. to coarsely xtln fossiliferous limestone with matrix of argillaceous l.s.
56			? 56.1				Rubble		
57									
58							Open,rough,vuggy		
59			58.3 ?				Tight,rough (2)		

Geotechncial Information by: P. Patchin & D. Dahlstrom 10/4/89.

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 5

Project Number: 5121

Hole Number: G-2A

Project: Bechtel Geotechnical Logging

Location: Disposal Cell Area

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
59		Run 1 cont'd		1			Open,rough (3)		Chert and argillaceous limestone as above.
	59.5'								
		Run 2 0.4'/0.6' 66%	59.7	1	0'/0.6' 0%		Spun Open,rough Tight,rough (2)		
60									
	60.1'								
		Run 3 2.9'/2.9' 100%		1	1.0'/2.9' 34% L.P. = .5'	4	Tight,smooth Open,smooth Open,rough (2)		
61									
						4	Open,rough,FeOx Open,rough,MnOx, (2)		
62									
						3	Open,stylolitic, clay Open stylolitic, FeOx		62.5-63.1' Chert layer.
63							Tight,smooth Tight,rough		
		Run 4 9.4'/10.0' 94%		2	6.1'/10.0' 61% L.P. = 1.3'	5	Open,rough Open,rough,FeOx Open,rough Open,rough,FeOx		
64									
						2	Open,rough,FeOx Tight,rough		
65									
						3	Open,rough Spun (2)		65.7-68.2' Vuggy-argillaceous limestone, partially dissolved.
66									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 5

Project Number: 5121

Hole Number: G-2A

Project: Bechtel Geotechnical Logging

Location: Disposal Cell Area

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
66		Run 4 cont'd	66.2	2			Spun Open,rough,vuggy		Chert and argillaceous limestone as above.
							Rubble		
67			66.8 ?				Open,rough,vuggy (2)		
						4	Open,rough,vuggy, cly (2)		
							Open,rough,FeOx		
68									
						2	Tight,rough		
							Tight,rough,FeOx		
69							Tight,smooth, glauc. 15°		
						3	Tight,rough,FeOx		
							Tight,rough, stylolitic, glauc. 20°FeOx		
70									
						1	Tight,rough		
71									
							Tight,rough		
							Tight,rough		
						3	Open,rough,glauc. 25°		
72							Stylolite		71.7-74.0' CHERT-light bluish gray(5B 7/1)(70-80%) with argillaceous limestone: grayish orange(10YR 8/2)(20-30%) limestone, mod. hard to medium mod. weathering, argil ls as irregular remanant layers within chert.
	Weathered L.S.					0	Stylolite		
73	Competent L.S.								

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 5

Project Number: 5121

Hole Number: G-2A

Project: Bechtel Geotechnical Logging

Location: Disposal Cell Area

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
73		Run 5		3					CHERT, as above.
		9.6' / 10.0'			9.2 / 10.0	2	Tight,rough		
74		96%			92%		Open,stylolitic, MnOx		74.0-75.0' LIMESTONE, finely xln, light olive gry(5Y 6/1), silty, 30% CHERT v. lt. gry (N8), stylolitic, hard slightly weathered.
					L.P. = 1.5'	4	Open,stylolitic Stylolites,weak (2)		
75							Tight,rough (2)		75.0-80.3' SILTY ARGILLACEOUS LIMESTONE: dark yellowish brown(10YR 4/2)(60%) with CHERT: mottled-light bluish gray(5B 7/1) to light gray(N7). Limestone: medium hardness, slightly weathered. Chert: mod. weathered-vuggy pinpoint to 4mm.
						1			
76									
						1	Tight,smooth		Chert finely divided to layers 0.3' thick.
77									
						2	Tight,rough,MnOx		
78							Open,smooth		
						1	Tight,rough		
79							Tight,smooth, stylolitic, shaley, MnOx (2)		
						2			
80									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 5

Project Number: 5121

Hole Number: G-2A

Project: Bechtel Getechnical Logging

Location: Disposal Cell Area

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
80		Run 5 contd	? 80.6	3			Open,smooth, shaley		80.3-83.0' LIMESTONE finely xln, fresh, lt. gry(N7), fossiliferous, stylolitic, no chert, hard.	
							Open,stylolitic, MnOx			
81			81.0 ?				Open,smooth			
							Open,rough,stylolitic green min.(glauc?) MnOx			
						3	Stylolite,weak			
82							Stylolites			
							Tight,smooth			
						1	Stylolites			
83									Total Depth	83.0'

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 6

Project Number: 5121

Hole Number: G-3

Project: BECHTEL Geotechnical Logging

Location: N.101195.3 W. 50948.6 G.S.Elev. 654.0

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
54									For description of overburden from 0-54.6' see original log for G-3.
54.6									BEGIN CORING AT 54.6'
55		Run #1		1			1.7' CORE LOSS IN RUN #1, LOCATION UNKNOWN		54.6-66.0' ARGILLACEOUS LIMESTONE (50%) and CHERT. LS: Silty, grayish orange (10 YR 7/4), permeable, medium hard to soft where vuggy, abundant MnOx specks, moderate severely weathered, occasional stylolites, little FeOx. Two thin (0.4') interbeds of coarse crystalline, light gray (N7) LS, very small silt content, very slightly permeable, moderately hard, fossiliferous.
56		6.7'/8.4' 80%			4.8'/8.4' 57% L.P.= 0.7'		Fractures surfaces are generally unmatched in Run #1. Loss may have occurred in small increments over length of run. Fractures are open, smooth and rough, with clay, occasionally vuggy and severely weathered; some are spun.		CHERT: Very light gray (N8) to grayish orange pink (5 YR 7/2) mottled texture, finely divided, abundant MnOx healed dendritic fractures, FeOx.
57									
58									
59									
60				1					

Geotechnical Information
by Rick McClure 10/25/89

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 6

Project Number: 5121

Hole Number 6-3

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
60		Run #1 cont		1			Core Loss Location unknown.		Argillaceous Limestone and Chert, as above.
61									
62									
63									
		Run #2				3	Open,rough,abund clay, MnOx, vuggy (2)		
							Open, spun		
64		8.0' / 8.5' 94%			4.1' / 8.5' 48%	3	Open,rough,abund clay, vuggy, MnOx (2)		
					L.P.= 0.5'				
65			? 65.1				Open,smooth,FeOx MnOx		
			65.7			> 6	Open, rough,clay calcite		
		65.6	?	1 2			Open, smooth, MnOx (3)		
		65.7	?				Open,rough,MnOx little clay (2)		66.0'-74.4' CALCAREOUS SILTSTONE (70%) and CHERT SS: Pale yellowish orange (10YR 8/6), very permeable, soft to very soft, fractured areas are extremely vuggy,
66						5	Open,smooth,clay FeOx, MnOx,		
							Open, rough,vugs contact		
67							Open,rough,wthrd, vuggy (4)		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 6

Project Number: 5121

Hole Number: G-3

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
67		Run 2 cont.		2		4	Open,rough,vuggy, clay Open,smooth,clay Open,smooth,clay slightly vuggy		CALCAREOUS SILTSTONE and CHERT (cont.) moderate to severely weathered, abundant solution features (small voids, core loss, rubble), some FeOx discoloration in rubble.
68						>6	Open,rough,clay vuggy (2)		
							Open,smooth,abund clay, MnOx; vert same (3)		
69			? 69.1			>6	Open,rough,abund. clay,vuggy, vert same (2)		CHERT: Grayish orange pink (10R 8/2) to white (N9) to light gray (N7) moderately hard where permeable to very hard, slightly weathered to fresh, fossilferous, abundant MnOx healed fractures, FeOx, few calcite lined vugs, nodular.
			69.4 ?				Silty limestone & chert rubble, abund. clay severely wthrd.		
70						2			
							Open, rough, abund clay, vuggy (3)		
71									
		71.5'				4	Open,smooth,.5mm glauc, clay Open, smooth, clay (2)		
		Run 3					Open, smooth glauc. clay		
72		6.7'/6.7' 100%			4.8'/6.7' 72% L.P. = 1.0'	3	Open, spun (3)		
73						3	Open, rough, MnOx little clay and FeOx (2)		
				2			Open,smooth,abund dusky yellow grn (5FY 5/2) clay		
74									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 6

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-3

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
74		Run 3 cont.		2		4	Open, smooth, greenish gray clay (2)		CALCAREOUS SILTSTONE and CHERT, as above.
							Open, rough, stylolitic, carb clay or cherty clay		74.4-79.5 ARGILLACEOUS LIMESTONE (65%) and CHERT. LS: Yellowish gray (5Y 7/2), "bone marrow" vuggy texture, medium hard, moderate to moderate severely weathered where vuggy, silty, permeable. CHERT: Very light gray (N8) to grayish blue (5B 5/2), hard to very hard, abundant healed dendritic fracture, few calcite lined vugs, nodular.
75				2		2	Open, rough little clay		
				3					
76						3	Open, rough, vuggy clay (7)		
77						3			
							Open, spun		
78		79.2				3	Open, smooth		
		Run 4					Vuggy		
79		9.4'/10.0			7.3'/10.0	2			79.5-88.2' LIMESTONE (80%) and CHERT.
	WEATHERED L.S. 79.5'	94%			73% L.P. = 1.0'		Open, spun (4)		LS: Light gray (N7), fine to coarsely crystalline, moderately hard to hard, very slightly to severely weathered, occasional stylolites, few vuggy fractures fossiliferous. Several thin (.03') interbeds of argillaceous LS, as in section 74.4-
	COMPETENT								
80						4	Open, smooth, carb. clay		
							Open, rough, stylolitic, carb. clay		
81				3			Stylolites (2)		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 6

Project Number: 5121

Hole Number: G-3

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
81		Run 4 cont		3		2			LIMESTONE and CHERT (cont.) 79.5'. CHERT: Light bluish gray (5B 7/1) to grayish blue (5 PB 5/2), nodular, some MnOx healed and open fractures, few calcite lime vugs.
							Open, smooth		
							Open, spun		
82									
						3	Open, rough, stylolitic, carb clay, pyrite Stylolite		
							Open, spun		
83							Open, rough		
						3	Open, rough, slightly vuggy, FeOx, little cl		
							Open, smooth, FeOx, calcite		
84				3					
				4			Open, smooth		
						1	Open, smooth, horn coral (?)		
85									
						2	Open, rough, pin-point vugs, open verticle fractures, little clay		
86							Open, rough, fossiliferous, crinoid stem		
						>6			
			? 86.9						
87							Rough, abundant silty lime cly.		
						>6	Chert rubble, severely wthrd. fossilif. where fresh, abund. silty lime clay		
			87.5 ?	4					Stylolite
88									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 6

Project Number: 5121

Hole Number: G-3

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
88		Run 4		4			Open, smooth		LIMESTONE and CHERT, as above.
		End							Total Depth. 88.2'
89									

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 1 of 5

Project Number: 5121

Hole Number: G-4

Project: BECHTEL Geotechnical Logging

Location: N.101140.6 W.51295.6 G.S.ELEV. 644.0

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
53									For description of overburden from 0-53.0' see original log for G-4. BEGIN CORING AT 53.0'.
54		Run 1 6.2'/8.0' 78%		1	3.1'/8.0' 39% L.P. = 0.5'		1.8' CORE LOSS BETWEEN 53.0' - 58.1'. Exact location unknown. Fractures in top 3.2' of core are solution features. Features in top 1.9' of core include: 0.4' of subangular, blocky chert gravels, severly weathered, very little clay; 5cm diameter cavity; dentritic & verticle open fractures: 95% chert. Features in remaining 1.3' of top 3.2' of core include: very severely weathered LS cavities and large vugs; silty L.S. is very soft; abundant clay; 90% chert.		Top 0.3' of core sample Limestone, light gray (N7) moderately crystalline, fossiliferous, moderately hard. Next 0.4' chert gravel and 1.2' chert, as described in DISCONTINUITY column. 53.0-71.0' ARGILLACEOUS LIMESTONE (60-70%) and CHERT, slightly mottled and finely divided above 60.0', below 60.0' chert becomes nodular. LS: dark yellowish orange (10YR 6/6) to yellowish gray (5Y 7/2), very soft to medium hard, very severe to moderately weathered, very silty, permeable Above 58.0, extremely vuggy and very severely weathered. CHERT: White (N9) to light bluish gray (5B 7/1), zones of healed dendritic fractures and calcite lined vugs.
55									
56									
57									
58									

Geotechnical Information
by R. McClure 10/24/89

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 5

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-4

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
58		Run 1 cont.		1		>6	Open, rough, extremely vuggy abund. clay & silt (2)		Argillaceous Limestone and Chert as above.
							Open, rough, abund. clay & silt (3)		
59						3			
60									60.0' Chert becomes more nodular.
						3	Open, smooth, abund. clay and silt (5)		
61									
		Run 2				4	Open, rough, pin-point vugs, dark red clay, FeOx		
		10.0'/10.0'			7.5'/10.0'		Open, smooth, cly MnOx specks		
62							Open, spun (2)		
		100%			75%	5	Open, rough, cly MnOx specks		
					L.P. = 1.4'		Open, spun, calcite lined vugs		
63							Open, spun		
						2	Open, rough, clay, 25°		
							Open, spun		
							Open, spun (2)		
64				1			Open, smooth carb clay		
				2		4	Open, smooth, abund. carb. clay 20°		
65				2			Open, rough, vuggy, clay		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 5

Project Number: 5121

Hole Number G-4

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
65		Run 2 cont		2		3	Open, rough (2)		Argillaceous Limestone and chert, as above
							Open, rough,clay		
66						1	Open, rough 25° Calcite lined vugs, vuggy zone		66.4'-69.3 "Bone marrow" type texture, L.S. becomes yellowish gray, vuggy.
67						2	Open, rough, calcite, FeOx, clay, vuggy		
68						1	Open, rough, little, clay, vuggy (2)		
69						2	Open, rough, carb. clay, slightly vuggy Open, smooth, clay		
70						1			
71	Weathered Limestone						Open, rough, stylolitic, green clay (2) Open,rough,vugs green clay		
	Competent Limestone	Run 3				4	Open, rough, stylolitic,carb clay Stylolite Open, spun		71.0-81.0 LIMESTONE (80%) and CHERT. LS: Very light (N8) to light gray (N7), fine to moderately crystalline, hard, slightly
72				2					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 5

Project Number: 5121

Hole Number G-4

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
72		Run 3 cont. 10.0'/10.0' 100%		2		2	Stylolite,		LIMESTONE and CHERT (cont.) weathered, fossiliferous, many stylolites. Small zones of slightly argillaceous LS, silty and slightly permeable. CHERT: Very light gray (N8) to light bluish gray (5B 7/1) healed and solutioned dendritic and vertical fractures.
				2	7.0'/10.0' 70%		Open, rough, stylolitic, carb. clay		
73				3			Stylolite		
						1	Open, spun Tight, rough		
					L.P. = 1.2'				
74						3	Open, rough (2)		
							Open, rough, healed and open vertical fractures, MnOx		
75						2			
							Open, rough		
76							Open, smooth, MnOx		
						1	Open, rough, slightly vuggy		
							Stylolite		
77							Open, spun		
						4	Open, smooth Open, spun		
78							Open, rough (2)		
						3	Stylolite		
79				3			Open, smooth		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 5

Project Number: 5121

Hole Number: G-4

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
79		Run 3		3			Open, spun		Limestone and chert, as above.	
							Open, rough, stylolite, carb. clay			
80										
							Open, spun (3)			
81		End		3					Total Depth 81.0'	

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 5

Project Number: 5121

Hole Number: G-5

Project: Bechtel Geotechnical Logging

Location: N. 100650.0 W. 51250 G.S.Elev. 635.90

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Augered and sampled to 38.0'. Rotary drilled 38.0-40.0'. See original boring G-5 log for sample description 0-40'.
									Begin Coring 40.0'
40		Run 1		1	.63'/3.0'		Clay		40.0-40.1' CLAY seam, mod. yellowish brn(10YR 5/4), with fine chert fragments.
		3.0'/3.0'				6	Open,rough,FeOx (3)		40.1-54.6' ARGILLACEOUS SILTY LIMESTONE(65%) intermixed with CHERT(35%). L.S. is finely to med. xln., grayish orange(10YR 7/4) to yellowish gry(5Y 8/1), slightly to v. silty, med. to mod. severely wthrd. and fractured, locally vuggy, with some FeOx stn on fracts., MnOx specks throughout rock fabric. Chert: mottled v. light gry (N8) to grysh orange(10YR 7/4), nodular to finely divided with l.s., fractured (healed) with abundant MnOx filling, fossiliferous, slightly wthrd., v. hard.
					21%		Tight,smooth		
41		100%			L.P. * .4		Open,rough,FeOx, MnOx (4)		
						6	Open,rough,shaley (3)		
42							Tight,rough,FeOx		
						> 6	Open,rough,FeOx, MnOx, cly		
							Rubble		
43		Run 2		1	1.65'/5.0'		Open(2mm),rough, clay		
		5.0'/5.0'				3	Tight, rough		
					33%		Open, spun (2)		
44		100%			L.P. * .5'		Open,rough (3)		
						6	Open,spun		
							Open,rough,FeOx		
45									

Geotechnical Information by: D. Dahlstrom & P. Patchin 10/10/89

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 5

Project Number: 5121

Hole Number: G-5

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location: Adjacent to Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
45		Run 2 cont'd		1		>6	Rubble		
46							Tight, rough, vert Vert. weak		
						3	Tight, rough Clay seam		46.6-47.0' CLAY seam, mod. reddish brn(10R 4/6), with fine to med. chert gravel (angular).
47						>6	Rubble Rubble		
48		Run 3 4.7'/4.7' 100%		2	1.03'/4.7' 22% L.P. * .7'	4	Open, rough, shaley (4)		
49						>6	Tight, rough Rubble Tight, rough, 25° Open, rough, 25°		
50						>6	Open, rough Rubble(vertical fractures)		
51						>6	Rubble Rubble		
52									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 5

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-5

Project: Bechtel Geotechnical Logging

Location: Adjacent to Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
52		Run 3 cont'd 52.7'		2		5	Tight, rough, MnOx, 55° dip Open, smooth, MnOx (2)		LIMESTONE and CHERT, as above.
							Open, rough, clay Open, smooth, contact, MnOx		
53		Run 4 3.7'/4.3' 86%		2	1.81/4.3 42% L.P. = 1.0	5	Open, smooth, FeOx, MnOx spex (2) Open, rough, MnOx specks (4)		
54									
						4	Open, smooth Open, rough, MnOx specks		54.6-60.0' LIMEY SILTSTONE, yellowish gry(5Y 7/2) with approximately 20% chert, finely divided with siltstone. L.S. is mod. hard, mod. wthrd., with MnOx specs. Chert white with "bone marrow" texture. Occaisional vug to 4mm. Rubblized from 55.7-59.5' (possible void).
55									
						>6	Open, smooth		
56						>6	Rubble + 0.6' of loss: 55.6-57.0'.		
57		Run 5 0.0'/1.0' 0%		3	0.0'/1.0' 0%				
58		Run 6 3.6'/5.0' 72%		3	1.98'/5.0' 40% cont'd	>6	Rubble + 1.0' of loss: 58.0-59.4'.		
59									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 5

Project Number: 5121

Hole Number G-5

Project: Bechtel Geotechnical Logging

Location: Adjacent to Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
59		Run 6 cont'd		3	L.P. = .8'	6	Rubble and core loss Open, rough, 35° Tight, rough, FeOx specks		LIMESTONE and CHERT, as above.
60							Open		
						1	Open(5mm), rough, contact Tight, rough, cont. cly, MnOx specks		Stylolite
61						> 6	Tight, smooth, contact Rubble Open, rough Open, rough, cont., stylolitic Stylolite		61.0-73.0' LIMESTONE with CHERT(30%). L.S. is slightly wthrd to fresh, yellowish gry (5Y 8/1) to v. light gry(N8), finely xln to coarse. Nodules of white fossiliferous chert to .5'. LIMEY SILTSTONE beds to .5' from 62.5-66.5' are wthrd. and oxidized (grayish orange(10YR 7/4)) and rubblized Limestone is fossiliferous and hard.
62						4	Stylolite Tight, rough, cont. Open(5mm), rough Open(1mm), rough Open, rough		
63		Run 7 4.8'/5.0' 96%		3	3.02'/5.0' 60%	> 6	Rubble + 0.2' core loss Spun		
64					L.P. = .8'	> 6	Open, rough Rubblized Open, rough, contact (2)		Euhedral calcite and oxidized pyrite.
65						1	Tight, stylolitic		
66									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 5

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-5

Project: Bechtel Geotechnical Logging

Location: Adjacent to Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
66		Run 7 cont'd		3		6	Open, rough (2)		LIMESTONE and CHERT as above.
							Rubble		
67	Weathered Limestone								
	Competent Limestone						Tight, smooth, contact		
				4		2	Open, smooth, contact		
68		Run 8		4	3.6'/5.0'				
		5.0'/5.0'			72%	1	Open, smooth		
69		100%			L.P. = .8'		Tight, smooth, bryozoan		
						2	Open, smooth (2)		
70									
						6			
							Sampled →		
71							Rubble		
							Open, smooth (2)		
						6	Rubble, friable		
72							Tight, rough, 30°		
						3	Open, smooth, non-planar, contact (2)		
73									Total Depth 73.0'

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-6

Project: Bechtel Geotechnical Logging

Location: N. 100450.0 W. 51150.0 G.S.Elev. 639.70

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
									Augered and sampled 0-23.5'. Roller-bit drilled to 25.0'. See original log G-6 for overburden description 0-23.5'
25									Begin Coring 25.0'
		Run 1 2.0'/2.0' 100%		1	.76'/2.0' 38% L.P. * .7'		Clay seam	?	25.0-25.4' GRAVELLY CLAY, moderate yellow brown(10YR 5/4), subangular chert to 0.13 cm, weathered.
26								?	25.4-26.1' LIMESTONE, yellowish gray(5Y 7/2), hard, finely xln, MnOx flakes throughout. FeOx near bottom of core sample, top spun, bottom weathered, stylolites at 25.5, 25.8 and 25.9'.
							Clay seam		
27									26.1-27.0' GRAVELLY CLAY, mod. yellow brown(10YR 5/4) to olive black(5Y 2/1), as above.
		Run 2 1.3'/4.0' 33%		1	.33'/4.0' 8% L.P. = .3'		2.7' of core loss in Run 2, location unknown.		1.3' ARGILLACEOUS LIMESTONE (70%) and CHERT(30%) recovered from Run 2. L.S.: grayish orange pink(5YR 7/2), mod. hard, MnOx and FeOx streaking, fossiliferous, mod. weathered. CHERT: light bluish gray (5B 7/1), FeOx.
28									
29									
30									

Geotechnical Information by: R. McClure & P. Patchin 10/12/89

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-6

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
30		Run 2 cont'd		1						
31										
		Run 3		1	.6 / 9.0				1.3' CHERT recovered from Run 3. Nodular chert as above, fragmented, rubbly and vuggy, moderate to severely weathered, MnOx stained. GRAVELLY CLAY, moderate yellow brown(10YR 5/4) with angular chert near bottom of run. FeOx inclusions moderately weathered.	
		1.3' / 9.0'			6%					
32		14%			L.P. = .6'					
33										
34							7.7' of core loss throughout core run.			
35										
36										
37										

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 7

Project Number: 5121

Hole Number: G-6

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
37		Run 3 cont'd		1					CHERT, as above.
38									
							7.7' of core loss in Run 3.		
39									
40									
		Run 4		1	4.6'/9.0'				40.6-49.0 ARGILLACEOUS LIMESTONE(60%) and CHERT(40%). L.S.: silty, grayish orange (10YR 7/4), fine to med. grain, mod. hard, FeOx weathered staining and streaking, fossiliferous, occasional stylolities and vugs. CHERT: finely divided, light bluish gray(5B 7/1), mottled.
		8.2'/9.0'	40.6 ?		51%		Open,rough		
41		91%			L.P. = .6	2	Open,contact, FeOx, 13°		
			?				Open,spun		
42			42.1				Open(2cm), FeOx, cly,rough (2)		
			42.1	2					
							Tight,rough,FeOx (2)		
43									
						2	Tight,rough,FeOx, vuggy		43.8-44.2 LIMESTONE: competent
44									-continued-

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 7

Project Number: 5121

Hole Number: G-6

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
44		Run 4 cont'd		2			Open, smooth		yellowish gray(5Y 8/1), med. to coarsely crystalline, small stylolites, moderately hard.
						2	Open(8mm), rough, vuggy		
45							Tight, rough		
							Open(5mm), rough		
							Open, smooth, 20°		
						5	Tight, rough, contact		
							Tight, smooth		
46							Tight, smooth, 30°		
							Stylolite		
						3	Open, cly, rough		
							Open, rough, cont., glauc.		46.7-47.1' LIMESTONE, as competent L.S. above.
47							Tight, rough, contact		
							Tight, smooth		
						4	Tight, weak		
							Open, smooth, FeOx, cly		
48							Tight, rough		
							Tight, rough, FeOx		
							Tight, smooth, FeOx MnOx (2)		
						6	Open, rough, cly (2)		
49									
		Run 5		2	1.3'/5.0'				49.0-53.2' ARGILLACEOUS LIMESTONE. Dark yellowish orange (10YR 6/6). Silty to finely crystalline, med. hard. Very rubbly and fragmented. Moderately weathered with FeOx and MnOx on frags and rubble.
		5.0'/5.0'					Chert rubble		
					26%	6			
50		100%			L.P. = .3'		Spun		
							Open, rough		
							Vuggy, rubblized (4)		
						6			
							Rubble		
51									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 7

Project Number: 5121

Hole Number: G-6

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
51		Run 5 cont'd		2		> 6	Tight, rough Open, smooth, clay, FeOx, vertical fractures, tight MnOx		ARGILLACEOUS LIMESTONE, as above.
52				3		> 6	Rubble Tight, rough, 20° Tight, rough		
53							Rubble		53.2-58.8' ARGILLACEOUS LIMESTONE, and CHERT, as in 40.6'-49.0' interval.
54						> 6	Open, rough Spun Tight, rough		
55		Run 6 4.0'/4.0' 100%		3	2.7'/4.0' 68% L.P. = .8'	3	Open, smooth Tight, rough Open, stylolitic glauc., 10°		
56						2	Open, rough Spun Spun, glauc., clay		
57						2	Open, rough, stylol, clay Tight, smooth, 30°		
58						4	Spun Open, smooth, 20° Spun Tight, rough		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 6 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-6

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
58	Weathered L.S.	Run 7			4.7'/7.0'	4	Tight, rough		
		7.0'/7.0'			67%		Open,rough,FeOx		
							Open, spun		
59	59.0	100%			L.P. = 1.2'		Open,sty.,bl. cly		58.8-63.2' ARGILLACEOUS LIMESTONE(90%) and CHERT(10%). L.S.: Yellowish gray(5Y 7/2), very silty with decreasing $CaCO_3$ concentration with depth. Very fine to coarsely crystalline and vuggy texture. "Bone marrow" texture at 60.3'. Medium hard with very slight FeOx weathering. CHERT: Very light gray(N8) to light bluish gray(5B 7/1). Nodules increase in size and concentration with depth. Vuggy texture, very slight weathering.
	Competent L.S.					2	Open, rough		
							Open, spun		
60						3	Tight, rough (2)		
							Open, rough (2)		
61						3	Spun		
							Open, rough		
62							Spun		
						2	Open, rough		
63							Tight,smooth (2)		
						5	Open,stylol., contact, glauc.		63.2-65.0' ARGILLACEOUS LIMESTONE. Light bluish gray(5B 7/1) med. hard. Silty microcrystalline texture, very slight weathering.
							Tight, rough		
							Spun		
64						1	Tight, smooth		
65									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 7 of 7

Project Number: 5121

Hole Number: G-6

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
65		Run 8			.97'/2.0		Open, stylol., cly, contact		65.0-67.0' LIMESTONE. Light gray(N7), hard, very slight weathering, some MnOx flakes and stylolites. Black shaley clay in fracture at 65.0', 65.2' and 66.0'.
		1.8'/2.0'			49%	3	Open, rough, stylol glauc., cly(blk)		
							Open, rough		
66		90%			L.P.		Open, stylol., glauc., blk cly		
			? 66.5		.8'	>6	Open, spun (3)		
67			66.7 ?						
									Total Depth 67.0'

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 6

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-7

Project: Bechtel Geotechnical Logging

Location: N. 101200.0 W. 50450.0 G.S.Elev. 633.30

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden samples 0-19', see original G-7 log.
19									Begin Coring 19.0'
		Run 1 1.9'/2.0' 95%		1	0%		Spun (2) Open,abund. FeOx and MnOx Vert., open,abund. FeOx and MnOx		19.0-19.8' CLAY, mod. yellow brn(10YR 5/4), subang. chert gravel, 2mm-3cm, sev. wthrd. 19.8-20.2' L.S., ylwsh gry(5Y 7/2), coarse micro-xln, many MnOx flakes to 1cm, FeOx, mod. hard, slightly to mod. wthrd. 20.2-20.6' CHERT, MnOx healed vert. fracts. and streaking, gravelly with depth. 20.6-21.0' CLAY(Residuum?), reddish brn(5YR 4/4-3/4) chert gravel.
20									
21									
27									Roller-bit drilled from 21.0' to 27.0'. Possible clay filled cavity. Resumed Coring 27.0'
28		Run 2 1.1'/3.0' 37%		1	0%		1.1' core loss in Run 2, location unknown.		27.1-27.4? CHERT, mottled pinkish gray(5YR 8/1), microcrystalline, dendritic MnOx streaking, v. hard. Severely weathered, vuggy, dark yellowish orange(10YR 6/6) at 27.4', clay, possible top of cavity.
29									

Geotechnical Information by: R. McClure & P. Patchin 10/13/89

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 6

Project Number: 5121

Hole Number: G-7

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location: N.E. of Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
29		Run 2 cont'd		1					29.5-29.8(?) CHERT GRAVEL, mottled very light gray(N8) to light gray(N7), subangular 2mm-3cm fragments, very severely weathered with no fresh surfaces, some dark yellowish orange(10YR 6/6) clay.
30		Run 3		1	0%				29.8-30.1(?) CHERT, as in interval from 27.1-27.4', healed verticle fractures, FeOx, bottom of core is moderately weathered.
		1.3'/7.0'							
31		19%							
32									
33							5.7' core loss throughout Run 3.		
34									
35									
36									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 6

Project Number: 5121

Hole Number: G-7

Project: Bechtel Geotechnical Logging

Location: N.E. of Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
36		Run 3 cont'd		1					1.1' CHERT GRAVEL, recovered in Run 3, very light gray(N8), vuggy, severely wthrd rinds, some cly. 0.5' of subrounded 1.5cm gravel; 0.6' of subangular to ang. frags, possible void fill.
37		Run 4	? 37.4	1	3.5'/8.0'				37.0-37.4' LIMESTONE, mottled yellowish gray(5Y 7/2), med. to coarsely xln, mod. hard to hard, v. slightly wthrd. Bottom of competent piece contains vuggy, mod. wthrd chert, some clay.
		5.7'/8.0'			44%				37.4-39.7(?) Core Loss
38		71%			L.P. = .5'				
39									
									39.7-39.9'(?) CHERT GRAVEL as 1.1' chert gravel above, interval from 37.0-37.4!
40			39.7 ?				Chert rubble		39.9-55.6' ARGILLACEOUS LIMESTONE(65%) and CHERT(35%), finely divided, mottled coarsely microcrystalline. L.S.: Silty, grayish orange(10YR 7/4), med. hard, some planar and wavy laminations, stylolitic, few 0.1' sections are vuggy. FeOx rinds on healed vertical fractures. CHERT: grayish pink(5YR 7/2) to light bluish gray(5B 7/1), microcrystalline, very hard.
41						2	Open, rough Open, rough, FeOx (2)		
42						3	Open, smooth (2)		
						3	Open, smooth, 35° Open, rough Open, spun, FeOx		
43									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 6

Project Number: 5121

Hole Number: G-7

Project: Bechtel Geotechnical Logging

Location: N.E. of Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
43		Run 4 cont'd		1		4	Open, rough Open,stylol.,cly (brn) Open, smooth Stylolite,weak		ARGILLACEOUS LIMESTONE and CHERT, as above.
44				2		2	Open, rough,10°		
							Open, rough (3)		
45		Run 5 7.8'/9.0' 87%		2	1.6'/9.0' 18% L.P. = .7'	> 6	Open, rough, "wafer-like"(7) Tight, rough Open, smooth Open, rough Tight, rough		
46			? 46.7				Open,rough,vuggy		
47			47.5 ?				Tight, smooth Open,rough,vuggy cly		
48						5	Tight, rough Open, rough (3)		48.9-50.0' CHERT, nodule.
49						3	Vert.,tight,FeOx, MnOx Open,rough,cont.		
50									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 6

Project Number: 5121

Hole Number: G-7

Project: Bechtel Geotechnical Logging

Location: N.E. of Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
50		Run 5 cont'd		2		> 6	Tight, rough (4) Tight, smooth(3)		ARGILLACEOUS LIMESTONE and CHERT, as above.
51			? 51.6			> 6	Rubble		
52			52.0 ?			> 6	Open, rough Tight, smooth Tight,smooth,cont Vert., tight,rough MnOx,FeOx		
53						6	Rubble Vert.,tight,rough Open, rough Tight, rough Vert.,tight,rough (2)		
54		Run 6 9.0'/10.0' 90%		3	4.8'/10.0' 48% L.P. = 1.5'		Open, rough Open,rough,vuggy Open,rough		
55	Weathered LS 55.5					6	Open,smooth,cly 20° Tight, rough Vert.,tight,rough		55.6-63.7' VERY SILTY LIMESTONE (80%) and CHERT(20%). L.S.: Yellowish gray(5Y 7/2) to lt. olive gry(5Y 6/1), med. hard, high permeability, "bone marrow" and vuggy texture. 56.4-56.9' limestone, med. lt. gray (N6), hard, competent, MnOx flakes, small stylolites,
56	Competent LS					> 6	Open, rough (2) Rubble		
57							Open, stylol, cly(carb)		-continued-

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 6

Project Number: 5121

Hole Number: G-7

Project: Bechtel Geotechnical Logging

Location: N.E. of Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
57		Run 6 cont'd		3		3	Tight, rough (5)		crinoid stems, fossiliferous, fresh. CHERT: Grayish blue (5PB 5/2), MnOx healed dendritic fractures, very hard.
58						3	Open, rough		
59						4	Tight, rough (2)		
60							Open, rough, rubblized (2)		
61						4	Tight, rough (5)		
62						2	Open, stylol., carb clay		
63						0			
64				4		2	Open, stylol., glauc., 15° Open, stylo., glauc., carb cly		63.7-64.0' LIMESTONE, as in 56.4-56.9'. Total Depth 64.0'

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 7

Project Number: 5121

Hole Number: G-8

Project: Bechtel Geotechnical Logging

Location: N. 100450.0 W.49900.0 G.S.Elev. 655.3

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
	Augered and sampled from 0-30.0' (split-spoon and shelby tube)								For description of overburden from 0.0-30.0', see original log for boring G-8.
30									Begin Coring 30.0
		Run 1		1	2.7'/10.0'				30.0-34.1' CLAY (70%) and LIMESTONE (30%). CLAY is moderate yellowish brown(10YR 5/4), with fine chert gravel (10%). LIMESTONE is pale yellowish brown(10YR 6/2), argillaceous, slightly weathered, hard, dense, stylolitic, with hematite after pyrite specks, fossilferous.
		9.0'/10.0'			27%				
31		.90%			L.P. * .5'		From 30.0-34.1' 1.0' Core Loss - Location Unknown		
32									
33									
34							Stylolites (3)		34.1-44.1' LIMESTONE, argillaceous, as above with approximately 10-20% CHERT interbedded with LIMESTONE, and as nodules Some coarsely xln. sections of
35							Open,rough,clay Tight,smooth,10°		

Geotechnical Information by: D. Dahlstrom and P. Patchin 10/6/89.

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 7

Project Number: 5121

Hole Number: G-8

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location: Disposal Cell Footprint

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
35		Run 1 cont'd		1		2	Tight, rough, MnOx specs		LIMESTONE, slightly weathered CHERT is hard, very pale orange (10YR 8/2). L.S. has pyrite (fresh with halos) replacing fossils (crinoids). Some clay filling of partings.
							Stylolite		
36							Open, rough, clay, broken stylolite (2)		
						4	Open (1cm), rough, clay (2)		
							Stylolite		
37							Open (1mm), rough, clay 15° (2)		
						6	Spun (3)		
							Stylolite		
38							Open, rough, clay		
							Stylolite		
							Horizontal fractures, tight		
						6	Dipping fracture, open, rough, FeOx stained 65°		
39							Open (1mm), smooth clay		
							Tight, rough, clay		
						2	Open (1mm), rough		
							Open, smooth, FeOx		
40		Run 2		1	4.0'/10.0'				
		7.7'/10.0'	40.5 ?		40%		Open, smooth, clay 15°		
41		77%		2	L.P. * .6		Open, rough, vuggy contact, FeOx		
						2	Open (1cm), rough contact		
42									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 7

Project Number: 5121

Hole Number: 6-8

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location: Disposal Cell Footprint

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
42		Run 2 cont'd	0	2			Open,rough,clay		LIMESTONE and CHERT, as above.
43									
			43.5				Open,rough,clay 15°		
44						4	Open(5mm),rough, FeOx,10° Open,rough,clay (4)		44.1'-69.2' INTERMIXED CHERT and ARGILLACEOUS LIMESTONE approximately 50/50. Chert is finely divided with limestone and as nodules, fractured with MnOx filling, fossiliferous, vuggy, hard to very hard, very pale orange(10YR 8/2) to pale yellowish orange, some as void fill gravel. Limestone is slightly to highly argillaceous and silty, grayish orange(10YR 7/4) and dark yellowish orange(10YR 6/6), FeOx stnd., moderately hard to soft. Very soft friable sections of limestone shown below.
45						4	Open,rough,FeOx, (1-3mm) Open,rough,(15°) Open(1mm),rough		
46						3	Open(1mm),rough, 25° (2) Open,rough,FeOx Open(1mm),rough, clay		
47						4	Weak,stylolites (2) Open,rough,FeOx, spex.(5)		
48						1			
49									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 7

Project Number: 5121

Hole Number: G-8

Project: Bechtel Geotechnical Logging

Location: Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
49		Run 2 cont'd		2		2	Open,rough,FeOx spex Open,rough,cly (2)		CHERT and ARGILLACEOUS LIMESTONE, as above.
50		Run 3 7.6'/8.0' 95%		2	2.5'/8.0' 31%	> 6	Rubble Open,smooth (2) Open(3cm),rough		
51						3	Open(1-20mm), rough Open(1-10mm), rough Open,smooth Spun		
52				3		> 6	Open(1mm),rough Rubble (friable)		52.8-54.5' Soft, friable, rubblized, v. little chert, v. argillaceous.
53						> 6	Rubble with .4' core loss		
54						> 6	Open,smooth Open,rough(22°) (3)		
55						> 6	Rubble Friable Open(1mm),rough		
56									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-8

Project: Bechtel Geotechnical Logging

Location: Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
56		Run 3 cont'd		3		3	Open,rough (2) (25°)		CHERT and ARGILLACEOUS LIMESTONE, as above.	
							Open,smooth,FeOx (1cm)			
57							Open,friable (3)		57.0-58.0' Rubblized, no chert.	
						>6				
58							Open,smooth (3) (30°)			
		Run 4		3	3.9'/7.0'	>6				
		7.0'/7.0'			55%		(20°)		58.4-59.0' Rubblized chert.	
							Open,smooth,FeOx (3)			
59		100%			L.P. = .7'					
						>6	Open,smooth (30°)			
							Open,smooth,FeOx			
							Open,rough (2)			
							Open,smooth (15°)		59.7-60.5' Rubble	
60						>6	Rubble			
							Stylolite,weak (3)			
61							Tight,rough			
				4		3	Tight,smooth (2)			
62						3	Tight,rough,FeOx			
							Open(1mm),rough, FeOx			
							Open,rough, FeOx, (30°)			
63										

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 6 of 7

Project Number 5121

Hole Number G-8

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location: Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
63		Run 4 cont'd		4		3	Open(1mm),smooth Open(1mm),rough (3) (20°)		CHERT and ARGILLACEOUS LIMESTONE, as above.
64							Clay (40°)		
						3	Open,friable		
65							Open,rough, (25°)		
		Run 5		4	3.9'/10.0'		Open,non-planar, rough		
		10.0'/10.0'				> 6	Open,friable(1cm)		
					39%		Open,friable, rubbly		
66		100%			L.P. = .7'		Open,friable(25°)		
						5	Spun Open(2mm),smooth (15°)		
							Spun		
67							Spun Spun		
						5	Spun (2)		
							Open,rough, stylolitic		
68							Spun		
							Open(1cm),smooth, MnOx		
						3	Open,smooth (10°)		
							Tight,rough,MnOx		
69	Weathered Limestone 69.2						Open,rough,MnOx, (30°)		69.2-75.0' Very SILTY LIMESTONE INTERMIXED with CHERT (25%). Limestone is light olive gray (5Y 6/1), v. little HCL reaction, fine grnd., v. fractured.
	Competent Limestone					2	Open,smooth		-continued-
70									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 7 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-8

Project: Bechtel Geotechnical Logging

Location: Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
70		Run 5 cont'd		5			Open,rough		fossiliferous, mod. hard to med. hard, v. fractured 73-75'. CHERT is lt. bluish gry(5B 7/1) vuggy, v. hard, irregular fractured.
						6	Tight,rough (3)		
							Open,stylolitic, blk,cly		
71							Open,smooth,cly		
						4			
							Open,rough (3)		
72									
							Open,rough, rubblized		
						> 6	Open,rough		
73									
							Rubble		
						> 6			
74							Rubble		
						2	Tight,rough		
							Open,rough		
75									Total Depth 75.0'

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 6

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-9

Project: Bechtel Geotechnical Logging

Location: N. 100065.0 W. 49905.0 G.S.Elev. 656.00

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Augered and sampled from 0-37.5'. For sample descriptions see original borehole G-9 log.
37									
									Rotary drilled 37.5-38.0'.
38									Begin Coring 38.0'
		Run 1		1	2.6'/5.5'	> 6	Rubble		38.0-40.0 LIMESTONE-very light gray(N8), fossiliferous, med. to coarse grained, mod. hard, slight weathering.
		5.2'/5.5'			47%				
39		94%			L.P. = 1.1'				
						2	Open,rough		
							Open,spun		
40									40.0-41.5' ARGILLACEOUS LIMESTONE AND CHERT; ls: dusky yellow(5Y 6/4), slight to moderately severe weathering, vuggy, mod. hard. Chert: light gray(N7), hard, slight weathering. Chert as nodules to 10cm, to finely divided nodules 1mm thick, 5-10mm wide; 41.6-42.1' CLAY SEAM, gravelly, silty, stratified, FeOx stained partings, light olive brown (5Y 5/6).
						> 6	Rubble		
							Open,spun (5)		
41									
						> 6	Open		
							Clay Seam		
42							Open		42.1-66.0' ARGILLACEOUS LIMESTONE AND CHERT (proportions variable). Limestone: dark yellowish orange(10YR 6/6) to
						3	Open,spun (2)		
43							Open,rough,vuggy		-continued-

Geotechnical Information by: D. Dahlstrom & P. Patchin 10/9/89

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 6

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-9

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
43		Run 1 cont'd 43.5'		1		5	Open(0-2mm),rough Open,rough,FeOx spex (2)		moderate yellowish orange (10YR 5/4), mod. hard to soft (soft where vuggy), moderate to mod. severe weathering.
		Run 2		1	1.77' 7.5'		Open(5mm),rough		
44		5.2' 7.5'			24%		Open(1-5mm),rough (2)		Chert: very light gray(N8) to pale yellowish orange(10YR 8/6) hard to mod. hard, very slight to mod. weathering. Chert as nodules up to 0.6' thick to finely divided with limestone core generally vuggy.
		69%			L.P. * .8'	5	Open(1-5mm),rough FeOx spex (2)		
45							Open,smooth,FeOx spex (2)		
						6	Open(1-5mm),rough Open,rough Open,smooth,FeOx spex (3)		L.S.:Chert ratio: 42.1-61.0' 40:60 to 50:50 61.0-74.5' 70:30 to 60:40 74.5-76.0' 100:0
46									
						3	Open,rough,FeOx spex (2) Open,rough		
47							2.2' of core loss in 46.6-49.3. 0.5' recovery.		Orig. log indicates 2' of clay from 45.2-47.2' not recovered, may have been in interval 46.6-49.3'.
48									
49				2		2	Spun Open,smooth, 10° dip		
50									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 6

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-9

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
50		Run 2 contd		2		2	Open, rough		Argillaceous limestone and chert, as above.
51							Open,rough,vuggy		
		Run 3		2	2.09'/6.5'	0			
		5.8'/6.5'			32%		Soln. cavity		
52		89%			L.P. = 1.4'				
							Open,rough,FeOx		
						4	Open,smooth		
53							Open,rough (2)		
							Open,spun (2)		
						4	Tight,rough		
							Open,spun		
54							Open,smooth		
							Open,smooth,cly		
						6	Open,spun (2)		
55							Open,rough,FeOx (2)		
							Open,smooth		
			? 55.8				Open(1cm),rough, MnOx		
56							Open,rough,cly		
							Rubble		
57			56.5 ?				Tight,rough		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 6

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-9

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
57							Open,rough (2)		LIMESTONE and CHERT, as above.	
		57.5'				5				
		Run 4		3	1.0'/2.5'		Open,smooth,cly Open,smooth			
58		2.3'/2.5'			40%		Open,smooth,FeOx Parting,weak			
		92%			L.P. = .5'	5	Open,rough,FeOx (4)			
59										
						> 6	Smooth,FeOx Smooth,weak (3) Open,rough,FeOx			
60										
		Run 5		3	4.4/6.0	> 6	Rubble			
		6.0'/6.0'			79%		Tight,rough,FeOx Open,rough,FeOx, vuggy,rubblized (2)			
61		100%			L.P. = .9'		Tight,rough			
						4	Tight,rough, contact			
62							Tight,rough			
						3	Open,rough (2)			
							Open,smooth			
63										
						1	Tight,rough			
64										

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 6

Project Number: 5121

Hole Number: G-9

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
64						1	Tight,rough,FeOx		LIMESTONE and CHERT, as above.
65						4	Tight,smooth Stylolite,weak Open,rough,stylolite,blk cly Tight,rough		
66	Weathered Limestone Competent Limestone	Run 6 10.0'/10.0' 100%		4	9.2'/10.0' 92% L.P. = 1.6'	3	Open,rough Stylolitic,cly (2)		66.0-74.3' ARGILLACEOUS LIMESTONE and CHERT, L.S.: light olive gray(5Y 5/2), mod. hard, very slight weathering, very permeable?
67						3	Open,stylolitic, blk cly (3)		Chert: very light gray(N8) to med. bluish gray(5B 5/1), hard very slight to moderate weathering. Chert generally occurs as nodules 2-10cm thick.
68						2	Open,spun (2)		
69						2	Tight,rough (2)		
70						2	Stylolite Tight,rough		70.0'-CHERT, vuggy, numerous pinpoint vugs - "bone marrow" texture.
71							Open,spun		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 6

Project Number: 5121

Hole Number: G-9

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
71		Run 6 cont'd		4		2	Open,rough		LIMESTONE and CHERT, as above.
72							Open,stylolitic, blk cly,spun		
						2	Tight rough		
73							Tight,smooth		
						2	Open,rough, glaucon. (2)		
74							Tight,rough (2)		
						5	Open,smooth, 23° stylolitic		74.3-76.0' LIMESTONE: light gray(N7), mod. hard, fresh, stylolitic, fossiliferous fine xtln, minor silt fraction, low permeability.
							Open,rough,stylolitic, blk cly		
75							Stylolite		
76									Total Depth 76.0'

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 7

Project Number: 5121

Hole Number: G-13

Project: Bechtel Geotechnical Logging

Location: N. 99521.0 W. 50517.0 G.S.Elev. 654.70

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0-28.5', see original log for G-13.
28									Begin Coring 28.5'
		Run 1		1	2.5'/7.0'	1 / 0.5	Open, smooth		28.5-45.7' LIMESTONE(60%) and CHERT(40%) with zones of clay and chert rubble (cavity fill?) L.S.: Grayish orange pink (5YR 7/2), fine to medium microcrystalline, mod. hard to hard, slightly weathered (except for mod. to severely weathered fracture surfaces), large(3mm) MnOx flakes throughout, stylolitic, fossiliferous. CHERT: Nodular, abundant MnOx healed vertical fractures, v. light grey(N8) to pale red purple(5RP 6/2).
29		3.8'/7.0'			35%		Open, smooth, abun. cly, MnOx flakes		
		54%	? 29.8		L.P. = 0.7'		Open, spun, FeOx Open, spun Vert: rough, unconsolidated silty sandy cly with ang. blocky chert frags, FeOx.		
30									
31									
32									
33			32.8 ?				Rubble and clay		32.8-33.3' Clay, moderate yellowish brown(10YR 5/4) and subangular blocky chert rubble.
						> 6	Open, smooth, MnOx, FeOx - Rubble		
34				1			Open, spun		Stylolites, strong (2)

Geotechnical Information by R. McClure. 10/20/89

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-13

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
34		Run 1 cont'd		1		2	Open, spun Stylolites (2) Open,rough,abund. cly,FeOx,styl.		LIMESTONE and CHERT, as above.
35			? 35.2				Stylolites(2) Open,rough,abund. cly		
		35.5'					Open,rough,clay subang. chert to 1mm		
36		Run 2 1.8'/5.0' 36%			0.8'/5.0' 16% L.P. = 0.4'		Open,rough,clay, MnOx,FeOx		
37									
38									
39			38.7 ?						38.7-89.6' Clay and chert rubble, as in section 32.8-33.3'.
40						6	Open,rough,clay, FeOx Open,rough,abund. cly, sl. vuggy Open, rough		Severely weathered at 39.6'.
		40.5'				5	Open,rough,clay, MnOx Open, smooth Open,rough,abund. cly,sev.wthrd., FeOx,MnOx flks		
41		Run 3		1					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-13

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
41		Run 3 cont'd		1	2.6'/10.0'				
		6.4'/10.0'			26%				
42		64%			L.P. = 0.5'				
43									
44									
			44.3 ?			>6	Rubble, chert gravels		44.3-45.0' Clay, dark yellowish brown(10YR 4/2), with fine grain to cobble size, angular chert rubble.
45							Open,rough,abund. cly,sev. wthrd. vuggy		
						3	Open,smooth,abund. FeOx discolor., some clay		45.7-62.8' ARGILLACEOUS LIMESTONE(65-75%) and CHERT. L.S.: Grayish orange(10YR 7/4) to dark yellowish orange(10YR 6/6), silty, very permeable, soft, moderately to severely weathered, abundant FeOx discoloration, zones are extremely vuggy with abundant clay, few areas of closely spaced fractures. CHERT: finely divided(45.7-55.0') to nodular with mottled texture(55.0-62.8'), very light
46							Open,rough,ext. vuggy,FeOx,cly (7)		
			? 46.5						
			46.6 ?				Open,as above w/ unconsol. silty sand and subang. chert fragments. (2)		
47			? ? 47.3	1 2					
			47.5 ?				Open,as above (2)		-continued-
48									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 7

Project Number: 5121

Hole Number: G-13

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS (TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION)	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION (TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION)	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION	CEMENTATION, HARDNESS, WEATHERED STATE
48		Run 3 cont'd		2		3	Open,rough,ext. vuggy,FeOx,cly		gray(N7) to medium gray(N5), MnOx, abundant healed fractures.	
							Open,rough,vuggy, cly,FeOx (3)			45.7-48.1' Extremely vuggy, severely weathered, abundant FeOx discoloration and closely spaced fractures.
49						3				
							Open,rough,clay (2)			
50						4	Open, spun			
		50.5'								50.5-52.1' Extremely vuggy, severely weathered zone, as in section 45.7-48.1'.
		Run 4			1.4'/4.5'					
51		4.2'/4.5'			30%		Open,rough,ext. vuggy,abund. clay (9)			
		93%			L.P. = 0.5'	4				
52										
						4	Open,rough,vuggy, some clay (2)			
53							Open,smooth,some clay			
							Open,rough,FeOx			
						4	Open,rough,clay (3)			
54			? 54.4							
							Open,rough,clay (2)			
55			54.7 ?				Open,smooth/rough wafer,clay			

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-13

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
55		Run 5		3	0.65'/2.0'		Open, smooth		ARGILLACEOUS LIMESTONE and CHERT, as above.
							Open, rough, sl. vuggy, clay		
		1.8'/2.0'	?		32%		Open, spun		
56		90%	55.9		L.P. = 0.4'		Open, rough (2)		
			56.1				Open, rough, clay, 15° (2)		
							Open, spun (2)		
57			?						
		Run 6	57.2		7.1'/9.0'		Open, smooth, MnOx, some FeOx, little cly (2)		
		8.4'/9.0'	57.3 ?		79%				
58		93%			L.P. = 1.0		Open, rough, abund. MnOx flakes, cly		
						3	Open, rough, grnsh gry (5GY 6/1) clay, FeOx		
							Open, rough, little clay		
59							Open, smooth, clay 15°		
			? 59.9						
60							Open, rough (2)		60.4-62.8' Moderately weathered, vuggy, possible gradational contact zone from grayish orange (10YR 6/6), weathered to yellowish gray (5Y 7/2), "bone marrow", argillaceous l.s.
			60.4 ?				Open, rough, clay w/ cly filled solutioned vert fracts., vuggy		
61						3	Open, smooth, grnsh gray clay, as above		
							Open, rough, very vuggy clay		
62				3					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 7

Project Number: 5121

Hole Number: G-13

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
62		Run 6 cont'd		3			Open,rough,clay, ang. chert, rubbley		ARGILLACEOUS LIMESTONE and CHERT, as above.
				4		3			
63							Open,rough,vuggy, clay		62.8-71.0' ARGILLACEOUS LIMESTONE(60%) and CHERT. L.S.: Yellowish gray(5Y 7/2), silty, permeable, medium hard, slight to very slightly weathered, "bone marrow," slightly vuggy texture. CHERT: Very light gray(N8) to grayish blue(5PB 5/2), nodular with little finely divided, some calcite filled vugs.
						1			
64							Open,smooth,stylolitic(?), carb. clay		
	Weathered Limestone					2	Open,rough,stylolitic, carb. clay		
	Competent Limestone						Open,rough,clay		
65									
						1	Open,rough,little grnsh gry cly		
66							Open,rough,carb. cly,fossilif. (2)		
		Run 7			3.5'/5.0'		Stylolite		
		5.0'/5.0'			70%	3	Open,rough,grnsh blk(5GY 2/1) shaley clay		
67		100%			L.P. = 2.4'		Open,smooth,20°		
						2	Tight, rough		
68									
						2	Open, rough (2)		
69				4					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 7 of 7

Project Number: 5121

Hole Number: G-13

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
69		Run 7 cont'd		4		1	Open,rough,calcite lined vugs		ARGILLACEOUS LIMESTONE and CHERT, as above.
70							Open,rough,vuggy		
						3	Open, rough (2)		
									Total Depth 71.0'
71				4					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 6
Project Number: 5121
Hole Number G-14

Project: BECHTEL Geotechnical Logging
Location: N.99199.0 W.49935.0 G.S. Elev.655.8

DEPTH	COMMENTS (TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION)	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION (TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION)	GRAPHIC LOG	LITHOLOGY (MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION; CEMENTATION HARDNESS WEATHERED STATE)
									For description of overburden from 0-37.5 see original 6-14 log.
37									Begin coring 37.5'
38	37.9	Run 1 25%		1	0%		Chert rubble		37.5-37.8' CORE LOSS
		Run 2 1.8'/2.1' 86%		1	.5'/2.1' 24% L.P. = .5'	> 6	Open, rough, abund. hematite (3) Clay Seam		37.8-38.3' CHERT, mottled light gray (N7) & yellowish gray (5Y 7/2), fractured w/abund. hematite on fracts, v. hard.
39			? 39.2				Chert Gravel Rubble		38.3-38.8' CLAY, yellowish gray (5Y 8/1), "soapy" texture, (kaolinitic).
40			39.5 ?			> 6			38.8-40.7' CHERT (70%) and LIMESTONE, slightly argillaceous Chert is v. hard slightly weathered, mottled, rubblized, L.S. is grayish orange (10YR 7/4) hard, slightly wthrd., hard. w/MnOx & FeOx stn. w/marcasite? in clay blebs. to 1 cm.
41		Run 3 4.6'/5.0' 92%	41.2	1	2.7'/5.0' 54% L.P. = .6'	> 6	Rubble w/FeOx		40.7-56.4' ARGILLACEOUS, LIMESTONE (70%) and CHERT (30%) finely divided together. L.S. is dark yellowish orange (10YR 6/6) to grayish orange (10YR 7/4), finely to occassionally coarsely crystalline.
42			41.6			> 6	Open, (5mm) abund FeOx, cly		

Geotechnical information by Paul Patchin 11/3/89

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 6

Project Number: 5121

Hole Number: G-14

Project: BECHTEL Geotechnical Logging

Location: N.99199.0 W.49935.0 G.S. Elev.655.8

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
42		Run 3 cont		1		3	Stylolite, weak Tight(25°) rough FeOx Open,(15mm) soln cavity, FeOx		micritic, permeable, mod. to mod. severely weathered, med. hard, locally very solutioned with interconnected vugs, & FeOx stn., slightly stylolitic, MnOx specks throughout, locally fossiliferous, large (to 2cm) wthrd. pyrite? blebs at 42.6'. CHERT is very pale orange (10YR 8/2) to v. light gray (N8) finely divided with L.S., occasionally nodular to .5', very hard, v. slightly wthrd, fractured (healed) with abund MnOx in fracts., fossiliferous, locally vuggy, with minor FeOx inclusions.
43							Open,rough,vuggy (5mm) FeOx Open, spun		
						3	Open, soln.cavity (2cm) abund. FeOx Open, spun, FeOx		
44							Open(2mm) rough soln. FeOx (2)		
						5	Open,(1cm) abund. soln. FeOx Open, rough FeOx Stylolites (2) weak		
45			?						
		Run 4 7.7'/9.0' 86%	45.2 45.8 ?	2	6.6'/9.0' 74% L.P. = 1.3'		Open, spun Open, rough		
						3	Open,rough,vuggy FeOx		
46							Tight, smooth, abund.FeOx,MnOx		
						2	Open, spun, stylolitic		
47			? 47.3						
							Open, spun (2)		
48			47.7 ?				Tight, rough		
						3	Open (1mm) rough		
49							Open, smooth		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 6

Project Number: 5121

GEOTECHNICAL ATTACHMENT

Hole Number: G-14

Project: BECHTEL Geotechnical Logging

Location: N.99199.0 W.49935.0 G.S.Elev 655.8

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
49		Run 4 cont		2		2	Open, spun		ARGILLACEOUS LIMESTONE & CHERT, as above
							Tight, smooth, 37° FeOx, MnOx		
50						2	Tight, rough		
			? 50.9				Open, rough		
51			51.3			1	Open, rough, vuggy		
52						2	Open, rough, MnOx, cly, FeOx		
53							Tight, rough, vuggy, MnOx specs.		
						3	Tight, rough (2)		
							Tight, smooth		
54		Run 5 .7'/.7' 100%		2	0%	2	Open, spun, FeOx (2)		
54.7'		Run 6 .7'/1.7' 41%		3	0%		1.0' of core loss; location in section unknown.		
55									
56									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 6

Project Number: 5121

Hole Number: G-14

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location: N.99199.0 W.49935.0 G.S.Elev 655.8

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
56	Weathered Limestone	Run 6 cont					↓		56.4-69.8' ARGILLACEOUS SILTY LIMESTONE (80%) and CHERT finely divided together. Limestone is silty, permeable, possibly dolomitic (delayed HCL reaction), light olive gray (5Y 6/1), mod. hard, slightly to mod. wthrd., occasionally vuggy, occasional MnOx veins. CHERT is light gray (N7) to light bluish gray (5B 7/1) mottled, v. hard, slightly wthrd. to fresh, occasionally vuggy with "bone-marrow" texture and euhedral qtz. vug filling. CHERT nodule (bed?) from 61.5' to 62.7' with glauconitic clay-filled fracture .1' thick.
	↑ 56.6'	Run 7			5.8' / 10.1'				
57	↓ Competent Limestone	10.1' / 10.1'			57%				
		100%			L.P. = .8'	2	Open, rough		
							Open, spun		
58							Tight, rough		
						5			
							Tight, rough (2)		
							Tight, rough open, spun		
59						1	Open (2mm) rough		
60							Tight, rough, MnOx, FeOx		NOTE: Run #7 core pieces were out of place and reversed in position. Difficult to correct but able to piece most of run together.
						3			
							Tight, smooth		
61							Tight, smooth		
						3	Open (1cm), rough, FeOx		
							Open, rough, rubbly glauc. cly (3)		
62									
						2	Glauc. clay seam		
							Open, smooth		
							Open (1mm), glauc. cly (2)		
63									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 6

Project Number: 5121

Hole Number: G-14

Project: BECHTEL Geotechnical Logging

Location: N.99199.0 · W.49935.0 G.S.Elev 655.8

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
63		Run 7 cont.		3		0			ARGILLACEOUS SILTY LIMESTONE and CHERT, as above.
							Tight, rough, mechanical		
64							Tight, rough		
						> 6	Tight, rough, 45°		
65				4			Rubble (Prob. mechan.)		
						> 6	Open, rough, rubbly (2)		
66							Tight, rough		
		66.5'				2			
		Run 8		4	6.9'/9.9' 70%				
67		9.5'/9.9' 96%			L.P. = 2.0'	2	Tight, smooth Tight, smooth contact carb cly		
68						2	Tight, rough carb cly(minor)		
						5	Open, stylolitic carb. cly. Open (4mm)smooth glauc.(abund)cly Open,rough,abund. glauc.,FeOx (3) Open (2mm) stylolitic carb. cly.		69.0-69.8' Weathered and fractured chert, vuggy with glauconitic clay fract. filling & FeOx. 69.8-73.0' LIMESTONE (cont'd.)
69									
70									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 6

Project Number: 5121

Hole Number: G-14

Project: BECHTEL Geotechnical Logging

Location: N.99199.0 W.49935.0 G.S.Elev 655.8

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
70		Run 8 cont		4		1	Stylolitic, weak		light gray (N7) med. to coarsely crystalline, hard, fresh, stylolitic, fossiferous thickly bedded, with one small (3cm) chert nodule. Glauconite? specks from 70.0' - 70.5'.
71						1	Stylolites		
							Tight, smooth		
72						1	Open, smooth		
73				5		3	Open, rough, 25° carb. cly Tight, smooth, contact		73.0-76.0' ARGILLACEOUS SILTY LIMESTONE & CHERT, as in 56.4'-69.8' interval. Mod. vuggy, FeOx stain from 75.8-76.0'.
							Tight, smooth		
74						> 6	Open, rough, rubbly Vert. tight, rough Rubble		
75						4			
76			? 76.0				Tight, smooth(2) Tight, rough Open, rough, FeOx, vuggy		76.0-76.4' CORE LOSS?
									Total Depth 76.4'

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 5
Project Number: 5121
Hole Number: G-15

Project: BECHTEL Geotechnical Logging
Location: N.98924.0 W.50447.0 G.S. ELEV:658.0

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Augered and sampled from 0-41.0'. For description of overburden, see original G-15 log.
42									41.0-43.0' drilled with tri-cone bit.
43									Begin Coring 43.0'
		Run 1		1	3.4'/7.5'				
		4.4'/7.5' 59%			45% L.P. = 1.3'				
44							3.1' of core loss within 43.0-46.9' interval.		43.0-46.9' Recovered .8' of core comprised of weathered CHERT. Chert is v. hard, mottled med, light gray (N7) to grayish orange (10YR 7/4), slightly to mod. severely wthrd., vuggy, fractured, abund. FeOx and MnOx stn.
45									
46									
47							Open, rough (2)		46.9-64.4' ARGILLACEOUS LIMESTONE (65%) and CHERT (35%) intermixed. L.S. is permeable, silty, finely crystalline (micritic) grayish orange (10YR 7/4).
						2	Open, smooth stylolitic		
48									

Geotechnical Information by Paul Patchin 11/6/89

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 5

Project Number: 5121

GEOTECHNICAL ATTACHMENT

Hole Number: G-15

Project: BECHTEL Geotechnical Logging

Location: N.98924.0 W.50447.0 G.S. ELEV.658.0

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
48		Run 1 cont.		1		1	Stylolite		Med. hard to soft, mod. to mod. severely weathered with MnOx specks throughout matrix, no fossils, FeOx and clay on some fracture surfaces CHERT is mottled med. light gray (N6) to very light gray (N8), finely divided with limestone and nodular to .5', v. hard, fractured with MnOx infilling, occasionally vuggy, fossiliferous (partially replaced).
49							Tight, rough, FeOx		
						1	Tight, rough, FeOx		
50							Open, rough, abund FeOx		
		50.5'				2			
		Run 2		1	1.25'/1.5' 83%		Tight, rough, stylolite, contact, glauc?		
51		1.5'/1.5' 100%			L.P. = .8'	2	Open, spun (2)		
52									
		Run 3 2.4'/2.4' 100%		1	1.4'/2.0' 70% L.P. = .7'	2	Tight, smooth		
53							Tight, smooth		
						3	Tight, smooth, stylolitic, MnOx		
54							Open(1mm) rough abund. FeOx Open, spun (3)		At 54.4' driller probably lifted core-barrel then placed back down without flushing cuttings. Then cored 1.2' of cuttings on Run 4.
		54.4'				2			
		Run 4 .4/.4'		2	100%				
55	54.8	Run 5 (cont.)							

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 5

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-15

Project: BECHTEL Geotechnical Logging

Location: N.98924.0 W.50447.0 G.S. ELEV.658.0

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
55		Run 5 cont. 1.2'/1.2' 100%		2	.6'/1.2' 50% L.P. = .6	3	Vertical, tight, smooth, FeOx (2) Tight, rough, FeOx Vug		ARGILLACEOUS LIMESTONE & CHERT, as above.
56		Run 6 4.7'/5.0' 94%	56.3 ?	2	3.5'/5.0' 70% L.P. = .9'		Rubble		
57							Tight, rough, FeOx Tight, smooth, 22°		
						2			
58							Tight, rough		
						3	Tight, smooth, FeOx		
59							Tight, smooth 8°		
						1			
60							Tight, rough		
						> 6	Tight, rough Open, rough, vuggy, Rubble		
61		Run 7 9.5'/9.5' 100%		3	6.2'/9.5' 65%	3	Open, smooth, FeOx Open, vuggy, rough FeOx (abund) (2)		
62									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 5

Project Number: 5121

Hole Number: G-15

Project: BECHTEL Geotechnical Logging

Location: N.98924.0 W.50447.0 G.S. ELEV.658.0

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
62		Run 7 cont		3	L.P. = 1.4'	1	Tight, rough		ARGILLACEOUS LIMESTONE
63						2	Open, (5mm) FeOx gry cly, rough		
64							Tight, rough		
						1			64.4-69.1' CALCAREOUS SILTSTONE (60%) and CHERT (40%) intermixed and finely divided. Siltstone is argillaceous, permeable, light olive gray (5Y 6/1) med. hard, slightly to mod. weathered, mod. solutioned with vugs to 1 cm., no fossils, low reaction to HCL. CHERT is light gray (N7) to white (N9), mod. weathered with vugs to 2cm partially filled with eahedral and drusy quartz, v. hard., locally "bone marrow texture".
65							Tight, rough (2)		
						3	Tight, rough		
66							Open, spun		
						2	Open, rough, vuggy, FeOx		
67							Tight, rough		
						3	Open, vuggy, rough, FeOx		
68							Tight, rough, vuggy		
						3	Open, rough, rubbly (3) vuggy		
69	WEATHERED LIMESTONE 69.0'						Tight, rough		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 5
Project Number: 5121
Hole Number: G-15

Project: BECHTEL Geotechnical Logging
Location: N98924.0 W.50447.0 G.S. ELEV.658.0

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
69	Competent Limestone	Run 7 cont.		3		2	Open, stylolitic carb. cly		69.1-70.1' CALCAREOUS SILTSTONE (50%) & CHERT (50%) finely divided together, as above but siltstone is greenish gray (5GY 6/1) and stylolitic with carbonaceous & glauconitic clay infilling. Chert is light bluish gry(5B 7/1)to med.bluish g
							Stylolite		
							Open(2mm) smooth 15°, glauc. cly		
70						4	Open, rough		
							Open, rough, glauc. cly		
		70.5							
		Run 8		4	4.8 / 5.0		Open, spun		70.1-70.3 CHERT, white (N9) to mod. dk. gry. (N4) very fractured (healed) and mod. wthrd., abund. MnOx or carbonaceous cly.
							Stylolitic, weak		
71		5.0 / 5.0			96% L.P. = 1.6'				
		100%				0			70.3-74.0' LIMESTONE, light gray (N7) to very light gray (N8) finely to med. crystalline, fresh, hard to very hard, fossiliferous with occassional chert nodules (white) to 2', From 70.3 to 70.5' is medium gray (N5) very stylolitic, very fossiliferous, possible disseminated glauconite.
72						1			
							Tight, smooth		
73									
						> 6			74.0-75.5' CALCAREOUS SILTSTONE & CHERT as in 64.4 -69.1' interval. Less solutioned, yellowish gray (5Y 7/2), hard.
							Chert, rubble		
74						0			
75									Total Depth 75.5'

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 7 of 7

Project Number: 5121

Hole Number: G-16

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
									Augered and sampled from 0-34'. See original log for description of unconsolidated material. 34.0-34.5' drilled with roller bit. No sample.
									Begin Coring 34.5'
		Run 1	34.9	1	0'/5.0'		open, rough, FeOx stain (2)		34.5 – 56.5 silty, argillaceous limestone and chert
							open, rough Rubble		
35		1.0'/5.0' 20%			0%	>6			Limestone: dusky yellow (5Y 6/4) to dark yellowish orange (10 YR 6/6) with MnOx blebs. Medium hard to soft. Moderately severe to severe weathering.
36						>6			Chert: generally mottled very light gray (N8) & medium light gray (N6) also pale yellowish orange (10YR 8/6). Hard to med. hard. Slight to mod. severe weather.
							open, rough, clay-lined FeOx stained (2)		
37			37.1			>6			Ratio: Limestone : Chert 34.5–39.5 10 : 90 39.5– 60 : 40 chert occurs as layers up to 0.3' thick and as finely divided masses within the silty, argillaceous limestone
38						>6			
39				1					

Geotechnical Information by:

D. Dahlstrom 4/16/90

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 7

Project Number: 5121

Hole Number: G-16

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
39		Run 1 cont.	39.1 / 39.5	1 / 1		> 6	Rubble - FeOx stained weathering rinds on all surfaces		silty, argillaceous limestone and chert as above
		Run 2 0.7' / 1.5' 47%	40.3	1	0.0' / 1.5' 0%	> 6	Rubble open, rough (3)		
40				1					
41		Run 3 6.1' / 5.5' 110%		1	3.7' / 5.5' 67% LP= 1.1'	0			
42						4	open (0-2cm), rough (2) open (0-1cm) rough, MnOx specks open (0-3cm), rough, clay-lined, FeOx stained		
43						> 6	open, rough, FeOx stained calcite-lined Rubble open, rough, MnOx stained FeOx-stained (2)		vuggy
44						3	open, rough, MnOx specks (4)		
45						1	healed fracture in chert, filled with silty, arg limestone		
46				1					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-16

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
46		Run 3 Cont.	46.5 ?	1			open (0-3cm), rough		silty, argillaceous limestone and chert as above	
				1		>6	open, rough (2)			
		Run 4		2	4.4' / 10.0'					
47		8.9' / 10.0'	? 47.0		44%		open (0-5mm), rough			
		89%			LP = 1.1'	4	open, rough			
							open			
48							open (0-8mm), rough		very	
						3	open (0-5mm), rough			
							open (0-5mm) rough, Silica coated			
49							open (2)			
						5	open (0-1cm), rough			
							open, rough, MnOx specks			
							open (0-1cm), rough			
50						>6	open (0-2cm) rough			
			50.7 ?							
51							open, rough			
			7 51.3			>6	open (0-1cm), rough (4)		"bone marrow" chert (rugosy) ~51.5 – 53.3	
52							open (0-2cm) rough			
						2	open, rough		mechanical fracture	
53				2						

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-16

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
53		Run 4 cont.		2		2	open (0-2cm), rough tight, rough (3)		silty, argillaceous limestone and chert as above
54						3	open, rough (2)		
55						1			pinpoint vugs in limestone 54.9 – 55.6'
56				2		>6	open (0-5mm), rough weak fractures → open, rough, glauconitic (2) chert nubble, open, rough open (0-2cm), rough open (0-1cm), rough, clay lined (2)		numerous mudstone stringers 56.2 – 56.5' 56.5 – 62.0' medium to coarse crystalline limestone with minor chert layers
57		Run 5 4.1'/4.0' 103%		3	3.25'/4.0' 81% LP = 14'	0	stylolite – strong		Limestone: fossiliferous, stylolitic, light bluish gray (5B 7/1) to grayish orange (10YR 7/4) iron-stained in proximity of chert layers. Moderately hard. Very slight to moderate weathering
58						1	stylolite – broken stylolite – strong (4)		Chert: occurs as discrete, nubbly layers. Mottled light gray (N8) to pale yellowish orange (10YR 8/6). Very hard to hard. Moderate weathering
59						>6	stylolite – broken		Ratio of Limestone : Chert 90 : 10
60				3			open, rough chert nubble		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 7

Project Number: 5121

Hole Number: G-16

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
60		Run 5 cont.		3 3		1	stylolite - mechanical fracture		crystalline limestone with minor chert as above
		Run 6		3	1.2' / 2.0'		open, rough (2)		
61		2.0' / 2.0' 100%			60% LP = 0.75'	2	stylolite - strong		
							open, rough (2)		62-70.2" crystalline and silty argillaceous limestone and chert.
62			62.5	3		> 6	chert rubble		Limestone: grain-supported with silty, argillaceous matrix to entirely silty, argillaceous limestone
		Run 7		3	1.7' / 7.5'		chert rubble open, rough		
63		3.2' / 7.5' 43%	? 63.0		23% LP = 0.5'	3	open (0-5mm), rough		crystalline portions very light gray (N8), silty-argillaceous: Dark yellowish orange (10YR 6/6). Medium hard. Moderate weathering.
							open, rough (2)		
64						2	open (0-5mm) rough, MnO_2 specks		Chert: white (N9) to medium light gray (N6). Very hard to moderately hard. Very slight to moderate weathering. chert occurs only as distinct layers up to 0.3' thick
							open, smooth, FeOx stained (2)		
65						> 6	open, rough (2)		
			66.2				open, rough, bryozoans rubble		
66			66.2			> 6			
67									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 7

Project Number: 5121

Hole Number: G-16

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
67		Run 7 cont.				>6			limestone and chert as above
68						>6			
69	weathered limestone			4		>6			
70	competent limestone	Run 8 1.4' / 1.5' 93%	70.1		0.95 / 1.5' 63% LP= 0.6'	2	open, rough (4)		
71				4		>6	open, smooth (2)		71.3 to 80.4' silty, argillaceous to coarsely crystalline, fossiliferous, stylolitic limestone and chert.
		Run 9 8.5' / 8.9' 96%		4	6.9' / 8.9' 78% LP= 1.8'		open, rough; open (~1cm), rough; open, rough, bryozoan		Limestone: Light to medium Gray (N7 – N5). Moderately hard. Slight weathering.
72						1	light, rough (mechanical?)		Chert: White (N9) to light bluish gray (5B 9/1) Very hard to moderately hard. Very slight to moderate weathering
73						1	stylolite-strong; stylolite-broken		Ratio: Arg Ls : Cryst. Ls : Chert 40 : 40 : 20
74				4					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 1

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-16

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
74		Run 9 cont.		4		4	stylolite - broken (3) open, rough shaley		limestone and chert available	
75						0	stylolite, strong			
76						2	open, rough open (stylolite?)			
77						7	stylolite - strong (3)			
						6	open, rough (2)			
78				4 5		1	tight, rough stylolite - strong			
79						2	stylolite - broken stylolite - strong (2) stylolite broken			
			200				mechanical fracture			
80				5		7 6			Total Depth 80.4'	
			204							

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 7

Project Number: 5121

Hole Number: G-18

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
									0-17.5 ft augered and sampled. See original log for descriptions. Auger refusal at 17.5'. Boring advanced from 17.5 to 36.0' with tricone roller bit. No sample recovered. Begin NXB coring at 36.0'
36		Run 1 4.0' / 7.0' 57%		1	0.85' / 7.0' 12% LP=0.45'	> 6	open, rough spun (2); tight, rough 60° dip; open (0-3cm), rough spun (3)		36.0'-71.0' Silty, argillaceous limestone and chert. Minor crystalline, fossiliferous limestone beds 39.4' and 63.8' (see descriptions at these footages)
37			? 37.9			> 6	open (0-3cm), rough, 65° dip; rubble		Limestone: grayish orange (10YR 7/4) to dark yellowish orange (10YR 6/6), generally with MnOx blebs. Medium hard to very soft. Moderate to very severe weathering. Massive bedding.
38						> 6			Chert: white (N9) to mottled very light gray (N8) to med. light gray (N6) and pinkish gray (5YR 8/1) Very hard to moderately hard. Fresh to moderately severe weathering. Chert occurs as discrete layers up to 0.3', as finely divided masses in argillaceous limestone, and as brecciated masses with interstitial argillaceous limestone.
39			39.4 ?			> 6	open, rough		
40				1			tight, rough		

Geotechnical Information by:
D. J. Dahlstrom 6/2/90

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-18

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
40		Run 1 cont.	? 40.6	1		> 6	open (0-2cm) rough open, rough		Ratios of limestone : Chert 36-65.2' 50 : 50 65.2-71.0 70 : 30 39.4-46.7 limestone includes both silty, argillaceous layers and medium to very coarse crystalline limestone. Ratio: Silty, Arg. : Crystalline : Chert 20 : 50 : 30
41						> 6			
42			42.1 ?	1		> 6	open, rough		
43		Run 2 4.7'/6.0'		1	2.2'/6.0' 37% LP = 0.7'	6	open (0-1cm) rough open (0-5mm) rough tight, rough (mechanical?) Stylolite - strong open (0-1cm), rough (2)		vuggy xtl
44						> 6	tight, rough, FeOx blebs open rough (6) open (0-5mm) rough		
45						1	open, rough (3)		
46				1		4	tight, rough (mechanical?)		
47				2			open, rough, 30° dip		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 7

Project Number: 5121

Hole Number: G-18

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
47		Run 2 cont.	47.7	2		7 / 6	open, rough; tight, rough; open, rough		Silty, argillaceous limestone and chert as above.
48				2		7 / 6			
49		Run 3 3.4'/4.0' 85%	49.0 50.0	2	1.0'/4.0' 25% LP= 0.55'	7 / 6			
50			50.0			7 / 6	open, rough; tight, rough; light, smooth, fill, stain, 90° dip		
51						4	open (0-1cm), rough; open (0-5mm), rough; tight, rough (2)		
52				2		7 / 6	open, rough (3)		
53		Run 4 6.0'/6.0' 100%		2	4.6'/6.0' 77% LP= 0.8'	7 / 6	open (3); open (0-5cm), rough; open, rough; stylolite - strong; open		
54				2					

WELDON SPRING REMEDIAL-ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 7

Project Number: 5121

Hole Number: G-18

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
54		Run 4 cont		2		2	spun open, rough		Silty, argillaceous limestone and chert as above
55						3	open, rough, FeOx stain tight, rough (mechanical?) open, rough, MnOx specks		
56						2	stylolite - broken tight, rough, MnOx specks (2)		
57				2 3		5	open, rough (2) stylolite - broken (2)		
58						2	open, rough, MnOx specks open, rough, FeOx stain		
59		Run 5 9.9'/10.0' 99%		3	5.8'/10.0' 58% LP = 0.9'	5	open, rough open (0-1cm), rough open, rough (3)		59.5 – 61.0 – "bone marrow" chert – extremely vuggy
60						7 6	open (0-2cm), rough (2) open, rough (2) rubble open (0-5mm), rough open, rough		vuggy chert
61				3					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 7

Project Number: 5121

Hole Number G-18

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
61		Run 5 cont.		3			open, rough rubble			
						>6	open, rough, MnOx specks 20° dip			
							open (0-5mm), rough			
							tight, rough, glauconitic stylolite - broken			
62						6	open, rough			
							open, rough, 35° dip			
							tight, rough, MnOx specks			
							open, rough (?)			
63						2				
							open (0-2mm), rough, silt-lined		63.8 – 66.1 layer of very coarse crystalline, fossiliferous limestone. Grades downward into silty, argillaceous limestone	
							stylolite - strong (?)			
64						3	tight, rough stylolite - broken			
							tight, rough, FeOx stain			
65						1	open, rough, clay-lined rubble			
							stylolite - mechanical break			
66				3			open, smooth, MnOx blebs			
				4			stylolite, broken, FeOx stain			
							stylolite strong			
67							tight, rough, MnOx blebs			
							tight, smooth, MnOx blebs			
							tight, rough, 70° dip			
							open, rough, MnOx blebs		rubble	
68				4						

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 6 of 7

Project Number: 5121

Hole Number: G-18

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION, TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
68		Run 5 cont.		4					silty, argillaceous limestone and chert as above.
						> 6	open (0-3cm), rough		
							open, rough		
							rubble		
				4			open, rough, MnOx specks		
69		Run 6 10.0/10.0 100%		4	6.2'/10.0' 62% LP = 1.2'	2	tight, rough, MnOx blebs		
							open, rough (2)		
70						> 6	open (0-3cm), rough, FeOx stain		
							open, rough, FeOx blebs, 20° dip		
							open (0-4cm), rough		
							open, rough		
							open (0-1cm) rough (2)		
	weathered limestone 71.2'								71.0-79.0' medium to coarse crystalline limestone and chert. Limestone of variable purity. Silter layers have higher permeability.
71	Competent limestone					1	open, rough		Limestone: fossiliferous, NOT oolitic, includes several shaley partings from 77.4' to TD. Light gray (N7) to medium gray (N5). Moderately hard. Slight weathering. Massive bedding.
72						3	tight, rough, fossiliferous		
							open, rough		
							tight, rough		
73						2	open, rough, fossiliferous		Chert: white (N9) and mottled very light gray (N8) to medium gray. Very hard to moderately hard. Very slight to moderate weathering. Occurs as large (up to 0.4'), irregularly shaped masses in limestone. Generally fractured.
							open, smooth		
							open, rough		
74						2	tight, rough		
							weak fracture in chert (mechanical)		
75				4					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 7 of 7

Project Number: 5121

Hole Number: G-18

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
75		Run 6 cont.		4		5	tight, rough, fossiliferous (3)			
				4			open, rough, fossiliferous			
				5			tight, rough			
							open, rough			
76						2	tight, rough			
77						2	shale rubble		shaley partings	
							open, rough			
78						3	open, rough, shaley (?)			
							open (0-2cm), rough shaley			
				5					Total Depth = 79.0'	
79										

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 4

Project Number: 5121

Hole Number: G-19

Project: BECHTEL Geotechnical Logging

Location: N. 101700 W.51950 G.S.Elev. 619.4'

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0 - 41.5' see original G-19 log.
41									
	41.5'								BEGIN CORING AT 41.5'.
42		Run 1 5.1'/8.0' 64%		1	1.4'/8.0' 18% L.P. = 1.0'		2.9' core loss in Run 1. Location unknown.		Core sample consists of ARGILLACEOUS LIMESTONE finely divided with CHERT. Limestone is grayish orange (10YR 7/4), very silty and permeable, severely to very severely weathered, vuggy, slowly reactive to HCL, medium hard to soft, with pervasive MnOx flakes. Chert is white (N9) to medium gray (N5), very hard to hard, slightly silty and permeable, and mod. weathered. 0.4' chert nodule near top of sample. 1.5' of sample contains rubble from rocks described above.
43									
44									
45									
46									
47									

Geotechnical Information by R. McClure, 11/17/89

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 4

Project Number: 5121

Hole Number: G-19

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
47		Run 1 cont.		1			Core loss, as above.		Sample, as above.
48									
49									
		49.5'							
		Run 2					0.6' of core loss between interval 49.5'-51.0'. Exact location unknown.		Sample is closely fractured and rubblized chert. Chert is light (N7) to med. gray (N6) with abundant FeOx status. Where fractured, fresh with rinds, rubble is mod. wthrd. and permeable; some glauconitic clay.
50		8.4'/9.0' 93%			4.4'/9.0' 49%				
51					L.P. = 0.9'	1	Stylolite Stylolite Open, stylolite, ext. weathered, no clay		51.0-51.8' LIMESTONE, light (N7) to med. gray (N6), hard, mod. weathered, coarsely crystalline, stylolites, fossiliferous. 51.8-54.7' ARGILLACEOUS LIMESTONE (55%) and CHERT. LS: Grayish orange (10YR 7/4) very silty and permeable, moderately weathered, moderately hard, pervasive MnOx flakes, slowly reactive to HCL. 53.3-53.7' slightly vuggy. CHERT: Nodular, very light gray (N8) to med. light gray (N6), very hard, few fossils at contacts with LS. Finely divided 53.0'-54.2'.
52						3	Open, rough (3)		
53				1/2		2	Tight, rough Open, rough, slightly vuggy		
54									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 4

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-19

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
54		Run 2 cont.		2		2	Open, rough Rubblized, chert FeOx Open, rough		54.7-66.0' LIMESTONE (85%) and CHERT. LS: Very light gray (N7), fine to coarsely crystalline, moderately hard to hard, moderately weathered, abundant stylolitic type fracture with carbonaceous clay, some MnOx flakes, highly fractured with extensive vertical fractures. LS, where coarsely crystalline, is slightly silty and permeable. CHERT: Occurs as thin (0.1') stringers and is rubblized, white (N9) to light gray (N7), very hard, fragments have slightly weathered rinds, MnOx.
55	Weathered Limestone Competent Limestone					1	Tight, rough Open, rough, stylolitic little carb.cly.		
56						6	Open, rough Open, smooth, calcite Open, rough Open, rough, rubblized		
57						>6	Open, rough, rubblized, (4) vert; same Open,rough,clay Open, smooth, Stylolite		
58		58.5'				6	Open, rough (3) Open, rough, stylolitic carb. clay Open, rough		
59		Run 3 7.5'/7.5' 100%			3.9'/7.5' 52%	>6	Open, spun (2) Open, rough, stylolitic some clay (2) Rubble		
60					L.P. = 0.9'	>6	Open, smooth (2) Vert; open,rough, small horizontal fracture same Open, rough		
61				2			Rubble		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 4

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-19

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
61		Run 3 cont		2		>6	Open, rough (2) Vert: open, rough (3)		LIMESTONE and CHERT, as above.
							Rubble		
62							Rough, stylolitic carb. clay (2)		
				2		>6	Rubble		
				3			Rough, stylolitic carb. clay (2)		
							Rubble		62.7-63.3' Argillaceous Limestone finely divided with chert.
63							Rough, stylolitic carb. clay		
						>6			
							Rubble		
							Rough, stylolitic carb. clay (2)		
64							Rubble		
						1			
							Tight, smooth		
65							Open, stylolite, carb. clay		65.1-66.0' Argillaceous Limestone finely divided with chert.
						>6			
							Open, rough Vert: same		
66				3			Rubble		
									TOTAL DEPTH 66.0'

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 5

Project Number: 5121

Hole Number: G-20

Project: BECHTEL Geotechnical Logging

Location: N. 101850 W. 50950 G.S.Elev. 630.3'

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0-32.5', see original G-20 log.
32									
	32.5'								BEGIN CORING AT 32.5'.
		Run 1		1			1.1' of core loss in Run 1. Location Unknown		Core sample consists of Argillaceous Limestone and Chert as described in 36.9-59.7'. Fractures are severely to completely weathered with solution zones and abundant vuggs.
33		2.4'/3.5'			1.8'/3.5'				
		69%			51%				
					L.P. = 0.5'				
34									
35									
			? 36.0						
36									
		Run 2							
		4.1'/5.0'			3.5'/5.0'				
37		82%	36.9 ?		70%		Rubble, chert, vuggy		36.9-59.7' ARGILLACEOUS LIMESTONE (55%) and CHERT. LS: Grayish orange (10YR 7/4) very silty and permeable, slowly reactive to HCL, moderately hard to soft, moderately severe to completely
					L.P. = 0.8'		Open, rough, clay crinoid stem(2)		
38				1					

Geotechnical Information by R. McClure, 11/20/89

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 5

Project Number: 5121

Hole Number: G-20

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
38		Run 2 cont		1		1	Open, rough, FeOx		weathered, vuggy and solutioned in zones. LS has thin microcrystalline zone above 41.0', these are fossiliferous, hard and mod. weathered.
39						2	Open, rough, vuggy		CHERT: Finely divided throughout, with thick (to 1.0') nodule above 48.4'. Chert is white (N9) to med. gray (N5), mod. hard, severely weathered to very hard, fresh. Chert has: abundant MnOx replacement, healed dendritic fractures. Large calcite x-tals 46.0'-48'.
							Tight, rough, MnOx		
40						2	Open, smooth, clay		
							Open, rough, vuggy		
41							Stylolite		
		Run 3				3	Open, rough, solutioned		
							Tight, rough		
		4.3'/5.0'			1.2'/5.0'		Open, rough		
42		86%			24%				
					L.P. = 0.8'		Open, spun (3)		42.7-44.9', extremely vuggy with solution zones, core loss.
			? 42.9				Rough, vuggy		
43							Chert, rubble, vuggy		
			43.2 ? ? 43.7				Rough, vuggy		
							Open, rough, vuggy		
44							Rough, vuggy		
			44.0 ? ? 44.6				Chert, rubble, vuggy		
							Open, rough, vuggy		
45			44.7 ?				Open, rough, vuggy		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 5

Project Number: 5121

Hole Number: G-20

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
45		Run 3 cont		2		>6			ARGILLACEOUS LIMESTONE and CHERT, as above.
46							Rubble		
		Run 4		2		>6	Open, smooth		
							Open, rough MnOx FeOx		
		5.0'/5.0'			2.5'/5.0'		Open, smooth, clay		
47		100%			50%	1	Stylolite		
					L.P. = 0.9'		Open, 2cm, smooth, FeOx Calcite-x-tal		
48						3	Open, smooth (2) vert: smooth, MnOx, FeOx		
49						3	Open, rough, vuggy (3)		
50							Open, spun (2)		
						5	Open, rough, vuggy (2)		
							Open, smooth, glauc. clay		
51							Open, rough, glauc. clay (2)		
		Run 5 4.9'/5.0' 98%			3.9'/5.0' 78%	3	Open, rough (2)		
52				2					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 5

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-20

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
52		Run 5 cont		2	L.P. = 0.7'	2	Open, spun		Argillaceous Limestone and Chert, as above
							Open, smooth, 5°		52.0-52.9' Chert nodule.
53						2	Open, smooth, 10° clay		
				2 / 3			Open, smooth, glauc. clay		
54						3			54.5-57.3' Vuggy zone
							Open, rough, spun (3) vuggy		
55							Vuggy		
						>6	Open, rough, glauc. clay, vuggy		
			? 55.9				Rough, vuggy		
56									56.0-56.4' Carbonaceous siltstone.
		Run 6	56.0 ? 56.5			>6	Smooth, 10°		
							Open, smooth		
							Rough, vuggy Void?		
		4.9' / 5.0'	56.6 ?		2.6' / 5.0'		Rubble, chert, vuggy		
57							Rough, vuggy		
		98%			52%	2	Open, rough, vuggy		
					L.P. = 0.5'		Rough, spun		
							Open, rough, glauc. clay (2)		
58						3			
							Open, smooth		
							Open, rough		
59				3					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 5
Project Number: 5121
Hole Number: G-20

Project: BECHTEL Geotechnical Logging
Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
59		Run 6 cont.		3		3	Open, smooth Open, rough Open, smooth, glauc. clay, 0.5 cm thick		Argillaceous Limestone and Chert, as above. 59.6-59.7', Abundant glauconitic clay in fractures and thinly bedded through core.
60						>6	Open, smooth, carbon clay, stylolitic Chert, fragments fresh		59.7-66.0' LIMESTONE (70%) and CHERT. LS: Light (N7) to medium gray (N5), fine to coarsely crystalline, hard, slightly weathered with a thin moderately weathered zone, abundant stylolitic fractures with carbonaceous clay. Coarsely crystalline LS is slightly permeable. Finely crystalline is fossiliferous, some MnOx. CHERT: Nodular, with a small zone finely divided (63.0' - 63.6') and vuggy. White (N9) rinds with light bluish gray (5B 7/1) interiors, hard to very hard, some MnOx.
61		Run 7 5.0'/5.0' 100%		3 4	4.1'/5.0' 82% L.P. = 1.0'	0	Stylolite		
62						>6	Open, smooth		
63							Rubble		
						2	Open, rough, carbon clay, slightly vuggy		
64							Open, smooth, 150 carbon. clay		
						2	Stylolite, weak Open, stylolitic, carbon. clay(2)		
65						2	Open, spun		
66				4					Total Depth 66.0'.

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-21

Project: BECHTEL Geotechnical Logging

Location: N. 101,336 W. 52,116 G.L.Elev. 638.7'

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0-34.2', see original G-21 log.
34	34.2'								BEGIN CORING AT 34.2'.
35		Run 1 0.9'/5.0' 18%		1	0% L.P. = 0.2'		4.1' of core loss in Run 1. Location unknown		Core sample is finely divided argillaceous limestone and chert in four segments less than 0.2' in length. Segments are severely weathered and have FeOx stains. Chert is exteremely fractured (healed). Abundant MnOx replacement. Sample also contains 0.1' chert rubble with severely weathered rinds, abundant FeOx and MnOx. No clay on segment fractures or rubble.
36									
37									
38									
39				1					

Geotechnical Information
by R. McClure 11/16/89

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-21

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
39		39.2'		1					Core sample from Run 2 consists of angular, coarse chert fragments (3mm) slightly cemented with light brown (5YR 5/6) clay. Sample is unconsolidated, and crumbles easily by finger pressure. Some larger (to 3cm), severely weathered chert rubble as within chert/clay matrix.
		Run 2			0% L.P. =		4.6' of core loss in Run 2. Location unknown.		
40		0.4' / 5.0'			0'				
		8%							
41									
42									
43									
44		44.2'							
		Run 3					3.9' core loss in Run 3. Location unknown.		0.2' of sample is subangular chert rubble. Chert is severely weathered, hard, and has some crinoid stems. Chert rubble is more consolidated material similar to that from Run 2. Here clay is dark reddish brown (10R 3/4). Rubble is coated with dark yellowish orange (10YR 6/6) clay.
45		1.1' / 5.0'			0.45' / 5.0'				
		22%			9% L.P. =				
46				1	0.45'				

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-21

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
46		Run 3 cont.		1			Core loss, Location unknown.		0.9' of sample core is finely divided clay and chert. Clay is dark yellowish orange (10YR 6/6) and unreactive to HCL. Chert is white (N9) to med. gray (N5) with abundant MnOx replacement. Sample core is: vuggy at the top, extremely vuggy with solution voids (1.5cm dia.) at bottom; some hematite (after pyrite), severely weathered, permeable.
47									
48									
49		49.2'							
		Run 4					2.1' of core loss in Run 4, Location unknown.		Core sample from Run 4 is chert gravels. Gravels are severely weathered, slightly permeable, vuggy and increase in size with depth (2cm-4cm). Some gravel are fragmented, exhibiting weathered rinds & fresh interior. Few vugs filled with mod. brown (5RY 3/4) clay.
50		0.9'/3.0'							
		30%			0% L.P. = 0.15'				
51									
52		52.2'							
		Run 5			0% L.P. = 0.1'		1.5' of core loss in Run 5. Location unknown.		Sample from Run 5 is chert gravels, as described in Run 4. Except vugs have no clay, fossiliferous abundant
		0.5'/2.0'							
53		25%		1					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 7

Project Number: 5121

Hole Number: G-21

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
53		Run 5 cont					Core loss. Location unknown		MnOx streak, speak and as replacement, moderately weathered.
54		54.2	?						54.2-54.4' CHERT, white to light gray (N7), FeOx, MnOx healed fractures.
		Run 6	52.4				Smooth, FeOx, MnOx		
							Void		
55		2.2' / 3.0'			1.4' / 3.0'				
		73%	55.2		47%		Smooth, pin-point vugs		55.2-62.5' ARGILLACEOUS LIMESTONE (70%) and CHERT.
							Open, rough, clay		LS: Grayish orange (10YR 7/4) silty, very permeable, quickly reactive to HCL, medium hard, moderately weathered, few MnOx flakes throughout core.
					L.P. = 1.0'				
56						3			
							Open, smooth (3)		CHERT: Primarily thinly (0.1') bedded with some finely divided, near top, and nodules near bottom. Chert is pinkish gray (5YR 8/1) to light bluish gray (5B 7/1), slightly permeable and fossiliferous near contact with LS. Nodules have abundant MnOx healed dendritic fractures, slightly weathered, hard to very hard, some hematite.
57		57.2'							
						>6			
		Run 7					LS Rubble		
58		5.0' / 5.0'		1 / 2	4.5' / 5.0'				
		100%			91%	2	Open, rough		
					L.P. = 0.7'		Open, smooth 15°		
59						2	Open, smooth		
60							Open, smooth, glauc. clay		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-21

Project: BECHTEL Geotechnical Logggfng

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
60		Run 7 cont.		2		3	Tight, rough Open, smooth, 25°, glauc.clay		Argillaceous Limestone and Chert, as above.
61							Open, rough		58.7-59.2' Limestone, moderate yellowish brown (10YR 5/4), slightly silty, crystalline, slightly permeable, hard, abundant MnOx.
						3	Open, smooth (2)		59.9-60.5' Chert nodule, abundant fossils at upper and lower contacts.
62		67.2'					Open, rough, stylolitic, carbon. clay		
		Run 8				3	Open, smooth, 10°. vert:smooth Open, spun, glauc. clay		62.5-69.2' ARGILLACEOUS LIMESTONE (60%) and CHERT.
63		4.0'/4.0'			4.0'/4.0'		Open, rough (2)		LS: Yellowish gray (5Y 7/2), silty, very permeable, slowly reactive to HCL, medium hard, mod. to severely wthrd., some FeOx discoloration, few MnOx discoloration, few MnOx specks. "Bone-Marrow", vuggy texture 63.7-67.2'.
		100%			100% L.P. = 2.4'	2			
64							Open, rough, stylolitic, glauc. clay		
						0			CHERT: Finely divided where "Bone-Marrow" textured, nodular elsewhere, white (N9) to purplish red purple (5 RP 4/2), very hard to hard (slightly permeable where hard), abundant calcite-lined vugs, nodules have healed dendritic fractures.
65						0	Calcite-lined vugs		
66		66.2'		2					
		Run 9		3		2	Open, rough (2)		
67									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 6 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-21

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
67	Run 9: Original log indicates C.R. of 4.5' w/100% recovery. Core length is actually 5.0'. Core	Run 9 cont		3		1			
		5.0'/5.0'			4.1'/5.0'		Open, smooth glauc. clay (2)		
68	runs and recovery in preceding runs were double checked and appear o.k.	100%			82% L.P. = 1.2'	2	Open, 14mm, stylolitic carb. clay		
69	The 4.5' C.R. ended in the center of the long piece.					>6	Open, smooth, glauc. clay (2) Stylolite Vert; smooth, fresh		69.2-71.0' LIMESTONE, light (N7) to med. gray (N6), fine to coarsely crystalline, hard, very slightly weathered, stylolite. Bottom of weathered limestone/top of competent limestone at 69.2'.
70						>6	Open, smooth, fresh, rubblized Open, rough, stylolitic, carb. clay		
71	71.2' Run 10: Core run was changed on original log to 3.9'. All fractures are tight fits with no apparent core loss.	Run 10				0			71.0-75.1' ARGILLACEOUS LIMESTONE (60%) and CHERT. LS: Light olive gray (5Y 6/1), as in 62.5-69.2'. CHERT: Finely divided, where vuggy, and nodular. White (N9) weathering rinds around grayish blue (5PB 5/2) interior.
72		3.9'/3.9'			3.3'/3.9'		Tight, rough		
		100%			85% L.P. = 1.4'	3	Open, smooth, vuggy Tight, rough		
73						1	Tight, smooth		
74				3					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 7 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: G-21

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
74		Run 10 cont.		3					Argillaceous Limestone and Chert, as above
							Tight, rough		
75									
									Total Depth 75.1'.
									Total depth was 0.5' deeper than indicated on original log due to discrepancy in Run 8.

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 6

Project Number: 5121

Hole Number: GMW-1 (MW-2001)

Project: BECHTEL Geotechnical Logging

Location: (AEC) N.100857.7 W.52544.3 G.S.ELEV 611.75

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Augered & sampled from 0-14.5' (auger refusal). Drilled with tricone bit from 14.5-26.5' ("sound bedrock"). For description 0-26.5' interval see original GMW-1 log.
26									
	26.5'								Begin Coring 26.5'
27		Run 1 100%		1	100% 5/5				26.5'-34.7' ARGILLACEOUS LIMESTONE (50%) & CHERT (50%) INTERBEDDED. L.S. is grayish orange (10YR 7/4), mod. hard to hard, slightly to moderately weathered, fractured, permeable, locally slightly vuggy. CHERT is mottled white (N9) and light gray (N7) predominantly nodular with some finely divided with L.S. Nodule from 28.5'-29.6'. Chert is very hard, very slightly weathered, fractured (healed) with MnOx and FeOx in fracts.
28		Run 2 4.7'/5.0' 94%	? 28.1 28.3	1	.5'/5.0' 10% L.P. = .5'	> 6	Open, spun (8)		
29						> 6	Open, spun, rubbly (4) Open(1mm) smooth FeOx Tight, smooth, FeOx Open, spun (2)		
30						4	Contact Tight,smooth,FeOx Open, spun		
31						> 6	Open, spun (10)		

Geotechnical Information by Paul Patchin 11/7/89

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 6

Project Number: 5121

Hole Number: GMW-1 (MW-2001)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
31		Run 2 cont		1		> 6	Open, spun (9)		ARGILLACEOUS LIMESTONE & CHERT, as above.
32									
		Run 3		1	1.5'/5.0'	2	Open, smooth, 14°		
		4.5'/5.0'			30%		Open, spun		
33		90%			L.P. = .45'	6	Spun Open,rough,FeOx Open(3mm) rough Spun Stylolite, weak		
34							Open, spun, FeOx Tight,rough, 25°		
						4	Tight, rough Tight, smooth Tight, rough		34.7-40.6' ARGILLACEOUS SILTY LIMESTONE (70%) and CHERT (30%) intermixed L.S. is silty or dolomitic (slower reaction to HCL), between grayish orange (10YR 7/4) and light olive gray (5Y 6/1), mod. weathered and vuggy, very permeable, med. to mod hard. CHERT is white (N9) to very light gray (N8) finely divided with limestone, moderately weathered, vuggy with "bone marrow texture" and euhedral quartz filling of vugs.
35						2	Open, spun (2)		
			36.5						
36			36.0				Rubble		
						> 6	Open, spun,vuggy Tight, rough Open, smooth		
37									
		Run 4		2	2.3'/5.0'	5	Open, rubbly Tight, rough		
		4.9'/5.0' 98%			46%		Open, rough (2) Tight, rough		
38									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 6

Project Number: 5121

Hole Number: GMW-1 (MW-2001)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
38		Run 4 cont		2	L.P. = .7'	> 6	Tight, rough Rubble Tight, smooth, planar 10°		ARGILLACEOUS SILTY LIMESTONE and CHERT, as above.
39							Tight, rough Open, smooth		
						> 6			
40							Rubble		
			? 40.5 40.6 ?			> 6	Open, rough, FeOx Stylolite, weak Tight, rough		40.6-40.7' LIMESTONE, Med. light gray (N6), med. crystalline, fossiliferous, hard, fresh
41							Vert, tight, smooth Open, smooth, contact glauc. clay		40.7-41.1' CHERT, white (N9) to v. light gray, v. hard, slightly weathered, fractured with clay filling.
						2	Open, smooth, silty		41.1-52.7' LIMESTONE (70%) & CHERT (30%) interbedded. Limestone is very slightly argillaceous finely to med. crystalline, mod. hard to hard, slightly to occasionally moderately weathered, fossiliferous, with occasional silty argillaceous beds to .3' (grayish orange pink 5YR 7/2). CHERT is mainly nodular & mottled, very light gray (N8) to medium gray (N5), very hard, occasionally vuggy, fossiliferous, MnOx.
42		Run 5 4.5'/5.0 90%		2	1.6'/5.0' 32% L.P. = .8'	2			
43							Open, spun (2) Open, spun (2)		
						6	Open, rough Open, spun Tight, rough		
44							Open, rough		
			44.5	3		4	Open, spun (4)		
45									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 6

Project Number: 5121

Hole Number: GMW-1 (MW-2001)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
45		Run 5 cont.		3		4	Spun Open, rough (2) Spun		LIMESTONE and CHERT as above.
46						4	Open, rough Spun Open, rough Spun		
47		Run 6 2.0'/2.0' 100%		3	.4'/2.0' 20% L.P. = .9'	6	Open, spun, MnOx (2) Spun Open, smooth Open, rough Spun, FeOx Open, spun (2)		
48						6	Open, spun "poker chip" (3) Tight, smooth, MnOx Open, spun (2)		
49		Run 7 2.9'/3.0' 97%	49.6 / 49.7	3	1.4'/3.0' 47% L.P. = .55'	6	Open, spun (4) Rubble Rubble		
50						3	Spun Spun		
51						3	Spun (3) Vert, open, rough		
52									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 6

Project Number: 5121

Hole Number: GMW-1 (MW-2001)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
52		Run 8		3	3.5'/5.0'		Open, spun		
	WEATHERED LIMESTONE	4.8'/5.0'			70% L.P. = .9'		Open, spun, cly FeOx		52.7-53.1' Very weathered CHERT with SILTSTONE, vuggy, rubblized, yellowish gray (5Y 8/1); minor clay, FeOx staining.
53		96%	53.1				Rubble		
	COMPETENT LIMESTONE		53.3				Open, smooth, carb cly		53.1-53.3' Core Loss
							Open, 8mm, abund blk carb cly, minor FeOx		53.3-53.5' Limestone, light olive gray (5Y 6/1) to olive gray (5Y 4/1) very fossiliferous, possibly carbonaceous, bounded by stylolites. (Possible marker bed), hard v. slightly weathered, healed vertical fracts.
54				4			Open(2mm) smooth abund carb cly & glauc		
55							Tight, rough		53.5-57.8' SILTY LIMESTONE (60%) and CHERT intermixed. L.S. is possibly dolomitic, light olive gray (5Y 6/1) with olive gray (5Y 4/1) mottling, slighty stylolitic with carbonaceous clay filling, hard, locally vuggy. CHERT is light gray (N8) to light bluish gray (5B 7/1) finely divided with L.S. and nodular to .2' with some banding.
							Open, spun		
56							Open, rough, rubbly		
							Open, rough, rubbly		
							Tight, rough		
57									
		Run 9 3.0'/3.0'		4	2.5'/3.0'				57.8-60.0' LIMESTONE, light olive gray (5Y 6/1) to medium gray (N5), hard fresh, stylolitic, finely to coarsely crystalline, fossiliferous, with minor chert nodules to 3cm. Large (5cm) brown calcite filled solution cavity at 57.8'.
							Open (5mm) carb. clay		
					82%		Open, rough		
58		100%			L.P. = .7'		Open, spun Brown Calcite		
							Vert, tight, healed		
							Tight, rough		
							Open, spun, stylolitic		
59									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 6 of 6

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-1 (MW-2001)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
59		Run 8 cont.		4			Open (1mm) stylolitic carb clay Stylolite Spun (3)			
60									Total Depth	60.0'

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 4

Project Number:

GEOTECHNICAL ATTACHMENT

Hole Number: GMW-2 (MW-2002)

Project: Bechtel Geotechnical Relogging

Location: N of Ash Pond

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
									For description of overburden from 0 to 24.5' see original GMW-2 log. Auger refusal @ 24.5'
	24.5								Begin Coring @ 24.5'
25		Run 1 0.2 / 4.0 5%		1	0' / 4' 0%		open, rough, FeOx specs (2)		24.5 – 24.7 Chert (80%) & Siltstone (20%) Chert: white to light Yellowish Orange (10YR 6/6), very hard, very slight to moderate weathering Siltstone: finely divided inclusions within chert; Dark Yellowish Orange (10YR 6/6) with numerous FeOx specks, medium to soft, moderately severe weathering
26						>6			
27						>6			
28						>6			
						%			
29		Run 2 1.4 / 1.2 117%			0' / 1.2' 0%	4	rubble; open, rough; tight, smooth; open, rough (0-1cm); open, rough, MnOx blebs; open, rough, FeOx stain (2)		28.5 – 32.5 Chert (95%) w/ minor argillaceous limestone inclusions. Chert: grayish orange (10YR 7/4) to dark gray (N3), fossiliferous, massive layers to 0.25', hard to moderately hard, very slight to moderate weathering. Limestone: dark yellowish orange (10YR 6/6); soft, severe weathering
30		Run 3		1					

Geotechnical Information by D. Dahlstrom 4/4/90

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 4

Project Number:

Hole Number: GMW-2 (MW-2002)

Project:

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
30		Run 3 2.0/2.8 71%		1	0'/28' 0%	>6			In rubblized zones, chert gravel recovered; clasts 0.5–4 cm, weathering rinds around entire grains
31							rubble		
						>6	open, rough, MnOx blebs		
							open, rough, FeOx stain (0–2.5 cm) (2)		
32							open, rough, MnOx blebs (2)		
						4	open, rough, FeOx stain (0–1.5 cm) (2) (0–1 cm)		32.5–35.7
33		Run 4 2.3/2.3 100%			0'/2.3' 0%		open, rough, MnOx specks (9)		Chert (70%) with interbedded silty, argillaceous limestone (30%) – chert: very light gray (N8) to pale yellowish orange (10YR 8/2) massive layers to 0.2' to finely divided w/ limestone, hard to moderately hard, slight to moderate weathering
						>6			
34							open, rough (2cm)		Limestone: grayish orange (10YR 7/4) medium hard, moderate weathering
						4	tight, rough		0.2' thick lens of medium crystalline limestone 35.6–32.8'
35		Run 5 7.3/8.8 83%			1.3'/8.8' 15% L.P. = 0.8'		open, rough; tight, rough; open, rough (0–2cm)		
						6	tight, rough, FeOx specks; open, rough (8)		35.7–43.4 (TD) Silty, argillaceous limestone (60%) with chert (40%) chert finely divided to discrete layers up to 5cm thick.
36							stylolyte (weak)		
						3	open, rough (8)		Limestone: Grayish orange (10YR 7/4), medium hardness, moderately severe weathering
37				1					continued:

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 4

Project Number:

Hole Number: GMW-2 (MW-2002)

Project:

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
37				1		>6			Chert: very light gray (N8) to light brownish gray (5YR 6/1) generally mottled, darker toward edges of inclusions, very hard, moderate weathering.
38				1		>6			
				2		>6	open, rough (2)		
39						3	open, rough (0-1 cm) tight, rough		
40						>6	open, rough (15)		
41						5			
42						4	open, rough, stalay		
43						>6	open, rough (2)		
44		Run 6 2.3/2.7		2			open, rough (2)		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 4

Project Number:

Hole Number: GMW-2 (MW-2002)

Project:

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
44		Run 6 2.3 / 4.8 128%		2	0.35' / 1.8' 19% LP. = 0.35'	7 6	open, rough, shaley; tight, smooth; open, rough (0-1 cm); tight, rough, max blebs; open, rough, FeOx specks (2)		silty, argillaceous limestone & chert as above
45	Weathered LS to total depth			2			tight, rough; open, rough (0-1 cm); open, rough		Total Depth 45.4'
46							excess core logged - bottom 0.2' may not belong with this core		drill bit & reaming shell broken off - hole abandoned, GMW-2A (MW-2002A) drilled as a replacement

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 5

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-2A (MW-2002A)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For a description of overlying material, see original log for GMW-2/2A. Hole GMW-2 was abandoned when drill bit + reaming shell were broken off @ ~45.5 ft. Core was logged from 24.5 - 45.1'. Only the first 7.5' of core were described on Bechtel's composite log. the remaining description is of GMW-2A. Apparently, GMW-2A was augered to refusal without sampling, then drilled to 32' without sampling.
32									Begin Coring
		Run 1 0.8' / 1.0' 80%		1	0' / 1.0' 0%	>6	open, rough; open (0-1 cm), rough (2)		32.2 - 51.6 silty, argillaceous limestone to calcareous cemented siltstone with chert. Limestone/Siltstone: grayish orange (10YR 7/4), medium hardness, moderately severe weathering. Chert: very light gray (N8) to mottled very light gray (N8)/ medium gray (N5), hard to moderately hard, slight to moderate weathering - (vuggy, "bone marrow" texture at 45.5') Chert occurs as layers up to 0.8' (32.2 - 33') & as finely divided masses within limestone
33							open, rough, MnO2 blebs (3)		
		Run 2 4.3' / 5.0' 86%		2	0.4' / 5.0' 8% LP=	4	open (0-1 cm), rough MnO2 blebs (3)		
34					0.4'		open (0-5 mm), rough (6)		
35				2		>6			

Geotechnical Information by D. Dahlstrom 4/4/90

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1a of 5

Project Number: 5121

Hole Number: GMW-2A (mw-2009)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
35						5	open (0-2cm), rough open, rough (2) open tight, rough open, rough			
36										

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 5

Project Number: 5121

Hole Number: GMW-2A (MW-2002)

Project: Bechtel Geotechnical Relogging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
36		Run 2 cont.		1					Ratio Limestone/Siltstone : Chert	
						7			33–35.4'	60:40
									37–42.1'	90:30
							Rubble (chert)		42.1–51.4	50:50
37										
							open, rough, max blebs			
							tight, rough			
							open, rough, max blebs			
						6	tight, rough			
							open, rough			
				4			open (0-3mm), rough			
38							open, rough			
		Run 3		1						
		4.6/5.0'			1.5'/5.0'	7				
		92%			30%	6	open, rough			
							tight, rough, max blebs			
							open (0-2cm), rough			
39					LP=		open, rough (2)			
					0.45'		open (0-1cm), rough (3)			
						7				
						6				
40							open, rough			
							open			
						4				
							open (0-3mm), rough			
41							open			
							open, rough			
						5	open (0-5mm), rough (2)			
				1			open, rough, clay lined			
				2			open, rough, max blebs			
42							open, rough (3)			
						3				
43				2						

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 5

Project Number: 5121

Hole Number: GMW-2A (MW-2003)

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Relogging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
43		Run 4		2			open, rough, MnOx blebs		Silty, argillaceous limestone to calcareous cemented siltstone and chert as above
		2.8'/5.0'			0.85'/5.0'		open, rough, silica coated		
						6	open, rough, MnOx blebs		
		56%			17%				
44					LP=		open, rough		
					0.55'		open (0-2cm), rough, glauconitic		
						5	spun		
							open, rough (2)		
							open (0-1cm) rough		
45									
						6	Rubble		45.4-50' "bone marrow" chert
46									
						6			
47									
						6			
48				2					
		Run 5		2					
		4.8'/5.0			2.3'/5.0'	6	Rubble		
		96%			46%		open, rough (2)		
					LP=		open (0-3cm) rough		
49					0.75'		open (0-2cm) rough		
							tight, rough, slickey MnOx blebs (2)		
						4	tight, rough, MnOx blebs		2cm x 5cm
							open, rough, MnOx blebs		euhedral calcite lined vug of quartz
50				2					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 5

Project Number: 5121

Hole Number: GMW-2A (MW-2007A)

Project: Bechtel Geotechnical Relogging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
50		Run 5 cont		2					Silty, argillaceous limestone to calcareous cemented siltstone and chert as above
						4	open (0-2cm), rough open, rough (2)		
51							open (0-1cm) rough, shaly open, rough, glauconitic open (0-1cm)		50.9-51.1 glauconitic, shaley partings
						3	open, rough, MnOx coatings		51.6'-59' limestone and chert Limestone: light bluish gray (5B 7/1) to grayish orange (10YR 7/4) medium to coarse grained crystalline to silty, argillaceous limestone. Silty beds at 53.7'-54', 57'-57.7'. Silty beds Fe-stained, crystalline unstained except along stylolites
52							stylolyte - mechanical fracture		
						2	open, rough		
53				2					
		Run 6 5.0' 5.0' 100%		3	1.75' 5.0' 35%	4	open stylolyte (strong) open, rough stylolyte, strong open, smooth open, rough (3)		crystalline limestone fossiliferous, stylolitic, medium hard, slight to moderately severe weathering Chert: mottled very light gray (N8) to medium gray (N5), hard, slight weathering chert occurs as beds to 0.6' thick and as finely divided masses in silty, argillaceous limestone.
54					LP= 0.5'		open, rough (2)		
						6	open Rubble open, rough (2)		
55							Rubble		Ratio of limestone : chert 51.6-54: 99+ : 1 54-59': 70 : 30
						6	open		
56							open, smooth open, rough (2)		
						6	open, rough, MnOx blebs open, smooth		
57				3			Rubble		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 5

Project Number: 5121

Hole Number: GMW-2A (MW-2000)

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Relogging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
57		Run 6 cont.		3			open, rough (2)		limestone and chert as above	
						>6	Rubble open, rough			
58				3						
		Run 7 1.0'/2.0' 50%		3	0'/50' 0%	>6	stylolyte, broken open (0-5mm), rough open, rough (7)			
59										
						>6				
60	weathered Ls to total depth.			3					Total Depth 60'	

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 5

Project Number: 5121

Hole Number: GMW-3 (MW-2003)

Project: BECHTEL Geotechnical Logging

Location: N. 100353.6 W. 52299.1 G.S.Elev. 637.0

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
									Augered and sampled from 0-28.0'. For description of this interval see original GMW-3 log.
28									Begin Coring at 28.0'.
		Run 1 1.4'/6.0 23%		1	0%		4.6' of core loss. Location in section unknown.		Core recovery 1.4'. Consists of .4' of GRAVELLY CLAY, dark yellowish orange (10YR 6/6) with chert gravel (30%) up to 3cm. Next 1.0' is chert, fractured rubblized, v. light gray (N8), weathered, locally very vuggy with FeOx stain and clay. Some possible void fill gravel.
29									
30									
31									
32									
33									

Geotechnical Information
by Paul Patchin 11/4/89

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 5

Project Number: 5121

Hole Number: GMW-3 (MW-2003)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
33		Run 1 cont.		1						
34		Run 2 .7/5.0 14%		1	0%				Run 2 - .7' core recovery First .5' is very wthrd. and vuggy CHERT GRAVEL (probable void fill), abund. FeOx stain, v.hard, white (N9); Next .2' is limestone, light olive gray (5Y5/2) with minor chert finely divided. L.S. is argillaceous, micritic mod. weathered, slightly solutioned.	
35										
36							4.3' of core loss in run. Location in section unknown.			
37										
38									38.8-39.3' LIMESTONE, light olive gray (5Y 5/2) with minor finely divided CHERT. L.S. is slightly argillaceous, micritic mod. wthrd. slightly solutioned.	
39		Run 3 5.0'/5.0' 100%		1	3.3'/5.0 66%		Rubble rough, 30°; Open, FeOx; Open, soln, rough, FeOx		39.3-45.7' ARGILLACEOUS SILTY LIMESTONE (60%) and CHERT (40%) finely divided together; L.S.	
40										

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 5

Project Number: 5121

Hole Number: GMW-3 (MW-2003)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
40		Run 3 cont.		1	L.P. = .8'	4	Tight, rough, FeOx Tight, rough, abund. FeOx Open (1mm) rough, FeOx		is grayish orange (10YR 7/4) to dark yellowish orange (10YR 6/6), micritic, permeable, med. hard to soft, mod. to mod. severely weathered, locally vuggy, pinpoint to 3cm. CHERT is v. light gray (N8) to light bluish gray (5B 7/1), v. hard, slightly weathered with abund. fracts. healed with MnOx.
41						2	Tight, rough Solutioned Open (2mm), rough FeOx Open (1mm) rough		
42						1	Tight, smooth, carb. cly, 8°		
43						2	Open, spun, FeOx Tight, rough, FeOx		
44		Run 4 4.6'/5.0' 92%		1	1.5'/5.0' 30% L.P. = 1.1'	3	Open (4mm) rough FeOx Open (3mm) rough Open, rough		
45				2		> 6	Chert rubble with clay and FeOx stain. .4' core loss in interval		45.2-47.7' CHERT, rubblized, mottled grayish orange (10YR 7/4) and light gray (N7), v. hard, slightly to mod. weathered & vuggy, with clay seams (v.light gray, N8) that are "soapy", abund. FeOx & MnOx, occasional glauconite clay fracture filling.
46						> 6			
47									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 5

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-3 (MW-2003)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
47		Run 4 cont.		2		>	Chert rubble (cont.)		CHERT, as above.
						6	Open 30°, smooth FeOx		47.7'-59.0' - ARGILLACEOUS SILTY LIMESTONE (70%) and CHERT, finely divided. L.S. is as in 39.3'-45.2' interval but less weathered (slightly to mod. weathered) slightly less HCL reaction (siltier or dolomitic), slightly vuggy from 56.3 to 59.0', MnOx specks in matrix from 47.7'-50', no fossils throughout, CHERT is 50/50 nodular and finely divided, nodules to .3', very light gray (N8) to grayish-orange (10YR 7/4), with abund. MnOx fract. filling, v. hard, vuggy from 56.3-59.0' with secondary euhedral quartz filling.
48							Open, smooth, glauc. cly, FeOx		
						4	Stylolite (2) weak		
49							Tight, rough (2)		
							Tight, smooth		
		Run 5		2	3.3'/5.0'	2			
		4.8'/5.0'			66%		Tight, smooth		
50		96%			L.P. = .8'		Open, spun		
							Open, spun, FeOx cly		
						3			
51							Tight, rough (2)		
						6			
52							Open, rough (2)		
							Open, smooth		
						4	Open, rough (2)		
							Tight, smooth 22°		
53							Tight, smooth (2)		
							Vert, tight, rough		
							Open, rough		
			53.8				Open, rough rubblized (2)		
54									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 5

Project Number: 5121

Hole Number: GMW-3 (MW-2003)

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
54		Run 6		3	2.8'/5.0'	3	Open, spun		Argillaceous Limestone with Chert.
		4.7'/5.0'			56%		Tight, smooth 10°		
55		94%			L.P. = .8'		Open, 15°, smooth FeOx, cly		
						1	Open, rough		
56			? 56.0				Open, rough		
							Open, spun		
			56.3 ?				Open, smooth		
57							Tight, rough		
						4	Open, rough		
							Tight, rough (4)		
58	WEATHERED LIMESTONE					4			
							Tight, rough (3)		Total Depth 59.0'
59	Very near contact with competent limestone.								

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 6

Project Number: 5121

Hole Number: GMW-4 (MW-2004)

Project: BECHTEL Geotechnical Logging

Location: N.101449.1 W.51753.4 G.S.Elev. 642.89

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0-37.0, see original log for GMW-4.
37									BEGIN CORING AT 37.0'.
38		Run 1 1.6'/5.0' 32%		1	0% L.P. = 0.3'		3.4' CORE LOSS IN RUN #1. LOCATION UNKNOWN. Fractures are open, rough, abundant clay and some FeOx staining. Chert rubble (0.2') has severely weathered rind, abundant dark reddish brown (10R 3/4) clay. Core is argillaceous limestone (40-50%) and chert.		37.0'-63.9' ARGILLACEOUS LIMESTONE (30-70%) and CHERT, finely divided, mottled, 70% chert above 56.0', below, percent L.S. increases to 70%, chert becomes nodular. L.S.: Grayish orange (10YR 7/4), medium to hard, moderate to very severely weathered, silty, very permeable. 37.0-56.0', extremely vuggy, severely weathered, medium hard (with soft zones). 56.0-63.9', hard, moderately weathered, pervasive MnOx flakes. CHERT: Moderate orange pink (5 YR 8/4), to light gray (N7) to medium gray (N5), very abundant MnOx and MnOx healed dendritic fractures, some FeOx, fossiliferous zones.
39									
40									
41									
42									

Geotechnical Information by Rick McClure 10/27/89

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 6

Project Number: 5121

Hole Number: GMW-4 (MW-2004)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
42		Run 2	? 42.5	1			Open, rough clay		ARGILLACEOUS LIMESTONE and CHERT, as above.
		0.7' / 5.0'					Open, smooth, abund MnOx & FeOx (2)		
43		14%			0% L.P. = 0.2'		Rough, vuggy, little dark reddish brown clay, FeOx, fossilferous		
44									
45									
46									
47			46.8				Rough, vuggy, abund clay, FeOx		
		Run 3					4.0' CORE LOSS IN RUN #3, LOCATION UNKNOWN.		
		1.0' / 5.0'					Core sample contains: 0.4' of large (0.2') chert cobbles with severely wthrd rinds & dark reddish brown clay; fractures		
48		20%			0% L.P. = 0.3'				
49									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 6

Project Number: 5121

Hole Number: GMW-4 (MW-2004)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
49		Run 3 cont.		1			generally are open; rough with clay; 0.2' thick stringer (0.1' above 52.0' marker) of coarsely crystalline LS light gray (N7), moderately hard, fossilferous.		ARGILLACEOUS LIMESTONE and CHERT, as above. (cont.)
50									
51									
52									
		Run 4		1		5	Open, rough		
		2.6'/3.0'			0.7'/3.0'		Vuggy		
53		87%			23% L.P. = 0.4'	6	Open, spun (8)		
54			? 54.1				Open,rough,vuggy		
						>6	Rough, vuggy Rough, rubble		
			54.5 ?				Open, spun (2)		
55							Open,rough,vuggy		
		Run 5				>6	Open,smooth, FeOx (2)		
		2.0'/2.0'			0.6'/2.0'		Open, spun (3)		
56		100%			30%		Open,rough,vuggy Spun		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 6

Project Number: 5121

Hole Number: GMW-4 (MW-2004)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
56		Run 5 cont		1	L.P. = 0.6'	3	Open, spun (2)		56.3-56.9' Chert nodule, very abundant MnOx.
57				1			Open, rough, abund. clay		
		Run 6 5.0'/5.0'		2	3.2'/5.0'	2	Open, rough 10°		57.3-58.1' Chert nodule, crinoid stem, abundant MnOx healed fractures
58		100%			63% L.P. = 0.8'		Open, spun		
						5	Open, smooth, little clay, calcite		
							Open, rough, cly rubbly (3)		
59						2	Open, smooth		
							Open, spun		59.8-60.2' LS has white, non-$CaCO_2$ healed vertical fractures
60							Open, smooth, abund clay		
						2	Open, rough, abund clay, rubble		
61							Stylolite,		
						6	Open, rough, smooth, abund. MnOx, FeOx, clay		
62							Rubble, angular fragmented, fresh chert		
		Run 7 4.9'/5.0'		2	2.3'/5.0'	6	Open, spun (2) rubble		
		98%			46% L.P. = 0.9'		Open, smooth, greenish gray (5G 6/1) clay		Stylolite, strong
63							Open, smooth, abund. MnOx (2)		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 6

Project Number: 5121

Hole Number: GMN-4 (MW-2004)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
63		Run 7 cont		2		1			ARGILLACEOUS LIMESTONE and CHERT, as above
							Open, rough, stylolitic, dark reddish brown clay, carb. cly		63.9'-70.1' ARGILLACEOUS LIMESTONE (75%) and CHERT "bone marrow", vuggy texture. LS: Yellowish gray (5Y 7/2) medium hard to very soft, moderate to severly weathered vuggy with extremely vuggy zones, silty, very permeable, some FeOx stains. CHERT: White (N9) to grayish blue (5 PB 5/2) hard to very hard, slightly permeable below 67.5', some open and healed dendritic fractures.
64						3	Open, smooth, dk reddish brwn cly greenish gry cly		
65							Open,rough,vuggy (2)		
						>6	Open, rough, extremely vuggy (2)		
				2			Vuggy rubble		
66			? 66.4	3			Open, rough, extremely vuggy (2)		
			66.5 ?				Rough, vuggy (3) Vuggy LS/Chert rubble		
67		Run 8							
		4.7'/5.0'			4.0'/5.0'	3	Open, rough, extremely vuggy (2)		
68		94%	68.1 68.4		80% L.P. = 0.8'	> 6	Rough, vuggy (2)		
69							Open, rough, FeO		69.0-70.0 Stringers of LS and Chert.
	Weathered Limestone					2	Open, rough, stylolitic, carb. clay Open, smooth, glauc. clay		
70									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 6 of 6

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-4 (MW-2004)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
70	Competent Limestone	Run 8 cont.		3		2	Open, stylolite, abund, dl olive clay, glauc. FeOx Stylolite Open, smooth Vert: open,smooth abund. FeOx,MnOx		70.1'-72.0' LIMESTONE, Medium light gray (N6) to medium bluish gray (5B 5/1) hard, fresh, finely crystalline, abundant crinoid stems, stylolites.
71						3	Open, rough, stylolitic Stylolite Stylolite, weak		70.8'-71.2' Chert nodule, abundant FeOx, MnOx stains, crinoid stem.
72				3					Total Depth 72.0

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 7

Project Number: 5121

Hole Number: GMW-5 (MW-2005)

Project: BECHTEL Geotechnical Logging

Location: N. 101131.4 W. 51951.6 G.S.Elev. 635.6

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
31									For description of overburden from 0-32.7', see original log for GMW-5.
32	32.7'								BEGIN CORING AT 32.7'.
33		Run 1		1			2.5' core loss in Run 1. Location unknown		0.4' of sample is cored chert, very pale orange (10YR 8/2) to med. gray (N5), very hard, fresh. 0.4' of sample is chert gravel. Gravel is hard, mod. weathered, vugs have dark yellowish orange (10YR 6/6) clay.
		0.8' / 3.3'							
		24%			0%				
34					L.P. = 0.2'				
35									
36									
		Run 2					No recovery.		No explanation for lack of recovery in Run 2 on original log.
		0' / 5.0'							
37		0%			0%				
38				1					

Geotechnical Information
by R. McClure, 11/14/89

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-5 (MW-2005)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
38		Run 2 cont		1			No recovery		No recovery on Run 2.	
39										
40										
41										
42		Run 3 1.3'/5.0' 26%			0% L.P. = 0.2'		3.7' core loss from 41.0'-46.0' in Run 3. Location unknown		0.6' of sample is cored chert, as in Run 1. 0.7' of sample is chert gravel, as in Run 1 and chert fragments. Fragments are angular, very hard, abundant FeOx stains. Gravel more vuggy than gravel in Run 1. Hematite in vugs.	
43										
44										
45				1						

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 7

Project Number: 5121

Hole Number: GMW-5 (MW-2005)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
45		Run 3 cont.	? 46.0	1			Core loss, Location unknown		Chert, as above.
46		Run 4 1.0'/1.7' 59%	46.7 ?		0.6'/1.7' 34% L.P. = 0.5'	2			46.7-48.9' CHERT (65%) and LIMESTONE. CHERT: Mottled grayish orange pink (5YR 7/2) to light gray (N7), very hard, MnOx healed fractures, fossiliferous zones.
47			47.7				Open, spun (3)		LS: Grayish orange pink (5YR 7/2), hard, slightly weathered, crystalline (?), very slightly permeable. Zones of increased silt content, moderately hard, permeable.
48		Run 5 2.3'/3.3' 70%	? 48.9		0.9'/3.3' 27% L.P. = 0.5'	3	Tight, rough		48.9-49.9' Void (?) 49.9-50.9' CHERT GRAVELS and fragments, as in Runs 1 and 3.
49							Open, spun Vert; open, smooth, FeOx staining Void?		
50			49.9 ?			>6	Chert rubble		
51		Run 6 4.9'/5.0' 98%	? 51.5 51.6 ?	1	4.0'/5.0 80% L.P. = 0.7'	4	Open, smooth, vuggy Open, rough, vuggy (2) Void Open, rough, vuggy rubbly		50.9-66.9' ARGILLACEOUS LIMESTONE (65%) and CHERT. LS: Grayish orange (10YR 7/4) to yellowish gray (5Y 7/2), mod. hard, slight to moderately weathered where vuggy, few small fossiliferous zones,
52									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 7

Project Number: 5121

Hole Number: GMW-5 (MW-2005)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
52		Run 6 cont.		1		4	Open, rough, rubbly (2)		very little MnOx specks in matrix, silty, very permeable, fine texture. CHERT: White (N9) to light bluish gray (5B 7/1) to pale red purple (5RP 6/2), nodular with small zones that are finely divided, fossiliferous zones, some healed vertical fracture, calcite-lined vugs.
							Open, spun		
53				2		1	Open, rough		
							Tight, rough		
54						1	Open, spun, glauc. clay		
55							Tight, rough, stylolitic, carb. clay		
						2	Open, smooth, clay		
56									
		Run 7				3	Open, rough, MnOx		
		4.9'/5.0'			3.8'/5.0'		Tight, rough		
57							Open, spun		
		98%			76%	2			
					L.P. = 0.6'		Tight, rough (2)		
58									
						>6	Open, rough, vuggy		58.5-62.0' Bone-marrow, coarse texture, mod. weathered.
59				2			Rubble		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-5 (MW-2005)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
59		Run 7 cont	562 ? 593 ?	2		>6	Rubble Void ?		Argillaceous Limestone and Chert, as above.	
60						3	Open, rough, vuggy (4)			
							Open, rough, vuggy, rubbly			
61		Run 8		3		5	Open, rough, vuggy (2)			
							Open, spun			
		4.8'/5.0'			2.9'/5.0'		Open, rough, vuggy (2)			
62		96%			58%	3				
					L.P. = 0.8'		Open, spun (2)			
63							Open, rough			
			? 638				Open, smooth glauc. clay Void		63.7-65.0' Limestone light gray (N7), hard, finely microcrystalline, abundant crinoid stems, stylolites. Two thin stringer of LS at core losses, LS is moderately weathered, mod. hard, slightly permeable, fossiliferous.	
64		64.1	639 ? 642 ?				Open, smooth, carb. clay (2) Void			
							Open, rough (2)			
							Open, rough, stylolitic Stylolite			
65						1	Open, rough (2)			
66				3						

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 6 of 7

Project Number: 5121

Hole Number: GMW-5 (MW-2005)

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
66		Run 9		3		5	Open, rough		Argillaceous Limestone and Chert, as above.
		4.8'/5.0'			3.3'/5.0'				66.9-76.0' LIMESTONE (70-80%) and CHERT.
67		96%			67%	3			LS: Very pale orange (10YR 8/2) to yellowish gray (5Y 7/2), permeable to slightly permeable, silty to coarsely crystalline, abundant fossils throughout, medium to moderately hard, mod. weathered, extremely reactive to HC , abundant MnOx flakes in matrix, stylolites.
					L.P. = 0.7'		Open, spun (9)		
68						2			
69						>6			CHERT: Very light gray (N8) to pale blue (PB 7/2), very hard to hard, zones very slightly permeable, fossiliferous, finely divided with nodules, healed vertical fractures, some FeOx staining.
							Rubble		
70							Open, spun Tight, rough		
			? 70A				Open, spun Void		
71			70B ?				Vert; open, rough, rubbly		
		Run 10		4		5	Open, rough		
		4.9'/5.0'			2.6'/5.0'				
72							Open, spun (7)		
		98%			62% L.P. = 0.8'	5	Vert: Tight, rough, rubble		
73				4					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 7 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-5 (MW-2005)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
73		Run 10 cont.		4		4	Open, rough, vert (2)		Limestone and Chert, as above.	
							Open, spun			
							Tight, rough			
			?							
74			74.1							
						>6	Void			
							Rubble			
			74.2 ?							
							Open, rough, rubbly FeOx (2)			
							Open, rough			
75										
						>6				
							Stylolite			
							Rubble			
76	ALL WEATHERED			4			Open, stylolitic, carb. clay			
									Total Depth 76.0'.	

