FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1983E

MAJOR PERMIT AMENDMENT APPLICATION

VOLUME 4 OF 4

Prepared for

Texas Regional Landfill Company, LP

February 2023

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER
02/09/2023

Prepared by

Weaver Consultants Group, LLC
TBPE Registration No. F-3727
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WCG Project No. 0771-356-11-35

This document is intended for permitting purposes only.

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MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX III I
LANDFILL GAS MANAGEMENT PLAN

Prepared for

Texas Regional Landfill Company, LP

February 2023

MATT K. STUTZ
93662
02/09/2023

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CONTENTS

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CONTENTS (Continued)

STATE OF TEXAS
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TABLES

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1 INTRODUCTION

1.1 Scope

This Landfill Gas Management Plan (LGMP) has been developed for the Fort Worth C&D Landfill consistent with the requirements set forth in the Texas Commission on Environmental Quality (TCEQ) Municipal Solid Waste (MSW) regulations Title 30 Texas Administrative Code (TAC) §330.371, §330.159, and RCRA Subtitle D regulations in 40 CFR §258.23. The existing landfill is owned and operated by Texas Regional Landfill Company, LP.

This LGMP describes the existing and proposed upgrades to the landfill gas (LFG) monitoring network. It also discusses the operation and monitoring of this network, notification procedures, and possible remediation activities, if required.

1.2 Purpose

Title 30 TAC §330.159 requires landfills to develop a LGMP in accordance with Title 30 TAC §330.371. Compliance with Title 30 TAC §330.371 requires landfills to implement a routine monitoring program for methane to verify that (1) the concentration of methane gas generated by the facility does not exceed 1.25% by volume in facility structures (excluding LFG control or recovery system components) within the permit boundary, and (2) the concentration of methane gas does not exceed 5% by volume in monitoring points, probes, subsurface soils, or other matrices at the facility boundary as defined by the legal description in the permit or permit by rule.

The purpose of the LGMP is to provide guidelines for management of LFG at the site. These guidelines cover the evaluation of LFG migration at the permit boundary and in structures within the permit boundary. The presence of LFG will be verified by monitoring LFG concentrations in monitoring probes near the facility's permit boundary and within on-site occupied structures. LFG migration may be controlled by various options which are discussed in Section 5.

The LFG monitoring (postclosure care period) program will continue for a period of 30 years after final closure of the facility or until the owner or operator receives written authorization from TCEQ to revise or discontinue the program.

2 SITE CHARACTERISTICS

2.1 Introduction

The Fort Worth C&D Landfill is an existing Type IV municipal solid waste (MSW) disposal facility located approximately 15 miles southeast of downtown Fort Worth and adjacent to the City of Kennedale in Tarrant County, Texas. The address of the landfill is:

Fort Worth C&D Landfill
4144 Dick Price Road
Fort Worth, TX 76140

A site plan for the Fort Worth C&D Landfill is included as Figure III I-A-1 in Appendix III I-A. The current TCEQ approved LFG monitoring probe network includes a total of thirteen (13) existing LFG monitoring probes located along the existing permit boundary as shown on Figure III I-A-1. Information regarding the existing LFG monitoring probes is included in Appendix III I-C.

This LGMP addresses the existing monitoring probes as well as the additional monitoring probes and proposed trench vents required by the proposed expansion of the Fort Worth C&D Landfill. As a result of the proposed landfill expansion, 4 existing LFG monitoring probes will be abandoned, 4 new probes will be installed, and 9 existing probes will remain in-place. In addition, 6 trench vents are proposed to be installed. The 4 existing probes will be abandoned to allow for future filling and/or to facilitate site operations. At landfill completion, the monitoring network will consist of 13 LFG monitoring probes and 6 trench vents as shown on Figure III I-A-1 in Appendix III I-A. Table III I-1 summarizes the probes that will remain in-place, probes that will be abandoned, and the probes that will be added as part of this plan. Refer to Section 3 for a detailed discussion on the perimeter monitoring network.

Table III I-1
List of Existing and Proposed LFG Monitoring Probes

Existing Probes To Remain In-Place	Existing Probes To Be Abandoned	New Probes To Be Added
GMP-1A	GMP-6B	GMP-6C
GMP-2	GMP-9	GMP-9A
GMP-3D	GMP-10	GMP-10A
GMP-4B	GMP-11	GMP-11A
GMP-5A		
GMP-7A		
GMP-8		
GMP-12		
GMP-13		

The design of the LFG monitoring system for this site is based on the following factors: geologic conditions, hydrogeologic conditions, hydraulic conditions, location of facility structures and off-site structures, underground utilities, land use, nature and age of waste, climate, and depth of waste. These factors are described in detail in the following subsections.

2.2 Geologic Conditions

The site stratigraphy is presented in the text, borings, and geologic cross sections in Part III, Appendix IIIG. The site-specific lithologies include four geologic units (Alluvium, Woodbine Formation, Grayson Shale, and Mainstreet Limestone). Groundwater occurs in the Woodbine and Alluvium, generally flowing east to west towards Village Creek. Refer to Part III, Appendix IIIG – Geology Report for additional information on geologic conditions at the site. Based on the site geology, a single probe design will be used for the proposed new probes.

2.3 Hydrogeologic Conditions

The uppermost groundwater at the site is generally located in the Quaternary Alluvium and Woodbine Formation. Groundwater flows predominantly from the east to the west towards Village Creek. Refer to Part III, Appendix IIIG – Geology Report for additional information on hydrogeologic conditions at the site. To provide for complete coverage in monitoring soil layers from near ground surface to the bottom of waste, the proposed probes will be extended down to the lowest bottom of waste elevation within 1,000 feet of the probe location.

2.4 Hydraulic Conditions

The site is located to the immediate east of Village Creek. The site drains generally east to Village Creek. Village Creek discharges to Lake Arlington approximately 1 mile north of the site. The hydraulic conditions were considered in the layout of the LFG monitoring probes. Each probe location was evaluated, and two probes (GMP-6B and GMP11) will be relocated so there is no interference with surface drainage structures or roads (e.g., probes not located within channels, letdowns, ponds, etc.).

2.5 Facility Structures Within the Permit Boundary

Currently, there are three on-site enclosed structures located within the existing permit boundary: landfill office, scalehouse, and the landfill maintenance building. The scale house will be relocated as shown on Figure III I-A-1. All these structures will be equipped with continuous LFG monitoring systems or will be monitored quarterly. Existing and future onsite structures (per any future permit amendments or modifications), including but not limited to buildings, subsurface vaults, utilities, or any other areas where potential gas buildup would be of concern installed within the permit boundary will be monitored as described in Section 3.2 of this appendix. For future development at the site, the LFG monitoring system will be reviewed and revised as needed to protect human health and the environment.

2.6 Underground Utilities

In developing the design of the LFG monitoring system, the location of underground utilities was reviewed as possible pathways for LFG migration. Six passive trench vent pipes are proposed to be installed near underground utilities where they cross the permit boundary to monitor for the potential presence of LFG.

Currently, the Barnett Gathering, LP pipeline easement containing a buried gas pipeline crosses the south side of the permit boundary, and the Tarrant County Water Control and Improvement District easement contains three underground water lines that cross the northern permit boundary in four locations. Six utility trench vents (UV-1 through UV-6) will be installed nearby these utility crossings to monitor for the potential presence of LFG, as shown on Figure III I-A-1 in Appendix III I-A.

In addition, all future underground utilities which cross the permit boundary will be vented and monitored as well. A construction detail for the passive trench vent pipes is provided on Figure III I-A-2 in Appendix III I-A. The vents will be equipped with monitoring ports to facilitate routine methane monitoring.

2.7 Land Use and Offsite Structures

Land use within one mile of the site consists of open/agricultural, undeveloped, floodplain, single familu residential land and rural residential with scattered commercial and light industrial facilities located in the near vicinity the landfill property. Major commercial/light industrial facilities are located primarily to the east/norhteast and west within the 1-mile radius of the landfill property. There are two rural residential areas to the south of the landfill property. Please refer to Parts I/II, Section 7-Land Use for additional information.

A site map showing the off-site structures located within 1,000 feet of the permit boundary is presented in Appendix III I-B. Based on the surrounding land use and off-site structures, the inter-probe spacing was adjusted based on nearby off-site structures. The inter-probe spacing between the probes will be less than 1,000 feet except for in areas where there are nearby off-site structures, in which case the spacing will be less than 600 feet. For future development at the site, the LFG monitoring system will be reviewed and revised as needed to protect human health and the environment.

2.8 Nature and Age of Waste

The Fort Worth C&D Landfill is currently operated as a Type IV municipal solid waste disposal facility. The facility accepts construction and demolition (C&D) waste for disposal from both public and private entities in and around Tarrant County and surrounding counties.

The major classifications of solid waste to be accepted at the Fort Worth C&D Landfill include yard waste, Classes 2 and 3 industrial waste, construction-demolition waste, and rubbish. The facility will not accept for disposal putrescible wastes, Class 1 industrial waste, liquid waste, regulated hazardous waste, prohibited PCBs, infectious medical waste, and other wastes prohibited by TCEQ regulations.

The currently permitted 99.9-acre disposal area began accepting waste in 1988. Refer to Parts I/II, Sections 2 and 3 for additional information.

2.9 Climate

The climate of the region is characterized as very warm and humid. According to the U.S. Climate Data for the region, the average annual precipitation is approximately 38.8 inches. The temperature ranges between an average low of 35°F in January and an average high of 95°F in July and August. The climate was considered in the surface completion design of the probes.

2.10 Depth of Waste and Liner Description

The filled areas of the existing landfill were constructed consistent with the permit requirements in effect at that time. The existing disposal areas consist of approximately 77.7 acres of lined disposal area.

The liner system for the Fort Worth C&D Landfill was developed by excavating to the underlying unweathered shale (in-situ liner). Three feet of compacted clay is installed in areas outside of the unweathered shale (i.e., excavation sideslopes). The minimum elevation of the landfill liner system excavation is 550 feet above mean sea level (ft-msl) and the maximum elevation of the landfill final cover will be increased from 820 ft-msl to 860 ft-msl. Refer to Appendix IIIA for more information on the liner system and waste depth.

Waste depth and liner configurations were considered in the probe design. The proposed probes are designed to monitor subsurface soil layers and extend down to the lowest bottom of waste elevation near the probe location.

2.11 Summary

The probe design and monitoring system layout was based on the geologic conditions, hydrogeologic conditions, hydraulic conditions, location of the facility structures, underground utilities, land use, climate, and depth of waste discussed in the above sections. The LFG monitoring system, along with quarterly monitoring, will continue to meet the performance standards of Title 30 TAC §330.371(a) based on above mentioned parameters and the probe design.

3 MONITORING

3.1 Perimeter Monitoring

3.1.1 Existing Perimeter Monitoring Network

The site currently has thirteen permanent existing LFG monitoring probes to monitor the concentration of methane gas in accordance with Title 30 TAC §330.371(a)(2). The locations of the existing perimeter monitoring probes are shown on Figure III I-A-1 in Appendix III I-A. The boring logs for the existing LFG monitoring probes are included in Appendix III I-C.

As a result of the proposed landfill expansion as listed in Table III I-1, 4 of the existing LFG monitoring probes will be abandoned, 4 new probes and 6 trench vents will be added, and 9 of the existing LFG monitoring probes will remain. At landfill completion, the monitoring network will consist of 13 LFG monitoring probes and 6 trench vents as shown on Figure III I-A-1 in Appendix III I-A. The existing probes will be abandoned and re-drilled to allow for future filling and/or to facilitate site operations. The abandonment will include removing the surface completion material, attempting to pull the probe casing materials, and grouting the borehole with bentonite grout from the total depth to surface. The probes will be abandoned and plugged in accordance with applicable rules in Title 16 TAC Chapter 76.

One of the probes to be abandoned, GMP-6B, is currently located in historic waste. This probe will be abandoned and replaced with GMP-6C to allow development of the perimeter berm and road and facilitate site operations.

3.1.2 Proposed Landfill Gas Monitoring Network

As part of the proposed landfill expansion, 4 existing probes will be abandoned and 4 new probes will be installed as the site develops. The proposed perimeter landfill gas monitoring network will consist of 13 LFG monitoring probes. The proposed replacement probes will be installed prior to abandoning the corresponding existing probes and installed in accordance with applicable rules in Title 16 TAC Chapter 76.

The location of the proposed new probes, the existing probes that will be abandoned, and the existing probes that will be remain in-place are shown on Figure III I-A-1 in Appendix III I-A. The proposed probe is designed to be a single tube probe and will be installed similar to the detail shown on Figure III I-A-2 in Appendix III I-A. The depth of the new probe will be dependent on the field conditions at the time of installation, however at a minimum; the depth of the probe will extend down to the lowest bottom of waste placement elevation within 1,000 feet of the proposed probe location. Data regarding the new probes is summarized in Table III I-2 below.

Table III I-2
Proposed LFG Monitoring Probe Data[1]

Probe ID	Probe Ground Surface Elevation[2] (ft msl)	Lowest Bottom of Waste within 1,000 ft[3] (ft msl)	Proposed Probe Bottom Elevation (ft msl)	Proposed Boring Depth (ft bgs)
GMP-1A	616.0	550.0	567.0	49.0
GMP-2	636.3	550.0	570.0	66.3
GMP-3D	650.3	550.0	616.0	34.3
GMP-4B	661.3	550.0	633.0	28.3
GMP-5A	657.4	550.0	622.0	35.4
GMP-6C	658.0	565.0	563.0	95.0
GMP-7A	594.7	550.0	567.0	27.7
GMP-8	586.0	550.0	569.0	17.0
GMP-9A	596.0	550.0	548.0	48.0
GMP-10A	595.0	550.0	548.0	47.0
GMP-11A	595.0	550.0	548.0	47.0
GMP-12	677.0	568.0	610.0	67.0
GMP-13	656.0	550.0	595.0	61.0

[1] The data given is approximate. Actual probe ground elevation, bottom elevation, and depth will be determined prior to and/or at the time of installation.

[2] Probe ground surface elevation based on aerial topographic survey flown on February 17, 2022.

[3] Lowest bottom of waste elevation within 1,000 feet of the proposed probe based on Drawing A.1 – Overall Base Grading Plan Included in Part III, Appendix IIIA.

3.1.3 Proposed Passive Trench Vents

Six LFG trench vents are proposed to be installed near the existing underground utilities trenches where they cross the permit boundary, as discussed in Section 2.6 and shown on Figure III I-A-1. Future passive trench vents will also be installed in or near any future underground utilities which crosses the permit boundary. A typical detail of the vent pipe construction is shown on Figure III I-A-2 in Appendix III I-A. The underground utility locations will be identified and located by representatives of the utility easement owners.

3.1.4 Monitoring Procedures

All monitoring probes/trench vents will be sampled for methane during the quarterly monitoring period. In addition, sampling for specified trace gases may be conducted as requested by the Executive Director of the TCEQ.

Methane concentrations will be measured using a portable gas detection device pre-calibrated against reference methane standard. In accordance with manufacturer recommendations, the portable gas detector will be field calibrated prior to each monitoring event. As such, the portable gas detector will be field calibrated at least once a quarter prior to taking the quarterly probe measurements. The portable gas detection device will be equipped with a suction sampling line. The sampling line will be connected to the top of each probe and on each passive trench vent to enable gas samples to be drawn directly into the monitoring instrument without diluting the sample. The instrument is designed to give a direct reading of the methane concentration in, either percent of the LEL or percent methane by volume. A qualified landfill representative or consultant will conduct the monitoring and the percent methane by volume reading from the device will be recorded. The monitoring equipment will be maintained and calibrated in accordance with the manufacturer's recommended procedures prior to use.

Monitoring data will be recorded on the Landfill Gas Monitoring Report (LGMR) form shown in Appendix III I-D, or a similar form, and the data maintained in the facility's Site Operating Record. Probe and passive trench vent monitoring procedures will be as recommended by the gas detection device instrument manufacturer. The manufacturers' information on perimeter monitoring equipment currently used at the site is provided in Appendix III I-E. However, the site may use equipment, similar or equivalent to the existing equipment to measure methane concentrations in the future.

If LFG monitoring determines that methane has been detected in concentrations exceeding the regulatory limit, notification procedures, as described in Section 4, and remediation procedures, as described in Section 5, will be implemented.

3.1.5 Maintenance Procedures

As part of the overall maintenance program, routine inspection of the probes/trench vents will be conducted at least once a quarter. In addition, each time LFG monitoring is conducted, the sampler will inspect the integrity of the monitoring probes/trench vent. The sampler will record pertinent information on the LGMR form (Appendix III I-D) or similar form. Each probe/trench vent will be routinely inspected once a quarter for the following:

- Verify that the monitoring probes/trench vents are clearly numbered.
- Verify that the protective cover or piping is intact and is not bent or excessively corroded.
- Verify that the concrete pad is intact.
- Verify that the padlock is functional on the probe casing.
- Verify that the visible portion of the PVC riser is intact.

If damage or excessive wear to the monitoring probe/trench vent is observed, it will be reported to the Landfill Manager and the monitoring probe/trench vent will be repaired if the damage is affecting the accuracy of the probe. If it is not possible to repair the monitoring probe/trench vent and the damage can potentially affect the accuracy of future monitoring results, the monitoring probe/trench vent will be abandoned and replaced with a new monitoring probe/trench vent in accordance with Sections 3.1.2, 3.1.3, and 3.4 of this plan.

3.2 Monitoring of Facility Structures

3.2.1 Monitoring Procedures

All on-site structures will be sampled for methane or have continuous monitors checked during the quarterly monitoring period. In addition, sampling for specified trace gases may be conducted as requested by the Executive Director of the TCEQ. Routine methane monitoring will be performed using a combustible gas indicator (CGI), or an equivalent instrument (e.g., Landtec® GA-90, GEM-2000, photo/flame ionization detector, etc.) capable of detecting methane gas at concentrations of 0.5 percent to 100 percent by volume.

These instruments will be calibrated, used, and maintained in accordance with the equipment manufacturers' recommended procedures. The information, measurements, and observations required to be taken at each sampling location during each monitoring event will include:

- Documentation of the sampling location designation, date and time of each measurement, general condition/integrity of the gas monitoring probe, and name(s) of sampling personnel.
- Methane concentrations in units of percent by volume methane and percent Lower Explosive Limit (LEL).

The monitoring records will be recorded on data sheets similar to the sample one attached to this document (see Appendix III I-D). The exact format of the monitoring form may be modified from the example attached to this document, but the data recorded during each monitoring event will at a minimum include the information identified above.

The continuous monitor/alarm will include an audible alarm if methane concentrations exceed 1.25% by volume (which is 25 percent of LEL) for methane. If a methane level above the regulatory limit is detected or the continuous monitor/alarm is sounded, it will be documented in percent methane by volume and reported as outlined in Section 3.3.

Should continuous monitor be installed, the performance will be tested using a known methane calibration gas at least once a quarter prior to taking the quarterly measurements and will be documented on the LGMR form shown in Appendix III I-D or using a similar form. If the monitoring equipment alarm does not test properly during quarterly testing, they will be repaired or replaced. The manufacturer's information regarding the monitors/alarms that may be used at the site is provided in Appendix III I-E.

If methane concentrations exceeding the regulatory limits are detected within an enclosed building, the building will be immediately evacuated and ventilated by opening doors and windows. Notification procedures described in Section 4 will then be implemented.

3.2.2 Maintenance Procedures

If installed, the continuous LFG monitors/alarms will be maintained and tested in accordance with the manufacturer's recommendations and specifications. According to the manufacturer's information in Attachment III I-D, the alarm does not require regular maintenance and it uses a self-purging semi-conductor sensor that has a 7- to 10-year life expectancy. As such, the sensor will be replaced every 7-10 years. In addition, on a quarterly basis the monitors/alarms will be inspected to ensure they are properly installed and connected to power.

3.3 Recordkeeping/Reporting

The recordkeeping and reporting requirements will be consistent with those outlined in Title 30 TAC §330.159, §330.371, and §330.125. Records will be maintained for the methane monitoring. The records will be kept on site and maintained as part of the Site Operating Record. Field data will be recorded on the LGMR form (or similar form) shown in Appendix III I-D.

The LFG monitoring probes/trench vents and any on-site occupied structures will be monitored quarterly and the results will be placed in the Site Operating Record and made available to the TCEQ upon request.

For those quarterly LFG monitoring events when the measured methane levels are either: (1) above 5% methane by volume in monitoring points, probes, subsurface soils, or other matrices at the facility boundary defined by the legal description in the permit; or (2) above 1.25% methane by volume in air in facility structures (excluding gas control or recovery system components), LFG monitoring reports will be submitted to the TCEQ.

3.4 Contingency Plan

In accordance with Title 30 TAC §330.371(g)(3), the following contingency plan will be used if the main monitoring system breaks down or becomes ineffective.

LFG Monitoring Probes/Trench Vents

1. Within 60 days, when it is noted that an LFG monitoring probe/trench vent has become inoperative, a notification will be submitted to the TCEQ. The notification will describe the proposed repair and the schedule for implementation. The damaged or inoperative LFG monitoring probe/trench vent will be replaced with a new probe/trench vent similar to the details of the existing probe/trench vent.
2. Should a monitoring event occur prior to replacement of a damaged probe/trench vent, a bar-hole will be placed next to the damaged probe/trench vent, and a portable gas detection device suitable for methane detection will be used until the probe/trench vent is replaced. The portable gas detection device will be calibrated prior to use per the manufacturer's guidance.
3. Upon completion of the replacement probe/trench vent, an installation report including any boring logs and construction details will be submitted to the TCEQ.

Continuous LFG Monitors/Alarms

1. Damaged or inoperative continuous monitors/alarms will be repaired or replaced within 30 days of the monitoring event during which the damage was noted.
2. A portable gas detection device calibrated for 1.25% volume will be used to monitor weekly until the stationary unit(s) is replaced.

4 EXCEEDANCE ACTION PLAN

4.1 Exceedance Response Measures

This action plan has been prepared for the protection of human health and the environment in the event concentrations of methane exceed allowable limits either within any enclosed structures that may be constructed within the permit boundary or in the LFG monitoring probes. The appropriate emergency response is different for each situation; therefore, the following plan will address the situations for enclosed structures and probes separately.

This action plan will be implemented upon the initial exceedance of a perimeter monitoring probe/trench vent or enclosed structure monitor.

4.1.1 Initial Action

The initial action in the event methane is detected at levels above regulation limits is to immediately take all necessary steps to ensure protection of human health and notify the Executive Director, local and county officials, emergency officials, and the public as outlined in Section 4.2. The specific response depends on the circumstances of the situation.

Building/Structures. If a continuous monitoring device installed within an occupied enclosed structure located within the permit boundary is triggered or if LFG monitoring equipment indicates that 1.25 percent methane by volume has been exceeded, the building or structure is to be immediately evacuated of all personnel and the Landfill Manager will be notified. Personnel (except for qualified monitoring personnel) will not be allowed to re-enter the affected building or structure until additional measures are taken. Notification procedures will be implemented as described in Section 4.2.

Perimeter Monitoring Probes/Trench Vents. If an exceedance of allowable limits of methane is detected at the permit boundary in one of the monitoring probes/trench vents, the Landfill Manager will be notified immediately. The immediate emergency response measure will be for the Landfill Manager to determine if any nearby buildings or structures (including off site) are at risk and if evacuation of the buildings should be requested. Notification procedures will be implemented as described in Section 4.2.

4.2 Notification Procedures

When methane levels above the regulatory limit have been detected, sampling personnel will immediately notify the Landfill Manager by telephone, SMS text message, or e-mail. The Landfill Manager or his representative will then notify the Executive Director of the TCEQ, and the following local/county officials, and emergency officials by writing (telephone, letter, fax, or e-mail) within 7-days after initial detection:

Executive Director
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087
Telephone: 512-239-3900
Fax: 512-239-3939
E-mail: execdir@tceq.texas.gov

City of Kennedale Fire Department
405 Municipal Drive
Kennedale, TX 76060
Telephone: 817-478-5416

Tarrant County Emergency Management
100 E. Weatherford St., #305
Fort Worth, TX 76196
Telephone: 817-884-1804
E-mail: dmmccurdy@tarrantcounty.com

City of Kennedale
405 Municipal Drive
Kennedale, TX 76060
Telephone: 817-985-2104

The public (property owners located within 1,000 feet of the affected probe/vent) will also be notified by writing or telephone, or e-mail after the initial detection.

The site will then take action as described in Section 5. Subsequent notifications during remediation activities will be followed as described in the remediation plan, if deemed necessary.

The TCEQ will be notified again in writing for any additional monitored points that were not part of the original notification which now exhibit methane exceedances above the regulatory limit. If the new monitored points affect property owners which were not originally notified, they will be notified as described above.

4.3 Placement into Operating Record

Records of LFG monitoring, including the data and methane gas levels, whether for routine monitoring, or remediation purposes, will be maintained and placed in the Site Operating Record. In the event that levels of methane above the regulatory limit have been detected either in facility structures and monitoring points, in monitoring probes/trench vents, a description of steps taken to protect human health must also be placed in the Site Operating Record. Notifications made verbally or in writing will also be recorded and placed into the Site Operating Record. These placements into the Site Operating Record will occur within 7 days after detection of methane above the regulatory limit.

5 REMEDIATION PLAN

Once methane levels above regulatory limits have been accurately detected in the facility buildings/structures or in one or more of the LFG monitoring probes/utility trench vents at the permit boundary, the remediation plan as listed below will be developed and implemented within 60 days of detection. An incident specific remediation plan may also be prepared and/or implemented. The Executive Director may establish an alternative schedule for demonstrating compliance with routine monitoring and required actions if methane gas exceeds the limits noted in Title 30 TAC §330.371(a).

The first remediation action will be an investigation of the cause of the methane levels. The investigation may include some or all of the following elements, depending on the circumstances:

- Bar-hole probe or hydropunch testing in the vicinity of the impacted monitoring probe/trench vent
- Sampling and laboratory analysis of LFG samples collected from the monitoring probe/trench vent to determine the concentration of methane and trace compounds
- A gas analysis to try to determine the source
- Additional LFG monitoring

Using accumulated data, an assessment will be made to determine an appropriate course of action to mitigate the LFG migration. Such actions may vary with the specific incident, but may include (and are not limited to) installation of the following:

- Passive vents
- Cut-off trenches
- Active GCCS

The incident specific remediation actions will be performed within 60 days of the detection per Title 30 TAC §330.371(c)(3). The TCEQ will be notified that this or an incident-specific remediation plan has been implemented within 60 days of detection.

6 LFG COLLECTION AND CONTROL SYSTEMS

6.1 Existing LFG System

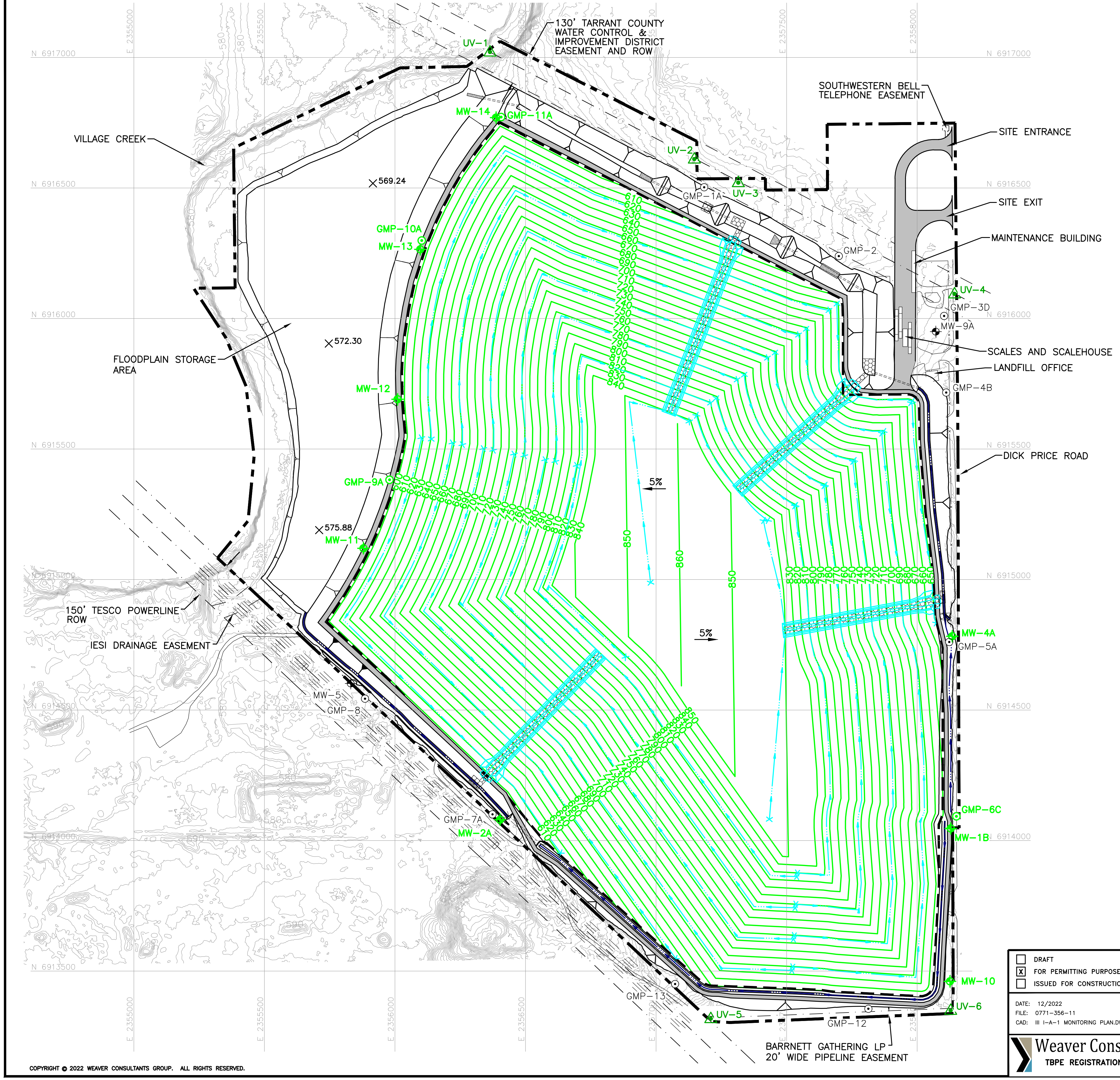
The Fort Worth C&D Landfill does not currently have a gas collection and control (GCCS) system. Because this facility accepts mainly C&D waste, a GCCS is not proposed at this time.

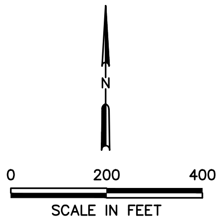
APPENDIX III I-A

PERIMETER LANDFILL GAS MONITORING SYSTEM
LANDFILL GAS PROBE/VENT DETAILS

MATT K. STUTZ
93662
02/09/2023

Includes Figures III I-A-1 and III I-A-2





LEGEND

— · · — · · —	PERMIT BOUNDARY
— — — —	LIMIT OF WASTE
630	EXISTING CONTOUR
N 6915000	STATE PLANE COORDINATE
860	FINAL COVER CONTOUR
▨	DRAINAGE LETDOWN
→	DRAINAGE SWALE
→	PERIMETER CHANNEL
— · — · —	EASEMENT
▨	GABIONS
←	DRAINAGE CHANNEL
MW-2A	PERMITTED GROUNDWATER MONITORING WELL
GMP-4B	PERMITTED GAS MONITORING PROBE
MW-4A	PROPOSED GROUNDWATER MONITORING WELL
GMP-6C	PROPOSED GAS MONITORING PROBE
UV-1	PROPOSED UTILITY TRENCH VENT

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN 02-17-2022. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE, NAD 1983.

MATT K. STUTZ
93662
02/09/2023

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 12/2022
FILE: 0771-356-11
CAD: III I-A-1 MONITORING PLAN.DWG

DRAWN BY: JDW
DESIGN BY: CAM
REVIEWED BY: CRM

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
TEXAS REGIONAL LANDFILL COMPANY, LP

REVISIONS

NO.	DATE	DESCRIPTION

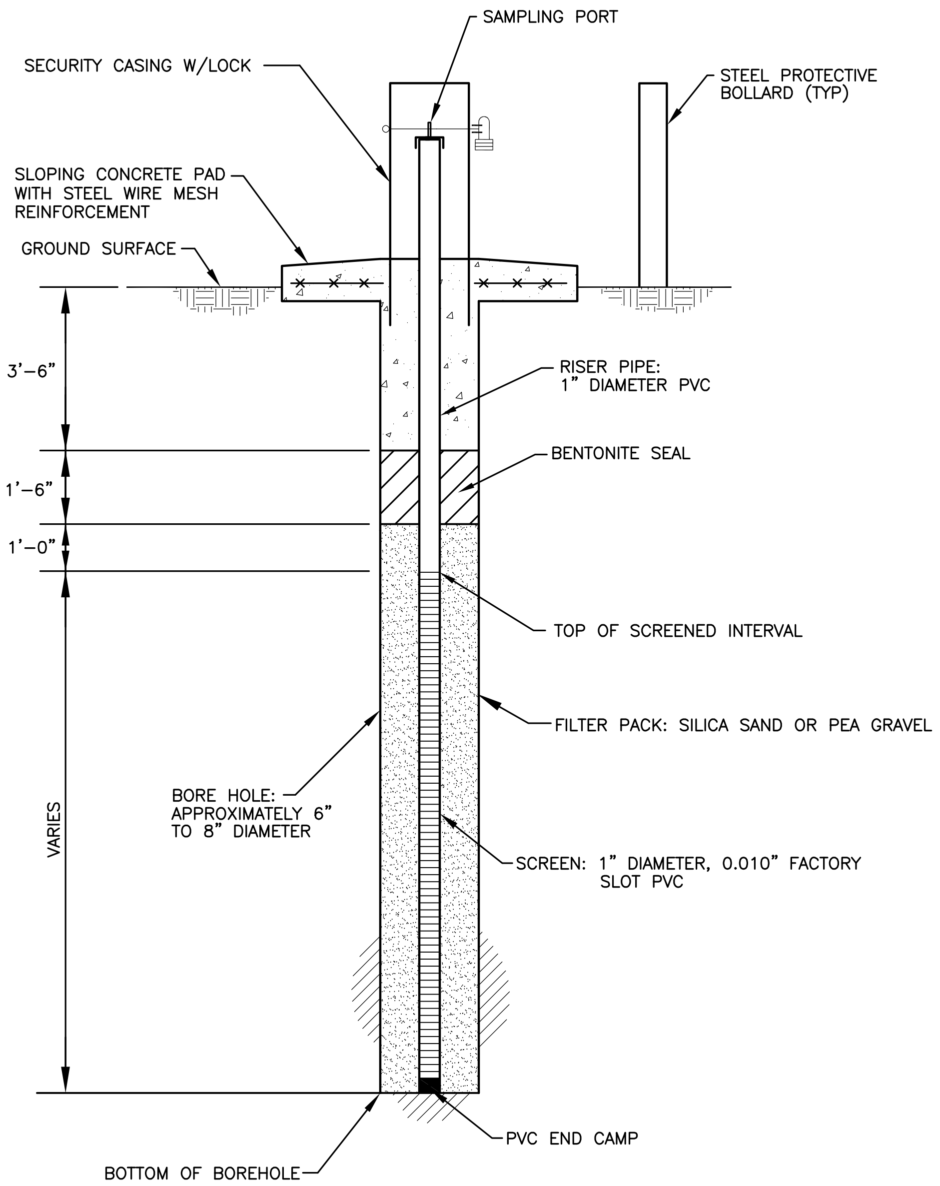
MAJOR PERMIT AMENDMENT PERIMETER LANDFILL GAS MONITORING SYSTEM

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS

WWW.WCGRP.COM

FIGURE III I-A-1

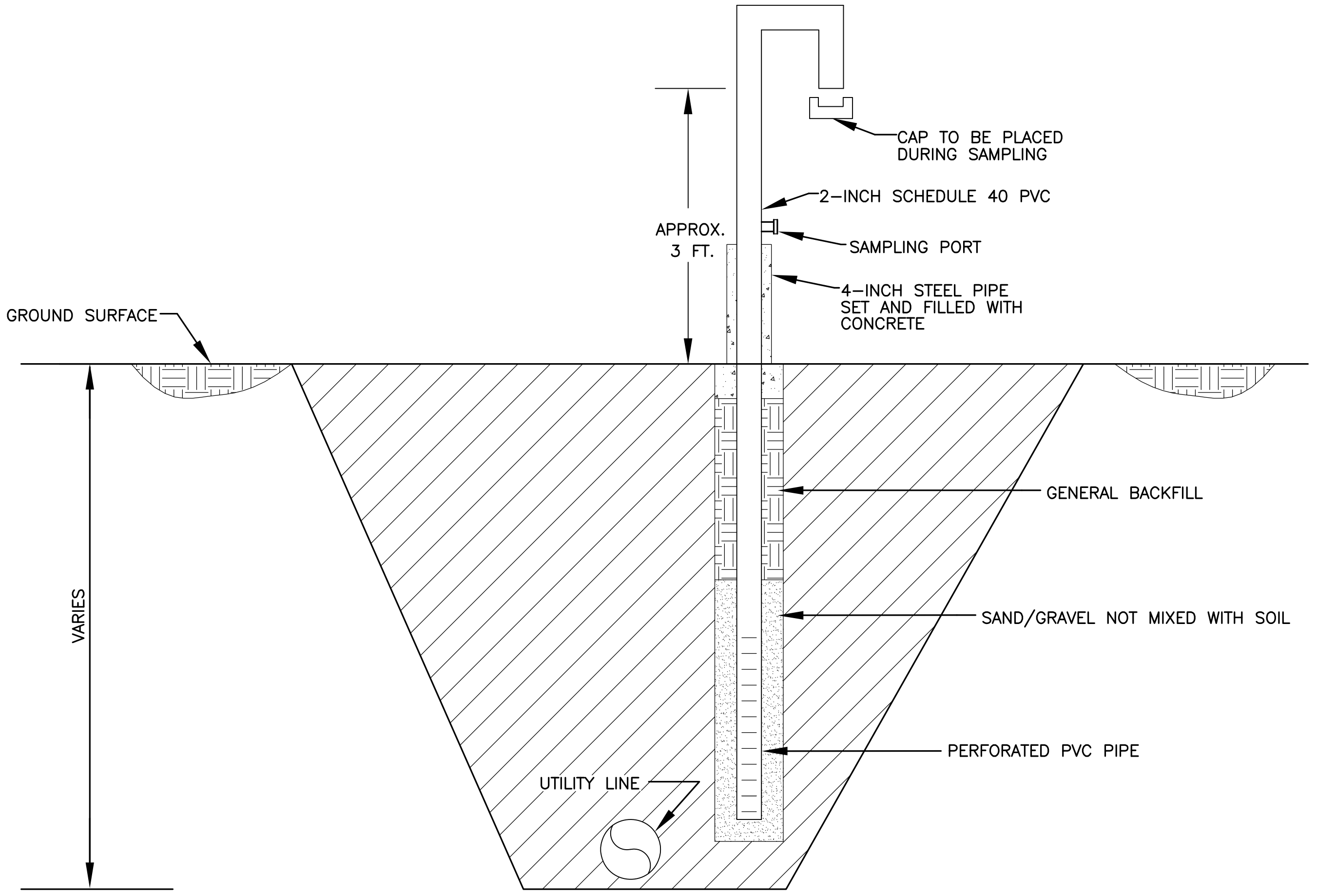
0:\0771\356\EXPANSION 2022\PART III\IIII\I-A-1 MONITORING PLAN.dwg, jwilson, 1:2



LFG MONITORING PROBE (LFG1 I-A-2)
NTS

NOTES:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.
2. ACTUAL DIMENSION OF THE GAS MONITORING PROBE WILL BE DETERMINED BASED ON FIELD CONDITIONS AT THE TIME OF CONSTRUCTION.



LFG UTILITY TRENCH VENT (LFG2 I-A-2)
NTS

NOTES:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.
2. ACTUAL DIMENSION OF THE LFG TRENCH VENT WILL BE DETERMINED BASED ON FIELD CONDITIONS AT THE TIME OF CONSTRUCTION.

MATT K. STUTZ
93662
02/09/2023

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 12/2022
FILE: 0771-368-11
CAD: III I-A-2 PROBE/VENT DETAILS.DWG

DRAWN BY: VRS
DESIGN BY: SR
REVIEWED BY: NT

PREPARED FOR
TEXAS REGIONAL LANDFILL COMPANY, LP

REVISIONS

NO.	DATE	DESCRIPTION

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

MAJOR PERMIT AMENDMENT
LANDFILL GAS PROBE/ VENT DETAILS

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS

WWW.WCGRP.COM

FIGURE III I-A-2

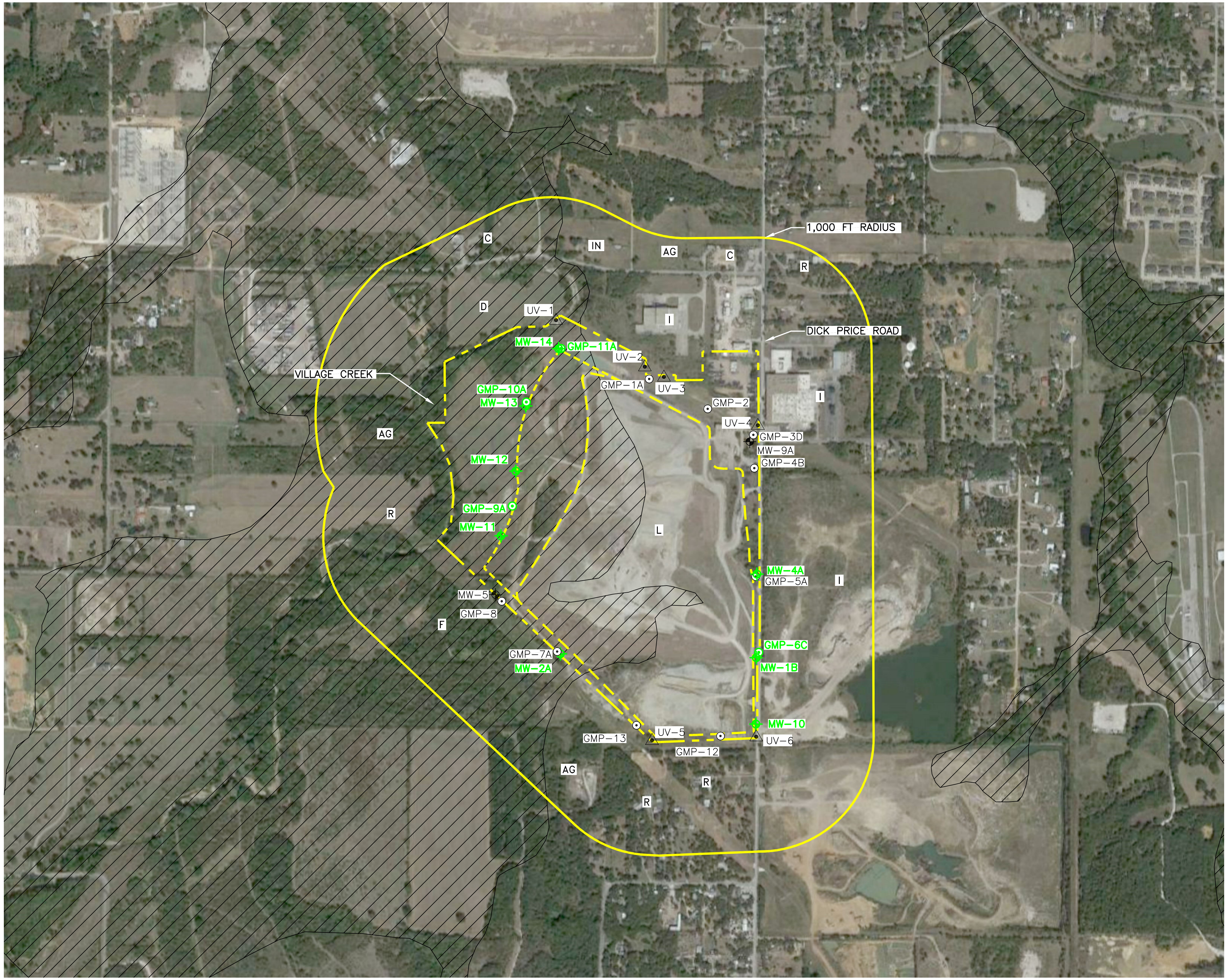
O:\0771\356\EXPANSION 2022\PART III\III I-A-2_PROBE DETAILS.dwg, jpuhr, 1:2.04651

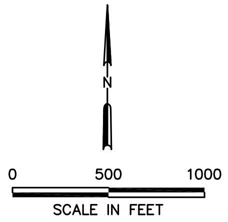
APPENDIX III I-B

SURROUNDING DEVELOPMENT MAP

STATE OF TEXAS
MATT K. STUTZ
93662
LICENSED
PROFESSIONAL ENGINEER
02/09/2023

Includes Figure III I-B-1





LEGEND

L	PERMIT BOUNDARY
	PERMITTED LIMIT OF WASTE
	PROPOSED LIMIT OF WASTE
MW-2A	PERMITTED GROUNDWATER MONITORING WELL
GMP-4B	PERMITTED GAS MONITORING PROBE
MW-4A	PROPOSED GROUNDWATER MONITORING WELL
GMP-6C	PROPOSED GAS MONITORING PROBE
UV-1	PROPOSED UTILITY TRENCH VENT
▨ F	FEMA 100-YEAR FLOODPLAIN
L	LANDFILL
I	INDUSTRIAL
R	RESIDENTIAL
AG	AGRICULTURAL/UNDEVELOPED
D	DEDICATED (SEE NOTE 2)
C	COMMERCIAL
IN	INFRASTRUCTURE

NOTES:

1. AERIAL IMAGERY PROVIDED BY GOOGLE EARTH DATED 12/6/2019.
2. DEDICATED AREAS INCLUDE GOVERNMENT OWNED PROPERTIES, LANDFILLS, GOLF COURSE, AND OPEN SPACES.

MATT K. STUTZ
93662
02/09/2023

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 12/2022
FILE: 0771-356-11
CAD: III I-B-1 SURROUNDING DEV.DWG

DRAWN BY: JDW
DESIGN BY: JBP
REVIEWED BY: CRM

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
TEXAS REGIONAL LANDFILL COMPANY, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT SURROUNDING DEVELOPMENT MAP

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS

WWW.WCGRP.COM

FIGURE III I-B-1

O:\0771\356\EXPANSION 2022\PART III\IIII\III I-B-1 SURROUNDING DEV.dwg, jpuhr, 1:2

APPENDIX III I-C

EXISTING LANDFILL GAS MONITORING PROBE INFORMATION

STATE OF TEXAS
MATT K. STUTZ
93662
LICENSED
PROFESSIONAL ENGINEER
02/09/2023

Includes pages III I-C-1 through III I-C-39

Note: The contents of this appendix were taken from permitted Appendix III I-LGMP (MSW Permit No. 1983C and 1983D).

SOIL BOREHOLE LOG

SITE NAME AND LOCATION
SOIL GAS PROBE INSTALLATIONS
FORT WORTH C & D LANDFILL
TARRANT COUNTY, TEXAS
IESI

ELEVATION (MSL-FT) 611.50

DRILLING METHOD: Hollow Stem Auger

SAMPLING METHOD: Disturbed

BORING NO. SGMP- 1

SHEET 1 OF 2

WATER LEVEL				
TIME	SEE NOTE NO. 2			
DATE	AT BOTTOM OF LOG			
CAVED DEPTH				

DRILLING	
START	FINISH
TIME	TIME
NA	NA
DATE	DATE
6-13-05	6-13-05

LOCATION SEE PLAN OF BORINGS

DRILL RIG CME-75

ANGLE Vertical BEARING ------

DRILLER S.C.

DRILLING CONTR TEXPLOR

DEPTH IN FEET	BLOWS/6 IN ON SAMPLER	SYMBOL	SAMPLE	DESCRIPTION OF MATERIALS	%REC/ %RQD	COMPRESSIVE STRENGTH (tsf)/ %STRAIN	% PASSING #200 SIEVE	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	UNIT DRY WEIGHT (pcf)	POCKET PENETROMETER
0.0		▨		Light Brown to Tan Clay								
5.0				(CH)								
		▨		Tan Sandy Clay (CL)								
		▨		Tan and Light Brown Clay								
10.0												
				(CH)								
15.0		▨		Tan Shaley Clay								
20.0												
25.0												
30.0												
				- gray and tan								
35.0												

LOGGED BY B.W.

CHK'D BY J.H.

Tracking Codes: 052021.GPJ CUSTISOL 6/27/05

TEAM Consultants, Inc.

(Continued)

PLATE III I-C-1

SOIL BOREHOLE LOG

SITE NAME AND LOCATION SOIL GAS PROBE INSTALLATIONS FORT WORTH C & D LANDFILL TARRANT COUNTY, TEXAS IESI	DRILLING METHOD: Hollow Stem Auger SAMPLING METHOD: Disturbed	BORING NO. SGMP- 1 SHEET 2 OF 2	
ELEVATION (MSL-FT) 611.50			

WATER LEVEL				
TIME	SEE NOTE NO. 2			
DATE	AT BOTTOM OF LOG			
CAVED DEPTH				

DRILLING	START	FINISH
TIME	NA	NA
DATE	6-13-05	6-13-05

LOCATION SEE PLAN OF BORINGS

DRILL RIG CME-75

ANGLE Vertical BEARING ------

DRILLER S.C.

DRILLING CONTR TEXPLOR

DEPTH IN FEET	BLOWS/6 IN ON SAMPLER	SYMBOL	SAMPLE	DESCRIPTION OF MATERIALS	%REC/ %RQD	COMPRESSIVE STRENGTH (tsf)/ %STRAIN	% PASSING #200 SIEVE	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	UNIT DRY WEIGHT (pcf)	POCKET PENETROMETER
35.0				Gray and Tan Shaley Clay (CH)								
				Gray Shale								
40.0												
45.0												
50.0												
55.0												
60.0												
65.0												
70.0												

Notes: (1) Completion Depth = 45.0 Feet
(2) No Groundwater Observed During Drilling
(3) Soil Gas Monitoring Probe installed upon Completion of Drilling.

III I-C-2

LOGGED BY B.W.

CHK'D BY J.H.

Tracking Codes: 052021.GPJ, CUSTISOL 6/27/05

TEAM Consultants, Inc.

PLATE

SOIL GAS PROBE NUMBER: SGMP- 1

BORING NO. X-REF: SGMP- 1

SOIL GAS PROBE CONSTRUCTION SUMMARY

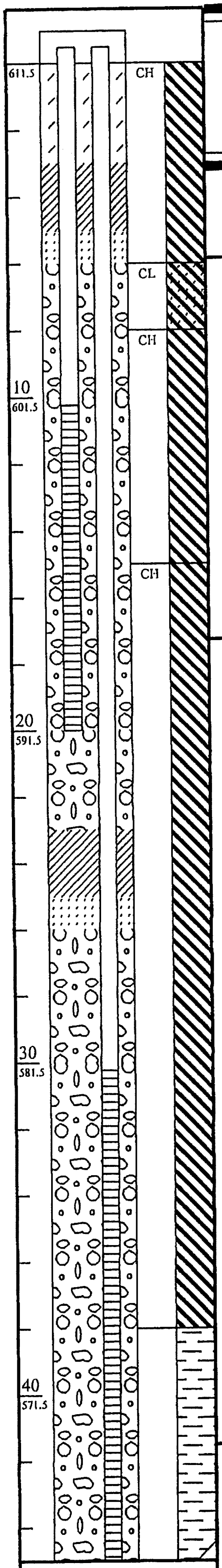
SURVEY COORDS: N 6916535

(CASING) E 2357086

SURFACE ELEVATION: 611.5 MSL

TOP OF PVC CASING ELEVATION: 614.6 MSL

TOP OF PAD: 612.1 MSL



T.D.= 45.0 FT.

DRILLING SUMMARY:

TOTAL DEPTH: 45.0'

BOREHOLE DIAMETER: 8.25"

CASING STICK-UP: 3.1'

DRILLER: S.C.

RIG: CME-75

BIT(S): Hollow Stem Auger

DRILLING FLUID: NA

PROTECTIVE CASING: 4.0" Dia. Steel Protective Casing

CONSTRUCTION TIME LOG:

	START		FINISH	
TASK:	DATE	TIME	DATE	TIME
DRILLING:	6/13/2005	NA	6/13/2005	NA
GEOPHYS,LOGGING:	NA	NA	NA	NA
CASING:	6/13/05	NA	6/13/05	NA
FILTER PLACEMENT:	6/13/05	NA	6/13/05	NA
CONCRETE PAD:	6/15/05	NA	6/15/05	NA
DEVELOPMENT:	NA	NA	NA	NA

PROBE DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☐ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft)
-3.1 / 10.0	C1	614.6 / 601.5
10.0 / 20.0	S1	601.5 / 591.5
-3.1 / 30.0	C2	614.6 / 581.5
30.0 / 45.0	S2	581.5 / 566.5
45.0 / 45.0	C3	566.5 / 566.5

C1: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Riser

S1: 1.0" I.D. Schedule 40 PVC Machine Slotted Screen (0.010")

C2: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Riser

S2: 1.0" I.D. Schedule 40 PVC Machine Slotted Riser (0.010")

C3: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Bottom Cap

FILTER PACK: (6.0'-23.0') Pea Gravel
(26.0'-45.0') Pea Gravel

FINE SAND: (5.0'-6.0') #10/20 Filter Sand
(25.0'-26.0') #10/20 Filter Sand

SEAL: (3.0'-5.0') Bentonite Seal
(23.0'-25.0') Bentonite Seal

CEMENT SEAL: (0.0'-3.0') Concrete Seal

DEVELOPMENT:

NA

STABILIZATION TEST DATA:

NA

TIME	pH	SPEC. COND.	TEMP. (C)

RECOVERY DATA:

Q= GAL. So=

100					
80					
60					
40					
20					
0	20	40	60	80	100

NA

COMMENTS:
1) All depths referenced to ground level.
2) Elevations referenced to mean sea level (MSL)
3) Caps placed on bottoms of upper and lower screened intervals.

SITE NAME: FORT WORTH C & D LANDFILL

LOCATION: IESI

SUPERVISED BY: B.W.

CHK'D BY: J.H. / D.W.B.

Tracking Codes: 05202I.GPJ, TEAM- MONITOR WELL CONSTRUCTION LOG, 6/27/05

SCS ENGINEERS

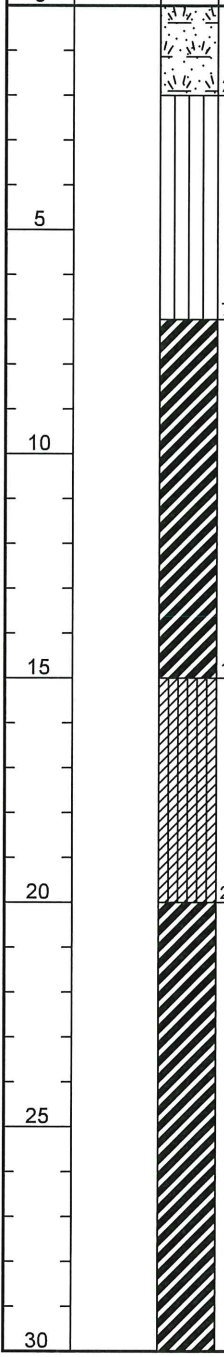
SCS Engineers
3900 Kilroy Airport Way
Long Beach, CA 90806
Telephone: 562-426-9544

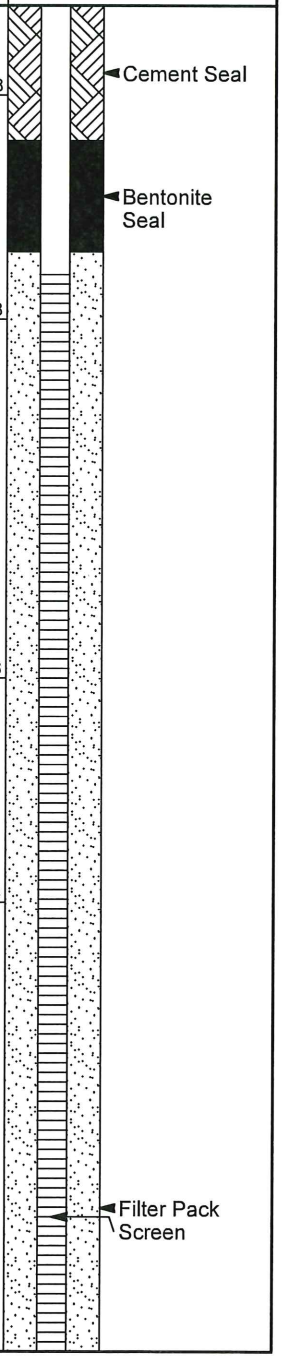
WELL NUMBER GMP-1A

PAGE 1 OF 2

CLIENT Waste Connections
PROJECT NAME Fort Worth C&D Landfill
PROJECT NUMBER
PROJECT LOCATION
DATE STARTED 12/13/21 **COMPLETED** 12/15/21
GROUND ELEVATION 614.8 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem
AT TIME OF DRILLING ---
LOGGED BY TM **CHECKED BY** GC
AT END OF DRILLING ---
NOTES N32.635571, W97.237307
AFTER DRILLING ---

DEPTH (ft)	NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0			Topsoil, light brown, soft, dry, with some pebbles	
2.0			612.8 Clayey silt, light brown, soft, dry	
7.0			607.8 Clay, light brown, soft to moderately soft, dry	
15.0			599.8 Silty clay, light brown, soft, dry	
20.0			594.8 Clay, light brown, soft, dry	





1/19/22
GILBERT GABALDÓN
GEOLOGY
#4415

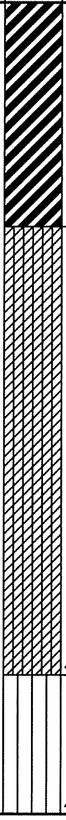
(Continued Next Page)

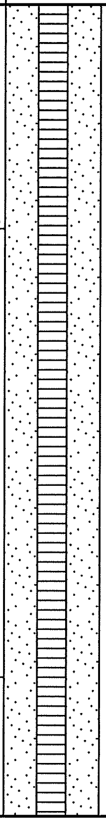
SCS Engineers
3900 Kilroy Airport Way
Long Beach, CA 90806
Telephone: 562-426-9544

WELL NUMBER GMP-1A

CLIENT Waste Connections
PROJECT NAME Fort Worth C&D Landfill
PROJECT NUMBER
PROJECT LOCATION

DEPTH (ft)	NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
30			Clay, light brown, soft, dry *(continued)*		
35			35.0	579.8	
			Silty clay, grey, soft, dry		
40					
45			45.0	569.8	
			Clayey silt, grey, soft, dry		
			48.1	566.7	





Bottom of borehole at 48.1 feet.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION SOIL GAS PROBE INSTALLATIONS FORT WORTH C & D LANDFILL TARRANT COUNTY, TEXAS IESI	DRILLING METHOD: Hollow Stem Auger SAMPLING METHOD: Disturbed	BORING NO. SGMP- 2 SHEET 1 OF 2
ELEVATION (MSL-FT) 635.05		

WATER LEVEL				
TIME	SEE NOTE NO. 2			
DATE	AT BOTTOM OF LOG			
CAVED DEPTH				

DRILLING	
START	FINISH
TIME	TIME
NA	NA
DATE	DATE
6-13-05	6-13-05

LOCATION SEE PLAN OF BORINGS

DRILL RIG CME-75

ANGLE Vertical BEARING ------

DRILLER S.C.

DRILLING CONTR TEXPLOR

DEPTH IN FEET	BLOWS/6 IN ON SAMPLER	SYMBOL	SAMPLE	DESCRIPTION OF MATERIALS	%REC/ %RQD	COMPRESSIVE STRENGTH (tsf)/ %STRAIN	% PASSING #200 SIEVE	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	UNIT DRY WEIGHT (pcf)	POCKET PENETROMETER
0.0				Reddish Brown Sandy Clay								
5.0												
				(CL)								
				Light Brown Clay								
10.0												
				- brown								
15.0												
				- tan w/occasional sand								
20.0												
25.0												
30.0												
				- gray and tan								
35.0				(CH)								

III I-C-6

LOGGED BY B.W.

CHK'D BY J.H.

Tracking Codes: 052021.GPJ, CUSTISOL 6/27/05

TEAM Consultants. Inc.

(Continued)

PLATE

SOIL BOREHOLE LOG

SITE NAME AND LOCATION
SOIL GAS PROBE INSTALLATIONS
FORT WORTH C & D LANDFILL
TARRANT COUNTY, TEXAS
IESI

ELEVATION (MSL-FT) 635.05

DRILLING METHOD: Hollow Stem Auger

SAMPLING METHOD: Disturbed

BORING NO. SGMP- 2

SHEET 2 OF 2

WATER LEVEL				
TIME	SEE NOTE NO. 2			
DATE	AT BOTTOM OF LOG			
CAVED DEPTH				

DRILLING	
START	FINISH
TIME	TIME
NA	NA
DATE	DATE
6-13-05	6-13-05

LOCATION SEE PLAN OF BORINGS

DRILL RIG CME-75

ANGLE Vertical BEARING ------

DRILLER S.C.

DRILLING CONTR TEXPLOR

DEPTH IN FEET	BLOWS/6 IN ON SAMPLER	SYMBOL	SAMPLE	DESCRIPTION OF MATERIALS	%REC/ %RQD	COMPRESSIVE STRENGTH (tsf)/ %STRAIN	% PASSING #200 SIEVE	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	UNIT DRY WEIGHT (pcf)	POCKET PENETROMETER
35.0				Gray Shale								
40.0												
45.0				Notes: (1) Completion Depth = 45.0 Feet (2) No Groundwater Observed During Drilling (3) Soil Gas Monitoring Probe installed upon Completion of Drilling.								
50.0												
55.0												
60.0												
65.0												
70.0												

III I-C-7

LOGGED BY B.W.

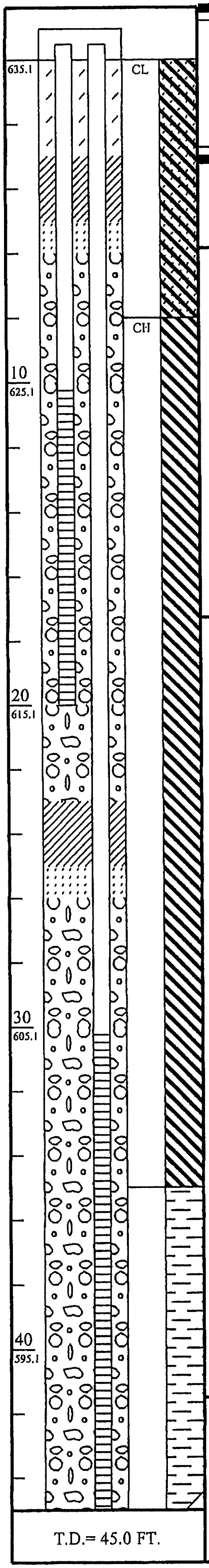
CHK'D BY J.H.

Tracking Codes: 053021.GPJ, CUSTTSOL 6/27/05

SOIL GAS PROBE NUMBER: SGMP- 2

BORING NO. X-REF: SGMP- 2

SOIL GAS PROBE CONSTRUCTION SUMMARY



SURVEY COORDS: N 6916239
(CASING) E 2357700

SURFACE ELEVATION: 635.1 MSL
TOP OF PVC CASING ELEVATION: 638.2 MSL
TOP OF PAD: 635.7 MSL

DRILLING SUMMARY:

TOTAL DEPTH: 45.0'
BOREHOLE DIAMETER: 7.25"
CASING STICK-UP: 3.1'
DRILLER: S.C.

RIG: CME-75
BIT(S): Hollow Stem Auger

DRILLING FLUID: NA

PROTECTIVE CASING: 4.0" Dia. Steel Protective Casing

CONSTRUCTION TIME LOG:

	START		FINISH	
TASK:	DATE	TIME	DATE	TIME
DRILLING:	6/13/2005	NA	6/13/2005	NA
GEOPHYS,LOGGING:	NA	NA	NA	NA
CASING:	6/13/05	NA	6/13/05	NA
FILTER PLACEMENT:	6/13/05	NA	6/13/05	NA
CONCRETE PAD:	6/15/05	NA	6/15/05	NA
DEVELOPMENT:	NA	NA	NA	NA

PROBE DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☐ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft)
-3.1 / 10.0	C1	638.2 / 625.1
10.0 / 20.0	S1	625.1 / 615.1
-3.1 / 30.0	C2	638.1 / 605.1
30.0 / 45.0	S2	605.1 / 590.1
45.0 / 45.0	C3	590.1 / 590.1

C1: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Riser

S1: 1.0" I.D. Schedule 40 PVC Machine Slotted Screen (0.010")

C2: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Riser

S2: 1.0" I.D. Schedule 40 PVC Machine Slotted Riser (0.010")

C3: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Bottom Cap

FILTER PACK: (6.0'-23.0') Pea Gravel
(26.0'-45.0') Pea Gravel

FINE SAND: (5.0'-6.0') #10/20 Filter Sand
(25.0'-26.0') #10/20 Filter Sand

SEAL: (3.0'-5.0') Bentonite Seal
(23.0'-25.0') Bentonite Seal

CEMENT SEAL: (0.0'-3.0') Concrete Seal

DEVELOPMENT:

NA

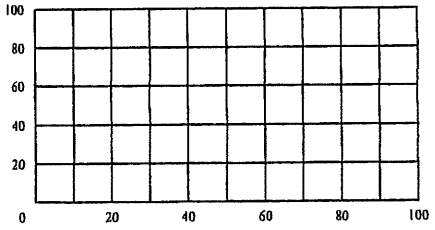
STABILIZATION TEST DATA:

NA

TIME	pH	SPEC. COND.	TEMP. (C)

RECOVERY DATA:

Q= GAL. So= ______



NA

COMMENTS: 1) All depths referenced to ground level.
2) Elevations referenced to mean sea level (MSL)
3) Caps placed on bottoms of upper and lower screened intervals.

SITE NAME: FORT WORTH C & D LANDFILL
LOCATION: IESI

SUPERVISED BY: B.W.
CHK'D BY: J.H. / D.W.B.

Tracking Codes: 05202l.GPJ, TEAM- MONITOR WELL CONSTRUCTION LOG, 6/27/05

SOIL BOREHOLE LOG

SITE NAME AND LOCATION
SOIL GAS PROBE INSTALLATION
FORT WORTH C & D SLF
IESI
TARRANT COUNTY, TEXAS

TEAM PROJECT NO. 062080E

ELEVATION (MSL-FT)

DRILLING METHOD: 6" Flight Augers
SAMPLING METHOD: Disturbed

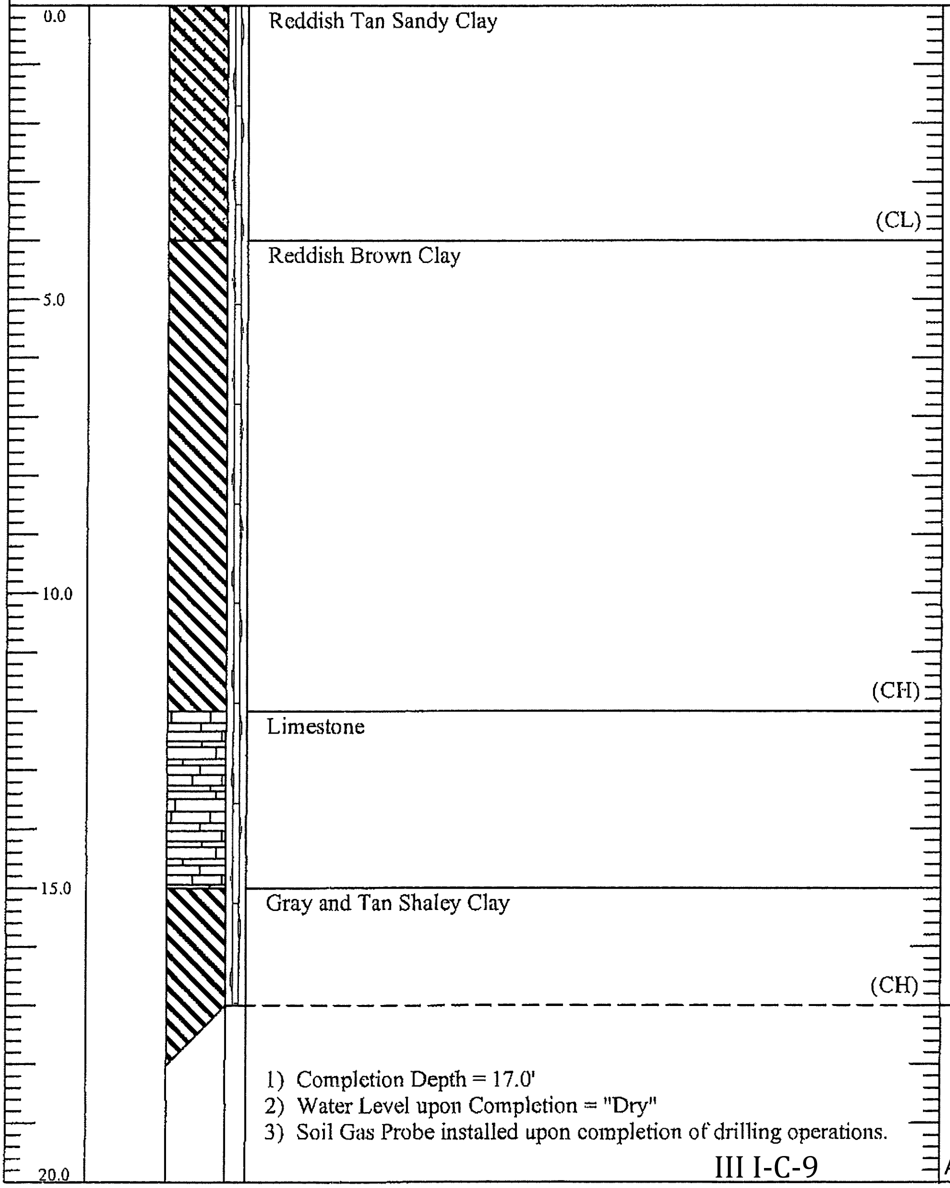
BORING NO. SGP-3C
SHEET 1 OF 1

WATER LEVEL	NA			
TIME	NA			
DATE	NA			
CAVED DEPTH	NA			

DRILLING	
START	FINISH
TIME	TIME
NA	NA
DATE	DATE
11/17/2006	11/17/2006

LOCATION SEE PLAN OF BORINGS
DRILL RIG Mobile CME-75
ANGLE Vertical BEARING ------

DRILLER S.C.
DRILLING CONTR Texplor of Dallas



DEPTH IN FEET	BLOWS/6 IN ON SAMPLER	SYMBOL	SAMPLE	DESCRIPTION OF MATERIALS	REC%/ RQD%	COMPRESSIVE STRENGTH (tsf)/ %STRAIN	% PASSING #200 SIEVE	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	UNIT DRY WEIGHT (pcf)	POCKET PENETROMETER
0.0				Reddish Tan Sandy Clay (CL)								
5.0				Reddish Brown Clay (CH)								
10.0												
				Limestone								
15.0				Gray and Tan Shaley Clay (CH)								
20.0												

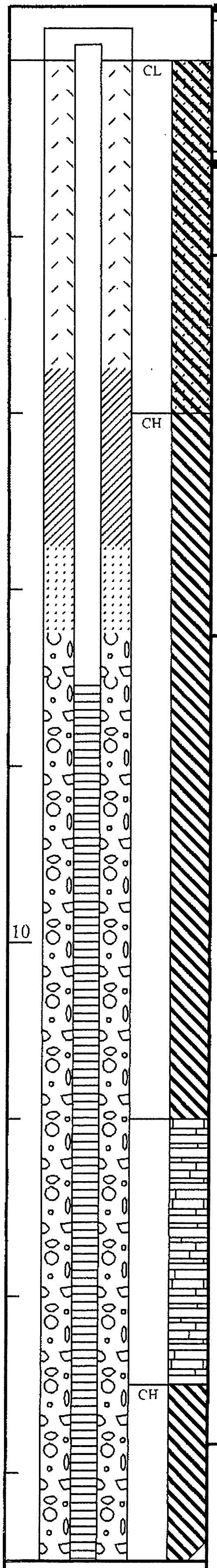
1) Completion Depth = 17.0'
2) Water Level upon Completion = "Dry"
3) Soil Gas Probe installed upon completion of drilling operations.

LOGGED BY A.G.
CHK'D BY J.H.

SOIL GAS PROBE NUMBER: SGP-3C

BORING NO. X-REF: SGP-3C

SOIL GAS PROBE CONSTRUCTION SUMMARY



T.D.= 17.0 FT.

SURVEY COORDS: N 6915858
(CASING) E 2357723

SURFACE ELEVATION: 633.34 MSL
TOP OF CASING ELEVATION: 636.28 MSL
TOP OF PAD: 633.29 MSL

DRILLING SUMMARY:

TOTAL DEPTH: 17.0'
BOREHOLE DIAMETER: 6.0"
CASING STICK-UP: 3.0'
DRILLER: S.C./Texplor
RIG: Mobile CME-75
BIT(S): 6" Flight Augers
DRILLING FLUID: NA
PROTECTIVE CASING: 4.0" Dia. Steel Protective Cover

CONSTRUCTION TIME LOG:

	START		FINISH	
TASK:	DATE	TIME	DATE	TIME
DRILLING:	11/17/2006	NA	11/17/2006	NA
GEOPHYS.LOGGING:	NA	NA	NA	NA
CASING:	12/12/2006	NA	12/12/2006	NA
FILTER PLACEMENT:	11/17/2006	NA	11/17/2006	NA
CONCRETE PAD:	12/12/2006	NA	12/12/2006	NA
DEVELOPMENT:	NA	NA	NA	NA

PROBE DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☐ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft)
-3.0 / 7.0	C1	/
7.0 / 17.0	S1	/
17.0 / 17.0	C2	/
/		/
/		/

C1: 1.0 " I.D. Schedule 40 PVC Threaded Flush Joint
S1: 1.0" I.D. Schedule 40 PVC Machine Slotted (0.010")
C2: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Bottom Cap

FILTER PACK: (6.5'-17.0') Pea Gravel
FINE SAND: (5.5'-6.5') #10-20 Sand
SEAL: (3.5'-5.5') Bentonite Slurry Seal
CEMENT SEAL: (0.0'-3.5') Concrete Seal

DEVELOPMENT:

NA

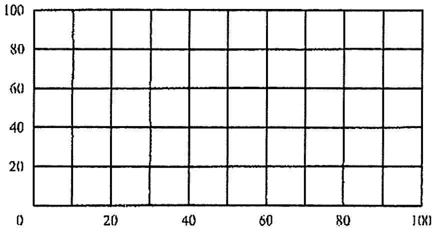
STABILIZATION TEST DATA:

NA

TIME	pH	SPEC. COND.	TEMP. (C)

RECOVERY DATA:

Q= GAL. So=



NA

SITE NAME: FORT WORTH C & D SLF
LOCATION: TARRANT COUNTY, TEXAS

COMMENTS: 1) All depths referenced to ground level.
2) Elevations referenced to mean sea level (MSL).

SUPERVISED BY: A.G.
CHK'D BY: J.H.

Tracking Codes: FORTWORTH C&D.GPJ, TEAM-MONITOR WELL CONSTRUCTION LOG, 11/2/06

SCS ENGINEERS

SCS Engineers
3900 Kilroy Airport Way
Long Beach, CA 90806
Telephone: 562-426-9544

WELL NUMBER GMP-3D

PAGE 1 OF 2

CLIENT Waste Connections

PROJECT NAME Fort Worth C&D Landfill

PROJECT NUMBER

PROJECT LOCATION

DATE STARTED 12/13/21 **COMPLETED** 12/15/21

GROUND ELEVATION 650.1 ft **HOLE SIZE** 7.25 inches

DRILLING CONTRACTOR WEST Drilling

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem

∇ **AT TIME OF DRILLING** 18.00 ft / Elev 632.10 ft

LOGGED BY TM **CHECKED BY** GC

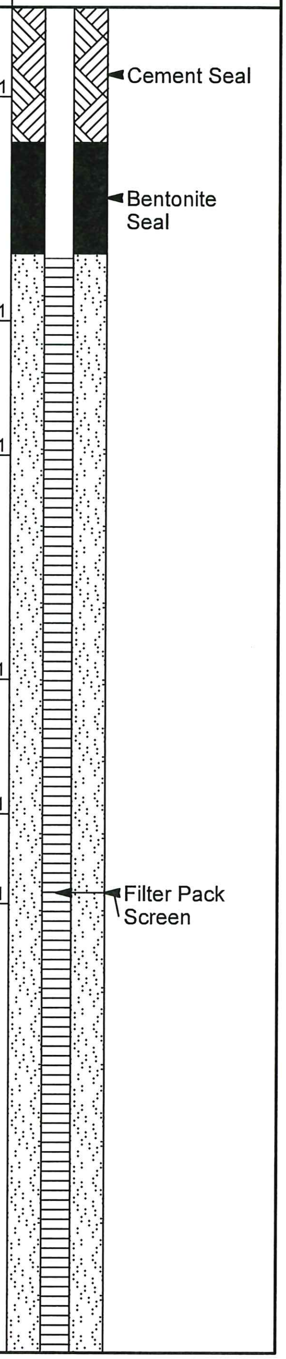
AT END OF DRILLING ---

NOTES N32.634350, W97.234341

AFTER DRILLING ---

DEPTH (ft)	NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			Topsoil with some pebbles	
2.0			Clayey Silt, Brown/Red, soft, dry	648.1
7.0			Clay, brown, soft dry	643.1
10.0			Clayey silt, brown/red, soft, slightly moist	640.1
15.0			Silt, grey, soft, slightly moist, changes to brown/red at 16'	635.1
18.0 ∇			Silt, brown/red, saturated	632.1
20.0			Clay, brown with mottling, hard, moist, with some silt	630.1

WELL DIAGRAM



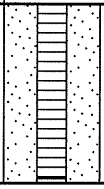
GILBERT GABALDON
GEOLOGY
#4419
1/19/22

(Continued Next Page)

SCS ENGINEERS
SCS Engineers
3900 Kilroy Airport Way
Long Beach, CA 90806
Telephone: 562-426-9544

WELL NUMBER GMP-3D

CLIENT Waste Connections
PROJECT NAME Fort Worth C&D Landfill
PROJECT NUMBER
PROJECT LOCATION

DEPTH (ft)	NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
30		▨	Clay, brown with mottling, hard, moist, with some silt *(continued)*	
		34.0	616.1	

Bottom of borehole at 34.0 feet.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION
SOIL GAS PROBE INSTALLATION
FORT WORTH C & D SLF
IESI
TARRANT COUNTY, TEXAS

TEAM PROJECT NO. 062080E

ELEVATION (MSL-FT)

DRILLING METHOD: 6" Flight Augers

SAMPLING METHOD: Disturbed

BORING NO. SGP-4A

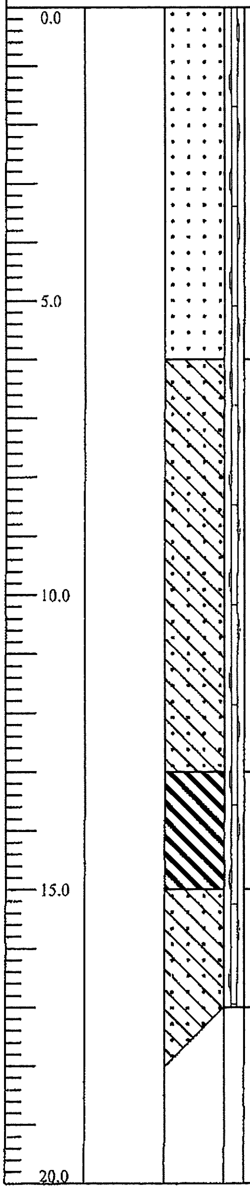
SHEET 1 OF 1

WATER LEVEL	NA			
TIME	NA			
DATE	NA			
CAVED DEPTH	NA			

DRILLING	
START	FINISH
TIME	TIME
NA	NA
DATE	DATE
11/17/2006	11/17/2206

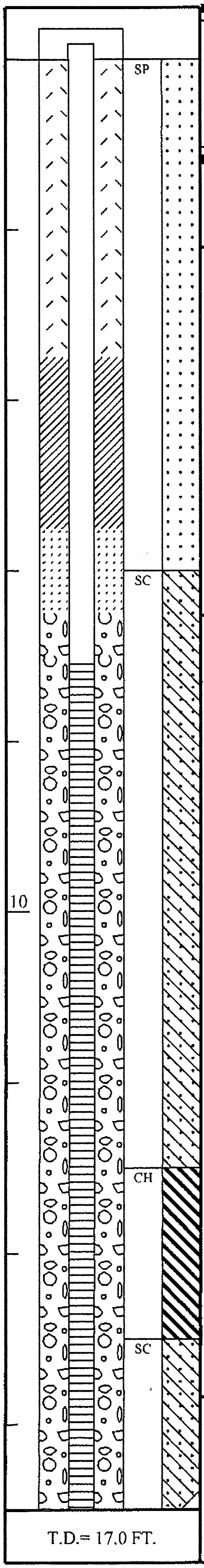
LOCATION SEE PLAN OF BORINGS
DRILL RIG Mobile CME-75
ANGLE Vertical BEARING ------

DRILLER S.C.
DRILLING CONTR Texplor of Dallas
LOGGED BY A.G.
CHK'D BY J.H.



DEPTH IN FEET	BLOWS/6 IN ON SAMPLER	SYMBOL	SAMPLE	DESCRIPTION OF MATERIALS	REC%/ RQD%	COMPRESSIVE STRENGTH (tsf)/ %STRAIN	% PASSING #200 SIEVE	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	UNIT DRY WEIGHT (pcf)	POCKET PENETROMETER
0.0				Reddish Brown Sand (SP)								
				Tan and Reddish Brown Clayey Sand - reddish brown (SC)								
				Gray and Tan Shaley Clay (CH)								
15.0				Dark Brown Clayey Sand (SC)								

1) Completion Depth = 17.0'
2) Water Level upon Completion = "Dry"
3) Soil Gas Probe installed upon complction of drilling operations.



SOIL GAS PROBE NUMBER: SGP-4A
BORING NO. X-REF: SGP-4A

SOIL GAS PROBE CONSTRUCTION SUMMARY

SURVEY COORDS: N 6915713
(CASING) E 2357937

SURFACE ELEVATION: 649.80 MSL
TOP OF CASING ELEVATION: 653.10 MSL
TOP OF PAD: 649.95 MSL

DRILLING SUMMARY:

TOTAL DEPTH: 17.0'
BOREHOLE DIAMETER: 6.0"
CASING STICK-UP: -0.50'
DRILLER: S.C./Texplor

RIG: Mobile CME-75
BIT(S): 6" Flight Augers

DRILLING FLUID: NA

PROTECTIVE CASING: 4.0" Dia. Steel Protective Cover

CONSTRUCTION TIME LOG:

	START		FINISH	
TASK:	DATE	TIME	DATE	TIME
DRILLING:	11/17/2006	NA	11/17/2006	NA
GEOPHYS.LOGGING:	NA	NA	NA	NA
CASING:	12/12/2006	NA	12/12/2006	NA
FILTER PLACEMENT:	11/17/2006	NA	11/17/2006	NA
CONCRETE PAD:	12/12/2006	NA	12/12/2006	NA
DEVELOPMENT:	NA	NA	NA	NA

PROBE DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☐ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft)
-3.0 / 7.0	C1	/
7.0 / 17.0	S1	/
17.0 / 17.0	C2	/
/		/
/		/

C1: 1.0 " I.D. Schedule 40 PVC Threaded Flush Joint
S1: 1.0" I.D. Schedule 40 PVC Machine Slotted (0.010")
C2: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Bottom Cap

FILTER PACK: (6.5'-17.0') Pea Gravel

FINE SAND: (5.5'-6.5') #10-20 Sand

SEAL: (3.5'-5.5') Bentonite Slurry Seal

CEMENT SEAL: (0.0'-3.5') Concrete Seal

DEVELOPMENT:

NA

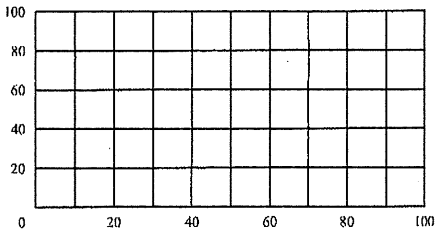
STABILIZATION TEST DATA:

NA

TIME	pH	SPEC. COND.	TEMP. (C)

RECOVERY DATA:

Q= GAL. So=



NA

COMMENTS: 1) All depths referenced to ground level.
2) Elevations referenced to mean sea level (MSL).

SITE NAME: FORT WORTH C & D SLF
LOCATION: TARRANT COUNTY, TEXAS

SUPERVISED BY: A.G.
CHK'D BY: J.H.

Tracking Codes: FORTWORTH C&D.GPJ, TEAM-MONITOR WELL CONSTRUCTION LOG, 11/2/06

SCS ENGINEERS
SCS Engineers
3900 Kilroy Airport Way
Long Beach, CA 90806
Telephone: 562-426-9544

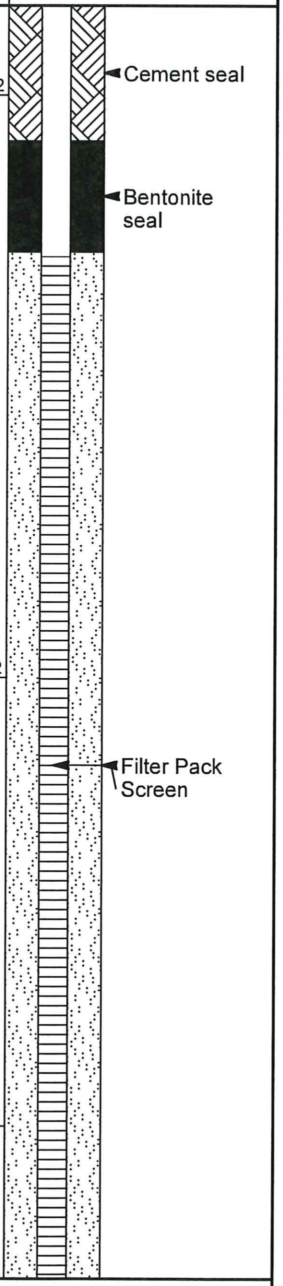
WELL NUMBER GMP-4B

PAGE 1 OF 1

CLIENT Waste Connections
PROJECT NAME Fort Worth C&D Landfill
PROJECT NUMBER
PROJECT LOCATION
DATE STARTED 12/13/21 **COMPLETED** 12/15/21
GROUND ELEVATION 661.2 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem
AT TIME OF DRILLING ---
LOGGED BY TM **CHECKED BY** GC
AT END OF DRILLING ---
NOTES N32.633380, W97.234324
▽ **AFTER DRILLING** 26.45 ft / Elev 634.75 ft

DEPTH (ft)	NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			Topsoil	
		2.0		659.2
			Clayey silt, brown/red, dry, soft, with some pebbles 1/8" to 1/4"	
5				
10				
15		15.0		646.2
			Silty sand, brown, soft, very fine grained, slighty moist	
20				
25		25.0		636.2
			Clay, dark brown, moderatley soft, dry, with some silt	
			▽	
		28.4		632.8

WELL DIAGRAM



GILBERT GABALDÓN
#4419

Bottom of borehole at 28.4 feet.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

SOIL GAS MONITORING PROBE
INSTALLATIONS
FT. WORTH C & D SLF
IESI

TARRANT COUNTY, TEXAS

ELEVATION (MSL-FT) 657.02

DRILLING METHOD: 8" Hollow-Stem Auger

SAMPLING METHOD: Disturbed

BORING NO. SGMP-5

SHEET 1 OF 1

WATER LEVEL	32.0'				
TIME	NA				
DATE	3/10/03				
CAVED DEPTH	NA				

DRILLING	
START	FINISH
TIME	TIME
NA	NA
DATE	DATE
3-10-03	3-10-03

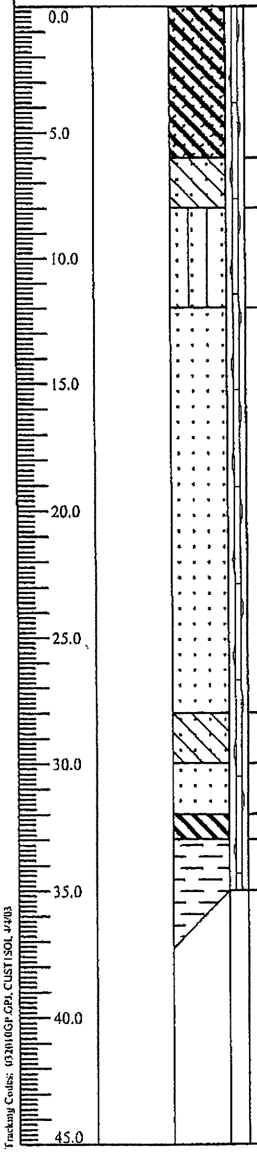
COORDINATES N6914725.46, E2358115.71

DRILL RIG Mobile B-59

ANGLE Vertical BEARING ------

DRILLER Brian Kern, License No. TX 54611M

DRILLING CONTR TEAM Consultants, Inc.



DESCRIPTION OF MATERIALS	%REC/ %RXD	COMPRESSIVE STRENGTH (tsf)/ %STRAIN	% PASSING #200 SIEVE	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	UNIT DRY WEIGHT (pcf)	POCKET PENETROMETER
Stiff brown sandy clay, moist (CL)								
Compact tan clayey sand, moist (SC)								
Slightly compact light tan silty sand, dry (SM)								
Slightly compact tan sand, dry (SP)								
Slightly compact tan to reddish-brown clayey sand, moist (SC)								
Compact reddish-brown gravelly sand, wet to water-bearing (SP)								
Very stiff brown shaley clay, wet (CH)								
Gray shale								

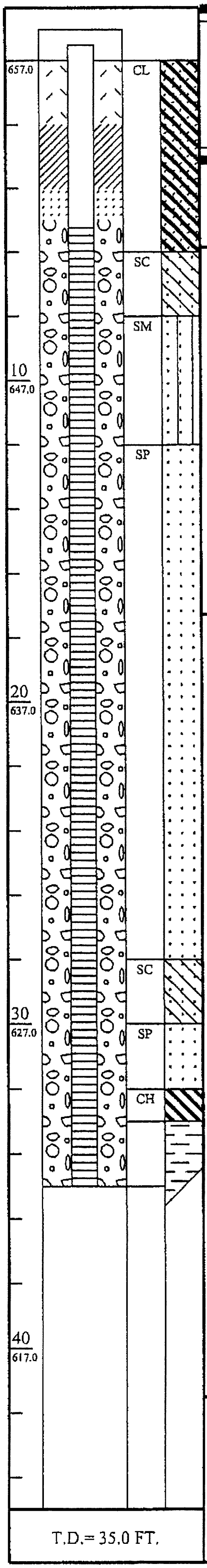
1) Completion Depth = 35.0'
2) Water Level upon Completion = 32.0'
3) Soil Gas Probe installed upon completion of drilling operations.

LOGGED BY B.W.

CHK'D BY J.H.

Tracking Codes: 032010GP.GPJ, CUST1SOL 4/4/03

TEAM Consultants, Inc.



T.D.= 35.0 FT.

SOIL GAS PROBE NUMBER: SGMP-5
BORING NO. X-REF: SGMP-5

SOIL GAS PROBE CONSTRUCTION SUMMARY

SURVEY COORDS: N 6914725.46
(CASING) E 2358115.71

SURFACE ELEVATION: 657.0 MSL
TOP OF CASING ELEVATION: 660.6 MSL
TOP OF PAD: 657.2 MSL

DRILLING SUMMARY:

TOTAL DEPTH: 35.0'
BOREHOLE DIAMETER: 8.0"
CASING STICK-UP: 3.57'
DRILLER: Brian Kern, License No. TX 54611M

RIG: Mobile B-59
BIT(S): 8" Hollow-Stem Auger

DRILLING FLUID: NA

PROTECTIVE CASING: 4" Square Steel Cover

PROBE DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☐ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft)
-3.6 / 5.0	C1	660.6 / 652.0
5.0 / 35.0	S1	652.0 / 622.0
35.0 / 35.0	C2	622.0 / 622.0
/		/
/		/

C1: 1.0 " I.D. Schedule 40 PVC Threaded Flush Joint
S1: 1.0" I.D. Schedule 40 PVC Machine Slotted (0.010")
C2: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Bottom Cap

FILTER PACK: (5.0'-35.0') Pea Gravel

FINE SAND: (4.0'-5.0') #10-20 Sand

SEAL: (2.0'-4.0') Bentonite Chip Seal

CEMENT SEAL: (0.0'-2.0') Concrete

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	3/10/2003	NA	3/10/2003	NA
GEOPHYS.LOGGING:	NA	NA	NA	NA
CASING:	3/10/03	NA	3/10/03	NA
FILTER PLACEMENT:	3/10/03	NA	3/10/03	NA
CONCRETE PAD:	3/10/03	NA	3/10/03	NA
DEVELOPMENT:	NA	NA	NA	NA

DEVELOPMENT:

NA

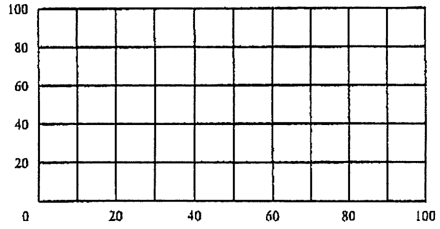
STABILIZATION TEST DATA:

NA

TIME	pH	SPEC. COND.	TEMP. (C)

RECOVERY DATA:

Q= GAL. So=



NA

COMMENTS: 1) All depths referenced to ground level.
2) Elevations referenced to mean sea level (MSL).

SITE NAME: FORTH WORTH C & D LANDFILL
LOCATION: TARRANT COUNTY, TEXAS

SUPERVISED BY: B.W.
CHK'D BY: J.H.

Tracking Codes: 032010GP.GPJ, TEAM- MONITOR WELL CONSTRUCTION LOG, 4/4/03

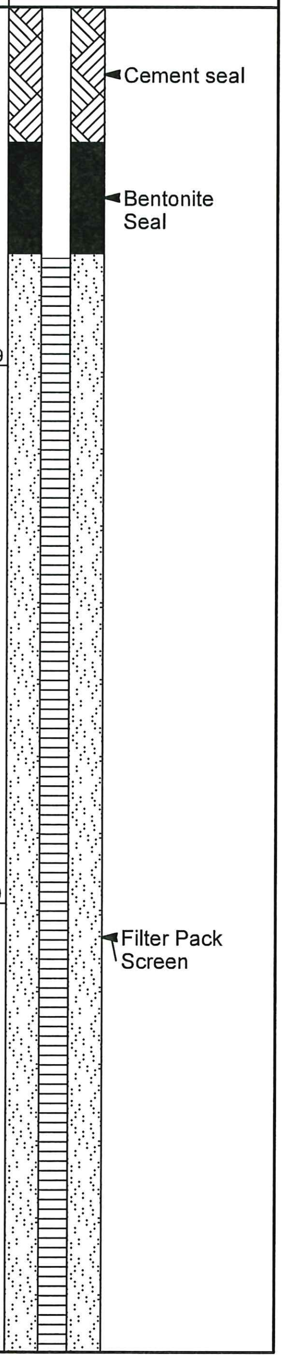
SCS ENGINEERS
SCS Engineers
3900 Kilroy Airport Way
Long Beach, CA 90806
Telephone: 562-426-9544

WELL NUMBER GMP-5A

PAGE 1 OF 2

CLIENT Waste Connections
PROJECT NAME Fort Worth C&D Landfill
PROJECT NUMBER
PROJECT LOCATION
DATE STARTED 12/15/21 **COMPLETED** 12/15/21
GROUND ELEVATION 659.9 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem
∇ **AT TIME OF DRILLING** 33.00 ft / Elev 626.90 ft
LOGGED BY TM **CHECKED BY** GC
AT END OF DRILLING ---
NOTES N32.630752, W97.234300
AFTER DRILLING ---

DEPTH (ft)	NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0			Silt, light brown/tan, loose, dry, with some pebbles 1/8" to 1/4"	
8.0			651.9 Clayey silt, dark brown, soft, dry, with some pebbles 1/8" to 1/4", color change to grey/brown at 15'	
20.0			639.9 Silty clay, brown with mottling, soft, dry, slightly wet at 25'	
30.0			629.9	



STATE OF TEXAS
GILBERT GABALDÓN
GEOLOGY
#4419
LICENSED PROFESSIONAL GEOSCIENTIST

(Continued Next Page)

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SCS Engineers
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Telephone: 562-426-9544

WELL NUMBER GMP-5A

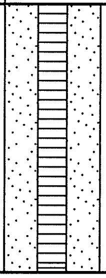
PAGE 2 OF 2

CLIENT Waste Connections

PROJECT NAME Fort Worth C&D Landfill

PROJECT NUMBER

PROJECT LOCATION

DEPTH (ft)	NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
30			Clayey silt, red/brown, soft, saturated ∇		
35			36.0	623.9	

Bottom of borehole at 36.0 feet.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION SOIL GAS MONITORING PROBE INSTALLATIONS FT. WORTH C & D SLF IESI TARRANT COUNTY, TEXAS	DRILLING METHOD: 8" Hollow-Stem Auger	BORING NO. SGMP-6	
	SAMPLING METHOD: Disturbed	SHEET 1 OF 1	
		DRILLING	
		START	FINISH
	WATER LEVEL 35.0'	TIME	TIME
	TIME NA	NA	NA
	DATE 3/10/03	DATE	DATE
ELEVATION (MSL-FT) 657.21	CAVED DEPTH NA	3-10-03	3-10-03

COORDINATES N6914059.60, E2357780.20

DRILL RIG Mobile B-59

ANGLE Vertical BEARING ------

DRILLER Brian Kern, License No. TX 54611M

DRILLING CONTR TEAM Consultants, Inc.

DEPTH IN FEET	BLOWS/6 IN ON SAMPLER	SYMBOL	SAMPLE	DESCRIPTION OF MATERIALS	%REC/ %RXD	COMPRESSIVE STRENGTH (tsf)/ %STRAIN	% PASSING #200 SIEVE	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	UNIT DRY WEIGHT (pcf)	POCKET PENETROMETER
0.0				Slightly compact tan clayey sand, dry (SC)								
				Stiff to very stiff brown to gray sandy clay, moist								
5.0												
				- gray to brown								
10.0												
15.0												
20.0												
25.0												
				- brown								
30.0												
35.0				- w/occasional gravel, wet								
				(CL)								
				Gray shale w/limestone seams								
40.0												
				1) Completion Depth = 42.0' 2) Water Level upon Completion = 35.0' 3) Soil Gas Probe installed upon completion of drilling operations.								
45.0												

LOGGED BY B.W.

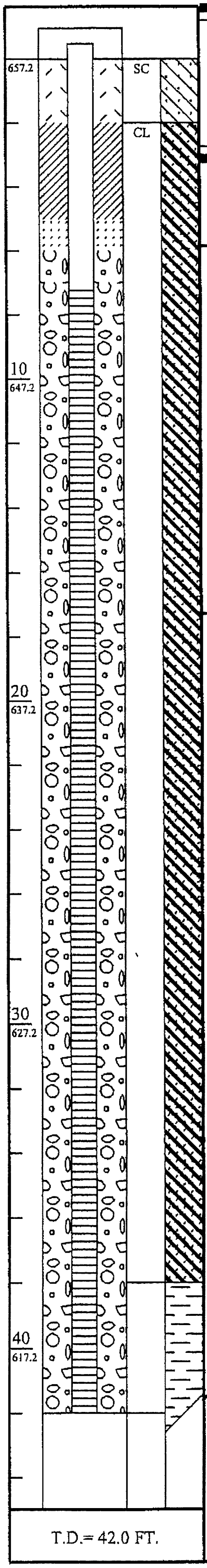
CHK'D BY J.H.

Tracking Codes: 0320HGP.GPJ, CUSTSOL 4/4/03

SOIL GAS PROBE NUMBER: SGMP-6

BORING NO. X-REF: SGMP-6

SOIL GAS PROBE CONSTRUCTION SUMMARY



SURVEY COORDS: N	6914059.60	SURFACE ELEVATION:	657.2 MSL
(CASING) E	2357780.20	TOP OF CASING ELEVATION:	659.9 MSL
		TOP OF PAD:	656.9 MSL

DRILLING SUMMARY:

TOTAL DEPTH: 42.0'

BOREHOLE DIAMETER: 8.0"

CASING STICK-UP: 2.64'

DRILLER: Brian Kern, License No. TX 54611M

RIG: Mobile B-59

BIT(S): 8" Hollow-Stem Auger

DRILLING FLUID: NA

PROTECTIVE CASING: 4" Square Steel Cover

CONSTRUCTION TIME LOG:

	START		FINISH	
TASK:	DATE	TIME	DATE	TIME
DRILLING:	3/10/2003	NA	3/10/2003	NA
GEOPHYS.LOGGING:	NA	NA	NA	NA
CASING:	3/10/03	NA	3/10/03	NA
FILTER PLACEMENT:	3/10/03	NA	3/10/03	NA
CONCRETE PAD:	3/10/03	NA	3/10/03	NA
DEVELOPMENT:	NA	NA	NA	NA

PROBE DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☐ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft)
-2.6 / 7.0	C1	659.9 / 650.2
7.0 / 42.0	S1	650.2 / 615.2
42.0 / 42.0	C2	615.2 / 615.2

C1: 1.0 " I.D. Schedule 40 PVC Threaded Flush Joint

S1: 1.0" I.D. Schedule 40 PVC Machine Slotted (0.010")

C2: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Bottom Cap

FILTER PACK: (6.0'-42.0') Pea Gravel

FINE SAND: (5.0'-6.0') #10-20 Sand

SEAL: (2.0'-5.0') Bentonite Chip Seal

CEMENT SEAL: (0.0'-2.0') Concrete

DEVELOPMENT:

NA

STABILIZATION TEST DATA:

NA

TIME	pH	SPEC. COND.	TEMP. (C)

RECOVERY DATA:

Q= GAL. So=

NA

COMMENTS: 1) All depths referenced to ground level.

2) Elevations referenced to mean sea level (MSL).

SITE NAME: FORTH WORTH C & D LANDFILL

LOCATION: TARRANT COUNTY, TEXAS

SUPERVISED BY: B.W.

CHK'D BY: J.H.

Tracking Codes: 032010GP.GPJ, TEAM- MONITOR WELL CONSTRUCTION LOG, 4/4/03

TEAM Consultants, Inc.

III I-C-21

PLATE B-2

SCS ENGINEERS
SCS Engineers
3900 Kilroy Airport Way
Long Beach, CA 90806
Telephone: 562-426-9544

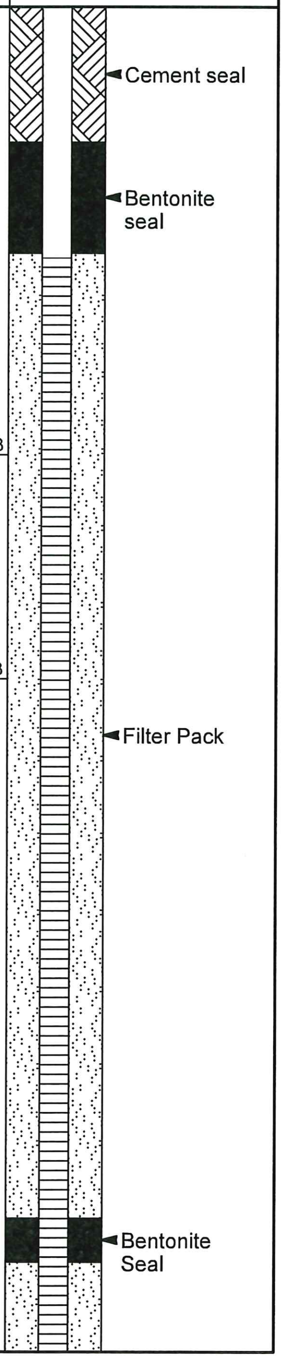
WELL NUMBER GMP-6B

PAGE 1 OF 2

CLIENT Waste Connections
PROJECT NAME Fort Worth C&D Landfill
PROJECT NUMBER
PROJECT LOCATION
DATE STARTED 12/16/21 **COMPLETED** 12/17/21
GROUND ELEVATION 675.3 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem
∇ **AT TIME OF DRILLING** 33.50 ft / Elev 641.80 ft
LOGGED BY TM **CHECKED BY** GC
AT END OF DRILLING ---
NOTES N32.628146, W97.234331
AFTER DRILLING ---

DEPTH (ft)	NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	
0				Topsoil, clay, brown, soft with some pebbles 1/8" to 1/4", Fill material (concrete debris)	
10			10.0	Clayey silt, light brown/tan, loose, dry, with pebbles 1/8" to 1/4"	665.3
15			15.0	Clay, dark brown, soft, dry, with pebbles 1/8" to 1/4", color change to black at 25', water encountered at 33.5'	660.3
25		Hole collapsed at 25' getting pipe out of hole on 12/16/2021, added bentonite seal at 27'-28' due to void space			
30		Rebar at 30',			

WELL DIAGRAM



STATE OF TEXAS
GILBERT GABALDON
GEOLOGY
#4419
LICENSED PROFESSIONAL GEOSCIENTIST

(Continued Next Page)

SCS ENGINEERS
SCS Engineers
3900 Kilroy Airport Way
Long Beach, CA 90806
Telephone: 562-426-9544

WELL NUMBER GMP-6B

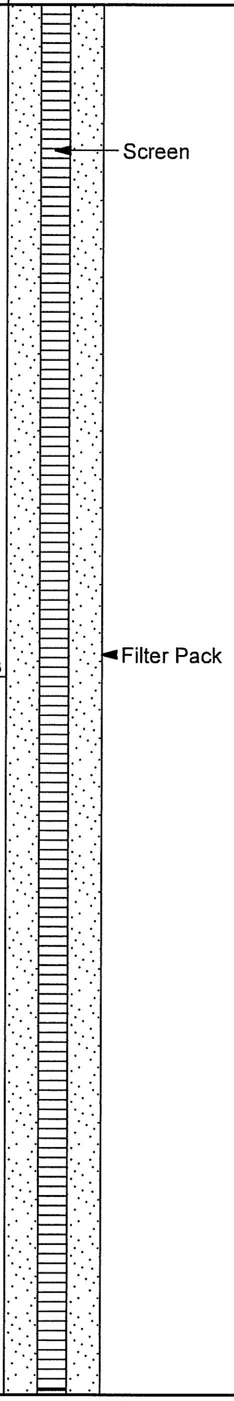
CLIENT Waste Connections

PROJECT NAME Fort Worth C&D Landfill

PROJECT NUMBER

PROJECT LOCATION

DEPTH (ft)	NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
30		indicates fill material very few cuttings coming up Drilled to 61', rods seized in hole and lost 40' of auger, redrilled to 61', no cuttings from 45'-61', noticed some wet grey silt on bit and auger	▨	Clay, dark brown, soft, dry, with pebbles 1/8" to 1/4", color change to black at 25', water encountered at 33.5' *(continued)* ∇	
45.0				Silt, grey, soft, wet	630.3
61.0					614.3



Bottom of borehole at 61.0 feet.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

SOIL GAS MONITORING PROBE
INSTALLATIONS
FT. WORTH C & D SLF
IESI

TARRANT COUNTY, TEXAS

ELEVATION (MSL-FT) 605.53

DRILLING METHOD: 8" Hollow-Stem Auger

SAMPLING METHOD: Disturbed

BORING NO. SGMP-7

SHEET 1 OF 1

WATER LEVEL	NA			
TIME	NA			
DATE	3/10/03			
CAVED DEPTH	NA			

DRILLING	
START	FINISH
TIME	TIME
NA	NA
DATE	DATE
3-10-03	3-10-03

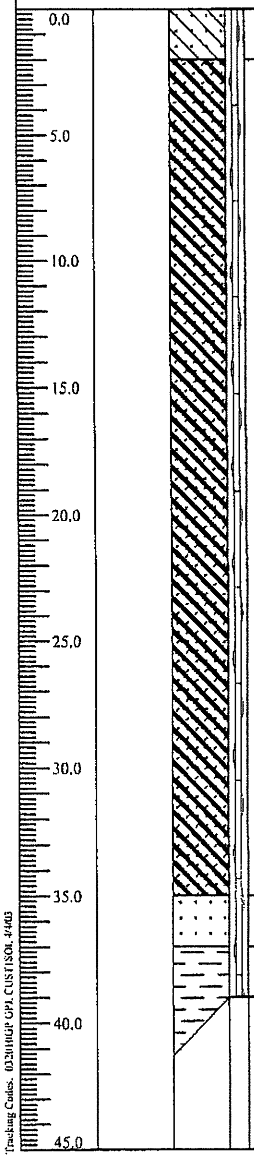
COORDINATES N6914059.30, E2356783.38

DRILL RIG Mobile B-59

ANGLE Vertical BEARING ------

DRILLER Brian Kern, License No. TX 54611M

DRILLING CONTR TEAM Consultants, Inc.



DEPTH IN FEET	BLOWS/6 IN ON SAMPLER	SYMBOL	SAMPLE	DESCRIPTION OF MATERIALS	%REC/ %RXD	COMPRESSIVE STRENGTH (tsf)/ %STRAIN	% PASSING #200 SIEVE	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	UNIT DRY WEIGHT (pcf)	POCKET PENETROMETER
				Slightly compact reddish-brown and tan clayey sand, dry to moist (SC)								
				Soft to stiff reddish-brown sandy clay, moist - brown and gray - soft brown w/gravel, moist to wet (CL)								
				Slightly compact brown gravelly sand, water-bearing (SP)								
				Gray shale								

1) Completion Depth = 39.0'
2) Water Level upon Completion = NA
3) Soil Gas Probe installed upon completion of drilling operations.

LOGGED BY B.W.

CHK'D BY J.H.

Tracking Codes: 0330HGP.GPJ CUSTISOL 4/4/03

SCS ENGINEERS

SCS Engineers
3900 Kilroy Airport Way
Long Beach, CA 90806
Telephone: 562-426-9544

WELL NUMBER GMP-7A

PAGE 1 OF 2

CLIENT Waste Connections

PROJECT NAME Fort Worth C&D Landfill

PROJECT NUMBER

PROJECT LOCATION

DATE STARTED 12/13/21 **COMPLETED** 12/14/21

GROUND ELEVATION 595.8 ft **HOLE SIZE** 7.25 inches

DRILLING CONTRACTOR WEST Drilling

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem

▽ **AT TIME OF DRILLING** 30.00 ft / Elev 565.80 ft

LOGGED BY TM **CHECKED BY** GC

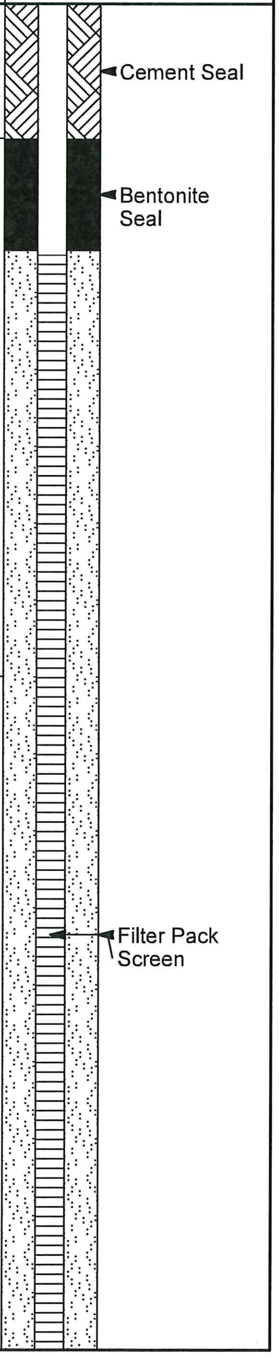
AT END OF DRILLING ---

NOTES N32.629015, W97.240023

AFTER DRILLING ---

DEPTH (ft)	NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			Topsoil, brown, soft, dry, with pebbles	
3.0			Clayey silt, dark brown, soft, dry, with pebbles 1/8" to 1/4"	592.8
15.0			Clay, dark brown, moderately soft, dry, with some pebbles 1/8" to 1/4"	580.8
30.0 ▽				565.8

WELL DIAGRAM



GILBERT GABALDÓN
GEOLOGY
#4419

(Continued Next Page)

SCS Engineers
3900 Kilroy Airport Way
Long Beach, CA 90806
Telephone: 562-426-9544

WELL NUMBER GMP-7A

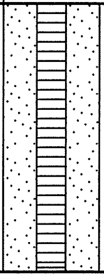
PAGE 2 OF 2

CLIENT Waste Connections

PROJECT NAME Fort Worth C&D Landfill

PROJECT NUMBER

PROJECT LOCATION

DEPTH (ft)	NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
30			Clayey silt, light brown, soft, saturated	
35			36.0	559.8

Bottom of borehole at 36.0 feet.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION SOIL GAS MONITORING PROBE INSTALLATIONS FT. WORTH C & D SLF IESI TARRANT COUNTY, TEXAS	DRILLING METHOD: 8" Hollow-Stem Auger		BORING NO. SGMP-8
	SAMPLING METHOD: Disturbed		SHEET 1 OF 1
ELEVATION (MSL-FT) 586.05			

						DRILLING START	DRILLING FINISH
WATER LEVEL	13.0'					TIME	TIME
TIME	NA					NA	NA
DATE	3/11/03					DATE	DATE
CAVED DEPTH	NA					3-11-03	3-11-03

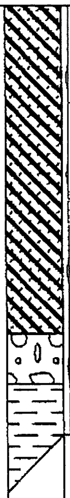
COORDINATES N6914543.22, E2355885.46

DRILL RIG Mobile B-59

ANGLE Vertical BEARING ------

DRILLER Brian Kern, License No. TX 54611M

DRILLING CONTR TEAM Consultants, Inc.



DEPTH IN FEET	BLOWS/6 IN ON SAMPLER	SYMBOL	SAMPLE	DESCRIPTION OF MATERIALS	%REC/ %RXD	COMPRESSIVE STRENGTH (tsf)/ %STRAIN	% PASSING #200 SIEVE	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	UNIT DRY WEIGHT (pcf)	POCKET PENETROMETER
0.0				Stiff dark brown to light brown sandy clay, moist								
5.0												
10.0				- soft light brown w/gravel, wet (CL)								
				Loose tan sandy gravel (GW)								
15.0				Gray shale								
20.0				1) Completion Depth = 17.0' 2) Water Level upon Completion = 13.0' 3) Soil Gas Probe installed upon completion of drilling operations.								
25.0												
30.0												
35.0												
40.0												
45.0												

LOGGED BY B.W.

CHK'D BY J.H.

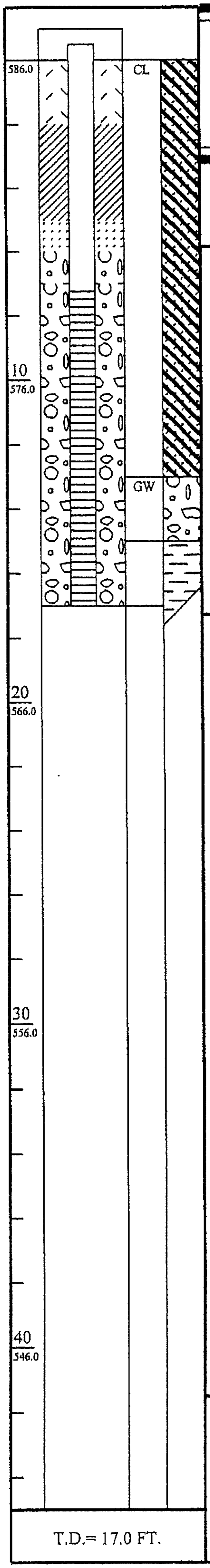
Tracking Code: 0320IGP.GPJ_CUST1SOL 4/4/03

III I-C-27

SOIL GAS PROBE NUMBER: SGMP-8

BORING NO. X-REF: SGMP-8

SOIL GAS PROBE CONSTRUCTION SUMMARY



SURVEY COORDS: (CASING)	N 6914543.22 E 2355885.46	SURFACE ELEVATION:	586.0 MSL
		TOP OF CASING ELEVATION:	589.0 MSL
		TOP OF PAD:	586.1 MSL

DRILLING SUMMARY:

TOTAL DEPTH: 17.0'

BOREHOLE DIAMETER: 8.0"

CASING STICK-UP: 2.94'

DRILLER: Brian Kern, License No. TX 54611M

RIG: Mobile B-59

BIT(S): 8" Hollow-Stem Auger

DRILLING FLUID: NA

PROTECTIVE CASING: 4" Square Steel Cover

CONSTRUCTION TIME LOG:

	START		FINISH	
TASK:	DATE	TIME	DATE	TIME
DRILLING:	3/11/2003	NA	3/11/2003	NA
GEOPHYS.LOGGING:	NA	NA	NA	NA
CASING:	3/11/03	NA	3/11/03	NA
FILTER PLACEMENT:	3/11/03	NA	3/11/03	NA
CONCRETE PAD:	3/11/03	NA	3/11/03	NA
DEVELOPMENT:	NA	NA	NA	NA

PROBE DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☐ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft)
-2.9 / 7.0	C1	589.0 / 579.0
7.0 / 17.0	S1	579.0 / 569.0
17.0 / 17.0	C2	569.0 / 569.0
/		/
/		/

C1: 1.0 " I.D. Schedule 40 PVC Threaded Flush Joint

S1: 1.0" I.D. Schedule 40 PVC Machine Slotted (0.010")

C2: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Bottom Cap

FILTER PACK: (6.0'-17.0') Pea Gravel

FINE SAND: (5.0'-6.0') #10-20 Sand

SEAL: (2.0'-5.0') Bentonite Chip Seal

CEMENT SEAL: (0.0'-2.0') Concrete

DEVELOPMENT:

NA

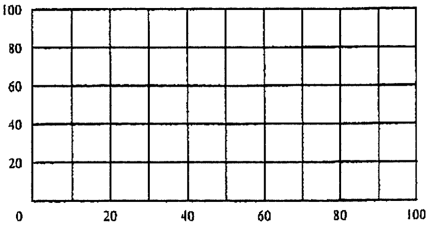
STABILIZATION TEST DATA:

NA

TIME	pH	SPEC. COND.	TEMP. (C)

RECOVERY DATA:

Q= GAL. So=



NA

COMMENTS: 1) All depths referenced to ground level.

2) Elevations referenced to mean sea level (MSL).

SITE NAME: FORTH WORTH C & D LANDFILL

LOCATION: TARRANT COUNTY, TEXAS

SUPERVISED BY: B.W.

CHK'D BY: J.H.

Tracking Codes: 032010GP.GPJ, TEAM- MONITOR WELL CONSTRUCTION LOG, 4/4/03

SOIL BOREHOLE LOG

SITE NAME AND LOCATION
SOIL GAS PROBE INSTALLATIONS
FORT WORTH C & D LANDFILL
TARRANT COUNTY, TEXAS
IESI

ELEVATION (MSL-FT) 582.55

DRILLING METHOD: Hollow Stem Auger

SAMPLING METHOD: Disturbed

BORING NO. SGMP- 9

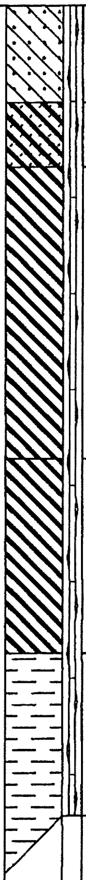
SHEET 1 OF 1

WATER LEVEL				
TIME	SEE NOTE NO. 2			
DATE	AT BOTTOM OF LOG			
CAVED DEPTH				

DRILLING	
START	FINISH
TIME	TIME
NA	NA
DATE	DATE
6-14-02	6-14-02

LOCATION SEE PLAN OF BORINGS
DRILL RIG CME-75
ANGLE Vertical BEARING ------

DRILLER S.C.
DRILLING CONTR TEXPLOR



DEPTH IN FEET	BLOWS/6 IN ON SAMPLER	SYMBOL	SAMPLE	DESCRIPTION OF MATERIALS	%REC/ %RQD	COMPRESSIVE STRENGTH (tsf)/ %STRAIN	% PASSING #200 SIEVE	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	UNIT DRY WEIGHT (pcf)	POCKET PENETROMETER
0.0				Reddish Brown Clayey Sand (SC)								
				Reddish Brown Sandy Clay (CL)								
5.0 10.0				Dark Gray Clay w/sand - brown - w/occasional gravel - tan (CH)								
15.0				Tan and Light Gray Shaley Clay (CH)								
20.0				Gray Shale								
25.0 30.0 35.0				Notes: (1) Completion Depth = 25.0 Feet (2) No Groundwater Observed During Drilling (3) Soil Gas Monitoring Probe installed upon Completion of Drilling.								

LOGGED BY B.W.
CHK'D BY J.H.

Tracking Codes: 052021.GPJ, CUSTISOL 6/27/05

III I-C-29

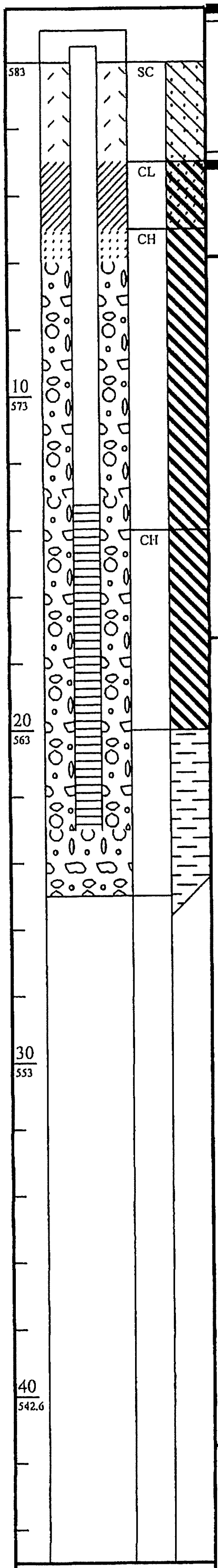
TEAM Consultants. Inc.

PLATE

SOIL GAS PROBE NUMBER: SGMP- 9

BORING NO. X-REF: SGMP- 9

SOIL GAS PROBE CONSTRUCTION SUMMARY



T.D.= 25.0 FT.

SURVEY COORDS: N 6915469
(CASING) E 2356196

SURFACE ELEVATION: 583 MSL
TOP OF PVC CASING ELEVATION: 586.18 MSL
TOP OF PAD: 583.69 MSL

DRILLING SUMMARY:

TOTAL DEPTH: 25.0'
BOREHOLE DIAMETER: 7.25"
CASING STICK-UP: 3.2'
DRILLER: S.C.

RIG: CME-75
BIT(S): Hollow Stem Auger

DRILLING FLUID: NA

PROTECTIVE CASING: 4.0" Dia. Steel Protective Casing

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	6/14/2002	NA	6/14/2002	NA
GEOPHYS,LOGGING:	NA	NA	NA	NA
CASING:	6/14/05	NA	6/14/05	NA
FILTER PLACEMENT:	6/14/05	NA	6/14/05	NA
CONCRETE PAD:	6/15/05	NA	6/15/05	NA
DEVELOPMENT:	NA	NA	NA	NA

PROBE DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☐ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft)
-3.2 / 13.0	C1	586.2 / 570.0
13.0 / 23.0	S1	570.0 / 560.0
23.0 / 23.0	C2	560.0 / 560.0
/		/
/		/

C1: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Riser

S1: 1.0" I.D. Schedule 40 PVC Machine Slotted Screen (0.010")

C2: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Bottom Cap

FILTER PACK: (6.0'-25.0') Pea Gravel

FINE SAND: (5.0'-6.0') #10/20 Filter Sand

SEAL: (3.0'-5.0') Bentonite Seal

CEMENT SEAL: (0.0'-3.0') Concrete Seal

DEVELOPMENT:

NA

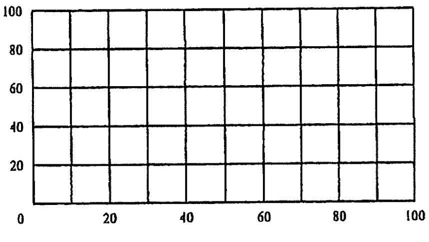
STABILIZATION TEST DATA:

NA

TIME	pH	SPEC. COND.	TEMP. (C)

RECOVERY DATA:

Q= GAL. So=



NA

COMMENTS: 1) All depths referenced to ground level.
2) Elevations referenced to mean sea level (MSL)

SITE NAME: FORT WORTH C & D LANDFILL
LOCATION: IESI

SUPERVISED BY: B.W.
CHK'D BY: J.H. / D.W.B.

Tracking Codes: 052021.GPJ, TEAM- MONITOR WELL CONSTRUCTION LOG, 6/27/05

SOIL BOREHOLE LOG

SITE NAME AND LOCATION
SOIL GAS PROBE INSTALLATIONS
FORT WORTH C & D LANDFILL
TARRANT COUNTY, TEXAS
IESI

ELEVATION (MSL-FT) 582.38

DRILLING METHOD: Hollow Stem Auger

SAMPLING METHOD: Disturbed

BORING NO. SGMP-10

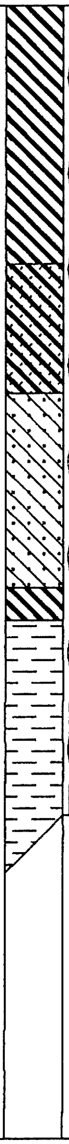
SHEET 1 OF 1

WATER LEVEL				
TIME	SEE NOTE NO. 2			
DATE	AT BOTTOM OF LOG			
CAVED DEPTH				

DRILLING	
START	FINISH
TIME	TIME
NA	NA
DATE	DATE
6-14-02	6-14-02

LOCATION SEE PLAN OF BORINGS
DRILL RIG CME-75
ANGLE Vertical BEARING ------

DRILLER S.C.
DRILLING CONTR TEXPLOR



DEPTH IN FEET	BLOWS/6 IN ON SAMPLER	SYMBOL	SAMPLE	DESCRIPTION OF MATERIALS	%REC/ %RQD	COMPRESSIVE STRENGTH (tsf)/ %STRAIN	% PASSING #200 SIEVE	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	UNIT DRY WEIGHT (pcf)	POCKET PENETROMETER
0.0				Dark Brown Clay								
				- brown								
5.0												
				(CH)								
				Brown Sandy Clay								
10.0												
				(CL)								
				Light Brown Clayey Sand								
15.0				- reddish brown w/occasional gravel								
				(SC)								
				Gray and Tan Shaley Clay (CH)								
20.0				Gray Shale								
25.0												
30.0												
35.0												

Notes: (1) Completion Depth = 25.0 Feet
(2) Groundwater Observed @ 18.0 Feet During Drilling
(3) Soil Gas Monitoring Probe Installed Upon Completion of Drilling.

LOGGED BY B.W.
CHK'D BY J.H.

Tracking Codes: 052021.GPJ CUSTISOL 6/27/05

III I-C-31

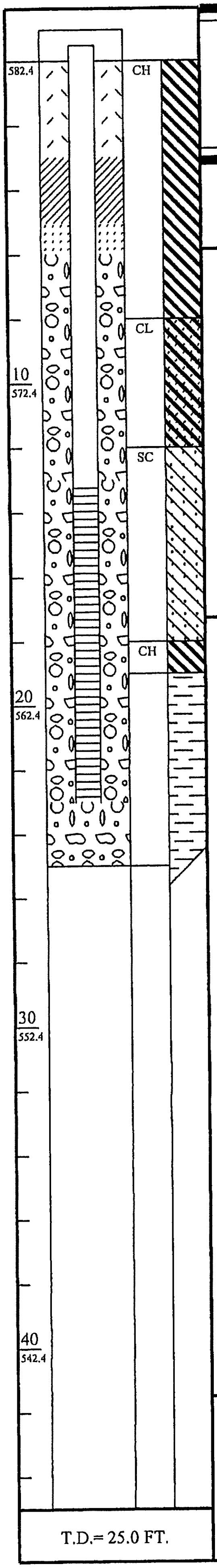
TEAM Consultants, Inc.

PLATE

SOIL GAS PROBE NUMBER: SGMP-10

BORING NO. X-REF: SGMP-10

SOIL GAS PROBE CONSTRUCTION SUMMARY



T.D.= 25.0 FT.

SURVEY COORDS: N 6916361
(CASING) E 2356401

SURFACE ELEVATION: 582.4 MSL
TOP OF PVC CASING ELEVATION: 585.48 MSL
TOP OF PAD: 583.07 MSL

DRILLING SUMMARY:

TOTAL DEPTH: 25.0'
BOREHOLE DIAMETER: 7.25"
CASING STICK-UP: 3.1'
DRILLER: S.C.

RIG: CME-75
BIT(S): Hollow Stem Auger

DRILLING FLUID: NA

PROTECTIVE CASING: 4.0" Dia. Steel Protective Casing

CONSTRUCTION TIME LOG:

	START		FINISH	
TASK:	DATE	TIME	DATE	TIME
DRILLING:	6/14/2002	NA	6/14/2002	NA
GEOPHYS,LOGGING:	NA	NA	NA	NA
CASING:	6/14/05	NA	6/14/05	NA
FILTER PLACEMENT:	6/14/05	NA	6/14/05	NA
CONCRETE PAD:	6/15/05	NA	6/15/05	NA
DEVELOPMENT:	NA	NA	NA	NA

PROBE DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☐ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft)
-3.1 / 13.0	C1	585.5 / 569.4
13.0 / 23.0	S1	569.4 / 559.4
23.0 / 23.0	C2	559.4 / 559.4
/		/
/		/

C1: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Riser
S1: 1.0" I.D. Schedule 40 PVC Machine Slotted Screen (0.010")
C2: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Bottom Cap

FILTER PACK: (6.0'-25.0') Pea Gravel

FINE SAND: (5.0'-6.0') #10/20 Filter Sand

SEAL: (3.0'-5.0') Bentonite Seal

CEMENT SEAL: (0.0'-3.0') Concrete Seal

DEVELOPMENT:

NA

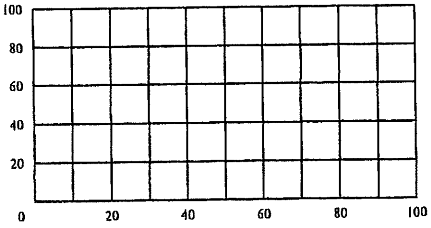
STABILIZATION TEST DATA:

NA

TIME	pH	SPEC. COND.	TEMP. (C)

RECOVERY DATA:

Q= GAL. So=



NA

SITE NAME: FORT WORTH C & D LANDFILL
LOCATION: IESI

COMMENTS: 1) All depths referenced to ground level.
2) Elevations referenced to mean sea level (MSL)

SUPERVISED BY: B.W.
CHK'D BY: J.H./D.B.

Tracking Codes: 052021.GPJ, TEAM- MONITOR WELL CONSTRUCTION LOG, 6/27/05

TEAM Consultants, Inc.

PLATE

SOIL BOREHOLE LOG

SITE NAME AND LOCATION
SOIL GAS PROBE INSTALLATIONS
FORT WORTH C & D LANDFILL
TARRANT COUNTY, TEXAS
IESI

ELEVATION (MSL-FT) 590.41

DRILLING METHOD: Hollow Stem Auger

SAMPLING METHOD: Disturbed

BORING NO. SGMP-11

SHEET 1 OF 1

WATER LEVEL				
TIME	SEE NOTE NO. 2			
DATE	AT BOTTOM OF LOG			
CAVED DEPTH				

DRILLING	
START	FINISH
TIME	TIME
NA	NA
DATE	DATE
6-14-02	6-14-02

LOCATION SEE PLAN OF BORINGS

DRILL RIG CME-75

ANGLE Vertical BEARING ------

DEPTH IN FEET	BLOWS/6 IN ON SAMPLER	SYMBOL	SAMPLE	DESCRIPTION OF MATERIALS	%REC/ %RQD	COMPRESSIVE STRENGTH (tsf)/ %STRAIN	% PASSING #200 SIEVE	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	UNIT DRY WEIGHT (pcf)	POCKET PENETROMETER
0.0				Reddish Brown Sandy Clay (CL)								
				Tan Clay (CH)								
				Tan Shaley Clay								
5.0												
10.0												
15.0												
20.0				- gray and tan								
				Gray Shale								
25.0												
30.0												
				Notes: (1) Completion Depth = 30.0 Feet (2) No Groundwater Observed During Drilling (3) Soil Gas Monitoring Probe installed upon Completion of Drilling.								
35.0												

III I-C-33

DRILLER S.C.

DRILLING CONTR TEXPLOR

LOGGED BY B.W.

CHK'D BY J.H.

Tracking Codes: 052021.GPJ, CUSTISOL 6/27/05

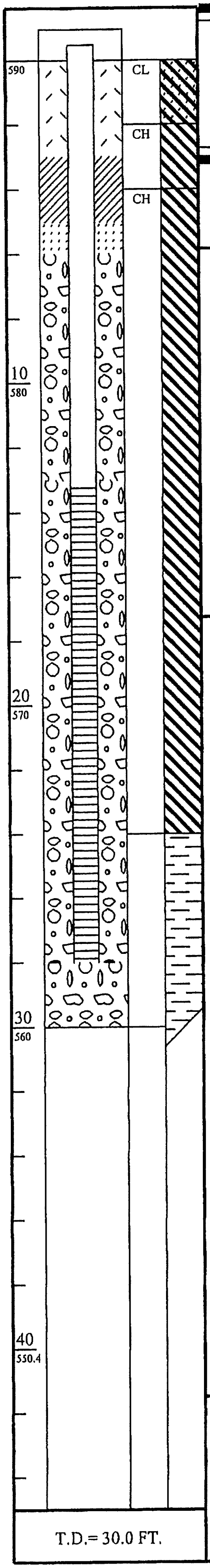
TEAM Consultants, Inc.

PLATE

SOIL GAS PROBE NUMBER: SGMP-11

BORING NO. X-REF: SGMP-11

SOIL GAS PROBE CONSTRUCTION SUMMARY



SURVEY COORDS: N 6916820
(CASING) E 2356488

SURFACE ELEVATION: 590 MSL
TOP OF PVC CASING ELEVATION: 592.29 MSL
TOP OF PAD: 589.93 MSL

DRILLING SUMMARY:

TOTAL DEPTH: 30.0'
BOREHOLE DIAMETER: 7.25"
CASING STICK-UP: 2.4'
DRILLER: S.C.

RIG: CME-75
BIT(S): Hollow Stem Auger

DRILLING FLUID: NA

PROTECTIVE CASING: 4.0" Dia. Steel Protective Casing

CONSTRUCTION TIME LOG:

	START		FINISH	
TASK:	DATE	TIME	DATE	TIME
DRILLING:	6/14/2002	NA	6/14/2002	NA
GEOPHYS,LOGGING:	NA	NA	NA	NA
CASING:	6/14/05	NA	6/14/05	NA
FILTER PLACEMENT:	6/14/05	NA	6/14/05	NA
CONCRETE PAD:	6/15/05	NA	6/15/05	NA
DEVELOPMENT:	NA	NA	NA	NA

PROBE DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☐ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft)
-2.4 / 13.0	C1	592.3 / 576.9
13.0 / 28.0	S1	576.9 / 561.9
28.0 / 28.0	C2	561.9 / 561.9

C1: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Riser
S1: 1.0" I.D. Schedule 40 PVC Machine Slotted Screen (0.010")
C2: 1.0" I.D. Schedule 40 PVC Threaded Flush Joint Bottom Cap

FILTER PACK: (6.0'-30.0') Pea Gravel

FINE SAND: (5.0'-6.0') #10/20 Filter Sand

SEAL: (3.0'-5.0') Bentonite Seal

CEMENT SEAL: (0.0'-3.0') Concrete Seal

DEVELOPMENT:

NA

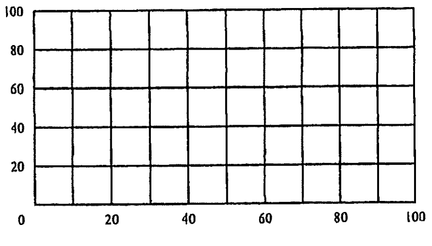
STABILIZATION TEST DATA:

NA

TIME	pH	SPEC. COND.	TEMP. (C)

RECOVERY DATA:

Q= GAL. So=



NA

COMMENTS: 1) All depths referenced to ground level.
2) Elevations referenced to mean sea level (MSL)

SITE NAME: FORT WORTH C & D LANDFILL
LOCATION: IESI

SUPERVISED BY: B.W.
CHK'D BY: J.H. / D.B.

Tracking Codes: 052021.GPJ, TEAM- MONITOR WELL CONSTRUCTION LOG, 6/27/05

PLATE

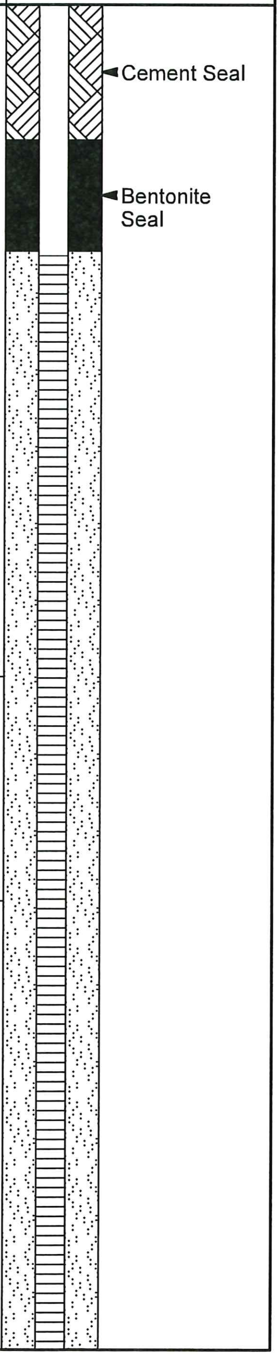
SCS ENGINEERS
SCS Engineers
3900 Kilroy Airport Way
Long Beach, CA 90806
Telephone: 562-426-9544

WELL NUMBER GMP-12

PAGE 1 OF 3

CLIENT Waste Connections
PROJECT NAME Fort Worth C&D Landfill
PROJECT NUMBER
PROJECT LOCATION
DATE STARTED 12/15/21 **COMPLETED** 12/15/21
GROUND ELEVATION 677.7 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem
∇ **AT TIME OF DRILLING** 37.00 ft / Elev 640.70 ft
LOGGED BY TM **CHECKED BY** GC
AT END OF DRILLING ---
NOTES N32.626902, W97.235381
AFTER DRILLING ---

DEPTH (ft)	NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
0			Silt, brown/orange, very soft. loose, dry		
5					
10					
15			15.0	662.7	
			Clayey silt, orange, very soft, loose, dry		
20			20.0	657.7	
			Clay, grey, soft, dry		
25					
30			30.0	647.7	



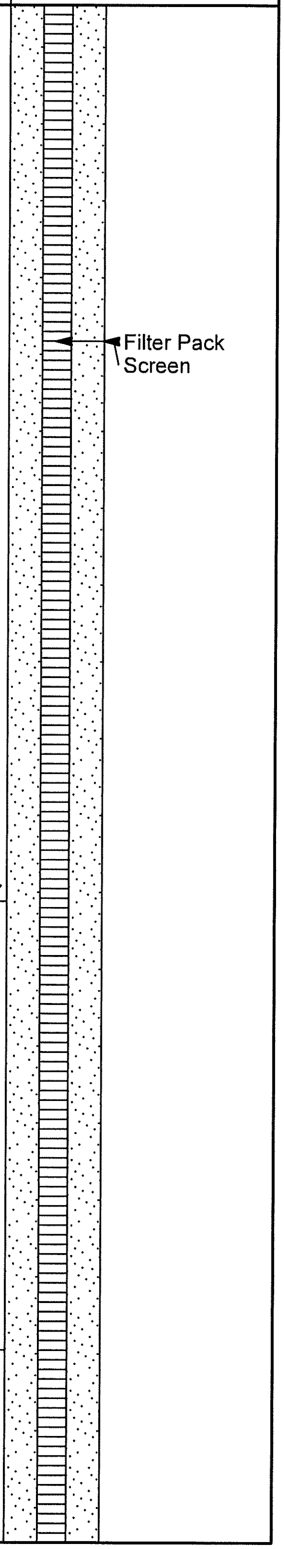
GILBERT GABALDON
GEOLOGY
#4419

GENERAL BH / TP / WELL - ITX.GDT - 1/19/22 17:17 - C:\USERS\4787ARB\DOCUMENTS\GINT\FORT WORTH C&D.GPJ

(Continued Next Page)

WELL NUMBER GMP-12

CLIENT Waste Connections
PROJECT NAME Fort Worth C&D Landfill
PROJECT NUMBER
PROJECT LOCATION

DEPTH (ft)	NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
30			Silt, brown, water encountered at 37'		
35					
			∇		
40					
45					
50		50.0		627.7	
			Silty sand, light brown/tan, very fine grained, saturated		
55					
60		60.0		617.7	
			Shale, dark grey/black, hard, dry		

III I-C-36

(Continued Next Page)

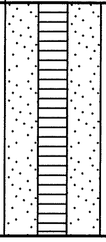
WELL NUMBER GMP-12

CLIENT Waste Connections

PROJECT NAME Fort Worth C&D Landfill

PROJECT NUMBER

PROJECT LOCATION

DEPTH (ft)	NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
65		▤	Shale, dark grey/black, hard, dry *(continued)* 69.5	608.2 

Bottom of borehole at 69.5 feet.

SCS ENGINEERS
SCS Engineers
3900 Kilroy Airport Way
Long Beach, CA 90806
Telephone: 562-426-9544

WELL NUMBER GMP-13

PAGE 1 OF 2

CLIENT Waste Connections

PROJECT NAME Fort Worth C&D Landfill

PROJECT NUMBER

PROJECT LOCATION

DATE STARTED 12/14/21 **COMPLETED** 12/15/21

GROUND ELEVATION 656.5 ft **HOLE SIZE** 7.25 inches

DRILLING CONTRACTOR WEST Drilling

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem

∇ **AT TIME OF DRILLING** 30.00 ft / Elev 626.50 ft

LOGGED BY TM **CHECKED BY** GC

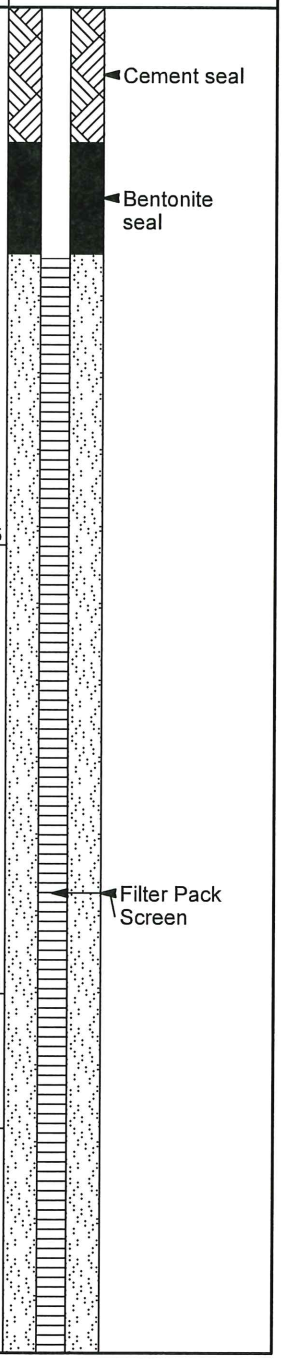
AT END OF DRILLING ---

NOTES N32.627194, W97.237770

AFTER DRILLING ---

DEPTH (ft)	NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			Silt, red/brown/orange, loose, very soft, dry	
12.0			Clayey silt, light brown/tan, loose, very soft, dry, color change at 20' to dark brown	644.5
22.0			Silty clay, dark brown with grey mottling, very soft, slightly moist	634.5
25.0			Clayey silt, dark brown, very soft, slightly moist to wet, water encountered at 30'	631.5
30			∇	

WELL DIAGRAM



1/19/22
GILBERT GABALDÓN
GEOLOGY
#4419
LICENSED

GENERAL BH / TP / WELL - ITX.GDT - 1/19/22 17:17 - C:\USERS\4787ARB\DOCUMENTS\GINT\FORT WORTH C&D.GPJ

(Continued Next Page)

SCS ENGINEERS

SCS Engineers
3900 Kilroy Airport Way
Long Beach, CA 90806
Telephone: 562-426-9544

WELL NUMBER GMP-13

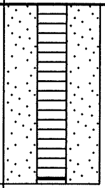
PAGE 2 OF 2

CLIENT Waste Connections

PROJECT NAME Fort Worth C&D Landfill

PROJECT NUMBER

PROJECT LOCATION

DEPTH (ft)	NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
30			Clayey silt, dark brown, very soft, slightly moist to wet, water encountered at 30' *(continued)* 34.0 622.5	
35				
40				
45				
50				
55				
60				

Bottom of borehole at 62.0 feet.

