IOWA

Jolly, Becky <becky.jolly@dnr.iowa.gov>

Fwd: Cargill Closure Report and Permit Application

1 message

Rath, Brian <brian.rath@dnr.iowa.gov> Thu, May 16, 2024 at 3:58 PM
To: Becky Jolly <becky.jolly@dnr.iowa.gov>

Becky - Please file this email and the attachments to 62-SDP-04-89. This email and the attachments address my request for information noted in Doc 109309. I will now issue the closure permit. Thanks.

Brian Rath, P.E.
Environmental Engineer Senior
Solid Waste and Contaminated Sites Section
Iowa Department of Natural Resources
6200 Park Ave, Suite 200
Des Moines, IA 50321
515-537-4051
brian.rath@dnr.iowa.gov
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IOWA DEPARTMENT OF NATURAL RESOURCES

---------- Forwarded message ---------
From: **Phipps, Gerald** <gphipps@hrgreen.com>
Date: Thu, May 16, 2024 at 11:26 AM
Subject: RE: Cargill Closure Report and Permit Application
To: Rath, Brian <brian.rath@dnr.iowa.gov>
Cc: Woodson, Stacy <swoodson@hrgreen.com>, Steve Phillips <Steven_Phillips@cargill.com>, Amundson, Rose <ramundson@hrgreen.com>

Brian,

Attached is the summary memo that we reviewed this morning.

Thank you.

Jerry Phipps, PE

Senior Project Manager - Water | Associate

Direct 319.841.4379 | **Cell** 515.290.3057

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From: Rath, Brian <brian.rath@dnr.iowa.gov>
Sent: Thursday, May 16, 2024 10:28 AM
To: Phipps, Gerald <gphipps@hrgreen.com>
Cc: Woodson, Stacy <swoodson@hrgreen.com>; Steve Phillips <Steven_Phillips@cargill.com>; Amundson, Rose <ramundson@hrgreen.com>
Subject: Re: Cargill Closure Report and Permit Application

I'm not requiring a call, but I'm always open to a call to make sure we are on the same page. I'm open anytime today and tomorrow.

Brian Rath, P.E.
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On Thu, May 16, 2024 at 10:20 AM Phipps, Gerald <gphipps@hrgreen.com> wrote:

> Will do. Would you like to have a call to discuss first?
>
> **Jerry Phipps, PE**
>
> Senior Project Manager - Water | Associate
>
> **Direct** 319.841.4379 | **Cell** 515.290.3057
>
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>
>

From: Rath, Brian <brian.rath@dnr.iowa.gov>
Sent: Thursday, May 16, 2024 9:41 AM
To: Phipps, Gerald <gphipps@hrgreen.com>
Cc: Woodson, Stacy <swoodson@hrgreen.com>; Steve Phillips <Steven_Phillips@cargill.com>; Amundson, Rose <ramundson@hrgreen.com>
Subject: Re: Cargill Closure Report and Permit Application

That is good news! Please provide documentation of the field verification along with a summary/background of the situation that led to this, and have it signed by a PE.

Brian Rath, P.E.
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On Thu, May 16, 2024 at 9:04 AM Phipps, Gerald <gphipps@hrgreen.com> wrote:

> Brian,
>
> Rose at HR Green completed hand augering at survey point 35171 on May 10th, 2024 and found no CCR within 40" of ground surface, exceeding the requirement of 36" of total cover. Would you like to have a call to discuss? If so, please let me know some times that work for you.
>
> Thanks,
>
> **Jerry Phipps, PE**
>
> Senior Project Manager - Water | Associate
>
> **Direct** 319.841.4379 | **Cell** 515.290.3057
>
> HR Green® | Building Communities. Improving Lives.

From: Rath, Brian <brian.rath@dnr.iowa.gov>
Sent: Wednesday, April 24, 2024 10:25 AM
To: Amundson, Rose <ramundson@hrgreen.com>
Cc: Woodson, Stacy <swoodson@hrgreen.com>; Phipps, Gerald <gphipps@hrgreen.com>; Steve Phillips <Steven_Phillips@cargill.com>
Subject: Re: Cargill Closure Report and Permit Application

Thanks for setting up the call yesterday, Again, I apologize for the confusion that I have caused. 35171 is the only point short on compacted fill as the location lost 0.4' while placing the loose fill, which implies there is only 1.6' of compacted soil. As previously discussed, the other two points were considered deficient on loose fill as we considered placement of erosion stone as protection of the compacted layer or increasing the loose soil thickness. However, as you pointed out yesterday, 35146 is not deficient. But 35145 is still 0.44' of loose fill. But as agreed upon in our call, this point is in a previously closed and approved area, so we are not pursuing correction of the deficiency.

So the only point of concern is 35171 as it does not appear to have any loose fill and is deficient in the compacted fill thickness. Although this is close to the edge of the cap, the transition of the cap to the existing ground outside the waste boundary should not yet be occurring. Further, IAC does not allow for a deficiency in thickness. However, we recognize this is a localized issue and agreed to allow the permit holder to evaluate the permeability of this area versus the entirety of the cap as the intent in IAC for the compacted fill is limiting infiltration. It is recommended that the permit holder submit this analysis informally to the DNR for consideration. If we agree with the analysis and the results, a more formal response may be requested.

Even if this is acceptable, the loose fill thickness is deficient. Therefore, the placement of erosion stone or other material as protection of the compacted layer or to increase the loose soil thickness is needed. Please also include the proposed remedy in the informal submittal.

Lastly, we understand the responses to the other comments are in the process of being addressed.

As always, continue to reach out with any questions.

Thanks,

Brian

Brian Rath, P.E.
Environmental Engineer Senior
Solid Waste and Contaminated Sites Section

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IOWA | Department of Natural Resources

On Tue, Apr 23, 2024 at 2:46 PM Amundson, Rose <ramundson@hrgreen.com> wrote:

> Hello Brian,
>
> We wanted to provide you with some updated information before our meeting today. Attached please find an updated North Fill Area figure. It appears that the y-axis labels did not align with the grid lines, in the attached document this has been updated.
>
> Can we discuss your comment referencing grid points 35145, 35146, and 35171 as having insufficient compacted clay thickness? It appears that we may be looking at the data differently and would like to clarify. The measurements on the top of clay liner for these locations are points 35145 and 35146 on the grid map. The spreadsheet indicates that the clay thickness at these locations is adequate. However, the loose fill/vegetative layer is less than desired thickness for point 35145. Both the compacted clay liner and loose fill thicknesses are sufficient for point 35146.
>
> Thank you,
>
> **Rose Amundson, CGP**
>
> Lead Scientist - Transportation | Environmental
>
> HRGreen
> 8710 Earhart Lane SW | Cedar Rapids, IA 52404
> **Main** 319.841.4000 | **Direct** 319.841.4329 | **Cell** 319.321.9573
>
> HRGREEN.COM
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> HR Green® | Building Communities. Improving Lives.
>
>
>
> ---
>
> **From:** Rath, Brian <brian.rath@dnr.iowa.gov>
> **Sent:** Friday, April 5, 2024 8:28 AM
> **To:** Woodson, Stacy <swoodson@hrgreen.com>; Amundson, Rose <ramundson@hrgreen.com>; Phipps, Gerald <gphipps@hrgreen.com>

Cc: Steve Phillips <Steven_Phillips@cargill.com>
Subject: Re: Cargill Closure Report and Permit Application

Good morning. I'm following up on our conversation from the end of February, which came out of this email chain.

At that time, we talked through the DNR's comments and you were going to make the noted changes to both documents. You were also going to investigate the thickness deficiencies. Per my notes, you were first going to check with your surveyor to confirm the thickness calculations. If those checked out, you were going to consider (for the erosion layer) adding erosion stone as protection instead of adding soil. We also discussed more frequent inspections to monitor the areas. For the compacted clay, we did not come to a potential resolution but we could discuss further after you looked into it. Please submit an action plan, including an implementation schedule, to address the thickness deficiencies on or before April 30, 2024. Please also submit the revisions to the closure permit application by the same date.

Thanks,
Brian

Brian Rath, P.E.
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On Fri, Feb 23, 2024 at 3:39 PM Rath, Brian <brian.rath@dnr.iowa.gov> wrote:

> Sorry, forgot to give a timeframe. I'd like to have a resolution (or an action plan if needed) to the noted items in the closure report by March 15. Thanks.
>
> **Brian Rath, P.E.**
> **Environmental Engineer Senior**

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On Fri, Feb 23, 2024 at 3:34 PM Rath, Brian <brian.rath@dnr.iowa.gov> wrote:

> Good afternoon. The DNR has reviewed Documents 108408 and 108654 as submitted by you (HRGreen) for the above-referenced facility, and we have a few comments. Before drafting a formal letter, I wanted to reach out with some comments. Please note that we are not requesting changes at this time, but instead want to start a dialogue. After you've reviewed these comments, I'd recommend a phone call/virtual meeting to discuss.
>
> Thanks,
> Brian
>
> **Closure Report**
>
> Section 2.7 notes that not all thickness checks were passing. In reviewing the data, the DNR concurs that there are acceptable reasons for most of these, especially when it comes to the thickness of the vegetative/erosion layer. However, there are several points (35145, 35146, and 35171) that have inadequate compacted clay thickness. Please advise how these comply with the approved construction documents for quality control.
>
> Further, it was noted during our review that the grid numbers for several points in the tables do not match the map (35063 and 35171 to name a couple). We ask that you review the data against the tables.
>
> **Closure Permit Application**
>
> Use of leachate for dust control will not be allowed (page 7 of the PDF). However, leachate for irrigation of the cap vegetation will be allowed as currently included in the permit, but we will be placing a deadline on that allowance.
>
> In the ERRAP, it notes that there are no electrical systems or buildings at the site other than the office. The leachate lagoon has a building along with a pumping system and controls for the leachate loadout.
>
> Also in the ERRAP, 3.7 Working Areas is intended to refer to the working face of an active landfill or other areas of operation. These should be noted as NA for a closed facility. Similarly, 3.8 Hot Loads is related to receiving smoldering or actively burning loads at an active landfill, therefore this is also not applicable. 4.3 Waste Gases should have a similar statement to what is stated in Section 3 as there is no landfill gas from

this type of landfill. 4.8 Off-Site Releases will need to be reworded to reflect this is a closed landfill now and waste cannot be disposed of at a closed landfill. Instead, it would need to be disposed of at an active permitted landfill. Section 6.4 Waste Subsidence is more likely due to the settlement of the waste and not due to seismic activity. 7.5 Special Populations should include a review and documentation of daycares, schools, nursing homes, hospitals, etc. within 5 miles. The fire department is noted earlier in Section 7, so it should be included in 7.6. Section 11 Training is still required.

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4 attachments

- **mem-2024-05-35171_Investigation.pdf**
  1371K
- **2024_Updates-Cargill-CCR_Landfill-ClosurePermitApplication.pdf**
  195K
- **Cargill CCR Landfill - Terracon Project No. 08195294_Borrow Rpt.pdf**
  2708K
- **North Fill Areas 4-12-24.pdf**
  960K

EXECUTIVE SUMMARY

This closure permit is for sanitary disposal permit 62-SDP-04-89P. This permit includes two fill areas ("North Fill Area" and "South Fill Area") that are jointly referred to as the "Cargill CCR Landfill".

Closure construction activities were recently completed at the Cargill CCR Landfill and site activities are limited to leachate hauling activities. Thus, Cargill is hereby seeking a closure permit for the allowed 10-year term as provided for in sub-rule 103.1 (6).

This executive summary provides a description of the current and proposed permit conditions as listed on Section 2 of the Iowa Department of Natural Resources (IDNR) Permit Form 50. This includes the following:

- Summary of modifications, if any, to the approved plans and specifications that occurred during the current permit cycle.
- Summary of each Special Provision of the current permit to determine if it is to remain the same, be revised, or be removed.
- Summary of each permit amendment, if any, that occurred during the current permit cycle to determine if it shall be included with the renewed permit, be revised or be removed.
- Provide documentation and certification as required for new permit amendment requests, if any.
- Provide documentation and certification as required for new variance requests from Iowa Administrative Code requirements, if any.

Specific reference in this permit renewal application is to [567] IAC Chapter 103, *Sanitary Landfills: Coal Combustion Residue,* as last amended effective 10/31/07.

A. Modifications to Approved Plans and Specifications Modifications

There have been no modifications to the approved plans and specifications during the current permit cycle other than those proposed with this permit renewal application and what has been previously submitted and approved related to the Closure Plan and in amendments 1-5. In summary, the revised plans and specifications of this application propose the following:

- Landfill design criteria and operating requirements will be consistent with current rules of IAC Chapter 103, *Sanitary Landfills: Coal Combustion Residue,* as last amended effective 10/31/07.
- Monitoring of groundwater at the facility will move forward as specified by IDNR in 2023 and according to the findings of the 2023 AQWR.
- Leachate management for both the Cargill CCR Landfill will utilize the existing collection system, conveyance piping, and storage lagoon.
- The primary methods of leachate disposal will be discharge authorized under existing permits to the Cargill plant's wastewater treatment plant or to a publicly owned treatment works (POTW).
- Owner responsibilities during and after closure of the site are as described in the Closure /Post-closure Requirements section of this permit renewal application.

Refer to the appropriate sections of these supporting documents for more detail.

B. Current Permit Special Provisions

The initial permit for the Cargill CCR Landfill was issued prior to promulgation of the current CCR rules (Chapter 103) and was modified extensively over the years with a patchwork of amendments and variances. The permit renewal in 2014 these as they are no longer applicable. Amendments our outlined below in Section C.

Copies of the Sanitary Disposal Project permits (62-SDP-04-89P issued on March 2, 1999 and January 7, 2014), with amendments are attached in Appendix A of this submittal for reference by the reviewer.

This section addresses those Special Provisions (Section X) that have bearing on the closure permit process. For simplicity, this section lists by number the provisions as presented in permit 62-SDP-04-89P.

Section X, Special Provisions of Permit 62-SDP-04-89P (referenced by item number)

1. This item should be revised to state that the permit holder was previously authorized to accept CCR and has since completed closure activities and no longer is authorized to haul and dispose of CCR at the site.

2. As noted in Special Provisions Item 1 above, this landfill is closed and no longer hauling or handling CCR. Therefore, this item should be deleted.

3. No change to this Special Provision is recommended.

4. This item should be revised to reflect access via all-weather roads is provided to the leachate lagoon for hauling purposes.

5. This should be revised to include MW-26 to the well network, as specified in 2023 by IDNR and completed in the 2023 AWQR. Additional parameters as specified by IDNR in 2023 and as identified in the 2023 AWQR should be included in the permit. No further changes are requested for this special provision.

6. Item 6(a) should refer to the Cargill Eddyville Plant in place of the “on-site facility”.

7. Remove item.

8. No change to this Special Provision is recommended.

9. Remove item.

10. No change to this Special Provision item is recommended.

11. No change to this Special Provision is recommended.

C. Current Permit Amendments

There were five amendments that were issued during the last permit cycle of 62-SDP-04-89P. Copies of pertinent Permit Amendments are attached in Appendix A of this document for reference by the reviewer. The following is the status of each Permit Amendment with recommendations of whether they should be included with the renewed permit, be revised, or be removed.

- Permit Amendment No. 1 (December 23, 2016) deleted the requirement for an annual engineering inspection. This closure permit should incorporate this amendment.

- Permits Amendment No. 2 (December 30, 2019) approves the Final Proposed Schedule for Permit Amendment. Has been executed no longer applies.

- Permits Amendment No. 3 (May 14, 2020) approved Beneficial use of Leach at CCR Landfill. Although not intended as the primary handling of leachate, can remain as a viable option for leachate use.

- Permits Amendment No. 4 (April 12, 2021) includes approval of Closure and Post-Closure Plan. This should apply and as specified within the Closure Permit application.

- Permits Amendment No. 5 (March 18, 2022) approves the Ash Landfill Verification Cover study collected on the existing North Cell cap. This can remain within the permit to verify conditions of the cap not constructed in 2022-2023.

D. New Permit Amendments

This application is for a closure permit and there no permit amendments requested.

E. New Variance Requests

No new variances from the rules are requested.

EMERGENCY RESPONSE AND REMEDIAL ACTION PLAN

567 IAC 103.2(455B)

Supporting Documentation for Sanitary Disposal Project Closure Permit Application

Permit Number: 62-SDP-04-89P

Cargill CCR Landfill
Eddyville, Iowa

A. INTRODUCTION

This Emergency Response and Remedial Action Plan (ERRAP) is for the Cargill CCR Landfill located in Mahaska County, Iowa. This is intended to fulfill the requirements of Iowa Code Section 455B.306(6)d and Iowa Administrative Code (IAC) [567] Chapter 103.2.

B. FACILITY INFORMATION

1. Permitted Entity: Cargill, Inc.

2. DNR Permit Number: 62-SDP-04-89P

3. Facility Description:

   The two disposal areas at this site are referred to as the "North Fill Area" and the South Fill Area" for the controlled disposal of coal combustion residue (CCR) generated at the Eddyville processing plant. The landfills are currently inactive and closed as of 2023.

   The Cargill landfills were developed from an abandoned open pit coal mine during the late 1980's. Gypsum was landfilled at the South Fill Area from 1990 to 1991. CCR was deposited at the North Fill Area from early 1990 until the summer of 2000. Temporary closure provisions were implemented at the landfills during the fall of 2000, when CCR disposal was diverted to the Ottumwa Midland landfill.

   The site is located approximately 6.5 miles northwest of the City of Eddyville in Mahaska County, Iowa. The site occupies some 80 acres of land (refer to Appendix A of this ERRAP for Location and Site Maps).

4. Responsible Official and Contact Information

   Steve Phillips, Environmental Manager
   Cargill, Inc.
   1 Cargill Drive
   Eddyville, Iowa 52553
   (641) 969-3818

5. Project Location

   The Cargill CCR Landfill is located in the SW ¼, NE ¼, Section 30 T74N-R16W and the NW ¼, ES ¼ Section 30, T74N-R16W, of West Des Moines Township, Mahaska County, Iowa.

6. Site and Environs Map

   A site map showing the fill areas and immediately surrounding environs is provided in Appendix A of this ERRAP.

C. REGULATORY REQUIREMENTS

1. Iowa Code 455B.306(6)d Criteria Citation

   This ERRAP has been prepared pursuant to Iowa Code Section 455B.306(6)*d*. This ERRAP establishes provisions to minimize the possibility of fire, explosion, or any release to air, land, water of pollutants that could threaten human health and the environment, and the identification of possible occurrences that may endanger human health and environment.

2. Permit Provisions Reference

   This ERRAP addresses, as applicable, requirements of the Sanitary Disposal Project Permit(s).

   As required, the initial ERRAP for this site was submitted to the department prior to December 31, 2001. An updated ERRAP meeting the requirements of the IAC [567] Chapter 103.2 must be

submitted at the time of each permit renewal or permit reissuance application and/or with any request for permit modifications to incorporate a facility expansion or significant changes in facility operations that require modification of any currently approved ERRAP.

D. EMERGENCY CONDITIONS, RESPONSE ACTIVITIES, AND REMEDIAL ACTION

1. Utilities Failure

1.1 Short Term (48 hours or less)

(a) Electricity
The landfill site is a private, controlled site. Electrical service is provided to a small office structure and leachate lagoon pumping structure for the pump and leachate loadout operations; however, no other electrical systems are present at the site. A short-term power outage should not affect site operations. If electrical service to the site structures is required, a portable generator will be secured to provide electricity until repairs are made.

(b) Liquid Propane/Natural Gas Service
There is currently no propane or natural gas service to the site.

(c) Water
Potable water is available to the facility from the Mahaska Rural Water System. Due to the current inactive status of the facility, the water has been shut off at the main service valve. When the site is activated, this water service may be turned on if needed. Should the service fail, water will be hauled to the site pending restoration of the water service.

(d) Scale
No scale is present at the site.

1.2 Long Term (Over 48 hours)

(a) Electricity
Electrical service is provided to the site office building and leachate lagoon pumping structure for the pump and leachate loadout operations; however, no other electrical systems are present at the site. A long-term power outage will not affect facility operations. If electrical service to the structures is required, an electrical generator will be secured to provide electricity until service is restored.

(b) Liquid Propane/Natural Gas Service
There is currently no propane or natural gas service to the site.

(c) Water
Potable water is available to the facility from the Mahaska Rural Water System. Due to the inactive status of the facility, the water has been shut off at the main service valve. When the site is activated, this water service may be turned on if needed. Should the service fail, water will be hauled to the site pending restoration of the water service.

(d) Scale
No scale is present at the site.

2. Weather Related Events

2.1 Tornado

(a) Personnel Safety
No provisions for an on-site storm shelter are provided. The facility is currently inactive and therefore unmanned with the exception of short periods during facility inspections and groundwater monitoring activities. When the site is active, there would likely be one or two equipment operators on site. In the event of a pending tornado (warning condition) or damaging windstorm, personnel present at the site will proceed to the nearest safe area.

(b) Leachate Storage/Transportation
The leachate collection system conveys leachate into a storage basin located on the northwestern corner of the facility. The leachate in the storage basin is collected and hauled off-site for disposal at a permitted facility.

A tornado is not anticipated to interrupt operation of the leachate collection system. Any damage that should occur will be identified during a subsequent inspection. Temporary measures will be implemented to manage the leachate until the system can be repaired.

(c) Bulk Fuel Storage
No bulk fuel storage is present at the site.

(d) Landfill Gas (Methane) System
No landfill gas system is present at the site.

(e) Hazardous Waste Storage/Operations
No hazardous waste storage/operations areas are present at the site.

(f) Buildings General Operations
Tornado damage to the site office building will not create an immediate concern. If necessary, a temporary building will be secured until the damaged building is repaired or replaced.

Significant physical damage to the landfill areas is not anticipated by tornadic events. Any damage that occurs will be identified during subsequent landfill inspections. Appropriate remedial actions will be identified and implemented as soon as practicable to restore the damaged areas.

2.2 Wind Storms

(a) Personnel Safety
No provisions for an on-site storm shelter are provided. The facility is currently unmanned with the exception of short periods during facility inspections and groundwater monitoring activities. When the site is active, there would likely be one or two equipment operators on site. In the event of a pending damaging windstorm, personnel present at the site will proceed to the nearest safe area.

(b) Leachate Storage/Transportation
Windstorms are not anticipated to have any adverse effect on the leachate collection and discharge system.

(c) Bulk Fuel Storage
No bulk fuel storage is present at the site.

(d) Landfill Gas (Methane) System
No landfill gas system is present at the site.

(e) Hazardous Waste Storage/Operations
No hazardous waste storage/operations areas are present at the site.

(f) Buildings General Operations

Windstorms may cause minor damage to the site office building. Damage to the building will not cause an immediate concern at the facility. Any damage will be identified during subsequent landfill inspections and repairs will be made as soon as practicable.

No significant physical damage to the landfill areas is anticipated by windstorms.

2.3 Intense Rain Storms and Erosion

(a) Leachate Storage/Transportation
An intense rainstorm is not anticipated to produce an immediate additional quantity of leachate from these areas. If the leachate quantity exceeds the capacity of the storage basin, the leachate will be discharged in accordance with the provisions of the SDP permit.

(b) Bulk Fuel Storage
No bulk fuel storage is present at the site.

(c) Landfill Gas (Methane) System
No landfill gas system is present at the site.

(d) Hazardous Waste Storage/Operations
No hazardous waste storage/operations areas are present at the site.

(e) Buildings/General Operations
An intense rainstorm is not expected to have significant adverse effect on the site office building or landfill areas. However, some temporary ponding and washed out areas could result.

Storm water controls including riprap let-downs, let-down pipes, terraces, and vegetative cover have been installed and are maintained. Storm water is routed by controlled drainage into sedimentation basins that drain into a ditch along the west property boundary. This ditch eventually flows into Little Bluff Creek.

Any development of surface erosion will be identified during facility inspections. Remedial operations will be implemented as soon as practicable to repair damage to the landfill and return the site to its proper operating condition.

2.4 Lightning Strikes

(a) Leachate Storage/Transportation
No damage to the leachate collection system is expected by lightning strikes. The lagoon structure contains the pump and leachate loadout electrical equipment. Should repairs be needed, they will be made as soon as practicable and will not impede the collection and hauling of leachate from the facility.

(b) Bulk Fuel Storage
No bulk fuel storage is present at the site.

(c) Landfill Gas (Methane) System
No landfill gas system is present at the site.

(d) Hazardous Waste Storage/Operations
No hazardous waste storage/operations areas are present at the site.

(e) Buildings/General Operations
A lightning strike may cause damage to the site office building, or lagoon structure, or cause a power failure. No immediate concern is anticipated. Repairs will be made as soon as practicable to restore the electrical service and so not to impede the collection and hauling of leachate from the facility.

2.5 Flooding

(a) Leachate Storage/Transportation
The leachate collection and storage system is located at an elevation such that flooding is not expected to have any adverse impact.

(b) Bulk Fuel Storage
No bulk fuel storage is present at the site.

(c) Landfill Gas (Methane) System
No landfill gas system is present at the site.

(d) Hazardous Waste Storage/Operations
No hazardous waste storage/operations areas are present at the site.

(e) Buildings/General Operations
The building and landfill areas are located at an elevation such that flooding is not expected to have any adverse impact.

2.6 Event and Post Event Conditions
Regularly scheduled facility inspections are conducted in accordance with the permit provisions. These inspections will allow timely identification and remediation of damage or maintenance conditions to maintain compliance with the permit conditions.

3. Fire and Explosions

3.1 Waste Materials
The waste material deposited at this site are relatively inert and are not combustible.

3.2 Buildings and Site
In the event of fire or explosion, the Eddyville Fire Department should be immediately contacted by dialing 911.

No flammable or explosive substances are stored in the building and therefore the risk of fire is low. Grass or tree fires could be caused by lightning strikes, or careless human actions. If the fire is small and not capable of generating toxic fumes or resulting in an explosion, operating personnel may attempt to extinguish the fire using approved methods including covering with soil. If the fire is major or capable of generating toxic fumes or causing an explosion, all operating personnel will be immediately evacuated to a safe area.

3.3 Equipment
In the event of fire or explosion, the Eddyville Fire Department should be immediately contacted by dialing 911.

