Environmental Resources Management

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29 July 2010

Via Electronic Mail

Mr. Matt McClincy
Oregon Department of Environmental Quality
Northwest Region
2020 Southwest Fourth Avenue
Suite 400
Portland, Oregon 97201-4987Subject:

Subject: Subsurface Debris Investigation
Technical Memorandum
Arkema Inc., Portland Facility

Dear Mr. McClincy:

This technical memorandum was prepared by ERM-West, Inc. (ERM) on behalf of Legacy Site Services, LLC (LSS) to summarize the subsurface debris investigation results at the Arkema Inc., facility (the site) in Portland, Oregon. The subsurface debris investigation was conducted in support of the Groundwater Barrier Wall (GWBW) design, as part of the Groundwater Source Control Measure (SCM) implementation. The work was completed on 26 through 28 April 2010 in accordance with the work plan letter submitted to the Oregon Department of Environmental Quality on 12 April 2010.

Background

LSS intends to design, permit, and implement a Groundwater SCM at the site to mitigate migration of constituents of concern in groundwater into the Willamette River. The Groundwater SCM will consist of a GWBW coupled with a groundwater extraction and treatment system to maintain the hydraulic gradient necessary to mitigate contaminant migration in groundwater around the barrier wall and into the river. The GWBW consists of a slurry wall set back from the top of the

riverbank and extending along the southeastern boundary of the site and north to Dock 2 (Figure 1).

Previous investigations and historical data indicate that fill material was placed to a maximum depth of approximately 20 feet in the proposed location of the GWBW. The fill material consists primarily of soil from historical placement of dredge spoils. The fill reportedly also contains demolition debris such as bricks and concrete. Drill rigs have encountered refusal at nearly 20 locations in the vicinity of the planned slurry wall (Figure 1). Refusal at each location was within the fill material, and it is believed to be related to the presence of concrete and construction debris.

Areas of refusal within the fill layer are primarily located between an area just south of Dock 1 and halfway between Docks 1 and 2 (Figure 1). Historical information indicated that obstructions were located at depths less than 20 feet below ground surface (bgs). The subsurface debris investigation was performed in order to supplement historical data by excavating potential debris within the fill material along the alignment of the proposed slurry wall.

In addition, further geotechnical information about the fill material was required to facilitate design of the slurry wall. This information was needed to update the slope stability analysis, determine the final slurry wall alignment, and more accurately estimate the amount and feasibility of debris removal required during slurry wall installation. A greater understanding of the fill material will ultimately result in reducing uncertainty with respect to construction of the GWBW.

The specific objectives of this investigation were as follows:

- Revise the conceptual alignment of the slurry wall based on the selected construction method of traditional slurry wall trenching;
- Identify the location of potential obstructions along the alignment of the slurry wall based on subsurface utility maps and locations of historical borings with refusal;
- Observe subsurface obstructions to determine if debris will interfere with slurry wall installation, and remove observed obstructions, if possible;

- Observe the steepness of excavation sidewall slopes to refine assumptions for the required pre-clearance excavation, and associated costs during slurry wall installation; and
- Obtain geotechnical parameters of the fill material in order to update the slope stability assessment.

The field procedures for the investigation are presented below.

Field Procedures

The subsurface debris investigation was conducted from 26 through 28 April 2010. The investigation included the completion of three test trenches along the proposed GWBW alignment. Field activities are discussed below.

Utility Location

Buried utility overlays were compiled based on available historical site plans. These overlays were used to identify areas in which buried utilities were more likely to be encountered during the investigation, and to delineate areas requiring excavation of utilities during slurry wall construction.

Prior to field activities, the trenching locations were marked in the field for inspection and approval by a facility representative familiar with utilities at the site. No active utilities were anticipated to be encountered during trenching activities, as all underground utilities in the area were abandoned during plant demolition in 2004. The only active underground utilities in vicinity of the proposed trenching locations are storm water discharge drains. The only active aboveground utilities are electrical power lines mounted to poles. As per previous subsurface investigations at the site, abandoned and active utilities were identified using the compiled utility overlay map and by discussion with a facility representative.

Trenching Methods

Three test trenches were excavated in areas where drill rigs have historically encountered refusal along the slurry wall alignment (Figure 1). These locations include the area to the south of Dock 1 and the area between Docks 1 and 2.

Trenches were excavated by Berner Construction using an excavator. Test Trenches 1 and 2 each extended slightly more than 100 feet in length, and Trench 3 extended approximately 30 feet. Each trench was excavated in several stages. The total length of each trench was based on the amount and nature of obstructions encountered, as well as the amount of trench sidewall sloughing. The test trenches were excavated to the maximum trench depth practicable, up to a maximum of 22 feet bgs. Obstructions that could adversely impact the slurry wall construction encountered during excavation activities were observed, documented, and removed.

The trenches were backfilled by backhoe and bucket-compacted in lifts. Trenching was implemented in stages such that excavation and backfilling were completed within one work day. No excavated soil was left at grade overnight. The excavated areas were resurfaced with imported, clean, crushed rock.

Excavated Material Management

The excavated soil staging areas were lined with plastic sheeting and bermed. The first approximately 20 linear feet of excavated material was laid on the plastic sheeting linearly adjacent to the test pit. Soil from the remaining 20-foot sections of each trench was placed in the previously excavated section and bucket-compacted in lifts. The final section of the trench was filled with the material excavated from the initial 20 linear feet of trenching. Potential fugitive dust was mitigated by ensuring that the excavated soil remained sufficiently moist until it was backfilled.

The trench locations were selected in order to avoid known areas with potentially gross contamination (i.e. Acid Plant non-aqueous phase liquid area). The excavated material was visually surveyed for gross contamination such as free product, dark staining, or very strong odors. No indications of gross contamination were observed in any of the excavated material.

Several large pieces of concrete were removed from the trenches. The concrete pieces were cleaned by pressure washing with water within the lined and bermed staging area. The large pieces of concrete debris were stored on existing concrete pads for later off-site disposal.