APPENDIX III I-D

LANDFILL GAS MONITORING REPORT FORM

STATE OF TEXAS
MATT K. STUTZ
93662
LICENSED
PROFESSIONAL ENGINEER
02/09/2023

Includes page III I-D-1 through III I-D-2

FORT WORTH C&D LANDFILL
LANDFILL GAS MONITORING REPORT FORM

Sampled by:______________________________ Date:________________________________

Time:________(Start) __________ (Finish) Temperature:________________________

Weather:_____________________ Barometric Pressure (optional): ________________

Monitoring Equipment:_________________ Date of Calibration: ___________________

CALIBRATION:

Standard Concentration: ______ % by Vol. Instrument Reading: ____________%

Probe No.	% Methane (By Volume)^3 0-100	%^{1} LEL 0-100	Static Pressure "w.c."^{2} (Optional)	O_2 % (Optional)	Probe Integrity Verified Yes/No
GMP-1A					
GMP-2					
GMP-3D					
GMP-4B					
GMP-5A					
GMP-6C					
GMP-7A					
GMP-8					
GMP-9A					
GMP-10A					
GMP-11A					
GMP-12					
GMP-13					
UV-1					
UV-2					
UV-3					
UV-4					
UV-5					
UV-6					

Onsite Structures	Verify if Continuous LFG Alarm is Operational (Circle One)		Was Continuous LFG Alarm Tested (Circle One)		Continuous LFG Alarm Activated (>1.25% CH_4 by volume / LEL>25%)[3] During Previous Quarter (Circle One)	
Landfill Office	YES	NO	YES	NO	YES	NO
Scalehouse	YES	NO	YES	NO	YES	NO
Maintenance Facility	YES	NO	YES	NO	YES	NO
	YES	NO	YES	NO	YES	NO

[1] % LEL = (20) x (observed % methane) – Note: Record >100% in LEL column if percent methane is over 5%. The reference to LEL is for methane by volume % conversion purpose only.

[2] "w.c." – Inches Water Column

[3] Monitoring results shall be recorded as percent methane by volume. The reference to LEL is for methane by volume % conversion purpose only.

APPENDIX III I-E

TYPICAL MONITORING EQUIPMENT MANUFACTURER'S INFORMATION

STATE OF TEXAS
MATT K. STUTZ
93662
LICENSED
PROFESSIONAL ENGINEER
02/09/2023

Includes pages III I-E-1 through III I-E-12

PERIMETER MONITORING EQUIPMENT

CES LANDTEC

An ISO 9001 Certified Company

GEM™ 2000

PORTABLE GAS ANALYZER
Instrumentation

The GEM ™ 2000 combines the GEM ™ 500 and the GA-90 into one faster, more accurate, intrinsically safe instrument

The **GEM™2000** was designed by **CES-LANDTEC** specifically for use on landfills to monitor landfill gas (LFG) extraction systems, flares, and migration control systems.

The **GEM™2000** samples and analyzes the Methane, Carbon Dioxide and Oxygen content of landfill gas. The easy-to-read LCD screen shows the results as percentages of CH_4, CO_2, O_2 and "balance" gas. The **GEM™2000** calculates and displays gas flow rate. It also measures and displays Btu content, temperature (w/optional probe), relative and atmospheric pressures and CH_4 LEL (Lower Explosive Limit).

GEM™2000
"The Future of Landfill Gas Monitoring"

Performance

New technological advances in hardware and software dramatically improve speed and accuracy

Safe

Certified Intrinsically Safe for landfill use

Efficient

Two operating modes, each with two screens for streamlined functionality

Flexible

DataField software offers integration with various PC applications

Experience

Built on the success of hundreds of field-tested instruments

"The best just got better!"

DataField COMPATIBLE

♦ 850 South Via Lata, Suite 112 ♦ Colton, CA 92324 ♦ Phone (800) LANDTEC ♦ (909) 783-3636
Visit our web site at http://www.ces-landtec.com

GEM™2000 Multi-Functional Analyzer

Diverse Field Applications... monitors migration control systems, gas extraction systems, flares, migration probes, and more.

Gas Extraction Monitor Mode... provides automatic sampling and analysis of gas composition % by volume CH_4, CO_2, O_2 and balance gas, % LEL CH_4, temperature (with optional probe), static pressure, differential pressure, and barometric pressure. Calculates gas flow rates (SCFM) as well as Btu content.

Landfill Gas Analyzer Mode... provides automatic sampling and analysis of gas composition % by volume CH_4, CO_2, O_2 and % balance gas, % LEL CH_4, temperature (with optional probe), barometric pressure and relative pressure. Can be used for data logging, with user programmed intervals.

Easy to Read Display... extra large backlit LCD shows up to five gases, atmospheric and gas vacuum pressure, temperature, ID code – all at the same time.

Intrinsically Safe... essential for protecting personnel who work with hazardous and explosive landfill gases.

On Site Calibration... rapid field calibration checking or adjustment can be carried out on site.

Automatic Purge... automatically purges analyzer when a new ID is selected. (This feature can be turned off).

Light-Weight Compact Size... easy to carry. Weighs less than five pounds.

Quick Analysis... completes sampling and displays gas analysis and flow results in less than one minute.

Infrared Gas Analyzer... provides accurate measurements of methane (CH_4), and carbon dioxide (CO_2).

Gas Temperature... read when using optional temperature probe or can be entered manually.

Durable Oxygen Sensor... provided by the galvanic cell principle, not influenced by other gases (i.e. CH_4, CO_2, CO, SO_2 or H_2S).

User Friendly On-Screen Menu... in each mode the user performs most operations in just two screens.

PC Data Downloading... provided by RS232 interface with **DataField CS** software (Release 3.0 or later).

Data Storage/Retrieval... stores prior measurements taken for each monitoring point, 900 monitoring points total.

Date/Time Stamp... recorded for all stored data.

Prior Data Recall... allows user to view prior data for each monitoring point.

Methane Analysis... displayed as either % CH_4 by volume or LEL CH_4 (Landfill Gas Analyzer Mode only).

Durable Construction... built of strong, durable plastic material suitable for harsh landfill environments.

All Weather Use... designed to operate in extremes from 32°F to 104°F. Sealed, weather-tight case.

Built-in Adjustable Alarms... allows user to set alarm limits for CH_4 and O_2.

Rechargeable Batteries... internal, rechargeable nickel metal hydride batteries are standard.

Operating Time... approximately 8 hours with normal pump usage (approximately 10 hours without pump running).

Fast Recharge Time... approximately 3 hours from complete discharge.

Battery Check... battery life is continuously displayed.

Monitoring Point ID Codes... provides alphanumeric identification of monitoring points for data storage and recall.

ID Comments... allows user to answer up to 3 questions with a list of 9 potential answers each.

Imperial vs. SI Units... can display measurements in Imperial (USA) or SI (metric) units.

Interfaces to DataField Management Software... which provides statistical analysis and reporting of LFG data.

Multiple Flow Meter Analysis... calculates gas flow with Accu-Flo Wellheads, Orifice plates and Pitot tubes.

Gold Warranty Service Program... ensures that your analyzer is properly maintained for optimum performance. (Optional).

Additional Information

The **CES-LANDTEC** team is committed to introducing new and more efficient technologies into an industry which recognizes innovation.

The **GEM™2000** is part of **CES-LANDTEC**'s family of products developed specifically for the landfill industry. Other **CES-LANDTEC** products and services include:

- GEM™500
- Accu-Flo Wellheads
- DataField SES Environmental Management System
- SEM-500
- DataField Online Service
- MANAGEbyNet Project Management Software
- QuickSWPPP Software

— Providing Technology and Software for a better Environment —

GEM™2000 Typical Accuracy

CONCENTRATION	% CH_4 by VOLUME	% CO_2 by VOLUME	% O_2 by VOLUME
5% (LEL CH_4)	±0.3%	±0.3%	±1.0%
FULL SCALE	±3.0%(70%)	±3.0%(40%)	±1.0%(25%)

GEM™2000 Specifications

	SENSOR RANGE	RESOLUTION
Methane- CH_4	0-70%	0.1%
Carbon Dioxide - CO_2	0-40%	0.1%
Oxygen - O_2	0-25%	0.1%
Pressures (diff)	0-10" W.C.	0.001" W.C.
(static)	0-100" W.C.	0.1" W.C.

Pump Flow Rate – 500 cc/min at nominal flow, 250 cc/min at 80" W.C.
Vacuum – Up to 80" W.C.
UL Certified to Class 1, Zone 1, AEx Ib d IIa T4

An involved and contributing member of the Solid Waste Association of North America.

An ISO 9001 Certified Company
850 South Via Lata, Suite 112 Colton, CA 92324

Western Sales Office
(800) 821-0496 • Fax (909) 825-0591
Eastern Sales Office
(800) 390-7745 • Fax (301) 391-6546

REV 0303

ensure the best possible accuracy.

2.13 Update Site Data

Allows the user to answer questions (pre-defined in LSGAM software) relating to the site (e.g. name of operator, weather conditions, etc.). Site Questions are different than ID Questions. Once answered, site answers to site questions will be associated with all subsequent readings until the instrument is turned off or the question answers are updated.

This is covered in detail in section 3.2 of this manual.

2.14 Data Logging (GA mode only)

Enables the user to leave the Instrument unattended to take samples at pre-determined intervals. The reading interval and pump run time may be edited prior to commencing the logging cycle. The ID code may ONLY be set in LSGAM communication software.

Once the logging function is activated, the instrument will carry out a 30 second 'Warm-up' countdown (displayed bottom right) and begin the first sample. After each sample, the unit will automatically sleep to conserve power if the time between the pump ending and the next sample is greater than 30 seconds.

The instrument is reactivated (awakened) during a logging cycle, the LANDTEC logo will be displayed for a few seconds and the Gas Reading screen will be displayed. This will initiate a 30 second countdown to the next sample being taken unless the operator stops the logging function. The data will be logged against the ID setup through LSGAM for the Data Logging function

2.15 Operating Language

The operating language of the instrument can be set to English, German, Spanish, French, Italian or Brazilian Portuguese through this option.

2.16 View Data

The view data allows the user to see the readings that are in the GEM2xxx memory. Often the amount of data stored is more than can be displayed adequately on one screen so pressing the ⑤ key will allow the user to see additional screens with stored data. The 2 '∧', 4 '<', 6 '>' and 8 'v' cursor keys will move forward or backwards through the instruments memory. Pressing the ① key will exit to the Gas Reading screen.

2.17 Adjust Contrast

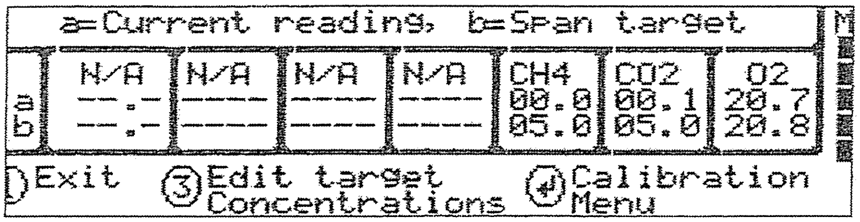
The GEM2xxx automatically adjusts the screen contrast according to the ambient temperature to maintain normal viewing.

The contrast can be manually adjusted by using the 4 '<' and 6 '>' cursor keys. The manual contrast setting is stored when the '↵' key is pressed.

2.18 Field Calibration

Whenever carrying out a user calibration function it is important to ensure the correct values are entered. Additionally, in the case of a zeroing function, ensure only certified gas or ambient air is used and no connection is made to a probe or wellhead fitting. Additionally, ensure the instrument is purged of any residual gas that may be inside the instrument prior to zeroing. Calibration cylinders are sold by LANDTEC. The regulator, sold by LANDTEC, is set to 0.5 liters per minute and 15 psig maximum. A normal field calibration usually requires the gas to be running for about two minutes.

Upon selecting this option, the Field Calibration screen is displayed. A brief description of the user span calibration procedure and the current reading (row 'a') and user span calibration gas values (row 'b') are displayed.



a=Current reading, b=Span target

	N/A	N/A	N/A	N/A	CH4	CO2	O2
a	--.-	----	----	----	00.0	00.1	20.7
b	--.-	----	----	----	05.0	05.0	20.8

The span gas values may be changed via the '③ **Edit Target Concentrations**' option. Once this option has been selected, **all** the gas values will require entry. Each entry is to be confirmed by pressing the '↵' key. It is important to confirm the concentration of the calibration gas(es) used and enter the value(s) properly.

The calibration menu has the following menu options:

ZERO CHANNEL
SPAN CHANNEL
CONFIRM CALIBRATION
FACTORY SETTINGS
LAST FIELD CAL'D
EXIT MENU

2.18.1 Zero Channels

Selected from the '**Field Calibration**' - '**↵-Calibration Menu**' allows the relevant reading to be zeroed. When selected, a list of the available options will be displayed, this usually includes CH_4, and O_2, also the Gas Pod (if fitted).

Supply a zero gas mixture to the instrument for the gas to be zeroed. Ensure the reading for the selected gas has settled to its lowest value before selecting the zero function. When the required option is selected, the user zero function will be carried out automatically. The operation will be carried out when the '↵' key is pressed.

2.18.2 Span Channels

Spanning Channels should be carried out prior to use or when the ambient operating temperature changes greater than +/- 20 degrees Fahrenheit. Selected from the '**Field Calibration**' - '**↵-Calibration Menu**', allows the relevant reading to be span calibrated (in accordance with the calibration value entered). When selected, a list of the available options will be displayed, which includes CH_4, CO_2, O_2, (CO & H_2S internally for the Plus) and if an external Gas Pod is fitted (H2S, CO, SO2, H2, NO2, Cl2, or HCN).

When the required option is selected from the list, the span calibration function will be carried out automatically. When carrying out this procedure, ensure the span calibration procedure (as outlined below) is followed:

1. Apply the relevant known certified gas concentration through the inlet port of the Instrument.
2. Wait until the current gas reading has stabilized.
3. Select the required calibration option via the '**↵-Calibration Menu**'.

2.18.3 Factory Settings

This will clear any user zero and span calibration data. It will also restore the pre-programmed factory settings for **ALL** channels – CH_4, CO_2, O_2 (CO & H_2S for the Plus) or Gas Pod (if fitted) and pressure transducers.

2.18.4 Last Field Cal

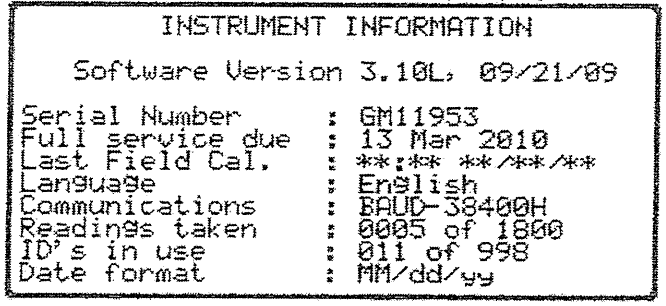
Displays the date the last field calibration was carried out (zero or span).

2.19 Mode of Operation

Allows changing instrument between GA mode and GEM mode of operation.

2.20 Information Screen

The information screen will automatically display the following information:



```
         INSTRUMENT INFORMATION

   Software Version 3.10L, 09/21/09

Serial Number       : GM11953
Full service due    : 13 Mar 2010
Last Field Cal.     : **:** **/**/**
Language            : English
Communications      : BAUD-38400H
Readings taken      : 0005 of 1800
ID's in use         : 011 of 998
Date format         : MM/dd/yy
```

Navigation

Note: This menu item is specific to GEM2NAV instrument models.

This feature has two options Navigation Screen ON and Navigation Screen OFF. If the Navigation is turned ON, a navigation screen will appear after selecting a well ID. If the Navigation screen is OFF you will skip entering through the navigation screen. If all well locations are known, the user may choose to turn this feature off. Even if this feature is turned off, the GPS will record the related information with readings.

2.21 Exit Menu

The Exit Menu simply exits the main menu screen and returns to the gas reading screen.

7 Service & Maintenance

7.1 Factory Service

LANDTEC Facilities are the ONLY authorized service centers for the GEM™ Family of instruments. LANDTEC offers a several service plans to facilitate your bi-annual Factory Servicing of the instrument. Please contact your LANDTEC representative for more information on the service plan that best fits your specific needs. Factory Service includes but is not limited to the following;

General operations

The main functions of the gas analyzers operation are checked to ensure that they are within specification.

Barometric pressure reading

The barometric pressure reading is checked to ensure it is within specification. This is carried out by way of comparing the atmospheric reading against a known standard. If necessary, reprogramming is quoted.

Static and differential pressure readings

The static and differential pressure transducers are checked to ensure they are within specifications. This is carried out by comparing instrument readings to a known standard, applying a known pressure and noting both readings. If necessary, reprogramming will be quoted.

Pump functionality (flow and vacuum)

All flow and vacuum functions of the internal pump are checked to ensure the operation is within specification.

Water ingress/blockage

The internal filters are checked for cleanliness and moisture ingress to ensure they are not contaminated.

Flow fail setting

The flow fail function is checked to ensure proper operation within the specified limits.

Gas pod and Temperature probe connectivity reading

The connectivity of the gas analyzer is checked to ensure correct operation and reading performance with accessories.

Computer controlled gas check

Inward and outward gas checks are carried out by way of connecting the gas analyzer to a custom built computer controlled calibration chamber and proprietary software. At the inward stage, two sets of readings are taken - one using the customer's calibration settings and a second set using factory calibration settings. During this process a range of gases are used that span the reading range of the gas analyzer.

Structural and aesthetics check

The instrument is checked for cracks, scratches and broken or missing pieces.

7.2 Factory Service Facilities

LANDTEC North America
850 S. Via Lata, Suite 112
Colton, CA 92324
USA
Sales Tel: +1 (800) 821-0496 or +1 (909) 783-3636
Service Tel: 1 (909) 783-3636 x6141
Web: www.LANDTECNA.com

LANDTEC Europe
Formerly Geotechnical Instruments
Sovereign House Queensway
Leamington Spa, Warwickshire CV31 3JR,
England
Tel: +44(0)1926 338111
Web: www.geotech.co.uk

LANDTEC South America
LANDTEC Produtos e Servicoŝ Ambientais Ltda.
Rua Pedroso de Carmargo, 237 - Chácara
Santo Antonio - SP/SP CEP 0417-010
Brazil
Phone: +55(11) 5181-6591
Web: www.landtecbrazil.com.br

7.3 User Maintenance

This instrument is designed to be low maintenance and rugged. However, field calibrations are recommended prior to use or when the ambient operating temperature of the instrument changes more than +/- 20 degrees Fahrenheit. See section 2.18 for further information on field calibrations. Additionally, it may be necessary to change the user accessible filters and o-rings from time to time.

There are two user accessible filters, the particulate filter is located in the back of the instrument, see section 1.1 for location, and the water trap filter which is part of the included hose kit. There are four user changeable o-rings, one on the particulate filter cover, one on the outside of the water trap filter housing, one on the inside of the water trap filter housing, and one on the ends of each male quick connect fitting included on the hose kits.

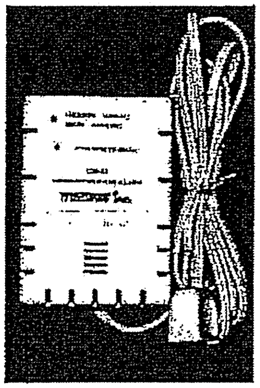
Note: The o-rings on the male quick connect fittings should be routinely checked as dust and dirt from the various wells they connect to can be abrasive. A damaged or leaky o-ring may allow air intrusion into your gas sample. This intrusion of air may not be noticed when calibrating the instrument because the calibration does not occur under vacuum.

BUILDING MONITORING EQUIPMENT

GAS DETECTION
Macurco inc.

COMBUSTIBLE GAS ALARM

Residential landfill buildings commercial



GD-21

- 120 VOLT PLUG IN UNIT
- ATTRACTIVE CASE
- LOUD BUZZER ALARM
- EASY INSTALLATION
- GAS DETECTION IS FIRE PREVENTION

FEATURES:

- Detects many combustible gases: Natural Gas, LP, Propane, Butane, and Gasoline Fumes.
- Standard Calibration setting is 25% of LEL (Lower Explosive Limit) for natural gas.
- Loud Buzzer (similar to a smoke alarm buzzer) wakes even heavy sleepers.
- Stand Alone Unit: Plug into any 120 VAC power outlet.
- Ignition protected: Explosion Proof Design.
- Maintenance free electronic sensor, supervised.
- Small, compact, attractive white case.
- Easy to install: Just hang unit on a screw or nail, and plug it in.
- Special calibrations are available.

SPECIFICATIONS:

POWER: 120 VAC, 60 Hz
CURRENT: Less than 10 watts
SHIPPING WEIGHT: 1 lb
COLOR: White
ALARM SOUND: 88 dB @ 10 ft
ALARM SET POINT: 25% of LEL natural gas
SENSOR MAINTENANCE: none
SENSOR LIFE: 7 – 10 years
SIZE: 4½ x 3¼ x 1¾ inches

DETECTOR LOCATION:

WHERE: Gas detectors should be placed near the source of the potential leak, namely near a gas appliance such as a furnace, water heater, or gas log fireplace. Because of various odors and gases given off in cooking, place the unit near, but not in the kitchen.

MOUNTING HEIGHT: For natural gas and methane which are lighter than air, mount the unit 1 ft below the ceiling. For propane, LP, and other gases that are heavier than air, mount the detector 1 ft above the floor

MANUFACTURER:

Macurco Inc.
3946 S. Mariposa Street
Englewood, CO 80110
303-781-4062 Fx: 303-761-6640
www.macurco.com

DISTRIBUTED BY:

MACURCO GAS DETECTORS

GD-21

INSTALLATION & OPERATING INSTRUCTIONS

WWW.MACURCO.COM

GENERAL INFORMATION

The GD-21 is a 120VAC plug in type unit, with a self-contained alarm. The standard calibration is to 25% of LEL (Lower Explosive Level) of a mixture of Methane (natural gas) and air. The GD-21 will alarm at about 25% of LEL of Propane, Butane and LP Gas. To detect the complete list of gases on the data sheet will normally require a special calibration, for a nominal charge. However, the following gases can be detected with the standard calibration: Acetylene, Gasoline fumes and Lacquer thinners. See the GD-21 data sheet for a list of other gases that can be detected, and other technical information.

LOCATION

The unit on average can cover about 900 sq. ft. The coverage depends on air movement in the room or facility. Locate the unit high if the gas of concern is lighter than air, such as natural gas (methane). If the gas of concern is heavier than air; such as butane, propane, alcohols or gasoline; mount the detector relatively low. Extra detectors may be needed near any areas were people work or the air is stagnant.

The location selected should not be near a corner, as this can be dead air space. The location selected must also have a 120 VAC power outlet within nine feet. It is not suggested to locate gas detectors in kitchens or bathrooms, because of frequent unwanted alarms due to the normal use in those rooms of products containing combustible gases.

INSTALLATION

At the desired location, start a #6 or #8 wood screw of adequate length. Turn the screw into the wall until only 1/4 inch of the screw protrudes. Note the keyhole shaped mounting pattern on the back of the detector. Slip the larger part of this mounting pattern over the mounting screw head and allow the GD-21 to settle over the screw. Insert the plug into a 120 VAC outlet.

OPERATION

When power is first applied to the detector, it will go through a warm-up period of about two minutes. The unit has an internal delay that prevents alarms during the warm-up period. The green light will blink on and off during the two-minute delay period, and will glow brightly, continuously afterwards. The ***PUSH HERE TO RESET*** button resets the 2 minute delay. Once the unit is fully operational (the green light on continuously) test the unit by directing gas from an *un-lighted* butane cigarette lighter into the detector near the slot closest to the word ALARM on the decal. The buzzer will alarm loudly and the light should turn red. The GD-21 will shut off the buzzer and turn the light green automatically once the air clears. However, the ***PUSH HERE TO RESET*** button may be pushed to reset the two minute delay and silence the buzzer while the air clears.

The unit has a trouble signal to indicate problems in the gas-sensing element. This is a chirping sound, along with the light changing to a yellow color, to indicate your detector is inoperable. Return the unit to the factory for service. The detector should be tested regularly, about every 6 months, by using gas from an *un-lighted* cigarette lighter, as detailed above.

REV. 12/97

ALARM ACTIONS

Various fumes and gases from normal household products such as aerosol spray cans and cleaning agents can cause the GD-21 to alarm. Strong cooking odors may cause the GD-21 to alarm. The data sheet has a list of the gases that can cause alarms. If such an alarm occurs, push the *PUSH HERE TO RESET* button on the detector, which will silence the alarm for two minutes, while allowing the air to clear.

All of the above mentioned unwanted alarms are related to normal day time activities in a home, and should be of no concern if they can be easily traced to by-products of normal activities. **HOWEVER, DURING THE NIGHT WHEN THERE IS NOT NORMAL ACTIVITY TO PRODUCE FUMES, ALL ALARMS BY THE GD-21 MUST BE TREATED AS POTENTIAL EMERGENCIES.**

SENSOR POISONS

The gas sensing tip in the detector is designed with extreme sensitivity to the environment. As a result, the sensing function of the tip may be deteriorated if it is exposed to a direct spray from aerosols such as paints, silicone vapors, etc., or to a high density of corrosive gases (such as hydrogen sulfide, sulfur dioxide) for an extended period of time.

SERVICING OF UNIT

The GD-21 does not require regular maintenance. The unit uses a self-purging semi-conductor sensor that has a 7-10 year life expectancy. All maintenance and repair of products manufactured by Macurco, Inc. are to be performed at the Macurco manufacturing facility. Macurco does not sanction any third-party repair facilities.

LIMITED WARRANTY

The GD-21 gas detectors are warranted to be free from defective material and workmanship for a period of one (1) year from the date of installation. If any component becomes defective during the warranty period, it will be replaced or repaired free of charge, if the unit is returned in accordance with the instructions below. This warranty <u>does not</u> apply to units that have been altered or had repair attempted, or that have been subjected to abuse, accidental or otherwise. The above warranty is in lieu of all other express warranties, obligations or liabilities. THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE ARE LIMITED TO A PERIOD OF ONE (1) YEAR FROM THE PURCHASE DATE. Macurco shall not be liable for any incidental or consequential damages for breach of this or any other warranty express or implied arising out of or related to the use of said gas detector. Manufacturer or its agents liability shall be limited to replacement or repair as set forth above. Buyer's sole and exclusive remedies are return of the goods and repayment of the price, or repair and replacement of non-conforming goods or parts. (The Uniform Commercial Code applicable in the State of Colorado shall govern.)

RETURN INSTRUCTIONS

Call (303) 781-4062 for a Return Authorization number. Then carefully pack the gas detector with a written description of the nature of the return. Send the unit to the following address:

Macurco Inc.
3946 South Mariposa Street
Englewood, Colorado 80110

WWW.MACURCO.COM

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1983E

MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX IIIJ
CLOSURE PLAN

Prepared for

Texas Regional Landfill Company, LP

February 2023

NEVZAT TURAN
84059

02/09/2023

Prepared by

Weaver Consultants Group, LLC
TBPE Registration No. F-3727
6420 Southwest Blvd., Suite 206
Fort Worth, Texas 76109
817-735-9970

WCG Project No. 0771-356-11-35

This document is intended for permitting purposes only.

CONTENTS

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER
02/09/2023

TABLES AND FIGURES

Figures

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER
02/09/2023

1 INTRODUCTION

This Final Closure Plan has been prepared for the Fort Worth C&D Landfill consistent with Title 30 Texas Administrative Code (TAC) Section 330. The landfill completion plan for this site consists of final contours and drainage features for the completed landfill. This plan is provided in Figure IIIJ-1 – Landfill Completion Plan.

This attachment addresses §330.56(l).

2 FINAL COVER SYSTEM

2.1 Introduction

The final cover system for the Fort Worth C&D Landfill has been developed to incorporate the requirements of §330.253(b)(1) and (3). The rules state that the owner or operator of the landfill unit shall complete closure activities for the unit in accordance with the approved closure plan within 180 days following the initiation of closure activities. Such a system will include installation of a multi-layer cover system and a storm water runoff control system. The storm water runoff controls are addressed in Appendix IIIF – Surface Water Drainage Plan. The final cover system design is discussed below. Final cover system design drawings are included in Appendix IIIA-A.

2.2 Cover System Design

The final cover system will provide a low maintenance cover, protect against erosion, reduce rainfall percolation through the cover system and subsequently minimize leachate generation within the landfill. As depicted on Figure IIIJ-1, a maximum slope of 5 percent is provided for the top slopes. Typical sideslopes 3H:1V is provided to minimize erosion and facilitate drainage of the landfill. The components of the final cover system include (from top to bottom):

- 1.5-ft thick compacted soil layer composed of clayey soil classified by the Unified Soil Classification System (USCS) as “SC” (clayey soil), “CL” (lean clay), or “CH” (fat clay) and having a coefficient of permeability (i.e., hydraulic conductivity) no greater than $1x10^{-5}$ cm/s (i.e., $k \leq 1x10^{-5}$ cm/s); and
- A 6-inch or 12-inch thick topsoil layer capable of sustaining native plant growth and seeded or sodded immediately after installation. If the underlying compacted soil layer is classified as SC or CL, the minimum topsoil thickness is 6 inches. If the underlying compacted soil layer is classified as CH, the minimum topsoil thickness is 12 inches.

The topsoil layer is provided to minimize the erosion potential of the cover slopes. This layer was evaluated using the universal soil loss equation (USLE) developed by the United States Department of Agriculture (USDA) Soil Conservation Service (SCS).

The evaluation is presented in Appendix IIIF. The final cover systems are designed to minimize infiltration of surface water into the underlying waste material.

2.3 Installation Methods and Procedures

The final cover system will be constructed in accordance with the requirements listed on the permit drawings in Appendix IIIA-A and the Final Cover System Quality Control Plan (FCSQCP) presented in Appendix IIIE. Testing and evaluation of the final cover system during construction will be in accordance with FCSQCP.

3 CLOSURE PROCEDURES

3.1 Sequence of Final Cover Placement

The Fort Worth C&D Landfill may place final cover over the landfill unit throughout the active life of the landfill or at closure for the entire final cover area as a single construction event. As detailed on Drawings I/II-A.4 through I/II-A.7, final cover may be placed as the site is being developed, although final cover may be installed as a single construction event at the end of the site life. The final cover placement procedure listed below will be followed until the entire waste footprint is closed:

- Survey controls will be implemented to control the filling of solid waste to the top of the daily/intermediate cover layer elevation.
- The final cover system layers will be constructed over areas that have reached the bottom of final cover grades. Testing of the various components of the final cover system will be performed in accordance with this closure plan (see Section 2.3).
- A final cover certification report, complete with an as-built survey, will be prepared by an independent licensed professional engineer and submitted to the TCEQ for approval.
- The TCEQ approved final cover certification report will be maintained in the Site Operating Record, and the final cover log (see Part IV – Section 24.6.1) will be updated to reflect the area where final cover has been placed. The TCEQ Regional Office will also be notified that final cover placement has occurred at the site.

Note that the placement of final cover does not represent closure of a portion of the site. Closure for the landfill unit is discussed in Section 3.2 and closure of the other MSW units at the site is discussed in Section 3.3. Requirements for final closure of the site are discussed in Section 4. Post-closure care activities will commence once the entire site has been closed as discussed in Section 4.

3.2 Landfill Unit Closure During Active Life

Should closure of the landfill become necessary at any time during the active life of the landfill, the following steps will be taken:

- Engineering plans will be developed to address site closure at the time of discontinued waste filling.
- The final waste received will be placed and properly compacted.
- Excavations will be filled with suitable material, and the site will be graded to promote runoff and prevent ponding.
- The final cover system will be constructed according to specifications.
- The top of the landfill will be regraded and reshaped as needed to provide the proper slope for positive drainage.
- As noted above (first bullet), a revised final closure plan will be developed and submitted to the TCEQ for approval.
- Following application of final cover, the site will be vegetated with appropriate grasses to minimize erosion. The established grasses will provide a minimum of 90 percent coverage of the final cover system.
- A surface water management system will be constructed to minimize erosion.
- A closure certification will be prepared by an independent licensed professional engineer and submitted to TCEQ for approval.
- All proper notices and documentation will be filed with the appropriate agencies.

3.2.1 Estimate of Largest Active Disposal Area

The largest area that could be open within the next year is shown on Figure IIIL-1 in Appendix IIIL. Consistent with this rule and TCEQ guidelines for financial assurance to complete closure and postclosure activities, financial assurance will be posted for the current active area as discussed in Appendix IIIL – Cost Estimate for Closure and Postclosure Care. As additional liner areas developed, Appendix IIIL will be updated (closure plan does not need to be updated) per §305.70(j) to ensure continued compliance with financial assurance requirements. The entire 184.3-acre site will also need to be administratively closed.

Supporting calculations are presented in Appendix IIIL – Cost Estimate for Closure and Postclosure Care.

3.2.2 Estimate of Maximum Inventory of Waste Ever On Site

The estimate of maximum inventory of waste (defined as waste and daily cover) ever on site over the active life of the facility is approximately 31.3 million cubic yards. The site life calculations (Appendix IIIB – Site Life Calculations) show that approximately 18,300,000 cubic yards of airspace remain (using the February 17, 2022 topographic map and the proposed closure plan).

4 SCHEDULE OF UNIT CLOSURE AND FACILITY FINAL CLOSURE

4.1 Final Closure Requirements

Consistent with §330.253(e), the site will be closed implementing the following steps.

- No later than 45 days prior to initiation of final closure activities for the Type IV municipal solid waste landfill (MSWLF) unit, the Executive Director of the TCEQ will be notified that a notice of the intent to close the unit has been placed in the operating record.
- No later than 90 days prior to initiation of final closure activities for the Type IV MSWLF unit, a public notice of facility closure which contains the name, address, and physical location of the facility, the permit number, and the last date of intended receipt of waste, will be provided in the newspaper of the largest circulation in the vicinity of the facility (e.g., the Dallas Morning News). The Fort Worth C&D Landfill will also make available a copy of the approved final closure and postclosure plan at the landfill office for public access and review.
- Following notification of the Executive Director of the TCEQ, a minimum of one sign will be posted at the main entrance notifying all persons utilizing the facility of the closure date or date after which further receipt of waste is prohibited. In addition, barriers or gates will be installed at access points following the closure date to prevent unauthorized dumping of solid waste at the facility.
- Final closure activities will commence at the Type IV MSWLF unit no later than 30 days after the date the Type IV MSWLF unit receives the known final receipt of waste. If the Type IV MSWLF unit has remaining capacity and there is a reasonable likelihood that the Type IV MSWLF unit will receive additional waste, final closure activities will commence no later than one year after the most recent receipt of wastes.
- Final closure activities of the Type IV MSWLF unit will be completed in accordance with the Final Closure Plan within 180 days following the beginning of closure.
- Following completion of final closure activities, a documented certification, signed by an independent licensed professional engineer, will be submitted to the TCEQ for review and approval. This certification will verify that final

closure has been completed in accordance with the final closure plan and will include all applicable documentation necessary for certification of final closure. Once approved, this application will be placed in the operating record.

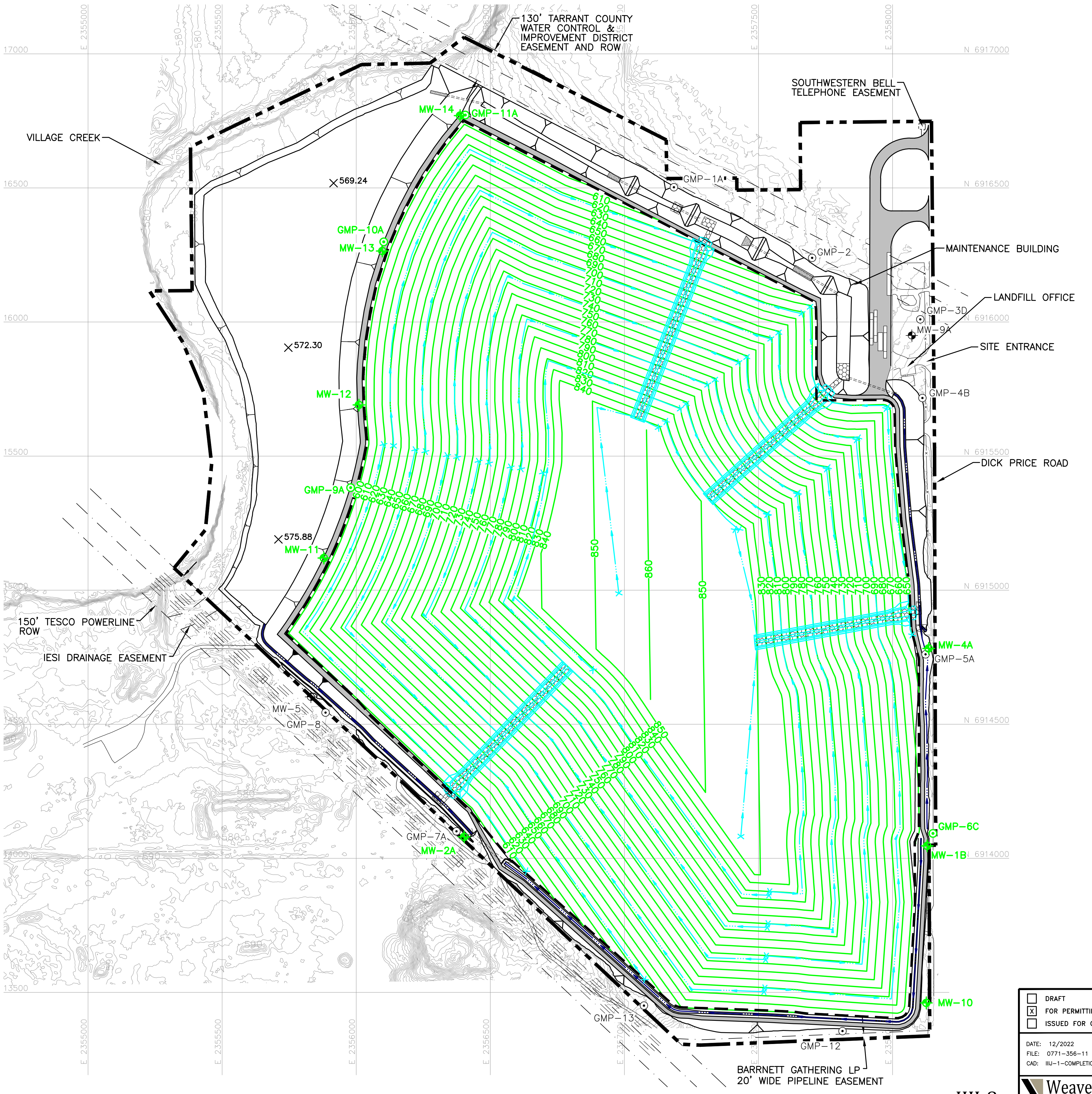
- Within 10 days after completion of final closure activities of the facility, a certified copy of an Affidavit to the Public (most current format provided by the TCEQ will be used) will be submitted to the TCEQ and placed in the operating record. In addition, a certified notation will be recorded in the Denton County Deed records that will in perpetuity notify any potential purchaser of the property that the land has been used as a landfill facility and the use of the land is restricted according to the provisions specified in Attachment 13 – Postclosure Care Plan. Within 10 days after completion of final closure activities of the facility, a certified copy of the modified deed will be submitted to the TCEQ and placed in the operating record.

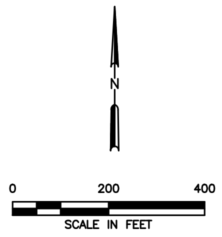
Following receipt of the required final closure documents and an inspection report from the TCEQ district office verifying proper closure of the Type IV MSWLF facility according to this Final Closure Plan, the Executive Director may acknowledge the termination of operation and closure of the facility and deem it properly closed. The steps in the closure process are depicted on Figure 12.3 – Final Closure Schedule.

4.2 Provisions for Extending Closure Period

If the Fort Worth C&D Landfill has remaining capacity at the time of its closure, final closure activities will begin no later than one year after the most recent receipt of waste. A request for an extension beyond the one-year deadline for the initiation of final closure may be submitted to the Executive Director for review and approval and will include all applicable documentation to demonstrate that; (1) the unit or site has the capacity to receive additional waste, and (2) the Fort Worth C&D Landfill has taken all steps necessary to prevent threats to human health and the environment.

Closure activities will be completed within 180 days following the initiation of final closure activities. If necessary, a request for an extension of the completion of final closure activities will be submitted to the Executive Director for approval. This request will include all applicable documentation necessary to demonstrate that final closure will take longer than 180 days and all steps have been taken and will continue to be taken to prevent threats to human health and the environment from the unclosed site. In accordance with §330.253(e)(10), post-closure care maintenance will begin immediately upon the date of final closure as approved by the Executive Director.





LEGEND

▬ · ▬	PERMIT BOUNDARY
▬ ▬	PERMITTED LIMITS OF WASTE
750	EXISTING CONTOUR
N 6816000	STATE PLANE COORDINATE
32° 21' 20"	GEODETIC COORDINATE
— · —	EASEMENT
— · —	RELOCATED EASEMENT
800	FINAL COVER CONTOUR
▨	DRAINAGE LETDOWN
→	DRAINAGE SWALE
▨	GABIONS
MW-7	EXISTING GROUNDWATER MONITORING WELL
GMP-12	EXISTING GAS MONITORING PROBE
MW-7	FUTURE GROUNDWATER MONITORING WELL
GMP-17	FUTURE GAS MONITORING PROBE

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN ON 02-17-2022. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983.

NEVZAT TURAN
84059

02/09/2023

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 12/2022
FILE: 0771-356-11
CAD: IIIJ-1-COMPLETION PLAN.DWG

DRAWN BY: JDW
DESIGN BY: BPY
REVIEWED BY: NT

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
TEXAS REGIONAL LANDFILL COMPANY, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
LANDFILL COMPLETION PLAN

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS

WWW.WCGRP.COM

FIGURE IIIJ-1

Fort Worth C&D Landfill
Figure IIIJ-2 – Final Closure Schedule

	30 DAYS	30 DAYS	30 DAYS	30 DAYS	30 DAYS	30 DAYS	30 DAYS	30 DAYS	30 DAYS	30 DAYS
Written notification of closure to TCEQ		—	—							
Public notice of facility closure published in newspaper	—	—	—							
Posting of sign		●								
Initiation of final closure activities				●						
Time interval for completion of final closure activities				—	—	—	—	—	—	
Submit engineering certification of final closure to TCEQ										●
Submit certified copies of Affidavit to the Public and modified deed to TCEQ										●

Note: Schedule is based on anticipated date of beginning final closure activities. Heavy vertical line signifies final receipt of waste. Schedule is shown for reference purposes only. Implementation of closure activities shall follow the TCEQ approved closure plan and applicable rules.

5 CLOSURE COST ESTIMATE

A detailed written cost estimate, in current dollars, showing the cost of hiring a third party to close the largest area of the landfill ever requiring a final cover at any time during the active life of the unit is provided in Part III, Appendix IIIL – Closure and Postclosure Care Cost Estimate.

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1983E

MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX IIIK
POSTCLOSURE CARE PLAN

Prepared for

Texas Regional Landfill Company, LP

February 2023

NEVZAT TURAN
84059
02/09/2023

Prepared by

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817-735-9970

WCG Project No.0771-356-11-35

This document is intended for permitting purposes only.

CONTENTS

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER

02/09/2023

1 INTRODUCTION

This attachment addresses §330.56(m).

This Postclosure Care Plan has been prepared for the Fort Worth C&D Landfill consistent with Title 30 Texas Administrative Code (TAC) Section 330. The landfill completion plan for this site consists of final contours and drainage features as depicted on Figure IIIJ-1 – Landfill Completion Plan.

2 POSTCLOSURE ACTIVITIES

2.1 Monitoring and Maintenance

In accordance with §330.463(b)(1), postclosure care maintenance will commence upon completion of final closure requirements set forth in Appendix IIIJ – Closure Plan. Postclosure care maintenance will continue for a period of 5 years unless the TCEQ approves a postclosure period of a different duration. Postclosure care maintenance will consist, at a minimum, of the following requirements carried out by Texas Regional Landfill Company, LP:

- Retain the right of entry and maintain all rights-of-way to the closed landfill.
- Conduct site inspections a minimum of twice yearly after closure.
- Conduct maintenance and/or remediation activities, as needed, to maintain the integrity and effectiveness of the final cover, site vegetation, and drainage control systems. Vegetation shall be maintained on the final cover to provide a minimum of 85 percent coverage.
- Manage surface runon and runoff in order to minimize the erosion of the final cover system.
- Correct the effects of settlement, subsidence, ponded water, erosion, or other events or failures in as much as these situations are detrimental to the integrity of the closed landfill.
- Maintain the groundwater monitoring system in accordance with §330.463(a)(2) and §330.463(b)(1)(C) and monitor groundwater in accordance with an approved Groundwater Sampling and Analysis Plan. However, Texas Regional Landfill Company, LP reserves the right to request TCEQ approval of (1) an alternative monitoring frequency, and (2) an alternative list of parameters to be monitored. Such requests will be based on supporting data available at the time of the request.

2.2 Decreasing Postclosure Period

The length of the postclosure care maintenance period may be decreased by the Executive Director if Texas Regional Landfill Company, LP submits, to the Executive Director for review and approval, a documented certification signed by an independent licensed professional engineer. Any such certification would include all applicable documentation necessary to support the certification, that demonstrates that the reduced period is sufficient to protect human health and the environment. Applicable documentation may include data from monitoring of groundwater and surface water. The certified documentation must be reviewed and approved by the TCEQ prior to decreasing the length of the postclosure care maintenance period.

2.3 Increasing Postclosure Period

The length of the postclosure care maintenance period may be increased by the TCEQ if it is determined that the increased duration is necessary to protect human health and the environment.

2.4 Completion of Postclosure Period

Upon completion of the postclosure care maintenance period, Texas Regional Landfill Company, LP will submit to the TCEQ documented certification, signed by an independent licensed professional engineer, verifying that postclosure care maintenance has been completed in accordance with the approved Postclosure Plan. The submittal will include all documentation necessary for certification of completion of postclosure care maintenance. The certification will be placed in the Site Operating Record upon approval. In addition, Texas Regional Landfill Company, LP will submit to the Executive Director a request for voluntary revocation of the facility permit. Approval of voluntary revocation will be placed in the Site Operating Record.

3 PERSON RESPONSIBLE FOR CONDUCTING POSTCLOSURE ACTIVITIES

At the time of development of this document, the following position will be responsible for overseeing and/or conducting postclosure care activities at this landfill.

Region Engineer
Texas Regional Landfill Company, LP
c/o Waste Connections
3 Waterway Square Place Suite 550
The Woodlands, TX 77380
(832) 442-2900

The position responsible for conducting postclosure activities is subject to change. However, as part of the closure notification to TCEQ, as required by Title 30 TAC §330.463(b)(3)(B), Texas Regional Landfill Company, LP will notify the TCEQ regarding the responsible position.

4 POSTCLOSURE LAND USE

4.1 Intended Use

The property is currently planned to be kept as an open green space during the post-closure period.

4.2 Constraints on Postclosure Construction

There are no current plans to construct buildings or other structures on the closed Fort Worth C&D Landfill. Nevertheless, any future construction activities on the closed landfill will be subject to the provisions of Title 30 TAC §330.954, which require, among other things, prior approval of the TCEQ.

5 POSTCLOSURE COST ESTIMATE

A detailed written cost estimate, in current dollars, of the cost of hiring a third party to conduct postclosure care activities for the Type IV municipal solid waste unit, in accordance with the Postclosure Care Plan, is provided in Appendix IIIL – Cost Estimate for Closure and Postclosure Care. The estimated postclosure care cost estimate presented in Appendix IIIL will be updated as needed to ensure continued compliance with the financial assurance requirement.

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1983E

MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX IIIL
COST ESTIMATE FOR CLOSURE AND POSTCLOSURE CARE

Prepared for

Texas Regional Landfill Company, LP

February 2023

NEVZAT TURAN
84059

02/09/2023

Prepared by

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WCG Project No. 0771-356-11-35

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CONTENTS

TABLES

FIGURES

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER
02/09/2023

1 INTRODUCTION

This Cost Estimate for Closure and Postclosure Care has been prepared consistent with Title 30 Texas Administrative Code (TAC) Chapter 330. Cost estimates are required for solid waste landfill facilities whose debts and liabilities could become the debts and liabilities of a state or the United States (i.e., in the event of forced closure, which occurs when an operational municipal solid waste landfill facility can no longer operate because of an inability to manage the incurred debts and liabilities). At such time, the responsibility for closure would be assumed by the TCEQ.

2 CLOSURE COST ESTIMATE

This cost estimate shows the cost of hiring a third party to close the largest area ever requiring closure at any time during the active life of the landfill. The closure cost estimate includes: (1) engineering costs required to administratively close the facility; (2) construction costs involved with the construction of the final cover system, landfill gas system, and other activities required to close the facility; and (3) contingencies and other administrative costs that may be incurred during closure activities. A summary of closure cost estimate is presented in Table 1.

An assessment will be completed each year to verify that the closure cost estimate shown in Table 1 is consistent with the current permit conditions and the projected permit conditions for the upcoming 12-month period. The assessment will verify that the closure costs are based on the current active and inactive areas and that all other permit conditions are addressed by the closure cost estimate (e.g., the number of groundwater monitor wells and landfill gas probes in the estimate match the wells and probes that are either in-place or need to be installed to match the number of wells and probes listed in the permit for the current phase of development).

The estimates will be updated, as needed, consistent with the procedures noted in Section 4. Continuous financial assurance coverage for closure of the facility will be provided until the facility reaches postclosure status and the requirements of the facility's final closure plan have been approved by the Executive Director. Approval documentation will be placed in the Site Operating Record. Additional information regarding the closure cost estimate is summarized below.

2.1 Engineering Costs

The existing costs are based on closing the largest area scheduled to receive final cover, which is 77.7 acres. A boundary survey will be required for the filing of the affidavit of closure, deed recording of any area of the site that has received waste, and publishing the public notice of closure activities. A topographic survey will be required to determine the existing height and top slope of the landfill so that permit compliance can be evaluated and the final closure system, drainage system, and final grading can be engineered. An inspection of the site is included to identify any disposal areas requiring closure, drainage and erosion protection improvements, and identify any potential regulatory deficiencies. The engineering costs include the cost to develop construction plans and closure schedules, closure testing and inspections, and permit document preparation. In addition, administration costs (i.e., for construction contracts) have also been included.

2.2 Construction Costs

Construction costs include construction of final cover system, site grading/drainage improvements and sedimentation controls for the 77.7 acres. Figure IIIL-1 shows the largest area to receive final cover.

TABLE 1
FORT WORTH C&D LANDFILL - CLOSURE COST ESTIMATE

Largest landfill area to be closed and capped = 77.7 Acres

Item No.	Description	Unit[1]	Unit Cost[2]	Quantity	Total Cost
	ENGINEERING				
1.1	Topographic Survey	LS	$4,000	1	$4,000
1.2	Boundary Survey for Affidavit	LS	$6,200	1	$6,200
1.3	Pre-Design Site Evaluation	LS	$36,200	1	$36,200
1.4	Development of Engineering Plans and Documents	LS	$25,000	1	$25,000
1.5	Administration	LS	$6,200	1	$6,200
1.6	QA/QC, CQA Surveying, and Cert. (Final Report)	AC	$3,700	77.7	$287,490
ENGINEERING TOTAL					**$365,090**
2.0	**CONSTRUCTION**				
2.1	Final Cover System				
2.1.1	1.5-ft-thick Compacted Soil Layer	CY	$3.65	188,034	$686,324
2.1.1	1-ft-thick (worst case) Topsoil Layer	CY	$2.40	125,356	$300,854
2.1.3	Cover Vegetation (fetilizing, seeding, and mulching)	AC	$3,050	77.7	$236,985
2.1.4	Grading and Drainage	AC	$3,650	77.7	$283,605
2.2	Wood Processing/Composting area (15 acres)				
2.2.1	Closure of Composting Area -grading & revegetation	LS	$27,200	1	$27,200
2.2.2	Closure of Composting Area -unprocessed & processed materials	CY	$2.30	104,000	$239,200
2.3.1	Closure of Wood Processing Area -grading & revegetation	LS	$6,800	1	$6,800
2.3.2	Closure of Wood Processing Area -unprocessed mat'l	CY	$2.30	20,000	$46,000
2.3.3	Closure of Wood Processing Area -processed mat'l	CY	$0.60	8,000	$4,800
2.4	Large Items/White Goods Storage Area (100 ft X 100 ft)				
2.4.1	Clousre of large Items/White Goods Area - grading & revegetation	LS	$2,300	1	$2,300
2.4.2	Closure of large Items/White Goods Area - material disposition	CY	$2.40	500	$1,200
2.5	C&D Recyclable Sorting Area (2 Acres)				
2.5.1	Closure of C&D Recycable Sorting Area -grading & revegetation	LS	$4,500	1	$4,500
2.5.2	Closure of C&D Recycable Sorting Area - material disposition	CY	$2.40	1,000	$2,400
2.6	Cleanup Scalehouse, Maintenance Building, and Office	LS	$23,700	1	$23,700
CONSTRUCTION SUBTOTAL					**$1,865,869**
ENGINEERING AND CONSTRUCTION SUBTOTAL					**$2,230,959**
3.0	**CONTINGENCY 10%**				**$223,096**
4.0	**CONTRACT PERFORMANCE BONDS (1.5% of Eng/Constr Subtotal)**				**$33,464**
5.0	**TCEQ CONTRACT ADMIN & LEGAL FEES (1% of Eng/Constr Subtotal)**				**$22,310**
TOTAL CLOSURE COST					**$2,509,828**

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[1] LS = Lump Sum; AC = Acres; CY = Cubic Yards.

[2] Unit costs are in 2023 dollars. Unit costs are based on current market conditions, typical engineering costs, and industry standards related to construction and reflect input from Waste Connections and Weaver Consultants Group, LLC.

3 POSTCLOSURE CARE COST ESTIMATE

The postclosure care period has been established by TCEQ regulations to be 5 years. This detailed cost estimate shows the cost of hiring a third party to conduct routine maintenance and maintaining during the post closure period. During this period, continuous maintenance must be ongoing to assure the integrity and effectiveness of the final cover system, monitoring systems, leachate collection system, drainage system, and landfill gas system. A summary of postclosure costs is presented in Table 2. The costs will be adjusted annually as indicated in Section 4.

Engineering postclosure estimates include the cost of annual site inspections, corrective plans and specifications, and site compliance monitoring. The estimates are based on completely postclosure care within the entire permit boundary. Site inspections will be performed annually and will include identification of areas experiencing settlement or subsidence, identification of erosion or other drainage-related problems, and inspection of the leachate collection system, gas control and monitoring system, and the groundwater monitoring system. Correctional plans and specifications include the costs for an engineering consultant to prepare construction plans and specifications to correct problems identified during the site inspections. Gas monitoring and groundwater sampling and analysis will be performed as outlined in the postclosure plan.

Postclosure construction/maintenance estimates include the costs to correct problems identified during the engineering site inspections and as specified by the engineer's correctional plans and specifications. These costs will also include any ongoing site maintenance that is needed throughout the postclosure period. These costs include cover and drainage maintenance and annual seeding and mowing costs.

TABLE 2

FORT WORTH C&D - POSTCLOSURE CARE COST ESTIMATE[1,3]

10	Number of Groundwater wells
13	Number of LFG Detection Probes
77.7	AC, Final Cover Area
184.3	AC, Permit Boundary
5	years, Post Closure Care Period

Item No.	Description	Unit[2]	Unit Cost[1]	Quantity	Total Cost
1.0	**ENGINEERING**				
1.1	Facility Inspection and Record Keeping	YR	$6,700	1	$6,700
1.2	Incidental Engineering Work	LS	$5,600	1	$5,600
2.0	**FINAL COVER MAINTENANCE**				
2.1	Facility Maintenance & Repairs	YR	$23,400	1	$23,400
2.2	Mowing	AC	$100	77.7	$7,770
3.0	**MONITORING**				
3.1	Quarterly Methane Gas Monitoring & Report	EA	$1,675	4.0	$6,700
3.2	Groundwater Sampling/Lab & Report	EA	$2,675	10.0	$26,750
	ANNUAL COST				**$76,920**
4.0	CONTINGENCY 10%				$7,692.0
5.0	TCEQ ADMINISTRATION COST (5% of total post-closure cost)				$3,846.0
	TOTAL ANNUAL POSTCLOSURE CARE COST				**$88,458.0**
	TOTAL POST CLOSURE CARE COST				**$442,290.0**

[1] Unit cost are in 2023 dollars.

[2] LS = Lump Sum; YR = Year, AC = Acre, EA = Each

[3] Units costs are estimates for post-closure care based on activities performed by a third-party.

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NEVZAT TURAN
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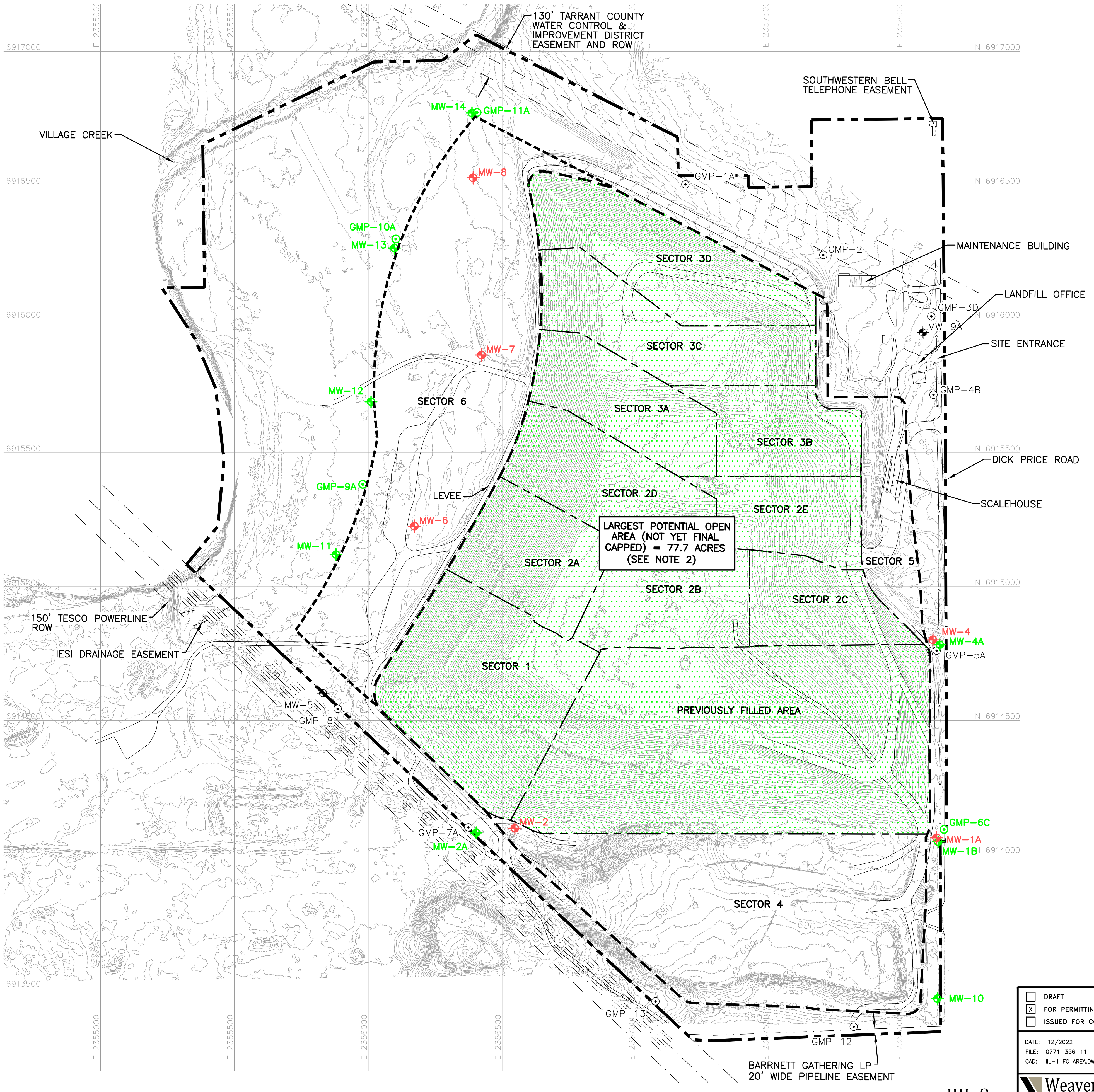
4 COST ESTIMATE ADJUSTMENTS

During the active life of the site, Texas Regional Landfill Company, LP will annually adjust the cost estimates for inflation within 60 days prior to the anniversary date of the establishment of the financial instrument(s). The adjustment may be made by recalculating the maximum costs of closure in current dollars, or by using an inflation factor derived from the most recent Implicit Price Deflator for Gross National Product published by the United States Department of Commence in its Survey of Current Business. The inflation factor is the result of dividing the latest published annual deflator by the deflator for the previous year. The first adjustment is made by multiplying the closure cost estimate by the inflation factor. The result is the adjusted closure cost estimate. Subsequent adjustments are made by multiplying the latest adjusted closure estimate by the latest inflation factor.

An increase in the closure or postclosure cost estimate and the amount of financial assurance will be made if changes to the final closure or postclosure care plan or the landfill conditions increase the maximum cost.

A reduction in the closure or postclosure care cost estimate and the amount of financial assurance may be submitted if the cost estimate exceeds the maximum costs of closure at any time during the remaining life of the unit or postclosure care remaining over the postclosure care period. Texas Regional Landfill Company, LP will submit written notice to the executive director of the detailed justification for the reduction of the cost estimates and the amount of financial assurance. A reduction in the cost estimate and financial assurance shall be considered a permit modification.



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0 200 400
SCALE IN FEET

LEGEND

— - —	LANDFILL PERMIT BOUNDARY
— — —	LIMITS OF WASTE
- - - -	PROPOSED LIMIT OF WASTE
—700—	EXISTING CONTOUR
N 6816000	STATE PLANE COORDINATE
32° 21' 20"	GEODETIC COORDINATE
—— - ——	SECTOR BOUNDARY
⊗ EW-A9	EXISTING LFG EXTRACTION WELL
——	EXISTING LFG COLLECTION PIPING
⊕ MW-7	EXISTING GROUNDWATER MONITORING WELL
⊙ GMP-12	EXISTING GAS MONITORING PROBE
🟩	AREA REQUIRING FINAL COVER
⊕ MW-7	PROPOSED GROUNDWATER MONITORING WELL
⊙ GMP-17	PROPOSED GAS MONITORING PROBE
⊕ MW-7	EXISTING GROUNDWATER MONITORING WELL (TO BE ABANDONED)

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN ON 02-17-2022. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983.
2. NOTE THAT THE ACREAGE USED IN THE CLOSURE COST ESTIMATE WILL BE EVALUATED ANNUALLY AND UPDATED AS NEEDED TO REFLECT INCREASE OR DECREASES IN THIS ACREAGE, AS OUTLINED IN PART III, APPENDIX IIIL.

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02/09/2023

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 12/2022
FILE: 0771-356-11
CAD: IIIL-1 FC AREA.DWG

DRAWN BY: SRF
DESIGN BY: JBP
REVIEWED BY: CRM

PREPARED FOR
TEXAS REGIONAL LANDFILL COMPANY, LP

REVISIONS

NO.	DATE	DESCRIPTION

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

MAJOR PERMIT AMENDMENT LARGEST AREA TO REQUIRE FINAL COVER

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS

WWW.WCGRP.COM

FIGURE IIIL-1

O:\0771\356\EXPANSION 2022\PART III\IIIL\IIIL-1 LARGEST AREA TO REQUIRE FC.dwg, jwilson, 1:2

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1983E

MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIM
GEOTECHNICAL REPORT

Prepared for

Texas Regional Landfill Company, LP

February 2023

DAVID E. POE
81734
02/09/2023

Prepared by

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WCG Project No. 0771-356-11-35

This document is intended for permitting purposes only.

CONTENTS

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02/09/2023

CONTENTS (Continued)

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TABLES

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1 INTRODUCTION

This appendix addresses §330.63(e)(5)(A) and (B).

The purpose of this report is to present the geotechnical analysis and design for the proposed major permit amendment for the vertical and lateral expansion of the Fort Worth C&D Landfill (landfill). The landfill is a Type IV landfill, and accepts brush, construction and demolition waste, and rubbish. Municipal solid waste is not accepted at this landfill. This report is based on the geotechnical investigations and testing information that has previously been compiled from the subsurface investigations at the site and additional information obtained during recent investigations.

This report contains a compilation of geotechnical analysis and design information, including:

- Slope stability analyses based on the geotechnical testing results and subsurface conditions, including groundwater, for landfill excavations, landfill completion, and sequence of development (interim condition analysis) plans; and
- Settlement analysis of the final cover system, which are also based on the landfill excavation and completion plans.

As this landfill is a Type IV landfill and does not incorporate a leachate collection and removal system, analysis of settlement of the landfill bottom liner was deemed unnecessary and has not been incorporated into this appendix. Testing of the in-situ unweathered shale/marl (Grayson Formation) which comprises the floor and portions of sidewalls of the landfill indicates this shale/marl will undergo little or no consolidation settlement during future waste loading and will not influence the overall performance of the liner or final cover systems. It is further assumed that the generally low plasticity, sandy and gravelly alluvium soils will undergo primary and partial secondary consolidation during waste placement and prior to final cover installation and will not impact the long-term performance of the final cover system and has therefore not been incorporated into the final cover settlement analysis.

This report also provides geotechnical recommendations for construction of the landfill components, including bottom liner (for sidewall areas receiving 3-foot-thick recompacted clay liner over alluvium) and final cover systems. The construction quality control and material and construction specifications for the groundwater protection components of the landfill are provided in Appendix IIID – Liner Quality Control Plan (LQCP) and Appendix IIIE – Final Cover System Quality Control Plan (FCSQCP).

2 LABORATORY TESTING

2.1 Introduction

Numerous geological investigations have been performed at the landfill and included the sampling and geotechnical testing of samples obtained during the investigations. A brief description of the geological/geotechnical characteristics of the site are provided in the Section 3 of this appendix. Additional geological and hydrogeological discussion is provided in Appendix IIIG – Geology Report of this application.

The subsurface conditions beneath the site are divided into four geological units and further divided into seven geotechnical strata (i.e., "soil layers"). The geologic description of the site stratigraphy is presented in the Geology Report (Appendix G). Note that the nomenclature for the units and layers is generally the same as used in the current permit (1983D) and are as summarized below.

- Quaternary Alluvium
  - Layer I: Alluvial Clay (CL, CH)
  - Layer II: Alluvial Sand and Gravel (SP, SC, GP, GC)
  - Layer III: Slopewash (CL, CH, SC)
- Woodbine Formation (outcrops only on eastern portion of site)
  - Layer IV: Sand and Clay Layers (CL, SP-SC, SC, SP)
- Grayson Formation
  - Layer V: Weathered Shale (CH, CL)
  - Layer VI: Unweathered Shale (CH, CL)
- Main Street Formation
  - Layer VII: Limestone

2.2 Previous Geotechnical Investigations

A field exploration program to evaluate the southern expansion area (Sector 4) of the site was conducted by WCG from December 2018 to March 2019 in accordance with a Soil Boring Plan which was approved by the Texas Commission on Environmental Quality (TCEQ) on January 3, 2019. Eleven borings (WC-1 through WC-11) were drilled, and piezometers were installed at four of the boring locations (WC-1, WC-6, WC-8, and WC-10) under the direction of a geologist. Additional information on the most recent TCEQ-approved Soil Boring Plan, the associated field activities, the location of the borings, the boring logs, and the hydrogeologic site characterization is presented in the Appendix IIIG – Geology Report.

As part of the previous permit amendment application (MSW-1983D), Geosyntec conducted a field investigation in December 2013. Seven (7) borings (B-201 through B-207) were drilled and the borings were logged by a field engineer. Periodic standard penetration tests (SPTs) were performed to evaluate soil consistency and to classify the soils, and samples were collected and sent to TRI Environmental, Inc. (TRI) in Austin, Texas for testing to characterize the geotechnical properties of the soils and strata at the locations of interest at the site.

Other subsurface investigation activities at the site have been completed by Baker-Shiflett (1986 and 1991), Freese and Nichols (1989 and 2001), Biggs and Matthews (2001), and Team Consultants (2013). As part of these investigations a total of 93 boreholes were drilled at the site, of which nine were completed as groundwater monitoring wells and 17 were completed as piezometers. During these subsurface investigations, samples were collected, and laboratory testing was performed to characterize the geotechnical and hydrogeological properties of the soils and strata at the site. Information on the boring locations and depths, and logs of the borings, are provided in the Appendix IIIG – Geology Report.

The geotechnical data from the above investigations is discussed in Section 3 of this report, summarized in Table 3.1 through 3.5 (for investigations conducted in 2013 and 2019), and included in Appendix IIIM-C. A summary of the laboratory tests performed is presented in Table 2-1 of this report.

2.3 Previous Geotechnical Laboratory Testing

Laboratory tests have been conducted on samples collected during the various field investigations described above. Testing was conducted on select samples recovered from the borings drilled to evaluate the physical and engineering properties of the different strata. Laboratory tests were performed in general accordance with ASTM procedures. Available laboratory testing results from the previous investigations are provided in Appendix IIIM-C, and on boring logs included in Appendix IIIG – Geology Report.

Table 2-1
Geotechnical Test Methods Performed

Test	Test Method
Sieve Analysis (Passing No. 200)	ASTM D 1140
Atterberg Limits (Liquid & Plastic Limit)	ASTM D 4318
Moisture Content	ASTM D 2216
Unconfined Compression	ASTM D 2166 & Pocket Penetrometer
Drained Triaxial Compression Test	ASTM D 2850
Undrained Triaxial Compression Test	ASTM D 4767
Coefficient of Permeability (Hydraulic Conductivity)	ASTM D 5084 Method F
Consolidation	ASTM D 2435
Hand Penetrometer Testing	ASTM D 2573
Standard Proctor	ASTM D 698

2.3.1 Classification Tests

Classification tests consisting of Atterberg limits, percent passing the number 200 sieve, dry unit weight, and moisture content were performed on selected soil samples recovered from boreholes. These test results are presented in Appendix IIIM-C and are summarized in Table 3-1. Classification tests were used to characterize the soils according to the Unified Soil Classification System (USCS) and to evaluate the physical properties of the soils.

2.3.2 Material Strength Tests

Material strength tests were performed to provide generalized strength parameters that were used to evaluate the soils at the site and provide information for stability analyses performed of the proposed landfill expansion. Unconfined compression tests were performed in the field using a hand penetrometer, with additional laboratory unconfined compression tests (ASTM D 2166) also performed. Both drained (ASTM D 2850) and undrained (ASTM D 4767) triaxial strength testing also was performed on samples collected during field investigations. Shear strength parameters for each layer were developed from correlation of the field and laboratory test results. The shear strength correlations incorporated into the stability analyses performed of the landfill are presented in Table 3-3.

2.3.3 Coefficient of Permeability Tests

Laboratory coefficient of permeability (hydraulic conductivity) tests were performed to evaluate the hydrogeological properties of the soils and shale at the site.

The results are summarized in Table 3-2 and also provided in Appendix IIIG – Geology Report.

The index properties of Layer I, Layer III, and Layer V suggest that these materials can be remolded to produce low permeability recompacted liners. Laboratory tests on remolded samples from Layer I and V to measure their hydraulic conductivity reveal that these materials have a low permeability. The geometric mean of the hydraulic conductivity of remolded Layer I samples is $3.8\text{x}10^{-8}$ cm/s, and the geometric mean of the hydraulic conductivity of remolded Layer V samples is $1.8\text{x}10^{-8}$ cm/s. The results confirm that Layer I and V can produce low-permeability remolded soil with hydraulic conductivity less than $1\text{x}10^{-7}$ cm/s. Layer III materials are geologically similar to those found in Layer I (CH and CL soils) and would additionally be anticipated to produce an adequate low-permeability remolded soil suitable for use as recompacted clay liner and final cover infiltration soil.

2.3.4 Consolidation Tests

Various consolidation tests have been performed on samples obtained from field investigations. The results are presented in Table 3-4.

As shown, the site strata generally exhibit consolidation characteristics of medium to high plasticity clays. Testing off the Grayson shale/marl demonstrates that the shale is a hard geological formation with high shear strength and relatively high preconsolidation pressures with associated low consolidation properties. The shales are expected to undergo little primary consolidation during future waste loading. As the landfill does not incorporate leachate collection and removal systems, and based on the strength and consolidation characteristics of the shale foundation stratum, analysis of the load-induced settlement within the (primarily) shale foundation was not performed.

2.3.5 Moisture-Density Relationships

Standard Proctor laboratory compaction tests were performed during previous recompacted clay liner construction activities at the site. The tests were performed to evaluate the moisture-density relationship of the clay soils that can be used for bottom liner and final cover construction.

Remolded samples for coefficient of permeability tests were compacted by static loading the sample to approximately 95 percent of the standard Proctor maximum dry density at approximately the optimum moisture content determined from the Proctor test. These values were reviewed for comparison with typical landfill liner properties incorporated into the stability analyses. The results to date demonstrate that the on-site clays are suitable for bottom liner construction, and able to achieve the $1\text{x}10^{-7}$ cm/sec permeability criteria. Sufficient soil quantities suitable for liner and final cover construction is available on-site, although clayey soils may also be imported from off-site borrow sources if needed.

2.4 Conclusion of Laboratory Testing

Classification testing along with unit weight, moisture content, and sieve analysis results were used to support field observations during subsurface explorations. Testing results were also used to support the subsurface characterization which includes the three formations that exist generally across the site. Additionally, soil strength parameters from both field and laboratory were conservatively generalized and selected for use in the geotechnical stability analysis included in this report.

3 PROPERTIES OF SITE SOILS AND LANDFILL COMPONENTS

3.1 General

This section of the report includes the generalized stratigraphy for the site, typical properties of subsurface soils, potential uses of materials that may be excavated during construction, and soil material requirements for various components of the landfill. The results of the geotechnical testing performed on site soils are included in Appendix IIIM-C, and summarized in Tables 3-1 through 3-5, below.

3.2 Site-Specific Stratigraphy

The currently permitted site-specific geologic characterization is detailed in the Geology Report (Appendix IIIG). The permitted site-specific stratigraphic units are delineated on the basis regional geologic formation nomenclature and include Quaternary Alluvium, Woodbine Formation, Grayson Shale, Mainstreet Limestone, and Pawpaw Formation. The “Grayson Shale” is also referred to as “Grayson Marl,” consistent with BEG nomenclature (BEG, 1987). However, for this appendix, the more general term shale is used in describing this formation.

3.2.1 Layer 1 – Quaternary Alluvium

The majority of surficial sediments across the site consist of Quaternary Alluvium. According to BME (2015), the predominant sediments within this unit consist of varying proportions of poorly consolidated clay, sand, gravel, and silt exhibiting varying degrees of saturation (from dry to wet) with a maximum thickness of about 45 feet. Alluvium is not present in the easternmost site area, where the Grayson Marl and Woodbine formations outcrop parallel to Dick Price Road. The alluvium sediments have been removed by site development excavations within the currently constructed limits of waste but are anticipated to be encountered in the exterior cell excavation sideslopes during construction of Sectors 4, 5, and 6.

3.2.2 Layer 2 – Woodbine Formation

The Woodbine Formation outcrops along the easternmost portion of the site. According to BME (2015), the predominate sediments within this unit consist of unconsolidated to poorly consolidated sand and clay exhibiting varying degrees of saturation (from dry to wet) and a maximum thickness of about 40 feet.

3.2.3 Layer 3 – Grayson Marl (Shale)

The Grayson Marl outcrops west of the Woodbine outcrop in a limited area in the northcentral portion of the site and underlies the alluvium and Woodbine sediments. According to BME (2015), the Grayson Marl consists of moist, weathered, clayey shale overlying dry, unweathered, calcareous, clayey shale with an overall maximum thickness of about 100 feet. The weathered shale is described as blocky and jointed with sand-filled joints at outcrop. The unweathered shale is described as massive, fossiliferous, calcareous shale containing nodular limestone near its base.

3.2.4 Layer 4 – Main Street Limestone

Underlying the Grayson Marl, the Main Street Limestone consists of hard, dry limestone interbedded with dry, calcareous, clayey shale that ranges in thickness from about 28 to 31 feet across the site. It is noted that the BEG (1987) regional geologic formation taxonomy categorized the Grayson Marl and Main Street Limestone as a single undivided formation.

3.2.5 Layer 5 – Pawpaw Formation

The Pawpaw Formation underlies the Main Street Limestone and consists predominately of hard, dry, calcareous shale. None of the existing boreholes have penetrated the vertical extent of the Pawpaw beneath the site.

3.2.6 Alluvium Groundwater Zone

According to the existing subsurface characterization, groundwater within the alluvium is unconfined and constitutes the facility's designated uppermost aquifer. Groundwater within the Alluvium zone flows to the west toward Village Creek. Field slug test data for this zone indicate a hydraulic conductivity range of 1.61×10^{-3} to 9.71×10^{-3} cm/sec (BME, 2015). Recharge to the Alluvium groundwater zone occurs primarily by infiltration of precipitation. As described in Appendix IIID – Liner Quality Control Plan (LQCP), a groundwater dewatering underdrain has been included in portions of future sidewall recompacted clay liner to control hydrostatic uplift pressures on the bottom of the liner from this groundwater.

3.3 Material Requirements for Landfill Components

Construction of the landfill will require clay or clayey soils which can be recompacted to have an in-place hydraulic conductivity of 1×10^{-7} cm/sec or less for sidewall liner areas requiring a recompacted clay liner (i.e., areas identified as not having sufficient in-situ shale to act as liner). Low permeability soils also will be required for the soil infiltration layer component of the final cover system.

Soil will also be required for use as protective cover over the recompacted clay liner, operational cover soil, berm and roadway construction, and other miscellaneous general and structural fill requirements. Granular material (i.e., gravel) will be used for the underdrain sidewall sumps or underdrain collection trenches.

Testing requirements and construction quality control and quality assurance for recompacted clay liner soils are detailed in Appendix IIID – LQCP. Testing requirements and construction quality control and quality assurance for final cover soils are detailed in Appendix IIIJ – Closure Plan and in Appendix IIIE – FCSQCP. Liner and final cover details are presented in Appendix IIIA-A – Liner and Final Cover System Details.

Table 3-1[8]
Summary of Geotechnical Material Property Test Results: 2013 and 2019 Geotechnical Investigations

Boring Number	Sample Depth		Layer	USCS[2] Classification	Water Content[3]	Atterberg Limits[4,5]			Fines[6]	Specific Gravity[7]	Dry Unit Weight
	Start ft BGS[1]	End ft BGS[1]			%	LL %	PL %	PI %	%	-	pcf
B-201	2	3	Fill	CH	17.5	55	21	34	88	-	-
	9	10.5	II	SC	9.1	29	14	15	48	-	-
	19	20.5	V	CH	18.2	54	21	33	96.5	-	-
	20.5	22	VI	CH	16.5	56	21	35	76	-	-
B-202	4	6	Fill	CH	12.9	54	20	34	58.2	-	-
	7	8.5	I	CL	15.4	43	18	25	81	-	-
	9	11	I	CL	15.4	45	15	30	81.9	-	-
	14	16	I	CL	16.4	43	16	27	86.4	-	-
	17	18.5	I	CH	19.6	53	17	36	85	-	-
	19	21	I	CL	16.9	48	20	28	84.2	-	110.2
	24	25	II	CH	20.2	54	17	37	59.6	-	-
	27	28.5	V	CH	25.2	68	24	44	93	2.79	-
B-203	3	4.5	Fill	CL	11.2	43	17	26	56.7	-	-
	4.5	6	Fill	CL	12.6	42	17	25	75	2.78	-
	7	9	I	CL	14.3	44	16	28	73.5	-	-
	13	15	I	CH	19.3	52	18	34	78.8	-	99.5
	15	16.5	I	CH	24.8	66	22	44	83	2.77	-
	17	19	II	CL	11.6	38	13	25	56.4	-	-
	23	23.9	V	CH	16.6	59	22	37	98.4	-	106.3
	23.9	25.4	VI	CL	13.4	47	19	28	95	-	-
B-204	4	6	Fill	CH	14.8	50	19	31	90.8	-	-
	9	11	I	CL	13.7	38	17	21	94.7	-	114.4
	12.5	13.75	I	CL	10.8	34	15	19	64.4	-	-
	15.5	17.5	I	CL	14.9	34	14	20	60.8	-	-
	19	21	II	CL	12.7	33	12	21	52.4	-	-
	24.3	25.8	II	SM	12.4	23	NP	NP	21	-	-
B-205	8.5	10	II	CL	17.1	31	13	18	62	-	-
	19	20.5	II	SM	14.1	23	NP	NP	36	2.74	-
	29.25	30.75	II	SM	20.4	23	NP	NP	4	-	-

Table 3-1[8] (Continued)
Summary of Geotechnical Material Property Test Results: 2013 and 2019 Geotechnical Investigations

Boring Number	Sample Depth		Layer	USCS[2] Classification	Water Content[3]	Atterberg Limits[4,5]			Fines[6]	Specific Gravity[7]	Dry Unit Weight
	Start	End				LL	PL	PI			
	ft BGS[1]	ft BGS[1]			%	%	%	%		ft BGS[1]	ft BGS[1]
B-206	8	9.5	Fill	CL	23.2	41	17	24	61	-	-
	10	12	Fill	CL	23.1	44	17	27	73.5	-	101
	20	21.5	Fill	CL	19.1	44	17	27	93.7	-	-
	25	26.5	III	CL	22.7	39	14	25	78	2.79	-
	28	30	III	CH	20.8	66	23	43	97.3	-	103
	33	35	V	CH	26.8	68	26	42	95.5	-	-
	35	36.5	V	CL	15.2	46	18	28	85	-	-
	38	39.5	VI	CL	15.4	39	16	23	83	2.8	-
B-207	5	6	Fill	CL	13.2	35	19	16	57.5	-	-
	6	7.5	Fill	CL	14.3	35	15	20	65	-	-
	29	30.5	III	-	14.6	-	-	-	-	-	-
	33	34	III	CL	16.5	37	23	14	55.9	-	-
	49	50.5	V	CL	16.2	47	18	29	86	-	-
WC-1	40	42	VI	-	10.1	38	17	21	91.1	-	-
WC-3	8	10	I	-	18.8	41	15	26	63.7	-	109.1
	10	15	I	-	23.6	49	22	27	81.1	-	-
	20	25	V	-	17.4	59	25	34	92.0	-	-
WC-4	69	70	III	-	16.1	-	-	-	66.6	-	-
WC-5	53	55	V	-	17.2	-	-	-	76.4	-	-
WC-6	23	25	II	-	7.1	-	-	-	42.6	-	-
	48	50	V	-	18.8	66	24	42	98.3	-	112.7
WC-7	13	15	II	-	14.0	-	-	-	54.8	-	-
	21	22	III	-	14.2	28	13	15	60.3	-	113.0
	28	30	IV	-	0.3	-	-	-	45.3	-	-
	30	32	IV	-	1.8	-	-	-	40.1	-	-
	48	50	V	-	23.3	39	17	22	78.1	-	-
WC-8	35	37	II	-	16.7	-	-	-	47.7	-	-
	56	58	V	-	20.8	43	16	27	81.2	-	-

Table 3-1[8] (Continued)
Summary of Geotechnical Material Property Test Results:
2013 and 2019 Geotechnical Investigations

Boring Number	Sample Depth		Layer	USCS[2] Classification	Water Content[3]	Atterberg Limits[4 5]			Fines[6]	Specific Gravity[7]	Dry Unit Weight
	Start	End				LL	PL	PI			
	ft BGS[1]	ft BGS[1]			%	%	%	%	%	-	pcf
WC-9	10	13	II	-	19.0	-	-	-	45.4	-	103.8
	18	20	HI	-	21.8	45	16	29	87.8	-	-
WC-10	7	9	II	-	16.4	-	-	-	24.0	-	-
	18	20	V	-	22.5	63	14	49	88.7	-	103.7

[1] BGS = Below ground surface.

[2] USCS = Unified Soil Classification System.

[3] Moisture content measured in accordance with ASTM D2216. If multiple values were reported for a given depth, average value is included in table. Appendix 1 and Appendix 2 contain complete report for every test.

[4] Atterberg Limits measured in accordance with ASTM D4318.

[5] NP results indicate nonplastic soil.

[6] Fines = Particles finer than #200 sieve (0.074 mm).

[7] Specific gravity measured in accordance with ASTM D854.

[8] Laboratory data compiled in above table from 2013 and 2019 geotechnical investigations and are assumed representative of the geological conditions present at the site. Table reproduced from Permit Amendment Application, Fort Worth C&D Landfill, Geosyntec Consultants, March 9, 2021 (Technically Complete).

Table 3-2[3]
Summary of Hydraulic Conductivity Test Results

Boring Number	Layer	USCS[1] Classification or Rock	Vertical Hydraulic Conductivity[2]	Horizontal Hydraulic Conductivity[2]	Remolded Hydraulic Conductivity[2]
			k_v (cm/s)	ki_h (cm/s)	k (cm/s)
B-13	I	CL	-	-	4.17E-08
B-13	I	CL	-	-	1.69E-08
B-25	I	CL	-	-	2.94E-08
B-25	I	CL	-	-	9.60E-08
WC-3	I	CL	9.30E-09	-	-
Layer I Geometric Mean			9.30E-09	-	3.76E-08
WC-9	III	CL	1.40E-08	-	-
Layer II Geometric Mean			1.40E-08	-	-
B-6	V	SH-CH	-	-	2.16E-08
B-6	V	SH-CH	-	-	8.49E-09
B-15	V	SH-CH	-	-	3.13E-08
WC-3	V	SH-CH	7.90E-09		-
WC-5	V	SH-Grayson	2.40E-09		-
Layer V Geometric Mean			4.35E-09	-	1.79E-08
B-21	VI	SH-Grayson	4.31E-09	1.96E-08	-
B-21	VI	SH-Grayson	-	1.16E-08	-
B-21	VI	SH-Grayson	3.99E-09	5.63E-09	-
B-21	VI	SH-Grayson	-	1.29E-08	-
B-101	VI	SH-Grayson	4.57E-08	-	-
B-101	VI	Calc. Shale	-	1.30E-05	-
B-102	VI	Calc. Shale	1.56E-08	-	-
B-102	VI	SH-Grayson	-	1.55E-05	-
B-103	VI	Calc. Shale	-	2.22E-05	-
B-104	VI	Calc. Shale	-	1.14E-04	-
B-104	VI	Calc. Shale	8.10E-09	-	-
B-105	VI	SH-Grayson	-	4.88E-06	-
B-105	VI	SH-Grayson	-	1.10E-05	-
B-105	VI	SH-Grayson	-	3.92E-05	-
B-105	VI	SH-Grayson	5.73E-09	-	-
WC-1	VI	SH-Grayson	3.20E-08	-	-
WC-5	VI	SH-Grayson	6.20E-10	-	-
Layer VI Geometric Mean			7.61E-09	1.30E-06	-

Table 3-2[3] (Continued)
Summary of Hydraulic Conductivity Test Results

Boring Number	Layer	USCS[1] Classification or Rock	Vertical Hydraulic Conductivity[2]	Horizontal Hydraulic Conductivity[2]	Remolded Hydraulic Conductivity[2]
			k_h (cm/s)	k_h (cm/s)	k (cm/s)
B-21	VII	LM-Main St.	2.94E-08	1.09E-08	-
B-101	VII	LM-Main St.	2.06E-08	-	-
B-104	VII	LM-Main St.	-	1.98E-05	-
B-105	VII	LM-Main St.	9.83E-08	-	-
Layer VII Geometric Mean			3.90E-08	4.65E-07	-

[1] USCS = Unified Soil Classification System. Also, "SH" refers to shale (rock), "Calc." refers to calcareous, and "LM" refers to limestone (rock).

[2] Hydraulic Conductivity values evaluated in accordance with ASTM D5084.

[3] Laboratory data compiled in above table from 2013 and 2019 geotechnical investigations and are assumed representative of the geological conditions present at the site. Table reproduced from Permit Amendment Application, Fort Worth C&D Landfill, Geosyntec Consultants, March 9, 2021 (Technically Complete).

Table 3-3[4]
Summary of Shear Strength Test Results

Boring Number	Sample Depth		Layer	Undrained Shear Strength[2]			Drained Shear Strength[3]	
	Start	End		Su	c	ϕ	c'	ϕ'
	ft BGS[1]	ft BGS[1]		psf	psf	degrees	psf	degrees
B-201	3	4.3	Fill (Perimeter Road)	9,403	-	-	-	-
B-201	3	4.3	Fill (Perimeter Road)	-	5,544	11.8°	-	-
B-204	4	6	Fill (Levee)	-			-	-
B-206	10	12	Fill (Stockpile)	2,016	-	-	-	-
B-202	4	6	Fill (Levee)	-	-	-	331.2	24.1°
B-206	10	12	Fill (Stockpile)	-	-	-		
B-206	20	21.5	Fill (Stockpile)	-	-	-		
Fill		Average		5,709	5,544	11.8°	331.2	24.1°
B-202	9	11	I	-	3,355 5.8°		-	-
B-202	14	16	I	-			-	-
B-202	19	21	I	-	-	-	345.6	21.6°
Layer I Average				-	3,355	5.8°	345.6	21.6°
B-203	17	19	II	-	1,469	24.7°	-	-
B-204	19	21	II	-			-	-
Layer II Average				-	1,469	24.7°	-	-
B-206	33	35	V	-	-	-	417.6	22.3°
WC-3	20	25	V	-	-	-	302.4	19.3°
WC-5	53	55	V	706	-	-	-	-
WC-6	81	84	V	5,458	-	-	-	-
WC-7	55	57	V	504	-	-	-	-
WC-8	56	58	V	20,074	-	-	-	-
Layer V Average				6,686	-	-	360.0	20.8°
WC-3	58	63	VI	10,598	-	-	-	-
WC-3	75	77	VI	12,787	-	-	-	-
WC-4	160	162	VI	19,109	-	-	-	-
WC-5	126	134	VI	35,438	-	-	-	-
WC-7	83	85	VI	13,752	-	-	-	-
WC-7	104	106	VI	23,515	-	-	-	-
WC-7	124	126	VI	23,515	-	-	-	-
WC-9	38	40	VI	7,848	-	-	-	-
Layer VI Average				18,320	-	-	-	-

Table 3-3[4] (Continued)
Summary of Shear Strength Test Results

Boring Number	Sample Depth		Layer	Undrained Shear Strength[2]			Drained Shear Strength[3]	
	Start	End		Su	c	ϕ	c'	ϕ'
	ft BGS[1]	ft BGS[1]		psf	psf	degrees	psf	degrees
WC-4	174	176	VII	27,878	-	-	-	-
WC-5	146	149	VII	67,867	-	-	-	-
WC-5	161	163	VII	19,008	-	-	-	-
WC-7	120	122	VII	53,208	-	-	-	-
Layer VII Average				41,990	-	-	-	-

[1] BGS = Below ground surface.

[2] Undrained shear strengths measured in accordance with ASTM D2850 and ASTM D2166.

[3] Drained shear strengths measured in accordance with ASTM D4767.

[4] Laboratory data compiled in above table from 2013 and 2019 geotechnical investigations and are assumed representative of the geological conditions present at the site. Table reproduced from Permit Amendment Application, Fort Worth C&D Landfill, Geosyntec Consultants, March 9, 2021 (Technically Complete).

Table 3-4[4]
Summary of Consolidation Test Results

Boring Number	Sample Depth Layer		Layer	Preconsolidation Pressure[3]	Compression Index[2]	Recompression Index
	Start	End		σ'$_p$	C_c	C_r
	ft BGS[1]	ft BGS[1]		psf		
B-204	9	11	Fill	3,000	0.120	0.033
B-206	10	12	Fill	5,900	0.208	0.022
B-202	19	21	I	3,600	0.140	0.020
B-203	13	15	I	6,200	0.144	0.017
B-206	28	30	III	4,100	0.203	0.058
B-203	23	23.9	V	10,000	0.177	0.020

[1] BGS = Below ground surface.

[2] One-dimensional consolidation tests performed in accordance with ASTM D 2435, Method B.

[3] Preconsolidation pressures evaluated per Casagrande Method (1936).

[4] Laboratory data compiled in above table from 2013 and 2019 geotechnical investigations and are assumed representative of the geological conditions present at the site. Table reproduced from Permit Amendment Application, Fort Worth C&D Landfill, Geosyntec Consultants, March 9, 2021 (Technically Complete).

Table 3-5[1]
Summary of Laboratory Test Results – Previous Subsurface Investigations

Test		Layer I		Layer II		Layer III		Layer IV		Layer V		Layer VI		Layer VII	
		Avg. Value	# of Tests	Avg. Value	# of Tests	Avg. Value	# of Tests	Avg. Value	# of Tests	Avg. Value	# of Tests	Avg. Value	# of Tests	Avg. Value	# of Tests
Classification	Liquid Limit, %	44	35	26.5	5	55	2	41	2	53	16	38	24	-	-
	Plasticity Index (%)	29.5	35	14	5	38	2	26	2	34	16	21	8	-	-
	% Passing #200 Sieve	76	36	38	7	91	2	50	3	97	16	93	9	-	-
	Moisture Content, (%)	18	16	13	3	14	2	15	3	17	7	12.3	47	11.3	5
	Unit Dry Weight (pcf)	110	16	122	3	115	2	108	3	117	7	124	45	124	5
Hydraulic Conductivity	Vertical (cm/s)	-	-	-	-	-	-	-	-	-	-	1.4E-08	6	3.9E-08	3
	Horizontal (cm/s)	-	-	-	-	-	-	-	-	-	-	2.0E-05	11	9.9E-06	2
	Remolded (cm/s)	4.6E-08	4	-	-	-	-	-	-	2.1E-08			3		

[1] Laboratory data compiled in above table from 2013 and 2019 geotechnical investigations and are assumed representative of the geological conditions present at the site. Table reproduced from Permit Amendment Application, Fort Worth C&D Landfill, Geosyntec Consultants, March 9, 2021 (Technically Complete).

4 CONSTRUCTION CONSIDERATIONS

4.1 General

This section contains recommendations for excavation of the landfill, soil liner, and final cover materials and construction. Additionally, operational cover soils, final cover construction, and perimeter embankment construction-related recommendations are included in this section.

The landfill currently has a permitted footprint of 184.3 acres and a waste disposal footprint of approximately 99.9 acres. The waste disposal footprint will be expanded to 121.9 acres for this permit amendment.

Sectors 1 through 3 have been completely constructed, with Sectors 4, 5 and 6 remaining unconstructed. The remaining sectors will be constructed with an in-situ shale liner, except in those areas identified to not have sufficient shale to meet the minimum requirements set forth in Appendix IIID- LQCP, and thus requiring construction of a recompacted clay liner. Recompacted clay liner installation will generally be limited to areas of exposed Layer I – Alluvium, which has been observed in monitoring wells and previous cell construction activities to have the potential to be water bearing.

The floor of the future sectors are generally founded in Layer VI – Unweathered Shale. The previously constructed sectors incorporate underdrains for groundwater uplift control in areas that did not have sufficient shale to act as in-situ liner. Underdrain construction has generally been limited to sidewall construction.

4.2 Landfill Excavation

The landfill base grades in the lateral expansion areas will be founded primarily in Layer I – Alluvium and Layer IV – Unweathered Shale. The excavation for the liner construction will be performed in a manner that will achieve reasonable segregation of liner quality material from soils that are not suitable for a liner. Soil materials to be used for liner construction will be stockpiled separately, according to construction material properties outlined in Section 3 and based on visual observation during excavation.

Excavation of the soils encountered will be achieved with equipment such as excavators. Local areas of the hard shale or cemented sands may be encountered intermittently within the excavation and/or as the depth of excavation into shale. These zones can be broken up with an excavator equipped with a hydraulic hammer tool or ripped. The hydraulic hammer may be fitted with a pointed chisel or moil for the hard shale or a blunt tool for harder cemented material. Blasting of hard rock will not be required and will not be used at this site.

Excavation cut slopes will be graded no steeper than 3H:1V. Excavation cut slopes within the future sector construction areas may require erosion protection if an extended period of time occurs between excavation and liner construction. Interim erosion protection can be accomplished by diverting runoff away from the slopes. "Track walking" with a bulldozer up and down the slopes will create the effect of "mini-dikes" with the bulldozer tracks, which will reduce erosion.

Prior to beginning construction of the liner components, the subgrade area will be stripped to a depth sufficient to remove all loose surface soils or soft zones within the exposed excavation. The liner base grades will be proof-rolled with heavy, rubber-tired construction equipment or equivalent to detect soft areas. Soft areas will be undercut to firm material and backfilled with suitable compacted clay fill, as discussed in Section 2 of Appendix IIID – LQCP. Preparation of the liner base grades will result in a surface that is stable and that does not exhibit significant rutting from the construction traffic. The prepared liner base grades (if required) will be approved by a Professional of Record (POR), tested to verify that it meets the requirements outlined in Section 4.3, and surveyed to verify grades.

4.3 Soil Liner Construction

Areas that do not possess sufficient in-situ shale to act as bottom liner will be lined with a 3-foot-thick recompacted clay liner. The clay liner will have a maximum hydraulic conductivity of $1\text{x}10^{-7}$ cm/s. Details for the liner system are provided in Appendix IIIA (Appendix IIIA-A) and Appendix IIID – LQCP. Adequate soil liner material will be available from proposed landfill excavations, onsite, or offsite borrow sources to provide material for the liner construction.

The soils used for liner construction will have the minimum soil property values listed in Table 4-1 that will be verified by preconstruction testing in a soils laboratory. The soil liner properties and preconstruction testing requirements are also included in Appendix IIID – LQCP.

Table 4-1
Soil Liner and Overliner Properties

Test	Specifications
Hydraulic Conductivity of Remolded Soils[1]	1.0x10^{-7} cm/s or less
Plasticity Index	15 minimum
Liquid Limit	30 minimum
Percent Passing No. 200 Mesh Sieve	30 minimum
Percent Passing 1-inch Sieve	100

[1] A hydraulic conductivity test will be performed on soil samples remolded per ASTM D 698 in accordance with Appendix IIID – LQCP.

Prior to construction of each new liner area, conformance tests that include liquid limit, plastic limit, percent passing the No. 200 sieve, Standard Proctor (ASTM D 698) and remolded hydraulic conductivity tests will be performed for the soils to be used as clay liner. Additional conformance tests will be conducted during construction if there are visual changes in the borrow material or the liquid limit or plasticity index vary by more than 10 points. The soil liner construction and testing procedures are outlined in Appendix IIID – LQCP.

4.4 Groundwater Underdrain Drainage Materials

The groundwater underdrain drainage geosynthetic will consist of a double-sided geocomposite installed below the recompacted clay liner as described in Appendix IIID-LQCP and will generally be limited to areas identified to have exposed water-bearing alluvium. Collection trenches will collect the underdrain waters, and sidewall sumps will be installed to allow removal of the groundwater from beneath the recompacted clay liner. The material specifications and construction procedures for the underdrain components are presented in Appendix IIID – LQCP. The underdrain design and demonstrations are presented in Appendix IIID-C.

4.5 Recompacted Clay Liner Protective Cover

The protective cover is a 12-inch-thick soil layer installed over the recompacted clay liner (only). Protective cover is not required over the in-situ shale liner. The protective cover may be placed with construction equipment in one lift. Placement of the protective cover is described in Appendix IIID – LQCP.

4.6 Operational Cover Soils

Operational cover soils include daily and intermediate cover soils. All soils excavated at the site may be used for operational cover, including shale that is sufficiently broken down by equipment or weathering to facilitate its use.

4.7 Composite Final Cover Construction

4.7.1 Final Cover Infiltration Layer Construction

The infiltration layer of the final cover system will be constructed with clayey material and will be a minimum of 18 inches thick. As described in Appendix IIIJ– Closure Plan, the infiltration layer will consist of 18 inches of earthen material with a coefficient of permeability equal to or less than $1x10^{-5}$ cm/s. The purpose of this layer is to reduce infiltration of surface water into the underlying waste. The final cover material and construction requirements are described in Appendix IIIE – FCSQCP.

4.7.2 Final Cover Erosion Layer Construction

As shown in Appendix IIIA-A, the final cover system will include a 6 or 12-inch-thick erosion layer, with the required thickness being based on the properties of the infiltration layer soils. The erosion layer will protect the infiltration layer and will support vegetative growth. The erosion layer may be spread and placed as a single 6-inch-thick lift (with soils that will support vegetation) or with two 6-inch-thick lifts (with the upper 6 inches capable of supporting vegetation) over the entire final cover area as the final cover is constructed. After spreading, each lift will be rolled lightly to reduce future erosion but not to the extent that compaction would inhibit plant growth. The top 6 inches of the erosion layer will consist of (1) topsoil stockpiled during the excavation process, (2) other on-site excavated soils amended as necessary to be capable of sustaining vegetation, and/or (3) imported soil materials. Whether placed in a single lift or two lifts, the erosion layer (top of final cover) will sustain vegetative growth.

4.8 Perimeter Embankment Construction

Perimeter embankments (berms) previously were constructed at the landfill, and will be constructed for future Sectors 4, 5 and 6. Constructed embankments will have side slopes no steeper than 3H:1V.

Prior to beginning embankment fill placement, the subgrade area will be stripped to a depth sufficient to remove all topsoil and vegetation. Topsoil will be stockpiled for later use. The subgrade area will be proof-rolled with heavy, rubber-tired construction equipment to detect soft areas. Soft areas will be undercut to firm material and backfilled with suitable compacted clay fill. The subgrade preparation will result in a subgrade surface that is stable and does not exhibit significant rutting from construction equipment traffic.

A sufficient amount of soil is available from the landfill excavations or stockpiles to construct the perimeter embankments and other features that require stable soil fill material. Placement of embankment soil as structural fill is described in Section 2 of the Appendix IIID – LQCP. As necessary, the outside slope of all embankment construction will be vegetated to minimize erosion and desiccation.

4.9 General Earthen Fill Construction

Earthen fill material may be required for subgrade preparation, haul roads, and other miscellaneous fill. Material availability, compactability, and long-term maintenance requirements will be considered when evaluating the excavated soils for use as earth fill. Most soils that will be excavated for landfill development are suitable for use as earth fill. Placement of general fill is described in Section 2 of the Appendix IIID – LQCP.

5 SLOPE STABILITY ANALYSIS

5.1 General

This slope stability analysis has been developed to analyze excavation slopes, interim slopes, and landfill completion slopes using critical sections for each condition. The computer model SLIDE2 (RocScience, Inc., 2020) was used to analyze the stability of excavation slopes, interim fill slopes, and the final configuration of the site. SLIDE2 is an industry standard computer program developed by RocScience, Inc.

SLIDE2 is a two-dimensional slope stability program for evaluating the safety factor or probability of failure of circular and non-circular failure surfaces in soil or rock slopes. SLIDE2 analyzes the stability of slip surfaces using vertical slice or non-vertical slice limit equilibrium methods like Bishop, Janbu, Spencer, and Sarma, among others. Individual slip surfaces can be analyzed, or search methods can be applied to locate the critical slip surface for a given slope. SLIDE2 incorporates a windows-based interface that allows input of analysis sections and geological conditions from AutoCAD design drawings. The input file for the SLIDE2 program includes:

- Slope surface geometry.
- Subsurface information to identify different types of soil materials in horizontal and vertical directions so that each subsurface segment is identified with corresponding soil strength parameters.
- Groundwater information. The program is capable of modeling multiple groundwater surfaces that may be applicable to various subsurface soil components identified in the second bullet.
- Material strength information. Each soil section (horizontal or vertical) identified in the second bullet is assigned with strength parameters including cohesion and friction angle for both total and effective stresses.
- Model control and simulation user interface of the model that allows selection of the method of analysis (e.g., Simplified Bishop) and identifying simulation control parameters.

Automatic failure surface generation functions, that use either initiation/ termination ranges of the failure surface or use search boxes to define failure surface location, are used to locate the critical failure surface. The two methods employed for this slope stability analysis are described below.

1. Simplified Janbu Method – This method uses the method of slices to determine the stability of the mass above a failure surface.
2. Simplified Bishop Method – This method uses the method of slices to discretize the soil mass for determining the factor of safety.

In general, the stability of various critical sections were analyzed under static conditions for short-term (excavation and construction) and long-term (after construction) safety. The slope stability analyses are provided in Appendix IIIM-A. The stability of the underdrain geocomposite installed on portions of sector sidewalls was also evaluated using infinite slope stability analysis, and is presented in Appendix IIIM-A.

The stability analysis has been developed using demonstrations showing that, for each analyzed section, the forces resisting movement of the slopes are higher than the forces that potentially create movement. Therefore, the ratio of forces resisting movement to the forces potentially creating movement is defined as the factor of safety (FS). When the FS is equal to or greater than 1.0, it means that the slope is stable. In the slope stability analysis, a factor of safety greater than 1.0 is desired. The FS value is increased for the increased uncertainty for the system analyzed. A factor of safety of 1.5 is acceptable for long-term (effective) stress conditions, and a factor of safety of 1.3 is acceptable for short term (total or undrained) stress conditions. All analyses were performed for both long-term and short-term conditions.

5.2 Sections Selected for Analysis

Slope stability analyses were performed on critical sections to evaluate the stability of the perimeter berms/cell excavations, interim fill, and final cover slopes. The geometries of the slopes analyzed were determined by reviewing the proposed excavation plan and final contour plan presented in the applicaiton. The evaluation locations were selected to analyze critical slopes consisting of profiles that include the landfill configuration as well as natural materials at the toe and below the landfill excavation.

Figures showing the location of the cross sections analyzed for slope stability are included in Appendix IIIM-A (refer to Appendix IIIM-A-1 for the perimeter berm/excavation slope stability, Appendix IIIM-A-2 for the interim conditions, and Appendix IIIM-A-3 for final cover slope stability analyses).

5.3 Configurations Analyzed

The perimeter berm/excavation, interim, and final landfill slopes were modeled to represent critical conditions, and the analysis was performed using circular and block failure surfaces. All slopes (including perimeter berm and excavation slopes, interim slopes, and final cover slopes) will be constructed with 3H:1V grades. A copy of the top of liner plan and final completion plan showing the locations of the cross sections selected for analysis are included in Appendix IIIM-A. Additionally, the sections analyzed (including model failure surfaces and factors of safety) are graphically illustrated in Appendix IIIM-A. Note that for this landfill, with exterior slopes of 3H:1V, the interim and final cover slope configurations differ only by fill height.

5.4 Input Parameters

The cross sections for slope stability analysis were developed from the proposed excavation plan and the landfill completion plan (see figures included in Appendix IIIM-A). The soil parameters were selected based on a review of the boring logs and laboratory test results from the subsurface investigation studies at the site and upon engineering judgment and experience with similar materials. Table 5-1 summarizes the unit weights and strength parameters used for the stability analyses for the evaluated landfill slopes (excavation, interim and final cover slopes).

Table 5-1
Summary of Material Weight and Strength Parameters Used in the Slope Stability Analysis

Stratum	Total Unit Weight γ (pcf)	Drained (Effective Stress) Analysis		Undrained (Total Stress) Analysis		
		c' (psf)	ϕ' (degrees)	c (psf)	ϕ (degrees)	Su (psf)
Structural Fill	130	331.2	24.1	5,544	11.8	
Layer I – Alluvial Clay	130	345.6	21.6	3,355	5.8	
Layer II/III – Alluvial Sand[1]	135	0	31	0	31	
Layer V – Weathered Shale	140	360	20.8			6,686
Layer VI – Unweathered Shale	145	2000	25			18,320
Layer VII – Limestone[2]	150	4000	30			41,990
Layer	**γ (pcf)**	**Drained Strength**		**Undrained Strength**		
		c' (psf)	**ϕ' (degrees)**	**c (psf)**	**ϕ (degrees)**	**Su (psf)**
Final Cover Soil	120	230	19	400	0	
Liner Cover Soil	120	230	19	400	0	
Compacted Soil for Liner/Cover	120	230	19	1100	0	
Waste Material	90	For $\sigma_v' < 772$ psf, $c' = 501$ psf and $\phi' = 0°$ For $\sigma_v' > 772$ psf, $c' = 0$ psf and $\phi' = 33°$				

[1] The alluvial sand layer was modeled as a cohesionless material with a friction angle of 31 degrees; this is consistent with previous analyses for the site, and considered appropriate for this type of sand layer.

[2] The unweathered shale and limestone layers are included in this analysis for completeness, but their depth below ground surface and relatively high shear strengths mean that critical shear surfaces do not tend to pass through these layers.

[3] γ = moist unit weight; c' = effective-stress cohesion; ϕ' = effective-stress friction angle; c = undrained cohesion; and ϕ = undrained friction angle.

5.5 Results of Stability Analysis

5.5.1 Stability Analysis Using SLIDE2

The results of the stability analyses using SLIDE2 computer program indicate that the proposed perimeter berm/excavation, interim and final configuration slopes are stable under the conditions analyzed. Table 5-2 summarizes the results of the stability analyses for the landfill slopes and compares the calculated factor of safety to the recommended minimum factor of safety. The recommended minimum factors of safety for the conditions analyzed were determined using recommendations from the Corps of Engineers "Design and Construction of Levees" manual (EM 1110-2-1913) and the EPA's "Technical Guidance Manual for Design of Solid Waste Disposal Facilities," as 1.3 for short-term slope stability and 1.5 for long-term slope stability.

Table 5-2
Summary of Slope Stability Analysis for the Perimeter Berm/Excavation Configuration

Analyzed Section-Run	**Failure Type**	**Minimum Factor of Safety Generated**[1]		**Factor of Safety Acceptable**
		Effective Stress	**Total Stress**	
		1.5	**1.3**	
Excavation Slope A	Bishop-Circular	2.42	10.56	YES

[1] Recommended Minimum Factor of Safety for long-term stability analysis using effective stress is 1.5 and short-term stability analysis using total stress is 1.3. Rankine Block analysis uses interface strength values where applicable and if the interface strength values are lower than internal strength values of adjoining landfill components.

Table 5-3
Summary of Slope Stability Analysis for Interim Landfill Configuration

Slope Designation	**Method of Analysis**	**Minimum Factor of Safety Generated**[1]		**Factor of Safety Acceptable**	
		Effective Stress	**Total Stress**	**Effective**	**Total**
		1.5	**1.3**		
Interim Fill Slope C-1	Bishop-Circular	2.09	2.09	YES	YES
Interim Fill Slope C-2	Rankine-Block	2.49	2.49	YES	YES

[1] Long-term factor of safety for temporary slopes is 1.5.

Table 5-4
Summary of Slope Stability Analysis for the Final Cover Landfill Configuration

Slope Designation	Method of Analysis	Minimum Factor of Safety Generated[1]		Acceptable Factor of Safety	
		Effective Stress	Total Stress	Effective	Total
Final Cover Slope B-1	Bishop-Circular	2.01	2.04	YES	YES
Final Cover Slope B-2	Rankine-Block	2.20	2.26	YES	YES
Final Cover Slope D-1	Bishop-Circular	2.03	2.06	YES	YES
Final Cover Slope D-2	Rankine-Block	1.89	1.89	YES	YES

[1] Recommended Minimum Factor of Safety for long-term stability analysis using effective stress is 1.5 and short-term stability analysis using total stress is 1.3.

Computer-generated slope stability analysis output is included in Appendix IIIM-A. The minimum calculated factor of safety for the closed condition is 1.89, which is greater than the recommended minimum factor of safety of 1.5 for long-term slope stability.

5.5.2 Infinite Slope Stability Analysis

Infinite slope stability analysis for the recompacted clay liner and final cover systems has been included in this design in addition to block method analysis discussed in the previous section. The infinite liner analyses also addresses shear forces within the geocomposite underdrain system. The infinite final cover slope stability analysis addresses the shear forces within the final cover system. These calculations are presented in Appendix IIIM-A-4. As demonstrated in Appendix IIIM-A-4, the liner and cover systems are structurally stable using the strength parameters shown.

6 FINAL COVER SETTLEMENT AND STRAIN ANALYSIS

6.1 General

The purpose of the settlement analysis is to demonstrate that the final cover will not be adversely impacted by settlement of waste below the final cover. As the bottom liner is founded primarily in shale, and does not incorporate leachate collection, settlement of the foundation (shale) and bottom liner has not been incorporated into this evaluation.

6.2 Final Cover Settlement and Strain

The Final Cover Settlement Analysis is presented in Appendix IIIM-B-1. Landfill final cover settlement occurs primarily due to settlement and degradation of waste materials. In general, foundation settlement is insignificant in comparison to the settlement of deposited waste. Waste settlement consists of primary and secondary settlement. For this analysis, the conservative approach of using settlement properties of MSW was used.

Settlement of solid waste generally begins rapidly as the waste load is placed and continues to occur for long periods of time after the initial placement. Initially, waste will undergo primary settlement due to its own weight, final cover, equipment, etc. Primary settlement occurs quickly, generally within the first month after loading. Therefore, the weight of the final cover system is the only remaining factor that contributes to primary consolidation. By the time the construction of the final cover is complete, settlement of the waste due to the weight of the final cover will be complete.

Secondary settlement continues at substantial rates for periods of time well beyond primary settlement. It is a combination of mechanical secondary compression, physico-chemical reaction, and bio-chemical decay.

A strain analysis has been incorporated into the final cover settlement analysis presented in Appendix IIIM-B-1. The purpose of the settlement and strain analysis is to demonstrate that the final cover will be stable as designed and maintain positive drainage. If it is considered that the waste settlement is uniform, then the sideslopes are expected to maintain positive drainage. Based on the estimates of settlement for the maximum waste thickness (where maximum waste settlement is expected to occur on the top deck of the landfill) and minimum waste thickness (where minimum settlement is expected to occur on the top deck of the landfill), the landfill final cover will be subject to a (compressive) strain of 0.66 percent. That is less than the allowable strain for the final cover soil infiltration layer.

7 CONCLUSIONS

7.1 General Findings

This geotechnical analysis has been developed using (1) various geotechnical data obtained from field and laboratory testing performed on the soil samples recovered at the site; (2) general soil stratigraphy of the project area; and (3) known geotechnical characteristics of the founding geological formation, of solid waste, of geosynthetic materials commonly used for landfill development, and of soils used for various components of landfills. It is concluded, based on this geotechnical analysis, that the proposed landfill and its components (e.g., recompacted clay liner, final cover, perimeter berm/excavations and interim and final fill slopes) will be geotechnically stable and will function as designed. The following summarizes various findings of the geotechnical analysis.

- Geotechnical engineering tests were performed in accordance with industry practice and recognized procedures (e.g., ASTM standards).
- Stability of the proposed landfill berms and excavation slopes, recompacted clay liner slopes, interim fill slopes, and the final cover are acceptable as designed (see Appendix IIIM-A).
- Stability of the liner and final cover system components is acceptable as designed (see Appendix IIIM-A).
- Settlement of the final cover system will not adversely affect the final cover system, and the final cover system will function as designed (see Appendix IIIM-B).

7.2 Geotechnical Properties of Soils and Usage

Based on review of previous geotechnical investigations for the landfill, previous investigations by others, and based on WCG's working experience with the site conditions at the C&D Landfill, the following general conclusions are presented related to the soil strata encountered at the site:

- Layer I soils (Alluvial clay, CL, CH) are suitable for use as recompacted clay liner, final cover infiltration layer, general and structural fill, operational cover, and protective cover. Soils stripped from surface or with high organic content (roots, etc.) are suitable for use as topsoil.

- Layer II soils (Alluvial sand and gravel (SP, SC, GP, GC)) are suitable for use as general and structural fill, sump and trench backfill (if conforming to gradation requirements), operational cover, and protective cover.
- Layer III soils (Slopewash (CL, CH, SC)) are suitable for use as recompacted clay liner, final cover infiltration layer, general and structural fill, final cover system erosion layer, operational cover, and protective cover.
- Layer IV soils (Woodbine Formation (CL, SP-SC, SC, SP)) are suitable for use as general and structural fill, operational cover, and protective cover.
- Layer V soils (weathered shale, generally broken or decomposed (CH, CL)) are suitable for use as recompacted clay liner (if sufficiently weathered or broken down mechanically), general and structural fill, final cover infiltration layer, operational cover, and protective cover.
- The softer portions of Layer VI soils (generally shale) are suitable for use as operational and protective cover, and possibly structural fill if sufficient soils are infilled into voids created by broken shale.

The index properties of Layers I, III, and V suggest that these materials are suitable for use as low permeability recompacted clay liner. Laboratory tests on remolded samples from these layers confirm that the required permeability requirements for liner can be achieved with these soils.

APPENDIX IIIM-A

SLOPE STABILITY ANALYSIS

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CONTENTS

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INTRODUCTION

This appendix includes the slope stability analysis for the landfill slopes during various phases of the site development and the final landfill configuration. General slope stability for the excavation and interim and closed conditions were evaluated by using the SLIDE2 computer program, as developed by RocScience, Inc. (2020). The Simplified Bishop method was used for circular failure surfaces, and the Simplified Janbu method using Rankine Block was used for the translational (block) slope stability analysis. Infinite slope stability has also been analyzed for the liner and final cover system. Soil profiles analyzed for each configuration for the slope stability analysis are provided in the sub-appendices, along with SLIDE2 computer output files as applicable. The stability analysis for the site is provided in the following four appendices.

- Appendix IIIM-A-1 includes the slope stability analysis for the excavated landfill condition.
- Appendix IIIM-A-2 includes the slope stability analysis for the interim slope landfill condition.
- Appendix IIIM-A-3 includes the slope stability analysis of the final cover configuration.
- Appendix IIIM-A-4 includes the infinite slope stability evaluation.

Required:

A. Evaluate the slope stability of the proposed landfill configuration including excavation grades, interim fill slopes, and final closure condition slopes.

B. Evaluate the veneer stability of the bottom liner and final cover systems. Analysis is performed by the Infinite Slope Analysis Method.

For this slope stability analysis, the analysis description, input parameters, analysis section plans, and the sections analyzed (with analysis results) are presented in Appendix IIIM-A. SLIDE2 computer model output files are presented in Appedices IIIM-A-1 (Excavation Grades), IIIM-A-2 (Interim Conditions) and IIIM-A-3 (Final Closure Conditions). Infinite slope stability analyses are presented in Appendix IIIM-A-4.

Given:

1. Site plans showing the sections analyzed for this analysis are presented on Sheets IIIM-A-7 and IIIM-A-7A .
2. Modeling parameters were derived from field and laboratory testing, and are summarized in Table IIIM-A-1, below. The results of field and laboratory testing are discussed in Appendix IIIM. Assumptions regarding waste density are discussed in Appendix IIIM.
3. The proposed bottom liner system for the landfill will consist of either in-situ shale or (from the bottom up) 3-foot-thick recompacted clay liner ($k < 1x10^{-7}$ cm/s) and 1-foot-thick soil protective cover. Infinite stability analysis results for the clay liner option of the bottom liner system are presented in Appendix IIIM-A-4.
4. The proposed final cover system for the landfill will consist of (from the bottom up) 1.5-foot-thick recompacted clay and 6 to 12 inches of soil protective cover. Infinite stability analysis results for the final cover system are presented in Appendix IIIM-A-4.
5. The recompacted clay liner and protective cover were analyzed for stability as a single (thickened) layer with assigned strength parameters of the weakest component of the proposed composite liner system.

Method: A. Evaluate the slope stability of the proposed landfill configuration including excavation grades, interim fill slopes, and final landfill slopes.

1. Determine critical excavation, interim and final landfill configuration slopes in the proposed design.
2. Select a soil profile for each critical section using available boring logs and geologic cross sections near each section. Information for this effort was derived from Appendix IIIG-Geology Report.
3. Select material properties using unit weights and strength parameters for the proposed sections (See Table IIIM-A-1, below).
4. Perform slope stability analyses:
    a. Analyze the excavation and exterior berm liner slopes using SLIDE2 computer model and the simplified Bishop method of circular failure surfaces. Analyses were performed for both effective (drained) stress conditions and total (undrained) stress conditions. The effective stress conditions represent long-term conditions, and the total stress conditions represent short-term conditions. Analysis section plans and analysis sections are presented as Sheets IIIM-A-7 through 11, and the SLIDE2 output files and results are presented in Appendix IIIM-A-1.

    b. Analyze a typical landfill interim slope using SLIDE2 computer model and the simplified Bishop method of circular failure surfaces and the Bishops method for block failure surfaces at the bottom liner interface. Circular failure plane analyses were performed for total (undrained) stress and effective (drained, or long term) stress conditions. The effective stress conditions represent long-term conditions, and the total stress conditions represent short-term conditions. Analysis section plans and analysis sections are presented as Sheets IIIM-A-7 through IIIM-A-11, and the SLIDE2 output files and results are presented in Appendix IIIM-A-2.

    c. Analyze the final closure condition slopes using SLIDE2 computer model and the simplified Bishop method of circular failure surfaces and the Bishops method for block failure surfaces at the bottom liner interface. Circular failure plane analyses were performed for total (undrained) stress and effective (drained, or long term) stress conditions. The effective stress conditions represent long-term conditions, and the total stress conditions represent short-term conditions. Analysis section plans and analysis sections are presented as Sheets IIIM-A-7 through IIIM-A-11, and the SLIDE2 output files and results are presented in Appendix IIIM-A-3.

5. Evaluate the stability of the proposed bottom liner system and the final cover system using infinite slope stability analysis. The results of the infinite slope stability analyses are presented in Appendix IIIM-A-4.

a. Verify that the tensile stress in the bottom liner system (side slopes with underdrain) will be less than the yield stress by using Koerner's method (reference 4) for determination of shear stress in liner systems considering cohesion/adhesion forces.

c. Use Duncan and Buchignani's method for infinite stability analyses to evaluate the internal stability of the liner systems.

References:

1. Duncan, J.M. and Buchignani, A.L., *An Engineering Manual for Slope Stability Studies,* Department of Civil Engineering-University of California-Berkeley, 1975.
2. TRI, Interface Friction/Direct Shear Testing & Slope Stability Issues. Short Course, November 12-13, 1998. Austin, Texas.
3. US Army Corps of Engineers, *Slope Stability* , Engineering and Design Manual, EM 1110-2-1902, October 31, 2003.
4. Koerner, Robert M., *Designing with Geosynthetics* , 5th Ed., Prentice-Hall, Inc., 2005.
5. SLIDE 2 (computer program for slope stability analyses), Rocscience Inc.
6. Das, Braja M., *Principles of Geotechnical Engineering* , 5th Ed., Brooks/Cole, 2002.
7. Gilbert, Robert B, *Peak Versus Residual Strength for Waste Containment Systems,* Proceedings the 15th GRI Conference on Hot Topics in Geosynthetics-II (Peak/Residual; RECMs; Installation; Concerns)
8. Bouzza, A., Zornberg, J.G., and Adam, D. *Geosynthetics in Waste Containment Facilities: Recent Advances* , 2002.

Solution:

A. Slope stability analyses of the proposed excavation slopes.

1. The locations of the critical sections selected for the stability analysis for the proposed excavation slopes are shown on Sheets IIIM-A-7. Sections analyzed are also shown with the critical failure surfaces for each of the analyses performed and the resulting factors of safety.

2. The soil profile used for each analysis was based on boring log data from previous site investigations from the undeveloped area of the site and the geologic cross sections (see Appendix IIIG-Geology Report). Generalized soil profiles for the site also are shown in Appendix IIIG-Geology Report of this application.

3. A summary table (IIIM-A-1) presents the assumed material weight and strength properties for the analyses performed for this appendix.

4. The material weight and strength parameter determination for each material type was based on laboratory testing results (Atterberg limits, natural moisture content, unit weight, percent finer than #200 sieve, and Standard Proctor), industry references and engineering judgment based on previous experience with similar materials. Laboratory testing results from previous investigations are included in Appendix IIIM-C.
5. The output from the slope stability analyses are presented in Table IIIM-A-2, below.

B. Infinite slope stability of the proposed bottom liner and final cover systems.

1. The sidewall anchor demonstration for bottom liner installation is provided on Sheets IIIM-A-4-2 through IIIM-A-4-4.
2. Infinite slope stability analysis of the bottom liner system is provided on Sheets IIIM-A-4-5 and IIIM-A-4-6.
3. Infinite slope stability analysis of the final cover system is provided on Sheets IIIM-A-10 and IIIM-A-11.

Conclusion: Based on the slope stability analyses provided in this Appendix, the proposed critical slopes for the excavation, interim, and final cover conditions have adquate factors of safety to be considered stable. In addition, the infinite stability analysis demonstrates that the proposed liner system has adequate factors of safety to be considered stable.

Table IIIM-A-1. Summary of Material Properties From SLIDE2 Slope Stability Analyses

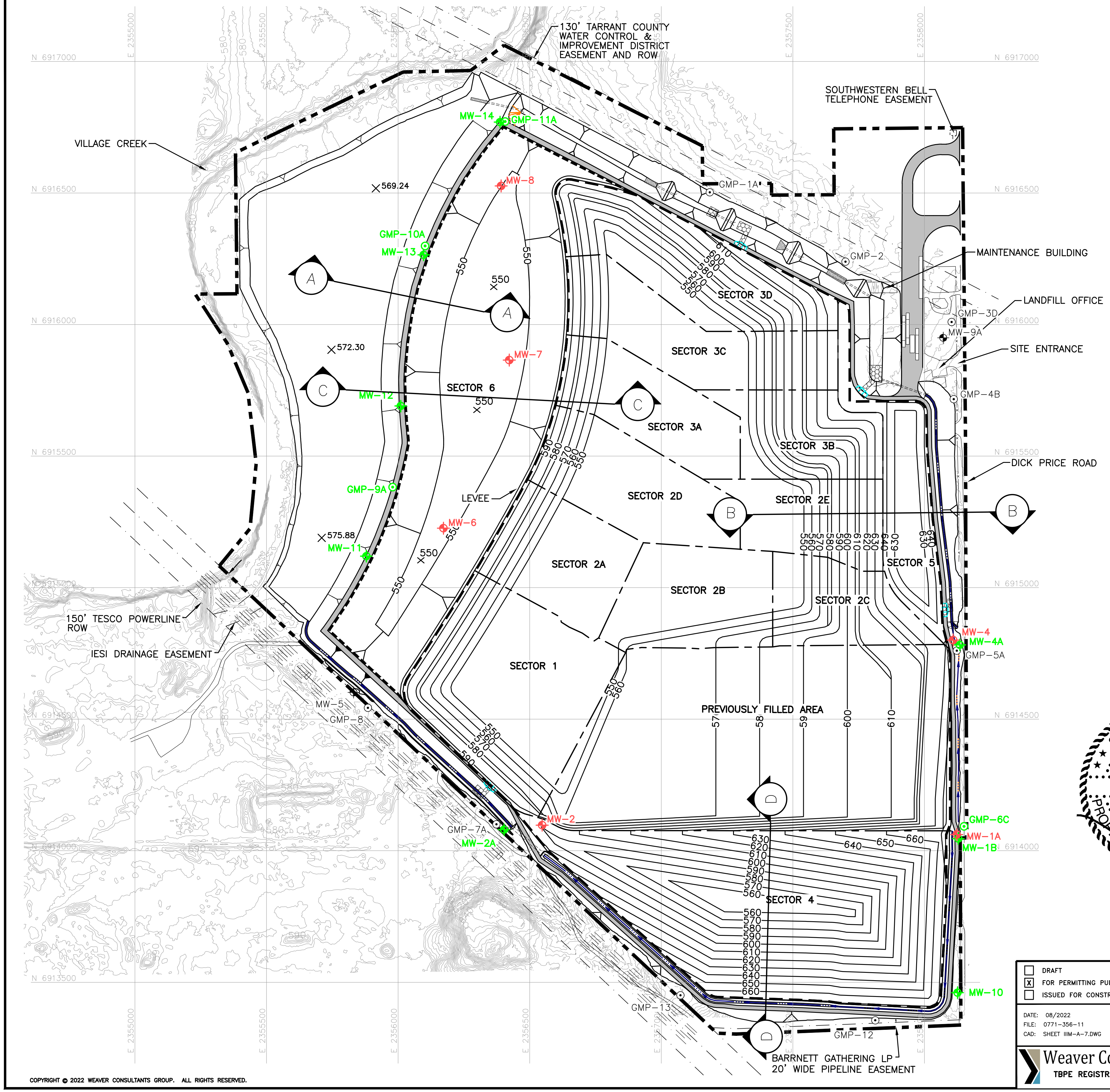
Soil Description	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Effective Stress		Total Stress	
			Cohesion (psf)	Angle of Internal Friction (degrees)	Cohesion (psf)	Angle of Internal Friction (degrees)
Final Cover Material	120	125	230	19	400	0
Waste (Overburden: 0-772 psf)	90	90	501	0	501	0
Waste (Overburden: > 772 psf)	90	90	0	33	0	33
Protective Cover	120	125	230	19	1100	0
Geocomposite/Clay	120	125	100	16	100	16
Recompacted Clay Liner	120	125	230	19	1100	0
Alluvial Clay	130	135	345.6	21.6	3,355	5.8
Unweathered Shale	145	150	2,000	25	18,320	0

Table IIIM-A-2. SLIDE2 Stability Modeling Output

Analyzed Section-Run[1]	**Method**	**Stress Condition**		**Factor of Safety Acceptable**
		Effective Stress	**Total Stress**	
Recommended Min. Factor of Safety		**1.5**[2]	**1.3**[2]	
Excavation Slope A-Interior	Bishop-Circular	**2.42**	**10.56**	YES
Interim Slope B-1	Bishop-Circular	**2.09**	**2.09**	YES
Interim Slope B-2	Rankine-Block	**2.49**	**2.49**	YES
Final Cover C-1	Bishop-Circular	**2.01**	**2.04**	YES
Final Cover C-2	Rankine-Block	**2.20**	**2.26**	YES
Final Cover D-1	Bishop-Circular	**2.03**	**2.06**	YES
Final Cover D-2	Rankine-Block	**1.89**	**1.89**	YES

[1] For interim and final cover configurations Run 1 represents circular failure, and Run 2 represents block failure.

[2] Recommended minimum factor of safety provided in Reference 3 on Sheet IIIM-A-4.



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SCALE IN FEET

LEGEND

▬ ▪ ▪ ▬	PERMIT BOUNDARY
▬ ▬ ▬ ▬	PERMITTED LIMIT OF WASTE
- - - - -	PROPOSED LIMIT OF WASTE
630	EXISTING CONTOUR
N 6915000	STATE PLANE COORDINATE
—— – ——	SECTOR BOUNDARY
550	PROPOSED EXCAVATION CONTOUR
570	PERMITTED EXCAVATION CONTOUR
MW-2A	PERMITTED GROUNDWATER MONITORING WELL
MW-9A	PROPOSED GROUNDWATER MONITORING WELL
MW-4	PERMITTED GROUNDWATER MONITORING WELL (TO BE ABANDONED)
⊙ GMP-4B	PERMITTED GAS MONITORING PROBE
A —— A	SECTION LOCATION

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN 02-17-2022.
2. THE EXPANSION LIMIT OF WASTE IS LOCATED A MINIMUM OF 125-FT FROM THE PERMIT BOUNDARY.
3. REFER TO "ENVIRONMENTAL MONITORING" SECTION FOR INFORMATION REGARDING LANDFILL PERIMETER GROUNDWATER AND LFG MONITORING NETWORKS.

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CAD: SHEET IIIM-A-7.DWG

DRAWN BY: RAA
DESIGN BY: MB
REVIEWED BY: DEP

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
TEXAS REGIONAL LANDFILL COMPANY, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
SLOPE STABILITY ANALYSIS
SECTION LOCATIONS

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TARRANT COUNTY, TEXAS

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SHEET IIIM-A-7

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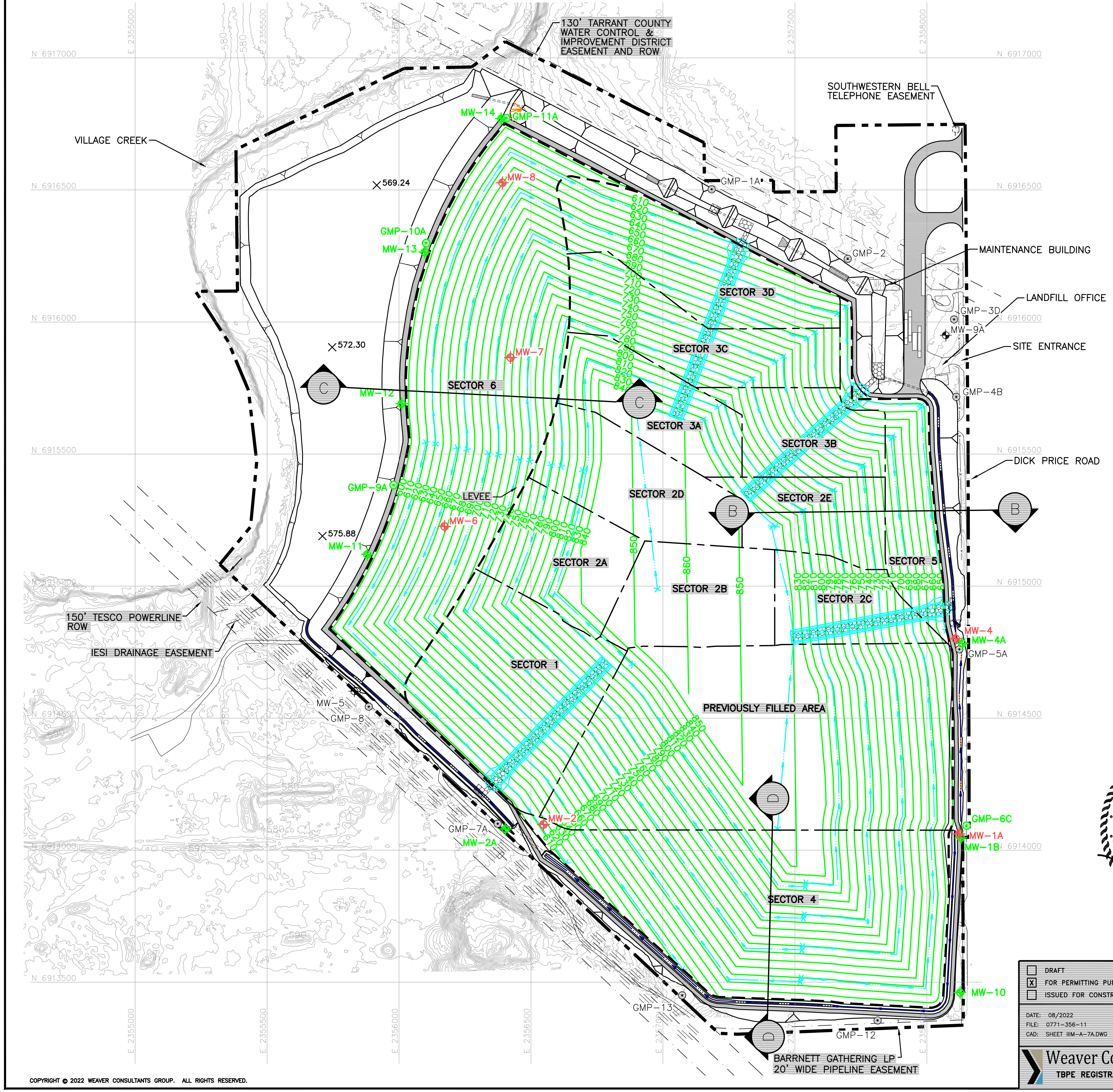

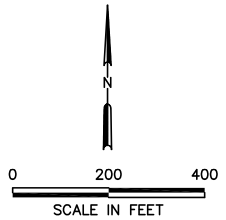

LEGEND

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— — —	PERMITTED LIMIT OF WASTE
- - - -	PROPOSED LIMIT OF WASTE
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N 6915000	STATE PLANE COORDINATE
— - —	SECTOR BOUNDARY
550	PROPOSED FINAL COVER CONTOUR
MW-2A	PERMITTED GROUNDWATER MONITORING WELL
MW-9A	PROPOSED GROUNDWATER MONITORING WELL
MW-4	PERMITTED GROUNDWATER MONITORING WELL (TO BE ABANDONED)
GMP-4B	PERMITTED GAS MONITORING PROBE
B B	SECTION LOCATION

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN 02-17-2022.
2. THE EXPANSION LIMIT OF WASTE IS LOCATED A MINIMUM OF 125-FT FROM THE PERMIT BOUNDARY.
3. REFER TO "ENVIRONMENTAL MONITORING" SECTION FOR INFORMATION REGARDING LANDFILL PERIMETER GROUNDWATER AND LFG MONITORING NETWORKS.