If the fire is small, and not capable of generating toxic fumes or resulting in an explosion, operating personnel may attempt to extinguish the fire using approved methods including covering with soil. If the fire is major or capable of generating toxic fumes or causing an explosion, all operating personnel will be immediately evacuated to a safe area.

3.4 Fuels
No fuels are stored at the facility.

3.5 Utilities
Electrical service is provided to the site office building and leachate lagoon pumping structure for the pump and leachate loadout operations. All utility fires will be immediately reported to the Eddyville Fire Department by calling 911.

3.6 Facilities
All fires noted in connection with the facility will be immediately reported to the Eddyville Fire Department by calling 911.

3.7 Working Areas
This section is not applicable. The landfill facility is closed.

3.8 Hot Loads
This section is not applicable. The landfill facility does not receive loads of material.

3.9 Waste Gases
This section is not applicable. There is not a waste gas (methane) system at the landfill.

3.10 Evacuation
Currently, the "closed" status of the facility prevents the need for daily site operations. Personnel are infrequently at the site during facility inspections and during groundwater monitoring activities.

In the event of fire and/or explosions necessitate evacuation, personnel should meet outside the gate on 325th Street. The Eddyville Fire Department should then be immediately notified by calling 911.

In the event that conditions warrant evacuation of surrounding residents, these efforts will be coordinated by the Mahaska County Sheriff's Department.

4. Regulated Waste Spills and Releases

4.1 Waste Materials
Any spills outside of the permitted area will be removed with a loader or other applicable equipment, and placed in the active disposal area.

4.2 Leachate
Leachate is contained in a storage basin located on the northwestern portion of the property. The leachate is hauled off-site at a permitted facility or applied to the fill areas in accordance with the SDP permit.

4.3 Waste Gases
This section is not applicable from this type of landfill.

4.4 Waste Stockpiles and Storage Facilities
This section is not applicable. No waste stockpiles or storage facilities are present at the site.

4.5 Waste Transport Systems
No waste is transported to the site.

4.6 Litter and Airborne Particulates
Currently, the landfill is closed and a soil cover has been installed overlying the waste fill areas. This is not applicable.

4.7 Site Drainage Systems
The site drainage system includes let-down structures and terraces to control surface flow. Storm water is routed by controlled drainage into two sedimentation basins.

4.8 Off-Site Releases
The facility is a closed landfill and as such cannot receive waste for disposal. Any release of waste that occurs off-site will be cleaned up using loaders or other appropriate equipment and disposed of at an active permitted landfill.

5. Hazardous Materials and Spills
No hazardous materials have been managed or disposed at this site; therefore; no provisions regarding response actions are necessary.

5.1 Load Check Control Points
This section is not applicable. No hazardous materials are permitted or managed at the facility.

5.2 Mixed Waste Deliveries
This section is not applicable. No hazardous materials are permitted or managed at the facility.

5.3 Fuels
This section is not applicable. No fuels are stored or managed at the facility.

5.4 Waste Gases
This section is not applicable. No hazardous materials are permitted or managed at the facility.

5.5 Site Drainage Systems
No hazardous materials are permitted or have been received at the site.

The site drainage system includes let-down structures and terraces to control surface flow. Storm water is routed by controlled drainage into two sedimentation basins. Flow off-site does not occur from the on-site lagoon.

5.6 Off-Site Releases
This section is not applicable. No hazardous materials are permitted or managed at the facility.

6. Land and Waste Mass Movement

6.1 Earthquakes
The facility is located in Mahaska County in southern Iowa. Data available from the National Seismic Hazards Mapping Project, conducted by the United States Geological Service, indicates the site has a very low probability of seismic activity with forces significant enough to cause damage.

In the event of seismic activity, the landfill will be physically inspected to identify any visible damage to the temporary cover, slopes, and groundwater monitoring systems. Any resulting damage will be documented and appropriate remedial measures will be developed and implemented to ensure the integrity of the landfill.

6.2 Slope Failure
The integrity of the landfill will be observed following any seismic event and during regularly scheduled inspections. Inspection of the groundwater monitoring wells will also be conducted.

If damage is observed, the area will be isolated by establishing an exclusion zone surrounding the damage. All persons and vehicles will be prevented from entering the exclusion zone. The damage will be assessed and appropriate remedial measures will be formulated and implemented to correct the damage.

6.3 Waste Shifts
The landfill cover and slopes will be observed during scheduled inspections for any evidence of differential waste shifting. Any cracks, changes in topography, or damage to groundwater monitoring wells and leachate piezeometers will be evaluated and documented. Corrective measures will be evaluated and the appropriate remedy will be implemented to correct any damage.

6.4 Waste Subsidence

Inspections subsequent to seismic events and as part of routine inspections will identify evidence of waste subsidence that could affect the integrity of the landfill cover, leachate piezeometers, or groundwater monitoring wells. Any cracks, water ponding, or changes in topography will be identified and documented. Corrective measures will be evaluated and the appropriate remedial action will be identified and implemented.

Corrective measures may include the placement of additional cover material in an affected area to restore adequate surface water drainage and protect the integrity of the landfill cover and slopes.

7. Emergency Release Notifications and Reporting

7.1 Federal Agencies

Emergency and release notifications may be required to federal as well as state and local agencies. The need for notification of federal authorities will be determined upon contact of local and state authorities.

If notification of federal authorities is required, it should be made to the following:

Duty Officer
National Response Center
U.S. Coast Guard
400 Seventh Street SW
Washington, D.C. 20590
Telephone: 1-800-424-8802

U.S. Environmental Protection Agency, Region VII
901 N. 5th Street
Kansas City, KS 66101
Telephone: 913-281-0991

Any reporting to federal authorities will be upon request.

7.2 State Agencies

Notification of emergencies and releases must be made to the Central Office of the Iowa Department of Natural Resources (IDNR) in Des Moines, Iowa in all instances that can be defined as a “hazardous condition”. Based on the definition listed in the Iowa Administrative Code (IAC) Chapter 131, a *hazardous condition* means:

> *Any situation involving the actual, imminent or probable spillage, leakage, or release of a hazardous substance onto the land, into a water of the state or into the atmosphere which, because of the quantity, strength and toxicity of the substance, its mobility in the environment and its persistence, creates an immediate or potential danger to the public health of safety or to the environment.*

Verbal notification of a hazardous condition must be made to IDNR by telephone at (515) 281-8694 as soon as possible, but not later than six hours after the onset of the hazardous condition or discovery of the hazardous condition.

Additional notification may be given to the required IDNR field office in Des Moines, Iowa.

Iowa Department of Natural Resources
Field Office 5
502 E 9th, Suite
Des Moines, IA 50319-0034
Telephone: 515-725-0268

A written report of such hazardous conditions must be made within 30 days and mailed to the IDNR at the following address.

Iowa Department of Natural Resources
Land Quality Bureau
502 E 9th Street
Telephone: 515-725-8200

Additional information relative to verbal and written reporting to IDNR is contained in IAC [567] Chapter 131, a copy of which is included in Appendix B of this ERRAP.

7.3 County and City Agencies

Chapter [567] 131 of the Iowa Administrative Code (IAC) requires notification of a hazardous condition to the local police department, or the office of the sheriff of the affected county as soon as possible, but not later than six (6) hours after the onset of the hazardous condition or discovery of the hazardous condition.

These notifications to the Mahaska County Sheriff's Department and the City of Eddyville Police Department can be made by calling 911.

Mahaska County Sheriff's Department
214 High Ave. East
Oskaloosa, IA 52577
Call 911
641-673-4302 (Secondary Phone)

City of Eddyville Police Department
103 Walnut Street
Eddyville, IA 52553
Call 911
641-969-4220 (Secondary Phone)

Depending on the nature of the incident, medical assistance may be required. The Eddyville Volunteer Fire Department can be contacted to provide medical assistance. Monroe, Mahaska, and Wapello Counties also have medical assistance available. These organizations can be contacted by calling 911.

7.4 News Media

Notification to the news media of any emergencies or releases will be done only after notification has been made to the IDNR, local emergency response agencies, and the official point of contact for Cargill Inc.

Any news media notifications and subsequent discussions with the media will be conducted by authorized Cargill Inc. representatives.

7.5 Public and Private Facilities with Special Populations within 5 miles

No public or private schools, daycare facilities, assisted living facilities, or medical facilities appear to be located within 5 miles of the facility. No emergency events or release scenarios are expected to impact any special populations within the designated five (5) mile radius of the landfill.

7.6 Emergency Response Agencies and Contact Information

Local Agency Contacts

Mahaska County Sheriff's Department
214 High Ave. East
Oskaloosa, IA 52577

Call 911
641-673-4322 (Secondary Phone)

Eddyville Police Department
103 Walnut Street
Eddyville, IA 52553
Call 911
641-969-4220 (Secondary Phone)

Eddyville Volunteer Fire Department
501 Walnut Street
Eddyville, IA 52553
Call 911
Secondary 641-969-4870

Mahaska County Hospital
1229 C Ave East
Oskaloosa, IA 52577
Call 911
Secondary 641-672-3100

State Agency Contacts
Iowa Department of Natural Resources
Land Quality Bureau
502 E. 9th Street
Des Moines, IA 50319
Telephone: 515-725-8200

Iowa Department of Natural Resources
Field Office 5
502 E 9th Street
Des Moines, IA 50319-0034
Telephone: 515-725-0268

Federal Agency Contacts
Duty Officer
National Response Center
U.S. Coast Guard
400 Seventh Street SW
Washington, D.C. 20590
Telephone: 1-800-424-8802

U.S. Environmental Protection Agency, Region VII
901 N. 5th Street
Kansas City, KS 66101
Telephone: 913-281-0991

7.7 Reporting Requirements and Forms
All reporting associated with releases is to be forwarded to the Central Office of the IDNR at the following address.

IDNR Emergency Response Unit
401 SW 7th Street, Suite I
Des Moines, IA 50309

The initial verbal report is to be provided by telephone to the IDNR by calling 515-281-8694. The notification must be made as soon as possible, but not later than six (6) hours after the onset of

the hazardous condition or discovery of the hazardous condition. The same initial verbal reporting requirement applies to the Police Department and/or the Sheriff Department. These agencies can be contacted by calling 911.

The verbal report, or initial notification should provide information on as many of the below items as data allows.

(a) The exact location of the hazardous condition.
(b) The time and date of onset or discovery of the hazardous condition.
(c) The name of the material, the manufacturer's name and volume of each material involved in the hazardous condition in addition to contaminants within the material if they by themselves could cause a hazardous condition.
(d) The medium (land, water, or air) in which the hazardous condition occurred or exists.
(e) The name, address, and telephone number of the party responsible for the hazardous condition.
(f) The time and date of the verbal report to the department of the hazardous condition.
(g) The weather conditions at the time of the hazardous condition onset or discovery.
(h) The name, mailing address and telephone number of the person reporting the hazardous condition.
(i) The name and telephone number of the person closest to the scene of the hazardous condition who can be contacted for further information and action.
(j) Any other information, such as the circumstances leading to the hazardous condition, visible effects and containment measures taken that may assist in proper evaluation by the department.

Within thirty (30) days of the hazardous condition, a written report will be submitted to the IDNR and will contain the following information:

(a) The exact location of the hazardous condition.
(b) The time and date of onset or discovery of the hazardous condition.
(c) The name of the material, the manufacturer's name and volume of each material involved in the hazardous condition in addition to contaminants within the material if they by themselves could cause a hazardous condition.
(d) The medium (land, water, or air) in which the hazardous condition occurred or exists.
(e) The name, address, and telephone number of the party responsible for the hazardous condition.
(f) The time and date of the verbal report to the department of the hazardous condition.
(g) The weather conditions at the time of the hazardous condition onset or discovery.
(h) The name, mailing address and telephone number of the person reporting the hazardous condition.
(i) The name and telephone number of the person closest to the scene of the hazardous condition who can be contacted for further information and action.
(j) Any other information, such as the circumstances leading to the hazardous condition, visible effects and containment measures taken that may assist in proper evaluation by the department.

All subsequent findings and laboratory results should be reported and submitted in writing to the department as soon as they become available.

Additional information relative to verbal and written reporting to IDNR is contained in IAC [567] Chapter 131, a copy of which is included in Appendix B of this ERRAP.

8. Emergency Waste Management Procedures

8.1 Communications

In the event of an emergency, assistance should be obtained by calling 911. The Landfill point of contact and other appropriate agencies and authorities listed in Section 7 of this document will also be notified.

Communications between on-site personnel will be verbal (person to person) or by telephone, including cellular phones, or two-way radio.

8.2 Temporary Discontinuation of Services – Short and Long Term

Cargill has stopped hauling CCR to the landfill. Landfill operations are limited to leachate hauling from the site.

8.3 Facilities Access and Re-Routing

If either full or partial operations are maintained, but limited access or rerouting is necessary, instructions to the contract haulers and operator will be issued Cargill. Particularly where rerouting is necessary, temporary barricades, traffic cones, etc. may be used to facilitate the rerouting process.

8.4 Waste Acceptance

The landfill is currently closed and no waste materials are permitted or accepted.

8.5 Wastes in Process

The landfill is currently closed and no waste materials are permitted or accepted.

9. Primary Emergency Equipment Inventory

9.1 Major Equipment

No major equipment is currently available at the closed landfill. Major equipment needed for response actions will be secured on an as needed basis through coordination with the resident contractors at the Cargill Plant, or the Mahaska County Sheriff's Department and the Eddyville Fire Department.

9.2 Fire Hydrants and Water Sources

A water source with a quantity sufficient for fighting a large fire is not currently available at the site. Any water needed to fight a large fire will obtained from nearby surface sources or hauled from the Cargill Inc. Eddyville Plant.

9.3 Off-Site Equipment Resources

Off-site equipment needed for response actions will be secured on an as needed basis through coordination with the Mahaska County Sheriff's Department and the Eddyville Volunteer Fire Department.

10. Emergency Aid

10.1 Responder Contacts

Responses to emergencies will depend on the type of emergency or release. All emergency response activities should be coordinated through the Mahaska County Sheriff Department by Calling 911.

A complete listing of response contacts and phone numbers is provided in Appendix C.

10.2 Medical Services

Emergency medical response and ambulance service is available by contacting the Mahaska County Sheriff's Department by calling 911. Local medical assistance and ambulance service is available from the Eddyville Volunteer Fire Department. In addition, Monroe, Mahaska, and

Wapello Counties have ambulance service and medical assistance available. These organizations can be contacted by calling 911.

Medical services are available from the Mahaska County Hospital, the Ottumwa Regional Health Center, and the Monroe County Hospital.

Mahaska County Hospital
1229 C Ave East
Oskaloosa, IA 52577
Call 911 641-672-3100 (Secondary)

Ottumwa Regional Health Center
1001 E. Pennsylvania Ave
Ottumwa, IA 52501
Call 911 641-682-8585 (Secondary)

Monroe County Hospital
6580 165th Street
Albia, IA 52531
Call 911 641-932-2134 (Secondary)

A complete listing of response contacts and phone numbers is provided in Appendix C.

10.3 Contracts and Agreements
The responders listed in this ERRAP are available at no direct cost to the user. No prior contract or agreement is required to obtain these services. A listing of the emergency service contacts is provided in Appendix C.

11. ERRAP Training Requirements

11.1 Training Providers
Training will be provided by Cargill staff.

11.2 Employee Orientation
Employee training will be provided to employees with tasks that include operations, maintenance, oversight, or other activities related to the closed solid waste facility. Training will be provided during onboarding or when an employee's responsibilities change to included tasks related to the closed facility.

11.3 Annual Training Updates
Training will be provided by Cargill to employees on an annual basis. Training will consist of this document, past operations, and site observations and activities over the previous year.

11.4 Training Completion and Record Keeping
Records will be kept detailing attendance, inspection records reviewed, and topics addressed. Records will be kept on site or at the Cargill Corn Plant in Eddyville.

12. Reference Tables, Figures, and Maps
Applicable references, figures and maps are provided in the Appendices of this document. These include the following:
A. Location and Site Maps
B. IAC [567] Chapter 131, Notification of Hazardous Conditions
C. Emergency Contacts and Telephone Numbers

Site Characterization Report

Cargill CCR Landfill
Eddyville, Iowa
February 6, 2020
Terracon Project No. 08195294

Prepared for:
Cargill, Inc.
Eddyville, Iowa

Prepared by:
Terracon Consultants, Inc.
Des Moines, Iowa

February 6, 2020

Cargill, Inc.
1 Cargill Drive
Eddyville, Iowa 52553-9772

Attn: Mr. Ed Brown
E: E_Brown@cargill.com

Re: Site Characterization Report
Cargill CCR Landfill
SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa
Terracon Project No. 08195294

Dear Mr. Brown:

We have performed geotechnical exploration and site characterization services for the referenced project in general accordance with Terracon Proposal No. P08195294 dated December 4, 2020. This report presents the findings of the subsurface exploration and laboratory test data, and provides general geotechnical recommendations concerning earthwork for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Adam S. Maher, E.I.
Staff Engineer

Brett E. Bradfield, P.E.
Senior Engineering Consultant

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Site Characterization Report

Cargill CCR Landfill

SW Corner of Galeston Avenue and 325th Street

Eddyville, Iowa

Terracon Project No. 08195294

February 6, 2020

INTRODUCTION

This report presents the results of our subsurface exploration and site characterization services performed for the proposed final closure of the CCR Landfill located at the southwest corner of Galeston Avenue and 325th Street about 5½ miles northwest of Eddyville, Iowa. The purpose of these services is to provide information and general geotechnical recommendations relative to:

- Subsurface soil and bedrock conditions
- Groundwater conditions
- Summary of laboratory data
- General fill placement and compaction criteria

The Scope of Services for this project included the advancement of 14 test borings to depths ranging from approximately 19½ to 20½ feet below existing site grades in the areas for obtaining fill materials for development of cover for the nearby landfill.

Maps showing the site and boring locations are shown in the **Site Location and Exploration Plan** section. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and as separate graphs in **Exploration Results**.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration.

Item	Description
Parcel Information	■ The site for obtaining fill material for the project is located at the southwest corner of Galeston Avenue and 325th Street about 5½ miles northwest of Eddyville, Iowa. ■ North borrow area: 24 acres ■ South borrow area: 9 acres ■ Latitude/Longitude: 41.1849°, -92.7396° (approximate) ■ See **Site Location**

Item	Description
Existing Improvements	Borrow sites are located to the east of the existing landfill
Current Ground Cover	Cropland/grassland
Existing Topography	■ North site: slopes down to the east with about 40 feet of elevation change (elev. 820 to 780 feet) ■ South site: slopes down to the north with about 50 feet of elevation change (elev. 840 to 790 feet)

PROJECT DESCRIPTION

Our final understanding of the project conditions is as follows:

Item	Description
Borrow Description	■ Cargill is proceeding with final closure of the CCR Landfill which will involve using soils from the explored borrow sites as landfill cover. The proposed north and south borrow soil areas are located directly east of the existing landfills.

GEOTECHNICAL CHARACTERIZATION

Subsurface Conditions

We have developed a general characterization of the subsurface soil, bedrock and groundwater conditions based upon our review of the data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical recommendations. Conditions encountered at each exploration point are indicated on the individual logs. The GeoModel and individual logs can be found in **Exploration Results** and the GeoModel can be found in **Figures**.

Stratification boundaries on the GeoModel and boring logs represent the approximate location of changes in soil and bedrock types; in situ, the transition between materials may be gradual. As noted in **General Comments**, the characterizations are based on widely spaced exploration points across the site, and variations are likely

As part of our review, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
	Surface Materials	Root zone / topsoil of approximately 2 to 5 inches
1	**Surficial Fat Clays (weathered loess)**	High plasticity clays, trace sand, gray with brown and dark brown Encountered to depths of about 4 to 5½ feet bgs in the borings
2	**Lean Clays (loess soils)**	Low to moderate plasticity clays, trace sand Relatively high water content (28% to 32%) Encountered to depths of about 5½ to 14 feet bgs in the borings
3	**Sandy Clays (glacial soils)**	Sandy lean clay and clayey sands, brown Generally encountered to about 10½ to 13 feet bgs in the borings Not encountered in Borings 3, 7, 9, or 14
4	**Bedrock**	Highly weathered shale, shale, and sandstone Occasional zones of dark gray carbonaceous shale Encountered at depths of about 7 to 13 feet bgs and to the termination of all the borings

Groundwater Conditions

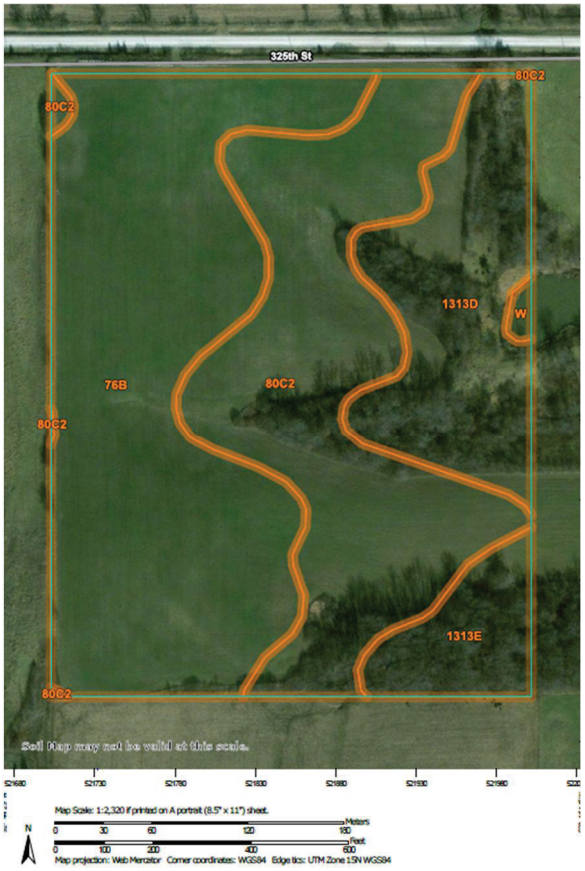
The boreholes were observed while drilling, shortly after drilling, and up to one day after drilling for the presence and level of groundwater. A relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Long term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels in materials of this type. The water levels observed in the boreholes can be found on the boring logs in **Exploration Results**, and are summarized below.

Boring Number	Groundwater Elevation While Drilling (feet) [1]	Groundwater Elevation After Drilling (feet) [1]	Groundwater Elevation On 1/8/20 (feet) [2]
1	795	795	N/A
5 and 8	785 to 787½	785½ to 789	789½
11 and 14	None observed	None observed	809 to 814½
2 and 3	None observed	None observed	N/A
4, 6, 7, 10, 12, and 13	None observed	None observed	None observed

1. bgs = below existing ground surface
2. All borings except Borings 1, 2, and 3 were performed on 1/7/20.

The Natural Resource Conservation Service Web Soil Survey (WSS) indicates the primary near surface soil units at the sites are Ladoga silt loam and Clinton silt loam with minor amounts of Munterville silt loam. The WSS only characterizes the general site soils for depths of about 6 feet bgs, so likely only represents Model Layers 1 and 2. The following table summarizes the properties and qualities of these soil units as mapped and described by the WSS.

Soil Unit Name	Map Unit Symbol(s)	Drainage Class	Approximate Depth to Seasonal High Water Table
Ladoga silt loam	76B	Moderately well drained	4 to 6 feet
Clinton silt loam	80C2	Moderately well drained	4 to 6 feet
Munterville silt loam	1313D/1313E	Moderately well drained	24 to 30 inches



North Borrow Site South Borrow Site

(https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

In our experience, groundwater levels in the soil types encountered can commonly occur in the high water content and relatively low strength Model Layer 2 loess soils. Groundwater level

fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structures may be different than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL DATA SUMMARY

The bulk samples of similar soil types obtained from borings in similar areas or topographic position were combined into composite samples for characterization of geotechnical parameters. Atterberg Limits tests, grain size analyses, standard Proctor moisture-density compaction relationships, and falling head permeameter tests were performed on the 14 composite samples. The results are summarized in the table below, and shown on the logs of the borings and individual data sheets:

Boring No.	Depth (ft.)	Atterberg Limits			Percent Fines	Standard Proctor		Hydraulic Conductivity ($\times 10^{-8}$ cm/s) [1]
		LL	PL	PI		Max. Dry Density (pcf)	Optimum Moisture Content (%)	
Model Layer 1 - Fat Clay (CH)								
1 and 2	0 – 5	55	22	33	97.9	98.0	23.4	0.843
6 and 8	0 – 5	57	20	37	98.9	97.1	21.2	1.41
11 and 14	0 – 5	55	22	33	97.9	99.4	21.8	2.02
12 and 13	0 – 5	54	23	31	97.9	98.8	23.0	3.64
Model Layer 2 - Lean Clay (CL)								
1 and 2	5 - 10	43	19	24	96.2	106.2	18.7	4.39
3 4	10 – 15 5 – 10	45	19	26	99.0	112.0	15.6	3.21
6 and 7	5 – 10	45	18	27	98.1	106.7	19.2	2.11
8 and 9	5 – 10	41	19	22	94.5	107.6	18.8	2.64
10, 12, and 13	5 – 10	42	19	23	96.0	106.4	18.8	3.27
Model Layer 3 - Sandy Lean Clay (CL) and Clayey Sand (SC)								
5	5 – 10	39	15	24	80.9	109.7	17.4	2.64
10 and 11	10 – 15	29	16	13	37.7	114.2	14.7	1.21

Boring No.	Depth (ft.)	Atterberg Limits			Percent Fines	Standard Proctor		Hydraulic Conductivity (× 10^{-8} cm/s) [1]
		LL	PL	PI		Max. Dry Density (pcf)	Optimum Moisture Content (%)	
Model Layer 4 - Bedrock								
7 and 8	10 - 15	33	16	17	76.1	115.4	14.3	28.7
11	15 – 20	46	21	25	84.9	101.5	21.7	11.3
14	10 – 15							
4 and 5	15 – 20	40	19	21	76.1	102.9	19.1	2.11

1. Hydraulic conductivity tests were performed on remolded samples compacted to 95% of standard Proctor density at a moisture of 2% above optimum.

