Texas Commission on Environmental Quality

Waste Permits Division Correspondence Cover Sheet

Date: 1-3-2023
Facility Name: Beck Landfill Permit
or Registration No.: 1848A

Nature of Correspondence:
☐ Initial/New
☒ Response/Revision to TCEQ Tracking No.: 27818258(from subject line of TCEQ letter regarding initial submission)

Affix this cover sheet to the front of your submission to the Waste Permits Division. Check appropriate box for type of correspondence. Contact WPD at (512) 239-2335 if you have questions regarding this form.

Table 1 - Municipal Solid Waste Correspondence

Applications	Reports and Notifications
☐ New Notice of Intent	☐ Alternative Daily Cover Report
☐ Notice of Intent Revision	☐ Closure Report
☐ New Permit (including Subchapter T)	☐ Compost Report
☐ New Registration (including Subchapter T)	☐ Groundwater Alternate Source Demonstration
☒ Major Amendment	☐ Groundwater Corrective Action
☐ Minor Amendment	☐ Groundwater Monitoring Report
☐ Limited Scope Major Amendment	☐ Groundwater Background Evaluation
☐ Notice Modification	☐ Landfill Gas Corrective Action
☐ Non-Notice Modification	☐ Landfill Gas Monitoring
☐ Transfer/Name Change Modification	☐ Liner Evaluation Report
☐ Temporary Authorization	☐ Soil Boring Plan
☐ Voluntary Revocation	☐ Special Waste Request
☐ Subchapter T Disturbance Non-Enclosed Structure	☐ Other:
☐ Other:	

Table 2 - Industrial & Hazardous Waste Correspondence

Applications	Reports and Responses
☐ New	☐ Annual/Biennial Site Activity Report
☐ Renewal	☐ CPT Plan/Result
☐ Post-Closure Order	☐ Closure Certification/Report
☐ Major Amendment	☐ Construction Certification/Report
☐ Minor Amendment	☐ CPT Plan/Result
☐ CCR Registration	☐ Extension Request
☐ CCR Registration Major Amendment	☐ Groundwater Monitoring Report
☐ CCR Registration Minor Amendment	☐ Interim Status Change
☐ Class 3 Modification	☐ Interim Status Closure Plan
☐ Class 2 Modification	☐ Soil Core Monitoring Report
☐ Class 1 ED Modification	☐ Treatability Study
☐ Class 1 Modification	☐ Trial Burn Plan/Result
☐ Endorsement	☐ Unsaturated Zone Monitoring Report
☐ Temporary Authorization	☐ Waste Minimization Report
☐ Voluntary Revocation	☐ Other:
☐ 335.6 Notification	
☐ Other:	

MUNICIPAL SOLID WASTE PERMIT MAJOR AMENDMENT

Part I Application for Permit Amendment

(TAC Title 30 Rule §330.59)

BECK COMPANIES

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: September 2022

STATE OF TEXAS
Juliana C. Morelli
Geology
10670
LICENSED
PROFESSIONAL GEOSCIENTIST

Juliana Morelli
1-3-22

Prepared by:

POWER ENGINEERS

PROJECT NUMBER: 150051.05.01

PROJECT CONTACT: Julie Morelli

EMAIL: Julie.Morelli@powereng.com

PHONE: 210-951-6424

REVISED JANUARY 2, 2023

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STATE OF TEXAS
Juliana C. Morelli
Geology
10670
LICENSED
PROFESSIONAL GEOSCIENTIST

Juliana Morelli
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1.0 FORM TCEQ-0650 (305.45(a)(1-(5))

Texas Commission on Environmental Quality

Part I Application Form for New Permit, Permit Amendment, or Registration for a Municipal Solid Waste Facility

Application Tracking Information

Facility Name: Beck Landfill

Permittee or Registrant Name: Nido, Ltd

MSW Authorization Number: 1848A

Initial Submission Date: September 9, 2022

Revision Date: September 28, 2022

Instructions for completing this Part I Application Form are provided in TCEQ 00650-instr[1]. Include a Core Data Form (TCEQ 10400)[2] with the application for the facility owner, and another Core Data Form for the operator if different from the owner. If you have questions, contact the Municipal Solid Waste Permits Section by email to mswper@tceq.texas.gov, or by phone at 512-239-2335.

Application Data

1. Submission Type	
☐ Initial Submission	☒ Notice of Deficiency (NOD) Response

2. Authorization Type	
☒ Permit	☐ Registration

3. Application Type	
☐ New Permit	
☒ Permit Major Amendment	☐ Permit Limited Scope Major Amendment
☐ New Registration	

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[1] www.tceq.texas.gov/downloads/permitting/waste-permits/msw/forms/00650-instr.pdf

[2] www.tceq.texas.gov/goto/coredata

4. Application Fee

Amount

☒ $2,050—New Landfill Permits, and Landfill Permit Major Amendments Described in 30 TAC 305.62(j)(1)

☐ $150—Other Permits, Landfill Limited Scope Major Amendments, Permit Amendments for Storage and Processing Facilities, and Registrations

Payment Method

☐ Check

☒ Online through ePay portal www3.tceq.texas.gov/epay/

If paid online, enter ePay Trace Number: 582EA000504507

5. Application URL

For applications other than those for arid exempt landfills, provide the URL address of a publicly accessible internet web site where the application and all revisions to the application will be posted.

http://downloads.cecinc.com/Beck Landfill MSW 1848A Amendment/

6. Party Responsible for Publishing Notice

Indicate who will be responsible for publishing notice:

☐ Applicant ☐ Agent in Service ☒ Consultant

Contact Name: Cindy Wilson

Title: Project Assistance

Email Address: cindy.wilson@powereng.com

7. Alternative Language Notice

Use the Alternative Language Checklist on Public Notice Verification Form TCEQ-20244-Waste-NORI, TCEQ-20244-Waste-NAPD, or TCEQ-20244-Waste-NAORPM available at www.tceq.texas.gov/permitting/waste_permits/msw_permits/msw_notice.html to determine if an alternative language notice is required.

Is an alternative language notice required for this application?

☒ Yes ☐ No

Indicate the alternative language: spanish

8. Public Place for Copy of Application

Name of the Public Place: Schertz Library

Physical Address: 798 Schertz Parkway

City: Schertz County: Guadalupe State: TX Zip Code: 78154

Phone Number: 210-619-1700

9. Consolidated Permit Processing

Is this submittal part of a consolidated permit processing request, in accordance with 30 TAC Chapter 33?

☐ Yes ☒ No

If "Yes", indicate the other TCEQ program authorizations requested:

10. Confidential Documents

Does the application contain confidential documents?

☐ Yes ☒ No

If "Yes", reference the confidential documents in the application, but submit the confidential documents as an attachment in a separate binder marked "CONFIDENTIAL."

11. Permits and Construction Approvals

Mark the following table to indicate status of other permits or approvals.

Table 1. Permits and Construction Approvals.

Permit or Approval	Received	Pending	Not Applicable
Hazardous Waste Management Program under Texas Solid Waste Disposal Act			X
Underground Injection Control Program under Texas Injection Well Act			X
National Pollutant Discharge Elimination System Program under Clean Water Act; Waste Discharge Program under Texas Water Code, Chapter 26	X		
Prevention of Significant Deterioration Program under Federal Clean Air Act (FCAA); Nonattainment Program under the FCAA			X
National Emission Standards for Hazardous Air Pollutants Preconstruction Approval under the FCAA			X

Permit or Approval	**Received**	**Pending**	**Not Applicable**
Ocean Dumping Permits under Marine Protection Research and Sanctuaries Act			X
Dredge or Fill Permits under Clean Water Act			X
Licenses under the Texas Radiation Control Act			X
Other (describe):			
Other (describe):			

12. Facility General Information

Facility Name: Beck Landfill

Contact Name: Grant Norman Title: General Manager

MSW Authorization Number (if existing): 1848

Regulated Entity Reference Number: **RN**102310968

Physical or Street Address (if available): 550 FM 78

City: Schertz County: Guadalupe State: TX Zip Code: 78154

Phone Number: 210-349-2491

Latitude (Degrees, Minutes Seconds): 29º 33'7.87"

Longitude (Degrees, Minutes Seconds): -98º 15' 44.31"

Benchmark Elevation (above mean sea level): 775 feet

Description of facility location with respect to known or easily identifiable landmarks:

Gated entrance located directly off FM 78 in Schertz, TX, next door to Sonic Drive In

Access routes from the nearest United States or state highway to the facility:

Approx. 2.1 miles northeast of Loop 1604 and FM78; gated entrance on the south side.

Coastal Management Program

Is the facility within the Coastal Management Program boundary?

☐ Yes ☒ No

13. Facility Types

☐ Type I ☒ Type IV ☐ Type V

☐ Type IAE ☐ Type IVAE ☐ Type VI

14. Activities Conducted at the Facility

☒ Storage ☒ Processing ☒ Disposal

15. Facility Waste Management Units

Check the box for each type of waste management unit proposed.

☒ Landfill Unit(s)
☐ Incinerator(s)
☐ Class 1 Landfill Unit(s)
☐ Process Tank(s)
☒ Storage Tank(s)
☐ Tipping Floor
☐ Storage Area
☒ Other (specify):

☒ Container(s)
☒ Roll-off Boxes
☐ Surface Impoundment
☐ Autoclave(s)
☐ Refrigeration Unit(s)
☒ Mobile Processing Unit(s)
☐ Compost Pile(s) or Vessel(s)

brush grinding and other recycling activities

16. Description of Proposed Facility or Changes to Existing Facility

Provide a brief description of the proposed activities if application is for a new facility, or the proposed changes to an existing facility or permit conditions if the application is for an amendment.

Vertical expansion.

17. Facility Contact Information

Site Operator (Permittee or Registrant)

Name: Nido, Ltd.

Customer Reference Number: **CN** 603075011

Contact Name: Grant Norman Title: General Manager

Mailing Address: P.O. Box 790641

City: San Antonio County: Bexar State: TX Zip Code: 78279

Phone Number: 210-349-2491

Email Address: gnorman@beckcompanies.com

Texas Secretary of State (SOS) Filing Number: 0800579842

Operator (if different from *Site Operator*)

Name: Beck Landfill

Customer Reference Number: **CN** 603075011

Contact Name: Grant Norman Title: General Manager

Mailing Address: P.O. Box 790641

City: San Antonio County: Bexar State: TX Zip Code: 78279

Phone Number: 210-349-2491

Email Address: gnorman@beckcompanies.com

Texas Secretary of State (SOS) Filing Number: 0800579842

Consultant (if applicable)

Firm Name: Civil and Environmental Consultants, Inc.

Consultant Name: Adam Mehevec

Texas Board of Professional Engineers Firm Registration Number: F-83

Contact Name: Adam Mehevec Title: ______

Mailing Address: 3711 S MoPac Expressway, Bldg. 1, Suite 550

City: Austin County: Travis State: TX Zip Code: 78746

Phone Number: 512-329-0006

Email Address: amehevec@cecinc.com

Agent in Service (required for out-of-state applicants)

Name: N/A

Mailing Address: ______

City: ______ County: ______ State: TX Zip Code: ______

Phone Number: ______

Email Address: ______

18. Facility Supervisor License

Indicate the level of Municipal Solid Waste Facility Supervisor license, as defined in 30 TAC Chapter 30, Occupational Licenses and Registrations, Subchapter F that the individual who supervises or manages the operations will obtain prior to commencing operations.

☒ Class A Supervisor License ☐ Class B Supervisor License

19. Ownership Status of the Facility

Business Type

☐ Corporation
☐ Individual
☐ Sole Proprietorship
☐ General Partnership
☒ Limited Partnership
☐ City Government
☐ County Government
☐ State Government
☐ Federal Government
☐ Other Government
☐ Military
☐ Other (specify): ______

Facility Owner

Does the Site Operator (Permittee or Registrant) own all the facility units and all the facility property?

☐ Yes ☒ No

If "No", provide the following information for other owners.

Owner Name: Cibolo Industries, LTD
Mailing Address: P.O. Box 790641
City: San Antonio County: Bexar State: TX Zip Code: 78279
Phone Number: 210-349-2491
Email Address: gnorman@beckcompanies.com

20. Other Government Entities Information

Texas Department of Transportation

District: San Antonio
District Engineer's Name: Gina E. Gallegos, P.E.
Mailing Address: 4615 NW Loop 410
City: San Antonio County: Bexar State: TX Zip Code: 78229
Phone Number: 210-615-1110
Email Address: Gina.Gallegos@txdot.gov

Local Government Authority Responsible for Road Maintenance (if applicable)

Government or Agency Name: City of Schertz
Contact Person's Name: Suzanne Williams
Mailing Address: 10 Commercial Place
City: Schertz County: Guadalupe State: TX Zip Code: 78154
Phone Number: 210-619-1800
Email Address: swilliams@schertz.com

City Mayor Information

City Mayor's Name: Ralph Gutierrez
Mailing Address: 1400 Schertz Parkway
City: Schertz County: Guadalupe State: TX Zip Code: 78154
Phone Number: 210-619-1000
Email Address: Ralphgutierrez@schertz.com

City Health Authority

Authority Name: City of Schertz
Contact Person's Name: Amanda Cantu, Sanitarian
Mailing Address: 1400 Schertz Parkway
City: Schertz County: Guadalupe State: TX Zip Code: 78154
Phone Number: 210-619-1673
Email Address: acantu@schertz.com

County Judge Information

County Judge's Name: Kyle Kutscher
Mailing Address: 211 W. Court Street
City: Seguin County: Guadalupe State: TX Zip Code: 78155
Phone Number: 830-303-8857
Email Address: Kyle.Kutcher@co.guadalupe.tx.us

County Health Authority

Agency Name: Guadalupe County Environmental Heath Department
Contact Person's Name: Shelly Reed Jackson
Mailing Address: 2605 N. Guadalupe Street
City: Seguin County: Guadalupe State: TX Zip Code: 78155
Phone Number: 830-303-4188
Email Address: shelly.jackson@co.guadalupe.tx.us

State Representative Information

District Number: 44
State Representative's Name: John Kuempel
District Office Mailing Address: 200 N. River Street #100-E
City: Seguin County: Guadalupe State: TX Zip Code: 78155
Phone Number: 830-379-8732
Email Address: John.Kuempel@house.texas.gov

State Senator Information

District Number: 25
State Senator's Name: Donna Campbell
District Office Mailing Address: 229 Hunters Village, Ste. 105
City: New Braunfels County: Comal State: TX Zip Code: 78132
Phone Number: 830-626-0065
Email Address: Donna.Campbell@senate.texas.gov

Council of Governments (COG)

COG Name: Alamo Area Council of Governments
COG Representative's Name: Diane Rath
COG Representative's Title: Executive Director
Mailing Address: 2700 NE Loop 410, Suite 101
City: San Antonio County: Bexar State: TX Zip Code: 78217
Phone Number: 210-362-5200
Email Address: drath@aacog.com

River Basin Authority

Authority Name: San Antonio River Authority
Contact Person's Name: Derek Bose, General Manager
Watershed Sub-Basin Name: Mid Cibolo Creek
Mailing Address: 201 W. Sheridan
City: San Antonio County: Bexar State: TX Zip Code: 78204
Phone Number: 210-302-3616
Email Address: Dboese@sara-tx.org

U.S. Army Corps of Engineers District

Indicate the U.S. Army Corps of Engineers district in which the facility is located:

☐ Albuquerque, NM ☐ Galveston, TX
☒ Ft. Worth, TX ☐ Tulsa, OK

Local Government Jurisdiction

Within City Limits of: Schertz

Within Extraterritorial Jurisdiction of: ______________________________

Is the facility located in an area in which the governing body of the municipality or county has prohibited the storage, processing, or disposal of municipal or industrial solid waste?

☐ Yes ☒ No

If "Yes", provide a copy of the ordinance or order as an attachment.

Signature Page

Site Operator or Authorized Signatory

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: Grant Norman Title: General Manager

Email Address: gnorman@beckcompanies.com

Signature: Grant Norman Date: 1/3/2023

Operator or Principal Executive Officer Designation of Authorized Signatory

To be completed by the operator if the application is signed by an authorized representative for the operator.

I hereby designate Grant Norman as my representative and hereby authorize said representative to sign any application, submit additional information as may be requested by the Commission; and/or appear for me at any hearing or before the Texas Commission on Environmental Quality in conjunction with this request for a Texas Water Code or Texas Solid Waste Disposal Act permit. I further understand that I am responsible for the contents of this application, for oral statements given by my authorized representative in support of the application, and for compliance with the terms and conditions of any permit which might be issued based upon this application.

Operator or Principal Executive Officer Name: Ben Davis

Email Address: bdavis@beckcompanies.com

Signature: Ben Davis Date: 1-3-2023

Notary

SUBSCRIBED AND SWORN to before me by the said ____________________

On this 3rd day of January, 2023

My commission expires on the 31st day of August, 2024

Rachel Lynne Dorman

Notary Public in and for

Travis County, Texas

RACHEL LYNNE DORMAN
My Notary ID # 129108222
Expires August 31, 2024

Note: Application Must Bear Signature & Seal of Notary Public

Part I Attachments

Refer to instruction document 00650-instr for professional engineer seal requirements.

Attachments Table 1. Required attachments.

Required Attachments	Attachment Number
Supplementary Technical Report	2.0
Property Legal Description	5.0
Property Metes and Bounds Description	5.0
Facility Legal Description	5.0
Facility Metes and Bounds Description	5.0
Metes and Bounds Drawings	5.0
On-Site Easements Drawing	
Land Ownership Map	4.0
Landowners List	4.0
Mailing Labels (printed and electronic)	4.0
Texas Department of Transportation (TxDOT) County Map	4.0
General Location Map	4.0
General Topographic Map	4.0
Verification of Legal Status	6.0
Property Owner Affidavit	6.0
Evidence of Competency	7.0

Attachments Table 2. Additional attachments as applicable.

Additional Attachments as Applicable (select all that apply and add others as needed)	Attachment Number
☒ TCEQ Core Data Form(s)	1.1
☐ Signatory Authority Delegation	N/A
☒ Fee Payment Receipt	9.0
☐ Confidential Documents	N/A
☐ Waste Storage, Processing and Disposal Ordinances	N/A
☐ Final Plat Record of Property	N/A

Additional Attachments as Applicable (select all that apply and add others as needed)	Attachment Number
☒ Certificate of Fact (Certificate of Incorporation)	6.0
☐ Assumed Name Certificate	N/A
Other (describe):	
Other (describe):	
Other (describe):	

1.1 Core Data Form

1.2 Permits or Construction Approvals (305.4(a)(7))

The following permits or construction approvals and regulatory programs were reviewed as they relate to Beck Landfill and are found to be not applicable:

- Hazardous Waste Management Program under the Texas Solid Waste Disposal Act;
- 30 TAC §331.121: No Class I Wells are present on-site or will be installed on-site;
- 30 TAC §331.122: No Class III Wells are present on-site or will be installed on-site;
- 30 TAC §305.50: The Beck Landfill is not applying for a hazardous or industrial solid waste permit or a post-closure order; therefore, this regulation does not apply.
- 30 TAC §305.48: The Beck Landfill is not applying for a wastewater discharge permit;
- 30 TAC §305.54: The Beck Landfill is not applying for a radioactive materials disposal license;
- 30 TAC §336.207: The Beck Landfill is not applying for a radioactive materials disposal license;
- 30 TAC §336.513: The Beck Landfill is not applying for a permit covering the disposal of radioactive material;
- 30 TAC §336.617: The Beck Landfill is not applying for a permit covering the disposal of radioactive material;
- Beck landfill is not regulated under the Prevention of Significant Deterioration Program under the Federal Clean Air Act (FCAA);
- No additional requirements associated with a Nonattainment Program under the FCAA apply to Beck Landfill.
- National emission standards for hazardous air pollutants preconstruction approval under the FCAA are not applicable to Beck Landfill.
- Ocean dumping permits under the Marine Protection Research and Sanctuaries Act does not apply to Beck Landfill.
- No dredge or fill permits under the FCAA;
- No licenses under the Texas Radiation Control Act;
  No subsurface area drip dispersal system permits under Texas Water Code, Chapter 32.

Other environmental permits and programs that apply at Beck Landfill include;

- 30 TAC §330 Subchapter E: As a solid waste landfill facility, the Beck Landfill has developed an SOP in compliance outlining the facility's methods for complying with 30 TAC §330 Subchapter D. The Beck Landfill does not operate a separately authorized solid waste storage or processing activity at the landfill as described in 30 TAC §330.201; therefore, this regulation does not apply.
- 30 TAC §305.48: Beck Landfill is authorized to discharge stormwater associated with industrial activities under the Texas Pollutant Discharge Elimination System (TPDES) Multi-Sector General Permit, Sector L (landfills) issued August 2021.

2.0 SUPPLEMENTARY TECHNICAL REPORT (305.45(a)(8))

2.1 General Description of the Facility (305.45(a)(8))

Beck Landfill is located on approximately 163 acres in Schertz, Texas. The Landfill is operated in accordance with the existing Municipal Solid Waste (MSW) Permit Number 1848A as a Type IV construction and demolition debris disposal site. Waste loads are inspected at the entrance to the landfill and approved loads, transported by third-party haulers, are weighed and directed to the active, working face of the Landfill. Loads containing unauthorized waste streams are rejected and are directed off the premises. Access to the site is controlled through a lockable gate and manned scale office. Appropriate signage is posted to instruct haulers regarding permitted activities.

The majority of industrial activities are conducted outdoors. Outdoor activities include the occasional use of a screening plant, operation of a Type IV landfill, a truck scale, a ticket office, equipment parking, and material storage areas. Soil cover on the working face is applied weekly or more frequently, as needed. Rainwater that comes into contact with the active working face is captured and isolated to prevent a discharge. Liquids derived from areas where trash is placed is collected and pumped back to the working face for dust control. No discharge or removal of leachate is performed.

Following unloading, haul trucks return to the scale to determine the weight of material disposed. Haulers are issued a ticket to track the costs and quantities associated with the disposal. Windblown trash is collected daily, or as needed, to prevent nuisance conditions.

Beck Landfill does not operate a collection or transportation service for waste disposed at the Landfill. Beck does not perform treatment of wastes prior to disposal. No injection activity occurs on-site or is planned to occur on-site in the future.

3.0 FACILITY LOCATION (330.59(b))

Beck Landfill is located off of Farm to Market Road (FM) 78 in Schertz, Guadalupe County, Texas. Travel west along FM78, approximately 2.6 miles from East Loop 1604 in San Antonio, Texas. The Landfill is located on the south side of FM78, next door to the Sonic Drive-In.

The coordinates to the entrance of the landfill are: -98.2645733º North, 29.5545795º West

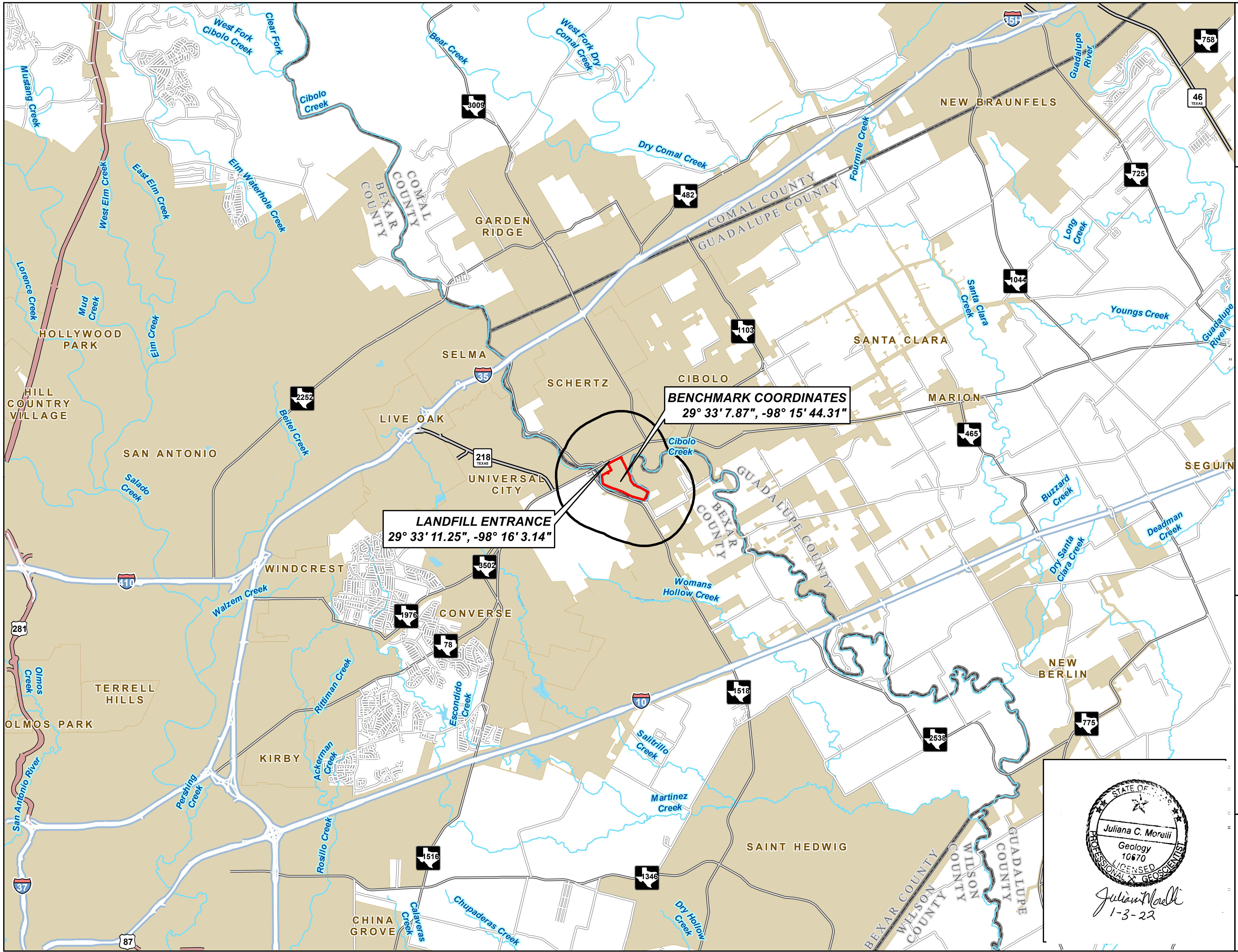
4.0 MAPS (330.59(c))

General location maps and land ownership maps are included as attachments to Part I of this Application in conformance with 30 TAC 305.46 and 335.59(c). Part I of this major modification application includes General Location Maps showing the property boundary, latitudes and longitudes, and other required information. In addition, Part I includes the Land Ownership Map. Additional information is provided in Section 5.0 below.

NIDO, LTD.
BECK LANDFILL

FIGURE 1-1A:
GENERAL LOCATION MAP

SCHERTZ, GUADALUPE
COUNTY, TEXAS



BENCHMARK COORDINATES
29° 33' 7.87", -98° 15' 44.31"

LANDFILL ENTRANCE
29° 33' 11.25", -98° 16' 3.14"

STATE OF TEXAS
Juliana C. Morelli
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1-3-22

Legend

- 🟥 Permit Boundary
- ☐ 1-Mile Radius
- Interstate Highway
- US Highway
- State Highway
- FM Road
- County Road
- Stream
- Waterbody
- City Limits
- County Boundary

Map Sources: TxDOT 2021, USGS

0 1 2
Miles
1 inch = 2 miles

POWER ENGINEERS

Date: 1/3/2023
Rev. 0

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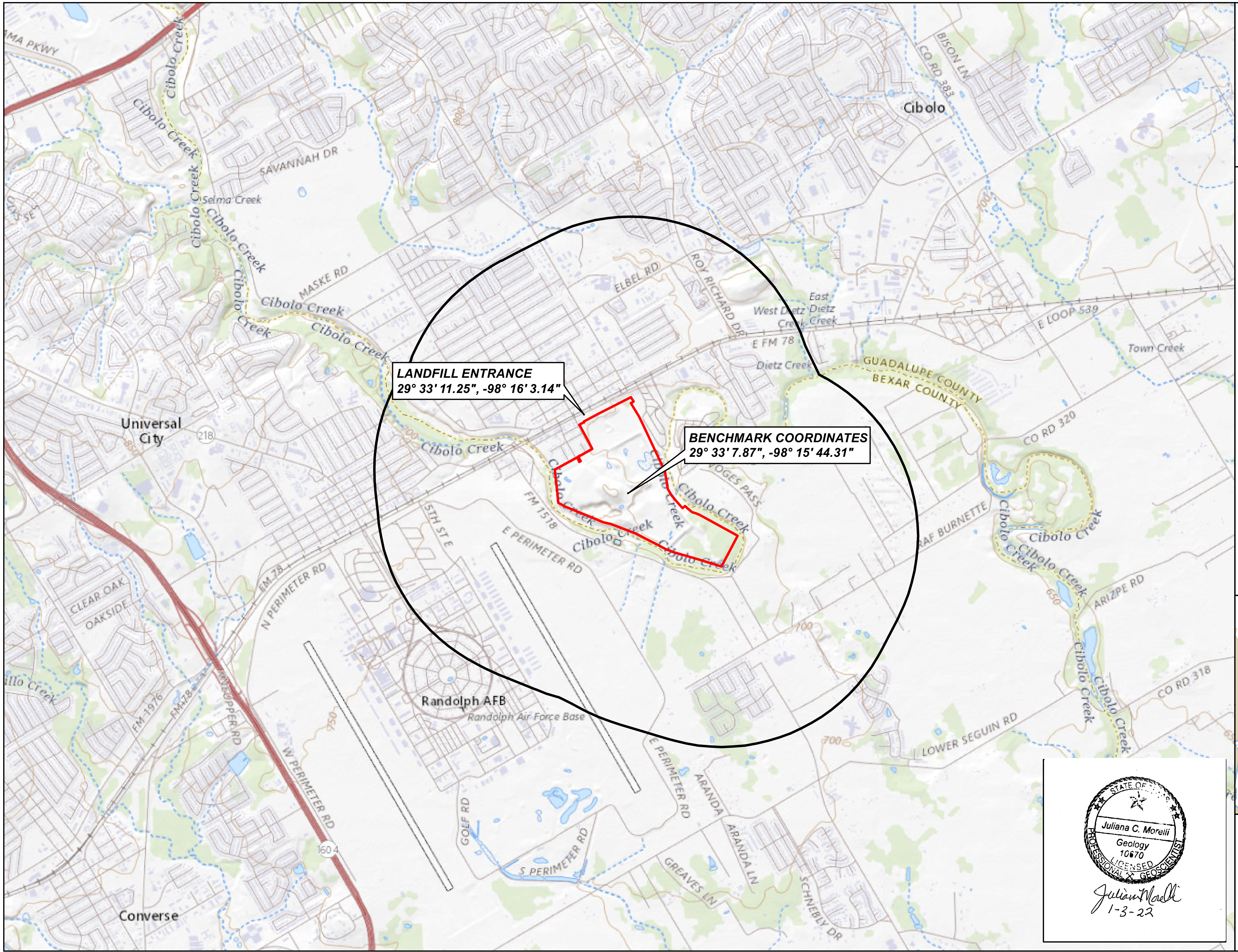
NIDO, LTD.
BECK LANDFILL

FIGURE 1-1B:
GENERAL LOCATION MAP
USGS TOPOGRAPHIC MAP

SCHERTZ, GUADALUPE
COUNTY, TEXAS



LANDFILL ENTRANCE
29° 33' 11.25", -98° 16' 3.14"

BENCHMARK COORDINATES
29° 33' 7.87", -98° 15' 44.31"

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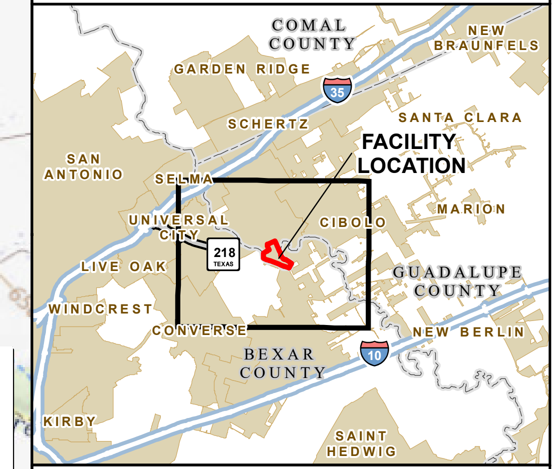
10670
Juliana Morelli
1-3-22

Legend

- 🟥 Permit Boundary
- ☐ 1-Mile Radius

Map Sources:
TxDOT 2021, USGS Topographic Basemap



0 0.5 1
Miles
1 inch = 0.5 miles

Date: 1/3/2023
Rev. 0

POWER ENGINEERS

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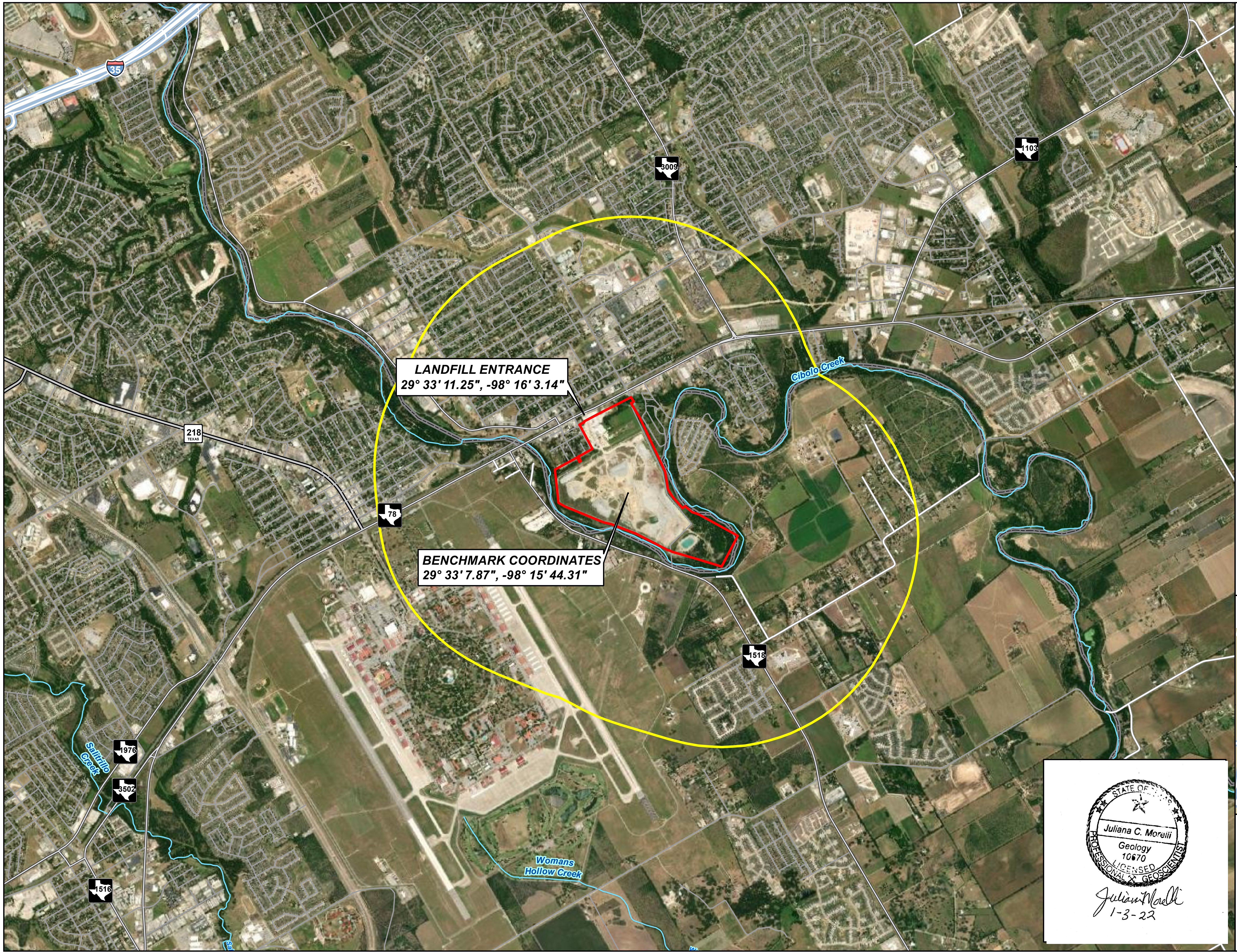
NIDO, LTD.
BECK LANDFILL

FIGURE 1-1C: GENERAL LOCATION MAP AERIAL MAP

SCHERTZ, GUADALUPE COUNTY, TEXAS



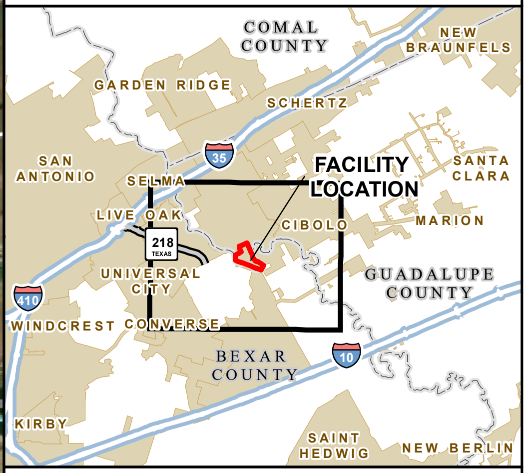
LANDFILL ENTRANCE
29° 33' 11.25", -98° 16' 3.14"

BENCHMARK COORDINATES
29° 33' 7.87", -98° 15' 44.31"

Legend

- 🟥 Permit Boundary
- 🟨 1-Mile Radius
- Interstate Highway
- State Highway
- FM Road
- County Road
- Local Road
- Stream
- County Boundary

Map Sources:
TxDOT 2021, NHD, ESRI World Imagery 2021



0 0.5 1
Miles
1 inch = 0.5 miles

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PROFESSIONAL GEOSCIENTIST

Juliana Morelli
1-3-22

Date: 1/3/2023
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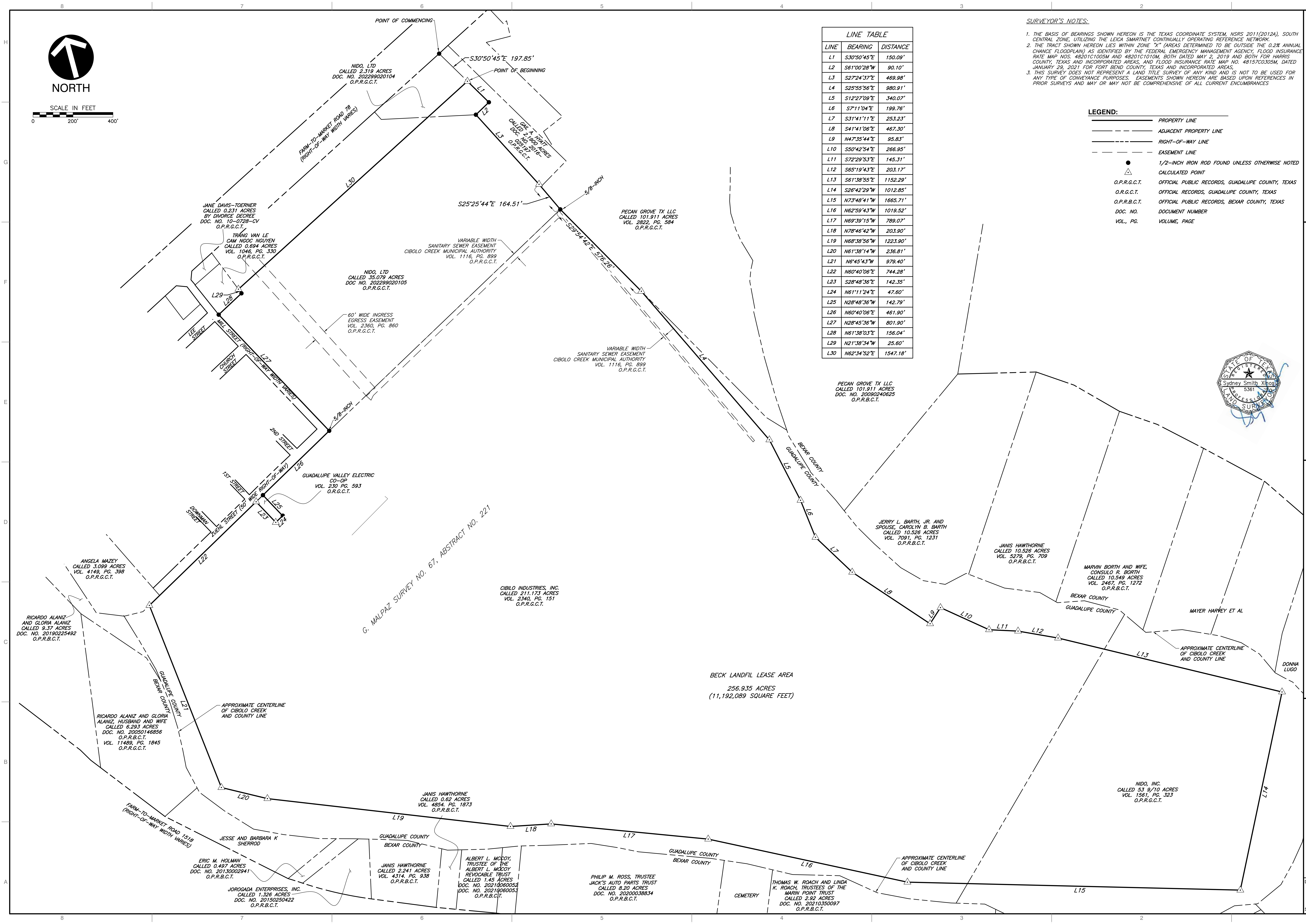
5.0 PROPERTY OWNER INFORMATION (330.59(d))

5.1 Updated Landowner Tracts

Nido, LTD and Cibolo Industries, LTD are now the two legal entities owning all parcels within the permitted boundary for MSW Permit #1848A. The recently executed deeds are provided herein. The records at the Guadalupe County Appraisal District (GCAD) are still updating, so GCAD Maps do not represent the current ownership.



LINE TABLE		
LINE	BEARING	DISTANCE
L1	S30°50'45"E	150.09'
L2	S61°00'28"W	90.10'
L3	S27°24'37"E	469.98'
L4	S25°55'56"E	980.91'
L5	S12°27'09"E	340.07'
L6	S7°11'04"E	199.76'
L7	S31°41'11"E	253.23'
L8	S41°41'06"E	467.30'
L9	N47°35'44"E	95.83'
L10	S50°42'54"E	266.95'
L11	S72°29'53"E	145.31'
L12	S65°19'43"E	203.17'
L13	S61°38'55"E	1152.29'
L14	S26°42'29"W	1012.85'
L15	N73°48'41"W	1665.71'
L16	N62°59'43"W	1019.52'
L17	N69°39'15"W	789.07'
L18	N78°46'42"W	203.90'
L19	N68°38'56"W	1223.90'
L20	N61°38'14"W	236.81'
L21	N6°45'43"W	979.40'
L22	N60°40'06"E	744.28'
L23	S28°48'36"E	142.35'
L24	N61°11'24"E	47.60'
L25	N28°48'36"W	142.79'
L26	N60°40'06"E	461.90'
L27	N28°45'36"W	801.90'
L28	N61°38'03"E	156.04'
L29	N21°38'34"W	25.60'
L30	N62°34'52"E	1547.18'

SURVEYOR'S NOTES:

1. THE BASIS OF BEARINGS SHOWN HEREON IS THE TEXAS COORDINATE SYSTEM, NSRS 2011(2012A), SOUTH CENTRAL ZONE, UTILIZING THE LEICA SMARTNET CONTINUALLY OPERATING REFERENCE NETWORK.
2. THE TRACT SHOWN HEREON LIES WITHIN ZONE "X" (AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN) AS IDENTIFIED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY, FLOOD INSURANCE RATE MAP NOS. 48201C1005M AND 48201C1010M, BOTH DATED MAY 2, 2019 AND BOTH FOR HARRIS COUNTY, TEXAS AND INCORPORATED AREAS, AND FLOOD INSURANCE RATE MAP NO. 48157C0305M, DATED JANUARY 29, 2021 FOR FORT BEND COUNTY, TEXAS AND INCORPORATED AREAS,
3. THIS SURVEY DOES NOT REPRESENT A LAND TITLE SURVEY OF ANY KIND AND IS NOT TO BE USED FOR ANY TYPE OF CONVEYANCE PURPOSES. EASEMENTS SHOWN HEREON ARE BASED UPON REFERENCES IN PRIOR SURVEYS AND MAY OR MAY NOT BE COMPREHENSIVE OF ALL CURRENT ENCUMBRANCES

LEGEND:

━━━━	PROPERTY LINE
─── ─ ─ ───	ADJACENT PROPERTY LINE
───‑‑‑───	RIGHT-OF-WAY LINE
— — — —	EASEMENT LINE
●	1/2-INCH IRON ROD FOUND UNLESS OTHERWISE NOTED
△	CALCULATED POINT
O.P.R.G.C.T.	OFFICIAL PUBLIC RECORDS, GUADALUPE COUNTY, TEXAS
O.R.G.C.T.	OFFICIAL RECORDS, GUADALUPE COUNTY, TEXAS
O.P.R.B.C.T.	OFFICIAL PUBLIC RECORDS, BEXAR COUNTY, TEXAS
DOC. NO.	DOCUMENT NUMBER
VOL., PG.	VOLUME, PAGE

Sydney Smith Xinos
5361

REVISION RECORD

NO	DATE	DESCRIPTION
△		

Civil & Environmental Consultants, Inc.
3711 South MoPac Expressway · Building 1, Suite 550 · Austin, TX 78746
Ph: 512.439.0400 · Fax: 512.329.0096
www.cecinc.com
Texas Registered Surveying Firm 10194419
Texas Registered Engineering Firm F-38

LEASE BOUNDARY SURVEY
BECK LANDFILL
550 FM 78
CITY OF SCHERTZ
GUADALUPE COUNTY, TEXAS

NIDO, INC. AND CIBOLO INDUSTRIES, INC.
DOC. NOS. 202299020104, 202299020105,
VOL. 2340, PG. 151 AND VOL. 1561 PG. 323
GUADALUPE COUNTY, TEXAS

DATE:	JANUARY 03, 2023	DRAWN BY:	APV
DWG SCALE:	1"=200'	CHECKED BY:	ESH
PROJECT NO:	317-935	APPROVED BY:	SSX

DRAWING NO.:
I-5
SHEET 1 OF 1

P:\310-000\311-653\-Survey\Dwg\311-653 BECK OVERALL LEASE AREA EXHIBIT 2 EASEMENTS.dwg{EXHIBIT} LS:(1/3/2023 - ehopkin) - LP: 1/3/2023 1:34 PM

256.935 ACRES
BECK LANDFILL
SCHERTZ, TX

PROJECT NO.: 311-653
AUGUST 29, 2022

LEGAL DESCRIPTION

BEING A 256.935 ACRE TRACT OF LAND OUT OF THE G. MALPAZ SURVEY NO. 67, ABSTRACT NO. 221, AND BEING A PORTION OF A CALLED 2.319 ACRE TRACT CONVEYED TO NIDO, LTD. PER DEED RECORDED AS DOCUMENT NO. 202299020104 OF THE OFFICIAL PUBLIC RECORDS OF GUADALUPE COUNTY, TEXAS (O.P.R.G.C.T.), AND BEING A PORTION OF A CALLED 35.079 ACRE TRACT CONVEYED TO NIDO, LTD. PER DEED RECORDED AS DOCUMENT NO. 202299020105, O.P.R.G.C.T., AND BEING OUT OF A CALLED 211.173 ACRE TRACT CONVEYED TO CIBOLO INDUSTRIES, INC. PER DEED RECORDED AS VOLUME 2340, PAGE 151, O.P.R.G.C.T., AND BEING OUT OF A CALLED 53 9/10 ACRE TRACT CONVEYED TO NIDO, INC. PER DEED RECORDED AS VOLUME 1561, PAGE 323, O.P.R.G.C.T.; SAID 256.935 ACRE TRACT BEING DESCRIBED MORE PARTICULARLY BY METES AND BOUNDS AND FOLLOWS:

COMMENCING, for reference, at a 1/2 inch iron rod found at the common north corner of a called 2.1900 acre tract conveyed to Gail A. Hyatt per deed recorded as Document No. 2016-025197, O.P.R.G.T.C., and of said 2.319 acre tract, said point being on the southeasterly right-of-way line of Farm-to-Market Road 78 (right-of-way width varies);

THENCE, along the common line of said 2.319 acre tract and of said 2.1900 acre tract, S30°50'45"E, a distance of 197.85 feet to a calculated point for the **POINT OF BEGINNING** and most northerly corner hereof;

THENCE, , along the common line of said 2.319 acre tract and of said 2.1900 acre tract and then of a called 101.911 acre tract conveyed to Pecan Grove TX LLC per deed recorded as Volume 2822, Page 584, O.P.R.G.C.T., the following four (4) courses and distances:

1. S30°50'45"E, a distance of 150.09 feet to a found 1/2 inch iron rod;
2. S61°00'28"W, a distance of 90.10 feet to a found 1/2 inch iron rod;
3. S27°24'37"E, a distance of 469.98 feet to a calculated point;
4. S25°25'44"E, a distance of 164.51 feet to a 5/8 inch iron rod found at the common northeast corner of said 35.079 acre tract and of said 211.173 acre tract;

THENCE, over and across said 211.173 acre tract, and of said 59 9/10 acre, the following nineteen (19) courses and distances:

1. S29°54'42"E, a distance of 576.26 feet to a calculated point;
2. S25°55'56"E, a distance of 980.91 feet to a calculated point;
3. S12°27'09"E, a distance of 340.07 feet to a calculated point;

4. S07°11'04"E, a distance of 199.76 feet to a calculated point;
5. S31°41'11"E, a distance of 253.23 feet to a calculated point;
6. S41°41'06"E, a distance of 467.30 feet to a calculated point;
7. N47°35'44"E, a distance of 95.83 feet to a calculated point;
8. S50°42'54"E, a distance of 266.95 feet to a calculated point;
9. S72°29'53"E, a distance of 145.31 feet to a calculated point;
10. S65°19'43"E, a distance of 203.17 feet to a calculated point;
11. S61°38'55"E, a distance of 1,152.29 feet to a calculated point;
12. S26°42'29"W, a distance of 1,012.85 feet to a calculated point;
13. N73°48’41"W, a distance of 1,665.71 feet to a calculated point;
14. N62°59'43"W, a distance of 1,019.52 feet to a calculated point;
15. N69°39'15"W, a distance of 789.07 feet to a calculated point;
16. N78°46'42"W, a distance of 203.90 feet to a calculated point;
17. N68°38'56"W, a distance of 1223.90 feet to a calculated point;
18. N61°38'14"W, a distance of 236.81 feet to a calculated point
19. N06°45'43"W, a distance of 979.40 feet to a calculated point on the common line of said 211.173 acre tract and a called 3.099 acre tract conveyed to Angela Mazey per deed recorded as Volume 4149, Page 398, O.P.R.G.C.T.;

THENCE, along the common line of said 211.173 acre tract, and of said 3.099 acre tract and then of the southeasterly right-of-way line of Zuehl Street (50 foot wide right-of-way) N60°40'06"E, a distance of 744.28 feet to a calculated point at a common corner of said 211.173 acre tract and of that certain tract of land conveyed to Guadalupe Valley Electric Co-op per deed recorded as Volume 230, Page 593, O.R.G.C.T.;

THENCE, along the common line of said 211.173 acre tract, and of said Guadalupe Valley Electric Co-op tract, the following three (3) courses and distances:

1. S28°48'36"E, a distance of 142.35 feet to a calculated point;

2. N61°11'24"E, a distance of 47.60 feet to a found 1/2 inch iron rod;

3. N28°48'36"W, a distance of 142.79 feet to a 1/2 inch iron rod found on the southeasterly right-of-way line of Zuehl Street;

THENCE, along the common line of said 211.173 acre tract, and of the southeasterly right-of-way line of Zuehl Street, N60°40’06”E, a distance of 461.90 feet to a 5/8-inch iron rod found at the southeasterly corner of the intersection of Mill Street (right-of-way width varies) and of Zuehl Street, being the common corner of said 211.173 acre tract and of said 35.079 acre tract;

THENCE, along the common line of Mill Street and of said 35.079 acre tract, N28°45’36”W, a distance of 801.90 feet to a 1/2-inch iron rod found at the westerly common corner of a called 0.694 acre tract conveyed to Trang Van Le and Cam Ngoc Nguyen per deed recorded in Volume 1046, Page 330, O.P.R.G.C.T. and of said 35.079 acre tract;

THENCE, along the common line of said 35.079 acre tract, and of said 0.694 acre tract and then of a called 0.231 acre tract conveyed to Jane Davis-Toerner per Divorce Decree recorded as Document No. 10-0728-CV, O.P.R.G.C.T., the following two (2) courses and distances:

1. N61°38’03”E, a distance of 156.04 feet to a found 1/2-inch iron rod;

2. N21°38’34”W, a distance of 25.60 feet to a calculated point;

THENCE, over and across said 35.079 tract, N62°34’52”E, a distance of 1,547.18 feet to the **POINT OF BEGINNING,** and containing 256.935 acres (11,192,089 square feet) of land, more or less.

THE BASIS OF BEARING OF THIS SURVEY IS TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NSRS 2011(2012A), SOUTH CENTRAL ZONE, UTILIZING THE LEICA SMARTNET CONTINUALLY OPERATING REFERENCE NETWORK.

Witness my hand and seal this 29th day of August, 2022.

Sydney Smith Xinos, R.P.L.S. 5361
Civil & Environmental Consultants, Inc.
3711 S. MoPac Expressway, Building 1, Suite 550
Austin, TX 78746
Texas Registered Surveying Firm No. 10194419

SYDNEY SMITH XINOS
5361

6.0 LEGAL AUTHORITY (330.59(e))

Verification of legal status (30 TAC §218.5 and §330.59(e))
Attach to this form verification of legal status. This may be a one-page certificate of incorporation (Certificate of Fact), issued by the Texas SOS. If providing an alternative document documenting legal status, attach that form instead. In addition, provide a list of all persons having over 20% ownership in this facility in the table below (attach additional pages as necessary):

Nido LTD dba Beck Landfill:

Name	Title	Contact Information
Nido, Ltd.	Owner/Operator	210-349-2491
Cibolo Industries, Ltd.	Owner (landowner)	210-349-2491

OFFICE OF THE COMPTROLLER
TEXAS

Franchise Tax Account Status

As of : 09/06/2022 08:23:52

This page is valid for most business transactions but is not sufficient for filings with the Secretary of State

NIDO, LTD	
Texas Taxpayer Number	17423417561
Mailing Address	PO BOX 790641 SAN ANTONIO, TX 78279-0641
Right to Transact Business in Texas	ACTIVE
State of Formation	TX
Effective SOS Registration Date	01/01/2006
Texas SOS File Number	0800579838
Registered Agent Name	LEE C MCCARTY
Registered Office Street Address	126 E. TURBO DRIVE SAN ANTONIO, TX 78216

OFFICE OF THE COMPTROLLER
TEXAS

Franchise Tax Account Status

As of : 09/06/2022 08:19:10

This page is valid for most business transactions but is not sufficient for filings with the Secretary of State

---

CIBOLO INDUSTRIES, LTD	
Texas Taxpayer Number	30008875830
Mailing Address	126 E TURBO DR SAN ANTONIO, TX 78216-3309
Right to Transact Business in Texas	ACTIVE
State of Formation	TX
Effective SOS Registration Date	01/01/2003
Texas SOS File Number	0800152934
Registered Agent Name	LEE C MCCARTY
Registered Office Street Address	126 E. TURBO DRIVE SAN ANTONIO, TX 78279

NOTICE OF CONFIDENTIALITY RIGHTS: IF YOU ARE A NATURAL PERSON, YOU MAY REMOVE OR STRIKE ANY OR ALL OF THE FOLLOWING INFORMATION FROM ANY INSTRUMENT THAT TRANSFERS AN INTEREST IN REAL PROPERTY BEFORE IT IS FILED FOR RECORD IN THE PUBLIC RECORDS: YOUR SOCIAL SECURITY NUMBER OR YOUR DRIVER'S LICENSE NUMBER.

SPECIAL WARRANTY DEED

STATE OF TEXAS §
§ KNOW ALL MEN BY THESE PRESENTS:
COUNTY OF GUADALUPE §

THAT **LEE C. MCCARTY, AS INDEPENDENT EXECUTOR OF THE ESTATE OF DANIEL E. MCCARTY** ("**Grantor**"), for and in consideration of TEN AND NO/100 DOLLARS ($10.00) and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, from **NIDO, LTD**., a Texas limited partnership ("**Grantee**"), with a mailing address of 122 E. Turbo Drive, San Antonio, Texas 78216, has GRANTED, SOLD, and CONVEYED, and by these presents does GRANT, SELL, and CONVEY, unto the said Grantee that certain real property situated in the County of Guadalupe, State of Texas, more particularly described on Exhibit A attached hereto and made a part hereof for all purposes (the "**Land**"), together with all buildings, structures, improvements and fixtures thereon (the "**Improvements**"), and all easements, leases, licenses, rights-of-way, interests, rights and appurtenances pertaining thereto (collectively, the "**Appurtenances**").

For the same consideration, Grantor has GRANTED, SOLD and CONVEYED, and by these presents does GRANT, SELL and CONVEY unto Grantee, without warranty, express or implied, all right, title and interest of Grantor, if any, in and to: (i) strips and gores, if any, between the Property and any abutting or adjacent properties, whether owned or claimed by deed, limitations or otherwise, and whether located inside or outside the Property, (ii) any land lying in or under the bed of any creek, stream or waterway or any highway, avenue, street, road, alley, easement or right of way, open or proposed, in, or across, abutting or adjacent to the Property, (iii) all utilities, sewage treatment capacity and water capacity serving or which will serve the Land and or the Improvements, and (iv) licenses, permits, contract rights, warranties, guaranties, entitlements and governmental approvals pertaining to the Land and/or the Improvements to the extent the same relate solely to the Land and/or the Improvements and are transferable, and (v) development and zoning rights pertaining to the Land and/or the Improvements.

The Land, Improvements, and Appurtenances are sometimes collectively herein referred to as the "**Property**."

This Special Warranty Deed is made and accepted expressly subject all matters of record recorded in the real property records of Guadalupe County, Texas, to the extent same are valid, currently in existence and affect the Property.

TO HAVE AND TO HOLD the Property, together with all and singular the rights and appurtenances thereto in anywise belonging, unto Grantee, and Grantee's successors and assigns, forever, and Grantor does hereby bind Grantor and Grantor's successors and assigns to WARRANT and FOREVER DEFEND, all and singular the Property unto Grantee and Grantee's successors and assigns against every person whomsoever lawfully claiming or to claim the same or any part thereof by, through or under Grantor, but not otherwise and subject, however, as aforesaid, to the Permitted Exceptions.

IN WITNESS WHEREOF, Grantor has executed this deed to be effective as of the date set forth in the notary block below.

GRANTOR:

Lee C. McCarty

LEE C. MCCARTY, AS INDEPENDENT EXECUTRIX OF THE ESTATE OF DANIEL E. MCCARTY

STATE OF TEXAS §
§
COUNTY OF BEXAR §

This instrument was acknowledged before me on the 22 day of June, 2022, by Lee C. McCarty, as Independent Executrix of The Estate of Daniel E. McCarty.

Lori S Navarro
Notary Public, State of Texas

[SEAL] Lori S Navarro
My Commission Expires
10/24/2025
Notary ID
7177468

EXHIBIT A

Legal Description

BEING A 2.319 ACRE TRACT OF LAND OUT OF THE G. MALPAZ SURVEY NO. 67, ABSTRACT NO. 221, AND BEING A REMAINDER PARCEL OF THE 243.088 ACRE TRACT CONVEYED TO DANIEL E. MCCARTY PER DEED RECORDED IN VOLUME 729, PAGE 1246 OF THE OFFICIAL RECORDS OF GUADALUPE COUNTY, TEXAS, AND BEING DESCRIBED MORE PARTICULARLY BY METES AND BOUNDS AND FOLLOWS:

BEGINNING AT A ½-INCH IRON ROD FOUND ON THE SOUTHERLY RIGHT-OF-WAY LINE OF FARM-TO-MARKET ROAD 78 (RIGHT-OF-WAY WIDTH VARIES) AT THE MOST WESTERLY CORNER OF THE TRACT CONVEYED TO GAIL A. HYATT PER DEED RECORDED AS DOCUMENT NO. 2016-025197 OF THE OFFICIAL PUBLIC RECORDS OF GUADALUPE COUNTY, TEXAS (O.P.R.G.C.T.), FOR THE MOST NORTHERLY CORNER AND **POINT OF BEGINNING** HEREOF;

THENCE, ALONG A SOUTHWESTERLY LINE AND A NORTHWESTERLY LINE OF SAID GAIL A. HYATT TRACT THE FOLLOWING TWO (2) COURSES AND DISTANCES:

1. S30°50'45"E, A DISTANCE OF 347.94 FEET TO A FOUND ½-INCH IRON ROD;

2. S61°00'28"W, A DISTANCE OF 90.10 FEET TO A ½-INCH IRON ROD FOUND AT A COMMON CORNER OF SAID GAIL A. HYATT TRACT AND OF THE TRACT CONVEYED TO NIDO, INC. PER DEED RECORDED IN VOLUME 1322, PAGE 194, O.P.R.G.C.T.;

THENCE, ALONG NORTHEASTERLY LINES OF SAID NIDO, INC. TRACT THE FOLLOWING TWO (2) COURSES AND DISTANCES:

1. N78°02'35"W, A DISTANCE OF 474.02 FEET TO A CALCULATED POINT;

2. N27°17'51"W, A DISTANCE OF 49.98 FEET TO A CALCULATED POINT ON THE SOUTHERLY RIGHT-OF-WAY LINE OF FARM-TO-MARKET ROAD 78;

THENCE, ALONG THE SOUTHERLY RIGHT-OF-WAY LINE OF FARM-TO-MARKET ROAD 78, N62°42'03"E, A DISTANCE OF 435.58 FEET TO THE **POINT OF BEGINNING**, AND CONTAINING 2.319 ACRES OF LAND, MORE OR LESS.

202299020104
I certify this instrument was ELECTRONICALLY FILED
and RECORDED in the OFFICIAL PUBLIC RECORDS
of Guadalupe County, Texas on
06/28/2022 11:29:20 AM PAGES: 3 LEAH
TERESA KIEL, COUNTY CLERK

Teresa Kiel

7.0 EVIDENCE OF COMPETENCY (330.59(f))

Evidence of Competency:

Provide the below information per 30 TAC §330.59(f) as applicable to the facility (attach additional sheets as needed).

List of all Texas solid waste sites that the owner and operator have owned or operated within the last ten years:

Site Name	Site Type	Permit/Reg No.	County	Dates of Operation
Beck Landfill	MSW Type IV	1848	Guadalupe	1985-Now

List of all solid waste sites in all states, territories, or counties in which the owner and operator have a direct financial interest:

Site Name	Location	Dates of Operation	Regulatory Agency (Provide Name and Address)
Beck Landfill	Guadalupe County	1985-Now	TCEQ 12100 Park 35 Circle, Austin, TX

Names of the principals and supervisors of the owner's and operator's organization, together with previous affiliations with other organizations engaged in solid waste activities.

Name	Previous Affiliation	Other Organization
Ben Davis, Principal/Owner	30+ years Beck Landfill, Nido, LTD (MSW Permit #1848)	None
Ken McCarty, Principal/Owner	30+ years Beck Landfill, Nido, LTD (MSW Permit #1848)	Multi-Source Sand and Gravel Company, Ltd.
Lee McCarty, Principal/Owner	30+ years Beck Landfill, Nido, LTD (MSW Permit #1848)	Multi-Source Sand and Gravel Company, Ltd.
Grant Norman, Managing Director	30+ years of waste industry and landfill operations experience Beck Landfill, Nido, LTD (MSW Permit # 1848)	Browning Ferris Industries Type I Landfill: Industrial Waste and Landfill Operations Waste Management Type I Landfill: Industrial Waste Operations Texas Disposal Systems Type I Landfill: Environmental Management and Sales Management

For landfill permit applications only, evidence of competency to operate the facility shall also include landfilling and earthmoving experience if applicable, and other pertinent experience, or licenses as described in 30 TAC 30 possessed by key personnel. The number and size of each equipment type to be dedicated to facility operation should be specified in greater detail on Part IV of the application within the site operating plan.

Beck Landfill Equipment List

Equipment Description	**Number of Units per CU Yards**		**Equipment Size**	**Equipment Function**
	≤1.5 million cubic yards/year	**>1.5 million cubic yards/year**		
Landfill compactor	1	2	Minimum weight of 50,000 pounds	Waste compaction and fire protection
Bulldozer	1	1	Caterpillar D6 or equivalent	Waste spreading, waste compaction, cover soil spreading, slope maintenance and fire protection
Excavator	1	1	Minimum weight of 20,000 pounds	Cover soil excavation, cell excavation, construction and fire protection
Front End Loader	1	2	John Deere 544 equivalent or larger	Loading of soil, fire protection, retrieval of recyclable materials and removal of non-conforming wastes from the working face, road maintenance
Dump Truck	1	2	Minimum heaped capacity of 10 cubic yards	Hauling of cover soil, hauling of excavated cell materials, and fire protection
Motor Grader/Maintainer	1	1	Minimum eight of 10,000 pounds	Site road maintenance, slope maintenance
Water Pump	1	1	4” or 6” Pump	Removal of below grade stormwater and perched groundwater
Water Truck	1	1	Minimum 1,500-gallon tank capacity	Site maintenance, dust control, and fire protection
Sweeper	1	1	Minimum 4ft broom width	Site maintenance, hard surface sweeping, dust and mud control

Landfill Staffing Levels

Landfill Position	**Name(s)**	**License/Certification and Expiration**
Landfill Facility Manager (LFM)	Grant Norman	MWSOL MSW Operator A No. SW0005998 Exp. 6/20/2023
Landfill Supervisor (LS)	1	Working on Operator A licensing
Equipment Operators	3 – 5	N/A
Gate Attendants	1 – 2	N/A
Landfill Spotters	2 – 5	N/A
Other Personnel (laborers)	1 – 3	N/A

8.0 APPOINTMENTS (330.59(g))

9.0 APPLICATION FEE (330.59(h))

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
EPAY • ONLINE PAYMENT APPLICATION

Questions or Comments >>

Shopping Cart | Select Fee | Search Transactions | Sign Out

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Note: It may take up to 3 working days for this electronic payment to be processed and be reflected in the TCEQ ePay system. Print this receipt and the vouchers for your records. An email receipt has also been sent.

Transaction Information

Trace Number: 582EA000504507
Date: 09/05/2022 08:48 PM
Payment Method: CC - Authorization 000005365D
ePay Actor: ADAM WADE MEHEVEC
Actor Email: amehevec@cecinc.com
IP: 4.7.147.10
TCEQ Amount: $2,050.00
Texas.gov Price: $2,096.38*

* This service is provided by Texas.gov, the official website of Texas. The price of this service includes funds that support the ongoing operations and enhancements of Texas.gov, which is provided by a third party in partnership with the State.

Payment Contact Information

Name: ADAM WADE MEHEVEC
Company: CEC
Address: 3711 SOUTH MOPAC BLDG 1 550, AUSTIN, TX 78746
Phone: 512-587-4475

Cart Items

Click on the voucher number to see the voucher details.

Voucher	Fee Description	AR Number	Amount
591414	NONHAZARDOUS WASTE PERMIT - NEW & AMENDMENTS (INCLUDING LIMITED SCOPE)		$2,000.00
591415	30 TAC 305.53B WASTE NOTIFICATION FEE		$50.00
		TCEQ Amount:	$2,050.00

[ePay Again] [Exit ePay]

Note: It may take up to 3 working days for this electronic payment to be processed and be reflected in the TCEQ ePay system. Print this receipt for your records.

10.0 SUPPLEMENTAL INFORMATION

Updates to MSW Permit 1848A are proposed to incorporate all prior minor and major modifications and amendments to the current MSW Permit No. 1848A. In addition, this facility proposes a vertical expansion of the landfill that will increase capacity and address recent changes to the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 (Volume 8 Version 2).

Texas Department of Health

Robert Bernstein, M.D., F.A.C.P.
Commissioner

1100 West 49th Street
Austin, Texas 78756-3199
(512) 458-7111

Robert A. MacLean, M.D.
Deputy Commissioner
Professional Services

Hermas L. Miller
Deputy Commissioner
Management and Administration

OCT 16 1985

CERTIFIED MAIL #501-346/501-347
RETURN RECEIPT REQUESTED

Mr. Benjamin Davis, President
Beck Ready Mix, Inc.
P.O. Box 32641
San Antonio, Texas 78216

Mr. Don McCarty
126 E. Turbo
San Antonio, Texas 78216

Subject: Solid Waste - Guadalupe County

Dear Messrs. Davis and McCarty:

This letter is in follow-up to our meeting on September 19, 1985, and the proposed improvement schedule submitted by your engineer, Mr. Walter Snowden.

Since the area in question has been in continuous use as a Type IV landfill prior to state permitting requirements, the site can remain in operation pending permit processing provided the site is otherwise in compliance with the Texas Department of Health (TDH) regulatory requirements. Inspection reports by our regional personnel reveal the site is in general compliance except for groundwater protection and submission of a complete permit application.

In accordance with TDH enforcement policy a mandatory compliance schedule for bringing the site into compliance in an orderly manner is hereby issued. Failure to comply with the following schedule will forfeit your rights to operate under a grandfather status and cause TDH to seek corrective injunctive relief and appropriate civil penalties through the office of the Attorney General.

1. Prior to November 8, 1985, you or your representative shall have completed and resubmitted Part A of the Department's permit application along with the application fee as outlined in the enclosed excerpt (Section 325.63) from the Department's regulations.

SNOWDEN, INC.

2. Prior to December 10, 1985, you or your representative shall have completed the soils investigation, topographical and boundary survey work required as a basis for preparing an operational and construction design for the slurry wall proposed by your engineers.

3. Prior to February 15, 1986, the design review documents shall be completed and submitted to the Department.

The Department will respond to this initial submittal within 15 days.

4. Within 21 days after reviewing TDH comments and approval, the plans and specifications shall be revised and the contract advertised for construction bids.

   The bidding period shall not exceed 30 days and the contract award shall be within ten days after bids are opened. Start of construction shall be within 21 days of the award of contract and the construction period shall not exceed 105 days.

If you become aware that for reasons beyond your control full compliance cannot be attained as outlined in the above compliance schedule, you should submit a written request for an extension to TDH, outlining the reason for the delay and the date that compliance will be attained.

Grandfather status is an interim status which allows operation of a facility during the completion of the permitting process. Such status is not to imply that completion and submission of a complete application is not required nor does it relieve you of any responsibility for operation in compliance with the regulations governing a permitted site.

If you have any questions concerning this letter or if we may be of any assistance to you regarding solid waste management, you may contact Mr. Jerry L. Garnett, P.E., of my staff here in Austin at telephone number (512) 458-7271 or you may prefer to contact Mr. Raymond B.

Whitley, P.E., Regional Director of Environmental and Consumer Health Protection at P.O. Drawer 630, Uvalde, Texas 78801; telephone number (512) 278-7173.

Sincerely yours,

L B Griffith

for L. D. Thurman, P.E., Acting Chief
Bureau of Solid Waste Management

JLG:gsr

cc: Region 9, TDH
Snowden, Inc.

PART II

MUNICIPAL SOLID WASTE PERMIT MAJOR AMENDMENT

Part II Application for Permit Amendment

(TAC Title 30 Rule §330.61)

STATE OF TEXAS
Juliana C. Morelli
Geology
10670
LICENSED
PROFESSIONAL GEOSCIENTIST
Juliana Morelli
1-3-22

STATE OF TEXAS
ADAM W. MEHEVEC
84736
LICENSED
PROFESSIONAL ENGINEER
1-2-2023

BECK
COMPANIES

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: September 2022

Prepared by:

POWER
ENGINEERS

PROJECT NUMBER: 150051.05.01

PROJECT CONTACT: Julie Morelli

EMAIL: Julie.Morelli@powereng.com

PHONE: 210-951-6424

Juliana C. Morelli
Geology
10670
Juliana Morelli
1-3-23

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ADAM W. MEHEVEC
84736
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STATE OF TEXAS
ADAM W. MEHEVEC
84736
LICENSED PROFESSIONAL ENGINEER
1-2-2023

STATE OF TEXAS
Juliana C. Morelli
Geology
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Juliana Morelli
1-3-22

TCEQ FORM 20885 – APPLICATION FOR MSW PERMIT, PART II

Texas Commission on Environmental Quality
Part II Application Form for New Permit or Permit Amendment for a Municipal Solid Waste Landfill Facility

I. Application Information

1. Facility Name: Beck Landfill
2. Permittee Name: Nido, Ltd. dba Beck Landfill
3. MSW Authorization #: 1848
4. Initial Submittal Date: September 9, 2022

II. Existing Conditions Summary - 30 TAC §330.61(a)

Provide information to address any site-specific conditions that require special design considerations and possible mitigation of conditions as follows.

1. Provide a summary describing the existing conditions at the site and within the areas surrounding the site, which may include discussions of any additional land-use, environmental, or special issues related to the facility.

See Part II, Attachment A

2. Provide brief descriptions of all site-specific conditions at the facility that require special design considerations.

Beck Landfill is an existing Type IV landfill that is in operation at 550 FM 78 in Schertz, Guadalupe County, Texas. This facility was initially authorized in 1989 by the Texas Department of Health (TDH) in accordance with the design standards of the Municipal Solid Waste Management Regulations adopted in December 1986.

3. Indicate that reports of site-specific conditions that require special design considerations and mitigation of such conditions are provided under Sections VIII – XVI below with regard to (a) facility impacts on surrounding areas; (b)transportation; (c) general geology and soils; (d) groundwater and surface water; (e) existing and abandoned oil and water wells; (f) floodplains and wetlands; (g) endangered or threatened species impacts; and (h) compliance with the Texas Natural Resources Code, Chapter 191 (Texas Antiquities Code).

Reports of site-specific conditions that require special design considerations and mitigation of such conditions are provided under Sections VIII-XVI below with regard to (a) through (h) of this part.

III. Waste Acceptance Plan - 30 TAC §330.61(b)

1. ☐ If this application is for a Type I or Type IAE MSW landfill facility, attach completed Form No. TCEQ-20873. Attachment No.:
2. ☑ If this application is for a Type IV or Type IVAE MSW landfill facility, attach completed Form No. TCEQ-20890. Attachment No.: B

IV. General Location Maps - 30 TAC §330.61(c)

Provide General Location Maps that accurately show the features listed below. Provide all General Location Maps in a single attachment and include the drawing number in the space provided. Include notes on each map, as needed, to describe information pertaining to the map.

1. The prevailing wind direction with a wind rose. Figure 2-1
2. All known water wells within 500 feet of the proposed permit boundary with the state well numbering system designation for Water Development Board “located wells.”
   Figure 2-4
3. All structures and inhabitable buildings within 500 feet of the proposed facility.
   Figure 2-3
4. (i) Schools, (ii) licensed day-care facilities, (iii) churches, (iv) hospitals, (v) cemeteries, (vi) ponds, (vii) lakes, and (viii) residential, (ix) commercial, and (x) recreational areas within one mile of the facility. Figure 2-3
5. The location and surface type of all roads within one mile of the facility that will normally be used by the owner or operator for entering or leaving the facility. Figure 2-5
6. Latitudes and longitudes. Figure 2-1
7. Area streams. Figure 2-7
8. Airports within six miles of the facility. Figure 2-2
9. The property boundary of the facility. Figure 2-1
10. (i) Drainage, (ii) pipeline, and (iii) utility easements within or adjacent to the facility.
    Figure 2-5
11. (i) Facility access control features. Figure 2-5
12. (i) Archaeological sites, (ii) historical sites, and (iii) sites with exceptional aesthetic qualities adjacent to the facility. Figure 2-6

V. Facility Layout Maps - 30 TAC §330.61(d)

Provide the Facility Layout Map(s) as a single attachment, and include drawing number(s) in the space provided. Include notes on each map, as needed, to describe information on the map.

Provide a map or set of maps of the facility layout showing:

1. The outline of the units; Attachment C - Site Layout Map (2-1)
2. General locations of main interior facility roadways; Attachment C - Site Layout Maps
3. Locations of monitor wells; Attachment C - Site Layout Maps
4. Locations of buildings; Attachment C - Site Layout Maps

5. Any other graphic representations or marginal explanatory notes necessary to communicate the proposed construction sequence; Attachment C - Site Layout Maps
6. Fencing; Attachment C - Site Layout Maps
7. Provisions for the maintenance of any natural windbreaks, such as greenbelts, where they will improve the appearance and operation of the facility and, where appropriate, plans for screening the facility from public view; Attachment C - Site Layout Maps
8. All site entrance roads from public access roads; Attachment C - Site Layout Maps
9. General locations of main interior facility roadways that can be used to provide access to fill areas; Attachment C - Site Layout Maps
10. Sectors with appropriate notations to communicate the types of wastes to be disposed of in individual sectors; Attachment C - Site Layout Maps
11. The general sequence of filling operations; Attachment C - Site Layout Maps
12. Sequence of excavations and filling; Attachment C - Site Layout Maps
13. Dimensions of cells or trenches; Att C - Site Layout and
14. Maximum waste elevations and final cover. Att C - Site Layout

VI. General Topographic Maps - 30 TAC §330.61(e)

1. Provide general topographic map(s) consisting of United States Geological Survey 7 ½-minute quadrangle sheets or equivalent for the facility.
   Map No(s). Part I, Attachment 4, Figure 1B
2. At least one of the general topographic maps provided is at a scale of one-inch equals 2,000 feet.
   ☑ Yes

VII. Aerial Photograph - 30 TAC §330.61(f)

Provide an aerial photograph approximately 9” x 9” with a scale within a range of one-inch equals 1,667 feet to one-inch equals 3,334 feet and showing the area within at least one-mile radius of the site boundaries. Mark the site boundaries and fill areas on the aerial photograph(s). A series of aerial photographs can be used to show growth trends.
Attachment No.(s): Part I, Attachment 4, Figure 1C

VIII. Land-Use Map - 30 TAC §330.61(g)

Provide a constructed map of the facility showing the following land-use features (list the map number(s) in the space provided):

1. The boundary of the facility; Part II, Attachment C, Figure 2-3
2. Existing zoning on or surrounding the property ; Part II, Att C, Fig.2-3
3. Actual uses (e.g., agricultural, industrial, residential, etc.) both within the facility and within one mile of the facility. Part II, Att C, Fig.2-3
4. Drainage, pipeline, and utility easements within the facility; Part II, Att C, Fig.2-3
5. Access roads serving the facility; Part II, Att C, Fig.2-3

6. Check the following facilities if they are within one mile of the facility boundary and indicate on map. Figure 2-3
   - (a) ☑ residences;
   - (b) ☑ commercial establishments;
   - (c) ☑ schools;
   - (d) ☑ licensed day-care facilities;
   - (e) ☑ churches;
   - (f) ☑ cemeteries;
   - (g) ☐ ponds or lakes; and
   - (h) ☐ recreational areas.

IX. Impact on Surrounding Area - 30 TAC §330.61(h)

Address the facility's impacts on cities, communities, groups of property owners, or individuals and describe mitigation of conditions as required. Attach additional pages as necessary. If a land use compatibility analysis report prepared by a qualified professional is provided, indicate the location within the application. Attachment No.:

1. **Impacts to Surrounding Areas:**
   (a) Provide information regarding the likely impacts of the facility on cities, communities, groups of property owners, or individuals by analyzing the compatibility of land use, zoning in the vicinity, community growth patterns, and other factors associated with the public interest; and

See Part II, Attachment D

(b) Describe any special design considerations and possible mitigation of potential impacts, as necessary.

See Part II, Attachment D

Published Zoning Map: If available, provide a published zoning map for the facility and within two miles of the facility for the county or counties in which the facility is or will be located.

2. **Special or Nonconforming Use Permit:**

   (a) Does the site require approval as a nonconforming use or a special permit from the local government having jurisdiction? ☐ Yes ☑ No

   (b) If yes, provide a copy of such approval. Attachment No.:

3. **Character of Surrounding Land Use:** Describe the character of the surrounding land uses within one mile of the proposed facility.

See Part II, Attachment D

4. **Growth Trends and Directions of Major Development:**
(a) Provide information about growth trends within five miles of the facility.

See Part II, Attachment D

(b) Describe the directions of major development.

See Part II, Attachment D

5. **Number of and Proximity to Residences and Other Uses:** Indicate the approximate number and proximity of residences and other uses within one mile of the facility as follows. Population density and proximity to residences and other uses may be considered in the assessment.

(a) Number of, distance, and directions to residences:

4,014 housing units within 1 mile

(i) Indicate the distance to the nearest residences: 0 feet

(ii) Provide directions to the nearest residences:

Western side at FM78

(b) Number of, distance, and directions to commercial establishments:

Cemex Concrete plant, co-located on norther portion of property

(i) Indicate the distance to the nearest commercial establishments: feet

(ii) Provide directions to the nearest commercial establishments:

See Attachment D

(c) Number of, distance, and directions to schools:

five schools. nearest is 0.33 mile north

(d) Number of, distance, and directions to churches:

Nine churches within one mile. Closest is ~0.06 miles southwest of the facility

(e) Number of, distance, and directions to cemeteries:

Three familiy cemeteries are within one mile. Adjacent to the north.

(f) Number of, distance, and directions to historic structures and sites:

(g) Number of, distance, and directions to archaeologically significant sites:

See Part II, Attachment C, Figure 2-6

(h) Number of, distance, and directions to sites having exceptional aesthetic quality:

none

6. **Known Wells**. Provide information and discussion of all known wells within 500 ft. of the proposed facility. Provide the well information using Table VIII-1 below. If site has more than 5 wells within the radius, include wells information as an attachment.

None

Table VIII-1. Well Information

Wells Within 500 ft. Radius of the Proposed Facility							
Well Locator	Well ID No.	Depth (ft.)	Completion Date	Completion Formation	Well Use	Longitude	Latitude
See Tabl	3-2 in	Part III	Geology	Report			

X. Transportation and Airport Safety - 30 TAC §330.61(i) and §330.545

1. **Transportation:** Attach completed Transportation Data and Coordination Report Form for Municipal Solid Waste Type I Landfills, TCEQ-20719. Attachment No.: E
2. **Airport Safety:**

(a) Is the facility located, or will be located, within 10,000 feet of any airport runway end used by turbojet aircraft? ☑ Yes ☐ No

(b) Is the facility located, or will be located, within 5,000 feet of any airport runway end used by only piston-type aircraft? ☐ Yes ☑ No

(i) If the answer is "Yes" to either (a) or (b) above, indicate the distance of the facility from the nearest airport runway end used by only turbojet aircraft: feet or piston-type aircraft: feet; and

(ii) Provide required demonstration to show that the municipal solid waste facility units are or will be designed and operated so as not to pose a bird hazard to aircraft.

(c) Is the facility located, or will be located, within a six-mile radius of any small general service airport runway end used by turbojet or piston-type aircraft? ☐ Yes ☑ No

(d) Is the facility located, or will be located, within a five-mile radius of any large general public airport runway end used by turbojet or piston-type aircraft? ☑ Yes ☐ No

(i) If the answer to either of subsection (c) or (d) above is "Yes," has the applicant notified the affected airport as required?
☑ Yes ☐No. Explain: Randolph Air Force Base has been notifed.

(ii) Also, has the applicant notified the Federal Aviation Administration as required?
☑ Yes ☐No. Explain: FAA was notified. The Case is under review.

(iii) Provide copies of the notifications to the affected airport and to FAA.
Part II Attachment F

(iv) All landfill facilities within a six-mile radius of any small general service airport runway or within a five-mile radius of any large general public commercial airport runway shall be critically evaluated to determine if an incompatibility exists. Include any coordination received from the affected airport and from the FAA concerning compatibility.

(e) Will the subject landfill accept waste streams that include putrescible waste?
☐ Yes ☑ No.

(i) If the answer to subsection (e) is "Yes," address the potential for the facility to attract birds and cause significant hazards to low-flying aircraft. Guidelines regarding location of landfills near airports can be found in Federal Aviation Administration Order 5200.5(A), January 31, 1990 (or the replacement active orders, notices, and advisory circular guidelines from the FAA can be used).

XI. General Geology and Soils Statement and Location Restrictions - 30 TAC §330.61(j) and §§ 330.555 - 330.559

1. Discuss in general terms the geology and soils of the proposed site.

Part II Attachment G

2. Fault Areas

(a) Will the municipal solid waste landfill units at the facility or a lateral expansion of the facility be located within 200 feet of a fault that has had displacement in Holocene time?
☐Yes ☑No
If the answer is "Yes," provide demonstration to show that an alternative setback distance of less than 200 feet will prevent damage to the structural integrity of the landfill unit and will be protective of human health and the environment. Attachment No.:

(b) Is the facility located within areas that may be subject to differential subsidence or active geological faulting? ☐Yes ☑No
If the answer is "Yes," provide a detailed fault study. Attachment No.:

(c) Is an active fault known to exist within 1/2 mile of the site? ☐Yes ☑No
If the answer is "Yes," investigate the site for unknown faults and discuss its results. Attachment No.:

(d) Is the facility located in areas experiencing withdrawal of crude oil, natural gas, sulfur, etc., or significant amounts of groundwater? ☐Yes ☑No
If the answer is "Yes," investigate the site in detail for the possibility of differential subsidence or faulting that could adversely affect the integrity of landfill liners and discuss the site investigation and its results. Attachment No.:

(e) If conducted, were the studies of differential subsidence or faulting conducted under the direct supervision of a licensed professional engineer experienced in geotechnical engineering or a licensed professional geoscientist qualified to evaluate conditions of differential subsidence or faulting? ☐Yes ☐No. Explain
Not performed

(f) If conducted, do the studies of differential subsidence or faulting establish the limits (both upthrown and downthrown) of the zones of influence of all active faulted areas within the site vicinity? ☐Yes ☐No. Explain Not performed

(g) If conducted, do the studies of differential subsidence include information or data addressing the following shown below, as applicable:

Table X-1. Information included in Fault Area Studies

Information to be included, as applicable:	Yes	Not Applicable
(i) structural damage to constructed facilities (roadways, railways, and buildings);	☐	☑
(ii) scarps in natural ground;	☐	☑
(iii) presence of surface depressions (sag ponds and ponded water);	☐	☑
(iv) lineation's noted on aerial maps and topographic sheets;	☐	☑
(v) structural control of natural streams;	☐	☑
(vi) vegetation changes;	☐	☑
(vii) crude oil and natural gas accumulations;	☐	☑
(viii) electrical spontaneous potential and resistivity logs (correlation of subsurface strata to check for stratigraphic offsets);	☐	☑
(ix) earth electrical resistivity surveys (indications of anomalies that may represent fault planes);	☐	☑
(x) open cell excavations (visual examinations to detect changes in subsoil texturing and/or weathering indicating stratigraphic offsets);	☐	☑
(xi) changes in elevations of established benchmarks; and	☐	☑
(xii) references to published geological literature pertaining to area conditions.	☐	☑

(h) If the site is or will be located within a zone of influence of active geological faulting or differential subsidence, does the application provide substantial evidence that the zone of influence will not affect the site?
☐Yes ☑No Attachment No.:

Address the following statement:

3. ☑ No solid waste disposal shall be accomplished within a zone of influence of active geological faulting or differential subsidence because active faulting results in slippage along failure planes, thus creating preferred seepage paths for liquids.

4. <u>Seismic Impact Zones</u>

(a) Is the proposed facility located in a seismic impact zone, as defined in 30 TAC §330.557?
☐Yes ☑No
Provide information to support response. Attachment No.:

(b) For facilities located in a seismic impact zone, provide a detailed demonstration showing that all containment structures, including liners, leachate collection systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site. Attachment No.:

5. Unstable Areas

(a) Is the facility located in an unstable area, as defined in 30 TAC §330.559?
☐Yes ☑No Explain: ____

(b) If the facility is located in an unstable area, provide a demonstration that engineering measures have been incorporated into the landfill unit's design to ensure that the integrity of the structural components of the landfill unit will not be disrupted.
Attachment No.:
The demonstration considered at least the following factors:

(i) on-site or local soil conditions that may result in significant differential settling;
☐Yes ☐No

(ii) on-site or local geologic or geomorphologic features; ☐Yes ☐No and

(iii) on-site or local human-made features or events (both surface and subsurface).
☐Yes ☐No

XII. Groundwater and Surface Water - 30 TAC §330.61(k) and §330.549

1. Groundwater

Provide an attachment containing data about the site-specific groundwater conditions at and near the site, from published and open-file sources, including:

- Aquifer names and their association with geologic units described in the General Geology and Soils Statement;
- Groundwater quality, including, if available, typical values or value ranges for total dissolved solids content; and
- Present use(s) of groundwater withdrawn from aquifers at and near the site, if available.

Attachment No.: II - H

Address the following as applicable:

(a) Is the facility located over the Edwards Aquifer recharge zone, as defined in 30 TAC §330.549? ☐Yes ☑No.
If yes, discuss how the facility will comply with the applicable requirements in 30 TAC Chapter 213 (relating to Edwards Aquifer).

(b) A Type I or Type IAE landfill is prohibited on the recharge zone of the Edwards Aquifer; the applicant will not locate a Type I or Type IAE landfill on the recharge zone of the Edwards Aquifer. Select either statement that applies:

☐ (i) The facility is not or will not be located over the Edwards Aquifer Recharge Zone.

☑ (ii) The facility is not a Type I or Type IAE landfill.

(c) A new landfill cell or an aerial expansion of an existing landfill cell managing Class 1 non-hazardous industrial solid waste may not be located in areas described in 30 TAC § 335.584(b)(1) and (2) (relating to Location Restrictions), unless the Executive Director (ED) approves an engineered design that the applicant has demonstrated will provide equal or greater protection to human health and the environment:

(i) Does the application propose Class 1 nonhazardous industrial solid waste cells or units at the subject facility? ☐Yes ☑No

(ii) If yes, discuss how the facility would comply with the location restriction requirements under 30 TAC §335.584(b)(1) and (2). Include any applicable equivalency demonstration that would provide equivalent or greater protection to human health and the environment. Attachment No.:

2. Surface Water

(a) Provide data on surface water at and near the site (including lakes, ponds, creeks, streams, rivers, or similar water bodies).
Attachment Nos.: II - H

(b) Provide information demonstrating how the municipal solid waste facility will comply with applicable Texas Pollutant Discharge Elimination System (TPDES) storm water permitting requirements and the Clean Water Act, §402, as amended TPDES MSGP

(i) The facility has obtained TPDES permit coverage under the following individual wastewater permit(s) (list permit number(s)): TXR05AW45 . A copy of the permit(s) is provided in Attachment No.: Part II - H , or

(ii) A certification statement indicating that the applicant will obtain the appropriate TPDES permit coverage when required.
☐Yes ☐No. Explain

XIII. Abandoned Oil and Water Wells - 30 TAC §330.61(l)

1. Water Wells

(a) Are there any existing or abandoned water wells within the facility? ☐Yes ☑No

(i) If no, move to Item No. 2 below.

(ii) If yes, address the following:

(1) Provide a map showing the water well locations, identity, status, and use. Attachment No.:

(2) Will all the water wells be capped, plugged, and closed prior to construction at the facility? ☐Yes ☐No.

(3) If yes, provide written certification that all such wells will be capped, plugged, and closed in accordance with all applicable rules and regulations of TCEQ or other state agency within 30 days prior to construction at the facility. Attachment No.:

(4) If no, identify and describe the water wells that will be capped, plugged, and closed in accordance with all applicable rules and regulations of TCEQ or other state agency. Attachment No.:

(5) Also, identify the wells necessary for use, and that will remain in use, for supply for operations at the facility. Attachment No.:

(6) Are the water wells that will remain in use for supply for operations at the facility located outside of the groundwater monitoring well network and not subject to impact from landfill operations? ☐Yes ☐No. If no, explain

(7) The water wells that will remain in use for supply for operations at the facility and that are located inside of the groundwater monitoring network, but outside the landfill unit boundary, are identified in Attachment No.: for ED approval.

2. Oil and Gas Wells

   (a) Are there any existing or abandoned on-site crude oil, natural gas, or other wells associated with mineral recovery under the jurisdiction of the Railroad Commission of Texas?
   ☐Yes ☑No

      (i) If yes, address the following items:

         (1) Provide a map showing well locations, identity, type, and status.
         Attachment No.:

         (2) Identify and annotate the oil or natural gas wells that are producing and will remain in their current state, provided such wells do not affect or hamper landfill operations.

         (3) Provide written certification that all the oil and natural gas wells, other than the producing wells approved for retention, have been properly capped, plugged, and closed at the time of application in accordance with all applicable rules and regulations of the Railroad Commission of Texas.
         Attachment No.:

XIV. Floodplains - 30 TAC §330.61(m)(1) and §330.547

1. Describe the location of the facility with respect to floodplains.

See Part II Attachment J

2. Provide a copy of the Federal Emergency Management Administration (FEMA) flood map for the area to show the facility boundary and to illustrate the information described in Section 1 above. Attachment No.: II - J

3. For construction of levees or other improvements associated with flood control on the proposed facility, provide data on floodplains in accordance with 30 TAC Chapter 301 Subchapter C (relating to Approval of Levees and Other Improvements). Part III, Attachment C2

4. Address the following requirements with regard to the location of the facility:

   (a) Provisions to ensure that no solid waste disposal operation is conducted within the facility in areas that are located in a 100-year floodway as defined by FEMA. See III, C-2

   (b) Designs that demonstrate that municipal solid waste management units, including storage and processing facilities, located in 100-year floodplains will not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to human health and the environment.

See III, C-2

   (c) Demonstrate MSW storage and processing facilities shall be located outside of the 100-year floodplain unless the owner or operator demonstrates that the facility is designed and will operate to prevent washout during a 100-year storm event, or obtains a conditional letter of map amendment from FEMA. See III, C-2

(d) If applicable, provide a copy of the conditional letter of map amendment (or other applicable FEMA approval) from the FEMA administrator for development within a floodplain.
See III, C-2

(e) References to provisions, designs, and narratives regarding floodplains in Part III of the application. See III, C-2

XV. Wetlands - 30 TAC §330.61(m)(2) and §330.553

1. Provide a wetlands determination under applicable federal, state, and local laws and discuss wetlands in accordance with 30 TAC §330.553. Demonstration can be made by providing evidence that the facility has a Corps of Engineers permit for the use of any wetlands area. Attachment No.: II - Att L

   (a) If applicable, provide a copy of any Corps of Engineers permit issued to the applicant for the use of any wetlands area within the facility. Attachment No.: N/A

2. Identify wetlands located within the facility boundary, attach necessary maps and drawings.

See Part II Attachment L

3. Where new municipal solid waste landfill units, lateral expansions, material recovery operations from a landfill, and storage or processing units are to be located in wetlands, discuss the identified wetlands considering the following:

   (a) Locating the landfill units, lateral expansions, material recovery operation from a landfill, and storage or processing units away from the identified wetlands. N/A

   (b) Steps taken to avoid impacts to wetlands to the maximum extent practicable to achieve no net loss of wetlands (as defined by acreage and function).

N/A

   (c) For unavoidable impacts:

      (i) Clearly rebut the presumption that a practicable alternative to the proposed facility or recovery operation is available that does not involve wetlands.

N/A

      (ii) Demonstrate that the construction and operation of the municipal solid waste landfill unit, material recovery operation from a landfill, and storage or processing units will not:

         (1) cause or contribute to violations of any applicable state water quality standard;

The existing facility has not and will not contribute to a violation of WQ Standard

         (2) violate any applicable toxic effluent standard or prohibition under the Clean Water

The existing facility is authorized to discharge stormwater under TPDES MSGP.

         (3) jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of a critical habitat, protected under the Endangered Species Act of 1973; or

No impacts to species or habitat are anticipated. See II-L

         (4) violate any requirement under the Marine Protection, Research, and Sanctuaries Act of 1972 for the protection of a marine sanctuary.

This facility does not discharge into or near a marine sanctuary.

(iii) Demonstrate the integrity of the landfill unit and its ability to protect ecological resources by addressing the following factors showing that the municipal solid waste landfill unit or recovery operation will not cause or contribute to significant degradation of wetlands:

(1) erosion, stability, and migration potential of native wetland soils, muds, and deposits used to support the landfill unit; N/A

(2) erosion, stability, and migration potential of dredged and fill materials used to support the landfill unit; N/A

(3) the volume and chemical nature of the waste managed in the landfill unit; C&D

(4) impacts on fish, wildlife, and other aquatic resources and their habitat from release of the solid waste; N/A

(5) the potential effects of catastrophic release of waste to the wetland and the resulting impacts on the environment; and N/A

(6) any additional factors, as necessary, to demonstrate that ecological resources in the wetland are sufficiently protected. N/A

(iv) Demonstrate steps taken to minimize unavoidable impacts to wetlands to the maximum extent practicable. N/A

(v) Demonstrate offsetting of remaining unavoidable wetland impacts through all appropriate and practicable compensatory mitigation actions (e.g., restoration of existing degraded wetlands or creation of man-made wetlands). N/A

XVI. Endangered or Threatened Species - 30 TAC §330.61(n) and §330.551

1. Provide Endangered Species Act compliance demonstrations as required under applicable state and federal laws. Attachment No.: II - L

2. Determine and discuss whether the facility is in the range of endangered or threatened species.

See Part II Attachment L

3. If the facility is located in the range of endangered or threatened species, provide a biological assessment prepared by a qualified biologist in accordance with standard procedures of the United States Fish and Wildlife Service (USFW) and the Texas Parks and Wildlife Department (TPWD) to determine the effect of the facility on the endangered or threatened species. Where a previous biological assessment has been made for another project in the general vicinity, a copy of that assessment may be submitted for evaluation. Attachment No.: L

4. Provide coordination correspondence with and responses from the USFW and the TPWD concerning locations and specific data relating to endangered and threatened species in Texas.

See Part II Attachment L

5. Describe how the facility will comply with recommendations from the TPWD and USFW regarding protection of endangered and threatened species.

See Part II Attachment L

6. Discuss the impact of the solid waste disposal facility upon endangered or threatened species:

See Part II Attachment L

7. Describe how the facility design, construction, and operation will not result in the destruction or adverse modification of the critical habitat of endangered or threatened species, or cause or contribute to the taking of any endangered or threatened species.

This is an existing facility with no lateral expansion of solid waste management activities. No impacts to species or habitat is anticipated.

XVII. Texas Historical Commission Review 30 TAC §330.61(o)

1. Provide correspondence to and a review letter from the Texas Historical Commission documenting compliance with the Natural Resources Code, Chapter 191, Texas Antiquities Code.
   Attachment No.: II - M

XVIII. Council of Governments 30 TAC §330.61(p)

1. Provide documentation that Parts I and II of the application were submitted to the applicable council of governments for compliance with regional solid waste plans. Also provide a review letter if received from the applicable council of governments.
   Attachment No.: II - N
2. Provide documentation that a review letter was requested from any local governments as appropriate for compliance with local solid waste plans.
   Attachment No.: II - N

XIX. Easement Protections 30 TAC §330.543(a)

1. Will the applicant design and operate the facility such that no solid waste unloading, storage, disposal, or processing operations will occur within any easement, buffer zone, or right-of-way that crosses the facility? ☑Yes
2. Will the applicant design and operate the facility such that no solid waste disposal shall occur within 25 feet of the center line of any utility line or pipeline easement but no closer than the easement? ☑Yes
3. Will the applicant clearly mark all pipeline and utility easements with posts that extend at least six feet above ground level, spaced at intervals no greater than 300 feet?
   ☑Yes

XX. Buffer Zones 30 TAC §330.543(b)

1. Provide the buffer zone distance (i.e. 50 feet for Arid Exempt and Type IV landfills, 125 feet for Type I landfills) at the facility to demonstrate compliance with 30 TAC §330.543(b).

50 feet

2. Provide references for the application drawings and maps that clearly show the buffer zones around the facility. Attachment(s) No.:

XXI. Coastal Areas 30 TAC §330.561

1. A new landfill cell or an aerial expansion of an existing landfill cell managing Class 1 industrial solid waste (other than waste which is Class 1 because of asbestos content) may not be located in areas:
   - (a) On a barrier island or peninsula.
   - (b) Within 1,000 feet of an area subject to active coastal shoreline erosion, if the area is protected by a barrier island or peninsula, except as allowed under 30 TAC §335.584(b)(4).
   - (c) Within 5,000 feet of coastal shorelines that are subject to active shoreline erosion and which are unprotected by a barrier island or peninsula, except as allowed under 30 TAC §335.584(b)(4).
2. Describe the location of the facility with regard to distance to coastal shoreline subject to active shoreline erosion.

Facility is >5,000 feet from any coastal shorelines.

XXII. Type I and Type IV Landfill Permit Issuance Prohibited – 30 TAC §330.563

Address the following statements.

1. The commission may not issue a permit for a Type IV landfill that is subject to the conditions specified in Texas Health and Safety Code, §361.122, Denial of Certain Landfill Permits. Is the proposed facility a Type IV landfill located in the area subject to the referenced statute?
   ☐Yes ☑No Explain
2. The commission may not issue a permit for a Type I or Type IV landfill that is subject to the conditions specified in Texas Health and Safety Code, §361.123, Limitation on Locations of Municipal Solid Waste Landfills. Is the proposed facility a Type I or Type IV landfill located in the area subject to the referenced statute?
   ☐Yes ☑ No Explain

Attachments

Table Att-1. Required Attachments

Attachments	**Attachment No.**
Existing Conditions Summary	II- A
Waste Acceptance Plan Form	II - B
General Location Maps	II - B
Facility Layout Maps	II - B
General Topographic Maps	II - B
Aerial Photographs	II - B
Land Use Map	II - B
Transportation and Airport Safety Form	II - C
Federal Aviation Administration Coordination Letters, if applicable	II - C
Entity Exercising Maintenance Resp. of Public Roadway, if applicable	II -D
Fault Lines, if applicable	II -G
Seismic Impact Zones, if applicable	II - G
Unstable areas, if applicable	II - G
Site Specific Groundwater Conditions	II - H
Site Specific Surface Water Conditions	II - H
Texas Pollutant Discharge Elimination System (TPDES)	II - H
Abandoned Oil and Water Wells, if applicable	II - I
FEMA Map	II - J
Facility Design Demonstration for Flood Map, or Conditional Letter of Map Amendment from FEMA, if applicable	II - J
Wetland Documentation, if applicable	II - K
Endangered or Threatened Species Documents, if applicable	II - L
Texas Historical Commission Letter(s)	II - M
Council of Governments/Local Governments Review Request Coordination Letter(s)	II - N
Buffer Zones	
Others (describe):	
Others (describe):	
Others (describe):	
Confidential Documents, if applicable	

ATTACHMENT A - EXISTING CONDITIONS SUMMARY (§330.61(a))

Beck Landfill is an existing Type IV landfill that is in operation at 550 FM 78 in Schertz, Guadalupe County, Texas. This facility was initially authorized in 1989 by the Texas Department of Health (TDH) in accordance with the design standards of the Municipal Solid Waste Management Regulations adopted in December 1986. The original Site Development Plan (hard copy only) includes the solid waste and design data required by Section 325.74, Technical Information Required for Landfill Sites Serving 5000 Persons or More. The TCEQ (formerly the Texas Natural Resource Conservation Commission (TNRCC)) took jurisdiction over Type IV Landfills in Texas in October 1993. Revisions to MSW regulations have occurred over time, the most significant of which occurred in 2006. Part IV of MSW Permit No. 1848 was modified to conform with relevant regulatory updates.

Necessary revisions to MSW Permit No. 1848 have occurred over time, and as a result, the applicant and TCEQ acknowledge that a formal update to the format of the permit will be useful for the successful operation and compliance tracking for the facility. We further acknowledge that this existing facility was constructed prior to the current site selection and design criteria. To the extent practicable, this application conforms with 30 TAC 330.61, as applicable.

At the time of the 1989 application to the TDH, the applicant documented that waste disposal was taking place “in the southwest end of the site, and in the northwest portion of the site. These areas contain the ancient fill from Randolph Air Force Base, and part of the fill which has been placed while operating under the "Grandfather Status" set out in the compliance letter from the Texas Department of Health Bureau of Solid Waste Management dated October 16, 1985.

ATTACHMENT B - WASTE ACCEPTANCE PLAN

ATTACHMENT C - MAPS

General Location Maps (§330.61(c))

A General Location Map has been prepared and are included as Attachment C, Figures 2-1 through 2-6 of Part II of the application. These General Location Maps are provided in addition to those provided in Part I of the application and accurately show the following surrounding features:

- the prevailing wind direction with a wind rose;
- all known water wells within 500 feet of the proposed permit boundary with the state well numbering system designation for Water Development Board "located wells";
- all structures and inhabitable buildings within 500 feet of the proposed facility;
- schools, licensed day-care facilities, churches, hospitals, cemeteries, ponds, lakes, and residential, commercial, and recreational areas within one mile of the facility;
- the location and surface type of all roads within one mile of the facility that will normally be used by the owner or operator for entering or leaving the facility;
- latitudes and longitudes;
- area streams;
- airports within six miles of the facility;
- the property boundary of the facility;
- drainage, pipeline, and utility easements within or adjacent to the facility;
- facility access control features; and
- archaeological sites, historical sites, and sites with exceptional aesthetic qualities adjacent to the facility.

Facility Layout Maps (§330.61(d))

Facility Layout Maps have been prepared and are included Part III, Attachment D-1 of the application. These Facility Layout accurately show the following surrounding features:

- the outline of the units;
- general locations of main interior facility roadways, and for landfill units, the general locations of main interior facility roadways that can be used to provide access to fill areas;
- locations of monitor wells;
- locations of buildings;
- any other graphic representations or marginal explanatory notes necessary to communicate the proposed construction sequence of the facility;
- fencing;
- provisions for the maintenance of any natural windbreaks, such as greenbelts, where they will improve the appearance and operation of the facility and, where appropriate, plans for screening the facility from public view;
- all site entrance roads from public access roads; and
- for landfill units:
    - sectors with appropriate notations to communicate the types of wastes to be disposed of in individual sectors;
    - the general sequence of filling operations;
    - sequence of excavations and filling;
    - dimensions of cells or trenches; and
    - maximum waste elevations and final cover.

General Topo Maps (§330.61(e))

A General Topographic Map has is included as Part I, Attachment C, Figure 1-1B of the application. This map is excerpted from a United States Geological Survey 7 1/2-minute quadrangle sheets or equivalent for the facility. The scale is at least one inch equals 2,000 feet.

Aerial Photography (§330.61(f))

An Aerial Photograph is included in Part I, Attachment C, Figure 1-1C of the application. This map is excerpted an aerial photograph approximately nine inches by nine inches with a scale within a range of one inch equals 1,667 feet to one inch equals 3,334 feet and showing the area within at least a one-mile radius of the site boundaries. The site boundaries and actual fill areas are marked.