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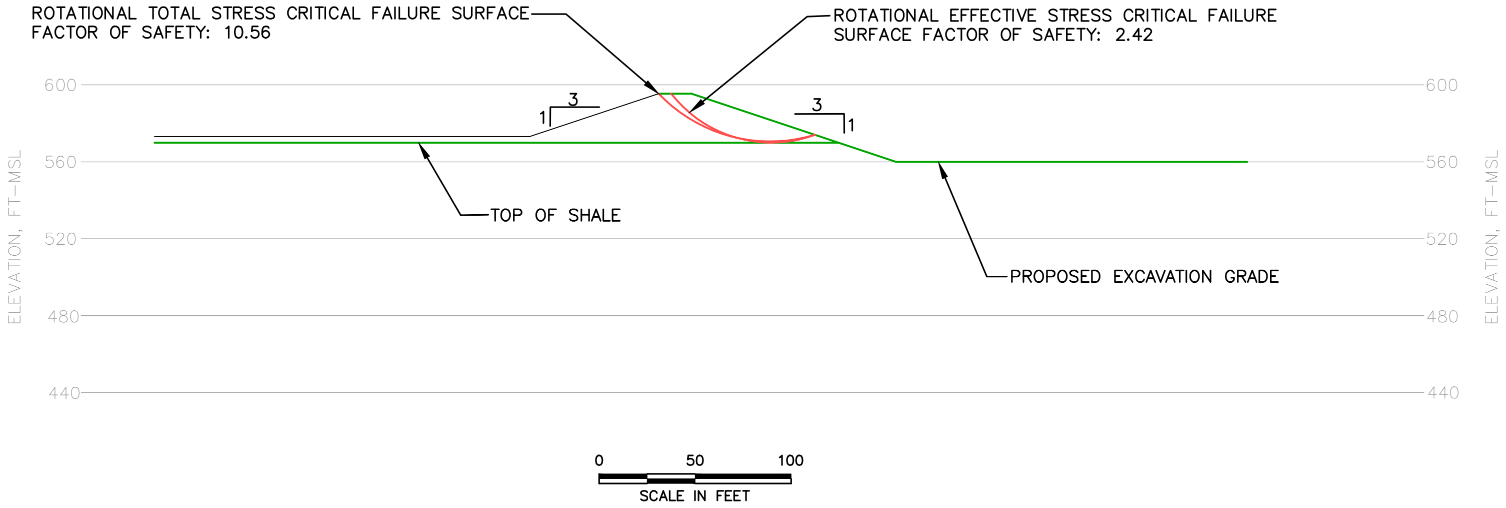

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DESIGN BY: MB
REVIEWED BY: DEP

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EXCAVATION SLOPE STABILITY SECTION

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SHEET IIIM–A–8

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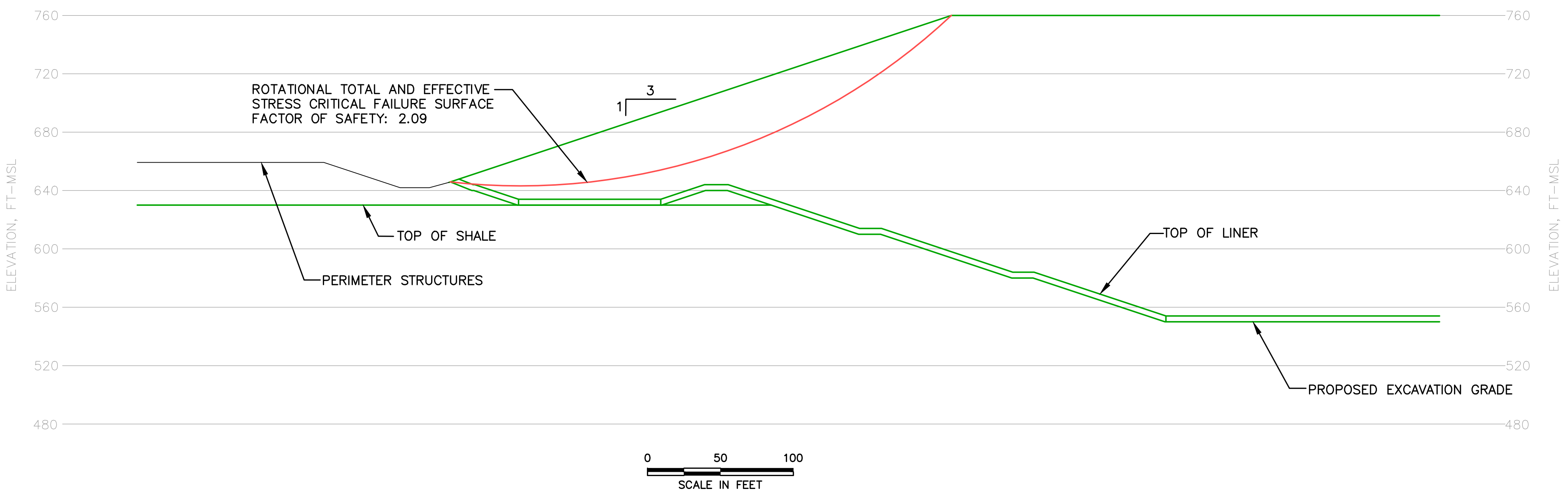
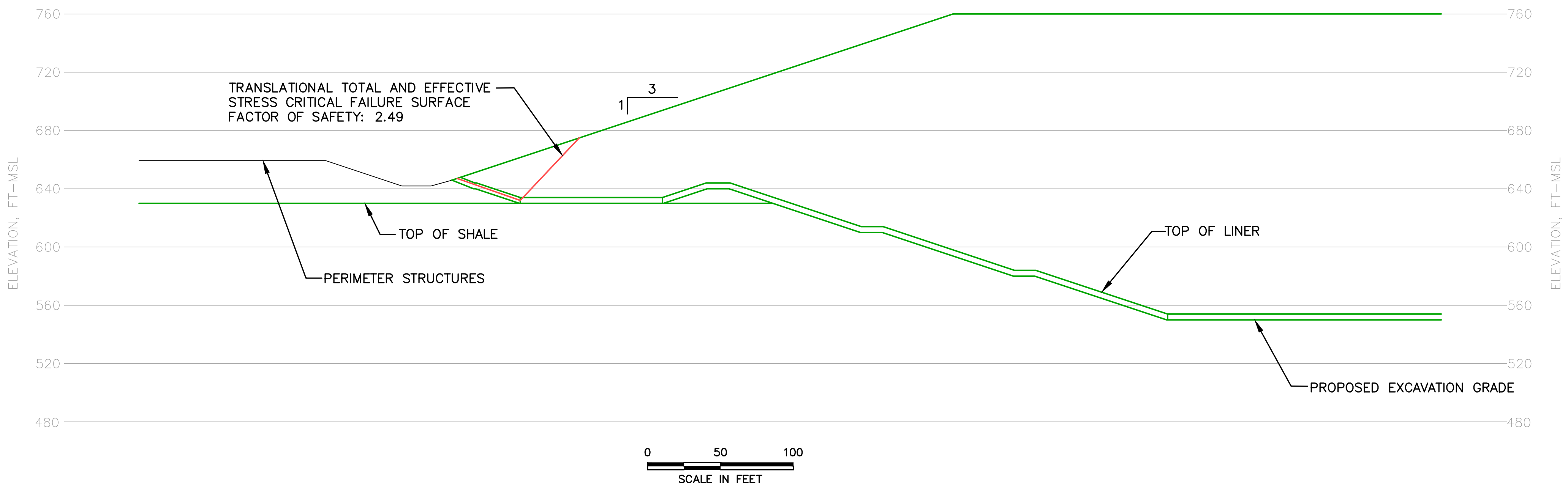
SECTION B–B – INTERIM CONDITION



SECTION B–B – INTERIM CONDITION



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81734
02/09/2023

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☐ ISSUED FOR CONSTRUCTION

DATE: 08/2022
FILE: 0771–356–11
CAD: SHEET IIIM–A–9.DWG

DRAWN BY: RAA
DESIGN BY: MB
REVIEWED BY: DEP

Weaver Consultants Group
TBPE REGISTRATION NO. F–3727

PREPARED FOR
TEXAS REGIONAL LANDFILL COMPANY, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
SLOPE STABILITY ANALYSIS
SLOPE STABILITY SECTION

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS

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SHEET IIIM–A–9

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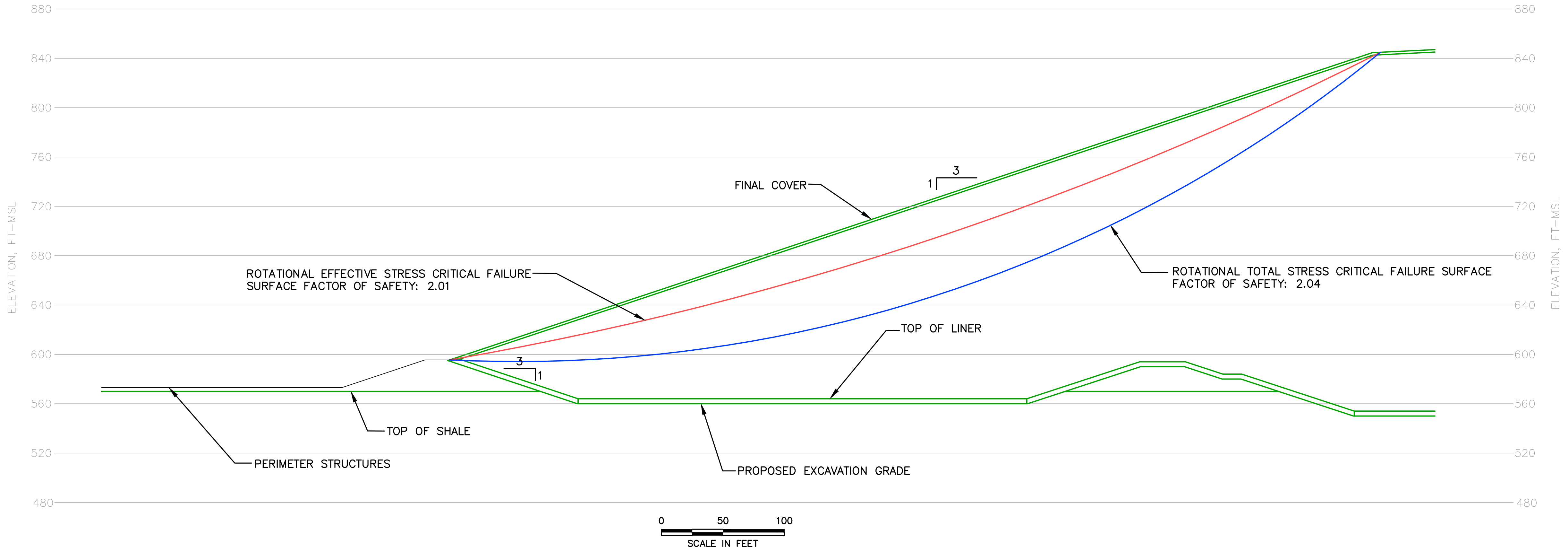
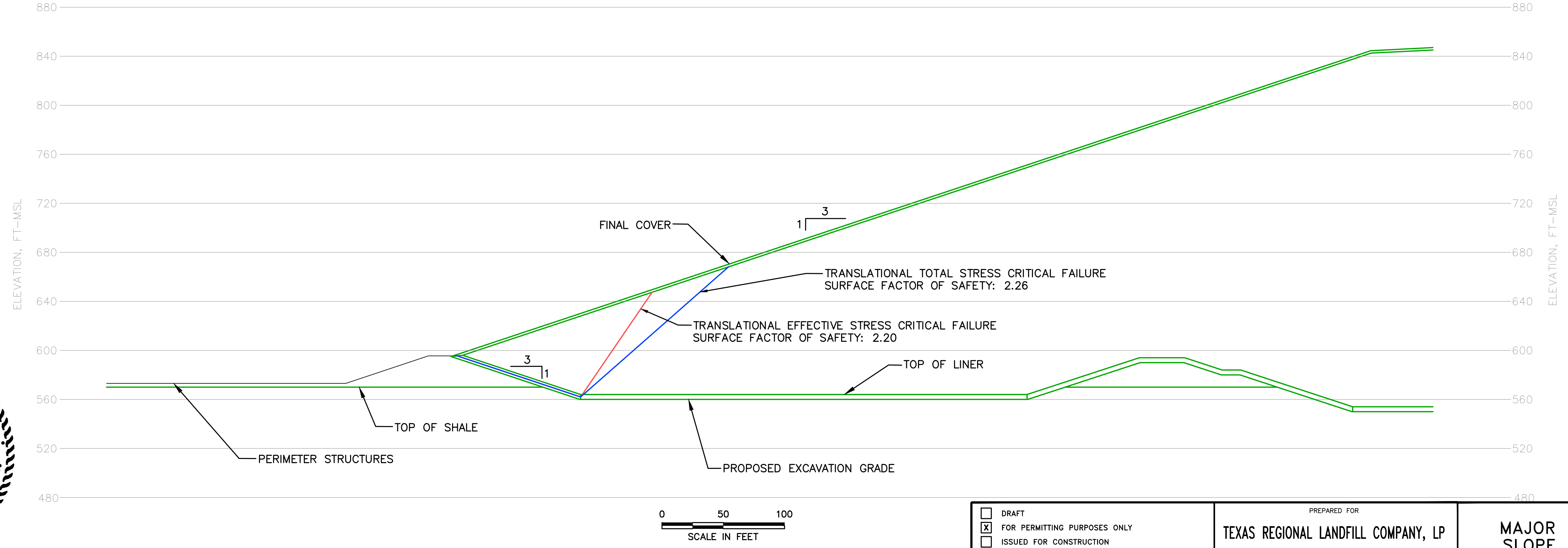
SECTION C–C – FINAL CONDITION



SECTION C–C – FINAL CONDITION



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DATE: 08/2022
FILE: 0771–356–11
CAD: SHEET IIIM–A–10.DWG

DRAWN BY: RAA
DESIGN BY: MB
REVIEWED BY: DEP

Weaver Consultants Group
TBPE REGISTRATION NO. F–3727

PREPARED FOR
TEXAS REGIONAL LANDFILL COMPANY, LP

REVISIONS		
NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
SLOPE STABILITY ANALYSIS
SLOPE STABILITY SECTION

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS

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SHEET IIIM–A–10

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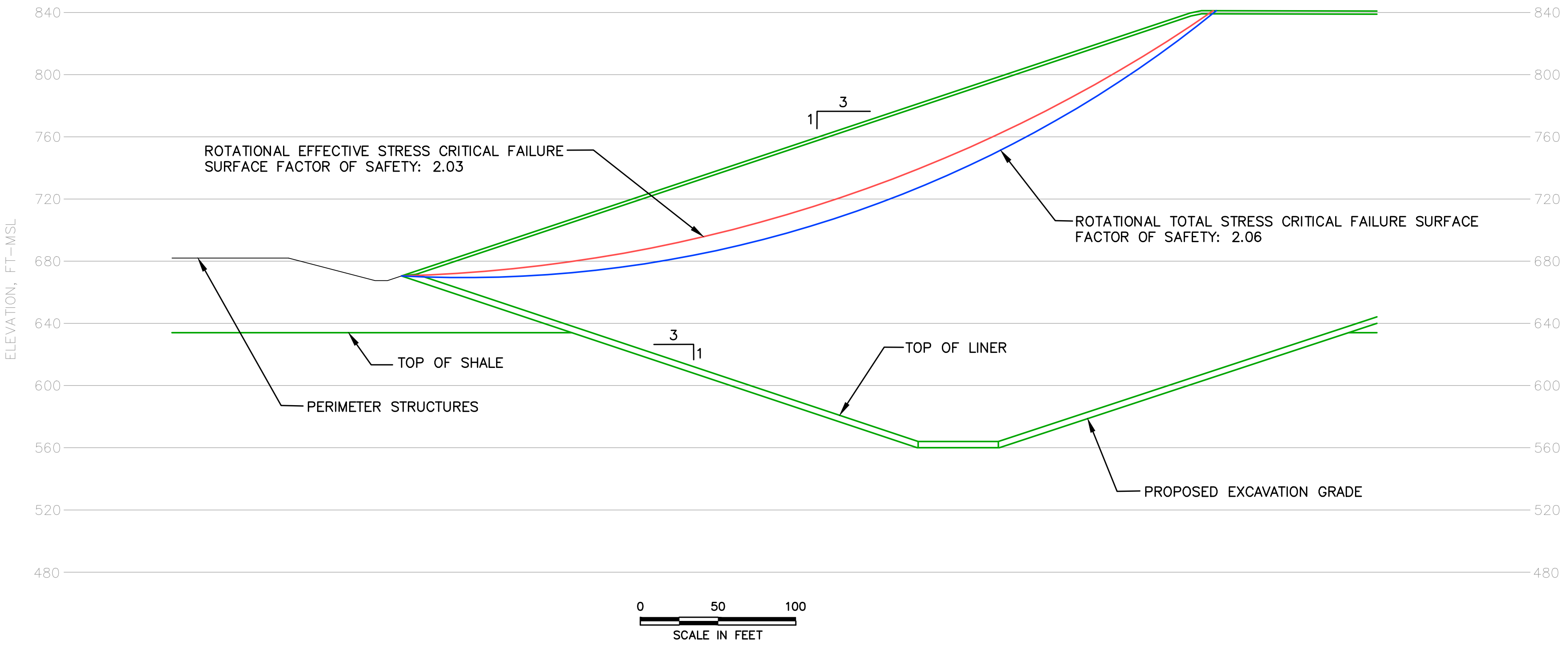
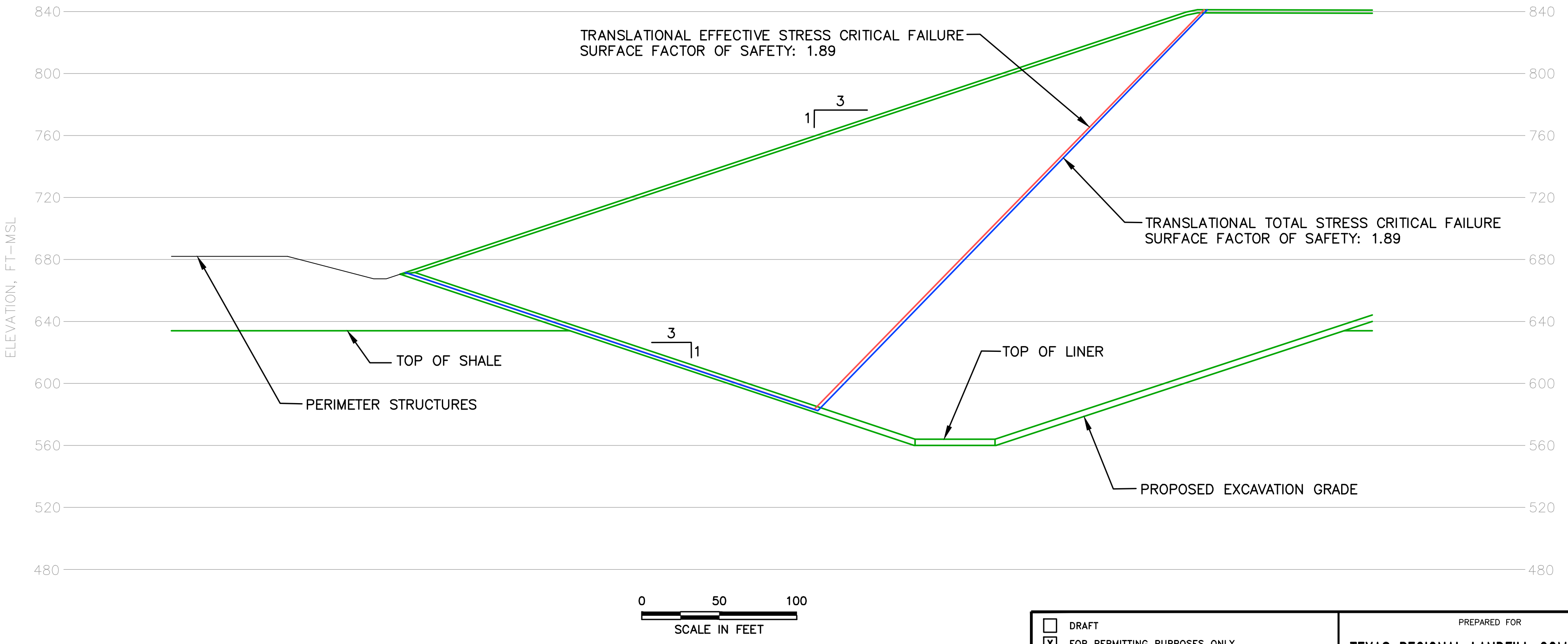
SECTION D–D – FINAL CONDITION



SECTION D–D – FINAL CONDITION



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☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 08/2022
FILE: 0771–356–11
CAD: SHEET IIIM–A–11.DWG

DRAWN BY: RAA
DESIGN BY: MB
REVIEWED BY: DEP

Weaver Consultants Group
TBPE REGISTRATION NO. F–3727

PREPARED FOR
TEXAS REGIONAL LANDFILL COMPANY, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
SLOPE STABILITY ANALYSIS
SLOPE STABILITY SECTION

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS

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SHEET IIIM–A–11

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APPENDIX IIIM-A-1

LANDFILL PERIMETER BERM/EXCAVATION CONFIGURATION STABILITY ANALYSIS

Includes pages IIIM-A-1-1 through IIIM-A-1-11

STATE OF TEXAS
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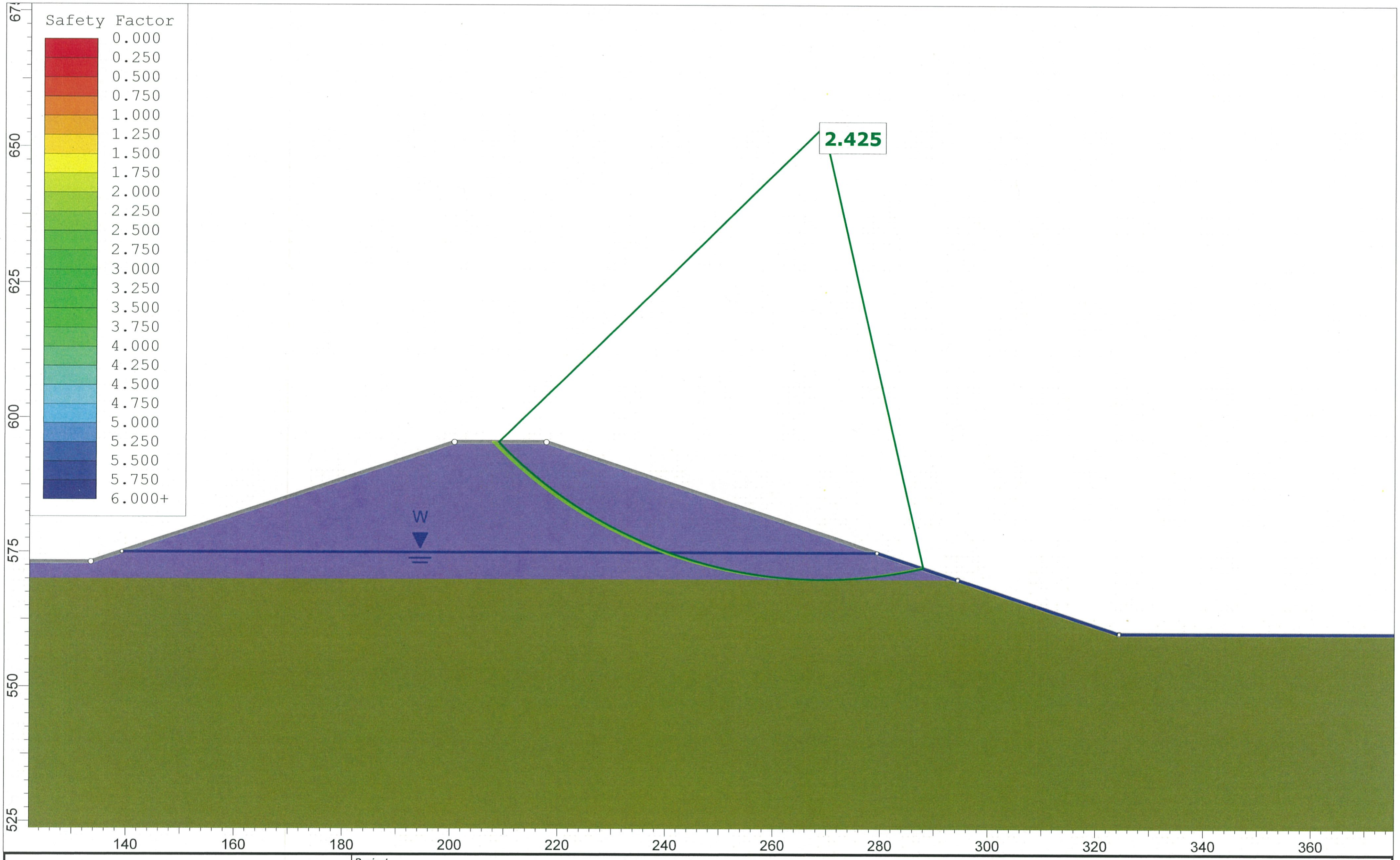
81734
LICENSED PROFESSIONAL ENGINEER
02/09/2023

SLOPE STABILITY SECTION A-A

SLIDE2 OUTPUT RESULTS



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SLIDEINTERPRET 9.018

Project	FORT WORTH C & D LANDFILL SLOPE STABILITY		
Group	ENGINEERING	*Scenario*	CIRCULAR-DRAINED CONDITION
Drawn By	PREP BY: MB CHKD BY:DEP	*Company*	WEAVER CONSULTANTS GROUP
Date	8/10/2022	*File Name*	SECTION A-EXCAVATION SLOPE-Drained-Circular.slmd

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Left to Right

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

ALLUVIUM

Color	🟪
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	130
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	345.6
Friction Angle [deg]	21.6
Water Surface	Water Table
Hu Value	1

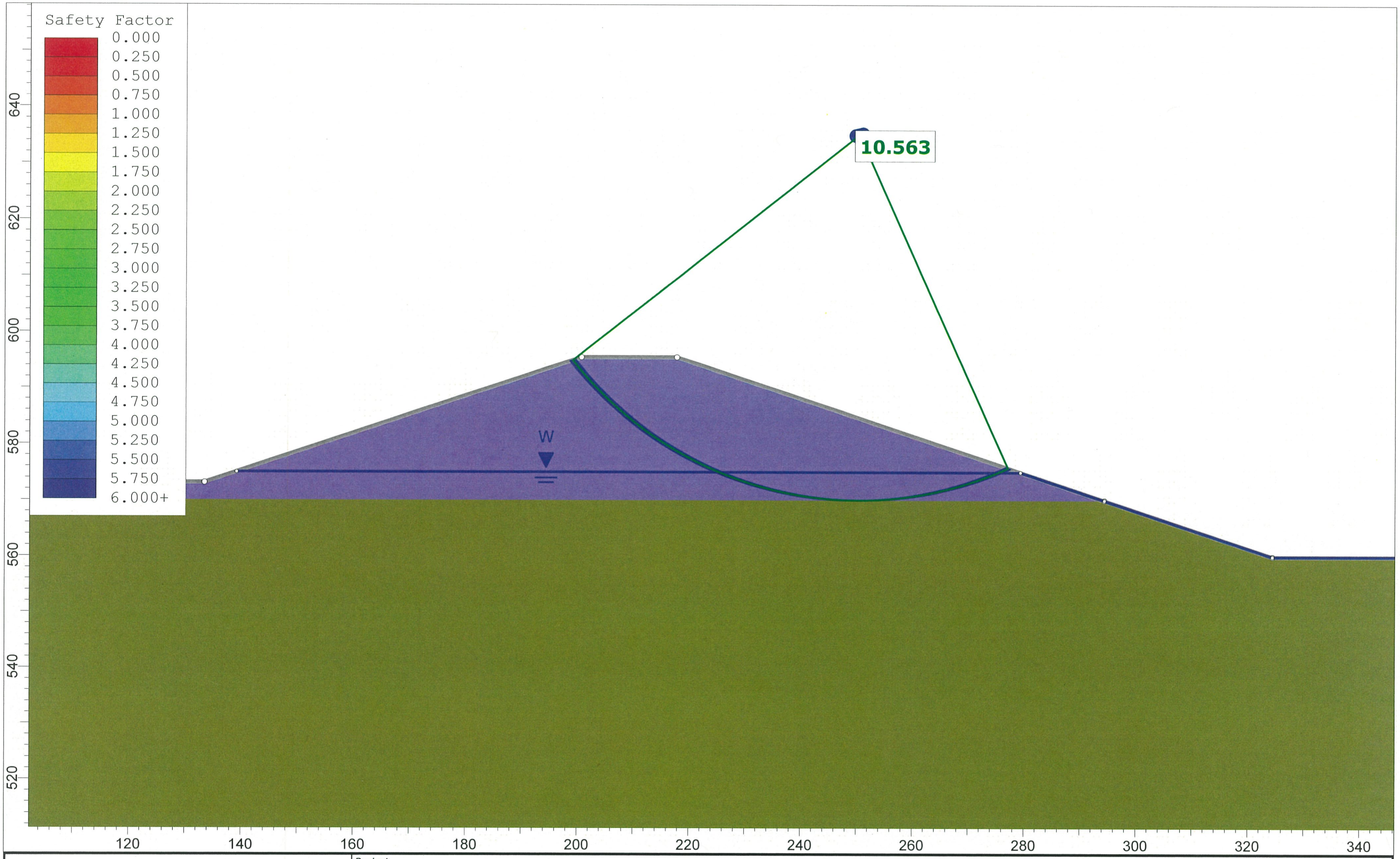
SHALE

Color	🟩
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	145
Saturated Unit Weight [lbs/ft3]	150
Cohesion [psf]	2000
Friction Angle [deg]	25
Water Surface	Water Table
Hu Value	1

Global Minimums

Method: bishop simplified

FS	2.424910
Center:	269.143, 653.915
Radius:	83.920
Left Slip Surface Endpoint:	208.900, 595.490
Right Slip Surface Endpoint:	287.952, 572.129
Resisting Moment:	5.18617e+06 lb-ft
Driving Moment:	2.1387e+06 lb-ft
Total Slice Area:	706.173 ft2
Surface Horizontal Width:	79.052 ft
Surface Average Height:	8.93302 ft



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Project FORT WORTH C & D LANDFILL
SLOPE STABILITY

Group ENGINEERING

Scenario CIRCULAR-UNDRAINED CONDITION

Drawn By PREP BY: MB CHKD BY:DEP

Company WEAVER CONSULTANTS GROUP

Date 8/10/2022

File Name SECTION A-EXCAVATION SLOPE-Unrained-Circular.slmd

SLIDEINTERPRET 9.018

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Left to Right

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

ALLUVIUM

Color	🟪
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	130
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	3355
Friction Angle [deg]	5.8
Water Surface	Water Table
Hu Value	1

SHALE

Color	🟩
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	145
Saturated Unit Weight [lbs/ft3]	150
Cohesion [psf]	18320
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

Global Minimums

Method: bishop simplified

FS	10.563000
Center:	250.356, 635.114
Radius:	65.110
Left Slip Surface Endpoint:	199.106, 594.956
Right Slip Surface Endpoint:	277.091, 575.746
Resisting Moment:	1.96824e+07 lb-ft
Driving Moment:	1.86334e+06 lb-ft
Total Slice Area:	963.953 ft2
Surface Horizontal Width:	77.985 ft
Surface Average Height:	12.3607 ft

APPENDIX IIIM-A-2

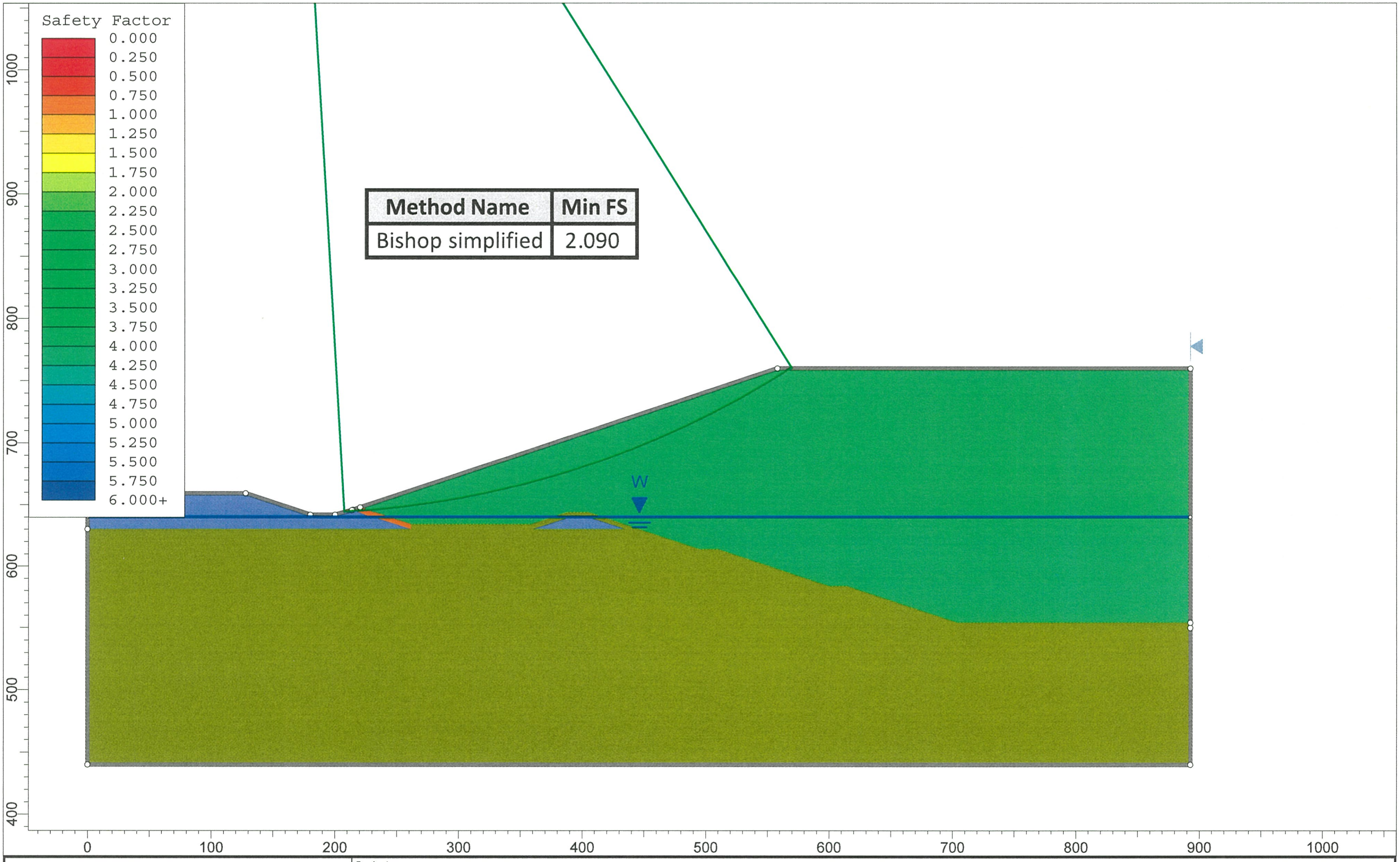
INTERIM SLOPE CONFIGURATION STABILITY ANALYSIS

Includes pages IIIM-A-2-1 through IIIM-A-2-21

STATE OF TEXAS
DAVID E. POE
81734
LICENSED
PROFESSIONAL ENGINEER
02/09/2023

SLOPE STABILITY SECTION B-B – INTERIM CONDITIONS

SLIDE2 OUTPUT RESULTS



Method Name	Min FS
Bishop simplified	2.090

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SLIDEINTERPRET 9.018

Project	FORT WORTH C & D LANDFILL SLOPE STABILITY		
Group	ENGINEERING	*Scenario*	CIRCULAR-DRAINED CONDITION
Drawn By	PREP BY: MB CHKD BY:DEP	*Company*	WEAVER CONSULTANTS GROUP
Date	8/14/2022	*File Name*	SECTION B-Drained-Circular.slmd

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

WASTE	
Color	🟩
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	90
Saturated Unit Weight [lbs/ft3]	90
Water Surface	Water Table
Hu Value	1

GEOCOMPOSITE/CLAY	
Color	🟧
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	125
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Water Table
Hu Value	1

ALLUVIUM	
Color	🟦
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	130
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	345.6
Friction Angle [deg]	21.6
Water Surface	Water Table
Hu Value	1

SHALE	
Color	🟩
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	145
Saturated Unit Weight [lbs/ft3]	150
Cohesion [psf]	2000
Friction Angle [deg]	25
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

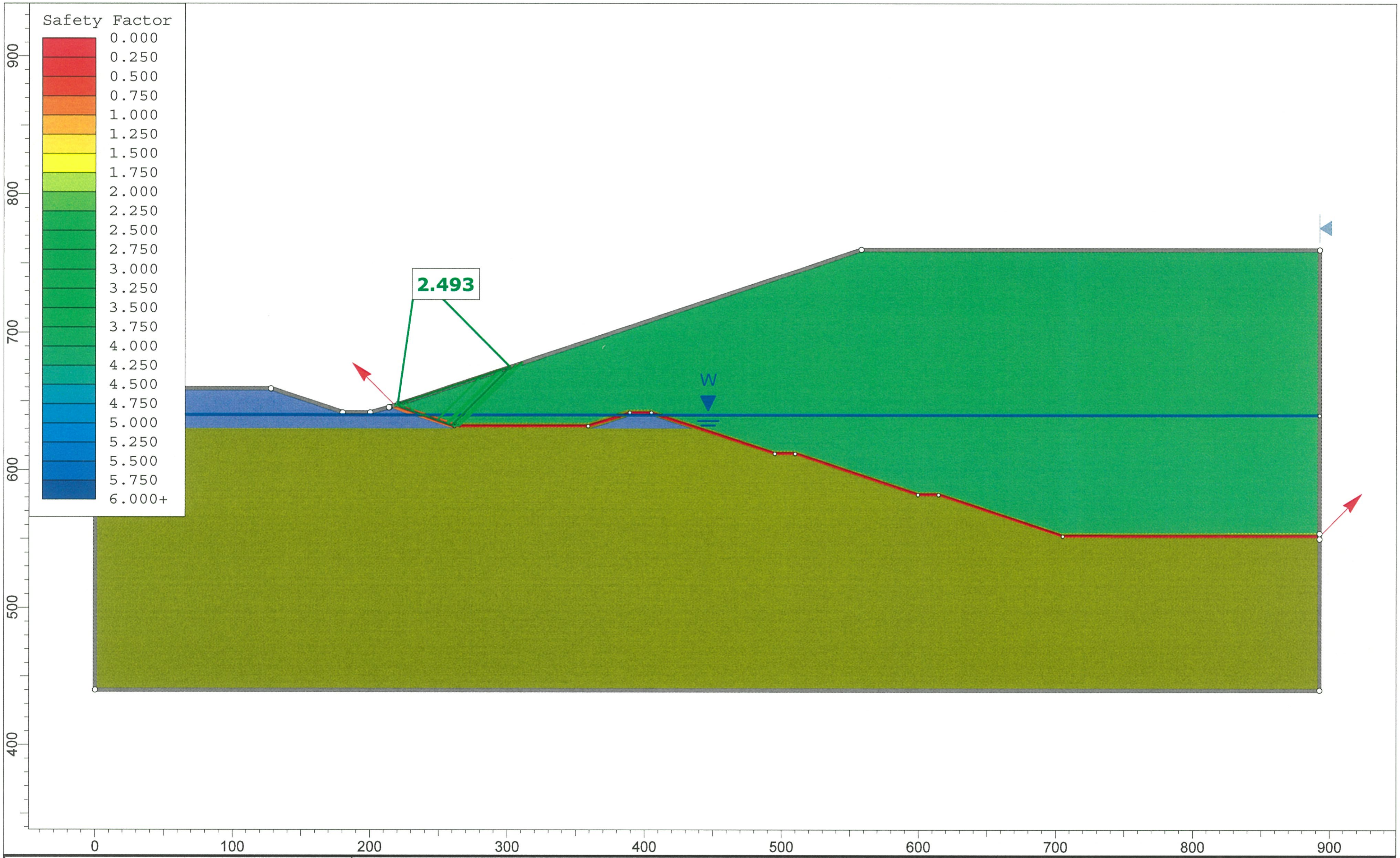
Name: SNF

Effective Normal (psf)	Shear (psf)
0	501
772	501
62565	40690

Global Minimums

Method: bishop simplified

FS	2.090260
Center:	163.493, 1404.338
Radius:	761.631
Left Slip Surface Endpoint:	207.754, 643.994
Right Slip Surface Endpoint:	569.585, 760.000
Resisting Moment:	2.9622e+08 lb-ft
Driving Moment:	1.41715e+08 lb-ft
Total Slice Area:	6726.73 ft2
Surface Horizontal Width:	361.831 ft
Surface Average Height:	18.5908 ft



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SLIDEINTERPRET 9.018

Project	FORT WORTH C & D LANDFILL SLOPE STABILITY		
Group	ENGINEERING	*Scenario*	BLOCK-DRAINED CONDITION
Drawn By	PREP BY: MB CHKD BY:DEP	*Company*	WEAVER CONSULTANTS GROUP
Date	8/14/2022	*File Name*	SECTION B-Drained-Block.slmd

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

WASTE

Color	🟩
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	90
Saturated Unit Weight [lbs/ft3]	90
Water Surface	Water Table
Hu Value	1

GEOCOMPOSITE/CLAY

Color	🟧
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	125
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Water Table
Hu Value	1

ALLUVIUM

Color	🟦
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	130
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	345.6
Friction Angle [deg]	21.6
Water Surface	Water Table
Hu Value	1

SHALE

Color	🟩
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	145
Saturated Unit Weight [lbs/ft3]	150
Cohesion [psf]	2000
Friction Angle [deg]	25
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

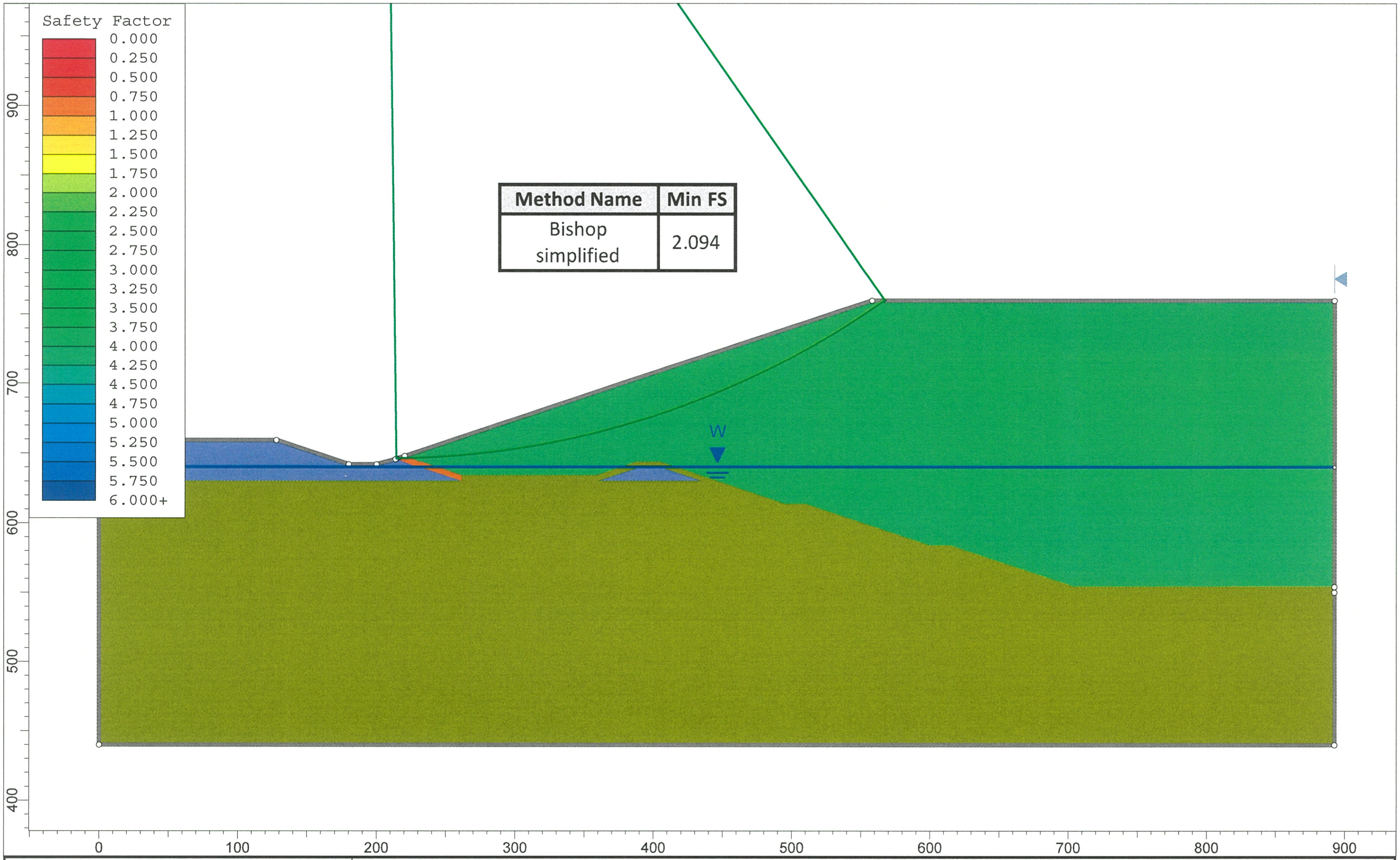
Name: SNF

Effective Normal (psf)	Shear (psf)
0	501
772	501
62565	40690

Global Minimums

Method: bishop simplified

FS	2.493200
Axis Location:	233.897, 743.142
Left Slip Surface Endpoint:	220.168, 647.779
Right Slip Surface Endpoint:	301.949, 674.941
Resisting Moment:	6.0606e+06 lb-ft
Driving Moment:	2.43086e+06 lb-ft
Total Slice Area:	1183.62 ft2
Surface Horizontal Width:	81.7813 ft
Surface Average Height:	14.473 ft



Method Name	Min FS
Bishop simplified	2.094

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Project FORT WORTH C & D LANDFILL
SLOPE STABILITY

Group ENGINEERING

Scenario CIRCULAR-UNDRAINED CONDITION

Drawn By PREP BY: MB CHKD BY:DEP

Company WEAVER CONSULTANTS GROUP

Date 8/14/2022

File Name SECTION B-Undrained-Circular.slmd

SLIDEINTERPRET 9.018

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

WASTE

Color	🟩
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	90
Saturated Unit Weight [lbs/ft3]	90
Water Surface	Water Table
Hu Value	1

GEOCOMPOSITE/CLAY

Color	🟧
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	125
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Water Table
Hu Value	1

ALLUVIUM

Color	🟦
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	130
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	3355
Friction Angle [deg]	5.8
Water Surface	Water Table
Hu Value	1

SHALE

Color	🟩
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	145
Saturated Unit Weight [lbs/ft3]	150
Cohesion [psf]	18320
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

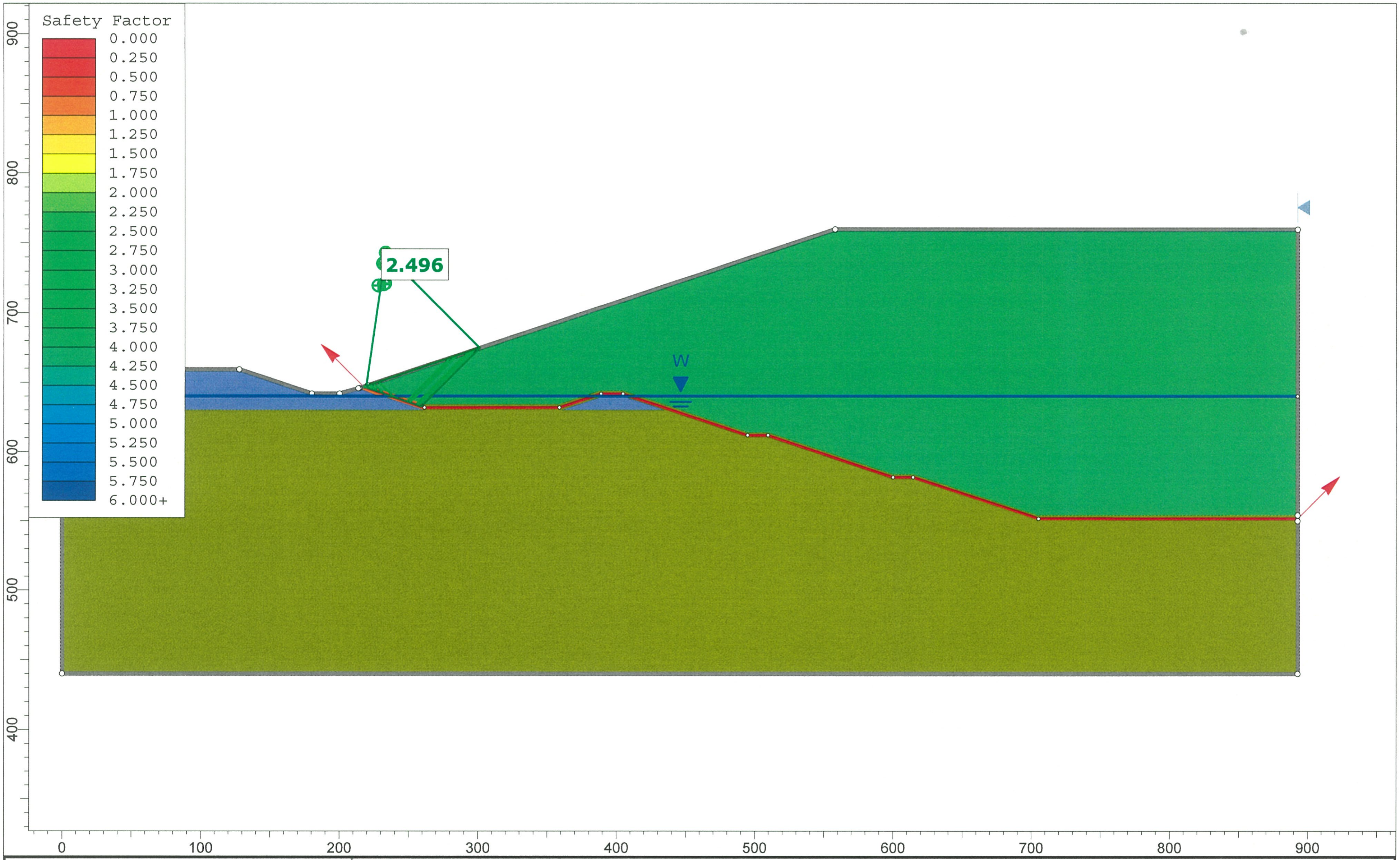
Name: SNF

Effective Normal (psf)	Shear (psf)
0	501
772	501
62565	40690

Global Minimums

Method: bishop simplified

FS	2.094360
Center:	206.708, 1272.494
Radius:	626.655
Left Slip Surface Endpoint:	214.470, 645.887
Right Slip Surface Endpoint:	567.327, 760.000
Resisting Moment:	2.70342e+08 lb-ft
Driving Moment:	1.29081e+08 lb-ft
Total Slice Area:	7495.69 ft2
Surface Horizontal Width:	352.857 ft
Surface Average Height:	21.2429 ft



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SLIDEINTERPRET 9.018

Project	FORT WORTH C & D LANDFILL SLOPE STABILITY		
Group	ENGINEERING	*Scenario*	BLOCK-UNDRAINED CONDITION
Drawn By	PREP BY: MB CHKD BY:DEP	*Company*	WEAVER CONSULTANTS GROUP
Date	8/14/2022	*File Name*	SECTION B-Undrained-Block.slmd

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

WASTE

Color	🟩
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	90
Saturated Unit Weight [lbs/ft3]	90
Water Surface	Water Table
Hu Value	1

GEOCOMPOSITE/CLAY

Color	🟧
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	125
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Water Table
Hu Value	1

ALLUVIUM

Color	🟦
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	130
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	3355
Friction Angle [deg]	5.8
Water Surface	Water Table
Hu Value	1

SHALE

Color	🟩
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	145
Saturated Unit Weight [lbs/ft3]	150
Cohesion [psf]	18320
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

Name: SNF

Effective Normal (psf)	Shear (psf)
0	501
772	501
62565	40690

Global Minimums

Method: bishop simplified

FS	2.496360
Axis Location:	233.253, 742.729
Left Slip Surface Endpoint:	219.555, 647.576
Right Slip Surface Endpoint:	301.157, 674.678
Resisting Moment:	5.99444e+06 lb-ft
Driving Moment:	2.40127e+06 lb-ft
Total Slice Area:	1173.74 ft2
Surface Horizontal Width:	81.602 ft
Surface Average Height:	14.3837 ft

APPENDIX IIIM-A-3

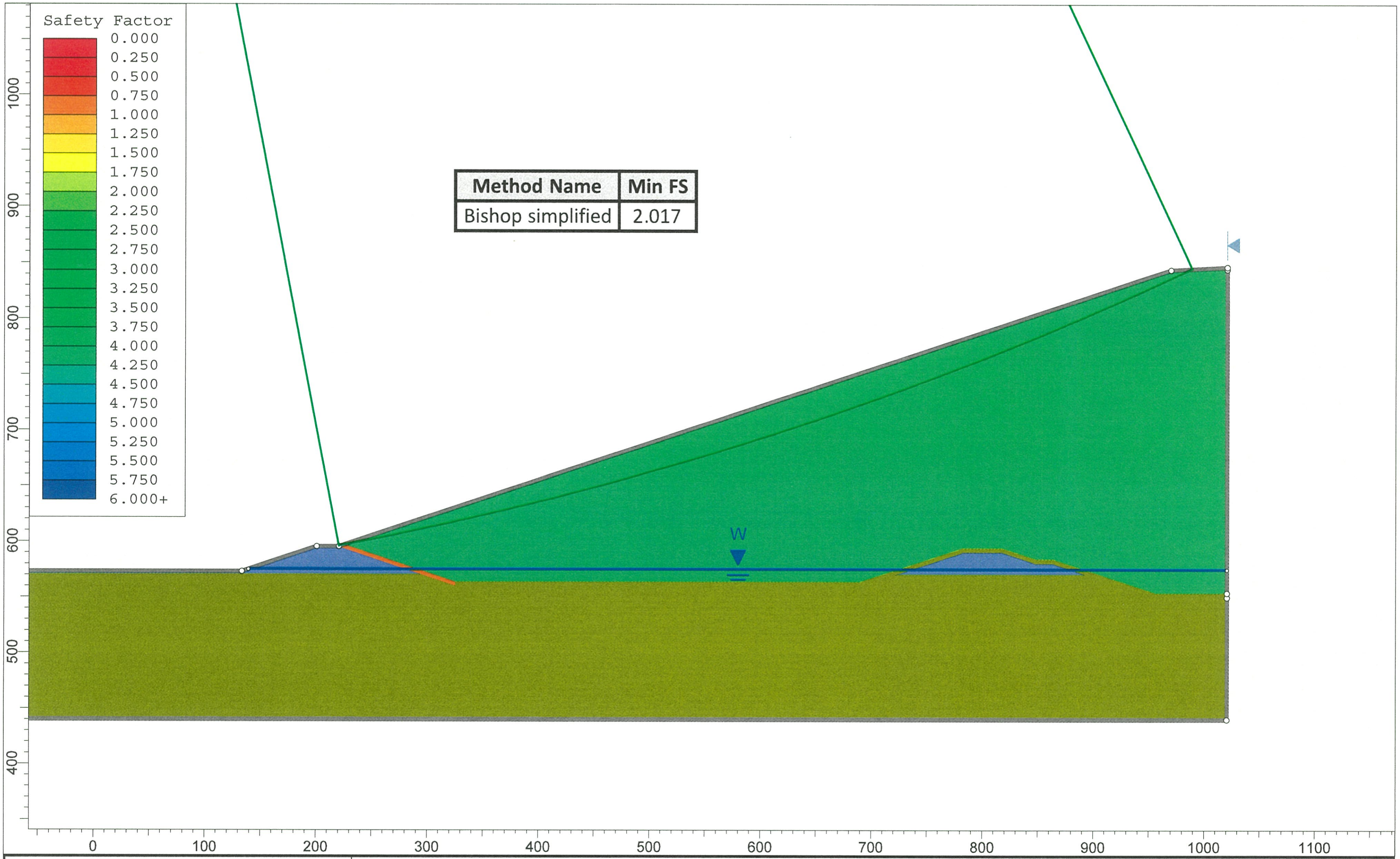
FINAL COVER CONFIGURATION
STABILITY ANALYSIS

Includes pages IIIM-A-3-1 through IIIM-A-3-50

STATE OF TEXAS
DAVID E. POE
81734
LICENSED
PROFESSIONAL ENGINEER
02/09/2023

SLOPE STABILITY SECTION C-C – FINAL CLOSURE CONDITIONS

SLIDE2 OUTPUT RESULTS



Method Name	Min FS
Bishop simplified	2.017

Weaver Consultants Group

SLIDEINTERPRET 9.018

Project	FORT WORTH C & D LANDFILL SLOPE STABILITY		
Group	ENGINEERING	*Scenario*	CIRCULAR-DRAINED CONDITION
Drawn By	PREP BY: MB CHKD BY:DEP	*Company*	WEAVER CONSULTANTS GROUP
Date	8/14/2022	*File Name*	SECTION C-Drained-Circular.slmd

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	🟨
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	230
Friction Angle [deg]	19
Water Surface	None
Ru Value	0

WASTE

Color	🟩
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	90
Saturated Unit Weight [lbs/ft3]	90
Water Surface	Water Table
Hu Value	1

GEOCOMPOSITE/CLAY

Color	🟧
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	125
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Water Table
Hu Value	1

ALLUVIUM

Color	🟦
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	130
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	345.6
Friction Angle [deg]	21.6
Water Surface	Water Table
Hu Value	1

SHALE

Color	🟩
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	145
Saturated Unit Weight [lbs/ft3]	150
Cohesion [psf]	2000
Friction Angle [deg]	25
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

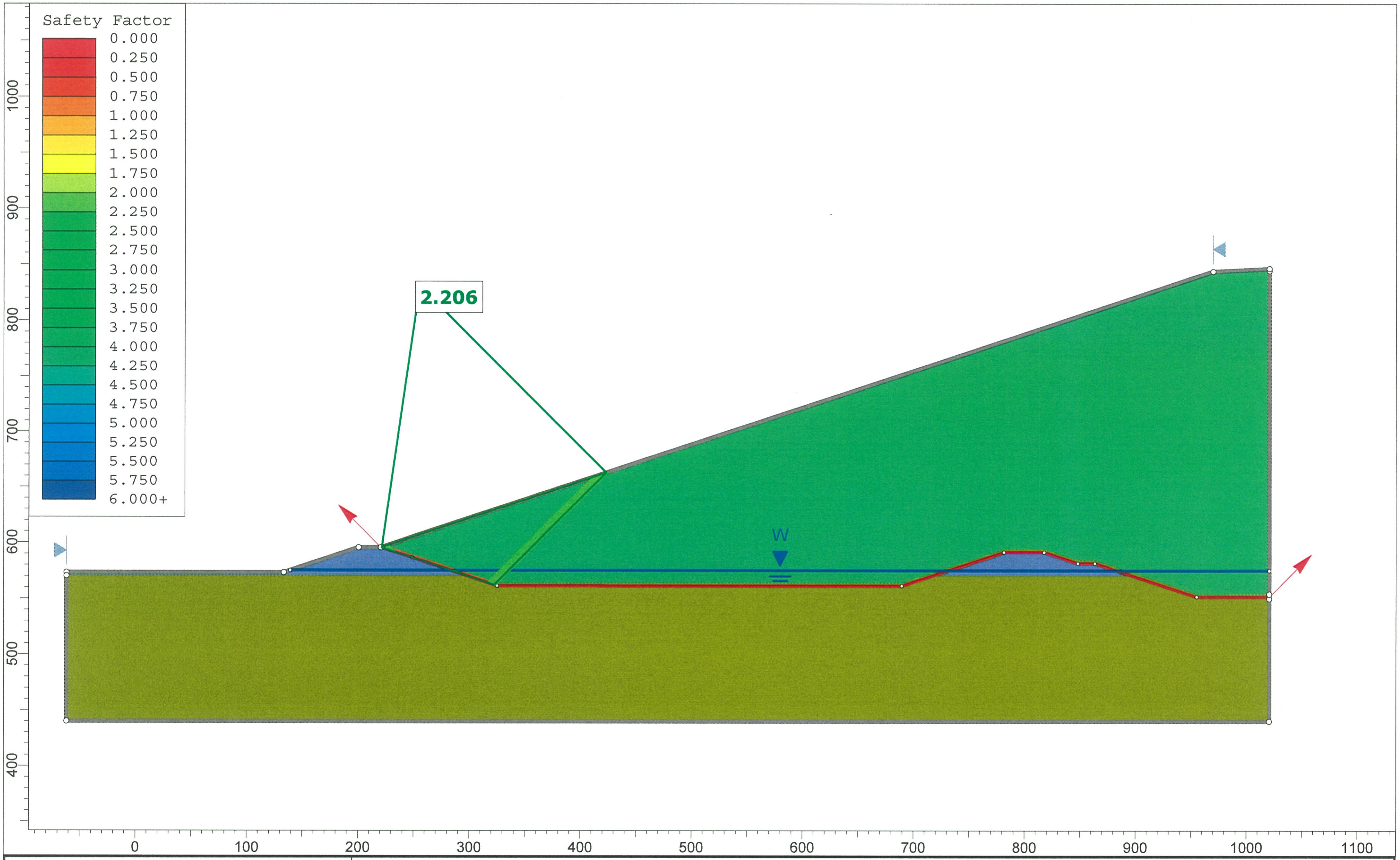
Name: SNF

Effective Normal (psf)	**Shear (psf)**
0	501
772	501
62565	40690

Global Minimums

Method: bishop simplified

FS	**2.017160**
Center:	-384.916, 3762.311
Radius:	3224.209
Left Slip Surface Endpoint:	220.727, 595.496
Right Slip Surface Endpoint:	989.006, 845.487
Resisting Moment:	2.97389e+09 lb-ft
Driving Moment:	1.4743e+09 lb-ft
Total Slice Area:	15722.5 ft2
Surface Horizontal Width:	768.279 ft
Surface Average Height:	20.4646 ft



Weaver Consultants Group

SLIDEINTERPRET 9.018

Project	FORT WORTH C & D LANDFILL SLOPE STABILITY
Group ENGINEERING	*Scenario* BLOCK-DRAINED CONDITION
Drawn By PREP BY: MB CHKD BY:DEP	*Company* WEAVER CONSULTANTS GROUP
Date 8/14/2022	*File Name* SECTION C-Drained-Block.slmd

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	🟨
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	230
Friction Angle [deg]	19
Water Surface	None
Ru Value	0

WASTE

Color	🟩
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	90
Saturated Unit Weight [lbs/ft3]	90
Water Surface	Water Table
Hu Value	1

GEOCOMPOSITE/CLAY

Color	🟧
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	125
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Water Table
Hu Value	1

ALLUVIUM

Color	🟦
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	130
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	345.6
Friction Angle [deg]	21.6
Water Surface	Water Table
Hu Value	1

SHALE

Color	🟩
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	145
Saturated Unit Weight [lbs/ft3]	150
Cohesion [psf]	2000
Friction Angle [deg]	25
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

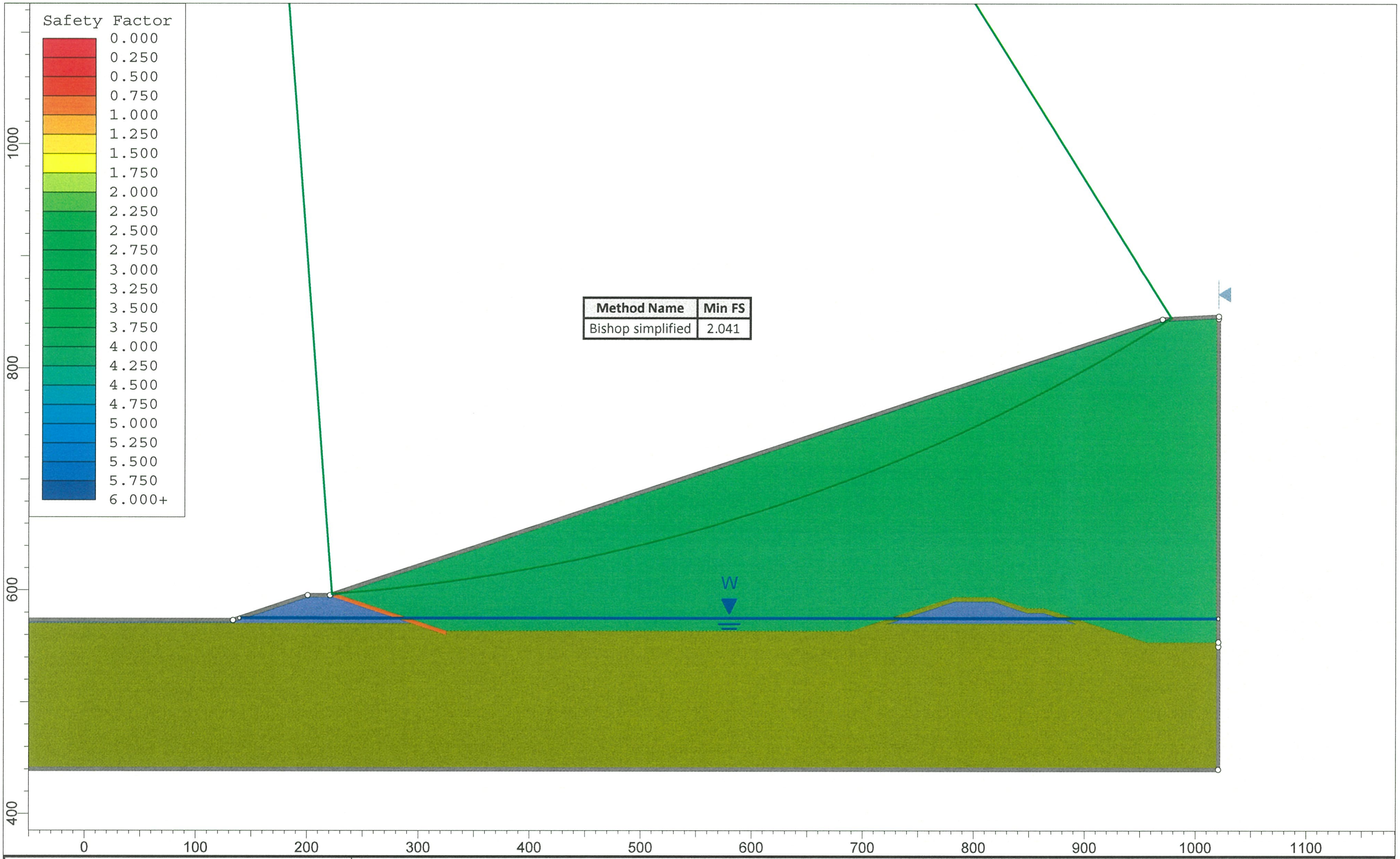
Name: SNF

Effective Normal (psf)	Shear (psf)
0	501
772	501
62565	40690

Global Minimums

Method: bishop simplified

FS	2.205760
Axis Location:	255.371, 831.007
Left Slip Surface Endpoint:	221.577, 595.778
Right Slip Surface Endpoint:	423.277, 662.835
Resisting Moment:	7.69436e+07 lb-ft
Driving Moment:	3.4883e+07 lb-ft
Total Slice Area:	6791.26 ft2
Surface Horizontal Width:	201.7 ft
Surface Average Height:	33.6701 ft



Method Name	Min FS
Bishop simplified	2.041

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SLIDEINTERPRET 9.018

Project	FORT WORTH C & D LANDFILL SLOPE STABILITY		
Group	ENGINEERING	*Scenario*	CIRCULAR-UNDRAINED CONDITION
Drawn By	PREP BY: MB CHKD BY:DEP	*Company*	WEAVER CONSULTANTS GROUP
Date	8/14/2022	*File Name*	SECTION C-Undrained-Circular.slmd

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC	
Color	🟨
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	1100
Friction Angle [deg]	0
Water Surface	None
Ru Value	0
WASTE	
Color	🟩
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	90
Saturated Unit Weight [lbs/ft3]	90
Water Surface	Water Table
Hu Value	1
GEOCOMPOSITE/CLAY	
Color	🟧
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	125
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Water Table
Hu Value	1
ALLUVIUM	
Color	🟦
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	130
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	3355
Friction Angle [deg]	5.8
Water Surface	Water Table
Hu Value	1
SHALE	
Color	🟩
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	145
Saturated Unit Weight [lbs/ft3]	150
Cohesion [psf]	18320
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

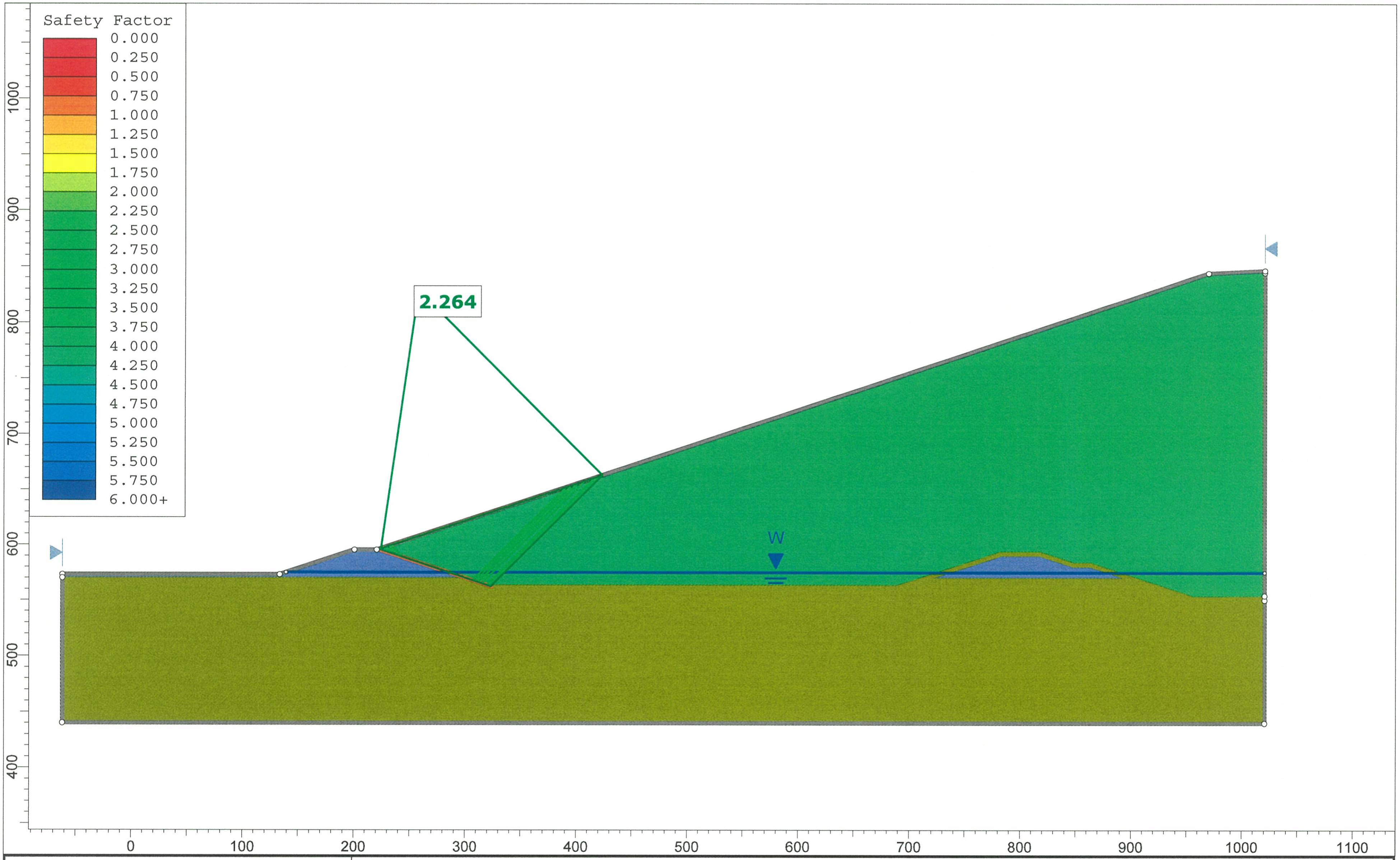
Name: SNF

Effective Normal (psf)	Shear (psf)
0	501
772	501
62565	40690

Global Minimums

Method: bishop simplified

FS	2.040570
Center:	101.442, 2235.104
Radius:	1643.477
Left Slip Surface Endpoint:	222.523, 596.093
Right Slip Surface Endpoint:	978.063, 844.941
Resisting Moment:	2.5569e+09 lb-ft
Driving Moment:	1.25303e+09 lb-ft
Total Slice Area:	26847.1 ft2
Surface Horizontal Width:	755.54 ft
Surface Average Height:	35.5336 ft



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SLIDEINTERPRET 9.018

Project	FORT WORTH C & D LANDFILL SLOPE STABILITY		
Group	ENGINEERING	*Scenario*	BLOCK-UNDRAINED CONDITION
Drawn By	PREP BY: MB CHKD BY:DEP	*Company*	WEAVER CONSULTANTS GROUP
Date	8/14/2022	*File Name*	SECTION C-Undrained-Block.slmd

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	🟨
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	1100
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

WASTE

Color	🟩
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	90
Saturated Unit Weight [lbs/ft3]	90
Water Surface	Water Table
Hu Value	1

GEOCOMPOSITE/CLAY

Color	🟧
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	125
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Water Table
Hu Value	1

ALLUVIUM

Color	🟦
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	130
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	3355
Friction Angle [deg]	5.8
Water Surface	Water Table
Hu Value	1

SHALE

Color	🟩
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	145
Saturated Unit Weight [lbs/ft3]	150
Cohesion [psf]	18320
Friction Angle [deg]	0.5
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

Name: SNF

Effective Normal (psf)	Shear (psf)
0	501
772	501
62656	41471

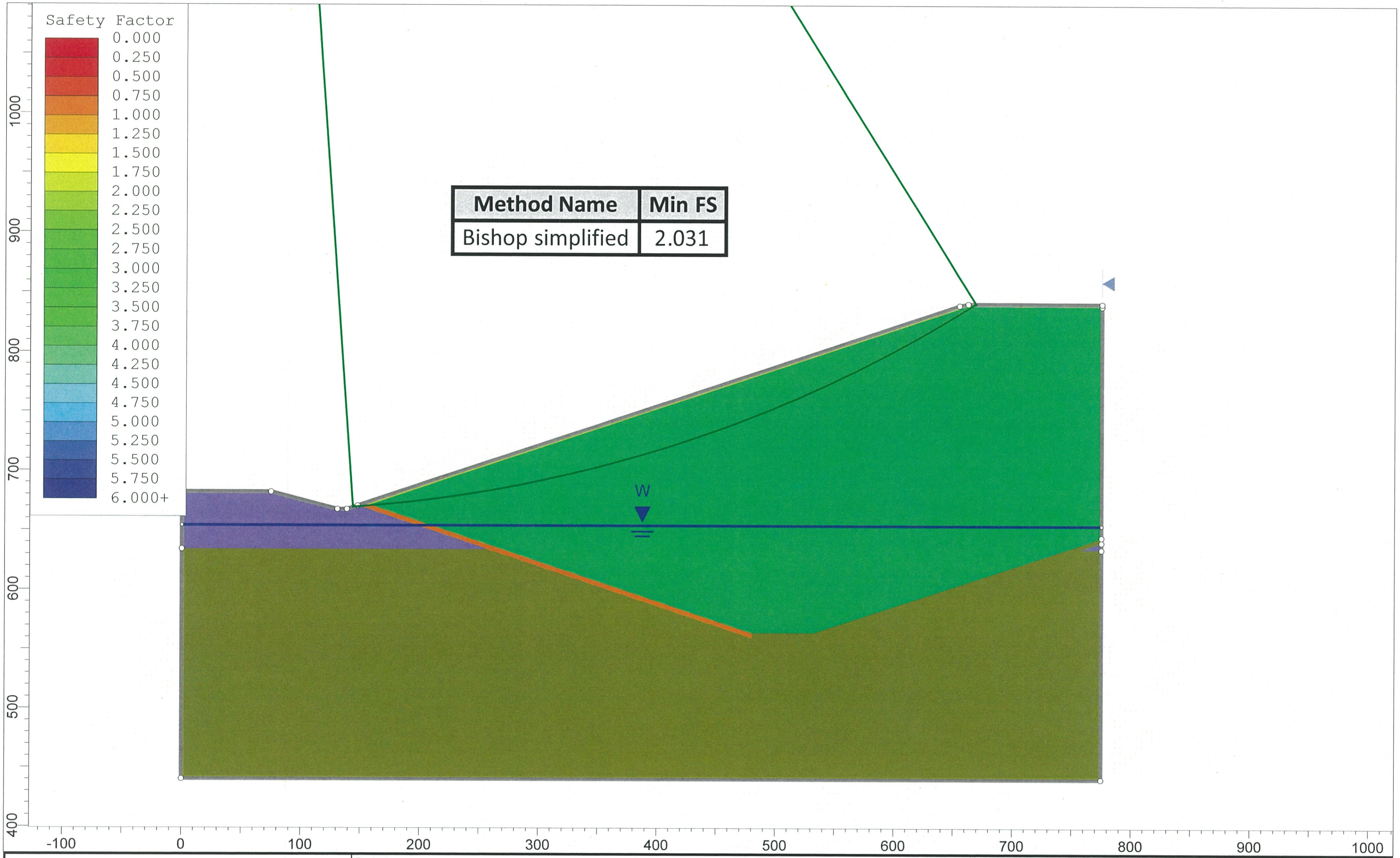
Global Minimums

Method: bishop simplified

FS	2.263890
Axis Location:	257.878, 828.853
Left Slip Surface Endpoint:	224.535, 596.762
Right Slip Surface Endpoint:	423.545, 662.924
Resisting Moment:	7.72284e+07 lb-ft
Driving Moment:	3.41132e+07 lb-ft
Total Slice Area:	6706.26 ft2
Surface Horizontal Width:	199.01 ft
Surface Average Height:	33.6981 ft

SLOPE STABILITY SECTION D-D – FINAL CLOSURE CONDITIONS

SLIDE2 OUTPUT RESULTS



Method Name	Min FS
Bishop simplified	2.031

Weaver Consultants Group

SLIDEINTERPRET 9.018

Project
FORT WORTH C & D LANDFILL
SLOPE STABILITY

Group ENGINEERING

Scenario CIRCULAR-DRAINED CONDITION

Drawn By PREP BY: MB CHKD BY:DEP

Company WEAVER CONSULTANTS GROUP

Date 8/14/2022

File Name SECTION D-Drained-Circular.slmd

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	🟨
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	230
Friction Angle [deg]	19
Water Surface	None
Ru Value	0

WASTE

Color	🟩
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	90
Saturated Unit Weight [lbs/ft3]	90
Water Surface	Water Table
Hu Value	1

GEOCOMPOSITE/CLAY

Color	🟧
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	125
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Water Table
Hu Value	1

ALLUVIUM

Color	🟪
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	130
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	345.6
Friction Angle [deg]	21.6
Water Surface	Water Table
Hu Value	1

SHALE

Color	🟩
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	145
Saturated Unit Weight [lbs/ft3]	150
Cohesion [psf]	2000
Friction Angle [deg]	25
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

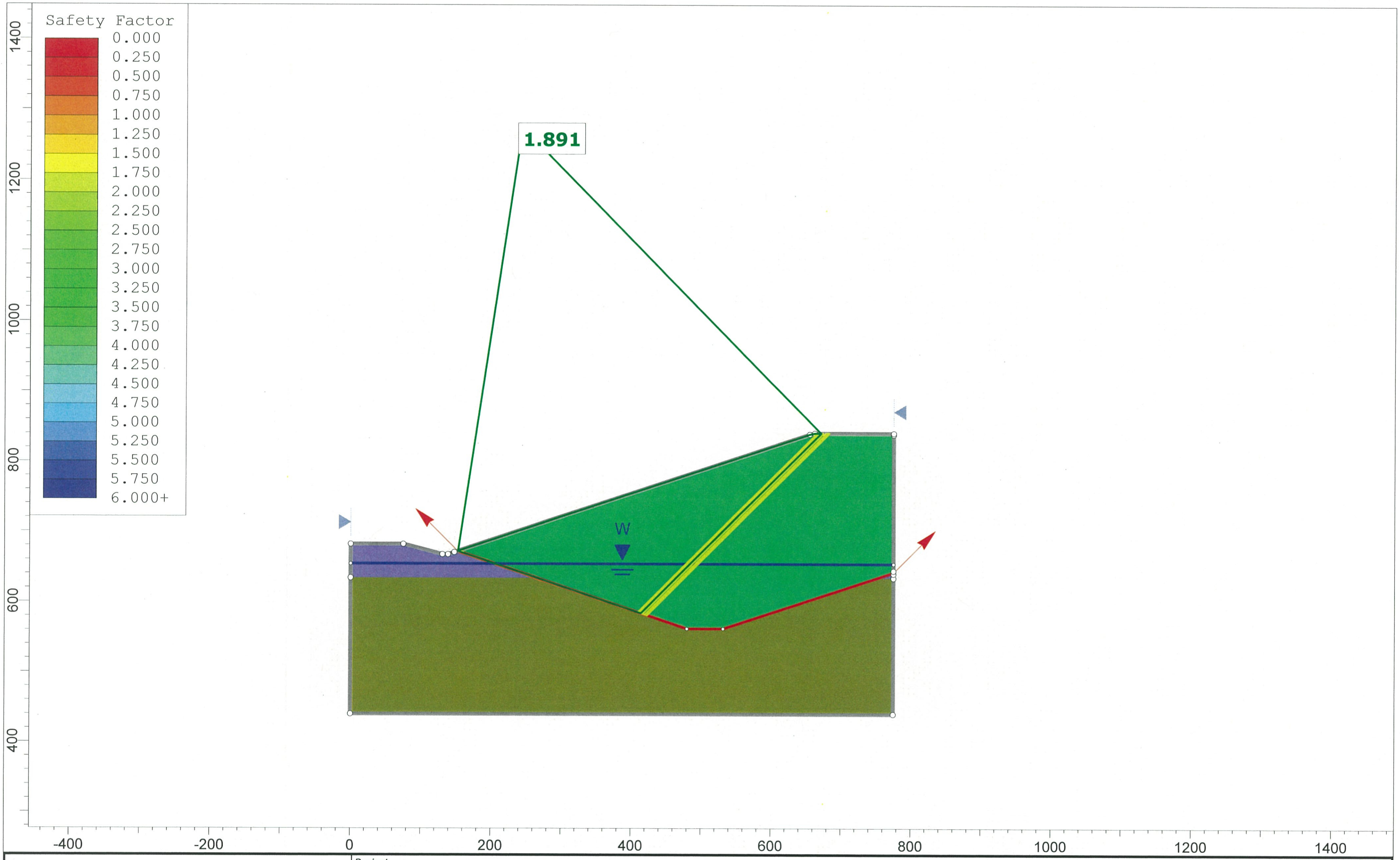
Name: SNF

Effective Normal (psf)	**Shear (psf)**
0	501
772	501
62565	40690

Global Minimums

Method: bishop simplified

FS	**2.031230**
Center:	62.730, 1803.167
Radius:	1136.877
Left Slip Surface Endpoint:	143.491, 669.163
Right Slip Surface Endpoint:	668.500, 841.122
Resisting Moment:	8.85924e+08 lb-ft
Driving Moment:	4.36151e+08 lb-ft
Total Slice Area:	13396.3 ft2
Surface Horizontal Width:	525.01 ft
Surface Average Height:	25.5163 ft



Weaver Consultants Group

SLIDEINTERPRET 9.018

Project	FORT WORTH C & D LANDFILL SLOPE STABILITY		
Group	ENGINEERING	*Scenario*	BLOCK-DRAINED CONDITION
Drawn By	PREP BY: MB CHKD BY:DEP	*Company*	WEAVER CONSULTANTS GROUP
Date	8/14/2022	*File Name*	SECTION D-Drained-Block.slmd

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	🟨
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	230
Friction Angle [deg]	19
Water Surface	None
Ru Value	0

WASTE

Color	🟩
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	90
Saturated Unit Weight [lbs/ft3]	90
Water Surface	Water Table
Hu Value	1

GEOCOMPOSITE/CLAY

Color	🟧
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	125
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Water Table
Hu Value	1

ALLUVIUM

Color	🟪
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	130
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	345.6
Friction Angle [deg]	21.6
Water Surface	Water Table
Hu Value	1

SHALE

Color	🟩
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	145
Saturated Unit Weight [lbs/ft3]	150
Cohesion [psf]	2000
Friction Angle [deg]	25
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

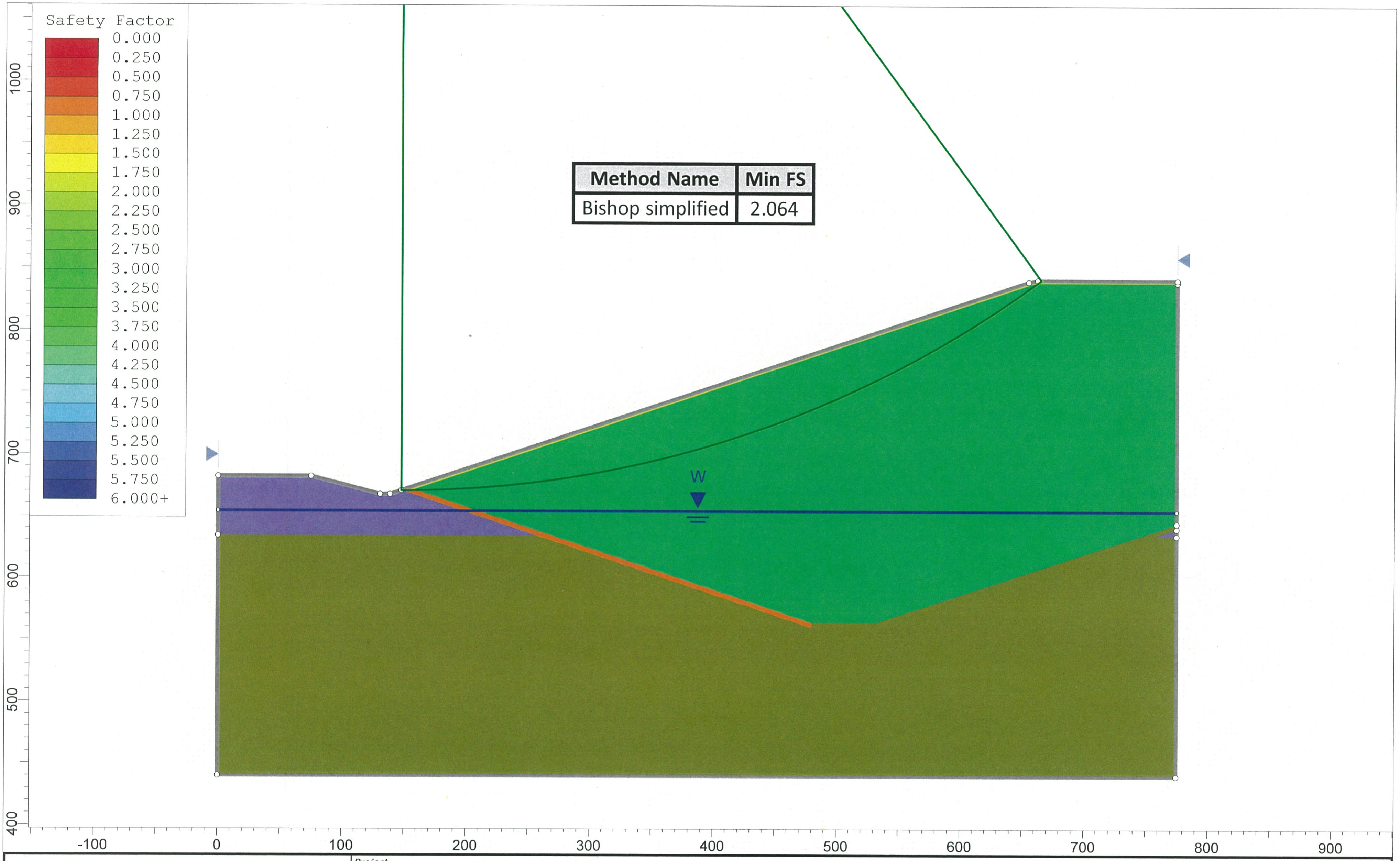
Name: SNF

Effective Normal (psf)	Shear (psf)
0	501
772	501
62565	40690

Global Minimums

Method: bishop simplified

FS	1.891040
Axis Location:	242.916, 1274.978
Left Slip Surface Endpoint:	152.659, 672.219
Right Slip Surface Endpoint:	670.969, 841.117
Resisting Moment:	1.1372e+09 lb-ft
Driving Moment:	6.01362e+08 lb-ft
Total Slice Area:	45967.9 ft2
Surface Horizontal Width:	518.31 ft
Surface Average Height:	88.6881 ft



Weaver Consultants Group

SLIDEINTERPRET 9.018

Project
FORT WORTH C & D LANDFILL
SLOPE STABILITY

Group ENGINEERING

Scenario CIRCULAR-UNDRAINED CONDITION

Drawn By PREP BY: MB CHKD BY:DEP

Company WEAVER CONSULTANTS GROUP

Date 8/14/2022

File Name SECTION D-Undrained-Circular.slmd

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	🟨
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	1100
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

WASTE

Color	🟩
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	90
Saturated Unit Weight [lbs/ft3]	90
Water Surface	Water Table
Hu Value	1

GEOCOMPOSITE/CLAY

Color	🟧
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	125
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Water Table
Hu Value	1

ALLUVIUM

Color	🟪
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	130
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	3355
Friction Angle [deg]	5.8
Water Surface	Water Table
Hu Value	1

SHALE

Color	🟫
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	145
Saturated Unit Weight [lbs/ft3]	150
Cohesion [psf]	18320
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

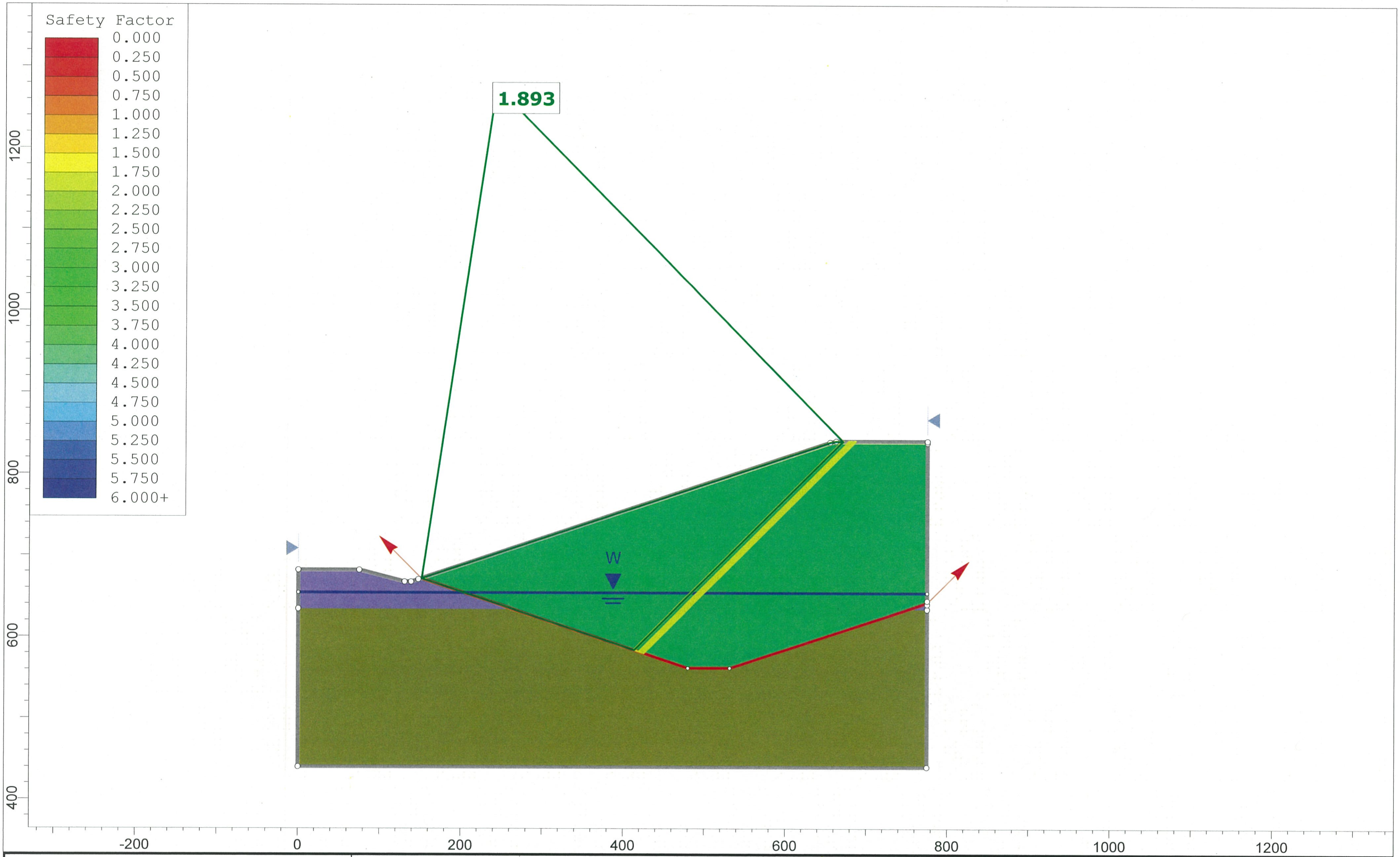
Name: SNF

Effective Normal (psf)	Shear (psf)
0	501
772	501
62565	40690

Global Minimums

Method: bishop simplified

FS	**2.064300**
Center:	147.594, 1539.629
Radius:	869.118
Left Slip Surface Endpoint:	147.536, 670.510
Right Slip Surface Endpoint:	664.765, 841.130
Resisting Moment:	8.31687e+08 lb-ft
Driving Moment:	4.02891e+08 lb-ft
Total Slice Area:	16455.5 ft2
Surface Horizontal Width:	517.229 ft
Surface Average Height:	31.8148 ft



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SLIDEINTERPRET 9.018

Project
FORT WORTH C & D LANDFILL
SLOPE STABILITY

Group ENGINEERING

Scenario BLOCK-UNDRAINED CONDITION

Drawn By PREP BY: MB CHKD BY:DEP

Company WEAVER CONSULTANTS GROUP

Date 8/14/2022

File Name SECTION D-Undrained-Block.slmd

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	🟨
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	1100
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

WASTE

Color	🟩
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	90
Saturated Unit Weight [lbs/ft3]	90
Water Surface	Water Table
Hu Value	1

GEOCOMPOSITE/CLAY

Color	🟧
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	125
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Water Table
Hu Value	1

ALLUVIUM

Color	🟪
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	130
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	3355
Friction Angle [deg]	5.8
Water Surface	Water Table
Hu Value	1

SHALE

Color	🟫
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	145
Saturated Unit Weight [lbs/ft3]	150
Cohesion [psf]	18320
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

Name: SNF

Effective Normal (psf)	Shear (psf)
0	501
772	501
62565	40690

Global Minimums

Method: bishop simplified

FS	**1.893140**
Axis Location:	241.824, 1275.376
Left Slip Surface Endpoint:	151.627, 671.875
Right Slip Surface Endpoint:	670.506, 841.118
Resisting Moment:	1.13974e+09 lb-ft
Driving Moment:	6.02034e+08 lb-ft
Total Slice Area:	45966.4 ft2
Surface Horizontal Width:	518.879 ft
Surface Average Height:	88.5879 ft

APPENDIX IIIM-A-4

INFINITE SLOPE STABILITY ANALYSIS

Includes pages IIIM-A-4-1 through IIIM-A-4-12

DAVID E. POE

81734

02/09/2023

FORT WORTH C & D LANDFILL
APPENDIX IIIM-A-4
0771-356-11-35
STABILITY ANALYSIS OF THE BOTTOM LINER SYSTEM

Required: Evaluate the stability of the recompacted clay liner system components

Procedure:

A. Bottom Liner System Stability
   1. Verify that the tensile stress in the liner system will be less than the yield stress of the liner components by using Koerner's method for determination of shear stress in liner systems considering cohesion/adhesion forces of the liner components. Underdrain geocomposite designed to be installed on 3H:1V sidewalls without anchor trenches, based on results of following analyses.

B. Infinite Slope Stability Analysis
   1. Use Duncan and Buchignani's method for infinite stability analyses to evaluate the internal stability of the bottom liner system using peak shear strength values

Contents:

- Verification that the tensile stress in the bottom liner system will be less than yield stress is provided on Sheets IIIM-A-4-2 through IIIM-A-4-4
- Infinite stability analysis to evaluate the internal stability of the bottom liner system is presente on Sheets IIIM-A-4-5 through IIIM-A-4-6

References:

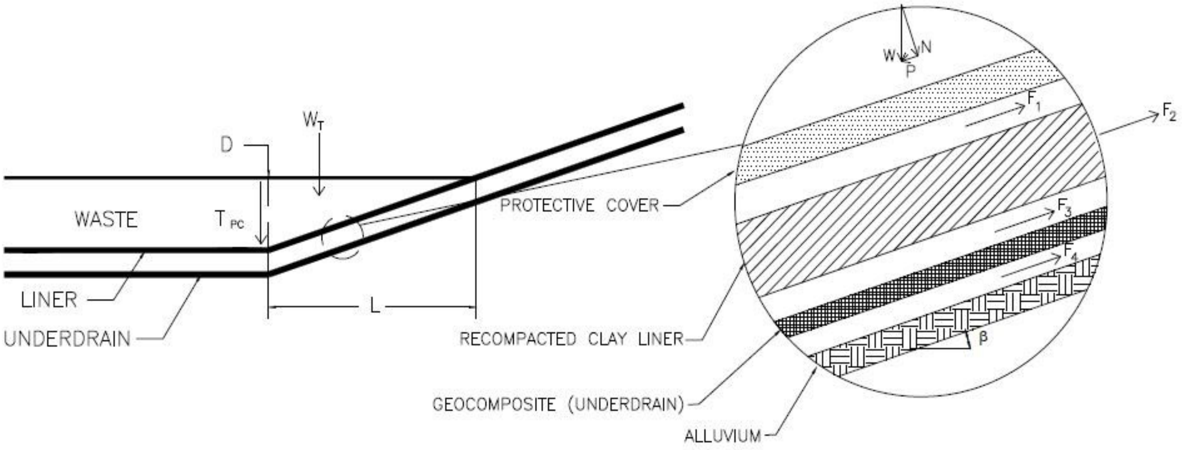
1. Koerner, Robert M., *Designing with Geosynthetics*, 3rd Edition, Prentice-Hall Inc., 1994.
2. Duncan, J.M. and Buchignani, A. L., *An Engineering Manual for Slope Stability Studies,* Department of Civil Engineering - University of California-Berkeley, 1975
3. USACE, *Slope Stability*, Engineering and Design Manual, EM 1110-2-1902, October 31, 2003.
4. Koerner, Robert M., *Analysis and Design of Veneer Cover Soils*, 1998 Sixth International Conference of Geosynthetics.
5. Koerner, George R. and Narejo, Dhani, *Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces,* GRI Report #30, June 14, 2005.
6. Gilbert, Robert B., *Peak Versus Residual Strength for Waste Containment Systems,*
7. Proceedings of the 15th GRI Conference, December 13, 2001.
8. NAVFAC Design Manual 7.01, September 1986.

A. Liner System Stability

Note: The liner system includes a 1-foot-thick protective cover and a 3-foot-thick recompacted clay liner underlain by 200-mil geocomposi

1. Verify that tensile stress in liner system is less than yield stress for the liner system.

Recompacted Clay Layer (All Areas)



Assume a Caterpillar D8T WH Track-Type Tractor

Operational Weight = 85,150 lb
Number of Tracks = 2
Track Width = 1.84 ft

W_W = Weight of solid waste, lb/ft
W_{PC} = Weight of protective cover, lb/ft
W_T = Combined weight of equipment, solid waste, and protective cover, lb/ft
T_{PC} = Friction force on edge of protective cover, lb/ft
W = Net force of equipment, waste, and protective cover on liner system, lb/ft
N = Normal force on liner system, lb/ft
P = Shearing force on liner system, lb/ft
β = Slope angle, deg
F_n = Resisting force, lb/ft, calculated using the equation:
$(N * \tan(\Delta_n)) + (C_{an} * L / \cos(\beta))$

F_1 = Resistance of protective cover/recompacted clay liner, lb/ft
F_2 = Resistance of internal recompacted clay liner, lb/ft
F_3 = Resistance of recompacted clay liner/geocomposite, lb/ft
F_4 = Resistance of geocomposite/alluvium, lb/ft

Δ_n = Interface friction angle of interface "n", deg
C_{an} = Adhesion of interface "n", psf
ϕ_n = Internal friction angle of material "n", deg
C_n = Cohesion of material "n", psf

γ_{was} = Unit weight of solid waste (including daily cover), pcf
D_{was} = Individual lift height, ft
ϕ_{was} = Internal friction angle of waste, deg
γ_{pc} = Unit weight of protective cover, pcf
D_{pc} = Thickness of protective cover and recompacted clay liner (combined), ft
ϕ_{pc} = Internal friction angle of protective cover/recompacted clay liner, deg
L = Horizontal length of lift, ft

Parameters:

$\beta_{sideslope}$ =	18.43	deg	γ_{was} =	90	pcf
Δ_1 =	19	deg	D_{was} =	10	ft
C_{a1} =	230	psf	ϕ_{was} =	33	deg
Δ_2 =	19	deg	γ_{pc} =	120	pcf
C_{a2} =	230	psf	D_{pc} =	4	ft
Δ_3 =	16	deg	ϕ_{pc} =	19	deg
C_{a3} =	100	psf	L =	30	ft
Δ_4 =	16				
C_{a4} =	100				

Note:
Interface friction strength values are selected conservatively from laboratory testing of similar material/interfaces. Prior to construction, laboratory tests will be performed to verify the assumed values for interface adhesion (or cohesion) and friction angle using project-specific soil and synthetic materials. The interface friction testing will be performed for the specific conditions analyzed. If test results differ from the assumed values, this analysis will be updated for acceptable factor of safety values using the procedure presented in the following sections.

Weight of Equipment

$$W_E = \frac{\text{Operational Weight}}{\text{Number of Tracks x Width of Track}}$$

W_E = 23,139 lb/ft

Weight of Solid Waste

$$W_W = \frac{D_{was} \text{ x } L \text{ x } \gamma_{was}}{2}$$

W_W = 13,500 lb/ft

Weight of Protective Cover

$$W_{PC} = D_{pc} \text{ x } \gamma_{pc} \text{ x } \frac{L}{\cos(\beta_{sideslope})}$$

W_{PC} = 15,178 lb/ft

Combined Weight of Equipment, Solid Waste, and Protective Cover/Recompacted Clay Liner,

$$W_T = W_E + W_W + W_{PC}$$

W_T = 51,817 lb/ft

FORT WORTH C & D LANDFILL
APPENDIX IIIM-A-4
0771-356-11-35
STABILITY ANALYSIS OF THE BOTTOM LINER SYSTEM

Friction Force on Edge of Protective Cover

$T_{PC} = k_o \times \sigma_v \times \tan \phi_{pc} \times D_{pc}$

where: $k_o = 1 - \sin \phi_{pc}$

$\sigma_v = \frac{D_{pc} \times \gamma_{pc}}{2}$ $T_{PC} =$ 223 lb/ft

Net Force of Equipment, Waste, and Protective Cover on Liner System

$W = W_T - T_{PC}$ $W =$ 51,594 lb/ft

$N = W \cos(\beta)$ $N =$ 48,948 lb/ft

$P_{sideslope} = W \sin(\beta)$ $P_{sideslope} =$ 16,311 lb/ft

Recompacted Clay Liner:

Resistance of Protective Cover/Recompacted Clay Liner = $F_1 =$ 24,127 lb/ft

$P_{sideslope} < F_1$ Therefore, protective cover soil is stable on the recompacted clay liner and a driving force equal to P is transferred to the next interface.

Resistance of Internal Recompacted Clay Liner= $F_2 =$ 24,127 lb/ft

$P_{sideslope} < F_2$ Therefore, the recompacted clay liner internally is stable and a driving force equal to P is transferred to the next interface.

Resistance of Recompacted Clay Liner/Geocomposite Interface= $F_3 =$ 17,198 lb/ft

$P_{sideslope} < F_3$ Therefore, recompacted clay liner is stable on the geocomposite and a driving force equal to P is transferred to the next interface.

Resistance of Geocomposite/Alluvium Liner= $F_4 =$ 17,198 lb/ft

$P_{sideslope} < F_4$ Therefore, the geocomposite is stable on the alluvium layer and a driving force equal to P is transferred to the next interface.

B. Infinite Slope Stability Analysis

Interface friction strength values are selected conservatively from laboratory testing of similar material/interfaces. Prior to construction, laboratory tests will be performed to verify the assumed values for interface adhesion (or cohesion) and friction angle using project-specific soil and synthetic materials. The interface friction testing will be performed for the specific conditions analyzed. If test results differ from the assumed values, this analysis will be updated for acceptable factor of safety values using the procedure presented in the following sections.

LINER SYSTEM

The liner system analyzed includes a 1-foot-thick protective cover and a 3-foot-thick recompacted clay liner overlying a 200-mil geocomposite underdrain layer.

1. Use Duncan and Buchignani's method for infinite stability analyses to evaluate the internal stability of the liner, and final cover systems using peak shear strength values.

The factor of safety is calculated using the following equation:

$$F.S. = A\frac{\tan\Delta}{\tan\beta} + B\frac{C_a}{\gamma H}$$

where:
Δ = Interface friction angle, deg
C_a = Adhesion, psf
β = Slope angle, deg
A = Parameter A from chart on sheet IIIM-A-4-8
B = Parameter B from chart on sheet IIIM-A-4-8
γ = Unit weight of soil, pcf
H = Thickness of material above interface, ft

An example using the recompacted clay liner/geocomposite interface of the liner system is provided below.

A. Define the shear strength parameters (peak shear strength parameters will be used for this example).

Δ = 16 deg
C_a = 100 psf

B. Calculate the pore pressure, r_u, using the following equation:

$$r_u = (T \text{ x } \gamma_w \text{ x } \cos^2 b) / (H \text{ x } \gamma)$$

where:
H = Thickness of material above interface, ft
γ_w = Unit weight of water, pcf
β = Slope angle, deg
T = Maximum head above interface, ft
γ = Unit weight of soil, pcf

H =	4	ft
γ_w =	62.4	pcf
β =	18.43	deg (3H:1V)
T =	0	ft
γ =	120	pcf

r_u = 0.00

Since T=0, there is no pore pressure build-up in the protective cover. If the soil material is assumed to be saturated, use a unit weight of 125 pcf for soil.

C. Calculate the slope ratio, b.

b = cot β = 3.0

D. Using ru and b, determine Parameters A and B from the charts on sheet IIIM-A-4-50.

A = 1.0
B = 3.3

E. Calculate the factor of safety and compare against the minimum recommended factor of safety.

F.S. = 1.55 > F.S._{min} = 1.5

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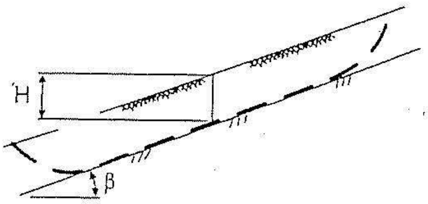
APPENDIX IIIM-A-4
0771-356-11-35
STABILITY ANALYSIS OF THE BOTTOM LINER SYSTEM

Component/Interface	Strength Parameters		H (ft)	γ (pcf)	β (deg)	T (ft)	r_u	b	A	B	Factor of Safety Generated	Recommended Minimum Factor of Safety	Acceptable Factor of Safety
	Cohesion/Adhesion (psf)	Friction Angle (deg)											
	Peak	Peak									Peak	Peak	Peak
Liner System - Reompacted Clay Liner Option (3H:1V Maximum Slope)													
Compacted Clay Liner													
Protective Cover/Recompacted Clay liner	230	19	1	120	18.43	0	0.00	3.0	1.0	3.3	7.36	1.5	YES
Recompacted Clay liner/Geocomposite	100	16	4	120	18.43	0	0.00	3.0	1.0	3.3	1.55	1.5	YES
Geocomposite/Alluvium	100	16	4	120	18.43	0	0.00	3.0	1.0	3.3	1.55	1.5	YES
Recompacted Clay Liner Internal	230	19	2.5	120	18.43	0	0.00	3.0	1.0	3.3	3.56	1.5	YES



γ = total unit weight of soil

γ_w = unit weight of water

c' = cohesion intercept

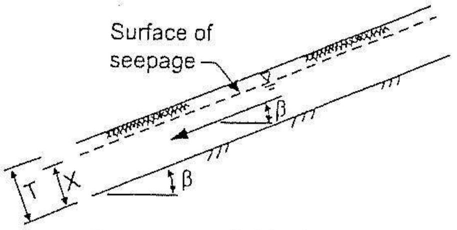
ϕ' = friction angle

r_u = pore pressure ratio = $u/\gamma H$

u = pore pressure at depth H

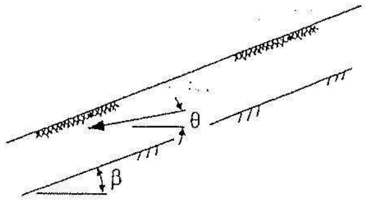
Steps.

1. Determine r_u from measured pore pressure or formulas at right.
2. Determine A and B from charts below.
3. Calculate $F = A\dfrac{\tan\phi'}{\tan\beta} + B\dfrac{c'}{\gamma H}$



Seepage parallel to slope

$$r_u = \frac{X}{T}\frac{\gamma_w}{\gamma}\cos^2\beta$$



Seepage emerging from slope

$$r_u = \frac{\gamma_w}{\gamma}\frac{1}{1+\tan\beta\tan\theta}$$

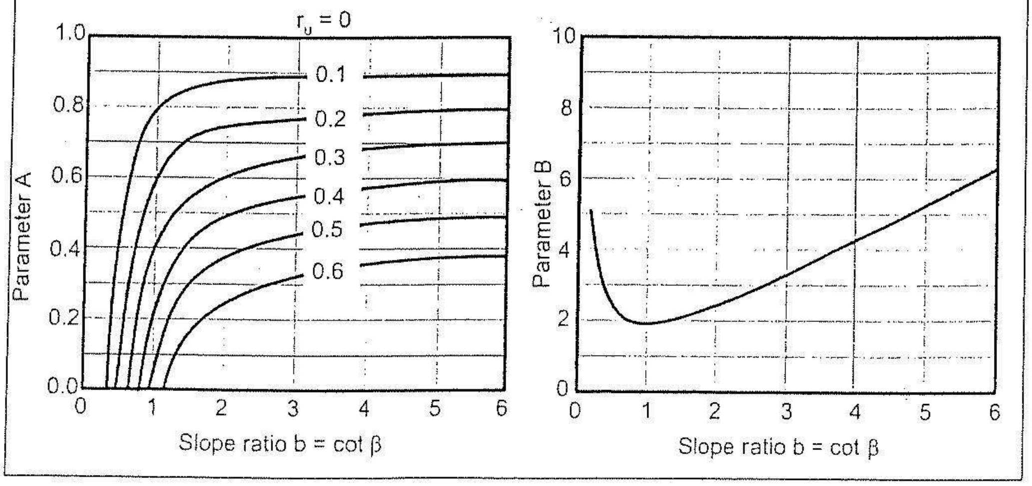


Figure E-7. Slope stability charts for infinite slopes (after Duncan, Buchianani, and DeWet 1987)

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APPENDIX IIIM-A-4
0771-356-11-35
STABILITY ANALYSIS OF THE FINAL COVER SYSTEM

Required: Evaluate the stability of the final cover system components

Procedure: A. Infinite Slope Stability Analysis

1. Use Duncan and Buchignani's method for infinite stability analyses to evaluate the internal stability of the bottom liner system using peak shear strength values

Contents: - Infinite stability analysis to evaluate the internal stability of the final cpver system is presented on Sheets IIIM-A-4-10 through IIIM-A-4-11

References:

1. Koerner, Robert M., *Designing with Geosynthetics* , 3rd Edition, Prentice-Hall Inc., 1994.
2. Duncan, J.M. and Buchignani, A. L., *An Engineering Manual for Slope Stability Studies,* Department of Civil Engineering - University of California-Berkeley, 1975
3. USACE, *Slope Stability* , Engineering and Design Manual, EM 1110-2-1902, October 31, 2003.
4. Koerner, Robert M., *Analysis and Design of Veneer Cover Soils* , 1998 Sixth International Conference of Geosynthetics.
5. Koerner, George R. and Narejo, Dhani, *Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces,* GRI Report #30, June 14, 2005.
6. Gilbert, Robert B., *Peak Versus Residual Strength for Waste Containment Systems,*
7. Proceedings of the 15th GRI Conference, December 13, 2001.
8. NAVFAC Design Manual 7.01, September 1986.

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APPENDIX IIIM-A-4
0771-356-11-35
STABILITY ANALYSIS OF THE FINAL COVER SYSTEM

A. Infinite Slope Stability Analysis

Interface friction strength values are selected conservatively from laboratory testing of similar material/interfaces. Prior to construction, laboratory tests will be performed to verify the assumed values for interface adhesion (or cohesion) and friction angle using project-specific soil and synthetic materials. The interface friction testing will be performed for the specific conditions analyzed. If test results differ from the assumed values, this analysis will be updated for acceptable factor of safety values using the procedure presented in the following sections.

LINER SYSTEM

The liner system includes a 1-foot-thick protective cover and a 3-foot-thick recompacted clay liner

1. Use Duncan and Buchignani's method for infinite stability analyses to evaluate the internal stability of the liner, and final cover systems using peak shear strength values.

The factor of safety is calculated using the following equation:

$$F.S. = A\frac{\tan\Delta}{\tan\beta} + B\frac{C_a}{\gamma H}$$

where:
Δ = Interface friction angle, deg
C_a = Adhesion, psf
β = Slope angle, deg
A = Parameter A from chart on sheet IIIM-A-4-8
B = Parameter B from chart on sheet IIIM-A-4-8
γ = Unit weight of soil, pcf
H = Thickness of material above interface, ft

An example using the protectie cover/recompacted clay liner interface of the liner system is provided below.

A. Define the shear strength parameters (peak shear strength parameters will be used for this example).

Δ = 16 deg
C_a = 100 psf

B. Calculate the pore pressure, r_u, using the following equation:

$$r_u = (T \times \gamma_w \times \cos^2 b) / (H \times \gamma)$$

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APPENDIX IIIM-A-4
0771-356-11-35
STABILITY ANALYSIS OF THE FINAL COVER SYSTEM

where: H = Thickness of material above interface, ft
γ_w = Unit weight of water, pcf
β = Slope angle, deg
T = Maximum head above interface, ft
γ = Unit weight of soil, pcf

H = 1 ft
γ_w = 62.4 pcf
β = 18.43 deg (3H:1V)
T = 0 ft
γ = 120 pcf

r_u = 0.00

Since T=0, there is no pore pressure build-up in the protective cover. If the soil material is assumed to be saturated, use a unit weight of 125 pcf for soil.

C. Calculate the slope ratio, b.

$b = \cot\beta =$ 3.0

D. Using r_u and b, determine Parameters A and B from the charts on sheet IIID-C-50.

A = 1.0
B = 3.3

E. Calculate the factor of safety and compare against the minimum recommended factor of safety.

F.S. = 3.61 > $F.S._{min}$ = 1.5

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APPENDIX IIIM-A-4
0771-356-11-35
STABILITY ANALYSIS OF THE FINAL COVER SYSTEM

Component/Interface	Strength Parameters		H (ft)	γ (pcf)	β (deg)	T (ft)	r_u	b	A	B	Factor of Safety Generated	Recommended Minimum Factor of Safety	Acceptable Factor of Safety
	Cohesion/Adhesion (psf)	Friction Angle (deg)											
	Peak	Peak									Peak	Peak	Peak
Liner System - Reompacted Clay Liner Option (3H:1V Maximum Slope)													
Compacted Clay Liner													
Protective Cover/Recompacted Clay liner	100	16	1	120	18.43	0	0.00	3.0	1.0	3.3	3.61	1.5	YES
Recompacted Clay Internal	230	19	2.5	120	18.43	0	0.00	3.0	1.0	3.3	3.56	1.5	YES

APPENDIX IIIM-B

FINAL COVER SYSTEM SETTLEMENT ANALYSIS

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02/09/2023

CONTENTS

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INTRODUCTION

This appendix includes the settlement, strain, and heave analyses for the foundation soils and the settlement and strain analyses for the overliner system and final cover systems. The following three appendices are developed for the foundation soils, overliner, and final cover, respectively.

- Appendix IIIM-B-1 includes the settlement and strain analyses for the final cover system.

APPENDIX IIIM-B-1

FINAL COVER SETTLEMENT ANALYSIS

Includes pages IIIM-B-1-1 through IIIM-B-1-12

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APPENDIX IIIM-B-1
0771-356-11-35
SOLID WASTE AND FINAL COVER
SETTLEMENT AND STRAIN

Required: Determine the post-settlement slope of the final cover system and verify that the strain induced on the final cover due to settlement is within acceptable limits. For this analysis a conservative approach of using MSW settlement parameters was used.

Method:

A. Estimate primary settlement of waste below the final cover system.
B. Estimate secondary settlement of waste below the final cover system.
C. Estimate total settlement of waste below the final cover system.
D. Verify that strain induced on the final cover due to settlement is within acceptable limits.

Description of Contents:

- Sheets IIIM-B-1-3 thru IIIM-B-1-8 present example calculations.
- Table 1 presents the final cover settlement point parameters and analysis results.
- Table 2 presents the strain calculations along the evaluation lines.
- Sheet IIIM-B-1-9 presents the analysis conclusions.
- Sheet IIIM-B-1-12 provides the final cover analysis points and evaluation lines supporting the strain calculations.

References:

1. Sowers, George F., Settlement of Solid Waste, *Proceedings of the Eighth International Conference on Soil Mechanics and Foundations Engineering, 1973* .
2. Quian, Xuede, R.M. Koerner, D. H. Gray, Geotechnical Aspects of Landfill Design and Construction, Prentice-Hall, Inc., New Jersey, 2002.
3. Koerner, Robert M., Designing with Geosynthetics, Third Edition. Prentice-Hall, New Jersey, 1994.
4. Acar, Yalcin B. & Daniel, David E., *Geoenvironment 2000 Characterization, Containment, Remediation, and Performance in Environmental Geotechnics,* Volume 2, American Society of Civil Engineers, 1995.
5. Zornberg, Jorge G., et al., *Retention of Free Liquids in Landfills Undergoing* Vertical Expansion, Journal of Geotechnical and Geoenvironmental Engineering, July 1999.
6. Fassett, Jeffrey B., et al., Geotechnical Properties of Municipal Solid Wastes and Their Use in Landfill Design, Waste Tech, 1994.
7. SETTLE3, Version 5.009, Copyright 2008-2021, Rockscience Inc.
8. Beggs, Ian D. et al, Assessment of Maximum Allowable Strains in Polyethylene and Polypropylene Geomembranes, Geo-Frontiers Congress, Austin, TX, 2005.

Solution:

A) Estimate primary settlement of waste below the final cover system.

MSW will undergo primary consolidation due to its own weight, final cover, equipment, etc. Primary consolidation occurs quickly, generally within the first month after loading. Therefore, the weight of the final cover system is the only remaining factor that contributes to primary consolidation. In addition, by the time the construction of the final cover is complete, settlement of the waste due to the weight of the final cover will be complete.

Primary settlement is calculated using the following equation:

$$S_p = \frac{H_o C_c}{1+e_o} \log\left(\frac{\sigma'_o + \Delta\sigma}{\sigma'_o}\right)$$

S_p = primary settlement, ft
H_o = waste thickness below the final cover system, ft
C_c = compression index
e_o = void ratio of the waste layer below final cover before settlement (i.e., before final cover placement)
$\Delta\sigma$ = change in loading/increase in overburden pressure, psf
σ'_o = overburden pressure acting at mid-height of refuse below the final cover, psf

For this site assume: C_c = 0.35 x e_o (Ref. 1, p. 210)

The compression index is a function of the void ratio. The compression index can range from C_c=0.15e_o to C_c=0.55e_o for fills that are low and high in organic content, respectively. An average compression index value was chosen because it is consistent with the types of waste accepted in the past. It is also representative of the minimal amount of settlement the site has experienced.

The average void ratio of waste below the final cover is estimated by determining the void ratio at the midpoint of the waste column below the final cover system. The void ratio is calculated for each settlement evaluation point using the following equation.

$e_o = 1.86 - 0.00102\,\sigma'_o$ (Ref. 5, p. 590)

where: σ'_o = overburden pressure in kPa

$\sigma'_o = 0.5\,\gamma_{msw}\,H_o$
$\Delta\sigma = \gamma_{cov}\,T_c$
γ_{msw} = unit weight of waste below the final cover system, pcf
γ_{cov} = unit weight of cover, pcf
T_c = thickness of final cover system, ft

Parameters:

γ_{cov} = 120 pcf
T_c = 2 feet (See Note 1, below)
γ_{msw} = varies (see Note 2, below)

Notes:
1. Tc value includes protective and final cover soils, intermediate cover, and grading soils.
2. The value γ_{msw} is selected based on the midpoint of the waste thicknesses below the final cover system using the assumed C&D waste unit weight of 90 pcf.

Example Calculations:

A) Estimate primary settlement of waste below the final cover system.

The settlement points analyzed are shown on Sheet IIIM-B-1-12. An example calculation of the estimated primary settlement is shown below for Evaluation Points FC5 and FC6. The estimated primary settlement for all evaluation points is shown in Table 1.

At Evaluation Point FC5:

Top of Final Cover Elevation (ft-msl)= 850.0
Bottom of Waste Elevation (ft-msl)= 554.0
H_o = 294.0 ft
γ_{msw} = 90.0 pcf

$\sigma'_o = 0.5\,\gamma_{msw}\,H_o$
σ'_o = 13230.0 psf
σ'_o = 633.5 kPa

$e_o = 1.86 - 0.00102\,\sigma'_o$
e_o = 1.21

$C_c = 0.35\ e_o$
$C_c =$ 0.42

$\Delta\sigma =$ 240.0 psf

$$S_p = \frac{294 \times 0.42}{1 + 1.21} \log\left(\frac{13230.0 + 240}{13230.0}\right)$$

$S_p =$ 0.4 ft

At Evaluation Point FC6:

Top of Final Cover Elevation (ft-msl)= 650.0
Bottom of Waste Elevation (ft-msl)= 644.0
$H_o =$ 4.0 ft
$\gamma_{msw} =$ 90.0 pcf

$\sigma'_o = 0.5\ \gamma_{msw}\ H_o$
$\sigma'_o =$ 180.0 psf
$\sigma'_o =$ 8.6 kPa

$e_o = 1.86 - 0.00102\ \sigma'_o$
$e_o =$ 1.85

$C_c = 0.35\ e_o$
$C_c =$ 0.65

$\Delta\sigma =$ 240.0 psf

$$S_p = \frac{4.0 \times 0.65}{1 + 1.85} \log\left(\frac{180 + 240}{180}\right)$$

$S_p =$ 0.3 ft

B) Estimate secondary settlement of waste below the final cover system.

Secondary consolidation continues at substantial rates for periods of time well beyond primary settlement. It is a combination of mechanical secondary compression, physico-chemical reaction, and bio-chemical decay. The settlement-log time relationship is similar to secondary compression of soils and can be expressed by:

$$S_c = \frac{H'_o\ \alpha}{1 + e'_o} \log\left(t_2/t_1\right)$$ (Ref. 2, p. 451)

Parameters:

S_c = secondary settlement, ft
α = secondary compression index
e'_o = void ratio of the waste layer below the final cover after primary settlement has occurred due to the final cover
H'_o = waste thickness below the final cover system after settlement, ft
t_1 = starting time of secondary settlement in years
t_2 = time at which settlement is determined in years

For this site assume: $\alpha = 0.03 \times e'_o$ (Ref. 1, p. 210)

As reported by Sowers (Ref. 1), the secondary compression index is used to estimate waste decomposition. The secondary compression index ranges from $\alpha = 0.03e'_o$ to $\alpha = 0.09e'_o$ for conditions that are unfavorable and favorable to decay, respectively. An average secondary compression index value was chosen because it is consistent with the types of waste accepted in the past. It is also representative of the minimal amount of settlement the site has experienced.

The void ratio of the waste below the final cover at closure is a function of the overburden pressure caused by placement of the final cover system. The void ratio is calculated for each settlement evaluation point using the following equation.

$$e'_o = 1.86 - 0.00102\ \sigma''_o$$ (Ref. 5, p. 590)

where: σ''_o = overburden pressure in kPa

$\sigma''_o = 0.5\ \gamma'_{msw}\ H'_o$
γ'_{msw} = unit weight of waste below the final cover after primary settlement has occurred, pcf

For this site, the void ratio after primary settlement for the waste/cover soils below the final cover system varies between1.5 to 1.9. Therefore, the secondary compression index will range between 0.09 to 0.11. Most literature sources report the secondary compression index in terms of the "modified secondary compression index" (Refs. 2, 6). The modified secondary compression index is defined by the following equation:

$$C'_\alpha = \frac{\alpha}{1 + e'_o}$$

The secondary compression index calculated for this site translates to a modified secondary compression index of 0.03 to 0.04 (for a void ratio of 1.5 to 1.9). These values are consistent with reported values for the modified secondary compression index which vary from 0.03 to 0.1 (Refs. 2, 6).

Time frame used for this analysis:

t_1 = 0.083 years
t_2 = 30.0 years (postclosure period)

An example calculation of the estimated secondary settlement using the above secondary settlement period is shown below for Evaluation Points FC5 and FC6. The estimated secondary settlement for all evaluation points is shown in Table 1.

At Evaluation Point FC5:

$H'_o = H_o - S_p$
$H_o' =$ 293.6 ft

$\sigma''_o = 0.5\, \gamma'_{msw}\, H'_o$
$\gamma'_{msw} =$ 90.0 pcf
$\sigma''_o =$ 13212.0 psf
$\sigma''_o =$ 632.6 kPa

$e'_o = 1.86 - 0.00102\, \sigma''_o$
$e'_o =$ 1.21

$\alpha = 0.03\, e'_o$
$\alpha =$ 0.04

$$S_c = \frac{H'_o\, \alpha}{1 + e'_o} \log (t_2/t_1)$$

$$S_c = \frac{293.6 \times 0.04}{1 + 1.21} \log\left(\frac{30}{0.083}\right)$$

$S_c =$ 12.4 ft

At Evaluation Point FC6:

$H'_o = H_o - S_p$
$H_o' =$ 3.7 ft

$\sigma''_o = 0.5\ \gamma'_{msw}\ H'_o$
$\gamma'_{msw} =$ 90.0 pcf
$\sigma''_o =$ 166.5 psf
$\sigma''_o =$ 8.0 kPa

$e'_o = 1.86 - 0.00102\ \sigma''_o$
$e'_o =$ 1.85

$\alpha = 0.03\ e'_o$
$\alpha =$ 0.06

$$S_c = \frac{H'_o\ \alpha}{1 + e'_o} \log (t_2/t_1)$$

$$S_c = \frac{3.7 \times 0.06}{1 + 1.85} \log\left(\frac{30}{0.083}\right)$$

$S_c =$ 0.2 ft

C) Estimate total settlement of waste below the final cover system.

Total settlement is the combination of primary and secondary settlement. An example calculation of the estimated total settlement is shown below for Evaluation Points FC5 and FC6. The estimated total settlement for all evaluation points is shown in Table 1.

At Evaluation Point FC5:				
Thickness of waste column, ft =	294.0	Primary Settlement =	0.4	ft
		Secondary Settlement =	12.4	ft
		Total Settlement =	12.8	ft
At Evaluation Point FC6:				
Thickness of waste column, ft=	4.0	Primary Settlement =	0.3	ft
		Secondary Settlement =	0.2	ft
		Total Settlement =	0.5	ft

D) Verify that strain induced on the final cover due to settlement is within acceptable limits.

Determine the post-settlement slope of the final cover system and verify the strain induced on the geocomposite due to settlement is within acceptable limits.

Note that negative values indicate the components are in compression.

$$\text{Strain} = \frac{L_{\mathrm{f}} - L_o}{L_o} x100$$

(Reference 2, Page 472)

L_f = Final distance between evaluation points after total settlement (ft)
L_o = Initial distance between evaluation points before total settlement (ft)

An example calculation of the estimated strain is shown below for Evaluation Points FC5 and FC6. The estimated strain for all evaluation points is shown in Table 2.

Evaluation Point FC5 to Evaluation Point FC6:

Initial Distance:
Evaluation Point FC5 Elev. = 850.0 ft-msl
Evaluation Point FC6 Elev. = 650.0 ft-msl
Plan View Distance= 646.9 ft
L_o= 677.1 ft

Total Settlement:
Total Settlement Point 1= 12.8 ft
Total Settlement Point 2= 0.5 ft

Final Distance (after settlement):
Evaluation Point 1 Elev. = 837.2 ft-msl
Evaluation Point 2 Elev. = 649.5 ft-msl
Plan View Distance= 646.9 ft
L_f= 673.6 ft

Strain= -0.52%

Conclusions:

Strain is acceptable.

- Compacted clay component of final cover has the smallest average allowable tensile strain value which is 0.5 percent (Reference 2, Page 469).
- The maximum calculated strain (-0.66%) represents compression versus tensile strain and is acceptable, therefore the system will be stable. No tensile strain was observed in the analysis results.

FORT WORTH C&D LANDFILL
APPENDIX IIIM-B-1
0771-356-11-35
SOLID WASTE AND FINAL COVER SETTLEMENT AND STRAIN

TABLE 1. FINAL COVER EVALUATION - SETTLEMENT SUMMARY[2]

Evaluation Point[1]	Initial Top of Final Cover Elevation (ft-msl)	Initial Top of Waste Elevation (ft-msl)	Bottom of Waste Elevation (ft-msl)	H_o (ft)	γ_{msw} (pcf)	σ'_o (psf)	$\Delta\sigma$ (psf)	e_o	C_c	S_p (ft)	H'_o (ft)	γ'_{msw} (pcf)	σ''_o (psf)	e'_o	α	S_c (ft)	Total Settlement (ft)	Post-Settlement Top of Final Cover Elevation (ft-msl)
FC1	860.0	858.0	554.0	304.0	90.0	13,680.0	240.0	1.19	0.42	0.4	303.6	90.0	13,662.0	1.19	0.04	12.7	13.1	846.9
FC2	830.0	828.0	554.0	274.0	90.0	12,330.0	240.0	1.26	0.44	0.4	273.6	90.0	12,312.0	1.26	0.04	11.7	12.1	817.9
FC3	830.0	828.0	599.1	228.9	90.0	10,300.5	240.0	1.36	0.47	0.5	228.4	90.0	10,278.0	1.36	0.04	10.1	10.6	819.4
FC4	670.0	668.0	668.1	0.1	90.0	4.5	240.0	1.86	0.65	0.0	0.1	90.0	4.5	1.86	0.06	0.0	0.0	670.0
FC5	850.0	848.0	554.0	294.0	90.0	13,230.0	240.0	1.21	0.42	0.4	293.6	90.0	13,212.0	1.21	0.04	12.4	12.8	837.2
FC6	650.0	648.0	644.0	4.0	90.0	180.0	240.0	1.85	0.65	0.3	3.7	90.0	166.5	1.85	0.06	0.2	0.5	649.5
FC7	840.0	838.0	554.0	284.0	90.0	12,780.0	240.0	1.24	0.43	0.4	283.6	90.0	12,762.0	1.24	0.04	12.0	12.4	827.6
FC8	600.0	598.0	594.0	4.0	90.0	180.0	240.0	1.85	0.65	0.3	3.7	90.0	166.5	1.85	0.06	0.2	0.5	599.5

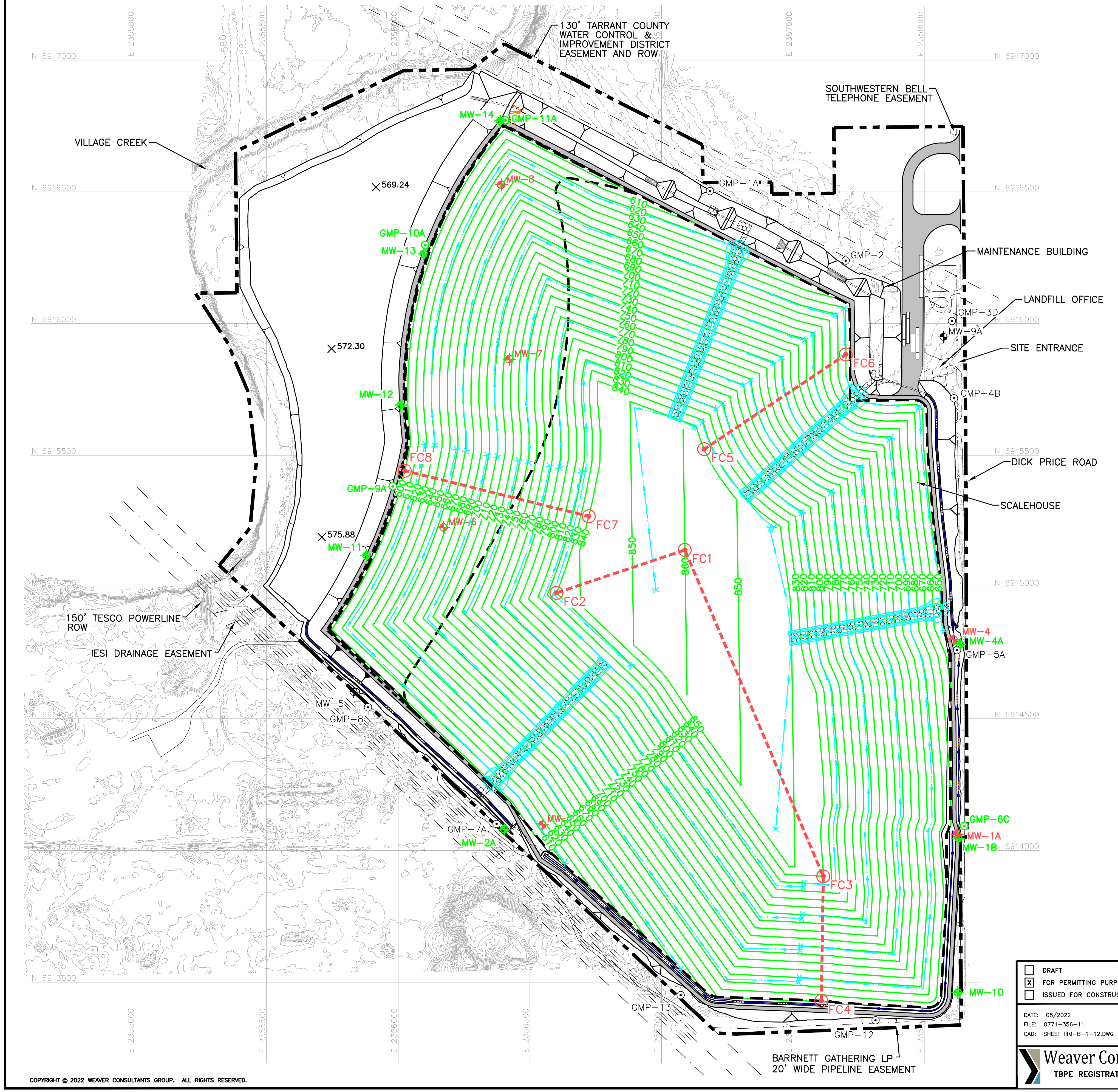
[1] Refer to Sheet IIIM-B-1-12 for Evaluation Point locations (FC1 thru FC8).

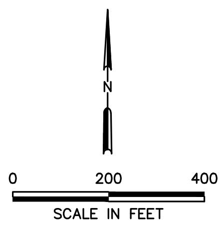
[2] Settlement calculations in above table rounded to one significant figure.

TABLE 2. FINAL COVER EVALUATION - FINAL GRADES AND STRAIN SUMMARY

Evaluation Point[1]		Initial Top of Final Cover Elevation (ft-msl)		Post-Settlement Top of Final Cover Elevation (ft-msl)		Plan View Distance (ft)	L_o (ft)	L_f (ft)	Initial Slope (ft/ft)	Post-Settlement Slope (ft/ft)	Tensile Strain (%)
A	B	A	B	A	B						
FC1	FC2	860.0	830.0	846.9	817.9	514.1	515.0	514.9	0.06	0.06	-0.01
FC1	FC3	860.0	830.0	846.9	819.4	1,346.1	1,346.5	1,346.4	0.02	0.02	0.00
FC3	FC4	830.0	670.0	819.4	670.0	472.9	499.2	495.9	0.34	0.32	-0.66
FC5	FC6	850.0	650.0	837.2	649.5	646.9	677.1	673.6	0.31	0.29	-0.52
FC7	FC8	840.0	600.0	827.6	599.5	720.1	759.0	755.3	0.33	0.32	-0.48

[1] Refer to Sheet IIIM-B-1-12 for Evaluation Point locations. The "A" and "B" points represent the upgradient and downgradient endpoints, respectively.





LEGEND

▬ ▪ ▬	PERMIT BOUNDARY
▬ ▬ ▬	PERMITTED LIMIT OF WASTE
- - - -	PROPOSED LIMIT OF WASTE
630	EXISTING CONTOUR
N 6915000	STATE PLANE COORDINATE
— - —	SECTOR BOUNDARY
560	PROPOSED FINAL COVER CONTOUR
MW-2A	PERMITTED GROUNDWATER MONITORING WELL
MW-9A	PROPOSED GROUNDWATER MONITORING WELL
MW-4	PERMITTED GROUNDWATER MONITORING WELL (TO BE ABANDONED)
GMP-4B	PERMITTED GAS MONITORING PROBE
FC2	FINAL COVER EVALUATION POINT
⊙- - - -⊙	FINAL COVER EVALUATION LINE

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN 02-17-2022.
2. THE EXPANSION LIMIT OF WASTE IS LOCATED A MINIMUM OF 125-FT FROM THE PERMIT BOUNDARY.
3. REFER TO "ENVIRONMENTAL MONITORING" SECTION FOR INFORMATION REGARDING LANDFILL PERIMETER GROUNDWATER AND LFG MONITORING NETWORKS.

DAVID E. POE
81734
02/09/2023

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 08/2022
FILE: 0771-356-11
CAD: SHEET IIIM-B-1-12.DWG

DRAWN BY: RAA
DESIGN BY: MB
REVIEWED BY: DEP

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
TEXAS REGIONAL LANDFILL COMPANY, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
FINAL COVER ANALYSIS POINT PLAN

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS

WWW.WCGRP.COM
SHEET IIIM-B-1-12

APPENDIX IIIM-C

LABORATORY TEST RESULTS

Includes pages IIIM-C-1 through IIIM-C-172

STATE OF TEXAS
DAVID E. POE
81734
LICENSED
PROFESSIONAL ENGINEER
02/09/2023

LABORATORY TEST RESULTS

The following Appendix IIIM-C presents the geotechnical laboratory test results of samples obtained during geotechnical and geological investigations at the site. The results presented were compiled from the 2020 Permit Amendment Application prepared by Geosyntec Consultants.

Laboratory results include testing of samples obtained during the field exploration program to evaluate the proposed expansion area as conducted by Weaver Consultants Group from December 2018 to March 2019. Explorations were performed in accordance with a Soil Boring Plan approved by the TCEQ on January 3, 2019. Eleven (11) borings (WC-1 through WC-11) were drilled, and piezometers were installed at four (4) of the boring locations (WC-1, WC-6, WC-8, and WC-10) under the direction of a geologist. Additional information related to these investigations is presented in Appendix IIIG of this application. During the geotechnical investigation, samples were collected, and hand penetrometer tests were periodically performed to evaluate soil consistency and to field classify the soils; these results are included on the boring logs presented in the Appendix IIIG - Geology Report. The soil samples were subsequently sent to an independent geotechnical laboratory, TRI Environmental, Inc. (TRI) in Austin, Texas, for testing to characterize the geotechnical properties of the soils and strata at the site. The geotechnical data from this investigation is discussed in Section 3 of this report and summarized in the tables included in Section 3.

Results are also provided from field investigations conducted by Geosyntec Consultants in December 2013 as a part of a previous permit amendment application (MSW-1983C). For this investigation, seven (7) borings (B-201 through B-207) were drilled and the borings logged by a field engineer. Periodic standard penetration tests (SPTs) were performed to evaluate soil consistency and to classify the soils, and samples were collected and sent to TRI for testing to characterize the geotechnical properties of the soils and strata at the locations of interest at the site. The geotechnical data from this investigation is also discussed in Section 3 of this report and summarized in the tables included in Section 3.

Other subsurface investigation activities at the site have been completed by Baker-Shiflett (1986 and 1991), Freese and Nichols (1989 and 2001), Biggs and Matthews (2001), and Team Consultants (2013). As part of these investigations a total of 93 boreholes were drilled at the site, of which nine were completed as groundwater monitoring wells and 17 were completed as piezometers. During these subsurface investigations, samples were collected, and laboratory testing was performed to characterize the geotechnical and hydrogeological properties of the soils and strata at the Site. Information on the boring locations and depths, and logs of the borings, are provided in the Appendix IIIG - Geology Report. The geotechnical data from these investigations is also discussed in Section 3 of this report and summarized in the tables included in Section 3.

APPENDIX 1 OF ATTACHMENT 3D.1

Geotechnical Data – Laboratory Test Results of Weaver's 2019 Subsurface Investigation

Client: Weaver Consultants Group
Project: FTW C&D Expansion

TRI Log #: 45844

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/2019
Quality Review/Date

COC Line #	Sample Identification	Fines (%)	Moisture Content (%)	Atterberg Limits			Moisture Content (%)	Dry Unit Weight (pcf)
				Liquid Limit	Plastic Limit	Plasticity Index		
-	Test Method	ASTM D1140	ASTM D2216	ASTM D4318, Method A : Multipoint			ASTM D7263	
1	WC-1 (40-42)	91.1	10.1	38	17	21	-	-
2	WC-3 (8-10)	63.7	18.8	41	15	26	17.6	109.1
3	WC-3 (10-15)	81.1	23.6	49	22	27	-	-
4	WC-3 (20-25)	92.0	17.4	59	25	34	-	-
8	WC-4 (69-70)	66.6	16.1	-	-	-	Non-Intact / Loose Material	
11	WC-5 (53-55)	76.4	17.2	-	-	-	-	-
15	WC-6 (23-25)	42.6	7.1	-	-	-	Non-Intact / Loose Material	
16	WC-6 (48-50)	98.3	18.8	66	24	42	17.5	112.7
19	WC-7 (13-15)	54.8	14.0	-	-	-	Non-Intact / Loose Material	
20	WC-7 (21-22)	60.3	14.2	28	13	15	14.2	113.0
21	WC-7 (28-30)	45.3	0.3	NL	NP	-	Non-Intact / Loose Material	
22	WC-7 (30-32)	40.1	1.8	NL	NP	-	Non-Intact / Loose Material	
23	WC-7 (48-50)	78.1	23.3	39	17	22	-	-
29	WC-8 (35-37)	47.7	16.7	-	-	-	Non-Intact / Loose Material	
30	WC-8 (56-58)	81.2	20.8	43	16	27	-	-
31	WC-8 (100-102)	-	-	-	-	-	-	-
32	WC-9 (10-13)	45.4	19.0	-	-	-	14.7	103.8
33	WC-9 (18-20)	87.8	21.8	45	16	29	-	-
34	WC-9 (38-40)	-	-	-	-	-	-	-
35	WC-9 (47-49)	-	-	-	-	-	-	-
36	WC-10 (6-8)	-	-	-	-	-	-	-
37	WC-10 (7-9)	24.0	16.4	-	-	-	-	-
38	WC-10 (18-20)	88.7	22.5	63	14	49	18.3	103.7

Note: NL = No Liquid Limit; NP = No Plastic Limit

Client: Weaver Consultants Group
Project: FTW C&D Expansion

TRI Log #: 45844

Jeffrey A. Kuhn, Ph.D., P.E., 10/18/2019
Quality Review/Date

Log.Line	45844.1	45844.3	45844.4	45844.11	45844.12	45844.33
Sample ID	WC-1 (40-42)	WC-3 (10-15)	WC-3 (20-25)	WC-5 (53-55)	WC-5 (126-134)	WC-9 (18-20)
w (%)	10.3	23.1	18.2	17.3	9.9	17.7
dd (pcf)	131.0	101.2	109.8	113.0	125.7	108.0
Sigma' (psi)	5.0	5.0	5.0	5.0	5.0	5.0
Sr (Gs=2.73)	93.7	92.4	89.8	93.1	75.7	83.8
Ksat (cm/s)*	3.2E-08	9.4E-09	7.9E-09	2.4E-09	6.2E-10	1.4E-08

* As-reported on 4/23/2019. Hydraulic Conductivity K at 20 ◦ C

Consolidated-Undrained Triaxial Compression

Client: Weaver Consultants Group
Project: FTW C&D Expansion
Sample: WC-3 (20-25)

TRI Log #: 45844.4
Test Method: ASTM D4767

Specimens				
Identification	1	2	3	4
Depth/Elev. (ft)	-	-	-	-
Eff. Consol. Stress (psi)	13.9	27.8	55.6	-
Initial Specimen Properties				
Avg. Diameter (in)	1.45	1.42	1.45	-
Avg. Height (in)	3.21	3.40	3.27	-
Avg. Water Content (%)	17.9	18.2	17.7	-
Bulk Density (pcf)	129.3	129.2	125.5	-
Dry Density (pcf)	109.6	109.3	106.6	-
Saturation (%)	88.3	88.8	81.0	-
Void Ratio, n	0.55	0.56	0.60	-
Total Back-Pressure (psi)	80.1	79.0	79.0	-
B-Value, End of Saturation	1.00	0.95	0.96	-

Note - A specific gravity of 2.73 was assumed for mass/volume calculations.

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear				
Void Ratio	0.55	0.56	0.60	-

Shear / Post-Shear				
Rate of Strain (%/hr)	0.25	0.25	0.25	-
Avg. Water Content (%)	24.1	24.5	23.8	-

At Failure								
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$				Ratio, $(\sigma_1'/\sigma_3')_{max}$			
Axial Strain at Failure (%), $\varepsilon_{a,f}$	14.7	4.2	4.7	-	0.7	3.2	3.5	-
Minor Effective Stress (psi), $\sigma_3'{}_f$	18.7	20.5	41.9	-	11.4	19.5	40.1	-
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	21.5	29.6	47.2	-	17.4	28.7	46.4	-
Pore Water Pressure, Δu_f (psi)	-4.9	7.3	13.7	-	2.5	8.2	15.6	-
Major Effective Stress (psi), $\sigma_1'{}_f$	40.1	50.0	89.1	-	28.8	48.2	86.5	-
Secant Friction Angle (degrees)	21.4	24.8	21.1	-	25.6	25.0	21.5	-
Effective Friction Angle (degrees)	19.3				19.3			
Effective Cohesion (psi)	2.1				2.7			

Note: The presented M-C parameters are based on a linear regression in modified stress space, across all assigned effective consolidation stresses. This fit does not purported to capture typical curvature of envelopes that may, in particular, be observed across broader range in effective stresses. Please note that the stresses associated with peak principal stress ratio and peak principal stress difference are presented in tabular form on the first page of the report. There are alternate interpretations to theses two failure criterion including but not limited to strain compatibility and post-peak.