Field Observations

The following information was recorded during trenching activities:

- Visual changes in fill material with depth bgs;
- Obstructions, including size, location, and material;
- Sidewall slope characteristics, such as amount of sloughing;
- Buried utilities encountered; and
- Organic vapors using a photoionization detector.

The field observations are summarized on the attached Figures 2, 3, and 4, which show the trench profiles and plan views. No organic vapors were detected in any of the materials excavated during the investigation.

Trench 1

Trench 1 was approximately 120 feet long, between 7 and 12 feet wide, and was completed between Dock 1 and Dock 2, as shown on Figure 1. A profile of Trench 1 is presented on Figure 2. The fill material located beneath the rail spur at the southern end of the trench consisted of light–brown, fine, sandy silt. This material extended approximately 25 feet north from the southern end of the trench and contained one large piece of concrete. The fill material to the north of the rail spur consisted of approximately 6 inches to 1 foot of asphalt and/or crushed rock surface underlain by 2 to 3 feet of brown, clayey, silt fill with little debris. This was underlain by between 6 and 19 feet of dark brown to gray or black silty clay intermixed with debris and woody material, followed by 1 to 10 feet of dark brown to black wet, organic, silty clay, and then 1 to 10 feet of brown silty clay. Several large chunks of concrete were removed from the excavation at 15 to 22 feet bgs and at the south end of the excavation.

Trench 2

Trench 2 was approximately 110 feet long, between 8 and 11 feet wide, and was completed south of Trench 1 and Dock 1, as shown on Figures 1 and 3. The material excavated along the entire length of the trench consisted of 3 to 6 inches of asphalt, underlain by 1 to 1½ feet of

crushed rock, and 17 feet of brown, medium-grained, silty, sand fill. No debris was encountered in the fill material.

Trench 3

Trench 3 was approximately 30 feet long, between 7 and 11 feet wide, and was completed approximately 30 feet south of Trench 2, as shown on Figures 1 and 4. The material excavated along the entire length of the trench consisted of 3 to 6 inches of asphalt, 1 to 1½ feet crushed rock, and 7 feet of brown, medium–grained, silty sand fill. No debris was encountered in the fill material. Two 10-inch diameter cast iron pipes were encountered in the trench at a depth of approximately 7 feet. The pipes were determined to be the former brine line pipes from the two southeastern salt pads. During plant operations, these brine lines were used to transfer brine solution to a sump and then to the chlorine cells rooms for processing. Following plant demolition in 2004, the line from the sump to the chlorine cell room was re-routed to the storm water system. The former brine lines from the salt pads currently collect storm water and discharge it to the storm water system. One of these salt pad storm water lines was damaged during the trench excavation. This line was plugged and abandoned in place. Storm water that had accumulated in the salt pads was then re-routed to another portion of the storm water system by removing part of the berms on the salt pads.

Geotechnical Samples

Bulk samples representative of the fill material were collected during the investigation. Two of the samples were collected from Trench 1 and one sample from Trench 2. Sampling locations are shown on Figures 2 and 3 respectively. One sample from Trench 1 (T1 90'N, 18'D) and one sample from Trench 2 (T2 10'N, 10'N) were submitted for geotechnical testing for the following parameters using the American Society for Testing and Materials (ASTM) guidelines outlined below.

- Moisture (ASTM D-2216);
- Grain-size analysis (ASTM D-422);
- Atterberg Limits (ASTM D-4318);
- Classification (ASTM D-2487); and
- Shear Strength, Triaxial CU (ASTM D-4767).

The geotechnical testing results are presented in the geotechnical laboratory report, included as Attachment A. The geotechnical analytical results will be used to confirm the current slope stability calculations and refine the GWBW alignment, including setback. The results of the slope stability analysis and final GWBW alignment will be presented in the Groundwater SCM Pre-Final Design described in the June 2009 *Draft Groundwater Source Control Design and Implementation Work Plan, Arkema Inc. Facility, Portland, Oregon*.

If you have any questions or require additional information, please feel free to contact us at (503) 488-5282.

Sincerely,

Brendan Robinson, P.E.
Project Manager

Erik C. Ipsen, P.E.
Partner

BAR/ECI/ssh/0114499
Attachments

cc: Todd Slater/LSS
Henning Larsen/DEQ
Tom Gainer/DEQ
Sean Sheldrake/EPA
David Livermore/Integral
Larry Patterson