GEOTECHNICAL OVERVIEW

The on-site soils generally consist of loess soils exhibiting high to moderately high plasticity with depth (Model layers 1 and 2), sandy lean clays (Model layer 3) and bedrock material consisting of weathered shale and sandstone. The Model layer 1, 2, and 3 soils are considered suitable as landfill cover materials, whereas the harder, less weathered bedrock material is likely not ideal landfill cover material as it is more blocky and would require a significant amount of watering and mechanical discing to break down into material that would behave like clay. Occasional sand and clayey sand layers were encountered in the Model Layer 3 glacial soils, and would generally not be considered suitable as cover material for the landfill without blending with clay soils to reduce permeability values to suitable levels. We suggest sand soils from the borrow sites be wasted in other grading areas or placed as fill in reclamation areas.

EARTHWORK

Site Preparation

Site preparation should commence with stripping of all vegetation, organic soils, root systems, and any soft, frozen or otherwise unsuitable materials from the site surface of the borrow area.

The sites should be graded to divert water runoff and any groundwater that collects in excavations. The site soils are susceptible to erosion. Erosion protection, such as sustainable vegetation, should be established on completed slopes and graded surfaces. It is the responsibility of the owner to maintain such planting.

Structural Fill Material Types

Shale and sandstone bedrock (Model Layer 4) were generally encountered below about 15 feet in the borings and would not be suitable as cover material for the landfill without significant watering and mechanical discing and pulverization efforts. In addition, excavation into bedrock materials will become more difficult and likely require dozers fitted with ripping attachments and/or large backhoes with rock teeth.

Model Layer 1, 2, and 3 overburden soils generally appear suitable as landfill cover material. Structural fill should meet the following material property requirements.

The glacial sands and clayey sands (in Model Layer 3) are generally not suitable as cover material for the landfill due to anticipated relatively high permeabilities; however, consideration could be given to blending sands with on-site clays to reduce permeabilities and make suitable as cover material.

Soil Type [1]	USCS Classification	Acceptable Location for Placement
Low plasticity fine-grained [2]	CL, ML	Landfill cover materials
Moderate to high plasticity fine-grained	CH, MH	Landfill cover materials

1. Structural fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.
2. By our definition, low plasticity materials has a liquid limit of 45 or less and a plasticity index of 23 or less (ASTM D4318).

Structural Fill Compaction Requirements

Structural fill should meet the following compaction requirements.

Item	Description
Maximum individual lift thickness	■ 9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used ■ 4 inches or less in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum compaction requirements [1]	**Fine-grained soils:** ■ 95% of maximum ■ Moderate to high plasticity fine-grained soils should not be compacted to more than 100% of maximum since over compacted clays could have increased swell potential.

Item	Description
Water content range [1]	**Fine-grained soils:** ■ 0 to +4% of optimum

1. Maximum density and optimum water content as determined using standard effort (ASTM D698).

Construction Observation and Testing

Terracon's involvement during the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

If requested, Terracon can provide testing and observation services during excavation of proposed cover material and during the placement and compaction.

GENERAL COMMENTS

Our analysis and opinions are based on our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon should be retained to provide observation and testing services during grading, excavation, and other earth-related construction phases of the project. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance on the services and any work product is limited to our client, and is not intended for third

parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

Brett E. Bradfield, P.E. 2/6/2020
Date

My license renewal date is December 31, 2020.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Boring Numbers	Boring Depths (feet)	Location
1 through 9	19½ to 20½	North Borrow Site
10 through 14	19½ to 20½	South Borrow Site

Boring Layout and Elevations: Terracon personnel staked the north borrow site boring locations using handheld GPS equipment using coordinates provided by HR Green on the provided "Soil Boring Location Plan" dated November 14, 2019. While on site, an HR Green representative selected the boring locations for the south borrow site we recorded the coordinates using a handheld GPS unit. The boring locations are shown on the **Exploration Plan**. The coordinates of the borings are indicated on the boring logs.

Approximate ground surface elevations were obtained by Terracon personnel using provided site topographic plans. Boring elevations on the boring logs are rounded to the nearest ½ foot. The locations and elevations of the borings are considered accurate only to the degree implied by the means and methods used to define them.

Subsurface Exploration Procedures: The borings were drilled with an ATV-mounted drilling rig using continuous flight solid-stem augers. Soil sampling was performed using split-barrel sampling procedures where a standard 2-inch outer diameter split-barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. The samples were placed in appropriate containers and taken to our laboratory for testing. We observed and recorded groundwater levels during, and up to 1 day after drilling and sampling. The borings were backfilled with auger cuttings and bentonite chips after drilling.

The drill crew prepared a field log of each boring to record field data including visual descriptions of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The boring logs included with this report represent an interpretation of the subsurface conditions at each boring location based on field and laboratory data, and observation of the samples.

Laboratory Testing

In the laboratory, water content tests were performed on portions of the recovered samples. Hand penetrometer tests were performed to estimate the consistency of select samples of fine-grained

soils. Laboratory tests completed for this project are included in **Exploration Results**, tabulated in **Geotechnical Data Summary** and included:

- Water (Moisture) Content of Soil
- Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- Laboratory Compaction Characteristics of Soil Using Standard Effort
- Grain Size Analysis (Sieve and Hydrometer)
- Hydraulic Conductivity – by falling head permeameter on remolded specimens

Atterberg Limits tests, grain size analyses, standard Proctor moisture-density relationship tests, and hydraulic conductivity tests were performed on 14 samples of soils consisting of a combined soils of the same layer from multiple borings located near each other. The results are shown on the logs of the borings and provided in the table below:

The samples were described in the laboratory based on visual observation, texture and plasticity, and the laboratory testing described above. The descriptions of the soils and rock indicated on the boring logs are in general accordance with the General Notes, Unified Soil Classification System (USCS), and Description of Rock Properties summarized and included in **Supporting Information**.

SITE LOCATION AND EXPLORATION PLAN

Contents:

Site Location Plan
Exploration Plan

Note: All attachments are one page unless noted above.

SITE LOCATION

Cargill CCR Landfill ■ Eddyville, Iowa
February 6, 2020 ■ Terracon Project No. 08195294

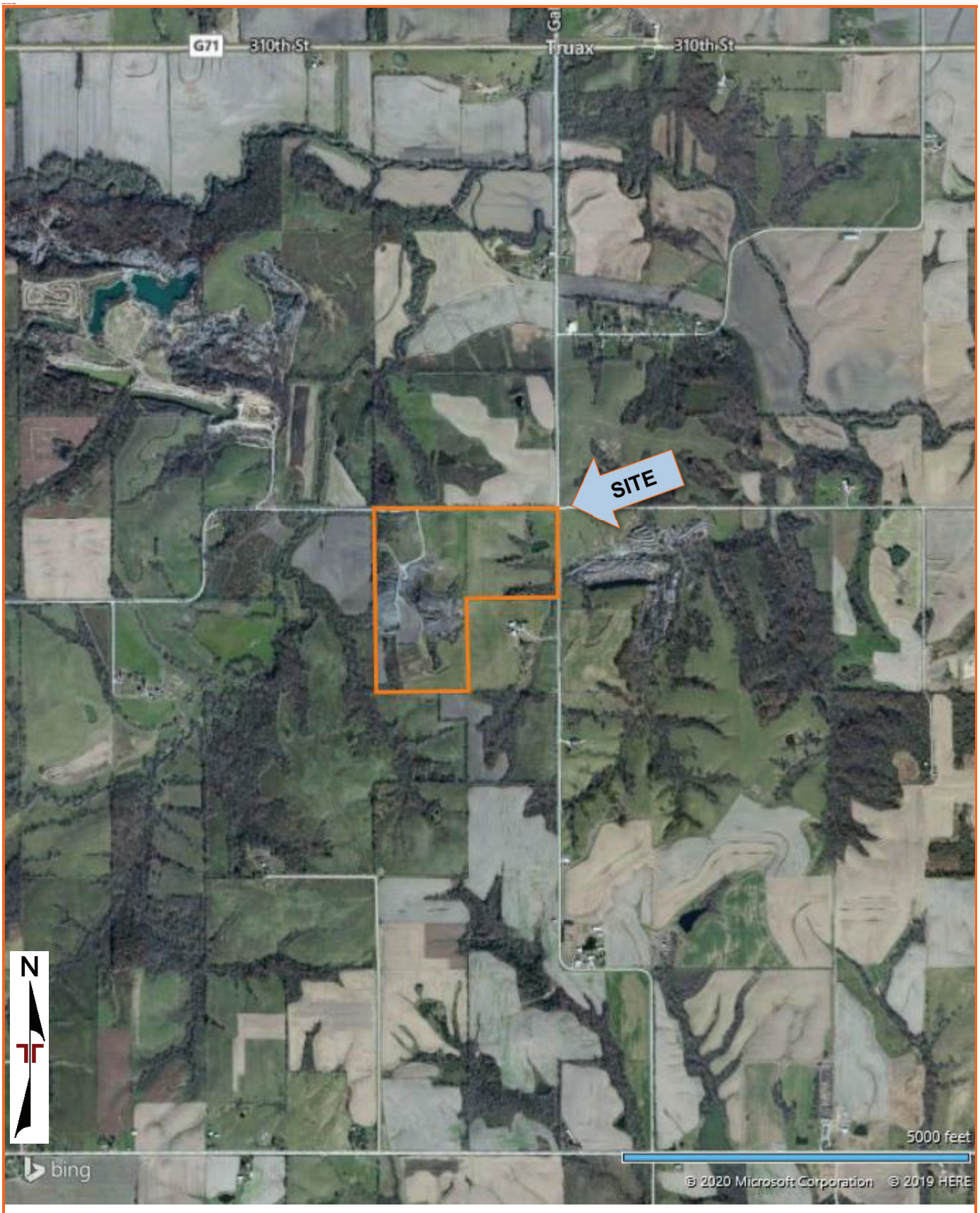


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Cargill CCR Landfill ■ Eddyville, Iowa
February 6, 2020 ■ Terracon Project No. 08195294

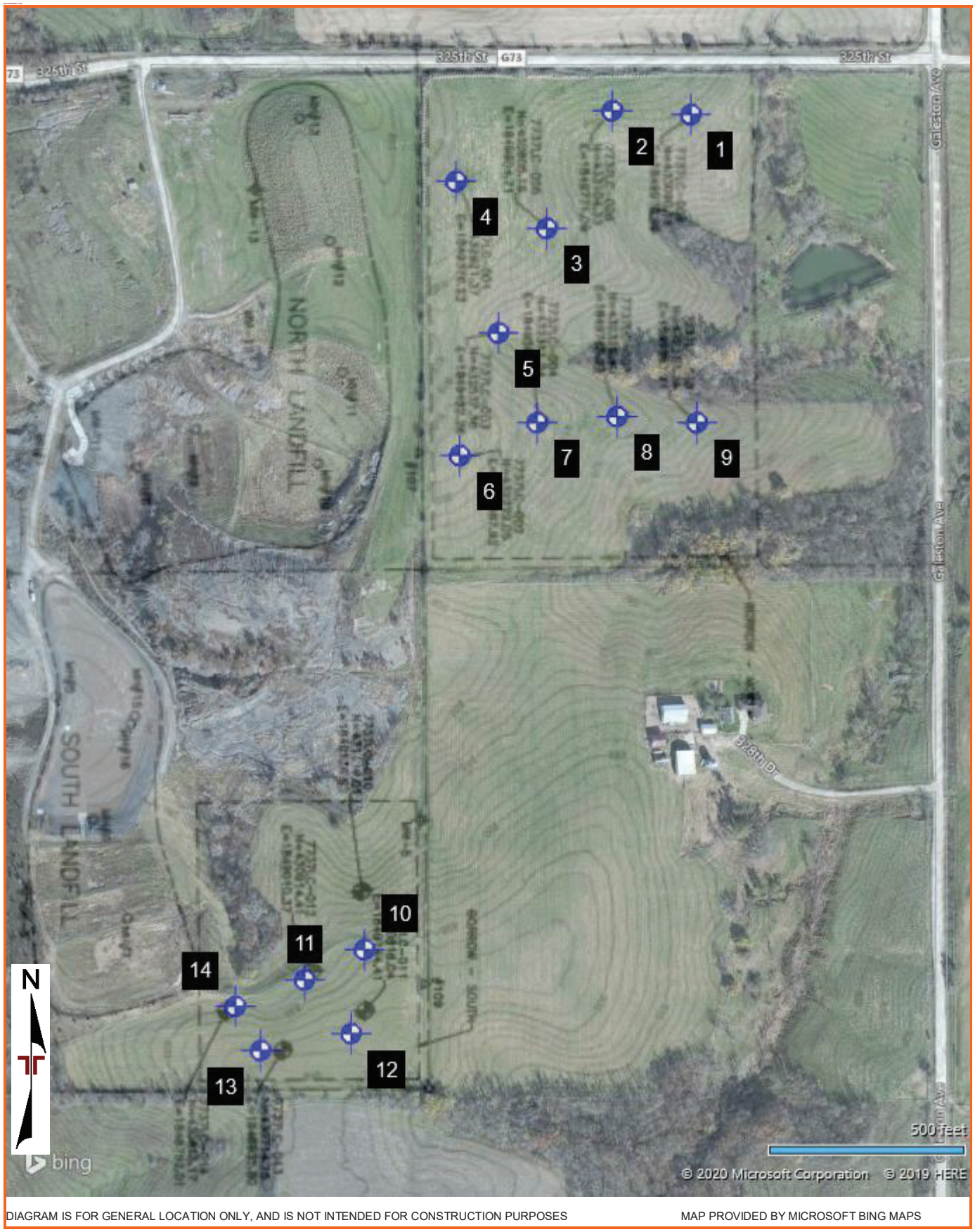


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

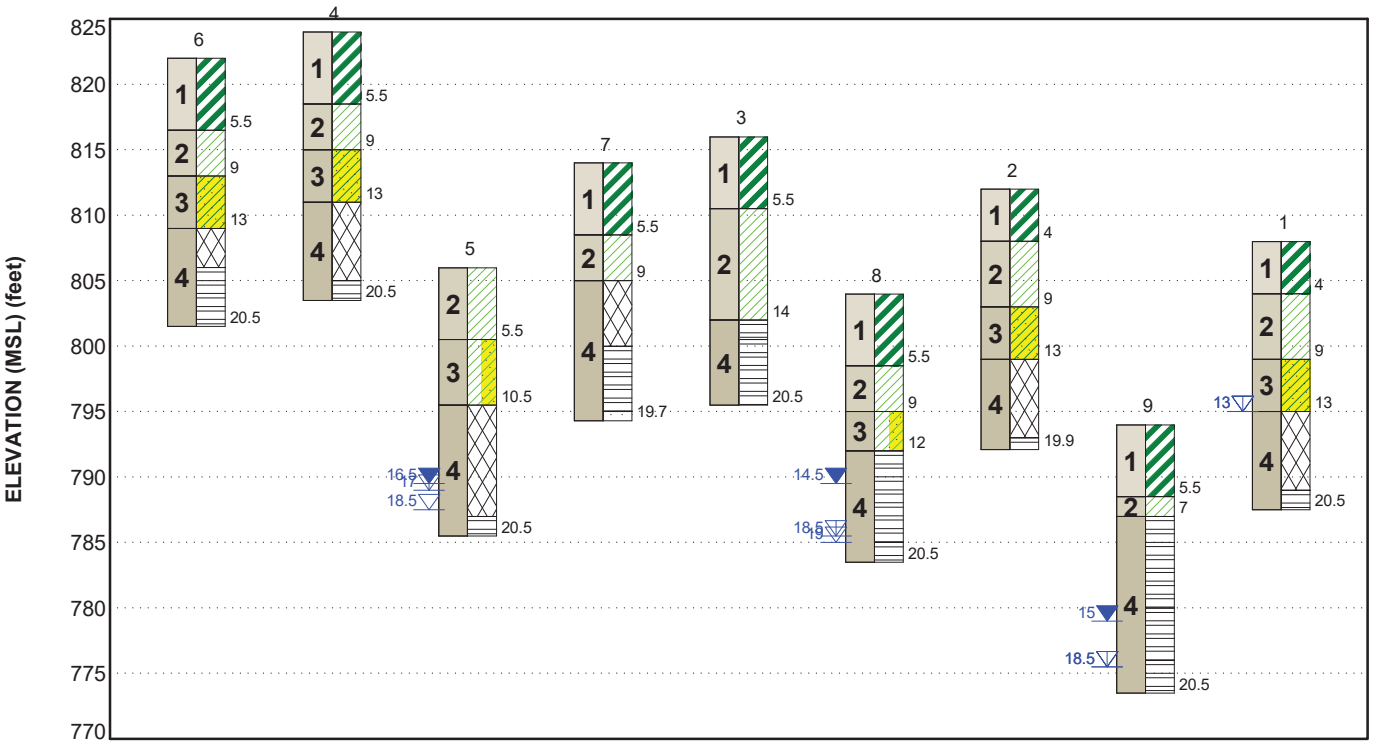
Contents:

Note: All attachments are one page unless noted above.

GEOMODEL

Cargill CCR Landfill ■ Eddyville, Iowa
Terracon Project No. 08195294

Terracon GeoReport



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Surficial Fat Clays (weathered loess soils)**	High plasticity clays, trace sand, gray with brown
2	**Lean Clays (loess soils)**	Low to moderate plasticity clays, relatively high moisture content, gray with brown
3	**Sandy Clays (glacial soils)**	Stiff sandy lean clay and medium dense clayey sands, brown
4	**Bedrock**	Shale with variable weathering and hardness, and Sandstone layers

LEGEND

- Fat Clay
- Lean Clay
- Sandy Lean Clay
- Highly Weathered Shale
- Shale
- Lean Clay with Sand
- Sandstone

- First Water Observation
- Second Water Observation
- Third Water Observation

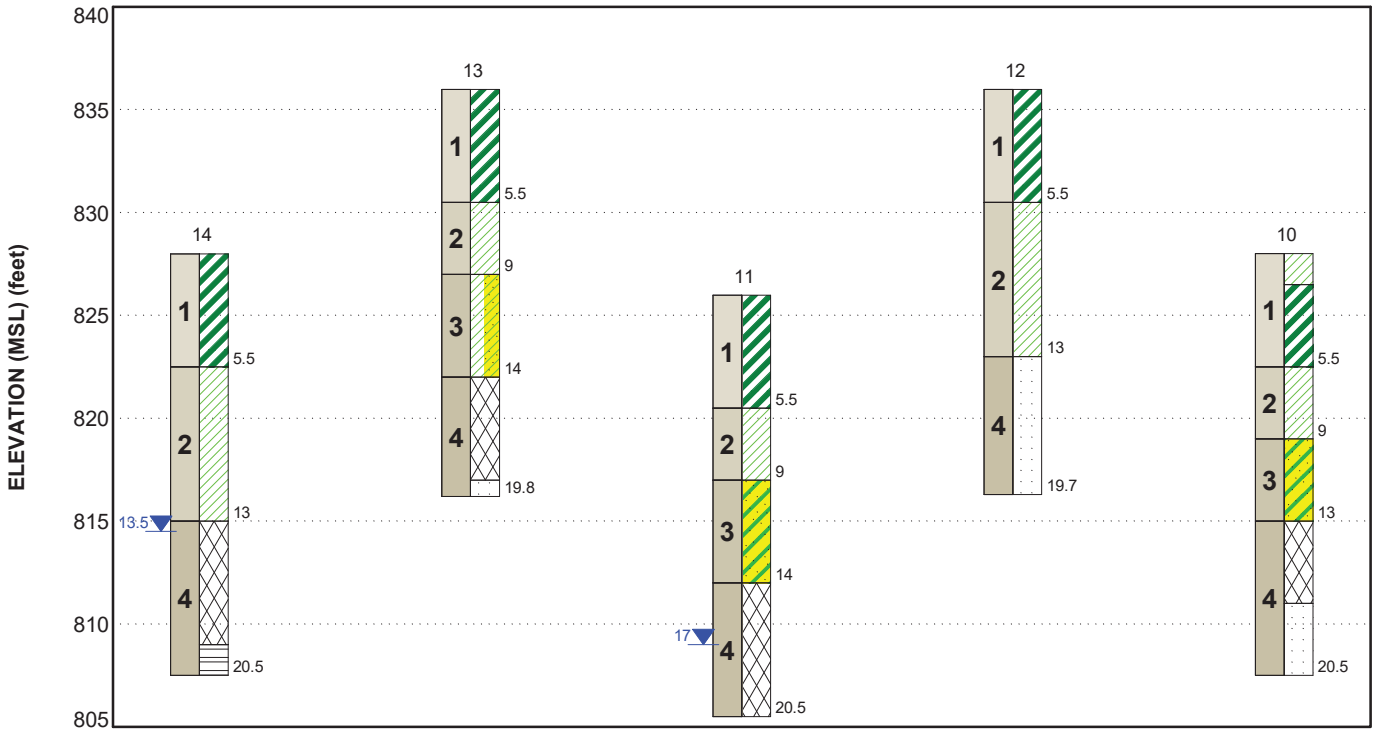
Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

GEOMODEL

Cargill CCR Landfill ■ Eddyville, Iowa
Terracon Project No. 08195294

Terracon GeoReport



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Surficial Fat Clays (weathered loess soils)**	High plasticity clays, trace sand, gray with brown
2	**Lean Clays (loess soils)**	Low to moderate plasticity clays, relatively high moisture content, gray with brown
3	**Sandy Clays (glacial soils)**	Stiff sandy lean clay and medium dense clayey sands, brown
4	**Bedrock**	Shale with variable weathering and hardness, and Sandstone layers

LEGEND

- Lean Clay
- Fat Clay
- Clayey Sand
- Highly Weathered Shale
- Sandstone
- Lean Clay with Sand
- Shale

- First Water Observation
- Second Water Observation
- Third Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

BORING LOG NO. 1

PROJECT: Cargill CCR Landfill

CLIENT: Cargill, Inc.
Eddyville, Iowa

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

LOCATION See Exploration Plan

Latitude: 41.1863° Longitude: -92.7387°

Approximate Surface Elev.: 808 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	0.0	808+/-	**Approx. 2 Inch Root Zone**
			FAT CLAY (CH), trace sand, gray with brown
	4.0	804+/-	
2			**LEAN CLAY (CL)**, trace sand, gray with brown, medium stiff
	9.0	799+/-	
3			**SANDY LEAN CLAY (CL)**, brown, stiff
	13.0	795+/-	
4			**SHALE***, brown, gray, and orange brown, highly weathered
	19.0	789+/-	
			SHALE*, dark gray
	20.5	787.5+/-	
			Boring Terminated at 20.5 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
5			10	3-2-2 N=4 3000 (HP)	1	27
10	▽		18	3-6-6 N=12 7000 (HP)	2	22
15			18	4-6-8 N=14	3	21
20			16	8-19-22 N=41	4	19

Stratification lines are approximate. In-situ, the transition may be gradual.
Bulk samples obtained at the following depths: 0'-5', 5'-10', 10'-15', and 15'-20'

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *13' While Drilling*

▽ *13' After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 01-08-2020 | Boring Completed: 01-08-2020

Drill Rig: 897 | Driller: MD

Project No.: 08195294

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 08195294 CARGILL CCR LANDF.GPJ TERRACON_DATATEMPLATE.GDT 2/4/20

BORING LOG NO. 2

PROJECT: Cargill CCR Landfill

CLIENT: Cargill, Inc.
Eddyville, Iowa

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

LOCATION See Exploration Plan

Latitude: 41.1864° Longitude: -92.7394°

Approximate Surface Elev.: 812 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
1	4.0	808+/-	**Approx. 5 Inch Root Zone** **FAT CLAY (CH)**, trace sand, gray with brown							
2	9.0	803+/-	**LEAN CLAY (CL)**, trace sand, gray with brown, medium stiff	5		X	14	2-2-4 N=6 3000 (HP)	1	31
3	13.0	799+/-	**SANDY LEAN CLAY (CL)**, trace gravel, brown, stiff	10		X	8	4-5-7 N=12 3500 (HP)	2	19
4	19.0	793+/-	**SHALE***, light brown gray, highly weathered	15		X	18	5-6-8 N=14	3	20
	19.9	792+/-	**SANDY SHALE***, brown gray			X	10	22-50/5"	4	13
			Boring Terminated at 19.9 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.
Bulk samples obtained at the following depths: 0'-5', 5'-10', 10'-15', and 15'-19'

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

None observed while drilling

None observed after drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 01-08-2020 | Boring Completed: 01-08-2020

Drill Rig: 897 | Driller: MD

Project No.: 08195294

BORING LOG NO. 3

PROJECT: Cargill CCR Landfill

CLIENT: Cargill, Inc.
Eddyville, Iowa

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

LOCATION See Exploration Plan

Latitude: 41.1855° Longitude: -92.74°

Approximate Surface Elev.: 816 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
1			**Approx. 2 Inch Root Zone** **FAT CLAY (CH)**, trace sand, brown, dark brown, and gray, medium stiff							
		5.5	810.5+/-	5		X	18	3-3-3 N=6 2500 (HP)	1	30
2			**LEAN CLAY (CL)**, trace sand, brown, medium stiff							
		14.0	802+/-	10		X	18	2-4-1 N=5 2000 (HP)	2	26
4			**SANDY SHALE***, light gray, laminated bedding			X	18	5-8-10 N=18	3	11
		15.5	800.5+/-	15						
			SHALE*, gray, brown, and orange brown							
		20.5	795.5+/-	20		X	18	8-10-11 N=21	4	13
			Boring Terminated at 20.5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.
Bulk samples obtained at the following depths: 0'-5', 5'-10', 10'-15', and 15'-20'

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

None observed while drilling

None observed after drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 01-07-2020 | Boring Completed: 01-07-2020

Drill Rig: 897 | Driller: CN

Project No.: 08195294

BORING LOG NO. 4

PROJECT: Cargill CCR Landfill

CLIENT: Cargill, Inc.
Eddyville, Iowa

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

LOCATION See Exploration Plan

Latitude: 41.1859° Longitude: -92.7409°

Approximate Surface Elev.: 824 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	0.0	824+/-	**Approx. 2 Inch Root Zone**
			FAT CLAY (CH), trace sand, gray with brown, medium stiff
	5.5	818.5+/-	
2			**LEAN CLAY (CL)**, trace sand, gray with brown
	9.0	815+/-	
3			**SANDY LEAN CLAY (CL)**, brown, stiff
	13.0	811+/-	
4			**SHALE***, gray, brown, and orange brown, highly weathered
	19.0	805+/-	
			SHALE*, light gray to gray, laminated bedding
	20.5	803.5+/-	
			Boring Terminated at 20.5 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
5			18	2-3-3 N=6 2500 (HP)	1	31
10			18	2-4-4 N=8 4000 (HP)	2	13
15			18	4-6-10 N=16 9000 (HP)	3	16
20	DCI @ 19' on 1/8/20		18	6-14-24 N=38 9000 (HP)	4	9