Land-Use Map (§330.61(g))

A Land-Use Map depicting the actual land-use within the facility and those properties within one-mile of the facility is included as **Part II, Attachment C, Figure 2-3.** As shown on the land-use map, Cibolo Creek flows roughly parallel to the southwestern, southeastern and a portion of the northeastern property line, and at some locations crosses into the facility property.

Samuel Clemens High School and Schertz Elementary School are shown to be located approximately 0.61 miles and 0.33 miles north of the facility, respectively. The Allison L. Steele Enhanced Learning Center, a drop-out prevention high school, is located approximately 0.42 miles northwest of the facility. Randolph Elementary School (Randolph Airforce Base), in Bexar County, is 0.78 miles southwest of the facility. Rose Garden Elementary School is located slightly southeast of the facility property boundary, approximately 0.51 miles.

Three cemeteries are located within one mile of the facility. Schneider Memorial Cemetery is the closest and abuts the northern portion of the northeastern facility property line. The Jacob Christian Seiler Cemetery and Seiler Cemetery are family cemeteries located approximately 0.17 and 0.42 miles, respectively, northeast of the northern portion of the facility. Five parks, Palm (0.18 miles) Cut Off (0.30 miles), Veterans (0.32 miles), Pickrell (0.49 miles) and Thulemeyer (0.72 miles), are located north and northwest of the facility. Randolph Airforce Base is located approximately 0.6 miles southwest of the facility boundary at its nearest point.

Nine church/chapel buildings were found to be located within one mile of the facility boundaries. Seven are located north of the facility, one to the northwest, and one lies to the southwest on Randolph Airforce Base. **Table C-1** listed the names of these churches/chapels, distance from the facility boundaries, and compass direction from the facility.

TABLE C-1 COMMUNITY FEATURES WITHIN ONE MILE OF THE FACILITY BOUNDARY

CHURCH NAME	DISTANCE FROM FACILITY BOUNDARY IN MILES	COMPASS DIRECTION FROM FACILITY
Church of the First Born	0.70	Northwest
First Baptist Church of Schertz	0.42	North
Grace Community Center Bible Church	0.06	Southwest
New Covenant Family Church	0.40	North
Pentecostal Life Church	0.2	North
Randolph AFB Chapel	0.96	Southwest
Salvation and Deliverance Church of Texas	0.14	North
Schertz Church of Christ	0.27	North
The Vineyard Followship Church	0.19	North

Four licensed daycare facilities are located within one mile of the landfill facility. These four day-cares are the First Baptist Church of Schertz listed in Table 2-1 above; the Brighter Futures Learning Center located approximately 0.95 miles northeast of the landfill facility; Mary's Little Lambs situated approximately 0.91 miles to the northwest, and A2Z Alphabet Alley Learning Center located approximately 0.19 miles northwest of the facility boundary.

ATTACHMENT D – FACILITY IMPACT AND EXISTING CONDITIONS (§330.61(h))

Beck Landfill operates the existing facility to avoid adverse impacts to human health or the environment. The following sections demonstrate both historical and forward-thinking information regarding likely impacts of the facility on cities, communities, groups or property owners, or individuals by analyzing the compatibility of land use, zoning in the vicinity, community growth patterns, and other factors associated with the public interest.

Zoning and Governing Jurisdiction

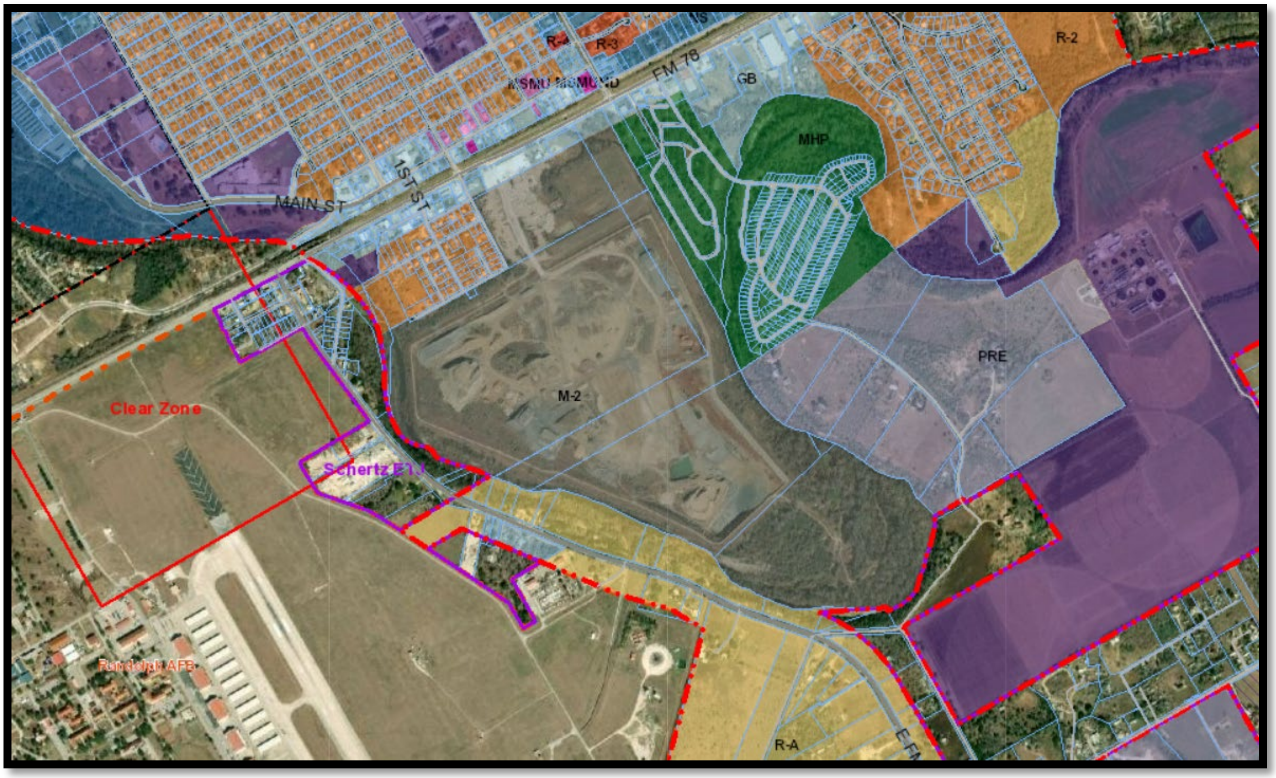
The facility is in Guadalupe County adjacent to the county line shared with Bexar County, parts of which are within two miles of the facility. The facility property is now located entirely within the City of Schertz corporate limits which has local authoritative jurisdiction over the facility. Other than the City of Schertz, portions of the cities of Universal City and Cibolo are also located within two miles of the facility boundary.

The site was originally authorized by the Texas Department of Health in 1989. At that time, the Landfill was totally within Guadalupe County and the service area of the Cibolo Creek Municipal Authority. The site was only partially within the City of Schertz, Texas. The additional political boundaries of Bexar County and the partial corporate limits of Universal City and Cibolo were within one mile of the original Landfill boundary, as well as a large portion of Randolph Air Force Base. The City of Schertz was however the only local municipality having an authoritative jurisdiction relevant to the site.

The City of Schertz enacted zoning, in the form of “use districts”, in the 1960's. Major revisions of the use districts have subsequently occurred in the 1970's and 1980's as corporate limits were extended. The Landfill, in general, was predominately zoned pre-development. A portion of the access road to this site was zoned general business. The balance of the site was not within the City of Schertz' city limits, and therefore, was not zoned. None of the above conditions restricted the site's use as a landfill.

As shown on the Schertz zoning map below, the facility property is zoned for heavy manufacturing (M-2). The frontage along FM-78, zoned “General Business” (GB) has been excluded from the permit boundary. Most of the properties within the City of Schertz located north of the landfill facility are zoned for residential, planned development or public uses. Some commercial use and pre-development zoned properties are interspersed with the residential zoned areas, but most are located along or near the corporate limits shared with Universal City, along Highway 78, F.M. 3009. Properties located within the City of Schertz corporate limits that lie south, east and west of the facility property are zoned mainly as residential, public use and pre-development with intermingled commercial zoned properties and non-zoned unincorporated properties. A large portion of a military installation, Randolph Air Force Base, falls within two miles of the western side of the facility property. A published zoning map for the base is not available.

City of Schertz Zoning Map (2022)



[1] City of Schertz Zoning Map

Zoned properties located within the corporate limits of the City of Cibolo lie within two miles east of the landfill facility. Most of the Cibolo properties are zoned for residential use. Much of the commercial and industrial zoned properties are located along Highway 78 between Borgfeld Road and E. Schaefer Road. Some agricultural zoned land is present south of E. Schaefer Road and adjoins Cibolo Creek. Those properties that lie within the corporate limits of Universal City and two mile west of the landfill facility are mostly zoned for residential use and open spaces. Commercial zoned properties are located mainly along FM 218 and Universal City Boulevard.

Character of Surrounding Land Use within One Mile

The current character of the surrounding land use within one mile of the facility property can be described as follows:

- Land located north of Highway 78, which borders the northern most facility property line, is mainly use for residential purposes, parks/open spaces and civic services (e.g., schools, police department, fire department).

---

[1] The City of Schertz (arcgis.com)

- South of Highway 78, the land is used mainly for agriculture and military (Randolph Airforce Base) uses with scattered residential and civic (school) uses.

Growth Trends within Five Miles

The area within five miles of the facility boundary extends beyond the northern and western county lines of Guadalupe County into Bexar and Comal countries. Population growth projections specific to this five-mile coverage area are not available. Therefore, census data for the cities of Schertz, Cibolo and Universal City and the three referenced counties, as well as growth projections from a 2021 regional water plan were used to represent the potential population growth trend for the coverage area.
Census data for the years 2010 and 2020 and percent population increase for the cities of Schertz, Cibolo and Universal City and the counties of Guadalupe, Bexar and Comal are listed below in **Table D-1**. As shown on this table, the population within the three cities and all three counties did increase with the highest percent increase occurring with the City of Cibolo.

TABLE D-1 2010 AND 2020 POPULATION

CITY OR COUNTY	2010 POPULATION	2020 POPULATION	PERCENT INCREASE
Schertz	31,465	42,002	33.5
Cibolo	15,349	32,276	110.3
Universal City	18,530	19,720	6.4
Bexar	1,714,773	2,009,324	17.2
Comal	109,472	161,501	47.5
Guadalupe	131,533	172,706	31.3

Population growth projections for Guadalupe, Bexar and Comal counties were obtained from the Texas Water Development Board (TWDB) 2021 South Central Texas Regional Water Plan. The population projections for these three counties are listed below in **Table D-2**. The projected population data listed in Table 2-3 indicates that a positive growth can be expected within the five-mile coverage area through the Year 2070.

TABLE D-2 POPULATION PROJECTIONS

COUNTY	PROJECTED POPULATION BY DECADE				
	2030	2040	2050	2060	2070
Bexar	2,231,550	2,468,254	2,695,668	2,904,319	3,094,726
Comal	193,188	234,515	276,239	317,682	357,464
Guadalupe	235,318	276,064	315,934	356,480	396,261

Residential and Other Uses within One Mile of the Facility

Beck Landfill is an existing facility. The online mapping and screening tool, EJScreen, which is maintained by the US Environmental Protection Agency (USEPA) was used obtain information regarding the of residences within a one-mile radius of the facility. Based on that information, there are approximately 4,014 housing units within a mile of the facility. The nearest residence abuts the western side of the facility boundary near the entrance to the facility off Highway 78. The population density within the coverage radius is approximately 1,340 per square mile. Numerous commercial establishments are also present within one mile of the facility boundary. The nearest commercial business is the CEMEX Concrete Plant which is located at the northern portion of the facility property (co-located). Other land uses (e.g., schools, cemeteries, churches) within the one-mile coverage radius and the proximity of the closest specific uses are as follows:

- Five schools of the Schertz-Cibolo-Universal City Independent School District are located within one mile of the landfill facility. The closest of these schools is Schertz Elementary School located approximately 0.33 miles north of the facility property. Other land uses (e.g., schools, cemeteries, parks) within the one-mile coverage radius and the closest
- Three family cemeteries are within one mile of the landfill facility. Schneider Memorial Cemetery is the closest and abuts the northern portion of the northeastern facility property line.
- Five parks are located to the north and northwest of the facility. The closest is Palm Park, a city park, that is within approximately 0.18 miles of the landfill boundary.
- A large area of Randolph Airforce Base is located approximately 0.6 miles southwest of the facility boundary at its nearest point. Most on the runway on the eastern side of the base is within the one-mile land use radius.
- Nine church/chapel buildings were identified to be present within one mile of the facility boundaries. Eight of the nine are located north of Highway 78. The ninth lies to the southwest on Randolph Airforce Base. The closest of these church buildings is Grace Community Center Bible Church, located approximately 0.06 miles southwest of the northern leg of the facility property.
- Four licensed daycare facilities were identified within one mile of the landfill facility. The closest day-care facility to the landfill is A2Z Alphabet Alley Learning Center, which lies approximately 0.19 miles to the northwest.

Wells within 500 feet

The online TWDB Groundwater Data Viewer and Texas Commission on Environmental Quality (TCEQ) Water Well Report Viewer were reviewed for information pertaining to existing water wells within 500 feet of the facility boundary. Two water wells were found to be within 500 feet of the facility boundaries. These wells are identified as 75’ feet and 55’ deep, respectively, for domestic water supply, in the Leona Formation, as noted in **Table D-3**, below.

Table D-3 Water Wells within One Mile of the Beck Landfill Boundaries

TWDB Well Report Number	Location	Bore Depth (ft.)	Use	Aquifer Name
68306D	29.550645° -98.268163°	75	Domestic	Leona
68314	29.555336° -98.264186°	55	Domestic	Leona

ATTACHMENT E - TXDOT COORDINATION (§330.61(i)(4))

As an existing facility served by existing roadway infrastructure, the Beck Landfill does not anticipate the need for roadway improvements to FM-78 as part of this permit amendment. The Beck Landfill's management has coordinated with TxDOT and the City of Schertz regarding traffic and location restrictions for the facility and that no roadway improvements will be requested. Documentation of coordination with TxDOT and the City of Schertz are included with this submittal as **Attachment E**.

ATTACHMENT F - AIRPORT IMPACTS AND COORDINATION WITH FAA (§330.61(i)(5))

Beck Landfill re-evaluated the potential need for coordination and construction constraints with the United States Department of Transportation (DOT), Federal Aviation Administration (FAA) for the proposed alteration described in the 2020 Amendment. Airspace Designations are "A" to "G" where "A" is most restrictive. The nearest airspace to Beck Landfill is Randolph Air Force Base which has an Airspace "D" Designation, as noted in the Air Traffic Organization Policy, Subj: Airspace Designations and Reporting Points Order J.O. 7400-11C (Last Updated: August 13, 2018):

ASW TX D San Antonio, Randolph AFB, TX
San Antonio, Randolph AFB, TX
(lat. 29°31'47"N., long. 98°16'44"W.)
That airspace extending upward from the surface to and including 3,300 feet MSL within a
4.4-mile radius of Randolph AFB excluding that airspace within the San Antonio International Airport, TX, Class C airspace area. This Class D airspace area is effective during the specific
dates and times established by a Notice to Airmen. The effective date and time will thereafter be continuously published in the Airport/Facility Directory.

AMENDMENTS 06/23/94 59 FR 24344 (Revised)
https://www.faa.gov/documentLibrary/media/Order/JO_7400.11C.pdf

Additional information regarding Class D Airspace was reviewed in Title 14 Chapter I Subchapter E Part 71 Subpart D—Class D Airspace:

§71.61 Class D airspace.
The Class D airspace areas listed in subpart D of FAA Order 7400.11C (incorporated by reference, see §71.1) consist of specified airspace within which all aircraft operators are subject to operating rules and equipment requirements specified in part 91 of this chapter. Each Class D airspace area designated for an airport in subpart D of FAA Order 7400.11C (incorporated by reference, see §71.1) contains at least one primary airport around which the airspace is designated.

An Obstruction Evaluation / Airport Airspace Analysis (OE/AAA) is required for proposed off-airport construction or alteration to promote air safety and efficient use of the navigable airspace. The affecting regulations included 14 CFR Part 77, Advisory Circular 70/7460-1L Change 2 (re: obstruction marking and lighting), and Forms 7460-1 and 7460-2. Forms will be submitted electronically through this website: NEW USER REGISTRATION

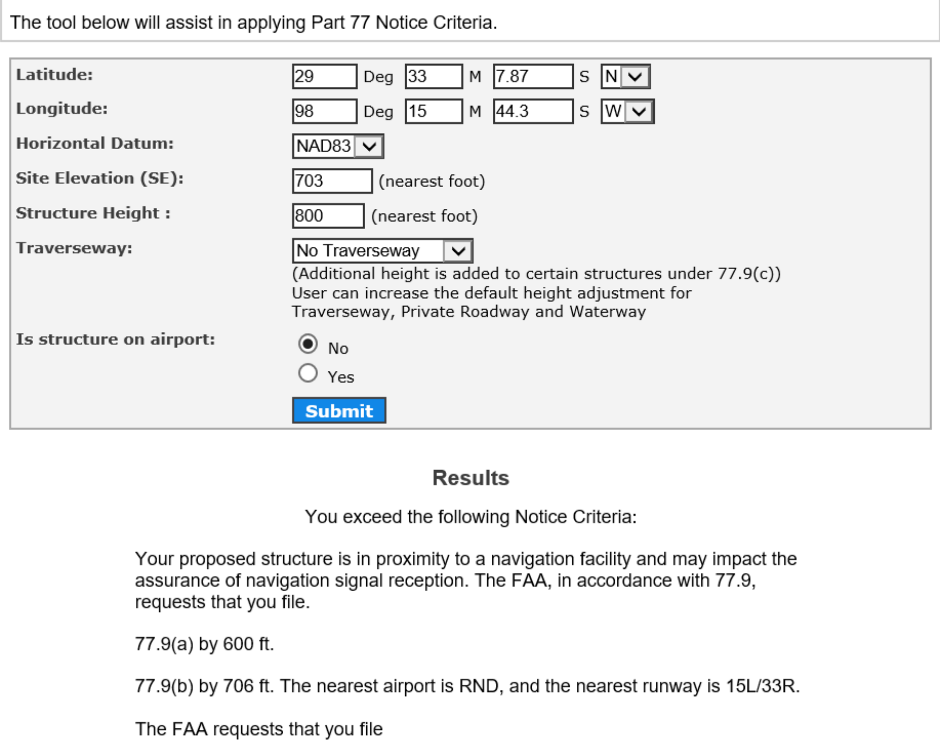
The requirements for filing with the Federal Aviation Administration for proposed structures vary based on a number of factors: height, proximity to an airport, location, and frequencies emitted from the structure, etc., In accordance with 14 CFR Part 77.9, Beck Landfill filed notice with the FAA on June 21, 2022.

Aeronautical Study Number(s) (ASN): 2022-ASW-13343-OE, 2022-ASW-13344-OE, 2022-ASW-13345-OE, and 2022-ASW-13342-O have been assigned. An approved FAA study is required for construction of surface extending outward and upward at any of the following slopes:

- 100 to 1 for a horizontal distance of 20,000 ft. from the nearest point of the nearest runway of each airport described in 14 CFR 77.9(d) with its longest runway more than 3,200 ft. in actual length, excluding heliports
- 50 to 1 for a horizontal distance of 10,000 ft. from the nearest point of the nearest runway of each airport described in 14 CFR 77.9(d) with its longest runway no more than 3,200 ft. in actual length, excluding heliports
- 25 to 1 for a horizontal distance of 5,000 ft. from the nearest point of the nearest landing and takeoff area of each heliport described in 14 CFR 77.9(d)

Beck Landfill has conducted an in-person interview with Randolph Air Force Base and obtained site-specific constraint requirements and will conform with these requirements. A figure depicting the FAA constraints is provided as **Attachment F**.

NOTE: An online tool is available to facilitate an initial review of potential to obstruct. Based on the following inputs, our project would require analysis and coordination with FAA.



The tool below will assist in applying Part 77 Notice Criteria.

Latitude: 29 Deg 33 M 7.87 S N
Longitude: 98 Deg 15 M 44.3 S W
Horizontal Datum: NAD83
Site Elevation (SE): 703 (nearest foot)
Structure Height : 800 (nearest foot)
Traverseway: No Traverseway
(Additional height is added to certain structures under 77.9(c))
User can increase the default height adjustment for Traverseway, Private Roadway and Waterway
Is structure on airport: ● No ○ Yes

Results

You exceed the following Notice Criteria:

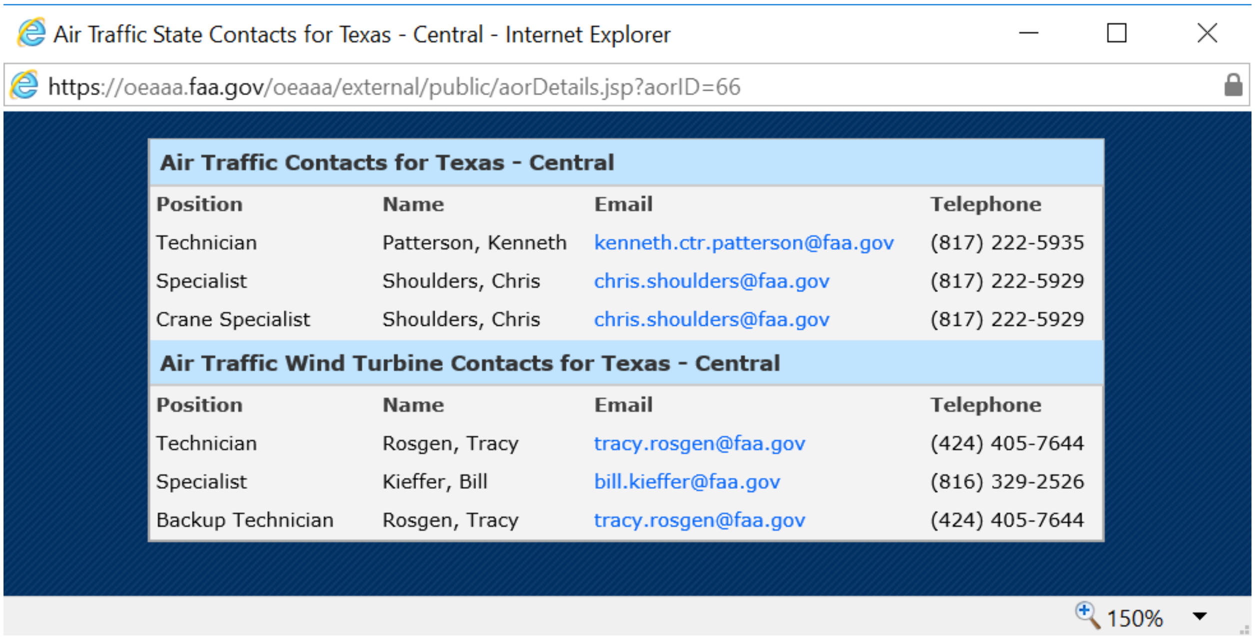
Your proposed structure is in proximity to a navigation facility and may impact the assurance of navigation signal reception. The FAA, in accordance with 77.9, requests that you file.

77.9(a) by 600 ft.

77.9(b) by 706 ft. The nearest airport is RND, and the nearest runway is 15L/33R.

The FAA requests that you file

NOTE: Following the Analysis of the potential to obstruct airspace for the offsite airport construction, coordinate with the FAA representative of their state and region. Randolph AFB is in the Central Texas Region and the contacts provided by FAA (https://oeaaa.faa.gov/oeaaa/external/public/aorMap.jsp) *are below:*



Air Traffic Contacts for Texas - Central

Position	Name	Email	Telephone
Technician	Patterson, Kenneth	kenneth.ctr.patterson@faa.gov	(817) 222-5935
Specialist	Shoulders, Chris	chris.shoulders@faa.gov	(817) 222-5929
Crane Specialist	Shoulders, Chris	chris.shoulders@faa.gov	(817) 222-5929

Air Traffic Wind Turbine Contacts for Texas - Central

Position	Name	Email	Telephone
Technician	Rosgen, Tracy	tracy.rosgen@faa.gov	(424) 405-7644
Specialist	Kieffer, Bill	bill.kieffer@faa.gov	(816) 329-2526
Backup Technician	Rosgen, Tracy	tracy.rosgen@faa.gov	(424) 405-7644

As a facility located within 10,000 feet of an airport runway end utilized by turbojet aircraft, the Beck Landfill maintains operations such that bird hazards to arriving and departing aircraft are not created. The waste accepted for disposal at the Beck Landfill is Type IV, non-putrescible waste only. No putrescible wastes that may serve to attract birds to the facility are accepted for disposal at the Beck Landfill. Putrescible wastes including general plant trash and lunch wastes that are generated on-site are managed through the strict requirement for employees to dispose of such wastes in covered and regularly emptied waste receptacles for off-site disposal. Employees are provided regular training on good housekeeping practices, including the proper management of wastes on-site. The Beck Landfill provide notice of the proposed vertical expansion to all airports within a six-mile radius as indicated on **Part II, Attachment C, Figure 2-2.**

Notice of Proposed Construction or Alteration - Off Airport

Add a New Case (Off Airport) - Desk Reference Guide V_2018.2.1

Add a New Case (Off Airport) for Wind Turbines - Met Towers (with WT Farm) - WT-Barge Crane - Desk Reference Guide V_2018.2.1

Project Name: BECK -000726473-22 **Sponsor:** Beck Landfill

Details for Case : Beck Landfill

Show Project Summary

Case Status

ASN:	2022-ASW-12865-OE	**Date Accepted:**	06/08/2022
Status:	Accepted	**Date Determined:**	
		Letters:	None
		Documents:	06/08/2022 311653-BECK LANDF...
Public Comments:	None		
			Project Documents: None

Construction / Alteration Information

Notice Of:	Alteration
Duration:	Permanent
if Temporary :	Months: Days:
Work Schedule - Start:	06/01/2023
Work Schedule - End:	12/31/2050

For temporary cranes-Does the permanent structure require separate notice to the FAA?
To find out, use the Notice Criteria Tool. If separate notice is required, please ensure it is filed.
If it is not filed, please state the reason in the Description of Proposal.

State Filing:	Not filed with State

Structure Summary

Structure Type:	LANDFILL | Existing Municipal Solid Waste Landfill
Structure Name:	Beck Landfill
FDC NOTAM:	
NOTAM Number:	
FCC Number:	
Prior ASN:	

Structure Details

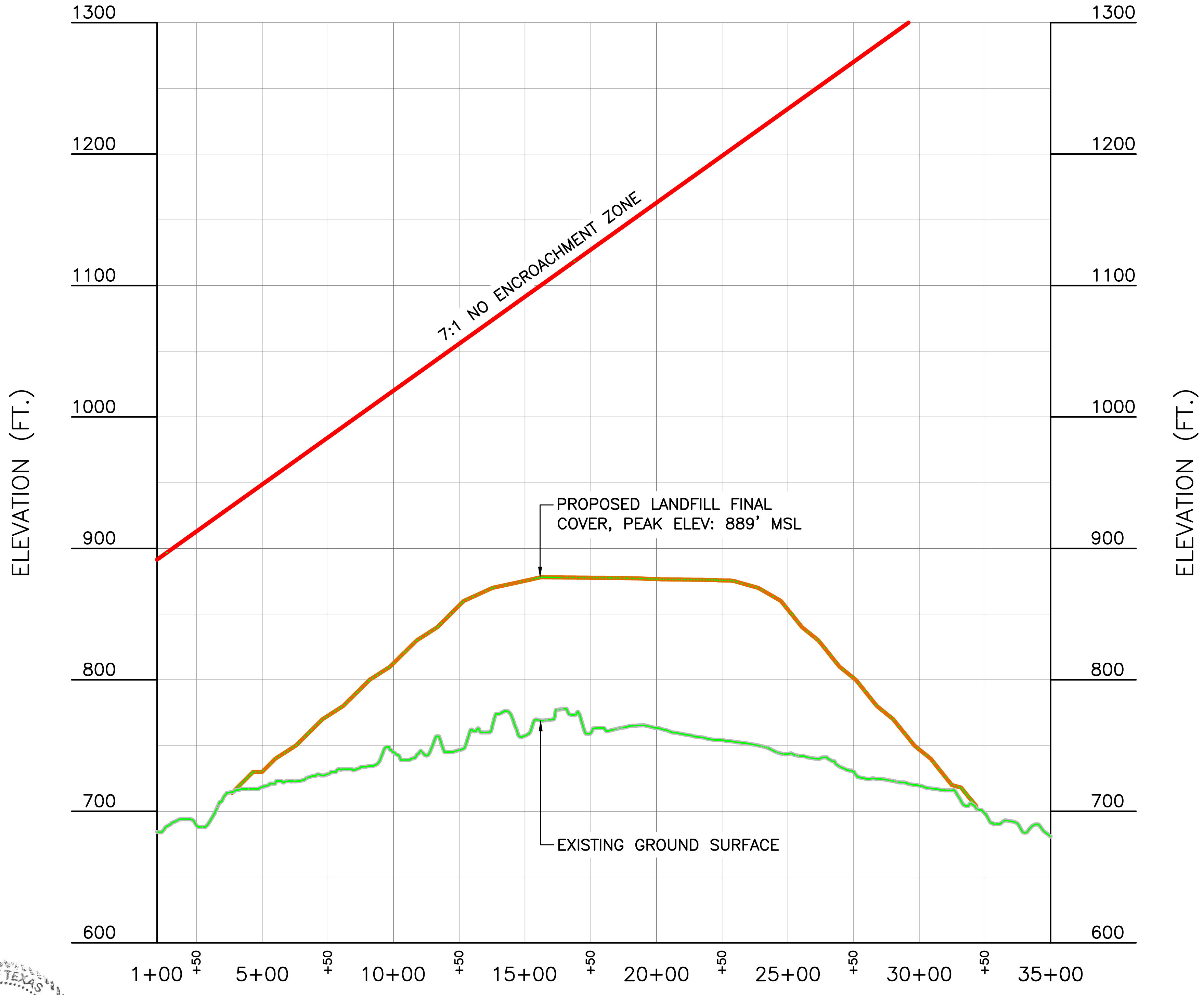
Latitude:	29° 32' 49.28" N
Longitude:	98° 15' 50.43" W
Horizontal Datum:	NAD83
Site Elevation (SE):	766 (nearest foot) PASSED
Structure Height (AGL):	889 (nearest foot)
Current Height (AGL): **** For notice of alteration or existing provide the current AGL height of the existing structure. Include details in the Description of Proposal***	766 (nearest foot)
Minimum Operating Height (AGL): **** For aeronautical study of a crane or construction equipment the maximum height should be listed above as the Structure Height (AGL). Additionally, provide the minimum operating height to avoid delays if impacts are identified that require negotiation to a reduced height. If the Structure Height and minimum operating height are the same enter the same value in both fields.***	(nearest foot)
Requested Marking/Lighting:	None
Other :	
Recommended Marking/Lighting:	
Current Marking/Lighting:	None
Other :	
Nearest City:	Schertz
Nearest State:	Texas
Description of Location: ***On the Project Summary page upload any certified survey.***	Landfill is located at 550 FM 78 in Schertz, Guadalupe County, Texas
Description of Proposal:	Vertical expansion of existing landfill to maximum height of 889' above mean sea level.

Proposed Frequency Bands

Low Freq	High Freq	Freq Unit	ERP	ERP Unit

PLAN VIEW

SCALE: 1" = 1000'



PROFILE VIEW

SCALE: 1" = 500'

ADAM W. MEHEVEC
84736
5-6-22

REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK: (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.

CEC
Civil & Environmental Consultants, Inc.
3711 South MoPac Expressway · Building 1, Suite 550 · Austin, TX 78746
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Texas Registered
Engineering Firm F-38

BECK COMPANIES

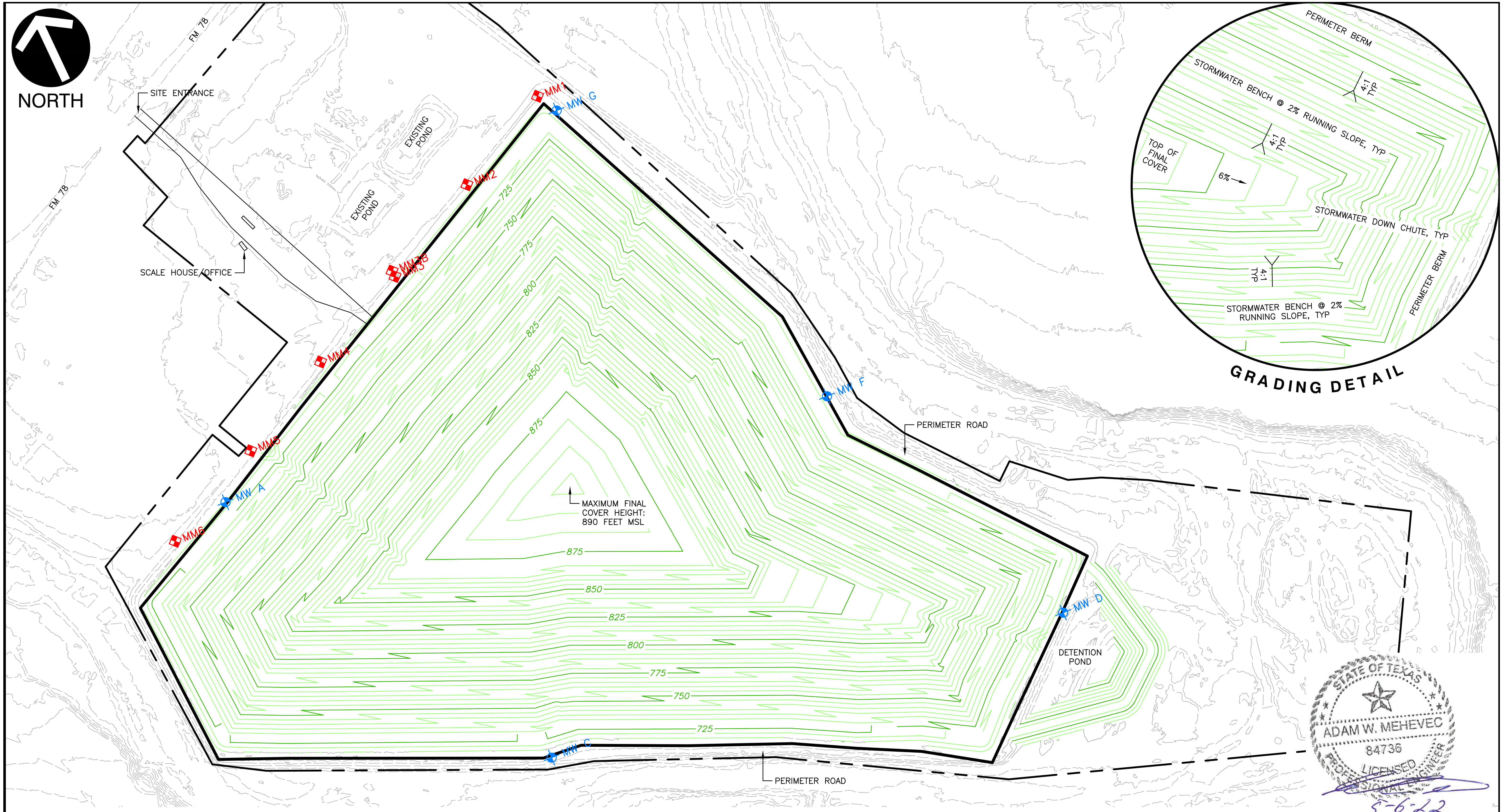
NIDO, LTD
BECK LANDFILL
BEXAR COUNTY, TEXAS

NO ENCROACHMENT EXHIBIT

DRAWN BY: BEO	CHECKED BY: DRAFT	APPROVED BY: DRAFT	FIGURE NO.:			
DATE: 10/1/2021	DWG SCALE: 1" = 300'	PROJECT NO: 311-653	1			

P:\310-000\311-653\-CADD\Dwg\SW01\311653-BECK LANDFIL No Encroachment.dwg{PROFILE} LS:(2/8/2022 - mvories) - LP: 2/8/2022 3:12 PM

P:\310-000\311-653\-CADD\Dwg\SW01\311653-BECK LANDFIL SITE LAYOUT PLAN D1-1.dwg{SOC 4} LS:(4/7/2022 - mvories) - LP: 5/4/2022 11:42 PM



ADAM W. MEHEVEC
84736
5-6-22

REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK: (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.

NOTES

1. ALL AREAS WITHIN THE LANDFILL FOOTPRINT THAT DO NOT HAVE FINAL COVER MAY BE USED FOR SOIL STOCKPILES, BRUSH STORAGE AND GRINDING, OR VEHICLE PARKING AND MAINTENANCE.
2. ALL MONITOR WELLS AND GAS PROBES HAVE BEEN PREVIOUSLY INSTALLED.
3. INTERIOR ACCESS AND PERIMETER ROADS SHALL BE SURFACED WITH CRUSHED STONE, GRAVEL, RECYCLED CONCRETE, OR EQUIVALENT ALL-WEATHER SURFACE.
4. SITE PERIMETER FENCING OR NATURAL BARRIERS WILL BE USED ALONG THE ENTIRE PERMIT BOUNDARY.
5. SOLID WASTE STORAGE AND PROCESSING AREAS WILL BE PLACED OUTSIDE OF THE 100-YEAR FLOODPLAIN OR WILL BE PROTECTED WITH A LEVEE THAT EXTENDS A MINIMUM OF ONE FOOT ABOVE THE FLOODPLAIN ELEVATION.
6. THERE ARE NO NATURAL WINDBREAKS, SUCH AS GREENBELTS, OR SCREENING PROPOSED FOR THE FACILITY.

LEGEND

⌖	EXISTING MONITOR WELL
◆	EXISTING GAS PROBE
— — —	LANDFILL PERMIT BOUNDARY
━━━	LANDFILL FOOTPRINT BOUNDARY
🟩	LANDFILL CONTOURS ARE TOP OF FINAL COVER. CONSTRUCT FINAL LAND FILL COVER: ±155 ACRES

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BECK COMPANIES

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BEXAR COUNTY, TEXAS

SITE LAYOUT PLAN

DRAWN BY: MFV	CHECKED BY: DRAFT	APPROVED BY: DRAFT	FIGURE NO.:
DATE: 03/07/2022	DWG SCALE: 1" = 400'	PROJECT NO: 311-653	D1.1

ATTACHMENT G GENERAL GEOLOGY AND SOIL STATEMENT (§330.61(j))

General geology and soils were originally discussed in several sections of the Snowden, 1989 permit application, including the Geotechnical Investigation in Attachment 11 and Soils Section (Snowden, 1989). Attachment 11 is included in Part III, Attachment G of this amendment application. Supplemental geotechnical borings were drilled at the southern and northern ends of the landfill site during two separate investigations in 2020 (see Part III, Attachment D5- Geotechnical Reports). The principal findings of these investigations regarding site geology, soil stratigraphy, and soil properties are summarized below.

General Geology

A review of historical and supplemental geotechnical information identified strata having characteristics matching the Pleistocene-age fluviatile terrace deposits overlying the undivided Cretaceous-age Navarro Group and Marlbrook Marl strata. Several of the geotechnical borings also penetrated discontinuous strata that may be Leona Formation deposits, or possibly basal terrace deposit beds.

The general area encompassing the project site is situated upon an alluvial deposit overlying shale of the Navarro and Taylor Formations. According to the Geologic Database of Texas, the Beck Landfill is wholly situated on an outcrop of Pleistocene Series fluviatile terrace deposits (Qt)[2]. These terrace deposits are comprised of gravel, sand, silt, and clay that were laid down as point bars, oxbows, and abandoned channel segments in low terrace deposits mainly above flood level along entrenched streams. The Pleistocene Series terrace deposits overlie the older Pleistocene Series Leona Formation, which outcrops adjacent to the terrace deposits near the landfill site. Calcareous silt that grades down into coarse gravel make up the Leona Formation. Where the Leona Formation was removed by erosion prior to fluviatile terrace deposition, the terrace deposits directly overlie the undivided Cretaceous Series Navarro Group and Marlbrook Marl (upper Taylor Group). The Navarro Group and Marlbrook Marl strata are comprised of marl, clay, sandstone, and siltstone. The undivided Navarro and Marlbrook outcrop several miles south, east and west of the landfill site.

The stratigraphy is extremely variable within the Alluvial Deposit and somewhat variable in the Navarro and Taylor Deposits due to historic erosion of Cibolo Creek. The lithologies and corresponding formations initially encountered at the Beck Landfill site are as follows. The sand and gravel deposits are removed at the time of this application and waste placement has occurred within the active permit footprint of the landfill.

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[2] USGS, Texas Geology Web Map Viewer. Accessed online at txpub.usgs.gov/txgeology/ on June 5, 2020.

Formation or Group Name	Depth Range in Feet[3]	Lithology
Pleistocene Series Fluviatile Terrace Deposits	0 to 38	High Plasticity Clay, Low Plasticity Clay and Sandy Clay, Clayey Sand and Clayey Gravel
Pleistocene Series Leona Formation	20 to 35	Clayey Gravel
Cretaceous Series Navarro Group and Marlbrook Marl	0 to 50+	High Plasticity Clay, Low Plasticity Clay and Clay-Shale

Soil Information

The landfill sits within Black Land Prairie which is the beginning of the Coastal Plains that extend from Mexico into New England. According to the Web Soil Survey of the Natural Resources Conservation Service (NRCS), soils underlying the landfill include the following:

- Sunev loam 0 to 1 percent slopes – the majority of the landfill was underlain by these soils, though nearly all removed as result of operations.
- Barbarosa silty clay, 0 to 1 percent slopes – located north of the landfill embankment dike.

The following soils are primarily located adjacent to the Cibolo Creek.

- Lewisvile silty clay, 0 to 1 percent slopes
- Patrick soils, 1 to 3 percent slopes, rarely flooded
- Tinn and Frio soils, 0 to 1 percent slopes, frequently flooded
- Bosque and Seguin soils, frequently flooded

The National Hydric Soil List and Web Soil Survey identifies the soil map unit Bosque and Seguin soils, frequently flooded (BO) as having the potential to contain hydric soil components. This soil map unit is mapped in association with an NHD-mapped stream adjacent to and within the Cibolo Creek. **Figure 2-7** contains a graphic representation of the soils mapped with the permit boundary.

Geologic Fault Assessment

The Beck Landfill site is located along the extreme southeastern edge of the northeast trending Balcones Fault Zone. The Balcones Fault Zone is generally comprised of a series of slip-drip normal faults with downward displacements to the southeast. Movement along these faults has displaced the Cretaceous-age strata outcrops within the general area of the Beck Landfill site. Movement along Balcones faults occurred primarily during the Miocene Epoch.

According to the Bureau of Economic Geology San Antonio Sheet, no mapped Balcones faults are located within or within 200 feet of the Beck Landfill. The nearest mapped fault is located approximately 1.5 miles to the northwest with a northeast-southwest trend. However, a fault located about 3 miles northeast of the landfill site does trend towards the southern end of the Beck Landfill. The southwestern extent of this fault has not been mapped due to the deposition of Quaternary-age sediments over the faulted Cretaceous formations covering any surficial evidence of fault line (see Part III, Attachment E). A

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[3] Below ground surface

review of the USGS Quaternary Fault and Fold Database[4] using the agency's Quaternary Faults Web Application found no reported Holocene displacement of faults within the Balcones Fault System.

Prior to construction, a geologic fault assessment was performed for the landfill site in accordance with subparagraph 325.74(b)(5)(J) of the Municipal Solid Waste Management Regulations. The work involved during the conduct of this study includes the following elements:

1. Review of geologic literature documenting surface fault evidence;
2. Analysis of topographic and subsurface structure contour maps for geomorphic features which are resultant of the manifestation of fault activity;
3. Site general area reconnaissance to locate physical evidence of distress which may be caused by fault activity; and
4. Preparation of a report presenting our findings and opinions based on the data obtained above (Snowden Attachment 11).

As any faulting would be associated with the inactive Balcones System, no movement associated with faults should be anticipated in the area of the landfill site. A joint trend as theorized in Snowden's Attachment 11 and as described therein would likewise have no effect upon the landfill substructure.

Analysis

The topographic map (one-foot contour) was analyzed to identify geomorphic features often associated with faulting. These features include minor topographic scarps, aligned drainage, or aligned natural ponds. None of these features were recognized within and surrounding the project site due to the overlying mantle of Alluvial Deposits.

A reconnaissance of the proposed Type IV landfill site and the surrounding area was performed to document physical evidence of possible geologic fault activity. Area roads were examined for pavement breaks. Building structures were examined for structural damage, and drainage ditches and area streams were examined for features which might be fault-related. No evidence of surface displacements which could be related to fault activity were identified within the site or the immediate surrounding area.

Conclusion

Assessment of this site based on our professional evaluation, geologic data gathered and experience with fault related features, indicates general geologic conditions favorable to development as a landfill site. Along with the proposed slurry trench design the site should be capable of development into an adequate Type IV Landfill. The geologic evaluations rendered in this report meet the standard of care of our profession. No other warranty or representation, either expressed or implied, is included or intended.

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[4] USGS Quaternary Faults Web Application accessed online at usgs.maps.arcgis.com/apps/webappviewer/index.html?id=5a6038b3a1684561a9b0aadf88412fcf on April 13, 2021

Seismic Impact Zones (§330.557)

30 TAC 330.557 defines a seismic impact zone as an area with a 10% or greater probability that the maximum horizontal acceleration in lithified earth material, expressed as a percentage of the earth's gravitational pull, will exceed 0.10g in 250 years. A review of the 2018 National Seismic Hazard Model for the conterminous United States found that the Beck Landfill site is not located in an area having a 10% or greater probability that the peak horizontal acceleration will exceed 0.10g. Additionally, the Beck Landfill is located within an area of the State where Holocene displacement of faults has not occurred.

Data on Unstable Areas (§330.559)

30 TAC 330.559 defines an unstable area as a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of a landfill's structural components responsible for preventing releases from the landfill. Unstable areas can include poor foundation conditions, areas susceptible to mass movement, and karst terrains. The owner or operator shall consider the following factors, at a minimum, when determining whether an area is unstable:

(1) on-site or local soil conditions that may result in significant differential settling;
(2) on-site or local geologic or geomorphologic features; and
(3) on-site or local human-made features or events (both surface and subsurface).

The Beck Landfill excavates through Pleistocene-age terrace deposits (clay, sand and gravel) and into the undivided Cretaceous-age Navarro Group and Marlbrook Marl, which consist of clay and shale material (impermeable). No on-site geologic or geomorphologic features have been observed. No on-site or local human-made features or events are observed to have created unstable conditions. The Beck Landfill does not appear to meet the definition of an “unstable area”.

add soils map

ATTACHMENT H - GROUNDWATER AND SURFACE WATER (§330.61(k))

Site Specific Groundwater Conditions

The uppermost groundwater-bearing unit at The Beck Landfill is encountered within the Pleistocene Series Leona Formation. The undivided Cretaceous Series Marlbrook Marl and Navarro Group are not known to produce groundwater within Guadalupe County (see Part III, Attachment E - Geology Report). Groundwater Detection monitoring events have been conducted in accordance with the requirements of MSW Permit No. 1848 since August 2000. Based on a review of the historical detection monitoring water level measurement record and water level observations recorded on landfill geotechnical boring logs, it appears that the uppermost groundwater-bearing unit is in an unconfined condition. Evaluation of the historical detection monitoring water level measurements and historical rainfall events found that groundwater levels in the uppermost unit are highly influenced by rainfall amounts and the fluctuation of water levels within the adjacent Cibolo Creek. This finding strongly suggests that the uppermost unit is hydraulically connected to the creek and that Cibolo Creek may receive discharge from the uppermost groundwater-being unit (effluent stream).

Generally, groundwater flow is from the northwest to southeast towards Cibolo Creek further supporting the likelihood that groundwater from the uppermost unit discharges to the creek. Due to the southerly groundwater flow direction and depth to groundwater being shallowest at MW-A and deepest at MW-F, annual detection monitoring events rotate around the Landfill from MW-A to MW-G and then in a counterclockwise rotation. Average historical well readings from the five monitor wells indicate that the average saturated thickness within the groundwater-bearing unit at the monitor wells ranges from approximately 5 feet to approximately 11 feet. Monitor wells MW-F and MW-G typically purge "dry" before three well volumes can be removed. However, recharge occurs within 24 hours such that sample volumes are typically obtained as required. This slow recharge rate suggests that the hydraulic conductivity of the uppermost unit variable across the site and possibly low. Historical water-level elevations at the Beck Landfill are presented in Part III, Attachment F of this application.

Surface Water at or near the Site

The Beck Landfill is surrounded to the west, south, and east by the Mid Cibolo Creek (TCEQ Stream Segment ID. No. 1913). The Mid Cibolo Creek flows from a point 100 meters (110 yards) downstream of IH-10 in Bexar/Guadalupe County to the Missouri-Pacific Railroad bridge west of Bracken in Comal County. This perennial, freshwater stream is not listed as impaired on the EPA-approved 2020 Texas Integrated Report Index of Surface Water Quality. Aquatic life use (ALU) is defined as "limited".

TPDES Stormwater Permits

The Beck Landfill has an active Texas Pollutant Discharge Elimination System (TPDES) Multi-Sector General Permit (MSGP) that authorizes discharges of stormwater associated with industrial activities. A site-specific Stormwater Pollution Prevention Plan (SWPPP) has been written and is implemented at the Facility. Sector-specific compliance practices are described for Sector L (Activity Code LF: Landfill) and Sector J (SIC Code 1442: construction sand and gravel). The Permit No. is **TXR05AW45**. Upon expiration, Beck Landfill will renew its authorization by submitting required documentation to the TCEQ. Copies of the SWPPP and permit correspondence are maintained at the Landfill and are available upon request.

Stormwater that comes in contact with solid waste will be treated as contaminated water and will be retained on-site. This water may be used as dust suppression on within the landfill working face but will not be applied in areas where solid waste is not exposed.

Stormwater that falls within the future excavations, outside of the dikes below the active waste, will be treated as uncontaminated stormwater and be diverted to site drainage systems and ultimately used for dust control on areas of the site where solid waste is not exposed, such as haul roads and within the sand and gravel mining operation footprint.

This permit amendment represents a vertical change within the existing landfill footprint on-site and no exceedances of state water quality standards, applicable effluent limitations, or non-compliances under the Clean Water Act are anticipated.

ATTACHMENT I - ABANDONED OIL AND WATER WELLS (§330.61(l))

As noted in the original application for this permit, the Texas Department of Health (TDH) guidelines for drinking water protection stated that water wells located within 500 feet of actual disposal areas should be evaluated to show that adequate protection to drinking water sources is provided. Texas Water Commission records indicate no water wells to exist within 500 feet of the proposed disposal site[5].

At the time of initial permitting, two recorded water wells Kx 68 - 30 6A and Kx 68 - 30 - 9A were known to be completed in Alluvial Aquifers similar to that anticipated at this site but each were located on the opposite side of Cibolo Creek which creates a hydraulic divide within the aquifer water system. Water wells within approximate 1000-foot radius at the time of application included Kx 68 - 30 - 603 completed in September 1956 producing from the Edwards Aquifer at depths of' 535 to 550 feet.

Interconnection with the Edwards Aquifer is precluded by the Navarro/Taylor shales. The review of other water wells within a one-mile radius of the site indicates one additional alluvial well and several municipal Edwards wells. The landfill operation is not expected to endanger the water supplies of any existing wells due to the differing aquifers and the divide created by Cibolo Creek.

The municipal waters for each of the surrounding Municipalities, including Randolph Air Force Base, are derived from Edwards Aquifer wells. All of the municipal wells with the exception of Randolph's wells, are in excess of three miles upgradient from the landfill site. Randolph's wells are located just beyond a one-mile radius in an upgradient segment of the Edwards Aquifer. The intake of surface waters intended for human consumption does not occur within any reasonable proximity to the site. The nearest application of surface waters for such purposes occurs at New Braunfels and Seguin each approximately 15 miles from the site along the Guadalupe River.

Sources of drinking water should thus in no way be impacted by the landfill development. The Alluvial Aquifer is further considered adequately protected by naturally occurring characteristics and the application of the slurry trench wall.

On-Site Oil or Water Wells

The locations of all existing and abandoned wells have been re-evaluated for this amendment application. A current list of identified existing and abandoned wells near the Beck Landfill is depicted in **Table I-1** below. The on-site wells are utilized for groundwater quality monitoring in accordance with the existing MSW permit. No other active or historical wells within the Beck Landfill facility are depicted on the Texas Water Development Board (TWDB) Groundwater Data Viewer (TWDB, accessed June 8, 2020).

---

[5] (Appendix A of Attachment 11 Geotechnical Investigation**, 1989 – see Part III, Attachment G**)

Table I-1 – Water Wells at the Beck Landfill

Well	Use	Latitude and Longitude
MW-A	Groundwater monitoring of perched aquifer outside of landfill dike-line.	29.548880°, -98.268411°
MW-C	Groundwater monitoring of perched aquifer outside of landfill dike-line.	29.544524°, -98.265643°
MW-D	Groundwater monitoring of perched aquifer outside of landfill dike-line.	29.543768°, -98.258393°
MW-F	Groundwater monitoring of perched aquifer outside of landfill dike-line.	29.547263°, -98.260227°
MW-G	Groundwater monitoring of perched aquifer outside of landfill dike-line.	29.551674°, -98.262166°
Piezometer A	Groundwater monitoring of leachate inside of the landfill dike-line	29.548868°, -98.268394°
Piezometer C	Groundwater monitoring of leachate inside of the landfill dike-line	29.544557°, -98.265645°
Piezometer D	Groundwater monitoring of leachate inside of the landfill dike-line	29.543796°, -98.258427°
Piezometer F	Groundwater monitoring of leachate inside of the landfill dike-line	29.547273°, -98.260264°
Piezometer G	Groundwater monitoring of leachate inside of the landfill dike-line	29.551662°, -98.262213°

No existing or abandoned on-site crude oil, natural gas wells, or other mineral recovery infrastructure regulated by the Railroad Commission of Texas (TXRRC) are present on-site (TRRC Public GIS Viewer, accessed June 8, 2022).

ATTACHMENT J - FLOODPLAINS AND WETLAND STATEMENT (§330.61(m))

At the time of application, the minimum required separating distance of 50 feet to be maintained between disposal operations and the boundary of the site to allow area for visual screening (it needed), surface drainage facilities, flood protection facilities, and a safety margin for methane gas and leachate monitoring will, in most cases, actually be exceeded due to the location of the flood protection levees. Upon completion of the landfill, the access roads will be widened, it necessary, onto completed portions of landfill. A minimum 3.5-foot tall barbed wire fence, or higher barrier marking the site perimeter, will be installed and maintained by the landfill supervisor, after construction of the dike.

A buffer zone of 200 feet, from the center line of the dike, is used parallel to Zuehl Street. This zone is deemed adequate as the 100-year flood plain dike to be constructed and the existing vegetation will totally screen the operation. In addition, the area in question is the area of long existing fill which the department is requiring be encapsulated and protected by the trench. It seems therefore reasonable that as fill already exists at a distance of less than 300 yards and prevents construction of the encapsulation trench and dike any further from Zuehl Street, a variance needs to be granted waving the required 300 yard buffer set out in the regulations, Section 325.42(4), and is so requested of the TDH (*excerpted from "Buffer Zones" (Snowden, 1989)*.

Buffer Zones

No solid waste unloading, storage, disposal, or processing operations are anticipated to impact buffer zones, easements, or rights-of-way on-site. This permit amendment represents a vertical change within an existing landfill footprint on-site that does not cross these features. All on-site landfill activities will continue to be conducted within the existing landfill footprint.

Floodplains

Data associated with floodplains in accordance with Chapter 301, Subchapter C of this title (relating to Approval of Levees and Other Improvements are reviewed and addressed in Part III, Attachment C-2 of this Application.

ATTACHMENT K - WETLANDS

An on-site field investigation to identify surface waters and wetlands and to assess their potential for regulation as waters of the United States (WOTUS), was conducted on September 27 and 28, 2021. No impacts to wetlands or WOTUS regulated by the U.S. Army Corps of Engineers (USACE) are anticipated as a result of this vertical expansion and permit modification. Results of a literature review and field survey are included in **Attachment L** to this Part.

ATTACHMENT L - ENDANGERED OR THREATENED SPECIES (§330.61(n))

As noted in the original application (*"Protection of Endangered Species" (Snowden, 1989),* the existence of any listed or proposed endangered species in the general area of the landfill is not anticipated. Migratory foul and other animals utilizing the creek system as a habitat corridor are however occasionally reported in the proximity of the site. The development of the proposed landfill is not anticipated to have any adverse effect on the existing wildlife.

A review of the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation was (IPaC) tool was performed on December 29, 2021. An on-site field investigation by qualified biologists was conducted on September 27 and 28, 2021. Based on the background literature review and the on-site field investigation, suitable habitat for federally listed species was observed for one species: the monarch butterfly. As a candidate species, the monarch butterfly does not currently have protections under the Endangered Species Act. The Project occurs within the primary migration corridor for the whooping crane, however, suitable habitat for the whooping crane, as well as other federally-listed bird species, was not observed during the on-site investigation. The ability of federally-listed birds to migrate through the Project Area is possible, however, these species are not anticipated in the Project Area due to the lack of suitable habitat.

No impacts listed threatened or endangered species nor their habitat are anticipated as a result of this vertical expansion (permit modification). See **Attachment L** to this Part for the full report.

POWER ENGINEERS

POWER ENGINEERS, INC.

85 N.E. LOOP 410
SUITE 207
SAN ANTONIO, TX 78216 USA

PHONE 210-446-1071

August 10, 2022

Mr. Ben Davis
President
Beck Companies
122 East Turbo Drive
San Antonio, TX 78216

Subject: Municipal Solid Waste Permit – Major Amendment
Environmental Supporting Documentation
Beck Companies Landfill
Guadalupe County, Texas

Dear Mr. Davis:

POWER Engineers, Inc. (POWER) was retained by Beck Companies (Beck) to perform an environmental and cultural resources assessment of the undeveloped portions of the Beck Landfill (Landfill) located in western Guadalupe County, Texas. The Landfill is located at 550 John E. Peterson Boulevard/Farm to Market Road 78, Schertz, Texas 78154 (Attachment A, Figure 1). The assessment will include a waters of the United States (WOTUS) delineation, a threatened and endangered species evaluation, and a cultural resource investigation in order to support a Major Amendment to the Landfill's Municipal Solid Waste Permit and ensure compliance under Texas Administrative Code (TAC) Title 30, Rules §330.551, §330.553, and §330.61. For the purposes of this report, the Project Area is defined as the undeveloped portions (i.e., not located within the active Landfill) of the approximately 266-acre Landfill.

This report and the results presented herein are meant to provide Beck with documentation to support any reporting under:

- the Clean Water Act (CWA), as regulated by the United States Army Corps of Engineers (USACE);
- the Endangered Species Act as regulated by the United States Fish and Wildlife Service (USFWS);
- the National Historic Preservation Act as regulated by the Texas Historical Commission; and
- the Title 30 of the TAC as regulated by the Texas Commission on Environmental Quality.

BACKGROUND LITERATURE REVIEW

Prior to the on-site field investigation, POWER performed a background literature review of the Project Area for potential WOTUS, including wetlands, and threatened and endangered species. The background review included an examination of the following resources:

- United States Geological Survey (USGS) 7.5-minute (1:24,000 quadrangle) Topographic Map Identification
- USFWS National Wetlands Inventory

- National Hydrography Dataset (NHD)
- Natural Resources Conservation Service (NRCS) National Hydric Soil List and Web Soil Survey
- Federal Emergency Management Agency
- National Oceanic and Atmospheric Administration Precipitation Analysis
- United States Drought Monitor
- Texas Parks and Wildlife Department (TPWD) Texas Ecosystem Analytical Mapper
- TPWD Texas Natural Diversity Database (TXNDD)
- USFWS Information for Planning and Consultation (IPaC)
- USACE Fort Worth District List of Section 10 Waterbodies
- Texas General Land Office (GLO) land ownership database

Interpretation of the USGS 7.5-minute topographic maps (Schertz, Texas) and NHD data identified Cibolo Creek adjacent to and within the Project Area (USGS 2022).

The USFWS National Wetlands Inventory review identified four forested riparian wetlands (PFO1A) associated with Cibolo Creek previously mapped adjacent to the Project Area (Attachment A, Figure 2) (USFWS 2022a).

According to the NRCS's National Hydric Soil List and Web Soil Survey, the soil map unit Bosque and Seguin soils, frequently flooded (BO), has the potential to contain hydric soil components. This soil map unit is mapped in association with an NHD-mapped stream adjacent to and within the Project Area, namely Cibolo Creek. Hydric soils are a technical parameter for wetland determination and when mapped by the soil survey, there is a general likelihood hydric soils will be found within the given area. Not all areas mapped as hydric soils are found to be hydric in the field (NRCS 2022).

Examination of Federal Emergency Management Agency floodplain maps indicated the entirety of the Project Area occurs within the 100-year floodplain (Zones AO and AE; FIRMette 48187C0220F; Attachment A, Figure 2) (FEMA 2022).

According to the National Oceanic and Atmospheric Administration Precipitation Analysis, the Project Area had 0.06 inch of precipitation during the seven days prior to the on-site field investigation (NOAA 2022). According to the United States Drought Monitor, the vicinity of the Project Area was not experiencing drought conditions at the time of the on-site field investigation (US Drought Monitor 2022).

Data from TPWD's Texas Ecosystem Analytical Mapper is generally consistent with the literature findings which defines the proposed Project as primarily occurring in the Texas Blackland Prairies Ecoregion (TPWD 2022a). The Texas Ecosystem Analytical Mapper data indicated the following ecological systems mapped within the Project Area:

- Urban Low Intensity; Barren;
- Blackland Prairie: Disturbance or Tame Grassland;
- Urban High Intensity;
- Central Texas: Floodplain Hardwood Forest;
- Central Texas: Floodplain Deciduous Shrubland;
- Central Texas: Floodplain Herbaceous Vegetation;
- Native Invasive: Deciduous Woodland; and
- Native Invasive: Huisache Woodland or Shrubland.

POWER conducted a review on December 29, 2021 of the USFWS' IPaC (USFWS 2022b) and TPWD's TXNDD (TPWD 2022b) for existing records regarding threatened and endangered species and sensitive vegetation communities known or suspected to occur within the Project Area. According to the IPaC review, nine federally listed threatened or endangered species have the potential to occur within the Project Area (see Table 3) (USFWS 2022b). Review of the TXNDD did not identify any previously mapped records for federally listed species or sensitive vegetation communities within the Project Area (TPWD 2022b).

A review of the USACE – Fort Worth District list of Section 10 waterbodies did not identify any potential Section 10 surface waters within the Project Area.

Available data from the Texas GLO did not indicate the presence of any state-owned lands within the Project Area (Texas GLO 2022).

ON-SITE FIELD INVESTIGATION

Following the background review, POWER conducted an on-site field investigation of the Project Area on September 27 and 28, 2021 to identify surface waters, wetlands, and threatened and endangered species habitat. Any waterbodies and wetlands identified within the Project Area were further assessed for their potential to be subject to the jurisdiction of the USACE – Fort Worth District. The scope of the on-site field investigation included:

- Identification of potential WOTUS (including wetlands) within the proposed Project that may be subject to Section 404 of the CWA and Section 10 of the Rivers and Harbors Act. The evaluation included assessments for ephemeral, intermittent, and perennial stream features; navigable and non-navigable waterways; deep-water habitats; wetlands; and any other special aquatic sites.
    - Streams are determined to be WOTUS if they exhibit a defined plane of ordinary high-water mark that is defined as the line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural lines impressed on the bank; shelving; changes in the character of soil; destruction of terrestrial vegetation; the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding areas.
    - In the case of non-navigable tributaries (to traditional navigable waters) that are not relatively permanent, the USACE will apply the "significant nexus" standard to assess flow characteristics and functions of the tributary and any adjacent wetlands to determine if they significantly affect the chemical, physical and biological integrity of downstream traditional navigable waters (United States Environmental Protection Agency – USACE, *2008 CWA Jurisdiction Following the U.S. Supreme Court's Decision in Rapanos v. United States & Carabell v. United States*).
    - As required by existing regulations, potential jurisdictional wetlands, were evaluated based on the presence of hydrophytic vegetation, wetland hydrology, and hydric soils (USACE, *1987 Wetland Delineation Manual*, and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region* [Version 2.0]).
- Identification of potential suitable habitat for federally listed threatened or endangered species and sensitive vegetation communities, as identified by the USFWS' IPaC and TPWD's TXNDD data for the Project Area.

Hydrology

Within the Great Plains Region, precipitation has the most substantial influence on establishing and maintaining wetland hydrology in locations exhibiting a low degree of slope and natural impoundments. During the on-site investigation, drainages and depressional areas within the Project Area were investigated for hydrologic indicators including, but not limited to, surface water, high water table, saturation, inundation visible on aerial imagery, aquatic fauna, and geomorphic position. Hydrology indicators for wetlands within the Project Area included saturated soils, high water table, surface water, drift deposits, and drainage patterns. Hydrology indicators observed for mapped wetlands included drainage patterns, FAC neutral test, inundation on aerial imagery, sparsely vegetated concave surface, surface soil cracks, and geomorphic position.

Soils

According to the NRCS Web Soil Survey (NRCS 2022), one potentially hydric soil map unit (Bosque and Seguin soils, frequently flooded [BO]) occurs in association with Cibolo Creek adjacent to and within the Project Area. The NRCS data was generally consistent with the soils observed during the on-site investigation. Hydric soils were observed in field mapped streams and wetlands (Tables 1 and 2). Hydric soil indicators for wetlands within the Project Area included redox dark surface.

Vegetation

The Project Area is the undeveloped portions of the Beck Landfill and is dominated by upland hardwood forests, upland shrublands, and upland herbaceous vegetation. During the on-site investigation, hydrophytic vegetation species were only observed within or adjacent to mapped streams and wetlands. Refer to Attachment B for representative photographs.

Common upland vegetation generally observed within the Project Area included:

- Bermudagrass (*Cynodon dactylon*);
- Johnsongrass (*Sorghum halepense*);
- Rooseveltweed (*Baccharis neglecta*);
- Virginia wildrye (*Elymus virginic*us);
- curly-mesquite (*Hilaria belangeri*);
- Indian woodoats (*Chasmanthium latifolium*);
- Texas croton (*Croton texensis*);
- spiny chloracantha (*Chloracantha spinosa*);
- velvet leaf senna (*Senna lindheimeriana*);
- southern dewberry (*Rubus trivialis*);
- saw greenbrier (*Smilax bona-nox*);
- Texas pricklypear (*Opuntia engelmannii* var. *lindheimeri*);
- Jerusalem thorn (*Parkinsonia aculeata*);
- sweet acacia (*Vachellia farnesiana*);
- cedar elm (*Ulmus crassifolia*);
- Chinese tallow (*Triadica sebifera*);
- sugarberry (*Celtis laevigata*);
- Texas ash (*Fraxinus albicans*); and
- Chinaberrytree (*Melia azedarach*).

Common vegetation generally observed along the banks of mapped stream features included:

- Bermudagrass;
- Johnsongrass;
- southwestern bristlegrass (*Setaria scheelei*);
- giant reed (*Arundo donax*);
- coral vine (*Antigonon leptopus*);
- green flatsedge (*Cyperus virens*);
- rough cocklebur (*Xanthium strumarium*);
- annual marsh elder (*Iva annua*);
- wax mallow (*Malvaviscus arboreus* var. *drummondii*);
- Indian woodoats;
- swamp smartweed (*Persicaria hydropiperoides*);
- southern dewberry;
- poison ivy (*Toxicodendron radicans*);
- common buttonbush (*Cephalanthus occidentalis*);
- Jerusalem thorn; Rooseveltweed;
- mesquite (*Prosopis glandulosa*);
- live oak (*Quercus virginiana*);
- pecan (*Carya illinoinensis*);
- sugarberry;
- black willow (*Salix nigra*);
- Chinaberrytree;
- eastern cottonwood (*Populus deltoides*);
- Chinese tallow;
- cedar elm; and
- American sycamore (*Platanus occidentalis*).

Common wetland vegetation observed included:

- annual marsh elder;
- swamp smartweed;
- green flatsedge;
- limestone quillwort (Isoetes butleri);
- buttonbush;
- Chinese tallow; and
- boxelder (*Acer negundo*).

RESULTS

WATERS OF THE UNITED STATES

The on-site field investigation identified five stream features within the Project Area (Table 1; Attachment A, Figure 3). No Section 10 waterbodies were identified within the Project Area. All mapped streams within the Project Area, other than Cibolo Creek, have ephemeral flow regimes (ST001, ST002, ST004, ST005). The portion of Cibolo Creek (ST003) adjacent to and within the Project Area had a highly variable ordinary high-Water Mark (OHWM) and alternated between ponded and dry segments. Due to difficult bank access and safety concerns, the portion of Cibolo Creek within the Project Area was not mapped in its entirety.

TABLE 1 STREAM FEATURES WITHIN THE PROJECT AREA

STREAM NAME (MAP LABEL)	FLOW REGIME	OHWM (FEET)	POTENTIAL WOTUS (Y/N)
Man-made drainage ditch (ST001)	Ephemeral	5	N
Unnamed internal drainage (ST002)	Ephemeral	5	N
Cibolo Creek (ST003)	Intermittent	60	Y
Unnamed internal drainage (ST004)	Ephemeral	5	N
Unnamed tributary to Cibolo Creek (ST005)	Ephemeral	3	Y

The on-site field investigation identified three wetland features and five waterbodies within the Project Area (Table 2; Attachment A, Figure 3). Mapped wetlands included one in-channel palustrine emergent (PEM) wetland (WET001), one riparian PEM wetland (WET002), and one riparian palustrine forested (PFO) wetland (WET003). Mapped ponds included four man-made retention ponds excavated in uplands (WB001, WB002, WB003, and WB005) and one natural pond adjacent to Cibolo Creek and ST004 (WB004).

TABLE 2 WETLAND AND WATERBODY FEATURES WITHIN THE PROJECT AREA

MAP LABEL	FEATURE TYPE	ASSOCIATED FEATURE	POTENTIAL WOTUS (Y/N)
WET001	PEM (In-channel)	Cibolo Creek	Y
WET002	PEM (Riparian)	Cibolo Creek	Y
WET003	PFO (Riparian)	Cibolo Creek	Y
WB001	Retention Pond	NA	N
WB002	Retention Pond	NA	N
WB003	Retention Pond	NA	N
WB004	Pond	Cibolo Creek	Y
WB005	Retention Pond	NA	N

THREATENED AND ENDANGERED SPECIES

POWER's review of the IPaC identified nine threatened or endangered species with the potential to occur in the Project Area (USFWS 2022b). Review of the TXNDD did not indicate any existing mapped records for federally-listed threatened and endangered species or sensitive vegetation communities within the Project Area (TPWD 2022b). A list of federally-listed threatened and endangered species for the Project Area and potential Project construction effects are presented in Table 3.

TABLE 3 THREATENED AND ENDANGERED SPECIES WITH POTENTIAL TO OCCUR IN THE PROJECT AREA

COMMON NAME[1]	SCIENTIFIC NAME	FEDERAL STATUS[2]	SUITABLE HABITAT	EFFECT
BIRDS				
Piping plover	*Charadrius melodus*	T	No	No Effect
Red knot	*Calidris canutus rufa*	T	No	No Effect
Whooping crane	*Grus americana*	E	No	No Effect
CLAMS				
False spike	*Fusconaia mitchelli*	PE	No	No Effect
Guadalupe orb	*Cyclonaias necki*	PE	No	No Effect
CRUSTACEANS				
Peck's Cave amphipod	*Stygobromus (=Stygonectes) pecki*	E	No	No Effect
INSECTS				
Comal Springs dryopid beetle	*Stygoparnus comalensis*	E	No	No Effect
Comal Springs riffle beetle	*Heterelmis comalensis*	E	No	No Effect
Monarch butterfly	*Danaus plexippus*	C	Yes	No Effect
PLANTS				
Bracted twistflower	*Streptanthus bracteatus*	PT	No	No Effect

[1] According to USFWS' IPaC (USFWS 2022b)
2 E – Endangered; T – Threatened; PE – Proposed Endangered; PT – Proposed Threatened; C - Candidate

Based on the results of the background review and the on-site field investigation, suitable habitat capable of supporting listed threatened or endangered species was observed within the Project Area for one species: the monarch butterfly (*Danaus plexippus*).

The monarch butterfly is known to utilize herbaceous and forested habitat within Central Texas for stopovers and feeding during fall migrations to over-wintering sites in Mexico and spring migrations to breeding sites in the northern United States and Canada. Monarchs passing through Texas in the spring lay eggs before dying and are highly dependent on milkweed plants (*Asclepias spp*.) for reproduction (NatureServe 2022).

CULTURAL RESOURCES ASSESSMENT

On January 14, 2022, POWER performed a file review to identify cultural resources recorded within and near the Project Area. The file review included data from the online restricted-access Texas Historical Commission's Texas Archeological Sites Atlas and Texas Historic Sites Atlas (THC 2022a and 2022b); National Park Service databases (NPS 2022a and 2022b); and the Texas Department of Transportation's NRHP Listed and Eligible Bridges database (TxDOT 2022a) and Historic Districts and Properties of Texas database (TxDOT 2022b). No cultural resources are recorded within or adjacent to the Project. The nearest recorded cultural resources, archeological site 41BX565 and the Rittiman Addition Cemetery are 435 feet and 135 feet, respectively, from the Project boundary.

CONCLUSIONS

WATERS OF THE UNITED STATES

The on-site field investigation identified five streams, three wetlands, and five waterbodies within the Project Area (Tables 1 and 2; Attachment A, Figure 3). The status of mapped features as potential WOTUS was determined based on connectivity to downstream relatively permanent or traditionally navigable waters in addition to man-made status. Please note that only the USACE can make the final determination on whether a stream, wetland, or pond is considered a WOTUS.

THREATENED AND ENDANGERED SPECIES

Based on the background literature review and the on-site field investigation, suitable habitat for federally listed species was observed for one species: the monarch butterfly. As a candidate species, the monarch butterfly does not currently have protections under the Endangered Species Act.

The Project occurs within the primary migration corridor for the whooping crane, however, suitable habitat for the whooping crane, as well as other federally-listed bird species, was not observed during the on-site investigation. The ability of federally-listed birds to migrate through the Project Area is possible, however, these species are not anticipated in the Project Area due to the lack of suitable habitat.

CULTURAL RESOURCES

Due to the lack of cultural resources recorded within the Project, POWER concludes the Project will have no effect on known cultural resources. However, the Project has not undergone a cultural resources survey. A survey may be required if Project permitting requires compliance with Section 106 of the National Historic Preservation Act or the Texas Antiquities Code. If cultural resources are encountered during construction of the Project, all activities at the location should be halted until the Texas Historical Commission is notified and an appropriate course of action is determined.

In the event the Project Area is modified and/or expanded to occur beyond the extent of that reviewed for this report, it is suggested that Beck contact POWER to determine if any additional investigations are needed.

Thank you for allowing POWER to assist Beck with this project. If you have any questions or comments, please contact me at 210-951-6424 or julie.morelli@powereng.com.

Sincerely,
POWER Engineers, Inc.

Juliana Morelli

Julie Morelli P.G., REM.
Sr. Project Manager

Enclosures:
Attachment A – Project Figures
Attachment B – Project Photographs

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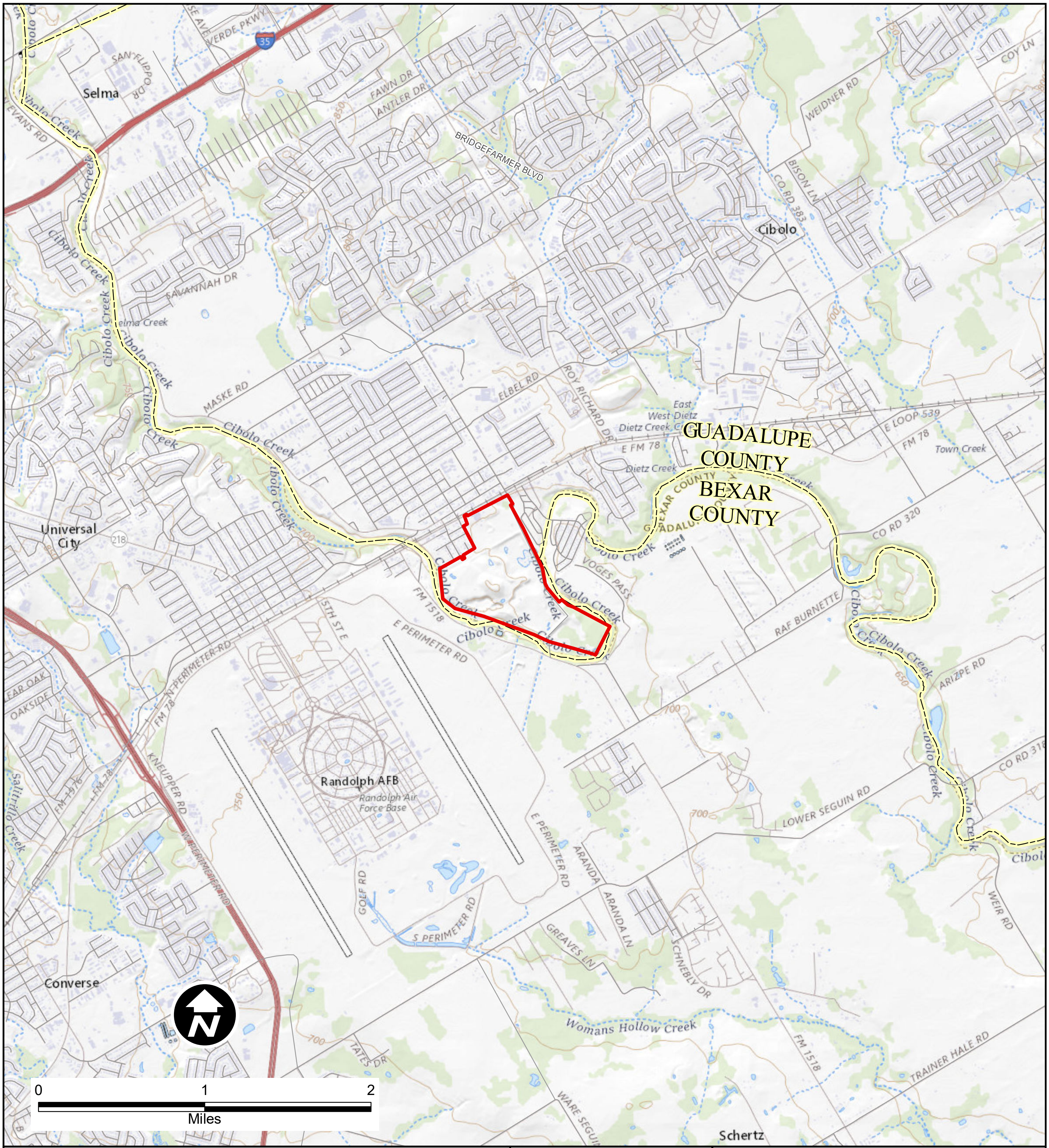
ATTACHMENT A PROJECT FIGURES



Legend

🟥 Permit Boundary

BECK LANDFILL

FIGURE 1:
PROJECT LOCATION MAP

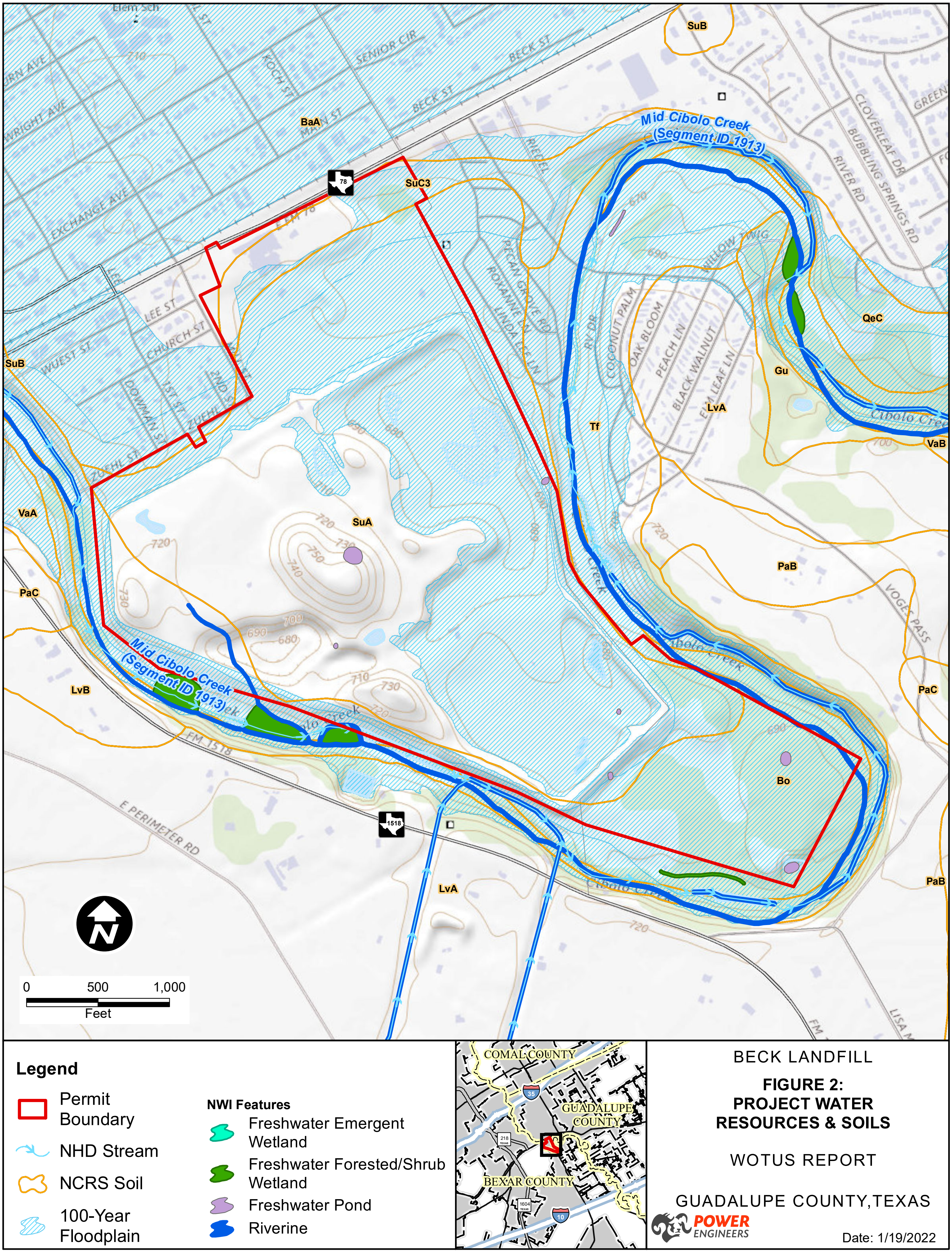
WOTUS REPORT

GUADALUPE COUNTY, TEXAS

POWER ENGINEERS

Date: 1/19/2022

Path: H:\Beck\GIS\150051 Landfill GIS_Maps_WOTUS\1_Project_Location.mxd



Legend

▭ Permit Boundary

〜 NHD Stream

◌ NCRS Soil

▨ 100-Year Floodplain

NWI Features

● Freshwater Emergent Wetland

● Freshwater Forested/Shrub Wetland

● Freshwater Pond

● Riverine

BECK LANDFILL

FIGURE 2:
PROJECT WATER RESOURCES & SOILS

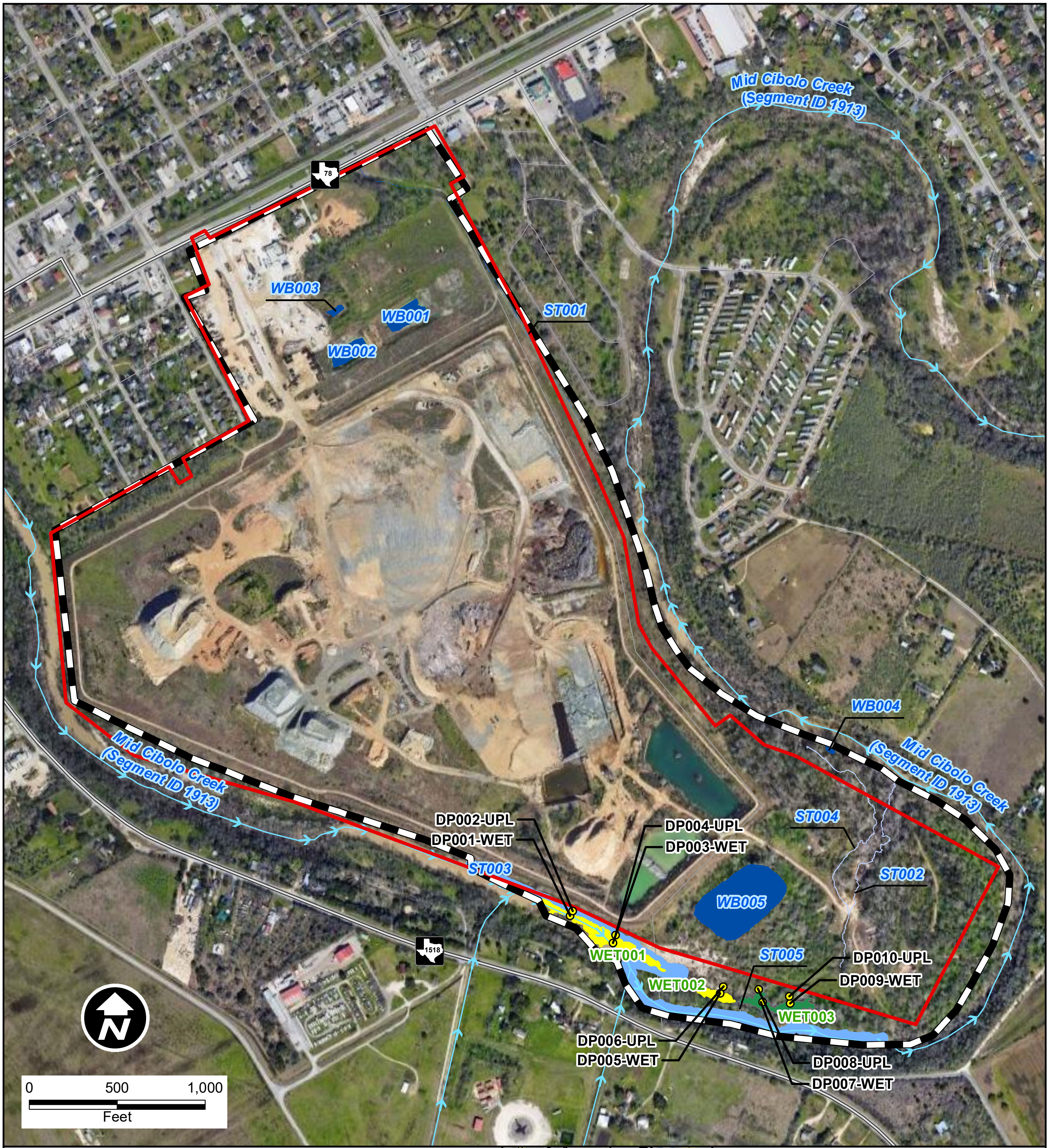
WOTUS REPORT

GUADALUPE COUNTY,TEXAS

POWER ENGINEERS

Date: 1/19/2022

Path: H:\Beck\GIS\150051 Landfill GIS_Maps_WOTUS\2_Water_Soil.mxd



Legend

🟥 Permit Boundary

▨ Survey Boundary

NHD Stream

● Data Point

Wetland Type

PEM Wetland

PFO Wetland

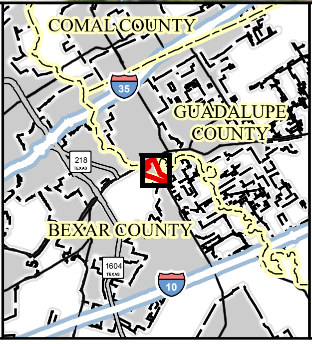
Stream Type

Ephemeral

Intermittent

Ditch

Waterbody



BECK LANDFILL

FIGURE 3:
WOTUS

WOTUS REPORT

GUADALUPE COUNTY,TEXAS

POWER ENGINEERS

Date: 1/19/2022

Path: H:\Beck\GIS\150051 Landfill GIS_Maps_WOTUS\3_WOTUS.mxd

ATTACHMENT B PROJECT PHOTOGRAPHS

PHOTO 1 UPSTREAM VIEW OF A MAN-MADE DRAINAGE DITCH (ST001). ST001 WAS IDENTIFIED AS AN EPHEMERAL DRAINAGE DITCH FEATURE AND IS NOT LIKELY TO BE CONSIDERED A POTENTIALLY JURISDICTIONAL WOTUS. PHOTOGRAPH FACES NORTHWEST.

PHOTO 2 DOWNSTREAM VIEW OF AN UNNAMED INTERNAL DRAINAGE (ST002). ST002 WAS IDENTIFIED AS AN EPHEMERAL DRAINAGE FEATURE AND IS NOT LIKELY TO BE CONSIDERED A POTENTIALLY JURISDICTIONAL WOTUS. PHOTOGRAPH FACES NORTH.

PHOTO 3 **UPSTREAM VIEW OF CIBOLO CREEK (ST003). ST003 WAS IDENTIFIED AS AN INTERMITTENT STREAM FEATURE AND IS LIKELY TO BE CONSIDERED A POTENTIALLY JURISDICTIONAL WOTUS. PHOTOGRAPH FACES SOUTHEAST.**

PHOTO 4 **DOWNSTREAM VIEW OF CIBOLO CREEK (ST003). ST003 WAS IDENTIFIED AS AN INTERMITTENT STREAM FEATURE AND IS LIKELY TO BE CONSIDERED A POTENTIALLY JURISDICTIONAL WOTUS. PHOTOGRAPH FACES EAST.**

PHOTO 5 DOWNSTREAM VIEW OF AN UNNAMED INTERNAL DRAINAGE (ST004). ST004 WAS IDENTIFIED AS AN EPHEMERAL DRAINAGE FEATURE AND IS NOT LIKELY TO BE CONSIDERED A POTENTIALLY JURISDICTIONAL WOTUS. PHOTOGRAPH FACES NORTH.

PHOTO 6 DOWNSTREAM VIEW OF AN UNNAMED TRIBUTARY TO CIBOLO CREEK (ST005). ST005 WAS IDENTIFIED AS AN EPHEMERAL STREAM FEATURE AND IS LIKELY TO BE CONSIDERED A POTENTIALLY JURISDICTIONAL WOTUS. PHOTOGRAPH FACES SOUTH.

PHOTO 7 **VIEW OF AN EMERGENT, IN-STREAM WETLAND WITHIN THE MAIN CHANNEL OF CIBOLO CREEK (WET001). WET001 WAS IDENTIFIED AS AN EMERGENT WETLAND FEATURE AND IS LIKELY TO BE CONSIDERED A POTENTIALLY JURISDICTIONAL WOTUS. PHOTOGRAPH IS FACING NORTH.**

PHOTO 8 **VIEW OF AN EMERGENT, RIPARIAN WETLAND ADJACENT TO CIBOLO CREEK (WET002). WET002 WAS IDENTIFIED AS AN EMERGENT WETLAND FEATURE AND IS LIKELY TO BE CONSIDERED A POTENTIALLY JURISDICTIONAL WOTUS. PHOTOGRAPH IS FACING SOUTH.**

PHOTO 9 VIEW OF A FORESTED, RIPARIAN WETLAND ADJACENT TO CIBOLO CREEK (WET003). WET003 WAS IDENTIFIED AS AN EMERGENT WETLAND FEATURE AND IS LIKELY TO BE CONSIDERED A POTENTIALLY JURISDICTIONAL WOTUS. PHOTOGRAPH IS FACING NORTH.

PHOTO 10 VIEW OF A MAN-MADE, RETENTION POND (WB001). WB001 WAS IDENTIFIED AS A MAN-MADE RETENTION POND EXCAVATED IN UPLANDS AND IS NOT LIKELY TO BE CONSIDERED A POTENTIALLY JURISDICTIONAL WOTUS. PHOTOGRAPH IS FACING EAST.

PHOTO 11 VIEW OF A MAN-MADE, RETENTION POND (WB002). WB002 WAS IDENTIFIED AS A MAN-MADE RETENTION POND EXCAVATED IN UPLANDS AND IS NOT LIKELY TO BE CONSIDERED A POTENTIALLY JURISDICTIONAL WOTUS. PHOTOGRAPH IS FACING SOUTHEAST.

PHOTO 12 VIEW OF A MAN-MADE, RETENTION POND (WB003). WB003 WAS IDENTIFIED AS A MAN-MADE RETENTION POND EXCAVATED IN UPLANDS AND IS NOT LIKELY TO BE CONSIDERED A POTENTIALLY JURISDICTIONAL WOTUS. PHOTOGRAPH IS FACING SOUTHEAST.

PHOTO 13 VIEW OF A NATURALLY OCCURING POND (WB004). WB004 WAS IDENTIFIED AS A NATURALLY OCCURING POND ASSOCIATED WITH CIBOLO CREEK AND IS LIKELY TO BE CONSIDERED A POTENTIALLY JURISDICTIONAL WOTUS. PHOTOGRAPH IS FACING NORTHEAST.

PHOTO 14 VIEW OF A MAN-MADE, RETENTION POND (WB005). WB005 WAS IDENTIFIED AS A MAN-MADE RETENTION POND EXCAVATED IN UPLANDS AND IS NOT LIKELY TO BE CONSIDERED A POTENTIALLY JURISDICTIONAL WOTUS. PHOTOGRAPH IS FACING NORTHEAST.

ATTACHMENT M - TEXAS HISTORICAL COMMISSION REVIEW (§330.61(o))

Historic Sites and Cultural Resources

On January 14, 2022, POWER performed a file review to identify cultural resources recorded within and near the Project Area. The file review included data from the online restricted-access Texas Historical Commission's Texas Archeological Sites Atlas and Texas Historic Sites Atlas (THC 2022a and 2022b); National Park Service databases (NPS 2022a and 2022b); and the Texas Department of Transportation's NRHP Listed and Eligible Bridges database (TxDOT 2022a) and Historic Districts and Properties of Texas database (TxDOT 2022b). No cultural resources are recorded within or adjacent to the Project. The nearest recorded cultural resources, archeological site 41BX565 and the Rittiman Addition Cemetery are 435 feet and 135 feet, respectively, from the Project boundary.

Due to the lack of cultural resources recorded within the Project, POWER concludes the Project will have no effect on known cultural resources. However, the Project has not undergone a cultural resources survey. A survey may be required if Project permitting requires compliance with Section 106 of the National Historic Preservation Act or the Texas Antiquities Code. If cultural resources are encountered during construction of the Project, all activities at the location should be halted until the Texas Historical Commission is notified and an appropriate course of action is determined. See **Attachment M** to this Part for the full report.

POWER ENGINEERS

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PHONE 281-765-5500
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August 26, 2022

Jeff Durst
Regional Reviewer
Texas Historical Commission
1511 Colorado Street
Austin TX 78701

Subject: Beck Companies Landfill Project, Guadalupe County, Texas

Dear Mr. Durst:

POWER Engineers, Inc. (POWER) was contracted by Beck Companies (Beck) to assist Beck in complying with the Natural Resources Code, Chapter 191, Texas Antiquities Code for the Beck Landfill Project (Project) in Guadalupe County, Texas. The Landfill is located at 550 John E. Peterson Boulevard/Farm to Market Road 78, Schertz, Texas 78154. Depicted in Figure 1 (attached), the Landfill permitted boundary (Project Area) consists of approximately 107.7 hectares (266 acres) (Figure 1).

The Project Area is an existing Texas Commission on Environmental Quality-permitted Type IV landfill (construction and demolition debris) that has been an authorized landfill since 1985. Beck is proposing an amendment to its existing permit to expand the landfill vertically. No horizontal expansion of the previously permitted boundary is proposed. No placement of waste outside the Project Area is proposed. Work outside the landfill waste placement area within the permitted area includes installation of rainwater collection pond(s).

A review of the Project Area is presented below, included is a review of geology, soils, previously recorded cultural resources information available through online databases. United States Geological Survey (USGS) topographic maps as well as aerial photography was reviewed to document historic disturbance within the Project Area. No State Historic Landmarks (SALs) or National Register of Historic Places (NRHP)-listed or eligible resources are within the Project Area. It is POWER's understanding that the Project would be on privately-owned land and use private funds. POWER seeks concurrence from the Texas Historical Commission (THC) that the Project is in compliance with the Natural Resources Code, Chapter 191, Texas Antiquities Code.

GEOLOGICAL SETTING

The proposed Project Area is within the southern extent of the Floodplains and Low Terraces sub-province of the Texas Blackland Prairies Ecoregion of Texas (USEPA 2003). The Floodplains and Low Terraces sub-province consisting of the broadest flood plains associated with the Brazos, Colorado and Trinity rivers and Holocene aged terrace deposits (USEPA 2003). Elevation within the Project Area ranges from approximately 680 to 700 feet above mean sea level (USGS 1992c). The surface geology of the Project Area is mapped as Pleistocene and Holocene-aged Terrace Deposits, which consist of sand, silt, clay, and gravel with indurated caliche on terraces along streams (USGS 2022).

Barbarosa, Sunev, Bosque and Seguin series soils are mapped within the Project Area (Soil Survey Staff 2022). The mapped soil unit name, setting, soil profile and if the soils are recent alluvium, are shown in Table 1. All the soils mapped within the Project Area are Mollisols that formed in calcareous alluvium (Soil Survey Staff 2022). Mollisols have deep, dark-colored, humic-rich surface horizons that offer nutrient rich topsoil that have prevalent earthworm activity that can lead to artifact mixing (Rapp and Hill 2006).

TABLE 1 SOIL MAP UNITS MAPPED WITHIN THE PROJECT AREA

MAP UNIT NAME	SETTING	PROFILE (CM)	RECENT ALLUVIUM?
Barbarosa silty clay, 0 to 3 percent slopes	formed in calcareous clayey sediments on uplands	Ap: 0-15: silty clay A: 15-60: silty clay Bt: 60-121: clay Btk: 121-182: clay	Yes
Sunev loam, 0 to 15 percent slopes	formed in calcareous loamy alluvium stream terraces or footslopes of valleys and ridges	Ap: 0-15: loam A: 15-30: loam Btk1: 30-53: loam Btk1: 53-152: loam Btk1: 152-183:loam	Yes
Bosque and Seguin soils, frequently flooded	Bosque loam: form in calcareous loamy alluvium of Pleistocene age derived from limestone and shale on treads of flood plains	Ap: 0-13: loam A1: 13-51: loam A2: 51-97: clay loam Bw: 97-127: clay loam Akb: 127-125: clay	Yes
	Seguin silty clay loam: form in calcareous alluvium along streams and rivers on flood plains	A: 0-33: silty clay loam Bw: 33-66: silty clay loam C: 66-157: silty clay loam	

Source: Soil Survey Staff 2022.

PREVIOUS ARCHEOLOGICAL RESEARCH

POWER conducted a review of records available online to determine if previously recorded sites and previous investigations have been recorded within a study area that extends one mile from the Project Area. The review indicated that no cultural resources are located within the Project Area and one previous investigation crosses portions of the Project Area. The review indicated that one resource, a National Historic Landmark (NHL), is recorded within the study area, as well as six archeological sites, seven cemeteries, and one Official Texas Historic Markers (OTHM). An additional 14 previous archeological surveys are mapped within the study area (THC 2022). These resources are discussed below and shown in Figures 2 and 3.

The Randolph Field Historic District, and NHL, is recorded within the study area, 956 meters (3,136 feet) from the Project Area. The district contains 350 contributing resources between 1931 and 1950, built as part of the Randolph Air Force Base (AFB) (Thomason 1994 and Cook 2001). These contributing elements include hangers, towers, garages, administrative buildings and other structures and infrastructure built to support the military purpose of the airbase. Many of these buildings were designed in the Spanish Colonial Revival and related Spanish Renaissance Revival and Spanish Mediterranean architectural styles. The layout of the Randolph AFB was designed with the prevailing winds in mind as it was to be an “Air City”. The Randolph Field Historic District was listed on the NRHP in 1994 and was designated an NHL in 2001 (Thomason 1994 and Cook 2001).

Of the six recorded archeological sites recorded within one mile of the Project Area, five are prehistoric and one is historic in age (Table 2). The prehistoric sites consisted of three campsites (41BX565, 41BX1984, and 41GU131) and two lithic scatters (41BX566 and 41GU2). Site

41BX1936 is the historic Stapper Cemetery. Site 41BX1984 and portions of site 41GU131 have been determined ineligible for listing on the NRHP. The remaining sites have not been formally evaluated for inclusion on the NRHP (THC 2022). Due to their distances from the Project Area, shown in Table 2, no impacts are anticipated for these sites.

Including the Stapper Cemetery (41BX1936), there are seven cemeteries mapped within one the study area (Table 3). Site 41BX1936 (Stapper Cemetery) and the Rittiman Addition (BX-C209) cemetery are located in Baxer County. The Jacob Christian Seiler (GU-C001), Jacob Christian & Emma Margele Seiler (GU-C005), Schneider Memorial (GU-C058), Dietz (GU-C080), and Schertz-Cibolo (GU-C082) cemeteries are in the study area in Guadalupe County, Texas. Both the Jacob Christian Seiler (GU-C001) and Jacob Christian & Emma Margele Seiler (GU-C005) cemeteries are designated Historic Texas Cemeteries (HTCs) (THC 2022). The Schneider Memorial (GU-C058) cemetery is mapped adjacent to the east of the Project Area, but is outside the Project Area (THC 2022). As no horizontal expansion of the Project Area is proposed, no impacts to the cemeteries are anticipated.

The OTHM mapped within the study area is Schertz (Marker Number 4597) which commemorates the German settlers who first settled in the area. Having come from New Braunfels, they arrived in the 1840s to farm, creating the communities of Cibolo Pit, Texas and Cutoff, Texas. In 1882, the name Schertz was adopted in honor of one of the early settlers, Sebastian Schertz (THC 2022). The Schertz marker is mapped 5,259 feet from the Project Area.

A total of 15 previous archeological investigations have been conducted within the study area (Table 4). Eleven of these surveys were conducted in advance of water system improvement (Henderson 1998, Padilla and Matthews 2018, Patton 2002, Shelton and Coleman 2012, Stotts et al. 2013, Owens and Smith 2019, and Young and Sanchez 2010), creek bank stabilization (Shipp 2008), waste water (Carpenter 2011), and recreation projects (Shafer and Hester 2013 and Shafer and Hester 2014). The remaining four previous investigations have little to no information avail on the THC database (THC 2022).

TABLE 2 ARCHEOLOGICAL SITES WITHIN ONE MILE OF PROJECT AREA

TRINOMIAL	SHPO ELIGIBILITY DETERMINATION	PERIOD	DESCRIPTION	DISTANCE TO PROJECT AREA (FEET)
41BX565	Undetermined	Prehistoric	campsite with flakes, mussel shell fragments, burned rock, and Rabdotus shells	408
41BX566	Undetermined	Prehistoric	two tertiary flakes located on an elevated knoll on an alluvial (Pleistocene) terrace	4,439
41BX1936	Undetermined	Historic	Stapper Cemetery	5,291
41BX1984	Ineligible	Prehistoric (Possibly Late Paleoindian to Archaic)	campsite with a hearth feature, burned rock scatter, flakes, and a possible St Mary's Hall point	1,370
41GU2	Undetermined	Prehistoric	lithic scatter	1,636
41GU131	Ineligible within ROW	Prehistoric	campsite with hearth feature and lithic scatter	4,940

TABLE 3 CEMETERIES WITHIN STUDY AREA

CEMETERY NUMBER	CEMETERY NAME	DESIGNATION	COUNTY	DISTANCE TO PROJECT AREA (FEET)
---	41BX1936 (Stapper Cemetery)	None	Baxter	5,291
BX-C209	Rittiman Addition	None	Baxter	123
GU-C001	Jacob Christian Seiler	HTC	Guadalupe	950
GU-C005	Jacob Christian & Emma Margele Seiler	HTC	Guadalupe	2,153
GU-C058	Schneider Memorial	None	Guadalupe	Adjacent
GU-C080	Dietz	None	Guadalupe	3,731
GU-C082	Schertz-Cibolo	None	Guadalupe	3,014

TABLE 4 PREVIOUS INVESTIGATIONS WITHIN ONE MILE OF THE THC PROPERTY

ATLAS NUMBER	DATE	REPORT TITLE	INVESTIGATION AGENCY
8400002904	1980	no information available	Air Force
8400002906/8400002907/8500002876/ 8500002877	**1982**	**no information available**	**Environmental Protection Agency/ Texas Water Development Board**
8400002917	1987	no information available	SDHPT
8400008474	1992	no information available	Federal Highway Administration
8400008768/8500009829	1998	An Archeological Survey of Proposed Water System Improvements for Cibolo Creek Municipal Authority, Guadalupe and Bexar Counties, Texas (Henderson 1998)	Texas Water Development Board
8400009610	2002	Phase I Archaeological Survey, West Dietz Creek Drainage Improvement Project, City Schertz, Guadalupe County, Texas (Patton 2002)	Federal Emergency Management Agency
8500015243	2008	A Cultural Resources Survey for the Cibolo Creek Bank Stabilization Project, Bexar and Guadalupe Counties, Texas — Bexar, Guadalupe Counties (Shipp 2008)	PBS&J
8500019795	2010	Intensive Archeological Survey of the Proposed Schaefer Road Drainage Phase I (CB-19) Project in Northeast Bexar County, Texas (Young and Sanchez 2010)	Blanton & Associates, Inc.
8500019801	2011	Intensive Archaeological Survey of Portions of the Olympia-Retama Sewer Line, Bexar and Guadalupe Counties, Texas (Carpenter 2011)	SWCA Environmental Consultants
8500020289/8500020436	2013	Results of an Intensive Cultural Resources Survey for the Proposed San Antonio Water System (SAWS) Regional Carrizo Project (RCP) in Bexar, Comal, and Guadalupe Counties, Texas (Stotts et al. 2013)	SWCA Environmental Consultants

ATLAS NUMBER	DATE	REPORT TITLE	INVESTIGATION AGENCY
8500021198	2012	Cultural Resources Survey of the Cibolo Creek Municipal Authority Water Reclamation Facility Upgrades, Bexar and Guadalupe Counties, Texas (Shelton and Coleman 2012)	AR Consultants
8500038160	2013	An Archaeological Survey of the Eight-Acre Veterans Park, Universal City, Bexar County, Texas (Shafer and Hester 2013)	Abasolo Archaeological Consultants
8400012446	2014	An Archaeological survey of the 1.5-mile Nature Trail, Universal City, Northeast Bexar County, Texas (Shafer and Hester 2014)	Abasolo Archaeological Consultants
8500081120	2018	Cultural Resources Investigations for the Schertz Colonies Drainage Improvement Project, Schertz, Guadalupe County, Texas (Padilla and Matthews 2018)	Raba Kistner Environmental, Inc.
8500081463	2019	Intensive Cultural Resources Survey of the Schertz-Seguin Local Government Corporation's Proposed Water System Improvements Project, Guadalupe County, Texas (Owens and Smith 2019)	Horizon Environmental Services, Inc.