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 7

Project Number: 5121

Hole Number: GMW-6 (MW-2006)

Project: Bechtel Geotechnical Logging

Location: (AEC) N. 101227.2 W. 49949.7 G.S.Elev. 634.09

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0-22.6', see original log for GMW-6.
									Begin Coring 22.6'
23		Run 1 2.7'/3.4' 79%	? 23.1	1	0.8'/3.4' 24% L.P. = 0.4'	6 .5'	Rubble		22.6-23.1' CHERT, rubble and cobbles, fresh to severely weathered.
						>6	Open, spun		23.8-25.8' LIMESTONE(60%) and CHERT(40%). LS: fine to coarsely microcrystalline, yellowish gray(5Y 7/2), hard, fracture surfaces are moderately weathered, core body is fresh, fossiliferous, stylolitic, MnOx flakes. CHERT: nodular, very light gray(N8), abundant MnOx healed vertical fractures, FeOx discoloration on horizontal fractures.
24			23.8 ?				Open,rough,FeOx, calc. x-tals		
						5	Open,rough,FeOx, organics,platey,clay		
							Open,rough,FeOx		
25							Open, spun (2)		
						3	Open,rough,stylolitic,organics		
							Open, rough		
							Open,rough,FeOx, abund. clay		25.8-53.2' ARGILLACEOUS LIMESTONE and CHERT. LS: Silty, permeable, grayish orange(10YR 7/4) to dark yellowish orange (10YR 6/6). Mod. to severely wthrd., soft to medium hard, FeOx. 25.8-46.0' silty limestone(50-70%) and chert are finely divided, with mottled texture. Many vuggy and closely fractured zones throughout
26							Open,rough,FeOx		
		Run 2 4.5'/4.5' 100%		1	3.5'/4.5' 78% L.P. = 1.0'	6	Open,rough,FeOx, clay (3),rubbly		
							Open, spun (2)		
27						0			
28									

-continued-

Geotechnical Information by R. McClure
10/19/99

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 7

Project Number: 5121

Hole Number: GMW-6 (MW-2006)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
28		Run 2 cont'd		1			Open, spun		ARGILLACEOUS LIMESTONE and CHERT, as above.
						3	Stylolite,strong		
							Open, spun (2)		25.8-53.2' section. CHERT: Very light gray(N8) to pale blue(5PB 7/2), abundant healed vertical fractures, MnOx, FeOx, and calcite x-tals.
29									
						1	Open,rough,clay		
30							Open,spun,clay		
		30.5'				> 6	Stylolite,strong		
		Run 3 100%			0% L.P. =0.2'		Rubble		
31							Open, spun		
		Run 4		1	2.6' / 5.0'		Open,rough,sandy clay,2.5 cm		
				2			Open, spun		
		4.9' / 5.0'			53%	6	Open,rough,vuggy (2)		31.6-34.1' Severely weathered with abundant vugs.
32		98%			L.P. = 0.8'		Open, spun (2)		
							Open,rough,vuggy		
							Open, spun		
			? 32.7			> 6	Open,rough,clay, FeOx		
							Open,rough,vuggy		
33			32.8 ?				Open, spun		
						3	Open,rough,vuggy, clay,FeOx (3)		
34							Open, spun		
						3	Open,spun,rubbly (2)		
35									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 7

Project Number: 5121

Hole Number: GMW-6 (MW-2006)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
35		Run 4 cont'd		2		2	Open,rough,FeOx		ARGILLACEOUS LIMESTONE and CHERT, as above.
36									
		Run 5 4.7'/5.0' 94%		2	1.9'/5.0' 38%	5	Open, spun (7)		
37			? 37.2 37.3 ?		L.P. = 0.6'	> 6	Open,rough (2) Rubble,chert, some clay		37.5-38.1' Clay, light olive gray(5Y 6/1) with subangular chert fragments above and below pure clay. Clay is plately with abundant MnOx flakes, FeOx streaks, 1.7" diameter.
38							Open,rough,clay (6)		
			? 38.7			> 6	Open,rough,vuggy (2) Open, rough (2)		38.7-40.1' Moderate to severely weathered with some vugs.
39			39.9 ?						
						6	Open,rough,vuggy (3) Open,smooth,clay Tight, rough		
40									
						2	Open, rough (2)		
41							Open, spun Open,smooth,clay (2)		40.9-43.7' Silty limestone and finely divided chert, as above, closely fractured, moderate severely weathered, soft.
		Run 6 5.0'/5.0' 100%		3	7.0'/5.0' 14%	> 6	Open, spun (8)		
42									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 7

Project Number: 5121

Hole Number: GMW-6 (MW-2006)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
42		Run 6 cont'd		3	L.P. = 0.3	> 6	Open, spun (4) Open, rough (2)		ARGILLACEOUS LIMESTONE and CHERT, as above.	
43							Open, spun Rubble			
						> 6	Open, rough Open, spun Open,rough,FeOx Open, rough (3) Open, spun (2)			
44							Open,rough,vert. w/ FeOx			
						> 6	Open, rough Tight, smooth Open, smooth Open,rough,FeOx			
45							Open, rough Open,rough,abund. FeOx			
						5	Open,rough,vuggy Open, spun Open,rough,vuggy, FeOx,clay,cal-cite x-tals(3)		45.0-46.5 Moderately weathered, vuggy zone.	
46										
		Run 7 100%			0% L.P. =0.2'	> 6	Open, spun Open,rough,vuggy, FeOx (2) Open,spun,FeOx		46.5-53.2 Chert becomes less finely divided, more nodular.	
		Run 8			2.5'/4.0		Rubble			
47		3.7/4.0	? 47.3		62%	> 6	Open, smooth Open,rough,FeOx, vuggy,sev.wthrd. (2)		47.3-49.0 Severely wthrd. zone with solutioning and vuggy texture. High silt content within ls. Chert has abundant healed vertical fractures, MnOx,FeOx, calcite.	
		74%	47.6 ?		L.P. = 0.9		Rubble, chert (cav. fill?)			
48						> 6	Open,rough/ smooth vert. fracts.,abund. FeOx		Solution hole at 48.1', 3 cm diameter. Open,calcite filled vug, 5 mm wide, 7 cm long.	
49										

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 7

Project Number: 5121

Hole Number: GMW-6 (MW-2006)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
49		Run 8 cont'd		3		2	Open, smooth, FeOx Tight, rough		ARGILLACEOUS LIMESTONE and CHERT, as above.	
50							Open, rough, vuggy, spun		50.1-51.0 Chert nodule.	
		50.5'		4		2	Open, smooth, FeOx			
		Run 9			0.6'/1.0'					
51		1.0'/1.0'					Open, rough, clay			
					60% L.P. ≈0.6'	6	Open, rough, stylolitic, carb. cly, FeOx			
		100%	?				Open, smooth			
		Run10	51.7	4	3.1'/5.0'		Open, spun carb. cly.			
52		4.5'/5.0'	51.8 ?				Open, rough, 25°, abund. FeOx			
		90%			62% L.P. ≈ 0.7'	2	Open, rough, FeOx			
53	Weathered L.S. 53.2						Open, spun		53.2-60.6 ARGILLACEOUS LIMESTONE(50-60%) and CHERT. Vuggy "bone marrow" type texture 53.2-54.1. LS: Silty, yellowish gray(5Y 7/2), medium to moderately hard, moderate to slightly weathered, permeable. CHERT: Very light gray(N8) to grayish blue(5PB 5/2), some healed vertical fractures.	
	Competent L.S.					2	Open, rough, stylolitic, carb. cly, calcite x-tals and lined vugs			
54			? 54.0				Open, rough, clay (2)			
			54.1 ? ? 54.7			6	Open, rough, vuggy, calcite filled geode			
55			55.1 ?				Open, rough, vuggy (4)			
						6	Open, rough, vuggy			
56										

WELDON SPRING REMEDIAL ACTION PROJECT

BOREHOLE LOG

Sheet 6 of 7

Project Number: 5121

Hole Number: GMW-6 (MW-2006)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
56		Run10 cont'd	56.1 56.2	4		6	Open,rough,vuggy Open,rough		ARGILLACEOUS LIMESTONE and CHERT, as above.
		Run11 4.5/4.5 100%	?	4	3.2/4.5 71% L.P. = 1.3	3	Open, smooth Open,spun Open,rough,stylolitic,carb.cly (2)		6 mm thick layer of crystalline calcite.
57									
58						1	Open,rough,clay, FeOx		
59				4 5		1	Open,smooth,stylolitic dk grn carb. clay, shaley		
60						3	Tight,rough,stylolite Open, smooth Stylolite Open,rough,stylolitic,dk grn shaley carb cly		60.6-65.0 LIMESTONE(70%) and CHERT(30%). LS: Fine to coarsely crystalline with some slightly silty, permeable zones, light gray(N7) to yellowish gray(5Y 7/2), hard to medium, very slightly weathered, stylolites, fossiliferous, some MnOx flakes. CHERT: Very light gray (N8) to grayish blue(5PB 5/2), some healed vertical fractures, nodular.
61		Run12 4.5/4.5 100%		5	3.1/4.5 69% L.P. = 0.9	2	Open,spun Stylolite Tight, spun		
62						1	Open,stylolitic, spun		
63									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 7 of 7

Project Number: 5121

Hole Number: GMW-6 (MW-2006)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	DEMENTATION HARDNESS WEATHERED STATE
63		Run12 contd		5					LIMESTONE and CHERT, as above.	
						2	Open, smooth (2)			
64										
						5	Open, spun Tight and open, smooth, fresh, MnOx Open, smooth			
65										
							Open, smooth Spun		Total Depth	65.5'

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 6

Project Number: 5121

Hole Number: GMW-7 (MW-2007)

Project: Bechtel Geotechnical Logging

Location: N. 100930.3 W. 50932.1 G.S.Elev. 651.89

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0.0-49.0', see original log for GMW-7 (MW-2007).
59									Begin Coring 59.0'
		Run 1 4.4'/5.0'	59.2	1	0%	> 6	Open, rough Open, rough, vuggy, cly		59.0-68.8' ARGILLACEOUS LIMESTONE(60-70%) and CHERT(30-40%), finely divided, mottled texture. L.S.: Yellowish gray (5Y 7/2) to dark yellowish orange(10YR 6/6), coarsely xln med. to soft, high silt content, moderately weathered. Fractures show severe weathering, FeOx, and carbonaceous clays. CHERT: Light bluish gray(5B 7/1) to grayish blue (5PB 5/2), abundant healed fractures, MnOx, FeOx.
60		88%	59.8				Rubble Open, rough		
						5	Open(1cm), smooth		
61						6	Open, rough (8)		
62						> 6	Open, spun Open, rough Tight, rough (2) Open, rough (2)		
63							Open, smooth, 20° Open, rough (2)		
						6	Open, spun (5)		
64				1					

Geotechnical Information by R. McClure 10/16/89

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 6

Project Number: 5121

Hole Number: GMW-7 (MW-2007)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
64		Run 2		1	1.4'/5.0'		Open, smooth (2)		ARGILLACEOUS LIMESTONE and CHERT, as above.
							Open, rough		
							Stylolite		
		4.5'/5.0'			27%		Open,rough,vuggy		
			?				Rubble		
			64.9						
65		90%							
							Open,spun,vuggy, FeOx,30°		
			65.2 ??						
			65.6				Open,spun		
66			65.8 ?						
							Rubble		
						>6	Open,rough,glauc. cly		
							Stylolite, 15°		
67							Open,rough,carb., cly,stylolitic		
							Open, rough		
						3	Tight, rough(2)		
68							Open(1cm),rough		
						5	Open, spun		
							Open,rough,FeOx		
							Open,rough,mod. wthrd. clay		
69							Open,rough,FeOx		68.8-76.0' CHERT(60-70%) and ARGILLACEOUS LIMESTONE(30-40%), finely divided, vuggy, "bone marrow" texture. CHERT: sub-angular nodules, color as chert above, MnOx healed dendritic fractures. L.S.: Yellowish gray(5Y 7/2), high silt content, permeable, med. hard, crinoids, very slightly weathered.
		Run 3		2	2.2'/5.0'	2	Open, smooth		
							Stylolite		
		4.7'/5.0'			44%		Open, rough		
							Open, spun		
70		94%			L.P. = 0.5'		Open,rough,stylolitic,carb. clay		
						3	Open, rough (2)		
71				2					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 6

Project Number: 5121

Hole Number: GMW-7 (MW-2007)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
71		Run 3 cont'd		2		4	Open, rough, carb. cly Open, spun, carb. cly Open(2cm), rough		CHERT and ARGILLACEOUS LIMESTONE, as above.
72			? 72.3						
			72.6 ?				Open, rough (4)		
73						>6	Open, spun Open, rough (3)		
74							Rubble		
		Run 4 4.5'/5.0' 90%			2.0'/5.0' 40% L.P. = 0.5'	5	Open, rough (2) Open, spun Open, rough (4)		
75			? 75.2						
			75.7 ?				Some rubble		
76						4	Open, spun Open, rough Tight, rough Open, rough, FeOx, MnOx		76.0-89.5' ARGILLACEOUS LIMESTONE(50-60%) and CHERT(40-50%) interbedded. L.S.: Yellowish gray(5Y 8/1), vuggy, slightly weathered, mod. hard, coarsely xln, high silt content, MnOx. CHERT: light bluish gray(5B 7/1) to light gray(N7), $CaCO_3$ (?) healed fractures, fossiliferous, MnOx.
77						4	Open, smooth, cly Open, smooth, carb. cly, 20° Open, smooth, grysh grn(10BY 5/2), glauc., FeOx		
78				2			Open, rough		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 6

Project Number: 5121

Hole Number: GMW-7 (MW-2007)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
78		Run 4 contd		2		2	Open,rough,carb. cly,stylolitic		78.0-79.9' Limestone, fine to coarsely crystalline, moderately hard, light gray(N7) - no chert.
				2			Open,rough,crinoid stem		
79		Run 5		3	1.3'/5.0'	2	Open,rough,70°		
		4.9'/5.0'			26%		Open,smooth/ rough,carb.cly, stylolitic		
80		98%			L.P. = 0.9'		Open, spun (5)		
			? 80.7			6			
81			80.8 ?						
						4	Open, rough (2)		
							Open, spun		
82							Open,rough,many vert. fracts.		
						> 6	Open,rough		
							Rubble		
							Open, rough		
							Vert., open,rough		
83							Open, rough, stylolitic		
						> 6	Rubble		
							Open(3cm),rough, 3 vert. fracts.		
84		Run 6			2.35'/5.0'		Open, rough (6)		
		4.7'/5.0'	? 84.6		47%				
85		94%	84.7 ?	3			Rubble		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 6

Project Number: 5121

Hole Number: GMW-7 (MW-2007)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
85		Run 6 contd	? 85.3	3	L.P. = 0.4'		Open, rough		ARGILLACEOUS LIMESTONE and CHERT as above.
			85.4				Open, spun		
			?				Open, rough (2)		
			? 85.9						
86							Open, spun (2)		
			86.0 ?						
						3	Open, rough		
							Open, rough, 50°		
87							Open, rough		
						> 6	Rubble		
88							Open, rough		88.1 Horn coral fossil on fracture.
				3		> 6	Open, rough (2) vert:tight, smooth,fresh(2)		
				4					
89	Weathered LS 89.5'						Open, smooth (2)		
		Run 7 4.8'/5.0' 96%			3.4'/5.0' 68%	2	Open, spun		89.5-94.0' LIMESTONE, yellowish gray(5Y 8/1) to olive black(5Y 2/1), fossiliferous, fine to coarsely crystalline, stylolitic, hard, fresh.
	Competent LS								
90					L.P. = 0.8'		Open, rough (2)		
			? 90.8				Rubble		
91							Open,smooth,dk grn carb cly		
			91.0 ?				Stylolite		
						3	Open,rough(2),cly as above,stylolitic		
92				4			Vert,tight,smooth		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 6

Project Number: 5121

Hole Number: GMW-7 (MW-2007)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
92		Run 7 cont'd		4			Open, rough (2)		LIMESTONE, as above.	
						3	Vert: tight,smooth fresh			
93							Open,rough			
						3	Vert: tight,smooth fresh			
							Open,rough,carb. clay			
94							Stylolite		Total Depth	94.0'
95										

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 4

Project Number: 5121

Hole Number: GMW-8 (MW-2008)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Augered and sampled from 0-31.5'. For description of this interval, see original GMW-8 log. Begin coring @ 31.5'
		Run 1	31.9	1	1.25' / 4.0'	7 / 6	open, rough		31.5-37.7 silty, argillaceous limestone and chert: Limestone: grayish orange (10YR 7/4) to dark yellowish orange (10YR 6/6) medium hard to soft. Moderate to moderately severe weathering. Chert: mottled very light gray (N8) to pale yellowish orange (10YR 8/6). Very hard to moderately hard. Slight to moderate weathering.
32		2.9' / 4.0' 73%	32.9		31% LP= 0.5'	> 6			
							open, rough, FeOx specks		
33							tight, rough, FeOx specks		
						3	open, rough, FeOx specks		Chert occurs as discrete layers up to 0.1' thick and as finely divided masses within a matrix of silty, argillaceous limestone.
							open (0.5mm), rough		
34							open, rough (2)		Ratio: limestone : chert 50 : 50
						> 6			
			36.1						
35				1		> 6			
		Run 2	35.5	1	0.85' / 2.0'		open, rough		
		1.9' / 2.0' 95%			23% LP= 0.45'	3	tight, rough, FeOx stain		
36							open, smooth, FeOx stain 50° dip		
							open, rough, clay filled		vug-sparry calcite fill
37				1					

Geotechnical information by: D. Dahlstrom 4/23/90

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 4

Project Number: 5121

Hole Number: GMW-8 (MW-2008)

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION)	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
37		Run 2 cont.	37.4	1		>6	open, rough, FeO, stain open, rough		37.7-41.9' chert with minor inclusions of silty, argillaceous limestone Chert – massive with numerous healed fractures filled with silica, minor strips – pinpoint to 2cm. Mottled white (N9) to pale (vip) yellowish orange (10YR 8/6) and medium gray (N5). Very hard. Slight to moderate weathering. May represent two episodes of silicification: mottled chert has fractures healed with medium gray chert. Limestone: see description for 34.5-37.7. Ratio of chert : limestone 95 : 5
38		Run 3 0.75'/1.0 75%	37.75	1	.75'/1.0' 75% LP= 0.75'	>6	open, rough		
			38.5	1			open, rough, MnO2 blebs		
39		Run 4 1.1'/2.0' 55%	39.4	1	0'/2' 0%	>6	open, rough open (0-2cm) rough open (0-5mm) rough		
40			40.5	1		>6	open, smooth, FeO, blebs open (2)		
		Run 5 .85'/1.0' 85%	40.65	1	0.85'/1.0' 85% LP= 0.85'				
41				1		2	open (0-1cm) rough		
		Run 6 4.0'/4.0' 100%		1	2.8'/4.0' 70% LP= 0.8'		open (0-5mm) rough, MnOx specks (2)		41.9-51.3' silty, argillaceous limestone and chert. Limestone: grayish orange (10YR 7/4) to yellowish gray (5Y 7/2) medium hard to soft. Moderate to moderately severe weathering vuggy from 45.2-51.3. Chert: occurs as finely clouded inclusions. Very light gray (N8) to Pale Blue (5B 6/2). Very hard to moderately hard. Very slight to moderately severe weathering
42				2		4	open (0-5mm) rough, glauconitic tight, rough (2)		
43						3	open (0-1cm), rough, open open (0-1cm), rough, MnO2 bits open (0-1cm) stylolitic?		
44				2					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 4

Project Number: 5121

Hole Number: GMW-8 (MW-2008)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN: LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
44		Run 6 cont		2		1	spaw		"Bone marrow" texture (extremely rugy) 48.4–49.5'. Ratio of limestone : chert 60 : 40
45				2		>6	open, rough, spaw open, rough (2)		
		Run 7 4.8'/5.0' 96%		2	2.0'/5.0' 40% LP= 0.4'				
46						3	open (0-5mm), rough (2) open (0-2cm) rough		
47						3	tight (chipped), rough open (0-3mm) rough (2)		
48						3	open (0-2cm), rough open, rough (5)		
49						>6	tight, rough open (0-1cm) rough tight, rough, 45° dip open (0-5mm), rough (2)		
50				2		5	open, rough, 45° dip vertical fracture weak tight, rough		
		Run 8		2 2	see next page				
51									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 4

Project Number: 5121

Hole Number: GMW-8 (MW-2008)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
51	weathered limestone competent limestone	Run 8 cont. 5.0'/5.0' 100%		2 3	2.85'/5.0' 57% LP=0.5'	4	open (0-1cm), rough open (0-2cm), rough, glauconitic open (0-4cm), rough open (0-3cm), rough		51.3' - 57.0' silty argillaceous to very coarsely crystalline limestone and chert. Limestone: light gray (N7). medium hardness. slight to moderate weathering. Chert: light gray (N7) to light bluish gray (5 B 7/1). Very hard, very slight weathering. Occurs both as discrete layers up to 0.3' thick and as finely divided masses within limestone.
52						4	open, rough open, smooth MnOx blebs open (0-1cm), rough open, rough, part open		
53						3	open tight, rough (3)		
54						3	open, rough, tight, rough, silica coated		
55				3		7	stylolite - strong open (0-1cm) rough open, rough open (4) tight, rough, 90° dip (2)		Pebble
		Run 9 1.5'/1.5'		3	0.85'/1.5' 57% LP=0.5'	6	open, rough		
56				3		5	open, rough tight, smooth, 75° dip open (2)		
57									Total Depth 57.0'

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 5

Project Number: 5121

Hole Number: GMW-9 (MW-2009)

Project: Bechtel Geotechnical Logging

Location: N.101351.5 W.50699.1 G.S.Elev. 636.35

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0-20.5', see original log for GMW-9.
20.5									Begin Coring at 20.5'.
21		Run 1 3.3'/9.0' 37%		1	1.3'/9.0' 13% L.P. = 0.5'		5.7' Core Loss in Run 1, location unknown. Run 1 Core sample consists of:		20.5-54.0' CHERT(70-90%) and ARGILLACEOUS LIMESTONE. CHERT: Light gray(N7) to light bluish gray(5B 7/1), finely divided, mottled to 39.0' marker, below 39.0' becomes 80-90% nodular. Chert rubble has severely weathered rind up to 4mm thick, moderately hard. Chert core has abundant MnOx healed fractures, abundant FeOx. Open 60° fracture surface (0.5' above 49.0' marker) has abundant FeOx staining. LS: Grayish orange(10YR 7/4) to dark yellowish orange (10YR 6/6), medium to soft (where very severely weathered and vuggy), severely weathered. Crystalline LS (above 29.0' marker) is coarsely crystalline moderately hard, grayish orange pink(5YR 7/2) to light gray (N7) with two stylolites, large abundant (3mm) MnOx flakes, FeOx.
22									
23									
24									
25									
26									

Fractures are open, rough, abund. clay, FeOx

Geotechnical Information by Rick McClure 10/26/89

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 5

Project Number: 5121

Hole Number: GMW-9 (MW-2009)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
26		Run 1 cont'd		1			5.7' Core Loss Location unknown		CHERT and ARGILLACEOUS LIMESTONE, as above.	
27										
28										
29										
		Run2			1.4'/10.0'		7.9' Core Loss in Run 2 Location unknown			
30		2.1/10.0			14%					
		21%			L.P. = 0.4'		Fractures are generally open, rough, clay, FeOx			
31										
32										
33				1						

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 5

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-9 (MW-2009)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
33		Run 2 contd		1			7.9' Core Loss Location unknown.		CHERT and ARGILLACEOUS LIME-STONE, as above.	
34										
35										
36										
37										
38										
39										
		39.5								
40		Run 3		1			4.7' Core Loss in Run 3			

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 5

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-9 (MW-2009)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
40		Run 3		1	0.8'/10.0'		4.7' Core Loss in Run 3, location unknown.		CHERT and ARGILLACEOUS LIMESTONE, as above.
		5.3'/10.0'			8%				
41		53%			L.P. = 0.4'		Fractures are as in Run 2, with closely spaced fractures and rubble.		
42									
43									
44									
45									
46									
47				1					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 5

Project Number: 5121

Hole Number: GMW-9 (MW-2009)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
47		Run 3 cont'd		1					CHERT and ARGILLACEOUS LIMESTONE, as above.	
				2						
48										
49										
		49.5								
		Run 4		2	0%		3.5' Core Loss in Run 4, location unknown.			
50		1.0 / 4.5			L.P. = 0.2'					
		22%					Core sample consists of 0.8' chert rubble and 0.2' chert			
51										
52										
53										
54	All Weathered Limestone			2					Total Depth 54.0'	

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 5

Project Number: 5121

Hole Number: GMW-10 (MW-2010)

Project: Bechtel Geotechnical Logging

Location: N.101151.5 W.50100.0 G.S.Elev. 642.97

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0-32.8', see original log for GMW-10.
32									Begin Coring at 32.8'
33		Run 1 5.9'/6.2' 95%		1	2.6'/6.2' 42% L.P. = 0.6'		0.3' Core Loss in Run 1, Location Unknown		32.8-59.0' ARGILLACEOUS LIMESTONE and CHERT. Percent LS widely varies (40-80%). Mottled, finely divided to 50.0'. Chert becomes more nodular below 50.0' LS: Pale yellowish orange(10YR 8/6) to dark yellowish orange(10YR 6/6), silty, permeable, medium hard with soft zones, moderately severely weathered. Zones are extremely vuggy and rubbly, abundant clay, some FeOx.
34							Fractures in Run 1 are generally open, rough, vuggy, FeOx, moderate to severely wthrd, and contain clay. Several fractures are spun. Solution features are common; one 0.4 above 34' mark (at chert-limestone contact) is circular, 2 cm dia., smooth, with no clay.		1.4' below 34' marker is 0.5' LS; coarsely microcrystalline, yellowish gray(5Y 7/2), moderately hard, slightly weathered, few MnOx, fossiliferous.
35									
36									CHERT: finely divided, becomes nodular below 50.0', color varies, (very light gray
37				1					-continued-

Geotechnical Information by R. McClure.
10/24/89

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 5

Project Number: 5121

Hole Number: GMW-10 (MW-2010)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
37		Run 1 cont'd		1					(N8) to light bluish gray (5B 7/1), to grayish orange pink(5YR 7/2)), abundant MnOx healed vertical and dendritic fractures, rubble is moderately weathered, some FeOx.
38									
39									
		Run 2			1.3'/10.0'		2.8' Core Loss in Run 2, location unknown.		
		7.2'/10.0'			13%				
40		72%			L.P. = 0.5'		Fracture descriptions for Run 2 are as Run 1 Fractures are more closely spaced. Solution features and vugs are larger and more abundant.		
				1					
				2					
41									
42									
43									
44				2					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 5

Project Number: 5121

Hole Number GMW-10 (MW-2010)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
44		Run 2 cont'd		2			2.8' of Core Loss in Run 2 Location unknown		ARGILLACEOUS LIMESTONE and CHERT, as above.
45									
46									
47									
48									
49		Run 3			2.2'/10.0'		2.7' Core Loss in Run 3, location unknown.		
		7.3'/10.0'			22%		Fractures in Run 3 are generally open, rough, with clay and FeOx. Zones		
50		73%			L.P. = 0.4'				
51				2			-continued-		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 5

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-10 (MW-2010)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
51		Run 3 cont'd		2			(Fractures, Run 3 continued)		ARGILLACEOUS LIMESTONE and CHERT, as above.	
52				2/3			are vuggy, and moderate to moderately severely wthrd Core segments are generally 0.3'. Large solution feature are not as common as Runs 1 & 2. Strong stylolite 0.5' below 49.0' marker.			
53										
54										
55										
56										
57										
58				3						

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 5

Project Number: 5121

Hole Number: GMW-10 (MW-2010)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
58	All Weathered Limestone	Run 3 cont.		3					ARGILLACEOUS LIMESTONE and CHERT, as above.	
		End		3						
59									Total Depth	59.0'

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 7

Project Number: 5121

Hole Number: GMW-11 (MW-2011)

Project: Bechtel Geotechnical Logging

Location: N. 100898.2 W.50032.5 G.S.Elev 653.25

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Augered and sampled to 32.0'. 32.0-74.0' cored using NXB bit. See original boring log GMW-11 for sample description 0-32.'
32									Begin Coring 32.0'
		Run 1		1	3.4' / 7.0'				32.0-32.6' GRAVELLY,SILTY,CLAY Mod. yellowish brn(10YR 5/4), subrounded chert gravel with weathering rinds.
		6.6' / 7.0'	32.4		49%	1	Clay Seam Open, spun (2)		32.6-51.9' LIMESTONE and CHERT intermixed. L.S.: silty,argillaceous, FeOx-stained l.s., dark yellowish orange(10YR 6/6) mod. to medium hardness, mod. to mod. severe weathering; interbedded with fossiliferous med. to coarse grained l.s., light bluish gray(5B 7/1) with minor FeOx streaking, hard, v. slight weathering to fresh. CHERT: light gray(N7) to mottled light gray and medium gry (N5), hard, slight weathering to fresh. Occurs as nodules up to 0.4' thick in fossiliferous limestone and as finely divided to massive replacement zones in silty argillaceous limestone.
33		94%			L.P. = .9'	5	Cly parting,weak Open,rough,FeOx, cly Vuggy Contact,cly,rough (2)		
34						4	Open,rough,cly Open, spun Tight, smooth Open,stylolitic, cly,MnOx		
35						6	Open,cly,smooth (3) Tight,smooth,cly Stylolite,open, rough,weak Open,rough,cly (2)		
36						2	Open,rough,FeOx, cly Clay,parting Open,rough,cly		32.6-40.3' Sparse hematite after pyrite in limestone. 33.5' Vugs to 1.5cm, filled with oxidized pyrite.
37									

Geotechnical Information by: D. Dahlstrom, R. McClure, & P. Patchin 10/11/89.

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 7

Project Number: 5121

Hole Number: GMW-11 (MW-2011)

Project: Bechtel Geotechnical Logging

Location: Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
37		Run 1 cont'd		1			Open,rough,cly, FeOx,15°		32.6-41.0'	80% xtln l.s. 10% nodular chert 10% silty arg. l.s.
						3	Open(1cm),rough, cly, 15°			
							Open(1cm),rough, cly		41.0-44.2'	80% chert 20% silty, arg. l.s.
38										
						1			44.2-45.2'	xtln l.s.
							Tight,rough,cly, 5°,spun		45.7-51.9'	20% xtln l.s. 50% chert 30% silty, arg. l.s.
39										
		Run 2 9.1'/10.0' 91%	89.9 ?	1	4.6'/10.0' 46% L.P. = 1.2'					
40							Open,spun,rough, cly			
						3	Open,spun-not spun,clay			
							Open,rough,spun, conical			
41										
						>6	Rubble,spun			
							Spun			
42				2			Open,spun,rough, clay			
							Open,rough,clay			
						4	Tight,smooth,cly, 15°			
							Open,rough,clay			
							Tight,rough,clay			
43							Open(1.5cm),rough, clay,FeOx			
							Open(1.0cm),rough, clay			
						5	Open,rough,cly (2)			
44							Open,rough,clay, 15°			

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 7

Project Number: 5121

Hole Number: GMW-11 (MW-2011)

Project: Bechtel Geotechnical Logging

Location: Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
44		Run 2 contd		2					LIMESTONE and CHERT, as above.
						1	Open,rough,clay, FeOx		
45									
							Open,rough,clay		
						2	Open,rough,clay FeOx (4)		
46									
						4	Spun		
47									
							Open,smooth,clay, 15°		
						2	Open,smooth,clay, 8°		
48									
							Open,rough,clay		
						4	Contact,open, rough,5°,clay		
49							Open,rough,clay, (3)		
		Run 3		2	3.8'/9.0'				
		7.8'/9.0'			42%	3	Spun, clay (2)		
50		87%							
					L.P. = 0.8'		Open,rough,clay (5)		
						5			
				50.8/3			Contact(?),vuggy		
51									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-11 (MW-2011)

Project: Bechtel Geotechnical Logging

Location: Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
51		Run 3 cont'd		3			Open, rough (4)		
						5	Contact		
52			? 52.4				Open,rough,vuggy		51.9-71.3' Intermixed ARGILLACEOUS LIMESTONE(60%) and CHERT (40%). L.S. is as above with no interbd. coarsely xln pure L.S., increased fracts. and rubble, increase in silt content (more permeable). CHERT is as above, vuggy, vugs to 1 cm at 64.1' with euhedral and drusy quartz filling. Secondary calcite xls in l.s., little to no fossils. At 68.8-69.6' "Breccia"-like chert replacement in l.s. Angular "pieces" to .2'.
							Open,rough,FeOx		
53			53.4 ?						
54							Open,rough,vuggy (2)		
						3			
55							Open,rough (2)		
						2	Open,rough,vuggy		
56							Open,rough,clay, FeOx (2)		
							Rubble, spun		
			? 56.9				Open,rough,15°		
57							Open,rough,vuggy, FeOx		
			57.1 ?				Open,rough,vuggy, spun		
58				3			Spun		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-11 (MW-2011)

Project: Bechtel Geotechnical Logging

Location: Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
58		Run 4		3	2.0/9.0	4	Open,rough,vuggy (3)		LIMESTONE and CHERT, as above.
		7.8/9.0			22%		Spun		
59		87%	? 59.2		L.P. = .5'		Open, spun (2)		
							Spun		
60			59.8 ?				Tight,rough,FeOx		
						5	Tight,rough,cly		
				60.8 4			Tight, rough (2)		
61						3	Tight,vert.,healed,FeOx		
							Open,rough,FeOx		
62							Rubble		
						> 6	Vert.,rough,FeOx		
							Open,rough		
							Open(1cm),rough		
							Tight,rough,FeOx		
63						6	Tight,smooth,FeOx		
							Tight, smooth		
							Open,rough,rubbly		
							Tight,contact, smooth		
64							Tight,contact, rough		Vugs with euhedral qtz xls.
			64.3				Open,rough,vuggy		
			64.5				Open, rough		
							Rubble		
65									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 6 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-11 (MW-2011)

Project: Bechtel Geotechnical Logging

Location: Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
65		Run 4 contd				4	Spun Tight, rough Open, rubblized Open, rough, $CaCO_3$ xls.		LIMESTONE and CHERT, as above
66			? 66.3				Tight, rough Rubble		
67			66.7 ?				Open, rough		
68		Run 5 7.0'/7.0' 100%		4	2.3'/7.0' 33% L.P. = .45'	6 4	Spun Tight, rough, FeOx Spun (2) Open, rough Tight, rough Open, rough Tight, rough		
69						2	Open, rough Spun Tight, rough (2)		
70				5		4	Tight, smooth, 25° Spun Open, stylolitic Tight, rough		
71	Weathered Limestone Competent Limestone					3	Tight, smooth, shaley Open, stylolitic, blk cly Tight, stylolitic Tight, rough		71.3-74.0' LIMEY SILTSTONE and CHERT. SILTSTONE is non-fossiliferous, limey (minor HCL reaction), yellowish gray(5Y 7/2), -continued-
72									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 7 of 7

Project Number: 5121

Hole Number: GMW-11 (MW-2011)

Project: Bechtel Geotechnical Logging

Location: Disposal Cell

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
72		Run 5 contd		5			Tight, rough (2)		med. hard, slightly wthrd., finely xln; CHERT is white(N9) to lt. bluish gry(5B 7/1), finely divided with siltstone, vuggy with "bone marrow" texture, slightly wthrd., hard to v. hard, fractured, MnOx dendrites.
						5	Open, rough (2)		
73							Tight, rough (5)		
						4			
74									Total Depth 74.0

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 6

Project Number: 5121

Hole Number: GMW-12 (MW-2012)

Project: BECHTEL Geotechnical Logging

Location: N.101052.2 W.49641.6 G.S. Elev: 634.9

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0'-25.5', see original log for GMW-12.
25									
25	5								BEGIN CORING AT 25.5'.
26		Run 1 3.3'/3.5' 94%		1	1.1'/3.5' 31% L.P. = 0.35		Open, rough, clay		25.5'-50.5' ARGILLACEOUS LIMESTONE (40-60%) and CHERT. LS: Very pale orange (10YR 8/2) to grayish orange (10YR 7/4). From 25.8-36.0', thin beds (to 0.4'), mod. to coarsely crystalline, moderately weathered. Below 36.0', LS becomes increasingly more argillaceous, silty & very permeable, medium hard (with soft zones), moderate to severely weathered. Zones extremely vuggy and several solution cavities throughout. Residium type mud (very dusky red (10R 2/2)) in vugs at 34.0'. Microcrystalline LS is fossiliferous with abundant MnOx streaks. Horizontal fractures and solutioned zone have abundant FeOx discoloration. CHERT: Very light gray (N8) to grayish orange pink (5YR 7/2), primarily has mottled texture and finely divided, becoming more nodular with depth. Abundant MnOx healed dendritic fracture, FeOx.
							Open, spun		
							Open, rough, slightly vuggy		
						4			
27			?			6	Open, spun (5)		
			27.7				Open, rough, clay, vuggy,		
28			27.9 ?			4	Open, spun (2)		
							Open, rough, clay, FeOx, MnOx streaks		
			?						
29									
		Run 2 3.6'/5.0' 72%			1.7'/5.0' 34% L.P. = 0.7'		1.4' CORE LOSS IN RUN 2. Location unknown		
30									
			30.4 ?						
31				1					

Geotechnical Information by R. McClure 10/23/89

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 6

Project Number: 5121

Hole Number: GMW-12 (MW-2012)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
31		Run 2 cont.		1			Core Loss, Location unknown.		ARGILLACEOUS LIMESTONE and CHERT, as above.
32									
33									33.4-34.9' Fracture surfaces are severely solutioned & extremely vuggy with abundant clay.
34									
		Run 3			0.9'/5.0'	4			
		5.0'/5.0'			18%		Rubbly, chert Open, rough, abundant clay, sev. wthrd., ext. vuggy		34.9-36.0' Crystalline LS
35		100%			L.P. = 0.5'	2	Open, rough, little clay		
				1			Open, spun		
36				2		5	Open, rough, vuggy, FeOx, clay, calcite		36.0-40.5' Several soft zones that are severely weathered, solutioned, vuggy and closely fractured.
							Open, spun		
37						5	Open, smooth, bryozoa MnOx flakes		
							Open,rough, FeOx		
							Open, rough, abund. clay(2)		
38				2			Open, smooth, FeOx, calcite, fossiliferous		
							Open,rough,FeOx		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 6

Project Number: 5121

Hole Number: GMW-12 (MW-2012)

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TEST/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
38		Run 3 cont		2		6	Open,rough,abund clay (2) Open,rough,carb. clay, vuggy Open,rough,abund clay,vuggy (2) Open,rough,green carb. clay		ARGILLACEOUS LIMESTONE and CHERT, as above.
39		Run 4 2.0'/2.0' 100%			0.45'/2.0' 20% L.P. = 0.4'	5	Open,rough,soltn FeOx,carb. clay ext. vuggy Open,rough, FeOx Open,rough, FeOx Stylolitic Clay		
40						4	Open,spun (2) Open, smooth solutioned FeOx abund. clay (3)		
41		Run 5 2.8'/3.0' 93%	? 41.2		0.35'/3.0 12% L.P. = 0.35'		0.2' CORE LOSS IN RUN 5. Location Unknown		
42									
43									
44		Run 6 0.9'/1.0' 90%	? 44.4 / 44.5 ?		0% L.P. = 0.3'		Open, spun (2) Open, spun (2)		
45									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 6

Project Number: 5121

Hole Number: GMW-12 (MW-2012)

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
45		Run 7		3		6	Open, spun (3)		45.0-46.6' Nodular chert to 0.6' diameter.
		4.8'/5.0'			1.1'/5.0'		Open, rough (2)		
46		96%			22%	6	Open, rough, some clay		
					L.P. = 0.4'		Open, rough, 10°		
			?				Open, rough, 10° abund. FeOx		46.8-48.0' Very silty limestone, soft, very permeable, severely weathered and extremely vuggy.
47			47.1				Open, rough, ext vuggy, silty, abund. FeOx and clay, soltnd.(3)		
			47.3 ?			6	Rubble, angular, severely wthrd. chert., abund. FeOx, vugs&clay on fragments.		
48						6	Open, rough, little clay, 5° (3)		
							Open, rough		
							Open, rough, 15° platey clay		48.8-50.5' Nodular, interbedded LS/Chert.
49							Open, rough,clay		
						3	Open, rough, little clay 20°		
							Open, rough, abund.clay (2)		
50		Run 8				5	Open, smooth FeOx, 15°		
		5.0'/5.0'			3.25/5.0'		Open, smooth, abund. FeOx		50.5-60.0' ARGILLACEOUS LIMESTONE (60-70%) and CHERT, mottled, "bone-marrow", vuggy texture.
	Weathered Limestone						Open, spun		
51		100%			65%		Open,rough,carb. clay, stylolitic		
	Competent Limestone				L.P. = 0.6'	3	Open, smooth		LS: 50.5-52.1', light gray (N7) to med. light gray (N6), finely microcrystalline, fossiliferous, stylolites, few MnOx healed vertical fractures. Below 52.1', to
							Open, smooth, abund crinoid stems, FeOx		
52				3			Open, smooth, stylolitic carb clay		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 6

Project Number: 5121

Hole Number: GMW-12 (MW-2012)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
52		Run 8 cont		3		3	Open, smooth Open, rough (2)		ARGILLACEOUS LIMESTONE and CHERT (cont.) bottom, LS becomes silty, yellowish gray (5Y 7/2), permeable, medium hard, moderate to moderately severely weathered, zone appear stylolitic. CHERT: Pale blue (5PB 7/2) to grayish blue (% PB 5/2), MnOx flakes, angular fragments in mottled, finely divided, "bone-marrow" and nodular. Some vugs calcite lined.
53						2	Open, smooth Open, rough, abund. carb.clay		
54				3 4		3	Tight, rough calcite lined vug Open, spun (2)		
55		Run 9 4.9'/5.0' 98%			2.4'/5.0' 48% L.P. = 0.5'	3	Open, rough, vuggy, "bone-marrow texture (4)		
56						4	Open, spun		
57						3	Open, rough, vuggy, "bone-marrow" texture (6)		
58			? 58.0 58.1 ?			6	Open, rough (2) Tight, smooth, MnOx, fossiliferous (2) Open, smooth, carb clay Open, rough		
59									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 6 of 6

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-12 (MW-2012)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
59		Run 9		4		3	Tight, rough		ARGILLACEOUS LIMESTONE and CHERT, as above.	
							Open, smooth			
60		End		4			Open, rough, stylolitic, carb. clay		Total Depth	60.0'

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 1

Project Number: 5121

Hole Number: GMW-13 (MW-2013)

Project: Bechtel Geotechnical Logging

Location: N. 100820.7 W. 49538.3 G.S.Elev. 645.38

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0-27.5', see original log for GMW-13.
27.5									Begin Coring 27.5'
28		Run 1 2.2'/2.5' 88%	? 28.0 28.2 ? ? 28.8	1	1.0'/2.5' 40% L.P. = 0.5	>6	Open,spun,FeOx Stylolite		27.5-27.8' CLAY, grayish orange (10YR 7/4). 27.8-28.0' CHERT GRAVEL, sub-angular, vuggy. 28.2-60.0' ARGILLACEOUS LIMESTONE and CHERT, finely divided and nodular, mottled texture. Abundant vugs and solutioned fractures with clay, FeOx. L.S.: Pale yellowish orange(10YR 8/6) where silty and permeable to yellowish gray(5Y 8/1) where coarsely xln, vuggy, moderate to severely wthrd, soft to mod. hard fossiliferous in zones, FeOx, stylolitic, percent of limestone varies(40-70%) throughout. CHERT: Very light gray (N8) to light bluish gray(5B 7/1), 30-60%, abundant healed vertical fractures.
29			28.9 ?				Open,rough,clay, FeOx (3)		
30						3			
31		Run 2 4.7'/5.0' 94%	? 30.7 30.9 ?	1	2.1'/5.0' 43% L.P. = 1.1'	0	Tight,smooth, abund. MnOx, FeOx		31.0-32.1 L.S.,yellowish gry(5Y 8/1),coarsely xln, MnOx, abundant fossils, moderately hard.
32									

Geotechnical Information by R. McClure 10/17/89

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 7

Project Number: 5121

Hole Number: GMW-13 (MW-2013)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
32		Run 2 cont'd	? 32.5 32.7 ?	1		6	Tight, smooth Spun Open,smooth,MnOx, (2),verts.(2)		ARGILLACEOUS LIMESTONE and CHERT, as above.
33						3	Open, spun Open,smooth,calcite,FeOx, 60° Stylolite Open,rough,FeOx		
34						5	Open, rough Open,rough,FeOx Open, rough Tight, rough Open, spun		
35				1			Open,rough,FeOx		35.0-40.2' Argillaceous limestone(60%) and chert (40%), as above.
		Run 3 5.0'/5.0' 100%		2	3.3'/5.0' 66% L.P. = 1.1'	3	Open,rough,clay (2)		
36						5	Open,rough,clay, 30° Stylolite Open,rough,clay Open,spun Open, rough (2)		
37						1	Vug, FeOx		
38						2	Open,rough,clay Tight, smooth Open,smooth,clay		
39									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 7

Project Number: 5121

Hole Number: GMW-13 (MW-2013)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
39		Run 3 cont'd		2		4	Open,rough,FeOx Open,rough,ext. vuggy,FeOx,cly (3) 4cm open vug		ARGILLACEOUS LIMESTONE and CHERT, as above.
40			40.0						
		Run 4 4.6'/5.0' 92%	40.1		2.9'/5.0' 58% L.P. = 0.8	3	Open,ext. vuggy, clay(2), some calcite		40.2-48.8' Argillaceous limestone(50%) and chert (50%), as above.
41						4	Open,ext. vuggy, 3cm, clay Open, rough Open, ext. vuggy, clay		
42			? 42.4			>6	Open, spun Fully penetrating vug Spun		
			42.5 ?				Spun, vuggy		
43			? 43.3			>6	Open,rough,clay, some vugs		
			43.5 ?				Vuggy,sev. wthrd. Chert rubble		
44				2			Open,rough,vuggy		
				3		1	Open, spun		
45		Run 5 4.8'/5.0' 96%		3	1.4/5.0 29%	>6	Open, rough, brachiopod Open,rough,calcite Silty l.s.,chert, clay rubble		
46									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-13 (MW-2013)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
46		Run 5		3	L.P. = 0.8	6	Open,rough,FeOx, clay (6)		ARGILLACEOUS LIMESTONE and CHERT, as above.
47						5	Open,rough-smooth, 15°,cly,vuggy Open,rough,clay, vuggy (2) Open, rough (2)		
48						1	Open,rough,FeOx, spun		
49			? 49.5			5	Open, smooth Open, spun Open, rough (2)		48.8-50.5' Argillaceous limestone(80%) and chert (20%), as above.
50			49.6 49.9				Open,rough,spun		
		Run 6	50.0 ?		0.6'/1.1'	3	Open,smooth,clay, FeOx		
		1.1'/1.1'			55% L.P. = 0.6'		Open, smooth Open,spun,stylo-litic		50.5-54.0' Argillaceous limestone(60%) and chert (40%).
51		100%	?				Open, spun		
	51.1'	Run 7	51.2 51.3		0.65'/3.9	>6	Open, rough Rubble,subang. chert,sl.wthrd.		
		3.6/3.9	?? 51.8		17%		Open, rough (3) Open, spun (2)		
52		92%	51.9 ?		L.P. = 0.65'	5	Open, smooth (2) Stylolite, str. Open,rough,FeOx (2)		
53							Open, spun		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 7

Project Number: 5121

Hole Number: GMW-13 (MW-2013)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
53		Run 7 cont'd		3		3	Open, smooth, MnOx		
							Open, spun (2)		
54						> 6	Open, smooth		54.0-60.0' Chert (60%) and Argillaceous limestone (40%), as above.
							Open, spun		
			? 54.7				Tight, smooth, FeOx rough (2)		
55			54.8						
		Run 8	?	4	2.9'/5.0'	4	Open, rough, clay		
		5.0'/5.0'			58%		Open, smooth, "poker chip"		
56		100%			L.P. = 0.5'		Open, rough, carb. cly, stylolitic		
							Open, rough, clay (2)		
						5	Open, rough, v. vugy, rubbly, FeOx		
							Open, smooth, FeOx		56.7-57.8' Chert, as above, abundant healed vertical fractures, MnOx.
57							Open, smooth, 20° abund. FeOx		
						5	Open, rough, FeOx		
							Open, rough, stylolitic		
							Open, rough, rubbly, FeOx		
58							Open, rough, styl.		
							Stylolites (2)		
							Open, rough (2)		
59									
	↑						Open, smooth (2)		
60	Weathered L.S.								

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 7

Project Number: 5121

Hole Number: GMW-13 (MW-2013)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
60	Competent L.S.	Run 9		4	4.2'/5.0'	2	Open,smooth,contact		60.0-68.8' ARGILLACEOUS LIMESTONE(50%) and CHERT(50%), extremely vuggy and "bone marrow" texture, very permeable through vugs and silt. L.S.: Yellowish gray(5Y 7/2) to light olive gray(5Y 5/2), silty, permeable, moderately hard, very slightly weathered, fossiliferous, stylolitic. CHERT: Very light gray(N8) to grayish blue(5PB 5/2), finely divided, abundant MnOx healed vertical fractures, calcite filled vugs.
		5.0'/5.0'			84%		Open,rough,stylolitic,carb.cly		
61		100%			L.P. = 1.9'		Tight, smooth		
							Stylolite		
						3	Open,rough,stylolitic,carb.cly		
							Open,smooth,contact		
62							Open, rough		
							Open, spun		
				5		2			
63									
						0			63.4': 1.5 x 6.0 cm open, calcite filled vug.
64									
							Open,rough,vuggy		
						2	Open,rough,vuggy, calcite fill		65.1': 1.5 cm circular, open, calcite filled vug.
65									
		Run10		5	3.6'/5.0'				
		5.0'/5.0'			72%	3	Open,rough,vuggy (3)		
66		100%			L.P. = 0.6'		Open,spun,contact		
							Open,rough,cont., carb. clay		
						3	Open,smooth,carb. clay		
67							Stylolite		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 7 of 7

Project Number: 5121

Hole Number: GMW-13 (MW-2013)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
67		Run10 contd		5			Tight, smooth		ARGILLACEOUS LIMESTONE and CHERT, as above.	
						2	Stylolite,smooth			
							Open,smooth,stylolitic,carb. clay			
68										
						3	Open,smooth,styl. glauc.?, MnOx			
							Open,rough,1.5cm			
							Open,rough,1.5cm, stylolitic		68.8-70.0' LIMESTONE, light gray(N7), fine to medium crystalline, stylolites, abundant bryozoan, crinoid stems, no chert.	
69							Stylolite,strong			
						1	Tight, smooth, hammer			
									Total Depth 70.0'	
70										

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 4

Project Number: 5121

Hole Number: GMW-14 (MW-2014)

Project: Bechtel Geotechnical Logging

Location: N.100736.9 W.49189.9 G.S.Elev.647.42

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0-33.0', see original log for GMW-14.
33									Begin Coring at 33.0'.
		Run 1		1	0%		1.2' Core Loss in Run 1, location unknown.		33.0-59.0' CHERT(70/30%) and ARGILLACEOUS LIMESTONE. CHERT: Finely divided, mottled texture, 70% above 46.0', below percent decreases to 30% and becomes nodular, grayish pink (5R 8/2) to light bluish gray (5B 7/1), very hard to moderately hard and slightly permeable(at 58.4-58.7'), fresh to moderately weathered rinds on chert gravels, abundant MnOx healed dendritic fractures FeOx stains. LS: Very pale orange(10YR 8/2) to grayish orange(10YR 7/4), medium hard to soft, moderate to very severely weathered, silty, very permeable, zones extremely vuggy with abundant FeOx stains and clay. Run 2 has few small(0.2') stringer of light gray(N7), coarsely crystalline, fossiliferous, moderately hard LS.
		0.8'/2.0'			0.2'				
34		40%					Primarily chert gravel with one 0.2' piece.		
35									
		Run 2			1.9'/5.0'		1.7' Core Loss in Run 2, location unknown.		
		3.3'/5.0'			38%				
36		66%			L.P. = 0.8'		0.4' chert gravel with 6 fractures in LS/chert core. Fractures are open, rough/smooth, FeOx, clay, some vugs.		
37									
38				1					

Geotechnical Information by R. McClure 10/26/89.

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 4

Project Number: 5121

Hole Number: GMW-14 (MW-2014)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
38		Run 2 cont.		1			1.7' Core Loss Location Unknown		CHERT and ARGILLACEOUS LIMESTONE, as above.
39									
40									
		Run 3			1.3'/5.0'		1.5' Core Loss in Run 3, location unknown.		
		3.5'/5.0'			26%				
41		70%			L.P. * 0.5'		Fractures are generally open, rough, vuggy, abundant clay and FeOx stains, some MnOx		
42									
43									
44									
45		End Run 3							

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 4

Project Number: 5121

Hole Number: GMW-14 (MW-2014)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
45		Run 4		1	1.25'/5.0		1.3' Core Loss in Run 4, Location Unknown		CHERT and ARGILLACEOUS LIMESTONE, as above.
		3.7'/5.0'			25%				
46		74%		1/2	L.P. = 0.32'		Fractures are as in Run 3, with more closely spaced fracts. and abundant vugs, some rubble and 0.5' clay and chert gravel above 50.0' marker. Clay is light olive gray (5Y 6/1).		46.0'-Chert (50%) becomes nodular and percent begins to decrease.
47									
48									
49									
50		Run 5			.35/5.0	>6	Open, spun Open,rough,abun. clay,FeOx (2)		
		4.9'/5.0'	? 50.7		7%		Open,rough (2)		
51		98%	50.8 ?		L.P. = 0.3'	5	Open,rough,abun. clay,some FeOx (3) Open, spun		
52				2			Open,rough,clay		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 4

Project Number: 5121

Hole Number: GMW-14 (MW-2014)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
52		Run 5 cont'd		2		4	Open,rough,styl., carb. clay Open, rough Open, smooth Vert: open, smooth,abund. MnOx, FeOx		ARGILLACEOUS LIMESTONE and CHERT, as above.
53						6	Open,rough,MnOx Open,rough,clay, sl. vuggy (3) Open,smooth,clay (2)		
54						> 6	Open,rough,little clay (3) Open,rough,abund. clay,FeOx,sl. vuggy		
55				2			Open,rough,abun. clay,ext,vuggy(2)		
		Run 6 4.0/4.0 100%		3	1.6/4.0 40% L.P. = 0.4'	4	Open, spun (2) Open,rough,clay, vuggy (2) Open,rough,FeOx		
56						6	Open,rough,vuggy Open,rough,styl., carb. clay Open, smooth		56.8-59.0' Argillaceous Limestone (70%) and Chert, as above.
57						4	Open,rough,vuggy, little clay, rubbly (4) Open,rough,clay vuggy (2) Open,rough,clay, vuggy,rubbly		
58	All Weathered Limestone					4	Open, smooth Open,rough,abund. clay,some FeOx (2) Open,pin-point vugs,clay		
59									Total Depth 59.0'

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-15 (MW-2015)

Project: Bechtel Core Geotechnical Logging

Location: N. 100099.7 W. 50550.5 G.S.Elev. 657.40

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS FLAWARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
	Augered and sampled from surface to 36.5'.								For description of overburden samples, see original log for GMW-15.
36									Begin Coring 36.5'
37		Run 1 1.8/4.0 45%		1	0%	>6	Clay and Chert Rubble		36.5-40.5 CLAY and CHERT GRAVEL. Approx. 1.8' recovered.
						>6			
38						>6			
39						>6			
40						>6			
41		40.5' Run 2 0/4 0%		1	0%	>6			40.5-44.5' Core Loss

Geotechnical Information by: P. Patchin & D. Dahlstrom 10/3/89.

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 7

Project Number: 5121

Hole Number: GMW-15 (MW-2015)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
41		Run 2 cont.		1					CORE LOSS, as above.
42									
43									
44		44.5'							
		Run 3		1	0%				
45		0.5'/1.5'							
		33%	45.5				Rubble Open,rough		45.5-47.7' CHERT, mottled very light gray(N8) and lt. gray (N7), fractured, rubblized, slightly weathered (weathering rinds).
46		Run 4		1	2.3'/5.0'				
		4.0'/5.0'			46%				
47		80%	47.0		L.P. = .6' 4 > 4"	> 6	Rubble Open,rough,clay		47.7-48.2' CHERT, as above, solid piece.
48									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-15 (MW-2015)

Project: Bechtel Beotechnical Logging

Location: Disposal Cell Area

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
48		Run 4 cont.		1		4	Tight,rough,FeOx, blebs Open(1mm),rough, clay Open(1cm),rough, clay		48.2-70.4' INTERMIXED ARGILLACEOUS LIMESTONE(50%) and CHERT (50%). LIMESTONE is very pale orange(10YR 8/2) to grayish orange(10YR 7/4), finely xln. with minor coarsely xln. layers to .3'. L.S. is porous and silty, mod. to severely weathered, med. hardness to soft. Becomes siltier from 62.5-70.4'. Solutioned from 50.3-52.3'. CHERT is white(N9) to grayish orange(10YR 7/4), nodular and interlacing with l.s. beds to .4', slightly to mod. weathered, chert "Breccia Replacement" at 70.0-70.3', hard to very hard, fractured, with MnOx infilling and healed.
49						3	Open(5mm),rough, clay and chert Tight,rough,clay (2) Open(1mm),rough, clay		
50						>6	Rubble Open(5mm),rough, clay Open,rough,spun		
51		Run 5 4.5'/5.0' 90%	51.6 52.1	1	2.4'/5.0' 48% L.P. = 1.0'	>6	Open(3cm),rough, clay vugs(2) Open,rough,clay (2)		
52						>6	Open,rough,clay Open(1cm),rough, clay Open(5mm),smooth, clay Open,spun,clay		
53				2		1	Tight,smooth, 20° dip		
54						3	Open(0-5mm),clay, rough Tight,smooth, 20° Open(1mm-1cm), smooth,MnOx,30°		Vug to 3cm.
55									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-15 (MW-2015)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
55		Run 5 cont'd		2		> 6	Spun Rubble		ARGILLACEOUS LIMESTONE and CHERT, as above.
56							Open, rough Rubble		
		Run 6 5.0'/5.0' 100%		2	2.65'/5.0' 53% L.P. = .4	> 6	Open(1-5mm), rough clay Tight, rough Tight, smooth, cly 15° dip		
57						5	Open(1-3mm), rough clay Open(0-2mm), smooth Open(0-1mm), smooth Open(0-4mm), rough		
58							Rubble		
						> 6	Open(0-3mm), rough Open(0-1mm), rough		
59							Tight, rough (4)		
						> 6	Open(0-1mm), rough gry cly Tight, angular, FeOx specks		
60							Open(1-4mm), rough Open(1-5mm), rough 25° dip		
						> 6	Rubble Open(2-8mm), rough		
61		Run 7 2.0'/2.0' 100%		2	1.12'/2.0' 56%	5	Open(1-5mm), rough Open(1-2mm), smooth Open(4-5mm), rough Spun		
62									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 7

Project Number: 5121

Hole Number: GMW-15 (MW-2015)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
62		Run 7 cont'd		2		2	Open, rough (2)		ARGILLACEOUS LIMESTONE and CHERT, as above.
				3			FeOx stain		
63									
		Run 8		3	0%	>6			
		1.3'/2.5'					Core Loss and Rubble		
64		52%							
						>6			
65									
						>6	Open, rough		
		65.5							
		Run 9		3	2.7'/5.0'				
66		4.8'/5.0'			54%	>6			
		96%			L.P. = .5'		Rubble		
67			67.2				Open, rough (2)		
							Spun		
							Open, rough, 15° dip		
							Open (2-10mm), rough		
							Tight, smooth, cly, 20° dip		
68							Tight, smooth, FeOx		
						3	Open, smooth, 20° dip		
							Open, spun		
							Tight, rough, stylolitic, MnOx		
69									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 6 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-15 (MW-2015)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
69		Run 9 cont'd		3		3	Open,rough (2) Open,smooth (2)		LIMESTONE, as above.
70	Weathered L.S. 70.4	70.5'				4	dip 30° Open, rough, stylolitic		70.4-77.4' SILTY LIMESTONE intermixed with nodular and bedded CHERT. Limestone is argillaceous, light olive gray (5Y 6/1), finely xln., (grained) mod. hard, slightly to mod. weathered, some shaley partings, slightly stylolitic, solution features pinpoint to 3 cm (at 73.3'). CHERT(40%) is white(N9) to light bluish gray (5B 7/1), lacy intermixed texture, vuggy pinpoint to 1 cm, fossiliferous, v. hard, fresh.
	Competent L.S.	Run 10		3	2.5'/5.0'		Open, rough		
71		5.0'/5.0'			50%		Tight, rough, stylolitic Tight,rough,glauc.		
		100%			L.P. = .6'	3	Open,rough,shale Open, tight		
72							Spun		
				4		3	Open, rough (2)		
73						4	Tight,rough Open,rough Open,rough,30°		
74						> 6	Open,rough (3)		
75		75.5'				> 6	Open,rough, stylolitic		
		Run 11		4	3.35'/5.0' 67%		Open,rough,shaley		
76									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 7 of 7

Project Number:

GEOTECHNICAL ATTACHMENT

Hole Number: GMW-15 (MW-2015)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
76		4.8'/5.0' 96%		4	L.P. * 1.1'	3	Spun Open, rough (2)		SILTY LIMESTONE, as above.
77						3	Open, smooth Open, rough, stylolitic Open(1cm),rough		77.4-78.4' CHERT, v. light gry (N8) to white(N9), v. hard, fresh, fossiliferous, fractured (healed).
78			? 78.4			> 6	Open, rough, stylolitic, fossiliferous Open, rough		78.4-79.9' LIMESTONE, v. light gray(N8) to yellowish gray (5Y 7/2), finely to coarsely xln., hard, fossiliferous, stylolitic. Horn coral fossil on stylolite at 78.4'.
79			78.6 ?			1	Tight,smooth,25° dip,silica-coated		
80							Open,smooth (3)		79.9-80.5' CHALK white(N9), soft to v. soft, strong HCL reaction, finely xln. Total Depth 80.5'
81									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 1 of 3

Project Number: 5121

Hole Number: GMW-16 (MW-4001)

Project: Bechtel Geotechnical Relogging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									Boring begun with auger from 0-4'. According to original log, NX core from 4' to 41.8'. First sample in box (chert gravel) marked at 13.5'. Bedrock encountered at 14.0'.
13.5	Top of bedrock 14.0'	Run 1 3.8'/4.5' 84%	14.5	1	0'/4.5' 0%	7/6	Rubble		13.5-34.0' Silty, argillaceous limestone and chert. Limestone: pale yellowish orange (10YR 8/6) to dark yellowish orange (10YR 6/6). Medium hard to soft. Moderately severe to very severe weathering. Chert: very light gray (N8) to medium gray (N5) to pale yellowish orange (10YR 8/6). Very hard to medium hard. Slight to severe weathering. Some zones reduced to chert gravel. Chert occurs as discrete layers up to 0.3' thick, as finely diced masses within the silty arg. limestone and as brecciated zones with interstitial silty, arg. limestone.
14						7/6	open, rough, FeOx stain up; open, rough; open, rough, clay lined		
							open, rough Rubble		
15			15.1			7/6	Rubble; open, rough; open, smooth, dip 90°; open (0-5cm) rough; open rough (?)		
							Rubble		
16						7/6	open (0-5cm) rough FeOx stained		
17			17.1 / 17.5			7/6	open, rough		Ratio of limestone : chert: 13.5-15.0 10:90; 15.0-22.0 40:60; 22-26.0 90:10
							Rubble		
18				1					

Geotechnical Information by: D. Dahlstrom 4/25/90

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 2 of 5

Project Number: 5121

Hole Number: GMW-16 (MW-400L)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
18		Run 2 4.0' 4.0' 100%		1	2.5' 4.0' 63% LP= 0.75'	7 6	Rubble; open, rough, FeOx stain; open, rough, 90° dip (2); tight, rough, MnOx; open, rough, clay lined 30° dip		Silty, argillaceous limestone and chert as above – Ratio of limestone : chert 26.0'–34.0' – 60:40
19						2	open, rough, MnOx specks; spun		
20						7 6	open, rough, clay lined dip 30°; Rubble; open, rough, glauconite		
21						3	clay filled void; open, rough, FeOx stained		0.15' of gravelly clay fill
22		Run 3 4.0' 4.0' 100%			0.75' 4.0' 19% LP= 0.4	7 6	open, rough (4) MnOx specks; open (0-1cm), rough (2) MnOx specks; open (0-2cm), rough; open (0-1cm), rough		
23				1 2		5	spun (3); open (0-1cm), rough; open (0-1cm), rough (2)		
24						5	open (0-1cm), rough; tight, rough; weak, mechanical; tight, rough; open, rough		
25				2					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 8 of 9

Project Number: 5121

Hole Number: GMW-16 (MW-4001)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
25		Run 3 cont.		2		5	tight, rough, 20° dip open, rough (2) open (0-1cm) rough open (0-5mm) rough (2)		silty, argillaceous limestone and chert as above	
				2					rg (1cm)	
26		Run 4 3.8'/3.8' 100%		2	1.6'/3.8' 42% LP= 0.45	5	open, rough, MnOx specks 90° dip open (0-1cm), rough open, rough (2)			
27						3	tight, rough, MnOx specks (2) open (0-2cm), rough (2)			
28						5	open, rough (3) open (0-5mm), rough (2)			
29				2		4	open, rough open (0-2cm) rough (4)		"bone marrow" chert 29.1 – 30.6'	
30		Run 5 4.1'/4.2' 98%		2	1.3'/4.2' 31% LP= 0.9'	5	weak, mechanical open, rough weak, mechanical			
31						4	open (0-5mm) rough open, rough (2)			
32				2						

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 5

Project Number: 5121

Hole Number: GMW-16 (MW-4001)

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Relogging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
32		Run 5 Cont.		2		3	tight, rough (3)		silty, argillaceous limestone and chert as above
33	↑ weathered Limestone 34.0'			2 3 3		7 6	open (0-1cm), rough, glauconitic; open (0-3cm), rough, shaley, rock stained; open, rough, shaley (2)		
34	Competent Limestone ↓	Run 6 4.0'/4.0' 100%		3	3.0'/4.0' 75% LP= 2.0'	0	stylolite-mechanical; stylolite-strong (2)		34.0 - 41.8' Silty, argillaceous to medium to coarse crystalline limestone and chert. Limestone: light gray (N7), fossiliferous, stylolitic, moderately hard. Very slight weathering
35						0			chert: white (N9) to light gray (N7) to dusky blue (5PB 3/2). Very hard to moderately hard, fresh to slight weathering
36						3	tight, rough; stylolite, strong; tight, rough; stylolite-broken		chert occurs as discrete layers up to 0.7' and as irregularly shaped masses up to 0.5' thick, generally terminating against stylolites.
37				3		4	stylolite-strong; tight, smooth (3); tight, rough; open (0-2cm), rough		Ratio of limestone: chert 34.0-41.8' 80:40
38		Run 7 2.5'/2.5' 100%		3	1.85'/2.5' 74% LP= 1.1'	4	stylolite-broken; tight, rough; stylolite-strong; stylolite-broken; stylolite-strong		
39				3					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 5

Project Number: 5121

Hole Number: GMW-16 (MW-4001)

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
39		Run 7 cont.		3		1	open, rough		Silty argillaceous to crystalline limestone and chert as above.
40	Run 8 0.2' / 0.2' 100%			3		3	tight, rough, FeOx stain; tight, smooth		
				3	0%				
		Run 9 0.9' / 1.0' 90%		3	0.35' / 1.0' 35% LP= 0.35'		open, smooth; light, rough; open, rough (2); open (0-5cm) rough; open, rough		
41			41.6	3		6			Total Depth 41.8'
			41.8						

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 7

Project Number: 5121

GEOTECHNICAL ATTACHMENT

Hole Number: GMW-17 (MW-2017)

Project: BECHTEL Geotechnical Logging

Location: N.100201.0 W.49049.9 G.S.ELEV: 657.71

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									For description of overburden from 0-23.0' see original log for GMW-17.
23									
23									Begin Coring at 23.0.
		Run 1 .35'/1.0' 35%	23.65'	1	0%				
24									3.7' CORE RECOVERY First .1' is dark yellowish orange (10YR 6/6) CLAY with CHERT GRAVEL pieces. Chert is white and very wthrd. Next.2' is rubblized weathered white CHERT with abund. FeOx and MnOx. Remaining 3.4' is slightly ARGILLACEOUS LIMESTONE (80%) and nodular CHERT (20%). L.S. is pale yellowish brn. (10YR 6/2) to grayish orange (10YR 7/4), finely to coarsely crystalline, moderately weathered, locally fossiliferous, abund. FeOx stained clay on fracture surfaces, abundant pyrite (wthrd.) replacement of fossils for first 1.5' of limestone, slightly stylolitic, CHERT is white mod. weathered, generally fractured, with MnOx on fracts.
		Run 2 3.7'/9.0' 56%		1	1.25'/9.0' 14% L.P. = .45'		5.3' of core loss in Run 2 location in section unknown		
25									
26									
27									
28									

Geotechnical Information by Paul Patchin 11/2/89

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 7

Project Number: 5121

GEOTECHNICAL ATTACHMENT

Hole Number: GMW-17 (MW-2017)

Project: BECHTEL Geotechnical Logging

Location: N.100201.0 W.49049.9 G.S.EVEL: 657.71

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
28		Run 2 cont		1			Run 2 1" = 1' Cly & Chert Chert rubble		ARGILLACEOUS LIMESTONE and CHERT, as above.
29							Limestone Chert		
30							Limestone		
31							Chert Limestone Chert rubble		
32							Limestone Chert Limestone Most fracts. are open with abund. clay.		
33		Run 3 5.0'/5.0' 100%		1	1.0'/5.0' 20% L.P. = .6'		Chert & minor limestone rubble w/clay Rubble Open(3mm) smooth clay (2) Open(3mm) smooth clay FeOx (4) Open (8mm) FeOx		33.0-33.8' Weathered CHERT pieces with minor limestone pieces, white (N9) to very pale orange (10YR 8/2) with weathering rinds, hard, abund. FeOx stain, with nodules of metallic mineral to 2cm, wthrd, silver colored on fresh surface, v. hard., L.S. is severely wthrd. with abund. fossils & hematite replacement of fossils,
34									
35									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 7

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-17 (MW-2017)

Project: BECHTEL Geotechnical Logging

Location: N100201.0 W.49049.9 G.S.ELEV: 657.71

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
35		Run 3 cont		1		5	Vertical, stylolitic, healed Open, spun, cly FeOx Tight,rough,FeOx		coarsely crystalline, clay coating on some pieces yellowish gray (5Y 8/1). Possible void fill. 33.8-52.3' ARGILLACEOUS LIMESTONE (70%) and CHERT (30%), intermixed. L.S. is pale yellowish brown (10YR 6/2) to dark yellowish orange (10YR 6/6), soft to hard, slightly to mod. severely weathered and solutioned, fossiliferous, thinly bedded, finely (micritic) to coarsely (minor) xln, locally highly oxidized with abund. FeOx stain, abund. clay filling of fractures and stylolites, hematite replacement of fossils (crinoids). Chert is predominantly finely divided with limestone, occasionally nodular, mottled white to light bluish gray (5B 7/1) very hard, occasionally vuggy with FeOx stain, fractured, reddish "outlining" of chert (hematite?) from 36.0-45.0'. Solution cavities to 8mm (appear interconnected) at 36.0-36.2' with very heavy FeOx staining. 41.9-42.6' CLAY SEAM with chert. Clay is light olive gray (5Y 6/1) with minor orange FeOx staining. Chert (15%) is white (N9) angular, to 1cm, minor MnOx stn.
36						3	Open,rough,clay FeOx Open, smooth, clay, FeOx Open(1cm) rough abund FeOx, cly Open, rough,FeOx		
37						> 6	Tight, rough, abund. FeOx cly Stylolite Open, stylolitic FeOx &MnOx(2) Open(1cm) rough FeOx clay		
38				1			CHERT rubble		
39		Run 4 5.9'/6.0' 98%		2	2.4'/6.0' 40% L.P. = .45'	> 6	Open, rough, cly Spun Tight, rough cly Open(1mm) cly(2) Open (3mm) rough		
40						> 6	Open, rough Tight, stylolitic cly Open, stylolitic cly (2) Open(3mm)cly,FeOx Vert. healed		
41						> 6	Open(2mm), clay FeOx (2) Clay filled stylolites (3) Tight,rough,FeOx Tight, stylolitic clay		
42						> 6	Tight, rough Stylolite, weak Open, smooth,FeOx Stylolites weak (2) CLAY SEAM		

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 7

Project Number: 5121

Hole Number: GMW-17 (MW-2017)

GEOTECHNICAL ATTACHMENT

Project: BECHTEL Geotechnical Logging

Location: N.100201.0 W.49049.9 G.S.ELEV: 657.71

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
42		Run 4 cont		2		> 6	Clay & Chert Seam Stylolites, weak (2)		L.S. is more argillaceous silty, & oxidized from: 36.1-36.8' 40.9-41.9' 44.1-52.0' Also exhibits increase in chert and disseminated MnOx in these zones. (See original GMW-17 log also).
43							Tight, stylolitic FeOx		
						> 6	Stylolitic, weak Open, rough, FeOx cly, rubblized Stylolite, weak cly		
44							Rubble		
		Run 5 6.3'/8.0' 79%		2	2.4'/8.0' 30% L.P. = .8'	1			
45							Tight, rough (2)		
				3		4	Spun (2)		
46									
						4	Spun (2) Tight, rough Open spun, glauc Tight, rough		
47									
						3	Tight, smooth Open, spun Open, rough		
48			? 48.3			5	Open, spun, FeOx Open, stylolitic FeOx Spun MnOx Open, rough, vuggy		
49			48.6 ?				Open, rough		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 5 of 7

Project Number: 5121

Hole Number: GMW-17 (MW-2017)

Project: BECHTEL Geotechnical Logging

Location: N.100201.0 W.49049.9 G.S.ELEV: 657.71

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
49		Run 5 cont		3		4	Open, rough, vuggy Tight, rough, vuggy Open (3mm) soln. FeOx rough (2)		ARGILLACEOUS LIMESTONE & CHERT, as above
50									
51			50.9						
							Rubble		
						> 6	Tight, rough Tight, smooth, FeOx clay		
52									
		Run 6 6.6'/7.0' 94%		3	4.6'/7.0' 66% L.P. = 2.5'	2	Open (1cm) smooth FeOx clay Open, rough, MnOx		52.5-55.0' BRECCIATED CHERT, light bluish gray (5B 7/1) chert (65%) is finely divided in white (N9) to light gray (N7) clay in brecciated texture. Rubblized with clay, and glauconite from 54.4-54.6. Possible clay filled void from 54.6 to 55.0'. Overall core is weathered, v. hard (chert) to soft (clay).
53						4	Open, rough, wthrd. brecciated (3)		
54							Open, rough, brecc		
			? 54.6				Tight, rough, rubbly (2) Rubble w/cly.		
55									55.0-61.8' SILTY ARGILLACEOUS LIMESTONE (60%) and CHERT (40%) as before but siltier and permeable. Occasionally solutioned & vuggy, less reaction to HCL near bottom of section.
						3	Open, rough Open (1mm) rough cly, FeOx Stylolite Open, stylolite, FeOx gry cly		
56									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 6 of 7

Project Number: 5121

Hole Number: GMW-17 (MW-2017)

Project: BECHTEL Geotechnical Logging

Location: N.100201.0 W.49049.9 G.S.ELEV: 657.71

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
56		Run 6 cont.		3/4	56.2	2	Tight, smooth Tight, rough		Silty Argillaceous Limestone and Chert, as above.
57						0			
58						4	Open, rough, silty FeOx Tight,rough,FeOx Tight, rough, FeOx cly (2)		
59									
60		Run 7 4.9'/5.0' 98%		4	3.9/5.0 78% L.P. = 1.3'	2	Open, rough, vuggy FeOx (2)		
61						4	Open, stylolitic carb. cly Spun Stylolite Open(1cm) rough Tight,smooth		
62	61.8' WEATHERED LIMESTONE COMPETENT LIMESTONE					2	Tight,smooth 28° Tight, smooth		61.8-64.0' Very SILTY LIMESTONE (50%) & CHERT (50%) as above but no oxidation and less reaction to HCL, light olive gray (5Y 6/1), very permeable, slightly to mod. vuggy. Chert is med. bluish
63						4	Tight, rough (4)		

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 7 of 7

Project Number: 5121

Hole Number: GMW-17 (MW-2017)

Project: BECHTEL Geotechnical Logging

Location: N.100201.0 W.49049.9 G.S.ELEV: 657.71

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
63		Run 7 cont.		4			Open (1.5cm) rough		gray (5B 5/1) and fractured.
									Total Depth 64.0'
64									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 5

Project Number: 5121

GEOTECHNICAL ATTACHMENT

Hole Number: GMW-18 (MW-2018)

Project: BECHTEL Geotechnical Logging

Location: N. 98298.9 W. 50381.6 G.S.Elev. 661.5

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
30									For description of overburden from 0-32.5' see original log for GMW-18.
31									
32									
	32.5'								BEGIN CORING AT 32.5'.
33		Run 1 1.5'/2.5' 60%		1	0.4'/2.5' 16% L.P. = 0.4'		1.0' core loss from 32.5'-35.0' Location unknown		1.3' of core sampled consists of limestone. LS: Light gray (N7), micro-crystalline, abundant fossils, mod. hard, slightly weathered. 0.2' of sample is chert, very light gray (N8), hard, hematite fossil replacement, MnOx.
34									
35									3.5' of core sampled contains shaley clay (70%) light gray (N7) to light greenish gray (5 GY 8/1) to mod. orange pink (10R 7/4) with 30% chert interbeds and angular gravels.
36		Run 2 3.5'/5.0' 70%			0% L.P. = 0.3'		1.5' core loss from 35.0'-40.0' Location unknown		
37				1					

Geotechnical Information
by R. McClure, 11/13/89

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 5

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMN-18 (MW-2018)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	CEMENTATION HARDNESS WEATHERED STATE
37		Run 2 cont.		1			Core loss. Location unknown.		Sample description, as above.	
38										
39										
40										
		Run 3					3.7' core loss from 40.5-45.0'. Location unknown.		0.8' of core sample consists of chert. CHERT: Dark yellowish orange (10YR 6/6) to med. light gray (N6), abundant FeOx stains, and healed vertical fractures, some MnOx. Gray fragments are very hard, angular, fresh.	
41		0.8'/5.0' 16%			0% L.P. = 0.2'					
42										
43										
44				1						

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 3 of 5

Project Number: 5121

Hole Number: GMW-18 (MW-2018)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TEST/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
44		Run 3 cont.		1			Core loss Location unknown.		Chert, as above.
45									
		Run 4 1.6'/5.0' 32%			0% L.P. = 0.3'		3.4' core loss from 45.0-50.0' Location unknown.		1.6' of sample consists of coarsely crystalline limestone (70%) and chert. LS: Grayish orange (10YR 7/4) silty zones, mod. hard, mod. severe weathered, few vugs, abundant FeOx staining. Chert is finely divided and fragmented at top of core sample. CHERT: Light gray (N7), very hard, fresh fragments with gravel, slight weathering rinds, abundant FeOx staining.
46									
47									
48				1/2					
49									
50									
		Run 5 0.9'/2.0' 45%			0% L.P. = 0.1'		1.1' core loss from 50.0-52.0' Location unknown		Sample is chert rubble, fresh to mod. weathered, abundant FeOx stains, MnOx replacement fossils, abundant clay on fragment surfaces.
51									

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 4 of 5

Project Number: 5121

Hole Number: GMW-18 (MW-2018)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
51		Run 5 cont		2			Core loss. Location unknown		Chert rubble, as above.
52									
		Run 6					1.9' of core loss from 52.0'-55.0' Location unknown		0.4' of core sample consists of angular chert fragment and rubble, as above. 0.6' of sample is mottled coarsely crystalline LS and chert. LS: Pale red (10R 6/2), mod. hard, fossiliferous, mod severely weathered. CHERT: Light bluish gray (5B 7/1) MnOx healed fractures
		1.1'/3.0' 37%			0.35/3.0' 12% L.P. = 0.3'				
53									
54									
55									55.0-57.0' CHERT (75%) and CLAY. CHERT: Light bluish gray (5B 7/1) to white (N9). Clay, med. gray (N5), shaley, fissile, soft, finely divided.
		Run 7			0.35/5.0'	>6	Chert rubble		
		5.0'/5.0' 100%			7% L.P. = 0.3'	>6	Open, smooth, clay		
56							Open, rough (2)		
							Open, smooth, clay		
							Open, rough, clay (2)		
57							Open, smooth, clay (2)		57.0-65.0' ARGILLACEOUS LIMESTONE (60%) and CHERT. LS: Dark yellowish orange (10YR 6/6), silty, very permeable, medium to soft, pin-point vugs, very severely
						5	Open, smooth		
							Open, rough rubble		
							Open, rough, vuggy		
				2			Open, smooth		
58									

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 5

Project Number: 5121

GEOTECHNICAL ATTACHMENT

Hole Number: GMW-18 (MW-2018)

Project: BECHTEL Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION; CEMENTATION, HARDNESS, WEATHERED STATE
58		Run 7 cont.		2		>6	Open, smooth		weathered. Abundant MnOx specks to 63.0'. CHERT: Very light gray (N8) to light bluish gray (5B 7/1), very hard, finely divided, becoming nodular below 60.0'. Abundant healed vertical fractures. Chert is vuggy, with some calcite lining.
59						>6	Open, rough, vuggy (7)		
60				2			Chert rubble		
		Run 8		3		>6	Open, smooth Open, smooth glauc. clay		
		5.0'/5.0'			1.1'/5.0'		Open, rough (2) Chert rubble		
61		100%			22%	>6	Open, rough		
					L.P. = 0.35'		Rubble Rubble		
62						4	Open, rough (3)		
							Open, smooth		
63						4	Open, rough Open, spun		
64							Open, rough Open, 2cm, quartz hematite filled void (2)		63.8-65.0' Bone-marrow type vuggy texture.
						4	Open, rough (3)		
65	ALL WEATHERED			3					Total Depth 65.0'.

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 1 of 6

Project Number: 5121

Hole Number: GMW-19 (MW-4019)

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
									0-20.2' augered, no samples taken. See original log for description of cuttings. Four-foot run, from 16.2 to 20.2' logged but not retained in core box.
20		20.2'							Begin coring at 20.2'
		Run 1 3.0' / 4.0' 75%		1	0.95' / 4.0' 24% LP= 0.6'		open, rough, MnOx stain (?)		20.2-21.9 very finely crystalline limestone and chert. Limestone: dark yellowish orange, moderately hard, moderate weathering. Chert: light gray (N7) to light brownish gray (5YR6/1) very hard, slight to moderate weathering. Chert occurs as nodules in limestone. Contains masses of hematite.
21						>6	open (0-1 cm), rough open (0-5 mm), rough, FeOx stained (?)		
			21.9				open, rough, clay coated		
22			22.4			>6	unconsolidated clay and gravelly clay		21.9-39.6 Residual product of weathering of cherty limestone: chert gravel and rubble with minor limestone and shale and layers of unconsolidated to poorly consolidated clay, gravelly clay and clayey gravel. In some cases chert clasts have fresh surfaces indicating fracturing during coring of intact rock. Other layers consist of clasts with weathering
			23.0				open, rough, clay coated		
23			23.5			>6	unconsolidated clay		
24		24.2'	24.2	1			limestone/chert rubble		
		Run 2 1.5' / 4.0' 38%		1	0.0' / 4.0' 0%	>6			
25				1					

Geotechnical Information by: D. Dahlstrom 5/16/90

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 2 of 6

Project Number: 5121

Hole Number: GMW-19 (MW-4019)

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
25		Run 2 (cont)		1		>6			rinds around entire surface, indicating unconsolidated gravelly zones. see "discontinuities" column for further description of discrete zones.
26			26.7			>6	chert rubble - clasts range in size from ~ 1cm to coarse pieces 6cm in length in general, clasts have some fresh surfaces, suggesting fracturing during coring.		
27						>6			
28		28.2'		1					
		Run 3 0.9'/2.3' 39%		1	0.0'/2.3' 0%	>6			
29						>6	1.1' of core loss, location unknown. Remainder consists of chert rubble with minor clay content		
30		30.5'	30.5	1		>6			
		Run 4 1.0'/1.5' 67%	31.0'	1	0.0'/1.5' 0%				
31						>6	chert rubble overlying poorly consolidated, poorly sorted sediments. Predominantly sub-angular sand-sized stains		
32		32.0		1					

WELDON SPRING REMEDIAL ACTION PROJECT

GEOTECHNICAL ATTACHMENT

Sheet 7 of 6

Project Number: 5121

Hole Number: GMW-19 (MW-4019)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
32		Run 5 1.0'/1.0' 100% 33.0'	33.0	1	0.0'/1.0' 0%	> 6	poorly consolidated gravelly clay. chert gravel more abundant at top of interval		clayey limestone weathering product as above.
33	Run 6 0.3'/0.4' 75%	33.4'	33.1 33.4	1	0%		highly weathered chert rubble		
		Run 7 0.9'/1.6' 56%		1	0.0'/1.6' 0%	> 6			
34		35.0	34.1 35.0			> 6	chert rubble overlying dark, fissile, slickensided mudstone open, rough, clay lined open (0-1cm), rough clay-lined open, rough		
35	Run 8 0.2'/0.4' 50%	35.4	35.2 35.4	1	0%		chert rubble		
		Run 9 1.0'/1.6' 63%		1	0.0'/1.6' 0%	> 6			
36		37.0	36.0			> 6	chert rubble- most surfaces lined with clay, smaller clasts have weathering rends around entire clasts open, rough (?)		
37	Run 10 0.2'/0.2' 100%	37.2	37.2	1	0%				
		Run 11 1.4'/1.8' 78%	37.6		0.0'/1.8' 0%	> 6	chert rubble with minor clasts of poorly consolidated clay and silt.		
38						> 6	most smaller chert clasts clay-lined		
39		39.0		1					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 4 of 6

Project Number: 5121-[illegible]

GEOTECHNICAL ATTACHMENT

Hole Number: GMW-19 (MW-4019)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
39		Run 12 2.9'/3.0' 97%	39.5–39.6	1	1.85'/3.0' 62% LP= 1.2'	>6	chert rubble –		cherty limestone weathering product as above
							poorly consolidated greenish clay open, rough (2)		39.6 – 53.3' silty, argillaceous limestone and chert. Limestone: massively bedded dark yellowish orange (10YR 6/6) with MnOx blebs to grayish orange (10 YR 7/4). medium hard to soft. Moderately severe weathering.
							chert rubble open, rough, MnOx blebs		
40				1		0			
				2					
41							light, rough, MnOx blebs		Chert: very light gray (N8) to medium light gray (N6). and light brownish gray (5YR 6/1). Very hard to hard. Very slight to moderate weathering.
						2	open (0–1cm), rough, MnOx blebs		
		42.0'		2					
42		Run 13 4.8'/4.8' 100%		2	2.2'/4.8' 46% LP= 0.5'	1	tight, rough, MnOx blebs		Chert occurs as irregularly shaped nodules up to 06' thick and as finely divided masses within limestone.
							open (0–5mm), rough (2)		
43						5			
							open (0–5mm), rough, MnOx blebs		vuggy
44						4	open (0–1cm), rough, MnOx blebs		44.4 – 45.0 – hematite after pyrite? – void fill – subsequently covered with calcite
							tight, rough (2) MnOx specks		
							fracture thru vug		vug
45						2	open (0–5mm) rough MnOx blebs		
46				2			open, rough, MnOx blebs, calcite coated		vug

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 5 of 6

Project Number: 5121

Hole Number: GMW-19 (MW-4019)

GEOTECHNICAL ATTACHMENT

Project: Bechtel Geotechnical logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	RQD	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION / CEMENTATION HARDNESS WEATHERED STATE
46		Run 13 (cont)		2		7	open, rough, MnOx blebs		silty, argillaceous limestone and chert as above
						6	open, rough; chert rubble		
		46.8'		2			open, rough		
		Run 14		2	3.05'				numerous healed fractures in chert
47		4.8' / 4.8'			4.8'				
		100%			64%	2	tight, rough, clay-lined		
					LP= 0.75'		open (0-1cm), rough FeOx stained		
48						2	open, rough, clay lined		
							open, rough, MnOx blebs (2)		48.7 – 51.4 "bone-marrow" chert
49						1			
50						3	open (0-1cm), rough		
51						7	open (0-2cm) rough; open, rough; limestone rubble; open, rough		
		51.6'		2		6	open (0-1cm), rough		
		Run 15		2	2.45'				
		3.4' / 3.4'			3.4'		tight, rough, MnOx blebs		
52		100%			72%		tight, rough, clay lined		
					LP= 0.9'	3	open, smooth, clay lined		
							open, smooth		
53				2					

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 6 of 6

GEOTECHNICAL ATTACHMENT

Project Number: 5121

Hole Number: GMW-19 (MW-4019)

Project: Bechtel Geotechnical Logging

Location:

DEPTH	COMMENTS: TESTS/MONITORING, INSTRUMENTATION, CORING RATE AND SMOOTHNESS, CORING FLUID LOSS, CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: RQD	FRACTURES PER FOOT	DESCRIPTION: TIGHTNESS, PLANARITY, SMOOTHNESS, FILLING, STAINING, ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY, CLASSIFICATION, COLOR, GRAIN SIZE, ALTERATION, CEMENTATION, HARDNESS, WEATHERED STATE
53	weathered limestone ↑	Run 15 (cont)		2			open, rough, clay-lined		53 – 54.3 – numerous shaley partings
	competent limestone ↓								53.3 – 59.5 very finely to very coarsely crystalline, fossiliferous, stylolitic limestone and chert with minor silty, argillaceous limestone and chert (57.8 – 58.5)
54							stylolite (13) broken, strong (3)		
		55.0'		2			broken		Limestone – massively bedded, light gray (N7) to medium gray (N5). Moderately hard, fresh.
55		Run 16 4.5'/4.5' 100%		2	4.3'/4.5' 96% LP= 2.5'		strong; broken, strong (6)		Chert: very light gray (N8) to medium bluish gray (5B 5/1), very hard to hard fresh to slight weathering. chert occurs as irregularly-shaped nodules up to 0.5' thick terminating against stylolites and as irregularly shaped masses in silty, argillaceous limestone.
56									
57									
58							open, rough, spun chert rubble		
							tight, rough stylolite – strong		
59									TD = 59.5'
		57.5		2					

APPENDIX C-1

COORDINATES OF BOREHOLES...

Table 4.9-1 Test pit
Boreholes and ~~Trenches~~
Used in the Database

WSSRAP ID	Old ID	Northing[a] (ft)	Westing (ft)	Ground Elevation (ft)	Depth To Filter Top (ft)	Total Depth (ft)
B-1		99507.3	52283.3	638.9	17.5	21.5
B-10		99257.8	52044.6	665.8	22.3	25.6
B-12		100003.4	51968.9	663.6	27.8	30.0
B-13		99890.2	51545.7	663.8	0.0	27.0
B-14		99236.9	50965.7	653.5	13.7	21.8
B-15		99420.6	51025.4	663.9	0.0	30.0
B-15A		99410.5	51021.6	663.4	24.3	37.0
B-18		99218.8	50750.8	658.8	22.3	24.4
B-19		99596.7	50805.6	645.4	0.0	21.5
B-20		99597.6	50956.6	643.8	27.8	29.5
B-22		99931.7	51266.7	647.4	12.0	15.0
B-5		99235.3	50975.6	653.3	18.0	21.5
B-6		99050.0	51224.3	663.7	17.7	21.5
B-7		98764.4	51596.9	658.2	20.1	22.8
B-8		98750.8	51969.1	646.7	26.2	33.0
G-1		98473.2	50581.0	668.0	0.0	84.0
G-13		99521.0	50517.0	654.7	0.0	71.0
G-14		99199.0	49935.0	655.8	0.0	76.4
G-15		98924.0	50447.0	658.0	0.0	75.5
G-16		98051.0	51007.0	656.7	0.0	80.4
G-18		101350.0	52551.0	633.8	0.0	79.0
G-19		101700.0	51950.0	619.4	0.0	66.0
G-2		100449.9	50577.3	657.9	0.0	64.0
G-20		101850.0	50950.0	630.3	0.0	66.0
G-21		101336.0	52116.0	638.7	0.0	74.5
G-2A		100440.0	50578.1	658.0	0.0	83.0
G-3		101195.3	50948.6	654.0	0.0	88.2
G-4		101140.6	51295.6	644.0	0.0	81.0
G-5		100650.0	51250.0	635.9	0.0	73.0
G-54-1		99718.0	49700.0	657.0	0.0	28.8
G-54-10		100681.0	50603.0	661.6	0.0	67.7
G-54-11		100761.0	50601.0	659.6	0.0	64.0
G-54-2		100606.0	50167.0	659.0	0.0	46.5
G-54-3		101491.0	50635.0	630.0	0.0	24.5
G-54-4		101103.0	49872.0	640.3	0.0	26.8
G-54-5		100388.0	49872.0	656.0	0.0	36.4
G-54-6		99250.0	50583.0	660.0	0.0	47.0
G-54-7		99918.0	50370.0	664.5	0.0	52.5
G-54-8		100810.0	50838.0	654.4	0.0	63.6
G-54-9		100732.0	50510.0	659.6	0.0	65.4
G-6		100450.0	51150.0	639.7	0.0	67.0
G-7		101200.0	50450.0	633.3	0.0	64.0
G-8		100450.0	49900.0	655.3	0.0	75.0
G-9		100065.0	49905.0	656.0	0.0	76.0

(a) Atomic Energy Commission Coordinate System

Table 4.3-1 (cont.)
Boreholes and Trenches
Used in the Database

WSSRAP ID	Old ID	Northing[a] (ft)	Westing (ft)	Ground Elevation (ft)	Depth To Filter Top (ft)	Total Depth (ft)
GT-2T-71		100381.3	49131.3	654.7	0.0	12.0
GT-2T-72		100864.2	49426.0	639.4	0.0	12.0
GT-2T-73		99346.1	49908.1	656.2	0.0	12.0
GT-2T-74		100002.3	49862.6	655.7	0.0	12.0
GT-2T-75		100970.4	50218.3	650.0	0.0	12.0
GT-2T-76		99071.0	50508.2	660.6	0.0	12.0
GT-2T-77		99739.0	50636.7	649.9	0.0	12.0
GT-2T-78		100495.3	50768.8	657.6	0.0	12.0
GT-2T-79		101256.9	51188.4	650.3	0.0	12.0
GT-2T-80		98894.6	51404.7	661.1	0.0	12.0
GT-2T-81		98818.2	51869.6	664.7	0.0	12.0
GT-2T-82		100196.1	52173.4	638.3	0.0	11.0
GT-31		99119.3	52130.8	632.5	4.0	34.0
GT-32		99939.8	52126.5	641.3	3.0	24.0
GT-33		99901.6	52079.0	664.6	4.0	51.0
GT-34		99546.3	52202.1	663.8	4.0	54.5
GT-35		99115.1	52039.3	664.3	4.0	54.0
GT-36		98864.4	52006.5	663.2	3.5	47.8
GT-37	GT-2B37	99800.0	49522.0	657.0	0.0	24.0
GT-38	GT-2B38	99700.0	49570.0	657.7	0.0	26.5
GT-39	GT-2B39	99900.0	49470.0	656.7	0.0	22.5
GT-40	GT-2B40	99700.0	49470.0	657.4	0.0	23.0
GT-41	GT-2B41	99900.0	49570.0	55.9	0.0	21.5
GT-42		101206.0	50804.6	648.0	0.0	57.0
GT-43		100736.6	50786.1	654.2	0.0	78.5
GT-44		101030.8	49875.6	643.3	0.0	49.5
GT-45		100775.2	49344.2	645.0	0.0	41.5
GT-46		100364.8	49340.0	651.8	0.0	40.5
GT-47		100024.8	50128.9	660.3	0.0	55.5
GT-48		99353.0	50568.1	657.7	0.0	53.6
GT-49		98517.3	50560.8	665.3	0.0	29.5
GT-50		99223.0	50905.0	653.8	0.0	55.5
GT-51		99725.9	50758.5	646.1	0.0	49.9
GT-52		100577.0	50335.0	658.8	0.0	70.2
GT-53		100284.0	50781.0	655.5	0.0	42.5
GT-54		100618.0	49635.0	652.4	0.0	50.0
GT-55		100490.0	49937.0	655.6	0.0	53.0
GT-56		99689.0	49971.0	657.1	0.0	43.0
GT-57		100017.0	49739.0	654.7	0.0	36.5
AH-1		100017.0	49739.0	654.7	0.0	151.6
AH-2		100284.0	50781.0	655.5	0.0	165.0
GTS-1		98670.0	50978.0	665.3	0.0	39.8
GTS-2		98165.0	50800.0	665.8	0.0	37.3
GTS-3		98110.0	51075.0	654.0	0.0	31.5
GTS-4		98475.0	51250.0	651.5	0.0	27.5

[a] Atomic Energy Commission Coordinate System

Table 4.3-1 (cont.)
Boreholes and Trenches
Used in the Database

WSSRAP ID	Old ID	Northing[a] (ft)	Westing (ft)	Ground Elevation (ft)	Depth To Filter Top (ft)	Total Depth (ft)
GTS-5		98607.7	51245.8	662.6	0.0	37.0
GTS-6		98933.0	51035.7	665.3	0.0	47.0
GTS-7		98771.0	51381.8	662.1	0.0	44.5
GT-58P		100952.3	50055.2	653.0	30.5	60.9
GT-59		99905.7	49963.8	657.0	0.0	27.0
GT-60P		100388.4	50260.4	660.6	58.2	67.5
GT-61		100609.3	50679.2	658.1	0.0	59.5
GT-62		100062.4	50630.9	657.3	0.0	43.5
GT-63P		98626.1	51472.0	656.9	35.2	51.0
GT-64P		100053.1	52053.3	640.9	22.0	57.0
GT-65P		101533.0	51161.1	634.9	48.0	60.0
GT-66P		100814.7	49527.9	644.7	23.1	47.5
GT-67P		100196.8	49036.8	657.7	34.5	60.0
MW-2001	GMW-1	100857.7	52544.3	611.8	31.6	64.0
MW-2002	GMW-2/2A	100657.3	52249.8	623.8	31.7	64.0
MW-2003	GMW-3	100353.6	52299.1	637.0	41.5	64.0
MW-2004	GMW-4	101449.1	51753.4	642.9	54.3	77.0
MW-2005	GMW-5	101131.4	51951.6	635.6	50.0	81.0
MW-2006	GMW-6	101227.2	49849.7	634.1	27.0	71.0
MW-2007	GMW-7	100930.3	50932.1	651.9	62.3	99.0
MW-2008	GMW-8	101707.4	50654.1	622.8	34.0	63.0
MW-2009	GMW-9	101351.5	50699.1	636.3	27.2	58.6
MW-2010	GMW-10	101151.5	50100.1	643.0	37.2	64.0
MW-2011	GMW-11	100898.2	50032.5	653.3	36.6	79.0
MW-2012	GMW-12	101052.2	49641.6	634.9	29.3	69.5
MW-2013	GMW-13	100820.7	49538.3	645.4	31.3	75.0
MW-2014	GMW-14	100736.9	49189.9	647.4	37.0	64.0
MW-2015	GMW-15	100099.7	50550.5	657.4	47.3	86.0
MW-2016	B-3	101532.6	51176.7	635.7	62.7	150.5
MW-2017	GMW-17	100201.0	49049.9	657.7	30.0	69.0
MW-2018	GMW-18	98296.9	50381.6	661.5	37.4	69.0
MW-2019		98287.4	50391.3	661.5	103.0	116.3
MW-2020	B-4	99548.3	49549.1	655.5	36.5	119.6
MW-2021		100634.9	52263.2	624.6	96.3	111.0
MW-2022		101154.8	51945.6	636.1	112.0	128.0
MW-2023		101551.0	51140.9	635.7	68.5	91.8
MW-2024		101552.0	51186.0	635.0	0.0	149.6
MW-2025		101688.3	50648.9	622.3	94.0	108.6
MW-2026		101215.3	49861.1	631.0	105.5	118.0
MW-2027		100858.0	9546.5	646.6	105.5	120.5
MW-2028		100092.5	50543.0	657.8	116.0	131.2
MW-2029		101452.6	51734.1	643.4	89.0	101.3
MW-3001		98852.6	51262.4	664.3	52.7	90.0
MW-3002B		98856.6	51245.6	664.7	134.0	150.0
MW-3003		100046.0	52094.5	644.3	75.7	89.5

[a] Atomic Energy Commission Coordinate System

Table 4.3-1 (cont.)
Boreholes and Trenches
Used in the Database

WSSRAP ID	Old ID	Northing[a] (ft)	Westing (ft)	Ground Elevation (ft)	Depth To Filter Top (ft)	Total Depth (ft)
MW-3006		100048.7	52070.6	645.9	120.0	135.5
MW-3007	B-17	100043.4	52082.1	645.5	39.0	99.1
MW-3008	B-19A	99546.4	50954.3	645.1	39.0	101.0
MW-3009	B-21	98832.5	52123.2	644.3	45.0	99.4
MW-3010	B-23	98471.5	50936.4	665.0	52.5	90.7
MW-3011	B-24	99969.1	51635.2	649.2	20.0	23.5
MW-3013	W-2	98984.5	52116.3	--	--	22.0
MW-3015	W-4	99942.9	50999.5	--	--	20.0
MW-3016	W-5	99251.4	51501.9	--	--	32.5
MW-3017	W-7	99409.5	50982.0	--	--	35.0
MW-3018	B-2	99255.8	52139.6	630.9	18.8	29.6
MW-3019A		97937.0	50946.6	660.1	0.0	44.2
MW-3019B		97932.6	50945.5	660.1	70.0	84.3
MW-4001	GMW-16	99049.1	52567.2	621.1	25.0	41.8
MW-4002	B-9	99848.3	54284.6	632.5	41.0	84.7
MW-4003	B-11	96958.3	52458.6	669.7	51.0	106.2
MW-4004/4B		97749.0	51689.0	651.7	63.0	75.0
MW-4005		97709.9	52371.9	656.3	63.9	78.8
MW-4006	B-16	99084.0	52513.0	621.5	20.5	28.5
MW-4007		99069.4	52545.4	621.5	77.0	90.0
MW-4008		98668.7	53180.5	635.5	70.0	83.0
MW-4009		99516.7	52671.9	624.2	64.0	76.8
MW-4010		100102.7	53029.8	629.1	64.6	77.1
MW-4011		100457.6	52720.5	626.9	64.1	78.7
MW-4012		101642.0	53034.3	615.4	62.7	80.2
MW-4013		101916.0	52193.0	606.8	37.5	60.0
MW-4014		102267.3	51592.4	607.5	43.0	66.4
MW-4015		102150.1	50509.5	617.9	40.0	63.2
MW-4016		102002.9	49981.7	643.1	71.6	85.3
MW-4017		101611.9	49287.3	649.5	62.3	85.1
MW-4018		101233.4	48677.0	648.0	61.5	82.5
MW-4019	GMW-19	98062.7	50160.7	645.7	39.8	58.8
MW-4020		99932.8	48704.2	657.9	65.0	81.3
MW-4021		99169.9	49187.6	650.1	49.0	71.0
MW-4022		97459.7	50447.4	666.3	67.0	90.9
MW-4023		98718.5	49845.1	646.5	30.5	70.0
OB-2j		99129.6	50159.7	657.0	0.0	140.3
PW-1		101061.0	50145.2	647.2	46.4	90.3
PW-2		99112.6	50150.8	657.0	42.5	92.1
PW-3		100208.6	52104.2	638.6	45.5	86.0
T-1		100546.5	52437.5	624.0	0.0	15.0
T-2		100555.5	50662.0	657.5	0.0	15.0
T-3		98621.0	50844.0	665.8	0.0	15.0
T-4		98886.5	50427.0	657.1	0.0	15.0
T-6		101206.5	50411.0	638.0	0.0	16.0

[a] Atomic Energy Commission Coordinate System

Table 4.3-1 (cont.)
Boreholes and Trenches
Used in the Database

WSSRAP ID	Old ID	Northing[a] (ft)	Westing (ft)	Ground Elevation (ft)	Depth To Filter Top (ft)	Total Depth (ft)
TR-1		99519.8	50913.3	646.6	0.0	19.5
TR-2		99412.6	50918.0	648.1	0.0	21.0
TR-3		99058.9	50925.6	660.6	0.0	27.2
TR-4		98336.0	50922.0	666.3	0.0	22.1
TR-5		98952.5	51074.4	665.4	0.0	22.8
TR-6		98433.5	51235.2	652.5	0.0	21.1
TR-7		98561.8	51526.9	648.0	0.0	23.2
TR-8		98684.0	52020.1	643.1	0.0	21.5
TR-9		99623.8	52375.0	639.6	0.0	20.3
TR-10		100067.5	52035.7	645.9	0.0	19.5
TR-11		99993.4	51537.5	644.9	0.0	21.1
TR-12		99947.8	51081.1	644.6	0.0	21.4
TR-13		99441.5	52242.1	636.1	0.0	20.8
TR-14		98860.9	52085.4	644.3	0.0	21.0
TR-15		99425.9	50734.2	661.9	0.0	15.0
TPMS-1		TO BE ESTABLISHED			0.0	6.5
TPMS-2					0.0	6.0
TPMS-3					0.0	7.0
TPMS-4					0.0	6.5
TPMS-5					0.0	10.0
TPMS-6					0.0	7.5
TPMS-7					0.0	9.5
TPMS-8					0.0	14.5
TPMS-9					0.0	15.0
TPBS-1		1044071.3[b]	439552.7	641.3	0.0	14.1
TPBS-2		1043432.5	439939.9	655.7	0.0	12.1
TPBS-3		1044587.1	438279.9	657.3	0.0	12.2
TPBS-4		1043097.7	440349.6	660.2	0.0	12.0
TPBS-5		1042961.9	439583.2	646.3	0.0	12.3
TPBS-6		1042369.1	440854.6	661.2	0.0	12.6
TPBS-7		1042865.9	441172.7	672.0	0.0	12.5
TPBS-8		1043578.6	441516.2	662.6	0.0	11.9
TPBS-9		1041564.8	441008.7	661.1	0.0	12.2
TPBS-10		1041550.3	440675.9	661.9	0.0	15.2
TPBS-11		1041626.3	439988.4	652.8	0.0	13.2
TPBS-12		1041260.0	441332.7	656.7	0.0	12.1
TPBS-13		1042507.6	441939.5	655.4	0.0	13.5
TPBS-14		1042733.9	442161.4	649.6	0.0	11.8
TPBS-15		1040527.6	441017.9	650.4	0.0	12.9
TPBS-16		1041033.5	441024.2	652.5	0.0	13.1
TPBS-17		1041050.7	440432.9	646.6	0.0	12.4
TPBS-18		1041846.0	440354.3	645.8	0.0	12.2
TPBS-19		1042226.3	439982.0	645.0	0.0	11.8

[a] Atomic Energy Commission Coordinate System
[b] Missouri State Plane Coordinates

Table 4.3-1 (cont.)
Boreholes and Trenches
Used in the Database

WSSRAP ID	Old ID	Northing[b] (ft)	Easting (ft)	Ground Elevation (ft)	Depth To Filter Top (ft)	Total Depth (ft)
TPBS-20		1042302.1	439213.0	630.8	0.0	8.9
TPBS-21		1035776.0	431284.0	529.5	0.0	12.3
TPBS-22		1035319.1	431048.3	517.3	0.0	5.6
TPBS-23		1034664.7	431132.3	515.2	0.0	13.1
TPBS-24		1034026.5	431092.6	504.0	0.0	11.6
TPBS-25		1033430.8	431094.9	503.3	0.0	12.5
TPBS-26		1032969.4	431062.8	497.7	0.0	13.4
TPBS-27		1032350.8	431030.4	488.7	0.0	12.5
TPBS-28		1031686.4	430597.9	510.5	0.0	12.4
TPBS-29		1031532.0	430195.4	511.9	0.0	12.0
TPBS-30		1031340.5	429726.5	514.3	0.0	12.4

[b] Missouri State Plane Coordinates

APPENDIX C-2

GROUNDWATER LEVEL MONITORING DATA

(AUGUST ~~NOVEMBER 1989~~)

1989 — AUGUST 1990

WELDON SPRING SITE REMEDIAL ACTION PROJECT
Route 2, Highway 94 South, St. Charles, Missouri 63303
Phone (314) 441-8086 Telecopy (314) 447-0803

WATER LEVEL MONITORING DATA - FORM 4.04.02.02

DATE: 8/27/8/28 PERSONNEL: TNA

WELL #	SWL (ft)	WELL #	SWL (ft)	WELL #	SWL (ft)
MW-2001	25.33	MW-3001	54.08	MW-4001	70.90
MW-2002	32.68	MW-3002	70.95	MW-4002	66.31
MW-2003	40.90	MW-3003	47.78	MW-4003	59.50
MW-2004	61.09	MW-3004		MW-4004	42.07
MW-2005	49.72	MW-3005	—	MW-4005	48.27
MW-2006 TNA	36.40	MW-3006	55.73	MW-4006	20.55
MW-2007	60.92	MW-3007	—	MW-4007	28.54
MW-2008	36.33	MW-3008	—	MW-4008	40.39
MW-2009	44.97	MW-3009	40.00	MW-4009	31.81
MW-2010	44.63	MW-3010	—	MW-4010	42.00
MW-2011	54.50	MW-3011		MW-4011	38.47
MW-2012	32.35	MW-3012		MW-4012	46.85
MW-2013	42.08	MW-3013		MW-4013	48.12
MW-2014	45.49	MW-3014	—	MW-4014	47.76
MW-2015	56.32	MW-3015		MW-4015	38.44
MW-2016	—	MW-3016	—	MW-4016	54.70
MW-2017	54.29	MW-3017	—	MW-4017	58.61
MW-2018	42.98	MW-3018		MW-4018	52.27
MW-2019	72.30	MW-3019		MW-4019	35.69
MW-2020				MW-4020	54.13
MW-2021	37.27	SURFACE WATER		MW-4021	43.90
MW-2022	51.77	FROG POND		MW-4022	73.65
MW-2023	54.71	RP-1		MW-4023	35.51
MW-2024	68.36	RP-2			
MW-2025	40.52	RP-3			
MW-2026 TNA	~~[illegible]~~ 46.02	RP-4			
MW-2027	54.50	ASH POND			
MW-2028	64.23				
2029	62.74				

PW1 - 50.60
PW2 - 47.75
PW3 - 41.96

GT-58P - 53.75
GT-60P - 59.29
GT-65P - 54.21
GT-66P - 41.82
GT-64P - 45.32

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WELDON SPRING SITE REMEDIAL ACTION PROJECT
7295 Highway 94 South, St. Charles, Missouri 63303
Phone (314) 441-8086 Telecopy (314) 447-0803

WATER LEVEL MONITORING DATA - FORM 4.4.2.1

DATE: 9-29 9-30 1989 PERSONNEL: TNA

WELL #	SWL (ft)	WELL #	SWL (ft)	WELL #	SWL (ft)
MW-2001	25.33	MW-3001	53.90	MW-4001	20.98
MW-2002	32.90	MW-3002	71.15	MW-4002	66.33
MW-2003	40.88	MW-3003	47.73	MW-4003	59.91
MW-2004	61.01	MW-3004	—	MW-4004	42.18
MW-2005	49.72	MW-3006	55.76	MW-4005	48.41
MW-2006	36.43	MW-3007	DESTROYED	MW-4006	20.59
MW-2007	60.85	MW-3008	—	MW-4007	28.65
MW-2008	36.21	MW-3009	39.96	MW-4008	40.42
MW-2009	42.18	MW-3010	—	MW-4009	31.82
MW-2010	44.77	MW-3012	DESTROYED	MW-4010	42.00
MW-2011	54.52	MW-3014	DESTROYED	MW-4011	38.50
MW-2012	32.78	MW-3018	—	MW-4012	46.99
MW-2013	42.22	MW-3019	56.42	MW-4013	48.13
MW-2014	45.51			MW-4014	47.77
MW-2015	56.05	SURFACE WATER		MW-4015	38.35
MW-2017	54.67	FROG POND		MW-4016	54.55
MW-2018	48.82	RP-1		MW-4017	58.41
MW-2019	72.58	RP-2		MW-4018	52.51
MW-2020	46.22	RP-3		MW-4019	35.77
MW-2021	37.70	RP-4		MW-4020	54.41
MW-2022 TNA	~~[illegible]~~ 51.75	ASH POND		MW-4021	44.03
MW-2023	54.71			MW-4022	75.35
MW-2024	68.44	PW-1	50.57	MW-4023	35.94
MW-2025	40.58	PW-2	47.61		
MW-2026	46.25	PW-3	44.83	GT-58P	53.79
MW-2027	54.82			GT-60P	59.06
MW-2028	64.44			GT-63P	46.59
MW-2029	62.73			GT-64P	45.37
	2" .17 .195		4" .34 .37	GT-65P	54.22
				GT-66P	42.01
				GT-67P	52.46

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WELDON SPRING SITE REMEDIAL ACTION PROJECT
7295 Highway 94 South, St. Charles, Missouri 63303
Phone (314) 441-8086 Telecopy (314) 447-0803

WATER LEVEL MONITORING DATA - FORM 4.4.2.1

DATE: 10-29-89 PERSONNEL: TNA, MJQ

WELL #	SWL (ft)	WELL #	SWL (ft)	WELL #	SWL (ft)
MW-2001	25.41	MW-3001	54.11	MW-4001	21.20
MW-2002	33.09	MW-3002	71.37	MW-4002	66.23
MW-2003	40.76	MW-3003	47.77	MW-4003	60.73
MW-2004	61.01	MW-3004	—	MW-4004	42.61
MW-2005	49.74	MW-3006	55.82	MW-4005	48.73
MW-2006	36.53	MW-3007	DESTROYED	MW-4006	20.84
MW-2007	60.90	MW-3008	—	MW-4007	28.97
MW-2008	36.25	MW-3009	40.10	MW-4008	40.65
MW-2009	42.49	MW-3010	—	MW-4009	31.98
MW-2010	44.93	MW-3012	DESTROYED	MW-4010	42.24
MW-2011	54.58	MW-3014	DESTROYED	MW-4011	38.71
MW-2012	32.92	MW-3018	—	MW-4012	47.00
MW-2013	42.60	MW-3019	58.68	MW-4013	48.09
MW-2014	45.59	3011	*25.24	MW-4014	47.80
MW-2015	56.17	SURFACE WATER		MW-4015	38.41
MW-2017	54.89	FROG POND		MW-4016	54.66
MW-2018	49.17	RP-1		MW-4017	58.48
MW-2019	72.88	RP-2		MW-4018	52.69
MW-2020	46.80	RP-3		MW-4019	35.74
MW-2021	37.48	RP-4		MW-4020	54.51
MW-2022	59.81	ASH POND		MW-4021	44.00
MW-2023	54.75			MW-4022	76.35
MW-2024	68.53	PW-1	50.62	MW-4023	36.11
MW-2025	40.61	PW-2	47.91		
MW-2026	46.34	PW-3	41.94	GT-58P	53.85
MW-2027	54.89			GT-60P	59.13
MW-2028	64.44			GT-63P	—
MW-2029	62.82			GT-64P	45.46
				GT-65P	54.28
				GT-66P	42.56
				GT-67P	53.05

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WELDON SPRING SITE REMEDIAL ACTION PROJECT
7295 Highway 94 South, St. Charles, Missouri 63303
Phone (314) 441-8086 Telecopy (314) 447-0803

WATER LEVEL MONITORING DATA - FORM 4.4.2.1

DATE: 11-29-89 PERSONNEL: TNA, MJQ

WELL #	SWL (ft)	WELL #	SWL (ft)	WELL #	SWL (ft)
MW-2001	25.58	MW-3001	54.80	MW-4001	21.46
MW-2002	33.28	MW-3002	71.81	MW-4002	66.29
MW-2003	41.19	MW-3003	48.29	MW-4003	61.83
MW-2004	61.42	MW-3004	—	MW-4004	43.07
MW-2005	49.89	MW-3006	56.07	MW-4005	49.45
MW-2006	36.94	MW-3007	DESTROYED	MW-4006	21.12
MW-2007	61.04	MW-3008	—	MW-4007	29.31
MW-2008	36.38	MW-3009	40.64	MW-4008	41.06
MW-2009	47.02	MW-3010	—	MW-4009	32.35
MW-2010	45.05	MW-3012	DESTROYED	MW-4010	42.42
MW-2011	54.60	MW-3014	DESTROYED	MW-4011	38.89
MW-2012	33.20	MW-3018	—	MW-4012	46.60
MW-2013	43.22	MW-3019	57.37	MW-4013	48.13
MW-2014	46.30	3D11	-25.28	MW-4014	47.90
MW-2015	56.73	SURFACE WATER		MW-4015	38.78
MW-2017	55.48	FROG POND	2.7	MW-4016	55.15
MW-2018	49.83	RP-1	1.2	MW-4017	58.89
MW-2019	73.25	RP-2 *	.7	MW-4018	53.29
MW-2020	47.72	RP-3	1.68	MW-4019	36.39
MW-2021	37.64	RP-4	1.25	MW-4020	55.10
MW-2022	52.09	ASH POND	Dry	MW-4021	44.64
MW-2023	55.96			MW-4022	75.19
MW-2024	68.88	PW-1	50.98	MW-4023	36.58
MW-2025	41.09	PW-2	49.58		
MW-2026	47.40	PW-3	42.47	GT-58P	53.91
MW-2027	54.72			GT-60P	59.75
MW-2028	64.86			GT-63P	47.36
MW-2029	63.13			GT-64P	45.70
				GT-65P	54.26
				GT-66P	42.93
		G3-05	89.06	GT-67P	54.19

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* AM surface measures taken

WELDON SPRING SITE REMEDIAL ACTION PROJECT
7295 Highway 94 South, St. Charles, Missouri 63303
Phone (314) 441-8086 Telecopy (314) 447-0803

WATER LEVEL MONITORING DATA - FORM 4.4.2.1

DATE: 12-21-89 PERSONNEL: MJQ

3" Snow, Cold

WELL #	SWL (ft)	WELL #	SWL (ft)	WELL #	SWL (ft)
MW-2001	25.50	MW-3001	54.45	MW-4001	21.46
MW-2002	33.21	MW-3002	71.84	MW-4002	66.30
MW-2003	41.03	MW-3003	48.03	MW-4003	61.77
MW-2004	61.24	MW-3004	—	MW-4004	43.01
MW-2005	49.88	MW-3006	55.93	MW-4005	49.38
MW-2006	36.78	MW-3007	DESTROYED	MW-4006	21.03
MW-2007	61.00	MW-3008	—	MW-4007	29.19
MW-2008	36.47	MW-3009	40.50	MW-4008	40.84
MW-2009	43.08	MW-3010	—	MW-4009	32.55
MW-2010	44.99	MW-3012	DESTROYED	MW-4010	42.53
MW-2011	54.52	MW-3014	DESTROYED	MW-4011	38.77
MW-2012	33.24	MW-3018	—	MW-4012	46.69
MW-2013	43.50	MW-3019	57.61	MW-4013	48.17
MW-2014	46.40	MW-3011	25.43	MW-4014	47.95
MW-2015	56.73	SURFACE WATER		MW-4015	38.60
MW-2017	55.64	FROG POND	2.6	MW-4016	54.91
MW-2018	50.05	RP-1	1.1	MW-4017	58.63
MW-2019	73.42	RP-2	.7	MW-4018	53.06
MW-2020	47.67	RP-3	1.64	MW-4019	36.16
MW-2021	37.56	RP-4	1.23	MW-4020	55.05
MW-2022	51.98	ASH POND	Dry	MW-4021	44.40
MW-2023	54.88			MW-4022	75.57
MW-2024	68.83	PW-1	50.78	MW-4023	36.67
MW-2025	40.85	PW-2	48.76		
MW-2026	46.54	PW-3	42.11	GT-58P	53.87
MW-2027	55.55			GT-60P	59.82
MW-2028	64.97			GT-63P	47.32
MW-2029	63.05			GT-64P	45.70
				GT-65P	54.30
				GT-66P	43.08
				GT-67P	54.74

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WELDON SPRING SITE REMEDIAL ACTION PROJECT
7295 Highway 94 South, St. Charles, Missouri 63303
Phone (314) 441-8086 Telecopy (314) 447-0803

WATER LEVEL MONITORING DATA - FORM 4.4.2.1

DATE: 1-17-90 PERSONNEL: MJQ, TWA

WELL #	SWL (ft)	WELL #	SWL (ft)	WELL #	SWL (ft)
MW-2001	25.45	MW-3001	54.74	MW-4001	21.40
MW-2002	33.23	MW-3002	71.87	MW-4002	99.22
MW-2003	40.95	MW-3003	48.04	MW-4003	61.95
MW-2004	61.18	MW-3004	—	MW-4004	42.83
MW-2005	49.43	MW-3006	55.97	MW-4005	49.32
MW-2006	36.65	MW-3007	DESTROYED	MW-4006	21.02
MW-2007	61.00	MW-3008	—	MW-4007	29.03
MW-2008	36.48	MW-3009	40.49	MW-4008	40.74
MW-2009	42.85	MW-3010	—	MW-4009	32.10
MW-2010	45.04	MW-3012	DESTROYED	MW-4010	42.24
MW-2011	54.65	MW-3014	DESTROYED	MW-4011	39.64
MW-2012	32.93	MW-3018	—	MW-4012	46.78
MW-2013	43.21	MW-3019	57.40	MW-4013	46.27
MW-2014	45.77	3011	25.28	MW-4014	47.88
MW-2015	56.58	SURFACE WATER		MW-4015	38.51
MW-2017	54.98	PROG POND	3.1	MW-4016	54.81
MW-2018	49.81	RP-1		MW-4017	58.57
MW-2019	73.32	RP-2		MW-4018	52.70
MW-2020	47.50	RP-3		MW-4019	35.73
MW-2021	37.36	RP-4		MW-4020	54.60
MW-2022	51.87	ASH POND	~~3.1~~ Dry	MW-4021	43.89
MW-2023	54.85			MW-4022	75.71
MW-2024	68.59	PW-1	50.79	MW-4023	36.52
MW-2025	40.66	PW-2	48.55		
MW-2026	46.38	PW-3	42.31	GT-58P	53.89
MW-2027	54.98			GT-60P	59.08
MW-2028	64.76			GT-63P	47.02
MW-2029	62.80			GT-64P	45.68
				GT-65P	54.29
				GT-66P	43.19
				GT-67P	54.30

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WELDON SPRING SITE REMEDIAL ACTION PROJECT
7295 Highway 94 South, St. Charles, Missouri 63303
Phone (314) 441-8086 Telecopy (314) 447-0803

WATER LEVEL MONITORING DATA - FORM 4.4.2.1

DATE: 2-18-90 PERSONNEL: MJQ, TNA

WELL #	SWL (ft)	WELL #	SWL (ft)	WELL #	SWL (ft)
MW-2001	25.46	MW-3001	56.45	MW-4001	21.43
MW-2002	33.42	MW-3002	720D	MW-4002	66.13
MW-2003	41.32	MW-3003	47.36	MW-4003	62.64
MW-2004	61.50	MW-3004	Box	MW-4004	42.91
MW-2005	50.19	MW-3006	56.16	MW-4005	49.65
MW-2006	36.98	MW-3008	Box	MW-4006	21.14
MW-2007	61.27	MW-3009	40.42	MW-4007	29.39
MW-2008	36.53	MW-3010	BOX	MW-4008	41.07
MW-2009	43.50	MW-3011	25.26	MW-4009	32.42
MW-2010	45.07	MW-3018	23.44	MW-4010	42.44
MW-2011	54.72	MW-3019	56.66	MW-4011	38.82
MW-2012	32.57			MW-4012	47.03 ?
MW-2013	43.60			MW-4013	47.65
MW-2014	46.21			MW-4014	47.92
MW-2015	56.46	SURFACE WATER		MW-4015	38.71
MW-2017	55.54	FROG POND	2.88	MW-4016	55.06
MW-2018	49.76	RP-1	1.28	MW-4017	58.76
MW-2019	73.62	RP-2	.8	MW-4018	53.18
MW-2020	47.41	RP-3		MW-4019	38.20
MW-2021	37.79	RP-4	1.37	MW-4020	55.38
MW-2022	52.34	ASH POND	Dry	MW-4021	44.41
MW-2023	55.08			MW-4022	75.95
MW-2024	69.18	PW-1	51.12	MW-4023	37.00
MW-2025	40.94	PW-2	49.41		
MW-2026	46.81	PW-3	M.B. ~~48.41~~ 42.12	GT-58P	53.97
MW-2027	55.38			GT-60P	57.93
MW-2028	64.74	GS-01	143.76	GT-63P	47.19
MW-2029	63.26	GS-02	217.17	GT-64P	45.84
		GS-03	3.78	GT-65P	54.33
		GS-04	OVERFLOWING	GT-66P	43.40
		GS-05	92.84	GT-67P	55.25

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WELDON SPRING SITE REMEDIAL ACTION PROJECT
7295 Highway 94 South, St. Charles, Missouri 63303
Phone (314) 441-8086 Telecopy (314) 447-0803

WATER LEVEL MONITORING DATA - FORM 4.4.2.1

DATE: 3-23-90 PERSONNEL: TNA, MJQ

WELL #	SWL (ft)	WELL #	SWL (ft)	WELL #	SWL (ft)
MW-2001	25.56	MW-3001	54.87	MW-4001	21.39
MW-2002	33.18	MW-3002	72.05	MW-4002	64.99
MW-2003	41.33	MW-3003	48.05	MW-4003	62.59
MW-2004	61.45	MW-3004	—	MW-4004	42.82
MW-2005	50.08	MW-3006	55.85	MW-4005	49.76
MW-2006	36.65	MW-3008	—	MW-4006	21.08
MW-2007	61.27	MW-3009	40.55	MW-4007	29.39
MW-2008	36.70	MW-3010	—	MW-4008	41.08
MW-2009	43.42	MW-3011	25.29	MW-4009	31.65
MW-2010	44.83	MW-3018	23.43	MW-4010	42.37
MW-2011	54.64	MW-3019	52.60	MW-4011	38.86
MW-2012	32.02			MW-4012	46.85
MW-2013	42.59			MW-4013	47.21
MW-2014	46.22			MW-4014	47.84
MW-2015	56.78	SURFACE WATER		MW-4015	38.88
MW-2017	55.74	FROG POND	2.88	MW-4016	55.39
MW-2018	50.20	RP-1	1.4	MW-4017	59.09
MW-2019	73.65	RP-2	.7	MW-4018	53.71
MW-2020	47.79	RP-3	1.93	MW-4019	36.49
MW-2021	37.55	RP-4	1.47	MW-4020	55.39
MW-2022	52.21	ASH POND	Approx. one 1 ft of water	MW-4021	44.65
MW-2023	55.13			MW-4022	76.09
MW-2024	68.95	PW-1	51.00	MW-4023	37.26
MW-2025	41.11	PW-2	48.77		
MW-2026	46.73	PW-3	42.32	GT-58P	53.88
MW-2027	55.33			GT-60P	59.77
MW-2028	64.90	GS-01	143.37	GT-63P	47.14
MW-2029	61.00	GS-02	217.64	GT-64P	45.70
		GS-03	2.4	GT-65P	54.31
		GS-04	0	GT-66P	~~59.77~~ 41.97
		GS-05	94.55	GT-67P	55.58

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WELDON SPRING SITE REMEDIAL ACTION PROJECT
7295 Highway 94 South, St. Charles, Missouri 63303
Phone (314) 441-8086 Telecopy (314) 447-0803

WATER LEVEL MONITORING DATA - FORM 4.4.2.1

DATE: 4/26/90 PERSONNEL: MJQ TNA

WELL #	SWL (ft)	WELL #	SWL (ft)	WELL #	SWL (ft)
MW-2001	24.95	MW-3001	54.10	MW-4001	20.55
MW-2002	32.47	MW-3002	71.31	MW-4002	57.44
MW-2003	40.79	MW-3003	47.63	MW-4003	61.58
MW-2004	61.09	MW-3004	—	MW-4004	42.10
MW-2005	49.76	MW-3006	55.10	MW-4005	48.84
MW-2006	35.69	MW-3008	—	MW-4006	20.41
MW-2007 TNA	60.90	MW-3009	39.52	MW-4007	28.50
MW-2008	35.76	MW-3010	—	MW-4008	39.81
MW-2009	43.47	MW-3011	25.28	MW-4009	31.65
MW-2010	44.50	MW-3018	22.46	MW-4010	40.24
MW-2011	54.80	MW-3019	56.84	MW-4011	38.07
MW-2012	30.82			MW-4012	48.35
MW-2013	41.43	57.77		MW-4013	47.77
MW-2014	45.49			MW-4014	47.73
MW-2015	56.07	SURFACE WATER		MW-4015	38.47
MW-2017	55.00	FROG POND	2.88	MW-4016	54.76
MW-2018	49.34	RP-1	1.58	MW-4017	58.52
MW-2019	72.90	RP-2 TNA	~~[illegible]~~ .97	MW-4018	52.42
MW-2020	46.05	RP-3	2.1	MW-4019	33.80
MW-2021	36.95	RP-4	1.66	MW-4020	51.00
MW-2022	51.72	ASH POND	141. APPROX.	MW-4021	44.02
MW-2023	53.89			MW-4022	75.86
MW-2024	63.15	PW-1	50.62	MW-4023	36.74
MW-2025	40.61	PW-2	48.15		
MW-2026	46.15	PW-3	41.81	GT-58P	53.79
MW-2027	57.77			GT-60P	59.01
MW-2028	64.34	GS-01	142.79	GT-63P	46.67
MW-2029	62.84	GS-02	217.38	GT-64P	45.39
		GS-03	.23	GT-65P	54.24
		GS-04	OVERFLOWING	GT-66P	40.82
		GS-05	93.37	GT-67P	54.95

SP

4040201/TXTJOANN

WELDON SPRING SITE REMEDIAL ACTION PROJECT
7295 Highway 94 South, St. Charles, Missouri 63303
Phone (314) 441-8086 Telecopy (314) 447-0803

WATER LEVEL MONITORING DATA - FORM 4.4.2.1

DATE: 5-24-90 PERSONNEL: NJQ TWH

WELL #	SWL (ft)	WELL #	SWL (ft)	WELL #	SWL (ft)
MW-2001	24.29	MW-3001	54.07	MW-4001	19.60
MW-2002	31.72	MW-3002	70.93	MW-4002	51.46
MW-2003	39.92	MW-3003	47.98	MW-4003	61.31
MW-2004	61.10	MW-3004	—	MW-4004	41.63
MW-2005	49.61	MW-3006	54.68	MW-4005	48.75
MW-2006	35.51	MW-3008	—	MW-4006	19.85
MW-2007	60.88	MW-3009	39.20	MW-4007	28.32
MW-2008	35.91	MW-3010	—	MW-4008	40.19
MW-2009	43.49	MW-3011	25.27	MW-4009	29.72
MW-2010	44.15	MW-3018	22.39	MW-4010	39.99
MW-2011	54.42	MW-3019	56.82	MW-4011	37.24
MW-2012	29.24			MW-4012	45.93
MW-2013	40.29			MW-4013	48.02
MW-2014	45.37			MW-4014	47.59
MW-2015	56.24	SURFACE WATER		MW-4015	37.44
MW-2017	54.98	FROG POND	2.94	MW-4016	54.48
MW-2018	49.54	RP-1	2.13	MW-4017	58.56
MW-2019	72.69	RP-2	1.51	MW-4018	52.03
MW-2020	46.22	RP-3	2.58	MW-4019	36.08
MW-2021	36.46	RP-4	2.22	MW-4020	54.60
MW-2022	57.22	ASH POND	2.23 ft	MW-4021	44.13
MW-2023	54.75			MW-4022	74.89
MW-2024	68.73	PW-1	50.50	MW-4023	36.56
MW-2025	40.54	PW-2	48.08		
MW-2026	46.00	PW-3	49.59	GT-58P	53.65
MW-2027	54.50			GT-60P	59.26
MW-2028	64.37	GS-01	142.07	GT-63P	46.60
MW-2029	62.76	GS-02	216.60	GT-64P	45.42
		GS-03	0.0	GT-65P	54.26
		GS-04	0.0	GT-66P	39.77
		GS-05	88.91	GT-67P	55.11

4040201/TXTJOANN

59.24

WELDON SPRING SITE REMEDIAL ACTION PROJECT
7295 Highway 94 South, St. Charles, Missouri 63303
Phone (314) 441-8086 Telecopy (314) 447-0803

WATER LEVEL MONITORING DATA - FORM 4.4.2.1

DATE: 8/30/90 PERSONNEL: MJQ MGT

WELL #	SWL (ft)	WELL #	SWL (ft)	WELL #	SWL (ft)
MW-2001	25.11	MW-3001	53.65	MW-4001	20.50
MW-2002	34.26	MW-3002	70.89	MW-4002	66.26
MW-2003	40.77	MW-3003	47.57	MW-4003	59.40
MW-2004	61.13	MW-3004	—	MW-4004	41.90
MW-2005	49.73	MW-3006	55.39	MW-4005	48.37 MGT
MW-2006	36.07	MW-3008	34.40	MW-4006	~~20.16~~ 20.26
MW-2007	60.99	MW-3009	39.44	MW-4007	28.49
MW-2008	36.50	MW-3010	54.78	MW-4008	40.29
MW-2009	43.29	MW-3011	—	MW-4009	31.67
MW-2010	44.30	MW-3018	—	MW-4010	41.83
MW-2011	54.53	MW-3019	56.35	MW-4011	38.28
MW-2012	32.06			MW-4012	46.48
MW-2013	41.42			MW-4013	48.19
MW-2014	45.25			MW-4014	47.82
MW-2015	56.52	SURFACE WATER		MW-4015	37.71
MW-2017	54.88 ~~54.53~~ MJQ	FROG POND	2.74	MW-4016	54.78
MW-2018	49.40	RP-1	2.00	MW-4017	54.54
MW-2019	72.28	RP-2	1.45	MW-4018	52.24
MW-2020	46.62	RP-3	—	MW-4019	36.06
MW-2021	37.13	RP-4	—	MW-4020	54.41
MW-2022	51.70	ASH POND	DRY	MW-4021	44.07
MW-2023	54.98			MW-4022	76.27
MW-2024	67.93	PW-1	50.73	MW-4023	36.09
MW-2025	40.61	PW-2	47.97		
MW-2026	46.09	PW-3	41.83	GT-58P	53.81
MW-2027	54.65			GT-60P	—
MW-2028	64.35	GS-01	140.56	GT-63P	47.39
MW-2029	62.91	GS-02	216.75	GT-64P	45.45
		GS-03	1.79	GT-65P	54.28
		GS-04	0.0	GT-66P	41.46
		GS-05	84.20	GT-67P	54.13

0 0 0 5

1.79 overflowing 0 0

216.75 140.56

4040201/TXTJOANN

APPENDIX D

LABORATORY SOIL TEST DATA SHEETS

APPENDIX D-1

SUMMARY OF PERMEABILITY TEST RESULT CORRECTIONS

GEOTECHNOLOGY INC
ENGINEERING AND ENVIRONMENTAL SERVICES
SAINT LOUIS • KANSAS CITY
2258 Grissom Drive
St. Louis, Missouri 63146
(314) 997-7440 FAX 997-2067

LETTER OF TRANSMITTAL

(5)

M-K FERGUSON RECEIVED OCT 05 1990 CONTRACT 3552

TO M-K Ferguson
7295 South 94 South
St. Charles, Missouri 63303

DATE October 3, 1990	JOB NO. 11295.000
ATTENTION Steve Huot	
RE: Test Results WSSRAP	
P.O. #3589 - 1002 - 3445	
Request #8 and	
Permeability Results Corrections	
Request #1 to #8	
Transmittal #17	

WE ARE SENDING YOU ☐ Attached ☐ Under separate cover via _____ the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☒ Test Results

COPIES	DATE	NO.	DESCRIPTION
		4	Triaxial Permeability

THESE ARE TRANSMITTED as checked below:

☐ For approval ☐ Approved as submitted ☐ Resubmit _____ copies for approval
☒ For your use ☐ Approved as noted ☐ Submit _____ copies for distribution
☒ As requested ☐ Returned for corrections ☐ Return _____ corrected prints
☐ For review and comment ☐ _____
☐ FOR BIDS DUE _____ 19 _____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS

Attached are test results completed since August 28,1990.
Also included is a list of individual testing and the
number of remolded samples, and a table of corrected
Permeability results of requests #1 through #8.

John A. Baker, P.E.
Vice President

COPY TO _____

SIGNED: John A. Baker

SUMMARY OF

PERMEABILITY TEST RESULT CORRECTIONS

Request No.	Sample I.D.	Sample No.	Depth (ft)	Confining Pressure (ksf)	Reported Value		Corrected Value	
					Total Head (ft)	Permeability (cm/sec)	Total Head (ft)	Permeability (cm/sec)
1	GTQ-1	ST-15	45.0 - 47.5	1	16.1	$2x10^{-7}$	11.6	$3x10^{-7}$
	GTQ-1	ST-15	45.0 - 47.5	3	48.2	$3x10^{-8}$	11.6	$1x10^{-7}$
	GTQ-3	ST-08	20.0 - 22.5	1	16.1	$9x10^{-8}$	11.6	$2x10^{-7}$
	GTQ-3	ST-08	20.0 - 22.5	3	48.2	$7x10^{-8}$	11.6	$1x10^{-7}$
	GTQ-4	ST-12	30.0 - 32.5	1	16.1	$1x10^{-7}$	11.6	$3x10^{-7}$
	GTQ-4	ST-12	30.0 - 32.5	3	48.2	$4x10^{-8}$	11.6	$6x10^{-8}$
	GTQ-4	ST-16	50.0 - 52.5	1	16.1	$1x10^{-7}$	11.6	$3x10^{-7}$
	GTQ-4	ST-16	50.0 - 52.5	3	48.2	$9x10^{-9}$	11.6	$9x10^{-8}$
	GTQ-8	ST-09	25.0 - 27.5	1	16.1	$5x10^{-5}$	11.6	$4x10^{-5}$
	GTQ-8	ST-09	25.0 - 27.5	3	48.2	$2x10^{-5}$	11.6	$2x10^{-5}$
	GTQ-8	ST-16	55.0 - 57.5	1	16.1	$3x10^{-7}$	11.6	$5x10^{-7}$
	GTQ-8	ST-16	55.0 - 57.5	3	48.2	$2x10^{-8}$	11.6	$9x10^{-8}$
	GTQ-10	ST-11	30.0 - 32.5	1	16.1	$3x10^{-7}$	11.6	$4x10^{-7}$
	GTQ-10	ST-11	30.0 - 32.5	3	48.2	$8x10^{-8}$	11.6	$4x10^{-7}$
2	GT-2T71	BU-02A	6.5 - 12.0	1	16.1	$1x10^{-8}$	11.6	$2x10^{-8}$
	GT-2T75	BU-02B	6.5 - 12.0	1	16.1	No Flow	11.6	$<1x10^{-9}$
	GT-2T77	BU-02A	7.5 - 10.5	1	16.1	$1x10^{-8}$	11.6	$2x10^{-8}$
	GT-2T78	BU-02B	6.5 - 12.0	1	16.1	$3x10^{-8}$	11.6	$4x10^{-8}$

Request No.	Sample I.D.	Sample No.	Depth (ft)	Confining Pressure (ksf)	Reported Value Total Head (ft)	Reported Value Permeability (cm/sec)	Corrected Value Total Head (ft)	Corrected Value Permeability (cm/sec)
3	TPBS-1	2A	2.6 - 7.1	1	16.1	$2x10^{-7}$	11.6	$3x10^{-7}$
	TPBS-1	4A	9.1 - 14.1	1	16.1	$3x10^{-8}$	11.6	$4x10^{-8}$
	TPBS-6	1A	0.6 - 9.1	1	16.1	$1x10^{-8}$	11.6	$2x10^{-8}$
	TPBS-6	2A	9.1 - 12.0	1	16.1	$9x10^{-9}$	11.6	$1x10^{-8}$
	TPBS-8	1A	0.6 - 4.3	1	16.1	$2x10^{-8}$	11.6	$3x10^{-8}$
	TPBS-8	2A	4.3 - 8.5	1	16.1	$9x10^{-8}$	11.6	$2x10^{-7}$
	TPBS-8	3A	8.5 - 11.5	1	16.1	$3x10^{-9}$	11.6	$5x10^{-9}$
	TPBS-10	1A	0.5 - 6.5	1	16.1	$8x0^{-8}$	11.6	$1x10^{-7}$
	TPBS-10	2A	8.2 - 10.9	1	16.1	$8x10^{-9}$	11.6	$2x10^{-8}$
	TPBS-10	3A	10.9 - 13.0	1	16.1	No Flow	11.6	$< 1x10^{-9}$
	TPBS-11	1A	0.6 - 10.4	1	16.1	$3x10^{-8}$	11.6	$3x10^{-8}$
	TPBS-11	2A	10.4 - 12.3	1	16.1	$2x10^{-8}$	11.6	$3x10^{-8}$
	TPBS-23	1A	0.7 - 13.1	1	16.1	$3x10^{-7}$	11.6	$4x10^{-7}$
4	GT-58P	ST-01	2.5 - 5.0	1	16.1	$1x10^{-7}$	11.6	$2x10^{-7}$
	GT-58P	ST-01	2.5 - 5.0	3	48.2	$2x10^{-8}$	11.6	$4x10^{-7}$
	GT-58P	ST-03	7.5 - 10.0	1	16.1	$4x10^{-8}$	11.6	$6x10^{-8}$
	GT-58P	ST-03	7.5 - 10.0	3	48.2	No Flow	11.6	$< 1x10^{-9}$
	GT-58P	ST-09	22.5 - 24.0	2	32.2	$1x10^{-8}$	11.6	$4x10^{-8}$
	GT-58P	ST-09	22.5 - 24.0	4	64.3	No Flow	11.6	$< 1x10^{-9}$
	GT-59	ST-02	5.0 - 7.5	1	16.1	$2x10^{-7}$	11.6	$4x10^{-7}$
	GT-59	ST-O2	5.0 - 7.5	3	48.2	$5x10^{-7}$	11.6	$2x10^{-7}$
	GT-59	ST-06	15.0 - 17.5	2	32.1	No Flow	11.6	$< 1x10^{-9}$
	GT-60P	ST-10	27.5 - 30.0	3	48.2	$1x10^{-8}$	11.6	$5x10^{-8}$
	GT-60P	ST-10	27.5 - 30.0	6	96.4	No Flow	11.6	$< 1x10^{-9}$

Request No.	Sample I.D.	Sample No.	Depth (ft)	Confining Pressure (ksf)	Reported Value Total Head (ft)	Reported Value Permeability (cm/sec)	Corrected Value Total Head (ft)	Corrected Value Permeability (cm/sec)
4	GT-60P	SB-15	40.5 - 41.0	4	64.3	$9x10^{-9}$	11.6	$7x10^{-8}$
	GT-60P	SB-15	41.0 - 41.5	7	112.5	$2x10^{-8}$	11.6	$2x10^{-7}$
	GT-60P	SB-17	48.5 - 49.0	4	64.3	$6x10^{-8}$	11.6	$3x10^{-7}$
	GT-60P	SB-17	48.5 - 49.0	7	112.5	$2x10^{-8}$	11.6	$2x10^{-7}$
	GT-62	ST-07	17.5 - 20.0	2	32.1	$2x10^{-8}$	11.6	$5x10^{-8}$
	GT-62	ST-07	17.5 - 20.0	4	32.1	No Flow	11.6	$<1x10^{-9}$
	GT-62S	SB-13	32.8 - 33.3	3	48.2	$6x10^{-6}$	11.6	$3x10^{-5}$
	GT-62S	SB-13	32.8 - 33.3	5	80.3	$7x10^{-9}$	11.6	$6x10^{-8}$
	GT-63P	ST-01	2.5 - 5.0	1	16.1	$5x10^{-9}$	11.6	$7x10^{-9}$
	GT-63P	ST-09	22.5 - 25.0	2	32.2	$3x10^{-9}$	11.6	$9x10^{-9}$
	GT-65S	SB-16	41.0 - 41.5	4	64.2	$2x10^{-7}$	11.6	$8x10^{-7}$
	GT-65S	SB-16	41.0 - 41.5	7	112.4	$3x10^{-8}$	11.6	$4x10^{-7}$
	GT-67P	ST-08	20.0 - 22.5	2	32.2	$4x10^{-8}$	11.6	$1x10^{-7}$
5	GTS-1	ST03	5.0 - 7.5	1	16.1	$1x10^{-7}$	11.6	$2x10^{-7}$
	GTS-3	ST02	5.0 - 7.5					
	GTS-2	ST02	2.5 - 5.0	1	16.1	$6x10^{-8}$	11.6	$8x10^{-8}$
	GTS-4	ST04	7.5 - 10.0					
	GTS-4	ST02	2.5 - 5.0	1	16.1	$2x10^{-7}$	11.6	$2x10^{-7}$
	GTS-4	ST04	7.5 - 10.0					
	GTS-5		0.0 - 5.0	1	16.1	$2x10^{-8}$	11.6	$2x10^{-8}$
	GTS-6		0.0 - 5.0	1	16.1	$9x10^{-8}$	11.6	$1x10^{-7}$
	GTS-7		0.0 - 5.0	1	16.1	$3x10^{-8}$	11.6	$5x10^{-8}$

Request No.	Sample I.D.	Sample No.	Depth (ft)	Confining Pressure (ksf)	Reported Value Total Head (ft)	Reported Value Permeability (cm/sec)	Corrected Value Total Head (ft)	Corrected Value Permeability (cm/sec)
6	GTQ-4	SS-05 SS-07	12.5 - 14.0 17.5 - 19.0	1	16.1	$2x10^{-7}$	11.6	$3x10^{-7}$
	GTQ-5	SS-05 SS-07	12.5 - 14.0 17.5 - 19.0	1	16.1	$4x10^{-8}$	11.6	$5x10^{-8}$
	GTQ-5*	SS-05 SS-07	12.5 - 14.0 17.5 - 19.0	1	16.1	$1x10^{-8}$	11.6	$2x10^{-8}$
7	EB-D EB-E		10 & 15 10 & 15	1 1	16.1 16.1	$3x10^{-6}$ $4x10^{-6}$	11.6 11.6	$3x10^{-6}$ $6x10^{-6}$
8	TPMS-1 TPMS-3	BU-O1 BU-01	0.0 - 6.0 1.0 - 6.0	1 1	16.1 16.1	$5x10^{-8}$ $2x10^{-7}$	11.6 11.6	$7x10^{-8}$ $3x10^{-7}$

*Sample with bentonite mixed.

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: Weldon Springs, MO.

CHECKED BY: LAB DM

DATE: August 1, 1988

TAC

LAB NAME: Chen

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
Admin. Bldg.-2	B-37 ST-03	5.0-7.5	24.4	101.2
	ST-06	10.5-13.0	25.1	100.3
	B-38 ST-03	4.5-7.0	27.3	96.8
	B-39 ST-03	5.5-8.0	23.2	100.6
	ST-05	12.0-14.5	25.1	99.4
	B-41* ST-05	7.5 -10.0	N/A	N/A
	B-37 SS-05	9.0-10.5	20.7	N/A
	B-38 SS-02	3.0-4.5	21.8	N/A
	B-39 SS-02	4.0-5.5	26.8	105.0

* Sample omitted due to disturbance

TEST PROCEDURE: ASTM D2216, USACOE EM-1110-2-1906 (App. II)

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: Weldon Springs, MO.

CHECKED BY: LAB DM

DATE: August 1, 1988

TAC

LAB NAME: Chen

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
Admin. Bldg.-2	B-41 SS-02	3.5-4.0	27.9	94.4
	SS-02	4.0-4.5	28.6	95.1
	SS-04	6.0-7.5	24.5	N/A

TEST PROCEDURE: ASTM D2216, USACOE EM-1110-2-1906 (App. II)

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

MECHANICAL SIEVE TEST RESULTS

SITE ID: Weldon Springs, MO.

LOCATION ID: Administration Bldg. 2

DATE: August 1, 1988

CHECKED BY: LAB DM

TAC

LAB NAME: Chen

SAMPLE ID	DEPTH INTERVAL (FT)	% PASSING STANDARD SIEVE NUMBERS *										
		3"	1 1/2"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200
B-37 ST-03	5.0- 7.5							99	99	98	98	97
ST-06	10.5-13.0							99	99	99	98	97
B-38 ST-03	4.5- 7.0										99	99
B-39 ST-05	12.0-14.5								99	98	96	94
B-38 SS-02	3.0- 4.5							99	99	99	98	98
B-39 SS-02	4.0- 5.5										99	99

TEST PROCEDURE: ASTM D422

*ENTER ONLY VALUES LESS THAN 100%.

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

HYDROMETER ANALYSIS TEST RESULTS

SITE ID: Weldon Springs, MO.

LOCATION ID: Administration Bldg. 2

DATE: August 1, 1988

CHECKED BY: LAB DM

LAB NAME: Chen

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	% FINER THAN (mm) *							
		.074 mm	.05 mm	.037 mm	.019 mm	.009 mm	.005 mm	.002 mm	.001 mm
B-37 ST-03	5.0- 7.5	97	-	84	72	49	41	35	32
ST-06	10.5-13.0	97	-	82	66	51	45	39	37
B-38 ST-03	4.5- 7.0	99	-	88	76	53	41	33	31
B-39 ST-05	12.0-14.5	94	-	81	71	60	52	48	46
B-38 SS-02	3.0- 4.5	98	-	84	68	45	35	27	25
B-39 SS-02	4.0- 5.5	99	-	79	65	43	33	25	23

TEST PROCEDURE: ASTM D422

* ENTER ONLY VALUE LESS THAN 100%

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SHRINKAGE LIMITS

SITE ID: Weldon Springs, MO.

LOCATION ID: Administration Bldg.-2

DATE: August 1, 1988

CHECKED BY: LAB DM

LAB NAME: Chen

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	SHRINKAGE LIMIT (%)	SHRINKAGE RATIO (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY
B-37 ST-03	5.0-7.5	11.29	1.94		
B-38 ST-03	4.5-7.0	18.44	1.70		
B-37 SB-01	1.5-3.0	8.29	2.04		
B-38 SS-02	3.0-4.5	19.43	1.66		
B-39 SS-02	4.0-5.5	15.87	1.78		
B-41 SS-02	3.5-4.0	11.78	1.92		
B-41 SS-02	4.0-4.5	12.83	1.90		

TEST PROCEDURE: ASTM D4318, D854

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: Weldon Springs, MO.

LOCATION ID: Administration Bldg.-2

DATE: August 1, 1988

CHECKED BY: LAB DM

LAB NAME: Chen

TAC

Atterberg - 10

SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY 3
B-37 ST-03	5.0-7.5	45	16	29	2.67
ST-06	10.5-13.0	55	16	39	
B-38 ST-03	4.5-7.0	48	19	29	
B-39 ST-03	5.5-8.0				2.66
ST-05	12.0-14.5	65	17	48	2.68
B-37 SB-01	1.5-3.0	58	24	34	
B-38 SS-02	3.0-4.5	37	19	18	
B-39 SS-02	4.0-5.5	38	19	19	
B-41 SS-02	3.5-4.0	48	20	28	

TEST PROCEDURE: ASTM D4318, D854

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: Weldon Springs, MO.

LOCATION ID: Administration Bldg.-2

DATE: August 1, 1988

CHECKED BY: LAB DM

LAB NAME: Chen

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY
B-41 SS-02	4.0-4.5	48	20	28	
SS-04	6.0-7.5	40	17	23	

TEST PROCEDURE: ASTM D4318, D854

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

3 tests

SITE ID: Weldon Springs, MO.

LOCATION ID: Administration Bldg.

DATE: August 1, 1988

CHECKED BY LAB: DM

LAB NAME: Chen

TAC:

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
B-37 ST-03	5.0-7.5	400	N/A

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
101.3	24.4	100+	0.648

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
105.4	23.0	100+	0.583

TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
100	0.643	N/A
400	0.640	N/A
400 w/ water	0.643	N/A
1000	0.638	2.29 E-2
2000	0.628	1.82 E-2
4000	0.614	1.05 E-2
8000	0.589	N/A
16000	0.549	5.25 E-3
4000	0.555	N/A
1000	0.565	N/A
250	0.582	N/A

TEST PROCEDURE: ASTM D2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: Weldon Springs, MO.

LOCATION ID: Administration Building

DATE: August 1, 1988

CHECKED BY LAB: DM

LAB NAME: Chen

TAC:

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
B-39 ST-03	5.5-8.0	800	N/A

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
96.9	24.8	92.9	0.711

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
102.4	25.1	100+	0.619

TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
100	0.708	N/A
400	0.704	N/A
800	0.702	N/A
800 w/ water	0.702	N/A
1000	0.701	N/A
2000	0.692	2.03 E-2
4000	0.671	7.96 E-3
8000	0.631	1.44 E-2
16000	0.576	2.26 E-3
4000	0.592	N/A
1000	0.606	N/A
250	0.619	N/A

TEST PROCEDURE: ASTM D2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: Weldon Springs, MO.

LOCATION ID: Administration Building

DATE: August 1, 1988

CHECKED BY LAB: DM

LAB NAME: Chen

TAC:

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
B-39 ST-05	12.0-14.5	1600	N/A

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
97.3	27.0	100+	0.722

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
96.9	28.6	100+	0.728

TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
100	0.718	N/A
500	0.715	N/A
1000	0.713	N/A
1600	0.710	N/A
1600 w/ water	0.725	N/A
4000	0.708	3.01 E-2
8000	0.675	9.75 E-3
16000	0.618	N/A
4000	0.656	N/A
1000	0.692	N/A
250	0.728	N/A

TEST PROCEDURE: ASTM D2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UU 2 parts

UNCONSOLIDATED - UNDRAINED TRIAXIAL "Q" TEST

SITE ID: Weldon Springs, MO.

LOCATION ID: Administration Building-2

DATE: August 1, 1988

LAB NAME: Chen

CHECKED BY: LAB DM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
B-37 ST-03	5.0-7.5	N/A	504

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
94.3	27.8	96.5	0.770

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
92.4	30.1	100.0	0.805

TEST PROCEDURE: USACOE EM-1110-2-1906 (App. X-27)

TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)
221	0.2				
264	0.4				
284	1.0				
327	1.5				
368	2.0				
431	2.5				
515	3.0				
552	4.0				
651	5.0				
727	6.0				
895	8.0				
1015	10.0				
1089	12.0				
1079	14.0				
1300	16.0				
1305	18.0				
1379	20.0				

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED - UNDRAINED TRIAXIAL "Q" TEST

SITE ID: Weldon Springs, MO.

LOCATION ID: Administration Building-2

DATE: August 1, 1988

LAB NAME: Chen

CHECKED BY: LAB DM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
B-37 ST-03	5.0-7.5	N/A	994

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
95.1	27.5	97.4	0.753

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
94.6	28.6	100.0	0.763

TEST PROCEDURE: USACOE EM-1110-2-1906 (App. X-27)

TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)
219	0.2				
350	0.4				
587	1.0				
800	1.5				
990	2.0				
1199	2.5				
1342	3.0				
1644	4.0				
1835	5.0				
1981	6.0				
2181	8.0				
2292	10.0				
2376	12.0				
2398	14.0				
2397	16.0				
2412	18.0				
2406	20.0				

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED - UNDRAINED TRIAXIAL "Q" TEST

SITE ID: Weldon Springs, MO.

LOCATION ID: Administration Building - 2

DATE: August 1, 1988

LAB NAME: Chen

CHECKED BY: LAB Lm

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
B-37 ST-03	5.0-7.5	N/A	2002

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
99.7	24.8	98.5	0.672

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
98.2	26.1	100.0	0.698

TEST PROCEDURE: USACOE EM-1110-2-1906 (App. X-27)

TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)
463	0.2				
683	0.4				
1094	1.0				
1481	1.5				
1690	2.0				
2091	2.5				
2401	3.0				
2673	4.0				
2856	5.0				
2971	6.0				
3091	8.0				
2964	10.0				
3034	12.0				
3175	14.0				
3119	16.0				
3009	18.0				
2847	20.0				

ATTACHMENT 11

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED - UNDRAINED TRIAXIAL "Q" TEST

SITE ID: Weldon Springs, MO.

LOCATION ID: Administration Building-2

DATE: August 1, 1988

LAB NAME: Chen

CHECKED BY: LAB DM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
B-38 ST-03	4.5-7.0	N/A	504

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
91.6	30.8	100+	0.821

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
89.0	32.7	100	0.874

TEST PROCEDURE: USACOE EM-1110-2-1906 (App. X-27)

TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)
644	0.2				
798	0.4				
1013	1.0				
1123	1.5				
1179	2.0				
1261	2.5				
1317	3.0				
1410	4.0				
1501	5.0				
1569	6.0				
1680	8.0				
1764	10.0				
1824	12.0				
1858	14.0				
1891	16.0				
1916	18.0				
1943	20.0				

ATTACHMENT 11

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED - UNDRAINED TRIAXIAL "Q" TEST

SITE ID: Weldon Springs, MO.

LOCATION ID: Administration Building-2

DATE: August 1, 1988

LAB NAME: Chen

CHECKED BY: LAB

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
B-38 ST-03	4.5-7.0	N/A	994

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
99.3	28.5	100+	0.678

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
92.5	30.0	100	0.802

TEST PROCEDURE: USACOE EM-1110-2-1906 (App. X-27)

TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)
368	0.2				
550	0.4				
1096	1.0				
1497	1.5				
1693	2.0				
1843	2.5				
1902	3.0				
2035	4.0				
2144	5.0				
2186	6.0				
2182	8.0				
2324	10.0				
2353	12.0				
2436	14.0				
2495	16.0				
2382	18.0				
2302	20.0				

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

MOISTURE DENSITY RELATIONSHIP

SITE ID: Weldon Springs, MO. LOCATION ID: Administration Bldg. 2

DATE: August 1, 1988 CHECKED BY LAB: DM

LAB NAME: Chen TAC:

SAMPLE ID	DEPTH INTERVAL (FT)	TEST METHOD	MAXIMUM DRY DENSITY (PCF)	OPTIMUM MOISTURE CONTENT (%)	TEST NO.
B-39 ST-03	5.5- 8.0	SP	107.5	17.9	1
Composite ST-04	9.5-12.0				2

TEST RESULTS #1	
DRY DENSITY (PCF)	MOISTURE CONTENT (%)
102.3	13.8
106.9	16.2
107.4	18.2
106.1	19.9

TEST RESULTS #2	
DRY DENSITY (PCF)	MOISTURE CONTENT (%)

TEST METHOD: SP- STANDARD PROCTOR (ASTM-0698) MP-MODIFIED PROCTOR (ASTM-D1557)

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: Weldon Springs, MO.

CHECKED BY: LAB DM

DATE: September, 20, 1988

TAC

LAB NAME: Chen

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
Raffinate Pit No. 4	3B-31 ST-02	4.0 - 6.5	20.9	103.1
	ST-06	18.0 - 20.5	20.1	104.6
	3B-32 ST-01	1.0 - 3.5	20.1	101.4
	ST-02	9.0 - 10.5	26.4	90.5
	ST-05	18.5 - 21.0	36.3	82.9
	3B-33 ST-04	5.0 - 7.5		
	ST-14	22.0 - 24.5	15.7	100.7
	3B-34 SS-05	7.0 - 8.5	20.8	
	SB-17	27.0 - 28.5	15.4	111.0

TEST PROCEDURE: ASTM D2216, USACOE EM-1110-2-1906 (App.II)

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: Weldon Springs, MO.

DATE: September 20, 1988

LAB NAME: Chen

CHECKED BY: LAB DM

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
Raffinate Pit No. 4	3B-35 SS-02	3.0 - 4.5	22.5	
	SS-08	13.0 - 14.5	18.9	
	SS-11	17.5 - 19.0	16.0	
	SB-15	25.0 - 26.5	20.8	104.6
	SS-20	31.0 - 32.5	19.8	
	3B-36 ST-06	8.5 - 11.0	22.6	100.2
	SS-09	14.0 - 15.5	23.8	
	ST-12	18.5 - 21.0	21.5	97.8

TEST PROCEDURE: ASTM D2216, USACOE EM-1110-2-1906 (App. II)

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

MECHANICAL SIEVE TEST RESULTS

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: September 20, 1988

CHECKED BY: LAB DM

TAC

LAB NAME: Chen

SAMPLE ID	DEPTH INTERVAL (FT)	% PASSING STANDARD SIEVE NUMBERS *										
		3"	1 1/2"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200
3B-31 ST-02	4.0 - 6.5								98	96	92	90
ST-06	18.0 -20.5								98	98	97	96
3B-32 ST-01	1.0 - 3.5									99	97	96
ST-02	9.0 -10.5							98	97	94	89	85
ST-05	18.5 -21.0				*	97	94	92	91	90	89	89
3B-33 ST-04	5.0 - 7.5								99	98	97	96
ST-14	22.0 -24.5								99	98	96	94
3B-34 SS-05	7.0 - 8.5							99	98	94	85	80
SB-17	27.0 -28.5								99	97	95	93

TEST PROCEDURE: ASTM D-422

* Two pieces coarse aggregate removed from sample for representativeness.

*ENTER ONLY VALUES LESS THAN 100%.

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

MECHANICAL SIEVE TEST RESULTS

SITE ID: Waldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: September 20, 1988

CHECKED BY: LAB DM

TAC

LAB NAME: Chen

SAMPLE ID	DEPTH INTERVAL (FT)	% PASSING STANDARD SIEVE NUMBERS *										
		3"	1 1/2"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200
3B-35 SS-02	3.0- 4.5								99	97	93	90
SS-08	13.0-14.5								98	96	90	86
SB-15	25.0-26.5								99	98	96	95
SS-20	31.0-32.5										99	99
3B-36 ST-06	8.5-11.0						99	99	97	93	84	78
SS-09	14.0-15.5							99	98	97	96	95
ST-12	18.5-21.0									99	99	99

TEST PROCEDURE: ASTM D-422

*ENTER ONLY VALUES LESS THAN 100%.