Stratification lines are approximate. In-situ, the transition may be gradual.
Bulk samples obtained at the following depths: 0'-5', 5'-10', 10'-15', and 15'-20'

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

None observed while drilling
None observed after drilling
None observed on 1/8/20
DCI @ 19' on 1/8/20

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 01-07-2020 | Boring Completed: 01-07-2020
Drill Rig: 897 | Driller: CN
Project No.: 08195294

BORING LOG NO. 5

PROJECT: Cargill CCR Landfill

CLIENT: Cargill, Inc.
Eddyville, Iowa

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

LOCATION See Exploration Plan

Latitude: 41.1848° Longitude: -92.7405°

Approximate Surface Elev.: 806 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
2	0	806	**Approx. 5 Inch Root Zone** **LEAN CLAY (CL)**, trace sand, brown and gray, medium stiff
2	5.5	800.5+/-	
3	5.5	800.5+/-	**LEAN CLAY (CL)**, with sand, brown to dark gray, very stiff
3	10.5	795.5+/-	
4	10.5	795.5+/-	**SHALE***, gray
4	19.0	787+/-	
4	19.0	787+/-	**CARBONACEOUS SHALE***, dark gray to black
4	20.5	785.5+/-	
	20.5	785.5+/-	***Boring Terminated at 20.5 Feet***

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
5			18	2-2-3 N=5 3000 (HP)	1	23
10			18	4-8-11 N=19 9000 (HP)	2	19
15			18	4-7-8 N=15 8000 (HP)	3	19
20			18	8-13-24 N=37	4	18

Stratification lines are approximate. In-situ, the transition may be gradual.
Bulk samples obtained at the following depths: 0'-5', 5'-10', 10'-15', and 15'-20'

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- *18.5' While Drilling*
- *17' After Drilling*
- *16.5' on 1/8/20*
- *WCI @ 18' on 1/8/20*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 01-07-2020 | Boring Completed: 01-07-2020

Drill Rig: 897 | Driller: CN

Project No.: 08195294

BORING LOG NO. 6

PROJECT: Cargill CCR Landfill

CLIENT: Cargill, Inc.
Eddyville, Iowa

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

LOCATION See Exploration Plan

Latitude: 41.1839° Longitude: -92.7408°

Approximate Surface Elev.: 822 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	0.0	822.0+/-	**Approx. 2 Inch Root Zone**
			FAT CLAY (CH), trace sand, gray and brown, medium stiff
	5.5	816.5+/-	
2	5.5	816.5+/-	**LEAN CLAY (CL)**, trace sand, brown
	9.0	813+/-	
3	9.0	813+/-	**SANDY LEAN CLAY (CL)**, trace gravel, brown, very stiff
			Cobble/Boulder encountered from 11.5 to 13 feet
	13.0	809+/-	
4	13.0	809+/-	**SHALE***, gray, brown, and orange brown, highly weathered
	16.0	806+/-	
	16.0	806+/-	**SANDY SHALE***, gray
	20.5	801.5+/-	
	20.5	801.5+/-	***Boring Terminated at 20.5 Feet***

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
5			18	2-2-3 N=5 3500 (HP)	1	29
10			18	5-6-9 N=15 9000 (HP)	2	22
			2	20-10-9 N=19	3	7
15			18	5-8-10 N=18	4	17
	DCI					
20				11-23-31 N=54	5	10

Stratification lines are approximate. In-situ, the transition may be gradual.
Bulk samples obtained at the following depths: 0'-5', 5'-10', 10'-15', and 15'-20'

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

None observed while drilling
None observed after drilling
None observed on 1/8/20
DCI *@ 17' on 1/8/20*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 01-07-2020 | Boring Completed: 01-07-2020
Drill Rig: 897 | Driller: CN
Project No.: 08195294

BORING LOG NO. 7

PROJECT: Cargill CCR Landfill

CLIENT: Cargill, Inc.
Eddyville, Iowa

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

LOCATION See Exploration Plan

Latitude: 41.1842° Longitude: -92.7401°

Approximate Surface Elev.: 814 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
1			**Approx. 2 Inch Root Zone**							
			FAT CLAY (CH), trace sand, gray with brown, medium stiff							
		5.5	808.5+/-	5			18	2-2-3 N=5 2000 (HP)	1	28
2			**LEAN CLAY (CL)**, trace sand, brown							
		9.0	805+/-							
3			**RESIDUAL SHALE***, gray brown, very stiff	10			18	5-7-9 N=16 9000 (HP)	2	17
		14.0	800+/-							
4			**SHALE***, gray, laminated bedding	15				5-9-13 N=22	3	12
		19.0	795+/-		DCI					
		19.7	**SANDSTONE***, brown and gray 794.5+/-					24-50/2"	4	12
			Boring Terminated at 19.7 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.
Bulk samples obtained at the following depths: 0'-5', 5'-10', 10'-15', and 15'-19'

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

None observed while drilling
None observed after drilling
None observed on 1/8/20
DCI @ 19' on 1/8/20

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 01-07-2020 | Boring Completed: 01-07-2020
Drill Rig: 897 | Driller: CN
Project No.: 08195294

BORING LOG NO. 8

PROJECT: Cargill CCR Landfill

CLIENT: Cargill, Inc.
Eddyville, Iowa

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

LOCATION See Exploration Plan

Latitude: 41.1842° Longitude: -92.7394°

Approximate Surface Elev.: 804 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
1		**Approx. 2 Inch Root Zone** **FAT CLAY (CH)**, trace sand, gray with brown, medium stiff								
				5		X	18	3-3-3 N=6 2500 (HP)	1	27
	5.5		798.5+/-							
2		**LEAN CLAY (CL)**, trace sand, gray with brown								
	9.0		795+/-							
3		**LEAN CLAY (CL)**, with sand and shale fragments, trace gravel, brown, very stiff		10		X	18	5-9-11 N=20	2	15
	12.0		792+/-							
4		**SHALE***, brown, gray, and orange brown, laminated bedding								
				15	▼ (14.5')	X	12	7-10-13 N=23	3	18
					WCI (18'), ▽ (18.5'), ▽ (19')					
	19.0		785+/-							
		CARBONACEOUS SHALE*, dark gray to black		20		X	12	35-35-24 N=59	4	24
	20.5		783.5+/-							

Boring Terminated at 20.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.
Bulk samples obtained at the following depths: 0'-5', 5'-10', 10'-15', and 15'-20'

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *19' While Drilling*
- ▽ *18.5' After Drilling*
- ▼ *14.5' on 1/8/20*
- *WCI @ 18' on 1/8/20*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 01-07-2020	Boring Completed: 01-07-2020
Drill Rig: 897	Driller: CN
Project No.: 08195294	

BORING LOG NO. 9

PROJECT: Cargill CCR Landfill

CLIENT: Cargill, Inc.
Eddyville, Iowa

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

LOCATION See Exploration Plan

Latitude: 41.1842° Longitude: -92.7386°

Approximate Surface Elev.: 794 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
1			**Approx. 5 Inch Root Zone**							
			FAT CLAY (CH), trace sand, brown with gray, medium stiff							
		5.5	788.5+/-	5						
						X	18	3-2-4 N=6 5000 (HP)	1	24
2			**LEAN CLAY (CL)**, trace sand, gray with brown							
		7.0	787+/-							
4			**SHALE***, light gray							
				10		X	18	4-8-11 N=19	2	23
		14.0	780+/-							
			SANDY SHALE*, gray		▼	X	18	20-50/5"	3	15
		18.0	776+/-	15						
			SHALE*, dark gray							
				20		X	18	20-36-50 N=86	4	15
		20.5	773.5+/-							
			Boring Terminated at 20.5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.
Bulk samples obtained at the following depths: 0'-5', 5'-10', 10'-15', and 15'-20'

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *18.5' While Drilling*
- ▽ *18.5' After Drilling*
- ▼ *15' on 1/8/20*
- *WCI @ 18' on 1/8/20*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 01-07-2020 | Boring Completed: 01-07-2020

Drill Rig: 897 | Driller: CN

Project No.: 08195294

BORING LOG NO. 10

PROJECT: Cargill CCR Landfill

CLIENT: Cargill, Inc.
Eddyville, Iowa

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

LOCATION See Exploration Plan

Latitude: 41.1805° Longitude: -92.7417°

Approximate Surface Elev.: 828 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	1.5	826.5+/-	**LEAN CLAY (CL)**, dark brown
1	5.5	822.5+/-	**FAT CLAY (CH)**, trace sand, gray with brown, stiff
2	9.0	819+/-	**LEAN CLAY (CL)**, trace sand, gray with brown
3	13.0	815+/-	**CLAYEY SAND (SC)**, trace gravel, brown, medium dense
4	17.0	811+/-	**SHALE***, occasional sandstone fragments, light gray, brown, and orange brown, highly weathered
	20.5	807.5+/-	**SANDSTONE***, gray brown
			Boring Terminated at 20.5 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
5			18	2-4-4 N=8 3500 (HP)	1	26
10			18	4-5-6 N=11	2	14
15			12	3-3-11 N=14 9000 (HP)	3	19
20	DCI @ 18' on 1/8/20			18-49-50/5"	4	16

Stratification lines are approximate. In-situ, the transition may be gradual.
Bulk samples obtained at the following depths: 0'-5', 5'-10', 10'-15', and 15'-20'

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

None observed while drilling
None observed after drilling
None observed on 1/8/20
DCI @ 18' on 1/8/20

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 01-06-2020 | Boring Completed: 01-06-2020
Drill Rig: 897 | Driller: CN
Project No.: 08195294

BORING LOG NO. 11

PROJECT: Cargill CCR Landfill

CLIENT: Cargill, Inc.
Eddyville, Iowa

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

LOCATION See Exploration Plan

Latitude: 41.1803° Longitude: -92.7423°

Approximate Surface Elev.: 826 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	
1	0	825.5+/-	**Approx. 2 Inch Root Zone** **FAT CLAY (CH)**, trace sand, gray with brown, stiff
2	5.5	820.5+/-	**LEAN CLAY (CL)**, trace sand, gray with brown
3	9.0	817+/-	**CLAYEY SAND (SC)**, trace gravel, brown, medium dense
4	14.0	812+/-	**SHALE***, gray, highly weathered
	20.5	805.5+/-	***Boring Terminated at 20.5 Feet***

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
5		18	3-3-5 N=8 3000 (HP)	1	27
10		18	3-4-5 N=9	2	18
15		18	2-4-6 N=10 9000 (HP)	3	26
20		10	8-9-9 N=18 9000 (HP)	4	24

WATER LEVEL OBSERVATIONS: ▼ 17' on 1/8/20; WCI @ 18' on 1/8/20

Stratification lines are approximate. In-situ, the transition may be gradual.
Bulk samples obtained at the following depths: 0'-5', 5'-10', 10'-15', and 15'-20'

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

None observed while drilling
None observed after drilling
▼ *17' on 1/8/20*
WCI @ 18' on 1/8/20

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 01-06-2020 | Boring Completed: 01-06-2020
Drill Rig: 897 | Driller: CN
Project No.: 08195294

BORING LOG NO. 12

PROJECT: Cargill CCR Landfill

CLIENT: Cargill, Inc.
Eddyville, Iowa

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

LOCATION See Exploration Plan

Latitude: 41.1799° Longitude: -92.7418°

Approximate Surface Elev.: 836 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
1		**Approx. 2 Inch Root Zone** **FAT CLAY (CH)**, trace sand, gray with brown, stiff								
		5.5	830.5+/-	5		X	18	3-4-4 N=8 2500 (HP)	1	29
2		**LEAN CLAY (CL)**, trace sand, brown, medium stiff								
		13.0	823+/-	10		X	18	2-2-2 N=4 1500 (HP)	2	30
4		**SANDSTONE***, brown		15	DCI	X	12	12-12-18 N=30	3	9
		19.7	816.5+/-			X		37-50/3"	4	9
		Boring Terminated at 19.7 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.
Bulk samples obtained at the following depths: 0'-5', 5'-10', 10'-15', and 15'-19'

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

None observed while drilling
None observed after drilling
None observed on 1/8/20
DCI @ 18.5' on 1/8/20

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 01-06-2020 | Boring Completed: 01-06-2020
Drill Rig: 897 | Driller: CN
Project No.: 08195294

BORING LOG NO. 13

PROJECT: Cargill CCR Landfill

CLIENT: Cargill, Inc.
Eddyville, Iowa

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

LOCATION See Exploration Plan

Latitude: 41.1798° Longitude: -92.7427°

Approximate Surface Elev.: 836 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
1	0.0	836+/-	**Approx. 2 Inch Root Zone**							
			FAT CLAY (CH), trace sand, gray with brown, medium stiff							
	5.5	830.5+/-		5		X	18	3-3-3 N=6 3000 (HP)	1	27
2			**LEAN CLAY (CL)**, trace sand, gray with brown							
	9.0	827+/-								
3			**LEAN CLAY (CL)**, with sand, orange brown, stiff	10		X	18	3-5-7 N=12 8000 (HP)	2	25
	14.0	822+/-								
4			**SHALE***, light gray brown, highly weathered	15	DCI	X	18	7-37-48 N=85	3	14
	19.0	817+/-								
	19.8	816+/-	**SANDSTONE***, light brown			X		38-50/4"	4	9
			Boring Terminated at 19.8 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.
Bulk samples obtained at the following depths: 0'-5', 5'-10', 10'-15', and 15'-19'

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

None observed while drilling
None observed after drilling
None observed on 1/8/20
DCI @ 18.5' on 1/8/20

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 01-06-2020 | Boring Completed: 01-06-2020
Drill Rig: 897 | Driller: CN
Project No.: 08195294

BORING LOG NO. 14

PROJECT: Cargill CCR Landfill

CLIENT: Cargill, Inc.
Eddyville, Iowa

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

LOCATION See Exploration Plan

Latitude: 41.1801° Longitude: -92.7429°

Approximate Surface Elev.: 828 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
1		**Approx. 2 Inch Root Zone**								
		FAT CLAY (CH), trace sand, gray with brown, stiff								
		5.5	822.5+/-	5						
							12	6-7-7 N=14 9000 (HP)	1	15
2		**LEAN CLAY (CL)**, trace sand, gray brown, medium stiff								
		13.0	815+/-	10						
							18	3-2-4 N=6 3500 (HP)	2	30
4		**RESIDUAL SHALE***, light gray, brown, and orange brown								
		19.0	809+/-	15						
							18	6-7-8 N=15 9000 (HP)	3	10
		SHALE*, with sandstone stringers, gray								
		20.5	807.5+/-	20			12	3-3-4 N=7	4	28
		Boring Terminated at 20.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.
Bulk samples obtained at the following depths: 0'-5', 5'-10', 10'-15', and 15'-20'

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

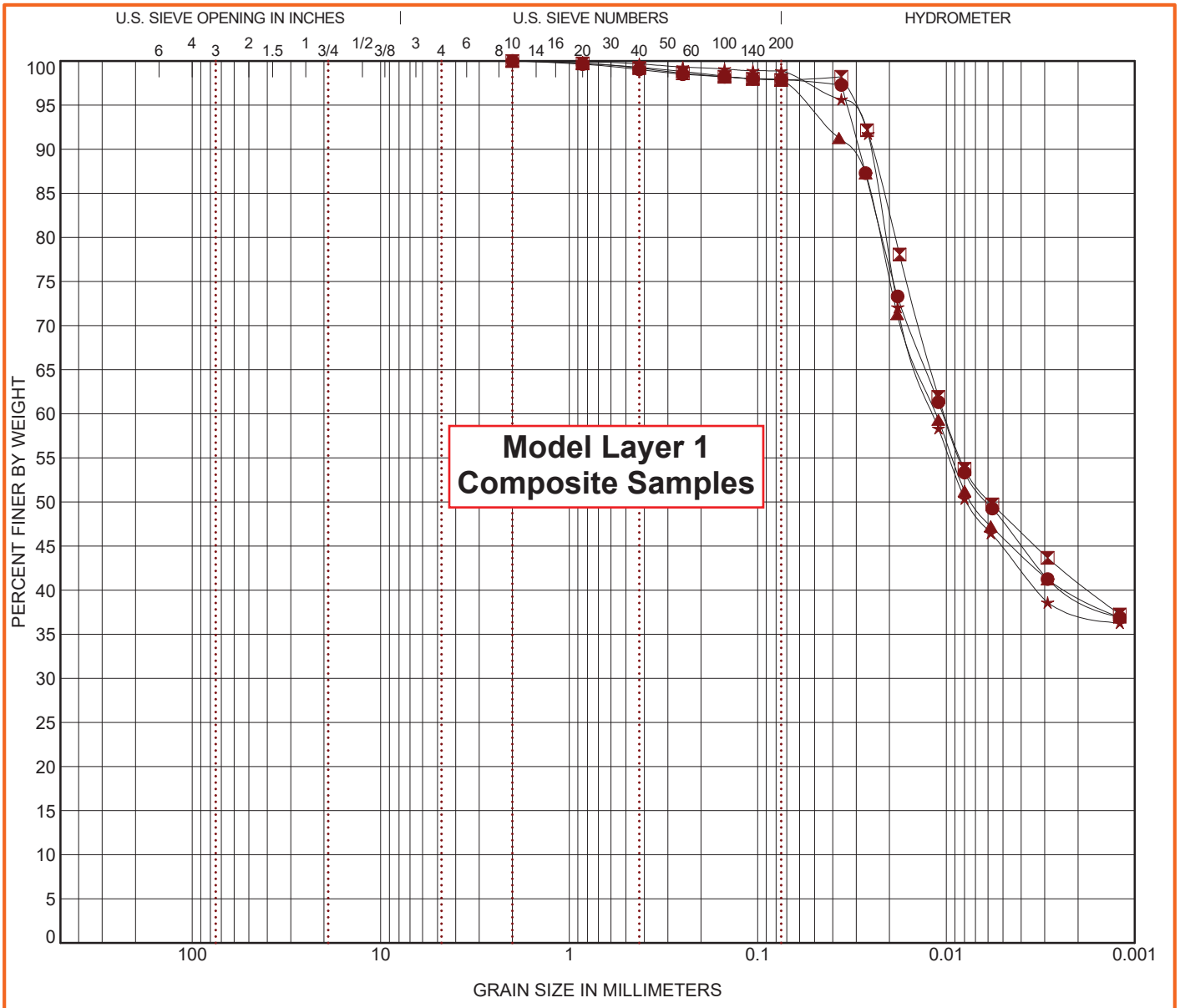
None observed while drilling
None observed after drilling
13.5' on 1/8/20
WCI @ 14.5' on 1/8/20

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 01-06-2020 | Boring Completed: 01-06-2020
Drill Rig: 897 | Driller: CN
Project No.: 08195294

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Model Layer	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	1 and 2	1	FAT CLAY (CH)		55	22	33		
⊠	11 and 14	1	FAT CLAY (CH)		55	22	33		
▲	12 and 13	1	FAT CLAY (CH)		54	23	31		
★	6 and 8	1	FAT CLAY (CH)		57	20	37		

Boring ID		Model Layer	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt		%Clay
●	1 and 2	1	2	0.01			0.0	0.0	2.1	50.2		47.7
⊠	11 and 14	1	2	0.01			0.0	0.0	2.1	49.3		48.5
▲	12 and 13	1	2	0.011			0.0	0.0	2.1	51.9		46.0
★	6 and 8	1	2	0.012			0.0	0.0	1.1	54.1		44.8

PROJECT: Cargill CCR Landfill

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

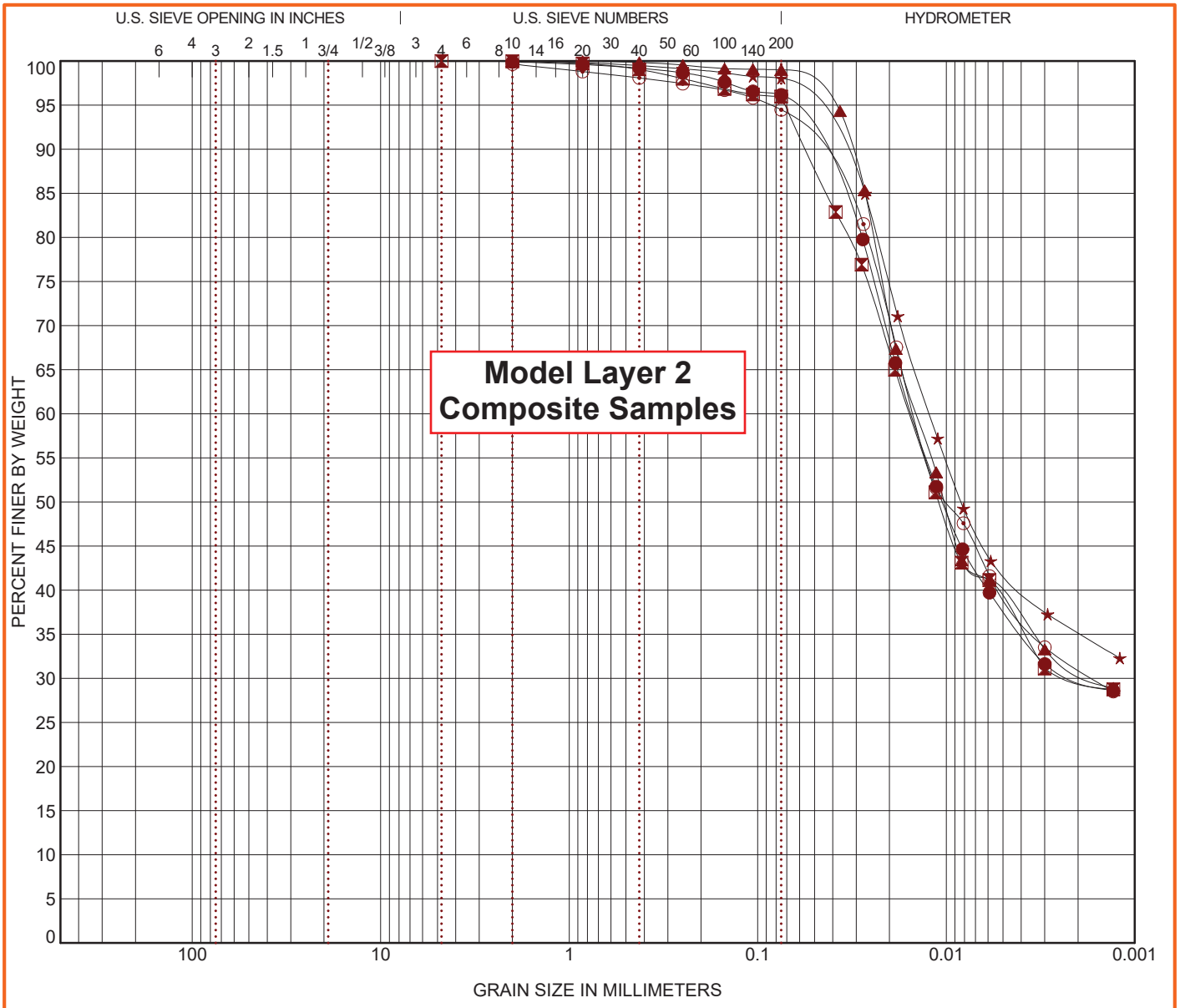
PROJECT NUMBER: 08195294

CLIENT: Cargill, Inc.
Eddyville, Iowa

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 INUSE08195294 CARGILL CCR LANDF.GPJ TERRACON_DATATEMPLATE.GDT 2/4/20

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Model Layer	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
● 1 and 2	2	LEAN CLAY (CL)		43	19	24		
⊠ 10, 12, and 13	2	LEAN CLAY (CL)		42	19	23		
▲ 3 and 4	2	LEAN CLAY (CL)		45	19	26		
★ 6 and 7	2	LEAN CLAY (CL)		45	18	27		
⊙ 8 and 9	2	LEAN CLAY (CL)		41	19	22		

Boring ID	Model Layer	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
● 1 and 2	2	2	0.015	0.002				3.7	58.4		37.7
⊠ 10, 12, and 13	2	4.75	0.016	0.002		0.0	0.0	4.0	57.3		38.7
▲ 3 and 4	2	2	0.014	0.002		0.0	0.0	1.0	59.7		39.3
★ 6 and 7	2	2	0.012					1.9	56.0		42.0
⊙ 8 and 9	2	2	0.015	0.002				5.2	54.9		39.6