Bold entries include portions of the proposed Project Area

A review of historic topographic maps and aerial images indicated that portions of the Project Area have been disturbed as far back as 1953. Evidence of excavations/mining are depicted within the Project Area on the 1953 USGS Schertz, Texas topographic map (Figure 4) as well as the 1992 USGS New Braunfels, Texas topographic map (Figure 5) (USGS 1953, 1958, 1985, 1992a, 1992b, and 1992c). Aerial images also show recent disturbance from 1992 to 2021 (Photo 6 through 8) (Google Earth 2022).

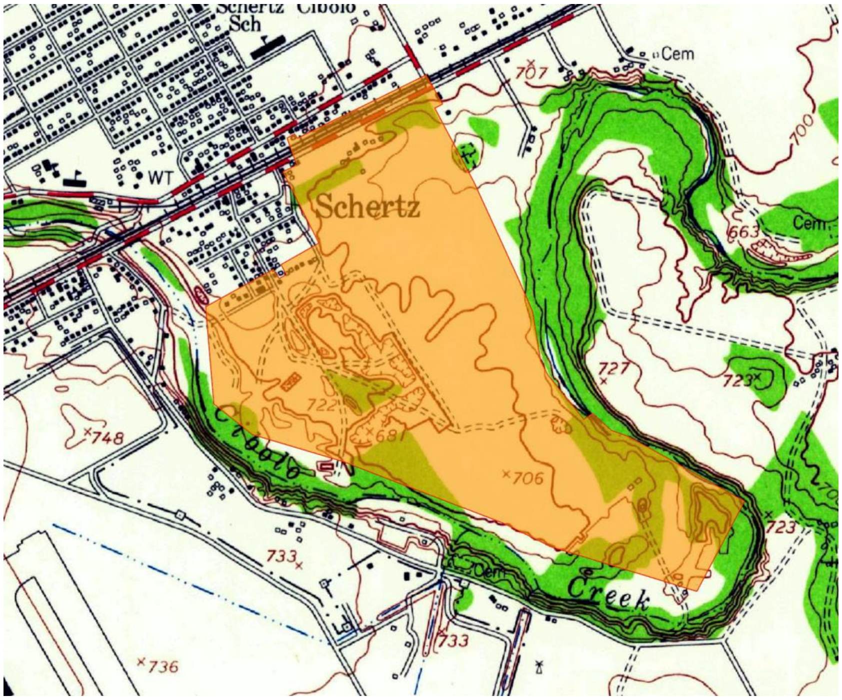

Figure 4: Excavation/mining activity depicted within the Project Area on the 1953 USGS Schertz, Texas 1:240,000 Topographic Map, Project Area in orange.

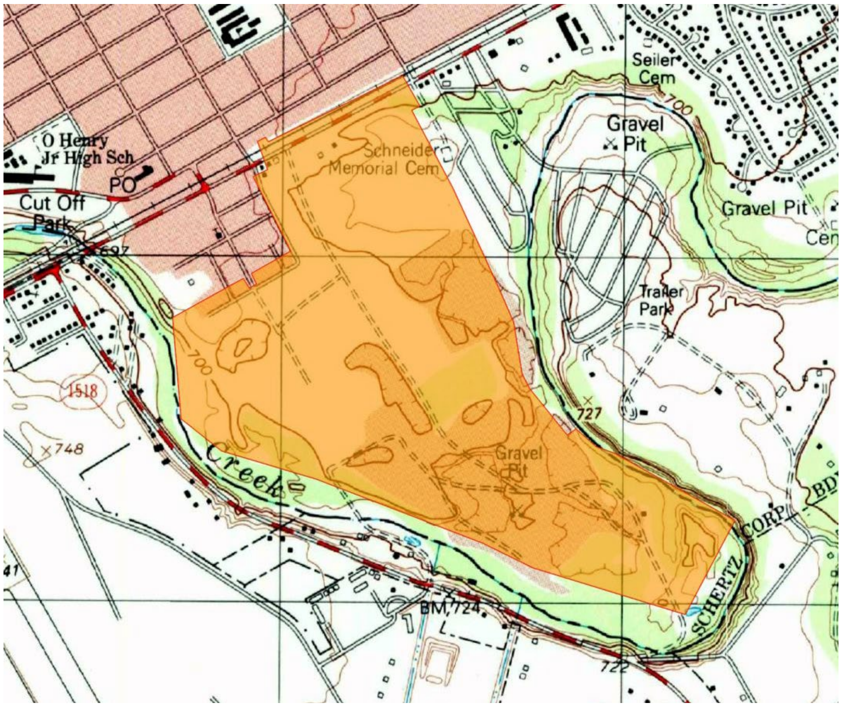

Figure 5: Gravel Pit depicted within the Project Area on the 1992 USGS New Braunfels, Texas 1:100,000 Topographic Map, Project Area in orange.

Figure 6: **Google Earth 1992 Aerial Image of Project Area, Project Area boundary in red.**

Figure 7: **Google Earth 2003 Aerial Image of Project Area, Project Area boundary in red.**

Figure 8: Google Earth 2021 Aerial Image of Project Area, Project Area boundary in red.

It is POWER's understanding that the Project would be on privately owned land and use private funds. Based on the file review, no SALs or NRHP-eligible or -listed properties are within the Project Area and the Project Area has been continually disturbed by excavations apparent in topographic maps and aerial photography since at least the 1950s, and serving as a landfill since 1985. Outside the obviously disturbed landfill waste placement, the Project Area is heavily disturbed by prior activity in the area, including mining, roadway construction, recreation, and other permitted activities, like storage. POWER seeks comment from the THC that the proposed vertical expansion of the landfill is in compliance with Natural Resources Code, Chapter 191, Texas Antiquities Code.

Sincerely,

Emily Duke. M.A., RPA
Cultural Resources Specialist/Principal Investigator

c: Julie Morelli (POWER)

Attachments: Figure 1 – Vicinity Map
Figure 2 – Topo Map
Figure 3 – Aerial Map

REFERENCES

Carpenter, Steve. 2011. *Intensive Archaeological Survey of Portions of the Olympia-Retama Sewer Line, Bexar and Guadalupe Counties, Texas.* SWCA Environmental Consultants. Austin.

Cook, Jody. 2001. "Randolph Field Historic District." National Historic Landmark Registration Form. National Parks Service. Atlanta, Georgia.

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Padilla, Antonio E. and Chris Matthews. 2018. *Cultural Resources Investigations for the Schertz Colonies Drainage Improvement Project, Schertz, Guadalupe County, Texas*. Raba Kistner Environmental, Inc. Schertz, Texas.

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_____. 1985. New Braunfels, Texas. Topographic Map. 1:100,000

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_____. 1992b. New Braunfels, Texas. Topographic Map. 1:100,000

_____. 1992c. Schertz, Texas. Topographic Map. 1:240:000.

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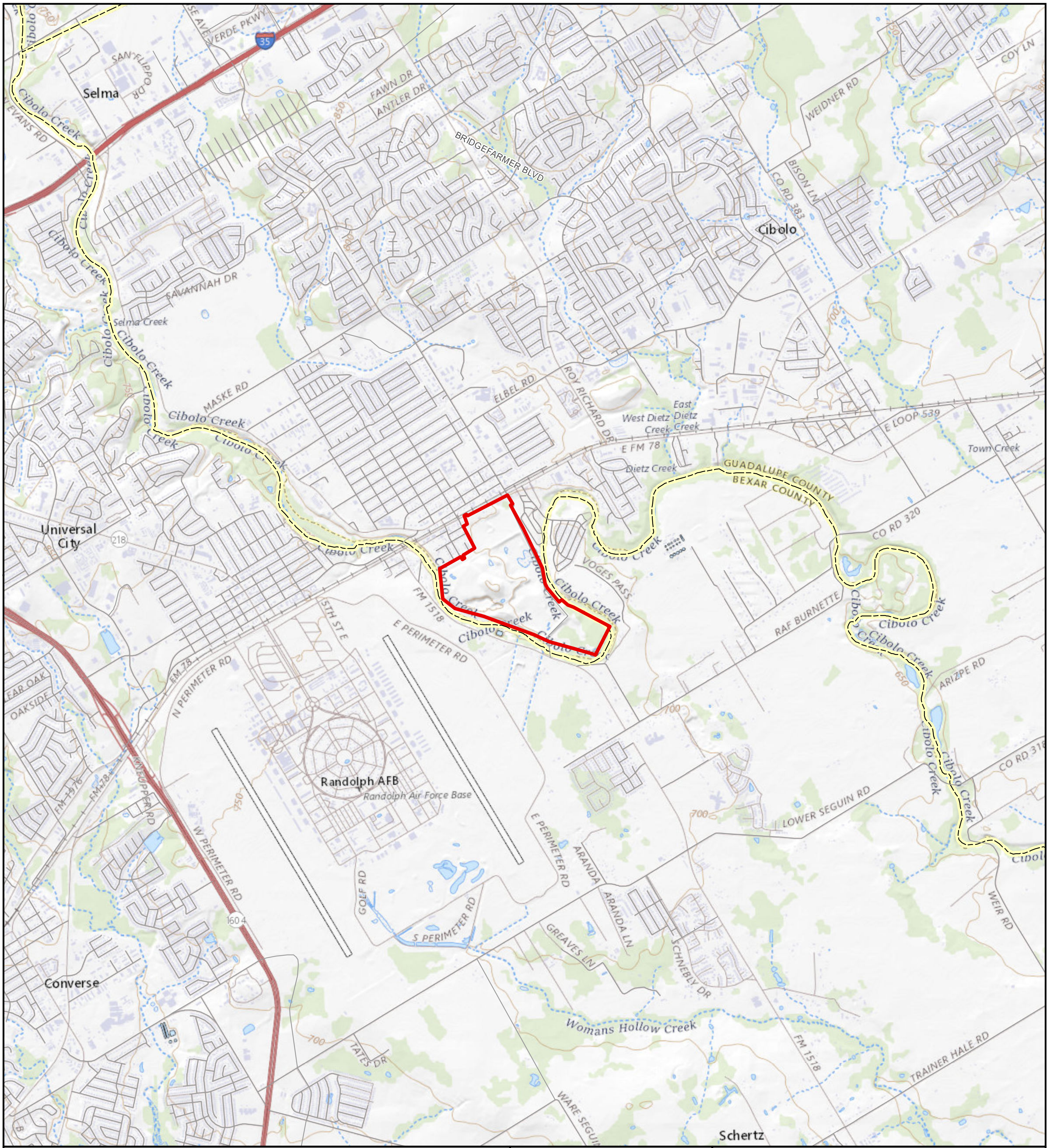


Legend

🟥 Project Area

0 0.5 1
Miles

Project Location

BECK COMPANIES LANDFILL PROJECT

FIGURE 1

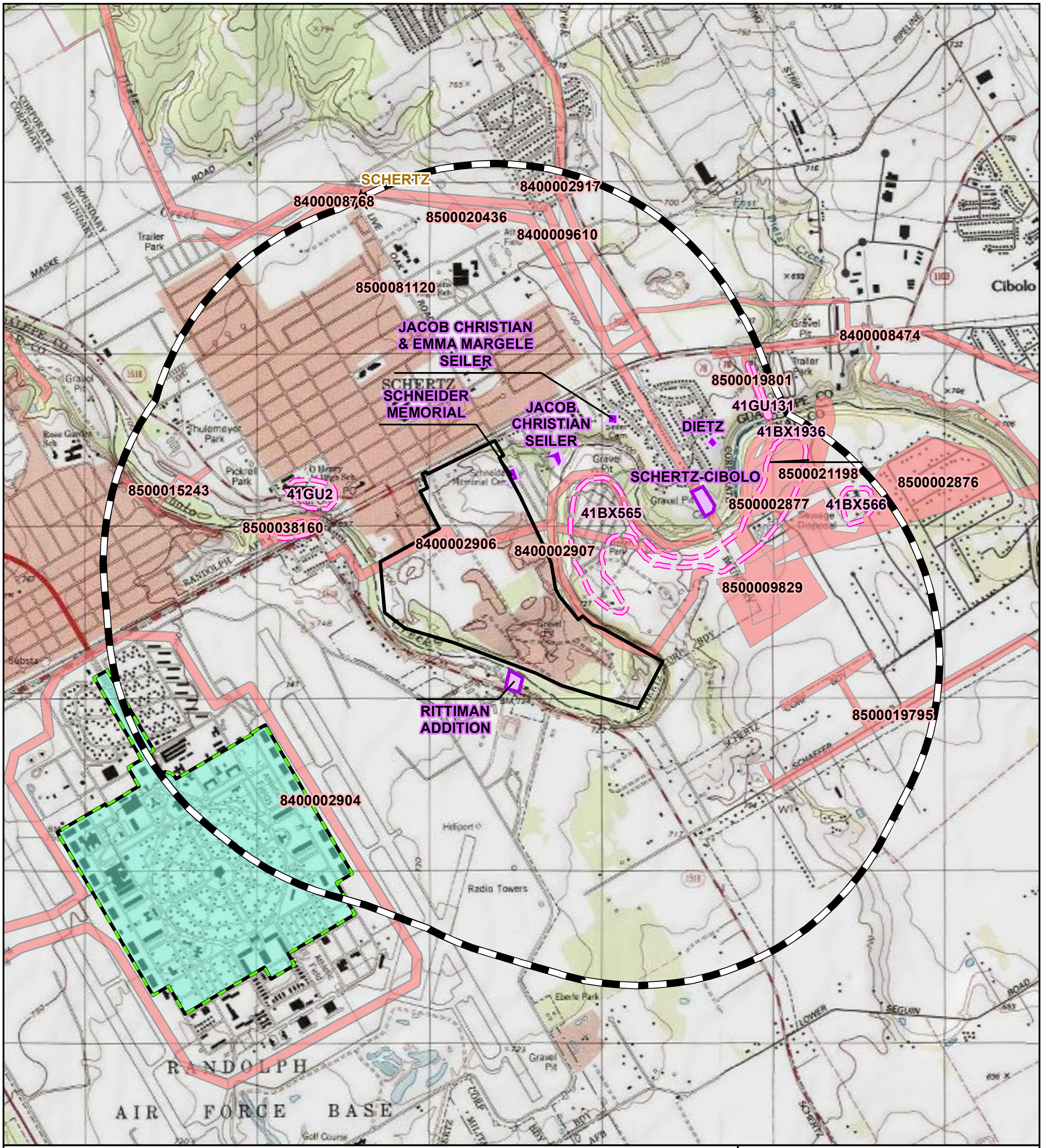
Vicinity Map

GADALUPE COUNTY,TEXAS

POWER ENGINEERS

Date: 8/23/2022

Path: G:\Projects\0_Beck\150051 Landfill GIS\Cultural\1_Vicinity_Map.mxd



Legend

- ▭ Project Area
- ◯ Study Area
- ★ Official Texas Historical Marker
- ▭ Previously Recorded Site Boundary
- ▭ Cemetery
- 🟥 Previous Investigations
- ▭ National Register of Historic Places Property
- 🟦 National Historic Landmark

N

0 1,000 2,000
Feet
0 500 1,000
Meters

NOT FOR PUBLIC DISCLOSURE

BECK COMPANIES
LANDFILL PROJECT

FIGURE 2

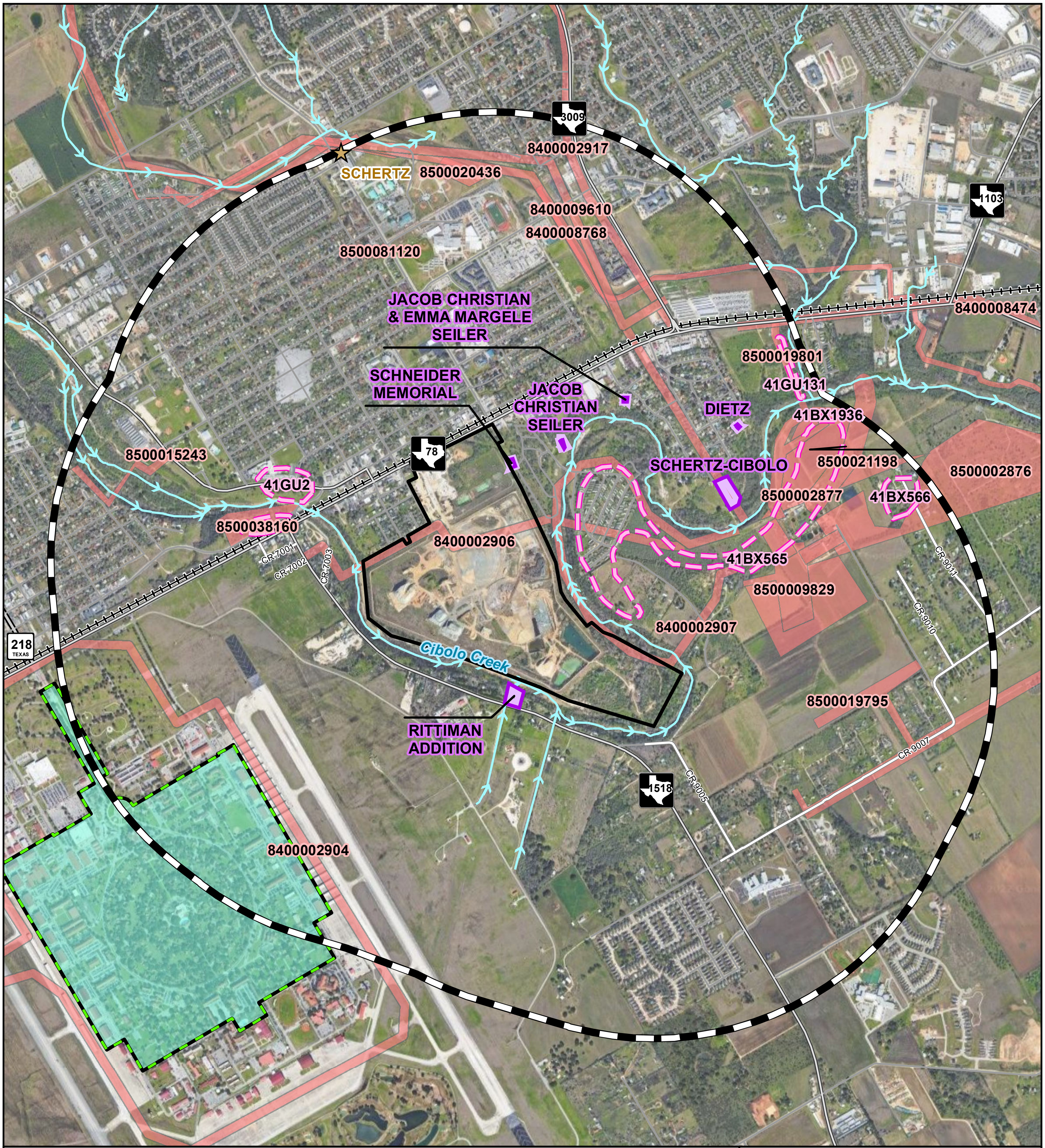
PROJECT AREA (TOPOGRAPHIC)

SCHERTZ & MARION QUADRANGLES
7.5 MINUTE TOPOGRAPHIC MAP

POWER ENGINEERS

Date: 8/23/2022

Document Path: G:\Projects\0_Beck\150051 Landfill GIS\Cultural\2_Project_Area_Topo.mxd



Legend

- ▭ Project Area
- Study Area
- ★ Official Texas Historical Marker
- Previously Recorded Site Boundary
- Cemetery
- 🟥 Previous Investigations
- National Register of Historic Places Property
- 🟩 National Historic Landmark

N

0 1,000 2,000
Feet

0 500 1,000
Meters

NOT FOR PUBLIC DISCLOSURE

BECK COMPANIES
LANDFILL PROJECT

FIGURE 3

PROJECT AREA (AERIAL)

POWER ENGINEERS

Date: 8/23/2022

Document Path: G:\Projects\0_Beck\150051 Landfill GIS\Cultural\3_Project_Area_Aerial2.mxd

From: Duke, Emily
To: Morelli, Julie; Comeaux, Jude
Cc: Schubert, Darren
Subject: Beck Companies Landfill Project THC Response
Date: Tuesday, December 6, 2022 3:24:52 PM

Hello everyone,

Please see the response below from the Texas Historical Commission in regards to the Beck Companies Landfill Project.

Thank you,

EMILY L. DUKE, MA, RPA (She/Her)
CULTURAL RESOURCE SPECIALIST I
PRINCIPAL INVESTIGATOR

281-765-5527
281-917-1965 work cell
270-991-5300 cell

POWER ENGINEERS INC.

From: noreply@thc.state.tx.us <noreply@thc.state.tx.us>
Sent: Tuesday, December 6, 2022 9:46 AM
To: Duke, Emily <emily.duke@powereng.com>; reviews@thc.state.tx.us
Subject: [EXTERNAL] Section 106 Submission

Re:
THC Tracking #202302374
Date: 12/06/2022
Beck Companies Landfill Project

550 John E. Peterson Boulevard
Schertz,TX 78154

Description: Beck is proposing an amendment to its existing permit to expand the landfill vertically. No horizontal expansion of the previously permitted boundary is proposed.

Dear Emily Duke:
Thank you for your submittal regarding the above-referenced project.

The review staff, led by Jeff Durst and Caitlin Brashear, has completed its review and has made the following determinations based on the information submitted for review:

Above-Ground Resources

- No further review of potential effects to above-ground historic resources is required under the Antiquities Code of Texas. However, should this project ultimately include any federal involvement, additional consultation with THC/SHPO under Section 106 of the National Historic Preservation Act will be required.

Archeology Comments

- No historic properties affected. However, if cultural materials are encountered during construction or disturbance activities, work should cease in the immediate area; work can continue where no cultural materials are present. Please contact the THC's Archeology Division at 512-463-6096 to consult on further actions that may be necessary to protect the cultural remains.

We look forward to further consultation with your office and hope to maintain a partnership that will foster effective historic preservation. Thank you for your cooperation in this review process, and for your efforts to preserve the irreplaceable heritage of Texas. If the project changes, or if new historic properties are found, please contact the review staff. If you have any questions concerning our review or if we can be of further assistance, please email the following reviewers: Jeff.Durst@thc.texas.gov, caitlin.brashear@thc.texas.gov.

This response has been sent through the electronic THC review and compliance system (eTRAC). Submitting your project via eTRAC eliminates mailing delays and allows you to check the status of the review, receive an electronic response, and generate reports on your submissions. For more information, visit http://thc.texas.gov/etrac-system [thc.texas.gov].

Sincerely,

for Mark Wolfe, State Historic Preservation Officer
Executive Director, Texas Historical Commission

Please do not respond to this email.

ATTACHMENT N - COUNCIL OF GOVERNMENTS AND LOCAL GOVERNMENT REVIEW (§330.61(p))

Alamo Area Council of Governments (AACOG)

Parts I and II of this application were submitted to AACOG on September 12, 2022. A review letter was requested as part of the submission. A response has not been received as of the submittal of this application. Records of correspondence with AACOG are included in **Attachment N** of this application.

City of Schertz Approval Letter

Parts I and II of this application were submitted to the City of Schertz on September 12, 2022. A review letter was requested as part of the submission. A response has not been received as of the submittal of this application. Records of correspondence with the City of Schertz are included in **Attachment N** of this application.

Cibolo Creek Municipal Authority (CCMA)

Parts I and II of this application were submitted to the CCMA on September 12, 2022. A review letter was requested as part of the submission. A response has not been received as of the submittal of this application. Records of correspondence with the CCMA are included in **Attachment N** of this application.

Schertz Fire Department Letter

Parts I and II of this application were submitted to the Schertz Fire Department on September 12, 2022. A review letter was requested as part of the submission. A response has not been received as of the submittal of this application. Records of correspondence with the Schertz Fire Department are included in **Attachment N** of this application.

PART III

MUNICIPAL SOLID WASTE PERMIT
MAJOR AMENDMENT

PART III-ATTACHMENT A
SITE DEVELOPMENT PLAN

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: Revised January 2023

Prepared by:

Civil & Environmental Consultants, Inc.

Texas Registration Number F-38
3711 S MoPac Expressway
Building 1 Suite 550,
Austin, Texas 78746
(512) 329-0006

ADAM W. MEHEVEC
84736
1-2-2023

TABLE OF CONTENTS

ADAM W. MEHEVEC
84736
1-2-2023

1.0 INTRODUCTION

Consistent with 30 TAC §330.63(a), this site development plan narrative is included as Attachment A - Site Development Plan. Attachment A provides an outline of the criteria used in the design of this facility for safeguarding the health, welfare, and physical property of the public and environment. The site development plan narrative also includes references to discussion of the geology, soil conditions, drainage, land use, zoning, adequacy of access roads and highways, and other considerations specific to this facility.

1.1 SITE LOCATION AND HISTORY

The Beck Landfill, located at 550 FM 78 in Schertz, Texas Guadalupe County, is an existing Type IV Solid Waste Disposal Facility which accepts brush, construction, or demolition waste, and/or rubbish in accordance with applicable State and Federal regulations. The Beck Landfill may not accept putrescible wastes, conditionally exempt small-quantity generator waste, or household wastes. The facility is currently owned by Cibolo Industries, Ltd. and operated by Nido, Ltd. The initial facility was given provisional authorization in 1985 by the Texas Department of Health (TDH) (See letters from TDH in Appendix A). The provisional authorization required that the facility file a MSW landfill permit application to obtain permanent authorization by November 8, 1985. MSW Permit 1848 was issued by the TDH in 1989. At the time of the 1989 application to the TDH, the applicant documented that waste disposal was taking place “in the south west end of the site, and in the north west portion of the site. These areas contain the ancient fill from Randolph Air Force Base, and part of the fill which has been placed while operating under the "Grandfather Status" set out in the compliance letter from the Texas Department of Health Bureau of Solid Waste Management dated October 16, 1985.

In addition, the application documented that gravel was “being removed from this area around the old Randolph Air Force Base fill. In general, the old fill is not being disturbed. When edges of the fill are encountered, excavation is halted, and the exposed face is investigated. If the characteristics of the fill are proper, the fill is covered immediately. Scattered and random surficial fill materials, usually 4 feet or less in depth, as well as improperly installed fills, as encountered in areas from which gravel is to be removed, are relocated to the current fill placement area, and placed in accordance with current TDH regulations.”

1.2 FACILITY DESCRIPTION

General activities which occur daily, include; but are not limited to, acceptance of construction and demolition waste; earth moving activities for periodic below-grade cell construction; excavation and application of daily, intermediate and final cover material to waste; stormwater management; minimization of leachate through currently permitted operational methods; construction quality assurance; maintenance of facility equipment, roads and structures; monitoring of groundwater; and monitoring for subsurface gas migration. The facility consists of a perimeter fence, scalehouse, maintenance shop, all-weather roads, soil stockpiles, groundwater monitoring wells, gas monitoring wells, and solid waste disposal area. Facilities for the control of stormwater runoff/run-on include benches, ditches and detention ponds and associated drainage structures.

This amendment application seeks to increase the permit boundary of the facility from 212 acres to 256.9 acres and increase the maximum permitted height of the disposal unit as depicted on the drawings included in Part III-Appendix D. No change in the permitted landfill footprint is proposed. The entire footprint of the disposal area has been previously excavated and partially filled, so no changes to the bottom excavation grades are proposed. The maximum permitted top of final cover elevation is proposed to be increased from 771 feet MSL to 890 feet MSL. No significant operational changes are being proposed as part of this amendment request.

The following table summarizes the proposed changes to the Facility Site Development and Site Operating Plans:

	Existing - Permit No. 1848	Expansion - Permit No. 1848A
Permitted Area (acres)	212	256.9
Waste Disposal Area (acres)	155	155
Total Capacity (cy)	12,383,486	26,417,117
Total Remaining Capacity	2,225,966	16,259,957
Remaining Site Life (years)	3	23
Maximum Elevation of Final Cover (msl)	771	890
Minimum Elevation of Landfill Excavation (ft-msl)	Varies based on encountered subsurface conditions	No change
Operating Hours	7:00 am to 7:00 pm	24 hours/day
Operational Procedures	Accepts brush, construction, or demolition waste, and/or rubbish	No Change
Stormwater Management System	Interim stormwater ponds only	Adding new permanent stormwater detention pond on southeast side of the landfill

MUNICIPAL SOLID WASTE PERMIT
MAJOR AMENDMENT

PART III-ATTACHMENT B
GENERAL FACILITY DESIGN

B
BECK
COMPANIES

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: Revised January 2023

Prepared by:

CEC
Civil & Environmental Consultants, Inc.

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3711 S MoPac Expressway
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(512) 329-0006

STATE OF TEXAS
ADAM W. MEHEVEC
84736
LICENSED PROFESSIONAL ENGINEER
1-2-2023

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ADAM W. MEHEVEC
84736
1-2-2023

1.0 FACILITY ACCESS

Access to Beck Landfill is controlled by a perimeter fence located along portions of the facility boundary, Cibolo Creek, which acts as a natural barrier, and a locking gate at the site entrance. The fence, creek, and gate will prevent the entry of livestock, protect the public from exposure to potential health and safety hazards, discourage unauthorized public access to the disposal operations, and discourage unauthorized entry or uncontrolled disposal of solid waste or prohibited materials. Perimeter fencing consisting of barbed wire, woven wire, or other suitable material will be provided. See Figure D1.1 for locations of the fencing.

An entrance gate is located on the entrance road. The gate is locked when the landfill personnel leave for the day. The perimeter fence and gate will be inspected periodically as specified in the Site Operating Plan. Maintenance will be performed as necessary. Should a breach be detected during inspection or at any other time, every reasonable effort will be made to make repairs within 24 hours of detection. Should repairs require more than 24 hours, temporary repairs will be performed within the time specified to the TCEQ region office following notification. The TCEQ region office will be notified of the breach within 24 hours of detection unless permanent repairs are made within eight hours of detection.

Entry to the active portion of the site will be restricted to designated personnel, approved waste haulers, properly identified persons whose entry is authorized by site management, and regulatory personnel. Visitors may be allowed on the active area only when accompanied by a site representative. Signs will be located along the entrance road directing traffic to the gatehouse. The gate attendant will restrict site access to authorized vehicles and direct these vehicles appropriately.

Waste hauling vehicles will be directed to appropriate fill areas by signs located along the landfill haul road and access road. These vehicles will deposit their loads and depart the site. Private, commercial, or public solid waste vehicles will not be allowed access to any areas other than the active portion of the landfill. Site personnel will provide traffic directions as necessary to facilitate safe movement of vehicles. Within the site, signs will be placed along the landfill haul road and access road at a frequency adequate for users to be able to determine the disposal area locations and which roads are to be used. Roads not being used for access to disposal areas will be blocked or otherwise marked for no entry.

2.0 WASTE MOVEMENT

The major classifications of solid waste to be accepted at Beck Landfill include brush, construction, or demolition waste, and/or rubbish (C&D waste). Waste disposal facilities include the C&D solid waste disposal area. Waste processing and/or storage facilities include the brush and wood grinding area. Drawing B.1 is a flow diagram that provides the storage, processing, and disposal sequences for the various wastes accepted. Waste enters the facility via the site entrance road. The gate attendant observes the incoming waste at the gatehouse, conducts waste screening and weighing, and documents the incoming waste. The gate attendant is familiar with the rules and regulations governing the various types of waste that can or cannot be accepted into this facility and will direct the waste hauler to the appropriate waste disposal, storage, or processing area. These gatehouse personnel will also have the authority to reject prohibited wastes and have the rejected waste removed by the waste haul vehicle or transporter immediately upon discovery.

Trained personnel will observe waste unloading at the active working face and will have the authority and responsibility to reject loads that contain prohibited wastes. These working face personnel will also have the authority to have prohibited waste removed by the waste haul vehicle or transporter immediately upon discovery.

2.1 WASTE DISPOSAL

The proposed landfill liner and final cover systems will meet all applicable Subtitle D requirements and TCEQ rules and guidelines for Type IV landfills. Provisions addressing design and construction are addressed in the liner quality control plan, the contaminated water management plan, and the final cover quality control plan.

The waste disposal area will be excavated with side slopes no steeper than 3H:1V. The in-situ liner system will be evaluated following excavation of a new waste disposal area. Information regarding materials and construction quality assurance are included in Attachment D7 - Liner Quality Control Plan. Liner system details are also included in Attachment D7.

The proposed landfill development method for the site is a combination of the below-grade area excavation fill followed by aerial fill to the proposed landfill completion height. Landfill development will generally follow the sequence of development as shown on Drawing D1.2, which will generally be in the order the cells are numbered.

Waste accepted for disposal will be directed to the active working face. Waste will be unloaded within the active working face, spread in layers and thoroughly compacted. Weekly operational cover of waste will be applied to control disease vectors, windblown waste, odors, fires, scavenging, and to promote runoff from the fill area. Operational cover consisting of a minimum of six inches of soil will be placed over wastes at the end of each week.

The aerial fill side slopes will not be steeper than 4H:1V, and the aerial fill top slope will be approximately six percent. A final cover will be constructed over the entire landfill as detailed in Attachment D8-Final Cover Quality Control Plan
Final cover placement will generally follow the sequence of development as shown on Drawing D1.3 through D1.6 and may be ongoing as the site is developed. Sectors will be closed according to the closure plan provided in Part III, Attachment H- Closure Plan.

3.0 STORAGE AND PROCESSING UNITS

The Beck Landfill facility contains the following storage and processing units:

1. Wood waste processing area, and
2. Recyclable material recovery area.

The wastes stored or processed in these areas emanate from residential, municipal, and commercial sources, and include brush, wood scraps, saw dust, pallets, other wood wastes, metal, concrete, plastic, and other recyclable materials. These facilities may not receive, process, or store regulated hazardous waste. There are no known waste constituents or characteristics that could be a limiting parameter that would impact or influence the design and operation of the facilities.

The types and an estimate of the amount of each waste to be received daily will vary based on market conditions and availability of storage or processing capacity. The maximum amount of waste to be stored at any point is based on the storage capacity of each unit. Material will be stored for a maximum of 180 days. The intended destination of material stored and/or processed at the wood waste processing area is for offsite use as a bio-fuel or onsite use for erosion controls and site roads.

All waste shall be stored in such a manner that it does not constitute a fire, safety, or health hazard or provide food or harborage for animals and vectors, and shall be contained or bundled so as not to result in litter. The brush storage and grinding area will be separated from any onsite structures or other facilities. Brush piles will be maintained at a maximum size of one acre to limit fire potential. See Section 7 of Part IV SOP for specific fire-fighting procedures for the proposed processing and storage areas. Pressurized water is available near all onsite buildings, but it is not planned to be used for firefighting purposes. The site water truck may be used for extinguishing fires as detailed in Part IV-Section 7. All employees working at or near the storage and processing areas shall be trained on the requirements of the Fire Protection Plan included in Part IV-Section 7.

Vehicle parking for equipment, employees, and visitors will be provided. Employees will park near the landfill maintenance facility and visitors will park at the scalehouse. Equipment can be parked adjacent to the storage or processing unit. See Part IV-Section 8.1 for access control provisions for the facility.

No processing or storage areas are susceptible to significant leaks or spills.

There is not significant noise pollution anticipated to be generated at the storage and processing areas. The loudest anticipated noise will be the back-up alarms from equipment operating at these facilities. The storage and processing areas will be set back as far as practicable from the permit boundary to mitigate noise pollution and will only be operated during the approved operating hours for the facility.

There are no sumps or floor drains required for any of the storage or processing facilities.

3.1 WOOD WASTE PROCESSING AREA

The wood waste processing area will be located within the landfill footprint and will process incoming yard trimmings, clean wood materials and vegetative materials, including trees and brush, into wood chips and mulch. The wood chips and mulch will be used on-site or sent offsite for further processing or use as a bio-fuel. The wood chips and mulch will be stored in small piles and will be managed to prevent fire, safety, or health hazards in accordance with 30 TAC§330.209(a). The active wood waste processing area will not be larger than approximately 150 feet by 150 feet. The wood processing area will be located outside of the 100-year floodplain boundary.

3.2 RECYCLABLE MATERIAL RECOVERY AREA

The recyclable material recovery area will be located within the landfill footprint and will process incoming metal, concrete, plastic, and other recyclable materials. The recycled materials will be sent offsite for processing. The materials will be stored in roll-offs or small piles and will be managed to prevent fire, safety, or health hazards in accordance with 30 TAC§330.209(a). The recyclable material area will not be larger than approximately 150 feet by 150 feet. The recyclable material area will be located outside of the 100-year floodplain boundary.

4.0 SANITATION

The solid waste processing and/or storage facilities include the wood waste processing area and recyclable materials area, which have been designed to facilitate proper cleaning. Refer to Section 2 - Waste Movement And Section 3 – Storage and Processing Units for a discussion of each of the solid waste processing facilities. Operational requirements for each facility are described in Part IV- Site Operating Plan, including a discussion of surface water controls, cleaning facilities, and contaminated water.

4.1 WOOD WASTE PROCESSING AREA

Wood wastes received will be chipped and stockpiled only to be used for site operations or sent offsite for further processing. The area will consist of small piles managed to prevent litter and control fire, health hazards and safety in accordance with §330.209(a). There are no water runon and runoff control, or additional sanitation controls required.

4.2 RECYCLABLE MATERIAL RECOVERY AREA

The recyclable material recovery area will be located within the landfill footprint and will process incoming metal, concrete, plastic, and other recyclable materials. The recycled materials will be sent offsite for further processing. The materials will be stored in roll-offs or small piles and managed to prevent litter and control fire, health hazards and safety in accordance with §330.209(a). There are no water runon and runoff control, or additional sanitation controls required.

5.0 WATER POLLUTION CONTROL

The processing and/or storage facilities will be maintained and operated to manage runon and runoff during the peak discharge from the 25-year, 24-hour storm event to prevent the off-site discharge of waste and feedstock material, including, but not limited to, processed or stored materials. Surface water in and around each processing and/or storage facility will be controlled to minimize surface water running onto, into, and off the processing and/or storage area. Since all contaminated water will be managed in a controlled manner, as discussed above, groundwater will be protected. Should the discharge of contaminated water become necessary, the facility will obtain specific written authorization from the TCEQ prior to discharge. The landfill and its processing and/or storage facilities will be operated consistent with §330.15(h)(1)-(4) regarding discharge of solid wastes or pollutants into waters of the United States or waters of the state.

The design of the landfill itself and the surface water management system for the facility will prevent the discharge of solid waste, pollutants, dredged or fill material and nonpoint source pollution that would violate any of the provisions referenced in 30 TAC§330.15(h). The facility has been designed to keep contaminated surface water (water that may have come into contact with waste at the landfill) separated from uncontaminated stormwater runoff. The contaminated water will not be discharged to the surface water management system at the site.

Refer to Section 2 - Waste Movement and Section 3 – Storage and Processing Units for a discussion of the solid waste processing and/or storage facilities and Part IV- Site Operating Plan for a discussion of operational requirements. Refer to Part III, Attachment D6 - Contaminated Water Plan for a discussion of contaminated water management.

6.0 ENDANGERED SPECIES PROTECTION

A detailed threatened and endangered species survey and assessment for the landfill expansion area was conducted by a qualified biologist. The surveys and assessments along with coordination with the United States Fish and Wildlife Service (USFWS) and the Texas Parks and Wildlife Department (TPWD) regarding endangered and threatened species is provided in Part II, Appendix II-H Endangered or Threatened Species Documentation.

Development of the facility shall be conducted to minimize potential impacts to endangered or threatened species. The facility and the operation of the facility will not result in the destruction or adverse modification of the critical habitat of endangered or threatened species, or cause or contribute to the taking of any endangered or threatened species.

7.0 BENCHMARK

The location and elevation of the permanent benchmark for the site is indicated on the Site Layout Plan (Figure D1.1). The benchmark is conveniently located near the scalehouse.

MUNICIPAL SOLID WASTE PERMIT
MAJOR AMENDMENT

PART III-ATTACHMENT C-1
FACILITY SURFACE WATER DRAINAGE REPORT

B
BECK
COMPANIES

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: Revised January 2023

Prepared by:

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APPENDIX C1-A
Drainage Maps and Existing/Post-development Comparison

APPENDIX C1-B
Existing Condition Hydrologic Calculations

APPENDIX C1-C
Post-development Hydrologic Calculations

APPENDIX C1-D
Perimeter Drainage System Design

APPENDIX C1-E
Final Cover Drainage Structure Design

APPENDIX C1-F
Intermediate Cover Erosion and Sedimentation Control Plan

APPENDIX C1-G
Intermediate Cover Erosion Control Structure Design

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1 INTRODUCTION

30 TAC §330.63(c) and 330.301-330.307

1.1 Purpose

This drainage analysis and design is prepared as part of a permit application for the expansion of the Beck Landfill and includes the demonstrations consistent with the requirements of 30 TAC Chapter §§330.63(c) and §§330.301-307. The drainage analysis and design is organized to include a narrative description of the existing and post-development conditions, the proposed drainage system design, effective erosional stability of top dome surfaces and external embankment side slopes during all phases of landfill operation, and a discussion of the existing/post-development comparison at the facility and property boundaries. Drainage calculations are included in the appendices to this section. Drainage design plans and details are included in Attachment C3. The following is a brief description of each of the appendices.

Appendix C1-A- Drainage Maps and Existing/Post-Development Comparison

Appendix C1-A includes drainage area maps that delineate the drainage areas that contribute surface water run-on and runoff at the facility and property boundaries and provide a summary of the peak flow rates, runoff volumes, and runoff velocities at locations along the facility boundary for the existing and post-development conditions. Appendix C1-A also includes a table summarizing the existing/post-development drainage analysis comparison.

Appendix C1-B- Existing Hydrologic Calculations

The existing hydrologic and hydraulic condition is the final permitted condition depicted in TCEQ MSW Permit 1848. The existing hydrologic and hydraulic evaluation is included in Appendix C1-B. The existing analysis includes delineations of drainage areas that contribute surface water run-on and runoff at comparison locations along the facility boundary.

The results of the existing hydrologic evaluation are provided on the existing conditions drainage analysis summary, which shows the 25- and 100-year peak flow rates, runoff volumes, and runoff velocities at comparison locations along the proposed facility boundary.

Appendix C1-C- Post-Development Hydrologic Calculations

The post-development hydrologic and hydraulic evaluation included in Appendix C1-C represents the proposed final closure landfill configuration. The post-development analysis includes delineations of drainage areas that contribute surface water run-on and runoff at comparison points along the proposed facility boundary.

The results of the post-development hydrologic evaluation are provided on the post-development boundary analysis summary, which shows the 25- and 100-year peak flow rates, runoff volumes, and runoff velocities at the comparison locations along the proposed permit boundary.

Appendix C1-D- Perimeter Drainage System Design

Appendix C1-D presents the hydraulic design of the perimeter drainage system. The perimeter drainage plan shows the locations of the perimeter drainage berms and detention ponds. The detention ponds are designed to provide the necessary storage and outlet control to mitigate impacts to the receiving channels downstream of the Beck Landfill. The perimeter berms are designed to convey the 25-year and 100-year, 24-hour storm event.

Appendix C1-E- Final Cover Drainage Structure Design

Appendix C1-E is limited to the design of the permanent final cover drainage structures (i.e., chute and bench system). The calculations demonstrate that the structures are designed to convey runoff produced from a 25-year storm event, to provide erosion protection, and to minimize sediment loss from the final cover condition.

Appendix C1-F - Intermediate Cover Erosion and Sedimentation Control Plan

Appendix C1-F provides a detailed erosion and sediment control plan during the intermediate cover phase of the landfill development.

Appendix C1-G- Intermediate Cover Erosion Control Structure Design

Appendix C1-G provides the supporting documentation to evaluate and design temporary erosion and sediment control structures for the intermediate cover phase of the landfill development.

6 EROSION AND SEDIMENTATION CONTROL

30 TAC §330.305(f) and §330.307

6.1 Final Cover Stormwater System Control Plan

Perimeter drainage channels and the detention pond will be constructed as the subsequent phased development of the landfill progresses. Erosion will be minimized in these structures by establishment of vegetation or with rock riprap, gabions, or other materials as provided for in the drainage design calculations for these permanent structures as found in Appendix C1-E Final Cover Drainage Structure Design.

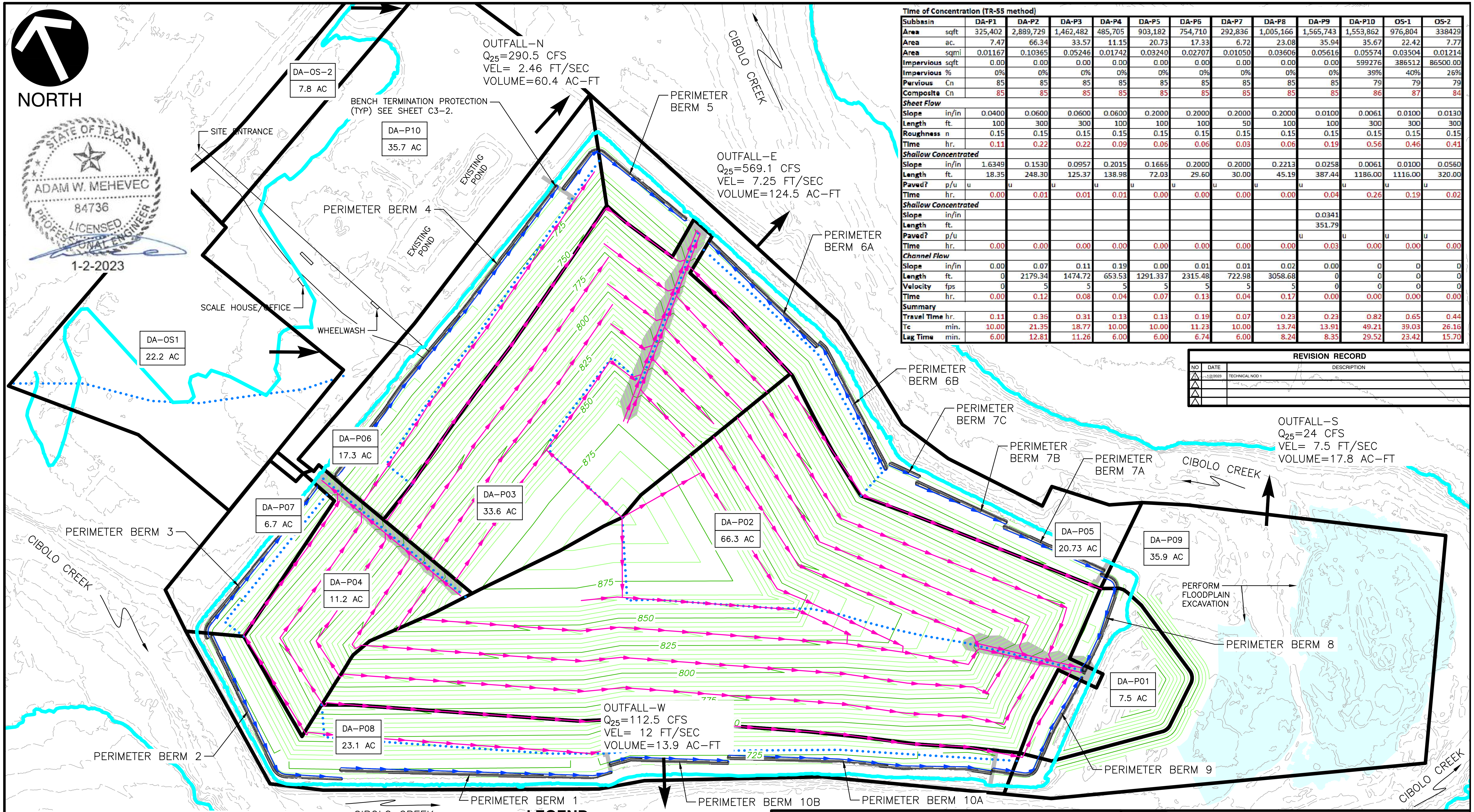
Berms, benches, and chutes will be constructed upon placement of the final cover. The final cover includes an erosion layer that is a minimum of 6 inches of earthen material capable of sustaining native plant life and will be seeded with native and introduced grasses immediately following the application of final cover in order to minimize erosion. A soil loss demonstration for the erosion layer is included in Appendix C1-E of this attachment. The benches and chutes include establishment of vegetation, Maccaferri gabion mattress, and other materials as provided in the drainage calculations for these permanent structures.

6.2 Final Cover Stormwater System Maintenance Plan

Beck Landfill will inspect, restore, and repair constructed permanent stormwater systems such as channels, drainage benches, chutes, and flood control structures in the event of washout or failure from extreme storm events. Excessive sediment will be removed, as needed, so that the drainage structures, such as the perimeter channels and detention pond, function as designed. Site inspections by landfill personnel will be performed weekly or within 48 hours of a rainfall event of 0.5 inches or more. The time frame for correction of damaged or deficient items under normal conditions will be within five working days after the inspection identifying these items. Normal conditions are weather, ground and other site-specific conditions that do not impede access to the item, result in additional damage to the site attempting to access or repair the item, or risk equipment or personnel safety. Documentation of the inspection will be included in the site operating record.

The following items will be evaluated during the inspections:

- Erosion of final cover areas, perimeter ditches, chutes, benches, detention pond, berms, and other drainage features
- Settlement of final cover areas, perimeter ditches, chutes, benches, and other drainage features
- Silt and sediment build-up in perimeter ditches, chutes, benches, and the detention pond
- Obstructions in drainage features



Time of Concentration (TR-55 method)

Subbasin		DA-P1	DA-P2	DA-P3	DA-P4	DA-P5	DA-P6	DA-P7	DA-P8	DA-P9	DA-P10	OS-1	OS-2
Area	sqft	325,402	2,889,729	1,462,482	485,705	903,182	754,710	292,836	1,005,166	1,565,743	1,553,862	976,804	338429
Area	ac.	7.47	66.34	33.57	11.15	20.73	17.33	6.72	23.08	35.94	35.67	22.42	7.77
Area	sqmi	0.01167	0.10365	0.05246	0.01742	0.03240	0.02707	0.01050	0.03606	0.05616	0.05574	0.03504	0.01214
Impervious	sqft	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	599276	386512	86500.00
Impervious	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	39%	40%	26%
Pervious	Cn	85	85	85	85	85	85	85	85	85	79	79	79
Composite	Cn	85	85	85	85	85	85	85	85	85	86	87	84
Sheet Flow													
Slope	in/in	0.0400	0.0600	0.0600	0.0600	0.2000	0.2000	0.2000	0.2000	0.0100	0.0061	0.0100	0.0130
Length	ft.	100	300	300	100	100	100	50	100	100	300	300	300
Roughness	n	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Time	hr.	0.11	0.22	0.22	0.09	0.06	0.06	0.03	0.06	0.19	0.56	0.46	0.41
Shallow Concentrated													
Slope	in/in	1.6349	0.1530	0.0957	0.2015	0.1666	0.2000	0.2000	0.2213	0.0258	0.0061	0.0100	0.0560
Length	ft.	18.35	248.30	125.37	138.98	72.03	29.60	30.00	45.19	387.44	1186.00	1116.00	320.00
Paved?	p/u	u	u	u	u	u	u	u	u	u	u	u	u
Time	hr.	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.04	0.26	0.19	0.02
Shallow Concentrated													
Slope	in/in									0.0341			
Length	ft.									351.79			
Paved?	p/u									u	u	u	u
Time	hr.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00
Channel Flow													
Slope	in/in	0.00	0.07	0.11	0.19	0.00	0.01	0.01	0.02	0.00	0	0	0
Length	ft.	0	2179.34	1474.72	653.53	1291.337	2315.48	722.98	3058.68	0	0	0	0
Velocity	fps	0	5	5	5	5	5	5	5	0	0	0	0
Time	hr.	0.00	0.12	0.08	0.04	0.07	0.13	0.04	0.17	0.00	0.00	0.00	0.00
Summary													
Travel Time	hr.	0.11	0.36	0.31	0.13	0.13	0.19	0.07	0.23	0.23	0.82	0.65	0.44
Tc	min.	10.00	21.35	18.77	10.00	10.00	11.23	10.00	13.74	13.91	49.21	39.03	26.16
Lag Time	min.	6.00	12.81	11.26	6.00	6.00	6.74	6.00	8.24	8.35	29.52	23.42	15.70

REVISION RECORD

NO	DATE	DESCRIPTION
1	1/2/2023	TECHNICAL NOD 1

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1-2-2023

REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK: (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.

SCALE IN FEET
0 400 800

NOTES

1. VELOCITIES AT OUTFALLS W, S, AND E TAKEN FROM CALCULATED FLOW VELOCITY OF CIBOLO CREEK IN HEC-RAS FLOODPLAIN MODELING. VELOCITIES INTERPOLATED BETWEEN 10 YEAR AND 50 YEAR EVENTS.
2. VELOCITY FOR OUTFALL-N ASSUMES 20' WIDE GRASS CHANNEL AT 0.1% SLOPE.
3. PERIMETER BERM FLOW PROFILES SHOWN ON DRAWINGS C1-2A THROUGH C1-2F. 25 YEAR FLOW DEPTHS FOR EACH BERM SHOWN ON FIGURE C1-2A.

LEGEND

PROPOSED DRAINAGE AREAS
TIME OF CONCENTRATION LINE
DA-P10 DRAINAGE AREA DESIGNATION
41.8 AC DRAINAGE AREA ACREAGE
100 YEAR FLOODPLAIN BASED ON LOMR APPLICATION
FINAL COVER DRAINAGE FLOW PATH
TYPICAL PERIMETER BERM

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BECK COMPANIES

NIDO, LTD
BECK LANDFILL
BEXAR COUNTY, TEXAS

PROPOSED DRAINAGE MAP

DRAWN BY:	MFV	CHECKED BY:	AWM	APPROVED BY:	AWM	FIGURE NO.:
DATE:	03/07/2022	DWG SCALE:	1" = 400'	PROJECT NO:	311-653	C1-2

P:\310-000\311-653\-CADD\Dwg\SW01\311653-BECK LANDFIL Final Cover DrainageR1.dwg{DRAINAGE} LS:(12/30/2022 - amehevec) - LP: 1/2/2023 10:50 PM

BECK LANDFILL
APPENDIX C1-D
FACILITY SURFACE WATER DRAINAGE REPORT
PERIMETER DRAINAGE BERM DESIGN

Includes pages C1-D-1 through C1-D-5

Revised January 2023

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NARRATIVE

30 TAC §330.305

This appendix presents the design of Beck Landfill perimeter drainage channels and detention pond in accordance with §330.305(a)-(d).

PERIMETER DRAINAGE PLAN

Drawing C1-2 depicts the perimeter drainage system and detention pond location for Beck Landfill. The typical section for the perimeter drainage berms is shown on Figure C1-2A and the detention pond details are shown on Figure C3-1. The perimeter berm hydraulic analysis is included for the 25-year rainfall event. Profiles for the perimeter berms are shown on Figures C1-2A through C1-2F.

PERIMETER BERM DESIGN SUMMARY

The perimeter berms are designed for the peak discharge resulting from the 25-year storm event while maintaining velocities between 2 fps and 6 fps. The typical perimeter berm has 2:1 sideslopes, two feet top width, and is two feet high. The berm slope is 2%. The largest area contributing to a perimeter berm occurs for Berm 8 (See Figure C1-2) and is 6.5 acres. The Rational Method and methods and parameters included in the TxDOT Hydraulic *Design Manual,* September 2019 will be used to calculate the peak flow anticipated in this worst-case perimeter berm.

The rational formula estimates the peak rate of runoff at a specific location in a watershed as a function of the drainage area, runoff coefficient, and mean rainfall intensity for a duration equal to the time of concentration. The rational formula is:

$$Q=CIA$$

Where:

Q = maximum rate of runoff (cfs)

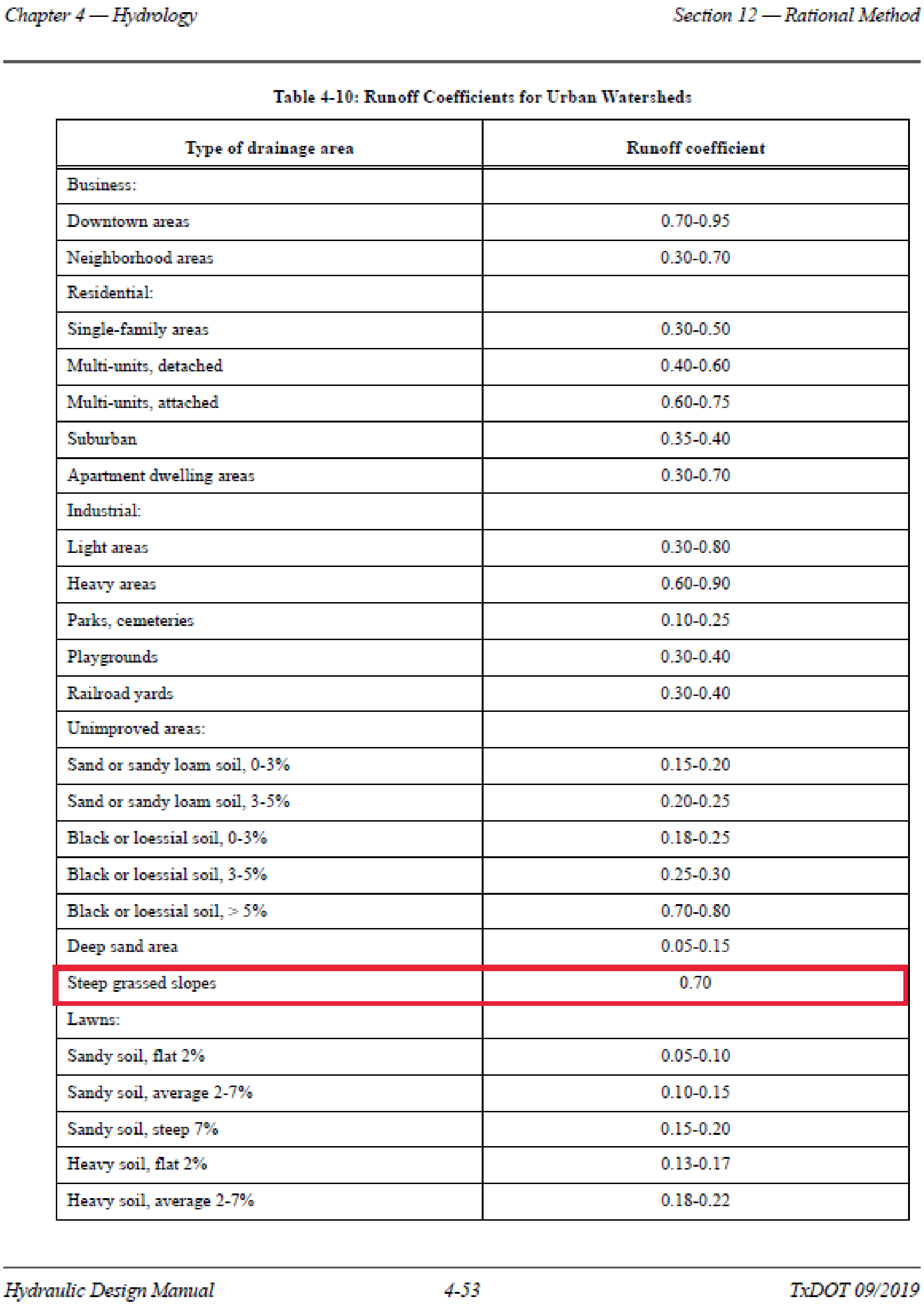
C = runoff coefficient

I = average rainfall intensity (in./hr.)

A = drainage area (ac)

Runoff Coefficient (C)

The following table from the TxDOT manual lists appropriate run-off coefficients for various uses and surface conditions. Steep grassed slopes was chosen as the most appropriate for the landfill final cover, which corresponds to a coefficient of 0.70.



Chapter 4 — Hydrology *Section 12 — Rational Method*

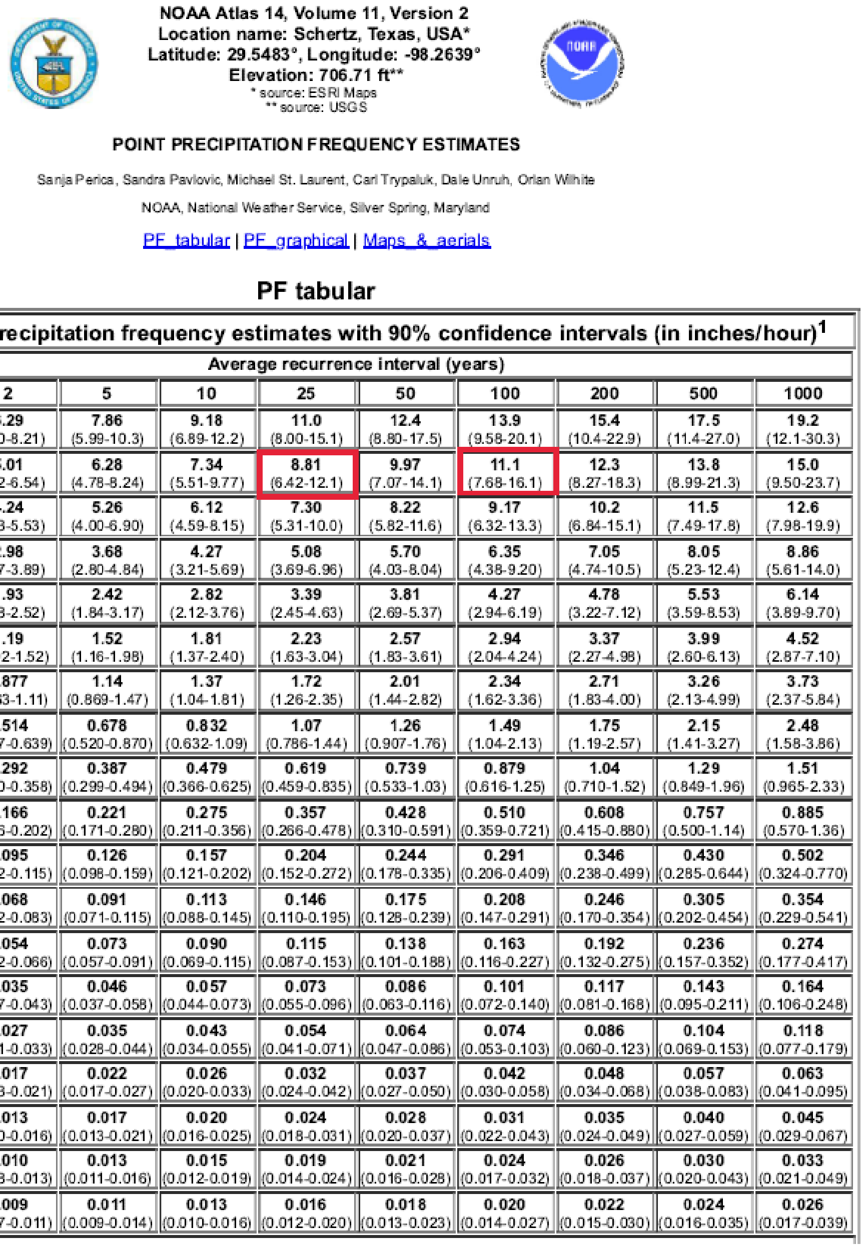
Table 4-10: Runoff Coefficients for Urban Watersheds

Type of drainage area	Runoff coefficient
Business:	
Downtown areas	0.70-0.95
Neighborhood areas	0.30-0.70
Residential:	
Single-family areas	0.30-0.50
Multi-units, detached	0.40-0.60
Multi-units, attached	0.60-0.75
Suburban	0.35-0.40
Apartment dwelling areas	0.30-0.70
Industrial:	
Light areas	0.30-0.80
Heavy areas	0.60-0.90
Parks, cemeteries	0.10-0.25
Playgrounds	0.30-0.40
Railroad yards	0.30-0.40
Unimproved areas:	
Sand or sandy loam soil, 0-3%	0.15-0.20
Sand or sandy loam soil, 3-5%	0.20-0.25
Black or loessial soil, 0-3%	0.18-0.25
Black or loessial soil, 3-5%	0.25-0.30
Black or loessial soil, > 5%	0.70-0.80
Deep sand area	0.05-0.15
Steep grassed slopes	0.70
Lawns:	
Sandy soil, flat 2%	0.05-0.10
Sandy soil, average 2-7%	0.10-0.15
Sandy soil, steep 7%	0.15-0.20
Heavy soil, flat 2%	0.13-0.17
Heavy soil, average 2-7%	0.18-0.22

Hydraulic Design Manual *4-53* *TxDOT 09/2019*

Rainfall Intensity (I)

The rainfall intensity (I) is the average rainfall rate in in./hr. for a specific rainfall duration and a selected frequency. The duration is assumed to be equal to the time of concentration. The intensity was taken from the following table from 2018 NOAA Atlas 14 Precipitation-Frequency Atlas of the United States, Volume 11, Version 2.0: Texas, assuming a time of concentration and storm duration of ten minutes. From the table the 25-year intensity is 8.8 in/hr and the 100-year intensity is 11.1 in/hr.



NOAA Atlas 14, Volume 11, Version 2
Location name: Schertz, Texas, USA*
Latitude: 29.5483°, Longitude: -98.2639°
Elevation: 706.71 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

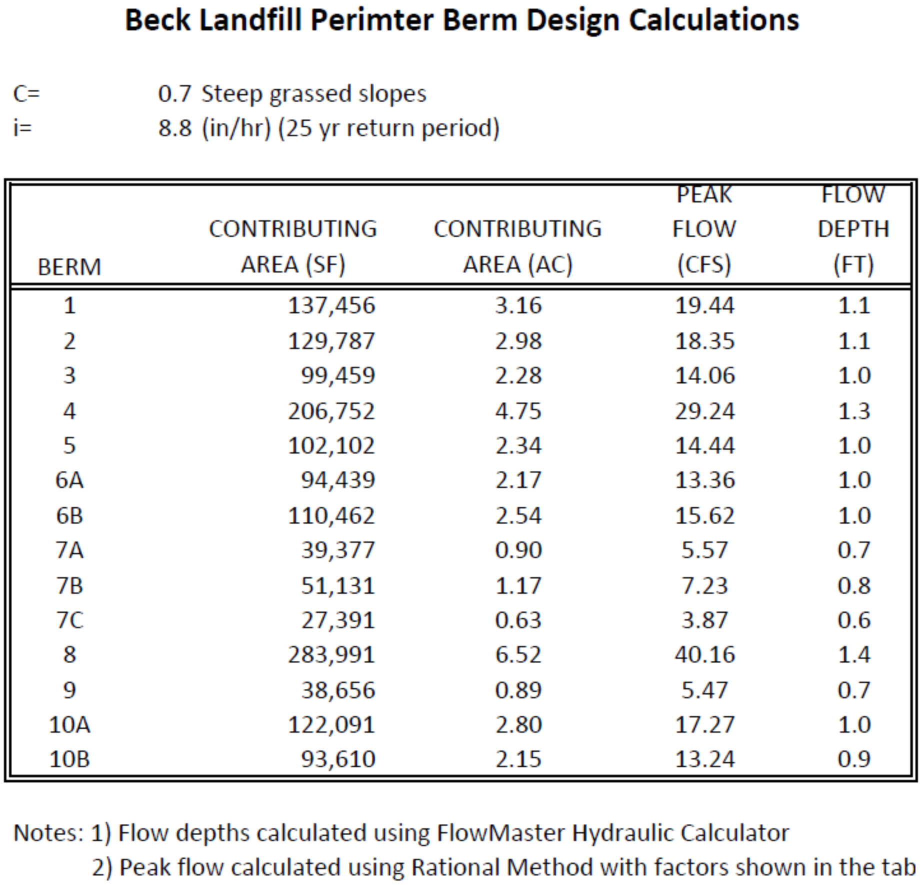
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	5.32 (4.03-7.02)	6.29 (4.80-8.21)	7.86 (5.99-10.3)	9.18 (6.89-12.2)	11.0 (8.00-15.1)	12.4 (8.80-17.5)	13.9 (9.58-20.1)	15.4 (10.4-22.9)	17.5 (11.4-27.0)	19.2 (12.1-30.3)
10-min	4.23 (3.20-5.59)	5.01 (3.82-6.54)	6.28 (4.78-8.24)	7.34 (5.51-9.77)	8.81 (6.42-12.1)	9.97 (7.07-14.1)	11.1 (7.68-16.1)	12.3 (8.27-18.3)	13.8 (8.99-21.3)	15.0 (9.50-23.7)
15-min	3.61 (2.73-4.77)	4.24 (3.23-5.53)	5.26 (4.00-6.90)	6.12 (4.59-8.15)	7.30 (5.31-10.0)	8.22 (5.82-11.6)	9.17 (6.32-13.3)	10.2 (6.84-15.1)	11.5 (7.49-17.8)	12.6 (7.98-19.9)
30-min	2.54 (1.92-3.36)	2.98 (2.27-3.89)	3.68 (2.80-4.84)	4.27 (3.21-5.69)	5.08 (3.69-6.96)	5.70 (4.03-8.04)	6.35 (4.38-9.20)	7.05 (4.74-10.5)	8.05 (5.23-12.4)	8.86 (5.61-14.0)
60-min	1.64 (1.24-2.16)	1.93 (1.48-2.52)	2.42 (1.84-3.17)	2.82 (2.12-3.76)	3.39 (2.45-4.63)	3.81 (2.69-5.37)	4.27 (2.94-6.19)	4.78 (3.22-7.12)	5.53 (3.59-8.53)	6.14 (3.89-9.70)
2-hr	0.974 (0.740-1.28)	1.19 (0.902-1.52)	1.52 (1.16-1.98)	1.81 (1.37-2.40)	2.23 (1.63-3.04)	2.57 (1.83-3.61)	2.94 (2.04-4.24)	3.37 (2.27-4.98)	3.99 (2.60-6.13)	4.52 (2.87-7.10)
3-hr	0.703 (0.536-0.920)	0.877 (0.663-1.11)	1.14 (0.869-1.47)	1.37 (1.04-1.81)	1.72 (1.26-2.35)	2.01 (1.44-2.82)	2.34 (1.62-3.36)	2.71 (1.83-4.00)	3.26 (2.13-4.99)	3.73 (2.37-5.84)
6-hr	0.401 (0.307-0.522)	0.514 (0.387-0.639)	0.678 (0.520-0.870)	0.832 (0.632-1.09)	1.07 (0.786-1.44)	1.26 (0.907-1.76)	1.49 (1.04-2.13)	1.75 (1.19-2.57)	2.15 (1.41-3.27)	2.48 (1.58-3.86)
12-hr	0.225 (0.173-0.290)	0.292 (0.220-0.358)	0.387 (0.299-0.494)	0.479 (0.366-0.625)	0.619 (0.459-0.835)	0.739 (0.533-1.03)	0.879 (0.616-1.25)	1.04 (0.710-1.52)	1.29 (0.849-1.96)	1.51 (0.965-2.33)
24-hr	0.127 (0.098-0.163)	0.166 (0.126-0.202)	0.221 (0.171-0.280)	0.275 (0.211-0.356)	0.357 (0.266-0.478)	0.428 (0.310-0.591)	0.510 (0.359-0.721)	0.608 (0.415-0.880)	0.757 (0.500-1.14)	0.885 (0.570-1.36)
2-day	0.072 (0.056-0.092)	0.095 (0.072-0.115)	0.126 (0.098-0.159)	0.157 (0.121-0.202)	0.204 (0.152-0.272)	0.244 (0.178-0.335)	0.291 (0.206-0.409)	0.346 (0.238-0.499)	0.430 (0.285-0.644)	0.502 (0.324-0.770)
3-day	0.052 (0.041-0.067)	0.068 (0.052-0.083)	0.091 (0.071-0.115)	0.113 (0.088-0.145)	0.146 (0.110-0.195)	0.175 (0.128-0.239)	0.208 (0.147-0.291)	0.246 (0.170-0.354)	0.305 (0.202-0.454)	0.354 (0.229-0.541)
4-day	0.042 (0.033-0.053)	0.054 (0.042-0.066)	0.073 (0.057-0.091)	0.090 (0.069-0.115)	0.115 (0.087-0.153)	0.138 (0.101-0.188)	0.163 (0.116-0.227)	0.192 (0.132-0.275)	0.236 (0.157-0.352)	0.274 (0.177-0.417)
7-day	0.027 (0.022-0.035)	0.035 (0.027-0.043)	0.046 (0.037-0.058)	0.057 (0.044-0.073)	0.073 (0.055-0.096)	0.086 (0.063-0.116)	0.101 (0.072-0.140)	0.117 (0.081-0.168)	0.143 (0.095-0.211)	0.164 (0.106-0.248)
10-day	0.021 (0.017-0.027)	0.027 (0.021-0.033)	0.035 (0.028-0.044)	0.043 (0.034-0.055)	0.054 (0.041-0.071)	0.064 (0.047-0.086)	0.074 (0.053-0.103)	0.086 (0.060-0.123)	0.104 (0.069-0.153)	0.118 (0.077-0.179)
20-day	0.014 (0.011-0.017)	0.017 (0.013-0.021)	0.022 (0.017-0.027)	0.026 (0.020-0.033)	0.032 (0.024-0.042)	0.037 (0.027-0.050)	0.042 (0.030-0.058)	0.048 (0.034-0.068)	0.057 (0.038-0.083)	0.063 (0.041-0.095)
30-day	0.011 (0.009-0.013)	0.013 (0.010-0.016)	0.017 (0.013-0.021)	0.020 (0.016-0.025)	0.024 (0.018-0.031)	0.028 (0.020-0.037)	0.031 (0.022-0.043)	0.035 (0.024-0.049)	0.040 (0.027-0.059)	0.045 (0.029-0.067)
45-day	0.009 (0.007-0.011)	0.010 (0.008-0.013)	0.013 (0.011-0.016)	0.015 (0.012-0.019)	0.019 (0.014-0.024)	0.021 (0.016-0.028)	0.024 (0.017-0.032)	0.026 (0.018-0.037)	0.030 (0.020-0.043)	0.033 (0.021-0.049)
60-day	0.008 (0.006-0.009)	0.009 (0.007-0.011)	0.011 (0.009-0.014)	0.013 (0.010-0.016)	0.016 (0.012-0.020)	0.018 (0.013-0.023)	0.020 (0.014-0.027)	0.022 (0.015-0.030)	0.024 (0.016-0.035)	0.026 (0.017-0.039)

For the worst-case perimeter berm:

$$Q_{25} = CIA$$
$$= (0.7)(8.8 \text{ in/hr})(6.52 \text{ Acres})$$
$$= 40.16 \text{ cfs}$$

$$Q_{100} = CIA$$
$$= (0.7)(11.1 \text{ in/hr})(6.52 \text{ Acres})$$
$$= 50.7 \text{ cfs}$$

The Flowmaster software package was utilized to determine flow depth for each of the perimeter berms and the table below lists each berm, the contributing area, and the calculated 25-year flow depth.

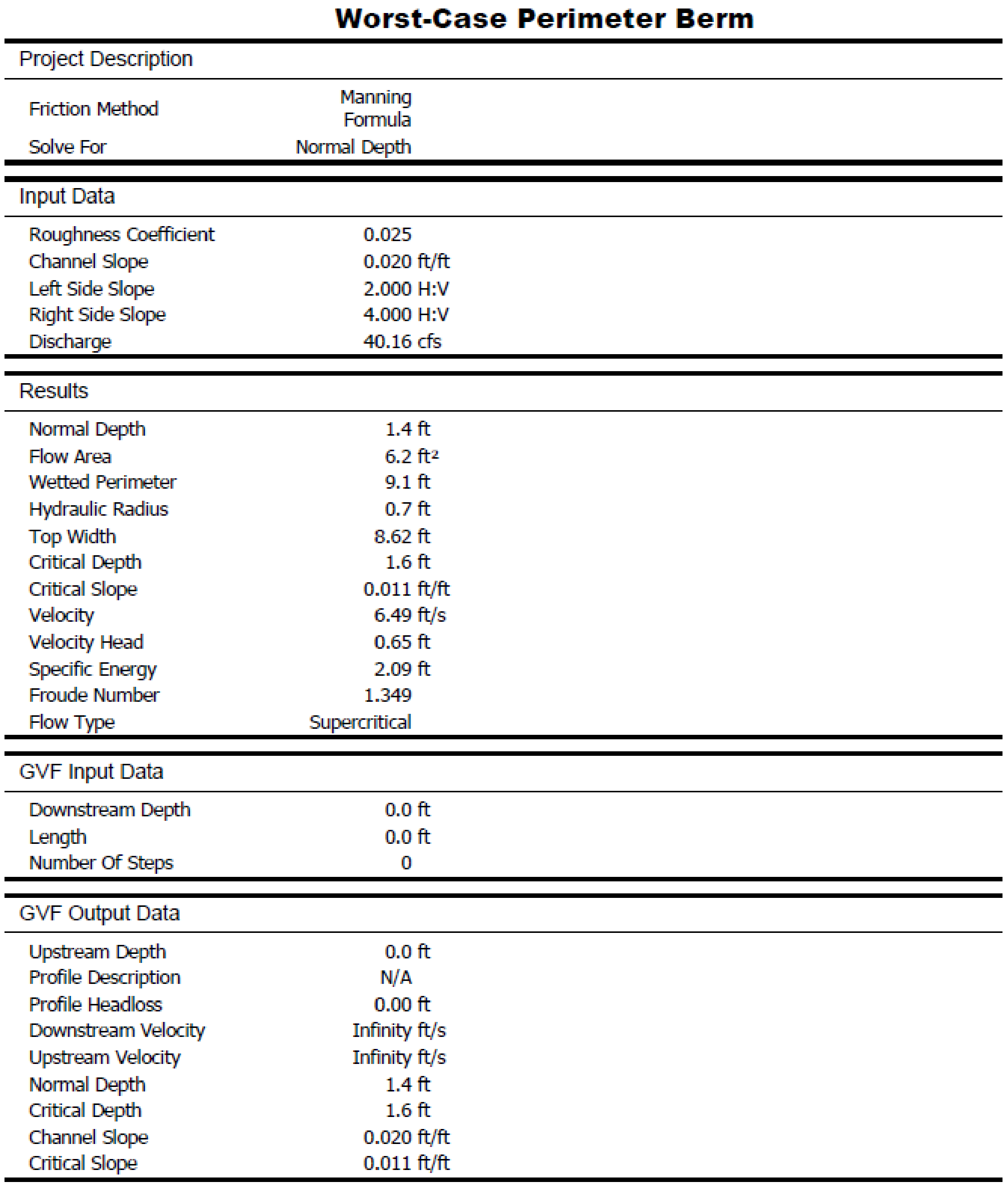


Beck Landfill Perimter Berm Design Calculations

C= 0.7 Steep grassed slopes
i= 8.8 (in/hr) (25 yr return period)

BERM	CONTRIBUTING AREA (SF)	CONTRIBUTING AREA (AC)	PEAK FLOW (CFS)	FLOW DEPTH (FT)
1	137,456	3.16	19.44	1.1
2	129,787	2.98	18.35	1.1
3	99,459	2.28	14.06	1.0
4	206,752	4.75	29.24	1.3
5	102,102	2.34	14.44	1.0
6A	94,439	2.17	13.36	1.0
6B	110,462	2.54	15.62	1.0
7A	39,377	0.90	5.57	0.7
7B	51,131	1.17	7.23	0.8
7C	27,391	0.63	3.87	0.6
8	283,991	6.52	40.16	1.4
9	38,656	0.89	5.47	0.7
10A	122,091	2.80	17.27	1.0
10B	93,610	2.15	13.24	0.9

Notes: 1) Flow depths calculated using FlowMaster Hydraulic Calculator
2) Peak flow calculated using Rational Method with factors shown in the tab



Worst-Case Perimeter Berm

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.025
Channel Slope	0.020 ft/ft
Left Side Slope	2.000 H:V
Right Side Slope	4.000 H:V
Discharge	40.16 cfs

Results	
Normal Depth	1.4 ft
Flow Area	6.2 ft²
Wetted Perimeter	9.1 ft
Hydraulic Radius	0.7 ft
Top Width	8.62 ft
Critical Depth	1.6 ft
Critical Slope	0.011 ft/ft
Velocity	6.49 ft/s
Velocity Head	0.65 ft
Specific Energy	2.09 ft
Froude Number	1.349
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.4 ft
Critical Depth	1.6 ft
Channel Slope	0.020 ft/ft
Critical Slope	0.011 ft/ft

DETENTION POND ANALYSIS

The rainfall depth, duration, and frequency relationships for the storm event for the facility was taken from the 2018 NOAA Atlas 14 Precipitation-Frequency Atlas of the United States, Volume 11, Version 2.0: Texas. Return periods of 25 and 100 years and a duration of 24 hours was used for the design storm. The synthetic rainfall distribution is the NRCS 24-hour Type Ill storm. The rainfall data for the facility located in Guadalupe County, Texas is shown on page C1-B-7. The details for the detention pond are shown on Figure C3-1 and the pond outlet design and elevation-stage-storage tables are shown on Page C1-B-9.

\\svr-fs-aus\projects\310-000\311-653\-CADD\Dwg\SW01\311653-BECK LANDFIL Perimeter Berm Profiles.dwg{C1-2A} LS:(1/3/2023 - jcarter) - LP: 1/3/2023 9:21 AM

ADAM W. MEHEVEC
84736
1-2-2023

REVISION RECORD		
NO	DATE	DESCRIPTION
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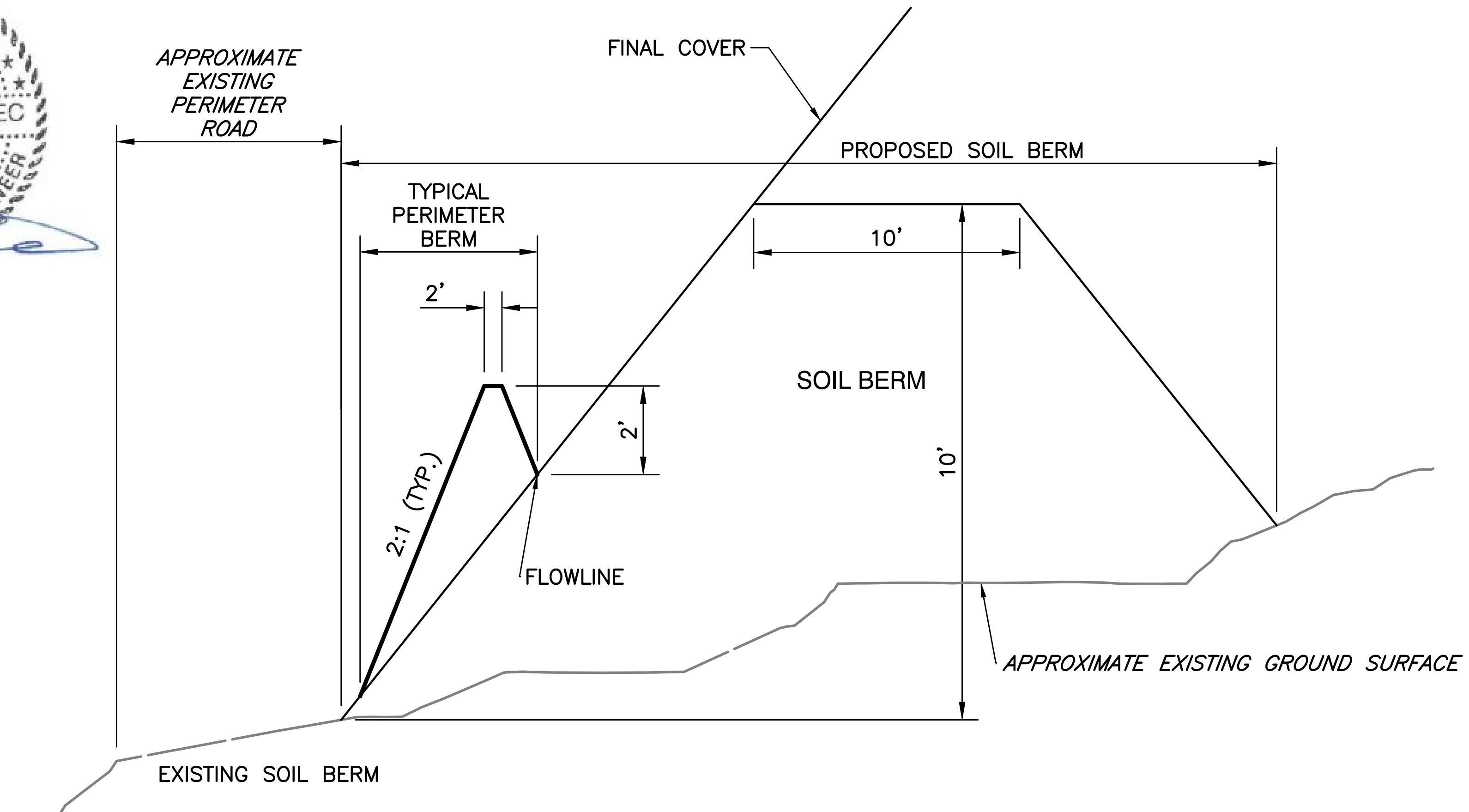
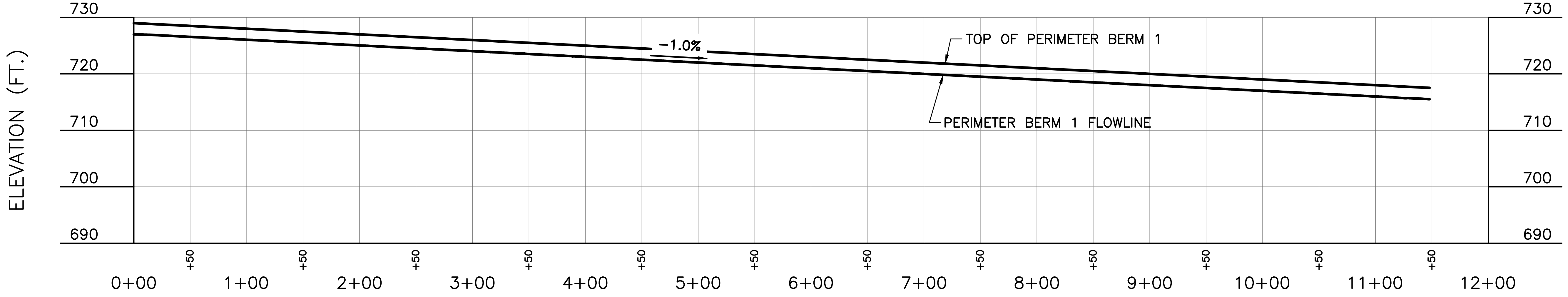


TYPICAL PERIMETER BERM ARRANGEMENT

SCALE H:1"=20'; V:1"=4'

BERM	CONTRIBUTING AREA (SF)	CONTRIBUTING AREA (AC)	PEAK FLOW (CFS)	FLOW DEPTH (FT)
1	137,456	3.16	19.44	1.1
2	129,787	2.98	18.35	1.1
3	99,459	2.28	14.06	1.0
4	206,752	4.75	29.24	1.3
5	102,102	2.34	14.44	1.0
6A	94,439	2.17	13.36	1.0
6B	110,462	2.54	15.62	1.0
7A	39,377	0.90	5.57	0.7
7B	51,131	1.17	7.23	0.8
7C	27,391	0.63	3.87	0.6
8	283,991	6.52	40.16	1.4
9	38,656	0.89	5.47	0.7
10A	122,091	2.80	17.27	1.0
10B	93,610	2.15	13.24	0.9



PERIMETER BERM 1 PROFILE

SCALE H:1"=100'; V:1"=20'

NOTES:

1. SEE FIGURE C1-2 FOR LOCATION OF PERIMETER BERMS.
2. ALL PERIMETER BERM PROFILE VIEWS ARE ORIENTED LOOKING TOWARD LANDFILL FROM PERIMETER.

REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.

SCALE IN FEET (HORIZONTAL)
0 100 200

SCALE IN FEET (VERTICAL)
0 20 40

SCALE IN FEET (VERTICAL)
0 4 8

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TYPICAL PERIMETER BERM ARRANGEMENT AND PERIMETER BERM 1 PROFILE

DRAWN BY:	JSC	CHECKED BY:	AWM	APPROVED BY:	AWM	FIGURE NO.:
DATE:	11/06/2022	DWG SCALE:	AS SHOWN	PROJECT NO:	311-653	C1-2A

\\svr-fs-aus\projects\310-000\311-653\-CADD\Dwg\SW01\311653-BECK LANDFIL Perimeter Berm Profiles.dwg{C1-2B} LS:(1/3/2023 - jcarter) - LP: 1/3/2023 9:21 AM

REVISION RECORD

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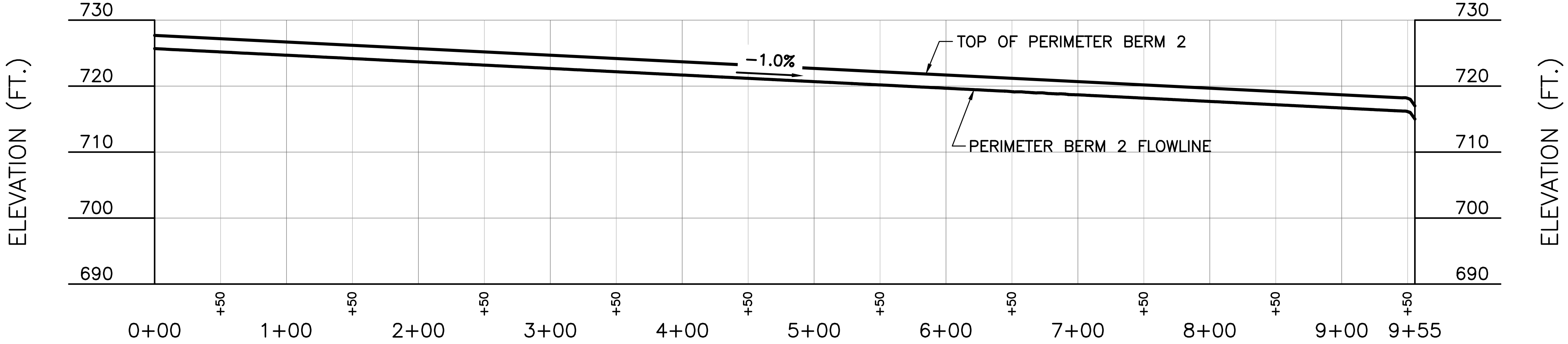
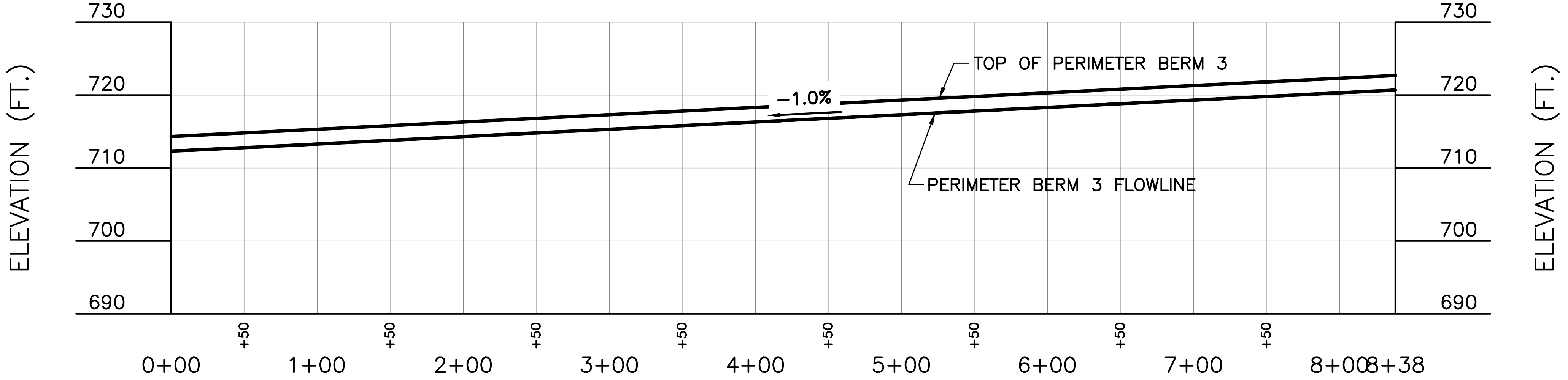


PERIMETER BERM 2 PROFILE

SCALE H:1"=100'; V:1"=20'



PERIMETER BERM 3 PROFILE

SCALE H:1"=100'; V:1"=20'

ADAM W. MEHEVEC
84736
1-2-2023

NOTES:

1. SEE FIGURE C1–2 FOR LOCATION OF PERIMETER BERMS.
2. ALL PERIMETER BERM PROFILE VIEWS ARE ORIENTED LOOKING TOWARD LANDFILL FROM PERIMETER.
3. SEE FIGURE C1–2A FOR FLOW DEPTH ALONG BERM.

REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.

SCALE IN FEET (HORIZONTAL)
0 100 200

SCALE IN FEET (VERTICAL)
0 20 40

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PERIMETER BERMS 2 AND 3 PROFILES

DRAWN BY: JSC	CHECKED BY: AWM	APPROVED BY: AWM	FIGURE NO.: C1-2B
DATE: 11/06/2022	DWG SCALE: AS SHOWN	PROJECT NO: 311-653	

\\svr-fs-aus\projects\310-000\311-653\-CADD\Dwg\SW01\311653-BECK LANDFIL Perimeter Berm Profiles.dwg{C1-2C} LS:(1/3/2023 - jcarter) - LP: 1/3/2023 9:20 AM

REVISION RECORD

NO	DATE	DESCRIPTION
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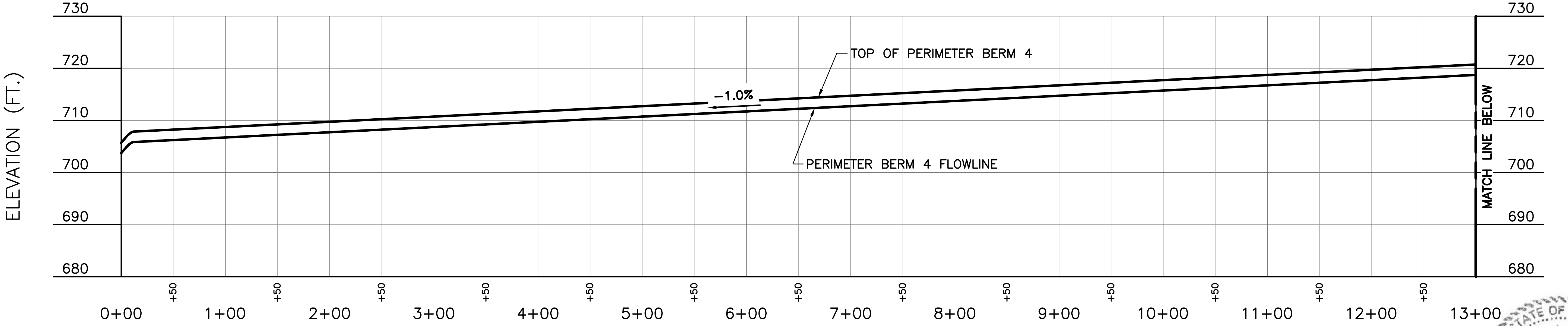
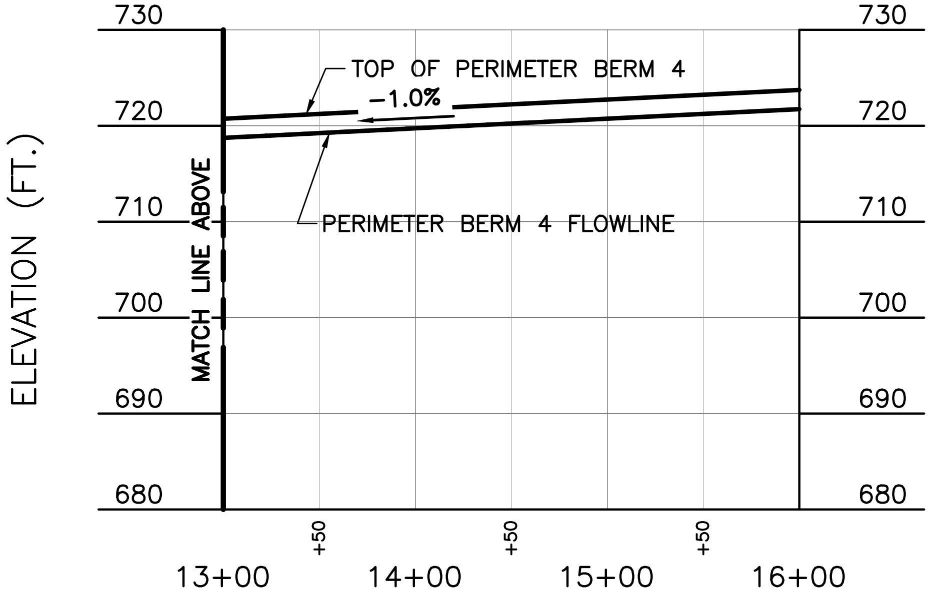


PERIMETER BERM 4 PROFILE

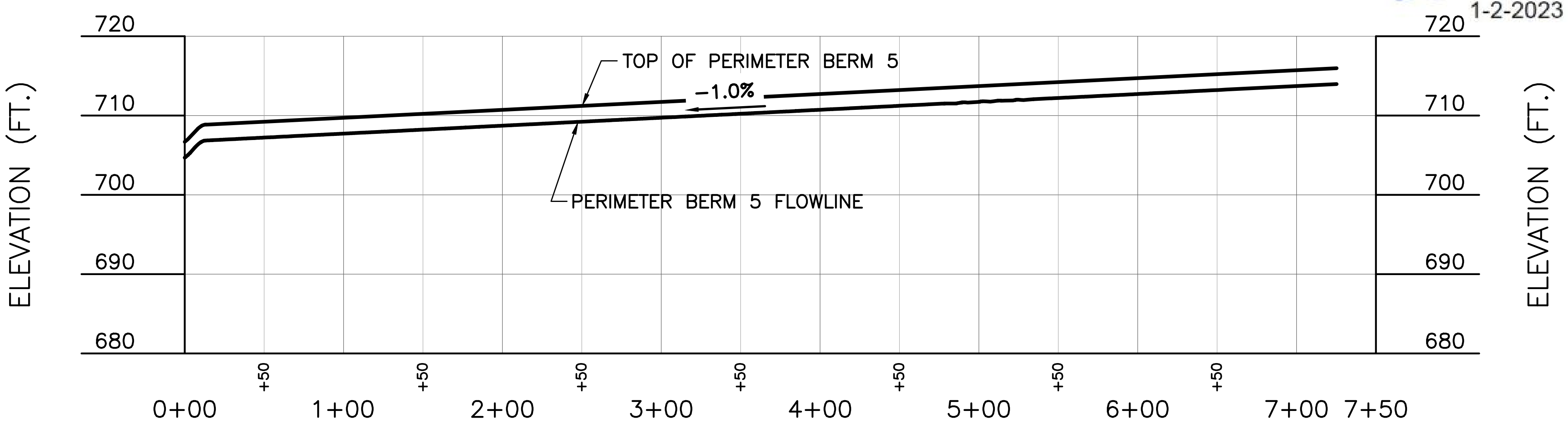
SCALE H:1"=100'; V:1"=20'

ADAM W. MEHEVEC
84736
1-2-2023



PERIMETER BERM 4 PROFILE

SCALE H:1"=100'; V:1"=20'



PERIMETER BERM 5 PROFILE

SCALE H:1"=100'; V:1"=20'

NOTES:

1. SEE FIGURE C1-2 FOR LOCATION OF PERIMETER BERMS.
2. ALL PERIMETER BERM PROFILE VIEWS ARE ORIENTED LOOKING TOWARD LANDFILL FROM PERIMETER.
3. SEE FIGURE C1-2A FOR FLOW DEPTH ALONG BERM.

REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.

SCALE IN FEET (HORIZONTAL)
0 100 200

SCALE IN FEET (VERTICAL)
0 20 40

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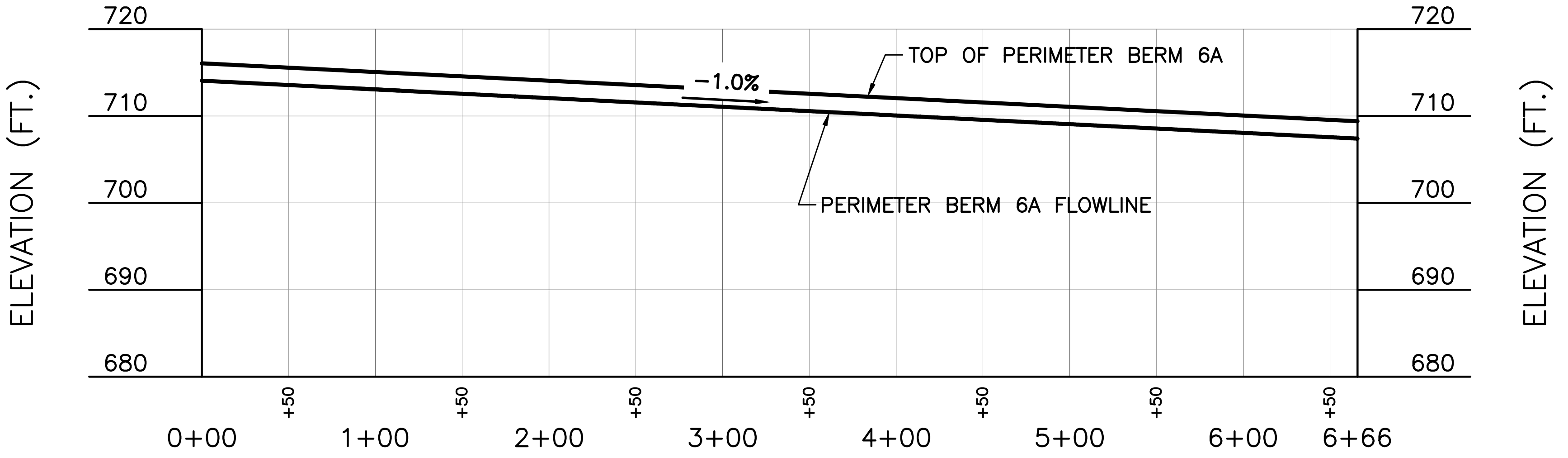
PERIMETER BERMS 4 AND 5 PROFILES

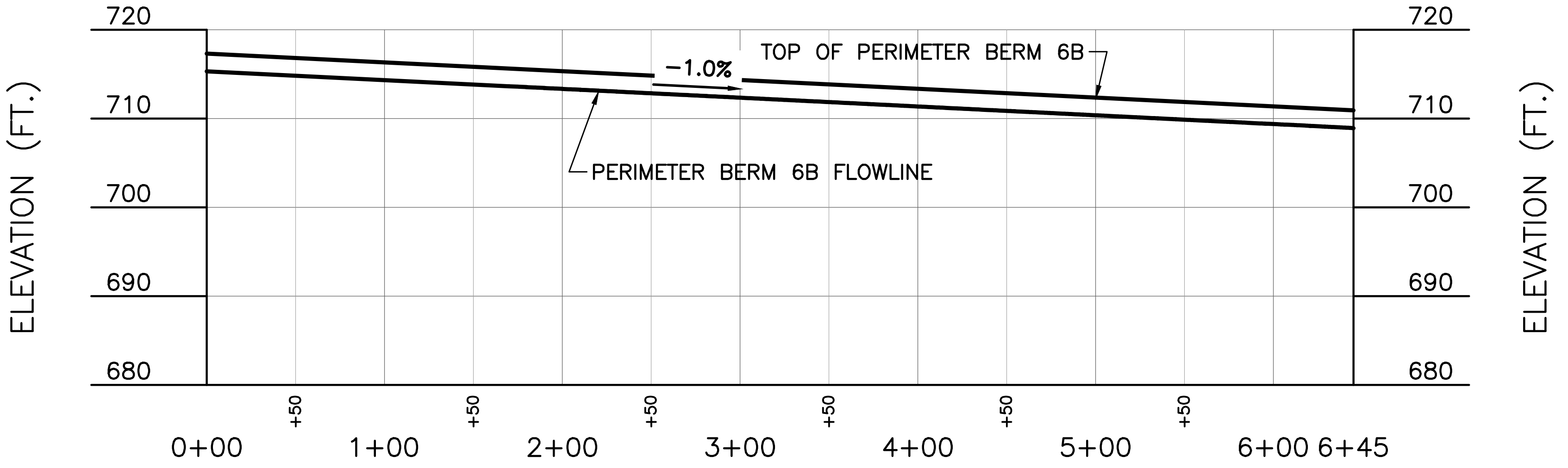
DRAWN BY:	JSC	CHECKED BY:	AWM	APPROVED BY:	AWM	FIGURE NO.:
DATE:	11/06/2022	DWG SCALE:	AS SHOWN	PROJECT NO:	311-653	C1-2C

REVISION RECORD		
NO	DATE	DESCRIPTION
1	1/2/2023	TECHNICAL NOD 1



PERIMETER BERM 6A PROFILE

SCALE H:1"=100'; V:1"=20'



PERIMETER BERM 6B PROFILE

SCALE H:1"=100'; V:1"=20'

ADAM W. MEHEVEC
84736
1-2-2023

NOTES:

1. SEE FIGURE C1-2 FOR LOCATION OF PERIMETER BERMS.
2. ALL PERIMETER BERM PROFILE VIEWS ARE ORIENTED LOOKING TOWARD LANDFILL FROM PERIMETER.
3. SEE FIGURE C1-2A FOR FLOW DEPTH ALONG BERM.

REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.