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

HYDROMETER ANALYSIS TEST RESULTS

15

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: September 20, 1988

CHECKED BY: LAB DM

LAB NAME: Chen

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	% FINER THAN (mm) *							
		.074 mm	.05 mm	.037 mm	.019 mm	.009 mm	.005 mm	.002 mm	.001 mm
3B-31 ST-02	4.0- 6.5	90	-	75	56	40	34	30	27
ST-06	18.0-20.5	96	-	82	62	40	32	25	22
3B-32 ST-01	1.0- 3.5	96	-	83	62	40	32	24	22
ST-02	9.0-10.5	85	-	76	68	57	53	50	49
3B-33 ST-04	5.0- 7.5	96	-	75	63	44	38	32	30
ST-14	22.0-24.5	94	-	78	61	37	30	21	19
3B-34 SS-05	7.0- 8.5	80	-	75	62	56	50	45	42
SB-17	27.0-28.5	93	-	80	62	44	34	28	27

TEST PROCEDURE: ASTM D-422

* ENTER ONLY VALUE LESS THAN 100%

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

HYDROMETER ANALYSIS TEST RESULTS

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: September 20, 1988

CHECKED BY: LAB DM

LAB NAME: Chen

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	% FINER THAN (mm) *							
		.074 mm	.05 mm	.037 mm	.019 mm	.009 mm	.005 mm	.002 mm	.001 mm
3B-35 SS-02	3.0- 4.5	90	-	81	69	59	55	49	48
SS-08	13.0-14.5	86	-	79	66	52	48	43	39
SB-15	25.0-26.5	95	-	82	68	52	44	40	38
SS-20	31.0-32.5	99	-	88	72	50	39	32	30
3B-36 ST-06	8.5-11.0	78	-	69	60	54	48	43	41
SS-09	14.0-15.5	95	-	85	63	43	37	30	28
ST-12	18.5-21.0	99	-	91	73	50	40	32	29

TEST PROCEDURE: ASTM D-422

* ENTER ONLY VALUE LESS THAN 100%

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: September 20, 1988

CHECKED BY: LAB DM

LAB NAME: Chen

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY 3
3B-31 ST-02	4.0- 6.5	36	16	20	2.68
3B-32 ST-01	1.0- 3.5	32	19	13	
ST-02	9.0-10.5	64	18	46	
3B-33 ST-04	5.0- 7.5	45	18	27	
ST-14	22.0-24.5	30	20	10	
3B-34 SS-05	7.0- 8.5	55	17	38	
SB-17	27.0-28.5	40	17	23	
3B-35 SS-02	3.0- 4.5	59	18	41	
SS-08	13.0-14.5	49	18	31	2.63
SB-15	25.0-26.5	42	17	25	
SS-20	31.0-32.5	45	20	25	

TEST PROCEDURE: ASTM D4318, D854

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: September 20, 1988

CHECKED BY: LAB DM

LAB NAME: Chen

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY
3B-36 ST-06	8.5-11.0	48	16	32	
SS-09	14.0-15.5	43	19	24	
ST-12	18.5-21.0	46	17	29	2.70

TEST PROCEDURE: ASTM D4318, D854

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: September 30, 1988

LAB NAME: Chen

CHECKED BY: LAB Dm

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
3B-32 ST-01	1.0-3.5	N/A	504

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
100.1	25.4	100	0.685	0.96

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
100.1	25.4	100	0.685

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.20	1176	216	4.99	3322	-173
0.41	1836	259	6.00	3223	-230
0.60	2122	288	6.99	3141	-259
0.80	2464	259	8.00	3081	-288
1.01	2788	202	9.00	3147	-317
1.40	2705	72	10.00	3280	-331
1.80	2806	29			
2.20	2893	0			
2.60	2986	-14			
2.99	3079	-29			
3.50	3168	-43			
4.00	3271	-72			
4.51	3293	-130			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906 (App. X-29)

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: August 30, 1988

LAB NAME: Chen

CHECKED BY: LAB DM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
3B-32 ST-01	1.0-3.5	N/A	994

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
94.9	28.7	100	0.776	N/A

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
94.9	28.7	100	0.776

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.20	2324	230			
0.40	2955	317			
0.60	3460	374			
0.80	3866	374			
1.00	4169	374			
1.40	4393	346			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906 (App. X-29)

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: September 30, 1988

LAB NAME: Chen

CHECKED BY: LAB Drn

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
3B-32 ST-01	1.0-3.5	N/A	2995

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
96.5	27.7	100	0.747	N/A

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
96.5	27.7	100	0.747

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.20	5386	619	5.01	7588	1642
0.41	6519	936	6.00	7604	1642
0.59	7128	1109	7.00	7645	1627
0.80	7589	1210	8.00	7686	1627
1.00	7773	1310	9.00	7754	1598
1.40	7902	1426	10.00	7801	1584
1.79	7818	1498	12.01	7919	1555
2.20	7776	1541	13.99	8015	1512
2.60	7712	1570	16.00	8127	1469
2.99	7677	1584	17.99	8170	1440
3.50	7641	1613	20.01	8186	1411
4.01	7603	1627			
4.50	7597	1627			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906 (App. X-29)

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "B" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: October 5, 1988

LAB NAME: Chen

CHECKED BY: LAB DM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
3B-32 ST-02	9.0-10.5	N/A	994

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
90.9	31.7	100	0.856	0.97

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
90.9	31.7	100	0.856

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.20	1345	130	5.00	2306	187
0.39	1497	202	6.00	2426	158
0.61	1582	230	7.00	2487	130
0.80	1632	259	8.00	2534	101
1.00	1681	259	9.00	2543	72
1.39	1755	274	10.00	2543	29
1.80	1830	259	12.00	2586	-14
2.20	1898	245	14.00	2639	-86
2.61	1951	245	16.00	2808	-130
3.00	1990	245	18.00	2957	-173
3.50	2066	230	20.00	2972	-202
4.00	2114	216			
4.50	2230	187			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906(App. X-29)

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "B" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: October 5, 1988

LAB NAME: Chen

CHECKED BY: LAB Dr2

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
3B-32 ST-02	9.0-10.5	N/A	2002

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
90.2	32.2	100	0.869	0.99

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
90.2	32.2	100	0.869

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.20	2601	173			
0.40	2864	302			
0.60	3011	346			
0.79	3045	360			
1.01	3038	374			
1.21	3030	389			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906(App. X-29)

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: October 5, 1988

LAB NAME: Chen

CHECKED BY: LAB DM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
3B-32 ST-02	9.0-10.5	N/A	4003

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
95.7	28.2	100	0.761	0.99

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
95.7	28.2	100	0.761

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.20	4596	86	6.00	4490	2074
0.40	4923	288	7.00	4542	2074
0.59	5036	533	8.01	4577	2088
0.81	4999	778	8.99	4549	2088
1.00	4920	979	10.00	4539	2088
1.40	4813	1267	12.01	4580	2045
1.80	4743	1454	14.00	4765	2002
2.21	4667	1584	15.99	4937	1944
2.60	4613	1670	18.00	5097	1872
3.00	4529	1786	20.00	5189	1742
3.50	4400	1944			
4.00	4392	2002			
5.01	4439	2030			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906 (App. X-29)

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: October 12, 1988

LAB NAME: Chen

CHECKED BY: LAB DM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
3B-33 ST-04	5.0 - 7.5	N/A	504

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURA-TION (%)	VOID RATIO e	B PARAM.
90.9	31.7	100	0.855	0.99

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
90.9	31.7	100	0.855

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.20	757	72	5.01	1970	86
0.40	861	130	6.00	2059	58
0.60	961	144	7.01	2066	29
0.81	1072	202	8.00	2088	14
1.01	1189	245	9.01	2109	-29
1.40	1333	245	10.00	2136	-58
1.80	1428	230	12.00	2273	-101
2.20	1513	216	14.00	2475	-158
2.60	1597	202	16.00	2672	-216
3.01	1677	187	18.00	2750	-259
3.50	1761	158	20.02	2759	-317
4.00	1819	130			
4.50	1892	115			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906 (App. X-29)

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: October 12, 1988

LAB NAME: Chen

CHECKED BY: LAB. DM

TAC.

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
3B-33 ST-04	5.0 - 7.5	N/A	994

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
90.1	32.3	100	0.872	0.96

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
90.1	32.3	100	0.872

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.20	1846	230	5.00	2114	346
0.39	2037	374	5.99	2125	331
0.60	2174	446	7.01	2215	288
0.80	2158	490	8.00	2324	245
1.00	2107	533	9.00	2459	202
1.40	2182	504	10.00	2451	187
1.80	2213	475	12.00	2557	115
2.20	1988	475	14.00	2640	86
2.60	2106	446	16.01	2793	-14
3.01	2057	446	18.00	2863	-72
3.50	2081	432	20.01	3001	-130
4.00	2090	389			
4.50	2110	374			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906(App. X-29)

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "B" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: October 12, 1988

LAB NAME: Chen

CHECKED BY: LAB DM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
3B-33 ST-04	5.0 - 7.5	N/A	2995

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
96.4	27.7	100	0.749	0.98

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
96.4	27.7	100	0.749

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.20	3421	173	4.99	3775	1094
0.41	3546	288	5.99	3797	1109
0.59	3601	389	6.99	3771	1123
0.80	3618	490	8.01	3745	1138
1.00	3649	562	9.01	3756	1123
1.41	3693	706	10.01	3718	1123
1.79	3715	806	12.00	3837	1123
2.20	3755	878	14.00	3888	1123
2.61	3717	950	16.00	3941	1094
3.00	3744	979	18.00	3982	1066
3.50	3764	1022	19.99	3997	1022
4.00	3738	1066			
4.49	3754	1080			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906 (App X-29)

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: September 22, 1988

LAB NAME: Chen

CHECKED BY: LAB DM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
3B-35 SB-15	25.0-26.5	N/A	994

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
103.4	23.4	100	0.631	0.98

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
103.4	23.4	100	0.631

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.20	1528	173			
0.40	1750	302			
0.60	1853	389			
0.80	1860	475			
1.00	1892	504			
1.41	1924	562			
1.81	1921	590			
2.21	1932	605			
2.59	1914	648			
2.99	1970	648			
3.50	2007	634			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906 (App. X-29)

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: September 22, 1988

LAB NAME: Chen

CHECKED BY: LAB

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
3B-35 SB-15	25.0-26.5	N/A	2002

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
103.5	23.3	100	0.628	N/A

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
103.5	23.3	100	0.628

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.21	2858	274			
0.39	3150	418			
0.60	3316	562			
0.80	3319	648			
1.01	3320	706			
1.40	3271	778			
1.79	3250	821			
2.21	3244	850			
2.60	3221	864			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906 (App. X-29)

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: September 22, 1988

LAB NAME: Chen

CHECKED BY: LAB. [illegible]

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
3B-35 SB-15	25.0-26.5	N/A	4003

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
103.7	23.2	100	0.625	N/A

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
103.7	23.2	100	0.625

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.21	5516	274	5.01	5846	1411
0.40	5879	461	6.00	5769	1454
0.61	6100	634	7.01	5749	1498
0.80	6210	763	8.00	5771	1526
1.01	6225	864	9.01	5734	1555
1.41	6174	994	10.00	5739	1570
1.81	6105	1080	12.00	5882	1598
2.21	6036	1166	13.99	5976	1584
2.61	6010	1210	15.99	5994	1613
3.01	5984	1253	17.99	5959	1613
3.49	5940	1310	19.99	5887	1598
4.00	5923	1339			
4.50	5877	1368			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906 (App. X-29)

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: October 12, 1988

LAB NAME: Chen

CHECKED BY: LAB Dm

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
3B-36 ST-06	8.5 - 11.0	N/A	504

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
97.5	27.0	100	0.730	0.99

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
97.5	27.0	100	0.730

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.19	815	86	4.99	1089	115
0.40	887	144	5.99	1103	115
0.60	954	144	7.00	1119	101
0.81	978	158	8.00	1138	86
1.00	990	173	9.00	1148	72
1.41	1014	173	10.00	1142	86
1.79	1034	158	12.00	1205	43
2.20	1040	158	14.01	1212	43
2.60	1056	144	15.99	1221	43
3.00	1062	144	18.00	1232	29
3.50	1073	130	20.00	1235	29
4.01	1074	130			
4.50	1070	130			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906(App. X-29)

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: October 12, 1988

LAB NAME: Chen

CHECKED BY: LAB Dm

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
SB-36 ST-06	8.5 - 11.0	N/A	994

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURA-TION (%)	VOID RATIO e	B PARAM.
102.1	24.1	100	0.651	0.96

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
102.1	24.1	100	0.651

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.20	1407	86	5.00	2098	374
0.40	1547	158	6.01	2167	346
0.60	1660	216	7.00	2170	331
0.80	1747	245	8.00	2161	302
1.01	1848	259	8.99	2147	288
1.39	1930	302	10.00	2162	274
1.80	2097	346	12.00	2444	245
2.20	2181	389	14.01	2533	230
2.60	2245	389	16.00	2404	173
3.00	2260	403	18.00	2406	144
3.51	2287	389	20.00	2427	130
3.99	2293	374			
4.50	2154	374			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906 (App. X-29)

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: Weldon Springs, MO.

LOCATION ID: Raffinate Pit No. 4

DATE: October 12, 1988

LAB NAME: Chen

CHECKED BY: LAB Dm

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
3B-36 ST-06	8.5 - 11.0	N/A	2995

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
104.9	22.5	100	0.608	0.98

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
104.9	22.5	100	0.98

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0.20	3938	202	5.00	4917	1080
0.40	4180	360	6.00	4914	1051
0.60	4309	490	7.00	4754	1066
0.80	4415	590	8.00	4716	1051
1.00	4468	691	9.00	4808	1037
1.40	4557	821	10.00	5032	1022
1.80	4605	893	12.00	5181	979
2.20	4629	950	14.00	5344	922
2.60	4672	979	16.00	5358	864
3.00	4691	1008	18.00	5324	821
3.49	4767	1037	20.00	5197	792
4.00	4841	1066			
4.51	4869	1080			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: USACOE EM-1110-2-1906(App. X-29)

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: Weldon Springs, MO.

DATE: October 13, 1988

LAB NAME: Chen

CHECKED BY: LAB DM

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
Raffinate Pit No. 4	3B-33 ST-04	5.0 - 7.5	TX	N/A	32.0	32.0	90.4	90.4	100	100	1.94	1.1 E-7

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE:

ATTACHMENT 7

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: WSSRAP 3

DATE: January 1989

LAB NAME: Chen

Chen Job No.: 1 296 89

CHECKED BY: LAB HB

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%) 55	DRY DENSITY (PCF) 39
GT 42	ST 05	9.5 - 12.0	16.9	113.3
GT 42	SB 08	17.0 - 18.5	12.4	119.4
GT 43	SS 02	1.5 - 3.0	14.5	-
GT 43	ST 04	6.0 - 8.5	24.4	98.6
GT 43	ST 10	21.5 - 23.75	18.6	106.5
GT 43	SB 17	40.0 - 41.5	17.6	109.9
GT 43	SS 19	50.0 - 51.0	20.4	N.P.
GT 44	ST 03	5.0 - 7.5	17.6	106.2
GT 44	SB 10	22.5 - 24.0	45.0	76.5
GT 45	SS 01	1.0 - 2.5	18.1	N.P.
GT 45	ST 04	7.5 - 10.0	21.3	103.3
GT 45	ST 07	15.0 - 17.5	22.1	104.5

TEST PROCEDURE: D2216

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: WSSRAP 3

CHECKED BY: LAB JB

DATE: January 1989

TAC

LAB NAME: Chen

Chen Job No.: 1 296 89

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
GT 46	ST 03	5.0 - 7.5	22.1	99.6
GT 47	ST 05	10.0 - 12.5	22.9	99.5
GT 47	SB 09	20.0 - 21.5	20.5	72.4
GT 47	SS 14	32.5 - 34.0	14.8	-
GT 48	ST 03	7.5 - 10.0	27.7	90.3
GT 48	ST 05	12.5 - 15.0	22.4	101.3
GT 48	ST 07	17.5 - 20.0	27.8	93.9
GT 48	SS 12	30.0 - 31.5	18.5	N.P.
GT 50	ST 02	2.5 - 5.0	21.1	104.7
GT 50	ST 06	12.5 - 15.0	26.9	95.8
GT 50	SB 08	17.5 - 19.0	14.0	114.3
GT 50	SS 14	32.5 - 34.0	18.0	-

TEST PROCEDURE: D2216

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: WSSRAP 3

CHECKED BY: LAB

DATE: Janurary 1989

TAC

LAB NAME: Chen

Chen Job No.: 1 296 89

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
GT 51	SS 01	0.0 - 1.5	22.9	N.P.
GT 51	ST 03	5.0 - 7.5	21.4	101.6
GT 51	ST 07	15.0 - 17.5	17.5	112.6
GT 51	SB 09	20.0 - 21.5	33.7	88.7
GT 51	SS 11	25.0 - 26.5	10.1	-
GT 52	ST 04	10.0 - 12.5	23.9	101.3
GT 52	ST 06	15.0 - 17.5	23.8	100.5
GT 52	SS 09	22.5 - 24.0	18.2	-
GT 52	SS 11	27.5 - 29.0	15.6	115.0
GT 52	SB 14	35.0 - 36.5	19.0	101.6
GT 52	SS 17	42.5 - 44.0	25.7	N.P.
GT 53	ST 02	2.5 - 4.0	21.4	102.3
GT 53	ST 04	7.5 - 10.0	22.3	103.8

TEST PROCEDURE: D2216

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: WSSRAP 3

CHECKED BY: LAB

DATE: January 1989

TAC

LAB NAME: Chen

Chen Job No. 1 296 89.

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
GT 53	ST 08	17.5 - 20.0	21.6	104.8
GT 53	SS 15	35.0 - 36.5	23.1	N.P.
GT 54	ST 03	4.5 - 7.0	21.8	100.1
GT 54	SS 08	17.0 - 18.5	21.8	-
GT 55	ST 02	2.5 - 5.0	22.8	96.0
GT 55	ST 04	7.5 - 10.0	30.7	89.4
GT 55	ST 06	12.5 - 15.0	22.8	103.7
GT 55	ST 08	17.5 - 20.0	22.5	103.0
GT 55	SB 12	27.5 - 29.0	25.2	99.6
GT 56	ST 02	5.0 - 7.5	20.4	101.1
GT 56	ST 04	10.0 - 12.5	26.5	98.1
GT 56	ST 06	15.0 - 17.0	19.0	109.9

TEST PROCEDURE: D2216

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: WSSRAP 3

CHECKED BY: LAB

DATE: January 1989

TAC

LAB NAME: Chen

Chen Job No.: 1 296 89

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
GT 56	SB 08	19.5 - 21.0	21.5	105.6
GT 56	SS 09	22.0 - 23.5	27.1	-
GT 57	SS 02	5.0 - 6.5	26.3	-
GT 57	ST 03	7.5 - 10.0	27.4	93.5
GT 57	SS 06	15.0 - 16.5	22.7	-
GT 57	SB 11	27.5 - 29.0	17.1	N.P.

TEST PROCEDURE: D2216

Request # 2
P.O. # 3509 - 1002 - 3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: WJJRAP

LOCATION ID: Disposal Cell

DATE: 1-2-89

CHECKED BY: LAE YY

LAE NAME: Geotechnology, Inc.

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY	SOIL CLASSIFICATION
GT-2T71 BU-01A	3.5 - 6.5				2.69	
GT-2T71 BU-02A	6.5 - 12				2.51	
GT-2T~~71~~72 BU-01A	7.0 - 10.5				2.68	
GT-2T74 BU-01A	4 - 8.5 * ~~7.0 - 10.5~~				2.74	
GT-2T75 BU-01A	2.5 - 6.5				2.61	
GT-2T75 BU-02B	6.5 - 12				2.71	
GT-2T77 BU-01B	1.5 - 4.0				2.55	
GT-2T77 BU-02A	7 - 10.5				2.66	
GT-2T78 BU-01A	4 - 6.5				2.71	
GT-2T78 BU-02B	6.5 - 12				2.69	
GT-2T79 BU-02A	6.5 - 12				2.72	

MISLABELLING
* CORRECTIONS MADE BY MKP, ECT 11/2/90

TEST PROCEDURE: Atterberg Limit (ASTM D4318)
Specific Gravity (ASTM D854)

Request #2

P.O. #3589-1002-3445

A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: WJURAP

DATE: 11-15-89

LAB NAME: Geotechnology

CHECKED BY: LAB 99

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
GT-2T71	BU-01A	3.5 - 6.5	28.3	N/A
GT-2T71	BU-02A	6.5 - 12.0	17.3	N/A
GT-2T72	BU-01A	7.5 - 10.5	22.1	N/A
GT-2T74	BU-01A	4 - 8.5	25.9	N/A
GT-2T75	BU-01A	2.5 - 6.5	20.8	N/A
GT-2T75	BU-02B	6.5 - 12.0	23.1	N/A
GT-2T77	BU-01B	1.5 - 4.0	16.6	N/A
GT-2T77	BU-02A	7.0 - 10.5	24.4	N/A
GT-2T78	BU-01A	4.0 - 6.5	14.7	N/A
GT-2T78	BU-02B	6.5 - 12.0	20.1	N/A
GT-2T79	BU-01A	1 - 6.5	14.0	N/A
GT-2T79	BU-02A	6.5 - 12.0	23.1	N/A
GT-2T80	BU-01A	0.5 - 8.0	18.1	N/A
GT-2T81	BU-01A	0.5 - 6.5	20.4	N/A
GT-2T81	BU-02A	6.5 - 12.0	21.0	N/A

TEST PROCEDURE: ASTM D2216

Request #2
P.O. # 3589-100L-3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: WJJ PAP

CHECKED BY: LAB 44

DATE: 11-15-89

TAC

LAB NAME: Geotechnology Inc

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
GT-2782	Bu-01A	0.5 - 3.5	13.8	N/A
GT-2782	Bu-02A	3.5 - 6.0	25.2	N/A
GT-2782	Bu-03A	6 - 10.0	16.2	N/A

TEST PROCEDURE: ASTM D2216

MKF-AL-ENG-6 (4/87)

ATTACHMENT 6

H 31

WATER CONTENT AND LIMIT DETERMINATIONS

PROJECT WSSRAR
JOB NO. 11295 DATE 6/7/89
BORING NO. GT-2T 79/82 TESTED BY SG
CALCULATED BY LAK CHECKED BY ML

Sample No. GT2T79	BU-01A					
Type of Test	mc	mc	LL	LL	PL	PL
Container No.	SG-10	S-11	SG-12	SG-13	SG-14	SG-15
No. of Blows			30	30		
Wt. Sample+Tare Wet	23.65	22.93	13.10	15.19	9.74	9.86
Wt. Sample+Tare Dry	20.88	20.21	9.23	10.64	8.17	8.24
Wt. of Water						
Tare	1.24					
Wt. of Dry Soil						
Water Content	MC=14.2	LL=49	PL=23	PI=26		

Sample No. GT-2T82	BU-01A					
Type of Test	mc	mc	LL	LL	PL	PL
Container No.	SG-20	SG-21	SG-22	SG-23	SG-24	SG-25
No. of Blows			30	30		
Wt. Sample+Tare Wet	21.44	22.84	16.67	15.38	9.91	9.84
Wt. Sample+Tare Dry	18.92	20.10	12.16	11.25	8.55	8.49
Wt. of Water						
Tare	1.24					
Wt. of Dry Soil						
Water Content	MC=24.4	LL=42	PL=19	PI=23		

Sample No.						
Type of Test						
Container No.						
No. of Blows						
Wt. Sample+Tare Wet						
Wt. Sample+Tare Dry						
Wt. of Water						
Tare						
Wt. of Dry Soil						
Water Content						

B 56

Request # 4
P.O. # 3509-1002-3445

MK FERGUSON
A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: WJJRAP

CHECKED BY: LAB 47

DATE: 1-9-90

TAC

LAB NAME: Geotechnology Inc

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
DISPOSAL CELL	GT-58P STO3	TOP 7.5 - 10	21.5	N/A
"	GT-58P STO3	BOT 7.5 - 10	11.7	N/A
"	GT 59 STO2	5 - 7.5	*	*
"	GT59 STO6	15 - 17.5	*	*
"	GT 62 STO7	TOP 17.5 - 20.0	30.5	*
"	GT 62 STO7	BOTTOM 17.5 - 20.0	25.0	*
"	GT 67P STO4	10 - 12.5	*	*

* classification and sample information only

TEST PROCEDURE: MOISTURE CONTENT (ASTM)
DRY DENSITY (ASTM D2937)

MKF-AL-ENG-6 (4/87)

ATTACHMENT 6

K 104

Request # 4
P.O.# 3509 - 1002 - 3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: WSS RAP (DISPOSAL CELL) CHECKED BY: LAB 47

DATE: 1-4-~~89~~ 90 TAC

LAB NAME: Geotechnology, Inc.

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
GT-58P	ST01	TOP 2.5-5.0	19.8	N/A
GT-58P	JT01	BOTTOM 2.5-5.0	26.0	N/A
GT-58P	SB-11	28.5-29	1.30	117.4
GT-61	SB-13	50.5-51.5	11.0	118.9

TEST PROCEDURE: MOISTURE CONTENT (ASTM D2216)
DRY DENSITY (ASTM D2937)

MKF-AL-ENG-6 (4/87)

ATTACHMENT 6 J 94

Report # 4
P.O.# 3589-100C-3445

A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: DU POUR CELL

CHECKED BY:LAB 44

DATE: 12-19-89

TAC

LAB NAME: Geo technology

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
GT-638	5109	22.5-25.0	16.4	113.9

TEST PROCEDURE:

MKF-AL-ENG-6 (4/87)

ATTACHMENT 6

I 16

Request # 4
P.O. # 3509 - 1002 - 3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: WJSRAP

LOCATION ID: Disposal cell

DATE: 1-4-90

CHECKED BY: LAB 47

LAB NAME: Geotechnology, Inc

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY	SOIL CLASSIFICATION
GT 58P ST01	2.5-5.0	54	21	~~24~~ 23*		CH
GT-58P ST03	7.5-10				2.69	
GT-58P ST09	22.5-24				2.65	
GT 60 P ST10-	27.5-30				2.70	
GT-62 SB15	38-39-				2.76	
GT-63P JT09	22.5-25				2.75	

MATH ERROR
* CORRECTION MADE BY MK
ECT, 1/2/90

TEST PROCEDURE: Atterberg Limit (ASTM D4318)
Specific Gravity (ASTM D854)

Request # 4
P.O. # 3509 - 1002 - 3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: WJJRAP

LOCATION ID: Disposal cell

DATE: 2/15/90

CHECKED BY: LAE 4/4

LAB NAME: Geotechnology Inc

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY	SOIL CLASSIFICATION
GT-60P ST04	12.5'-15'				2.72	

TEST PROCEDURE: Atterberg Limit (ASTM D4318)
Specific Gravity (ASTM D854)

K 110

GRADATION AND ATTERBERG LIMIT TESTS

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: See Below

DATE: January 1989

CHECKED BY: LAB RM

LAB NAME: Chen

TAC

Chen Job No.: 1 296 89

LOCATION/ SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX 27 (%)	SPECIFIC GRAVITY 10
GT 43/ ST 04	6.0 - 8.5	48	16	32	2.658
GT 43/ ST 10	21.5 - 23.75	47	15	32	2.713
GT 43/ SB 17	40.0 - 41.5	31	19	12	2.587
GT 47/ ST 05	10.0 - 12.5	45	17	28	2.688
GT 47/ SB 09	20.0 - 21.5	51	15	36	-
GT 48/ ST 03	7.5 - 10.0	41	18	23	-
GT 48/ ST 07	17.5 - 20.0	60	17	43	2.672
GT 50/ ST 02	2.5 - 5.0	47	18	29	2.719
GT 50/ ST 06	12.5 - 15.0	63	18	45	2.736
GT 51/ SS 01	0.0 - 1.5	33	22	11	-
GT 51/ ST 03	5.0 - 7.5	44	16	28	2.634

TEST PROCEDURE: D-4318 & D-854

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: See Below

DATE: January 1989

CHECKED BY: LAB RM

LAB NAME: Chen

TAC

Chen Job No.: 1 296 89

LOCATION/ SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY
GT 51/ ST 07	15.0 - 17.5	39	14	25	2.675
GT 51/ SB 09	20.0 - 21.5	74	24	50	2.788
GT 52/ ST 04	10.0 - 12.5	61	17	44	-
GT 52/ ST 06	-	-	-	-	2.786
GT 52/ SB 14	35.0 - 36.5	42	14	28	2.638
GT 53/ ST 04	7.5 - 10.0	54	16	38	2.731
GT 53/ ST 08	17.5 - 20.0	58	17	41	2.704
GT 54/ ST 03	4.5 - 7.0	42	17	25	-
GT 55/ ST 04	7.5 - 10.0	50	21	29	2.746
GT 55/ ST 06	12.5 - 15.0	51	18	33	2.821
GT 55/ ST 08	17.5 - 20.0	42	15	27	-

TEST PROCEDURE: D-4318 & D-854

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: WSSRAP-3

LOCATION ID: See Below

DATE: January 1989

CHECKED BY: LAB RM

LAB NAME: Chen

TAC

Chen Job No.: 1 296 89

LOCATION/ SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY
GT 55/ SB 12	27.5 - 29.0	70	20	50	-
GT 56/ ST 02	5.0 - 7.5	30	18	12	2.615
GT 56/ ST 06	15.0 - 17.0	44	15	29	-
GT 56/ SB 08	19.5 - 21.0	42	15	27	2.664
GT 56/ SS 09	22.0 - 23.5	71	21	50	-
GT 57/ ST 03	7.5 - 10.0	42	17	25	-

TEST PROCEDURE: D-4318 & D-854

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

MECHANICAL SIEVE TEST RESULTS

22

SITE ID: WSSRAP 3

LOCATION ID: See Below

DATE: January 1989

CHECKED BY: LAB RM

TAC

LAB NAME: Chen

Chen Job No.: 1 296 89

LOCATION/ SAMPLE ID	DEPTH INTERVAL (FT)	% PASSING STANDARD SIEVE NUMBERS *										
		3"	1 1/2"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200
GT 43/ ST 10	21.5-23.75						100	99	97	92	82	74
GT 43/ SS 19	50.0-51.0		100	88	82	71	55	42	33	29	26	25
GT 47/ ST 05	10.0-12.5							100	99	99	98	98
GT 48/ ST 03	7.5-10.0							100	99	99	98	97
GT 48/ ST 07	17.5-20.0								100	99	99	98
GT 50/ ST 02	2.5- 5.0									100	99	99
GT 50/ ST 06	12.5-15.0							100	99	98	97	95
GT 51/ ST 03	5.0- 7.5								100	99	99	98
GT 51/ ST 07	15.0- 17.5						98	96	93	87	75	70
GT 51/ SB 09	20.0-21.5			100	97	96	92	88	86	84	83	81
GT 52/ SB 14	35.0-36.5						100	98	96	91	81	74

TEST PROCEDURE: D-422

*ENTER ONLY VALUES LESS THAN 100%.

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

HYDROMETER ANALYSIS TEST RESULTS 18

SITE ID: WSSRAP 3

LOCATION ID: See Below

DATE: January 1989

CHECKED BY: LAB RM

LAB NAME: Chen

TAC

Chen Job No.: 1 296 89

LOCATION SAMPLE ID	DEPTH INTERVAL (FT)	% FINER THAN (mm) *							
		.074 mm	.05 mm	.037 mm	.019 mm	.009 mm	.005 mm	.002 mm	.001 mm
GT 43/ ST 10	21.5-23.75			65	57	51	45	37	34
GT 47/ ST 05	10.0-12.5			77	63	45	39	35	33
GT 48/ ST 03	7.5-10.0			92	71	49	39	31	28
GT 48/ ST 07	17.5-20.0			87	71	57	51	45	42
GT 50/ ST 02	2.5- 5.0			89	69	47	39	32	30
GT 50/ ST 06	12.5-15.0			88	73	59	53	49	46
GT 51/ ST 03	5.0- 7.5			83	63	43	35	31	28
GT 51/ ST 07	15.0-17.5			61	51	41	37	33	30
GT 51/ SB 09	20.0-21.5			81	78	72	70	67	64
GT 52/ SB 14	35.0-36.5			68	60	50	43	35	34

TEST PROCEDURE: D-422

* ENTER ONLY VALUE LESS THAN 100%

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

MECHANICAL SIEVE TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: See Below

DATE: January 1989

CHECKED BY: LAB RM

TAC

LAB NAME: Chen

LOCATION/ SAMPLE ID	DEPTH INTERVAL (FT)	% PASSING STANDARD SIEVE NUMBERS *										
		3"	1 1/2"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200
GT 53/ ST 04	7.5-10.0								100	99	98	97
GT 53/ ST 08	17.5-20.0							100	98	95	88	84
GT 53/ SS 15	35.0-36.5		100	95	86	78	71	66	62	58	55	53
GT 54/ ST 03	4.5- 7.0						100	99	98	98	98	97
GT 55/ ST 04	7.5-10.0									100	99	99
GT 55/ ST 06	12.5-15.0									100	99	99
GT 56/ ST 02	5.0- 7.5								100	99	98	98
GT 56/ ST 06	15.0-17.0						100	99	97	92	81	74
GT 56/ SB 08	19.5-21.0						100	99	97	92	82	81
GT 56/ SS 09	22.0-23.5			100	97	96	95	94	92	92	91	90
GT 57/ SB 11	27.5-29.0	100	82	64	50	45	42	39	37	36	35	35

TEST PROCEDURE: D-422

*ENTER ONLY VALUES LESS THAN 100%.

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

HYDROMETER ANALYSIS TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: See Below

DATE: January 1989

CHECKED BY: LAB RM

LAB NAME: Chen

TAC

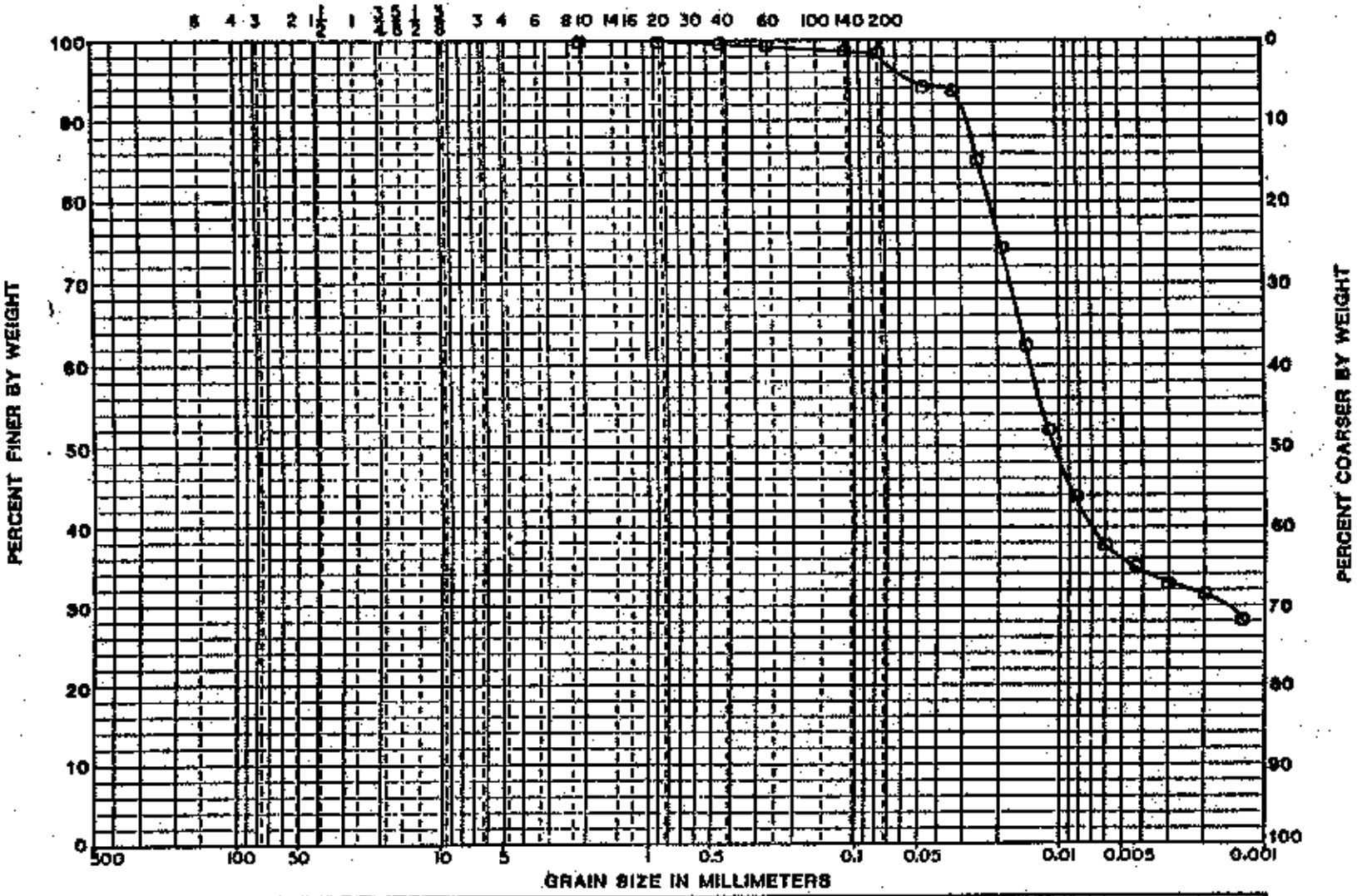
Chen Job No.: 1 296 89

LOCATION/ SAMPLE ID	DEPTH INTERVAL (FT)	% FINER THAN (mm) *							
		.074 mm	.05 mm	.037 mm	.019 mm	.009 mm	.005 mm	.002 mm	.001 mm
GT 53/ ST 04	7.5-10.0			87	71	55	49	44	42
GT 53/ ST 08	17.5-20.0			77	69	59	53	46	44
GT 54/ ST 03	4.5- 7.0			89	73	55	46	39	38
GT 55/ ST 04	7.5-10.0			89	75	57	49	42	40
GT 55/ ST 06	12.5-15.0			85	64	46	40	34	32
GT 56/ ST 02	5.0- 7.5			80	62	40	30	24	22
GT 56/ ST 06	15.0-17.0			67	59	51	45	38	36
GT 56/ SB 08	19.5-21.0			70	62	50	44	39	36

TEST PROCEDURE: D-422

* ENTER ONLY VALUE LESS THAN 100%

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU 01A	3.5-6.5	CL	24.9	39	22	17

PROJECT NSSRAP

BORING NO. CT-2T 71

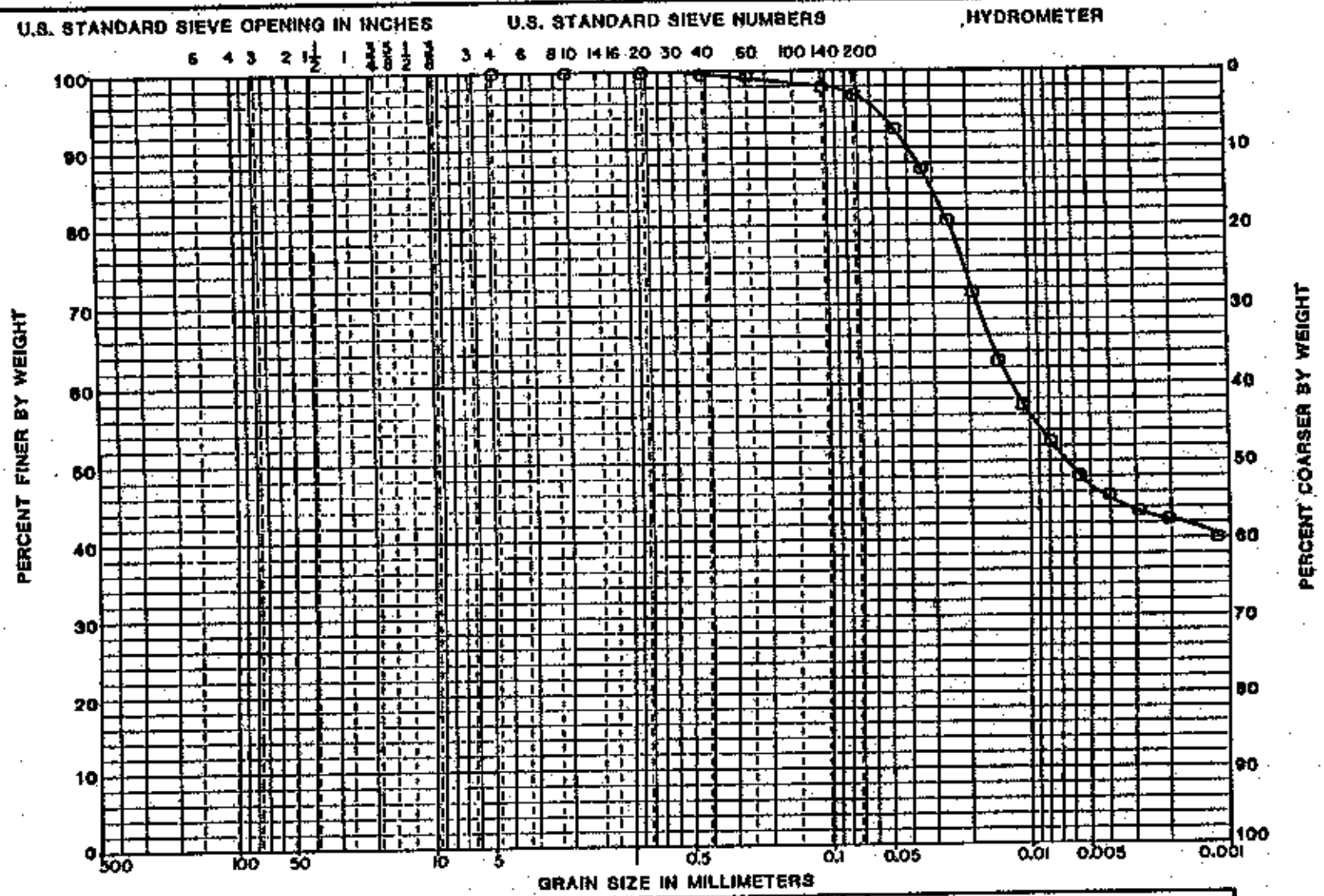
DATE 6-22-89

GEOTECHNOLOGY

11295

PLATE C6

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU 02A	6.5-12	CH	19.0	52	15	37

PROJECT WSSRAP

BORING NO. GT-2T 71

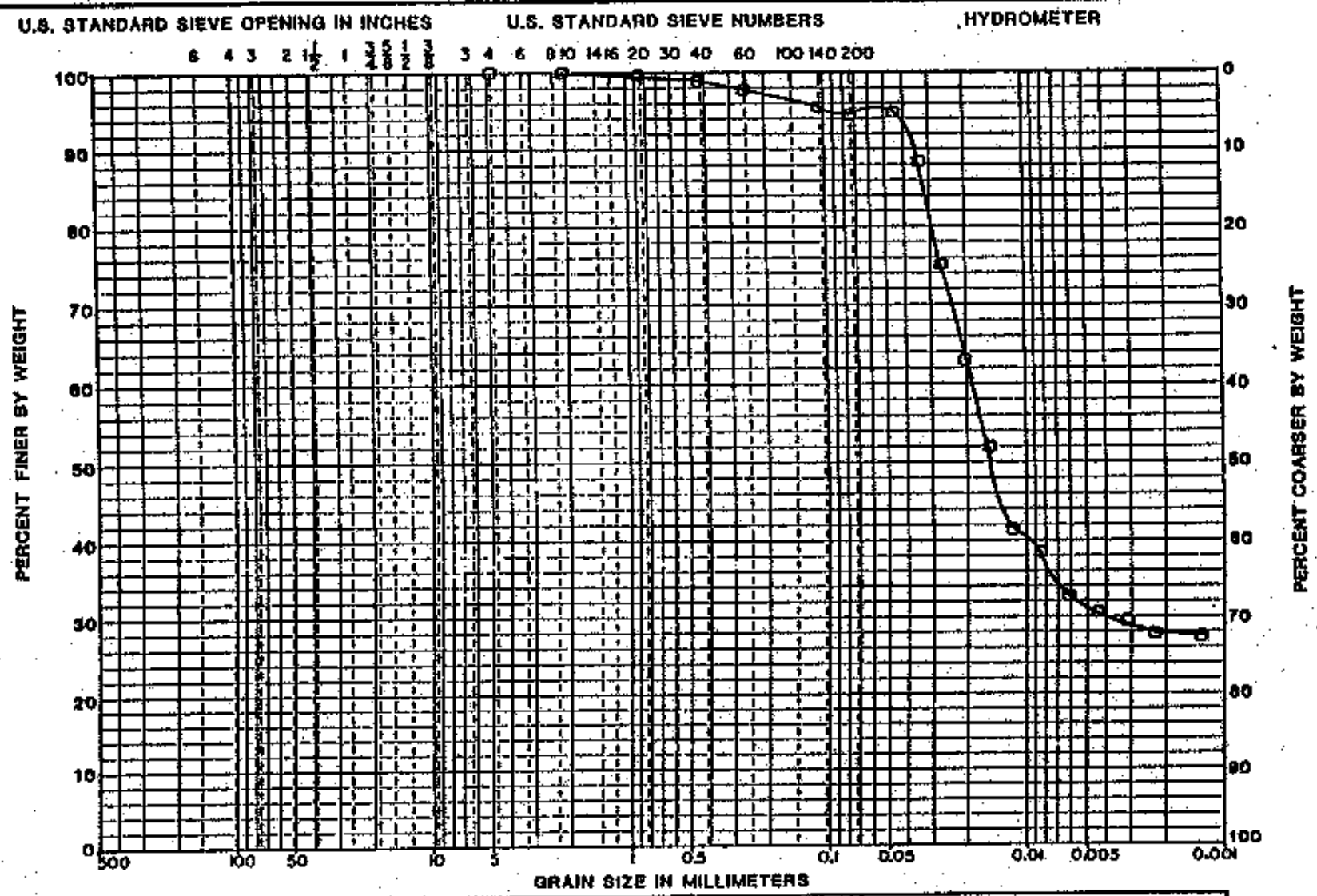
DATE 6-22-89

GEOTECHNOLOGY

PLATE 32

11295

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU 01A	7.5-10.5	CL-ML	23.9	27	21	6

PROJECT WSSRAP

BORING NO. GT-2T 72

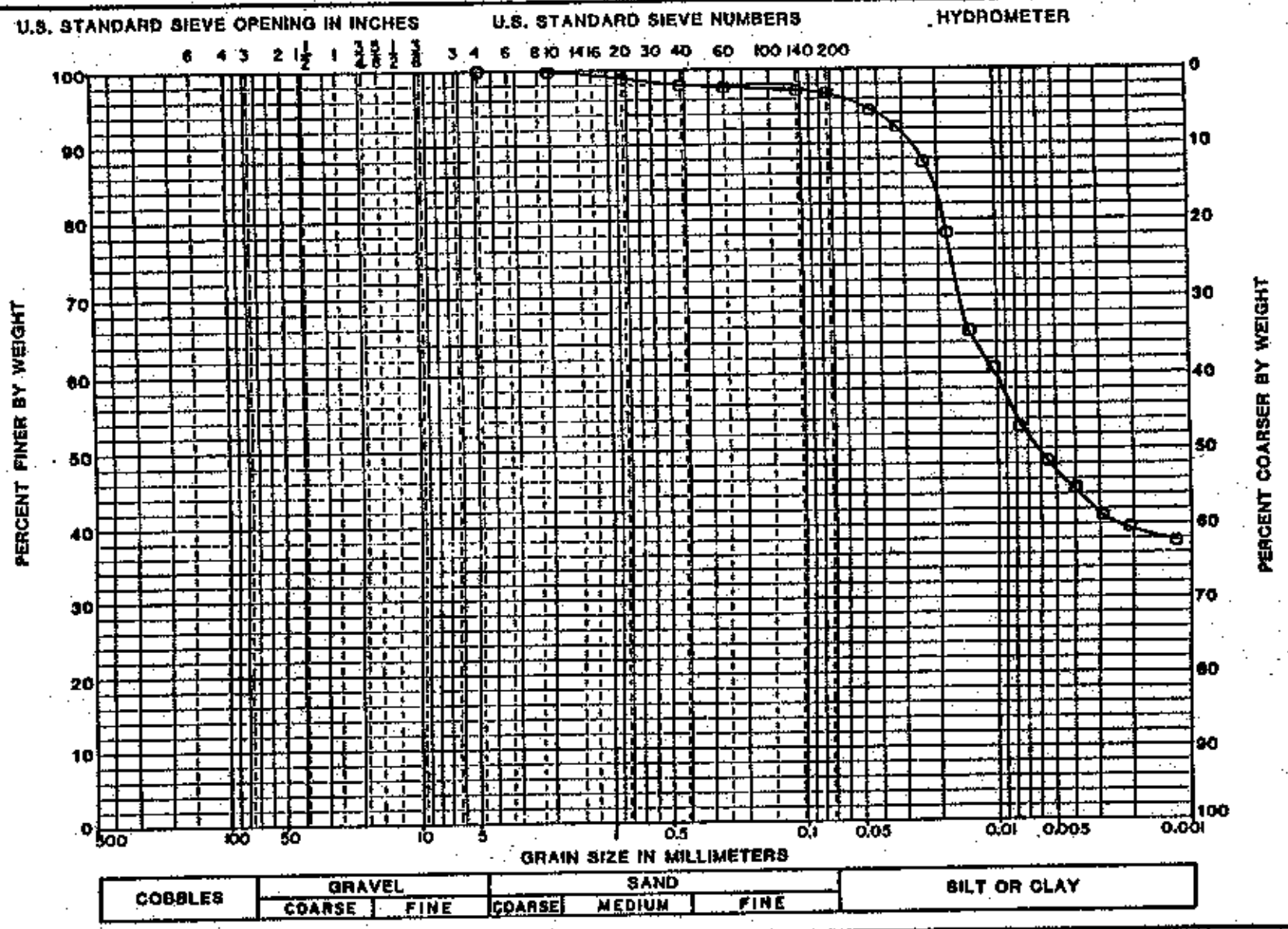
DATE 6-22-88

GEOTECHNOLOGY

PLATE 10

·11295

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU D1A	4.0-8.5	CL	30.1	42	18	24

PROJECT WSSRAP

BORING NO. GT-2T 74

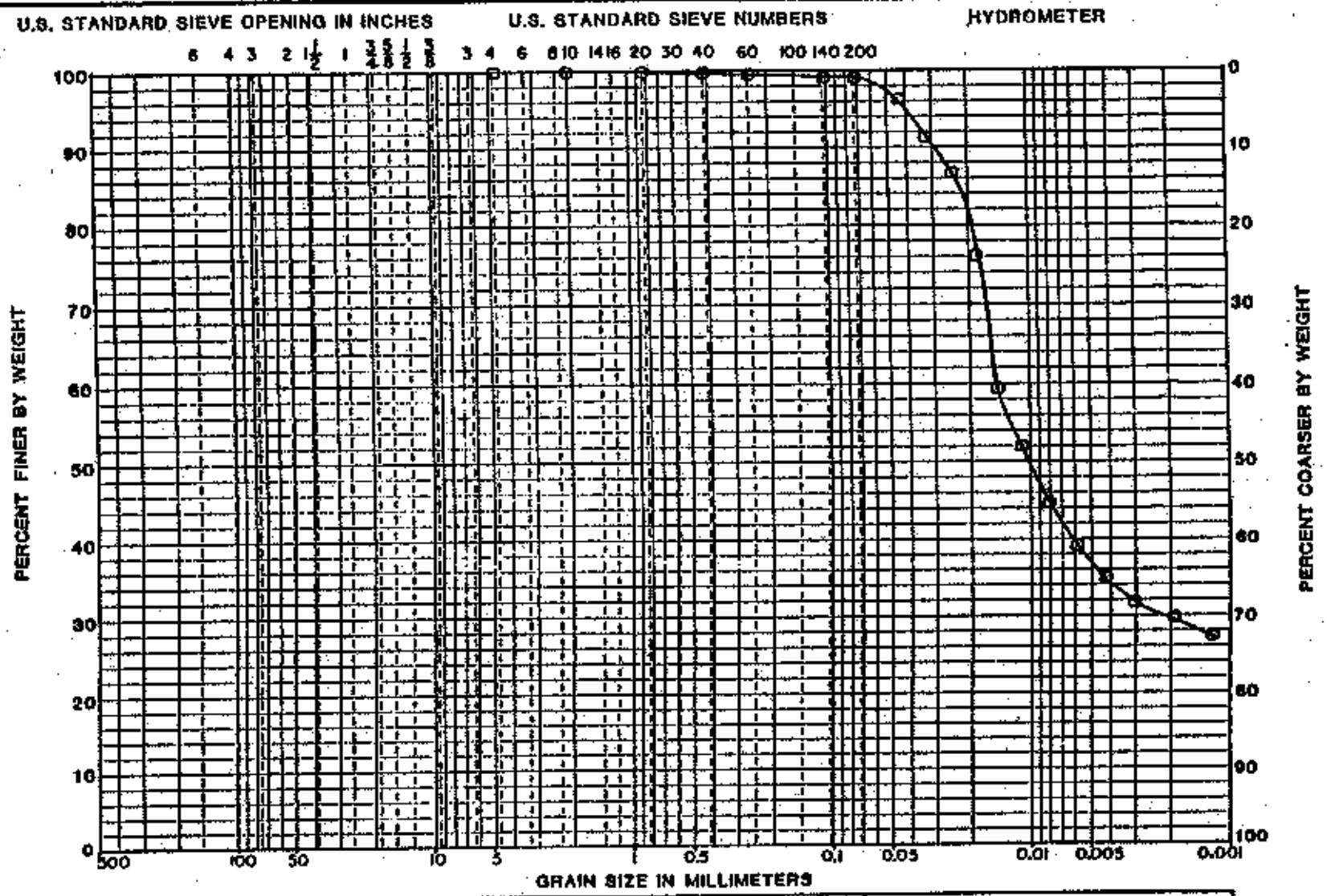
DATE 6-22-89

GEOTECHNOLOGY

PLATE 36

11295

GRADATI CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BW-01A	~~4-6.5~~ 2.5-6.5*	CL	22.0	39	22	17

PROJECT WSSRAP

BORING NO. GT-2175

DATE 8-7-89

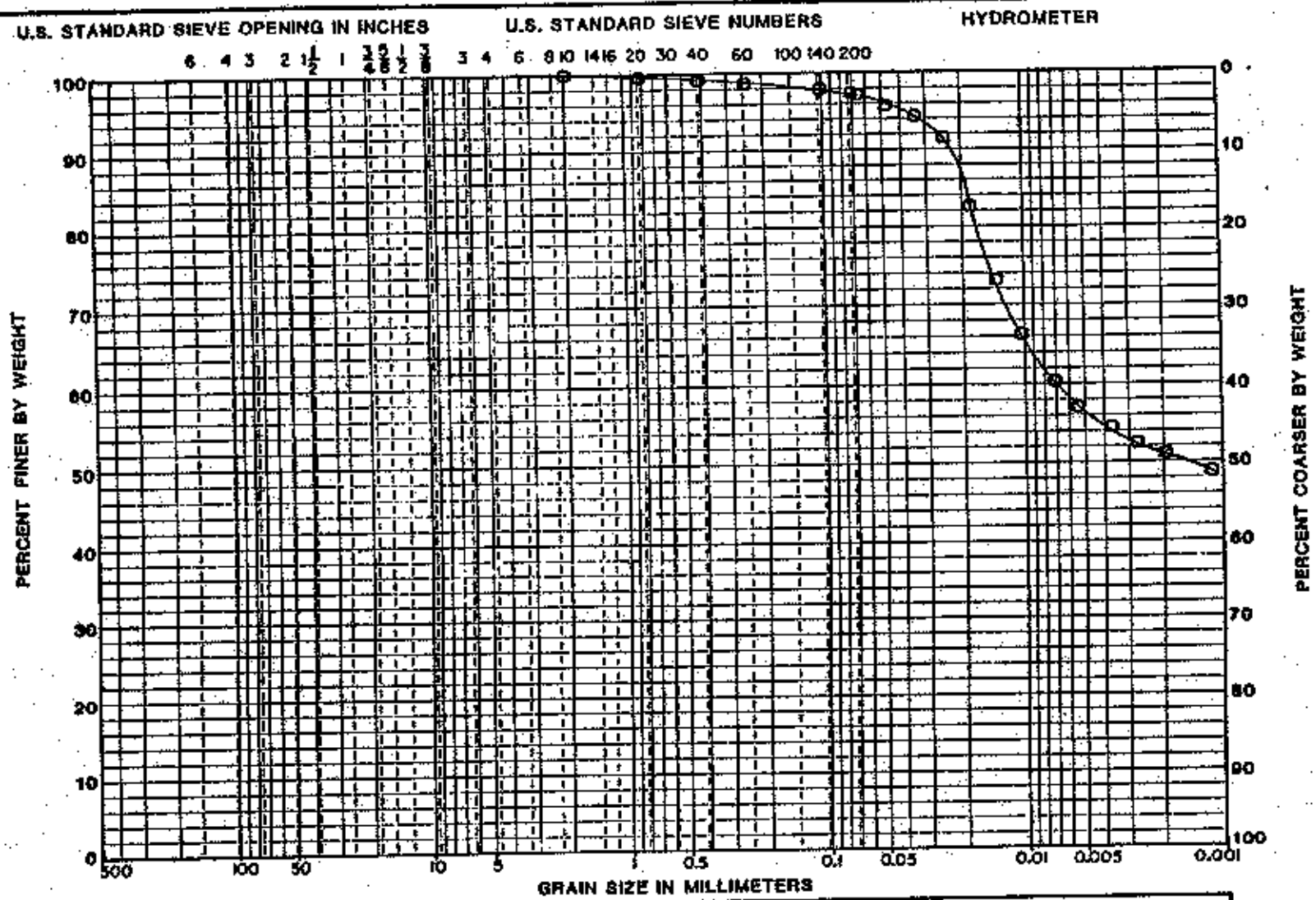
GEOTECHNOLOGY

*Corrected by S.G (MKF) 11/09/90

PLATE C/4

11295

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-02B	6.5-12	CH	24.6	77	21	56

PROJECT WSSRAP

BORING NO. GT-2175

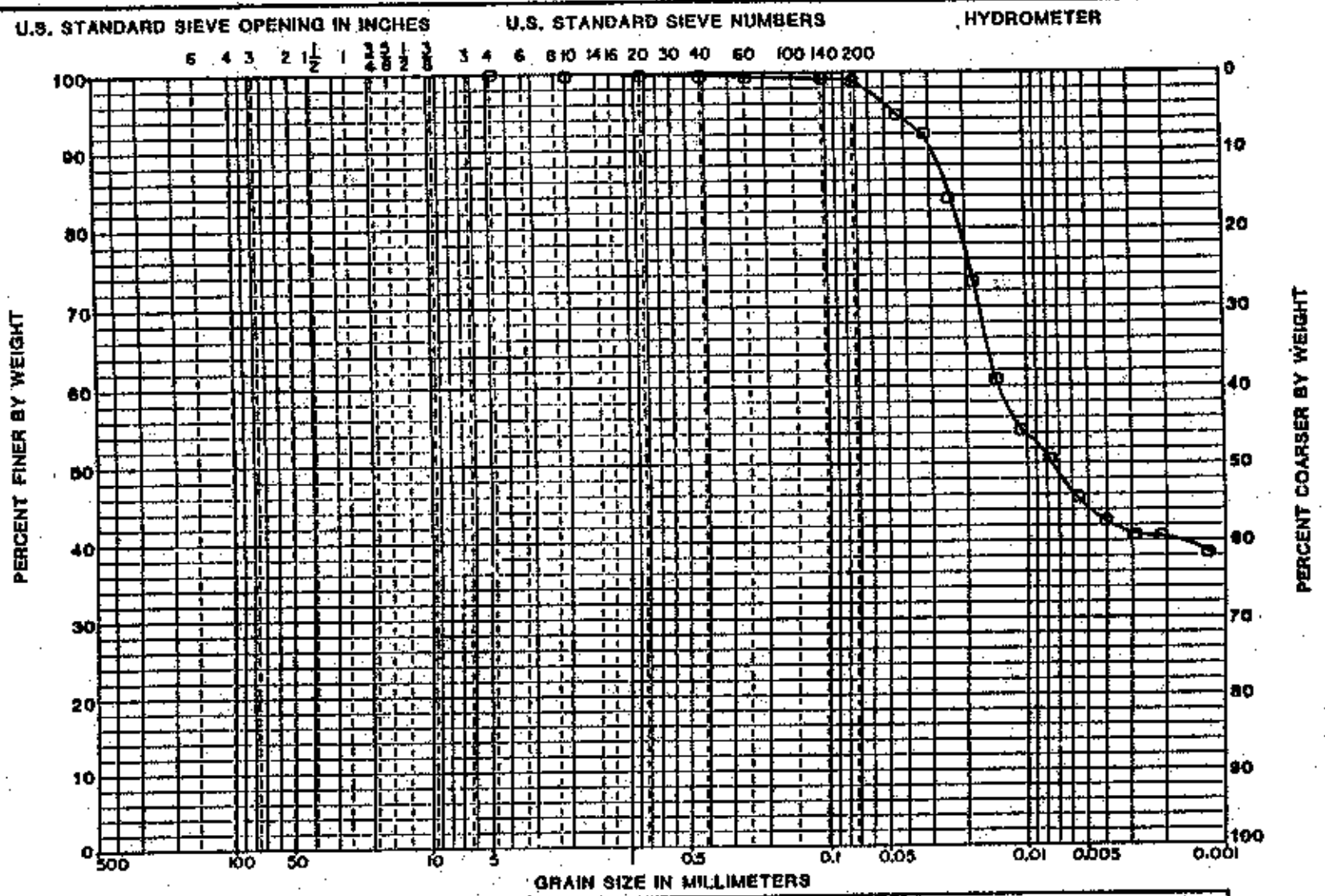
DATE 11-30-89

GEOTECHNOLOGY

11295

PLATE J-24

GRADATI CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU 018	1.5-4.0	CH	18.0	50	17	33

PROJECT WSSRAP

BORING NO. GT-2T 77

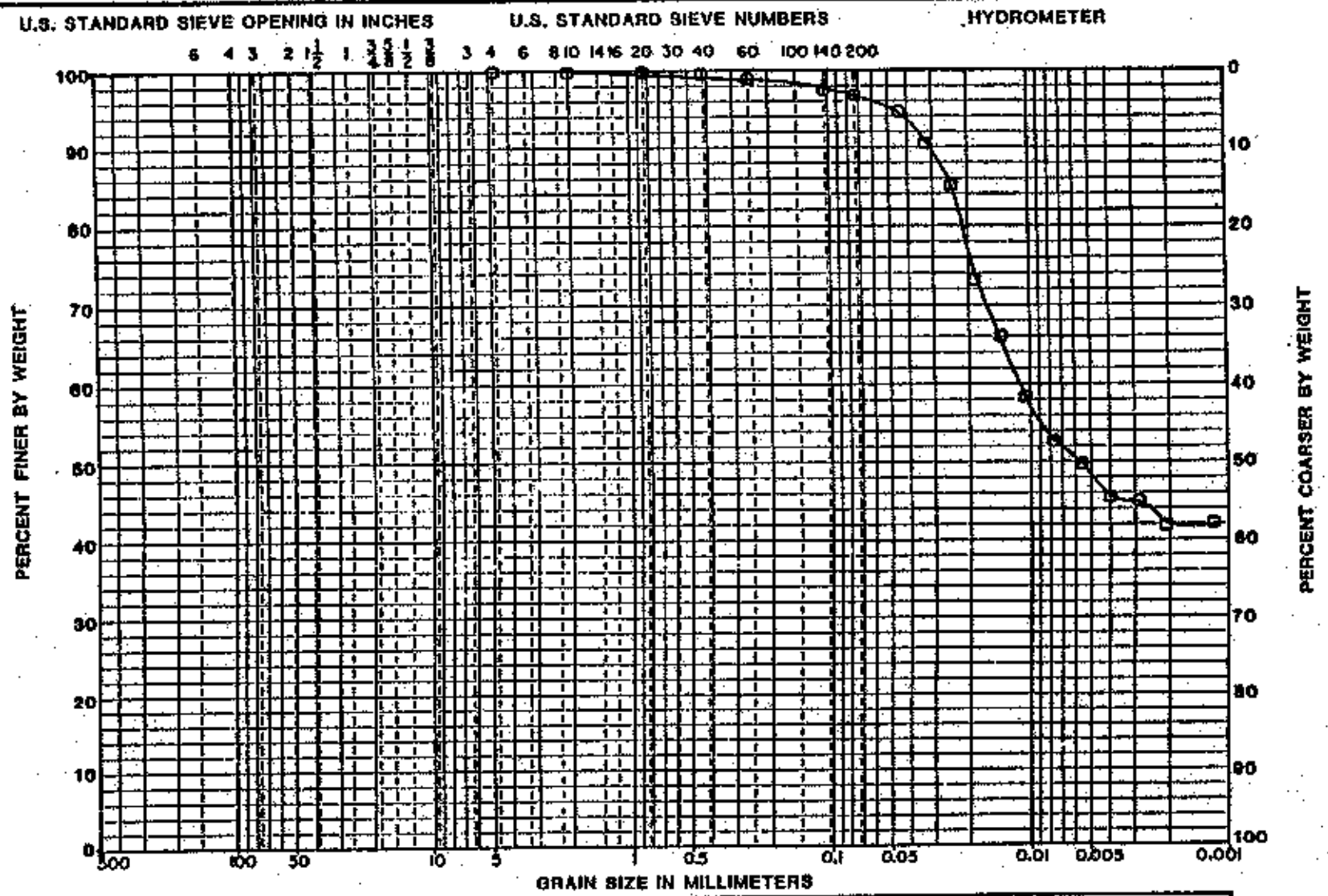
DATE 6-22-88

GEOTECHNOLOGY

11295

PLATE D40

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU 02A	7.0-10.5	CL	25.0	49	23	26

PROJECT WSSRAP

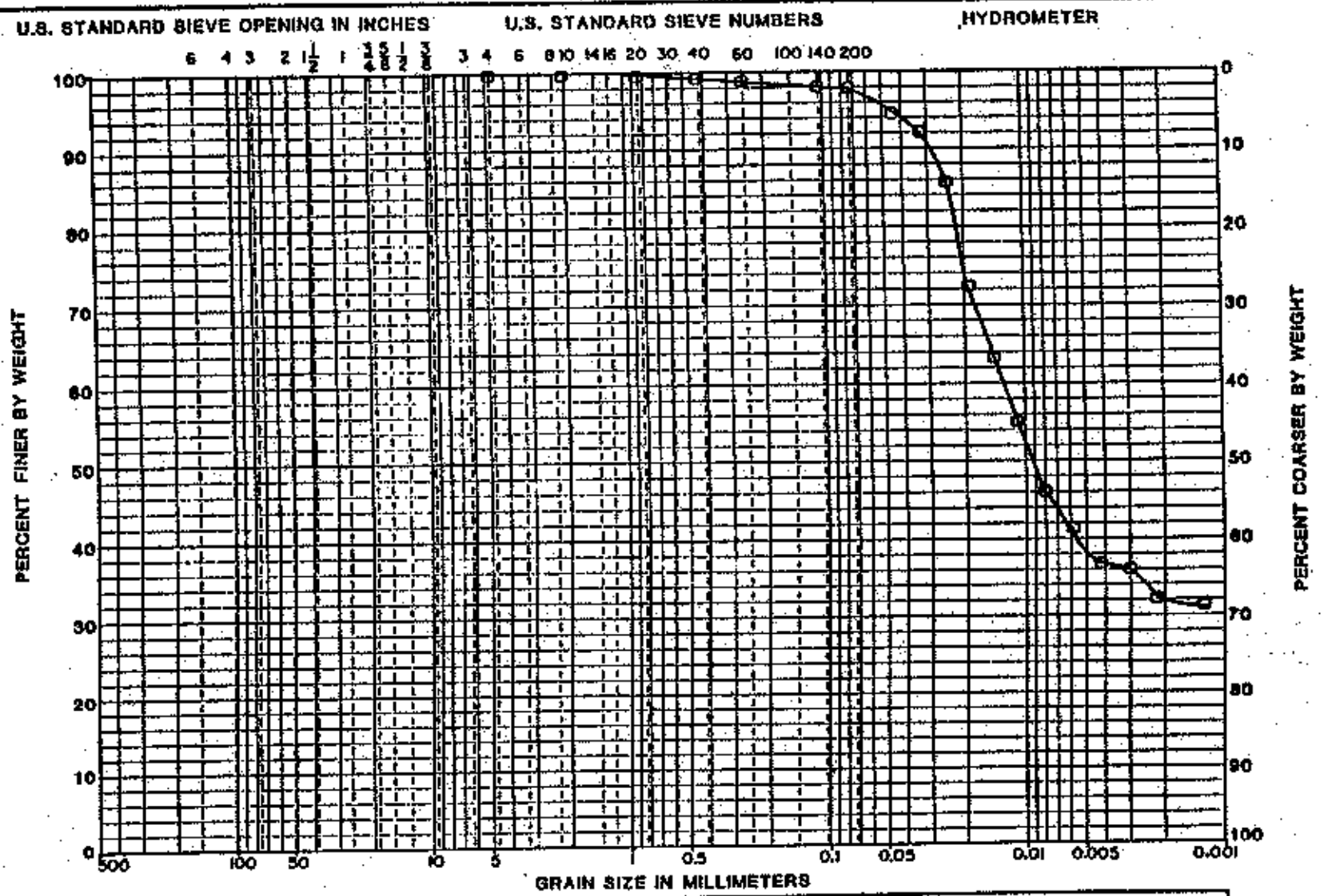
BORING NO. GT-2T 77

DATE 8-22-88

GEOTECHNOLOGY

PLATE 44

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU 01A	4.0-6.5	CL	14.8	28	18	10

PROJECT MSSRAP

BORING NO. GT-21 78

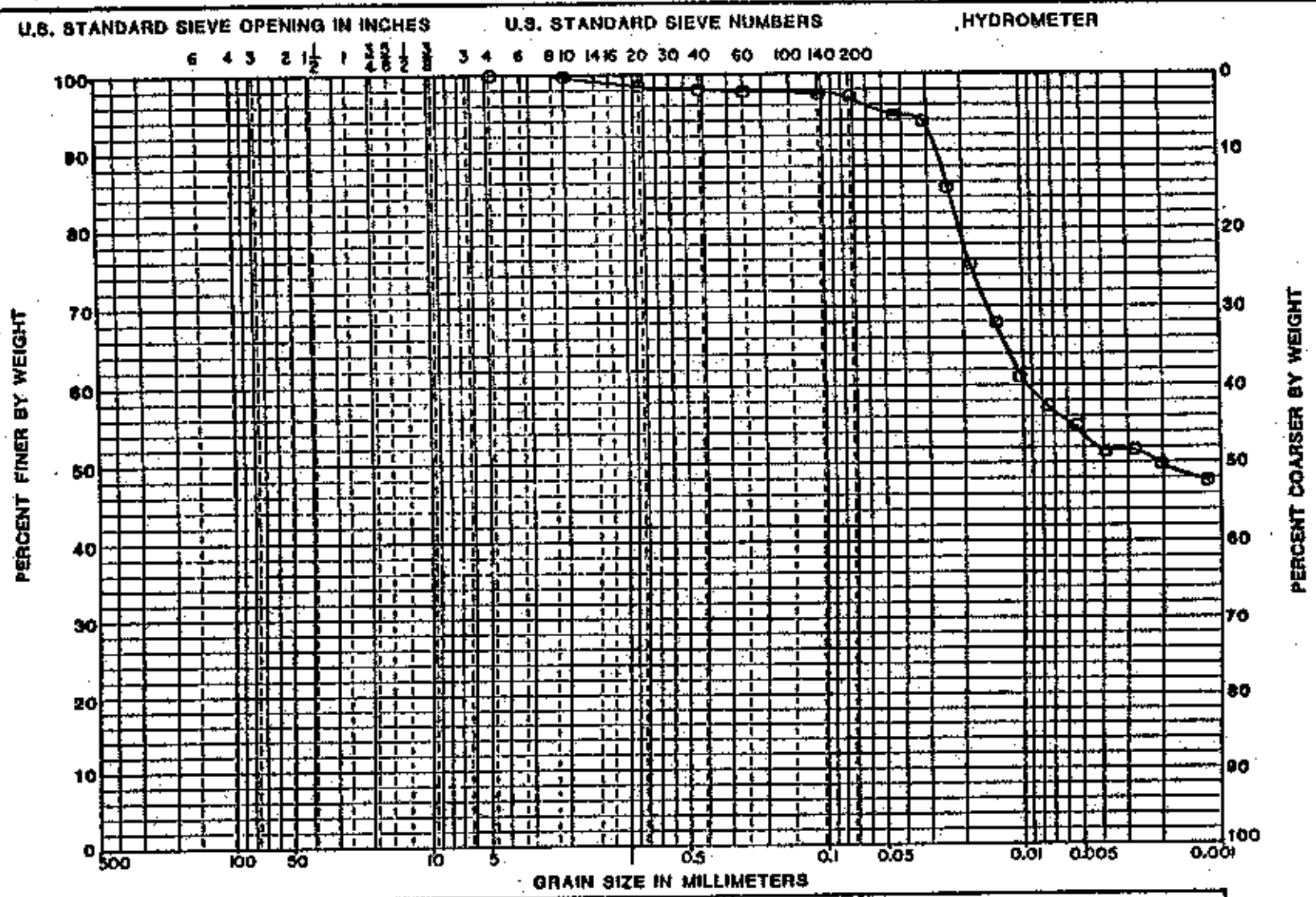
DATE 6-22-89

GEOTECHNOLOGY

PLATE D48

11295

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU 02B	6.5-12	CH	24.9	58	19	39

PROJECT WSSRAP

BORING NO. GT-2T 78

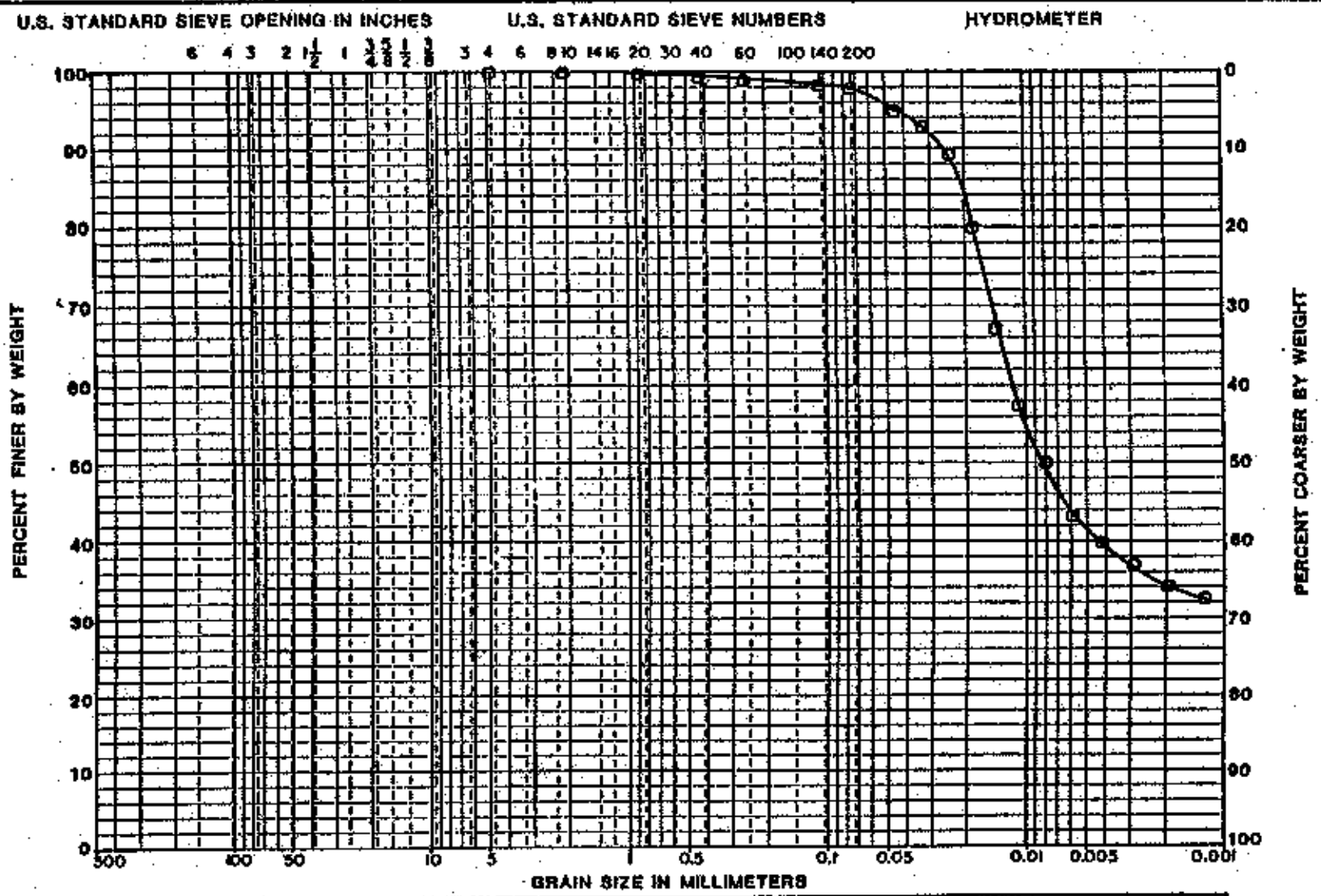
DATE 8-22-89

GEOTECHNOLOGY

PLATE 52

11295

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU 01A	1.0-8.5	CL	8.9	49	23	26

PROJECT VESRAP

BORING NO. GT-2T 79

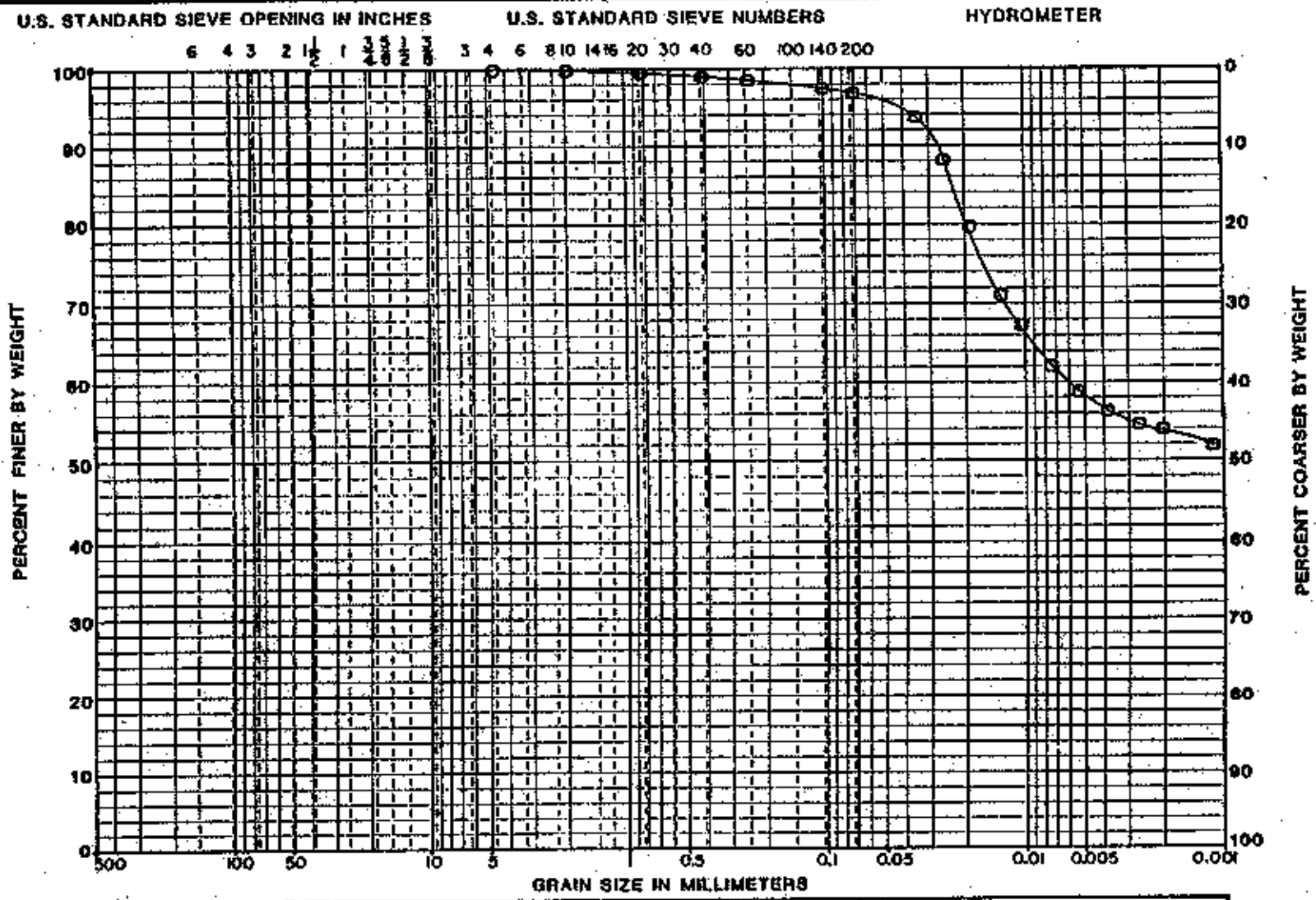
DATE 6-22-88

GEOTECHNOLOGY

11295

PLATE C 18

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-02A	6.5-12	CH	16.3	62	19	43

PROJECT WSSRAP

BORING NO. GT-2T79

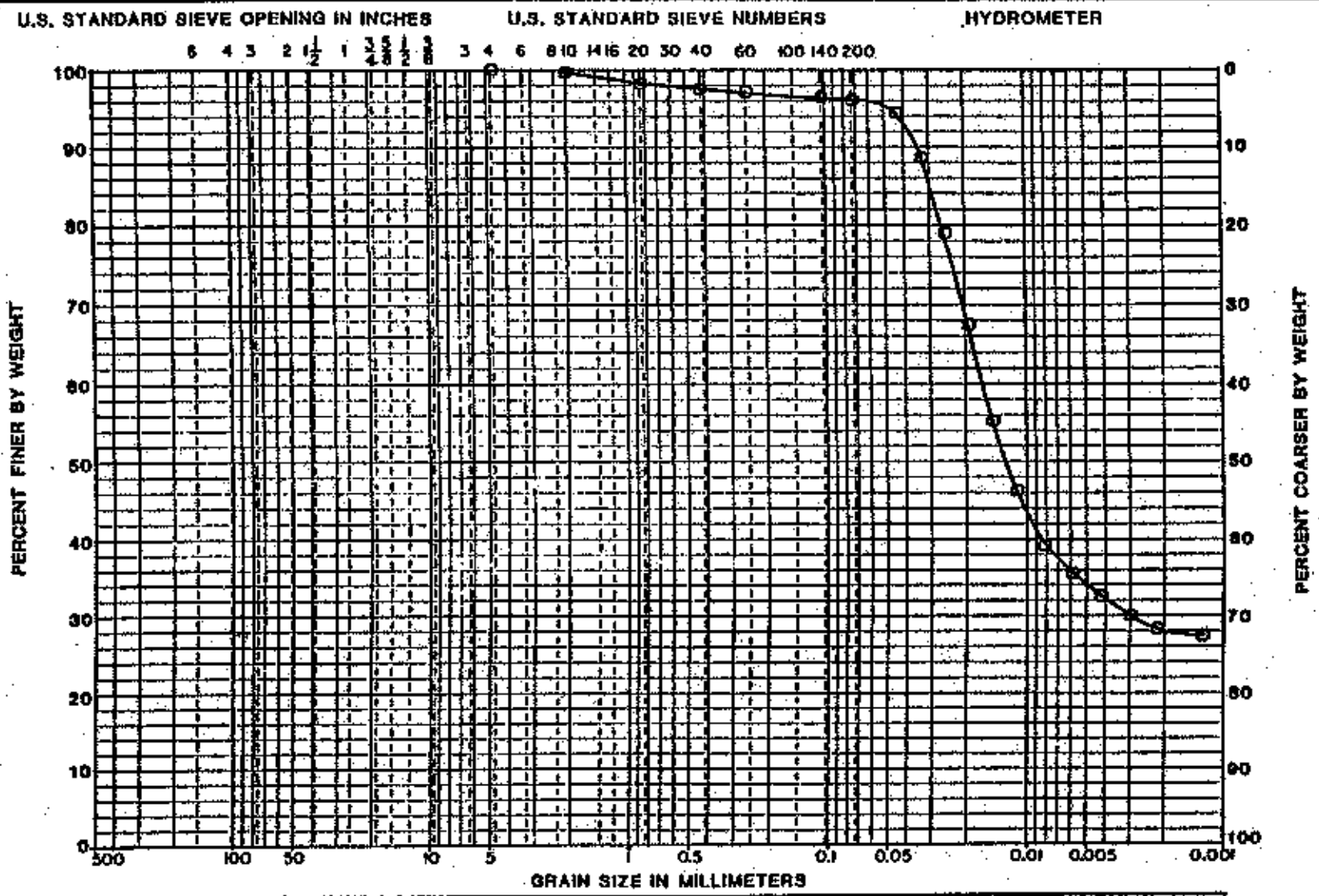
DATE 11-30-89

GEOTECHNOLOGY

PLATE J 28

11295

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BW-01A	0.5-8	CL	46.0	38	20	18

PROJECT WSSRAP

BORING NO. CT-2T80

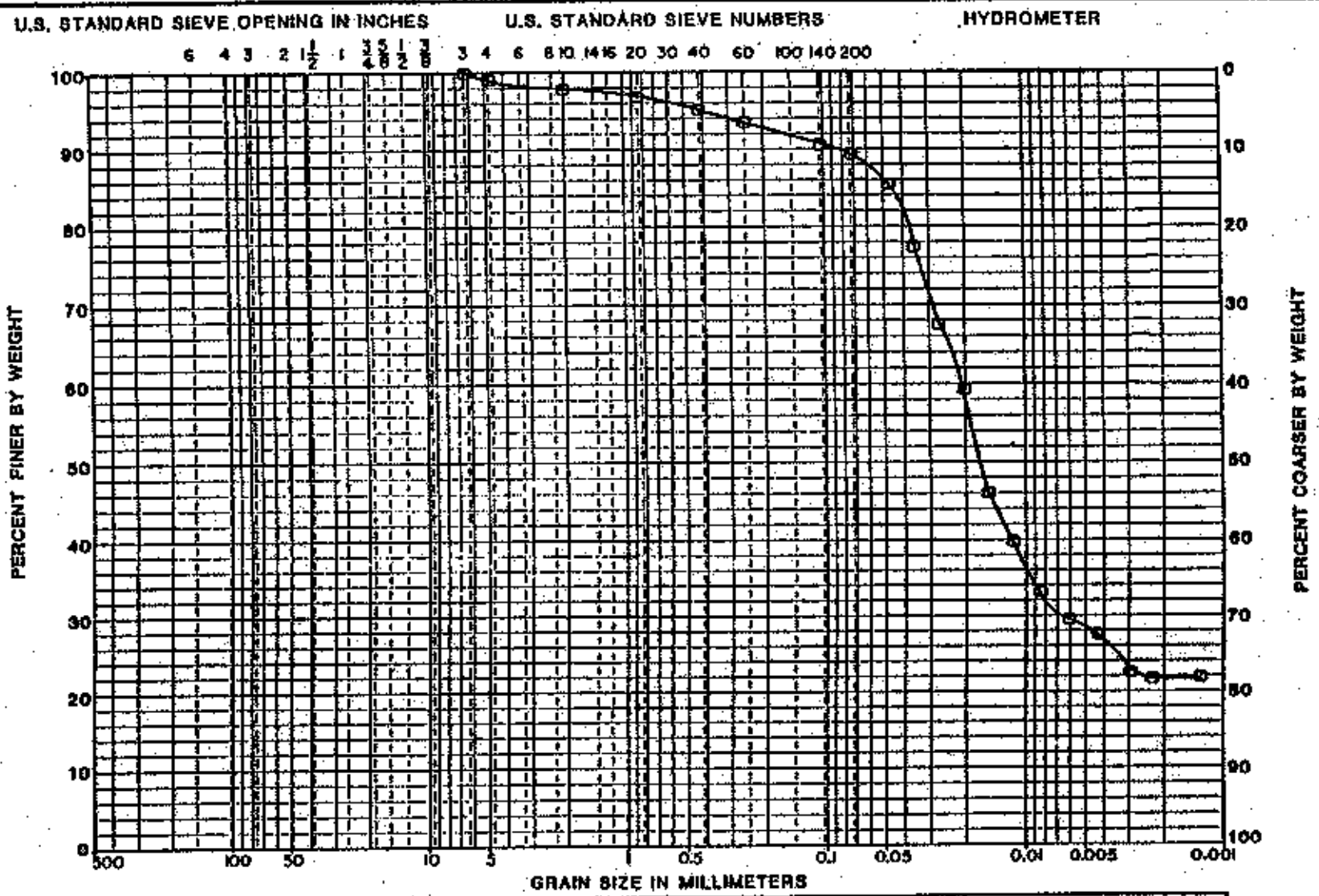
DATE 6-12-89

GEOTECHNOLOGY

11295

PLATE C 22

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU D1A	0.5-6.5	CL	9.0	36	18	18

PROJECT WSSRAP

BORING NO. GT-2T 81

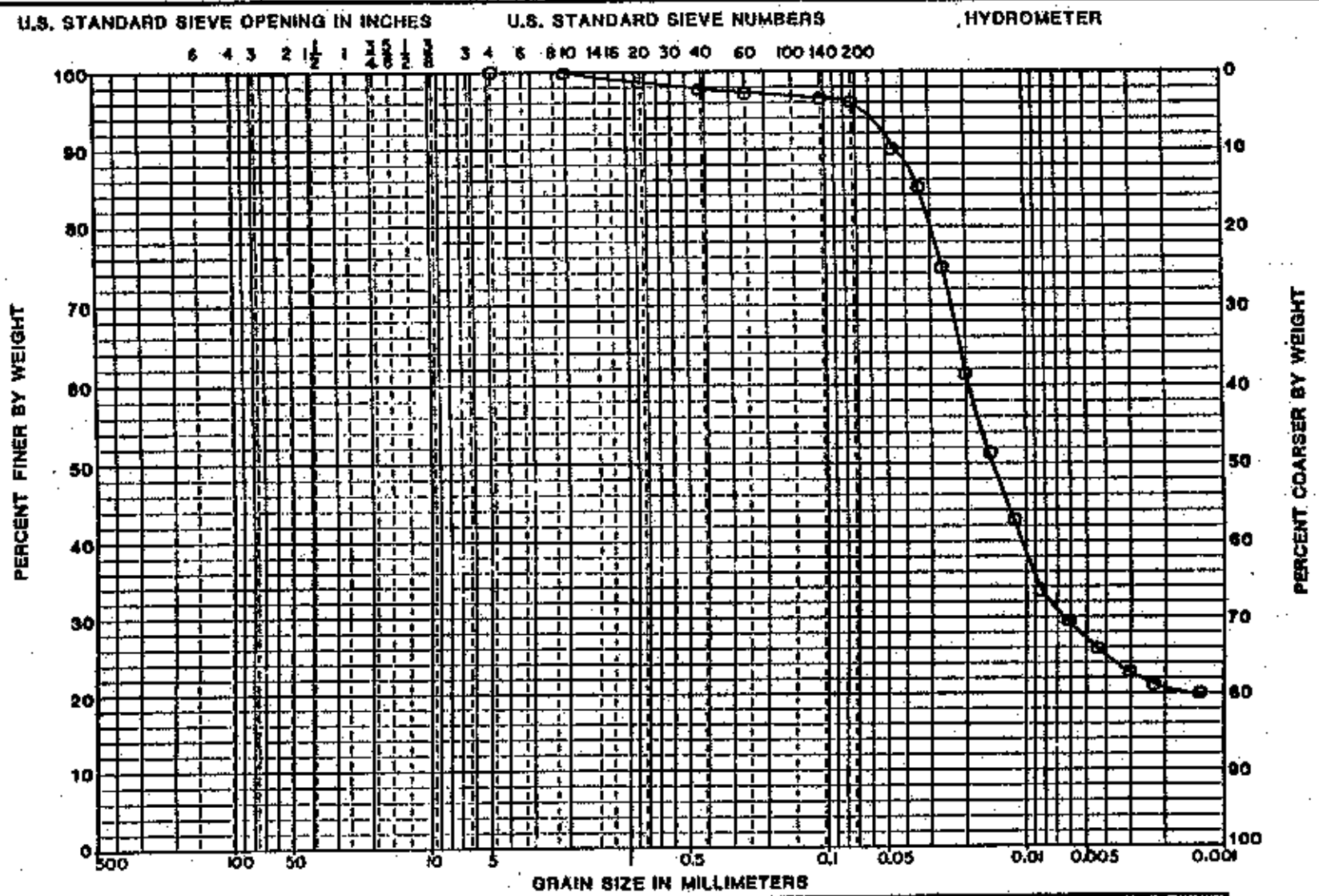
DATE 8-22-89

GEOTECHNOLOGY

PLATE D56

11285

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU 02A	6.5-12.0	CL	21.7	40	17	23

PROJECT WSSRAP

BORING NO. CT-2T 81

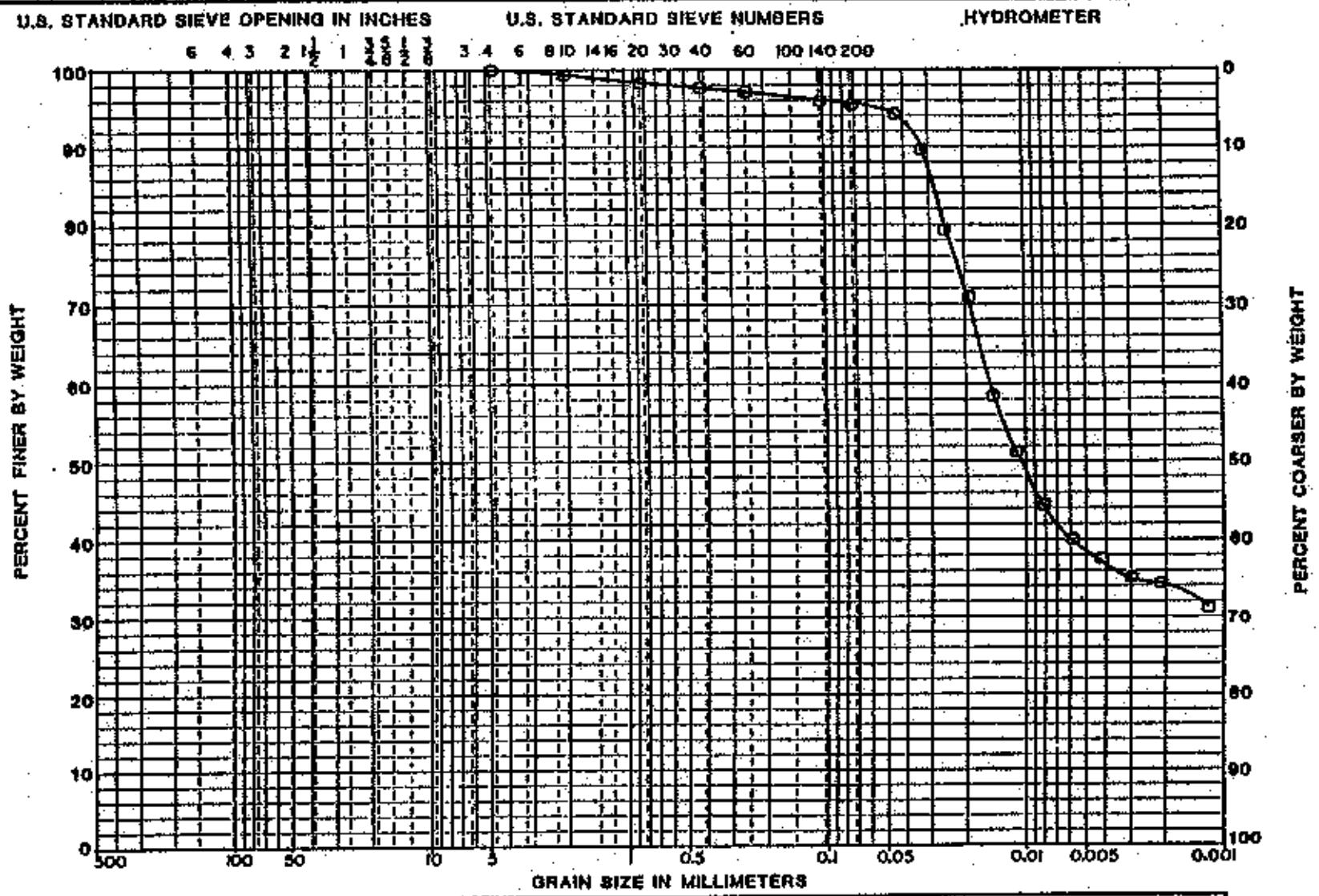
DATE 6-22-88

GEOTECHNOLOGY

PLATE 60

11295

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BV-01A	0.5-3.5	CL	15.5	42	19	23

PROJECT WSSRAP

BORING NO. GT-2T82

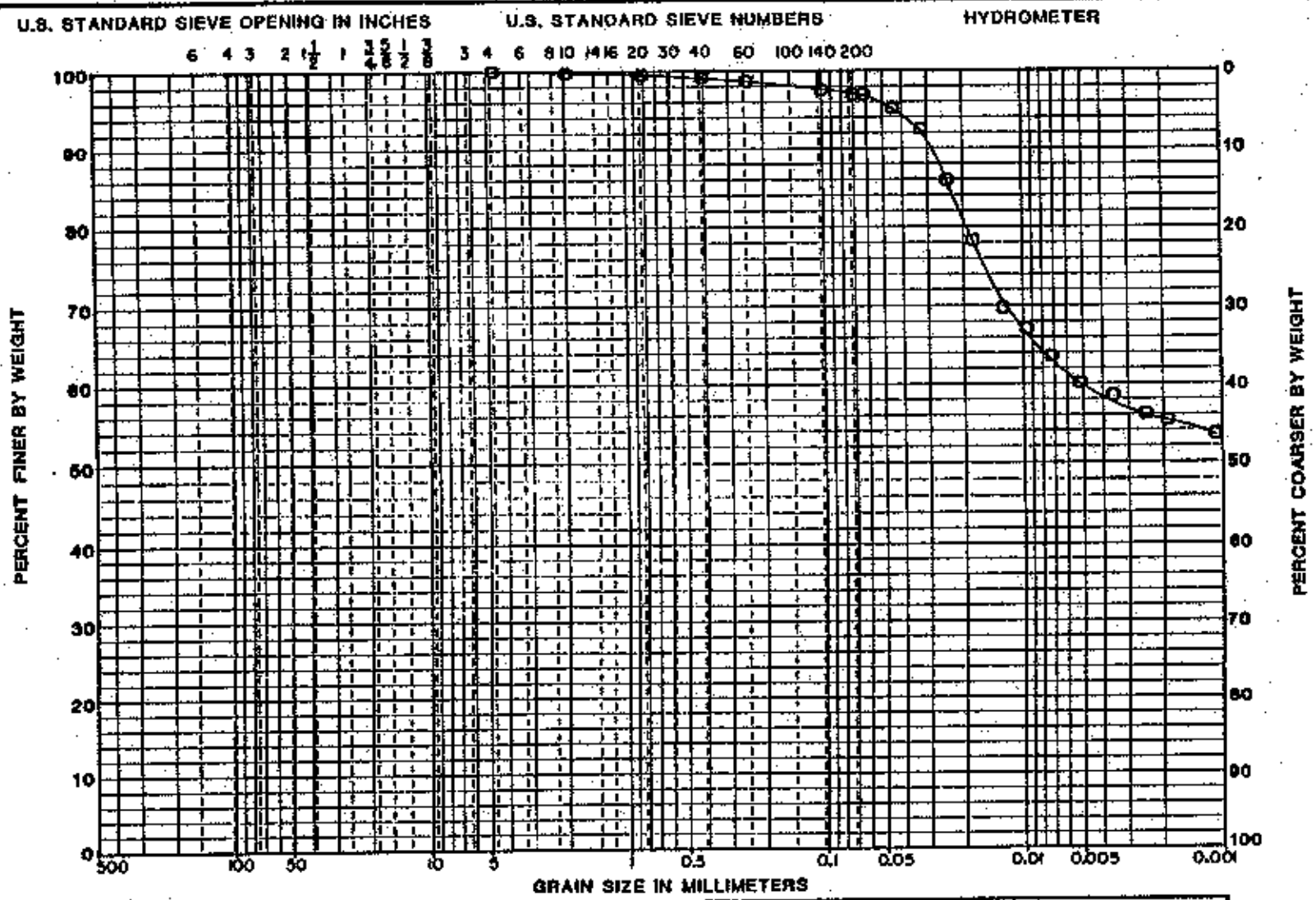
DATE 5-7-89

GEOTECHNOLOGY

11295

PLATE C26

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-02A	3.5-6	CH	20.4	53	22	31

PROJECT WSSRAP

BORING NO. GT-2T82

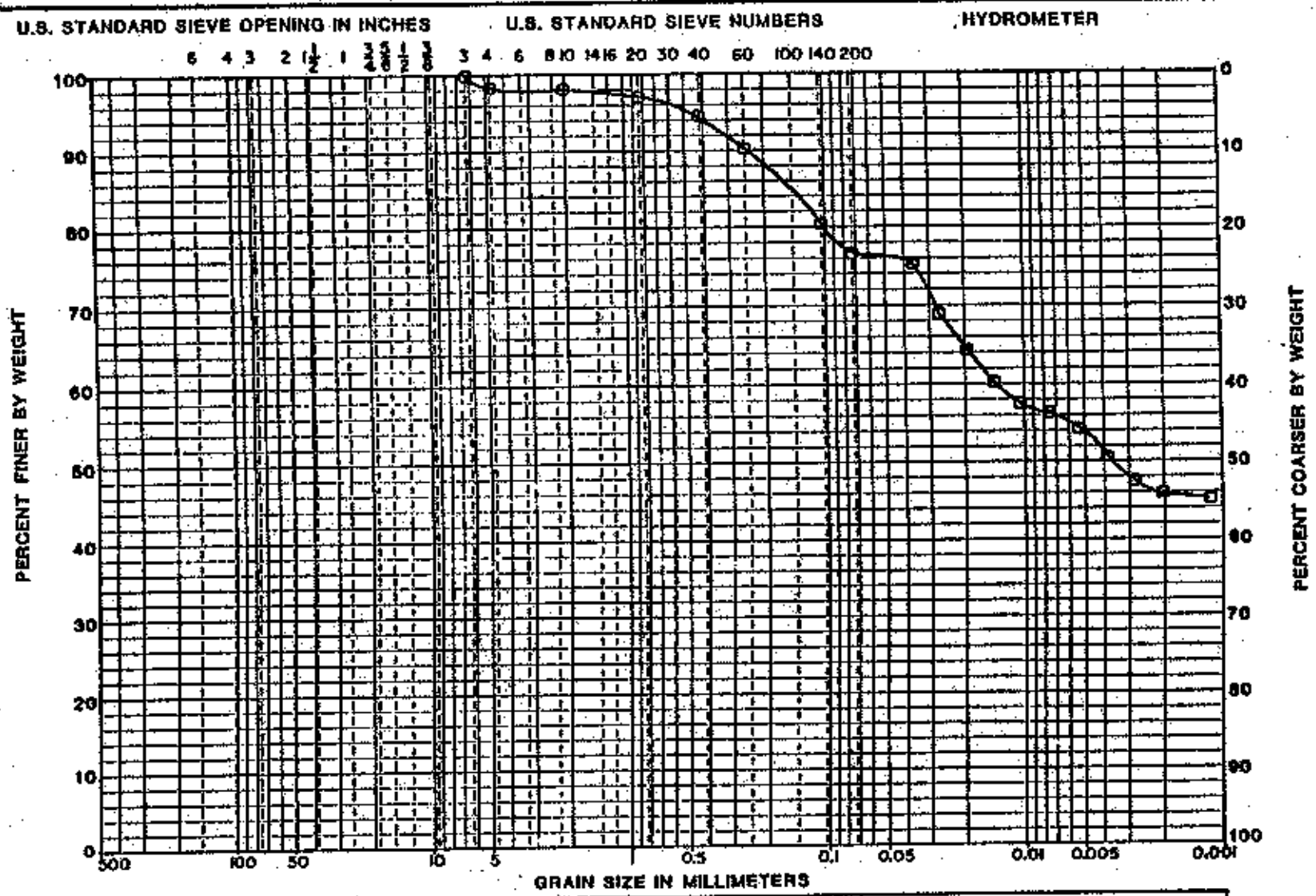
DATE 11-30-89

GEOTECHNOLOGY

11295

PLATE J 32

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU 03A	~~8.0~~ 6-10.0	CL	19.3	48	21	27

PROJECT WSSRAP

BORING NO. GT-2T 82

DATE 6-22-89

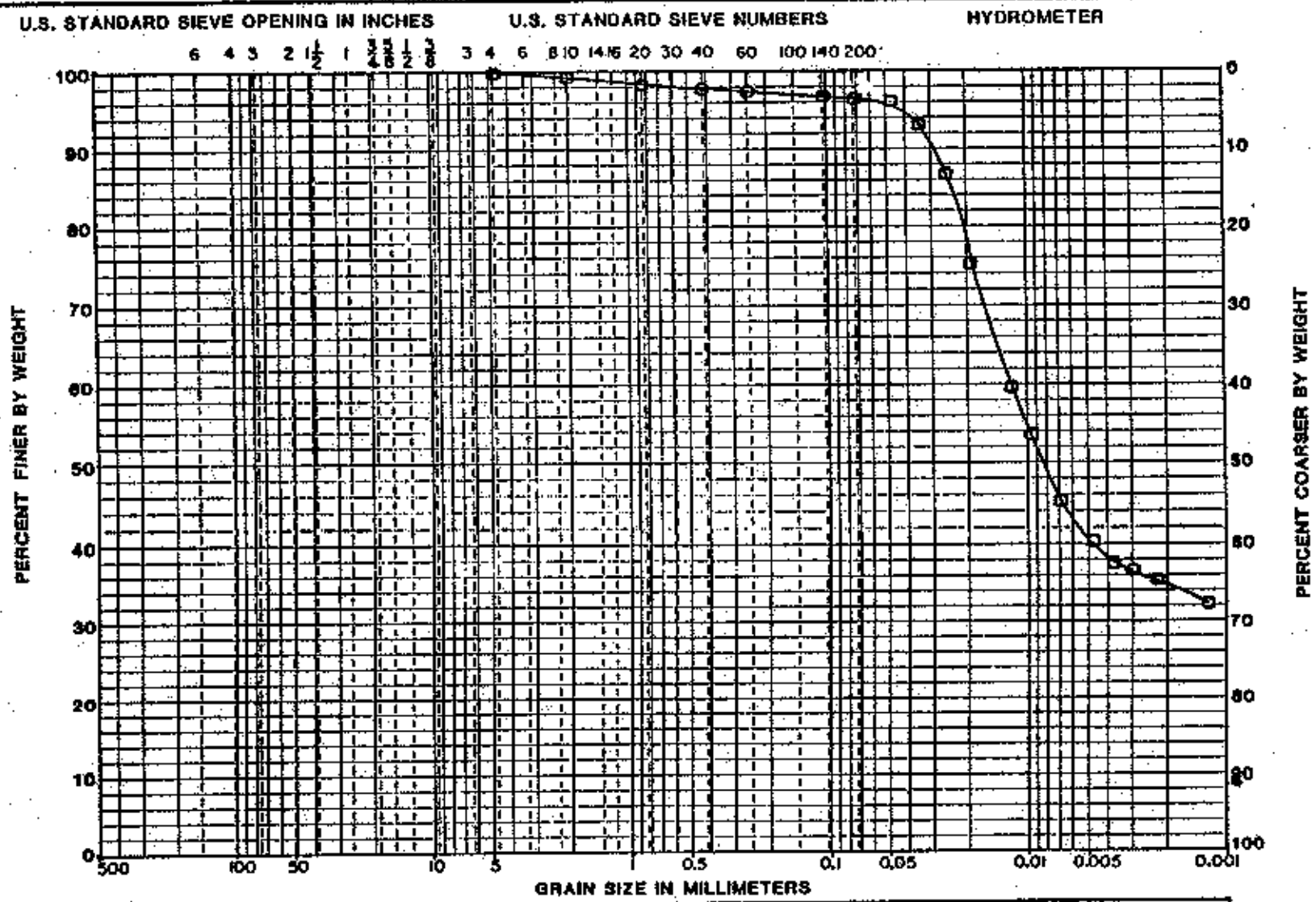
GEOTECHNOLOGY

* REVISED FOR CONSISTENCY. CORRECTION MADE BY MKF, SCT 11/2/90

PLATE D64

11255

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
ST-01	2.5-5.0	CH	25.8	54	21	~~24~~ 23*

PROJECT WSSRAP

BORING NO. GT-58P

DATE 11-30-89

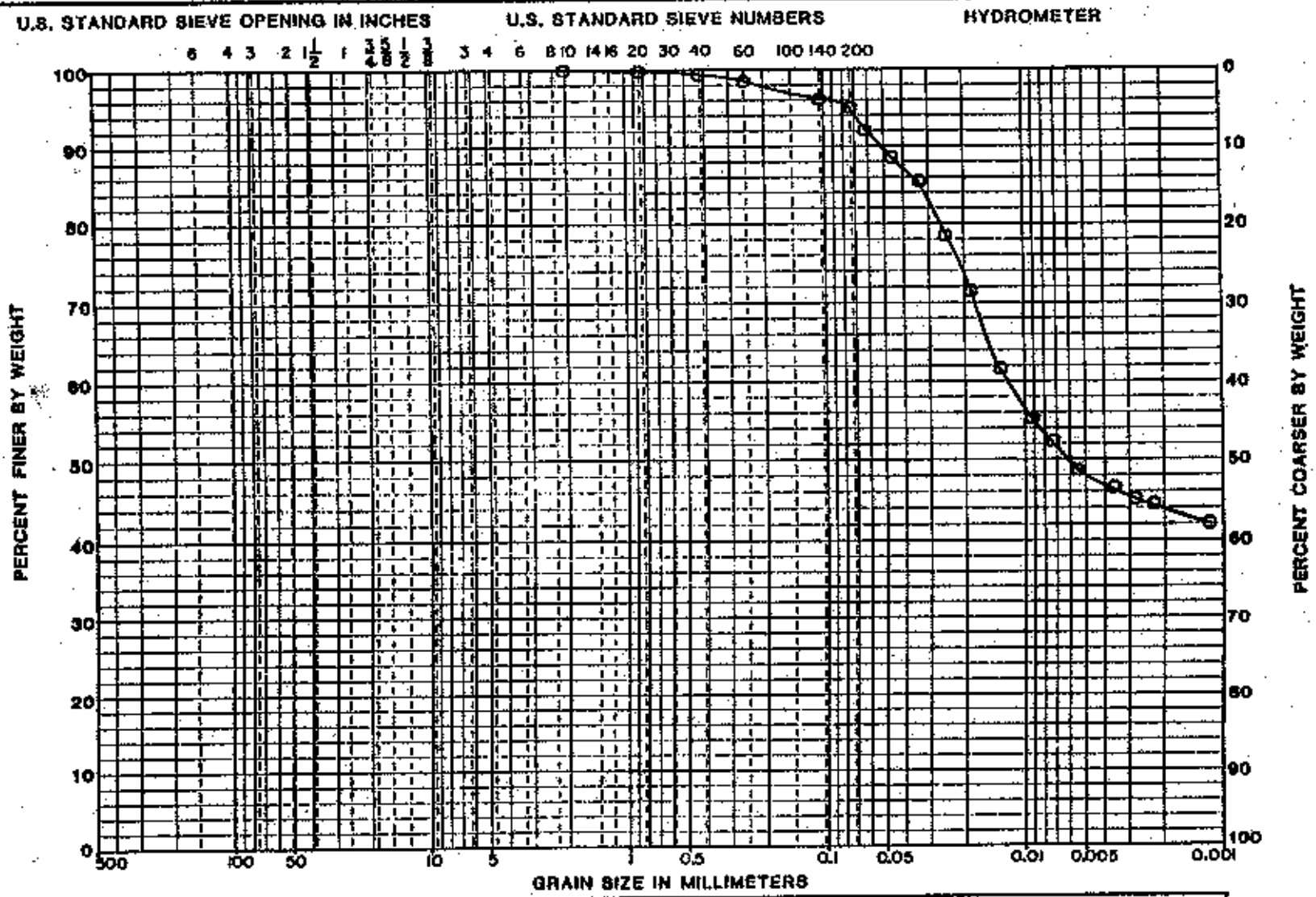
GEOTECHNOLOGY

* REVISED FOR MATH ERROR. CORRECTION MADE BY MKF, ECT 11/2/90

PLATE J 111

11295

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
ST-03	7.5-10.0	CH	22.8	66	20	46

PROJECT MSSRAP

BORING NO. GT-58P

DATE 9-20-89

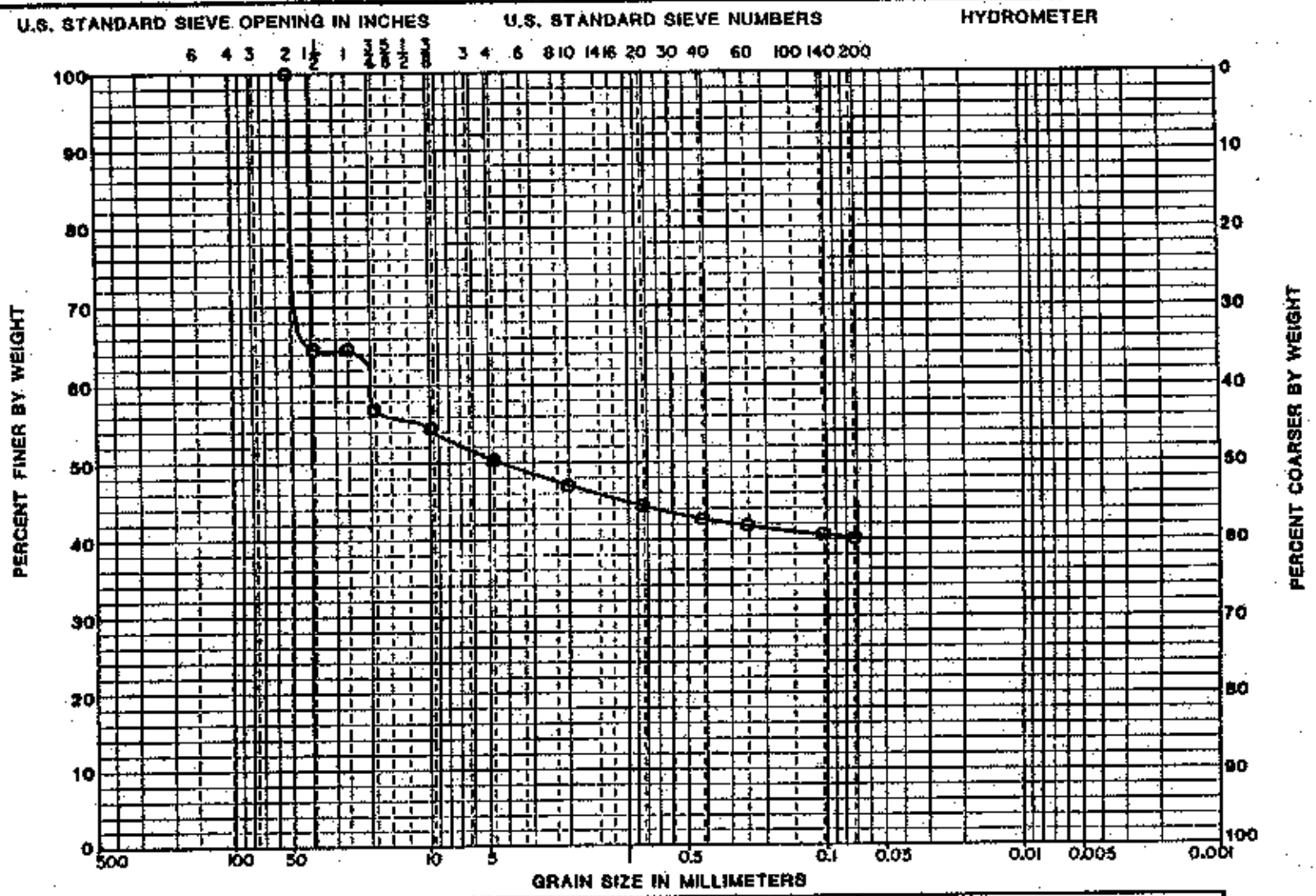
GEOTECHNOLOGY

CHECKED BY: JA

PLATE G 128

11295.001

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
SB-11	28.5-29.5	SC	18.5			

PROJECT MSSRAP

BORING NO. GT 58P

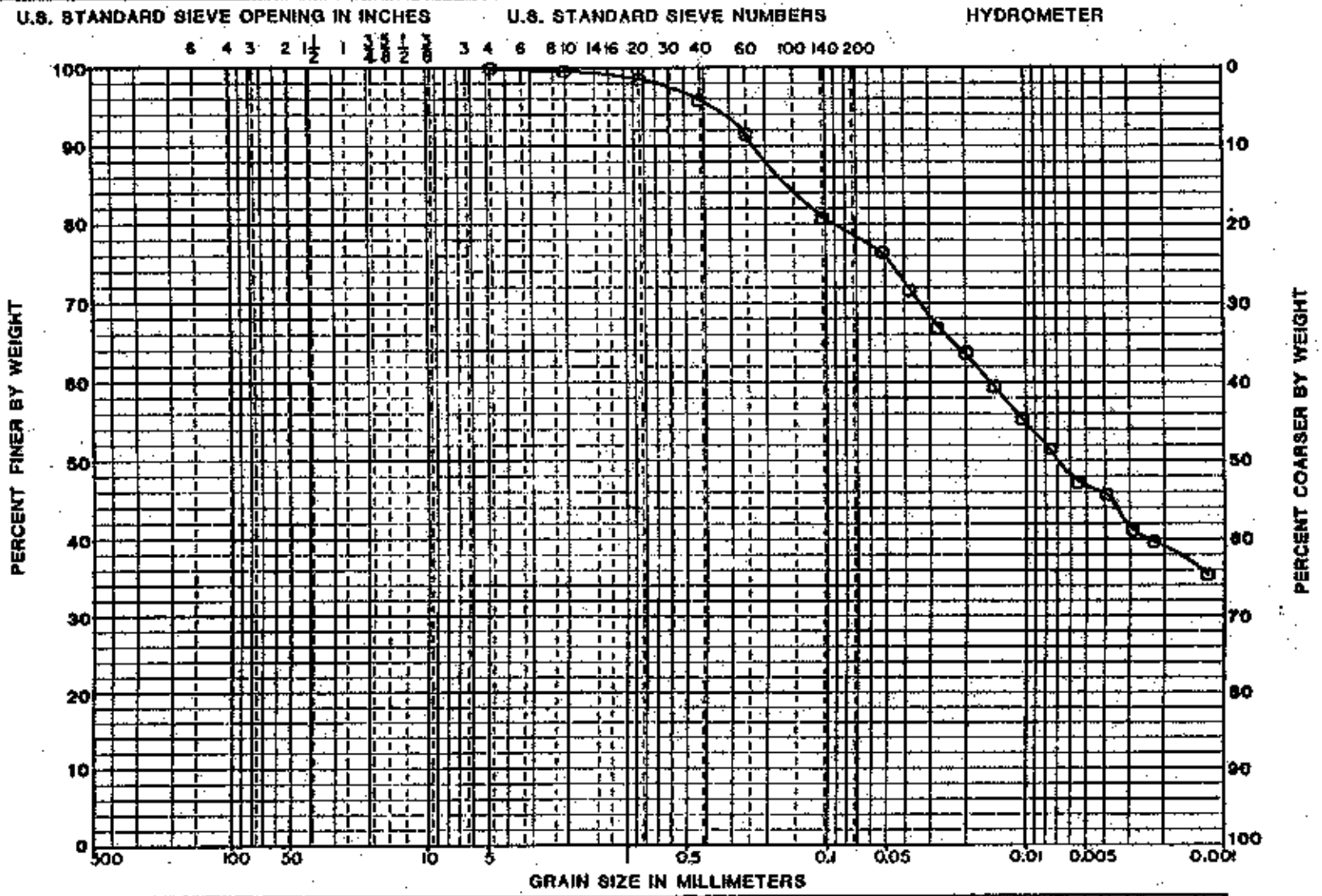
DATE 11-13-88

GEOTECHNOLOGY

11295

PLATE J 115

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
ST 10	27.5-30.0	CL	26.2	44	17	~~28~~ 27*

PROJECT WSSRAP

BORING NO. GT-60P

DATE 9-20-89

GEOTECHNOLOGY

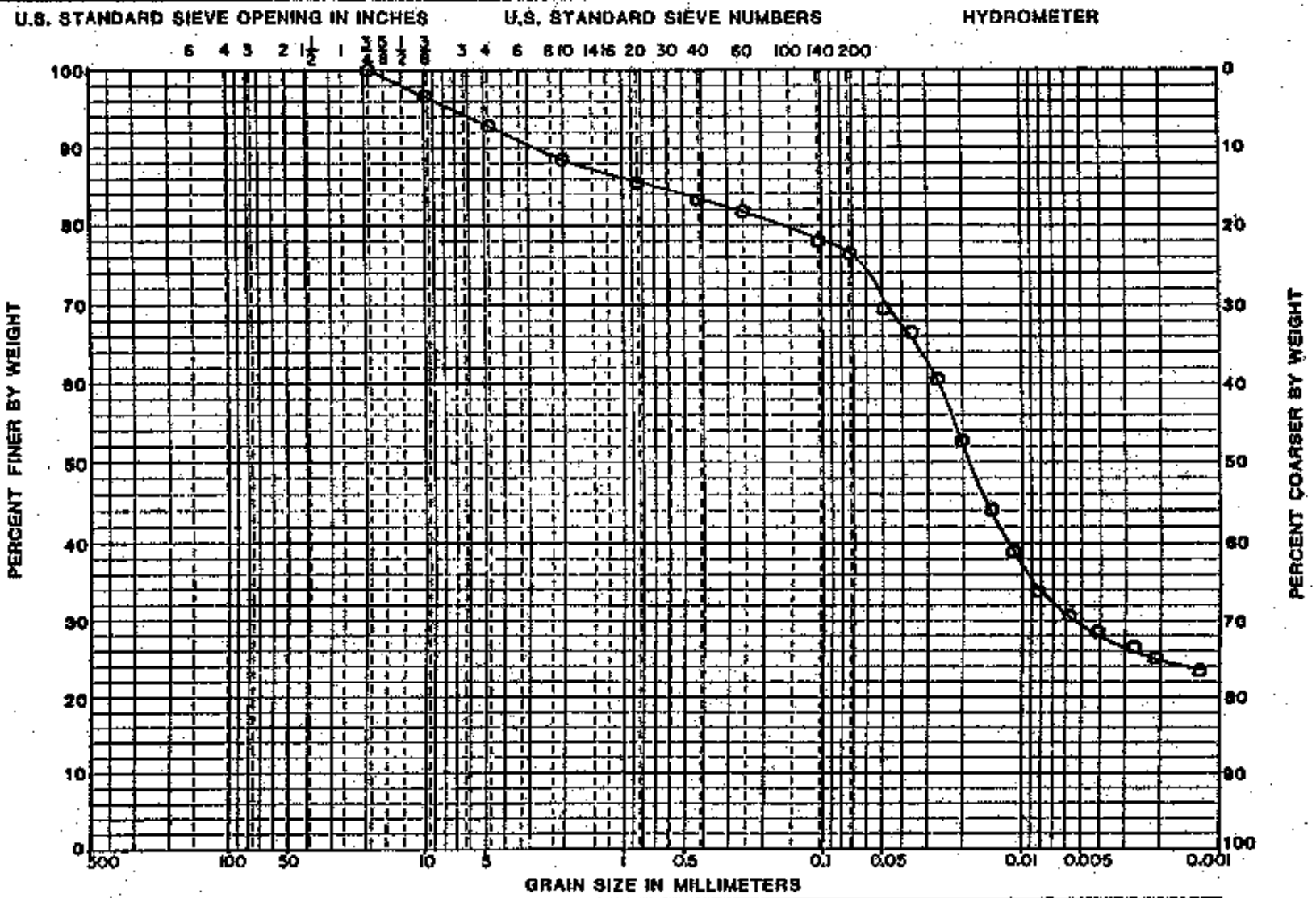
*MATH ERROR. CORRECTION BY MKF, GT 10/4/90

CHECKED BY: JA

PLATE G 129

11295

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
SB-15	41.41.5	CL	0.6	35	22	13

PROJECT WSSRAP

BORING NO. GT-60P

DATE 4-6-90

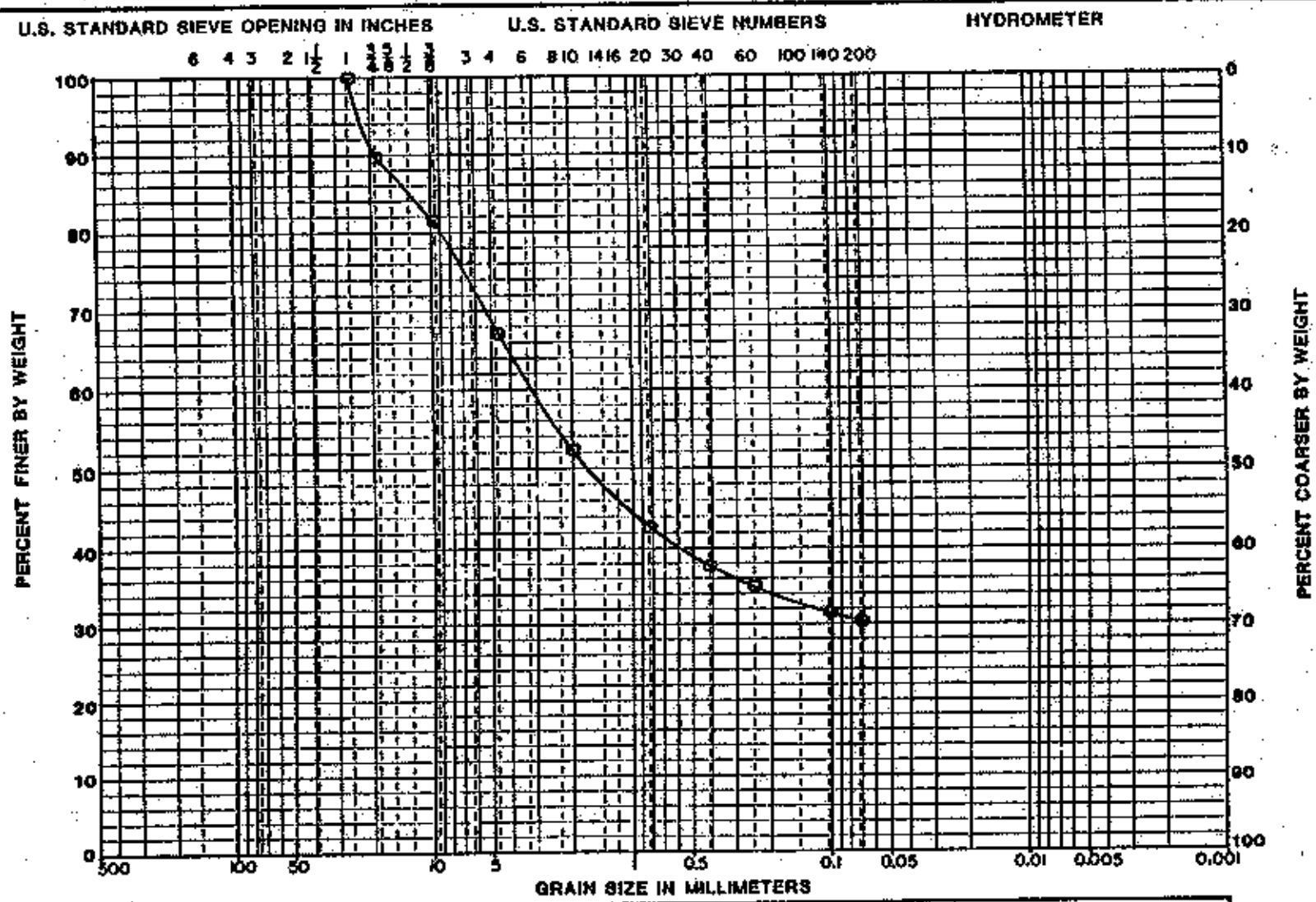
GEOTECHNOLOGY

ENGINEERING AND ENVIRONMENTAL SERVICES
ST. LOUIS, MISSOURI

11295.000

PLATE 42

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
SS-18	45-48.5	SC	21.2			

PROJECT WSSRAP

BORING NO. CT-60P

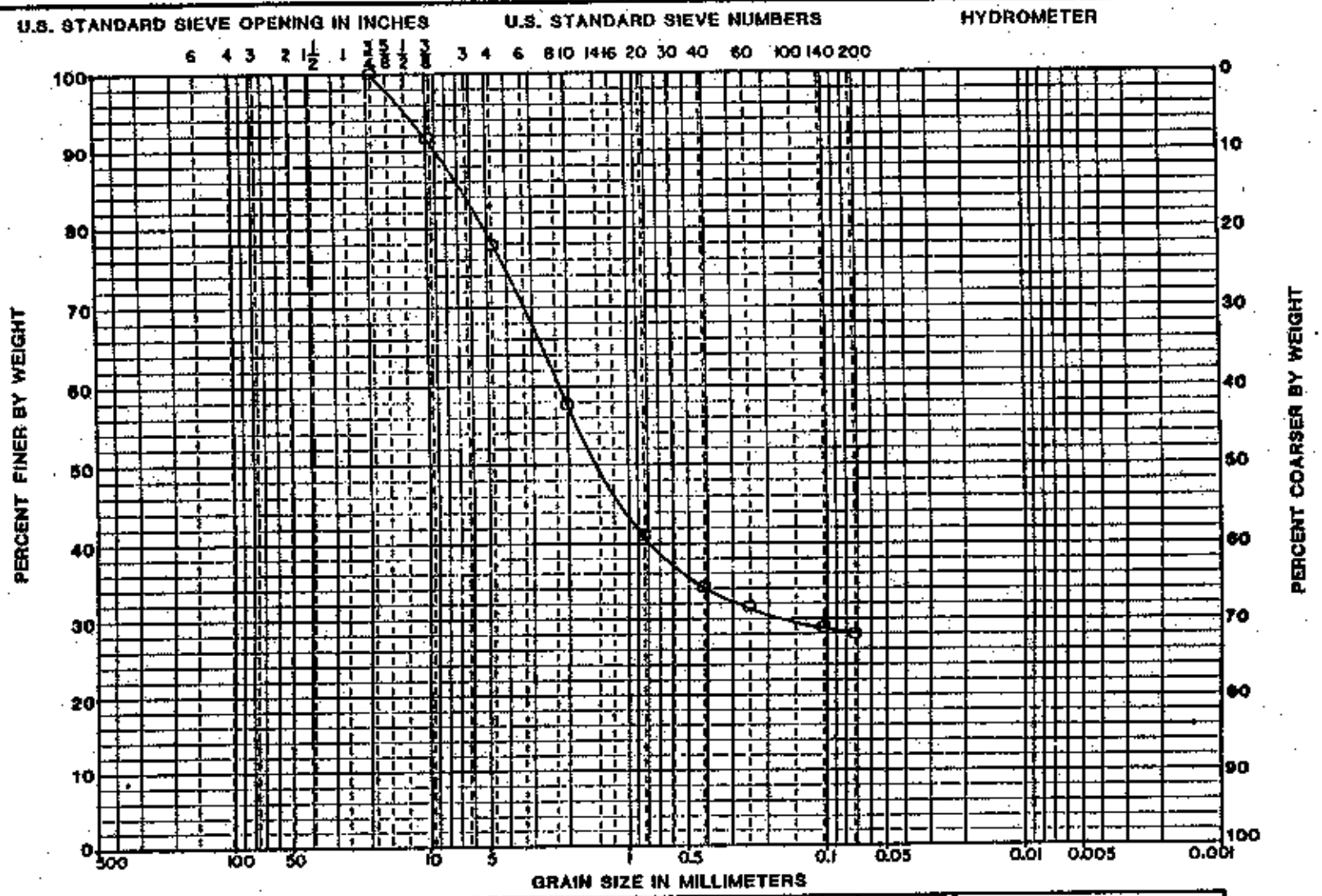
DATE 3-23-90

GEOTECHNOLOGY

11295

PLATE N 21

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
SB-17	48.5-49	SC	22.3			

PROJECT MSSRAP

BORING NO. GT-60P

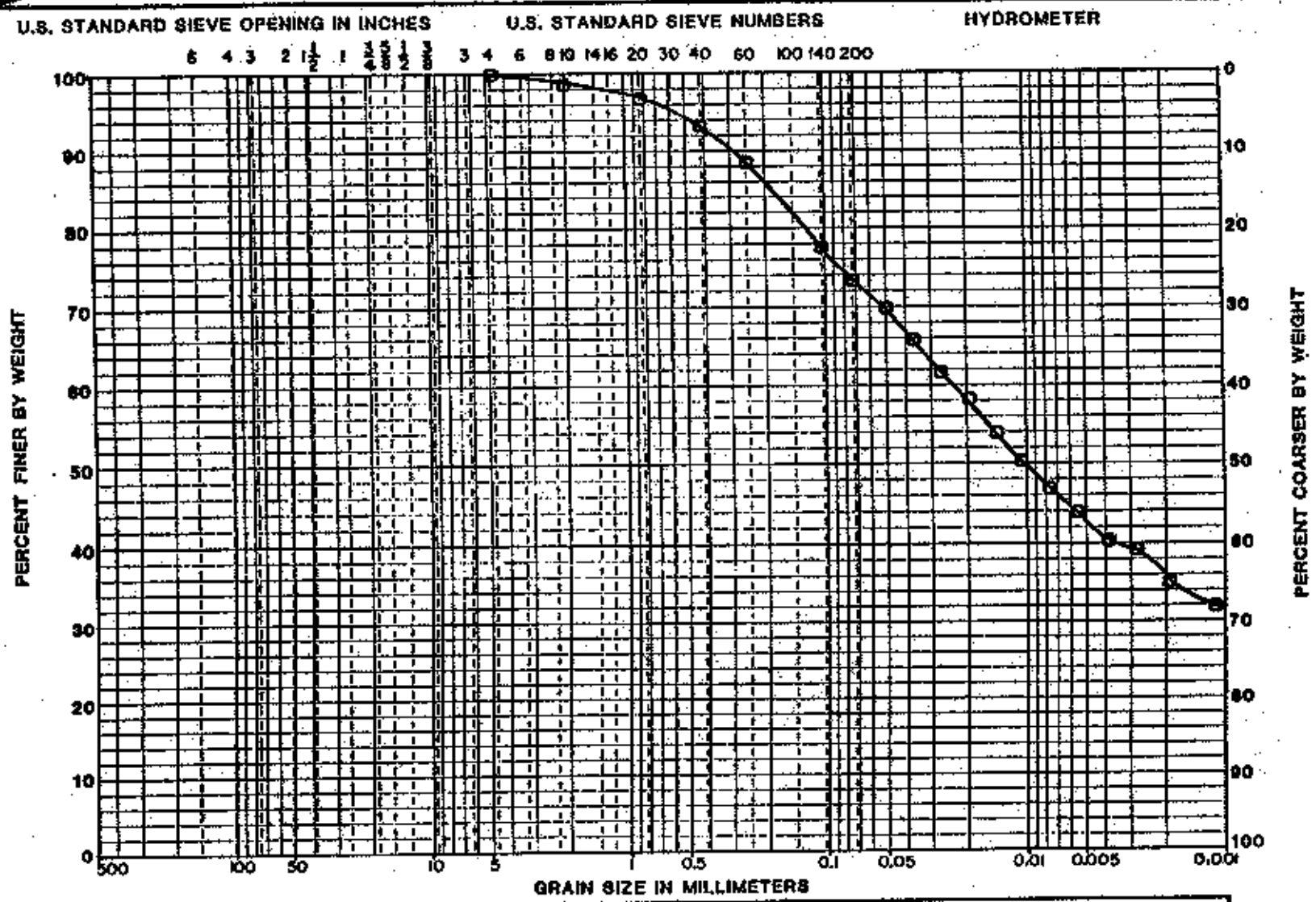
DATE 3-6-90

GEOTECHNOLOGY

11285.000

PLATE 23

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.W.T.%	LL	PL	PI
SS-13	32.5-34.0	CH	16.3			

PROJECT WSSRAP

BORING NO. GT 61

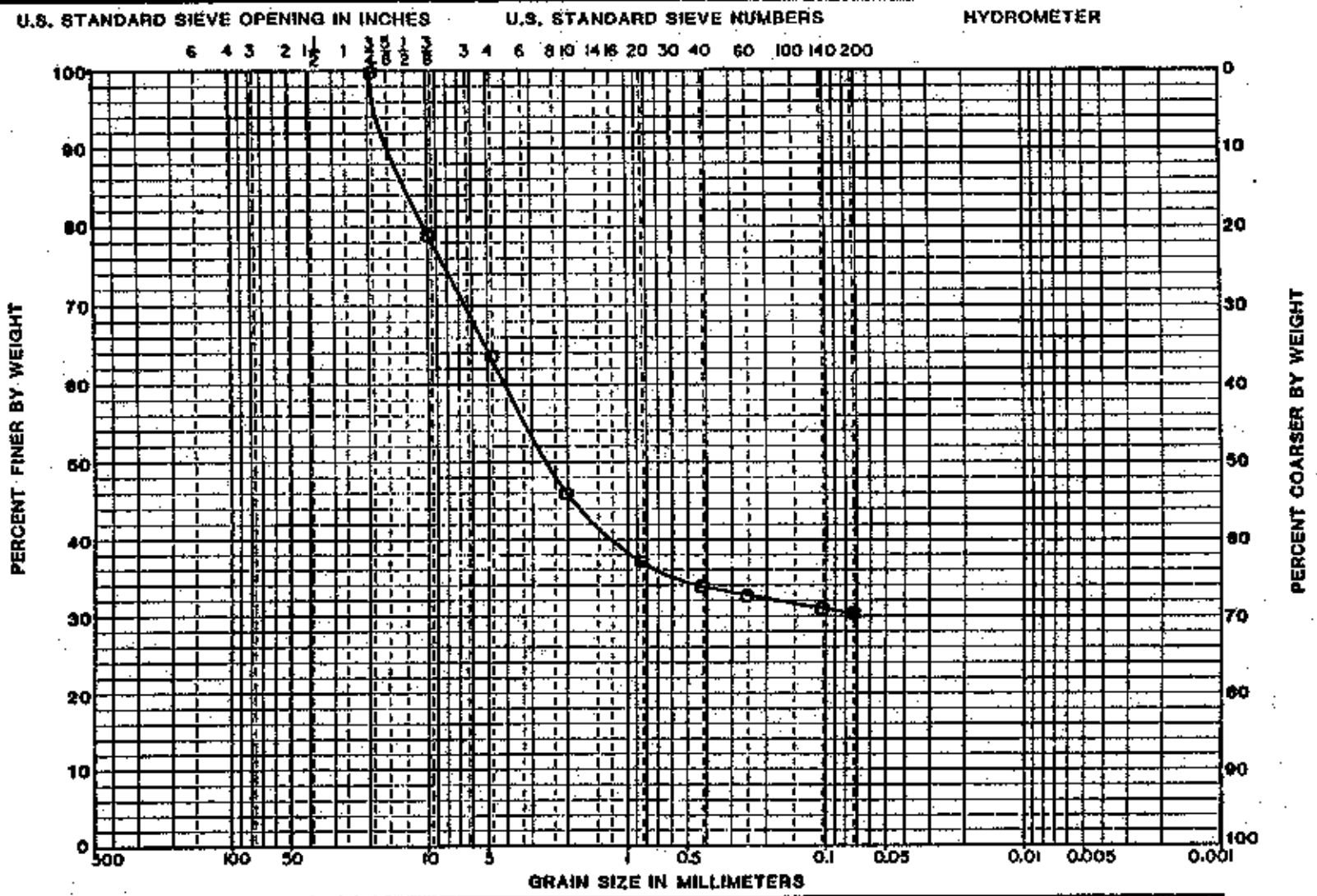
DATE 10-9-89

GEOTECHNOLOGY

11285.000

PLATE H 38

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
SB-18	50.5-51.5	GC	9.4			

PROJECT WSSRAP

BORING NO. GT 61

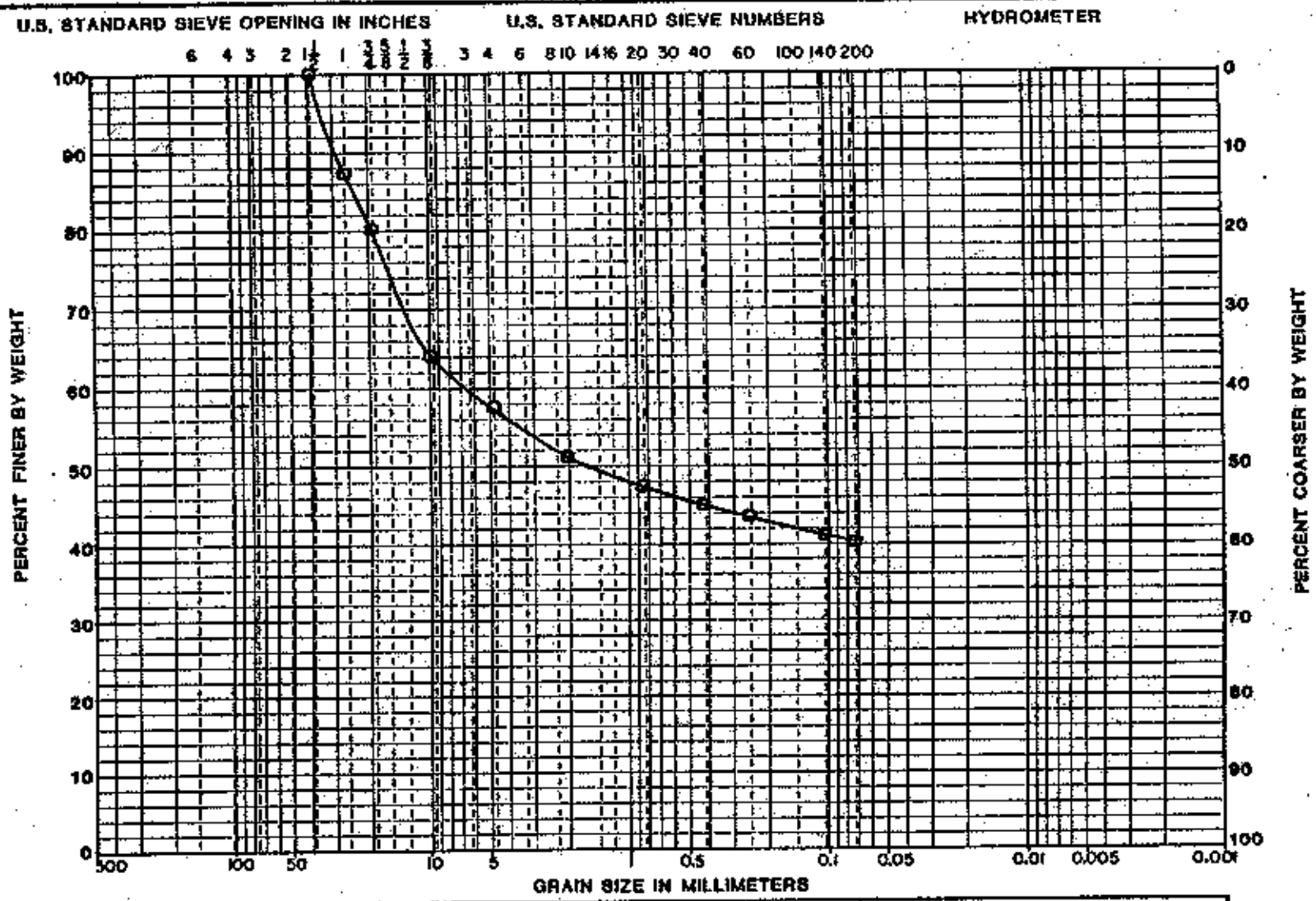
DATE 11-13-89

GEOTECHNOLOGY

11295

PLATE 117

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.W.T.%	LL	PL	PI
SB-15	38.0-39.0	GC	20.2			

PROJECT WSSRAP

BORING NO. GT 62

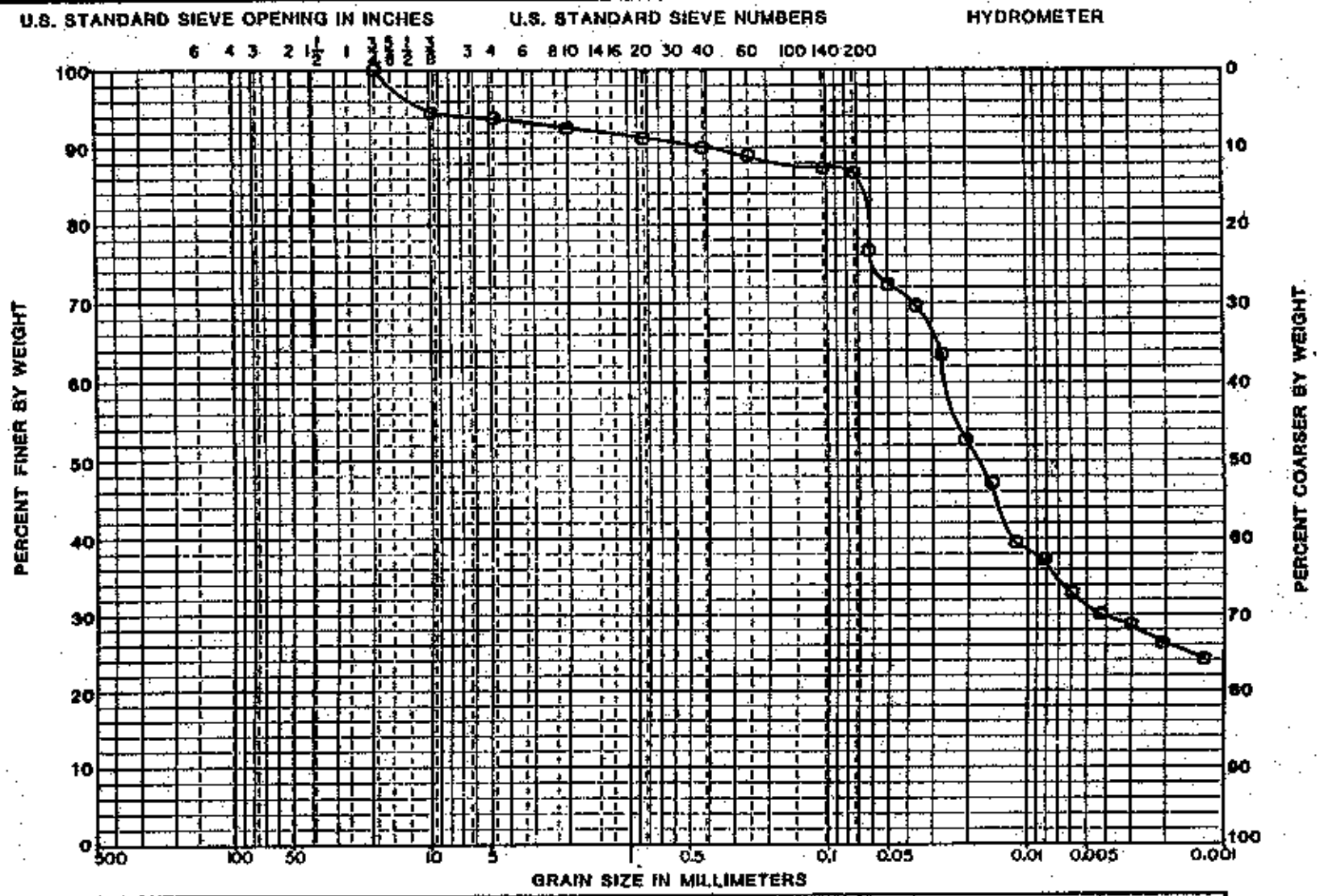
DATE 11-13-89

GEOTECHNOLOGY

11295

PLATE J 119

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
ST-01	2.5-5.0	CH	20.7	56	24	32

PROJECT NSSRAP

BORING NO. GT63P

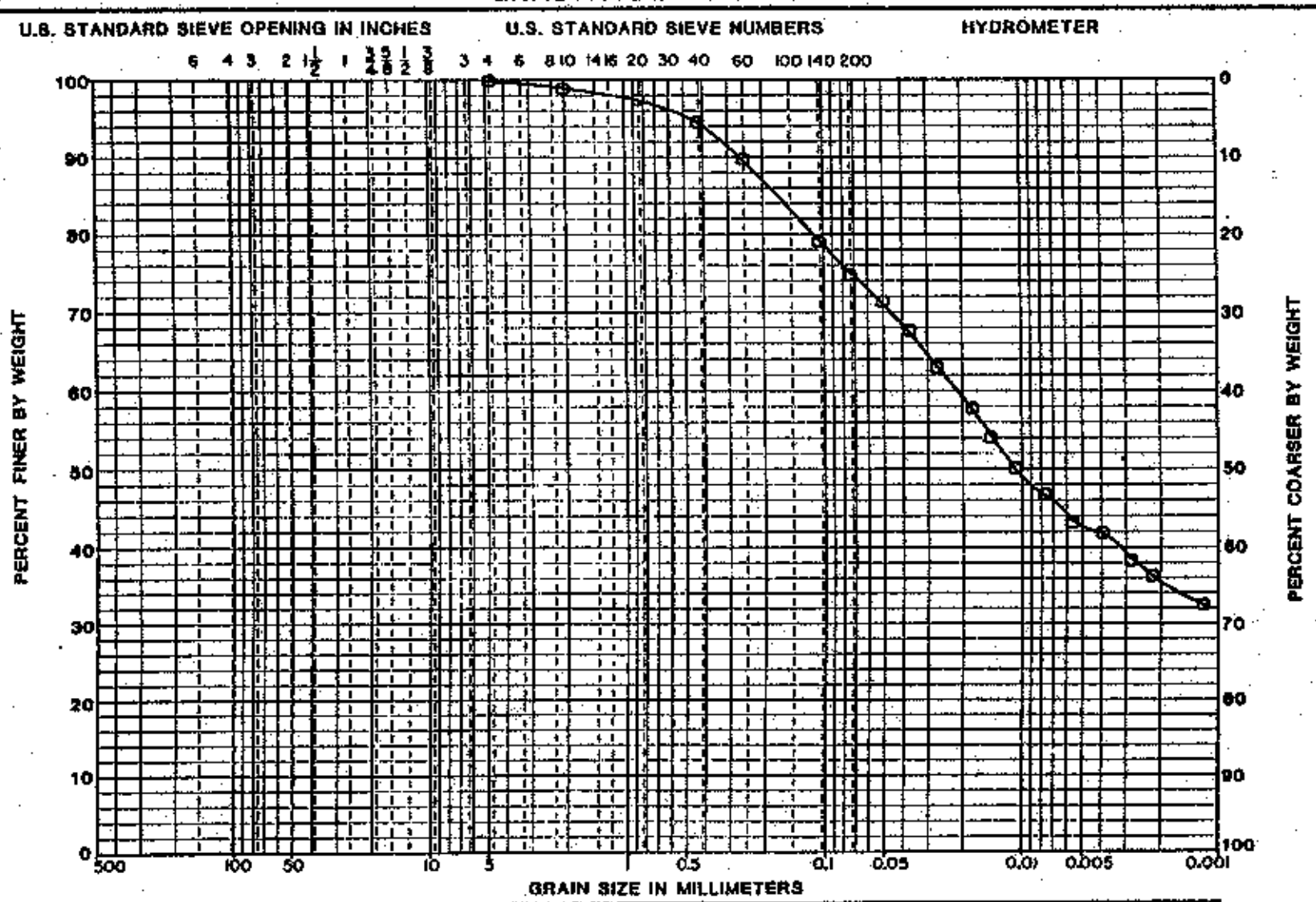
DATE 11-8-88

GEOTECHNOLOGY

PLATE H 42

11285

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
ST 09	22.5-25.0	CL	18.1	45	17	28

PROJECT WSSRAP

BORING NO. GT-63P

DATE 9-20-89

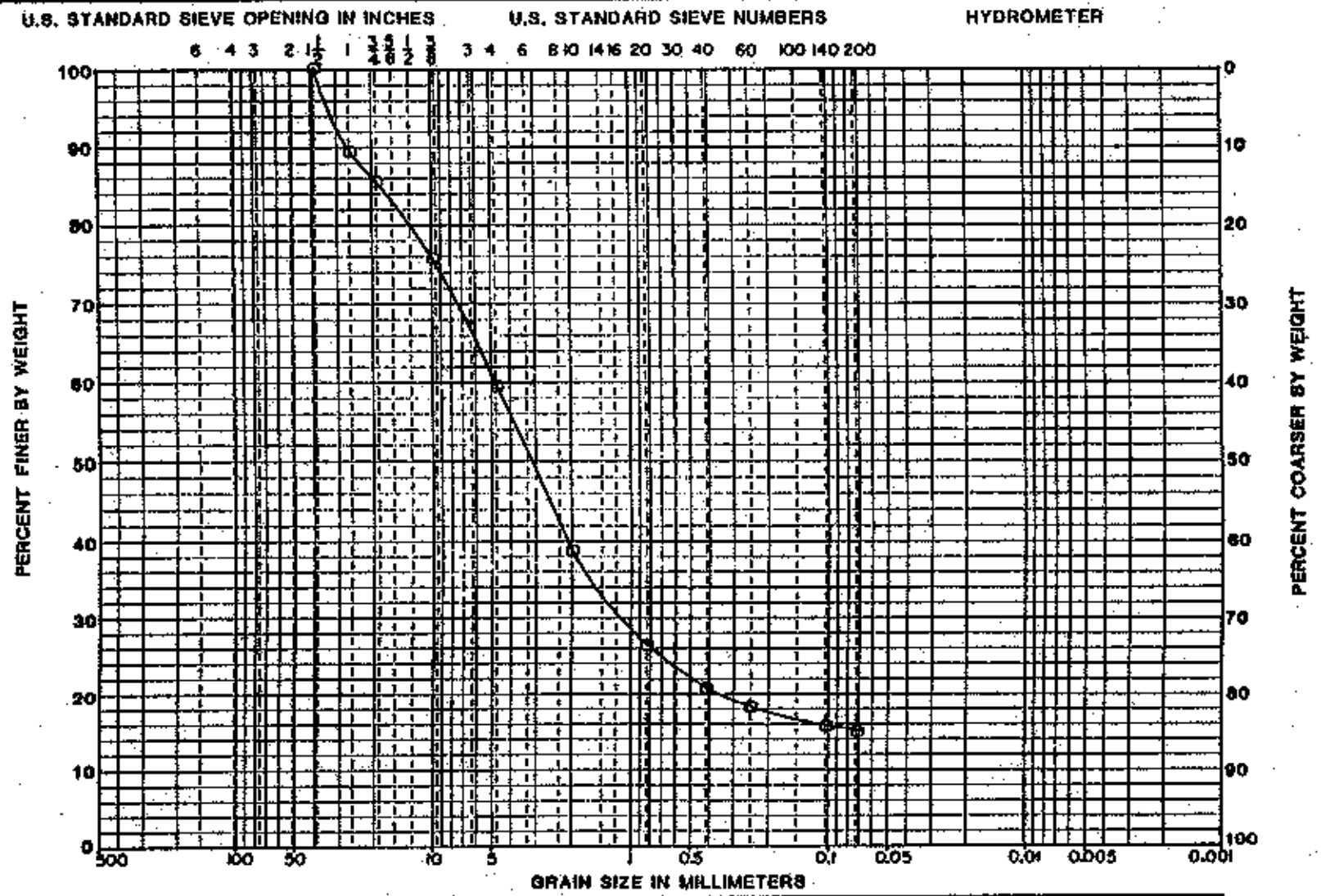
GEOTECHNOLOGY

11295.001

PLATE 13C

CHECKED BY: dA

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
SB-15	38-38.5	SC to GC	3.5			

PROJECT WSSRAP

BORING NO. GT-63P

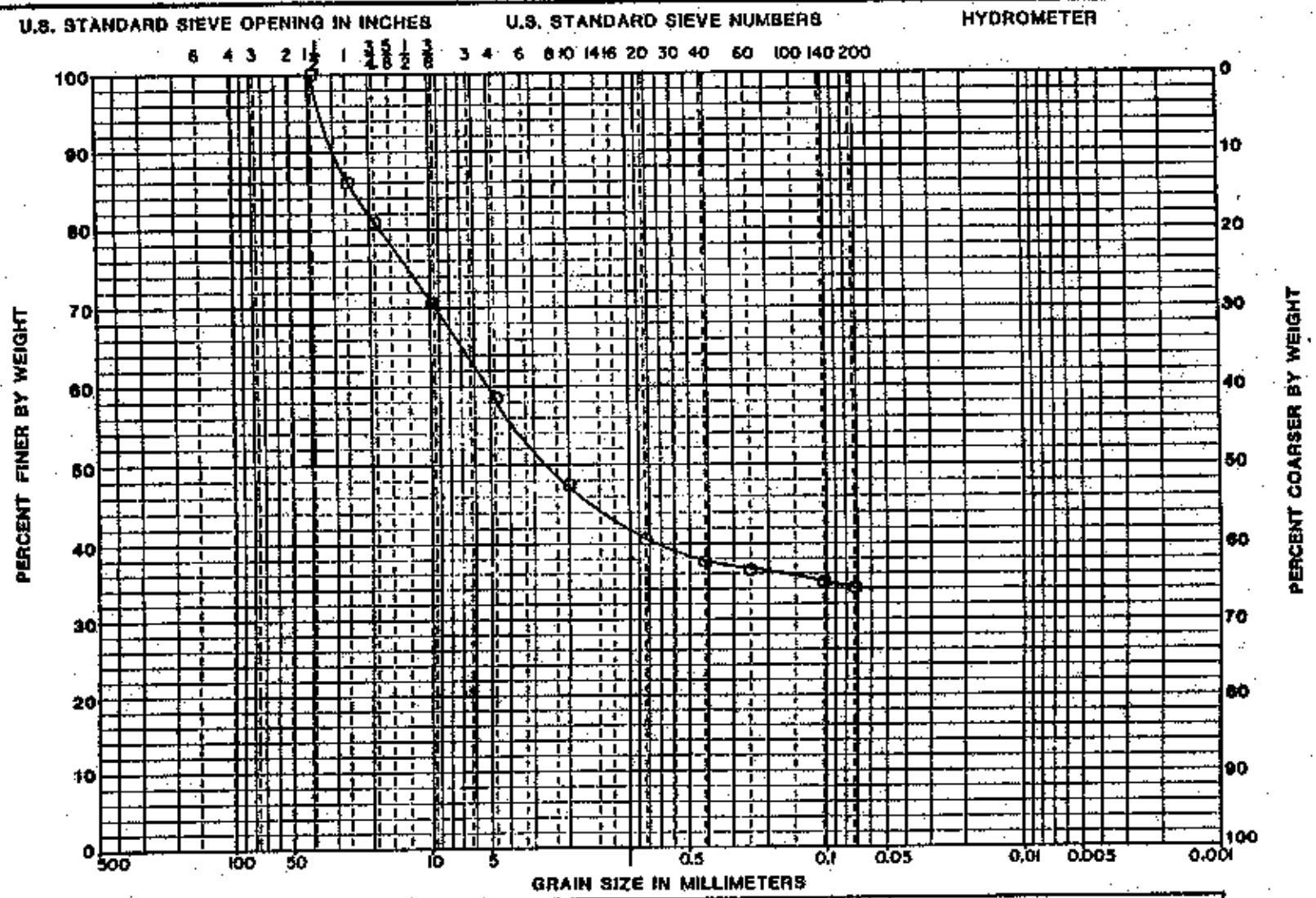
DATE 2-14-90

GEOTECHNOLOGY

11295.000

PLATE L 41

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
SB-15	40-41	GC	28.7			

PROJECT WSSRAP

BORING NO. GT-65P

DATE 2-14-90

GEOTECHNOLOGY

11295.000

PLATE 43

SHRINKAGE LIMIT TESTS

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

Request # 2

PHYSICAL PROPERTY TEST RESULTS

SITE ID: Disposal cell

LOCATION ID: Program 2A

DATE: 9-15-89

CHECKED BY: LAB YY

LAB NAME: Geotechnology Inc.