Jeffrey A. Kuhn , Ph.D., P.E., 5/1/2019
Analysis & Quality Review/Date

Consolidated-Undrained Triaxial Compression

Client: Weaver Consultants Group
Project: FTW C&D Expansion
Sample: WC-3 (20-25)

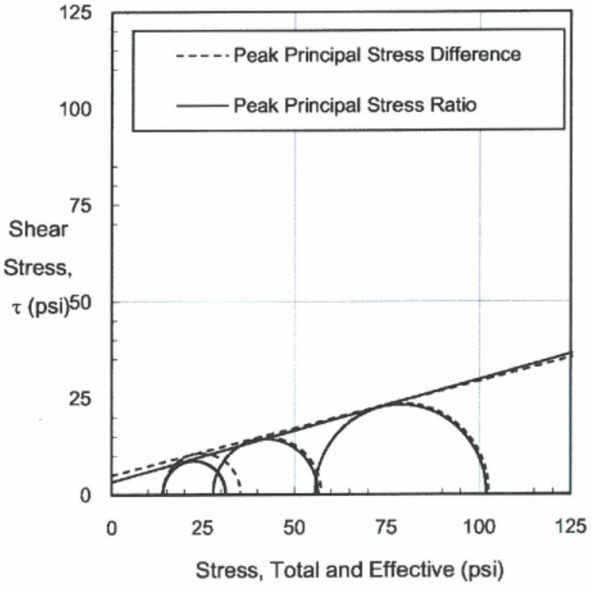
TRI Log #: 45844.4
Test Method: ASTM D4767

R / "Total Stress" Envelope			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Friction Angle (deg)	ϕ_R	13.7	14.8
Cohesion (psi)	c_R	5.0	3.3

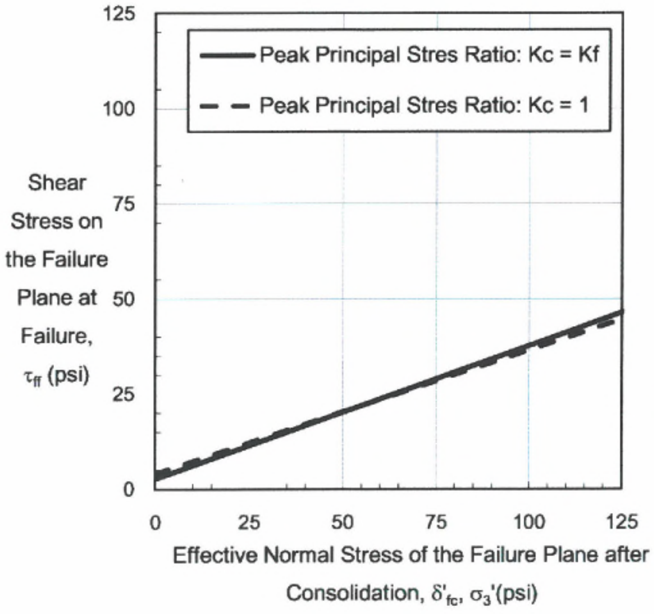
Kc = Kf Envelope, Effective Stress Envelope (Duncan et al. 1990)			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	ϕ'	19.3	19.3
Effective Cohesion (psi)	c'	2.1	2.7

Kc = 1 (τ_{ff} vs σ'_{fc}) Enelope, Total Stress Envelope (Duncan et al. 1990)			
Failure Criterion: Peak Principal Stress		Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Friction Angle (deg)	$d_{Kc=1}$	16.3	18.0
Cohesion (psi)	$\psi_{Kc=1}$	6.0	4.0

R / "Total Stress" Envelope



Three-Stage Rapid Drawdown Envelopes

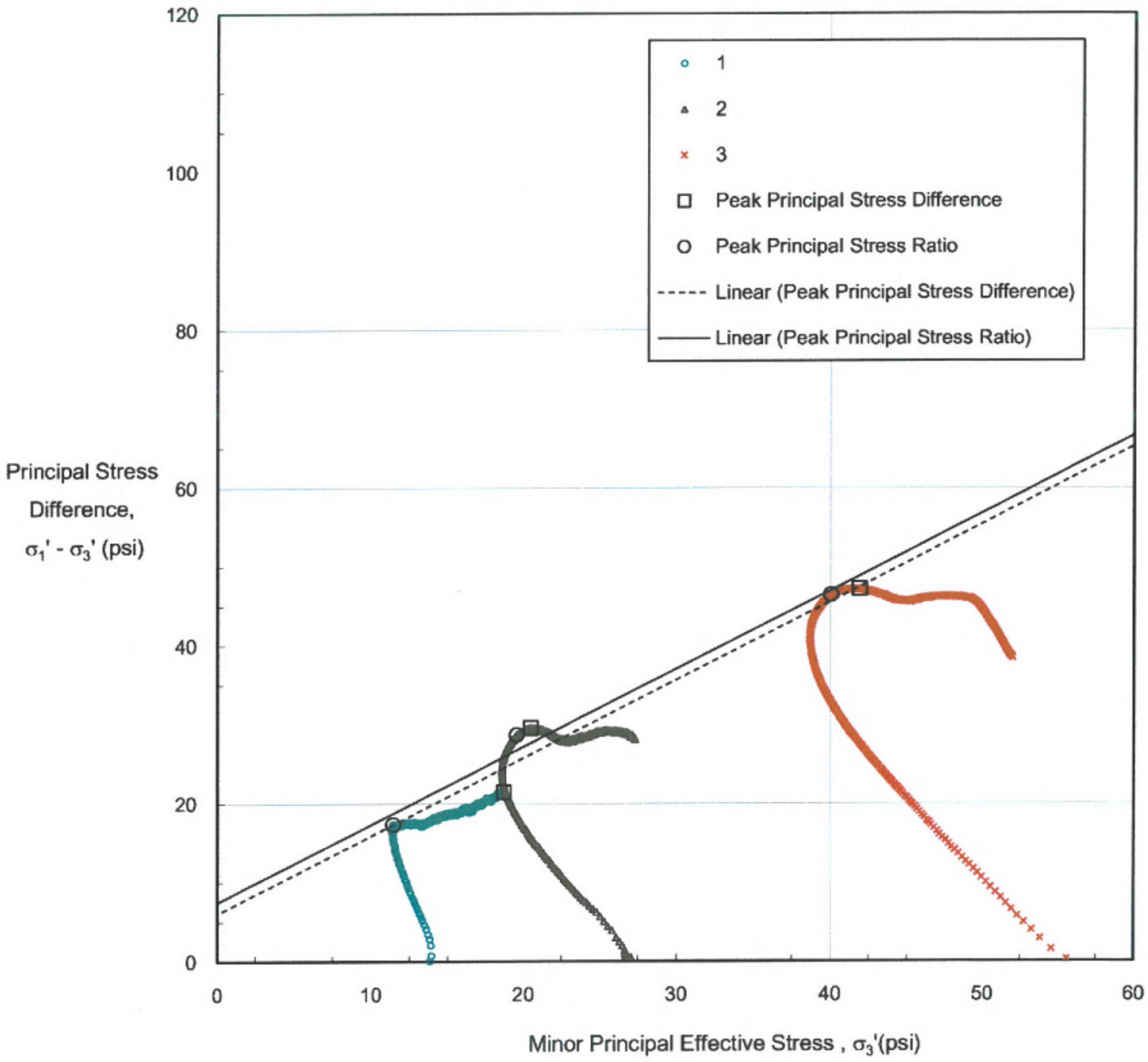


Consolidated-Undrained Triaxial Compression

Client: Weaver Consultants Group
Project: FTW C&D Expansion
Sample: WC-3 (20-25)

TRI Log #: 45844.4
Test Method: ASTM D4767

Modified Mohr-Coulomb



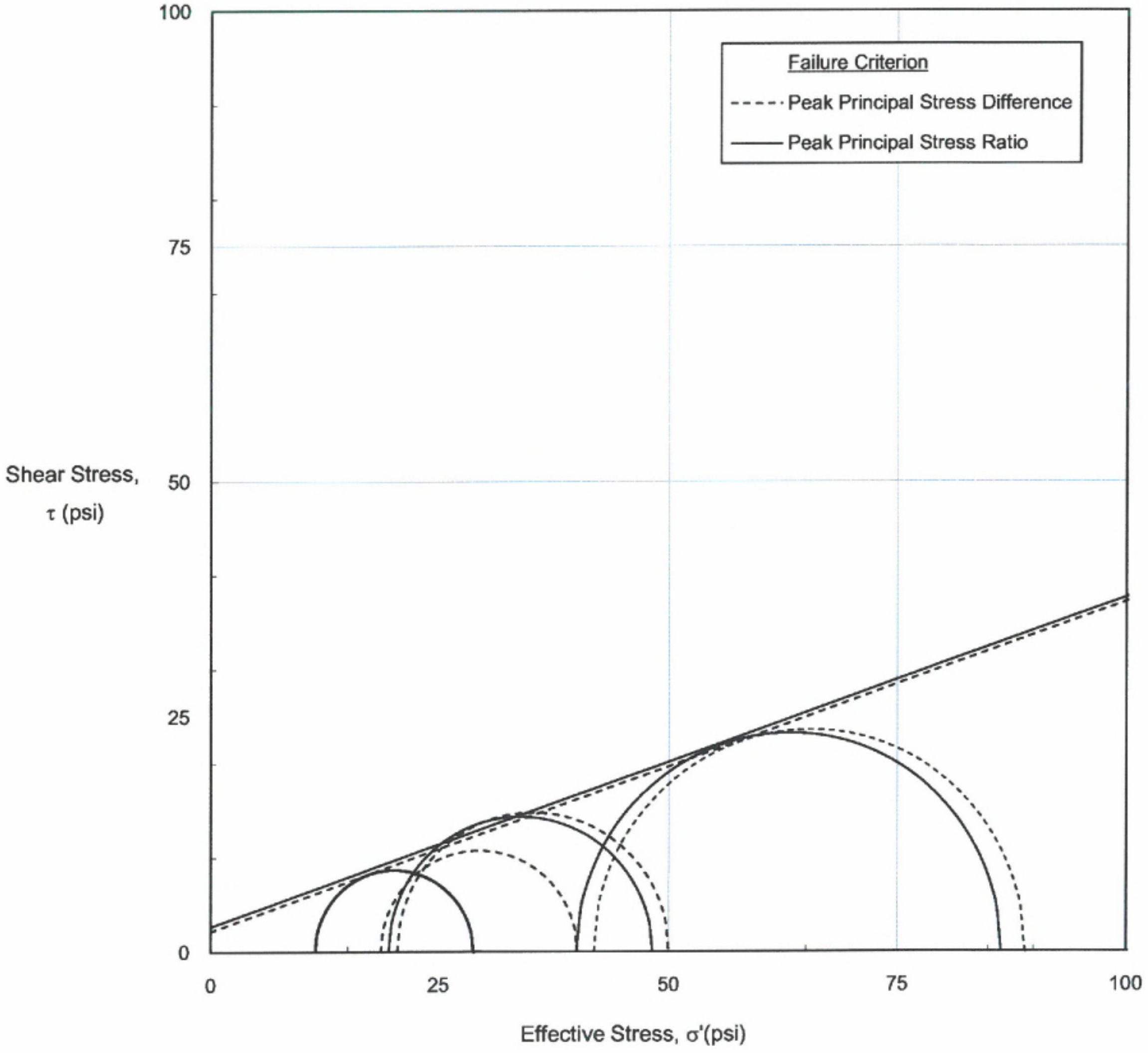
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	19.3	19.3
Effective Cohesion (psi)	2.1	2.7

Consolidated-Undrained Triaxial Compression

Client: Weaver Consultants Group
Project: FTW C&D Expansion
Sample: WC-3 (20-25)

TRI Log #: 45844.4
Test Method: ASTM D4767

Mohr-Coulomb

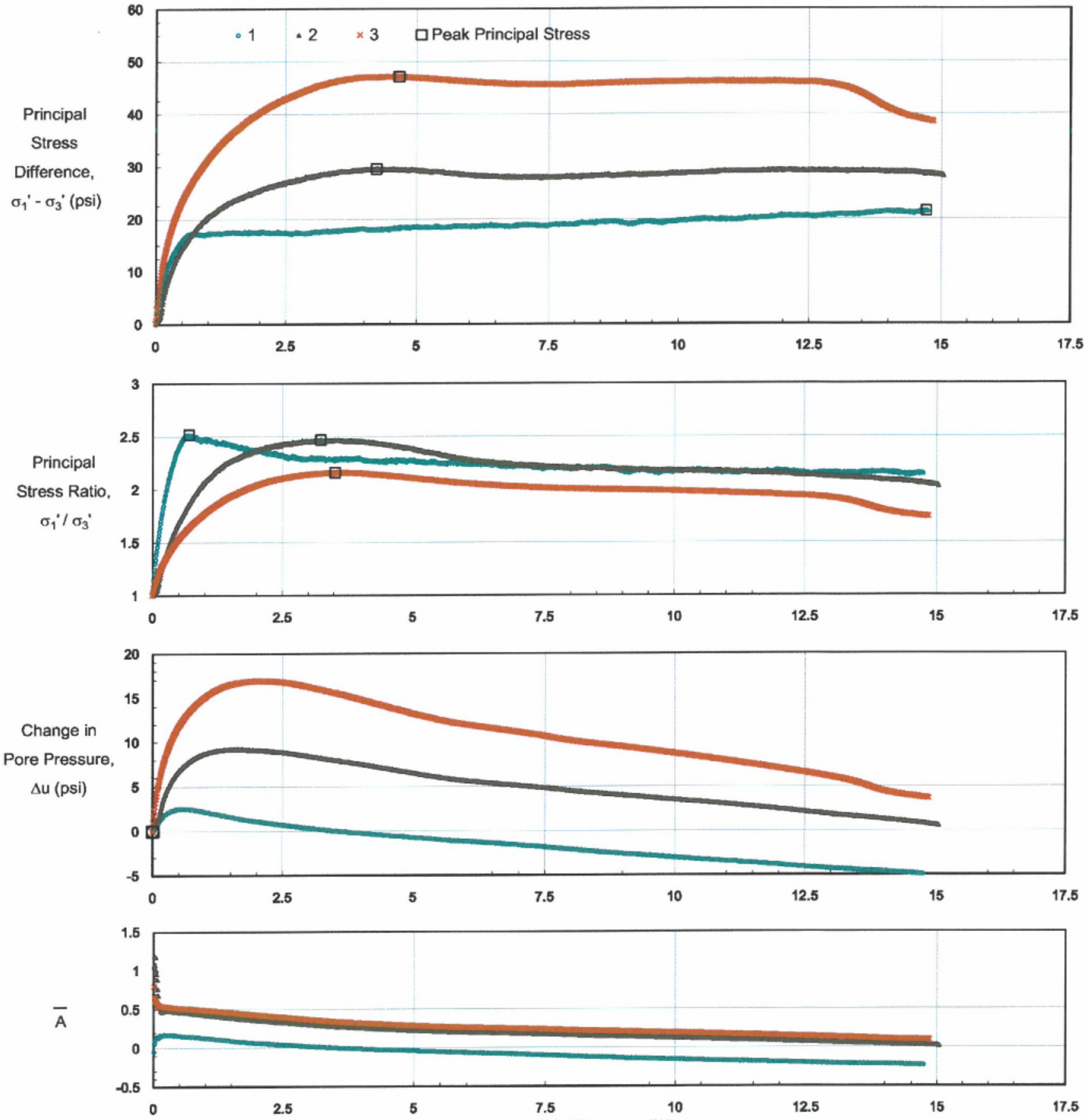


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	19.3	19.3
Effective Cohesion (psi)	2.1	2.7

Consolidated-Undrained Triaxial Compression

Client: Weaver Consultants Group
Project: FTW C&D Expansion
Sample: WC-3 (20-25)

TRI Log #: 45844.4
Test Method: ASTM D4767

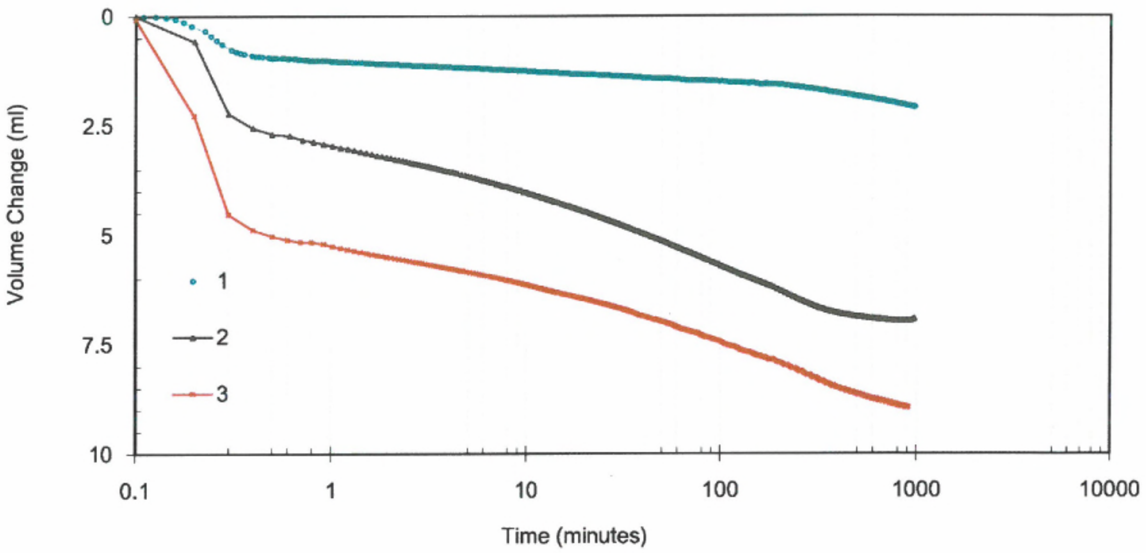


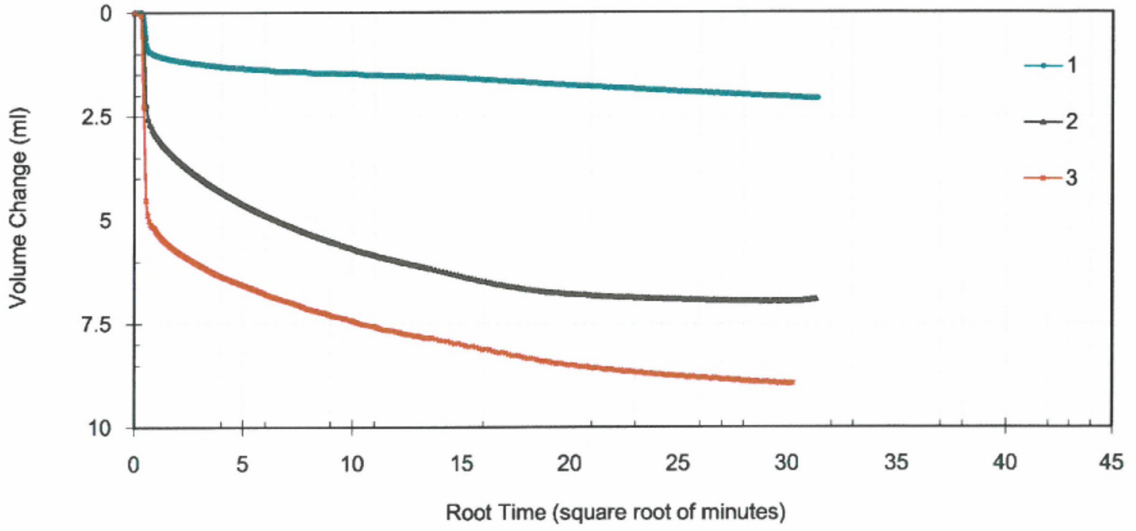
Consolidated-Undrained Triaxial Compression

Client: Weaver Consultants Group
Project: FTW C&D Expansion
Sample: WC-3 (20-25)

TRI Log #: 45844.4
Test Method: ASTM D4767

Consolidation

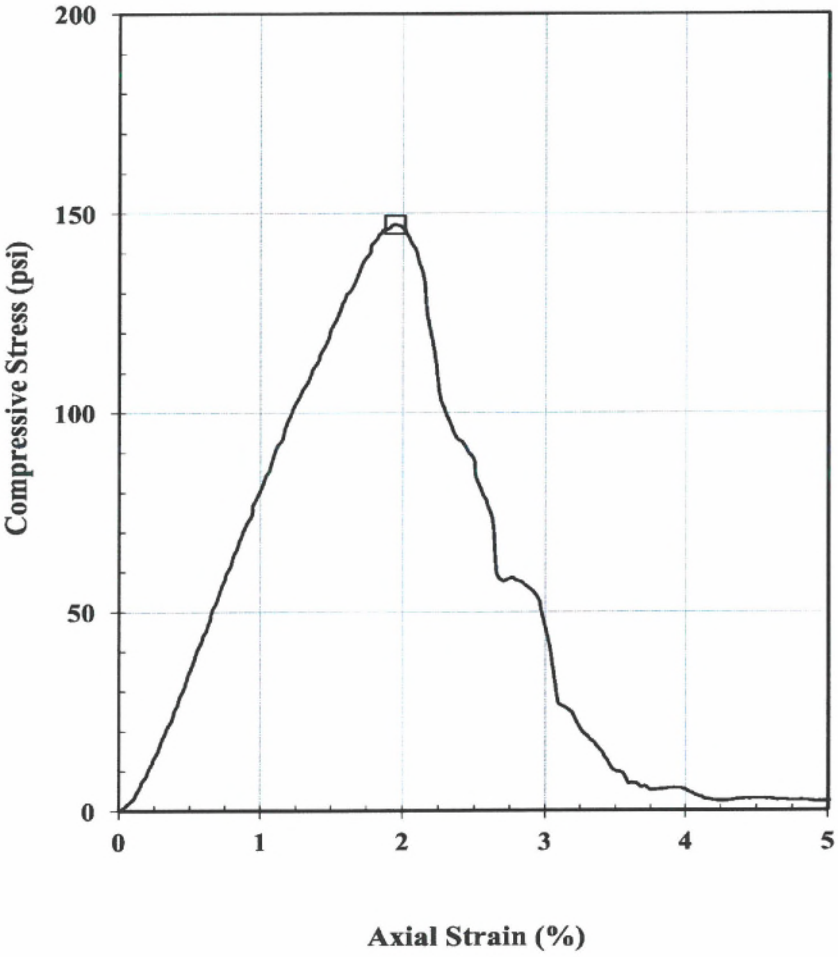




Unconfined Compression Test Report

Client:	Weaver Consultants Group
Project:	FTW C&D Expansion
Sample ID:	WC-3 (58-63)

TRI Log No.:	45844.5
Type of Specimen:	Intact
Test Method:	ASTM D2166
Strain Rate (%/min):	1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	3.62
Avg. Height (in)	H_o	7.29
Avg, Water Content (%)	w_o	13.1
Bulk Density (pcf)	γ_{total}	139.7
Dry Density (pcf)	γ_{dry}	123.5
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.34
Assumed Specific Gravity	G_s	2.65

Stresses at Failure	
Unconfined Compressive Strength (psi)	147.1
Axial Strain at Failure (%)*	1.9
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	147.1
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	73.6

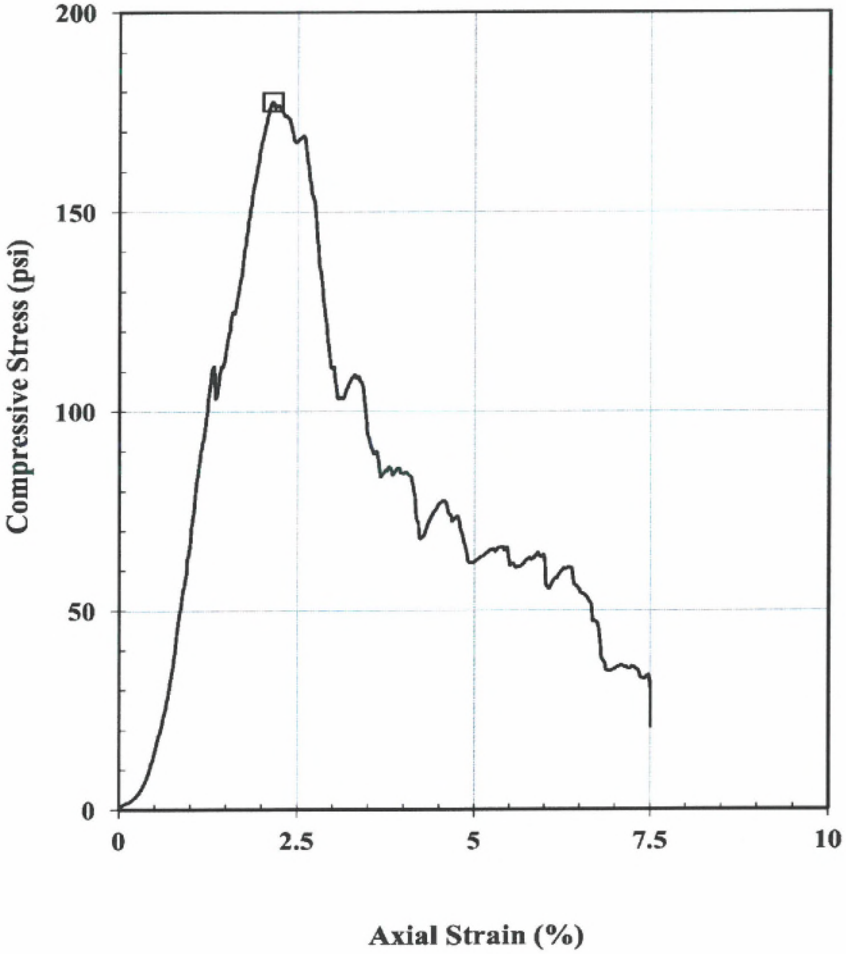
*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client:	Weaver Consultants Group
Project:	FTW C&D Expansion
Sample ID:	WC-3 (75-77)

TRI Log No.:	45844.6
Type of Specimen:	Intact
Test Method:	ASTM D2166
Strain Rate (%/min):	1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	3.69
Avg. Height (in)	H_o	7.65
Avg, Water Content (%)	w_o	9.0
Bulk Density (pcf)	γ_{total}	141.7
Dry Density (pcf)	γ_{dry}	130.1
Saturation (%)	S_r	88.9
Void Ratio	e_o	0.27
Assumed Specific Gravity	G_s	2.65

Stresses at Failure	
Unconfined Compressive Strength (psi)	177.5
Axial Strain at Failure (%)*	2.2
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	177.5
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	88.8

*End to end displacement measurement / global not localized strain measurement.

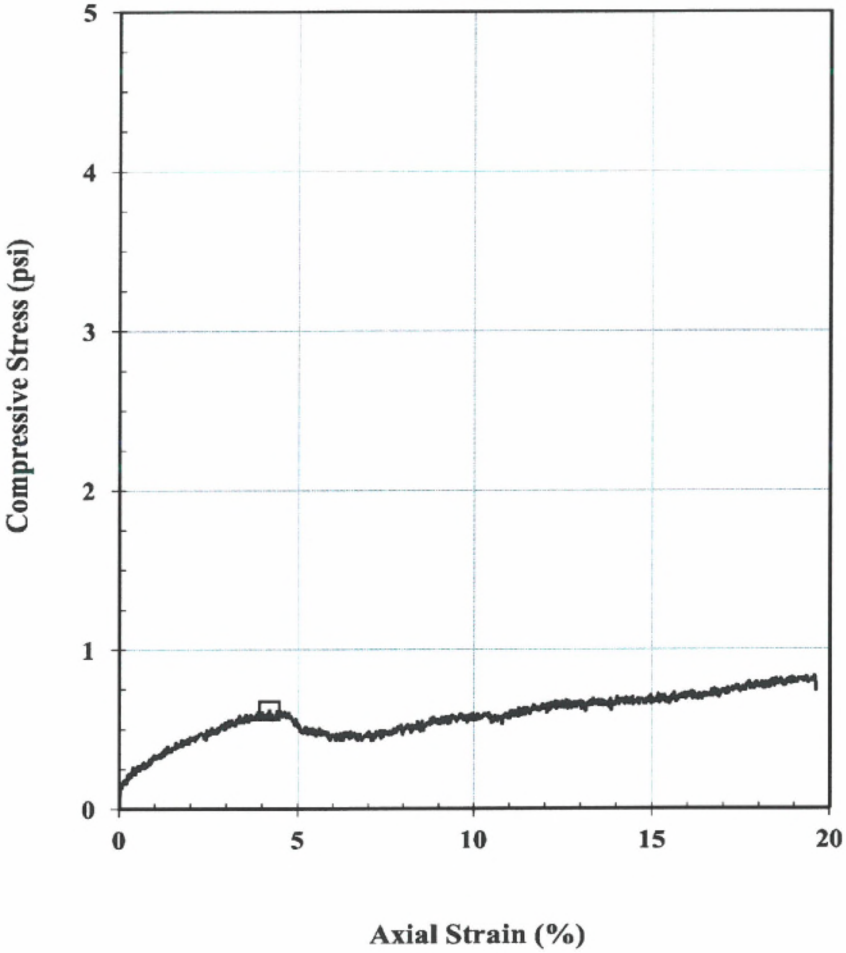
Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client: Weaver Consultants Group
Project: FTW C&D Expansion
Sample ID: WC-4 (68-69)

TRI Log No.: 45844.7
Type of Specimen: Intact
Test Method: ASTM D2166
Strain Rate (%/min): 1 % / min

Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	2.03
Avg. Height (in)	H_o	4.61
Avg, Water Content (%)	w_o	17.8
Bulk Density (pcf)	γ_{total}	111.8
Dry Density (pcf)	γ_{dry}	94.8
Saturation (%)	S_r	61.5
Void Ratio	e_o	0.74
Assumed Specific Gravity	G_s	2.65



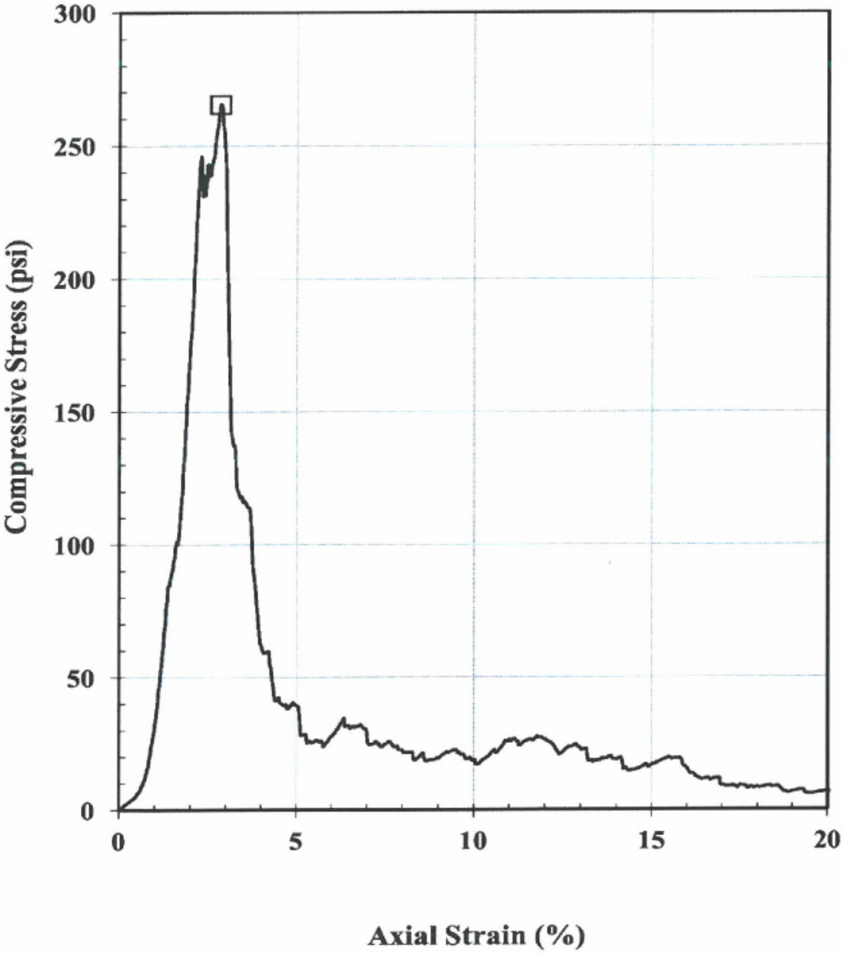
Stresses at Failure	
Unconfined Compressive Strength (psi)	0.6
Axial Strain at Failure (%)*	4.2
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	0.6
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	0.3

*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client:	Weaver Consultants Group	TRI Log No.:	45844.9
Project:	FTW C&D Expansion	Type of Specimen:	Intact
Sample ID:	WC-4 (160-162)	Test Method:	ASTM D2166
		Strain Rate (%/min):	1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	3.47
Avg. Height (in)	H_o	6.92
Avg, Water Content (%)	w_o	8.7
Bulk Density (pcf)	γ_{total}	143.4
Dry Density (pcf)	γ_{dry}	131.9
Saturation (%)	S_r	90.2
Void Ratio	e_o	0.25
Assumed Specific Gravity	G_s	2.65

Stresses at Failure	
Unconfined Compressive Strength (psi)	265.4
Axial Strain at Failure (%)*	2.8
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	265.4
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	132.7

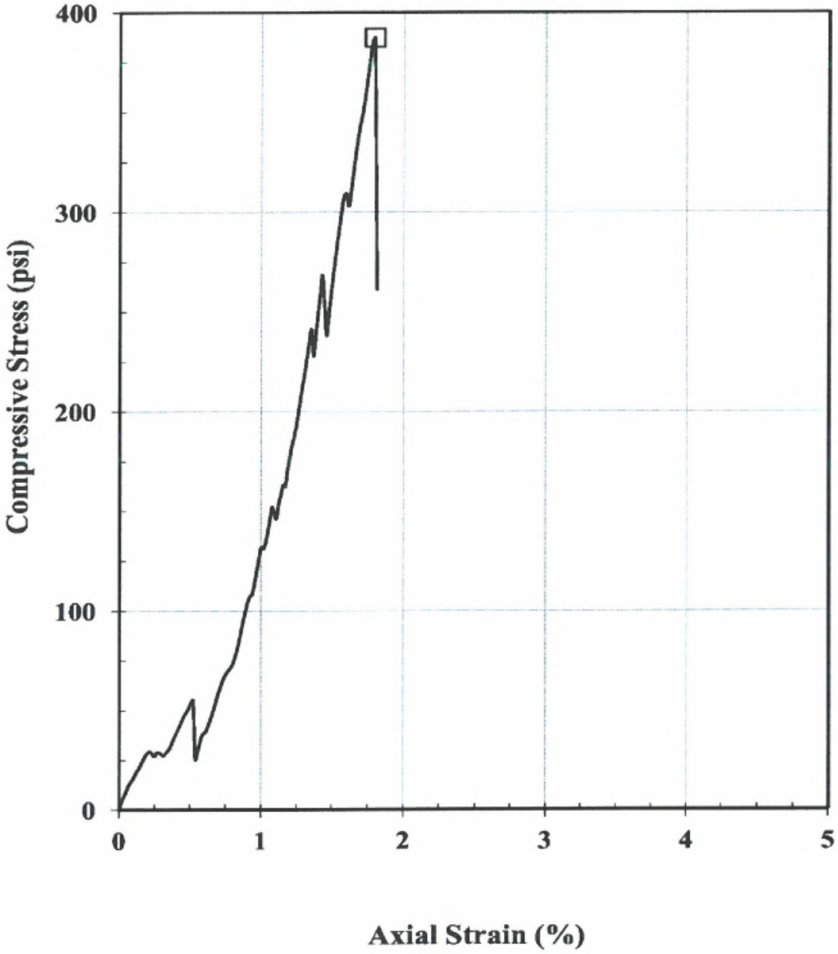
*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client:	Weaver Consultants Group
Project:	FTW C&D Expansion
Sample ID:	WC-4 (174-176)

TRI Log No.:	45844.10
Type of Specimen:	Intact
Test Method:	ASTM D2166
Strain Rate (%/min):	1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	3.36
Avg. Height (in)	H_o	6.71
Avg, Water Content (%)	w_o	4.6
Bulk Density (pcf)	γ_{total}	148.0
Dry Density (pcf)	γ_{dry}	141.5
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.17
Assumed Specific Gravity	G_s	2.65

Stresses at Failure	
Unconfined Compressive Strength (psi)	387.3
Axial Strain at Failure (%)*	1.8
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	387.3
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	193.6

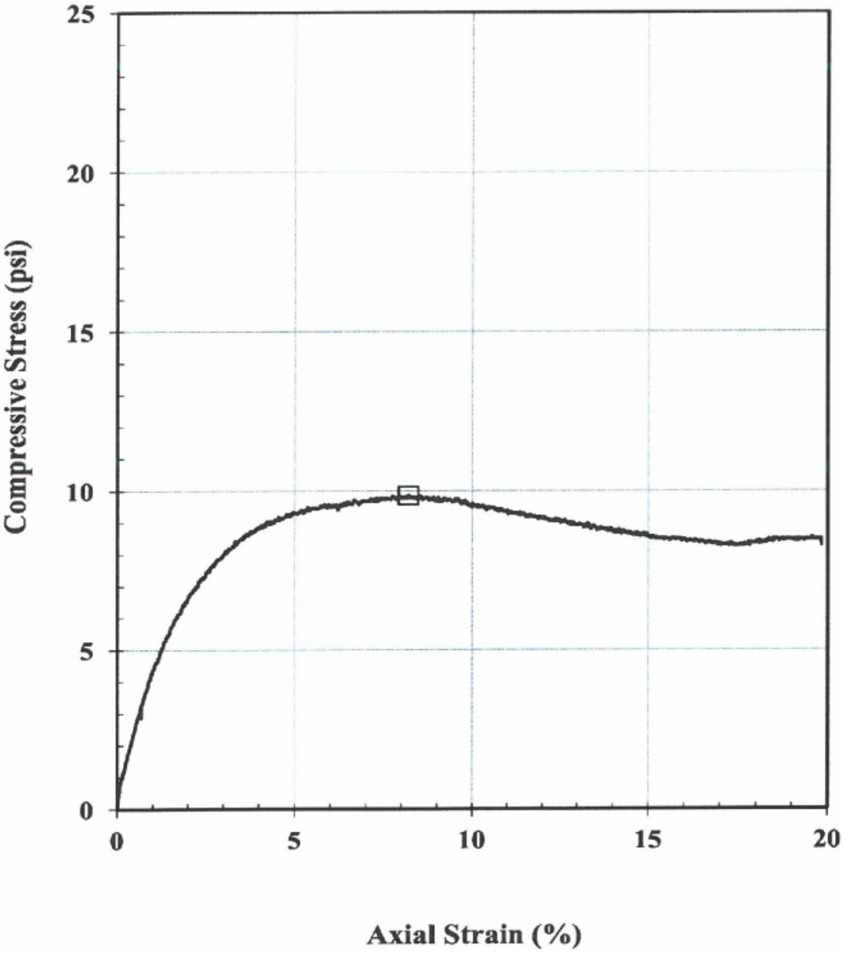
*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client:	Weaver Consultants Group	TRI Log No.:	45844.11
Project:	FTW C&D Expansion	Type of Specimen:	Intact
Sample ID:	WC-5 (53-55)	Test Method:	ASTM D2166
		Strain Rate (%/min):	1 % / min

Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	2.79
Avg. Height (in)	H_o	6.56
Avg, Water Content (%)	w_o	25.0
Bulk Density (pcf)	γ_{total}	122.8
Dry Density (pcf)	γ_{dry}	98.3
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.68
Assumed Specific Gravity	G_s	2.65



Stresses at Failure	
Unconfined Compressive Strength (psi)	9.8
Axial Strain at Failure (%)*	8.2
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	9.8
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	4.9

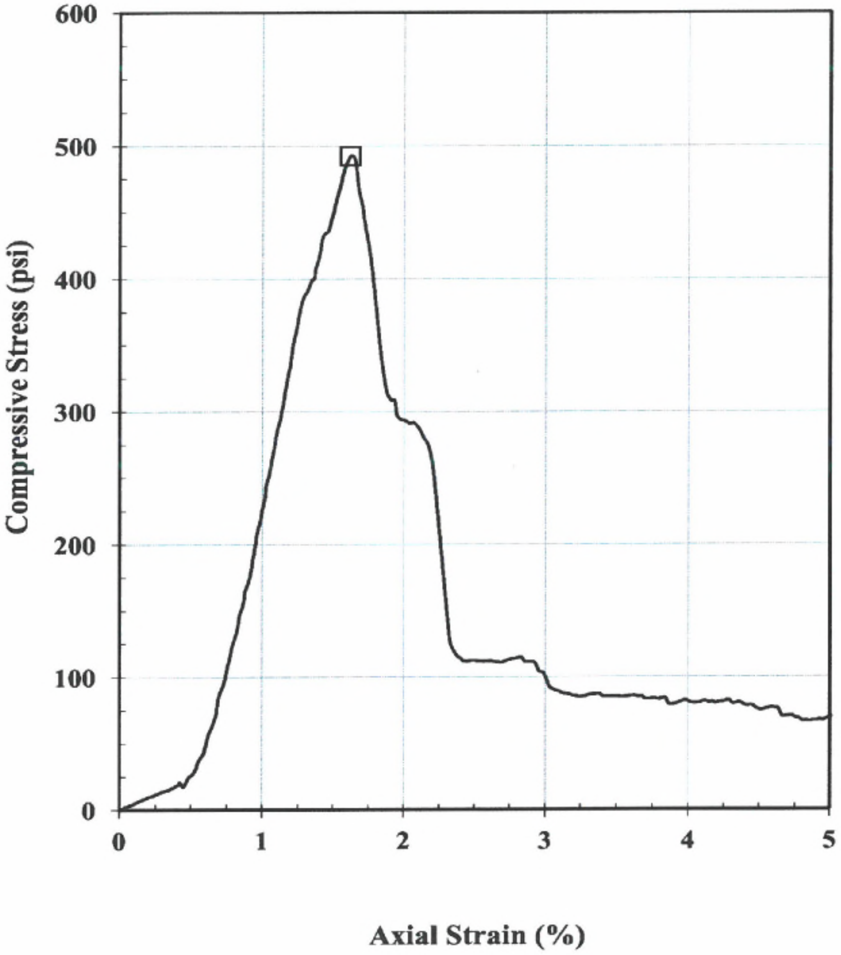
*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client:	Weaver Consultants Group
Project:	FTW C&D Expansion
Sample ID:	WC-5 (126-134)

TRI Log No.:	45844.12
Type of Specimen:	Intact
Test Method:	ASTM D2166
Strain Rate (%/min):	1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	3.46
Avg. Height (in)	H_o	7.55
Avg, Water Content (%)	w_o	11.2
Bulk Density (pcf)	γ_{total}	143.9
Dry Density (pcf)	γ_{dry}	129.4
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.28
Assumed Specific Gravity	G_s	2.65

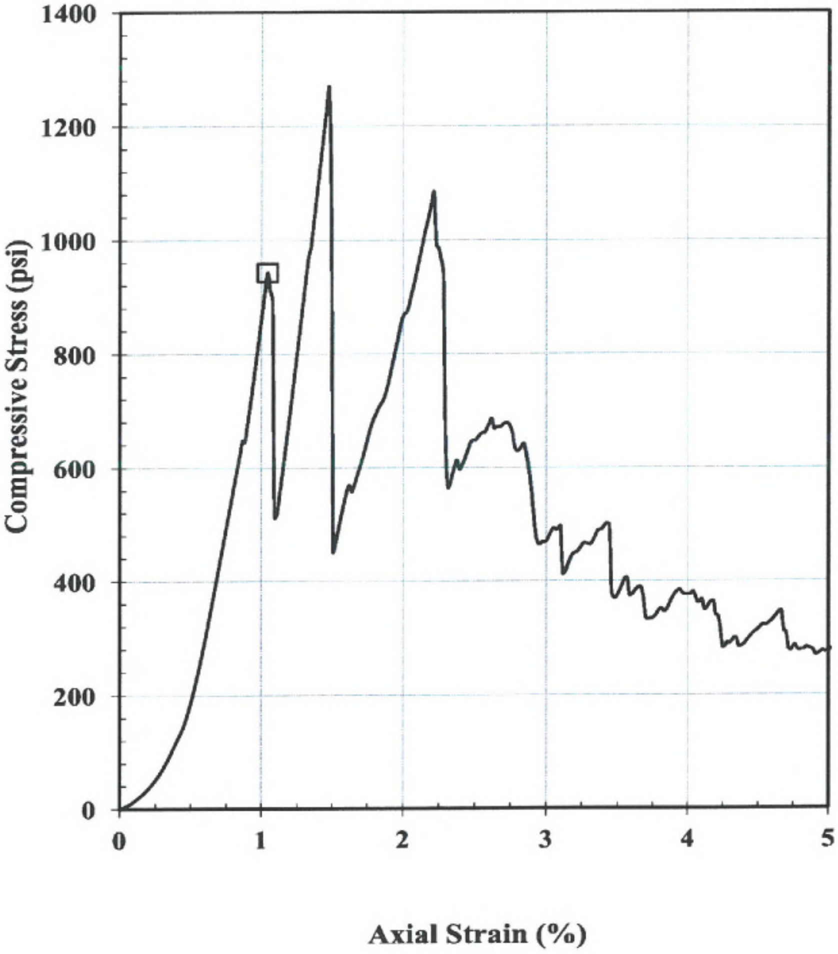
Stresses at Failure	
Unconfined Compressive Strength (psi)	492.1
Axial Strain at Failure (%)*	1.6
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	492.1
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	246.1

*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client:	Weaver Consultants Group	TRI Log No.:	45844.13
Project:	FTW C&D Expansion	Type of Specimen:	Intact
Sample ID:	WC-5 (146-149)	Test Method:	ASTM D2166
		Strain Rate (%/min):	1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	3.43
Avg. Height (in)	H_o	6.99
Avg, Water Content (%)	w_o	8.5
Bulk Density (pcf)	γ_{total}	148.1
Dry Density (pcf)	γ_{dry}	136.5
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.21
Assumed Specific Gravity	G_s	2.65

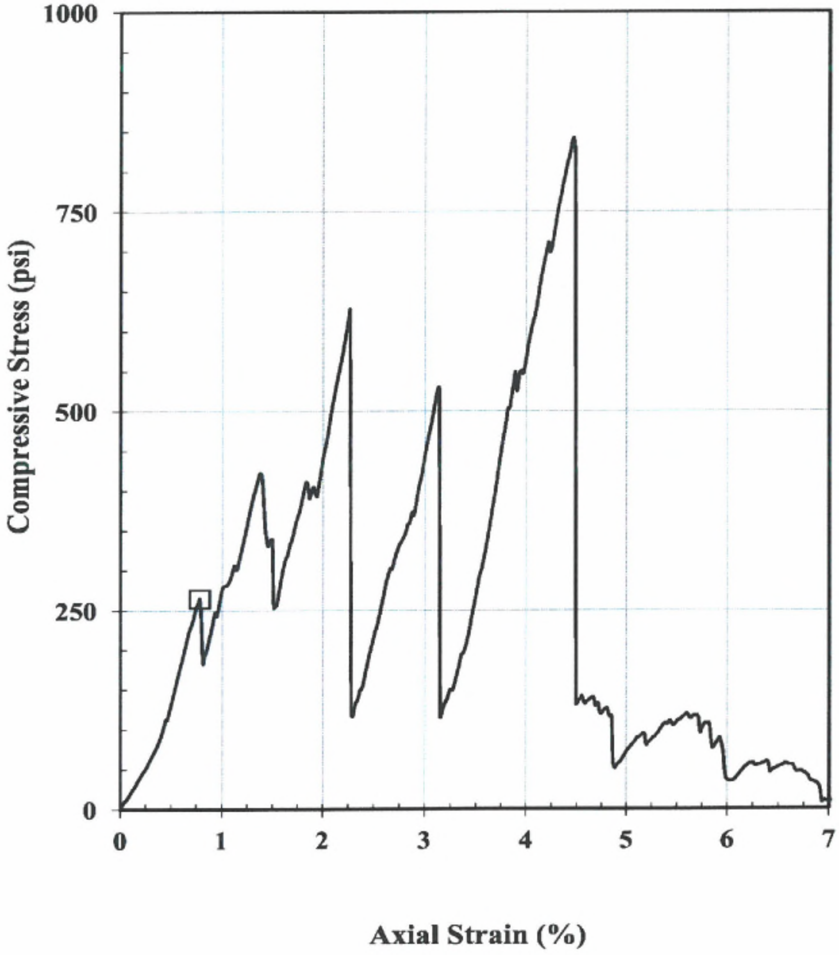
Stresses at Failure	
Unconfined Compressive Strength (psi)	942.6
Axial Strain at Failure (%)*	1.0
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	942.6
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	471.3

*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client:	Weaver Consultants Group	TRI Log No.:	45844.14
Project:	FTW C&D Expansion	Type of Specimen:	Intact
Sample ID:	WC-5 (161-163)	Test Method:	ASTM D2166
		Strain Rate (%/min):	1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	3.41
Avg. Height (in)	H_o	6.85
Avg, Water Content (%)	w_o	10.2
Bulk Density (pcf)	γ_{total}	151.5
Dry Density (pcf)	γ_{dry}	137.5
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.20
Assumed Specific Gravity	G_s	2.65

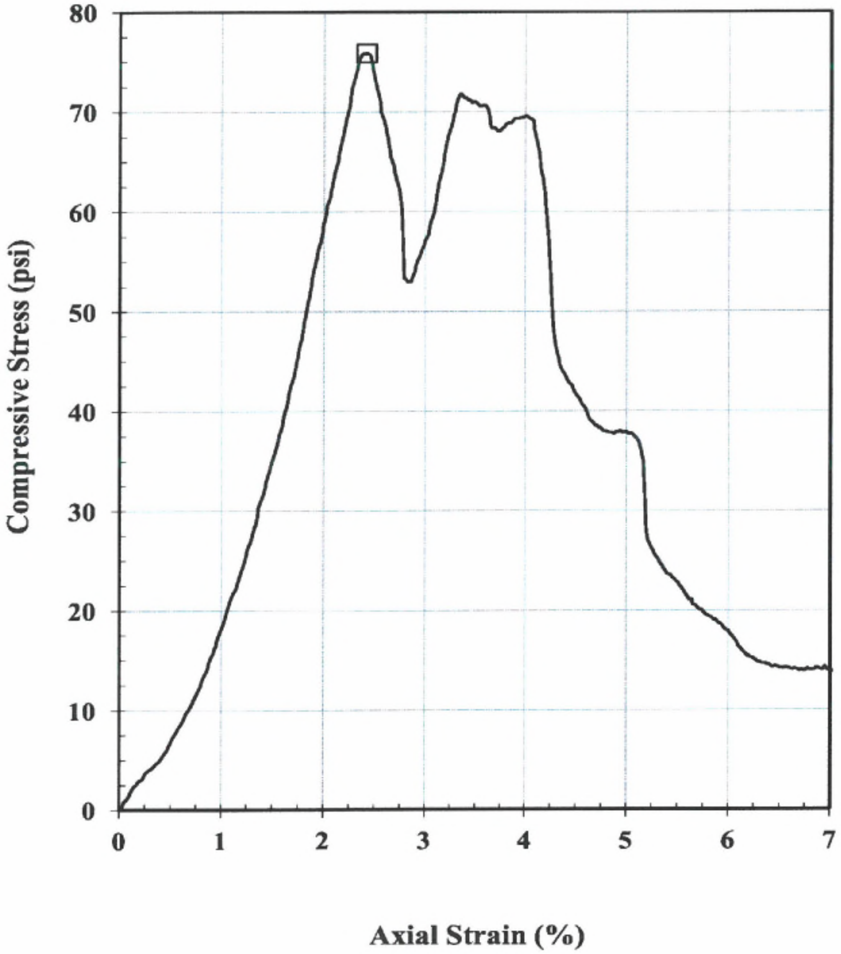
Stresses at Failure	
Unconfined Compressive Strength (psi)	264.0
Axial Strain at Failure (%)*	0.8
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	264.0
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	132.0

*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client:	Weaver Consultants Group	TRI Log No.:	45844.18
Project:	FTW C&D Expansion	Type of Specimen:	Intact
Sample ID:	WC-6 (81-84)	Test Method:	ASTM D2166
		Strain Rate (%/min):	1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	3.65
Avg. Height (in)	H_o	7.17
Avg, Water Content (%)	w_o	16.0
Bulk Density (pcf)	γ_{total}	137.6
Dry Density (pcf)	γ_{dry}	118.6
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.39
Assumed Specific Gravity	G_s	2.65

Stresses at Failure	
Unconfined Compressive Strength (psi)	75.9
Axial Strain at Failure (%)*	2.4
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	75.9
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	37.9

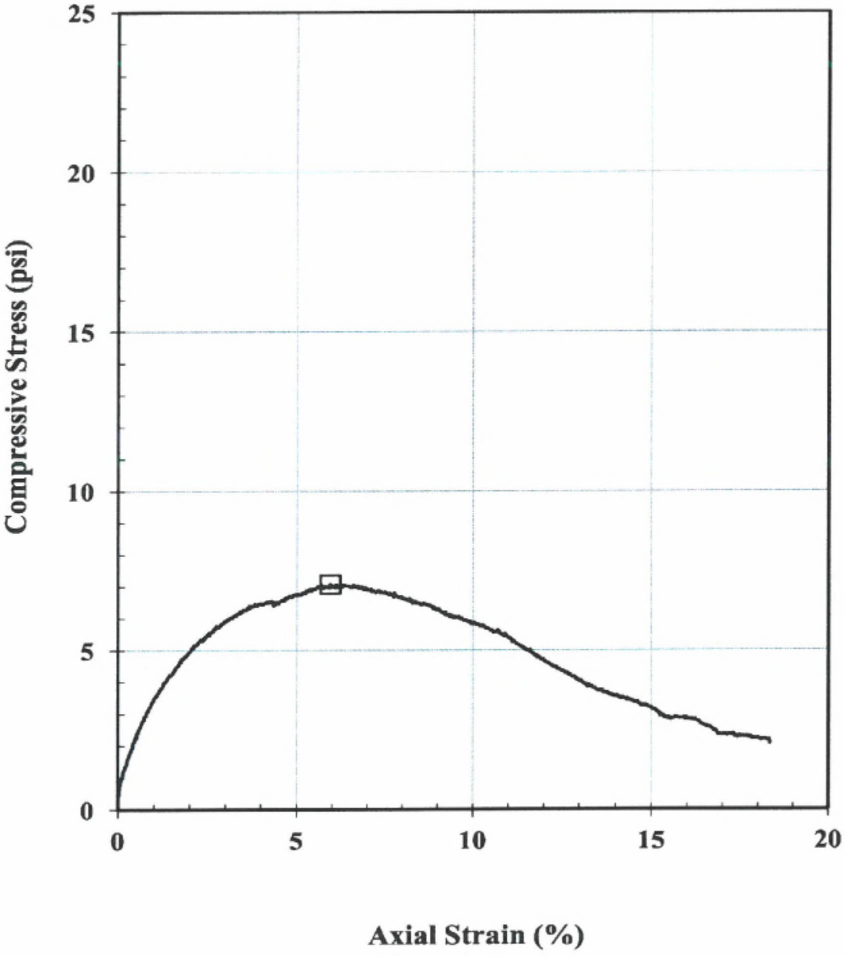
*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client:	Weaver Consultants Group
Project:	FTW C&D Expansion
Sample ID:	WC-7 (55-57)

TRI Log No.:	45844.24
Type of Specimen:	Intact
Test Method:	ASTM D2166
Strain Rate (%/min):	1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	4.10
Avg. Height (in)	H_o	8.17
Avg, Water Content (%)	w_o	19.7
Bulk Density (pcf)	γ_{total}	129.9
Dry Density (pcf)	γ_{dry}	108.5
Saturation (%)	S_r	99.3
Void Ratio	e_o	0.52
Assumed Specific Gravity	G_s	2.65

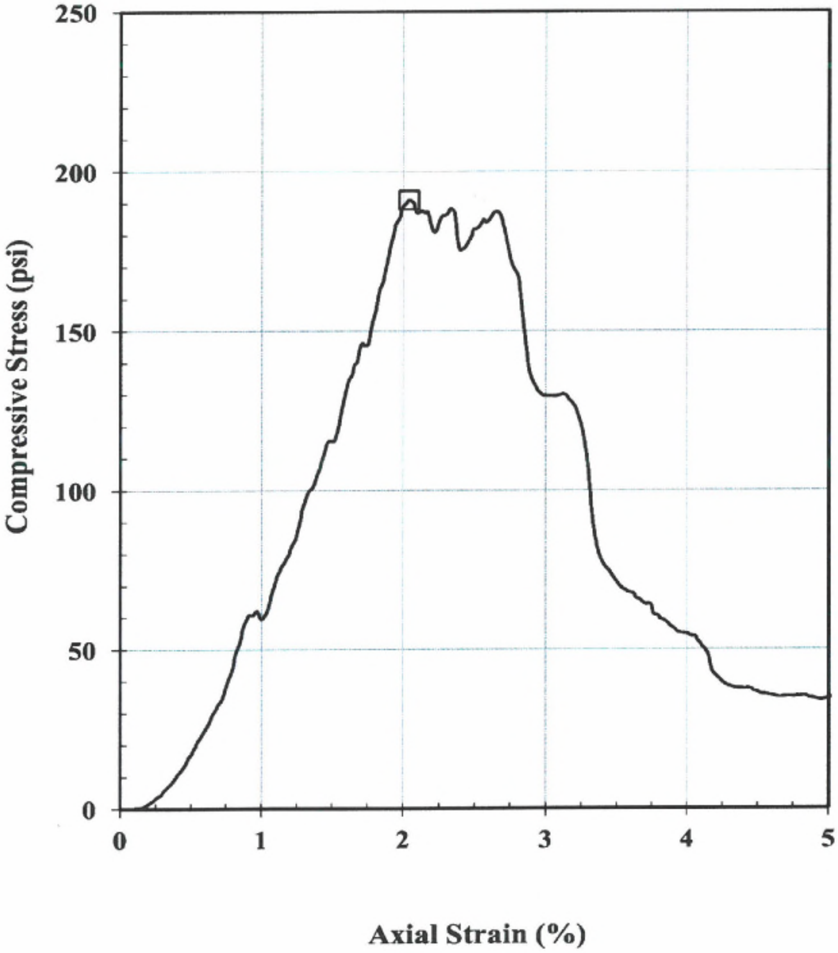
Stresses at Failure	
Unconfined Compressive Strength (psi)	7.1
Axial Strain at Failure (%)*	5.9
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	7.1
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	3.5

*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client:	Weaver Consultants Group	TRI Log No.:	45844.25
Project:	FTW C&D Expansion	Type of Specimen:	Intact
Sample ID:	WC-7 (83-85)	Test Method:	ASTM D2166
		Strain Rate (%/min):	1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	3.68
Avg. Height (in)	H_o	7.74
Avg, Water Content (%)	w_o	15.9
Bulk Density (pcf)	γ_{total}	140.2
Dry Density (pcf)	γ_{dry}	121.0
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.37
Assumed Specific Gravity	G_s	2.65

Stresses at Failure	
Unconfined Compressive Strength (psi)	191.0
Axial Strain at Failure (%)*	2.0
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	191.0
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	95.5

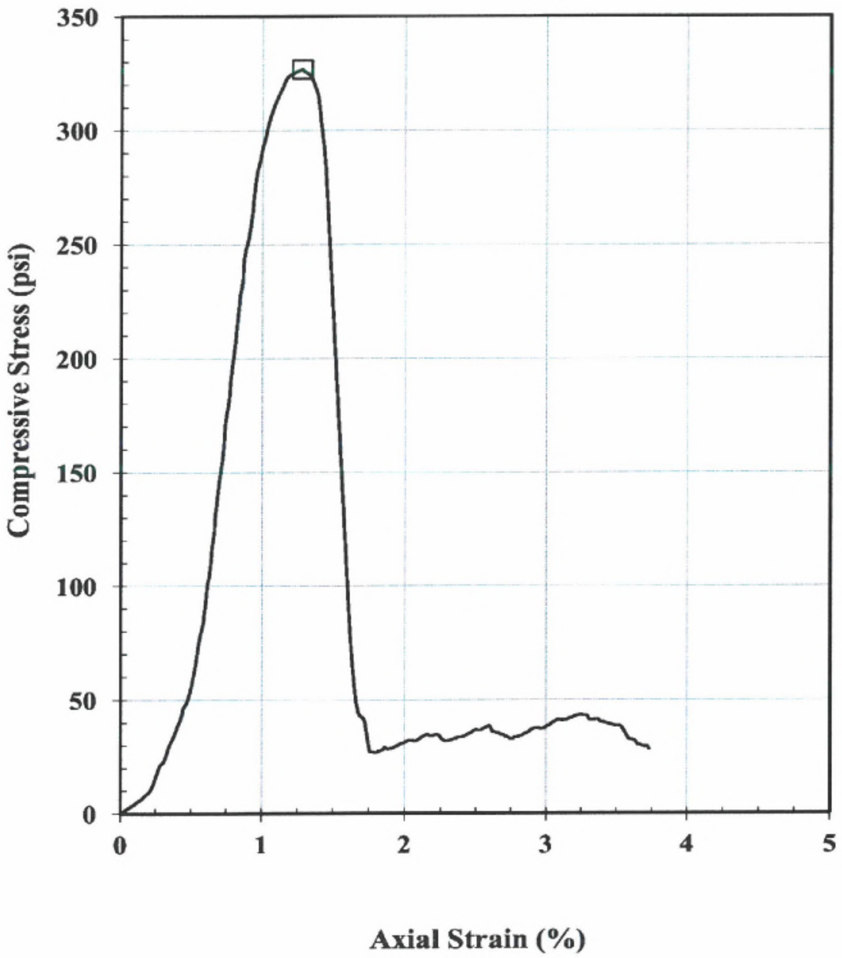
*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client: Weaver Consultants Group
Project: FTW C&D Expansion
Sample ID: WC-7 (104-106)

TRI Log No.: 45844.26
Type of Specimen: Intact
Test Method: ASTM D2166
Strain Rate (%/min): 1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	3.66
Avg. Height (in)	H_o	7.44
Avg, Water Content (%)	w_o	13.6
Bulk Density (pcf)	γ_{total}	141.0
Dry Density (pcf)	γ_{dry}	124.0
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.33
Assumed Specific Gravity	G_s	2.65

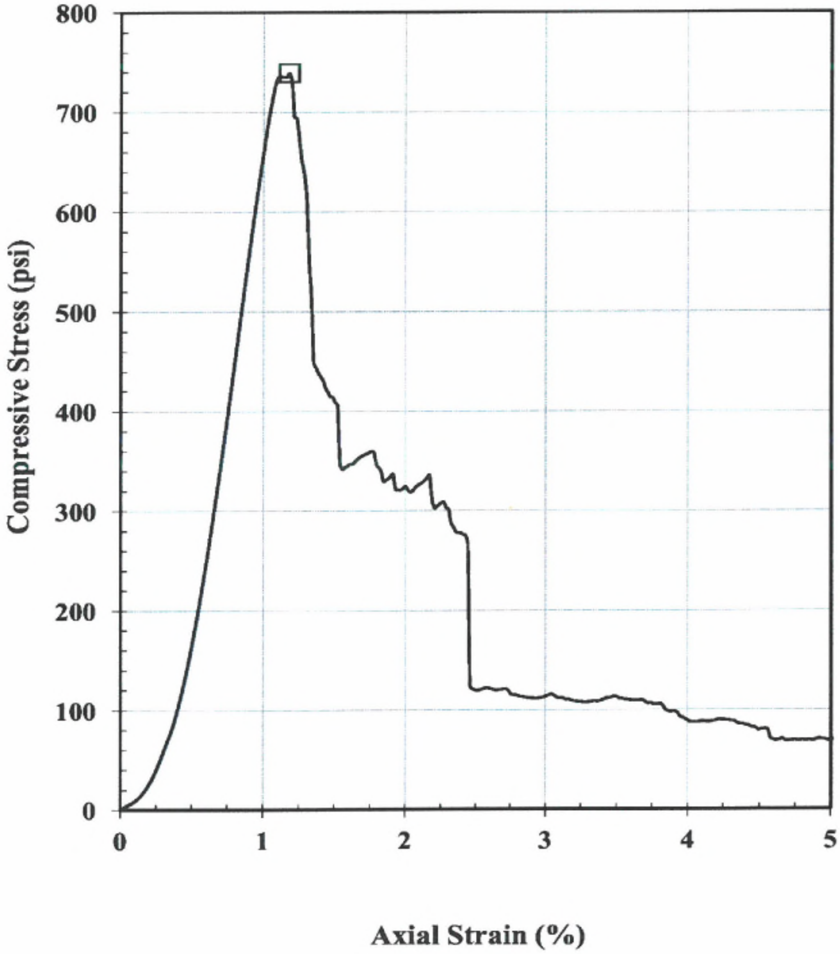
Stresses at Failure	
Unconfined Compressive Strength (psi)	326.7
Axial Strain at Failure (%)*	1.3
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	326.7
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	163.3

*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client:	Weaver Consultants Group	TRI Log No.:	45844.27
Project:	FTW C&D Expansion	Type of Specimen:	Intact
Sample ID:	WC-7 (120-122)	Test Method:	ASTM D2166
		Strain Rate (%/min):	1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	3.63
Avg. Height (in)	H_o	7.84
Avg, Water Content (%)	w_o	9.8
Bulk Density (pcf)	γ_{total}	148.3
Dry Density (pcf)	γ_{dry}	135.0
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.23
Assumed Specific Gravity	G_s	2.65

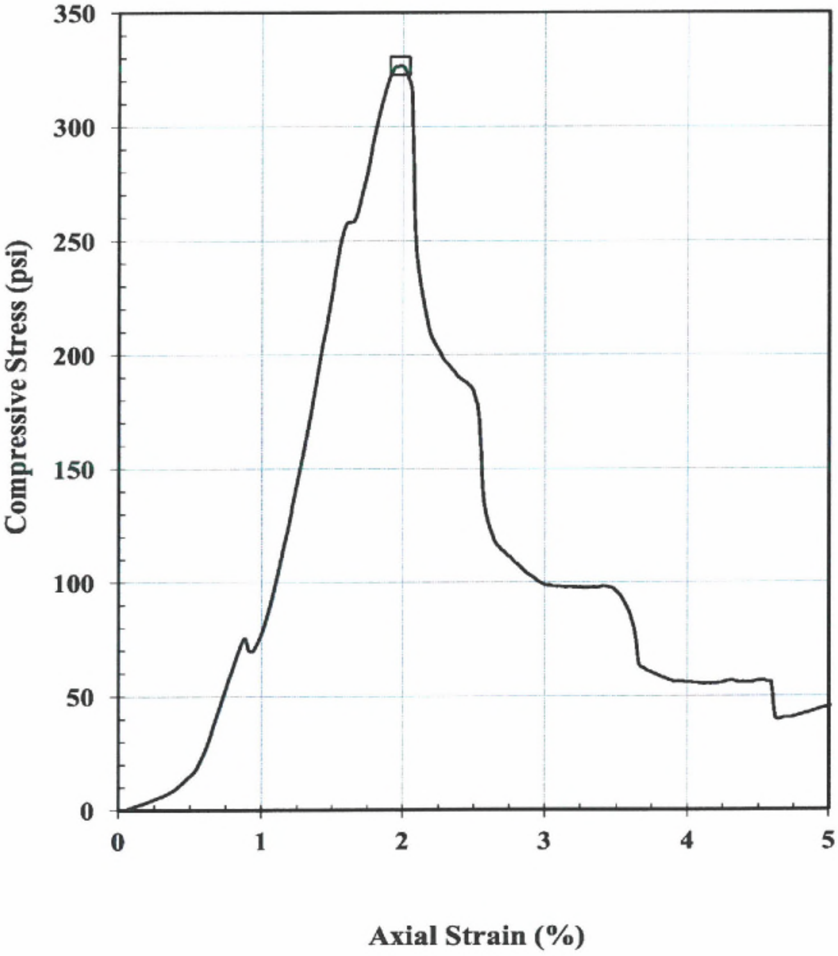
Stresses at Failure	
Unconfined Compressive Strength (psi)	739.0
Axial Strain at Failure (%)*	1.2
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	739.0
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	369.5

*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client:	Weaver Consultants Group	TRI Log No.:	45844.28
Project:	FTW C&D Expansion	Type of Specimen:	Intact
Sample ID:	WC-7 (124-126)	Test Method:	ASTM D2166
		Strain Rate (%/min):	1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	3.67
Avg. Height (in)	H_o	7.60
Avg, Water Content (%)	w_o	13.0
Bulk Density (pcf)	γ_{total}	149.4
Dry Density (pcf)	γ_{dry}	132.2
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.25
Assumed Specific Gravity	G_s	2.65

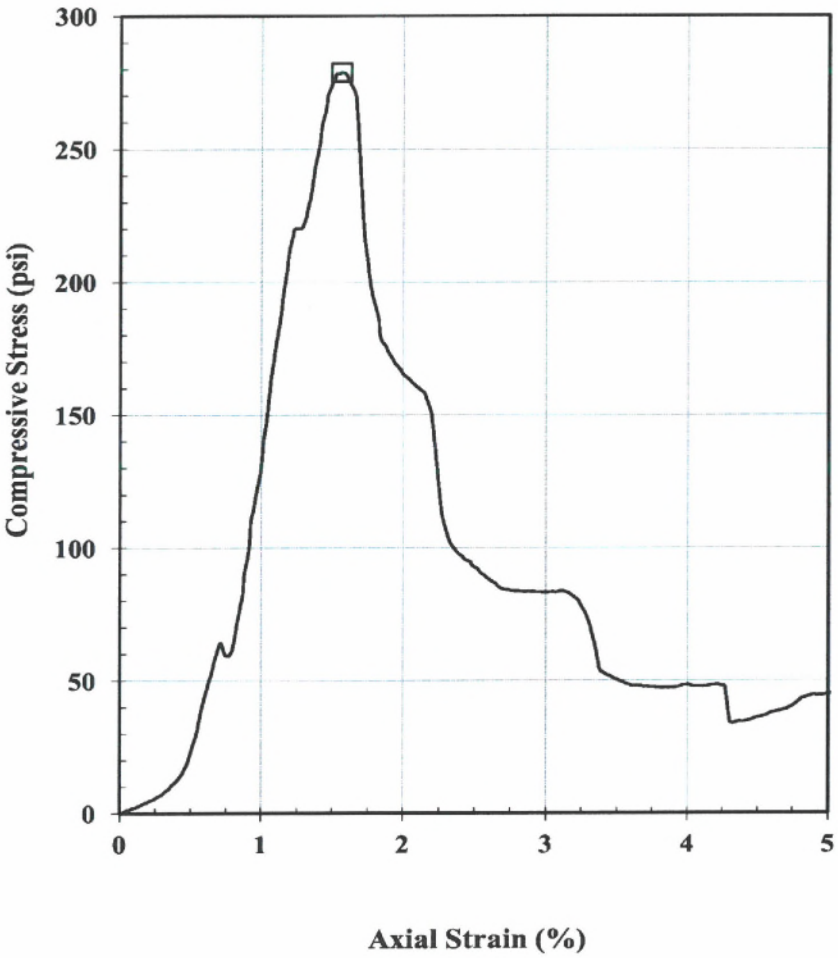
Stresses at Failure	
Unconfined Compressive Strength (psi)	326.6
Axial Strain at Failure (%)*	2.0
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	326.6
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	163.3

*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client:	Weaver Consultants Group	TRI Log No.:	45844.30
Project:	FTW C&D Expansion	Type of Specimen:	Intact
Sample ID:	WC-8 (56-58)	Test Method:	ASTM D2166
		Strain Rate (%/min):	1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	3.98
Avg. Height (in)	H_o	7.98
Avg, Water Content (%)	w_o	21.2
Bulk Density (pcf)	γ_{total}	117.0
Dry Density (pcf)	γ_{dry}	96.6
Saturation (%)	S_r	80.8
Void Ratio	e_o	0.71
Assumed Specific Gravity	G_s	2.65

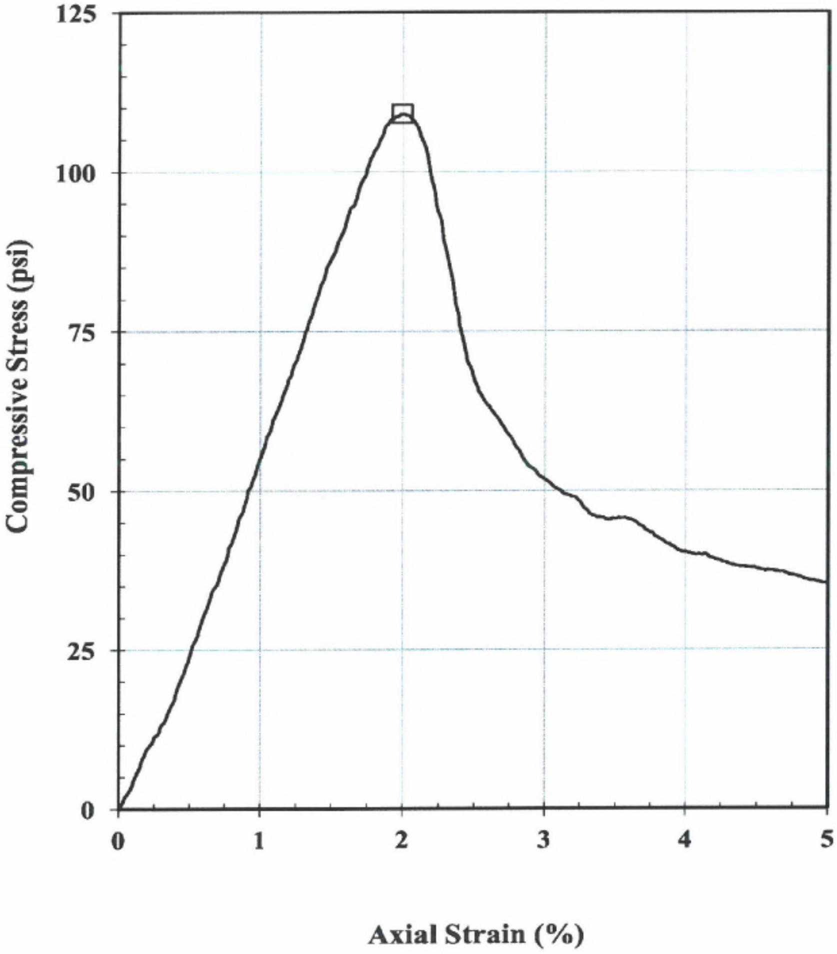
Stresses at Failure	
Unconfined Compressive Strength (psi)	278.7
Axial Strain at Failure (%)*	1.6
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	278.7
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	139.4

*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

Unconfined Compression Test Report

Client:	Weaver Consultants Group	TRI Log No.:	45844.34
Project:	FTW C&D Expansion	Type of Specimen:	Intact
Sample ID:	WC-9 (38-40)	Test Method:	ASTM D2166
		Strain Rate (%/min):	1 % / min



Specimen Condition at Time of Test		
Specimen No.		1
Avg. Diameter (in)	D_o	3.41
Avg. Height (in)	H_o	7.02
Avg, Water Content (%)	w_o	10.9
Bulk Density (pcf)	γ_{total}	133.3
Dry Density (pcf)	γ_{dry}	120.2
Saturation (%)	S_r	68.2
Void Ratio	e_o	0.38
Assumed Specific Gravity	G_s	2.65

Stresses at Failure	
Unconfined Compressive Strength (psi)	109.0
Axial Strain at Failure (%)*	2.0
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	109.0
Minor Principal Stress, σ_3 (psi)	0.0
Undrained Shear Strength, S_u (psi)	54.5

*End to end displacement measurement / global not localized strain measurement.

Jeffrey A. Kuhn, Ph.D., P.E., 5/1/19
Quality Review/Date

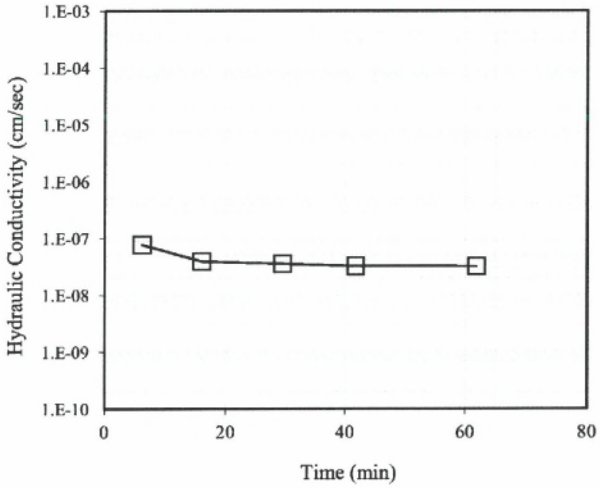
TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA
TRI

Hydraulic Conductivity

Client:	Weaver Consultants Group
Project:	FTW C&D Expansion
Sample ID:	WC-1 (40-42)

TRI Log #:	45844.1
Test Method:	ASTM D5084 Method F

Initial Values	
Sample Condition	Undisturbed
Diameter (in)	3.48
Height (in)	3.19
Initial Mass (g)	1154.7
Sample Area (in^2)	9.53
Water Content (%)	10.3
Total Unit Weight (pcf)	144.5
Dry Unit Weight (pcf)	131.0
Specific Gravity (Assumed)	2.73
Degree of Saturation	93.7
Void Ratio	0.30
Porosity	0.23
1 Pore Volume (cc)	115.1
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.96



Specimen Image

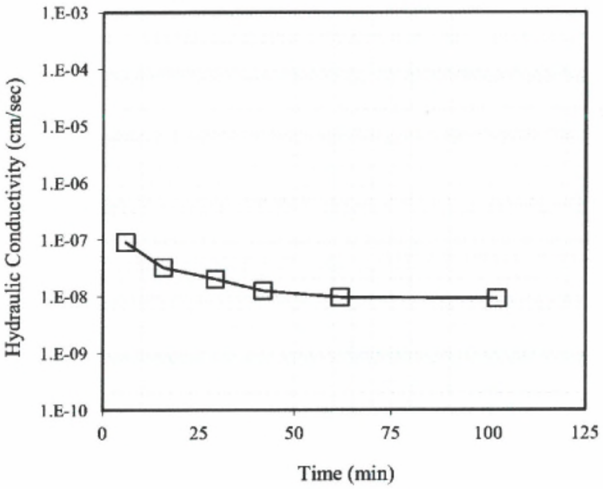
Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
16.0	3.9E-08
29.5	3.6E-08
41.8	3.2E-08
61.9	3.2E-08
Average, Last 2 Readings	**3.2E-08**

Jeffrey A. Kuhn, Ph.D., P.E., 4/23/2019
Analysis & Quality Review/Date

Hydraulic Conductivity

Client: Weaver Consultants Group
Project: FTW C&D Expansion
Sample ID: WC-3 (10-15)

TRI Log #: 45844.3
Test Method: ASTM D5084 Method F



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.79
Height (in)	2.46
Initial Mass (g)	493.7
Sample Area (in^2)	6.13
Water Content (%)	23.1
Total Unit Weight (pcf)	124.6
Dry Unit Weight (pcf)	101.2
Specific Gravity (Assumed)	2.73
Degree of Saturation	92.4
Void Ratio	0.68
Porosity	0.41
1 Pore Volume (cc)	100.3
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.95

Specimen Image

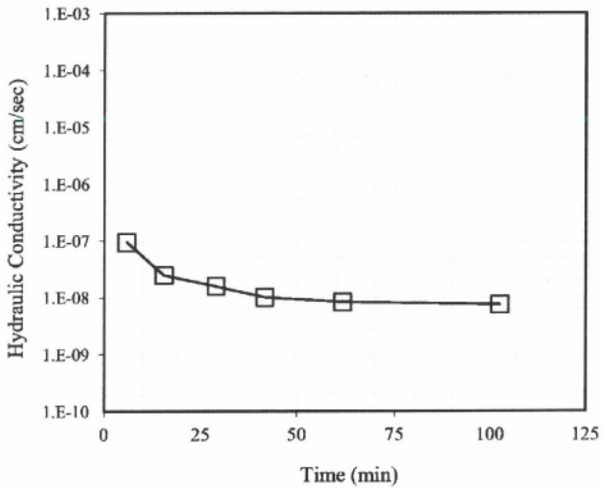
Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
29.2	2.0E-08
41.7	1.2E-08
61.8	9.6E-09
102.1	9.2E-09
Average, Last 2 Readings	**9.4E-09**

Jeffrey A. Kuhn, Ph.D., P.E., 4/23/2019
Analysis & Quality Review/Date

Hydraulic Conductivity

Client: Weaver Consultants Group
Project: FTW C&D Expansion
Sample ID: WC-3 (20-25)

TRI Log #: 45844.4
Test Method: ASTM D5084 Method F



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.80
Height (in)	3.09
Initial Mass (g)	649.3
Sample Area (in^2)	6.17
Water Content (%)	18.2
Total Unit Weight (pcf)	129.7
Dry Unit Weight (pcf)	109.8
Specific Gravity (Assumed)	2.73
Degree of Saturation	89.8
Void Ratio	0.55
Porosity	0.36
1 Pore Volume (cc)	111.0
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.78*

Specimen Image

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
29.1	1.6E-08
41.6	1.0E-08
61.7	8.3E-09
102.5	7.4E-09
Average, Last 2 Readings	**7.9E-09**

*75 psi back-pressure for 48 hrs+

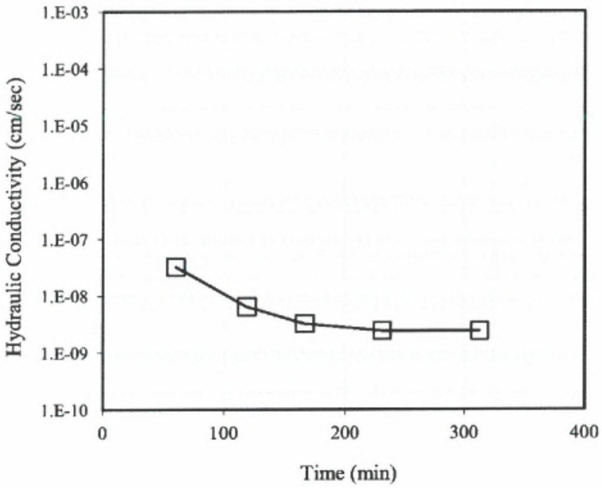
Jeffrey A. Kuhn, Ph.D., P.E., 4/23/2019
Analysis & Quality Review/Date

Hydraulic Conductivity

Client: Weaver Consultants Group
Project: FTW C&D Expansion
Sample ID: WC-5 (53-55)

TRI Log #: 45844.11
Test Method: ASTM D5084 Method F

Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.72
Height (in)	4.47
Initial Mass (g)	905.0
Sample Area (in^2)	5.81
Water Content (%)	17.3
Total Unit Weight (pcf)	132.6
Dry Unit Weight (pcf)	113.0
Specific Gravity (Assumed)	2.73
Degree of Saturation	93.1
Void Ratio	0.51
Porosity	0.34
1 Pore Volume (cc)	143.4
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.90*



Specimen Image

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
118.9	6.4E-09
166.5	3.2E-09
230.9	2.4E-09
313.0	2.4E-09
Average, Last 2 Readings	**2.4E-09**

*75 psi back-pressure for 48 hrs+

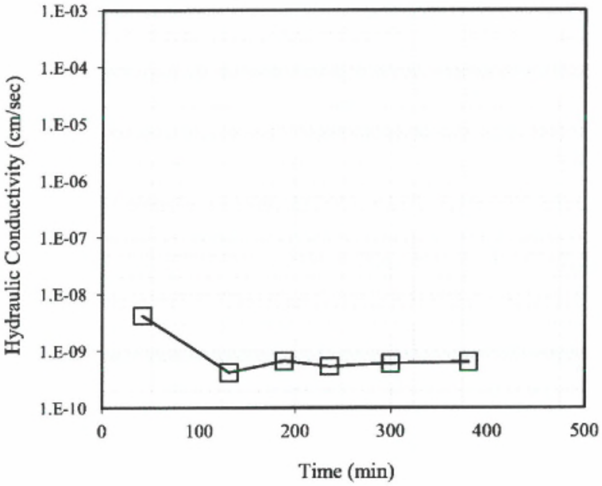
Jeffrey A. Kuhn, Ph.D., P.E., 4/23/2019
Analysis & Quality Review/Date

Page 1 of 1

Hydraulic Conductivity

Client:	Weaver Consultants Group
Project:	FTW C&D Expansion
Sample ID:	WC-5 (126-134)

TRI Log #:	45844.12
Test Method:	ASTM D5084 Method F



Specimen Image

Initial Values	
Sample Condition	Undisturbed
Diameter (in)	3.32
Height (in)	3.15
Initial Mass (g)	988.5
Sample Area (in^2)	8.65
Water Content (%)	9.9
Total Unit Weight (pcf)	138.1
Dry Unit Weight (pcf)	125.7
Specific Gravity (Assumed)	2.73
Degree of Saturation	75.7
Void Ratio	0.36
Porosity	0.26
1 Pore Volume (cc)	117.2
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.96

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
188.6	6.6E-10
236.4	5.3E-10
299.9	6.0E-10
380.8	6.4E-10
Average, Last 2 Readings	**6.2E-10**

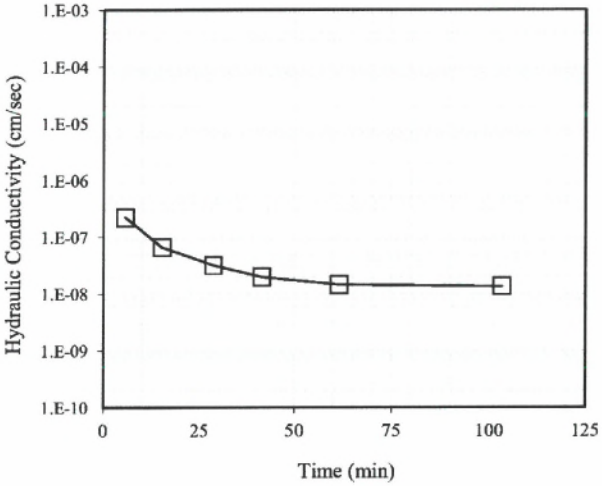
Jeffrey A. Kuhn, Ph.D., P.E., 4/23/2019
Analysis & Quality Review/Date

Page 1 of 1

Hydraulic Conductivity

Client: Weaver Consultants Group
Project: FTW C&D Expansion
Sample ID: WC-9 (18-20)

TRI Log #: 45844.33
Test Method: ASTM D5084 Method F



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.77
Height (in)	4.94
Initial Mass (g)	993.5
Sample Area (in^2)	6.03
Water Content (%)	17.7
Total Unit Weight (pcf)	127.1
Dry Unit Weight (pcf)	108.0
Specific Gravity (Assumed)	2.73
Degree of Saturation	83.8
Void Ratio	0.58
Porosity	0.37
1 Pore Volume (cc)	178.5
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.95

Specimen Image

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
28.8	3.2E-08
41.5	2.0E-08
61.5	1.4E-08
103.2	1.3E-08
Average, Last 2 Readings	**1.4E-08**

Jeffrey A. Kuhn, Ph.D., P.E., 4/23/2019
Analysis & Quality Review/Date

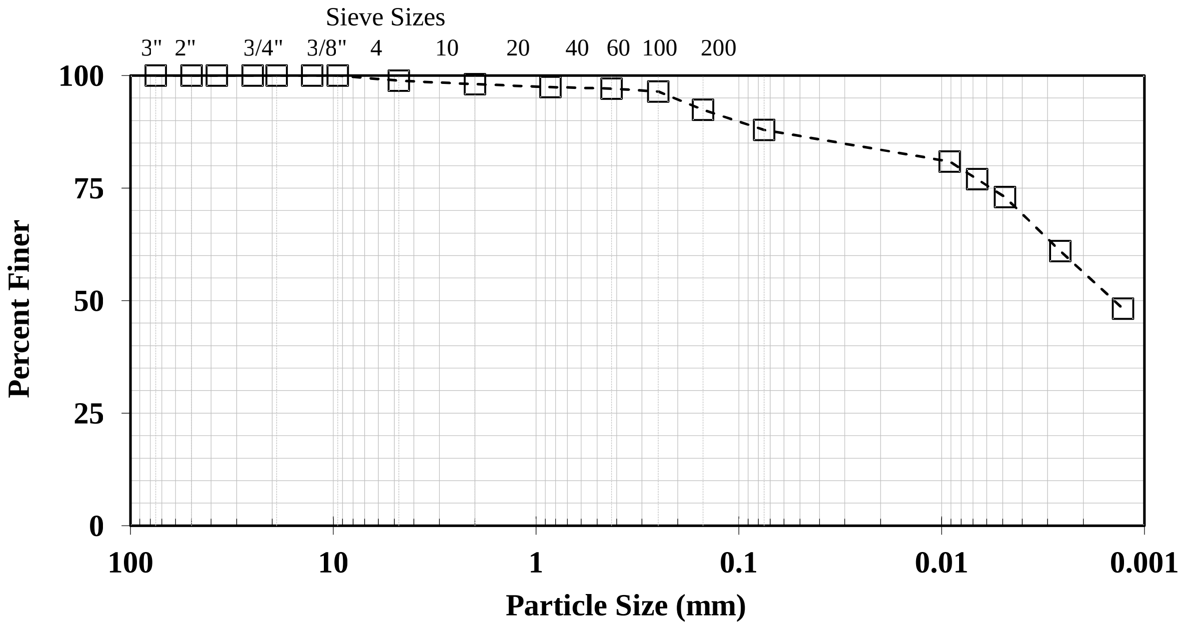
Page 1 of 1

APPENDIX 2 OF ATTACHMENT 3D.1

Geotechnical Data – Laboratory Test Results of Geosyntec's 2013 Subsurface Investigation

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-201 2-3'	Test Date:	01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	98.9
No. 10 (2.00 mm)	98.1
No. 20 (850 μm)	97.5
No. 40 (425 μm)	97.1
No. 60 (250 μm)	96.5
No. 100 (150 μm)	92.4
No. 200 (75 μm)	88.0
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	87.9
0.005 mm	73.3
0.001 mm	43.9

USCS Classification (ASTM D2487)	Fat Clay (CH)	
As-Received Moisture Content (%)	(ASTM D2216)	17.5
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	55
	Plastic Limit	21
	Plastic Index	34
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

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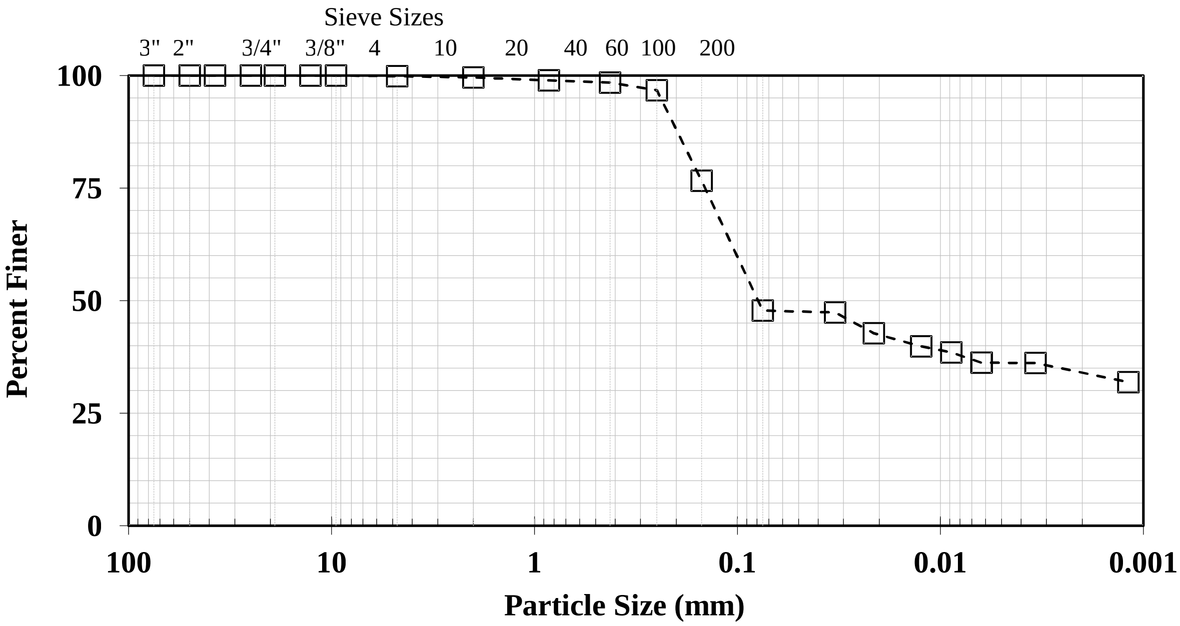
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-36

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-201 9-10.5'	Test Date:	01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.9
No. 10 (2.00 mm)	99.6
No. 20 (850 µm)	99.0
No. 40 (425 µm)	98.5
No. 60 (250 µm)	96.7
No. 100 (150 µm)	76.6
No. 200 (75 µm)	47.8
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	47.8
0.005 mm	34.7
0.001 mm	31.2

USCS Classification (ASTM D2487)	Clayey Sand (SC)	
As-Received Moisture Content (%)	(ASTM D2216)	9.1
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	29
	Plastic Limit	14
	Plastic Index	15
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2014

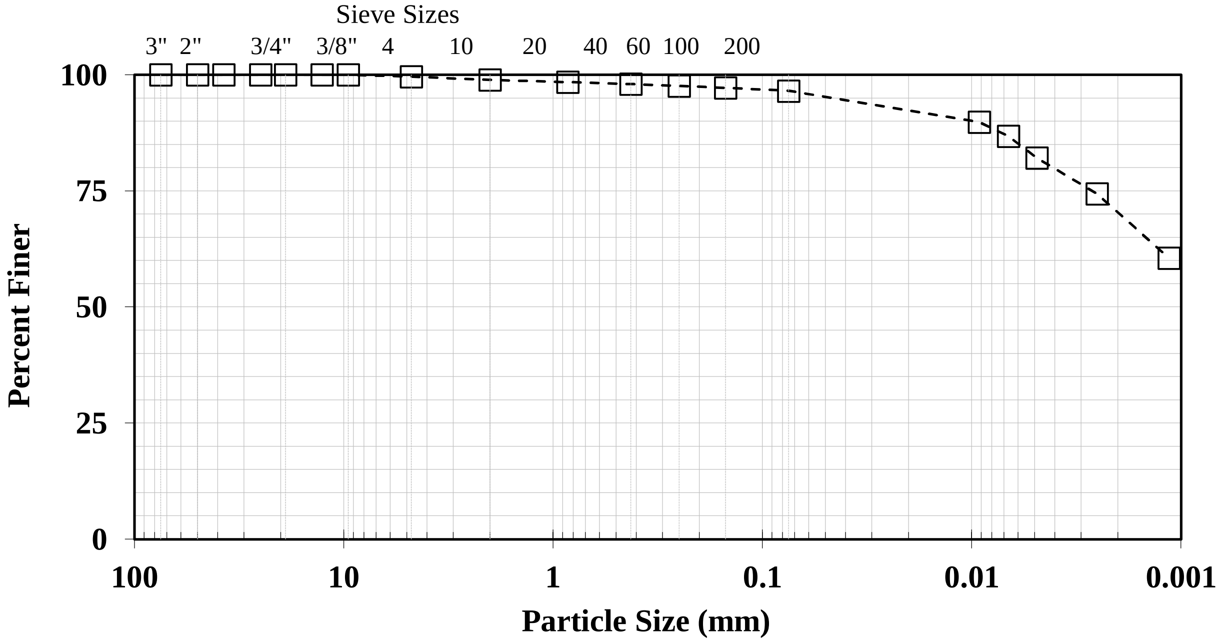
Quality Review/Date

Tested by: Kahlil Hart

IIIM-C-37

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-201 19-20.5'	Test Date:	02/11/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.6
No. 10 (2.00 mm)	98.9
No. 20 (850 µm)	98.4
No. 40 (425 µm)	98.0
No. 60 (250 µm)	97.6
No. 100 (150 µm)	97.2
No. 200 (75 µm)	96.5
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	96.5
0.005 mm	82.5
0.001 mm	58.2

USCS Classification (ASTM D2487)	Fat Clay (CH)	
As-Received Moisture Content (%)	(ASTM D2216)	18.2
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	54
	Plastic Limit	21
	Plastic Index	33
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/18/2014

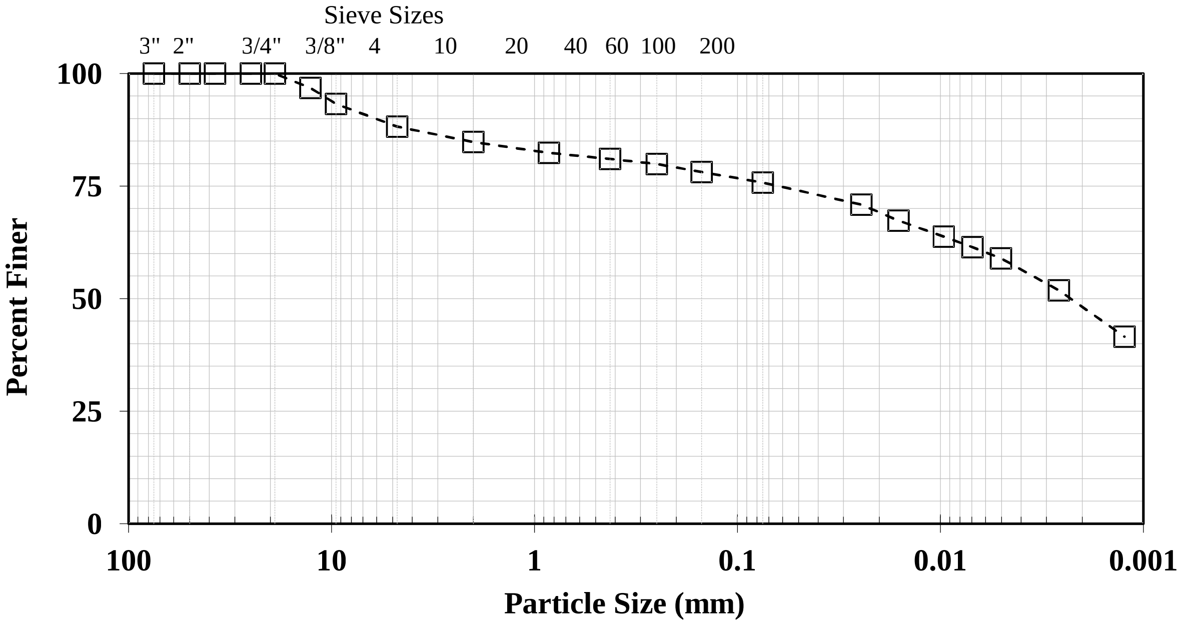
Quality Review/Date

Tested by: Kahlil Hart

IIIM-C-38

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-201 20.5-22'	Test Date:	01/17/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	96.8
3/8 in.	93.3
No. 4 (4.75 mm)	88.2
No. 10 (2.00 mm)	84.8
No. 20 (850 µm)	82.4
No. 40 (425 µm)	81.0
No. 60 (250 µm)	79.9
No. 100 (150 µm)	78.2
No. 200 (75 µm)	75.8
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	75.7
0.005 mm	58.9
0.001 mm	38.6

USCS Classification (ASTM D2487)	Fat Clay with Sand (CH)	
As-Received Moisture Content (%)	(ASTM D2216)	16.5
Atterberg Limits (ASTM D 4318, Method B : Single-Point*)	Liquid Limit (3 pt)	56
	Plastic Limit	21
	Plastic Index	35
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

*Limited sample quantity for multi-point liquid limit testing.

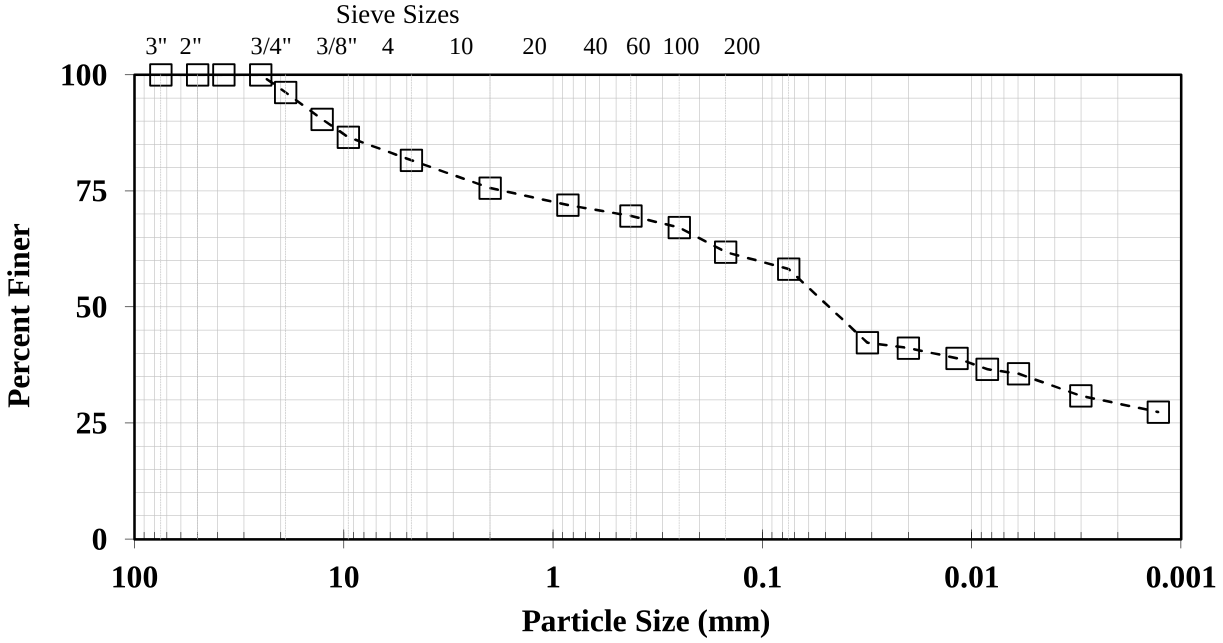
Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-39

Particle Size Analysis for Soils

Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Sample: B-202 4-6'

TRI Log#: E2377-59-05
Test Method: D422
Test Date: 02/11/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	96.2
1/2 in.	90.4
3/8 in.	86.6
No. 4 (4.75 mm)	81.6
No. 10 (2.00 mm)	75.6
No. 20 (850 µm)	71.9
No. 40 (425 µm)	69.6
No. 60 (250 µm)	67.1
No. 100 (150 µm)	61.8
No. 200 (75 µm)	58.2
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	57.9
0.005 mm	35.1
0.001 mm	26.3

USCS Classification (ASTM D2487)	Sandy Fat Clay (CH)	
As-Received Moisture Content (%)	(ASTM D2216)	12.9
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	54
	Plastic Limit	20
	Plastic Index	34
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/18/2014
Quality Review/Date
Tested by: Kahlil Hart

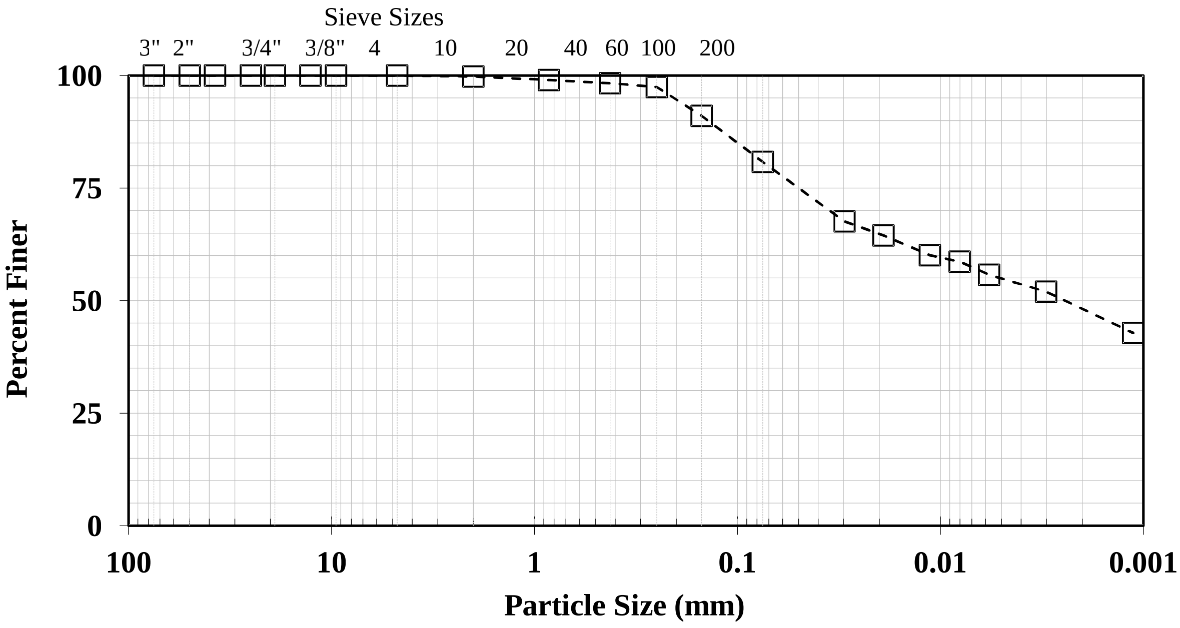
IIIM-C-40

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

Particle Size Analysis for Soils

Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Sample: B-202 7-8.5'

TRI Log#: E2377-59-05
Test Method: D422
Test Date: 01/15/14



Sieve Analysis

Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.00 mm)	99.8
No. 20 (850 µm)	99.0
No. 40 (425 µm)	98.3
No. 60 (250 µm)	97.4
No. 100 (150 µm)	91.1
No. 200 (75 µm)	80.8

Hydrometer Analysis

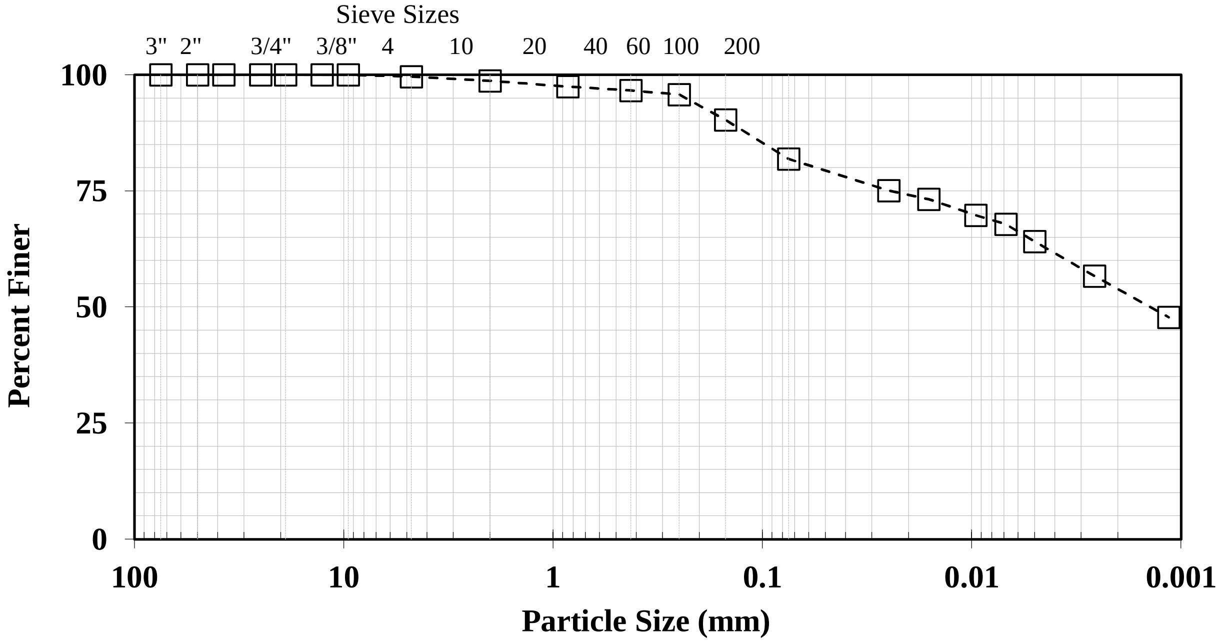
Particle Size	Percent Passing
0.074 mm	80.6
0.005 mm	54.5
0.001 mm	41.8

USCS Classification (ASTM D2487)	Lean Clay with Sand (CL)	
As-Received **Moisture Content (%)**	(ASTM D2216)	15.4
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	43
	Plastic Limit	18
	Plastic Index	25
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2014
Quality Review/Date
Tested by: Kahlil Hart

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-202 9-11'	Test Date:	02/11/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.6
No. 10 (2.00 mm)	98.7
No. 20 (850 µm)	97.4
No. 40 (425 µm)	96.6
No. 60 (250 µm)	95.7
No. 100 (150 µm)	90.3
No. 200 (75 µm)	81.9
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	81.8
0.005 mm	64.1
0.001 mm	46.3

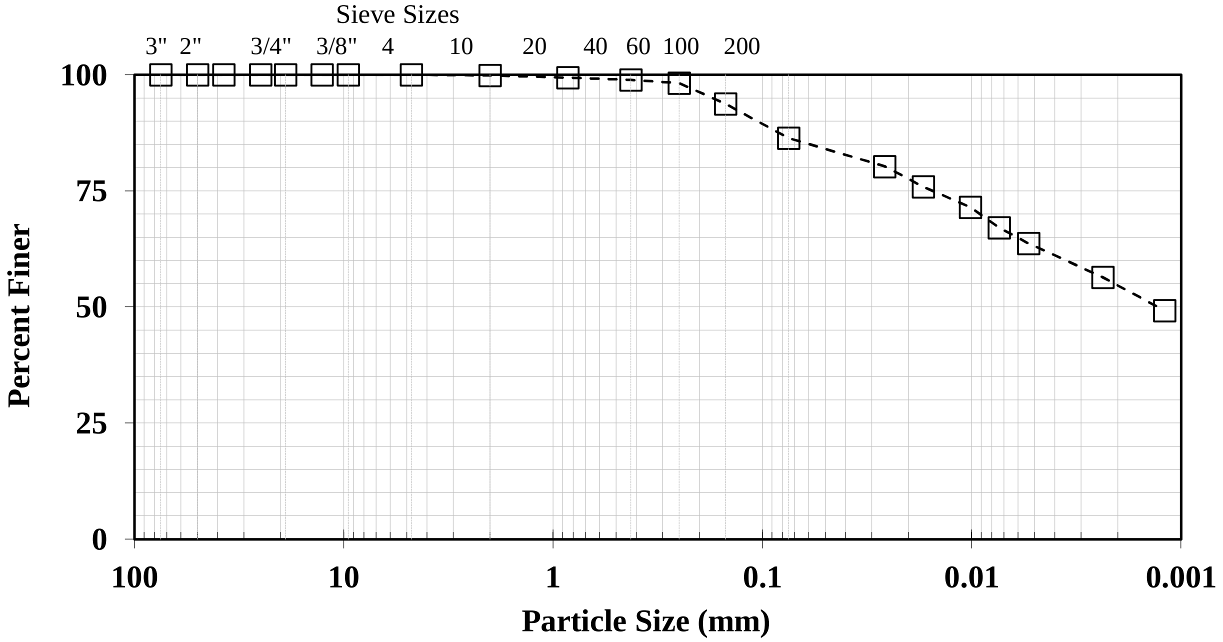
USCS Classification (ASTM D2487)	Lean Clay with Sand (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	15.4
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	45
	Plastic Limit	15
	Plastic Index	30
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/28/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-42

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#: E2377-59-05
Project:	Ft. Worth C&D	Test Method: D422
Sample:	B-202 14-16'	Test Date: 02/18/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.00 mm)	99.9
No. 20 (850 µm)	99.4
No. 40 (425 µm)	98.9
No. 60 (250 µm)	98.2
No. 100 (150 µm)	93.7
No. 200 (75 µm)	86.4
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	86.3
0.005 mm	62.9
0.001 mm	47.3

USCS Classification (ASTM D2487)	Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	16.4
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	43
	Plastic Limit	16
	Plastic Index	27
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014

Quality Review/Date

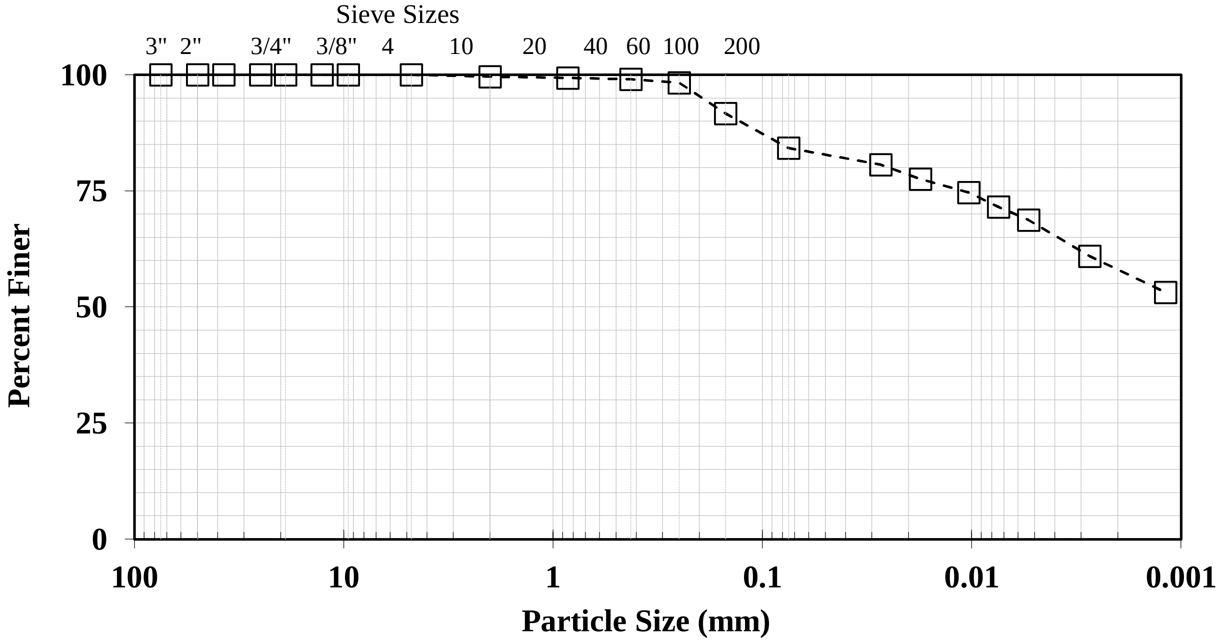
Tested by: Kahlil Hart

IIIM-C-43

Particle Size Analysis for Soils

Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Sample: B-202 19-21'

TRI Log#: E2377-59-05
Test Method: D422
Test Date: 02/11/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.00 mm)	99.6
No. 20 (850 µm)	99.3
No. 40 (425 µm)	99.0
No. 60 (250 µm)	98.3
No. 100 (150 µm)	91.7
No. 200 (75 µm)	84.2
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	84.2
0.005 mm	68.2
0.001 mm	51.6

USCS Classification (ASTM D2487)	Lean Clay with Sand (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	16.9
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	48
	Plastic Limit	20
	Plastic Index	28
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

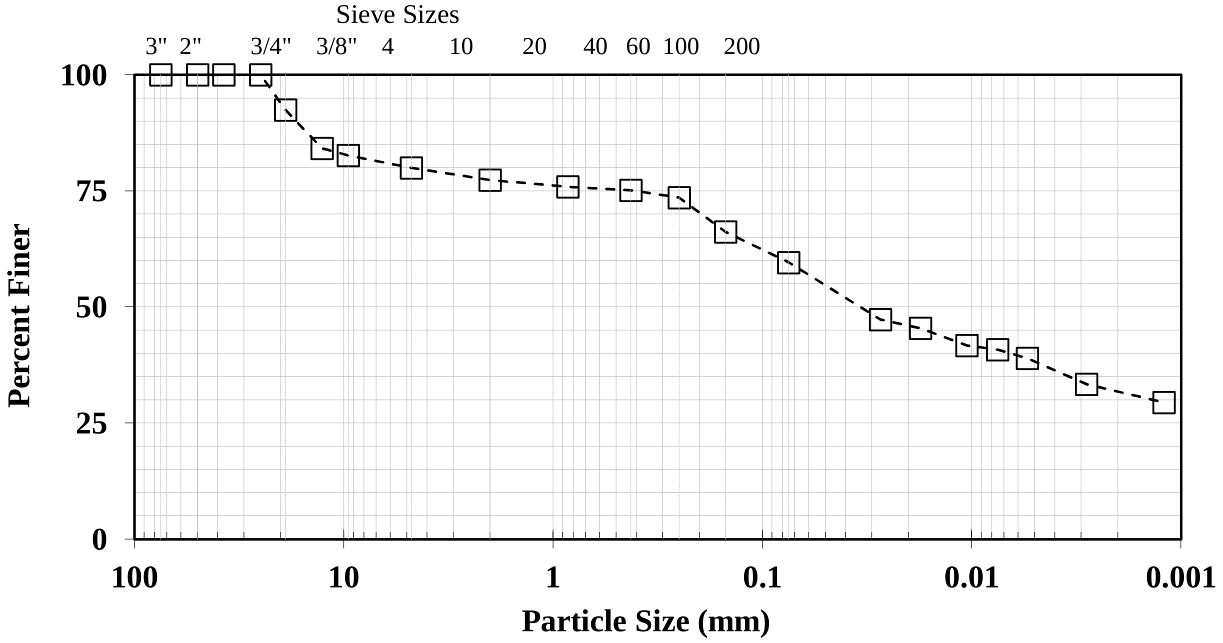
Jeffrey A. Kuhn, Ph.D., P.E., 2/18/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-44

Particle Size Analysis for Soils

Client: Geosyntec Comsultants, Inc.
Project: Ft.Worth C&D
Sample: B-202 24-25'

TRI Log#: E2377-59-05
Test Method: D422
Test Date: 01/00/00



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	92.4
1/2 in.	84.2
3/8 in.	82.6
No. 4 (4.75 mm)	79.9
No. 10 (2.00 mm)	77.4
No. 20 (850 µm)	75.9
No. 40 (425 µm)	75.1
No. 60 (250 µm)	73.5
No. 100 (150 µm)	66.2
No. 200 (75 µm)	59.6
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	59.4
0.005 mm	38.5
0.001 mm	28.6

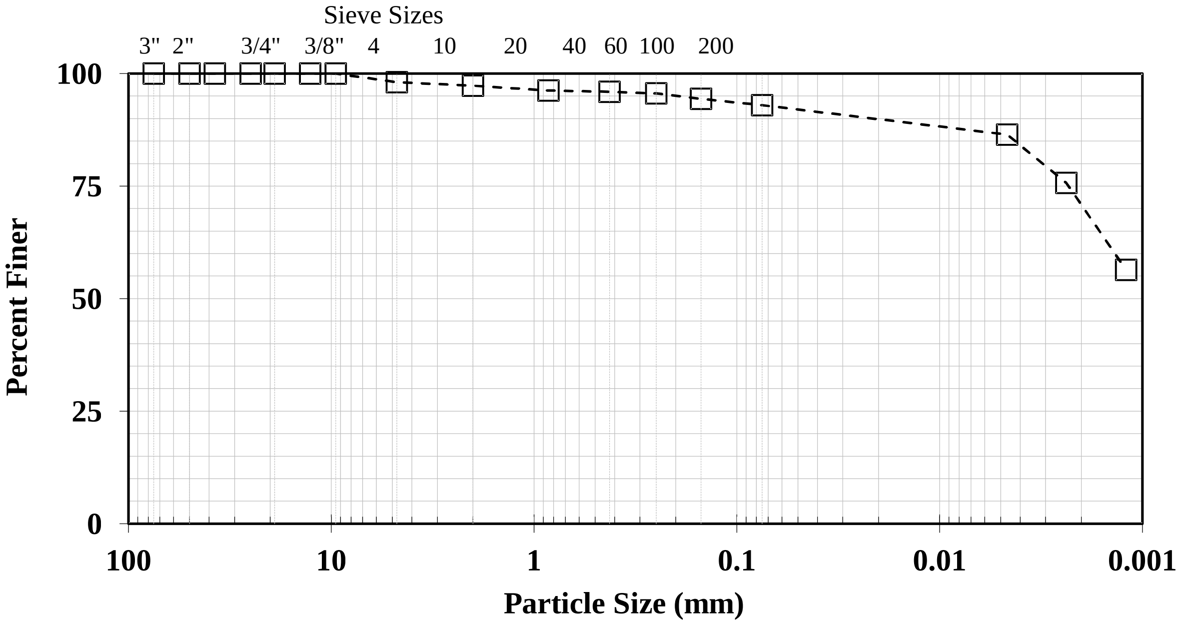
USCS Classification (ASTM D2487)	Sandy Fat Clay (CH)	
As-Received Moisture Content (%)	(ASTM D2216)	20.2
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	54
	Plastic Limit	17
	Plastic Index	37
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-45

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-202 27-28.5'	Test Date:	01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	98.1
No. 10 (2.00 mm)	97.3
No. 20 (850 µm)	96.2
No. 40 (425 µm)	95.9
No. 60 (250 µm)	95.6
No. 100 (150 µm)	94.4
No. 200 (75 µm)	93.0
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	92.9
0.005 mm	86.6
0.001 mm	51.1

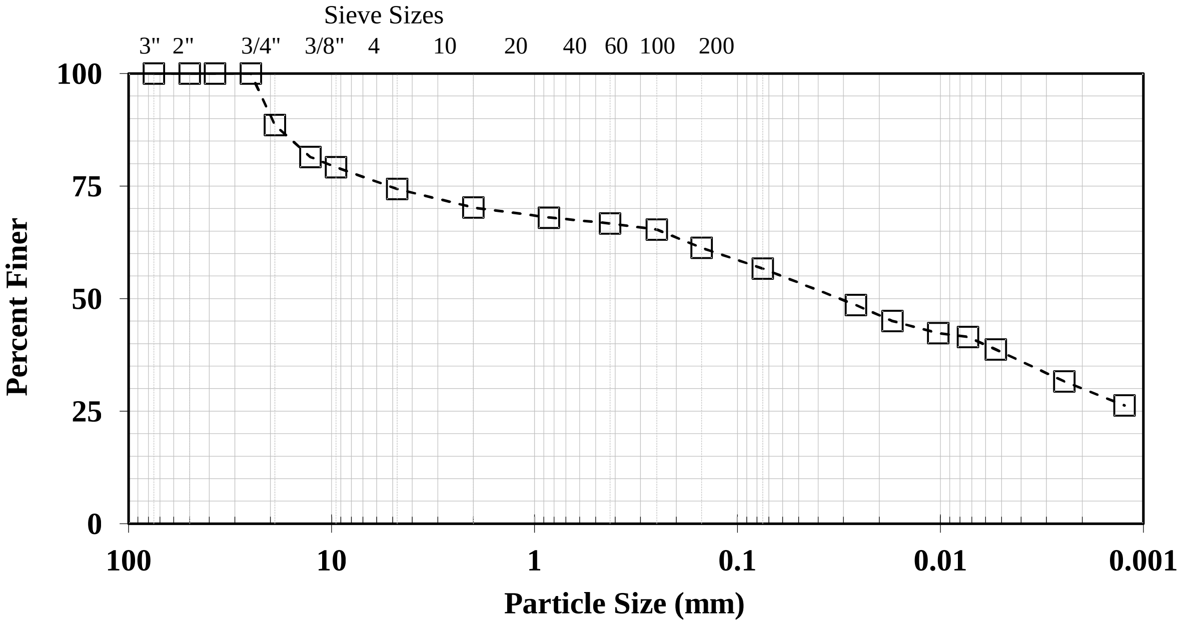
USCS Classification (ASTM D2487)	Fat Clay (CH)	
As-Received Moisture Content (%)	(ASTM D2216)	25.2
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	68
	Plastic Limit	24
	Plastic Index	44
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	2.79
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-46

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-203 (3-4.5')	Test Date:	01/27/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	88.6
1/2 in.	81.4
3/8 in.	79.2
No. 4 (4.75 mm)	74.4
No. 10 (2.00 mm)	70.3
No. 20 (850 µm)	68.0
No. 40 (425 µm)	66.7
No. 60 (250 µm)	65.4
No. 100 (150 µm)	61.3
No. 200 (75 µm)	56.7
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	56.6
0.005 mm	38.1
0.001 mm	24.5

USCS Classification (ASTM D2487)	Sandy Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	11.2
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	43
	Plastic Limit	17
	Plastic Index	26
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

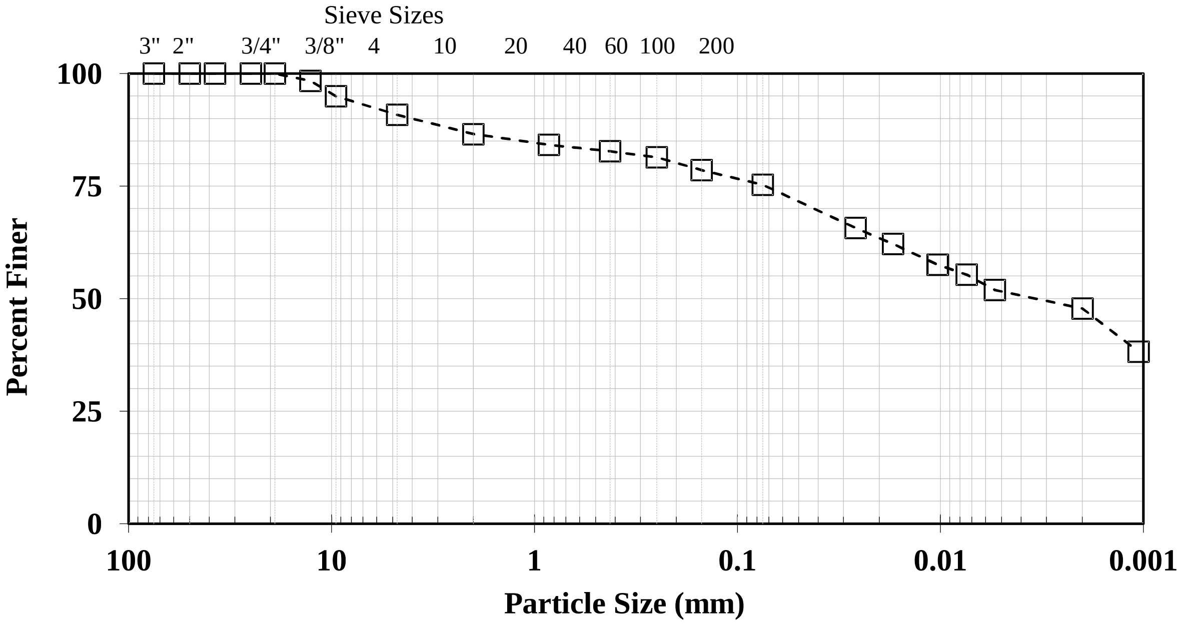
Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-47

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-203 4.5-6'	Test Date:	01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	98.4
3/8 in.	95.0
No. 4 (4.75 mm)	90.8
No. 10 (2.00 mm)	86.5
No. 20 (850 µm)	84.2
No. 40 (425 µm)	82.7
No. 60 (250 µm)	81.4
No. 100 (150 µm)	78.5
No. 200 (75 µm)	75.3
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	75.2
0.005 mm	51.2
0.001 mm	37.4

USCS Classification (ASTM D2487)	Lean Clay with Sand (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	12.6
Atterberg Limits (ASTM D 4318, Method B : Single-Point*)	Liquid Limit (3 pt)	42
	Plastic Limit	17
	Plastic Index	25
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	2.78
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

*Limited sample quantity for multi-point liquid limit testing.

Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014

Quality Review/Date

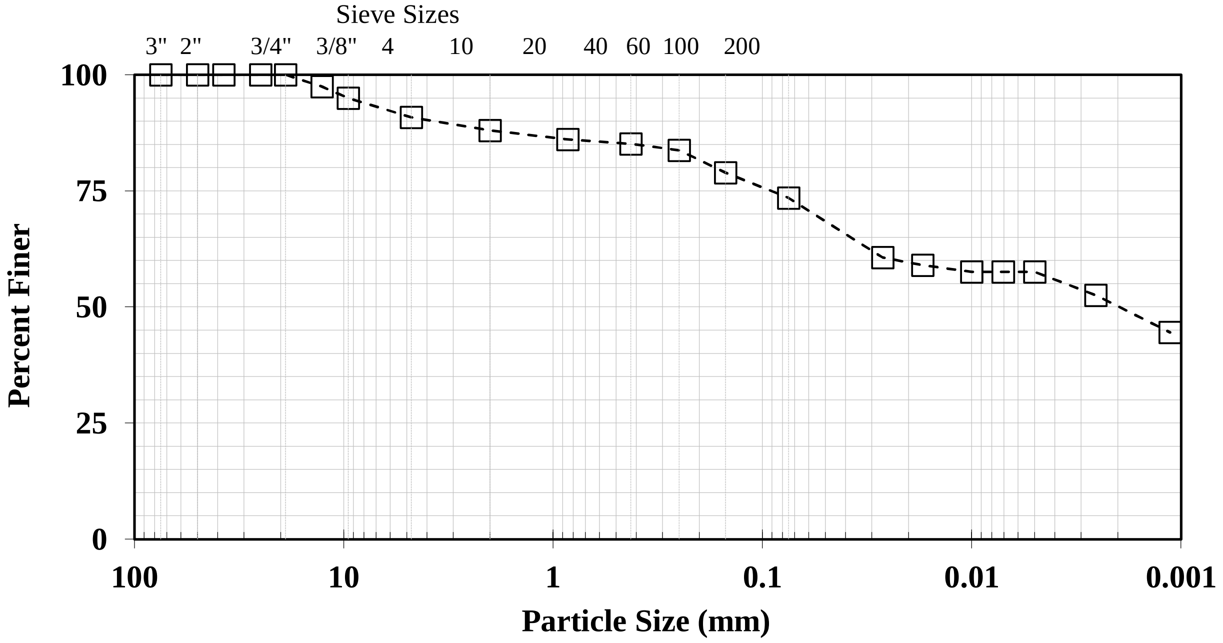
Tested by: Kahlil Hart

IIIM-C-48

Particle Size Analysis for Soils

Client: Geosyntec Comsultants, Inc.
Project: Ft.Worth C&D
Sample: B-203 7-9'

TRI Log#: E2377-59-05
Test Method: D422
Test Date: 12/11/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	97.4
3/8 in.	95.0
No. 4 (4.75 mm)	90.8
No. 10 (2.00 mm)	88.0
No. 20 (850 µm)	86.1
No. 40 (425 µm)	85.1
No. 60 (250 µm)	83.7
No. 100 (150 µm)	78.9
No. 200 (75 µm)	73.5
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	73.3
0.005 mm	57.5
0.001 mm	43.3

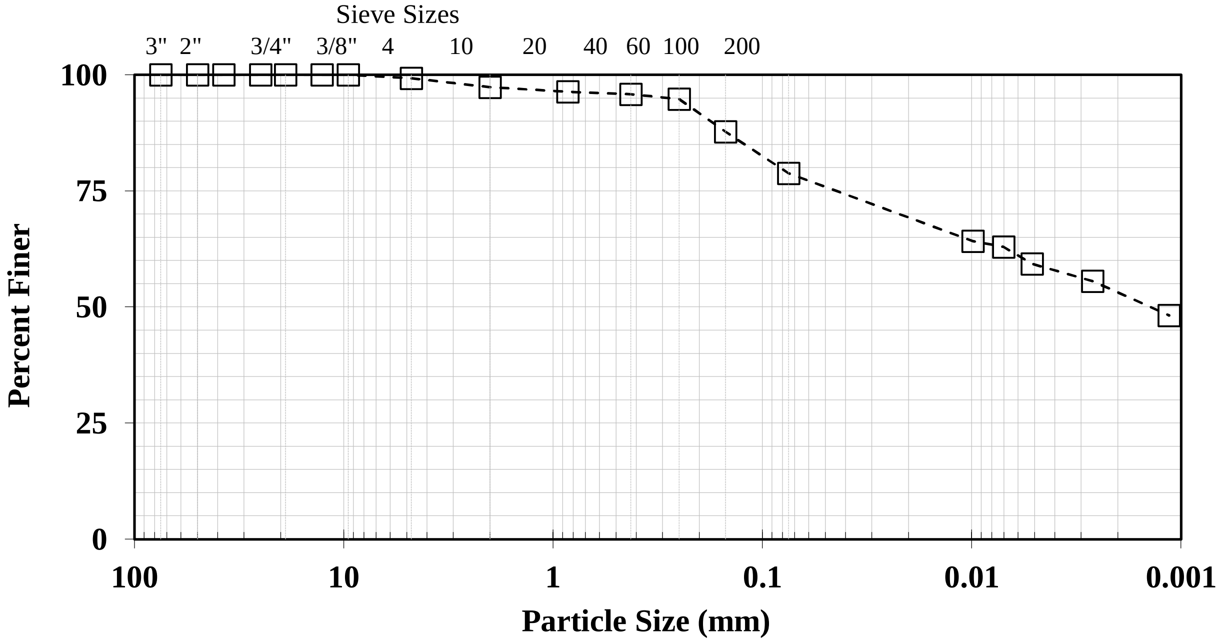
USCS Classification (ASTM D2487)	Lean Clay with Sand (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	14.3
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	44
	Plastic Limit	16
	Plastic Index	28
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/28/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-49

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#: E2377-59-05
Project:	Ft. Worth C&D	Test Method: D422
Sample:	B-203 13-15'	Test Date: 02/11/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.2
No. 10 (2.00 mm)	97.3
No. 20 (850 µm)	96.3
No. 40 (425 µm)	95.8
No. 60 (250 µm)	94.8
No. 100 (150 µm)	87.7
No. 200 (75 µm)	78.8
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	78.7
0.005 mm	58.9
0.001 mm	47.0

USCS Classification (ASTM D2487)	Fat Clay with Sand (CH)	
As-Received Moisture Content (%)	(ASTM D2216)	19.3
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	52
	Plastic Limit	18
	Plastic Index	34
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014
Quality Review/Date
Tested by: Kahlil Hart

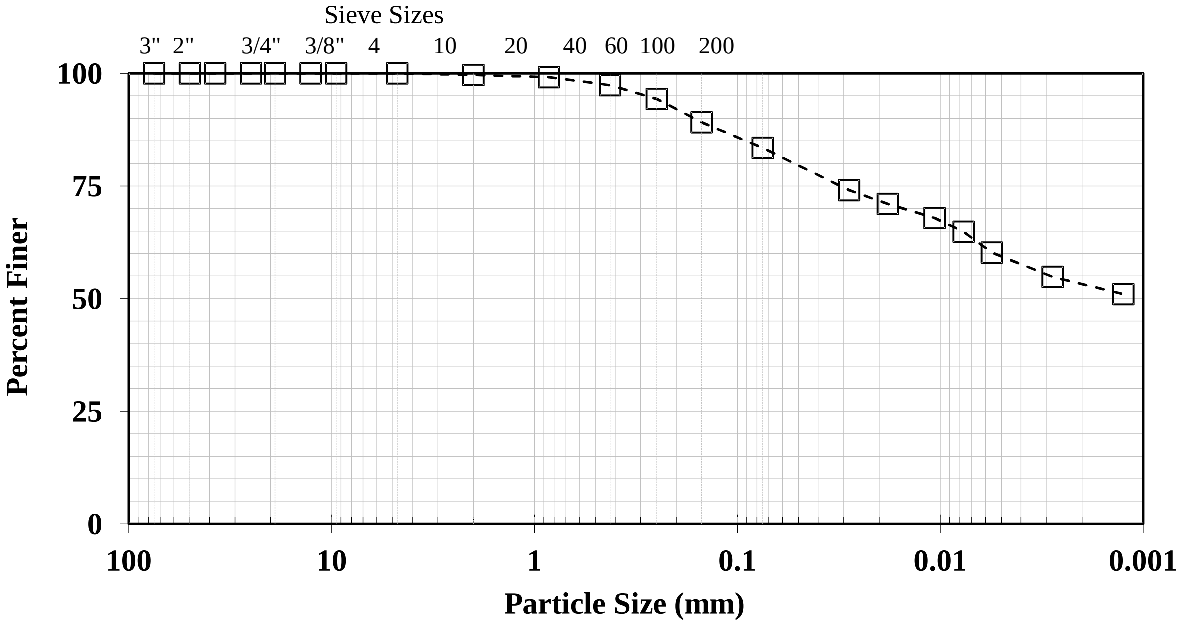
IIIM-C-50

TRI/ENVIRONMENTAL, INC.

A Texas Research International Company

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-203 15-16.5'	Test Date:	01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.00 mm)	99.6
No. 20 (850 μm)	99.1
No. 40 (425 μm)	97.4
No. 60 (250 μm)	94.3
No. 100 (150 μm)	89.1
No. 200 (75 μm)	83.4
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	83.3
0.005 mm	58.6
0.001 mm	49.9

USCS Classification (ASTM D2487)	Fat Clay with Sand (CH)	
As-Received Moisture Content (%)	(ASTM D2216)	24.8
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	66
	Plastic Limit	22
	Plastic Index	44
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	2.77
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014

Quality Review/Date

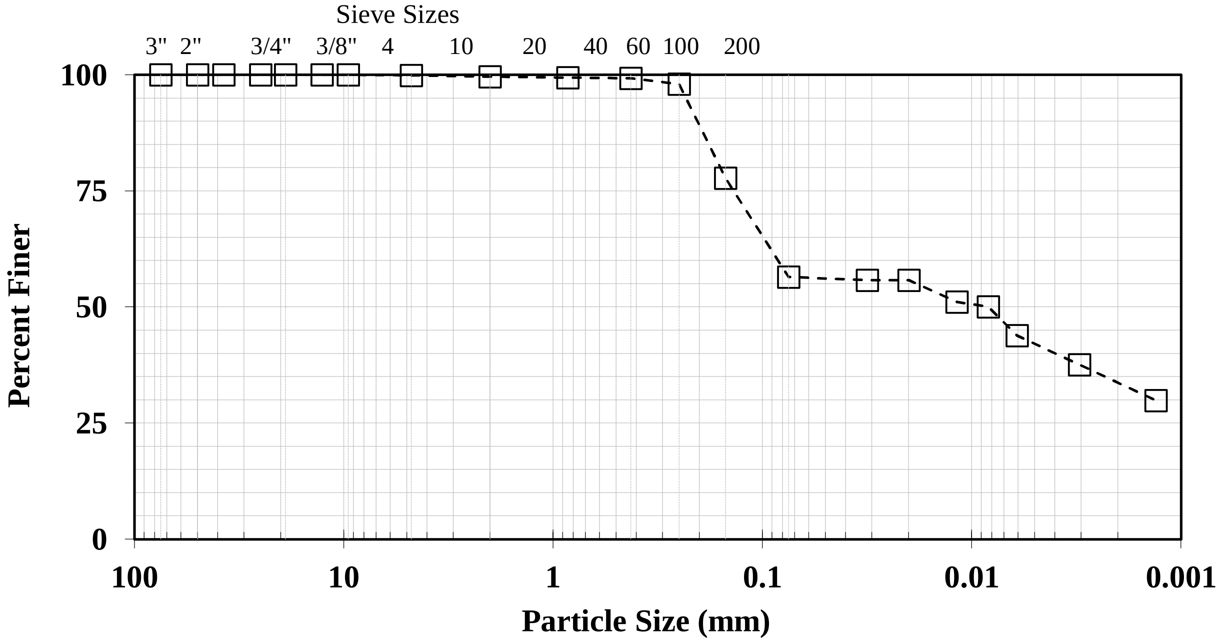
Tested by: Kahlil Hart

IIIM-C-51

Particle Size Analysis for Soils

Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Sample: B-203 17-19'

TRI Log#: E2377-59-05
Test Method: D422
Test Date: 02/11/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.9
No. 10 (2.00 mm)	99.6
No. 20 (850 µm)	99.4
No. 40 (425 µm)	99.2
No. 60 (250 µm)	98.0
No. 100 (150 µm)	77.7
No. 200 (75 µm)	56.4
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	56.4
0.005 mm	40.0
0.001 mm	27.3

USCS Classification (ASTM D2487)	Sandy Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	11.6
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	38
	Plastic Limit	13
	Plastic Index	25
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

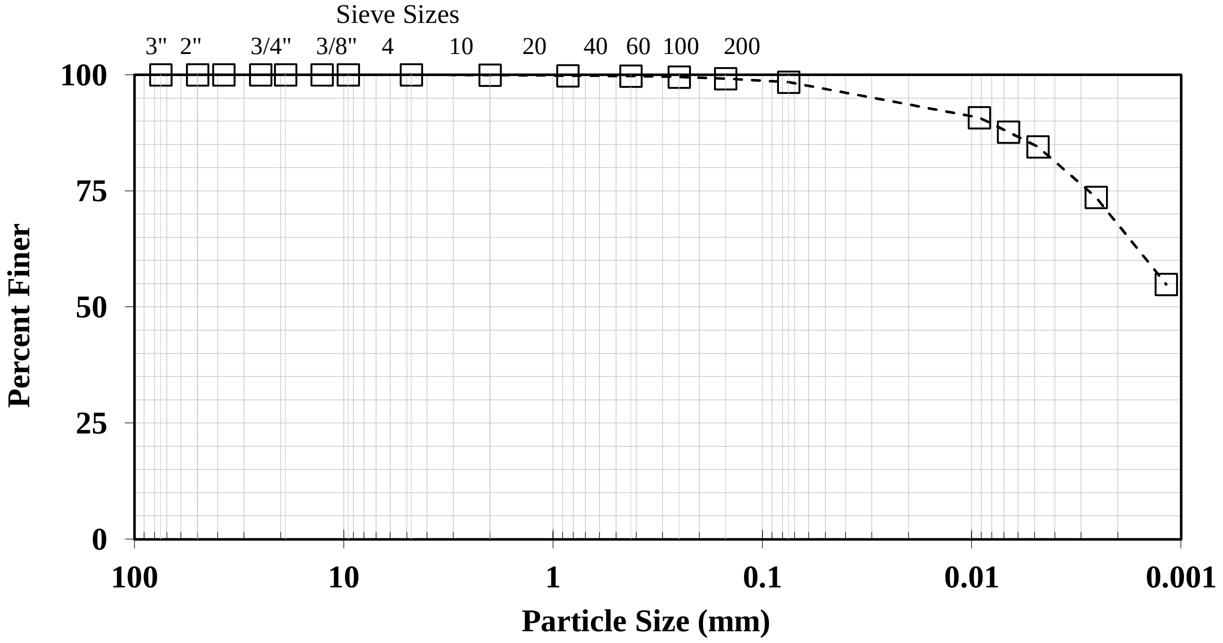
Jeffrey A. Kuhn, Ph.D., P.E., 2/18/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-52

Particle Size Analysis for Soils

Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Sample: B-203 23-23.9'

TRI Log#: E2377-59-05
Test Method: D422
Test Date: 02/11/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.00 mm)	99.9
No. 20 (850 µm)	99.8
No. 40 (425 µm)	99.7
No. 60 (250 µm)	99.5
No. 100 (150 µm)	99.2
No. 200 (75 µm)	98.4
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	98.4
0.005 mm	84.9
0.001 mm	50.9

USCS Classification (ASTM D2487)	Fat Clay (CH)	
As-Received Moisture Content (%)	(ASTM D2216)	16.6
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	59
	Plastic Limit	22
	Plastic Index	37
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/18/2014
Quality Review/Date
Tested by: Kahlil Hart

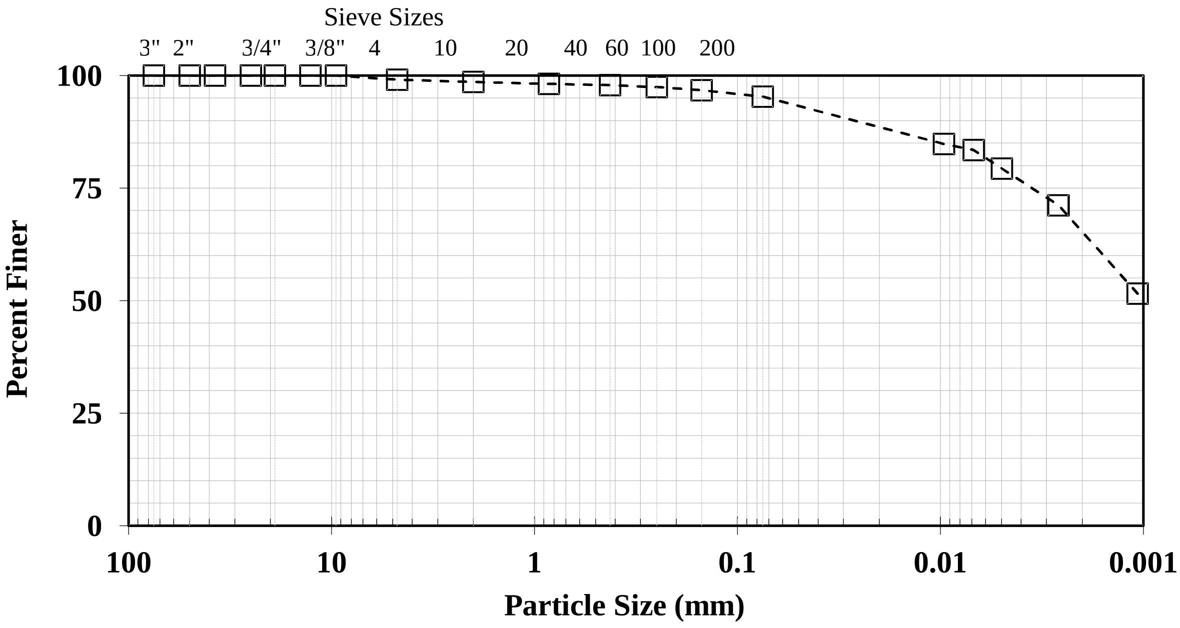
IIIM-C-53

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

Particle Size Analysis for Soils

Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Sample: B-203 23.9-24.8'

TRI Log#: E2377-59-05
Test Method: D422
Test Date: 01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.1
No. 10 (2.00 mm)	98.6
No. 20 (850 µm)	98.2
No. 40 (425 µm)	97.8
No. 60 (250 µm)	97.4
No. 100 (150 µm)	96.7
No. 200 (75 µm)	95.3
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	95.3
0.005 mm	79.4
0.001 mm	50.2

USCS Classification (ASTM D2487)	Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	13.4
Atterberg Limits (ASTM D 4318, Method B : Single-Point*)	Liquid Limit (3 pt)	47
	Plastic Limit	19
	Plastic Index	28
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

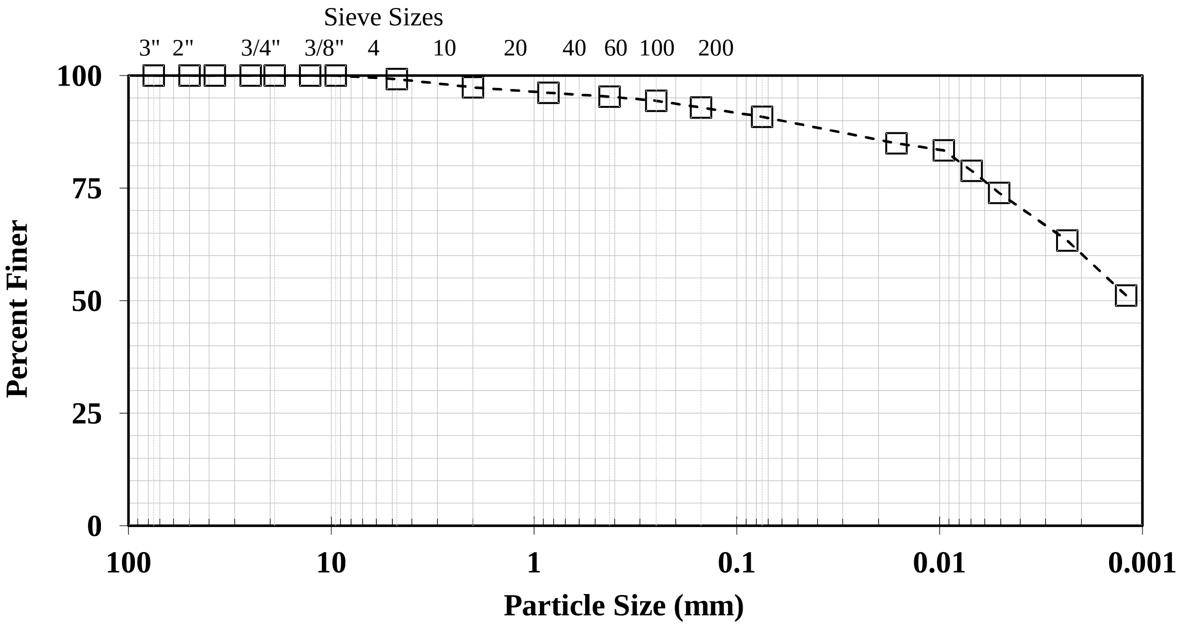
*Limited sample quantity for multi-point liquid limit testing.

Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-54

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-204 (4-6')	Test Date:	01/27/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.2
No. 10 (2.00 mm)	97.4
No. 20 (850 μm)	96.2
No. 40 (425 μm)	95.3
No. 60 (250 μm)	94.4
No. 100 (150 μm)	92.9
No. 200 (75 μm)	90.8
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	90.8
0.005 mm	73.7
0.001 mm	47.8

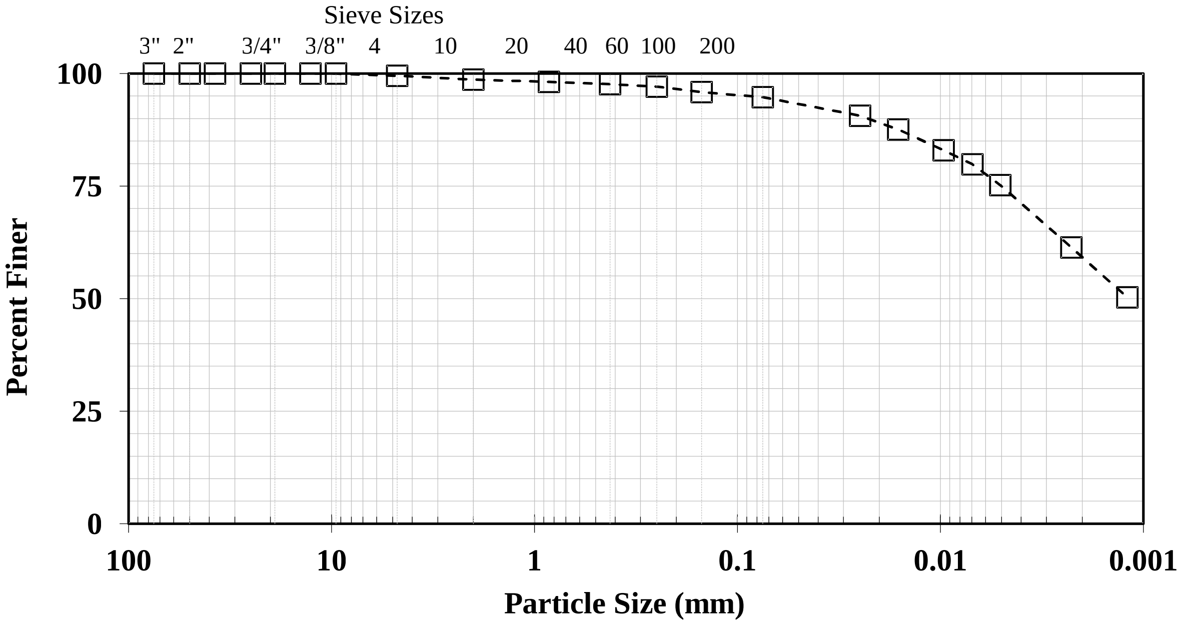
USCS Classification (ASTM D2487)	Fat Clay (CH)	
As-Received Moisture Content (%)	(ASTM D2216)	14.8
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	50
	Plastic Limit	19
	Plastic Index	31
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-55

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-204 (9-11')	Test Date:	01/27/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.5
No. 10 (2.00 mm)	98.7
No. 20 (850 µm)	98.1
No. 40 (425 µm)	97.7
No. 60 (250 µm)	97.1
No. 100 (150 µm)	95.9
No. 200 (75 µm)	94.7
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	94.7
0.005 mm	75.0
0.001 mm	47.1

USCS Classification (ASTM D2487)	Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	13.7
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	38
	Plastic Limit	17
	Plastic Index	21
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014

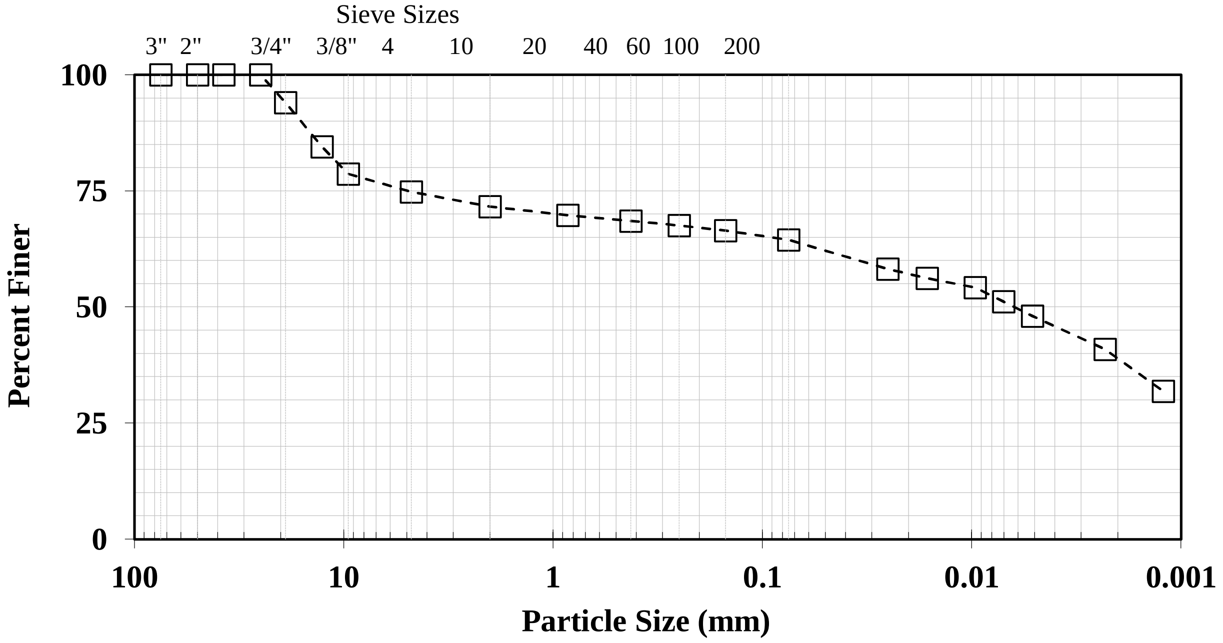
Quality Review/Date

Tested by: Kahlil Hart

Particle Size Analysis for Soils

Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Sample: B-204 12.5-13.75'

TRI Log#: E2377-59-05
Test Method: D422
Test Date: 02/18/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	94.0
1/2 in.	84.5
3/8 in.	78.7
No. 4 (4.75 mm)	74.8
No. 10 (2.00 mm)	71.6
No. 20 (850 μm)	69.8
No. 40 (425 μm)	68.5
No. 60 (250 μm)	67.5
No. 100 (150 μm)	66.4
No. 200 (75 μm)	64.4
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	64.3
0.005 mm	47.8
0.001 mm	29.1

USCS Classification (ASTM D2487)	Sandy Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	10.8
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	34
	Plastic Limit	15
	Plastic Index	19
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/28/2014

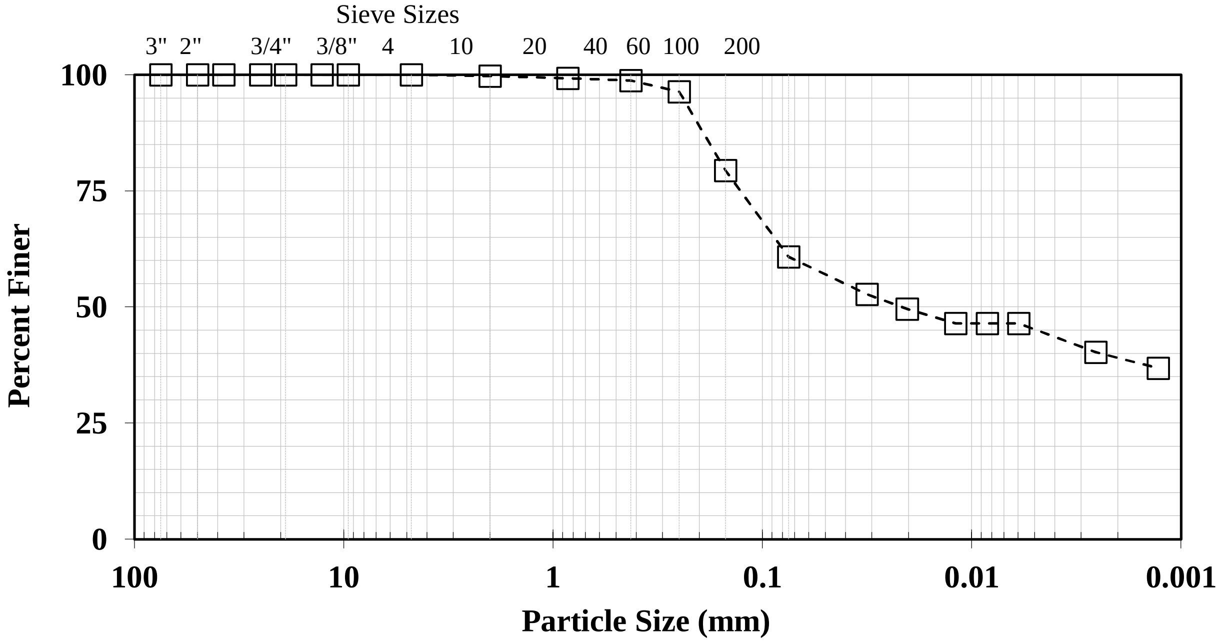
Quality Review/Date

Tested by: Kahlil Hart

IIIM-C-57

Particle Size Analysis for Soils

Client:	Geosyntec Comsultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft.Worth C&D	Test Method:	D422
Sample:	B-204 15.5-17.5'	Test Date:	01/00/00



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.00 mm)	99.7
No. 20 (850 µm)	99.3
No. 40 (425 µm)	98.8
No. 60 (250 µm)	96.3
No. 100 (150 µm)	79.4
No. 200 (75 µm)	60.8
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	60.6
0.005 mm	46.5
0.001 mm	35.6

USCS Classification (ASTM D2487)	Sandy Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	14.9
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	34
	Plastic Limit	14
	Plastic Index	20
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014

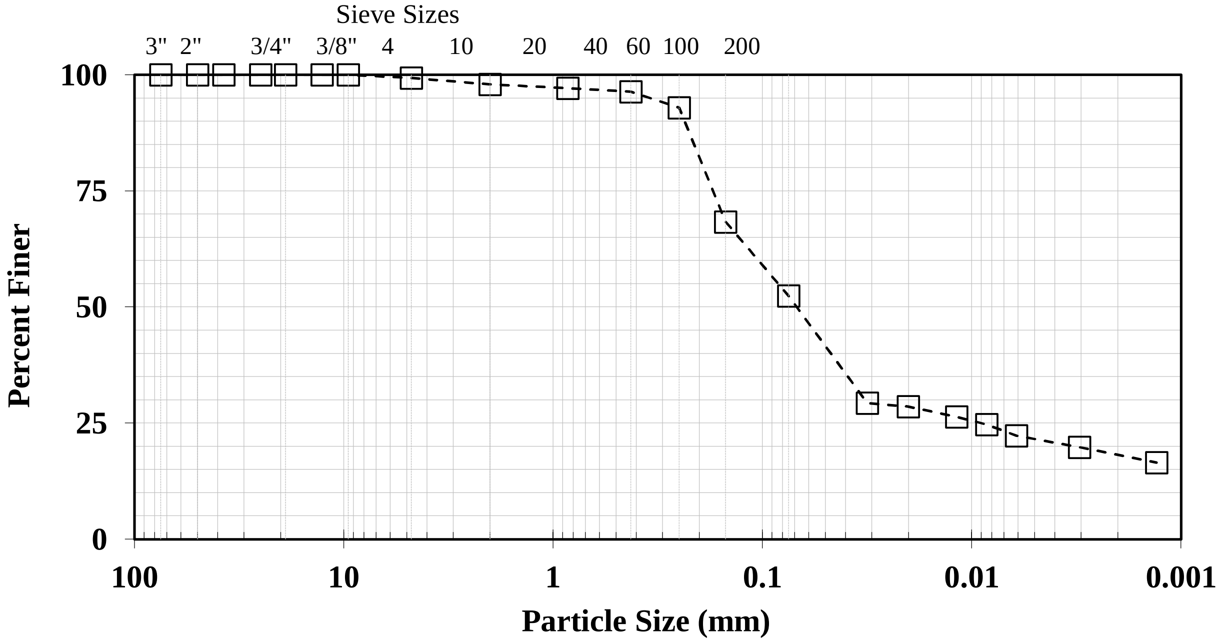
Quality Review/Date

Tested by: Kahlil Hart

IIIM-C-58

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-204 19-21'	Test Date:	02/11/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.3
No. 10 (2.00 mm)	98.0
No. 20 (850 μm)	97.1
No. 40 (425 μm)	96.3
No. 60 (250 μm)	92.9
No. 100 (150 μm)	68.3
No. 200 (75 μm)	52.4
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	52.0
0.005 mm	20.7
0.001 mm	15.5

USCS Classification (ASTM D2487)	Sandy Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	12.7
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	33
	Plastic Limit	12
	Plastic Index	21
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/18/2014

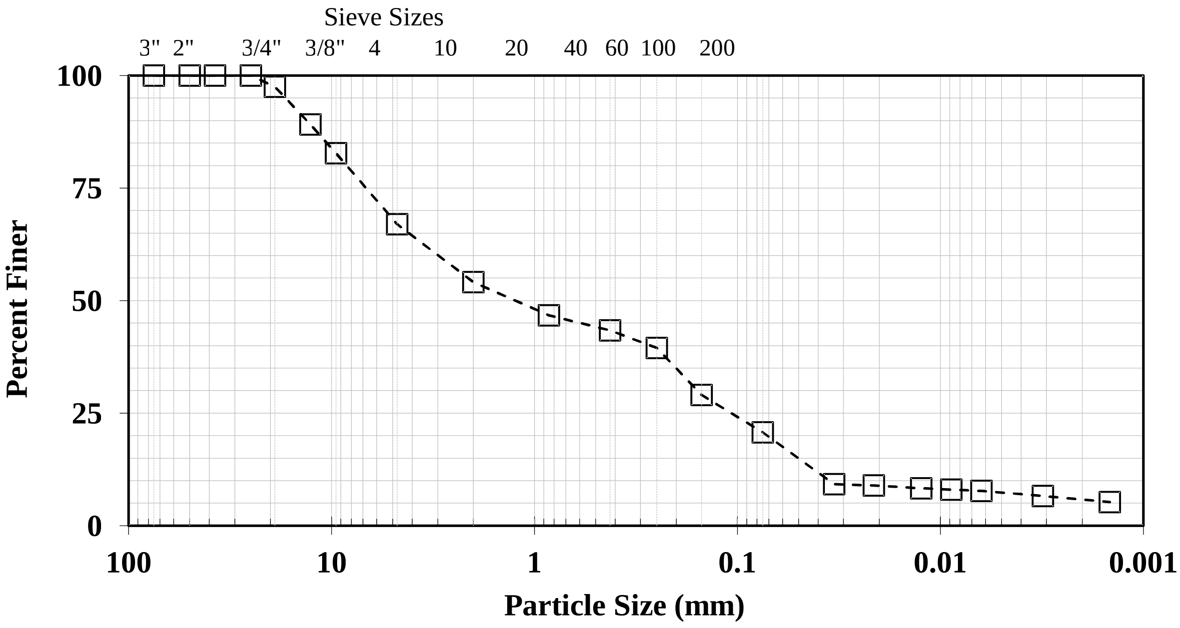
Quality Review/Date

Tested by: Kahlil Hart

IIIM-C-59

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-204 24.3-25.8'	Test Date:	01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	97.5
1/2 in.	89.2
3/8 in.	82.8
No. 4 (4.75 mm)	67.0
No. 10 (2.00 mm)	54.1
No. 20 (850 µm)	46.7
No. 40 (425 µm)	43.4
No. 60 (250 µm)	39.5
No. 100 (150 µm)	29.0
No. 200 (75 µm)	20.7
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	20.5
0.005 mm	7.6
0.001 mm	4.5

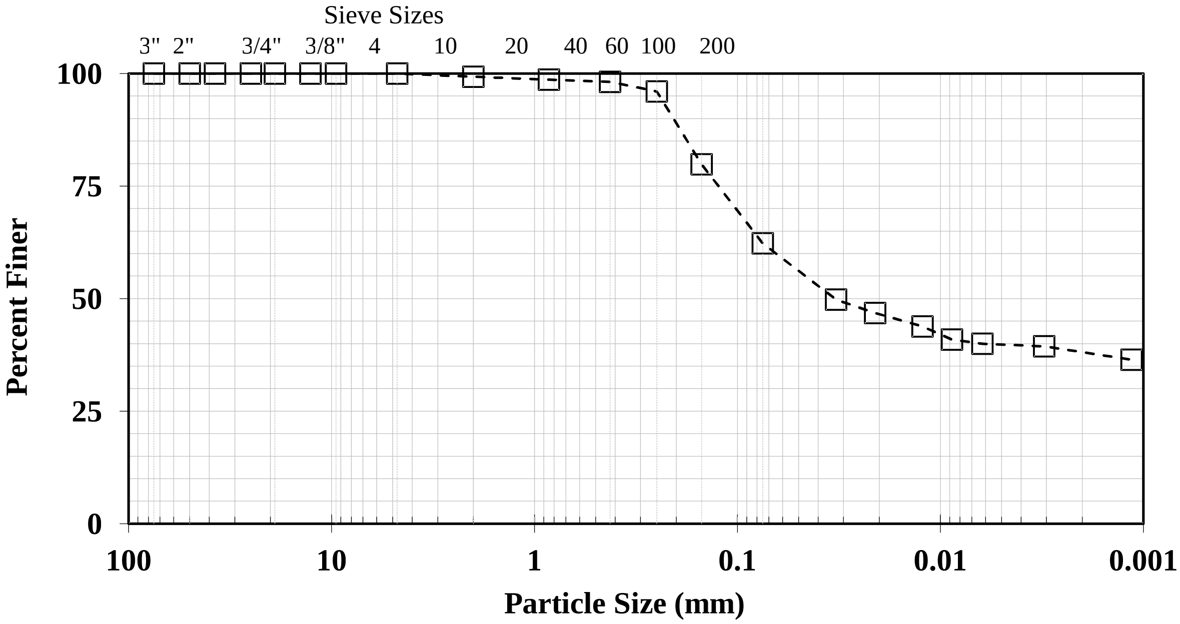
USCS Classification (ASTM D2487)	Silty Sand with Gravel (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	12.4
Atterberg Limits (ASTM D 4318, Method B : Single-Point*)	Liquid Limit (3 pt)	23
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

*Limited sample quantity for multi-point liquid limit testing.

Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2014
Quality Review/Date
Tested by: Kahlil Hart

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-205 8.5-10'	Test Date:	01/20/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.00 mm)	99.3
No. 20 (850 µm)	98.7
No. 40 (425 µm)	98.2
No. 60 (250 µm)	96.0
No. 100 (150 µm)	79.9
No. 200 (75 µm)	62.3
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	62.1
0.005 mm	39.4
0.001 mm	36.0

USCS Classification (ASTM D2487)	Sandy Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	17.1
Atterberg Limits (ASTM D 4318, Method B : Single-Point*)	Liquid Limit (3 pt)	31
	Plastic Limit	13
	Plastic Index	18
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

*Limited sample quantity for multi-point liquid limit testing.

Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2014

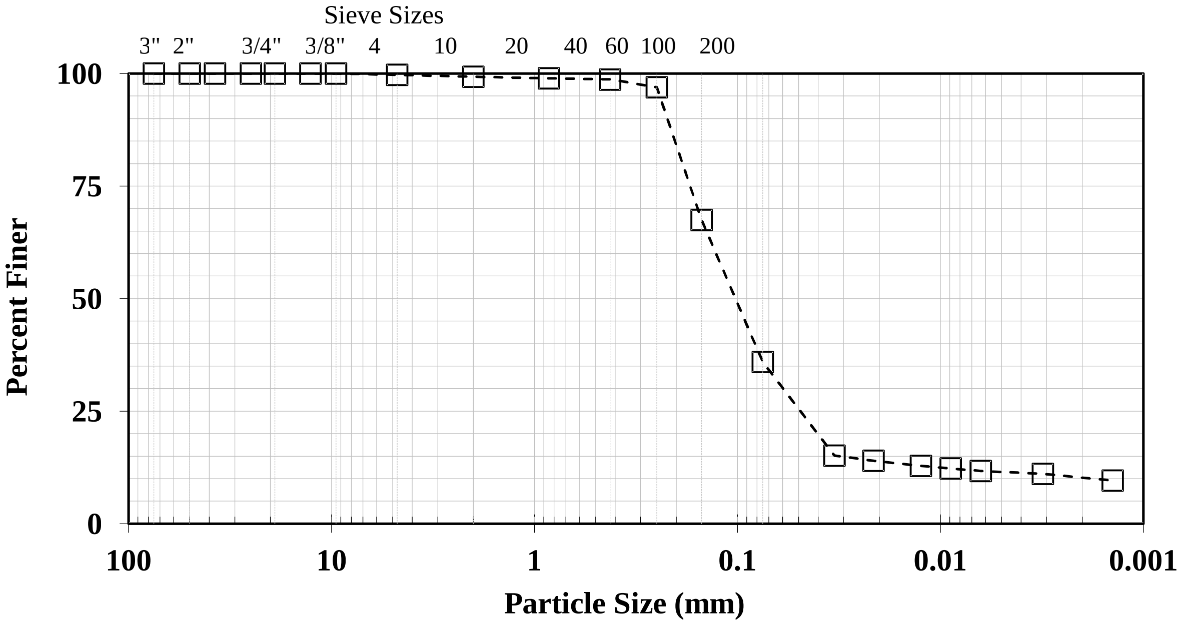
Quality Review/Date

Tested by: Kahlil Hart

IIIM-C-61

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-205 19-20.5'	Test Date:	01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.7
No. 10 (2.00 mm)	99.3
No. 20 (850 µm)	99.0
No. 40 (425 µm)	98.7
No. 60 (250 µm)	96.9
No. 100 (150 µm)	67.5
No. 200 (75 µm)	35.9
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	35.6
0.005 mm	11.3
0.001 mm	9.0

USCS Classification (ASTM D2487)	Silty Sand (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	14.1
Atterberg Limits (ASTM D 4318, Method B : Single-Point*)	Liquid Limit (3 pt)	23
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	2.74
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

*Limited sample quantity for multi-point liquid limit testing.

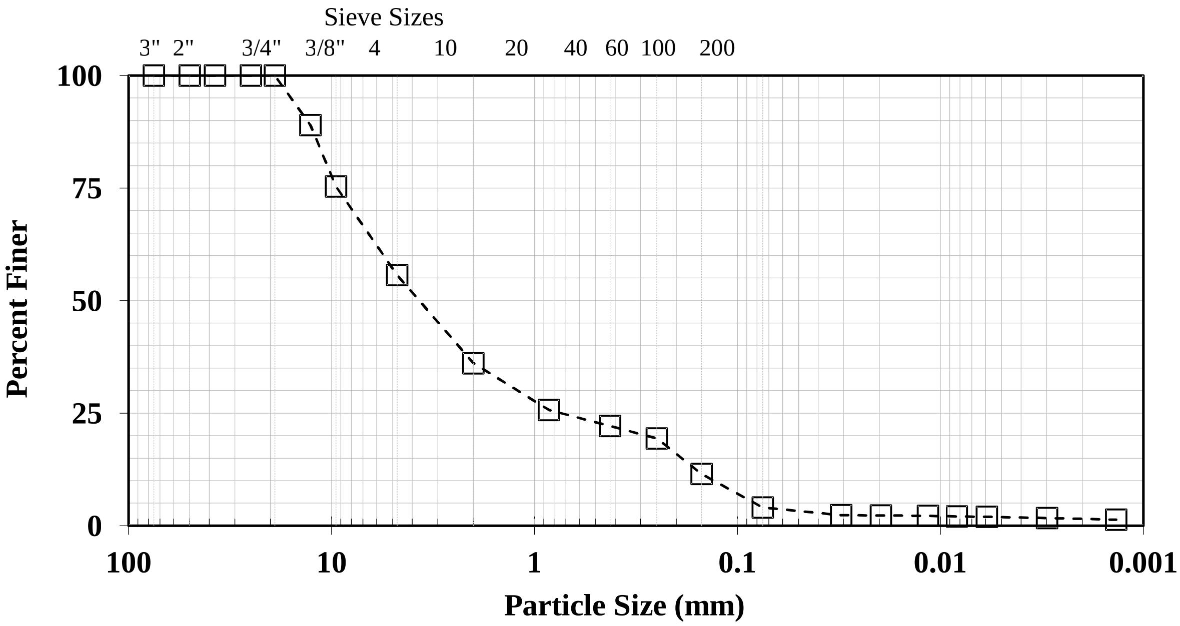
Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-62

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-205 29-30.5'	Test Date:	01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	89.0
3/8 in.	75.4
No. 4 (4.75 mm)	55.7
No. 10 (2.00 mm)	36.1
No. 20 (850 µm)	25.7
No. 40 (425 µm)	22.1
No. 60 (250 µm)	19.4
No. 100 (150 µm)	11.5
No. 200 (75 µm)	4.1
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	4.0
0.005 mm	1.9
0.001 mm	1.2

USCS Classification (ASTM D2487)	Silty Sand with Gravel (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	20.4
Atterberg Limits (ASTM D 4318, Method B : Single-Point*)	Liquid Limit (3 pt)	23
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

*Limited sample quantity for multi-point liquid limit testing.

Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-63

TRI/ENVIRONMENTAL, INC.

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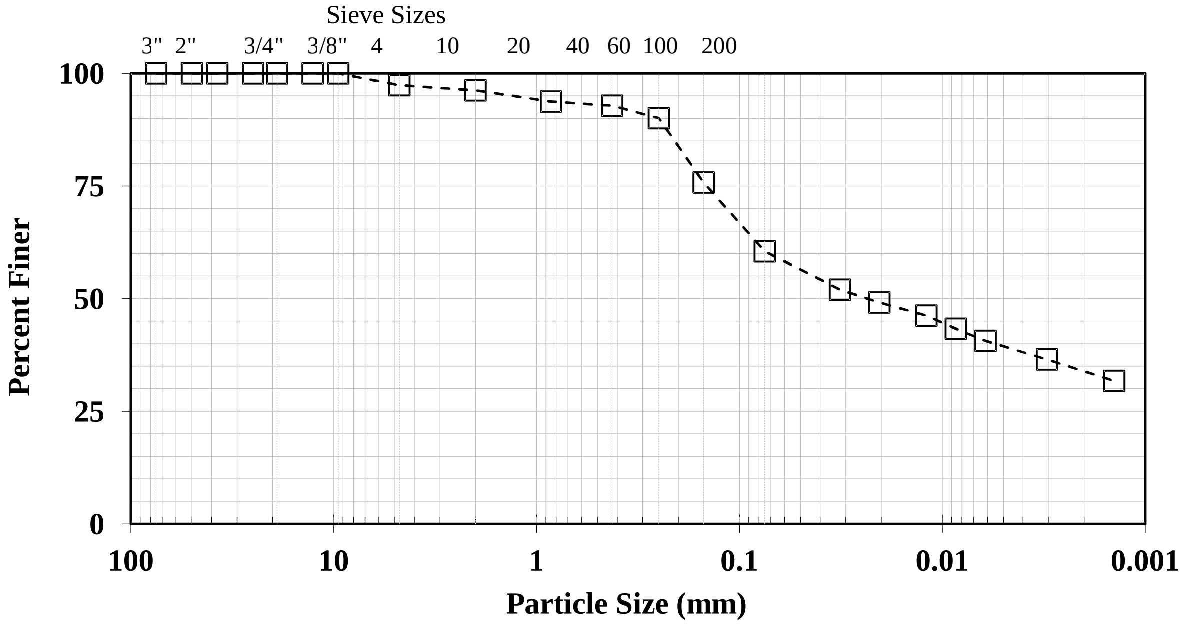
Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-206 8-9.5'	Test Date:	01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	97.4
No. 10 (2.00 mm)	96.2
No. 20 (850 µm)	93.7
No. 40 (425 µm)	92.8
No. 60 (250 µm)	90.0
No. 100 (150 µm)	75.8
No. 200 (75 µm)	60.5
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	60.4
0.005 mm	39.0
0.001 mm	29.5

USCS Classification (ASTM D2487)	Sandy Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	23.2
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	41
	Plastic Limit	17
	Plastic Index	24
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2014

Quality Review/Date

Tested by: Kahlil Hart

TRI/ENVIRONMENTAL, INC.
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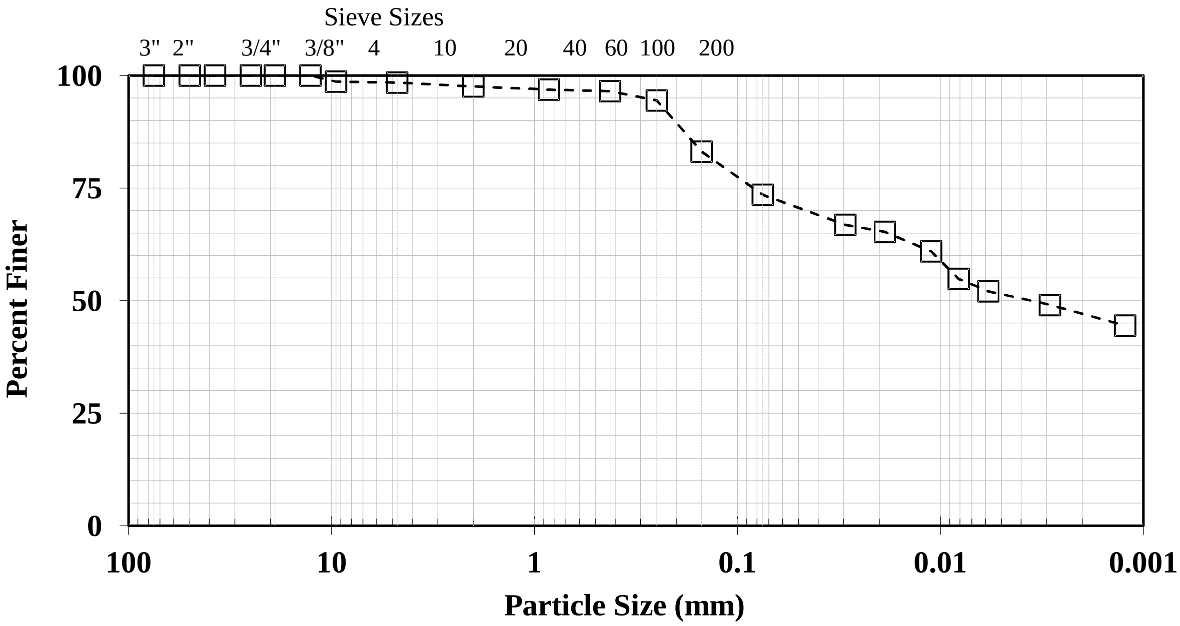
Particle Size Analysis for Soils

Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Sample: B-206 (10-12')

TRI Log#: E2377-59-05
Test Method: D422
Test Date: 01/27/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	98.6
No. 4 (4.75 mm)	98.4
No. 10 (2.00 mm)	97.6
No. 20 (850 µm)	96.9
No. 40 (425 µm)	96.5
No. 60 (250 µm)	94.5
No. 100 (150 µm)	83.1
No. 200 (75 µm)	73.5
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	73.4
0.005 mm	50.9
0.001 mm	43.3

USCS Classification (ASTM D2487)	Lean Clay with Sand (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	23.1
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	44
	Plastic Limit	17
	Plastic Index	27
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

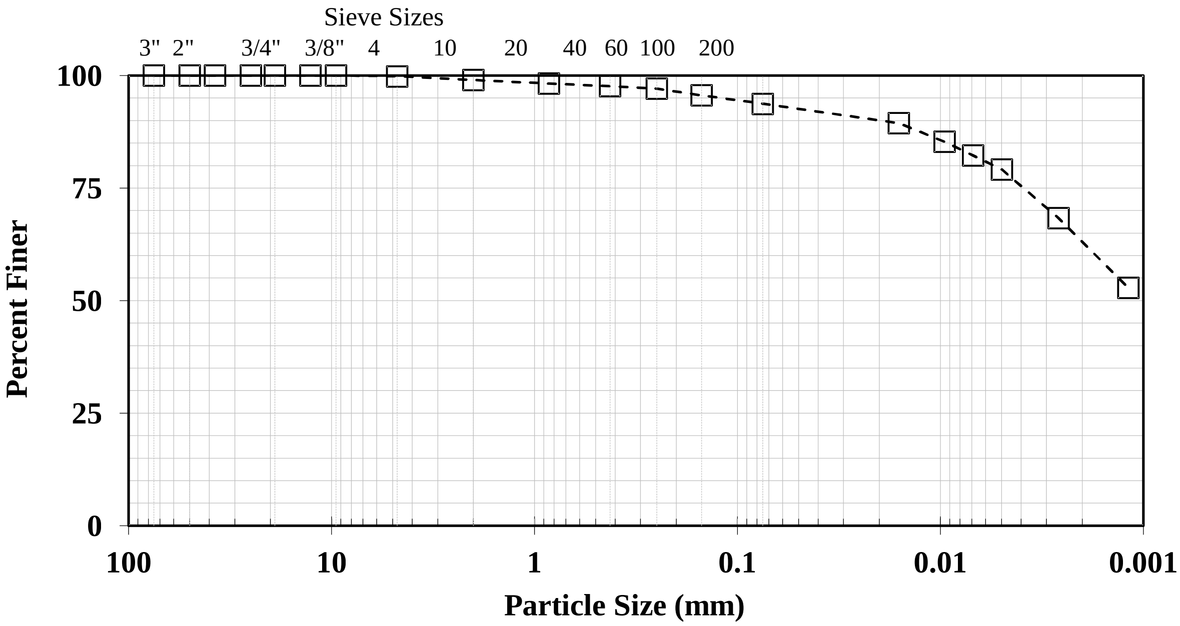
Jeffrey A. Kuhn, Ph.D., P.E., 2/18/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-65

Particle Size Analysis for Soils

Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Sample: B-206 20-21.5'

TRI Log#: E2377-59-05
Test Method: D422
Test Date: 01/27/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.8
No. 10 (2.00 mm)	99.0
No. 20 (850 µm)	98.2
No. 40 (425 µm)	97.7
No. 60 (250 µm)	97.1
No. 100 (150 µm)	95.6
No. 200 (75 µm)	93.7
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	93.7
0.005 mm	79.2
0.001 mm	49.5

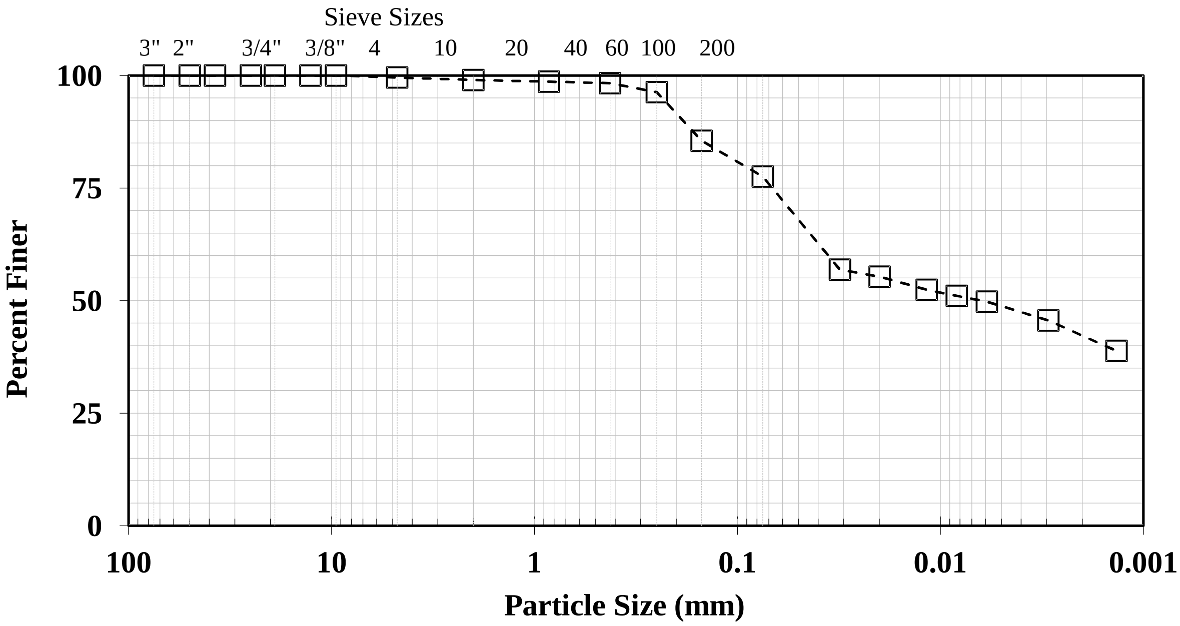
USCS Classification (ASTM D2487)	Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	19.1
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	44
	Plastic Limit	17
	Plastic Index	27
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/18/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-66

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-206 25-26.5'	Test Date:	01/15/14



Sieve Analysis	
Sieve Size	**Percent Passing**
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.6
No. 10 (2.00 mm)	99.0
No. 20 (850 µm)	98.6
No. 40 (425 µm)	98.3
No. 60 (250 µm)	96.3
No. 100 (150 µm)	85.5
No. 200 (75 µm)	77.6
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	77.3
0.005 mm	49.1
0.001 mm	36.2

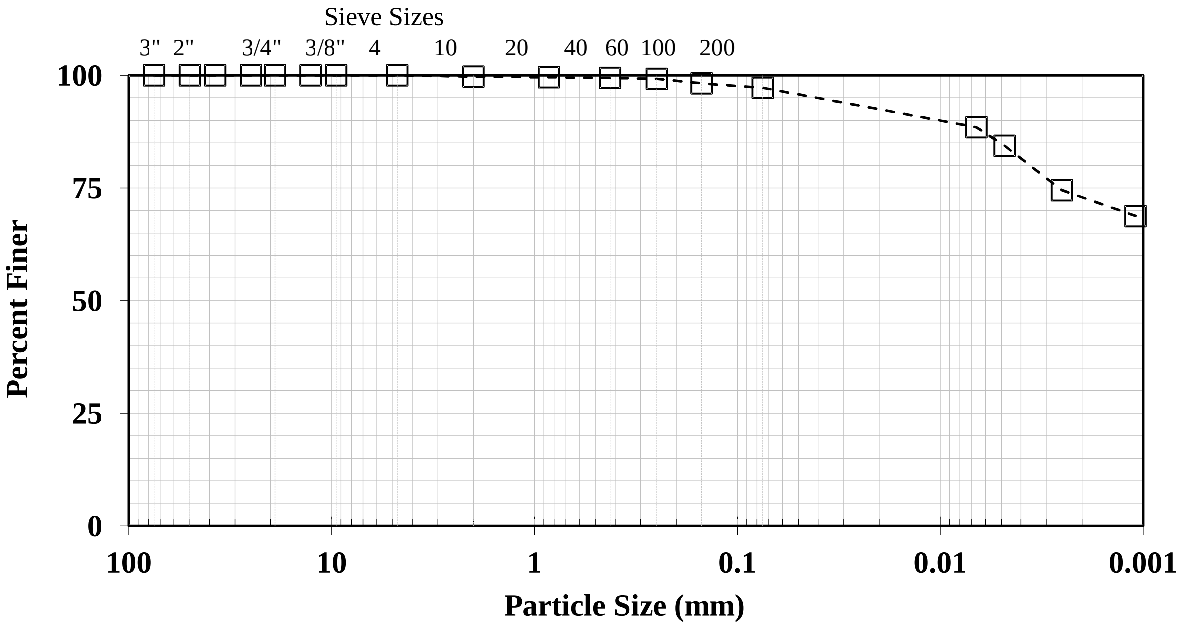
USCS Classification (ASTM D2487)	Lean Clay with Sand (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	22.7
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	39
	Plastic Limit	14
	Plastic Index	25
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	2.79
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-67

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-206 28-30'	Test Date:	02/11/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.00 mm)	99.7
No. 20 (850 µm)	99.6
No. 40 (425 µm)	99.5
No. 60 (250 µm)	99.2
No. 100 (150 µm)	98.3
No. 200 (75 µm)	97.3
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	97.2
0.005 mm	84.8
0.001 mm	68.2

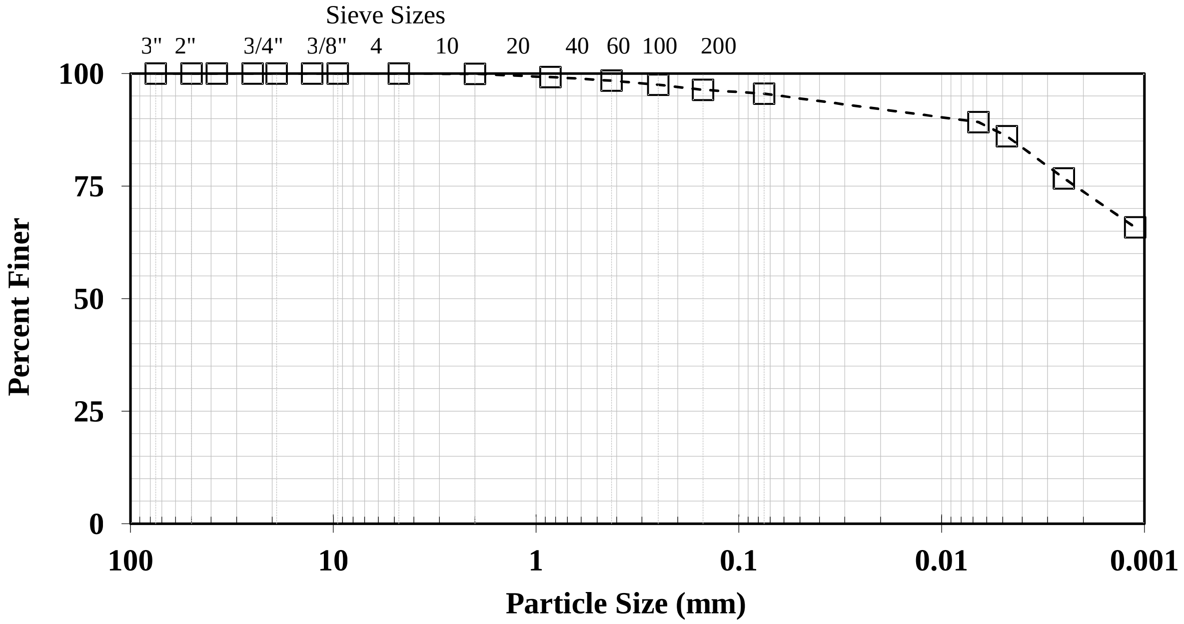
USCS Classification (ASTM D2487)	Fat Clay (CH)	
As-Received Moisture Content (%)	(ASTM D2216)	20.8
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	66
	Plastic Limit	23
	Plastic Index	43
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/18/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-68

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-206 33-35'	Test Date:	02/11/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.00 mm)	99.9
No. 20 (850 μm)	99.2
No. 40 (425 μm)	98.4
No. 60 (250 μm)	97.5
No. 100 (150 μm)	96.4
No. 200 (75 μm)	95.5
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	95.5
0.005 mm	86.6
0.001 mm	64.4

USCS Classification (ASTM D2487)	Fat Clay (CH)	
As-Received Moisture Content (%)	(ASTM D2216)	26.8
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	68
	Plastic Limit	26
	Plastic Index	42
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-69

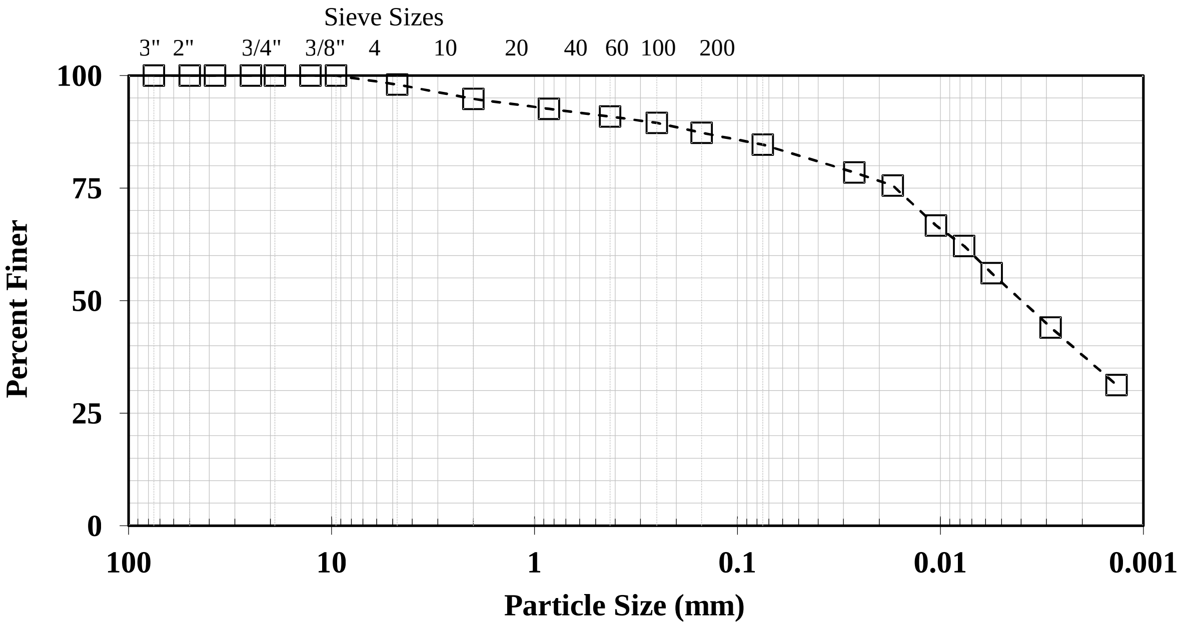
TRI/ENVIRONMENTAL, INC.

A Texas Research International Company

Particle Size Analysis for Soils

Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Sample: B-206 35-36.5'

TRI Log#: E2377-59-05
Test Method: D422
Test Date: 01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	98.0
No. 10 (2.00 mm)	94.8
No. 20 (850 µm)	92.6
No. 40 (425 µm)	90.9
No. 60 (250 µm)	89.5
No. 100 (150 µm)	87.3
No. 200 (75 µm)	84.6
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	84.6
0.005 mm	53.9
0.001 mm	26.0

USCS Classification (ASTM D2487)	Lean Clay with Sand (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	15.2
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	46
	Plastic Limit	18
	Plastic Index	28
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2014

Quality Review/Date

Tested by: Kahlil Hart

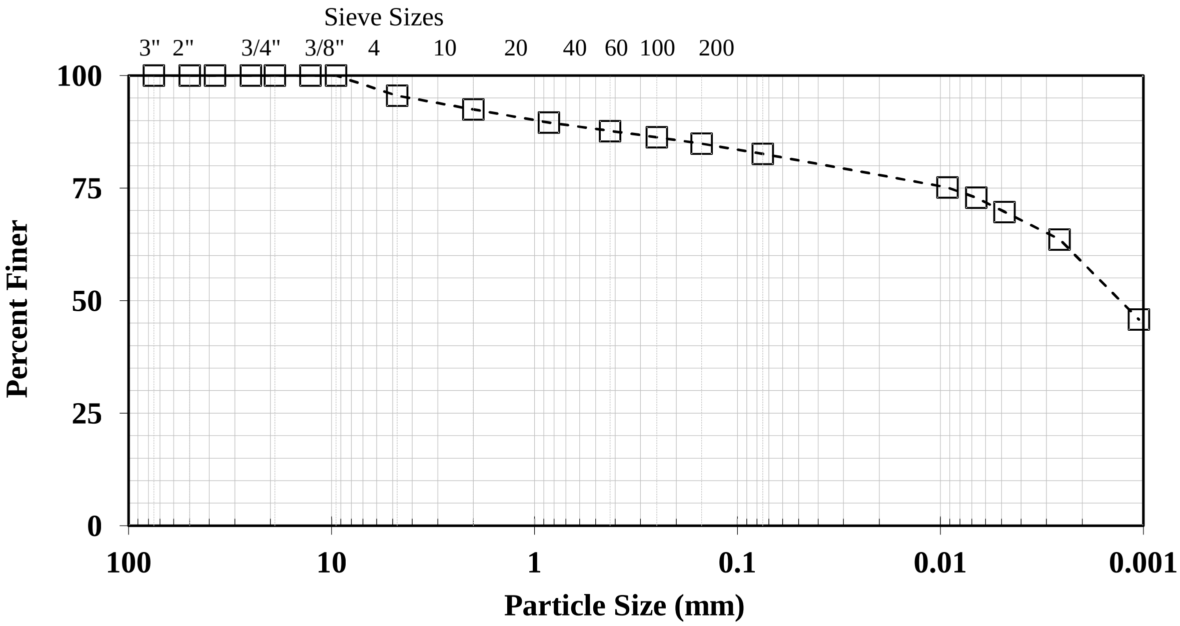
IIIM-C-70

TRI/ENVIRONMENTAL, INC.

A Texas Research International Company

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-206 38-39.5'	Test Date:	01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	95.5
No. 10 (2.00 mm)	92.5
No. 20 (850 µm)	89.6
No. 40 (425 µm)	87.7
No. 60 (250 µm)	86.3
No. 100 (150 µm)	84.9
No. 200 (75 µm)	82.6
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	82.6
0.005 mm	70.0
0.001 mm	44.8

USCS Classification (ASTM D2487)	Lean Clay with Sand (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	15.4
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	39
	Plastic Limit	16
	Plastic Index	23
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	2.80
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014

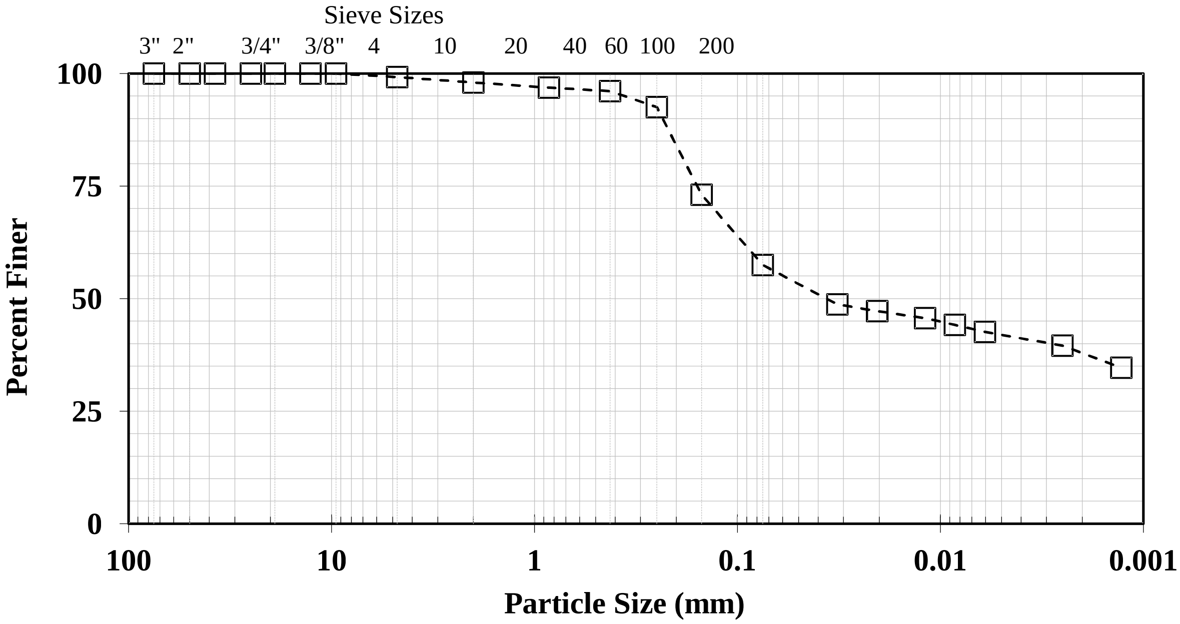
Quality Review/Date

Tested by: Kahlil Hart

IIIM-C-71

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-207 (5-6')	Test Date:	01/27/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.2
No. 10 (2.00 mm)	98.0
No. 20 (850 μm)	96.9
No. 40 (425 μm)	96.1
No. 60 (250 μm)	92.6
No. 100 (150 μm)	73.1
No. 200 (75 μm)	57.5
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	57.3
0.005 mm	41.7
0.001 mm	32.8

USCS Classification (ASTM D2487)	Sandy Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	13.2
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	35
	Plastic Limit	19
	Plastic Index	16
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/28/2014

Quality Review/Date

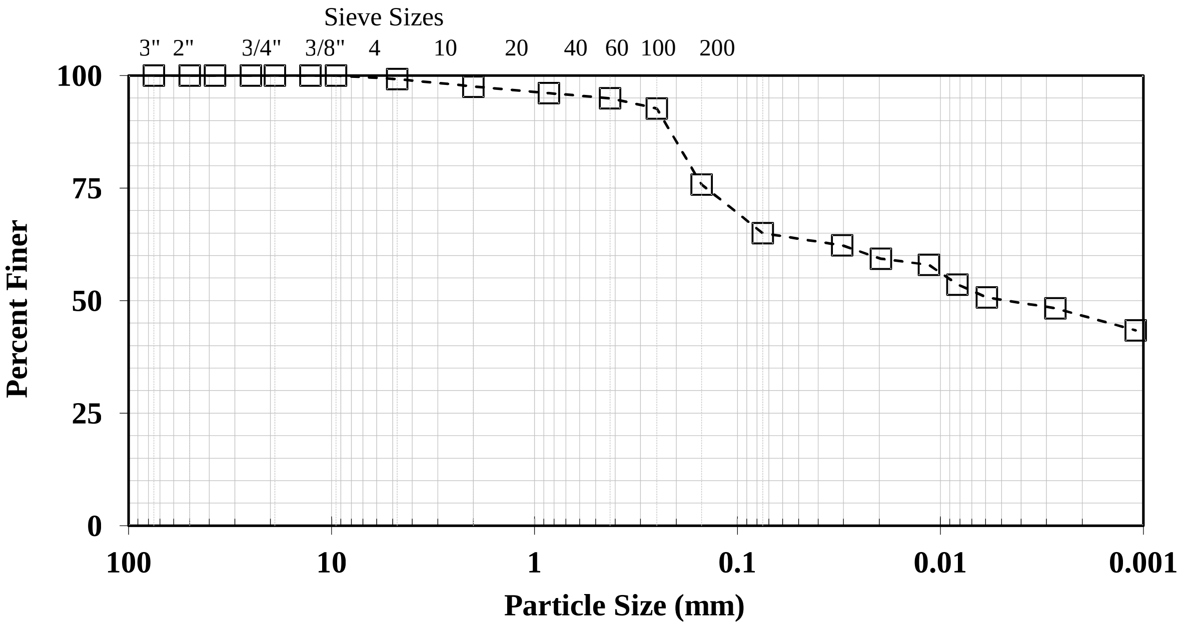
Tested by: Kahlil Hart

IIIM-C-72

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-207 6-7.5'	Test Date:	01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.2
No. 10 (2.00 mm)	97.6
No. 20 (850 µm)	96.1
No. 40 (425 µm)	95.0
No. 60 (250 µm)	92.7
No. 100 (150 µm)	75.8
No. 200 (75 µm)	65.0
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	65.0
0.005 mm	49.3
0.001 mm	42.9

USCS Classification (ASTM D2487)	Sandy Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	14.3
Atterberg Limits (ASTM D 4318, Method B : Single-Point*)	Liquid Limit (3 pt)	35
	Plastic Limit	15
	Plastic Index	20
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

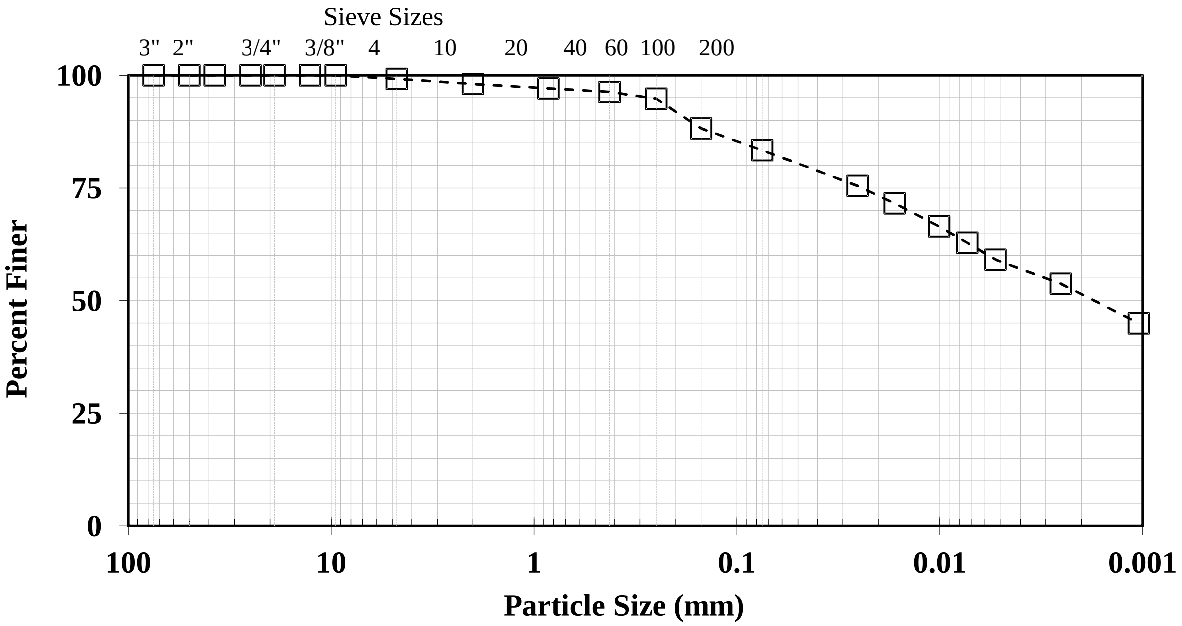
*Limited sample quantity for multi-point liquid limit testing.

Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-73

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-207 29-30.5'	Test Date:	01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.2
No. 10 (2.00 mm)	98.1
No. 20 (850 µm)	97.1
No. 40 (425 µm)	96.3
No. 60 (250 µm)	94.8
No. 100 (150 µm)	88.2
No. 200 (75 µm)	83.4
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	83.3
0.005 mm	58.4
0.001 mm	44.5

USCS Classification (ASTM D2487)	*	
As-Received Moisture Content (%)	(ASTM D2216)	14.6
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	*
	Plastic Limit	*
	Plastic Index	- -
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

*Inadequate sample for Atterberg Limit testing.

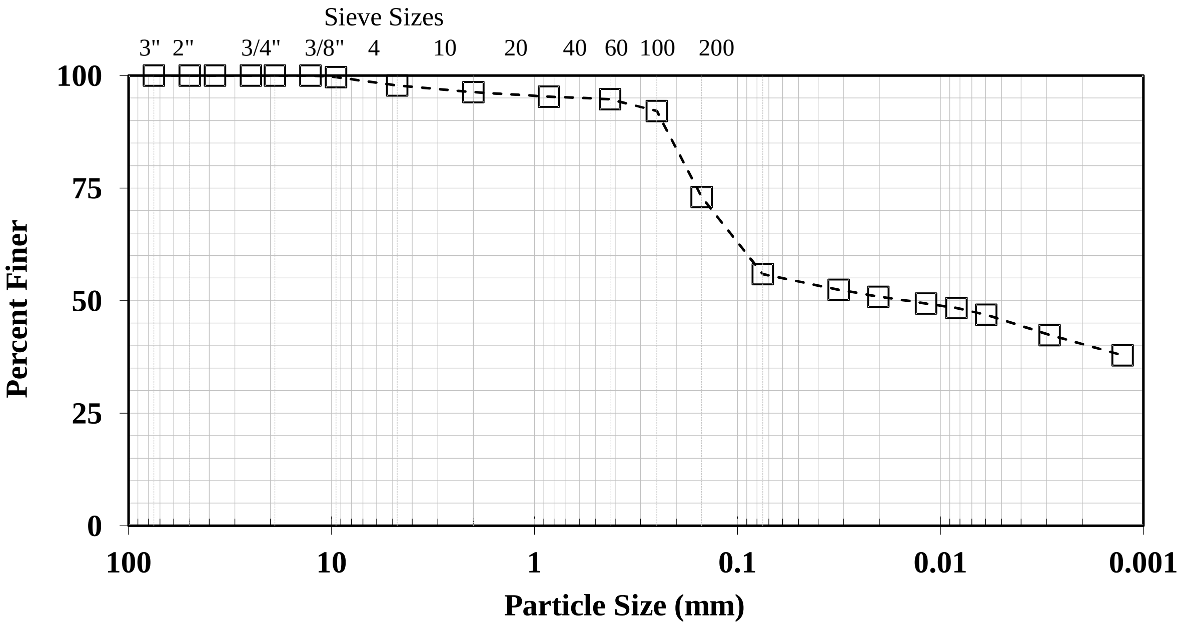
Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2014
Quality Review/Date
Tested by: Kahlil Hart

IIIM-C-74

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

Particle Size Analysis for Soils

Client:	Geosyntec Consultants, Inc.	TRI Log#:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	D422
Sample:	B-207 33-34'	Test Date:	02/11/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	99.6
No. 4 (4.75 mm)	97.8
No. 10 (2.00 mm)	96.3
No. 20 (850 µm)	95.3
No. 40 (425 µm)	94.7
No. 60 (250 µm)	92.1
No. 100 (150 µm)	73.0
No. 200 (75 µm)	55.9
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	55.8
0.005 mm	46.1
0.001 mm	36.6

USCS Classification (ASTM D2487)	Sandy Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	16.5
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	37
	Plastic Limit	14
	Plastic Index	23
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 2/21/2014
Quality Review/Date
Tested by: Kahlil Hart

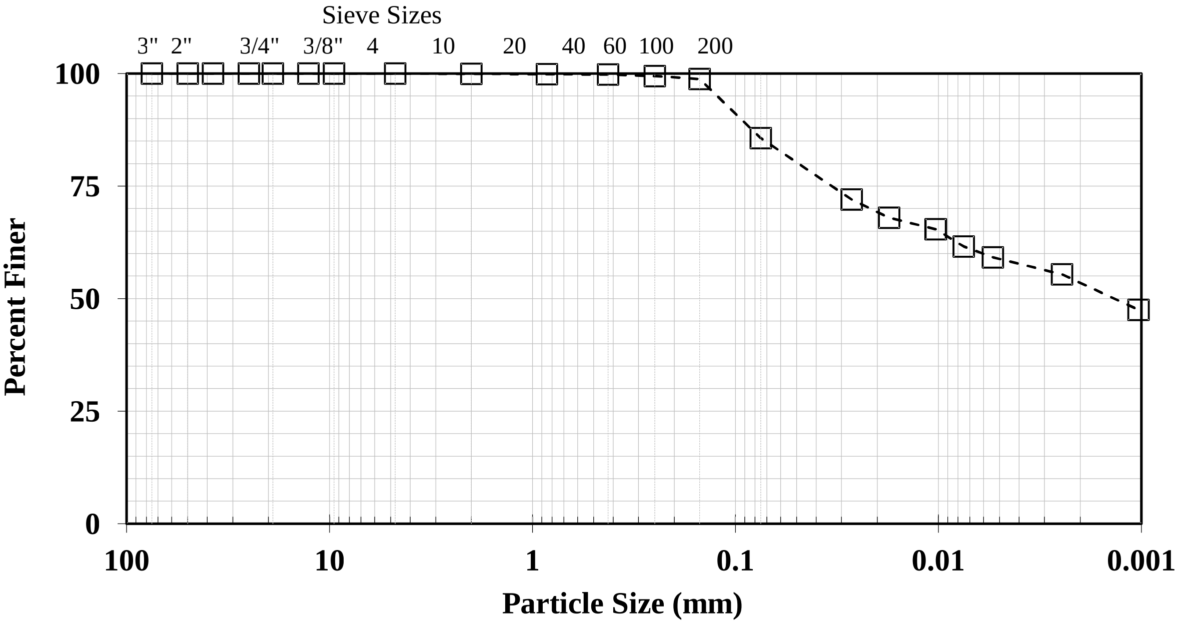
IIIM-C-75

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

Particle Size Analysis for Soils

Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Sample: B-207 49-50.5'

TRI Log#: E2377-59-05
Test Method: D422
Test Date: 01/15/14



Sieve Analysis	
Sieve Size	Percent Passing
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
1/2 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.00 mm)	100.0
No. 20 (850 µm)	99.9
No. 40 (425 µm)	99.8
No. 60 (250 µm)	99.5
No. 100 (150 µm)	98.8
No. 200 (75 µm)	85.6
Hydrometer Analysis	
Particle Size	Percent Passing
0.074 mm	85.5
0.005 mm	58.6
0.001 mm	47.2

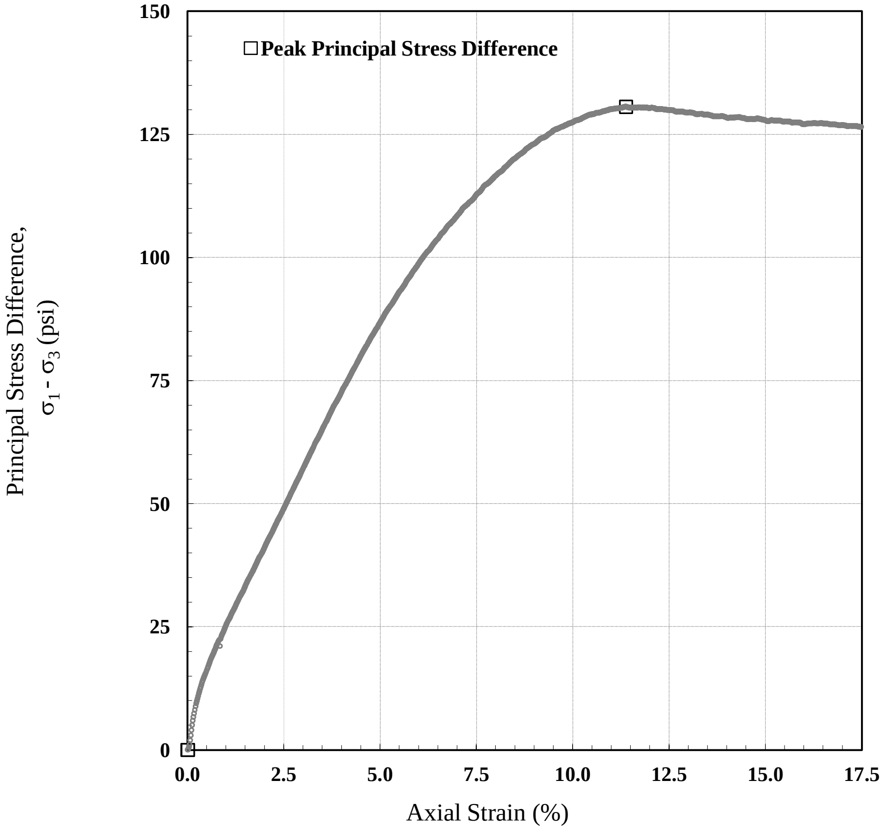
USCS Classification (ASTM D2487)	Lean Clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	16.2
Atterberg Limits (ASTM D 4318, Method A : Multipoint)	Liquid Limit (3 pt)	47
	Plastic Limit	18
	Plastic Index	29
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2014
Quality Review/Date
Tested by: Kahlil Hart

Unconsolidated-Undrained (Q) Triaxial Compression

Client: Geosyntec Consultants, Inc.
Project: Ft.Worth C&D
Sample: B-201 (3-4.3')

TRI Log #: E2377-59-05
Test Method: ASTM D2850



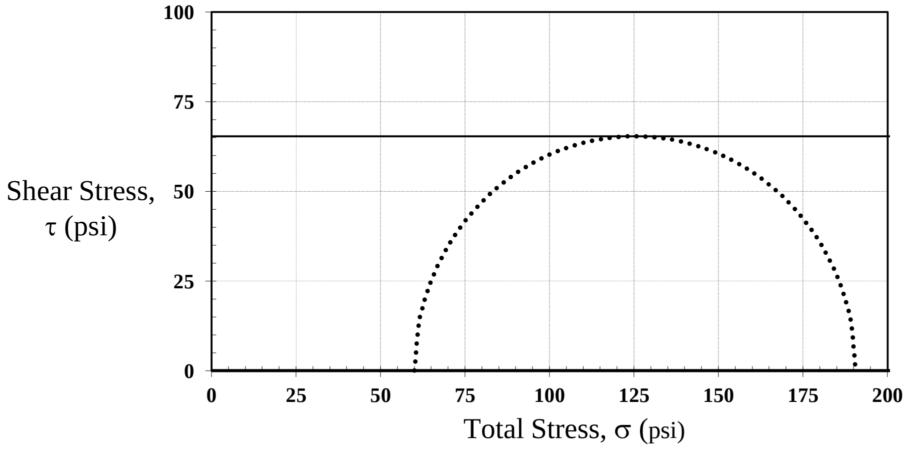
Test Parameters	
Eff. Consol. Stress (psi)	60.0
Rate of Strain (%/hr)	60

Initial Properties	
Avg. Diameter (in)	2.81
Avg. Height (in)	5.71
Avg. Water Content (%)	10.7
Bulk Density (pcf)	137.3
Dry Density (pcf)	124.0
Saturation (%)	85.1
Void Ratio	0.33
Specific Gravity (Assumed)	2.65

At Failure - Maximum Deviator Stress	
Axial Strain at Failure (%)	11.4
Minor Total Stress (psi)	60.0
Major Total Stress (psi)	190.6
Principal Stress Diff. (psi)	130.6

Total Stress Envelope	
Friction Angle (deg)	0
Undrained Shear Strength, S_u (psi)	65.3
S_u / σ_3	1.1

Note: The Mohr failure envelope was taken as a horizontal straight line. It should, however, be noted that the specimen was partially saturated.



Jeffrey A. Kuhn , Ph.D., P.E., 3/12/2014
Analysis & Quality Review/Date
Specimens Prepared By: Mark Fountain, Ph.D.

IIIM-C-77

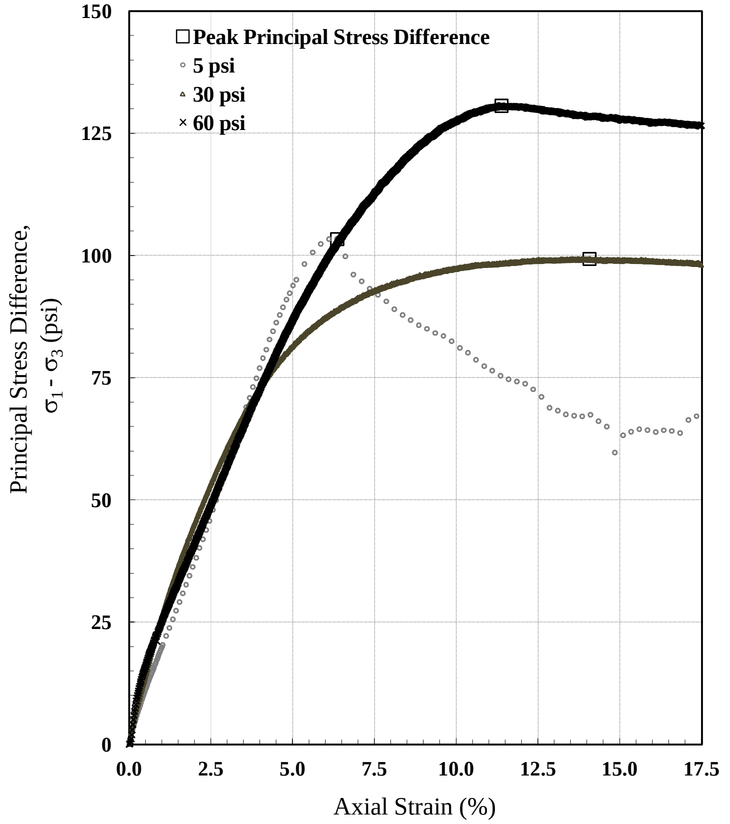
1 of 1

TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA

Unconsolidated-Undrained (Q) Triaxial Compression

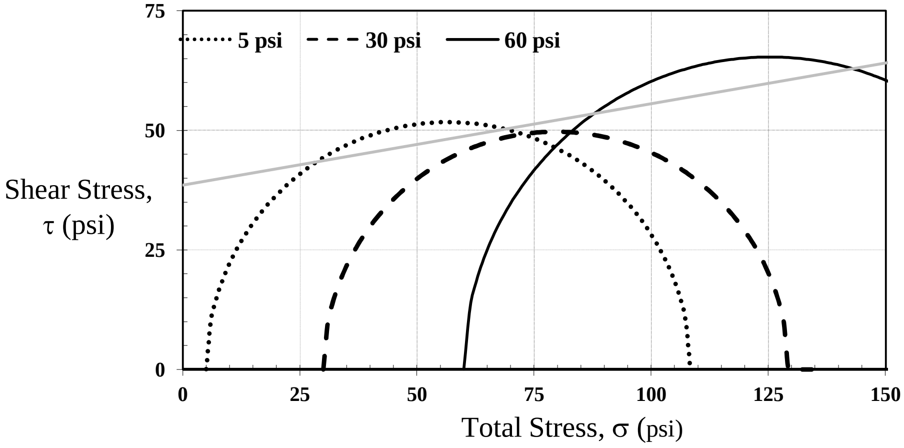
Client: Geosyntec Consultants
Project: Ft. Worth C&D
Sample: Fill Material

TRI Log #: E2377-59-05
Test Method: ASTM D2850



Samples			
Sample I.D.	B-204	B-204	B-201
Depth/Elev. (ft)	4-6	4-6	3-4.3
Eff. Consol. Stress (psi)	5.0	30.0	60.0
Initial Properties			
Avg. Diameter (in)	2.84	2.83	2.81
Avg. Height (in)	5.62	5.76	5.71
Avg. Water Content (%)	11.8	9.8	10.7
Bulk Density (pcf)	136.8	138.7	137.3
Dry Density (pcf)	122.4	126.3	124.0
Saturation (%)	89.1	84.0	85.1
Void Ratio	0.35	0.31	0.33
Specific Gravity (Assumed)	2.65	2.65	2.65

At Failure			
Failure Criterion	Maximum Deviator Stress		
Rate of Strain (%/hr)	60	60	60
Axial Strain at Failure (%)	6.4	14.1	11.4
Minor Total Stress (psi)	5.0	30.0	60.0
Major Total Stress (psi)	108.4	129.3	190.6
Principal Stress Diff. (psi)	103.4	99.3	130.6



Total Stress Envelope	
Friction Angle (deg)	11.8
Cohesion (psi)	38.5

Note: Specimens are partially saturated.

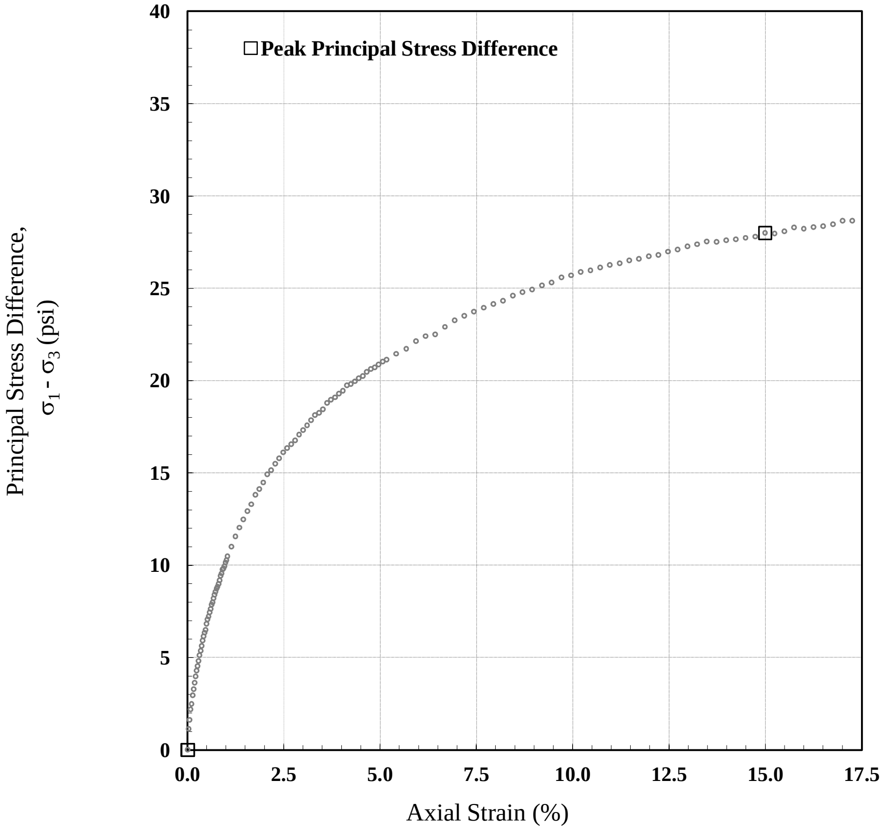
Jeffrey A. Kuhn , Ph.D., P.E., 3/17/2014
Analysis & Quality Review/Date

Specimens Prepared By: Mark Fountain, Ph.D.

Unconsolidated-Undrained (Q) Triaxial Compression

Client: Geosyntec Consultants, Inc.
Project: Ft.Worth C&D
Sample: B-206 (10-12')

TRI Log #: E2377-59-05
Test Method: ASTM D2850



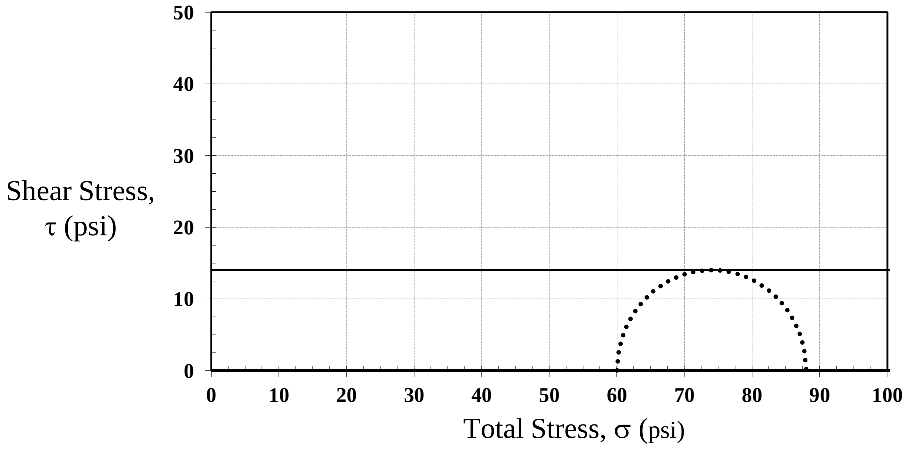
Test Parameters	
Eff. Consol. Stress (psi)	60.0
Rate of Strain (%/hr)	60

Initial Properties	
Avg. Diameter (in)	2.83
Avg. Height (in)	5.87
Avg. Water Content (%)	23.4
Bulk Density (pcf)	128.6
Dry Density (pcf)	104.2
Saturation (%)	100.0
Void Ratio	0.59
Specific Gravity (Assumed)	2.65

At Failure - Maximum Deviator Stress	
Axial Strain at Failure (%)	15.0
Minor Total Stress (psi)	60.0
Major Total Stress (psi)	88.0
Principal Stress Diff. (psi)	28.0

Total Stress Envelope	
Friction Angle (deg)	0
Undrained Shear Strength, S_u (psi)	14.0
S_u / σ_3	0.2

Note: The Mohr failure envelope was taken as a horizontal straight line.



Jeffrey A. Kuhn , Ph.D., P.E., 3/17/2014

Analysis & Quality Review/Date

Specimens Prepared By: Mark Fountain, Ph.D.

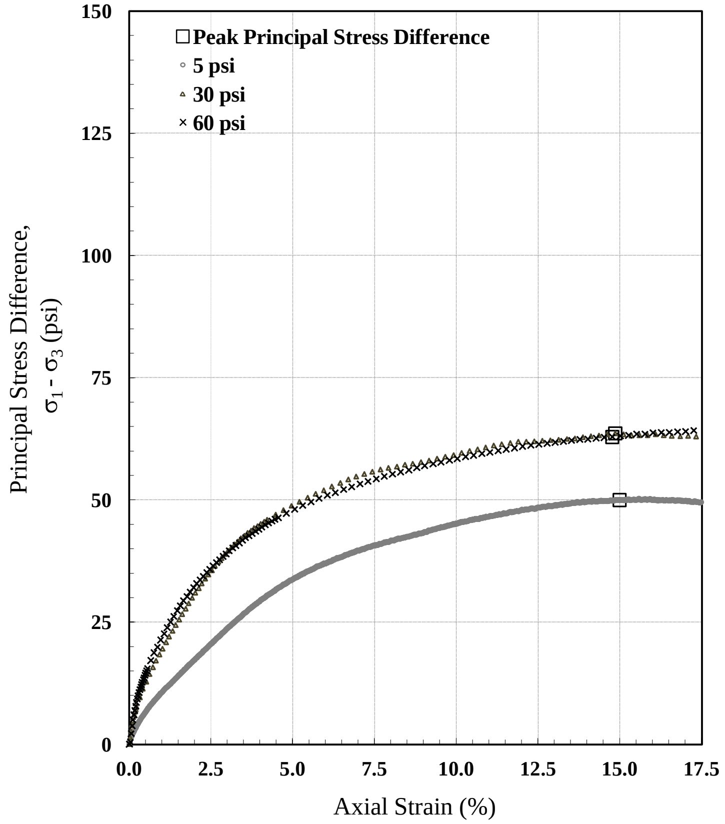
IIIM-C-79

1 of 1

Unconsolidated-Undrained (Q) Triaxial Compression

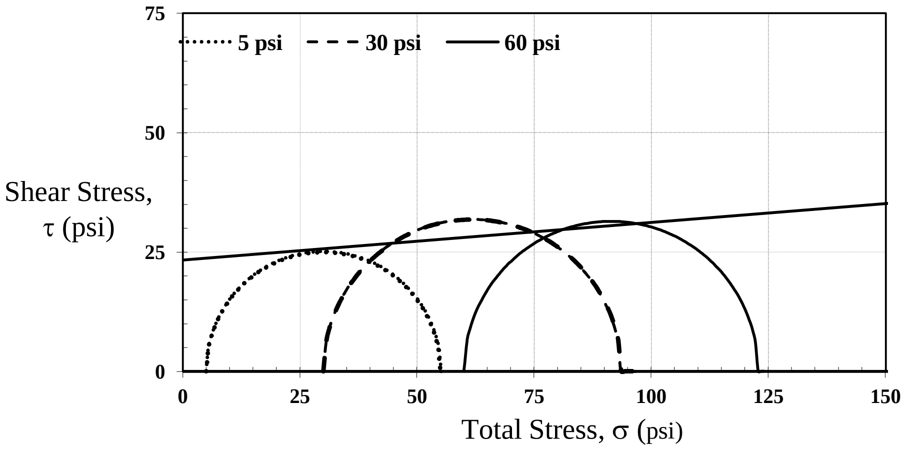
Client: Geosyntec Consultants
Project: Ft. Worth C&D
Sample: Geologic Layer 1

TRI Log #: E2377-59-05
Test Method: ASTM D2850



Samples			
Sample I.D.	B-202	B-202	B-202
Depth/Elev. (ft)	9-11	14-16	14-16
Eff. Consol. Stress (psi)	5.0	30.0	60.0
Initial Properties			
Avg. Diameter (in)	2.84	2.85	2.88
Avg. Height (in)	5.79	5.88	6.05
Avg. Water Content (%)	13.7	15.8	15.6
Bulk Density (pcf)	131.9	134.5	131.9
Dry Density (pcf)	116.1	116.2	114.1
Saturation (%)	85.1	98.5	91.8
Void Ratio	0.43	0.42	0.45
Specific Gravity (Assumed)	2.65	2.65	2.65

At Failure			
Failure Criterion	Maximum Deviator Stress		
Rate of Strain (%/hr)	60	60	60
Axial Strain at Failure (%)	15.0	14.9	14.8
Minor Total Stress (psi)	5.0	30.0	60.0
Major Total Stress (psi)	55.0	93.6	122.9
Principal Stress Diff. (psi)	50.0	63.6	62.9



Total Stress Envelope*	
Friction Angle (deg)	5.8
Cohesion (psi)	23.3

*Undrained shear strength envelope fit based on a linear regression in modified Mohr-Coulomb space.

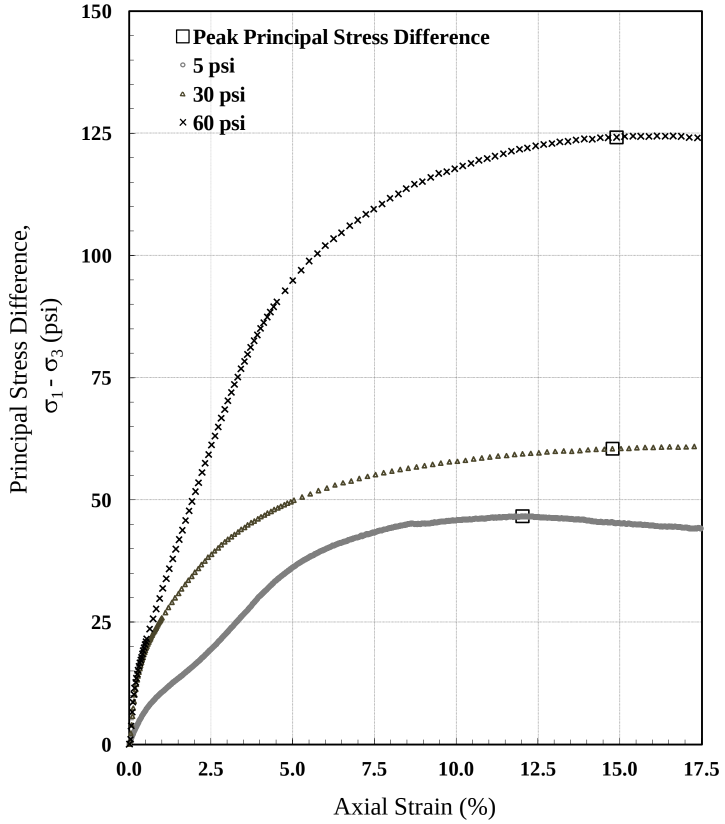
Jeffrey A. Kuhn , Ph.D., P.E., 2/19/2014
Analysis & Quality Review/Date
Specimens Prepared By: Mark Fountain, Ph.D.

IIIM-C-80
1 of 1

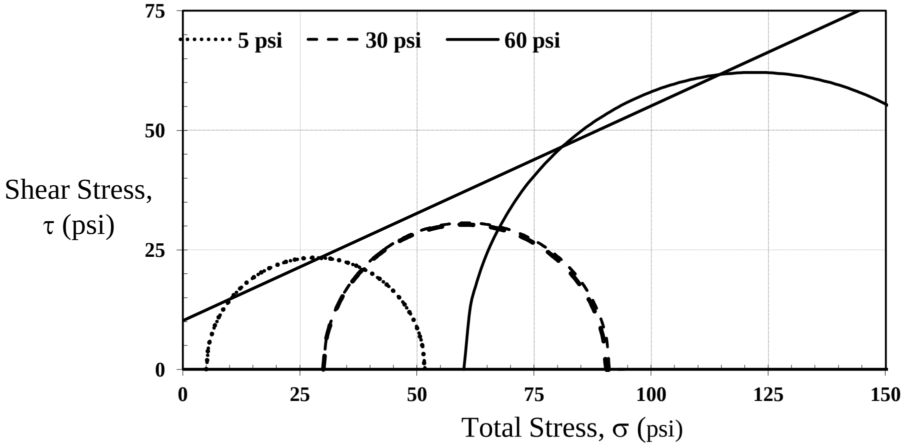
Unconsolidated-Undrained (Q) Triaxial Compression

Client:	Geosyntec Consultants	TRI Log #:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D2850
Sample:	Geologic Layer 2		

Samples			
Sample I.D.	B-204	B-203	B-203
Depth/Elev. (ft)	19-21	17-19	17-19
Eff. Consol. Stress (psi)	5.0	30.0	60.0
Initial Properties			
Avg. Diameter (in)	2.85	2.83	2.80
Avg. Height (in)	5.72	5.62	5.79
Avg. Water Content (%)	14.3	17.7	11.9
Bulk Density (pcf)	133.5	135.1	137.3
Dry Density (pcf)	116.8	114.8	122.6
Saturation (%)	91.1	100.0	90.6
Void Ratio	0.42	0.44	0.35
Specific Gravity (Assumed)	2.65	2.65	2.65



At Failure			
Failure Criterion	Maximum Deviator Stress		
Rate of Strain (%/hr)	60	60	60
Axial Strain at Failure (%)	12.0	14.8	14.9
Minor Total Stress (psi)	5.0	30.0	60.0
Major Total Stress (psi)	51.7	90.5	184.2
Principal Stress Diff. (psi)	46.7	60.5	124.2



Total Stress Envelope*	
Friction Angle (deg)	24.7
Cohesion (psi)	10.2

*Undrained shear strength envelope fit based on a linear regression in modified Mohr-Coulomb space.

Jeffrey A. Kuhn , Ph.D., P.E., 2/19/2014
Analysis & Quality Review/Date
Specimens Prepared By: Mark Fountain, Ph.D.

Consolidated-Undrained ($\bar{R}$) Triaxial Compression

Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Sample: Fill Material

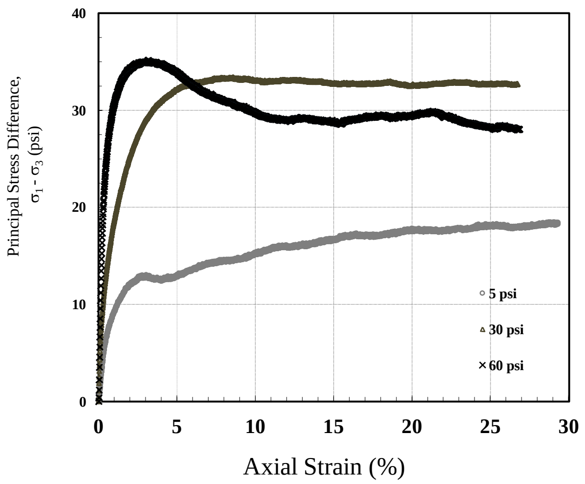
TRI Log #: E2377-59-05
Test Method: ASTM D4767
Test Date: 1/22/2014

$\bar{R}$-Envelope, Effective Stress	
Effective Friction Angle (deg)	24.1
Effective Cohesion (psi)	2.3

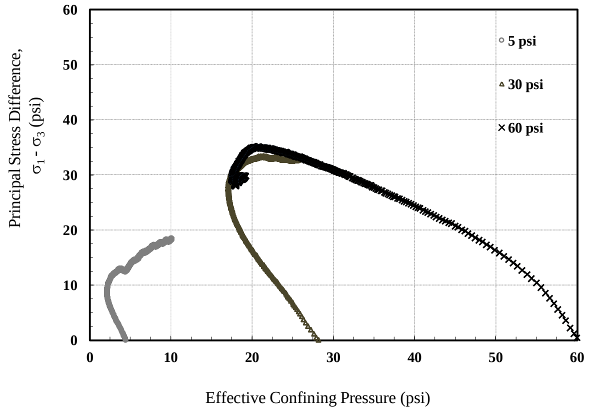
R-Envelope, "Total" Stress	
Friction Angle (deg)	9.7
Cohesion (psi)	5.2

Samples			
Sample I.D.	B-202	B-206	B-206
Depth/Elev. (ft)	4-6	10-12	20-21.5
Eff. Consol. Stress (psi)	5.0	30.0	60.0
Initial Properties			
Avg. Diameter (in)	2.01	2.85	2.84
Avg. Height (in)	4.42	5.67	5.73
Avg. Water Content (%)	16.3	20.4	16.3
Bulk Density (pcf)	122.6	130.2	133.7
Dry Density (pcf)	105.4	108.1	114.9
Saturation (%)	76.0	100.0	98.4
Void Ratio	0.57	0.53	0.44
Specific Gravity (Assumed)	2.65	2.65	2.65
Total Back-Pressure (psi)	81.0	90.3	79.5
B-Value, End of Saturation	0.99	0.95	0.98
Post-Consolidation			
Void Ratio	0.56	0.48	0.34
Area (in^2)	3.15	6.22	6.04
At Failure			
Failure Criterion	Peak Principal Stress Ratio		
Rate of Strain (%/hr)	0.60	0.25	0.60
Axial Strain at Failure (%)	1.2	3.6	5.0
Minor Total Stress (psi)	4.4	28.2	60.1
Major Total Stress (psi)	14.7	58.7	94.1
Minor Effective Stress (psi)	2.2	17.4	19.0
Major Effective Stress (psi)	12.5	47.9	52.9
Principal Stress Diff. (psi)	10.3	30.5	33.9

Stress-Strain



Modified Mohr-Coulomb



Jeffrey A. Kuhn , Ph.D., P.E., 2/5/2014

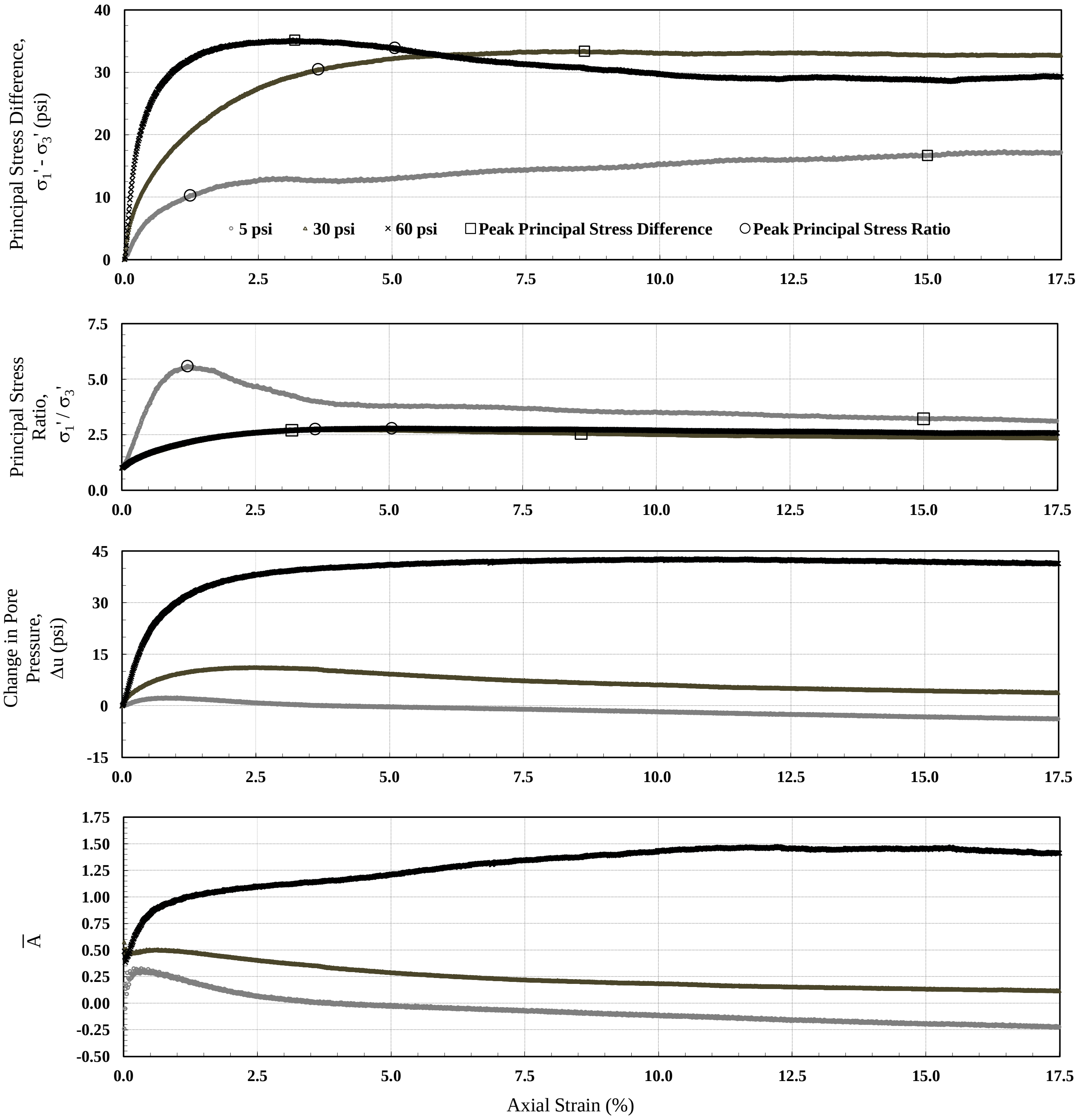
Analysis & Quality Review/Date

Specimens Prepared By: Mark Fountain, Ph.D.

Consolidated-Undrained ($\overline{\text{R}}$) Triaxial Compression

Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Sample: Fill Material

TRI Log #: E2377-59-05
Test Method: ASTM D4767
Test Date: 1/22/2014



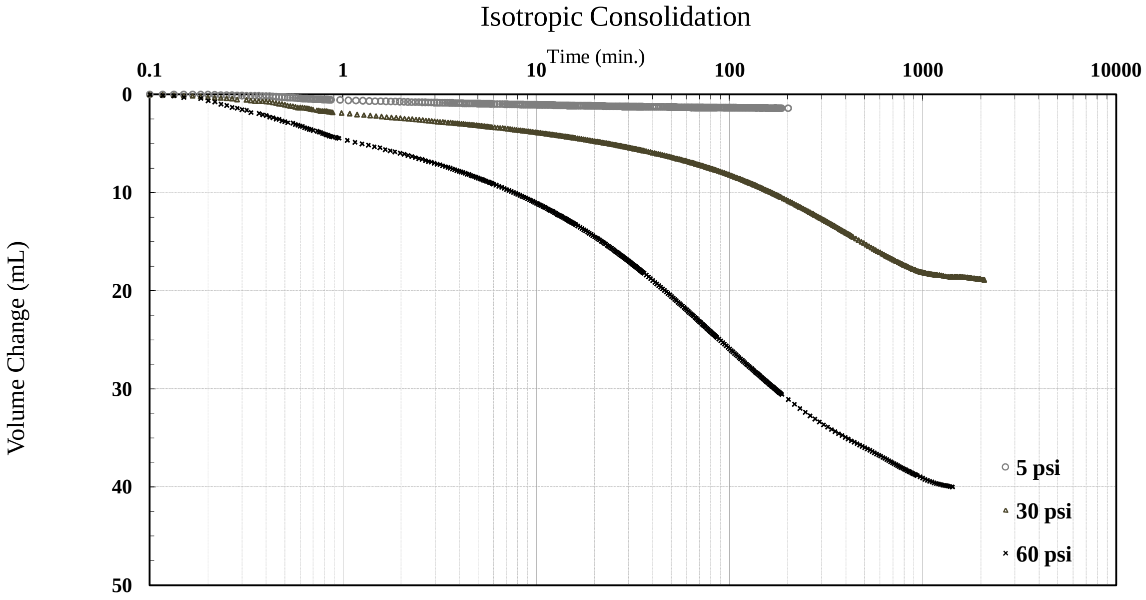
Consolidated-Undrained ($\bar{R}$) Triaxial Compression

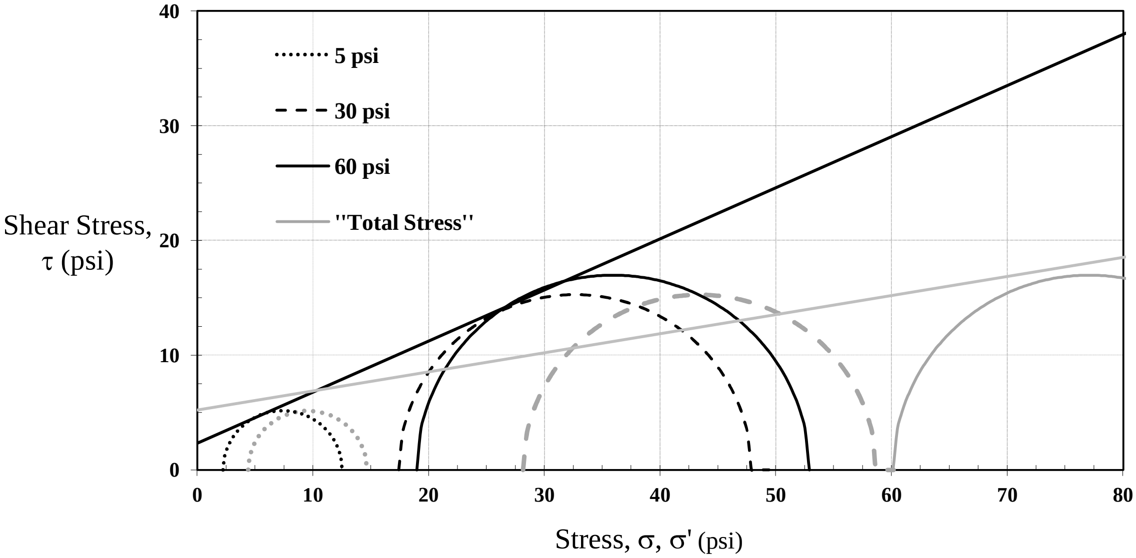
Client:	Geosyntec Consultants, Inc.	TRI Log #:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D4767
Sample:	Fill Material	Test Date:	1/22/2014

			Samples		
Sample I.D.			1	2	3
Depth/Elev. (ft)			-	-	-
Eff. Consol. Stress (psi)			5.0	30.0	60.0
Pre-Test Specimen Image					
Post-Test Specimen Image					
Final Water Content (%)	Top	1	23.3	23.2	16.9
		2	25.3	26.8	17.2
		3	26.2	25.6	24.0
	Bottom	4	24.4	23.0	23.6

Consolidated-Undrained ($\bar{R}$) Triaxial Compression

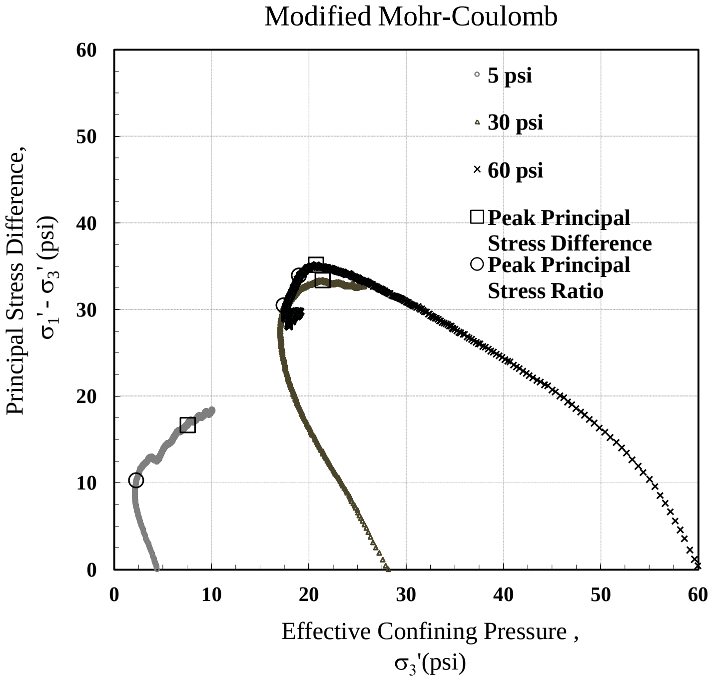
Client:	Geosyntec Consultants, Inc.	TRI Log #:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D4767
Sample:	Fill Material	Test Date:	1/22/2014

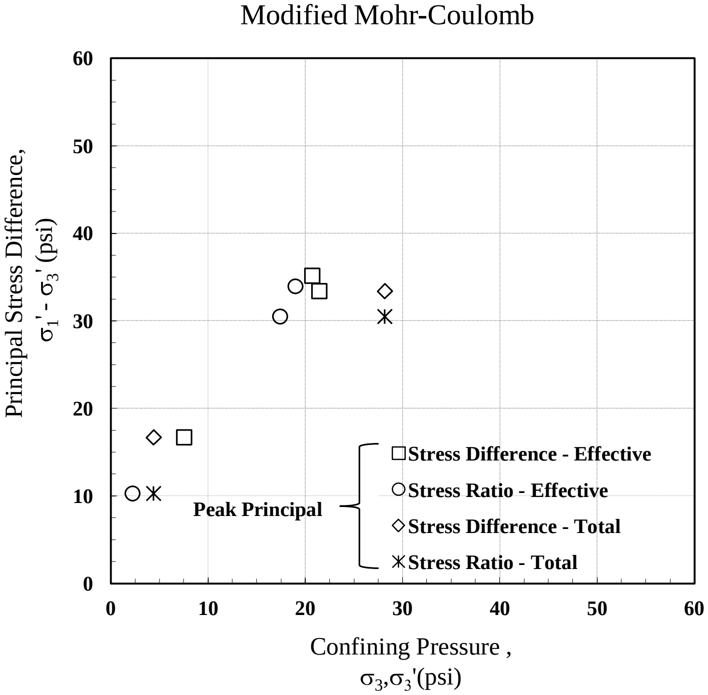




Consolidated-Undrained ($\overline{R}$) Triaxial Compression

Client:	Geosyntec Consultants, Inc.	TRI Log #:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D4767
Sample:	Fill Material	Test Date:	1/22/2014

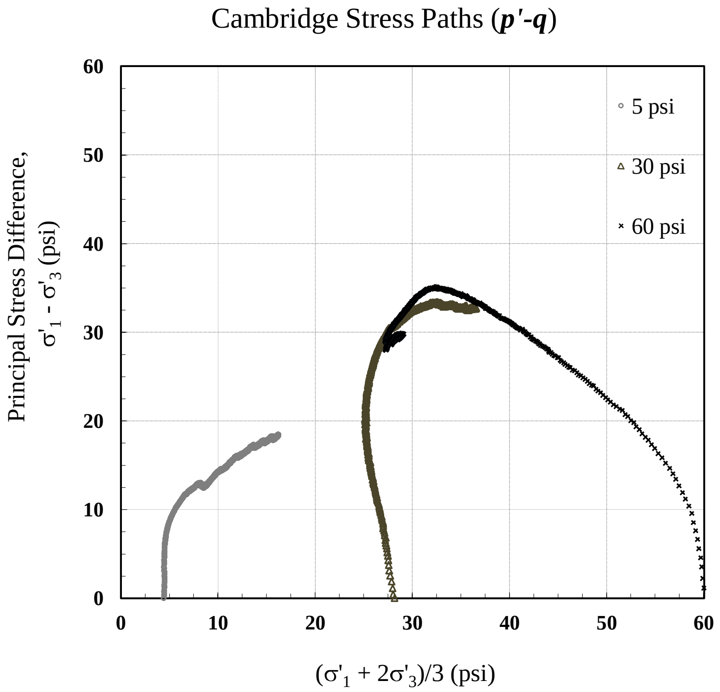


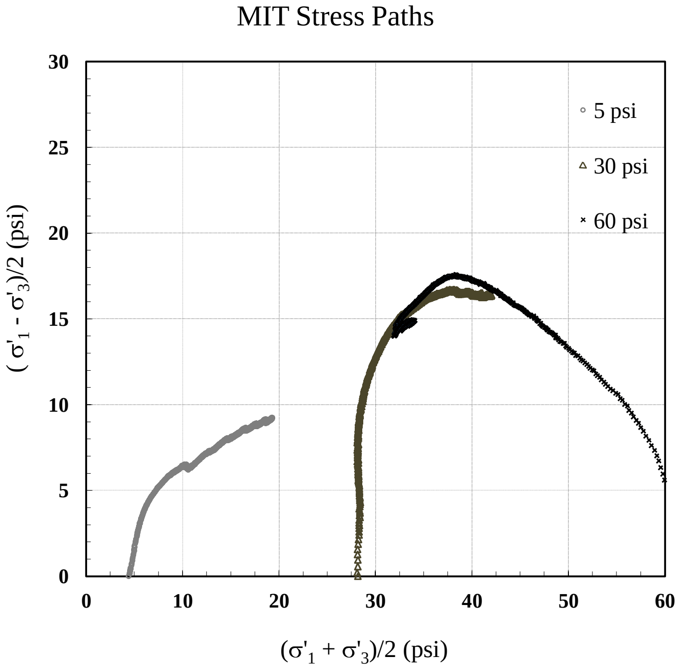


IIIM-C-86
5 of 6

Consolidated-Undrained ($\overline{R}$) Triaxial Compression

Client:	Geosyntec Consultants, Inc.	TRI Log #:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D4767
Sample:	Fill Material	Test Date:	1/22/2014





TESTING, RESEARCH, CONSULTING AND FIELD SERVICES

AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA

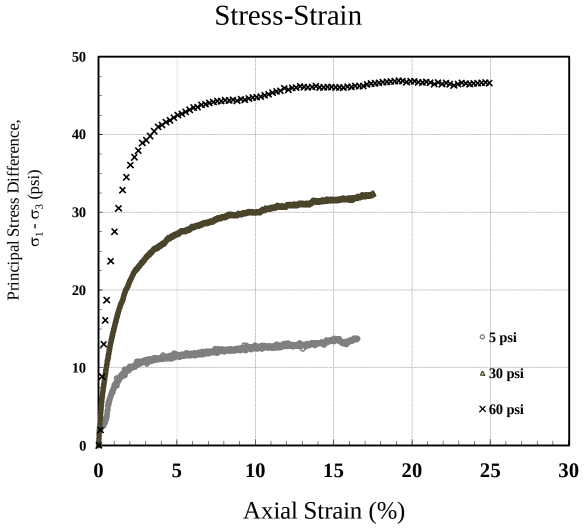
Consolidated-Undrained ($\bar{R}$) Triaxial Compression

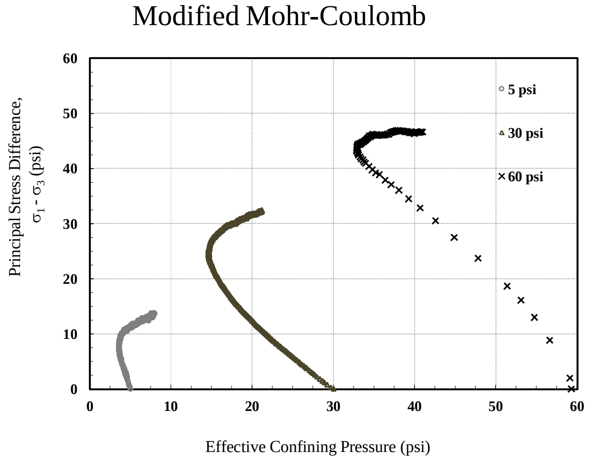
Client:	Geosyntec	TRI Log #:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D4767
Sample:	Geologic Layer 1	Test Date:	1/30/2014

$\bar{R}$-Envelope, Effective Stress	
Effective Friction Angle (deg)	21.6
Effective Cohesion (psi)	2.4

R-Envelope, "Total" Stress	
Friction Angle (deg)	14.0
Cohesion (psi)	2.8

Samples			
Sample I.D.	B-202	B-202	B-202
Depth/Elev. (ft)	19-21	19-21	19-21
Eff. Consol. Stress (psi)	5.0	30.0	60.0
Initial Properties			
Avg. Diameter (in)	1.92	2.02	1.92
Avg. Height (in)	4.42	4.08	4.07
Avg. Water Content (%)	21.2	15.6	16.6
Bulk Density (pcf)	133.8	121.8	131.2
Dry Density (pcf)	110.4	105.3	112.5
Saturation (%)	100.0	72.6	93.4
Void Ratio	0.50	0.57	0.47
Specific Gravity (Assumed)	2.65	2.65	2.65
Total Back-Pressure (psi)	64.9	79.9	80.4
B-Value, End of Saturation	0.96	0.96	0.99
Post-Consolidation			
Void Ratio	0.50	0.53	0.39
Area (in^2)	2.90	3.16	2.78
At Failure			
Failure Criterion	Peak Principal Stress Ratio		
Rate of Strain (%/hr)	0.80	0.80	1.20
Axial Strain at Failure (%)	1.7	5.2	8.1
Minor Total Stress (psi)	5.0	30.0	59.3
Major Total Stress (psi)	14.8	57.6	103.7
Minor Effective Stress (psi)	3.8	15.2	33.0
Major Effective Stress (psi)	13.5	42.8	77.4
Principal Stress Diff. (psi)	9.8	27.6	44.4





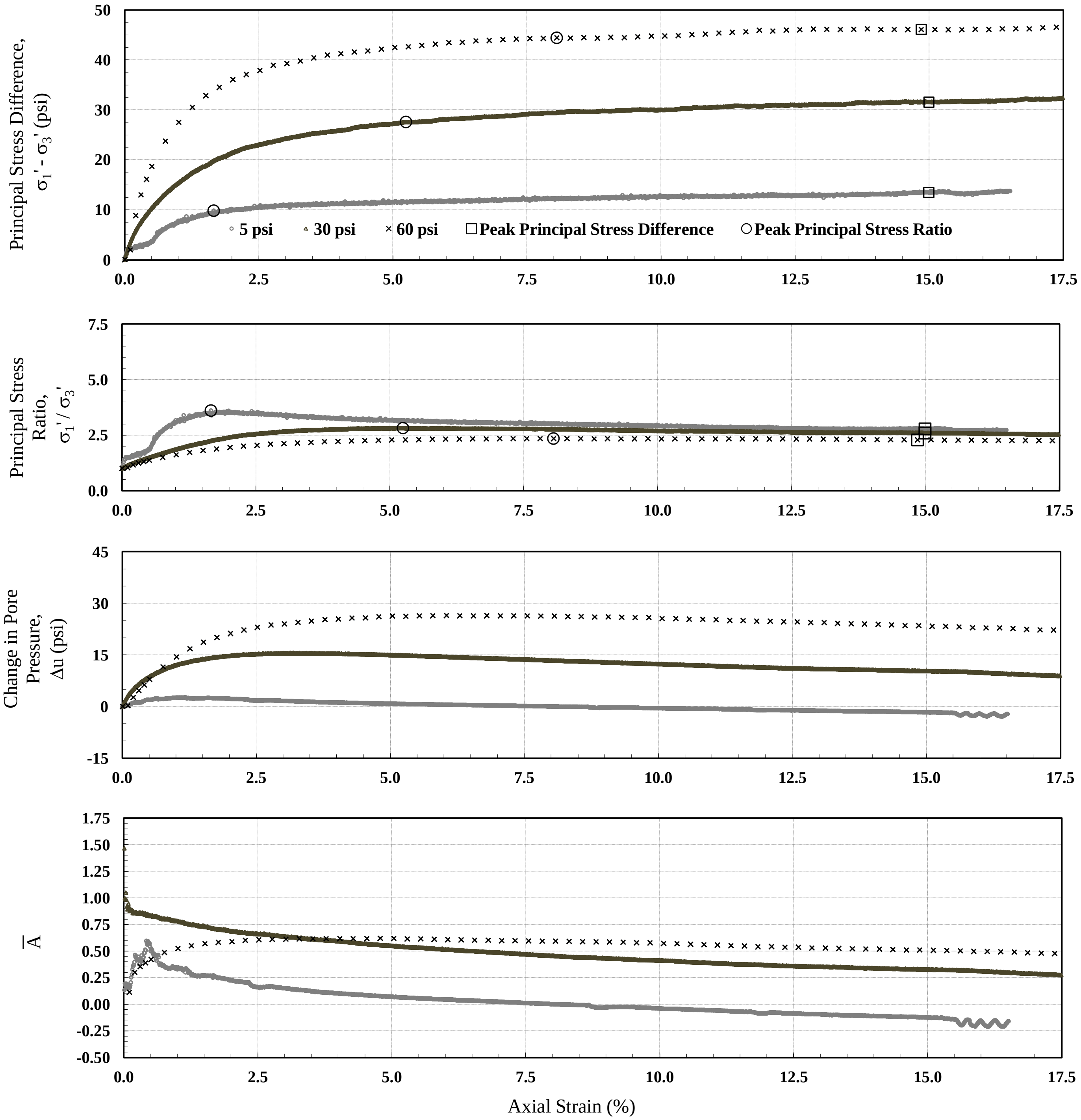
Jeffrey A. Kuhn , Ph.D., P.E., 9/30/2014

Analysis & Quality Review/Date

Specimens Prepared By: Mark Fountain, Ph.D.

Consolidated-Undrained ($\bar{R}$) Triaxial Compression

Client:	Geosyntec	TRI Log #:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D4767
Sample:	Geologic Layer 1	Test Date:	1/30/2014



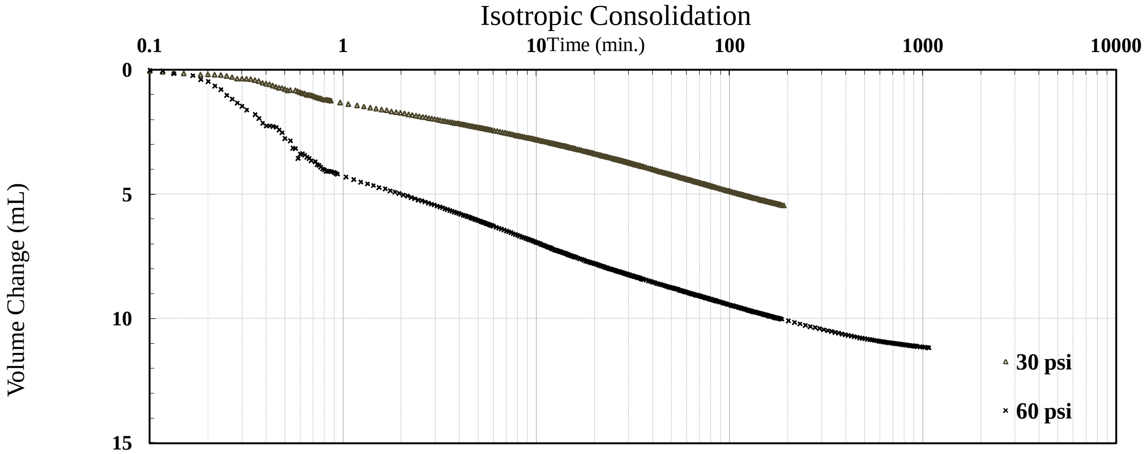
Consolidated-Undrained ($\bar{R}$) Triaxial Compression

Client:	Geosyntec	TRI Log #:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D4767
Sample:	Geologic Layer 1	Test Date:	1/30/2014

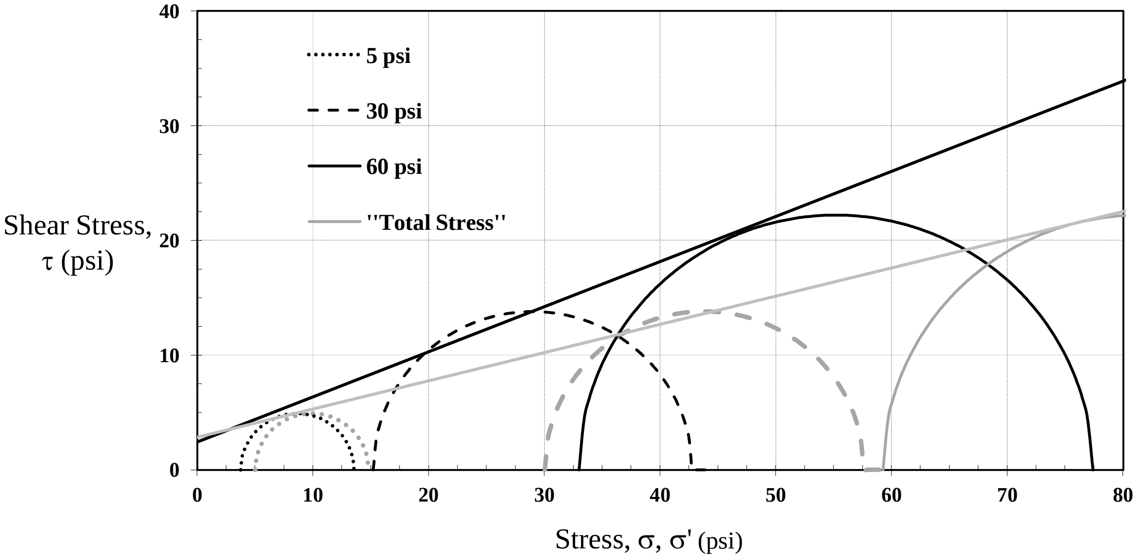
<table>
<tr><th colspan="6">Samples</th></tr>
<tr><td colspan="3">Sample I.D.</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td colspan="3">Depth/Elev. (ft)</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td colspan="3">Eff. Consol. Stress (psi)</td><td>5.0</td><td>30.0</td><td>60.0</td></tr>
<tr><td colspan="3">Pre-Test Specimen Image</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Post-Test Specimen Image</td><td>No Image Available</td><td></td><td></td></tr>
<tr><td rowspan="4">Final Water Content (%)</td><td>Top</td><td>1</td><td>19.5</td><td>17.3</td><td>17.7</td></tr>
<tr><td></td><td>2</td><td>19.1</td><td>17.1</td><td>17.5</td></tr>
<tr><td></td><td>3</td><td>19.6</td><td>17.1</td><td>17.6</td></tr>
<tr><td>Bottom</td><td>4</td><td>19.2</td><td>17.4</td><td>18.1</td></tr>
</table>

Consolidated-Undrained ($\overline{R}$) Triaxial Compression

Client:	Geosyntec	TRI Log #:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D4767
Sample:	Geologic Layer 1	Test Date:	1/30/2014

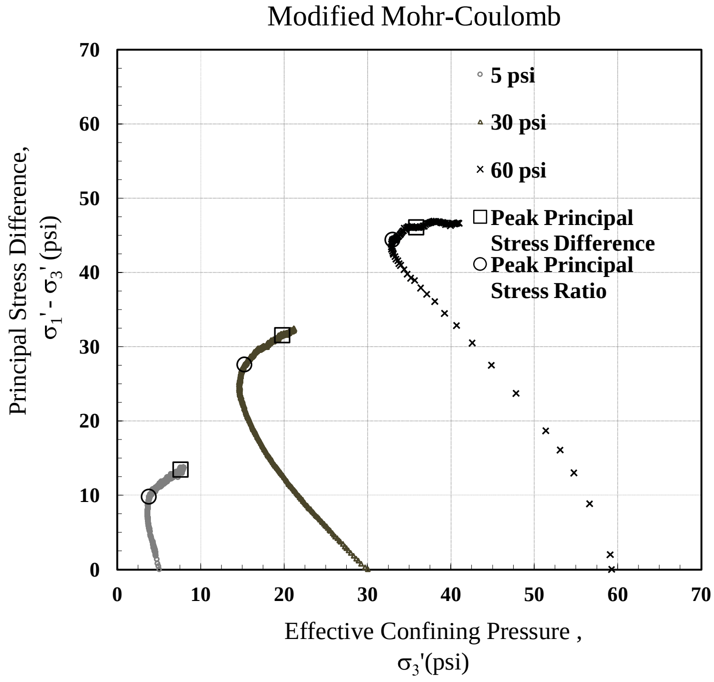


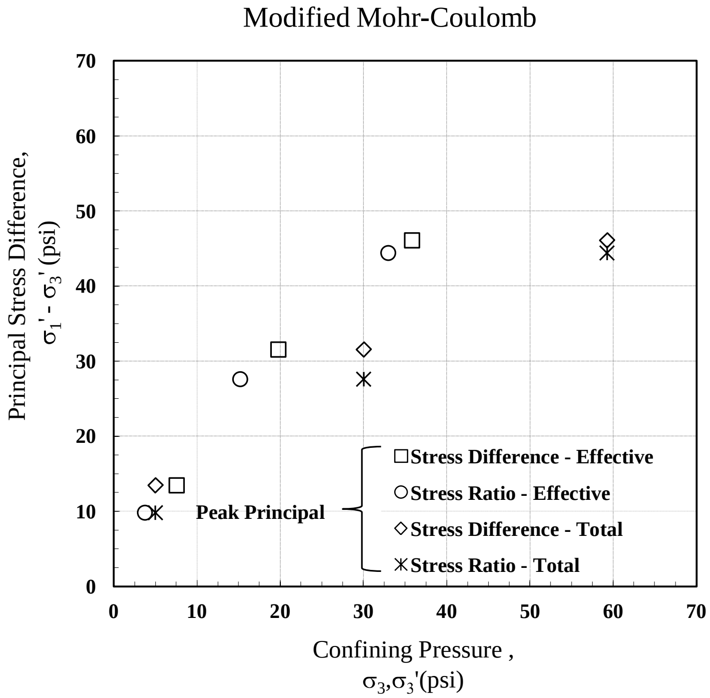
Note: Sample 1 was back-pressure saturated at its target effective of 5.0 psi. Accordingly, no consolidation data is available. Acquisition of consoldation volume changes for the 30 psi specimen were interrupted after approximately 200 minutes. Values of A bar during the first 2.5% of shear indicate that the sample was still undergoing primary consolidation at the onset of shearing.



Consolidated-Undrained ($\bar{R}$) Triaxial Compression

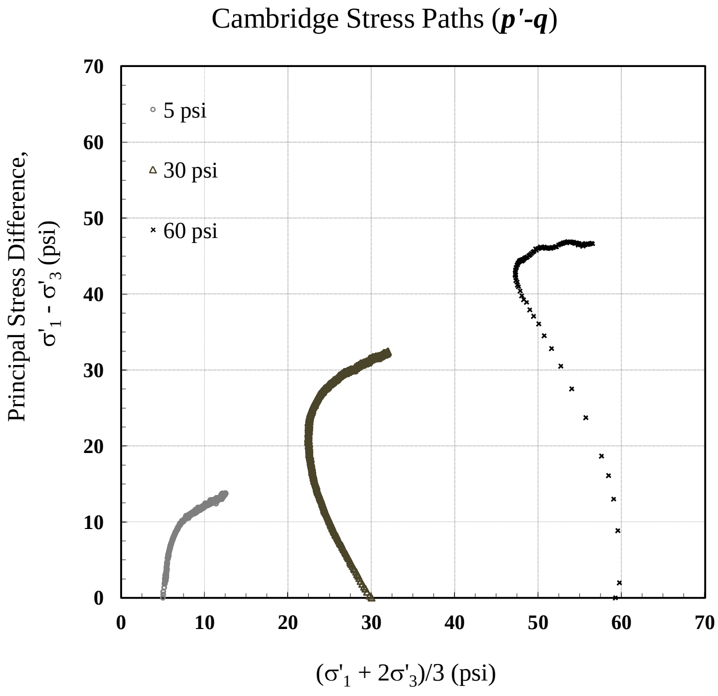
Client:	Geosyntec	TRI Log #:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D4767
Sample:	Geologic Layer 1	Test Date:	1/30/2014

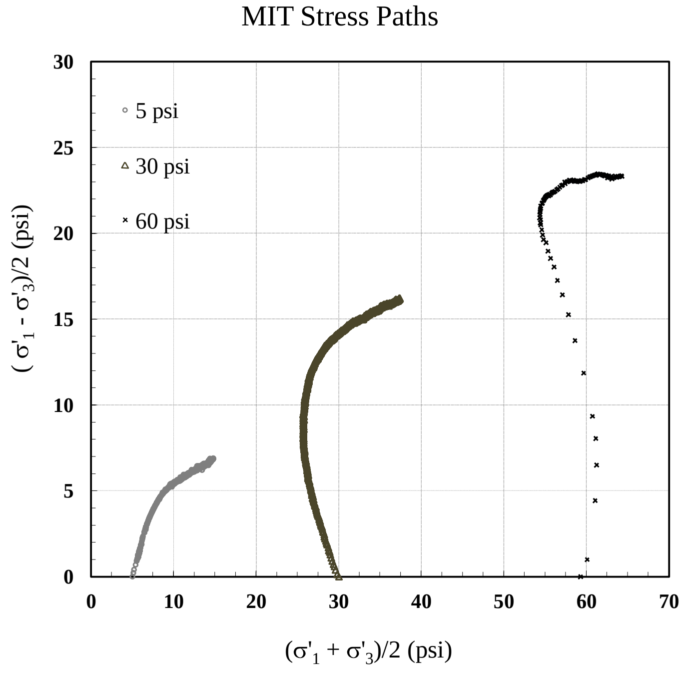




Consolidated-Undrained ($\bar{R}$) Triaxial Compression

Client:	Geosyntec	TRI Log #:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D4767
Sample:	Geologic Layer 1	Test Date:	1/30/2014





Consolidated-Undrained ($\bar{R}$) Triaxial Compression

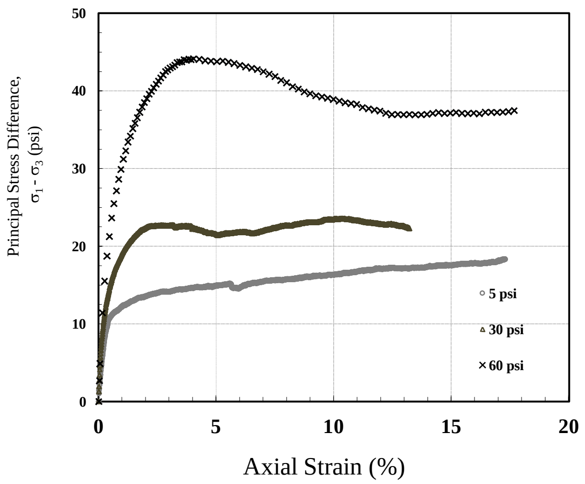
Client:	Geosyntec	TRI Log #:	E2377-59-05
Project:	FT. Worth C&D	Test Method:	ASTM D4767
Sample:	Geologic Layer 5	Test Date:	1/31/2014

$\bar{R}$-Envelope, Effective Stress	
Effective Friction Angle (deg)	22.3
Effective Cohesion (psi)	2.9

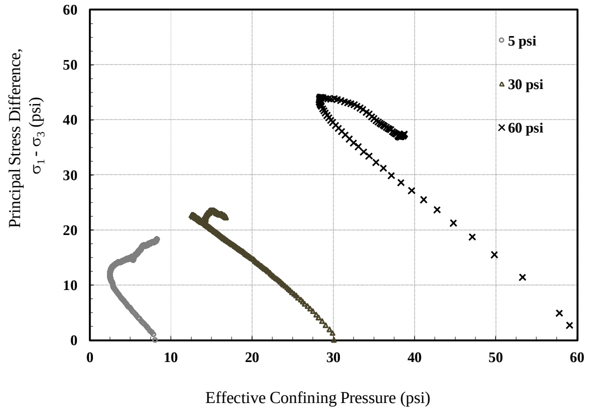
R-Envelope, "Total" Stress	
Friction Angle (deg)	13.4
Cohesion (psi)	2.7

Samples			
Sample I.D.	B-206	B-206	B-206
Depth/Elev. (ft)	33-35	33-35	33-35
Eff. Consol. Stress (psi)	5.0	30.0	60.0
Initial Properties			
Avg. Diameter (in)	2.86	2.83	2.84
Avg. Height (in)	5.80	5.75	5.59
Avg. Water Content (%)	26.7	26.2	24.8
Bulk Density (pcf)	124.1	123.0	124.0
Dry Density (pcf)	98.0	97.5	99.4
Saturation (%)	100.0	99.5	98.9
Void Ratio	0.69	0.70	0.66
Specific Gravity (Assumed)	2.65	2.65	2.65
Total Back-Pressure (psi)	81.9	80.6	79.8
B-Value, End of Saturation	0.96	0.98	0.97
Post-Consolidation			
Void Ratio	0.69	0.63	0.57
Area (in^2)	6.41	6.13	6.09
At Failure			
Failure Criterion	Peak Principal Stress Ratio		
Rate of Strain (%/hr)	0.50	0.50	0.50
Axial Strain at Failure (%)	1.4	2.7	3.6
Minor Total Stress (psi)	8.0	30.1	60.0
Major Total Stress (psi)	20.9	52.7	104.0
Minor Effective Stress (psi)	2.6	12.5	28.3
Major Effective Stress (psi)	15.5	35.2	72.3
Principal Stress Diff. (psi)	12.9	22.7	44.0

Stress-Strain



Modified Mohr-Coulomb



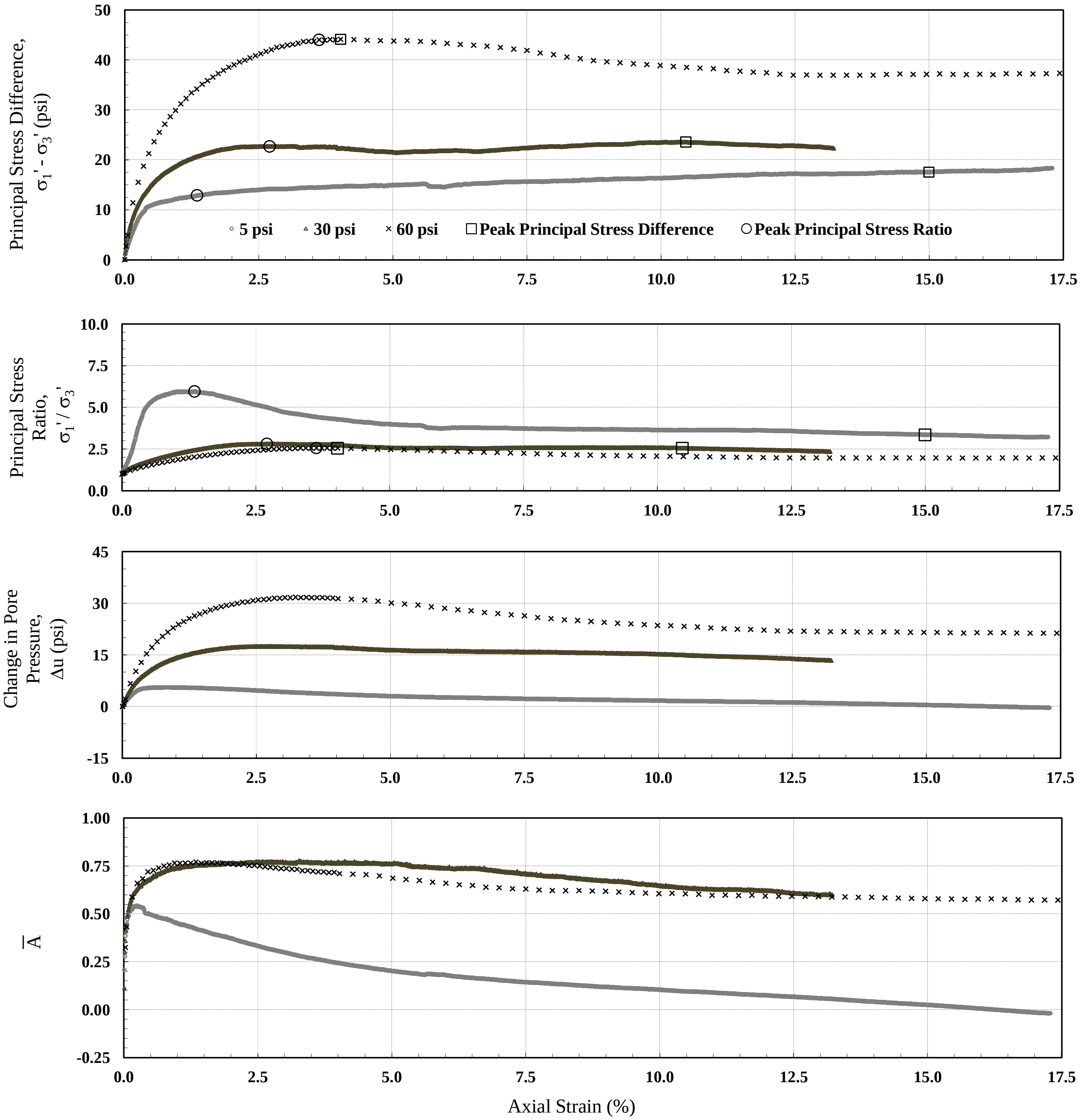
Jeffrey A. Kuhn , Ph.D., P.E., 2/14/2014

Analysis & Quality Review/Date

Specimens Prepared By: Mark Fountain, Ph.D.

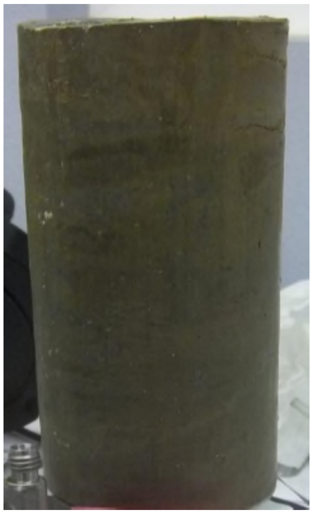
Consolidated-Undrained ($\bar{R}$) Triaxial Compression

Client:	Geosyntec	TRI Log #:	E2377-59-05
Project:	FT. Worth C&D	Test Method:	ASTM D4767
Sample:	Geologic Layer 5	Test Date:	1/31/2014



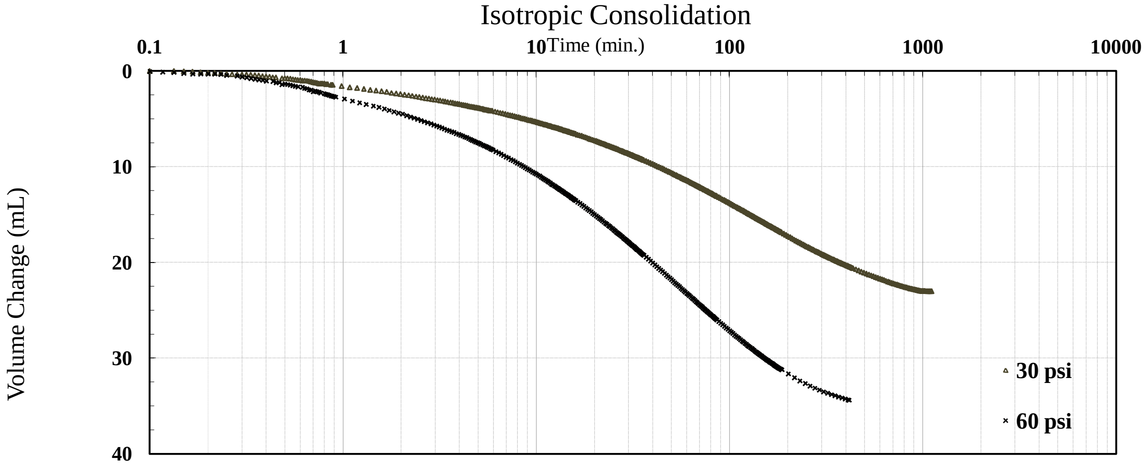
Consolidated-Undrained ($\bar{R}$) Triaxial Compression

Client:	Geosyntec	TRI Log #:	E2377-59-05
Project:	FT. Worth C&D	Test Method:	ASTM D4767
Sample:	Geologic Layer 5	Test Date:	1/31/2014

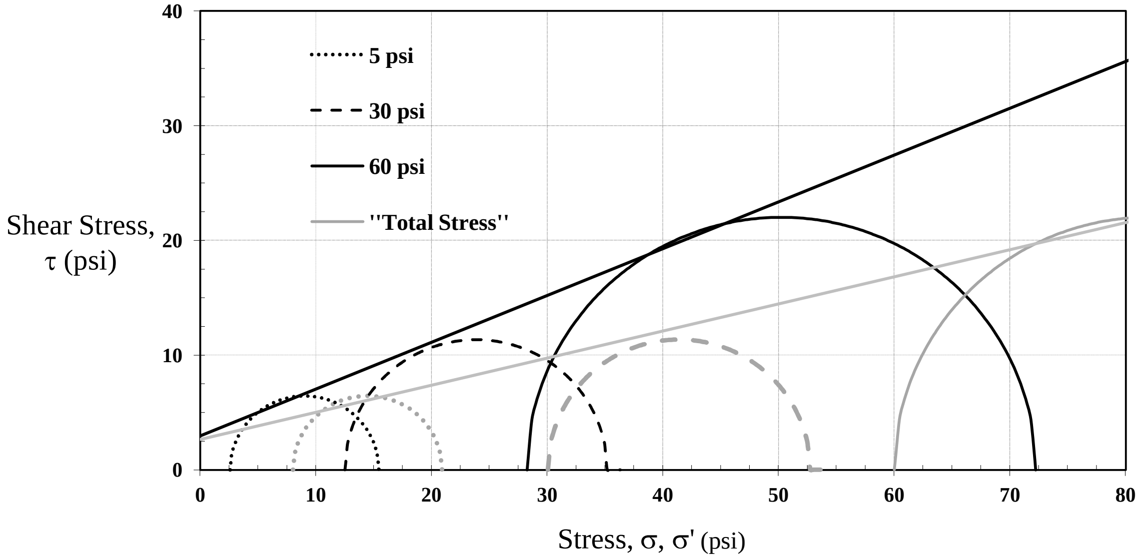
			Samples		
Sample I.D.			1	2	3
Depth/Elev. (ft)			-	-	-
Eff. Consol. Stress (psi)			5.0	30.0	60.0
Pre-Test Specimen Image					No Image Available
Post-Test Specimen Image					
Final Water Content (%)	Top	1	27.8	27.7	25.7
		2	27.3	26.9	30.4
		3	27.5	27.2	29.2
	Bottom	4	27.0	27.4	28.4

Consolidated-Undrained ($\bar{R}$) Triaxial Compression

Client:	Geosyntec	TRI Log #:	E2377-59-05
Project:	FT. Worth C&D	Test Method:	ASTM D4767
Sample:	Geologic Layer 5	Test Date:	1/31/2014



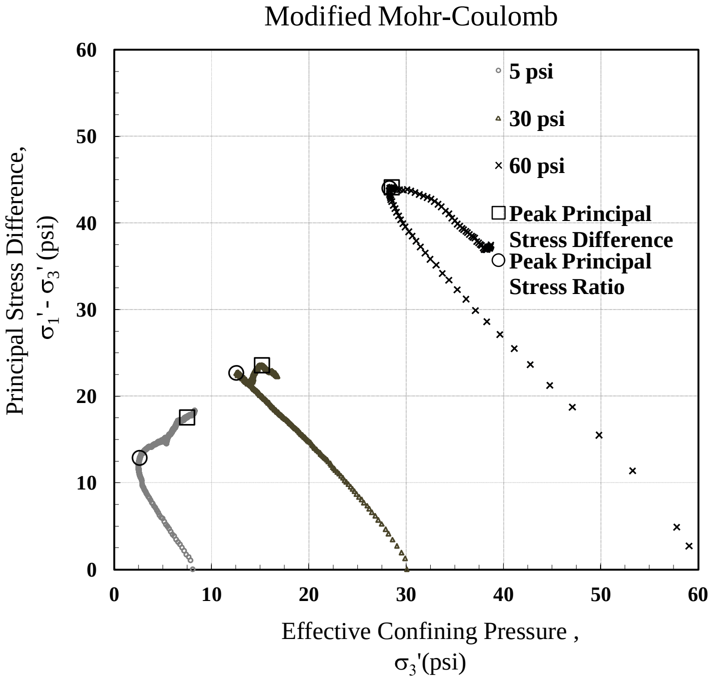
Note: Sample 1 was back-pressure saturated at its target effective of 5.0 psi.
Accordingly, no consolidation data is availab.e

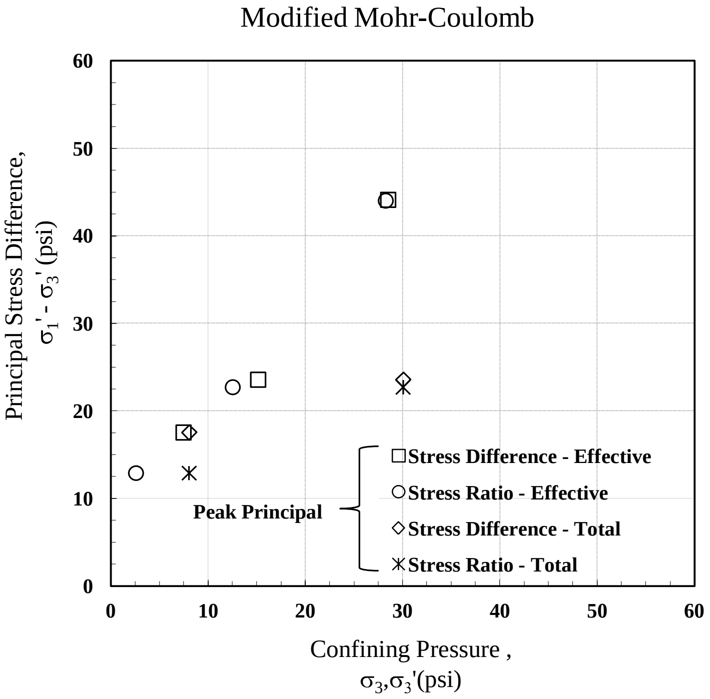


Consolidated-Undrained ($\bar{R}$) Triaxial Compression

Client: Geosyntec
Project: FT. Worth C&D
Sample: Geologic Layer 5

TRI Log #: E2377-59-05
Test Method: ASTM D4767
Test Date: 1/31/2014

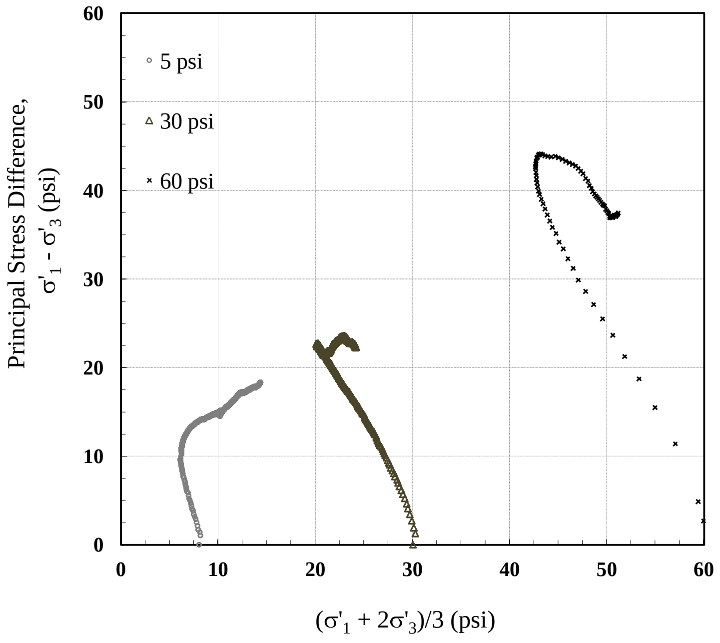




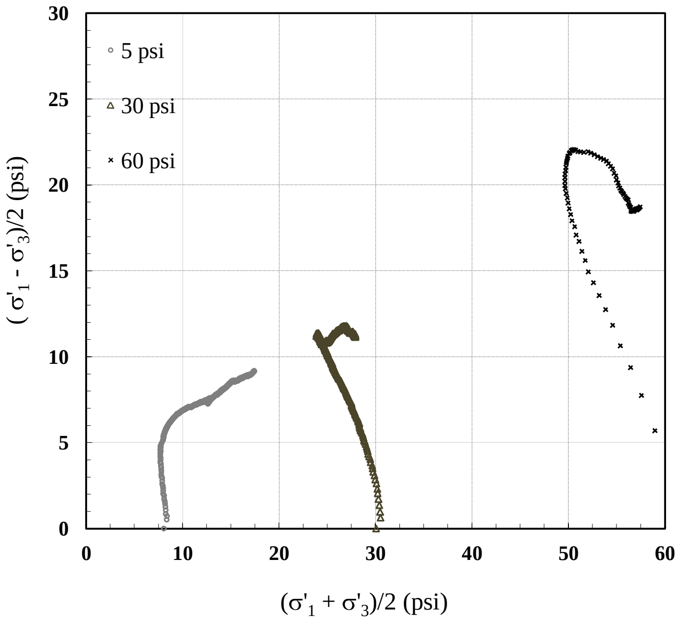
Consolidated-Undrained ($\bar{R}$) Triaxial Compression

Client:	Geosyntec	TRI Log #:	E2377-59-05
Project:	FT. Worth C&D	Test Method:	ASTM D4767
Sample:	Geologic Layer 5	Test Date:	1/31/2014

Cambridge Stress Paths (***p'*-*q***)



MIT Stress Paths



IIIM-C-99

6 of 6

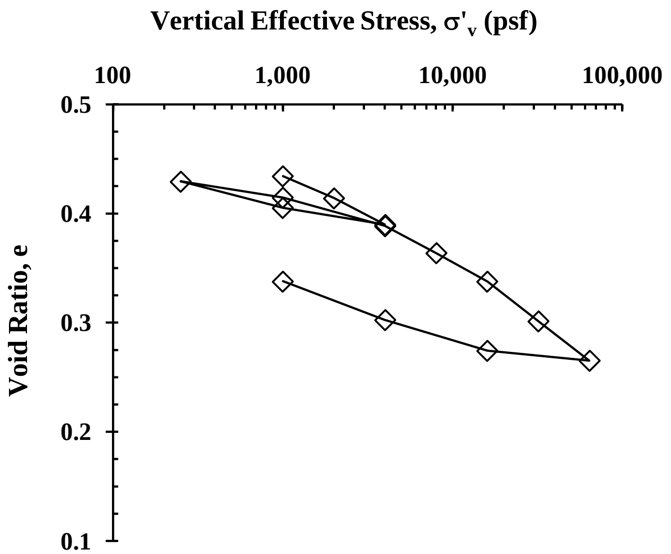
One-Dimensional Consolidation Properties of Soil

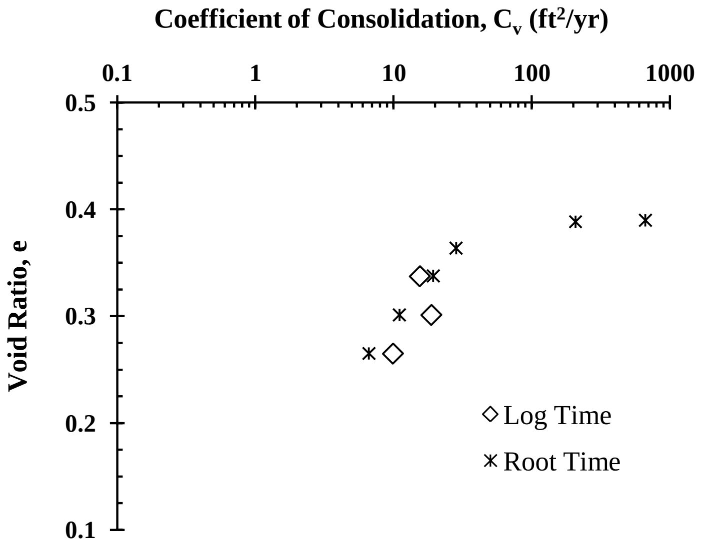
Client: Geosyntec
Project: Ft. Worth C&D
Specimen: B204 (9-11')

TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 01/17/14

Soil Specimen Properties	
Initial Specimen Water Content (%)	15.2
Final Specimen Water Content (%)	15.4
Specimen Diameter (in)	2.498
Initial Specimen Height (in)	0.999
Final Specimen Height (in)	0.925
Final Differential Height (in)	0.074
Initial Dry Unit Weight, γ_o lb_f/ft^3	114.4
Final Dry Unit Weight, γ_f lb_f/ft^3	123.6
Initial Void Ratio, e_o	0.445
Final Void Ratio, e_f	0.338
Initial Degree of Saturation (%)	90.5
Preconsolidation Pressure (psf)	≈3000
Swell Pressure (psf), Maximum Measured	583
Compression Index, C_c	0.120
Recompression Index, C_r	0.033

σ'_v	e	Strain, ε	C_v (ft^2/year)	
(psf)	(-)	(%)	Log Time	Root Time
Initial	0.445	0.0	-	-
1,000	0.434	0.8	-	-
2,000	0.414	2.2	-	-
4,000	0.390	3.8	-	664
1,000	0.405	2.8	-	-
250	0.429	1.1	-	-
1,000	0.414	2.1	-	-
4,000	0.388	3.9	-	207
8,000	0.363	5.6	-	28
16,000	0.337	7.4	15.46	19
32,000	0.301	10.0	18.67	11
64,000	0.265	12.5	9.84	7
16,000	0.274	11.8	-	-



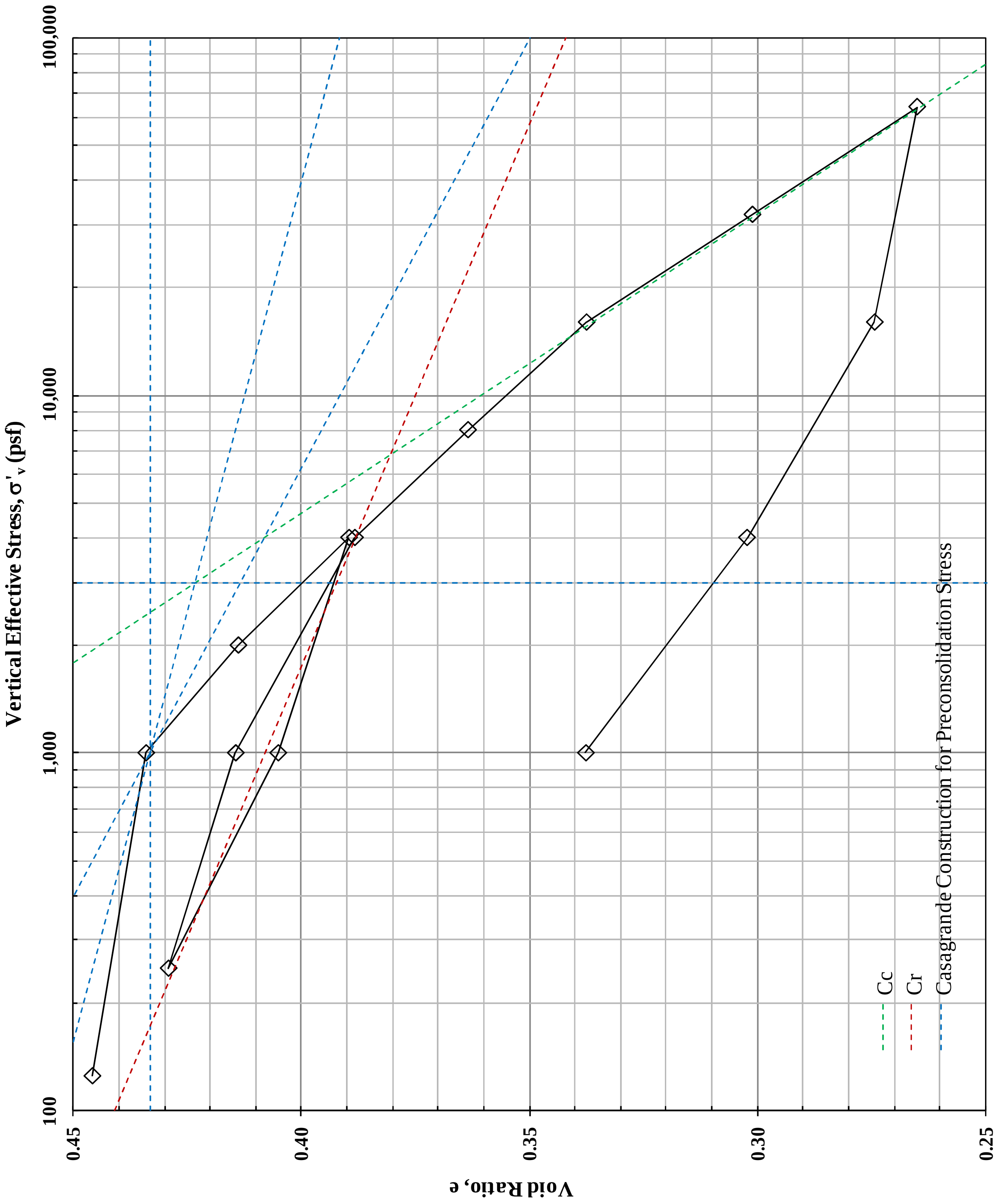


The undisturbed specimen was provided by the client. The specimen was trimmed using a trimming turntable and mounted. The specimen was inundated with tap water during testing. Coefficient of Consolidation was determined using the Log Time and Root Time Methods. Gs was assumed to be 2.65. Calculations include machine deflections measured at each loading step. The preconsolidation pressure was determined using the Casagrande construction technique.