PROJECT: Cargill CCR Landfill

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

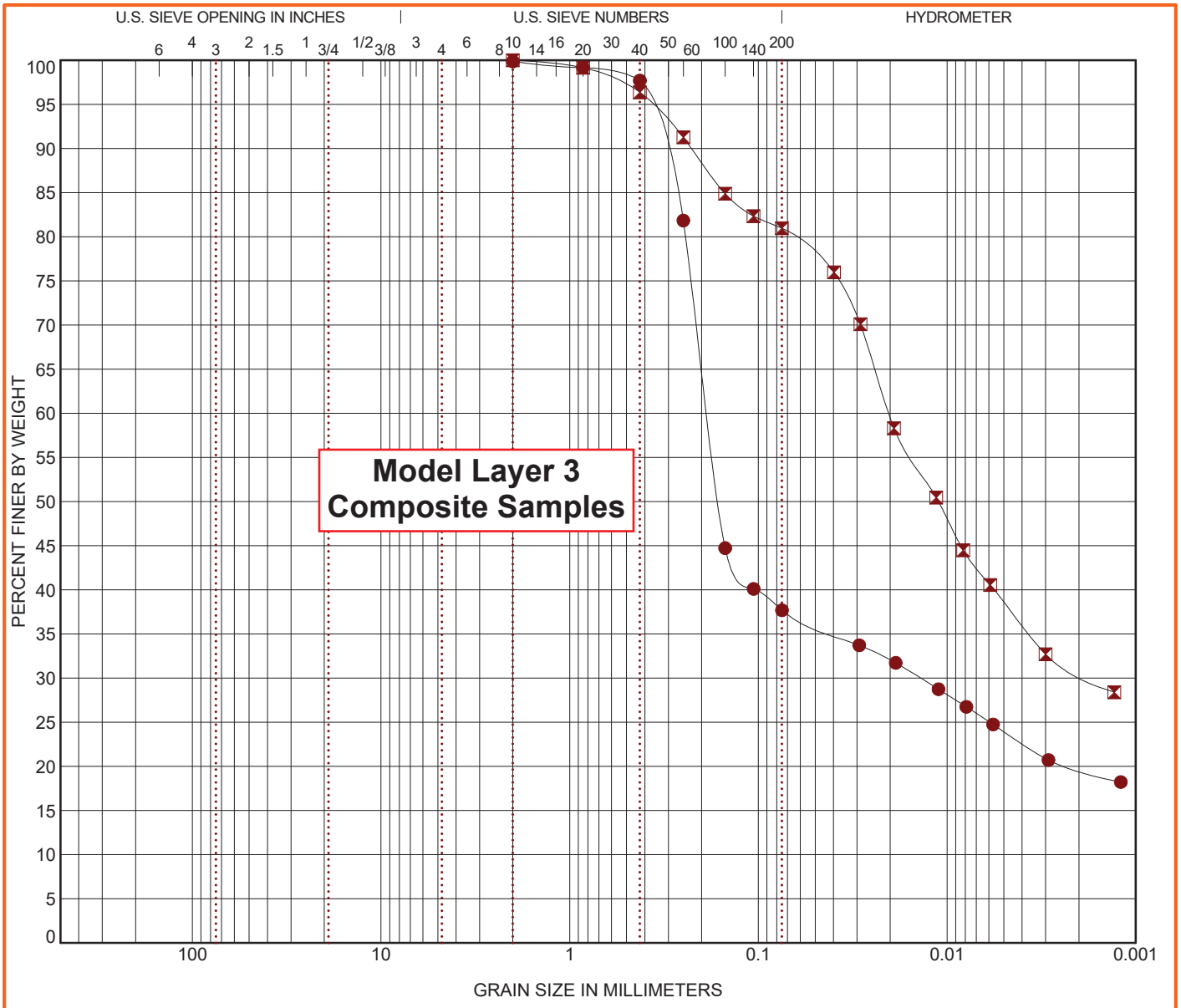
Terracon
600 SW 7th St, Ste M
Des Moines, IA

PROJECT NUMBER: 08195294

CLIENT: Cargill, Inc.
Eddyville, Iowa

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Model Layer	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
● 10 and 11	3	CLAYEY SAND (SC)		29	16	13		
⊠ 5	3	LEAN CLAY with SAND (CL)		39	15	24		

Boring ID	Model Layer	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
● 10 and 11	3	2	0.185	0.014				62.2	13.7		24.0
⊠ 5	3	2	0.02	0.002		0.0	0.0	19.0	42.3		38.6

PROJECT: Cargill CCR Landfill

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

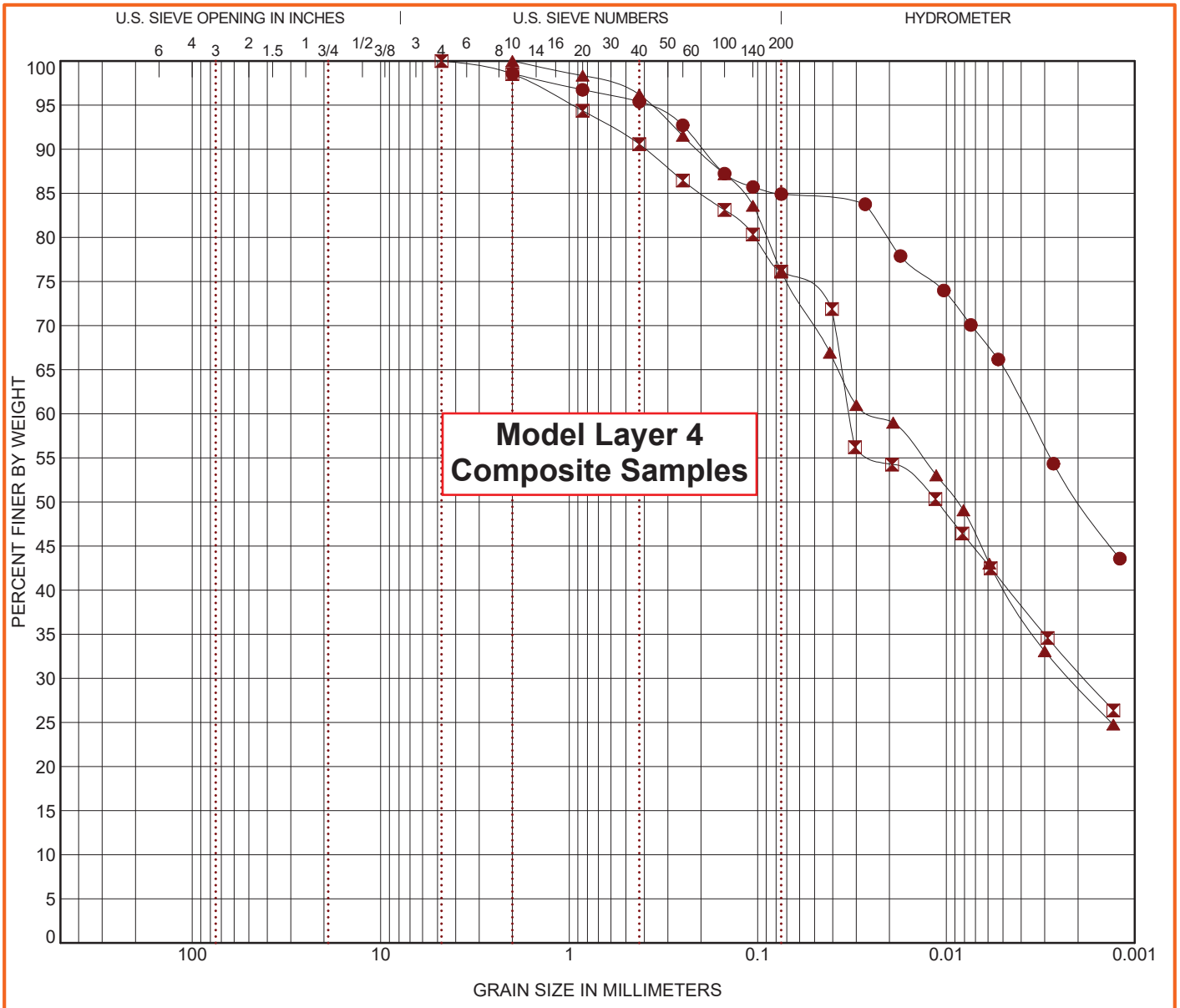
PROJECT NUMBER: 08195294

CLIENT: Cargill, Inc.
Eddyville, Iowa

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 INUSE08195294 CARGILL CCR LANDF.GPJ TERRACON_DATATEMPLATE.GDT 2/4/20

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Model Layer	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	11 and 14	4	Shale, highly weathered, and LEAN CLAY with SAND (CL)		46	21	25		
⊠	4 and 5	4	Shale, highly weathered		40	19	21		
▲	7 and 8	4	Shale, highly weathered		33	16	17		

	Boring ID	Model Layer	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	11 and 14	4	2	0.004					13.7	19.8		65.1
⊠	4 and 5	4	4.75	0.033	0.002		0.0	0.0	23.9	35.3		40.8
▲	7 and 8	4	2	0.024	0.002		0.0	0.0	23.9	35.5		40.6

PROJECT: Cargill CCR Landfill

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

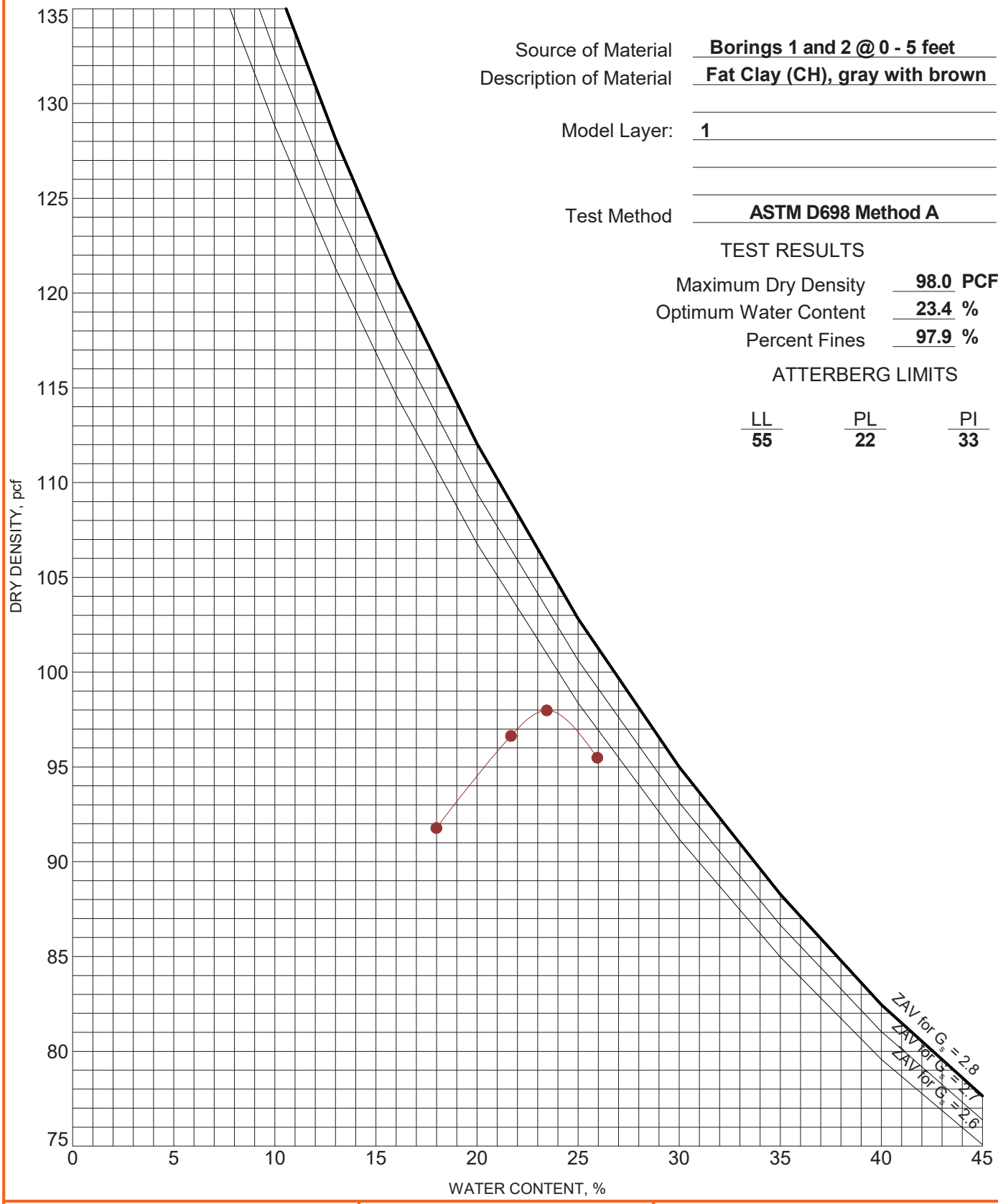
PROJECT NUMBER: 08195294

CLIENT: Cargill, Inc.
Eddyville, Iowa

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 INUSE08195294 CARGILL CCR LANDF.GPJ TERRACON_DATATEMPLATE.GDT 2/4/20

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**Borings 1 and 2 @ 0 - 5 feet**
Description of Material	**Fat Clay (CH), gray with brown**
Model Layer:	**1**
Test Method	**ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**98.0**	**PCF**
Optimum Water Content	**23.4**	**%**
Percent Fines	**97.9**	**%**

ATTERBERG LIMITS

LL	PL	PI
55	**22**	**33**

PROJECT: Cargill CCR Landfill

PROJECT NUMBER: 08195294

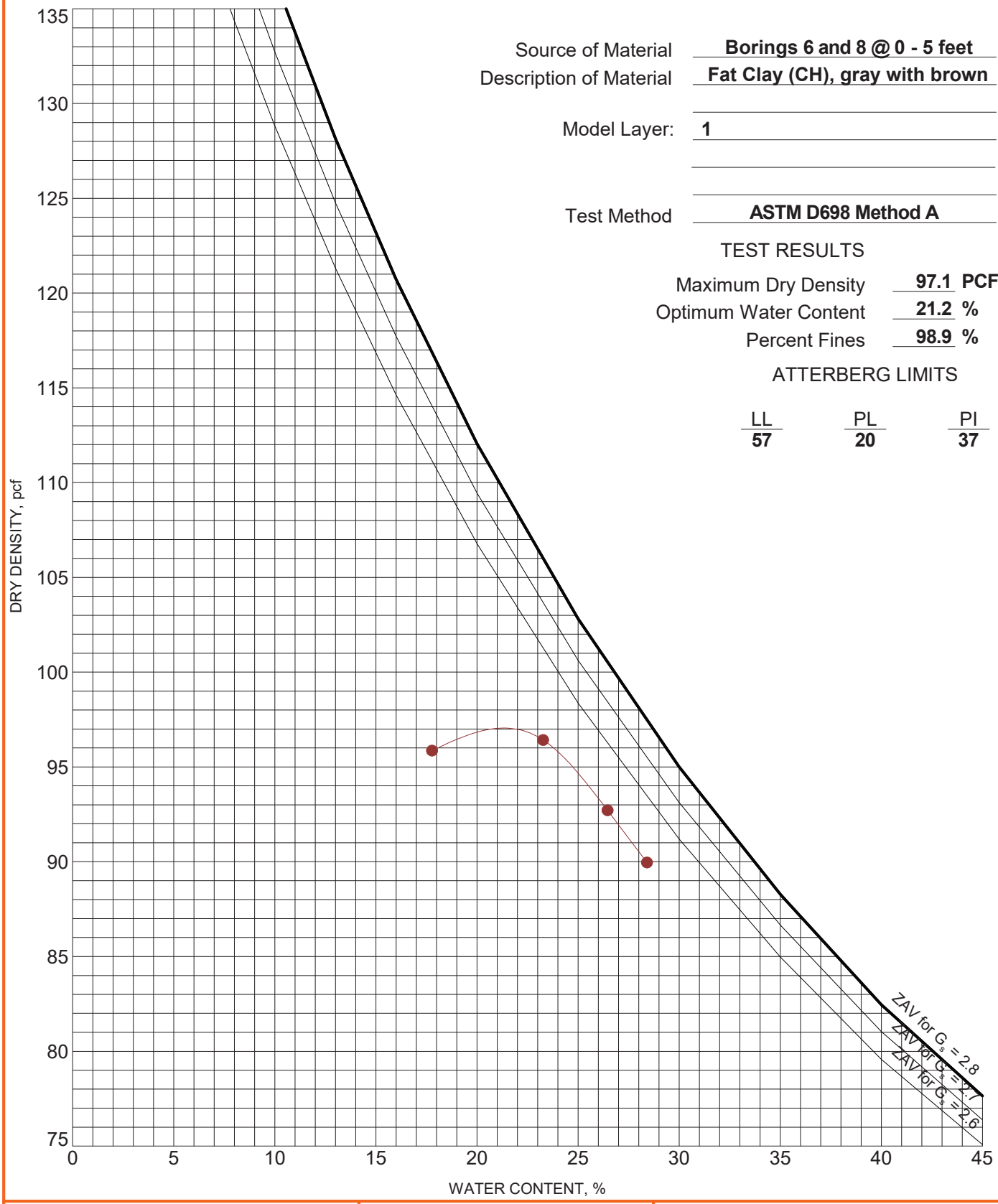
SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

CLIENT: Cargill, Inc.
Eddyville, Iowa

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**Borings 6 and 8 @ 0 - 5 feet**
Description of Material	**Fat Clay (CH), gray with brown**
Model Layer:	**1**
Test Method	**ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**97.1**	**PCF**
Optimum Water Content	**21.2**	**%**
Percent Fines	**98.9**	**%**

ATTERBERG LIMITS

LL	PL	PI
57	**20**	**37**

PROJECT: Cargill CCR Landfill

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

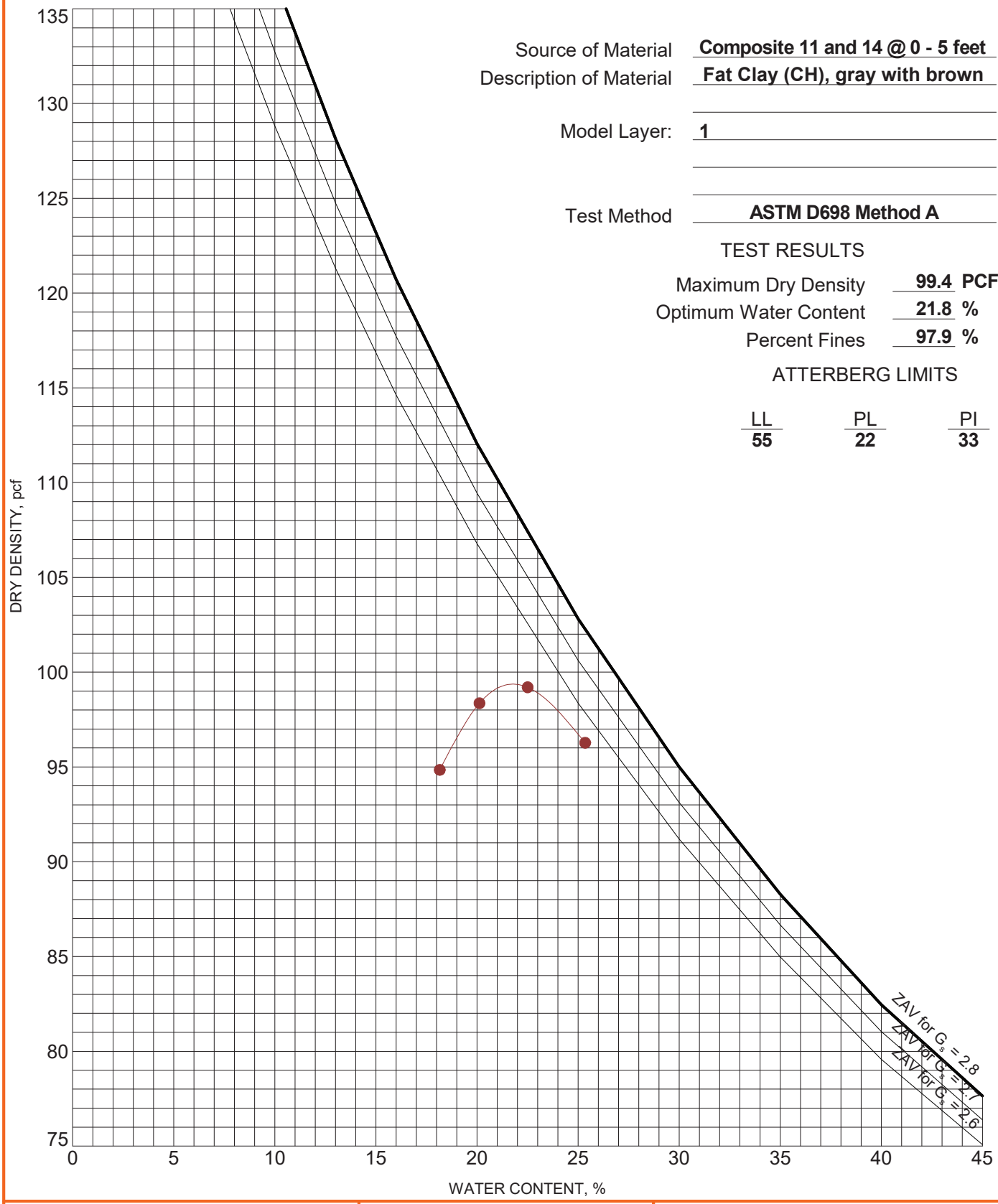
Terracon
600 SW 7th St, Ste M
Des Moines, IA

PROJECT NUMBER: 08195294

CLIENT: Cargill, Inc.
Eddyville, Iowa

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**Composite 11 and 14 @ 0 - 5 feet**
Description of Material	**Fat Clay (CH), gray with brown**
Model Layer:	**1**
Test Method	**ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**99.4**	**PCF**
Optimum Water Content	**21.8**	**%**
Percent Fines	**97.9**	**%**

ATTERBERG LIMITS

LL	PL	PI
55	**22**	**33**

PROJECT: Cargill CCR Landfill

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

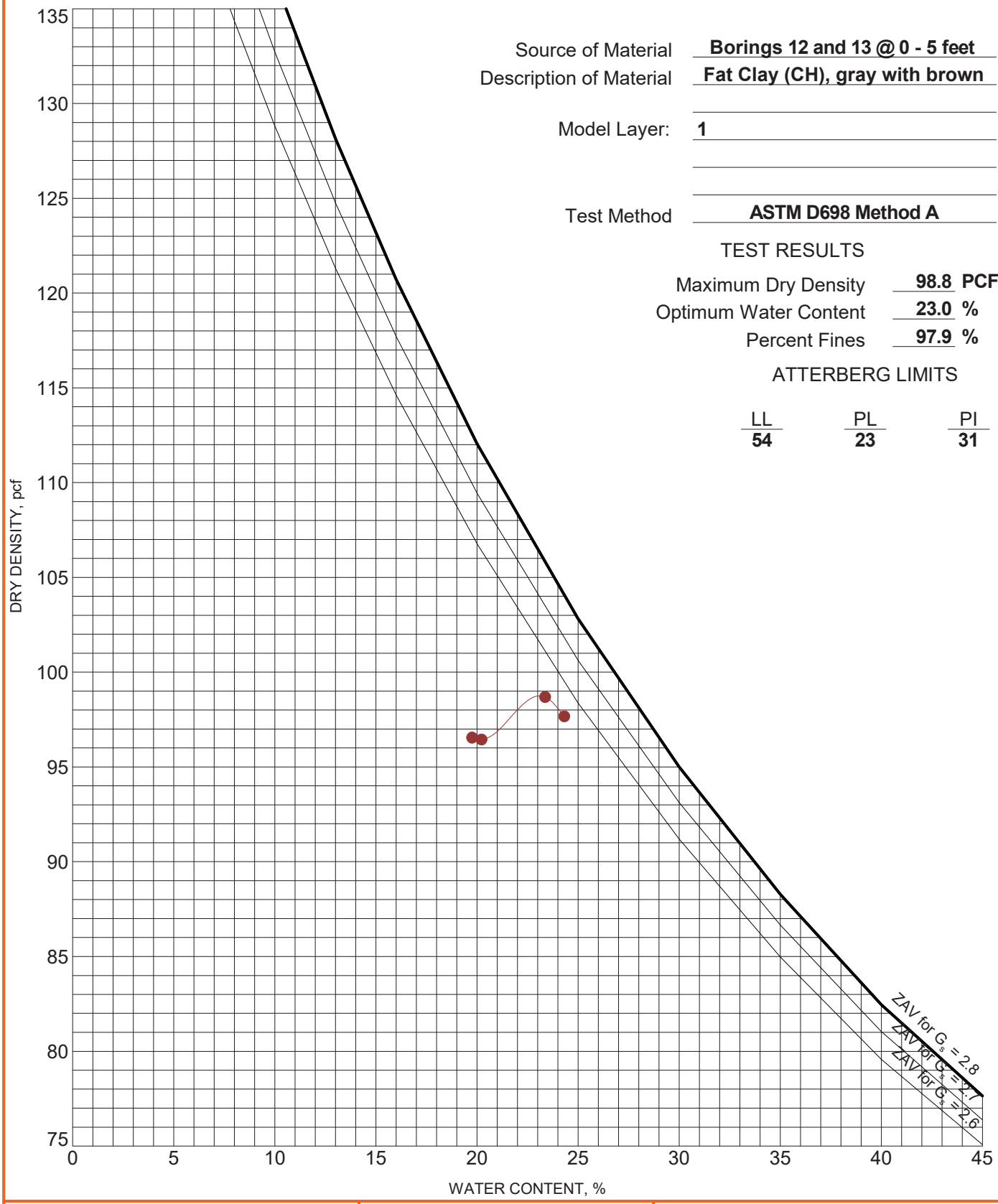
Terracon
600 SW 7th St, Ste M
Des Moines, IA

PROJECT NUMBER: 08195294

CLIENT: Cargill, Inc.
Eddyville, Iowa

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**Borings 12 and 13 @ 0 - 5 feet**
Description of Material	**Fat Clay (CH), gray with brown**
Model Layer:	**1**
Test Method	**ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**98.8 PCF**
Optimum Water Content	**23.0 %**
Percent Fines	**97.9 %**