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	~~PLASTIC LIMIT~~ SHRINKAGE LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY	SOIL CLASSIFICATION
GT-2T71 Bu-02A	6.5-12		8.26			
GT-2T75 Bu-02B	6.5-12		7.27			
GT-2T79 Bu--01A	1.5-6.5		10.74* ~~17.47~~			
GT-2T81 Bu-01A	—		17.47* ~~10.74~~			

* RESULTS WERE MISPLACED. CORRECTIONS MADE BY MKF, ECT 11/2/90

TEST PROCEDURE:

F-99

SHRINKAGE FACTORS

PROJECT WSSRAP JOB NO. 11245.000

DATE 6/19/89

[illegible]ED BY YY & AB

CALC. BY YY CHECKED BY YY

Remarks: 1 - Gray, slightly silty clay to clay

2 - Gray clay, trace fine gravel & sand

3 - Brown and gray, slightly silty clay

Borings No.		GT 2771	GT-2771	GT-2775	GT-2775	GT-2781	GT-2781
Sample No.		BU-02A 6.5-12	BU-02A 6.5-12	BU-02B 6.5-12	BU-02B 6.5-12	BU-01~~A~~ —	BU-01~~A~~ — *
Tare No.		1	2	3	4	7	8
Wt. Wet Soil + Tare (gms)		45.00	44.36	43.58	43.50	47.09	47.17
Wt. Dry Soil + Tare (gms)		37.47	36.88	34.41	34.77	40.51	40.36
Wt. of Dish (gms)		22.93	22.72	22.24	22.73	22.68	22.92
Wt. of Dry Soil (gms)	1	14.54	14.16	12.17	12.04	17.83	17.44
Moisture Content (w%)	2	51.79	52.82	71.24	72.51	36.90	39.05
Volume of Wet Soil (cc)	3	13.57	13.32	13.55	13.58	13.54	13.54
Volume of Tare (cc)		13.57	13.38	13.55	13.58	13.54	13.54
Wt. of Displaced Hg + Dish (gms)		983.4	979.5	964.5	961.2	1023.4	1015.4
Wt. of Dish (gms)		885.1	885.1	885.1	885.1	885.1	885.1
Wt. of Displaced Hg (gms)		98.3	94.4	79.4	76.1	138.3	130.3
Volume of Displaced Hg (gms)							
Volume of Dry Soil (cc)	4	7.27	6.98	5.87	5.62	10.22	9.63
$SL = 2 - (\frac{3-4}{1} \times 100)$ Note: SL ≤ PL		8.46	8.05	8.13	6.40	18.30	16.63
$SR = \frac{1}{4}$							

* TYPO ERROR. CORRECTIONS MADE BY MKF EET 11/2/90

GEOTECHNOLOGY

SHRINKAGE FACTORS

PROJECT WSSRAP JOB NO. 11295.000

DATE 6/19/09

TESTED BY YY & AB

CALC. BY YY CHECKED BY YY

Remarks:

Borings No.		GT-2779 1-6.5	GT-2779 1-6.5				
Sample No.		B4 01A	B4 01A				
Tare No.		5	6				
Wt. Wet Soil + Tare (gms)		45.40	44.93				
Wt. Dry Soil + Tare (gms)		38.26	37.86				
Wt. of Dish (gms)		23.16	23.97				
Wt. of Dry Soil (gms)	1	15.10	13.89				
Moisture Content (w%)	2	47.28	50.90				
Volume of Wet Soil (cc)	3	13.22	13.53				
Volume of Tare (cc)		13.22	13.53				
Wt. of Displaced Hg + Dish (gms)		992.3	990.0				
Wt. of Dish (gms)		885.1	885.1				
Wt. of Displaced Hg (gms)		107.2	104.9				
Volume of Displaced Hg (gms)							
Volume of Dry Soil (cc)	4	7.92	7.75				
$SL = 2 - (\frac{3-4}{1} \times 100)$ Note: SL ≈ PL		12.18	9.29				
$SR = \frac{1}{4}$							

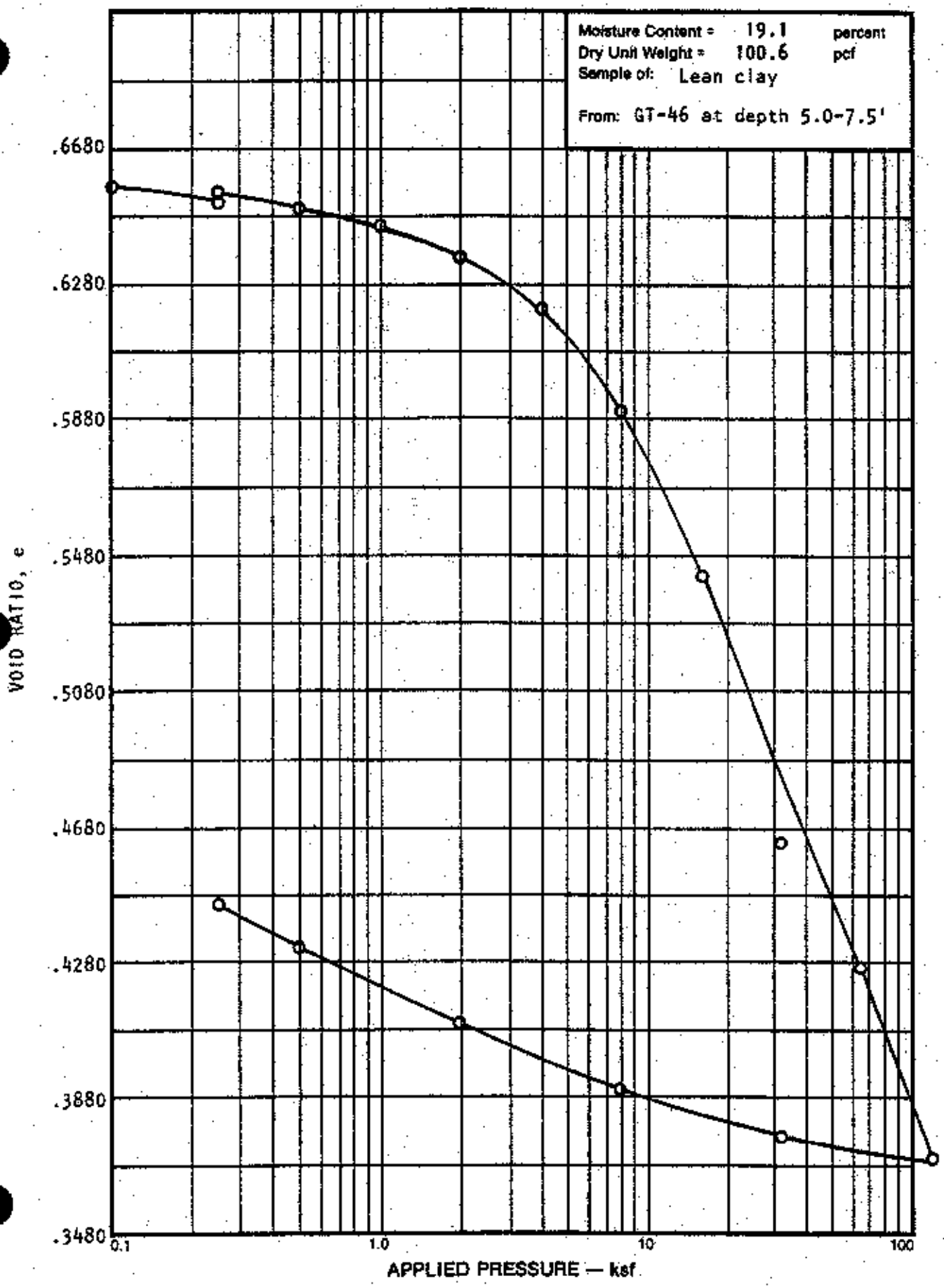
GEOTECHNOLOGY

F 102

CONSOLIDATION TESTS

CA-1A-79

chen and associates, inc.



1 296 89

SWELL-CONSOLIDATION TEST RESULTS Fig. 1

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: GT-46

DATE: January 1989

CHECKED BY LAB: G.

LAB NAME: Chen-Northern

TAC:

Chen Job No.: 1 296 89

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
ST 03	5.0-7.5	250	-

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
100.6	19.1	77.8	.6576

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
115.3	20.5	100+	.4326

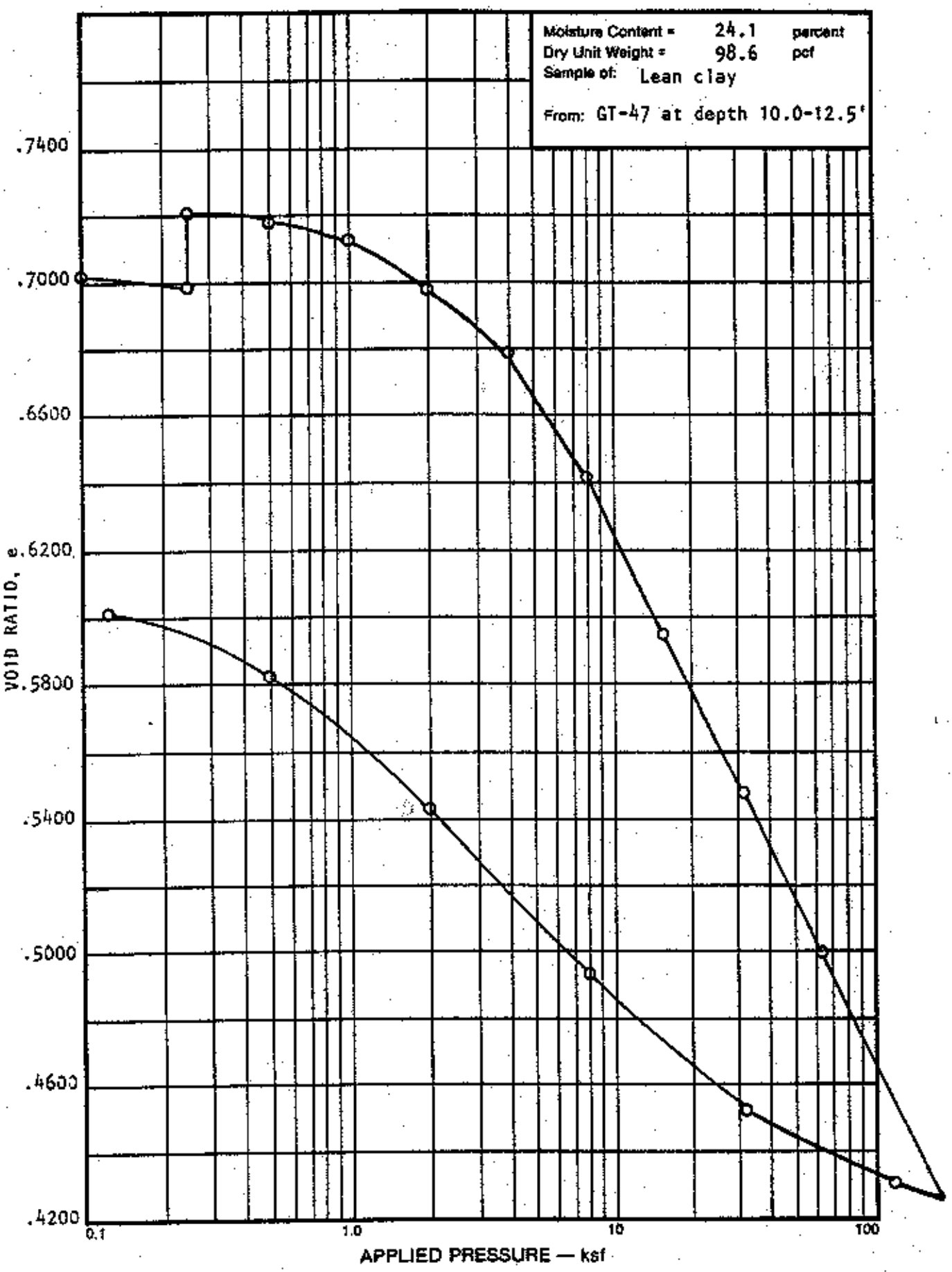
TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
0	.6576	-
100	.6569	-
250	.6549	-
250 w/ water	.6529	-
500	.6496	-
1000	.6452	2.94×10^{-3}
2000	.6363	9.73×10^{-4}
4000	.6211	2.21×10^{-3}
8000	.5899	3.73×10^{-3}
16000	.5406	2.66×10^{-3}
32000	.4637	-
64000	.4264	1.13×10^{-3}
120000	.3689	-
32000	.3758	-
8000	.3888	-
2000	.4107	-
500	.4326	-

TEST PROCEDURE: D-2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

CA-1A-79

chen and associates, inc.



1 296 89

SWELL-CONSOLIDATION TEST RESULTS

Fig. 2

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: GT-47

DATE: January 1989

CHECKED BY LAB:

LAB NAME: Chen-Northern

TAC:

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
ST 05	10.0-12.5	250	-

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
98.6	24.1	92.3	.7027

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
104.5	24.0	100+	.5815

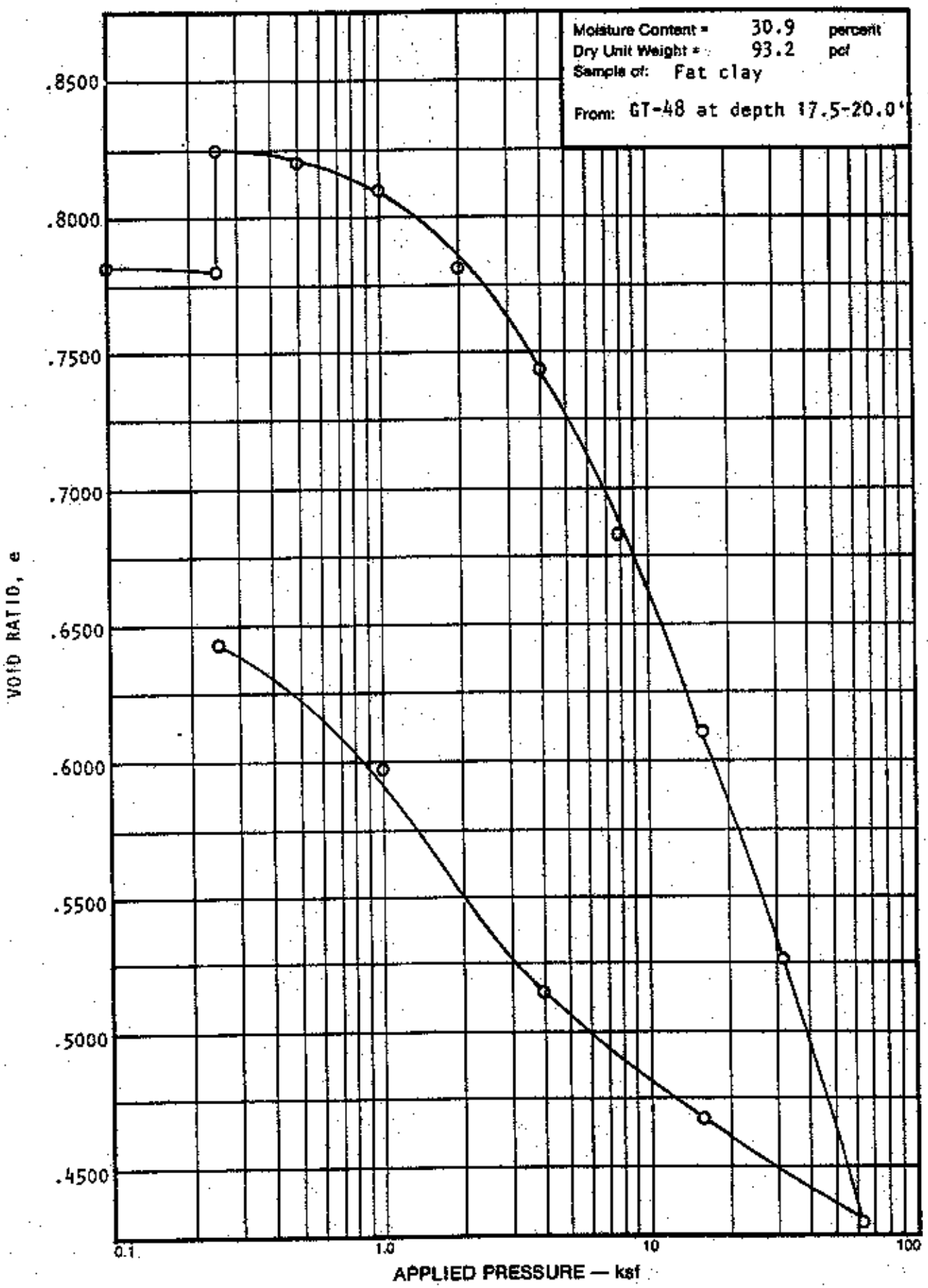
TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
0	.7027	-
100	.7018	-
250	.6995	-
250 w/ water	.7204	-
500	.7181	-
1000	.7127	1.37×10^{-4}
2000	.6981	1.76×10^{-4}
4000	.6793	2.93×10^{-4}
8000	.6416	2.83×10^{-4}
16000	.5944	2.07×10^{-4}
32000	.5476	3.38×10^{-4}
64000	.4986	1.99×10^{-4}
120000	.4298	1.84×10^{-4}
32000	.4507	-
8000	.4920	-
2000	.5420	-
500	.5815	-

TEST PROCEDURE: D-2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

CA-1A-79

chen and associates, inc.



1 296 89

SWELL-CONSOLIDATION TEST RESULTS

Fig. 3

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: GT-48

DATE: January 1989

CHECKED BY LAB: [illegible]

LAB NAME: Chen-Northern

TAC:

Chen Job No.: 1 296 89

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
ST-07	17.5-20.0	250	-

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
93.2	30.9	100+	.7899

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
101.4	29.7	100+	.6452

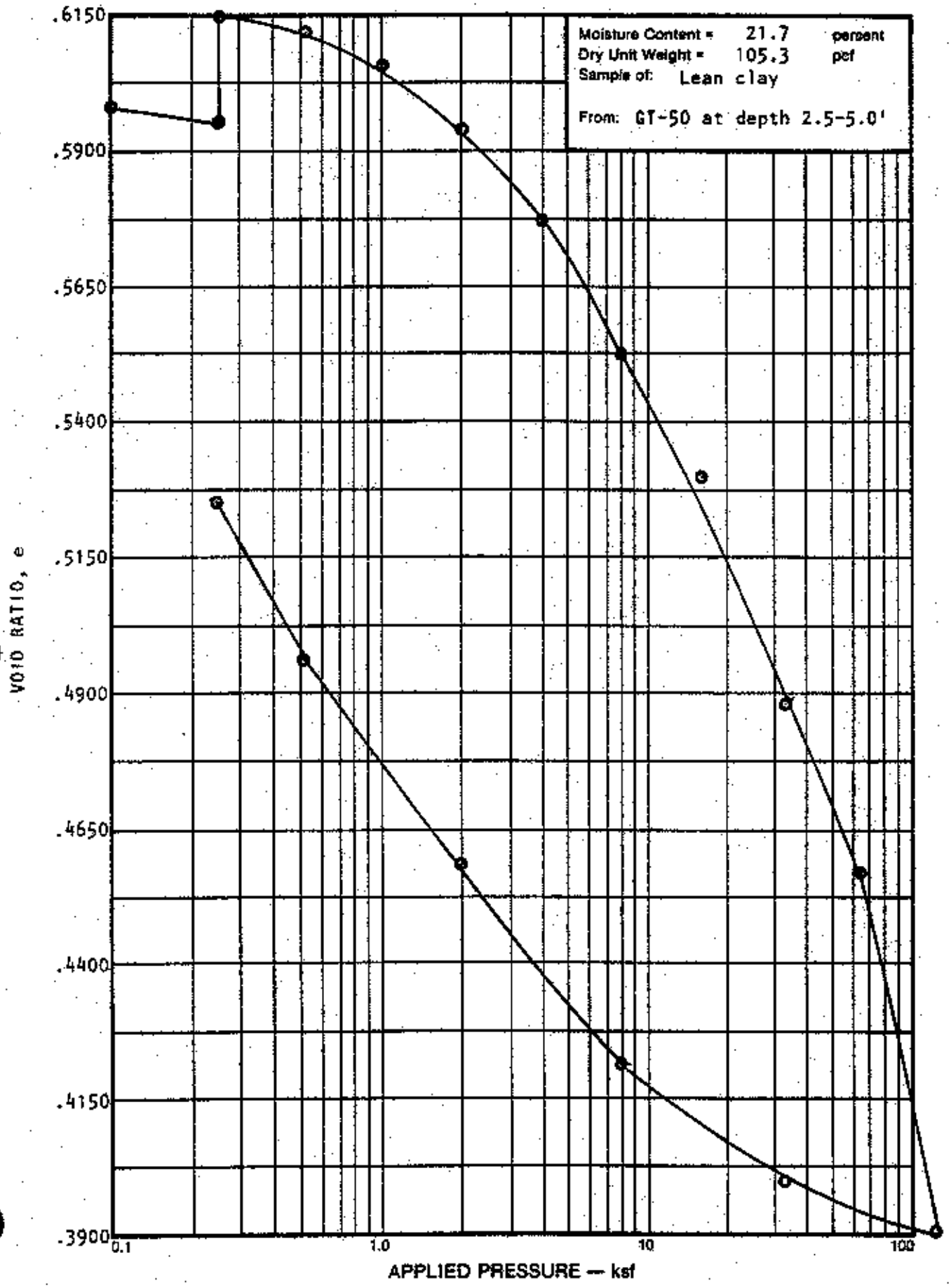
TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
0	.7899	-
100	.7878	-
250	.7829	-
250 w/ water	.8259	-
500	.8218	8.18×10^{-5}
1000	.8100	4.55×10^{-5}
2000	.7846	5.25×10^{-5}
4000	.7482	3.89×10^{-5}
8000	.6865	4.55×10^{-5}
16000	.6090	4.26×10^{-5}
32000	.5256	3.73×10^{-5}
64000	.4274	3.97×10^{-5}
16000	.4669	-
4000	.5157	-
1000	.5986	-
250	.6452	-

TEST PROCEDURE: D-2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

CA-1A-79

chen and associates, inc.



1 296 89

SWELL-CONSOLIDATION TEST RESULTS

Fig. 4

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: GT-50

DATE: January 1989

CHECKED BY LAB: RM

LAB NAME: Chen-Northern, Inc.

TAC:

Chen Job No.: 1 296 89

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
ST-02	2.5-5.0	250	-

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
105.3	21.7	97.8	.6002

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
* 110.5	20.9	100	* .5247

* Data Suspect

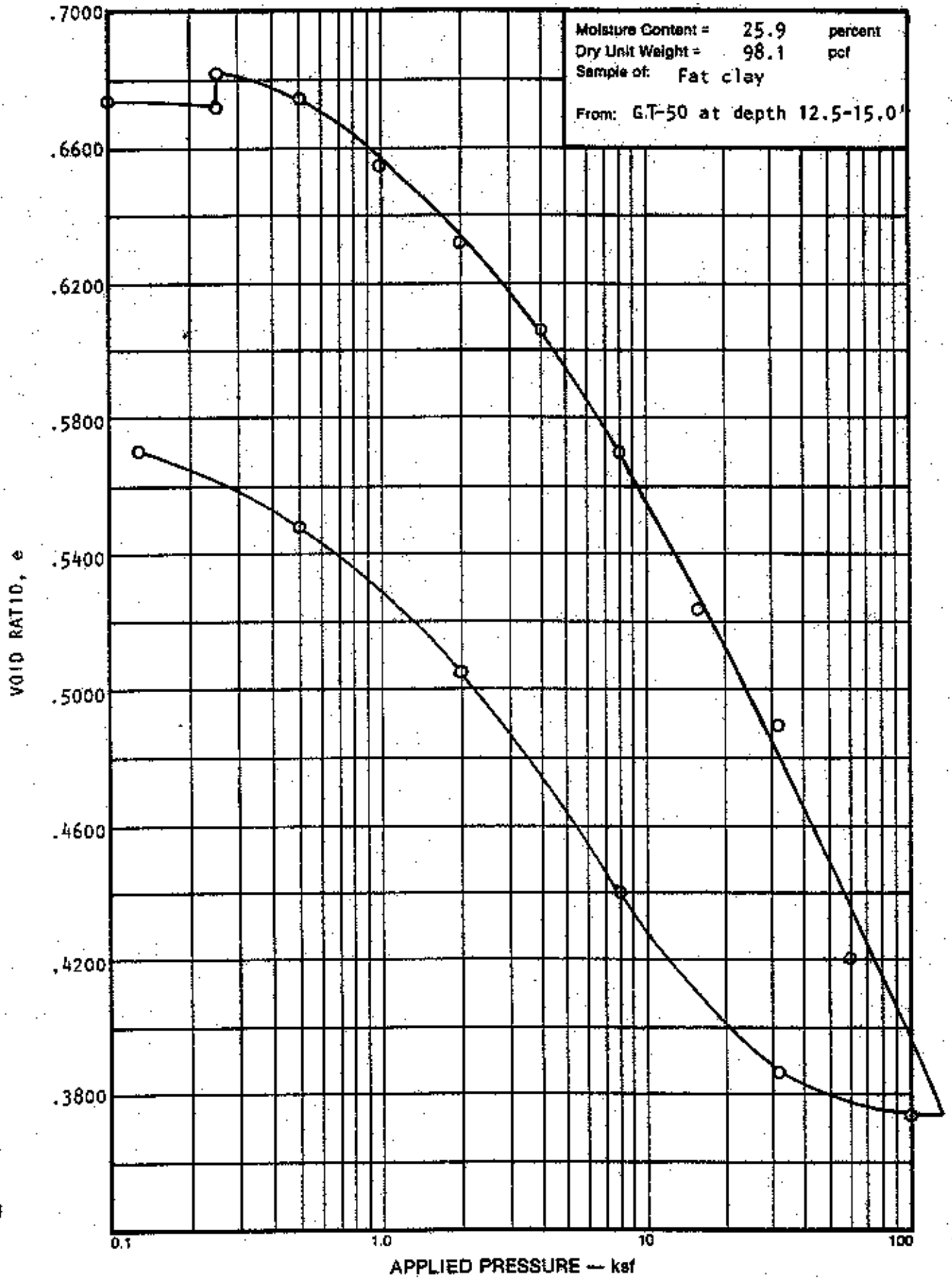
TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
0	.6002	-
100	.5979	-
250	.5953	-
250 w/ water	.6147	-
500	.6121	-
1000	.6067	1.20×10^{-4}
2000	.5944	2.44×10^{-4}
4000	.5769	2.40×10^{-4}
8000	.5525	2.67×10^{-4}
16000	.5300	2.02×10^{-4}
32000	.4884	1.45×10^{-4}
64000	.4573	3.72×10^{-4}
128000	.3901	5.16×10^{-5}
32000	.3999	-
8000	.4212	-
2000	.4584	-
500	.4957	-

TEST PROCEDURE: D-2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

CA-1A-79

chen and associates, inc.



1 296 89

SWELL-CONSOLIDATION TEST RESULTS

Fig. 5

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: GT-50

DATE: January 1989

CHECKED BY LAB:

LAB NAME: Chen-Northern

TAC:

Chen Job No. 1 296 89

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
ST 06	12.5-15.0	250	-

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
98.1	25.9	100+	.6746

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
104.6	26.2	100+	.5480

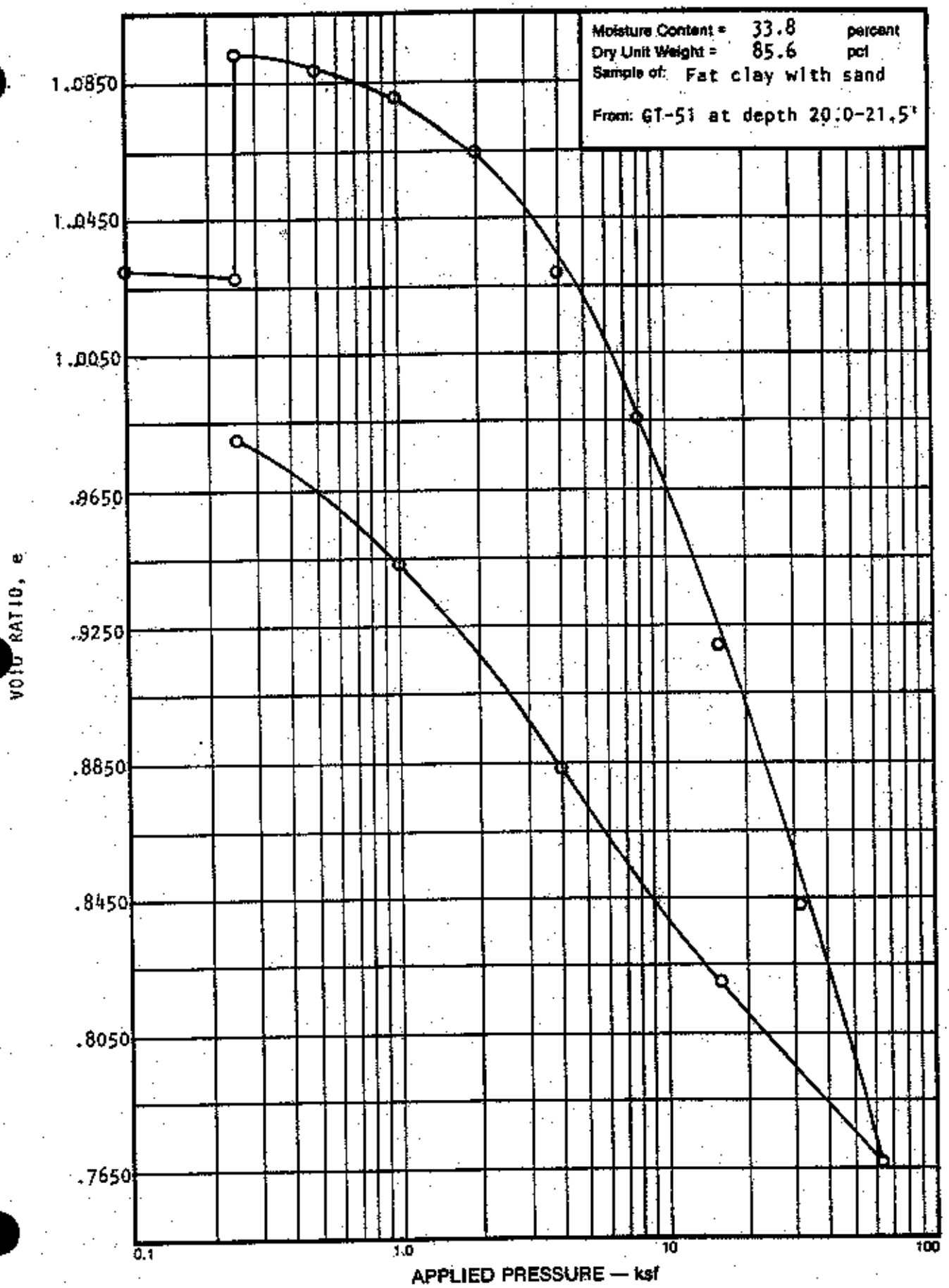
TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
0	.6746	-
100	.6746	-
250	.6728	-
250 w/ water	.6826	-
500	.6755	-
1000	.6547	-
2000	.6322	6.67×10^{-5}
4000	.6067	1.03×10^{-4}
8000	.5705	1.07×10^{-4}
16000	.5225	1.10×10^{-4}
32000	.4886	1.09×10^{-4}
64000	.4196	7.02×10^{-5}
100000	.3720	-
32000	.3846	-
8000	.4399	-
2000	.5053	-
500	.5480	-

TEST PROCEDURE: D-2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

CA-1A-79

chen and associates, inc.



1 296 89

SWELL-CONSOLIDATION TEST RESULTS

Fig. 6

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: GT-51

DATE: January 1989

CHECKED BY LAB:

LAB NAME: Chen-Northern

Chen Job No.: 1 296 89

TAC:

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
SB 09	20.0-21.5	250	-

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
85.6	33.8	91.2	1.0338

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
87.9	37.8	100+	.9808

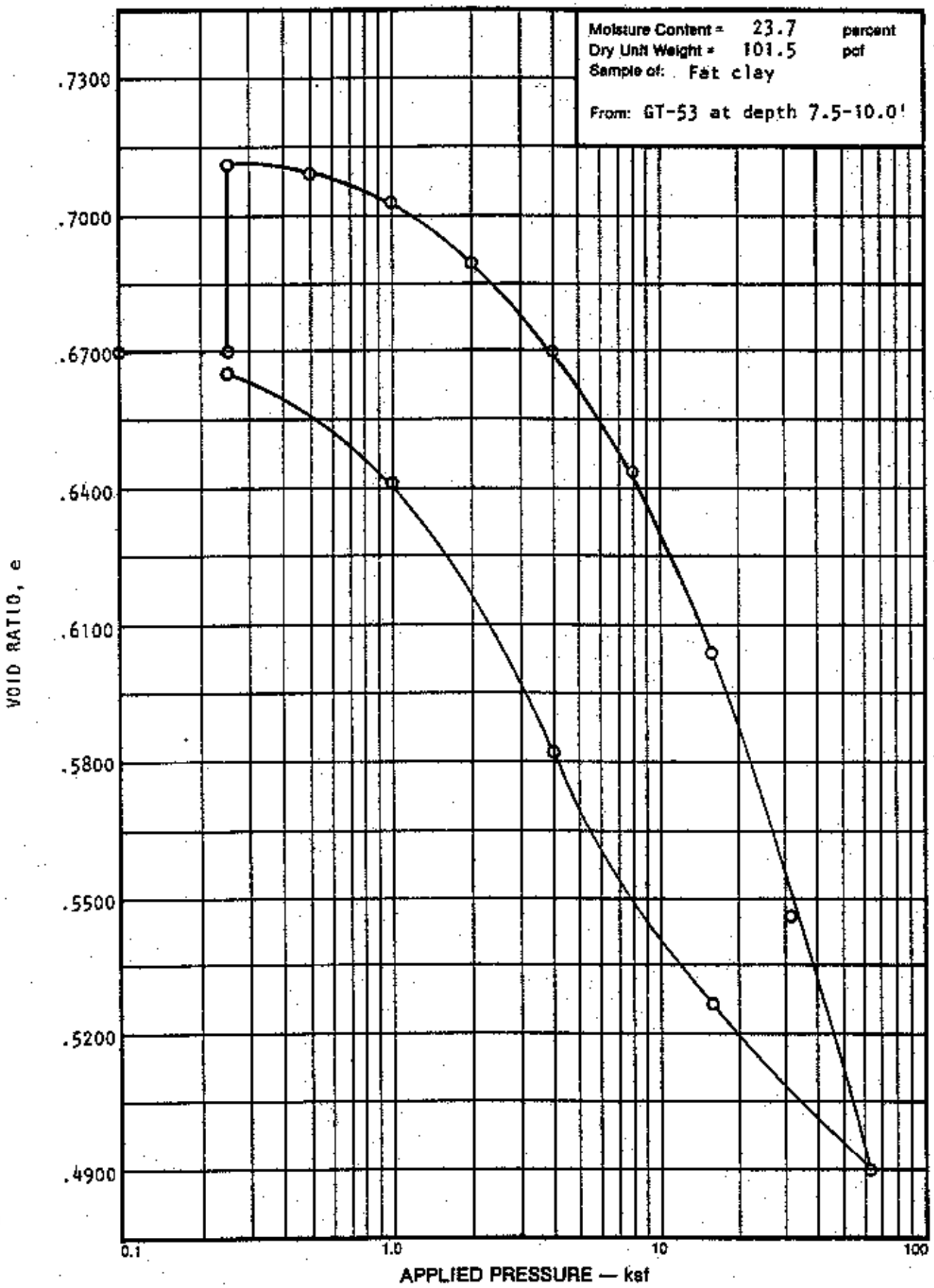
TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
0	1.0338	-
100	1.0311	-
250	1.0281	-
250 w/ water	1.0936	-
500	1.0898	-
1000	1.0824	9.66×10^{-5}
2000	1.0646	2.04×10^{-4}
4000	1.0292	2.71×10^{-4}
8000	.9860	1.43×10^{-4}
16000	.9202	1.18×10^{-4}
32000	.8432	7.63×10^{-5}
64000	.7663	5.93×10^{-5}
16000	.8206	-
4000	.8847	-
1000	.9445	-
250	.9808	-

TEST PROCEDURE: D-2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

CA-1A-79

chen and associates, inc.



1 296 89

SWELL-CONSOLIDATION TEST RESULTS

Fig. 7

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: GT-53

DATE: January 1989

CHECKED BY LAB: [illegible]

LAB NAME: Chen-Northern

TAC:

Chen Job No.: 1 296 89

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
ST 04	7.5-10.0	250	-

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
101.5	23.7	95.3	.6797

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
102.1	25.6	100+	.6705

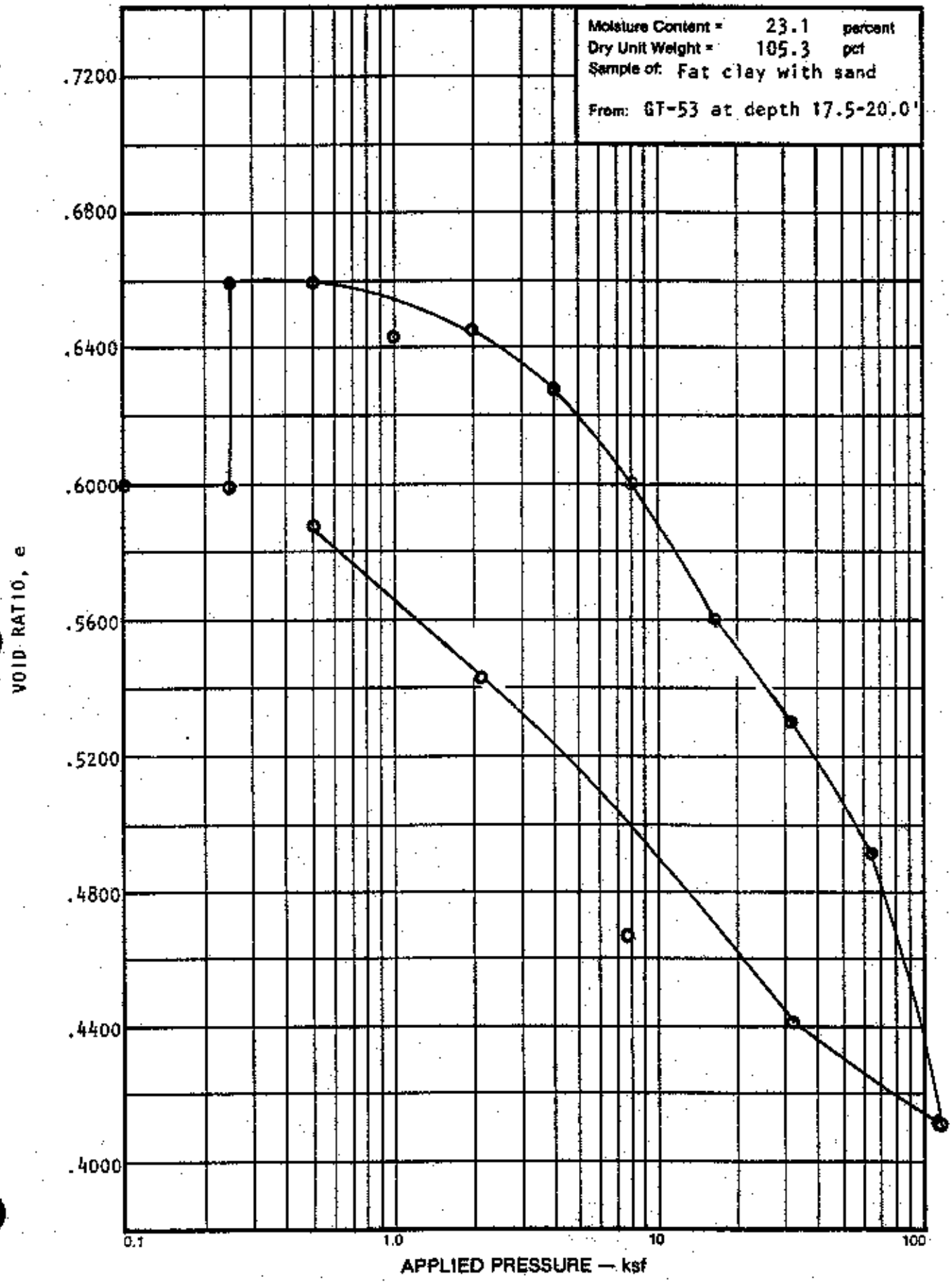
TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
0	.6797	-
100	.6700	-
250	.6664	-
250 w/ water	.7126	-
500	.7106	-
1000	.7038	8.43×10^{-5}
2000	.6903	6.38×10^{-5}
4000	.6696	6.13×10^{-5}
8000	.6441	6.36×10^{-5}
16000	.6044	4.58×10^{-5}
32000	.5471	3.32×10^{-5}
64000	.4899	3.43×10^{-5}
16000	.5262	-
4000	.5823	-
1000	.6421	-
250	.6705	-

TEST PROCEDURE: D-2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

CA-MA-79

chen and associates, inc.



1 296 89

SWELL-CONSOLIDATION TEST RESULTS

Fig. 8

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: GT-53

DATE: January 1989

CHECKED BY LAB: RM

LAB NAME: Chen-Northern, Inc.
Chen Job No.: 1 296 89

TAC:

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
ST-08	17.5-20.0	250	-

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
105.3	23.1	100	.6013

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
* 104.2	25.7	100	* .6182

* Data Suspect

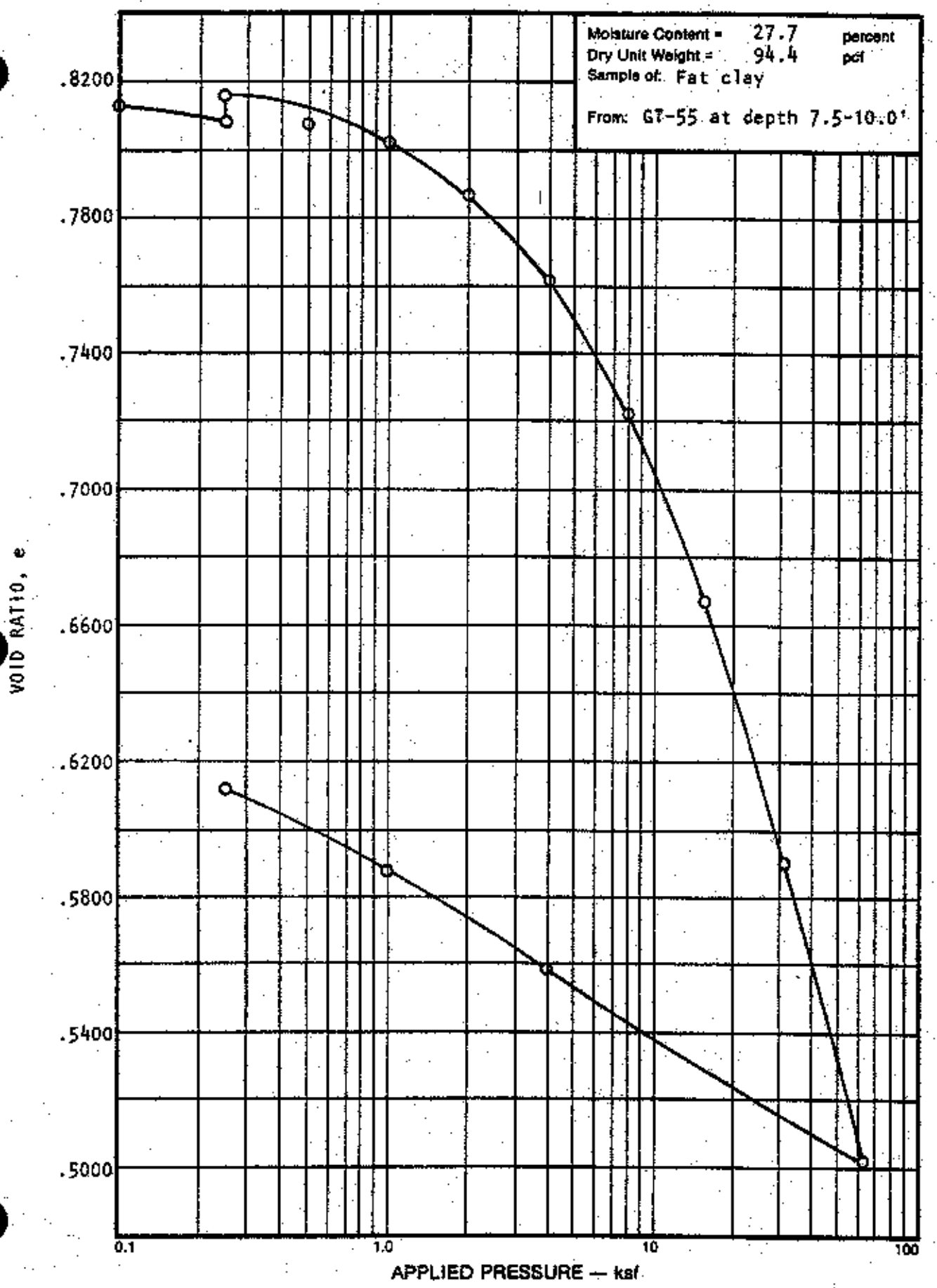
TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
0	.6013	-
100	.6009	-
250	.5999	-
250 w/ water	.6609	-
500	.6599	-
1000	.6417	-
2000	.6422	-
4000	.6288	1.49×10^{-4}
8000	.6047	1.04×10^{-4}
16000	.5624	-
32000	.5304	6.05×10^{-5}
64000	.4914	1.21×10^{-4}
128000	.4113	4.80×10^{-4}
32000	.4421	-
8000	.4665	-
2000	.5435	-
500	.5884	-

TEST PROCEDURE: D-2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

CA-1A-79

chen and associates, inc.



1 296 89

SWELL-CONSOLIDATION TEST RESULTS

Fig. 9

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: GT-55

DATE: January 1989

CHECKED BY LAB: [illegible]

LAB NAME: Chen-Northern

TAC:

Chen Job No.: 1 296 89

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
ST 04	7.5-10.0	250	-

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
94.4	27.7	93.3	.8160

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
106.4	23.0	100+	.5869

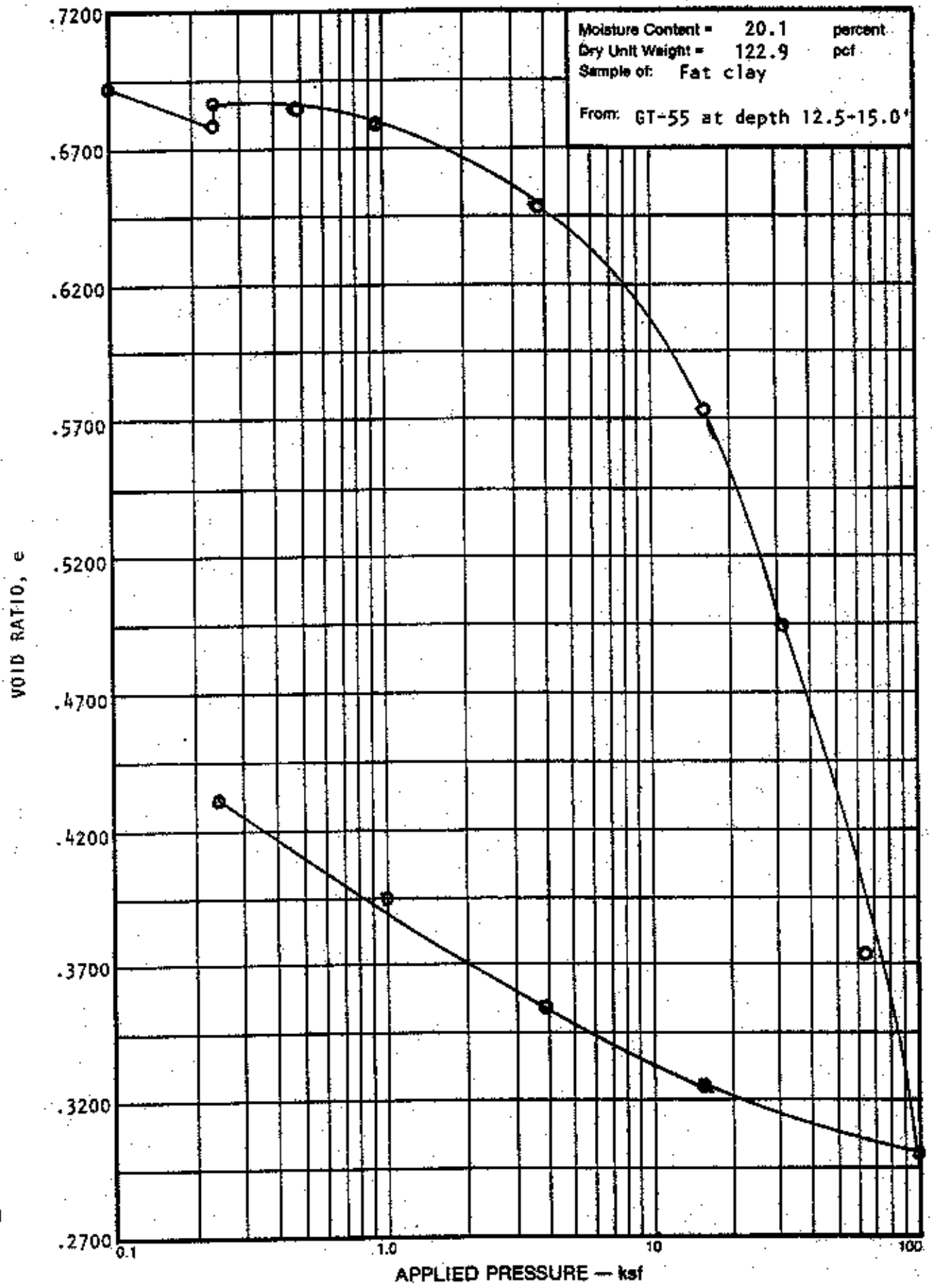
TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
0	.8160	-
100	.8138	-
250	.8099	-
250 w/ water	.8167	-
500	.8087	-
1000	.8038	9.69×10^{-4}
2000	.7880	6.69×10^{-4}
4000	.7616	9.36×10^{-4}
8000	.7220	6.65×10^{-4}
16000	.6680	4.57×10^{-4}
32000	.5713	3.82×10^{-4}
64000	.5008	4.21×10^{-4}
16000	.5142	-
4000	.5591	-
1000	.5869	-

TEST PROCEDURE: D-2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

CA-1A-79

chen and associates, inc.



1 296 89

SWELL-CONSOLIDATION TEST RESULTS

Fig. 10

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: GT-55

DATE: January 1989

CHECKED BY LAB: RM

LAB NAME: Chen-Northern, Inc.

TAC:

Chen Job No.: 1 296 89

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
ST-06	12.5-15.0	250	-

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
104.0	22.4	91.3	.6925

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
* 122.9	20.1	100	* .4319

* Data Suspect

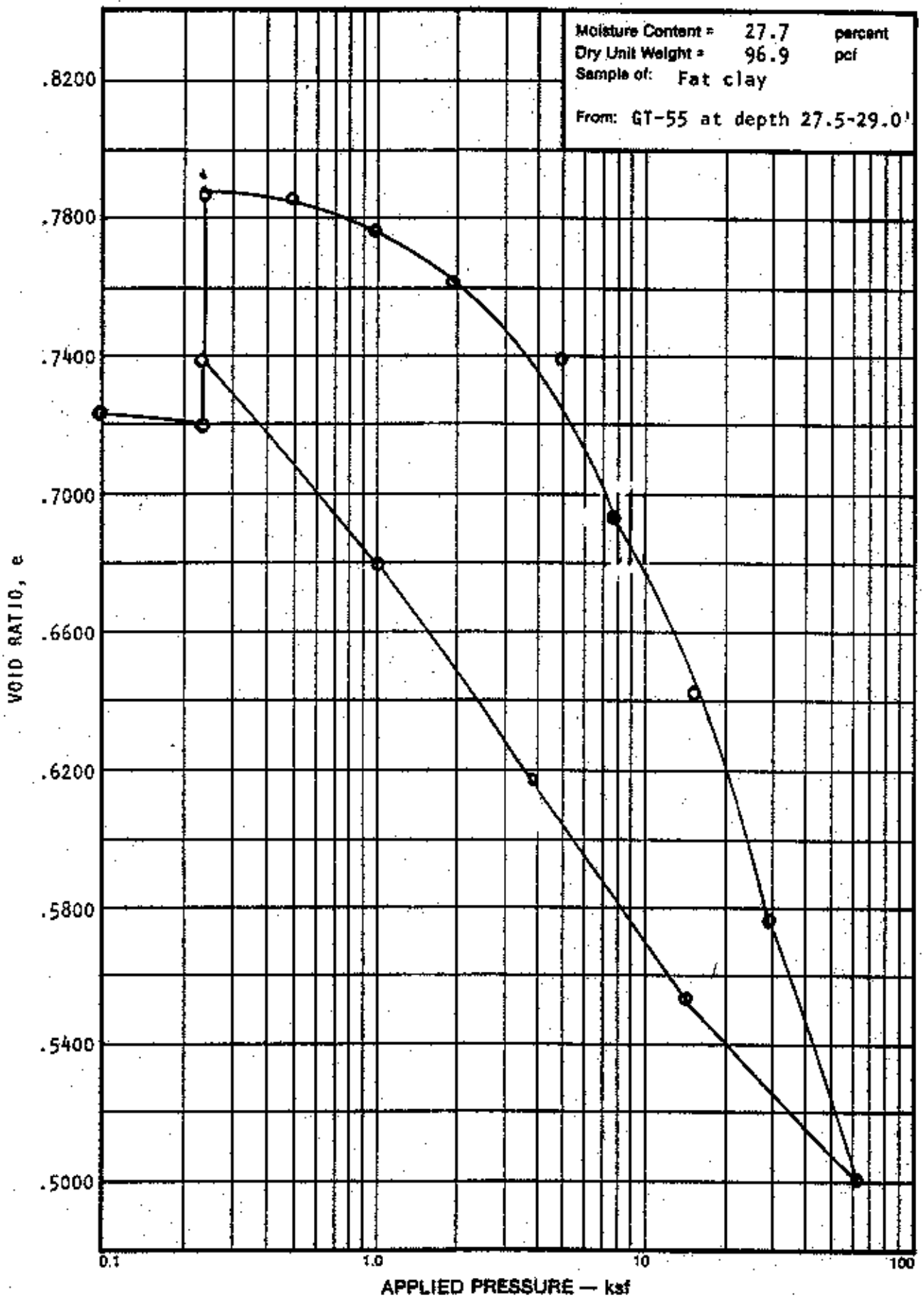
TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
0	.6925	-
100	.6913	-
250	.6792	-
250 w/ water	.6872	-
500	.6845	-
1000	.6807	-
2000	.6691	1.46×10^{-4}
4000	.6487	2.95×10^{-4}
8000	.6200	-
16000	.5730	2.36×10^{-4}
32000	.4950	2.19×10^{-4}
64000	.3743	5.88×10^{-4}
100000	.3013	1.90×10^{-4}
16000	.3253	-
4000	.3543	-
1000	.3964	-
250	.4319	-

TEST PROCEDURE: D-2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

CA-1A-79

chen and associates, inc.



1 296 89

SWELL-CONSOLIDATION TEST RESULTS

Fig. 11

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: GT-55

DATE: January 1989

CHECKED BY LAB: RM

LAB NAME: Chen-Northern, Inc.

TAC:

Chen Job No.: 1 296 89

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
SB-12	27.5-29.0	250	-

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
96.9	27.7	100	.7400

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
* 96.8	31.7	100	* .7411

* Data Suspect

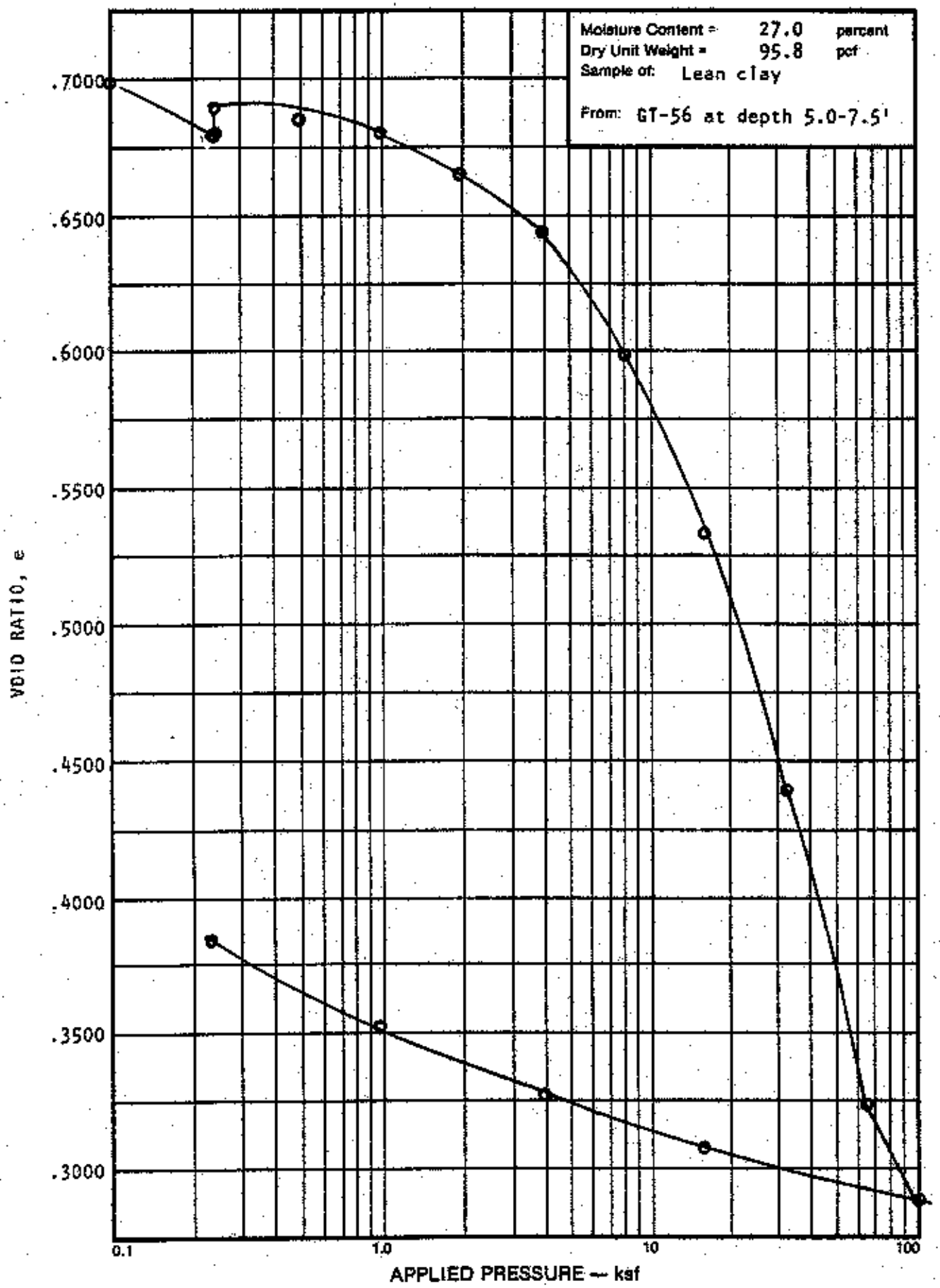
TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
0	.7400	-
100	.7260	-
250	.7205	-
250 w/ water	.7891	-
500	.7896	-
1000	.7792	6.39×10^{-5}
2000	.7643	5.42×10^{-5}
4000	.7418	5.82×10^{-5}
8000	.6952	7.26×10^{-5}
16000	.6439	-
32000	.5794	4.92×10^{-5}
64000	.5022	2.99×10^{-5}
16000	.5546	-
4000	.6193	-
1000	.6722	-
250	.7411	-

TEST PROCEDURE: D-2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

CA-1A-79

chen and associates, inc.



1 296 89

SWELL-CONSOLIDATION TEST RESULTS

Fig. 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: GT-56

DATE: January 1989

CHECKED BY LAB: RM

LAB NAME: Chen-Northern, Inc.

TAC:

Chen Job No.: 1 296 89

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
ST-02	5.0-7.5	250	-

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
95.8	27.0	100	.7070

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
* 118.3	22.0	100	* .3828

* Data Suspect

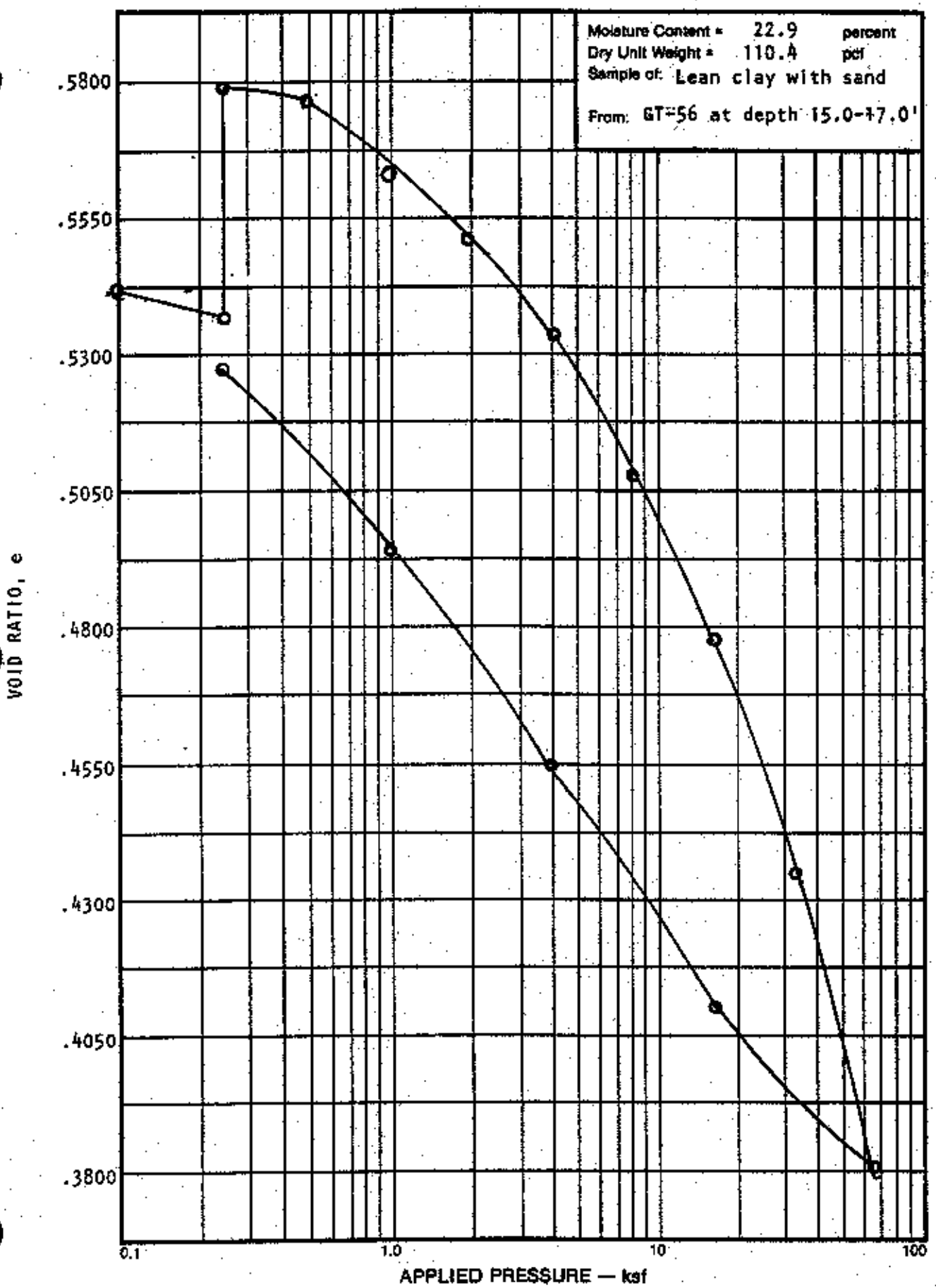
TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
0	.7070	-
100	.6995	-
250	.6832	-
250 w/ water	.6893	-
500	.6850	-
1000	.6831	-
2000	.6695	3.53×10^{-4}
4000	.6407	1.79×10^{-3}
8000	.5990	-
16000	.5571	1.67×10^{-3}
32000	.5325	1.80×10^{-3}
64000	.3247	-
100000	.2879	3.34×10^{-4}
16000	.3089	-
4000	.3273	-
1000	.3554	-
250	.3828	-

TEST PROCEDURE: D-2435

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

CA-1A-79

chen and associates, inc.



1 296 89

SWELL-CONSOLIDATION TEST RESULTS

Fig. 13

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP 3

LOCATION ID: GT-56

DATE: January 1989

CHECKED BY LAB: RM

LAB NAME: Chen-Northern, Inc.
Chen Job No.: 1 296 89

TAC:

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
ST-06	15.0-17.0	250	-

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
107.4	20.1	95.5	.5693

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
* 110.4	22.9	100	* .5269

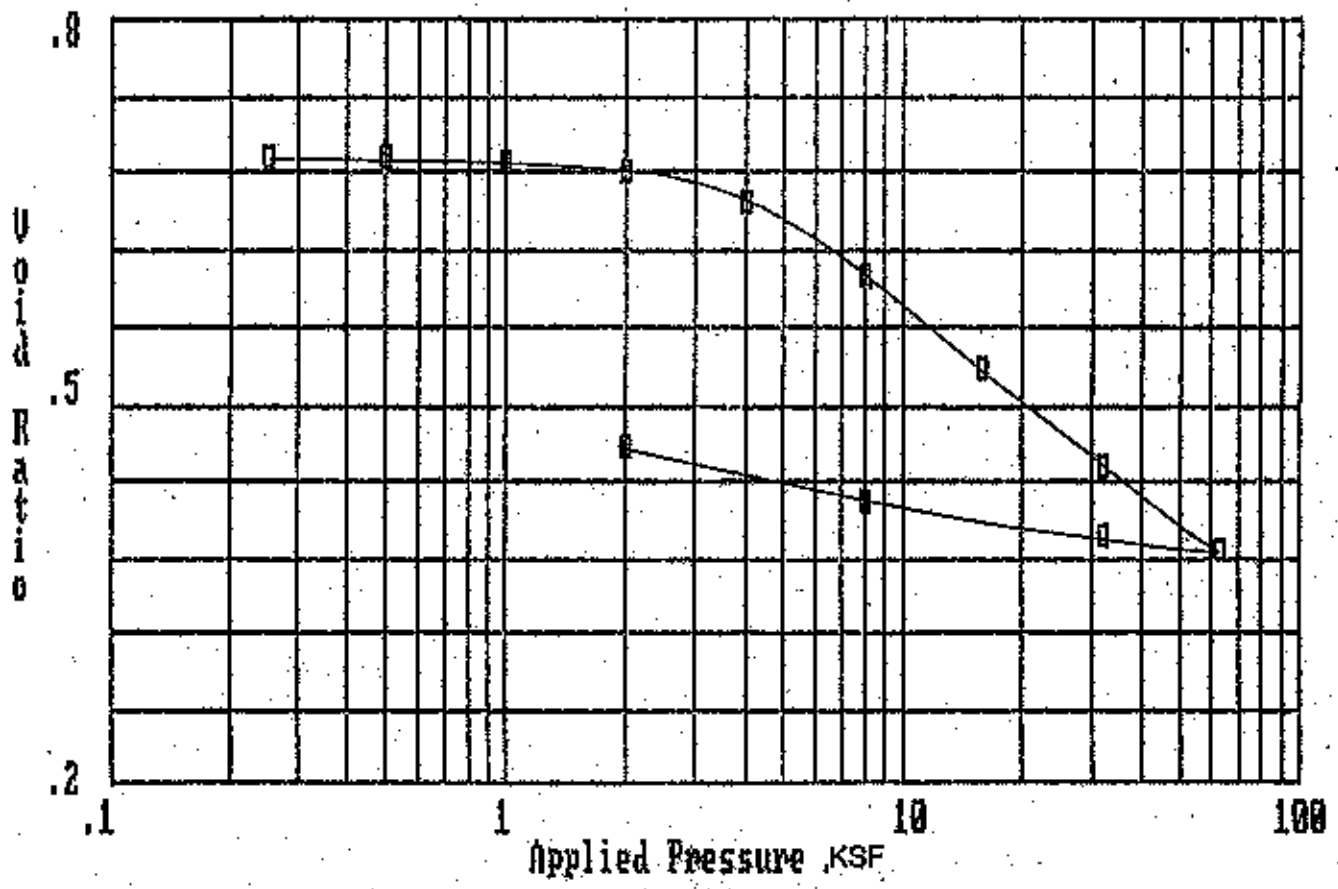
* Data Suspect

TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm3/sec)
0	.5693	-
100	.5413	-
250	.5367	-
250 w/ water	.5788	-
500	.5765	-
1000	.5629	5.96×10^{-5}
2000	.5509	2.09×10^{-4}
4000	.5336	2.88×10^{-4}
8000	.5080	2.54×10^{-4}
16000	.4779	1.20×10^{-4}
32000	.4354	6.94×10^{-5}
64000	.3810	5.71×10^{-5}
16000	.4109	-
4000	.4553	-
1000	.4934	-
250	.5269	-

TEST PROCEDURE: D-2435

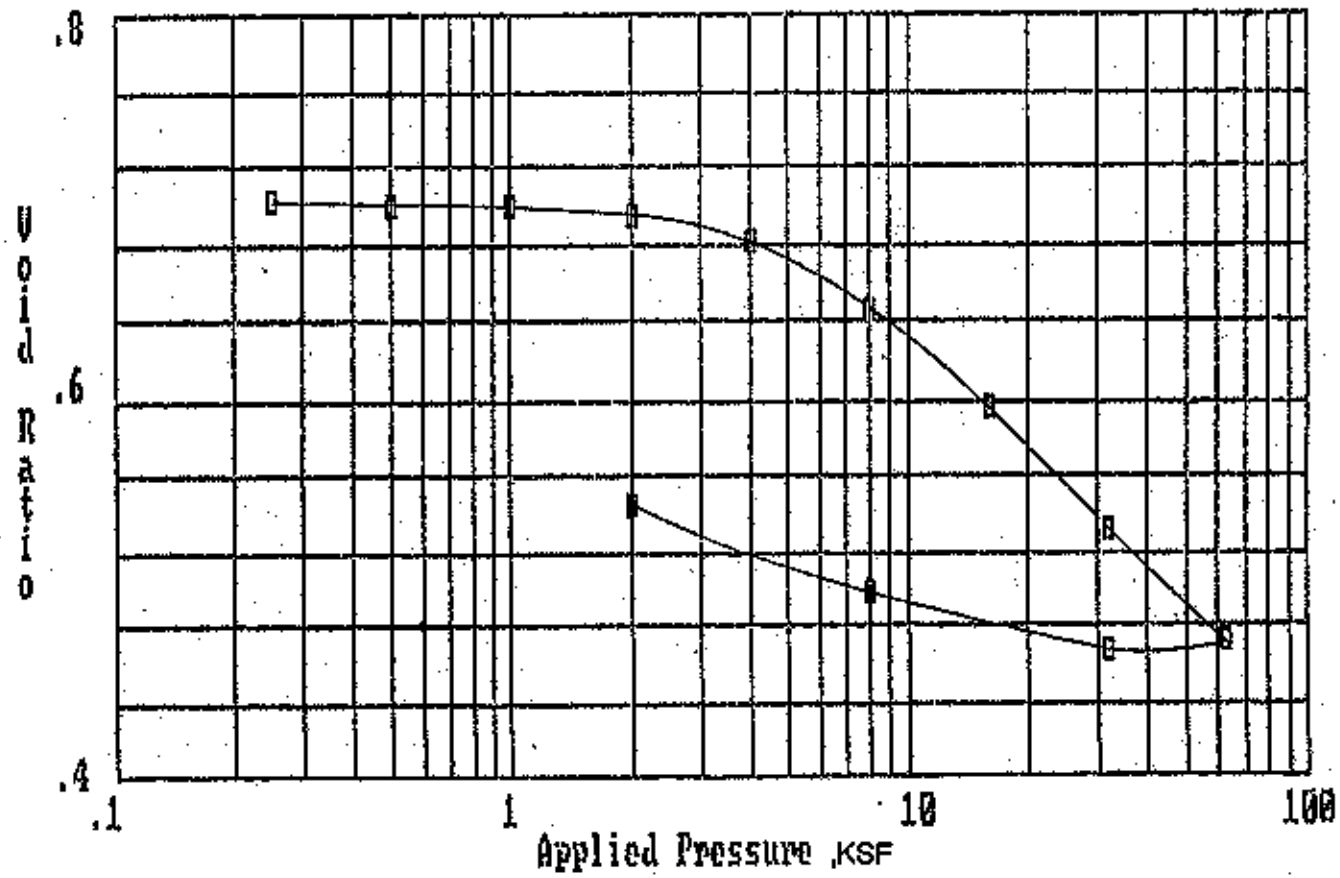
NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

Boring No. = GT-2T71	Depth = 6.5-12	Number = DU-02A

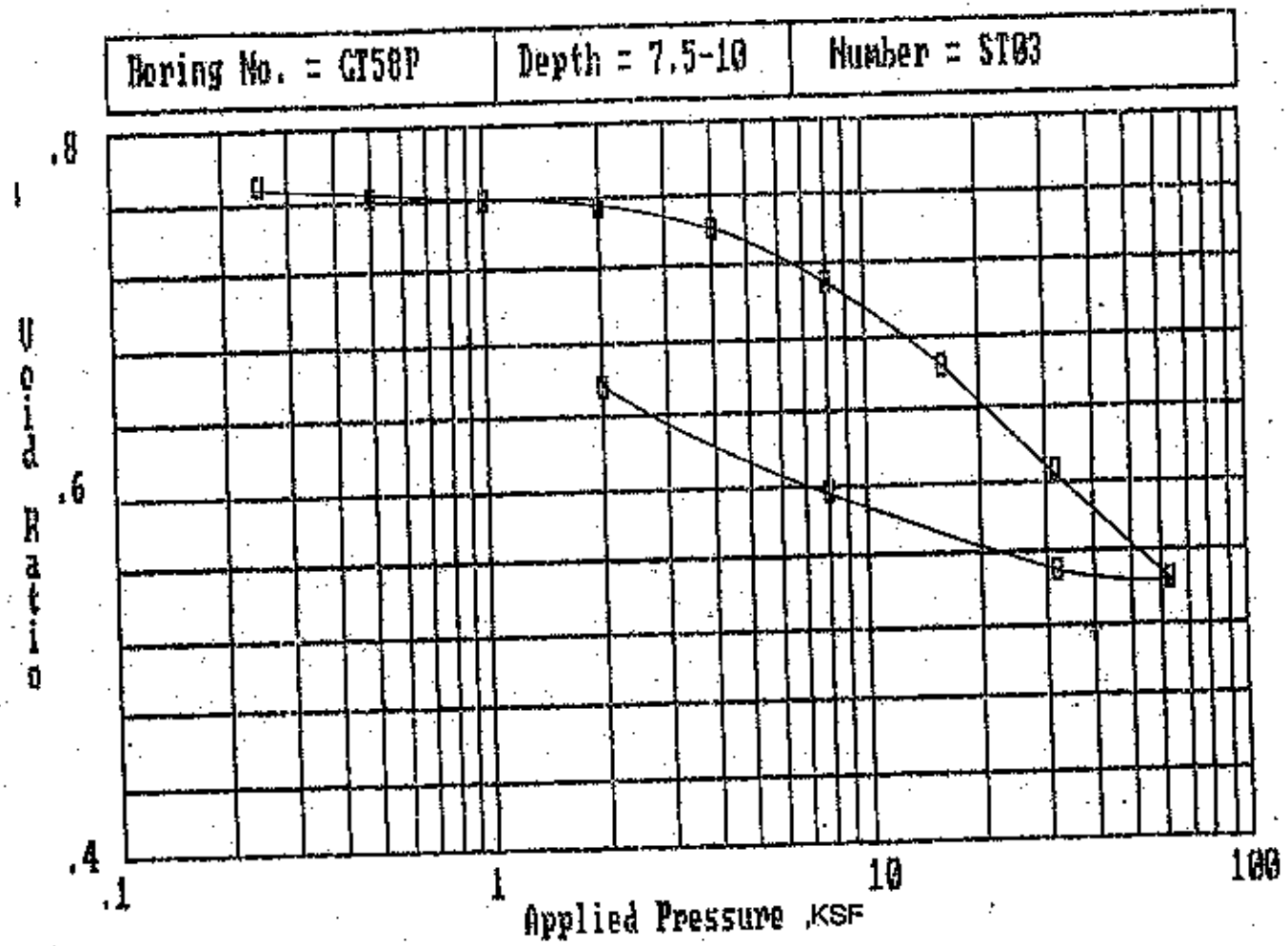


Checked by: JA

Boring No. = GT-2T75	Depth = 6.5-12	Number = BU-02D



checked by: JA



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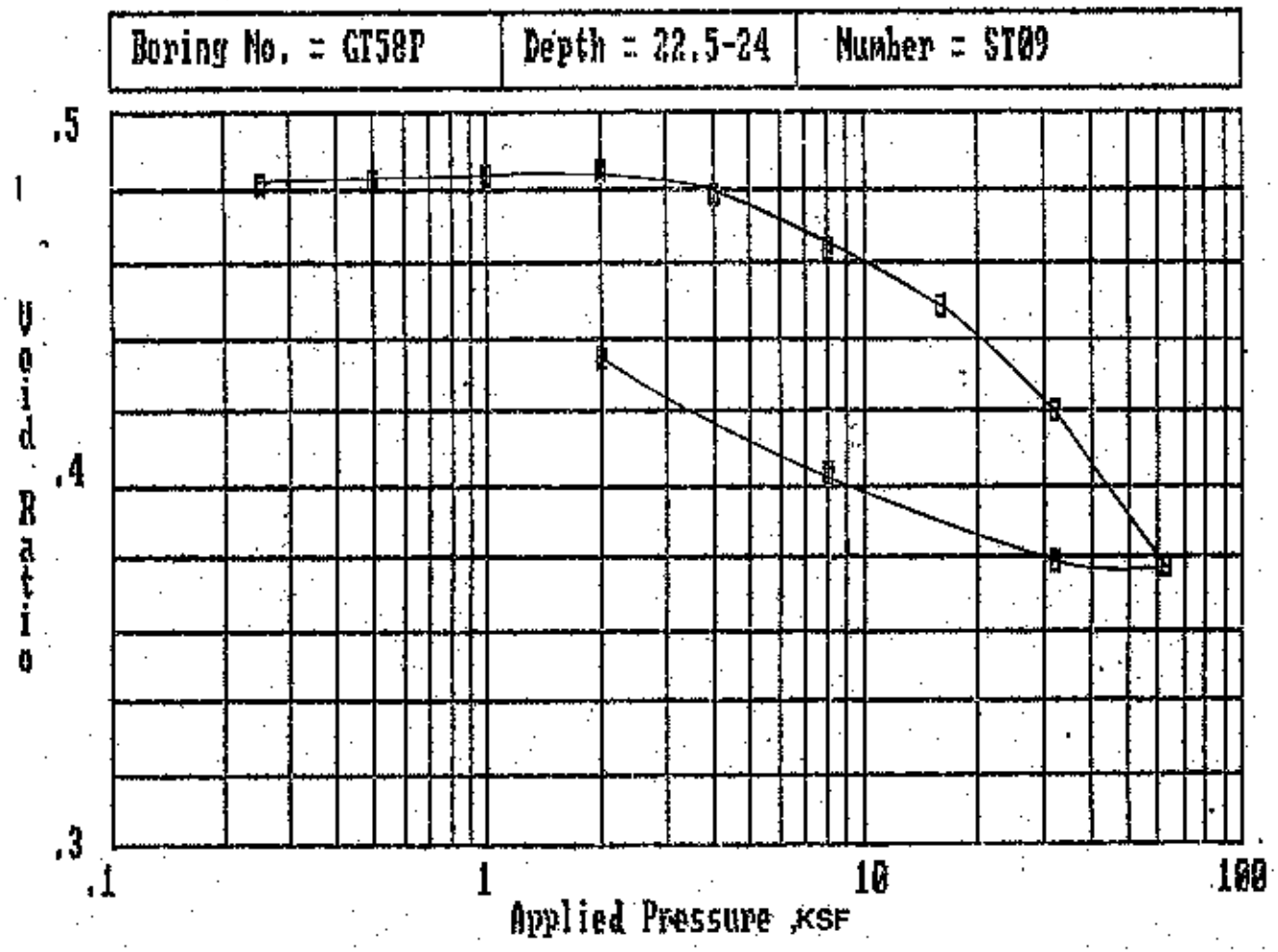
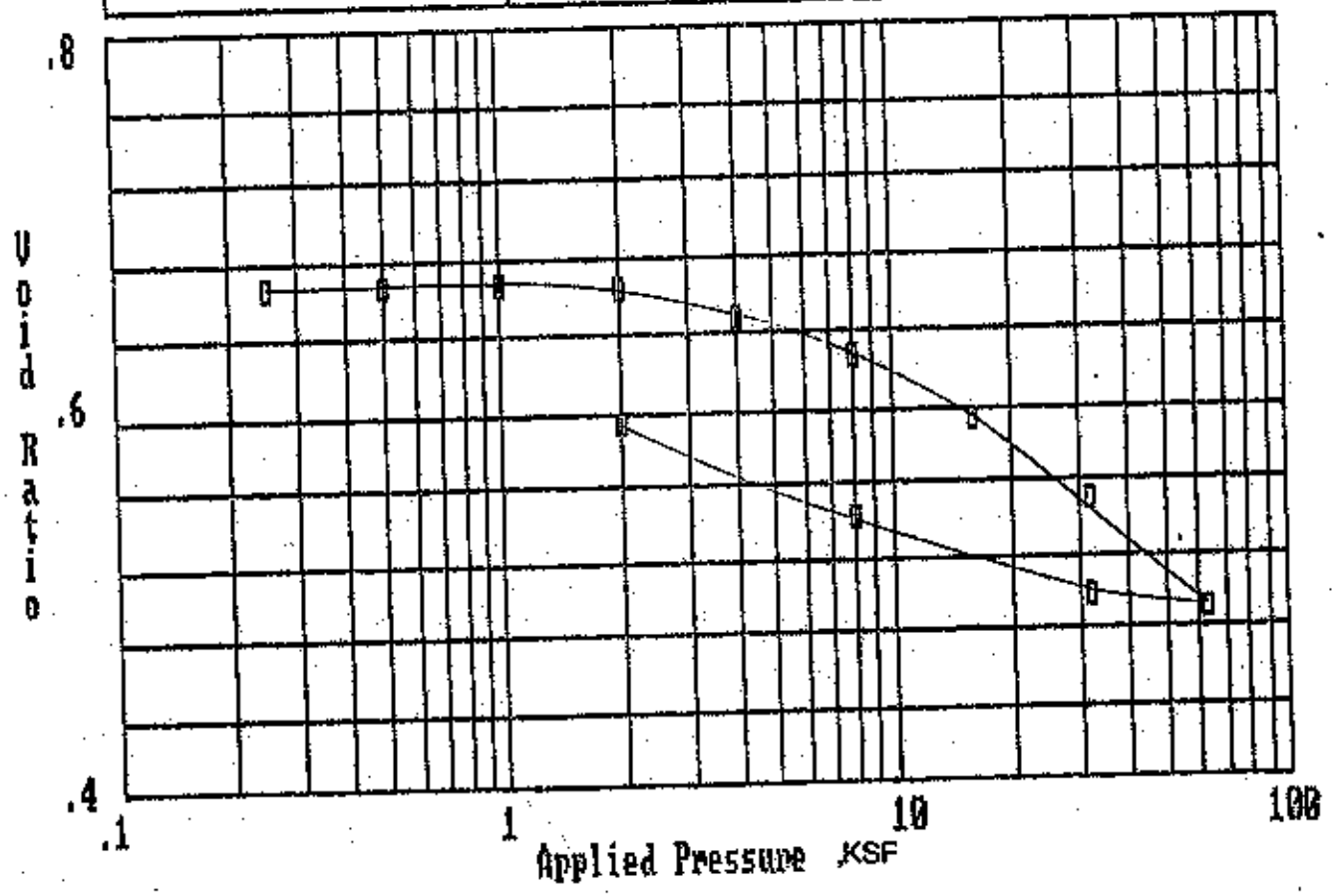


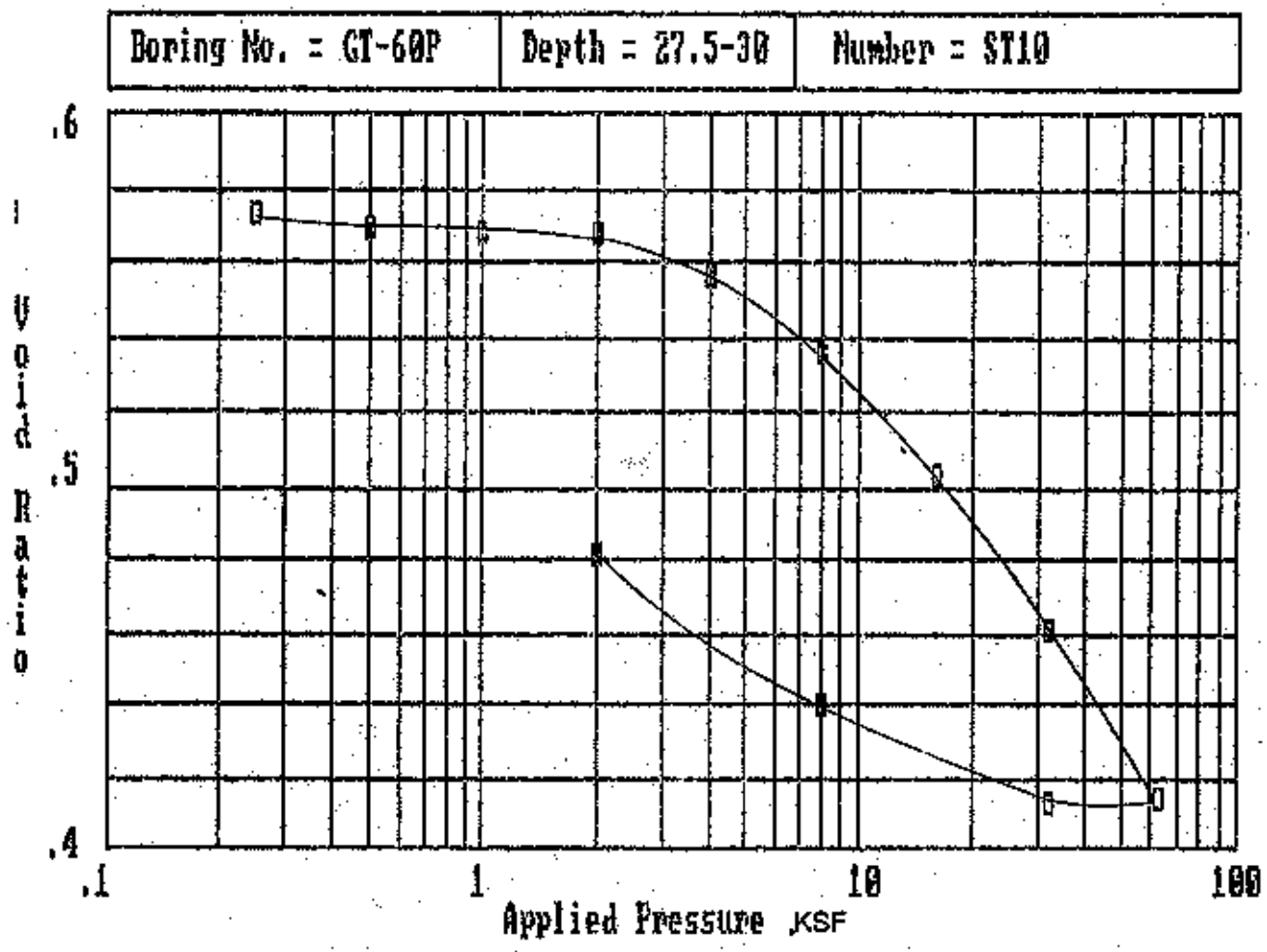
checked by: dA

H 49

Boring No. = GT-60P	Depth = 12.5-15	Number = ST04

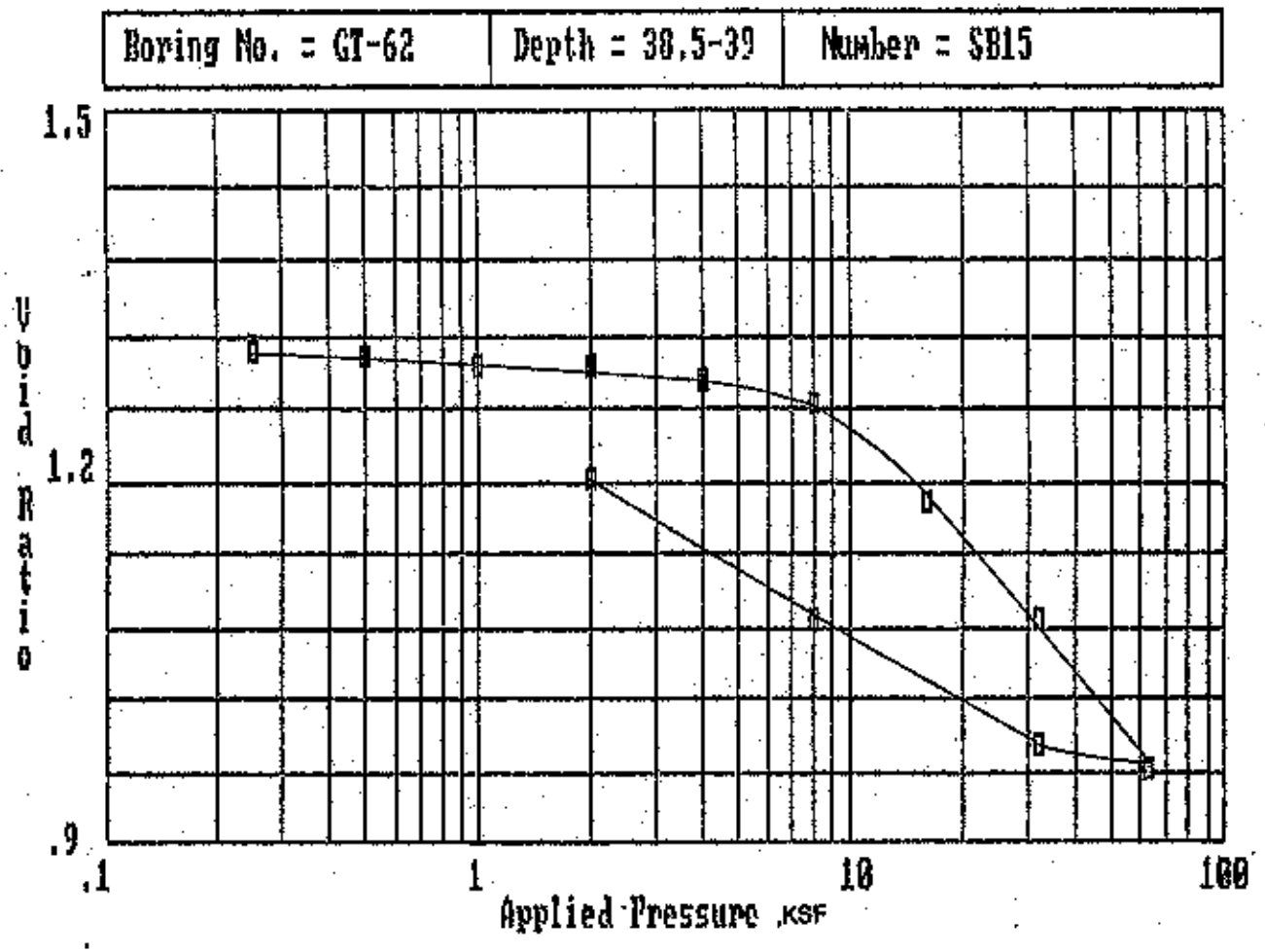


checked by:



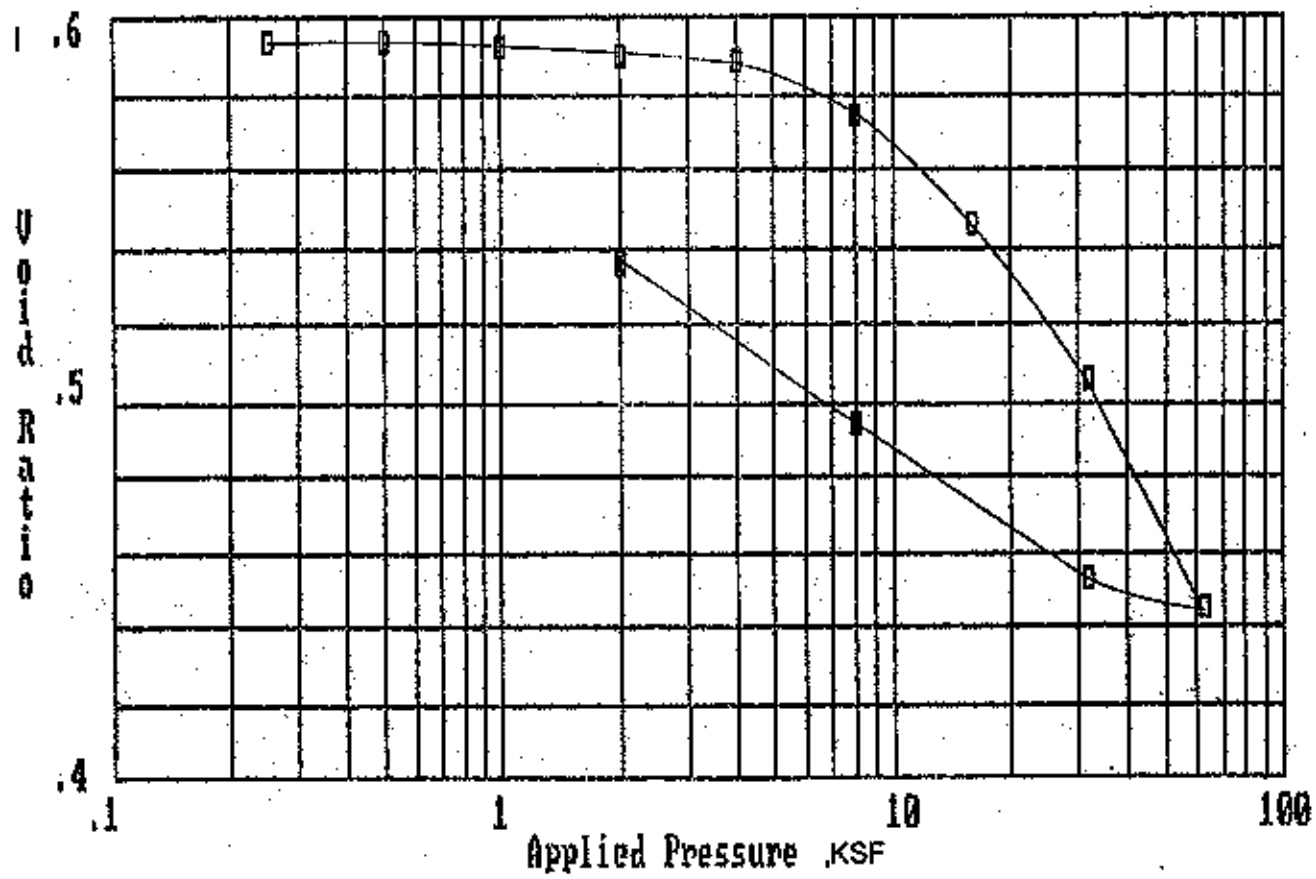
Checked By: JA

G 156


Boring No. = GT-62
Depth = 38.5-39
Number = SB15
1.5
1.2
.9
Void Ratio
.1
1
10
100
Applied Pressure ,KSF

J 124

Boring No. = GT63P	Depth = 22.5-25	Number = ST09



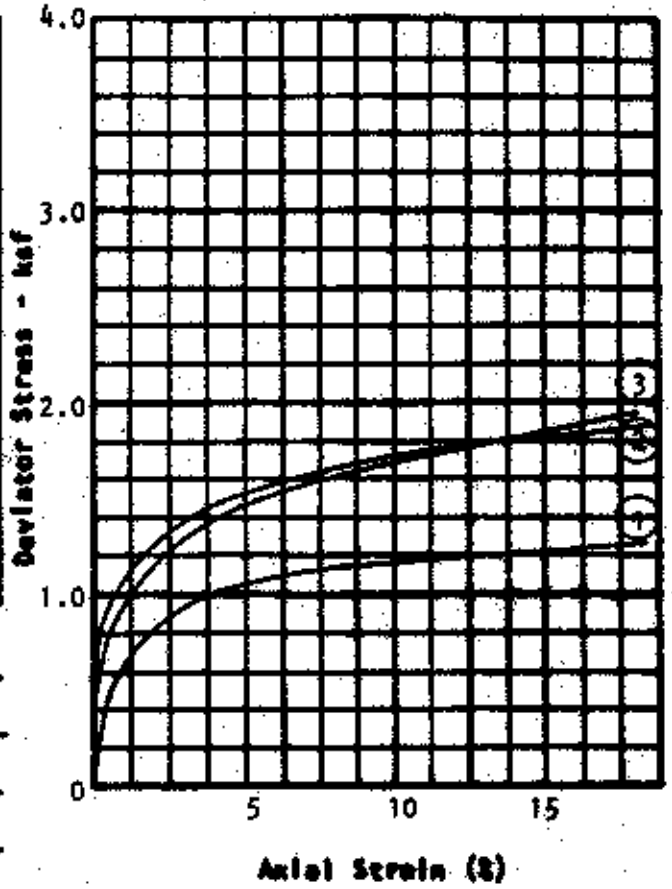
CHECKED BY: JA

TRIAXIAL SHEAR TESTS
UNCONSOLIDATED UNDRAINED

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-43 ST-10 21.5 - 23.8			
HEIGHT - INCH	5.97	5.77	5.90	
DIAMETER - INCH	2.87	2.87	2.88	
WATER CONTENT - %	18.8	18.8	19.6	
DRY DENSITY - pcf	107.0	106.7	105.7	
$\sigma_1-\sigma_3$ - ksf	1.33	1.89	1.97	
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				



TYPE OF SPECIMEN Natural Shelby Tube

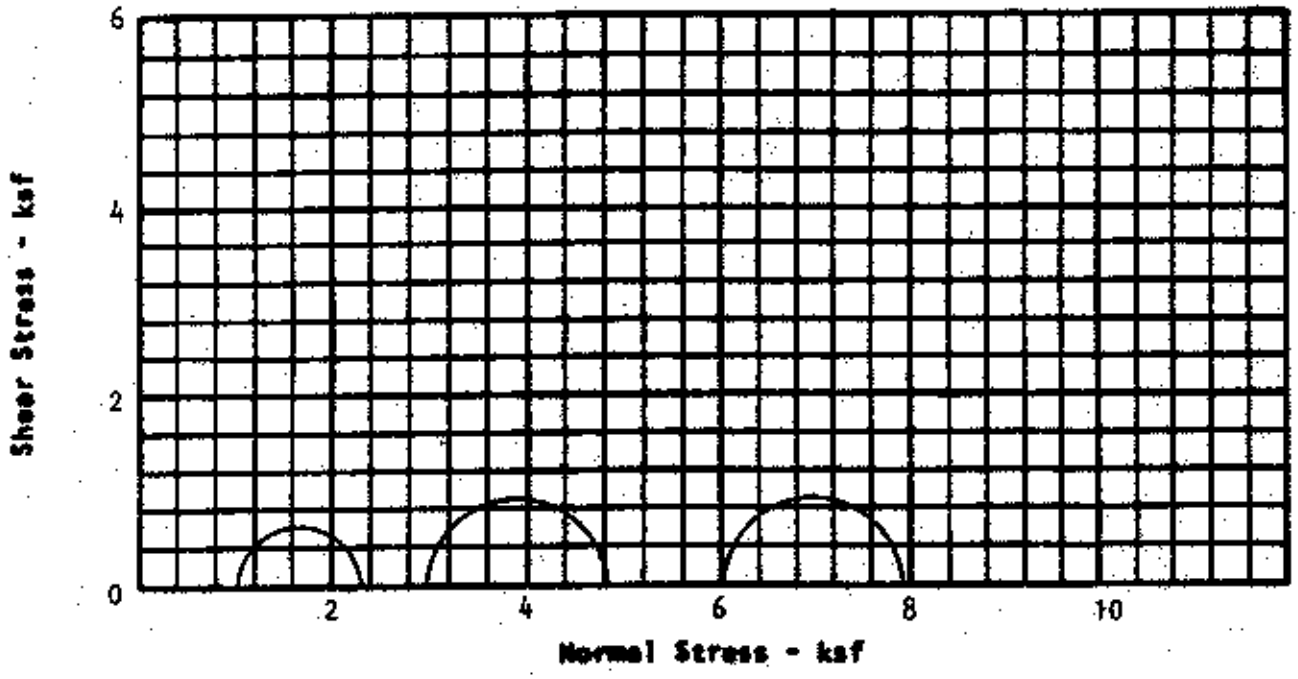
SOIL DESCRIPTION Lean clay, CL

TYPE OF TEST Saturated - Unconsolidated Undrained

TAN ϕ N/A

ϕ N/A

Avg. **COHESION - ksf** 0.87



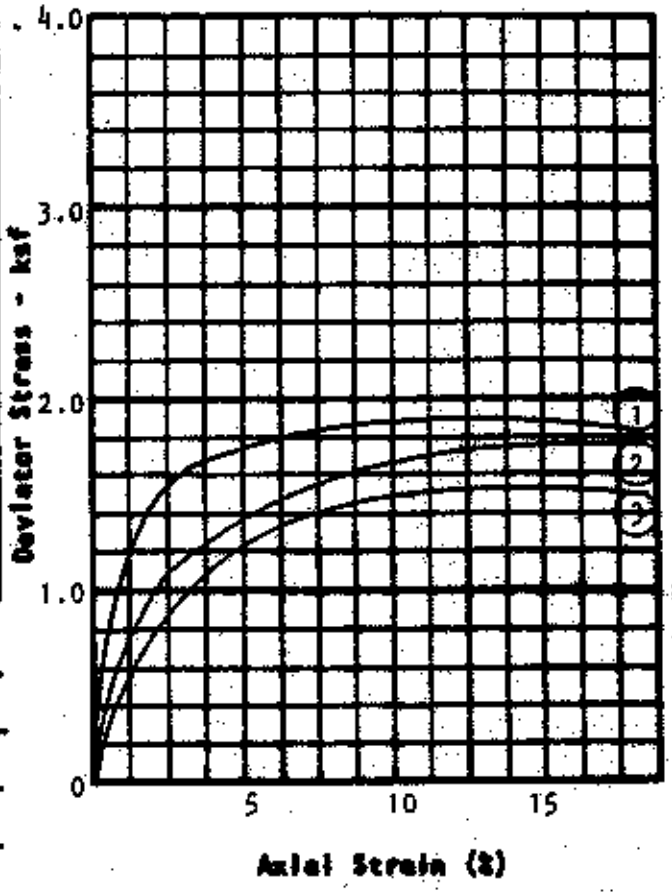
1 296 89

TRIAXIAL SHEAR TEST RESULTS

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-48 ST-03 7.5 - 10.0			
HEIGHT - INCH	5.72	5.89	5.83	
DIAMETER - INCH	2.89	2.88	2.89	
WATER CONTENT - %	24.5	25.9	25.7	
DRY DENSITY - pcf	95.8	95.3	97.0	
$\sigma_1 - \sigma_3$ - ksf	1.89	1.78	1.57	
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				



TYPE OF SPECIMEN Natural Shelby Tube

SOIL DESCRIPTION Lean clay, CL

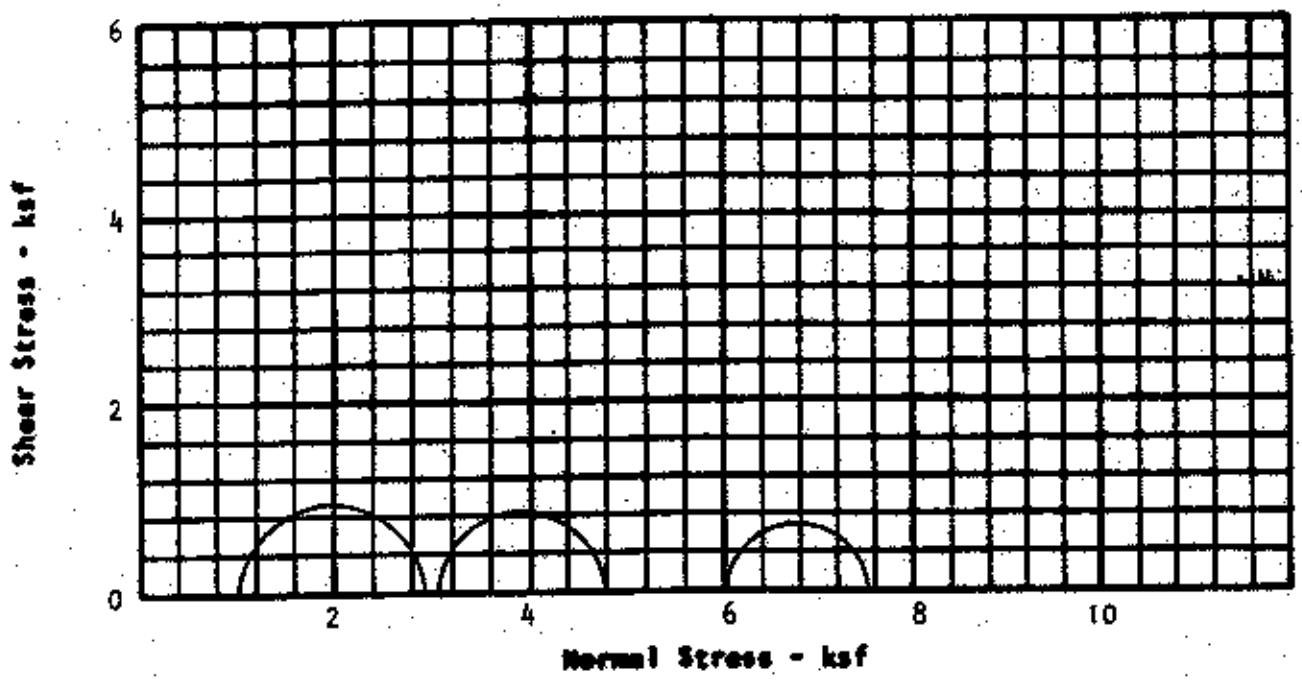
TYPE OF TEST Saturated - Unconsolidated

Undrained

TAN ϕ N/A

ϕ N/A

Avg. **COHESION - ksf** .87



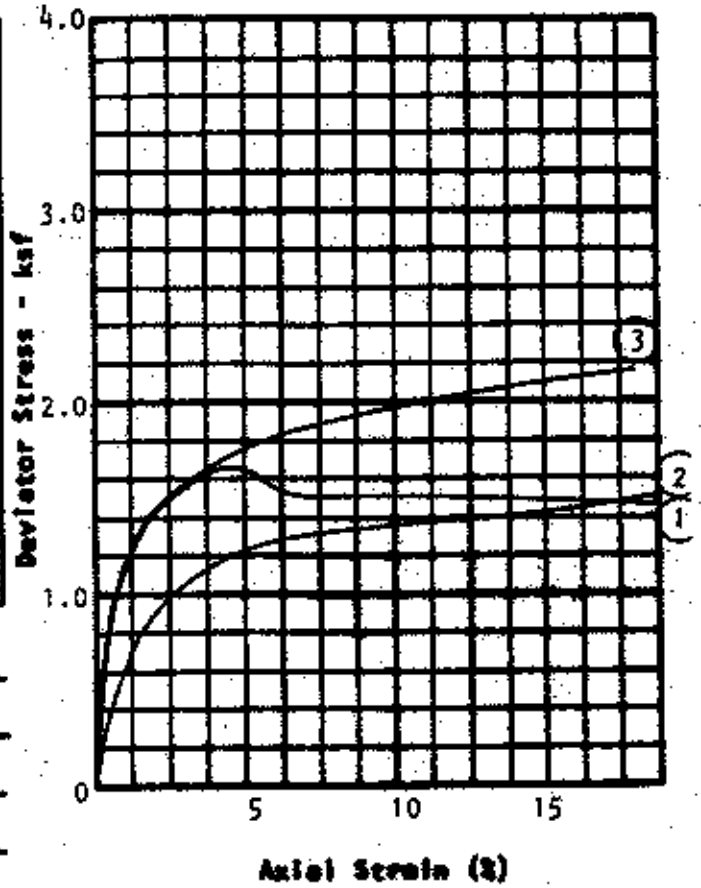
1 296 89

TRIAXIAL SHEAR TEST RESULTS

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-48 ST-07 17.5 - 20.0			
HEIGHT - INCH	5.93	5.92	5.92	
DIAMETER - INCH	2.89	2.88	2.89	
WATER CONTENT - %	29.1	26.4	28.2	
DRY DENSITY - pcf	93.5	97.5	95.4	
$\sigma_1 - \sigma_3$ - ksf	1.62	1.47	2.18	
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				



TYPE OF SPECIMEN Natural Shelby Tube

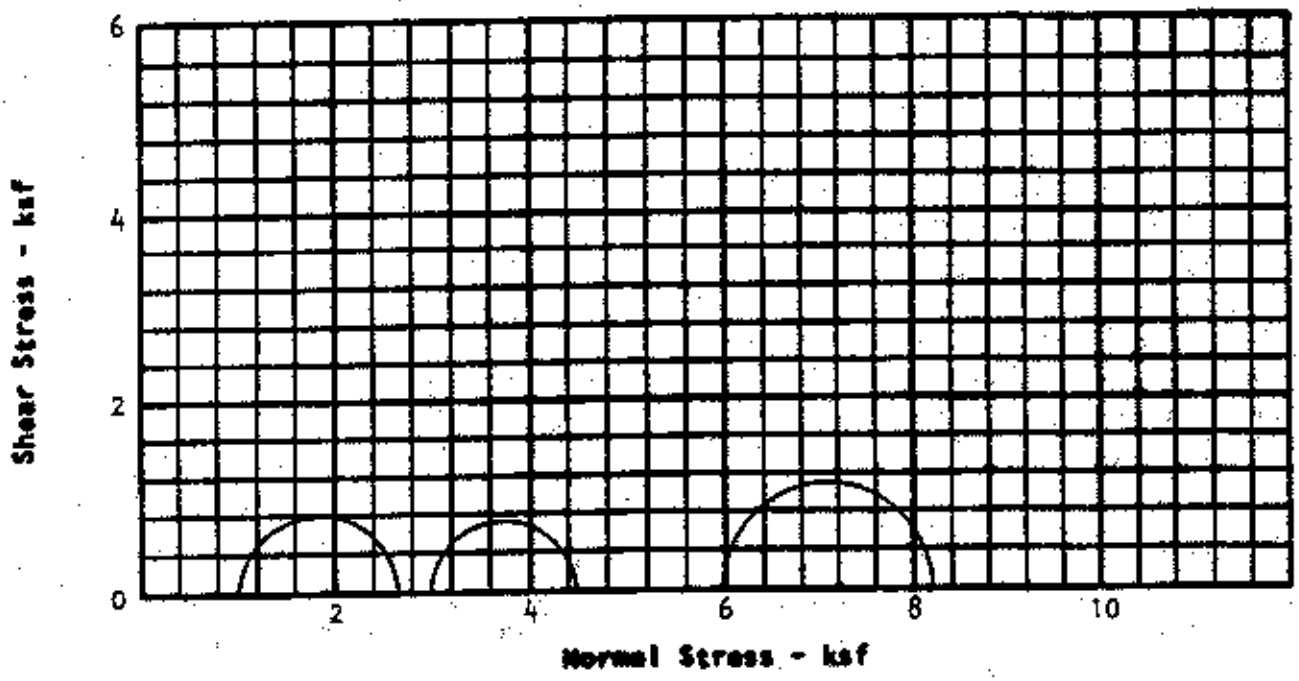
SOIL DESCRIPTION Fat clay, CH

TYPE OF TEST Saturated - Unconsolidated, Undrained

TAN ϕ N/A

ϕ N/A

Avg. **COHESION - ksf** 0.88



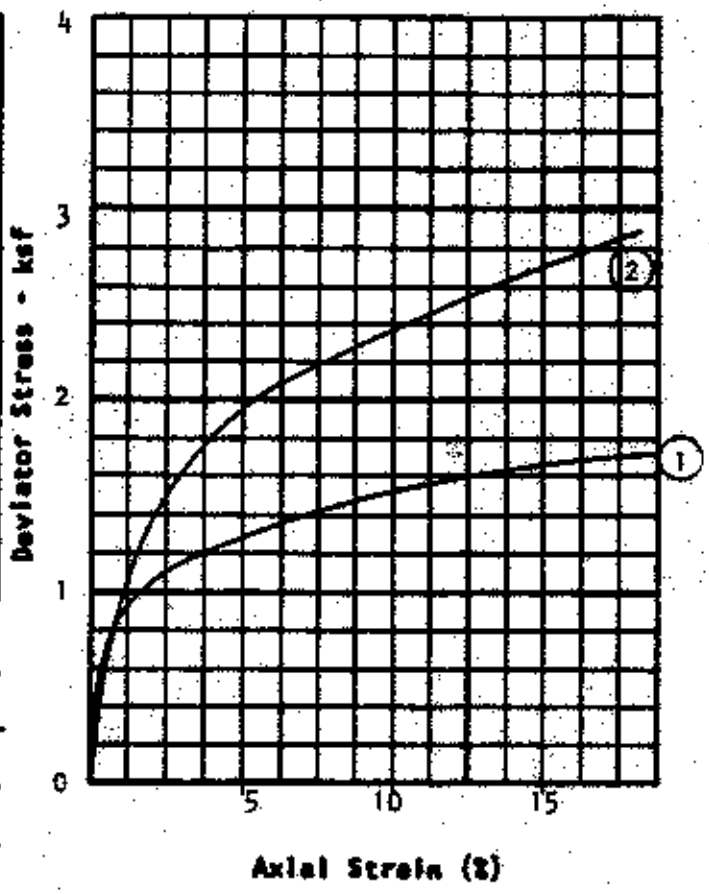
1 296 89

TRIAXIAL SHEAR TEST RESULTS

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-50 ST-02 2.5 - 5.0			
HEIGHT - INCH	5.08	5.49		
DIAMETER - INCH	2.84	2.88		
WATER CONTENT - %	28.9	26.8		
DRY DENSITY - pcf	87.5	96.0		
$\sigma_1 - \sigma_3$ - ksf	1.73	2.90		
σ_3 - ksf	1.00	3.00		
σ - ksf				



TYPE OF SPECIMEN: Natural Shelby Tube

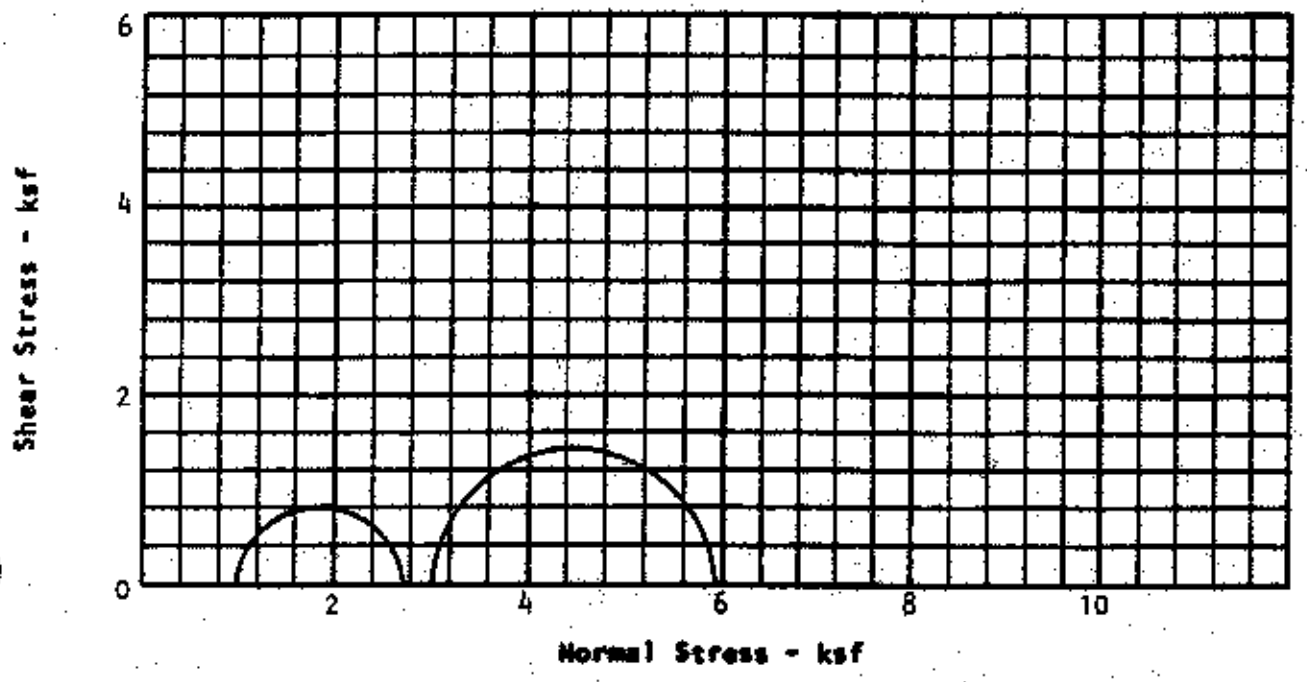
SOIL DESCRIPTION: Lean clay, CL

TYPE OF TEST: Saturated - Unconsolidated Undrained

TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: 1.16



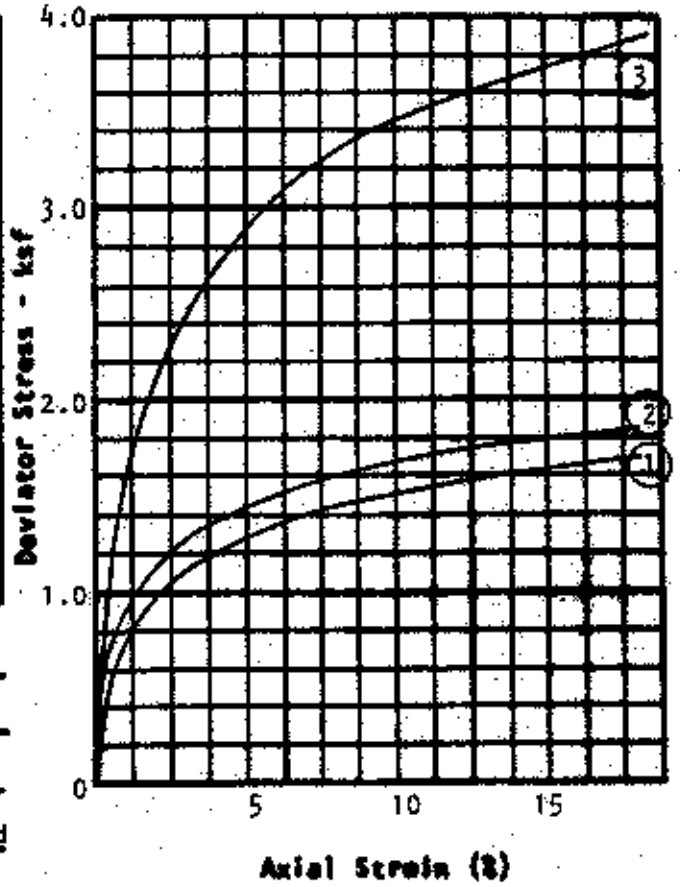
1 296 89

TRIAXIAL SHEAR TEST RESULTS

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-50 ST-06 12.5 - 15.0			
HEIGHT - INCH	5.87	5.86	6.22	
DIAMETER - INCH	2.88	2.88	2.84	
WATER CONTENT - %	28.7	26.3	23.0	
DRY DENSITY - pcf	93.9	97.3	100.7	
$\sigma_1-\sigma_3$ - ksf	1.73	1.85	3.89	
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				



TYPE OF SPECIMEN Natural Shelby Tube

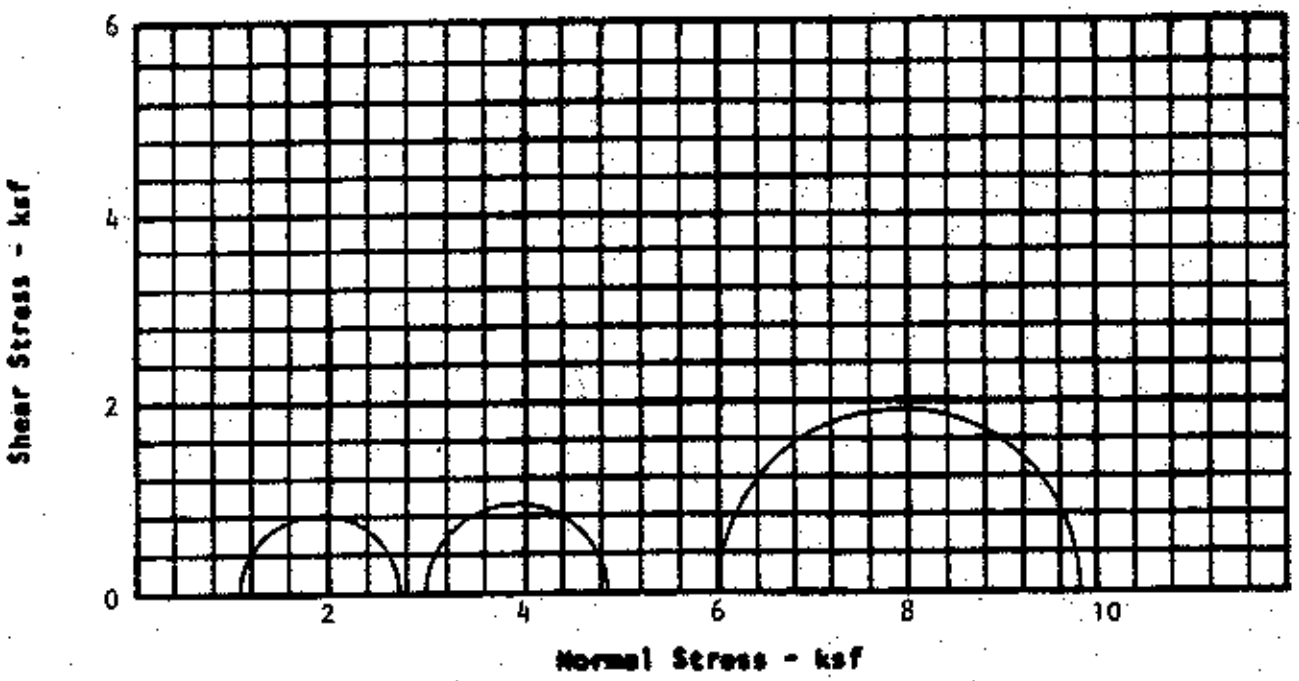
SOIL DESCRIPTION Fat clay, CH

TYPE OF TEST Saturated - Unconsolidated Undrained

TAN ϕ N/A

ϕ N/A

Avg. **COHESION - ksf** 1.25



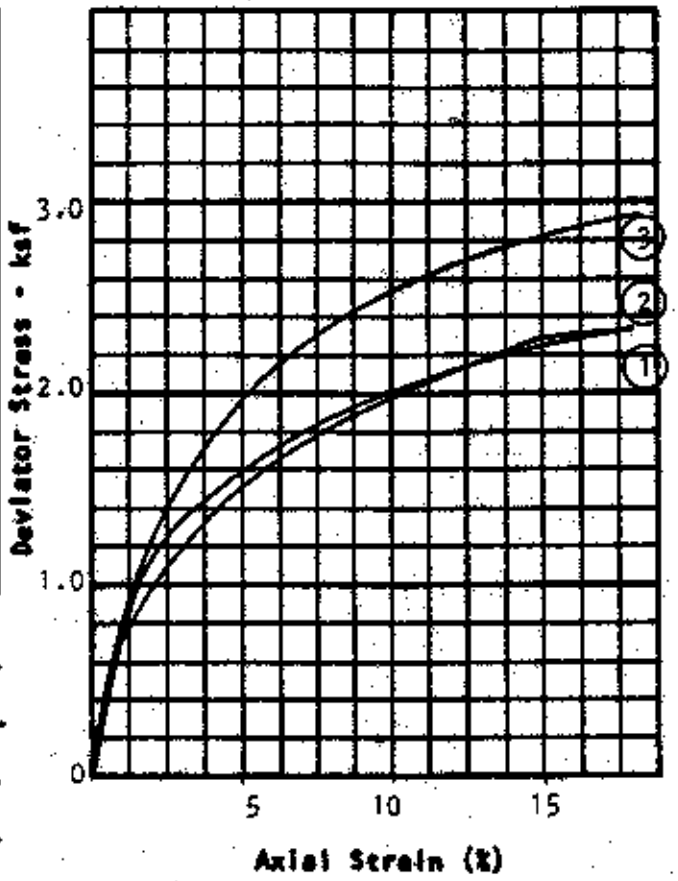
1 296 89

TRIAXIAL SHEAR TEST RESULTS

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-51 ST-03 5.0 - 7.5			
HEIGHT - INCH	5.90	5.97	5.86	
DIAMETER - INCH	2.87	2.86	2.86	
WATER CONTENT - %	23.6	24.0	24.0	
DRY DENSITY - pcf	99.1	98.0	98.8	
$\sigma_1 - \sigma_3$ - ksf	2.41	2.43	2.92	
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				



TYPE OF SPECIMEN Natural Shelby Tube

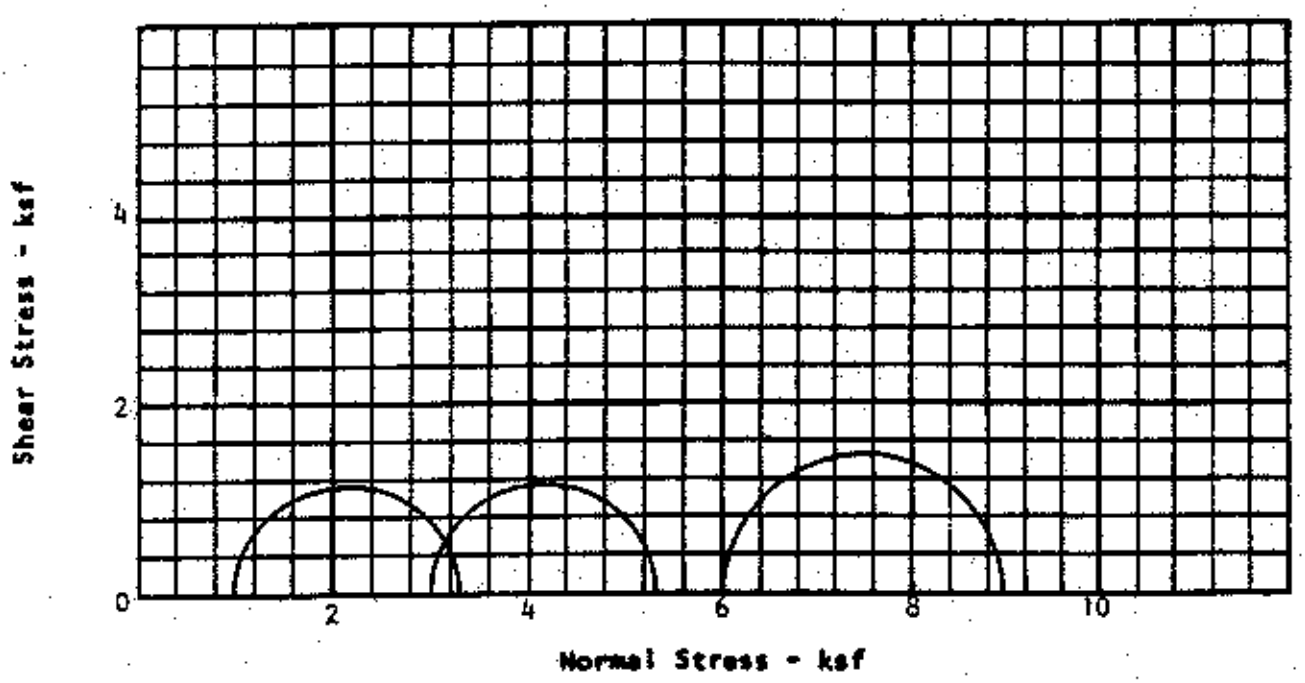
SOIL DESCRIPTION Lean clay, CL

TYPE OF TEST Saturated - Unconsolidated Undrained

TAN ϕ N/A

ϕ N/A

Avg. **COHESION - ksf** 1.29



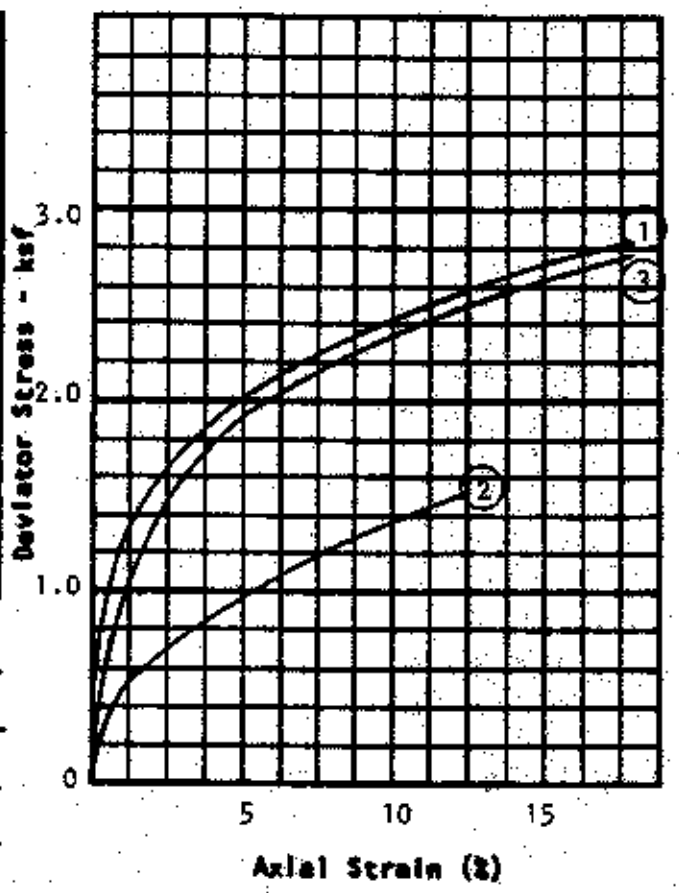
1 296 89

TRIAXIAL SHEAR TEST RESULTS

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-52 ST-04 10.0 - 12.5			
HEIGHT - INCH	5.97	5.98	5.76	
DIAMETER - INCH	2.89	2.87	2.87	
WATER CONTENT - %	23.2	23.4	24.3	
DRY DENSITY - pcf	101.9	100.5	99.3	
$\sigma_1 - \sigma_3$ - ksf	2.88	1.51	2.71	
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				



TYPE OF SPECIMEN: Natural Shelby Tube

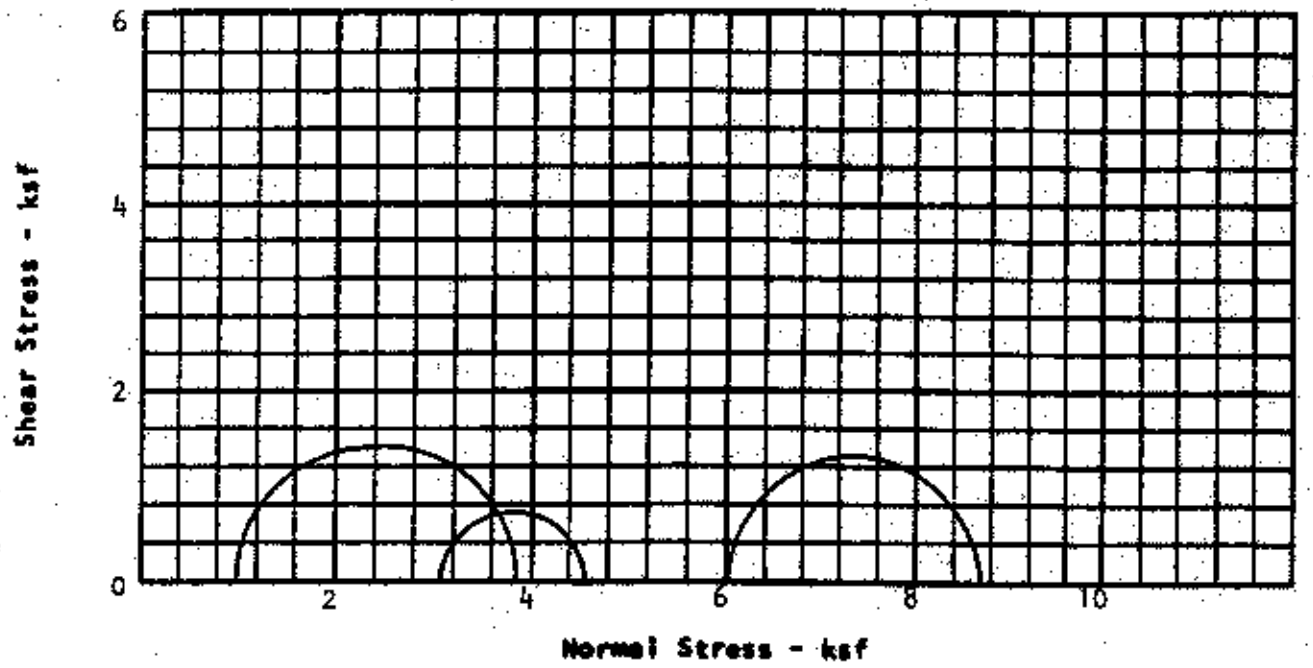
SOIL DESCRIPTION: Fat clay, CH

TYPE OF TEST: Saturated - Unconsolidated Undrained

TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: 1.18



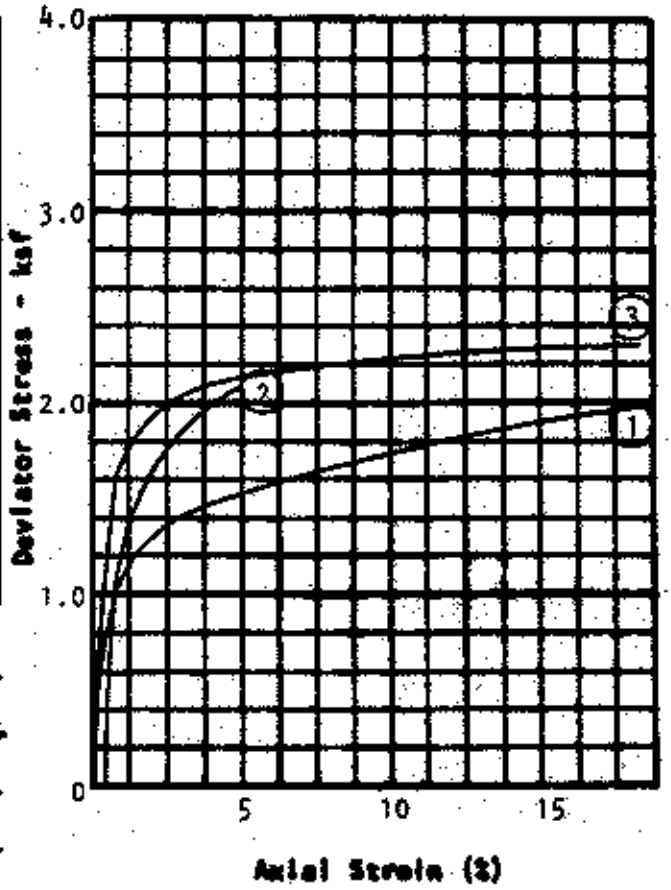
1 296 89

TRIAXIAL SHEAR TEST RESULTS

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-52 SB-14 35.5 - 36.5 MKF. SG. 11/90			
HEIGHT - INCH	5.91	5.70	5.52	
DIAMETER - INCH	2.37	2.37	2.41	
WATER CONTENT - %	19.0	15.3	15.3	
DRY DENSITY - pcf	101.6	116.2	116.2	
$\sigma_1-\sigma_3$ - ksf	1.95	2.09	2.29	
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				



TYPE OF SPECIMEN: Natural Shelby Tube

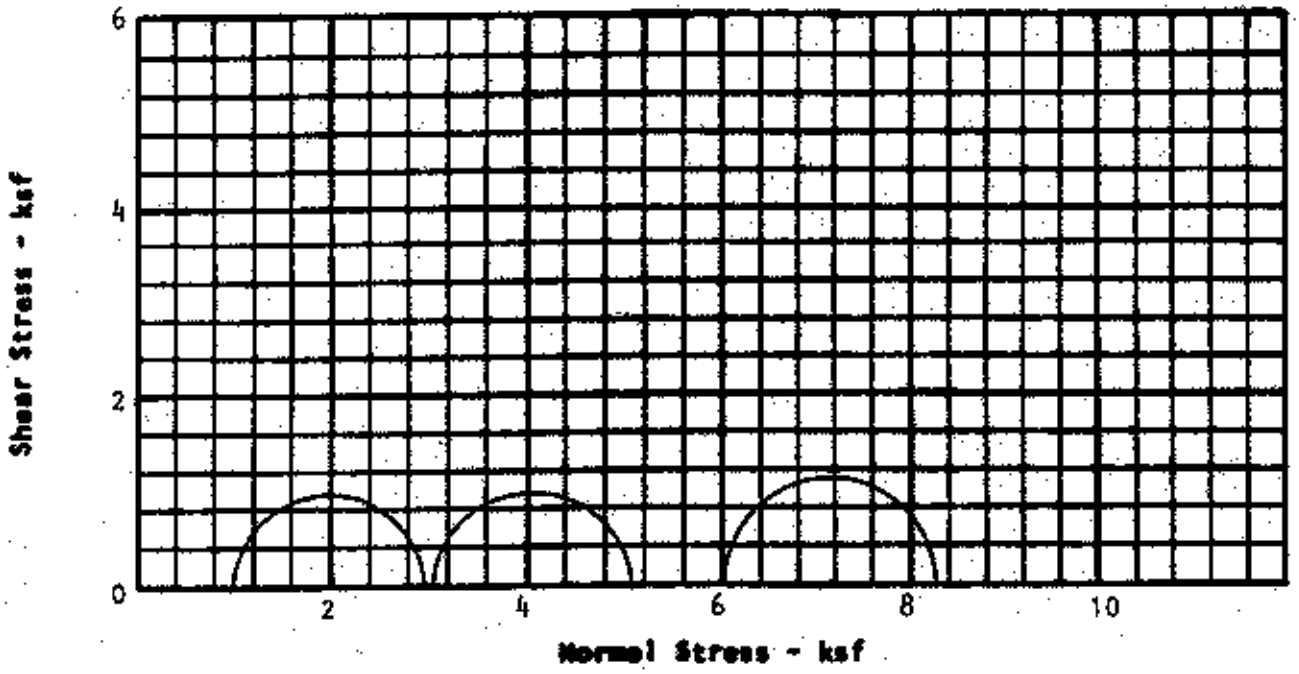
SOIL DESCRIPTION: Lean clay, CL

TYPE OF TEST: Saturated - Unconsolidated, Undrained

TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: 1.06



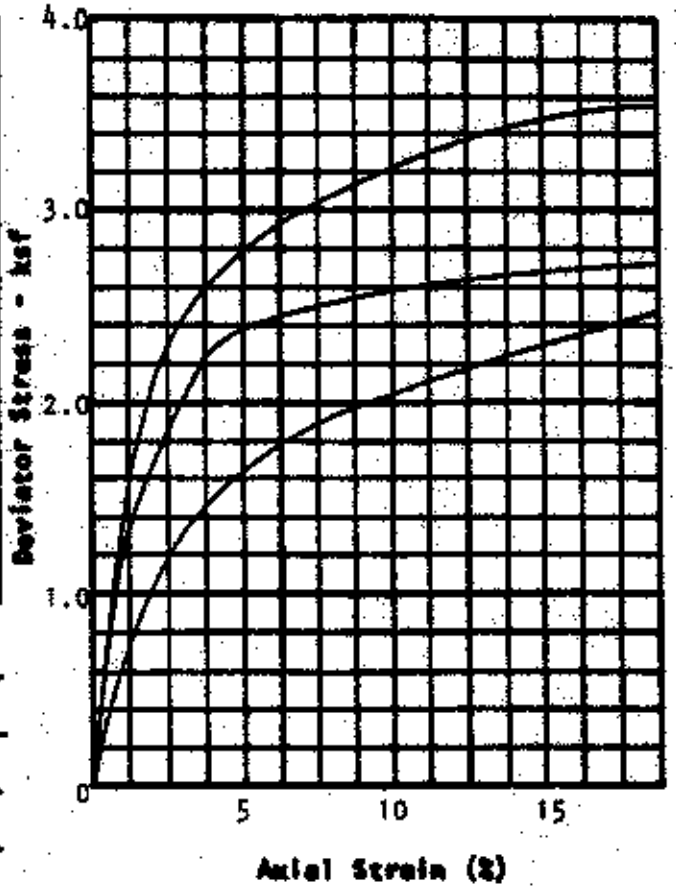
1 296 89

TRIAXIAL SHEAR TEST RESULTS

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION	GT-55 ST-06 12.5-15.0			
HEIGHT - INCH	6.029	5.869	5.369	
DIAMETER - INCH	2.874	2.874	2.874	
WATER CONTENT - %	22.1	23.8	24.3	
DRY DENSITY - pcf	103.5	100.7	98.9	
$\sigma_1 - \sigma_3$ - ksf	3.55	2.77	2.43	
σ_1 Total - ksf	4.54	5.07	8.43	
σ_3 - ksf	.99	2.30	6.00	



TYPE OF SPECIMEN: Natural

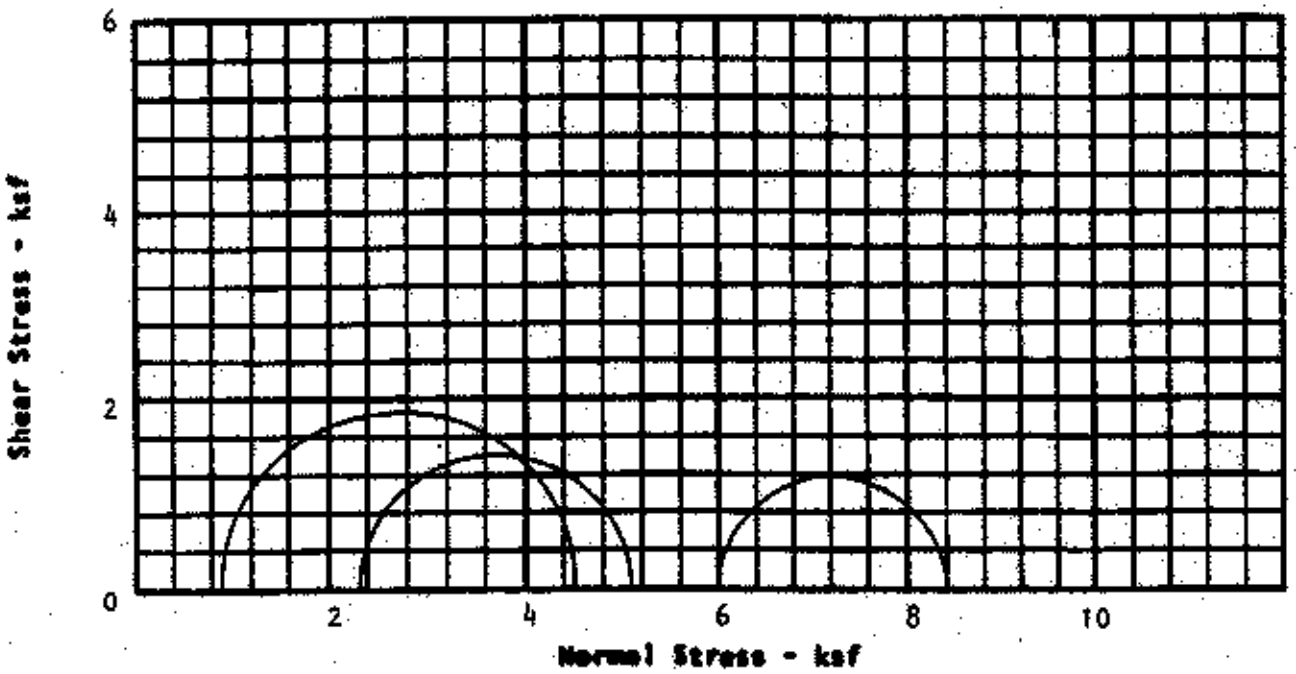
SOIL DESCRIPTION: Fat clay, CH

TYPE OF TEST: Saturated, Unconsolidated, Undrained.