SCALE IN FEET (HORIZONTAL)
0 100 200

SCALE IN FEET (VERTICAL)
0 20 40

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PERIMETER BERMS 6A AND 6B PROFILES

DRAWN BY: JSC	CHECKED BY: AWM	APPROVED BY: AWM	FIGURE NO.: C1-2D
DATE: 11/06/2022	DWG SCALE: AS SHOWN	PROJECT NO: 311-653	

\\svr-fs-aus\projects\310-000\311-653\-CADD\Dwg\SW01\311653-BECK LANDFIL Perimeter Berm Profiles.dwg{C1-2D} LS:(1/3/2023 - jcarter) - LP: 1/3/2023 9:19 AM

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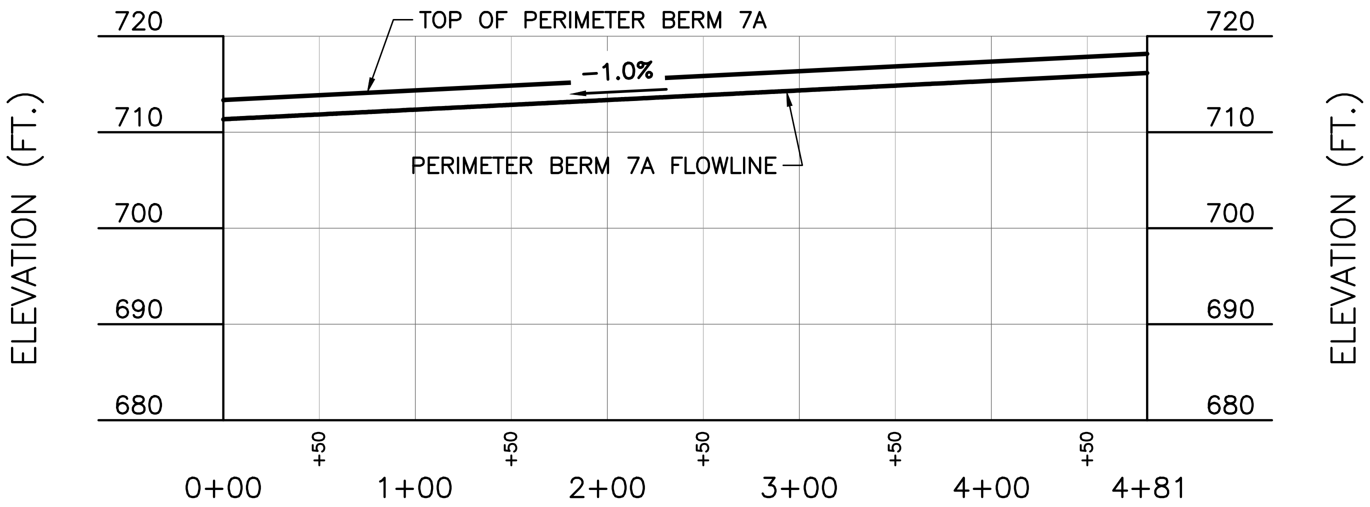

PERIMETER BERM 7A PROFILE

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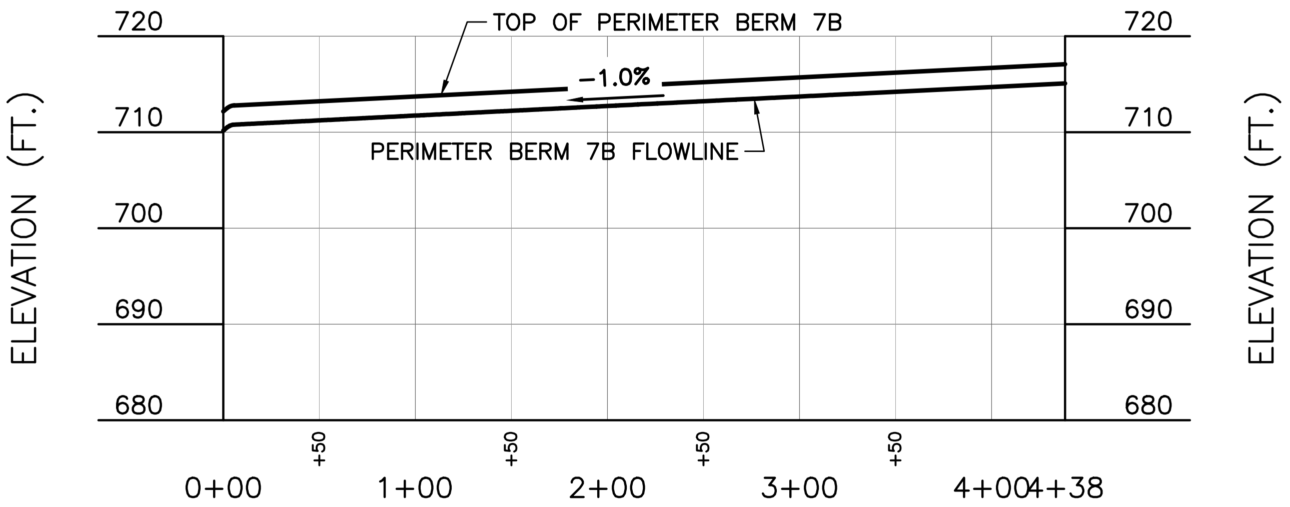
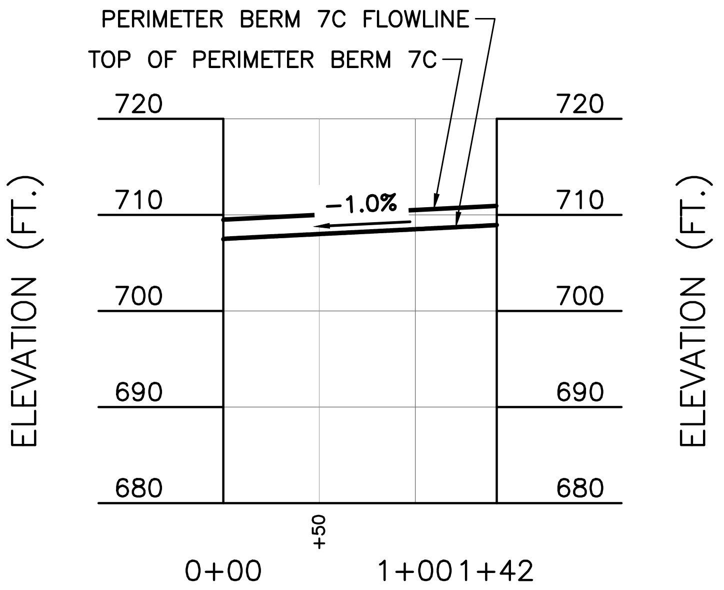


PERIMETER BERM 7B PROFILE

SCALE H:1"=100'; V:1"=20'



PERIMETER BERM 7C PROFILE

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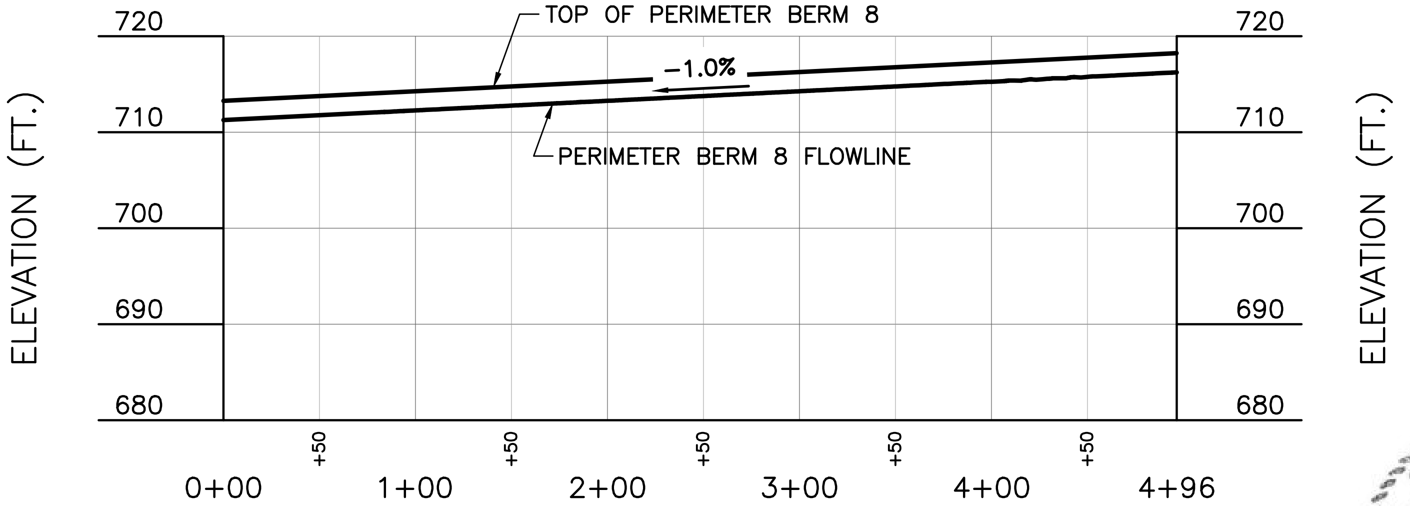

PERIMETER BERM 8 PROFILE

SCALE H:1"=100'; V:1"=20'

ADAM W. MEHEVEC
84736
1-2-2023

NOTES:

1. SEE FIGURE C1-2 FOR LOCATION OF PERIMETER BERMS.
2. ALL PERIMETER BERM PROFILE VIEWS ARE ORIENTED LOOKING TOWARD LANDFILL FROM PERIMETER.
3. SEE FIGURE C1-2A FOR FLOW DEPTH ALONG BERM.

REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.

SCALE IN FEET (HORIZONTAL)
0 100 200

SCALE IN FEET (VERTICAL)
0 20 40

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Texas Registered Engineering Firm F-38

BECK COMPANIES

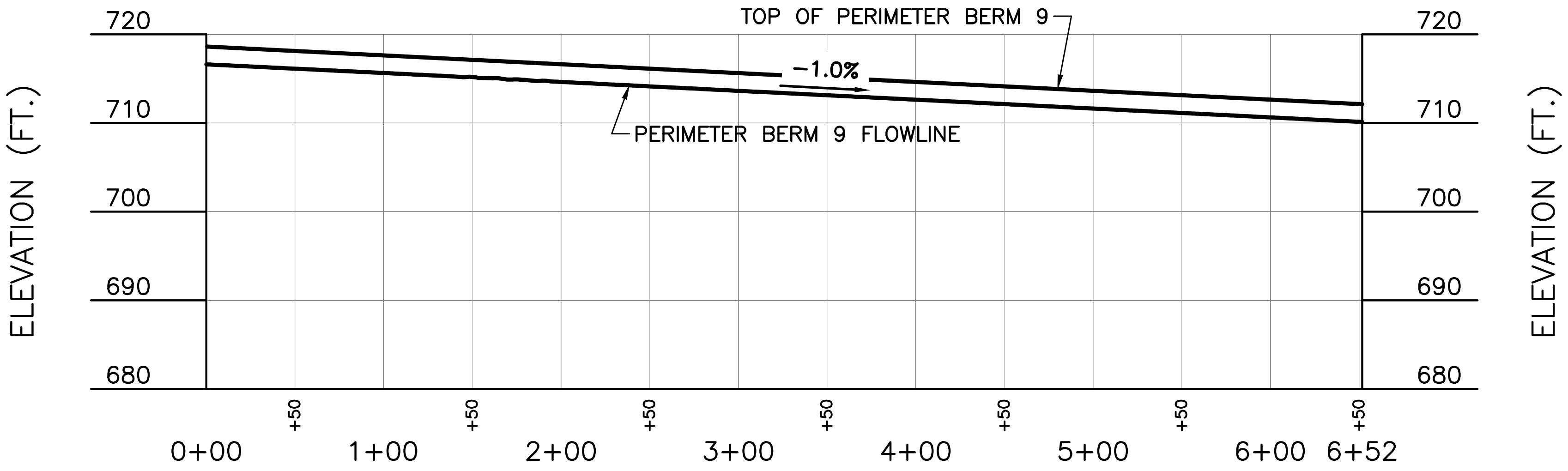
NIDO, LTD
BECK LANDFILL
BEXAR COUNTY, TEXAS

PERIMETER BERMS 7A, 7B, 7C AND 8 PROFILES

DRAWN BY: JSC	CHECKED BY: AWM	APPROVED BY: AWM	FIGURE NO.: C1-2E
DATE: 11/06/2022	DWG SCALE: AS SHOWN	PROJECT NO: 311-653	

\\svr-fs-aus\projects\310-000\311-653\-CADD\Dwg\SW01\311653-BECK LANDFIL Perimeter Berm Profiles.dwg{C1-2E} LS:(1/3/2023 - jcarter) - LP: 1/3/2023 9:18 AM

\\svr-fs-aus\projects\310-000\311-653\-CADD\Dwg\SW01\311653-BECK LANDFIL Perimeter Berm Profiles.dwg{C1-2F} LS:(1/3/2023 - jcarter) - LP: 1/3/2023 9:16 AM



PERIMETER BERM 9 PROFILE

SCALE H:1"=100'; V:1"=20'

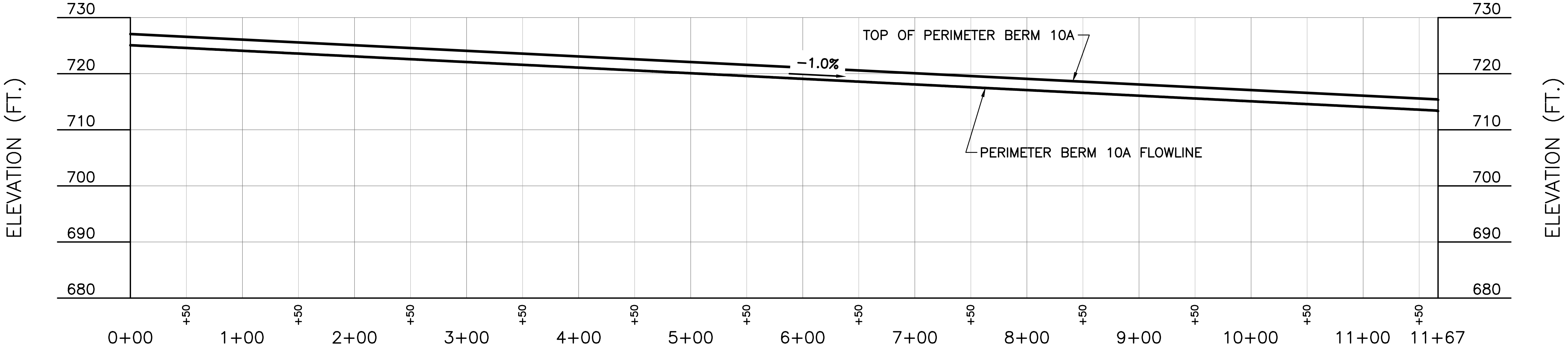
REVISION RECORD		
NO	DATE	DESCRIPTION
△1	1/2/2023	TECHNICAL NOD 1
△		
△		
△		

NOTES:

1. SEE FIGURE C1-2 FOR LOCATION OF PERIMETER BERMS.
2. ALL PERIMETER BERM PROFILE VIEWS ARE ORIENTED LOOKING TOWARD LANDFILL FROM PERIMETER.
3. SEE FIGURE C1-2A FOR FLOW DEPTH ALONG BERM.

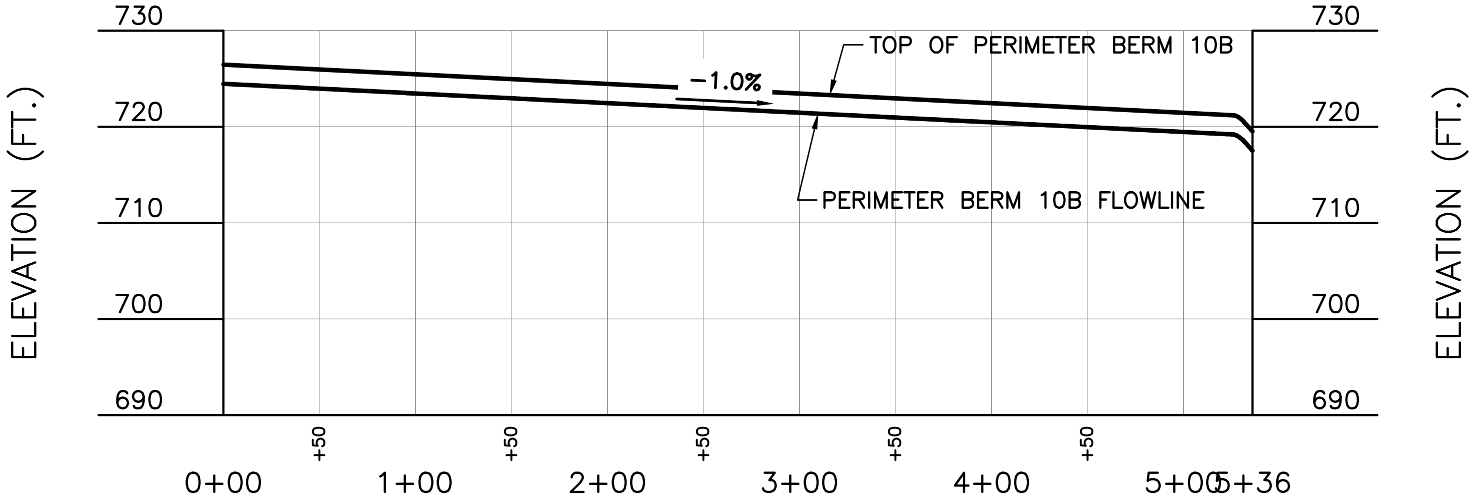
REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.



PERIMETER BERM 10A PROFILE

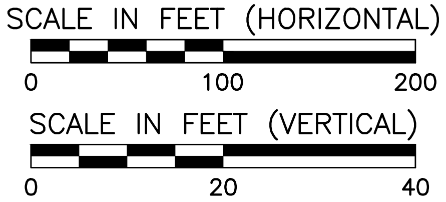
SCALE H:1"=100'; V:1"=20'



PERIMETER BERM 10B PROFILE

SCALE H:1"=100'; V:1"=20'

ADAM W. MEHEVEC
84736
1-2-2023



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PERIMETER BERMS 9, 10A AND 10B PROFILES

DRAWN BY:	JSC	CHECKED BY:	AWM	APPROVED BY:	AWM	FIGURE NO.:	C1-2F
DATE:	11/06/2022	DWG SCALE:	AS SHOWN	PROJECT NO:	311-653		

MUNICIPAL SOLID WASTE PERMIT
MAJOR AMENDMENT

PART III-ATTACHMENT C2 - FLOOD CONTROL ANALYSIS

BECK
COMPANIES

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: Revised January 2023

Prepared by:

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ADAM W. MEHEVEC
84736
1-2-2023

TABLE OF CONTENTS

APPENDIX C2-A

APPENDIX C2-B

ADAM W. MEHEVEC
84736
1-2-2023

Discussion of 100 Year Floodplain

The current FEMA map panels for the area around the landfill property are numbers 48187C0210F & 48029C0295F, which were revised in 2007 and 2010, respectively. At the time the model for these panels was created, the Beck Landfill was permitted to be filled to its final grades, but not yet constructed to an extent where the entire footprint was above the calculated 100-year water surface. FEMA modeled this permitted future condition by placing blocked obstructions on the cross-sections that traverse the landfill footprint, so that the model accounted for the authorized final condition of the landfill. FEMA then extended the floodplain across the portions of the landfill that had not yet been constructed above the 100-year water surface elevations.

To prevent the wash-out of waste by a flood event, the entire landfill footprint is encompassed by a compacted clay berm, which extends above the current 100-year flood elevation. As part of the amendment application, Beck Landfill is proposing to extend the berm 10 feet vertically to provide additional freeboard above the 100-year event. The entire footprint of the landfill and perimeter berm is currently constructed above the 100-year water surface and Beck Landfill has submitted a LOMR application to the City of Schertz and FEMA to revise the affected panels to accurately reflect the lateral extents of the floodplain. The LOMR application has updated cross-sections affected by the landfill with current topography and re-delineated the extents of the floodplain. The floodway shown on these panels was not revised since the new topography did not affect the areas shown as floodway. The LOMR application maintains the hydrologic flow values included in the effective FEMA model.

The City of Schertz has approved the LOMR application and a copy of their concurrence is included in this section. The LOMR has been submitted to FEMA and has been assigned Case No. 22-06-2567P. A complete copy of the LOMR application is included in Appendix C2-A.

Stormwater Detention and Sedimentation Pond

The proposed stormwater pond for the landfill is within the 100-year floodplain. The pond will be excavated below grade and include above grade compacted soil berms to provide additional volume. The purpose of the pond is to provide detention and sedimentation capacity for the landfill. The pond will be constructed at the same location as the existing stormwater pond and the proposed soil berms will be tied into the existing landfill perimeter berm to minimize the encroachment on the floodplain. In order to offset the loss of flow area in the floodplain from the pond berm, the area south of the new pond is proposed to be excavated to enhance flow through Cibolo Creek. A no-rise certification for the proposed pond was submitted to the City of Schertz for review and a copy of the submittal is included in Appendix C2-B. Based on the modeling in the no-rise certification, there is no increase in the calculated water surface elevation of the floodplain from the pond construction, since the areas along the creek will be excavated to completely offset any effects of the new pond.

The City of Schertz approved the no-rise certification for the pond construction on October 20, 2022.

NORTH

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0220F

FIRM

FLOOD INSURANCE RATE MAP

GUADALUPE COUNTY,
TEXAS
AND INCORPORATED AREAS

PANEL 220 OF 480

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

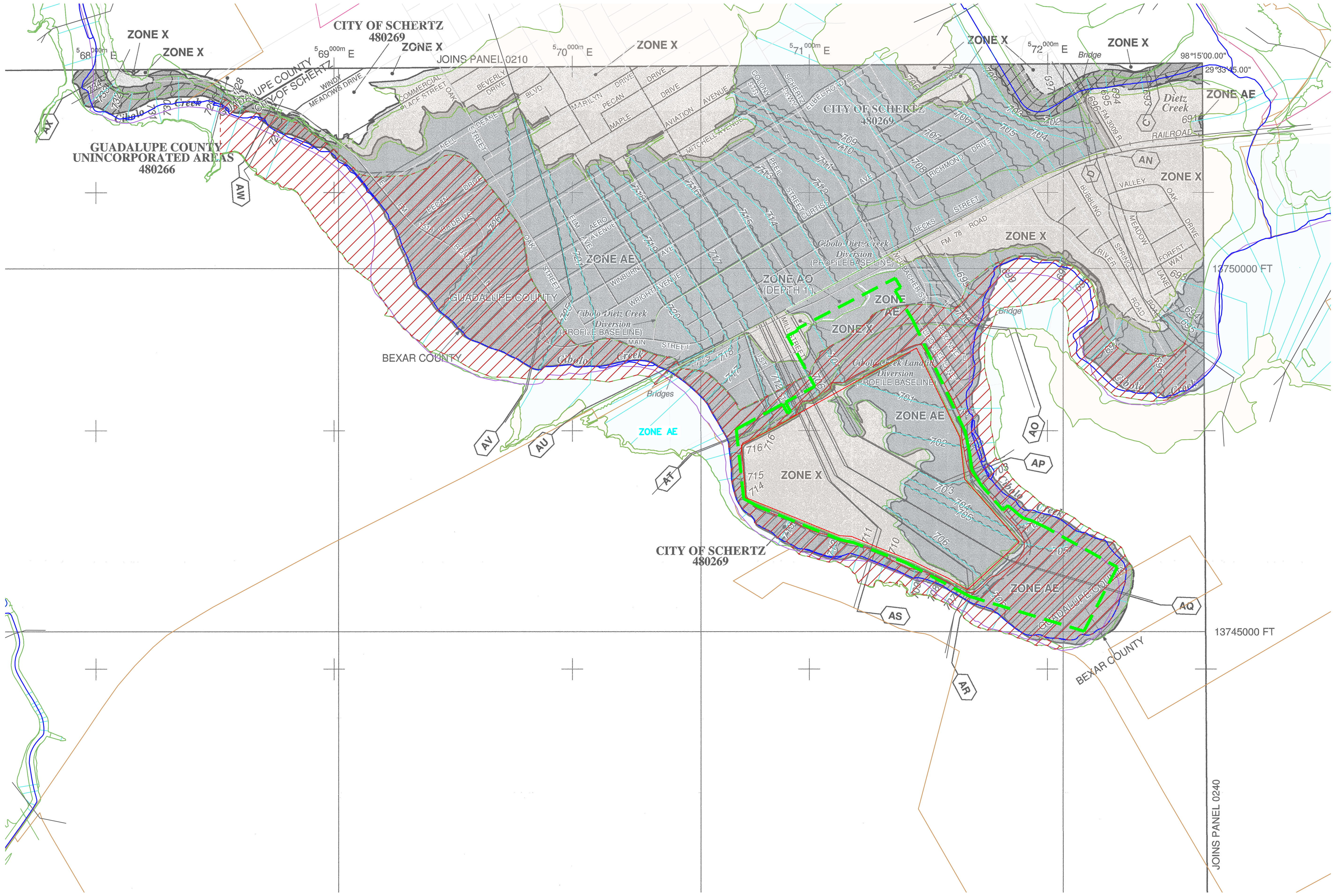
COMMUNITY	NUMBER	PANEL	SUFFIX
GUADALUPE COUNTY	480266	0220	F
SCHERTZ, CITY OF	480269	0220	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
48187C0220F

EFFECTIVE DATE
NOVEMBER 2, 2007

Federal Emergency Management Agency



LEGEND

▨ SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

▨ FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

▨ OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

☐ OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

▨ COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

▨ OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

————————	Floodplain boundary
—— —— ——	Floodway boundary
– ——— ——— –	Zone D boundary
●●●●●●●●●●●●●●●●	CBRS and OPA boundary
▨ ←	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
~~ 513 ~~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

(A)————(A)	Cross section line
(23)- - - - - - - -(23)	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
$^{42}75^{000m}$N	1000-meter Universal Transverse Mercator grid ticks, zone 14
6000000 FT	5000-foot grid values: Texas State Plane coordinate system, south central zone (FIPSZONE 4204), Lambert Conformal Conic
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
November 2, 2007
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

LEGEND

— · — · —	*LANDFILL PERMIT BOUNDARY*
————	*LANDFILL FOOTPRINT BOUNDARY*

REFERENCE

AERIAL IMAGERY PROVIDER: GOOGLE EARTH; DATE OF PHOTOGRAPHY: 11/22/2019.

ELEVATION CONTOURS: STRATEGIC MAPPING PROGRAM (STRATMAP) CENTRAL TEXAS LIDAR, 2017–01–01 (DATA COLLECTION PERIOD: 01/28/201/ THROUGH 03/22/201/).

SCALE IN FEET
0 1000 2000

ADAM W. MEHEVEC
84736
1-2-2023

REVISION RECORD

NO	DATE	DESCRIPTION
1	1-2-2023	TECHNICAL NOD 1

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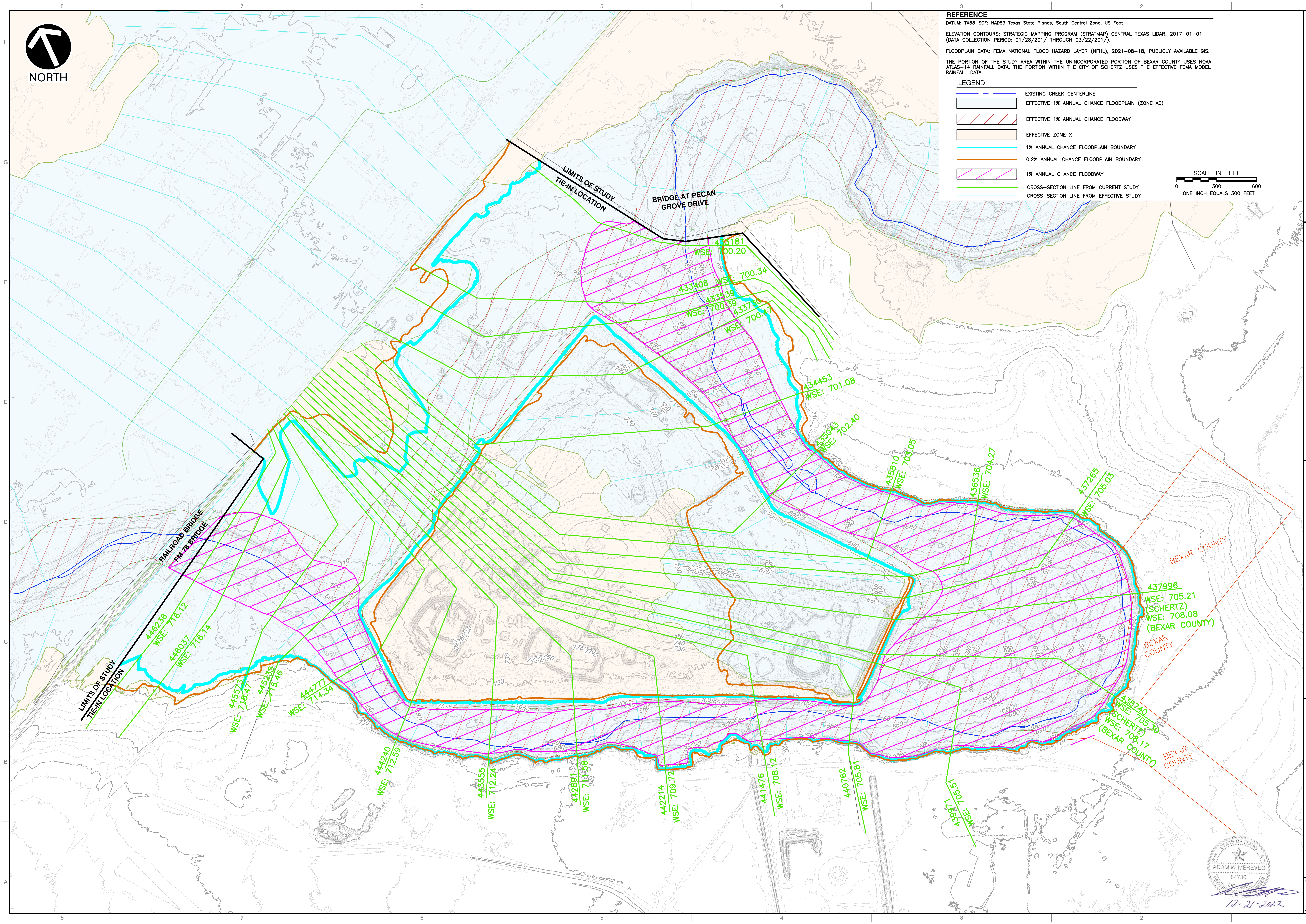
BECK LANDFILL EXPANSION
600 FM 78, SCHERTZ, TEXAS 78154
GUADALUPE COUNTY, TEXAS

FLOOD INSURANCE RATE MAP (FIRM)
48187C0220F

DATE:	12/21/2022	DRAWN BY:	AGT
DWG SCALE:	1" = 1000'	CHECKED BY:	JCM
PROJECT NO:	311-653.SITE		
APPROVED BY:			AWM

DRAWING NO.:
C2-1
SHEET **C2-1** OF **C2-1**



REFERENCE

DATUM: TX83–SCF: NAD83 Texas State Planes, South Central Zone, US Foot

ELEVATION CONTOURS: STRATEGIC MAPPING PROGRAM (STRATMAP) CENTRAL TEXAS LIDAR, 2017–01–01 (DATA COLLECTION PERIOD: 01/28/201/ THROUGH 03/22/201/).

FLOODPLAIN DATA: FEMA NATIONAL FLOOD HAZARD LAYER (NFHL), 2021–08–18, PUBLICLY AVAILABLE GIS.

THE PORTION OF THE STUDY AREA WITHIN THE UNINCORPORATED PORTION OF BEXAR COUNTY USES NOAA ATLAS–14 RAINFALL DATA. THE PORTION WITHIN THE CITY OF SCHERTZ USES THE EFFECTIVE FEMA MODEL RAINFALL DATA.

LEGEND

— — —	EXISTING CREEK CENTERLINE
☐	EFFECTIVE 1% ANNUAL CHANCE FLOODPLAIN (ZONE AE)
▨	EFFECTIVE 1% ANNUAL CHANCE FLOODWAY
☐	EFFECTIVE ZONE X
—	1% ANNUAL CHANCE FLOODPLAIN BOUNDARY
—	0.2% ANNUAL CHANCE FLOODPLAIN BOUNDARY
▨	1% ANNUAL CHANCE FLOODWAY
—	CROSS–SECTION LINE FROM CURRENT STUDY
—	CROSS–SECTION LINE FROM EFFECTIVE STUDY

SCALE IN FEET
0 300 600
ONE INCH EQUALS 300 FEET

REVISION RECORD

NO	DATE	DESCRIPTION

Texas Registered Engineering Firm F-38

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BECK LANDFILL EXPANSION
600 FM 78, SCHERTZ, TEXAS 78154
GUADALUPE COUNTY, TEXAS

TOPOGRAPHIC WORK MAP

DATE:	12/22/2022	DRAWN BY:	AGT
DWG SCALE:	1" = 300'	CHECKED BY:	JCM
PROJECT NO:	311-653.SITE		
APPROVED BY:	AWM		

ADAM W. MEHEVEC
84736

12-21-2022

DRAWING NO.: **C2-2**

SHEET 2 OF 4

\\svr-fs-aus\projects\310-000\311-653\-CADD\Dwg\CV01\31653-CV01-TopoWorkMap-REV1.dwg{2} LS:(12/22/2022 – jcarter) – LP: 12/22/2022 9:19 AM

BECK LANDFILL
APPENDIX C2-B
No-Rise Certification for Proposed Stormwater Pond

City of Schertz

Floodplain Permit

Permit PRGR202202064

Date Issued: October 20, 2022 **Expires:** April 18, 2023

Project Address: 550 FM 78;

Subdivision:

Lot # **Block #**

Owner Information:

Contractor:

Proposed Use: **Not Applicable**

Description of Work:

- Floodplain:
- Clearing and Grading: Disturbing Soil (Greater than 1/10th of an Acre)

Note: Permit is for construction of new detention basin for landfill.

Conditions:

Issued By:
Engineering Department

Kathy Woodlee

Kathy Woodlee
City Engineer
(210) 619-1823

Permits are non-transferable and shall be displayed on site at all times.

MUNICIPAL SOLID WASTE PERMIT MAJOR AMENDMENT

PART III-ATTACHMENT D
WASTE MANAGEMENT UNIT DESIGN

BECK
COMPANIES

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: Revised January 2023

Prepared by:

CEC
Civil & Environmental Consultants, Inc.

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ADAM W. MEHEVEC
84736
1-2-2023

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TABLES AND FIGURES

Tables

Figures

ADAM W. MEHEVEC
84736
1-2-2023

1 WASTE MANAGEMENT UNIT DESIGN

30 TAC §330.63(d)

The Beck Landfill, located at 550 FM 78 in Schertz, Texas Guadalupe County, is an existing Type IV Solid Waste Disposal Facility which accepts brush, construction, or demolition waste, and/or rubbish in accordance with applicable State and Federal regulations. The proposed Beck Landfill facility boundary encompasses about 257 acres. The landfill facility is accessed from FM 78 through an entrance road. A gatehouse and scales are located within the facility boundary along with a wood waste processing area and recyclables collection area.

The landfill footprint will cover approximately 154.6 acres and have a disposal capacity of approximately 26.4 million cubic yards which will provide about 23 years of site life. The landfill method will be below-grade fill with 3H:1V liner sidewall slopes and aerial fill with 4H:1V final cover side slopes, with a maximum six percent final cover top slope. The drainage system will be designed to meet or exceed TCEQ requirements for runon and runoff. The landfill liner, final cover, gas monitoring, and groundwater monitoring systems will be designed to meet the TCEQ requirements.

The following table provides a summary of the proposed permit conditions:

Table D-1

	Proposed Permit No. 1848A
Permitted Area (acres)	256.9
Waste Disposal Area (acres)	154.6
Total Capacity (cy)	26,417,117
Total Remaining Capacity (cy)	16,259,957*
Remaining Site Life (years)	23
Maximum Elevation of Final Cover (msl)	889
Minimum Elevation of Landfill Excavation (ft-msl)	640 MSL

* Remaining capacity as of June 16, 2021.

2 STORAGE AND TRANSFER UNITS

30 TAC §330.63(d)(1)(A)

The storage and transfer units will be designed for the rapid processing and minimum detention of solid waste at the facility and will be managed to prevent nuisances and fire hazards. The design of the storage and transfer units will be sufficient to control and contain a worst-case spill or release from the units and the unenclosed areas associated with the units, and will account for precipitation from the 25-year, 24-hour rainfall event. The storage and transfer units will include the wood waste processing area and recyclable material recovery area. All storage and processing areas will be located outside of the 100-year floodplain. Material will only be held in these areas for a maximum of 180 days.

2.1 Wood Waste Processing Area

The wood waste processing area will be located within the landfill footprint and will process incoming yard trimmings, clean wood materials and vegetative materials, including trees and brush, into wood chips and mulch. The wood chips and mulch will only be used on-site or taken offsite for further processing or use. The wood chips and mulch will be stored in small piles and will be managed to prevent fire, safety, or health hazards in accordance with 30 TAC§330.209(a). The wood waste processing area will not be larger than approximately 150 feet by 150 feet.

2.2 Recyclable Material Recovery Area

The recyclable material recovery area will be located within the landfill footprint and will process incoming metal, concrete, plastic, and other recyclable materials. The recycled materials will be sent offsite for processing. The materials will be stored in roll-offs or small piles and will be managed to prevent fire, safety, or health hazards in accordance with 30 TAC§330.209(a). The recyclable material area will not be larger than approximately 150 feet by 150 feet. The recyclable material area will be located outside of the 100-year floodplain boundary.

3 LANDFILL UNITS

30 TAC §330.63(d)(4)

The landfill unit design includes all weather operation, landfilling methods, landfill design parameters, site life projection, landfill cross sections, and the liner and final cover quality control plans.

3.1 All Weather Operation (30 TAC §330.63(d)(4)(A))

The landfill access roads will be constructed of crushed stone, gravel, concrete rubble, masonry rubble, wood chips, or other similar materials to provide access to the disposal area during all weather conditions. To enhance operating efficiency during wet weather, a disposal area close to the all weather roads may be reserved for wet weather operations. The wet weather area will move as operations progress.

Site personnel will maintain the access roads for all weather access. Stockpiles of crushed stone, gravel, concrete rubble, masonry rubble, wood chips or other similar material will be available for use in maintaining passable access roads. Grading equipment or other appropriate equipment will be used as necessary to control or remove mud from the access roads and the entrance road.

Tracking of mud onto public roads will be minimized by the all weather surfaces of the access roads and the entrance road. A minimum of 900 feet of paved entrance and access road will be maintained between the entrance and the closest waste disposal area to provide mud control for waste hauling vehicles prior to exiting the site and returning to public roads. Additional mud control will be provided by speed bumps along the access route. A street sweeper will also be used, as necessary, to clean internal paved roads. The street sweeper will not normally be used on public roads. In the event the sweeper is required to clean the public road, a traffic control plan approved by TxDOT will be developed and the approved traffic controls will be maintained during the entire period when the sweeper is active on the roadway.

3.2 Landfilling Methods (30 TAC §330.63(d)(4)(B))

The development method for the landfill will be a combination of area-excavation fill followed by aerial fill to the proposed landfill completion height. Final cover placement will occur after areas have been taken to final grade and no further waste placement is planned for that area. Completed areas will be closed according to the closure plan provided in Part III, Attachment H - Closure Plan.

3.3 Landfill Design Parameters (30 TAC §330.63{d)(4)(C))

The 256.9 permitted acres will include 154.6 acres for waste disposal and 110.5 acres of buffer and other non-fill areas. The elevation of deepest excavation will be approximately 640 feet msl and the maximum elevation of final cover will be 889 feet msl. The maximum elevation of disposed waste will be 887 feet msl

Excavation sideslopes will not exceed 3H:1V and waste sideslopes will not exceed 4H:1V. Final cover top slopes will have a six percent slope, Excavation and final completion plans are presented in Attachment D1.

3.4 Site Life Projection (30 TAC §330.63(d)(4)(D))

The total volume available for waste disposal calculations and assumptions for the waste volume and site life estimate are included in Attachment D4 - Site Life.

3.5 Landfill Cross Sections (30 TAC §330.63(d)(4)(E) and (F))

Cross sections of the landfill unit are provided in Attachment D2 - Cross Sections. The section locations were selected to represent the conditions across the entire site. These sections show the top of the levee, top of the proposed fill (top of the final cover), maximum elevation of the proposed fill, top of waste, existing ground, bottom of the excavation, side slopes of excavations, gas probes, groundwater monitoring wells, and the initial and static levels of any water encountered, Soil borings, monitoring wells, and gas monitoring probes near the sections have been projected onto the sections.

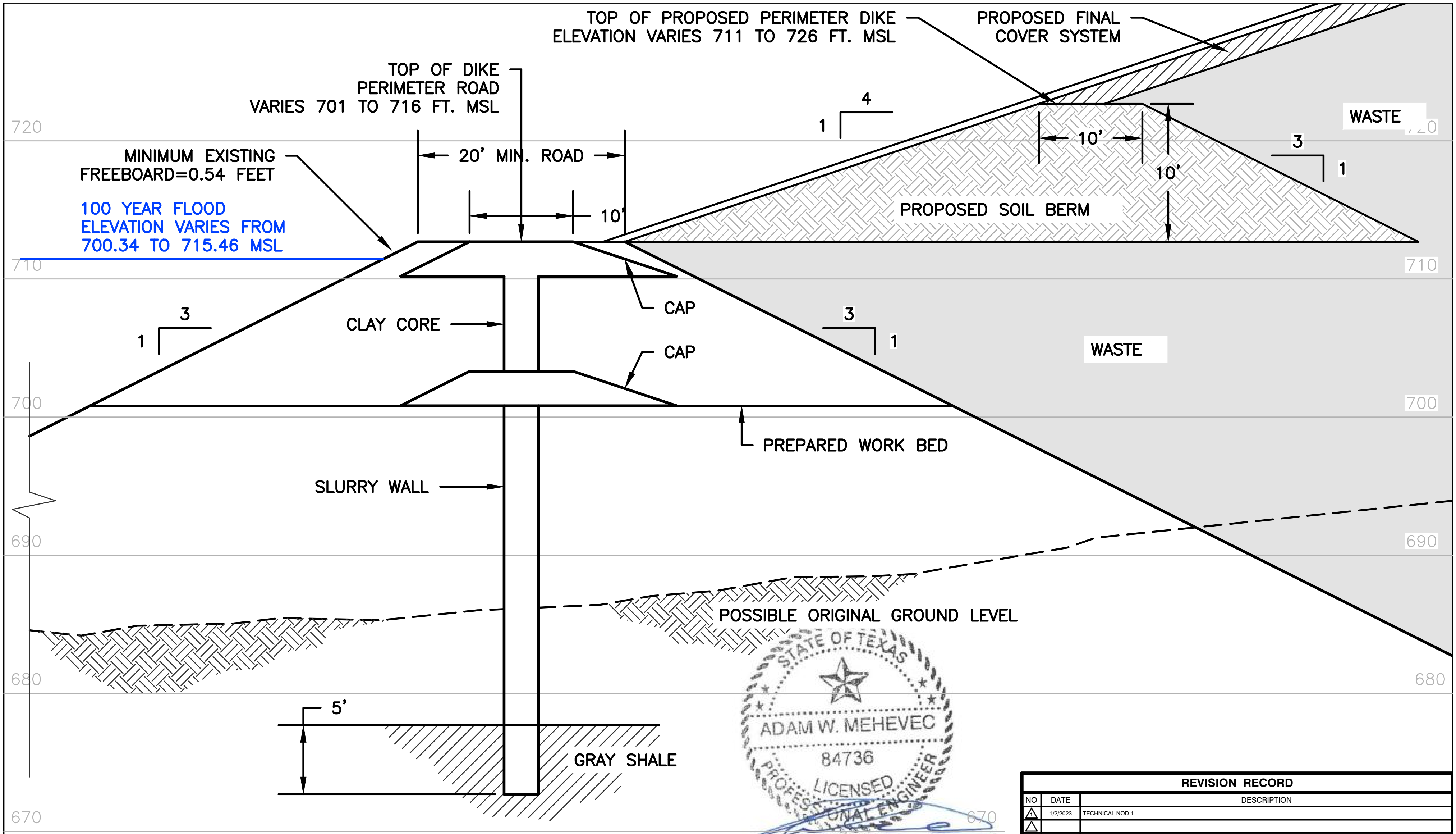
3.6 Liner Quality Control Plan (30 TAC §330.63(d)(4)(G))

The quality control plan for the liner system is provided in Attachment D7 - Liner Quality Control Plan. The Beck landfill utilizes an in-situ clay liner, but can construct a compacted clay liner system if the encountered native soils are not satisfactory. Details of the liner system are provided in Attachment D7 – Liner Quality Control Plan.

3.7 Final Cover Quality Control Plan (30 TAC §330.457)

The quality control plan for the final cover system is provided in Attachment D8 - Final Cover Quality Control Plan. Details of the final cover system are provided in Attachment D3.

P:\310-000\311-653\-CADD\Dwg\SW01\311653-BECK LANDFIL Slurry Trench - Dike.dwg{D-2} LS:(12/23/2022 - amehevec) - LP: 12/23/2022 4:27 PM



ADAM W. MEHEVEC
84736
1-2-2023

NOTE: MONITOR WELLS ARE INSTALLED OUTSIDE OF THE SLURRY WALL AT THE SHOWN LOCATIONS AND A PIEZOMETER IS INSTALLED INSIDE THE SLURRY WALL AT THESE SAME LOCATIONS.

REVISION RECORD

NO	DATE	DESCRIPTION
1	1/2/2023	TECHNICAL NOD 1
△		
△		
△		

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Texas Registered
Engineering Firm F-38

BECK COMPANIES

NIDO, LTD
BECK LANDFILL
BEXAR COUNTY, TEXAS

TYPICAL EXISTING PERIMETER DIKE DETAIL

DRAWN BY:	MFV	CHECKED BY:	AWM	APPROVED BY:	AWM	FIGURE NO.:	D-2
DATE:	08/2022	DWG SCALE:	1" = 500'	PROJECT NO:	311-653		

MUNICIPAL SOLID WASTE PERMIT MAJOR AMENDMENT

PART III-ATTACHMENT D1
SITE LAYOUT

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: Revised January 2023

Prepared by:

Civil & Environmental Consultants, Inc.

Texas Registration Number F-38
3711 S MoPac Expressway
Building 1 Suite 550,
Austin, Texas 78746
(512) 329-0006

ADAM W. MEHEVEC
84736
1-2-2023

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STATE OF TEXAS
ADAM W. MEHEVEC
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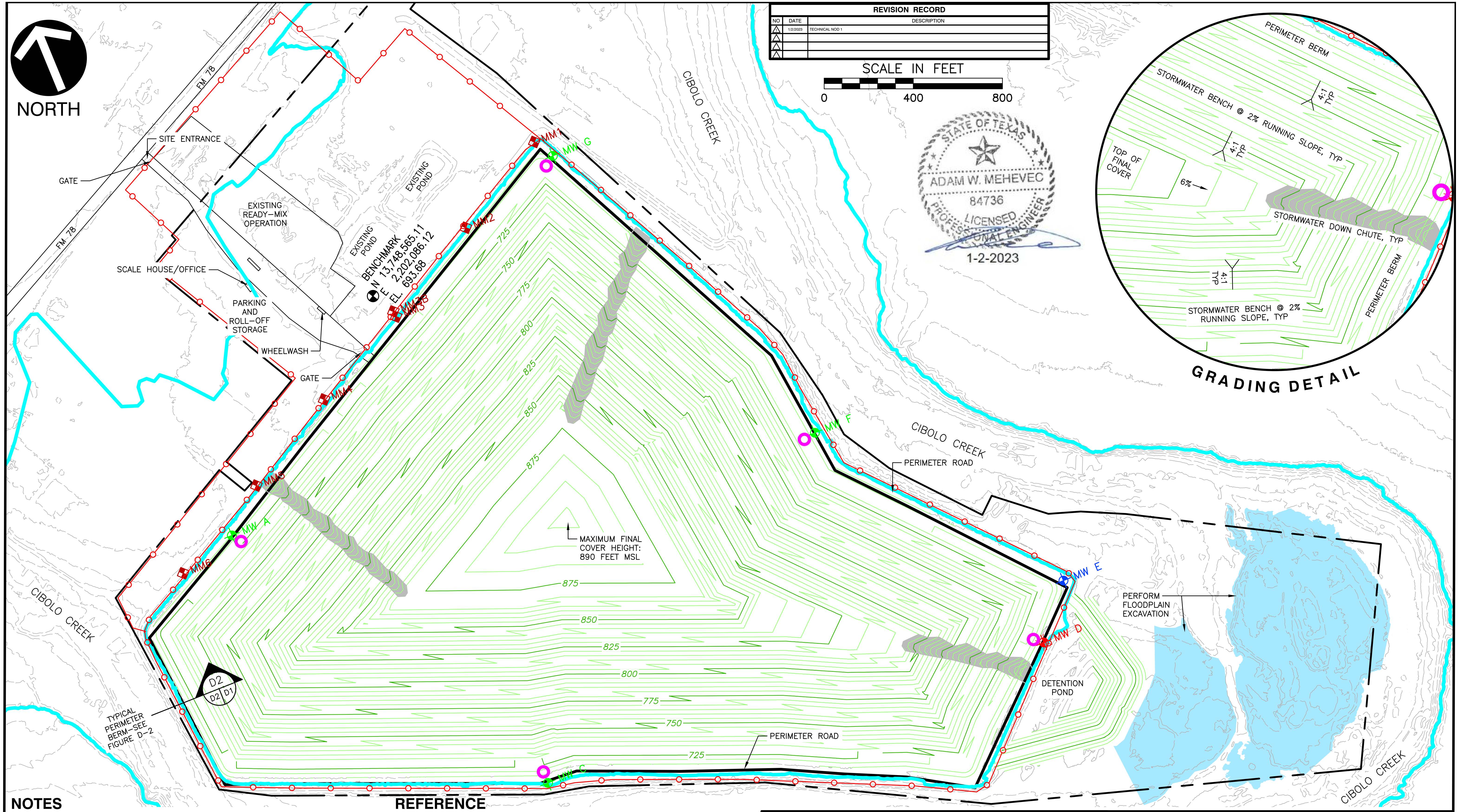
PROFESSIONAL ENGINEER
1-2-2023



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△1	1/2/2023	TECHNICAL NOD 1
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SCALE IN FEET

0 400 800

ADAM W. MEHEVEC
84736
1-2-2023

NOTES

1. ALL AREAS WITHIN THE LANDFILL FOOTPRINT THAT DO NOT HAVE FINAL COVER MAY BE USED FOR SOIL STOCKPILES, BRUSH STORAGE AND GRINDING, OR VEHICLE PARKING AND MAINTENANCE.
2. ALL MONITOR WELLS AND GAS PROBES HAVE BEEN PREVIOUSLY INSTALLED. MONITOR WELL D IS BEING RELOCATED AND WILL BECOME MONITOR WELL E.
3. INTERIOR ACCESS AND PERIMETER ROADS SHALL BE SURFACED WITH CRUSHED STONE, GRAVEL, RECYCLED CONCRETE, OR EQUIVALENT ALL–WEATHER SURFACE.
4. SITE PERIMETER FENCING OR NATURAL BARRIERS WILL BE USED ALONG THE ENTIRE PERMIT BOUNDARY.
5. SOLID WASTE STORAGE AND PROCESSING AREAS WILL BE PLACED OUTSIDE OF THE 100–YEAR FLOODPLAIN OR WILL BE PROTECTED WITH A LEVEE THAT EXTENDS A MINIMUM OF ONE FOOT ABOVE THE FLOODPLAIN ELEVATION.
6. THERE ARE NO NATURAL WINDBREAKS, SUCH AS GREENBELTS, OR SCREENING PROPOSED FOR THE FACILITY.

REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK: (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.

LEGEND

⊕	EXISTING MONITOR WELL	— — —	LANDFILL PERMIT BOUNDARY
◆	EXISTING GAS PROBE	▬	LANDFILL FOOTPRINT BOUNDARY
○	EXISTING PIEZOMETER	▬	100 YEAR FLOODPLAIN BASED ON LOMR APPLICATION
⊕	MONITOR WELL TO BE REMOVED	▨	LANDFILL CONTOURS ARE TOP OF FINAL COVER.
⊕	PROPOSED MONITOR WELL	—o—o—	FENCE (BARBED–WIRE OR CHAIN LINK)

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BECK LANDFILL
BEXAR COUNTY, TEXAS

SITE LAYOUT PLAN

DRAWN BY: MFV	CHECKED BY: AWM	APPROVED BY: AWM	FIGURE NO.:
DATE: 08/2022	DWG SCALE: 1" = 400'	PROJECT NO: 311-653	D1.1

P:\310-000\311-653\-CADD\Dwg\SW01\311653-BECK LANDFIL SITE LAYOUT PLAN D1-1.dwg{D1-1} LS:(12/23/2022 - amehevec) - LP: 12/23/2022 11:36 AM

\\svr-fs-aus\projects\310-000\311-6531-CADD\Dwg\SW01\311653-BECK LANDFILL Original Excavation.dwg{EXCAVATION} LS:(12/16/2022 - jcarter) - LP: 12/16/2022 10:26 AM

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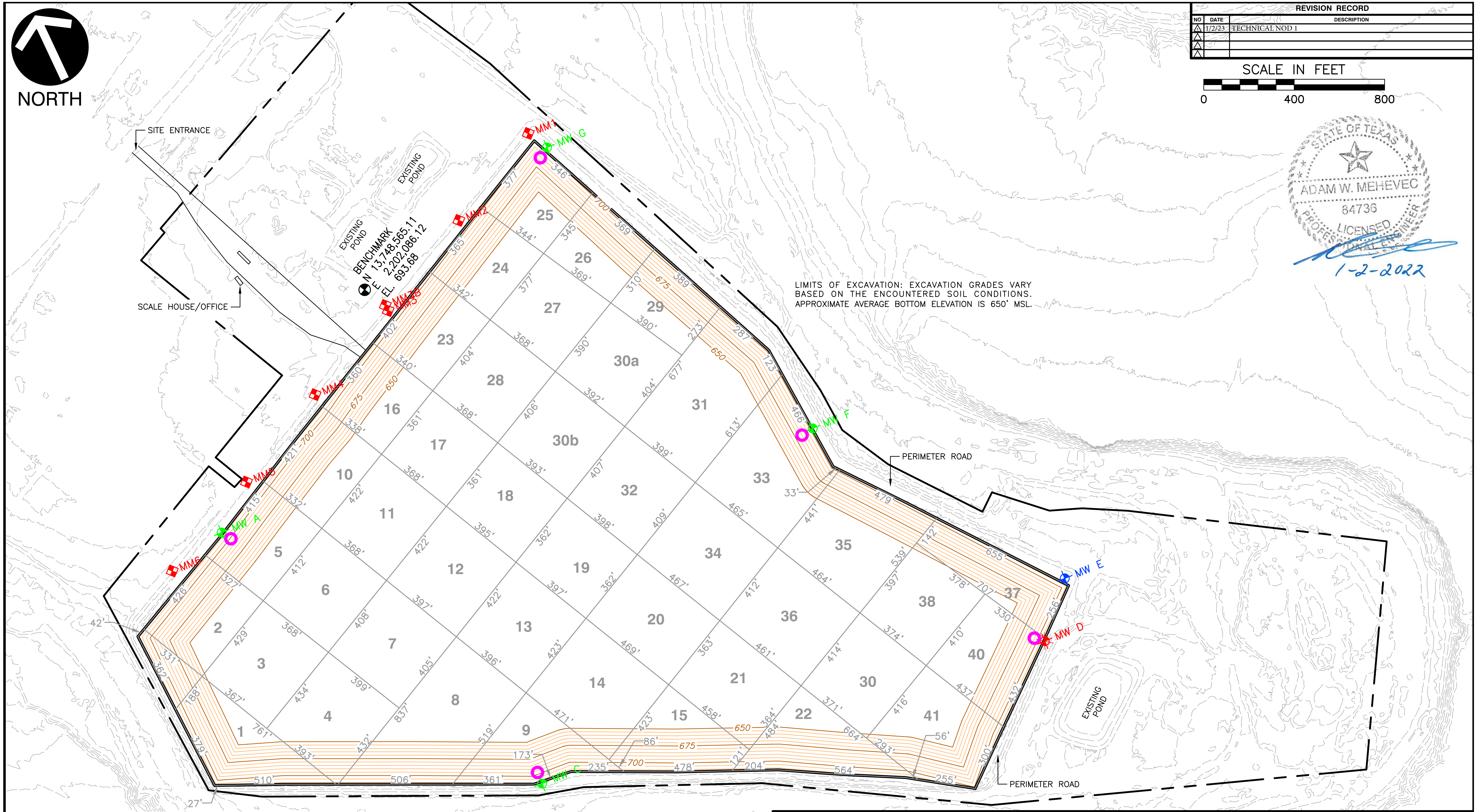

LIMITS OF EXCAVATION: EXCAVATION GRADES VARY BASED ON THE ENCOUNTERED SOIL CONDITIONS. APPROXIMATE AVERAGE BOTTOM ELEVATION IS 650' MSL.

ADAM W. MEHEVEC
84736

1-2-2022

REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK: (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.

NOTES

1. EXCAVATION EMBANKMENTS ARE GRADED AT A 3:1 SLOPE.
2. ALL CELLS HAVE BEEN PREVIOUSLY EXCAVATED AND PARTIALLY FILLED WITH WASTE.
3. CELL DESIGNATIONS SHOWN ARE FROM CURRENT PERMIT AND REPRESENT THE GENERAL SEQUENCE IN WHICH THE CELLS WERE DEVELOPED.

LEGEND

⊕	EXISTING MONITOR WELL
◆	EXISTING GAS PROBE
○	EXISTING PIEZOMETER
⊕	MONITOR WELL–TO BE REMOVED
⊕	PROPOSED MONITOR WELL
— — —	LANDFILL PERMIT BOUNDARY
———	LANDFILL FOOTPRINT BOUNDARY

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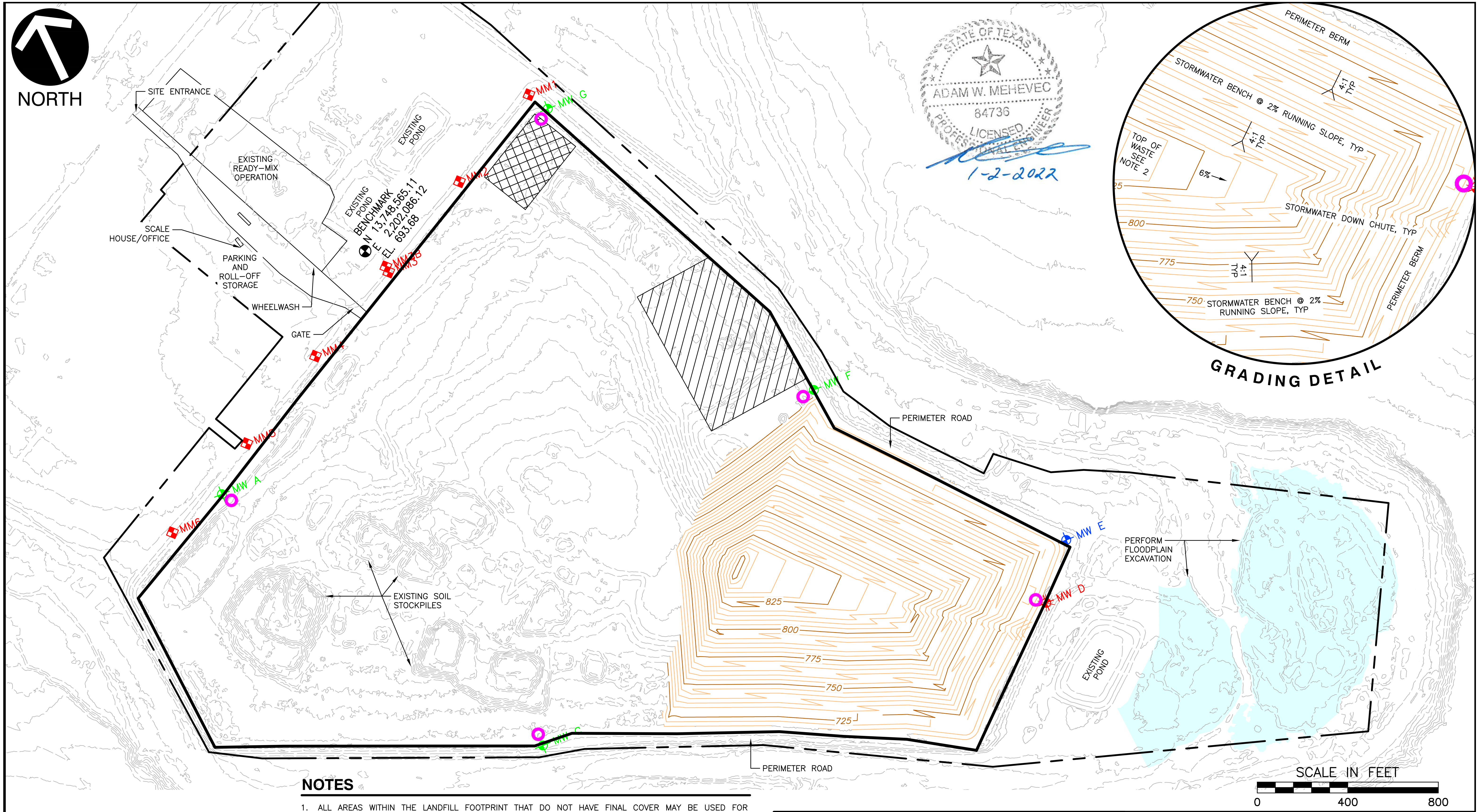
EXCAVATION PLAN

DRAWN BY:	MFV	CHECKED BY:	AWM	APPROVED BY:	AWM	FIGURE NO.:	D1.2
DATE:	08/2022	DWG SCALE:	1" = 400'	PROJECT NO:	311-653		



ADAM W. MEHEVEC
84736
1-2-2022

NOTES

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2. FILL SOUTHERN AREAS TO 1848A GRADES AND INSTALL INTERMEDIATE COVER.
3. INTERIM SLOPE FACE SHALL BE GRADED AT 3:1 MAXIMUM SLOPE.

LEGEND

⊕	EXISTING MONITOR WELL	— — —	LANDFILL PERMIT BOUNDARY
◆	EXISTING GAS PROBE	━━━	LANDFILL FOOTPRINT BOUNDARY
○	EXISTING PIEZOMETER	▨	BRUSH/ROLL–OFF STORAGE AREA
⊕	MONITOR WELL–TO BE REMOVED	▩	MAINTENANCE AREA
⊕	PROPOSED MONITOR WELL		

REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK: (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.

REVISION RECORD

NO	DATE	DESCRIPTION
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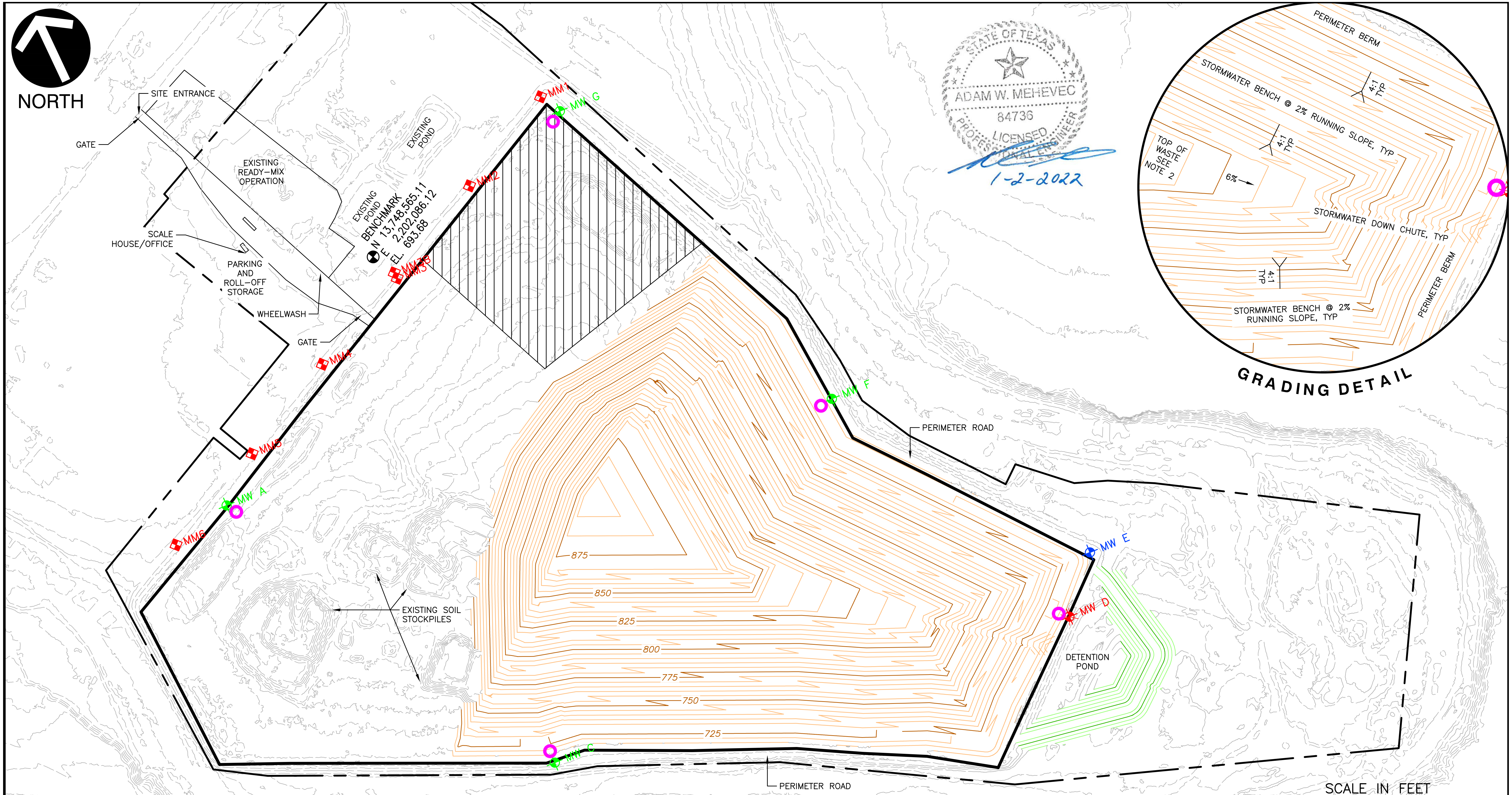
SEQUENCE PLAN (SEQUENCE 1)

DRAWN BY: MFV		CHECKED BY: AWM		APPROVED BY: AWM		FIGURE NO.: D1.3
DATE: 08/2022		DWG SCALE: 1" = 400'		PROJECT NO: 311-653		

\\svr-fs-aus\projects\310-000\311-6531-CADD\Dwg\SW01\311653-BECK LANDFILL Sequence of Fill 1.dwg{SOC 1} LS:(12/16/2022 - jcarter) - LP: 12/16/2022 10:45 AM



ADAM W. MEHEVEC
84736

1-2-2022

NOTES

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2. CONTINUE TO FILL AREAS TO 1848A GRADES AND INSTALL INTERMEDIATE COVER.
3. INTERIM SLOPE FACE SHALL BE GRADED AT 3:1 MAXIMUM SLOPE.

REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK: (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.

LEGEND

⊕	EXISTING MONITOR WELL	— — —	LANDFILL PERMIT BOUNDARY
◆	EXISTING GAS PROBE	━━━	LANDFILL FOOTPRINT BOUNDARY
○	EXISTING PIEZOMETER	▨	BRUSH/ROLL-OFF STORAGE AREA
⊕	MONITOR WELL-TO BE REMOVED	▩	MAINTENANCE AREA
⊕	PROPOSED MONITOR WELL		

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SEQUENCE PLAN (SEQUENCE 2)

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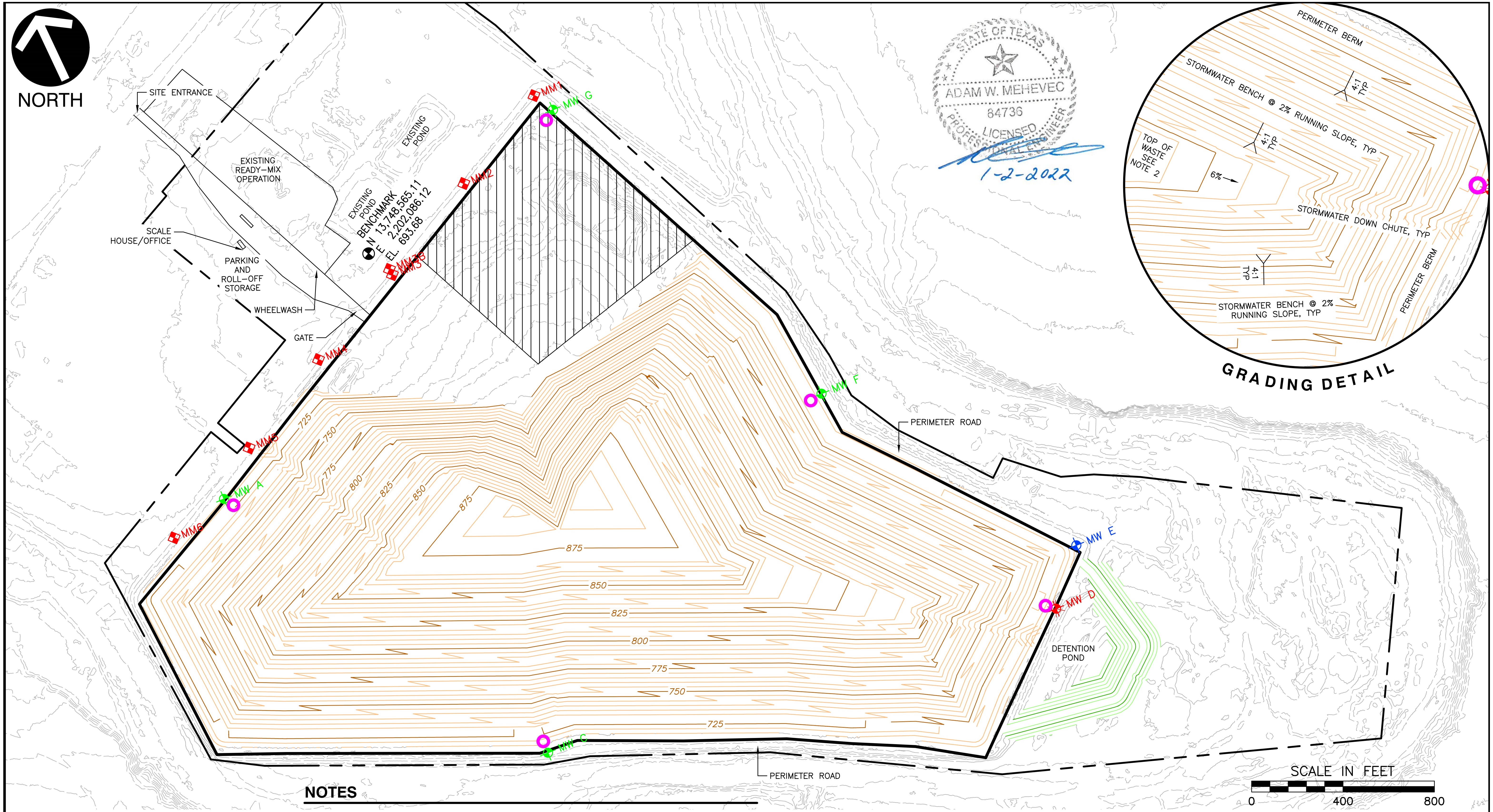

STATE OF TEXAS
ADAM W. MEHEVEC
84736
LICENSED
PROFESSIONAL ENGINEER

1-2-2022

NOTES

1. ALL AREAS WITHIN THE LANDFILL FOOTPRINT THAT DO NOT HAVE FINAL COVER MAY BE USED FOR SOIL STOCKPILES, BRUSH STORAGE AND GRINDING, OR VEHICLE PARKING AND MAINTENANCE.
2. CONTINUE TO FILL AREAS TO 1848A GRADES AND INSTALL INTERMEDIATE COVER.
3. INTERIM SLOPE FACE SHALL BE GRADED AT 3:1 MAXIMUM SLOPE.

LEGEND

⊕	EXISTING MONITOR WELL	— — —	LANDFILL PERMIT BOUNDARY
◆	EXISTING GAS PROBE	━━━	LANDFILL FOOTPRINT BOUNDARY
○	EXISTING PIEZOMETER	▨	BRUSH/ROLL-OFF STORAGE AREA AND MAINTENANCE AREA
⊕	MONITOR WELL–TO BE REMOVED		
⊕	PROPOSED MONITOR WELL		

REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK: (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.

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SEQUENCE PLAN (SEQUENCE 3)

DRAWN BY:	MFV	CHECKED BY:	AWM	APPROVED BY:	AWM	FIGURE NO.: D1.5
DATE:	08/2022	DWG SCALE:	1" = 400'	PROJECT NO:	311-653	

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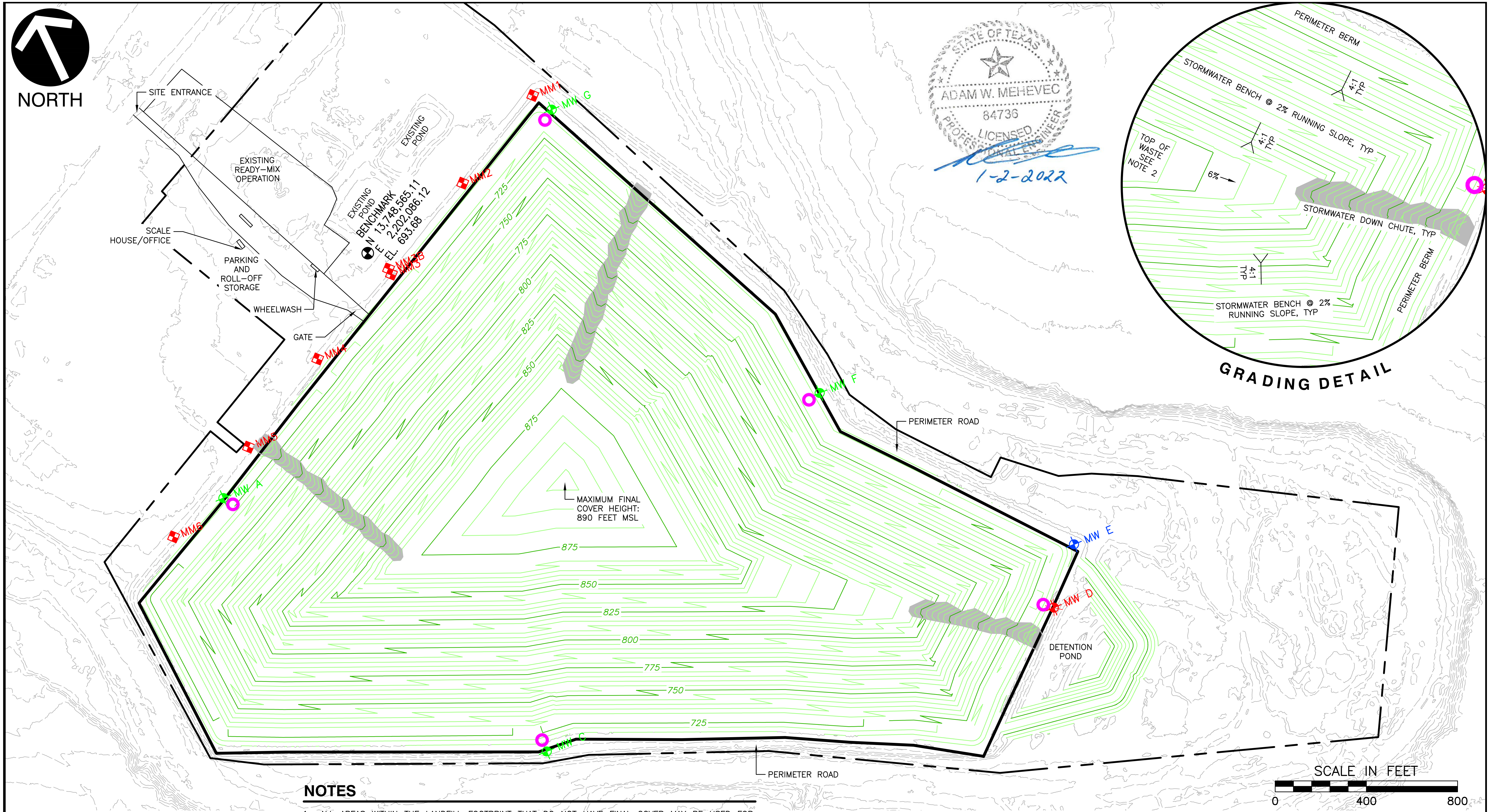

ADAM W. MEHEVEC
84736
1-2-2022

NOTES

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2. CONTINUE TO FILL AREAS TO 1848 A GRADES AND INSTALL INTERMEDIATE COVER.
3. INTERIM SLOPE FACE SHALL BE GRADED AT 3:1 MAXIMUM SLOPE.

LEGEND

●	EXISTING MONITOR WELL
◆	EXISTING GAS PROBE
○	EXISTING PIEZOMETER
●	MONITOR WELL–TO BE REMOVED
●	PROPOSED MONITOR WELL
— — —	LANDFILL PERMIT BOUNDARY
━━	LANDFILL FOOTPRINT BOUNDARY
🟩	CONSTRUCT FINAL LAND FILL COVER: ±155 ACRES

REFERENCE

TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY BY FIRMATEK: (SEPTEMBER 15, 2021) AUGMENTED WITH A PORTION OF THE EXISTING GROUND SURFACE PREPARED BY CEC.

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SEQUENCE PLAN (SEQUENCE 4)

DRAWN BY: MFV	CHECKED BY: AWM	APPROVED BY: AWM	FIGURE NO.:
DATE: 08/2022	DWG SCALE: 1" = 400'	PROJECT NO: 311-653	D1.6

MUNICIPAL SOLID WASTE PERMIT MAJOR AMENDMENT

PART III-ATTACHMENT D5
GEOTECHNICAL DESIGN

BECK
COMPANIES

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: September 2022
Revision 1 January 2023

Prepared by:

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Civil & Environmental Consultants, Inc.

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1-2-2023

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Appendix D5-A
Settlement Analysis

Appendix D5-B
Slope Stability Analyses

Appendix D5-C
Previous Geotechnical Report

STATE OF TEXAS
ADAM W. MEHEVEC
84736
LICENSED PROFESSIONAL ENGINEER
1-2-2023

INTRODUCTION

This Geotechnical Design Report present the results of the geotechnical engineering analysis performed in connection with the Permit Amendment Application for vertical expansion for the Beck Landfill located in Guadalupe County, Texas. The entire footprint of the landfill has been excavated and is currently partially filled with waste. The Beck Landfill is a Type IV landfill that accepts construction and demolition debris and is owned and operated by NIDO, Ltd. and is regulated by Texas Commission on Environmental Quality (TCEQ) under MSW Permit No. 1848.

The geotechnical characteristics of the site are summarized herein and are based on the information from previous geotechnical investigations of the site performed by Snowden, Inc. (Last Revised 1985) and Terracon (October, 2020).

Engineering analyses performed as part of this Geotechnical Design Report include the following:

- an analysis for settlement;
- stability of final filled landfill.

These calculations, along with the geotechnical properties of the subsurface described in Section 2 of this report, demonstrate that the soils at the site location are suitable for the intended landfill construction purposes. Descriptions of the engineering properties of the subsurface and the analyses performed are presented in the following sections. Calculations performed as part of the engineering evaluation are included in the attached appendices of this report and are summarized in the following sections.

This report supplements other reports and analyses included in the Permit Amendment Application. The analyses in this report are intended to address specific requirements of the Texas Commission on Environmental Quality (TCEQ) as they relate to municipal solid waste landfills. This report is intended to be considered as an integral part of the Permit Amendment Application.

1. GEOTECHNICAL TESTING

This Geotechnical Design Report is based on the field explorations described in Attachment E — Geology Report. All laboratory testing procedures followed the commonly accepted ASTM testing standards, as follows:

- Tests to determine Atterberg limits were performed in accordance with ASTM D 4318,
- Gradation testing and percent passing the number 200 sieve tests were performed in accordance with ASTM C 136 and ASTM D1140, respectively.
- Tests to determine moisture content were performed in accordance with ASTM D 2216.
- Permeability tests using tap water as the permeant were performed in accordance with ASTM D 5084.

These test results were used to classify the soils according to the Unified Soil Classification System (USCS) and to evaluate the engineering properties of the soils.

2. SUBSURFACE MATERIALS

The stratigraphy beneath the proposed Beck Landfill was characterized using information from the site exploration for the site and is presented in Attachment E — Geology Report.

Two strata have been identified by the current and previous subsurface explorations of the site and are described as follows:

- Unit I is composed primarily of alluvial silty clays, sands, and gravels deposited by Cibolo Creek encountered from the surface to a depth of up to 25 feet below ground surface (bgs).

- Unit II is composed primarily of low permeability clays and shales. Unit II is part of the Navarro Formation.

Table D5-1

Beck Landfill

Generalized Site Stratigraphy

Geologic Unit	Lithology	Average Depth to Top of Unit (ft)
Unit I	Silty Clay, Sand, and Gravel	Surface
Unit II	Clay and Shale	10-25

The Beck Landfill is wholly situated within the fluviatile terrace deposits (Qt) of the Pleistocene. This rock unit is comprised of gravel, sand, silt, and clay; adjacent to the Edwards Plateau, predominantly gravel, limestone, and chert; southeastward in vicinity of Tertiary rocks, increasing in amounts of sand, silt, and clay; contiguous terraces are separated by a solid line. The clay and shale of the Navarro and Taylor formations underlie the alluvial materials. The stratigraphy is variable within the Alluvial Deposit and somewhat variable in the Navarro and Taylor Deposits due to historic erosion of Cibolo Creek.

The Navarro Shale was shown by the laboratory portion of the previous investigations to be relatively impermeable. The Navarro Group, consisting of the upper Kemp Formation and the lower Corsicana Formation, represent the youngest of the Cretaceous age deposits in the central Texas vicinity. Generally, the Navarro deposit could be described as a gray calcareous clay shale. At least two beds of the Navarro, are indicated by geologic sources, to contain limey sandstones and concretionary siltstones. Neither of these beds were encountered by the exploratory borings. The uppermost portion of the deposit has weathered to produce an expansive tan-gray clay. The depth of weathering, as indicated by the borings, was somewhat variable beneath this site. This variation is primarily due to the natural joint structure and development of gypsum type deposits within such joints. Areas for greater and/or lesser potential moisture migration are thus expressed within the upper deposits. The determined values of permeability, however indicate all of the Navarro deposit, regardless of the state of weathering, to likely retain low permeabilities. The total thickness and position of the Navarro Group deposits could not be accurately determined by the exploratory borings performed.

2.1 Material Properties

The laboratory test results are included in Attachment E, - Geology Report. These test results were reviewed along with the boring logs to develop generalized soil properties for use in the analyses. The landfill excavation completely removed the Unit I material and was extended into the unweathered portion of Unit II.

2.2 Material Requirements

On-site soils are intended to be used for the construction of the infiltration layer and erosion layer components of the final cover system. Additionally, on-site soils will be required for operational cover. The bottom liner system utilized in-situ clay soils of Unit II and the entire liner system has been previously constructed.

The compacted final cover infiltration layer must be constructed from soils that can be compacted to form a low hydraulic conductivity barrier. The classification and hydraulic conductivity test results indicate that the clays excavated from the site will be satisfactory for use as compacted soil infiltration layer material. Classification and hydraulic conductivity test results for the compacted final cover infiltration layer will be verified prior to construction in accordance with Attachment D8 — Final Cover Quality Control Plan.

Erosion layer soils will not contain large rocks. Operational cover soils will not have been previously mixed with waste materials and erosion layer material will be capable of sustaining vegetation. The test results and boring logs indicate that any of the soil material excavated from the site will be suitable for use as operational cover and that the surficial soils will be suitable for use as the upper layer of the final cover system erosion layer. Classification results for erosion layer soils will be verified prior to construction in accordance with Attachment D8 — Final Cover Quality Control Plan.

3 EARTHWORK

3.1 Excavation

All excavation has been completed at the site and all of the landfill cells are partially filled with waste.

3.2 General Fill

General fill will be required to construct access roads and perimeter berms for landfill operations. General fill material shall be placed in accordance with the Liner Quality Control Plan contained in Attachment D7.

4 CONSTRUCTION BELOW THE GROUNDWATER TABLE

All landfill disposal cells have been previously constructed and none of them were excavated below the groundwater table.

5 SETTLEMENT ANALYSIS

5.1 Subgrade Heave

Heave or rebound can occur in cohesive soils after the removal of overburden. Heave occurs relatively soon after excavating the overburden and is directly related to the depth of the excavation. The potential heave in the subgrade beneath the floor of the landfill is expected to be minimal and should be uniform over the landfill floor. As such, any heave that may occur during and soon after excavation should not adversely affect the performance of the in-situ liner system.

5.2 Subgrade Settlement

Settlement may occur due to consolidation of cohesive soils from the weight of the landfill components (i.e., solid waste and operational cover, and final cover systems). However, since the landfill has ben previously excavated and does not have a leachate collection system, the expected minor degree of subgrade settlement will not affect the landfill's performance.

5.3 Solid Waste Settlement

Consolidation and decomposition can produce settlement within the solid waste. Primary consolidation results from stress increase and occurs soon after load application and secondary consolidation results from the decomposition of solid waste. Due to the length of time that it will take to construct and fill the landfill, most of the consolidation in the waste will have occurred prior to construction of the final cover system. Minor settlement that occurs after the construction of the final cover system will be corrected by the addition of erosion layer material in accordance with Attachment I — Post Closure Plan.

6 SLOPE STABILITY ANALYSIS

Slope stability analyses were performed on representative cross-sections of the landfill to evaluate the stability of the final waste slope and final cover slope, stability of excavated interior 3 Horizontal to 1 Vertical (3H:1V) side slopes prior to waste disposal, and stability of the perimeter berm under rapid drawdown conditions following a 100-year flood event. Table D5-2 summarizes the unit weights and strength parameters that were used for the stability analyses. The analyses use effective stress parameters. The unit weights and strength parameters for the in-situ soils were selected based on a review of the boring logs and historical laboratory and field test results, as well as prior CEC experience where applicable field data was not present. The unit weights and strength parameters for the liner/cover material and solid waste were selected based on prior CEC experience and laboratory test values. Site specific strength parameters for the liner and cover geosynthetic materials will be verified prior to construction in accordance with Attachment D7 — Liner Quality Control Plan and Attachment D8 — Final Cover Quality Control Plan.

Table D5-2
Beck Landfill
Summary of Material Weight and Strength Properties

Material	Dry Unit Weight (pcf)	Effective Angle of Internal Friction φ' (deg.)	Effective Cohesion, c' (psf)
C&D Waste	60	35	0
Clay Subgrade	108	0	1,400
Shale Subgrade	118	27	0
Compacted Perimeter Berm	123	28	270
In-situ Clay Liner	123	28	270

Slide, a computer program developed to model the slope stability, was used to analyze the stability of the final waste slopes and final cover slopes, stability of excavated 3H:1V interior side slopes, and stability of the perimeter berm following rapid drawdown. The results of the stability analyses indicate that the proposed slopes are stable under the conditions analyzed. Table D5-3 summarizes the results of the static stability analyses and compares the calculated factor of safety to the recommended minimum factor of safety. Table D5-4 summarizes the results of the excavated 3H:1V interior side slope analyses, and Table D5-5 summarizes the results of the rapid drawdown analyses. The recommended minimum factors of safety were selected from the Corps of Engineers "Design and construction of Levees" manual (EM 1110-2-1913) or CEC's experience. The slope stability analyses are provided in Appendix D5-B.

The final waste slope stability, excavated 3H:1V slope stability and rapid drawdown slope stability were analyzed for two failure modes to include circular arc failure surfaces and non-circular failure surfaces. Analysis were performed using properties of the solid waste, in-situ clay liner and supporting soils.

Table D5-3
Beck Landfill
Summary of Static Slope Stability Analyses

Cross Section	Failure Type	Minimum Factor of Safety	Allowable Factor of Safety
A	Circular	2.47	1.5
A	Non-Circular	2.34	1.5
B	Circular	2.43	1.5
B	Non-Circular	2.34	1.5
C	Circular	2.30	1.5
C	Non-Circular	2.23	1.5
D	Circular	2.46	1.5
D	Non-Circular	2.36	1.5

Table D5-4
Beck Landfill
Summary of 3H:1V Excavated Slope Stability Analyses

Cross Section	Failure Type	Minimum Factor of Safety	Allowable Factor of Safety
A	Circular	1.90	1.3
A	Non-Circular	1.82	1.3
B	Circular	1.88	1.3
B	Non-Circular	1.82	1.3
C	Circular	1.85	1.3
C	Non-Circular	1.76	1.3
D	Circular	1.78	1.3
D	Non-Circular	1.66	1.3

Table D5-5
Beck Landfill
Summary of Rapid Drawdown Slope Stability Analyses

Cross Section	Failure Type	Minimum Factor of Safety	Allowable Factor of Safety
A	Not Performed (1)	Not Applicable	1.5
B	Circular	1.59	1.5
B	Non-Circular	1.58	1.5
C	Circular	1.87	1.5
C	Non-Circular	1.86	1.5
D	Circular	2.61	1.5
D	Non-Circular	2.54	1.5

Notes
1. At Cross Section A the 100-year flood elevation is essentially the same elevation as the bottom of the perimeter berm. Therefore, at this location the perimeter berm would not be saturated, and a rapid drawdown analysis was not performed for Cross Section A

The slope stability analyses were performed for 3H:1V excavation and liner slopes, and 4H:1V final waste slopes. Any changes to the excavation plan, liner system, final cover system, or landfill completion plan will require that the permit be revised. Waste must be placed and properly compacted in horizontal lifts generally less than 20 feet thick. Temporary construction slopes should not be steeper than 3H:1V and concentrated loadings such as heavy equipment and soil stockpiles should not be placed near the crest of slopes unless the permit is revised.

7 LINER CONSTRUCTION

The entire landfill footprint has been excavated and an in-situ liner from the unweathered portion of Unit II was used in all cells.

8 COVER CONSTRUCTION

8.1 Operational Cover

The operational cover should be constructed of soils that are free of waste and debris. Suitable cover soils should be available from on-site sources such as the proposed landfill excavations or on-site borrows. Requirements for the placement of operational cover are provided in Part IV — Site Operating Plan.

8.2 Final Cover

The final cover for the Beck Landfill has been designed in accordance with 30TAC§330.457(a)(2), since the landfill does not have a synthetic bottom liner system. The final cover consists of a minimum 18-inch re-compacted cohesive soil cover, exhibiting a minimum hydraulic conductivity of 1.0 x 10^{-5} cm/sec, overlain by a minimum 6-inch erosion layer consisting of earthen material that is capable of sustaining native plant growth.

The final cover plan and details are included in Attachment D3 - Construction Design Details.

The infiltration layer material must consist of relatively homogeneous cohesive materials that are free of debris, rocks greater than 1 inch in diameter, plant materials, frozen materials, foreign objects, and organic material. The infiltration layer should be constructed directly over the intermediate cover once the waste has reached final grades.

The erosion layer should consist of: (1) topsoil stockpiled during the excavation process, (2) on-site soil that has been modified to be capable of sustaining vegetation, or (3) an imported material suitable to sustain vegetation growth. This layer may be spread and placed in one lift over the compacter soil layer. After spreading, the layer may be rolled lightly to reduce future erosion, although not to the extent that compaction would inhibit plant growth.

8.3 Final Cover Testing and Documentation

CQA testing of the final cover system must be performed during construction. Final cover system requirements are outlined in Attachment D8 — Final Cover Quality Control Plan.

Appendix D5-A

Settlement Analysis

STATE OF TEXAS
ADAM W. MEHEVEC
84736
LICENSED PROFESSIONAL ENGINEER
1-2-2023

PROJECT **Beck Landfill** PROJECT NO. **311-653**

Vertical Expansion Permit Application PAGE **1** OF **5**

Settlement Analysis

MADE BY **ZLM** DATE **4/7/2022** CHECKED BY **TDM** DATE **4/22/2022**

MADE BY **EDC** DATE **12/212022** CHECKED BY **TDM** DATE **4/22/2022**

CALCULATION BRIEF

BECK LANDFILL
VERTICAL EXPANSION PERMIT APPLICATION
FINAL COVER SETTLEMENT ANALYSIS

OBJECTIVE: Estimate the overall settlement that may occur in existing construction and demolition (C&D) waste at the Beck Landfill. This settlement will occur as new C&D waste is placed on top of the existing waste in accordance with the vertical expansion proposed grading, and also as decomposition of the existing waste occurs. Evaluate if the benches constructed in the final slopes will provide enough post-settlement grade to maintain drainage. Also, this calculation provides a sample cross section and 10-layer settlement calculation example.

METHODOLOGY: Use the method established by Sowers for calculating both primary and secondary waste settlement.

REFERENCES:

1. Sowers, G. F., “Settlement of Waste Disposal Fills,” Proceedings, 8th International Conference on Soil Mechanics and Foundation Engineering, Moscow, 1973.

ANALYSIS:

Overall settlement of existing waste will occur as new waste is placed in accordance with the proposed vertical expansion grades. Settlement of existing waste will occur through both primary and secondary consolidation. Sowers has provided the following methods for estimating both primary and secondary settlement of waste.

Primary Settlement

Primary settlement in waste is similar to primary consolidation in a soil and is due to the compression of the waste by an overlying load. In an effort to be conservative, the primary settlement of the waste mass was calculated using typical municipal solid waste (MSW) waste properties. In actuality, C&D waste is comprised of construction materials, aggregates, and similar materials that are likely to settle less than a comparable MSW waste column. CEC believes the settlements calculated using MSW properties will be greater than actual settlements from C&D waste, and therefore provide a conservative estimate of anticipated settlement. The method used to estimate primary settlement in this analysis was developed by Sowers [Reference Number (Ref. No.) 1].

The Sowers equation for primary settlement of waste is:

$$\Delta H = \frac{C_c H}{1 + e_o} \log \frac{\sigma_o + \Delta\sigma}{\sigma_o}$$

Where: ΔH = Primary settlement (ft);
Cc = Coefficient of primary consolidation (dimensionless);
H = Existing waste thickness (ft);
e_o = Initial void ratio of existing waste (dimensionless);
σ_o = Initial effective vertical stress in existing waste (psf); and
$\Delta\sigma$ = Change in vertical effective stress produced by surcharge load from overlay waste (psf).

Sowers related C to the initial void ratio and the decomposition environment as follows:

C_c = $0.15e_o$ (anaerobic, poor decomposition); and
C_c = $0.55e_o$ (aerobic, good decomposition).

The estimate of primary settlement in this analysis was made assuming a poor decomposition environment ($C_c = 0.15e_o$), since the existing waste is relatively old and anaerobic conditions are present with minimal further decomposition anticipated. Sowers recommends a void ratio of between 15 for very poorly compacted municipal solid waste to a low of 2 for well-compacted waste. The void ratio assumed in this analysis was 4, to represent MSW with relatively good decomposition that has already occurred in the existing waste.

Secondary Settlement

Secondary settlement in waste is similar to secondary consolidation in a soil and is due to the rearranging of the waste due primarily to decomposition. The method used to estimate secondary settlement in this analysis was developed by Sowers (Ref. 1). The Sowers equation for secondary settlement of waste is:

$$\Delta Hs = \frac{\alpha H}{1+e}\log\frac{t2}{t1}$$

Where: ΔHs = Secondary settlement (ft);
α = Coefficient of secondary consolidation (dimensionless);
H = Waste thickness (ft);
e = Void ratio of waste (dimensionless);
t1 = Time of initial primary consolidation (months); and
t2 = Time of secondary consolidation (months).

Sowers also related α to the initial void ratio and the decomposition environment as follows:

α = 0.03e (anaerobic, poor decomposition); and
α = 0.09e (aerobic, good decomposition).

The estimate of secondary settlement in this analysis was made assuming a poor decomposition environment (α = 0.03e). Sowers also recommends a time of initial primary consolidation (t1) of 1 month after placement of the waste. In this analysis, the time of secondary consolidation (t2) was taken as 240 months, since this represents approximately half of the estimated age of old existing waste. There is no as-built information available regarding the existing waste base grades. However, based on assumptions contained in the original landfill permit application, it is assumed that existing waste was placed at a constant base elevation of 650 feet above sea-level (FASL).

Settlement Analysis

In order to estimate the overall settlement that will occur in the existing waste along the drainage benches, a pair of points were placed approximately every 250 linear feet along each bench. At each location, one point was located at the crest of the bench, and one point was located at the toe of the bench. The thicknesses of the existing waste and the proposed vertical expansion waste were estimated at each point based on the existing and final grades shown on the attached Figures 1 and 2, respectively. Primary and secondary settlement was calculated, using the equations provided above, at each point location.

In all, settlement calculations were performed at 250 locations (125 sets of points) located along the drainage benches. Spreadsheets to estimate the primary and secondary settlement at each point location are attached to this calculation brief. The purpose of each spreadsheet is as follows:

- The Attachment 1 spreadsheet calculates the overall settlement that will occur at each point location as vertical expansion waste is placed. Figure 3 provides an example of the primary settlement calculation for Point No. 30. As shown, the calculation divides the existing waste into ten (10) equal thickness layers and calculates settlement for each layer and then sums the ten (10) layer settlements to obtain the total primary settlement for the existing waste.;

- The Attachment 2 spreadsheet shows the pre-settlement and post-settlement height difference between each set of points, in order to demonstrate that the benches will maintain sufficient grade across the bench to provide drainage during post-settlement conditions and prevent reverse gradient and overspilling of a bench; and

- The Attachment 3 spreadsheet shows the pre-settlement and post-settlement height difference between each set of points, in order to demonstrate that the benches will maintain sufficient grade along the bench to provide positive drainage during post-settlement conditions and prevent reverse gradient and ponding of stormwater on a bench.

RESULTS

Primary and Secondary Settlement

The results from the primary and secondary overall settlement evaluation (see Attachment 1) shows that the total settlement at each point ranges from 3.4 feet to 15.4 feet. In percentages, this equates to 5.7% to 22.3% of the existing waste thickness. This range is fairly consistent with the range of 8 to 20 percent provided by Sowers, as being typical of the percent settlement experienced by municipal solid waste. As such, the estimated magnitude of overall settlement in the proposed vertical expansion grading is reasonable.

Referring to Attachment 2, it is seen that each set of points across the benches will maintain a positive post-settlement grade between the outside edge of the bench and inside edge of the bench, and reversal of the across-the-bench gradient and overspilling will not occur. Referring to Attachment 3, it is seen that each set of points along the benches will maintain a positive post-

PROJECT **Beck Landfill** PROJECT NO. **311-653**

Vertical Expansion Permit Application PAGE **5** OF **5**

Settlement Analysis

MADE BY **ZLM** DATE **4/7/2022** CHECKED BY **TDM** DATE **4/22/2022**

MADE BY **EDC** DATE **12/212022** CHECKED BY **TDM** DATE **4/22/2022**

settlement grade, and reversal of the along-the-bench gradient and ponding of stormwater will not occur.

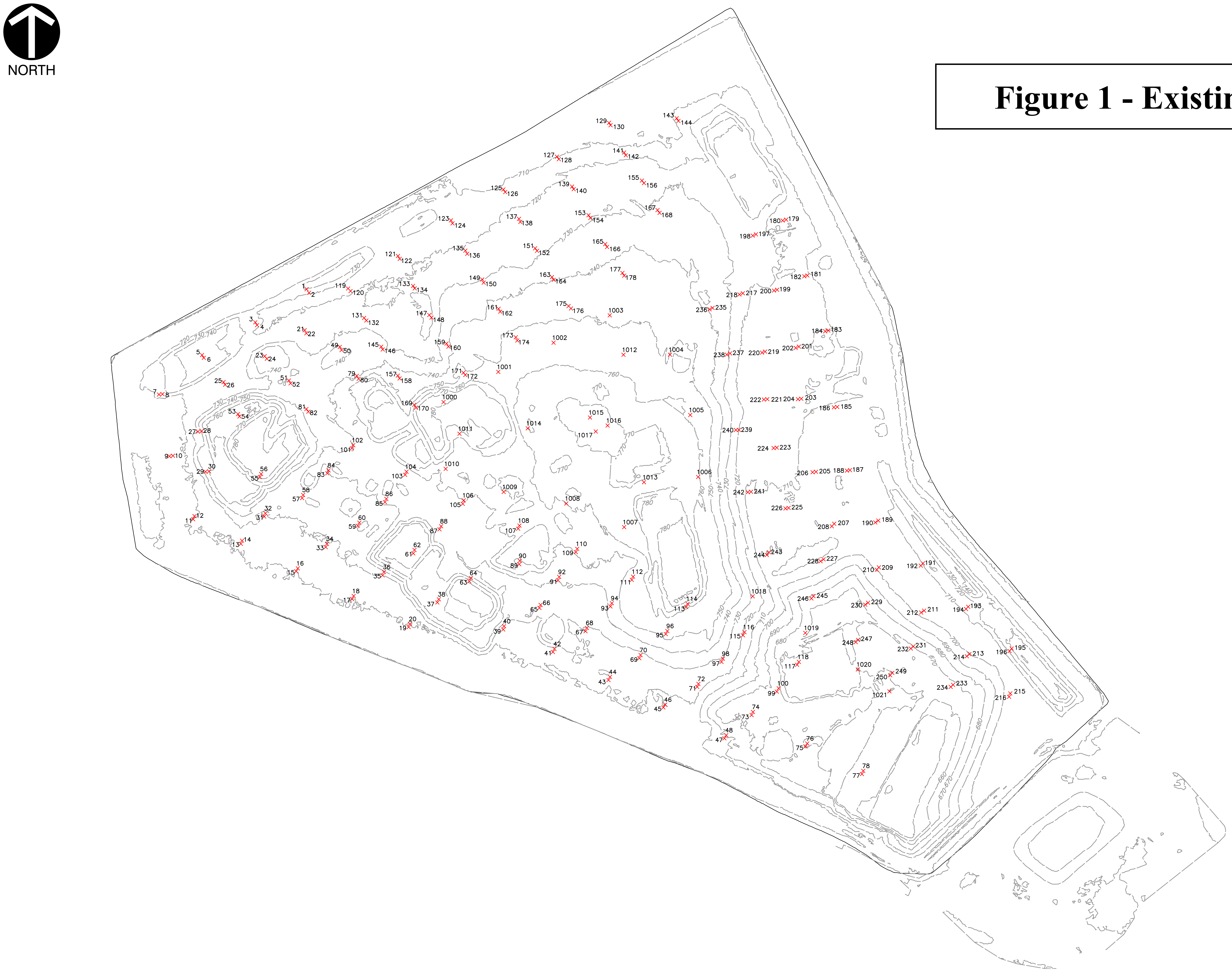
CONCLUSION: Generally, the estimated settlement calculated for each point is consistent with typically accepted MSW settlement values. Using typical MSW properties, each drainage bench will maintain positive grade across and along the bench in order to function as intended. In reality, the benches will likely experience less settlement than estimated in this calculation as C&D waste is less likely to settle than MSW. As such, the estimated settlement values are acceptable, and the configuration of the benches will be sufficient to maintain positive drainage to let downs and perimeter drainage features.

FIGURES

FIGURE 1

EXISTING GRADES

Figure 1 - Existing Grades



REFERENCE

EXISTING GROUND CONTOURS: UNITED STATES GEOLOGICAL SURVEY (USGS) HURRICANE LIDAR, 20190220 SUPPLEMENTED WITH SURVEY BY FIRMATEK DATED OCTOBER 24, 2020.

SCALE IN FEET

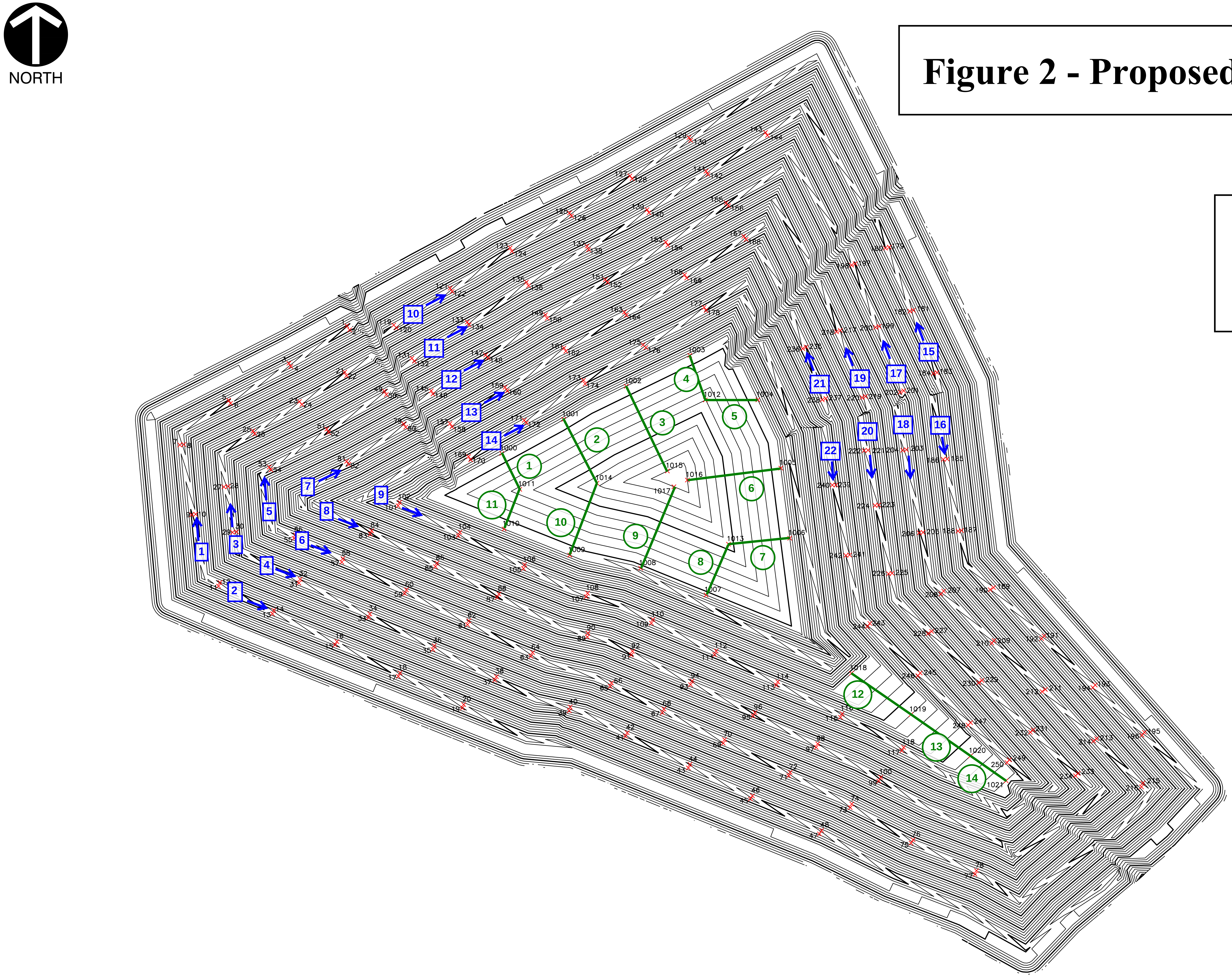
0 200 400

P:\310-000\311-653\-Calculations\Slope Stability\Settlement\Settlement Points.dwg{1} LS:(12/21/2022 - scoll) - LP: 12/21/2022 12:48 PM

FIGURE 2

PROPOSED VERTICAL EXPANSION FINAL GRADES

Figure 2 - Proposed Vertical Expansion Final Grades



1	BENCH NUMBER
↑	BENCH FLOW DIRECTION
⑤	TOP DECK LINE NUMBER

REFERENCE

EXISTING GROUND CONTOURS: UNITED STATES GEOLOGICAL SURVEY (USGS) HURRICANE LIDAR, 20190220 SUPPLEMENTED WITH SURVEY BY FIRMATEK DATED OCTOBER 24, 2020.