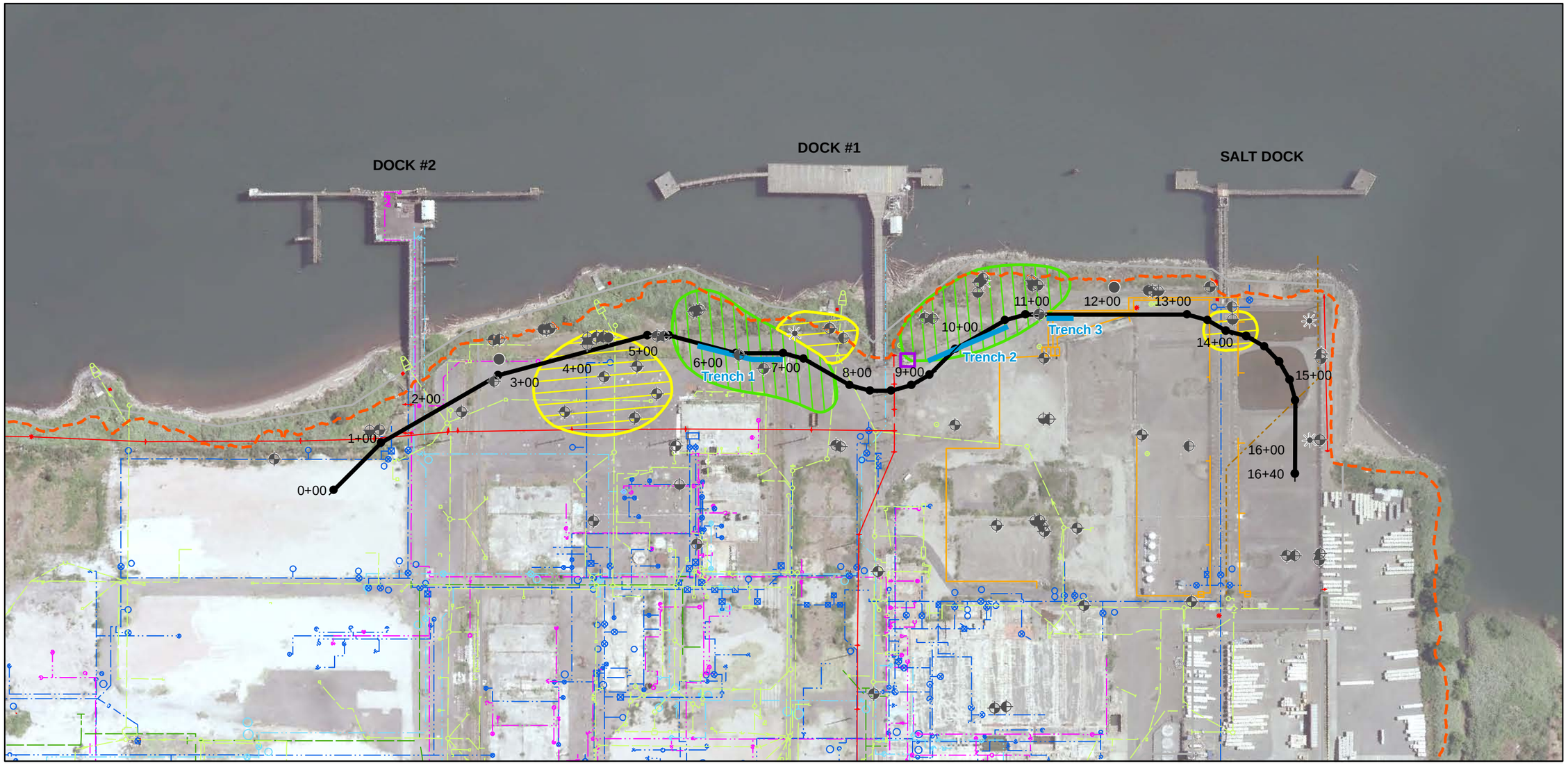
Figures

Project: 0093634.05

Date: 06/30/2010

Drawn By: mike.appel

File: F:\RM106\A\Arkema\0093634 Riverbank Soil Screening\GIS\TrenchDesign\Figure 1 - Trenching locations.mxd



Legend

Existing Monitoring Wells
- Shallow Zone
- Shallow-Intermediate Zone
- Intermediate Zone
- Deep Zone
- Gravel Zone
- Basalt Zone

- Mud Rotary Boring
- CPT Boring Location
- Proposed Barrier Wall Alignment
- Debris Investigation Trench Location
- Top of Bank (35 ft Contour or defined break in grade)

Areas of Subsurface Debris
- Soft Debris
- Refusal/Concrete Debris

- Parcel and Property Boundaries
- Brine Line
- 24" Abandoned Steel
- Industrial Stormwater Drain
- Domestic Sewer
- City Water Line
- River Water Line
- Steam Line
- Domestic Water Line
- Electric Power Line (Overhead)
- Electrical Substation

N

0 150 300 Feet

Figure 1
Trenching Locations
Subsurface Debris Investigation
Arkema Inc. Facility
Portland, Oregon

Data Sources: Aerial Photo: City of Portland, June 2008
Utility locations approximate, from Arkema facility maps.

ERM 04/10

CAD File:	Drawn By:	Date:	Project No.
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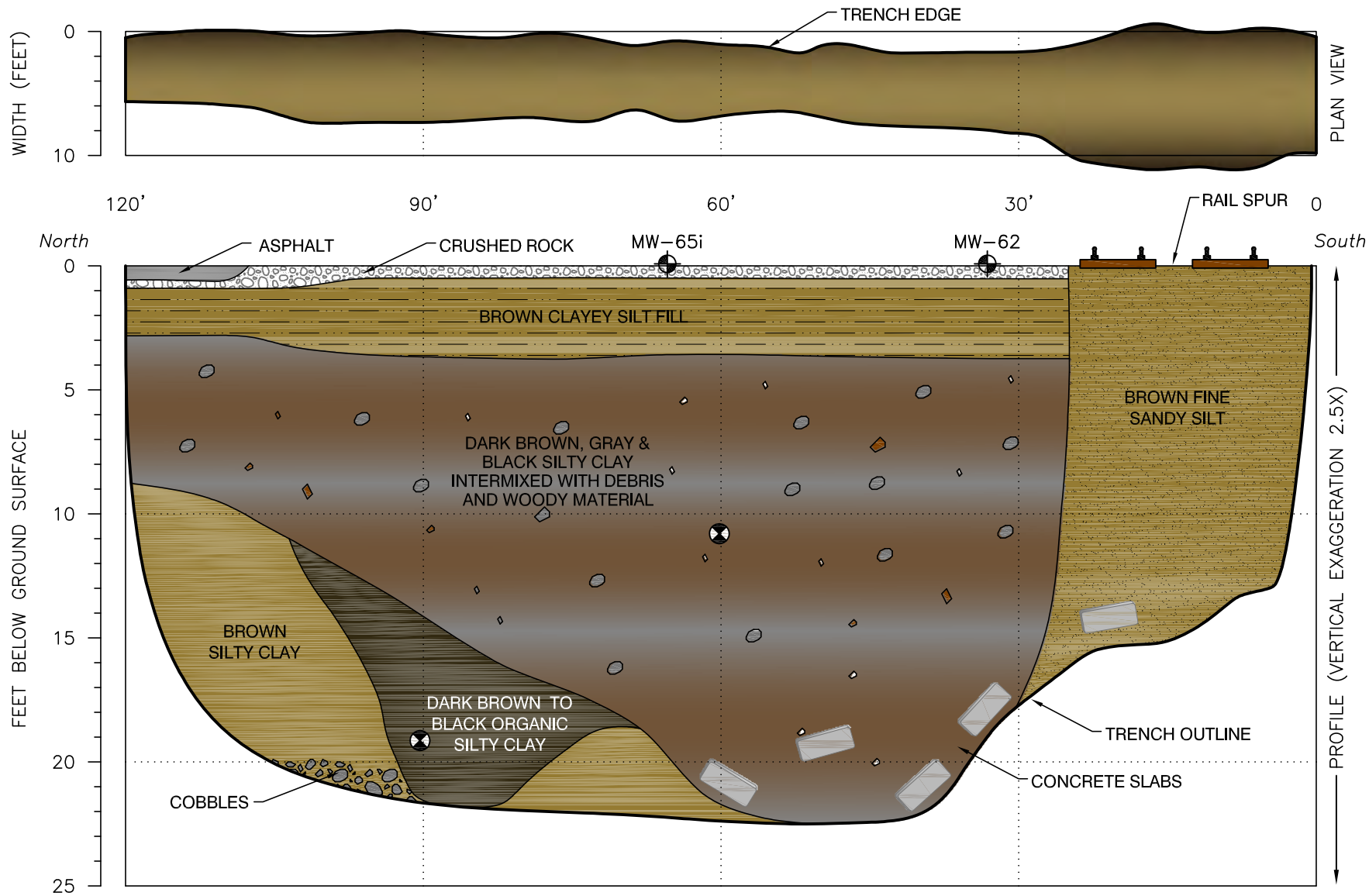