ATTERBERG LIMITS

LL	PL	PI
54	**23**	**31**

PROJECT: Cargill CCR Landfill

PROJECT NUMBER: 08195294

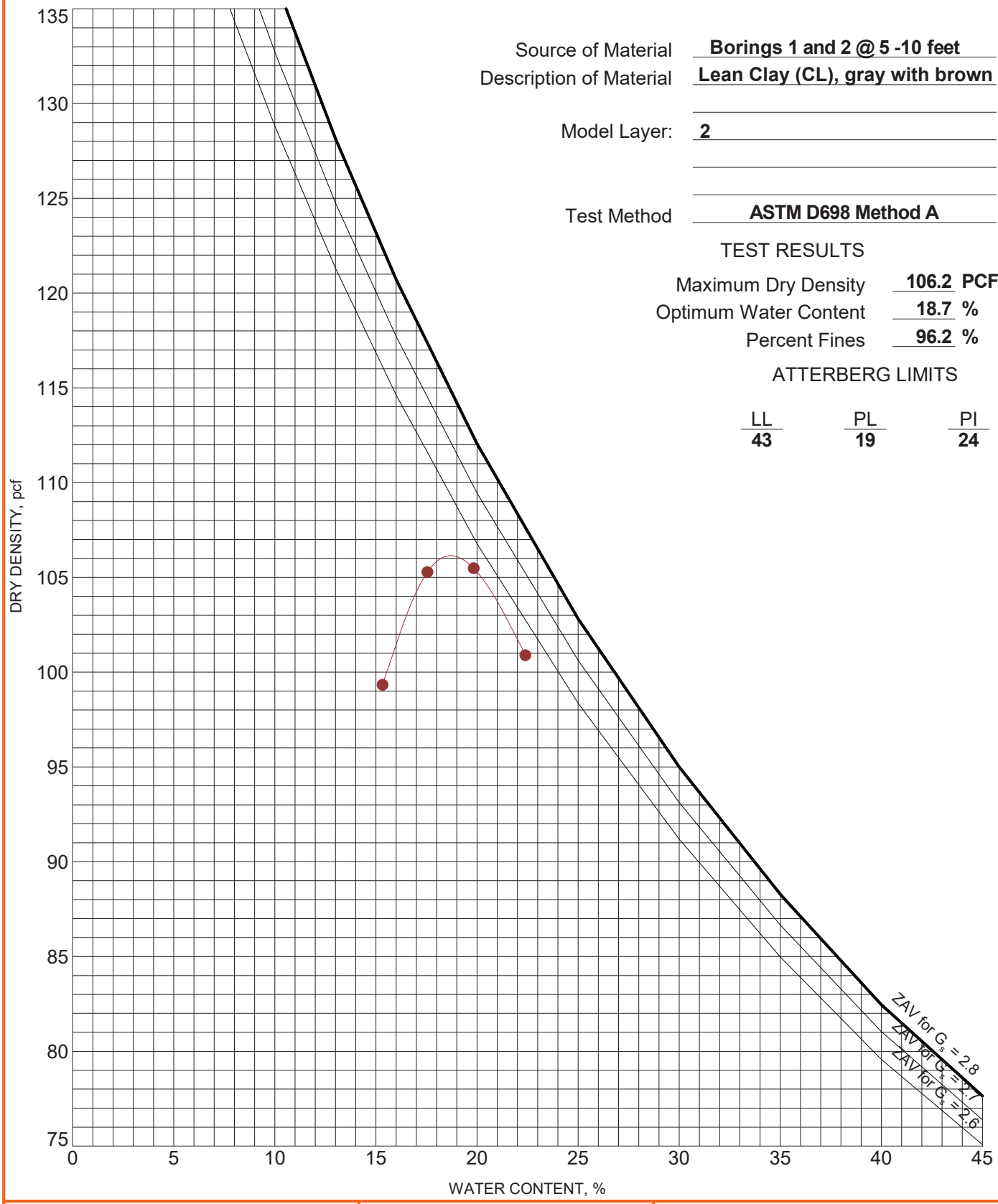
SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

CLIENT: Cargill, Inc.
Eddyville, Iowa

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**Borings 1 and 2 @ 5 -10 feet**
Description of Material	**Lean Clay (CL), gray with brown**
Model Layer:	**2**
Test Method	**ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**106.2 PCF**
Optimum Water Content	**18.7 %**
Percent Fines	**96.2 %**

ATTERBERG LIMITS

LL	PL	PI
43	**19**	**24**

PROJECT: Cargill CCR Landfill

PROJECT NUMBER: 08195294

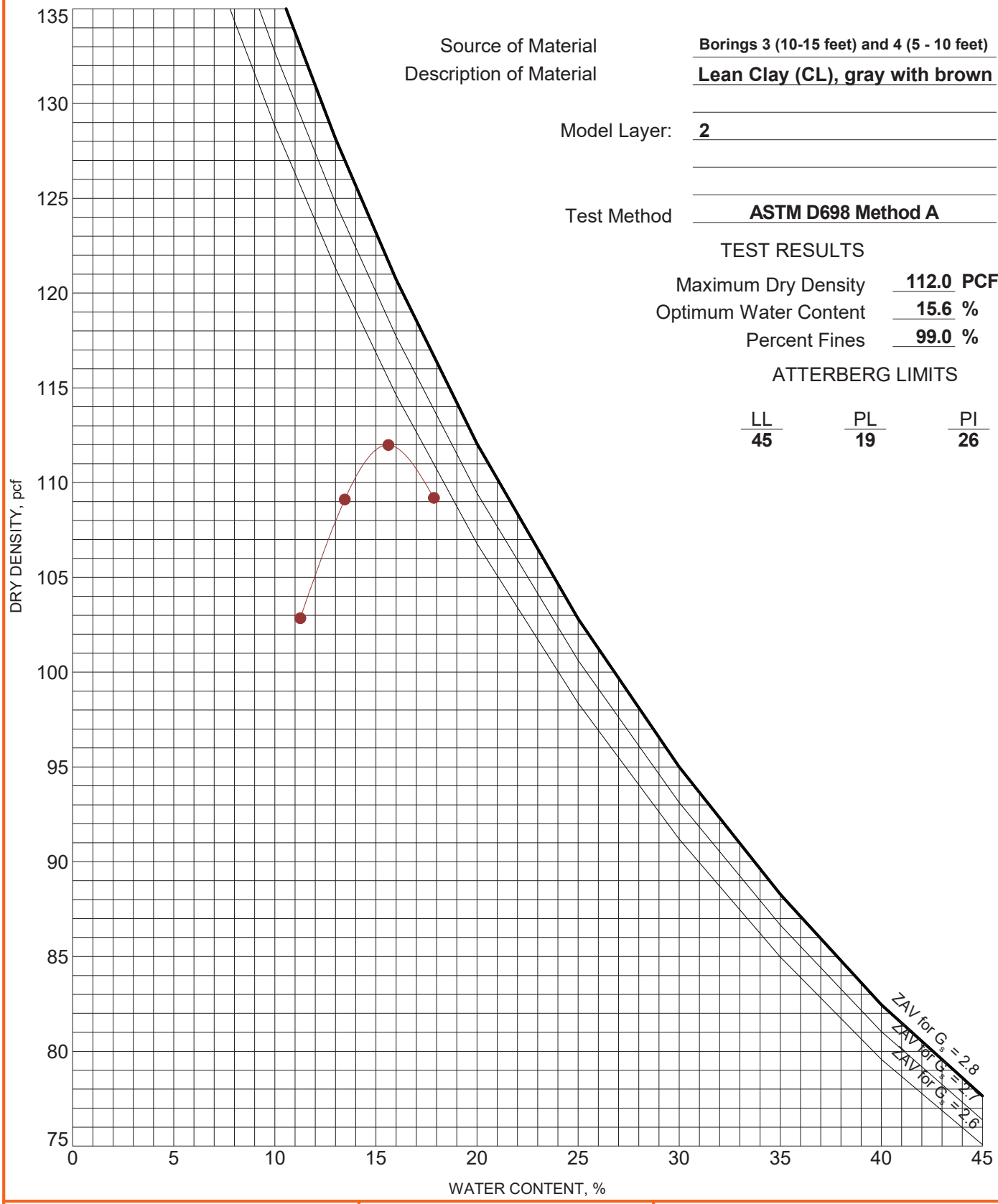
SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

CLIENT: Cargill, Inc.
Eddyville, Iowa

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**Borings 3 (10-15 feet) and 4 (5 - 10 feet)**
Description of Material	**Lean Clay (CL), gray with brown**
Model Layer:	**2**
Test Method	**ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**112.0 PCF**
Optimum Water Content	**15.6 %**
Percent Fines	**99.0 %**

ATTERBERG LIMITS

LL	PL	PI
45	**19**	**26**

PROJECT: Cargill CCR Landfill

PROJECT NUMBER: 08195294

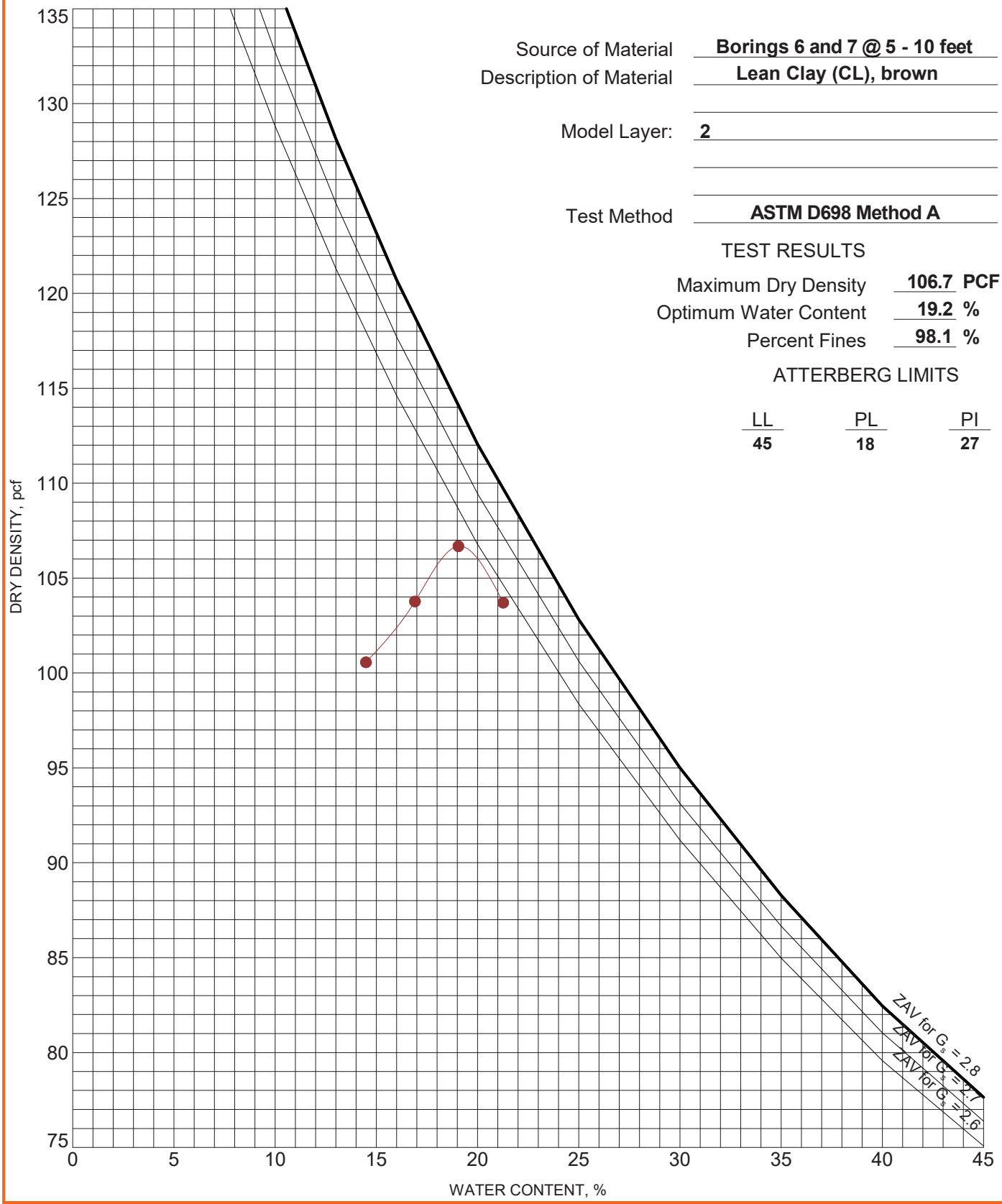
SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

CLIENT: Cargill, Inc.
Eddyville, Iowa

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**Borings 6 and 7 @ 5 - 10 feet**
Description of Material	**Lean Clay (CL), brown**
Model Layer:	**2**
Test Method	**ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**106.7 PCF**
Optimum Water Content	**19.2 %**
Percent Fines	**98.1 %**

ATTERBERG LIMITS

LL	PL	PI
45	**18**	**27**

PROJECT: Cargill CCR Landfill

PROJECT NUMBER: 08195294

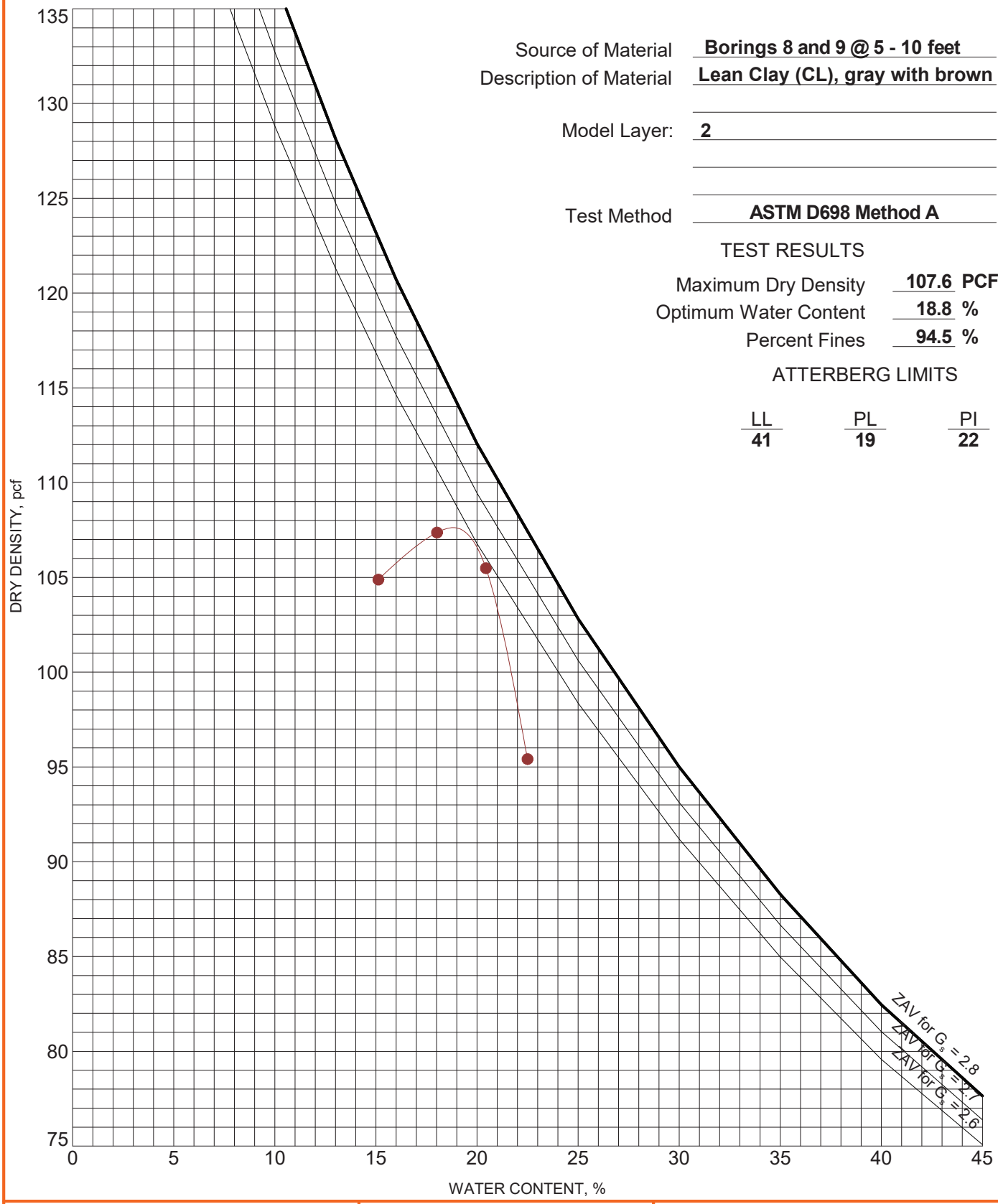
SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

CLIENT: Cargill, Inc.
Eddyville, Iowa

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**Borings 8 and 9 @ 5 - 10 feet**
Description of Material	**Lean Clay (CL), gray with brown**
Model Layer:	**2**
Test Method	**ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**107.6**	**PCF**
Optimum Water Content	**18.8**	**%**
Percent Fines	**94.5**	**%**

ATTERBERG LIMITS

LL	PL	PI
41	**19**	**22**

PROJECT: Cargill CCR Landfill

PROJECT NUMBER: 08195294

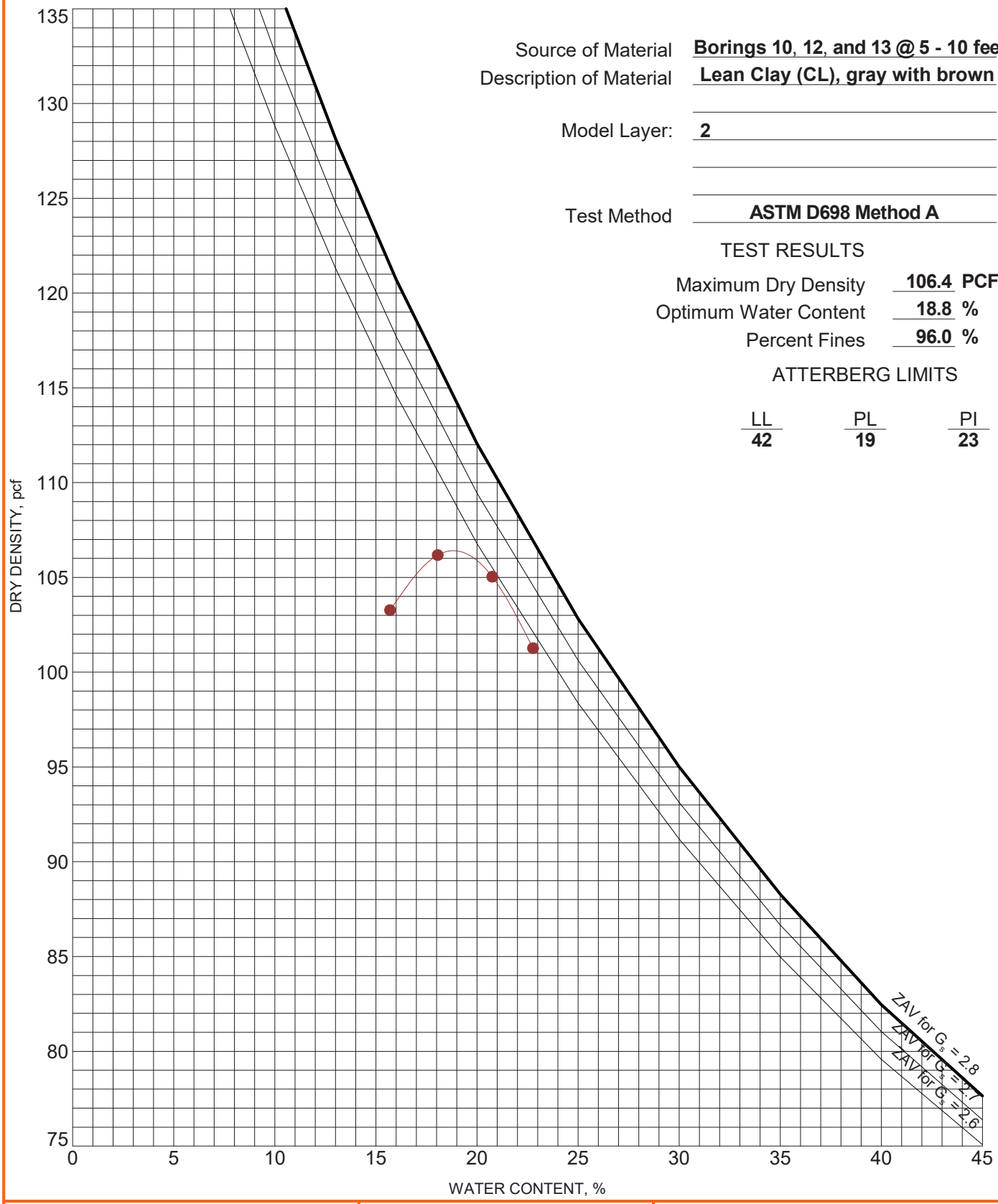
SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

CLIENT: Cargill, Inc.
Eddyville, Iowa

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**Borings 10, 12, and 13 @ 5 - 10 feet**
Description of Material	**Lean Clay (CL), gray with brown**
Model Layer:	**2**
Test Method	**ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**106.4**	**PCF**
Optimum Water Content	**18.8**	**%**
Percent Fines	**96.0**	**%**

ATTERBERG LIMITS

LL	PL	PI
42	**19**	**23**

PROJECT: Cargill CCR Landfill

PROJECT NUMBER: 08195294

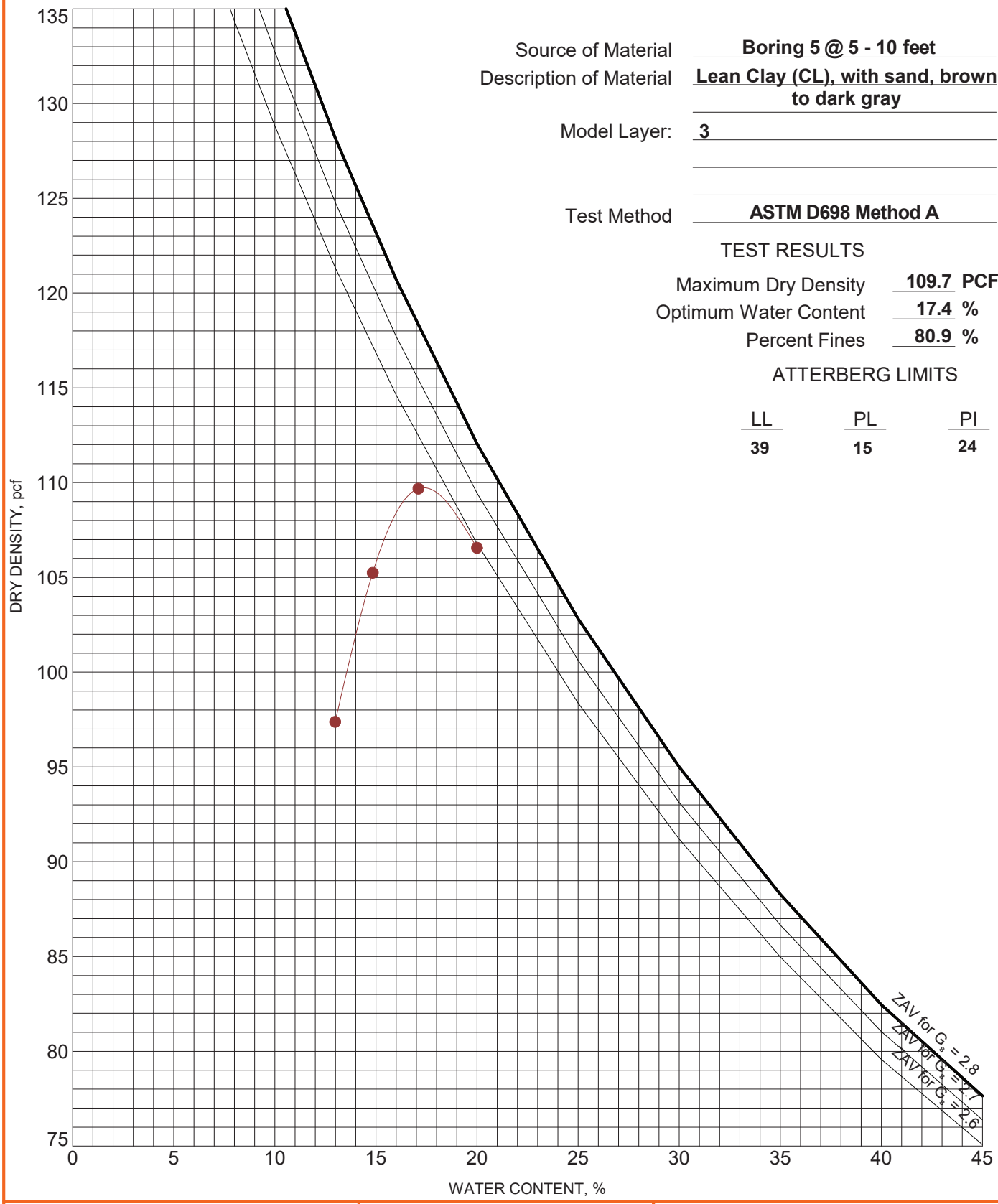
SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

CLIENT: Cargill, Inc.
Eddyville, Iowa

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**Boring 5 @ 5 - 10 feet**
Description of Material	**Lean Clay (CL), with sand, brown to dark gray**
Model Layer:	**3**
Test Method	**ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**109.7**	**PCF**
Optimum Water Content	**17.4**	**%**
Percent Fines	**80.9**	**%**