Jeffrey A. Kuhn, Ph.D., P.E., 2/10/2014
Quality Review/Date
Specimen Prepared by: Mark Fountain, Ph.D.

One-Dimensional Consolidation Properties of Soil

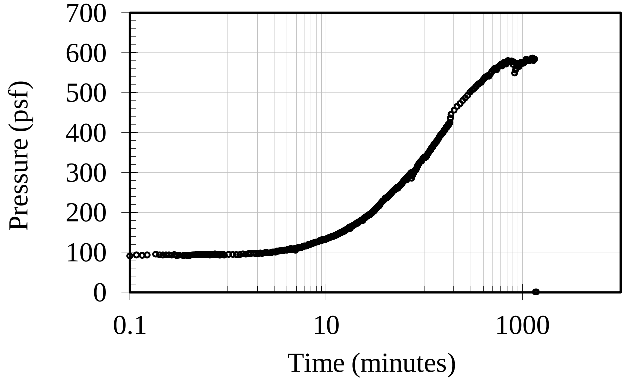
Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B204 (9-11')	Test Date:	01/17/14



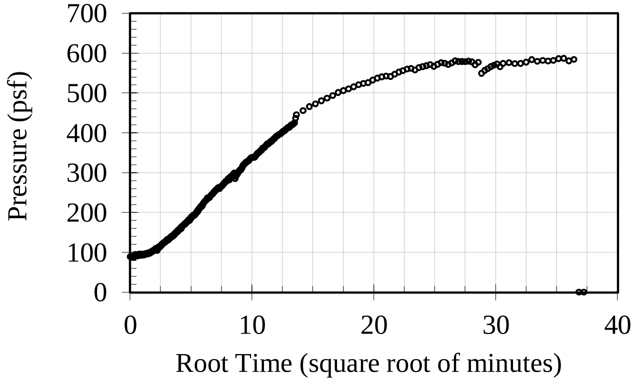
One-Dimensional Consolidation Properties of Soil

Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B204 (9-11')	Test Date:	01/17/14

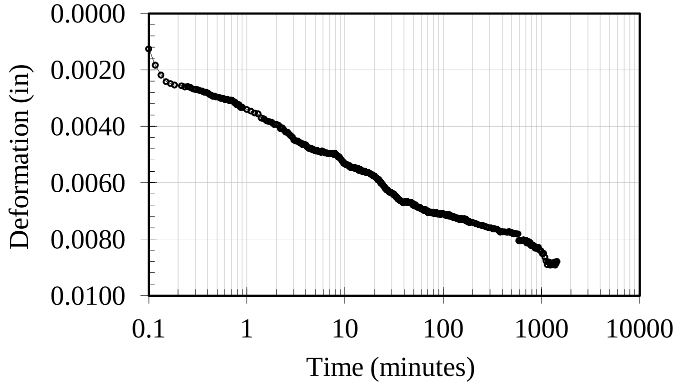
Stage 1: Swell Pressure Measurement



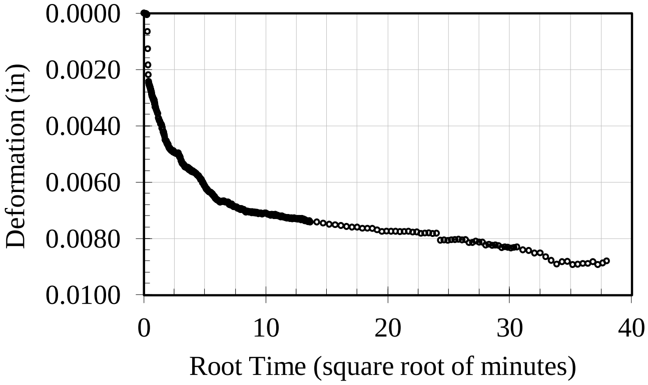
Stage 1: Swell Pressure Measurement



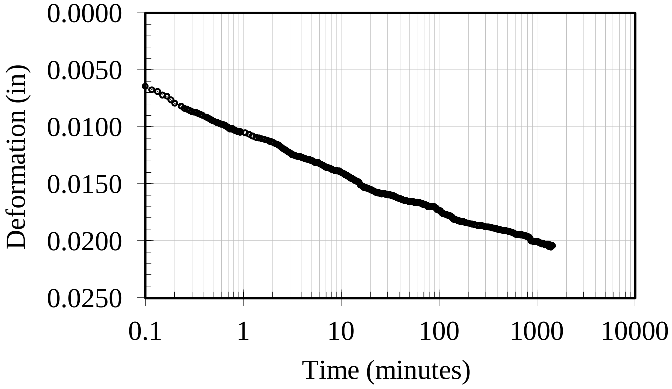
Stage 2: 1000psf



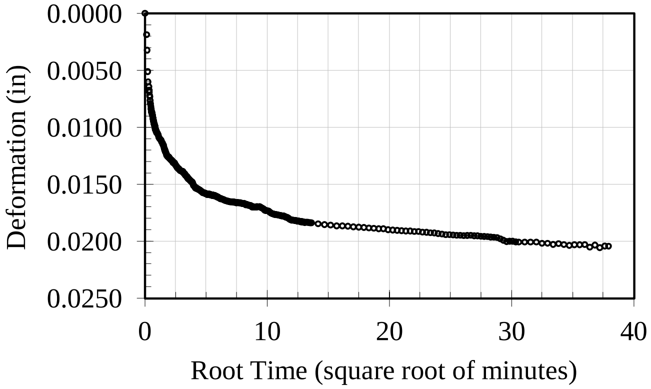
Stage 2: 1000psf



Stage 3: 2000psf

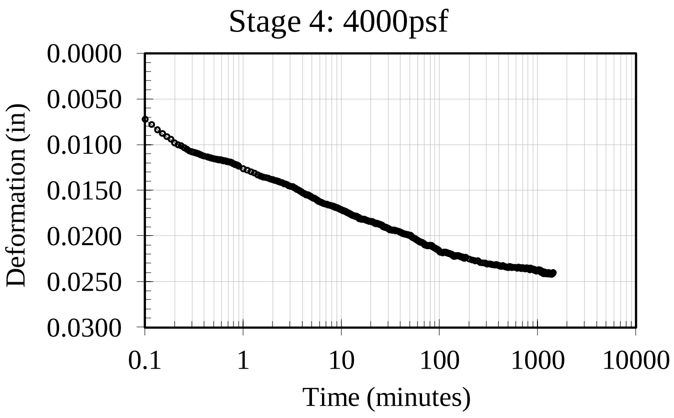


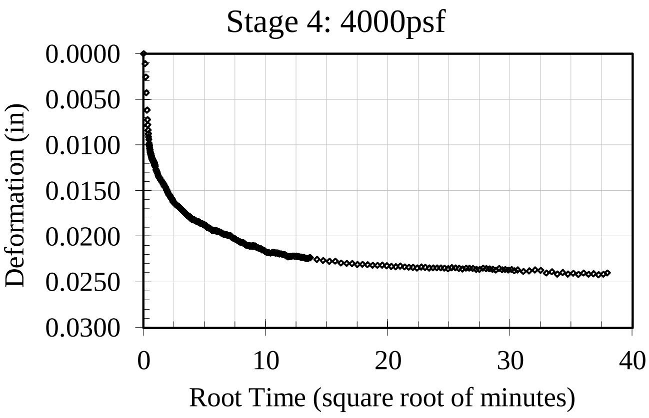
Stage 3: 2000psf

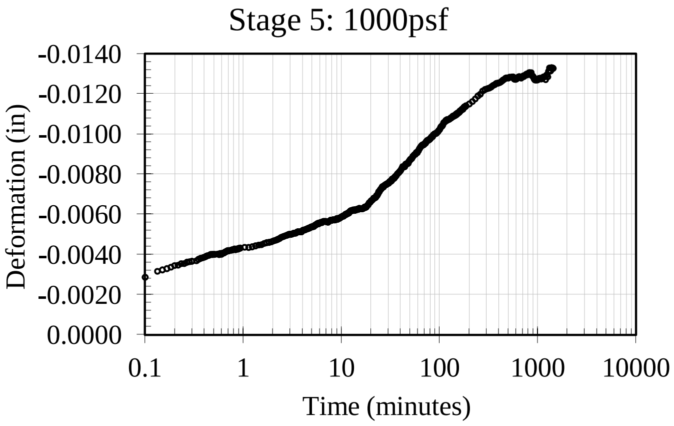


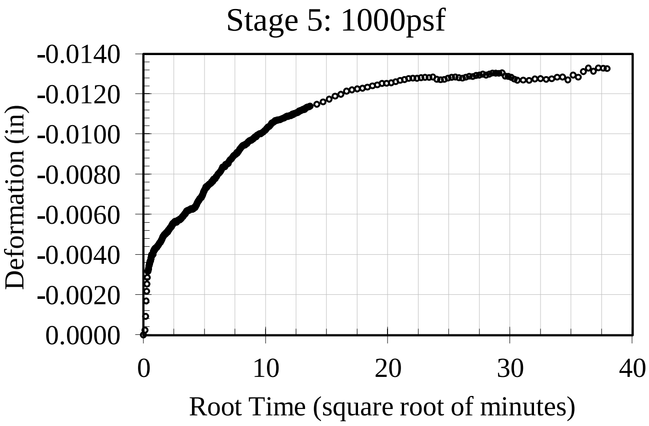
One-Dimensional Consolidation Properties of Soil

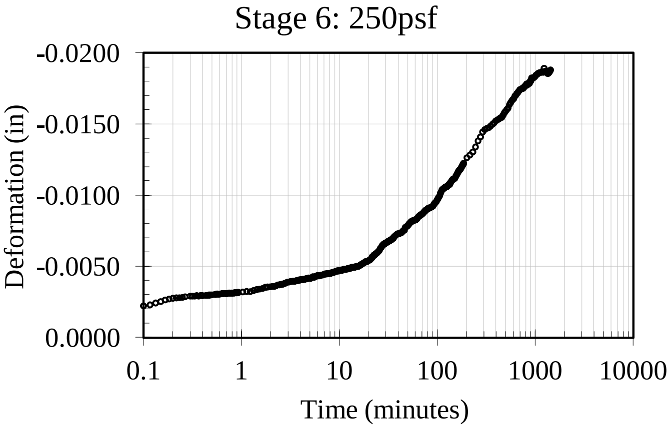
Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B204 (9-11')	Test Date:	01/17/14

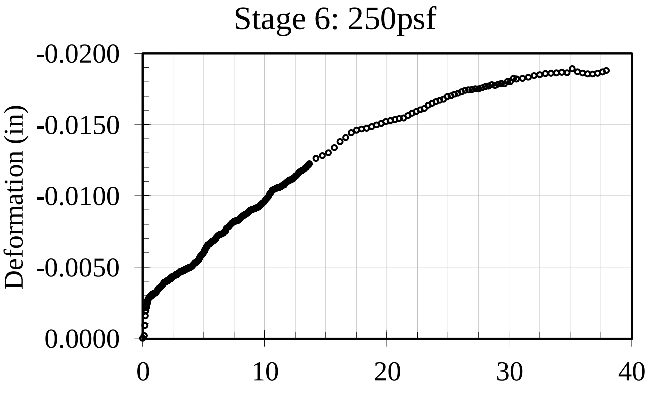








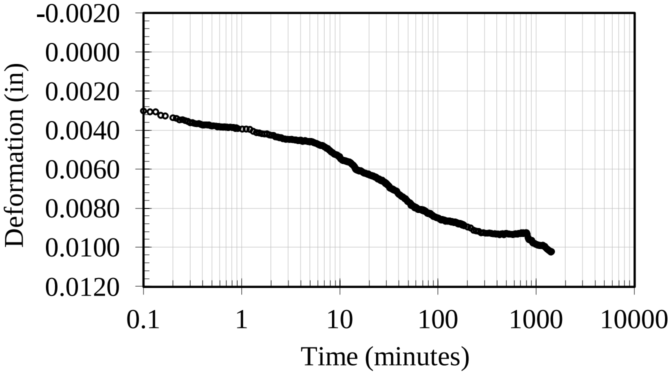




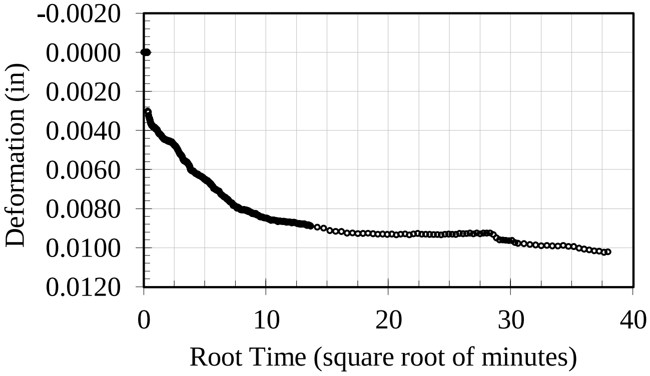
One-Dimensional Consolidation Properties of Soil

Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B204 (9-11')	Test Date:	01/17/14

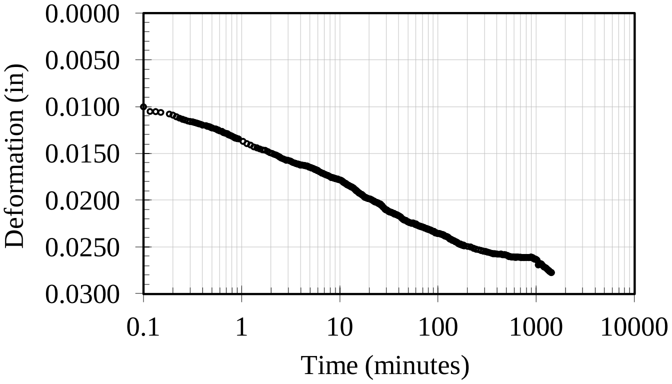
Stage 7: 1000psf



Stage 7: 1000psf



Stage 8: 4000psf



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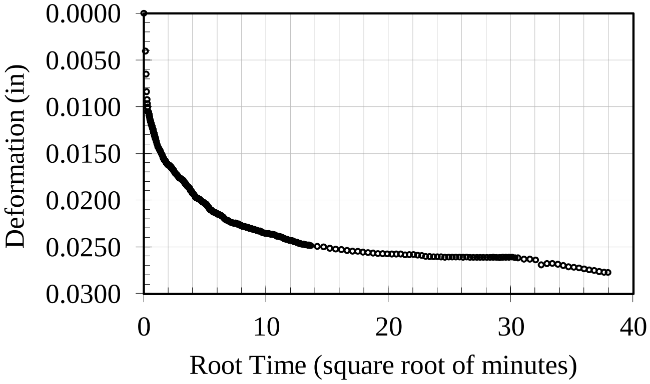
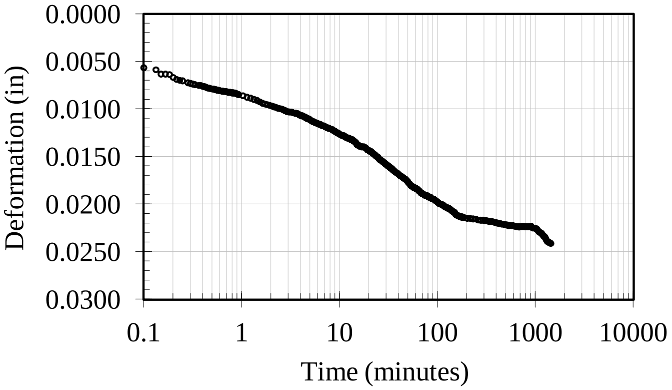
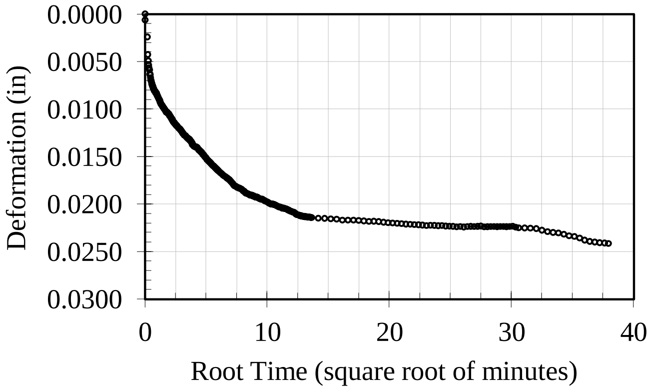


Stage 9: 8000psf



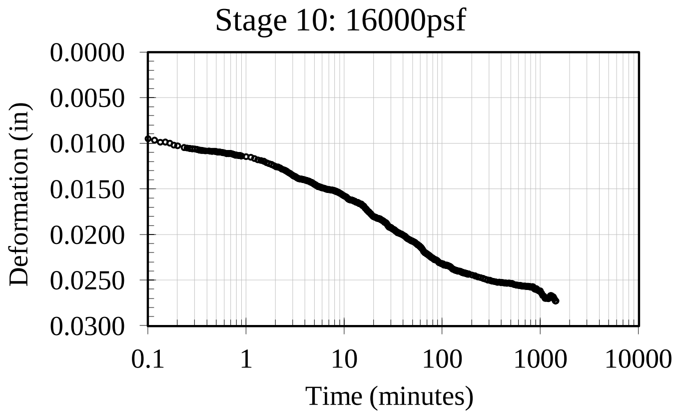
Stage 9: 8000psf

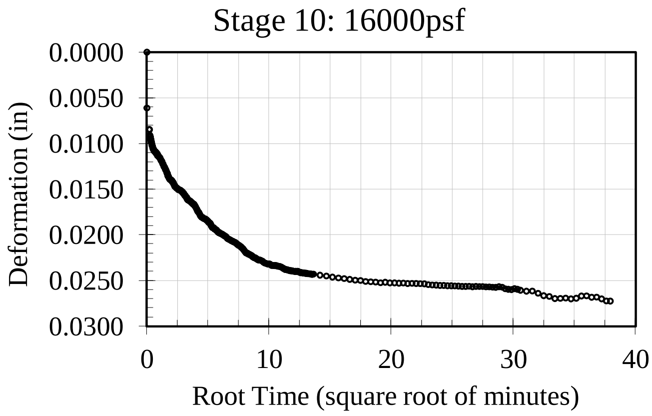


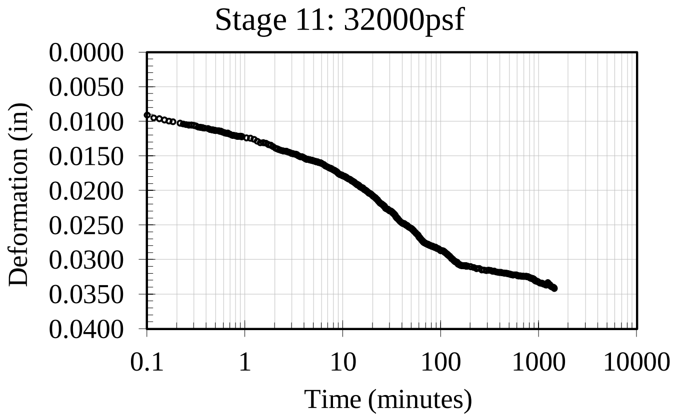
One-Dimensional Consolidation Properties of Soil

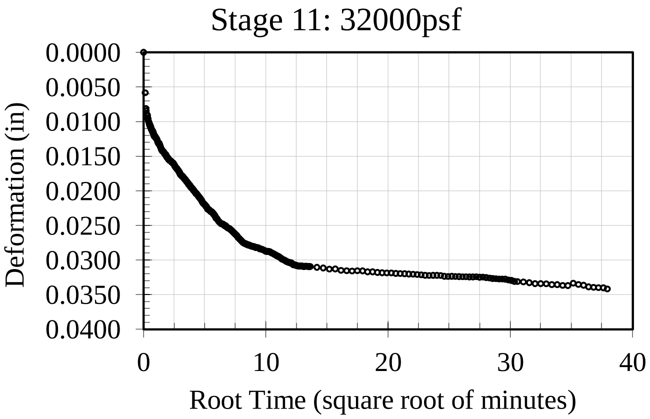
Client: Geosyntec
Project: Ft. Worth C&D
Specimen: B204 (9-11')

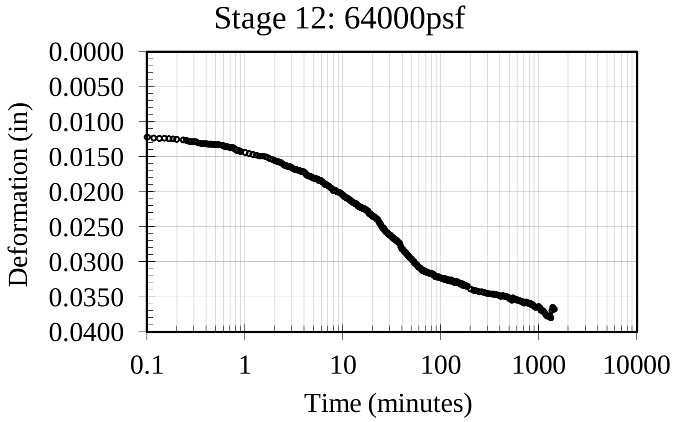
TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 01/17/14

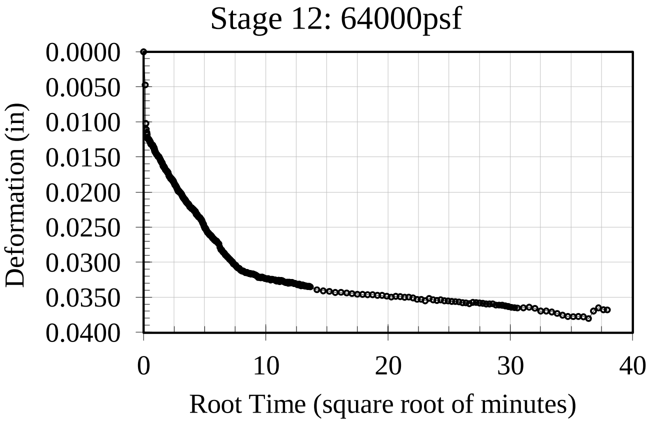








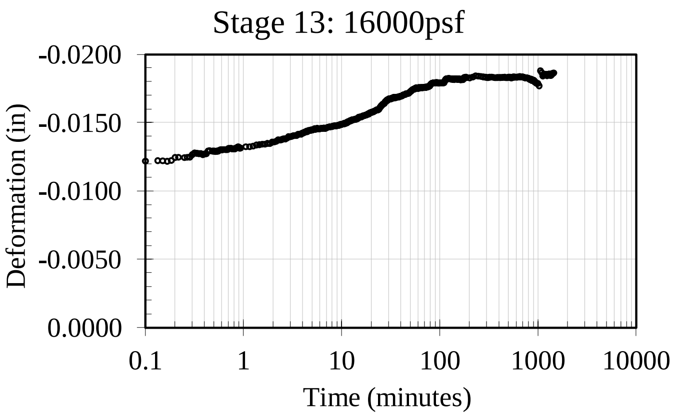


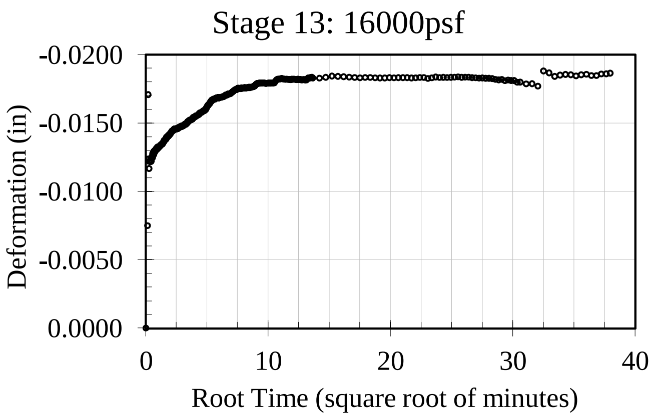


One-Dimensional Consolidation Properties of Soil

Client: Geosyntec
Project: Ft. Worth C&D
Specimen: B204 (9-11')

TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 01/17/14


Stage 13: 16000psf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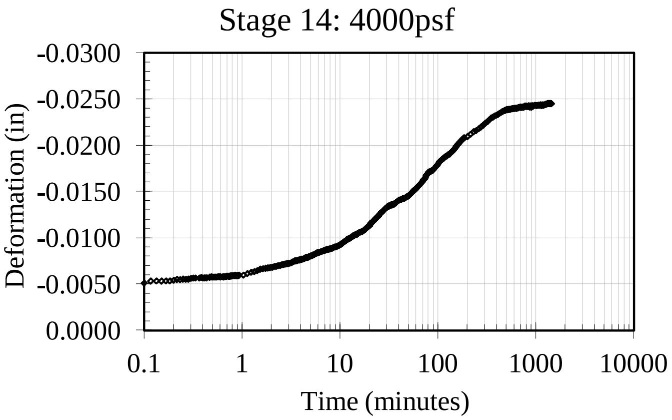
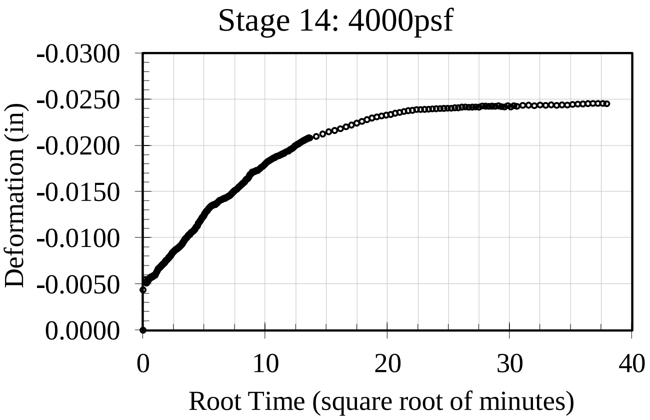
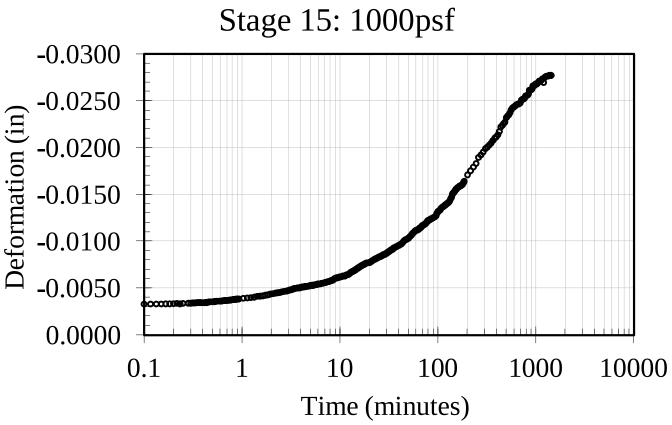
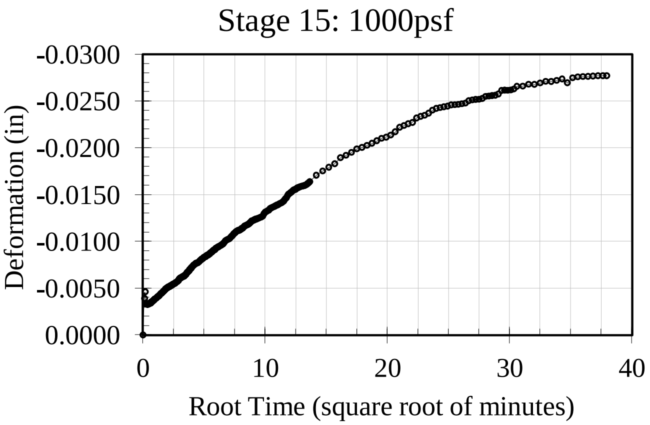

Stage 14: 4000psf


Stage 14: 4000psf


Stage 15: 1000psf


Stage 15: 1000psf

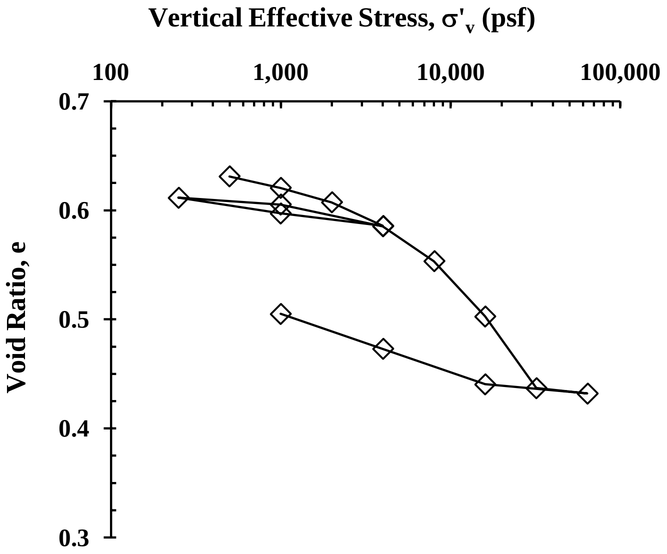
One-Dimensional Consolidation Properties of Soil

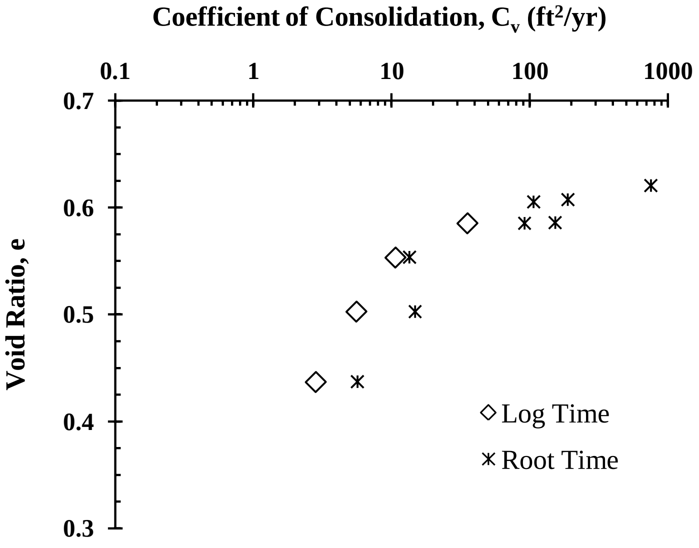
Client: Geosyntec
Project: Ft. Worth C&D
Specimen: B206 (10-12')

TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 01/17/14

Soil Specimen Properties	
Initial Specimen Water Content (%)	24.9
Final Specimen Water Content (%)	20.6
Specimen Diameter (in)	2.497
Initial Specimen Height (in)	0.999
Final Specimen Height (in)	0.918
Final Differential Height (in)	0.081
Initial Dry Unit Weight, γ_o lb_f/ft^3	101.0
Final Dry Unit Weight, γ_f lb_f/ft^3	109.9
Initial Void Ratio, e_o	0.638
Final Void Ratio, e_f	0.505
Initial Degree of Saturation (%)	≈100
Preconsolidation Pressure (psf)	≈5900
Swell Pressure (psf), Maximum Measured	198
Compression Index, C_c	0.208
Recompression Index, C_r	0.022

σ'_v	e	Strain, ε	C_v (ft^2/year)	
(psf)	(-)	(%)	Log Time	Root Time
Initial	0.638	0.0	-	-
500	0.631	0.4	-	-
1,000	0.621	1.0	-	750
2,000	0.607	1.8	-	190
4,000	0.586	3.2	-	150
1,000	0.597	2.5	-	-
250	0.612	1.6	-	-
1,000	0.605	2.0	-	110
4,000	0.585	3.2	35	92
8,000	0.553	5.1	11	13
16,000	0.503	8.2	5.5	15
32,000	0.437	12.3	2.8	5.7
64,000	0.432	12.5	-	-





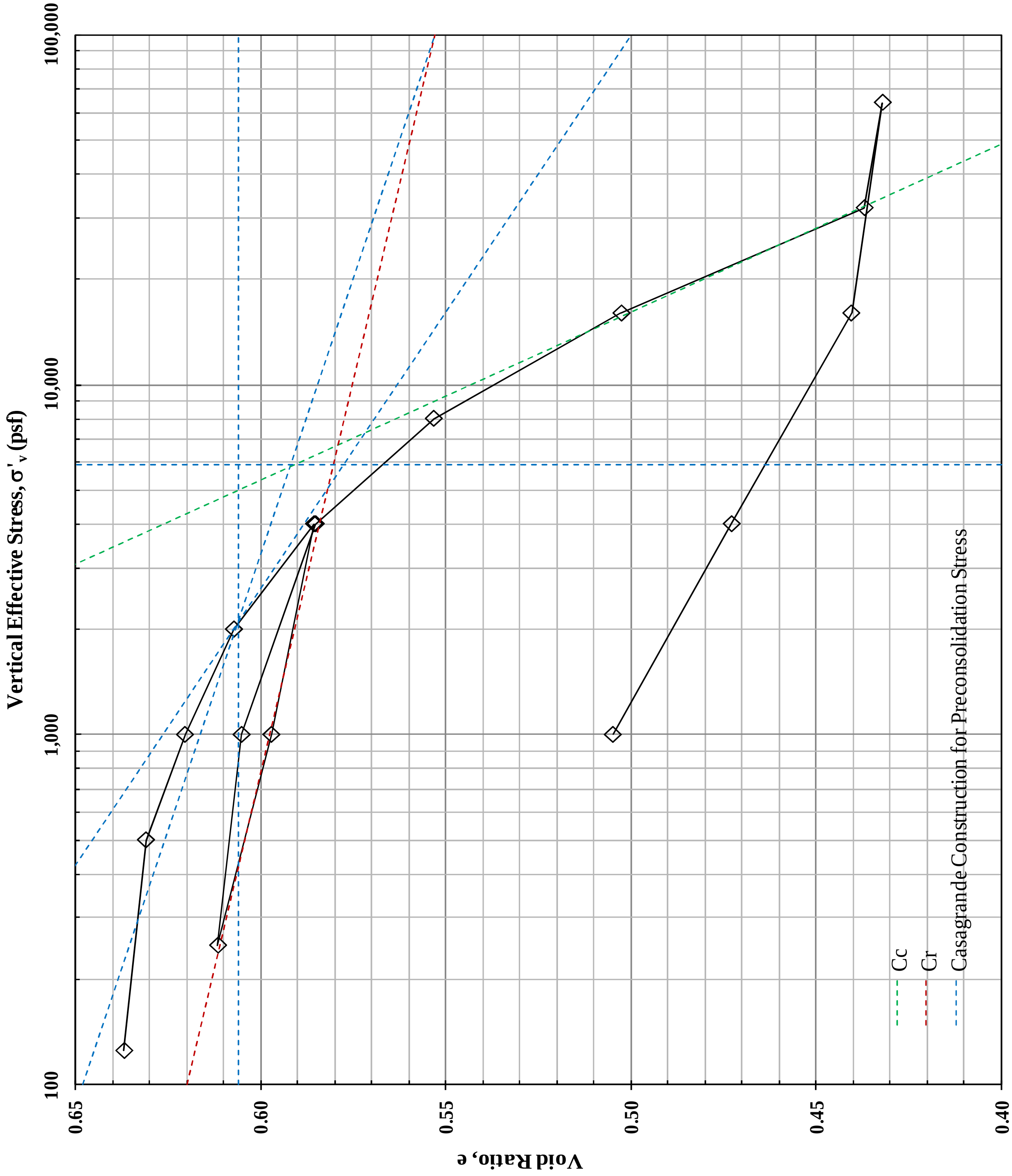
The undisturbed specimen was provided by the client. The specimen was trimmed using a trimming turntable and mounted. The specimen was inundated with tap water during testing. Coefficient of Consolidation was determined using the Log Time and Root Time Methods. Gs was assumed to be 2.65. Calculations include machine deflections measured at each loading step. The preconsolidation pressure was determined using the Casagrande construction technique.

Jeffrey A. Kuhn, Ph.D., P.E., 2/10/2014
Quality Review/Date
Specimen Prepared by: Mark Fountain, Ph.D.

One-Dimensional Consolidation Properties of Soil

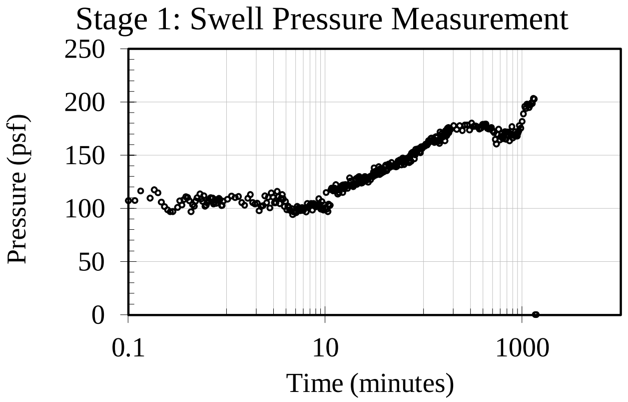
Client: Geosyntec
Project: Ft. Worth C&D
Specimen: B206 (10-12')

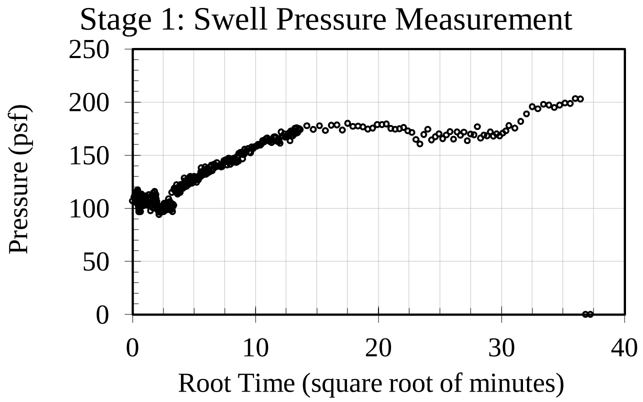
TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 01/17/14

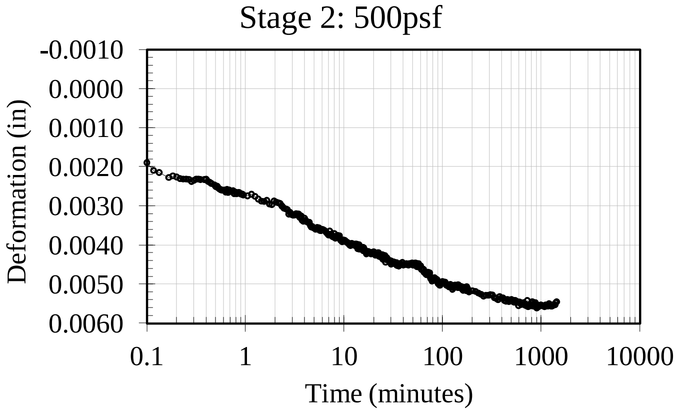


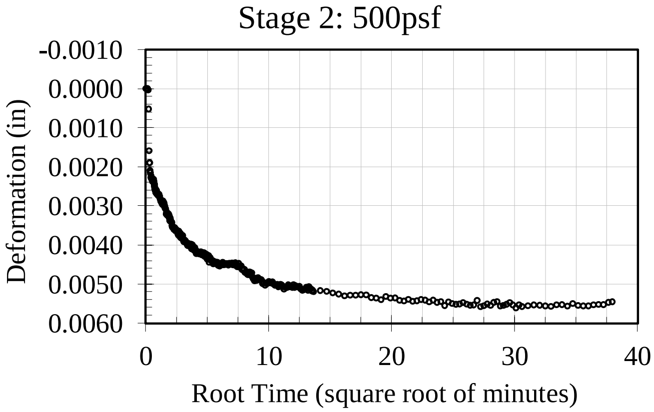
One-Dimensional Consolidation Properties of Soil

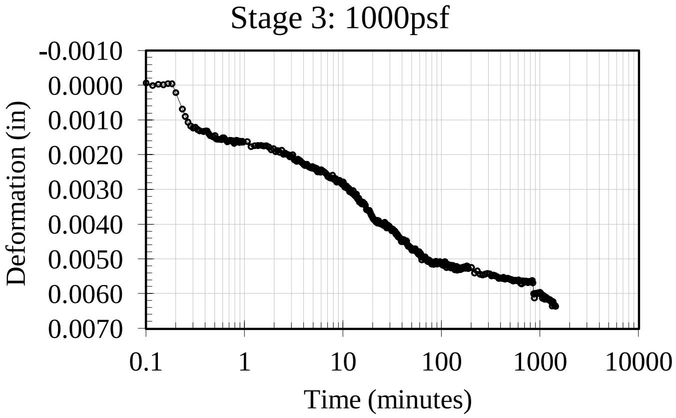
Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B206 (10-12')	Test Date:	01/17/14

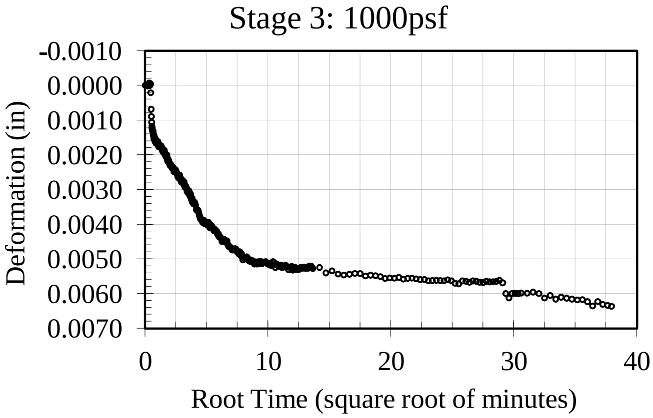

Stage 1: Swell Pressure Measurement


Stage 1: Swell Pressure Measurement


Stage 2: 500psf

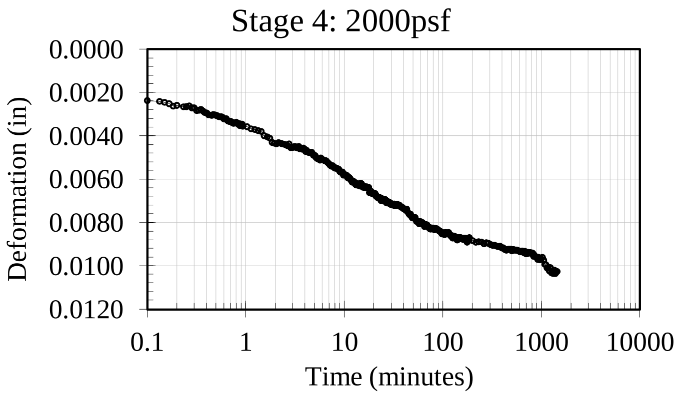

Stage 2: 500psf

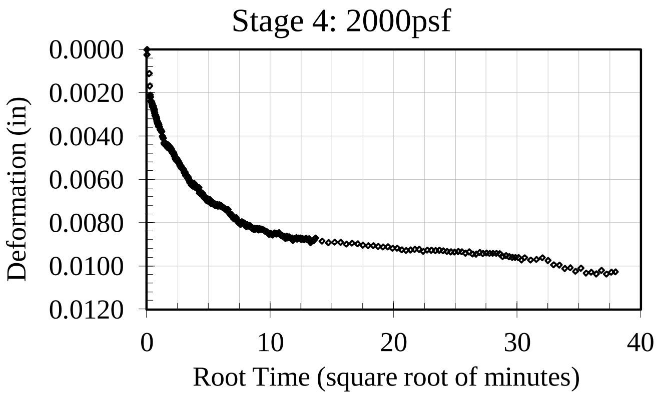

Stage 3: 1000psf

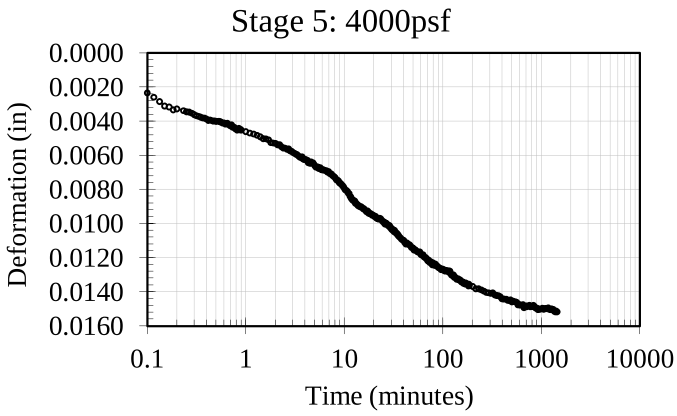

Stage 3: 1000psf

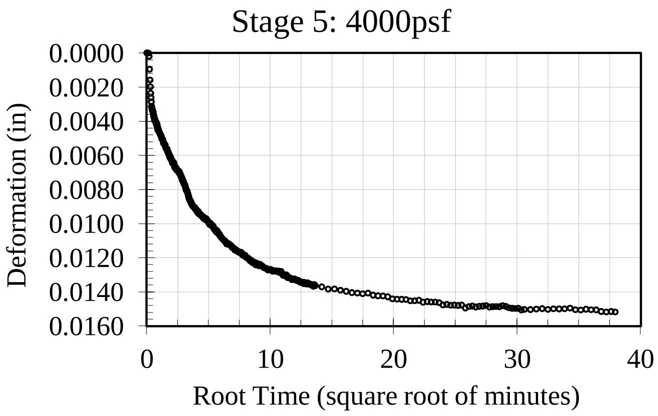
One-Dimensional Consolidation Properties of Soil

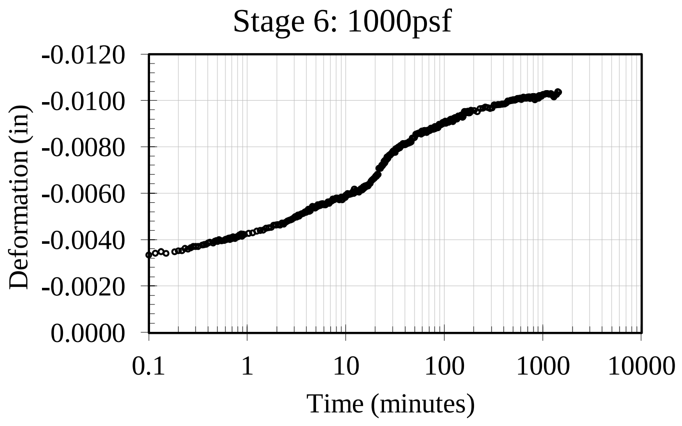
Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B206 (10-12')	Test Date:	01/17/14

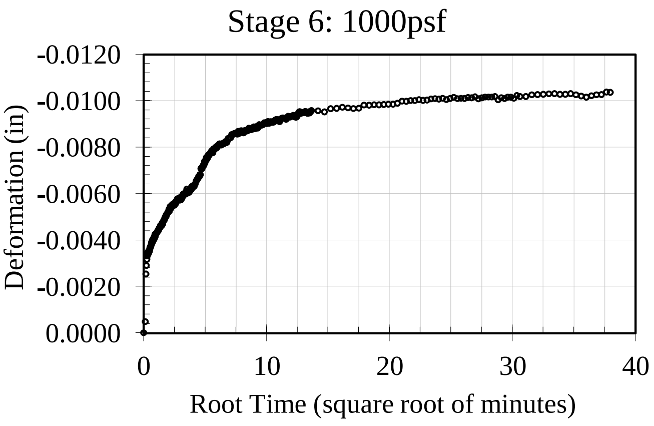








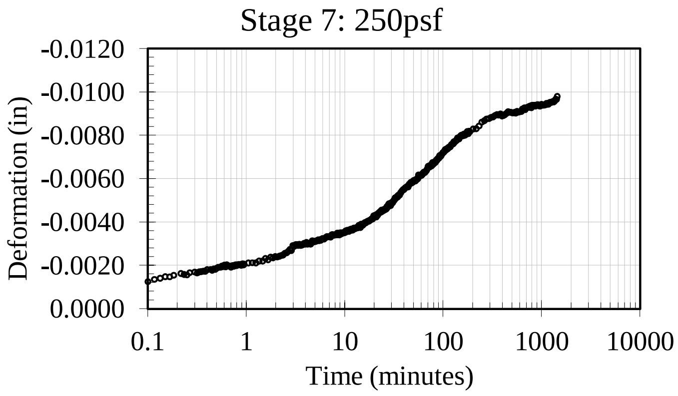


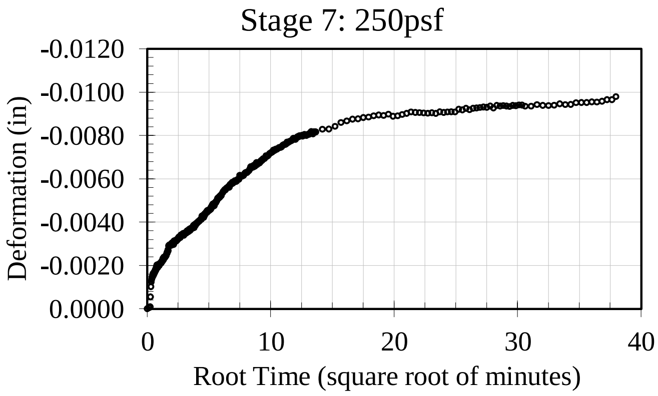


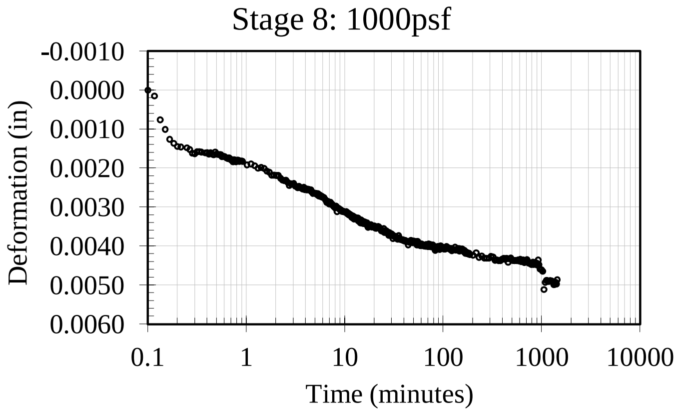
One-Dimensional Consolidation Properties of Soil

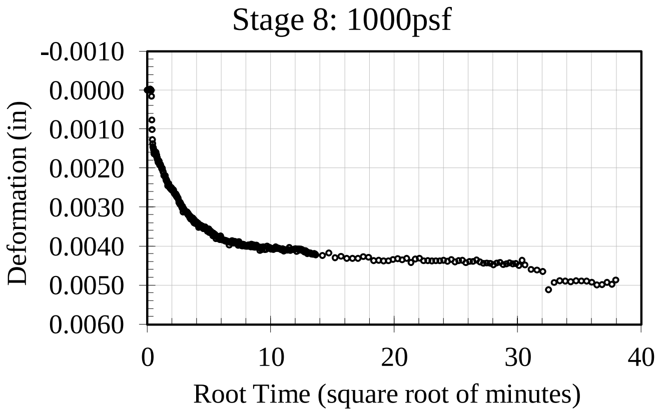
Client: Geosyntec
Project: Ft. Worth C&D
Specimen: B206 (10-12')

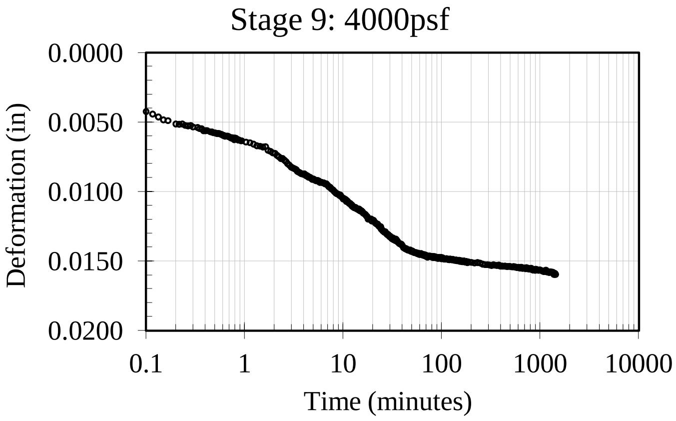
TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 01/17/14

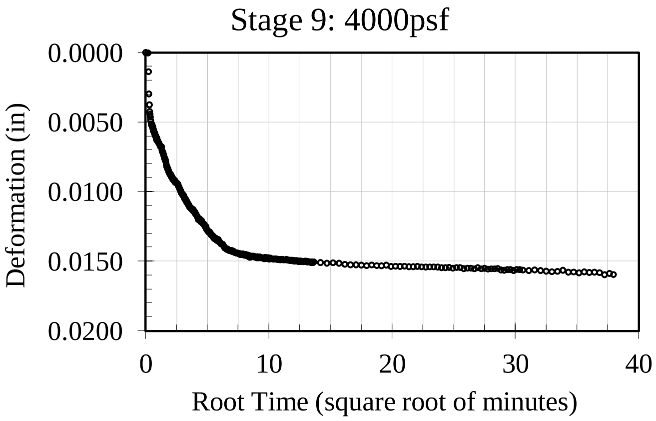








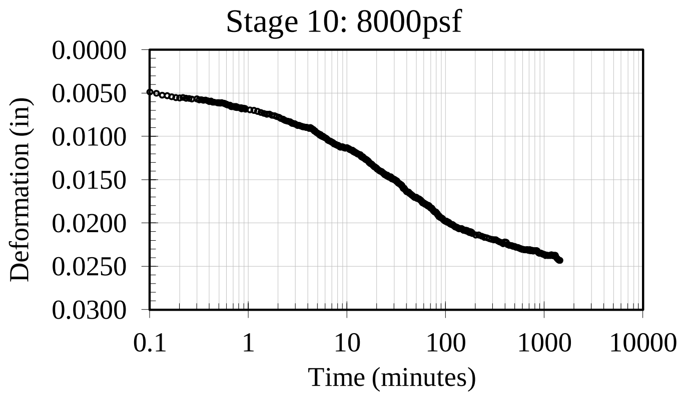


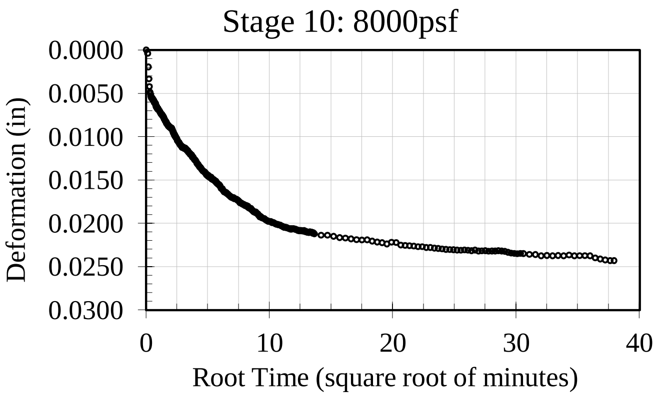


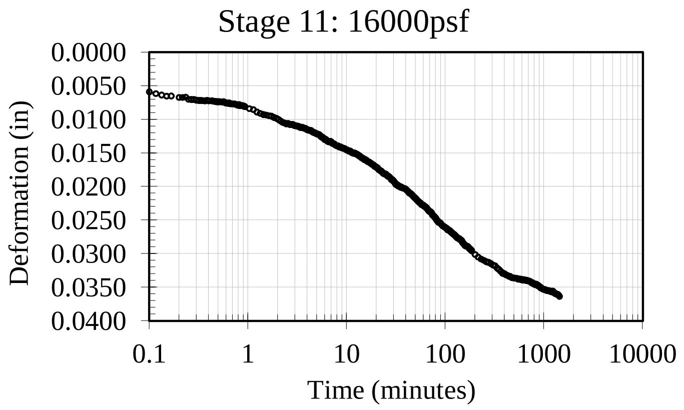
One-Dimensional Consolidation Properties of Soil

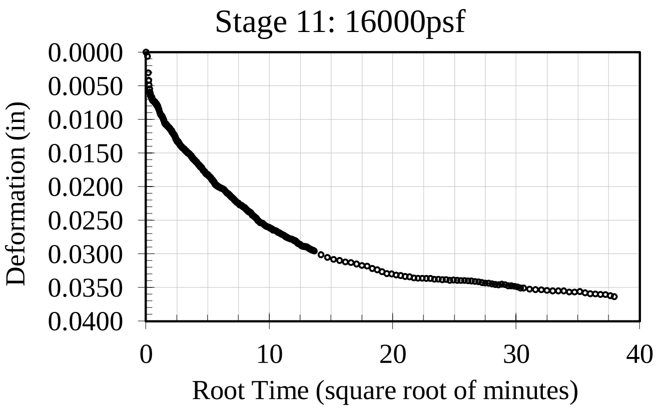
Client: Geosyntec
Project: Ft. Worth C&D
Specimen: B206 (10-12')

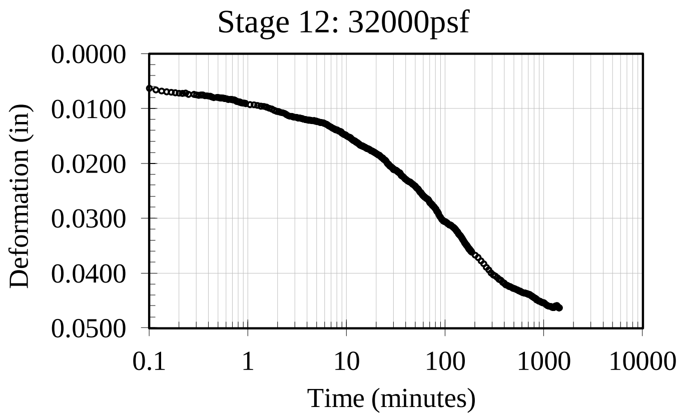
TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 01/17/14

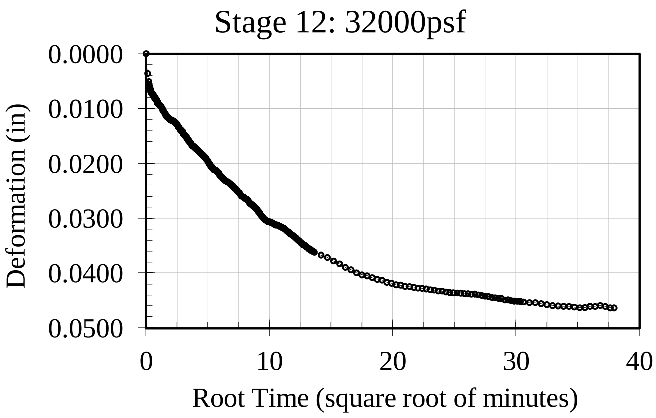

Stage 10: 8000psf


Stage 10: 8000psf


Stage 11: 16000psf

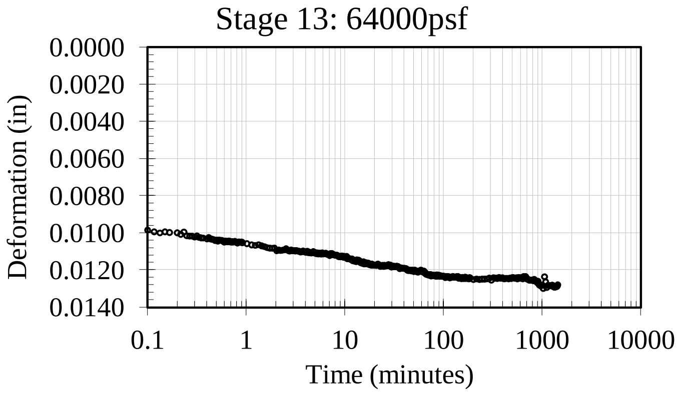

Stage 11: 16000psf

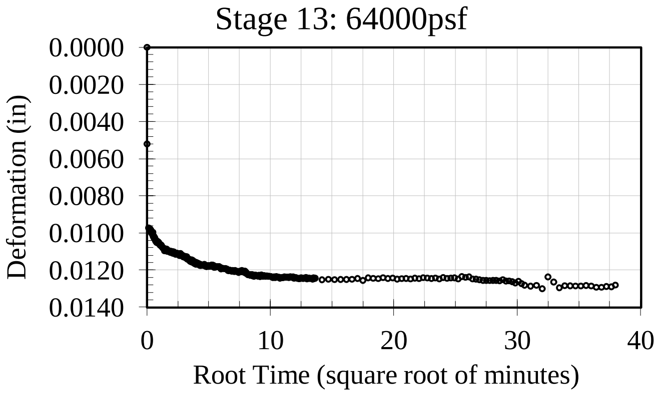

Stage 12: 32000psf

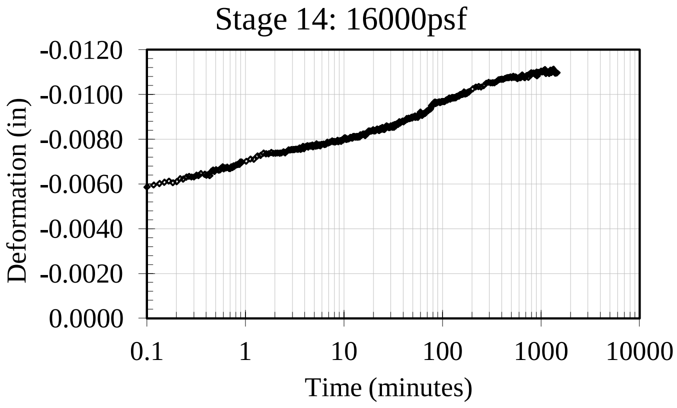

Stage 12: 32000psf

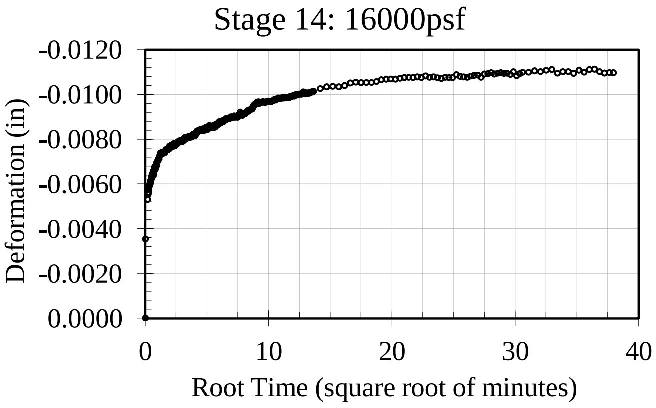
One-Dimensional Consolidation Properties of Soil

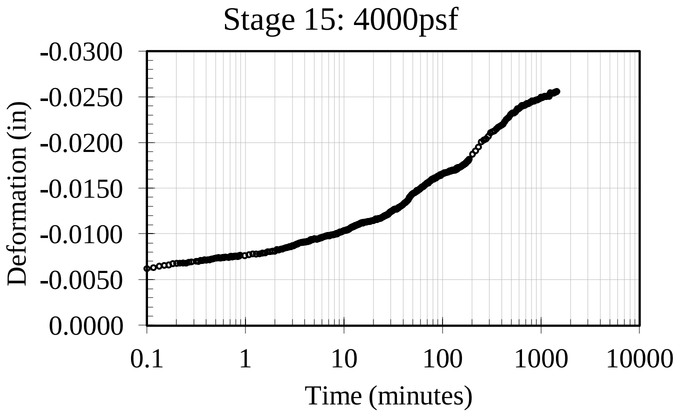
Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B206 (10-12')	Test Date:	01/17/14

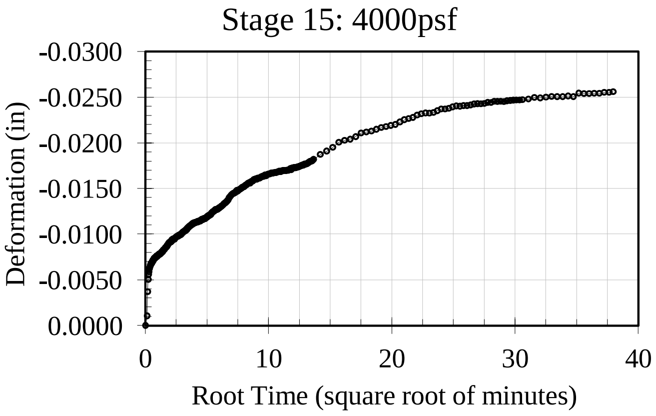








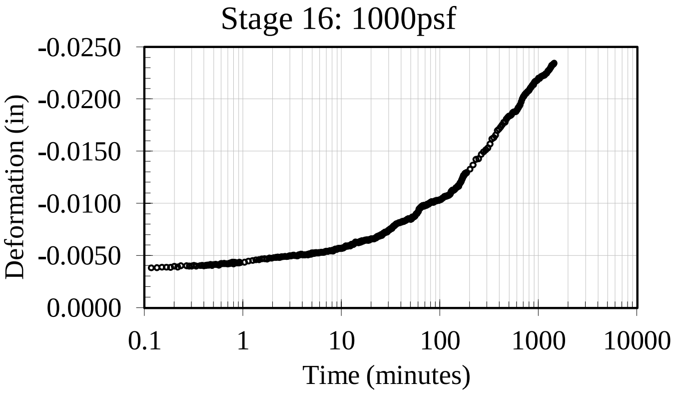


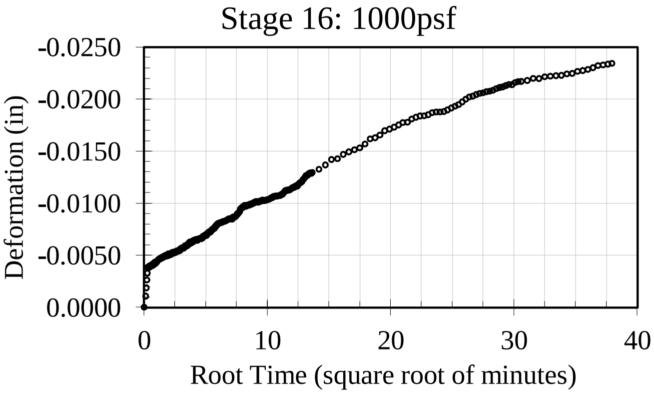


One-Dimensional Consolidation Properties of Soil

Client: Geosyntec
Project: Ft. Worth C&D
Specimen: B206 (10-12')

TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 01/17/14



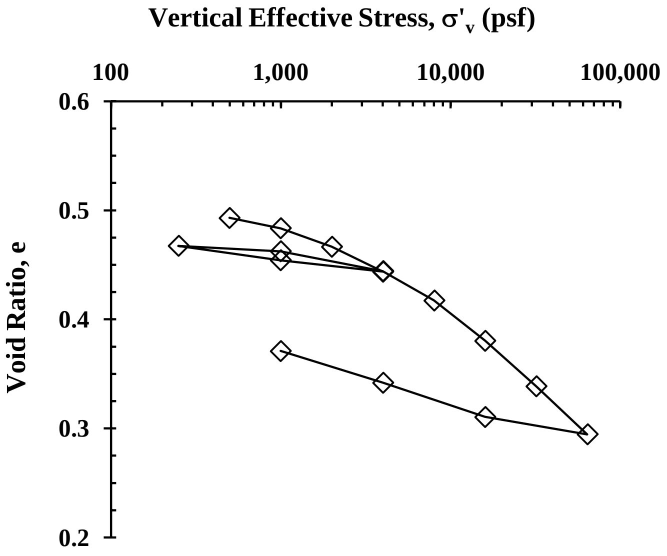


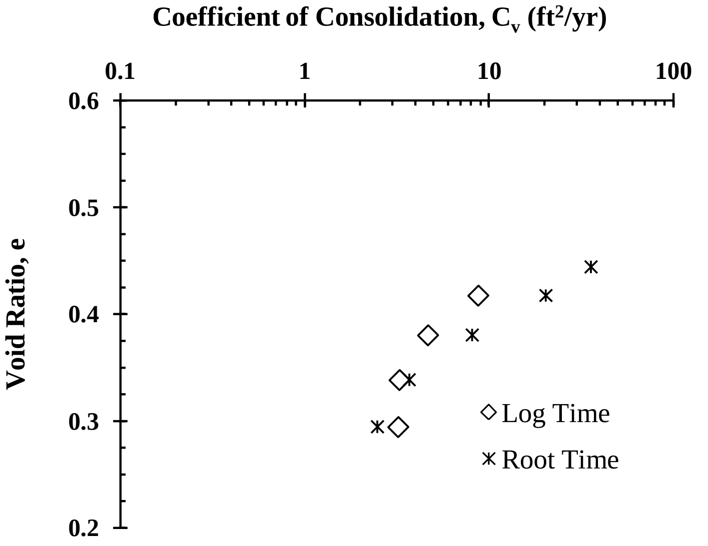
One-Dimensional Consolidation Properties of Soil

Client:	Geosyntec		TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D		Test Method:	ASTM D 2435, Method B
Specimen:	B202 (19-21')		Test Date:	01/17/14

Soil Specimen Properties	
Initial Specimen Water Content (%)	18.0
Final Specimen Water Content (%)	16.4
Specimen Diameter (in)	2.497
Initial Specimen Height (in)	0.992
Final Specimen Height (in)	0.907
Final Differential Height (in)	0.085
Initial Dry Unit Weight, γ_o lb_f/ft^3	110.2
Final Dry Unit Weight, γ_f lb_f/ft^3	120.6
Initial Void Ratio, e_o	0.500
Final Void Ratio, e_f	0.371
Initial Degree of Saturation (%)	95.5
Preconsolidation Pressure (psf)	≈3600
Swell Pressure (psf), Maximum Measured	245
Compression Index, C_c	0.140
Recompression Index, C_r	0.020

σ'_v	e	Strain, ε	C_v (ft^2/year)	
(psf)	(-)	(%)	Log Time	Root Time
Initial	0.500	0.0	-	-
500	0.493	0.5	-	-
1,000	0.483	1.1	-	-
2,000	0.467	2.2	-	-
4,000	0.444	3.8	-	-
1,000	0.454	3.1	-	-
250	0.467	2.2	-	-
1,000	0.462	2.5	-	-
4,000	0.444	3.7	-	36
8,000	0.417	5.5	8.75	20
16,000	0.380	8.0	4.67	8
32,000	0.339	10.8	3.27	4
64,000	0.294	13.7	3.21	2





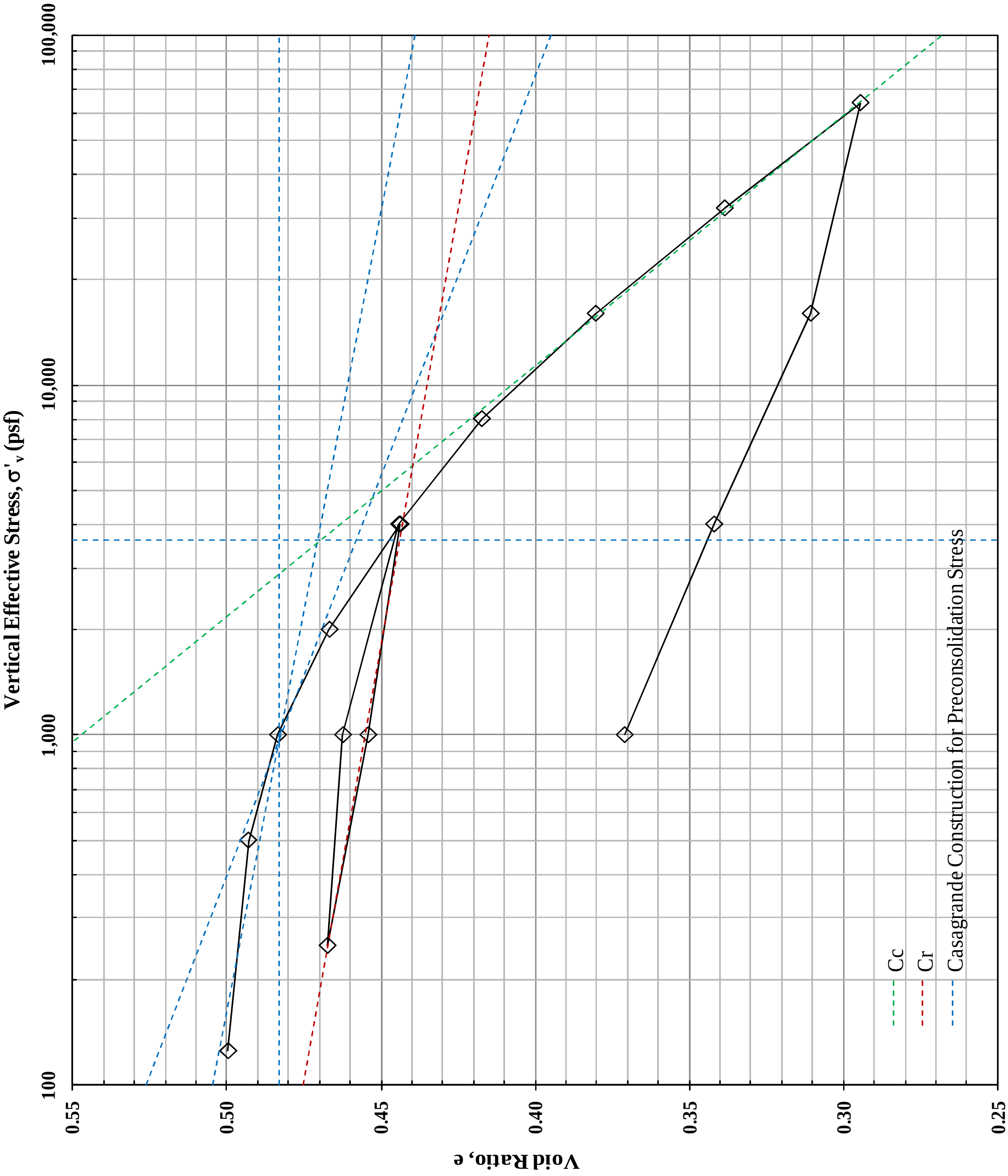
The undisturbed specimen was provided by the client. The specimen was trimmed using a trimming turntable and mounted. The specimen was inundated with tap water during testing. Coefficient of Consolidation was determined using the Log Time and Root Time Methods. Gs was assumed to be 2.65. Calculations include machine deflections measured at each loading step. The preconsolidation pressure was determined using the Casagrande construction technique.

Jeffrey A. Kuhn, Ph.D., P.E., 2/10/2014
Quality Review/Date
Specimen Prepared by: Mark Fountain, Ph.D.

One-Dimensional Consolidation Properties of Soil

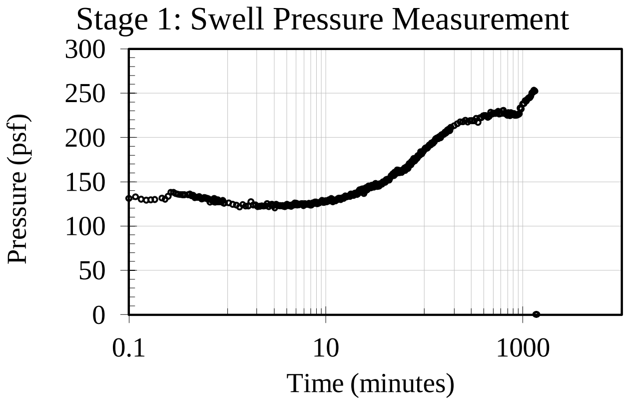
Client: Geosyntec
Project: Ft. Worth C&D
Specimen: B202 (19-21')

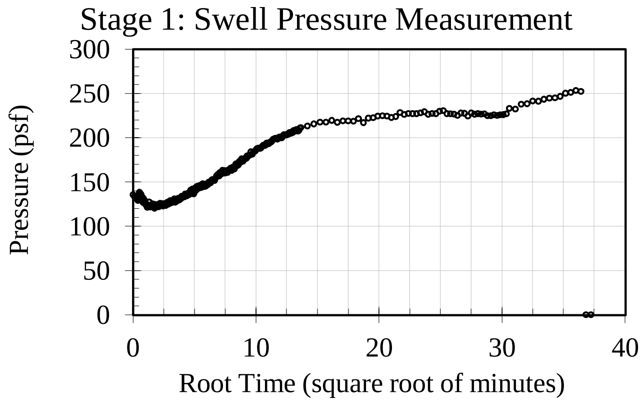
TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 01/17/14

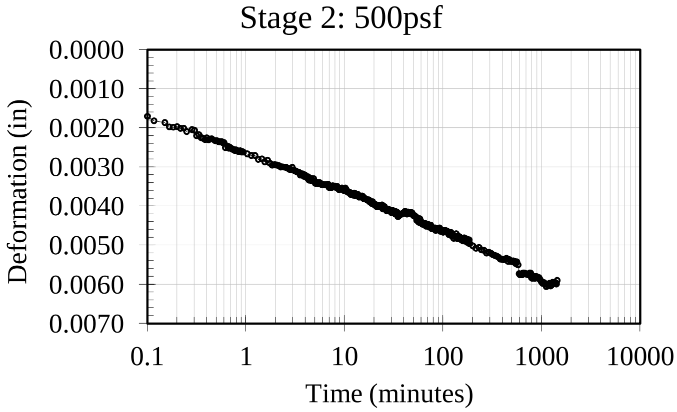


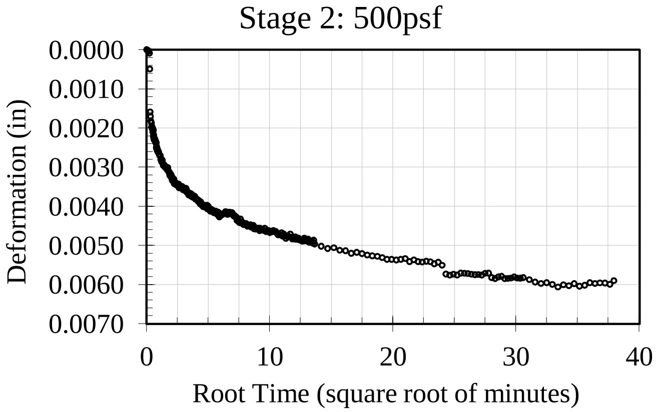
One-Dimensional Consolidation Properties of Soil

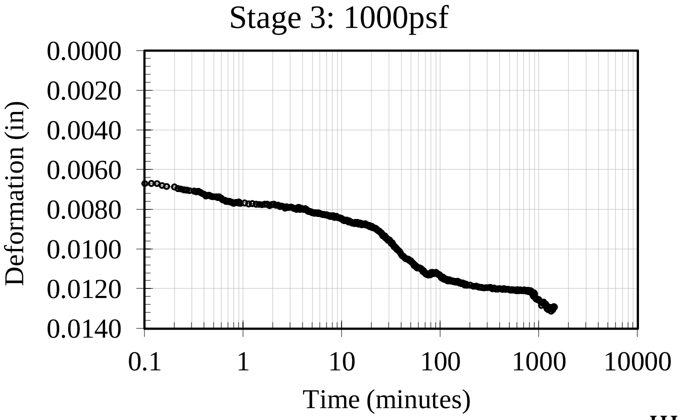
Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B202 (19-21')	Test Date:	01/17/14

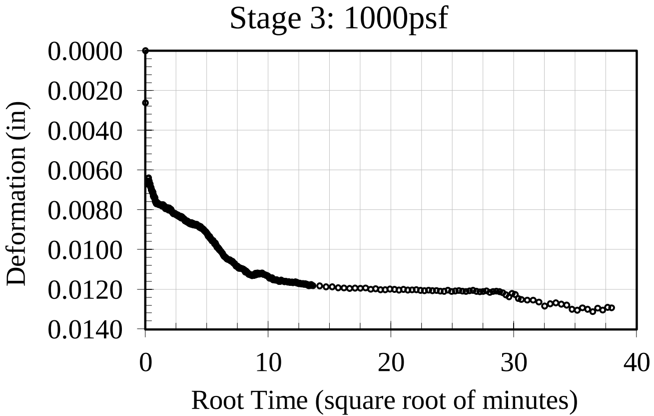






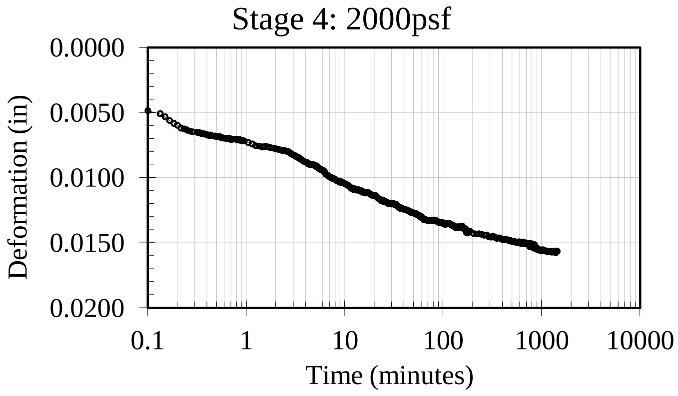


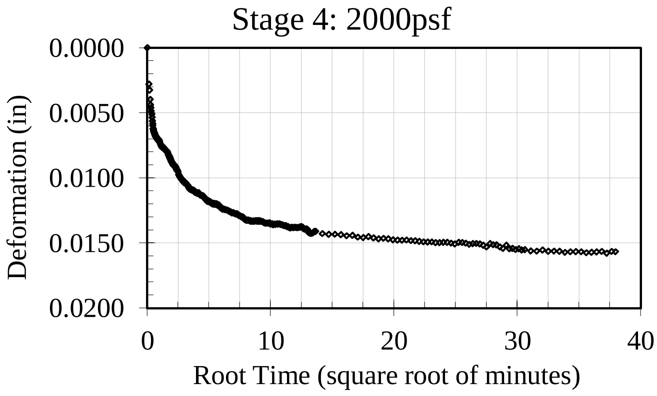


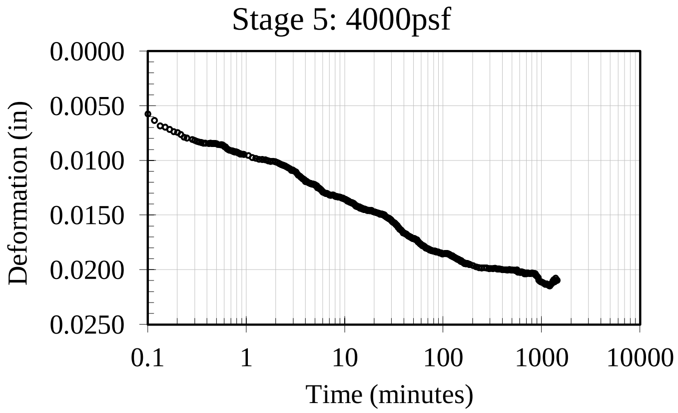


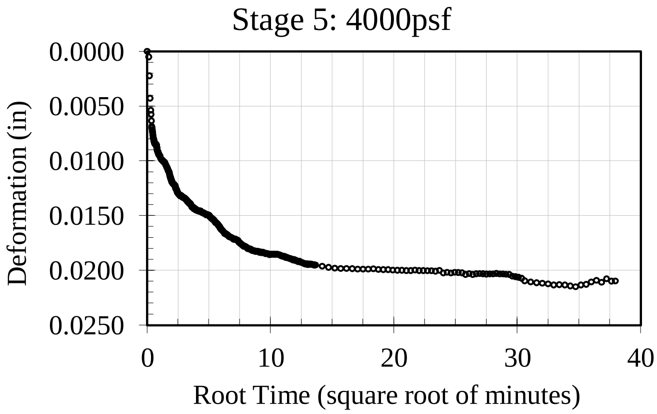
One-Dimensional Consolidation Properties of Soil

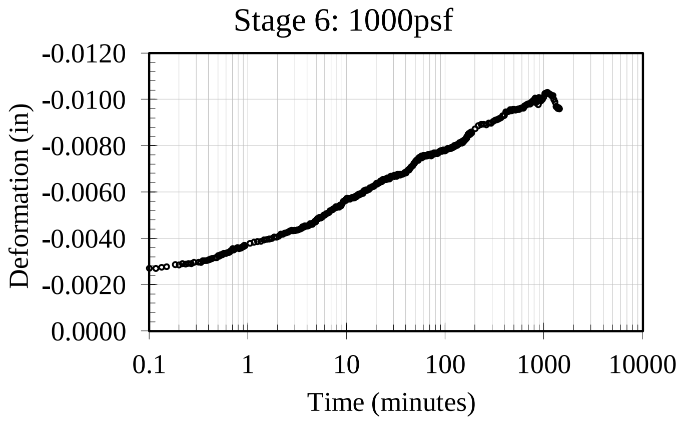
Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B202 (19-21')	Test Date:	01/17/14

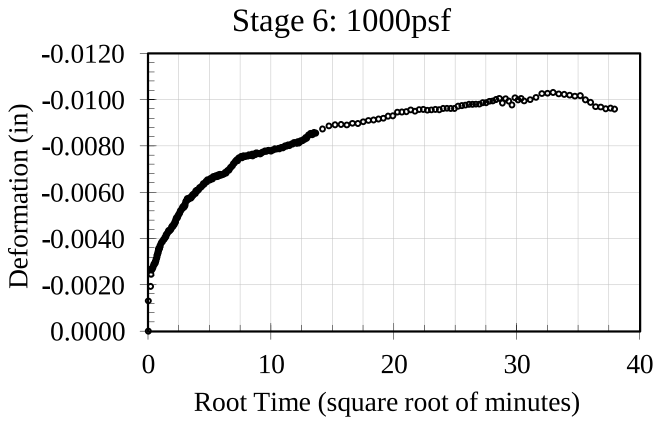








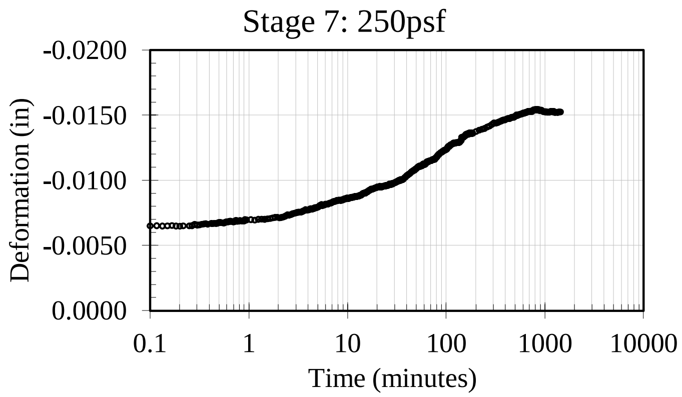


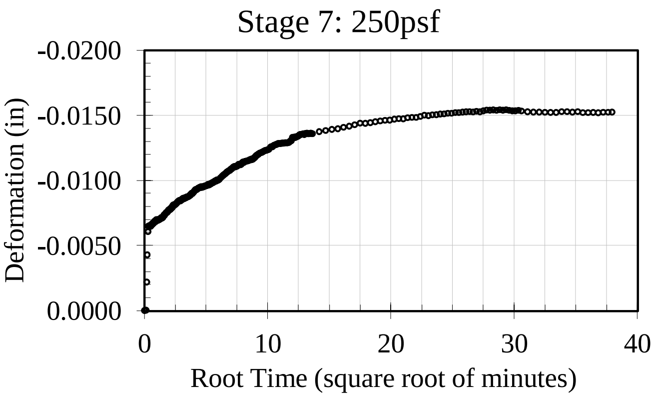


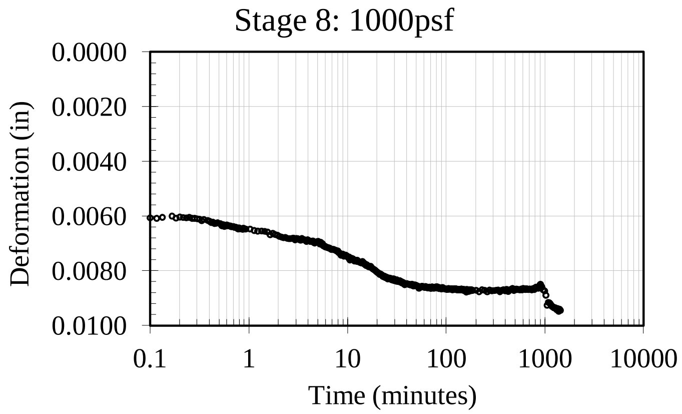
One-Dimensional Consolidation Properties of Soil

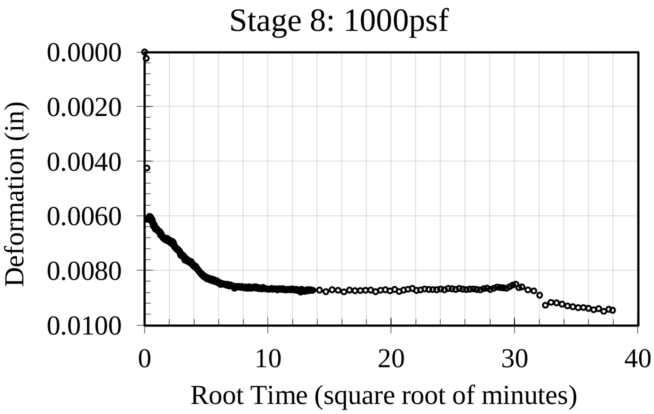
Client: Geosyntec
Project: Ft. Worth C&D
Specimen: B202 (19-21')

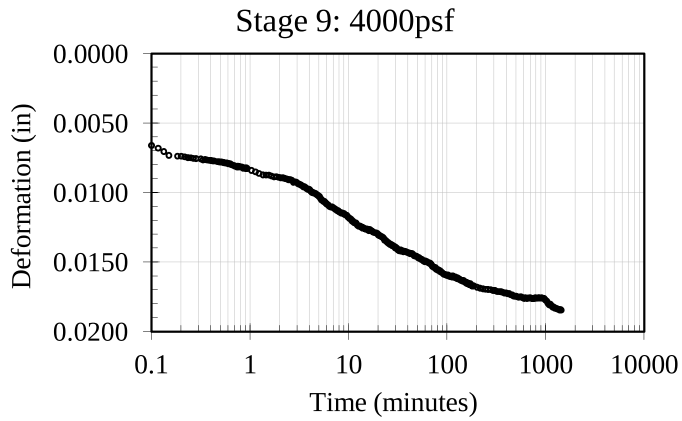
TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 01/17/14

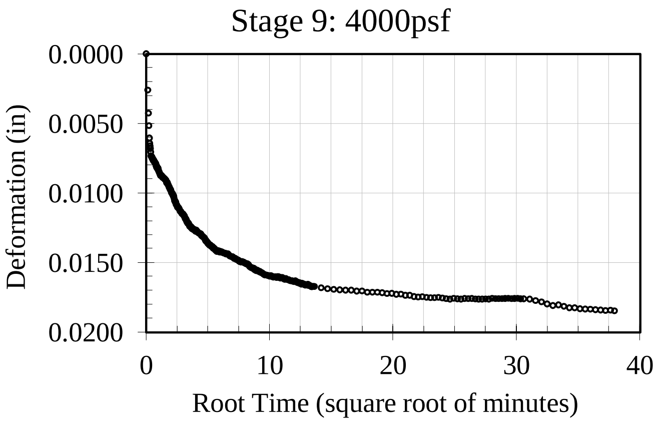






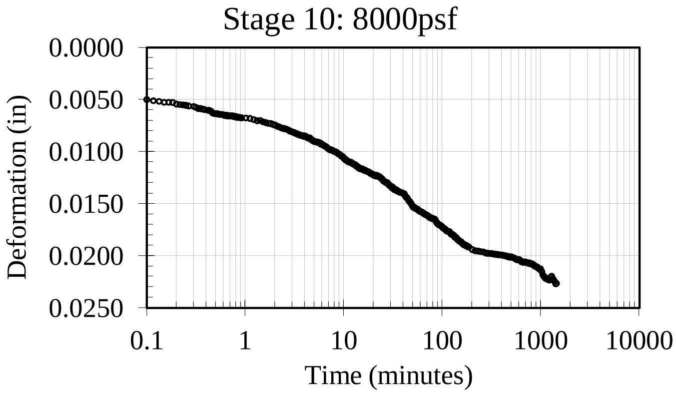


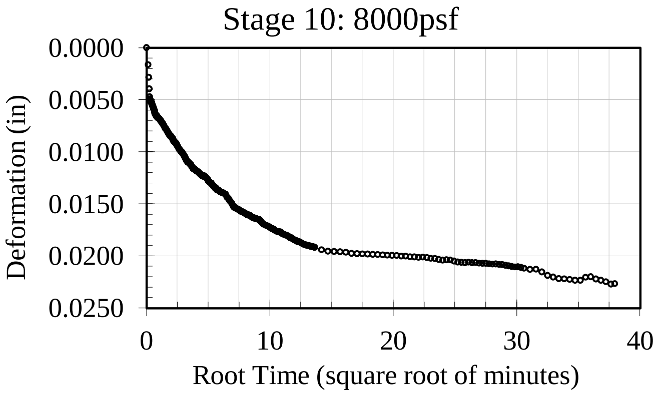


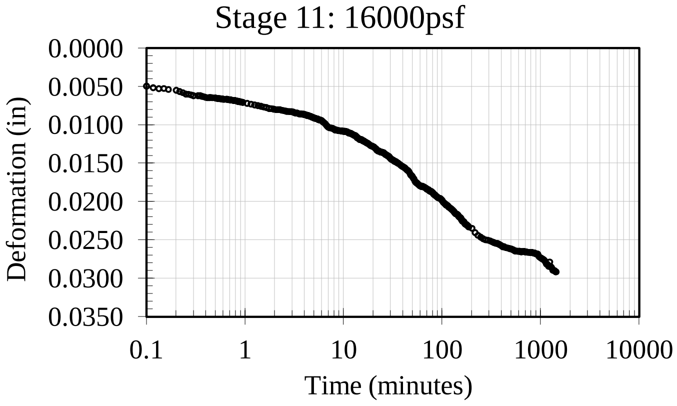


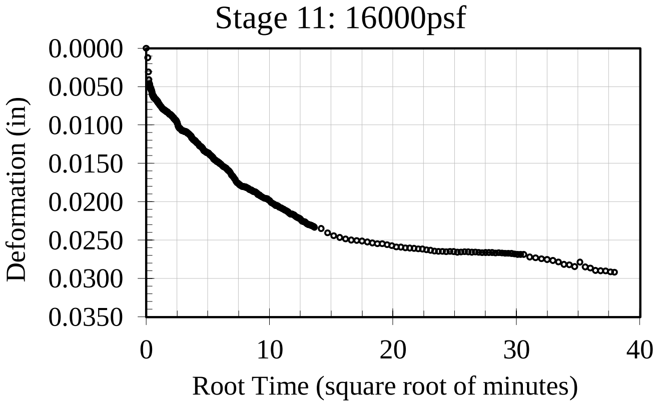
One-Dimensional Consolidation Properties of Soil

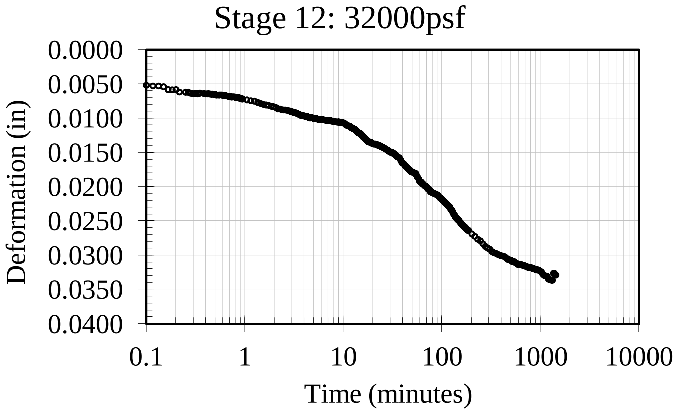
Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B202 (19-21')	Test Date:	01/17/14

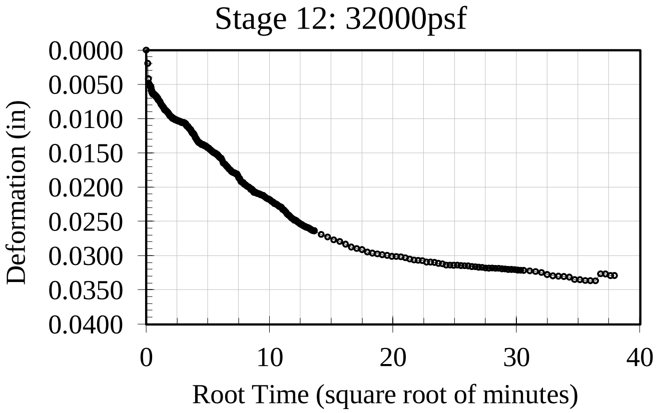






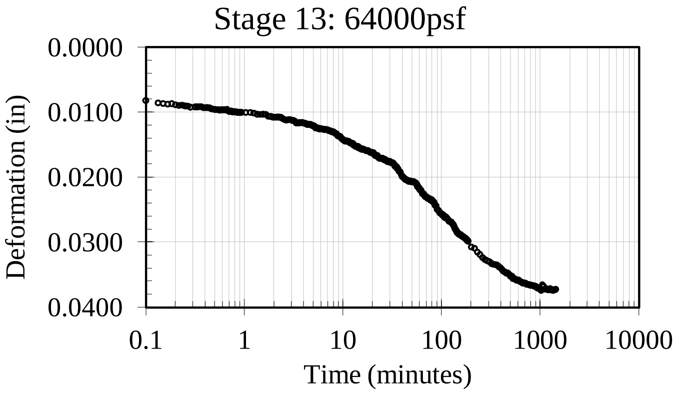


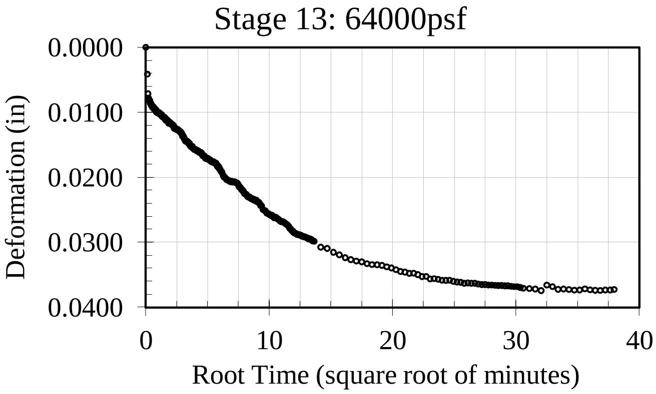


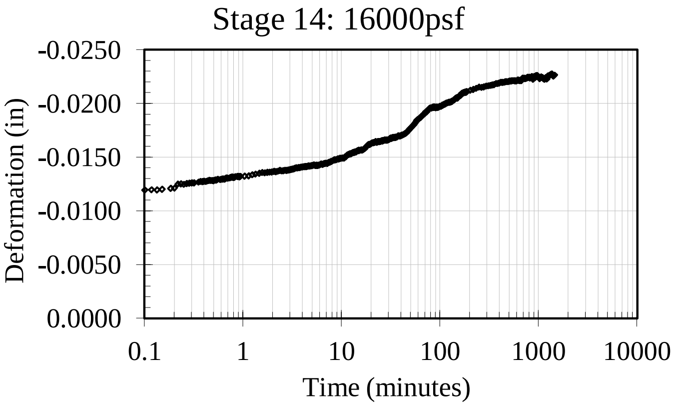


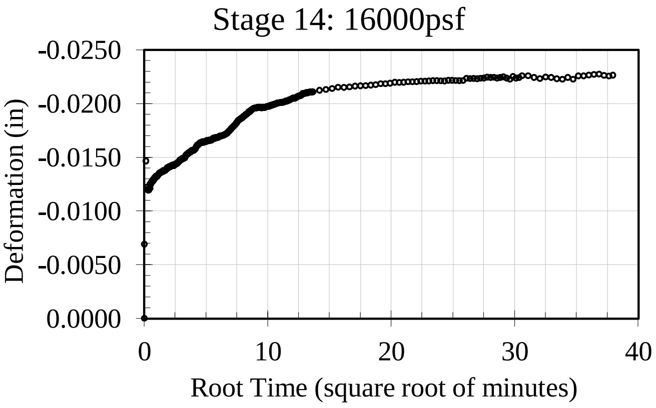
One-Dimensional Consolidation Properties of Soil

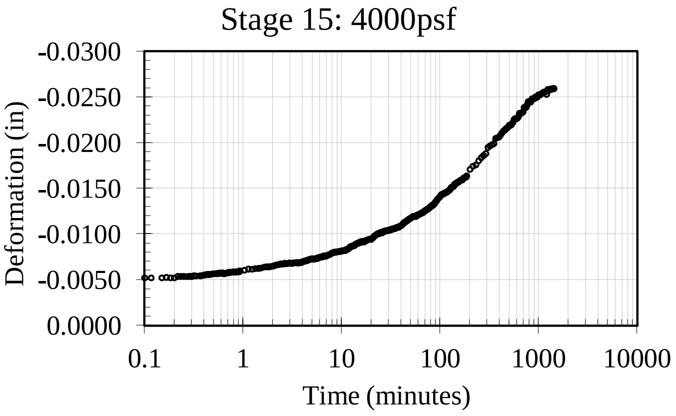
Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B202 (19-21')	Test Date:	01/17/14

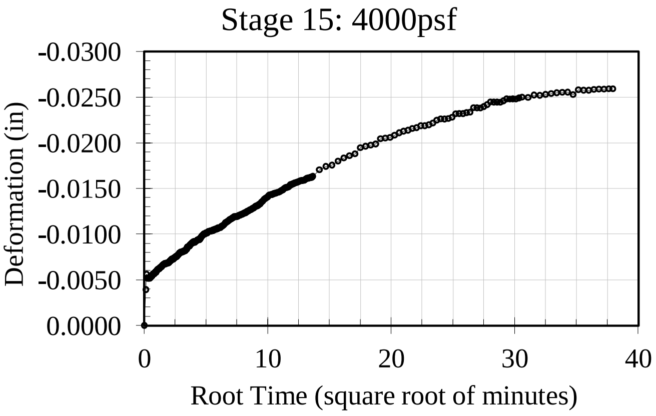






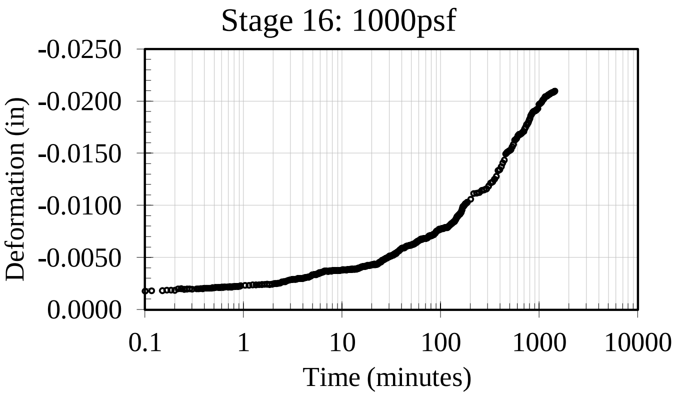


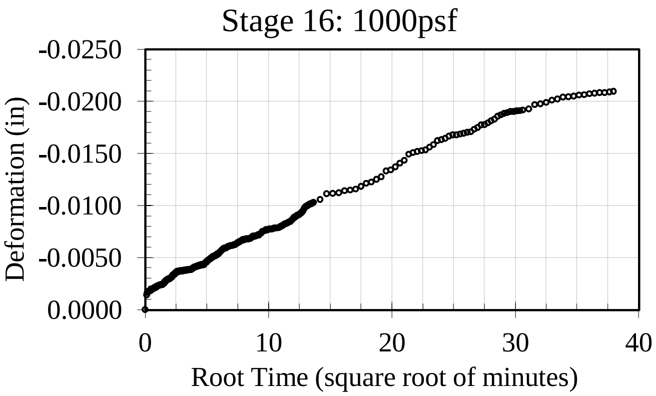




One-Dimensional Consolidation Properties of Soil

Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B202 (19-21')	Test Date:	01/17/14





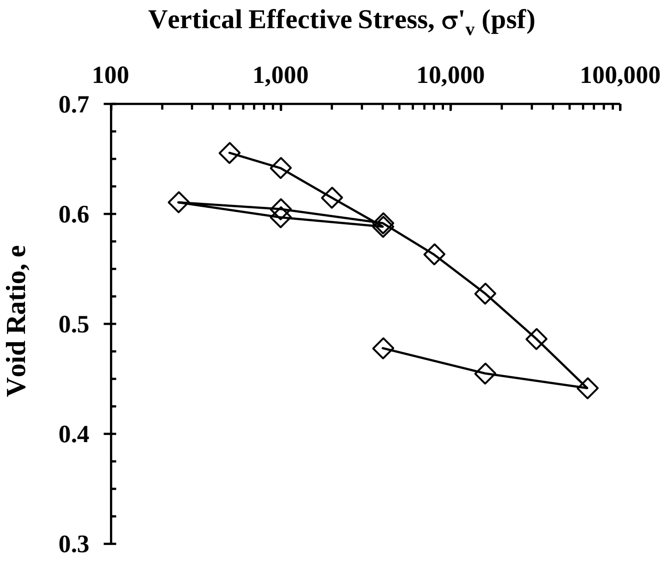
IIIM-C-122
8 of 8

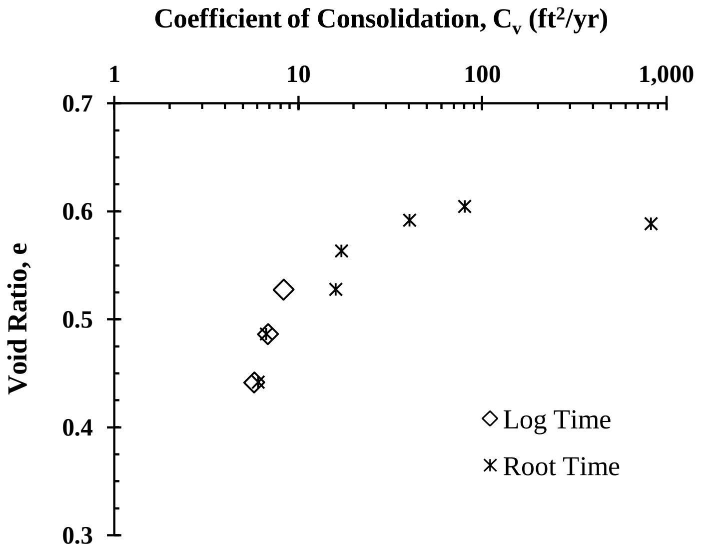
One-Dimensional Consolidation Properties of Soil

Client:	Geosyntec Consultants, Inc.	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B-203 13-15'	Test Date:	02/03/14

Soil Specimen Properties	
Initial Specimen Water Content (%)	17.5
Final Specimen Water Content (%)	19.1
Specimen Diameter (in)	2.497
Initial Specimen Height (in)	1.003
Final Specimen Height (in)	0.878
Final Differential Height (in)	0.125
Initial Dry Unit Weight, γ_o lb_f/ft^3	99.5
Final Dry Unit Weight, γ_f lb_f/ft^3	113.7
Initial Void Ratio, e_o	0.662
Final Void Ratio, e_f	0.455
Initial Degree of Saturation (%)	70.0
Preconsolidation Pressure (psf)	≈6200
Swell Pressure (psf), Maximum Measured	219
Compression Index, C_c	0.144
Recompression Index, C_r	0.017

σ'$_v$	e	Strain, ε	C_v (ft^2/year)	
(psf)	(-)	(%)	Log Time	Root Time
Initial	0.662	0.0	-	-
500	0.656	0.4	-	-
1,000	0.642	1.2	-	-
2,000	0.615	2.9	-	-
4,000	0.588	4.4	-	830
1,000	0.597	3.9	-	-
250	0.611	3.1	-	-
1,000	0.604	3.5	-	80
4,000	0.592	4.3	-	40
8,000	0.563	6.0	-	17
16,000	0.528	8.1	8.3	16
32,000	0.486	10.6	6.8	6.7
64,000	0.442	13.3	5.8	6.1
16,000	0.455	12.5	-	-
4,000	0.478	11.1	-	-



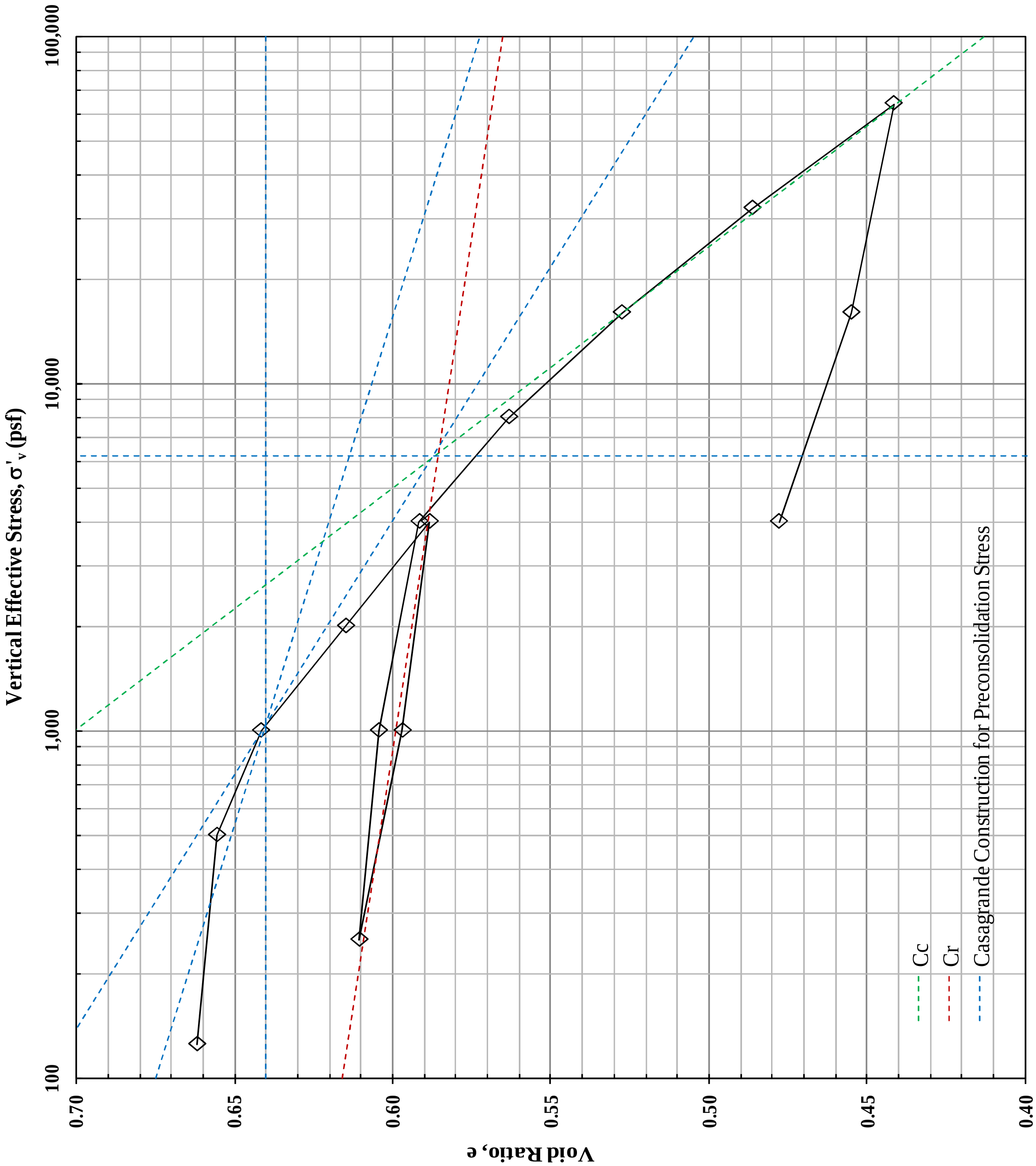


The undisturbed specimen was provided by the client. The specimen was trimmed using a trimming turntable and mounted. The specimen was inundated with tap water during testing. Coefficient of Consolidation was determined using the Log Time and Root Time Methods. Gs was assumed to be 2.65. Calculations include machine deflections measured at each loading step. The preconsolidation pressure was determined using the Casagrande construction technique.

Jeffrey A. Kuhn, Ph.D., P.E., 2/24/2014
Quality Review/Date
Specimen Prepared by: Mark Fountain, Ph.D.

One-Dimensional Consolidation Properties of Soil

Client:	Geosyntec Consultants, Inc.	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B-203 13-15'	Test Date:	02/03/14

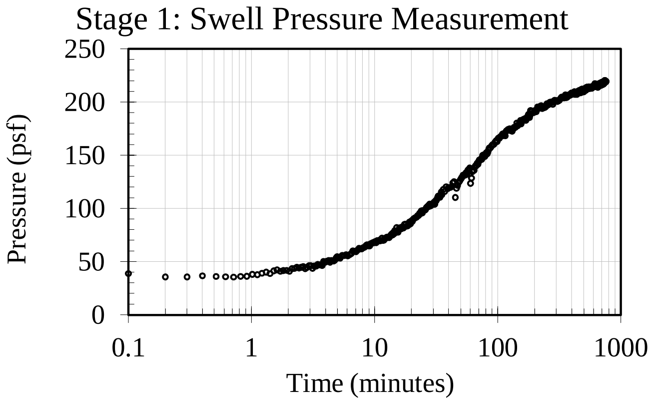


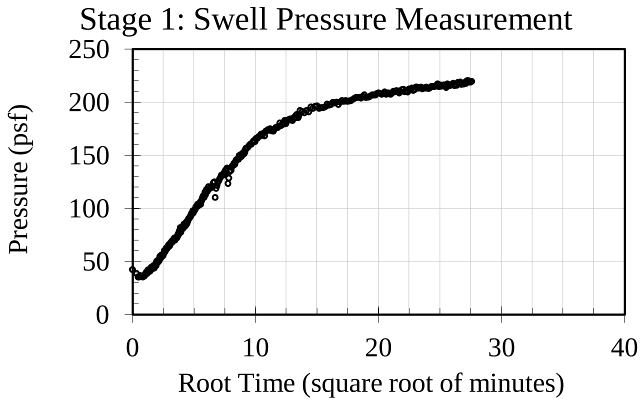
IIIM-C-124

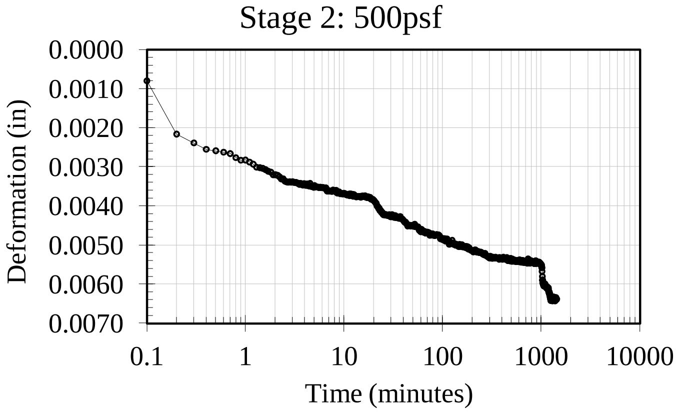
One-Dimensional Consolidation Properties of Soil

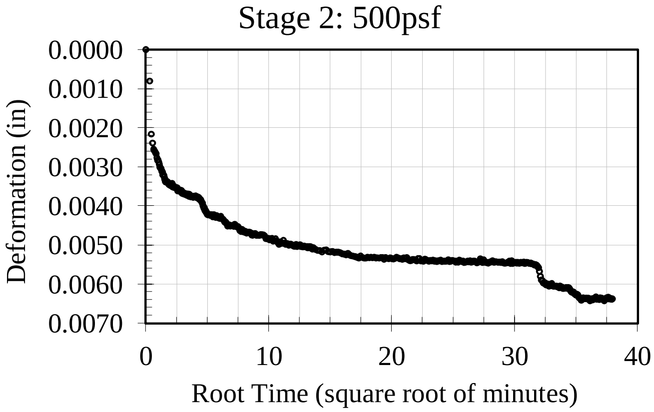
Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Specimen: B-203 13-15'

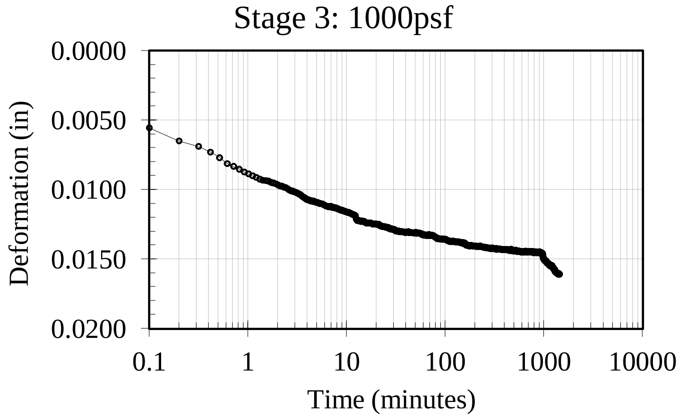
TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 02/03/14

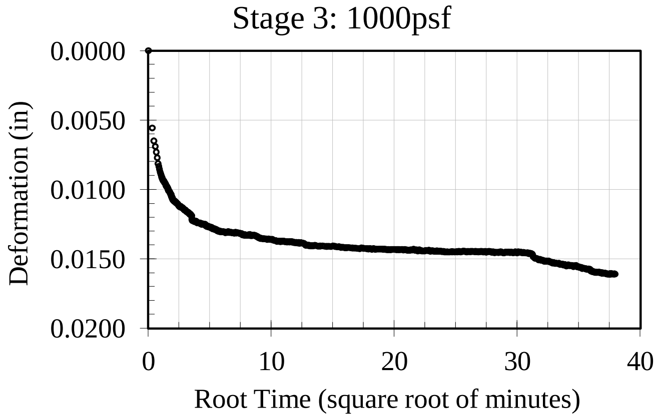








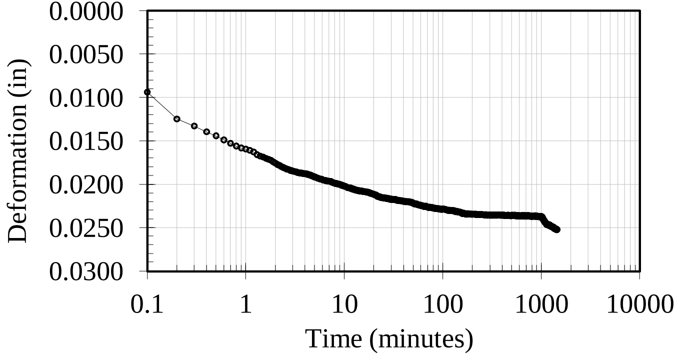


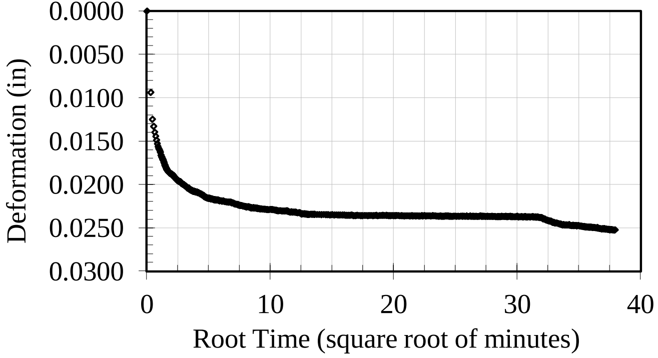


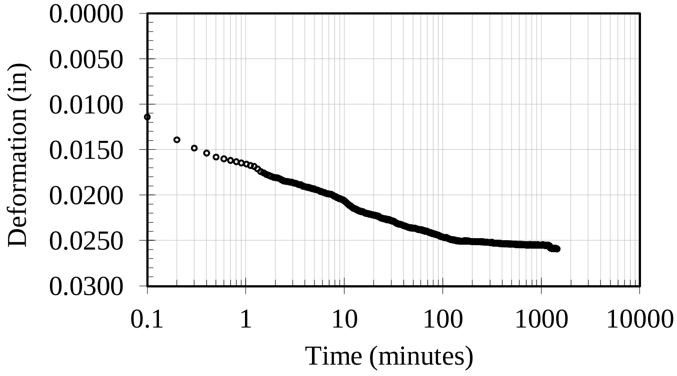
One-Dimensional Consolidation Properties of Soil

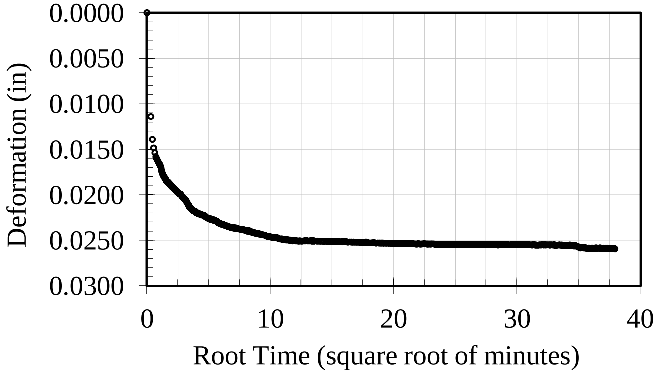
Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Specimen: B-203 13-15'

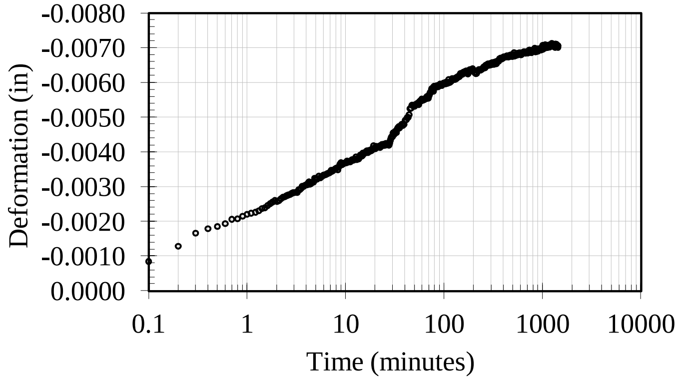
TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 02/03/14


Stage 4: 2000psf


Stage 4: 2000psf


Stage 5: 4000psf


Stage 5: 4000psf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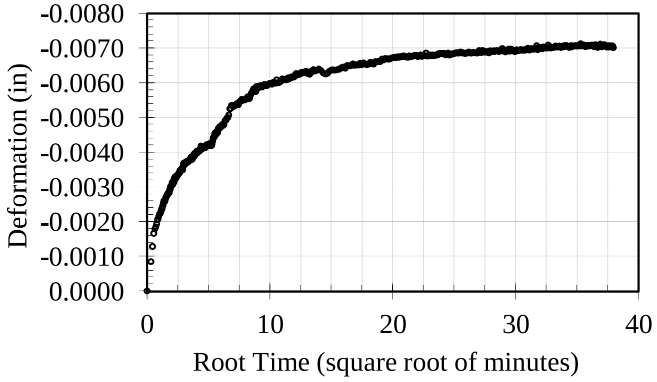
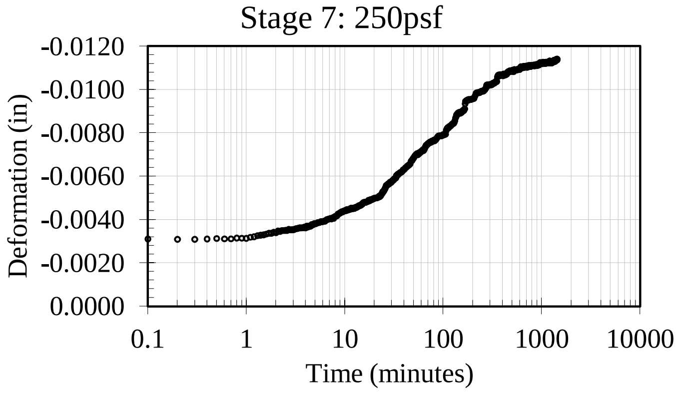
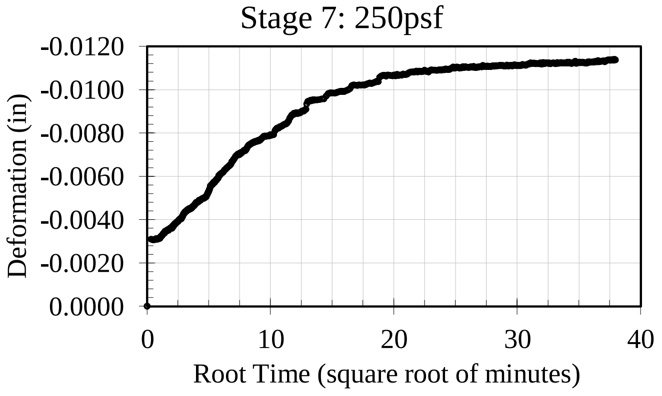

Stage 6: 1000psf

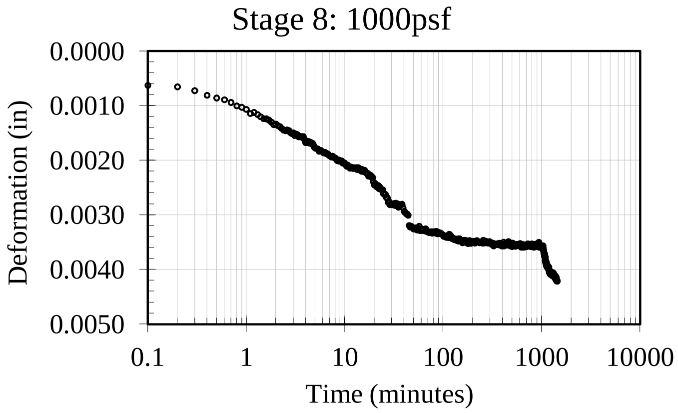
One-Dimensional Consolidation Properties of Soil

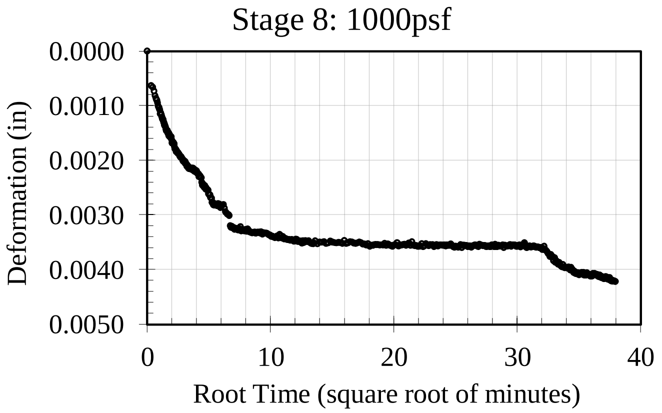
Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Specimen: B-203 13-15'

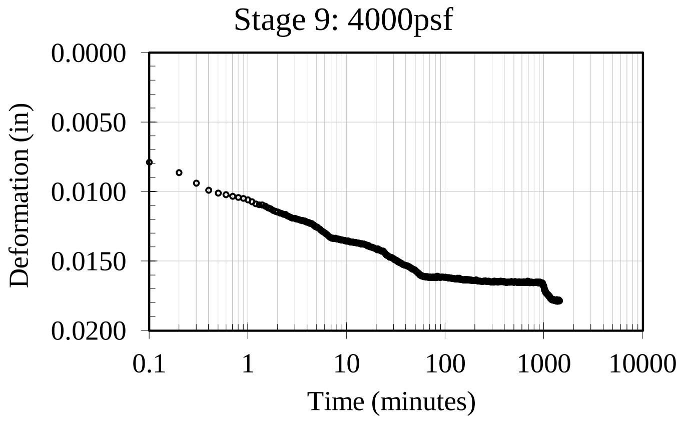
TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 02/03/14

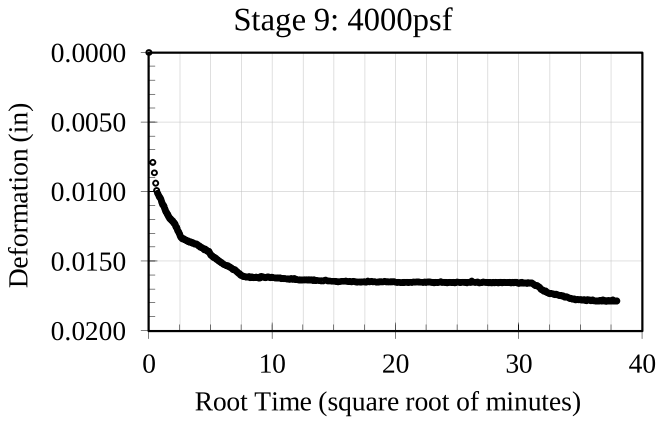






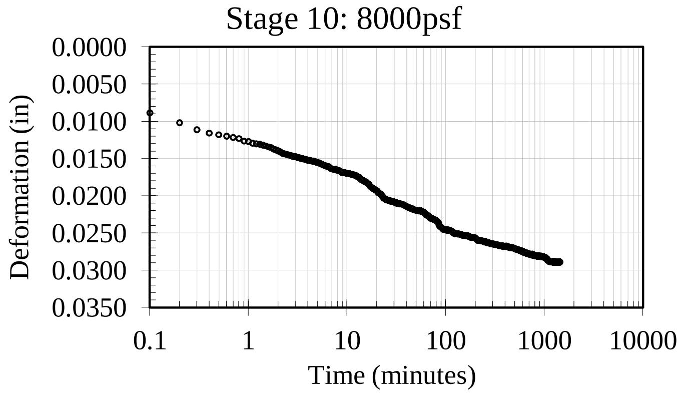


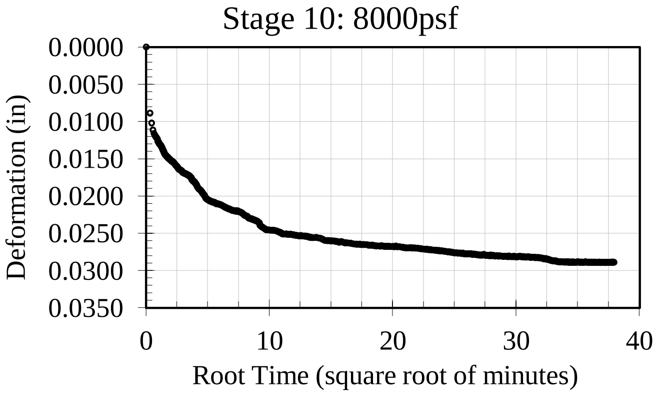


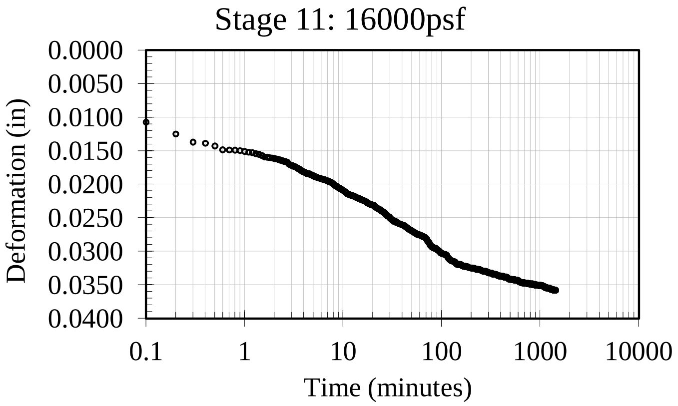


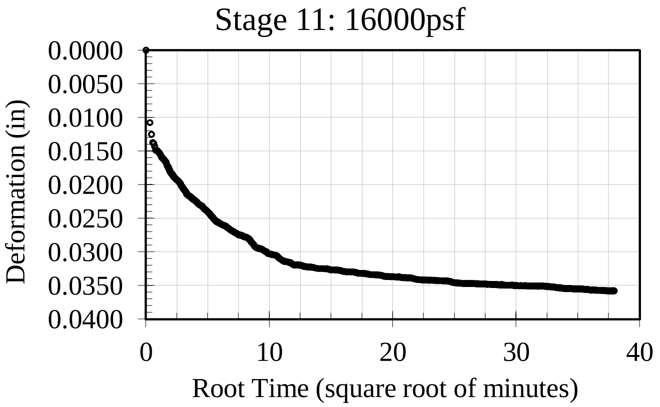
One-Dimensional Consolidation Properties of Soil

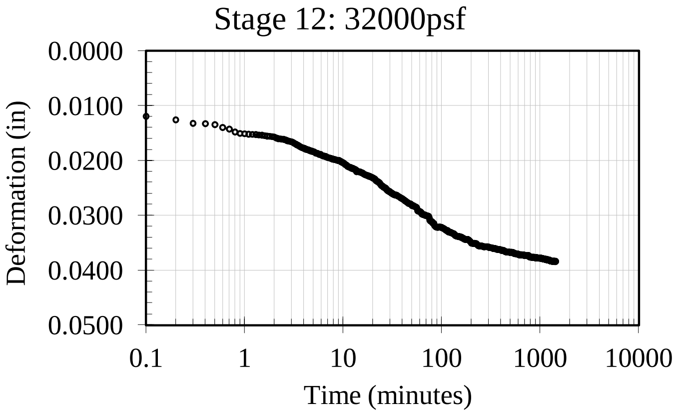
Client:	Geosyntec Consultants, Inc.	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B-203 13-15'	Test Date:	02/03/14

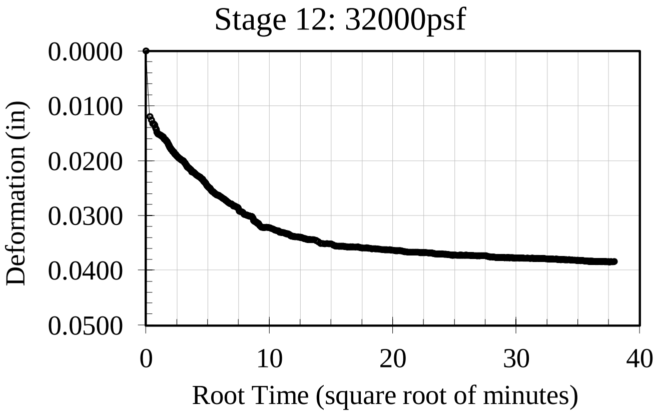








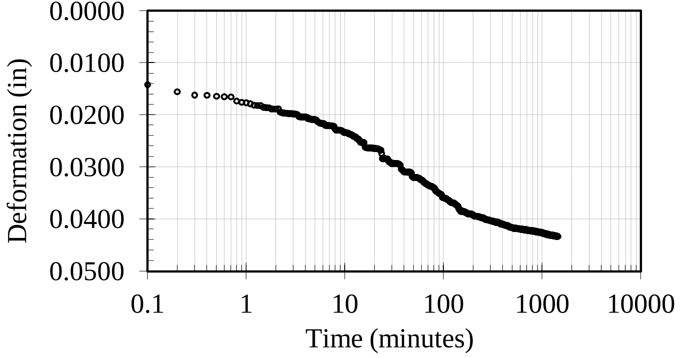




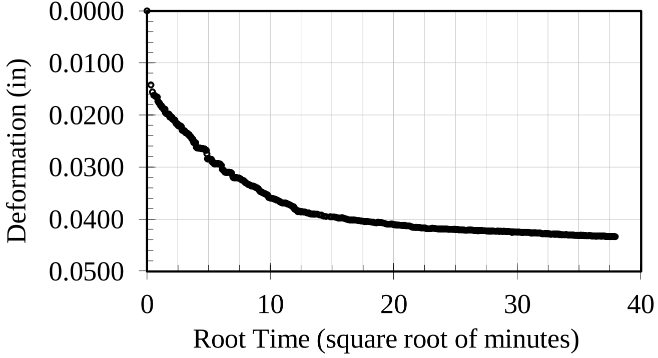
One-Dimensional Consolidation Properties of Soil

Client:	Geosyntec Consultants, Inc.	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B-203 13-15'	Test Date:	02/03/14

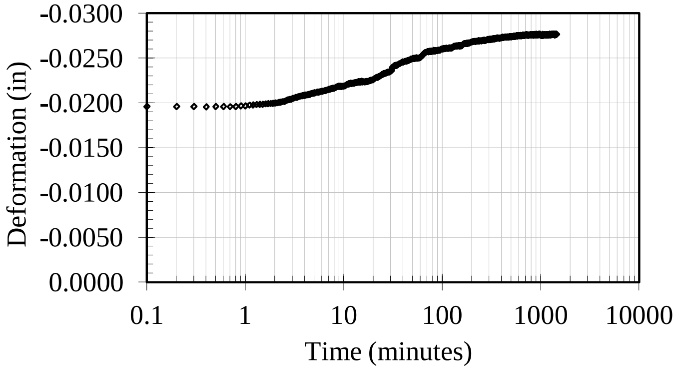
Stage 13: 64000psf



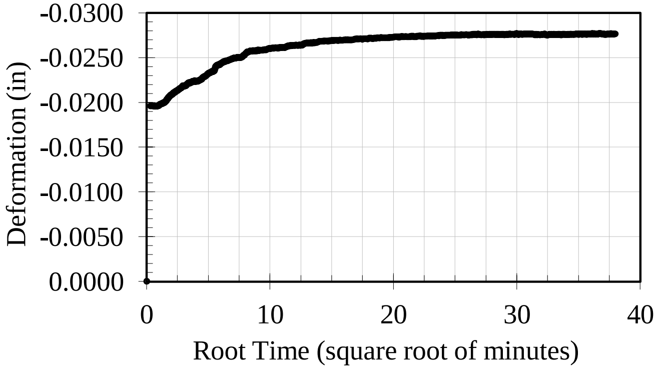
Stage 13: 64000psf



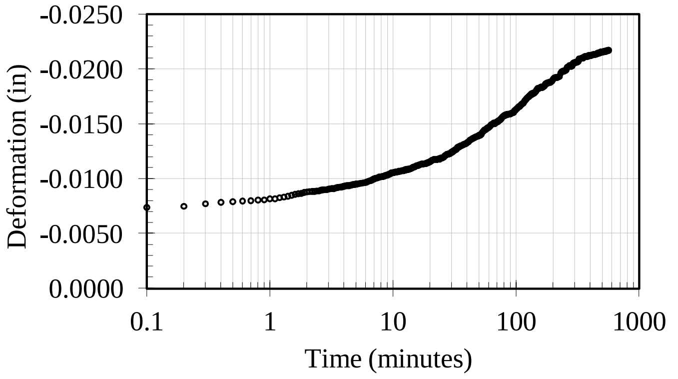
Stage 14: 16000psf



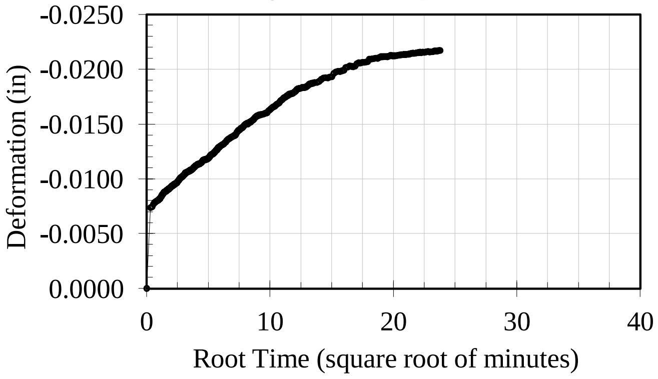
Stage 14: 16000psf



Stage 15: 4000psf



Stage 15: 4000psf



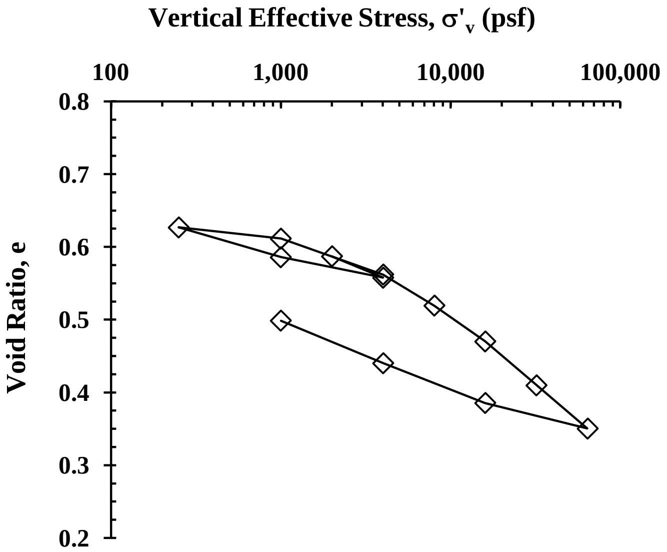
One-Dimensional Consolidation Properties of Soil

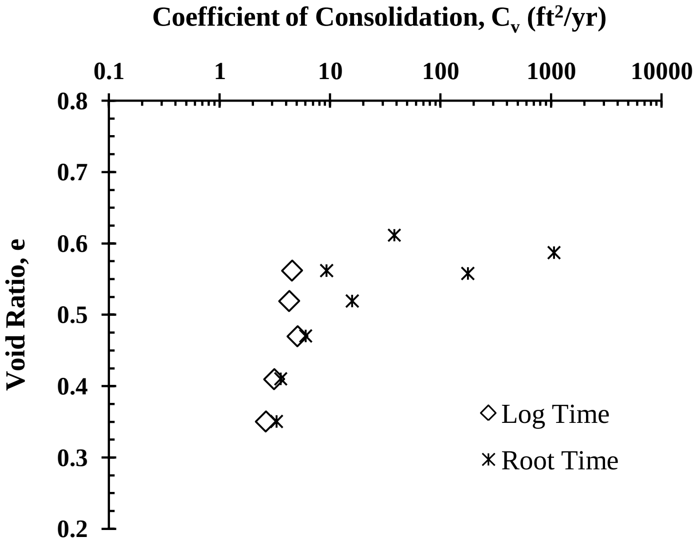
Client: Geosyntec
Project: Ft. Worth C&D
Specimen: B206 (28-30')

TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 01/17/14

Soil Specimen Properties	
Initial Specimen Water Content (%)	22.9
Final Specimen Water Content (%)	23.5
Specimen Diameter (in)	2.497
Initial Specimen Height (in)	1.003
Final Specimen Height (in)	0.936
Final Differential Height (in)	0.067
Initial Dry Unit Weight, γ_o lb_f/ft^3	103.0
Final Dry Unit Weight, γ_f lb_f/ft^3	110.4
Initial Void Ratio, e_o	0.606
Final Void Ratio, e_f	0.498
Initial Degree of Saturation (%)	≈100
Preconsolidation Pressure (psf)	≈4100
Swell Pressure (psf), Maximum Measured	982
Compression Index, C_c	0.203
Recompression Index, C_r	0.058

σ'$_v$	e	Strain, ε	C_v (ft^2/year)	
(psf)	(-)	(%)	Log Time	Root Time
Initial	0.606	0.0	-	-
2,000	0.587	1.2	-	1059
4,000	0.558	3.0	-	176
1,000	0.586	1.2	-	-
250	0.627	-1.3	-	-
1,000	0.611	-0.4	-	38
4,000	0.562	2.7	4.49	9
8,000	0.519	5.4	4.25	16
16,000	0.470	8.4	5.04	6
32,000	0.410	12.2	3.09	4
64,000	0.350	15.9	2.61	3
16,000	0.385	13.7	-	-
4,000	0.440	10.3	-	-





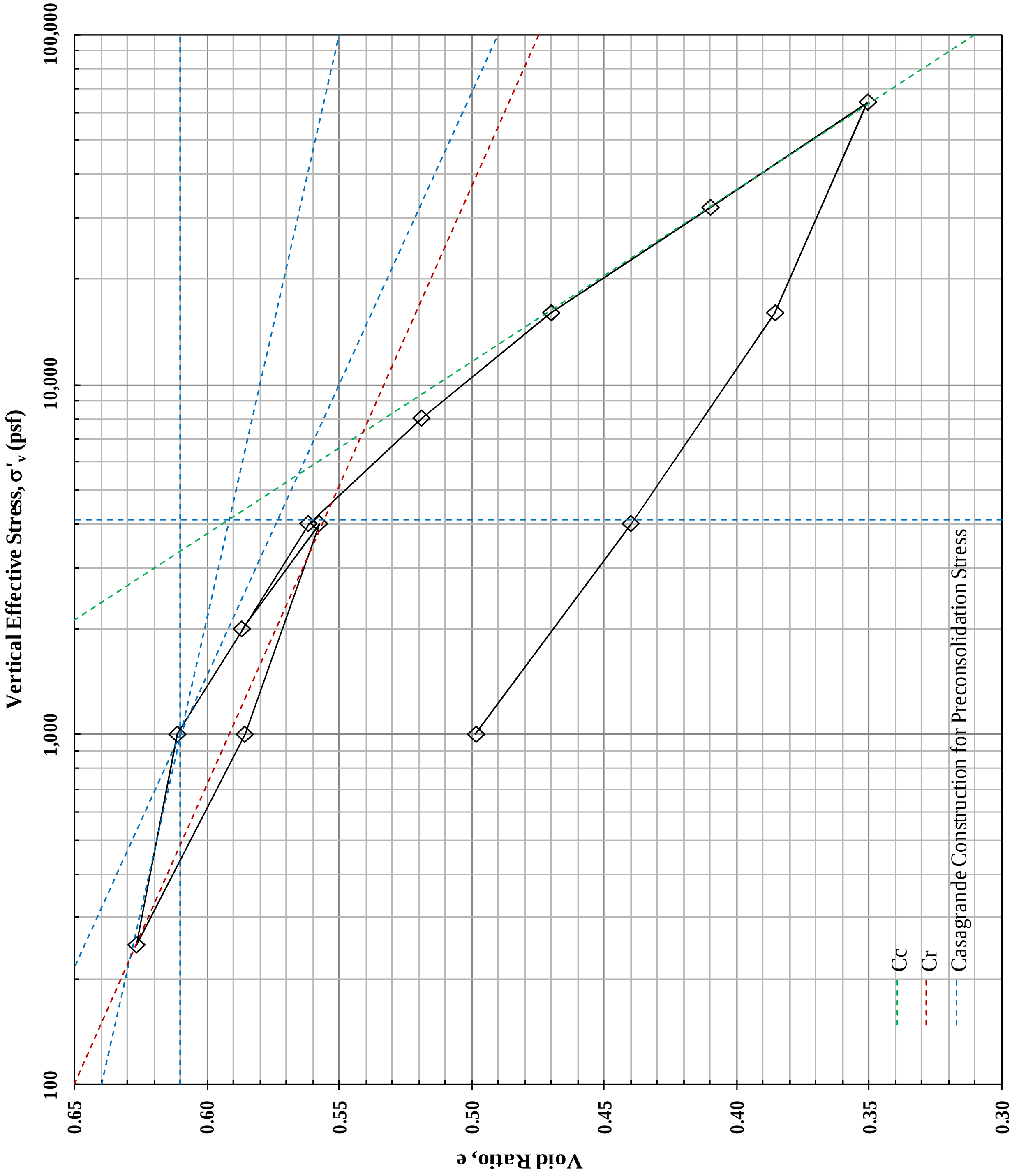
The undisturbed specimen was provided by the client. The specimen was trimmed using a trimming turntable and mounted. The specimen was inundated with tap water during testing. Coefficient of Consolidation was determined using the Log Time and Root Time Methods. Gs was assumed to be 2.65. Calculations include machine deflections measured at each loading step. The preconsolidation pressure was determined using the Casagrande construction technique.