LEGEND

MONITORING WELL LOCATION

GEOTECHNICAL SAMPLE LOCATION

Figure 2

Trench 1 Cross Section

LSS Subsurface Debris Investigation

Portland, Oregon

ERM 06/10

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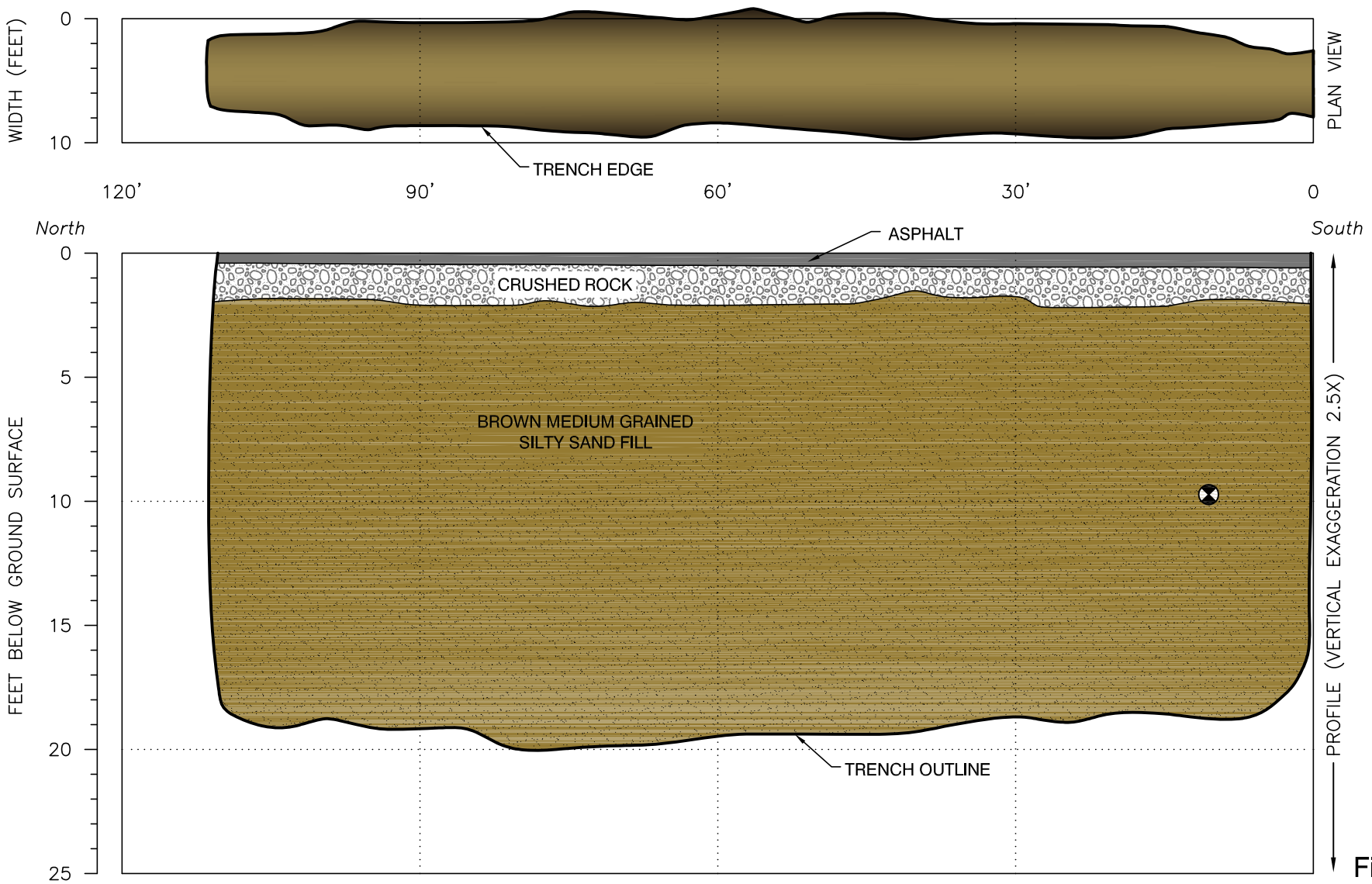