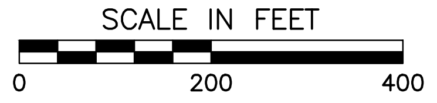


FIGURE 3

CROSS SECTION OF SETTLEMENT POINT NO. 30 AND 10-LAYER SETTLEMENT CALCULATION EXAMPLE

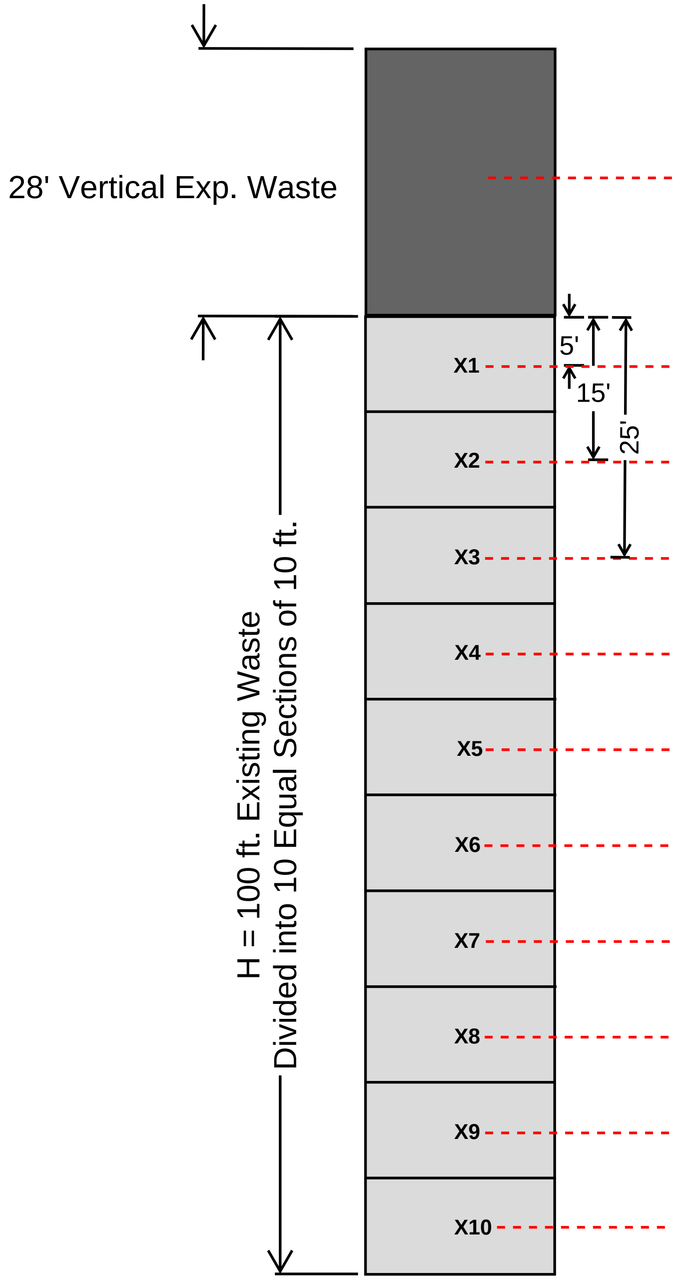
$$\Delta H_i = \frac{\left(\frac{C_C H}{1+\ e_0}\right)}{10}\ log\left(\frac{(\sigma_{0i}+\Delta\sigma)}{\sigma_{0i}}\right)$$

Cc = coefficient of primary consolidation = 0.6
H = Existing waste thickness = 100 ft
γ = unit weight of waste = 60 pcf
eo = initial void ratio of existing waste = 4.0

$$\text{Layer 1 Settlement} = \Delta \mathrm{H}_1 = \frac{\left(\frac{0.6 \text{ x } 100 \text{ ft}}{1+4}\right)}{10}\ \log\left(\frac{(300 \text{ psf}+1{,}680 \text{ psf})}{300 \text{ psf}}\right) = 0.98 \text{ ft}$$

$$\Delta H = \sum \Delta\mathrm{H}_1 +\ \Delta\mathrm{H}_2 + \Delta\mathrm{H}_3 + \Delta\mathrm{H}_4 + \Delta\mathrm{H}_5 + \Delta\mathrm{H}_6 + \Delta\mathrm{H}_7 + \Delta\mathrm{H}_8 + \Delta\mathrm{H}_9 + \Delta\mathrm{H}_{10}$$

$$\Delta\mathrm{H} = \sum 0.98' + 0.55' + 0.39' + 0.30' + 0.25' + 0.21' + 0.19' + 0.16' + 0.15' + 0.13' = 3.31 \text{ ft}$$



Δσ = Change in vertical effective stress produced
by surcharge load from vertical expansion waste

Δσ = 28 ft x 60 pcf = 1,680 psf

σoi = Initial effective vertical stress produced by
weight of existing waste in Layer i at
mid-point of Layer i

σo1 = X1 ft x γ = 5 ft x 60 pcf = 300 psf

σo2 = X2 ft x γ =15 ft x 60 pcf = 900 psf

σo3 = X3 ft x γ = 25 ft x 60 pcf =1,500 psf

σo4 = X4 ft x γ = 35 ft x 60 pcf = 2,100 psf

σo5 = X5 ft x γ = 45 ft x 60 pcf = 2,700 psf

σo6 = X5 ft x γ = 55 ft x 60 pcf = 3,300 psf

σo7 = X7 ft x γ = 65 ft x 60 pcf = 3,900 psf

σo8 = X8 ft x γ = 75 ft x 60 pcf =4,500 psf

σo9 = X9 ft x γ = 85 ft x 60 pcf =5,100 psf

σo10 = X10 ft x γ = 95 ft x 60 pcf = 5,700 psf

FIGURE 3 - CROSS SECTION OF SETTLEMENT POINT NO. 30
AND 10-LAYER SETTLEMENT CALCULATION EXAMPLE

ATTACHMENT 1

SETTLEMENT SPREADSHEET

BECK LANDFILL
ATTACHMENT 1 - SETTLEMENT SPREADSHEET

Project: Beck Landfill
Project No.: 311-653
Subject: Final Grades Settlement
Prepared By: ZLM 4/7/2022, EDC 12/21/2022
Checked By: TDM 4/22/2022

Unit Weight of Waste (pcf) =	60
Void Ratio (e_o) =	4
Compression Index (C_c) =	0.60
Coefficient of Secondary Consolidation (α) =	0.12

Pt	Existing Waste El. (ft)	Existing Waste Thick (ft)	Vertical Expansion Waste El. (ft)	Vertical Expansion Waste Thick (ft)	Front of Primary Settle Eqn	Primary Settlement in Each of 10 Equal Layers										Total Primary Settle. (ft)	Secondary Settle. (ft)	Total Settle. (ft)	Post Settle Final El. (ft)
						1	2	3	4	5	6	7	8	9	10				
1	729.60	80	730.25	1	0.96	0.06	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.1	4.5	4.7	725.6
2	722.74	73	729.21	6	0.87	0.39	0.18	0.12	0.09	0.07	0.06	0.05	0.04	0.04	0.03	1.1	4.2	5.2	724.0
3	721.93	72	735.04	13	0.86	0.58	0.30	0.21	0.16	0.13	0.11	0.09	0.08	0.07	0.07	1.8	4.1	5.9	729.1
4	721.92	72	733.33	11	0.86	0.54	0.27	0.18	0.14	0.11	0.09	0.08	0.07	0.06	0.06	1.6	4.1	5.7	727.6
5	743.70	94	740.15	0	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	5.4	5.4	734.8
6	743.52	94	738.30	0	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	5.3	5.3	733.0
7	724.04	74	745.22	21	0.89	0.74	0.41	0.29	0.23	0.19	0.16	0.14	0.12	0.11	0.10	2.5	4.2	6.7	738.5
8	726.59	77	743.30	17	0.92	0.67	0.36	0.25	0.19	0.16	0.13	0.12	0.10	0.09	0.08	2.2	4.4	6.5	736.8
9	717.72	68	750.36	33	0.81	0.83	0.51	0.38	0.31	0.26	0.22	0.20	0.18	0.16	0.14	3.2	3.9	7.0	743.3
10	719.00	69	748.37	29	0.83	0.81	0.48	0.36	0.29	0.24	0.21	0.18	0.16	0.15	0.13	3.0	3.9	6.9	741.4
11	720.40	70	753.62	33	0.84	0.86	0.52	0.39	0.31	0.26	0.23	0.20	0.18	0.16	0.15	3.3	4.0	7.3	746.3
12	719.00	69	751.70	33	0.83	0.84	0.51	0.38	0.31	0.26	0.22	0.20	0.18	0.16	0.15	3.2	3.9	7.1	744.6
13	722.06	72	749.30	27	0.86	0.81	0.47	0.35	0.28	0.23	0.20	0.17	0.15	0.14	0.13	2.9	4.1	7.0	742.3
14	722.68	73	747.43	25	0.87	0.78	0.45	0.33	0.26	0.21	0.18	0.16	0.14	0.13	0.12	2.8	4.2	6.9	740.5
15	720.14	70	744.37	24	0.84	0.76	0.44	0.32	0.25	0.21	0.18	0.16	0.14	0.12	0.11	2.7	4.0	6.7	737.7
16	722.03	72	742.44	20	0.86	0.71	0.40	0.28	0.22	0.18	0.16	0.14	0.12	0.11	0.10	2.4	4.1	6.5	735.9
17	720.00	70	739.38	19	0.84	0.68	0.38	0.27	0.21	0.17	0.15	0.13	0.11	0.10	0.09	2.3	4.0	6.3	733.1
18	721.05	71	737.43	16	0.85	0.64	0.34	0.24	0.19	0.15	0.13	0.11	0.10	0.09	0.08	2.1	4.1	6.1	731.3
19	719.28	69	734.31	15	0.83	0.60	0.32	0.23	0.17	0.14	0.12	0.10	0.09	0.08	0.07	1.9	4.0	5.9	728.4
20	719.91	70	732.44	13	0.84	0.55	0.29	0.20	0.15	0.12	0.10	0.09	0.08	0.07	0.06	1.7	4.0	5.7	726.7
21	727.00	77	759.92	33	0.92	0.91	0.54	0.40	0.32	0.27	0.23	0.20	0.18	0.16	0.15	3.4	4.4	7.8	752.2
22	727.57	78	758.10	31	0.93	0.88	0.52	0.38	0.30	0.25	0.22	0.19	0.17	0.15	0.14	3.2	4.4	7.6	750.5
23	745.00	95	764.02	19	1.14	0.80	0.42	0.29	0.22	0.18	0.15	0.13	0.12	0.10	0.09	2.5	5.4	7.9	756.1
24	745.00	95	762.11	17	1.14	0.76	0.39	0.27	0.21	0.17	0.14	0.12	0.11	0.10	0.09	2.3	5.4	7.8	754.3
25	725.90	76	768.77	43	0.91	0.99	0.62	0.47	0.38	0.32	0.28	0.25	0.22	0.20	0.18	3.9	4.3	8.3	760.5
26	725.30	75	767.05	42	0.90	0.98	0.61	0.46	0.37	0.32	0.27	0.24	0.22	0.20	0.18	3.8	4.3	8.1	758.9
27	731.90	82	775.32	43	0.98	1.05	0.65	0.49	0.39	0.33	0.29	0.25	0.23	0.21	0.19	4.1	4.7	8.7	766.6
28	741.94	92	773.28	31	1.10	0.99	0.57	0.41	0.33	0.27	0.23	0.20	0.18	0.16	0.15	3.5	5.3	8.7	764.5
29	743.40	93	779.31	36	1.12	1.05	0.62	0.45	0.36	0.30	0.26	0.23	0.20	0.18	0.17	3.8	5.3	9.2	770.2
30	749.50	100	777.34	28	1.19	0.98	0.55	0.39	0.30	0.25	0.21	0.19	0.16	0.15	0.13	3.3	5.7	9.0	768.3
31	729.99	80	777.96	48	0.96	1.07	0.67	0.51	0.42	0.35	0.31	0.27	0.24	0.22	0.20	4.3	4.6	8.8	769.1
32	729.02	79	776.10	47	0.95	1.05	0.66	0.50	0.41	0.35	0.30	0.27	0.24	0.22	0.20	4.2	4.5	8.7	767.4
33	729.00	79	772.48	43	0.95	1.02	0.63	0.48	0.39	0.33	0.29	0.25	0.23	0.21	0.19	4.0	4.5	8.5	764.0
34	729.53	80	770.55	41	0.95	1.01	0.62	0.46	0.38	0.32	0.27	0.24	0.22	0.20	0.18	3.9	4.5	8.4	762.1
35	729.89	80	767.38	37	0.96	0.97	0.59	0.44	0.35	0.30	0.26	0.23	0.20	0.18	0.17	3.7	4.6	8.3	759.1
36	736.92	87	765.52	29	1.04	0.92	0.53	0.38	0.30	0.25	0.21	0.19	0.16	0.15	0.13	3.2	5.0	8.2	757.3
37	755.01	105	762.49	7	1.26	0.48	0.21	0.14	0.10	0.08	0.07	0.06	0.05	0.04	0.04	1.3	6.0	7.3	755.2
38	755.71	106	760.56	5	1.27	0.36	0.15	0.09	0.07	0.05	0.04	0.04	0.03	0.03	0.03	0.9	6.0	6.9	753.6
39	724.21	74	756.89	33	0.89	0.88	0.53	0.39	0.32	0.26	0.23	0.20	0.18	0.16	0.15	3.3	4.2	7.5	749.4
40	725.04	75	755.03	30	0.90	0.86	0.51	0.37	0.30	0.25	0.21	0.19	0.17	0.15	0.14	3.1	4.3	7.4	747.6
41	724.00	74	752.57	29	0.89	0.84	0.49	0.36	0.29	0.24	0.21	0.18	0.16	0.14	0.13	3.0	4.2	7.3	745.3
42	725.87	76	750.66	25	0.91	0.80	0.46	0.33	0.26	0.22	0.18	0.16	0.14	0.13	0.12	2.8	4.3	7.1	743.5
43	722.76	73	747.61	25	0.87	0.78	0.45	0.33	0.26	0.21	0.18	0.16	0.14	0.13	0.12	2.8	4.2	6.9	740.7
44	724.96	75	745.66	21	0.90	0.73	0.41	0.29	0.23	0.19	0.16	0.14	0.12	0.11	0.10	2.5	4.3	6.8	738.9
45	719.53	70	742.70	23	0.83	0.74	0.42	0.31	0.24	0.20	0.17	0.15	0.13	0.12	0.11	2.6	4.0	6.6	736.1
46	719.97	70	740.80	21	0.84	0.71	0.40	0.29	0.22	0.19	0.16	0.14	0.12	0.11	0.10	2.4	4.0	6.4	734.4
47	701.45	51	736.94	35	0.62	0.72	0.46	0.36	0.29	0.25	0.22	0.19	0.17	0.16	0.15	3.0	2.9	5.9	731.0
48	698.83	49	735.34	37	0.59	0.70	0.46	0.35	0.29	0.25	0.22	0.19	0.18	0.16	0.15	3.0	2.8	5.7	729.6
49	739.99	90	786.14	46	1.08	1.14	0.70	0.52	0.42	0.36	0.31	0.27	0.24	0.22	0.20	4.4	5.1	9.5	776.6
50	740.76	91	784.37	44	1.09	1.12	0.68	0.51	0.41	0.34	0.30	0.26	0.23	0.21	0.19	4.3	5.2	9.4	774.9
51	737.92	88	791.22	53	1.06	1.18	0.74	0.56	0.46	0.39	0.34	0.30	0.27	0.25	0.23	4.7	5.0	9.7	781.5
52	739.00	89	789.41	50	1.07	1.17	0.73	0.55	0.45	0.38	0.33	0.29	0.26	0.24	0.22	4.6	5.1	9.7	779.7
53	763.00	113	798.87	36	1.36	1.17	0.67	0.48	0.38	0.31	0.27	0.23	0.21	0.19	0.17	4.1	6.5	10.5	788.3
54	763.08	113	797.30	34	1.36	1.15	0.65	0.47	0.37	0.30	0.26	0.23	0.20	0.18	0.16	4.0	6.5	10.4	786.9
55	781.99	132	807.47	25	1.58	1.09	0.57	0.39	0.30	0.25	0.21	0.18	0.16	0.14	0.13	3.4	7.5	10.9	796.5
56	783.49	133	805.66	22	1.60	1.02	0.52	0.35	0.27	0.22	0.18	0.16	0.14	0.12	0.11	3.1	7.6	10.7	794.9
57	735.99	86	803.75	68	1.03	1.26	0.82	0.64	0.53	0.45	0.40	0.36	0.32	0.29	0.27	5.3	4.9	10.3	793.5
58	735.61	86	801.93	66	1.03	1.25	0.81	0.63	0.52	0.45	0.39	0.35	0.32	0.29	0.27	5.3	4.9	10.2	791.8
59	737.31	87	798.75	61	1.05	1.23	0.79	0.61	0.50	0.43	0.37	0.33	0.30	0.27	0.25	5.1	5.0	10.1	788.7
60	737.64	88	796.86	59	1.05	1.22	0.78	0.60	0.49	0.42	0.37	0.33	0.29	0.27	0.25	5.0	5.0	10.0	786.8
61	778.00	128	793.74	16	1.54	0.83	0.40	0.27	0.20	0.16	0.13	0.12	0.10	0.09	0.08	2.4	7.3	9.7	784.1
62	777.94	128	791.99	14	1.54	0.77	0.37	0.24	0.18	0.15	0.12	0.10	0.09	0.08	0.07	2.2	7.3	9.5	782.5
63	766.02	116	788.58	23	1.39	0.96	0.50	0.35	0.27	0.22	0.18	0.16	0.14	0.12	0.11	3.0	6.6	9.6	778.9
64	751.19	101	786.76	36	1.21	1.10	0.64	0.46	0.37	0.30	0.26	0.23	0.20	0.18	0.17	3.9	5.8	9.7	777.1
65	732.94	83	782.68	50	1.00	1.11	0.70	0.53	0.43	0.37	0.32	0.28	0.25	0.23	0.21	4.4	4.7	9.2	773.5
66	733.00	83	780.90	48	1.00	1.09	0.68	0.52	0.42	0.36	0.31	0.27	0.25	0.22	0.21	4.3	4.7	9.1	771.8
67	729.58	80	778.73	49	0.95	1.07	0.68	0.52	0.42	0.36	0.31	0.28	0.25	0.23	0.21	4.3	4.5	8.9	769.9
68	729.70	80	776.89	47	0.96	1.06	0.66	0.50	0.41	0.35	0.30	0.27	0.24	0.22	0.20	4.2	4.6	8.8	768.1
69	726.33	76	774.03	48	0.92	1.04	0.65	0.50	0.41	0.35	0.30	0.27	0.24	0.22	0.20	4.2	4.4	8.5	765.5
70	727.81	78	772.16	44	0.93	1.02	0.64	0.48	0.39	0.33	0.29	0.26	0.23	0.21	0.19	4.0	4.4	8.5	763.7
71	722.99	73	768.85	46	0.88	0.99	0.63	0.48	0.39	0.33	0.29	0.26	0.23	0.21	0.19	4.0	4.2	8.2	760.7
72	723.50	73	767.02	44	0.88	0.98	0.61	0.47	0.38	0.32	0.28	0.25	0.22	0.20	0.19	3.9	4.2	8.1	758.9
73	686.38	36	764.05	78	0.44	0.72	0.52	0.43	0.37	0.33	0.30	0.28	0.26	0.24	0.22	3.7	2.1	5.7	758.3
74	686.00	36	762.16	76	0.43	0.71	0.51	0.42	0.37	0.33	0.30	0.27	0.25	0.23	0.22	3.6	2.1	5.7	756.5
75	680.00	30	758.81	79	0.36	0.62	0.46	0.38	0.33	0.30	0.27	0.25	0.24	0.22	0.21	3.3	1.7	5.0	753.8
76	680.00	30	757.57	78	0.36	0.62	0.45	0.38	0.33	0.30	0.27	0.25	0.23	0.22	0.21	3.3	1.7	5.0	752.6
77	668.00	18	753.97	86	0.22	0.43	0.33	0.28	0.25	0.23	0.21	0.20	0.19	0.18	0.17	2.5	1.0	3.5	750.5
78	667.99	18	752.18	84	0.22	0.43	0.33	0.28	0.25	0.23	0.21	0.20	0.19	0.18	0.17	2.4	1.0	3.5	748.7
79	739.96	90	814.24	74	1.08	1.34	0.88	0.68	0.57	0.49	0.43	0.38	0.35	0.32	0.29	5.7	5.1	10.9	803.4
80	743.21	93	812.32	69	1.12	1.34	0.87	0.67	0.55	0.47	0.41	0.37	0.33	0.30	0.28	5.6	5.3	10.9	801.4
81	735.83	86	819.16	83	1.03	1.35	0.90	0.71	0.59	0.51	0.45	0.41	0.37	0.34	0.31	6.0	4.9	10.9	808.3
82	735.50	86	817.54	82	1.03	1.34	0.89	0.70	0.59	0.51	0.45	0.40	0.37	0.34	0.31	5.9	4.9	10.8	806.8
83	739.99	90	830.65	91	1.08	1.43	0.96	0.76	0.64	0.55	0.49	0.44	0.40	0.37	0.34	6.4	5.1	11.5	819.1
84	742.23	92	828.87	87	1.11	1.43	0.95	0.75	0.63	0.54	0.48	0.43	0.39	0.36	0.33	6.3	5.3	11.6	817.3
85	744.34	94	825.45	81	1.13	1.43	0.94	0.73	0.61	0.53	0.46	0.41	0.38	0.34	0.32	6.1	5.4	11.5	813.9
86	747.24	97	823.59	76	1.17	1.43	0.93	0.72	0.60	0.51	0.45	0.40	0.36	0.33	0.31	6.0	5.6	11.6	812.0
87	744.95	95	820.42	75	1.14	1.40	0.91	0.71	0.59	0.50	0.44	0.40	0.36	0.33	0.30	5.9	5.4	11.4	809.1
88	744.99	95	818.49	73	1.14	1.39	0.90	0.70	0.58	0.50	0.43	0.39	0.35	0.32	0.29	5.8	5.4	11.3	807.2
89	756.21	106	813.31	57	1.27	1.36	0.84	0.64	0.52	0.44	0.38	0.33	0.30	0.27	0.25	5.3	6.1	11.4	801.9
90	757.23	107	811.54	54	1.29	1.35	0.82	0.62	0.50	0.42	0.36	0.32	0.29	0.26	0.24	5.2	6.1	11.3	800.2

BECK LANDFILL
ATTACHMENT 1 - SETTLEMENT SPREADSHEET

Pt	Existing Waste El. (ft)	Existing Waste Thick (ft)	Vertical Expansion Waste El. (ft)	Vertical Expansion Waste Thick (ft)	Front of Primary Settle Eqn	Primary Settlement in Each of 10 Equal Layers										Total Primary Settle. (ft)	Secondary Settle. (ft)	Total Settle. (ft)	Post Settle Final El. (ft)
						1	2	3	4	5	6	7	8	9	10				
91	740.51	91	810.11	70	1.09	1.32	0.86	0.66	0.55	0.47	0.41	0.37	0.33	0.30	0.28	5.6	5.2	10.7	799.4
92	742.06	92	808.27	66	1.10	1.31	0.84	0.65	0.54	0.46	0.40	0.36	0.32	0.29	0.27	5.4	5.3	10.7	797.6
93	742.38	92	805.64	63	1.11	1.29	0.83	0.63	0.52	0.45	0.39	0.35	0.31	0.28	0.26	5.3	5.3	10.6	795.0
94	743.75	94	803.76	60	1.12	1.28	0.81	0.62	0.51	0.43	0.38	0.33	0.30	0.27	0.25	5.2	5.4	10.6	793.2
95	751.16	101	800.87	50	1.21	1.26	0.77	0.57	0.46	0.39	0.34	0.30	0.27	0.24	0.22	4.8	5.8	10.6	790.3
96	753.30	103	798.93	46	1.24	1.23	0.74	0.55	0.44	0.37	0.32	0.28	0.25	0.23	0.21	4.6	5.9	10.5	788.4
97	727.64	78	795.97	68	0.93	1.18	0.78	0.61	0.51	0.44	0.39	0.35	0.31	0.29	0.27	5.1	4.4	9.6	786.4
98	729.29	79	794.07	65	0.95	1.18	0.77	0.60	0.50	0.43	0.38	0.34	0.30	0.28	0.26	5.0	4.5	9.6	784.5
99	687.43	37	790.80	103	0.45	0.79	0.58	0.49	0.43	0.38	0.35	0.32	0.30	0.28	0.27	4.2	2.1	6.3	784.5
100	684.54	35	789.15	105	0.41	0.74	0.55	0.46	0.41	0.37	0.34	0.31	0.29	0.27	0.26	4.0	2.0	6.0	783.2
101	739.99	90	857.65	118	1.08	1.55	1.07	0.86	0.73	0.64	0.57	0.52	0.47	0.44	0.41	7.2	5.1	12.4	845.3
102	740.06	90	855.76	116	1.08	1.54	1.06	0.85	0.72	0.63	0.57	0.51	0.47	0.43	0.40	7.2	5.1	12.3	843.4
103	746.25	96	852.84	107	1.15	1.58	1.07	0.85	0.72	0.62	0.55	0.50	0.45	0.42	0.39	7.1	5.5	12.6	840.2
104	746.91	97	850.95	104	1.16	1.57	1.06	0.84	0.71	0.62	0.55	0.49	0.45	0.41	0.38	7.1	5.5	12.6	838.3
105	746.82	97	847.31	100	1.16	1.55	1.04	0.83	0.70	0.60	0.53	0.48	0.44	0.40	0.37	7.0	5.5	12.5	834.8
106	750.04	100	845.43	95	1.20	1.56	1.04	0.82	0.69	0.59	0.52	0.47	0.43	0.39	0.36	6.9	5.7	12.6	832.8
107	753.50	104	842.10	89	1.24	1.56	1.03	0.80	0.67	0.57	0.51	0.45	0.41	0.38	0.35	6.7	5.9	12.6	829.5
108	753.94	104	840.54	87	1.25	1.56	1.02	0.79	0.66	0.57	0.50	0.45	0.40	0.37	0.34	6.7	5.9	12.6	827.9
109	751.49	101	837.54	86	1.22	1.53	1.00	0.78	0.65	0.56	0.49	0.44	0.40	0.37	0.34	6.6	5.8	12.4	825.2
110	751.29	101	835.64	84	1.22	1.52	0.99	0.77	0.64	0.55	0.49	0.44	0.39	0.36	0.33	6.5	5.8	12.3	823.4
111	754.87	105	832.87	78	1.26	1.51	0.98	0.75	0.62	0.53	0.47	0.42	0.38	0.34	0.32	6.3	6.0	12.3	820.6
112	754.77	105	830.95	76	1.26	1.50	0.96	0.74	0.61	0.53	0.46	0.41	0.37	0.34	0.31	6.2	6.0	12.2	818.7
113	766.65	117	828.27	62	1.40	1.49	0.92	0.69	0.56	0.47	0.41	0.36	0.32	0.29	0.27	5.8	6.7	12.4	815.8
114	770.45	120	826.34	56	1.45	1.46	0.88	0.66	0.53	0.44	0.38	0.34	0.30	0.27	0.25	5.5	6.9	12.4	813.9
115	719.35	69	823.29	104	0.83	1.24	0.87	0.70	0.60	0.53	0.48	0.43	0.40	0.37	0.34	6.0	4.0	9.9	813.4
116	718.41	68	821.40	103	0.82	1.23	0.86	0.69	0.59	0.52	0.47	0.43	0.39	0.36	0.34	5.9	3.9	9.8	811.6
117	667.32	17	816.89	150	0.21	0.47	0.37	0.32	0.29	0.27	0.25	0.24	0.23	0.22	0.21	2.9	1.0	3.9	813.0
118	667.95	18	814.05	146	0.22	0.48	0.38	0.33	0.30	0.28	0.26	0.24	0.23	0.22	0.21	2.9	1.0	3.9	810.1
119	719.04	69	749.77	31	0.83	0.82	0.50	0.37	0.30	0.25	0.21	0.19	0.17	0.15	0.14	3.1	3.9	7.0	742.7
120	719.46	69	747.76	28	0.83	0.80	0.48	0.35	0.28	0.23	0.20	0.18	0.16	0.14	0.13	2.9	4.0	6.9	740.9
121	716.20	66	744.96	29	0.79	0.78	0.47	0.35	0.28	0.23	0.20	0.18	0.16	0.14	0.13	2.9	3.8	6.7	738.3
122	716.80	67	743.09	26	0.80	0.76	0.45	0.33	0.26	0.22	0.19	0.16	0.15	0.13	0.12	2.8	3.8	6.6	736.5
123	714.14	64	739.85	26	0.77	0.74	0.43	0.32	0.26	0.21	0.18	0.16	0.14	0.13	0.12	2.7	3.7	6.4	733.5
124	714.77	65	737.96	23	0.78	0.71	0.41	0.30	0.24	0.20	0.17	0.15	0.13	0.12	0.11	2.5	3.7	6.2	731.7
125	711.72	62	734.95	23	0.74	0.69	0.40	0.30	0.23	0.20	0.17	0.15	0.13	0.12	0.11	2.5	3.5	6.0	728.9
126	714.04	64	733.11	19	0.77	0.65	0.36	0.26	0.21	0.17	0.14	0.13	0.11	0.10	0.09	2.2	3.7	5.9	727.2
127	709.76	60	729.88	20	0.72	0.64	0.37	0.27	0.21	0.17	0.15	0.13	0.12	0.10	0.09	2.2	3.4	5.7	724.2
128	711.56	62	728.09	17	0.74	0.59	0.33	0.23	0.18	0.15	0.13	0.11	0.10	0.09	0.08	2.0	3.5	5.5	722.6
129	705.60	56	724.86	19	0.67	0.60	0.35	0.25	0.20	0.17	0.14	0.12	0.11	0.10	0.09	2.1	3.2	5.3	719.6
130	705.81	56	723.28	17	0.67	0.58	0.33	0.24	0.19	0.15	0.13	0.11	0.10	0.09	0.08	2.0	3.2	5.2	718.1
131	727.13	77	777.84	51	0.93	1.07	0.68	0.52	0.42	0.36	0.32	0.28	0.25	0.23	0.21	4.3	4.4	8.7	769.1
132	727.86	78	775.87	48	0.93	1.05	0.66	0.50	0.41	0.35	0.31	0.27	0.24	0.22	0.20	4.2	4.4	8.7	767.2
133	720.82	71	773.13	52	0.85	1.02	0.66	0.51	0.42	0.36	0.31	0.28	0.25	0.23	0.21	4.3	4.0	8.3	764.8
134	720.71	71	771.44	51	0.85	1.01	0.65	0.50	0.41	0.35	0.31	0.27	0.25	0.23	0.21	4.2	4.0	8.2	763.2
135	721.36	71	768.09	47	0.86	0.98	0.62	0.48	0.39	0.33	0.29	0.26	0.23	0.21	0.19	4.0	4.1	8.1	760.0
136	722.75	73	766.40	44	0.87	0.97	0.61	0.46	0.38	0.32	0.28	0.25	0.22	0.20	0.19	3.9	4.2	8.0	758.4
137	722.25	72	762.99	41	0.87	0.94	0.59	0.44	0.36	0.31	0.27	0.24	0.21	0.19	0.18	3.7	4.1	7.8	755.1
138	722.56	73	761.25	39	0.87	0.93	0.57	0.43	0.35	0.30	0.26	0.23	0.20	0.18	0.17	3.6	4.1	7.8	753.5
139	722.79	73	757.96	35	0.87	0.90	0.55	0.41	0.33	0.28	0.24	0.21	0.19	0.17	0.16	3.4	4.2	7.6	750.4
140	722.95	73	756.22	33	0.88	0.88	0.53	0.39	0.32	0.27	0.23	0.20	0.18	0.16	0.15	3.3	4.2	7.5	748.7
141	713.97	64	753.07	39	0.77	0.86	0.54	0.41	0.34	0.29	0.25	0.22	0.20	0.18	0.17	3.5	3.7	7.1	746.0
142	716.72	67	751.24	35	0.80	0.84	0.52	0.39	0.32	0.27	0.23	0.20	0.18	0.17	0.15	3.3	3.8	7.1	744.2
143	712.40	62	748.07	36	0.75	0.82	0.51	0.39	0.31	0.27	0.23	0.21	0.18	0.17	0.15	3.2	3.6	6.8	741.3
144	713.13	63	746.26	33	0.76	0.80	0.49	0.37	0.30	0.25	0.22	0.19	0.17	0.16	0.14	3.1	3.6	6.7	739.5
145	731.05	81	805.78	75	0.97	1.25	0.83	0.65	0.55	0.47	0.42	0.37	0.34	0.31	0.29	5.5	4.6	10.1	795.7
146	730.96	81	803.99	73	0.97	1.24	0.82	0.64	0.54	0.46	0.41	0.37	0.33	0.31	0.28	5.4	4.6	10.0	794.0
147	715.84	66	801.16	85	0.79	1.13	0.78	0.63	0.53	0.47	0.42	0.38	0.34	0.32	0.30	5.3	3.8	9.0	792.1
148	719.98	70	799.29	79	0.84	1.15	0.78	0.62	0.53	0.46	0.41	0.37	0.34	0.31	0.29	5.3	4.0	9.3	790.0
149	729.96	80	796.05	66	0.96	1.19	0.78	0.61	0.51	0.43	0.38	0.34	0.31	0.28	0.26	5.1	4.6	9.7	786.4
150	730.80	81	794.18	63	0.97	1.19	0.77	0.60	0.50	0.42	0.37	0.33	0.30	0.28	0.25	5.0	4.6	9.6	784.6
151	728.39	78	791.03	63	0.94	1.16	0.75	0.59	0.49	0.42	0.37	0.33	0.30	0.27	0.25	4.9	4.5	9.4	781.6
152	729.02	79	789.20	60	0.95	1.15	0.74	0.58	0.48	0.41	0.36	0.32	0.29	0.26	0.24	4.8	4.5	9.3	779.9
153	728.64	79	785.92	57	0.94	1.13	0.72	0.56	0.46	0.39	0.35	0.31	0.28	0.25	0.23	4.7	4.5	9.2	776.7
154	729.39	79	784.20	55	0.95	1.12	0.71	0.55	0.45	0.38	0.34	0.30	0.27	0.25	0.23	4.6	4.5	9.1	775.1
155	725.49	75	780.95	55	0.91	1.08	0.70	0.54	0.45	0.38	0.33	0.30	0.27	0.25	0.23	4.5	4.3	8.8	772.1
156	725.72	76	779.09	53	0.91	1.07	0.69	0.53	0.44	0.37	0.33	0.29	0.26	0.24	0.22	4.4	4.3	8.8	770.3
157	743.15	93	833.81	91	1.12	1.47	0.98	0.77	0.65	0.56	0.49	0.44	0.40	0.37	0.34	6.5	5.3	11.8	822.0
158	743.78	94	831.91	88	1.13	1.46	0.97	0.76	0.64	0.55	0.49	0.44	0.40	0.36	0.34	6.4	5.4	11.8	820.1
159	736.82	87	829.06	92	1.04	1.40	0.95	0.75	0.63	0.55	0.49	0.44	0.40	0.37	0.34	6.3	5.0	11.3	817.8
160	738.48	88	827.30	89	1.06	1.41	0.94	0.74	0.62	0.54	0.48	0.43	0.39	0.36	0.33	6.2	5.1	11.3	816.0
161	743.28	93	824.04	81	1.12	1.41	0.93	0.73	0.61	0.52	0.46	0.41	0.37	0.34	0.31	6.1	5.3	11.4	812.6
162	744.28	94	822.16	78	1.13	1.41	0.92	0.72	0.60	0.51	0.45	0.40	0.36	0.33	0.31	6.0	5.4	11.4	810.8
163	739.22	89	818.98	80	1.07	1.37	0.90	0.71	0.59	0.51	0.45	0.40	0.36	0.33	0.31	5.9	5.1	11.0	807.9
164	739.96	90	817.14	77	1.08	1.36	0.89	0.70	0.58	0.50	0.44	0.39	0.36	0.33	0.30	5.9	5.1	11.0	806.1
165	736.31	86	813.92	78	1.04	1.32	0.87	0.69	0.57	0.49	0.44	0.39	0.35	0.32	0.30	5.8	4.9	10.7	803.2
166	737.00	87	812.10	75	1.04	1.32	0.87	0.68	0.56	0.49	0.43	0.38	0.35	0.32	0.29	5.7	5.0	10.6	801.4
167	730.99	81	808.90	78	0.97	1.27	0.85	0.67	0.56	0.48	0.43	0.38	0.35	0.32	0.30	5.6	4.6	10.2	798.7
168	731.84	82	807.08	75	0.98	1.26	0.84	0.66	0.55	0.47	0.42	0.38	0.34	0.31	0.29	5.5	4.7	10.2	796.9
169	766.98	117	861.80	95	1.40	1.73	1.13	0.88	0.73	0.63	0.55	0.49	0.45	0.41	0.38	7.4	6.7	14.1	847.7
170	775.09	125	859.90	85	1.50	1.75	1.11	0.86	0.70	0.60	0.52	0.47	0.42	0.38	0.35	7.2	7.1	14.3	845.6
171	754.91	105	857.08	102	1.26	1.65	1.10	0.87	0.73	0.63	0.56	0.50	0.46	0.42	0.39	7.3	6.0	13.3	843.8
172	754.97	105	855.39	100	1.26	1.64	1.09	0.86	0.72	0.62	0.55	0.50	0.45	0.41	0.38	7.2	6.0	13.2	842.2
173	752.20	102	852.03	100	1.23	1.61	1.07	0.85	0.71	0.61	0.54	0.49	0.44	0.41	0.38	7.1	5.8	13.0	839.1
174	752.94	103	850.22	97	1.24	1.60	1.07	0.84	0.70	0.61	0.54	0.48	0.44	0.40	0.37	7.0	5.9	12.9	837.3
175	746.93	97	846.95	100	1.16	1.55	1.04	0.83	0.69	0.60	0.53	0.48	0.44	0.40	0.37	6.9	5.5	12.5	834.5
176	747.36	97	845.02	98	1.17	1.55	1.03	0.82	0.69	0.59	0.53	0.47	0.43	0.40	0.37	6.9	5.6	12.4	832.6
177	742.68	93	841.78	99	1.11	1.50	1.01	0.80	0.68	0.59	0.52	0.47	0.43	0.39	0.36	6.8	5.3	12.1	829.7
178	743.14	93	839.92	97	1.12	1.50	1.00	0.80	0.67	0.58	0.52	0.46	0.42	0.39	0.36	6.7	5.3	12.0	827.9
179	716.98	67	732.03	15	0.80	0.59	0.32	0.22	0.17	0.14	0.12	0.10	0.09	0.08	0.07	1.9	3.8	5.7	726.3
180	716.99	67	730.09	13	0.80	0.56	0.29	0.20	0.15	0.13	0.11	0.09	0.08	0.07	0.07	1.7	3.8	5.6	724.5
181	711.27	61	736.79	26	0.74	0.71	0.42	0.31	0.25	0.21	0.18	0.16	0.14	0.13	0.12	2.6	3.5	6.1	730.7
182	712.51	63	734.97	22	0.75	0.68	0.40	0.29	0.23	0.19	0.16	0.14	0.13	0.11	0.10	2.4	3.6	6.0	729.0
183	717.62	68	741.46	24	0.81	0.74	0.43	0.31	0.25	0.20	0.17	0.15	0.14	0.12	0.11	2.6	3.9	6.5	735.0
184	711.26	61	739.60	28	0.74	0.74	0.45	0.33	0.27	0.23	0.19	0.17	0.15	0.14	0.13	2.8	3.5	6.3	733.3
185	704.00	54	747.90	44	0.65	0.80	0.52	0.41	0.34	0.29	0.26	0.23	0.21	0.19	0.17	3.4	3.1	6.5	741.4
186	704.03	54	746.02	42	0.65	0.79	0.51	0.40	0.33	0.28	0.25	0.22	0.20	0.18	0.17	3.3	3.1	6.4	739.6
187	701.04	51	742.66	42	0.61	0.76	0.50	0.39	0.32	0.28	0.24	0.22	0.20	0.18	0.16	3.2	2.9	6.1	736.5
188	701.01	51	740.92	40	0.61	0.75	0.49	0.38	0.31	0.27	0.24	0.21	0.19	0.17	0.16	3.2	2.9	6.1	734.8
189	702.19	52	737.84	36	0.63	0.73	0.47	0.36	0.29	0.25	0.22	0.20	0.18	0.16	0.15	3.0	3.0	6.0	731.9
190	702.04	52	735.98	34	0.62	0.72	0.45	0.35	0.29	0.24	0.21	0.19	0.17	0.15	0.14	2.9	3.0	5.9	730.1
191	710.74	61	732.88	22	0.73	0.67	0.39	0.28	0.23	0.19	0.16	0.14	0.13	0.11	0.10	2.4	3.5	5.9	727.0

BECK LANDFILL
ATTACHMENT 1 - SETTLEMENT SPREADSHEET

Pt	Existing Waste El. (ft)	Existing Waste Thick (ft)	Vertical Expansion Waste El. (ft)	Vertical Expansion Waste Thick (ft)	Front of Primary Settle Eqn	Primary Settlement in Each of 10 Equal Layers										Total Primary Settle. (ft)	Secondary Settle. (ft)	Total Settle. (ft)	Post Settle Final El. (ft)
						1	2	3	4	5	6	7	8	9	10				
192	705.30	55	731.09	26	0.66	0.67	0.41	0.30	0.24	0.20	0.18	0.16	0.14	0.13	0.12	2.5	3.2	5.7	725.4
193	713.66	64	727.87	14	0.76	0.56	0.30	0.21	0.16	0.13	0.11	0.10	0.09	0.08	0.07	1.8	3.6	5.5	722.4
194	713.83	64	726.10	12	0.77	0.52	0.27	0.19	0.15	0.12	0.10	0.09	0.08	0.07	0.06	1.6	3.6	5.3	720.8
195	730.56	81	723.04	0	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	4.6	4.6	718.4
196	721.86	72	721.16	0	0.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	4.1	4.1	717.1
197	722.48	72	760.09	38	0.87	0.92	0.56	0.42	0.34	0.29	0.25	0.22	0.20	0.18	0.16	3.6	4.1	7.7	752.4
198	723.21	73	758.18	35	0.88	0.90	0.55	0.41	0.33	0.28	0.24	0.21	0.19	0.17	0.16	3.4	4.2	7.6	750.6
199	719.00	69	764.84	46	0.83	0.96	0.61	0.47	0.38	0.33	0.28	0.25	0.23	0.21	0.19	3.9	3.9	7.8	757.0
200	719.27	69	762.99	44	0.83	0.94	0.60	0.45	0.37	0.32	0.28	0.24	0.22	0.20	0.18	3.8	4.0	7.8	755.2
201	715.29	65	769.73	54	0.78	0.98	0.64	0.50	0.41	0.36	0.31	0.28	0.25	0.23	0.21	4.2	3.7	7.9	761.8
202	715.95	66	767.83	52	0.79	0.97	0.63	0.49	0.40	0.35	0.31	0.27	0.25	0.23	0.21	4.1	3.8	7.9	760.0
203	715.48	65	777.17	62	0.79	1.02	0.68	0.53	0.45	0.39	0.34	0.31	0.28	0.25	0.24	4.5	3.7	8.2	769.0
204	716.00	66	775.29	59	0.79	1.01	0.67	0.52	0.44	0.38	0.33	0.30	0.27	0.25	0.23	4.4	3.8	8.2	767.1
205	704.00	54	771.60	68	0.65	0.92	0.63	0.50	0.43	0.37	0.33	0.30	0.28	0.25	0.24	4.3	3.1	7.3	764.3
206	705.51	56	769.82	64	0.67	0.92	0.63	0.50	0.42	0.37	0.33	0.30	0.27	0.25	0.23	4.2	3.2	7.4	762.4
207	707.29	57	767.35	60	0.69	0.92	0.62	0.49	0.41	0.36	0.32	0.29	0.26	0.24	0.22	4.1	3.3	7.4	759.9
208	707.98	58	765.37	57	0.70	0.92	0.61	0.48	0.41	0.35	0.31	0.28	0.25	0.23	0.22	4.1	3.3	7.4	758.0
209	701.52	52	762.64	61	0.62	0.86	0.59	0.47	0.40	0.35	0.31	0.28	0.25	0.23	0.22	4.0	2.9	6.9	755.7
210	700.39	50	760.87	60	0.60	0.85	0.58	0.46	0.39	0.34	0.30	0.27	0.25	0.23	0.21	3.9	2.9	6.8	754.1
211	702.55	53	758.05	56	0.63	0.85	0.57	0.45	0.38	0.33	0.29	0.26	0.24	0.22	0.20	3.8	3.0	6.8	751.2
212	701.65	52	756.23	55	0.62	0.83	0.56	0.45	0.37	0.33	0.29	0.26	0.24	0.22	0.20	3.7	3.0	6.7	749.5
213	699.61	50	753.03	53	0.60	0.81	0.54	0.43	0.36	0.32	0.28	0.25	0.23	0.21	0.20	3.6	2.8	6.5	746.6
214	697.98	48	751.17	53	0.58	0.79	0.53	0.42	0.36	0.31	0.28	0.25	0.23	0.21	0.19	3.6	2.7	6.3	744.9
215	704.00	54	748.45	44	0.65	0.80	0.53	0.41	0.34	0.29	0.26	0.23	0.21	0.19	0.18	3.4	3.1	6.5	741.9
216	704.00	54	746.51	43	0.65	0.79	0.52	0.40	0.33	0.28	0.25	0.22	0.20	0.18	0.17	3.4	3.1	6.4	740.1
217	723.18	73	792.01	69	0.88	1.14	0.76	0.60	0.50	0.43	0.38	0.34	0.31	0.28	0.26	5.0	4.2	9.2	782.8
218	725.12	75	790.20	65	0.90	1.14	0.75	0.59	0.49	0.42	0.37	0.33	0.30	0.28	0.25	4.9	4.3	9.2	781.0
219	718.00	68	797.00	79	0.82	1.13	0.77	0.61	0.52	0.45	0.40	0.36	0.33	0.31	0.28	5.2	3.9	9.1	788.0
220	718.00	68	795.16	77	0.82	1.12	0.76	0.61	0.51	0.45	0.40	0.36	0.33	0.30	0.28	5.1	3.9	9.0	786.2
221	716.00	66	805.67	90	0.79	1.15	0.79	0.64	0.55	0.48	0.43	0.39	0.36	0.33	0.31	5.4	3.8	9.2	796.5
222	716.00	66	803.81	88	0.79	1.14	0.79	0.63	0.54	0.47	0.42	0.38	0.35	0.32	0.30	5.4	3.8	9.1	794.7
223	712.98	63	802.22	89	0.76	1.11	0.77	0.62	0.53	0.47	0.42	0.38	0.35	0.32	0.30	5.3	3.6	8.9	793.4
224	713.73	64	800.40	87	0.76	1.11	0.77	0.62	0.53	0.46	0.41	0.37	0.34	0.32	0.30	5.2	3.6	8.9	791.5
225	709.56	60	797.89	88	0.71	1.06	0.74	0.60	0.51	0.45	0.41	0.37	0.34	0.31	0.29	5.1	3.4	8.5	789.4
226	709.47	59	796.07	87	0.71	1.06	0.73	0.60	0.51	0.45	0.40	0.36	0.33	0.31	0.29	5.0	3.4	8.4	787.6
227	708.17	58	793.50	85	0.70	1.03	0.72	0.58	0.50	0.44	0.39	0.36	0.33	0.30	0.28	4.9	3.3	8.3	785.2
228	707.22	57	791.61	84	0.69	1.02	0.71	0.58	0.49	0.43	0.39	0.35	0.32	0.30	0.28	4.9	3.3	8.1	783.5
229	674.24	24	789.38	115	0.29	0.58	0.44	0.38	0.34	0.31	0.29	0.27	0.25	0.24	0.23	3.3	1.4	4.7	784.7
230	671.28	21	787.49	116	0.26	0.52	0.40	0.35	0.31	0.29	0.27	0.25	0.23	0.22	0.21	3.0	1.2	4.3	783.2
231	670.20	20	784.57	114	0.24	0.50	0.39	0.33	0.30	0.27	0.26	0.24	0.23	0.21	0.20	2.9	1.2	4.1	780.5
232	667.98	18	782.78	115	0.22	0.46	0.35	0.31	0.28	0.25	0.24	0.22	0.21	0.20	0.19	2.7	1.0	3.7	779.0
233	667.99	18	780.04	112	0.22	0.45	0.35	0.31	0.28	0.25	0.24	0.22	0.21	0.20	0.19	2.7	1.0	3.7	776.3
234	667.18	17	778.32	111	0.21	0.44	0.34	0.29	0.27	0.24	0.23	0.21	0.20	0.19	0.18	2.6	1.0	3.6	774.7
235	739.00	89	820.01	81	1.07	1.37	0.91	0.71	0.59	0.51	0.45	0.41	0.37	0.34	0.31	6.0	5.1	11.1	809.0
236	739.18	89	818.17	79	1.07	1.36	0.90	0.70	0.59	0.51	0.45	0.40	0.36	0.33	0.31	5.9	5.1	11.0	807.2
237	728.88	79	823.95	95	0.95	1.32	0.90	0.72	0.61	0.54	0.48	0.43	0.39	0.36	0.34	6.1	4.5	10.6	813.3
238	732.23	82	822.03	90	0.99	1.34	0.91	0.72	0.61	0.53	0.47	0.42	0.39	0.35	0.33	6.1	4.7	10.8	811.3
239	719.81	70	832.05	112	0.84	1.27	0.90	0.73	0.63	0.55	0.50	0.45	0.42	0.39	0.36	6.2	4.0	10.2	821.9
240	724.31	74	830.32	106	0.89	1.31	0.91	0.74	0.63	0.55	0.50	0.45	0.41	0.38	0.36	6.2	4.2	10.5	819.8
241	709.98	60	827.91	0	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	3.4	3.4	824.5
242	709.99	60	826.07	0	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	3.4	3.4	822.6
243	708.00	58	823.62	116	0.70	1.12	0.80	0.66	0.57	0.51	0.46	0.42	0.39	0.37	0.34	5.7	3.3	9.0	814.6
244	709.65	60	821.67	112	0.72	1.14	0.81	0.67	0.58	0.51	0.46	0.42	0.39	0.36	0.34	5.7	3.4	9.1	812.6
245	678.50	29	819.74	141	0.34	0.68	0.52	0.45	0.40	0.37	0.34	0.32	0.30	0.29	0.27	4.0	1.6	5.6	814.2
246	677.76	28	817.97	140	0.33	0.67	0.51	0.44	0.40	0.36	0.34	0.31	0.30	0.28	0.27	3.9	1.6	5.5	812.5
247	669.97	20	815.84	146	0.24	0.52	0.41	0.35	0.32	0.30	0.28	0.26	0.25	0.24	0.23	3.1	1.1	4.3	811.6
248	669.90	20	814.08	144	0.24	0.52	0.40	0.35	0.32	0.29	0.27	0.26	0.25	0.23	0.22	3.1	1.1	4.3	809.8
249	669.40	19	812.05	143	0.23	0.51	0.40	0.35	0.31	0.29	0.27	0.25	0.24	0.23	0.22	3.1	1.1	4.2	807.9
250	669.35	19	810.30	141	0.23	0.50	0.39	0.34	0.31	0.29	0.27	0.25	0.24	0.23	0.22	3.0	1.1	4.1	806.2
1000	782.75	133	868.00	85	1.59	1.82	1.15	0.88	0.72	0.61	0.54	0.48	0.43	0.39	0.36	7.4	7.6	15.0	853.0
1001	752.25	102	868.00	116	1.23	1.69	1.14	0.91	0.77	0.67	0.60	0.54	0.49	0.45	0.42	7.7	5.8	13.5	854.5
1002	755.02	105	868.00	113	1.26	1.70	1.15	0.91	0.77	0.67	0.59	0.53	0.49	0.45	0.41	7.7	6.0	13.7	854.3
1003	748.55	99	868.00	119	1.18	1.66	1.13	0.91	0.77	0.67	0.60	0.54	0.49	0.46	0.42	7.6	5.6	13.3	854.7
1004	751.20	101	868.00	117	1.21	1.68	1.14	0.91	0.77	0.67	0.60	0.54	0.49	0.45	0.42	7.7	5.8	13.4	854.6
1005	758.48	108	868.00	110	1.30	1.73	1.16	0.91	0.77	0.67	0.59	0.53	0.48	0.44	0.41	7.7	6.2	13.9	854.1
1006	760.65	111	868.00	107	1.33	1.74	1.16	0.91	0.77	0.66	0.59	0.53	0.48	0.44	0.41	7.7	6.3	14.0	854.0
1007	764.79	115	868.00	103	1.38	1.76	1.16	0.91	0.76	0.66	0.58	0.52	0.47	0.43	0.40	7.7	6.6	14.2	853.8
1008	760.31	110	868.00	108	1.32	1.74	1.16	0.91	0.77	0.66	0.59	0.53	0.48	0.44	0.41	7.7	6.3	14.0	854.0
1009	759.14	109	868.00	109	1.31	1.73	1.16	0.91	0.77	0.66	0.59	0.53	0.48	0.44	0.41	7.7	6.2	13.9	854.1
1010	753.76	104	868.00	114	1.25	1.70	1.15	0.91	0.77	0.67	0.59	0.54	0.49	0.45	0.42	7.7	5.9	13.6	854.4
1011	764.03	114	876.52	112	1.37	1.80	1.20	0.95	0.80	0.69	0.61	0.55	0.50	0.46	0.42	8.0	6.5	14.5	862.0
1012	755.47	105	877.96	122	1.27	1.75	1.19	0.95	0.80	0.70	0.62	0.56	0.51	0.47	0.44	8.0	6.0	14.0	863.9
1013	769.99	120	881.07	111	1.44	1.86	1.23	0.97	0.81	0.70	0.62	0.55	0.50	0.46	0.43	8.1	6.9	15.0	866.1
1014	765.00	115	883.26	118	1.38	1.84	1.24	0.98	0.82	0.71	0.63	0.57	0.52	0.48	0.44	8.2	6.6	14.8	868.5
1015	773.88	124	888.00	114	1.49	1.92	1.27	1.00	0.83	0.72	0.64	0.57	0.52	0.47	0.44	8.4	7.1	15.4	872.6
1016	770.49	120	888.00	118	1.45	1.90	1.27	1.00	0.84	0.72	0.64	0.58	0.52	0.48	0.44	8.4	6.9	15.3	872.7
1017	772.12	122	888.00	116	1.47	1.91	1.27	1.00	0.83	0.72	0.64	0.57	0.52	0.48	0.44	8.4	7.0	15.4	872.6
1018	727.99	78	838.00	110	0.94	1.37	0.95	0.77	0.66	0.58	0.52	0.47	0.43	0.40	0.37	6.5	4.5	11.0	827.0
1019	672.12	22	828.00	156	0.27	0.57	0.45	0.39	0.35	0.32	0.30	0.28	0.27	0.26	0.25	3.4	1.3	4.7	823.3
1020	670.05	20	818.00	148	0.24	0.52	0.41	0.36	0.32	0.30	0.28	0.26	0.25	0.24	0.23	3.2	1.1	4.3	813.7
1021	680.00	30	812.00	132	0.36	0.70	0.53	0.46	0.41	0.37	0.34	0.32	0.30	0.28	0.27	4.0	1.7	5.7	806.3

ATTACHMENT 2

DRAINAGE ACROSS FINAL COVER BENCH SPREADSHEET

BECK LANDFILL
ATTACHMENT 2 - DRAINAGE ACROSS FINAL COVER BENCH SPREADSHEET

Project: Beck Landfill
Project No.: 311-653
Subject: Final Grades Settlement - Verification that Bench Maintains Drainage Across Bench
Prepared By: ZLM 4/7/2022, EDC 12/21/2022
Checked By: TDM 4/22/2022

Bench No.	Outside Edge Bench Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)	Inside Edge Bench Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)		Pre-Settle Diff. (ft)	Post-Settle Diff. (ft)		Maintains Drainage Across Bench
1	1	730.25	725.57	2	729.21	724.00		1.04	1.56		Yes
	3	735.04	729.14	4	733.33	727.61		1.71	1.54		Yes
	5	740.15	734.80	6	738.30	732.96		1.85	1.84		Yes
	7	745.22	738.49	8	743.30	736.77		1.92	1.72		Yes
	9	750.36	743.31	10	748.37	741.43		1.99	1.89		Yes
2	11	753.62	746.33	12	751.70	744.56		1.91	1.78		Yes
	13	749.30	742.27	14	747.43	740.52		1.87	1.74		Yes
	15	744.37	737.69	16	742.44	735.91		1.93	1.78		Yes
	17	739.38	733.07	18	737.43	731.30		1.95	1.77		Yes
	19	734.31	728.41	20	732.44	726.73		1.87	1.68		Yes
3	21	759.92	752.16	22	758.10	750.45		1.82	1.70		Yes
	23	764.02	756.08	24	762.11	754.35		1.91	1.73		Yes
	25	768.77	760.52	26	767.05	758.91		1.72	1.62		Yes
	27	775.32	766.57	28	773.28	764.55		2.04	2.02		Yes
	29	779.31	770.16	30	777.34	768.34		1.97	1.82		Yes
4	31	777.96	769.12	32	776.10	767.39		1.85	1.73		Yes
	33	772.48	763.95	34	770.55	762.12		1.93	1.84		Yes
	35	767.38	759.13	36	765.52	757.34		1.86	1.79		Yes
	37	762.49	755.22	38	760.56	753.64		1.93	1.58		Yes
	39	756.89	749.35	40	755.03	747.60		1.86	1.75		Yes
	41	752.57	745.31	42	750.66	743.53		1.91	1.78		Yes
	43	747.61	740.69	44	745.66	738.90		1.95	1.79		Yes
	45	742.70	736.13	46	740.80	734.38		1.90	1.76		Yes
	47	736.94	731.03	48	735.34	729.60		1.60	1.43		Yes
5	49	786.14	776.62	50	784.37	774.93		1.77	1.69		Yes
	51	791.22	781.47	52	789.41	779.73		1.81	1.75		Yes
	53	798.87	788.33	54	797.30	786.87		1.57	1.45		Yes
6	55	807.47	796.52	56	805.66	794.94		1.81	1.58		Yes
	57	803.75	793.49	58	801.93	791.77		1.82	1.72		Yes
	59	798.75	788.66	60	796.86	786.85		1.89	1.81		Yes
	61	793.74	784.05	62	791.99	782.50		1.76	1.56		Yes
	63	788.58	778.94	64	786.76	777.07		1.82	1.87		Yes
	65	782.68	773.52	66	780.90	771.83		1.78	1.69		Yes
	67	778.73	769.87	68	776.89	768.12		1.84	1.75		Yes
	69	774.03	765.50	70	772.16	763.69		1.87	1.82		Yes
	71	768.85	760.68	72	767.02	758.92		1.83	1.75		Yes
	73	764.05	758.31	74	762.16	756.50		1.88	1.81		Yes
	75	758.81	753.81	76	757.57	752.60		1.23	1.21		Yes
	77	753.97	750.48	78	752.18	748.70		1.79	1.77		Yes

BECK LANDFILL
ATTACHMENT 2 - DRAINAGE ACROSS FINAL COVER BENCH SPREADSHEET

Bench No.	Outside Edge Bench Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)	Inside Edge Bench Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)		Pre-Settle Diff. (ft)	Post-Settle Diff. (ft)		Maintains Drainage Across Bench
7	79	814.24	803.37	80	812.32	801.39		1.92	1.98		Yes
	81	819.16	808.30	82	817.54	806.75		1.63	1.55		Yes
8	83	830.65	819.14	84	828.87	817.31		1.78	1.84		Yes
	85	825.45	813.92	86	823.59	812.00		1.86	1.92		Yes
	87	820.42	809.06	88	818.49	807.22		1.93	1.85		Yes
	89	813.31	801.92	90	811.54	800.22		1.77	1.69		Yes
	91	810.11	799.39	92	808.27	797.57		1.84	1.82		Yes
	93	805.64	795.04	94	803.76	793.21		1.87	1.83		Yes
	95	800.87	790.29	96	798.93	788.42		1.95	1.86		Yes
	97	795.97	786.42	98	794.07	784.52		1.90	1.90		Yes
	99	790.80	784.48	100	789.15	783.18		1.65	1.31		Yes
9	101	857.65	845.27	102	855.76	843.42		1.90	1.85		Yes
	103	852.84	840.20	104	850.95	838.33		1.90	1.87		Yes
	105	847.31	834.83	106	845.43	832.83		1.88	1.99		Yes
	107	842.10	829.46	108	840.54	827.94		1.56	1.52		Yes
	109	837.54	825.18	110	835.64	823.36		1.90	1.82		Yes
	111	832.87	820.56	112	830.95	818.74		1.92	1.83		Yes
	113	828.27	815.82	114	826.34	813.93		1.93	1.89		Yes
	115	823.29	813.37	116	821.40	811.61		1.89	1.77		Yes
	117	816.89	813.04	118	814.05	810.11		2.84	2.93		Yes
10	119	749.77	742.74	120	747.76	740.85		2.01	1.88		Yes
	121	744.96	738.26	122	743.09	736.50		1.88	1.76		Yes
	123	739.85	733.50	124	737.96	731.73		1.90	1.77		Yes
	125	734.95	728.94	126	733.11	727.23		1.85	1.71		Yes
	127	729.88	724.22	128	728.09	722.58		1.79	1.64		Yes
	129	724.86	719.56	130	723.28	718.09		1.58	1.46		Yes
11	131	777.84	769.09	132	775.87	767.20		1.97	1.90		Yes
	133	773.13	764.84	134	771.44	763.22		1.70	1.62		Yes
	135	768.09	760.01	136	766.40	758.36		1.69	1.65		Yes
	137	762.99	755.14	138	761.25	753.48		1.74	1.65		Yes
	139	757.96	750.38	140	756.22	748.74		1.75	1.65		Yes
	141	753.07	745.97	142	751.24	744.16		1.83	1.81		Yes
	143	748.07	741.26	144	746.26	739.54		1.80	1.72		Yes
12	145	805.78	795.67	146	803.99	793.96		1.79	1.71		Yes
	147	801.16	792.12	148	799.29	790.04		1.87	2.08		Yes
	149	796.05	786.38	150	794.18	784.56		1.86	1.82		Yes
	151	791.03	781.64	152	789.20	779.86		1.83	1.78		Yes
	153	785.92	776.75	154	784.20	775.07		1.73	1.68		Yes
	155	780.95	772.12	156	779.09	770.33		1.87	1.79		Yes
13	157	833.81	822.01	158	831.91	820.15		1.90	1.86		Yes
	159	829.06	817.79	160	827.30	816.00		1.75	1.79		Yes
	161	824.04	812.61	162	822.16	810.77		1.88	1.85		Yes
	163	818.98	807.95	164	817.14	806.15		1.84	1.80		Yes
	165	813.92	803.23	166	812.10	801.45		1.82	1.79		Yes
	167	808.90	798.68	168	807.08	796.88		1.82	1.80		Yes

BECK LANDFILL
ATTACHMENT 2 - DRAINAGE ACROSS FINAL COVER BENCH SPREADSHEET

Bench No.	Outside Edge Bench Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)	Inside Edge Bench Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)		Pre-Settle Diff. (ft)	Post-Settle Diff. (ft)		Maintains Drainage Across Bench
14	169	861.80	847.74	170	859.90	845.60		1.90	2.14		Yes
	171	857.08	843.79	172	855.39	842.16		1.69	1.63		Yes
	173	852.03	839.07	174	850.22	837.30		1.80	1.77		Yes
	175	846.95	834.47	176	845.02	832.59		1.93	1.88		Yes
	177	841.78	829.73	178	839.92	827.91		1.85	1.82		Yes
15	179	732.03	726.28	180	730.09	724.52		1.94	1.76		Yes
	181	736.79	730.66	182	734.97	728.95		1.82	1.70		Yes
	183	741.46	734.98	184	739.60	733.29		1.86	1.69		Yes
16	185	747.90	741.40	186	746.02	739.60		1.88	1.81		Yes
	187	742.66	736.51	188	740.92	734.84		1.74	1.67		Yes
	189	737.84	731.86	190	735.98	730.09		1.86	1.76		Yes
	191	732.88	727.01	192	731.09	725.39		1.79	1.62		Yes
	193	727.87	722.41	194	726.10	720.81		1.76	1.60		Yes
	195	723.04	718.43	196	721.16	717.06		1.87	1.37		Yes
17	197	760.09	752.39	198	758.18	750.58		1.91	1.82		Yes
	199	764.84	756.99	200	762.99	755.23		1.85	1.76		Yes
	201	769.73	761.82	202	767.83	759.96		1.91	1.86		Yes
18	203	777.17	768.96	204	775.29	767.12		1.88	1.84		Yes
	205	771.60	764.26	206	769.82	762.44		1.78	1.82		Yes
	207	767.35	759.94	208	765.37	757.99		1.98	1.95		Yes
	209	762.64	755.74	210	760.87	754.10		1.76	1.63		Yes
	211	758.05	751.24	212	756.23	749.54		1.82	1.71		Yes
	213	753.03	746.57	214	751.17	744.87		1.86	1.70		Yes
	215	748.45	741.93	216	746.51	740.07		1.94	1.86		Yes
19	217	792.01	782.83	218	790.20	781.00		1.81	1.84		Yes
	219	797.00	787.95	220	795.16	786.17		1.84	1.78		Yes
20	221	805.67	796.49	222	803.81	794.68		1.86	1.81		Yes
	223	802.22	793.35	224	800.40	791.53		1.82	1.82		Yes
	225	797.89	789.40	226	796.07	787.63		1.82	1.77		Yes
	227	793.50	785.23	228	791.61	783.46		1.89	1.77		Yes
	229	789.38	784.68	230	787.49	783.22		1.89	1.45		Yes
	231	784.57	780.48	232	782.78	779.04		1.78	1.44		Yes
	233	780.04	776.32	234	778.32	774.74		1.72	1.58		Yes
21	235	820.01	808.95	236	818.17	807.17		1.84	1.78		Yes
	237	823.95	813.34	238	822.03	811.27		1.92	2.06		Yes
22	239	832.05	821.87	240	830.32	819.83		1.73	2.03		Yes
	241	827.91	824.49	242	826.07	822.64		1.85	1.85		Yes
	243	823.62	814.65	244	821.67	812.59		1.95	2.05		Yes
	245	819.74	814.15	246	817.97	812.51		1.77	1.65		Yes
	247	815.84	811.56	248	814.08	809.81		1.76	1.74		Yes
	249	812.05	807.88	250	810.30	806.15		1.75	1.73		Yes

ATTACHMENT 3

DRAINAGE ALONG FINAL COVER BENCH SPREADSHEET

BECK LANDFILL
ATTACHMENT 3 - DRAINAGE ALONG FINAL COVER BENCH SPREADSHEET

Project: Beck Landfill
Project No.: 311-653
Subject: Final Grades Settlement - Verification that Bench Maintains Drainage Along Bench
Prepared By: ZLM 4/7/2022, EDC 12/21/2022
Checked By: TDM 4/22/2022

Bench No.	Bench High Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)	Bench Low Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)		Pre-Settle Diff. (ft)	Post-Settle Diff. (ft)		Maintains Drainage Along Bench
1	9	750.36	743.31	7	745.22	738.49		5.14	4.82		Yes
	7	745.22	738.49	5	740.15	734.80		5.07	3.69		Yes
	5	740.15	734.80	3	735.04	729.14		5.11	5.65		Yes
	3	735.04	729.14	1	730.25	725.57		4.79	3.58		Yes
	10	748.37	741.43	8	743.30	736.77		5.07	4.66		Yes
	8	743.30	736.77	6	738.30	732.96		5.00	3.81		Yes
	6	738.30	732.96	4	733.33	727.61		4.97	5.35		Yes
	4	733.33	727.61	2	729.21	724.00		4.12	3.60		Yes
2	11	753.62	746.33	13	749.30	742.27		4.32	4.07		Yes
	13	749.30	742.27	15	744.37	737.69		4.92	4.58		Yes
	15	744.37	737.69	17	739.38	733.07		4.99	4.62		Yes
	17	739.38	733.07	19	734.31	728.41		5.07	4.66		Yes
	12	751.70	744.56	14	747.43	740.52		4.28	4.03		Yes
	14	747.43	740.52	16	742.44	735.91		4.98	4.61		Yes
	16	742.44	735.91	18	737.43	731.30		5.01	4.61		Yes
	18	737.43	731.30	20	732.44	726.73		5.00	4.57		Yes
3	29	779.31	770.16	27	775.32	766.57		4.00	3.59		Yes
	27	775.32	766.57	25	768.77	760.52		6.54	6.05		Yes
	25	768.77	760.52	23	764.02	756.08		4.75	4.45		Yes
	23	764.02	756.08	21	759.92	752.16		4.10	3.92		Yes
	30	777.34	768.34	28	773.28	764.55		4.06	3.80		Yes
	28	773.28	764.55	26	767.05	758.91		6.23	5.64		Yes
	26	767.05	758.91	24	762.11	754.35		4.94	4.56		Yes
	24	762.11	754.35	22	758.10	750.45		4.01	3.89		Yes
4	31	777.96	769.12	33	772.48	763.95		5.48	5.16		Yes
	33	772.48	763.95	35	767.38	759.13		5.10	4.83		Yes
	35	767.38	759.13	37	762.49	755.22		4.89	3.91		Yes
	37	762.49	755.22	39	756.89	749.35		5.60	5.86		Yes
	39	756.89	749.35	41	752.57	745.31		4.32	4.04		Yes
	41	752.57	745.31	43	747.61	740.69		4.96	4.62		Yes
	43	747.61	740.69	45	742.70	736.13		4.91	4.56		Yes
	45	742.70	736.13	47	736.94	731.03		5.76	5.10		Yes
	32	776.10	767.39	34	770.55	762.12		5.55	5.27		Yes
	34	770.55	762.12	36	765.52	757.34		5.03	4.78		Yes
	36	765.52	757.34	38	760.56	753.64		4.96	3.70		Yes
	38	760.56	753.64	40	755.03	747.60		5.53	6.03		Yes
	40	755.03	747.60	42	750.66	743.53		4.37	4.07		Yes
	42	750.66	743.53	44	745.66	738.90		5.00	4.63		Yes
	44	745.66	738.90	46	740.80	734.38		4.86	4.52		Yes
	46	740.80	734.38	48	735.34	729.60		5.46	4.78		Yes
5	53	798.87	788.33	51	791.22	781.47		7.65	6.85		Yes
	51	791.22	781.47	49	786.14	776.62		5.08	4.86		Yes
	54	797.30	786.87	52	789.41	779.73		7.89	7.14		Yes
	52	789.41	779.73	50	784.37	774.93		5.04	4.80		Yes

BECK LANDFILL
ATTACHMENT 3 - DRAINAGE ALONG FINAL COVER BENCH SPREADSHEET

Bench No.	Bench High Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)	Bench Low Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)		Pre-Settle Diff. (ft)	Post-Settle Diff. (ft)		Drainage Along Bench
6	55	807.47	796.52	57	803.75	793.49		3.72	3.03		Yes
	57	803.75	793.49	59	798.75	788.66		5.00	4.83		Yes
	59	798.75	788.66	61	793.74	784.05		5.01	4.61		Yes
	61	793.74	784.05	63	788.58	778.94		5.16	5.11		Yes
	63	788.58	778.94	65	782.68	773.52		5.90	5.42		Yes
	65	782.68	773.52	67	778.73	769.87		3.95	3.65		Yes
	67	778.73	769.87	69	774.03	765.50		4.70	4.37		Yes
	69	774.03	765.50	71	768.85	760.68		5.19	4.82		Yes
	71	768.85	760.68	73	764.05	758.31		4.80	2.37		Yes
	73	764.05	758.31	75	758.81	753.81		5.24	4.50		Yes
	75	758.81	753.81	77	753.97	750.48		4.84	3.33		Yes
	56	805.66	794.94	58	801.93	791.77		3.73	3.17		Yes
	58	801.93	791.77	60	796.86	786.85		5.07	4.92		Yes
	60	796.86	786.85	62	791.99	782.50		4.87	4.35		Yes
	62	791.99	782.50	64	786.76	777.07		5.23	5.42		Yes
	64	786.76	777.07	66	780.90	771.83		5.86	5.25		Yes
	66	780.90	771.83	68	776.89	768.12		4.01	3.71		Yes
	68	776.89	768.12	70	772.16	763.69		4.73	4.43		Yes
	70	772.16	763.69	72	767.02	758.92		5.15	4.76		Yes
	72	767.02	758.92	74	762.16	756.50		4.86	2.42		Yes
	74	762.16	756.50	76	757.57	752.60		4.59	3.91		Yes
	76	757.57	752.60	78	752.18	748.70		5.40	3.89		Yes
7	81	819.16	808.30	79	814.24	803.37		4.92	4.93		Yes
	82	817.54	806.75	80	812.32	801.39		5.22	5.37		Yes
8	83	830.65	819.14	85	825.45	813.92		5.20	5.22		Yes
	85	825.45	813.92	87	820.42	809.06		5.04	4.86		Yes
	87	820.42	809.06	89	813.31	801.92		7.11	7.15		Yes
	89	813.31	801.92	91	810.11	799.39		3.19	2.53		Yes
	91	810.11	799.39	93	805.64	795.04		4.48	4.35		Yes
	93	805.64	795.04	95	800.87	790.29		4.77	4.76		Yes
	95	800.87	790.29	97	795.97	786.42		4.90	3.87		Yes
	97	795.97	786.42	99	790.80	784.48		5.17	1.93		Yes
	84	828.87	817.31	86	823.59	812.00		5.28	5.30		Yes
	86	823.59	812.00	88	818.49	807.22		5.10	4.79		Yes
	88	818.49	807.22	90	811.54	800.22		6.95	6.99		Yes
	90	811.54	800.22	92	808.27	797.57		3.26	2.65		Yes
	92	808.27	797.57	94	803.76	793.21		4.51	4.36		Yes
	94	803.76	793.21	96	798.93	788.42		4.84	4.79		Yes
	96	798.93	788.42	98	794.07	784.52		4.85	3.91		Yes
	98	794.07	784.52	100	789.15	783.18		4.92	1.34		Yes
9	101	857.65	845.27	103	852.84	840.20		4.81	5.06		Yes
	103	852.84	840.20	105	847.31	834.83		5.53	5.38		Yes
	105	847.31	834.83	107	842.10	829.46		5.21	5.37		Yes
	107	842.10	829.46	109	837.54	825.18		4.56	4.28		Yes
	109	837.54	825.18	111	832.87	820.56		4.67	4.62		Yes
	111	832.87	820.56	113	828.27	815.82		4.60	4.74		Yes
	113	828.27	815.82	115	823.29	813.37		4.98	2.45		Yes
	115	823.29	813.37	117	816.89	813.04		6.40	0.34		Yes
	102	855.76	843.42	104	850.95	838.33		4.81	5.09		Yes
	104	850.95	838.33	106	845.43	832.83		5.52	5.49		Yes
	106	845.43	832.83	108	840.54	827.94		4.89	4.89		Yes
	108	840.54	827.94	110	835.64	823.36		4.90	4.58		Yes
	110	835.64	823.36	112	830.95	818.74		4.68	4.63		Yes
	112	830.95	818.74	114	826.34	813.93		4.61	4.81		Yes
	114	826.34	813.93	116	821.40	811.61		4.94	2.32		Yes
	116	821.40	811.61	118	814.05	810.11		7.35	1.50		Yes

BECK LANDFILL
ATTACHMENT 3 - DRAINAGE ALONG FINAL COVER BENCH SPREADSHEET

Bench No.	Bench High Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)	Bench Low Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)	Pre-Settle Diff. (ft)	Post-Settle Diff. (ft)	Drainage Along Bench
10	119	749.77	742.74	121	744.96	738.26	4.81	4.47	Yes
	121	744.96	738.26	123	739.85	733.50	5.11	4.76	Yes
	123	739.85	733.50	125	734.95	728.94	4.90	4.56	Yes
	125	734.95	728.94	127	729.88	724.22	5.07	4.72	Yes
	127	729.88	724.22	129	724.86	719.56	5.02	4.67	Yes
	120	747.76	740.85	122	743.09	736.50	4.68	4.35	Yes
	122	743.09	736.50	124	737.96	731.73	5.13	4.77	Yes
	124	737.96	731.73	126	733.11	727.23	4.85	4.50	Yes
	126	733.11	727.23	128	728.09	722.58	5.01	4.65	Yes
	128	728.09	722.58	130	723.28	718.09	4.81	4.49	Yes
11	131	777.84	769.09	133	773.13	764.84	4.70	4.25	Yes
	133	773.13	764.84	135	768.09	760.01	5.05	4.83	Yes
	135	768.09	760.01	137	762.99	755.14	5.10	4.87	Yes
	137	762.99	755.14	139	757.96	750.38	5.02	4.75	Yes
	139	757.96	750.38	141	753.07	745.97	4.89	4.42	Yes
	141	753.07	745.97	143	748.07	741.26	5.01	4.71	Yes
	132	775.87	767.20	134	771.44	763.22	4.43	3.97	Yes
	134	771.44	763.22	136	766.40	758.36	5.04	4.86	Yes
	136	766.40	758.36	138	761.25	753.48	5.15	4.88	Yes
	138	761.25	753.48	140	756.22	748.74	5.03	4.75	Yes
	140	756.22	748.74	142	751.24	744.16	4.97	4.57	Yes
	142	751.24	744.16	144	746.26	739.54	4.98	4.62	Yes
12	145	805.78	795.67	147	801.16	792.12	4.62	3.55	Yes
	147	801.16	792.12	149	796.05	786.38	5.12	5.74	Yes
	149	796.05	786.38	151	791.03	781.64	5.02	4.74	Yes
	151	791.03	781.64	153	785.92	776.75	5.10	4.89	Yes
	153	785.92	776.75	155	780.95	772.12	4.97	4.63	Yes
	146	803.99	793.96	148	799.29	790.04	4.70	3.92	Yes
	148	799.29	790.04	150	794.18	784.56	5.11	5.48	Yes
	150	794.18	784.56	152	789.20	779.86	4.98	4.69	Yes
	152	789.20	779.86	154	784.20	775.07	5.00	4.79	Yes
	1554	812.00	806.29	156	779.09	770.33	32.91	35.96	Yes
13	157	833.81	822.01	159	829.06	817.79	4.75	4.23	Yes
	159	829.06	817.79	161	824.04	812.61	5.02	5.17	Yes
	161	824.04	812.61	163	818.98	807.95	5.06	4.67	Yes
	163	818.98	807.95	165	813.92	803.23	5.06	4.71	Yes
	165	813.92	803.23	167	808.90	798.68	5.02	4.55	Yes
	158	831.91	820.15	160	827.30	816.00	4.60	4.15	Yes
	160	827.30	816.00	162	822.16	810.77	5.14	5.23	Yes
	162	822.16	810.77	164	817.14	806.15	5.03	4.62	Yes
	164	817.14	806.15	166	812.10	801.45	5.04	4.70	Yes
	166	812.10	801.45	168	807.08	796.88	5.01	4.56	Yes
14	169	861.80	847.74	171	857.08	843.79	4.73	3.95	Yes
	171	857.08	843.79	173	852.03	839.07	5.05	4.72	Yes
	173	852.03	839.07	175	846.95	834.47	5.07	4.60	Yes
	175	846.95	834.47	177	841.78	829.73	5.17	4.75	Yes
	170	859.90	845.60	172	855.39	842.16	4.51	3.44	Yes
	172	855.39	842.16	174	850.22	837.30	5.17	4.87	Yes
	174	850.22	837.30	176	845.02	832.59	5.20	4.71	Yes
	176	845.02	832.59	178	839.92	827.91	5.10	4.68	Yes
15	183	741.46	734.98	181	736.79	730.66	4.67	4.33	Yes
	181	736.79	730.66	179	732.03	726.28	4.76	4.38	Yes
	184	739.60	733.29	182	734.97	728.95	4.63	4.34	Yes
	182	734.97	728.95	180	730.09	724.52	4.88	4.43	Yes

BECK LANDFILL
ATTACHMENT 3 - DRAINAGE ALONG FINAL COVER BENCH SPREADSHEET

Bench No.	Bench High Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)	Bench Low Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)		Pre-Settle Diff. (ft)	Post-Settle Diff. (ft)		Drainage Along Bench
16	185	747.90	741.40	187	742.66	736.51		5.24	4.89		Yes
	187	742.66	736.51	189	737.84	731.86		4.82	4.65		Yes
	189	737.84	731.86	191	732.88	727.01		4.96	4.85		Yes
	191	732.88	727.01	193	727.87	722.41		5.01	4.59		Yes
	186	746.02	739.60	188	740.92	734.84		5.10	4.75		Yes
	188	740.92	734.84	190	735.98	730.09		4.94	4.75		Yes
	190	735.98	730.09	192	731.09	725.39		4.89	4.71		Yes
	192	731.09	725.39	194	726.10	720.81		4.99	4.57		Yes
	194	726.10	720.81	196	721.16	717.06		4.94	3.75		Yes
17	201	769.73	761.82	199	764.84	756.99		4.90	4.83		Yes
	199	764.84	756.99	197	760.09	752.39		4.75	4.60		Yes
	202	767.83	759.96	200	762.99	755.23		4.83	4.74		Yes
	200	762.99	755.23	198	758.18	750.58		4.81	4.65		Yes
18	203	777.17	768.96	205	771.60	764.26		5.57	4.70		Yes
	205	771.60	764.26	207	767.35	759.94		4.25	4.32		Yes
	207	767.35	759.94	209	762.64	755.74		4.71	4.20		Yes
	209	762.64	755.74	211	758.05	751.24		4.58	4.49		Yes
	211	758.05	751.24	213	753.03	746.57		5.02	4.68		Yes
	213	753.03	746.57	215	748.45	741.93		4.58	4.64		Yes
	204	775.29	767.12	206	769.82	762.44		5.47	4.68		Yes
	206	769.82	762.44	208	765.37	757.99		4.45	4.44		Yes
	208	765.37	757.99	210	760.87	754.10		4.50	3.89		Yes
	210	760.87	754.10	212	756.23	749.54		4.64	4.57		Yes
	212	756.23	749.54	214	751.17	744.87		5.06	4.67		Yes
	214	751.17	744.87	216	746.51	740.07		4.66	4.79		Yes
19	219	797.00	787.95	217	792.01	782.83		4.99	5.12		Yes
	220	795.16	786.17	218	790.20	781.00		4.96	5.17		Yes
20	221	805.67	796.49	223	802.22	793.35		3.45	3.14		Yes
	223	802.22	793.35	225	797.89	789.40		4.33	3.95		Yes
	225	797.89	789.40	227	793.50	785.23		4.39	4.17		Yes
	227	793.50	785.23	229	789.38	784.68		4.13	0.55		Yes
	229	789.38	784.68	231	784.57	780.48		4.81	4.19		Yes
	231	784.57	780.48	233	780.04	776.32		4.53	4.16		Yes
	222	803.81	794.68	224	800.40	791.53		3.41	3.15		Yes
	224	800.40	791.53	226	796.07	787.63		4.33	3.90		Yes
	226	796.07	787.63	228	791.61	783.46		4.46	4.17		Yes
	228	791.61	783.46	230	787.49	783.22		4.12	0.24		Yes
	230	787.49	783.22	232	782.78	779.04		4.71	4.18		Yes
	232	782.78	779.04	234	778.32	774.74		4.46	4.30		Yes
21	237	823.95	813.34	235	820.01	808.95		3.94	4.38		Yes
	238	822.03	811.27	236	818.17	807.17		3.86	4.10		Yes
22	239	832.05	821.87	241	827.91	824.49		4.13	-2.62		No
	241	827.91	824.49	243	823.62	814.65		4.29	9.84		Yes
	243	823.62	814.65	245	819.74	814.15		3.89	0.49		Yes
	245	819.74	814.15	247	815.84	811.56		3.89	2.60		Yes
	247	815.84	811.56	249	812.05	807.88		3.79	3.68		Yes
	240	830.32	819.83	242	826.07	822.64		4.25	-2.81		No
	242	826.07	822.64	244	821.67	812.59		4.39	10.05		Yes
	244	821.67	812.59	246	817.97	812.51		3.70	0.09		Yes
	246	817.97	812.51	248	814.08	809.81		3.89	2.69		Yes
	248	814.08	809.81	250	810.30	806.15		3.78	3.66		Yes

BECK LANDFILL
ATTACHMENT 3 - DRAINAGE ALONG FINAL COVER BENCH SPREADSHEET

TOP DECK SETTLEMENT EVALUATION

Top Deck Line	Top Deck High Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)	Top Deck Low Point	Pre Settle Elev. (ft)	Post Settle Elev. (ft)		Pre-Settle Diff. (ft)	Post-Settle Diff. (ft)		Maintains Drainage Along Line
1	1011	876.52	862.02	1000	868.00	853.05		8.52	8.97		Yes
2	1014	883.26	868.47	1001	868.00	854.49		15.26	13.98		Yes
3	1015	888.00	872.56	1002	868.00	854.32		20.00	18.24		Yes
4	1012	877.96	863.92	1003	868.00	854.72		9.96	9.19		Yes
5	1012	877.96	863.92	1004	868.00	854.55		9.96	9.36		Yes
6	1016	888.00	872.73	1005	868.00	854.12		20.00	18.61		Yes
7	1013	881.07	866.09	1006	868.00	854.00		13.07	12.09		Yes
8	1013	881.07	866.09	1007	868.00	853.79		13.07	12.30		Yes
9	1017	888.00	872.65	1008	868.00	854.02		20.00	18.63		Yes
10	1014	883.26	868.47	1009	868.00	854.08		15.26	14.38		Yes
11	1011	876.52	862.02	1010	868.00	854.39		8.52	7.63		Yes
12	1018	838.00	827.03	1019	828.00	823.29		10.00	3.74		Yes
13	1019	828.00	823.29	1020	818.00	813.69		10.00	9.60		Yes
14	1020	818.00	813.69	1021	812.00	806.29		6.00	7.40		Yes

Appendix D5-B

Slope Stability Analyses

ADAM W. MEHEVEC
84736
1-2-2023

PROJECT	**Beck Landfill**	PROJECT NO.	**311-653**
	Vertical Expansion Permit Application	PAGE **1** OF **7**	
	Overall Slope Stability		

MADE BY	**ZLM**	DATE	**3/18/2022**	CHECKED BY	**TDM**	DATE	**4/22/2022**
MADE BY	**BTN**	DATE	**12/15/2022**	CHECKED BY	**EDC**	DATE	**12/20/2022**

CALCULATION BRIEF

BECK LANDFILL
VERTICAL EXPANSION PERMIT APPLICATION
OVERALL SLOPE STABILITY

OBJECTIVE: Evaluate the overall (i.e., at final grades) slope stability of the final grading configurations at the Beck Landfill, using slope stability cross-sections to model the critical slopes of the landfill area. The landfill area consists of an existing construction and demolition (C&D) landfill. The landfill footprint has previously been excavated to proposed base grades and is in the process of being filled to the currently permitted final grades. The slope stability analyses presented herein will encompass failure surfaces within the C&D waste configured to the vertical expansion final grades, existing base liner system, and existing foundation soils under static conditions. As the Beck Landfill is not located in a seismic region, no seismic analysis is included with this calculation. This analysis will also evaluate the stability of a 3 Horizontal to 1 Vertical (3H:1V) excavation side slope, prior to waste disposal. This analysis will also evaluate the stability of the perimeter berm under rapid drawdown conditions following a 100-year flood event.

METHODOLOGY: Use the slope stability computer software SLIDE to evaluate slope stability by means of circular and non-circular failure search methods under static conditions.

REFERENCES:

1. Slide; Version 9.026 64-bit, Rocscience Inc., November 22, 2022.

2. Beck Readymix Concrete Company Type IV Landfill Permit Application No. 1848, prepared by Snowden, Inc., Last Revised January 1989.

3. “Geotechnical Data Report: Beck Landfill Southeast Section” prepared by Terracon October 20, 2020.

4. Waste Materials in Construction (pp. 225-231), edited by Th.G. Aalbers, J.J.J.M. Goumans, and H.A. van der Sloot, 1991.

5. Construction Demolition Waste (pp. 150-154), edited by Mukesh C. Limbachiya and J. J. Roberts, 2004.

6. Proceedings of the First International Conference on Construction Materials and Structures (p. 591), edited by Steven O. Ekolu, Morgan Dundu, and Xiaojian Gao, 2014.

7. Kavazanjian, E. Jr., et al, "Evaluation of MSW Properties for Seismic Analysis," Geoenvironment 2000, ASCE Geotechnical Special Publication No. 46, 1995.

8. "Geotechnical Engineering Investigation Manual", R.E. Hunt, 1984.

ANALYSIS:

Overall slope stability of the Beck Landfill final grading configuration was analyzed using four (4) cross-sections located in the landfill area to evaluate the final grading configurations of the landfill. The cross-sections were located to encompass critical locations and combinations of the waste mass under the proposed vertical expansion final grading configuration. CEC is not aware of record drawings detailing the base grading configuration, base grading was considered as a crucial factor in selection of cross-section locations. Based on previously permitted documents, it is assumed that the base grades are located at a bottom elevation of 650 ft above mean sea level and consist of 3 horizontal to 1 vertical (3H:1V) excavated sideslopes. Cross-sections were also located to evaluate critical areas surrounding the landfill, such as Cibolo Creek, or residential areas that are located downslope of the landfill. The cross-section locations and final grading configurations are shown on the attached Figure 1.

The overall stability of the landfill depends on the individual shear strength properties of the soils, waste, and base liner system components used in its construction. This analysis incorporates shear strength properties for the C&D waste material using data from Ref. Nos. 4, 5, and 6, as well as typical municipal solid waste (MSW) properties (Ref. No. 7) for comparison. Table 1 and graph below present the peak shear strength properties determined for the various waste materials. CEC notes that strengths used for C&D stability analysis used a composite strength curve that combined the lowest C&D waste strength per literature sources considered, and typical MSW strengths, which are considered were shown to be lower at higher normal loads.

PROJECT **Beck Landfill** PROJECT NO. **311-653**

Vertical Expansion Permit Application

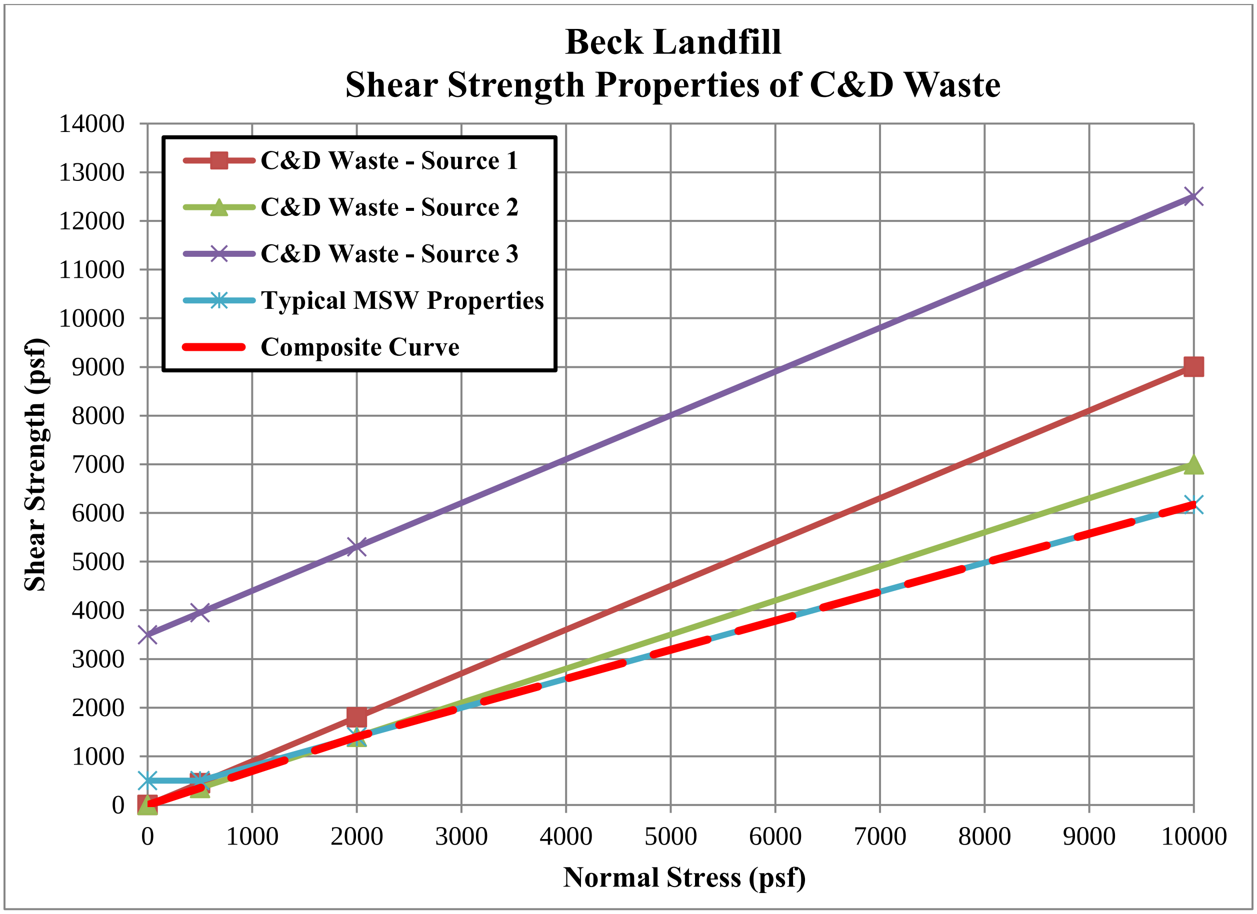
Overall Slope Stability

MADE BY **ZLM** DATE **3/18/2022** CHECKED BY **TDM** DATE **4/22/2022**

MADE BY **BTN** DATE **12/15/2022** CHECKED BY **EDC** DATE **12/20/2022**

Table 1 - Waste Shear Strength Properties

	Friction Angle (degrees)	**Cohesion (psf)**
C&D Waste - Source 1 (Ref. No. 4)	42	0
C&D Waste - Source 2 (Ref. No. 5)	35	0
C&D Waste - Source 3 (Ref. No. 6)	42	3,500
Typical MSW	0 for 0 < σ < 500 psf, and 33 for σ > 500 psf	500 psf for 0 < σ < 500 psf, and 0 for σ > 500 psf



As shown in the above graph, a composite curve was developed to represent the lowest anticipated peak shear strength properties of the C&D waste at different normal stresses. These normal and shear stress parameters were then input into the SLIDE program to model the C&D waste mass. A table of normal shear stress points used to represent the modeled composite shear strength is shown in Table 2.

Table 2 - Waste Shear Strength Properties Used in Slope Stability Analysis

Effective Normal Stress (psf)	Shear Stress (psf)
0	0
2,000	1,400
10,000	6,169

The Beck Landfill liner system was excavated to base grades and constructed with an in-situ clay liner. All excavation of the landfill footprint has previously occurred, and no further excavation or lateral expansion is proposed with this permit amendment application. The shear strength properties for the various soils materials used in the construction of Beck Landfill are listed below.

Shear Strength and Unit Weight Properties of Clay Subgrade (Ref. No. 2 and Similar Site Experience):

Unit Weight = 108 pcf
ϕ = 0 degrees
c = 1,400 psf

Shear Strength and Unit Weight Properties of Shale Subgrade (Ref. No. 8):

Unit Weight = 118 pcf
ϕ = 27 degrees
c = 0 psf

Shear Strength and Unit Weight Properties of Soil Perimeter Berm (CEC Experience with Similar Site):

Unit Weight = 123 pcf
ϕ = 28 degrees
c = 270 psf

<u>Shear Strength and Unit Weight Properties of In-situ Clay Liner (CEC Experience with Similar Site)</u>:

Unit Weight = 123 pcf
ϕ = 28 degrees
c = 270 psf

A piezometric surface was conservatively assumed to develop within the waste mass to the top of the soil perimeter berm elevation. CEC notes that this does not necessarily indicate that the waste mass is saturated, however, for modeling purposes, CEC intended to build some conservatism into the models. CEC does not possess any data currently that would indicate a piezometric surface has developed in the waste mass.

STATIC SLOPE STABILITY RESULTS

As stated above, a total of four (4) slope stability cross-sections were analyzed to encompass critical locations and combinations of waste mass and final grades. For each cross section, two (2) failure search methods were performed, including circular and non-circular search routines. The following minimum factors of safety (FS) were obtained for each of the cross-sections analyzed. Outputs for the static slope stability analyses are included as Attachment 1 at the end of this calculation brief.

Table 3 – Static Slope Stability Results

Cross Section	Failure Type	Minimum Factor of Safety
A	Circular	2.47
A	Non-Circular	2.34
B	Circular	2.43
B	Non-Circular	2.34
C	Circular	2.30
C	Non-Circular	2.23
D	Circular	2.46
D	Non-Circular	2.36

As shown in Table 3, all FSs are greater than 1.50, which is a generally accepted minimum FS required to demonstrate long-term slope stability under static conditions.

3H:1V EXCAVATION SIDE SLOPE STABILITY RESULTS

The four (4) slope stability cross-sections were also analyzed to evaluate the stability of a 3H:1V excavation side slope, prior to waste disposal. For each cross section, two (2) failure search methods were performed, including circular and non-circular search routines. Each cross section models a 3H:1V slope excavated into the shale subgrade and clay subgrade. The clay perimeter berm fill was also included in the analyses as this fill serves to increase the forces driving instability in the models. The following minimum FSs were obtained for each of the cross-sections analyzed. Outputs for the 3H:1V excavation slope stability analyses are included as Attachment 2 at the end of this calculation brief.

Table 4 – 3H:1V Excavation Slope Stability Results

Cross Section	Failure Type	Minimum Factor of Safety
A	Circular	1.90
A	Non-Circular	1.82
B	Circular	1.88
B	Non-Circular	1.82
C	Circular	1.85
C	Non-Circular	1.76
D	Circular	1.78
D	Non-Circular	1.66

As shown in Table 4, all FSs are greater than 1.30, which is a generally accepted minimum FS required to demonstrate short-term slope stability during construction.

RAPID DRAWDOWN SLOPE STABILITY RESULTS

The four (4) slope stability cross-sections were also analyzed to evaluate the stability of the perimeter berm under rapid drawdown conditions. For this analysis it was assumed the 100-year flood would pond against the perimeter berm, the clay perimeter berm fill and clay subgrade would become saturated, and then the ponded water would be rapidly drawn down to below the elevation of the clay subgrade following cessation of flooding. The 100-year flood elevation was determined at each cross section using the Federal Emergency Management Agency Flood Hazard Layer, dated 8/18/21. Figure 2 shows the cross sections and 100-year flood elevations at each location. It is noted that for Cross Section A the 100-year flood elevation was essentially the same elevation as the bottom of the perimeter berm. Therefore, at this location the perimeter berm would not be saturated, and a rapid drawdown analysis was not performed for Cross Section A.

For each cross section, two (2) failure search methods were performed, including circular and non-circular search routines. The following minimum FSs were obtained for each of the cross-sections analyzed. Outputs for the rapid drawdown slope stability analyses are included as Attachment 3 at the end of this calculation brief.

Table 5 – Rapid Drawdown Slope Stability Results

Cross Section	Failure Type	Minimum Factor of Safety
A	Not Performed	NA
B	Circular	1.59
B	Non-Circular	1.58
C	Circular	1.87
C	Non-Circular	1.86
D	Circular	2.61
D	Non-Circular	2.54

As shown in Table 5, all FSs are greater than 1.50 during rapid drawdown conditions.

CONCLUSIONS: As shown above, the calculated FSs indicate that the overall stability of the Beck Landfill will be stable under long-term static conditions (FS $\geq$ 1.5), under short-term 3H:1V excavated side slope conditions (FS $\geq$ 1.3) and under rapid drawdown conditions (FS $\geq$ 1.5) for the assumptions and conditions modeled.

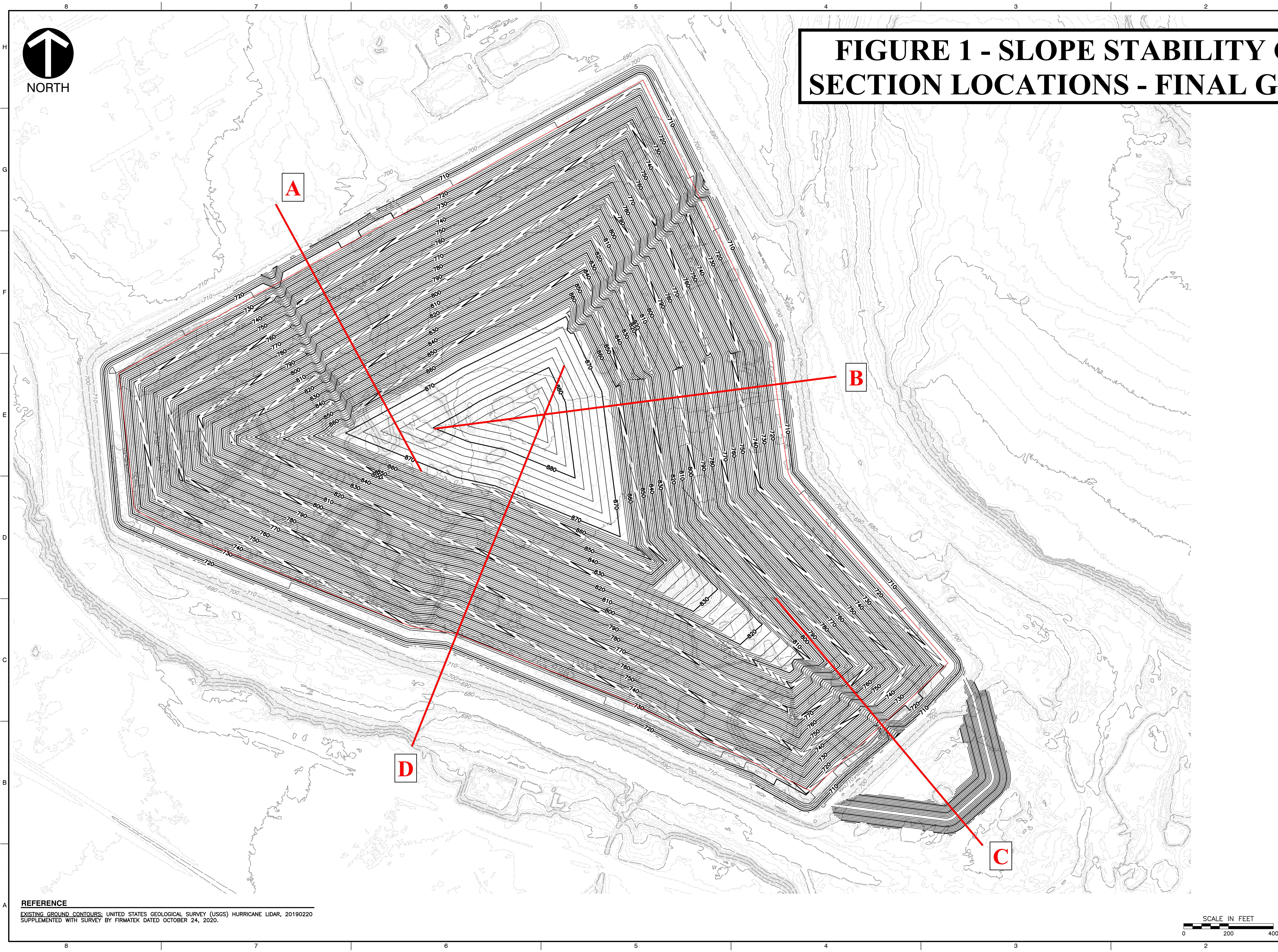
Please note that these assumptions do not model interim slope conditions, nor do they account for any additional loading from stockpiled materials located above proposed final grading. It is recommended to verify the material property assumptions included in this calculation for consistency with actual site conditions prior to increasing waste placement from the currently permitted elevations.

Also, laboratory testing for unit weight and shear strength properties should be performed on the specific soil materials to be used in landfill construction (i.e., shale and clay subgrades, cohesive soil for soil perimeter berm) to verify the material properties are consistent with the shear strength property assumptions listed in the table above, under moderate to high normal loads.

FIGURE 1

SLOPE STABILITY CROSS-SECTION LOCATIONS – FINAL GRADING

FIGURE 1 - SLOPE STABILITY CROSS SECTION LOCATIONS - FINAL GRADING



REFERENCE

EXISTING GROUND CONTOURS: UNITED STATES GEOLOGICAL SURVEY (USGS) HURRICANE LIDAR, 20190220 SUPPLEMENTED WITH SURVEY BY FIRMATEK DATED OCTOBER 24, 2020.

\\svr-austin\projects\310-000\311-653\-Calculations\Slope Stability\References\311653-SW06-TopOfWasteReview.dwg{LAYOUT1} LS:(3/22/2022 - zmetzler) - LP: 3/22/2022 2:39 PM

FIGURE 2

100-YEAR FLOOD ELEVATIONS AT SLOPE STABILITY CROSS SECTIONS

FIGURE 2 - 100-YEAR FLOOD ELEVATIONS AT SLOPE STABILITY CROSS SECTIONS

REFERENCE

DATUM: TX83-SCF: NAD83 Texas State Planes, South Central Zone, US Foot

ELEVATION CONTOURS: STRATEGIC MAPPING PROGRAM (STRATMAP) CENTRAL TEXAS LIDAR, 2017-01-01
(DATA COLLECTION PERIOD: 01/28/201/ THROUGH 03/22/201/).

FLOODPLAIN DATA: FEMA NATIONAL FLOOD HAZARD LAYER (NFHL), 2021-08-18, PUBLICLY AVAILABLE GIS.