Jeffrey A. Kuhn, Ph.D., P.E., 2/10/2014
Quality Review/Date
Specimen Prepared by: Mark Fountain, Ph.D.

One-Dimensional Consolidation Properties of Soil

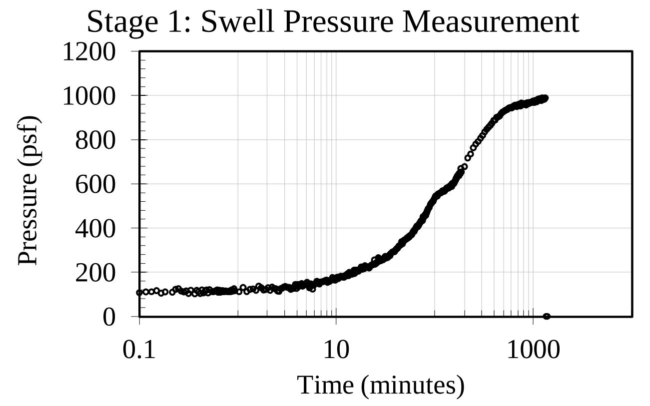
Client: Geosyntec
Project: Ft. Worth C&D
Specimen: B206 (28-30')

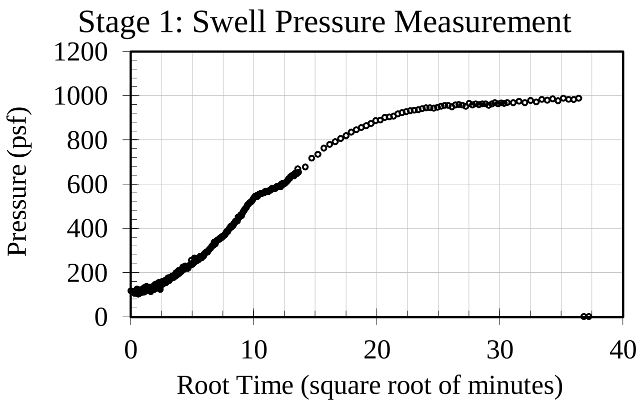
TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 01/17/14

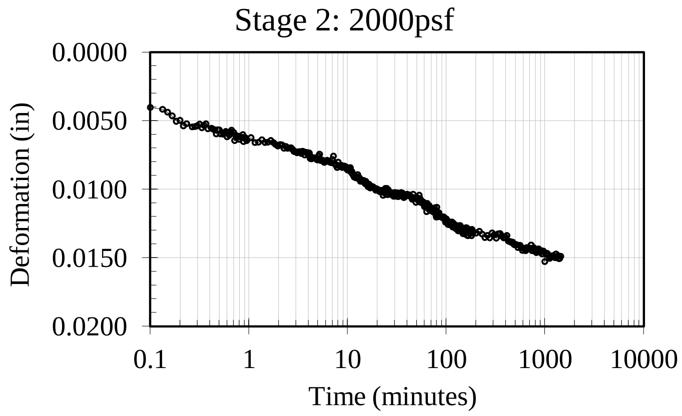


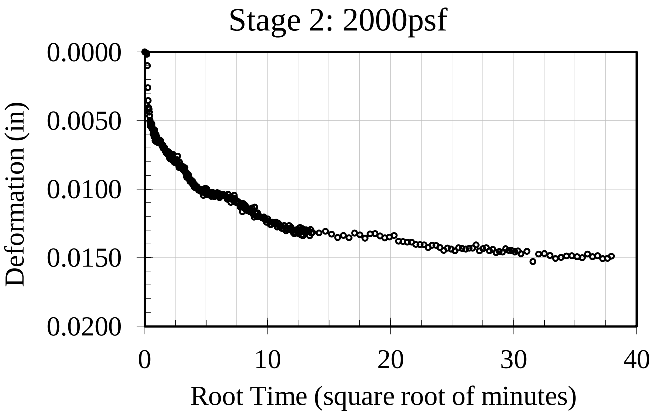
One-Dimensional Consolidation Properties of Soil

Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B206 (28-30')	Test Date:	01/17/14


Stage 1: Swell Pressure Measurement


Stage 1: Swell Pressure Measurement


Stage 2: 2000psf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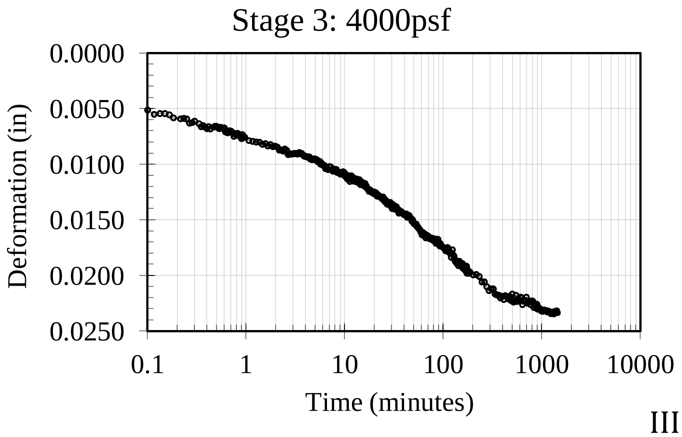
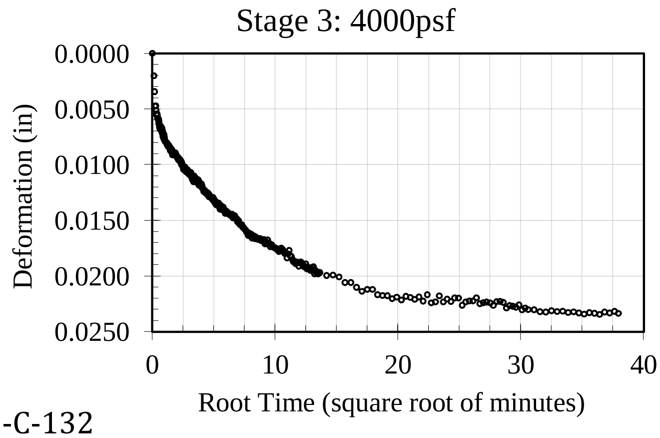
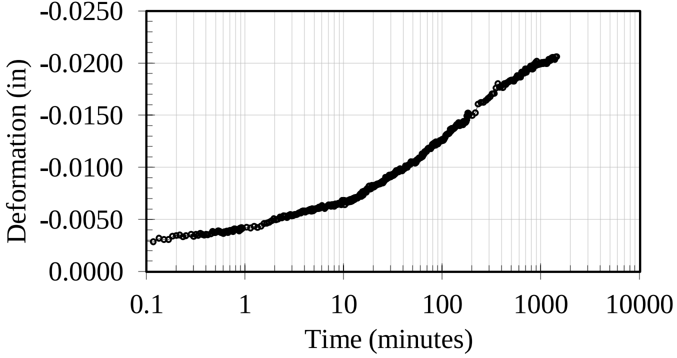
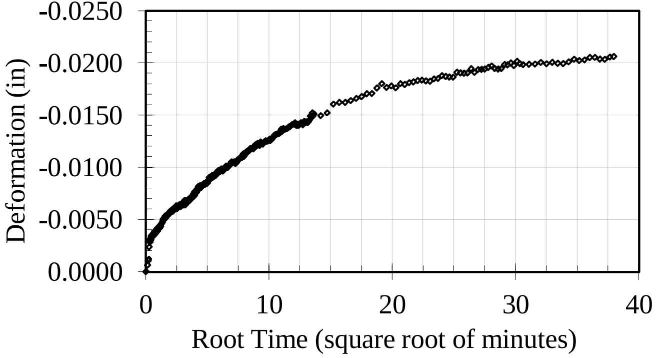

Stage 3: 4000psf


Stage 3: 4000psf

One-Dimensional Consolidation Properties of Soil

Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B206 (28-30')	Test Date:	01/17/14


Stage 4: 1000psf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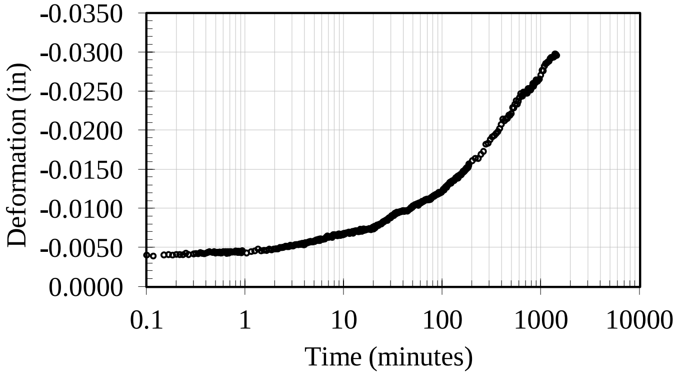
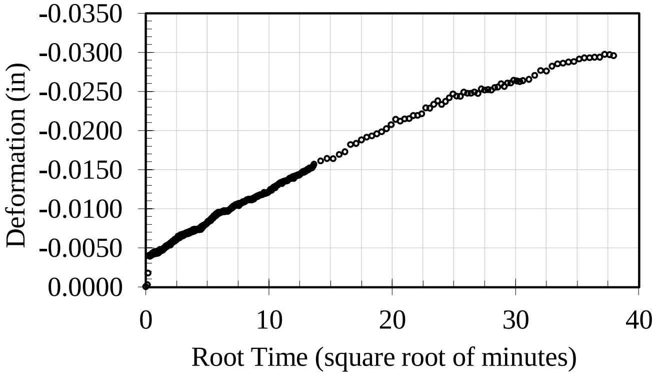
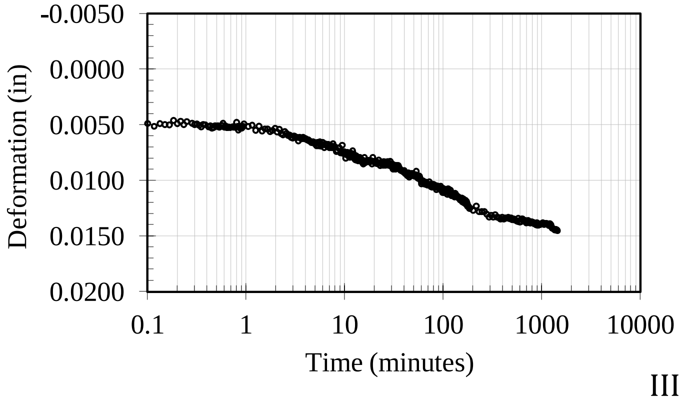
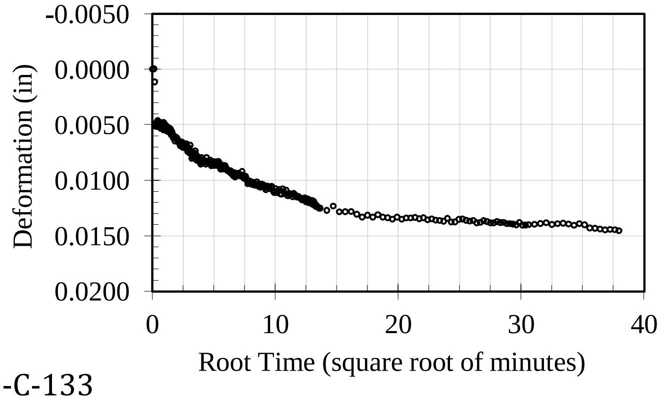

Stage 5: 250psf


Stage 5: 250psf

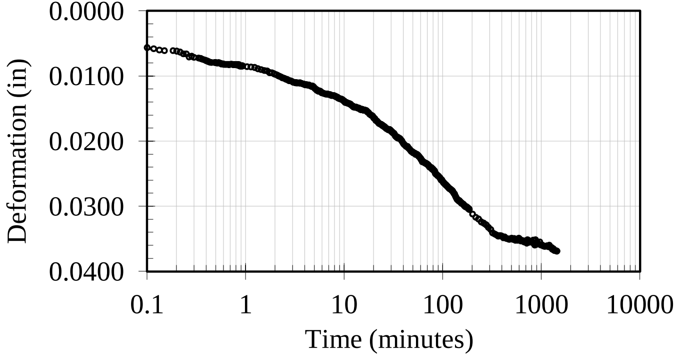

Stage 6: 1000psf


Stage 6: 1000psf

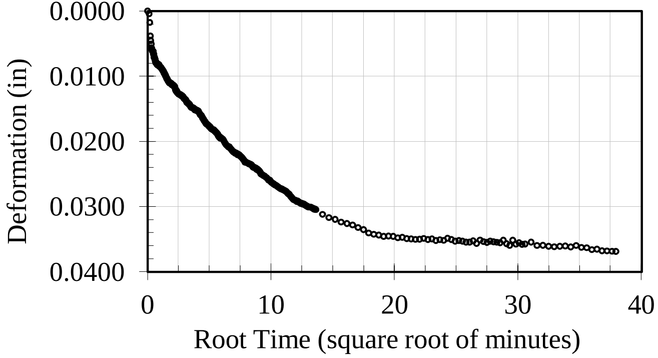
One-Dimensional Consolidation Properties of Soil

Client:	Geosyntec	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B206 (28-30')	Test Date:	01/17/14

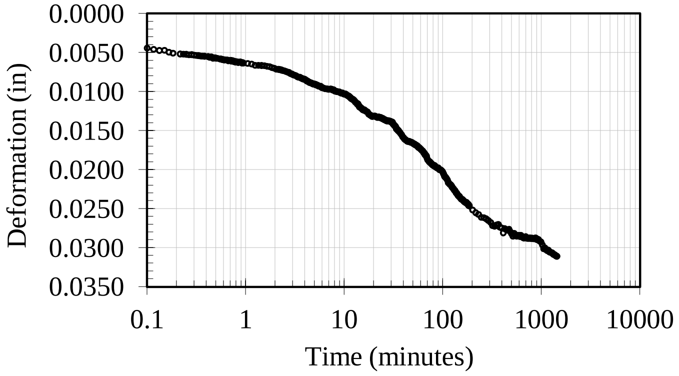
Stage 7: 4000psf



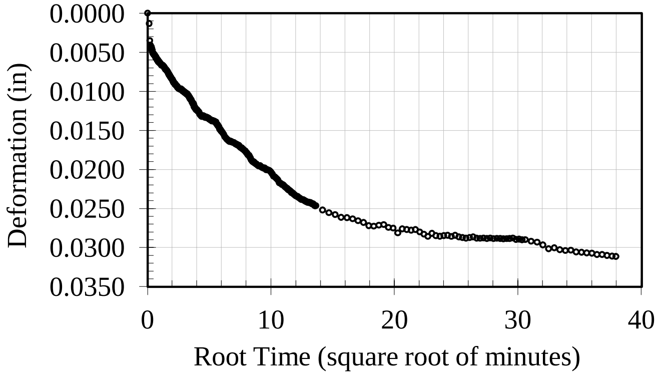
Stage 7: 4000psf



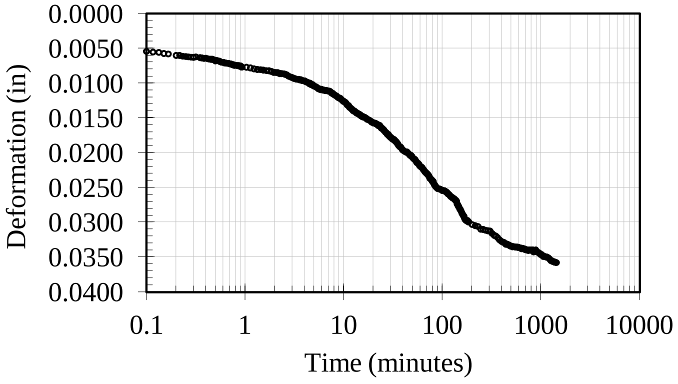
Stage 8: 8000psf



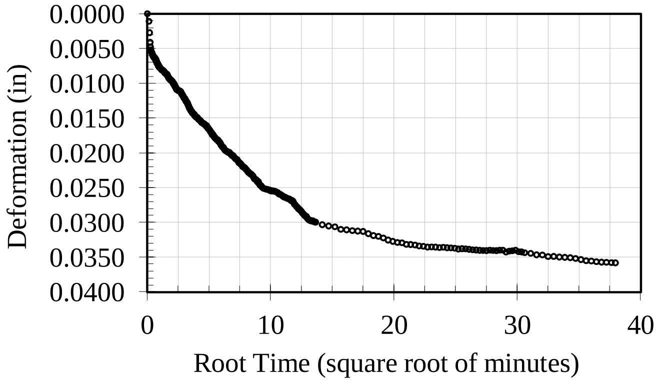
Stage 8: 8000psf



Stage 9: 16000psf



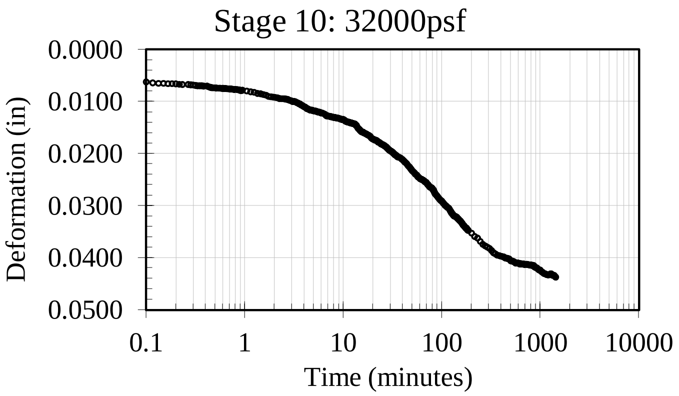
Stage 9: 16000psf

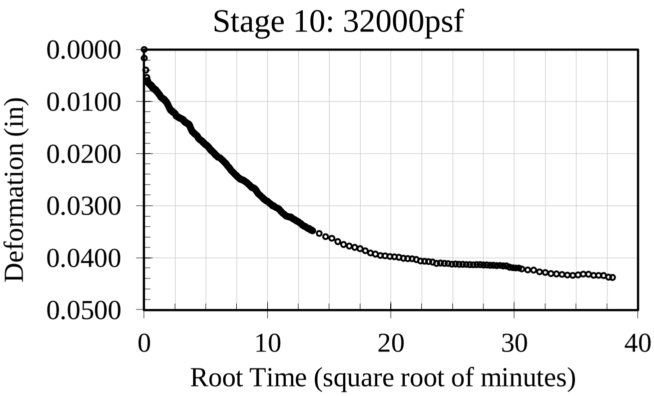


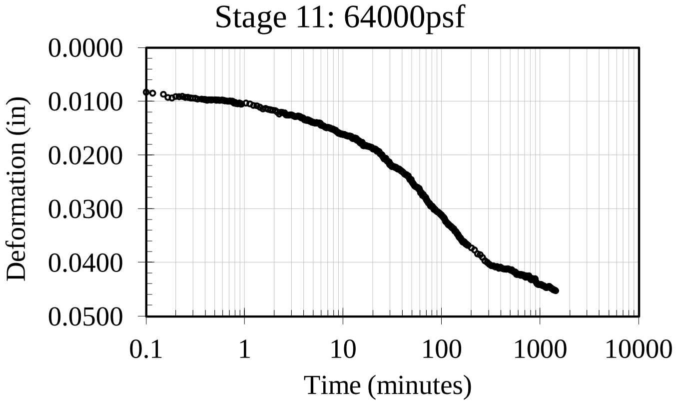
One-Dimensional Consolidation Properties of Soil

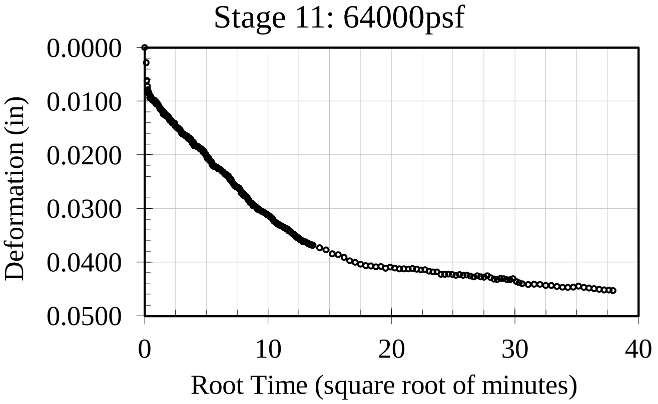
Client: Geosyntec
Project: Ft. Worth C&D
Specimen: B206 (28-30')

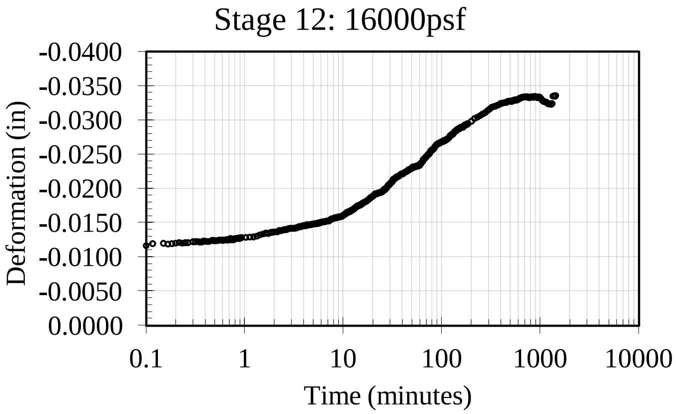
TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 01/17/14

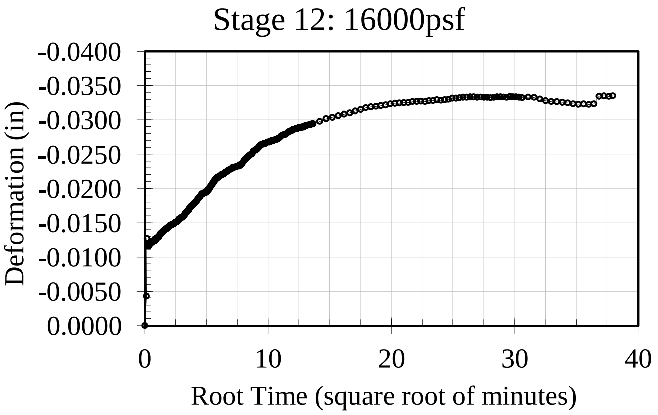

Stage 10: 32000psf


Stage 10: 32000psf


Stage 11: 64000psf


Stage 11: 64000psf

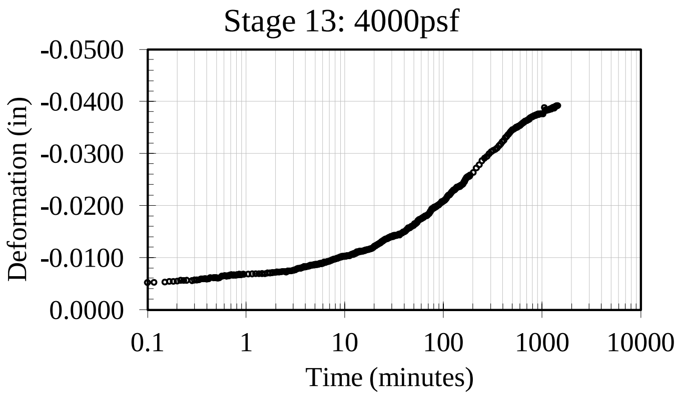

Stage 12: 16000psf

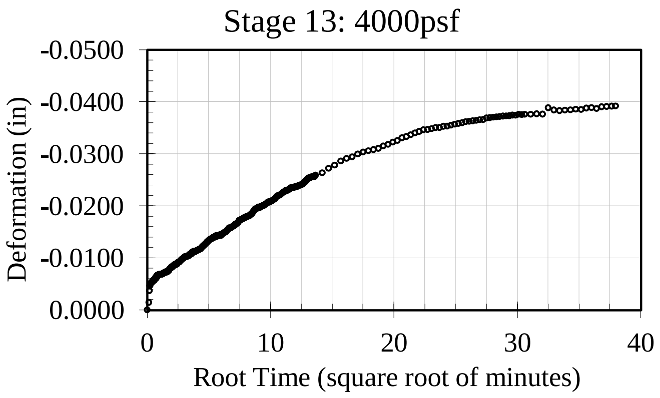

Stage 12: 16000psf

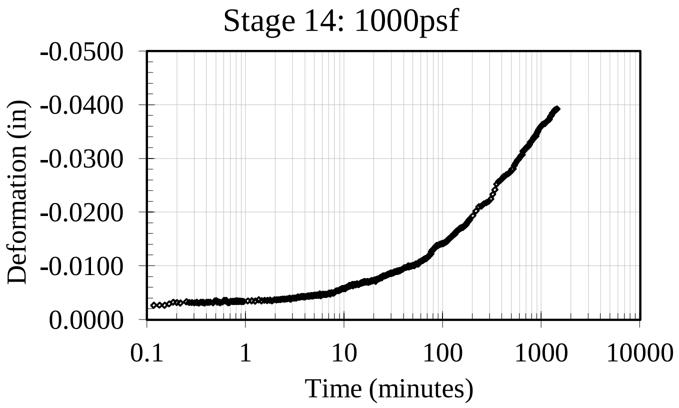
One-Dimensional Consolidation Properties of Soil

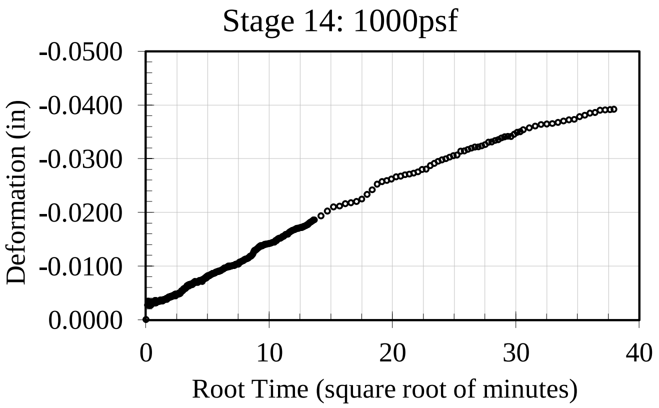
Client: Geosyntec
Project: Ft. Worth C&D
Specimen: B206 (28-30')

TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 01/17/14









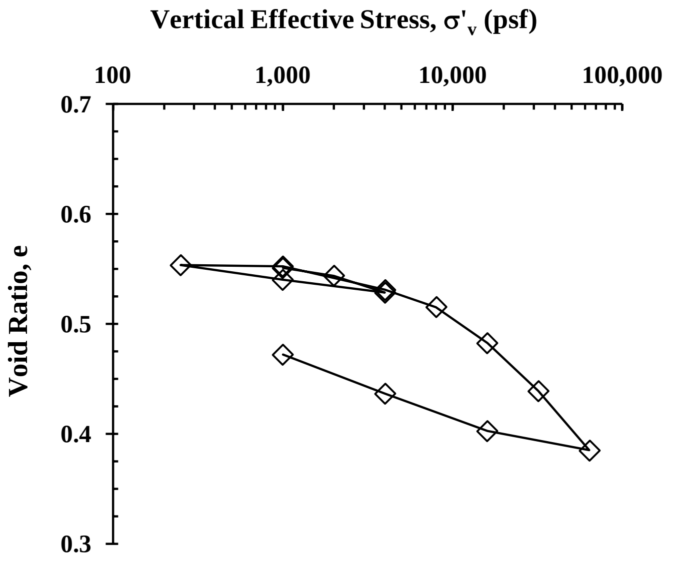
One-Dimensional Consolidation Properties of Soil

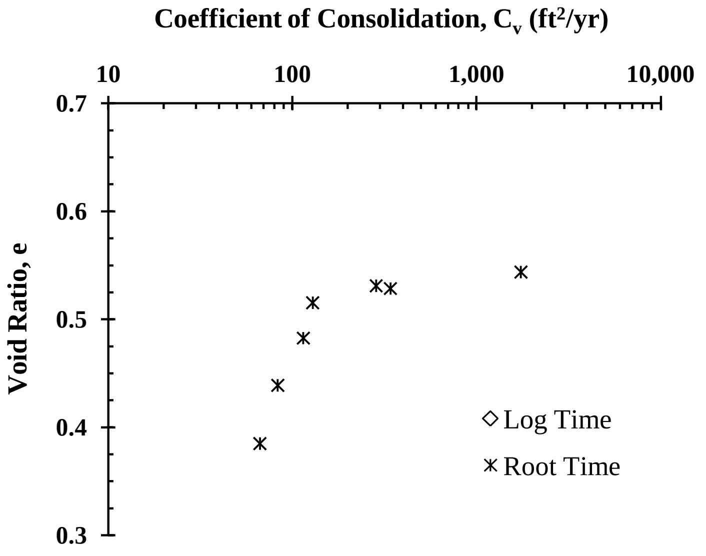
Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Specimen: B-203 23-23.9'

TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 02/03/14

Soil Specimen Properties	
Initial Specimen Water Content (%)	23.3
Final Specimen Water Content (%)	26.5
Specimen Diameter (in)	2.497
Initial Specimen Height (in)	0.992
Final Specimen Height (in)	0.916
Final Differential Height (in)	0.076
Initial Dry Unit Weight, γ_o lb_f/ft^3	106.3
Final Dry Unit Weight, γ_f lb_f/ft^3	115.1
Initial Void Ratio, e_o	0.556
Final Void Ratio, e_f	0.436
Initial Degree of Saturation (%)	≈100
Preconsolidation Pressure (psf)	≈10000
Swell Pressure (psf), Maximum Measured	561
Compression Index, C_c	0.177
Recompression Index, C_r	0.020

σ'_v	e	Strain, ε	C_v (ft^2/year)	
(psf)	(-)	(%)	Log Time	Root Time
Initial	0.556	0.0	-	-
1,000	0.551	0.3	-	-
2,000	0.544	0.8	-	1700
4,000	0.528	1.8	-	340
1,000	0.540	1.0	-	-
250	0.553	0.2	-	-
1,000	0.552	0.2	-	-
4,000	0.531	1.6	-	290
8,000	0.515	2.6	-	130
16,000	0.482	4.7	-	120
32,000	0.439	7.5	-	83
64,000	0.385	11.0	-	67
16,000	0.402	9.9	-	-
4,000	0.436	7.7	-	-
1,000	0.472	5.4	-	-



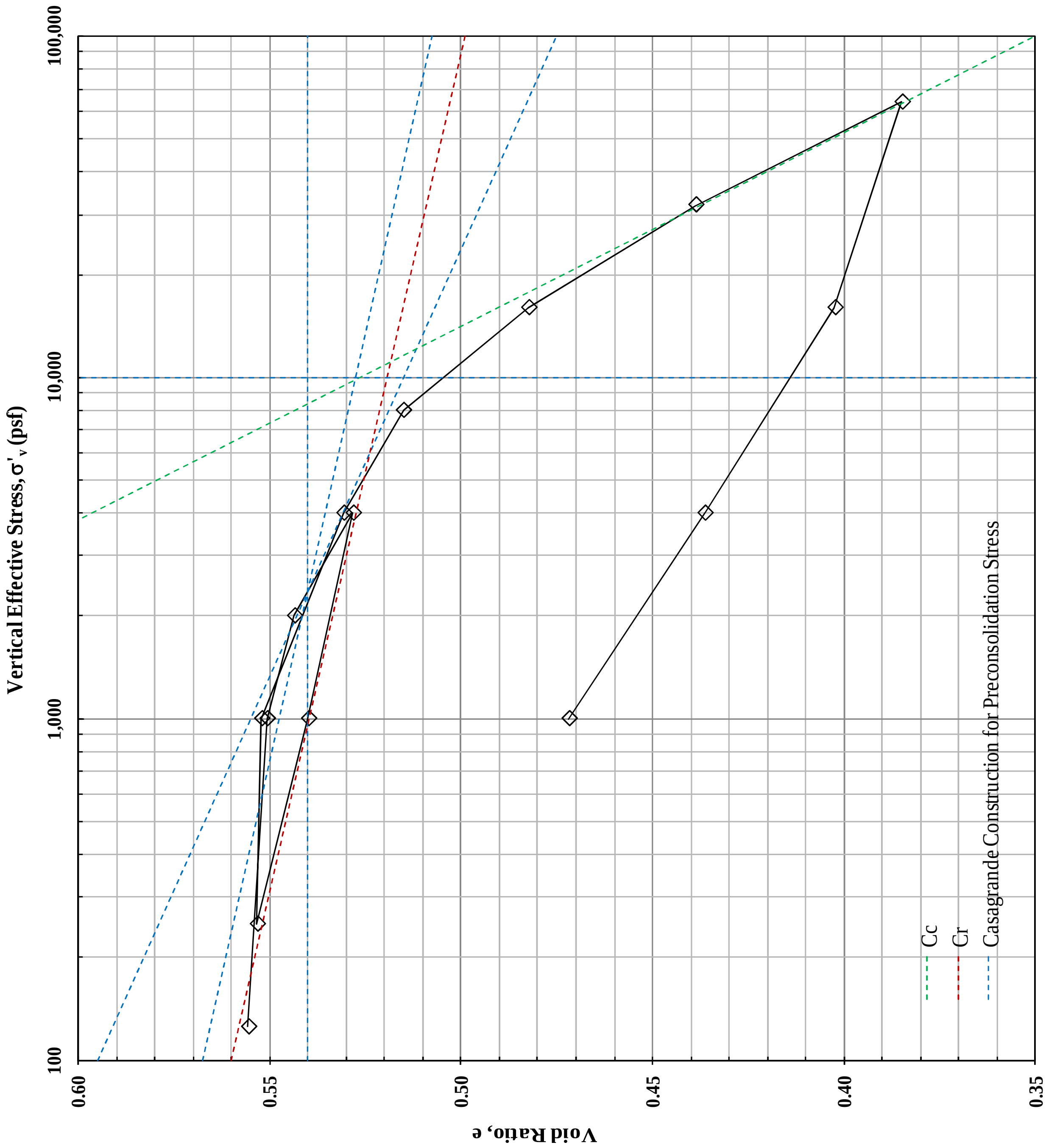


The undisturbed specimen was provided by the client. The specimen was trimmed using a trimming turntable and mounted. The specimen was inundated with tap water during testing. Coefficient of Consolidation was determined using the Log Time and Root Time Methods. Gs was assumed to be 2.65. Calculations include machine deflections measured at each loading step. The preconsolidation pressure was determined using the Casagrande construction technique.

Jeffrey A. Kuhn, Ph.D., P.E., 2/24/2014
Quality Review/Date
Specimen Prepared by: Mark Fountain, Ph.D.

One-Dimensional Consolidation Properties of Soil

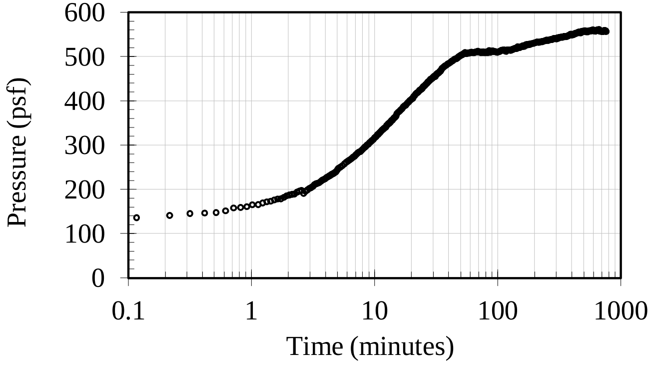
Client:	Geosyntec Consultants, Inc.	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B-203 23-23.9'	Test Date:	02/03/14



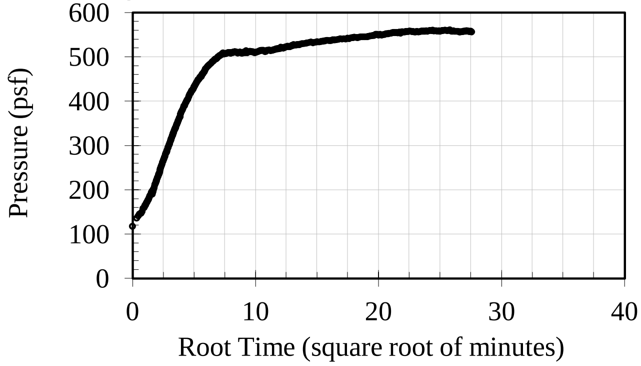
One-Dimensional Consolidation Properties of Soil

Client:	Geosyntec Consultants, Inc.	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B-203 23-23.9'	Test Date:	02/03/14

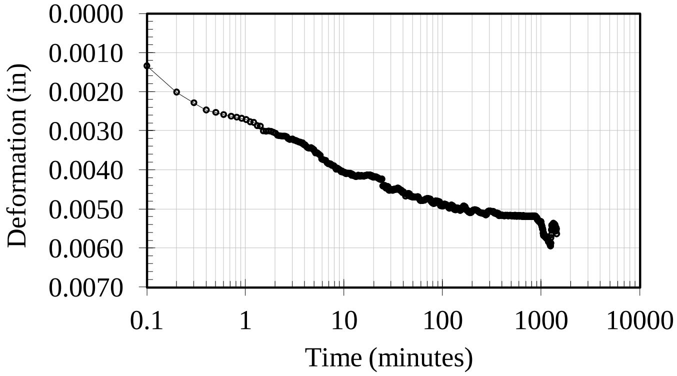
Stage 1: Swell Pressure Measurement



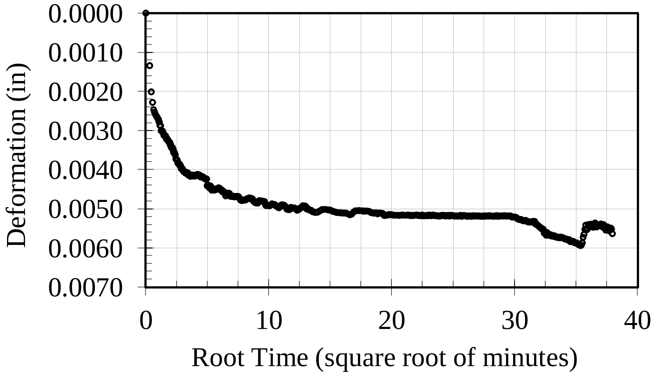
Stage 1: Swell Pressure Measurement



Stage 2: 1000psf



Stage 2: 1000psf



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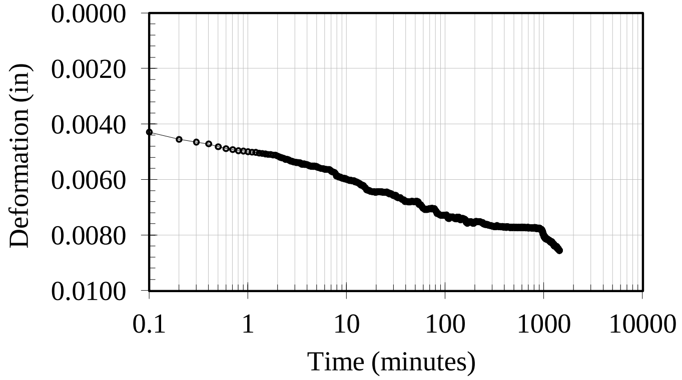

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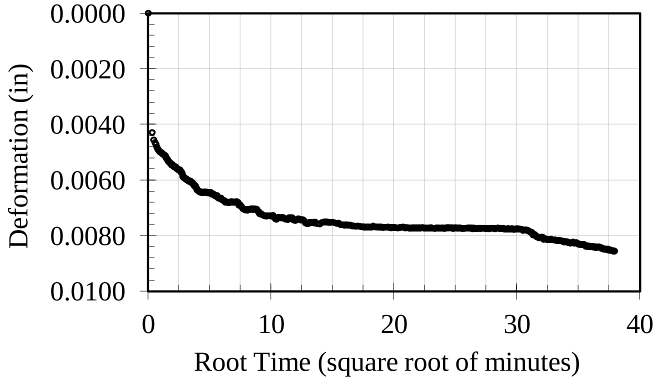
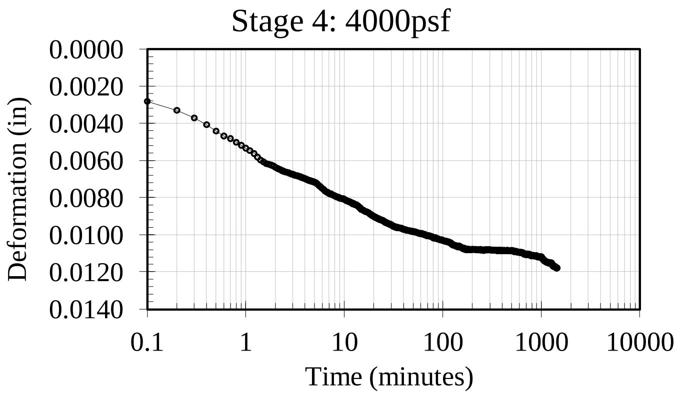
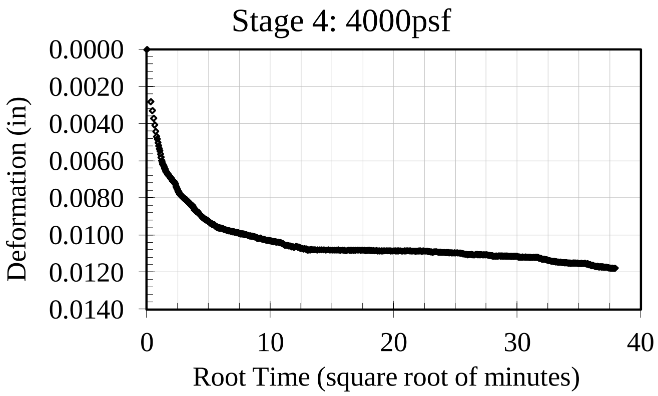


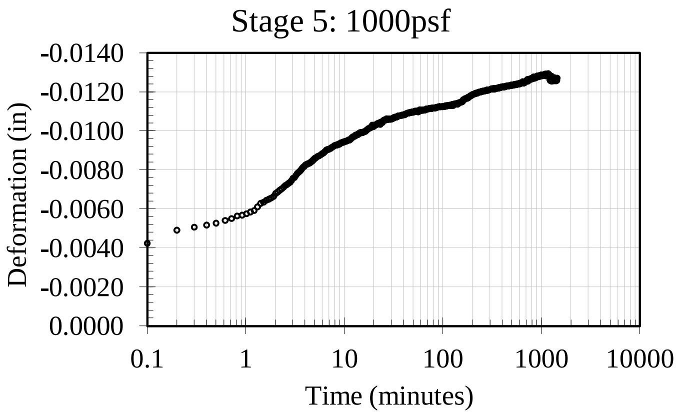
One-Dimensional Consolidation Properties of Soil

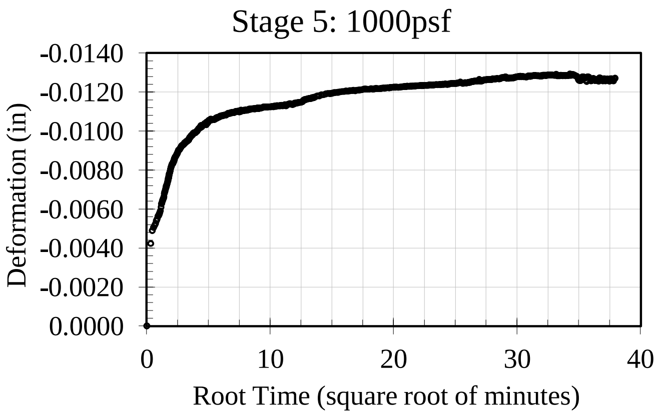
Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Specimen: B-203 23-23.9'

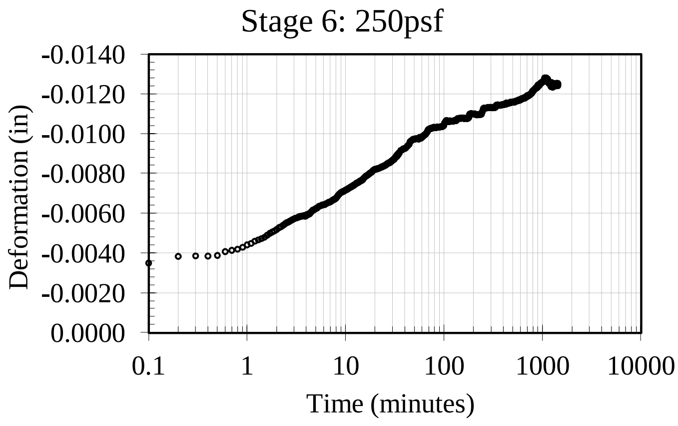
TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 02/03/14

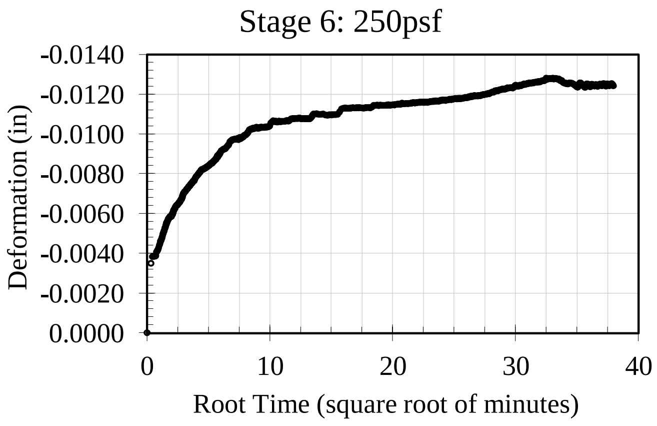








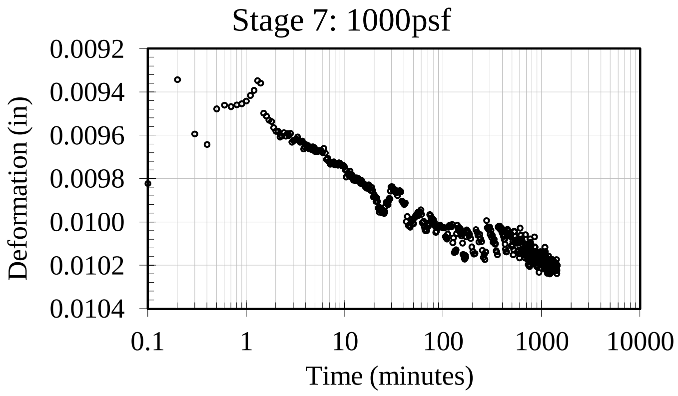


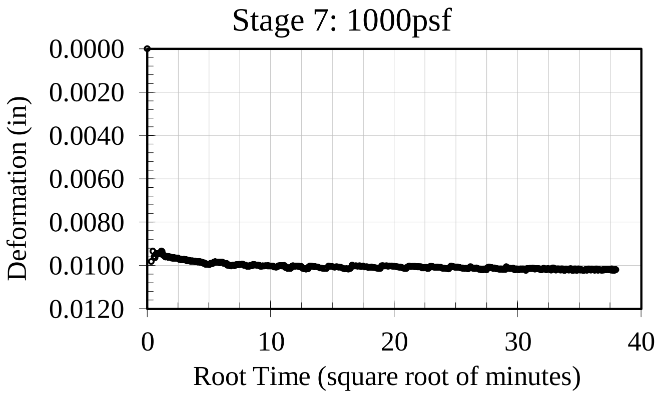


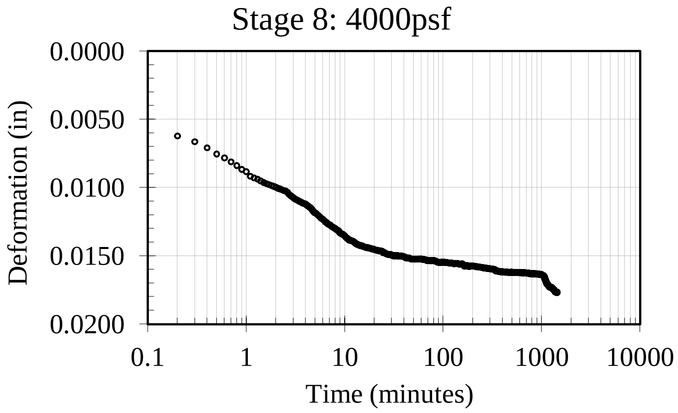
One-Dimensional Consolidation Properties of Soil

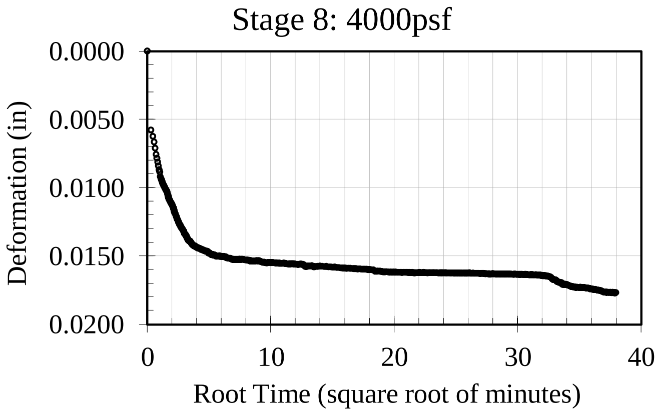
Client: Geosyntec Consultants, Inc.
Project: Ft. Worth C&D
Specimen: B-203 23-23.9'

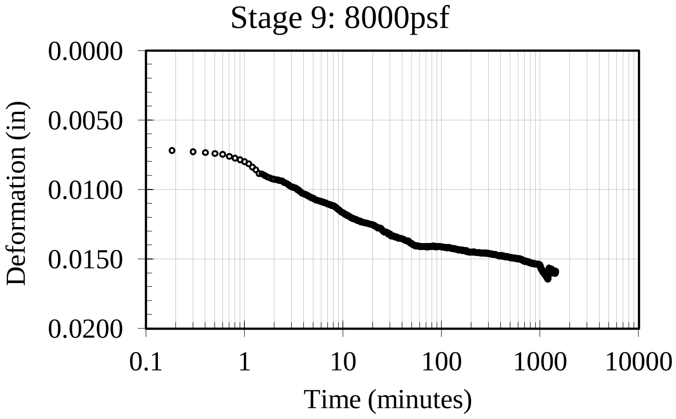
TRI Log No.: E2377-59-05
Test Method: ASTM D 2435, Method B
Test Date: 02/03/14

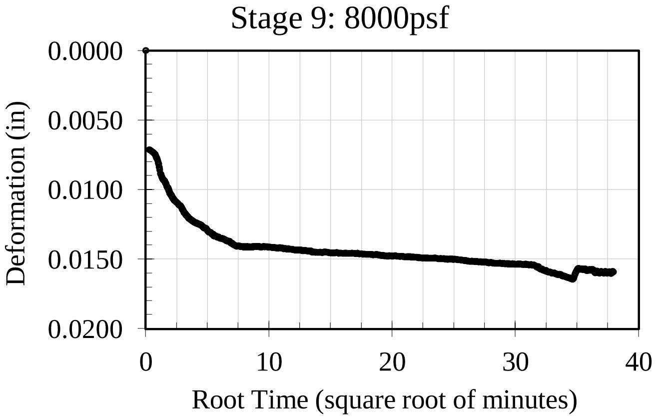






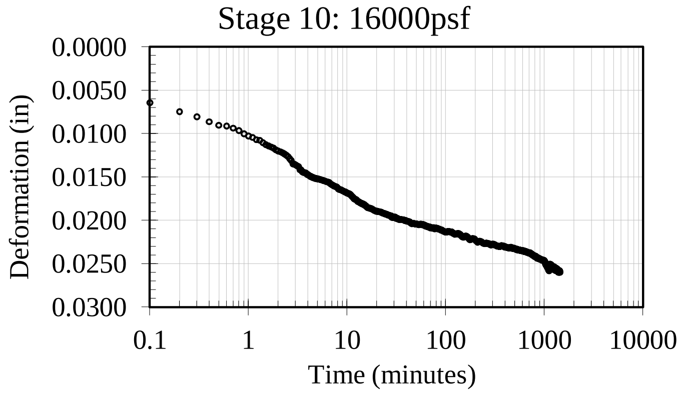


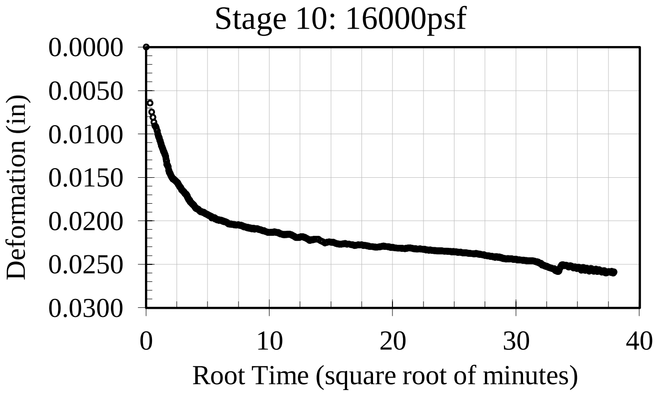


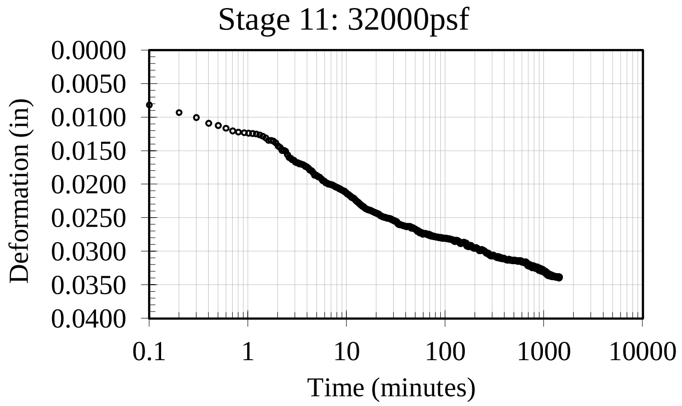


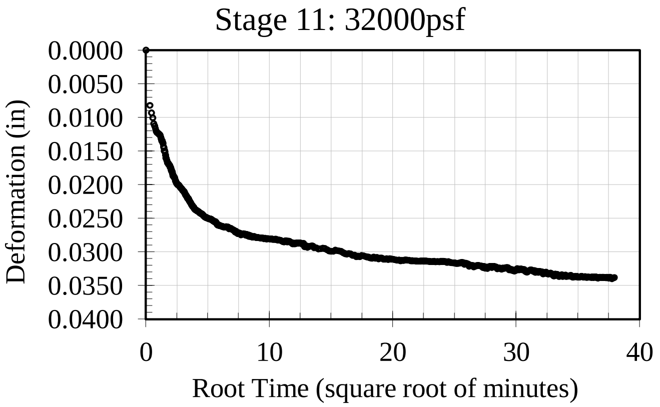
One-Dimensional Consolidation Properties of Soil

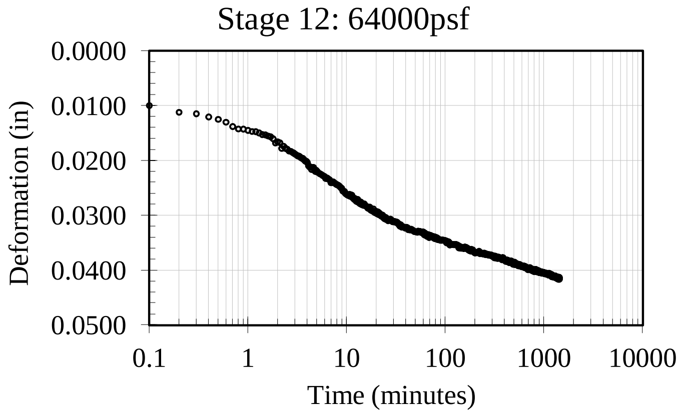
Client:	Geosyntec Consultants, Inc.	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B-203 23-23.9'	Test Date:	02/03/14

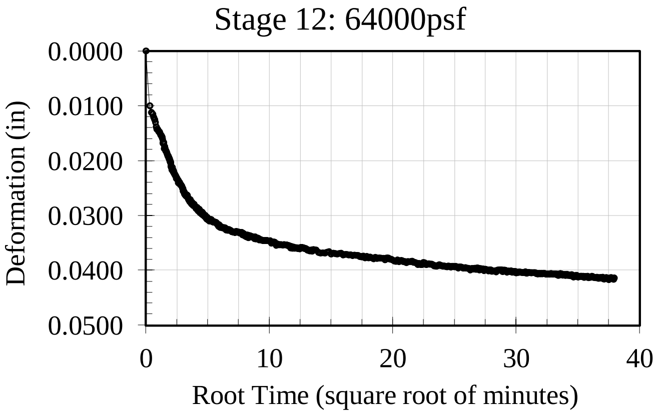






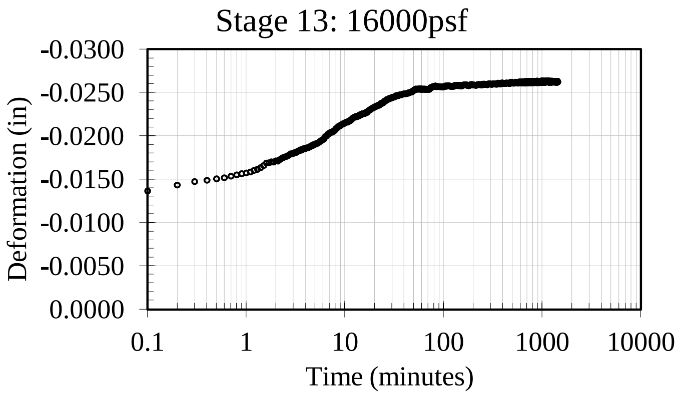


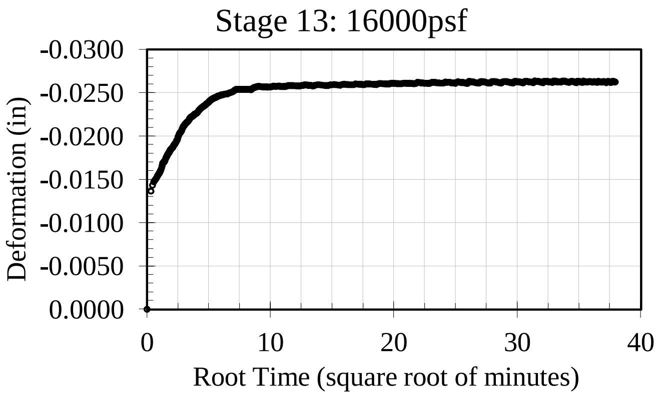


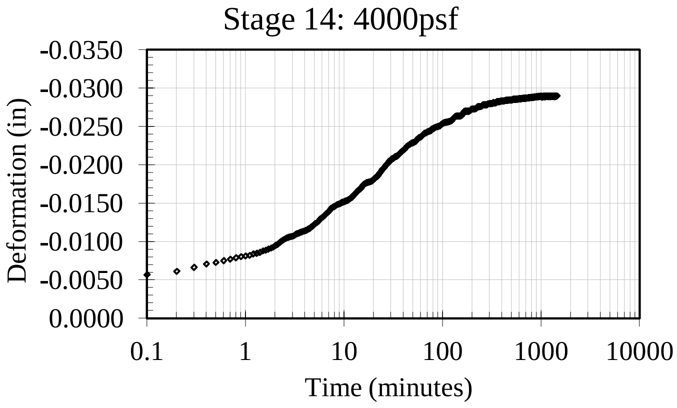


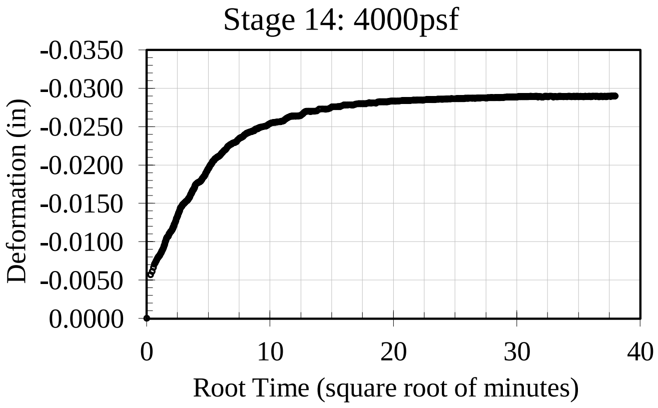
One-Dimensional Consolidation Properties of Soil

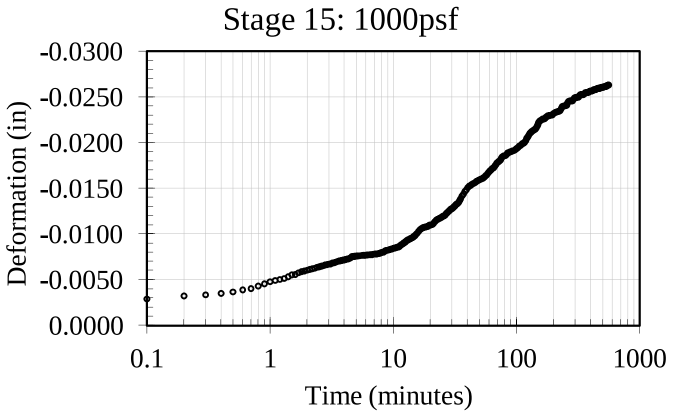
Client:	Geosyntec Consultants, Inc.	TRI Log No.:	E2377-59-05
Project:	Ft. Worth C&D	Test Method:	ASTM D 2435, Method B
Specimen:	B-203 23-23.9'	Test Date:	02/03/14

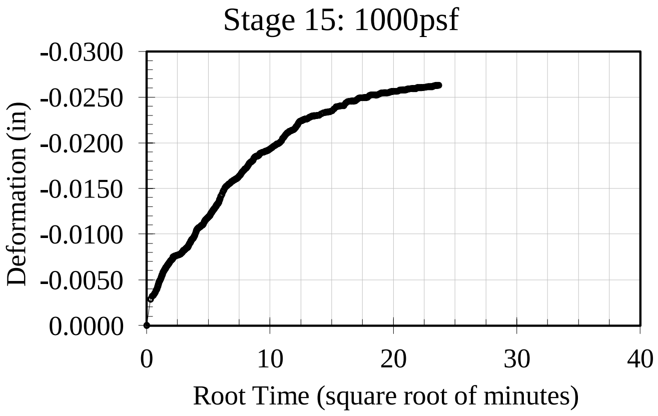












APPENDIX 3 OF ATTACHMENT 3D.1

Geotechnical Data – Laboratory Test Results of Other Previous Subsurface Investigations

Ta[illegible]E.1
Summary of Geotechnical Laboratory Test Results

Boring No.	Sample Depth feet	Geologic Deposit	Soil Type	% Passing No. 200 Sieve	Unit Dry Weight lb/cu ft	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Vertical Permeability cm/sec	Horizontal Permeability cm/sec	Remolded Permeability cm/sec	Unconfined Compressive Strength psi
B-1	3.5 - 5.0	Quaternary Alluvium	CL	55									
B-2	7.0 - 8.0	Quaternary Alluvium	CL	93			42	15	27				
B-2	16.1 - 17.0	Weathered Shale	SH-CH	99			59	22	37				
B-2	19.8 - 20.4	Weathered Shale	SH-CH		107	24							
B-3	6.5 - 8.0	Quaternary Slopewash	CL	86	124	9	41	12	29				
B-3	8.8 - 9.5	Quaternary Slopewash	CH		129	12							
B-3	11.5 - 12.5	Quaternary Slopewash	CH	98			51	17	34				
B-3	18.5 - 19.1	Weathered Shale	SH-CL	96			48	17	31				
B-4	3.0 - 4.5	Quaternary Alluvium	CL	64			34	13	21				
B-4	6.0 - 7.5	Quaternary Alluvium	CL	63			37	14	23				
B-4	7.5 - 9.0	Quaternary Alluvium	CL	71			38	14	24				
B-4	9.0 - 10.5	Quaternary Alluvium	CL		111	21							
B-5	1.5 - 3.0	Quaternary Alluvium	CL	71			45	14	31				
B-5	3.0 - 4.5	Quaternary Alluvium	CL	74			38	13	25				
B-5	4.5 - 6.0	Quaternary Alluvium	CL		110	15							
B-5	10.5 - 11.6	Weathered Shale	SC-CH	97			54	20	34				
B-6	3.0 - 4.5	Quaternary Slopewash	CL		109	17							
B-6	4.5 - 6.0	Quaternary Slopewash	CL	74			38	14	24				
B-6	10.5 - 15.0	Weathered Shale	SH-CH									2.16E-08	
B-6	15.2 - 16.0	Weathered Shale	SH-CH	98			51	19	32			8.49E-09	
B-6	23.9 - 24.4	Weathered Shale	SH-CL	97			47	17	30				
B-6	122.5 - 123.3	Unweathered Shale	SH-Paw Paw	92			52	22	30				
B-7	15.5 - 17.3	Unweathered Shale	SH-Grayson				26	14	12				
B-7	20.7 - 22.0	Unweathered Shale	SH-Grayson				21	12	9				
B-7A	10.3 - 12.0	Quaternary Alluvium	GC	13									
B-8	1.5 - 3.0	Quaternary Alluvium	CL	65			33	13	20				
B-8	4.5 - 6.0	Quaternary Alluvium	CL	55			24	12	12				
B-8	6.0 - 7.5	Quaternary Alluvium	SC		118	17							
B-9	3.0 - 4.5	Quaternary Alluvium	CH	92	101	21	50	14	36				
B-9	7.5 - 9.0	Quaternary Alluvium	CH	91	112	17	52	15	37				
B-9	9.0 - 10.5	Quaternary Alluvium	SC	49	120	16	27	11	16				
B-9	13.5 - 15.0	Quaternary Alluvium	CH	71			50	14	36				
B-10	6.0 - 7.5	Weathered Shale	SH-CH	97	120	14	59	18	41				
B-10	9.0 - 10.5	Weathered Shale	SH-CH	97			64	20	44				
B-10	22.6 - 23.9	Weathered Shale	SH-CL	96			49	18	31				
B-11	4.5 - 6.0	Quaternary Alluvium	CL	71			31	13	18				
B-11	6.0 - 7.5	Quaternary Alluvium	CL		114	17							
B-11	13.5 - 14.4	Weathered Shale	SH-CL	95			43	16	27				
B-12	3.0 - 4.5	Quaternary Alluvium	CL	65			35	13	22				
B-12	4.5 - 6.0	Quaternary Alluvium	SC	43			33	13	20				
B-12	9.0 - 10.5	Quaternary Alluvium	CL	54			34	13	21				
B-12	10.5 - 12.0	Weathered Shale	SH-CH		111	20							
B-12	12.0 - 13.0	Weathered Shale	SH-CH		114	18							
B-12	14.2 - 14.5	Unweathered Shale	SH-Grayson	98			51	24	27				
B-13	0.0 - 6.0	Quaternary Alluvium	CL									4.17E-08	
B-13	1.5 - 3.0	Quaternary Alluvium	CL	73			48	17	31			1.69E-08	
B-13	3.0 - 4.5	Quaternary Alluvium	CL		110	20							
B-13	4.5 - 6.0	Quaternary Alluvium	CL	78			48	15	33				
B-13	6.0 - 7.5	Quaternary Alluvium	CL	70			29	11	18				

Tab[illegible].1
Summary of Geotechnical Laboratory Test Results

Boring No.	Sample Depth feet	Geologic Deposit	Soil Type	% Passing No. 200 Sieve	Unit Dry Weight lb/cu ft	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Vertical Permeability cm/sec	Horizontal Permeability cm/sec	Remolded Permeability cm/sec	Unconfined Compressive Strength psi
B-13	7.5 - 9.0	Quaternary Alluvium	SC	48									
B-14	6.0 - 7.5	Quaternary Alluvium	CL	75			37	11	26				
B-14	9.5 - 10.7	Quaternary Alluvium	CL	81			42	12	30				
B-14	15.3 - 16.3	Quaternary Alluvium	CH	82			52	14	38				
B-14	25.0 - 26.0	Quaternary Alluvium	CH		111	19							
B-14	28.9 - 29.7	Unweathered Shale	SH-Grayson	97			38	19	19				
B-15	5.0 - 10.0	Weathered Shale	SH-CH									3.13E-08	
B-15	4.5 - 6.0	Weathered Shale	SH-CH	98			59	20	39				
B-15	8.1 - 8.8	Weathered Shale	SH-CH		121	15							
B-15	14.7 - 15.4	Weathered Shale	SH-CH	96			56	17	39				
B-15	16.9 - 17.5	Weathered Shale	SH-CH		127	13							
B-15	26.9 - 27.5	Weathered Shale	SH-CH	99			67	23	44				
B-15	32.1 - 33.5	Unweathered Shale	SH-Grayson	98			49	20	29				
B-16	4.5 - 6.0	Woodbine	SC		114	15							
B-16	6.0 - 7.5	Woodbine	SC		100	13							
B-16	7.5 - 8.5	Woodbine	SC		111	17							
B-16A	2.5 - 12.9	Woodbine	SC	24									
B-16A	7.5 - 9.0	Woodbine	SC	67			42	15	27				
B-16A	17.5 - 18.7	Woodbine	CL	53			40	15	25				
B-17	3.0 - 4.5	Quaternary Alluvium	CL	65			33	11	22				
B-17	4.5 - 6.0	Quaternary Alluvium	CL		116	15							
B-17	6.0 - 7.5	Quaternary Alluvium	CL	74			34	12	22				
B-17	9.0 - 10.5	Quaternary Alluvium	CL	68			30	12	18				
B-18	3.0 - 4.5	Quaternary Alluvium	CH	80			53	20	33				
B-18	4.5 - 6.0	Quaternary Alluvium	CL		106	20							
B-18	6.0 - 7.5	Quaternary Alluvium	CL	75			37	14	23				
B-18	7.5 - 9.0	Quaternary Alluvium	CL		117	15							
B-18	9.0 - 10.5	Quaternary Alluvium	CL	78	124	14	30	13	17				
B-19	1.5 - 3.0	Quaternary Alluvium	CL	71	122	13	40	12	28				
B-19	6.0 - 7.5	Quaternary Alluvium	CL	61	113	16	33	12	21				
B-19	9.0 - 10.0	Weathered Shale	SH-CH	99	119	16	57	19	38				
B-19	20.0 - 21.1	Unweathered Shale	SH-Grayson	99			42	20	22				
B-20	5.7 - 7.0	Quaternary Alluvium	SC	47	128	7	26	11	15				
B-20	13.0 - 14.5	Quaternary Alluvium	CL	85	104	21	49	15	34				
B-20	17.5 - 19.0	Quaternary Alluvium	CL	64	112	21	36	12	24				
B-20	30.0 - 31.9	Unweathered Shale	SH-Grayson	97			36	17	19				
B-21	1.5 - 3.0	Quaternary Slopewash	CH		117	14							
B-21	3.0 - 4.5	Quaternary Slopewash	CH	93			59	17	42				
B-21	4.5 - 5.0	Quaternary Slopewash	CH	89	112	13	51	18	33				
B-21	10.4 - 11.1	Weathered Shale	SH-CL	96			41	15	26				
B-21	14.1 - 14.8	Weathered Shale	SH-CH	96			60	21	39				
B-21	27.9 - 29.9	Unweathered Shale	SH-Grayson							4.31E-09	1.96E-08		
B-21	27.9 - 29.9	Unweathered Shale	SH-Grayson								1.16E-08		
B-21	75.8 - 76.6	Unweathered Shale	SH-Grayson							3.99E-09	5.63E-09		
B-21	75.8 - 76.6	Unweathered Shale	SH-Grayson								1.29E-08		
B-21	104.2 - 105.0	Limestone	LM-Main St.							2.94E-08	1.09E-08		
B-23	1.5 - 3.0	Quaternary Alluvium	CL	54			31	13	18				
B-23	3.0 - 4.5	Quaternary Alluvium	SC	35			24	12	12				
B-23	9.0 - 11.0	Quaternary Alluvium	GC	18									

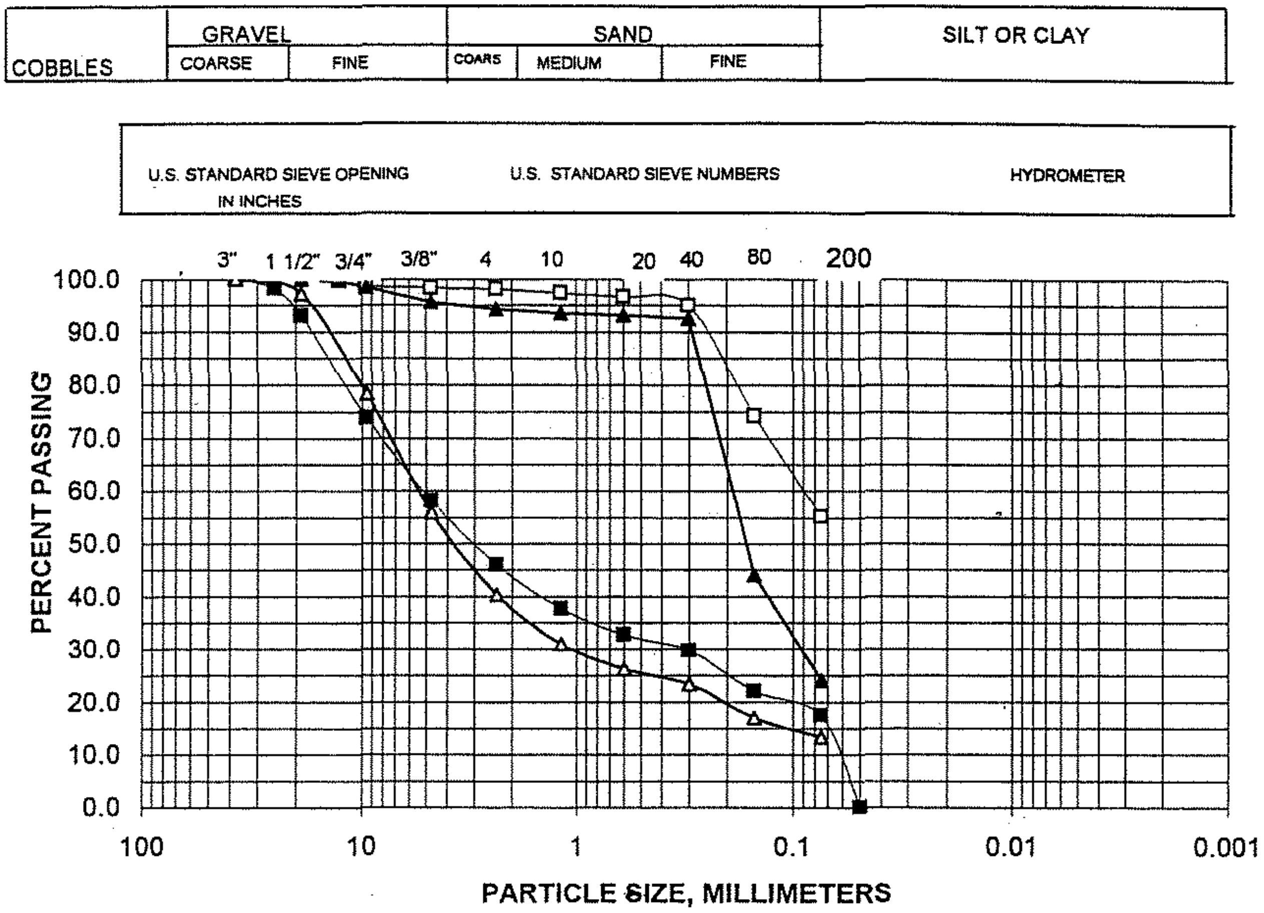
Ta E.1
Summary of Geotechnical Laboratory Test Results

Boring No.	Sample Depth feet	Geologic Deposit	Soil Type	% Passing No. 200 Sieve	Unit Dry Weight lb/cu ft	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Vertical Permeability cm/sec	Horizontal Permeability cm/sec	Remolded Permeability cm/sec	Unconfined Compressive Strength psi
B-24	1.5 - 3.0	Quaternary Alluvium	CL		102	21							
B-24	3.0 - 4.5	Quaternary Alluvium	CH	73			50	18	32				
B-24	6.0 - 7.5	Quaternary Alluvium	GC	45			25	13	12				
B-24	10.5 - 11.7	Weathered Shale	SH-CH	98			52	21	31				
B-24	13.7 - 14.8	Unweathered Shale	SH-Grayson	97			51	23	28				
B-25	4.0 - 7.5	Quaternary Alluvium	CL									2.94E-08	
B-25	3.0 - 4.5	Quaternary Alluvium	CL	77			42	13	29			9.60E-08	
B-25	7.5 - 9.0	Quaternary Alluvium	CL	75			47	14	33				
B-25	9.0 - 10.5	Quaternary Alluvium	CL		109	19							
B-25	10.5 - 12.0	Quaternary Alluvium	CL	70			31	14	17				
B-101	17.6 - 18.0	Unweathered Shale	SH-Grayson			18							
B-101	66.4 - 67.4	Unweathered Shale	SH-Grayson		142.9	6.3	45	19	26	4.57E-08			
B-101	19.5 - 20.5	Unweathered Shale	Calc. Shale		123.4	10					1.30E-05		
B-101	23.9 - 24.8	Unweathered Shale	SH-Grayson	96	129	11	39	19	20				230.6
B-101	33.2 - 33.8	Unweathered Shale	Calc. Shale		128	10							197.2
B-101	5.0 - 6.0	Unweathered Shale	SH-Grayson			23	26	13	13				
B-101	15.0 - 16.0	Unweathered Shale	SH-Grayson		100	26	32	19	13				
B-101	28.6 - 29.1	Unweathered Shale	SH-Grayson		120	9							
B-101	69.0 - 69.5	Unweathered Shale	SH-Grayson		117	16							
B-101	44.1 - 44.4	Limestone	LM-Main St.		116	15							
B-101	41.2 - 41.5	Limestone	LM-Main St.		132.5	8.9				2.06E-08			
B-102	37.6 - 38.4	Unweathered Shale	Calc. Shale		141.2	7.1				1.56E-08			
B-102	15.1	Unweathered Shale	SH-Grayson		128.7	9.3					1.55E-05		
B-102	15.0 - 18.0	Unweathered Shale	SH-Grayson		131	8	39	18	21				362.5
B-102	5.0 - 6.0	Unweathered Shale	SH-Grayson		102	18	31	14	17				
B-102	19.0 - 19.3	Unweathered Shale	SH-Grayson		124	19							
B-102	29.1 - 29.4	Unweathered Shale	SH-Grayson		133	8							
B-102	34.3 - 34.6	Unweathered Shale	SH-Grayson		138	7							
B-102	25.0 - 26.7	Unweathered Shale	Calc. Shale		141	10							955.6
B-103	15.0 - 16.7	Unweathered Shale	SH-Grayson		134	9							395.8
B-103	19.7 - 20.3	Unweathered Shale	Calc. Shale		137	9							1119.4
B-103	5.0 - 6.0	Unweathered Shale	SH-Grayson	61	74	29	39	19	20				
B-103	17.0 - 17.3	Unweathered Shale	SH-Grayson		128	12							
B-103	27.0 - 27.3	Unweathered Shale	SH-Grayson		140	9							
B-103	25.0 - 26.0	Unweathered Shale	Calc. Shale		120.3	12.1	38	16	22		2.22E-05		
B-104	26.4	Unweathered Shale	Calc. Shale		125.6	10.1					1.14E-04		
B-104	38.2 - 39.3	Unweathered Shale	Calc. Shale		120	13.9				8.10E-09			
B-104	19.6	Limestone	LM-Main St.		120.5	11.1					1.98E-05		
B-104	26.4 - 27.4	Unweathered Shale	Calc. Shale		131	12							526.4
B-104	7.0 - 7.8	Unweathered Shale	Calc. Shale		95	9	25	12	13				
B-104	15.3 - 15.6	Unweathered Shale	Calc. Shale		123	14							
B-104	30.8 - 31.1	Unweathered Shale	Calc. Shale		136	8							
B-104	38.2 - 38.7	Unweathered Shale	Calc. Shale		123	11							
B-104	19.6 - 21.0	Limestone	LM-Main St.		119	13							1630.6
B-105	44.6 - 45.6	Unweathered Shale	SH-Grayson		132	11	33	19	15		4.88E-06		295.8
B-105	64.4	Unweathered Shale	SH-Grayson		132.4	9.7					1.10E-05		
B-105	99.7	Unweathered Shale	SH-Grayson		128.8	7.3					3.92E-05		
B-105	109.3 - 110.5	Unweathered Shale	SH-Grayson		136.9	7.3				5.73E-09			
B-105	133.7 - 134.8	Limestone	LM-Main St.		131.6	8.5				6.83E-08			

Table [illegible].1

Summary of Geotechnical Laboratory Test Results

Boring No.	Sample Depth feet	Geologic Deposit	Soil Type	% Passing No. 200 Sieve	Unit Dry Weight lb/cu ft	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Vertical Permeability cm/sec	Horizontal Permeability cm/sec	Remolded Permeability cm/sec	Unconfined Compressive Strength psi
B-105	53.6 - 54.7	Unweathered Shale	SH-Grayson		132	10							247.2
B-105	64.4 - 65.7	Unweathered Shale	SH-Grayson		132	13	43	18	25				362.5
B-105	77.1 - 78.0	Unweathered Shale	SH-Grayson		118	14							295.8
B-105	86.6 - 88.1	Unweathered Shale	SH-Grayson		133	9	48	19	29				197.2
B-105	5.0 - 6.0	Unweathered Shale	SH-Grayson		115	10	32	14	18				
B-105	36.8 - 40.0	Unweathered Shale	SH-Grayson		104	15	40	16	24				
B-105	42.0 - 42.3	Unweathered Shale	SH-Grayson		101	13							
B-105	47.9 - 48.2	Unweathered Shale	SH-Grayson		116	17							
B-105	60.5 - 60.8	Unweathered Shale	SH-Grayson		129	12							
B-105	74.0 - 74.5	Unweathered Shale	SH-Grayson		121	16							
B-105	83.4 - 83.7	Unweathered Shale	SH-Grayson		113	17							
B-105	98.6 - 98.9	Unweathered Shale	SH-Grayson		130	11							
B-105	128.2 - 128.5	Unweathered Shale	SH-Grayson		130	10							
B-105	99.7 - 100.3	Unweathered Shale	SH-Grayson				43	18	24				



BORING NUMBER	DEPTH	SYMBOL	LL	PI	DESCRIPTION	PERCENT PASSING #200
1	3.5 - 5.0	□	—	—	sandy clay	55.2
23	9.0 - 11.0	■	—	—	clayey gravel with sand	17.5
7A	10.3 - 12.0	△	—	—	clayey gravel with sand	13.4
16A	2.5 - 12.9	▲	—	—	clayey sand	24.2

Project: C&D LANDFILL - FORT WORTH, TEXAS

PARTICLE SIZE DISTRIBUTION CURVES

Project Number: IES01382

FREESE AND NICHOLS, INC.

Figure 4E.2

TRIAXIAL SHEAR TEST

Consolidated-Undrained (R)
Single Specimen-Multistage

Proctor No.: WM-1

PROJECT: 819 Project

SAMPLE DESCRIPTION: Reddish brown sandy lean clay (CL)

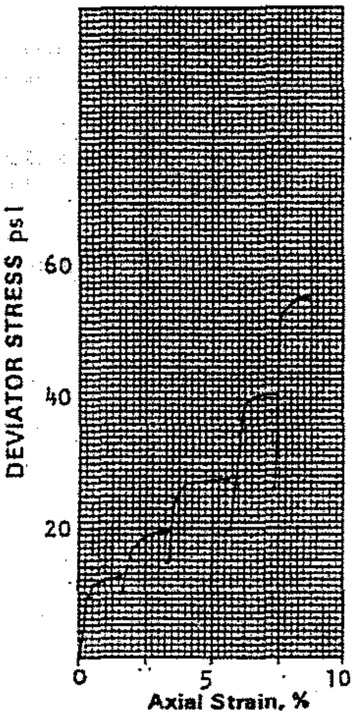
LOCATION: Tarrant County, Texas

LIQUID LIMIT: 25 **PLASTICITY INDEX:** 12 **(-) 200:** 53 **REPORT NO:** 892555

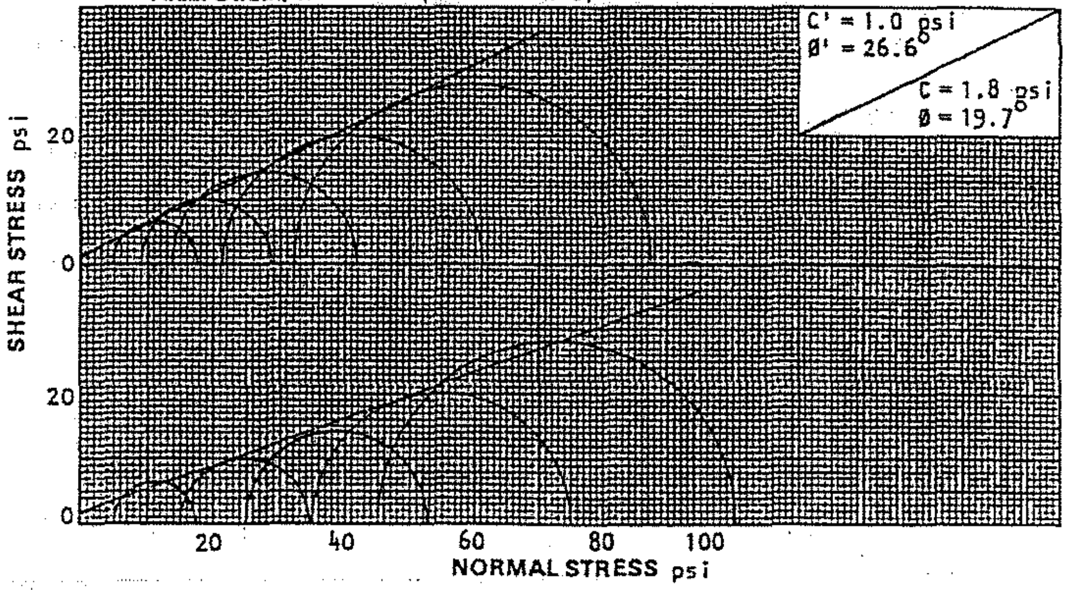
SPECIFIC GRAVITY: 2.75

	SAMPLE NO.	1	2	3
INITIAL	SAMPLE DIAMETER, in.	1.35		
	SAMPLE HEIGHT, in.	3.00		
	WATER CONTENT, %	12.40		
	DRY DENSITY, pcf	113.80		
	SATURATION, %	67.40		
	VOID RATIO	0.507		
FINAL	WATER CONTENT, %	--		
	DRY DENSITY, pcf	--		
	SATURATION, %	--		
	VOID RATIO	--		
	PORE PRESSURE, psi	0.03	5.90	10.72
	MINOR PRIN. STRESS, psi*	5.00	15.00	25.00
	MAX. DEV. STRESS, psi	12.31	19.62	27.62
	MAJOR PRIN. STRESS, psi*	17.31	34.62	52.62
	STRAIN RATE, %/min.	0.1		

+



Backpressure = 85psi *Total Stress +Additional Data on Pg 2



TRIAXIAL SHEAR TEST

Consolidated-Undrained (R)
Single Specimen-Multistage

Proctor No.: WM-4

PROJECT: 819 Project

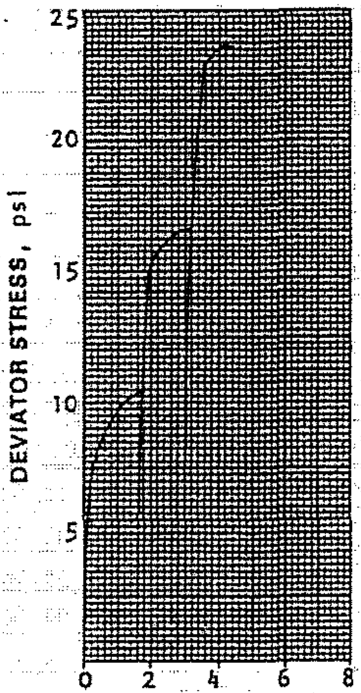
SAMPLE DESCRIPTION: Brown sandy lean clay (CL)

LOCATION: Tarrant County, Texas

LIQUID LIMIT: 42 PLASTICITY INDEX: 25 (-) 200: 74

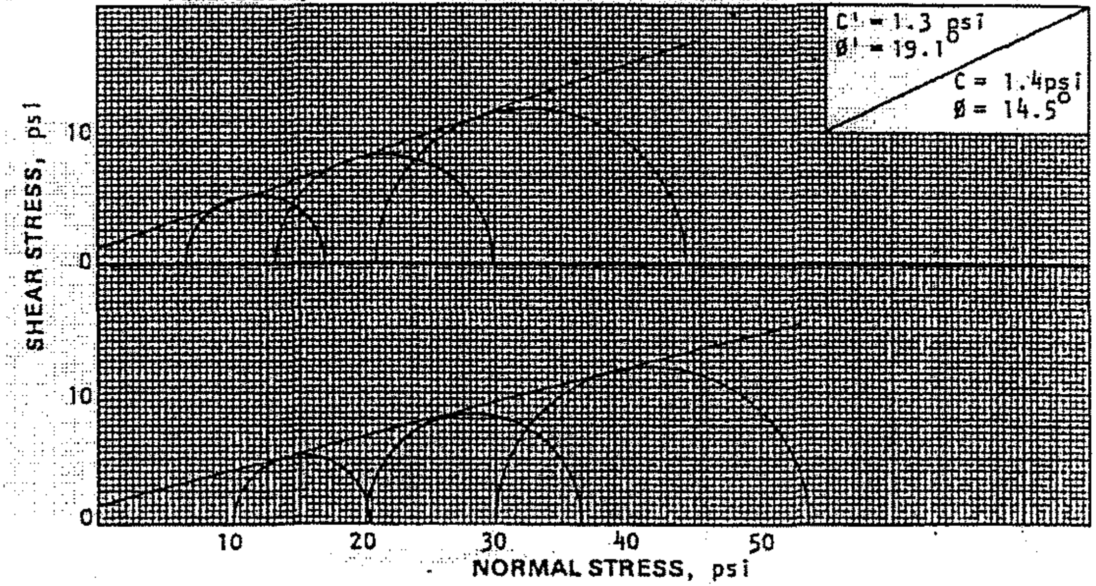
REPORT NO: 892555

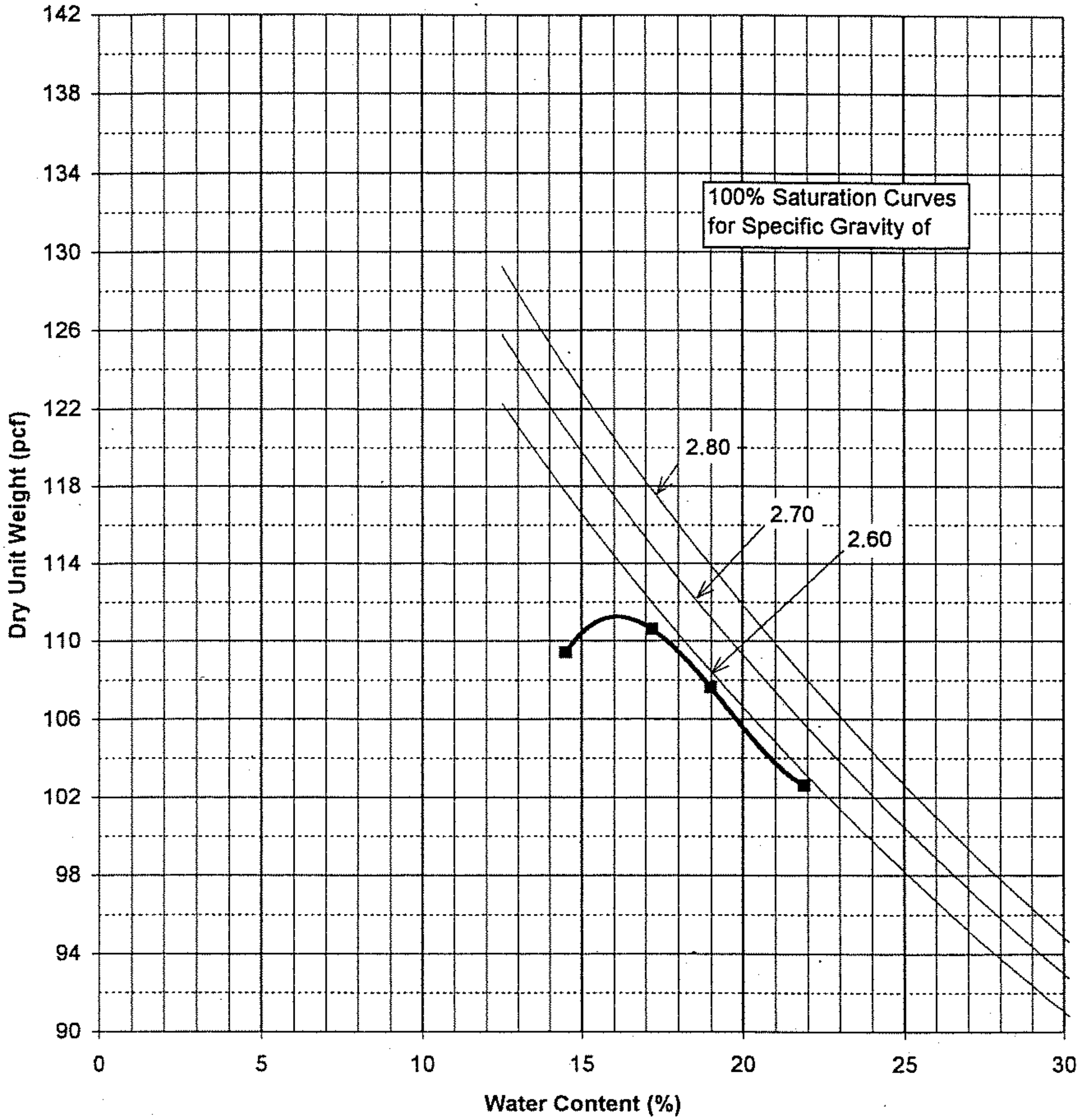
SPECIFIC GRAVITY: 2.82



	SAMPLE NO.	1	2	3
INITIAL	SAMPLE DIAMETER, in.	1.35		
	SAMPLE HEIGHT, in.	3.00		
	WATER CONTENT, %	18.60		
	DRY DENSITY, pcf	102.50		
	SATURATION, %	73.20		
	VOID RATIO	0.715		
FINAL	WATER CONTENT, %			20.80
	DRY DENSITY, pcf			110.70
	SATURATION, %			99.90
	VOID RATIO			0.587
PORE PRESSURE, psi		3.36	6.85	9.21
MINOR PRIN. STRESS, psi *		10.00	20.00	30.00
MAX. DEV. STRESS, psi		10.29	16.75	23.65
MAJOR PRIN. STRESS, psi *		20.29	36.75	53.65
STRAIN RATE, %/min.		0.1		

Backpressure = 95 psi * Total Stress





Sample No.	B-6	Depth	10' to 15	Maximum Dry Unit Weight	111.1 pcf
Test Method	ASTM D-698-A			Optimum Water Content	16.3 %

Sample Description Light tan & gray lean clay with sand

Liquid Limit	39	Plasticity Index	22	Specific Gravity	2.81

% Gravel	% Sand	% Fines	% Oversize Fraction

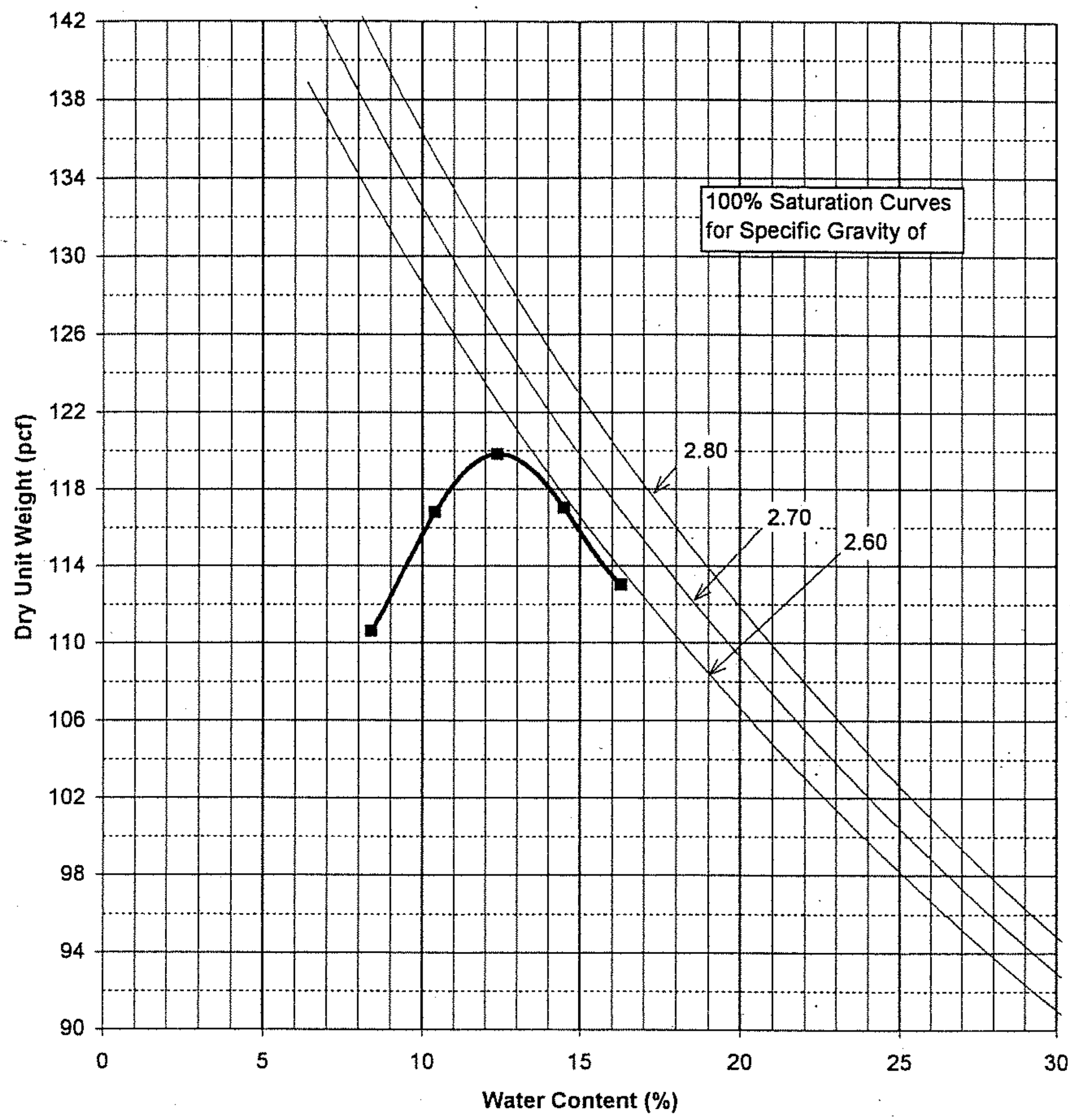
PROJECT: C&D Landfill - Fort Worth, Texas
PROJECT NUMBER: IES01382
MATERIAL SOURCE:

COMPACTION TEST

Freese and Nichols, Inc.

Plotted by: JDK
Reviewed by: CNE

File: Geotech Lab Results2
Date: 12/4/2001



Sample No.	B-11	Depth	6' to 9'	Maximum Dry Unit Weight	119.8 pcf
Test Method	ASTM D-698-A			Optimum Water Content	12.5 %
Sample Description	Reddish brown sandy lean clay				
Liquid Limit	25	Plasticity Index	12	Specific Gravity	2.75
% Gravel	% Sand	% Fines	% Oversize Fraction		

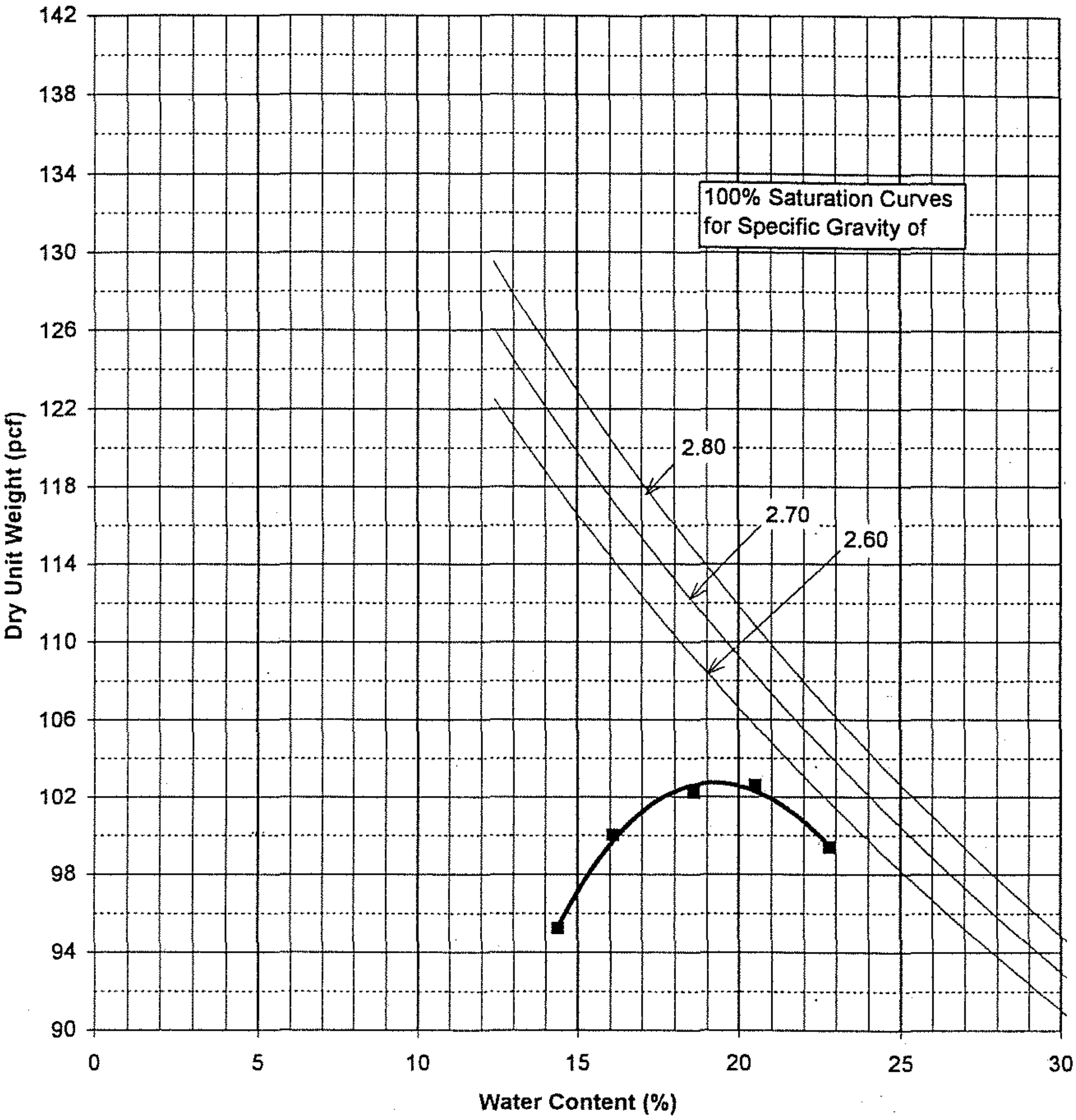
PROJECT: C&D Landfill - Fort Worth, Texas
PROJECT NUMBER: IES01382
MATERIAL SOURCE:

COMPACTION TEST

Freese and Nichols, Inc.

Plotted by: JDK
Reviewed by: CNE

File: Geotech Lab Results2
Date: 12/4/2001



Sample No.	B-13	Depth	0' to 6'	Maximum Dry Unit Weight	103.1 pcf
Test Method	ASTM D-698-A			Optimum Water Content	19.5 %
Sample Description	Dark brown sandy lean clay				
Liquid Limit	43	Plasticity Index	25	Specific Gravity	2.8
% Gravel	% Sand	% Fines		% Oversize Fraction	

PROJECT: C&D Landfill - Fort Worth, Texas
PROJECT NUMBER: IES01382
MATERIAL SOURCE:

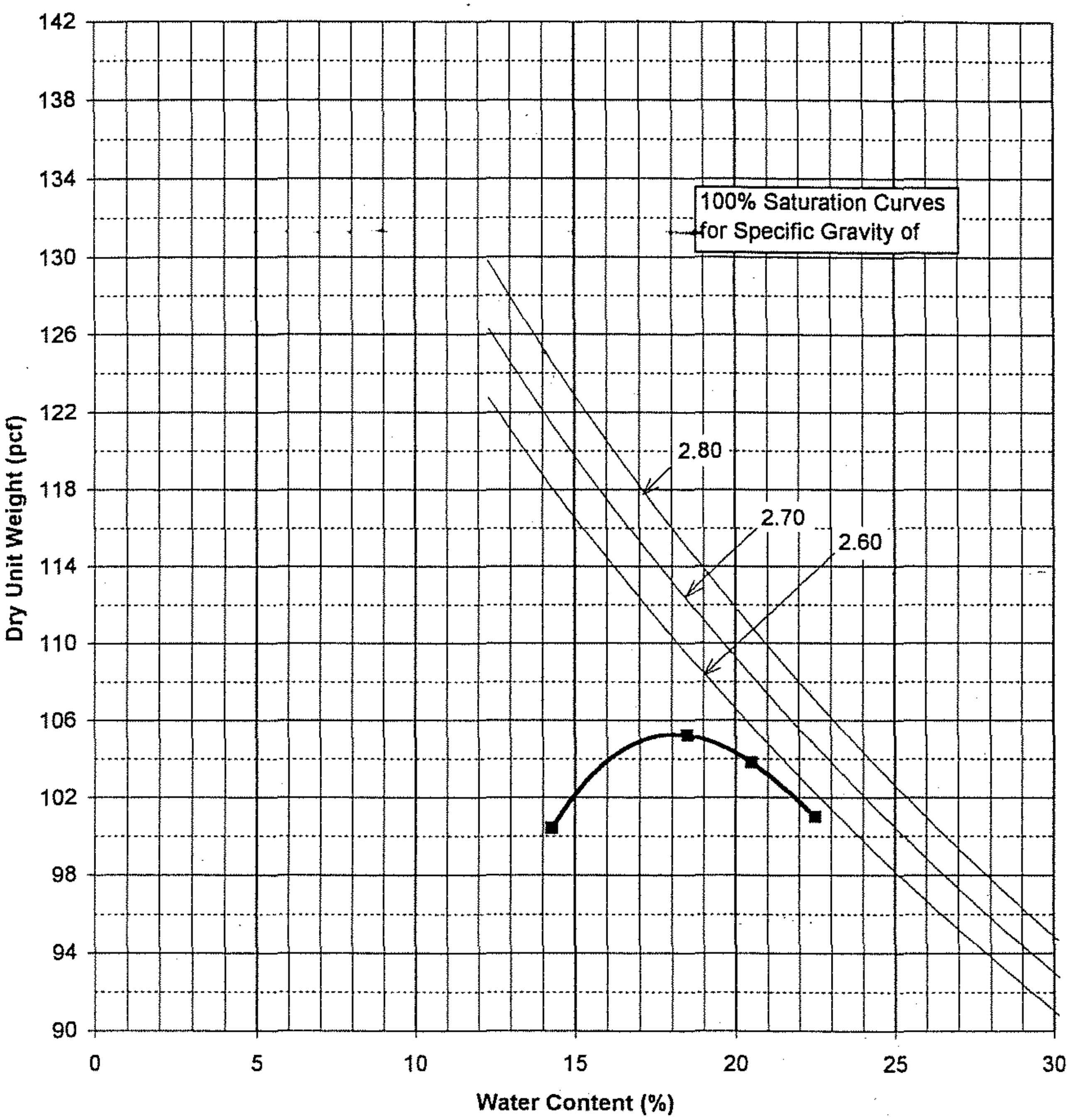
COMPACTION TEST

Freese and Nichols, Inc.

Pg. No. 3D.1-App 3 - 10

Plotted by: JDK
Reviewed by: CNE

May 2020
File: Geotech Lab Results2
Date: 12/4/2001



Sample No. B-14 Depth 12' to 15	Maximum Dry Unit Weight	105.1 pcf	
Test Method ASTM D-698-A	Optimum Water Content	18.5 %	
Sample Description Brown fat clay with sand			
Liquid Limit 52	Plasticity Index 34	Specific Gravity 2.82	
% Gravel	% Sand	% Fines	% Oversize Fraction

PROJECT: C&D Landfill - Fort Worth, Texas
PROJECT NUMBER: IES01382
MATERIAL SOURCE:

COMPACTION TEST

Pg. No. 3D.1-App 3 - 11
May 2020

Freese and Nichols, Inc.

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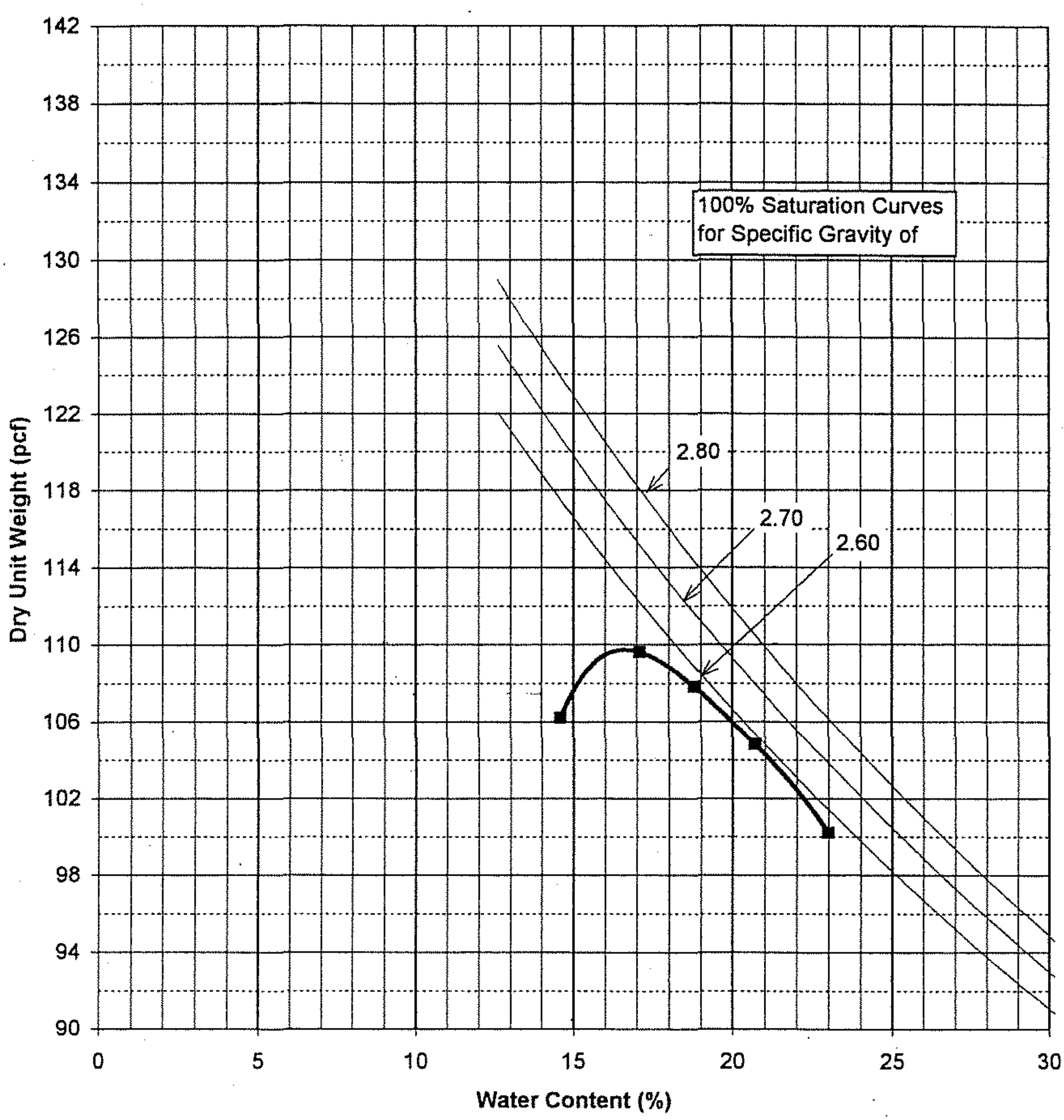
Date: 12/4/2001



Sample No.	B-15	Depth	5' to 10'	Maximum Dry Unit Weight	109.7 pcf
Test Method	ASTM D-698-A			Optimum Water Content	17.1 %
Sample Description	Light tan lean clay				
Liquid Limit	41	Plasticity Index	25	Specific Gravity	2.81
% Gravel	% Sand	% Fines	% Oversize Fraction		

PROJECT: C&D Landfill - Fort Worth, Texas
PROJECT NUMBER: IES01382
MATERIAL SOURCE:

COMPACTION TEST

Freese and Nichols, Inc.

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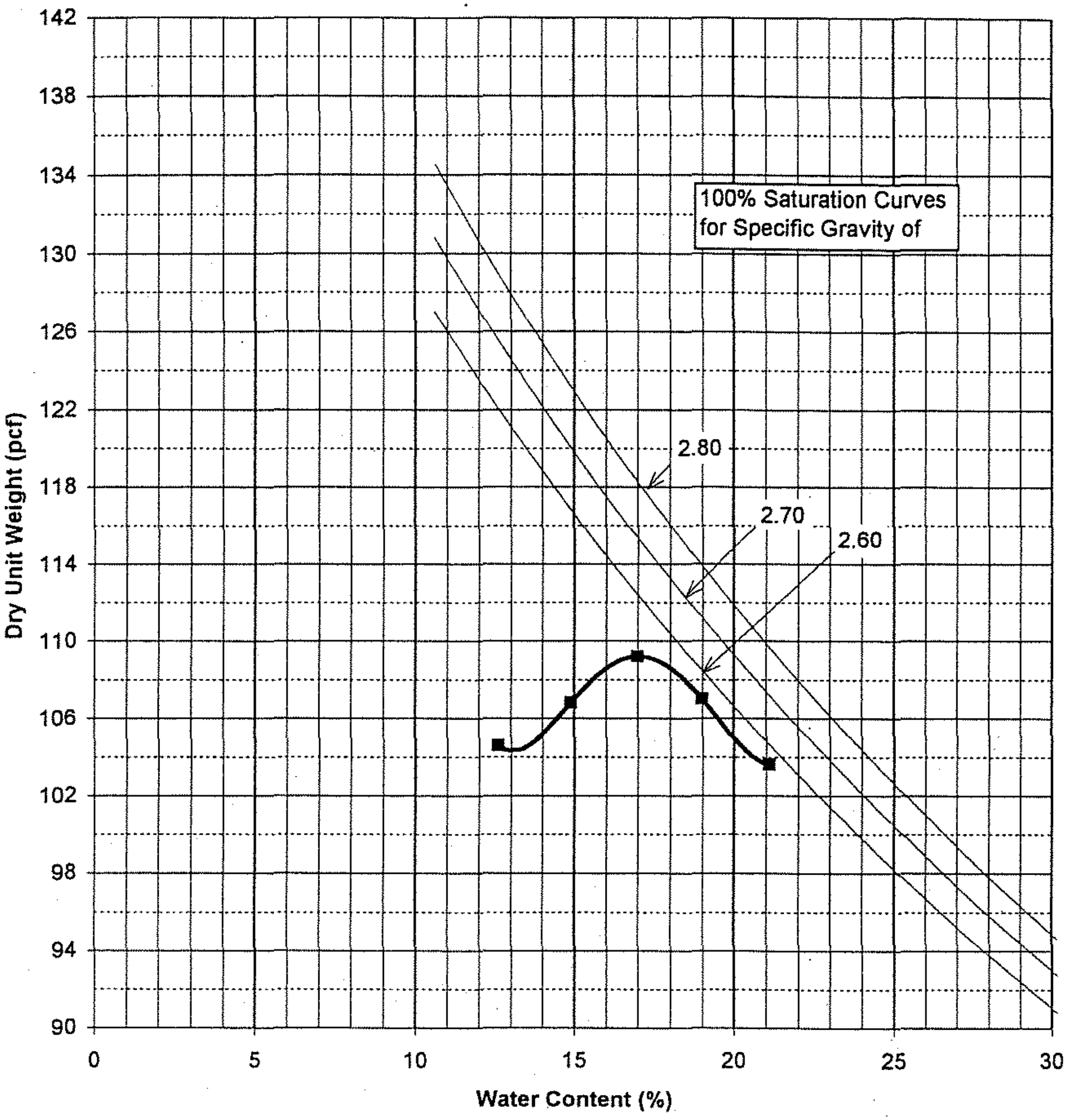
Reviewed by: CNE

File: Geotech Lab Results2
Date: 12/4/2001



Sample No.	B-25	Depth	4' to 7.5	Maximum Dry Unit Weight	109.2 pcf
Test Method	ASTM D-698-A			Optimum Water Content	17.0 %
Sample Description	Reddish brown sandy lean clay				
Liquid Limit	25	Plasticity Index	12	Specific Gravity	2.82
% Gravel	% Sand	% Fines		% Oversize Fraction	

PROJECT: C&D Landfill - Fort Worth, Texas
PROJECT NUMBER: IES01382
MATERIAL SOURCE:

COMPACTION TEST

Freese and Nichols, Inc.

Pg. No. 3D.1-App 3 - 13

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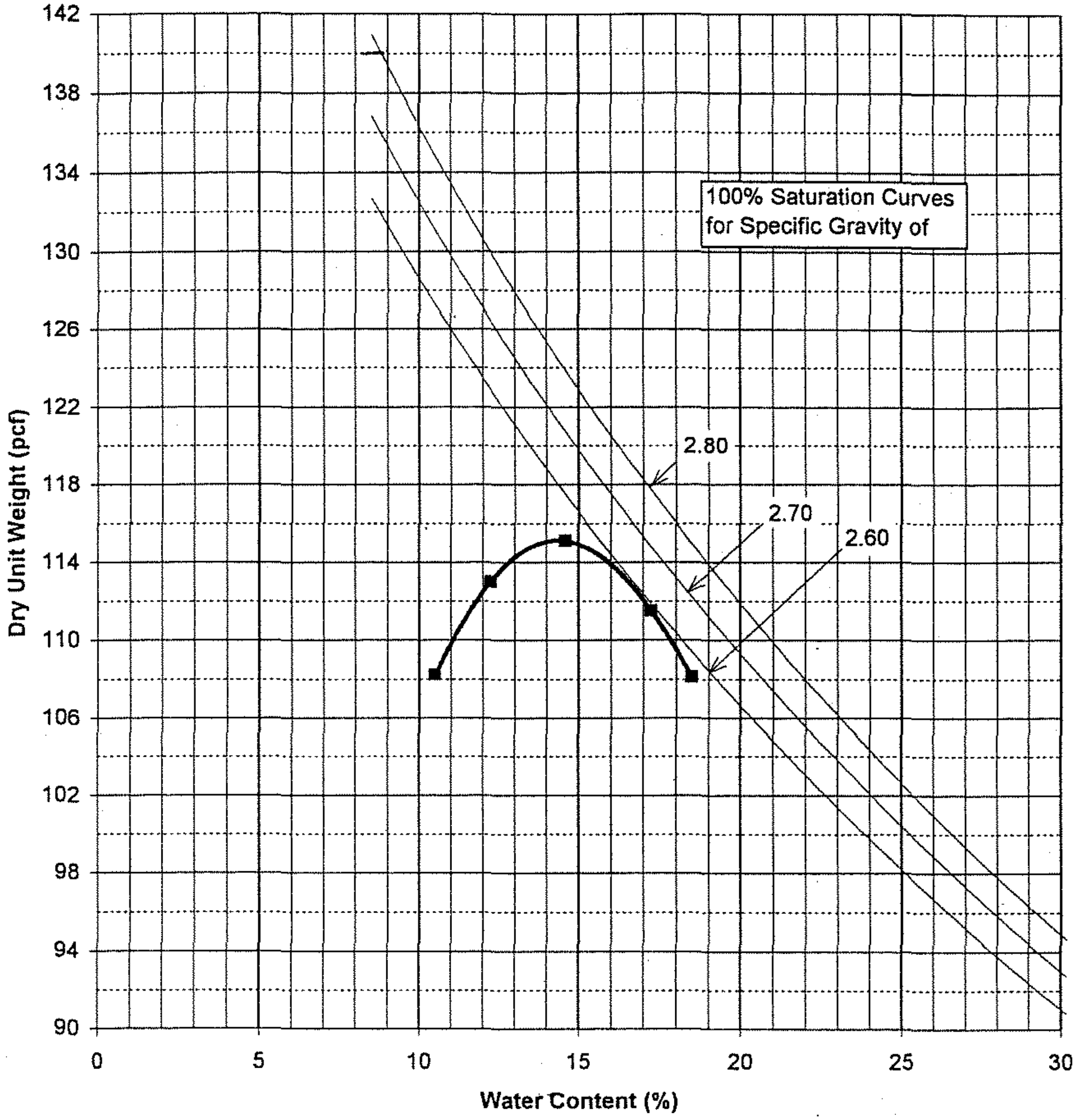
File: Geotech Lab Results2
Date: 12/4/2001



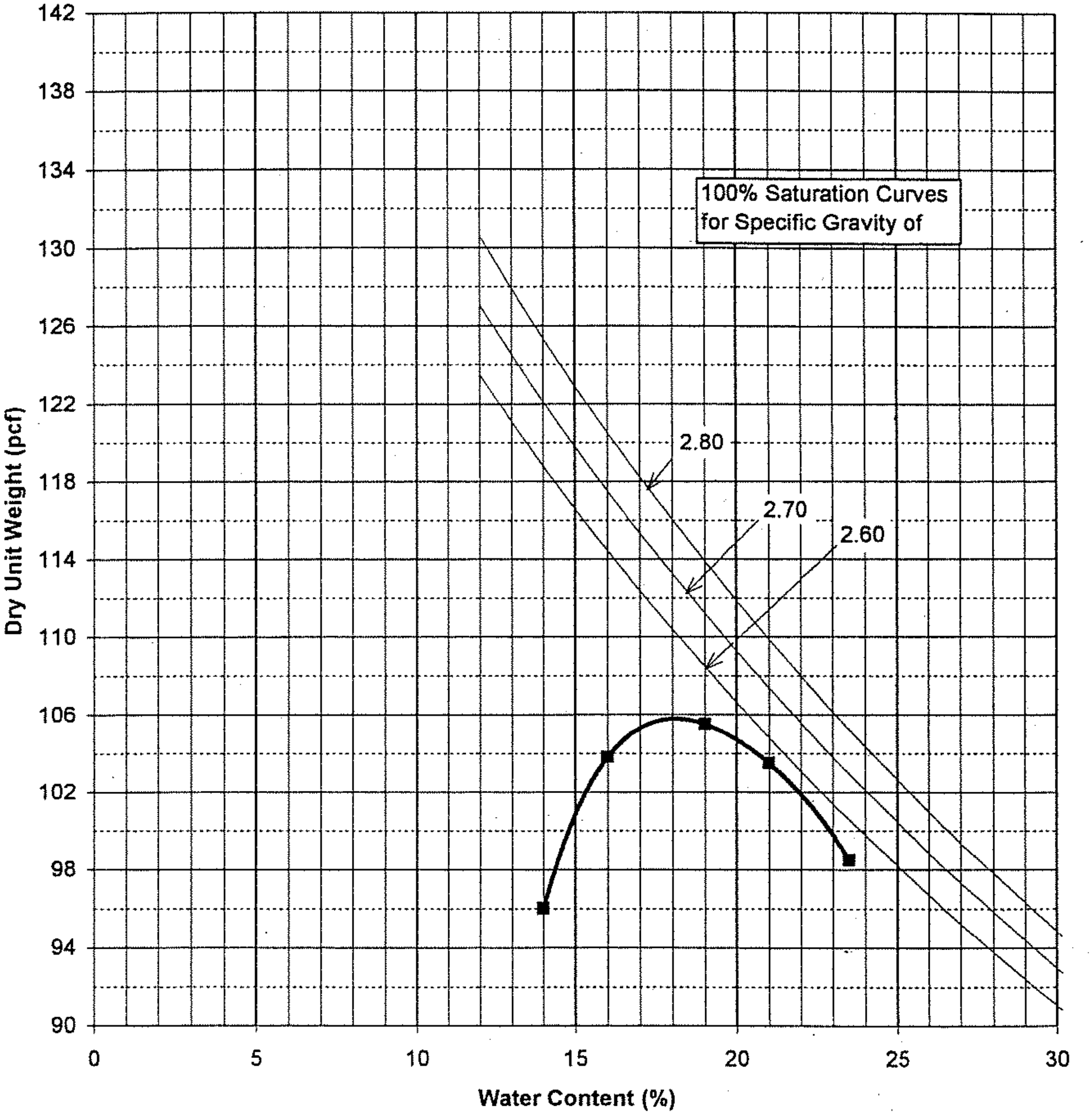
Sample No.	B-102 Deptl0' - 5', 6' - 8.5'		Maximum Dry Unit Weight		115.1 pcf
Test Method	ASTM D-698-91, D-4318, D-11		Optimum Water Content		14.6 %
Sample Description	Sandy clay, brown-tan				
Liquid Limit	n/a	Plasticity Index	n/a	Specific Gravity	2.7
% Gravel	% Sand	% Fines	% Oversize Fraction		

PROJECT: C&D Landfill - Fort Worth, Texas
PROJECT NUMBER: IES01382
MATERIAL SOURCE:

COMPACTION TEST

Freese and Nichols, Inc.

Plotted by: JDK
Reviewed by: CNE



Sample No. B-103/B-101	Depth 6' - 9'/6' - 10'	Maximum Dry Unit Weight		105.9 pcf	
Test Method	ASTM D-698-91, D-4318, D-11	Optimum Water Content		18.3 %	
Sample Description	Clay with sand, dark gray				
Liquid Limit	n/a	Plasticity Index	n/a	Specific Gravity	2.7
% Gravel	% Sand	% Fines	% Oversize Fraction		

PROJECT: C&D Landfill - Fort Worth, Texas
PROJECT NUMBER: IES01382
MATERIAL SOURCE:

COMPACTION TEST

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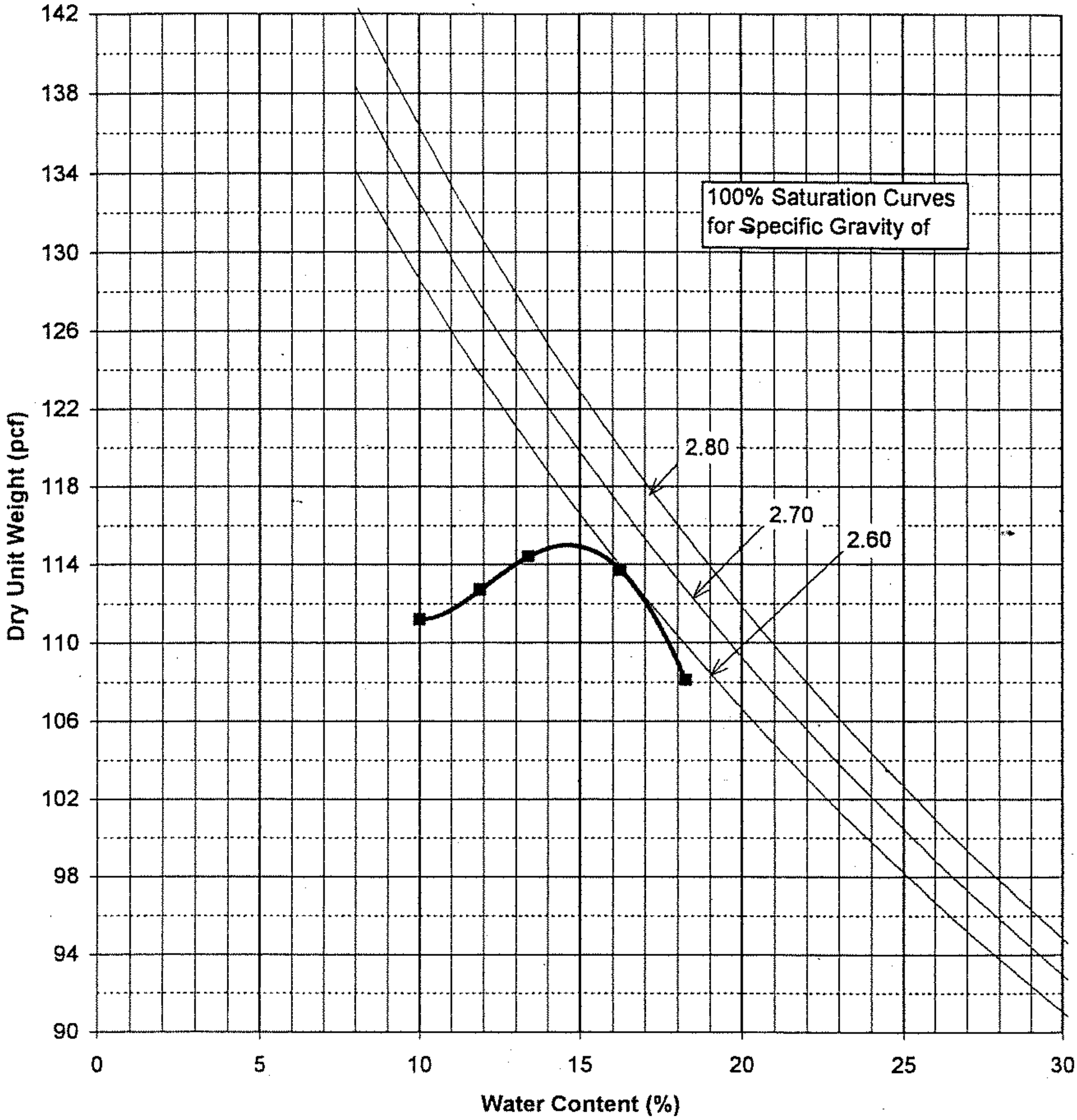
Date: 12/4/2001



Sample No. B-104/B-105	Depth 2' - 5'/2' - 5'	Maximum Dry Unit Weight		114.8 pcf	
Test Method	ASTM D-698-91, D-4318, D-11	Optimum Water Content		14.7 %	
Sample Description	Sandy clay, tan				
Liquid Limit	n/a	Plasticity Index	n/a	Specific Gravity	2.7
% Gravel	% Sand	% Fines		% Oversize Fraction	

PROJECT: C&D Landfill - Fort Worth, Texas
PROJECT NUMBER: IES01382
MATERIAL SOURCE:

COMPACTION TEST

Pg. No. 3D.1-App 3 - 16
May 2020

Freese and Nichols, Inc.

Plotted by: JDK
Reviewed by: CNE

File: Geotech Lab Results2
Date: 12/4/2001

STS Consultants, Ltd.
Laboratory Services Group 750 Corporate Woods Parkway Vernon Hills, Illinois 60061 phone (847)279-2500 fax(847)279-2550

HYDRAULIC CONDUCTIVITY DETERMINATION
ASTM D 5084, Method C (EM-1110-2-1906 7)
Rising tailwater method in a triaxial permeameter

STS PROJECT NO.: 32406

PROJECT: Trinity Engineering / Kleinfelder

DATE: 12/11/2001

SUMMARY OF TEST RESULTS

BORING NO. 101

DEPTH (ft.) 19.5-20.5

TEST NO. B101S3H

HYDRAULIC CONDUCTIVITY DIRECTION Horizontal

CLASSIFICATION Clay Stone -- Gray (small cracks and fissures noted prior to specimen set up)

	INITIAL	FINAL
DRY UNIT WEIGHT (pcf)	123.4	122.5
WATER CONTENT (%)	10.0	14.6
DIAMETER (cm)	3.017	3.017
LENGTH (cm)	2.650	2.670

HYDRAULIC GRADIENT (MAXIMUM) 35.6

PERCENT SATURATION 100.6 (Percent saturation calculation is based on final measurements and an estimated specific gravity.)

HYDRAULIC CONDUCTIVITY k (cm/sec) **1.30E-05**

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HYDRAULIC CONDUCTIVITY DETERMINATION
ASTM D 5084, Method C (EM-1110-2-1906 7)
Rising tailwater method in a triaxial permeameter

Laboratory Services Group 750 Corporate Woods Parkway Vernon Hills, Illinois 60061 (847)279-2500 fax(847)279-2550

STS PROJECT NO.: 32406

PROJECT: Trinity Engineering / Kleinfelder

DATE: 12/11/2001

SUMMARY OF TEST RESULTS

BORING NO.	101
DEPTH (ft.)	41.2-41.5
TEST NO.	B101S2V
HYDRAULIC CONDUCTIVITY DIRECTION	Vertical
CLASSIFICATION	Clay Stone -- Gray

	INITIAL	FINAL
DRY UNIT WEIGHT (pcf)	132.5	125.3
WATER CONTENT (%)	8.9	13.7
DIAMETER (cm)	5.041	5.120
LENGTH (cm)	9.411	9.650

HYDRAULIC GRADIENT (MAXIMUM)	17.5	
PERCENT SATURATION	103.0	(Percent saturation calculation is based on final measurements and an estimated specific gravity.)
HYDRAULIC CONDUCTIVITY k (cm/sec)	**2.06E-08**	

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HYDRAULIC CONDUCTIVITY DETERMINATION
ASTM D 5084, Method C (EM-1110-2-1906 7)
Rising tailwater method in a triaxial permeameter

Laboratory Services Group 750 Corporate Woods Parkway Vernon Hills, Illinois 60061 (847)279-2500 fax(847)279-2550

STS PROJECT NO.: 32406

PROJECT: Trinity Engineering / Kleinfelder

DATE: 12/11/2001

SUMMARY OF TEST RESULTS

BORING NO.	101
DEPTH (ft.)	66.4-67.2
TEST NO.	B101S1V
HYDRAULIC CONDUCTIVITY DIRECTION	Vertical
CLASSIFICATION	Clay Stone -- Gray

	INITIAL	FINAL
DRY UNIT WEIGHT (pcf)	142.9	139.6
WATER CONTENT (%)	6.3	8.5
DIAMETER (cm)	5.028	5.056
LENGTH (cm)	6.155	6.230

HYDRAULIC GRADIENT (MAXIMUM)	26.7	
PERCENT SATURATION	103.3	(Percent saturation calculation is based on final measurements and an estimated specific gravity.)
HYDRAULIC CONDUCTIVITY k (cm/sec)	**4.57E-08**	

B101S1.xls

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HYDRAULIC CONDUCTIVITY DETERMINATION
ASTM D 5084, Method C (EM-1110-2-1906 7)
Rising tailwater method in a triaxial permeameter

STS PROJECT NO.: 32406

PROJECT: Trinity Engineering / Kleinfelder

DATE: 12/11/2001

SUMMARY OF TEST RESULTS

BORING NO. 103

DEPTH (ft.) 25.0-26.0

TEST NO. B103S1H

HYDRAULIC CONDUCTIVITY DIRECTION Horizontal

CLASSIFICATION Clay Stone -- Gray (small cracks and fissures noted prior to specimen set up)

	INITIAL	FINAL
DRY UNIT WEIGHT (pcf)	120.3	119.2
WATER CONTENT (%)	12.1	16.1
DIAMETER (cm)	3.059	3.059
LENGTH (cm)	2.368	2.389

HYDRAULIC GRADIENT (MAXIMUM) 39.4

PERCENT SATURATION 101.3 (Percent saturation calculation is based on final measurements and an estimated specific gravity.)

HYDRAULIC CONDUCTIVITY k (cm/sec) **2.22E-05**

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HYDRAULIC CONDUCTIVITY DETERMINATION
ASTM D 5084, Method C (EM-1110-2-1906 7)
Rising tailwater method in a triaxial permeameter

STS PROJECT NO.:	32406
PROJECT:	Trinity Engineering / Kleinfelder
DATE:	12/11/2001

SUMMARY OF TEST RESULTS

BORING NO.	104
DEPTH (ft.)	19.6
TEST NO.	B104S3H
HYDRAULIC CONDUCTIVITY DIRECTION	Horizontal
CLASSIFICATION	Clay Stone -- Gray (small cracks and fissures noted prior to specimen set up)

	INITIAL	FINAL
DRY UNIT WEIGHT (pcf)	120.5	119.0
WATER CONTENT (%)	11.1	16.5
DIAMETER (cm)	3.083	3.083
LENGTH (cm)	3.270	3.311

HYDRAULIC GRADIENT (MAXIMUM)	28.5	
PERCENT SATURATION	103.0	(Percent saturation calculation is based on final measurements and an estimated specific gravity.)
HYDRAULIC CONDUCTIVITY k (cm/sec)	**1.98E-05**	

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HYDRAULIC CONDUCTIVITY DETERMINATION
ASTM D 5084, Method C (EM-1110-2-1906 7)
Rising tailwater method in a triaxial permeameter

STS PROJECT NO.:	32406
PROJECT:	Trinity Engineering / Kleinfelder
DATE:	12/11/2001

SUMMARY OF TEST RESULTS

BORING NO.	104
DEPTH (ft.)	26.4
TEST NO.	B104S2H
HYDRAULIC CONDUCTIVITY DIRECTION	Horizontal
CLASSIFICATION	Clay Stone -- Gray (small cracks and fissures noted prior to specimen set up)

	INITIAL	FINAL
DRY UNIT WEIGHT (pcf)	125.6	125.5
WATER CONTENT (%)	10.1	13.9
DIAMETER (cm)	3.072	3.072
LENGTH (cm)	3.291	3.295

HYDRAULIC GRADIENT (MAXIMUM)	28.4	
PERCENT SATURATION	104.5	(Percent saturation calculation is based on final measurements and an estimated specific gravity.)
HYDRAULIC CONDUCTIVITY k (cm/sec)	**1.14E-04**	

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HYDRAULIC CONDUCTIVITY DETERMINATION
ASTM D 5084, Method C (EM-1110-2-1906 7)
Rising tailwater method in a triaxial permeameter

STS PROJECT NO.: 32406

PROJECT: Trinity Engineering / Kleinfelder

DATE: 12/11/2001

SUMMARY OF TEST RESULTS

BORING NO.	104
DEPTH (ft.)	38.2-39.3
TEST NO.	B104S1V
HYDRAULIC CONDUCTIVITY DIRECTION	Vertical
CLASSIFICATION	Clay Stone -- Gray

	INITIAL	FINAL
DRY UNIT WEIGHT (pcf)	120.0	119.9
WATER CONTENT (%)	13.9	15.4
DIAMETER (cm)	5.028	5.028
LENGTH (cm)	9.156	9.166

HYDRAULIC GRADIENT (MAXIMUM)	18.0	
PERCENT SATURATION	98.8	(Percent saturation calculation is based on final measurements and an estimated specific gravity.)
HYDRAULIC CONDUCTIVITY k (cm/sec)	**8.10E-09**	

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HYDRAULIC CONDUCTIVITY DETERMINATION
ASTM D 5084, Method C (EM-1110-2-1906 7)
Rising tailwater method in a triaxial permeameter

Laboratory Services Group 750 Corporate Woods Parkway Vernon Hills, Illinois 60061 phone (847)279-2500 fax(847)279-2550

STS PROJECT NO.:	32406
PROJECT:	Trinity Engineering / Kleinfelder
DATE:	12/11/2001

SUMMARY OF TEST RESULTS

BORING NO.	105
DEPTH (ft.)	109.3-110.5
TEST NO.	B105S1V
HYDRAULIC CONDUCTIVITY DIRECTION	Vertical
CLASSIFICATION	Clay Stone -- gray

	INITIAL	FINAL
DRY UNIT WEIGHT (pcf)	136.9	134.5
WATER CONTENT (%)	7.3	10.3
DIAMETER (cm)	5.000	5.028
LENGTH (cm)	8.001	8.053

HYDRAULIC GRADIENT (MAXIMUM)	20.6	
PERCENT SATURATION	104.0	(Percent saturation calculation is based on final measurements and an estimated specific gravity.)
HYDRAULIC CONDUCTIVITY k (cm/sec)	**5.73E-09**	

STS Consultants, Ltd.