LEGEND

⊗ GEOTECHNICAL SAMPLE LOCATION

Figure 3

Trench 2 Cross Section

LSS Subsurface Debris Investigation

Portland, Oregon

ERM 06/10

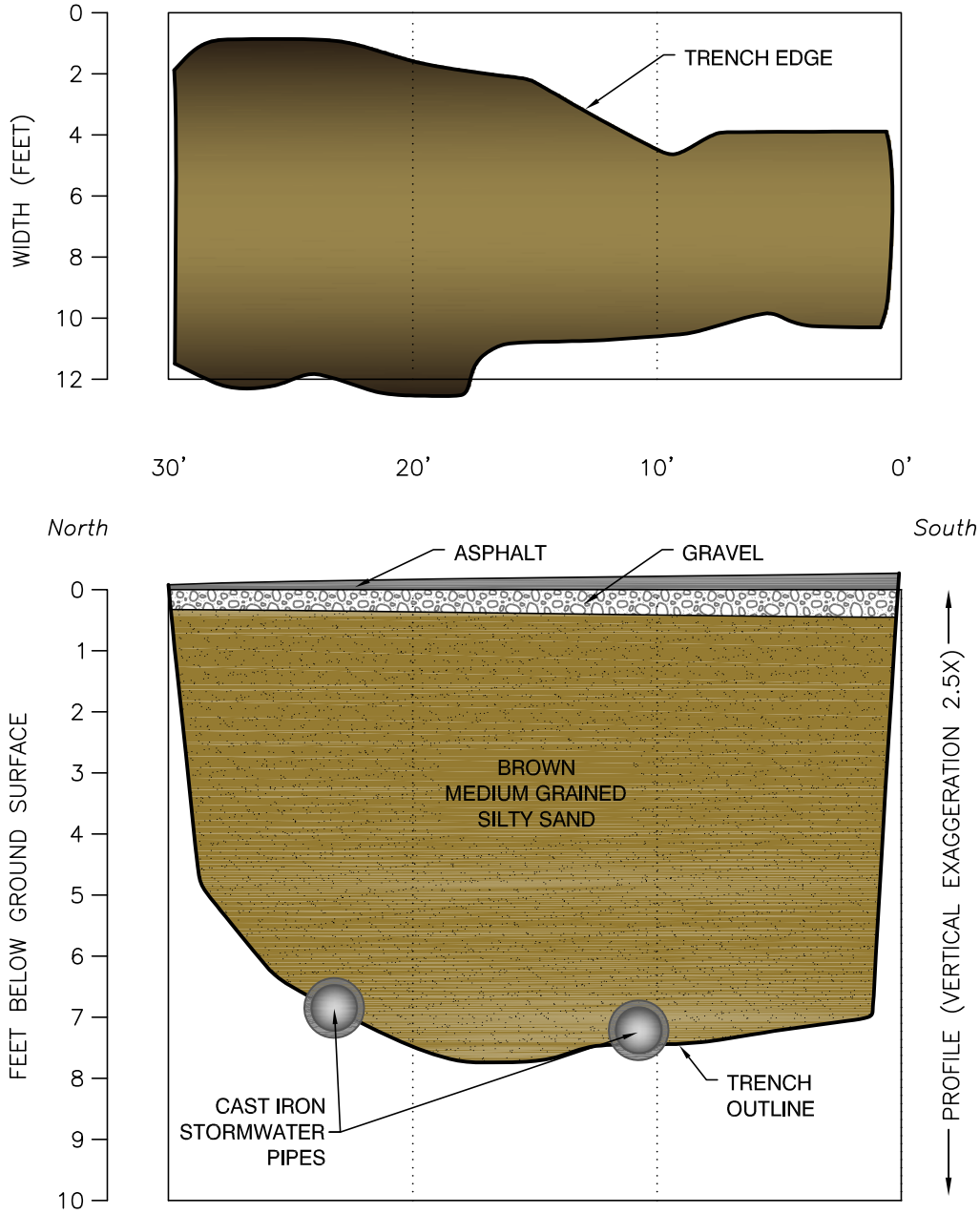

Figure 4

Trench 3 Cross Section

LSS Subsurface Debris Investigation

Portland, Oregon

ERM 06/10

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Drawn By: R. Olson

Date: 06/17/10

Project No. 0114499.03

Attachment A
Geotechnical Analytical Report

GEOCON
NORTHWEST, INC.
GEOTECHNICAL/ENVIRONMENTAL CONSULTANTS

May 25, 2010
File No. P1701-05-02

Mr. Brendan Robinson
ERM West
101 SW Main Street, Suite 804
Portland, Oregon 97204

SUBJECT: AREKMA, 6400 NW FRONT AVENUE
PORTLAND, OREGON
GEOTECHNICAL LABORATORY TEST RESULTS

Dear Mr. Robinson:

Geocon Northwest is pleased to submit the enclosed geotechnical laboratory test results of samples submitted by ERM for the above-referenced project. The samples were identified as:

T1,90'N,18'D; T2,10'N, 10'D

The requested geotechnical laboratory tests and confining pressures for direct shear and triaxial shear tests were provided by representatives of ERM West.

The following pages present the results of the geotechnical laboratory testing.

Please contact the undersigned if you have any questions regarding this information.

Sincerely,
Geocon Northwest, Inc.