TAN ϕ: N/A

ϕ: N/A

COHESION - ksf: Avg. = 1.46



1 296 89

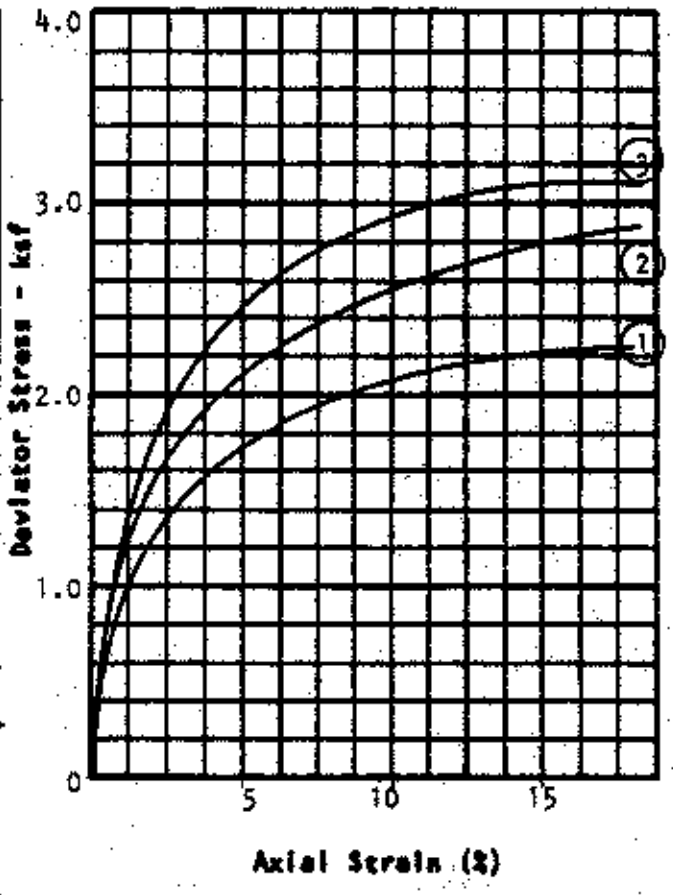
TRIAXIAL SHEAR TEST RESULTS

Fig. 14

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-55 ST-08 17.5 - 20.0			
HEIGHT - INCH	5.81	5.74	5.76	
DIAMETER - INCH	2.87	2.87	2.83	
WATER CONTENT - %	22.8	21.9	22.8	
DRY DENSITY - pcf	103.2	104.0	101.9	
$\sigma_1 - \sigma_3$ - ksf	2.24	2.94	3.13	
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				



TYPE OF SPECIMEN: Natural Shelby Tube

SOIL DESCRIPTION: Fat clay, CH

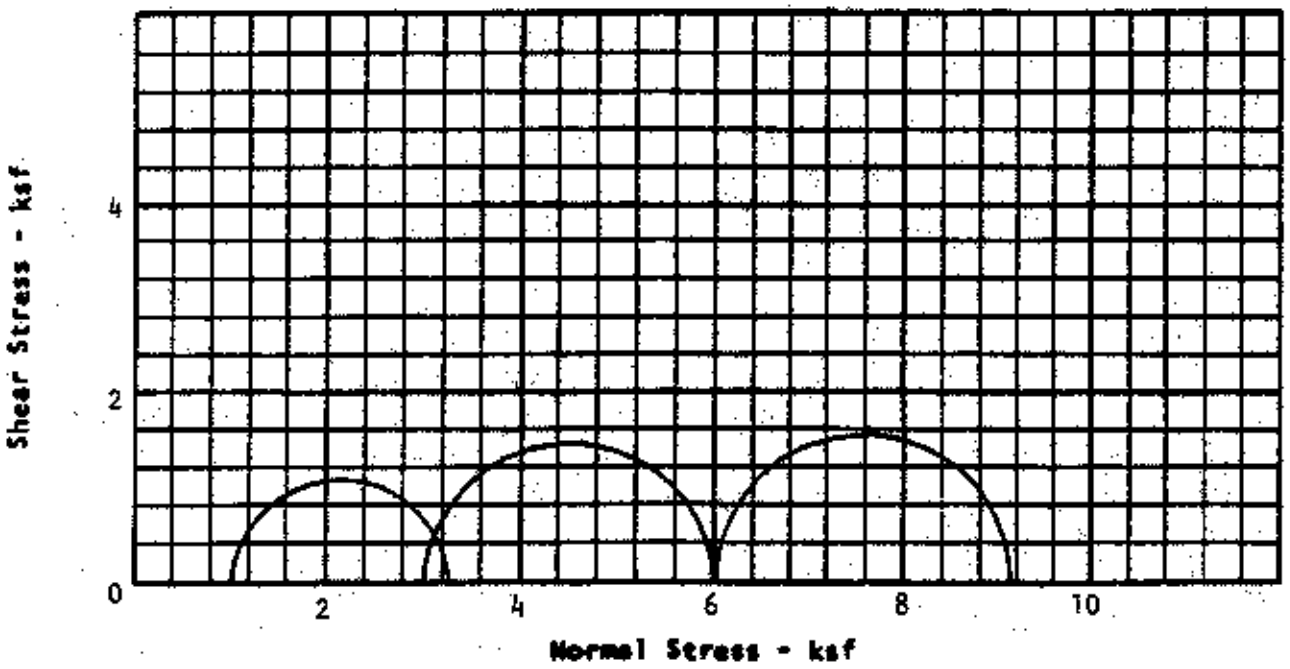
TYPE OF TEST: Saturated - Unconsolidated

Undrained

TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: 1.38



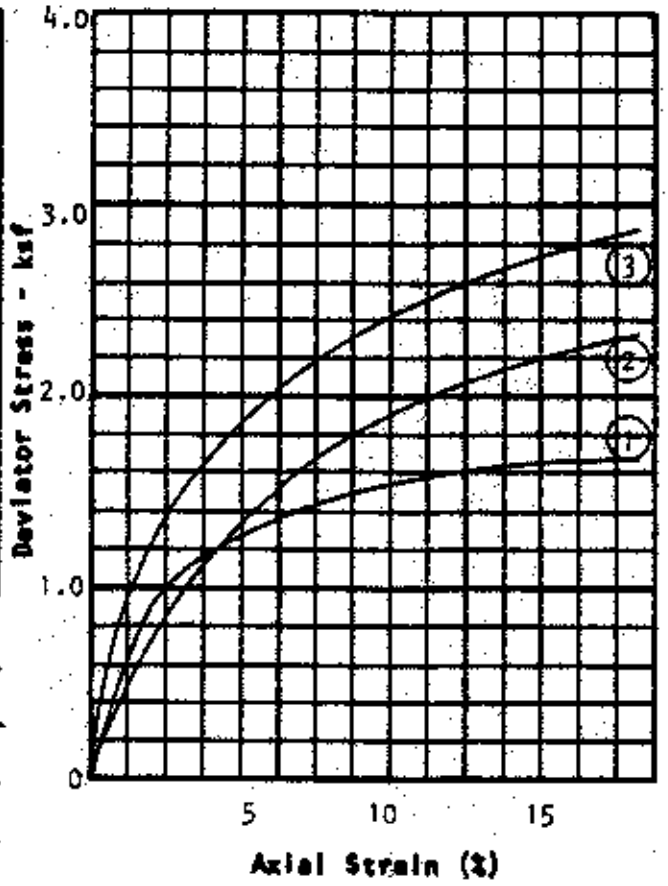
1 296 89

TRIAXIAL SHEAR TEST RESULTS

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-56 ST-02 5.0 - 7.5			
HEIGHT - INCH	5.36	5.41	5.40	
DIAMETER - INCH	2.88	2.88	2.88	
WATER CONTENT - %	23.2	11.3	21.5	
DRY DENSITY - pcf	98.9	109.7	103.2	
$\sigma_1 - \sigma_3$ - ksf	3.38	4.72	5.86	
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				



TYPE OF SPECIMEN: Natural Shelby Tube

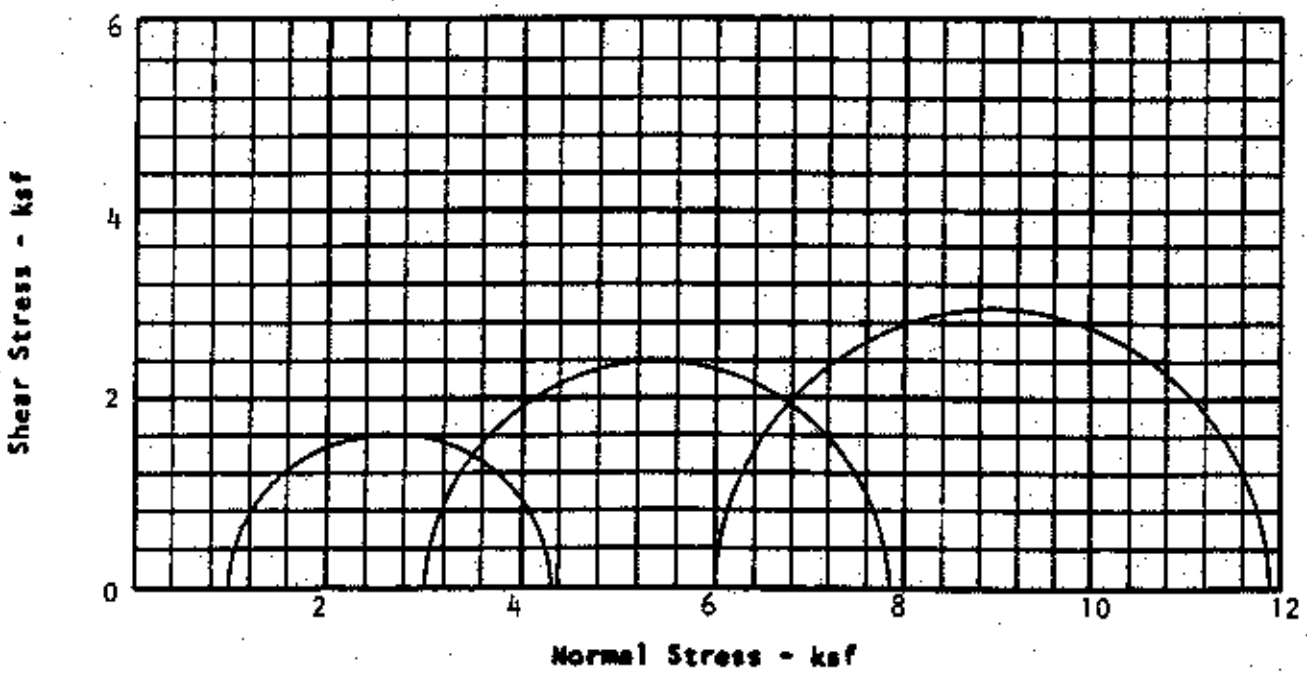
SOIL DESCRIPTION: Lean clay, CL

TYPE OF TEST: Saturated - Unconsolidated Undrained

TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: 2.33



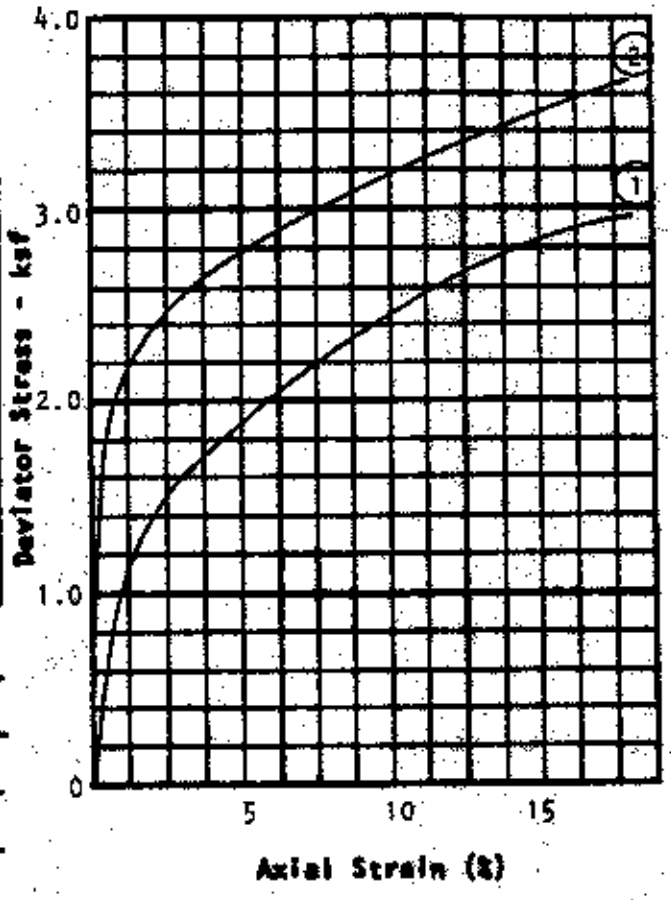
1 296 89

TRIAXIAL SHEAR TEST RESULTS

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DETPH, Ft.	GT-56 SB-08 19.5 - 21.0			
HEIGHT - INCH	4.78	5.67		
DIAMETER - INCH	2.38	2.37		
WATER CONTENT - %	18.5	24.2		
DRY DENSITY - pcf	110.4	100.7		
$\sigma_1 - \sigma_3$ - ksf	2.98	3.65		
σ_3 - ksf	1.00	3.00		
σ - ksf				



TYPE OF SPECIMEN: Natural Shelby Tube

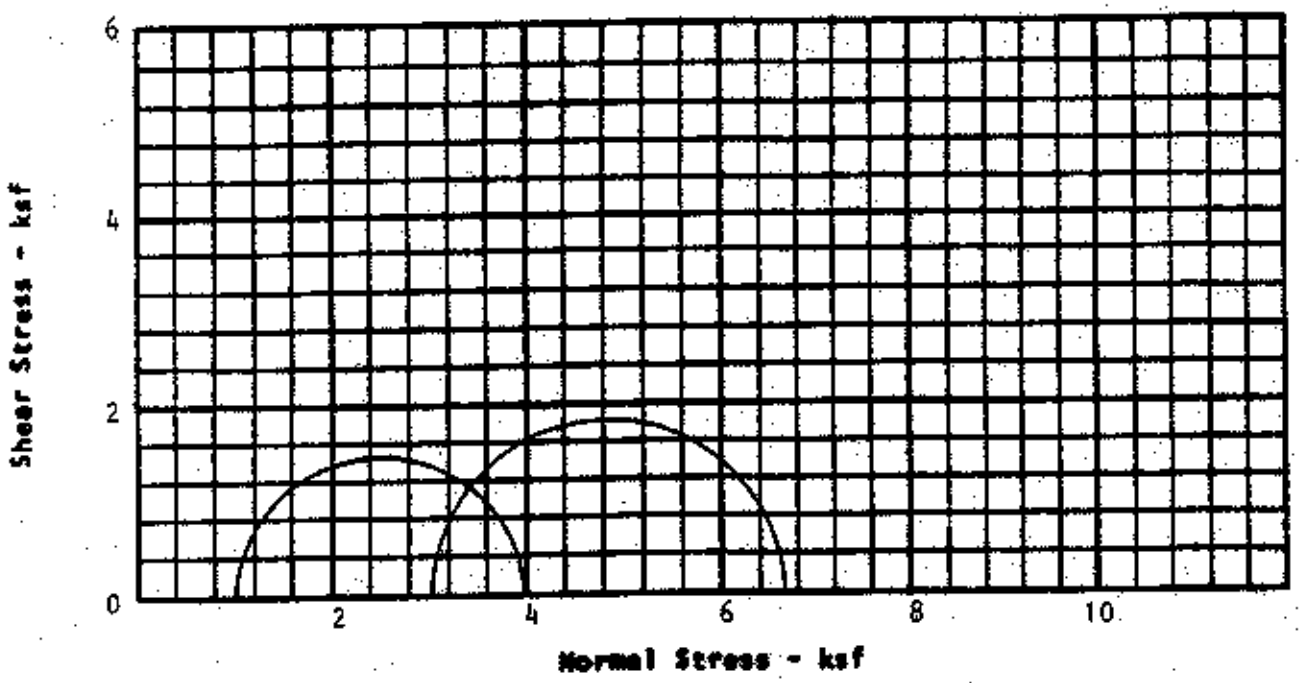
SOIL DESCRIPTION: Lean clay, CL

TYPE OF TEST: Saturated - Unconsolidated, Undrained

TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: 1.66

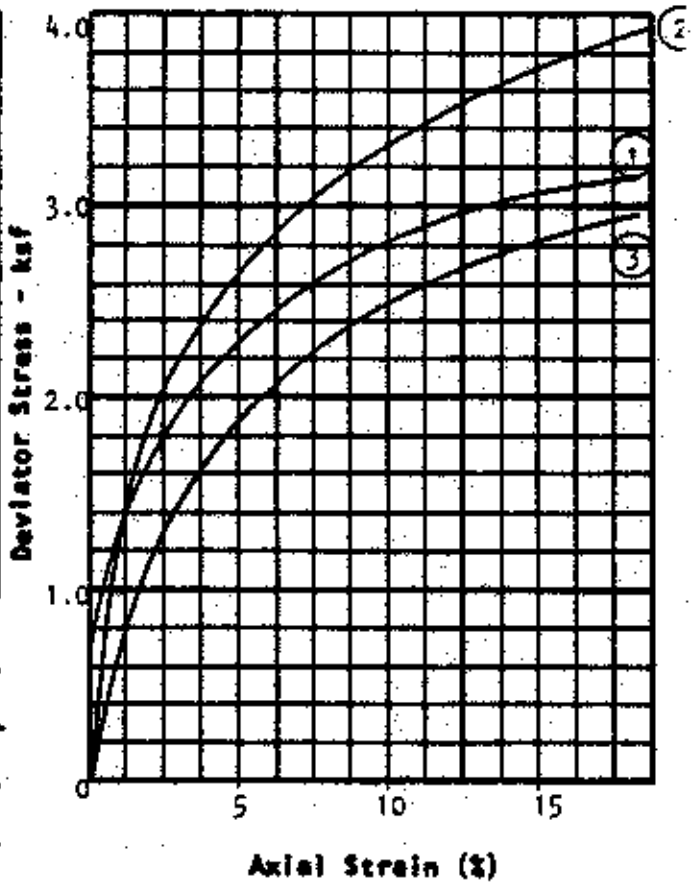


TRIAXIAL SHEAR TEST RESULTS

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-57 ST-03 7.5 - 10.0			
HEIGHT - INCH	6.02	5.86	5.98	
DIAMETER - INCH	2.88	2.88	2.87	
WATER CONTENT - %	20.8	19.8	22.0	
DRY DENSITY - pcf	104.2	104.8	104.3	
$\sigma_1 - \sigma_3$ - ksf	3.20	3.92	3.02	
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				



TYPE OF SPECIMEN: Natural Shelby Tube

SOIL DESCRIPTION: Lean clay, CL

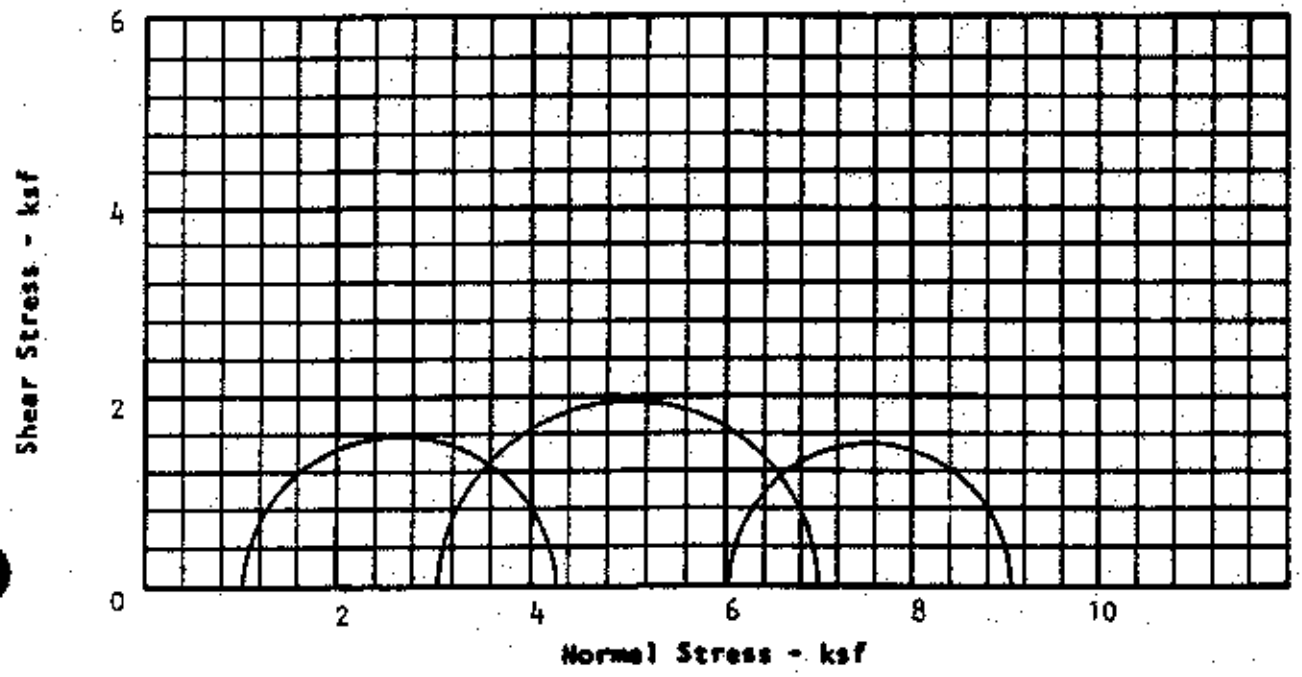
TYPE OF TEST: Saturated - Unconsolidated

Undrained

TAN ϕ: N/A

ϕ: N/A

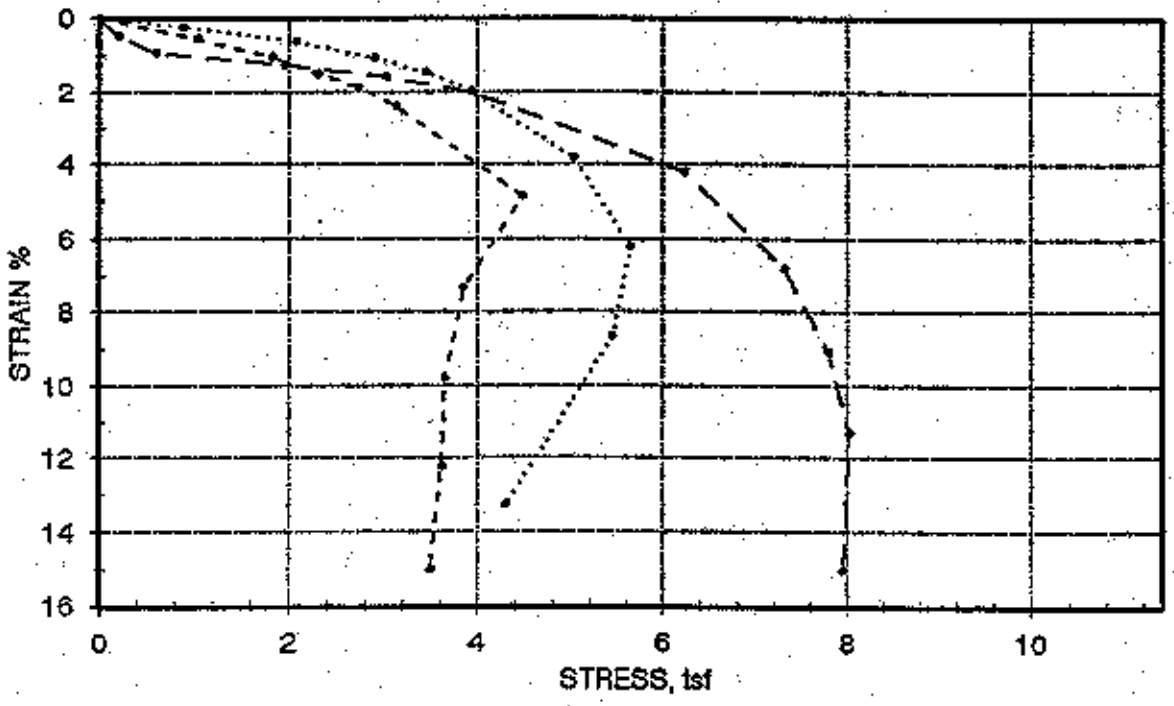
Avg. COHESION - ksf: 1.69



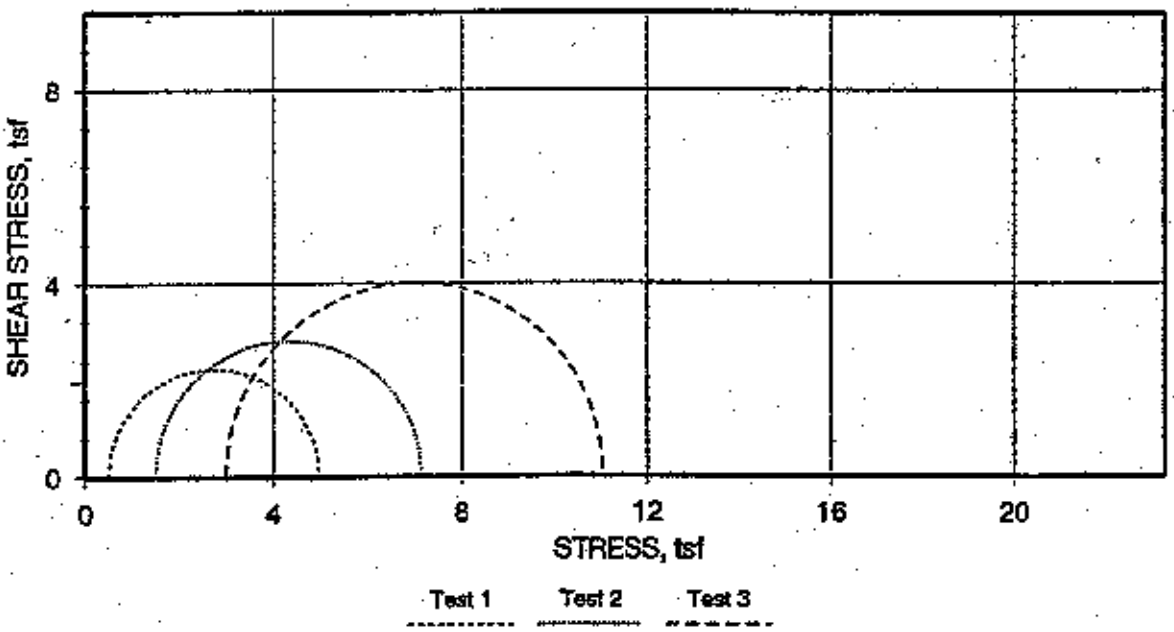
1 296 89

TRIAXIAL SHEAR TEST RESULTS

WSSRAP - JOB NO: 11295.000
UNCONSOLIDATED - UNDRAINED TEST
STRESS PATH



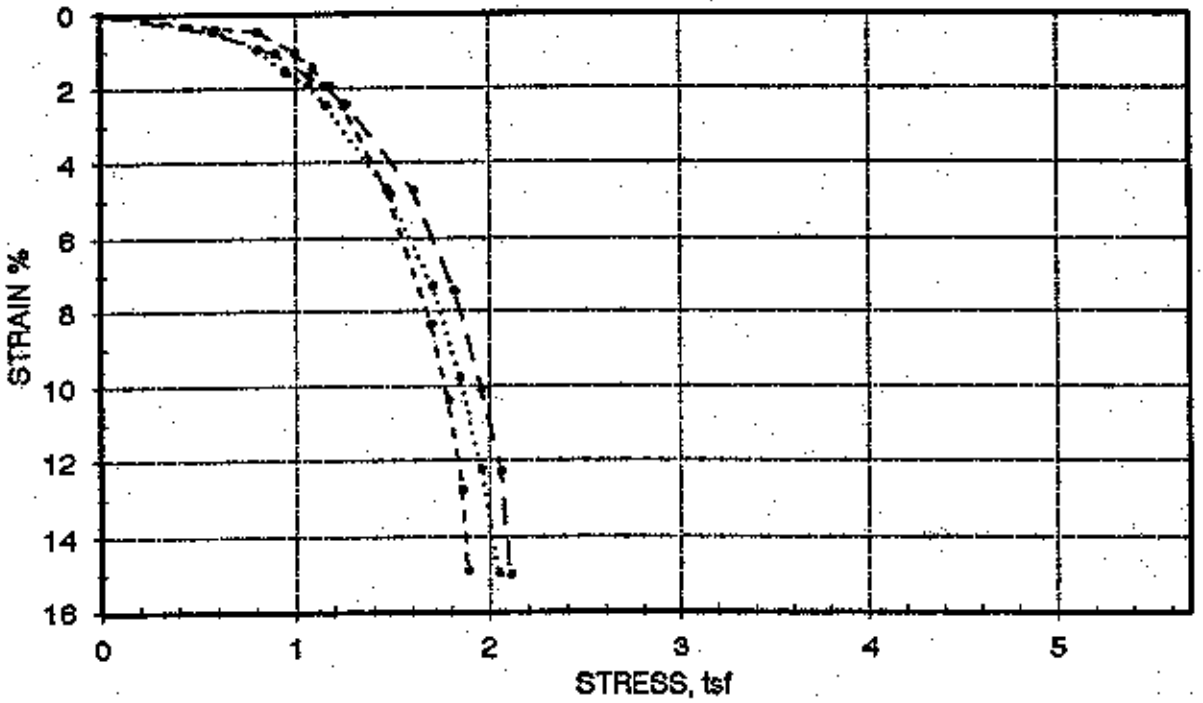
MOHR'S CIRCLES



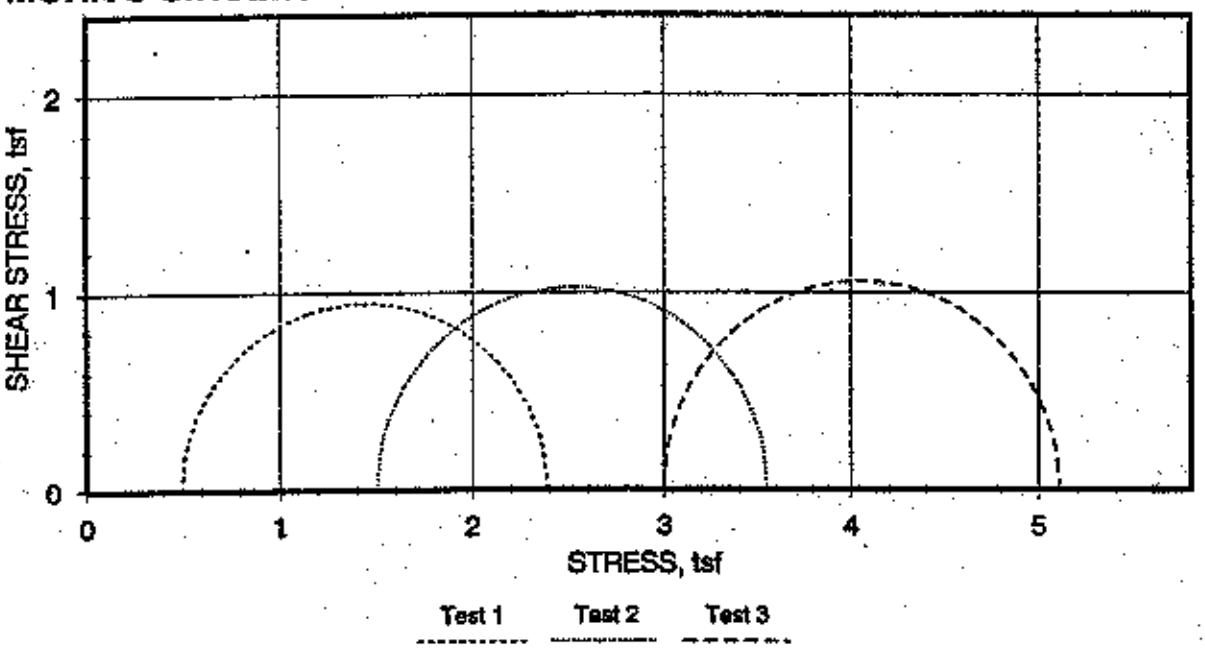
Boring No: GT-2T78
Sample No: BU-01A
Depth: 4-6 FT.

checked by: J. K5

WSSRAP - JOB NO.: 11295
UNCONSOLIDATED - UNDRAINED TEST
STRESS PATH



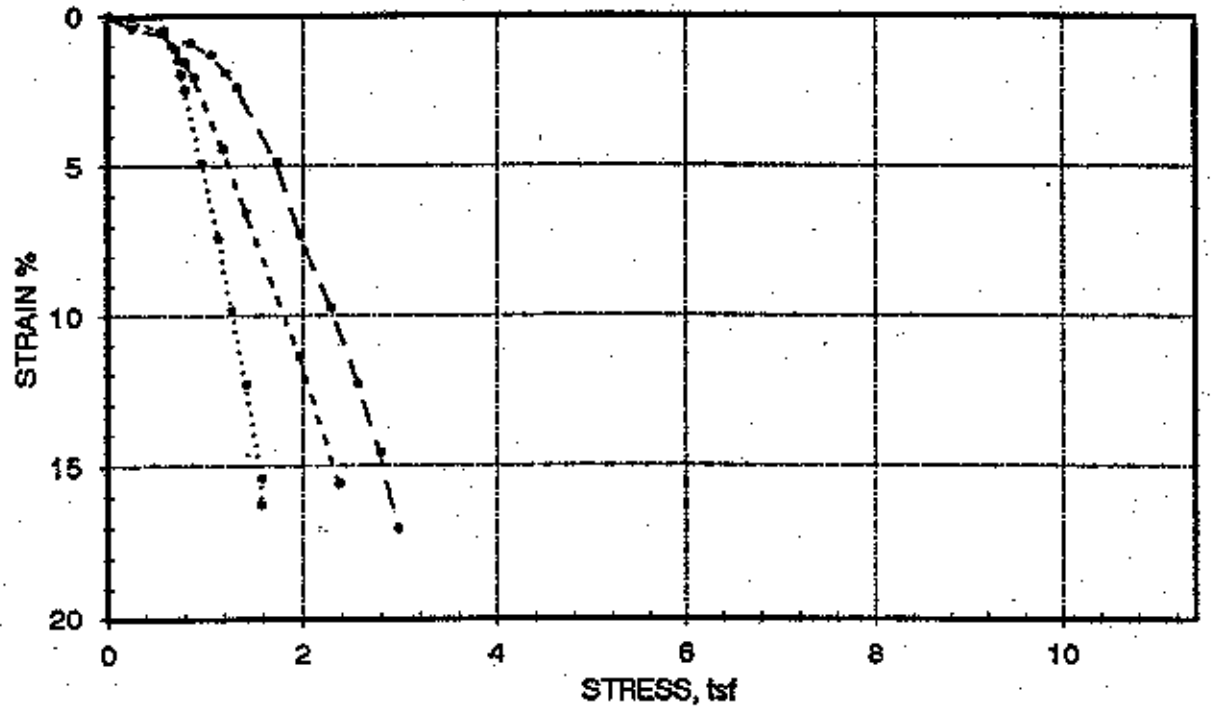
MOHR'S CIRCLES



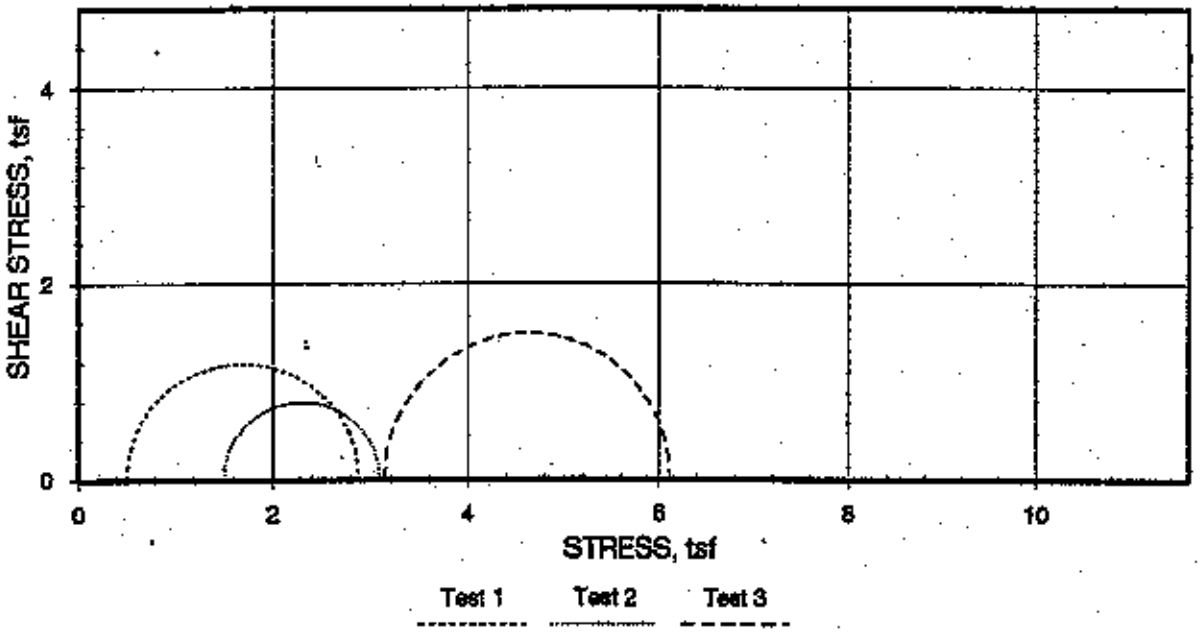
Boring No: GT-2T71
Sample No: BU-02A
Depth: 6.5-12 FT

F 27

WSSRAP - JOB NO. 11295
UNCONSOLIDATED - UNDRAINED TEST
STRESS PATH



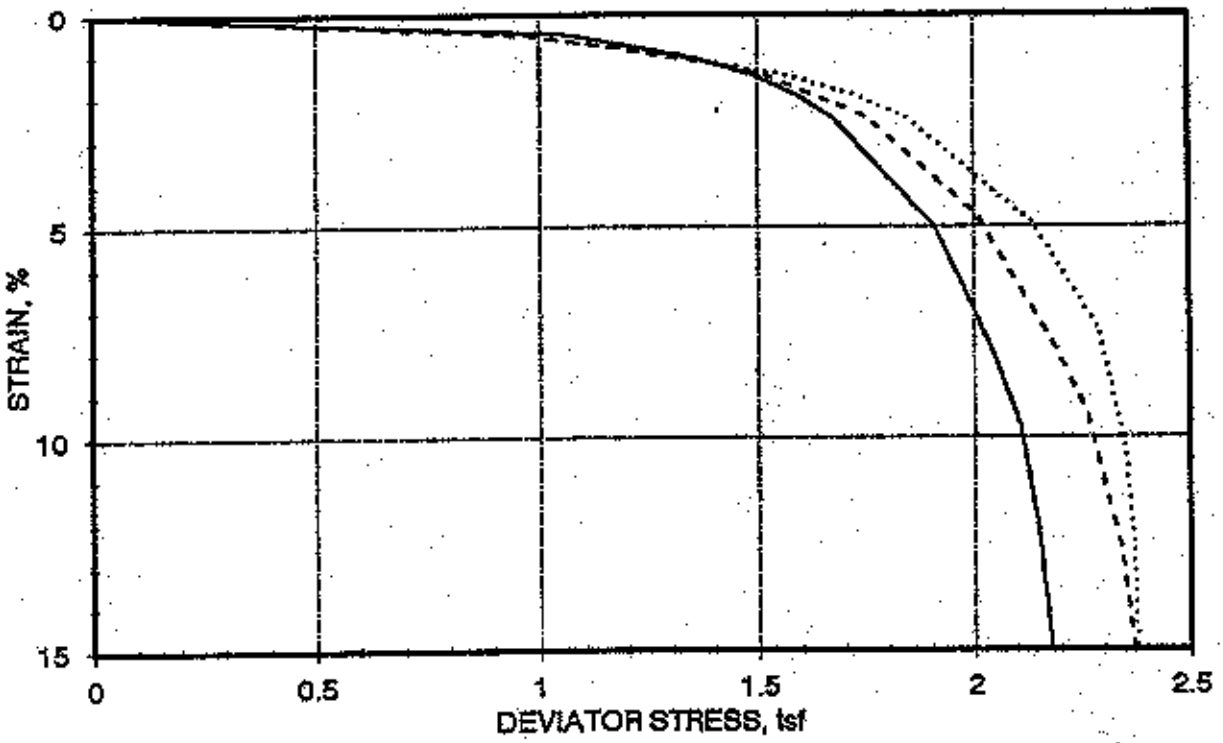
MOHR'S CIRCLES



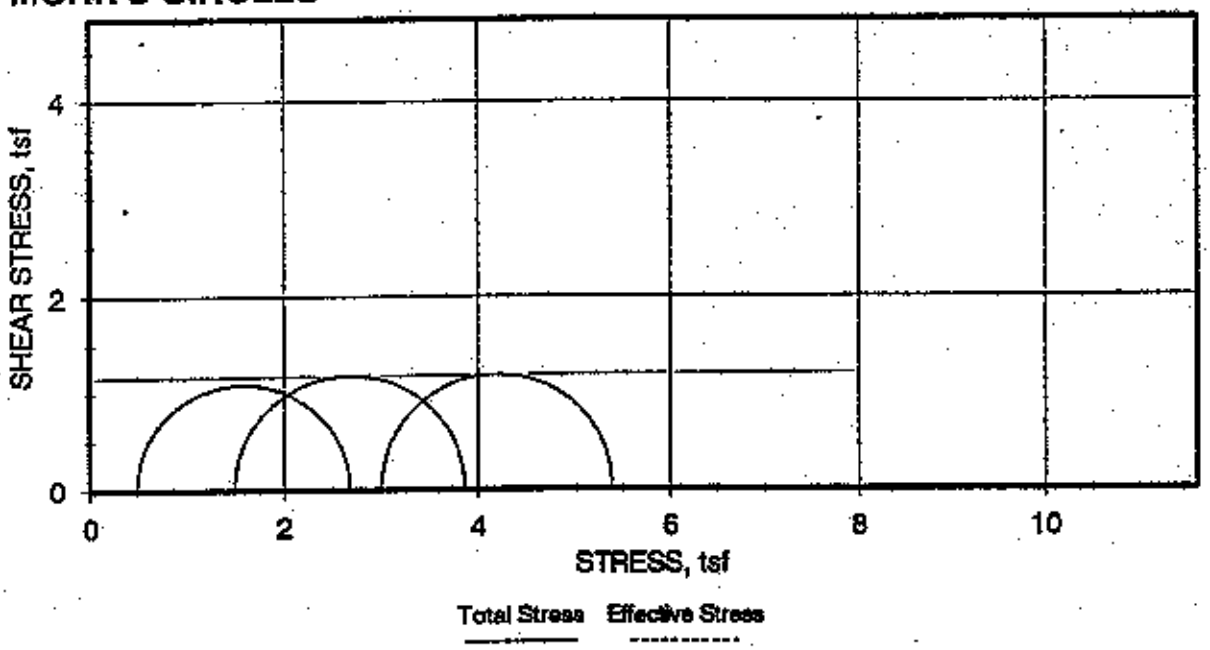
Boring No: GT-2T75
Sample No: BU-01A
*Depth: 2.5-6.5 **

* MKP SG 11/90

STRESS - STRAIN PLOT



MOHR'S CIRCLES



Boring No: GT-2T78
*Sample No: BU-024**
Depth: 6.5-12 FT.

*MKF 56 4/90

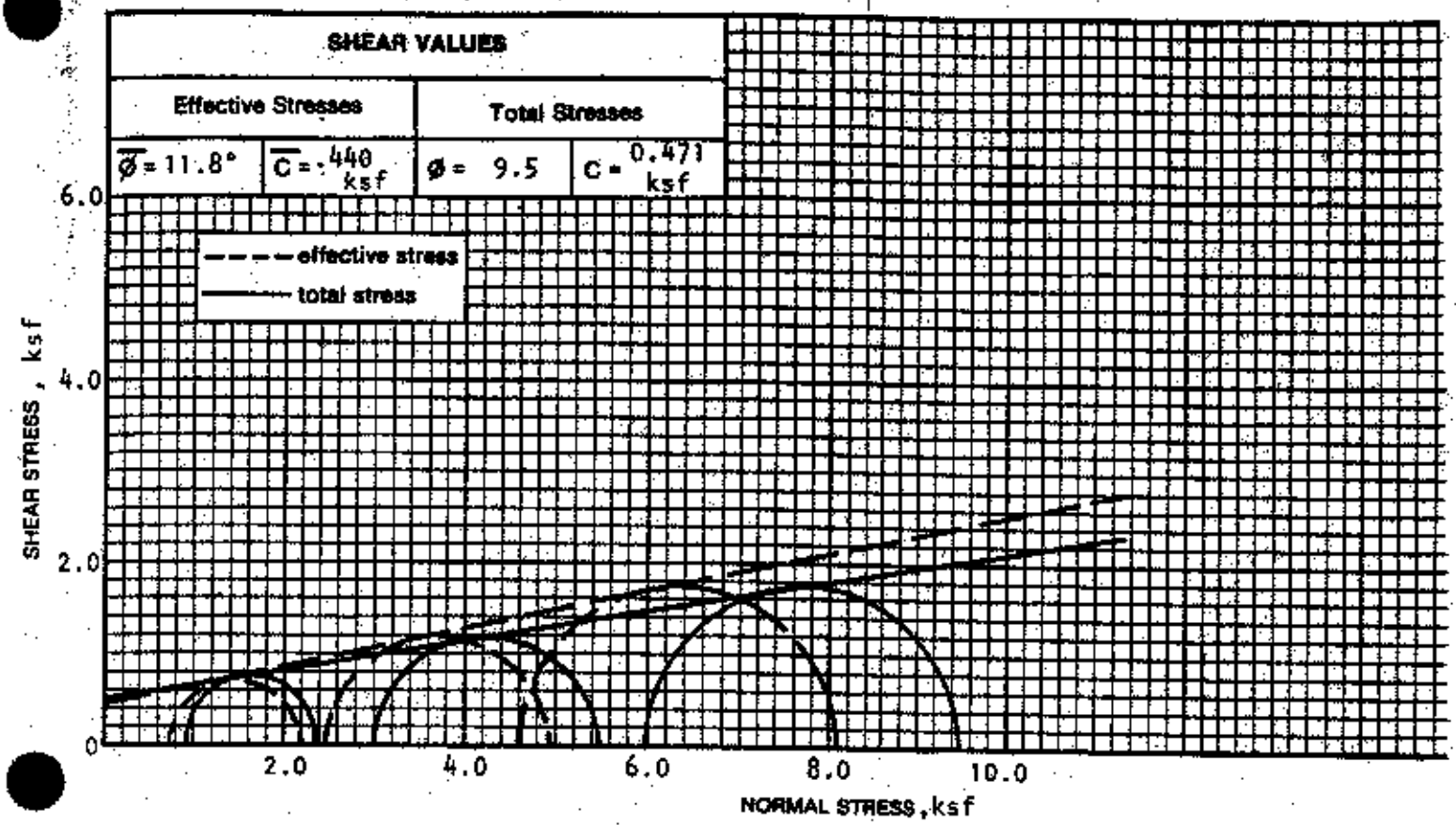
D 10

TRIAXIAL SHEAR STRENGTH
CONSOLIDATED UNDRAINED

SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

Job No. 1 296 89
Date January 19, 1989
Type of Test Saturated, Consolidated, Undrained

SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 11.8°	$\bar{C}$ = .440 ksf	ϕ = 9.5	C = 0.471 ksf



Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-43	6.0-8.5	ST	6.092	2.882	95.5	27.8	Lean clay - CL
2	GT-43	6.0-8.5	ST	6.088	2.878	89.9	32.3	Lean clay - CL
3	GT-43	6.0-8.5	ST	5.991	2.878	87.6	34.2	Lean clay - CL

Specimen Number	"B" Parameter	TEST VALUES AT MAXIMUM PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ϵ%	
1	.96	0.994	2.367	1.373	0.778	2.151	0.216	4.51	
2	.98	2.995	5.513	2.518	2.434	4.952	0.562	9.99	
3	.96	6.005	9.384	3.379	4.666	8.044	1.339	14.029	

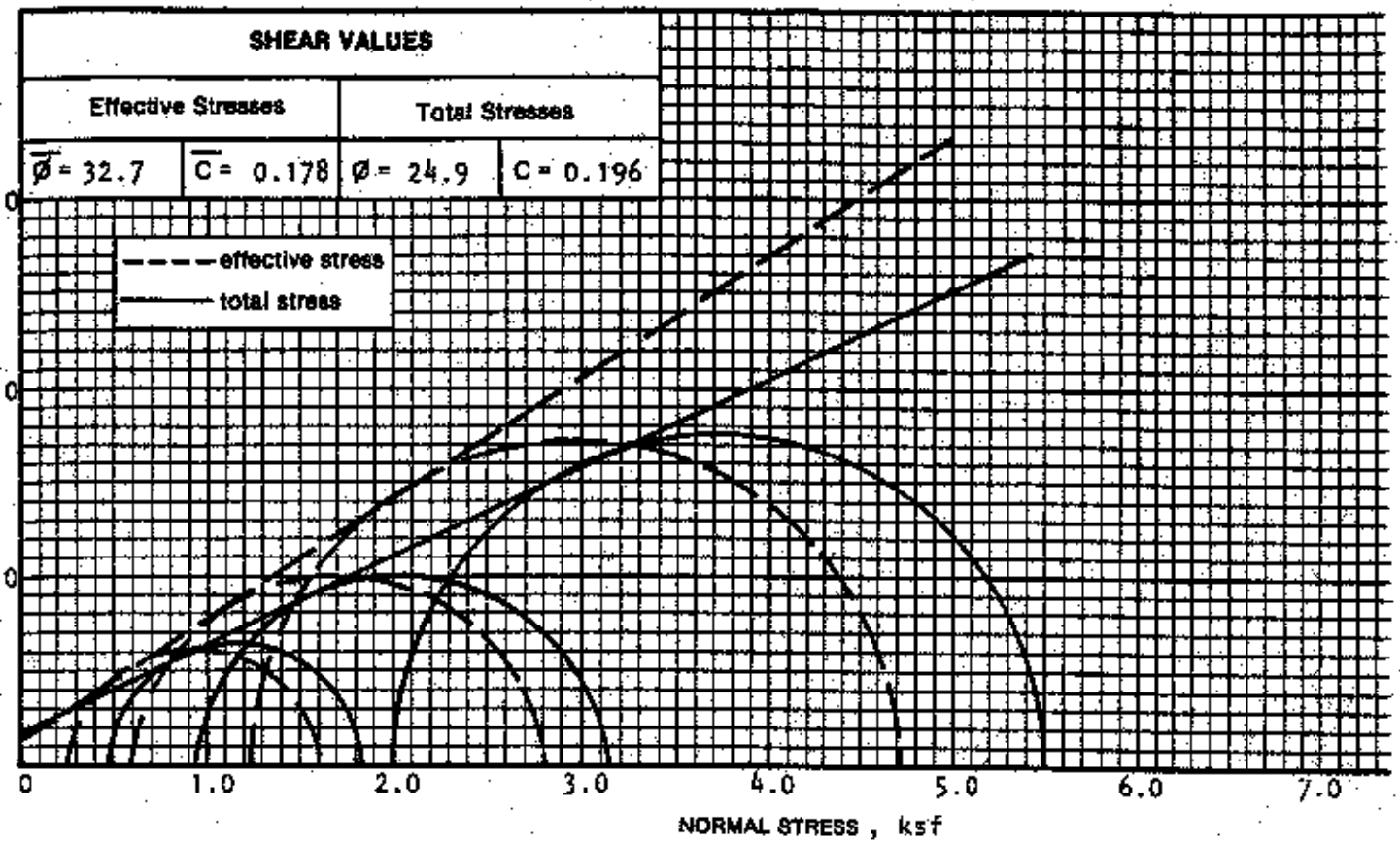
Remarks: Sample had pre-existing fractures, resulting in lower friction angles.

Fig. 1

SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

Job No. 1 296 89
Date January 20, 1989
Type of Test Saturated, Consolidated, Undrained

SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 32.7	$\bar{C}$ = 0.178	ϕ = 24.9	C = 0.196



Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-44	5.0-7.5	ST	6.051	2.875	107.0	18.6	Lean clay - CL
2	GT-44	5.0-7.5	ST	6.062	2.864	104.7	20.2	Lean clay - CL
3	GT-44	5.0-7.5	ST	6.14	2.838	105.8	19.7	Lean clay - CL

Specimen Number	"B" Parameter	TEST VALUES AT MAXIMUM PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ϵ%	
1	.97	0.504	1.814	1.310	0.274	1.583	0.230	1.0	
2	.98	0.994	3.115	2.121	0.634	2.755	0.360	3.5	
3	.98	2.002	5.512	3.510	1.210	4.720	0.792	7.0	

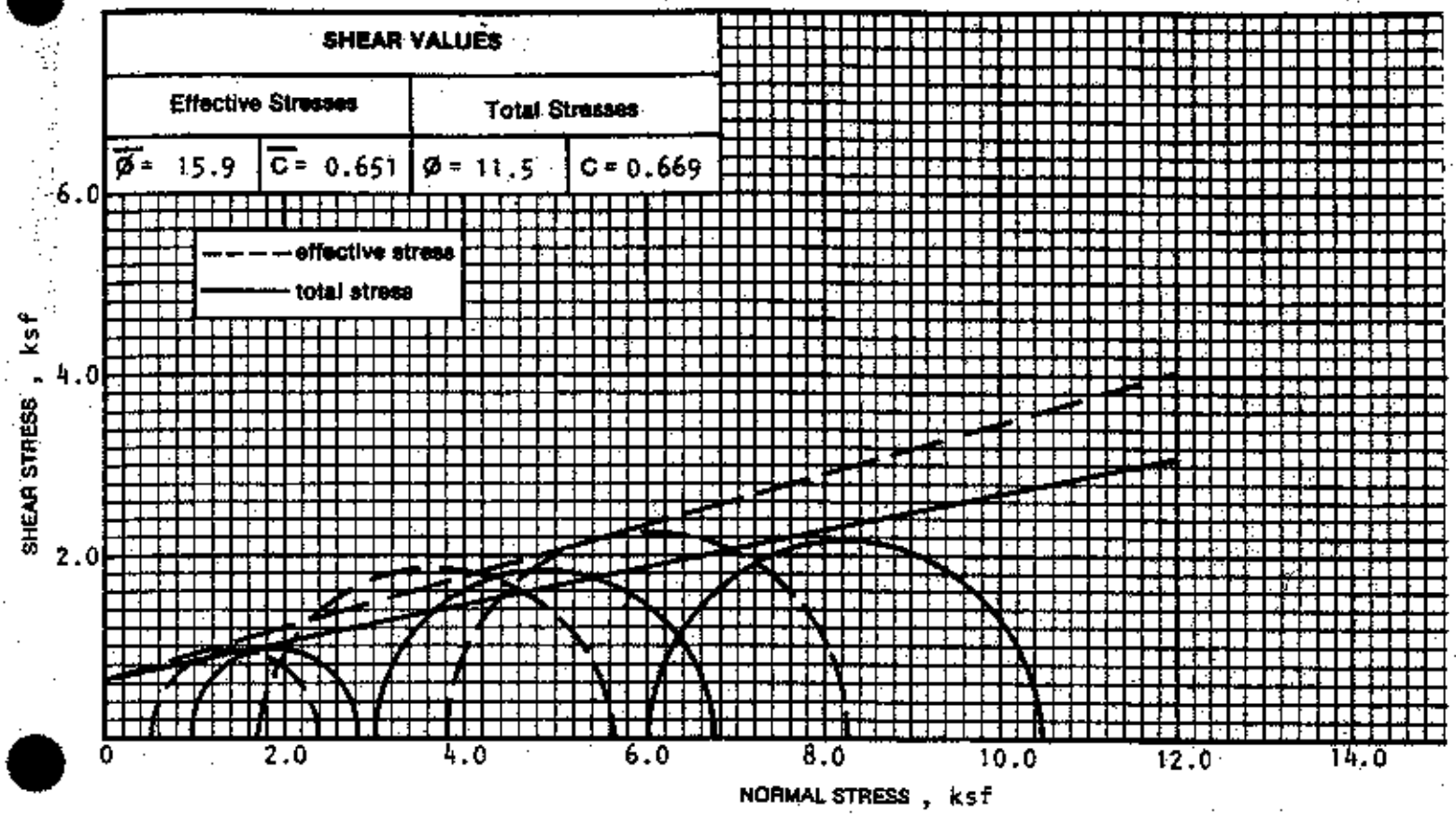
Remarks:

Fig.

SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

Job No. 1 296 89
Date January 1989
Type of Test Saturated, Consolidated, Undrained

SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 15.9	$\bar{C}$ = 0.651	ϕ = 11.5	C = 0.669



Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-48	12.5-15.0	ST	6.082	2.879	102.0	22.9	Fat clay - CH
2	GT-48	12.5-15.0	ST	6.105	2.877	102.1	23.6	Fat clay - CH
3	GT-48	12.5-15.0	ST	6.006	2.885	97.5	26.1	Fat clay - CH

Specimen Number	"B" Parameter	TEST VALUES AT MAXIMUM PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ϵ%	
1	.97	0.994	2.815	1.821	.562	2.383	0.432	3.0	
2	.95	2.995	6.719	3.724	1.800	5.524	1.195	4.0	
3	.96	6.005	10.361	4.356	3.874	8.230	2.131	4.5	

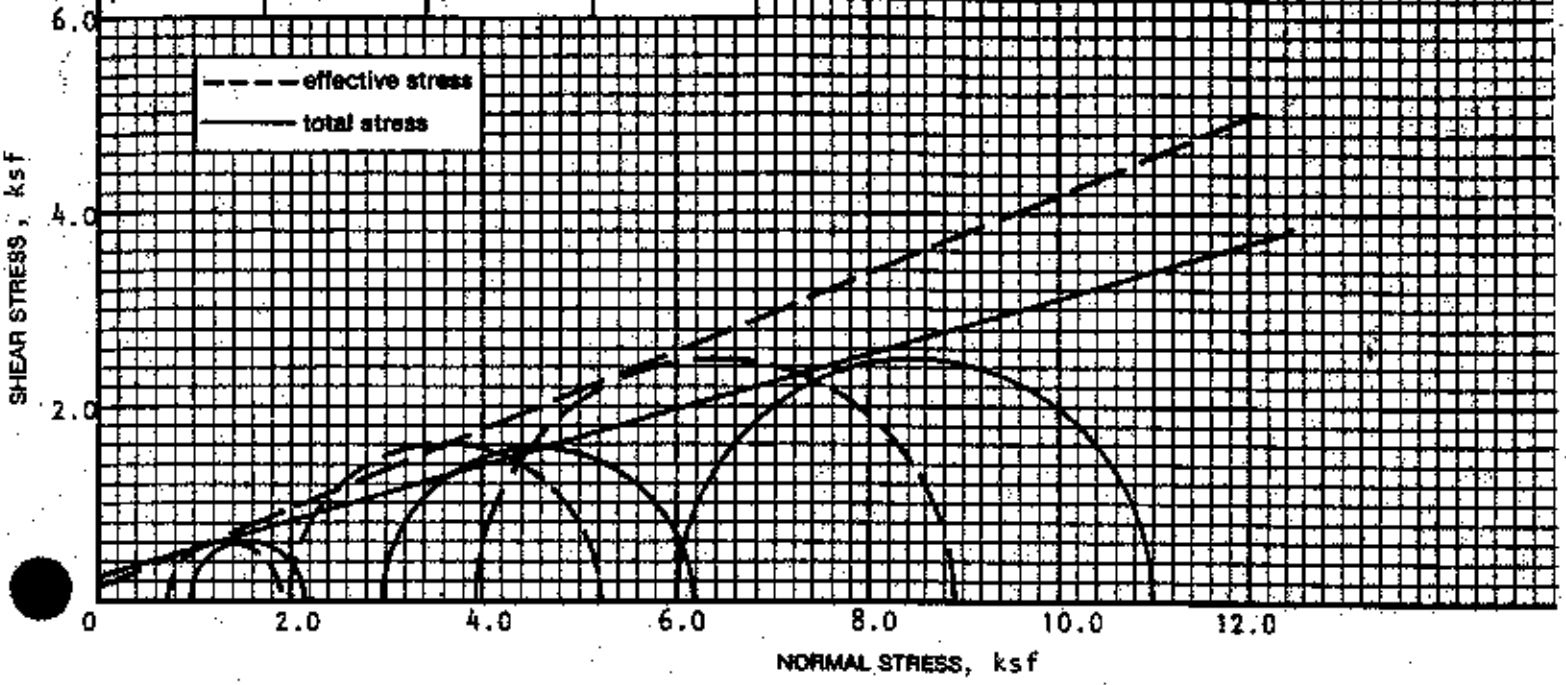
Remarks:
Sample had pre-existing fractures, resulting in lower friction angles.

Fig. 1

SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

Job No. 1 296 89
Date January 20, 1989
Type of Test Saturated, Consolidated, Undrained

SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 21.8	$\bar{C}$ = 0.147	ϕ = 15.9	C = 0.228



Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-52	15.0-17.5	ST	6.082	2.880	101.5	24.5	Lean clay - CL
2	GT-52	15.0-17.5	ST	5.972	2.878	102.6	23.5	Lean clay - CL
3	GT-52	15.0-17.5	ST	6.049	2.883	104.3	22.7	Lean clay - CL

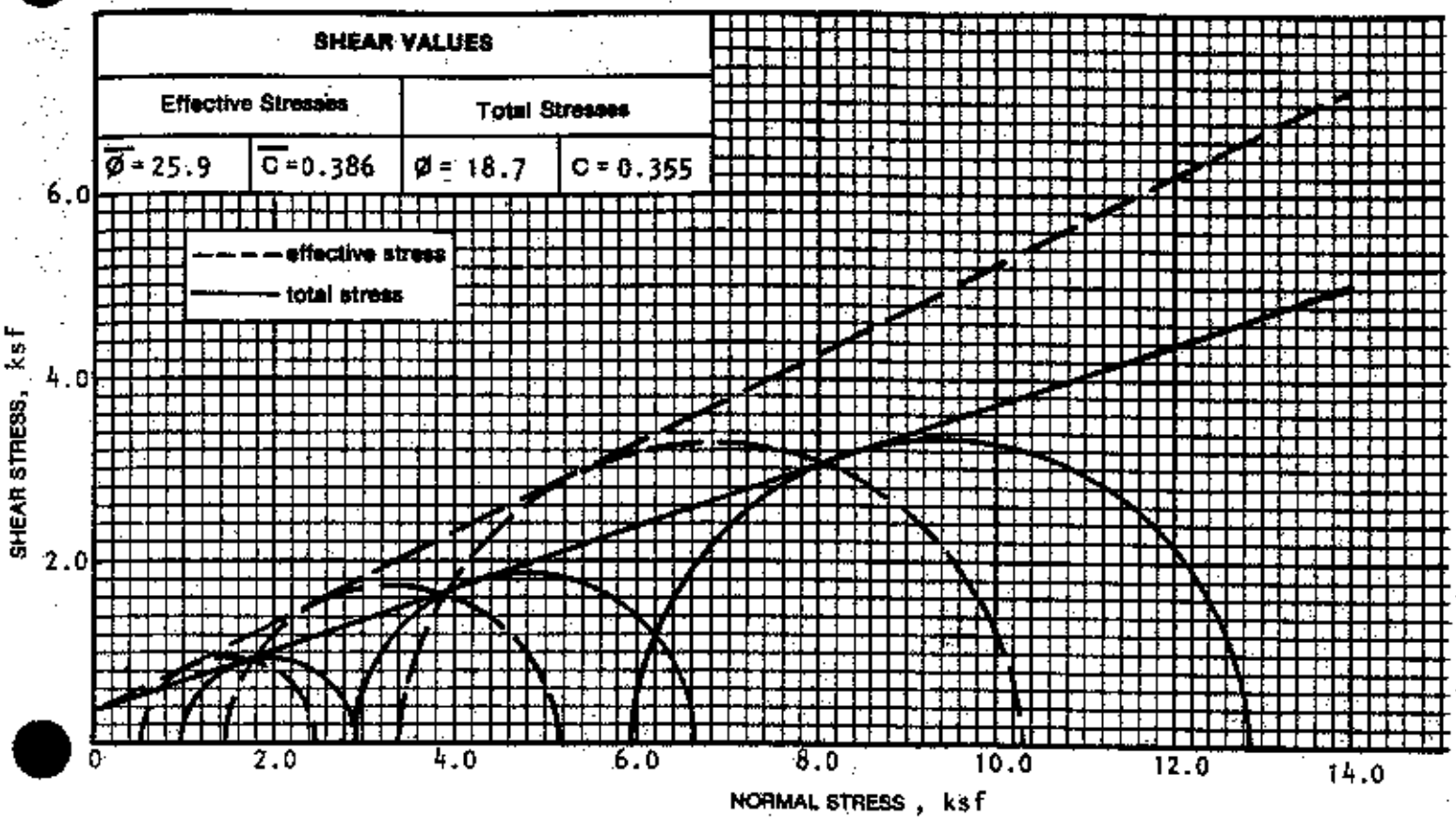
Specimen Number	"B" Parameter	TEST VALUES AT MAXIMUM PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ϵ%	
1	.95	0.994	2.160	1.166	0.778	1.944	0.216	4.5	
2	.95	2.995	6.172	3.177	2.030	5.208	0.965	3.5	
3	.93	6.005	10.979	4.974	3.960	8.934	2.045	6.0	

Remarks: Sample had pre-existing fractures, resulting in lower friction angles.

Fig. 11

SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

Job No. 1 296 89
Date January 20, 1989
Type of Test Saturated, Consolidated, Undrained



Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-54	4.5-7.0	ST	5.912	2.876	96.8	25.0	Lean clay - CL
2*	GT-54	4.5-7.0	ST	6.035	2.870	99.5	24.9	Lean clay - CL
3*	GR-54	4.5-7.0	ST	6.035	2.870	99.5	24.9	Lean clay - CL

Specimen Number	"B" Parameter	TEST VALUES AT MAXIMUM PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ϵ%	
1	.95	0.994	3.033	2.039	0.547	2.586	0.446	2.6	
2	.95	2.995	6.628	3.633	1.498	5.131	1.498	4.0	
3	.95	6.005	12.726	6.721	3.542	10.264	2.462	7.0	

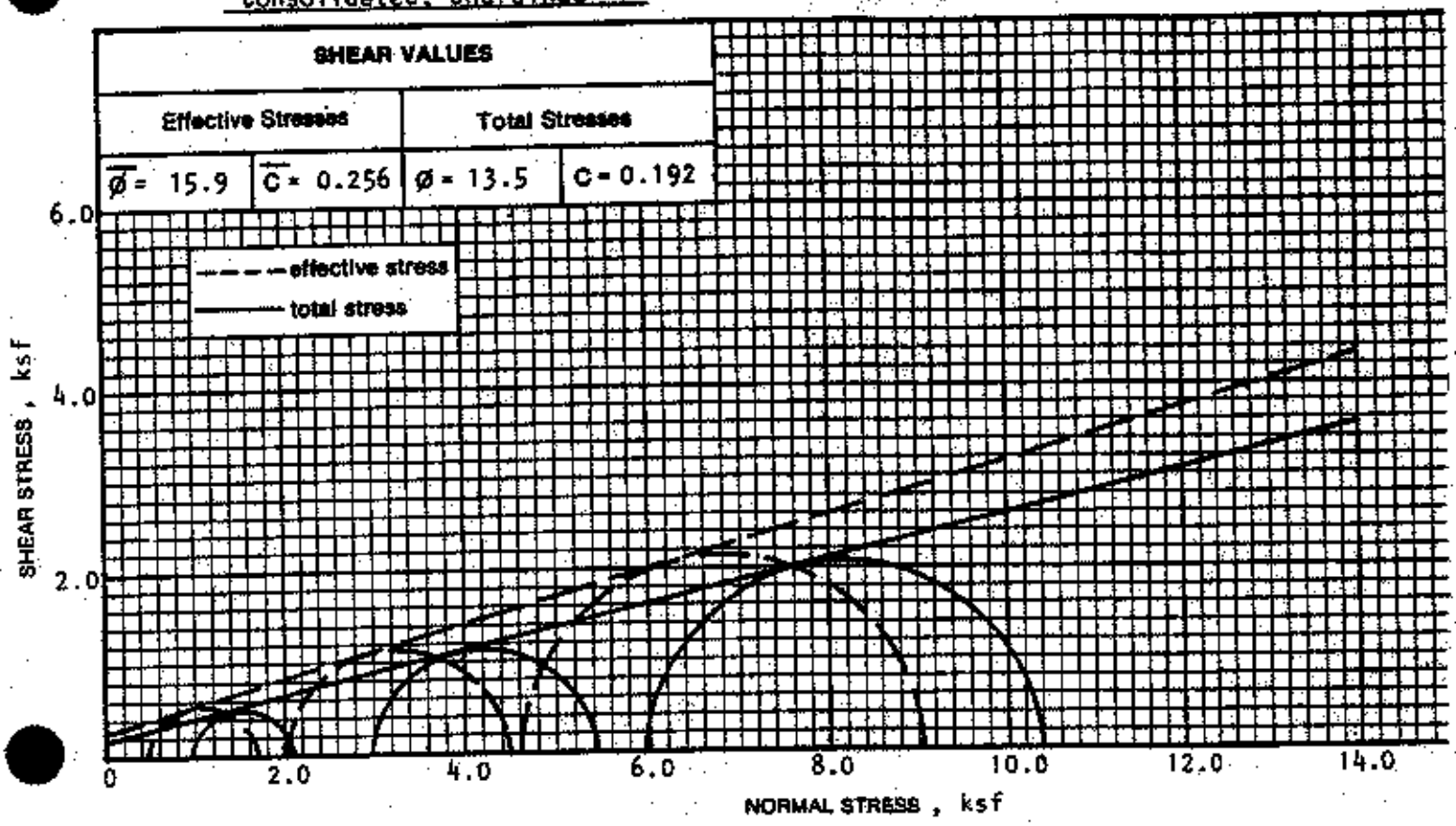
Remarks: * Sample 2 and 3 are multi-staged due to lack of sample.

Fig. 19

SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

Job No. 1 296 89
Date January 1989
Type of Test Saturated, Consolidated, Undrained

SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 15.9	$\bar{C}$ = 0.256	ϕ = 13.5	C = 0.192



Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1*	GT-55	27.5-29.0	SB	5.568	2.374	101.4	23.7	Fat clay - CH
2*	GT-55	27.5-29.0	SB	5.568	2.374	101.4	23.7	Fat clay - CH
3*	GT-55	27.5-29.0	SB	5.568	2.374	101.4	23.7	Fat clay - CH

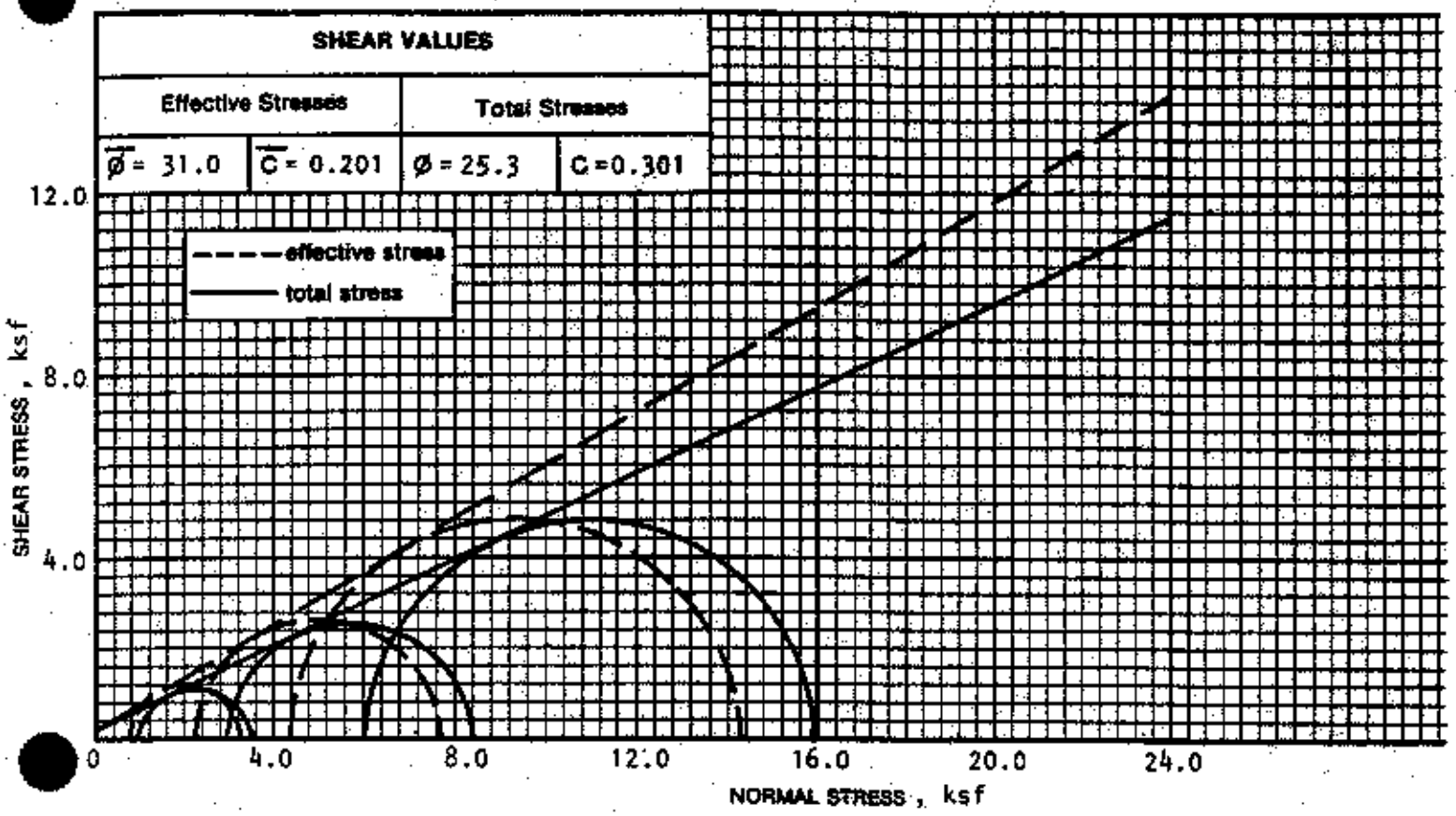
Specimen Number	"B" Parameter	TEST VALUES AT MAXIMUM PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ϵ%	
1*	.95	0.994	2.082	1.088	0.576	1.664	0.418	3.5	
2*	.95	2.995	5.305	2.310	2.102	4.412	0.893	5.5	
3*	.95	6.005	10.137	4.132	4.594	8.726	1.411	10.4	

Remarks: * Sample had pre-existing fractures, resulting in lower fraction angle.

Fig.

SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

Job No. 1 296 89
Date January 1989
Type of Test Saturated, Consolidated, Undrained



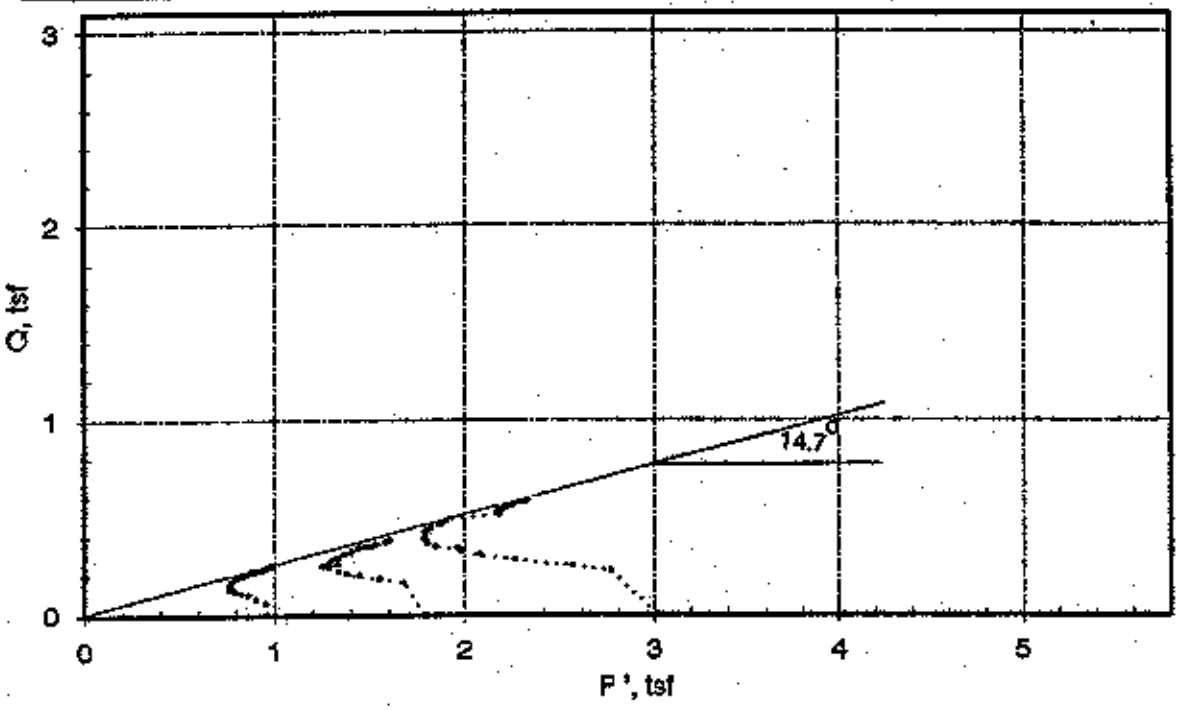
Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1*	GT-56	5.0-7.5	ST	7.0	2.877	103.7	22.1	Lean clay - CL
2*	GT-56	5.0-7.5	ST	7.0	2.877	103.7	22.1	Lean clay - CL
3*	GT-56	5.0-7.5	ST	7.0	2.877	103.7	22.1	Lean clay - CL

Specimen Number	"B" Parameter	TEST VALUES AT MAXIMUM PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ϵ%	
1*	.97	0.994	3.496	2.502	0.806	3.308	0.187	2.2	
2*	.97	2.995	8.299	5.304	2.232	7.536	0.763	3.5	
3*	.97	6.005	15.956	9.951	4.334	14.285	1.670	7.1	

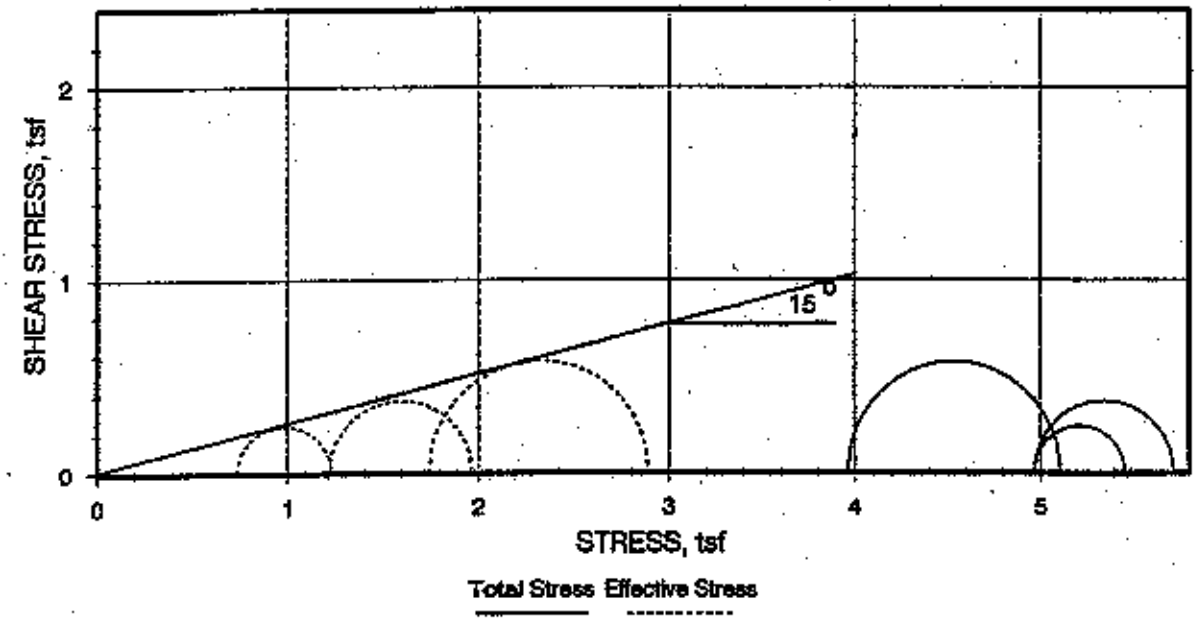
Remarks: * Specimens are multi-staged due to insufficient material.

Fig. 2

WSSRAP - JOB NO.: 11295
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH

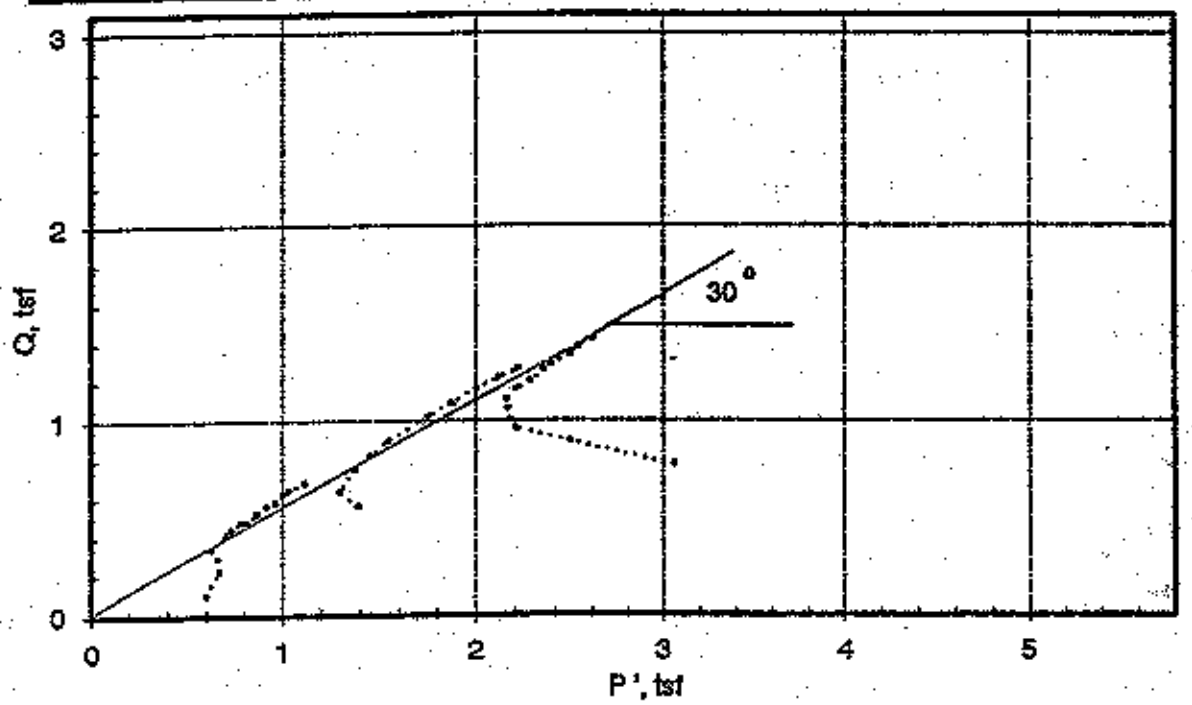


MOHR'S CIRCLES

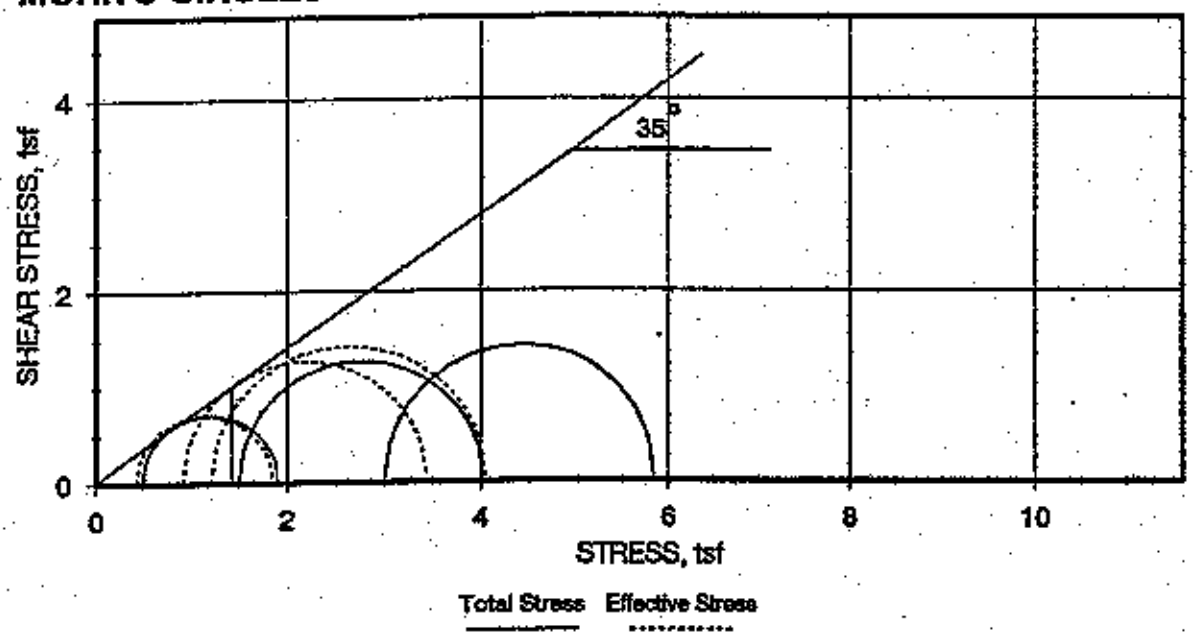


Boring No: GT-2T71
Sample No: BU-01A
Depth: 3.5-6.5 ft

WSSRAP - JOB NO: 11295.000
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



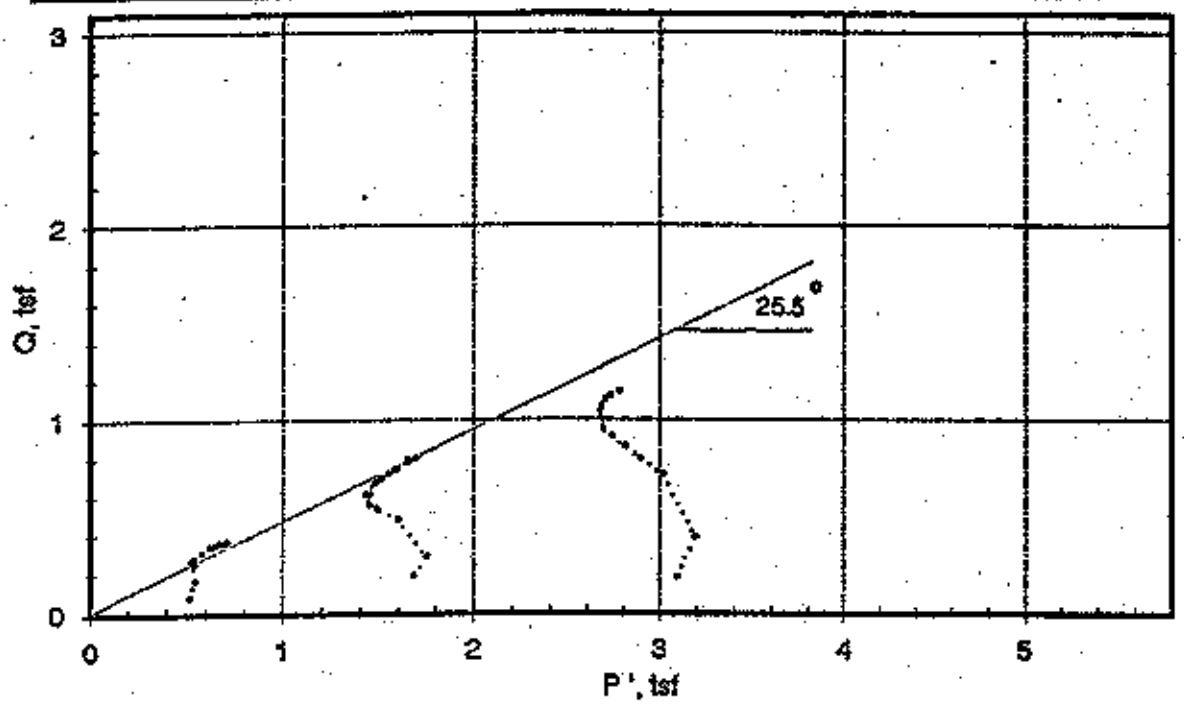
MOHR'S CIRCLES



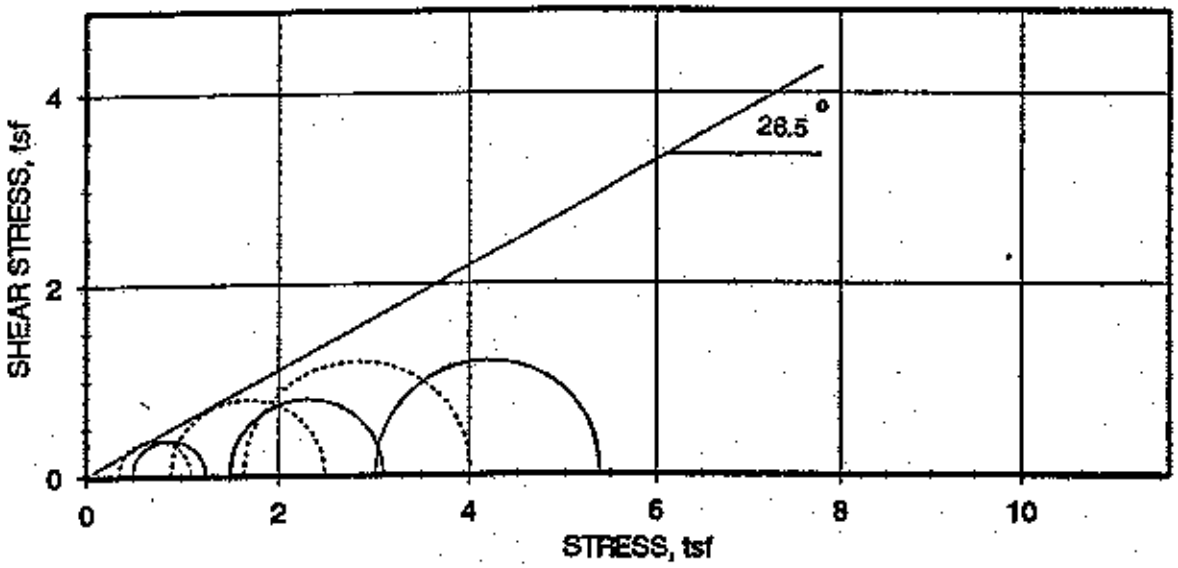
Boring No: GT-2T74
Sample No: BU-01A
Depth: 4-8.5

P 39
Checked by: [illegible]

WSSRAP - JOB NO: 11295.000
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES

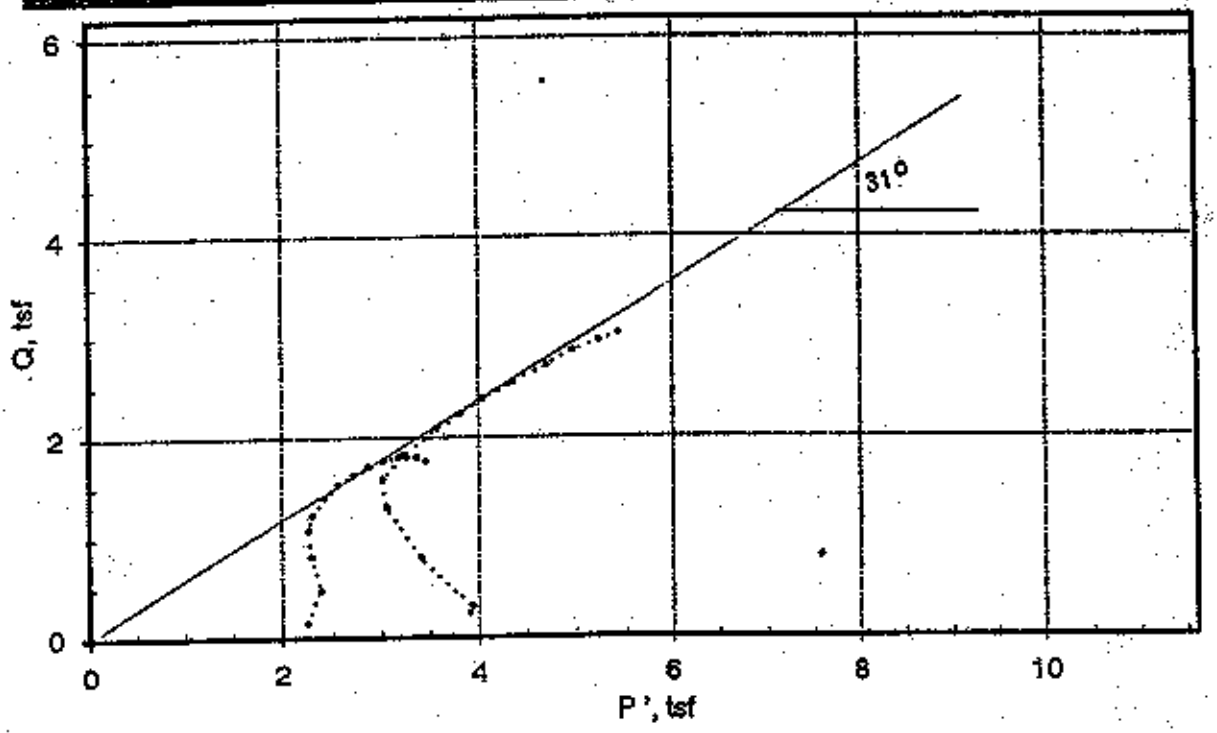


Total Stress ——— Effective Stress - - - - -

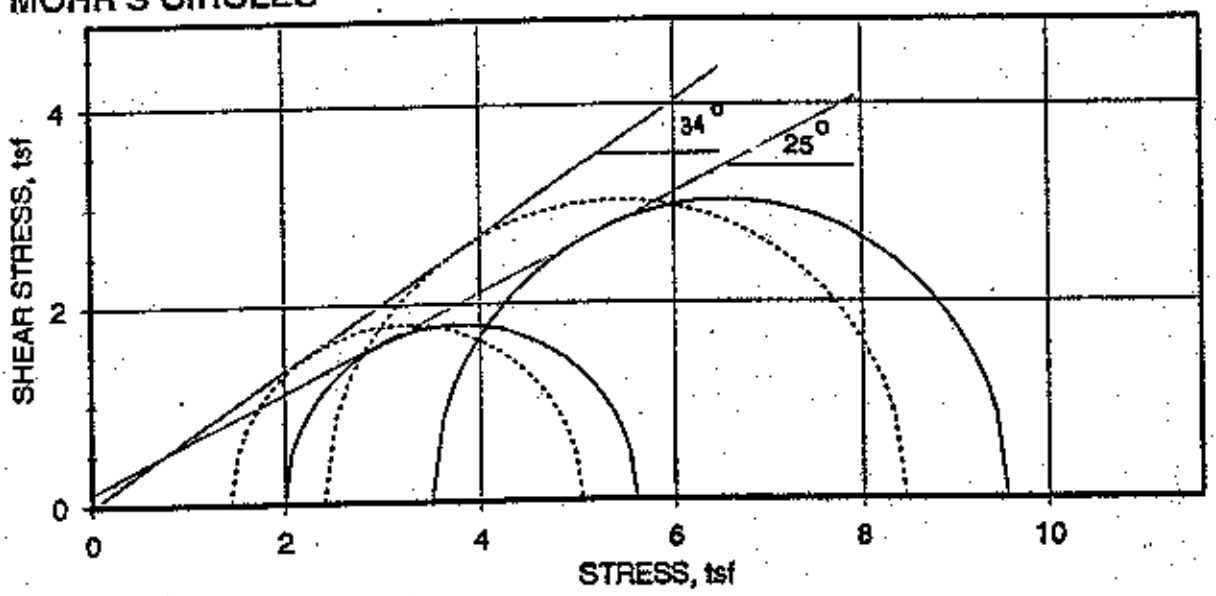
Boring No: GT-2777
Sample No: BU-01B
Depth: 1.5-4 FT

P 54

WSSRAP - JOB NO.: 11295.000
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES



Total Stress ——— Effective Stress - - - - -

Boring No: GT-60P
Sample No: SB-15
Depth: 40-41.5 FT.

0 53

PERMEABILITY

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WSSRAP 3

DATE: January 1989

LAB NAME: Chen-Northern

Chen Job No.: 1 296 89

CHECKED BY: LAB

TAC

* NOTE: Data Suspect

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	EFFECTIVE CONSOLIDATION PRESSURE, psi	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
GT 43	ST 04	6.0- 8.5	TX	0.5	27.0	-	95.7	-	-	-	3.6	* 9.2×10^{-4}
	ST 04	-	-	2.0	-	30.5	-	91.6	-	100	3.6	7.0×10^{-8}
GT 43	SB 17	40.0-41.5	TX	3.0	21.7	-	106.3	-	99.7	-	3.6	6.1×10^{-8}
	SB 17	-	-	5.0	-	21.4	-	106.8	-	100	3.6	3.8×10^{-8}
GT 45	ST 07	15.0-17.5	TX	1.5	19.9	-	106.5	-	92.9	-	3.6	* 8×10^{-5}
	ST 07	-	-	4.0	-	23.5	-	102.8	-	100	3.6	1.7×10^{-8}
GT 46	ST 03	5.0- 7.5	TX	0.5	20.0	-	103.7	-	87.2	-	2.6	* 5.0×10^{-4}
	ST 03	-	-	3.0	-	23.3	-	103.0	-	100	2.6	3.2×10^{-6}
GT 48	ST 05	12.5-15.0	TX	1.0	22.4	-	101.3	-	91.6	-	3.6	* 5.5×10^{-4}

ATTACHMENT 7

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WSSRAP 3

DATE: January 1989

LAB NAME: Chen-Northern
Chen Job No.: T 296 89

CHECKED BY: LAB [illegible]

TAC

*Data Suspect

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	EFFECTIVE CONSOLIDATION PRESSURE, psi	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
GT 48	ST 05	-	-	3.5	-	25.7	-	99.2	-	100	3.6	1.0×10^{-8}
GT 50	ST 02	2.5- 5.0	TX	0.5	23.5	-	102.7	-	99.7	-	2.6	* 3.0×10^{-4}
	ST 02	-	-	3.0	-	26.3	-	98.2	-	100	2.6	2.0×10^{-5}
GT 50	SB 08	17.5-19.0	TX	1.5	14.4	-	113.8	-	82.0	-	3.6	1.5×10^{-7}
	SB 08	-	-	4.0	-	20.9	-	107.4	-	100	3.6	6.5×10^{-8}
GT 51	ST 07	15.0-17.5	TX	1.5	16.5	-	113.2	-	96.7	-	3.6	3.2×10^{-6}
	ST 07	-	-	4.0	-	19.4	-	108.6	-	100	3.6	1.7×10^{-8}
GT 51	SB 09	20.0-21.5	TX	2.0	28.1	-	92.7	-	89.0	-	3.6	2.6×10^{-7}
	SB 09	-	-	4.5		35.3		87.7	-	100	3.6	5.0×10^{-8}
GT 52	ST 06	15.0-17.5	TX	1.5	25.0	-	100.1	-	99.6	-	3.6	3.2×10^{-6}

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE:

ATTACHMENT 7

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WSSRAP 3

DATE: January 1989

LAB NAME: Chen-Northern

Chen Job No.: 1 296 89

CHECKED BY: LAB [signature]

TAC

* Data Suspect

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	EFFECTIVE CONSOLIDATION PRESSURE, psi	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
GT 52	ST 06	-	-	4.0	-	30.8	-	91.7	-	100	-	N/A
GT 55	ST 04	7.5-10.0	TX	1.0	28.8	-	94.0	-	95.6	-	-	* 6.1×10^{-5}
	ST 04	-	-	3.5	-	30.9	-	92.8	-	100	-	1.9×10^{-6}
GT 55	SB 12											
	SB 12											
GT 56	ST 04	10.0-12.5	TX	1.0	26.7	-	96.2	-	98.1	-	2.6	2.4×10^{-7}
	ST 04	-	-	3.5	-	29.7	-	92.6	-	100	2.6	2.9×10^{-8}

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE:

ATTACHMENT 7

request # 4
P.O. # 3509 -1002 -3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WJJ PAP

DATE: 1-17-90

LAB NAME: Geotechnology, Inc.

CHECKED BY: LAB YY

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
DISTURBED CELL	GT 58P ST03	7.5 - 10	CH		21.9	23.8	104.8		97.9		16.06	4×10^{-9}
"	GT 58P ST03	7.5 - 10	CH		21.9	23.8	104.8		97.9		" 48.19	no flow
"	GT59 ST02	5 - 7.5	CH		23.0	21.8	102.4		96.2*		16.06	2×10^{-7}
"	GT59 ST02	5 - 7.5	CH		23.0	21.8	102.4		96.2*		48.19	5×10^{-7}
"	GT55 ST06	15 - 17.5	CH		19.3	20.2	110.5		99.3*		32.13	no flow
"	GT 60P ST10	27.5 - 30	CH		18.7	19.6	109.1		92.8		48.19	1×10^{-8}
"	GT 60P ST10	27.5 - 30	CH		18.7	19.6	109.1		92.8		96.39	no flow
"	GT 62 ST07	17.5 - 20.0	CH		25.7	24.5	100.3		97.0**		32.13	2×10^{-8}
"	GT 62 ST07	17.5 - 20.0	CH		25.7	24.5	100.3		97.0**		32.13	no flow
"	GT63P ST01	2.5 - 5.0	CH		22.9	24.2	100.4		91.2*		16.06	5×10^{-9}

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE: EM 1110-2-1906

* - Assumed sp. gravity of 2.67

Request #4
P.O. # 3509-1002-3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WSSRAP

DATE: 6-4-90

LAB NAME: Geotechnology, Inc

CHECKED BY: LAB 44

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
GT-60P	58-15	40.5 - 41.0	CH	—	19.0	20.4	105.5		87.6*		64.3	9×10^{-9}
GT-60P	38-15	41.0 - 41.5	CH	—	20.9	19.8	105.1		95.4*		" 112.5	2×10^{-8}

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE: EM 1110-2-1906

* Assumed sp. gravity of 2.67

request # 4
P.O. # 3509 -1002 -3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WSSFAP

DATE: 4-10-90

LAB NAME: Geotechnology, Inc

CHECKED BY: LAB 47

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
DISPOSAL CELL	GT-60P SB-17	48.5 - 49	CH		13.9	22.4	105.1		63.4*		64.3	6×10^{-8}
"	GT-60P SB-17	48.5 - 49	CH		13.9	22.4	105.1		63.4*		" 112.5	2×10^{-8}

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE: EM 1110-2-1906

MKE-AL-ENG-7 (4/87)

* Assumed sp. gravity of 2.67

ATTACHMENT 1/2

request # 4
P.O. # 3509 -1002 -3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WJSRAP

DATE: 3/6/90

LAB NAME: Geotechnology

CHECKED BY: LAB TV

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
DISPOSAL CELL	GT-625 SB-15	32.8-33.3	CH		7.8	15.8	100.1		30.8*		48.18	6x10^-6
"	GT-625 SB-15	32.8-33.3	CH		7.8	15.8	100.1		30.8*		" 80.30	7x10^-9 **
"	GT-655 SB 16	41-41.5	CH		29.5	33.0	81.3		73.6*		64.24	2x10^-7
"	GT-655 SB-16	41-41.5	CH		29.5	33.0	81.3		73.6*		112.42	3x10^-8

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE: EM 1110-2-1906

* Assumed sp. gravity of 2.67

1 of 5

Request #4
P.O.# 3589-1002-3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WNRAP

DATE: 11-9-89

LAB NAME: GEOTECHNOLOGY INC

CHECKED BY: LAB 47

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
DNPOVAC CELL	GT-67P STD 9	22.5-25			17.6	19.1	110.0		89.4		32.2	3.301×10^{-9}
"	GT67P STD8	20-22.5			17.9	19.8	110.2		91.3		32.2	4.134×10^{-8}

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE: EM 1110-2-1906

request # 2
P.O. # 3509 -1002 -3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WJJZAP

DATE: 1-9-90

LAB NAME: Geotechnology, Inc

CHECKED BY: LAB 47

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
DISPOSAL CELL	GT-2771 BU-02A	6.5 - 12	CH	97.6	21.0	23.65	104.4		105.4*		16.06	1X10^-8
"	GT-2777 BU-02A	7.5 - 10.5	CH	97.5	22.0	22.7	103.0		95.7		" 16.06	1X10^-8

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE: EM 1110-2-1906

Request #2
P.O. # 3509 -1002 -3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WSSRAP

DATE: 6-4-90

LAB NAME: Geotechnology

CHECKED BY: LAB 77

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
GT-2T75	BU-02B	6.5-12.0'	CH	95.3	23.4	24.9	97.5		86.3		16.1	NO FLOW
GT-2T78	BU-02B	6.5-12.0'	CH	95.2	24.0	29.1	99.2		93.3		" 16.1	3×10^{-8}

*TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL, BACKPRESSURE FALLING HEAD TEST PROCEDURE: EM 1110-2-1906

MKF-AI-ENG-7 (4/87)

ATTACHMENT 7/7

CAPILLARY MOISTURE

TABLE I

Summary of Capillary-Moisture Relationship Test Results

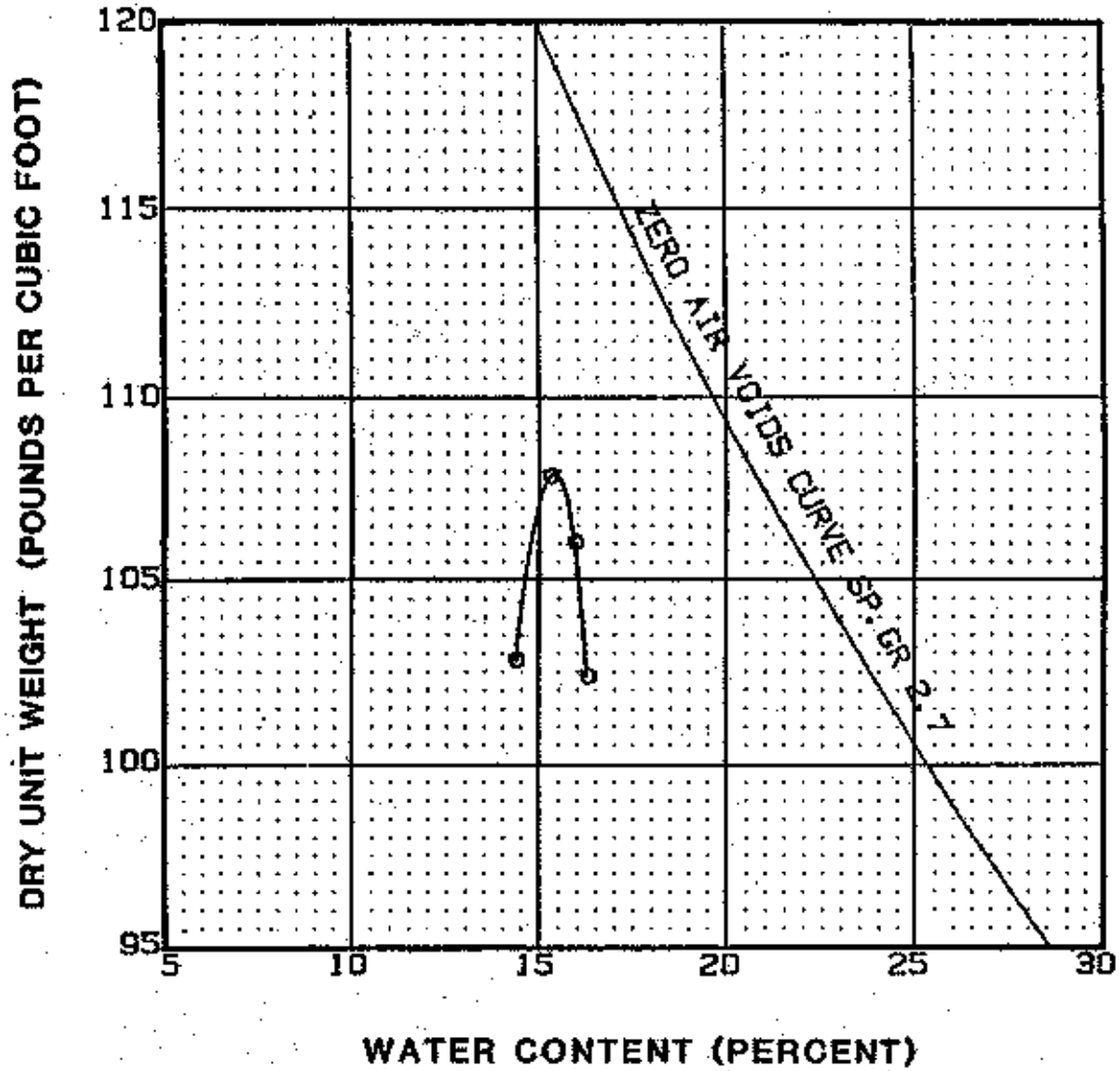
Job No. 1 627 90

August 1, 1990

Boring No.	GT-2T71	GT-2T71	GT-2T74	GT-2T75	GT-2T75	GT-2T77	GT-2T77	GT-2T78	GT-2T78
Depth, feet	3.5-6.5	6.5-12.0	4.0-8.5	2.5-6.5	6.5-12.0	1.5-4.0	~~7.5~~ 7.0-10.5	4.0-6.5	6.5-12.0
Sample ID	BU-01A	BU-02A	BU-01A	BU-01A	BU-02B	BU-01B	BU-02A	BU-01A	BU-02B
Average Initial Moisture Content, %	18.5	22.0	19.0	19.8	22.6	18.9	22.9	14.7	24.4
Average Initial Dry Density, pcf	102.5	101.2	101.0	103.3	97.6	99.7	98.6	109.2	99.0
Average Initial Compaction, %	94.9	94.7	95.1	95.6	95.4	95.6	94.5	95.0	95.0
Tension, bar	Moisture Content								
0.3	23.1	22.7	19.0	20.2	24.5	20.9	27.1	18.4	29.6
1.0	23.5	22.9	19.6	19.9	23.8	21.1	25.4	14.9	27.5
4.0	20.3	20.3	17.4	17.8	21.3	18.4	22.6	13.4	24.1
15.0	20.2	20.5	17.2	17.4	21.2	17.9	21.6	13.4	24.2

COMPACTION TESTS
MOISTURE-DENSITY RELATIONSHIP

Job # 11295
Date: 6-22-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
108.0	15.4	28.3

DESCRIPTION

GT-2T 71 BU 01A

ATTERBERG LIMITS

LL- 39 PL- 22 PI- 17

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

WSSRAP

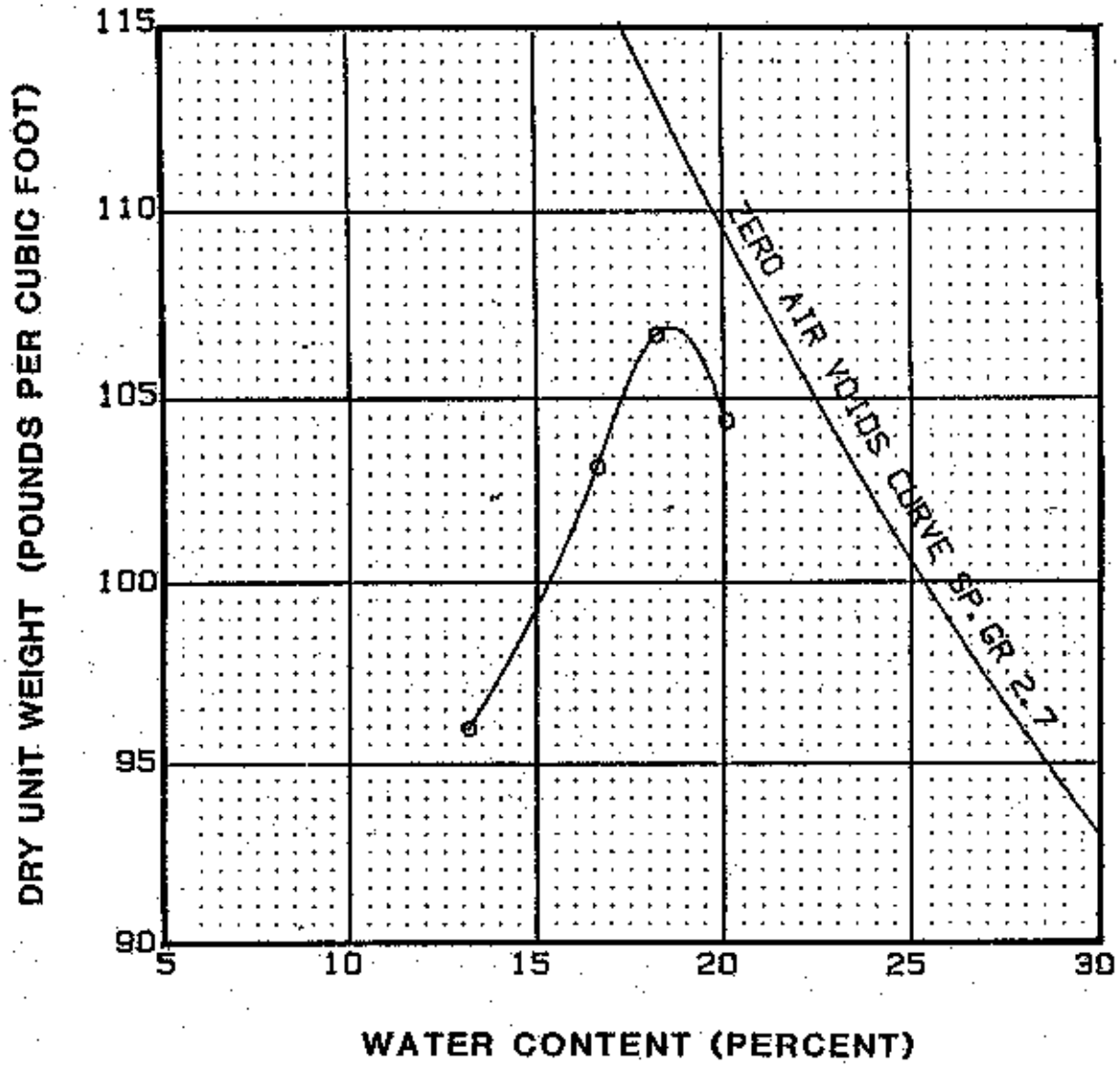
COMPACTION TEST

GEOTECHNOLOGY

PLATE 43

L-2 10/88

Job # 11295
Date: 7-27-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
106.9	18.5	

DESCRIPTION

Brown and Grey Mottled Clay

ATTERBERG LIMITS

LL-52 PL-15 PI-37

CLASSIFICATION SYSTEM

UNIFIED : CH

AASHTO :

SAMPLE INFORMATION

BU-12A GT-2T71*

8.5-12.0 FEET

WSSRAP

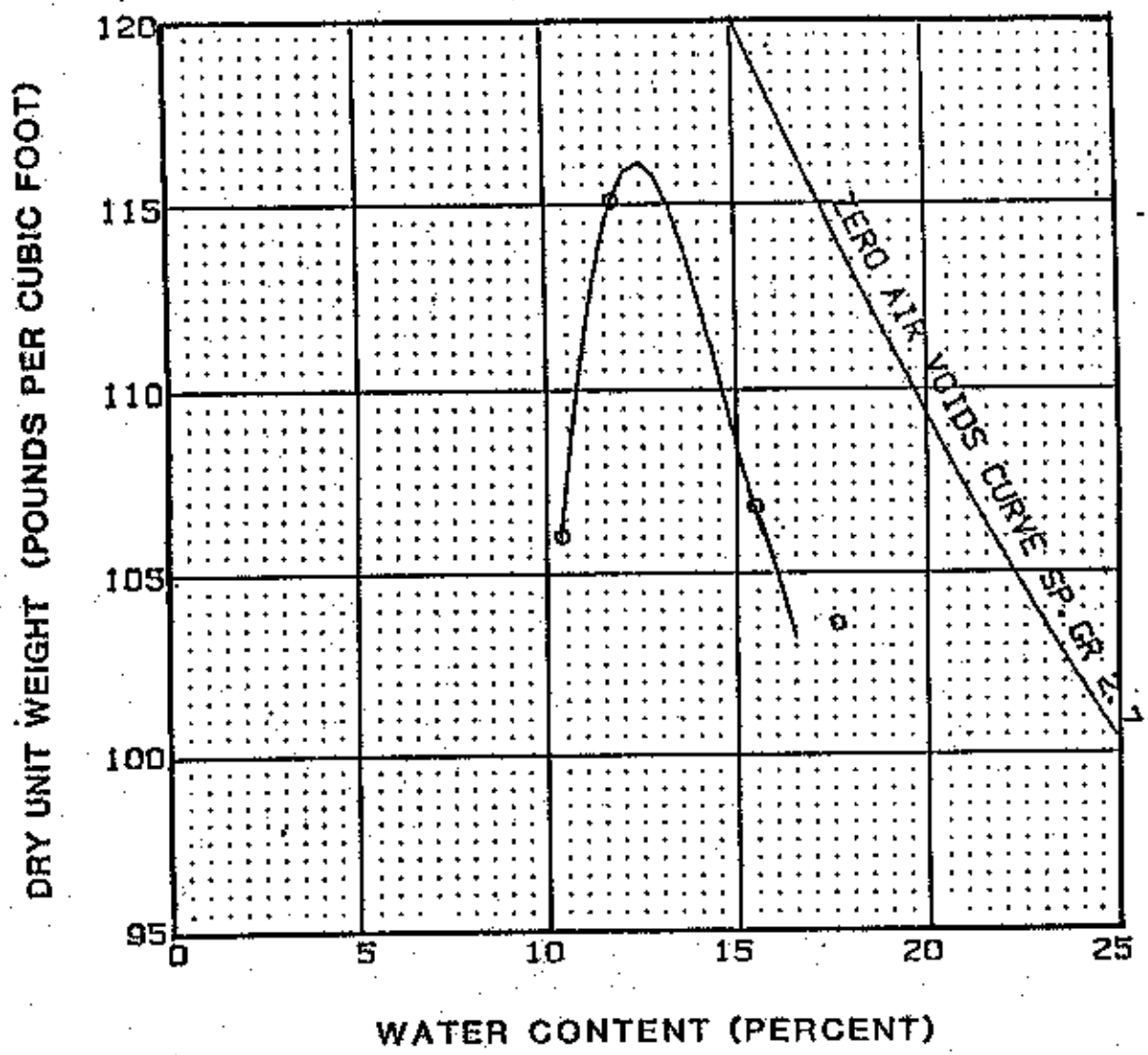
COMPACTION TEST

GEOTECHNOLOGY

* NOT LABELLED. CORRECTION MADE BY MKF, RCT 11/2/90

PLATE F116

Job # 11295
Date: 7-1-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
116.1	12.5	20.7

DESCRIPTION

Gray silty CLAY to clayey SILT

ATTERBERG LIMITS

LL- 27 PL- 21 PI- 6

CLASSIFICATION SYSTEM

UNIFIED : CL-ML

AASHTO :

SAMPLE INFORMATION

Boring # GT-2T 72
Sample # BU-01A 7.5-10.5

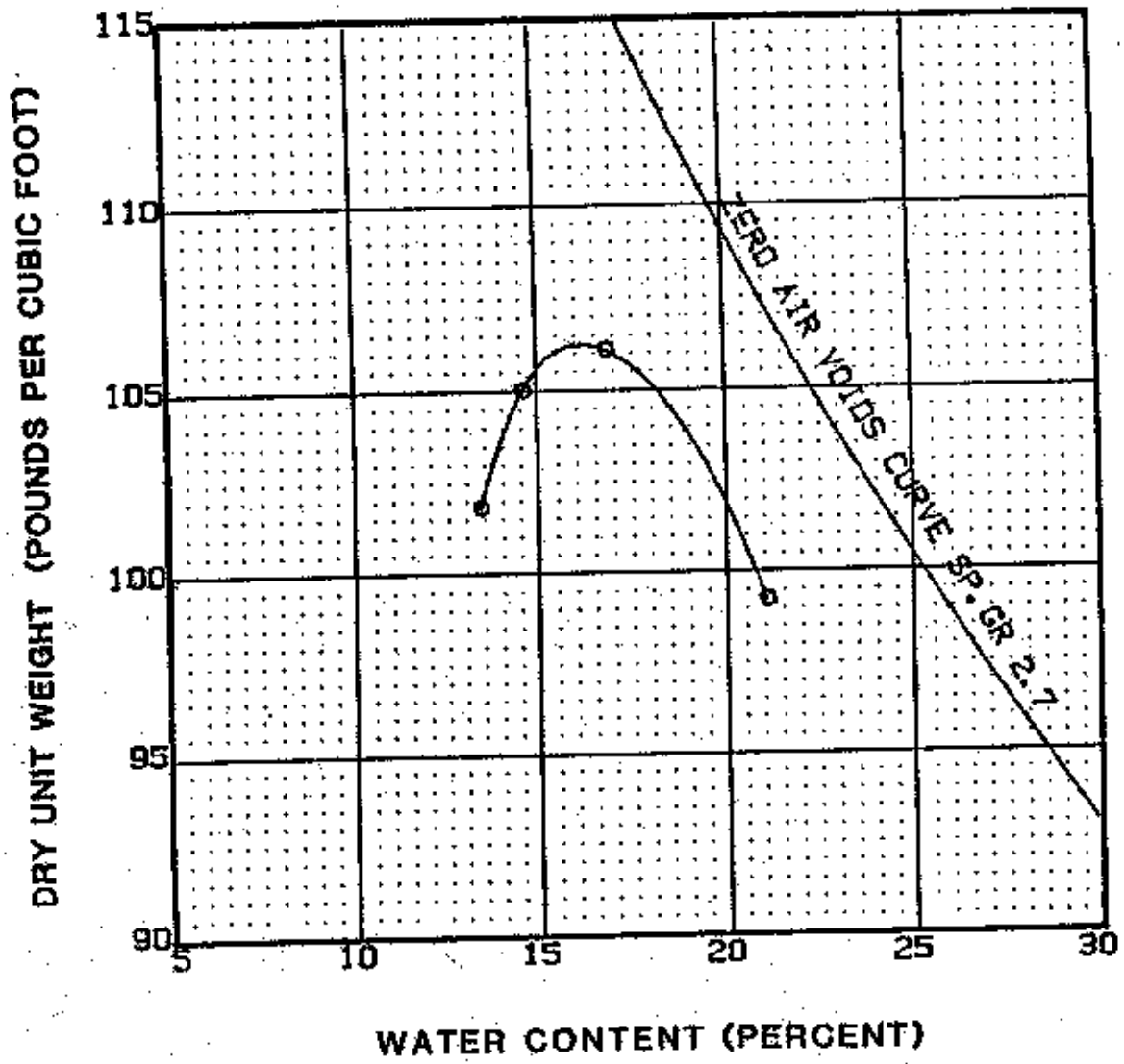
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE E4

Job # 11295
Date: 8-22-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
106.3	18.1	27.8

DESCRIPTION

GT-2T 74 BU 01A

ATTERBERG LIMITS

LL- 42 PL- 18 PI- 24

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

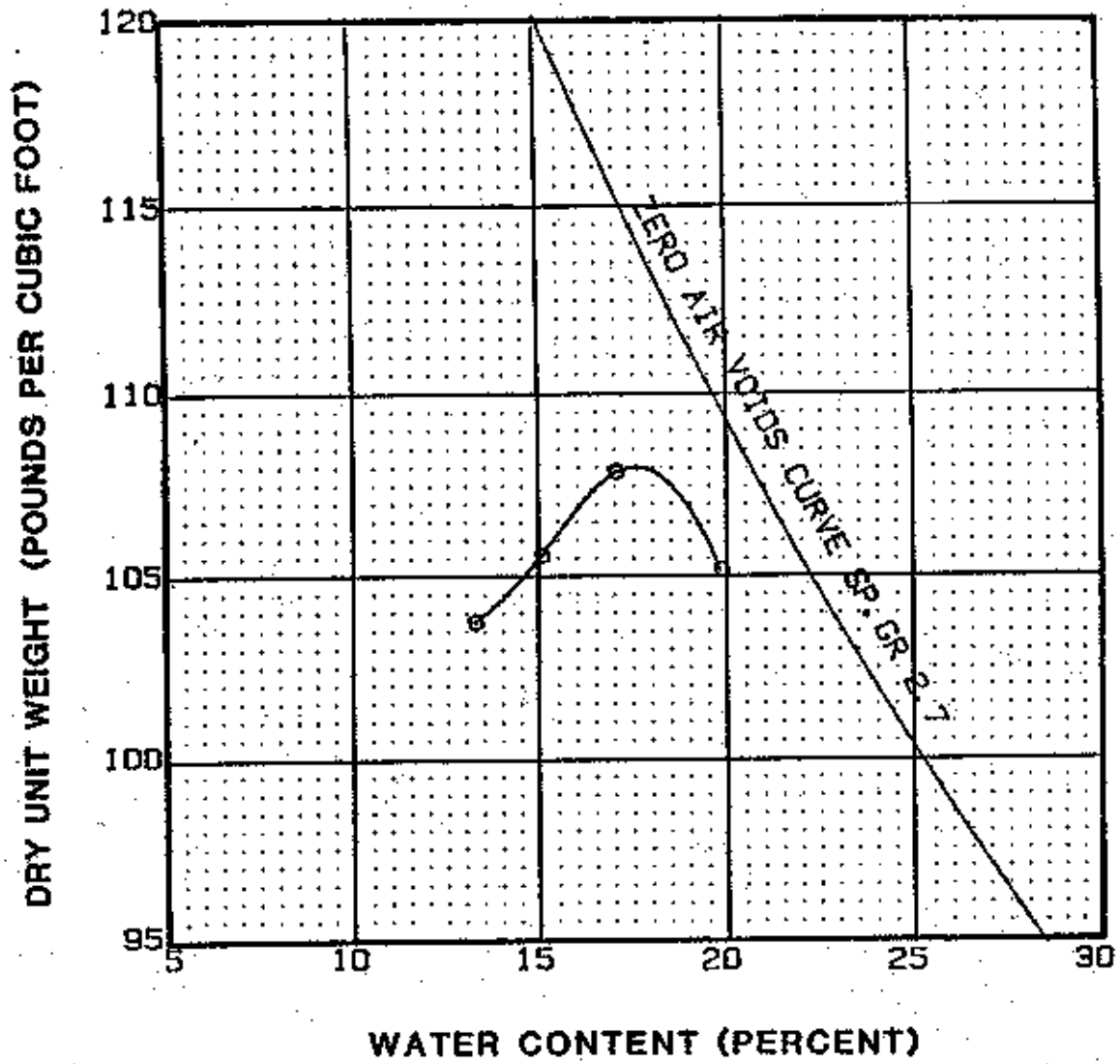
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE C 35

Job # 11295
Date: 6-22-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
108.0	17.6	15.3

DESCRIPTION

GT-2T 75 9U 01A

ATTERBERG LIMITS

LL- 38 PL- 22 PI- 17

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

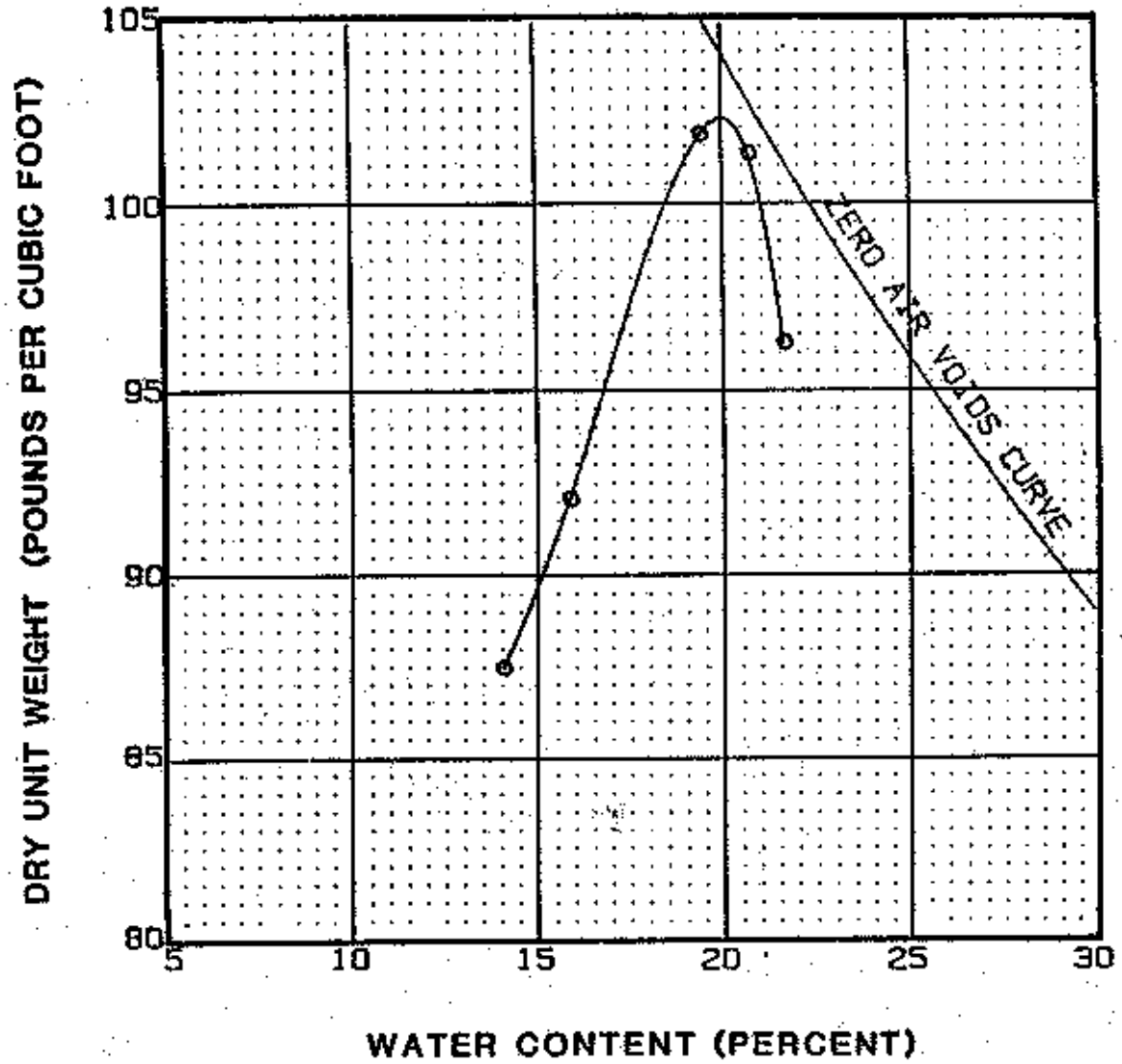
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE 45

Job # 11295
Date: 6-22-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
102.3	20.1	23.3

DESCRIPTION

GT-2T 75 BU 029

ATTERBERG LIMITS

LL- 77 PL- 21 PI- 56

CLASSIFICATION SYSTEM

UNIFIED : CH

AASHTO :

SAMPLE INFORMATION

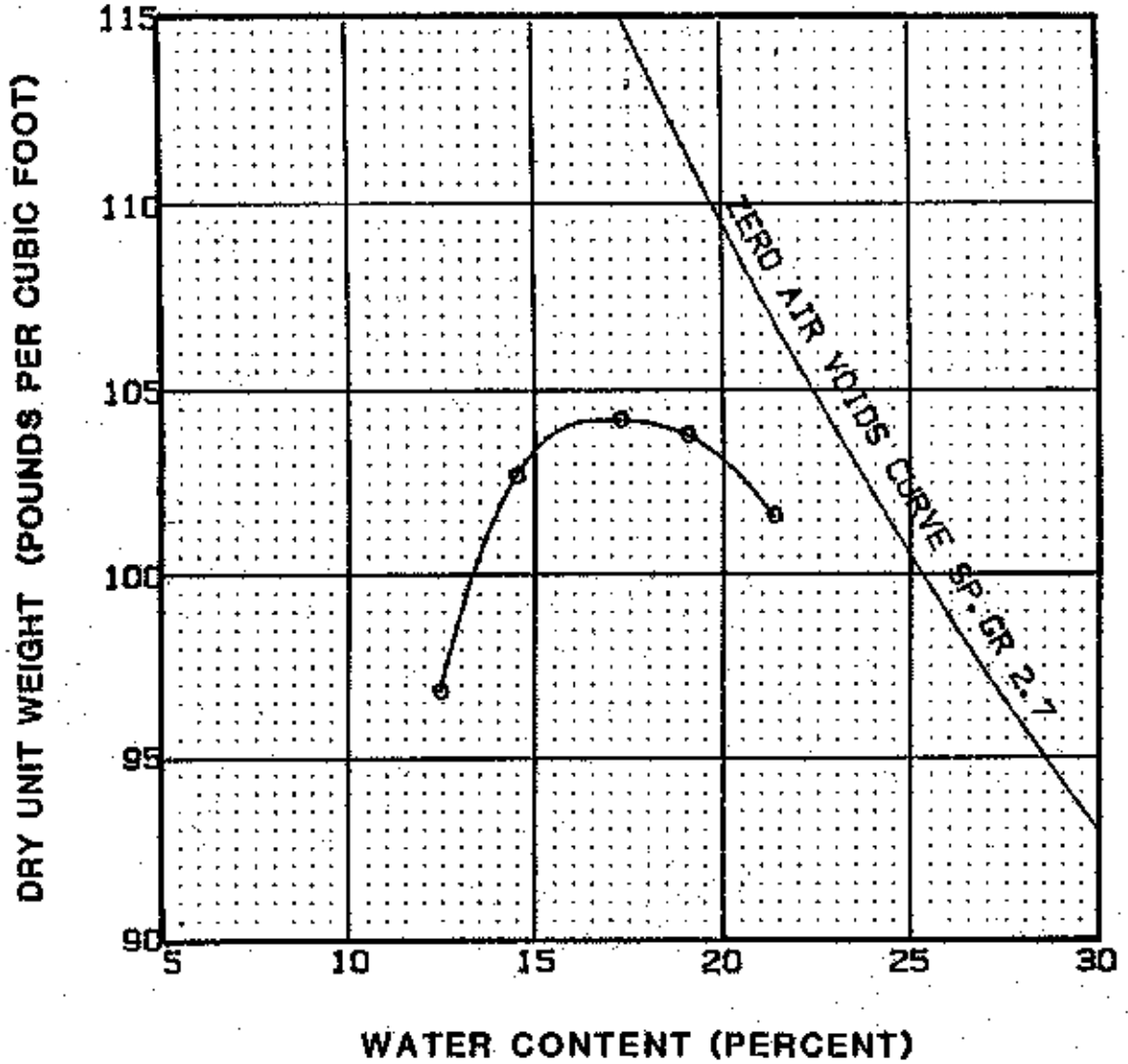
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE C 37

Job # 11295
Date: 8-28-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
104.3	16.6	13.0

DESCRIPTION

Light brown CLAY

ATTERBERG LIMITS

LL- 50 PL- 17 PI- 33

CLASSIFICATION SYSTEM

UNIFIED : CH

AASHTO :

SAMPLE INFORMATION

Boring I.D. # GT-2T 77
Sample I.D. # BU 018 1.5-4.0

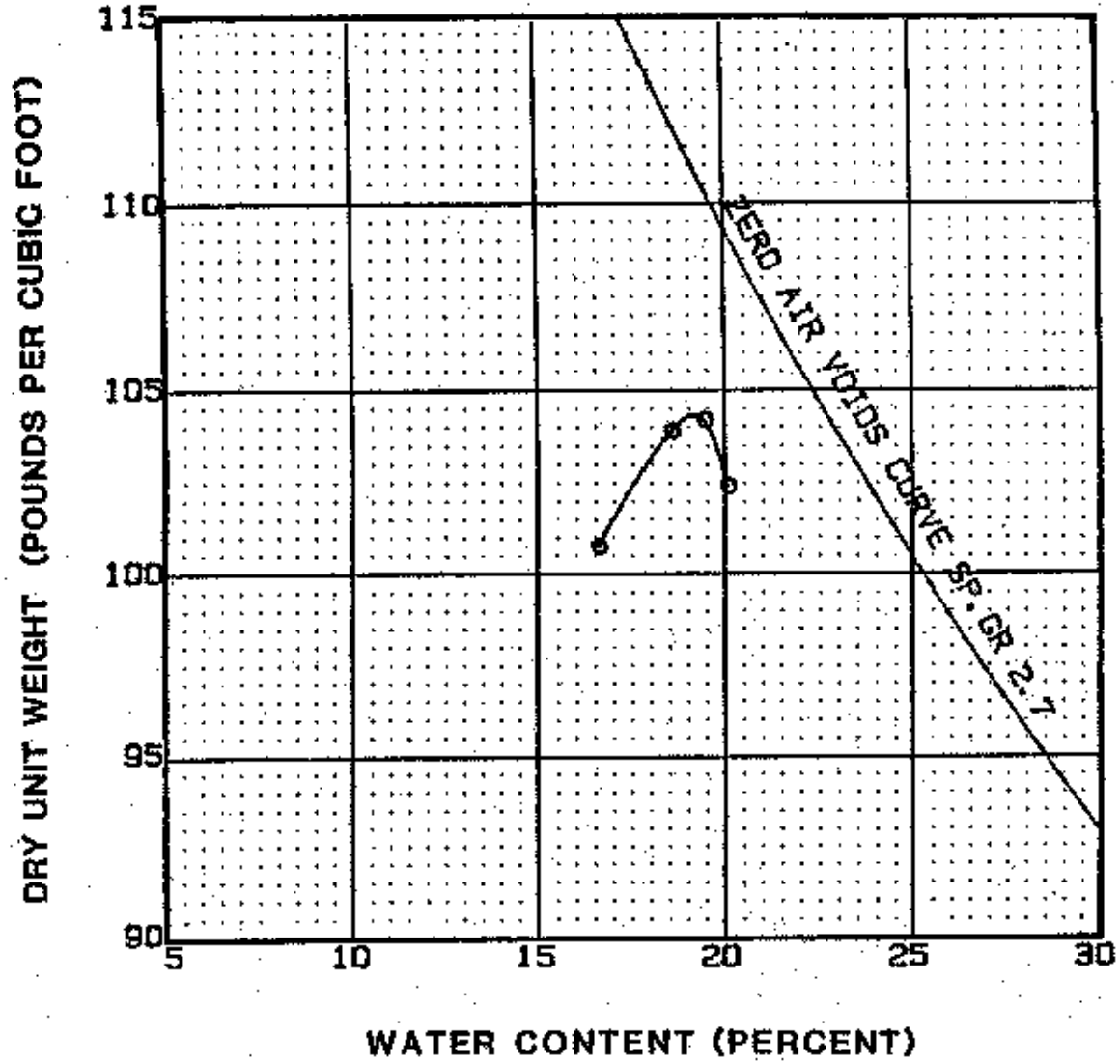
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE D 14

Job # 11295
Date: 6-28-95



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
104.4	19.2	24.4

DESCRIPTION

Brown SILTY CLAY with gray and red streaks

ATTERBERG LIMITS

LL- 49 PL- 23 PI- 26

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

Boring I.D. # CT-2T 77
Sample I.D. # SU-02A 7.0-10.5

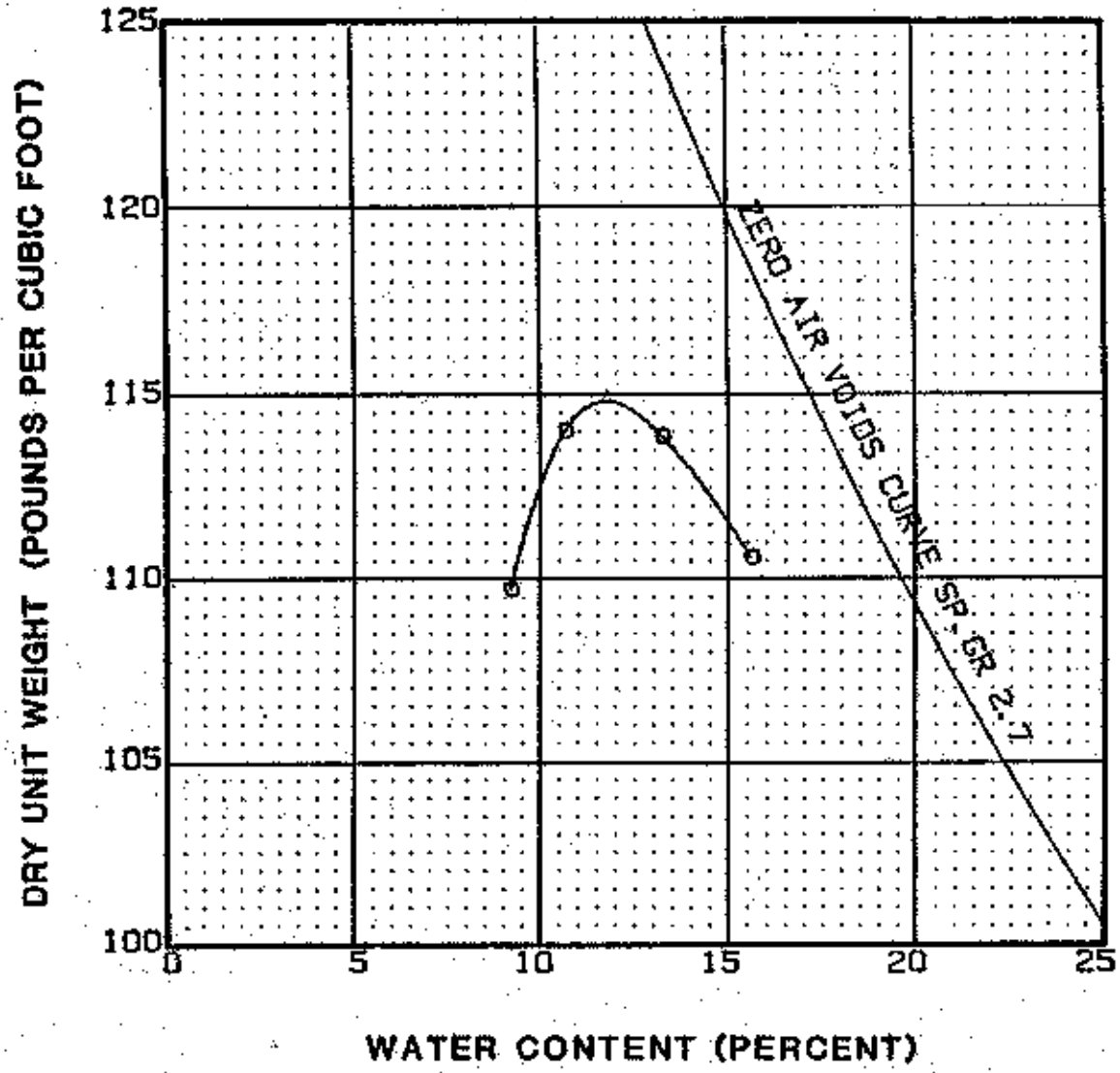
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE D 18

Job # 11295
Date: 6-22-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
114.9	11.7	15.5