LEGEND

— — —	EXISTING CREEK CENTERLINE
▭	EFFECTIVE 1% ANNUAL CHANCE FLOODPLAIN (ZONE AE)
▨	EFFECTIVE 1% ANNUAL CHANCE FLOODWAY
▭	EFFECTIVE ZONE X
—	1% ANNUAL CHANCE FLOODPLAIN BOUNDARY
—	0.2% ANNUAL CHANCE FLOODPLAIN BOUNDARY
▨	1% ANNUAL CHANCE FLOODWAY
—	CROSS-SECTION LINE FROM CURRENT STUDY
—	CROSS-SECTION LINE FROM EFFECTIVE STUDY

SCALE IN FEET
0 300 600
ONE INCH EQUALS 300 FEET

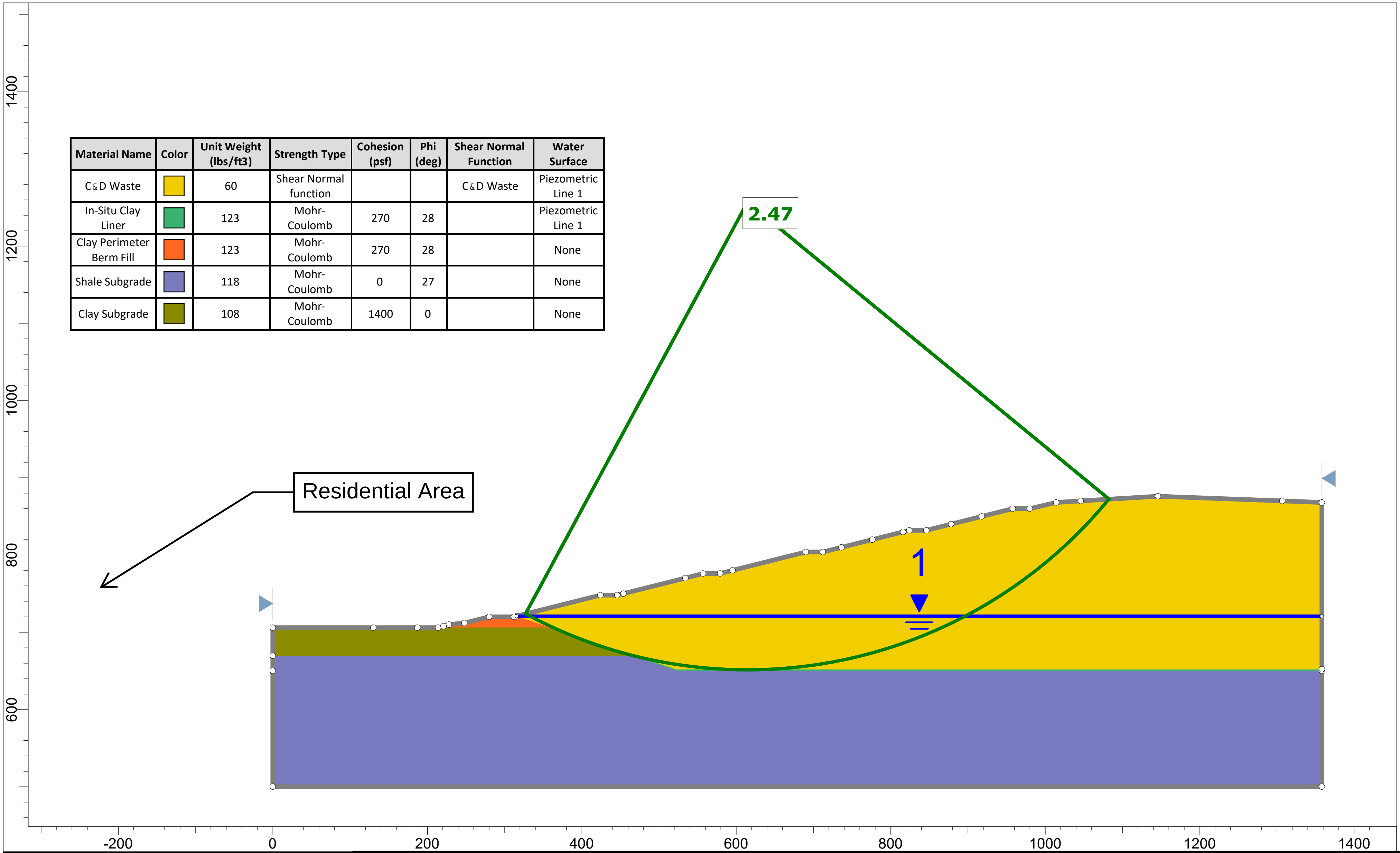
P:\310-000\311-653\-CADD\Dwg\CV01\311653-CV01-TopoWorkMap-REV1.dwg{2} LS:(11/30/2022 - amehevec) - LP: 11/30/2022 6:20 PM

ATTACHMENT 1

STATIC SLOPE STABILITY SLIDE OUTPUTS

CROSS-SECTION A

STATIC SLOPE STABILITY CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface
C&D Waste	🟨	60	Shear Normal function			C&D Waste	Piezometric Line 1
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28		Piezometric Line 1
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28		None
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27		None
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0		None

rocscience

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section A, Circular

Created By: BTN	Checked By: EDC
Created Date12-15-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:02.121s
Date Created:	3/24/2022, 9:28:32 AM

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

C&D Waste	
Color	🟨
Strength Type	Shear Normal function
Unit Weight [lbs/ft3]	60
Water Surface	Piezometric Line 1
Hu Value	1
In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	Piezometric Line 1
Hu Value	1
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Shear Normal Functions

Name: C&D Waste

Effective Normal (psf)	Shear (psf)
0	0
2000	1400
10000	6169

Global Minimums

Method: gle/morgenstern-price

FS	2.470970
Center:	614.604, 1257.108
Radius:	605.881
Left Slip Surface Endpoint:	327.112, 723.778
Right Slip Surface Endpoint:	1082.505, 872.190
Resisting Moment:	1.18894e+09 lb-ft
Driving Moment:	4.81166e+08 lb-ft
Resisting Horizontal Force:	1.80859e+06 lb
Driving Horizontal Force:	731938 lb
Total Slice Area:	77125.5 ft2
Surface Horizontal Width:	755.393 ft
Surface Average Height:	102.1 ft

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.47097

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	5.48559	706.358	-28.0331	C&D Waste	0	34.992	43.1596	106.646	152.352	0	152.352	129.371	129.371
2	19.168	13241.5	-26.7245	C&D Waste	0	34.992	132.512	327.432	768.849	301.091	467.758	702.131	401.04
3	19.168	29374.8	-24.712	C&D Waste	0	34.992	228.146	563.742	1682.76	877.415	805.345	1577.77	700.351
4	15.9983	36762.4	-22.8931	Clay Subgrade	1400	0	566.579	1400	2644.74	0	2644.74	2405.49	2405.49
5	15.9983	47726.9	-21.2603	Clay Subgrade	1400	0	566.579	1400	3365.83	0	3365.83	3145.39	3145.39
6	15.9983	57788.8	-19.6453	Clay Subgrade	1400	0	566.579	1400	4032.14	0	4032.14	3829.89	3829.89
7	15.9983	66080.9	-18.0465	Clay Subgrade	1400	0	566.579	1400	4584.49	0	4584.49	4399.89	4399.89
8	15.9983	70954.4	-16.4621	Clay Subgrade	1400	0	566.579	1400	4913.48	0	4913.48	4746.06	4746.06
9	15.9983	77544.4	-14.8905	Clay Subgrade	1400	0	566.579	1400	5346.97	0	5346.97	5196.31	5196.31
10	10.3632	53935.1	-13.6036	In-Situ Clay Liner	270	28	638.769	1578.38	5743.62	3282.92	2460.7	5589.04	2306.12
11	15.2434	84514.2	-12.3616	C&D Waste	207.75	30.8002	724.671	1790.64	6120.69	3465.39	2655.3	5961.87	2496.48
12	15.2434	90868.4	-10.8897	C&D Waste	207.75	30.8002	782.863	1934.43	6557.65	3661.12	2896.53	6407.04	2745.92
13	15.2434	96852	-9.42506	C&D Waste	207.75	30.8002	838.395	2071.65	6958.26	3831.56	3126.7	6819.09	2987.53
14	15.2434	102476	-7.96662	C&D Waste	207.75	30.8002	891.241	2202.23	7322.79	3977.07	3345.72	7198.06	3220.99
15	15.2434	107845	-6.51337	C&D Waste	207.75	30.8002	943.079	2330.32	7658.56	4097.93	3560.63	7550.89	3452.96
16	15.2434	111816	-5.06432	C&D Waste	207.75	30.8002	974.209	2407.24	7884	4194.37	3689.63	7797.67	3603.3
17	15.2434	113157	-3.61851	C&D Waste	207.75	30.8002	964.192	2382.49	7914.7	4266.6	3648.1	7853.73	3587.13
18	15.3071	117336	-2.17199	In-Situ Clay Liner	270	28	920.76	2275.17	8085.99	4314.79	3771.2	8051.07	3736.28
19	15.3071	121606	-0.723842	In-Situ Clay Liner	270	28	962.529	2378.38	8304.18	4338.93	3965.25	8292.02	3953.09
20	15.3071	125158	0.723842	In-Situ Clay Liner	270	28	997.074	2463.74	8464.75	4338.93	4125.82	8477.35	4138.42
21	15.3071	127981	2.17199	In-Situ Clay Liner	270	28	1024.65	2531.88	8568.75	4314.79	4253.96	8607.62	4292.83
22	14.7878	126072	3.5969	C&D Waste	207.75	30.8002	1143.75	2826.17	8660.06	4267.67	4392.39	8731.95	4464.28
23	14.7878	128400	4.99941	C&D Waste	207.75	30.8002	1176.66	2907.49	8727.13	4198.31	4528.82	8830.07	4631.76
24	14.7878	130405	6.40493	C&D Waste	207.75	30.8002	1208.69	2986.63	8767.74	4106.15	4661.59	8903.42	4797.27
25	14.7878	130518	7.81434	C&D Waste	207.75	30.8002	1214.9	3001.99	8678.37	3991.04	4687.33	8845.1	4854.06
26	14.7878	128937	9.22852	C&D Waste	207.75	30.8002	1199.63	2964.24	8476.8	3852.76	4624.04	8671.71	4818.95

27	14.7878	129481	10.6484	C&D Waste	207.75	30.8002	1224.11	3024.75	8416.54	3691.05	4725.49	8646.7	4955.65
28	14.7878	130124	12.0749	C&D Waste	207.75	30.8002	1255.81	3103.08	8362.5	3505.6	4856.9	8631.15	5125.55
29	14.7878	130425	13.5091	C&D Waste	207.75	30.8002	1288	3182.61	8286.37	3296.06	4990.31	8595.81	5299.75
30	14.7878	130377	14.952	C&D Waste	207.75	30.8002	1320.88	3263.85	8188.6	3062	5126.6	8541.34	5479.34
31	14.7878	129974	16.4046	C&D Waste	207.75	30.8002	1354.63	3347.26	8069.49	2802.96	5266.53	8468.3	5665.34
32	14.7878	129208	17.8682	C&D Waste	207.75	30.8002	1389.41	3433.19	7929.08	2518.39	5410.69	8376.99	5858.6
33	14.7878	128070	19.3439	C&D Waste	207.75	30.8002	1425.32	3521.92	7767.2	2207.68	5559.52	8267.57	6059.89
34	14.7878	125192	20.8331	C&D Waste	207.75	30.8002	1442.56	3564.53	7501.14	1870.14	5631	8050.07	6179.93
35	14.7878	120306	22.3372	C&D Waste	207.75	30.8002	1438.04	3553.36	7117.27	1505	5612.27	7708.14	6203.14
36	14.7878	117442	23.8577	C&D Waste	207.75	30.8002	1470.32	3633.12	6857.44	1111.37	5746.07	7507.7	6396.33
37	14.7878	114707	25.3963	C&D Waste	207.75	30.8002	1511.62	3735.17	6605.55	688.283	5917.26	7323.2	6634.91
38	14.7878	111536	26.9548	C&D Waste	207.75	30.8002	1553.92	3839.7	6327.21	234.614	6092.6	7117.44	6882.82
39	15.4912	112943	28.5734	C&D Waste	207.75	30.8002	1540.03	3805.37	6035.02	0	6035.02	6873.74	6873.74
40	15.4912	108423	30.2554	C&D Waste	207.75	30.8002	1467.55	3626.26	5734.53	0	5734.53	6590.57	6590.57
41	15.4912	103330	31.9669	C&D Waste	207.75	30.8002	1389.94	3434.49	5412.86	0	5412.86	6280.27	6280.27
42	15.4912	97631.1	33.7109	C&D Waste	207.75	30.8002	1306.8	3229.07	5068.27	0	5068.27	5940.15	5940.15
43	15.4912	89362.8	35.4911	C&D Waste	207.75	30.8002	1192.96	2947.77	4596.39	0	4596.39	5447.04	5447.04
44	15.4912	79387.4	37.3117	C&D Waste	207.75	30.8002	1059.86	2618.88	4044.68	0	4044.68	4852.42	4852.42
45	15.4912	71173.2	39.1776	C&D Waste	207.75	30.8002	951.448	2351	3595.3	0	3595.3	4370.66	4370.66
46	15.4912	62193.4	41.0945	C&D Waste	207.75	30.8002	835.36	2064.15	3114.11	0	3114.11	3842.7	3842.7
47	15.4912	50499.8	43.0692	C&D Waste	207.75	30.8002	687.277	1698.24	2500.3	0	2500.3	3142.74	3142.74
48	15.4912	37440.8	45.1098	C&D Waste	2.27374e-13	34.992	518.27	1280.63	1829.47	0	1829.47	2349.73	2349.73
49	15.4912	23303.5	47.2264	C&D Waste	1.13687e-13	34.992	320.178	791.15	1130.21	0	1130.21	1476.29	1476.29
50	15.4912	7976.89	49.4313	C&D Waste	0	34.992	108.643	268.454	383.505	0	383.505	510.402	510.402

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.47097

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	327.112	723.778	0	0	0
2	332.597	720.857	682.135	3.11217	0.261404
3	351.765	711.206	10646.3	217.933	1.1727
4	370.933	702.385	29870.5	1082.75	2.07596
5	386.932	695.63	56816.7	2797.94	2.81925
6	402.93	689.405	86847.1	5386.6	3.54916
7	418.928	683.694	118954	8865.42	4.26227
8	434.926	678.481	151930	13172.7	4.95529
9	450.925	673.754	184237	18146.2	5.62514
10	466.923	669.5	216062	23734.1	6.26873
11	477.286	666.992	237096	27727.9	6.67033
12	492.53	663.651	268609	34111	7.23733
13	507.773	660.719	299793	40929.2	7.77424
14	523.016	658.188	330201	48047.5	8.279
15	538.26	656.055	359430	55320.1	8.74977
16	553.503	654.315	387158	62600.6	9.18481
17	568.747	652.964	412683	69671.2	9.5826
18	583.99	652	435034	76252.5	9.94178
19	599.297	651.419	453846	82169.5	10.2623
20	614.604	651.226	470210	87501.6	10.5416
21	629.911	651.419	483860	92115.2	10.7787
22	645.218	652	494596	95896.9	10.9729
23	660.006	652.93	503487	98954.4	11.1191
24	674.794	654.223	509626	101132	11.2242
25	689.582	655.883	512975	102389	11.2878
26	704.37	657.913	513358	102671	11.3099
27	719.157	660.315	510760	101970	11.2903
28	733.945	663.096	505490	100357	11.2292
29	748.733	666.259	497637	97871.3	11.1265
30	763.521	669.812	487276	94564.3	10.9827
31	778.309	673.761	474503	90501.3	10.7983
32	793.096	678.115	459437	85762.5	10.5736
33	807.884	682.882	442217	80440.6	10.3096
34	822.672	688.073	423007	74639.3	10.0068
35	837.46	693.7	402164	68500.1	9.66635
36	852.248	699.776	380219	62190.2	9.28928
37	867.036	706.316	357150	55780	8.87679
38	881.823	713.337	333165	49377.5	8.43029
39	896.611	720.857	308601	43103.3	7.95125
40	912.102	729.294	281582	36652.7	7.41632
41	927.593	738.33	252535	30334.8	6.84962
42	943.085	747.997	221773	24301.2	6.25335
43	958.576	758.333	189667	18696.9	5.62989
44	974.067	769.379	157405	13721	4.98188
45	989.558	781.185	126099	9507.85	4.31194
46	1005.05	793.809	95474.2	6045.18	3.62298
47	1020.54	807.321	66360.8	3382.55	2.91796
48	1036.03	821.801	40818.9	1568.07	2.19995
49	1051.52	837.352	20411.2	524.551	1.47213
50	1067.01	854.096	6454.58	83.1109	0.737715
51	1082.5	872.19	0	0	0

Discharge Sections

Entity Information

Piezoline

X	Y
315.429	720.857
1358	720.857

External Boundary

X	Y
0	706
0	669.5
0	650
0	500
1358	500
1358	650
1358	652
1358	868
1307	870
1146	876
1046	870
1014	868
980	860
958	860
918	850
878	840
846	832
824	832
816	830
776	820
736	810
712	804
690	804
595	780
579	776
557	776
534	770
454	750
446	748
424	748
315.429	720.857
312	720
280	720
248	712
228	710
221	708
214	706
187	706
130	706

Material Boundary

X	Y
463.735	669.5
522.354	650

Material Boundary

X	Y
522.354	650
1358	650

Material Boundary

X	Y
214	706
354.012	706

Material Boundary

X	Y
522.354	652
1358	652

Material Boundary

X	Y
315.429	720.857
360.072	706
469.747	669.5
522.354	652

Material Boundary

X	Y
0	669.5
463.735	669.5

Material Boundary

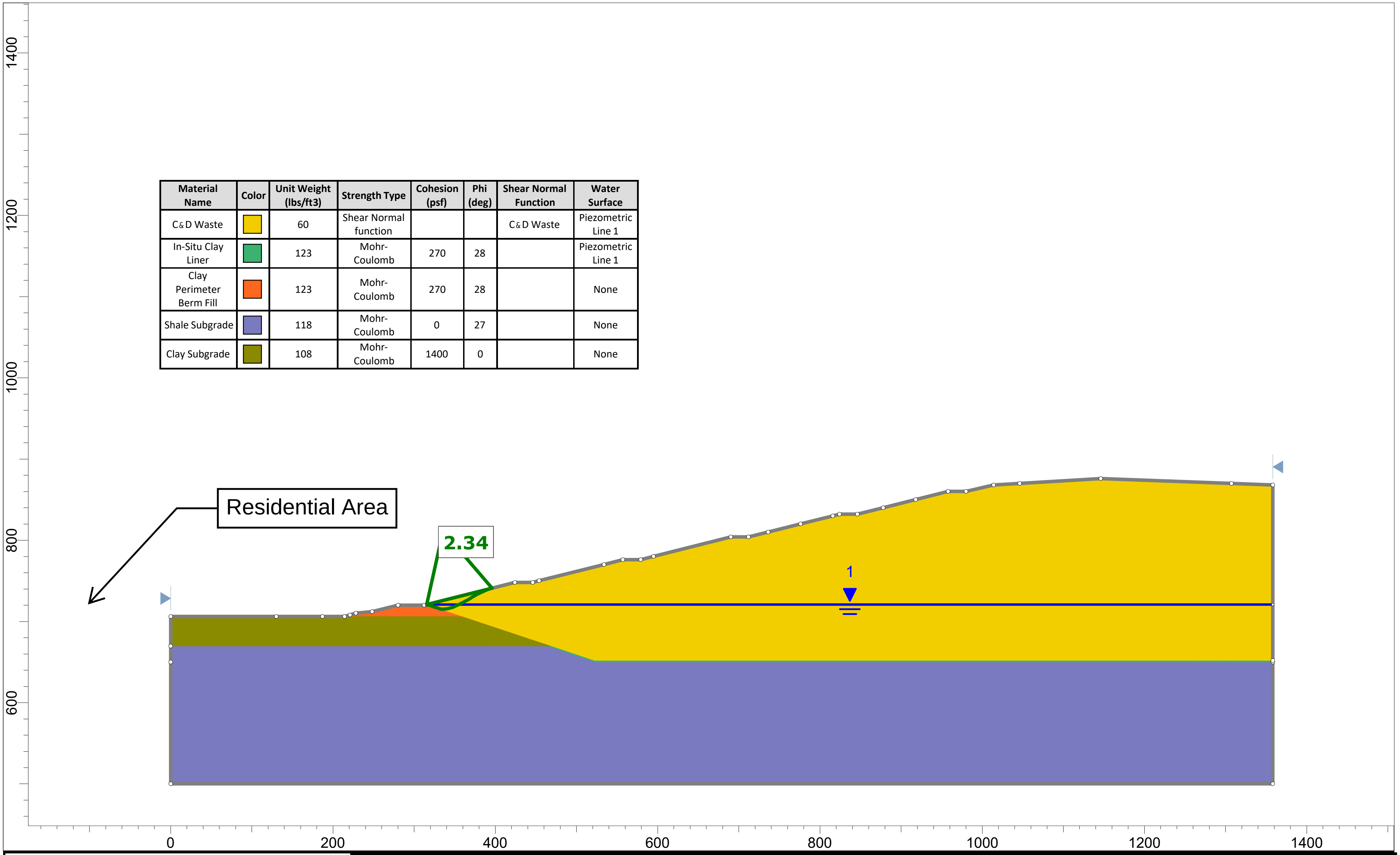
X	Y
463.735	669.5
469.747	669.5

Material Boundary

X	Y
354.012	706
360.072	706

CROSS-SECTION A

STATIC SLOPE STABILITY NON-CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface
C&D Waste	🟨	60	Shear Normal function			C&D Waste	Piezometric Line 1
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28		Piezometric Line 1
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28		None
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27		None
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0		None

rocscience

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section A, Non-Circular

Created By: BTN	Checked By: EDC
Created Date12-15-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:15.997s
Date Created:	3/24/2022, 9:28:32 AM

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

C&D Waste	
Color	🟨
Strength Type	Shear Normal function
Unit Weight [lbs/ft3]	60
Water Surface	Piezometric Line 1
Hu Value	1
In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	Piezometric Line 1
Hu Value	1
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Shear Normal Functions

Name: C&D Waste

Effective Normal (psf)	Shear (psf)
0	0
2000	1400
10000	6169

Global Minimums

Method: gle/morgenstern-price

FS	2.338890
Axis Location:	335.561, 811.452
Left Slip Surface Endpoint:	315.429, 720.857
Right Slip Surface Endpoint:	395.957, 740.989
Resisting Moment:	1.38856e+06 lb-ft
Driving Moment:	593684 lb-ft
Resisting Horizontal Force:	14002.8 lb
Driving Horizontal Force:	5986.92 lb
Total Slice Area:	507.247 ft2
Surface Horizontal Width:	80.5287 ft
Surface Average Height:	6.29896 ft

Global Minimum Coordinates

Method: gle/morgenstern-price

X	Y
315.429	720.857
318.462	719.847
321.496	718.836
324.571	717.815
327.646	716.788
329.982	716.009
332.317	715.403
335.035	715.151
337.863	715.187
340.775	715.694
343.799	716.29
347.227	717.112
350.711	718.702
354.194	720.346
356.374	721.473
358.555	722.595
360.897	723.796
363.239	724.992
365.23	726.004
367.222	727.151
369.214	728.463
371.205	729.705
374.873	731.864
377.661	733.408
380.076	734.662
382.492	735.831
384.908	736.916
387.337	737.922
390.822	739.243
393.699	740.234
395.957	740.989

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.33889

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.51661	40.239	-18.4257	C&D Waste	1.77636e-15	34.992	3.65166	8.54084	27.9527	15.7515	12.2012	26.7361	10.9846
2	1.51661	120.717	-18.4257	C&D Waste	3.55271e-15	34.992	11.2227	26.2486	84.7784	47.28	37.4984	81.0395	33.7595
3	0.0502938	5.38189	-18.4132	C&D Waste	0	34.992	15.2798	35.7377	114.621	63.5666	51.0539	109.534	45.9671
4	1.49209	199.912	-18.4132	C&D Waste	0	34.992	19.4212	45.4241	144.479	79.5871	64.8917	138.013	58.4261
5	1.49209	277.777	-18.4132	C&D Waste	0	34.992	27.7189	64.8315	203.199	110.583	92.6164	193.971	83.3885
6	1.53754	367.635	-18.3678	C&D Waste	1.42109e-14	34.992	36.5588	85.507	264.162	142.009	122.153	252.024	110.015
7	1.53754	450.191	-18.3678	C&D Waste	1.42109e-14	34.992	45.9838	107.551	327.509	173.865	153.644	312.241	138.376
8	1.53754	532.89	-18.4709	C&D Waste	0	34.992	55.915	130.779	392.645	205.817	186.828	373.968	168.151
9	1.53754	615.729	-18.4709	C&D Waste	2.84217e-14	34.992	66.2203	154.882	459.124	237.865	221.259	437.005	199.14
10	2.28697	1069.06	-18.4581	C&D Waste	0	34.992	79.5954	186.165	543.657	277.705	265.952	517.089	239.384
11	0.0482078	24.5066	-18.4581	C&D Waste	0	34.992	88.0029	205.829	596.065	302.024	294.041	566.691	264.667
12	2.33515	1272.37	-14.5388	C&D Waste	0	34.992	91.3998	213.774	626.813	321.421	305.392	603.109	281.688
13	1.35897	807.965	-5.30748	C&D Waste	2.84217e-14	34.992	91.5644	214.159	650.196	344.254	305.942	641.69	297.436
14	1.35897	845.961	-5.30748	C&D Waste	2.84217e-14	34.992	99.0329	231.627	683.027	352.132	330.895	673.827	321.695
15	1.4143	914.404	0.735054	C&D Waste	0	34.992	98.5104	230.405	684.655	355.505	329.15	685.919	330.414
16	1.4143	942.868	0.735054	C&D Waste	2.84217e-14	34.992	105.394	246.505	706.523	354.372	352.151	707.875	353.503
17	1.45591	990.086	9.87386	C&D Waste	0	34.992	99.9149	233.69	679.742	345.9	333.842	697.133	351.233
18	1.45591	999.745	9.87386	C&D Waste	2.84217e-14	34.992	106.107	248.173	684.621	330.087	354.534	703.09	373.003
19	1.51211	1046.99	11.1458	C&D Waste	5.68434e-14	34.992	110.675	258.856	682.678	312.885	369.793	704.484	391.599
20	1.51211	1054.26	11.1458	C&D Waste	0	34.992	117.097	273.878	685.546	294.295	391.251	708.617	414.322
21	1.71405	1200.07	13.4833	C&D Waste	0	34.992	120.505	281.849	674.82	272.177	402.643	703.713	431.536
22	1.71405	1201.88	13.4833	C&D Waste	0	34.992	127.783	298.87	673.492	246.532	426.96	704.131	457.599
23	1.74161	1203.32	24.5393	C&D Waste	0	34.992	118.674	277.565	605.425	208.901	396.524	659.606	450.705
24	1.74161	1165.73	24.5393	C&D Waste	5.68434e-14	34.992	126.447	295.746	581.779	159.285	422.494	639.509	480.224
25	1.74161	1126.73	25.27	C&D Waste	0	34.992	133.331	311.846	554.32	108.825	445.495	617.26	508.435
26	1.74161	1086.32	25.27	C&D Waste	0	34.992	141.483	330.914	530.259	57.5239	472.735	597.047	539.523

27	0.988996	597.578	27.3244	C&D Waste	0	34.992	144.891	338.883	500.049	15.9302	484.119	574.91	558.98
28	1.19155	699.182	27.3244	C&D Waste	0	34.992	144.829	338.74	483.914	0	483.914	558.744	558.744
29	2.18055	1220.96	27.2355	C&D Waste	5.68434e-14	34.992	138.053	322.891	461.274	0	461.274	532.332	532.332
30	2.3419	1227.51	27.1485	C&D Waste	5.68434e-14	34.992	129.08	301.903	431.289	0	431.289	497.48	497.48
31	2.3419	1141.39	27.0491	C&D Waste	5.68434e-14	34.992	119.981	280.622	400.891	0	400.891	462.154	462.154
32	1.99159	903.463	26.9428	C&D Waste	0	34.992	111.73	261.325	373.322	0	373.322	430.111	430.111
33	1.99159	833.963	29.9332	C&D Waste	2.84217e-14	34.992	100.102	234.128	334.469	0	334.469	392.108	392.108
34	1.99159	746.574	33.3693	C&D Waste	2.84217e-14	34.992	86.6484	202.661	289.516	0	289.516	346.584	346.584
35	1.99159	653.486	31.9514	C&D Waste	2.84217e-14	34.992	77.1712	180.495	257.85	0	257.85	305.981	305.981
36	1.83406	526.663	30.4883	C&D Waste	2.84217e-14	34.992	68.7317	160.756	229.652	0	229.652	270.119	270.119
37	1.83406	458.29	30.4883	C&D Waste	0	34.992	60.008	140.352	200.503	0	200.503	235.834	235.834
38	1.39364	304.558	28.9798	C&D Waste	0	34.992	53.3976	124.891	178.416	0	178.416	207.991	207.991
39	1.39364	269.149	28.9798	C&D Waste	0	34.992	47.3246	110.687	158.125	0	158.125	184.335	184.335
40	1.20795	206.17	27.426	C&D Waste	1.42109e-14	34.992	42.519	99.4472	142.067	0	142.067	164.132	164.132
41	1.20795	182.625	27.426	C&D Waste	1.42109e-14	34.992	37.7578	88.3114	126.159	0	126.159	145.752	145.752
42	1.20795	160.61	25.8273	C&D Waste	0	34.992	33.7373	78.9078	112.725	0	112.725	129.055	129.055
43	1.20795	140.123	25.8273	C&D Waste	1.42109e-14	34.992	29.5038	69.0061	98.5802	0	98.5802	112.86	112.86
44	2.41591	224.899	24.1842	C&D Waste	0	34.992	24.0649	56.2852	80.4075	0	80.4075	91.2147	91.2147
45	1.21434	88.2594	22.4976	C&D Waste	7.10543e-15	34.992	19.0851	44.6379	63.7683	0	63.7683	71.6727	71.6727
46	1.21434	73.7345	22.4976	C&D Waste	7.10543e-15	34.992	15.9725	37.358	53.3685	0	53.3685	59.9838	59.9838
47	3.48465	143.665	20.769	C&D Waste	0	34.992	11.0047	25.7387	36.7696	0	36.7696	40.9431	40.9431
48	1.43875	34.02	18.9998	C&D Waste	0	34.992	6.39821	14.9647	21.3782	0	21.3782	23.5813	23.5813
49	1.43875	22.305	18.9998	C&D Waste	0	34.992	4.19873	9.82036	14.0291	0	14.0291	15.4748	15.4748
50	2.25822	12.9077	18.4885	C&D Waste	0	34.992	1.55396	3.63454	5.19219	0	5.19219	5.71179	5.71179

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.33889

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	315.429	720.857	0	0	0
2	316.945	720.352	19.6617	0.3092	0.900959
3	318.462	719.847	79.5174	2.49661	1.79833
4	318.512	719.83	82.205	2.62359	1.82799
5	320.004	719.333	182.951	8.63919	2.70357
6	321.496	718.836	325.246	20.2848	3.56878
7	323.034	718.326	516.314	40.1454	4.44602
8	324.571	717.815	754.214	70.0365	5.30529
9	326.109	717.302	1041.84	112.136	6.14325
10	327.646	716.788	1379.46	168.319	6.95673
11	329.933	716.025	1976.49	281.824	8.115
12	329.982	716.009	1990.32	284.636	8.13869
13	332.317	715.403	2583.35	420.61	9.24751
14	333.676	715.277	2789.87	484.685	9.85564
15	335.035	715.151	3010.68	554.438	10.4345
16	336.449	715.169	3137.59	610.128	11.0043
17	337.863	715.187	3273.82	668.408	11.5393
18	339.319	715.44	3247.04	693.284	12.0524
19	340.775	715.694	3228.03	717.17	12.5259
20	342.287	715.992	3192	735.442	12.9746
21	343.799	716.29	3164.82	752.697	13.3782
22	345.513	716.701	3094.04	758.824	13.78
23	347.227	717.112	3036.28	763.862	14.1213
24	348.969	717.907	2761.56	709.317	14.4052
25	350.711	718.702	2519.19	657.365	14.6248
26	352.452	719.524	2295.67	605.664	14.7795
27	354.194	720.346	2106.14	559.171	14.8688
28	355.183	720.857	1993.91	530.178	14.8903
29	356.374	721.473	1868.56	496.771	14.8881
30	358.555	722.595	1651.88	436.584	14.8045
31	360.897	723.796	1436.23	374.123	14.6005
32	363.239	724.992	1237.84	315.043	14.2792
33	365.23	726.004	1082.46	268.183	13.915
34	367.222	727.151	898.272	215.137	13.4687
35	369.214	728.463	691.088	158.815	12.9421
36	371.205	729.705	524.497	114.718	12.3374
37	373.039	730.785	402.569	83.4705	11.714
38	374.873	731.864	296.116	57.7154	11.0291
39	376.267	732.636	232.82	43.0221	10.4694
40	377.661	733.408	176.722	30.7709	9.87734
41	378.868	734.035	139.03	22.8644	9.33907
42	380.076	734.662	105.558	16.3012	8.77877
43	381.284	735.246	80.4055	11.583	8.19748
44	382.492	735.831	58.4092	7.78982	7.5965
45	384.908	736.916	29.3098	3.25691	6.3407
46	386.123	737.419	20.4141	2.03228	5.68522
47	387.337	737.922	12.9691	1.13821	5.01561
48	390.822	739.243	2.72437	0.144198	3.02978
49	392.26	739.739	1.33916	0.0511886	2.18903
50	393.699	740.234	0.430143	0.0100651	1.34044
51	395.957	740.989	0	0	0

Discharge Sections

Entity Information

Piezoline

X	Y
315.429	720.857
1358	720.857

External Boundary

X	Y
0	706
0	669.5
0	650
0	500
1358	500
1358	650
1358	652
1358	868
1307	870
1146	876
1046	870
1014	868
980	860
958	860
918	850
878	840
846	832
824	832
816	830
776	820
736	810
712	804
690	804
595	780
579	776
557	776
534	770
454	750
446	748
424	748
315.429	720.857
312	720
280	720
248	712
228	710
221	708
214	706
187	706
130	706

Material Boundary

X	Y
463.735	669.5
522.354	650

Material Boundary

X	Y
522.354	650
1358	650

Material Boundary

X	Y
214	706
354.012	706

Material Boundary

X	Y
522.354	652
1358	652

Material Boundary

X	Y
315.429	720.857
360.024	706
469.747	669.5
522.354	652

Material Boundary

X	Y
0	669.5
463.735	669.5

Material Boundary

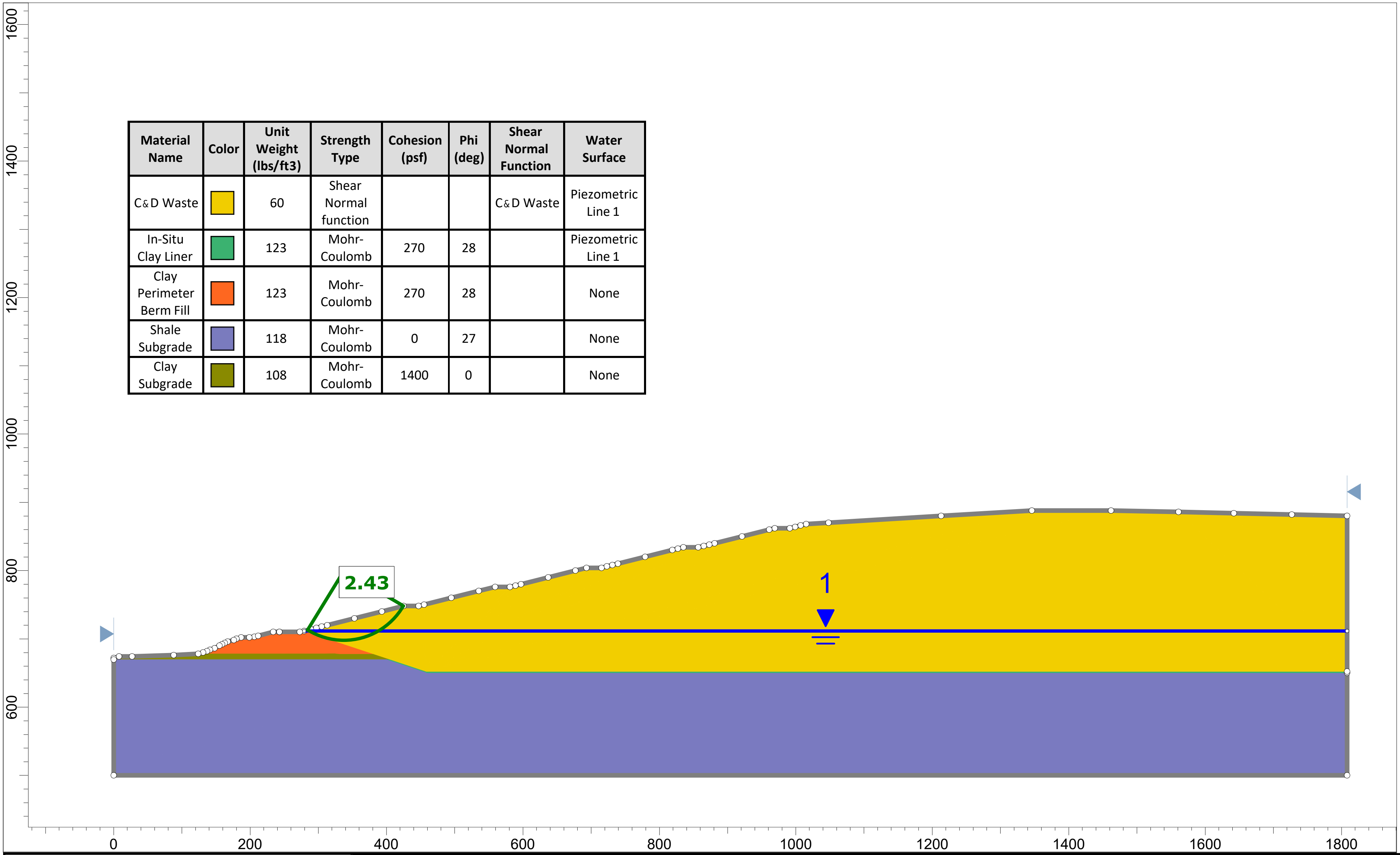
X	Y
354.012	706
360.024	706

Material Boundary

X	Y
463.735	669.5
469.747	669.5

CROSS-SECTION B

STATIC SLOPE STABILITY CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface
C&D Waste	🟨	60	Shear Normal function			C&D Waste	Piezometric Line 1
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28		Piezometric Line 1
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28		None
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27		None
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0		None

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SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section B, Circular

Created By: BTN	Checked By: EDC	Civil & Environmental Consultants, Inc.
Created Date12-15-22	Checked Date: 12-20-22	

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:02.385s
Date Created:	3/24/2022, 9:28:32 AM

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

C&D Waste	
Color	🟨
Strength Type	Shear Normal function
Unit Weight [lbs/ft3]	60
Water Surface	Piezometric Line 1
Hu Value	1
In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	Piezometric Line 1
Hu Value	1
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Shear Normal Functions

Name: C&D Waste

Effective Normal (psf)	Shear (psf)
0	0
2000	1400
10000	6169

Global Minimums

Method: gle/morgenstern-price

FS	2.428700
Center:	337.193, 799.312
Radius:	101.546
Left Slip Surface Endpoint:	284.068, 712.771
Right Slip Surface Endpoint:	424.790, 747.947
Resisting Moment:	8.97987e+06 lb-ft
Driving Moment:	3.6974e+06 lb-ft
Resisting Horizontal Force:	79649.2 lb
Driving Horizontal Force:	32795 lb
Total Slice Area:	3046.37 ft2
Surface Horizontal Width:	140.721 ft
Surface Average Height:	21.6482 ft

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.4287

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.99801	101.49	-30.8875	C&D Waste	0	34.992	17.9138	43.5072	62.1531	0	62.1531	51.4372	51.4372
2	3.00716	525.097	-29.2581	C&D Waste	0	34.992	43.7489	106.253	204.334	52.5442	151.79	179.825	127.281
3	3.00716	952.735	-27.3306	C&D Waste	0	34.992	60.2783	146.398	362.736	153.595	209.141	331.583	177.988
4	3.00716	1357.62	-25.4361	C&D Waste	2.84217e-14	34.992	77.7012	188.713	516.296	246.707	269.589	479.34	232.633
5	3.00716	1740.65	-23.571	C&D Waste	0	34.992	95.6223	232.238	664.034	332.265	331.769	622.315	290.05
6	3.00716	2102.79	-21.732	C&D Waste	5.68434e-14	34.992	113.698	276.139	805.082	410.596	394.486	759.762	349.166
7	3.00716	2444.87	-19.9163	C&D Waste	5.68434e-14	34.992	131.618	319.661	938.646	481.988	456.658	890.958	408.97
8	2.0649	1867.38	-18.4	C&D Waste	5.68434e-14	34.992	146.402	355.567	1045.36	537.413	507.952	996.663	459.25
9	2.83258	2797.42	-16.9506	C&D Waste	5.68434e-14	34.992	160.257	389.216	1141.8	585.78	556.024	1092.96	507.179
10	2.83258	3056.92	-15.2867	C&D Waste	5.68434e-14	34.992	175.612	426.51	1246.17	636.871	609.299	1198.17	561.301
11	2.83258	3301.46	-13.6359	C&D Waste	5.68434e-14	34.992	190.119	461.743	1342.1	682.466	659.631	1295.98	613.51
12	2.83258	3531.35	-11.9966	C&D Waste	5.68434e-14	34.992	203.674	494.662	1429.34	722.684	706.66	1386.06	663.38
13	2.83258	3746.89	-10.3672	C&D Waste	0	34.992	216.205	525.096	1507.77	757.632	750.138	1468.22	710.585
14	2.83258	3948.31	-8.74621	C&D Waste	0	34.992	227.676	552.956	1577.33	787.396	789.937	1542.31	754.91
15	2.83258	4135.81	-7.13228	C&D Waste	0	34.992	238.082	578.229	1638.09	812.051	826.041	1608.3	796.25
16	2.83258	4309.56	-5.52402	C&D Waste	1.13687e-13	34.992	247.445	600.969	1690.18	831.656	858.528	1666.25	834.597
17	2.83258	4469.69	-3.92012	C&D Waste	0	34.992	255.814	621.295	1733.82	846.259	887.564	1716.29	870.034
18	2.83258	4616.28	-2.31929	C&D Waste	0	34.992	263.26	639.38	1769.3	855.895	913.4	1758.63	902.738
19	2.83258	4749.41	-0.720274	C&D Waste	0	34.992	269.872	655.439	1796.93	860.585	936.341	1793.53	932.948
20	2.83258	4869.1	0.878182	C&D Waste	0	34.992	275.754	669.723	1817.09	860.342	956.749	1821.32	960.975
21	2.83258	4975.35	2.47732	C&D Waste	0	34.992	281.019	682.51	1830.18	855.163	975.013	1842.33	987.171
22	2.83258	5068.13	4.0784	C&D Waste	0	34.992	285.787	694.091	1836.6	845.038	991.56	1856.98	1011.94
23	2.83258	5147.36	5.68267	C&D Waste	1.13687e-13	34.992	290.183	704.768	1836.75	829.943	1006.81	1865.63	1035.69
24	2.83258	5212.97	7.29143	C&D Waste	0	34.992	294.329	714.837	1831.04	809.841	1021.19	1868.7	1058.85
25	2.83258	5264.8	8.906	C&D Waste	0	34.992	298.346	724.592	1819.82	784.684	1035.13	1866.57	1081.88
26	2.83258	5302.7	10.5277	C&D Waste	0	34.992	302.346	734.307	1803.42	754.411	1049.01	1859.61	1105.2

27	2.83258	5326.46	12.1581	C&D Waste	0	34.992	306.436	744.241	1782.15	718.948	1063.2	1848.17	1129.22
28	2.83258	5335.84	13.7984	C&D Waste	1.13687e-13	34.992	310.711	754.625	1756.24	678.203	1078.04	1832.55	1154.35
29	2.83258	5330.55	15.4505	C&D Waste	0	34.992	315.257	765.665	1725.88	632.071	1093.81	1813.02	1180.94
30	2.83258	5310.25	17.1158	C&D Waste	1.13687e-13	34.992	320.145	777.536	1691.2	580.43	1110.77	1789.78	1209.35
31	2.83258	5274.56	18.7961	C&D Waste	0	34.992	325.433	790.378	1652.25	523.136	1129.11	1763.01	1239.87
32	2.83258	5223.02	20.4934	C&D Waste	0	34.992	331.164	804.298	1609.02	460.026	1149	1732.8	1272.77
33	2.83258	5155.13	22.2098	C&D Waste	-1.13687e-13	34.992	337.368	819.365	1561.43	390.911	1170.52	1699.18	1308.27
34	2.83258	5070.3	23.9474	C&D Waste	1.13687e-13	34.992	344.056	835.609	1509.31	315.577	1193.73	1662.11	1346.53
35	2.83258	4967.86	25.7088	C&D Waste	1.13687e-13	34.992	351.225	853.021	1452.38	233.778	1218.6	1621.48	1387.7
36	2.83258	4847.04	27.4967	C&D Waste	0	34.992	358.853	871.547	1390.3	145.229	1245.07	1577.08	1431.85
37	2.83258	4706.95	29.3141	C&D Waste	1.13687e-13	34.992	366.898	891.086	1322.58	49.6063	1272.98	1528.6	1478.99
38	2.80543	4503.86	31.1555	C&D Waste	1.13687e-13	34.992	361.531	878.05	1254.36	0	1254.36	1472.92	1472.92
39	2.80543	4325.69	33.0244	C&D Waste	1.13687e-13	34.992	342.25	831.222	1187.46	0	1187.46	1409.93	1409.93
40	2.80543	4125.35	34.9339	C&D Waste	0	34.992	321.958	781.939	1117.06	0	1117.06	1341.94	1341.94
41	2.80543	3901.28	36.889	C&D Waste	1.13687e-13	34.992	300.549	729.944	1042.78	0	1042.78	1268.35	1268.35
42	2.80543	3651.63	38.8956	C&D Waste	0	34.992	277.891	674.913	964.162	0	964.162	1188.36	1188.36
43	2.80543	3374.24	40.9607	C&D Waste	1.13687e-13	34.992	253.817	616.445	880.636	0	880.636	1100.97	1100.97
44	2.80543	3066.43	43.0928	C&D Waste	1.13687e-13	34.992	228.128	554.054	791.507	0	791.507	1004.93	1004.93
45	2.80543	2724.98	45.302	C&D Waste	5.68434e-14	34.992	200.581	487.15	695.929	0	695.929	898.635	898.635
46	2.80543	2345.83	47.6011	C&D Waste	0	34.992	170.882	415.02	592.886	0	592.886	780.032	780.032
47	2.80543	1923.85	50.0066	C&D Waste	5.68434e-14	34.992	138.676	336.803	481.147	0	481.147	646.453	646.453
48	2.80543	1452.3	52.5395	C&D Waste	0	34.992	103.532	251.449	359.214	0	359.214	494.333	494.333
49	2.80543	922.12	55.2289	C&D Waste	0	34.992	64.9244	157.682	225.259	0	225.259	318.774	318.774
50	2.80543	320.53	58.1154	C&D Waste	0	34.992	22.2078	53.936	77.0514	0	77.0514	112.751	112.751

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.4287

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	284.068	712.771	0	0	0
2	286.066	711.576	110.1	1.26923	0.660475
3	289.074	709.891	585.977	16.8925	1.65126
4	292.081	708.337	1331.1	61.2283	2.63365
5	295.088	706.907	2303.34	145.021	3.60265
6	298.095	705.595	3462.28	275.737	4.55344
7	301.102	704.396	4769.41	457.676	5.48136
8	304.109	703.306	6188.16	692.138	6.38194
9	306.174	702.62	7208.73	882.859	6.98229
10	309.007	701.756	8648.72	1181.54	7.77927
11	311.839	700.982	10111.3	1518.83	8.5426
12	314.672	700.295	11572.4	1888.71	9.26941
13	317.505	699.693	13010	2283.94	9.95697
14	320.337	699.175	14404.1	2696.39	10.6028
15	323.17	698.739	15736.8	3117.3	11.2047
16	326.002	698.385	16992.3	3537.65	11.7605
17	328.835	698.111	18156.6	3948.38	12.2687
18	331.667	697.916	19218.3	4340.69	12.7274
19	334.5	697.802	20167.4	4706.29	13.1355
20	337.333	697.766	20996.3	5037.56	13.4917
21	340.165	697.81	21699	5327.8	13.7951
22	342.998	697.932	22271.3	5571.29	14.0446
23	345.83	698.134	22710.4	5763.45	14.2399
24	348.663	698.416	23015.2	5900.86	14.3803
25	351.496	698.778	23185.8	5981.35	14.4655
26	354.328	699.222	23223.7	6003.98	14.4952
27	357.161	699.749	23131.3	5969	14.4694
28	359.993	700.359	22912.3	5877.85	14.3882
29	362.826	701.055	22571.2	5733.09	14.2518
30	365.658	701.837	22113.6	5538.29	14.0604
31	368.491	702.71	21545.8	5297.99	13.8146
32	371.324	703.674	20875.4	5017.54	13.5151
33	374.156	704.733	20110.6	4703.05	13.1626
34	376.989	705.889	19261	4361.21	12.7582
35	379.821	707.147	18337.4	3999.2	12.303
36	382.654	708.511	17352.2	3624.54	11.7983
37	385.487	709.985	16319.6	3244.93	11.2458
38	388.319	711.576	15256	2868.08	10.6472
39	391.125	713.272	14143.4	2496.61	10.0108
40	393.93	715.095	12938.8	2126.52	9.33325
41	396.735	717.055	11653.7	1765.99	8.61698
42	399.541	719.16	10301.8	1423.01	7.86462
43	402.346	721.424	8899.65	1105.19	7.07895
44	405.152	723.859	7467.52	819.541	6.263
45	407.957	726.484	6030.54	572.185	5.42007
46	410.763	729.319	4620.55	367.994	4.55359
47	413.568	732.391	3278.63	210.136	3.66722
48	416.373	735.735	2058.9	99.4254	2.7647
49	419.179	739.397	1034.34	33.4085	1.84997
50	421.984	743.438	306.364	4.95738	0.927042
51	424.79	747.947	0	0	0

Discharge Sections

Entity Information

Piezoline

X	Y
279.273	711.576
1808	711.576

External Boundary

X	Y
206.442	702.93
199	702
187	702
180	700
176	698
167	696
163	694
159	692
155	690
148	686
141	684
137	682
131	680
124	678
88	676
27	674
8	674
0	672
0	669.5
0	500
1808	500
1808	650
1808	652
1808	880
1727	882
1642	884
1561	886
1462	888
1346	888
1213	880
1048	870
1015	868
1007	866
999	864
991	862

969	862
961	860
921	850
881	840
873	838
865	836
857	834
835	834
827	832
819	830
779	820
739	810
731	808
723	806
715	804
693	804
677	800
637	790
597	780
589	778
581	776
559	776
535	770
495	760
455	750
447	748
425	748
393	740
353	730
313	720
305	718
297	716
289	714
279.273	711.576
272.952	710
243.001	710
243	710
234	710
211.897	704.33

Material Boundary

X	Y
124	678
324.992	678
374.171	678

Material Boundary

X	Y
458.342	650
1808	650

Material Boundary

X	Y
290	706
374.171	678
399.723	669.5
458.342	650

Material Boundary

X	Y
243	710
278	710
284	708
290	706

Material Boundary

X	Y
458.342	652
1808	652

Material Boundary

X	Y
290	708
380.183	678
405.735	669.5
458.342	652

Material Boundary

X	Y
279.273	711.576
284	710
290	708

Material Boundary

X	Y
0	669.5
399.723	669.5

Material Boundary

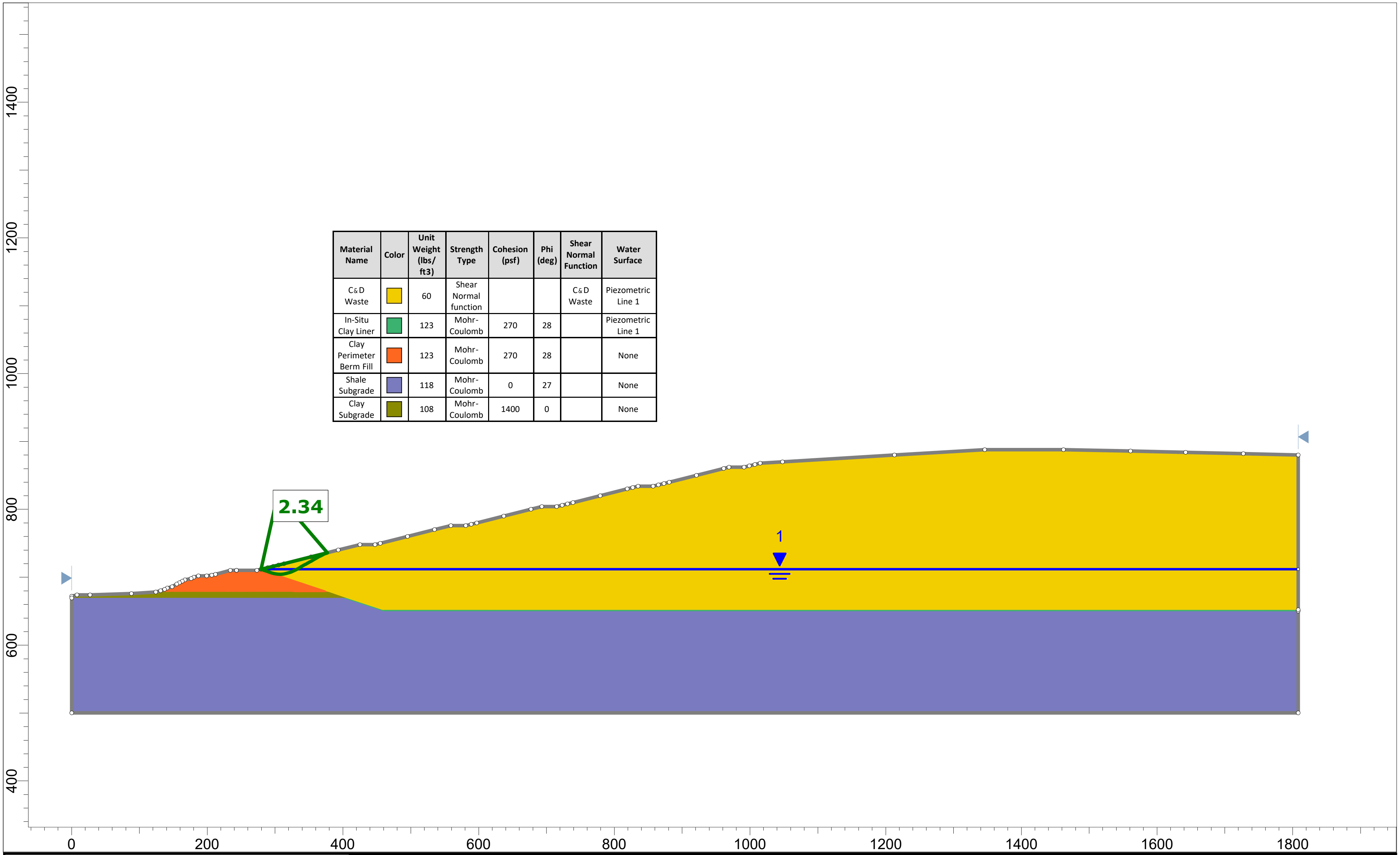
X	Y
399.723	669.5
405.735	669.5

Material Boundary

X	Y
374.171	678
380.183	678

CROSS-SECTION B

STATIC SLOPE STABILITY NON-CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface
C&D Waste	🟨	60	Shear Normal function			C&D Waste	Piezometric Line 1
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28		Piezometric Line 1
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28		None
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27		None
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0		None

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SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section B,Non- Circular

Created By: BTN	Checked By: EDC
Created Date12-15-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:27.414s
Date Created:	3/24/2022, 9:28:32 AM

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

C&D Waste	
Color	🟨
Strength Type	Shear Normal function
Unit Weight [lbs/ft3]	60
Water Surface	Piezometric Line 1
Hu Value	1
In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	Piezometric Line 1
Hu Value	1
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Shear Normal Functions

Name: C&D Waste

Effective Normal (psf)	Shear (psf)
0	0
2000	1400
10000	6169

Global Minimums

Method: gle/morgenstern-price

FS	2.336340
Axis Location:	303.700, 821.458
Left Slip Surface Endpoint:	279.273, 711.576
Right Slip Surface Endpoint:	376.950, 735.987
Resisting Moment:	2.85578e+06 lb-ft
Driving Moment:	1.22233e+06 lb-ft
Resisting Horizontal Force:	23432.7 lb
Driving Horizontal Force:	10029.6 lb
Total Slice Area:	855.877 ft2
Surface Horizontal Width:	97.6766 ft
Surface Average Height:	8.76236 ft

Global Minimum Coordinates

Method: gle/morgenstern-price

X	Y
279.273	711.576
283.498	710.215
287.557	708.814
291.269	707.579
294.98	706.343
298.829	705.228
303.046	704.495
307.263	704.199
311.897	704.571
316.53	705.407
321.018	706.73
323.115	707.505
326.847	709.045
330.93	711.166
333.193	712.466
335.455	713.761
338.627	715.57
340.935	716.881
343.104	718.107
345.272	719.328
348.701	721.251
350.984	722.522
353.482	723.904
357.173	726.009
360.582	727.983
363.99	729.839
368.301	732.035
372.625	734.087
376.95	735.987

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.33634

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.1124	76.4641	-17.846	C&D Waste	1.77636e-15	34.992	5.07503	11.857	38.1404	21.2019	16.9385	36.5065	15.3046
2	2.1124	229.392	-17.846	C&D Waste	0	34.992	15.6317	36.5209	115.812	63.6396	52.1729	110.78	47.1403
3	2.01733	364.672	-19.0473	C&D Waste	7.10543e-15	34.992	26.8549	62.7421	196.22	106.589	89.6312	186.949	80.3596
4	2.01733	509.833	-19.0473	C&D Waste	0	34.992	38.332	89.5565	277.988	150.05	127.938	264.753	114.703
5	0.0245433	7.09674	-19.0473	C&D Waste	1.42109e-14	34.992	44.3673	103.657	320.126	172.044	148.082	304.808	132.764
6	0.615201	184.765	-18.4104	C&D Waste	0	34.992	45.9954	107.461	332.212	178.698	153.514	316.902	138.204
7	1.54824	523.478	-18.4104	C&D Waste	0	34.992	52.5938	122.877	376.704	201.165	175.539	359.198	158.033
8	1.54824	607.29	-18.4104	C&D Waste	2.84217e-14	34.992	62.3497	145.67	441.422	233.323	208.099	420.668	187.345
9	3.03056	1431.36	-18.4104	C&D Waste	0	34.992	77.463	180.98	539.418	280.874	258.544	513.634	232.76
10	0.68112	365.908	-18.4104	C&D Waste	0	34.992	90.1697	210.667	620.374	319.421	300.953	590.36	270.939
11	1.92432	1116.65	-16.1634	C&D Waste	2.84217e-14	34.992	96.3742	225.163	665.556	343.896	321.66	637.623	293.727
12	1.92432	1236.59	-16.1634	C&D Waste	0	34.992	109.564	255.978	744.382	378.698	365.684	712.627	333.929
13	2.10858	1477.24	-9.8566	C&D Waste	5.68434e-14	34.992	113.195	264.461	785.33	407.53	377.8	765.663	358.133
14	2.10858	1590.28	-9.8566	C&D Waste	0	34.992	125.987	294.348	850.89	430.391	420.499	829	398.609
15	2.10861	1689.52	-4.01033	C&D Waste	0	34.992	128.062	299.197	873.858	446.434	427.424	864.879	418.445
16	2.10861	1774.92	-4.01033	C&D Waste	5.68434e-14	34.992	139.287	325.421	920.546	455.658	464.888	910.781	455.123
17	4.6332	4103.11	4.58917	C&D Waste	5.68434e-14	34.992	139.721	326.436	915.004	448.667	466.337	926.219	477.552
18	2.31665	2117.45	10.2289	C&D Waste	0	34.992	144.369	337.295	905.873	424.021	481.852	931.924	507.903
19	2.31665	2139.84	10.2289	C&D Waste	5.68434e-14	34.992	154.124	360.085	912.343	397.936	514.407	940.154	542.218
20	2.24403	2076.85	16.4258	C&D Waste	0	34.992	151.599	354.186	870.234	364.253	505.981	914.926	550.673
21	2.24403	2063.31	16.4258	C&D Waste	-5.68434e-14	34.992	160.98	376.105	860.266	322.972	537.294	907.724	584.752
22	2.09695	1906	20.2754	C&D Waste	5.68434e-14	34.992	162.623	379.942	820.938	278.162	542.776	881.014	602.852
23	1.86583	1664.9	22.4319	C&D Waste	5.68434e-14	34.992	167.051	390.289	787.518	229.96	557.558	856.48	626.52
24	1.86583	1630.89	22.4319	C&D Waste	5.68434e-14	34.992	175.42	409.84	767.38	181.896	585.484	839.797	657.901
25	2.04186	1732.46	27.4457	C&D Waste	0	34.992	174.601	407.927	707.529	124.778	582.751	798.21	673.432
26	2.04186	1665.08	27.4457	C&D Waste	5.68434e-14	34.992	184.512	431.082	674.437	58.6046	615.832	770.265	711.661

27	0.712566	564.379	29.8679	C&D Waste	0	34.992	186.54	435.822	635.354	12.7505	622.603	742.48	729.73
28	1.54988	1193.45	29.8679	C&D Waste	5.68434e-14	34.992	184.613	431.319	616.172	0	616.172	722.192	722.192
29	2.26245	1658.51	29.7901	C&D Waste	0	34.992	175.67	410.424	586.32	0	586.32	686.887	686.887
30	1.58571	1103.54	29.7078	C&D Waste	0	34.992	166.767	389.624	556.605	0	556.605	651.758	651.758
31	1.58571	1055.17	29.7078	C&D Waste	0	34.992	159.4	372.412	532.017	0	532.017	622.966	622.966
32	2.30882	1450.33	29.5828	C&D Waste	5.68434e-14	34.992	150.664	352.002	502.861	0	502.861	588.39	588.39
33	2.16834	1269.88	29.4857	C&D Waste	0	34.992	140.672	328.658	469.511	0	469.511	549.053	549.053
34	2.16834	1181.21	29.3884	C&D Waste	5.68434e-14	34.992	131.111	306.32	437.601	0	437.601	511.443	511.443
35	1.7144	871.59	29.2844	C&D Waste	0	34.992	122.651	286.554	409.363	0	409.363	478.148	478.148
36	1.7144	816.778	29.2844	C&D Waste	0	34.992	115.115	268.948	384.211	0	384.211	448.769	448.769
37	2.28267	1003.1	29.0993	C&D Waste	2.84217e-14	34.992	106.598	249.049	355.784	0	355.784	415.114	415.114
38	2.49789	988.421	28.9648	C&D Waste	0	34.992	96.4046	225.234	321.763	0	321.763	375.123	375.123
39	1.84573	655.665	29.6875	C&D Waste	2.84217e-14	34.992	86.2717	201.56	287.943	0	287.943	337.127	337.127
40	1.84573	590.235	29.6875	C&D Waste	2.84217e-14	34.992	77.9232	182.055	260.078	0	260.078	304.502	304.502
41	1.70436	486.126	30.0816	C&D Waste	2.84217e-14	34.992	69.5121	162.404	232.006	0	232.006	272.271	272.271
42	1.70436	428.741	30.0816	C&D Waste	0	34.992	61.5373	143.772	205.389	0	205.389	241.035	241.035
43	1.70436	374.399	28.5608	C&D Waste	0	34.992	54.6196	127.61	182.3	0	182.3	212.031	212.031
44	1.70436	323.1	28.5608	C&D Waste	0	34.992	47.3108	110.534	157.905	0	157.905	183.658	183.658
45	2.15512	339.973	26.9948	C&D Waste	0	34.992	40.0054	93.4662	133.523	0	133.523	153.902	153.902
46	2.15512	267.683	26.9948	C&D Waste	1.42109e-14	34.992	31.6385	73.9183	105.598	0	105.598	121.715	121.715
47	2.16228	200.819	25.3838	C&D Waste	7.10543e-15	34.992	24.0251	56.1309	80.1871	0	80.1871	91.5868	91.5868
48	2.16228	137.844	25.3838	C&D Waste	7.10543e-15	34.992	16.5568	38.6822	55.2605	0	55.2605	63.1165	63.1165
49	2.16224	79.766	23.7288	C&D Waste	3.55271e-15	34.992	9.71571	22.6992	32.4275	0	32.4275	36.6982	36.6982
50	2.16224	26.5887	23.7288	C&D Waste	0	34.992	3.24829	7.58911	10.8416	0	10.8416	12.2694	12.2694

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.33634

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	279.273	711.576	0	0	0
2	281.385	710.896	36.6595	0.652443	1.01961
3	283.498	710.215	148.443	5.2716	2.03387
4	285.515	709.519	339.283	17.7373	2.99263
5	287.533	708.822	610.226	41.9988	3.93717
6	287.557	708.814	614.027	42.383	3.94856
7	288.172	708.609	710.353	52.5767	4.23302
8	289.721	708.094	985.913	85.2234	4.94043
9	291.269	707.579	1309.93	129.228	5.63415
10	294.299	706.57	2088.82	254.464	6.94566
11	294.98	706.343	2290.89	290.661	7.23088
12	296.905	705.785	2847.55	401.001	8.01586
13	298.829	705.228	3473.55	535.727	8.76767
14	300.938	704.861	3999.94	672.956	9.55009
15	303.046	704.495	4577.33	830.688	10.286
16	305.155	704.347	4976.55	964.863	10.9725
17	307.263	704.199	5406.33	1110.43	11.6068
18	311.897	704.571	5713.4	1298.68	12.806
19	314.213	704.989	5669.17	1340.16	13.3002
20	316.53	705.407	5644.82	1378.32	13.7217
21	318.774	706.069	5409.31	1354.6	14.0589
22	321.018	706.73	5201.44	1328.24	14.3249
23	323.115	707.505	4906.51	1269.68	14.5084
24	324.981	708.275	4611.61	1202.82	14.6184
25	326.847	709.045	4347.83	1138.85	14.678
26	328.888	710.106	3954.03	1036.24	14.6854
27	330.93	711.166	3615.56	943.937	14.632
28	331.643	711.576	3488.49	908.625	14.5991
29	333.193	712.466	3226.19	834.484	14.5022
30	335.455	713.761	2864.23	730.018	14.2988
31	337.041	714.666	2625.08	659.984	14.1125
32	338.627	715.57	2396.49	592.658	13.8907
33	340.935	716.881	2085.26	500.813	13.5048
34	343.104	718.107	1814.63	421.468	13.0757
35	345.272	719.328	1564.52	349.24	12.5835
36	346.987	720.29	1381.21	297.387	12.1508
37	348.701	721.251	1209.16	249.981	11.6807
38	350.984	722.522	1000.47	194.451	10.9989
39	353.482	723.904	796.408	143.046	10.1825
40	355.327	724.957	652.654	109.625	9.53485
41	357.173	726.009	522.811	81.4181	8.85165
42	358.877	726.996	412.236	59.3386	8.19108
43	360.582	727.983	314.348	41.4067	7.50394
44	362.286	728.911	238.313	28.3845	6.79227
45	363.99	729.839	172.453	18.3028	6.05824
46	366.146	730.937	112.083	10.0062	5.10155
47	368.301	732.035	64.3385	4.63166	4.11756
48	370.463	733.061	34.0176	1.8471	3.10801
49	372.625	734.087	13.1221	0.476926	2.08151
50	374.787	735.037	3.30907	0.0602801	1.04362
51	376.95	735.987	0	0	0

Discharge Sections

Entity Information

Piezoline

X	Y
279.273	711.576
1808	711.576

External Boundary

X	Y
206.442	702.93
199	702
187	702
180	700
176	698
167	696
163	694
159	692
155	690
148	686
141	684
137	682
131	680
124	678
88	676
27	674
8	674
0	672
0	669.5
0	500
1808	500
1808	650
1808	652
1808	880
1727	882
1642	884
1561	886
1462	888
1346	888
1213	880
1048	870
1015	868
1007	866
999	864
991	862

969	862
961	860
921	850
881	840
873	838
865	836
857	834
835	834
827	832
819	830
779	820
739	810
731	808
723	806
715	804
693	804
677	800
637	790
597	780
589	778
581	776
559	776
535	770
495	760
455	750
447	748
425	748
393	740
353	730
313	720
305	718
297	716
289	714
279.273	711.576
272.952	710
243.001	710
243	710
234	710
211.897	704.33

Material Boundary

X	Y
124	678
324.992	678
374.171	678

Material Boundary

X	Y
458.342	650
1808	650

Material Boundary

X	Y
290	706
374.171	678
399.723	669.5
458.342	650

Material Boundary

X	Y
243	710
278	710
284	708
290	706

Material Boundary

X	Y
458.342	652
1808	652

Material Boundary

X	Y
290	708
374.171	680
380.183	678
405.735	669.5
458.342	652

Material Boundary

X	Y
279.273	711.576
284	710
290	708

Material Boundary

X	Y
0	669.5
399.723	669.5

Material Boundary

X	Y
399.723	669.5
405.735	669.5

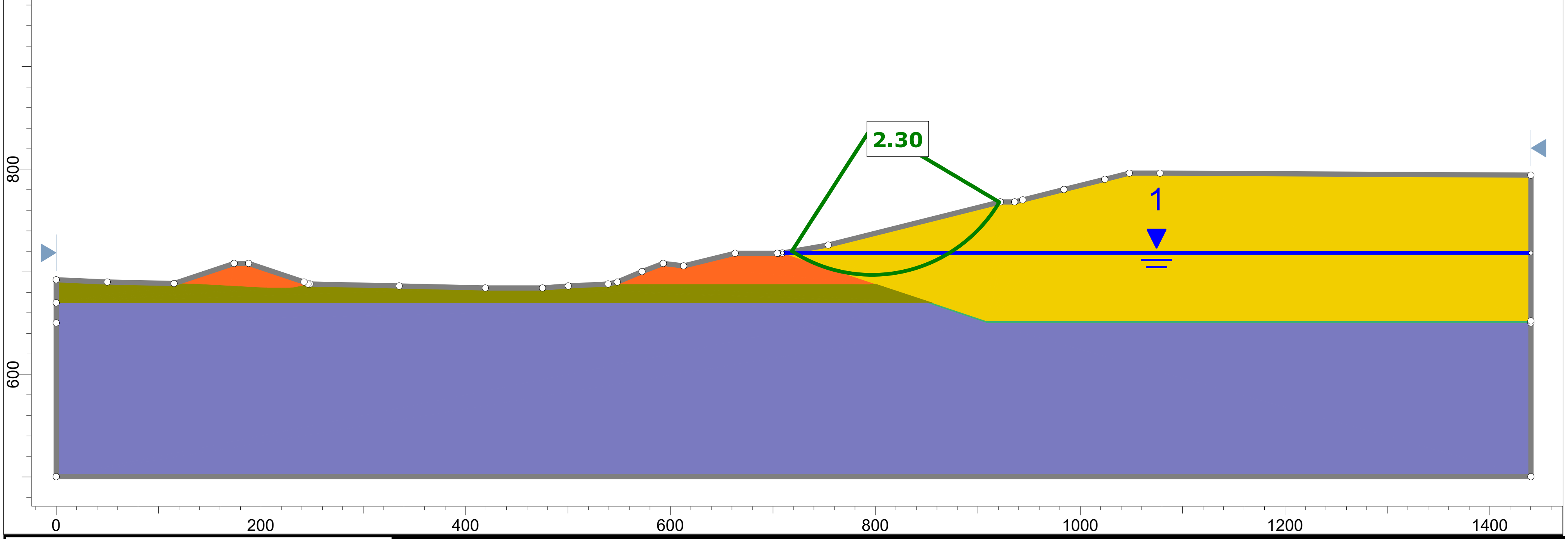
Material Boundary

X	Y
374.171	678
380.183	678

CROSS-SECTION C

STATIC SLOPE STABILITY CIRCULAR FAILURE SURFACE

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface
C&D Waste	🟨	60	Shear Normal function			C&D Waste	Piezometric Line 1
In Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28		Piezometric Line 1
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28		None
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27		None
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0		None



rocscience

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion	
Analysis Description: Section C, Circular	
Created By: BTN	Checked By: EDC
Created Date12-15-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:02.388s
Date Created:	3/24/2022, 9:28:32 AM

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

C&D Waste	
Color	🟨
Strength Type	Shear Normal function
Unit Weight [lbs/ft3]	60
Water Surface	Piezometric Line 1
Hu Value	1
In Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	Piezometric Line 1
Hu Value	1
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Shear Normal Functions

Name: C&D Waste

Effective Normal (psf)	Shear (psf)
0	0
2000	1400
10000	6169

Global Minimums

Method: gle/morgenstern-price

FS	2.301780
Center:	796.592, 841.457
Radius:	144.508
Left Slip Surface Endpoint:	718.462, 719.892
Right Slip Surface Endpoint:	920.870, 767.718
Resisting Moment:	2.37502e+07 lb-ft
Driving Moment:	1.03182e+07 lb-ft
Resisting Horizontal Force:	147409 lb
Driving Horizontal Force:	64041.3 lb
Total Slice Area:	6104.62 ft2
Surface Horizontal Width:	202.409 ft
Surface Average Height:	30.1599 ft

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.30178

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.5506	156.125	-32.1322	C&D Waste	0	34.992	23.2751	53.5741	76.5346	0	76.5346	61.916	61.916
2	3.86011	814.236	-30.6455	C&D Waste	1.42109e-14	34.992	53.8705	123.998	248.481	71.3411	177.14	216.564	145.223
3	3.86011	1479.32	-28.8821	C&D Waste	0	34.992	69.3859	159.711	437.29	209.13	228.16	399.015	189.885
4	3.86011	2108.79	-27.148	C&D Waste	0	34.992	86.0095	197.975	620.144	337.323	282.821	576.039	238.716
5	3.86011	2704.31	-25.4406	C&D Waste	0	34.992	103.347	237.882	796.203	456.371	339.832	747.041	290.67
6	3.86011	3267.38	-23.757	C&D Waste	5.68434e-14	34.992	121.037	278.6	964.673	566.673	398	911.398	344.725
7	3.86011	3799.26	-22.0949	C&D Waste	0	34.992	138.75	319.373	1124.82	668.575	456.249	1068.5	399.922
8	3.86011	4301.09	-20.4522	C&D Waste	0	34.992	156.197	359.532	1276	762.381	513.618	1217.75	455.367
9	5.91305	7490.84	-18.4	C&D Waste	5.68434e-14	34.992	177.505	408.577	1452.35	868.666	583.682	1393.3	524.634
10	4.07679	5799.12	-16.3223	C&D Waste	0	34.992	201.408	463.598	1629.57	967.285	662.284	1570.59	603.302
11	4.07679	6324.72	-14.6448	C&D Waste	0	34.992	223.877	515.315	1773.94	1037.77	736.167	1715.43	677.664
12	4.07679	6819.25	-12.98	C&D Waste	1.13687e-13	34.992	245.022	563.987	1906.02	1100.33	805.694	1849.55	749.216
13	4.07679	7283.35	-11.3263	C&D Waste	0	34.992	264.728	609.345	2025.62	1155.12	870.498	1972.59	817.474
14	4.07679	7717.59	-9.68209	C&D Waste	0	34.992	282.925	651.232	2132.63	1202.3	930.334	2084.36	882.064
15	4.07679	8122.44	-8.04592	C&D Waste	0	34.992	299.593	689.598	2227.12	1241.98	985.144	2184.77	942.794
16	4.07679	8498.3	-6.41633	C&D Waste	0	34.992	314.751	724.488	2309.25	1274.27	1034.98	2273.85	999.585
17	4.07679	8845.47	-4.79194	C&D Waste	0	34.992	328.458	756.038	2379.29	1299.24	1080.05	2351.75	1052.51
18	4.07679	9164.2	-3.17141	C&D Waste	0	34.992	340.805	784.457	2437.6	1316.95	1120.65	2418.72	1101.77
19	4.07679	9454.65	-1.55341	C&D Waste	1.13687e-13	34.992	351.91	810.02	2484.62	1327.44	1157.18	2475.08	1147.64
20	4.07679	9716.92	0.0633468	C&D Waste	1.13687e-13	34.992	361.917	833.053	2520.83	1330.75	1190.08	2521.23	1190.48
21	4.07679	9951.05	1.68015	C&D Waste	1.13687e-13	34.992	370.982	853.918	2546.77	1326.88	1219.89	2557.65	1230.77
22	4.07679	10157	3.2983	C&D Waste	0	34.992	379.273	873.004	2562.96	1315.82	1247.14	2584.82	1269
23	4.07679	10334.6	4.91909	C&D Waste	1.13687e-13	34.992	386.967	890.712	2569.98	1297.54	1272.44	2603.28	1305.74
24	4.07679	10483.8	6.54384	C&D Waste	0	34.992	394.238	907.448	2568.35	1272	1296.35	2613.58	1341.58
25	4.07679	10604.3	8.17389	C&D Waste	0	34.992	401.257	923.606	2558.57	1239.14	1319.43	2616.2	1377.06
26	4.07679	10695.8	9.81065	C&D Waste	0	34.992	408.191	939.566	2541.11	1198.88	1342.23	2611.69	1412.81

27	4.07679	10757.8	11.4555	C&D Waste	0	34.992	415.192	955.681	2516.36	1151.11	1365.25	2600.5	1449.39
28	4.07679	10790	13.11	C&D Waste	1.13687e-13	34.992	422.401	972.275	2484.68	1095.71	1388.97	2583.05	1487.34
29	4.07679	10791.7	14.7758	C&D Waste	0	34.992	429.942	989.633	2446.29	1032.54	1413.75	2559.7	1527.16
30	4.07679	10762.2	16.4544	C&D Waste	1.13687e-13	34.992	437.922	1008	2401.43	961.421	1440.01	2530.77	1569.35
31	4.07679	10700.8	18.1477	C&D Waste	0	34.992	446.428	1027.58	2350.15	882.162	1467.99	2496.47	1614.31
32	4.07679	10606.6	19.8576	C&D Waste	2.27374e-13	34.992	455.53	1048.53	2292.43	794.533	1497.9	2456.95	1662.41
33	4.07679	10478.5	21.5861	C&D Waste	0	34.992	465.266	1070.94	2228.18	698.271	1529.91	2412.26	1713.99
34	4.07679	10315.5	23.3355	C&D Waste	0	34.992	475.662	1094.87	2157.17	593.074	1564.1	2362.37	1769.3
35	4.07679	10116	25.1083	C&D Waste	0	34.992	486.715	1120.31	2079.04	478.596	1600.44	2307.12	1828.52
36	4.07679	9878.64	26.9073	C&D Waste	0	34.992	498.397	1147.2	1993.29	354.44	1638.85	2246.22	1891.78
37	4.07679	9601.53	28.7354	C&D Waste	0	34.992	510.648	1175.4	1899.29	220.15	1679.14	2179.27	1959.12
38	4.07679	9282.63	30.5961	C&D Waste	2.27374e-13	34.992	523.386	1204.72	1796.22	75.1982	1721.03	2105.71	2030.51
39	4.05813	8879.64	32.4889	C&D Waste	0	34.992	514.806	1184.97	1692.81	0	1692.81	2020.64	2020.64
40	4.05813	8473.54	34.418	C&D Waste	0	34.992	484.169	1114.45	1592.07	0	1592.07	1923.81	1923.81
41	4.05813	8017.91	36.3927	C&D Waste	0	34.992	451.807	1039.96	1485.66	0	1485.66	1818.67	1818.67
42	4.05813	7508.93	38.4191	C&D Waste	1.13687e-13	34.992	417.534	961.071	1372.96	0	1372.96	1704.12	1704.12
43	4.05813	6942.09	40.5041	C&D Waste	1.13687e-13	34.992	381.114	877.241	1253.2	0	1253.2	1578.75	1578.75
44	4.05813	6311.9	42.6562	C&D Waste	1.13687e-13	34.992	342.265	787.818	1125.45	0	1125.45	1440.8	1440.8
45	4.05813	5611.64	44.8857	C&D Waste	0	34.992	300.641	692.01	988.586	0	988.586	1288.03	1288.03
46	4.05813	4832.95	47.2055	C&D Waste	0	34.992	255.829	588.863	841.233	0	841.233	1117.56	1117.56
47	4.05813	3965.18	49.632	C&D Waste	0	34.992	207.329	477.225	681.75	0	681.75	925.636	925.636
48	4.05813	2994.42	52.1865	C&D Waste	0	34.992	154.536	355.709	508.156	0	508.156	707.287	707.287
49	4.05813	1901.91	54.898	C&D Waste	2.84217e-14	34.992	96.7238	222.637	318.054	0	318.054	455.668	455.668
50	4.05813	661.255	57.8075	C&D Waste	0	34.992	33.0134	75.9895	108.557	0	108.557	160.996	160.996

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.30178

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	718.462	719.892	0	0	0
2	721.012	718.29	182.015	1.77195	0.557767
3	724.872	716.003	958.387	23.4179	1.39973
4	728.732	713.874	2157.54	84.2443	2.23606
5	732.592	711.894	3717.3	198.943	3.06344
6	736.453	710.058	5578.55	378.213	3.87859
7	740.313	708.359	7685.13	628.905	4.67832
8	744.173	706.792	9983.74	954.212	5.45955
9	748.033	705.352	12424	1353.92	6.21933
10	753.946	703.385	16331.1	2102.27	7.33523
11	758.023	702.191	19098.3	2706.7	8.0665
12	762.1	701.126	21901.5	3376.19	8.76336
13	766.176	700.186	24692.2	4098.06	9.42324
14	770.253	699.37	27426.2	4857.57	10.0437
15	774.33	698.674	30063.8	5638.57	10.6226
16	778.407	698.098	32569.6	6424.07	11.1579
17	782.483	697.639	34912.4	7196.85	11.6478
18	786.56	697.298	37065.5	7939.97	12.0909
19	790.637	697.072	39006.5	8637.25	12.4856
20	794.714	696.961	40716.9	9273.72	12.8309
21	798.791	696.966	42182.1	9835.99	13.1256
22	802.867	697.085	43391	10312.5	13.3691
23	806.944	697.32	44336.2	10693.8	13.5606
24	811.021	697.671	45013.1	10972.7	13.6996
25	815.098	698.139	45420.4	11144.4	13.7858
26	819.175	698.724	45559.2	11206.3	13.8188
27	823.251	699.429	45433.1	11158.3	13.7986
28	827.328	700.255	45048.1	11002.6	13.7253
29	831.405	701.205	44412.3	10743.6	13.5989
30	835.482	702.28	43535.8	10387.8	13.4201
31	839.559	703.484	42431	9943.56	13.1891
32	843.635	704.821	41111.9	9420.84	12.9066
33	847.712	706.293	39595	8831.22	12.5734
34	851.789	707.906	37899.2	8187.49	12.1905
35	855.866	709.665	36045.8	7503.42	11.759
36	859.942	711.575	34059.6	6793.54	11.2802
37	864.019	713.644	31968.9	6072.78	10.7557
38	868.096	715.879	29806.8	5356.2	10.1872
39	872.173	718.29	27612.1	4658.6	9.57652
40	876.231	720.874	25328.1	3979.41	8.929
41	880.289	723.655	22867.6	3313.27	8.24417
42	884.347	726.646	20258.6	2675.97	7.52467
43	888.405	729.864	17535.2	2082.6	6.77311
44	892.463	733.331	14738.7	1547.17	5.99258
45	896.522	737.07	11920.6	1081.94	5.18608
46	900.58	741.112	9145.67	696.828	4.35707
47	904.638	745.495	6497.29	398.411	3.50896
48	908.696	750.269	4084.8	188.733	2.6454
49	912.754	755.498	2055.14	63.5134	1.77014
50	916.812	761.272	611.592	9.4693	0.887042
51	920.87	767.718	0	0	0

Discharge Sections

Entity Information

Piezoline

X	Y
709.141	718.29
1440	718.29

External Boundary

X	Y
612.738	705.608
593	708
572	700
548	690
539	688
500	686
475	684
419	684
335	686
248	688
246	688
242	690
188	708
174	708
115.227	688.465
50	690
0	692
0	669.5
0	650
0	500
1440	500
1440	650
1440	652
1440	794
1078	796
1048	796
1024	790
984	780
944	770
936	768
922	768
754	726
709.141	718.29
705.177	717.609
704	718
663	718

Material Boundary

X	Y
115.227	688.465
135	688
170	686
206	684
230	684
240	686
248	688

Material Boundary

X	Y
705.177	717.609
794.183	688
849.796	669.5
908.416	650

Material Boundary

X	Y
908.416	650
1440	650

Material Boundary

X	Y
539	688
794.183	688

Material Boundary

X	Y
908.416	652
1440	652

Material Boundary

X	Y
709.141	718.29
794.183	690
800.196	688
855.809	669.5
908.416	652

Material Boundary

X	Y
0	669.5
849.796	669.5

Material Boundary

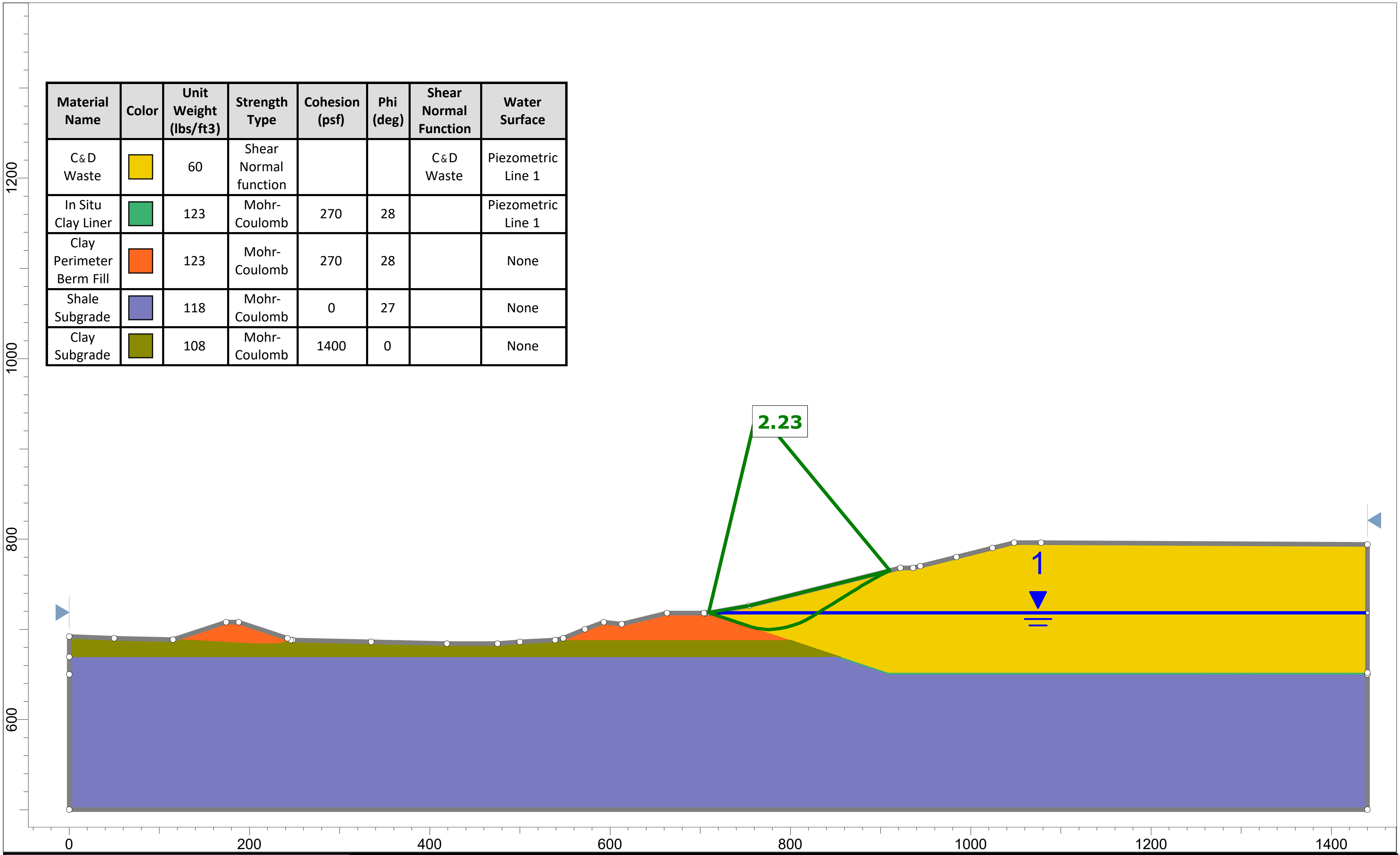
X	Y
849.796	669.5
855.809	669.5

Material Boundary

X	Y
794.183	688
800.196	688

CROSS-SECTION C

STATIC SLOPE STABILITY NON-CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface
C&D Waste	🟨	60	Shear Normal function			C&D Waste	Piezometric Line 1
In Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28		Piezometric Line 1
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28		None
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27		None
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0		None

rocscience

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section C, Non-Circular

Created By: BTN	Checked By: EDC
Created Date12-15-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:31.975s
Date Created:	3/24/2022, 9:28:32 AM

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

C&D Waste	
Color	🟨
Strength Type	Shear Normal function
Unit Weight [lbs/ft3]	60
Water Surface	Piezometric Line 1
Hu Value	1
In Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	Piezometric Line 1
Hu Value	1
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Shear Normal Functions

Name: C&D Waste

Effective Normal (psf)	Shear (psf)
0	0
2000	1400
10000	6169

Global Minimums

Method: gle/morgenstern-price

FS	2.225490
Axis Location:	762.881, 942.599
Left Slip Surface Endpoint:	709.141, 718.290
Right Slip Surface Endpoint:	910.084, 765.021
Resisting Moment:	2.38539e+07 lb-ft
Driving Moment:	1.07185e+07 lb-ft
Resisting Horizontal Force:	93429.9 lb
Driving Horizontal Force:	41981.7 lb
Total Slice Area:	3878.98 ft2
Surface Horizontal Width:	200.943 ft
Surface Average Height:	19.3038 ft

Global Minimum Coordinates

Method: gle/morgenstern-price

X	Y
709.141	718.29
717.117	715.645
725.149	713.016
733.181	710.478
741.213	707.662
748.045	705.348
755.281	702.988
762.514	701.144
768.902	700.193
775.289	699.655
781.031	700.079
787.479	700.816
794.407	702.076
801.336	703.88
810.294	707.012
816.956	710.209
824.168	714.203
831.379	718.72
835.618	721.362
839.857	723.995
845.763	727.652
855.182	733.453
862.183	737.723
867.477	740.925
873.28	744.549
878.802	748.06
884.324	751.378
892.165	755.817
901.124	760.575
910.084	765.021

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.22549

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.98812	240.224	-18.3444	C&D Waste	0	34.992	6.8078	15.1507	62.8883	41.2445	21.6438	60.631	19.3865
2	3.98812	720.672	-18.3444	C&D Waste	7.10543e-15	34.992	20.9799	46.6906	190.461	123.761	66.7004	183.505	59.7439
3	8.03185	2901.43	-18.1279	C&D Waste	1.42109e-14	34.992	43.9956	97.9117	386.935	247.06	139.875	372.531	125.471
4	4.01593	2169.82	-17.5302	C&D Waste	2.84217e-14	34.992	68.3957	152.214	586.129	368.681	217.448	564.524	195.843
5	4.01593	2641.8	-17.5302	C&D Waste	0	34.992	85.9298	191.236	721.033	447.838	273.195	693.889	246.051
6	4.01593	3130.58	-19.3208	C&D Waste	0	34.992	106.739	237.547	870.698	531.346	339.352	833.275	301.929
7	4.01593	3636.16	-19.3208	C&D Waste	0	34.992	126.642	281.841	1021.83	619.205	402.628	977.432	358.227
8	3.41624	3487.01	-18.7144	C&D Waste	5.68434e-14	34.992	144.477	321.532	1158.57	699.241	459.331	1109.63	410.388
9	3.41624	3844.58	-18.7144	C&D Waste	5.68434e-14	34.992	162.355	361.319	1287.63	771.456	516.17	1232.63	461.171
10	3.61778	4456.27	-18.0645	C&D Waste	0	34.992	179.351	399.143	1414.58	844.379	570.203	1356.08	511.705
11	3.61778	4851.23	-18.0645	C&D Waste	5.68434e-14	34.992	199.221	443.365	1551.39	918.011	633.378	1486.41	568.399
12	3.61671	5261.32	-14.3027	C&D Waste	5.68434e-14	34.992	210.785	469.1	1653.74	983.595	670.141	1600	616.402
13	3.61671	5657.62	-14.3027	C&D Waste	0	34.992	235.086	523.181	1788.53	1041.13	747.404	1728.6	687.47
14	3.19377	5293.04	-8.46578	C&D Waste	0	34.992	235.18	523.391	1832.43	1084.73	747.704	1797.43	712.7
15	3.19377	5537.14	-8.46578	C&D Waste	0	34.992	253.96	565.185	1921.8	1114.39	807.414	1884	769.614
16	3.19377	5761.46	-4.81498	C&D Waste	1.13687e-13	34.992	257.827	573.791	1957.32	1137.62	819.7	1935.6	797.982
17	3.19377	5966.02	-4.81498	C&D Waste	1.13687e-13	34.992	275.065	612.154	2028.91	1154.41	874.503	2005.74	851.333
18	5.74165	11083.5	4.22733	C&D Waste	0	34.992	261.616	582.223	1981.31	1149.56	831.748	2000.64	851.085
19	3.224	6363.62	6.51885	C&D Waste	1.13687e-13	34.992	273.213	608.032	1993.44	1124.82	868.622	2024.66	899.842
20	3.224	6448.27	6.51885	C&D Waste	1.13687e-13	34.992	287.635	640.128	2016.31	1101.84	914.465	2049.17	947.333
21	3.46422	6998.77	10.3026	C&D Waste	0	34.992	287.229	639.225	1983.87	1070.7	913.174	2036.09	965.386
22	3.46422	7047.9	10.3026	C&D Waste	0	34.992	302.323	672.817	1992.57	1031.4	961.167	2047.52	1016.12
23	3.46422	7068.72	14.5949	C&D Waste	0	34.992	299.919	667.466	1937.13	983.61	953.523	2015.23	1031.62
24	3.46422	7061.24	14.5949	C&D Waste	0	34.992	315.017	701.068	1928.85	927.323	1001.53	2010.88	1083.55
25	4.47904	9064.98	19.2723	C&D Waste	0	34.992	313.488	697.664	1846.98	850.317	996.662	1956.59	1106.27
26	4.47904	8945.02	19.2723	C&D Waste	0	34.992	333.709	742.665	1813.54	752.592	1060.95	1930.22	1177.63

27	3.33109	6531.31	25.6391	C&D Waste	0	34.992	325.868	725.216	1689.87	653.847	1036.02	1846.27	1192.42
28	3.33109	6378.21	25.6391	C&D Waste	0	34.992	342.099	761.338	1641.71	554.083	1087.63	1805.9	1251.82
29	3.60581	6702.89	28.9758	C&D Waste	0	34.992	345.949	769.906	1541.77	441.903	1099.87	1733.34	1291.44
30	3.60581	6465.92	28.9758	C&D Waste	1.13687e-13	34.992	364.606	811.428	1476.49	317.306	1159.18	1678.39	1361.09
31	3.26218	5622.37	32.0631	C&D Waste	0	34.992	370.293	824.084	1368.52	191.252	1177.26	1600.47	1409.22
32	3.26218	5382.03	32.0631	C&D Waste	1.13687e-13	34.992	388.101	863.715	1297.62	63.7418	1233.88	1540.73	1476.99
33	0.687263	1103.21	32.0631	C&D Waste	1.13687e-13	34.992	395.1	879.291	1256.13	0	1256.13	1503.63	1503.63
34	4.23882	6570.22	31.9313	C&D Waste	0	34.992	382.029	850.202	1214.58	0	1214.58	1452.66	1452.66
35	4.23882	6168.96	31.8492	C&D Waste	0	34.992	359.133	799.248	1141.78	0	1141.78	1364.88	1364.88
36	2.95304	4061.73	31.7619	C&D Waste	0	34.992	339.949	756.552	1080.79	0	1080.79	1291.25	1291.25
37	2.95304	3868.6	31.7619	C&D Waste	0	34.992	324.056	721.184	1030.26	0	1030.26	1230.89	1230.89
38	4.70959	5772.29	31.6289	C&D Waste	1.13687e-13	34.992	304.008	676.566	966.523	0	966.523	1153.76	1153.76
39	4.70959	5285.34	31.6289	C&D Waste	0	34.992	278.988	620.886	886.979	0	886.979	1058.81	1058.81
40	3.50049	3615.16	31.3794	C&D Waste	0	34.992	257.96	574.087	820.125	0	820.125	977.457	977.457
41	3.50049	3350.55	31.3794	C&D Waste	0	34.992	239.634	533.304	761.862	0	761.862	908.017	908.017
42	5.2941	4568.92	31.1658	C&D Waste	0	34.992	217.19	483.355	690.507	0	690.507	821.865	821.865
43	5.80261	4302.46	31.9863	C&D Waste	-5.68434e-14	34.992	186.142	414.257	591.796	0	591.796	708.049	708.049
44	5.52181	3381.28	32.4512	C&D Waste	0	34.992	154.007	342.741	489.63	0	489.63	587.559	587.559
45	5.52181	2707.3	31.0039	C&D Waste	5.68434e-14	34.992	125.559	279.43	399.186	0	399.186	474.641	474.641
46	3.92054	1548.55	29.5112	C&D Waste	2.84217e-14	34.992	102.86	228.914	327.021	0	327.021	385.243	385.243
47	3.92054	1257.1	29.5112	C&D Waste	0	34.992	83.8382	186.581	266.544	0	266.544	313.999	313.999
48	8.95989	1862.87	27.9732	C&D Waste	0	34.992	55.2952	123.059	175.799	0	175.799	205.166	205.166
49	4.47995	444.691	26.3901	C&D Waste	7.10543e-15	34.992	26.8488	59.7518	85.3597	0	85.3597	98.6818	98.6818
50	4.47995	148.23	26.3901	C&D Waste	0	34.992	8.9796	19.984	28.5486	0	28.5486	33.0042	33.0042

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.22549

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	709.141	718.29	0	0	0
2	713.129	716.967	110.312	1.58009	0.820639
3	717.117	715.645	445.843	12.7476	1.63776
4	725.149	713.016	1816.67	103.43	3.25855
5	729.165	711.747	2834.88	200.697	4.04953
6	733.181	710.478	4094.62	345.499	4.82312
7	737.197	709.07	5749.22	561.291	5.57606
8	741.213	707.662	7696.54	850.429	6.30532
9	744.629	706.505	9530.91	1154.18	6.90482
10	748.045	705.348	11575.7	1520.55	7.48336
11	751.663	704.168	13893.8	1970.3	8.07138
12	755.281	702.988	16445.1	2496.58	8.63233
13	758.897	702.066	18732.3	3022	9.16432
14	762.514	701.144	21231.7	3616.24	9.66601
15	765.708	700.668	22853.9	4063.78	10.0827
16	768.902	700.193	24578.5	4543.72	10.4738
17	772.095	699.924	25928.6	4964.14	10.8384
18	775.289	699.655	27352.9	5404.01	11.1758
19	781.031	700.079	28014.1	5807.51	11.7119
20	784.255	700.448	28160.6	5971.39	11.9721
21	787.479	700.816	28345.1	6129.66	12.2024
22	790.943	701.446	28090.9	6184.33	12.4158
23	794.407	702.076	27883.4	6229.51	12.5938
24	797.872	702.978	27175	6141.98	12.7358
25	801.336	703.88	26526.5	6046.85	12.8414
26	805.815	705.446	25038	5745.53	12.9241
27	810.294	707.012	23692.5	5446.06	12.9454
28	813.625	708.611	22076.2	5064.85	12.9215
29	816.956	710.209	20591.1	4702.26	12.8637
30	820.562	712.206	18760	4249.47	12.7631
31	824.168	714.203	17126.5	3835.51	12.6232
32	827.43	716.246	15538	3434.15	12.4629
33	830.692	718.29	14152.5	3078.25	12.271
34	831.379	718.72	13883.2	3008.42	12.2267
35	835.618	721.362	12294.1	2595.75	11.9222
36	839.857	723.995	10809.8	2212.28	11.5662
37	842.81	725.823	9837.77	1963.67	11.2882
38	845.763	727.652	8911.15	1729.92	10.9862
39	850.473	730.552	7539.37	1391.37	10.4561
40	855.182	733.453	6280.48	1092.58	9.86866
41	858.683	735.588	5432.52	898.992	9.39635
42	862.183	737.723	4644.79	726.947	8.89509
43	867.477	740.925	3583.68	509.07	8.08491
44	873.28	744.549	2519.16	315.133	7.13035
45	878.802	748.06	1650.38	178.241	6.16405
46	884.324	751.378	1019.06	91.8179	5.14848
47	888.244	753.597	696.62	53.6235	4.40176
48	892.165	755.817	433.808	27.5745	3.63705
49	901.124	760.575	92.6766	2.97457	1.83835
50	905.604	762.798	23.2114	0.373415	0.92167
51	910.084	765.021	0	0	0

Discharge Sections

Entity Information

Piezoline

X	Y
709.141	718.29
1440	718.29

External Boundary

X	Y
612.738	705.608
593	708
572	700
548	690
539	688
500	686
475	684
419	684
335	686
248	688
246	688
242	690
188	708
174	708
115.227	688.465
50	690
0	692
0	669.5
0	650
0	500
1440	500
1440	650
1440	652
1440	794
1078	796
1048	796
1024	790
984	780
944	770
936	768
922	768
754	726
709.141	718.29
705.177	717.609
704	718
663	718

Material Boundary

X	Y
115.227	688.465
135	688
170	686
206	684
230	684
240	686
248	688

Material Boundary

X	Y
705.177	717.609
794.183	688
849.796	669.5
908.416	650

Material Boundary

X	Y
908.416	650
1440	650

Material Boundary

X	Y
539	688
794.183	688

Material Boundary

X	Y
908.416	652
1440	652

Material Boundary

X	Y
709.141	718.29
794.183	690
800.196	688
855.809	669.5
908.416	652

Material Boundary

X	Y
0	669.5
849.796	669.5

Material Boundary

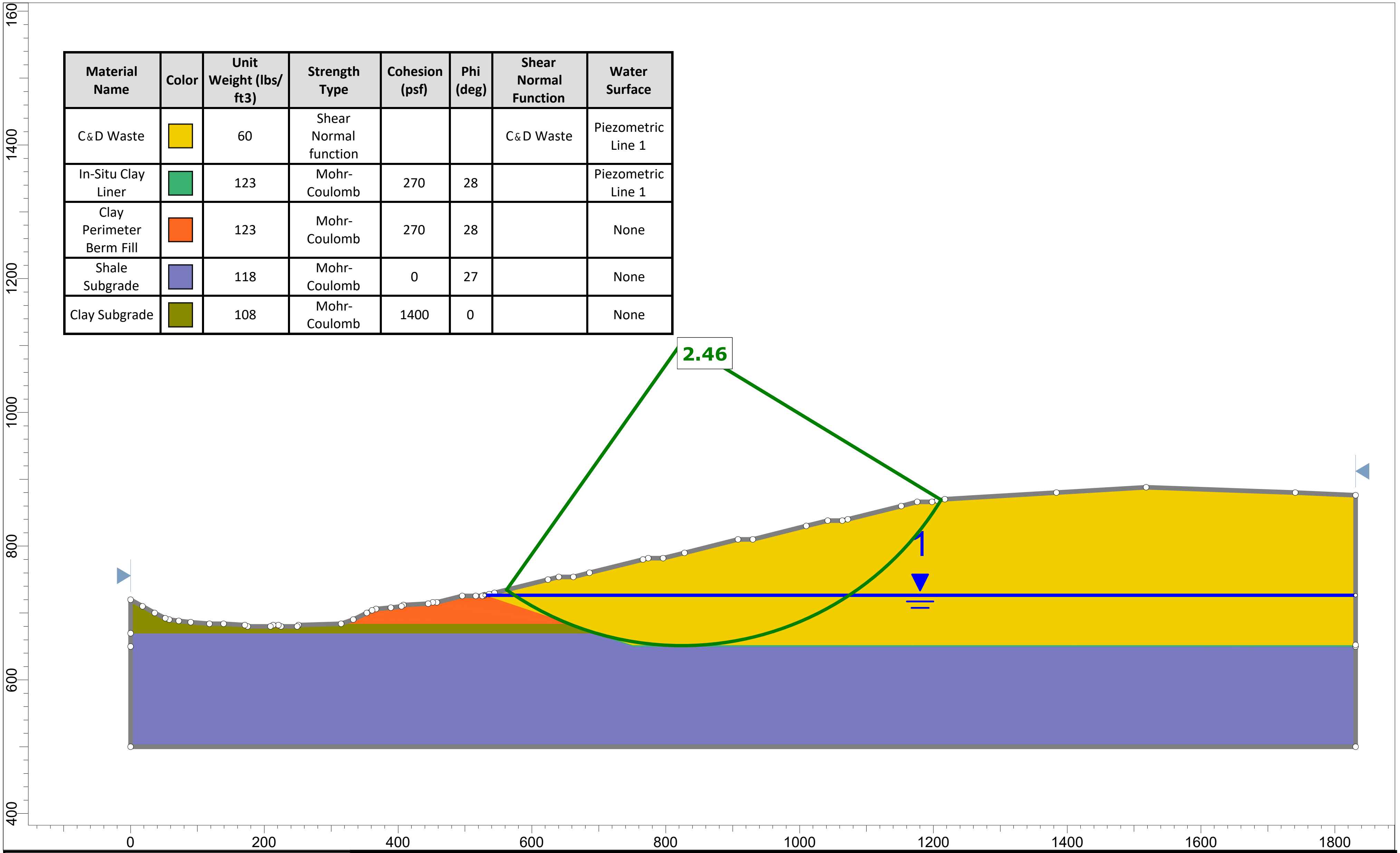
X	Y
849.796	669.5
855.809	669.5

Material Boundary

X	Y
794.183	688
800.196	688

CROSS-SECTION D

STATIC SLOPE STABILITY CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface
C&D Waste	🟨	60	Shear Normal function			C&D Waste	Piezometric Line 1
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28		Piezometric Line 1
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28		None
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27		None
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0		None

rocscience

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section D, Circular

Created By: BTN	Checked By: EDC	Civil & Environmental Consultants, Inc.
Created Date12-15-22	Checked Date: 12-20-22	

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:02.167s
Date Created:	3/24/2022, 9:28:32 AM

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

C&D Waste	
Color	🟨
Strength Type	Shear Normal function
Unit Weight [lbs/ft3]	60
Water Surface	Piezometric Line 1
Hu Value	1
In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	Piezometric Line 1
Hu Value	1
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Shear Normal Functions