ATTERBERG LIMITS

LL	PL	PI
39	**15**	**24**

PROJECT: Cargill CCR Landfill

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

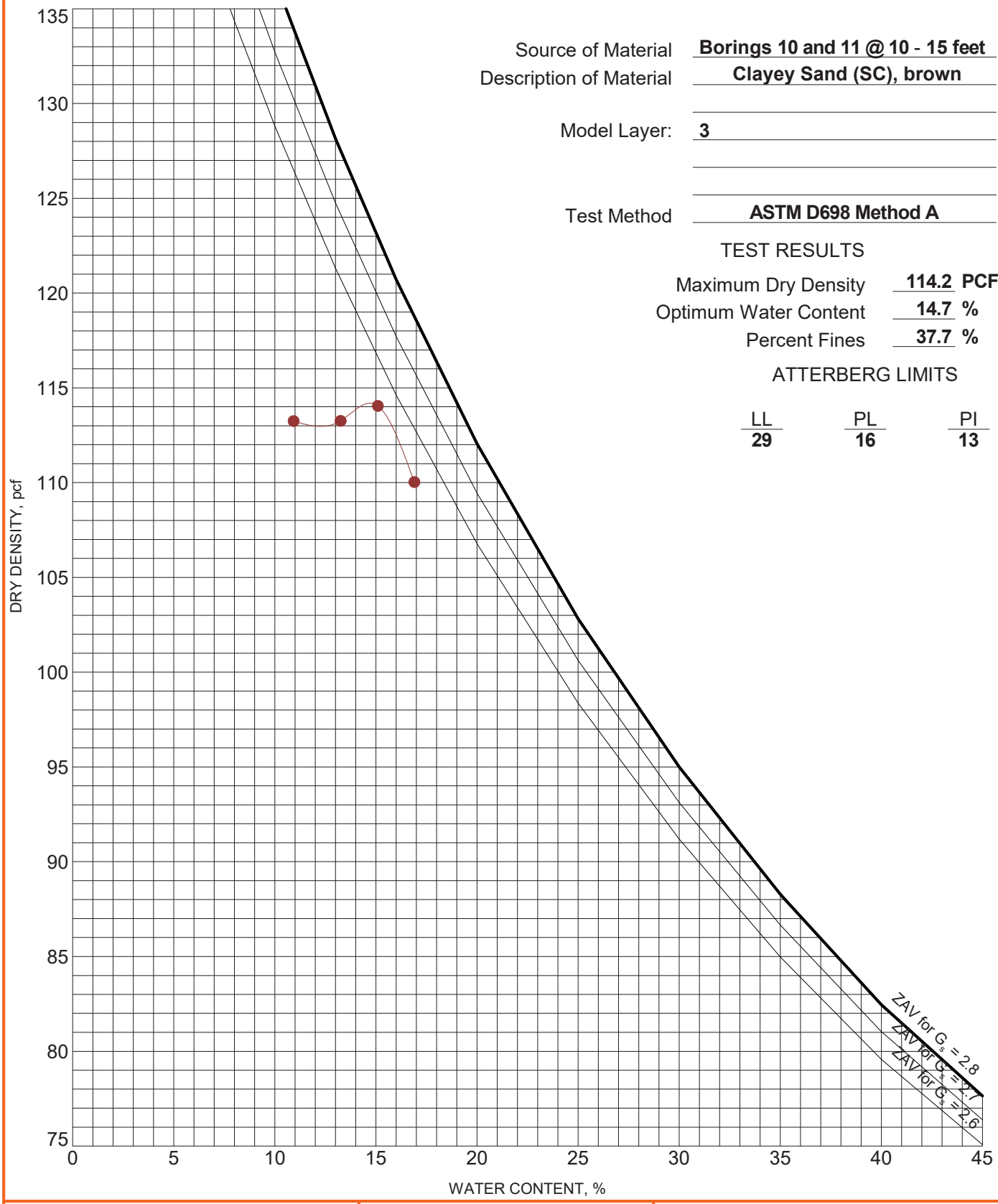
Terracon
600 SW 7th St, Ste M
Des Moines, IA

PROJECT NUMBER: 08195294

CLIENT: Cargill, Inc.
Eddyville, Iowa

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**Borings 10 and 11 @ 10 - 15 feet**
Description of Material	**Clayey Sand (SC), brown**
Model Layer:	**3**
Test Method	**ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**114.2 PCF**
Optimum Water Content	**14.7 %**
Percent Fines	**37.7 %**

ATTERBERG LIMITS

LL	PL	PI
29	**16**	**13**

PROJECT: Cargill CCR Landfill

PROJECT NUMBER: 08195294

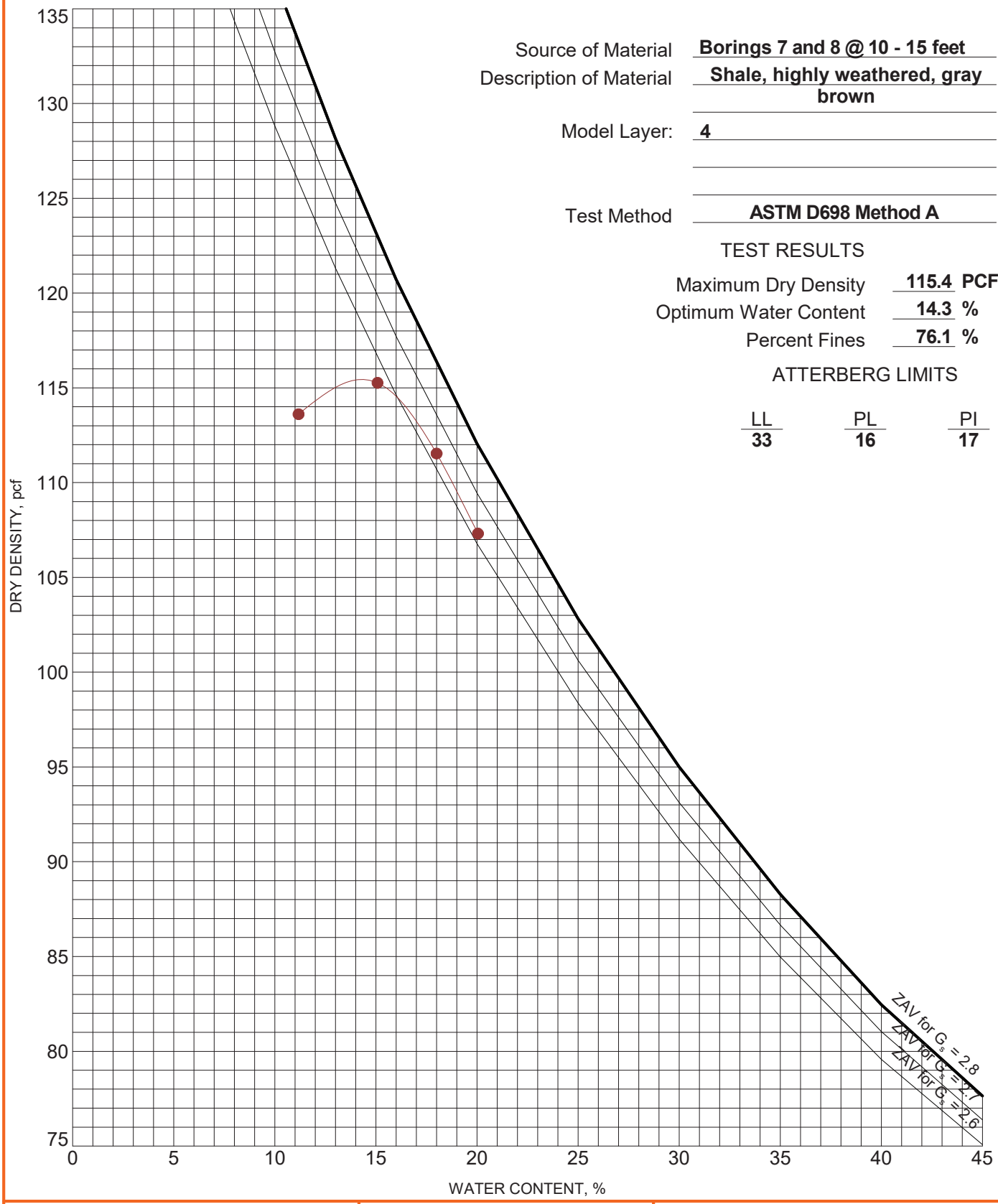
SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

CLIENT: Cargill, Inc.
Eddyville, Iowa

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**Borings 7 and 8 @ 10 - 15 feet**
Description of Material	**Shale, highly weathered, gray brown**
Model Layer:	**4**
Test Method	**ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**115.4 PCF**
Optimum Water Content	**14.3 %**
Percent Fines	**76.1 %**

ATTERBERG LIMITS

LL	PL	PI
33	**16**	**17**

PROJECT: Cargill CCR Landfill

PROJECT NUMBER: 08195294

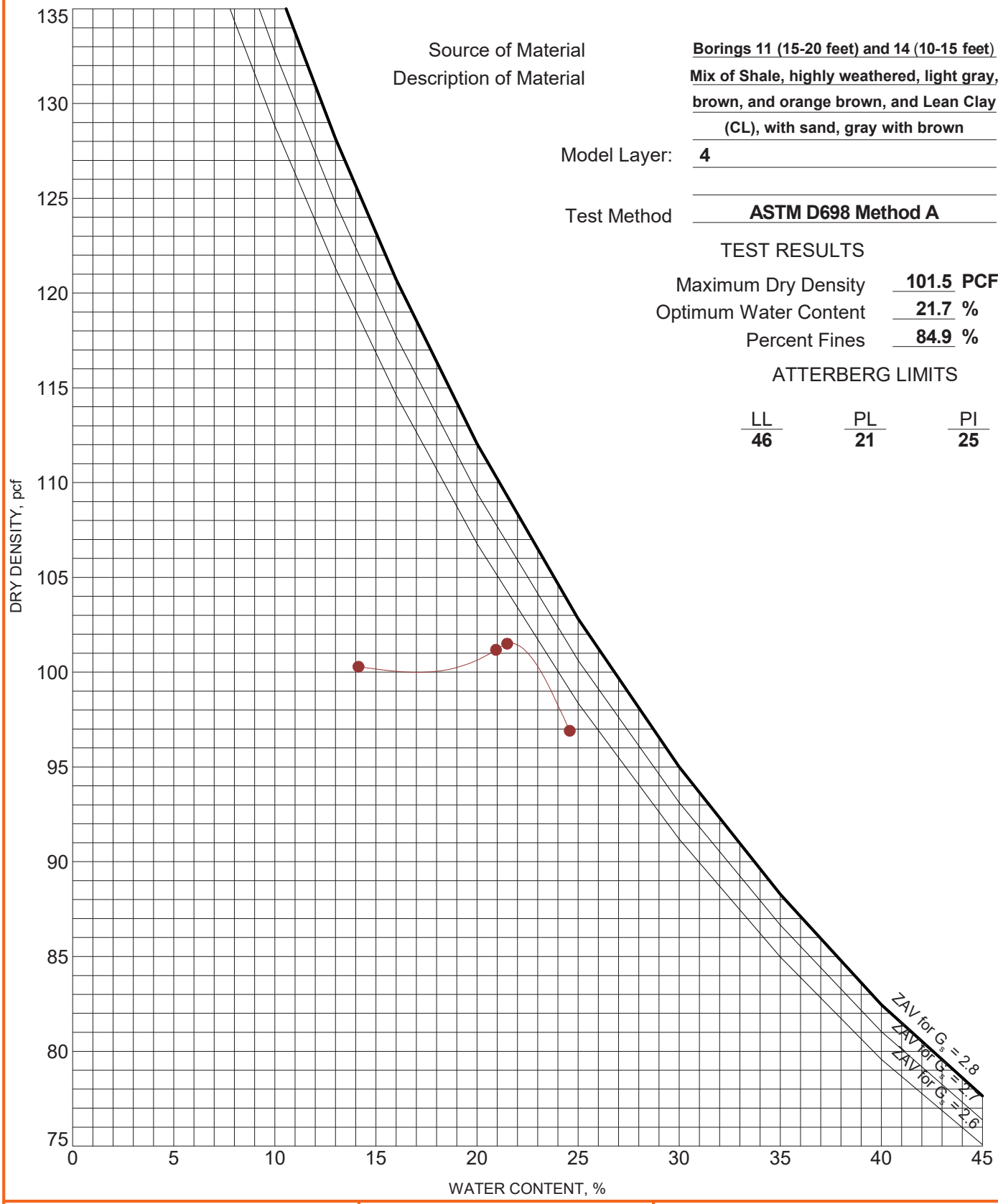
SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

CLIENT: Cargill, Inc.
Eddyville, Iowa

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **Borings 11 (15-20 feet) and 14 (10-15 feet)**

Description of Material: **Mix of Shale, highly weathered, light gray, brown, and orange brown, and Lean Clay (CL), with sand, gray with brown**

Model Layer: **4**

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**101.5 PCF**
Optimum Water Content	**21.7 %**
Percent Fines	**84.9 %**

ATTERBERG LIMITS

LL	PL	PI
46	**21**	**25**

PROJECT: Cargill CCR Landfill

PROJECT NUMBER: 08195294

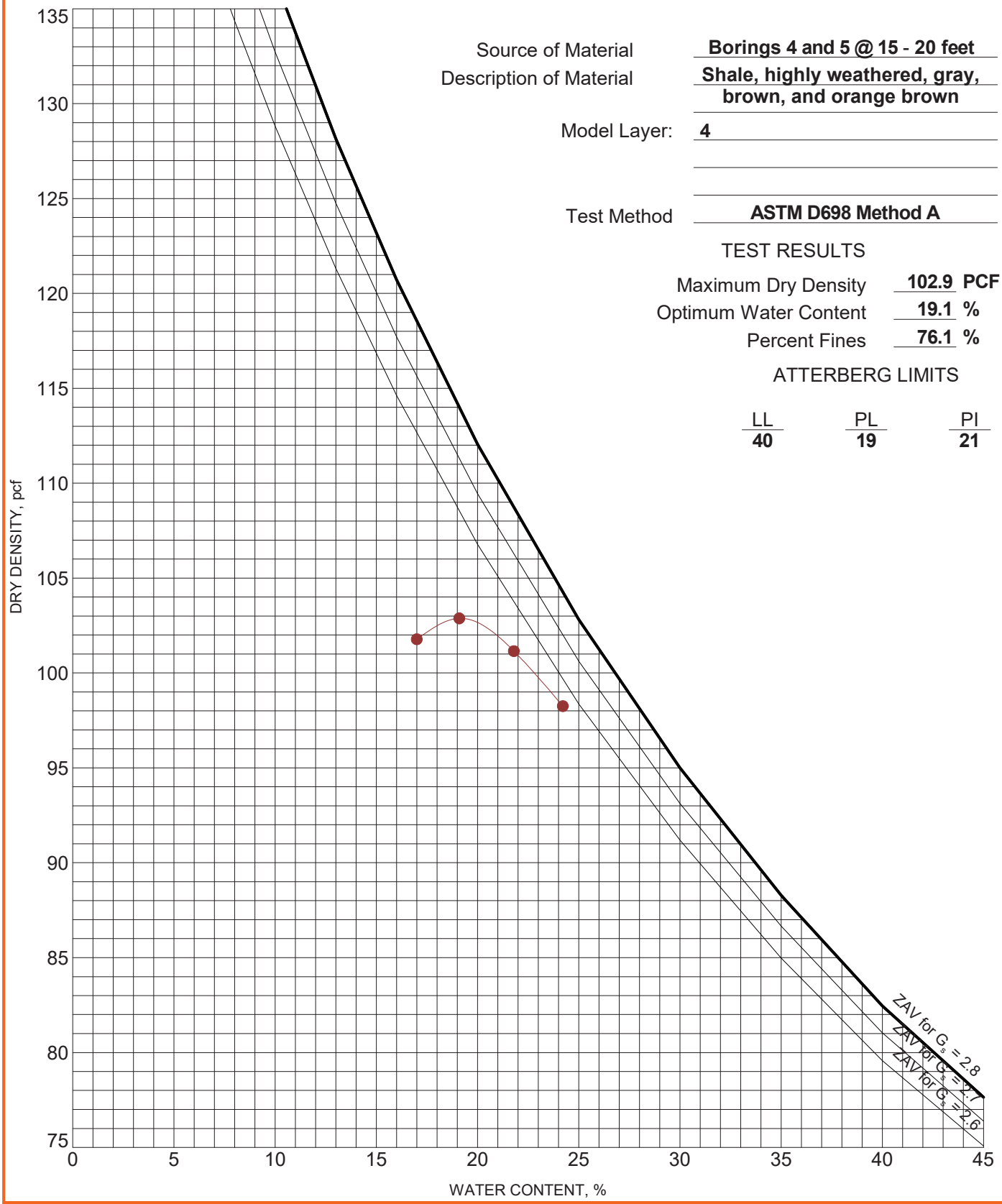
SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

CLIENT: Cargill, Inc.
Eddyville, Iowa

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**Borings 4 and 5 @ 15 - 20 feet**
Description of Material	**Shale, highly weathered, gray, brown, and orange brown**
Model Layer:	**4**
Test Method	**ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**102.9**	**PCF**
Optimum Water Content	**19.1**	**%**
Percent Fines	**76.1**	**%**

ATTERBERG LIMITS

LL	PL	PI
40	**19**	**21**

PROJECT: Cargill CCR Landfill

PROJECT NUMBER: 08195294

SITE: SW Corner of Galeston Avenue and 325th Street
Eddyville, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

CLIENT: Cargill, Inc.
Eddyville, Iowa

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Cargill CCR Landfill							
Date:	1/28/2020	Panel Number :	P-1					
Project No. :	O8195294	Permometer Data						
Boring No.:	1 and 2	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Model Layer:	1	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	0 - 5	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:	Remolded	M_2 =	1.040953	T = 0.0658646				

Material Description : Model Layer 1 - Fat Clay (CH), gray with brown

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			528.70	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			528.70	g	Tare No.:	328	Tare No.:	123
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	112.48	Wet Wt.+tare:	104.61
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	93.95	Dry Wt.+tare:	88.00
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	21.04	Tare Wt:	31.26
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	72.91	Dry Wt.:	56.74
Unit Wt.(wet):	**116.77**	pcf	**1.87**	$g/cm^{\wedge 3}$	Water Wt.:	18.53	Water Wt.:	16.61
Unit Wt.(dry):	**93.11**	pcf	**1.49**	$g/cm^{\wedge 3}$	% moist.:	**25.4**	% moist.:	**29.3**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = OMC =
% of max = +/- OMC =
Calculated % saturation: 97.53 Void ratio (e) = **0.81** Porosity (n)= **0.45**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/27/2020	300	16.7	0.082666	21	0.977	7.62E-09	2.16E-05	
1/27/2020	600	16.6	0.182666	21	0.977	8.45E-09	2.40E-05	
1/27/2020	900	16.5	0.282666	21	0.977	8.75E-09	2.48E-05	
1/27/2020	1200	16.4	0.382666	21	0.977	8.91E-09	2.53E-05	

SUMMARY

k_a =	8.43E-09	cm/sec		Acceptance criteria =	95 %
ki			Vm		
k1 =	7.62E-09	cm/sec	9.6	%	Vm = $\frac{\lvert k_a - k_i \rvert}{k_a} \times 100$
k2 =	8.45E-09	cm/sec	0.2	%	
k3 =	8.75E-09	cm/sec	3.7	%	
k4 =	8.91E-09	cm/sec	5.7	%	

Hydraulic conductivity	k =	**8.43E-09**	cm/sec	**2.39E-05**	ft/day
Void Ratio	e =	**0.81**			
Porosity	n =	**0.45**			
Bulk Density	γ =	**1.87**	g/cm^3	**116.8**	pcf
Water Content	W =	**0.38**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**8.64E-14**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Cargill CCR Landfill							
Date:	1/28/2020	Panel Number :	P-1					
Project No. :	O8195294	Permometer Data						
Boring No.:	6 and 8	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Model Layer:	1	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	0 - 5	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:	Remolded	M_2 =	1.040953	T = 0.0658646				

Material Description : Model Layer 1 - Fat Clay (CH), gray with brown

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			514.38	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			514.38	g	Tare No.:	501	Tare No.:	65
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	142.26	Wet Wt.+tare:	142.26
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	119.51	Dry Wt.+tare:	129.71
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	21.64	Tare Wt:	88.26
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	97.87	Dry Wt.:	41.45
Unit Wt.(wet):	**113.61**	pcf	**1.82**	$g/cm^{\wedge 3}$	Water Wt.:	22.75	Water Wt.:	12.55
Unit Wt.(dry):	**92.18**	pcf	**1.48**	$g/cm^{\wedge 3}$	% moist.:	**23.2**	% moist.:	**30.3**

Assumed Specific Gravity:	**2.70**	Max Dry Density(pcf) =		OMC =	
		% of max =		+/- OMC =	
Calculated % saturation:	98.66	Void ratio (e) =	**0.83**	Porosity (n)=	**0.45**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/27/2020	180	16.7	0.082666	21	0.977	1.27E-08	3.60E-05	
1/27/2020	360	16.6	0.182666	21	0.977	1.41E-08	3.99E-05	
1/27/2020	540	16.5	0.282666	21	0.977	1.46E-08	4.13E-05	
1/27/2020	720	16.4	0.382666	21	0.977	1.49E-08	4.21E-05	

SUMMARY

k_a =	1.41E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	1.27E-08	cm/sec	9.6	%	Vm = $\frac{\lvert ka-ki \rvert}{ka} \times 100$
k2 =	1.41E-08	cm/sec	0.2	%	
k3 =	1.46E-08	cm/sec	3.7	%	
k4 =	1.49E-08	cm/sec	5.7	%	

Hydraulic conductivity	k =	**1.41E-08**	cm/sec	**3.98E-05**	ft/day
Void Ratio	e =	**0.83**			
Porosity	n =	**0.45**			
Bulk Density	γ =	**1.82**	g/cm^3	**113.6**	pcf
Water Content	W =	**0.34**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**1.44E-13**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Cargill CCR Landfill							
Date:	1/28/2020	Panel Number :	P-1					
Project No. :	O8195294				Permometer Data			
Boring No.:	11 and 14	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Model Layer:	1	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	0.0-5.0	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:	Remolded	M_2 =	1.040953	T = 0.0658646				

Material Description : Model Layer 1 - Fat Clay (CH), gray with brown

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			540.00	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			540.00	g	Tare No.:	98	Tare No.:	97
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	143.66	Wet Wt.+tare:	151.26
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	122.50	Dry Wt.+tare:	125.88
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	33.26	Tare Wt:	32.61
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	89.24	Dry Wt.:	93.27
Unit Wt.(wet):	**119.27**	pcf	**1.91**	$g/cm^{\wedge 3}$	Water Wt.:	21.16	Water Wt.:	25.38
Unit Wt.(dry):	**96.41**	pcf	**1.54**	$g/cm^{\wedge 3}$	% moist.:	**23.7**	% moist.:	**27.2**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = OMC =
% of max = +/- OMC =
Calculated % saturation: 98.16 Void ratio (e) = **0.75** Porosity (n)= **0.43**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/27/2020	180	16.65	0.132666	21	0.977	2.04E-08	5.79E-05	
1/27/2020	360	16.5	0.282666	21	0.977	2.19E-08	6.20E-05	
1/27/2020	540	16.4	0.382666	21	0.977	1.98E-08	5.61E-05	
1/27/2020	720	16.3	0.482666	21	0.977	1.88E-08	5.33E-05	

SUMMARY

k_a =	2.02E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	2.04E-08	cm/sec	1.0	%	Vm = $\frac{\lvert ka-ki \rvert}{ka} \times 100$
k2 =	2.19E-08	cm/sec	8.1	%	
k3 =	1.98E-08	cm/sec	2.1	%	
k4 =	1.88E-08	cm/sec	7.1	%	

Hydraulic conductivity	k =	**2.02E-08**	cm/sec	**5.73E-05**	ft/day
Void Ratio	e =	**0.75**			
Porosity	n =	**0.43**			
Bulk Density	γ =	**1.91**	g/cm^3	**119.3**	pcf
Water Content	W =	**0.37**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**2.07E-13**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Cargill CCR Landfill							
Date:	1/28/2020	Panel Number : P-1						
Project No. :	O8195294	Permometer Data						
Boring No.:	12 and 13	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Model Layer:	1	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	0 - 5	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:	Remolded	M_2 =	1.040953	T = 0.0658646				

Material Description : Model Layer 1 - Fat Clay (CH), gray with brown

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			531.29	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			531.29	g	Tare No.:	56	Tare No.:	197
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	138.94	Wet Wt.+tare:	146.99
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	116.65	Dry Wt.+tare:	118.91
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	27.51	Tare Wt:	21.97
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	89.14	Dry Wt.:	96.94
Unit Wt.(wet):	**117.34**	pcf	**1.88**	g/cm^3	Water Wt.:	22.29	Water Wt.:	28.08
Unit Wt.(dry):	**93.87**	pcf	**1.50**	g/cm^3	% moist.:	**25.0**	% moist.:	**29.0**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = OMC =
% of max = +/- OMC =
Calculated % saturation: 98.29 Void ratio (e) = **0.80** Porosity (n)= **0.44**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/27/2020	120	16.6	0.182666	21	0.977	4.22E-08	1.20E-04	
1/27/2020	240	16.45	0.332666	21	0.977	3.87E-08	1.10E-04	
1/27/2020	360	16.35	0.432666	21	0.977	3.36E-08	9.53E-05	
1/27/2020	480	16.25	0.532666	21	0.977	3.12E-08	8.83E-05	

SUMMARY

k_a =	3.64E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	4.22E-08	cm/sec	16.0	%	Vm = $\frac{\lvert k_a - k_i \rvert}{k_a} \times 100$
k2 =	3.87E-08	cm/sec	6.1	%	
k3 =	3.36E-08	cm/sec	7.7	%	
k4 =	3.12E-08	cm/sec	14.5	%	

Hydraulic conductivity	k =	**3.64E-08**	cm/sec	**1.03E-04**	ft/day
Void Ratio	e =	**0.80**			
Porosity	n =	**0.44**			
Bulk Density	γ =	**1.88**	g/cm^3	**117.3**	pcf
Water Content	W =	**0.38**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**3.73E-13**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Cargill CCR Landfill							
Date:	1/28/2020	Panel Number : P-1						
Project No. :	O8195294	Permometer Data						
Boring No.:	1 and 2	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Model Layer:	2	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	5 - 10	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:	Remolded	M_2 =	1.040953	T = 0.0658646				

Material Description : Model Layer 2 - Lean Clay (CL), gray with brown

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			551.45	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			551.45	g	Tare No.:	164	Tare No.:	77
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	110.11	Wet Wt.+tare:	123.33
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	96.40	Dry Wt.+tare:	113.11
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	30.26	Tare Wt:	71.16
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	66.14	Dry Wt.:	41.95
Unit Wt.(wet):	**121.79**	pcf	**1.95**	g/cm^3	Water Wt.:	13.71	Water Wt.:	10.22
Unit Wt.(dry):	**100.88**	pcf	**1.62**	g/cm^3	% moist.:	**20.7**	% moist.:	**24.4**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = OMC =
% of max = +/- OMC =
Calculated % saturation: 98.05 Void ratio (e) = **0.67** Porosity (n)= **0.40**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/27/2020	120	16.6	0.182666	21	0.977	4.22E-08	1.20E-04	
1/27/2020	240	16.4	0.382666	21	0.977	4.46E-08	1.26E-04	
1/27/2020	360	16.2	0.582666	21	0.977	4.55E-08	1.29E-04	
1/27/2020	480	16.05	0.732666	21	0.977	4.32E-08	1.22E-04	

SUMMARY

k_a =	4.39E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	4.22E-08	cm/sec	3.7	%	Vm = $\frac{\lvert k_a - k_i \rvert}{k_a} \times 100$
k2 =	4.46E-08	cm/sec	1.5	%	
k3 =	4.55E-08	cm/sec	3.8	%	
k4 =	4.32E-08	cm/sec	1.6	%	