DESCRIPTION

GT-2T 78 BU 01A

ATTERBERG LIMITS

LL- 30 PL- 19 PI- 11

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

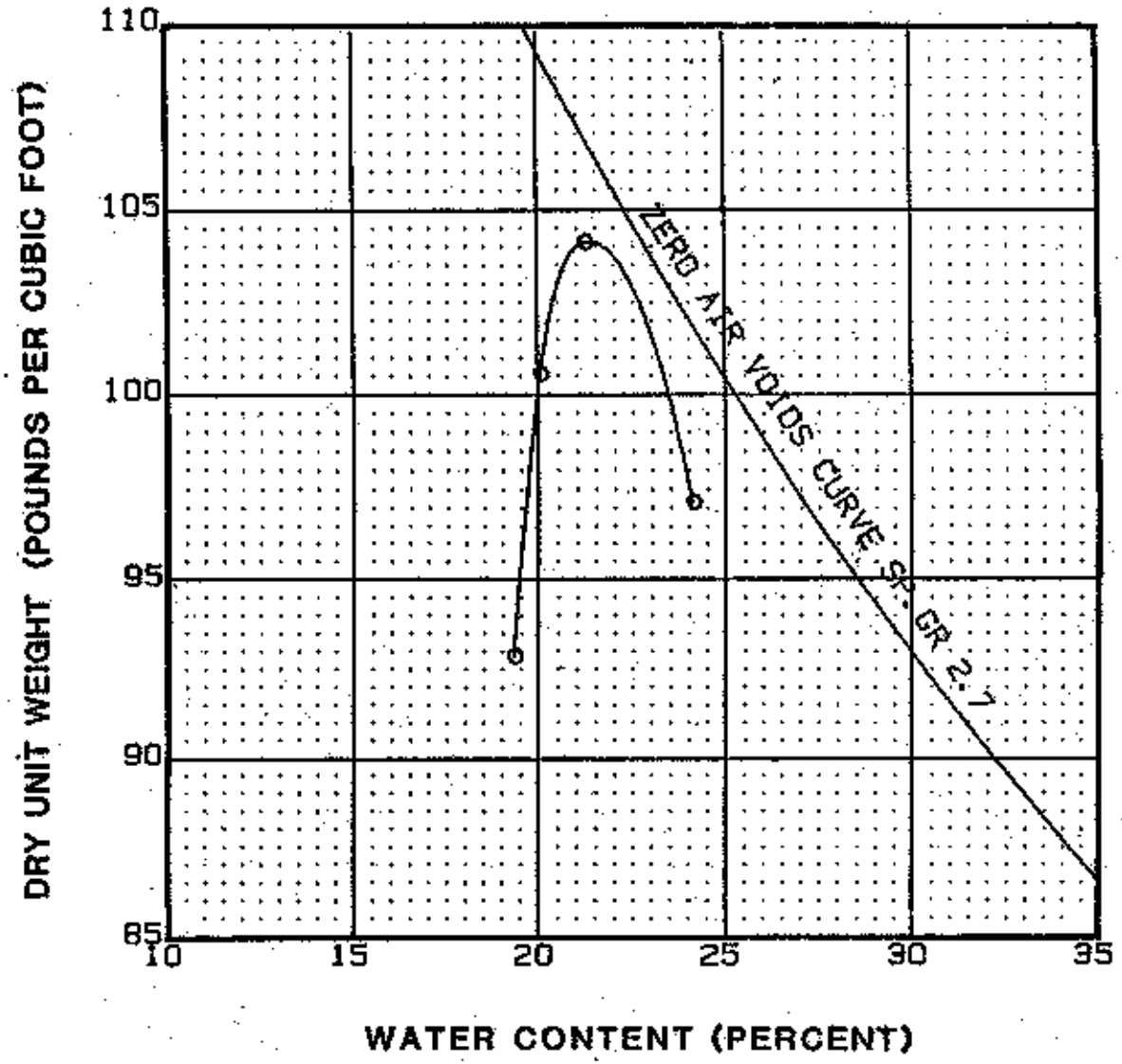
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE C 39

Job # 11295
Date: 4-19-90



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70 Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
104.2	21.3	

DESCRIPTION

Grayish brown CLAY

ATTERBERG LIMITS

LL= 58 PL= 19 PI= 39

CLASSIFICATION SYSTEM

UNIFIED : CH

AASHTO :

SAMPLE INFORMATION

GT-2178
BU-028 (6.5' - 12.0')

WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

Checked by 93

PLATE 04

CATION EXCHANGE CAPACITY

metaTRACE, Inc. 13715 Rider Trail North • Earth City, MO 63045 • (314) 298-8566

metaTRACE INC.
13715 RIDER TRAIL NORTH
EARTH CITY, MO. 63045

CLIENT : GEOTECHNOLOGY
PROJECT : 160-166
DATE : 06/19/89

DATE SAMPLED : 06/13/89
DATE ANALYZED : 06/18/89
METHOD : 9081

10/25/89

CUS_ID	LAB_ID	PARAMETER	CONC	UNITS	MATRIX	
T-2T-78 BU-01A-4-6.5	AA30392	CATION EXCHANGE CAPACITY	33.23	meq/100g	SOIL	Loess
T-2T-71 BU-02A-6.5-12	AA30393	CATION EXCHANGE CAPACITY	88.26	meq/100g	SOIL	Ferrelview
T-2T-77 BU-01B-1.5-4.0	AA30394	CATION EXCHANGE CAPACITY	70.21	meq/100g	SOIL	reworked Loess? Fach
T-2T-75 BU-02B-6.5-12.0	AA30395	CATION EXCHANGE CAPACITY	78.0	meq/100g	SOIL	Ferrelview
T-2T-74 BU-01A-4-8.5	AA30396	CATION EXCHANGE CAPACITY	83.91	meq/100g	SOIL	Reworked Loess? Ferre
T-2T-78 BU-02B-6.5-12.0	AA30397	CATION EXCHANGE CAPACITY	71.69	meq/100g	SOIL	Ferrelview
T-2T-72 BU-01A-7.5-10.5	AA30398	CATION EXCHANGE CAPACITY	49.02	meq/100g	SOIL	Loess
T-2T-77 BU-02A-7.0-10.5	AA30399	CATION EXCHANGE CAPACITY	59.65	meq/100g	SOIL	Ferrelview

(its not distinct but assumed in order)

Request #5

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

P.O. # 3589-1002-3445

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: WJJ RAP

CHECKED BY: LAB 44

DATE: 11-9-89

TAC

LAB NAME: Geotechnology Inc

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
GTS-1	ST03	TOP 5.0-7.5	26.7	N/A
GTS-1	ST03	MIDDLE 5.0-7.5	23.3	97.5
GTS-1	ST03	BOTTOM 5.0-7.5	22.8	N/A
GTS-2	ST02	TOP 2.5-5.0	24.2	N/A
GTS-2	ST02	MIDDLE 2.5-5.0	25.5	95.0
GTS-2	ST02	BOTTOM 2.5-5.0	26.6	N/A
GTS-2	ST04	TOP 7.5-10.0	20.5	103.0
GTS-2	ST04	BOTTOM 7.5-10.0	20.7	102.1
GTS-3	ST02	TOP 5.0-7.5	28.5	N/A
GTS-3	ST02	MIDDLE 5.0-7.5	29.6	89.9
GTS-3	ST02	BOTTOM 5.0-7.5	37.4	N/A
GTS-4	ST02	TOP 2.5-5.0	28.2	N/A
GTS-4	ST02	MIDDLE 2.5-5.0	28.4	92.3
GTS-4	ST02	BOTTOM 2.5-5.0	28.1	N/A
GTS-4	ST04	TOP 7.5-10.0	26.7	N/A

TEST PROCEDURE: ASTM D2216 & D2937

MKF-AL-ENG-6 (4/87)

ATTACHMENT 6 54

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

Request #5
P.O. # 3589-1002-3445

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: WWRAP

CHECKED BY: LAB 44

DATE: 11-5-85

TAC

LAB NAME: Geotechnology Inc

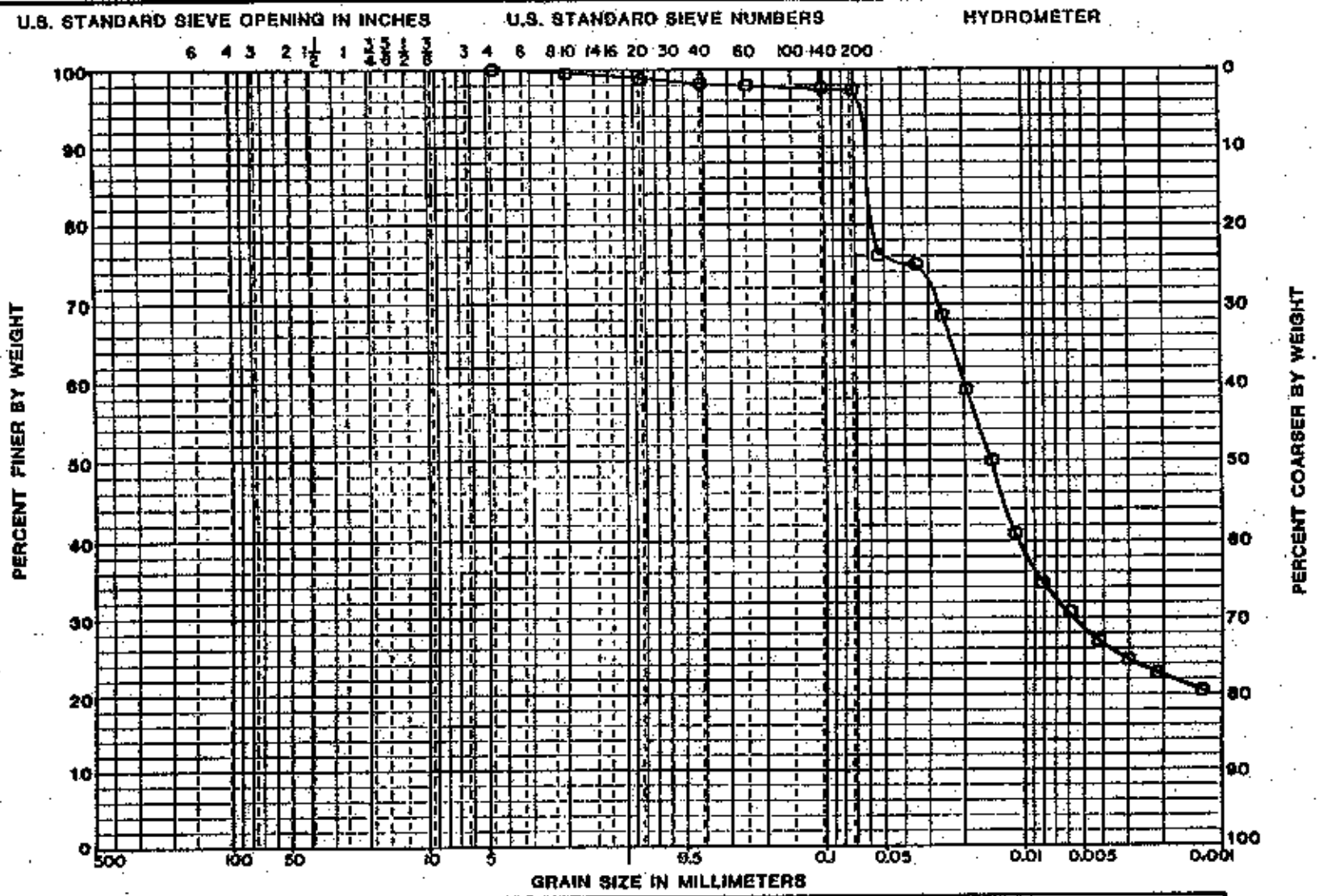
LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
GTS-4	ST04	MIDDLE 7.5-10.0	21.5	102.9
GTS-4	JT04	BOTTOM 7.5-10.0	21.5	N/A
GTS-5	BULK	0.0-5.0	21.7	N/A
GTS-6	BULK	0.0-5.0	19.7	N/A
GTS-7	BULK	0.0-5.0	23.8	N/A

TEST PROCEDURE: ASTM D2216 & D2937

MKF-AL-ENG-6 (4/87)

ATTACHMENT #59

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
ST-03	5.0-7.5	CL	25.2	40	20	20

PROJECT WSSRAP

BORING NO. GTS-1

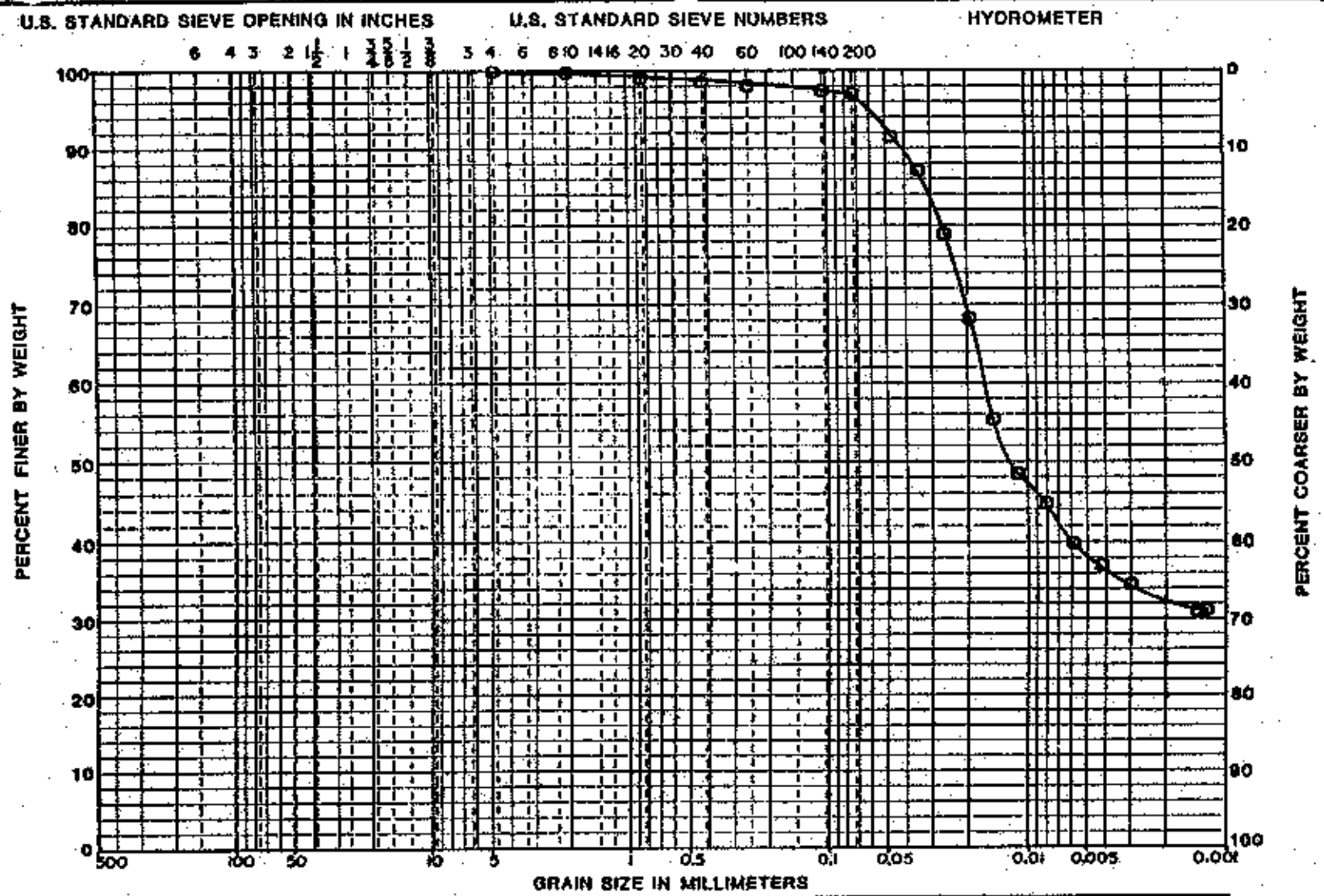
DATE 11-8-89

GEOTECHNOLOGY

11295

PLATE #82

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
COMP.	2.5-10.0	CL	5.4	44	20	24

PROJECT MSSRAP

BORING NO. CT5-2

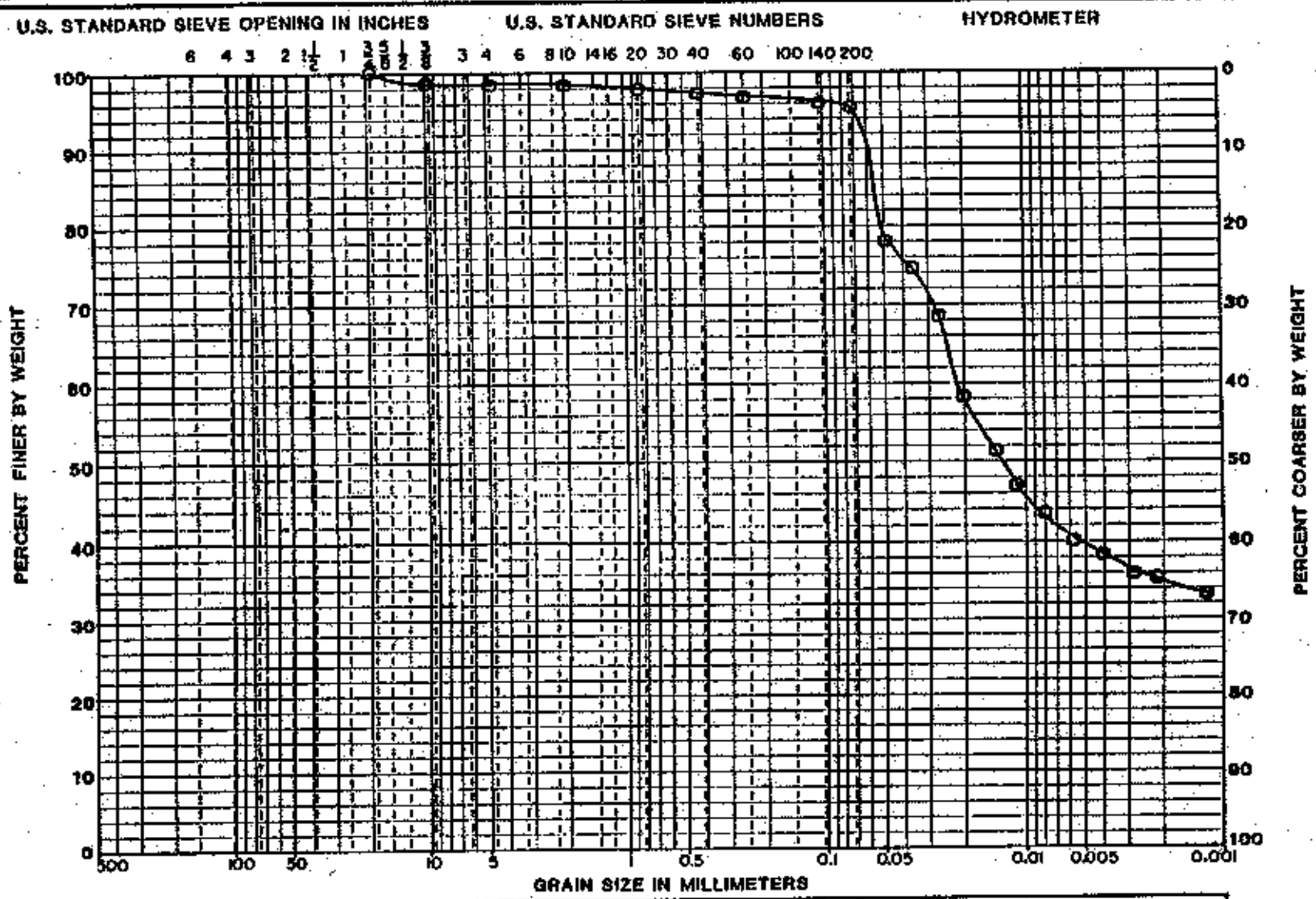
DATE 11-8-89

GEOTECHNOLOGY

PLATE H 86

1125

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
ST-02	5.0-7.5	CH	28.4	53	19	34

PROJECT VSSRAP

BORING NO. GTS-9

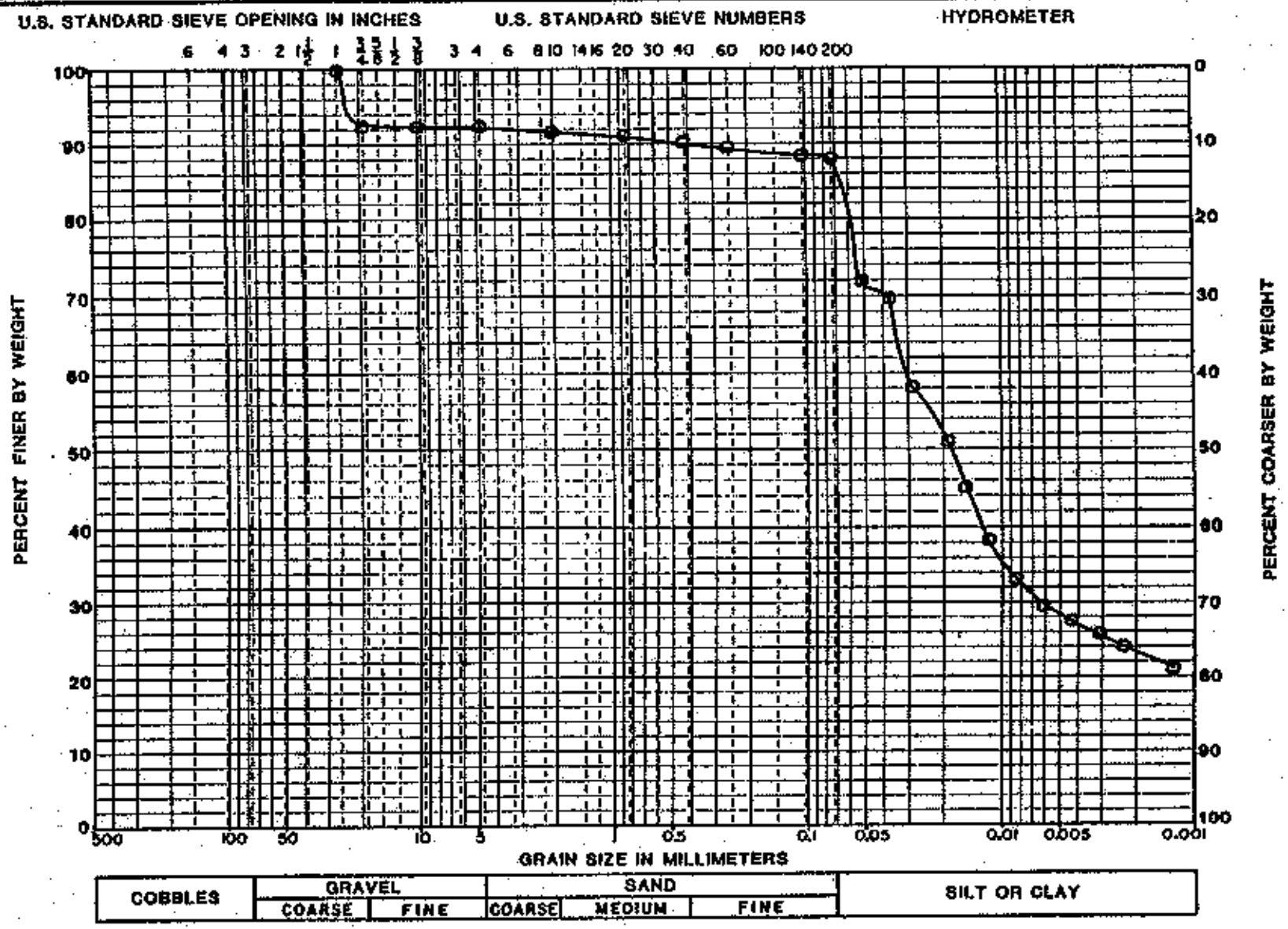
DATE 11-8-89

GEOTECHNOLOGY

11285

PLATE # 90

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
ST-02	2.5-5.0	CH	27.1	51	23	28

PROJECT NSSRAP

BORING NO. GTS-4

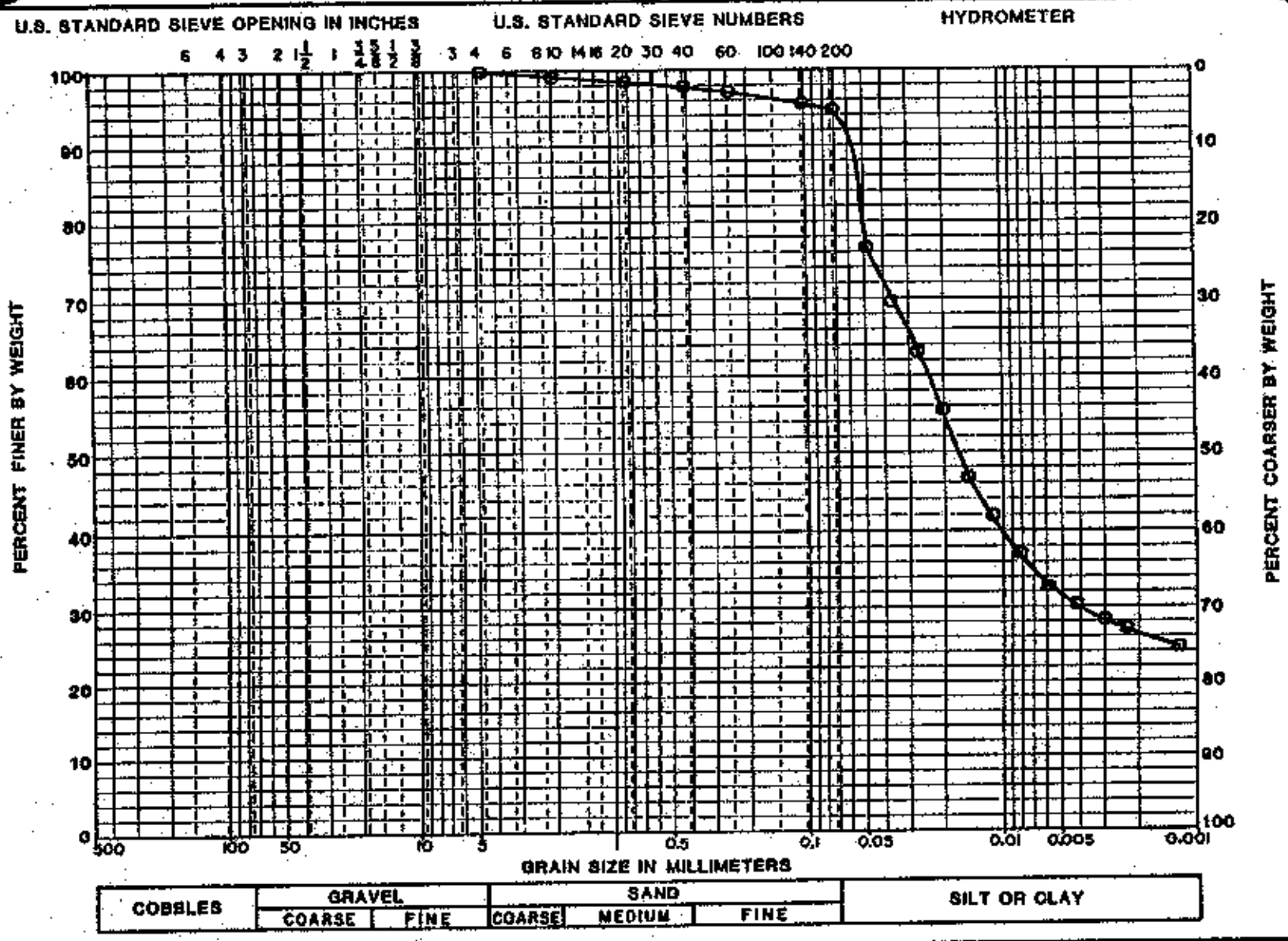
DATE 11-8-89

GEOTECHNOLOGY

PLATE H 94

11295

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
ST-04	7.5-10.0	CL	22.4	41	20	21

PROJECT WSSRAP

BORING NO. CTS-4

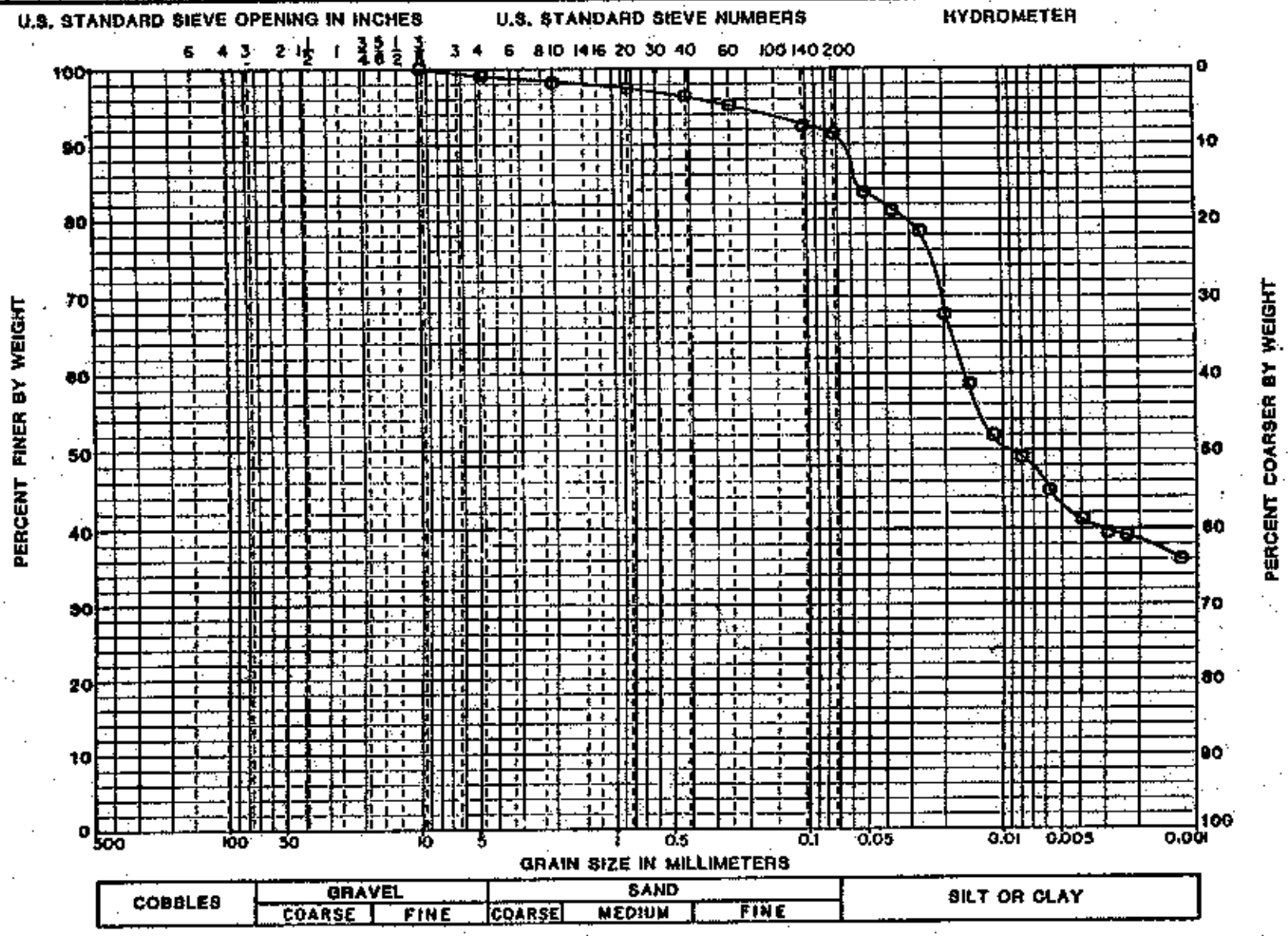
DATE 11-8-88

GEOTECHNOLOGY

11295

PLATE H 98

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BULK	0.0-5.0	CH	5.4	53	18	35

PROJECT WSSRAP

BORING NO. GTS-5

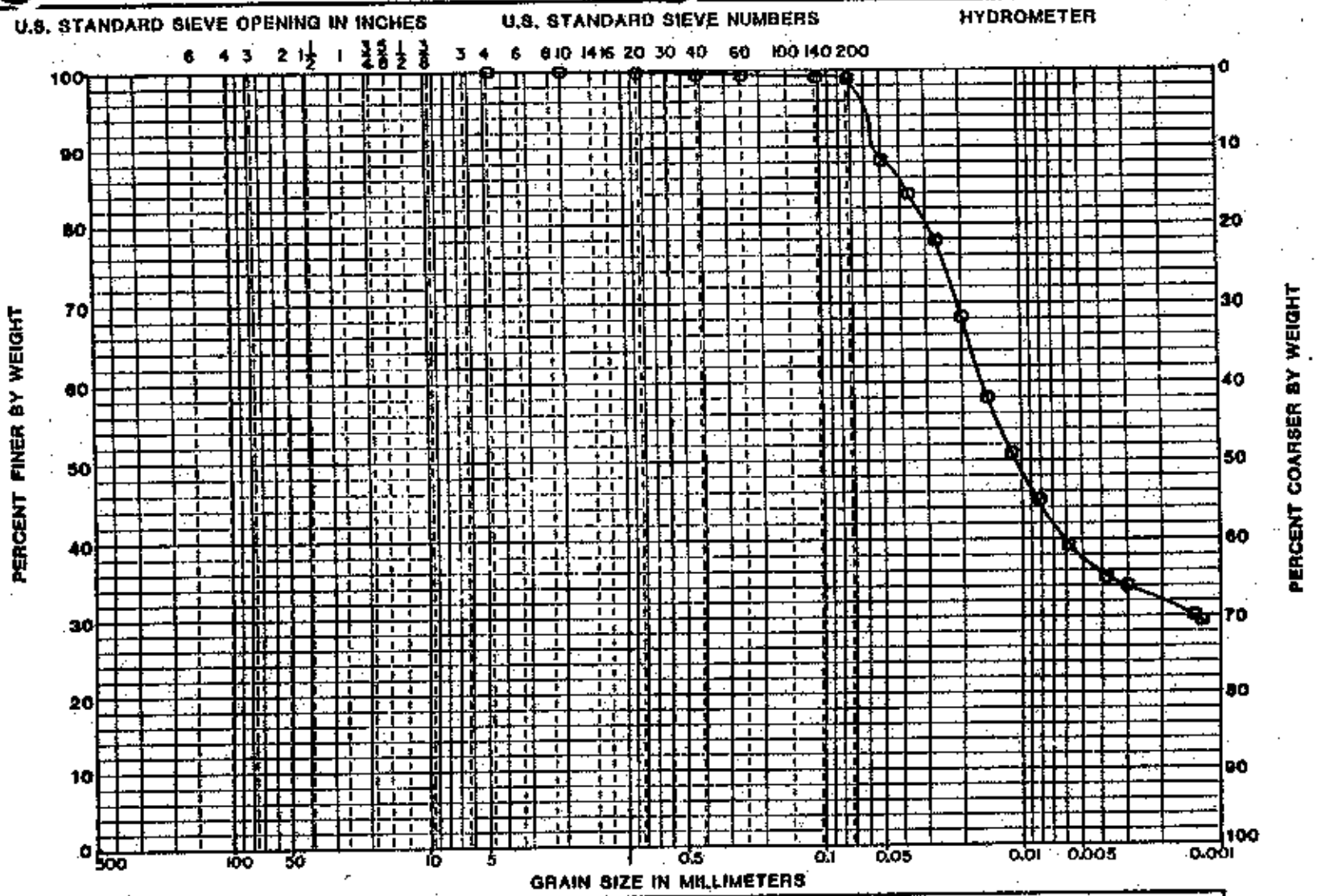
DATE 11-8-89

GEOTECHNOLOGY

PLATE # 102

1125

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BULK	0.0-5.0	CL	8.1	43	22	21

PROJECT WSSRAP

BORING NO. GTS-8

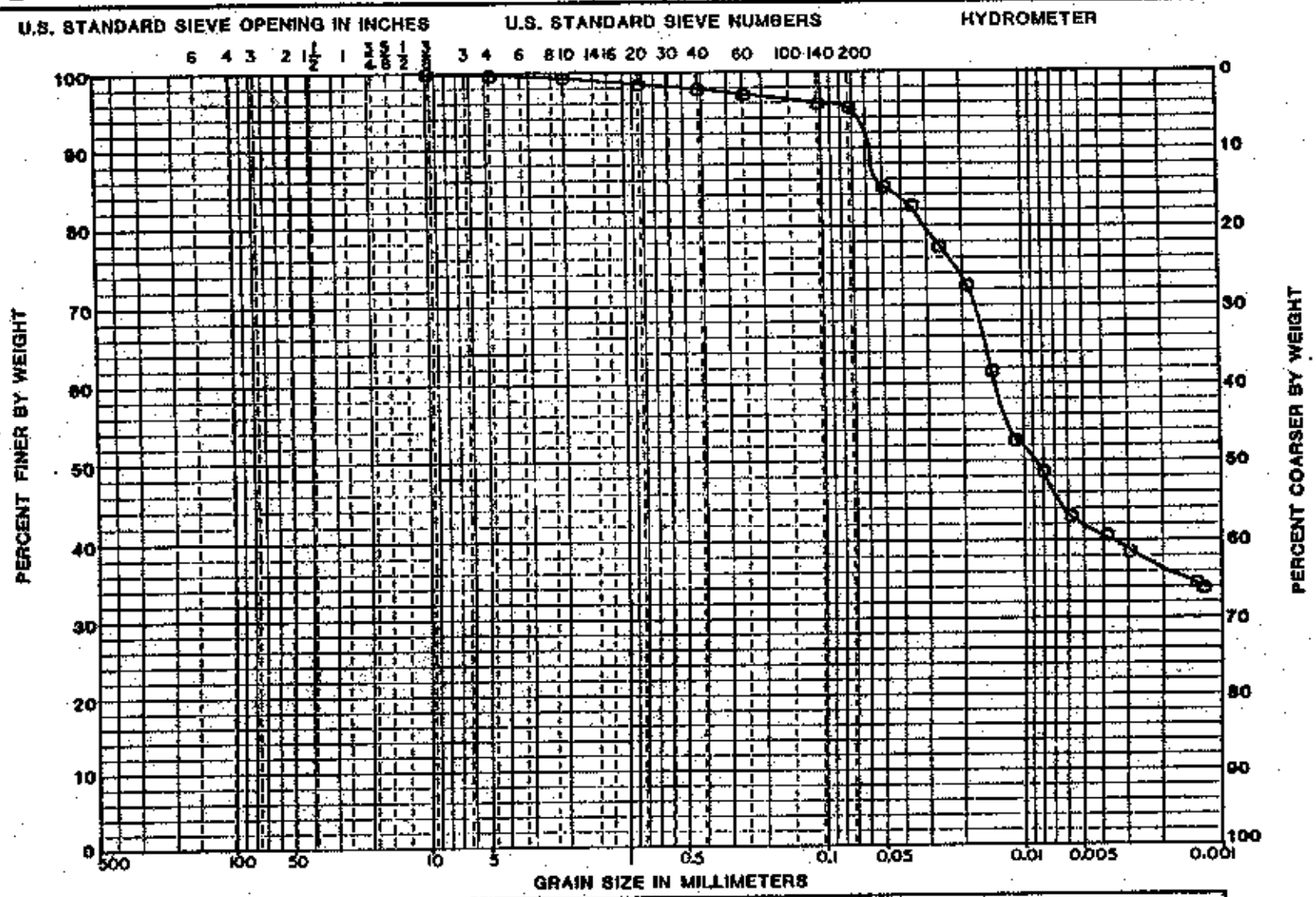
DATE 11-8-89

GEOTECHNOLOGY

11285

PLATE # 106

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BULK	0.0-5.0	CH	3.8	59	24	35

PROJECT WSSRAP

BORING NO. GTS-7

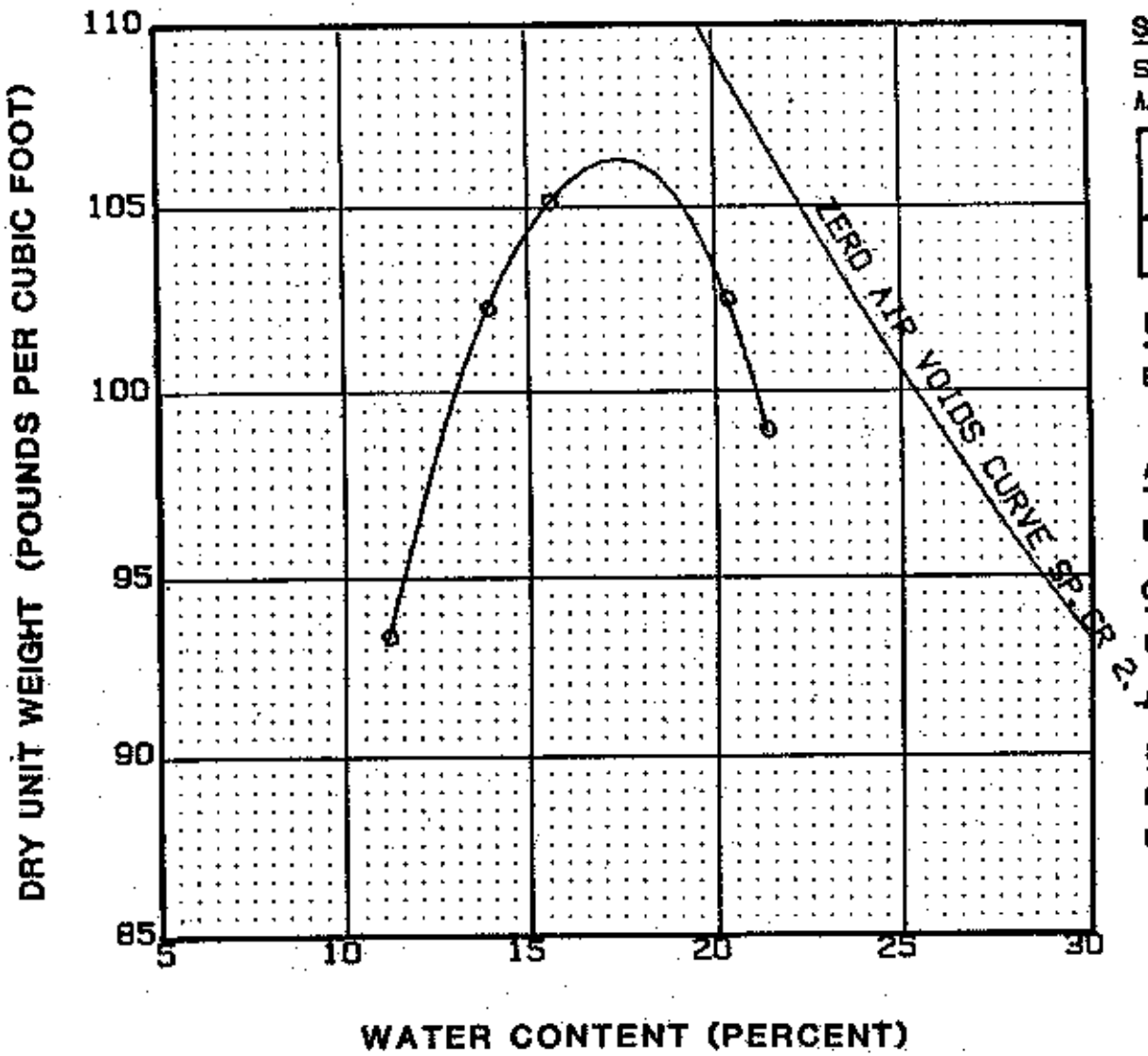
DATE 11-8-89

GEOTECHNOLOGY

J1285

PLATE H 110

Job # 11295
Date: 10-24-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70 Method A

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
106.4	17.5	21.7

DESCRIPTION

Brown CLAY

ATTERBERG LIMITS

LL- 53 PL- 18 PI- 35

CLASSIFICATION SYSTEM

UNIFIED : CH

AASHTO :

SAMPLE INFORMATION

GTS - 5
0.0-2.0 FT

WSSRAP

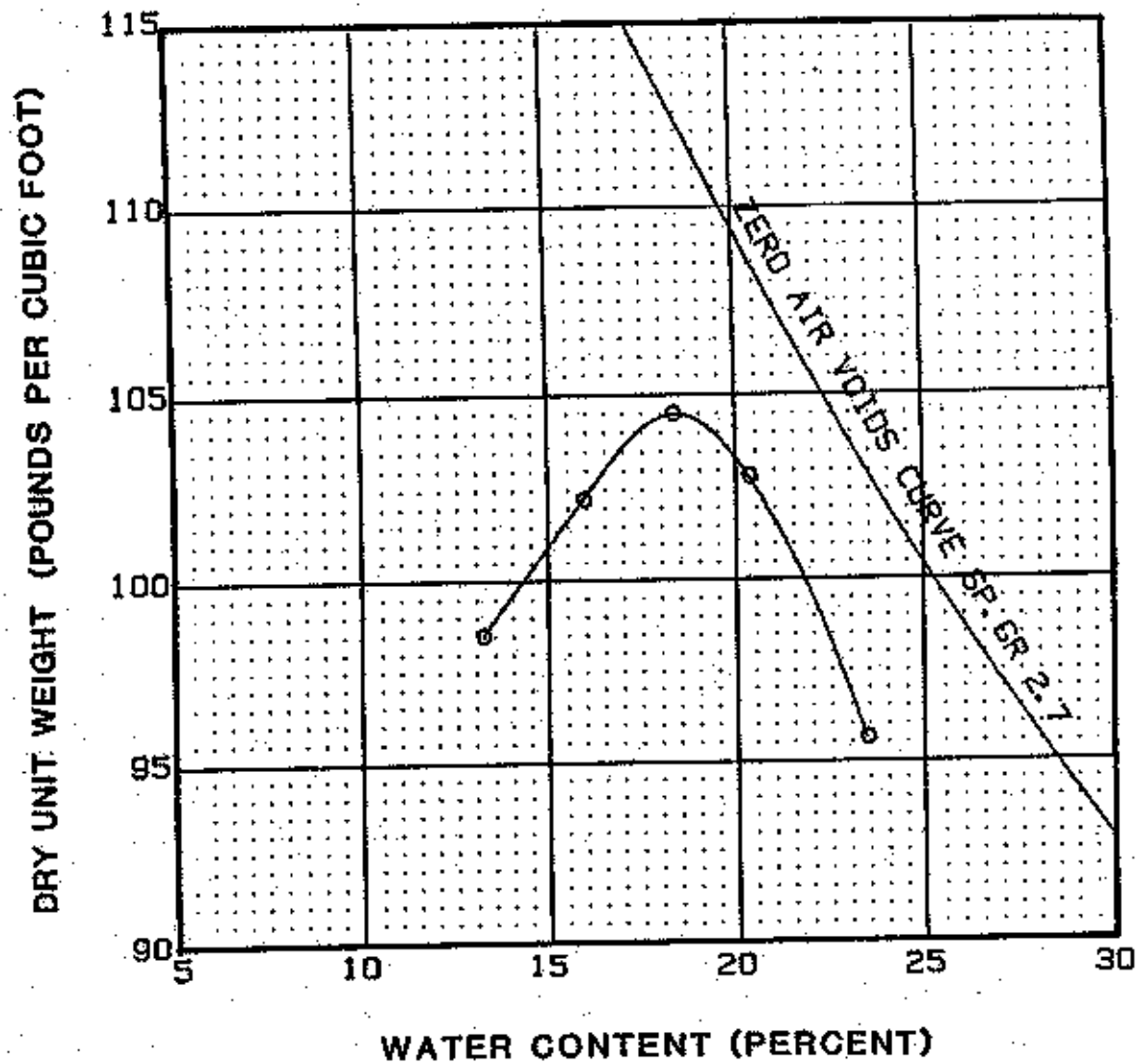
COMPACTION TEST

GEOTECHNOLOGY

Checked by TT

DATE 11/14

Job # 11295
Date: 10-18-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
104.6	18.3	19.7

DESCRIPTION

Brown silty CLAY

ATTERBERG LIMITS

LL- 43 PL- 22 PI- 21

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

GTS - 6 0.0-5.0 feet

WSSRAP

COMPACTION TEST

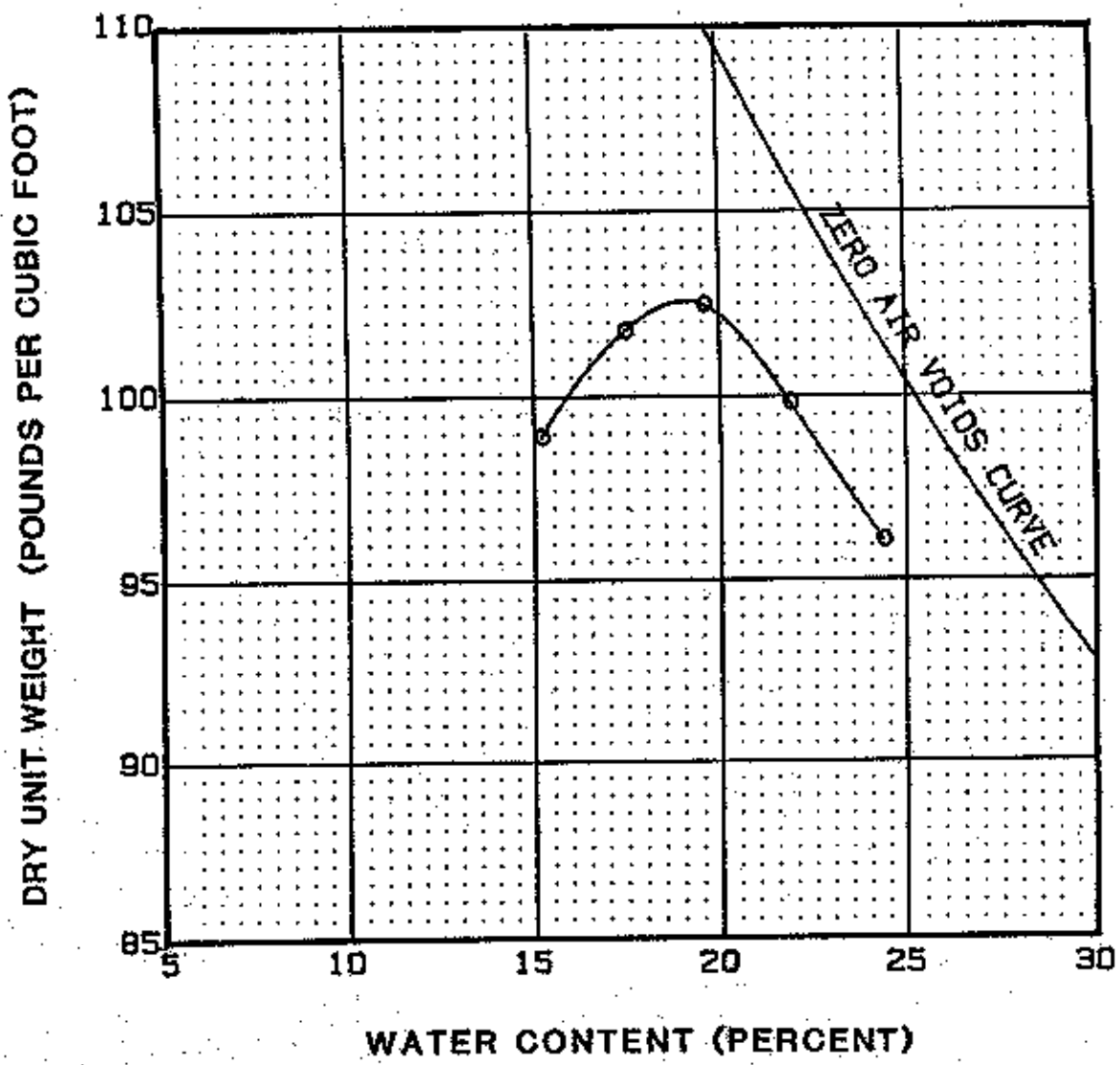
GEOTECHNOLOGY

Checked by TT

PLATE H 116

L-2 10/88

Job # 11295
Date: 10-23-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
102.7	19.2	23.8

DESCRIPTION

Brown Clay

ATTERBERG LIMITS

LL-59 PL-24 PI-35

CLASSIFICATION SYSTEM

UNIFIED : CH

AASHTO :

SAMPLE INFORMATION

GTS-7
0.0-5.0

WSSRAP

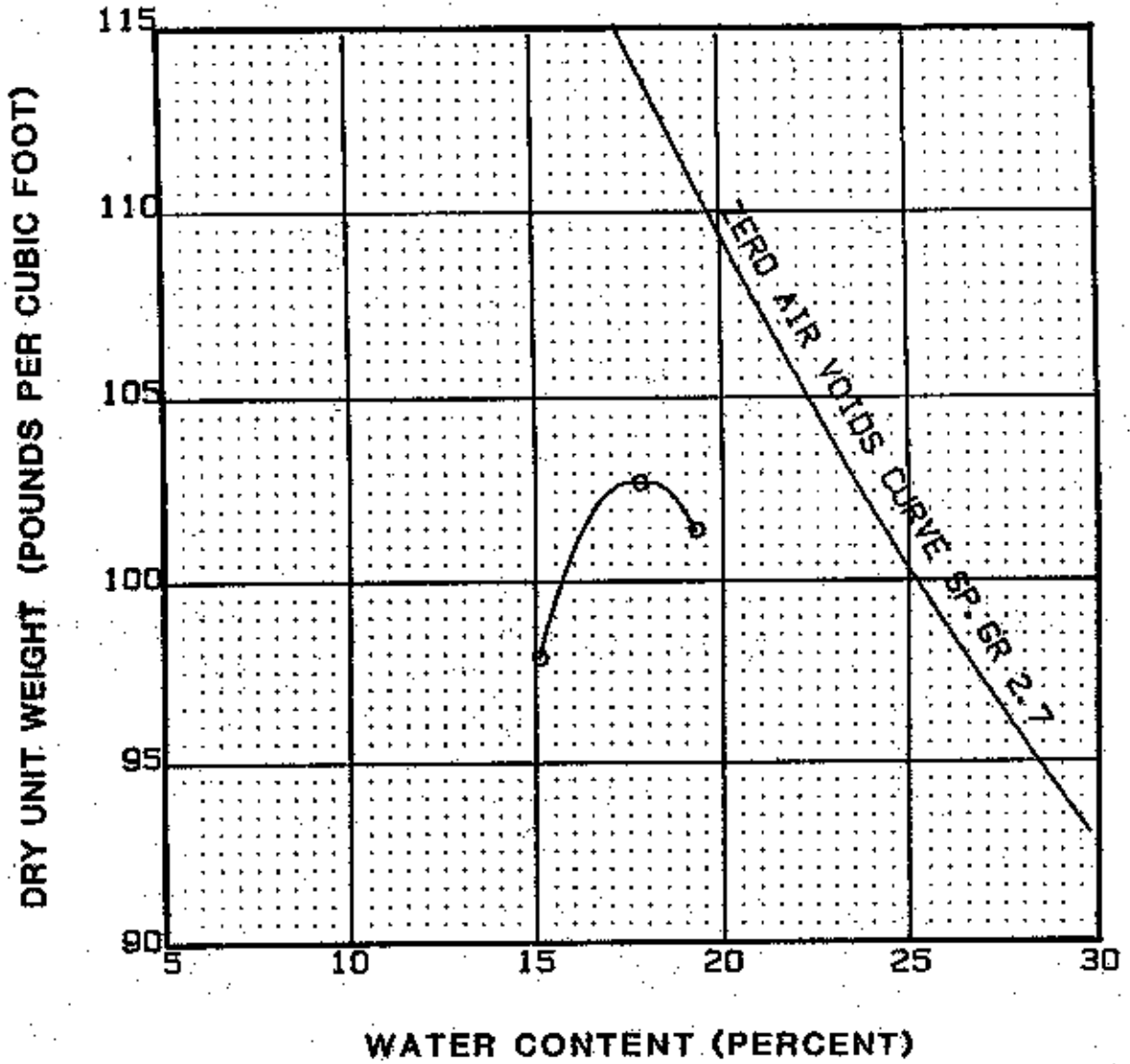
COMPACTION TEST

GEOTECHNOLOGY

Checked by yy

818 A

Job # 11295
Date: 11-11-89



SPECIFICATIONS

STANDARD PROCTOR

AASHO T 99-70, ASTM D 698-70 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
102.8	17.5	

DESCRIPTION

Composite: Brownish gray mottled, silty CLAY and gray, brownish yellow and brown CLAY

ATTERBERG LIMITS

LL- PL- PI-

CLASSIFICATION SYSTEM

UNIFIED : CL and CH

AASHTO :

SAMPLE INFORMATION

GTS-1, ST03, 5-7.5 FT - LL-40, PL-20, PI-20 (CL)

GTS-3, ST02, 5-7.5 FT - LL-53, PL-19, PI-34 (CH)

WSSRAP

COMPACTION TEST

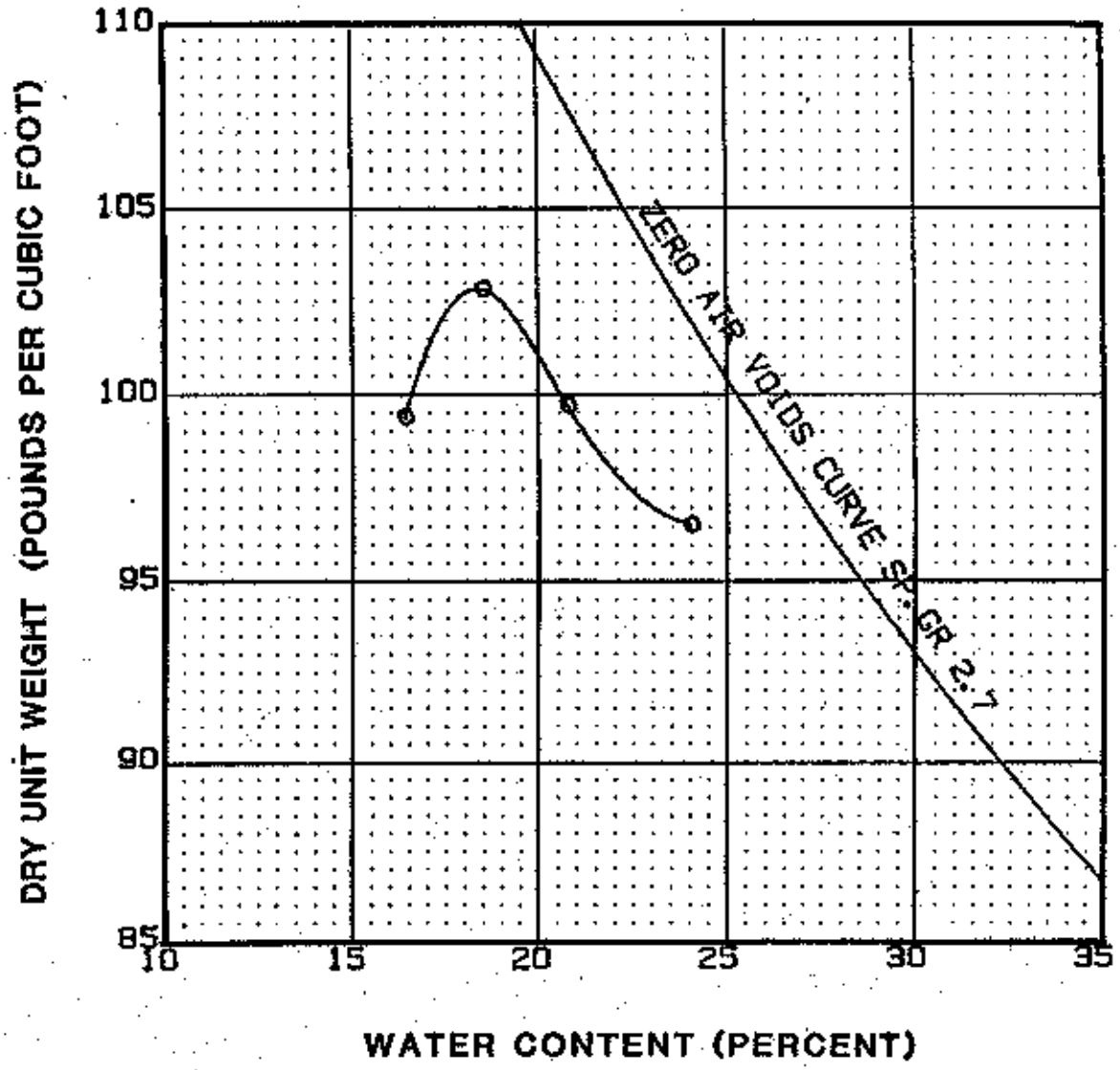
GEOTECHNOLOGY

Checked by 47

L-2 10/88

PLATE # 122

Job # 11295
Date: 11-11-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
103.0	18.3	

DESCRIPTION

Composite: Brownish gray, silCLAY and brownish gray to grayish brown, clayey SILT to silty CLAY

ATTERBERG LIMITS

LL- 44 PL- 20 PI- 24

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

GTS-2, ST02, 2.5- 5.0 FT
~~GTS-4~~ ST04, 7.5-10.0 FT

2.7 GTS-2 CORRECTION MADE BY MKF SC 11/9/90

WSSRAP

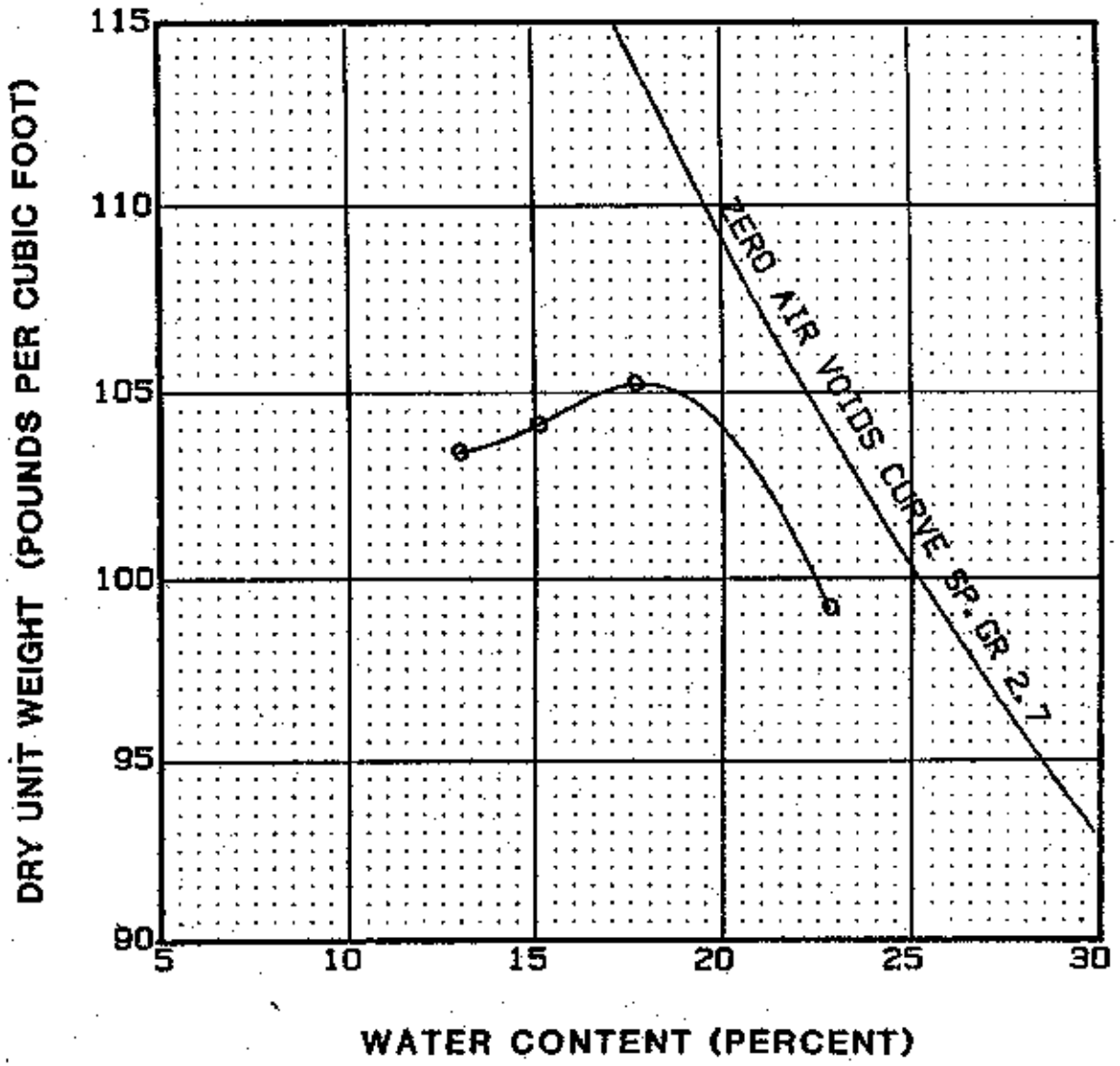
COMPACTION TEST

GEOTECHNOLOGY

Checked by 47

120

Job # 11295
Date: 11-11-99



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70 Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
105.3	17.7	

DESCRIPTION

Composite: Dark gray to bromish gray silty CLAY to CLAY and grayish brown and gray mottled, silty CLAY

ATTERBERG LIMITS

LL- PL- PI-

CLASSIFICATION SYSTEM

UNIFIED :

AASHTO :

SAMPLE INFORMATION

GTS-4, ST02, 2.5- 5.0 FT - LL-51, PL-23, PI-28 (CH)
GTS-4, ST04, 7.5-10.0 FT - LL-41, PL-20, PI-21 (CL)

WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

Checked by 44

PLATE H 124

Request #5
P.O. # 3509 -1002 -3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WJSPAP

DATE: 3/6/90

LAB NAME: Geotechnology

CHECKED BY: LAB 97

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%) INIT.	MOISTURE CONTENT (%) FINAL	DRY DENSITY (PCF) INIT.	DRY DENSITY (PCF) FINAL	SATURATION (%) INIT.	SATURATION (%) FINAL	TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
GTS-1 — GTS 3	ST03 — ST02	5 - 7.5 — 5 - 7.5	CH	95.7	21.1	23.8	98.4		80.0*		16.06	~~1×10⁻⁷~~
GTS-2 — GTS-4	ST02 — ST04	2.5 - 5.0 — 7.5 - 10	CH	95.0	21.7	22.7	97.8		81.1*		" 16.06	~~6×10⁻⁸~~
GTS-4 — GTS-4	ST02 — ST02	2.5 - 5 — 7.5 - 10	CH	97.2	20.8	21.4	102.3		86.8*		16.06	~~7×10⁻⁷~~

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE: EM 1110-2-1906

MKF-AL-ENG-7 (1/87) * Assumed Sp. Gravity 2.70 MKP. S.G. 11/09/90

ATTACHMENT 7

Request #5
P.O. # 3509 -1002 -3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WSSRAP

DATE: 4/10/90

LAB NAME: Geotechnology, Inc

CHECKED BY: LAB JT

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
Temporary Storage Area	GTS-7	0-5.0'	CH		21.0	24.6	99.2		82.5		16.1	~~3x10~~ $^{-8}$

*TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE: EM 1110-2-1906

MKF-AI-ENG-7 (1/87)

* G assumed 2.67 MKF. SG. 11/09/90

ATTACHMENT 2

Request # 5
P.O. # 3509 -1002 -3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WSSRAP

DATE: 6-6-90

LAB NAME: Geotechnology, Inc

CHECKED BY: LAB 75

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
Temporary Storage Area	GTS-5	0-5	CH	94.9	20.7	23.6	101.0		85.1 *		16.1	~~2x10~~ 8
"	GTS-6	0-5	CH	95.6	21.6	23.0	100.0		86.6 *		" 16.1	~~9x10~~ 8

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE: EM 1110-2-1906

* Assumed sp. Gravity 2.67 MKF - SG 11/09/90

P.O. # 3509-1002-3445

A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: WSSRAP

LOCATION ID: Material Staging Area (Test Pit Samples)

DATE: 8/7/90

CHECKED BY: LAB 97

LAB NAME: Geotechnology, Inc

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY	SOIL CLASSIFICATION
TPMS-1 Bu-01	0.0 - 6.0	51	19	32	N/A	CH
TPMS-2 Bu-01	0.0 - 2.0	49	20	29	N/A	CL
TPMS-2 Bu-02	2.0 - 6.0	67	21	46	N/A	CH
TPMS-3 Bu-01	1.0 - 6.0	39	20	19	N/A	CL
TPMS-4 Bu-01	1.0 - 3.5	49	20	29	N/A	CL
TPMS-4 Bu-02	4.0 - 6.5	73	24	49	N/A	CH
TPMS-5 Bu-01	1.0 - 7.0	37	17	20	N/A	CL
TPMS-5 Bu-02	8.0 - 10.0	73	24	49	N/A	CH
TPMS-6 Bu-01	1.0 - 5.0	40	18	22	N/A	CL
TPMS-6 Bu-02	5.5 - 7.5	72	25	47	N/A	CH
TPMS-7 Bu-01	1.0 - 7.0	37	17	20	N/A	CL
TPMS-7 Bu-02	7.0 - 9.5	82	24	58	N/A	CH
TPMS-8 Bu-01	1.0 - 5.0	30	19	11	N/A	CL
TPMS-8 Bu-02	5.0 - 10.5	63	19	44	N/A	CH

TEST PROCEDURE: ASTM D4318

MKF-AL-ENG-1 (4/87)

ATTACHMENT 1

R4

P.O. # 3509-1002-3445

A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: WSSRAP

LOCATION ID: Material Staging Area (Test Pit Samples)

DATE: 8/7/90

CHECKED BY: LAE 44

LAB NAME: Geotechnology, Inc

TAC

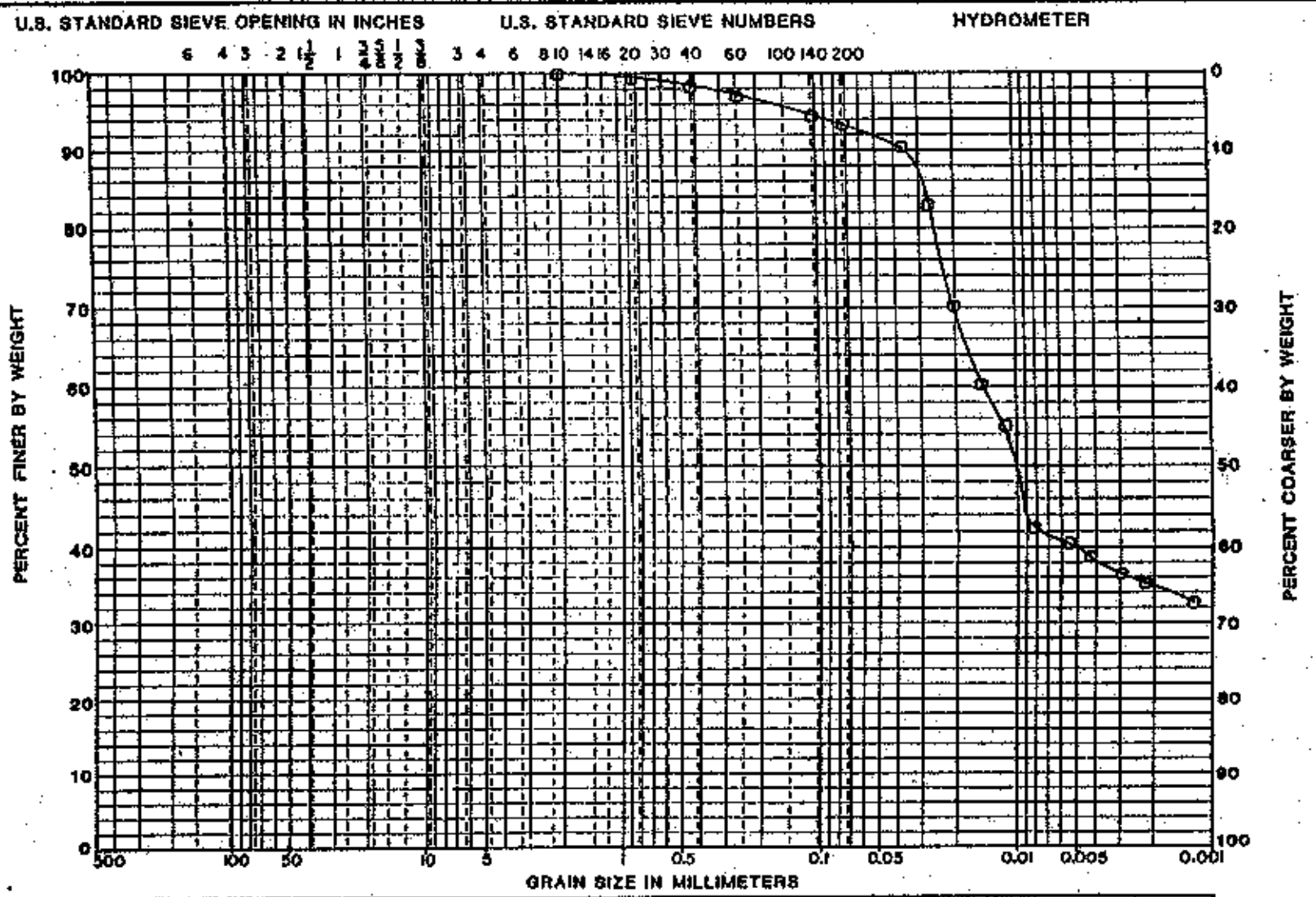
SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY	SOIL CLASSIFICATION
TPMS-1 BU-01	1.0-7.0	38	20	18.	N/A	CL
TPMS-9 BU-02	8.0-15.0	69	24	45	N/A	CH

TEST PROCEDURE: ASTM D 4318

MKF-AL-ENG-1 (4/87)

ATTACHMENT 1

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-D1	0.0-6.0	CH	20.0	51	19	32

PROJECT WSSRAP

BORING NO. TPMS-1

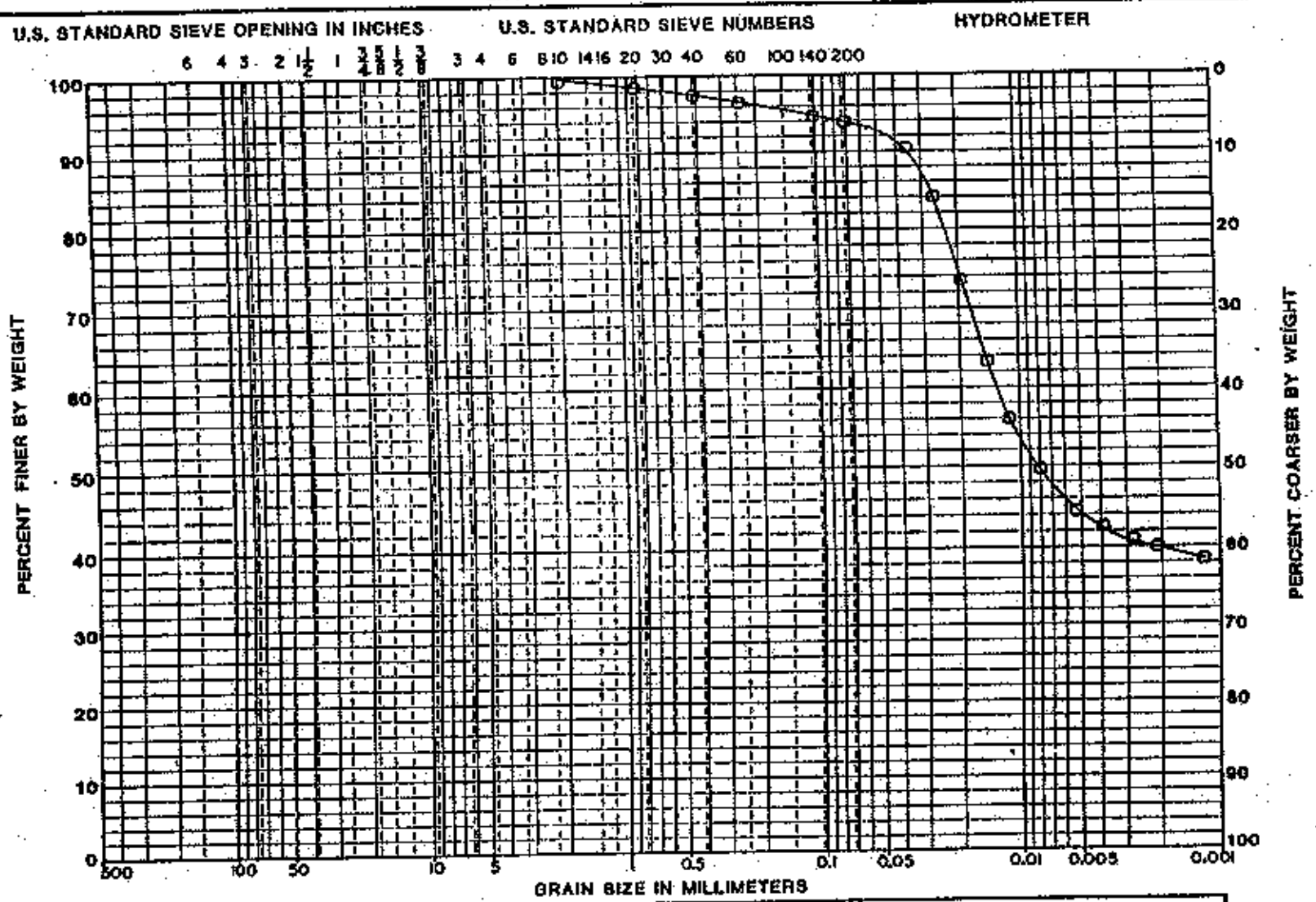
DATE 8-7-90

GEOTECHNOLOGY

PLATE B19

11295.000

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-01	0.0-2.0	CL	18.3	49	20	29

PROJECT WSSRAP

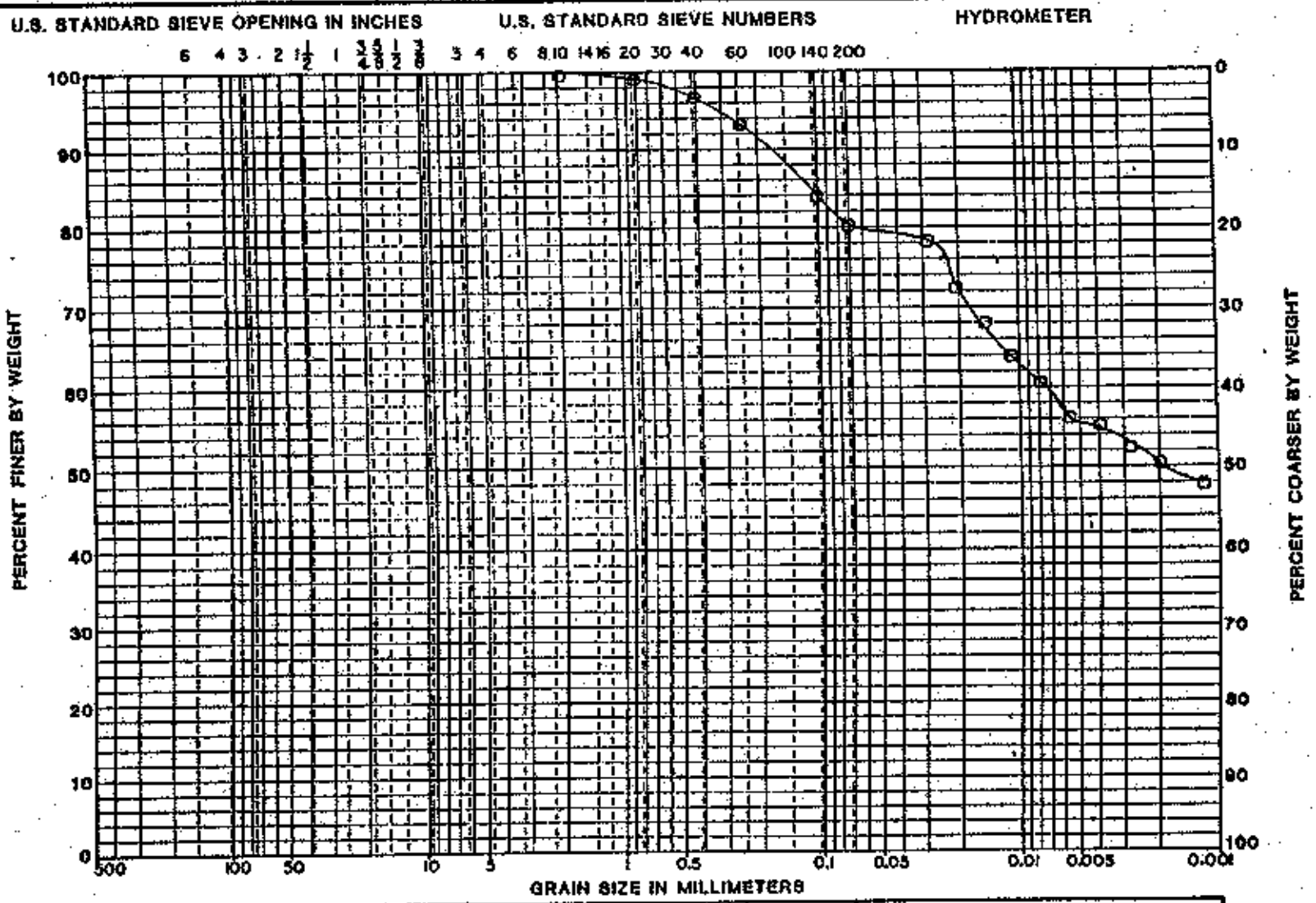
BORING NO. TPMS-2

DATE 8-7-90

GEOTECHNOLOGY

PLATE R 2-3

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-02	2.0-6.0	CH	21.9	67	21	46

PROJECT WSSRAP

BORING NO. TPHS-2

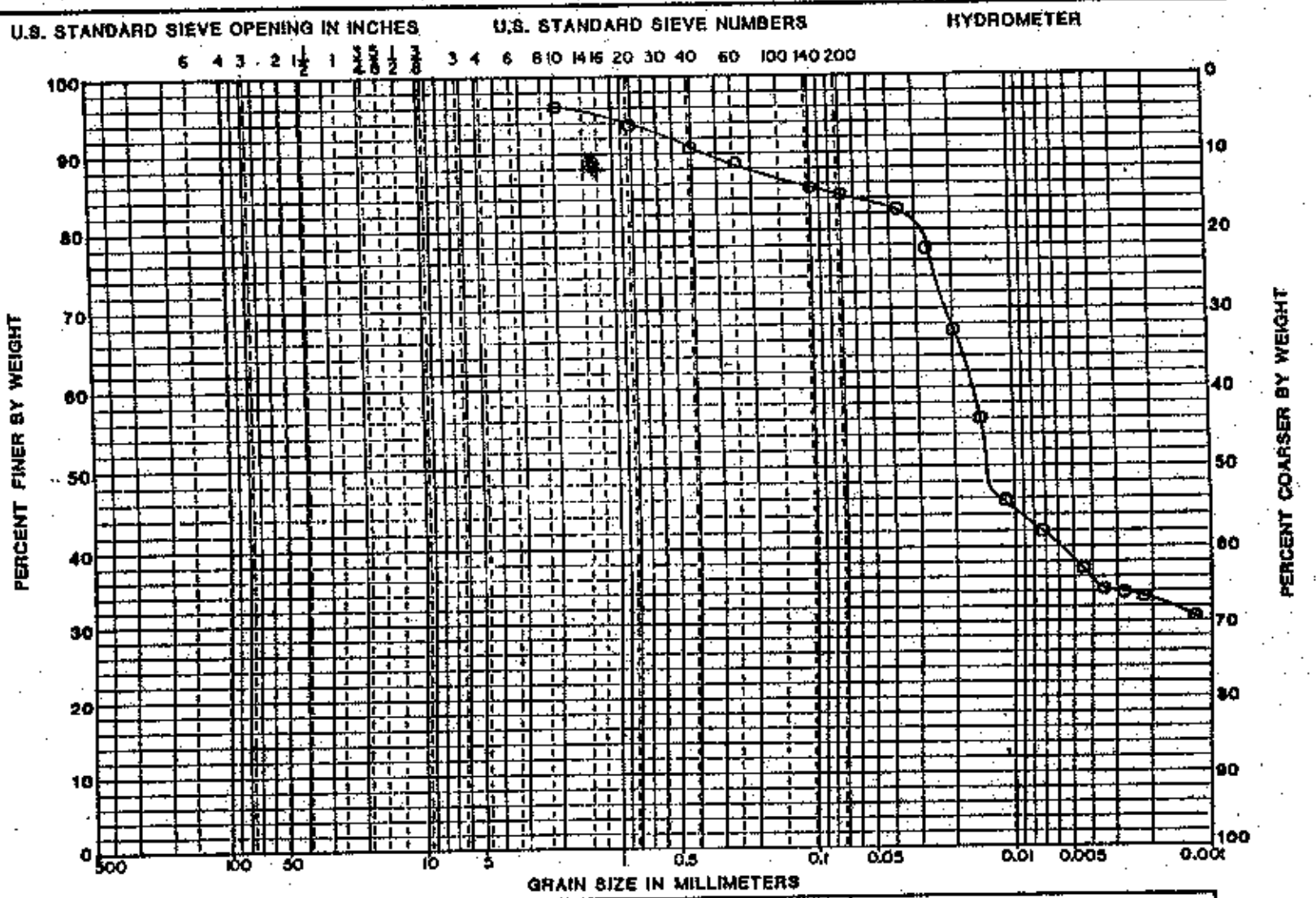
DATE 8-7-90

GEOTECHNOLOGY

PLATE

R 27

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-01	1.0-6.0	CL	22.4	39	20	19

PROJECT WSSRAP

BORING NO. TPMS-3

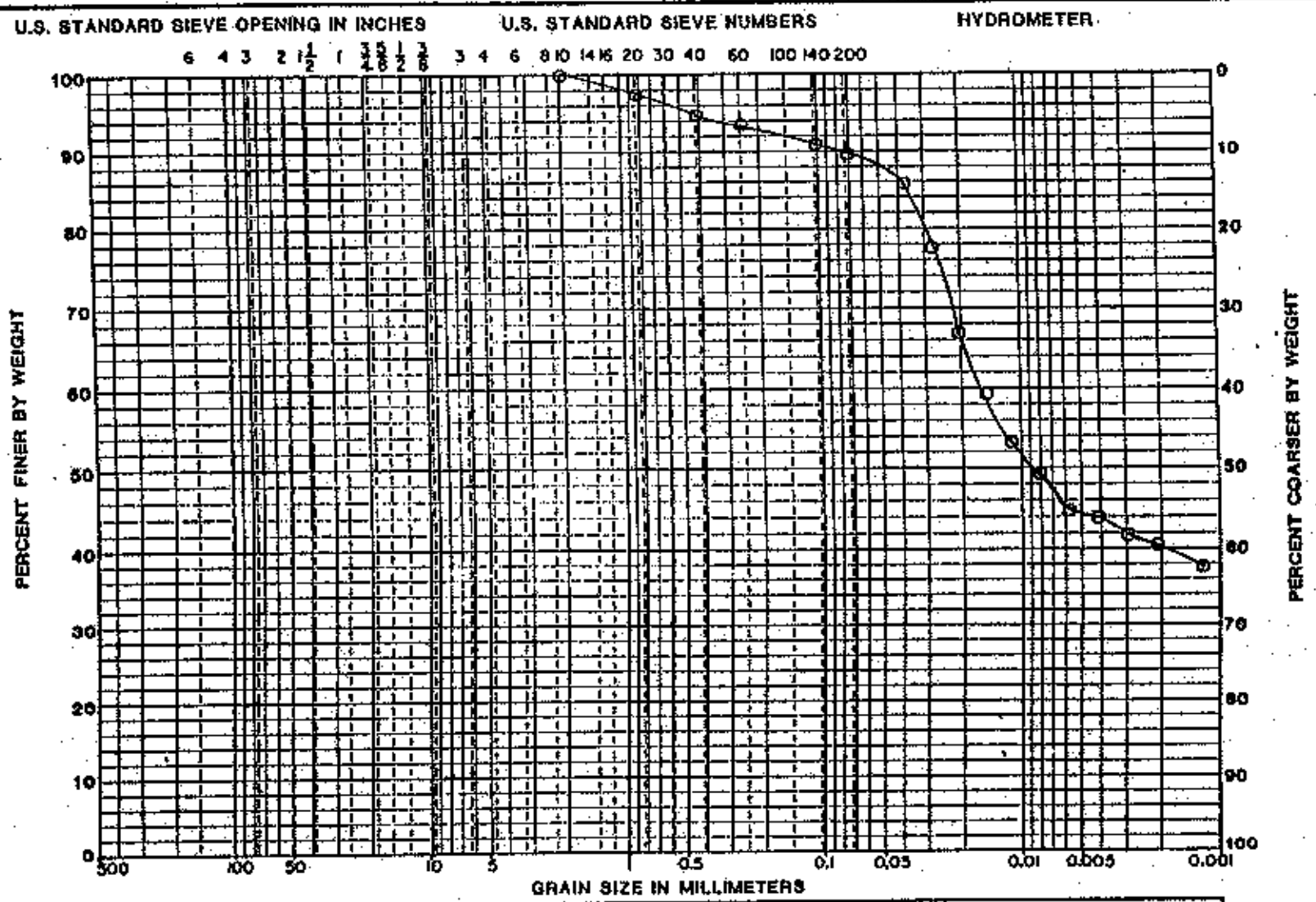
DATE 8-7-90

GEOTECHNOLOGY

PLATE

11295.100

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-01	1.0-3.5	CL	20.0	49	20	29

PROJECT WSSRAP

BORING NO. TPMS-4

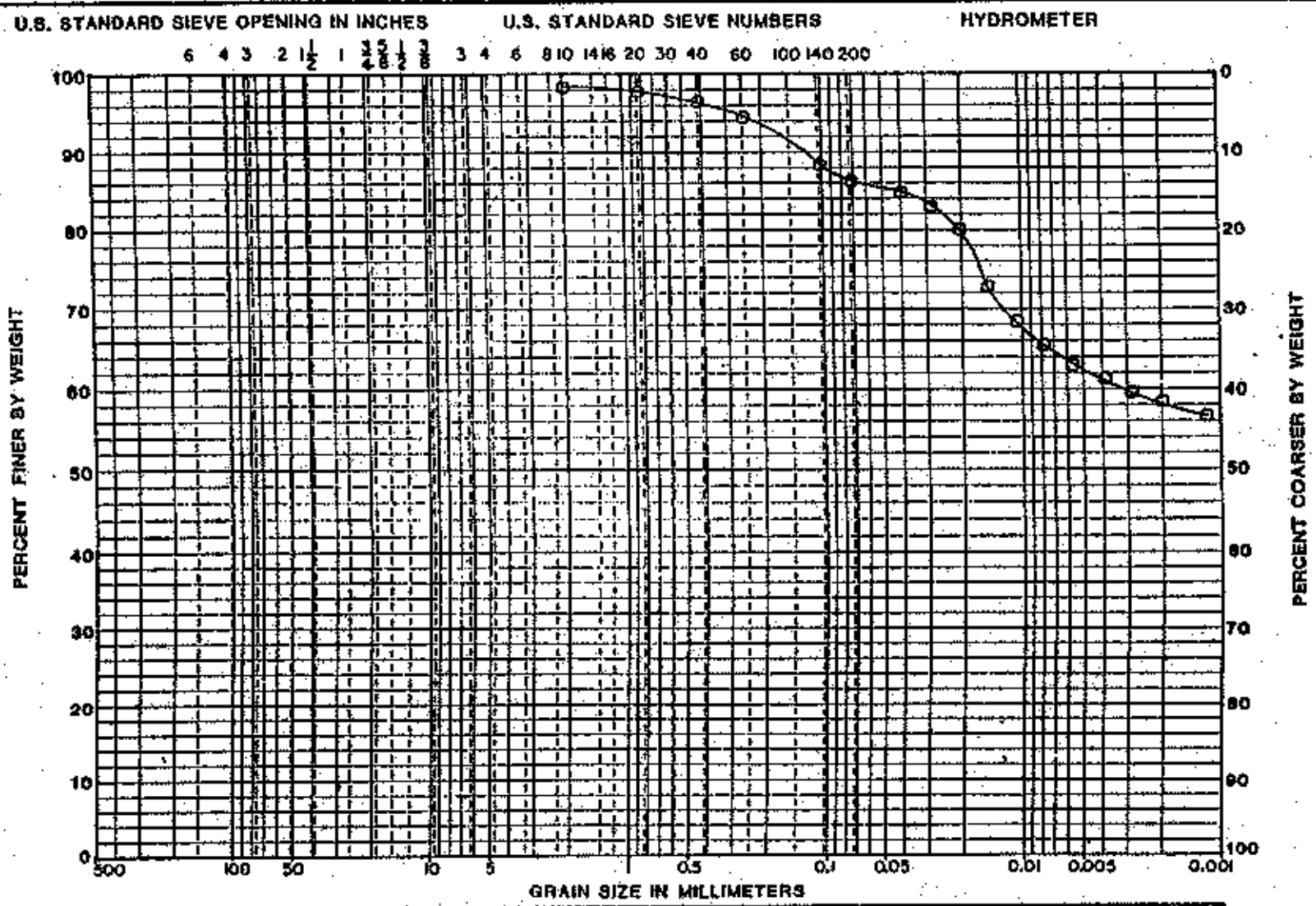
DATE 8-7-90

GEOTECHNOLOGY

PLATE

R 35

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-02	4.0-6.5	CH	27.5	73	24	49

PROJECT WSSRAP

BORING NO. TPMS-4

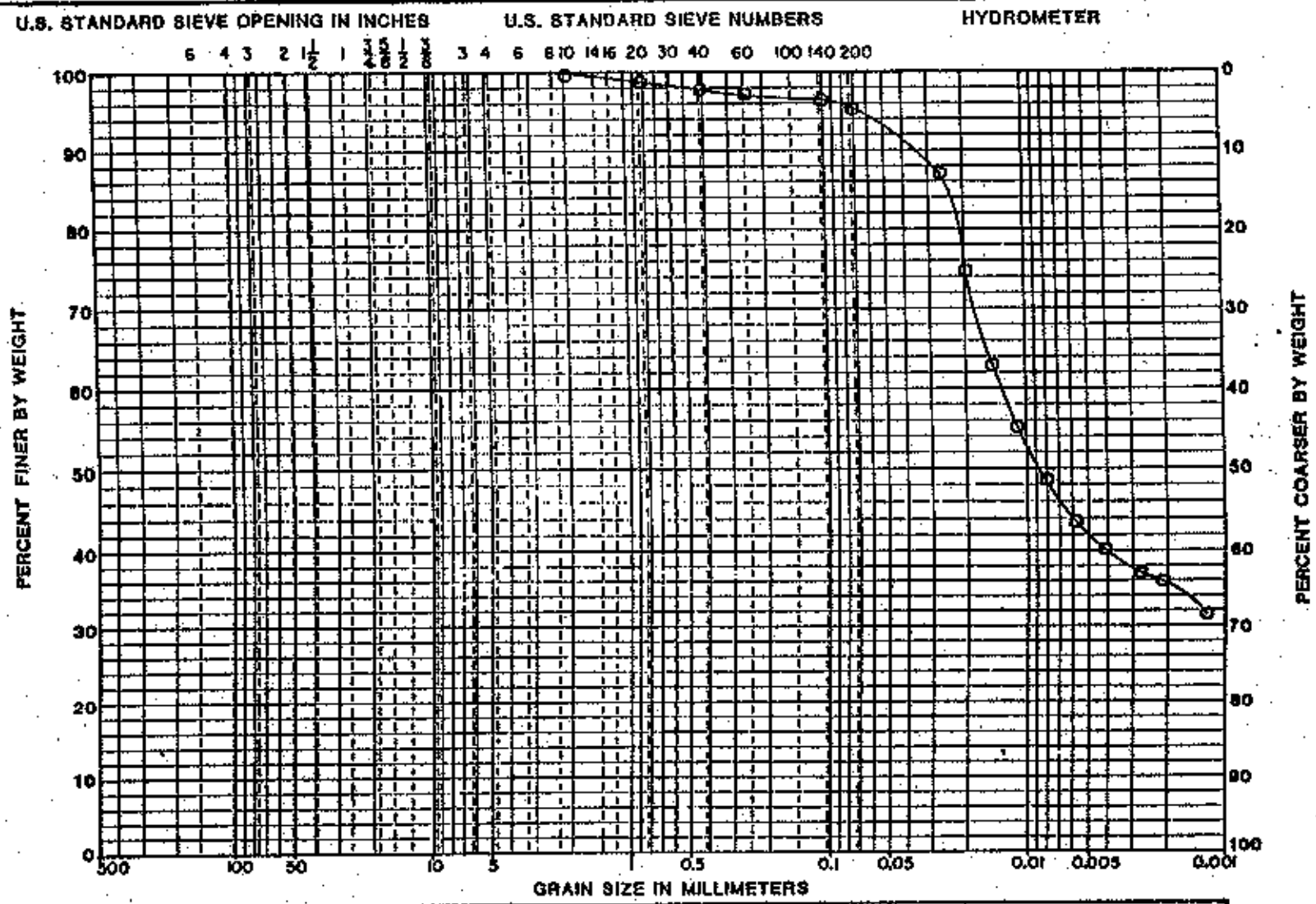
DATE 8-7-90

GEOTECHNOLOGY

PLATE

R 39

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-01	1.0-7.0	CL	19.8	37	17	20

PROJECT WSSRAP

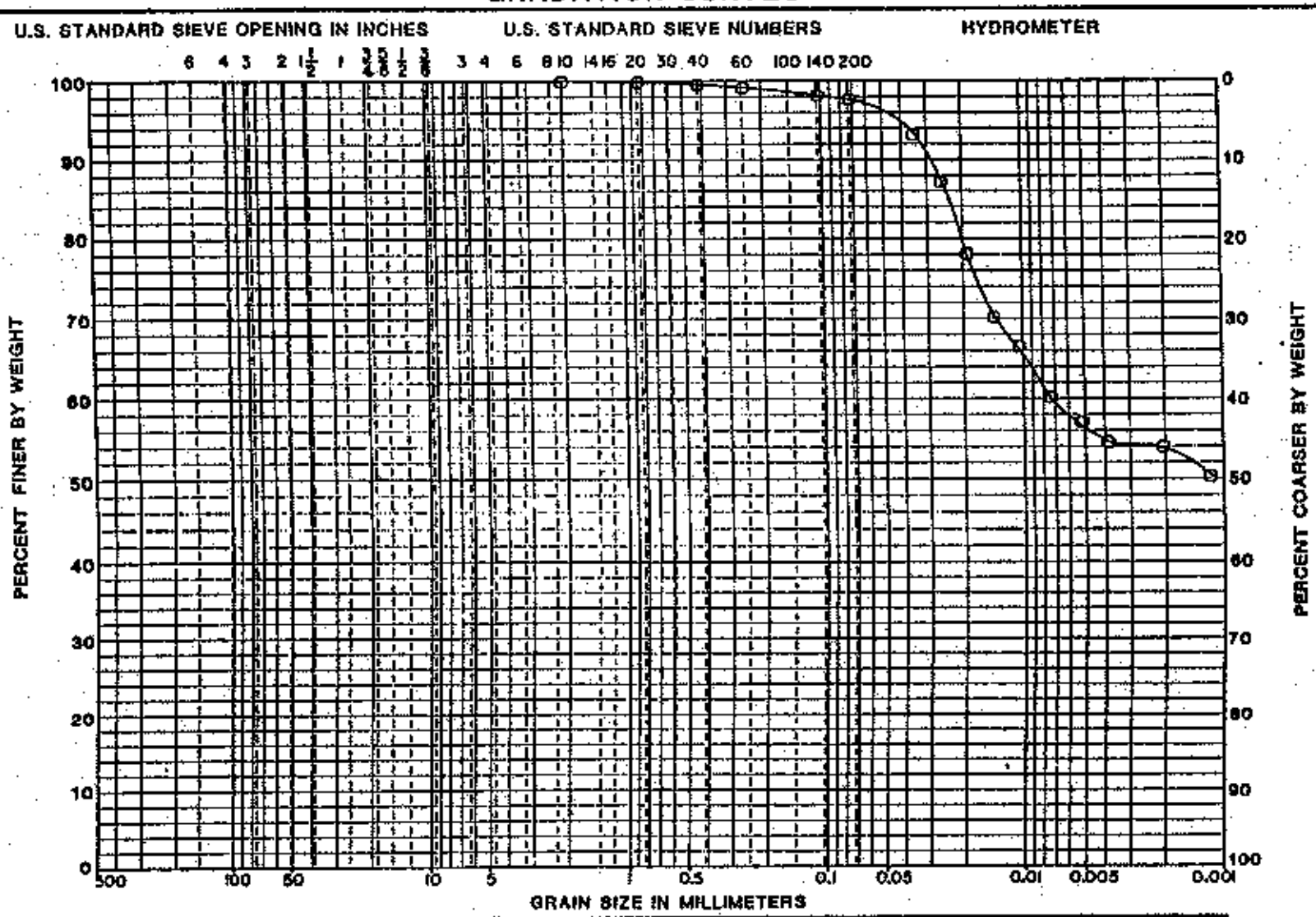
BORING NO. TPMS-5

DATE 8-8-90

GEOTECHNOLOGY

PLATE 43

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-02	8.0-10.0	CH	26.6	73	24	49

PROJECT WSSRAP

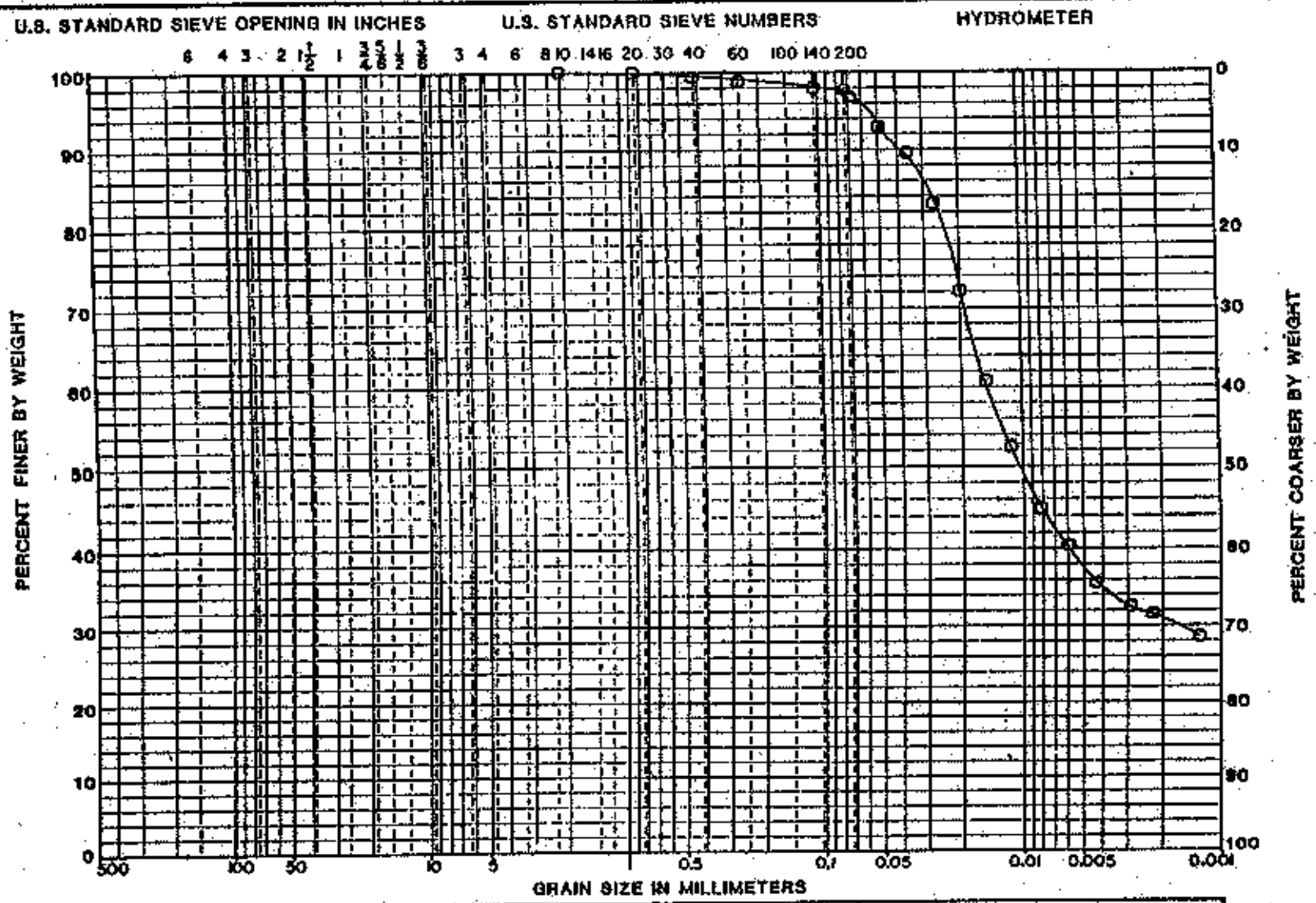
BORING NO. TPHS-5

DATE 8-9-80

GEOTECHNOLOGY

PLATE R 47

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-01	1.0-5.0	CL	15.7	40	18	22

PROJECT WSSRAP

BORING NO. TPMS-6

DATE 9-8-90

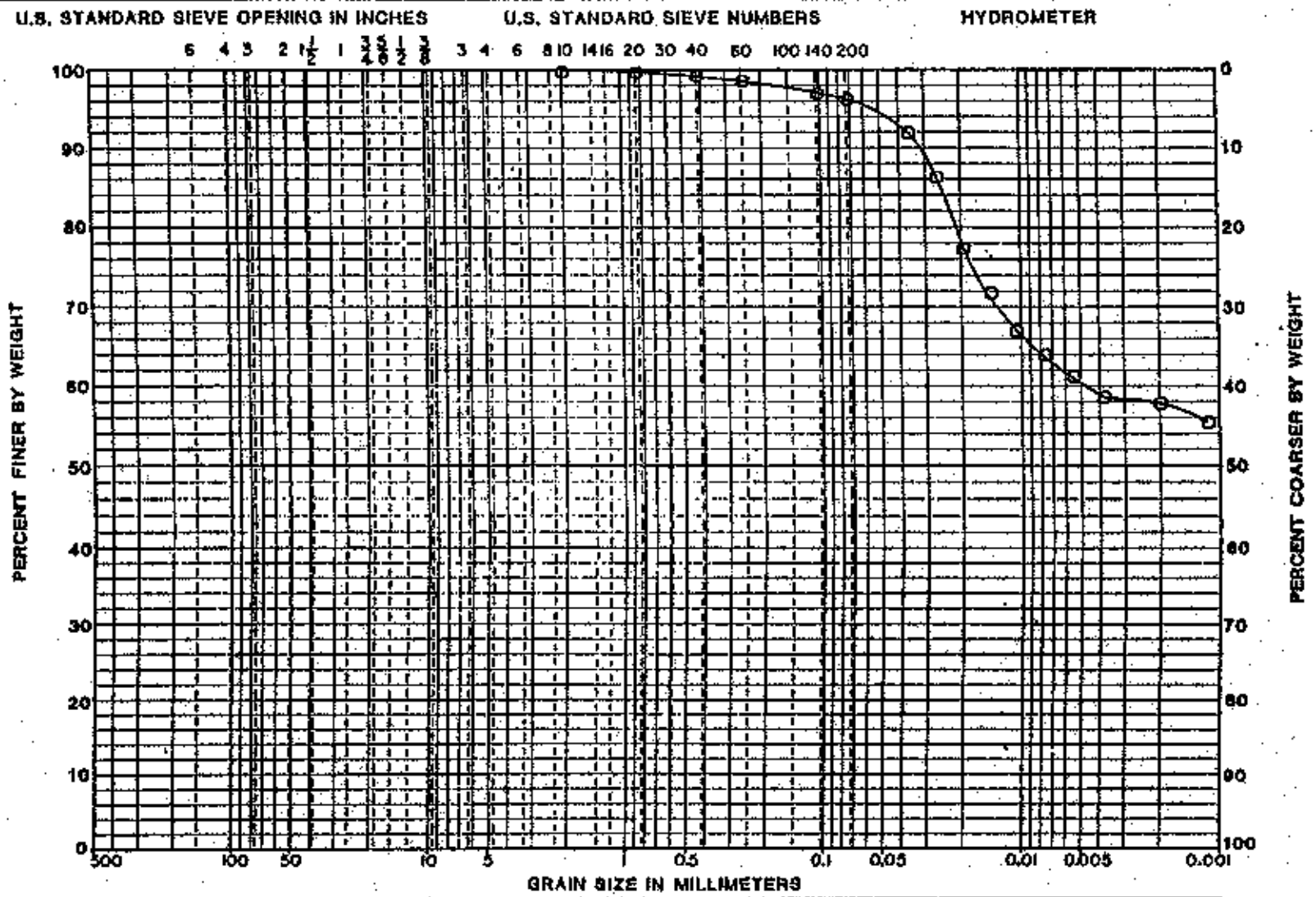
GEOTECHNOLOGY

11295.001

PLATE

R 51

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-02	5.5-7.5	CH	19.4	72	25	47

PROJECT WSSRAP

BORING NO. TPHS-8

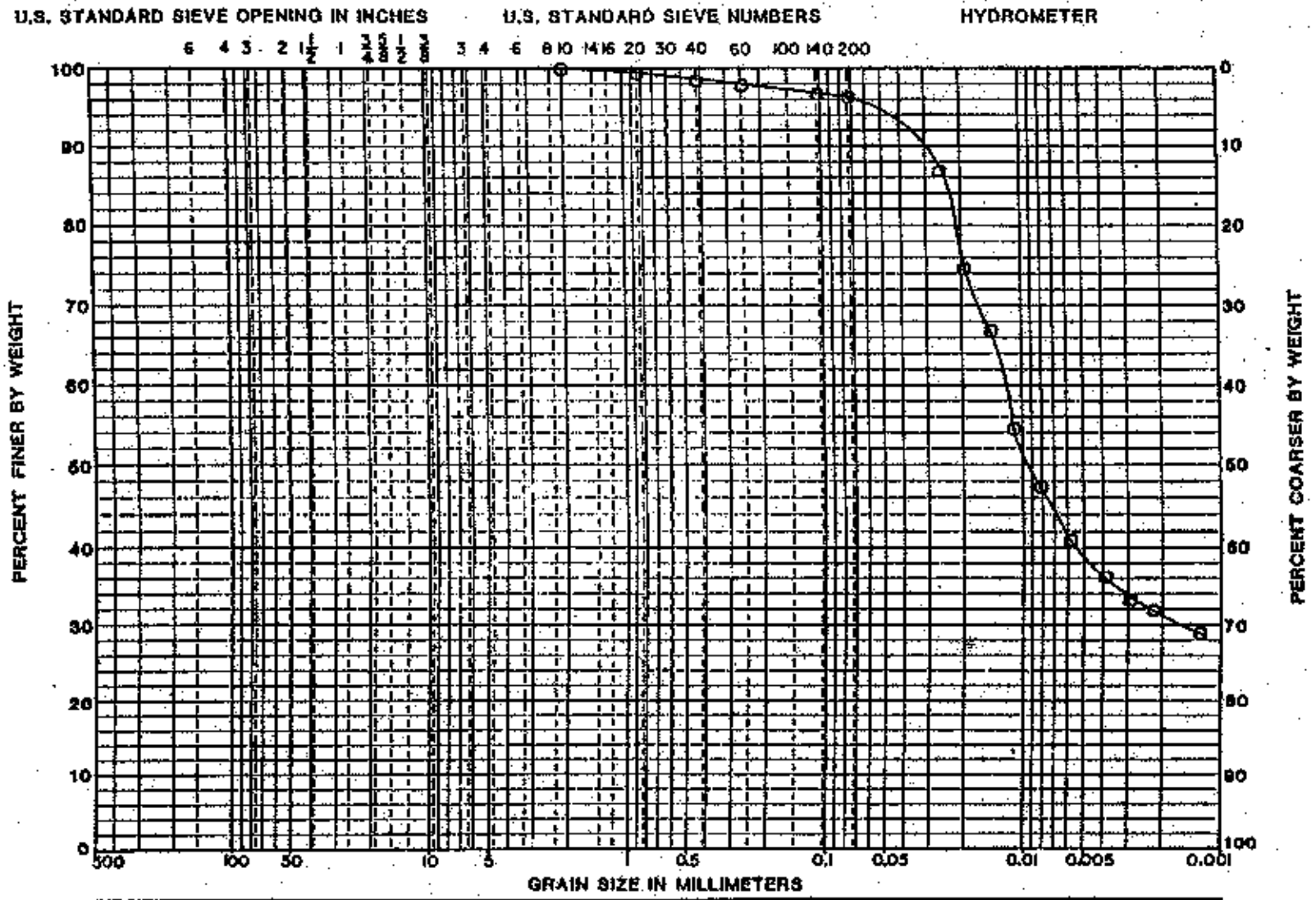
DATE 8-8-90

GEOTECHNOLOGY

PLATE

R 55

GRADATION CURVES



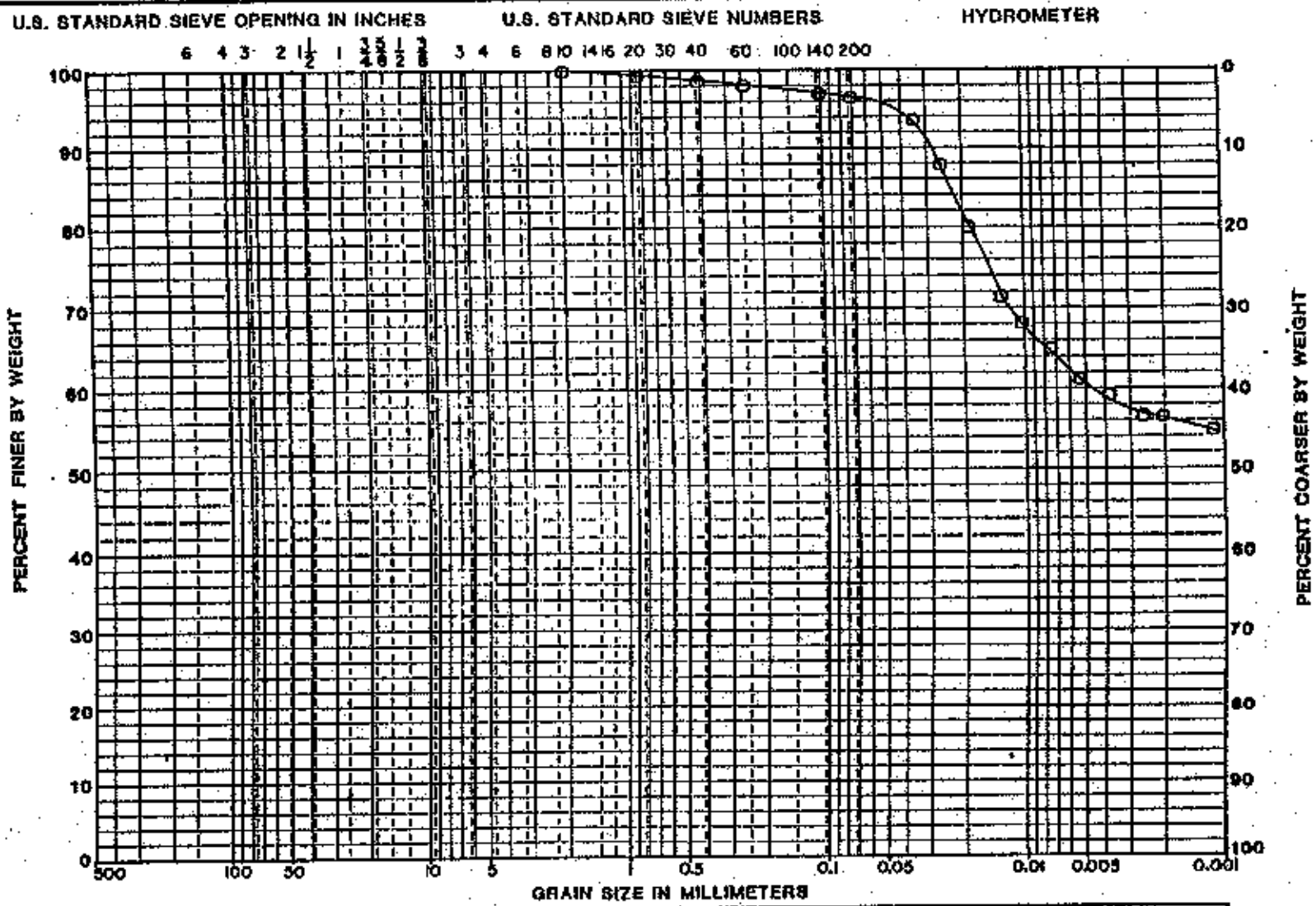
SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI	PROJECT WSSRAP
BU-01	1.0-7.0	CL	19.7	37	17	20	
							BORING NO. TPMS-7
							DATE 8-8-90
							GEOTECHNOLOGY

11295.001

PLATE

R59

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-02	7.0-9.5	CH	20.9	82	24	58

PROJECT WSSRAP

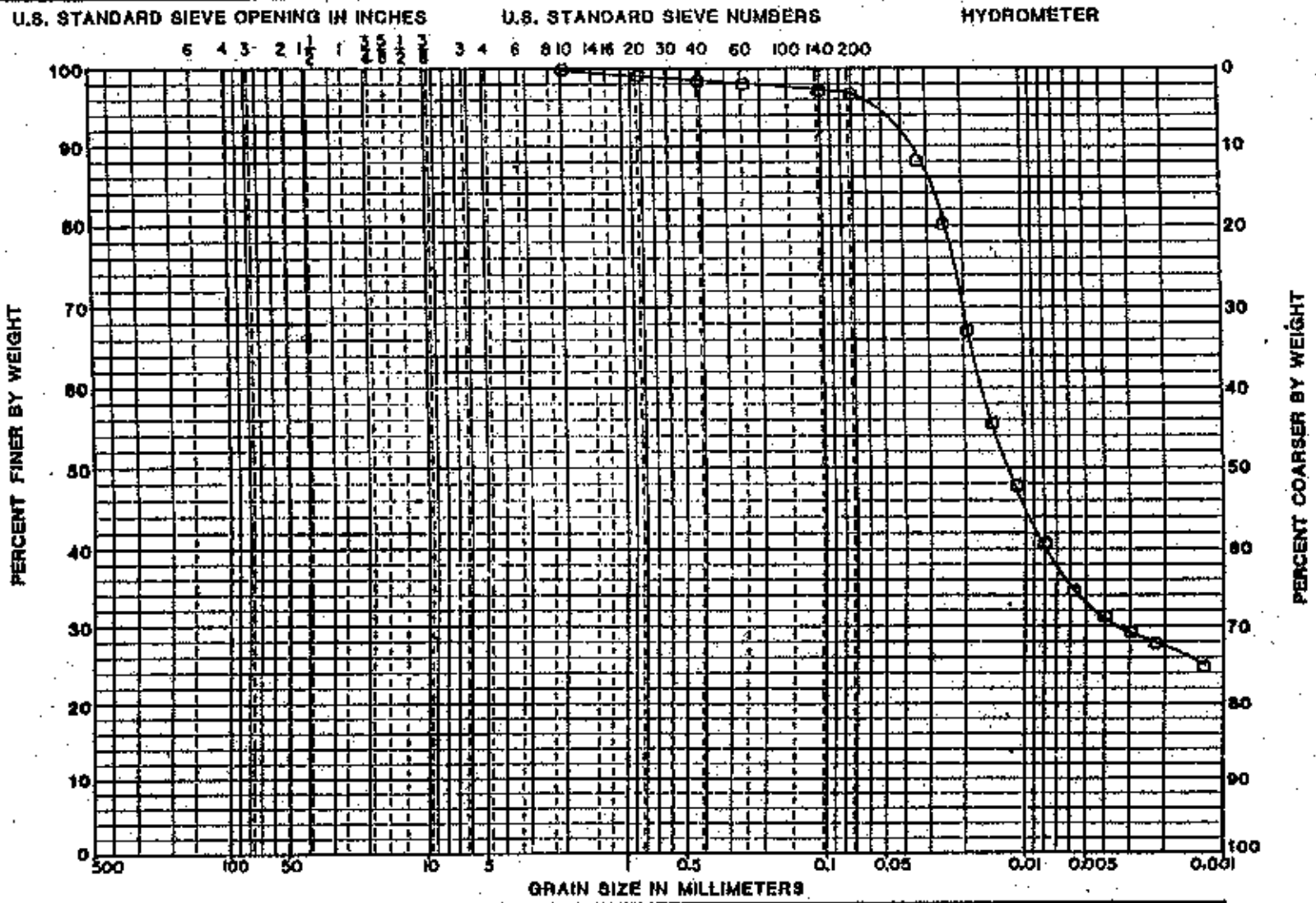
BORING NO. TPMS-7

DATE 8-8-90

GEOTECHNOLOGY

PLATE R 63

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-01	1.0-5.0	CL	9.9	30	19	11

PROJECT MSSRAP

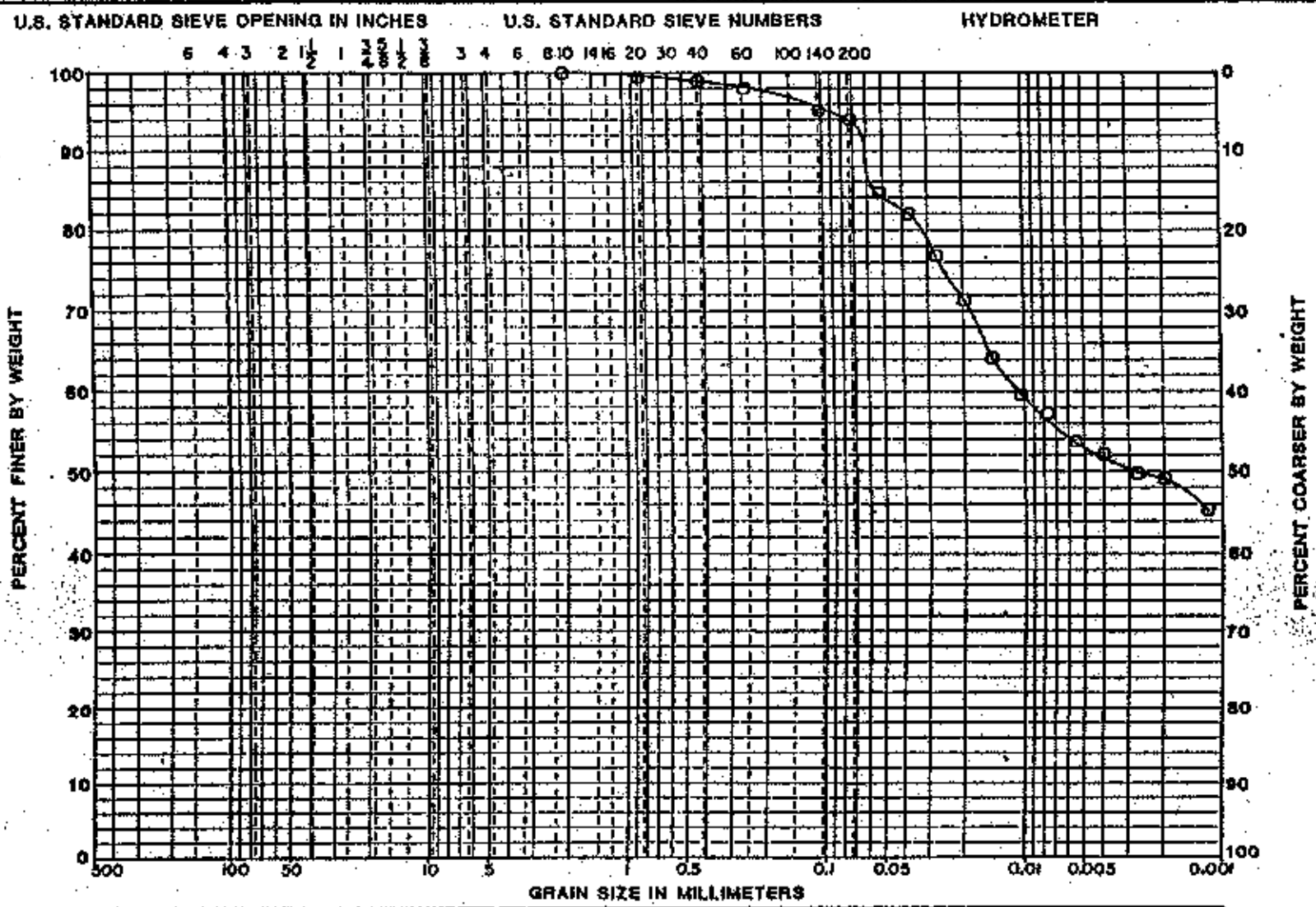
BORING NO. TPMS-8

DATE 8-8-90

GEOTECHNOLOGY

PLATE R 67

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-02	5.0-10.0	CH	23.1	63	19	44

PROJECT WSSRAP

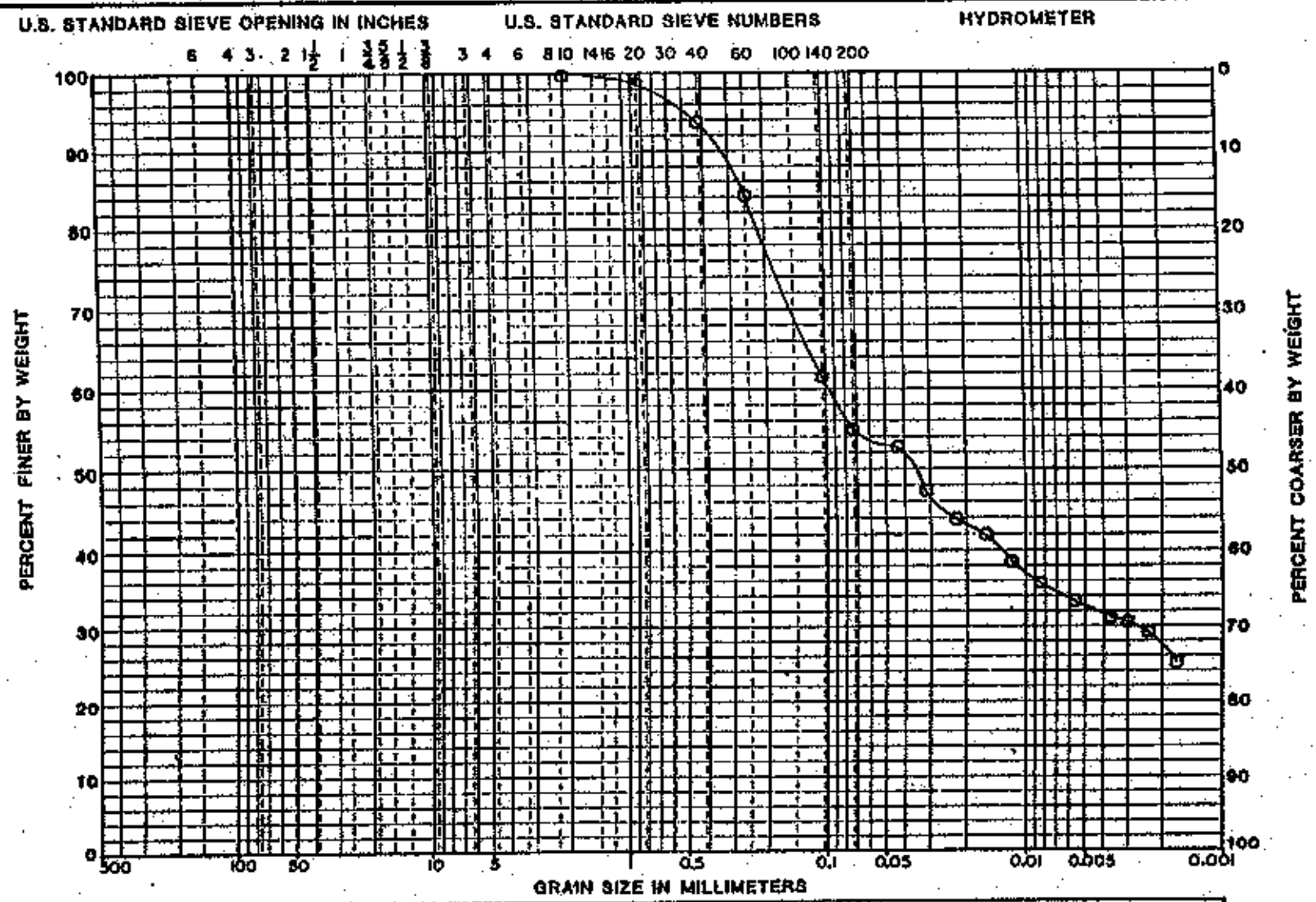
BORING NO. TPMS-8

DATE 8-9-90

GEOTECHNOLOGY

PLATE R 71

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-03	12.0-14.0	ML	11.1			

PROJECT WSSRAP

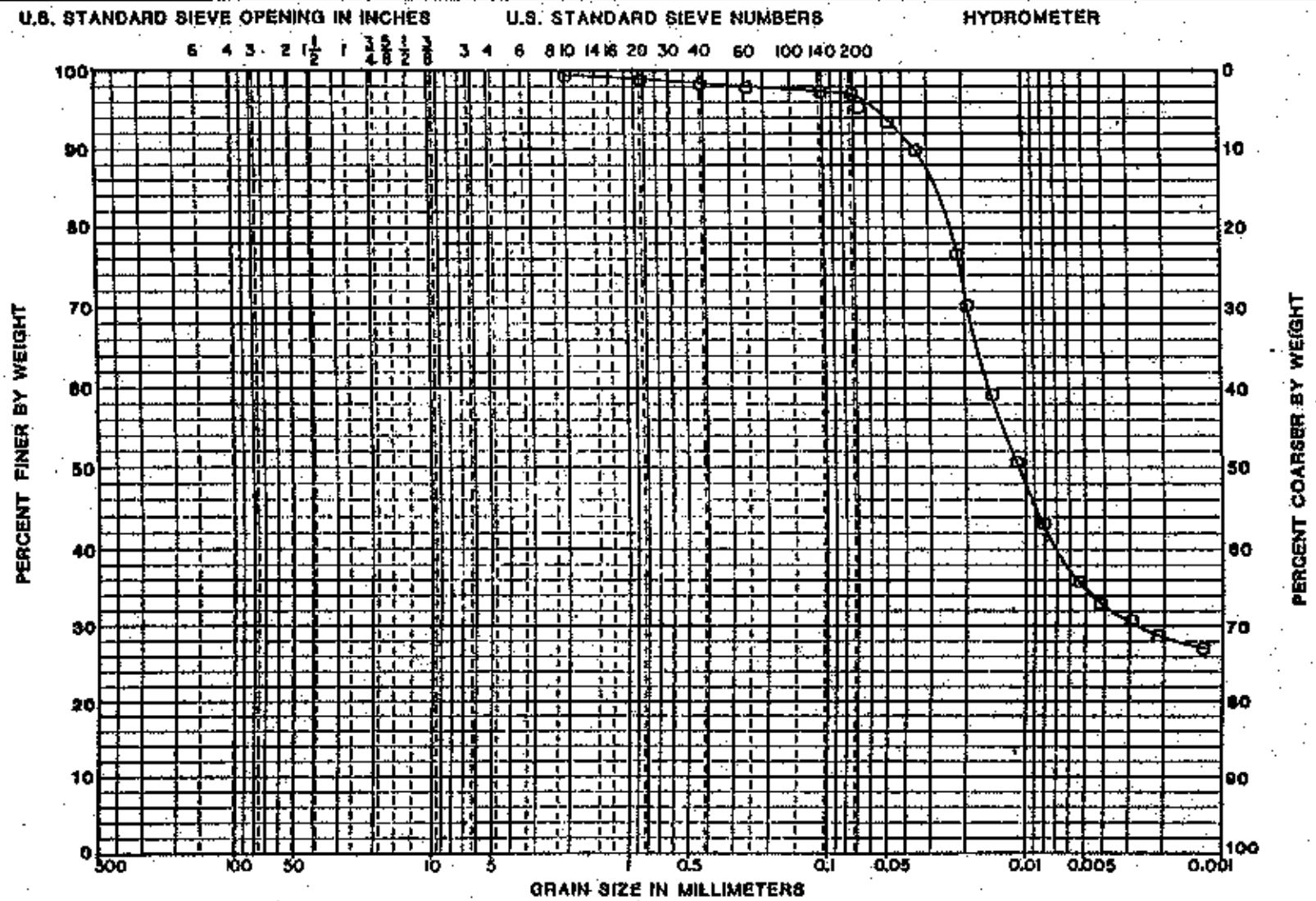
BORING NO. TPMS-8

DATE 8-8-90

GEOTECHNOLOGY

PLATE R 76

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
BU-01	1.0-7.0	CL	16.5	38	20	18

PROJECT WSSRAP

BORING NO. TPMS-9

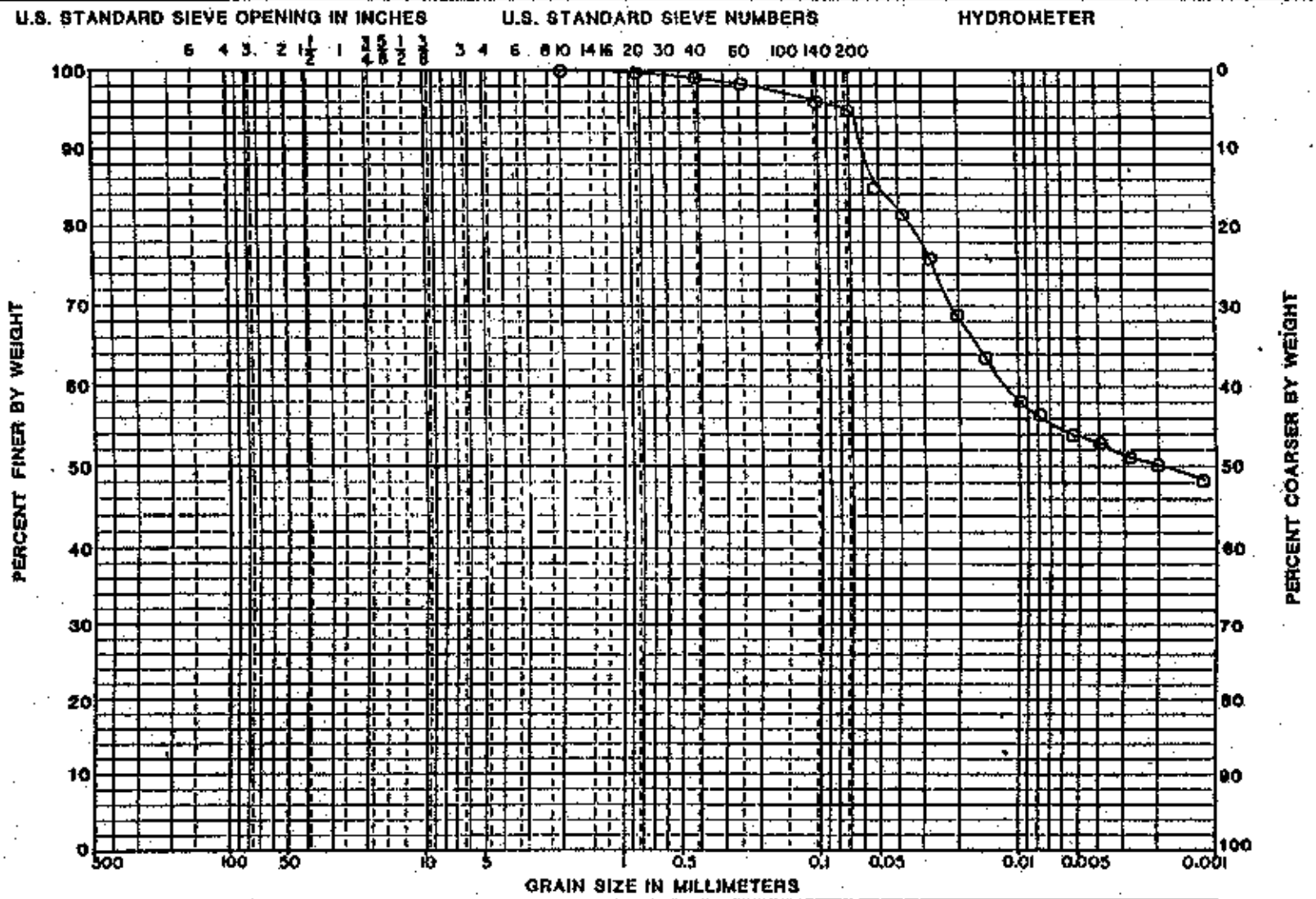
DATE 8-9-90

GEOTECHNOLOGY

11295.001

PLATE R 79

GRADATION CURVES



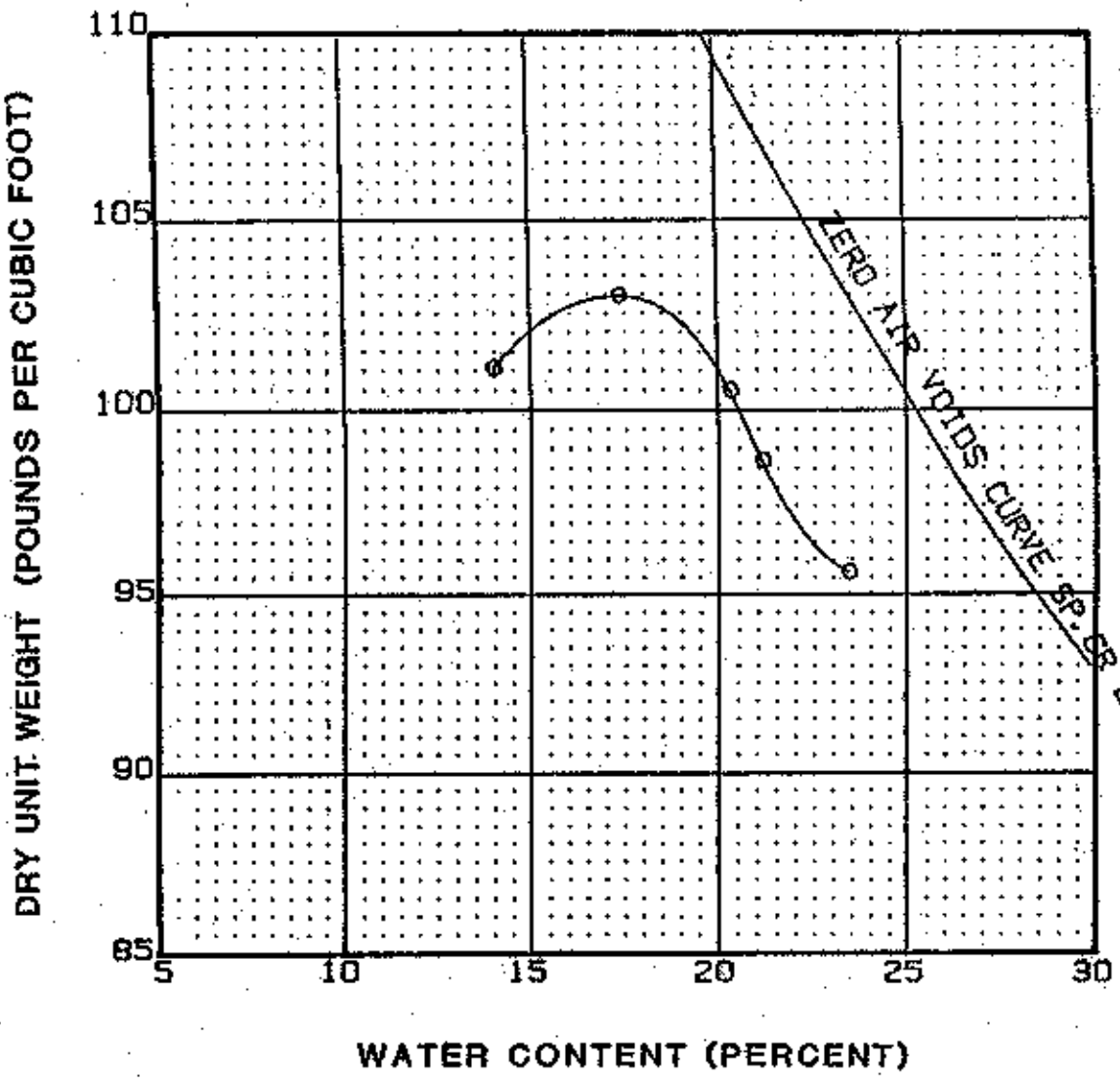
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI	PROJECT MSSRAP
BU-02	8.0-15.0	CH	15.1	69	24	45	
							BORING NO. TPMS-9
							DATE 8-9-90
							GEOTECHNOLOGY

PLATE 2 83

L-2 10/88

Job # 11295.000
Date: 8-8-90



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-78 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
103.0	17.4	

DESCRIPTION

Brown, occasionaly dark gray, CLAY

ATTERBERG LIMITS

LL- 51 PL- 19 PI- 32

CLASSIFICATION SYSTEM

UNIFIED : CH

AASHTO :

SAMPLE INFORMATION

TPNS-1, BU-01, 0.0'- 6.0'

WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

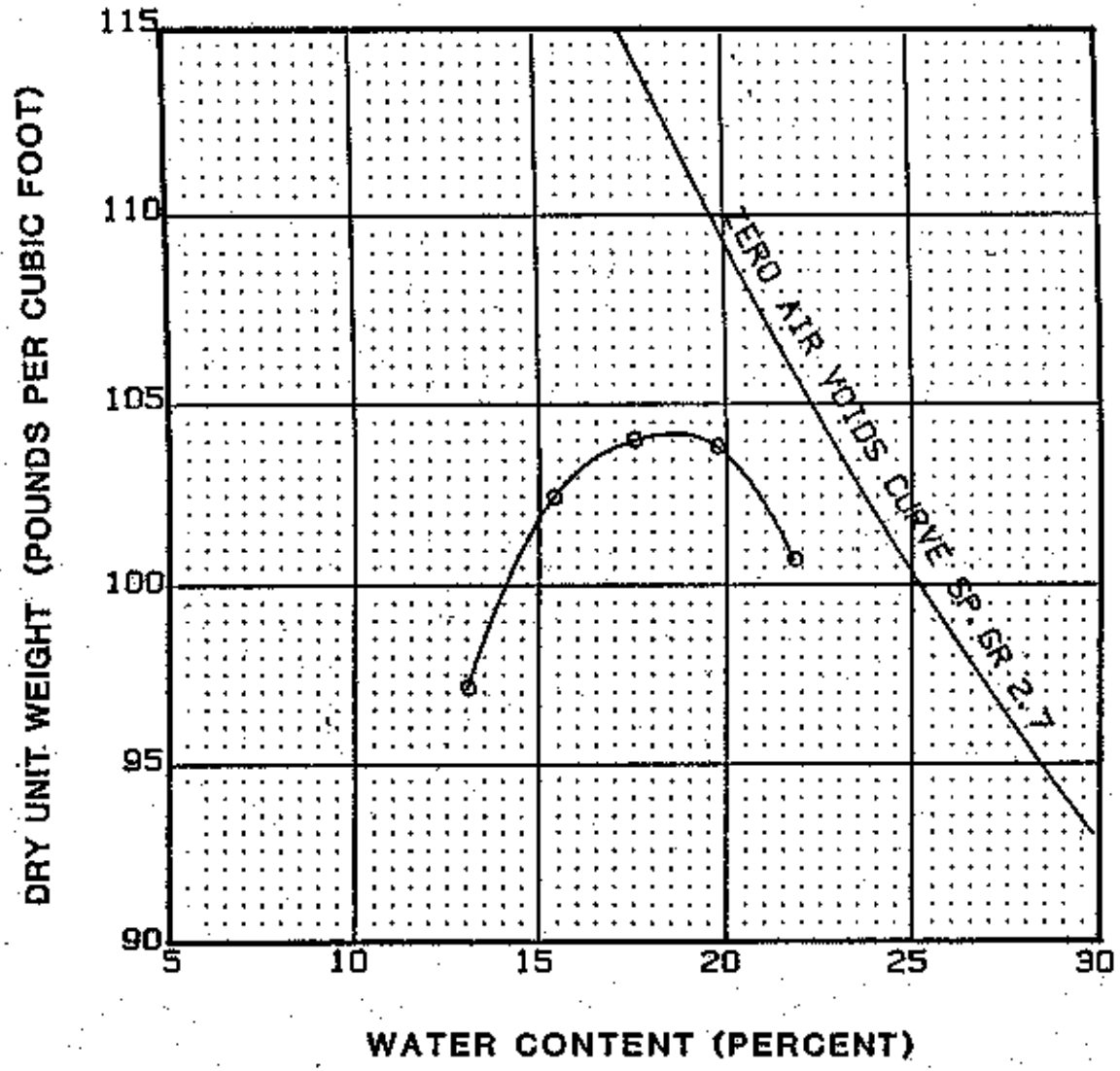
RGD

PLATE

R 87

L-2 10/88

Job # 11295.000
Date: 9-8-90



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-78 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
104.3	18.7	

DESCRIPTION

Gray, silty CLAY with topsoil, trace gravel

ATTERBERG LIMITS

LL- 49 PL- 20 PI- 29

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

TPMS-2, BU-01, 0.0' - 2.0'

WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

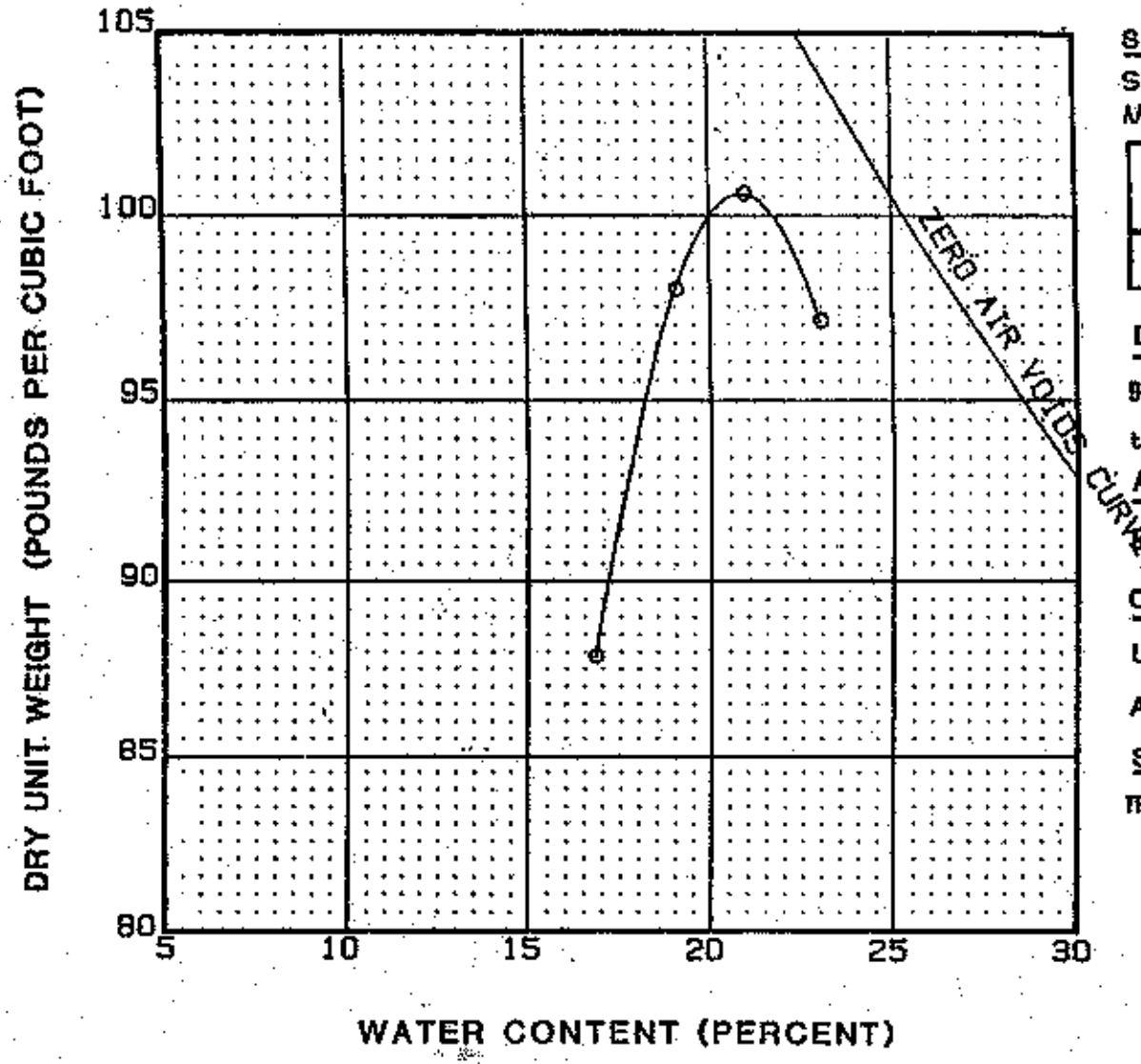
PLATE

R 89

R80

L-2 10/95

Job # 11295.000
Date: 8-8-90



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-78 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
100.6	21.0	

DESCRIPTION

Brownish gray, silty CLAY to CLAY, trace of gravel

ATTERBERG LIMITS

LL- 67 PL- 21 PI- 46

CLASSIFICATION SYSTEM

UNIFIED : CH

AASHTO .