Wesley Spang, Ph.D., P.E.
Principal Engineer

8283 SW Cirrus Drive ■ Beaverton, Oregon 97008 ■ Telephone (503) 626-9889 ■ Fax (503) 626-8611

ATTERBERG LIMITS TEST RESULTS

Sample Number	Liquid Limit	Plastic Limit	Plasticity Index	USCS
T1 90'N 18'D	30	22	8	ML

SHEAR STRENGTH TEST RESULTS

Sample Number	Shear Test	Cohesion (psf)*	Friction Angle (degrees)*
T1 90'N 18'D	TxCU	70	33
T2 10'N 10'D	DS	103	43

Tx CU - Triaxial shear, consolidated undrained with pore pressure
Effective stress strength values obtained at maximum principal stress ratio

DS – Direct Shear
Strength values obtained at maximum shear stress

* Cohesion and friction angle obtained from best-fit analysis of data

MOISTURE TEST RESULTS

Sample Number	Moisture Content (%)
T1 90'N 18'D	31.4
T2 10'N 10'D	7.9

SOIL CLASSIFICATION

Sample Number	USCS Classification
T1 90'N 18'D	ML
T2 10'N 10'D	SP-SM

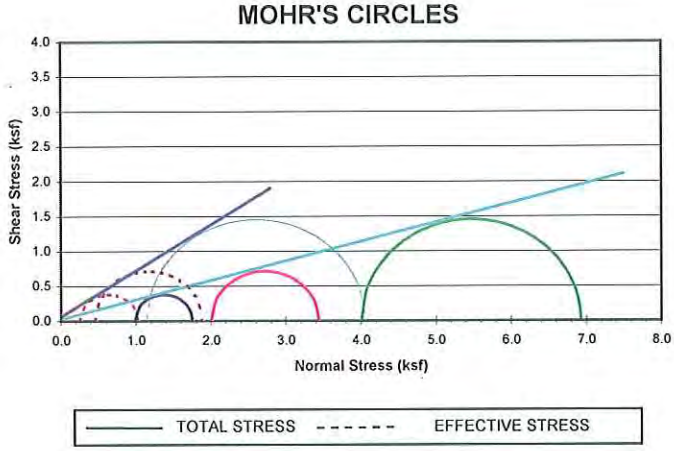
TRIAXIAL SHEAR STRENGTH - CU TEST

ASTM D4767

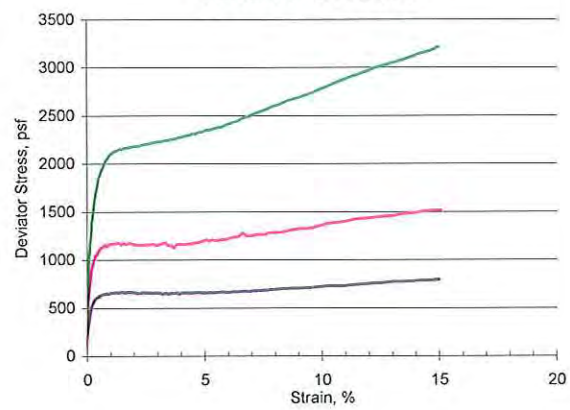
Project Name: Arkema
Project Number: P1701-05-02
Sample Number: T190N 18'D

	SAMPLE ID:	1	2	3
INITIAL CONDITIONS AT START OF TEST	HEIGHT (in.)	5.00	5.00	5.00
	DIAMETER (in.)	2.42	2.42	2.42
	MOISTURE CONTENT (%)	18.0	17.9	18.1
	SATURATION (%)	70.2	69.0	63.2
	DRY DENSITY (pcf)	85.1	85.1	84.9
AFTER SATURATION	DRY DENSITY (pcf)	84.1	83.9	84.4
AFTER CONSOLIDATION	DRY DENSITY (pcf)	83.7	86.3	89.8
SHEAR TEST CONDITIONS	DRY DENSITY (pcf)	83.6	86.4	90.0
	MOISTURE CONTENT (%)	26.1	24.7	24.3
	SATURATION (%)	96.4	99.4	99.4
	STRAIN RATE (%/min)	0.0167	0.0168	0.0166
	CELL PRESSURE (psf)	11060	13450	15520
	INITIAL BACK PRESSURE (psf)	10070	11440	11510
	INITIAL EFF CONFINING PRESS (psf)	990	2010	4010
	TOTAL MAJOR PRIN STR AT FAIL (psf)	1760	3450	6930
	EFF MAJOR PRIN STR AT FAIL (psf)	1030	1900	4060
	PORE PRESSURE AT FAIL (psf)	730	1550	2870
	EFF MINOR PRIN STR AT FAIL (psf)	260	460	1140