HYDRAULIC CONDUCTIVITY DETERMINATION
ASTM D 5084, Method C (EM-1110-2-1906 7)
Rising tailwater method in a triaxial permeameter

Laboratory Services Group 750 Corporate Woods Parkway Vernon Hills, Illinois 60061 phone (847)279-2500 fax(847)279-2550

STS PROJECT NO.:	32406
PROJECT:	Trinity Engineering / Kleinfelder
DATE:	12/11/2001

SUMMARY OF TEST RESULTS

BORING NO.	105
DEPTH (ft.)	133.7-134.8
TEST NO.	B105S2V
HYDRAULIC CONDUCTIVITY DIRECTION	Vertical
CLASSIFICATION	Clay Stone -- Gray

	INITIAL	FINAL
DRY UNIT WEIGHT (pcf)	131.6	131.2
WATER CONTENT (%)	8.5	10.5
DIAMETER (cm)	4.968	4.970
LENGTH (cm)	7.606	7.623

HYDRAULIC GRADIENT (MAXIMUM)	21.6	
PERCENT SATURATION	97.9	(Percent saturation calculation is based on final measurements and an estimated specific gravity.)
HYDRAULIC CONDUCTIVITY k (cm/sec)	**6.83E-08**	

TRINITY ENGINEERING / KLEINFELDER

Geotechnical Engineering, Environmental Services, and
Construction Materials Engineering and Testing

Hydraulic Conductivity Test Results

Flexible Wall Permeameter - Falling Head, Rising Tailwater, Constant Volume

Project Name: C&D Landfill for Freese & Nichols (IES01382)
Project Location: Fort Worth, Texas
Material Description: CLAY with sand, brown

TE/K Project No. 10726-2
Boring/Sample No. B-102
Boring Depth/Sample Lift: 0'-5', 6'-8.5'
Sample Orientation: Vertical
Remolded or Undisturbed: Remolded

Proctor Number: 5937
Lab Start Date: 10/3/01
Tested By: DEG
Permeameter ID: 3
Permeant Fluid: De-aired

Initial Sample Proerties

Length: 1.3 in
Diameter: 4 in
Moisture Content: 17.5 %
Wet Unit Weight: 127.1 pcf
Dry Unit Weight: 108.2 pcf

Final Sample Proerties

Length: 1.28 in
Diameter: 4 in
Moisture Content: 17.5 %
Wet Unit Weight: 131.6 pcf
Dry Unit Weight: 112.0 pcf

Soil Classification Proerties

Liquid Limit: N/A
Plastic Limit: N/A
Plasticity Index: N/A
Passing 200 Sieve N/A

Test Conditions

Total Back-Pressure: 80 psi
Maximum Hydraulic Gradient: 30 cm/cm
Sample Saturation at Test: 100 %

Date	Time	Cumul. Time, s	Reading, cm	Total Head Loss, cm	Temp, C	Rt	k @ 20C, m/sec	k @ 20C, cm/sec
10/3/01	10:25		9.50					
10/3/01	10:30	300	9.35	0.15	22	0.953	6.2E-11	6.2E-09
10/3/01	10:35	600	9.20	0.30	22	0.953	6.3E-11	6.3E-09
10/3/01	10:40	900	9.00	0.50	22	0.953	7.1E-11	7.1E-09
10/3/01	10:45	1200	8.95	0.55	22	0.953	5.9E-11	5.9E-09
10/3/01	10:50	1500	8.80	0.70	22	0.953	6.0E-11	6.0E-09
10/3/01	10:55	1800	8.65	0.85	22	0.953	6.2E-11	6.2E-09
10/3/01	11:00	2100	8.60	0.90	22	0.953	5.6E-11	5.6E-09
Average "k" for Last Four Readings							5.9E-11	5.9E-09

Comments:

The results shown on this report are for the exclusive use of the client for whom they were obtained and apply only to the samples tested and/or inspected. They are not intended to be indicative of the qualities of apparently identical products. The use of our name must receive prior written approval. Reports must be reproduced in their entirety. Test method based on ASTM D 5084, D 2216, and D 4767.

TRINITY ENGINEERING / KLEINFELDER

Geotechnical Engineering, Environmental Services, and
Construction Materials Engineering and Testing

Hydraulic Conductivity Test Results

Flexible Wall Permeameter - Falling Head, Rising Tailwater, Constant Volume

Project Name: C&D Landfill for Freese & Nichols (IES01382)
Project Location: Fort Worth, Texas
Material Description: CLAY with sand, brown

Project No. 10726-2
Boring and Depth: B-103, 6'-9'
B-101, 6'-10'
Sample Orientation: Vertical
Remolded or Undisturbed: Remolded

Proctor Number: 5938
Lab Start Date: 10/3/01
Tested By: DEG
Permeameter ID: 1
Permeant Fluid: De-aired

Initial Sample Proerties

Length: 1.75 in
Diameter: 3.8 in
Moisture Content: 12.3 %
Wet Unit Weight: 127.6 pcf
Dry Unit Weight: 113.7 pcf

Final Sample Proerties

Length: 1.72 in
Diameter: 3.8 in
Moisture Content: 16.5 %
Wet Unit Weight: 134.8 pcf
Dry Unit Weight: 115.7 pcf

Soil Classification Proerties

Liquid Limit: N/A
Plastic Limit: N/A
Plasticity Index: N/A
Passing 200 Sieve N/A

Test Conditions

Total Back-Pressure: 80 psi
Maximum Hydraulic Gradient: 30 cm/cm
Sample Saturation at Test: 100 %

Date	Time	Cumul. Time, s	Reading, cm	Total Head Loss, cm	Temp, C	Rt	k @ 20C, m/sec	k @ 20C, cm/sec
10/9/01	12:00		7.10					
10/9/01	12:00	30	6.50	0.60	22	0.953	2.8E-09	2.8E-07
10/9/01	12:01	60	6.00	1.10	22	0.953	2.6E-09	2.6E-07
10/9/01	12:01	90	5.50	1.60	22	0.953	2.6E-09	2.6E-07
10/9/01	12:02	120	5.10	2.00	22	0.953	2.5E-09	2.5E-07
10/9/01	12:02	150	4.70	2.40	22	0.953	2.5E-09	2.5E-07
10/9/01	12:03	180	4.30	2.80	22	0.953	2.5E-09	2.5E-07
10/9/01	12:03	210	4.00	3.10	22	0.953	2.4E-09	2.4E-07
10/9/01	12:04	240	3.80	3.30	22	0.953	2.3E-09	2.3E-07
10/9/01	12:04	270	3.50	3.60	22	0.953	2.2E-09	2.2E-07
Average "k" for Last Four Readings							2.3E-09	2.3E-07

Comments: Combined Sample

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TRINITY ENGINEERING / KLEINFELDER

Geotechnical Engineering, Environmental Services, and
Construction Materials Engineering and Testing

Hydraulic Conductivity Test Results

Flexible Wall Permeameter - Falling Head, Rising Tailwater, Constant Volume

Project Name: C&D Landfill for Freese & Nichols (IES01382)
Project Location: Fort Worth, Texas
Material Description: CLAY with sand, tan

TE/K Project No. 10726-2
Boring and Depth: B-104, 2'-5'
B-105, 2'-5'
Sample Orientation: Vertical
Remolded or Undisturbed: Remolded

Proctor Number: 5939
Lab Start Date: 10/3/01
Tested By: DEG
Permeameter ID: 2
Permeant Fluid: De-aired

Initial Sample Proerties

Length: 1.55 in
Diameter: 4 in
Moisture Content: 16.7 %
Wet Unit Weight: 134.1 pcf
Dry Unit Weight: 114.9 pcf

Final Sample Proerties

Length: 1.52 in
Diameter: 4 in
Moisture Content: 16.7 %
Wet Unit Weight: 140.8 pcf
Dry Unit Weight: 120.7 pcf

Soil Classification Proerties

Liquid Limit: N/A
Plastic Limit: N/A
Plasticity Index: N/A
Passing 200 Sieve N/A

Test Conditions

Total Back-Pressure: 80 psi
Maximum Hydraulic Gradient: 30 cm/cm
Sample Saturation at Test: 100 %

Date	Time	Cumul. Time, s	Reading, cm	Total Head Loss, cm	Temp, C	Rt	k @ 20C, m/sec	k @ 20C, cm/sec
10/3/01	8:50		11.00					
10/3/01	8:55	300	10.55	0.45	22	0.953	1.9E-10	1.9E-08
10/3/01	9:00	600	9.95	1.05	22	0.953	2.3E-10	2.3E-08
10/3/01	9:05	900	9.35	1.65	22	0.953	2.5E-10	2.5E-08
10/3/01	9:10	1200	8.85	2.15	22	0.953	2.5E-10	2.5E-08
10/3/01	9:15	1500	8.40	2.60	22	0.953	2.5E-10	2.5E-08
10/3/01	9:20	1800	8.30	2.70	22	0.953	2.2E-10	2.2E-08
Average "k" for Last Four Readings							2.4E-10	2.4E-08

Comments: Combined Sample

The results shown on this report are for the exclusive use of the client for whom they were obtained and apply only to the samples tested and/or inspected. They are not intended to be indicative of the qualities of apparently identical products. The use of our name must receive prior written approval. Reports must be reproduced in their entirety. Test method based on ASTM D 5084, D 2216, and D 4767.

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1983E

MAJOR PERMIT AMENDMENT APPLICATION

PART IV – SITE OPERATING PLAN

Prepared for

Texas Regional Landfill Company, LP

February 2023

NEVZAT TURAN
84059
02/09/2023

Prepared by

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817-735-9770

WCG Project No. 0771-356-11-35

This document is intended for permitting purposes only.

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER

02/09/2023

CONTENTS

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER
02/09/2023

CONTENTS (Continued)

CONTENTS (Continued)

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER
02/09/2023

CONTENTS (Continued)

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER
02/09/2023

CONTENTS (Continued)

Tables

Figures

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER

02/09/2023

1 INTRODUCTION

1.1 Terms of Reference

The Fort Worth C&D Landfill (hereafter referred to as the "facility" or "site") is a Type IV municipal solid waste (MSW) facility, operated by Texas Regional Landfill Company, LP. This Site Operating Plan (SOP) provides general instructions for site management and personnel to operate the facility in a manner consistent with the design of the facility and with the Texas Commission on Environmental Quality's (TCEQ's) rules to protect human health and the environment. This SOP complies with the requirements of 30 TAC Chapter 330 Subchapter D of the TCEQ Municipal Solid Waste Management Regulations (MSWMR) "Operational Standards for Solid Waste Land Disposal Sites" for Type IV landfills.

The specific procedures outlined in this SOP are operational requirements and must be understood, acknowledged, and followed by the site personnel. This SOP will be maintained as part of the Site Operating Record in an easily accessible location to allow the site operating personnel to review the SOP as needed. This SOP will be retained during the active life of the site and throughout the site's post-closure care maintenance period.

References to the term "Executive Director" used in this SOP shall refer to the Executive Director of the TCEQ or the designated representative of the Executive Director. References to information in the "permit" or "permit amendment application" for this facility shall refer to the most current version of these documents, including any amendments, modifications, or revisions as approved.

The Landfill Manager has overall responsibility for implementation and adherence to this SOP. Wherever this SOP describes procedures or requirements without naming a specific individual or position responsible for those requirements, the Landfill Manager shall have primary responsibility for those requirements. Where a specific individual or position is responsible for a particular task, that responsibility is described. Otherwise, the Landfill Manager may assign any qualified personnel to accomplish the requirements of this SOP.

1.2 Facilities Addressed by This SOP

Disposal of waste in the landfill is the primary site activity. Additionally, the following recycling-related processing and storage activities are allowed to occur on-site: (i) a large items/white goods (i.e., appliances) unloading and storage area for recycling or salvaging of these items; (ii) a construction and demolition (C&D) recyclable sorting area for sorting/processing and potential recycling of non-putrescible C&D material; and (iii) a wood processing/compost area (wood processing refers to chipping/mulching/grinding of brush, yard trimmings, wood materials, or other uncontaminated wood waste (no putrescible waste); and the composting operation is for composting of source-separated yard trimmings, clean wood material, vegetative material, pre-consumer green waste, paper, manure, clean soils, sand, and mulch).

This SOP addresses the relevant operational requirements and activities associated with these on-site processing/storage areas, as well as waste disposal operations.

1.3 Sequence of Landfill Operations

The facility is designed to operate as a multi-level, modified aerial fill landfill, with above and below-grade filling. The general sequence of anticipated landfill operations is shown on the drawings presented in Parts I/II, Appendix I/IIA (see Figures I/II-A.4 through I/II-A.7).

2 PRE-OPERATION NOTICE

At least 14 days prior to placement of waste in any newly constructed disposal area, the facility will provide written notice to the Executive Director in the form of a Soils and Liner Evaluation Report (SLER) of the final construction and lining of the new disposal area. Placement of waste in a newly constructed disposal area shall not occur unless either: (i) the Executive Director provides verbal or written approval; or (ii) by the end of the 14th day following submittal of the SLER to the Executive Director, no verbal or written response is received from the Executive Director indicating that the placement of waste should not commence. Following one of these two events, the Landfill Manager may direct waste placement to begin in the newly constructed cell.

3 RECORDKEEPING REQUIREMENTS

A Site Operating Record will be maintained to document operating and landfill construction related information as required by the TCEQ. The Site Operating Record will be kept either on-site or at the following alternate locations: (i) electronic files ("cloud" based or otherwise readily accessible at the facility); (ii) an off-site office building in Tarrant County owned/leased by Texas Regional Landfill Company, LP or an affiliated company; or (iii) an off-site commercial storage facility in Tarrant County. The Site Operating Record will include site-specific records in accordance with 30 TAC §330.125 and will be maintained and kept current for the life of the facility and during the post-closure care period. A detailed list of required information is provided below.

3.1 Required Information

The documents that will be maintained in the Site Operating Record are listed below in Table IV-1 and any other document(s) as specified by the approved permit or by the Executive Director. The recordkeeping information listed in Table IV-1 will be placed and retained in the Site Operating Record within seven (7) working days of the completion of listed activities or the receipt of analytical data. The Executive Director may set alternative schedules for recordkeeping and notification requirements pursuant to the terms of 30 TAC §330.125(g).

Other recordkeeping items that are identified in 30 TAC §330.125(b) but that are not required at this facility because they are not applicable are: (i) unit design documentation for the placement of leachate or gas condensate in a municipal solid waste landfill; (ii) small community exemption information; and (iii) spray-applied alternate (ADC) material.

3.2 Executive Director Access to Information

The facility will maintain the Site Operating Record in an organized format, where information is readily locatable and retrievable. The Site Operating Record will be furnished to the TCEQ upon request and will be made available for TCEQ inspection during normal operating hours.

Table IV-1
Recordkeeping Requirements

Record Needed	Description of Contents	Rule Citation (30 TAC)	Frequency	For More Information
Permit No. MSW- 1983D (including all modifications and amendments)	a. Site Development Plan b. Site Operating Plan c. Closure Plan d. Post-Closure Plan e. Landfill Gas Management Plan	330.121(a) and 330.125(a)	Upon Issuance of Permit, and Approved Modifications and Amendments	None
Location Restriction Demonstrations	Demonstrations that the site is in compliance with the location restriction criteria.	330.125(b)(1)	Submittal of Permit Amendment Application	Parts I/II of Permit Application
Information on Excluding Prohibited Waste	Record and retain inspection records, training procedures, and notification procedures relating to excluding the receipt of prohibited waste, including a record of unauthorized material incidents (receipt of prohibited waste and removal/remediation of the incident)	330.125(b)(2) and 330.133(b)	Per Occurrence	SOP Sections 5.6, 8.2
Gas Monitoring Results and Remediation Plans	Results from gas monitoring and any remediation plans related to explosive and other gases.	330.125(b)(3)	Gas Monitoring – Quarterly; Remediation Plans – Per Occurrence	SOP Sections 16 and 21. Part III SDP Appendix IIIJ
Groundwater Monitoring and Corrective Action Information	Demonstrations, certifications, findings, monitoring, testing, and analytical data relating to groundwater monitoring and/or corrective action.	330.125(b)(5)	Monitoring – Annual; Corrective Action and Other Documentation – As Required	Part III SDP Appendix IIIH
Closure and Post- Closure Care Data	Closure and Post-Closure Plans and applicable monitoring, testing, or analytical data relating to post- closure requirements.	330.125(b)(6)	Monitoring and Data – Annual	Part III SDP Appendix IIIJ and IIIK
Cost Estimates and Financial Assurance Documentation	Any and all cost estimates and financial assurance documentation relating to financial assurance for closure and post-closure care.	330.125(b)(7)	Annual	Part III SDP Appendix IIIL
Correspondence	Copies of correspondence and responses relating to the operation of the facility, modifications to the permit, approvals and other matters pertaining to technical assistance.	330.125(b)(9)	Per Occurrence	None
Special Waste Documentation	Documents, manifests, shipping documents, trip tickets, etc., involving special waste.	330.125(b)(10)	Per Occurrence	None
Liner Evaluation Reports, Ballast Evaluation Reports, and Liner Interim Status Reports	Documentation of construction of the liner for a new disposal area, along with evaluation and documentation of ballast (if required), and interim status of liner (if needed).	330.125(b)(12)	Per Occurrence	SOP Section 2; Part III SDP Appendix IIID (SLQCP)
Landfill Gas System Inspections	Documentation of inspection of the landfill gas monitoring system indicating the findings and documenting any repairs made.	330.125(b)(12) and 330.159	Inspect Gas Monitoring System – Quarterly	Part III SDP Appendix IIII
Personnel Training Records	Training records for all personnel will be maintained in accordance with 30 TAC §335.586(d) and (e).	330.125(e)	As Needed (Minimum Annually)	SOP Section 5.4
Required Personnel Operator Licenses	Licensing records will be maintained in accordance with 30 TAC Chapter 30, Subchapter F.	330.125(f)	As Needed	None
Waste Acceptance Rate Documentation	Documentation in the form of quarterly and annual solid waste summary reports will be maintained as required by 30 TAC §330.675.	330.125(h)	Quarterly and Annually, As Appropriate	SOP Section 4.2
Load Inspection Reports	A copy of the load inspection reports	330.127(5)(B)	Per Occurrence	SOP Section 5.6
Fire Occurrence Notices	Written description of waste-related fire that is not extinguished within 10 minutes of detection, including record of required notifications.	330.129	Per Occurrence	SOP Section 6
Access Control	A record of the required access inspections, findings, and any repairs made and notification of breach if applicable.	330.131	Inspect – Monthly; Repair/ Notification – As Needed, if not repairable within 8 hours of detection	SOP Section 7.2
Records of Alternate Operating Hours	Documentation of any dates, times, and durations when alternate operating hours are utilized.	330.135(d)	As Required	SOP Section 9
Landfill Marker Inspections	A record of the landfill marker inspections, findings, and any repairs.	330.143(a)	Monthly	SOP Section 13.3
Water, Crude Oil, and/or Natural Gas Well Location and Plugging Reports	Documentation of notification, certification of plugging, and a copy of the well plugging report.	330.161(a)-(c)	Within 30 Days of Discovery	SOP Section 22
Cover Inspection Record	A record of the required cover inspections, findings, and any corrective actions (e.g., repairs) taken. Includes inspecting for and remedy of ponded water.	330.165(h)	Active Facility – Weekly (and after storm events); Closed Facility – Per Post-Closure Plan (Semi-Annually)	SOP Section 24.5 and 24.6.2
Cover Application Log	A record showing site grid areas where weekly and/or intermediate cover has been placed each week.	330.165(h)	Weekly (when site is in operation)	SOP Section 24.6.1
Ponded Water Inspections	Inspection of the landfill waste fill areas to check for ponded water, and corrective actions to remove ponded water.	330.167	Part of Cover Inspections (see above)	SOP Sections 24 and 25

4 WASTE ACCEPTANCE RATES

4.1 Estimated Waste Acceptance Rates

The facility Waste Acceptance Plan required by 30 TAC §330.61(b) is presented in the Parts I/II Section 2.1.1 and includes information on the estimated annual waste acceptance rate (see Section 2.1.2 of Parts I/II). These estimated waste acceptance rates are not a limiting parameter of the site's permit or otherwise limit the waste acceptance or operations at the site. Elements of site operation(s) that are related to the waste acceptance rate (e.g., personnel, equipment, etc.) are shown in this SOP in matrix tables of requirements versus annual waste receipt tonnage, including Table IV-2 and Table IV-3 below.

4.2 Actual Waste Acceptance Rate Tracking

The actual waste acceptance rate will be tracked by quarter, and the actual annual waste acceptance rate will be a rolling average based on the sum of the previous four quarterly summary reports. The quarterly and annual solid waste summary reports for the facility will be maintained in the Site Operating Record. If the actual annual waste acceptance rate, as established by the sum of the previous four quarterly summary reports, exceeds the previous rate at which the site was operating, and the exceedance is not due to a temporary occurrence, the facility will adjust operations with regard to personnel and equipment needed to manage the waste as specified in Sections 5.1 and 5.2 of this SOP (see Tables IV-2 and IV-3), without the need for a permit modification, provided that the actual annual waste acceptance rate is within the range covered by this SOP.

If the actual annual waste acceptance rate exceeds the rates set forth in Tables VI-2 and IV-3 based on the sum of the last four quarterly summary reports, and the exceedance is not due to a temporary occurrence, the facility will file a permit modification within 90 days of the exceedance. The permit modification will identify any needed changes to the SOP to manage the increased waste acceptance rate to protect human health and the environment. These requirements do not make estimated waste acceptance rates a limiting parameter of a landfill permit.

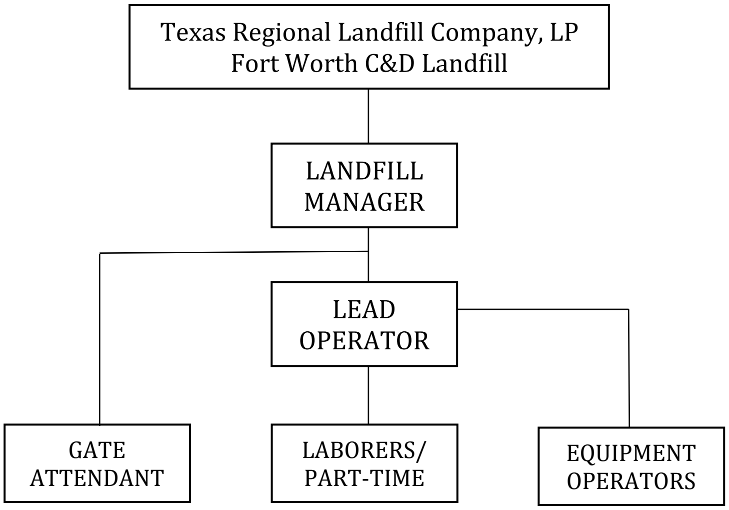
The general factors to be considered by the facility to evaluate whether an increase is temporary may include: storm events; natural disasters or other emergency conditions; increases in the receipt of construction or demolition debris, brush, and rubbish due to non-recurring commercial activity; receipt of waste diverted from other waste management facilities on a temporary basis; and similar occurrences that are not reflective of permanent increases in the tonnage/volume of solid waste to be managed by the facility.

5 GENERAL SITE OPERATING REQUIREMENTS

5.1 Facility Personnel

The general organizational structure for facility personnel will be as shown on the organizational chart shown below as Figure IV-1. The Landfill Manager will have overall responsibility for day-to-day landfill operations. Individual job titles and personnel are subject to change based on changes in operational conditions and changes in roles and responsibilities. However, total number of key site personnel will be sufficient to meet the requirements outlined in Table IV-1. In addition, training will be maintained regarding duties and responsibilities to ensure ongoing compliance with the requirements of this SOP.

Figure IV-1
Fort Worth C&D Landfill Organizational Chart



A detailed description of roles and responsibilities of facility personnel are described in the remainder of this section.

5.1.1 Landfill Manager

The Landfill Manager will ultimately be responsible for the day-to-day facility operations. The Landfill Manager will be directly responsible for staff and equipment allocation to ensure operation of the facility in accordance with the approved Site Development Plan, Site Operating Plan, and applicable TCEQ and federal regulations. The Landfill Manager serves as the emergency contact and coordinator for the facility and will be responsible for maintaining the Site Operating Record and required logs. In general terms, the Landfill Manager's qualifications should include work in the solid waste industry participating as a principal operator, foreman, supervisor, or manager of a solid waste facility. The Landfill Manager must be familiar with and have the aptitude to manage personnel and implement operational aspects of solid waste disposal operations. This includes having knowledge of relevant regulations and permit requirements; waste-handling and safe management practices for disposal of municipal solid waste; health and safety; and waste identification. The Landfill Manager or designated alternate has the responsibility to reject or have unauthorized wastes removed from the facility. The Landfill Manager will have or obtain and maintain an MSW Facility Class A License as a municipal solid waste facility supervisor in accordance with 30 TAC Chapter 30, Subchapter F.

5.1.2 Lead Operator

The Lead Operator will be responsible for conducting the actual landfill operations. The Lead Operator will consider personnel safety and direct equipment operators on a daily basis regarding waste disposal operations, excavation operations, and weekly cover placement. The Lead Operator will also perform other required tasks as directed by the Landfill Manager. The Lead Operator must have a minimum of one (1) year of landfill operations experience, with experience in earthmoving operations, who is familiar with SOP requirements and has the aptitude to manage personnel and implement operational aspects of solid waste disposal operations.

5.1.3 Gate Attendant

The Gate Attendants, stationed at the site entrance, have primary responsibility for receiving the incoming vehicles, collecting waste disposal fees, preliminary screening for prohibited wastes and visual inspection of select incoming trucks as specified elsewhere in the SOP. Gate Attendants record specific hauler information, volume estimates or weight, and provide directions to the driver with respect to on-site rules and the current unloading areas. At all times when the facility is open to receive waste from the general public, one of the Gate Attendants will be responsible for waste screening duties as outlined in Section 5.6 of this SOP. Accordingly, the minimum qualifications for the Gate Attendants will be the ability to perform clerical duties; possess basic communication skills; and comprehend in-house training on prohibited waste identification, health and safety response, and recordkeeping.

5.1.4 Equipment Operators

Equipment Operators' primary duties will include safe operation of the landfill-related and other facility equipment. Equipment Operators will be trained to identify prohibited/unacceptable waste materials as they are unloaded from incoming trucks at the working face. Equipment Operators will notify the Landfill Manager or designated alternate should any suspect wastes be observed at the working face. Equipment Operators' screening duties are further discussed in Section 5.6 of this SOP.

At all times when the facility is open to receive waste, at least one of the Equipment Operators will be designated as the operations lead on duty and will manage the active working face and direct the other Equipment Operators in the execution of their duties. At a minimum, all Equipment Operators that operate at the working face will be qualified to safely and effectively operate compactors and bulldozers at landfills, have the ability to operate other heavy equipment on-site, and have the ability to comprehend on-the-job training in landfill operations, health and safety, and waste identification.

Equipment operators may also perform maintenance and repair of heavy equipment, support equipment, and vehicles as directed by the Landfill Manager or designated alternate. Duties may include regular servicing of light and heavy equipment to maximize equipment performance and eliminate equipment downtime. Tasks may also include fueling equipment, maintaining the equipment maintenance yard and shop, and performing other duties as assigned. Equipment operators may also be responsible for patrolling for and picking up litter and windblown trash as needed.

5.1.5 Other Personnel (Laborers/Part-time)

The Landfill Manager may hire other personnel or third-party outside workers to perform mechanic duties (e.g., equipment repairs, servicing and fueling) as well as laborer activities (e.g., patrolling for and collecting windblown trash, other manual labor and site maintenance activities). These personnel will be employed on an as-needed basis (e.g., part-time) and accordingly, are not specifically reflected on the table of minimum personnel requirements.

5.1.6 Minimum Required Number of Personnel

Table IV – 2 provides a list of operational personnel that represents the minimum staffing levels required to maintain safe and efficient landfill operations for a range of waste acceptance rates. The estimated waste acceptance rates were discussed in Section 4.1 of this SOP.

Table IV-2
Minimum Facility Staffing Levels

Estimated Waste Acceptance Rate (tpy)	**Less than 600,000**	**600,001 to 1,200,000**
Staff Position	**Number of Personnel**	
Landfill Manager[1]	1	1
Lead Operator	1	1
Equipment Operators	2	4
Gate Attendant	1	2

[1] The Landfill Manager may perform other staff position duties and may designate an alternate to perform Landfill Manager duties when not at the site.

Required staff will not necessarily be on-site at the same time (e.g., Equipment Operators and other staff may work different shift schedules throughout the day). As changes in waste acceptance rates dictate, hours of operation and staff changes will be made to meet the staffing requirements listed above in Table IV-2. Additional staff will have qualifications commensurate with their duties, and key personnel will meet the minimum qualifications previously presented. The designated level of staffing will be maintained as required by operating conditions to ensure operations will be conducted in compliance with the TCEQ municipal solid waste management rules and the facility's permit provisions.

5.2 Equipment

Equipment requirements at the facility will vary based on actual operational requirements. Table IV – 3 provides a list of equipment that represents the minimum needed to undertake safe and efficient landfill operations for a range of waste acceptance rates. The estimated waste acceptance rates were discussed in Section 4.1 of this SOP. Equipment will be added or removed as needed to meet changes in waste disposal demands and supporting operational requirements.

Table IV-3
Minimum Equipment Dedicated to the Facility

Estimated Waste Acceptance Rate: tons per year (tpy)			Less than 600,000	600,001 to 1,200,000
Equipment Type	**Typical Size**[1]	**Function**	**Minimum Number**	
Compactor(s)	CAT 826 or similar	Waste spreading and compaction; fire protection	1	2
Bulldozer(s)	CAT D6, D7, or D8	Movement and placement of soil; waste spreading and	1	1
Scraper(s) or Excavator[2]	CAT 621F CAT 330 BL	Scraper: excavation and hauling of soil; fire protection Excavator: excavation of soil; fire protection	1 scraper or 1 excavator	2 scrapers or 1 excavator
Haul Truck(s)[2]	10 to 40 ton	Hauling of soil; fire protection	1	2
Motor Grader	CAT 12G	Maintenance of site roads	1	1
Pickup Truck(s) or ATV	$^1/_2$ ton or similar	Personnel use, litter control, maintenance	1	1
Water Truck(s)	1,000 to 4,000 gallons	Dust control; fire protection; earth fill compaction	1	1
Pump(s)	10 to 500 gpm	Storm water pumping	1	1

[1] The equipment typical size is the minimum size to be provided. The actual equipment manufacturers/model numbers of the heavy equipment and miscellaneous vehicles and equipment may vary. Compactor(s) shall be equipment having a minimum weight of 40,000 lbs. A Bulldozer meeting the minimum weight of a Compactor may be used in place of a Compactor while the Compactor is being maintained, repaired or the site is awaiting the arrival of backup equipment.

[2] Soil excavation and hauling will be conducted with scraper(s) or with an excavator and haul truck(s). The landfill will determine appropriate excavation equipment as the landfill is developed.

[3] In the event of equipment breakdown or maintenance, backup equipment will be provided from other company-affiliated facilities, or from contractors or local rental companies, to avoid interruption of waste services and required facility operations.

The above list identifies the minimum number and size of equipment that will be utilized based on the actual annual waste acceptance rate. Additional equipment may be used to meet operational needs beyond that specified in the above table. Changes in equipment required for temporary increases or decreases in waste acceptance rates will be left to the discretion of the Landfill Manager. In addition to the equipment listed above, miscellaneous vehicles, various other pumps, portable lighting, litter fences, instruments, and safety and training equipment may also be on-site as necessary to support operations.

Equipment will be routinely maintained, repaired, replaced, or supplemented with additional equipment as required to maintain uninterrupted operations. The equipment fleet at the facility is sized to meet current operating requirements, practices, and experience to account for periodic scheduled maintenance or short-term breakdowns. If additional equipment is needed within 24 hours of primary equipment breakdown, the facility has access to back-up waste spreading, compaction, and earthmoving equipment with equivalent performance capabilities from other company-affiliated facilities, or from local equipment dealers or contractors. Emergency backup equipment will be rented or made available from other company-affiliated facilities. Additional equipment may also be utilized or added as necessary to adequately perform all required operations. Construction may be performed by an outside contractor that will provide the additional construction equipment required, including earthwork equipment such as excavators, trucks, and soil compactors.

The following is a brief description of the function of the heavy equipment used for site operations.

- Landfill Compactor – used to spread and compact the volume of waste received at the working face. Also used to spread soil for fire protection and fire-fighting.
- Bulldozer – used to spread waste in conjunction with compactors, place, spread or remove cover material, prepare turnaround areas, and aid in preparation and construction of liners. Other tasks involving the placement and movement of soil will also be completed with bulldozers, including fire protection and fire-fighting. The number and type of bulldozers will be a function of the tasks performed.
- Scraper – used for excavation and hauling of soil for construction of liners, hauling soil for cover operations, for fire protection and fire-fighting, and for associated soil needs.
- Hydraulic Excavator – used to excavate soil and load dump trucks for use as weekly, intermediate, or final cover. Also used for fire protection and fire-fighting.
- Dump Truck – utilized to haul soil for construction of liners, cover operations, for fire protection and fire-fighting, and for associated soil needs.
- Motor Grader – used to grade access roads and provide all-weather access to the working face.
- Water Truck – used to control dust on site roads, to haul water for irrigation of vegetation at the facility, to supply construction water, and as fire control equipment.

As stated above, this list is subject to change as necessary to maintain effective site operations including compliance with permit provisions and regulatory requirements. The minimum number and types of equipment specified in Table IV-3 will be maintained.

5.3 General Instructions for Operating Personnel

This SOP contains the procedures necessary for daily operations of the facility and instructions for compliance with applicable regulations, including:

- Recordkeeping requirements;
- Personnel training requirements;
- Wastes authorized for receipt and disposal;
- Detection and prevention of disposal of prohibited waste, hazardous waste, and PCBs;
- Fire protection;
- Access control;
- Unloading waste;
- Facility operating hours;
- Site signage;
- Control of windblown waste and litter;
- Easements and buffer zones;
- Landfill markers and benchmark;
- Materials along the route to the site;
- Disposal of large items;
- Odor management criteria;
- Disease vector control;
- Site access roads;
- Salvaging and scavenging;
- Endangered/threatened species protection;
- Landfill gas control;
- Oil, gas and water wells;
- Compaction;
- Landfill cover;
- Ponded water;
- Waste in enclosed containers/vehicles;
- Disposal of special wastes;
- Disposal of industrial wastes;

- Visual screening of deposited waste; and
- Contaminated water management and discharge.

The procedures and instructions are included in the subsequent sections of this SOP.

5.4 Personnel Training

5.4.1 Overview of Training Program

Training of facility personnel will consist of classroom instruction and/or on-the-job training that instructs site personnel in the performance of their duties and compliance with this SOP, the facility's permits, and applicable regulations. Training will be directed by employees, supervisors, or other individuals experienced in waste management procedures and operations, health and safety, and related subjects needed for satisfactory job performance. This may include in-house training by qualified individuals within the company and its affiliates; as well as training at TCEQ-sponsored training courses or training events provided by other organizations as deemed appropriate by facility management. Training will include instruction in the solid waste management and related procedures relevant to each position. The training program will also ensure that personnel are familiar with emergency response procedures, emergency equipment, and emergency systems relevant to their position.

5.4.2 Training Frequencies and Position-Specific Training

Training will include both introductory and continuing training. Facility personnel must successfully complete initial training on topics relevant to their position within six (6) months after the date of their employment or assignment to the facility. When an existing employee is transferred or promoted to a new position at the facility with training requirements that differ from the previous position, that employee will receive the additional training required. Additional supervision will be provided to personnel during the training period, and personnel activities will be limited during the training period.

Facility personnel will take part in an annual review of the initial training topics relevant to their position. Table IV-4 presented below summarizes the position-specific training topics for facility personnel.

Table IV – 4
Position-Specific Training Topics

Position	Required Training Topics											
	Site Orientation/Initial Training	Site Operations	Endangered and Threatened Species	Health and Safety	Prohibited Waste, Hazardous Waste, & PCBs	Fire Prevention and Protection	Landfill Gas Management	Emergency Response	Spill Control	Litter Control	Random Inspections	Stormwater Inspections
Landfill Manager	X	X	X	X	X	X	X	X	X	X	X	X
Lead Operator	X	X	X	X	X	X	X	X	X	X	X	X
Gate Attendant	X			X	X	X		X		X	X	
Equipment Operators	X	X	X	X	X	X		X	X	X	X	
Laborers/Part-Time Laborers	X			X		X		X		X		

5.4.3 Training Recordkeeping

Documentation of training will be maintained in the Site Operating Record. Training records on current personnel must be kept until closure of the facility, and training records of former employees must be kept for at least three years from the date the employee last worked at the facility. Personnel training records may accompany personnel transferred within the same company.

5.5 Wastes Authorized for Receipt and Disposal

A Waste Acceptance Plan is provided in Section 2.1.1 of Parts I/II as required by 30 TAC §330.61(b). From this Waste Acceptance Plan, a list of the allowable wastes is provided below in Table IV-5, followed by a list of the prohibited wastes.

Table IV-5
Allowable Waste Types – Definitions, Acceptance Procedures, and Special Handling/Disposal Procedures

Allowable Waste Type	Definition; Regulatory Citation(s)	Acceptance Determination Procedures	Special Handling/ Disposal Procedures
Brush	30 TAC §330.3(18): Cuttings or trimmings from trees, shrubs, or lawns and similar materials.	Follow incoming load acceptance procedures set forth in SOP Section 5.6.2.	None
Construction Waste	30 TAC §330.3(33): Waste resulting from construction projects; includes all materials that are directly or indirectly the by-products of construction work, including, but not limited to, paper, cartons, gypsum board, wood excelsior, rubber, and plastics.	Follow incoming load acceptance procedures set forth in SOP Section 5.6.2.	None
Demolition Waste	30 TAC §330.3(33):Waste resulting from demolition projects; includes all materials that are directly or indirectly the by-products of or that result from demolition of buildings and other structures, including, but not limited to, paper, cartons, gypsum board, wood, excelsior, rubber, and plastics.	Follow incoming load acceptance procedures set forth in SOP Section 5.6.2.	None
Rubbish	30 TAC §330.3(130): Non-putrescible solid waste (excluding ashes), consisting of both combustible and noncombustible waste materials. Combustible rubbish includes paper, rags, cartons, wood, excelsior, furniture, rubber, plastics, brush, or similar materials; noncombustible rubbish includes glass, crockery, tin cans, aluminum cans, and similar materials that will not burn at ordinary incinerator temperatures (1,600 degrees Fahrenheit to 1,800 degrees Fahrenheit).	Follow incoming load acceptance procedures set forth in SOP Section 5.6.2.	None
Inert Material (consistent with the waste characteristics of construction or demolition waste and/or rubbish)	30 TAC §330.3(67): A natural or man-made non-putrescible, nonhazardous material that is essentially insoluble, usually including, but not limited to, soil, dirt, clay, sand, gravel, brick, glass, concrete with reinforcing steel, and rock. Consistent with the waste characteristics of construction or demolition waste and/or rubbish means having characteristics like those waste type entries in this table.	Follow incoming load acceptance procedures set forth in SOP Section 5.6.2.	None
Class 2 Industrial Solid Waste (free of putrescible waste and consistent with the waste characteristics of construction or demolition waste and/or rubbish)	30 TAC §330.3(22): Class 2 wastes are any individual industrial solid waste or combination of solid wastes that are <u>not</u> described as Hazardous, Class 1, or Class 3 as defined in 30 TAC §335.506 (relating to Class 2 Waste Determination). Free of putrescible waste means <u>not</u> having any waste defined as putrescible by 30 TAC §330.3(119); namely, <u>not</u> having organic wastes, such as garbage, wastewater treatment plant sludge, and grease trap waste that are capable of being decomposed by microorganisms with sufficient rapidity as to cause odors or gases or are capable of providing food for or attracting birds, animals, and disease vectors. Consistent with the waste characteristics of construction of demolition waste and/or rubbish means having characteristics like those waste type entries in this table.	This waste requires the Pre-Arrival Evaluation Screening Procedures set forth in SOP Section 5.6.2 to determine if the waste type is acceptable (i.e., meets the definitions in this table). Once pre-arrival screening is completed and the generator's waste is approved, follow Incoming Load Acceptance Procedures set forth in SOP Section 5.6.2.	Acceptance of this waste must not interfere with facility operation.
Class 3 Industrial Solid Waste (consistent with the waste characteristics of construction or demolition waste and/or rubbish)	30 TAC §330.3(23): Inert and essentially insoluble industrial solid waste, usually including, but not limited to, materials such as rock, brick, glass, dirt, and certain plastics and rubber, etc., that are not readily decomposable, as further defined in 30 TAC §335.507 (relating to Class 3 Waste Determination. Consistent with the waste characteristics of construction or demolition waste and/or rubbish means having characteristics like those waste type entries in this table.	Follow incoming load acceptance procedures set forth in SOP Section 5.6.2.	None
Non-regulated asbestos-containing materials (non-RACM)	30 TAC §330.3(93): Non-regulated asbestos-containing material as defined in 40 Code of Federal Regulations Part 61; this is asbestos material in a form such that potential health risks resulting from exposure to it are minimal. Non-RACM is asbestos-containing material that is <u>not</u> regulated asbestos-containing material as defined in 30 TAC §330.3(126). Regulated asbestos-containing material as defined in 40 Code of Federal Regulations Part 61, as amended, includes: friable asbestos material, Category I nonfriable asbestos-containing material that has become friable; Category I nonfriable asbestos-containing material that will be or has been subjected to sanding, grinding, cutting, or abrading; or Category II nonfriable asbestos-containing material that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations.	Follow incoming load acceptance procedures set forth in SOP Section 5.6.2.	Non-RACM will be disposed of at the active working face and covered in accordance with the procedures set forth in SOP Section 24. The non-RACM material shall not be placed on any surface or roadway that is subject to vehicular traffic or disposed of by any other means by which the material could be crumbled into a friable state.

Table IV-5 (Continued)
Allowable Waste Types – Definitions, Acceptance Procedures, and Special Handling/Disposal Procedures

Allowable Waste Type	Definition; Regulatory Citation(s)	Acceptance Determination Procedures	Special Handling/ Disposal Procedures
Empty containers used for pesticides, insecticides, herbicides, fungicides, or rodenticides (meeting the requirements of 30 TAC §330.171(c)(5)(A)).	30 TAC §330.171(c)(5)(A): Empty containers that have been used for pesticides, insecticides, herbicides, fungicides, or rodenticides may be disposed of at any landfill provided that: (i) the containers are triple-rinsed prior to receipt at the landfill; (ii) the containers are rendered unusable prior to or upon receipt at the landfill; and (iii) the containers are covered by the end of the same working day they are received.	Confirm that the containers have been triple-rinsed prior to receipt at the landfill. Also confirm that the containers are rendered unusable prior to receipt (or render them unusable upon receipt at the landfill. Then follow incoming load acceptance procedures set forth in SOP Section 5.6.2.	Empty containers will be disposed of at the active working face and must be covered at the end of the same working day they are received.
Mechanical shredding waste (containing no free liquids and not a hazardous waste)	Texas Health and Safety Code (THSC) §361.019(b): nonhazardous industrial solid waste generated by the mechanical shredding of motor vehicles, appliances, or other items of scrap, used, or obsolete metals. The waste must not be classified as a hazardous waste as defined in 30 TAC §330.3(62). The waste must not contain free liquids as defined by the U.S. Environmental Protection Agency (EPA) Method 9095 (Paint Filter Test), as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (EPA Publication Number SW-846).	This waste requires the Pre-Arrival Evaluation Screening Procedures set forth in SOP Section 5.6.2 to determine if the waste type is acceptable (i.e., meets the definitions in this table). Once pre-arrival screening is completed and the generator's waste is approved, follow Incoming Load Acceptance Procedures set forth in SOP Section 5.6.2.	Mechanical shredding waste will be disposed of at the working face and must be covered at the end of the same working day it is received.
Trash	30 TAC §330.3(160): Same as Rubbish.	Follow incoming load acceptance procedures set forth in SOP Section 5.6.2.	None
Yard waste that is free of putrescible and household waste	30 TAC §330.3(181): Leaves, grass clippings, yard and garden debris, and brush, including clean woody vegetative material not greater than six inches in diameter that results from landscaping maintenance and land-clearing operations. The term does not include stumps, roots, or shrubs with intact root balls.	Follow incoming load acceptance procedures set forth in SOP Section 5.6.2.	None
Scrap tires (slit and quartered or shredded and not from a tire disposer/recycler who is reimbursed from the State Waste Tire Recycling Fund)	30 TAC §330.3(136): Scrap Tire – Any tire that can no longer be used for its original intended purpose. Slit and quartered or shredded refers to scrap tires that have been cut into smaller pieces and are no longer whole tires	Follow incoming load acceptance procedures set forth in SOP Section 5.6.2.	None

Prohibited Wastes: The facility will not accept the following wastes:

- putrescible wastes;
- household wastes;
- regulated hazardous waste;
- conditionally exempt small-quantity generator waste;
- Class 1 industrial waste;
- special wastes (with the exception of those special wastes allowed by TCEQ regulations at Type IV MSW facilities and noted in the above list of wastes that are allowed to be accepted);
- regulated asbestos-containing materials (RACM);
- radioactive waste;
- prohibited polychlorinated biphenyls (PCB) waste;
- liquid waste;
- water and wastewater treatment sludges;
- grease/grit trap waste;
- lead acid storage batteries;
- used motor vehicle oil;
- used oil filters from internal combustion engines;
- whole used tires or whole scrap tires for disposal; and
- wastes incompatible with landfilling activities.

5.6 Methods for Detection and Prevention of Disposal of Prohibited Waste

This section describes the program that the facility will implement to detect and prevent the disposal of prohibited wastes. A list of prohibited wastes is presented above in the previous section of this SOP.

5.6.1 Overview of Methods

The following control methods are used to minimize the potential for receiving prohibited waste at the facility, and to detect and prevent the unauthorized disposal of prohibited waste at the facility:

- Pre-Arrival Evaluation Screening. Certain waste types must undergo a pre-arrival evaluation screening process. These waste types, and the procedures that will be followed, are presented in Section 5.6.2.
- Signage. Signs posted near the facility entrance inform potential customers of wastes that are not allowed and state the landfill's requirements for transporters.
- Screening at the Scale. Gate attendants answer customer inquiries and inform customers of the types of prohibited wastes. Gate attendants are trained to observe incoming waste
- loads for unauthorized waste material and will reject loads containing unauthorized waste.
- Program for Enclosed Containers and Enclosed Vehicles. Special procedures will apply to waste received in enclosed containers or enclosed vehicles, as discussed in Section 26 of this SOP.
- Program for Detection and Prevention of Regulated Hazardous Wastes and Prohibited PCBs. This program is discussed below in Section 5.6.3.
- Random Load Inspections. Random inspections of incoming loads are performed as discussed below in Section 5.6.3.
- Working Face Observations. Equipment operators at the working face observe each load as it is unloaded and disposed of, and are trained to identify prohibited/unacceptable wastes, and will reject loads containing unauthorized waste. Further details are provided below in Section 5.6.2.

5.6.2 Description of Procedures

This section describes the procedures that will be implemented during all periods of landfill operation to screen the incoming waste and take appropriate actions. As noted, the facility is allowed to accept rubbish, but is not allowed to accept putrescible waste (nor are they allowed to accept containers with putrescible wastes), and applicable requirements specific to these wastes are included below. These procedures are also part of the program for detection and prevention of disposal of regulated hazardous waste and prohibited PCB wastes. These procedures will be made available for review by the TCEQ. The procedures will be modified as necessary to accomplish its purpose.

<u>Pre-Arrival Evaluation Screening (only applies to certain waste types, as indicated below)</u>:

Pre-arrival evaluation screening procedures will be followed for the following waste types: (i) Class 2 industrial waste; and (ii) mechanical shredding waste. The Landfill Manager (or designated waste coordinator/analyst) will be responsible for conducting the pre-arrival evaluation screening to determine the acceptability of the waste. The procedures will be as follows:

1. The waste generator will provide the facility with completed waste profile documentation (either digital or hardcopy format) that describes the characteristics and classification of the waste. The profile documentation will include the addresses, contact names, phone numbers, and signatures by the generator. It will also include waste stream information sufficient to provide the facility with a clear understanding of the waste type, origin, shipping method, and anticipated volume/frequency of disposal.
2. The profile documentation will describe the physical and chemical composition of the waste, and may include process knowledge, safety data sheets (SDSs), manufacturer's literature, and/or analytical data. Any analytical data submitted to the facility must be less than 18 months old, must correlate to the information contained on the waste profile, must be signed, and must identify the analytical methods used and detection limits. The sampling, analysis, and interpretations must be in material conformance with currently applicable State and Federal regulatory requirements.
3. The waste profile documentation will be maintained in the Site Operating Record in either hardcopy or digital format and will be made available at the request of TCEQ. The waste profile documentation must be kept for the life of the site, including the post-closure care period.
4. The completed waste profile and any accompanying analytical test results will be evaluated by the facility to ensure that it meets the criteria for acceptance at the facility (which will confirm the waste is not a prohibited waste type).
5. Generators for a waste requiring pre-arrival evaluation screening are required to recertify each waste stream, at a minimum, once every three (3) years after the original waste profile documentation is approved. This is intended to verify that the waste stream has not significantly changed since the initial characterization.

<u>Procedures for All Incoming Loads</u>:

1. The Gate attendant will observe transportation vehicles arriving at the scale for indications that putrescible waste, containers with any putrescible wastes, or any other type of prohibited waste, may be present. Additionally:
    a. The gate attendant will obtain load documentation from transporters of enclosed vehicles, containers, or delivering stationary compactors to the landfill. Transporters without proper load documentation, route permits, or transportation certificates, as required by 30 TAC §330.7(c), on file with the landfill, will not be allowed to unload at the landfill.

  b. For waste hauling vehicles arriving with waste that requires Pre-Arrival Evaluation Screening (noted in the above subsection), the gate attendant will obtain and review the shipping documentation accompanying the arriving load to confirm that the information is complete, the waste has previously been profiled and approved through the pre-arrival screening process, and that the waste matches the description on the shipping documentation and profile. This will involve visually comparing the material presented for disposal to the waste profile documentation to confirm that the physical characteristics (i.e., color, odor, and appearance) of the material match those detailed on the waste profile. Any discrepancies (i.e., incomplete documentation, questionable waste characteristics) will be resolved prior to acceptance of the waste. In the event the discrepancies cannot be resolved, the waste load will be rejected.

2. Incoming loads will be subject to random inspections to check for prohibited wastes, as described subsequently in Section 5.6.3.

3. Incoming loads will be visually inspected by appropriately trained equipment operators at the working face. The equipment operators will have the authority and responsibility to reject unauthorized loads, have unauthorized material removed by the transporter, and/or assess appropriate surcharges and have the unauthorized material removed by on-site personnel.

4. Should indications of prohibited wastes be detected, appropriate landfill personnel will be summoned to conduct a thorough evaluation of the load, and also the generator may be contacted for further information. The driver will be directed to a lined area located near the working face, where the load will be discharged from the vehicle. The landfill personnel inspecting the load will spread out and break up the waste pile and inspect the material for putrescible or other prohibited waste.

5. Unauthorized waste will be placed back into the transporter's vehicle and the driver will be instructed to depart the site. Or, if this is not possible, the facility will isolate and secure this waste (e.g., place in an appropriate container) to prevent its inclusion into the landfill. The Landfill Manager will be notified to determine the appropriate course of procedures to be implemented to properly manage the prohibited waste.

6. If putrescible wastes are identified, the putrescible waste will be segregated, loaded into a transporter's vehicle or into suitable collection bins, and removed from the site within 24 hours for disposal at a Type I landfill.

7. A record of unauthorized waste removal and management will be maintained in the Site Operating Record.

8. The TCEQ will be notified of any incident involving the confirmed receipt or disposal of regulated hazardous waste or prohibited PCB waste at the facility as discussed below in Section 5.6.3.

5.6.3 Program for Detection and Prevention of Regulated Hazardous Wastes and Prohibited PCBs

The program for detection and prevention of disposal of prohibited waste at the facility, including regulated hazardous waste and prohibited PCB wastes, includes the following elements:

1. Informing generators and transporters of unauthorized waste types, including regulated hazardous wastes and prohibited PCB wastes.
2. Strict review of waste streams prior to acceptance as described previously in Section 5.6.2.
3. Training for facility personnel to recognize regulated hazardous and prohibited PCB wastes, and using these skills to perform screen the incoming wastes at the scales and at the working face.
4. Random inspections of incoming loads.
5. Records of random inspections.
6. Working face observations as described previously in Section 5.6.2.
7. Notification to TCEQ of incidents involving the confirmed receipt or disposal of regulated hazardous wastes and prohibited PCB wastes.
8. Provisions for remediation of the incident.

<u>Training</u>. The overall personnel training program that will be implemented at the facility will be as previously described in Section 5.4 of this SOP. This program will include training on topics specifically related to detection and exclusion of regulated hazardous waste and prohibited PCB wastes, including the following:

- Familiarization with applicable regulations;
- load inspection procedures;
- identification and recognition of regulated hazardous wastes, prohibited PCB wastes, and other prohibited wastes;
- waste handling procedures;
- health and safety;
- notification procedures; and
- recordkeeping.

Load Inspection Procedure. Random inspections of incoming waste loads will be performed by facility personnel trained in the recognition of prohibited waste including regulated hazardous waste and prohibited PCB waste. In addition to the random load inspections, incoming loads will be visually inspected at the working face as described previously in Section 5.6.2.

For the random load inspections, the Landfill Manager or designated alternate will objectively select an average of one (1) waste hauling vehicle per day based on days that the facility accepts waste. The waste hauling vehicles will be selected at varying times. Waste hauling vehicles that are from stationary compactors permitted in accordance with 30 TAC §330.7 and waste in enclosed containers or enclosed vehicles will be inspected in accordance with the procedures given in Section 26 of this SOP. The driver of the randomly selected load will be notified and instructed to proceed to a lined area near the working face. The waste will be spread sufficiently to determine the composition of the waste in order to inspect for regulated hazardous and prohibited PCB waste and other prohibited wastes.

Recordkeeping. As part of the program for detection and prevention of disposal of prohibited waste, the following documentation will be maintained in the Site Operating Record:

- Load Inspection Reports;
- records of regulated hazardous waste or prohibited PCB waste incident notifications;
- records of unauthorized material removal; and
- personnel training.

The Load Inspection Reports will be completed for loads subjected to random inspection. The reports will include the date and time of inspection, the name and address of the transporter, the type of vehicle, the size and contents of the load, and the results of the inspection.

Management and Notification of Incidents. If regulated hazardous or prohibited PCB waste is detected, the waste will be promptly returned to the vehicle and the waste will not be disposed of at the facility. If the hauler is not available the waste will be properly segregated and protected against the elements, secured against unauthorized removal, and isolated from other waste and landfill activities until arrangements can be made for appropriate handling and transportation to the generator or an appropriately authorized facility. If known, the hauler will be contacted and required to remove the waste from the facility. TCEQ (and any local pollution agency with jurisdiction who has requested to be notified) will be notified of any incident involving the confirmed disposal of regulated hazardous waste or prohibited PCB waste in the landfill. No notification will be provided for loads rejected by the facility or returned to the transporter or generator (i.e., loads that were rejected/returned before being received by the facility). A remediation plan will be submitted and coordinated with TCEQ for removal of regulated hazardous waste or prohibited PCB waste disposed of in the landfill.

6 FIRE PROTECTION PLAN

6.1 Fire Protection Training

Facility operations personnel (not including personnel with administrative duties only) will receive annual training in fire prevention and fire-fighting. The training will include:

- review and discussion of this Fire Protection Plan;
- fire prevention and hazard awareness;
- location of fire-fighting equipment and materials;
- operation of fire extinguishers;
- alternate fire-fighting methods, including use of soil stockpile and water truck;
- appropriate personnel protective equipment;
- properties of methane gas and proper safety procedures;
- facility evacuation procedures; and
- coordination with the local fire department.

Administrative personnel will receive annual training relating to fire prevention and hazard awareness and facility evacuation procedures. Records of training will be kept in the Site Operating Record.

6.2 Fire Prevention

The main potential fire hazard at this facility is operations associated with waste disposal (disposal truck traffic on-site, off-loading of waste at working face and handling waste during compaction for disposal), since some wastes are potentially combustible materials. Other site activities involving potentially combustible materials are vehicle fuel storage and dispensing, wood processing and composting, C&D material sorting for recycling, and landfill gas monitoring/management.

In order to minimize fire hazards at the site, the following standards are in effect:

- Smoking is allowed only in designated areas. Smoking is specifically prohibited:
  - on any area of the landfill waste footprint;
  - at fuel storage and dispensing areas;
  - at material processing/recycling areas; and
  - near landfill gas management system features (gas monitoring probes);
- Fuels will be stored and dispensed only in authorized areas. Efforts will be made to contain and control fuel spills immediately upon discovery.
  - Spilled fuel and impacted soil will be promptly collected, profiled, and properly disposed.
- No unauthorized burning of solid waste will be permitted at the site.
- "Hot loads" (burning waste from incoming loads) will not be placed at the working face. The gate attendants and equipment operators will observe incoming loads for signs of burning waste such as smoke, steam, or heat; and will manage hot loads as described subsequently in Section 6.4.2.
- Waste will be properly compacted and covered with soil as described in this SOP.

6.3 General Fire-Fighting Procedures

The following general procedures will be implemented in the event of a fire.

- If it can be done safely, fires will be promptly extinguished by trained site personnel.
- If necessary:
  - Contact the local fire department by calling 911.
  - Notify the Landfill Manager and alert other facility personnel.
  - Assess the extent of the fire and the potential for the fire to spread.
  - If safe, attempt to contain or extinguish the fire until the local fire department arrives.
  - Assist the local fire department as appropriate.
  - Evacuate the facility as necessary.

In general, fire-fighting methods include smothering a fire with soil, spraying a fire with water, using a fire extinguisher, or separating burning material from other waste. Fire-fighting equipment available at the site includes: (i) a water truck; (ii) fire extinguishers; and (iii) landfill equipment for transporting and placing soil or other earthen material to extinguish any fires.

6.4 Area-Specific Fire-Fighting Procedures

6.4.1 Working Face

Working Face Fire-Fighting Procedures. If there is a fire at the working face, incoming waste receipts will be temporarily suspended or rerouted to another portion of the disposal area and another working face established there until the fire is extinguished. The following fire-fighting methods may be employed at the working face:

- isolate the burning material from other waste using bulldozers and compactors;
- smother with soil or other earthen material using bulldozers or compactors;
- apply water from the water truck (replenished from on-site water sources);
- use a fire extinguisher on small fires;

If a fire cannot be extinguished using the above methods, the local fire department will be contacted immediately by telephoning 911. Facility personnel will use reasonable measures to contain the fire until the fire department arrives.

Calculation of Soil Stockpile Size Requirements. A soil stockpile or borrow area (such as an on-site borrow area from which weekly/intermediate cover soil is obtained) will be available at all times to provide a source of earthen material for extinguishing a fire. The stockpile/borrow area will have enough earthen material to cover the open area of the working face to a depth of six inches. Based on the anticipated ranges in size of the working face at the facility, the anticipated range of corresponding stockpile/borrow area sizes are as follows:

Area of Working Face (ft^2)	**Minimum Required Stockpile/Borrow Size (yd^3)**
2,500 (i.e., about 50' x 50')	46
10,000 (i.e., about 1/4 acre; about 100' x 100')	185
20,000 (i.e. about 1/2 acre; or 100' x 200	370
40,000 (i.e., about one (1) acre; or 200' x 200')	741
62,500 (i.e., about 250' x 250')	1,157
80,000 (i.e., about 280' x 280')	1,481

The Landfill Manager or designated alternate will estimate and adjust the appropriate stockpile/borrow area size as needed using the above table and the actual working face dimensions, or by calculating the volume in cubic yards using the formula: [(working face length (ft) x width (ft) x 0.5 ft thick)/27 ft^3/cy]. It is noted that the above table of working face areas and corresponding stockpile/borrow area sizes show the amount of earthen material that would be needed for typical conditions to cover the entire working face size. As daily landfill operations progress, the actual size of the open, uncovered portion of the working face may vary, and less earthen material may be required (i.e., just a portion of that day's working face may be open at any one time).

The maximum allowable size of the working face will be based on the availability of equipment to provide the fire protection described below (i.e., six-inch layer of earthen material within one hour of detection). Further, the facility will limit the size of the active working face to be as small an area as practical for the safe operation of the incoming waste hauling vehicles, operation of compaction equipment, and placement of weekly cover.

Calculation of Maximum Allowable Working Face Size from Fire-Fighting (Soil Covering) Requirements. Sufficient on-site equipment must be provided to place a six-inch layer of earthen material on any waste not already covered with six inches of earthen material within one hour of detecting a fire. Calculations demonstrating that the type and number of equipment listed previously in Table IV-3 in Section 5.2 of this SOP will be able to transport the required volume of earthen material are presented below. The calculation is performed to back-calculate (solve for) the maximum allowable size of the working face based on the equipment present and their earthmoving capabilities.

- Three (3) scenarios are analyzed based on the minimum pieces of earth moving (firefighting) equipment that would be available depending on the range of waste acceptance rates, as presented in Table IV-3 in Section 5.2.
- The equipment capabilities are as follows (using production rates published in Caterpillar Performance Handbook, Edition 31):
  - The equipment will push soil from the nearby stockpile(s) described above.
  - The average dozing distance is 100'.
  - Each piece of equipment (bulldozer(s) and compactor, when present) will have production equivalent to a D6 dozer pushing a loose soil stockpile – i.e., 624 cy/hr.
- The working face size in square feet is solved-for by dividing the production capacity by the required soil thickness, using consistent units. For example, with one bulldozer, the maximum allowable working face size is calculated as: [(624 cy/hr x 27 ft^3/cy) / 0.5 ft] = 33,700 ft^2 (rounded to the nearest 10 square feet). For a convenient frame of reference, this area can also be expressed as an equivalent square area by taking the square root of the

calculated area. The resulting calculation for all three scenarios is tabulated below.

Scenario	Equipment Piece(s)	Production Capacity (CY/hr)	Area (ft^2) That Can Be Covered by 6 inches of Soil in One Hour [i.e., Maximum Allowable Working Face Size]	Equivalent Square Dimensions of Calculated Area (ft x ft)
1	1 Bulldozer	624	33,700	180 x 180
2	1 Bulldozer + 1	1,248	67,390	260 x 260
3	1 Bulldozers + 2 Compactors or 2 Bulldozers + 1 Compactor	1,872	101,090	320 x 320

The above table presents the results of the calculation of the maximum allowable working face size based on the different anticipated scenarios of available equipment. It is noted that during a fire, other on-site equipment (e.g., water truck, fire extinguishers, excavator and dump truck, or scraper) can also be used to fight the fire. To be conservative, the soil covering/fire-fighting capabilities of these other equipment pieces have not been factored into the above calculation. It should be recognized that these other equipment pieces will add to the fire-fighting capabilities at the facility and through the calculation approach given above could support the ability to use a larger working face. In addition to meeting the above requirements, the facility will also limit the size of the active working face to be as small an area as practical for the safe operation of the incoming waste hauling vehicles, operation of compaction equipment, and placement of weekly cover. Based on the preceding calculations, the maximum allowable working face site is presented in Scenario 3 (e.g., 320’ by 320’), and the typical working face size is presented in Scenario 2 (e.g., 260’ x 260’).

6.4.2 Incoming Hot Load

“Hot loads” (burning waste from incoming loads) can be identified by the presence of smoke, steam, heat, or flames being released from the load, or notification by the driver. Any truck perceived to be carrying a hot load will be directed to a portion of the disposal area away from the working face, where the load can be discharged without danger of spreading the fire. The fire will then be extinguished by smothering with earthen material or the application of water. The waste will only be transported to the working face after the Landfill Manager or designated alternate has determined that no potential exists for the waste to re-ignite. No smoldering or smoking waste will be moved to the working face. Hot loads inadvertently discharged at the working face and resulting in a fire will be handled in the manner described above for managing a fire at the working face.

6.4.3 Vehicle or Equipment

If site equipment or a site-operated vehicle catches fire, the operator will attempt to bring the unit to a stop away from fuel areas, exposed waste material, and other equipment or vehicles. If possible, the operator will shut off the engine and set the brake. Fire may be extinguished by fire suppression equipment installed on some equipment or by trained personnel that will attempt to extinguish the fire using fire extinguishers or water. If the fire cannot be extinguished using the above methods, the local fire department will be contacted immediately at 911. Facility personnel will use reasonable measures to contain the fire until the fire department arrives.

6.4.4 Structures

Personnel will follow the general procedures outlined in Section 6.3 of this SOP for fires occurring in on-site structures. The potential for fires will be minimized by employing routine maintenance and cleanup. No site personnel will enter a structure that is on fire.

6.4.5 Wood Processing/Composting Area

If there is a fire at the wood processing/composting area, wood processing and composting activities will be temporarily suspended in the affected area until the fire is extinguished, and incoming related loads will be redirected away from the affected area. The following firefighting methods may be employed at the compost area:

- smother with soil;
- apply water from the water truck (replenished from on-site water sources);
- isolate the burning material from other compost materials;
- use a fire extinguisher on small fires;
- cut a firebreak around the fire to prevent it from spreading; and/or
- place earthen berms around the fire area to prevent it from spreading.

If a fire cannot be extinguished using the above methods, the local fire department will be contacted immediately by telephoning 911. Facility personnel will use reasonable measures to contain the fire until the fire department arrives. Upon extinguishing a wood processing/composting area fire, the portion of the area affected by the fire will remain closed while the area is inspected to verify that the fire is completely extinguished. Inspection of the fire area will be conducted by the Landfill Manager or designated alternate. A soil stockpile of at least 300 cubic yards will be maintained within 500 feet of the compost area to assist with small fires.

6.4.6 Other Areas

Fire-fighting procedures at the large items/white goods area and the C&D recyclable sorting area will be the same as for the working face, as described in Section 6.4.1.

6.5 Notification of TCEQ

If a fire is not extinguished within 10 minutes of detection, the facility will make every reasonable effort to contact the TCEQ Region 4 Office by phone, immediately but not later than four (4) hours after detection. The facility will provide the Region Office with a written description of the fire and resulting response within 14 days of the event.

7 ACCESS CONTROL

7.1 Access Control Measures

Access control to prevent unauthorized access, unauthorized dumping, and public exposure to the landfill is provided by: (i) fencing; (ii) control features at the main entrance/exit gates; (iii) locked gates at other secondary site access point(s) around the facility perimeter; (iv) natural barriers; and (v) site personnel awareness and observations for maintaining access control. The layout of the fencing around the site perimeter and the location of the main entrance/exit gate are shown on Parts I/IIA, Figure I/II-A.11 – Access Control Plan.

Fencing and gates will serve as the primary landfill access controls. To discourage unauthorized entry into the landfill facility, the perimeter of the facility will be protected by fencing along the north, east, and south sides of the site. The fence will be composed of (at minimum) barbed wire, woven wire, wooden fencing, plastic fencing, pipe fencing, field fence, or other fence materials. To the west, the site is bounded by natural barriers including Village Creek and its levee. The west side of the site is highly vegetated, which along with the presence of the creek and adjacent floodplains and earthen levee, provides a natural barrier to the facility to prevent unauthorized access.

The site is accessed through an entry gate at the main entrance. Secondary access gates along the perimeter fencing are kept locked except when in use. Entry to the landfill is restricted to only personnel whose entry is authorized by site management (e.g., the facility employees and contractors, authorized waste haulers, TCEQ personnel, properly identified visitors, etc.). Visitors entering the site are directed to the office location for check-in.

The Gate Attendant(s) will direct waste transport drivers to the proper disposal area. There, the drivers will be directed to a specific unloading area. The Gate Attendant(s) or other site personnel will also direct drivers needing access to other portions of the facility (e.g., construction contractors). Additionally, when appropriate, signs with directional arrows and/or barricades may be placed along site roads to direct traffic and control interior access.

During normal operating hours, facility personnel will be on duty at the scale house and in the vicinity of landfill operations to control access and disposal operations.

When the site is closed, the entry gate will be closed to prevent site access, and locked when no personnel are present on site.

7.2 Access Control Inspection, Maintenance, and Notifications

Access control features will be inspected monthly, and the results of the inspection will be documented. A breach in any perimeter fence or gate will be temporarily repaired within 24 hours of detection. If a breach of the perimeter fence or gate cannot be permanently repaired within 8 hours of detection of the breach, the facility will notify the TCEQ Region 4 Office along with any local pollution control agency with jurisdiction that has requested to be notified, within 24 hours of detection. For a temporary repair, the notification will include a schedule for when a permanent repair will be completed. Once the permanent repair is complete, the facility will notify the Region 4 Office of the completed repair. If a permanent repair is completed within 8 hours, no notification is required.

8 UNLOADING AREAS

8.1 Unloading at Working Face

Unloading of waste to be placed in the landfill will take place at the designated working face or recycling area under the supervision of trained site personnel. Equipment Operators will maintain the daily working face, the size of which will be limited to be as small an area as practical for the safe operation of the incoming waste hauling vehicles, operation of compaction equipment, and placement of weekly cover. Signs and barricades may be used in addition to instructions from site personnel to direct incoming loads to the designated unloading area.

Equipment Operators and other staff with responsibility for the working face operations will be appropriately trained as specified in Section 5.4 of this SOP with regard to approved waste acceptance procedures and requirements. This will include an understanding of prohibited waste (e.g., putrescible, hazardous, PCB, etc.) recognition and incident management methods. One or more of these trained employees will direct and visually monitor disposal of incoming loads of waste at the working face. Trained personnel will be on duty at all times when wastes are being discharged at the working face and will have the authority and responsibility to reject unauthorized loads, to assess appropriate surcharges, and to have unauthorized material removed by the transporter or on-site personnel or otherwise properly managed by the facility.

8.2 Unloading Unauthorized and Prohibited Wastes

Unloading of waste in unauthorized areas is prohibited. Waste deposited in an unauthorized area will be removed immediately and disposed of properly.

The methods employed at the site to detect and prevent the disposal of prohibited wastes were discussed in Section 5.6 and will be followed during waste unloading. If unauthorized or prohibited waste is detected by site personnel after it has been discharged, the procedures, notifications, and recordkeeping outlined in Sections 5.6.2 and 5.6.3 will be followed for the type of waste involved in the incident.

8.3 Large Items/White Goods Unloading and Collection Area

A staging area to unload and store received/salvaged large items/white goods (e.g., appliances) is allowed to be maintained at the site, either located on waste within the current landfill footprint, or in areas within the future landfill footprint. This area will have a size not larger than 100 feet by 100 feet. This storage area is allowed to move from time to time based on landfill operational needs. The materials allowed in this area are only those large items/white goods that have been received/salvaged from the authorized waste streams that are allowed to be accepted at this facility. The unloading of such items will be supervised by site personnel and the large items/white goods area will be policed regularly to ensure that any waste materials other than large items/white goods are removed and deposited in the landfill.

8.4 Wood Processing/Composting Area

An unloading and stockpiling area associated with the wood processing/composting area is allowed to be maintained at the site to facilitate segregation of uncontaminated wood materials (e.g., brush, leaves, grass clippings, other wood materials) and subsequent on-site grinding/chipping/mulching or composting. Compostable materials are items such as source-separated yard trimmings, clean wood material, vegetative material, pre-consumer green waste, paper, manure, clean soils, sand, and mulch. The wood processing/composting area will be a maximum of 15 acres in size and is allowed to be either located on waste within the current landfill footprint, or to be located in areas within the future landfill footprint. This area is allowed to move from time to time based on landfill operational needs. The materials allowed in this area are only those wood processing/composting materials that have been received from the authorized waste streams that are allowed to be accepted at this facility. The unloading of brush, wood, and compostable materials will be supervised by site personnel and the storage/processing area for these materials will be inspected monthly to ensure that any non-brush/wood/compostable materials are removed and deposited in the landfill. A composting area plan, providing additional operational details related to composting, is provided in Appendix IVB of this SOP.

8.5 C&D Recyclable Sorting Area

A special area to stage/sort and store potentially recyclable C&D materials received/salvaged at the facility is allowed to be maintained at the site, either located on waste within the current landfill footprint, or in areas within the future landfill footprint. This area will have a size not larger than two (2) acres. This area is allowed to move from time to time based on landfill operational needs. The materials allowed in this area are only those C&D materials that have been received/salvaged from the authorized waste streams that are allowed to be accepted at this facility. The unloading of such items will be supervised by site personnel and the C&D recycling area will be inspected monthly to ensure that any non-recyclable C&D materials are removed and deposited in the landfill.

8.6 Other Areas

Waste in Enclosed Containers or Enclosed Vehicles. Section 26 of the SOP contains special procedures that will be implemented for waste received in enclosed containers or enclosed vehicles.

Empty Containers. Empty containers (not containing waste) are allowed to be stored at the facility as long as they do not interfere with the operations of the landfill. The containers are allowed to be moved from time to time. Containers will not be stored if they contain waste, and storage of the containers will preclude nuisance conditions or the discharge of pollutants from the area.

9 FACILITY OPERATING HOURS

Waste Acceptance Hours. The operating times when the facility is allowed to accept waste are 4:00 a.m. to 8:00 p.m., seven days a week.

Operating Hours – Heavy Equipment / Transport. The operating times when the facility is allowed to operate heavy equipment for conducting landfill operations (e.g., waste compaction; earthmoving; cover soil excavation, spreading, and placement; on site construction or maintenance activities involving heavy equipment; etc.) and transport non-waste materials on or off site are 3:00 a.m. through 10:00 p.m., seven days a week.

Operating Hours – Other Activities. Site monitoring, surveying, maintenance, and other activities not requiring heavy equipment operation do not require specific approval and may be performed 7 days per week, 24 hours per day.

Alternate / Additional Operating Hours. The facility may request TCEQ approval of alternate waste acceptance or operating hours up to five (5) days in a calendar-year period to accommodate special occasions, special purpose events, holidays, and other special occurrences. Also, the TCEQ Region 4 Office may allow additional temporary waste acceptance or operating hours to address disasters, emergency situations, or other unforeseen circumstances that could result in the disruption of waste management services in the area. The facility will record in the Site Operating Record the dates, times, and durations when any alternate or additional operating hours are used.

Waste acceptance and operating hours outside default regulatory time periods are necessary to support the safe and efficient transportation, storage, processing, disposal, and other management of municipal solid waste generated within the communities and other areas served by the facility.

Reasons for Operating Hours. Operating hours beyond the default hours in 30 TAC § 330.135(a) are currently authorized by the TCEQ Executive Director via the issued and active Permit MSW-1983C (and were also authorized in predecessor permits issued for this facility). As such, this facility has a multi-decade operating history that allows operations beyond the default hours. For this SOP under permit amendment application MSW-1983D, no changes to the facility operating hours are proposed. The reason for the long-established operating hours is to accommodate the needs of our customer businesses and individuals in the communities this facility serves by offering a convenient window of operating hours for making waste deliveries. Correspondingly, these hours allow for the safe, efficient, and cost-effective management of processing and disposal activities at the facility. The operating hours account for customers who may be required by contract or otherwise choose to schedule waste collection services in the overnight or early morning hours, so that they may make their delivery into this facility promptly upon arrival, rather than lining up each morning outside the facility to wait for the gates to open. This also allows customers to travel to and from the facility during off-peak hours of traffic in the DFW Metroplex area, helping them avoid (and further contribute to) traffic congestion in the region. The ability to operate on weekends also provides a much-needed option for small haulers and members of the public for whom making waste deliveries during their typical Monday through Friday work week is not feasible.

10 SITE SIGNS

A conspicuous sign measuring at least 4-ft by 4-ft will be maintained at the site entrance. The sign will be readable from the facility entrance and will state, at a minimum, in letters at least 3 inches high:

- the name of the facility;
- the facility MSW permit number;
- the type of site (i.e., Type IV);
- the hours and days of operation;
- a 24-hour emergency contact phone number(s); and
- the phone number of the local fire department.

The contact phone number(s) will reach an individual with the authority to obligate the facility at all times that the facility is closed.

Other signs will be posted at the site entrance/gatehouse area or along roads within the site to provide pertinent rules, operational procedures, traffic control procedures, warnings, and other relevant site information including unauthorized/prohibited wastes.

11 CONTROL OF WINDBLOWN SOLID WASTE AND LITTER

The site will be operated in such a way as to minimize windblown material, using a combination of the measures described below.

- Incoming waste hauling vehicles will be encouraged to use adequate covers/tarps or other means of securing and containing the load during transport. The adequacy of covers will be checked at the gatehouse, and a sign will be prominently displayed at the gatehouse stating that all loads shall be properly covered.
- The active working face will be limited in size to as small an area as practical for the safe operating of the incoming waste hauling vehicles, operation of compaction equipment, and delivery/placement of weekly cover soils.
- Waste will be compacted with heavy equipment as it is placed at the working face.
- Cover soil will be applied to the working face at least once each week (as described in Section 24 of this SOP) and may be applied more frequently as needed to assist with the control of windblown waste.
- Perimeter fencing.
- Should windblown waste or litter escape the facility control measures and cross onto adjacent property, the facility will contact the adjacent property owner to seek permission for litter pick-up.
- The excavation and above-grade filled areas will provide some additional protection from prevailing winds.
- Temporary litter control fences include portable panels with wire-mesh screens of varying heights that can be placed as necessary, and as close as practicable near the downwind side of the working face.

The number, location, and maintenance of temporary fences will be determined by the Landfill Manager or designated alternate as needed based on operating and weather conditions.

Weather conditions may result in material occasionally being blown away from the working face during waste placement operations and along fences and access roads. Facility personnel (e.g., equipment operators and/or laborers) will collect litter within and around the site each day that the facility is operating. Windblown materials will be collected and returned to the active disposal area.

12 EASEMENTS AND BUFFER ZONES

This section of the SOP describes easement protection and buffer zones at the site.

12.1 Easements

Requirements: No solid waste unloading, storage, disposal, or processing operations shall occur within any easement, buffer zone, or right-of-way that crosses the site; and no solid waste disposal shall occur within 25 feet of the center line of any utility line or pipeline easement unless otherwise authorized by the Executive Director. All pipeline and utility easements must be clearly marked with posts that extend at least six feet above ground level, spaced at intervals no greater than 300 feet.

Protection of Site Easements: Existing easements on or adjacent to the site are presented in Section 2 of Parts I/IIC. A drawing showing the easements in relation to the limits of waste is presented in Parts I/IIC, Drawing I/IIC-1. As shown, there are no easements or rights-of-ways within the waste footprint.

12.2 Buffer Zones

Requirements: A buffer zone is defined as a zone free of municipal solid waste processing and disposal activities within and adjacent to the facility boundary on property owned or controlled by the owner or operator. No solid waste unloading, storage, disposal, or solid waste processing and disposal operations will occur within any buffer zone. The buffer zone must not be narrower than necessary to provide for safe passage for fire-fighting and other emergency vehicles.

Site Buffers: Buffer zones extending from the limit of waste to the facility boundary or adjacent to the facility boundary on property owned by the owner/operator will be as shown on the facility layout plan presented in Parts I/II, Appendix I/IIC, Figure I/IIC-1. As shown, a 50-ft (min) buffer is maintained. Additionally, the recycling-related storage/processing areas will be located (discussed in Section 8) such that they will meet the required 50-ft (min) buffer requirement. Buffer zones shall be clearly marked and maintained as detailed in Section 13 of this SOP.

13 LANDFILL MARKERS AND BENCHMARK

13.1 Required Landfill Markers

Landfill markers, consisting of metal or wood (or other durable material) posts extending at least 6-ft above ground level will be used to clearly mark specific site features. The markers will be color-coded to differentiate between features and will be visible during operating hours. The type, placement, and color-coding system for the markers are described below.

1. Facility Boundary Markers (Black) – Facility boundary markers will be placed at each corner of the facility and along each boundary line of the permit boundary at intervals no greater than 300 ft. Fencing is allowed to be placed within these markers as required.
2. Buffer Zone Markers (Yellow) – Markers identifying the buffer zone will be placed along each buffer zone boundary at all corners and between corners along the buffer zone at intervals no greater than 300 ft. Placement of the landfill grid markers (discussed below) is allowed to be made along a buffer zone boundary.
3. Easements and Rights-of-Way Markers (Green) – Easement and right-of-way markers will be placed along the centerline or boundary edges of pipeline and utility easements and along the boundary of a right-of-way at intervals no greater than 300 ft and at each corner within the site and at the intersection of the facility boundary.
4. Site Landfill Grid System Markers (White) – A landfill site grid system must be installed. The site grid system consists of lettered and/or numbered markers. The grid system will encompass at least the area expected to be filled within the next 3-yr period. Markers will be spaced no greater than 100-ft apart measured along perpendicular lines. Where markers cannot be seen from opposite boundaries, intermediate markers will be installed.
5. SLER Area Markers (Red) – SLER area markers will be placed so that areas for which a SLER has been submitted and approved by TCEQ are readily determinable. Such markers are to provide site workers immediate knowledge of the extent of approved disposal areas. These markers will be located so that they are not susceptible to being damaged during operations. The location of the SLER markers will be tied into the site grid system and will be reported on each SLER submitted. SLER markers will typically be

placed at the corners (boundaries) of the lined cell and will not be placed inside constructed areas. The SLER markers will be maintained for at least as long as the disposal cell for which they are marking is active.

6. Flood Protection Markers (Blue) – Flood protection markers will be installed along the boundary of the 100-year floodplain within the facility permit boundary. The area subject to flooding shall be marked by means of permanent posts spaced not more than 300 feet apart or closer if necessary to retain visual continuity.

13.2 Permanent Benchmark

A permanent benchmark has been established at the site. The benchmark has a bronze marker set in concrete with the benchmark elevations and survey dates stamped on it. The benchmark is established at the site in an area that is readily accessible and will not be used for disposal. The location, coordinates, and elevation of the benchmark are shown on the facility layout plan in Parts I/II, Appendix I/IIA, Figure I/II – A.1. The benchmark elevation was established using known and reliable benchmarks in the area, including nearby National Geodetic Survey (NGS) monuments (Note: NGS was formerly named the United States Coast and Geodetic Survey).

13.3 Inspection and Maintenance of Markers and Benchmark

The benchmark and all required site markers will be maintained so that they are visible during operating hours and will not be obscured by vegetation. Markers that are removed or destroyed will be replaced within 15 calendar days of removal or destruction. Landfill markers will be inspected monthly to ensure that they comply with the requirements of this SOP, and documentation of the inspections will be maintained at the facility. Markers that are damaged, missing, or that do not meet the regulatory requirements will be repaired or replaced within 15 calendar days of discovery of the deficiency. All markers will be repainted or otherwise maintained as necessary to retain visibility.

14 MATERIALS ALONG THE ROUTE TO THE SITE

Waste hauling vehicles arriving at the landfill will be encouraged to use adequate covers/tarps or other means of securing and containing the load during transport to prevent the escape of any part of the load enroute to the site or on the site by blowing or spilling. The adequacy of covers will be checked at the gatehouse, and a sign will be prominently displayed at the gatehouse stating that all loads shall be properly covered. Additionally, the facility may elect to add a surcharge, as appropriate, to encourage compliance.

Once per day on days when the facility is receiving waste, site personnel will pick up existing litter spilled along and within the rights-of-way of Dick Price Road (which is the public access road serving the facility) for two miles in either direction from the entrance used for the delivery of waste to the facility. This activity will be documented to demonstrate compliance. The facility will also consult with applicable state (i.e., Texas Department of Transportation), county, and/or local governments having maintenance authority over those road segments.

15 LARGE ITEMS/WHITE GOODS

Large, heavy or bulky items/white goods received at the site may have a designated unloading, collection and staging area; and are allowed to be salvaged/recycled as described in Section 19.1 of this SOP or may be disposed of at the working face. Items classified as large items or white goods may include, but are not limited to, appliances, air conditioner units, and large metal pieces. The materials allowed in this area are only those large items/white goods that have been received/salvaged from the authorized waste streams that are allowed to be accepted at this facility.

Care will be taken during disposal of large items to ensure they do not interfere with continued waste filling, and that smaller waste items are placed and compacted in and around the large item(s).

No chlorofluorocarbon (CFC)-containing appliances, or electrical equipment containing prohibited PCBs, will be accepted for disposal. Appliances such as refrigerators, freezers, and air conditioning units that have had CFCs removed and have certification of removal in accordance with Chapter 40 to the Code of Federal Regulations (40 CFR) § 82.156(f)(2) as amended (now § 82.155(b)(2)) are allowed to be accepted for disposal. In accordance with 40 CFR § 82.156(f) as amended (now § 82.155(b)(2)(ii)), signs will be posted indicating that appliances containing CFCs will not be accepted for disposal.

CFC-containing appliances such as refrigerators, freezers, and air conditioning units that are accepted for recycling (rather than disposal) will have a licensed CFC recovery technician come on-site to recover the CFCs or will be sent to an off-site facility for CFC recovery, in accordance with 40 CFR § 82.156(f) as amended (now § 82.155(b)). These items are allowed to be stored as potentially recyclable materials as described in Section 19.1 of this SOP prior to CFC recovery or shipment to an off-site facility.

16 ODOR MANAGEMENT PLAN

16.1 Identification of Potential Odor Sources

As a Type IV MSW facility, the allowable waste stream (i.e., brush, C&D, and rubbish-type materials) will reduce the potential for odor generation compared to other MSW facilities (e.g., Type I MSW landfills). Specifically, more odorous putrescible wastes, sludges, grease or grit trap wastes, liquid wastes, or dead animals are not allowed to be accepted at the facility, thereby eliminating the potential for generation of odors by these sources.

Potential odor sources at the facility may include allowable wastes delivered to the landfill and undergoing decomposition, the open working face, ponded water, or contaminated water.

16.2 Odor Control Measures

Control measures to further minimize odor generation and emissions, and to address specific potential sources, are as follows:

- Incoming wastes will be promptly landfilled and compacted. Wastes with odors will be promptly covered with other waste or with cover soil (see below).
- Cover will be applied on a weekly basis at minimum (per Section 24 of this SOP), to minimize conditions which could result in odors. If necessary, cover soil will be placed more frequently than weekly, or a cover soil thickness of greater than 6-inches will be used.
- Contaminated water may become a source of odors and will be segregated from clean surface water (i.e., storm water runoff) and managed in accordance with the Contaminated Water Management Plan (see Appendix IVA of this SOP for applicable operational details).
- Ponded water over waste disposal areas at the site will be controlled as described in Section 25 of this SOP, which will help eliminate the potential for occurrence of odors associated with ponded water.

17 DISEASE VECTOR CONTROL

Because of the types of waste the facility is allowed to accept and those that are prohibited, the attraction of disease vectors is expected to be minimal. In particular, the facility will not accept putrescible wastes, which are the types of wastes that most commonly attract vectors, such as rodents, excessive bird populations, flies, and mosquitoes. Also, the facility's routine operational requirements are designed to prevent vector habitation through the compaction and covering of waste and periodic grading/site-maintenance to eliminate potential environments that can attract vectors (e.g., eliminating weeds around the working face, eliminating ponded water).

Notwithstanding the foregoing, facility personnel will monitor ongoing operations and be prepared to take additional action as necessary to control vectors. These actions may include, as deemed appropriate by the Landfill Manager, any of the following measures:

- temporarily applying cover more frequently than once per week;
- temporarily applying a thicker layer of cover;
- use of bird control measures such as pyrotechnics, baiting, decoys, etc. to discourage birds at the site and scare them away if they become a nuisance; and/or
- contracting with professional exterminators, if necessary, to control rodents or other pests that appear at the site.

18 SITE ACCESS ROADS

18.1 Description of Site Roads

All-weather roadways will be used to provide access during wet weather from the site entrance at Dick Price Road (public roadway) to the waste unloading area being used during wet weather. On-site access roadways will be maintained in a clean and safe condition. At the facility, all-weather landfill access is provided by a paved entrance road from the entrance driveway along Dick Price Road to just beyond the scales, where the road then transitions to an all-weather surface that continues as an internal access road onto the landfill to the waste unloading area.

Additional internal roads needed to access waste unloading areas will be established to provide waste vehicle access and facilitate site operations as waste filling progresses. These internal roads will be accessed from the facility entrance road described above. Internal roads for use during wet weather conditions will be maintained so that continuous access to waste disposal areas is provided during both wet and dry weather. Reflective guideposts or other suitable reflective equipment may be used as needed along select internal access roads used between the scale house and disposal areas to help direct traffic during early morning or evening operations.

18.2 Mud and Dust Control Measures

The all-weather road surfacing on the internal roads, and the paved access road between the scale area and the entrance/exit to Dick Price Road will minimize dust generation and mud tracking by vehicles exiting the facility. The site will also utilize a motorized power broom or other equipment to remove dust, debris, and mud from the paved site access road; and a water truck to minimize dust generation, as needed and described further below.

Tracked mud and associated debris at the access to the facility on the public roadway will be removed at least once per day on days when mud and associated debris are being tracked onto the public roadway. Secondary site access points will also be inspected and cleaned as necessary when in use. If mud or other associated debris is observed, it will be removed using the power broom or other equipment; and if additional efforts are necessary to remove mud or other associated debris from the roads, by spray-washing the road surface using a water truck or other equipment. Site access roads may also be graded and maintained periodically as deemed appropriate by the Landfill Manager or designated alternate as needed to minimize depressions, ruts, and potholes, which can lead to mud formation.

During dry weather, the operator will control dust by periodically watering site roads using the water truck and/or sweeping the roads.

18.3 Road Maintenance Frequencies

Litter and any other debris along on-site access roadways will be picked up at least daily and taken to the working face or otherwise properly managed by facility personnel (e.g., equipment operators or laborers). On-site access roadways will be regraded by equipment operators to minimize depressions, ruts, and potholes at a minimum frequency of once per year.

19 SALVAGING AND SCAVENGING

19.1 Salvaging

Salvaging, defined as the "controlled removal of waste materials for utilization, recycling or sale," is allowed to be performed at the facility. Salvaging will not be allowed to interfere with prompt disposal of solid waste or otherwise create unsafe operating conditions or a public health nuisance. No items will be salvaged from the working face if the salvaging would endanger site personnel.

Potentially recyclable items such as shingles, sheetrock, cardboard, tires, land clearing debris, metal, concrete, bricks, large items/white goods, or other inert materials are allowed to be salvaged. Special wastes received at the disposal facility will not be salvaged. Pesticide, fungicide, rodenticide, and herbicide containers will not be salvaged unless bring salvaged through a state-sponsored recycling program.

Salvaged items will be temporarily stored in a designated area(s) at the landfill [i.e., the large items/white goods area and the C&D recyclable sorting area] located within the current or future waste footprint. Due to the location of access roads and waste placement, the location of these areas may vary over time. Concrete, bricks, or other inert materials are allowed to be used on-site for erosion control, road base materials, or other similar uses. Salvaged items will be removed often enough to prevent them from becoming a nuisance, to preclude the discharge of any pollutants from the area, and to prevent an excessive accumulation of the material at the site. Potentially recyclable materials will not be stored at the facility for more than 180 days.

19.2 Scavenging

Scavenging, defined as the "uncontrolled and unauthorized removal of materials at any point in the solid waste management system," will not be allowed at the facility. Scavenging will be prevented through the following controls:

- Access control measures such as fencing, gates, and facility personnel duties (described in Section 7.1);
- Access control inspections and maintenance (e.g., fence inspection and repair as described in Section 7.2);

- Litter control and pickup (described in Section 11);
- Vector control actions (described in Section 17); and
- Application of weekly cover, and inspection/repairs to cover (described in Section 24).

20 ENDANGERED SPECIES PROTECTION

Requirement: A facility and the operation of the facility must not result in the destruction or adverse modification of the critical habitat of endangered or threatened species, or cause or contribute to the taking of any endangered or threatened species. Facilities must be operated in conformance with any endangered or threatened species protection plan required by the commission.

Site-Specific Conditions and Protection: The U.S. Fish and Wildlife Services (FWS) and Texas Parks and Wildlife Department (TPWD) were contacted to request information regarding endangered or threatened species or their critical habitat with respect to the site. The FWS and TPWD response letters are included in Appendix I/IIB. In addition, a site-specific threatened and endangered species habitat assessment was completed by Weaver Consultants Group, LLC in November 2021 (refer to the TPWD tab in Appendix I/IIB). This study concluded that the area within the permit boundary would not likely be occupied by any federally-listed threatened and endangered species.

Therefore, it is concluded that the expansion of the Fort Worth C&D Landfill will not result in the destruction or adverse modification of the critical habitat of any threatened or endangered species, or cause or contribute to the taking of any threatened or endangered species.

21 LANDFILL GAS CONTROL

The monitoring and control of landfill gas will be in accordance with the approved Landfill Gas Management Plan presented in Part III, Appendix III I of the Site Development Plan. As stated in Section 3.1 of this SOP, the Landfill Gas Management Plan, as well as related landfill gas monitoring records and submittals, will be included in the Site Operating Record. Submittals will be made to TCEQ as outlined in the Landfill Gas Management Plan.

22 OIL, GAS, AND WATER WELLS

Information on nearby water wells and oil/gas wells is presented in Sections 2.5 of Parts I/II.

22.1 Oil and Gas Wells

As described in the above-referenced section, no existing or abandoned oil/gas wells were identified as being within the permit boundary. In the event that an oil or gas well is discovered during site development, the facility will:

- Within 30 days of discovery, provide written notification to the TCEQ's Executive Director of the location of any oil well, natural gas well, or other well associated with mineral recovery.
- Expose and cut the casing a minimum of 2-ft below the bottom of excavation for the liner at that location, followed by capping and plugging the well in accordance with all applicable rules and regulations of the Texas Railroad Commission, or other applicable state agency.
- Provide the Executive Director with written certification that all such wells have been capped, plugged, and closed in accordance with all applicable rules and regulations of the Texas Railroad Commission.
- Submit to the Executive Director of the TCEQ a copy of the well plugging report that was submitted to the appropriate state agency, within 30 days after the well has been plugged.

22.2 Water Wells

As described in the above-referenced section of Part II, no water wells were identified as being within the permit boundary. In the event that an on-site water well is discovered during the site development, the facility will:

- Within 30 days of discovery, provide written notification to the TCEQ's Executive Director of the location of the water well.
- Expose and cut the casing a minimum of 2-ft below the bottom of excavation for the liner at that location, followed by capping and plugging the well in

accordance with all applicable TCEQ rules and regulations, or the rules and regulations of any other applicable state agency.

- Provide the Executive Director with written certification that all such wells have been capped, plugged, and closed in accordance with all applicable rules and regulations.

Other types of wells will be plugged in accordance with the rules and regulations of the applicable state agency, and a copy of the well plugging report will be submitted to the appropriate state agency and the TCEQ within 30 days after the well has been plugged.

The facility will submit a permit modification application to TCEQ identifying any proposed changes to the liner installation plan as a result of any oil, gas, or water well abandonment.

23 COMPACTION

Waste will be compacted to provide more efficient use of available disposal capacity, to minimize future consolidation and settlement, to help provide a firmer base for proper application of intermediate and final cover, as well as aid in fire protection and litter control.

Upon unloading, incoming waste will be spread at the working face by a bulldozer or landfill compactor. Trained equipment operators will then use the heavy equipment to move, shape, and make repeated passes on the material to sufficiently minimize voids and produce a compact mass. The number of passes will depend upon the nature of the waste that is being compacted.

24 LANDFILL COVER

This section contains the general provisions for weekly, intermediate, and final cover for the facility. The Executive Director may grant a temporary waiver from the requirements for weekly and intermediate cover if site management demonstrates that there are extreme seasonal climatic conditions that make meeting such requirements impractical.

24.1 Soil Management

Soil will be obtained from on-site and off-site soil borrow sources and will be maintained in a soil stockpile as needed for facility operations, including application of cover and fire protection. The earthen material will consist of soil that has not previously come in contact with waste and will be of sufficient volume to meet the fire protection requirements specified in Section 6.4 of this SOP. As this earthen material is used, it will be replenished as soon as practical to meet the aforementioned fire protection requirements.

24.2 Weekly Cover

Cover will be placed at least weekly (i.e., all solid waste will be covered within one week or less of its placement at the working face). The purposes of weekly cover include minimization of fire hazards, odors, blowing litter, vector food and harborage, and infiltration of precipitation. In addition, cover materials should discourage scavenging, limit erosion, and improve the aesthetic appearance of the facility.

For standard soil cover as weekly cover, a minimum thickness of six inches of well-compacted soil will be applied in one lift. Scrapers or dump trucks will transport cover soil to the working face. A bulldozer or compactor will apply the soil cover. Soil cover will be clean soil material that has not been mixed with solid waste. Care will be taken to avoid mixing the landfilled waste with the soil cover material.

The facility may use a mixture of soil and mulch/compost as weekly cover to improve the soil's ability to withstand erosion. The amount of mulch/compost will not exceed 50 percent by volume of the cover applied (the remainder of which will be clean soil). Prior to its use, the facility will request a temporary authorization that includes an alternative cover operating plan (ACOP) [addressing the information required by 30 TAC §330.165(d)(1)(A) – (E)] and necessary provisions to conduct the trial period of usage, submit the required status reports, and obtain a permit modification to revise the permit to allow use of the soil and mulch/compost mixture on an ongoing basis after successful completion of the trial period. The facility will submit the temporary authorization request per the provisions of 30 TAC §305.62(k). Upon completion of the demonstration period a permit modification under the provisions of 30 TAC §305.70(l) will be submitted to TCEQ as a non-notice permit modification to incorporate the ACOP as an appendix to the SOP. The ACOP may be revised as necessary upon completion of the demonstration period to incorporate any changes to the use of the alternative cover during the trial period.

Storm water runoff from areas that have intact weekly cover is not considered as having come in contact with the working face or waste (i.e., uncontaminated water).

The Landfill Manager or designated alternate will document the weekly cover placement and indicate that he/she has visually verified the thickness and condition of the cover in a Cover Application Log (see Section 24.6 of this SOP).

24.3 Intermediate Cover

All disposal areas that will receive additional waste but have been inactive for longer than 180 days will be covered with intermediate cover. This intermediate cover will consist of an additional 6 inches of suitable earthen material applied over the weekly cover, for a total of at least 12 inches of material. The top 6 inches of this intermediate cover shall be material that is capable of sustaining native plant growth, graded to help prevent ponding of water, and seeded or sodded to control erosion (or consist of a material approved by the Executive Director that will otherwise control erosion).

Storm water runoff from areas that have intact intermediate cover is not considered as having come in contact with the working face or waste (i.e., uncontaminated water). Refer to the Intermediate Cover Erosion and Sediment Control Plan (ICESCP) presented in Attachment 2H of Part III (the Site Development Plan) for details on the erosion controls and management practices that shall apply to areas with intermediate cover draining to the site perimeter surface water management system.

When areas that have received intermediate cover are to become active again, the intermediate cover is allowed to be stripped off for use as weekly cover.

24.4 Final Cover

Final cover placement will occur in accordance with the Closure Plan (Appendix IIIJ of the Site Development Plan).

The final cover grading plan (i.e., landfill completion plan showing final contours) and final cover system components are presented in the Parts I/II. Specifically, refer to Parts I/II, Figure I/II – 2.1 for the final cover grading plan, and Site Development Plan Appendix IIIJ for the Closure Plan describing the final cover system components.

The Closure Plan presents the specific requirements and schedules for closure activities, and related final cover system specifications, Quality Assurance/Quality Control (QA/QC) requirements, certification requirements, notifications, etc. This includes requirements for establishing vegetation on the final cover. During the early stages of vegetative growth, mulching, slope soil regrading, and mowing will be performed as required to promote a complete vegetative coverage and effective erosion control.

24.5 Cover Inspection, Repair of Erosion, and Final Cover Maintenance

24.5.1 Inspection

During the active life of the landfill, inspection of intermediate and final cover, including checking for erosion and ponded water, will be performed on a weekly basis. The reports of these inspections will be maintained as part of the Site Operating Record.

24.5.2 Repair of Erosion

Erosion gullies or washed-out areas deep enough to jeopardize the intermediate or final cover (i.e., exceeding four inches in depth as measured from the vertical plane of the erosion feature and its 90-degree intersection with the horizontal slope face or surface) shall be repaired within five (5) days of detection unless the TCEQ regional office approves an extension (e.g., due to inclement weather, unfavorable seasonal weather conditions, extent of the damage and resulting repair work needing more time to complete, etc.). Repairs will typically consist of regrading, backfilling, compacting, and seeding, as necessary. The dates of detection of erosion and completion of repairs, and reasons for any delay of repairs, will be documented in the Cover Inspection Record (see Section 24.6).

24.5.3 Final Cover Maintenance

Maintenance of the integrity and effectiveness of the final cover system (cap) shall include mowing, and regular inspections and repairs to correct stressed or dead vegetation, erosion, settlement, cracking, and standing water.

- The final cover vegetation will be mowed periodically to maintain healthy vegetation, avoid die-out due to shading, eliminate woody-stemmed vegetation, and provide for adequate inspection of the cover system.
- The final cover will be inspected for conditions that could impact cover integrity, including settlement, ponding water, burrowing animals, erosion, stressed or dead vegetation, and seeps.
- Settled, depressed, or eroded areas will be filled with soil and graded to provide positive drainage, and then revegetated. The top six inches of soil fill used for repairs will be capable of supporting vegetation. Repair materials will be placed in a manner consistent with the original final cap system construction.
- Surface water conveyance devices on the cover will be inspected and maintained.

Areas with stressed or dead vegetation will be evaluated to determine the cause, and appropriate actions will be taken such as reseeding the areas or checking for the presence of landfill gas.

After Final Closure of the facility, the final cover will be inspected, repairs made, and documented in accordance with the Post Closure Plan (Appendix IIIK of the Site Development Plan).

24.6 Cover Documentation and Inspection Record

24.6.1 Cover Application Documentation

The Landfill Manager or designated alternate will maintain on a weekly basis a Cover Application Log to document those site grid areas where weekly cover and/or intermediate cover have been placed. The log will be kept at the site, readily available for inspection by the TCEQ and authorized agents or employees of local governments having jurisdiction. The log for weekly and intermediate cover will specify the date cover was placed, the method used, and the last area where cover was placed. For final cover, the log will specify the area covered, the date cover was applied, and the thickness applied that date. The Landfill Manager or designated alternate must sign each log entry to certify the work was accomplished as stated.

24.6.2 Cover Inspection Record

A Cover Inspection Record will also be maintained weekly and kept by the Landfill Manager or designated alternate to document the inspections described in Section 24.5, including the findings and any corrective actions (e.g., repairs) taken when necessary. For repairs made to the final cover system, the Cover Inspection Record will specify the area covered, the dates final cover was applied (repaired), and the thickness applied. The Landfill Manager or designated alternate will sign each entry to certify that the work was accomplished as stated in the record. The Cover Inspection Record will be placed in the Site Operating Record.

25 PONDED WATER

Ponding of water over waste-filled areas will be minimized to the extent possible. The techniques the site will use to minimize ponding of water will be: (i) thorough compaction of waste as described in Section 23 of this SOP, to limit differential waste settlement/consolidation; (ii) proper grading of final waste slopes to the elevations shown on the Final Cover Grading Plan (shown in Site Development Plan), which provide for positive surface water drainage without depressions or low spots; and (iii) proper grading of interim waste slopes to have positive surface water drainage.

Landfill areas will be inspected as described in Section 24.5 to identify areas where ponding has occurred, including inspections after specified storm events. In the event ponded water on the landfill is observed, action will be taken to remedy the problem (e.g., regrading, pumping out the ponded water, or grading a temporary drainage path at the down-gradient side), as appropriate. The area of ponding will be backfilled with clean soil and regraded within seven days of the

occurrence, weather permitting. Ponded water will be removed and managed as: (i) contaminated water if the ponded water has come in contact with waste; or (ii) as surface water if it has not come in contact with waste. Contaminated water will be managed in accordance with the Contaminated Water Management Plan presented in Appendix IVA of this SOP.

Potential actions to mitigate ponded water in advance of expected extended wet weather periods include inspecting for apparent low spots that could pond water and filling these areas, installing diversion berms to limit run-on, or installing a drainage outlet if possible. During and after extended wet weather conditions, potential corrective actions to remedy ponded water include using pumps to dewater ponded areas along with the aforementioned preventative measures as feasible. During or after periods of extended wet weather, access to pump and repair areas may be delayed.

As described in Section 24.5 and 24.6, inspections for ponded water and any corrective actions will be documented in the Cover Inspection Record.

26 WASTE FROM STATIONARY COMPACTORS AND WASTE IN ENCLOSED CONTAINERS OR VEHICLES

[**NOTE**: As of December 2022, when this SOP was being prepared, the TCEQ's monitoring program under 30 TAC §330.169 was not active. Notwithstanding the general procedures described below, until the TCEQ monitoring program is reactivated, only a transporter with a hauler trip ticket for a permitted municipal transporter route or stationary compactor may discharge the material at the landfill.]

Waste is allowed to be accepted for disposal from:

(i) a generator operating a stationary compactor that is only used to compact waste for disposal at a Type IV landfill and who has been granted a TCEQ permit-by-rule in accordance with 30 TAC §330.7(c)(1); and

(ii) a transporter using an enclosed container or enclosed vehicle to collect and transport brush, C&D, and rubbish along a special collection route for disposal at a Type IV landfill and who has been granted a TCEQ permit-by-rule in accordance with 30 TAC §330.7(c)(2).

Duly permitted stationary compactors, and municipalities having duly-permitted transporter routes, are exempt from the operational standards in 30 TAC §330.169(1)-(3); however, the transporter must provide a hauler trip ticket to the Gate Attendant prior to discharging the material at the landfill and otherwise comply with Section 26.1 below. Other transporters with enclosed containers or enclosed vehicles <u>not</u> having a hauler trip ticket for a duly permitted municipal collection route must meet the operational standards in §330.169(1)-(3) by complying with Section 26.2 below.

26.1 Waste from Stationary Compactors and Municipalities Having Transporter Routes

The following requirements apply for any waste received from (i) a duly permitted stationary compactor; or (ii) from a transporter using an enclosed container or enclosed vehicle along a duly-permitted municipal collection route:

1. The transporter will submit to the Gate Attendant a hauler trip ticket before being allowed to discharge any of the material at the landfill. Currently, Form

TCEQ-20077 is the trip ticket form issued by TCEQ for use by stationary compactors, and Form TCEQ-20078 is the trip ticket form issued by TCEQ for use by enclosed containers or vehicles. Note that other trip ticket forms issued by the TCEQ Executive Director that supersede these Forms may be used.

2. The facility will retain these trip tickets on-site for inspection by TCEQ, and these trip tickets must be maintained as a part of the Site Operating Record.
3. These waste hauling vehicles will be included in the random inspection program described in Section 5.6.3 of this SOP.

26.2 Waste in Other Enclosed Containers or Enclosed Vehicles

Waste in completely enclosed containers or enclosed vehicles other than those meeting the requirements listed above (not from a transporter using an enclosed container or enclosed vehicle along a duly permitted municipal collection route), will not be accepted for disposal at the facility, unless the following additional operating conditions and special procedures from 30 TAC §330.169(1)-(3) are met:

1. The facility is participating in the TCEQ Funding Program to monitor these activities as detailed in 30 TAC §330.169(2).*
2. Each enclosed container or enclosed vehicle has all required approvals and/or permits from the TCEQ in accordance with 30 TAC §330.7(c) relating to Collection and Transportation Requirements.
3. Enclosed containers or enclosed vehicles are accepted at their designated time and on the specified day in accordance with 30 TAC §330.169, TCEQ permits, or other orders of the TCEQ. The TCEQ Region 4 Office will be notified at least 24 hours prior to an enclosed container or vehicle unloading at the site.
4. A TCEQ Inspector is on-site and witnesses the unloading process to ensure that no putrescible waste or household waste is present. Any waste considered non-allowable by the TCEQ Inspector will be removed from the working face and subsequently removed from the site in accordance with 30 TAC §330.133.
5. Each transporter delivering waste in enclosed containers or enclosed vehicles, prior to discharging the load, provides the facility a TCEQ transporter trip ticket form for the route being delivered. This load documentation will be maintained in the Site Operating Record.
6. The TCEQ may revoke a transporter's authorization to deliver waste to a Type IV MSW facility for failure to comply with these regulations.

*The TCEQ will determine the approximate annual costs of implementing and maintaining the surveillance and enforcement of all the activities associated with the acceptance of enclosed containers or enclosed vehicles at Type IV landfills. Notification of these costs will be provided to each affected holder of a Type IV landfill permit with Notice of Public Hearing to apportion these costs. The public hearing will be held at a location to be determined by the commission with 20 days advance notice. Notice will be provided to Type IV Landfill Operators by written notice in regular and certified mail. The public hearing will be for the purpose of establishing the total compensation and expenditures required to administer this program and the apportionment of those costs to the Type IV Landfill Operators to be reimbursed to the commission. Unless other arrangements are made, the apportioned monthly payments will be due by the 10th day of each month. The apportioned costs to each Type IV landfill may be altered periodically to add or subtract landfills from the program. A 30-day notice will be provided to each participating Type IV landfill and/or proposed additional landfill and a hearing will be held upon request by one of the affected parties or on the Commissioner's own motion. If the landfill operator is delinquent in making the monthly payment, the landfill must immediately halt acceptance of waste in enclosed containers or enclosed vehicles and may be subject to other penalties allowable under state law.

27 DISPOSAL OF SPECIAL WASTES

Special wastes that may be accepted at the facility are those authorized by 30 TAC §330.171(a) and 30 TAC §330.5(a)(2), to include the waste types set forth in the facility Waste Acceptance Plan required by 30 TAC §330.61(b) (presented in Section 2.1.1 of Parts I/II) and identified in Section 5.5 of this SOP.

28 DISPOSAL OF INDUSTRIAL WASTES

28.1 Class 1 Industrial Solid Waste

Class 1 industrial solid waste (defined in 30 TAC §330.3(21)) will not be accepted at this facility.

28.2 Class 2 and 3 Industrial Solid Waste

The facility is allowed to accept Class 2 industrial solid waste as allowed by 30 TAC §330.173(i) (e.g., acceptance does not interfere with facility operation) and to the extent that it is consistent with the limitations established in 30 TAC §330.5(a)(2) for Type IV facilities. *Ref.*, Section 5.5 of this SOP above and the facility Waste Acceptance Plan required by 30 TAC §330.61(b) (presented in Section 2.1.1 of Parts I/II).

The facility is allowed to accept Class 3 industrial solid waste as allowed by 30 TAC §330.173(j) (e.g., acceptance does not interfere with facility operation) and to the extent that it is consistent with the limitations established in 30 TAC §330.5(a)(2) for Type IV facilities. *Ref.*, Section 5.5 of this SOP above and the facility Waste Acceptance Plan required by 30 TAC §330.61(b) (presented in Section 2.1.1 of Parts I/II).

29 VISUAL SCREENING OF DEPOSITED WASTE

Visual screening of deposited waste materials at the facility is provided at times when waste placement is occurring below-grade, or by way of already-filled portions of the landfill that shield the working face. Existing trees within the buffer along Dick Price Road will help screen the waste fill operation from public view. On the west side of the site, the levee and the natural floodplain buffer (which includes trees along Village Creek) also provides a significant natural visual screening of the landfill.

30 CONTAMINATED WATER MANAGEMENT AND DISCHARGE

Contaminated water will be managed in accordance with the Contaminated Water Management Plan presented in Appendix IVA of this SOP. Potentially contaminated liquids resulting from the operation of the facility shall be disposed of in a manner that will not cause surface water or groundwater pollution, and the facility shall implement necessary steps to control and prevent the unauthorized discharge of contaminated water from the facility.

With respect to contaminated water management in landfill areas (in particular, at the active working face), the procedures and requirements set forth in Appendix IVA will be followed.

With respect to contaminated water management at the on-site recycling-related storage/processing areas (large items/white goods storage area; the wood processing/composting area; and the C&D recyclable sorting area;), the materials that will be stored and processed in these areas are expected to have a low potential for the generation of contaminated water. The materials that will be stored and processed in these areas are essentially inert or minimally soluble or degradable, don't contain free liquids, and are not expected to require washing or other cleaning operations. Accordingly, during the normal course of operations of these recycling areas, stormwater contacting these areas will not be considered contaminated water. Nevertheless, best management practices will be implemented to properly manage and control surface water drainage in the vicinity of these areas, as described in Section 3 of the Site Development Plan Narrative. Furthermore, if contaminated water generation is suspected or confirmed, contaminated water will be managed in accordance with 30 TAC §330.207 and the management measures will be implemented in a similar manner as those for the active working face (see Appendix IVA).

31 COMPOSTING OPERATION

The site may implement a composting operation and will designate a composting area for this activity accordingly. An operations plan for composting is presented in Appendix IVB of this SOP.

32 FACILITY-GENERATED WASTES AND WASTEWATERS

The facility processing and storage areas (as described in Section 8 of this SOP) are not expected to generate wastes. Although not expected or planned, to the extent that wastes are generated, the wastes generated by the facility must be processed or disposed at an authorized solid waste management facility.

With respect to facility-generated wastewaters at processing and storage areas (which if generated, would be contaminated water), see Section 30 above.

APPENDIX IVA

CONTAMINATED WATER MANAGEMENT PLAN

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED PROFESSIONAL ENGINEER

02/09/2023

1 INTRODUCTION

This Contaminated Water Management Plan for the Fort Worth C&D Landfill (facility) provides details for the collection and containment, storage, and disposal of any contaminated water generated or any gas condensate generated at the site. The facility is operated as a Type IV landfill and consistent with 30 TAC Chapter 330, Subchapter H, will not have a leachate collection system. Also, the facility manages landfill gas, as described in the Landfill Gas Management Plan (Appendix IIII of the Site Development Plan).

Contaminated water is defined by 30 TAC §330.3(36) as leachate, gas condensate, or water that has come into contact with waste. Examples of contaminated water are stormwater runoff that has come in contact with waste at the working face, or stormwater runoff on weekly cover soil that is not intact and has exposed waste. As stated by 30 TAC §330.165(b), stormwater runoff from areas that have intact weekly cover is not considered as having come into contact with the working face or leachate (i.e., not contaminated water).

The management of both uncontaminated (i.e., clean) surface water and contaminated water (i.e., water that has come into contact with waste) is described in the remainder of this plan.

2 WORKING FACE WATER MANAGEMENT

2.1 Uncontaminated Water

Throughout the active life of the facility, best management practices will be used to manage surface water and minimize contaminated water generation at the facility. The facility will be graded with temporary and permanent drainage features to provided run-on/off controls for stormwater. Weekly, intermediate, and final cover will be graded and maintained to promote runoff, minimize the area of exposed waste, and prevent ponding of surface water as detailed in the Site Operating Plan (SOP). Should ponding of surface water occur in areas having intact weekly cover, intermediate cover, or final cover, the water shall be considered clean and discharged into the facility's surface water management system.

At the working face, a system of temporary diversion berms will be constructed around the active face as needed to minimize the possibility of clean stormwater run-on from becoming contaminated water. These temporary diversion berms will be constructed, as needed, with clean earthen material and will route clean stormwater into the surface water management system and away from the active face. Figure IV-A-1, presented at the end of this plan, illustrates the diversion berms, and provides the required size of the berms (which varies depending on their slope configuration and the contributing up-gradient drainage area). The design calculations for sizing of the diversion berms are provided in Appendix IIIF.

2.2 Contaminated Water

A system of temporary containment berms will be constructed around the down-gradient portions of the active face to collect and contain surface water that has come into contact with waste. Also, similar containment berms will be constructed elsewhere at the facility wherever they are needed to collect and contain contaminated water. Figure IV-A-1, presented at the end of this plan, illustrates the containment berms, and provides the required size of the berms (which varies depending on the size of the working face and the containment area). As mentioned, the design calculations for sizing of the containment berms are provided in Appendix IIIF – F.

Contaminated water that collects at the active working face is allowed to remain within the active face for evaporation or to be absorbed into the waste; provided, however, contaminated water shall not be allowed to remain ponded and become stagnant, nor shall contaminated water be allowed to cause nuisance conditions (e.g., odors) or the attraction of vectors as set forth in Sections 16 and 17 of the SOP. Contaminated water causing such problems shall be removed and disposed of at an authorized facility, as discussed subsequently in Section 3 of this plan. Contaminated water is also allowed to be applied to on-site haul roads located over existing lined areas for dust control (but only if the quantity is minimized to the extent that it does not run off when applied). If contaminated water generation occurs in areas adjacent to the active face or in other facility operations areas (e.g., storage/processing areas), contaminated water management measures will be implemented in a similar manner as those for the active face.

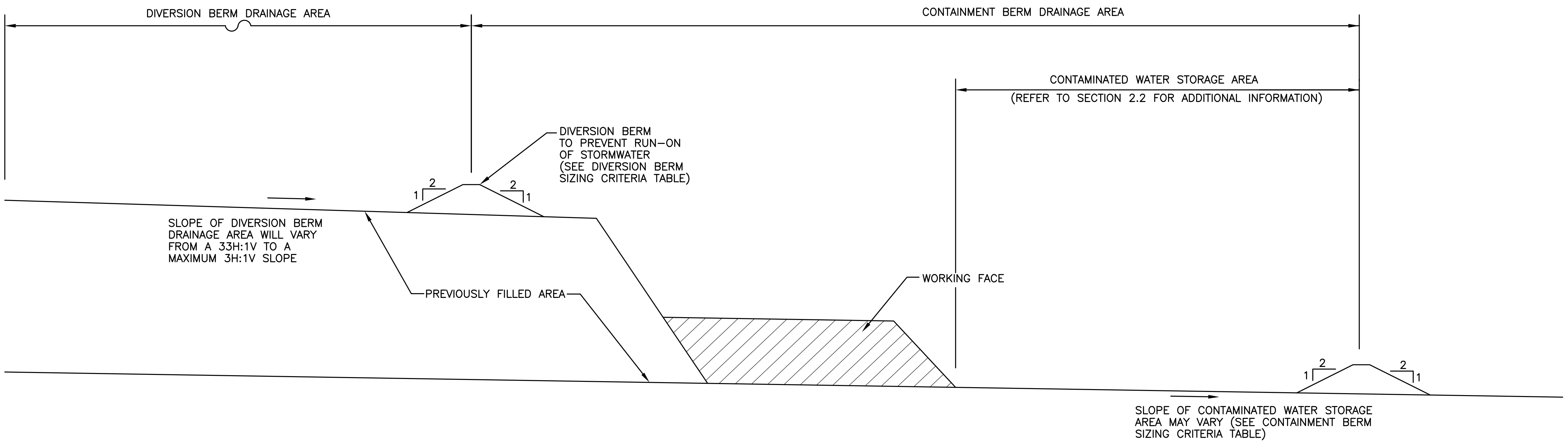
3 CONTAMINATED WATER DISCHARGE AND DISPOSAL

3.1 Contaminated Water Discharge

No discharge of contaminated water off-site or into waters of the United States shall occur without obtaining specific written authorization from the TCEQ prior to the discharge. The landfill will be operated consistent with §330.15(h) regarding discharge of solid wastes or pollutants into waters of the United States.

3.2 Contaminated Water Disposal

If necessary to address potential nuisance conditions, attraction of vectors, or interference with facility operations, contaminated water will be collected and transported off-site to a Publicly Owned Treatment Works (POTW), or similar facility, for treatment and disposal. Transportation will be by tanker truck. Sampling and analysis of the contaminated water will be performed as required by the POTW. The results of any monitoring required by the POTW, a copy of the disposal agreement, and documentation of disposal shall be placed in the Site Operating Record.



DIVERSION BERM SIZING CRITERIA *

DIVERSION BERM DRAINAGE AREA (ACRES)	MINIMUM 3%			MAXIMUM 33%		
	FLOW RATE (CFS)	FLOW DEPTH (FT)	REQUIRED MINIMUM DIVERSION BERM HEIGHT (FT)	FLOW RATE (CFS)	FLOW DEPTH (FT)	REQUIRED MINIMUM DIVERSION BERM HEIGHT (FT)
0.5	1.9	0.28	1.28	1.9	0.60	1.69
1	3.9	0.37	1.37	3.9	0.79	1.79
1.5	5.8	0.43	1.43	5.8	0.91	1.91
2	7.7	0.48	1.48	7.7	1.01	1.01
2.5	9.6	0.52	1.52	9.6	1.10	1.10
3	11.6	0.56	1.56	11.6	1.18	1.18

* DIVERSION BERM WILL BE SIZED USING THE ABOVE TABLE AS A GUIDELINE TO CONTAIN STORMWATER FROM THE 25-YEAR, 24-HOUR STORM EVENT. SUPPORTING CALCULATIONS ARE INCLUDED ON PAGES IIIC-A-6 AND IIIC-A-7.

CONTAINMENT BERM SIZING CRITERIA *

CONTAINMENT BERM DRAINAGE AREA (ACRES)	CONTAMINATED WATER STORAGE AREA (ACRES)	FLOOR SLOPE OF CONTAMINATED WATER STORAGE AREA	CALCULATED MINIMUM HEIGHT OF CONTAINMENT BERM (FT)	REQUIRED MINIMUM HEIGHT OF CONTAINMENT BERM (FT)
0.5	0.25	0 % 1 % 2 %	0.60 1.15 1.60	1.60 2.15 2.60
1.0	0.50	0 % 1 % 2 %	0.60 1.60 2.24	1.60 2.60 3.24
2.0	1.00	0 % 1 % 2 %	0.60 2.27 3.17	1.60 3.27 4.17
4.0	2.00	0 % 1 % 2 %	0.60 3.20 4.50	1.60 4.20 5.50

* CONTAINMENT BERM WILL BE SIZED USING THE ABOVE TABLE AS A GUIDLINE TO CONTAIN STORMWATER FROM THE 25-YEAR, 24-HOUR STORM EVENT. SUPPORTING CALCULATIONS ARE INCLUDED ON PAGES IIIC-A-2 THROUGH IIIC-A-5. NOTE THAT THE CRITERIA SET FORTH IN THE ABOVE TABLE IS BASED ON A MINIMUM DOWNSLOPE CONTAINMENT BERM LENGTH OF 100 FEET.

NEVZAT TURAN
84059
02/09/2023

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 12/2022
FILE: 0771-356-11
CAD: FIG IV-A-1-CONTAMINATED WATER.DWG

DRAWN BY: JDW
DESIGN BY: BY
REVIEWED BY: CRM

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
TEXAS REGIONAL LANDFILL COMPANY, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
LEACHATE AND CONTAMINATED WATER PLAN

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS

WWW.WCGRP.COM

FIGURE IV-A-1

O:\0771\356\EXPANSION 2022\PART IV\IVA\IV-A-1 CONTAMINATED WATER PLAN.dwg, jwilson, 1:2

APPENDIX IVB

COMPOSTING OPERATIONS PLAN AND COMPOST REFUND PROGRAM

The following appendix is a copy of the existing Composting Operations Plan and Compost Refund Program dated June 2013, initially approved by TCEQ through a permit modification to Permit No. MSW-1983B, and then copied in its entirety and approved by TCEQ as an appendix to the Permit No. MSW-1983C SOP. No changes are proposed for this permit amendment application, and this plan is being attached in its entirety as an appendix to the MSW-1983E SOP.

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER

02/09/2023

IESI – FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1983B

PERMIT MODIFICATION

PART IV – SITE OPERATING PLAN

APPENDIX IVB
COMPOSTING AREA PLAN AND COMPOST REFUND PROGRAM

BRYAN J. LARGENT
103618

6-20-13

Prepared for

IESI TX Landfill LP

June 2013

Prepared by

Weaver Boos Consultants, LLC–Southwest
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817-735-9770

WBC Project No. 0771-356-11-14-01

CONTENTS

STATE OF TEXAS
BRYAN J. LARGENT
103618
LICENSED PROFESSIONAL ENGINEER

4-22-13

1 INTRODUCTION

This Composting Area Plan and Compost Refund Program outlines (1) the operations and procedures of the composting area, and (2) provides the method to be used to capture expenses incurred as a direct result of the composting operations. The site may operate the composting facility without participating in the refund program.

Section 2 – Site Operations addresses the operational and procedural requirements for the composting area. IESI TX Landfill LP (IESI) will divert materials that can be composted (i.e., source-separated yard trimmings, clean wood material, vegetative material, pre-consumer green waste, paper, manure, clean soils, sand, and mulch) to a Composting Area located within the permit boundary of the site. The composting operation will be conducted by IESI or a third party contractor and is "exempt" per the requirements of Title 30 Texas Administrative Code (TAC) §332.3(d); however, the facility maintains compliance with the general and air quality requirements listed in Title 30 TAC §332.

Section 3 – Compost Refund Program Participation outlines the methods that will be used by IESI to participate in the Compost Refund Program administrated by Municipal Solid Waste (MSW) Section of the Texas Commission on Environmental Quality (TCEQ), Waste Permit Division. MSW landfill permittees are eligible to receive a credit of fifteen (15) percent of the solid waste fees collected by the facility up to allowable composting costs as provided for in Texas Health and Safety Code Section 361.025(a) provided that the facility demonstrates the following.

- The refunds are used to lease or purchase and operate equipment necessary to compost yard waste;
- Composting operations are actually performed; and
- The finished compost material produced by the facility is returned to beneficial use.

Per the June 13, 2003 TCEQ "Guidelines for Participation in the Compost Refund Program," all MSW facility permittees wanting to receive the compost refund must submit a compost plan to the TCEQ and receive written approval of the plan from the Waste Permits Division. The purpose of the compost plan is to provide the method to be used to capture expenses relative to the facility's equipment and operator costs incurred as a direct result of composting operations.

2 SITE OPERATIONS

2.1 Accepted Waste

Authorized materials such as source-separated yard trimmings and wood waste type materials from area residents, landscape companies, local businesses and other customers will be diverted from the IESI – Fort Worth C&D Landfill waste stream and directed to a Composting Area that will either be located (1) within the permit boundary or (2) on IESI TX Landfill LP-owned property south of the site (see Figure B-1). All composting operations at the facility will be conducted by IESI or a third party contractor. The materials to be processed at the facility consist of wood, clean yard trimmings, brush trimmings, pre-consumer green waste, and other feedstock materials that are allowed under 30 TAC §332.3(d) (composting operations exempt from facility notification, registration, or permit). The composting facilities will mainly receive yard and wood type waste as well as other exempt feedstock materials from the service area of the landfill (i.e., Tarrant County, Dallas County, and surrounding areas).

Those loads that are determined to possess unauthorized materials will be directed to the landfill working face for disposal. Storage and processing area capacity information for the Composting Area is provided in Table 2.1.

Table 2.1
Composting Area Capacity Information

Item	Quantity
Amount of composting material to be received daily	Incoming compost material to be directed to the Composting Area is highly variable. The estimated range to be directed to this area is between 0 tons/day and 2,000 tons/day (but not limited to).
Maximum amount of compost to be stored at any one point in time	104,000 cubic yards[1]
The maximum and average length of time the compost material will remain in the storage and processing area	Average – 6 months Maximum – 5 years
The maximum and average processing time (i.e., capacity of the equipment to reduce the size of the compost material)	13 to 52 cubic yards/hour

[1] Assumes sixteen piles of 160-foot diameter by 20-foot high (see Section 2.3 of this Composting Area Plan) in the 15-acre area (see Section 8.2 of the SOP).

2.2 Waste Exclusion Program

Qualified personnel at the Composting Area will monitor the unloading of feedstock and separate unacceptable materials that may be commingled with the incoming feedstock loads. Separated unauthorized materials will be appropriately disposed of at the IESI – Fort Worth C&D Landfill.

Trucks delivering materials to the site will enter the facility for evaluation and measurement of the feedstock material. All material received is logged in by the landfill personnel at the scale house. This documentation includes amount (volume) of material, transporter, and material description.

2.3 Material Handling, Processing, and Storage

Trucks delivering compostable material to the site will access the Composting Area using the existing access road shown on Figure B-1. After the appropriate information is obtained at the landfill scale house, the feedstock material is taken to the initial processing area and stockpiled with similar feedstock for subsequent periodic grinding. Each load of feedstock materials is not immediately processed (ground) as it arrives. The operations are based on efficiently managing processes and labor. Feedstock materials are generally stockpiled until a sufficient volume has accumulated to warrant grinding. After the material is ground, it is moved by the loader to the compost area. The loader, bulldozer, or excavator will create the initial static piles from the ground material.

Inspected and ground feedstock from the initial processing area is placed in the static pile Composting Area where the material remains under controlled conditions such as mixing and providing water as necessary for composting to occur. At the completion of composting, the material is ready to be distributed to the customers. The material may be used as a mixing agent to produce other final products, or may be packaged on-site/sent to a packaging plant to produce packaged compost products which are available in the retail market. The processed compost material is moved from the stock pile to the customer's transport vehicle by the excavator and/or loader.

The method of composting utilized by IESI or a third party contractor at the Composting Area will be the "static pile" composting method. Examples of equipment that may be used for composting operations include, but are not limited to, a water truck, a grinder, a wheel loader, bulldozer, and an excavator. Uses for the equipment may consist of the following:

- Grinder – used for grinding feed stock material into static piles.
- Water Truck – used to add moisture to static piles and to control dust around composting area.
- Wheel Loader and Excavator – Used to move compost feed stock, create the static compost piles, and move and load finished compost for distribution.

- Bulldozer – Used to move and turn composted feed stock and create compost piles.

If the composting area is operated by a third party contractor, the equipment used by the third party contractor will be used for composting operations only. The third party contractor will be responsible for providing all labor necessary to conduct the composting operations. The equipment provided by the third party composting contractor will be dedicated to the composting operations and will not be used to support landfill operations (i.e., composting operations equipment will be provided by the composting contractor and will be "in addition" to the landfill operations equipment listed in Table 3.1 of the landfill Site Operating Plan (Part IV)). In addition, if operations used by a third party contractor are significantly modified from the operations the site plans to utilize, a permit modification to this plan will be submitted to the TCEQ.

If IESI operates the composting area, the equipment used will be as follows:

- The grinder is used 100 percent (approximately 40 hours) of the time for the composting process, the bulldozer is used 40 percent of the time (approximately 15 hours) for the composting process , the wheel loader is used approximately 50 percent of the time (approximately 30 hours) for composting process, and the excavator is used approximately 10 percent of the time (approximately 5 hours) for composting process.

Unprocessed and processed compost material will be stored in piles as to not create an uncontrollable fire hazard. Compost materials will be stored in piles 20 feet high (maximum), 160 feet in diameter (maximum), and with a minimum of 50 feet between piles. These pile sizes (approximately 6,500 cubic yard piles) will allow for the facility to adequately manage fires, if they occur.

2.4 Surface Water Protection Plan

Stormwater that contacts "exempt" compostable material is not considered contaminated. Therefore, the stormwater runoff from the Composting Area will be handled as uncontaminated stormwater runoff, consistent with the site's TPDES stormwater permit. If during operations stormwater runoff impacts the stored "exempt" material (e.g., erosion of the stockpiled material), straw bales or a silt fence will be constructed downstream of the processing and storage area to prevent washout. Note that runoff from the Composting Area is conveyed to a stormwater detention pond before being discharged from the site.

2.5 Odor and Vector Control Plan

The compost operation will be conducted in a manner that prevents nuisance conditions from developing. Personnel will control on-site populations of disease vectors, which include rodents, excessive bird populations, flies, and other insects or animals capable of transmitting disease to humans. If odors become an issue in this area, the stored material will be systematically removed until the odors are eliminated. However, odors are not expected to be an issue in this area as the compost operations only accepts exempt material.

2.6 Air Quality

The setback distance from all adjacent property boundaries to the edge of the compost receiving area will be at least 50 feet. Consistent with the facility's Site Operating Plan, dust created by the use of the site access road and from the Composting Area will be controlled by watering the affected areas with the site's water truck. Vehicular speeds on non-paved roads will not exceed 10 mph in the Composting Area.

If either IESI or the third party contractor uses a grinder, the receiving chamber on the grinder will be adequately filled prior to commencement of grinding and will remain filled during grinding operations to control emissions from the receiving chamber. In addition, the operator will have portable watering equipment available during the grinding operation to control dust when stockpiling ground material.

All conveyors which off-load materials from grinders at a point which is not enclosed inside a building will have available water to control dust when stockpiling ground material.

The site will modify this air quality standard permit documentation should any changes to the composting operation reclassify it from an exempt operation to a notification, registration, or permit operation as authorized under Title 30 TAC §332.3.

2.7 Facility Closure

Upon decommissioning of the Composting Area, remaining compost material will be disposed of at the working face of the landfill. Processed compost material will either be distributed consistent with the distribution plan of this plan or disposed of at the working face of the landfill.

2.8 Compost Beneficial Use

Compost will be available for direct purchase by individuals, commercial customers, etc. The products will be available for direct purchase by customers, in bulk or in bags, at the location of the composting operation. Customers generally use these products for landscaping and gardening purposes (e.g., flower beds and/or vegetable gardens).

The compost produced by the IESI – Fort Worth C&D Landfill composting area is an extremely rich organic material and will be a dark, loose, earthy smelling material that resembles a rich soil. Its beneficial microorganisms help transform even the poorest soils, adding valuable time-release nutrients and organic material. The customers for the products range from individual homeowners that purchase bags of the compost to commercial customers that purchase material by the truckload for large applications.

Beneficial reuse is defined as any agricultural, horticultural, reclamation, or similar use of the compost, when used in accordance with generally accepted practice. Beneficial reuse does not include use as daily cover, placement in a disposal facility, or utilization for energy recovery. IESI – Fort Worth C&D Landfill may also use the compost material to promote the vegetative cover layer on landfill and non-landfill areas.

3 COMPOST REFUND PROGRAM PARTICIPATION

All composting operations described in the previous section will be conducted by IESI or a third party contractor retained by IESI. The credits received will be used to recapture costs incurred by IESI to operate or IESI to hire a third party contractor to conduct compost operations at a facility located within the permit boundary (e.g., the compost area). If IESI operates the composting area using its own equipment and labor, the cost and depreciation of the equipment (owned or leased) and labor will be used as the basis for determining the actual costs incurred by conducting composting operations at the facilities. If a third party contractor is used to operate the composting area, paid invoices received by IESI for the services of the third party contractor will be used as the basis for determining the actual costs incurred by conducting composting operations at the facility.

3.1 Record Keeping

Record keeping for analytical testing does not occur under Title 30 Texas Administrative Code (TAC) §332.71 as the composting operation does not require a notification, registration, or permit under Chapter 332-Composting Rules.

IESI or the third party contractor will prepare quarterly activity records for the composting operations regarding the feedstock materials that could have been otherwise disposed of at the IESI – Fort Worth C&D Landfill. These records will comply with the TCEQ's June 13, 2003, "Guidelines for Participation in the Compost Refund Program," Item 5. A copy of each activity report will be kept at the IESI – Fort Worth C&D Landfill office. The copy maintained at the landfill facility will be made available for inspection by TCEQ personnel, if necessary.

These quarterly reports will be signed and dated by the IESI – Fort Worth C&D Landfill manager. These quarterly reports will include the following information:

- Amount of feedstock material that has undergone primary processing.
- Volumes and types of incoming feedstock materials.
- Volume of finished compost – from IESI – Fort Worth C&D Landfill feedstock – that is ready from beneficial reuse as required by the "Guidelines for Participation in the Compost Refund Program," Item 5.A.i.
- Volume estimate of IESI – Fort Worth C&D Landfill's finished compost that has been moved from the third party contractor's (if used) facilities (i.e., sold) for beneficial reuse.

- Paid invoices from the transactions between the landfill and any party engaged in composting the material (if used). This documentation will show the eligible expenses incurred as a direct result of composting operations, as applicable, thereby complying with "Guidelines for Participation in the Compost Refund Program," Item 5.B and 5.C.

IESI – Fort Worth C&D Landfill will also maintain records of the amount of compost beneficially reused and make them available upon request to TCEQ personnel for compliance auditing purposes, as applicable:

- The amount of end product that is ready for beneficial reuse in cubic yards produced (Item 5.A.i.).
- The documentation (e.g., receipts) showing the amount of end product that has been moved from the facility for beneficial use showing dates, volume of compost, and recipient (Items 5.B.i).
- Records of the volume of any compost beneficially reused onsite, specifying the date(s), and a description of the beneficial reuse(s) (Item 5.B.ii).
- Documentation that any brush and/or mulch that has been sent off-site for composting and beneficial reuse (Item 5.B.iii).
- The cost of composting operations for the above materials during the same quarter (i.e., cost for contracted services) (Item 5C).

The quarterly reports will include, but not be limited to, a volume estimate of IESI – Fort Worth C&D Landfill's finished compost that has been moved from the facilities (i.e., sold or donated) for beneficial reuse and paid invoices from the transactions between the landfill and any third party engaged in composting the material. If a third party is used, copies of processed checks issued for payment to the third party contractor will serve as proof of payment of the invoice. The invoice number for which the check was issued will be included on the check. This documentation will show the expenses incurred as a direct result of composting operations, as applicable, thereby complying with "Guidelines for Participation in the Compost Refund Program," Item 5.B and 5.C.

The records will be kept in accordance with Title 30 TAC §330.219(b)(7). In this manner IESI – Fort Worth C&D Landfill will be complying with the requirements of the Compost Refund Program and providing a beneficial reuse of organic materials as compost.

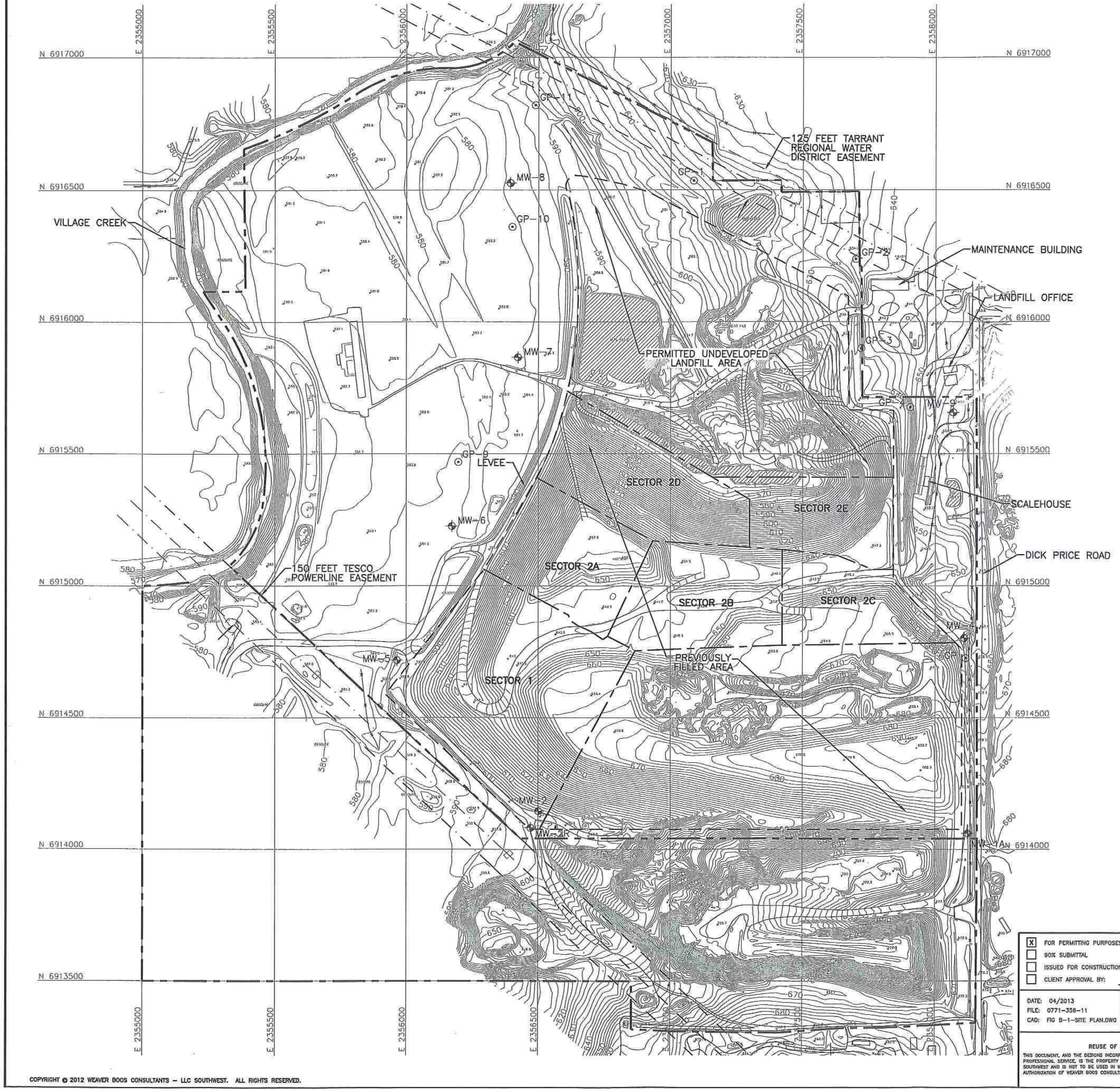
3.2 Reporting

IESI – Fort Worth C&D Landfill will submit the required quarterly TCEQ form (provided by TCEQ for each quarter) as an attachment to its quarterly landfill disposal report to the TCEQ Waste Permits Division. The report will include the volume and cost records required by "Guidelines for Participation in the Compost Refund Program," Items 6.A through B.

- A quarterly summary providing a detailed listing of expenses incurred by IESI or the third party contractor as a direct result of composting operations for each of the three months in a quarter. If a change in the compost facility operator occurs between quarterly reporting periods, two TCEQ reports will be submitted for that period. One report will cover the period that IESI was operating the compost operation and a second report will cover the remainder of the period that the third party was operating the compost operation. IESI will provide written notice to the TCEQ in the event a third party contractor assumes full control of the compost operations.
- The amount of end product that is ready for beneficial reuse in cubic yards or tons produced (Item 6.B).
- The documentation showing the amount of end product that has been moved from the sites for beneficial use (Item 6.B).
- The cost of composting operations for the above materials during the same quarter.

APPENDIX IVB-1

FIGURE



0 200 400
SCALE IN FEET

LEGEND

▬ ▬ - - ▬	PERMIT BOUNDARY
▬ - ▬ - ▬	APPROXIMATE IESI PROPERTY BOUNDARY
- - - - - - -	LIMIT OF WASTE
——600——	EXISTING CONTOUR
N 6915000	STATE PLANE COORDINATE
—— - —— - ——	SECTOR BOUNDARY
MW-7	GROUNDWATER MONITORING WELL
GP-4	LANDFILL GAS MONITORING PROBE

NOTES:

1. EXISTING CONTOURS COMPILED FROM AERIAL PHOTOGRAPHY, FLOWN JUNE 10, 2011 BY DALLAS AERIAL SURVEYS, INC., DALLAS, TEXAS.
2. THE COMPOSTING OPERATION WILL BE LOCATED WITHIN THE LANDFILL FOOTPRINT OR ON THE PROPERTY OWNED BY IESI TX LANDFILL LP TO THE SOUTH. THE AREA MAY BE MOVED FROM TIME TO TIME BASED ON THE LANDFILL SEQUENCE OF DEVELOPMENT AND LANDFILL OPERATIONAL NEEDS.

BRYAN J. LARGENT
103618

4-22-13

☒ FOR PERMITTING PURPOSES ONLY
☐ 90% SUBMITTAL
☐ ISSUED FOR CONSTRUCTION
☐ CLIENT APPROVAL BY: ____________

DATE: 04/2013
FILE: 0771-356-11
CAD: FIG B-1-SITE PLAN.DWG

DRAWN BY: SRF
DESIGN BY: BJL
REVIEWED BY: NT

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PREPARED FOR

IESI TX LANDFILL LP

REVISIONS

NO.	DATE	DESCRIPTION

PERMIT MODIFICATION SITE PLAN

FORT WORTH C&D LANDFILL
TARRANT COUNTY, TEXAS

Weaver Boos Consultants

TBPE REGISTRATION NO. F-3727

CHICAGO, IL
NAPERVILLE, IL
COLUMBUS, OH
DENVER, CO

FORT WORTH, TX
EVANSVILLE, IN
RIVERSIDE, MO

GRAND RAPIDS, MI
SOUTH BEND, IN
SPRINGFIELD, IL
CLEARMONT, FL

FIGURE B-1

O:\0771\356\Composting Mod\FIG B-1-SITE PLAN.dwg, 1:2