SAMPLE INFORMATION

TPMS-2 SU-02 2.0'-6.0'

WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

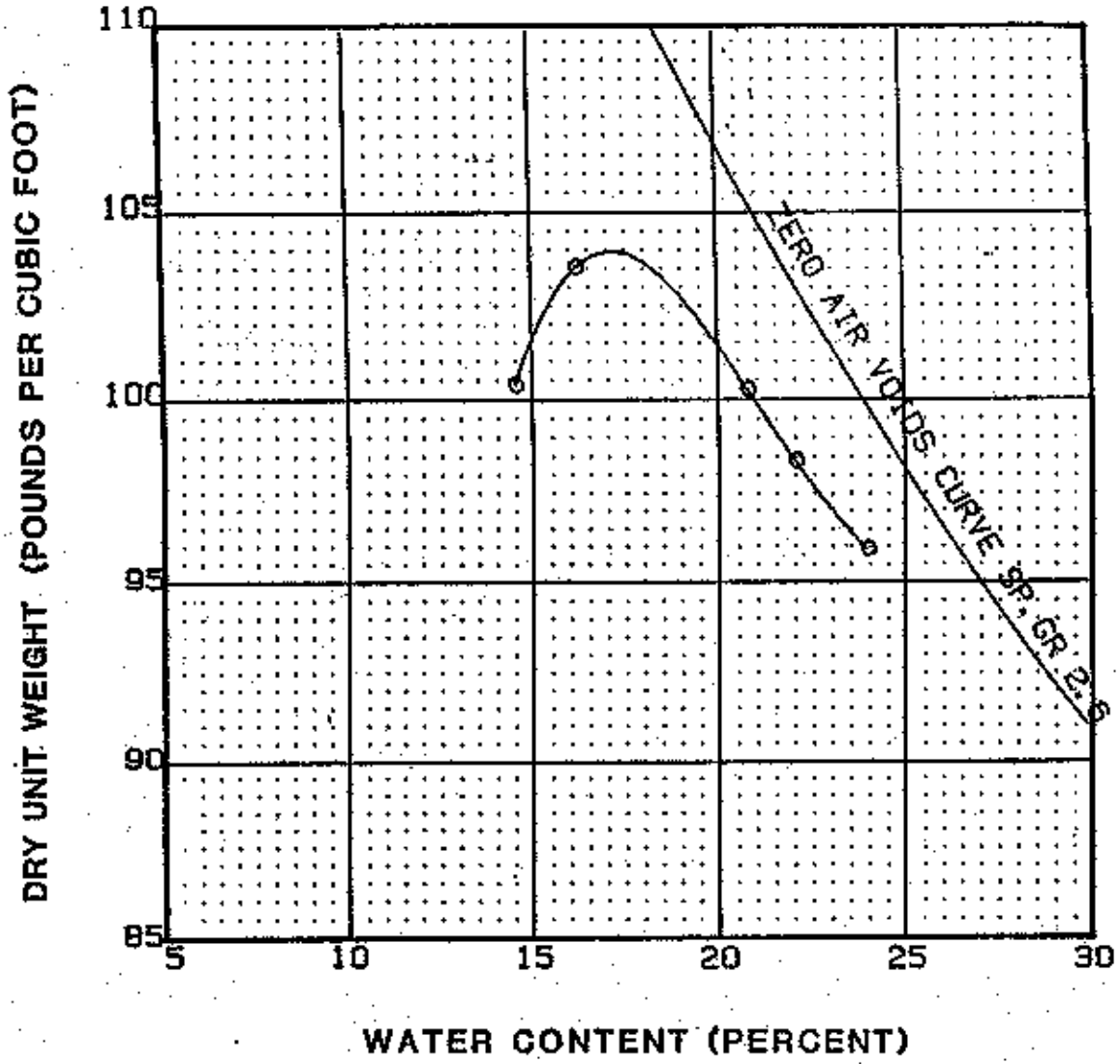
checked by TT

PLATE

R 91

L-2 10/88

Job # 11295.000
Date: 9-8-90



SPECIFICATIONS

STANDARD PROCTOR

AASHO T 99-70, ASTM D 698-78 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
104.0	17.1	

DESCRIPTION

Gray, silty CLAY to clayey SILT and dark gray, silty CLAY

ATTERBERG LIMITS

LL- 39 PL- 20 PI- 19

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO : .

SAMPLE INFORMATION

TPNS-3, BU-01, 1.0' - 6.0'

WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

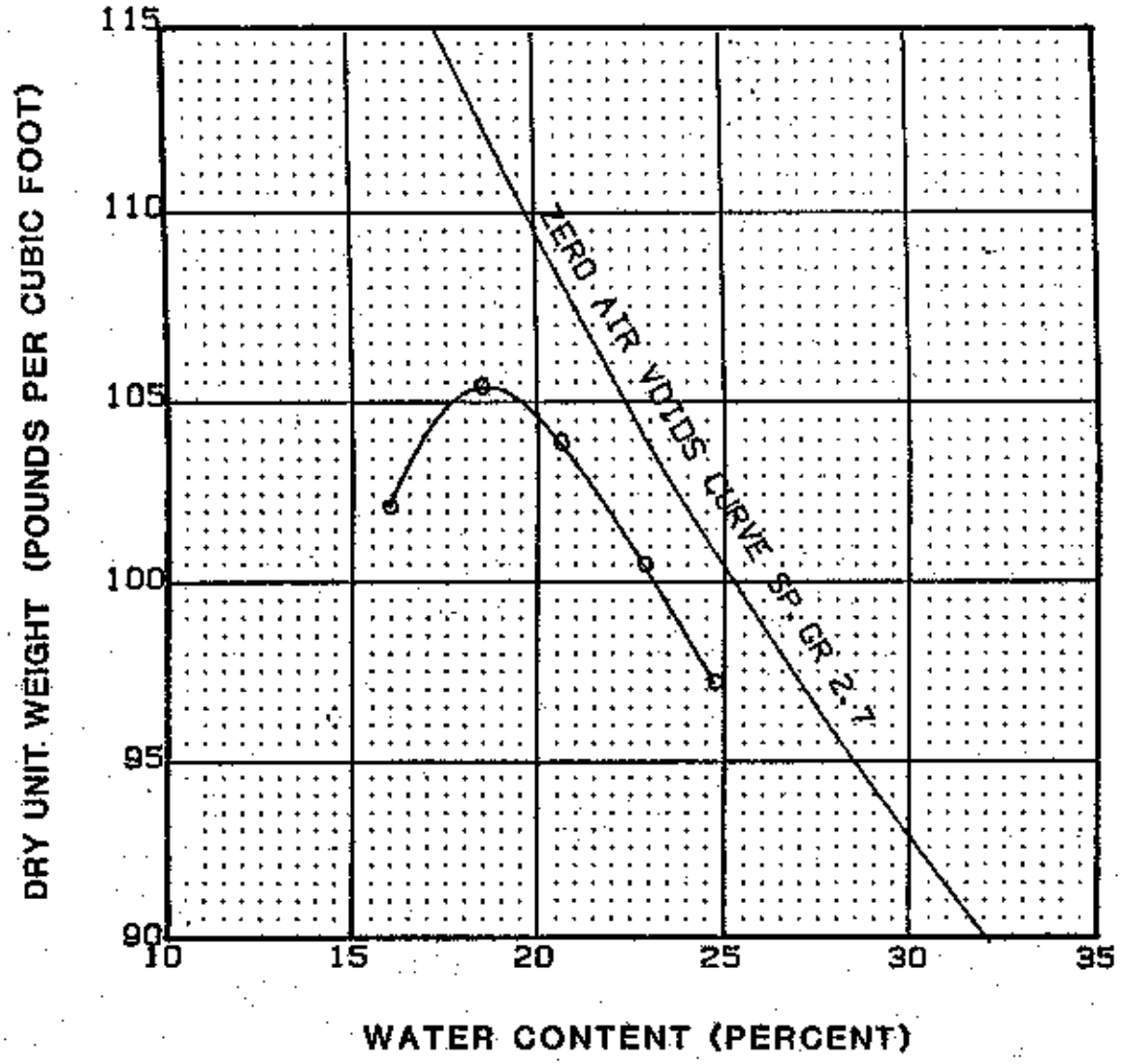
PLATE

R 93

RAN

L-2 10/88

Job # 11295.000
Date: 8-8-90



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-78 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
105.4	18.6	

DESCRIPTION

Brown and gray, silty CLAY

ATTERBERG LIMITS

LL- 49 PL- 20 PI- 29

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

TPMS-4 BU-01 1.0'-3.5'

WSSRAP

COMPACTION TEST

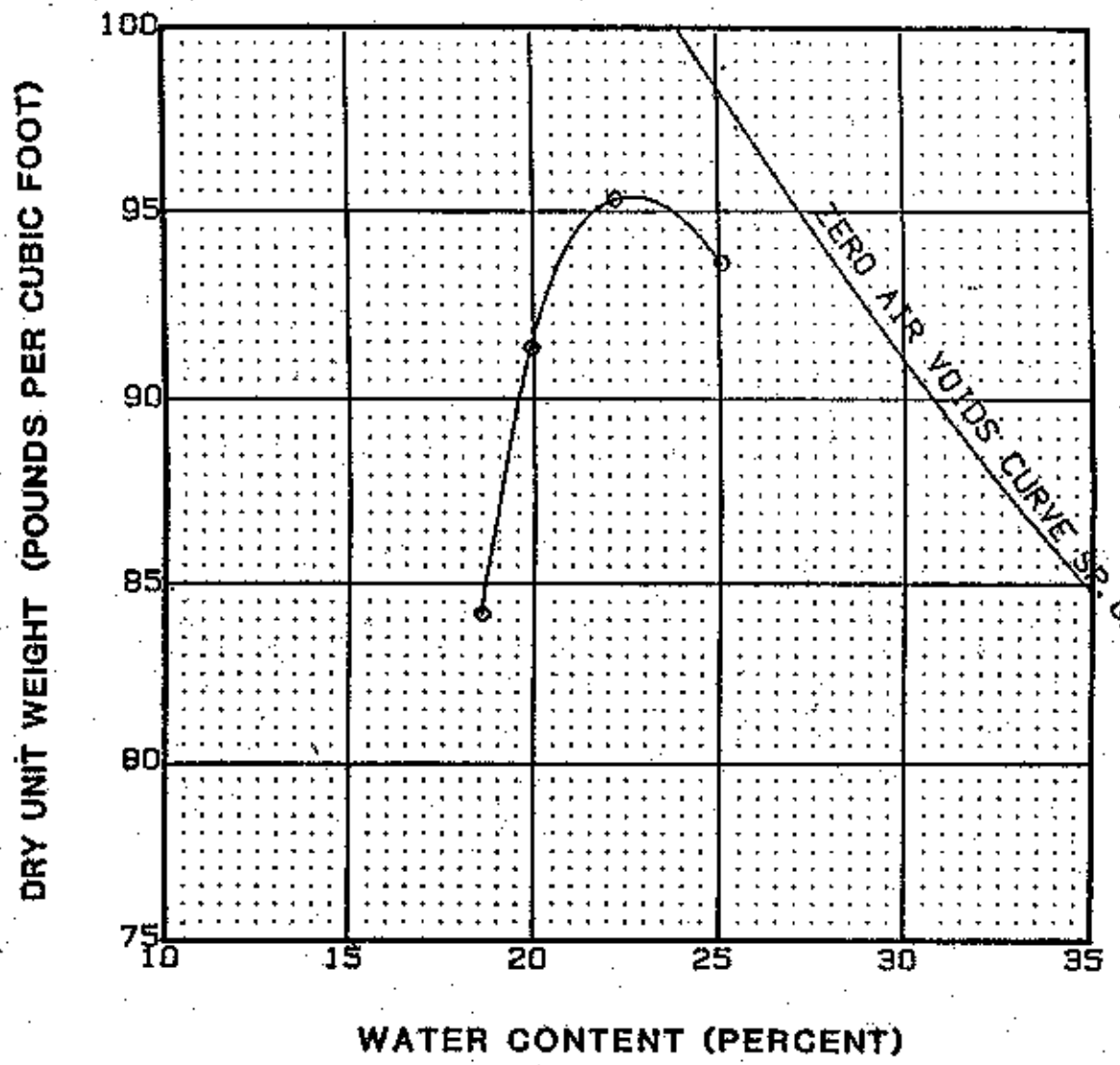
GEOTECHNOLOGY

checked by [illegible]

PLATE

R96

Job # 11295.000
Date: 8-13-90



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-78 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
95.5	22.8	

DESCRIPTION

Brownish gray and gray CLAYT

ATTERBERG LIMITS

LL- 73 PL- 24 PI- 49

CLASSIFICATION SYSTEM

UNIFIED : CH
AASHTO :

SAMPLE INFORMATION

TPMS-4, BU-02, 4.0'-6.0'

WSSRAP

COMPACTION TEST

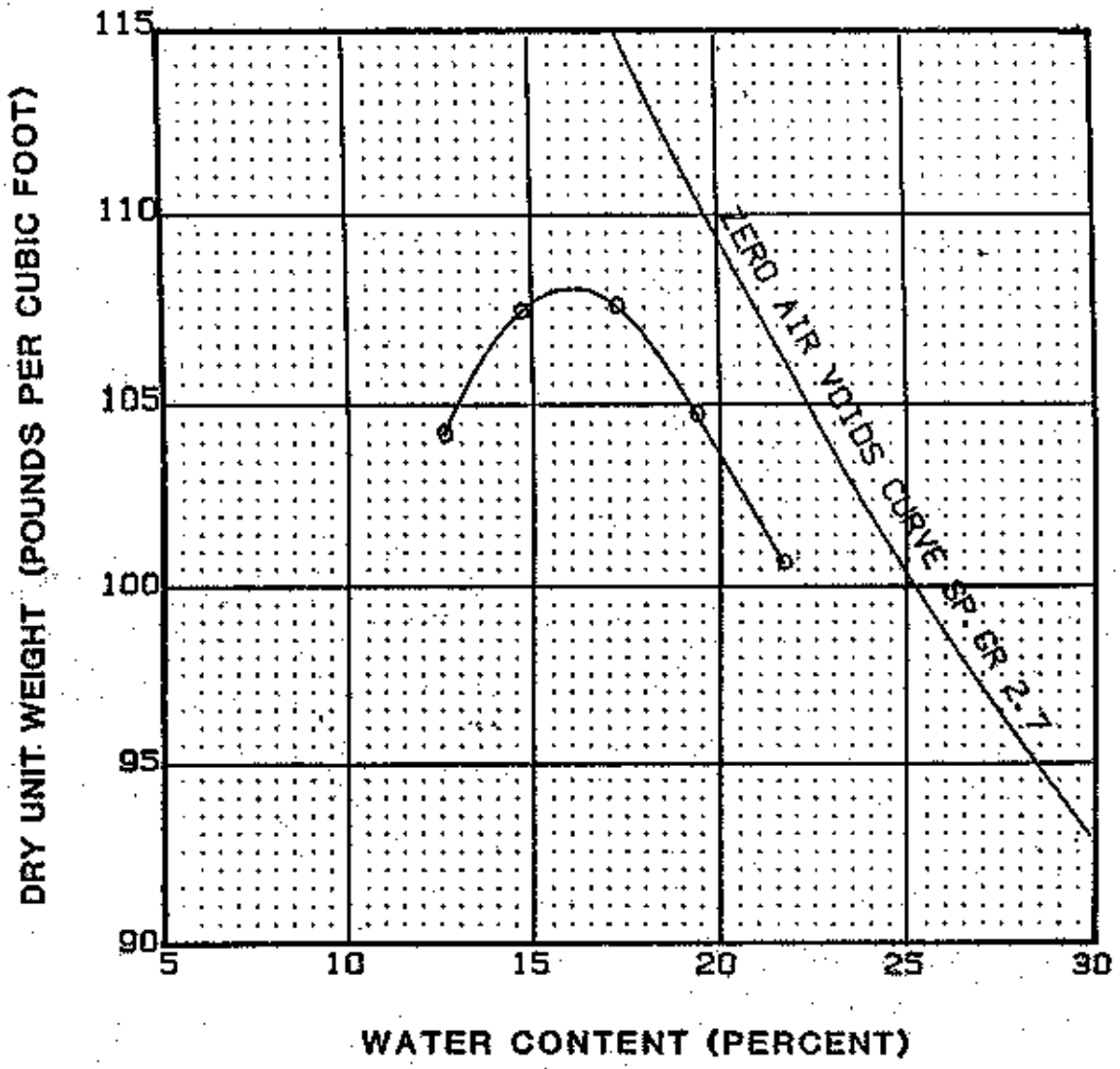
GEOTECHNOLOGY

PLATE

Checked by TT

L-2 10/86

Job # 11295.000
Date: 8-9-90



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-78 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
108.1	15.9	

DESCRIPTION

Brown and gray, silty CLAY

ATTERBERG LIMITS

LL- 37 PL- 17 PI- 20

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO : .

SAMPLE INFORMATION

TP95-5 SU-01 1.0'-7.0'

WSSRAP

COMPACTION TEST

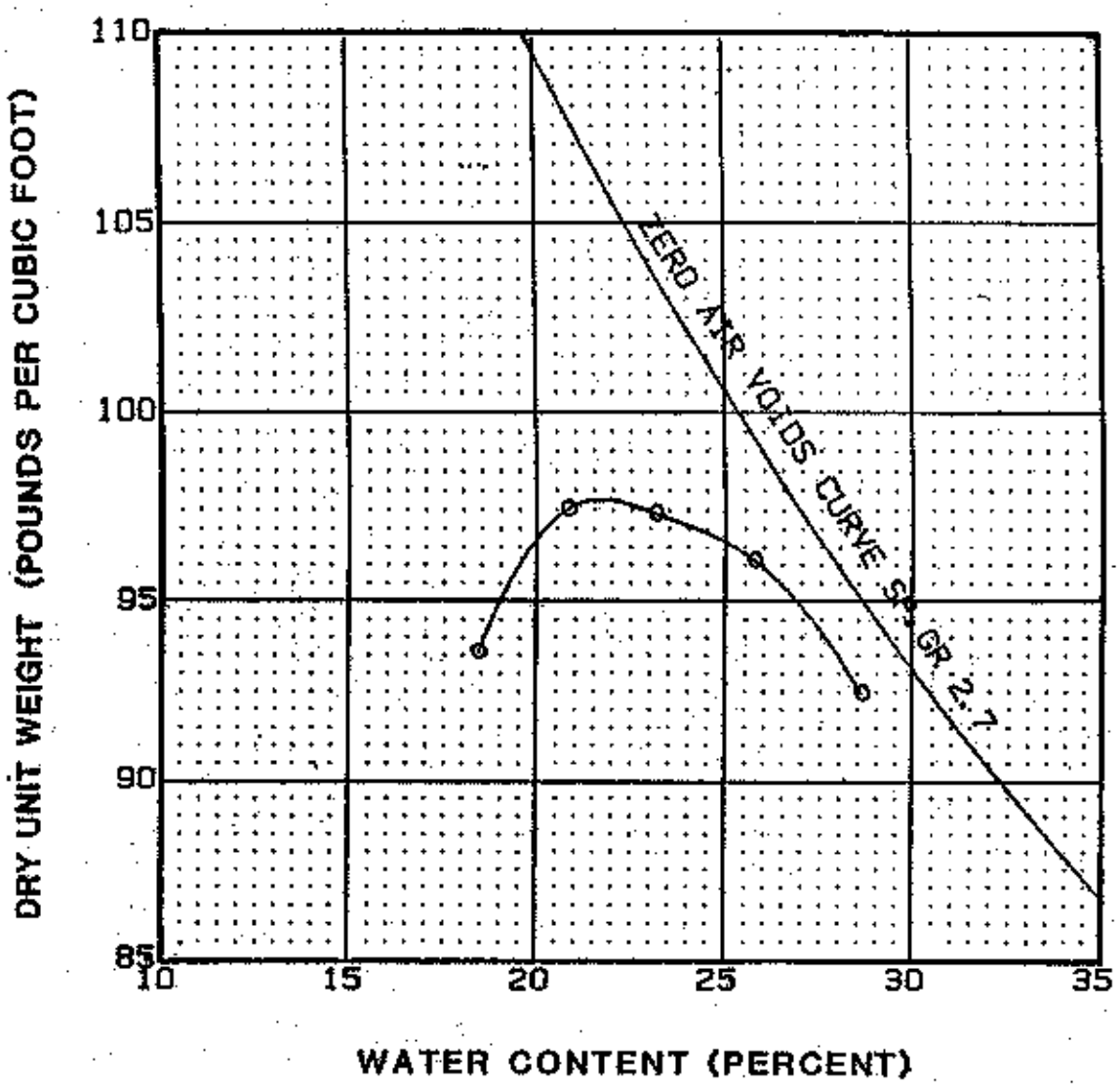
GEOTECHNOLOGY

Checked by YY

PLATE

R 49

Job # 11295.000
Date: 8-10-90



SPECIFICATIONS

STANDARD PROCTOR

AASHO T 99-70, ASTM D 698-78 (Method C)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
97.8	21.7	

DESCRIPTION

Gray and Brown CLAY

ATTERBERG LIMITS

LL-73 PL-24 PI- 49

CLASSIFICATION SYSTEM

UNIFIED : CH

AASHTO :

SAMPLE INFORMATION

TPMS -5, BU-02, 8.0-10.0

WSSRAP

COMPACTION TEST

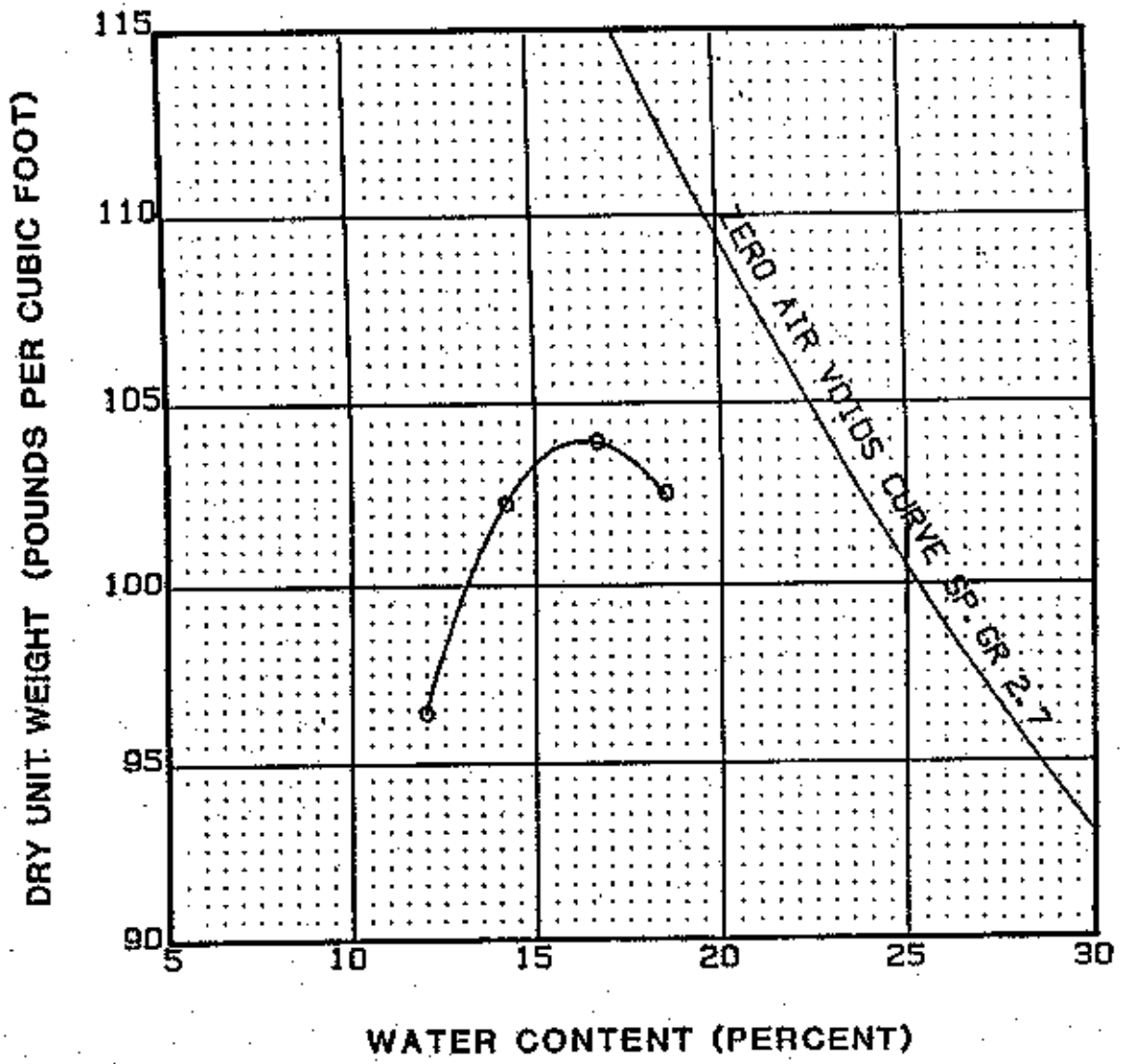
GEOTECHNOLOGY

Checked by YY

PLATE

B 101

Job # 11295.000
Date: 8-9-90



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
104.0	16.4	

DESCRIPTION

Brown, silty CLAY

ATTERBERG LIMITS

LL- 40 PL- 18 PI- 22

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO : .

SAMPLE INFORMATION

TPHS-8 BU-01 1.0'-5.0'

WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

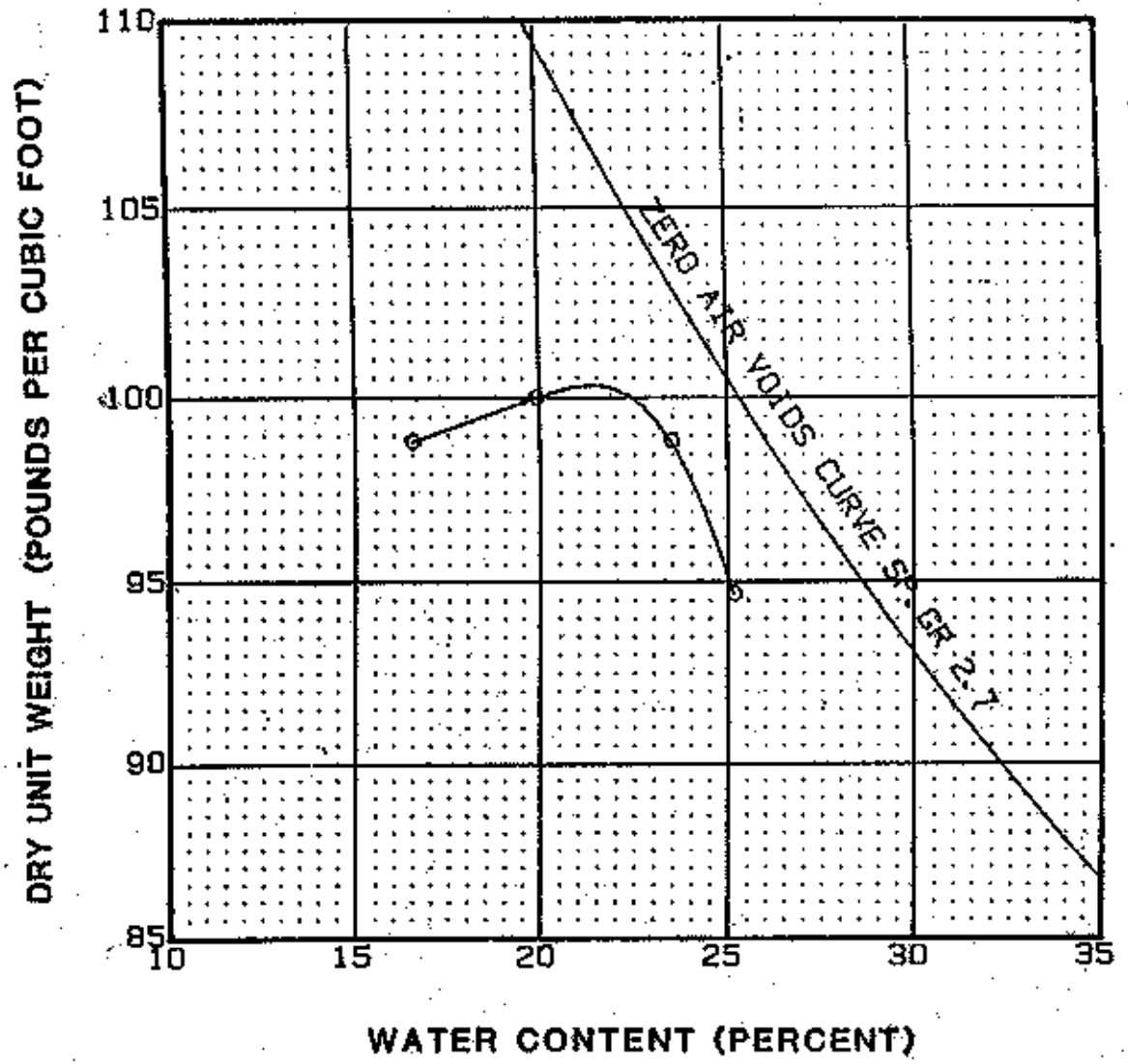
checked by JY

L-2 10/88

PLATE

R 103

Job # 11295.000
Date: 8-8-90



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-78 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
100.4	21.3	

DESCRIPTION

Brown and gray CLAY

ATTERBERG LIMITS

LL- 72 PL- 25 PI- 47

CLASSIFICATION SYSTEM

UNIFIED : CH

AASHTO :

SAMPLE INFORMATION

TPHS-6, BU-02, 5.5'-7.5'

WSSRAP

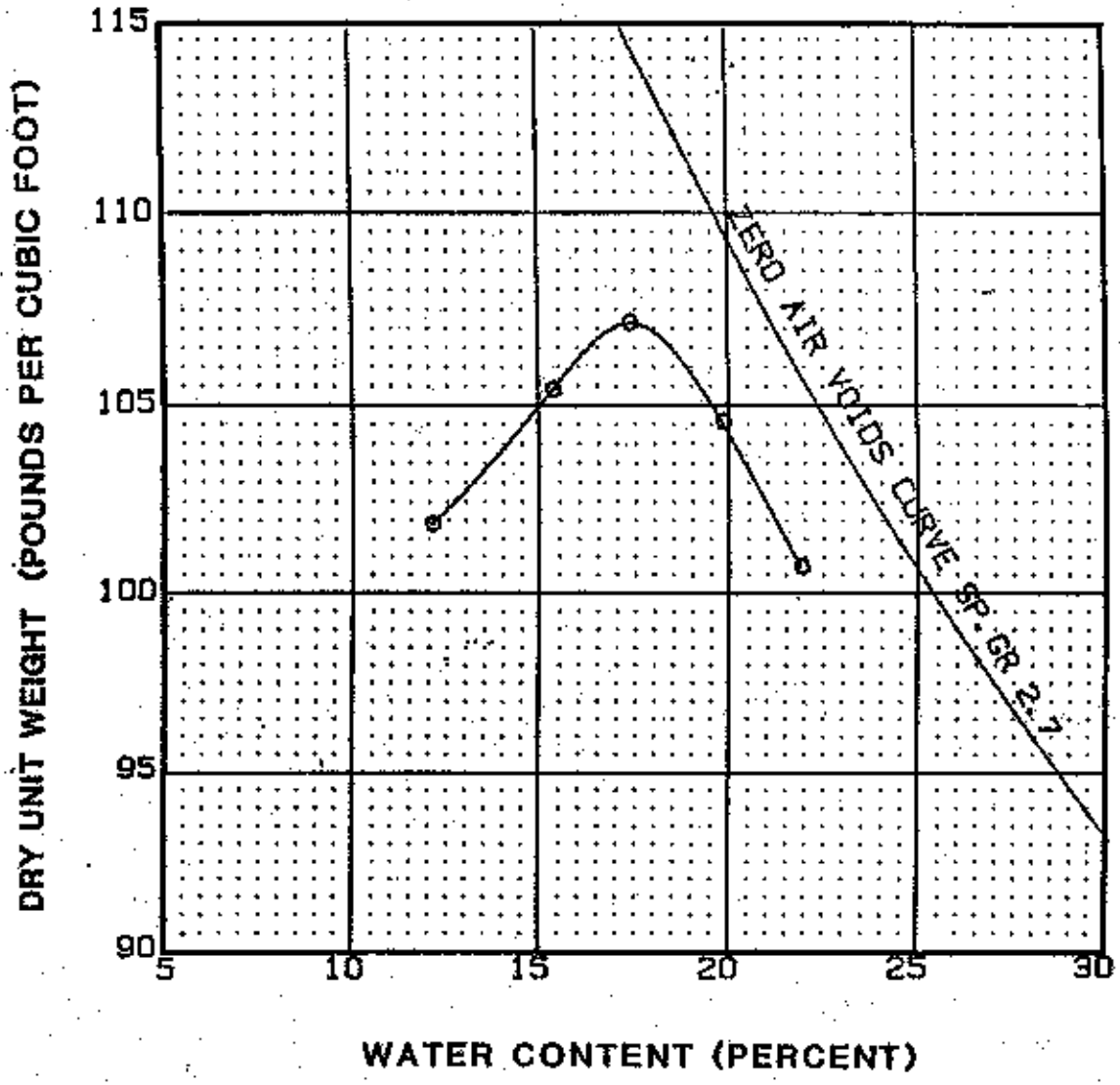
COMPACTION TEST

GEOTECHNOLOGY

PLATE

R 105

Job # 11295.000
Date: 8-9-90



SPECIFICATIONS

STANDARD PROCTOR

AASHO T 99-70, ASTM D 698-78 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
107.2	17.4	

DESCRIPTION

Brown, silty CLAY

ATTERBERG LIMITS

LL- 37 PL- 17 PI- 20

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

TPWS-7 BU-01 1.0'-7.0'

WSSRAP

COMPACTION TEST

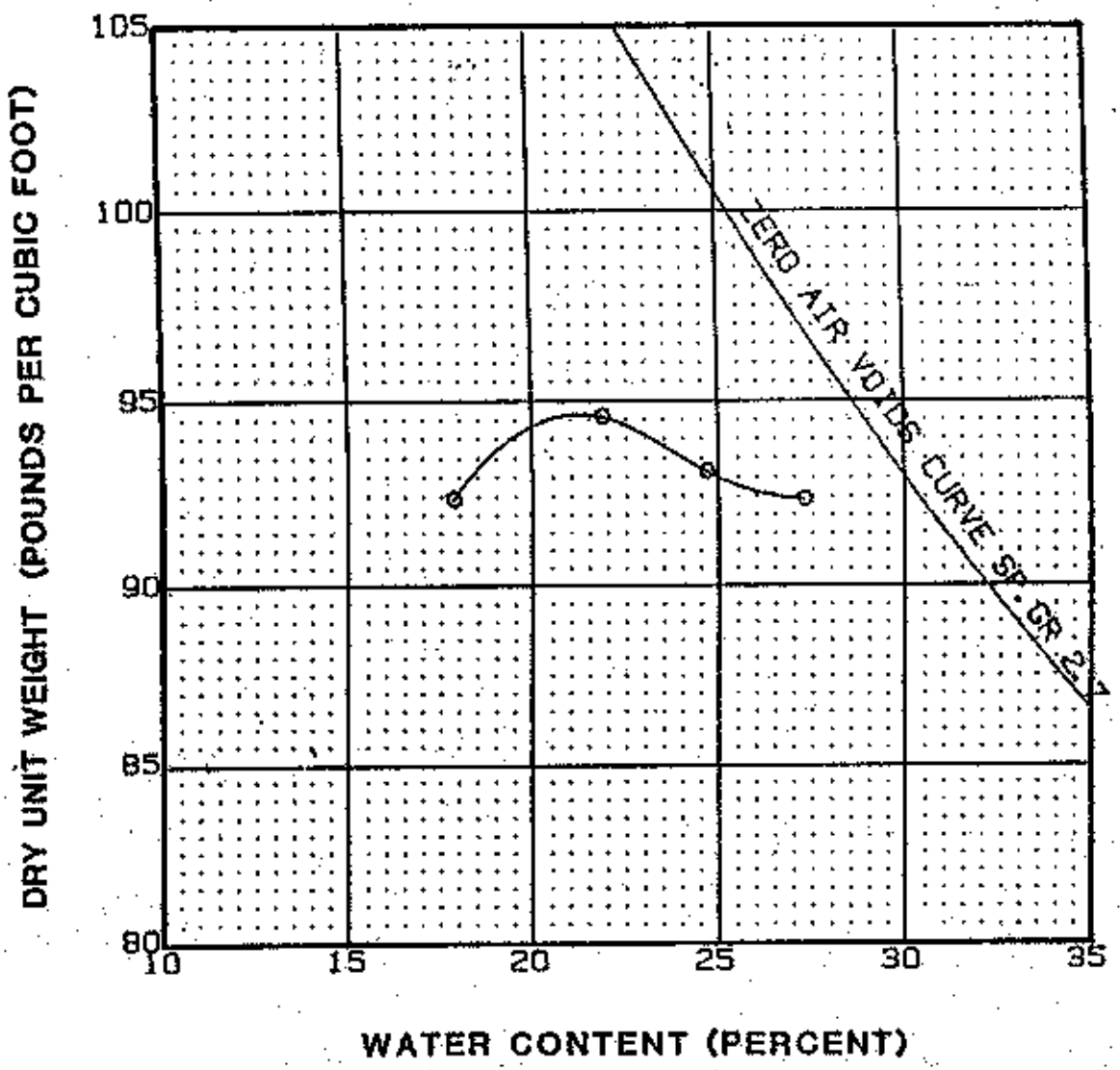
GEOTECHNOLOGY

checked by 74

PLATE

R 107

Job # 11295.000
Date: 9-9-90



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
94.7	21.1	

DESCRIPTION

Brown to dark brown CLAY

ATTERBERG LIMITS

LL- 82 PL- 24 PI- 58

CLASSIFICATION SYSTEM

UNIFIED : CH

AASHTO :

SAMPLE INFORMATION

TPNS 7, BU-02, 7.0'-9.5'

WSSRAP

COMPACTION TEST

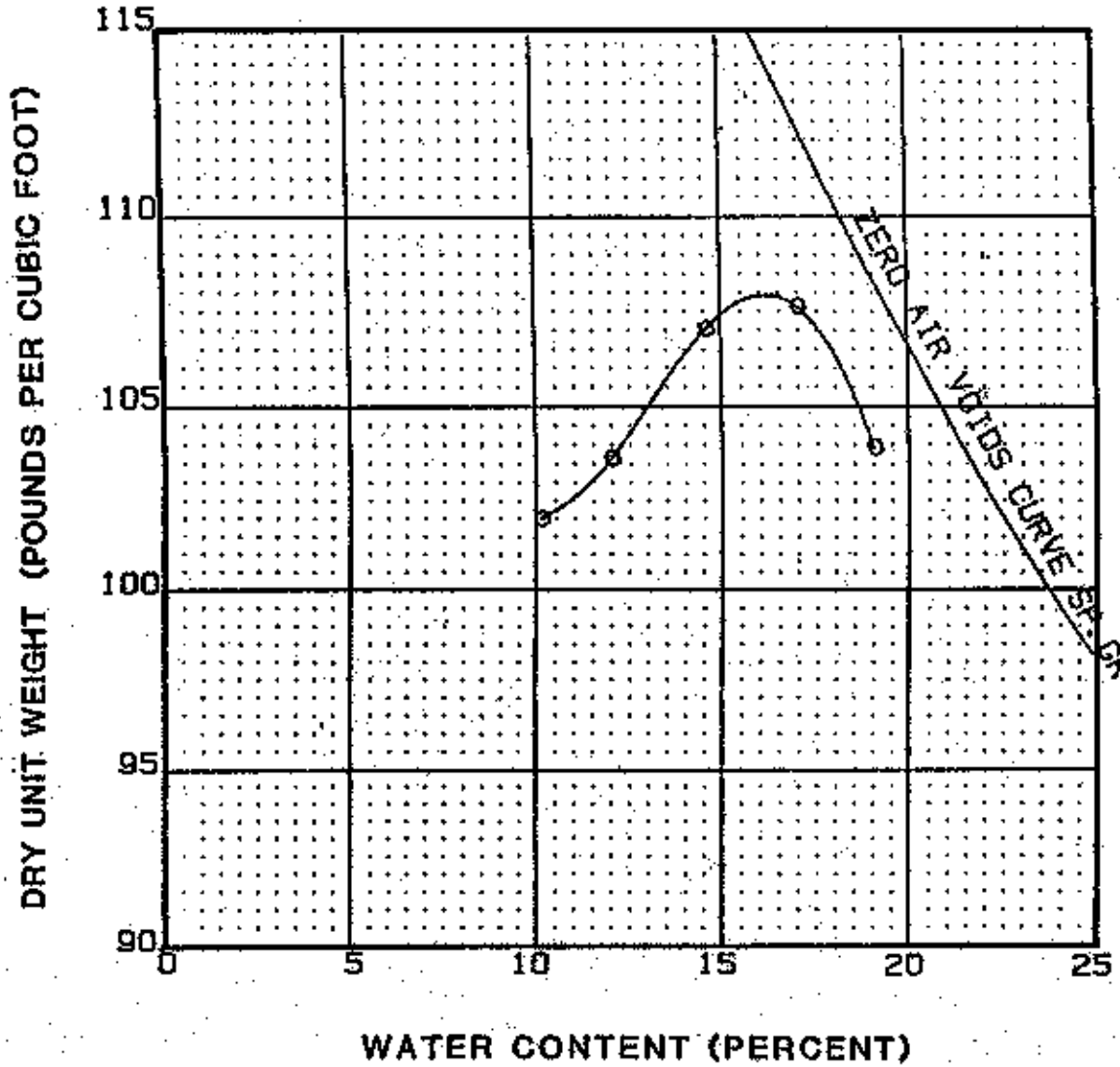
GEOTECHNOLOGY

PLATE

R102

RRD

Job # 11295.000
Date: 9-8-90



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-78 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
109.0	16.3	

DESCRIPTION

Brown and gray, silty CLAY

ATTERBERG LIMITS

LL- 30 PL- 19 PI- 11

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO : .

SAMPLE INFORMATION

TPHS-8, BU-01, 1.0' - 5.0'

WSSRAP

COMPACTION TEST

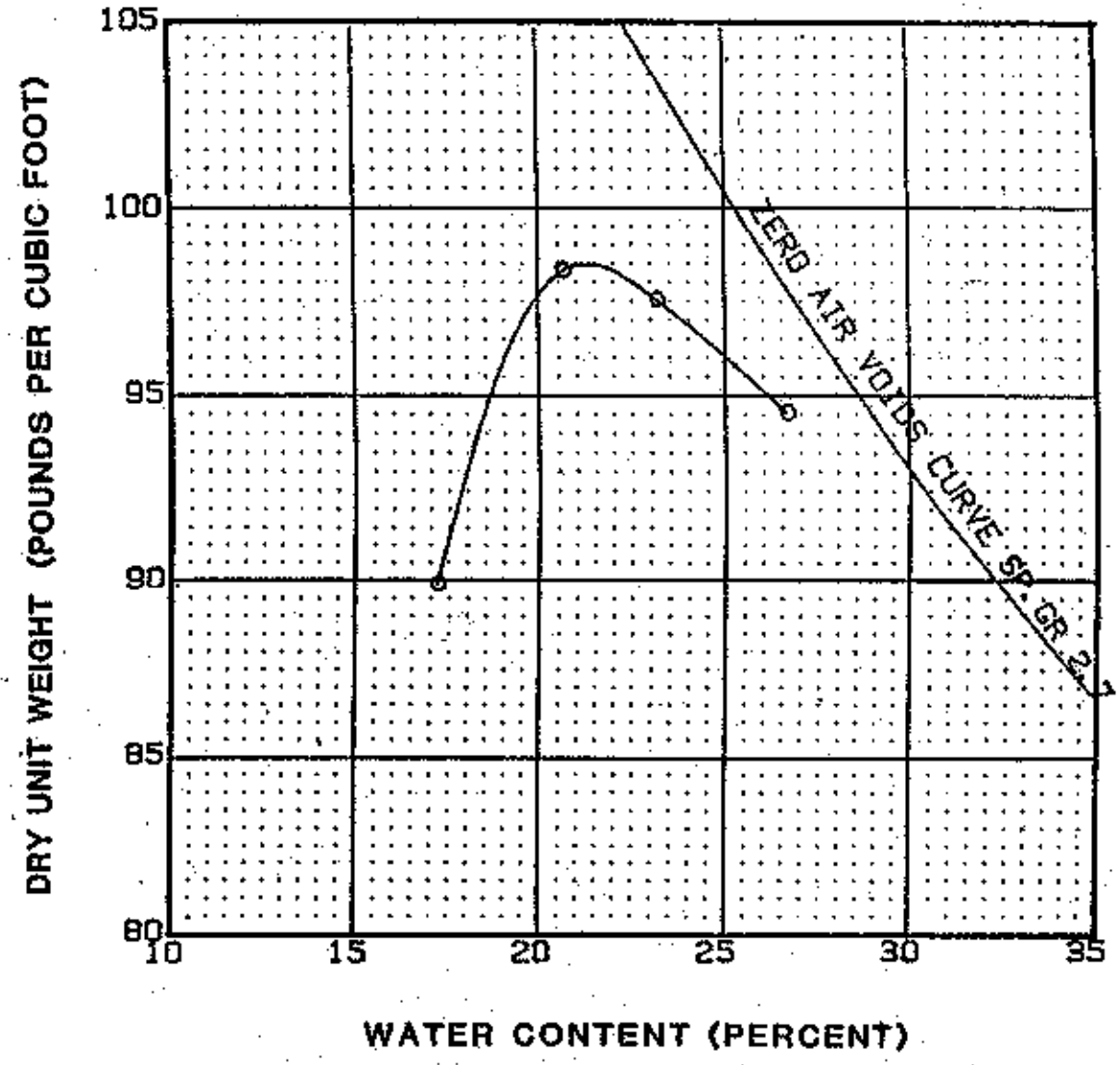
GEOTECHNOLOGY

PLATE

R 111

L-2 10/88

Job # 11295.000
Date: 8-9-90



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-78 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
98.6	21.4	

DESCRIPTION

Gray CLAY

ATTERBERG LIMITS

LL-63 PL-19 PI-44

CLASSIFICATION SYSTEM

UNIFIED : CH

AASHTO :

SAMPLE INFORMATION

TPNS-8 BU-02 5.0-10.5

WSSRAP

COMPACTION TEST

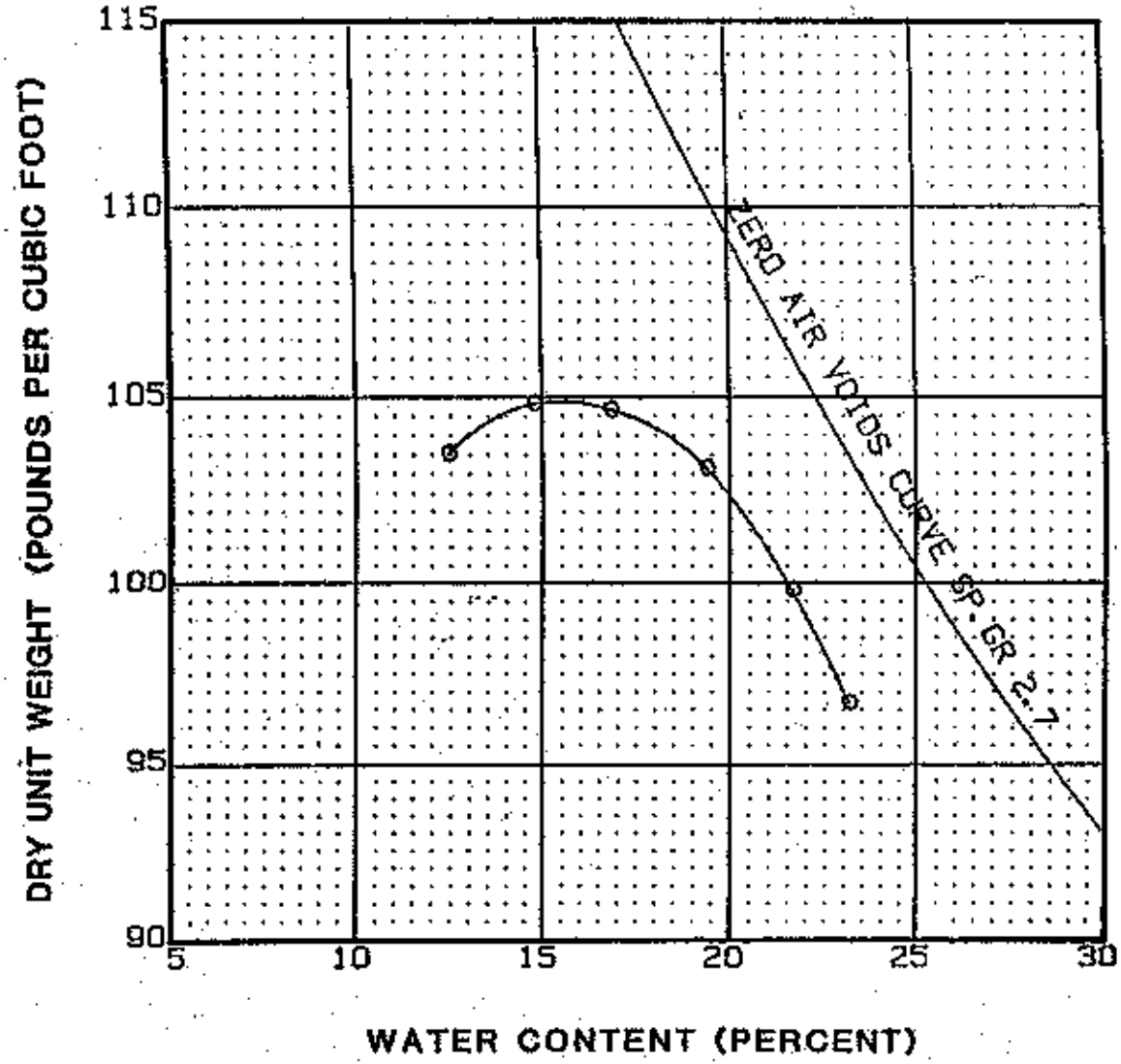
GEOTECHNOLOGY

checked by 77

PLATE

R 113

Job # 11295.000
Date: 8-9-90



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-78 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
104.9	15.4	

DESCRIPTION

Brown, silty CLAY

ATTERBERG LIMITS

LL- 38 PL- 20 PI- 18

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

TPWS-9, BU-01, 1.0'-7.0'

WSSRAP

COMPACTION TEST

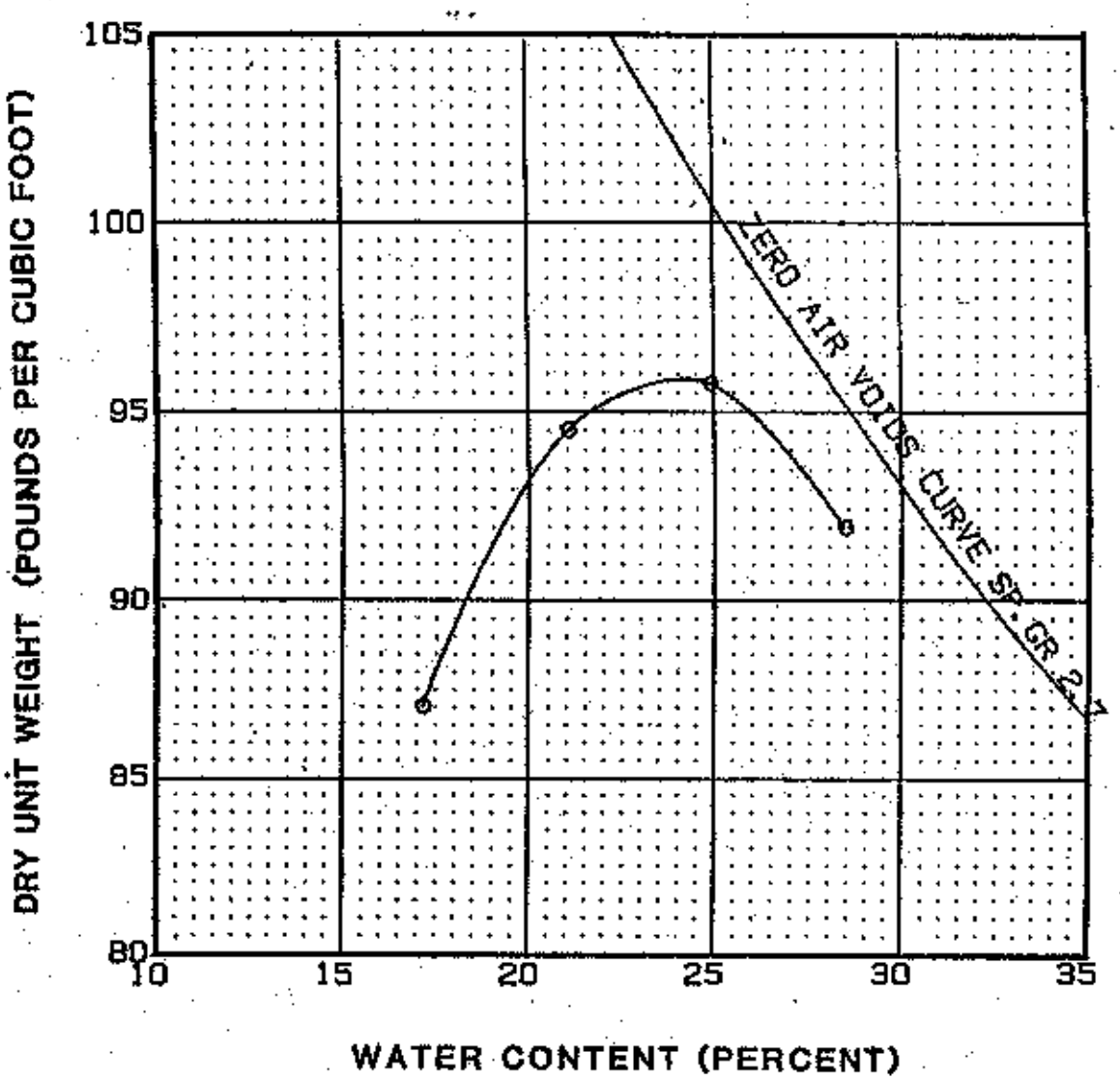
GEOTECHNOLOGY

checked by YY

PLATE

R 115

Job # 11295.000
Date: 8-8-90



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-78 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
95.9	24.1	

DESCRIPTION

Brown and orange CLAY with brown, silty clay

ATTERBERG LIMITS

LL- 69 PL- 24 PI- 45

CLASSIFICATION SYSTEM

UNIFIED : CH

AASHTO :

SAMPLE INFORMATION

TPWS-8, SU-02, 8.5' - 15.0'

WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

Checked by yy

PLATE

R 117

Request # 8

P.O. # 3509-1002-3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WSSRAP

DATE: 8/20/90

LAB NAME: Geotechnology, Inc

CHECKED BY: LAB 47

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
TPMS-1	BU-01	8.0-6.0	CH	95.7	17.7	25.1	98.6		68.5*		16.1	5×10^{-8}
TPMS-3	BU-01	1.0-6.0	CH	95.4	17.7	24.1	99.5		70.1*		" 16.1	2×10^{-7}

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE:

ATTACHMENT

R 119

MOISTURE, DRY DENSITY,
SPECIFIC GRAVITY

Request #3

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

P.O. #3589-1002-3445

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: WJJ RAP

CHECKED BY: LAB YY

DATE: 11-15-89

TAC

LAB NAME: Geotechnology Inc

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
TPBJ-1	2A	2.6-7.1	11.1	N/A
TPBJ-1	3A	7.1-7.2	26.4	N/A
TPBJ-1	4A	9.2-14.1	20.5	N/A
TPBJ-6	1A	0.6-9.1	24.6	N/A
TPBJ-6	2A	9.1-12.6	24.9	N/A
TPBJ-8	1A	0.6-4.3	21.8	N/A
TPBJ-8	2A	4.3-8.5	13.3	N/A
TPBJ-8	3A	8.5-11.9	21.0	N/A
TPBJ-10	1A	0.5-6.1	23.5	N/A
TPBJ-10	2A	8.2-10.9	20.1	N/A
TPBJ-10	3A	10.9-13.4	23.1	N/A
TPBJ-11	1A	0.6-10.4	25.3	N/A
TPBJ-11	2A	10.4-12.3	27.4	N/A
TPBJ-14	2A	2.9-8.4	25.2	N/A
TPBJ-14	3A	8.4-11.8	22.4	N/A

TEST PROCEDURE: ASTM D2216

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

Request #3
P.O. #3589-1002-3445

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: WJS RAB

DATE: 11-15-89

LAB NAME: Geotechnology

CHECKED BY: LAB 44

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
TPBJ-15	1A	2.4-10.8	25.5	N/A
TPBJ-15	2A	10.8-12.9	28.1	N/A
TPBJ-23	1A	0.7-13.1	26.2	N/A
TPBJ-28	1A	0.7-9.9	23.2	N/A
TPBJ-30	1A	1.8-13.4	28.0	N/A

TEST PROCEDURE: ASTM D2216

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: Borrow Source No. 1
LOCATION ID:
DATE: 6-27-89
CHECKED BY: LAB ML
LAB NAME: Geotechnolog
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY	SOIL CLASSIFICATION
TPBS-1 2A	2.6-7.1	31	18	13		CL
TPBS-1 3A	7.1-9.2	60	39	21		MH
TPBS-1 4A	9.2-14.1	42	24	18		CL
TPBS-6 1A	0.6-9.1	38	27	11		ML
TPBS-6 2A	9.1-12.6	64	20	44		CH
TPBS-8 1A	0.6-4.3	34	18	16		CL
TPBS-8 2A	4.3-8.5	31	19	12		CL
TPBS-8 3A	8.5-11.9	50	20	30		CL-CH
TPBS-10 1A	0.5-6.1	49	32	17		ML
TPBS-10 2A	8.2-10.9	43	32	11		ML
TPBS-11 1A	0.6-10.4	33	21	12		CL
TPBS-11 2A	10.4-12.3	57	30	27		CH
TPBS-14 2A	2.9-8.4	35	20	15		CL
TPBS-14 3A	8.4-11.8	Non-Plastic				ML

TEST PROCEDURE: ASTM D 4318

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: Borrow Source #No. 1
LOCATION ID:
DATE: 6-27-89
CHECKED BY: LAB ML
LAB NAME: Geotechnology Inc.
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY	SOIL CLASSIFICATION
TPBS-15 1A	2.4-10.8	41	32	9		ML
TPBS-15 2A	10.8-12.9	71	21	50		CH
TPBS-23 1A	0.7-13.1	37	16	21		CL
TPBS-28 1A	0.7-9.9	38	19	19		CL
TPBS-30 1A	1.8-12.4	37	25	12		ML
~~GTQ-5 ST 06~~	~~15.0-17.5~~	~~79~~	~~24~~	~~55~~		~~CH~~
TBS-10 3A	10.9-13.4	61	18	43		CH

TEST PROCEDURE: ASTM D 4318

Request # 3
P.O. # 3509 - 1002 - 3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: WJSRAP

LOCATION ID: Borrow Source Area

DATE: 1-4-90

CHECKED BY: LAB 4/7

LAB NAME: Geotechnology, Inc.

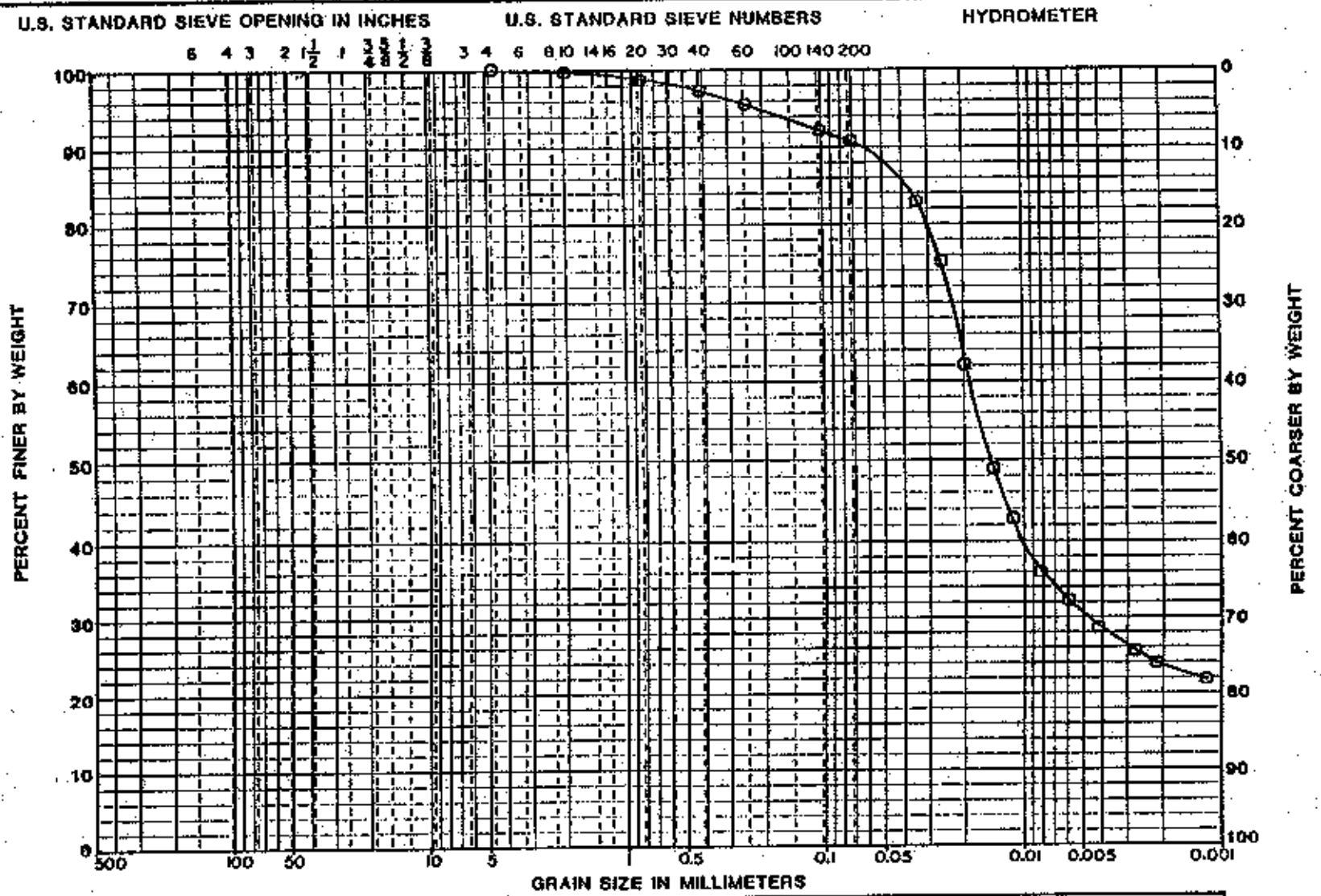
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY	SOIL CLASSIFICATION
TPBJ-1 2A	2.6 - 7.1				2.65	
TPBJ-1 3A	7.1-9.2				2.70	
TPBJ-1 4A	9.2-14.5				2.55	
TPBJ-6 1A	0.6-9.1				2.64	
TPBJ-6 2A	9.1-12.6				2.74	
TPBJ-8 1A	0.6-4.3				2.73	
TPBJ-8 2A	4.3-8.5				2.64	
TPBJ-8 3A	8.5-11.9				2.59	
TPBJ-11 1A	0.6-10.4				2.72	
TPBJ-11 2A	10.4-12.3				2.69	
TPBJ-23 1A	0.7-13.1				2.71	
TPBJ-28 1A	0.7-9.9				2.65	
TPBJ-30 1A	1.8-12.4				2.62	

TEST PROCEDURE: Atterberg Limit (ASTM D4318)
Specific Gravity (ASTM D854)

GRADATION AND ATTERBERG LIMIT TESTS

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
2A	2.8-7.1	CL	11.6	31	18	13

PROJECT WSSRAP

BORING NO. TPB5-1

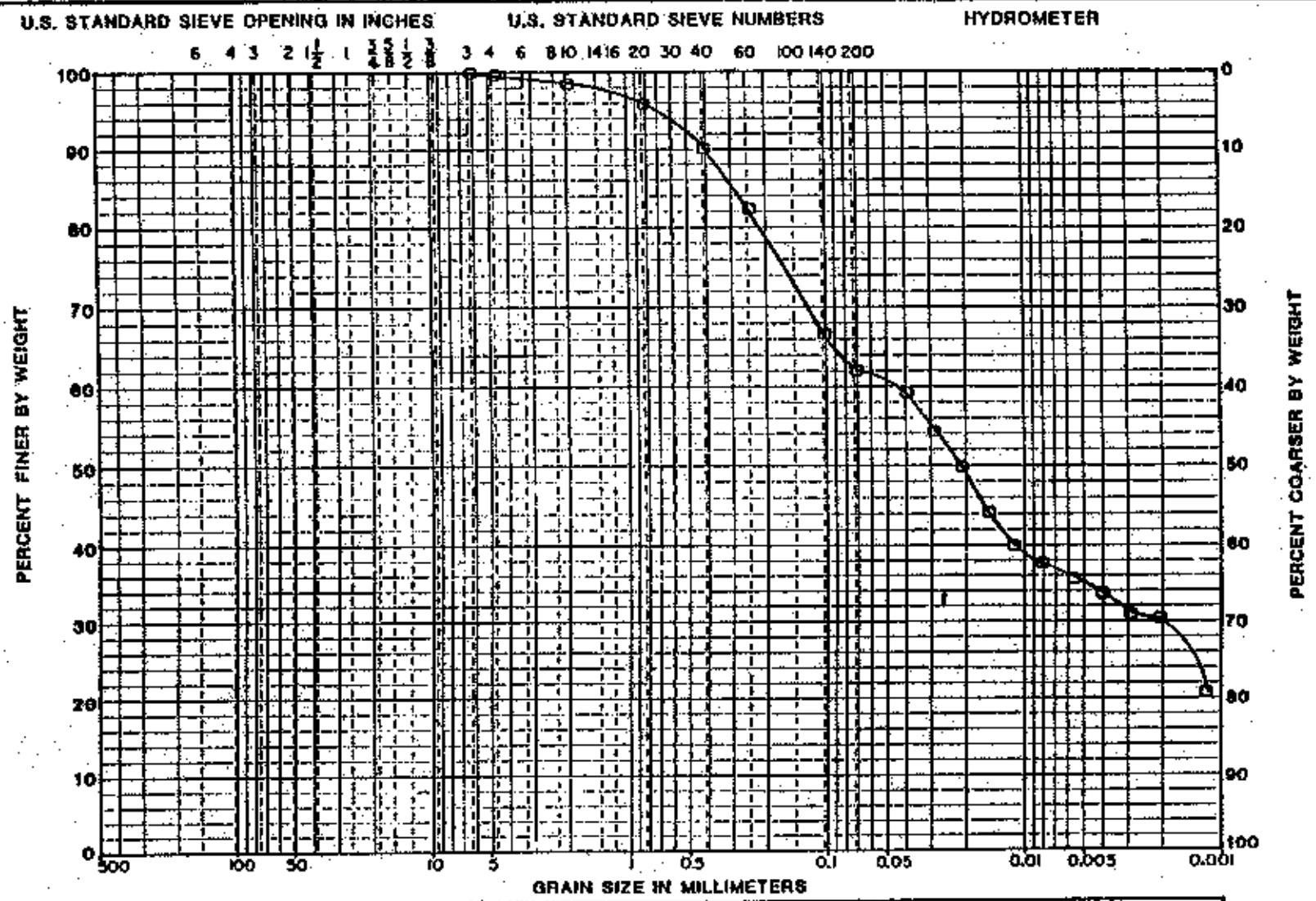
DATE 6-27-89

GEOTECHNOLOGY
ENGINEERING AND ENVIRONMENTAL SERVICES
SAINT LOUIS, MISSOURI

PLATE F4

11295

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
4A	9.2–14.1		18.2			

PROJECT WSSRAP

BORING NO. TPBS-1

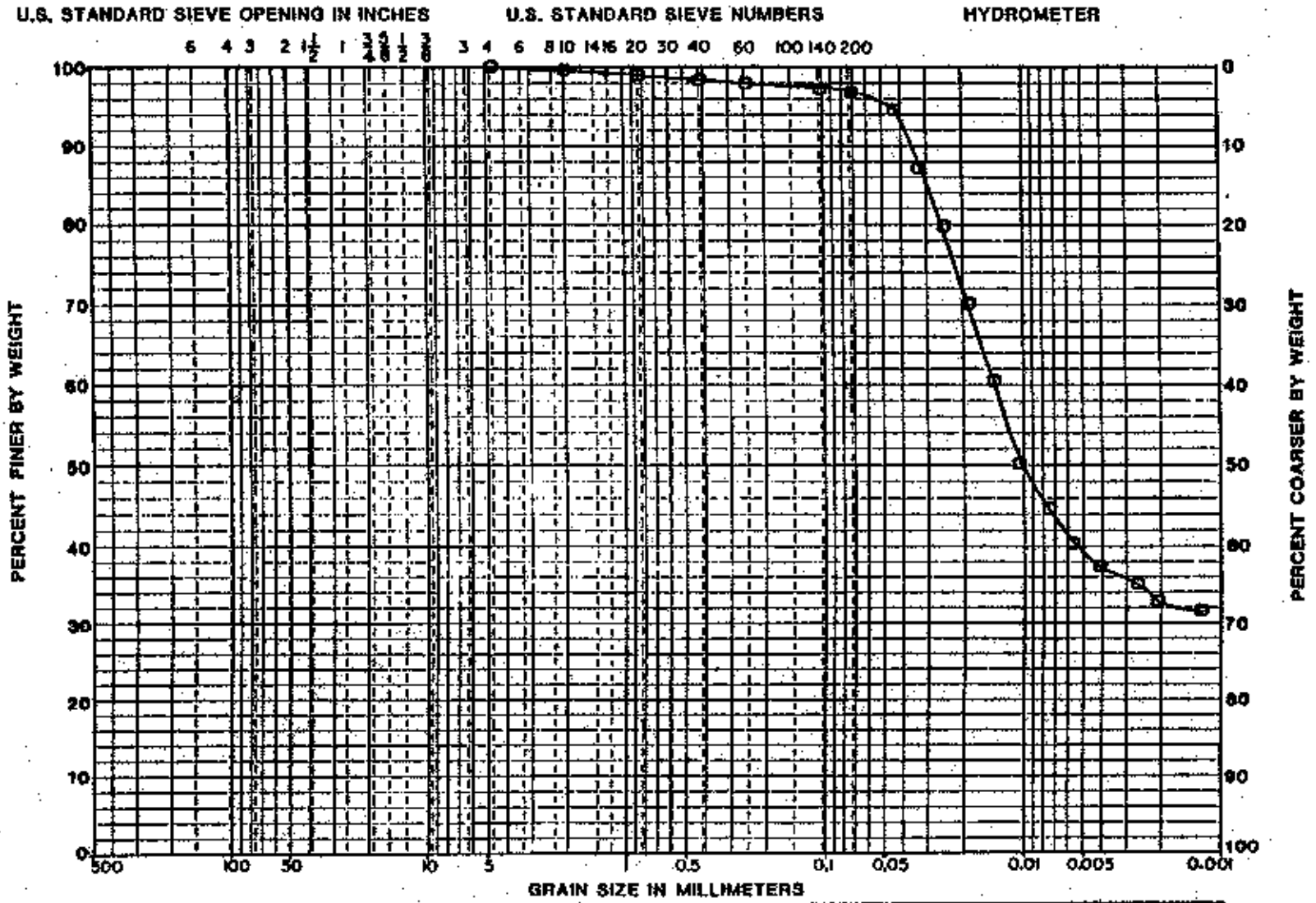
DATE 6-27-89

GEOTECHNOLOGY

11295

PLATE E-63

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
1A	0.6-9.1		25.6			

PROJECT WSSRAP

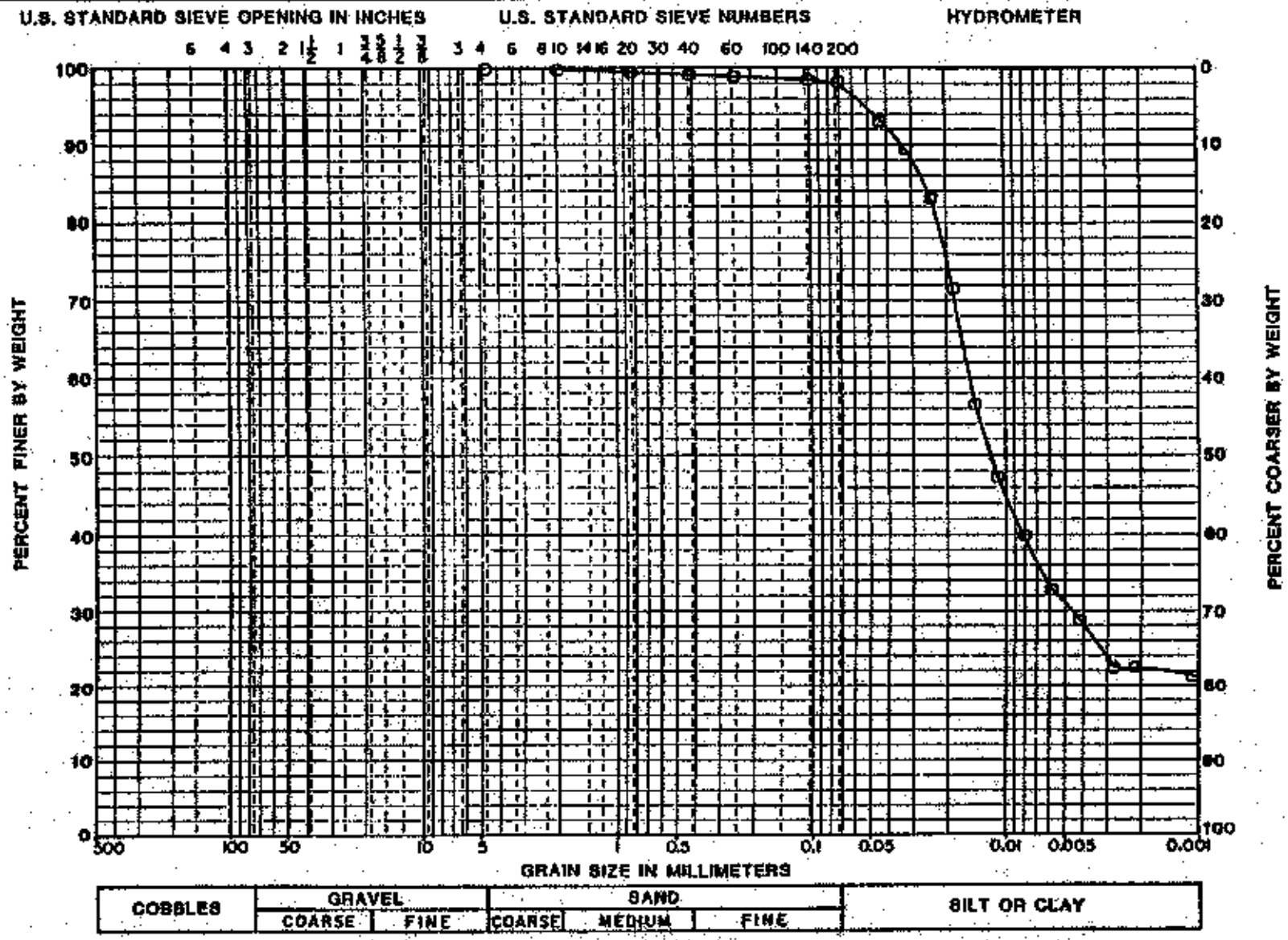
BORING NO. TPBS - 6

DATE 7-1-89

GEOTECHNOLOGY

PLATE 59

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
1A	0.6-4.3		19.7			

PROJECT WSSRAP

BORING NO. TPBS-8

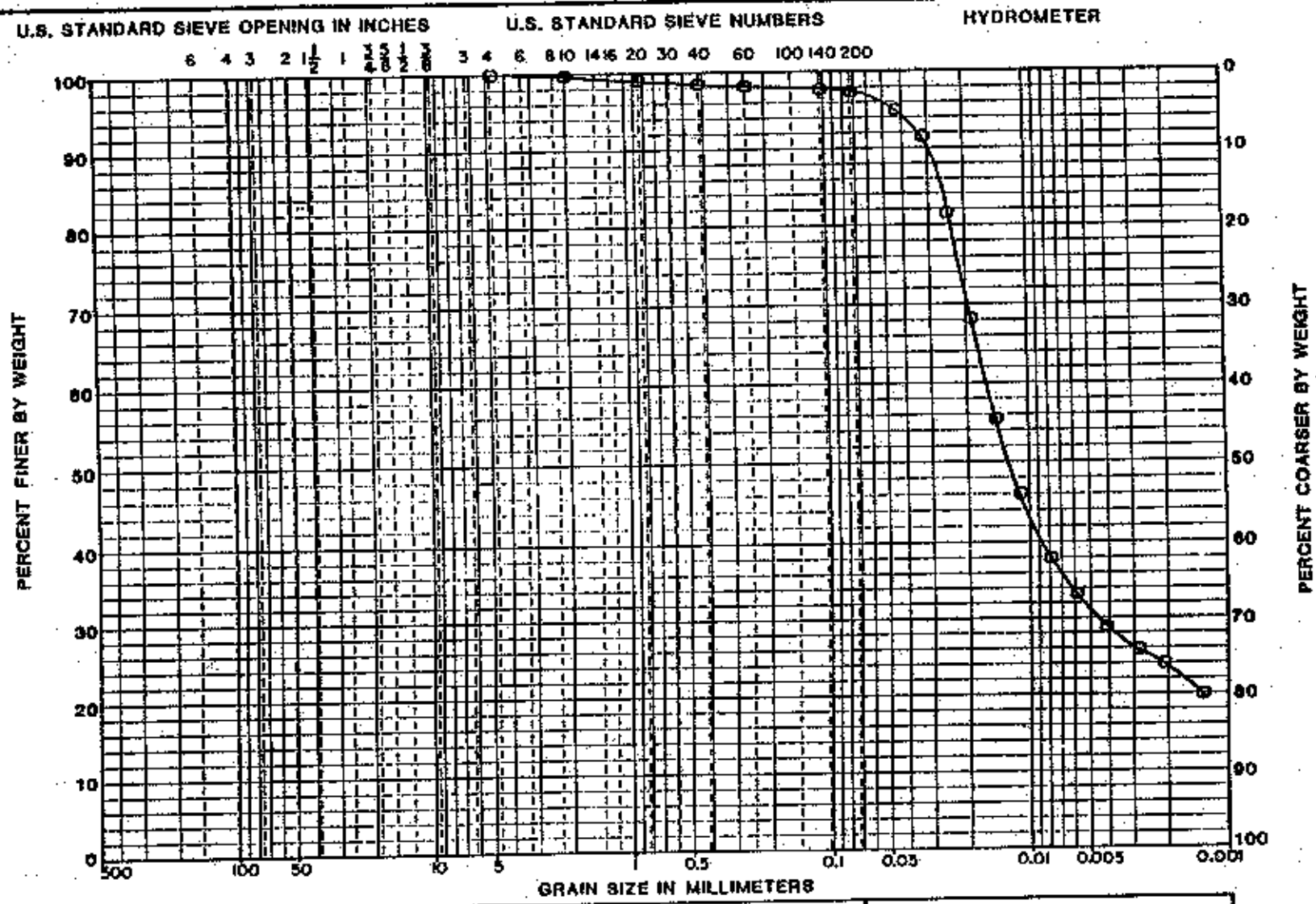
DATE 6-27-89

GEOTECHNOLOGY

PLATE E 55

11285

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
2A	4.3-8.5	CL	11.5	31	19	12

PROJECT WSSRAP

BORING NO. TPBS-8

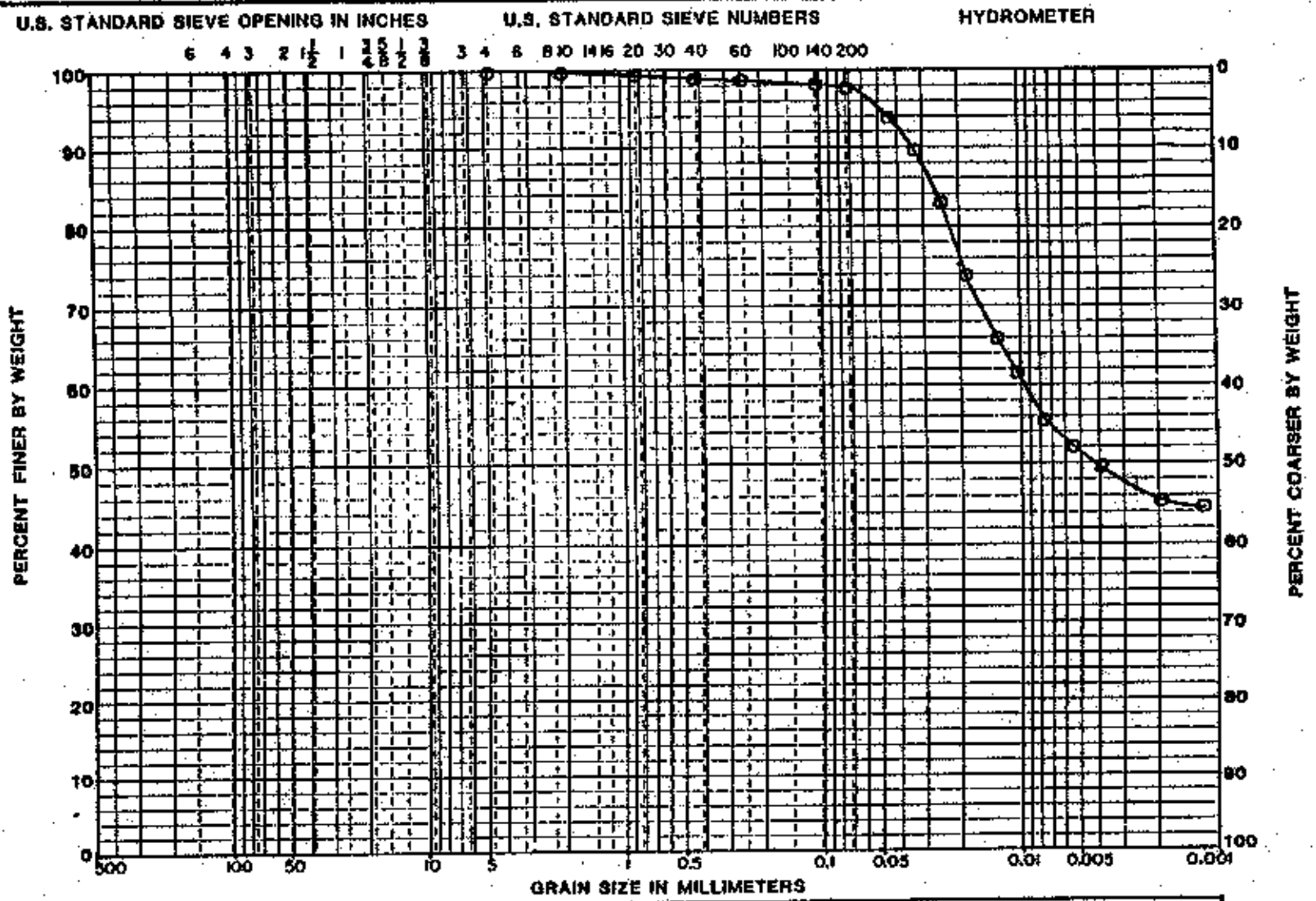
DATE 7-11-88

GEOTECHNOLOGY

11285

PLATE 5

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
3A	8.5-11.9		21.9			

PROJECT WSSRAP

BORING NO. TPBS - 8

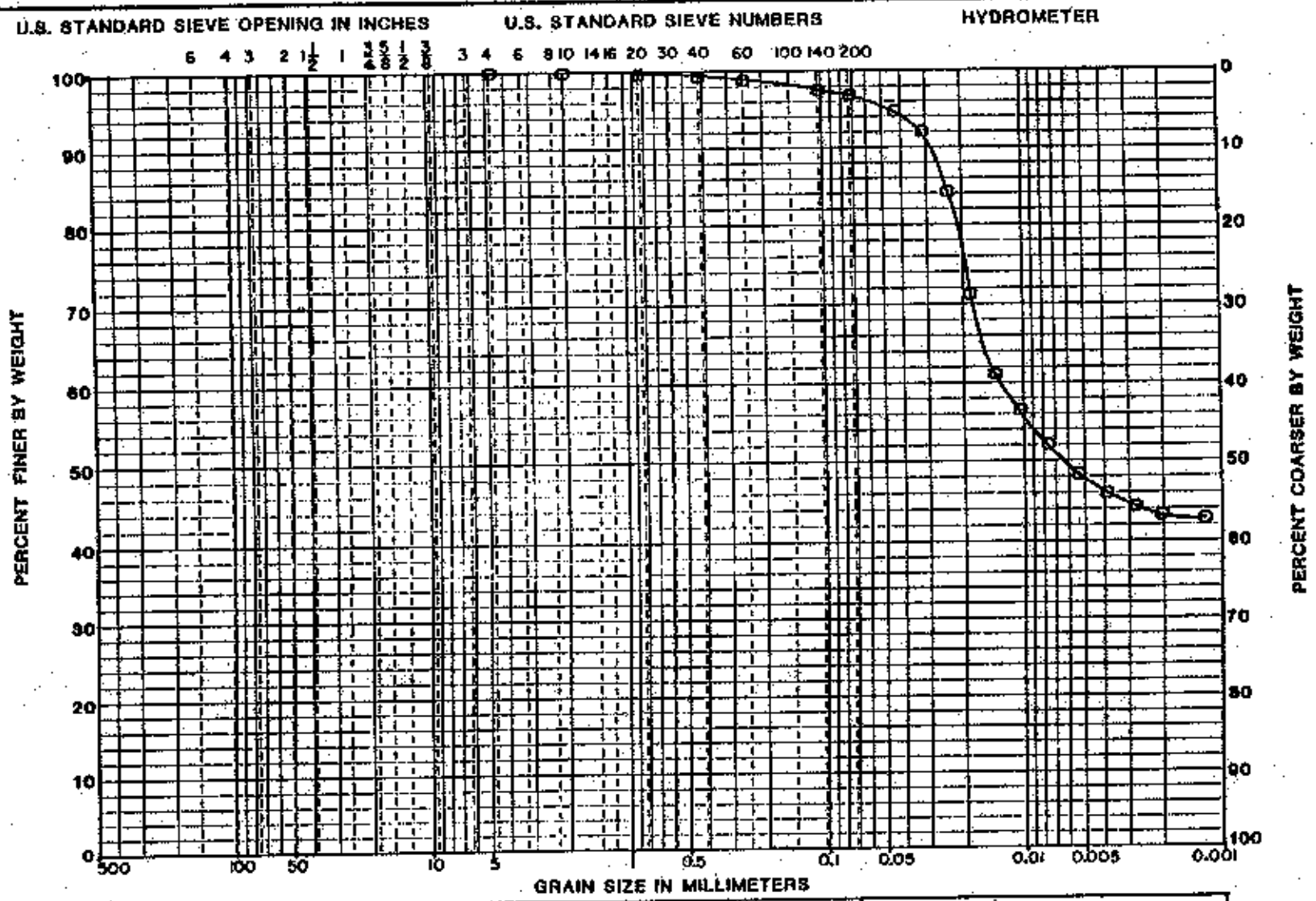
DATE 7-1-89

GEOTECHNOLOGY

11295

PLATE E 51

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
2A	8.2-10.9	ML	21.6	43	32	11

PROJECT WSSRAP

BORING NO. TPBS-10

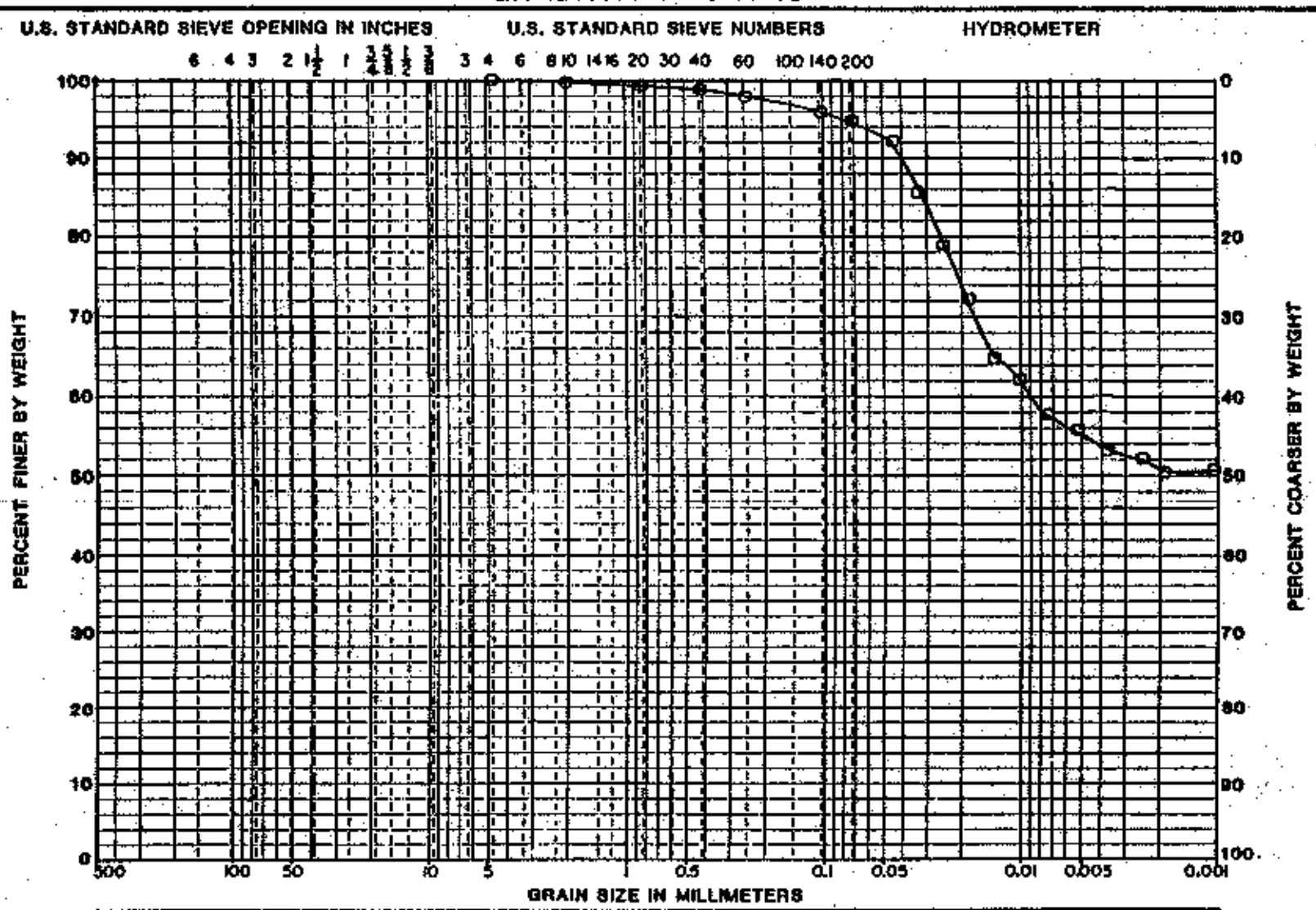
DATE 7-11-89

GEOTECHNOLOGY

11295

PLATE F6

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
3A	10.9-13.4		24.1			

PROJECT WSSRAP

BORING NO. TPBS-10

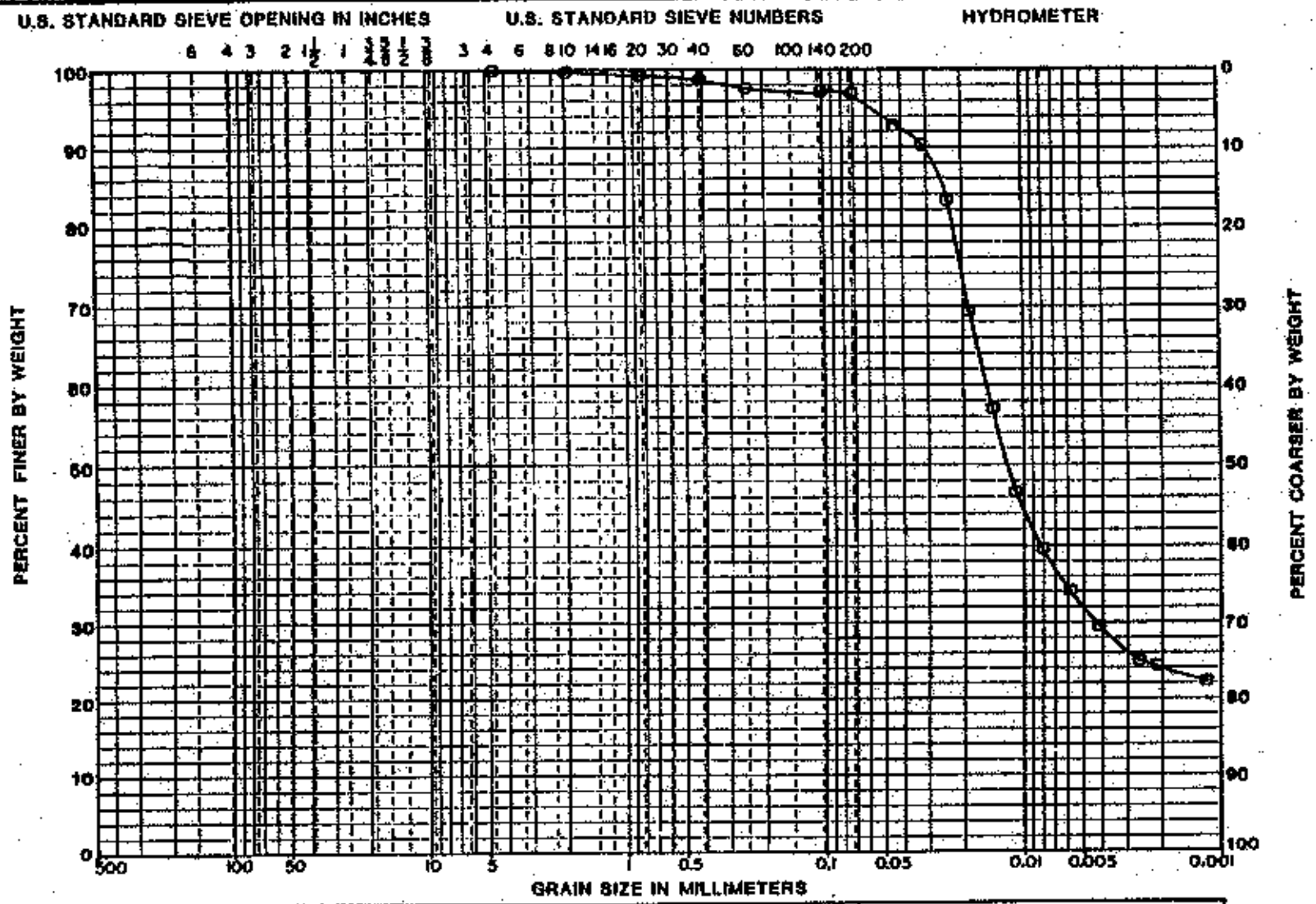
DATE 6-27-89

GEOTECHNOLOGY

11295

PLATE E 47

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
1A	0.6-10.4		24.4			

PROJECT WSSRAP

BORING NO. TPBS-11

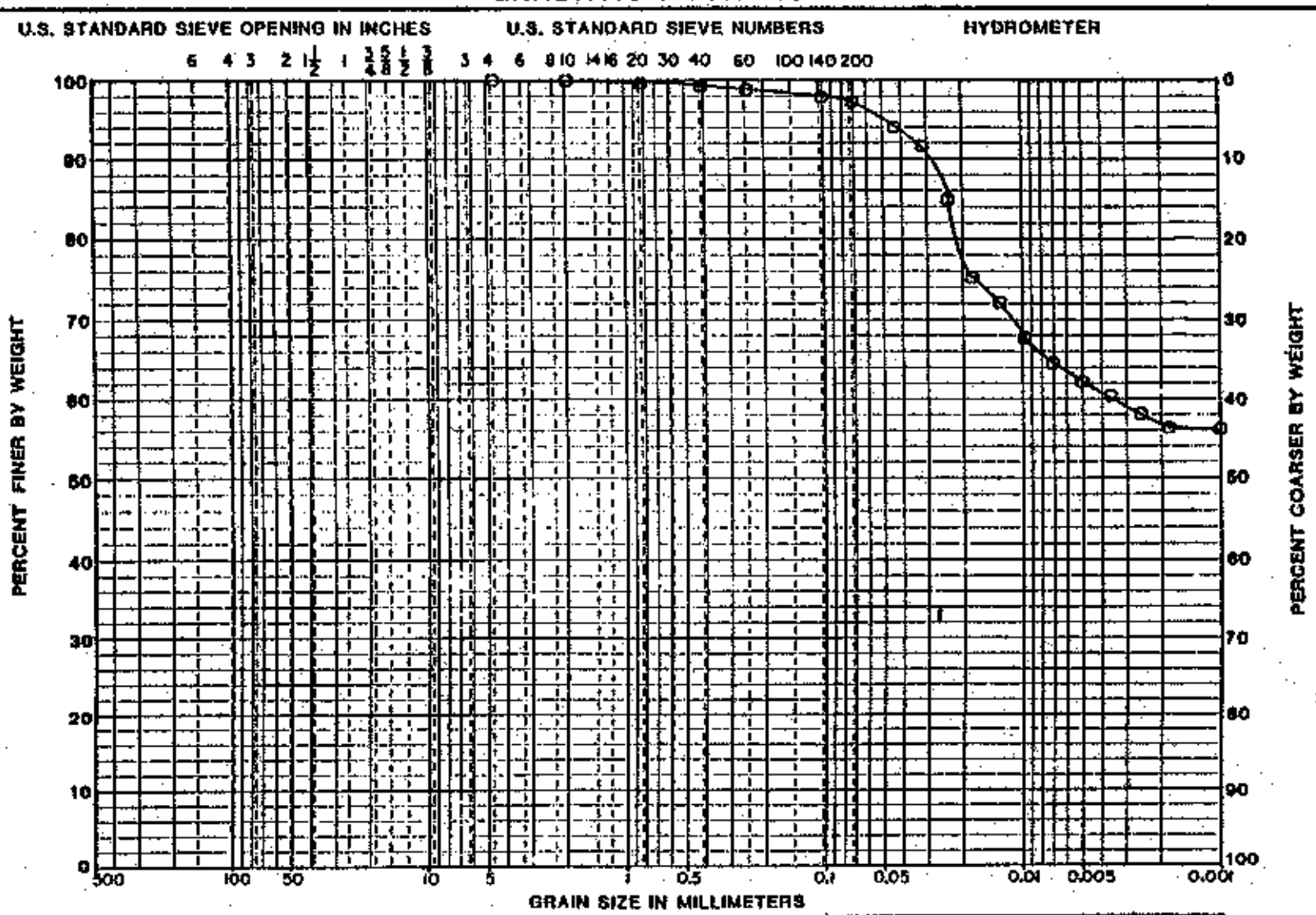
DATE 6-27-88

GEOTECHNOLOGY

11295

PLATE E 43

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
2A	10.4-12.3		29.0			

PROJECT WSSRAP

BORING NO. TPBS-11

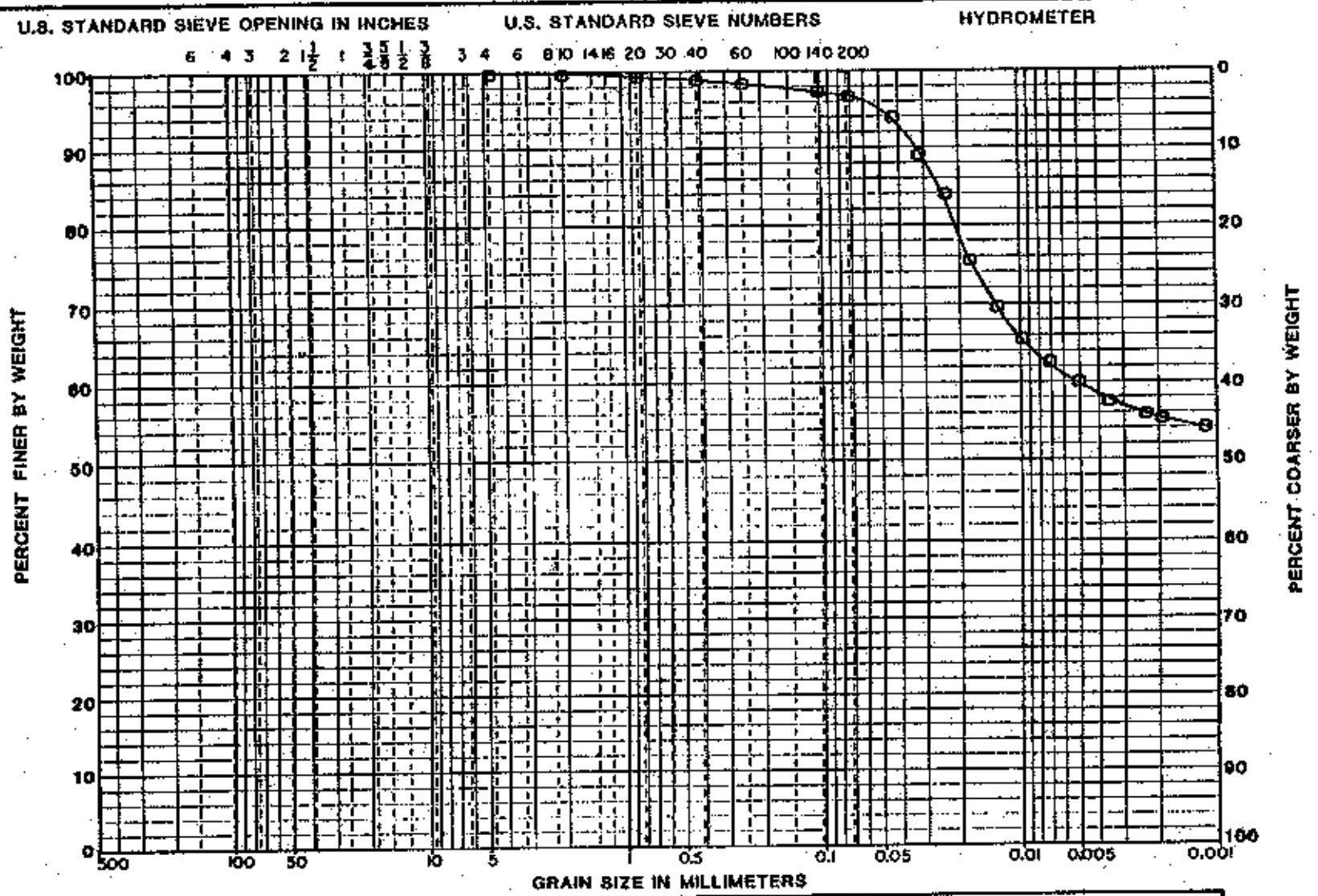
DATE 6-27-89

GEOTECHNOLOGY

11295

PLATE E 39

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
2A	10.4-12.3	CH	28.5	57	30	27

PROJECT MSSRAP

BORING NO. TPBS-11

DATE 7-11-89

GEOTECHNOLOGY

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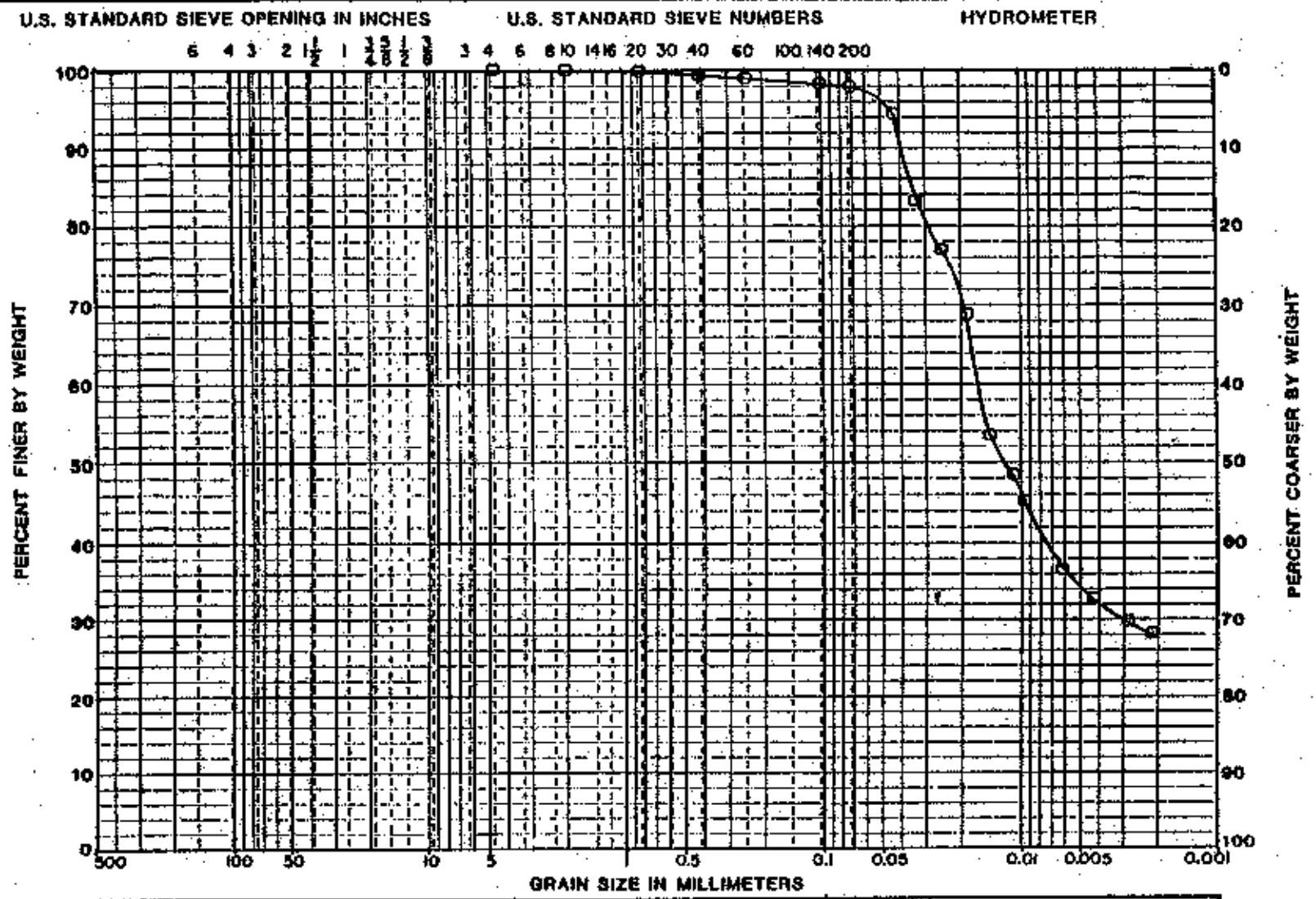
PLATE F 7

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
2A	2.9-8.4		24.8			

PROJECT WSSRAP

BORING NO. TPBS-14

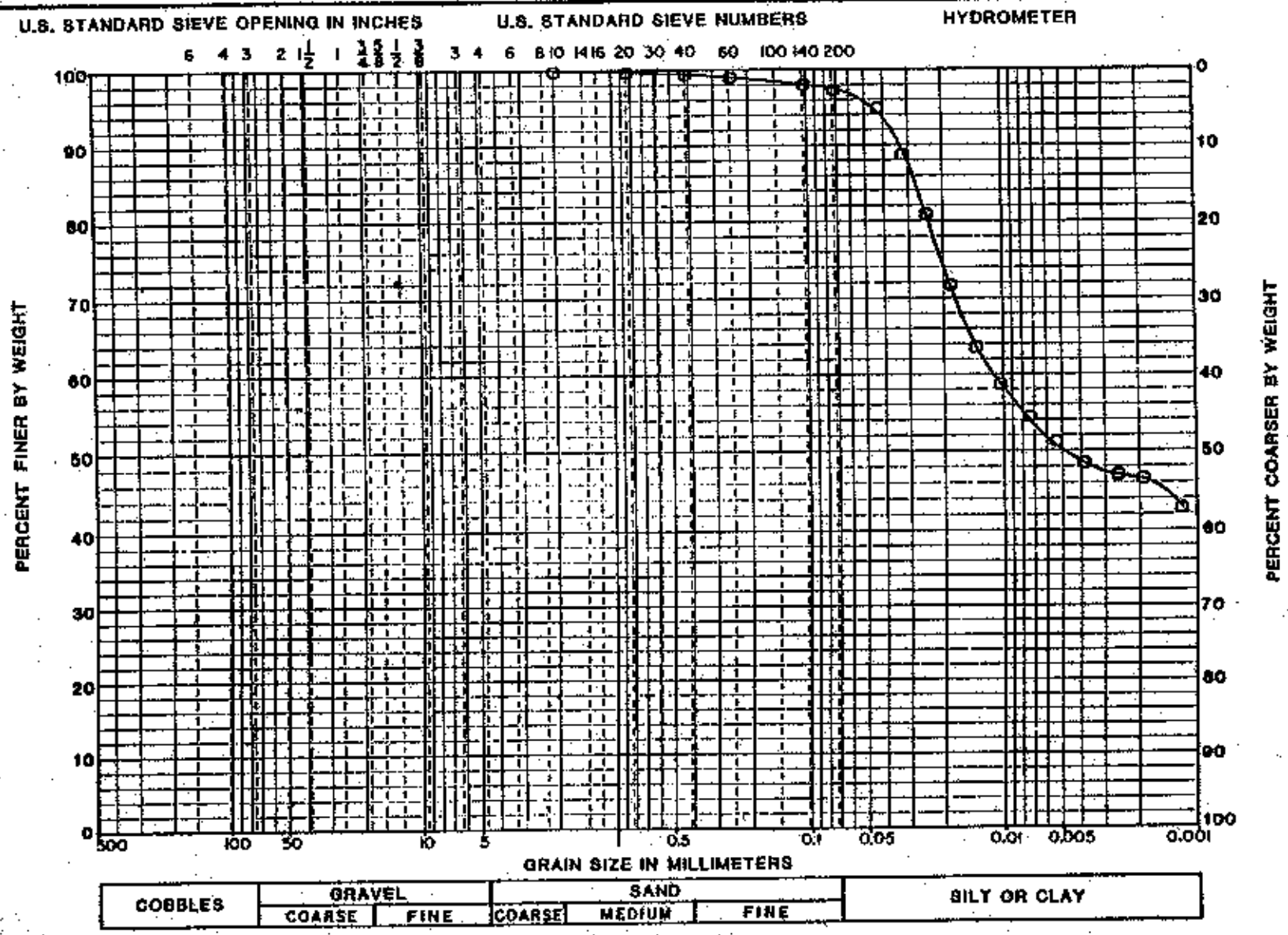
DATE 6-27-89

GEOTECHNOLOGY

11295

PLATE E 35

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
3A	8.4-11.8	ML	22.7			NP

PROJECT WSSRAP

BORING NO. TPBS-14

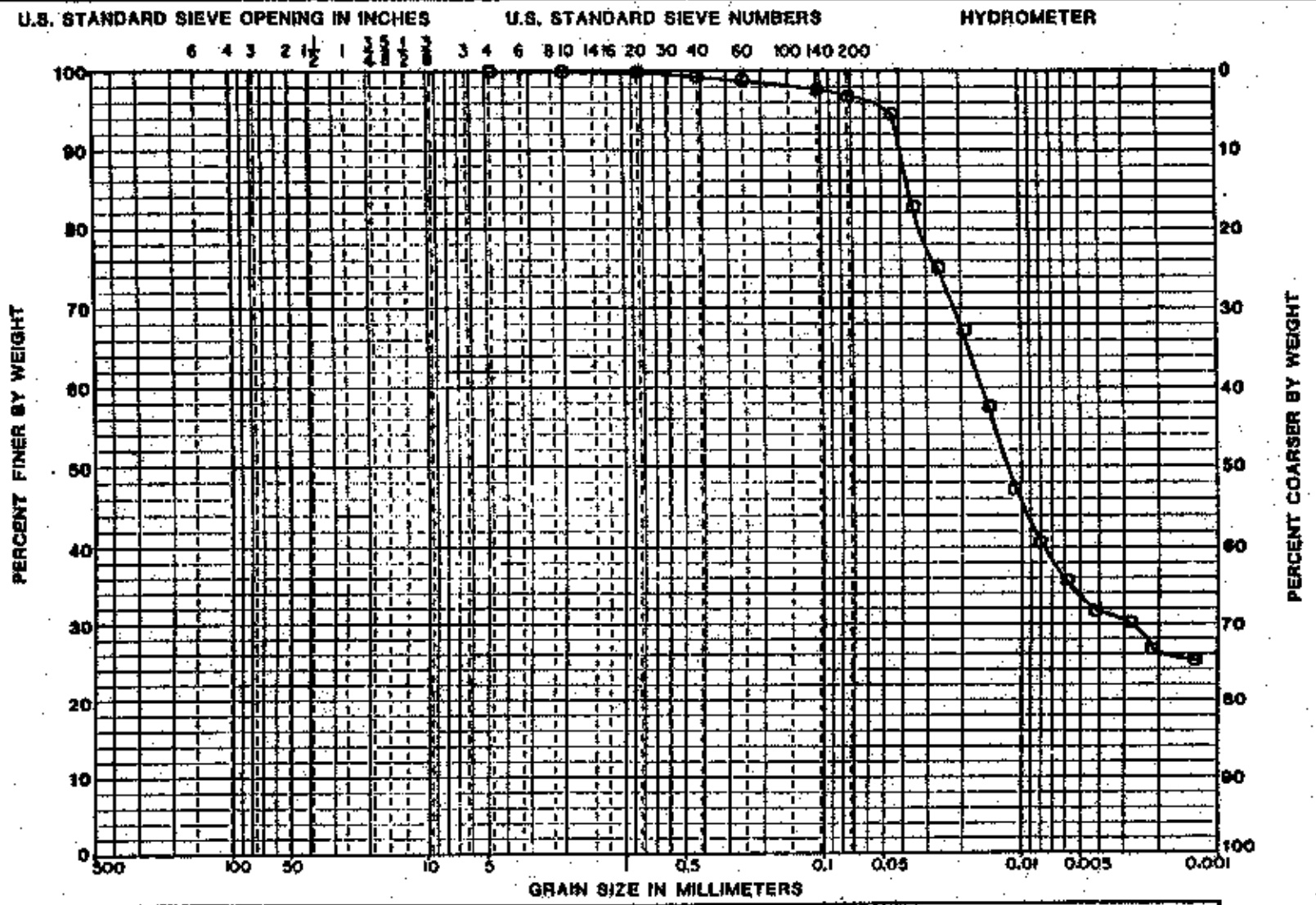
DATE 7-11-89

GEOTECHNOLOGY

11295

PLATE P8

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
1A	2.4-10.8		24.3			

PROJECT VSSRAP

BORING NO. TPBS - 15

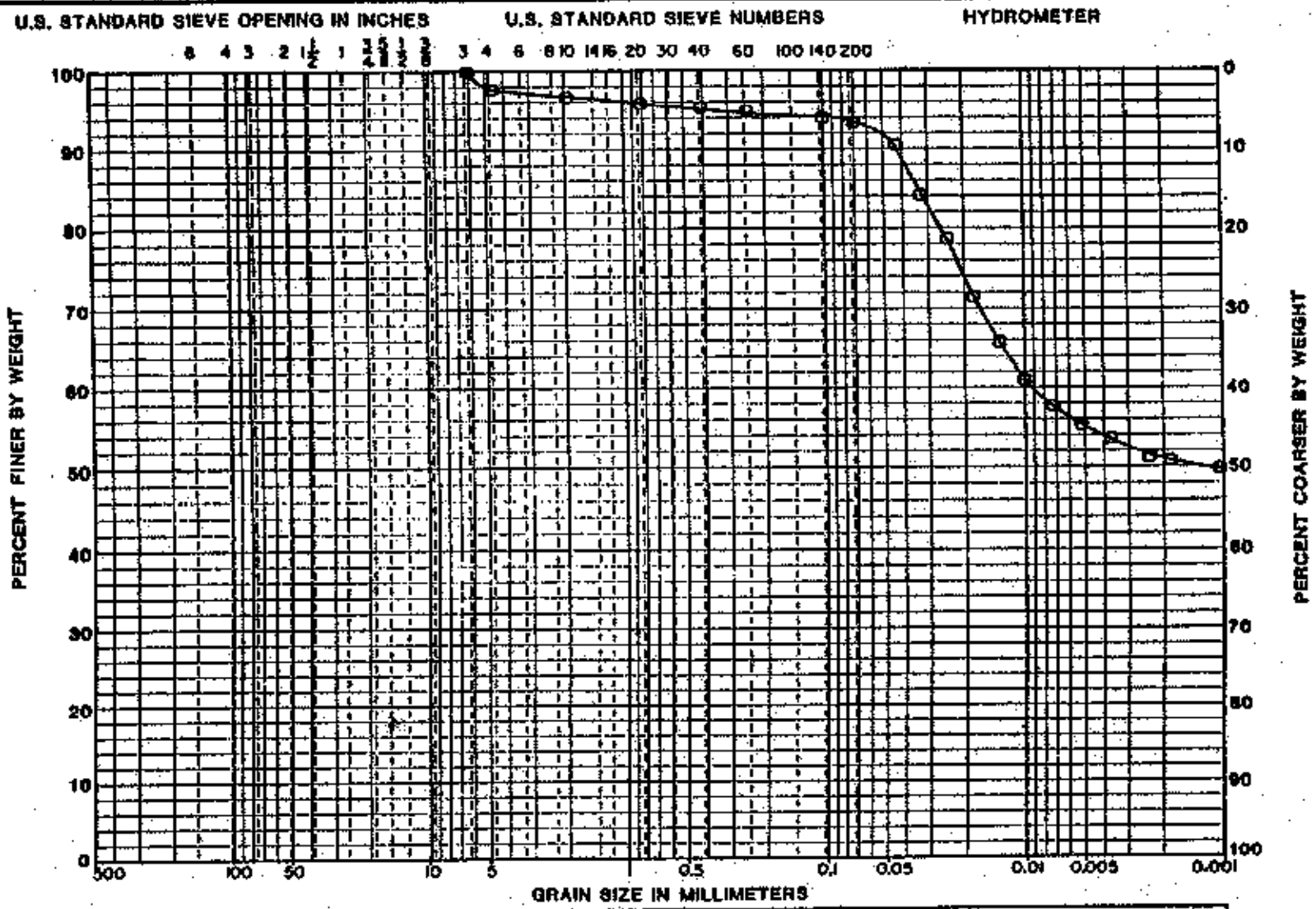
DATE 7-1-89

GEOTECHNOLOGY

11295

PLATE E 31

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
2A	10.8-13		27.1			

PROJECT WSSRAP

BORING NO. TPBS-15

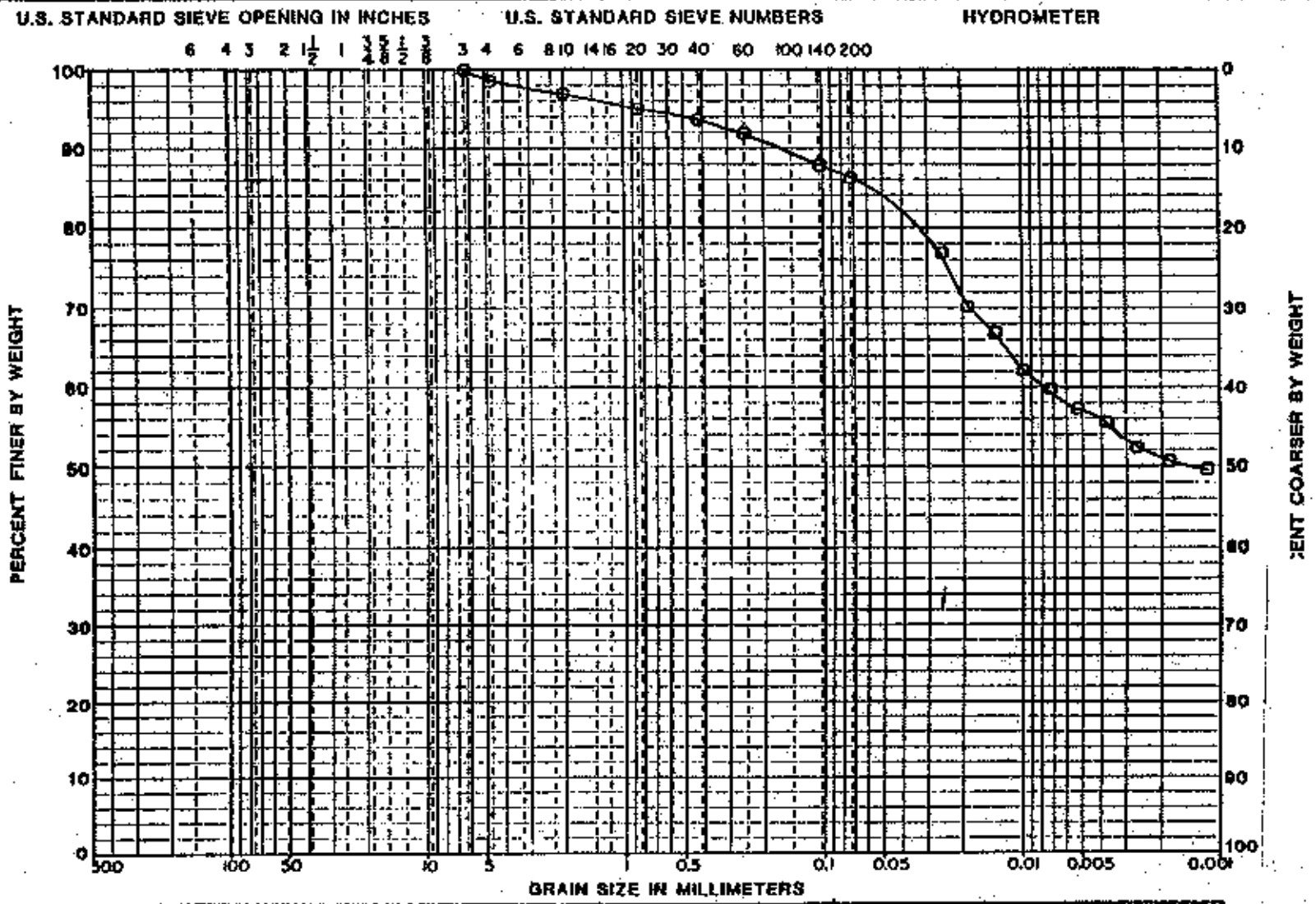
DATE 8-27-89

GEOTECHNOLOGY

11285

PLATE E27

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
3A	7.1-8.2		27.3			

PROJECT WSSRAP

BORING NO. TPBS - 15

DATE 7-1-89

GEOTECHNOLOGY

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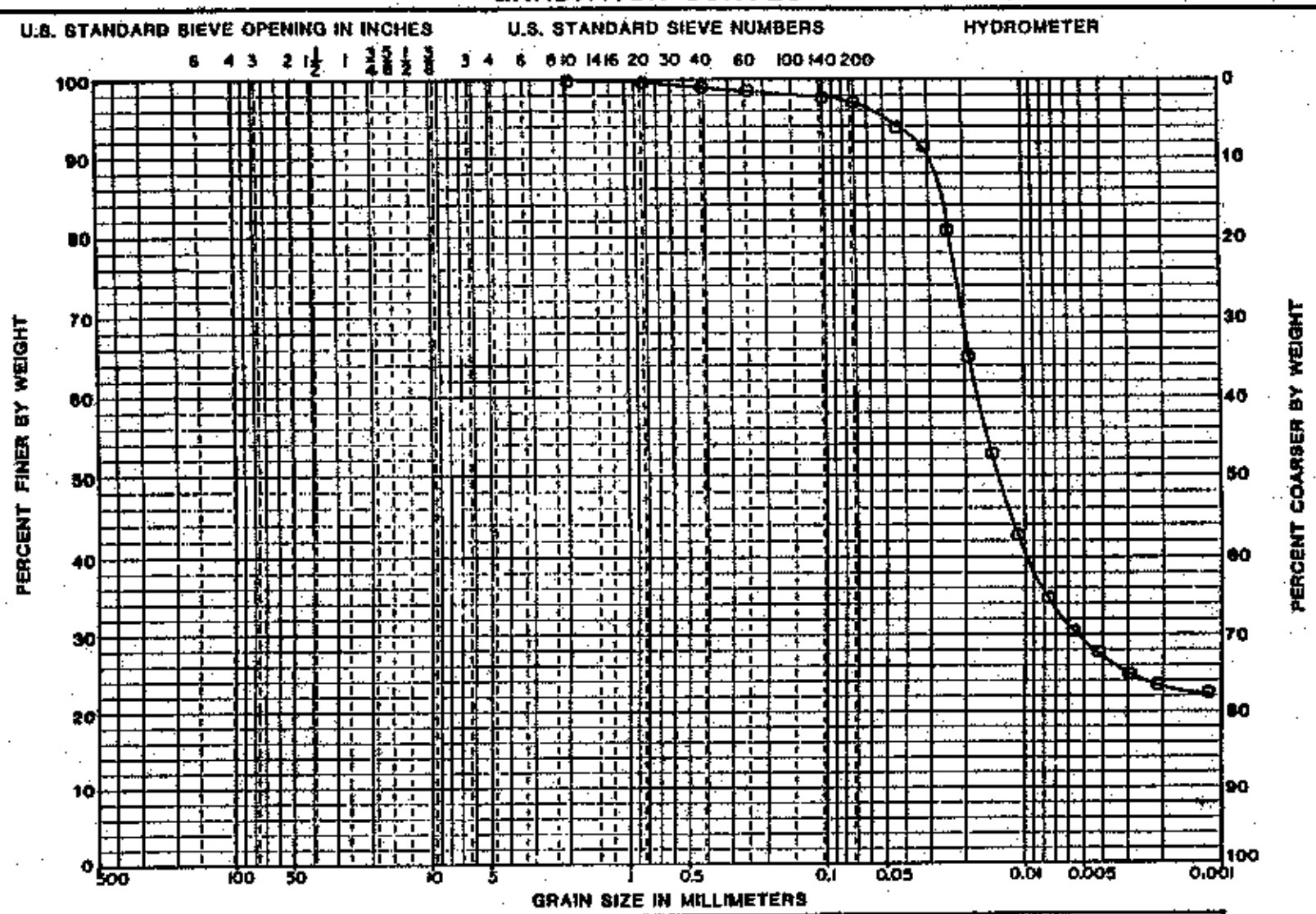
TPBS-15 Sheet 1

PLATE E67

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
1A	0.7-13.1		25.2			

PROJECT NSSRAP

BORING NO. TPBS-23

DATE 6-27-89

GEOTECHNOLOGY

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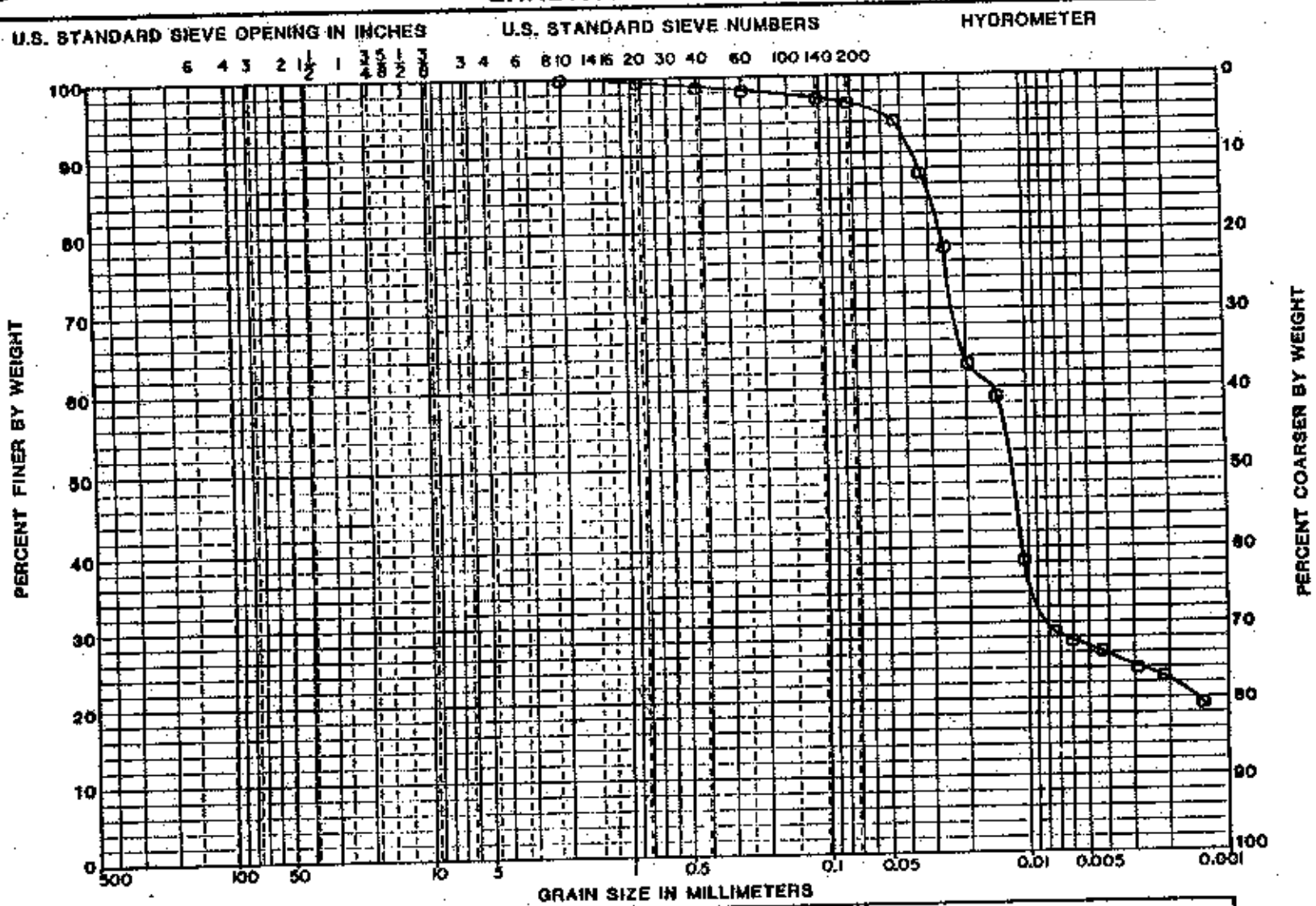
PLATE E 23

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
1A	0.7-13.1	CL	25.2	37	16	21

PROJECT WSSRAP

BORING NO. TPBS-23

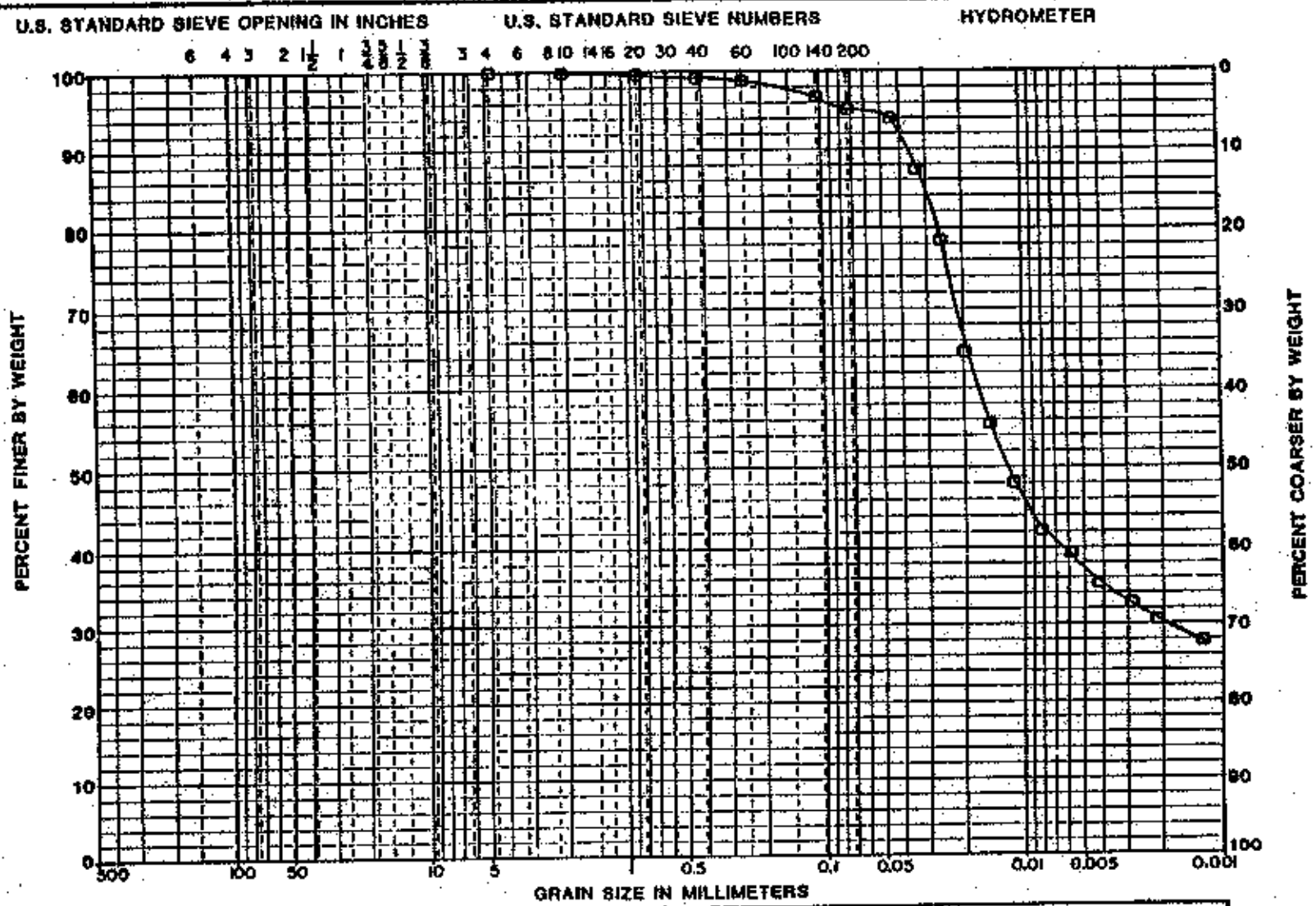
DATE 7-11-89

GEOTECHNOLOGY

11295

PLATE F-9

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
1A	0.7-9.9-		25.9			

PROJECT NSSRAP

BORING NO. TPBS - 28

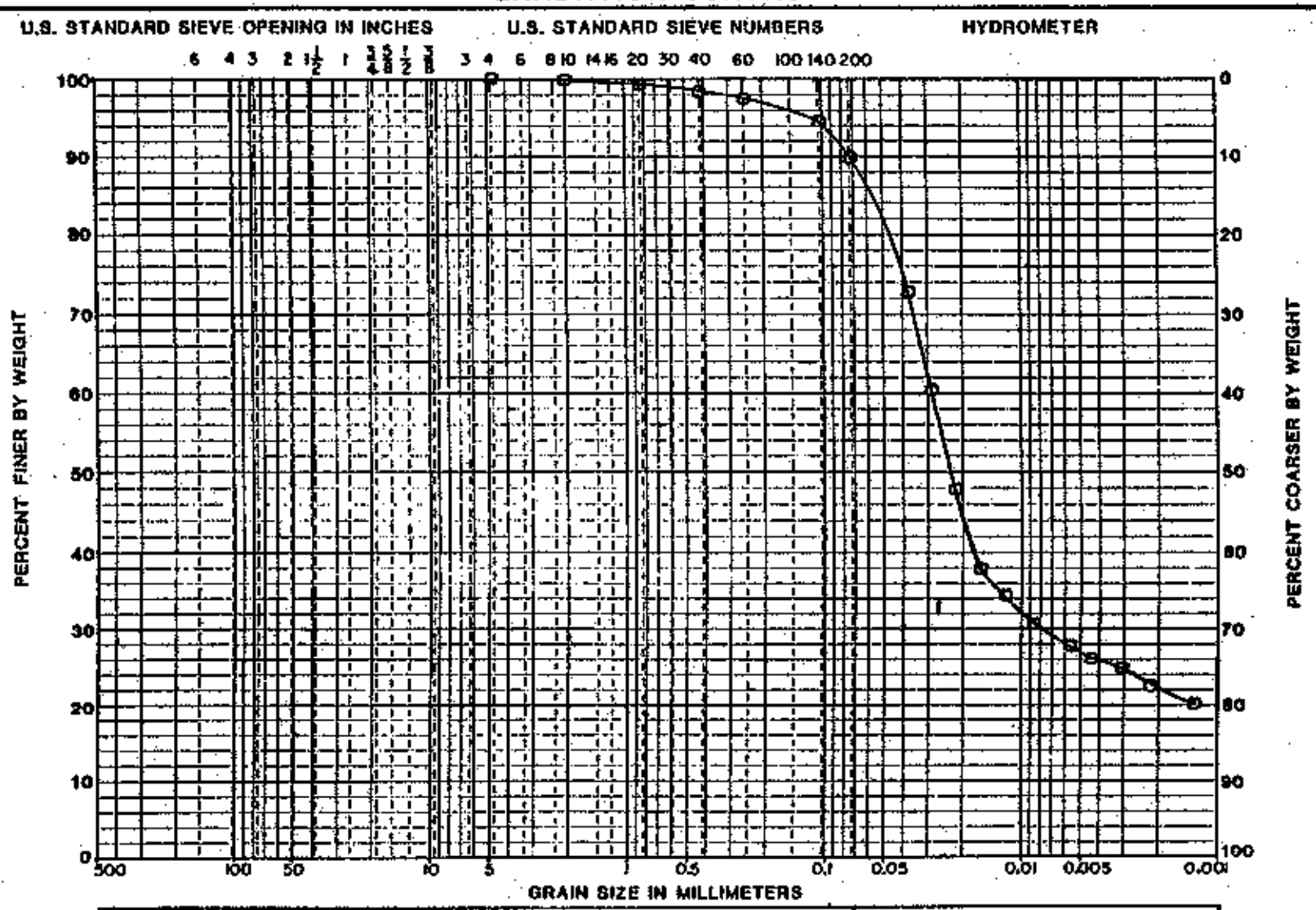
DATE 7-1-89

GEOTECHNOLOGY

11295

PLATE E 19

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
1A	1.8–12.4		28.6			

PROJECT MSSRAP

BORING NO. TPBS – 30

DATE 7-1-88

GEOTECHNOLOGY

11285

PLATE E 15

SHRINKAGE LIMITS

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

Request #3

PHYSICAL PROPERTY TEST RESULTS

SITE ID: Borrow Source #1

LOCATION ID: Program 3A

DATE: 9-15-89

CHECKED BY: LAB

LAB NAME: Geotechnology Inc.

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	~~PLASTIC LIMIT~~ SHRINKAGE LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY	SOIL CLASSIFICATION
TPBJ-1 4A	9.2 - 14.1		22.20			
TPBJ-8 2A	4.3 - 8.5		15.93			
TPBJ-10 3A	10.9 - 13.4		8.54			
TPBJ-11 2A	10.4 - 12.3		11.25			

TEST PROCEDURE:

F100

ATTACHMENT 1

SHRINKAGE FACTORS

PROJECT WSSRAP JOB NO. 11295.000

DATE 7/6/89

TESTED BY AB

CALC. BY YY CHECKED BY YY

Remarks: (1) Brown to Dark Brown Clay

(2) Light Brown silty clay

		1		2			
Borings No.		TP B5-8	TP B5-8	TP B5-1	TP B5-1		
Sample No.		2A 4.3'-8.5	2A 4.3'-8.5	4A 9.2-14.1	4A 9.2-14.1		
Tare No.		15	16	17	18		
Wt. Wet Soil + Tare (gms)		47.31	47.51	46.86	46.47		
Wt. Dry Soil + Tare (gms)		40.78	41.01	39.74	39.39		
Wt. of Dish (gms)		22.69	22.87	23.01	22.90		
Wt. of Dry Soil (gms)	1	18.09	18.14	16.73	16.49		
Moisture Content (w%)	2	36.10	35.83	42.56	43.00		
Volume of Wet Soil (cc)	3	13.57	13.55	13.55	13.59		
Volume of Tare (cc)		13.57	13.55	13.55	13.59		
Wt. of Displaced Hg + Dish (gms)		1019.3	1019.6	1000.3	994.8		
Wt. of Dish (gms)		885.1	885.1	885.1	885.1		
Wt. of Displaced Hg (gms)		134.2	134.5	115.2	109.7		
Volume of Displaced Hg (gms)							
Volume of Dry Soil (cc)	4	9.92	9.94	8.51	8.11		
$SL = 2 - (\frac{3-4}{1} \times 100)$ Note: SL ≈ PL		15.92	15.93	12.43	9.77		
$SR = \frac{1}{4}$							

GEOTECHNOLOGY

SHRINKAGE FACTORS

PROJECT WSS RAP JOB NO. 11295.000

DATE 6/29/89

TYPED BY AB

CALC. BY YY CHECKED BY YY

Remarks:

		1		2			
Borings No.		TPBJ-10	TPBJ-10	TPBJ-11	TPBJ-11		
Sample No.		3A 10.9-13.4	3A 10.9-13.4	2A 10.4-12.9	2A 10.4-12.9		
Tare No.		11	12	13	14		
Wt. Wet Soil + Tare (gms)		44.72	44.44	44.87	45.02		
Wt. Dry Soil + Tare (gms)		36.33	36.21	36.50	36.58		
Wt. of Dish (gms)		22.82	22.90	22.92	22.87		
Wt. of Dry Soil (gms)	1	13.51	14.21	13.58	13.71		
Moisture Content (w%)	2	62.10	57.92	61.63	61.56		
Volume of Wet Soil (cc)	3	13.58	13.54	13.55	13.56		
Volume of Tare (cc)		13.58	13.54	13.55	13.56		
Wt. of Displaced Hg + Dish (gms)		972.5	971.7	975.7	975.4		
Wt. of Dish (gms)		885.1	885.1	885.1	885.1		
Wt. of Displaced Hg (gms)		87.4	86.6	90.6	90.3		
Volume of Displaced Hg (gms)							
Volume of Dry Soil (cc)	4	6.46	6.40	6.70	6.67		
$SL = 2 - (\frac{3-4}{1} \times 100)$ Note: SL ≤ PL		9.40	7.67	11.19	11.30		
$SR = \frac{1}{4}$							

GEOTECHNOLOGY

F-103

IN SITU DENSITY

HTL FORM NO. 38D
SUBCONTRACT
NO. 3589-SC-WP117

PROJECT NO. 89-757

FIELD DENSITY TEST

DRIVE TUBE METHOD

PROJECT WELDON SPRING R.A.P. BACKHOE TEST PITS DATE OF TEST 4-17-89 TEST NO. 1

CLIENT MK-FERGUSON COMPANY CONTRACTOR

AREA REPRESENTED TEST PIT NO. TPBS-13

SAMPLE DESCRIPTION BROWN AND LIGHT GRAY MOTTLED SILTY CLAY, TRACE OF SAND, OXIDIZED SPOTS, AND IRON CONCRETIONS (CL)

METHOD OF COMPACTION N/A TYPE COMPACTOR N/A

LIFT NO. N/A LIFT THICKNESS N/A NO. OF PASSES N/A

WET DENSITY TUBE NO.

1. Weight of moist soil plus tube	2405.44	gms.
2. Weight of tube	618.95	gms.
3. Weight of moist soil	1786.49	gms.
4. Tube Constant	0.06595	
5. Wet Density (Item 3 x Item 4)	117.8	PCF

MOISTURE CONTENT AND DRY DENSITY TARE NO. 103

	FIELD OVEN	ASTM LAB OVEN
6. Weight of wet sample plus tare	gms.	745.26 gms.
7. Weight of dry sample plus tare	gms.	600.41 gms.
8. Weight of water in sample	gms.	144.85 gms.
9. Weight of tare	gms.	78.37 gms.
10. Weight of dry soil	gms.	522.04 gms.
11. Moisture Content	%	27.7 %
12. Dry Density (Item 5) / (1.0 plus Item 11 in a decimal)	PCF	92.2 PCF

COMPACTION DATA

13. Maximum Dry Density from Compaction Test	PCF	PCF
14. Optimum Moisture Content from Compaction Test	%	%
15. Apparent Percent Compaction	%	%
16. Aggregate Correction	%	%
17. Percent Compaction	%	%
18. Specified Minimum Percent Compaction	%	%

Test Depth: 4.6-5.0 FT.

Test Location :

Test Results & Remarks: BC = 30

TESTED BY R. CRAVEN
TECHNICIAN

TEST METHODS: ASTM D 2937-83 AND ASTM D 2216-80

Hannibal Testing Laboratories, Inc.
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HANNIBAL, MISSOURI 63401 • (314) 221-7714

HTL FORM NO. 38D
SUBCONTRACT
NO. 3589-SC-WP117

PROJECT NO. 89-757

FIELD DENSITY TEST

DRIVE TUBE METHOD

PROJECT WELDON SPRING R.A.P. BACKHOE TEST PITS DATE OF TEST 4-17-89 TEST NO. 2

CLIENT MK-FERGUSON COMPANY CONTRACTOR

AREA REPRESENTED TEST PIT NO. TPBS-14

SAMPLE DESCRIPTION BROWN AND LIGHT GRAY MOTTLED SILTY CLAY TRACE OF SAND, OXIDIZED SPOTS AND IRON CONCRETIONS, (CL)

METHOD OF COMPACTION N/A TYPE COMPACTOR N/A

LIFT NO. N/A LIFT THICKNESS N/A NO. OF PASSES N/A

WET DENSITY TUBE NO.

1. Weight of moist soil plus tube	2463.50	gms.
2. Weight of tube	645.88	gms.
3. Weight of moist soil	1817.62	gms.
4. Tube Constant	0.06484	
5. Wet Density (Item 3 x Item 4)	117.9	PCF

MOISTURE CONTENT AND DRY DENSITY TARE NO. 29

	FIELD OVEN	ASTM LAB OVEN
6. Weight of wet sample plus tare	gms.	762.72 gms.
7. Weight of dry sample plus tare	gms.	621.65 gms.
8. Weight of water in sample	gms.	141.07 gms.
9. Weight of tare	gms.	76.39 gms.
10. Weight of dry soil	gms.	545.26 gms.
11. Moisture Content	%	25.9 %
12. Dry Density (Item 5) / (1.0 plus Item 11 in a decimal)	PCF	93.6 PCF

COMPACTION DATA

13. Maximum Dry Density from Compaction Test	PCF	PCF
14. Optimum Moisture Content from Compaction Test	%	%
15. Apparent Percent Compaction	%	%
16. Aggregate Correction	%	%
17. Percent Compaction	%	%
18. Specified Minimum Percent Compaction	%	%

Test Depth: 4.9-5.3 FT.

Test Location :

Test Results & Remarks: BC = 25

TESTED BY R. CRAVEN
TECHNICIAN

TEST METHODS: ASTM D 2937-83 AND ASTM D 2216-80

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HTL FORM NO. 380
SUBCONTRACT
NO. 3589-SC-WP117

PROJECT NO. 89-757

FIELD DENSITY TEST

DRIVE TUBE METHOD

PROJECT WELDON SPRING R.A.P. BACKHOE TEST PITS DATE OF TEST 4-17-89 TEST NO. 3

CLIENT MK-FERGUSON COMPANY CONTRACTOR

AREA REPRESENTED TEST PIT NO. TPBS-15

SAMPLE DESCRIPTION LIGHT BROWN AND GRAY MOTTLED SILTY CLAY, TRACE OF SAND. (CL)

METHOD OF COMPACTION N/A TYPE COMPACTOR N/A

LIFT NO. N/A LIFT THICKNESS N/A NO. OF PASSES N/A

WET DENSITY TUBE NO.

1. Weight of moist soil plus tube	2324.25	gms.
2. Weight of tube	642.83	gms.
3. Weight of moist soil	1681.42	gms.
4. Tube Constant	0.06558	
5. Wet Density (Item 3 x Item 4)	110.3	PCF

MOISTURE CONTENT AND DRY DENSITY TARE NO. 107

	FIELD OVEN	ASTM LAB OVEN
6. Weight of wet sample plus tare	gms.	867.89 gms.
7. Weight of dry sample plus tare	gms.	716.03 gms.
8. Weight of water in sample	gms.	151.86 gms.
9. Weight of tare	gms.	77.00 gms.
10. Weight of dry soil	gms.	639.03 gms.
11. Moisture Content	%	23.8 %
12. Dry Density (Item 5) / (1.0 plus Item 11 in a decimal)	PCF	89.1 PCF

COMPACTION DATA

13. Maximum Dry Density from Compaction Test	PCF	PCF
14. Optimum Moisture Content from Compaction Test	%	%
15. Apparent Percent Compaction	%	%
16. Aggregate Correction	%	%
17. Percent Compaction	%	%
18. Specified Minimum Percent Compaction	%	%

Test Depth: 5.9-6.3 FT.

Test Location :

Test Results & Remarks: BC = 11

TESTED BY R. CRAVEN
TECHNICIAN

TEST METHODS: ASTM D 2937-83 AND ASTM D 2216-80

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HTL FORM NO. 38D
SUBCONTRACT
NO. 3589-SC-WP117

PROJECT NO. 89-757

FIELD DENSITY TEST

DRIVE TUBE METHOD

PROJECT BACKHOE TEST PITS WELDON SPRING R.A.P. DATE OF TEST 4-17-89 TEST NO. 4

CLIENT MK-FERGUSON COMPANY CONTRACTOR

AREA REPRESENTED TEST PIT NO. TPBS-16

SAMPLE DESCRIPTION BROWN AND LIGHT GRAY MOTTLED SILTY CLAY, TRACE OF SAND. (CL)

METHOD OF COMPACTION N/A TYPE COMPACTOR N/A

LIFT NO. N/A LIFT THICKNESS N/A NO. OF PASSES N/A

WET DENSITY TUBE NO.

1. Weight of moist soil plus tube	2498.88	gms.
2. Weight of tube	639.87	gms.
3. Weight of moist soil	1859.01	gms.
4. Tube Constant	0.06598	
5. Wet Density (Item 3 x Item 4)	122.7	PCF

MOISTURE CONTENT AND DRY DENSITY TARE NO. 113

	FIELD OVEN	ASTM LAB OVEN
6. Weight of wet sample plus tare	gms.	814.40 gms.
7. Weight of dry sample plus tare	gms.	670.64 gms.
8. Weight of water in sample	gms.	143.76 gms.
9. Weight of tare	gms.	79.17 gms.
10. Weight of dry soil	gms.	591.47 gms.
11. Moisture Content	%	24.3 %
12. Dry Density (Item 5) / (1.0 plus Item 11 in a decimal)	PCF	98.7 PCF

COMPACTION DATA

13. Maximum Dry Density from Compaction Test	PCF	PCF
14. Optimum Moisture Content from Compaction Test	%	%
15. Apparent Percent Compaction	%	%
16. Aggregate Correction	%	%
17. Percent Compaction	%	%
18. Specified Minimum Percent Compaction	%	%

Test Depth: 5.4-5.8 FT.