Hydraulic conductivity	k =	**4.39E-08**	cm/sec	**1.24E-04**	ft/day
Void Ratio	e =	**0.67**			
Porosity	n =	**0.40**			
Bulk Density	γ =	**1.95**	g/cm^3	**121.8**	pcf
Water Content	W =	**0.34**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**4.49E-13**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Cargill CCR Landfill							
Date:	1/28/2020	Panel Number :	P-1					
Project No. :	O8195294				Permometer Data			
Boring No.:	3 and 4	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Model Layer:	2	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	B-3 (10 - 15) and B-4 (5 - 10)	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:	Remolded	M_2 =	1.040953	T = 0.0658646				

Material Description : Model Layer 2 - Lean Clay (CL), gray with brown

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			566.44	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			566.44	g	Tare No.:	244	Tare No.:	A
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	109.61	Wet Wt.+tare:	165.51
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	96.80	Dry Wt.+tare:	141.88
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	24.03	Tare Wt:	30.33
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	72.77	Dry Wt.:	111.55
Unit Wt.(wet):	**125.10**	pcf	**2.00**	$g/cm^{\wedge 3}$	Water Wt.:	12.81	Water Wt.:	23.63
Unit Wt.(dry):	**106.38**	pcf	**1.70**	$g/cm^{\wedge 3}$	% moist.:	**17.6**	% moist.:	**21.2**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = OMC =
% of max = +/- OMC =
Calculated % saturation: 97.85 Void ratio (e) = **0.58** Porosity (n)= **0.37**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/27/2020	120	16.65	0.132666	21	0.977	3.06E-08	8.68E-05	
1/27/2020	240	16.5	0.282666	21	0.977	3.28E-08	9.30E-05	
1/27/2020	360	16.35	0.432666	21	0.977	3.36E-08	9.53E-05	
1/27/2020	480	16.25	0.532666	21	0.977	3.12E-08	8.83E-05	

SUMMARY

k_a =	3.21E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	3.06E-08	cm/sec	4.4	%	Vm = $\frac{\lvert ka-ki \rvert}{ka} \times 100$
k2 =	3.28E-08	cm/sec	2.3	%	
k3 =	3.36E-08	cm/sec	4.9	%	
k4 =	3.12E-08	cm/sec	2.8	%	

Hydraulic conductivity	k =	**3.21E-08**	cm/sec	**9.09E-05**	ft/day
Void Ratio	e =	**0.58**			
Porosity	n =	**0.37**			
Bulk Density	γ =	**2.00**	g/cm^3	**125.1**	pcf
Water Content	W =	**0.30**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**3.28E-13**	cm^2	(at 20 deg C)	

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Cargill CCR Landfill							
Date:	1/28/2020	Panel Number : P-1						
Project No. :	O8195294	Permometer Data						
Boring No.:	6 and 7	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Model Layer:	2	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	5 - 10	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:	Remolded	M_2 =	1.040953	T = 0.0658646				

Material Description : Model Layer 2 - Lean Clay (CL), brown

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			556.50	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			556.50	g	Tare No.:	211	Tare No.:	96
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	166.31	Wet Wt.+tare:	201.16
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	141.15	Dry Wt.+tare:	182.00
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	22.61	Tare Wt:	103.26
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	118.54	Dry Wt.:	78.74
Unit Wt.(wet):	**122.91**	pcf	**1.97**	$g/cm^{\wedge 3}$	Water Wt.:	25.16	Water Wt.:	19.16
Unit Wt.(dry):	**101.39**	pcf	**1.62**	$g/cm^{\wedge 3}$	% moist.:	**21.2**	% moist.:	**24.3**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = OMC =
% of max = +/- OMC =
Calculated % saturation: 99.17 Void ratio (e) = **0.66** Porosity (n)= **0.40**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/27/2020	120	16.7	0.082666	21	0.977	1.91E-08	5.40E-05	
1/27/2020	240	16.6	0.182666	21	0.977	2.11E-08	5.99E-05	
1/27/2020	360	16.5	0.282666	21	0.977	2.19E-08	6.20E-05	
1/27/2020	480	16.4	0.382666	21	0.977	2.23E-08	6.31E-05	

SUMMARY

k_a =	2.11E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	1.91E-08	cm/sec	9.6	%	Vm = $\frac{\lvert k_a - k_i \rvert}{k_a} \times 100$
k2 =	2.11E-08	cm/sec	0.2	%	
k3 =	2.19E-08	cm/sec	3.7	%	
k4 =	2.23E-08	cm/sec	5.7	%	

Hydraulic conductivity	k =	**2.11E-08**	cm/sec	**5.98E-05**	ft/day
Void Ratio	e =	**0.66**			
Porosity	n =	**0.40**			
Bulk Density	γ =	**1.97**	g/cm^3	**122.9**	pcf
Water Content	W =	**0.35**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**2.16E-13**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Cargill CCR Landfill							
Date:	1/28/2020	Panel Number : P-1						
Project No. :	O8195294	Permometer Data						
Boring No.:	8 and 9	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Model Layer:	2	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	5 - 10	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:	Remolded	M_2 =	1.040953	T = 0.0658646				

Material Description : Model Layer 2 - Lean Clay (CL), gray with brown

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			559.03	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			559.03	g	Tare No.:	15	Tare No.:	601
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	142.26	Wet Wt.+tare:	142.33
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	123.30	Dry Wt.+tare:	119.84
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	32.22	Tare Wt:	24.48
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	91.08	Dry Wt.:	95.36
Unit Wt.(wet):	**123.47**	pcf	**1.98**	$g/cm^{\wedge 3}$	Water Wt.:	18.96	Water Wt.:	22.49
Unit Wt.(dry):	**102.19**	pcf	**1.64**	$g/cm^{\wedge 3}$	% moist.:	**20.8**	% moist.:	**23.6**

Assumed Specific Gravity:	**2.70**	Max Dry Density(pcf) =		OMC =	
		% of max =		+/- OMC =	
Calculated % saturation:	98.05	Void ratio (e) =	**0.65**	Porosity (n)=	**0.39**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/27/2020	120	16.65	0.132666	21	0.977	3.06E-08	8.68E-05	
1/27/2020	240	16.55	0.232666	21	0.977	2.70E-08	7.64E-05	
1/27/2020	360	16.45	0.332666	21	0.977	2.58E-08	7.31E-05	
1/27/2020	480	16.4	0.382666	21	0.977	2.23E-08	6.31E-05	

SUMMARY

k_a =	2.64E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	3.06E-08	cm/sec	16.0	%	Vm = $\frac{\lvert k_a - k_i \rvert}{k_a} \times 100$
k2 =	2.70E-08	cm/sec	2.1	%	
k3 =	2.58E-08	cm/sec	2.4	%	
k4 =	2.23E-08	cm/sec	15.7	%	

Hydraulic conductivity	k =	**2.64E-08**	cm/sec	**7.49E-05**	ft/day
Void Ratio	e =	**0.65**			
Porosity	n =	**0.39**			
Bulk Density	γ =	**1.98**	g/cm^3	**123.5**	pcf
Water Content	W =	**0.34**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**2.71E-13**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Cargill CCR Landfill							
Date:	1/28/2020	Panel Number : P-1						
Project No. :	O8195294	Permometer Data						
Boring No.:	10, 12, and 13	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Model Layer:	2	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	5 - 10	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:	Remolded	M_2 =	1.040953	T = 0.0658646				

Material Description : Model Layer 2 - Lean Clay (CL), gray with brown

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			552.70	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			552.70	g	Tare No.:	27	Tare No.:	H
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	143.61	Wet Wt.+tare:	152.26
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	124.45	Dry Wt.+tare:	129.77
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	32.26	Tare Wt:	36.61
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	92.19	Dry Wt.:	93.16
Unit Wt.(wet):	**122.07**	pcf	**1.96**	g/cm^3	Water Wt.:	19.16	Water Wt.:	22.49
Unit Wt.(dry):	**101.07**	pcf	**1.62**	g/cm^3	% moist.:	**20.8**	% moist.:	**24.1**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = OMC =
% of max = +/- OMC =
Calculated % saturation: 97.60 Void ratio (e) = **0.67** Porosity (n)= **0.40**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/27/2020	120	16.6	0.182666	21	0.977	4.22E-08	1.20E-04	
1/27/2020	240	16.45	0.332666	21	0.977	3.87E-08	1.10E-04	
1/27/2020	360	16.35	0.432666	21	0.977	3.36E-08	9.53E-05	
1/27/2020	480	16.2	0.582666	21	0.977	3.41E-08	9.68E-05	

SUMMARY

k_a =	3.72E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	4.22E-08	cm/sec	13.6	%	Vm = $\frac{\lvert k_a - k_i \rvert}{k_a} \times 100$
k2 =	3.87E-08	cm/sec	4.0	%	
k3 =	3.36E-08	cm/sec	9.5	%	
k4 =	3.41E-08	cm/sec	8.1	%	

Hydraulic conductivity	k =	**3.72E-08**	cm/sec	**1.05E-04**	ft/day
Void Ratio	e =	**0.67**			
Porosity	n =	**0.40**			
Bulk Density	γ =	**1.96**	g/cm^3	**122.1**	pcf
Water Content	W =	**0.34**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**3.81E-13**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Cargill CCR Landfill							
Date:	1/28/2020	Panel Number : P-1						
Project No. :	O8195294	Permometer Data						
Boring No.:	5	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Model Layer:	3	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	5 -10	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:	Remolded	M_2 =	1.040953	T = 0.0658646				

Material Description : Model Layer 3 - Lean Clay (CL), with sand, brown to dark gray

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			563.00	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			563.00	g	Tare No.:	84	Tare No.:	316
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	164.45	Wet Wt.+tare:	168.44
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	141.70	Dry Wt.+tare:	143.03
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	24.22	Tare Wt:	31.26
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	117.48	Dry Wt.:	111.77
Unit Wt.(wet):	**124.34**	pcf	**1.99**	g/cm^3	Water Wt.:	22.75	Water Wt.:	25.41
Unit Wt.(dry):	**104.17**	pcf	**1.67**	g/cm^3	% moist.:	**19.4**	% moist.:	**22.7**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = OMC =
% of max = +/- OMC =
Calculated % saturation: 99.31 Void ratio (e) = **0.62** Porosity (n)= **0.38**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/27/2020	120	16.65	0.132666	21	0.977	3.06E-08	8.68E-05	
1/27/2020	240	16.55	0.232666	21	0.977	2.70E-08	7.64E-05	
1/27/2020	360	16.45	0.332666	21	0.977	2.58E-08	7.31E-05	
1/27/2020	480	16.4	0.382666	21	0.977	2.23E-08	6.31E-05	

SUMMARY

k_a =	2.64E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	3.06E-08	cm/sec	16.0	%	Vm = $\frac{\lvert ka-ki \rvert}{ka} \times 100$
k2 =	2.70E-08	cm/sec	2.1	%	
k3 =	2.58E-08	cm/sec	2.4	%	
k4 =	2.23E-08	cm/sec	15.7	%	

Hydraulic conductivity	k =	**2.64E-08**	cm/sec	**7.49E-05**	ft/day
Void Ratio	e =	**0.62**			
Porosity	n =	**0.38**			
Bulk Density	γ =	**1.99**	g/cm^3	**124.3**	pcf
Water Content	W =	**0.32**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**2.71E-13**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : Cargill CCR Landfill
Date: 1/28/2020 Panel Number : P-1
Project No. : O8195294 Permometer Data

Boring No.:	10 and 11	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Model Layer:	3	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	10 - 15	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:	Remolded	M_2 =	1.040953	T = 0.0658646				

Material Description : Model Layer 3 - Clayey Sand (SC), brown

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			573.20	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			573.20	g	Tare No.:	61	Tare No.:	44
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	138.77	Wet Wt.+tare:	141.26
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	122.32	Dry Wt.+tare:	121.29
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	23.64	Tare Wt:	23.11
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	98.68	Dry Wt.:	98.18
Unit Wt.(wet):	**126.60**	pcf	**2.03**	$g/cm^{\wedge 3}$	Water Wt.:	16.45	Water Wt.:	19.97
Unit Wt.(dry):	**108.51**	pcf	**1.74**	$g/cm^{\wedge 3}$	% moist.:	**16.7**	% moist.:	**20.3**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = OMC =
% of max = +/- OMC =
Calculated % saturation: 99.23 Void ratio (e) = **0.55** Porosity (n)= **0.36**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/27/2020	300	16.65	0.132666	21	0.977	1.23E-08	3.47E-05	
1/27/2020	600	16.5	0.282666	21	0.977	1.31E-08	3.72E-05	
1/27/2020	900	16.4	0.382666	21	0.977	1.19E-08	3.37E-05	
1/27/2020	1200	16.3	0.482666	21	0.977	1.13E-08	3.20E-05	

SUMMARY

k_a =	1.21E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	1.23E-08	cm/sec	1.0	%	Vm = $\frac{\lvert k_a - k_i \rvert}{k_a} \times 100$
k2 =	1.31E-08	cm/sec	8.1	%	
k3 =	1.19E-08	cm/sec	2.1	%	
k4 =	1.13E-08	cm/sec	7.1	%	

Hydraulic conductivity	k =	**1.21E-08**	cm/sec	**3.44E-05**	ft/day
Void Ratio	e =	**0.55**			
Porosity	n =	**0.36**			
Bulk Density	γ =	**2.03**	g/cm^3	**126.6**	pcf
Water Content	W =	**0.29**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**1.24E-13**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Cargill CCR Landfill							
Date:	1/28/2020	Panel Number : P-1						
Project No. :	O8195294	Permometer Data						
Boring No.:	7 and 8	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Model Layer:	4	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	10 - 15	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:	Remolded	M_2 =	1.040953	T = 0.0658646				

Material Description : Model Layer 4 - Shale, highly weathered, gray brown

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			577.00	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			577.00	g	Tare No.:	12	Tare No.:	333
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	135.51	Wet Wt.+tare:	137.48
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	119.57	Dry Wt.+tare:	118.26
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	21.63	Tare Wt:	21.19
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	97.94	Dry Wt.:	97.07
Unit Wt.(wet):	**127.44**	pcf	**2.04**	$g/cm^{\wedge 3}$	Water Wt.:	15.94	Water Wt.:	19.22
Unit Wt.(dry):	**109.60**	pcf	**1.76**	$g/cm^{\wedge 3}$	% moist.:	**16.3**	% moist.:	**19.8**

Assumed Specific Gravity:	**2.70**	Max Dry Density(pcf) =		OMC =	
		% of max =		+/- OMC =	
Calculated % saturation:	99.37	Void ratio (e) =	**0.54**	Porosity (n)=	**0.35**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/27/2020	60	16.15	0.632666	21	0.977	2.97E-07	8.42E-04	
1/27/2020	120	15.6	1.182666	21	0.977	2.83E-07	8.02E-04	
1/27/2020	180	15.05	1.732666	21	0.977	2.82E-07	7.99E-04	
1/27/2020	240	14.5	2.282666	21	0.977	2.84E-07	8.06E-04	

SUMMARY

k_a =	2.87E-07	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	2.97E-07	cm/sec	3.7	%	Vm = $\frac{\lvert ka-ki \rvert}{ka}$ x 100
k2 =	2.83E-07	cm/sec	1.2	%	
k3 =	2.82E-07	cm/sec	1.6	%	
k4 =	2.84E-07	cm/sec	0.8	%	

Hydraulic conductivity	k =	**2.87E-07**	cm/sec	**8.12E-04**	ft/day
Void Ratio	e =	**0.54**			
Porosity	n =	**0.35**			
Bulk Density	γ =	**2.04**	g/cm^3	**127.4**	pcf
Water Content	W =	**0.29**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**2.94E-12**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Cargill CCR Landfill							
Date:	1/28/2020	Panel Number : P-1						
Project No. :	O8195294	Permometer Data						
Boring No.:	11 and 14	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Model Layer:	4	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	B-11 (15 - 20) and B-14 (10 - 15)	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:	Remolded	M_2 =	1.040953	T = 0.0658646				

Material Description : Model Layer 4 - Mix of Shale, highly weathered, light gray and brown, and Lean Clay, with sand, gray with brown

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			532.00	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			532.00	g	Tare No.:	50	Tare No.:	120
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	142.88	Wet Wt.+tare:	165.51
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	125.88	Dry Wt.+tare:	137.02
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	26.61	Tare Wt:	22.99
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	99.27	Dry Wt.:	114.03
Unit Wt.(wet):	**117.50**	pcf	**1.88**	$g/cm^{\wedge 3}$	Water Wt.:	17	Water Wt.:	28.49
Unit Wt.(dry):	**100.32**	pcf	**1.61**	$g/cm^{\wedge 3}$	% moist.:	**17.1**	% moist.:	**25.0**

Assumed Specific Gravity:	**2.70**	Max Dry Density(pcf) =		OMC =	
		% of max =		+/- OMC =	
Calculated % saturation:	99.17	Void ratio (e) =	**0.68**	Porosity (n)=	**0.40**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/27/2020	60	16.55	0.232666	21	0.977	1.08E-07	3.06E-04	
1/27/2020	120	16.3	0.482666	21	0.977	1.13E-07	3.20E-04	
1/27/2020	180	16.05	0.732666	21	0.977	1.15E-07	3.26E-04	
1/27/2020	240	15.8	0.982666	21	0.977	1.17E-07	3.31E-04	

SUMMARY

k_a =	1.13E-07	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	1.08E-07	cm/sec	4.7	%	Vm = $\frac{\lvert k_a - k_i \rvert}{k_a} \times 100$
k2 =	1.13E-07	cm/sec	0.3	%	
k3 =	1.15E-07	cm/sec	1.8	%	
k4 =	1.17E-07	cm/sec	3.2	%	

Hydraulic conductivity	k =	**1.13E-07**	cm/sec	**3.21E-04**	ft/day
Void Ratio	e =	**0.68**			
Porosity	n =	**0.40**			
Bulk Density	γ =	**1.88**	g/cm^3	**117.5**	pcf
Water Content	W =	**0.28**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**1.16E-12**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Cargill CCR Landfill							
Date:	1/28/2020	Panel Number : P-1						
Project No. :	O8195294	Permometer Data						
Boring No.:	4 and 5	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Model Layer:	4	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	15 - 20	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:	Remolded	M_2 =	1.040953	T = 0.0658646				

Material Description : Model Layer 4 - Shale, highly weathered, gray, brown, and orange brown

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			536.61	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			536.61	g	Tare No.:	601	Tare No.:	474
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	112.20	Wet Wt.+tare:	170.03
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	96.74	Dry Wt.+tare:	139.94
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	23.61	Tare Wt:	24.51
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	73.13	Dry Wt.:	115.43
Unit Wt.(wet):	**118.52**	pcf	**1.90**	g/cm^3	Water Wt.:	15.46	Water Wt.:	30.09
Unit Wt.(dry):	**97.83**	pcf	**1.57**	g/cm^3	% moist.:	**21.1**	% moist.:	**26.1**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = OMC =
% of max = +/- OMC =
Calculated % saturation: 97.36 Void ratio (e) = **0.72** Porosity (n)= **0.42**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/27/2020	120	16.7	0.082666	21	0.977	1.91E-08	5.40E-05	
1/27/2020	240	16.6	0.182666	21	0.977	2.11E-08	5.99E-05	
1/27/2020	360	16.5	0.282666	21	0.977	2.19E-08	6.20E-05	
1/27/2020	480	16.4	0.382666	21	0.977	2.23E-08	6.31E-05	

SUMMARY

k_a =	2.11E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	1.91E-08	cm/sec	9.6	%	Vm = $\frac{\lvert k_a - k_i \rvert}{k_a} \times 100$
k2 =	2.11E-08	cm/sec	0.2	%	
k3 =	2.19E-08	cm/sec	3.7	%	
k4 =	2.23E-08	cm/sec	5.7	%	

Hydraulic conductivity	k =	**2.11E-08**	cm/sec	**5.98E-05**	ft/day
Void Ratio	e =	**0.72**			
Porosity	n =	**0.42**			
Bulk Density	γ =	**1.90**	g/cm^3	**118.5**	pcf
Water Content	W =	**0.33**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**2.16E-13**	cm^2	(at 20 deg C)	

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Cargill CCR Landfill ■ Eddyville, Iowa

Terracon Project No. 08195294

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
Standard Penetration Test	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (psf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 500	0 - 1
Loose	4 - 9	Soft	500 to 1,000	2 - 4
Medium Dense	10 - 29	Medium Stiff	1,000 to 2,000	4 - 8
Dense	30 - 50	Stiff	2,000 to 4,000	8 - 15
Very Dense	> 50	Very Stiff	4,000 to 8,000	15 - 30
		Hard	> 8,000	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	**Descriptive Term(s) of other constituents**	**Percent of Dry Weight**
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12

GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	**Particle Size**	**Term**	**Plasticity Index**
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

UNIFIED SOIL CLASSIFICATION SYSTEM

Terracon GeoReport

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E]		GW	Well-graded gravel [F]
			Cu < 4 and/or [Cc<1 or Cc>3.0] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E]		SW	Well-graded sand [I]
			Cu < 6 and/or [Cc<1 or Cc>3.0] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

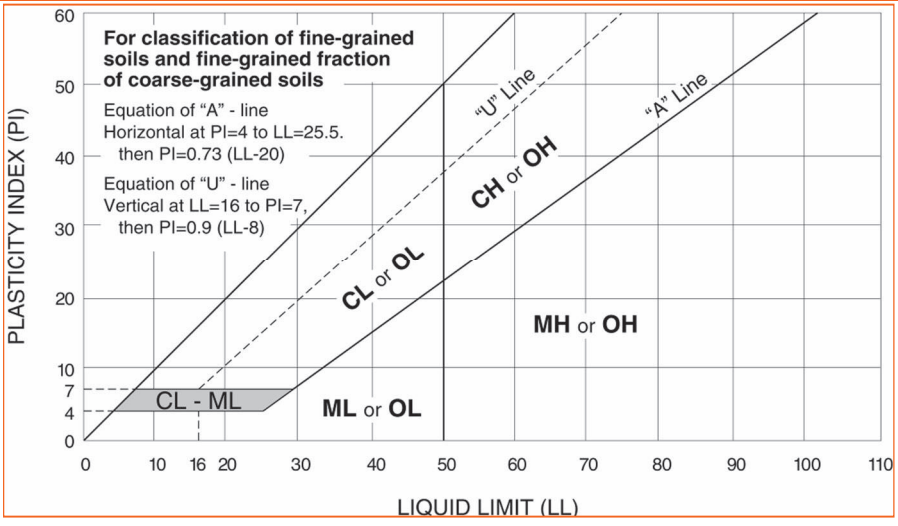
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



DESCRIPTION OF ROCK PROPERTIES

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi (MPa)**
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	**Medium**	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	**Thick**	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	**Massive**	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009
Technical Manual for Design and Construction of Road Tunnels – Civil Elements

MEMO

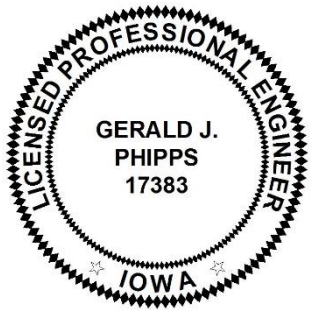
To:	Steve Phillips - Cargill
From:	HR Green, Inc.
Subject:	CCR Landfill Survey Point 35171
Project Number:	220964
Date:	May 16, 2024

On Friday, May 10th, 2024, staff from HR Green, Inc. (HR Green) and Garden & Associates, Ltd. (Garden) met at Cargill's CCR Landfill facility near Eddyville, IA to investigate the vegetative cover and clay cap thickness at survey point 35171. HR Green staff included Shaival Shah and Rose Amundson and Garden staff included Randy Nugteren and Brad Chamra. Ben Johannsen with Cargill was available on site to unlock the gate of the facility and then left.

Survey point 35171 is being investigated as a result of the survey elevations reported during closure construction activities. The survey at the top of coal combustion residual (CCR) or ash was reported at 798.831' and the top of clay cap was reported at 800.846'. At that time there was a reported clay cap thickness of 2.015'. Garden then surveyed the top of compacted fill or vegetative cover at 800.449' at a later date. As this elevation is lower than the previously surveyed top of clay cap, the thickness of vegetative cover was reported as a negative depth which resulted in some uncertainty of both the final thickness of clay cap and vegetative cover layer at this location. HR Green mobilized to the facility to complete a hand auger investigation of the survey point to review what was placed at this location upon completion of the project.

Prior to meeting on site, Garden staked the location of survey point 35171. Upon arriving onsite, HR Green started to hand auger at that location. The land surface had vegetation on it and from the surface to a depth of 11-12" brown clay was observed. From this depth down to approximately 40" a medium brown to grey/brown stiff clay soil was observed. CCR was not observed within 40" of the ground surface at this location. The observations indicate that a depth of approximately 1' of vegetative cover (or loose fill) was placed on top of over 2' of clay cap material at survey point 35171. As there was sufficient thickness of clay cap material at this location, no step out locations were augered during this investigation.

Attached to this memo are photographs of the soil that was observed in the boring, the stake with elevation information, and the ground surface at the time of completion of field activities.



I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

Gerald J. Phipps

Date: 5/16/2024

GERALD JAMES PHIPPS, P.E.

License No. **17383**

My renewal date is **December 31**, **2024**

Pages or sheets covered by this seal:

This memo

Site
Photographs

View across southern of North Cell, 35171 in the left side of the image.

View of 35171 stake with markings by Garden.

View of back of 35171 with ground elevation by Garden.

View of soil in boring with transition from vegetative cover to clay cap in auger.

View of soil from boring.

View of ground surface at end of field activities.

LEGEND
GREEN NUMBERS = ORIGINAL GRID POINT
RED NUMBERS = TOP OF ASH MEASURED ELEVATION
BLUE NUMBERS = TOP OF COMPACTED CLAY LAYER MEASURED ELEVATION
MAGENTA NUMBERS = TOP OF LOOSE COVER MEASURED ELEVATION

FILL AREA 1
AREA: 1.3 ACRES

FILL AREA 2
AREA: 1.1 ACRES

FILL AREA 3
AREA: 1.4 ACRES

FILL AREA 4
AREA: 2.05 ACRES