Name: C&D Waste

Effective Normal (psf)	Shear (psf)
0	0
2000	1400
10000	6169

Global Minimums

Method: gle/morgenstern-price

FS	2.456040
Center:	824.215, 1104.777
Radius:	453.519
Left Slip Surface Endpoint:	562.258, 734.565
Right Slip Surface Endpoint:	1211.643, 869.026
Resisting Moment:	7.40077e+08 lb-ft
Driving Moment:	3.01329e+08 lb-ft
Resisting Horizontal Force:	1.46388e+06 lb
Driving Horizontal Force:	596033 lb
Total Slice Area:	67030.1 ft2
Surface Horizontal Width:	649.385 ft
Surface Average Height:	103.221 ft

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.45604

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	12.058	4072.63	-34.3599	C&D Waste	0	34.992	121.272	297.85	425.5	0	425.5	342.587	342.587
2	13.442	13879.4	-32.4312	C&D Waste	0	34.992	277.439	681.401	1239.89	266.456	973.43	1063.61	797.15
3	13.442	23219.3	-30.4402	C&D Waste	1.13687e-13	34.992	350.512	860.871	2009.19	779.379	1229.82	1803.22	1023.84
4	13.442	32056.7	-28.4892	C&D Waste	0	34.992	426.622	1047.8	2750.29	1253.44	1496.85	2518.76	1265.32
5	13.442	40420.2	-26.5736	C&D Waste	2.27374e-13	34.992	504.296	1238.57	3460.21	1690.82	1769.39	3207.97	1517.15
6	13.442	48316.3	-24.6896	C&D Waste	207.75	30.8002	579.763	1423.92	4133.52	2093.39	2040.13	3866.99	1773.6
7	13.442	54155.6	-22.8337	C&D Waste	207.75	30.8002	608.337	1494.1	4620.63	2462.78	2157.85	4364.49	1901.71
8	13.9727	61490.9	-20.9671	Clay Subgrade	1400	0	570.023	1400	5004.78	0	5004.78	4786.35	4786.35
9	13.9727	68583.1	-19.0878	Clay Subgrade	1400	0	570.023	1400	5543.26	0	5543.26	5346.01	5346.01
10	13.9727	75275.6	-17.2296	Clay Subgrade	1400	0	570.023	1400	6044.14	0	6044.14	5867.36	5867.36
11	7.75177	44416.2	-15.7966	In-Situ Clay Liner	270	28	726.613	1784.59	6462.54	3614.01	2848.53	6256.98	2642.97
12	13.3799	80877.2	-14.415	C&D Waste	207.75	30.8002	818.912	2011.28	6815.17	3789.74	3025.43	6604.68	2814.94
13	13.3799	86151	-12.676	C&D Waste	207.75	30.8002	867.624	2130.92	7217.04	3990.93	3226.11	7021.9	3030.97
14	13.3799	91083.2	-10.9488	C&D Waste	207.75	30.8002	912.742	2241.73	7577.57	4165.58	3411.99	7401	3235.42
15	13.3799	95680.4	-9.23157	C&D Waste	207.75	30.8002	954.252	2343.68	7897.17	4314.19	3582.98	7742.08	3427.89
16	13.3799	99947.9	-7.52271	C&D Waste	207.75	30.8002	992.215	2436.92	8176.6	4437.16	3739.44	8045.57	3608.41
17	13.3799	102996	-5.82057	C&D Waste	207.75	30.8002	1009.06	2478.29	8343.66	4534.84	3808.82	8240.8	3705.96
18	13.3799	104016	-4.12357	C&D Waste	207.75	30.8002	989.666	2430.66	8336.42	4607.49	3728.93	8265.07	3657.58
19	12.959	103229	-2.45678	In-Situ Clay Liner	270	28	927.151	2277.12	8429.8	4654.94	3774.86	8390.02	3735.08
20	12.959	106339	-0.818705	In-Situ Clay Liner	270	28	956.055	2348.11	8586.38	4678.06	3908.32	8572.72	3894.66
21	12.959	108858	0.818705	In-Situ Clay Liner	270	28	977.92	2401.81	8687.38	4678.06	4009.32	8701.35	4023.29
22	12.959	110786	2.45678	In-Situ Clay Liner	270	28	993.237	2439.43	8735.02	4654.94	4080.08	8777.63	4122.69
23	13.1754	114394	4.1106	C&D Waste	207.75	30.8002	1095.28	2690.04	8772.12	4608.05	4164.07	8850.84	4242.79
24	13.1754	116096	5.78158	C&D Waste	207.75	30.8002	1116.24	2741.52	8787.31	4536.88	4250.43	8900.33	4363.45
25	13.1754	117491	7.45752	C&D Waste	207.75	30.8002	1136.69	2791.76	8776.12	4441.45	4334.67	8924.91	4483.46
26	13.1754	118575	9.13991	C&D Waste	207.75	30.8002	1157.03	2841.7	8739.96	4321.51	4418.45	8926.11	4604.6

27	13.1754	118864	10.8303	C&D Waste	207.75	30.8002	1169.03	2871.18	8644.66	4176.73	4467.93	8868.3	4691.57
28	13.1754	116910	12.5303	C&D Waste	207.75	30.8002	1148.08	2819.73	8388.33	4006.73	4381.6	8643.49	4636.76
29	13.1754	115577	14.2416	C&D Waste	207.75	30.8002	1145.46	2813.29	8181.86	3811.03	4370.83	8472.59	4661.56
30	13.1754	115364	15.9659	C&D Waste	207.75	30.8002	1169.41	2872.12	8058.6	3589.09	4469.51	8393.17	4804.08
31	13.1754	114816	17.7053	C&D Waste	207.75	30.8002	1194.75	2934.35	7914.12	3340.25	4573.87	8295.54	4955.29
32	13.1754	113917	19.4617	C&D Waste	207.75	30.8002	1221.54	3000.16	7748.02	3063.76	4684.26	8179.67	5115.91
33	13.1754	112657	21.2374	C&D Waste	207.75	30.8002	1249.93	3069.87	7559.92	2758.75	4801.17	8045.68	5286.93
34	13.1754	111022	23.0347	C&D Waste	207.75	30.8002	1279.96	3143.63	7349.16	2424.21	4924.95	7893.38	5469.17
35	13.1754	108999	24.8564	C&D Waste	207.75	30.8002	1311.66	3221.49	7114.57	2059	5055.57	7722.21	5663.21
36	13.1754	106571	26.7053	C&D Waste	207.75	30.8002	1344.98	3303.33	6854.61	1661.77	5192.84	7531.23	5869.46
37	13.1754	103468	28.5849	C&D Waste	207.75	30.8002	1375.91	3379.29	6551.25	1230.99	5320.26	7300.95	6069.96
38	13.1754	97975.2	30.4986	C&D Waste	207.75	30.8002	1378.16	3384.81	6094.4	764.882	5329.52	6906.15	6141.27
39	13.1754	92363.7	32.4509	C&D Waste	207.75	30.8002	1387.58	3407.96	5629.73	261.369	5368.36	6512.05	6250.68
40	12.5026	83636	34.3944	C&D Waste	207.75	30.8002	1366.55	3356.29	5281.68	0	5281.68	6217.17	6217.17
41	12.5026	79321.7	36.3319	C&D Waste	207.75	30.8002	1286.41	3159.48	4951.52	0	4951.52	5897.59	5897.59
42	12.5026	74511.7	38.319	C&D Waste	207.75	30.8002	1200.77	2949.14	4598.68	0	4598.68	5547.64	5547.64
43	12.5026	69164.6	40.3622	C&D Waste	207.75	30.8002	1109.02	2723.79	4220.66	0	4220.66	5163.25	5163.25
44	12.5026	63231.2	42.4695	C&D Waste	207.75	30.8002	1010.42	2481.63	3814.43	0	3814.43	4739.32	4739.32
45	12.5026	56650.8	44.6504	C&D Waste	207.75	30.8002	904.081	2220.46	3376.33	0	3376.33	4269.45	4269.45
46	12.5026	49348.7	46.9169	C&D Waste	207.75	30.8002	788.937	1937.66	2901.92	0	2901.92	3745.49	3745.49
47	12.5026	41230.3	49.284	C&D Waste	207.75	30.8002	663.67	1630	2385.83	0	2385.83	3156.98	3156.98
48	12.5026	31324.2	51.7712	C&D Waste	0	34.992	507.117	1245.5	1779.28	0	1779.28	2423.05	2423.05
49	12.5026	18855.7	54.4046	C&D Waste	0	34.992	300.626	738.349	1054.78	0	1054.78	1474.77	1474.77
50	12.5026	6333.46	57.2205	C&D Waste	0	34.992	99.0977	243.388	347.697	0	347.697	501.587	501.587

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.45604

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	562.258	734.565	0	0	0
2	574.316	726.321	4970.61	57.9585	0.668052
3	587.758	717.78	19290.9	474.753	1.40978
4	601.2	709.881	39874.8	1493.56	2.14508
5	614.642	702.586	65675.1	3293.2	2.87062
6	628.084	695.862	95721	5993.99	3.58315
7	641.526	689.683	129061	9657.65	4.27947
8	654.968	684.023	163393	14170.2	4.95655
9	668.941	678.668	198158	19558.2	5.63684
10	682.914	673.833	232928	25674.3	6.28999
11	696.886	669.5	267086	32382.8	6.91307
12	704.638	667.307	286893	36470.7	7.24475
13	718.018	663.868	321292	43966.9	7.79219
14	731.398	660.858	354624	51772.2	8.30604
15	744.778	658.27	386454	59718.2	8.78436
16	758.158	656.095	416400	67630.7	9.22529
17	771.538	654.329	444128	75335.9	9.62725
18	784.918	652.965	469014	82605.1	9.98878
19	798.297	652	490302	89179	10.3086
20	811.256	651.444	507008	94678.4	10.5776
21	824.215	651.259	520992	99436.1	10.8055
22	837.174	651.444	532060	103342	10.9917
23	850.133	652	540080	106307	11.1355
24	863.309	652.947	546209	108528	11.2379
25	876.484	654.281	549199	109699	11.2958
26	889.659	656.006	549045	109800	11.309
27	902.835	658.125	545768	108831	11.2774
28	916.01	660.646	539387	106813	11.2012
29	929.186	663.574	529955	103786	11.0805
30	942.361	666.918	517692	99840.6	10.9159
31	955.536	670.688	502728	95061.6	10.7077
32	968.712	674.894	485187	89545	10.4567
33	981.887	679.549	465214	83401	10.1637
34	995.062	684.67	442980	76751.8	9.82962
35	1008.24	690.272	418679	69730	9.45569
36	1021.41	696.375	392542	62475.5	9.04313
37	1034.59	703.003	364837	55133.4	8.5934
38	1047.76	710.182	335940	47860.2	8.10817
39	1060.94	717.943	306809	40878.1	7.58918
40	1074.11	726.321	277933	34314.9	7.03838
41	1086.62	734.88	249819	28411.4	6.48825
42	1099.12	744.074	220380	22825.9	5.91334
43	1111.62	753.955	189960	17674.5	5.31568
44	1124.13	764.581	158980	13063.7	4.69755
45	1136.63	776.026	127964	9085.37	4.06115
46	1149.13	788.377	97570.6	5812.02	3.40893
47	1161.63	801.745	68643.6	3289.22	2.74336
48	1174.14	816.273	42284.2	1526.13	2.06703
49	1186.64	832.144	20386.7	492.034	1.38257
50	1199.14	849.611	5723.33	69.193	0.692652
51	1211.64	869.026	0	0	0

Discharge Sections

Entity Information

Piezoline

X	Y
529.283	726.321
1831	726.321

External Boundary

X	Y
458	716
452	716
445	714
408	712
405	710
389	708
367	706
361	704
353	700
333	690
315	684
251	682
249	680
225	680
221	682
213	682
209	680
175	680
171	682
139	684
118	684
90	686
72	688
58	690
52	692
36	700
18	710
0	720
0	669.5
0	650
0	500
1831	500
1831	650
1831	652
1831	876

1741	880
1518	888
1384	880
1217	870
1206	868
1198	866
1176	866
1152	860
1072	840
1064	838
1042	838
1010	830
930	810
908	810
828	790
796	782
774	782
766	780
686	760
662	754
640	754
624	750
544	730
536	728
529.283	726.321
528	726
525.829	725.483
515.993	725.483
495.921	725.483

Material Boundary

X	Y
525.829	725.483
649.093	684
692.179	669.5
750.122	650

Material Boundary

X	Y
750.122	650
1831	650

Material Boundary

X	Y
315	684
649.093	684

Material Boundary

X	Y
750.122	652
1831	652

Material Boundary

X	Y
529.283	726.321
649.093	686
655.036	684
698.122	669.5
750.122	652

Material Boundary

X	Y
0	669.5
692.179	669.5

Material Boundary

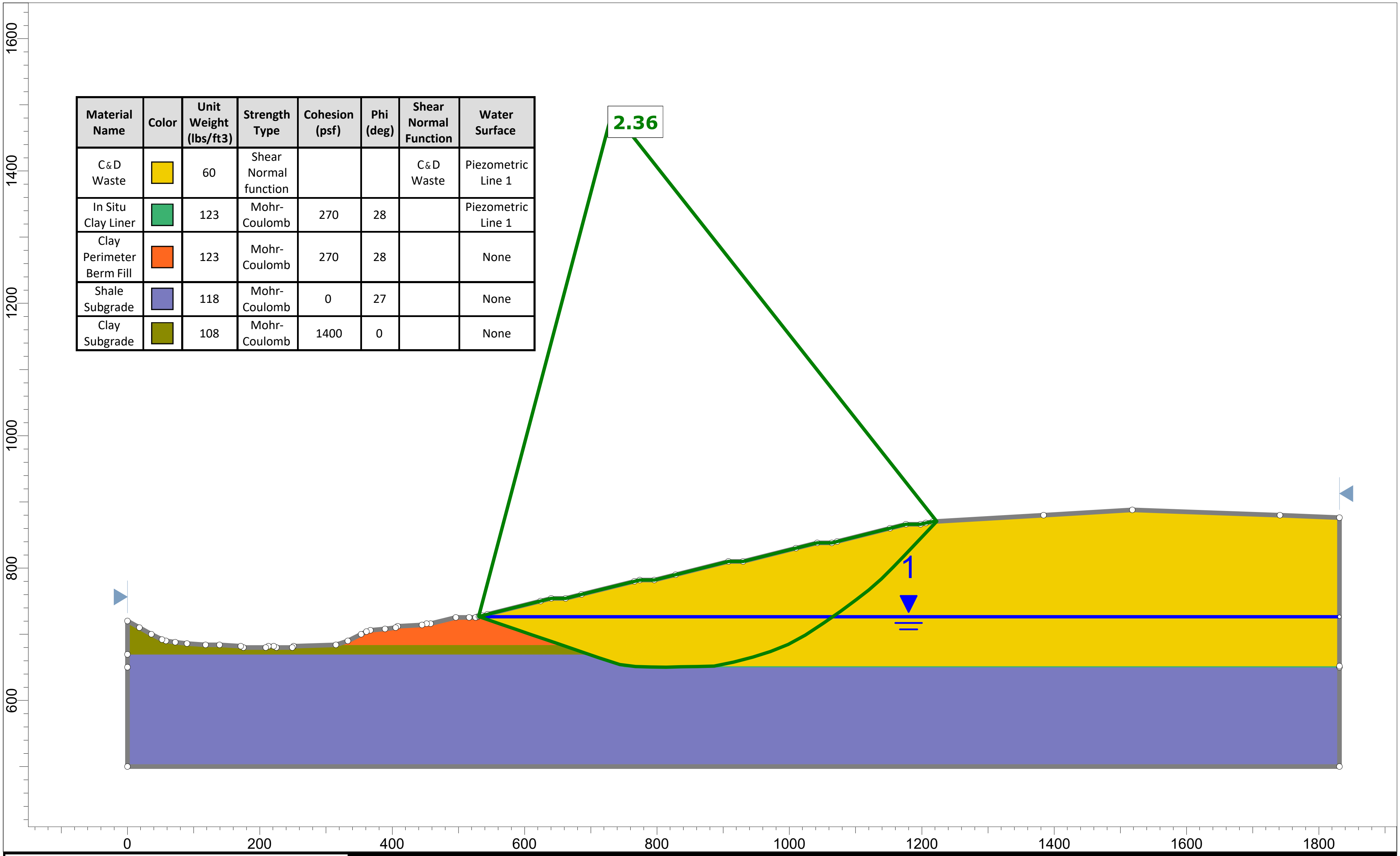
X	Y
649.093	684
655.036	684

Material Boundary

X	Y
692.179	669.5
698.122	669.5

CROSS-SECTION D

STATIC SLOPE STABILITY NON-CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface
C&D Waste	🟨	60	Shear Normal function			C&D Waste	Piezometric Line 1
In Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28		Piezometric Line 1
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28		None
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27		None
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0		None

rocscience

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section D, Non-Circular

Created By: BTN	Checked By: EDC	Civil & Environmental Consultants, Inc.
Created Date12-15-22	Checked Date: 12-20-22	

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:26.49s
Date Created:	3/24/2022, 9:28:32 AM

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

C&D Waste	
Color	🟨
Strength Type	Shear Normal function
Unit Weight [lbs/ft3]	60
Water Surface	Piezometric Line 1
Hu Value	1
In Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	Piezometric Line 1
Hu Value	1
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Shear Normal Functions

Name: C&D Waste

Effective Normal (psf)	Shear (psf)
0	0
2000	1400
10000	6169

Global Minimums

Method: gle/morgenstern-price

FS	2.360140
Axis Location:	732.752, 1490.793
Left Slip Surface Endpoint:	530.341, 726.585
Right Slip Surface Endpoint:	1222.672, 870.340
Resisting Moment:	1.31009e+09 lb-ft
Driving Moment:	5.55368e+08 lb-ft
Resisting Horizontal Force:	1.4313e+06 lb
Driving Horizontal Force:	606751 lb
Total Slice Area:	67994.1 ft2
Surface Horizontal Width:	692.33 ft
Surface Average Height:	98.2105 ft

Global Minimum Coordinates

Method: gle/morgenstern-price

X	Y
530.341	726.585
564.121	715.049
587.014	707.231
609.906	699.413
645.779	687.162
681.653	674.911
712.749	664.369
743.845	654.101
767.414	651.197
790.983	650.348
813.529	650.167
836.076	650.706
861.059	651.304
886.042	651.902
915.491	657.944
944.939	665.616
971.616	673.91
998.294	684.672
1023.85	698.658
1051.51	716.565
1077.57	734.584
1100.77	752.117
1120.02	766.787
1139.03	783.535
1156.77	801.141
1174.5	819.666
1198.59	845.003
1222.67	870.34

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.36014

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.77507	10.6602	-18.8557	C&D Waste	1.77636e-15	34.992	4.54181	10.7193	15.3133	0	15.3133	13.7622	13.7622
2	33.0049	20238.3	-18.8557	C&D Waste	0	34.992	89.4739	211.171	653.329	351.656	301.673	622.772	271.116
3	11.4462	16047.4	-18.8557	C&D Waste	5.68434e-14	34.992	203.055	479.238	1509.92	825.289	684.626	1440.57	615.281
4	11.4462	20697.2	-18.8557	C&D Waste	1.13687e-13	34.992	265.028	625.503	1962.79	1069.21	893.578	1872.28	803.067
5	11.4462	25347	-18.8557	C&D Waste	1.13687e-13	34.992	329.126	776.784	2422.83	1313.13	1109.7	2310.43	997.297
6	11.4462	29996.8	-18.8557	C&D Waste	0	34.992	395.31	932.988	2889.9	1557.06	1332.84	2754.89	1197.83
7	17.9368	56359.1	-18.8557	C&D Waste	0	34.992	483.327	1140.72	3499.74	1870.14	1629.6	3334.67	1464.53
8	17.9368	67526.9	-18.8557	C&D Waste	2.27374e-13	34.992	589.897	1392.24	4241.28	2252.37	1988.91	4039.83	1787.46
9	9.38758	38549.8	-18.8557	C&D Waste	207.75	30.8002	620.768	1465.1	4652.73	2543.52	2109.21	4440.73	1897.21
10	13.243	57781.5	-18.8557	Clay Subgrade	1400	0	593.185	1400	4942.85	0	4942.85	4740.27	4740.27
11	13.243	63697.4	-18.8557	Clay Subgrade	1400	0	593.185	1400	5450.31	0	5450.31	5247.73	5247.73
12	15.9598	85057.1	-18.7272	Clay Subgrade	1400	0	593.185	1400	6035.84	0	6035.84	5834.74	5834.74
13	15.136	89053.8	-18.7272	In Situ Clay Liner	270	28	805.38	1900.81	6772.82	3705.69	3067.13	6499.79	2794.1
14	15.5479	99813.9	-18.2723	In Situ Clay Liner	270	28	875.317	2065.87	7403.48	4025.95	3377.53	7114.47	3088.52
15	15.5479	108132	-18.2723	In Situ Clay Liner	270	28	948.999	2239.77	8050.87	4346.29	3704.58	7737.53	3391.24
16	17.0516	126395	-7.02571	C&D Waste	207.75	30.8002	971.222	2292.22	8068.7	4572.03	3496.67	7949.01	3376.98
17	6.51737	50195	-7.02571	In Situ Clay Liner	270	28	947.562	2236.38	8360.87	4662.65	3698.22	8244.09	3581.44
18	11.7845	93065.4	-2.06288	In Situ Clay Liner	270	28	934.025	2204.43	8339.09	4700.95	3638.14	8305.44	3604.49
19	11.7845	94006.1	-2.06288	In Situ Clay Liner	270	28	944.613	2229.42	8412.58	4727.44	3685.14	8378.56	3651.12
20	11.2735	90580.2	-0.45972	In Situ Clay Liner	270	28	935.063	2206.88	8386.25	4743.51	3642.74	8378.74	3635.23
21	11.2735	92423.2	-0.45972	In Situ Clay Liner	270	28	968.87	2286.67	8541.96	4749.15	3792.81	8534.19	3785.04
22	11.2735	94205.3	1.37042	In Situ Clay Liner	270	28	983.607	2321.45	8601.78	4743.56	3858.22	8625.31	3881.75
23	11.2735	95737.7	1.37042	In Situ Clay Liner	270	28	1014.73	2394.9	8723.09	4726.73	3996.36	8747.37	4020.64
24	12.4915	107871	1.37042	In Situ Clay Liner	270	28	1047.2	2471.53	8849.47	4708.99	4140.48	8874.52	4165.53
25	12.4915	109753	1.37042	In Situ Clay Liner	270	28	1080.95	2551.19	8980.64	4690.34	4290.3	9006.5	4316.16
26	12.4915	111634	1.37042	In Situ Clay Liner	270	28	1114.3	2629.91	9110.05	4671.7	4438.35	9136.71	4465.01

27	12.4915	113516	1.37042	In Situ Clay Liner	270	28	1147.25	2707.67	9237.62	4653.05	4584.57	9265.07	4612.02
28	0.479286	4390.4	11.5944	In Situ Clay Liner	270	28	1045.18	2466.76	8772.15	4640.66	4131.49	8986.59	4345.93
29	14.4846	132930	11.5944	C&D Waste	207.75	30.8002	1155.69	2727.59	8771.89	4544.87	4227.02	9009.01	4464.14
30	14.4846	133073	11.5944	C&D Waste	207.75	30.8002	1197.3	2825.8	8751.2	4359.43	4391.77	8996.85	4637.42
31	14.7242	132641	14.6029	C&D Waste	207.75	30.8002	1162.82	2744.41	8402.27	4147.02	4255.25	8705.23	4558.21
32	14.7242	130925	14.6029	C&D Waste	207.75	30.8002	1188.85	2805.86	8265.97	3907.65	4358.32	8575.7	4668.05
33	13.3385	118216	17.2701	C&D Waste	207.75	30.8002	1206.45	2847.38	8086.54	3658.58	4427.96	8461.61	4803.03
34	13.3385	117566	17.2701	C&D Waste	207.75	30.8002	1255.26	2962.59	8021.03	3399.81	4621.22	8411.29	5011.48
35	13.3385	116422	21.9714	C&D Waste	207.75	30.8002	1249.42	2948.8	7700.67	3102.53	4598.14	8204.74	5102.21
36	13.3385	114784	21.9714	C&D Waste	207.75	30.8002	1302.07	3073.06	7573.3	2766.73	4806.57	8098.61	5331.88
37	25.5606	212567	28.686	C&D Waste	207.75	30.8002	1304.89	3079.73	6980.22	2162.48	4817.74	7694.21	5531.73
38	27.6589	213914	32.92	C&D Waste	207.75	30.8002	1370.75	3235.16	6245.9	1167.42	5078.48	7133.36	5965.94
39	14.1046	98658.7	34.6696	C&D Waste	207.75	30.8002	1402.88	3311	5510.06	304.35	5205.71	6480.36	6176.01
40	11.9479	78458.7	34.6696	C&D Waste	207.75	30.8002	1389.65	3279.77	5153.31	0	5153.31	6114.46	6114.46
41	11.6008	72301.1	37.0779	C&D Waste	207.75	30.8002	1302.38	3073.81	4807.82	0	4807.82	5792.02	5792.02
42	11.6008	68217.8	37.0779	C&D Waste	207.75	30.8002	1237.94	2921.72	4552.68	0	4552.68	5488.18	5488.18
43	19.2513	104125	37.3082	C&D Waste	207.75	30.8002	1149.18	2712.23	4201.26	0	4201.26	5076.96	5076.96
44	19.016	90387.3	41.3706	C&D Waste	207.75	30.8002	995.835	2350.31	3594.15	0	3594.15	4471.19	4471.19
45	17.7333	70902.2	44.7934	C&D Waste	207.75	30.8002	834.616	1969.81	2955.85	0	2955.85	3784.47	3784.47
46	17.7333	56397.6	46.2509	C&D Waste	207.75	30.8002	678.066	1600.33	2336.05	0	2336.05	3044.39	3044.39
47	12.0427	28885.5	46.4506	C&D Waste	2.27374e-13	34.992	525.032	1239.15	1770.22	0	1770.22	2322.53	2322.53
48	12.0427	19751.2	46.4506	C&D Waste	0	34.992	362.129	854.675	1220.96	0	1220.96	1601.91	1601.91
49	12.0427	11744.7	46.4506	C&D Waste	1.13687e-13	34.992	217.294	512.845	732.639	0	732.639	961.224	961.224
50	12.0427	4167.86	46.4506	C&D Waste	0	34.992	77.8229	183.673	262.39	0	262.39	344.257	344.257

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.36014

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	530.341	726.585	0	0	0
2	531.116	726.321	7.57689	0.00532964	0.0403023
3	564.121	715.049	10327.5	315.367	1.74908
4	575.567	711.14	18556.1	756.292	2.33392
5	587.014	707.231	29265	1488.64	2.91199
6	598.46	703.322	42506.6	2586.13	3.48162
7	609.906	699.413	58332.3	4121.15	4.04121
8	627.843	693.287	88447.8	7573.59	4.89417
9	645.779	687.162	125019	12506.8	5.71282
10	655.167	683.956	145769	15644.4	6.12572
11	668.41	679.433	175986	20637	6.68824
12	681.653	674.911	208499	26434.2	7.2256
13	697.613	669.5	250632	34497.8	7.83713
14	712.749	664.369	297586	43827.6	8.37813
15	728.297	659.235	349215	54634.5	8.89181
16	743.845	654.101	405315	66813.3	9.36062
17	760.896	652	438847	75966.3	9.82082
18	767.414	651.197	451744	79502.7	9.98131
19	779.198	650.772	466301	84315.3	10.2493
20	790.983	650.348	481014	89048.8	10.4883
21	802.256	650.257	492324	92928.6	10.6891
22	813.529	650.167	504029	96717.6	10.8624
23	824.803	650.437	512808	99751.9	11.0078
24	836.076	650.706	521906	102630	11.125
25	848.568	651.005	532355	105616	11.2214
26	861.059	651.304	543186	108371	11.2829
27	873.551	651.603	554396	110869	11.3089
28	886.042	651.902	565980	113090	11.2996
29	886.522	652	565619	113007	11.2986
30	901.006	654.972	556306	110574	11.2419
31	915.491	657.944	547658	107822	11.1379
32	930.215	661.78	532563	103365	10.984
33	944.939	665.616	518375	98716.4	10.782
34	958.278	669.763	500948	93371.3	10.5582
35	971.616	673.91	484445	88004.8	10.2961
36	984.955	679.291	459686	81027.9	9.99672
37	998.294	684.672	436315	74273.5	9.6608
38	1023.85	698.658	372076	58391.9	8.91899
39	1051.51	716.565	298179	41799.2	7.97981
40	1065.62	726.321	264232	34553.8	7.45033
41	1077.57	734.584	238266	29158.5	6.97705
42	1089.17	743.351	211240	24057.2	6.49717
43	1100.77	752.117	185704	19513.2	5.99845
44	1120.02	766.787	146215	13134.4	5.13307
45	1139.03	783.535	104977	7778.3	4.2376
46	1156.77	801.141	67750.8	3992.09	3.37215
47	1174.5	819.666	36510.9	1583.46	2.48333
48	1186.54	832.334	20413.7	666.325	1.86953
49	1198.59	845.003	9311.09	203.121	1.24971
50	1210.63	857.671	2648.99	28.937	0.625862
51	1222.67	870.34	0	0	0

Discharge Sections

Entity Information

Piezoline

X	Y
529.283	726.321
1831	726.321

External Boundary

X	Y
458	716
452	716
445	714
408	712
405	710
389	708
367	706
361	704
353	700
333	690
315	684
251	682
249	680
225	680
221	682
213	682
209	680
175	680
171	682
139	684
118	684
90	686
72	688
58	690
52	692
36	700
18	710
0	720
0	669.5
0	650
0	500
1831	500
1831	650
1831	652
1831	876

1741	880
1518	888
1384	880
1217	870
1206	868
1198	866
1176	866
1152	860
1072	840
1064	838
1042	838
1010	830
930	810
908	810
828	790
796	782
774	782
766	780
686	760
662	754
640	754
624	750
544	730
536	728
529.283	726.321
528	726
525.829	725.483
515.993	725.483
495.921	725.483

Material Boundary

X	Y
525.829	725.483
649.093	684
692.179	669.5
750.122	650

Material Boundary

X	Y
750.122	650
1831	650

Material Boundary

X	Y
315	684
649.093	684

Material Boundary

X	Y
750.122	652
1831	652

Material Boundary

X	Y
529.283	726.321
649.093	686
655.036	684
698.122	669.5
750.122	652

Material Boundary

X	Y
0	669.5
692.179	669.5

Material Boundary

X	Y
649.093	684
655.036	684

Material Boundary

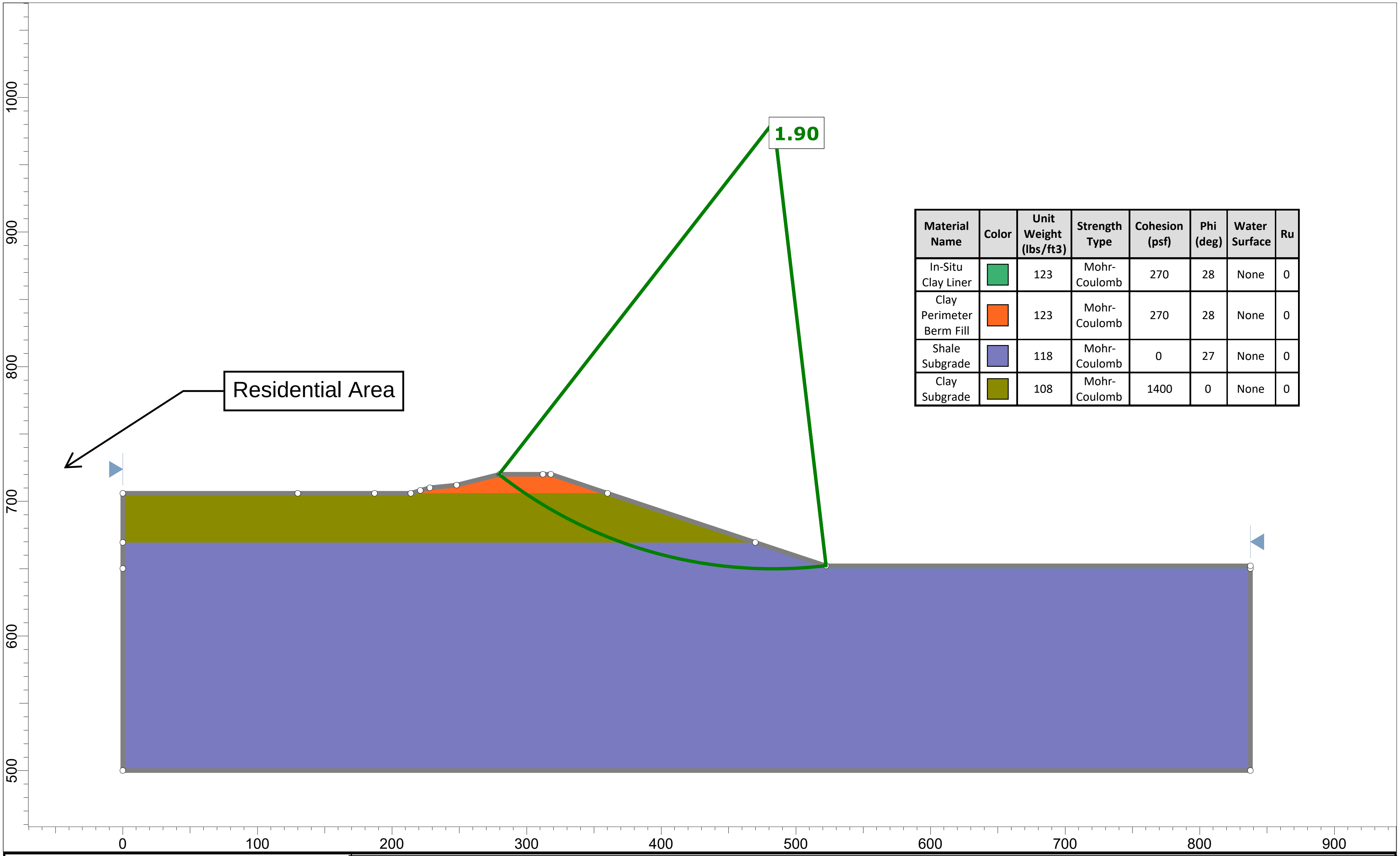
X	Y
692.179	669.5
698.122	669.5

ATTACHMENT 2

3H:1V EXCAVATION SIDE SLOPE STABILITY SLIDE OUTPUTS

CROSS-SECTION A

3H:1V EXCAVATION CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28	None	0
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28	None	0
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27	None	0
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0	None	0

rocscience

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section A, Circular Interior Slope Excavation

Created By: EDC	Checked By: EDC
Created Date12-20-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:00.964s
Author:	EDC
Company:	CEC
Date Created:	12/20/2022

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]: 62.4
Use negative pore pressure cutoff: Yes
Maximum negative pore pressure [psf]: 0
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Global Minimums

Method: gle/morgenstern-price

FS	1.901810
Center:	483.501, 981.823
Radius:	332.097
Left Slip Surface Endpoint:	279.398, 719.849
Right Slip Surface Endpoint:	522.339, 652.005
Resisting Moment:	1.08535e+08 lb-ft
Driving Moment:	5.70694e+07 lb-ft
Resisting Horizontal Force:	308208 lb
Driving Horizontal Force:	162060 lb
Total Slice Area:	5544.52 ft2
Surface Horizontal Width:	242.942 ft
Surface Average Height:	22.8224 ft

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.90181

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	4.78598	1160.17	-37.4024	Clay Perimeter Berm Fill	270	28	173.223	329.438	111.786	0	111.786	244.237	244.237
2	4.78598	3280.31	-36.3699	Clay Perimeter Berm Fill	270	28	276.409	525.678	480.861	0	480.861	684.424	684.424
3	4.78598	5317.04	-35.351	Clay Perimeter Berm Fill	270	28	374.996	713.171	833.483	0	833.483	1099.5	1099.5
4	4.78598	7278.89	-34.3448	Clay Perimeter Berm Fill	270	28	469.693	893.266	1172.19	0	1172.19	1493.13	1493.13
5	4.80507	9094.82	-33.3485	Clay Subgrade	1400	0	736.141	1400	1383.11	0	1383.11	1867.56	1867.56
6	4.80507	10705.4	-32.3616	Clay Subgrade	1400	0	736.141	1400	1711.24	0	1711.24	2177.71	2177.71
7	4.80507	12256.1	-31.3853	Clay Subgrade	1400	0	736.141	1400	2020.97	0	2020.97	2470.06	2470.06
8	4.80507	13748.7	-30.4191	Clay Subgrade	1400	0	736.141	1400	2314.61	0	2314.61	2746.83	2746.83
9	4.80507	14758.9	-29.4623	Clay Subgrade	1400	0	736.141	1400	2512.67	0	2512.67	2928.52	2928.52
10	4.80507	15196.7	-28.5145	Clay Subgrade	1400	0	736.141	1400	2601.22	0	2601.22	3001.15	3001.15
11	4.80507	15580.1	-27.5752	Clay Subgrade	1400	0	736.141	1400	2681.11	0	2681.11	3065.55	3065.55
12	4.80507	15911.6	-26.6438	Clay Subgrade	1400	0	736.141	1400	2753.22	0	2753.22	3122.55	3122.55
13	4.80507	16192.6	-25.72	Clay Subgrade	1400	0	736.141	1400	2817.99	0	2817.99	3172.59	3172.59
14	4.80507	16424.2	-24.8032	Clay Subgrade	1400	0	736.141	1400	2875.85	0	2875.85	3216.04	3216.04
15	4.80507	16607.6	-23.8933	Clay Subgrade	1400	0	736.141	1400	2927.08	0	2927.08	3253.19	3253.19
16	4.80507	16743.8	-22.9896	Clay Subgrade	1400	0	736.141	1400	2971.9	0	2971.9	3284.21	3284.21
17	4.80507	16835.9	-22.092	Clay Subgrade	1400	0	736.141	1400	3010.86	0	3010.86	3309.65	3309.65
18	4.80507	16958.3	-21.2001	Clay Subgrade	1400	0	736.141	1400	3057.9	0	3057.9	3343.43	3343.43
19	4.80507	17073.6	-20.3135	Clay Subgrade	1400	0	736.141	1400	3105.83	0	3105.83	3378.33	3378.33
20	4.90707	17551.8	-19.4226	Shale Subgrade	0	27	843.449	1604.08	3148.19	0	3148.19	3445.59	3445.59
21	4.90707	17663.4	-18.5273	Shale Subgrade	0	27	857.914	1631.59	3202.17	0	3202.17	3489.68	3489.68
22	4.90707	17725.7	-17.6367	Shale Subgrade	0	27	870.508	1655.54	3249.17	0	3249.17	3525.93	3525.93
23	4.90707	17739.5	-16.7505	Shale Subgrade	0	27	881.14	1675.76	3288.86	0	3288.86	3554.06	3554.06
24	4.90707	17705.5	-15.8683	Shale Subgrade	0	27	889.689	1692.02	3320.78	0	3320.78	3573.69	3573.69

25	4.90707	17624.3	-14.99	Shale Subgrade	0	27	896.041	1704.1	3344.47	0	3344.47	3584.4	3584.4
26	4.90707	17496.5	-14.1153	Shale Subgrade	0	27	900.053	1711.73	3359.45	0	3359.45	3585.79	3585.79
27	4.90707	17322.6	-13.244	Shale Subgrade	0	27	901.583	1714.64	3365.19	0	3365.19	3577.38	3577.38
28	4.90707	17103.2	-12.3757	Shale Subgrade	0	27	900.495	1712.57	3361.12	0	3361.12	3558.7	3558.7
29	4.90707	16838.8	-11.5103	Shale Subgrade	0	27	896.641	1705.24	3346.73	0	3346.73	3529.32	3529.32
30	4.90707	16529.8	-10.6476	Shale Subgrade	0	27	889.879	1692.38	3321.48	0	3321.48	3488.78	3488.78
31	4.90707	16176.5	-9.78735	Shale Subgrade	0	27	880.077	1673.74	3284.9	0	3284.9	3436.71	3436.71
32	4.90707	15779.3	-8.92929	Shale Subgrade	0	27	867.106	1649.07	3236.47	0	3236.47	3372.7	3372.7
33	4.90707	15338.5	-8.07325	Shale Subgrade	0	27	850.853	1618.16	3175.83	0	3175.83	3296.52	3296.52
34	4.90707	14854.5	-7.21902	Shale Subgrade	0	27	831.229	1580.84	3102.57	0	3102.57	3207.86	3207.86
35	4.90707	14327.5	-6.3664	Shale Subgrade	0	27	808.156	1536.96	3016.45	0	3016.45	3106.62	3106.62
36	4.90707	13757.8	-5.51519	Shale Subgrade	0	27	781.587	1486.43	2917.28	0	2917.28	2992.75	2992.75
37	4.90707	13145.4	-4.6652	Shale Subgrade	0	27	751.495	1429.2	2804.96	0	2804.96	2866.29	2866.29
38	4.90707	12490.6	-3.81624	Shale Subgrade	0	27	717.874	1365.26	2679.48	0	2679.48	2727.36	2727.36
39	4.90707	11814.6	-2.96812	Shale Subgrade	0	27	681.94	1296.92	2545.35	0	2545.35	2580.71	2580.71
40	4.90707	11077.2	-2.12065	Shale Subgrade	0	27	641.489	1219.99	2394.37	0	2394.37	2418.12	2418.12
41	4.90707	10218.7	-1.27364	Shale Subgrade	0	27	593.219	1128.19	2214.2	0	2214.2	2227.38	2227.38
42	4.90707	9315.64	-0.426917	Shale Subgrade	0	27	541.563	1029.95	2021.39	0	2021.39	2025.43	2025.43
43	4.90707	8370.62	0.419718	Shale Subgrade	0	27	486.819	925.837	1817.06	0	1817.06	1813.49	1813.49
44	4.90707	7383.61	1.26644	Shale Subgrade	0	27	429.156	816.173	1601.83	0	1601.83	1592.34	1592.34
45	4.90707	6354.58	2.11345	Shale Subgrade	0	27	368.767	701.325	1376.43	0	1376.43	1362.82	1362.82
46	4.90707	5283.48	2.96091	Shale Subgrade	0	27	305.859	581.686	1141.62	0	1141.62	1125.8	1125.8
47	4.90707	4170.21	3.80903	Shale Subgrade	0	27	240.648	457.666	898.221	0	898.221	882.199	882.199
48	4.90707	3014.68	4.65798	Shale Subgrade	0	27	173.352	329.683	647.039	0	647.039	632.915	632.915
49	4.90707	1816.73	5.50796	Shale Subgrade	0	27	104.19	198.15	388.891	0	388.891	378.845	378.845
50	4.50966	554.689	6.32463	In-Situ Clay Liner	270	28	182.996	348.024	146.742	0	146.742	126.459	126.459

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.90181

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	279.398	719.849	0	0	0
2	284.184	716.19	-418.684	-7.76871	1.06301
3	288.97	712.665	-44.6652	-1.65436	2.12122
4	293.756	709.27	993.111	54.9998	3.16988
5	298.542	706	2582.02	189.808	4.20433
6	303.347	702.838	3423.9	313.049	5.22406
7	308.152	699.793	5102.65	556.173	6.22051
8	312.957	696.862	7495.07	945.446	7.18945
9	317.762	694.04	10493.4	1498.47	8.12696
10	322.567	691.326	13782.1	2190.1	9.02932
11	327.372	688.715	17040.9	2971.98	9.89304
12	332.177	686.206	20237.1	3829.34	10.715
13	336.982	683.795	23342.8	4745.92	11.4924
14	341.787	681.481	26333.5	5704.38	12.2226
15	346.592	679.26	29187.8	6686.66	12.9033
16	351.397	677.131	31886.8	7674.39	13.5324
17	356.202	675.093	34413.6	8649.26	14.1081
18	361.008	673.143	36754.1	9593.53	14.6289
19	365.813	671.279	38921.5	10497.1	15.0935
20	370.618	669.5	40914.2	11347	15.5006
21	375.525	667.77	42228.8	11994.4	15.8563
22	380.432	666.125	43291.4	12536.5	16.1502
23	385.339	664.565	44095.3	12962.7	16.3818
24	390.246	663.088	44635.5	13264.5	16.5506
25	395.153	661.693	44908.6	13435.8	16.6562
26	400.06	660.379	44912.9	13473.1	16.6983
27	404.967	659.146	44648.5	13375.7	16.677
28	409.874	657.991	44117.7	13145.7	16.5924
29	414.781	656.914	43324.7	12787.6	16.4443
30	419.688	655.915	42275.9	12309	16.2334
31	424.595	654.992	40980.2	11719.9	15.96
32	429.503	654.146	39448.8	11032.6	15.6247
33	434.41	653.375	37695.8	10261.6	15.2281
34	439.317	652.679	35737.5	9423.2	14.7714
35	444.224	652.057	33593.4	8535.19	14.2557
36	449.131	651.509	31285.3	7616.31	13.6823
37	454.038	651.036	28838.2	6685.84	13.0528
38	458.945	650.635	26279.5	5763.07	12.3691
39	463.852	650.308	23639.3	4866.78	11.6333
40	468.759	650.053	20945.7	4013.73	10.8478
41	473.666	649.872	18237.8	3220.84	10.0153
42	478.573	649.763	15572.9	2505.19	9.13879
43	483.48	649.726	12993.5	1877.39	8.22159
44	488.387	649.762	10543	1344.48	7.26733
45	493.294	649.871	8266.55	909.716	6.28001
46	498.202	650.052	6210.52	572.167	5.26373
47	503.109	650.305	4422.21	326.529	4.22297
48	508.016	650.632	2949.71	162.975	3.16244
49	512.923	651.032	1841.67	67.1133	2.08702
50	517.83	651.505	1147.18	20.0585	1.00172
51	522.339	652.005	0	0	0

Discharge Sections

Entity Information

External Boundary

X	Y
0	706
0	669.5
0	650
0	500
837.618	500
837.618	650
837.618	652
522.354	652
469.747	669.5
360.072	706
318.004	720
312	720
280	720
248	712
228	710
221	708
214	706
187	706
130	706

Material Boundary

X	Y
463.735	669.5
522.354	650

Material Boundary

X	Y
522.354	650
837.618	650

Material Boundary

X	Y
214	706
354.012	706

Material Boundary

X	Y
0	669.5
463.735	669.5

Material Boundary

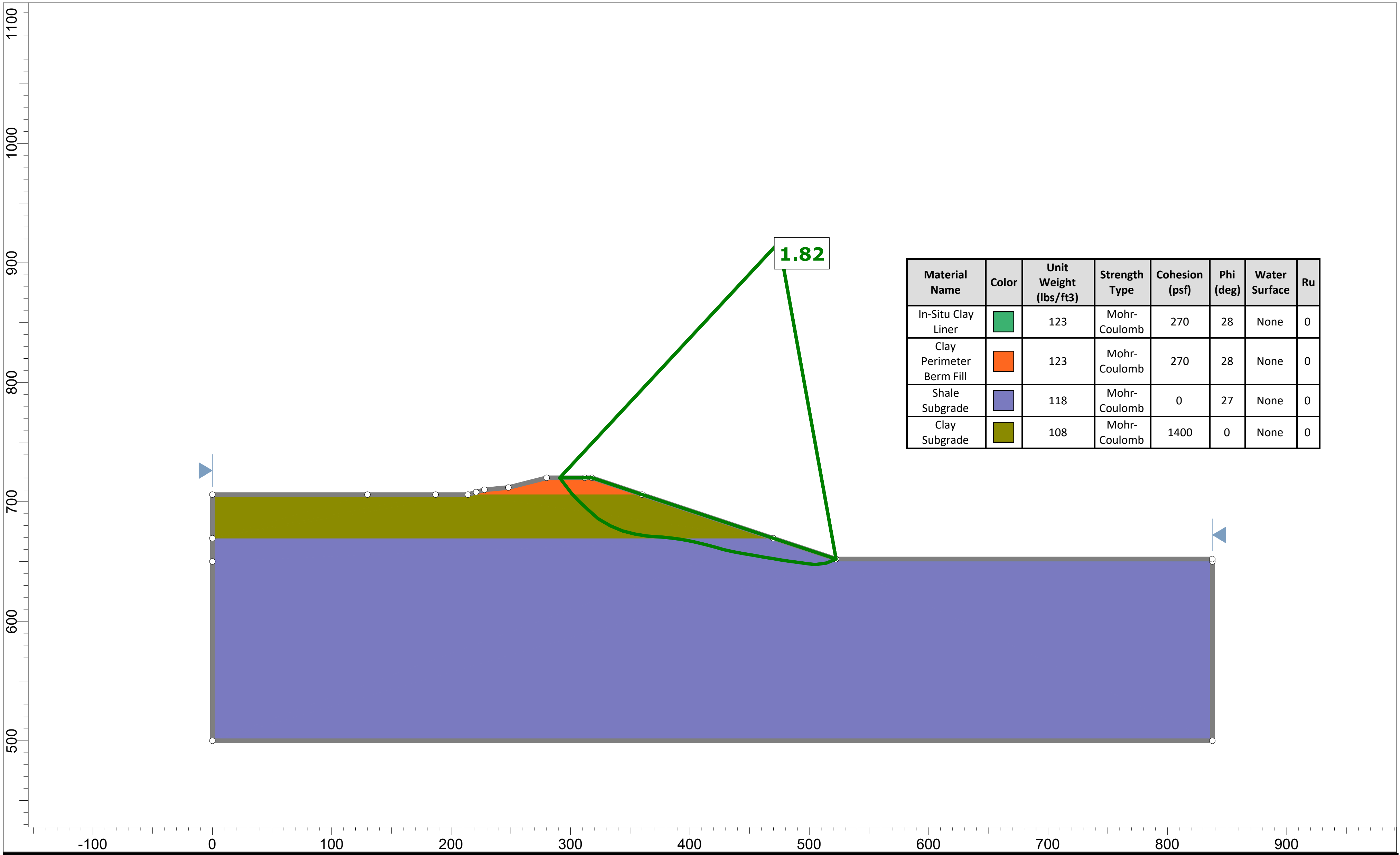
X	Y
463.735	669.5
469.747	669.5

Material Boundary

X	Y
354.012	706
360.072	706

CROSS-SECTION A

3H:1V EXCAVATION NON-CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28	None	0
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28	None	0
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27	None	0
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0	None	0

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section A, Non-Circular Interior Slope Excavation

Created By: EDC	Checked By: EDC
Created Date12-20-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:07.32s
Author:	EDC
Company:	CEC
Date Created:	12/20/2022

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Global Minimums

Method: gle/morgenstern-price

FS	1.820570
Axis Location:	474.700, 917.309
Left Slip Surface Endpoint:	291.046, 720.000
Right Slip Surface Endpoint:	522.354, 652.000
Resisting Moment:	7.6353e+07 lb-ft
Driving Moment:	4.1939e+07 lb-ft
Resisting Horizontal Force:	267044 lb
Driving Horizontal Force:	146681 lb
Total Slice Area:	5182.23 ft2
Surface Horizontal Width:	231.309 ft
Surface Average Height:	22.4039 ft

Global Minimum Coordinates

Method: gle/morgenstern-price

X	Y
291.046	720
295.118	714.743
300.902	706.843
306.686	700.809
314.914	693.138
323.142	685.822
333.394	679.778
343.667	675.52
353.806	672.919
363.945	671.316
371.035	670.772
377.233	670.376
384.249	669.683
391.264	668.745
397.652	667.668
404.039	666.368
413.233	664.175
422.426	661.662
427.971	660.048
436.251	658.22
444.149	656.783
455.274	654.769
462.462	653.589
469.65	652.408
475.856	651.404
482.058	650.4
489	649.408
497.136	648.265
505.09	647.449
514.448	648.704
522.354	652

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.82057

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	4.07203	1316.56	-52.24	Clay Perimeter Berm Fill	270	28	176.474	321.283	96.4497	0	96.4497	324.287	324.287
2	5.78414	6550.32	-53.7882	Clay Perimeter Berm Fill	270	28	337.511	614.463	647.84	0	647.84	1108.79	1108.79
3	0.808239	1349.87	-46.2123	Clay Perimeter Berm Fill	270	28	476.942	868.307	1125.25	0	1125.25	1622.82	1622.82
4	4.97628	9964.18	-46.2123	Clay Subgrade	1400	0	768.99	1400	1153.37	0	1153.37	1955.61	1955.61
5	4.11385	10242.6	-42.9915	Clay Subgrade	1400	0	768.99	1400	1676.63	0	1676.63	2393.52	2393.52
6	4.11385	11946.5	-42.9915	Clay Subgrade	1400	0	768.99	1400	2027.45	0	2027.45	2744.33	2744.33
7	4.11392	13589.8	-41.6437	Clay Subgrade	1400	0	768.99	1400	2391.45	0	2391.45	3075.24	3075.24
8	4.11392	14717.8	-41.6437	Clay Subgrade	1400	0	768.99	1400	2594.28	0	2594.28	3278.07	3278.07
9	5.1263	19219.4	-30.5205	Clay Subgrade	1400	0	768.99	1400	3026.08	0	3026.08	3479.42	3479.42
10	5.1263	19816.8	-30.5205	Clay Subgrade	1400	0	768.99	1400	3097.92	0	3097.92	3551.26	3551.26
11	10.2726	40511.5	-22.512	Clay Subgrade	1400	0	768.99	1400	3355.48	0	3355.48	3674.2	3674.2
12	5.06949	19922	-14.3891	Clay Subgrade	1400	0	768.99	1400	3555.92	0	3555.92	3753.21	3753.21
13	5.06949	19582.1	-14.3891	Clay Subgrade	1400	0	768.99	1400	3497.57	0	3497.57	3694.85	3694.85
14	5.06965	19106.2	-8.98637	Clay Subgrade	1400	0	768.99	1400	3574.92	0	3574.92	3696.53	3696.53
15	5.06965	18530.5	-8.98637	Clay Subgrade	1400	0	768.99	1400	3481.99	0	3481.99	3603.59	3603.59
16	3.54478	12611.1	-4.38872	Clay Subgrade	1400	0	768.99	1400	3542.16	0	3542.16	3601.18	3601.18
17	3.54478	12263.6	-4.38872	Clay Subgrade	1400	0	768.99	1400	3461.74	0	3461.74	3520.76	3520.76
18	6.19839	20582.4	-3.65374	Clay Subgrade	1400	0	768.99	1400	3368.74	0	3368.74	3417.84	3417.84
19	3.50773	11176.5	-5.64121	Clay Subgrade	1400	0	768.99	1400	3195.33	0	3195.33	3271.29	3271.29
20	3.50773	10865.6	-5.64121	Clay Subgrade	1400	0	768.99	1400	3120.86	0	3120.86	3196.81	3196.81
21	1.36781	4156.17	-7.61516	Clay Subgrade	1400	0	768.99	1400	3012.18	0	3012.18	3114.99	3114.99
22	5.64757	16755.9	-7.61516	Shale Subgrade	0	27	829.553	1510.26	2964.06	0	2964.06	3074.97	3074.97
23	6.38773	18260.8	-9.57111	Shale Subgrade	0	27	786.188	1431.31	2809.1	0	2809.1	2941.67	2941.67
24	6.38763	17689.9	-11.5048	Shale Subgrade	0	27	748.974	1363.56	2676.13	0	2676.13	2828.57	2828.57
25	4.59673	12472.6	-13.4123	Shale Subgrade	0	27	721.175	1312.95	2576.81	0	2576.81	2748.78	2748.78

26	4.59673	12307.7	-13.4123	Shale Subgrade	0	27	713.491	1298.96	2549.36	0	2549.36	2719.5	2719.5
27	4.59674	12186.4	-15.29	Shale Subgrade	0	27	694.09	1263.64	2480.03	0	2480.03	2669.78	2669.78
28	4.59674	12108.6	-15.29	Shale Subgrade	0	27	691.437	1258.81	2470.55	0	2470.55	2659.57	2659.57
29	5.54474	14534.5	-16.2333	Shale Subgrade	0	27	683.165	1243.75	2441	0	2441	2639.9	2639.9
30	4.13974	10748.5	-12.4457	Shale Subgrade	0	27	706.026	1285.37	2522.69	0	2522.69	2678.51	2678.51
31	4.13974	10578.8	-12.4457	Shale Subgrade	0	27	696.062	1267.23	2487.07	0	2487.07	2640.7	2640.7
32	3.9491	9897.95	-10.3152	Shale Subgrade	0	27	698.875	1272.35	2497.12	0	2497.12	2624.32	2624.32
33	3.9491	9672.36	-10.3152	Shale Subgrade	0	27	683.506	1244.37	2442.21	0	2442.21	2566.61	2566.61
34	5.56245	13239.4	-10.2608	Shale Subgrade	0	27	665.039	1210.75	2376.23	0	2376.23	2496.62	2496.62
35	5.56245	12788.2	-10.2608	Shale Subgrade	0	27	642.639	1169.97	2296.2	0	2296.2	2412.53	2412.53
36	3.59417	8010.35	-9.32657	Shale Subgrade	0	27	628.55	1144.32	2245.85	0	2245.85	2349.08	2349.08
37	3.59417	7796.39	-9.32657	Shale Subgrade	0	27	611.473	1113.23	2184.84	0	2184.84	2285.26	2285.26
38	7.18833	14980	-9.32657	Shale Subgrade	0	27	586.783	1068.28	2096.62	0	2096.62	2192.99	2192.99
39	6.20572	12213.7	-9.19297	Shale Subgrade	0	27	553.805	1008.24	1978.77	0	1978.77	2068.4	2068.4
40	6.20221	11431.3	-9.1954	Shale Subgrade	0	27	517.56	942.254	1849.27	0	1849.27	1933.06	1933.06
41	3.47067	6045.03	-8.1303	Shale Subgrade	0	27	492.256	896.186	1758.86	0	1758.86	1829.19	1829.19
42	3.47067	5775.26	-8.1303	Shale Subgrade	0	27	469.401	854.578	1677.2	0	1677.2	1744.26	1744.26
43	4.06821	6423.81	-7.99629	Shale Subgrade	0	27	444.894	809.96	1589.64	0	1589.64	1652.13	1652.13
44	4.06821	6048.49	-7.99629	Shale Subgrade	0	27	417.846	760.717	1492.99	0	1492.99	1551.69	1551.69
45	3.97691	5514.55	-5.85407	Shale Subgrade	0	27	394.246	717.752	1408.67	0	1408.67	1449.09	1449.09
46	3.97691	5085.08	-5.85407	Shale Subgrade	0	27	362.209	659.427	1294.2	0	1294.2	1331.34	1331.34
47	4.67923	5127.54	7.63536	Shale Subgrade	0	27	335.97	611.656	1200.44	0	1200.44	1155.4	1155.4
48	4.67923	3921.73	7.63536	Shale Subgrade	0	27	253.724	461.923	906.574	0	906.574	872.561	872.561
49	5.23785	2501.77	22.6305	Shale Subgrade	0	27	156.968	285.771	560.857	0	560.857	495.42	495.42
50	2.6683	328.201	22.6305	In-Situ Clay Liner	270	28	210.989	384.12	214.628	0	214.628	126.67	126.67

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.82057

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	291.046	720	0	0	0
2	295.118	714.743	-211.55	-3.94422	1.06812
3	300.902	706.843	2953.93	132.975	2.5775
4	301.71	706	3517.24	171.23	2.78713
5	306.686	700.809	5678.19	403.788	4.06758
6	310.8	696.973	8944.73	799.779	5.10942
7	314.914	693.138	13556.7	1456.47	6.13208
8	319.028	689.48	19141.4	2395.03	7.13196
9	323.142	685.822	25468	3627.15	8.10555
10	328.268	682.8	30671.1	5009.96	9.27703
11	333.394	679.778	36091.2	6621.96	10.3969
12	343.667	675.52	42477.9	9389.93	12.465
13	348.736	674.22	43204.4	10285.1	13.3904
14	353.806	672.919	43854.9	11136.1	14.248
15	358.876	672.117	42822.5	11502.3	15.035
16	363.945	671.316	41715.5	11763.9	15.7486
17	367.49	671.044	39953.3	11609.6	16.2028
18	371.035	670.772	38169.2	11392.9	16.6195
19	377.233	670.376	34736.1	10790.3	17.2567
20	380.741	670.029	33145.8	10492	17.5647
21	384.249	669.683	31529.7	10144	17.8345
22	385.616	669.5	31028.7	10039.5	17.9293
23	391.264	668.745	28581.8	9429.24	18.2579
24	397.652	667.668	26585.5	8899.37	18.5077
25	404.039	666.368	25280.7	8521.33	18.6273
26	408.636	665.272	24790.2	8358.57	18.6327
27	413.233	664.175	24304.9	8165.53	18.5704
28	417.83	662.919	24231	8079.63	18.4405
29	422.426	661.662	24157.3	7962.81	18.2434
30	427.971	660.048	24310	7859.69	17.9166
31	432.111	659.134	23692.1	7519.86	17.6094
32	436.251	658.22	23082.9	7166.9	17.2488
33	440.2	657.502	22117.8	6701.14	16.8555
34	444.149	656.783	21173.9	6237.69	16.4146
35	449.711	655.776	19867.4	5589.81	15.7143
36	455.274	654.769	18604.8	4958.45	14.9233
37	458.868	654.179	17671.4	4525.81	14.3652
38	462.462	653.589	16763.4	4108.6	13.7714
39	469.65	652.408	15020.5	3324.65	12.4807
40	475.856	651.404	13571.1	2702.41	11.262
41	482.058	650.4	12217.9	2144.46	9.95503
42	485.529	649.904	11381.5	1840.97	9.18808
43	489	649.408	10584	1562.46	8.39762
44	493.068	648.836	9682.49	1265.03	7.44361
45	497.136	648.265	8835.82	1000.92	6.4629
46	501.113	647.857	7842.33	752.573	5.48149
47	505.09	647.449	6929.57	543.045	4.4809
48	509.769	648.077	4604.48	264.174	3.28365
49	514.448	648.704	2848.57	102.971	2.07024
50	519.686	650.888	801.724	9.79769	0.700164
51	522.354	652	0	0	0

Discharge Sections

Entity Information

External Boundary

X	Y
0	706
0	669.5
0	650
0	500
837.618	500
837.618	650
837.618	652
522.354	652
469.747	669.5
360.072	706
318.004	720
312	720
280	720
248	712
228	710
221	708
214	706
187	706
130	706

Material Boundary

X	Y
463.735	669.5
522.354	650

Material Boundary

X	Y
522.354	650
837.618	650

Material Boundary

X	Y
214	706
354.012	706

Material Boundary

X	Y
0	669.5
463.735	669.5

Material Boundary

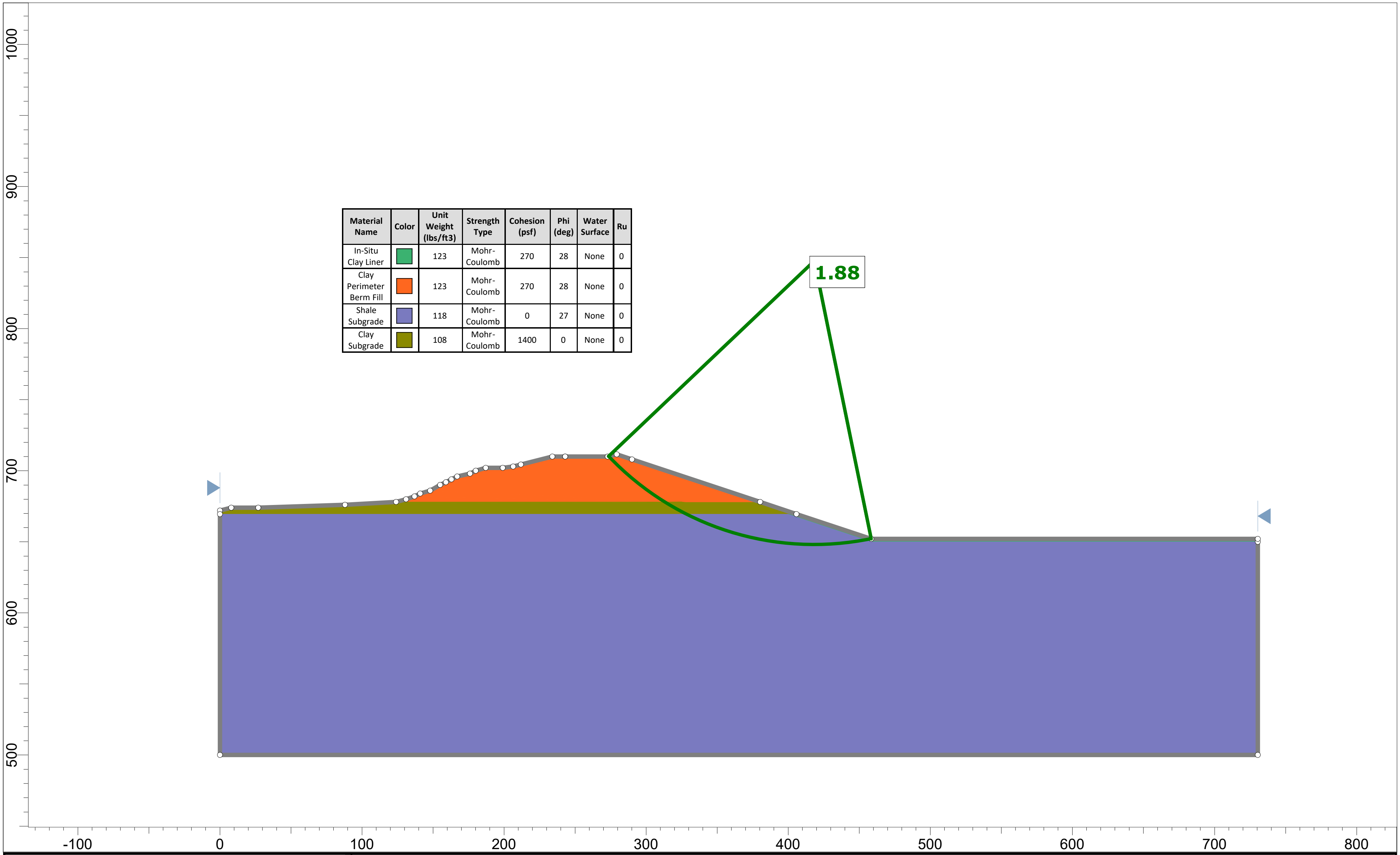
X	Y
463.735	669.5
469.747	669.5

Material Boundary

X	Y
354.012	706
360.072	706

CROSS-SECTION B

3H:1V EXCAVATION CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28	None	0
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28	None	0
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27	None	0
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0	None	0

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section B, Circular Interior Slope Excavation

Created By: EDC	Checked By: EDC
Created Date12-20-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

SLIDEINTERPRET 9.026

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Author:	EDC
Company:	CEC
Date Created:	12/20/22

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Global Minimums

Method: gle/morgenstern-price

FS	1.878100
Center:	418.363, 847.689
Radius:	199.735
Left Slip Surface Endpoint:	273.533, 710.145
Right Slip Surface Endpoint:	458.359, 652.000
Resisting Moment:	4.61525e+07 lb-ft
Driving Moment:	2.4574e+07 lb-ft
Resisting Horizontal Force:	213204 lb
Driving Horizontal Force:	113521 lb
Total Slice Area:	3577.49 ft2
Surface Horizontal Width:	184.826 ft
Surface Average Height:	19.356 ft

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.8781

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.58864	1010.16	-45.7404	Clay Perimeter Berm Fill	270	28	173.492	325.836	105.011	0	105.011	283.046	283.046
2	3.58864	2916.15	-44.2839	Clay Perimeter Berm Fill	270	28	291.237	546.973	520.912	0	520.912	804.958	804.958
3	3.58864	4061.41	-42.8626	Clay Perimeter Berm Fill	270	28	361.863	679.615	770.374	0	770.374	1106.2	1106.2
4	3.58864	4968.49	-41.4734	Clay Perimeter Berm Fill	270	28	417.751	784.579	967.781	0	967.781	1337.03	1337.03
5	3.58864	5807.89	-40.1134	Clay Perimeter Berm Fill	270	28	469.585	881.927	1150.87	0	1150.87	1546.48	1546.48
6	3.58864	6584.37	-38.78	Clay Perimeter Berm Fill	270	28	517.873	972.618	1321.43	0	1321.43	1737.52	1737.52
7	3.58864	7300.88	-37.4712	Clay Perimeter Berm Fill	270	28	562.981	1057.33	1480.76	0	1480.76	1912.3	1912.3
8	3.58864	7960.4	-36.1849	Clay Perimeter Berm Fill	270	28	605.24	1136.7	1630.03	0	1630.03	2072.75	2072.75
9	3.58864	8565.73	-34.9194	Clay Perimeter Berm Fill	270	28	644.943	1211.27	1770.27	0	1770.27	2220.51	2220.51
10	3.58864	9119.39	-33.6732	Clay Perimeter Berm Fill	270	28	682.339	1281.5	1902.36	0	1902.36	2356.96	2356.96
11	3.58864	9623.62	-32.4447	Clay Perimeter Berm Fill	270	28	717.635	1347.79	2027.04	0	2027.04	2483.25	2483.25
12	3.77953	10563.3	-31.201	Clay Subgrade	1400	0	745.434	1400	2137.08	0	2137.08	2588.54	2588.54
13	3.77953	10890.3	-29.9416	Clay Subgrade	1400	0	745.434	1400	2234.85	0	2234.85	2664.21	2664.21
14	3.77953	11172.4	-28.698	Clay Subgrade	1400	0	745.434	1400	2324.19	0	2324.19	2732.27	2732.27
15	3.77953	11411.2	-27.469	Clay Subgrade	1400	0	745.434	1400	2405.74	0	2405.74	2793.27	2793.27
16	3.71843	11453.4	-26.2633	Shale Subgrade	0	27	677.323	1272.08	2496.59	0	2496.59	2830.8	2830.8
17	3.71843	11672	-25.0797	Shale Subgrade	0	27	697.982	1310.88	2572.75	0	2572.75	2899.4	2899.4
18	3.71843	11849.6	-23.9074	Shale Subgrade	0	27	717.257	1347.08	2643.8	0	2643.8	2961.76	2961.76
19	3.71843	11987.5	-22.7457	Shale Subgrade	0	27	735.121	1380.63	2709.65	0	2709.65	3017.85	3017.85
20	3.71843	12086.7	-21.5938	Shale Subgrade	0	27	751.531	1411.45	2770.13	0	2770.13	3067.58	3067.58
21	3.71843	12148	-20.4509	Shale Subgrade	0	27	766.408	1439.39	2824.96	0	2824.96	3110.76	3110.76

22	3.71843	12172.4	-19.3166	Shale Subgrade	0	27	779.66	1464.28	2873.81	0	2873.81	3147.1	3147.1
23	3.71843	12160.7	-18.19	Shale Subgrade	0	27	791.172	1485.9	2916.26	0	2916.26	3176.23	3176.23
24	3.71843	12113.5	-17.0707	Shale Subgrade	0	27	800.804	1503.99	2951.75	0	2951.75	3197.66	3197.66
25	3.71843	12031.6	-15.9581	Shale Subgrade	0	27	808.402	1518.26	2979.76	0	2979.76	3210.92	3210.92
26	3.71843	11915.4	-14.8516	Shale Subgrade	0	27	813.791	1528.38	2999.6	0	2999.6	3215.4	3215.4
27	3.71843	11765.6	-13.7507	Shale Subgrade	0	27	816.788	1534.01	3010.65	0	3010.65	3210.53	3210.53
28	3.71843	11582.7	-12.655	Shale Subgrade	0	27	817.204	1534.79	3012.2	0	3012.2	3195.69	3195.69
29	3.71843	11367	-11.564	Shale Subgrade	0	27	814.845	1530.36	3003.5	0	3003.5	3170.23	3170.23
30	3.71843	11153.6	-10.4772	Shale Subgrade	0	27	811.98	1524.98	2992.93	0	2992.93	3143.09	3143.09
31	3.71843	10942.7	-9.39425	Shale Subgrade	0	27	808.498	1518.44	2980.12	0	2980.12	3113.88	3113.88
32	3.71843	10700.1	-8.31465	Shale Subgrade	0	27	801.784	1505.83	2955.35	0	2955.35	3072.53	3072.53
33	3.71843	10426.2	-7.23802	Shale Subgrade	0	27	791.667	1486.83	2918.07	0	2918.07	3018.62	3018.62
34	3.71843	10121.1	-6.16395	Shale Subgrade	0	27	777.994	1461.15	2867.66	0	2867.66	2951.69	2951.69
35	3.71843	9791.58	-5.09205	Shale Subgrade	0	27	761.12	1429.46	2805.48	0	2805.48	2873.3	2873.3
36	3.71843	9446.56	-4.02194	Shale Subgrade	0	27	741.638	1392.87	2733.66	0	2733.66	2785.8	2785.8
37	3.71843	9029.46	-2.95323	Shale Subgrade	0	27	715.17	1343.16	2636.11	0	2636.11	2673	2673
38	3.71843	8555.65	-1.88555	Shale Subgrade	0	27	682.818	1282.4	2516.86	0	2516.86	2539.34	2539.34
39	3.71843	8051.42	-0.818529	Shale Subgrade	0	27	646.595	1214.37	2383.33	0	2383.33	2392.57	2392.57
40	3.71843	7516.8	0.248212	Shale Subgrade	0	27	606.565	1139.19	2235.79	0	2235.79	2233.16	2233.16
41	3.71843	6951.79	1.31504	Shale Subgrade	0	27	562.845	1057.08	2074.63	0	2074.63	2061.71	2061.71
42	3.71843	6356.38	2.38232	Shale Subgrade	0	27	515.585	968.32	1900.44	0	1900.44	1878.99	1878.99
43	3.71843	5730.51	3.45043	Shale Subgrade	0	27	464.978	873.275	1713.9	0	1713.9	1685.86	1685.86
44	3.71843	5074.09	4.51975	Shale Subgrade	0	27	411.249	772.367	1515.86	0	1515.86	1483.35	1483.35
45	3.71843	4387.01	5.59064	Shale Subgrade	0	27	354.655	666.077	1307.25	0	1307.25	1272.53	1272.53
46	3.71843	3669.11	6.6635	Shale Subgrade	0	27	295.473	554.927	1089.11	0	1089.11	1054.59	1054.59
47	3.71843	2920.2	7.73871	Shale Subgrade	0	27	233.998	439.471	862.511	0	862.511	830.712	830.712
48	3.71843	2140.07	8.81668	Shale Subgrade	0	27	170.531	320.275	628.576	0	628.576	602.125	602.125
49	3.71843	1328.45	9.89779	Shale Subgrade	0	27	105.374	197.903	388.406	0	388.406	370.019	370.019
50	3.80607	466.839	10.9953	In-Situ Clay Liner	270	28	190.382	357.557	164.671	0	164.671	127.68	127.68

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.8781

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	273.533	710.145	0	0	0
2	277.122	706.462	-235.325	-5.03171	1.22491
3	280.711	702.962	543.677	23.2065	2.44415
4	284.299	699.632	1811.91	115.651	3.65213
5	287.888	696.46	3383.9	286.732	4.84334
6	291.477	693.437	5179.72	545.555	6.01252
7	295.065	690.553	7132.99	895.366	7.15461
8	298.654	687.803	9187.75	1334.58	8.26478
9	302.242	685.178	11296.6	1857.71	9.33863
10	305.831	682.672	13419.2	2456.11	10.372
11	309.42	680.281	15521.1	3118.64	11.3611
12	313.008	678	17572.5	3832.22	12.3025
13	316.788	675.711	19649.5	4622.89	13.2391
14	320.567	673.534	21699.8	5457.15	14.1162
15	324.347	671.465	23693.9	6318.24	14.9311
16	328.127	669.5	25606.1	7188.62	15.6815
17	331.845	667.665	27670.5	8120.17	16.3548
18	335.563	665.925	29554.6	9014.39	16.9621
19	339.282	664.277	31247.8	9853.64	17.5021
20	343	662.718	32741	10621.5	17.9736
21	346.719	661.246	34025.9	11302.9	18.3757
22	350.437	659.859	35095.9	11884.6	18.7078
23	354.156	658.556	35945	12355.4	18.9694
24	357.874	657.334	36568.9	12706	19.16
25	361.592	656.192	36964.4	12929.8	19.2794
26	365.311	655.129	37129.4	13022.4	19.3273
27	369.029	654.143	37063.9	12982.3	19.3037
28	372.748	653.233	36768.9	12810.7	19.2089
29	376.466	652.398	36247.9	12511.3	19.0426
30	380.184	651.637	35505.9	12090.8	18.8052
31	383.903	650.95	34547.4	11557.5	18.4972
32	387.621	650.334	33377.1	10921.5	18.1189
33	391.34	649.791	32004.4	10196	17.6709
34	395.058	649.319	30441.4	9396.59	17.1543
35	398.777	648.917	28702.7	8540.22	16.5699
36	402.495	648.586	26804.7	7645.1	15.9189
37	406.213	648.324	24764.1	6729.68	15.2031
38	409.932	648.132	22612.9	5816.07	14.4239
39	413.65	648.01	20384.3	4925.35	13.5837
40	417.369	647.957	18108.7	4075.98	12.685
41	421.087	647.973	15819.3	3284.76	11.7304
42	424.806	648.058	13551.2	2566.23	10.7233
43	428.524	648.213	11341.7	1932.04	9.66744
44	432.242	648.437	9230.05	1390.43	8.56672
45	435.961	648.731	7256.66	945.788	7.42572
46	439.679	649.095	5463.28	598.259	6.2493
47	443.398	649.53	3892.45	343.47	5.04272
48	447.116	650.035	2587.3	172.371	3.81152
49	450.835	650.612	1591.23	71.1887	2.5616
50	454.553	651.26	947.748	21.4908	1.299
51	458.359	652	0	0	0

Discharge Sections

Entity Information

External Boundary

X	Y
206.442	702.93
199	702
187	702
180	700
176	698
167	696
163	694
159	692
155	690
148	686
141	684
137	682
131	680
124	678
88	676
27	674
8	674
0	672
0	669.5
0	500
730.428	500
730.428	650
730.428	652
458.342	652
405.735	669.5
380.183	678
290	708
279.273	711.576
272.952	710
243.001	710
243	710
234	710
211.897	704.33

Material Boundary

X	Y
124	678
324.992	678
374.171	678

Material Boundary

X	Y
458.342	650
730.428	650

Material Boundary

X	Y
290	706
374.171	678
399.723	669.5
458.342	650

Material Boundary

X	Y
243	710
278	710
284	708
290	706

Material Boundary

X	Y
0	669.5
399.723	669.5

Material Boundary

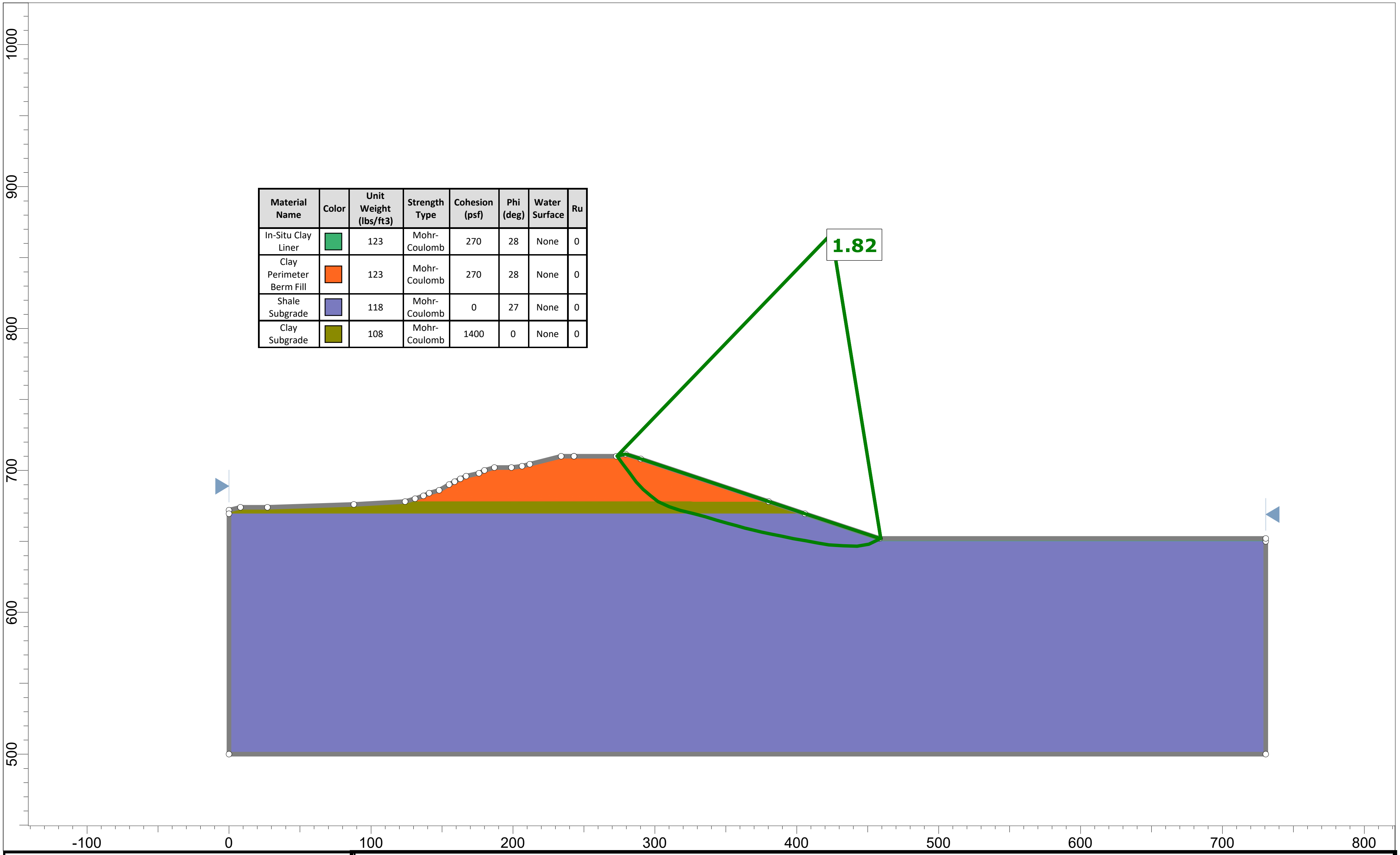
X	Y
399.723	669.5
405.735	669.5

Material Boundary

X	Y
374.171	678
380.183	678

CROSS-SECTION B

3H:1V EXCAVATION NON-CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28	None	0
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28	None	0
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27	None	0
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0	None	0

rocscience

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section B, Non-Circular Interior Slope Excavation

Created By: EDC	Checked By: EDC
Created Date12-20-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:06.576s
Author:	EDC
Company:	CEC
Date Created:	12/20/22

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Materials

In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟨
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Global Minimums

Method: gle/morgenstern-price

FS	1.823310
Axis Location:	424.419, 866.759
Left Slip Surface Endpoint:	273.446, 710.123
Right Slip Surface Endpoint:	459.144, 652.000
Resisting Moment:	4.94573e+07 lb-ft
Driving Moment:	2.71251e+07 lb-ft
Resisting Horizontal Force:	209326 lb
Driving Horizontal Force:	114806 lb
Total Slice Area:	3636.87 ft2
Surface Horizontal Width:	185.698 ft
Surface Average Height:	19.5849 ft

Global Minimum Coordinates

Method: gle/morgenstern-price

X	Y
273.446	710.123
277.492	704.461
282.224	698.09
287.011	691.665
291.805	686.579
296.997	682.176
302.19	678.015
310.034	674.462
317.878	671.858
326.98	669.59
335.193	667.41
343.406	664.986
351.619	662.562
357.5	660.983
363.381	659.404
369.262	657.967
375.144	656.53
381.793	655.192
389.751	653.507
397.709	651.821
406.02	650.39
414.309	648.949
422.56	647.49
432.515	646.803
442.469	646.516
450.783	648.016
459.144	652

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.82331

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	4.04588	1659.79	-54.4527	Clay Perimeter Berm Fill	270	28	190.063	346.543	143.957	0	143.957	409.951	409.951
2	4.73118	5766.91	-53.4029	Clay Perimeter Berm Fill	270	28	354.552	646.458	708.015	0	708.015	1185.47	1185.47
3	4.78758	8784.12	-53.3091	Clay Perimeter Berm Fill	270	28	469.233	855.558	1101.27	0	1101.27	1731.01	1731.01
4	4.79348	11247.1	-46.6971	Clay Perimeter Berm Fill	270	28	598.656	1091.53	1545.09	0	1545.09	2180.3	2180.3
5	5.19274	14152.9	-40.2928	Clay Perimeter Berm Fill	270	28	707.186	1289.42	1917.25	0	1917.25	2516.84	2516.84
6	5.19306	15785.5	-38.7064	Clay Perimeter Berm Fill	270	28	775.721	1414.38	2152.27	0	2152.27	2773.88	2773.88
7	3.92202	12571.3	-24.3631	Clay Subgrade	1400	0	767.834	1400	2649.68	0	2649.68	2997.39	2997.39
8	3.92202	12694.2	-24.3631	Clay Subgrade	1400	0	767.834	1400	2666.43	0	2666.43	3014.14	3014.14
9	3.92202	12716.7	-18.3656	Clay Subgrade	1400	0	767.834	1400	2817.9	0	2817.9	3072.81	3072.81
10	3.92202	12638.8	-18.3656	Clay Subgrade	1400	0	767.834	1400	2800.16	0	2800.16	3055.08	3055.08
11	3.03389	9682.24	-13.9936	Clay Subgrade	1400	0	767.834	1400	2890.51	0	2890.51	3081.86	3081.86
12	3.03389	9553.36	-13.9936	Clay Subgrade	1400	0	767.834	1400	2857.89	0	2857.89	3049.24	3049.24
13	3.03389	9424.48	-13.9936	Clay Subgrade	1400	0	767.834	1400	2825.73	0	2825.73	3017.09	3017.09
14	0.339442	1046.53	-14.8675	Clay Subgrade	1400	0	767.834	1400	2784.2	0	2784.2	2988.04	2988.04
15	3.93678	12054.9	-14.8675	Shale Subgrade	0	27	774.087	1411.4	2770.02	0	2770.02	2975.52	2975.52
16	3.93678	11906.3	-14.8675	Shale Subgrade	0	27	766.918	1398.33	2744.39	0	2744.39	2947.99	2947.99
17	4.1065	12290.7	-16.4432	Shale Subgrade	0	27	748.754	1365.21	2679.38	0	2679.38	2900.37	2900.37
18	4.1065	12188	-16.4432	Shale Subgrade	0	27	744.766	1357.94	2665.09	0	2665.09	2884.9	2884.9
19	4.1065	12085.3	-16.4432	Shale Subgrade	0	27	740.916	1350.92	2651.31	0	2651.31	2869.98	2869.98
20	4.1065	11982.6	-16.4432	Shale Subgrade	0	27	737.192	1344.13	2638	0	2638	2855.57	2855.57
21	2.94055	8503.69	-15.0299	Shale Subgrade	0	27	744.679	1357.78	2664.79	0	2664.79	2864.74	2864.74
22	2.94055	8423.86	-15.0299	Shale Subgrade	0	27	739.814	1348.91	2647.39	0	2647.39	2846.04	2846.04
23	2.94055	8344.03	-15.0299	Shale Subgrade	0	27	734.949	1340.04	2629.98	0	2629.98	2827.32	2827.32

24	2.94055	8264.2	-15.0299	Shale Subgrade	0	27	730.079	1331.16	2612.55	0	2612.55	2808.58	2808.58
25	2.94055	8172.03	-13.7305	Shale Subgrade	0	27	734.944	1340.03	2629.95	0	2629.95	2809.52	2809.52
26	2.94055	8067.54	-13.7305	Shale Subgrade	0	27	727.726	1326.87	2604.14	0	2604.14	2781.95	2781.95
27	2.94055	7963.04	-13.7305	Shale Subgrade	0	27	720.442	1313.59	2578.07	0	2578.07	2754.1	2754.1
28	2.94055	7858.55	-13.7305	Shale Subgrade	0	27	713.088	1300.18	2551.75	0	2551.75	2725.98	2725.98
29	3.32489	8731.7	-11.377	Shale Subgrade	0	27	721.973	1316.38	2583.54	0	2583.54	2728.81	2728.81
30	3.32489	8548.32	-11.377	Shale Subgrade	0	27	708.865	1292.48	2536.63	0	2536.63	2679.27	2679.27
31	3.97895	10053.9	-11.9517	Shale Subgrade	0	27	694.194	1265.73	2484.15	0	2484.15	2631.09	2631.09
32	3.97895	9880.51	-11.9517	Shale Subgrade	0	27	684.261	1247.62	2448.6	0	2448.6	2593.44	2593.44
33	3.97895	9707.38	-11.9644	Shale Subgrade	0	27	673.994	1228.9	2411.86	0	2411.86	2554.68	2554.68
34	3.97895	9534.47	-11.9644	Shale Subgrade	0	27	663.584	1209.92	2374.6	0	2374.6	2515.21	2515.21
35	4.15519	9735.61	-9.77218	Shale Subgrade	0	27	665.257	1212.97	2380.58	0	2380.58	2495.15	2495.15
36	4.15519	9491.35	-9.77218	Shale Subgrade	0	27	649.083	1183.48	2322.71	0	2322.71	2434.5	2434.5
37	4.14466	9180.49	-9.85557	Shale Subgrade	0	27	629.213	1147.25	2251.6	0	2251.6	2360.92	2360.92
38	4.14466	8858.34	-9.85557	Shale Subgrade	0	27	607.297	1107.29	2173.18	0	2173.18	2278.68	2278.68
39	4.12575	8501.14	-10.0303	Shale Subgrade	0	27	584.481	1065.69	2091.53	0	2091.53	2194.91	2194.91
40	4.12575	8188.24	-10.0303	Shale Subgrade	0	27	562.768	1026.1	2013.84	0	2013.84	2113.38	2113.38
41	4.97714	9303.88	-3.94741	Shale Subgrade	0	27	557.486	1016.47	1994.94	0	1994.94	2033.41	2033.41
42	4.97714	8533.21	-3.94741	Shale Subgrade	0	27	508.168	926.547	1818.45	0	1818.45	1853.52	1853.52
43	3.31809	5234.54	-1.65004	Shale Subgrade	0	27	473.212	862.812	1693.36	0	1693.36	1707	1707
44	3.31809	4839.8	-1.65004	Shale Subgrade	0	27	434.883	792.926	1556.2	0	1556.2	1568.73	1568.73
45	3.31809	4445.05	-1.65004	Shale Subgrade	0	27	396.936	723.737	1420.41	0	1420.41	1431.85	1431.85
46	4.15691	4798.46	10.2244	Shale Subgrade	0	27	368.105	671.169	1317.24	0	1317.24	1250.85	1250.85
47	4.15691	3752.39	10.2244	Shale Subgrade	0	27	282.858	515.737	1012.19	0	1012.19	961.173	961.173
48	2.78002	1790.75	25.4771	Shale Subgrade	0	27	221.591	404.029	792.95	0	792.95	687.365	687.365
49	2.78002	1052.84	25.4771	Shale Subgrade	0	27	127.82	233.055	457.396	0	457.396	396.492	396.492
50	2.80148	311.775	25.4771	In-Situ Clay Liner	270	28	211.563	385.745	217.686	0	217.686	116.879	116.879

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.82331

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	273.446	710.123	0	0	0
2	277.492	704.461	46.1452	1.18096	1.46601
3	282.224	698.09	2879.61	159.412	3.1686
4	287.011	691.665	7708.98	656.179	4.86522
5	291.805	686.579	12697.9	1452.09	6.52382
6	296.997	682.176	17466.7	2535.72	8.26018
7	302.19	678.015	22394.7	3916.28	9.91931
8	306.112	676.239	24089.2	4731.71	11.1128
9	310.034	674.462	25813.5	5604.35	12.2493
10	313.956	673.16	26471.2	6269.38	13.3243
11	317.878	671.858	27105.7	6926.17	14.3338
12	320.912	671.102	26961.6	7258.4	15.0675
13	323.946	670.346	26792.8	7560.71	15.7586
14	326.98	669.59	26599.8	7831.69	16.4058
15	327.32	669.5	26590	7863.96	16.4755
16	331.256	668.455	26437.6	8204.88	17.2417
17	335.193	667.41	26286.5	8505.63	17.9302
18	339.3	666.198	26459.1	8886	18.5641
19	343.406	664.986	26630.8	9227.12	19.1103
20	347.513	663.774	26801.5	9526.79	19.5681
21	351.619	662.562	26971.4	9782.95	19.9365
22	354.56	661.772	26885.7	9862.72	20.145
23	357.5	660.983	26800.5	9917.67	20.3073
24	360.441	660.193	26715.9	9947.82	20.4231
25	363.381	659.404	26631.8	9953.26	20.4925
26	366.322	658.685	26360.3	9863.75	20.5153
27	369.262	657.967	26091.4	9750.84	20.4916
28	372.203	657.248	25825.2	9615.31	20.4214
29	375.144	656.53	25561.7	9457.98	20.3048
30	378.468	655.861	24889.7	9116.67	20.1169
31	381.793	655.192	24229.9	8756.72	19.8699
32	385.772	654.349	23560	8341.62	19.4969
33	389.751	653.507	22899.6	7902.96	19.0402
34	393.73	652.664	22251.4	7445.41	18.5005
35	397.709	651.821	21613.2	6971.97	17.8786
36	401.864	651.105	20552.6	6339.71	17.143
37	406.02	650.39	19517.8	5715.25	16.3212
38	410.164	649.669	18531.2	5110.55	15.4178
39	414.309	648.949	17578.9	4524.54	14.4338
40	418.435	648.22	16693.8	3970.03	13.3773
41	422.56	647.49	15841.5	3438.99	12.2481
42	427.537	647.146	13751.9	2622.3	10.7959
43	432.515	646.803	11847.3	1930.31	9.25403
44	435.833	646.707	10438.9	1500.88	8.18178
45	439.151	646.612	9144.71	1135.48	7.07807
46	442.469	646.516	7963.41	829.531	5.94693
47	446.626	647.266	5445.59	428.33	4.49741
48	450.783	648.016	3510.86	185.218	3.01988
49	453.563	649.34	1844.46	65.0742	2.02061
50	456.343	650.665	883.231	15.6579	1.01563
51	459.144	652	0	0	0

Discharge Sections

Entity Information

External Boundary

X	Y
206.442	702.93
199	702
187	702
180	700
176	698
167	696
163	694
159	692
155	690
148	686
141	684
137	682
131	680
124	678
88	676
27	674
8	674
0	672
0	669.5
0	500
730.428	500
730.428	650
730.428	652
458.342	652
405.735	669.5
380.183	678
290	708
279.273	711.576
272.952	710
243.001	710
243	710
234	710
211.897	704.33

Material Boundary

X	Y
124	678
324.992	678
374.171	678

Material Boundary

X	Y
458.342	650
730.428	650

Material Boundary

X	Y
290	706
374.171	678
399.723	669.5
458.342	650

Material Boundary

X	Y
243	710
278	710
284	708
290	706

Material Boundary

X	Y
0	669.5
399.723	669.5

Material Boundary

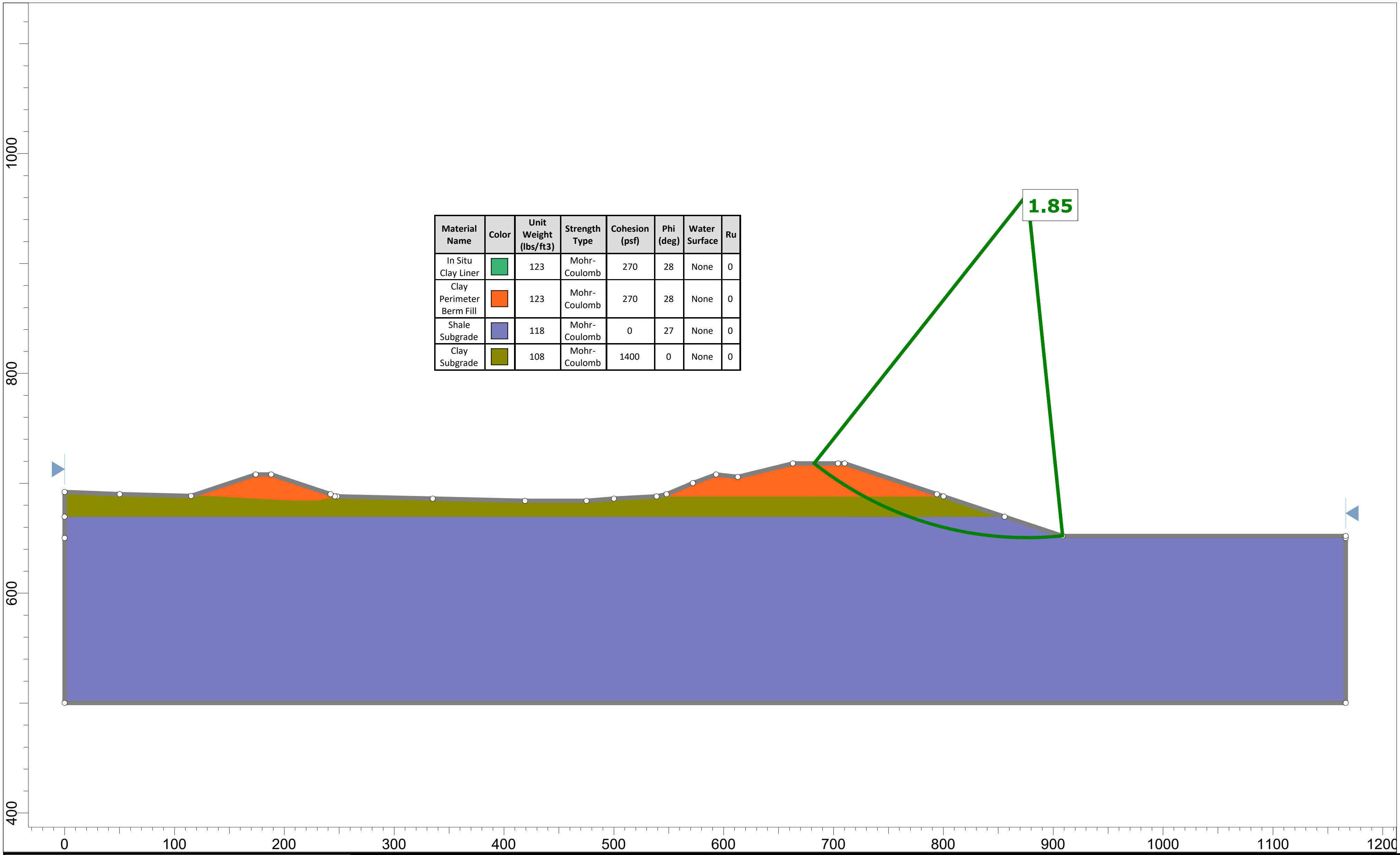
X	Y
399.723	669.5
405.735	669.5

Material Boundary

X	Y
374.171	678
380.183	678

CROSS-SECTION C

3H:1V EXCAVATION CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
In Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28	None	0
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28	None	0
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27	None	0
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0	None	0

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SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section C, Circular Interior Slope Excavation

Created By: EDC	Checked By: EDC
Created Date12-20-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Author:	EDC
Company:	CEC
Date Created:	12/20/22

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

In Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Global Minimums

Method: gle/morgenstern-price

FS	**1.845870**
Center:	876.521, 963.183
Radius:	312.806
Left Slip Surface Endpoint:	682.270, 718.000
Right Slip Surface Endpoint:	908.401, 652.005
Resisting Moment:	8.78935e+07 lb-ft
Driving Moment:	4.76162e+07 lb-ft
Resisting Horizontal Force:	264137 lb
Driving Horizontal Force:	143096 lb
Total Slice Area:	4557.11 ft2
Surface Horizontal Width:	226.131 ft
Surface Average Height:	20.1525 ft

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.84587

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	4.55147	990.402	-37.8608	Clay Perimeter Berm Fill	270	28	171.22	316.05	86.6074	0	86.6074	219.71	219.71
2	4.55147	2934.32	-36.8121	Clay Perimeter Berm Fill	270	28	273.108	504.122	440.319	0	440.319	644.72	644.72
3	4.55147	4805.94	-35.7776	Clay Perimeter Berm Fill	270	28	370.695	684.255	779.1	0	779.1	1046.23	1046.23
4	4.55147	6608.07	-34.7565	Clay Perimeter Berm Fill	270	28	464.429	857.276	1104.51	0	1104.51	1426.77	1426.77
5	4.55147	8343.32	-33.7478	Clay Perimeter Berm Fill	270	28	554.726	1023.95	1417.98	0	1417.98	1788.6	1788.6
6	4.55147	10014	-32.7508	Clay Perimeter Berm Fill	270	28	641.97	1184.99	1720.85	0	1720.85	2133.8	2133.8
7	4.55147	11279.7	-31.7649	Clay Perimeter Berm Fill	270	28	708.75	1308.26	1952.68	0	1952.68	2391.52	2391.52
8	4.55147	11984.2	-30.7894	Clay Perimeter Berm Fill	270	28	747.03	1378.92	2085.56	0	2085.56	2530.7	2530.7
9	4.55147	12625.8	-29.8237	Clay Perimeter Berm Fill	270	28	782.78	1444.91	2209.69	0	2209.69	2658.43	2658.43
10	4.55147	13210.6	-28.8672	Clay Perimeter Berm Fill	270	28	816.374	1506.92	2326.31	0	2326.31	2776.37	2776.37
11	4.56001	13683.8	-27.9186	Clay Subgrade	1400	0	758.45	1400	2447.7	0	2447.7	2849.59	2849.59
12	4.56001	13999.2	-26.9773	Clay Subgrade	1400	0	758.45	1400	2522.85	0	2522.85	2908.92	2908.92
13	4.56001	14268.4	-26.0439	Clay Subgrade	1400	0	758.45	1400	2590.63	0	2590.63	2961.27	2961.27
14	4.56001	14492.5	-25.1178	Clay Subgrade	1400	0	758.45	1400	2651.45	0	2651.45	3007.02	3007.02
15	4.56001	14672.4	-24.1987	Clay Subgrade	1400	0	758.45	1400	2705.66	0	2705.66	3046.5	3046.5
16	4.56001	14809.2	-23.2862	Clay Subgrade	1400	0	758.45	1400	2753.42	0	2753.42	3079.84	3079.84
17	4.56001	14903.8	-22.3799	Clay Subgrade	1400	0	758.45	1400	2794.94	0	2794.94	3107.24	3107.24
18	4.56001	14956.9	-21.4794	Clay Subgrade	1400	0	758.45	1400	2830.25	0	2830.25	3128.7	3128.7
19	4.56001	14969.3	-20.5845	Clay Subgrade	1400	0	758.45	1400	2859.39	0	2859.39	3144.24	3144.24
20	4.49659	14770.7	-19.701	Shale Subgrade	0	27	796.746	1470.69	2886.4	0	2886.4	3171.69	3171.69
21	4.49659	14777.1	-18.8285	Shale Subgrade	0	27	805.463	1486.78	2917.97	0	2917.97	3192.61	3192.61

22	4.49659	14743	-17.9605	Shale Subgrade	0	27	812.349	1499.49	2942.92	0	2942.92	3206.25	3206.25
23	4.49659	14669.1	-17.0967	Shale Subgrade	0	27	817.322	1508.67	2960.92	0	2960.92	3212.31	3212.31
24	4.49659	14555.8	-16.2369	Shale Subgrade	0	27	820.264	1514.1	2971.59	0	2971.59	3210.47	3210.47
25	4.49659	14403.9	-15.3809	Shale Subgrade	0	27	821.071	1515.59	2974.51	0	2974.51	3200.38	3200.38
26	4.49659	14213.8	-14.5284	Shale Subgrade	0	27	819.635	1512.94	2969.31	0	2969.31	3181.71	3181.71
27	4.49659	14038.8	-13.6791	Shale Subgrade	0	27	818.888	1511.56	2966.6	0	2966.6	3165.91	3165.91
28	4.49659	13874.5	-12.8329	Shale Subgrade	0	27	818.503	1510.85	2965.21	0	2965.21	3151.66	3151.66
29	4.49659	13673.2	-11.9895	Shale Subgrade	0	27	815.583	1505.46	2954.64	0	2954.64	3127.84	3127.84
30	4.49659	13435.2	-11.1488	Shale Subgrade	0	27	810.014	1495.18	2934.47	0	2934.47	3094.1	3094.1
31	4.49659	13160.9	-10.3105	Shale Subgrade	0	27	801.676	1479.79	2904.26	0	2904.26	3050.1	3050.1
32	4.49659	12850.6	-9.47438	Shale Subgrade	0	27	790.462	1459.09	2863.62	0	2863.62	2995.54	2995.54
33	4.49659	12504.5	-8.64032	Shale Subgrade	0	27	776.279	1432.91	2812.23	0	2812.23	2930.19	2930.19
34	4.49659	12123	-7.80811	Shale Subgrade	0	27	759.035	1401.08	2749.77	0	2749.77	2853.86	2853.86
35	4.49659	11706.1	-6.97755	Shale Subgrade	0	27	738.676	1363.5	2676.03	0	2676.03	2766.44	2766.44
36	4.49659	11254.2	-6.14846	Shale Subgrade	0	27	715.153	1320.08	2590.81	0	2590.81	2667.85	2667.85
37	4.49659	10767.4	-5.32066	Shale Subgrade	0	27	688.445	1270.78	2494.06	0	2494.06	2558.18	2558.18
38	4.49659	10262.4	-4.49398	Shale Subgrade	0	27	659.591	1217.52	2389.51	0	2389.51	2441.36	2441.36
39	4.49659	9718.19	-3.66823	Shale Subgrade	0	27	627.281	1157.88	2272.48	0	2272.48	2312.7	2312.7
40	4.49659	9066.22	-2.84324	Shale Subgrade	0	27	587.252	1083.99	2127.44	0	2127.44	2156.61	2156.61
41	4.49659	8373.85	-2.01884	Shale Subgrade	0	27	543.787	1003.76	1969.98	0	1969.98	1989.15	1989.15
42	4.49659	7647.1	-1.19486	Shale Subgrade	0	27	497.374	918.087	1801.85	0	1801.85	1812.22	1812.22
43	4.49659	6886.03	-0.371133	Shale Subgrade	0	27	448.145	827.218	1623.51	0	1623.51	1626.41	1626.41
44	4.49659	6090.66	0.452522	Shale Subgrade	0	27	396.248	731.423	1435.5	0	1435.5	1432.37	1432.37
45	4.49659	5260.99	1.27627	Shale Subgrade	0	27	341.849	631.008	1238.42	0	1238.42	1230.81	1230.81
46	4.49659	4396.98	2.10028	Shale Subgrade	0	27	285.123	526.3	1032.92	0	1032.92	1022.47	1022.47
47	4.49659	3498.61	2.92473	Shale Subgrade	0	27	226.259	417.644	819.673	0	819.673	808.113	808.113
48	4.49659	2565.8	3.74978	Shale Subgrade	0	27	165.446	305.391	599.363	0	599.363	588.519	588.519
49	4.49659	1598.47	4.57562	Shale Subgrade	0	27	102.873	189.89	372.678	0	372.678	364.446	364.446
50	4.67814	575.411	5.41912	In Situ Clay Liner	270	28	187.966	346.961	144.743	0	144.743	126.911	126.911