Test Location :

Test Results & Remarks: BC = 55

TESTED BY R. CRAVEN
TECHNICIAN

TEST METHODS: ASTM D 2937-83 AND ASTM D 2216-80

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HTL FORM NO. 38D
SUBCONTRACT
NO. 3589-SC-WP117

PROJECT NO. 89-757

FIELD DENSITY TEST

DRIVE TUBE METHOD

PROJECT WELDON SPRING R.A.P. BACKHOE TEST PITS DATE OF TEST 4-17-89 TEST NO. 5

CLIENT MK-FERGUSON COMPANY CONTRACTOR

AREA REPRESENTED TEST PIT NO. TPBS-17

SAMPLE DESCRIPTION BROWN MOTTLED LIGHT GRAY SILTY CLAY, TRACE OF SAND, (CL)

METHOD OF COMPACTION N/A TYPE COMPACTOR N/A

LIFT NO. N/A , LIFT THICKNESS N/A NO. OF PASSES N/A

WET DENSITY TUBE NO.

1. Weight of moist soil plus tube	2465.32	gms.
2. Weight of tube	614.46	gms.
3. Weight of moist soil	1850.86	gms.
4. Tube Constant	0.06525	
5. Wet Density (Item 3 x Item 4)	120.8	PCF

MOISTURE CONTENT AND DRY DENSITY TARE NO. 114

	FIELD OVEN	ASTM LAB OVEN
6. Weight of wet sample plus tare	gms.	1016.20 gms.
7. Weight of dry sample plus tare	gms.	829.68 gms.
8. Weight of water in sample	gms.	186.52 gms.
9. Weight of tare	gms.	76.79 gms.
10. Weight of dry soil	gms.	752.89 gms.
11. Moisture Content	%	24.8 %
12. Dry Density (Item 5) / (1.0 plus Item 11 in a decimal)	PCF	96.8 PCF

COMPACTION DATA

13. Maximum Dry Density from Compaction Test	PCF	PCF
14. Optimum Moisture Content from Compaction Test	%	%
15. Apparent Percent Compaction	%	%
16. Aggregate Correction	%	%
17. Percent Compaction	%	%
18. Specified Minimum Percent Compaction	%	%

Test Depth: 6.0-6.4 FT.

Test Location :

Test Results & Remarks: BC = 35

TESTED BY R. CRAVEN
TECHNICIAN

TEST METHODS: ASTM D 2937-83 AND ASTM D 2216-80

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HTL FORM NO. 38D
SUBCONTRACT
NO. 3589-SC-WP117

PROJECT NO. 89-757

FIELD DENSITY TEST

DRIVE TUBE METHOD

PROJECT WELDON SPRING R.A.P. BACKHOE TEST PITS DATE OF TEST 4-18-89 TEST NO. 6

CLIENT MK-FERGUSON COMPANY CONTRACTOR

AREA REPRESENTED TEST PIT NO. TPBS-18

SAMPLE DESCRIPTION BROWN MOTTLED LIGHT GRAY SILTY CLAY, TRACE OF SAND, (CL)

METHOD OF COMPACTION N/A TYPE COMPACTOR N/A

LIFT NO. N/A LIFT THICKNESS N/A NO. OF PASSES N/A

WET DENSITY TUBE NO.

1. Weight of moist soil plus tube	2419.50	gms.
2. Weight of tube	644.07	gms.
3. Weight of moist soil	1775.43	gms.
4. Tube Constant	0.06584	
5. Wet Density (Item 3 x Item 4)	116.9	PCF

MOISTURE CONTENT AND DRY DENSITY TARE NO. 105

	FIELD OVEN	ASTM LAB OVEN
6. Weight of wet sample plus tare	gms.	757.50 gms.
7. Weight of dry sample plus tare	gms.	644.71 gms.
8. Weight of water in sample	gms.	112.79 gms.
9. Weight of tare	gms.	78.06 gms.
10. Weight of dry soil	gms.	566.65 gms.
11. Moisture Content	%	19.9 %
12. Dry Density (Item 5) / (1.0 plus Item 11 in a decimal)	PCF	97.5 PCF
COMPACTION DATA		
13. Maximum Dry Density from Compaction Test	PCF	PCF
14. Optimum Moisture Content from Compaction Test	%	%
15. Apparent Percent Compaction	%	%
16. Aggregate Correction	%	%
17. Percent Compaction	%	%
18. Specified Minimum Percent Compaction	%	%

Test Depth: 4.8-5.2 FT.

Test Location :

Test Results & Remarks: BC = 59

TESTED BY R. CRAVEN
TECHNICIAN

TEST METHODS: ASTM D 2937-83 AND ASTM D 2216-80

Hannibal Testing Laboratories, Inc.
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HANNIBAL, MISSOURI 63401 • (314) 221-7714

HTL FORM NO. 38D
SUBCONTRACT
NO. 3589-SC-WP117

PROJECT NO. 89-757

FIELD DENSITY TEST

DRIVE TUBE METHOD

PROJECT WELDON SPRING R.A.P. BACKHOE TEST PITS DATE OF TEST 4-18-89 TEST NO. 7

CLIENT MK-FERGUSON COMPANY CONTRACTOR

AREA REPRESENTED TEST PIT NO. TPBS-19

SAMPLE DESCRIPTION BROWN MOTTLED LIGHT GRAY SILTY CLAY, TRACE OF SAND. (CL)

METHOD OF COMPACTION N/A TYPE COMPACTOR N/A

LIFT NO. N/A LIFT THICKNESS N/A NO. OF PASSES N/A

WET DENSITY TUBE NO.

1. Weight of moist soil plus tube	2503.39	gms.
2. Weight of tube	639.28	gms.
3. Weight of moist soil	1864.11	gms.
4. Tube Constant	0.06600	
5. Wet Density (Item 3 x Item 4)	123.0	PCF

MOISTURE CONTENT AND DRY DENSITY TARE NO. 104

	FIELD OVEN	ASTM LAB OVEN
6. Weight of wet sample plus tare	gms.	963.74 gms.
7. Weight of dry sample plus tare	gms.	791.39 gms.
8. Weight of water in sample	gms.	172.35 gms.
9. Weight of tare	gms.	78.36 gms.
10. Weight of dry soil	gms.	713.03 gms.
11. Moisture Content	%	24.02 %
12. Dry Density (Item 5) / (1.0 plus Item 11 in a decimal)	PCF	99.0 PCF

COMPACTION DATA

13. Maximum Dry Density from Compaction Test	PCF	PCF
14. Optimum Moisture Content from Compaction Test	%	%
15. Apparent Percent Compaction	%	%
16. Aggregate Correction	%	%
17. Percent Compaction	%	%
18. Specified Minimum Percent Compaction	%	%

Test Depth: 4.9-5.3 FT.

Test Location :

Test Results & Remarks: N/A

TESTED BY R. CRAVEN
TECHNICIAN

TEST METHODS: ASTM D 2937-83 AND ASTM D 2216-80

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HTL FORM NO. 38D
SUBCONTRACT
NO. 3589-SC-WP117

PROJECT NO. 89-757

FIELD DENSITY TEST

DRIVE TUBE METHOD

BACKHOE TEST PITS
PROJECT WELDON SPRING R.A.P. DATE OF TEST 4-18-89 TEST NO. 8
CLIENT MK-FERGUSON COMPANY CONTRACTOR
AREA REPRESENTED TEST PIT NO. TPBS-20
SAMPLE DESCRIPTION REDDISH BROWN SILTY CLAY, TRACE OF SAND, (CL)
METHOD OF COMPACTION N/A TYPE COMPACTOR N/A
LIFT NO. N/A LIFT THICKNESS N/A NO. OF PASSES N/A

WET DENSITY TUBE NO.

1. Weight of moist soil plus tube	2457.60	gms.
2. Weight of tube	618.62	gms.
3. Weight of moist soil	1838.98	gms.
4. Tube Constant	0.06602	
5. Wet Density (Item 3 x Item 4)	121.4	PCF

MOISTURE CONTENT AND DRY DENSITY TARE NO. 112

	FIELD OVEN	ASTM LAB OVEN
6. Weight of wet sample plus tare	gms.	815.70 gms.
7. Weight of dry sample plus tare	gms.	665.58 gms.
8. Weight of water in sample	gms.	150.12 gms.
9. Weight of tare	gms.	78.55 gms.
10. Weight of dry soil	gms.	587.03 gms.
11. Moisture Content	%	25.6 %
12. Dry Density (Item 5) / (1.0 plus Item 11 in a decimal)	PCF	96.7 PCF

COMPACTION DATA

13. Maximum Dry Density from Compaction Test	PCF	PCF
14. Optimum Moisture Content from Compaction Test	%	%
15. Apparent Percent Compaction	%	%
16. Aggregate Correction	%	%
17. Percent Compaction	%	%
18. Specified Minimum Percent Compaction	%	%

Test Depth: 5.4-5.8 FT.
Test Location :
Test Results & Remarks: N/A

TESTED BY R. CRAVEN
TECHNICIAN
TEST METHODS: ASTM D 2937-83 AND ASTM D 2216-80

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HTL FORM NO. 380
SUBCONTRACT NO. 3589-SC-WP117

PROJECT NO. 89-757

FIELD DENSITY TEST

DRIVE TUBE METHOD

PROJECT BACKHOE TEST PITS WELDON SPRING R.A.P. DATE OF TEST 4-19-89 TEST NO. 9

CLIENT MK-FERGUSON COMPANY CONTRACTOR

AREA REPRESENTED TEST PIT NO. TPBS-23

SAMPLE DESCRIPTION LIGHT BROWN MOTTLED GRAY SILTY CLAY, TRACE OF SAND, OXIDIZED SPOTS. (CL)

METHOD OF COMPACTION N/A TYPE COMPACTOR N/A

LIFT NO. N/A LIFT THICKNESS N/A NO. OF PASSES N/A

WET DENSITY TUBE NO.

1. Weight of moist soil plus tube	2447.17	gms.
2. Weight of tube	645.82	gms.
3. Weight of moist soil	1801.35	gms.
4. Tube Constant	0.06541	
5. Wet Density (Item 3 x Item 4)	117.8	PCF

MOISTURE CONTENT AND DRY DENSITY TARE NO. 103

	FIELD OVEN	ASTM LAB OVEN
6. Weight of wet sample plus tare	gms.	895.80 gms.
7. Weight of dry sample plus tare	gms.	715.57 gms.
8. Weight of water in sample	gms.	180.23 gms.
9. Weight of tare	gms.	78.39 gms.
10. Weight of dry soil	gms.	637.18 gms.
11. Moisture Content	%	28.3 %
12. Dry Density (Item 5) / (1.0 plus Item 11 in a decimal)	PCF	91.8 PCF

COMPACTION DATA

13. Maximum Dry Density from Compaction Test	PCF	PCF
14. Optimum Moisture Content from Compaction Test	%	%
15. Apparent Percent Compaction	%	%
16. Aggregate Correction	%	%
17. Percent Compaction	%	%
18. Specified Minimum Percent Compaction	%	%

Test Depth: 5.7-6.1 FT.

Test Location :

Test Results & Remarks:

TESTED BY R. CRAVEN
TECHNICIAN

TEST METHODS: ASTM D 2937-83 and ASTM D 2216-80

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HTL FORM NO. 38D
SUBCONTRACT
NO. 3589-SC-WP117

PROJECT NO. 89-757

FIELD DENSITY TEST

DRIVE TUBE METHOD

PROJECT BACKHOE TEST PITS WELDON SPRING R.A.P. DATE OF TEST 4-19-89 TEST NO. 10

CLIENT MK-FERGUSON COMPANY CONTRACTOR

AREA REPRESENTED TEST PIT NO. TPBS-26

SAMPLE DESCRIPTION LIGHT BROWN MOTTLED GRAY SILTY CLAY, TRACE OF SAND, OXIDIZED SPOTS, (CL)

METHOD OF COMPACTION N/A TYPE COMPACTOR N/A

LIFT NO. N/A LIFT THICKNESS N/A NO. OF PASSES N/A

WET DENSITY TUBE NO.

1. Weight of moist soil plus tube	2502.06	gms.
2. Weight of tube	642.88	gms.
3. Weight of moist soil	1859.18	gms.
4. Tube Constant	0.06636	
5. Wet Density (Item 3 x Item 4)	123.4	PCF

MOISTURE CONTENT AND DRY DENSITY TARE NO. 104

	FIELD OVEN	ASTM LAB OVEN
6. Weight of wet sample plus tare	gms.	817.25 gms.
7. Weight of dry sample plus tare	gms.	670.49 gms.
8. Weight of water in sample	gms.	146.76 gms.
9. Weight of tare	gms.	78.32 gms.
10. Weight of dry soil	gms.	592.17 gms.
11. Moisture Content	%	24.8 %
12. Dry Density (Item 5) / (1.0 plus Item 11 in a decimal)	PCF	98.9 PCF

COMPACTION DATA

13. Maximum Dry Density from Compaction Test	PCF	PCF
14. Optimum Moisture Content from Compaction Test	%	%
15. Apparent Percent Compaction	%	%
16. Aggregate Correction	%	%
17. Percent Compaction	%	%
18. Specified Minimum Percent Compaction	%	%

Test Depth: 4.9-5.3 FT.

Test Location :

Test Results & Remarks:

TESTED BY R. CRAVEN
TECHNICIAN

TEST METHODS: ASTM D 2937-83 and ASTM D 2216-80

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HTL FORM NO. 38D
SUBCONTRACT
NO. 3589-SC-WP117

PROJECT NO. 89-757

FIELD DENSITY TEST

DRIVE TUBE METHOD

PROJECT BACKHOE TEST PITS WELDON SPRING R.A.P. DATE OF TEST 4-19-89 TEST NO. 11

CLIENT MK-FERGUSON COMPANY CONTRACTOR

AREA REPRESENTED TEST PIT NO. TPBS-25

SAMPLE DESCRIPTION LIGHT BROWN MOTTLED GRAY SILTY CLAY, TRACE OF SAND, OXIDIZED SPOTS, (CL)

METHOD OF COMPACTION N/A TYPE COMPACTOR N/A

LIFT NO. N/A LIFT THICKNESS N/A NO. OF PASSES N/A

WET DENSITY TUBE NO.

1. Weight of moist soil plus tube	2513.40	gms.
2. Weight of tube	651.33	gms.
3. Weight of moist soil	1862.07	gms.
4. Tube Constant	0.06639	
5. Wet Density (Item 3 x Item 4)	123.6	PCF

MOISTURE CONTENT AND DRY DENSITY TARE NO. 105

	FIELD OVEN	ASTM LAB OVEN
6. Weight of wet sample plus tare	gms.	740.33 gms.
7. Weight of dry sample plus tare	gms.	614.12 gms.
8. Weight of water in sample	gms.	126.21 gms.
9. Weight of tare	gms.	78.04 gms.
10. Weight of dry soil	gms.	536.08 gms.
11. Moisture Content	%	23.5 %
12. Dry Density (Item 5) / (1.0 plus Item 11 in a decimal)	PCF	100.1 PCF
COMPACTION DATA		
13. Maximum Dry Density from Compaction Test	PCF	PCF
14. Optimum Moisture Content from Compaction Test	%	%
15. Apparent Percent Compaction	%	%
16. Aggregate Correction	%	%
17. Percent Compaction	%	%
18. Specified Minimum Percent Compaction	%	%

Test Depth: 4.1-4.5 FT.

Test Location :

Test Results & Remarks:

TESTED BY R. CRAVEN
TECHNICIAN

TEST METHODS: ASTM D 2937-83 and ASTM D 2216-80

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FIELD DENSITY TEST

DRIVE TUBE METHOD

PROJECT BACKHOE TEST PITS WELDON SPRING R.A.P. DATE OF TEST 4-19-89 TEST NO. 12

CLIENT MK-FERGUSON COMPANY CONTRACTOR

AREA REPRESENTED TEST PIT NO. TPBS-28

SAMPLE DESCRIPTION LIGHT BROWN MOTTLED GRAY SILTY CLAY, TRACE OF SAND, OXIDIZED SPOTS, (CL)

METHOD OF COMPACTION N/A TYPE COMPACTOR N/A

LIFT NO. N/A LIFT THICKNESS N/A NO. OF PASSES N/A

WET DENSITY TUBE NO.

1. Weight of moist soil plus tube	2480.74	gms.
2. Weight of tube	639.87	gms.
3. Weight of moist soil	1840.87	gms.
4. Tube Constant	0.06535	
5. Wet Density (Item 3 x Item 4)	120.3	PCF

MOISTURE CONTENT AND DRY DENSITY TARE NO. 107

	FIELD OVEN	ASTM LAB OVEN
6. Weight of wet sample plus tare	gms.	766.19 gms.
7. Weight of dry sample plus tare	gms.	622.30 gms.
8. Weight of water in sample	gms.	143.89 gms.
9. Weight of tare	gms.	76.96 gms.
10. Weight of dry soil	gms.	545.34 gms.
11. Moisture Content	%	26.4 %
12. Dry Density (Item 5) / (1.0 plus Item 11 in a decimal)	PCF	95.2 PCF

COMPACTION DATA

13. Maximum Dry Density from Compaction Test	PCF	PCF
14. Optimum Moisture Content from Compaction Test	%	%
15. Apparent Percent Compaction	%	%
16. Aggregate Correction	%	%
17. Percent Compaction	%	%
18. Specified Minimum Percent Compaction	%	%

Test Depth: 3.8-4.2 FT.

Test Location :

Test Results & Remarks:

TESTED BY R. CRAVEN
TECHNICIAN

TEST METHODS: ASTM D 2937-83 and ASTM D 2216-80

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NO. 3589-SC-WP117

PROJECT NO. 89-757

FIELD DENSITY TEST

DRIVE TUBE METHOD

PROJECT BACKHOE TEST PITS WELDON SPRING R.A.P. DATE OF TEST 4-20-89 TEST NO. 13

CLIENT MK-FERGUSON COMPANY CONTRACTOR

AREA REPRESENTED TEST PIT NO. TPBS-29

SAMPLE DESCRIPTION LIGHT BROWN MOTTLED GRAY SILTY CLAY, TRACE OF SAND, OXIDIZED SPOTS, (CL)

METHOD OF COMPACTION N/A TYPE COMPACTOR N/A

LIFT NO. N/A LIFT THICKNESS N/A NO. OF PASSES N/A

WET DENSITY TUBE NO.

1. Weight of moist soil plus tube	2476.66	gms.
2. Weight of tube	639.31	gms.
3. Weight of moist soil	1837.35	gms.
4. Tube Constant	0.06694	
5. Wet Density (Item 3 x Item 4)	123.0	PCF

MOISTURE CONTENT AND DRY DENSITY TARE NO. 113

	FIELD OVEN	ASTM LAB OVEN
6. Weight of wet sample plus tare	gms.	703.25 gms.
7. Weight of dry sample plus tare	gms.	566.78 gms.
8. Weight of water in sample	gms.	136.47 gms.
9. Weight of tare	gms.	79.17 gms.
10. Weight of dry soil	gms.	487.61 gms.
11. Moisture Content	%	28.0 %
12. Dry Density (Item 5) (1.0 plus Item 11 in a decimal)	PCF	96.1 PCF

COMPACTION DATA

13. Maximum Dry Density from Compaction Test	PCF	PCF
14. Optimum Moisture Content from Compaction Test	%	%
15. Apparent Percent Compaction	%	%
16. Aggregate Correction	%	%
17. Percent Compaction	%	%
18. Specified Minimum Percent Compaction	%	%

Test Depth: 4.8-5.2 FT.

Test Location :

Test Results & Remarks:

TESTED BY R. CRAVEN
TECHNICIAN

TEST METHODS: ASTM D 2937-83 and ASTM D 2216-80

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HTL FORM NO. 38D
SUBCONTRACT
NO. 3589-SC-WP117

PROJECT NO. 89-757

FIELD DENSITY TEST

DRIVE TUBE METHOD

PROJECT BACKHOE TEST PITS WELDON SPRING R.A.P. DATE OF TEST 4-20-89 TEST NO. 14

CLIENT MK-FERGUSON COMPANY CONTRACTOR

AREA REPRESENTED TEST PIT NO. TPBS-30

SAMPLE DESCRIPTION LIGHT BROWN MOTTLED GRAY SILTY CLAY, TRACE OF SAND, OXIDIZED SPOTS, (CL)

METHOD OF COMPACTION N/A TYPE COMPACTOR N/A

LIFT NO. N/A LIFT THICKNESS N/A NO. OF PASSES N/A

WET DENSITY TUBE NO.

1. Weight of moist soil plus tube	2435.38	gms.
2. Weight of tube	618.61	gms.
3. Weight of moist soil	1816.77	gms.
4. Tube Constant	0.06629	
5. Wet Density (Item 3 x Item 4)	120.4	PCF

MOISTURE CONTENT AND DRY DENSITY TARE NO. 114

	FIELD OVEN	ASTM LAB OVEN
6. Weight of wet sample plus tare	gms.	775.18 gms.
7. Weight of dry sample plus tare	gms.	629.39 gms.
8. Weight of water in sample	gms.	145.79 gms.
9. Weight of tare	gms.	76.76 gms.
10. Weight of dry soil	gms.	552.63 gms.
11. Moisture Content	%	26.4 %
12. Dry Density (Item 5) / (1.0 plus Item 11 in a decimal)	PCF	95.3 PCF

COMPACTION DATA

13. Maximum Dry Density from Compaction Test	PCF	PCF
14. Optimum Moisture Content from Compaction Test	%	%
15. Apparent Percent Compaction	%	%
16. Aggregate Correction	%	%
17. Percent Compaction	%	%
18. Specified Minimum Percent Compaction	%	%

Test Depth: 4.9-5.3 FT.

Test Location :

Test Results & Remarks:

TESTED BY R. CRAVEN
TECHNICIAN

TEST METHODS: ASTM D 2937-83 and ASTM D 2216-80

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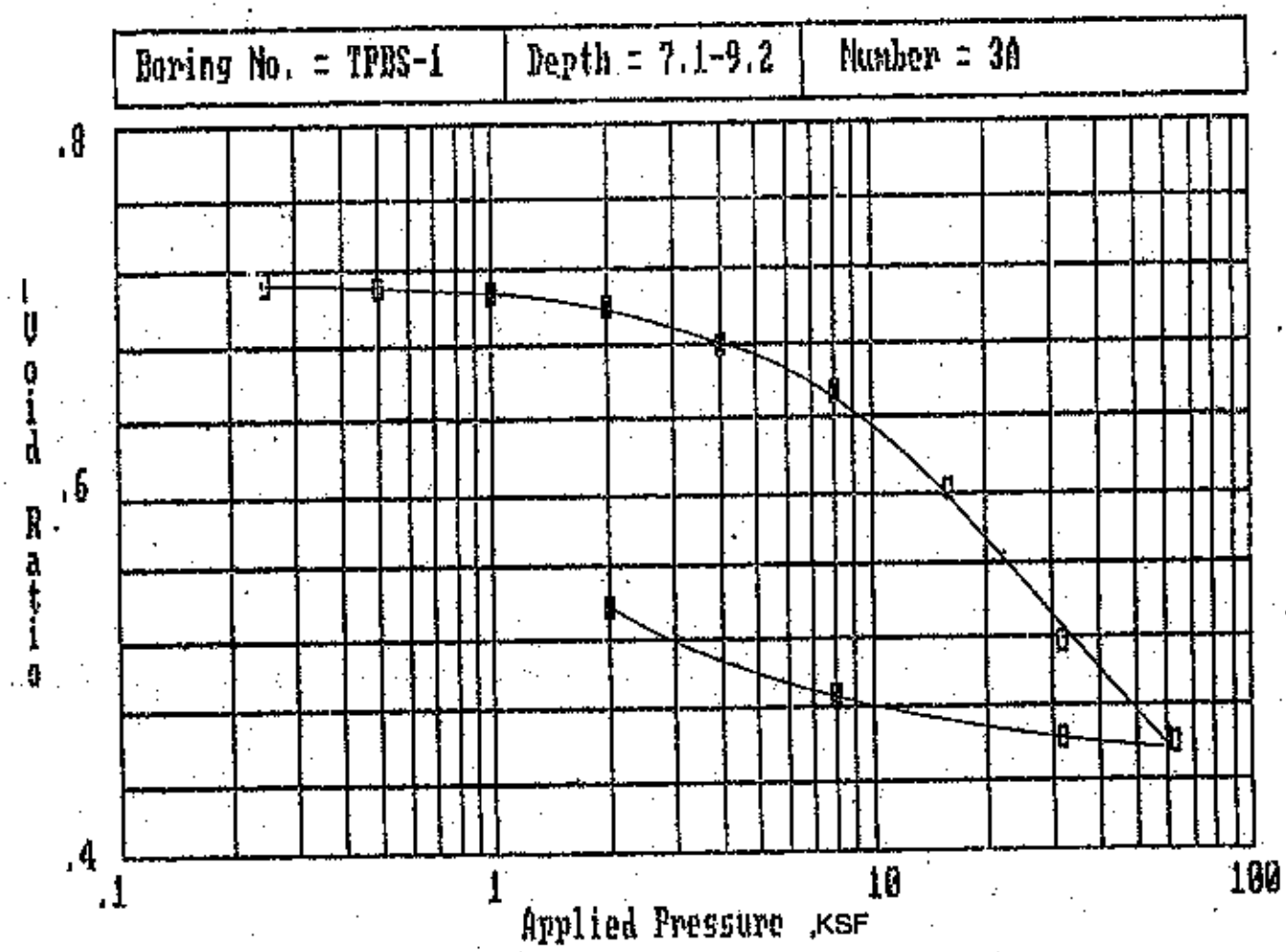
CONSOLIDATION TESTS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.6
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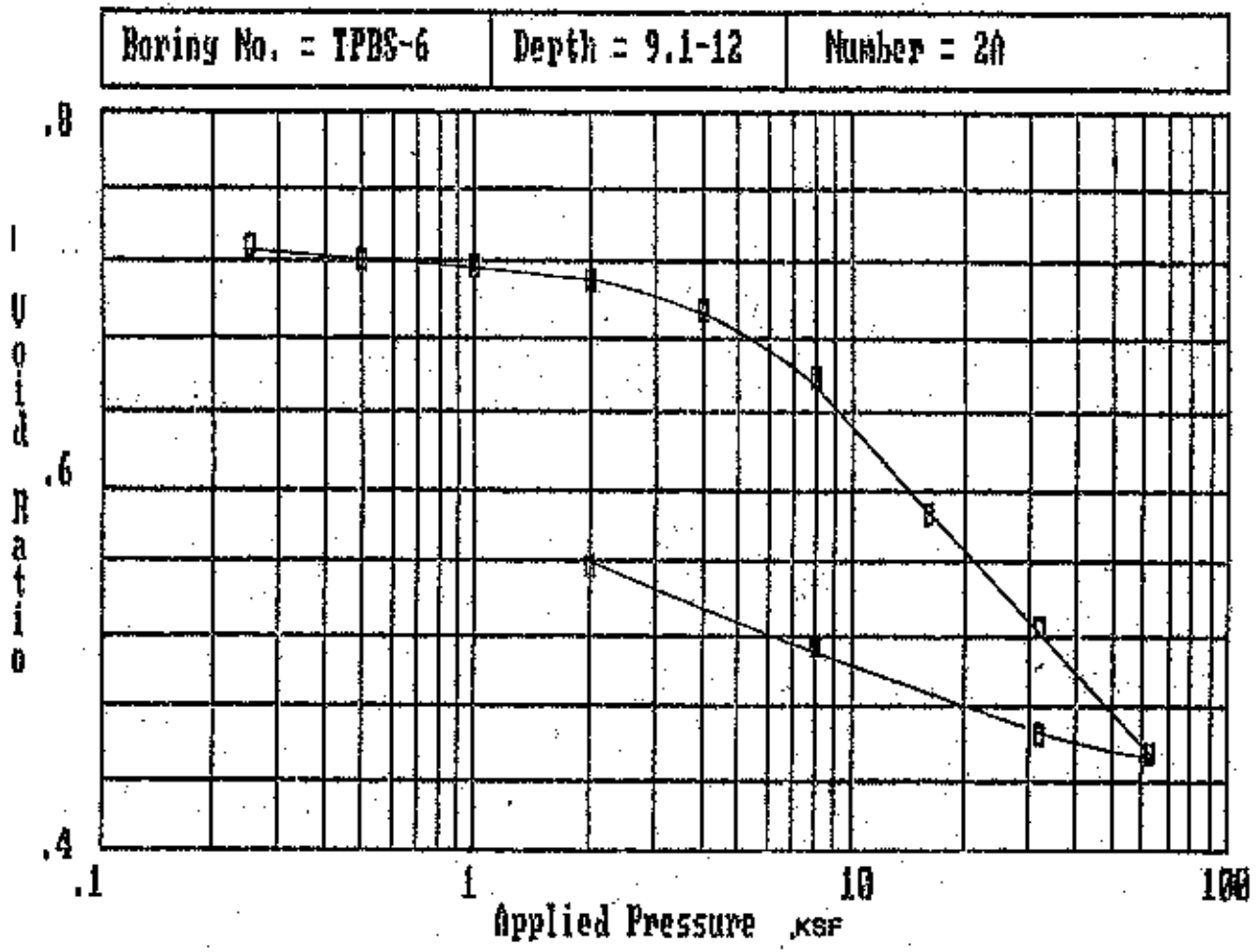
G 98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.4
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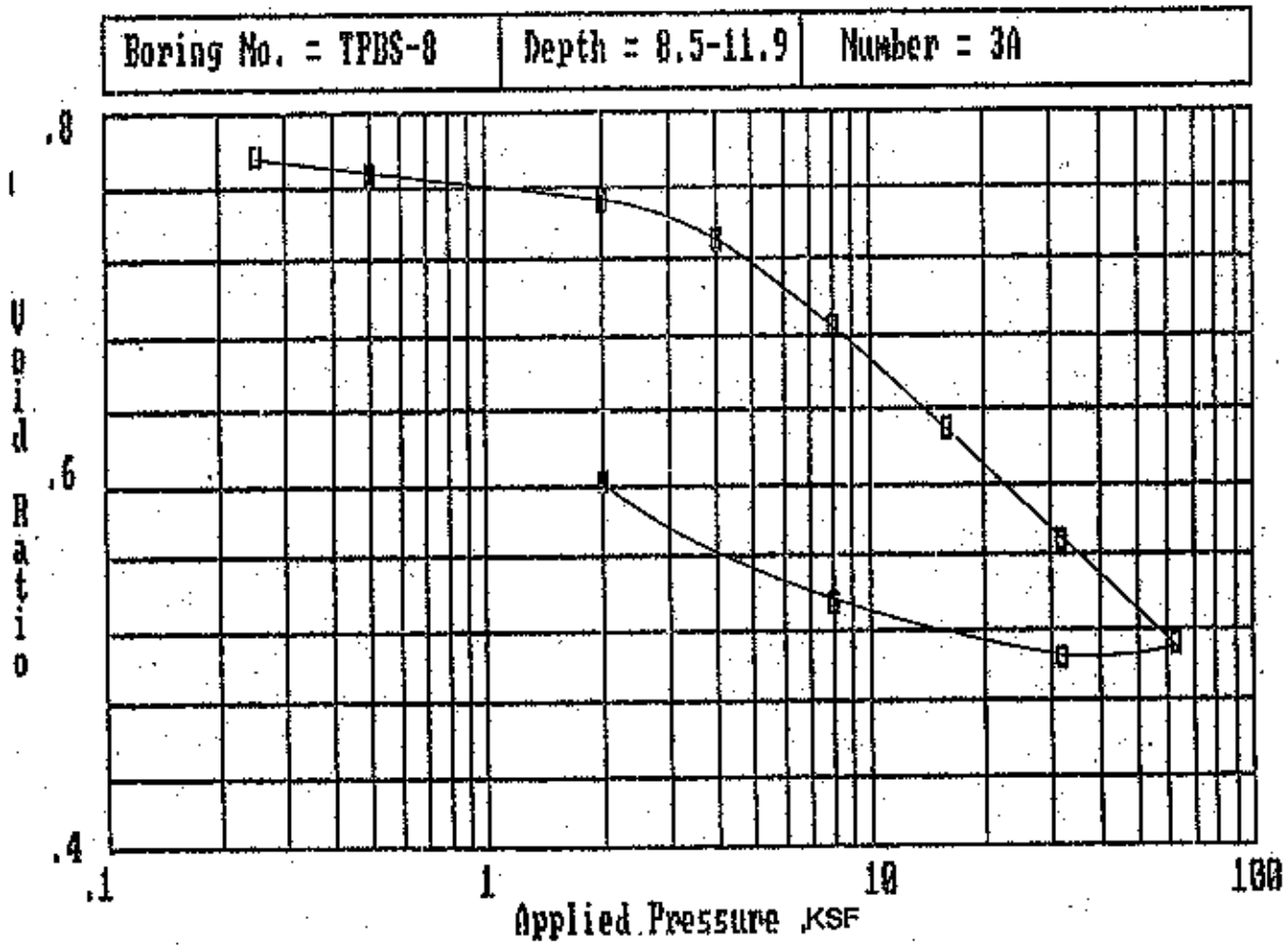
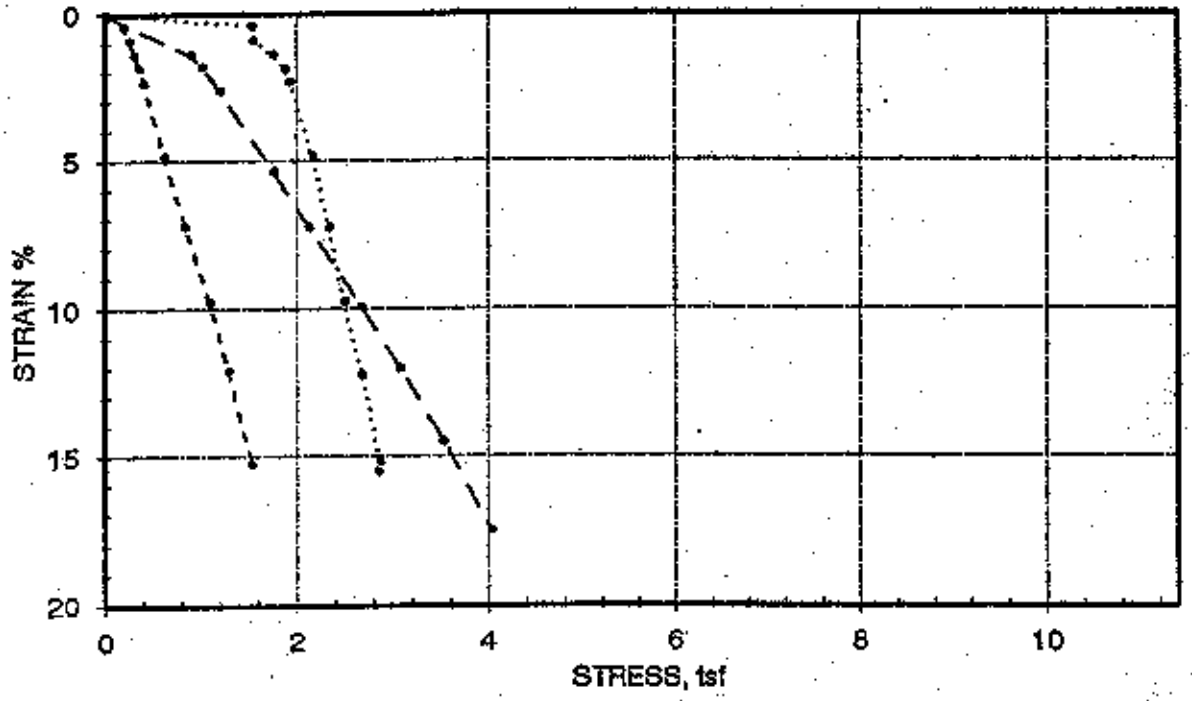
Applied Pressure ksf



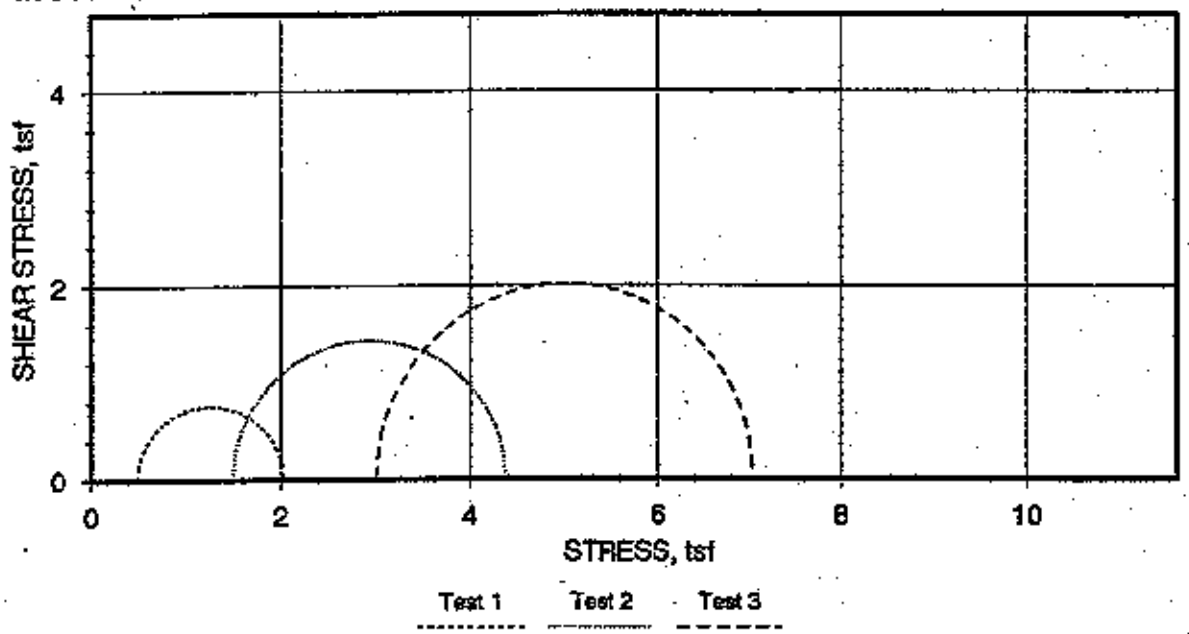
CHECKED BY: JA

TRIAXIAL SHEAR TESTS
UNCONSOLIDATED - UNDRAINED

WSSRAP - JOB NO. - 11295
UNCONSOLIDATED - UNDRAINED TEST
STRESS PATH



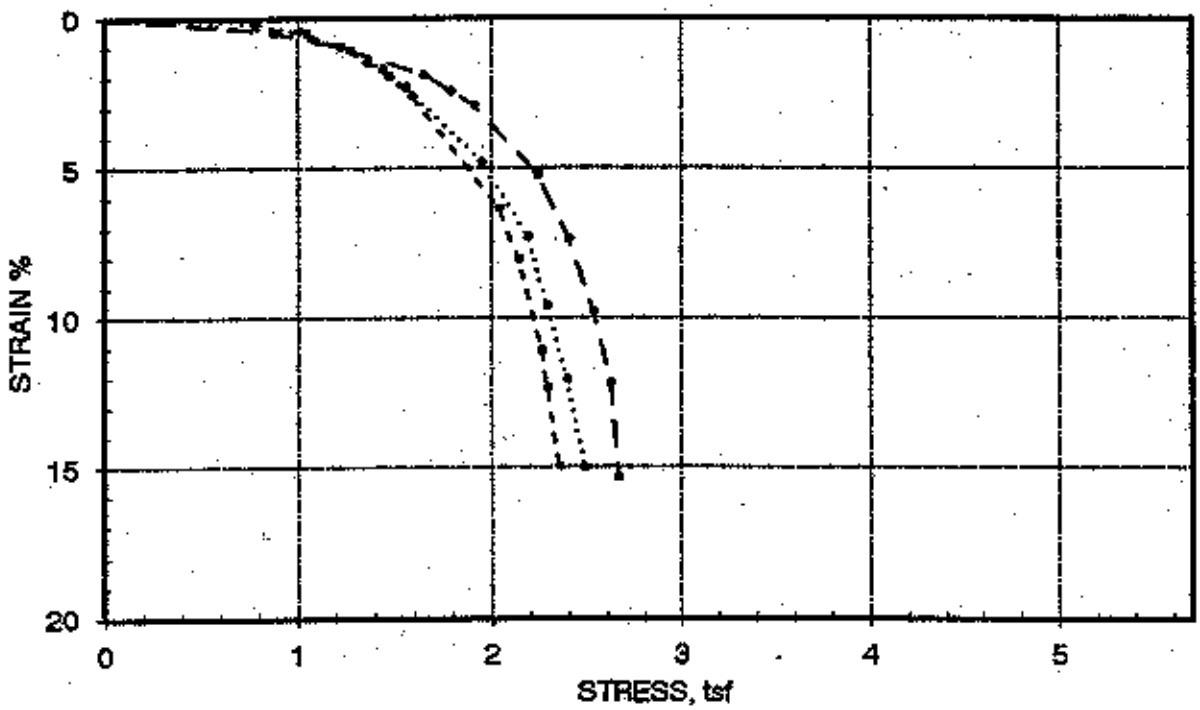
MOHR'S CIRCLES



Boring No: TPBS-1
Sample No: 2A
Depth: 2.6 - 7.1

J 72

WSSRAP - JOB NO: 11295
UNCONSOLIDATED - UNDRAINED TEST
STRESS PATH



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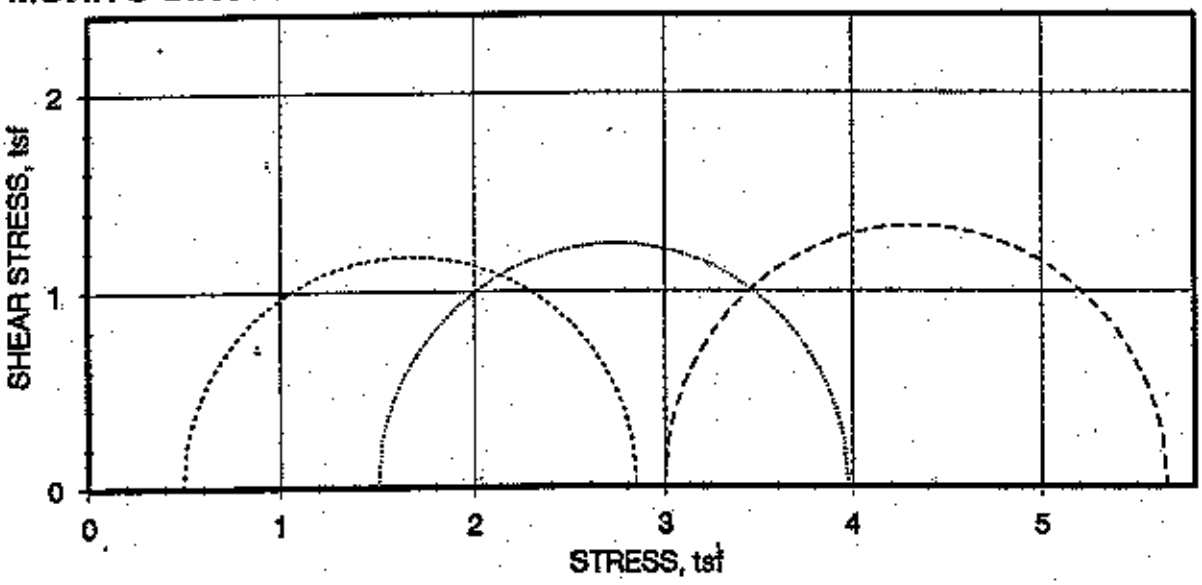
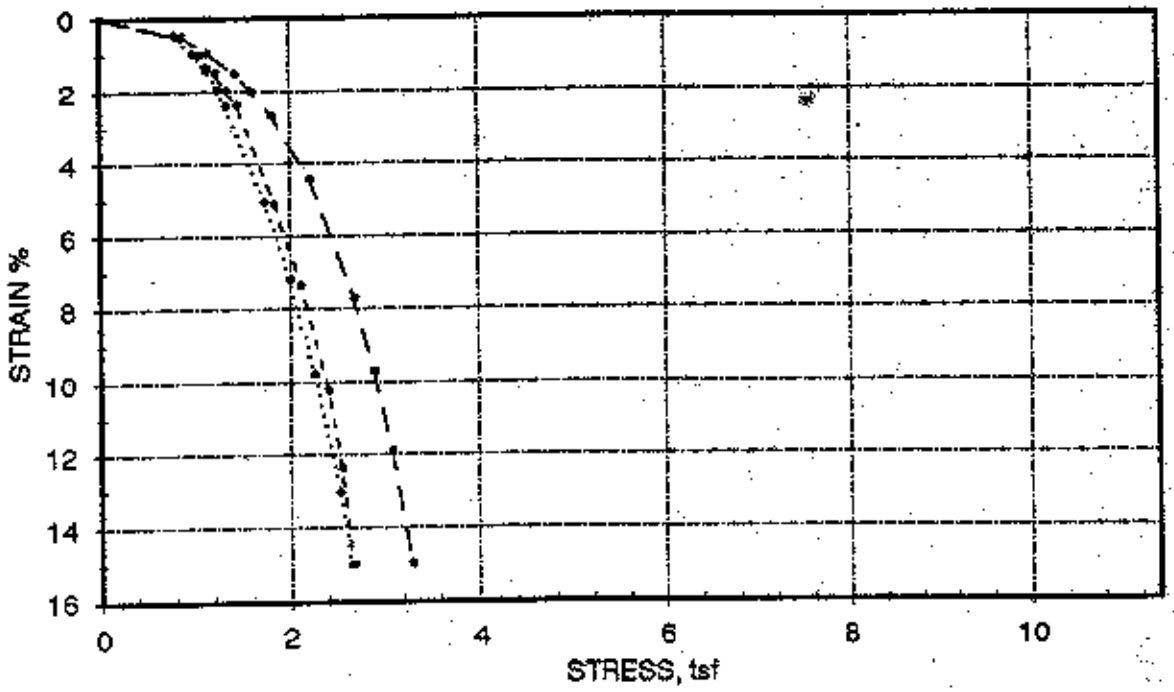


Test 1 Test 2 Test 3

TPBS-1

Boring No: TPBS-1
Sample No: 3A
Depth: 7.1 - 9.2 FT

WSSRAP - JOB NO: 11295.000
UNCONSOLIDATED - UNDRAINED TEST
STRESS PATH



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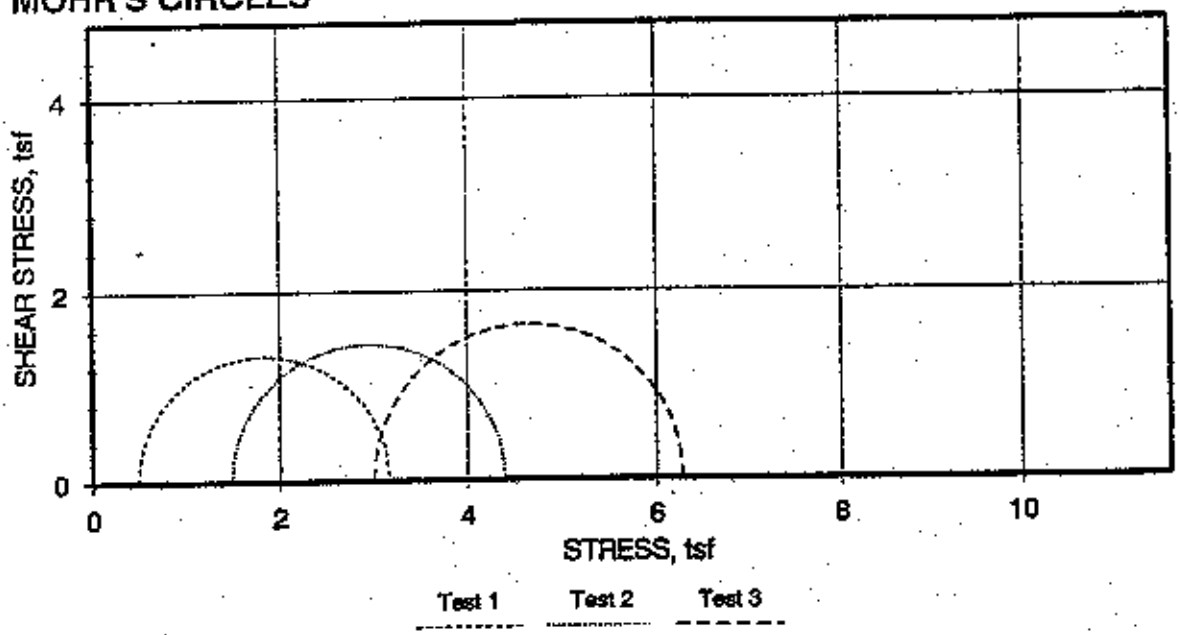
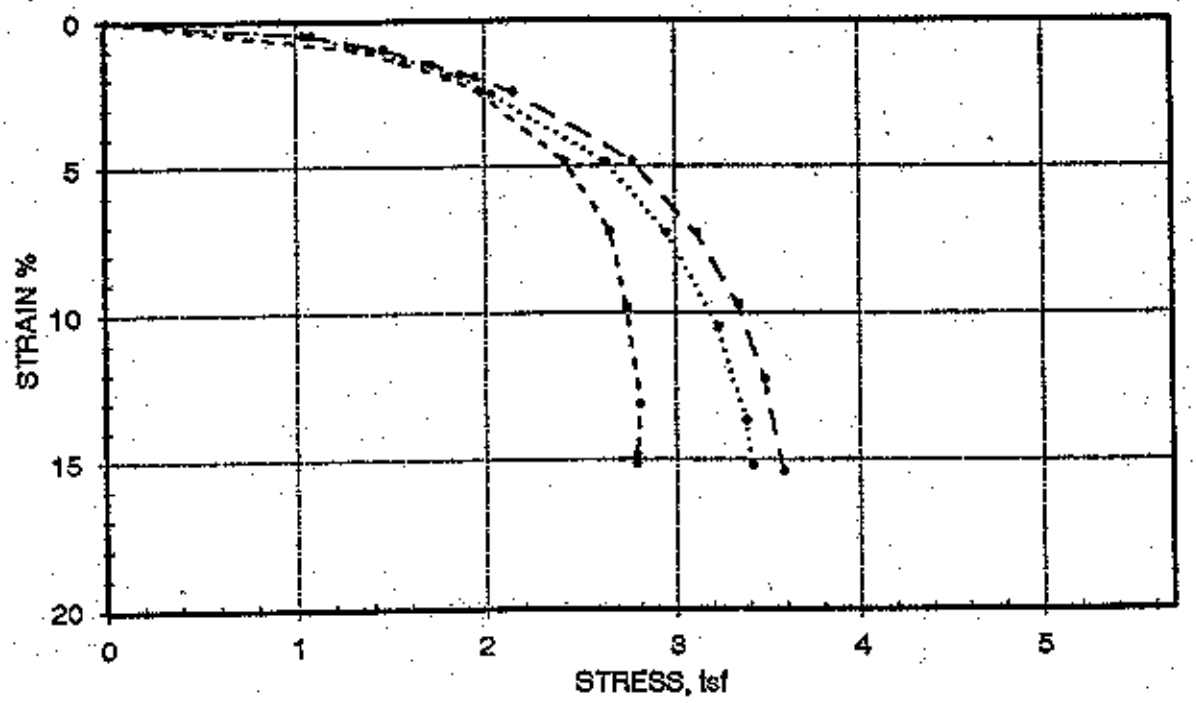


Boring No: TPBS-6
Sample No: 1A
Depth: 0.6-9.1

checked by: K 36

WSSRAP - JOB NO. - 11295.000
UNCONSOLIDATED - UNDRAINED TEST
STRESS PATH



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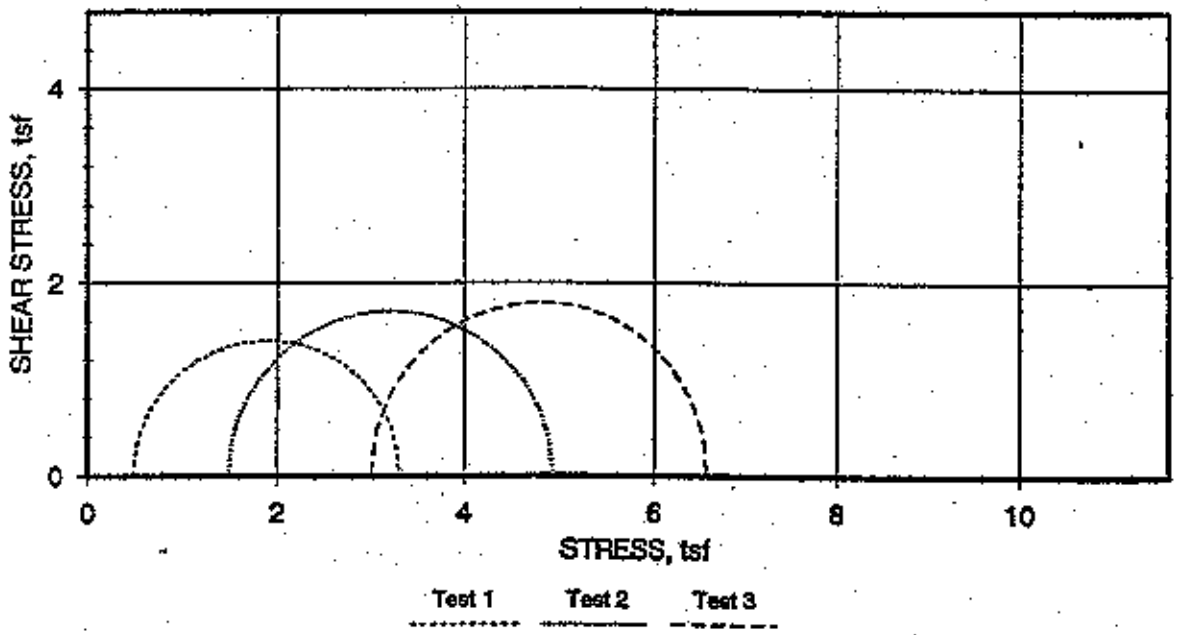
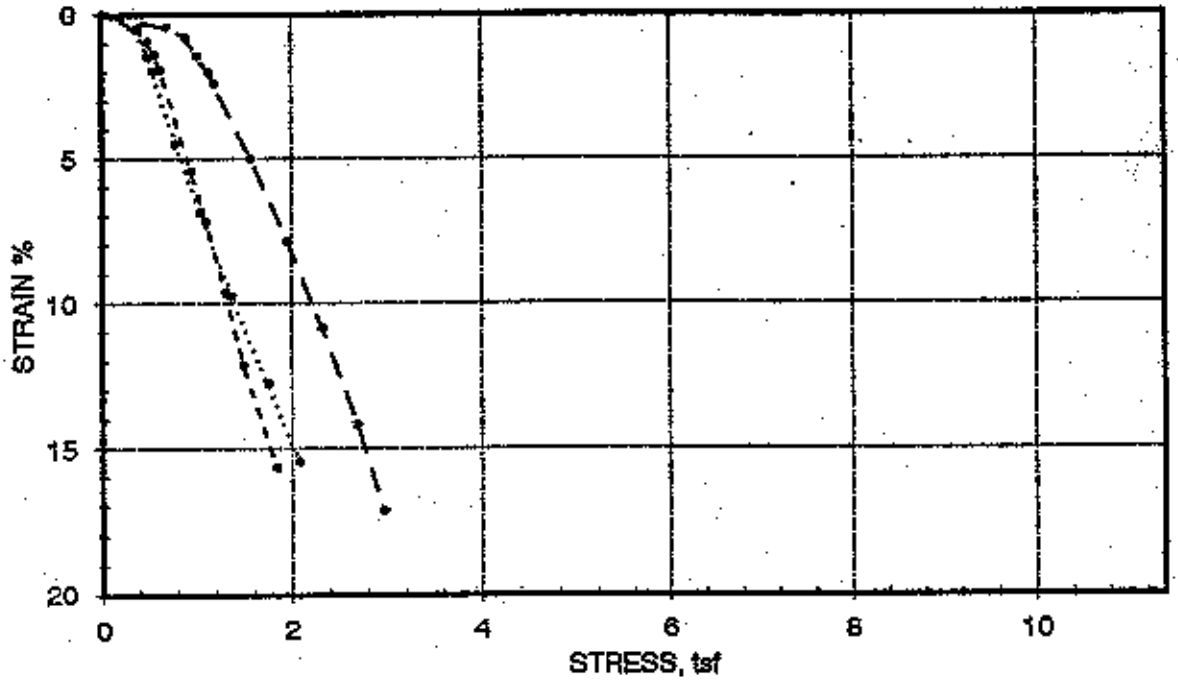


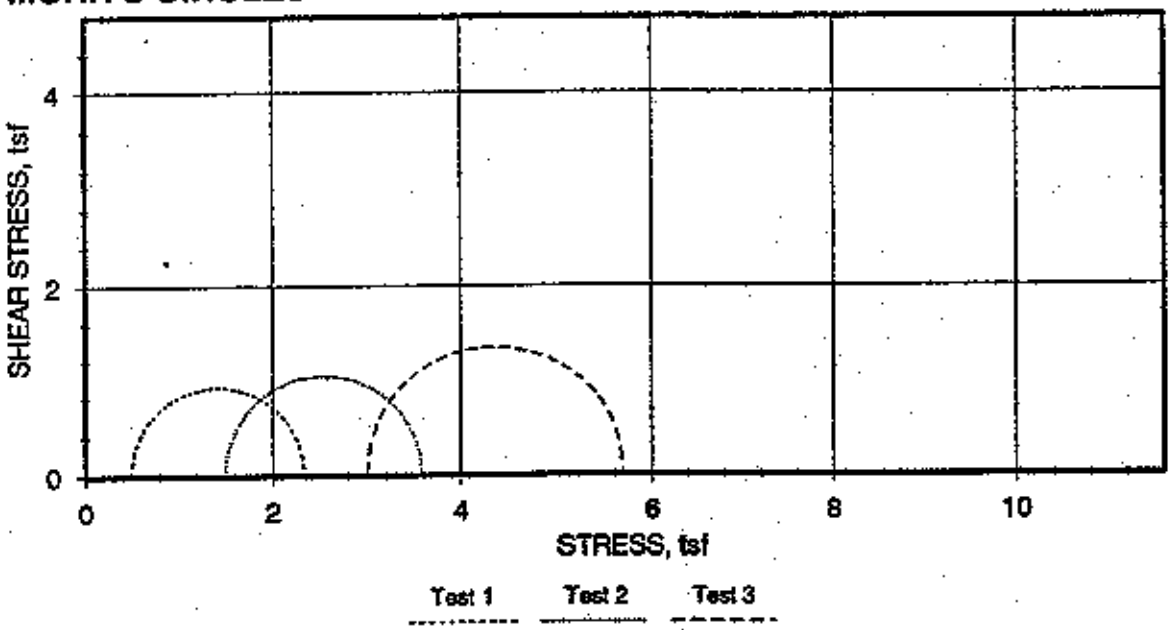
Boring No: TPBS-6
Sample No: 2A
Depth: 9.1-12.1 FT.

checked by K. 47

WSSRAP - JOB NO. - 11295.000
UNCONSOLIDATED - UNDRAINED TEST
STRESS PATH



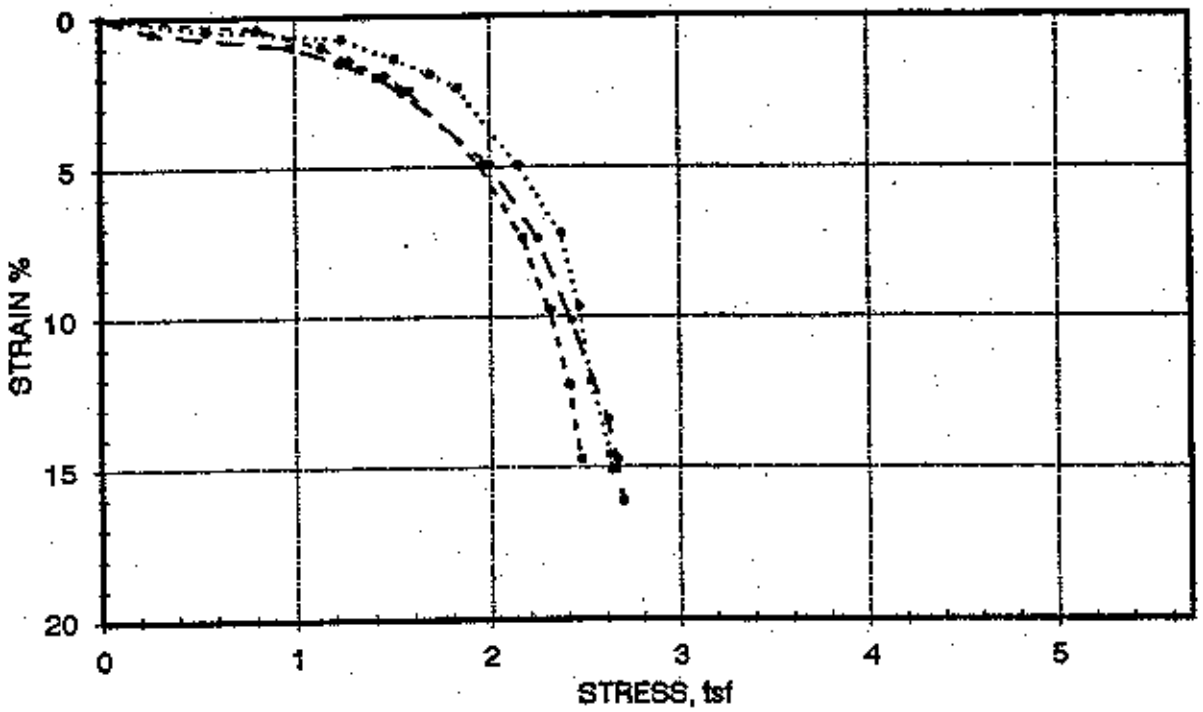
MOHR'S CIRCLES



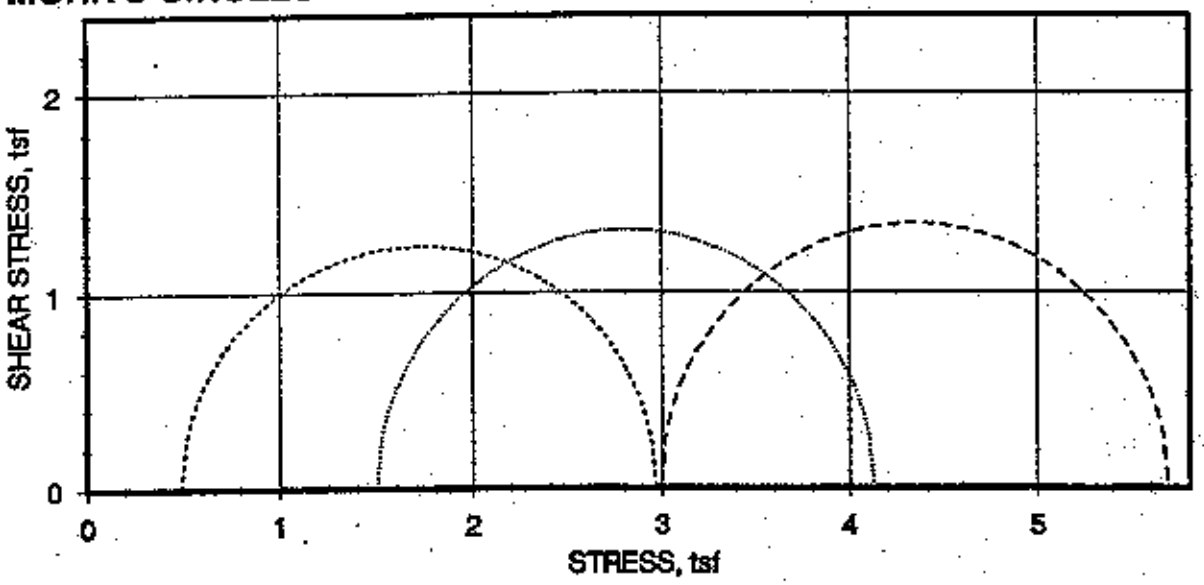
Boring No: TPBS-8
Sample No: 1A
Depth: 0.6-4.3

checked by K 58

WSSRAP , JOB NO. - 11295
UNCONSOLIDATED , UNDRAINED TEST
STRESS PATH



MOHR'S CIRCLES



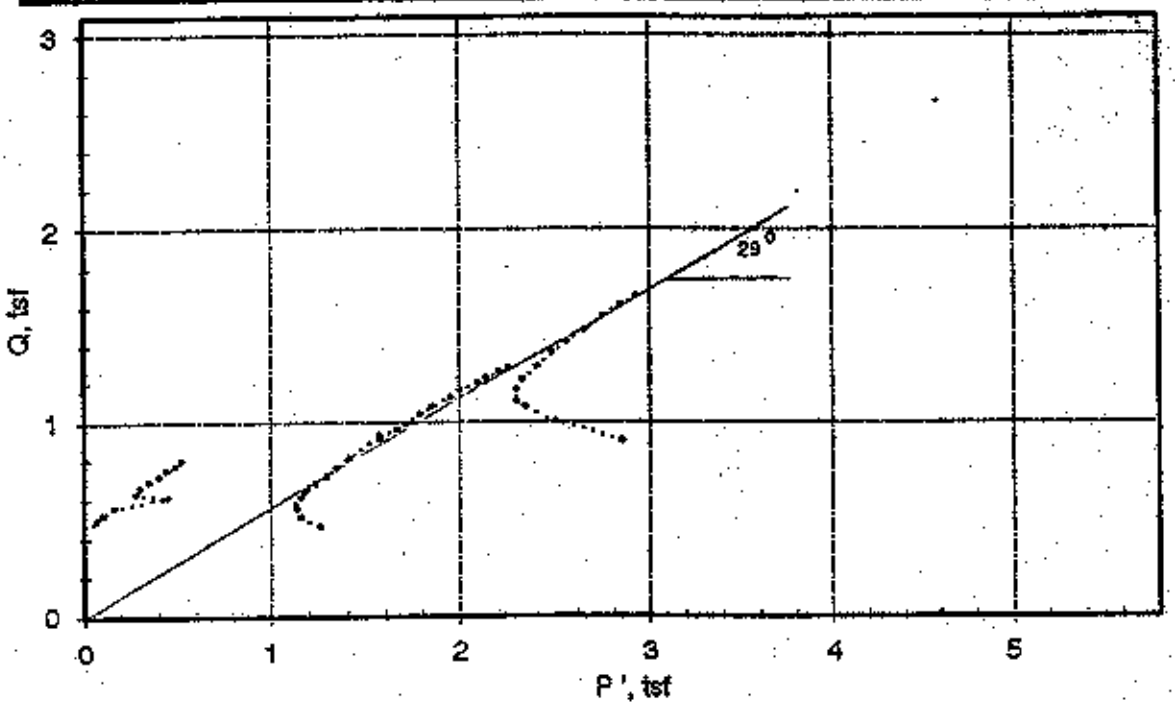
Test 1 Test 2 Test 3

TPB5-8

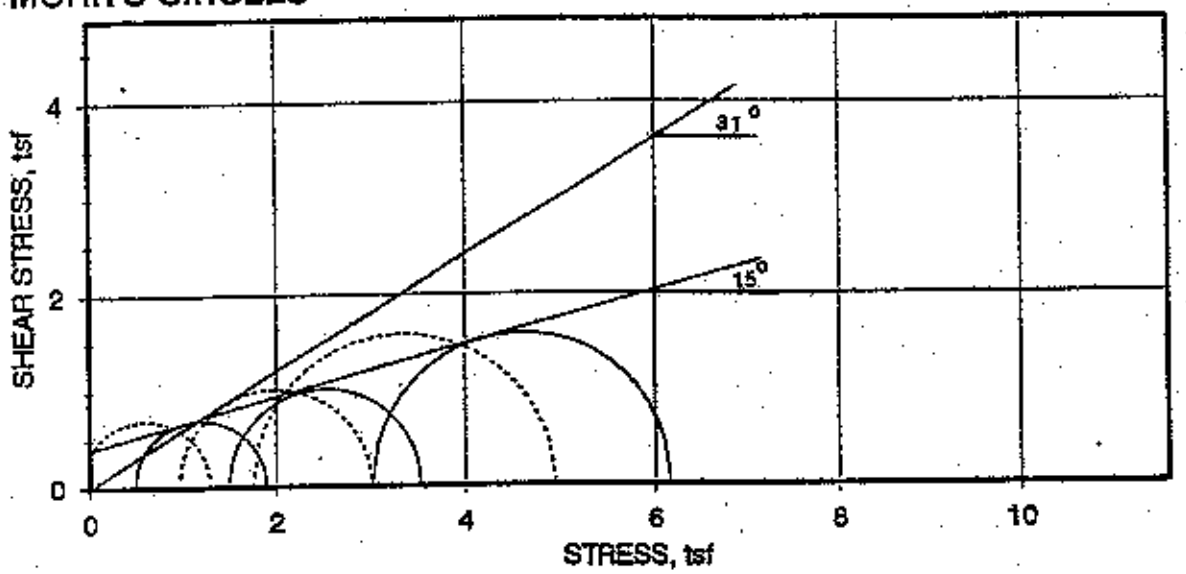
Boring No: TPB-8
Sample No: 3A
Depth: 8.5 - 11.5 FT

TRIAXIAL SHEAR STRENGTH
CONSOLIDATED - UNDRAINED

WSSRAP - JOB NO.: 11295.000
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



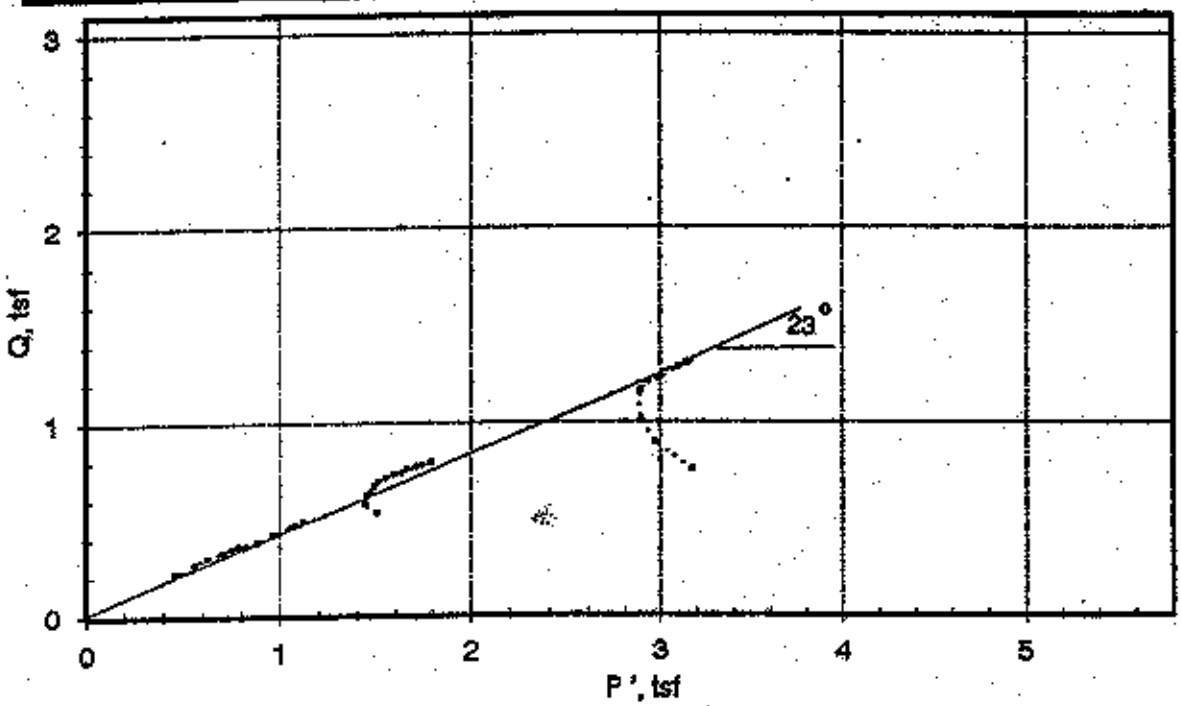
MOHR'S CIRCLES



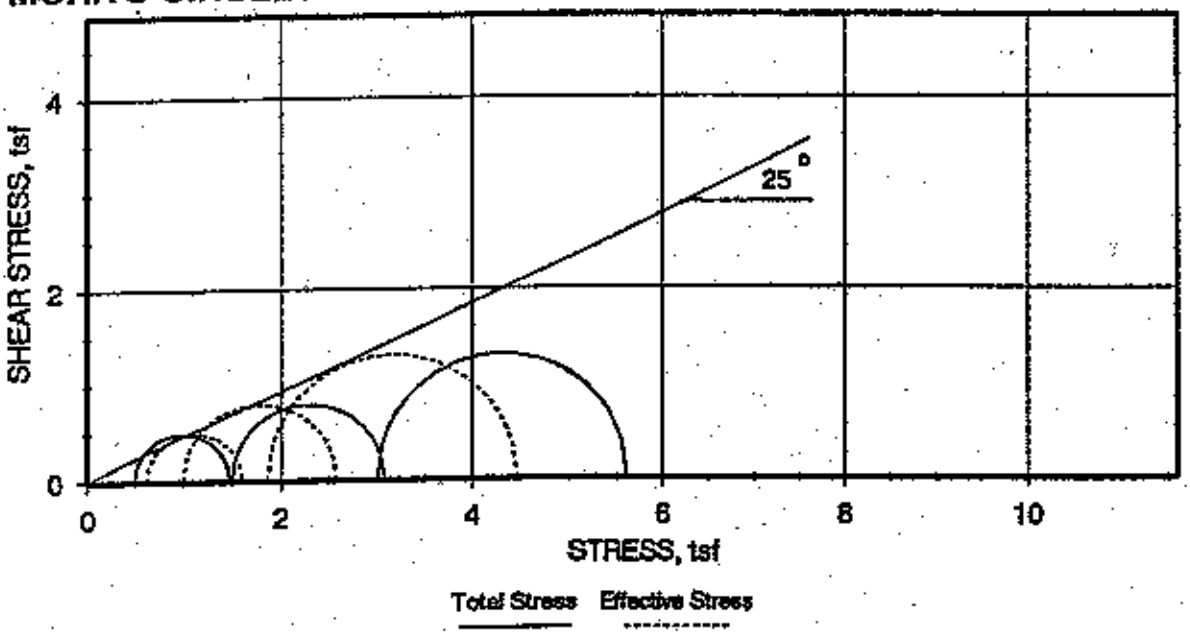
Boring No: TPBS-1
Sample No: 2A
Depth: 2.6-7.1

checked by: K 69

WSSRAP - JOB NO.: 11295.000
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH

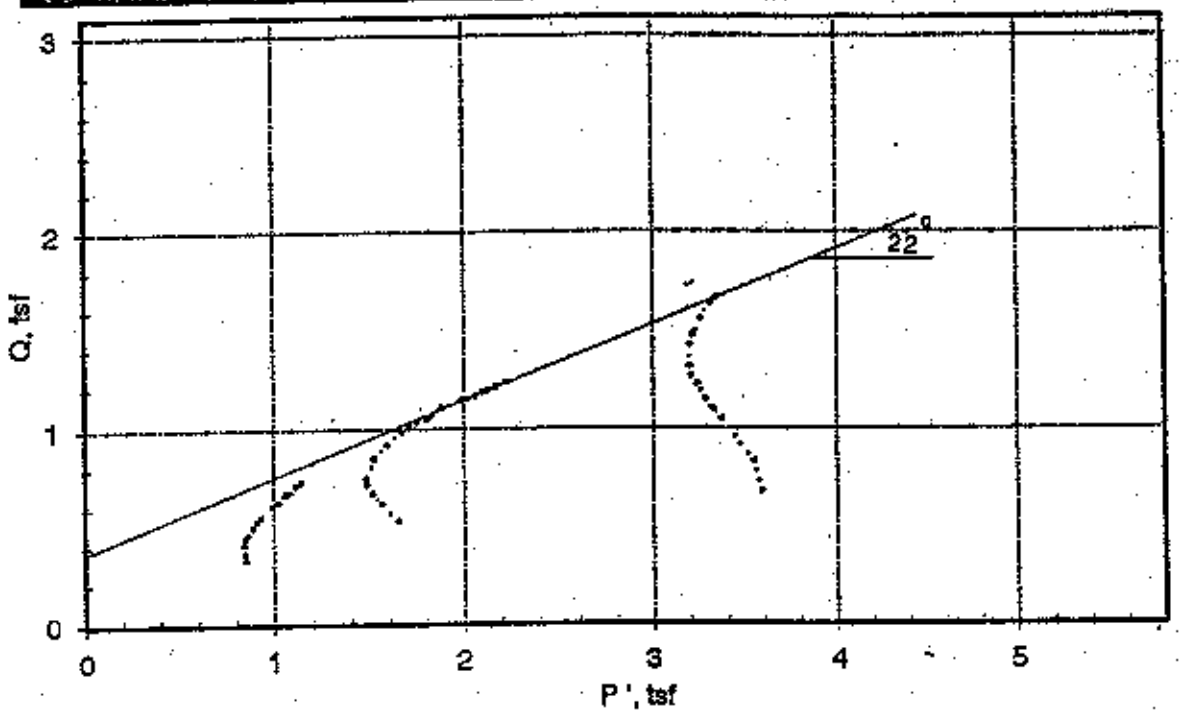


MOHR'S CIRCLES

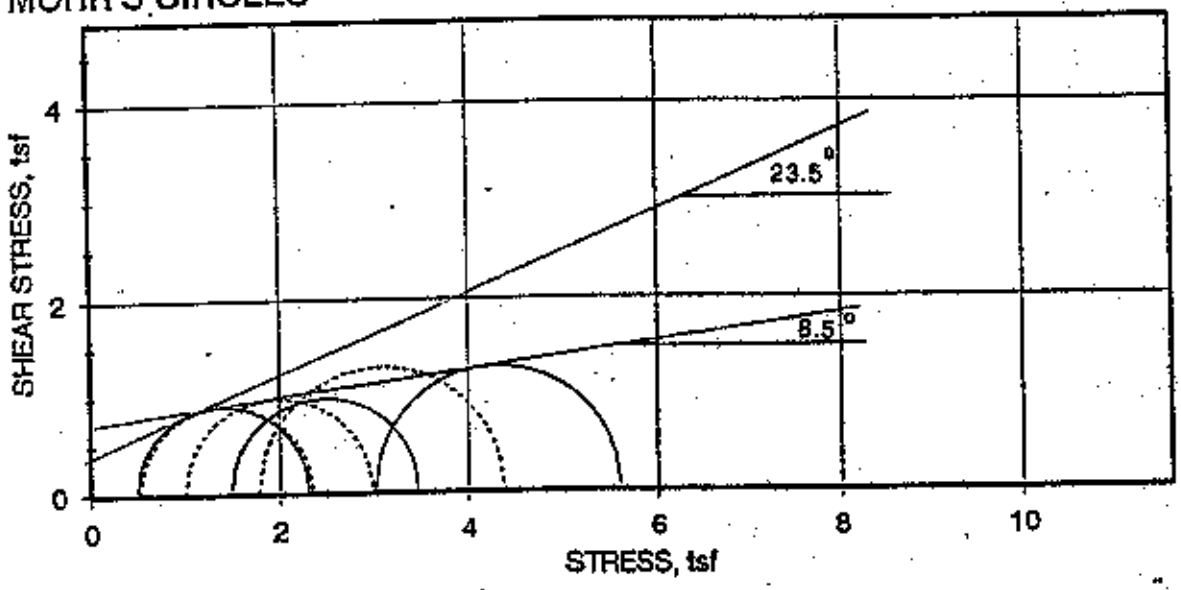


Boring No: TPBS-1
Sample No: 3A
Depth: 7.1-9.2 FT.

WSSRAP - JOB NO: 11295.000
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



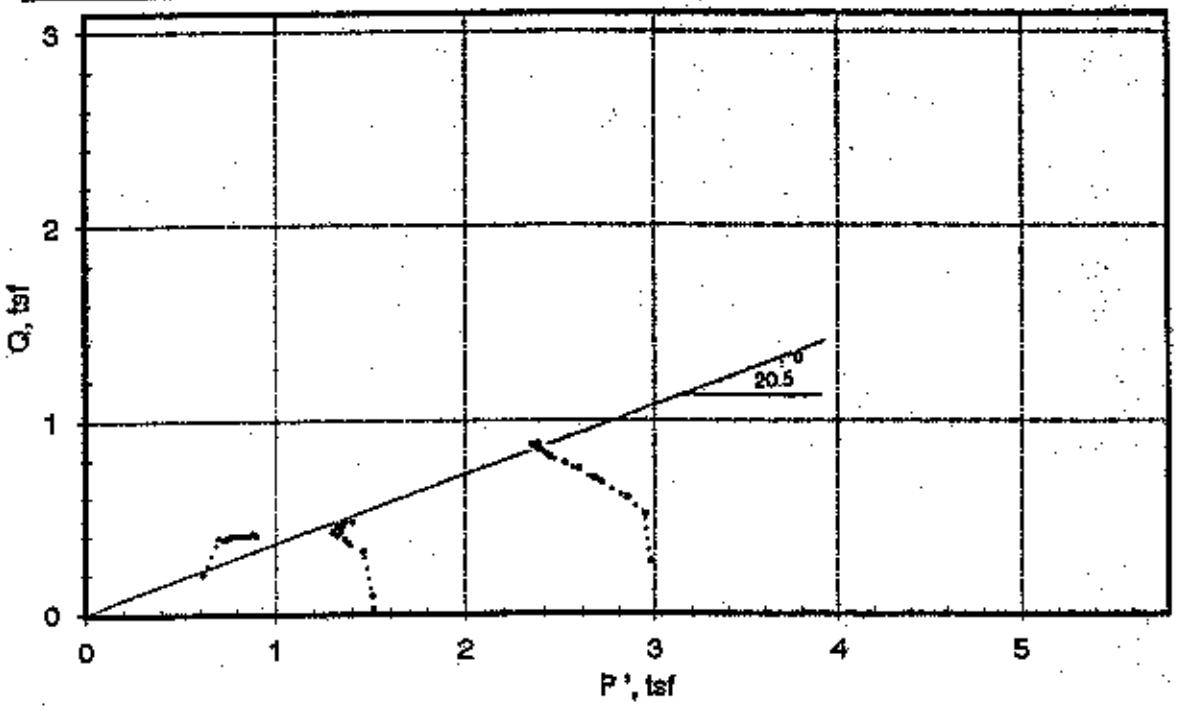
MOHR'S CIRCLES



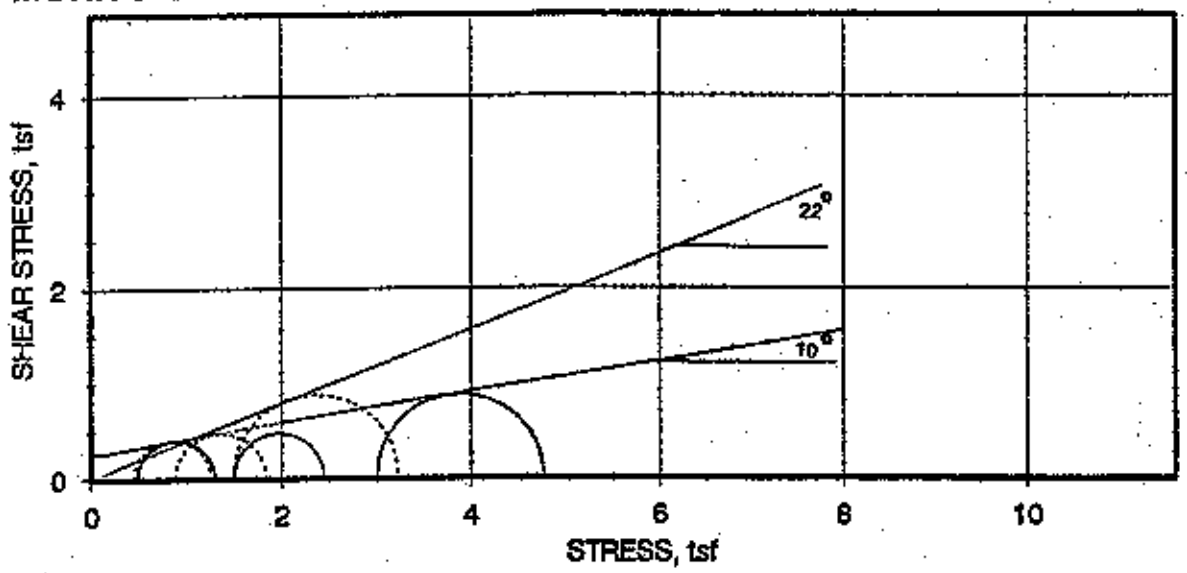
Boring No: TPBS-6
Sample No: 1A
Depth: 6-9 FT.

K 87

WSSRAP - JOB NO.- 11295
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES



Total Stress — Effective Stress ----------

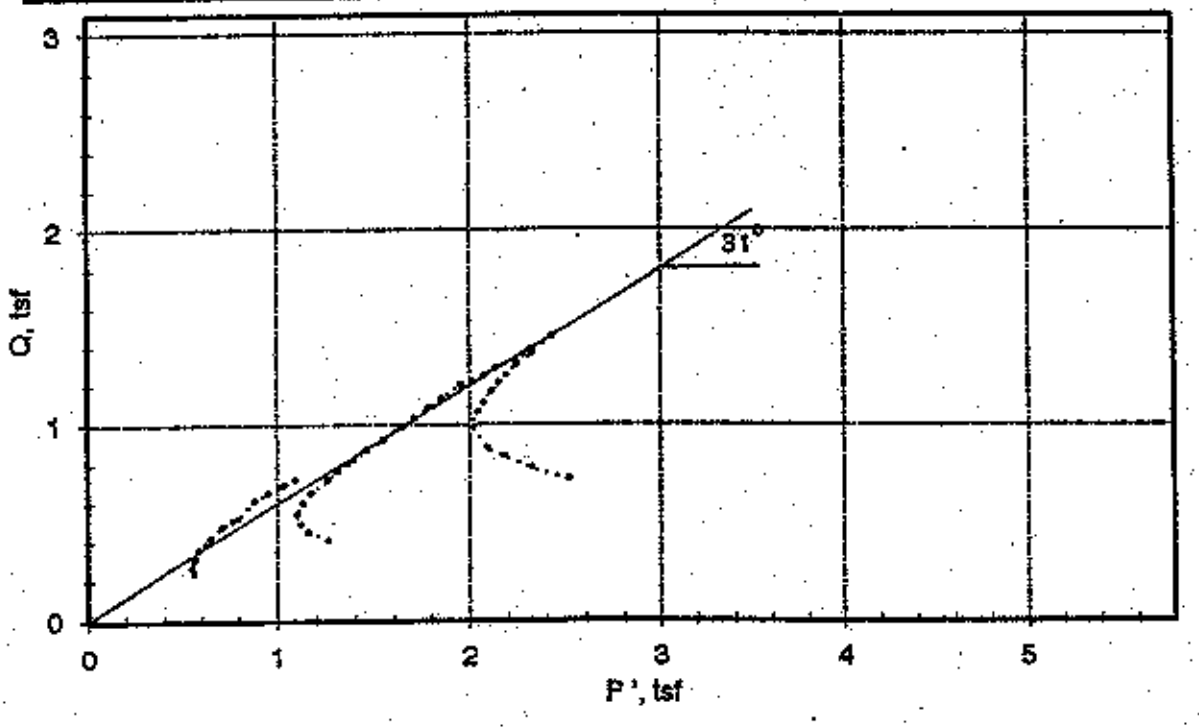
Boring No: TPBS-6
Sample No: 2A
Depth: 9.1-12 FT.

Check by: JN 4

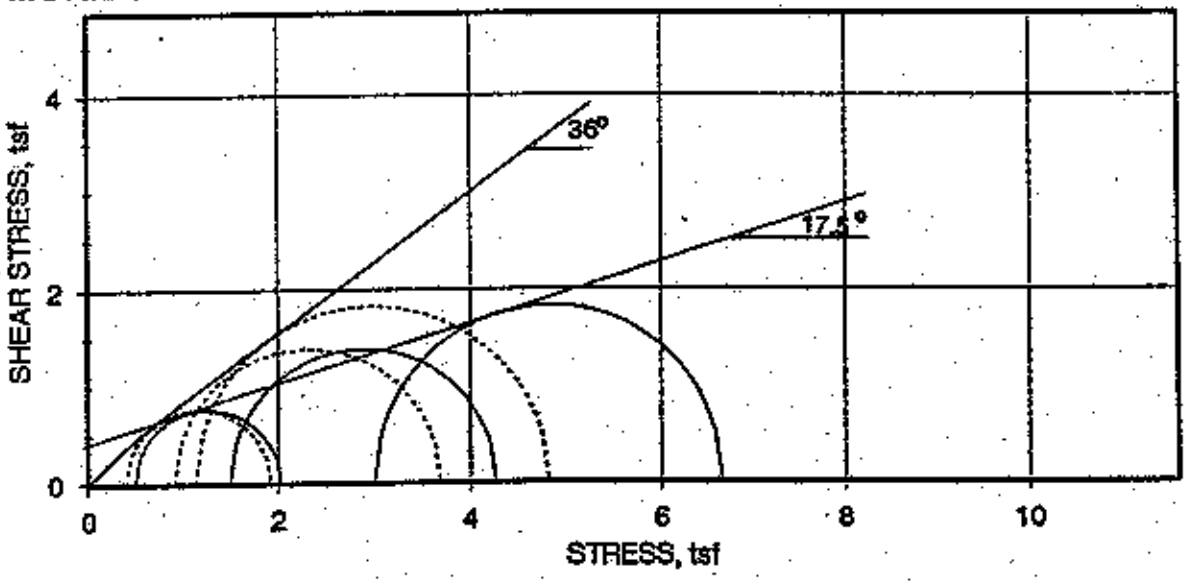
WSSRAP - JOB NO.: 11295

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

STRESS PATH



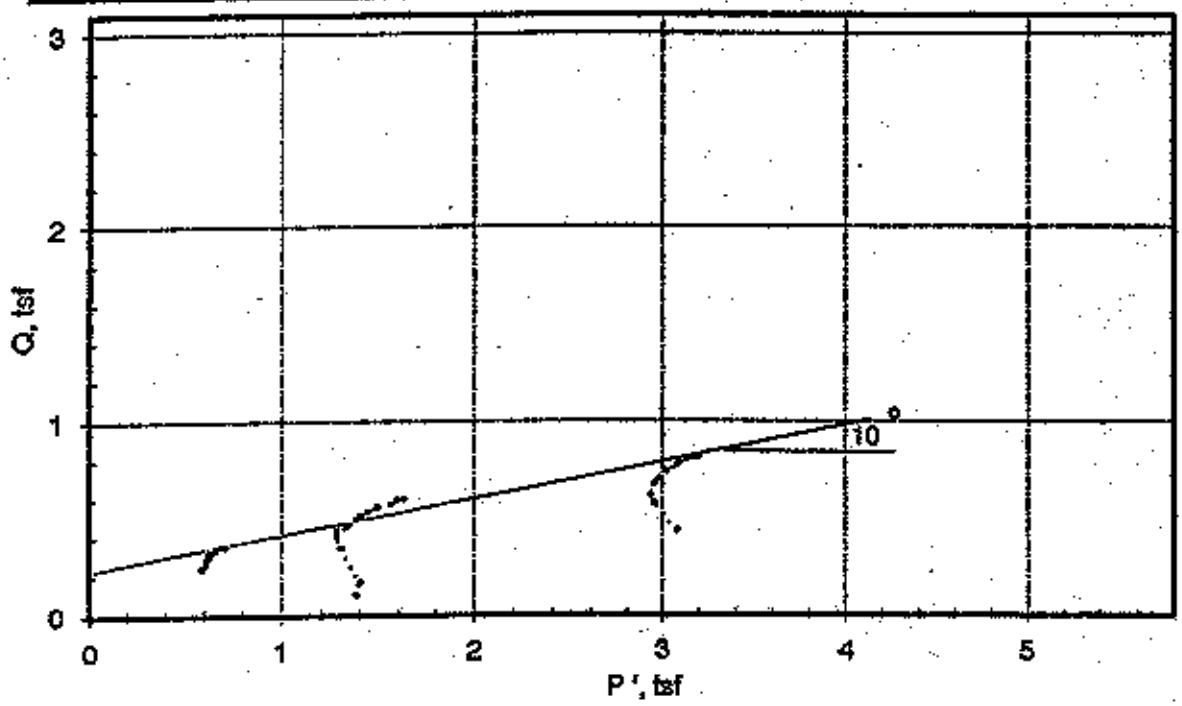
MOHR'S CIRCLES



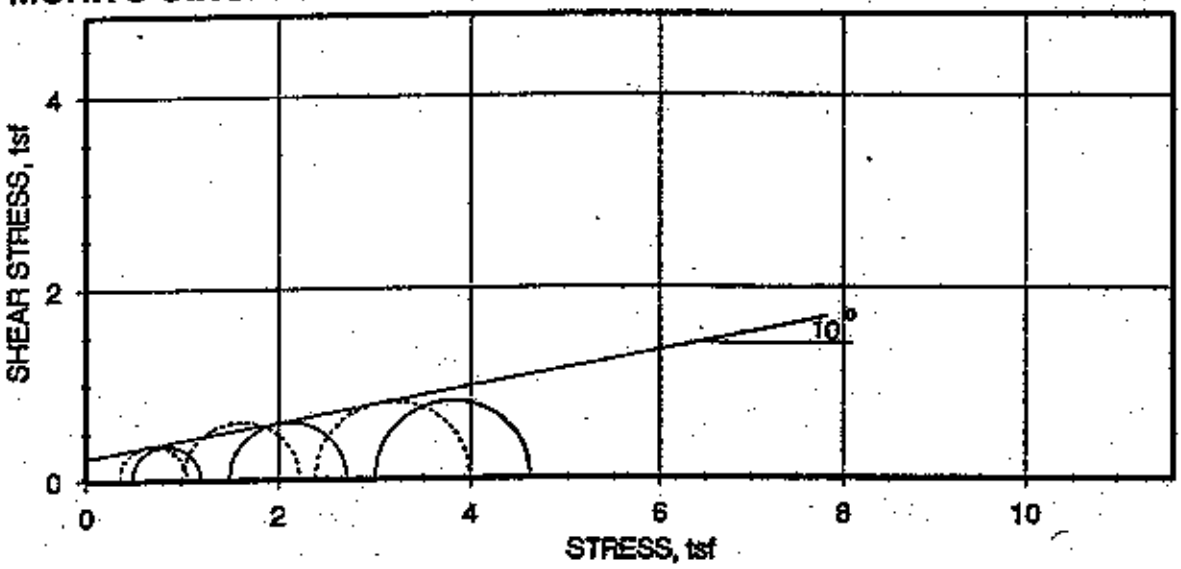
Total Stress ——— Effective Stress - - - - -

Boring No: TPBS-8
Sample No: 1A
Depth: 0.5-4.3 FT.

WSSRAP - JOB NO:- 11295
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES



Total Stress Effective Stress

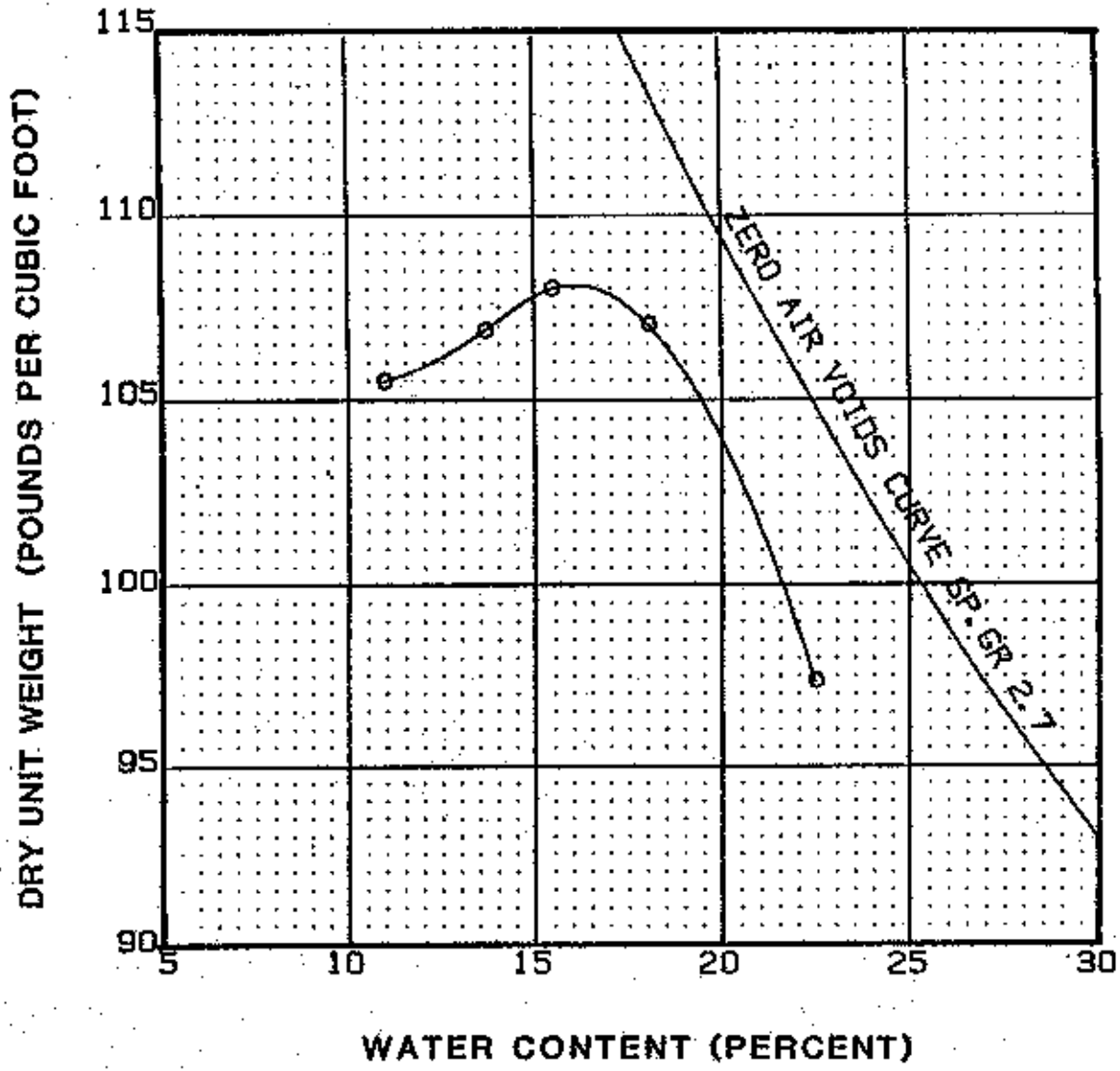
Boring No: TPBS-8
Sample No: 3A
Depth: 8.5-11.5 FT.

checked by: JJP

COMPACTION TESTS

L-2 10/86

Job # 11295
Date: 8-8-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
108.1	15.9	11.1

DESCRIPTION

Light brown silty clay

ATTERBERG LIMITS

LL- 31 PL- 18 PI- 13

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

TPBS-1 2A
2.8'-7.1'

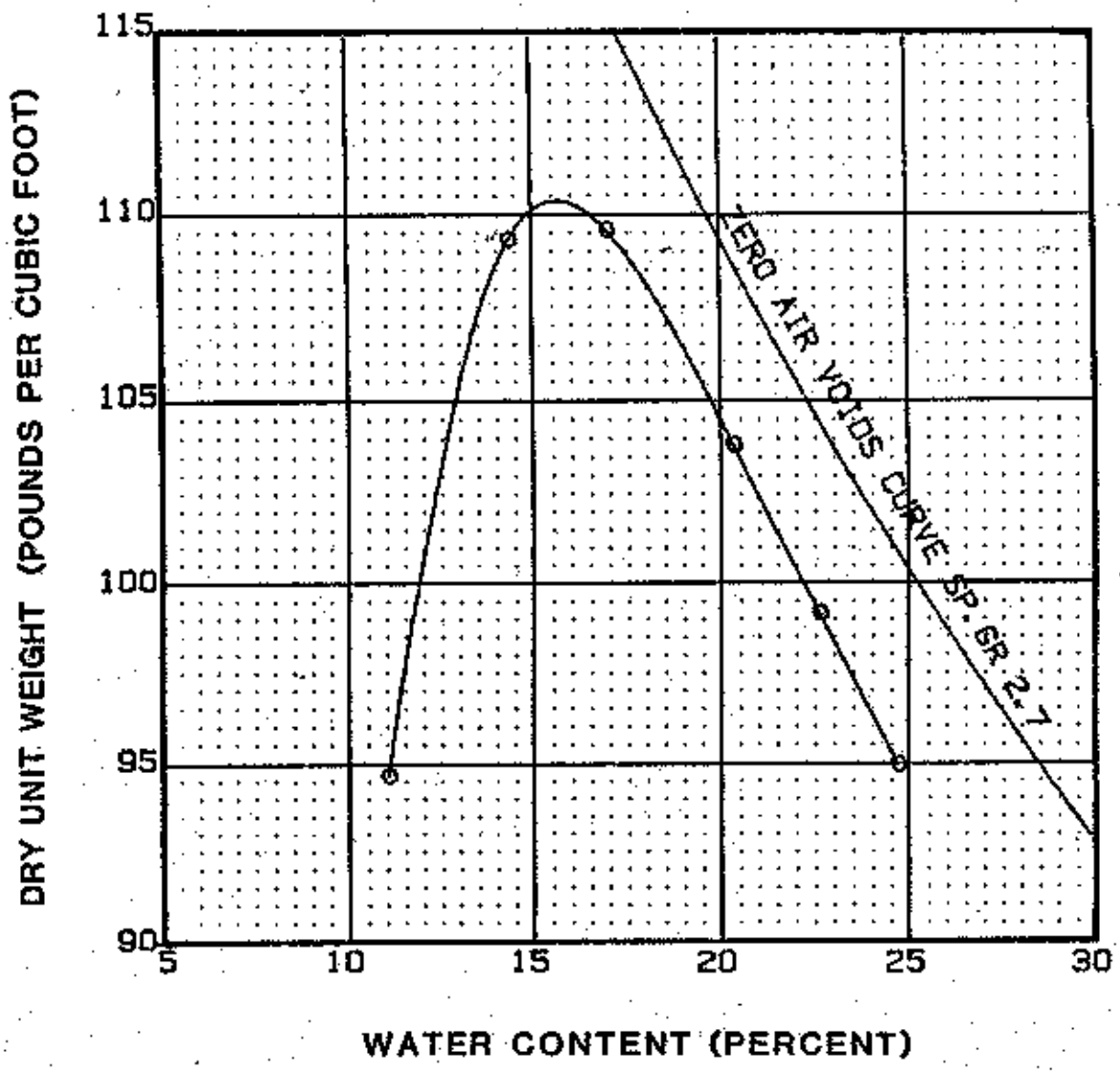
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE F/15

Job # 11295
Date: 8-28-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70 (Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
110.4	15.6	

DESCRIPTION

Light brown, silty CLAY

ATTERBERG LIMITS

LL- 31 PL- 18 PI- 13

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

Boring I.D. # TP85-1
Sample I.D. # 2A 2.6-7.1'

WSSRAP

COMPACTION TEST

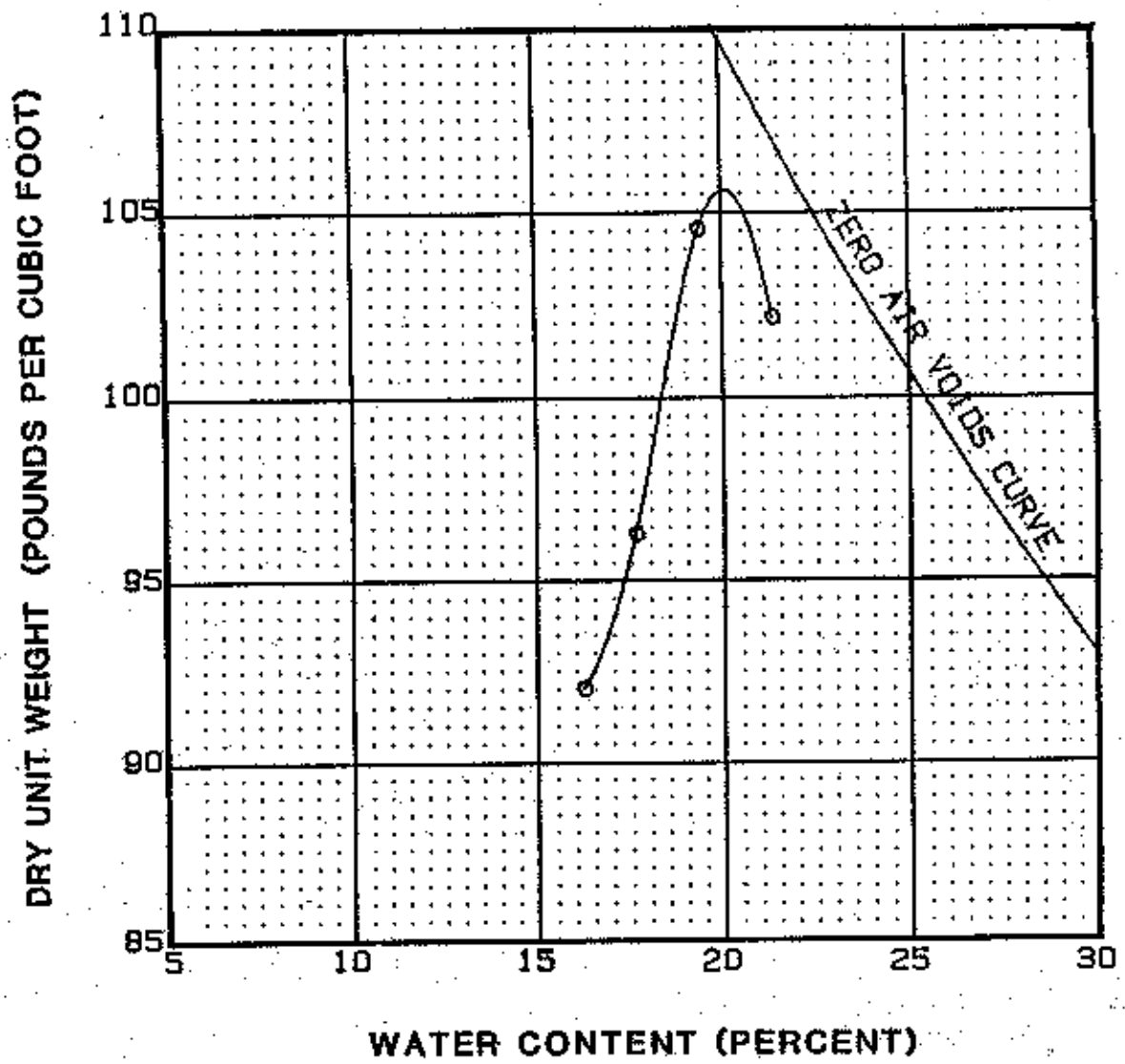
GEOTECHNOLOGY

PLATE F-113

L-2 10/88

L-2 10/88

Job # 11295
Date: 7-27-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
105.6	20.1	

DESCRIPTION

Tan Clay

ATTERBERG LIMITS

LL-60 PL-39 PI-21

CLASSIFICATION SYSTEM

UNIFIED : MH

AASHTO :

SAMPLE INFORMATION

TPBS - 1

3A 7.1-9.2

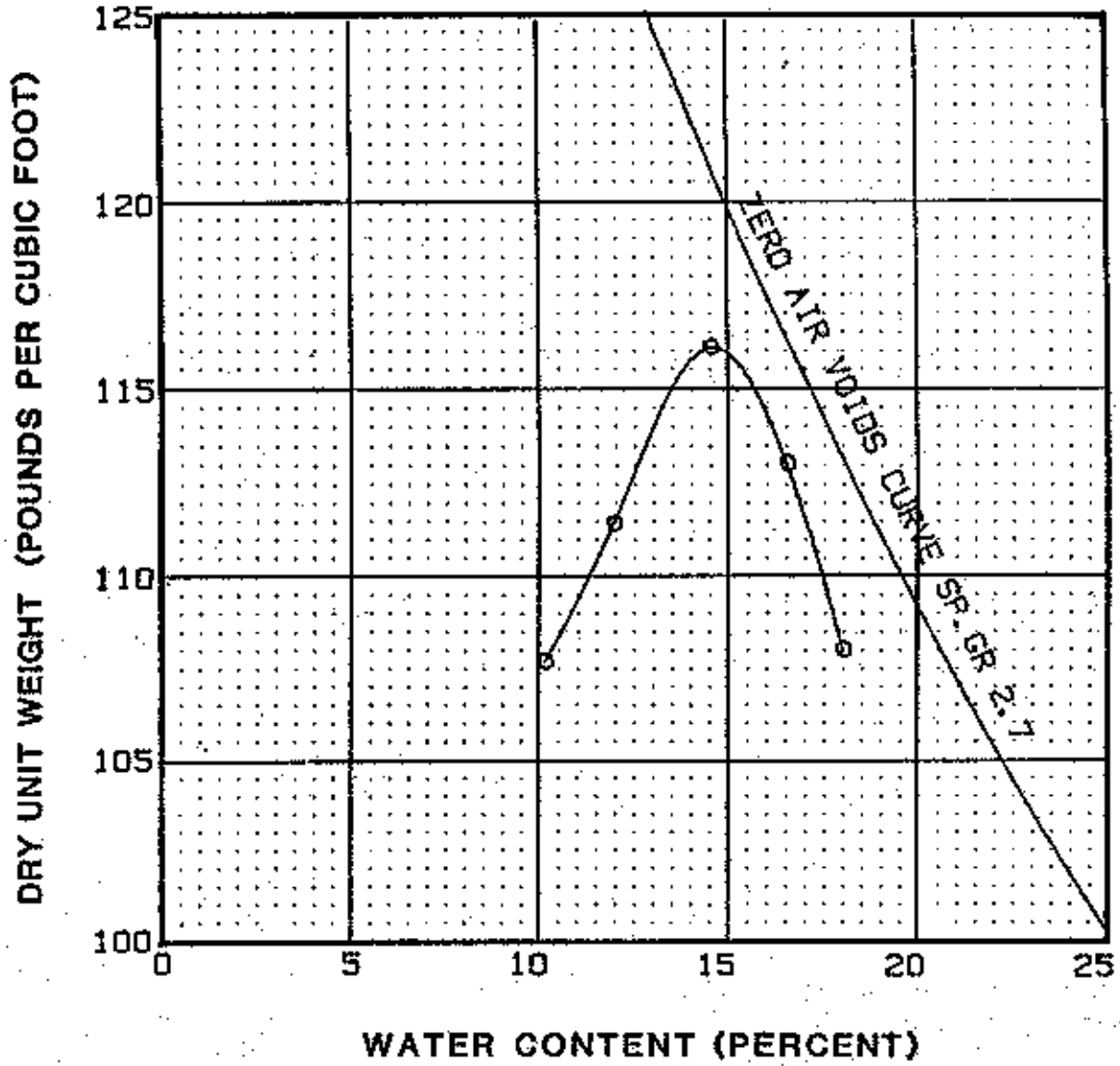
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE P-114

Job # 11295
Date: 6-26-99



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
116.1	14.6	20.5

DESCRIPTION

Gray, silty CLAY

ATTERBERG LIMITS

LL- 42 PL- 22 PI- 20

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

Boring I.D. # TPBS-1
Sample I.D. # 4A 9.2-14.1

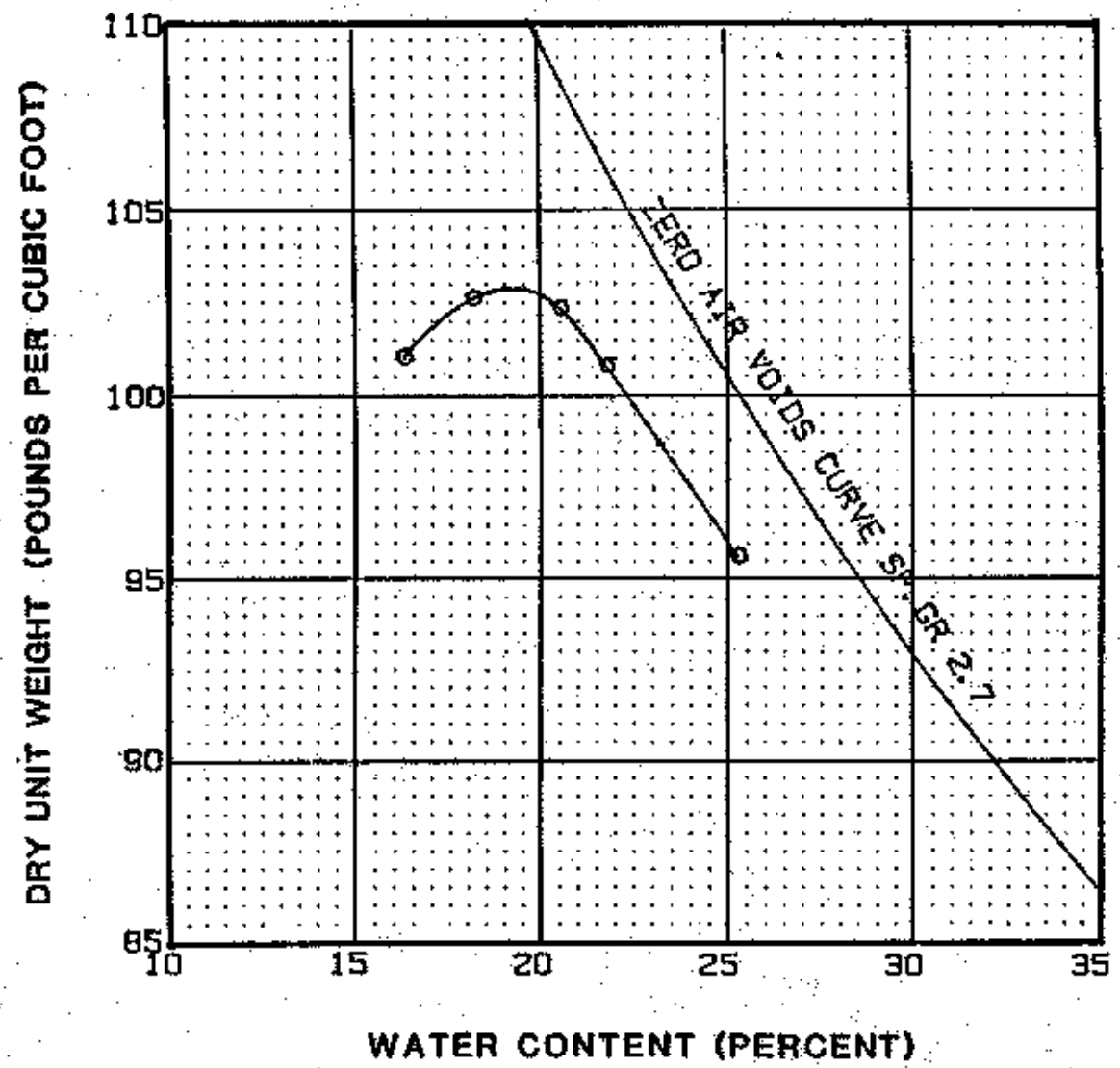
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE F 118

Job # 11295
Date: 8-27-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
102.9	19.3	24.6

DESCRIPTION

Brown and gray, silty CLAY.

ATTERBERG LIMITS

LL- 38 PL- 27 PI- 11

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

TP85 S 1A
Depth 0.5-8.1

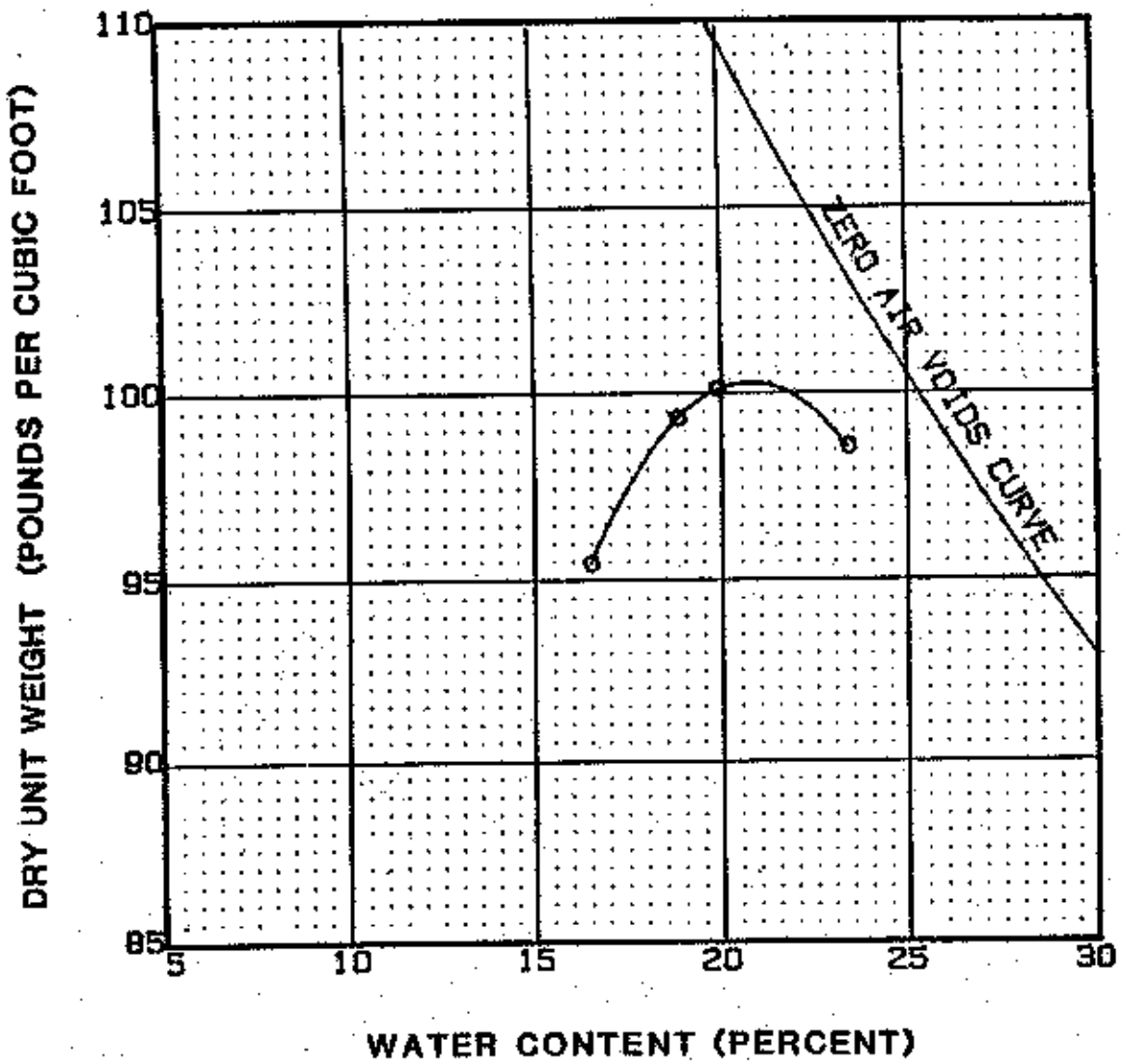
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE 22

Job # 11295
Date: 6-28-95



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70 Method A

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
100.3	20.9	24.9

DESCRIPTION

Gray CLAY

ATTERBERG LIMITS

LL- 64 PL- 20 PI- 44

CLASSIFICATION SYSTEM

UNIFIED : MH&OH

AASHTO :

SAMPLE INFORMATION

Boring I.D. # TP85-8
Sample I.D. # 2A 8.1-12.6

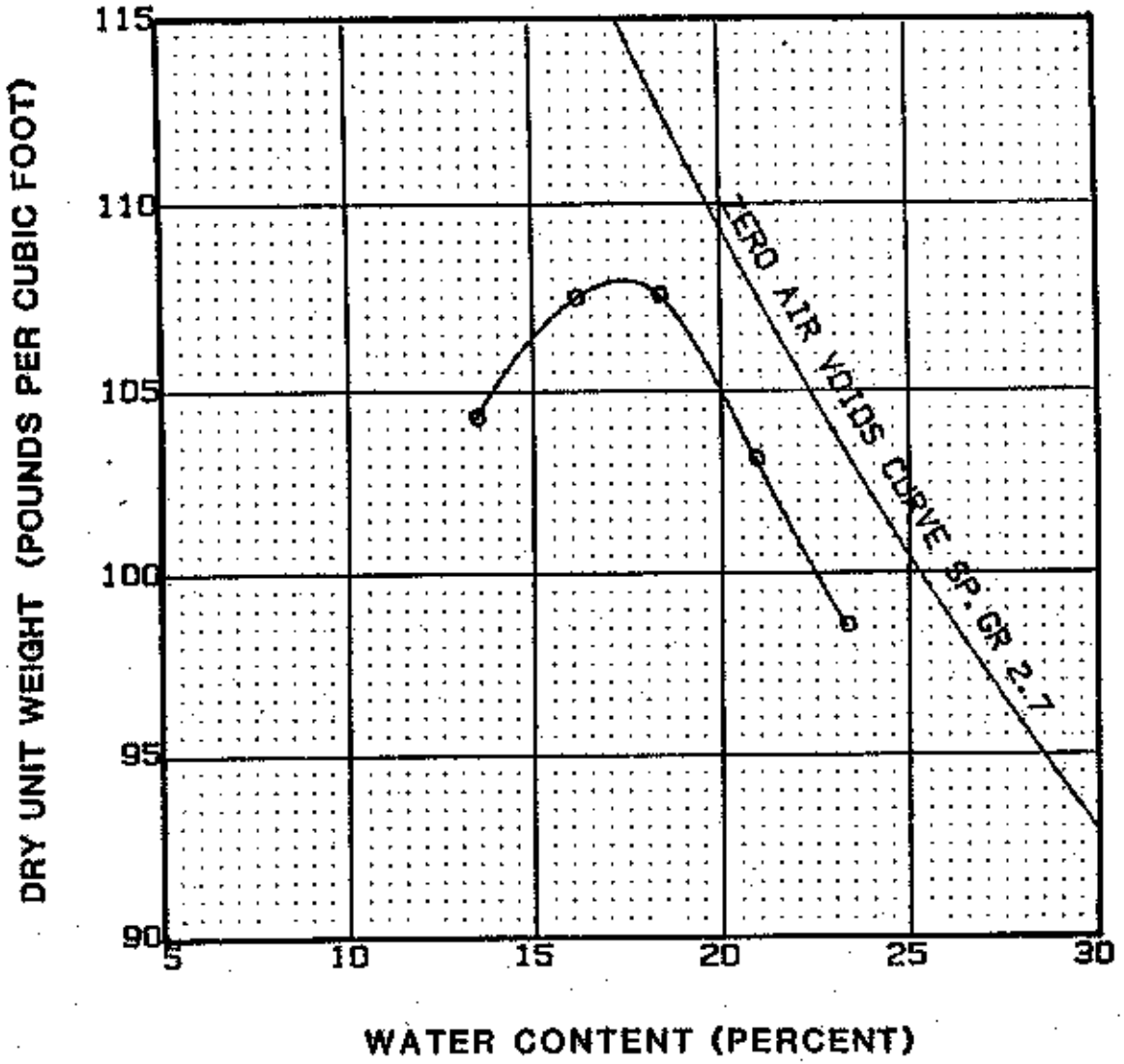
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE 16

Job # 11295
Date: 8-28-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70 Method A)

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
108.0	17.4	21.8

DESCRIPTION

Brown SILTY CLAY

ATTERBERG LIMITS

LL- 34 PL- 18 PI- 16

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

Boring I.D. # TPBS-8
Sample I.D. # 1A 0.6-4.3

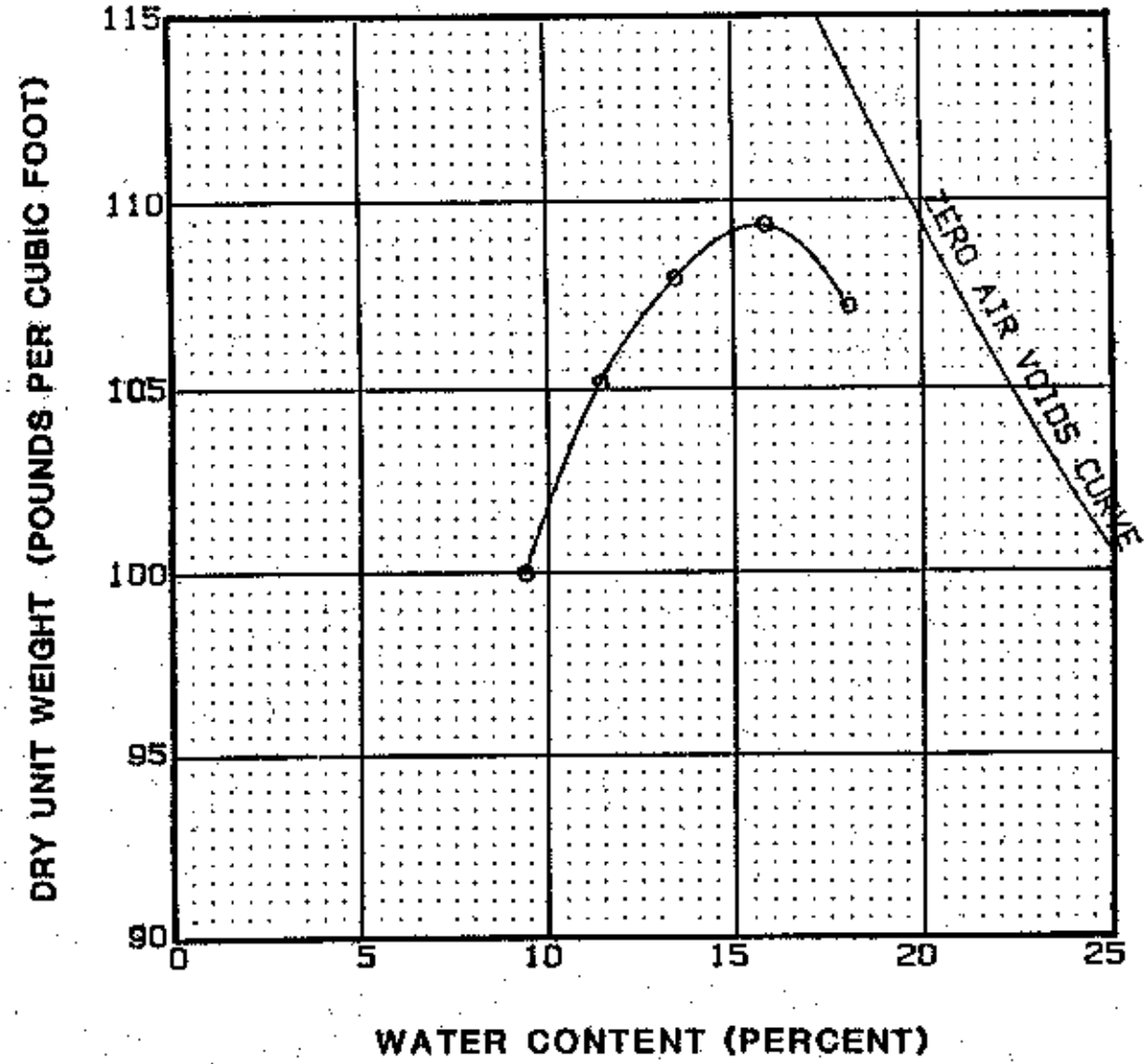
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE 20

Job # 11295
Date: 6-27-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
109.4	15.6	13.3

DESCRIPTION

Silty CLAY

ATTERBERG LIMITS

LL- 31 PL- 19 PI- 12

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

TP85 # 2A

Depth 4.3-6.5

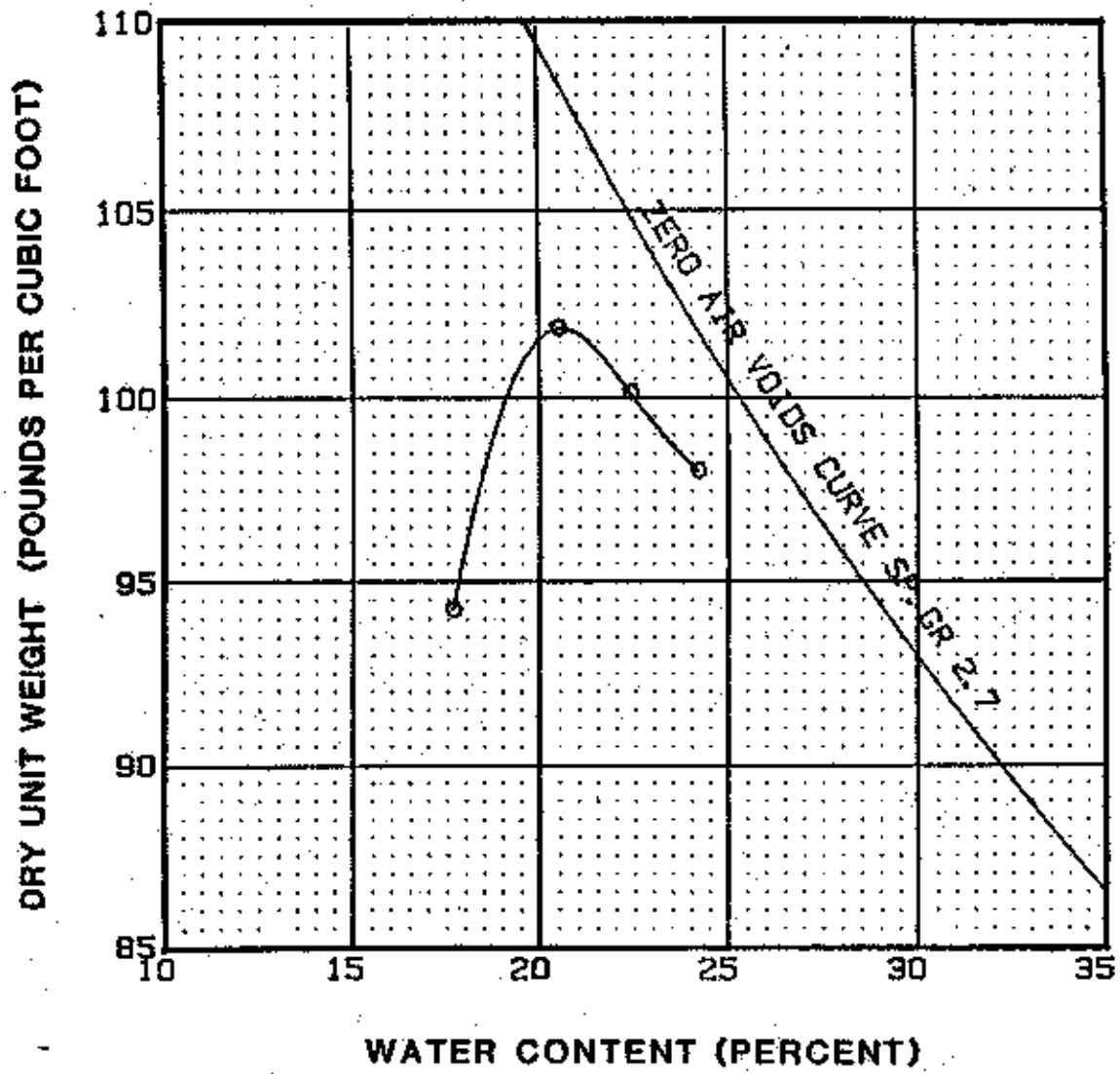
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE 24

Job # 11295
Date: 6-27-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
101.9	20.5	16.5

DESCRIPTION

Brown, silty CLAY

ATTERBERG LIMITS

LL- 50 PL- 20 PI- 30

CLASSIFICATION SYSTEM

UNIFIED : CL-CH

AASHTO :

SAMPLE INFORMATION

TPBS 8 3A
Depth 8.5-11.8

WSSRAP

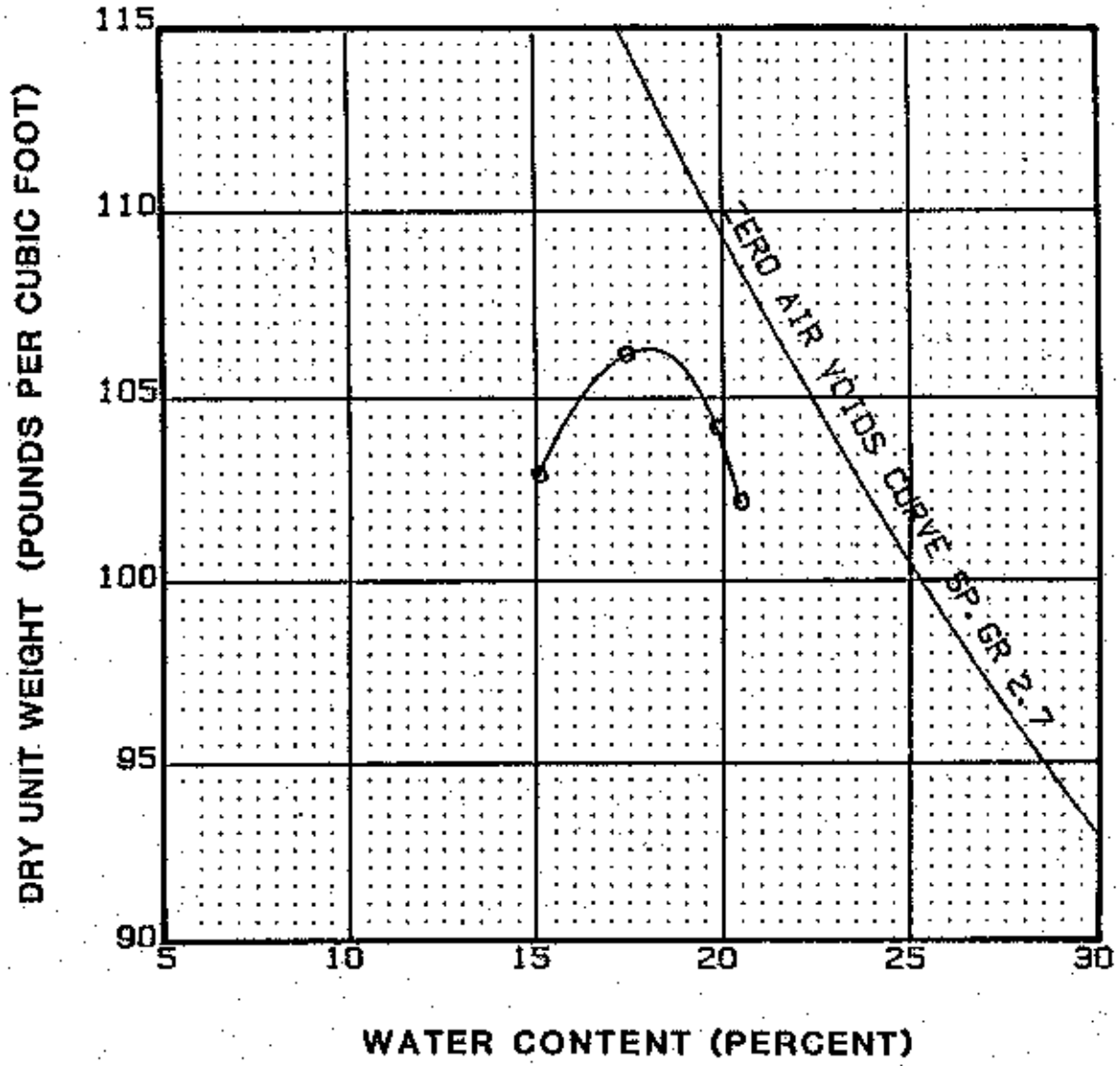
COMPACTION TEST

GEOTECHNOLOGY

PLATE D 12

L-2 10/88

Job # 11295
Date: 8-3-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
106.3	18.2	26.2

DESCRIPTION

Gray and brown, silty CLAY

ATTERBERG LIMITS

LL- 37 PL- 16 PI- 21

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

Boring I.D. # TPBS - 23
Sample I.D. # 1A 0.7-13.1

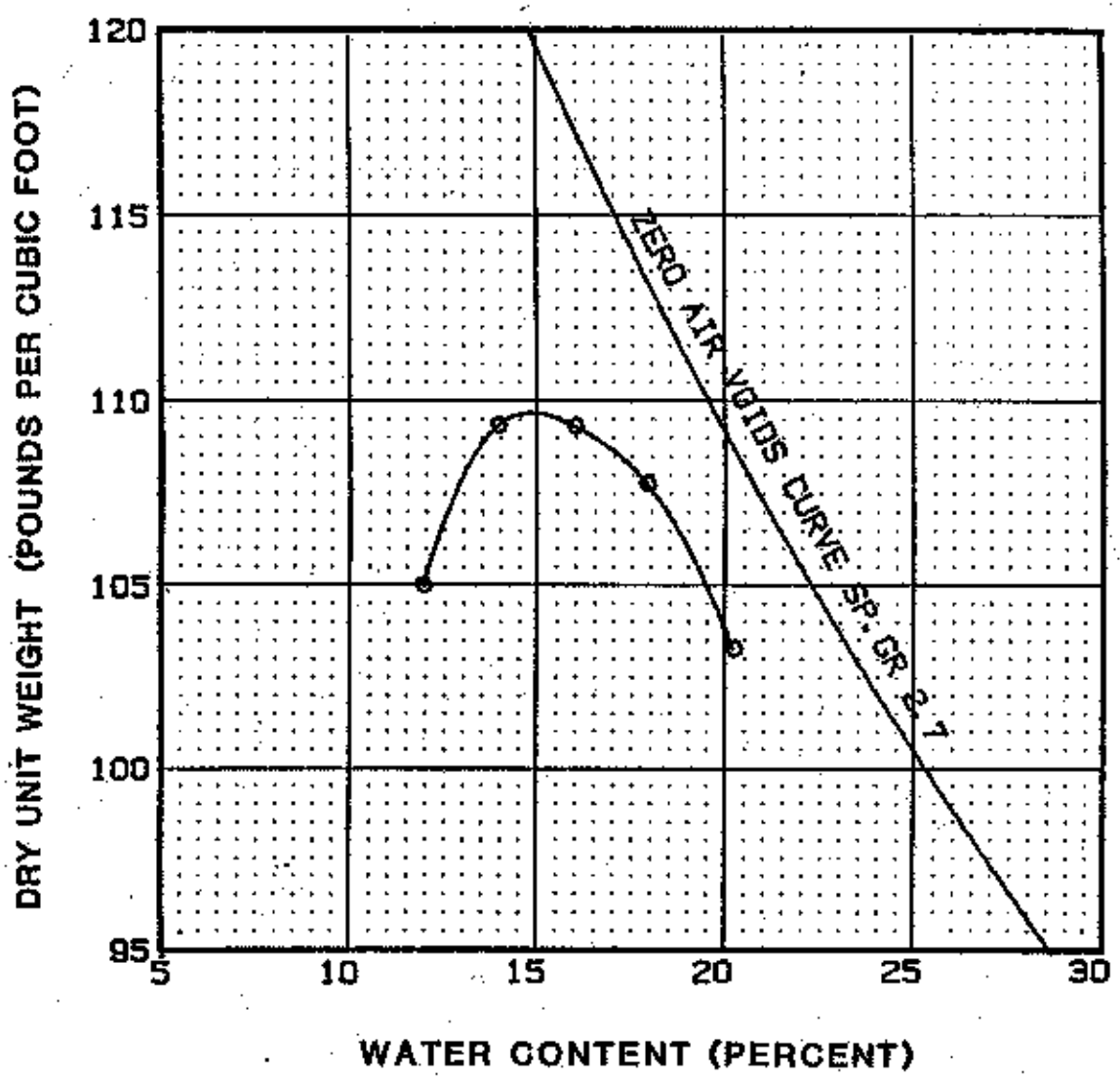
WSSRAP

COMPACTION TEST

GEOTECHNOLOGY
ENGINEERING AND ENVIRONMENTAL SERVICES
SAINT LOUIS, MISSOURI

PLATE F 117

Job # 11295
Date: 11-17-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
109.8	14.9	

DESCRIPTION

Brown, silty CLAY

ATTERBERG LIMITS

LL- 38 PL- 19 PI- 19

CLASSIFICATION SYSTEM

UNIFIED : CL

AASHTO :

SAMPLE INFORMATION

TPBS-28 1A
0.7-9.9 feet

WSSRAP

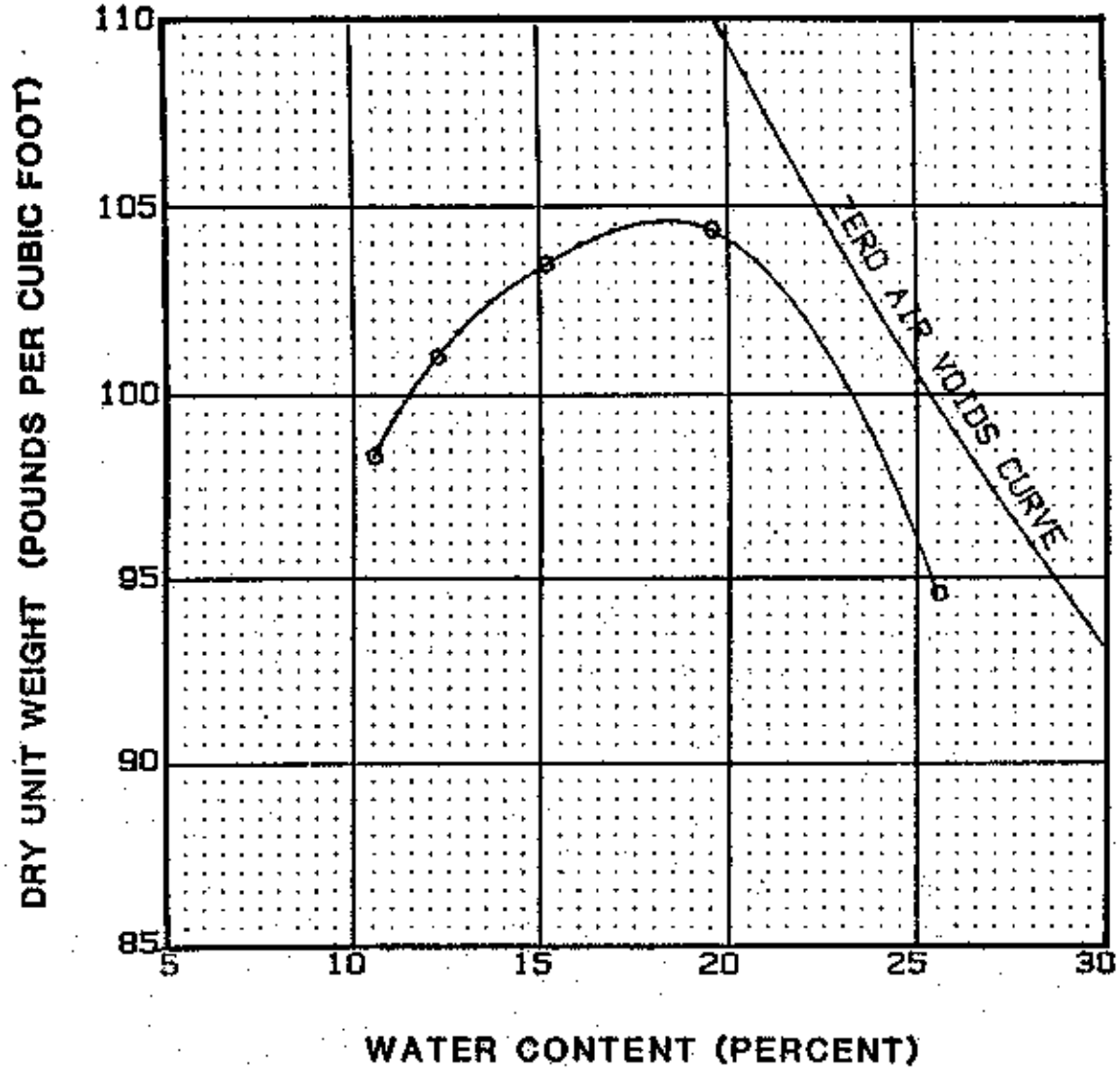
COMPACTION TEST

GEOTECHNOLOGY

checked by 44

PLATE J 69

Job # 11295
Date: 6-27-89



SPECIFICATIONS

STANDARD PROCTOR
AASHO T 99-70, ASTM D 698-70

MAX DRY DENSITY (PCF)	WATER CONTENT %	
	OPTIMUM	NATURAL
104.6	16.3	26.3

DESCRIPTION

Brown and gray, silty CLAY .

ATTERBERG LIMITS

L.L.- 37 P.L.- 25 PI- 12

CLASSIFICATION SYSTEM

UNIFIED : ML

AASHTO :

SAMPLE INFORMATION

TPBS 30 1A
Depth 1.0-12.4

WSSRAP

COMPACTION TEST

GEOTECHNOLOGY

PLATE D 76

PERMEABILITY

request #3
P.O. # 3509 -1002 -3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WSSRAP

DATE: 1-9-90

LAB NAME: Geotechnology

CHECKED BY: LAB 47

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
Borrow Source #1	TPBJ-1 2A	2.6 - 7.1	CH	98.0	18.4	19.1	108.2		92.3		16.1	2×10^{-7}
	TPBJ-1 4A	9.1 - 14.1	"	95.6	17.3	18.2	111.0		101.8**		" 16.1	3×10^{-8}
	TPBJ-6 1A	0.6 - 9.1	"	97.0	23.3	23.2	99.9		94.8		16.1	1×10^{-8}
	TPBJ-8 2A	4.3 - 8.5	"	96.9	19.6	20.2	106.0		93.4		16.1	9×10^{-8}
	TPBJ-10 1A	0.5 - 6.5	"	95.4	20.2	27.0	102.1		83.9*		16.1	8×10^{-8}
	TPBJ-10 2A	8.2 - 10.9	"	95.9	21.1	24.4	101.7		86.8*		16.1	8×10^{-9}
	TPBJ-11 1A	0.6 - 10.4	"	93.9	20.9	23.3	99.5		89.8		16.1	3×10^{-8}

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE: EM 1110-2-1906

Request # 3
P.O. # 3509 -1002 -3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WSSRAP

CHECKED BY: LAB 97

DATE: 3/6/90

TAC

LAB NAME: Geotechnology, Inc.

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
Barrow Source	TPBJ-6 2A	9.1-12	CH	94.3	24.3	28.9	94.6		82.5		16.06	~~9×10^{-9}~~
"	TPBJ-8 1A	0.6-4.3	CH	95.3	20.8	21.3	102.9		86.6		" 16.06	~~2×10^{-8}~~
"	TPBJ-10 3A	10.9-13	CH	95.1	24.5	30.1	97.0		89.8*		16.06	~~no flow~~
"	TPBJ-11 2A	10.4-12.3	CH	96.6	22.3	31.2	98.5		85.2		16.06	~~2×10^{-8}~~

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE: EM 1110-2-1906

Request # 2

P.O. # 3507-1002-3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PERMEABILITY TEST RESULTS

SITE ID: WS08AB

DATE: 7-18-90.

LAB NAME: Geotechnology, Inc

CHECKED BY: LAB 44

TAC

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	TEST METH.	COMPACTION (%)	MOISTURE CONTENT (%)		DRY DENSITY (PCF)		SATURATION (%)		TOTAL PRESSURE HEAD (FT)	PERMEABILITY (CM/SEC)
					INIT.	FINAL	INIT.	FINAL	INIT.	FINAL		
Borrow Source #1	TPB1-B 3A	8.5-11.5	CH		23.2	28.9	97.3		90.9		16.1	~~3X10^-9~~
"	TPB1-B3 2A	0.7-13.1	CH	95.3	21.5	22.1	102.0		86.6		" 16.1	~~5X10^-7~~

TEST METHODS: CH - CONSTANT HEAD FH - FALLING HEAD TX - TRIAXIAL BACKPRESSURE FALLING HEAD TEST PROCEDURE: ETL-1110-2-1906

ATTACHMENT 7

CAPILLARY - MOISTURE TESTS

TABLE I

Summary of Capillary-Moisture Relationship Test Results

Job No. 1 627 90

August 1, 1990

Boring No.	TPBS-1	TPBS-1	TPBS-6	TPBS-6	TPBS-8	TPBS-8	TPBS-8	TPBS-10	TPBS-10
Depth, feet	2.6-7.1	9.2-14.1	0.6-9.1	9.1-12.6	0.6-4.2	4.3-8.5	8.5-11.4	0.5-6.1	8.2-10.9
Sample ID	2A	4A	1A	2A	1A	2A	3A	1A	2A
Average Initial Moisture Content, %	18.1	17.1	22.7	23.8	20.5	18.5	23.6	20.1	20.7
Average Initial Dry Density, pcf	105.4	110.8	97.7	95.4	102.6	104.1	96.8	101.6	101.0
Average Initial Compaction, %	95.4	95.4	94.9	95.1	95.0	95.2	95.0	95.0	95.2
Tension, bar	Moisture Content								
0.3	18.3	17.9	23.0	30.1	23.1	19.4	28.4	24.2	25.7
1.0	17.8	17.3	22.1	28.9	21.6	18.5	25.9	22.5	23.6
4.0	16.4	15.5	19.8	25.2	19.9	16.0	22.5	19.2	20.3
15.0	16.2	15.6	19.2	24.4	20.2	16.0	23.0	19.7	20.8

Chen Northern, Inc.
Consulting Engineers and Scientists

Q3

TABLE I

Summary of Capillary-Moisture Relationship Test Results

Job No. 1 627 90

August 1, 1990

Boring No.	TPBS-10	TPBS-11	TPBS-11
Depth, feet	10.9-13.4	0.6-10.4	10.4-12.3
Sample ID	3A	1A	2A
Average Initial Moisture Content, %	23.2	21.1	23.6
Average Initial Dry Density, pcf	97.2	100.7	96.8
Average Initial Compaction, %	95.2	95.0	94.9
Tension, bar	Moisture Content		
0.3	30.6	21.2	33.0
1.0	28.2	20.4	30.7
4.0	24.1	17.5	26.1
15.0	24.7	18.2	27.2