MOHR'S CIRCLES



STRESS-STRAIN



Strength Parameters: At maximum principal stress ratio

	TOTAL	EFFECTIVE:
ϕ, degrees	15.4	33.3
c, psf	40	70

GEOCON

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

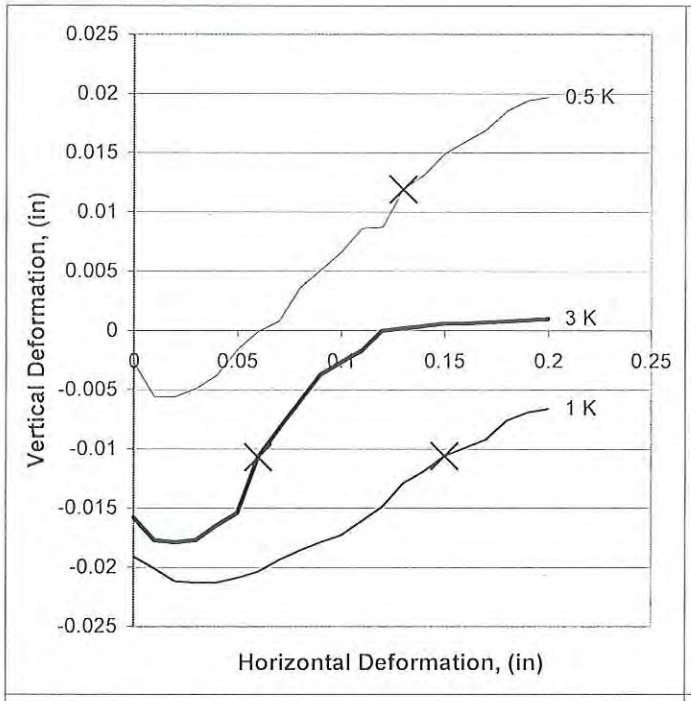
Arkema

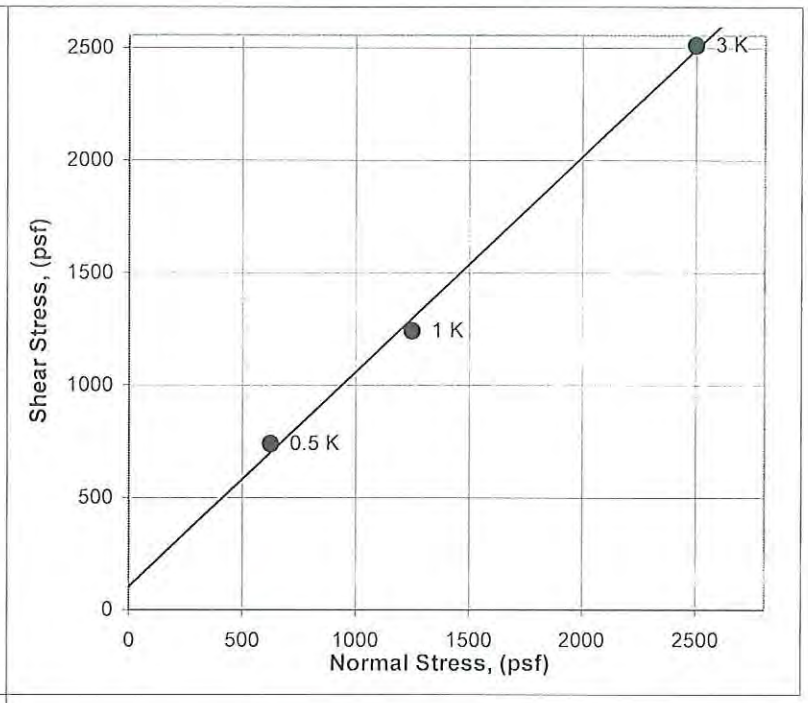
P1701-05-02 **Date:** Monday, May 10, 2010 **By:** Tom G.

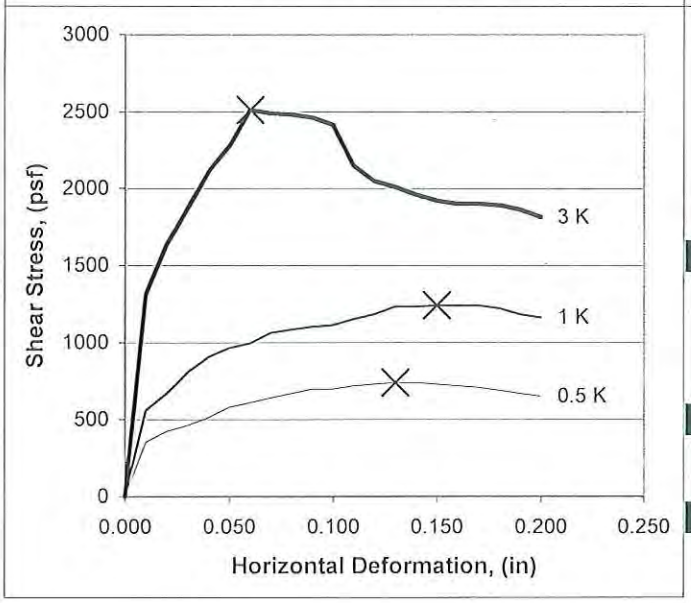
Sample No.: T2 10'N 10'D **Natural or Remold:** Remolded

Description: SM

Remarks:





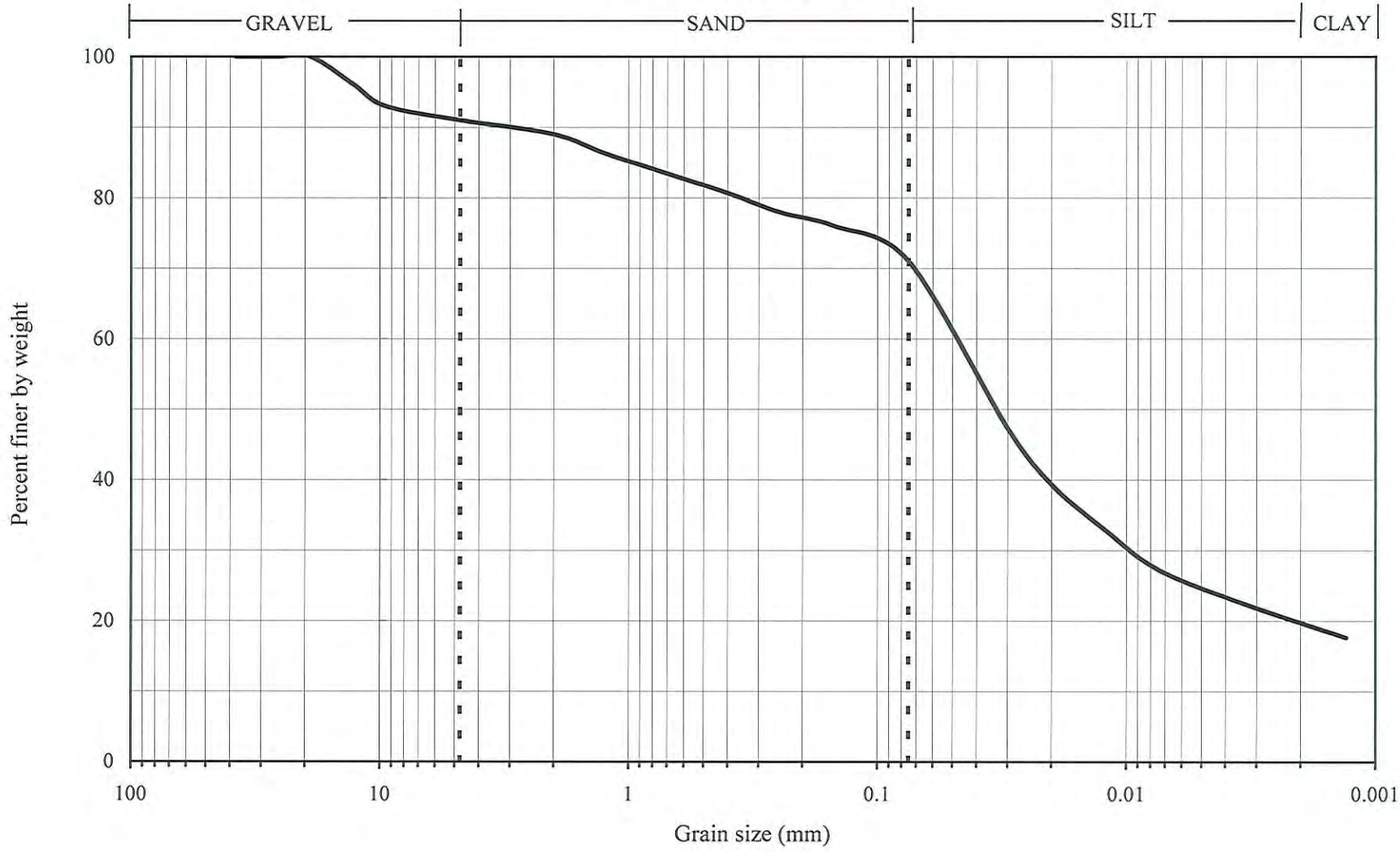
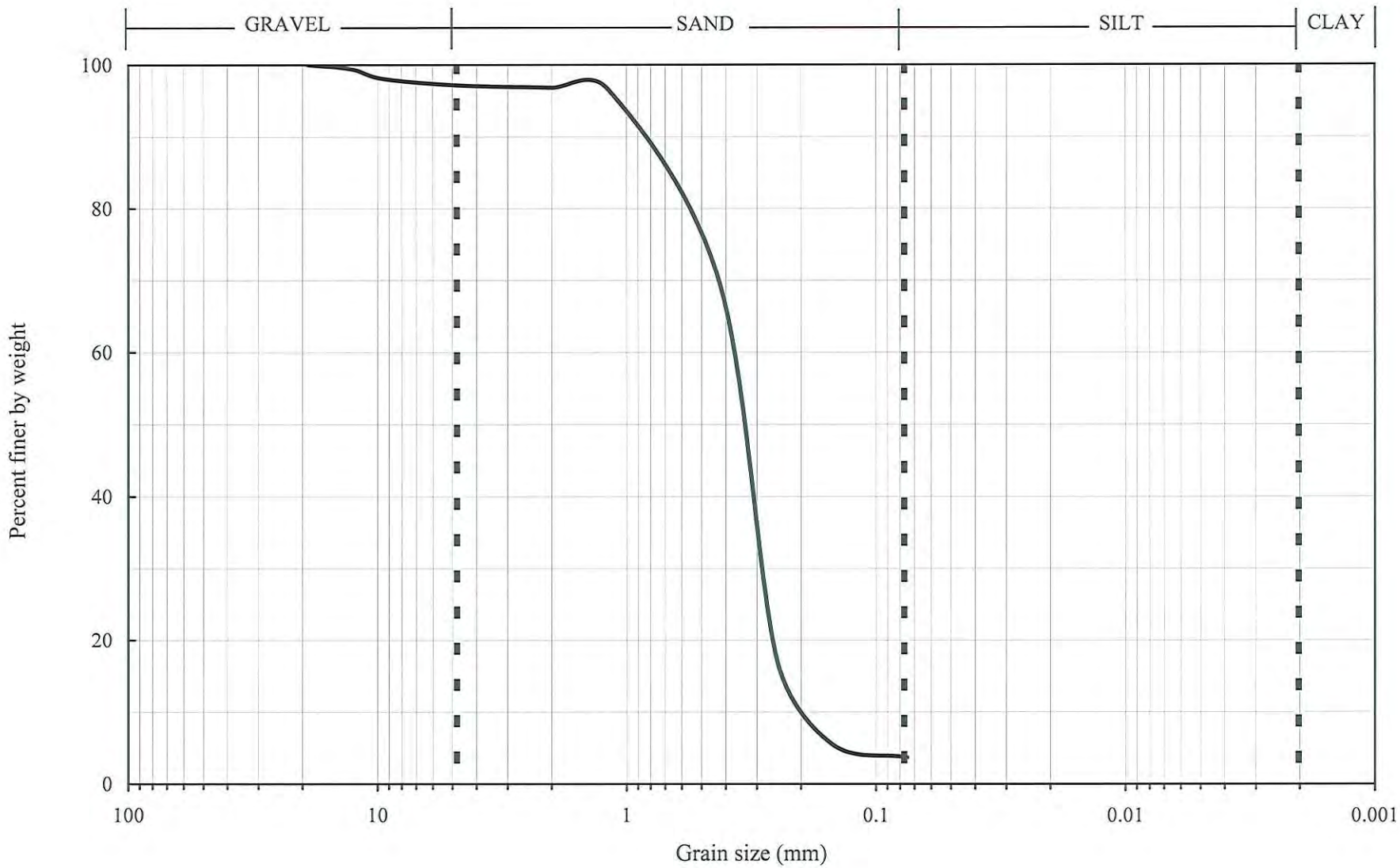


ϕ (Degrees)	43.7
c (psf)	103
Tan ϕ	0.956
Method	Calc

Load	0.5 K	1 K	3 K
INITIAL			
Water Content	8.0%	8.6%	9.5%
Dry Density (pcf)	103.4	102.8	101.8
Saturation*	35.3%	37.5%	40.1%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	21.8%	14.4%	21.0%
Dry Density (pcf)	101.5	103.4	101.7
FAILURE			
Normal Stress (psf)	625	1250	2500
Failure Stress (psf)	739	1241	2512
Failure Deffinition	Max	Max	Max
Displacement (in)	0.13	0.15	0.06
Rate (in/min)	0.0100	0.0100	0.0100

* Degree of saturation calculated with a specific gravity of 2.65

Grain Size Distribution (ASTM D1140 and D 422)
Arkema ERM
T1-90'N Depth = 18 feet



Grain Size Distribution (ASTM D1140 and D 422)
Arkema ERM
Sample T2-10'N Depth = 10 feet