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.84587

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	682.27	718	0	0	0
2	686.822	714.462	-472.017	-8.94812	1.08604
3	691.373	711.055	-213.786	-8.08936	2.16696
4	695.925	707.775	656.237	37.1225	3.2377
5	700.476	704.617	2032.99	152.622	4.29329
6	705.028	701.576	3822.91	356.589	5.32895
7	709.579	698.649	5942.33	660.24	6.34001
8	714.131	695.83	8222.98	1056.61	7.32209
9	718.682	693.118	10482.8	1523.88	8.27112
10	723.233	690.509	12689.3	2051.37	9.18307
11	727.785	688	14814.7	2626.76	10.0545
12	732.345	685.584	17274.3	3321.38	10.8836
13	736.905	683.263	19675.5	4062.32	11.6657
14	741.465	681.034	21993.7	4834.89	12.3982
15	746.025	678.896	24207.2	5623.66	13.0786
16	750.585	676.847	26296.9	6412.89	13.7049
17	755.145	674.885	28245.9	7186.81	14.2753
18	759.705	673.007	30038.9	7929.96	14.7881
19	764.265	671.213	31662.6	8627.49	15.242
20	768.825	669.5	33104.8	9265.43	15.636
21	773.322	667.89	34173.5	9776.3	15.9647
22	777.818	666.357	35029.6	10199.2	16.2334
23	782.315	664.899	35670.4	10526.5	16.4416
24	786.811	663.516	36094.3	10752.5	16.5888
25	791.308	662.206	36301.3	10873.4	16.6746
26	795.805	660.97	36292.7	10887.6	16.6989
27	800.301	659.804	36071.2	10795.6	16.6617
28	804.798	658.71	35639.7	10599.7	16.5631
29	809.294	657.686	35000.5	10303.3	16.4032
30	813.791	656.731	34158.6	9912.6	16.1824
31	818.288	655.844	33120.7	9435.35	15.9011
32	822.784	655.026	31895.6	8881.33	15.5599
33	827.281	654.276	30494	8261.94	15.1596
34	831.777	653.593	28928.7	7589.93	14.7012
35	836.274	652.976	27214.9	6879.18	14.1857
36	840.77	652.426	25369.7	6144.34	13.6144
37	845.267	651.941	23412.4	5400.48	12.9891
38	849.764	651.523	21364.5	4662.66	12.3114
39	854.26	651.169	19246.4	3944.86	11.5833
40	858.757	650.881	17083.9	3261.16	10.8072
41	863.253	650.658	14921.3	2627.19	9.98571
42	867.75	650.499	12791	2053.76	9.12172
43	872.247	650.405	10725.9	1549.14	8.21839
44	876.743	650.376	8760.31	1118.97	7.27908
45	881.24	650.412	6929.5	765.958	6.30763
46	885.736	650.512	5269.97	489.627	5.30805
47	890.233	650.677	3818.95	286.114	4.28457
48	894.73	650.907	2614.36	148.072	3.24165
49	899.226	651.201	1694.6	64.6242	2.18394
50	903.723	651.561	1098.41	21.4016	1.11622
51	908.401	652.005	0	0	0

Discharge Sections

Entity Information

External Boundary

X	Y
612.738	705.608
593	708
572	700
548	690
539	688
500	686
475	684
419	684
335	686
248	688
246	688
242	690
188	708
174	708
115.227	688.465
50	690
0	692
0	669.5
0	650
0	500
1166.24	500
1166.24	650
1166.24	652
908.416	652
855.809	669.5
800.196	688
794.183	690
710.039	718
704	718
663	718

Material Boundary

X	Y
115.227	688.465
135	688
170	686
206	684
230	684
240	686
248	688

Material Boundary

X	Y
704	718
794.183	688
849.796	669.5
908.416	650

Material Boundary

X	Y
908.416	650
1166.24	650

Material Boundary

X	Y
539	688
794.183	688

Material Boundary

X	Y
0	669.5
849.796	669.5

Material Boundary

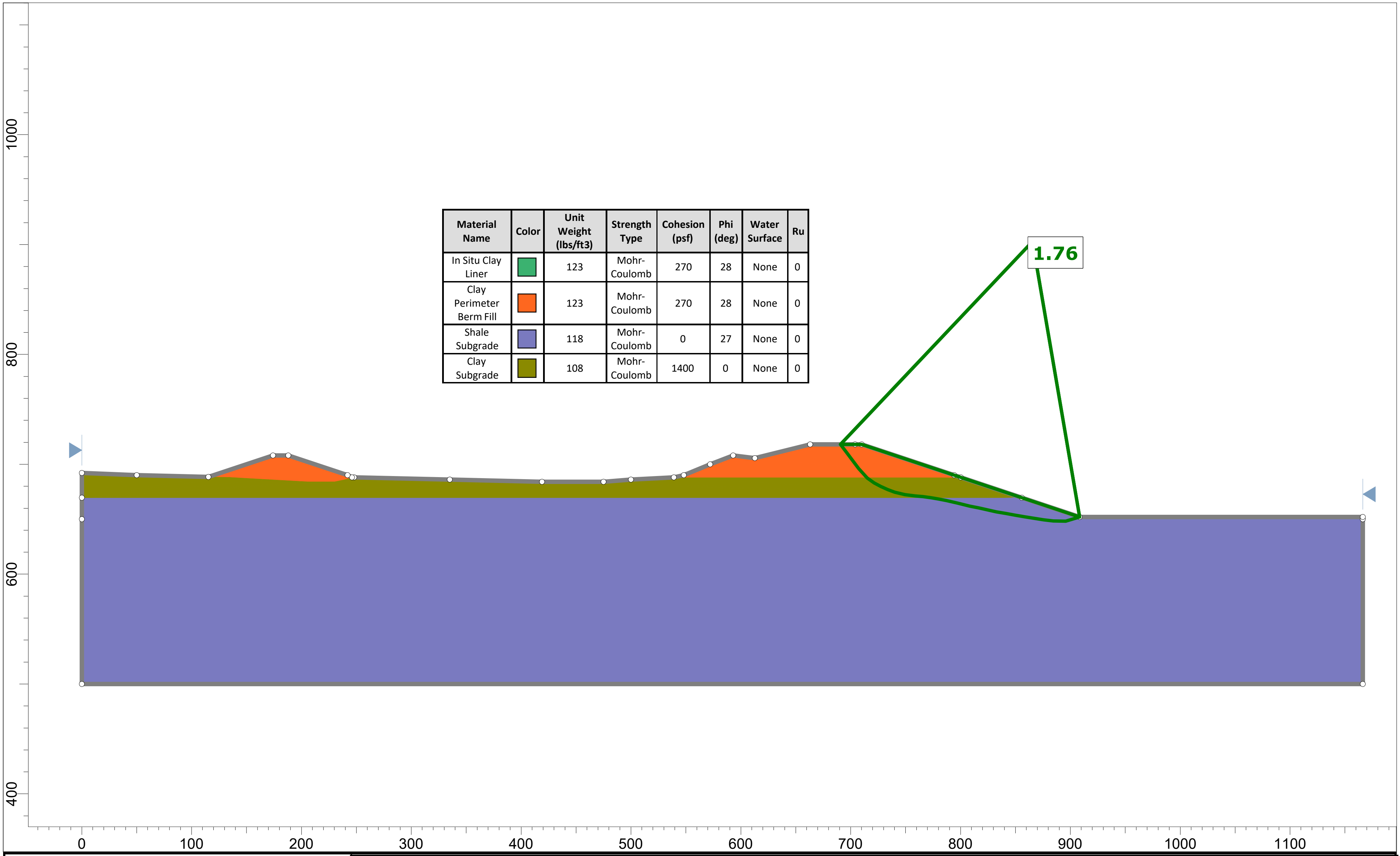
X	Y
849.796	669.5
855.809	669.5

Material Boundary

X	Y
794.183	688
800.196	688

CROSS-SECTION C

3H:1V EXCAVATION NON-CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
In Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28	None	0
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28	None	0
Shale Subgrade	🟦	118	Mohr-Coulomb	0	27	None	0
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0	None	0

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SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section C, Non-Circular Interior Slope Excavation

Created By: EDC	Checked By: EDC	Civil & Environmental Consultants, Inc.
Created Date12-20-22	Checked Date: 12-20-22	

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Author:	EDC
Company:	CEC
Date Created:	12/20/22

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

In Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Global Minimums

Method: gle/morgenstern-price

FS	1.755010
Axis Location:	865.574, 902.683
Left Slip Surface Endpoint:	690.732, 718.000
Right Slip Surface Endpoint:	908.416, 652.000
Resisting Moment:	6.62505e+07 lb-ft
Driving Moment:	3.77493e+07 lb-ft
Resisting Horizontal Force:	244367 lb
Driving Horizontal Force:	139239 lb
Total Slice Area:	4639.15 ft2
Surface Horizontal Width:	217.683 ft
Surface Average Height:	21.3115 ft

Global Minimum Coordinates

Method: gle/morgenstern-price

X	Y
690.732	718
696.239	710.612
701.745	703.313
707.251	696.163
715.059	687.348
721.216	683.057
727.393	679.66
733.569	676.877
739.929	674.523
749.289	672.329
758.664	671.124
765.831	670.442
772.999	669.51
780.166	668.328
787.334	666.895
797.852	664.426
808.369	661.881
816.495	660.146
824.621	658.41
832.747	656.673
841.221	655.131
849.696	653.595
858.109	652.073
866.902	650.753
875.674	649.441
884.445	648.314
895.806	648.067
908.416	652

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.75501

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	5.5064	2501.91	-53.3023	Clay Perimeter Berm Fill	270	28	207.079	363.425	175.708	0	175.708	453.549	453.549
2	5.50641	7475.54	-52.9683	Clay Perimeter Berm Fill	270	28	394.966	693.169	795.864	0	795.864	1319.4	1319.4
3	5.50637	12368.6	-52.4006	Clay Perimeter Berm Fill	270	28	572.18	1004.18	1380.79	0	1380.79	2123.8	2123.8
4	3.61522	10603.8	-48.4661	Clay Perimeter Berm Fill	270	28	732.013	1284.69	1908.35	0	1908.35	2734.75	2734.75
5	3.61522	12042.7	-48.4661	Clay Perimeter Berm Fill	270	28	805.226	1413.18	2150.01	0	2150.01	3059.07	3059.07
6	0.577178	2038.32	-48.4661	Clay Subgrade	1400	0	797.716	1400	2304.25	0	2304.25	3204.83	3204.83
7	6.15743	22540	-34.8739	Clay Subgrade	1400	0	797.716	1400	2819.16	0	2819.16	3375.11	3375.11
8	6.17611	23613.6	-28.8113	Clay Subgrade	1400	0	797.716	1400	3086.07	0	3086.07	3524.82	3524.82
9	6.17607	24113.2	-24.2554	Clay Subgrade	1400	0	797.716	1400	3253.06	0	3253.06	3612.49	3612.49
10	6.36021	24964.9	-20.3164	Clay Subgrade	1400	0	797.716	1400	3364.87	0	3364.87	3660.22	3660.22
11	4.67993	18184.5	-13.191	Clay Subgrade	1400	0	797.716	1400	3530.45	0	3530.45	3717.42	3717.42
12	4.67993	17842.5	-13.191	Clay Subgrade	1400	0	797.716	1400	3470.49	0	3470.49	3657.46	3657.46
13	4.68773	17403.7	-7.3244	Clay Subgrade	1400	0	797.716	1400	3566.16	0	3566.16	3668.69	3668.69
14	4.68773	16809.4	-7.3244	Clay Subgrade	1400	0	797.716	1400	3464.6	0	3464.6	3567.13	3567.13
15	3.5836	12426.1	-5.4329	Clay Subgrade	1400	0	797.716	1400	3428.08	0	3428.08	3503.95	3503.95
16	3.5836	12032.4	-5.4329	Clay Subgrade	1400	0	797.716	1400	3338.49	0	3338.49	3414.36	3414.36
17	3.58371	11663.2	-7.40849	Clay Subgrade	1400	0	797.716	1400	3192.61	0	3192.61	3296.34	3296.34
18	3.58371	11317.9	-7.40849	Clay Subgrade	1400	0	797.716	1400	3113.97	0	3113.97	3217.69	3217.69
19	0.06102	189.729	-9.36652	Clay Subgrade	1400	0	797.716	1400	3013.7	0	3013.7	3145.28	3145.28
20	3.5533	10910.2	-9.36652	Shale Subgrade	0	27	869.38	1525.77	2994.49	0	2994.49	3137.89	3137.89
21	3.5533	10639.2	-9.36652	Shale Subgrade	0	27	850.93	1493.39	2930.95	0	2930.95	3071.31	3071.31
22	3.58392	10482.8	-11.3027	Shale Subgrade	0	27	816.109	1432.28	2811.01	0	2811.01	2974.13	2974.13
23	3.58392	10260	-11.3027	Shale Subgrade	0	27	801.295	1406.28	2759.98	0	2759.98	2920.14	2920.14
24	5.25869	14708.2	-13.2132	Shale Subgrade	0	27	768.896	1349.42	2648.37	0	2648.37	2828.9	2828.9

25	5.25869	14342.6	-13.2132	Shale Subgrade	0	27	752.868	1321.29	2593.17	0	2593.17	2769.93	2769.93
26	5.2585	14009.6	-13.6021	Shale Subgrade	0	27	735.09	1290.09	2531.94	0	2531.94	2709.81	2709.81
27	5.2585	13792	-13.6021	Shale Subgrade	0	27	726.435	1274.9	2502.13	0	2502.13	2677.9	2677.9
28	4.063	10489	-12.0502	Shale Subgrade	0	27	730.024	1281.2	2514.48	0	2514.48	2670.32	2670.32
29	4.063	10311.8	-12.0502	Shale Subgrade	0	27	719.455	1262.65	2478.08	0	2478.08	2631.67	2631.67
30	4.063	10134.7	-12.0622	Shale Subgrade	0	27	708.6	1243.6	2440.71	0	2440.71	2592.14	2592.14
31	4.063	9957.91	-12.0622	Shale Subgrade	0	27	697.654	1224.39	2403	0	2403	2552.09	2552.09
32	4.063	9781.2	-12.0681	Shale Subgrade	0	27	686.469	1204.76	2364.48	0	2364.48	2511.25	2511.25
33	4.063	9604.58	-12.0681	Shale Subgrade	0	27	675.147	1184.89	2325.47	0	2325.47	2469.81	2469.81
34	4.23726	9794.63	-10.311	Shale Subgrade	0	27	673.5	1182	2319.8	0	2319.8	2442.33	2442.33
35	4.23726	9535.02	-10.311	Shale Subgrade	0	27	656.019	1151.32	2259.6	0	2259.6	2378.95	2378.95
36	4.23726	9274.64	-10.2705	Shale Subgrade	0	27	638.526	1120.62	2199.34	0	2199.34	2315.04	2315.04
37	4.23726	9013.49	-10.2705	Shale Subgrade	0	27	620.492	1088.97	2137.22	0	2137.22	2249.65	2249.65
38	4.2066	8703.7	-10.256	Shale Subgrade	0	27	603.347	1058.88	2078.16	0	2078.16	2187.33	2187.33
39	4.2066	8462	-10.256	Shale Subgrade	0	27	586.139	1028.68	2018.9	0	2018.9	2124.95	2124.95
40	4.39675	8480.27	-8.5397	Shale Subgrade	0	27	570.31	1000.9	1964.38	0	1964.38	2050.01	2050.01
41	4.39675	8063.98	-8.5397	Shale Subgrade	0	27	541.227	949.859	1864.2	0	1864.2	1945.47	1945.47
42	4.38587	7628.56	-8.50453	Shale Subgrade	0	27	512.249	899.002	1764.39	0	1764.39	1840.99	1840.99
43	4.38587	7212.9	-8.50453	Shale Subgrade	0	27	483.094	847.835	1663.97	0	1663.97	1736.21	1736.21
44	4.38566	6773.08	-7.32343	Shale Subgrade	0	27	456.497	801.157	1572.36	0	1572.36	1631.03	1631.03
45	4.38566	6309.77	-7.32343	Shale Subgrade	0	27	423.702	743.601	1459.4	0	1459.4	1513.85	1513.85
46	5.68025	7280.35	-1.24307	Shale Subgrade	0	27	391.83	687.666	1349.62	0	1349.62	1358.12	1358.12
47	5.68025	6096.44	-1.24307	Shale Subgrade	0	27	324.828	570.076	1118.84	0	1118.84	1125.88	1125.88
48	4.75338	3747.06	17.3225	Shale Subgrade	0	27	266.751	468.15	918.797	0	918.797	835.598	835.598
49	4.75338	2028.57	17.3225	Shale Subgrade	0	27	141.423	248.198	487.117	0	487.117	443.007	443.007
50	3.10293	381.661	17.3225	In Situ Clay Liner	270	28	212.516	372.968	193.655	0	193.655	127.373	127.373

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.75501

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	690.732	718	0	0	0
2	696.239	710.612	157.875	4.4873	1.62809
3	701.745	703.313	3791.93	214.876	3.24329
4	707.251	696.163	10514.4	889.02	4.83301
5	710.867	692.081	15656.8	1606.1	5.85701
6	714.482	688	21520.8	2589.62	6.86147
7	715.059	687.348	22561.8	2778.17	7.01984
8	721.216	683.057	29747.8	4536.16	8.67009
9	727.393	679.66	35304.2	6380.1	10.2438
10	733.569	676.877	39430.1	8182.3	11.7233
11	739.929	674.523	42280	9867.52	13.1368
12	744.609	673.426	42419.3	10654.8	14.0998
13	749.289	672.329	42492.8	11380.6	14.9933
14	753.976	671.726	40902	11586.6	15.8162
15	758.664	671.124	39250.1	11674.2	16.5641
16	762.248	670.783	37559.8	11543.5	17.0841
17	765.831	670.442	35838.9	11340.2	17.5585
18	769.415	669.976	34467.9	11190.3	17.9865
19	772.999	669.51	33060.1	10977	18.3678
20	773.06	669.5	33041.8	10974.8	18.3739
21	776.613	668.914	31707.7	10735.1	18.7043
22	780.166	668.328	30402	10461	18.9878
23	783.75	667.611	29490.7	10284.8	19.2261
24	787.334	666.895	28595.9	10079.2	19.416
25	792.593	665.66	27822.5	9911.12	19.6073
26	797.852	664.426	27065.2	9687.49	19.6939
27	803.11	663.153	26421.3	9447.62	19.6758
28	808.369	661.881	25784.9	9157.84	19.5532
29	812.432	661.014	24999.8	8797.32	19.3867
30	816.495	660.146	24226	8416.59	19.1582
31	820.558	659.278	23466	8019.51	18.8679
32	824.621	658.41	22717.8	7608.3	18.5159
33	828.684	657.541	21982.6	7186.31	18.103
34	832.747	656.673	21259.5	6756.05	17.6297
35	836.984	655.902	20194.1	6201.9	17.0725
36	841.221	655.131	19156.2	5656.69	16.4515
37	845.458	654.363	18139.2	5121.92	15.768
38	849.696	653.595	17151	4603.08	15.0233
39	853.902	652.834	16194.7	4105.56	14.2255
40	858.109	652.073	15265.7	3628.74	13.3714
41	862.506	651.413	14055.1	3095.62	12.421
42	866.902	650.753	12906.3	2605.84	11.4148
43	871.288	650.097	11816.7	2160.07	10.3592
44	875.674	649.441	10789.2	1758.19	9.25547
45	880.06	648.877	9673.43	1378.14	8.10817
46	884.445	648.314	8637.8	1048.67	6.9221
47	890.126	648.19	6578.45	614.527	5.33681
48	895.806	648.067	4871.25	315.649	3.70749
49	900.559	649.55	2241.11	90.7845	2.31971
50	905.313	651.032	846.701	13.5712	0.918277
51	908.416	652	0	0	0

Discharge Sections

Entity Information

External Boundary

X	Y
612.738	705.608
593	708
572	700
548	690
539	688
500	686
475	684
419	684
335	686
248	688
246	688
242	690
188	708
174	708
115.227	688.465
50	690
0	692
0	669.5
0	650
0	500
1166.24	500
1166.24	650
1166.24	652
908.416	652
855.809	669.5
800.196	688
794.183	690
710.039	718
704	718
663	718

Material Boundary

X	Y
115.227	688.465
135	688
170	686
206	684
230	684
240	686
248	688

Material Boundary

X	Y
704	718
794.183	688
849.796	669.5
908.416	650

Material Boundary

X	Y
908.416	650
1166.24	650

Material Boundary

X	Y
539	688
794.183	688

Material Boundary

X	Y
0	669.5
849.796	669.5

Material Boundary

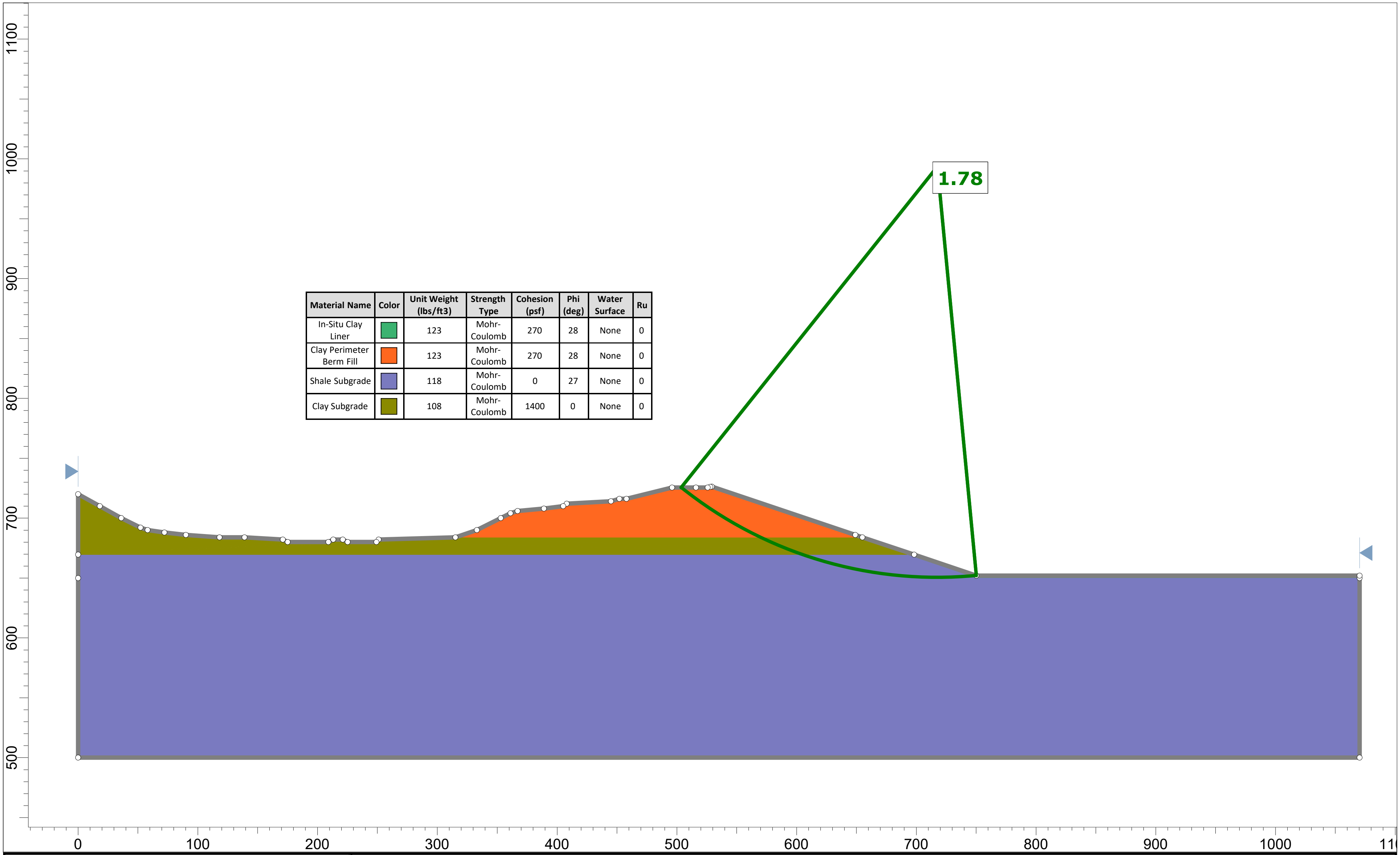
X	Y
849.796	669.5
855.809	669.5

Material Boundary

X	Y
794.183	688
800.196	688

CROSS-SECTION D

3H:1V EXCAVATION CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28	None	0
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28	None	0
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27	None	0
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0	None	0

rocscience

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section D, Circular Interior Slope Excavation

Created By: EDC	Checked By: EDC	Civil & Environmental Consultants, Inc.
Created Date12-20-22	Checked Date: 12-20-22	

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Author:	EDC
Company:	CEC
Date Created:	12/20/22

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Global Minimums

Method: gle/morgenstern-price

FS	1.779930
Center:	717.610, 993.529
Radius:	343.051
Left Slip Surface Endpoint:	503.519, 725.483
Right Slip Surface Endpoint:	750.071, 652.017
Resisting Moment:	1.13085e+08 lb-ft
Driving Moment:	6.3533e+07 lb-ft
Resisting Horizontal Force:	309408 lb
Driving Horizontal Force:	173831 lb
Total Slice Area:	5363.59 ft2
Surface Horizontal Width:	246.552 ft
Surface Average Height:	21.7544 ft

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.77993

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	5.09131	1248.85	-38.0747	Clay Perimeter Berm Fill	270	28	182.798	325.368	104.131	0	104.131	247.333	247.333
2	5.09131	3699.09	-37.0022	Clay Perimeter Berm Fill	270	28	300.757	535.326	499.004	0	499.004	725.659	725.659
3	5.09131	6056.36	-35.9446	Clay Perimeter Berm Fill	270	28	413.732	736.414	877.197	0	877.197	1177.18	1177.18
4	5.09131	8324.39	-34.901	Clay Perimeter Berm Fill	270	28	522.258	929.582	1240.49	0	1240.49	1604.84	1604.84
5	5.09131	10652.3	-33.8705	Clay Perimeter Berm Fill	270	28	633.745	1128.02	1613.71	0	1613.71	2039.09	2039.09
6	5.09131	12655.5	-32.8523	Clay Perimeter Berm Fill	270	28	730.22	1299.74	1936.65	0	1936.65	2408.19	2408.19
7	5.09131	13605.6	-31.8457	Clay Perimeter Berm Fill	270	28	777.104	1383.19	2093.6	0	2093.6	2576.28	2576.28
8	5.09131	14475	-30.8499	Clay Perimeter Berm Fill	270	28	820.931	1461.2	2240.33	0	2240.33	2730.67	2730.67
9	5.09131	15269.5	-29.8644	Clay Perimeter Berm Fill	270	28	862.068	1534.42	2378.04	0	2378.04	2873.04	2873.04
10	5.09131	15991.5	-28.8885	Clay Perimeter Berm Fill	270	28	900.681	1603.15	2507.28	0	2507.28	3004.25	3004.25
11	5.09131	16643	-27.9217	Clay Perimeter Berm Fill	270	28	936.902	1667.62	2628.53	0	2628.53	3125.05	3125.05
12	5.09131	17225.8	-26.9635	Clay Perimeter Berm Fill	270	28	970.836	1728.02	2742.14	0	2742.14	3236.02	3236.02
13	5.09131	17741.8	-26.0134	Clay Perimeter Berm Fill	270	28	1002.57	1784.5	2848.37	0	2848.37	3337.64	3337.64
14	5.0369	17907.1	-25.0759	Clay Subgrade	1400	0	786.548	1400	2983.81	0	2983.81	3351.86	3351.86
15	5.0369	18112.2	-24.1505	Clay Subgrade	1400	0	786.548	1400	3039.23	0	3039.23	3391.91	3391.91
16	5.0369	18264.4	-23.2317	Clay Subgrade	1400	0	786.548	1400	3087.82	0	3087.82	3425.45	3425.45
17	5.0369	18364.7	-22.3193	Clay Subgrade	1400	0	786.548	1400	3129.71	0	3129.71	3452.61	3452.61
18	5.0369	18414.2	-21.4128	Clay Subgrade	1400	0	786.548	1400	3164.95	0	3164.95	3473.4	3473.4
19	5.0369	18413.8	-20.5119	Clay Subgrade	1400	0	786.548	1400	3193.56	0	3193.56	3487.82	3487.82
20	5.0369	18364.4	-19.6162	Clay Subgrade	1400	0	786.548	1400	3215.46	0	3215.46	3495.78	3495.78

21	4.84127	17599.9	-18.7427	Shale Subgrade	0	27	925.008	1646.45	3231.34	0	3231.34	3545.2	3545.2
22	4.84127	17545.3	-17.891	Shale Subgrade	0	27	932.34	1659.5	3256.95	0	3256.95	3557.92	3557.92
23	4.84127	17445.5	-17.0433	Shale Subgrade	0	27	937.514	1668.71	3275.03	0	3275.03	3562.43	3562.43
24	4.84127	17300.9	-16.1994	Shale Subgrade	0	27	940.413	1673.87	3285.16	0	3285.16	3558.36	3558.36
25	4.84127	17112.3	-15.3591	Shale Subgrade	0	27	940.908	1674.75	3286.89	0	3286.89	3545.34	3545.34
26	4.84127	16880.1	-14.5222	Shale Subgrade	0	27	938.868	1671.12	3279.75	0	3279.75	3522.95	3522.95
27	4.84127	16605	-13.6884	Shale Subgrade	0	27	934.155	1662.73	3263.29	0	3263.29	3490.81	3490.81
28	4.84127	16287.2	-12.8576	Shale Subgrade	0	27	926.632	1649.34	3237.01	0	3237.01	3448.52	3448.52
29	4.84127	15927.3	-12.0296	Shale Subgrade	0	27	916.171	1630.72	3200.46	0	3200.46	3395.7	3395.7
30	4.84127	15525.7	-11.2041	Shale Subgrade	0	27	902.642	1606.64	3153.2	0	3153.2	3332	3332
31	4.84127	15108.3	-10.3809	Shale Subgrade	0	27	887.4	1579.51	3099.96	0	3099.96	3262.53	3262.53
32	4.84127	14735.7	-9.55987	Shale Subgrade	0	27	873.888	1555.46	3052.77	0	3052.77	3199.94	3199.94
33	4.84127	14329.4	-8.74084	Shale Subgrade	0	27	857.489	1526.27	2995.47	0	2995.47	3127.31	3127.31
34	4.84127	13882.6	-7.92361	Shale Subgrade	0	27	837.713	1491.07	2926.39	0	2926.39	3042.98	3042.98
35	4.84127	13395.6	-7.10799	Shale Subgrade	0	27	814.51	1449.77	2845.33	0	2845.33	2946.9	2946.9
36	4.84127	12868.7	-6.29382	Shale Subgrade	0	27	787.829	1402.28	2752.13	0	2752.13	2839.02	2839.02
37	4.84127	12302	-5.48092	Shale Subgrade	0	27	757.653	1348.57	2646.73	0	2646.73	2719.43	2719.43
38	4.84127	11695.7	-4.66913	Shale Subgrade	0	27	723.995	1288.66	2529.14	0	2529.14	2588.27	2588.27
39	4.84127	11069.2	-3.85828	Shale Subgrade	0	27	688.038	1224.66	2403.54	0	2403.54	2449.94	2449.94
40	4.84127	10389.7	-3.0482	Shale Subgrade	0	27	647.863	1153.15	2263.2	0	2263.2	2297.7	2297.7
41	4.84127	9590.13	-2.23873	Shale Subgrade	0	27	599.456	1066.99	2094.09	0	2094.09	2117.52	2117.52
42	4.84127	8747.95	-1.42971	Shale Subgrade	0	27	547.634	974.751	1913.06	0	1913.06	1926.72	1926.72
43	4.84127	7866.7	-0.620968	Shale Subgrade	0	27	492.748	877.057	1721.32	0	1721.32	1726.66	1726.66
44	4.84127	6946.41	0.187646	Shale Subgrade	0	27	434.963	774.204	1519.46	0	1519.46	1518.04	1518.04
45	4.84127	5987.08	0.996298	Shale Subgrade	0	27	374.461	666.515	1308.11	0	1308.11	1301.6	1301.6
46	4.84127	4988.7	1.80515	Shale Subgrade	0	27	311.436	554.334	1087.94	0	1087.94	1078.13	1078.13
47	4.84127	3951.22	2.61436	Shale Subgrade	0	27	246.089	438.022	859.668	0	859.668	848.431	848.431
48	4.84127	2874.59	3.42409	Shale Subgrade	0	27	178.627	317.944	624.001	0	624.001	613.313	613.313
49	4.84127	1758.72	4.23451	Shale Subgrade	0	27	109.253	194.463	381.654	0	381.654	373.565	373.565
50	4.7099	579.318	5.03476	In-Situ Clay Liner	270	28	195.156	347.365	145.502	0	145.502	128.309	128.309

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.77993

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	503.519	725.483	0	0	0
2	508.61	721.494	-514.785	-10.0118	1.11418
3	513.701	717.658	-130.465	-5.06403	2.22283
4	518.793	713.966	1002.6	58.1696	3.32051
5	523.884	710.414	2751.35	211.793	4.40182
6	528.975	706.997	5041.44	482.03	5.46165
7	534.067	703.709	7693.13	875.837	6.49497
8	539.158	700.547	10359.8	1363.37	7.49715
9	544.249	697.506	12995.7	1933.78	8.4636
10	549.341	694.582	15561.4	2573.48	9.39035
11	554.432	691.773	18022.1	3266.59	10.2736
12	559.523	689.075	20347.2	3995.61	11.1099
13	564.614	686.485	22509.8	4741.93	11.896
14	569.706	684	24485.7	5486.39	12.6294
15	574.743	681.643	27558.9	6514.86	13.3004
16	579.78	679.385	30463.5	7547.55	13.9152
17	584.816	677.223	33180.4	8563.76	14.472
18	589.853	675.155	35692.5	9543.25	14.9693
19	594.89	673.18	37984.7	10466.7	15.4056
20	599.927	671.295	40043.4	11315.9	15.7798
21	604.964	669.5	41856.3	12074.2	16.0912
22	609.805	667.857	42689	12507.8	16.3305
23	614.647	666.294	43268.2	12825.3	16.5106
24	619.488	664.81	43592.7	13021.2	16.631
25	624.329	663.404	43663.2	13092.5	16.6915
26	629.17	662.074	43481.7	13038.5	16.692
27	634.012	660.82	43052.1	12861.1	16.6326
28	638.853	659.641	42380.2	12564.3	16.5133
29	643.694	658.536	41473.9	12154.8	16.3343
30	648.535	657.504	40343	11641.5	16.0962
31	653.377	656.545	38999.5	11035.1	15.7991
32	658.218	655.658	37455.3	10347.8	15.4439
33	663.059	654.843	35716.2	9591.14	15.0314
34	667.901	654.099	33797.1	8779.86	14.5625
35	672.742	653.425	31715.9	7930.14	14.0382
36	677.583	652.821	29492.8	7058.84	13.46
37	682.424	652.287	27150.5	6183.14	12.8295
38	687.266	651.823	24714.2	5320.07	12.1483
39	692.107	651.427	22211.4	4486.07	11.4185
40	696.948	651.101	19667.2	3695.71	10.6425
41	701.789	650.843	17116.1	2963.44	9.82267
42	706.631	650.654	14612	2304.39	8.96204
43	711.472	650.533	12193.6	1727.49	8.06354
44	716.313	650.48	9899.84	1238.47	7.13066
45	721.155	650.496	7771.26	839.701	6.167
46	725.996	650.58	5849.38	529.913	5.17647
47	730.837	650.733	4176.56	304.01	4.16319
48	735.678	650.954	2795.87	152.96	3.13149
49	740.52	651.244	1750.86	63.7675	2.08583
50	745.361	651.602	1085.46	19.5312	1.03084
51	750.071	652.017	0	0	0

Discharge Sections

Entity Information

External Boundary

X	Y
458	716
452	716
445	714
408	712
405	710
389	708
367	706
361	704
353	700
333	690
315	684
251	682
249	680
225	680
221	682
213	682
209	680
175	680
171	682
139	684
118	684
90	686
72	688
58	690
52	692
36	700
18	710
0	720
0	669.5
0	650
0	500
1070.16	500
1070.16	650
1070.16	652
750.122	652
698.122	669.5
655.036	684
649.093	686
529.283	726.321
528	726
525.829	725.483
515.993	725.483
495.921	725.483

Material Boundary

X	Y
525.829	725.483
649.093	684
692.179	669.5
750.122	650

Material Boundary

X	Y
750.122	650
1070.16	650

Material Boundary

X	Y
315	684
649.093	684

Material Boundary

X	Y
0	669.5
692.179	669.5

Material Boundary

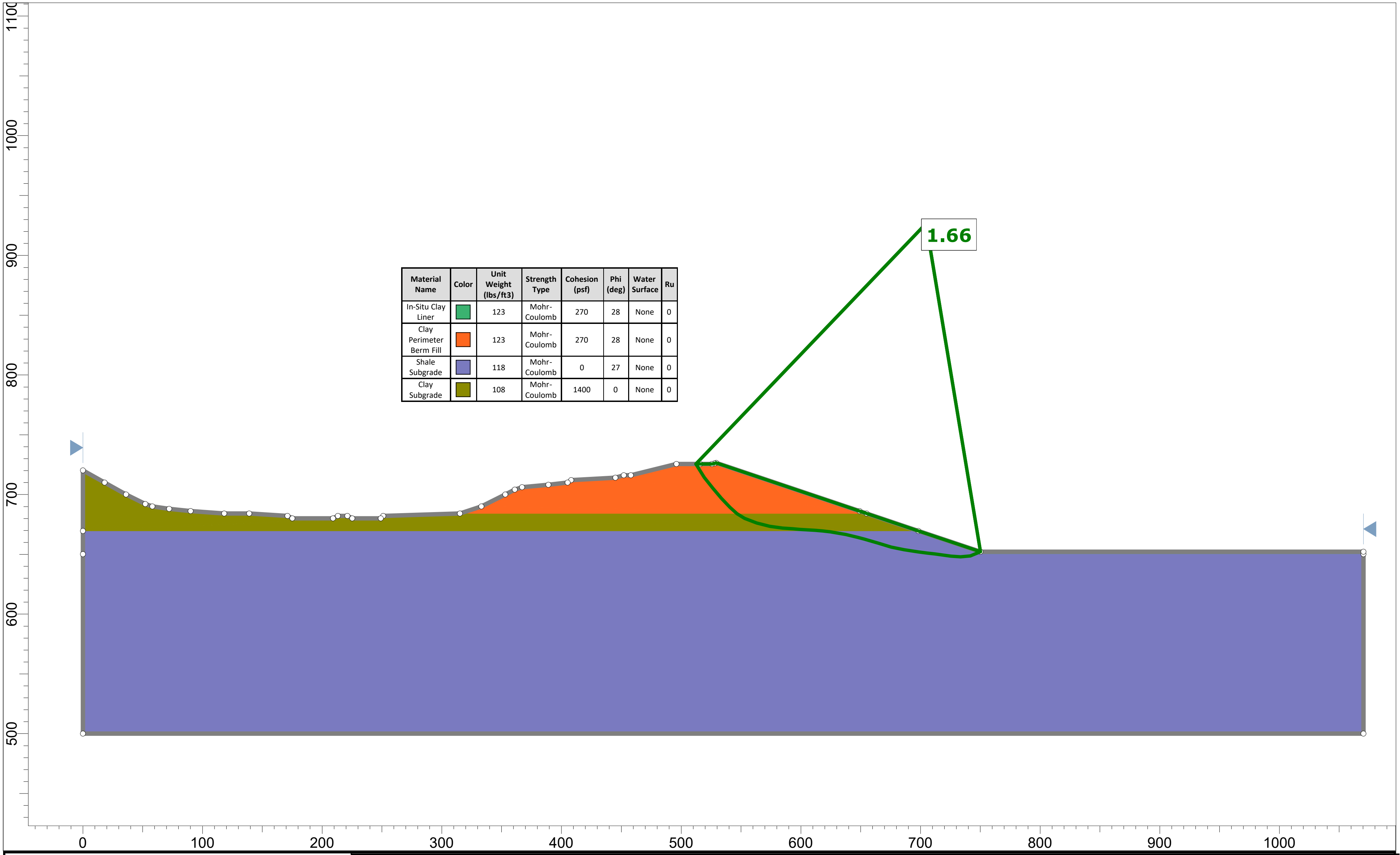
X	Y
649.093	684
655.036	684

Material Boundary

X	Y
692.179	669.5
698.122	669.5

CROSS-SECTION D

3H:1V EXCAVATION NON-CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28	None	0
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28	None	0
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27	None	0
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0	None	0

rocscience

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section D, Non-Circular Interior Slope Excavation

Created By: EDC	Checked By: EDC
Created Date12-20-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:10.348s
Author:	EDC
Company:	CEC
Date Created:	12/20/22

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Materials

In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟨
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

Global Minimums

Method: gle/morgenstern-price

FS	1.660310
Axis Location:	704.697, 926.556
Left Slip Surface Endpoint:	512.307, 725.483
Right Slip Surface Endpoint:	750.122, 652.000
Resisting Moment:	8.3132e+07 lb-ft
Driving Moment:	5.00703e+07 lb-ft
Resisting Horizontal Force:	278080 lb
Driving Horizontal Force:	167487 lb
Total Slice Area:	5588.98 ft2
Surface Horizontal Width:	237.815 ft
Surface Average Height:	23.5014 ft

Global Minimum Coordinates

Method: gle/morgenstern-price

X	Y
512.307	725.483
519.392	714.257
526.479	705.073
533.567	696.873
540.655	689.251
546.656	683.799
552.911	680.02
563.183	676.072
573.972	673.378
584.763	671.923
592.988	671.212
599.137	670.675
605.285	670.389
611.736	670.043
618.187	669.473
624.637	668.677
631.088	667.656
637.537	666.41
647.642	664.105
653.043	662.684
664.631	659.232
675.483	655.953
686.336	653.731
698.336	651.863
705.398	650.977
712.061	650.167
718.724	649.312
725.387	648.456
733.546	647.795
741.706	648.594
750.122	652

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.66031

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.54267	1222.96	-57.7424	Clay Perimeter Berm Fill	270	28	181.528	301.392	59.0397	0	59.0397	346.659	346.659
2	3.54267	3668.88	-57.7424	Clay Perimeter Berm Fill	270	28	324.859	539.367	506.605	0	506.605	1021.32	1021.32
3	3.54325	5893.18	-52.3432	Clay Perimeter Berm Fill	270	28	480.892	798.43	993.833	0	993.833	1617	1617
4	3.54325	7900.46	-52.3432	Clay Perimeter Berm Fill	270	28	597.874	992.657	1359.12	0	1359.12	2133.89	2133.89
5	3.54395	10024.9	-49.162	Clay Perimeter Berm Fill	270	28	744.789	1236.58	1817.87	0	1817.87	2679.56	2679.56
6	3.54395	11574.2	-49.162	Clay Perimeter Berm Fill	270	28	831.718	1380.91	2089.31	0	2089.31	3051.58	3051.58
7	7.08848	26700.5	-47.0769	Clay Perimeter Berm Fill	270	28	946.727	1571.86	2448.44	0	2448.44	3466.41	3466.41
8	5.77926	24805.3	-42.2588	Clay Perimeter Berm Fill	270	28	1098.79	1824.34	2923.29	0	2923.29	3921.67	3921.67
9	0.221354	996.474	-42.2588	Clay Subgrade	1400	0	843.216	1400	3243.78	0	3243.78	4009.94	4009.94
10	6.25478	28663.1	-31.1364	Clay Subgrade	1400	0	843.216	1400	3661.76	0	3661.76	4171.15	4171.15
11	5.13596	23920.7	-21.027	Clay Subgrade	1400	0	843.216	1400	4002.82	0	4002.82	4326.95	4326.95
12	5.13596	23923.9	-21.027	Clay Subgrade	1400	0	843.216	1400	3986.82	0	3986.82	4310.96	4310.96
13	5.3947	24920.8	-14.0175	Clay Subgrade	1400	0	843.216	1400	4164.34	0	4164.34	4374.85	4374.85
14	5.3947	24500.8	-14.0175	Clay Subgrade	1400	0	843.216	1400	4096.38	0	4096.38	4306.89	4306.89
15	5.3953	23903	-7.67859	Clay Subgrade	1400	0	843.216	1400	4213.82	0	4213.82	4327.5	4327.5
16	5.3953	23121.9	-7.67859	Clay Subgrade	1400	0	843.216	1400	4096.83	0	4096.83	4210.51	4210.51
17	4.11276	17056.7	-4.94269	Clay Subgrade	1400	0	843.216	1400	4079.52	0	4079.52	4152.44	4152.44
18	4.11276	16514.5	-4.94269	Clay Subgrade	1400	0	843.216	1400	3971.84	0	3971.84	4044.76	4044.76
19	6.14863	23679.9	-4.99179	Clay Subgrade	1400	0	843.216	1400	3835.04	0	3835.04	3908.69	3908.69
20	6.14879	22389	-2.66617	Clay Subgrade	1400	0	843.216	1400	3741.16	0	3741.16	3780.42	3780.42
21	6.45094	22026.9	-3.06348	Clay Subgrade	1400	0	843.216	1400	3532.55	0	3532.55	3577.68	3577.68
22	6.14364	19671	-5.05406	Clay Subgrade	1400	0	843.216	1400	3279.9	0	3279.9	3354.48	3354.48

23	0.307021	951.542	-5.05406	Shale Subgrade	0	27	990.508	1644.55	3227.62	0	3227.62	3315.22	3315.22
24	6.45038	19402.5	-7.0325	Shale Subgrade	0	27	941.565	1563.29	3068.14	0	3068.14	3184.29	3184.29
25	6.45011	18370.8	-8.99422	Shale Subgrade	0	27	875.373	1453.39	2852.44	0	2852.44	2991	2991
26	6.44982	17510.7	-10.9349	Shale Subgrade	0	27	819.04	1359.86	2668.88	0	2668.88	2827.12	2827.12
27	5.05238	13229	-12.8506	Shale Subgrade	0	27	775.126	1286.95	2525.79	0	2525.79	2702.62	2702.62
28	5.05238	12859.5	-12.8506	Shale Subgrade	0	27	755.582	1254.5	2462.1	0	2462.1	2634.46	2634.46
29	5.40052	13397.1	-14.7374	Shale Subgrade	0	27	722.739	1199.97	2355.08	0	2355.08	2545.19	2545.19
30	5.79393	14142.8	-16.5922	Shale Subgrade	0	27	698.665	1160	2276.63	0	2276.63	2484.8	2484.8
31	5.79393	14093	-16.5922	Shale Subgrade	0	27	698.448	1159.64	2275.93	0	2275.93	2484.04	2484.04
32	5.42629	13169.9	-16.8106	Shale Subgrade	0	27	697.352	1157.82	2272.35	0	2272.35	2483.04	2483.04
33	5.42629	13149.4	-16.8106	Shale Subgrade	0	27	698.225	1159.27	2275.19	0	2275.19	2486.14	2486.14
34	3.61753	8679.64	-11.5679	Shale Subgrade	0	27	731.646	1214.76	2384.11	0	2384.11	2533.86	2533.86
35	3.61753	8520.08	-11.5679	Shale Subgrade	0	27	718.384	1192.74	2340.89	0	2340.89	2487.93	2487.93
36	3.61753	8360.52	-11.5679	Shale Subgrade	0	27	704.983	1170.49	2297.21	0	2297.21	2441.52	2441.52
37	4.00026	9013.01	-8.84869	Shale Subgrade	0	27	705.892	1172	2300.19	0	2300.19	2410.08	2410.08
38	4.00026	8729.27	-8.84869	Shale Subgrade	0	27	682.704	1133.5	2224.62	0	2224.62	2330.91	2330.91
39	4.00026	8465.57	-8.84869	Shale Subgrade	0	27	660.907	1097.31	2153.59	0	2153.59	2256.48	2256.48
40	3.53095	7198.33	-7.15055	Shale Subgrade	0	27	645.512	1071.75	2103.43	0	2103.43	2184.41	2184.41
41	3.53095	6887.79	-7.15055	Shale Subgrade	0	27	616.168	1023.03	2007.8	0	2007.8	2085.1	2085.1
42	6.66295	12141.2	-6.9301	Shale Subgrade	0	27	574.458	953.778	1871.89	0	1871.89	1941.71	1941.71
43	6.6629	11033	-7.31947	Shale Subgrade	0	27	517.438	859.108	1686.1	0	1686.1	1752.56	1752.56
44	6.6629	9942.9	-7.31947	Shale Subgrade	0	27	463.58	769.687	1510.59	0	1510.59	1570.14	1570.14
45	4.07942	5503.03	-4.63175	Shale Subgrade	0	27	424.984	705.605	1384.83	0	1384.83	1419.26	1419.26
46	4.07942	5001.26	-4.63175	Shale Subgrade	0	27	384.196	637.885	1251.92	0	1251.92	1283.05	1283.05
47	4.08014	4324.43	5.59628	Shale Subgrade	0	27	353.567	587.03	1152.11	0	1152.11	1117.47	1117.47
48	4.08014	3470.85	5.59628	Shale Subgrade	0	27	280.716	466.075	914.725	0	914.725	887.219	887.219
49	5.71737	2836	22.0326	Shale Subgrade	0	27	180.983	300.488	589.742	0	589.742	516.501	516.501
50	2.69824	331.883	22.0326	In-Situ Clay Liner	270	28	233.583	387.821	221.589	0	221.589	127.061	127.061

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.66031

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	512.307	725.483	0	0	0
2	515.85	719.87	-311.696	-5.14181	0.945079
3	519.392	714.257	1381.08	45.5154	1.88758
4	522.936	709.665	4240.41	209.251	2.82508
5	526.479	705.073	8362.48	548.824	3.7549
6	530.023	700.973	13176.6	1077.47	4.67476
7	533.567	696.873	18795.7	1836.98	5.58202
8	540.655	689.251	30746.7	3965.86	7.34971
9	546.434	684	39747	6106.72	8.73461
10	546.656	683.799	40212.8	6215.58	8.78652
11	552.911	680.02	48774.7	8789.08	10.2149
12	558.047	678.046	52346.7	10486.7	11.3282
13	563.183	676.072	55887.1	12269.6	12.3824
14	568.577	674.725	56946.7	13589.4	13.4217
15	573.972	673.378	57914.8	14855.9	14.3869
16	579.367	672.651	56430.6	15410.7	15.2745
17	584.763	671.923	54861.3	15815.6	16.0814
18	588.875	671.568	52844.3	15794.3	16.6405
19	592.988	671.212	50789.1	15673.7	17.1504
20	599.137	670.675	47664	15320.5	17.8188
21	605.285	670.389	43550.5	14464.5	18.373
22	611.736	670.043	39330.5	13412	18.8298
23	617.88	669.5	35932.2	12474.2	19.1449
24	618.187	669.473	35715.7	12407.9	19.1576
25	624.637	668.677	32083.6	11270.5	19.3556
26	631.088	667.656	29349.5	10349.1	19.4235
27	637.537	666.41	27392.5	9625.35	19.3608
28	642.59	665.258	26387.4	9199.74	19.2207
29	647.642	664.105	25407.6	8748.98	19.0009
30	653.043	662.684	24850	8400.71	18.6782
31	658.837	660.958	24732.3	8146.8	18.2318
32	664.631	659.232	24614.6	7847.48	17.683
33	670.057	657.592	24555.9	7543.68	17.0772
34	675.483	655.953	24497	7202.58	16.3843
35	679.101	655.212	23615.6	6715.9	15.8749
36	682.718	654.472	22750.1	6235.83	15.3284
37	686.336	653.731	21900.8	5764.1	14.7454
38	690.336	653.109	20509.5	5136.17	14.0594
39	694.336	652.486	19163.9	4541.21	13.3313
40	698.336	651.863	17861.3	3980.27	12.5627
41	701.867	651.42	16513.7	3465.56	11.8521
42	705.398	650.977	15227.5	2990.95	11.1124
43	712.061	650.167	12915.8	2194.6	9.64336
44	718.724	649.312	10911.2	1550.45	8.08742
45	725.387	648.456	9115.23	1031.65	6.45719
46	729.466	648.125	7839.22	744.928	5.42828
47	733.546	647.795	6685.67	512.104	4.38015
48	737.626	648.195	4782.46	277.11	3.31618
49	741.706	648.594	3271.39	127.978	2.24029
50	747.424	650.908	872.127	10.9592	0.719944
51	750.122	652	0	0	0

Discharge Sections

Entity Information

External Boundary

X	Y
458	716
452	716
445	714
408	712
405	710
389	708
367	706
361	704
353	700
333	690
315	684
251	682
249	680
225	680
221	682
213	682
209	680
175	680
171	682
139	684
118	684
90	686
72	688
58	690
52	692
36	700
18	710
0	720
0	669.5
0	650
0	500
1070.16	500
1070.16	650
1070.16	652
750.122	652
698.122	669.5
655.036	684
649.093	686
529.283	726.321
528	726
525.829	725.483
515.993	725.483
495.921	725.483

Material Boundary

X	Y
525.829	725.483
649.093	684
692.179	669.5
750.122	650

Material Boundary

X	Y
750.122	650
1070.16	650

Material Boundary

X	Y
315	684
649.093	684

Material Boundary

X	Y
0	669.5
692.179	669.5

Material Boundary

X	Y
649.093	684
655.036	684

Material Boundary

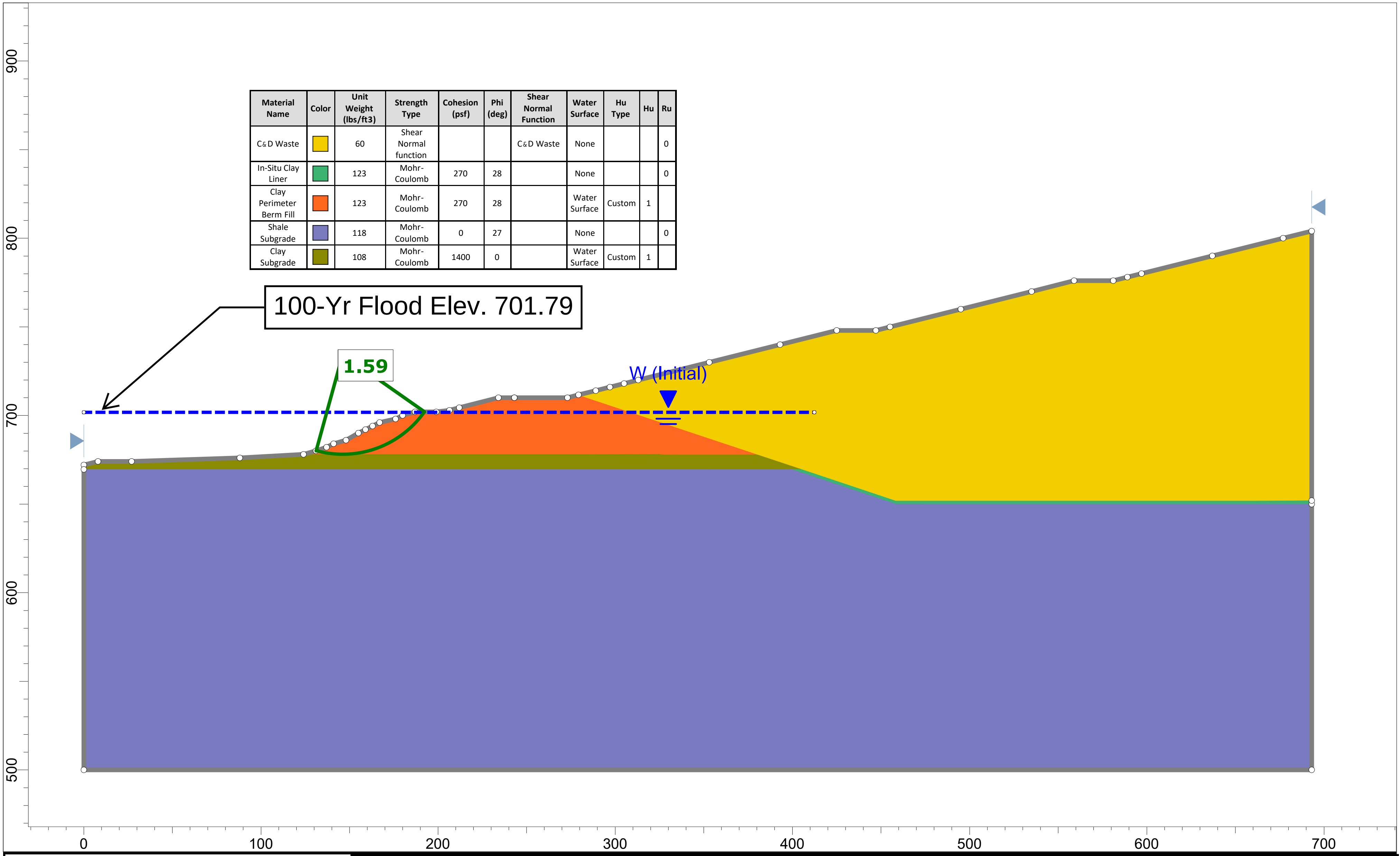
X	Y
692.179	669.5
698.122	669.5

ATTACHMENT 3

RAPID DRAWDOWN SLOPE STABILITY SLIDE OUTPUTS

CROSS-SECTION B

RAPID DRAWDOWN CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
C&D Waste	🟨	60	Shear Normal function			C&D Waste	None			0
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28		None			0
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28		Water Surface	Custom	1	
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27		None			0
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0		Water Surface	Custom	1	

rocscience

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section B, Circular Rapid Drawdown

Created By: EDC	Checked By: EDC
Created Date12-20-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Author:	EDC
Company:	CEC
Date Created:	12/20/22

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	Rapid Drawdown
Rapid Drawdown Method:	Effective Stress using B-Bar

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

C&D Waste	
Color	🟨
Strength Type	Shear Normal function
Unit Weight [lbs/ft3]	60
Water Surface	None
Ru Value	0
In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	Water Table
Hu Value	1
Rapid Drawdown Undrained Behaviour	Yes
RD Shear Strength Envelope Properties	CR: 0PhiR: 0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1
Rapid Drawdown Undrained Behaviour	Yes
RD Shear Strength Envelope Properties	CR: 0PhiR: 0

Shear Normal Functions

Name: C&D Waste

Effective Normal (psf)	Shear (psf)
0	0
2000	1400
10000	6169

Global Minimums

Method: gle/morgenstern-price

FS	1.586810
Center:	146.097, 734.532
Radius:	56.532
Left Slip Surface Endpoint:	131.088, 680.029
Right Slip Surface Endpoint:	192.330, 702.000
Resisting Moment:	1.91457e+06 lb-ft
Driving Moment:	1.20655e+06 lb-ft
Resisting Horizontal Force:	30787.8 lb
Driving Horizontal Force:	19402.3 lb
Total Slice Area:	1116.44 ft2
Surface Horizontal Width:	61.2426 ft
Surface Average Height:	18.2298 ft

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.58681

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.24682	57.0274	-14.7435	Clay Perimeter Berm Fill	270	28	196.715	312.15	102.468	23.1963	79.272	50.7015	27.5052
2	1.24682	168.771	-13.4405	Clay Perimeter Berm Fill	270	28	215.228	341.527	203.185	68.6636	134.522	151.75	83.0866
3	1.24682	275.929	-12.1445	Clay Perimeter Berm Fill	270	28	233.554	370.606	301.478	112.265	189.213	251.218	138.953
4	1.24682	378.572	-10.8548	Clay Perimeter Berm Fill	270	28	251.486	399.061	396.758	154.029	242.729	348.535	194.506
5	1.24682	477.823	-9.57072	Clay Perimeter Berm Fill	270	28	268.981	426.821	489.35	194.413	294.937	443.997	249.584
6	1.24682	594.709	-8.29143	Clay Perimeter Berm Fill	270	28	289.022	458.623	596.722	241.973	354.749	554.603	312.63
7	1.24682	716.013	-7.0163	Clay Perimeter Berm Fill	270	28	309.444	491.029	707.026	291.331	415.695	668.942	377.611
8	1.24682	832.952	-5.74465	Clay Perimeter Berm Fill	270	28	328.717	521.612	812.123	338.912	473.211	779.053	440.141
9	1.24682	923.179	-4.47584	Clay Perimeter Berm Fill	270	28	343.303	544.756	892.365	375.624	516.741	865.492	489.868
10	1.24682	990.655	-3.20922	Clay Perimeter Berm Fill	270	28	353.672	561.21	950.763	403.079	547.684	930.932	527.853
11	1.24682	1053.89	-1.94417	Clay Perimeter Berm Fill	270	28	362.5	575.218	1002.84	428.81	574.031	990.536	561.726
12	1.24682	1112.9	-0.68007	Clay Perimeter Berm Fill	270	28	369.734	586.697	1048.44	452.821	595.622	1044.05	591.233
13	1.24682	1167.7	0.583699	Clay Perimeter Berm Fill	270	28	375.349	595.608	1087.5	475.116	612.38	1091.32	616.204
14	1.24682	1223.45	1.84775	Clay Perimeter Berm Fill	270	28	380.08	603.115	1124.3	497.802	626.501	1136.56	638.762
15	1.24682	1315.73	3.11271	Clay Perimeter Berm Fill	270	28	388.851	617.033	1188.03	535.349	652.676	1209.17	673.822
16	1.24682	1412.47	4.37918	Clay Perimeter Berm Fill	270	28	397.053	630.048	1251.87	574.713	677.154	1282.27	707.56
17	1.24682	1504.96	5.64781	Clay Perimeter Berm Fill	270	28	403.5	640.278	1308.74	612.345	696.395	1348.64	736.298
18	1.24682	1593.17	6.91922	Clay Perimeter Berm Fill	270	28	408.256	647.824	1358.82	648.235	710.584	1408.36	760.128

19	1.24682	1677.06	8.19406	Clay Perimeter Berm Fill	270	28	411.407	652.824	1402.36	682.371	719.987	1461.6	779.228
20	1.24682	1752	9.47301	Clay Perimeter Berm Fill	270	28	412.488	654.54	1436.08	712.862	723.214	1504.9	792.041
21	1.24682	1813.71	10.7567	Clay Perimeter Berm Fill	270	28	411.151	652.419	1457.19	737.97	719.223	1535.3	797.332
22	1.24682	1870.75	12.046	Clay Perimeter Berm Fill	270	28	408.639	648.433	1472.91	761.179	711.732	1560.11	798.933
23	1.24682	1923.28	13.3414	Clay Perimeter Berm Fill	270	28	405.128	642.861	1483.8	782.553	701.246	1579.88	797.323
24	1.24682	1971.23	14.6438	Clay Perimeter Berm Fill	270	28	400.767	635.941	1490.3	802.064	688.237	1595.02	792.956
25	1.24682	2014.52	15.9541	Clay Perimeter Berm Fill	270	28	395.706	627.911	1492.81	819.679	673.134	1605.94	786.258
26	1.24682	2053.07	17.2729	Clay Perimeter Berm Fill	270	28	390.093	619.004	1491.75	835.363	656.384	1613.05	777.683
27	1.24682	2086.77	18.6013	Clay Perimeter Berm Fill	270	28	384.066	609.439	1487.47	849.075	638.39	1616.73	767.652
28	1.24682	2115.51	19.9401	Clay Perimeter Berm Fill	270	28	377.752	599.42	1480.32	860.771	619.552	1617.37	756.595
29	1.24682	2138.15	21.2903	Clay Perimeter Berm Fill	270	28	371.167	588.971	1469.88	869.981	599.899	1614.52	744.539
30	1.24682	2120.61	22.6531	Clay Perimeter Berm Fill	270	28	361.096	572.991	1432.69	862.847	569.842	1583.39	720.545
31	1.24682	2080.58	24.0296	Clay Perimeter Berm Fill	270	28	349.542	554.657	1381.92	846.557	535.359	1537.76	691.201
32	1.24682	2035	25.421	Clay Perimeter Berm Fill	270	28	338.25	536.738	1329.68	828.014	501.662	1490.44	662.427
33	1.24682	1983.7	26.8287	Clay Perimeter Berm Fill	270	28	327.233	519.256	1275.92	807.139	468.786	1441.43	634.288
34	1.24682	1926.46	28.254	Clay Perimeter Berm Fill	270	28	316.487	502.204	1220.56	783.848	436.717	1390.65	606.8
35	1.24682	1863.04	29.6987	Clay Perimeter Berm Fill	270	28	305.988	485.545	1163.43	758.045	405.381	1337.95	579.905
36	1.24682	1793.18	31.1646	Clay Perimeter Berm Fill	270	28	295.695	469.211	1104.28	729.62	374.662	1283.11	553.491
37	1.24682	1742.01	32.6534	Clay Perimeter Berm Fill	270	28	287.753	456.609	1059.76	708.798	350.964	1244.17	535.368
38	1.24682	1711.44	34.1676	Clay Perimeter Berm Fill	270	28	282.246	447.871	1030.89	696.36	334.529	1222.47	526.11
39	1.24682	1673.43	35.7094	Clay Perimeter Berm Fill	270	28	276.729	439.116	998.956	680.894	318.062	1197.87	516.981
40	1.24682	1615.37	37.2816	Clay Perimeter Berm Fill	270	28	270.105	428.606	955.566	657.271	298.295	1161.19	503.923
41	1.24682	1521.19	38.8875	Clay Perimeter Berm Fill	270	28	260.961	414.095	889.955	618.95	271.005	1100.43	481.48
42	1.24682	1416.97	40.5306	Clay Perimeter Berm Fill	270	28	251.367	398.872	818.917	576.544	242.373	1033.84	457.293
43	1.24682	1303.13	42.2151	Clay Perimeter Berm Fill	270	28	241.229	382.784	742.334	530.221	212.113	961.182	430.961

44	1.24682	1178.87	43.9458	Clay Perimeter Berm Fill	270	28	230.32	365.474	659.225	479.664	179.561	881.222	401.558
45	1.24682	1042.62	45.7285	Clay Perimeter Berm Fill	270	28	219.848	348.858	566.63	418.318	148.312	792.141	373.823
46	1.24682	859.422	47.5702	Clay Perimeter Berm Fill	270	28	205.26	325.709	441.351	336.578	104.773	665.905	329.327
47	1.24682	642.973	49.4793	Clay Perimeter Berm Fill	270	28	185.1	293.718	293.115	248.507	44.6078	509.68	261.173
48	1.24682	411.07	51.466	Clay Perimeter Berm Fill	270	28	162.273	257.497	130.634	154.148	-23.5138	334.392	180.244
49	1.24682	161.614	53.5437	Clay Perimeter Berm Fill	270	28	136.053	215.889	-49.1193	52.6477	-101.767	135.039	82.3909
50	0.148483	1.91765	54.7374	Clay Perimeter Berm Fill	270	28	118.505	188.045	-154.134	0	-154.134	13.4686	13.4686

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.58681

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	131.088	680.029	0	0	0
2	132.334	679.701	279.374	6.05624	1.24186
3	133.581	679.403	608.798	26.3409	2.47747
4	134.828	679.135	981.463	63.4804	3.7007
5	136.075	678.896	1390.5	119.343	4.90553
6	137.322	678.686	1829.41	195.059	6.08611
7	138.569	678.504	2298.9	291.926	7.23698
8	139.815	678.35	2793.98	410.23	8.35285
9	141.062	678.225	3306.51	549.103	9.4289
10	142.309	678.127	3822.48	705.743	10.4607
11	143.556	678.057	4330.79	876.709	11.4441
12	144.803	678.015	4826.1	1058.92	12.3755
13	146.049	678	5303.52	1248.96	13.2515
14	147.296	678.013	5758.62	1443.2	14.0694
15	148.543	678.053	6188.23	1638.09	14.8267
16	149.79	678.121	6593.46	1831.15	15.5212
17	151.037	678.217	6969.96	2018.49	16.1509
18	152.284	678.34	7312.68	2195.92	16.7145
19	153.53	678.491	7617.11	2359.42	17.2105
20	154.777	678.671	7879.3	2505.22	17.638
21	156.024	678.879	8095.85	2629.91	17.9962
22	157.271	679.116	8264.33	2730.66	18.2843
23	158.518	679.382	8382.95	2805.21	18.5019
24	159.764	679.677	8450.33	2851.83	18.6486
25	161.011	680.003	8465.48	2869.37	18.7241
26	162.258	680.36	8427.74	2857.27	18.7283
27	163.505	680.747	8336.73	2815.55	18.6613
28	164.752	681.167	8192.35	2744.79	18.5231
29	165.999	681.619	7994.68	2646.15	18.314
30	167.245	682.105	7744.2	2521.36	18.0342
31	168.492	682.625	7449.8	2375.3	17.6844
32	169.739	683.181	7118.28	2212.34	17.2651
33	170.986	683.774	6752.9	2035.87	16.7771
34	172.233	684.405	6357.11	1849.5	16.2215
35	173.479	685.075	5934.66	1656.94	15.5996
36	174.726	685.786	5489.57	1461.97	14.9128
37	175.973	686.54	5026.3	1268.38	14.1628
38	177.22	687.339	4539.02	1077.34	13.3521
39	178.467	688.185	4019.18	889.763	12.4828
40	179.714	689.081	3469.59	709.543	11.5578
41	180.96	690.031	2900.02	541.698	10.5804
42	182.207	691.036	2331.09	392.358	9.5542
43	183.454	692.102	1772.12	264.314	8.4832
44	184.701	693.233	1233.8	159.625	7.37179
45	185.948	694.435	729.304	79.5476	6.22483
46	187.194	695.714	279.278	24.6669	5.04748
47	188.441	697.078	-66.3041	-4.45653	3.84527
48	189.688	698.537	-262.648	-12.0366	2.62391
49	190.935	700.102	-264.437	-6.414	1.38945
50	192.182	701.79	-11.5714	-0.0298928	0.148014
51	192.33	702	0	0	0

Discharge Sections

Entity Information

Water Table

X	Y
0	701.79
412.374	701.79

External Boundary

X	Y
206.442	702.93
199	702
187	702
180	700
176	698
167	696
163	694
159	692
155	690
148	686
141	684
137	682
131	680
124	678
88	676
27	674
8	674
0	672
0	669.5
0	500
693	500
693	650
693	652
693	804
677	800
637	790
597	780
589	778
581	776
559	776
535	770
495	760
455	750
447	748
425	748
393	740
353	730
313	720
305	718
297	716
289	714
279.273	711.576
272.952	710
243.001	710
243	710
234	710
211.897	704.33

Material Boundary

X	Y
124	678
324.992	678
374.171	678

Material Boundary

X	Y
458.342	650
693	650

Material Boundary

X	Y
290	706
374.171	678
399.723	669.5
458.342	650

Material Boundary

X	Y
243	710
278	710
284	708
290	706

Material Boundary

X	Y
458.342	652
693	652

Material Boundary

X	Y
290	708
380.183	678
405.735	669.5
458.342	652

Material Boundary

X	Y
279.273	711.576
284	710
290	708

Material Boundary

X	Y
0	669.5
399.723	669.5

Material Boundary

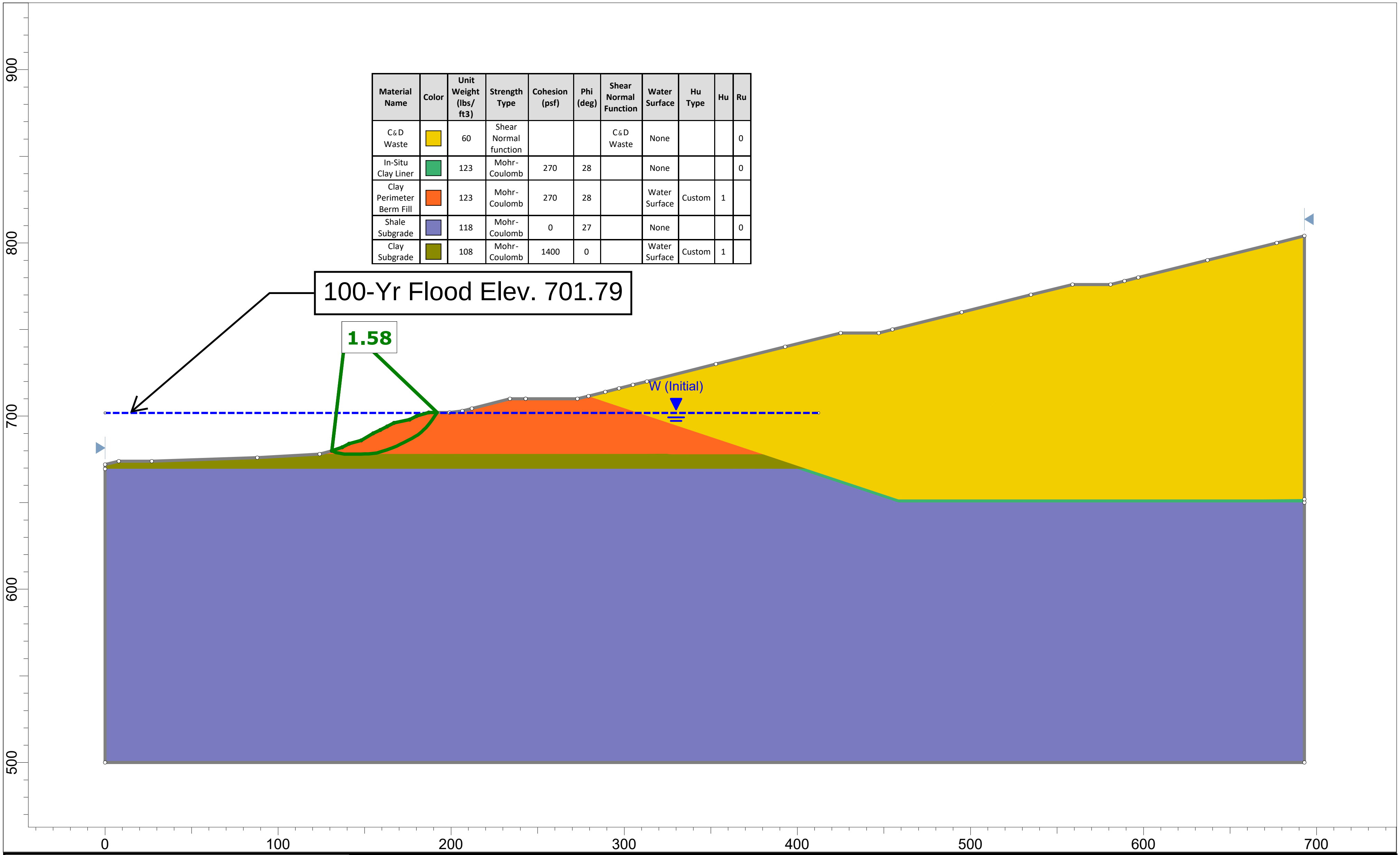
X	Y
399.723	669.5
405.735	669.5

Material Boundary

X	Y
374.171	678
380.183	678

CROSS-SECTION B

RAPID DRAWDOWN NON-CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
C&D Waste	🟨	60	Shear Normal function			C&D Waste	None			0
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28		None			0
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28		Water Surface	Custom	1	
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27		None			0
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0		Water Surface	Custom	1	

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section B, Non-Circular Rapid Drawdown

Created By: EDC	Checked By: EDC
Created Date12-20-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:07.221s
Author:	EDC
Company:	CEC
Date Created:	12/20/22

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	Rapid Drawdown
Rapid Drawdown Method:	Effective Stress using B-Bar

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

C&D Waste	
Color	🟨
Strength Type	Shear Normal function
Unit Weight [lbs/ft3]	60
Water Surface	None
Ru Value	0
In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	Water Table
Hu Value	1
Rapid Drawdown Undrained Behaviour	Yes
RD Shear Strength Envelope Properties	CR: 0PhiR: 0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1
Rapid Drawdown Undrained Behaviour	Yes
RD Shear Strength Envelope Properties	CR: 0PhiR: 0

Shear Normal Functions

Name: C&D Waste

Effective Normal (psf)	Shear (psf)
0	0
2000	1400
10000	6169

Global Minimums

Method: gle/morgenstern-price

FS	1.578770
Axis Location:	139.468, 751.937
Left Slip Surface Endpoint:	131.000, 680.000
Right Slip Surface Endpoint:	191.937, 702.000
Resisting Moment:	2.53797e+06 lb-ft
Driving Moment:	1.60799e+06 lb-ft
Resisting Horizontal Force:	31026.9 lb
Driving Horizontal Force:	19657.8 lb
Total Slice Area:	1128.87 ft2
Surface Horizontal Width:	60.9366 ft
Surface Average Height:	18.5252 ft

Global Minimum Coordinates

Method: gle/morgenstern-price

X	Y
131	680
133.336	678.967
135.626	678.481
138.246	678.001
141.689	678.001
145.126	678.001
147.911	678.027
150.084	678.099
152.254	678.202
154.634	678.415
156.928	678.7
159.805	679.524
162.681	680.466
165.557	681.492
168.433	682.639
170.643	683.747
172.852	684.854
175.061	685.961
177.259	687.092
179.021	688.084
180.776	689.107
182.799	690.827
184.079	692.057
185.358	693.287
186.731	694.903
187.756	696.196
189.15	698.129
190.543	700.062
191.937	702

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.57877

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.16779	65.0357	-23.8506	Clay Perimeter Berm Fill	270	28	214.198	338.17	156.454	28.2456	128.209	61.7559	33.5103
2	1.16779	195.107	-23.8506	Clay Perimeter Berm Fill	270	28	241.966	382.009	295.41	84.752	210.658	188.435	103.683
3	1.14509	299.1	-11.9954	Clay Perimeter Berm Fill	270	28	242.761	383.263	345.521	132.505	213.016	293.941	161.436
4	1.14509	387.128	-11.9954	Clay Perimeter Berm Fill	270	28	262.127	413.839	442.027	171.505	270.522	386.332	214.827
5	1.3101	547.771	-10.3682	Clay Perimeter Berm Fill	270	28	279.463	441.208	534.103	212.108	321.995	482.973	270.865
6	1.3101	672.68	-10.3682	Clay Perimeter Berm Fill	270	28	304.043	480.014	655.456	260.477	394.979	599.828	339.351
7	1.14764	692.88	-0.000490729	Clay Perimeter Berm Fill	270	28	299.697	473.153	688.355	306.281	382.074	688.353	382.072
8	1.14764	773.882	-0.000490729	Clay Perimeter Berm Fill	270	28	315.515	498.126	771.131	342.088	429.043	771.128	429.04
9	1.14764	848.63	-0.000490729	Clay Perimeter Berm Fill	270	28	330.429	521.671	848.454	375.13	473.324	848.451	473.321
10	1.1457	896.134	-0.000490729	Clay Perimeter Berm Fill	270	28	341.352	538.916	902.555	396.801	505.754	902.552	505.751
11	1.1457	942.265	-0.000490729	Clay Perimeter Berm Fill	270	28	351.712	555.273	953.746	417.227	536.519	953.743	536.516
12	1.1457	988.396	-0.000490729	Clay Perimeter Berm Fill	270	28	361.899	571.356	1004.42	437.654	566.769	1004.42	566.766
13	1.39253	1262.33	0.535941	Clay Perimeter Berm Fill	270	28	370.64	585.156	1052.6	459.875	592.722	1056.06	596.189
14	1.39253	1328.24	0.535941	Clay Perimeter Berm Fill	270	28	381.843	602.842	1109.87	483.889	625.983	1113.44	629.554
15	1.08657	1097.97	1.88326	Clay Perimeter Berm Fill	270	28	388.027	612.606	1156.98	512.632	644.347	1169.74	657.106
16	1.08657	1176.04	1.88326	Clay Perimeter Berm Fill	270	28	401.882	634.48	1234.57	549.082	685.485	1247.78	698.699
17	1.08476	1251.03	2.72393	Clay Perimeter Berm Fill	270	28	411.085	649.008	1297.88	585.069	712.808	1317.44	732.367
18	1.08476	1326.85	2.72393	Clay Perimeter Berm Fill	270	28	423.66	668.862	1370.68	620.528	750.149	1390.83	770.306

19	1.18991	1539.01	5.12287	Clay Perimeter Berm Fill	270	28	422.88	667.631	1403.98	656.144	747.839	1441.89	785.75
20	1.18991	1622.91	5.12287	Clay Perimeter Berm Fill	270	28	433.881	684.999	1472.42	691.916	780.503	1511.32	819.401
21	1.14742	1638.96	7.06522	Clay Perimeter Berm Fill	270	28	432.341	682.567	1500.56	724.638	775.923	1554.15	829.507
22	1.14742	1700.45	7.06522	Clay Perimeter Berm Fill	270	28	439.225	693.435	1548.19	751.824	796.367	1602.63	850.805
23	1.43812	2196.58	15.986	Clay Perimeter Berm Fill	270	28	394.53	622.872	1438.52	774.867	663.655	1551.55	776.68
24	1.43812	2250.9	15.986	Clay Perimeter Berm Fill	270	28	396.238	625.569	1462.75	794.028	668.725	1576.27	782.241
25	1.43811	2299.97	18.1389	Clay Perimeter Berm Fill	270	28	386.094	609.553	1449.95	811.344	638.605	1576.43	765.09
26	1.43811	2343.82	18.1389	Clay Perimeter Berm Fill	270	28	386.75	610.589	1467.37	826.814	640.554	1594.07	767.253
27	1.4381	2383.98	19.6262	Clay Perimeter Berm Fill	270	28	379.506	599.153	1460.03	840.984	619.045	1595.36	754.377
28	1.4381	2420.46	19.6262	Clay Perimeter Berm Fill	270	28	379.917	599.801	1474.12	853.852	620.265	1609.6	755.744
29	1.4381	2451.54	21.7503	Clay Perimeter Berm Fill	270	28	369.403	583.203	1453.87	864.82	589.049	1601.25	736.429
30	1.4381	2442.15	21.7503	Clay Perimeter Berm Fill	270	28	366.661	578.873	1442.41	861.506	580.906	1588.7	727.191
31	1.10467	1837.72	26.6203	Clay Perimeter Berm Fill	270	28	338.345	534.169	1340.79	843.961	496.827	1510.37	666.408
32	1.10467	1795.84	26.6203	Clay Perimeter Berm Fill	270	28	333.664	526.779	1307.66	824.73	482.934	1474.9	650.168
33	1.10467	1753.97	26.6203	Clay Perimeter Berm Fill	270	28	329.213	519.751	1275.21	805.5	469.712	1440.21	634.715
34	1.10467	1712.1	26.6203	Clay Perimeter Berm Fill	270	28	324.968	513.05	1243.38	786.269	457.113	1406.26	619.989
35	1.10467	1670.22	26.6203	Clay Perimeter Berm Fill	270	28	320.907	506.639	1212.09	767.038	445.049	1372.93	605.889
36	1.10467	1628.35	26.6203	Clay Perimeter Berm Fill	270	28	317.006	500.48	1181.28	747.808	433.469	1340.16	592.354
37	1.099	1577.91	27.2149	Clay Perimeter Berm Fill	270	28	311.034	491.051	1144.12	728.381	415.738	1304.07	575.69
38	1.099	1560.74	27.2149	Clay Perimeter Berm Fill	270	28	310.185	489.71	1133.67	720.455	413.218	1293.19	572.733
39	1.76149	2487.73	29.4033	Clay Perimeter Berm Fill	270	28	303.513	479.177	1109.88	716.473	393.406	1280.92	564.45
40	1.75496	2442.85	30.2293	Clay Perimeter Berm Fill	270	28	301.558	476.09	1093.76	706.16	387.597	1269.47	563.314
41	1.01164	1347.51	40.3646	Clay Perimeter Berm Fill	270	28	266.176	420.231	958.281	675.741	282.54	1184.53	508.791
42	1.01164	1276.48	40.3646	Clay Perimeter Berm Fill	270	28	262.559	414.521	911.924	640.119	271.805	1135.1	494.981
43	1.27968	1501.72	43.8684	Clay Perimeter Berm Fill	270	28	247.388	390.568	822.093	595.337	226.756	1059.9	464.559

44	1.27968	1365.65	43.8684	Clay Perimeter Berm Fill	270	28	241.313	380.978	750.111	541.393	208.718	982.076	440.683
45	1.37264	1288.54	49.6617	Clay Perimeter Berm Fill	270	28	218.168	344.437	614.812	474.816	139.996	871.718	396.902
46	1.02493	811.909	51.5892	Clay Perimeter Berm Fill	270	28	205.739	324.814	492.483	389.393	103.09	751.96	362.567
47	1.39355	829.172	54.2146	Clay Perimeter Berm Fill	270	28	183.249	289.308	325.058	288.746	36.312	579.275	290.529
48	1.39356	497.804	54.2146	Clay Perimeter Berm Fill	270	28	160.716	253.734	137.519	168.111	-30.5918	360.477	192.366
49	1.2425	164.105	54.2757	Clay Perimeter Berm Fill	270	28	135.662	214.18	-51.0895	53.893	-104.982	137.536	83.6428
50	0.151036	1.95062	54.2757	Clay Perimeter Berm Fill	270	28	119.549	188.741	-152.827	0	-152.827	13.3944	13.3944

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.57877

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	131	680	0	0	0
2	132.168	679.484	331.546	6.7963	1.17433
3	133.336	678.967	767.341	31.4022	2.34343
4	134.481	678.724	1130.09	68.7179	3.47973
5	135.626	678.481	1538.55	123.822	4.60123
6	136.936	678.241	2033.63	208.729	5.86024
7	138.246	678.001	2590.07	322.023	7.08721
8	139.394	678.001	2934.89	419.304	8.13075
9	140.541	678.001	3297.92	530.658	9.14093
10	141.689	678.001	3678.1	656.109	10.1142
11	142.835	678.001	4070.18	794.524	11.0456
12	143.98	678.001	4474.17	945.608	11.9337
13	145.126	678.001	4889.85	1108.79	12.776
14	146.519	678.014	5393.58	1318.23	13.7343
15	147.911	678.027	5912.19	1541.92	14.6173
16	148.998	678.063	6293.54	1716.04	15.2519
17	150.084	678.099	6687.21	1897	15.8374
18	151.169	678.15	7067.28	2076.21	16.3716
19	152.254	678.202	7457.27	2259.27	16.8548
20	153.444	678.309	7811.96	2436.9	17.325
21	154.634	678.415	8172.48	2613.19	17.7319
22	155.781	678.558	8456.41	2758.03	18.0636
23	156.928	678.7	8741.49	2896.91	18.3351
24	158.367	679.112	8717.64	2932.1	18.5899
25	159.805	679.524	8686.27	2948.42	18.749
26	161.243	679.995	8559.81	2916.02	18.8121
27	162.681	680.466	8426.09	2865.05	18.7791
28	164.119	680.979	8224.49	2775.86	18.6501
29	165.557	681.492	8016.26	2670.59	18.4253
30	166.995	682.066	7714.68	2522.32	18.1052
31	168.433	682.639	7415.72	2365.31	17.6905
32	169.538	683.193	7048.08	2196.37	17.3084
33	170.643	683.747	6693.59	2030.06	16.8717
34	171.747	684.3	6352.14	1867.27	16.3812
35	172.852	684.854	6023.61	1708.78	15.8376
36	173.957	685.408	5707.91	1555.3	15.242
37	175.061	685.961	5404.95	1407.44	14.5956
38	176.16	686.526	5101.01	1262.71	13.9036
39	177.259	687.092	4802.05	1123.14	13.1641
40	179.021	688.084	4236.28	891.565	11.885
41	180.776	689.107	3648.35	676.374	10.5029
42	181.787	689.967	3094.28	526.767	9.66135
43	182.799	690.827	2576.4	398.372	8.78967
44	184.079	692.057	1882.52	252.772	7.64755
45	185.358	693.287	1269.39	143.871	6.46624
46	186.731	694.903	575.847	52.021	5.16199
47	187.756	696.196	150.645	10.9763	4.16732
48	189.15	698.129	-221.759	-10.8185	2.79296
49	190.543	700.062	-263.085	-6.43384	1.40091
50	191.786	701.79	-5.83704	-0.0154844	0.151993
51	191.937	702	0	0	0

Discharge Sections

Entity Information

Water Table

X	Y
0	701.79
412.374	701.79

External Boundary

X	Y
206.442	702.93
199	702
187	702
180	700
176	698
167	696
163	694
159	692
155	690
148	686
141	684
137	682
131	680
124	678
88	676
27	674
8	674
0	672
0	669.5
0	500
693	500
693	650
693	652
693	804
677	800
637	790
597	780
589	778
581	776
559	776
535	770
495	760
455	750
447	748
425	748
393	740
353	730
313	720
305	718
297	716
289	714
279.273	711.576
272.952	710
243.001	710
243	710
234	710
211.897	704.33

Material Boundary

X	Y
124	678
324.992	678
374.171	678

Material Boundary

X	Y
458.342	650
693	650

Material Boundary

X	Y
290	706
374.171	678
399.723	669.5
458.342	650

Material Boundary

X	Y
243	710
278	710
284	708
290	706

Material Boundary

X	Y
458.342	652
693	652

Material Boundary

X	Y
290	708
380.183	678
405.735	669.5
458.342	652

Material Boundary

X	Y
279.273	711.576
284	710
290	708

Material Boundary

X	Y
0	669.5
399.723	669.5

Material Boundary

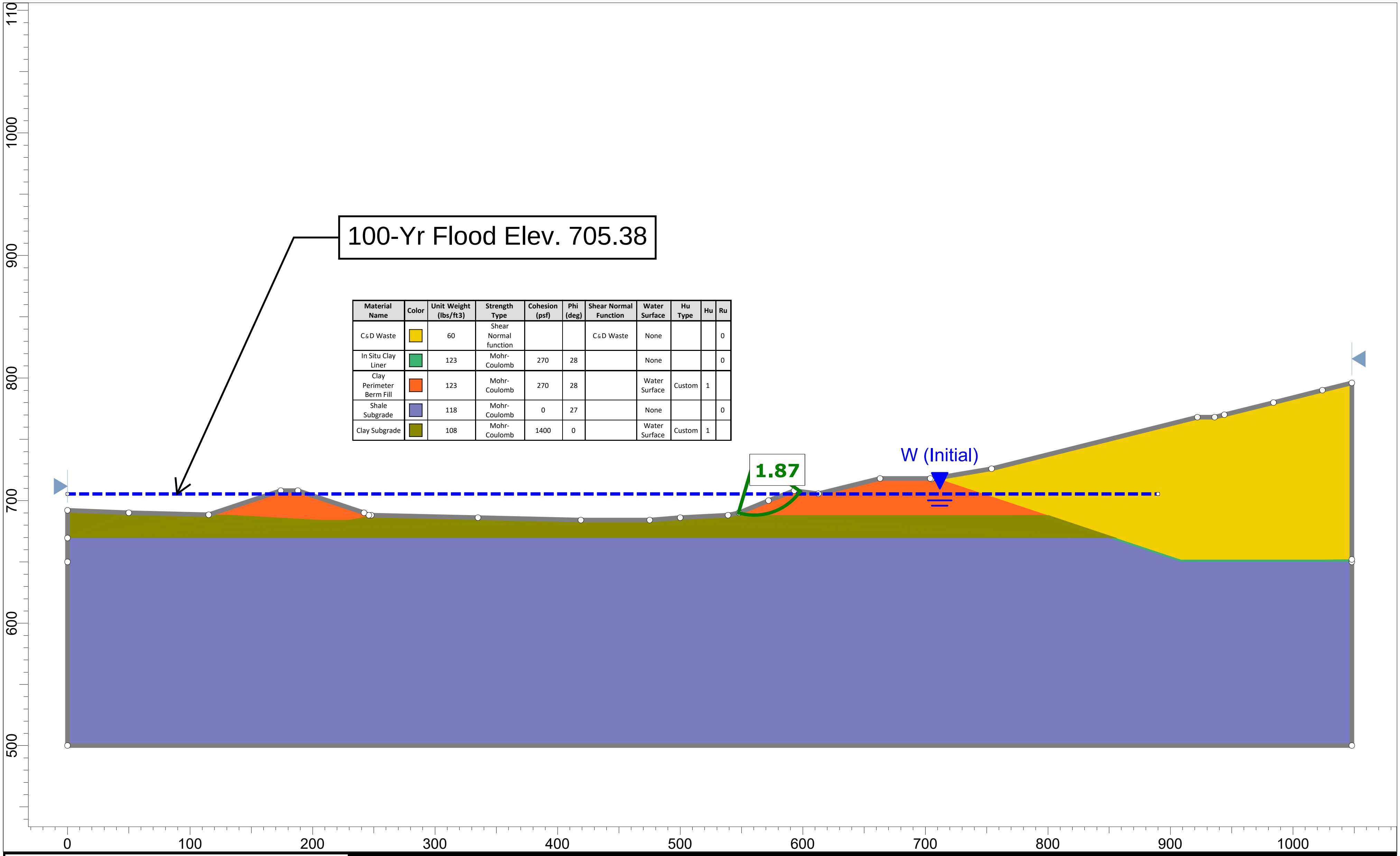
X	Y
399.723	669.5
405.735	669.5

Material Boundary

X	Y
374.171	678
380.183	678

CROSS-SECTION C

RAPID DRAWDOWN CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
C&D Waste	🟨	60	Shear Normal function			C&D Waste	None			0
In Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28		None			0
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28		Water Surface	Custom	1	
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27		None			0
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0		Water Surface	Custom	1	

rocscience

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section C, Circular Rapid Drawdown

Created By: EDC	Checked By: EDC
Created Date12-20-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Date Created:	3/24/2022, 9:28:32 AM

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	Rapid Drawdown
Rapid Drawdown Method:	Effective Stress using B-Bar

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

C&D Waste	
Color	🟨
Strength Type	Shear Normal function
Unit Weight [lbs/ft3]	60
Water Surface	None
Ru Value	0
In Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	Water Table
Hu Value	1
Rapid Drawdown Undrained Behaviour	Yes
RD Shear Strength Envelope Properties	CR: 0PhiR: 0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1
Rapid Drawdown Undrained Behaviour	Yes
RD Shear Strength Envelope Properties	CR: 0PhiR: 0

Shear Normal Functions

Name: C&D Waste

Effective Normal (psf)	Shear (psf)
0	0
2000	1400
10000	6169

Global Minimums

Method: gle/morgenstern-price

FS	1.870690
Center:	560.513, 734.138
Radius:	46.118
Left Slip Surface Endpoint:	547.510, 689.891
Right Slip Surface Endpoint:	598.078, 707.385
Resisting Moment:	1.24275e+06 lb-ft
Driving Moment:	664326 lb-ft
Resisting Horizontal Force:	24309.2 lb
Driving Horizontal Force:	12994.8 lb
Total Slice Area:	672.783 ft2
Surface Horizontal Width:	50.5672 ft
Surface Average Height:	13.3047 ft

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.87069

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.00114	34.1873	-15.7299	Clay Perimeter Berm Fill	270	28	163.252	305.394	83.8799	17.3143	66.5656	37.9	20.5857
2	1.00114	115.922	-14.4416	Clay Perimeter Berm Fill	270	28	177.067	331.237	173.902	58.7326	115.169	128.302	69.5694
3	1.00114	197.575	-13.1607	Clay Perimeter Berm Fill	270	28	191.223	357.719	265.085	100.11	164.975	220.372	120.262
4	1.00114	276.329	-11.8865	Clay Perimeter Berm Fill	270	28	205.147	383.766	353.98	140.018	213.962	310.799	170.781
5	1.00114	352.226	-10.6182	Clay Perimeter Berm Fill	270	28	218.7	409.119	440.123	178.478	261.645	399.122	220.644
6	1.00114	425.303	-9.35519	Clay Perimeter Berm Fill	270	28	231.749	433.531	523.065	215.509	307.556	484.886	269.377
7	1.00114	495.593	-8.09673	Clay Perimeter Berm Fill	270	28	244.169	456.764	602.381	251.128	351.253	567.645	316.517
8	1.00114	563.125	-6.8422	Clay Perimeter Berm Fill	270	28	255.844	478.605	677.678	285.349	392.329	646.979	361.63
9	1.00114	627.921	-5.59096	Clay Perimeter Berm Fill	270	28	266.672	498.861	748.609	318.184	430.425	722.504	404.32
10	1.00114	690.002	-4.34239	Clay Perimeter Berm Fill	270	28	276.566	517.369	814.876	349.643	465.233	793.875	444.232
11	1.00114	749.383	-3.09588	Clay Perimeter Berm Fill	270	28	285.454	533.996	876.239	379.734	496.505	860.8	481.066
12	1.00114	806.076	-1.85084	Clay Perimeter Berm Fill	270	28	293.284	548.643	932.513	408.462	524.051	923.035	514.573
13	1.00114	860.087	-0.606669	Clay Perimeter Berm Fill	270	28	300.019	561.242	983.579	435.832	547.747	980.402	544.57
14	1.00114	911.42	0.637212	Clay Perimeter Berm Fill	270	28	305.642	571.761	1029.38	461.845	567.532	1032.78	570.932
15	1.00114	960.076	1.88139	Clay Perimeter Berm Fill	270	28	310.152	580.199	1069.9	486.501	583.396	1080.09	593.584
16	1.00114	1006.05	3.12647	Clay Perimeter Berm Fill	270	28	313.567	586.587	1105.22	509.798	595.418	1122.34	612.545
17	1.00114	1049.34	4.37302	Clay Perimeter Berm Fill	270	28	315.918	590.985	1135.42	531.733	603.689	1159.58	627.848
18	1.00114	1089.92	5.62165	Clay Perimeter Berm Fill	270	28	317.25	593.477	1160.68	552.299	608.377	1191.9	639.605

19	1.00114	1127.79	6.87296	Clay Perimeter Berm Fill	270	28	317.623	594.174	1181.17	571.489	609.681	1219.45	647.965
20	1.00114	1162.93	8.12758	Clay Perimeter Berm Fill	270	28	317.103	593.202	1197.15	589.293	607.857	1242.44	653.143
21	1.00114	1195.3	9.38614	Clay Perimeter Berm Fill	270	28	315.769	590.705	1208.85	605.699	603.155	1261.05	655.352
22	1.00114	1224.89	10.6493	Clay Perimeter Berm Fill	270	28	313.7	586.836	1216.57	620.691	595.883	1275.56	654.87
23	1.00114	1251.65	11.9177	Clay Perimeter Berm Fill	270	28	310.985	581.757	1220.58	634.255	586.329	1286.22	651.965
24	1.00114	1275.56	13.1921	Clay Perimeter Berm Fill	270	28	307.711	575.631	1221.18	646.371	574.805	1293.3	646.933
25	1.00114	1295.93	14.4731	Clay Perimeter Berm Fill	270	28	303.888	568.48	1218.05	656.693	561.357	1296.49	639.795
26	1.00114	1310.06	15.7616	Clay Perimeter Berm Fill	270	28	299.294	559.887	1209.05	663.851	545.196	1293.52	629.672
27	1.00114	1320.71	17.0583	Clay Perimeter Berm Fill	270	28	294.362	550.66	1197.09	669.249	527.842	1287.41	618.165
28	1.00114	1328.3	18.3641	Clay Perimeter Berm Fill	270	28	289.222	541.044	1182.85	673.094	509.76	1278.86	605.77
29	1.00114	1332.75	19.6799	Clay Perimeter Berm Fill	270	28	283.94	531.163	1166.53	675.352	491.176	1268.08	592.729
30	1.00114	1334	21.0066	Clay Perimeter Berm Fill	270	28	278.575	521.128	1148.28	675.985	472.3	1255.26	579.271
31	1.00114	1331.96	22.3451	Clay Perimeter Berm Fill	270	28	273.179	511.034	1128.27	674.949	453.317	1240.56	565.607
32	1.00114	1326.53	23.6967	Clay Perimeter Berm Fill	270	28	267.793	500.958	1106.57	672.199	434.369	1224.1	551.903
33	1.00114	1317.62	25.0624	Clay Perimeter Berm Fill	270	28	262.448	490.958	1083.24	667.682	415.559	1205.97	538.288
34	1.00114	1305.1	26.4435	Clay Perimeter Berm Fill	270	28	257.164	481.075	1058.31	661.338	396.974	1186.21	524.875
35	1.00114	1288.85	27.8414	Clay Perimeter Berm Fill	270	28	251.956	471.331	1031.75	653.104	378.644	1164.82	511.719
36	1.00114	1268.73	29.2576	Clay Perimeter Berm Fill	270	28	246.823	461.729	1003.5	642.907	360.593	1141.77	498.863
37	1.00114	1244.57	30.6937	Clay Perimeter Berm Fill	270	28	241.757	452.253	973.429	630.666	342.763	1116.94	486.272
38	1.00114	1216.2	32.1515	Clay Perimeter Berm Fill	270	28	236.74	442.867	941.407	616.29	325.117	1090.21	473.92
39	1.00114	1183.42	33.633	Clay Perimeter Berm Fill	270	28	232.307	434.574	906.982	597.459	309.523	1061.52	464.06
40	1.00114	1145.99	35.1404	Clay Perimeter Berm Fill	270	28	232.303	434.567	868.047	558.538	309.509	1031.56	473.019
41	1.00114	1103.66	36.6764	Clay Perimeter Berm Fill	270	28	233.026	435.919	825.338	513.29	312.048	998.881	485.591
42	1.00114	1056.14	38.2437	Clay Perimeter Berm Fill	270	28	233.408	436.634	778.803	465.41	313.393	962.765	497.355
43	1.00114	1003.08	39.8455	Clay Perimeter Berm Fill	270	28	233.348	436.522	727.907	414.725	313.182	922.639	507.914

44	1.00114	944.097	41.4858	Clay Perimeter Berm Fill	270	28	232.722	435.351	672.017	361.038	310.979	877.81	516.772
45	1.00114	878.734	43.1686	Clay Perimeter Berm Fill	270	28	231.379	432.839	610.373	304.117	306.256	827.415	523.298
46	1.00114	796.678	44.8993	Clay Perimeter Berm Fill	270	28	227.075	424.786	534.801	243.691	291.11	761.079	517.388
47	1.00114	660.877	46.6839	Clay Perimeter Berm Fill	270	28	211.971	396.532	417.41	179.438	237.972	642.221	462.783
48	1.00114	510.817	48.5296	Clay Perimeter Berm Fill	270	28	194.236	363.356	286.546	110.968	175.578	506.318	395.35
49	1.00114	351.501	50.4453	Clay Perimeter Berm Fill	270	28	174.717	326.841	144.711	37.8082	106.903	356.248	318.44
50	1.51154	203.373	52.9816	Clay Perimeter Berm Fill	270	28	133.687	250.087	-37.4517	0	-37.4517	139.838	139.838

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.87069

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	547.51	689.891	0	0	0
2	548.512	689.609	187.267	3.70324	1.13289
3	549.513	689.351	409.564	16.1671	2.26052
4	550.514	689.117	663.267	39.1459	3.37767
5	551.515	688.907	943.463	73.9086	4.47926
6	552.516	688.719	1245.25	121.229	5.5604
7	553.517	688.554	1563.79	181.385	6.61621
8	554.518	688.412	1894.3	254.178	7.64233
9	555.519	688.291	2232.12	338.95	8.63447
10	556.521	688.193	2572.75	434.627	9.58872
11	557.522	688.117	2911.88	539.761	10.5014
12	558.523	688.063	3245.42	652.584	11.3693
13	559.524	688.031	3569.52	771.068	12.1894
14	560.525	688.02	3880.63	892.991	12.959
15	561.526	688.031	4175.5	1016	13.6757
16	562.527	688.064	4451.15	1137.69	14.3375
17	563.529	688.119	4704.98	1255.65	14.9427
18	564.53	688.196	4934.68	1367.52	15.4893
19	565.531	688.294	5138.26	1471.09	15.9765
20	566.532	688.415	5314.06	1564.31	16.4029
21	567.533	688.558	5460.7	1645.33	16.7678
22	568.534	688.723	5577.13	1712.56	17.0701
23	569.535	688.911	5662.51	1764.71	17.3095
24	570.536	689.123	5716.28	1800.75	17.4855
25	571.538	689.357	5738.1	1819.99	17.5978
26	572.539	689.616	5727.91	1822.08	17.6462
27	573.54	689.898	5686.24	1807.11	17.6305
28	574.541	690.206	5613.51	1775.41	17.5508
29	575.542	690.538	5510.27	1727.58	17.4073
30	576.543	690.896	5377.16	1664.52	17.2001
31	577.544	691.28	5214.92	1587.37	16.9297
32	578.546	691.692	5024.4	1497.52	16.5967
33	579.547	692.131	4806.57	1396.58	16.2016
34	580.548	692.6	4562.46	1286.34	15.7453
35	581.549	693.097	4293.25	1168.76	15.2287
36	582.55	693.626	4000.21	1045.94	14.6531
37	583.551	694.187	3684.78	920.095	14.0201
38	584.552	694.781	3348.59	793.495	13.3311
39	585.554	695.411	2993.46	668.473	12.5882
40	586.555	696.077	2622.25	547.511	11.7936
41	587.556	696.781	2243.39	434.029	10.9497
42	588.557	697.527	1861.58	330.239	10.0595
43	589.558	698.316	1480.99	237.905	9.12598
44	590.559	699.151	1106.72	158.547	8.15263
45	591.56	700.037	745.034	93.3713	7.14334
46	592.561	700.976	403.728	43.1611	6.10211
47	593.563	701.973	97.7788	8.6118	5.0333
48	594.564	703.035	-132.975	-9.16224	3.94156
49	595.565	704.168	-262.892	-13.0033	2.83169
50	596.566	705.38	-263.192	-7.85164	1.70876
51	598.078	707.385	0	0	0

Discharge Sections

Entity Information

Water Table

X	Y
0	705.38
889.805	705.38

External Boundary

X	Y
612.738	705.608
593	708
572	700
548	690
539	688
500	686
475	684
419	684
335	686
248	688
246	688
242	690
188	708
174	708
115.227	688.465
50	690
0	692
0	669.5
0	650
0	500
1048	500
1048	650
1048	652
1048	796
1024	790
984	780
944	770
936	768
922	768
754	726
709.141	718.29
705.177	717.609
704	718
663	718

Material Boundary

X	Y
115.227	688.465
135	688
170	686
206	684
230	684
240	686
248	688

Material Boundary

X	Y
705.177	717.609
794.183	688
849.796	669.5
908.416	650

Material Boundary

X	Y
908.416	650
1048	650

Material Boundary

X	Y
539	688
794.183	688

Material Boundary

X	Y
908.416	652
1048	652

Material Boundary

X	Y
709.141	718.29
794.183	690
800.196	688
855.809	669.5
908.416	652

Material Boundary

X	Y
0	669.5
849.796	669.5

Material Boundary

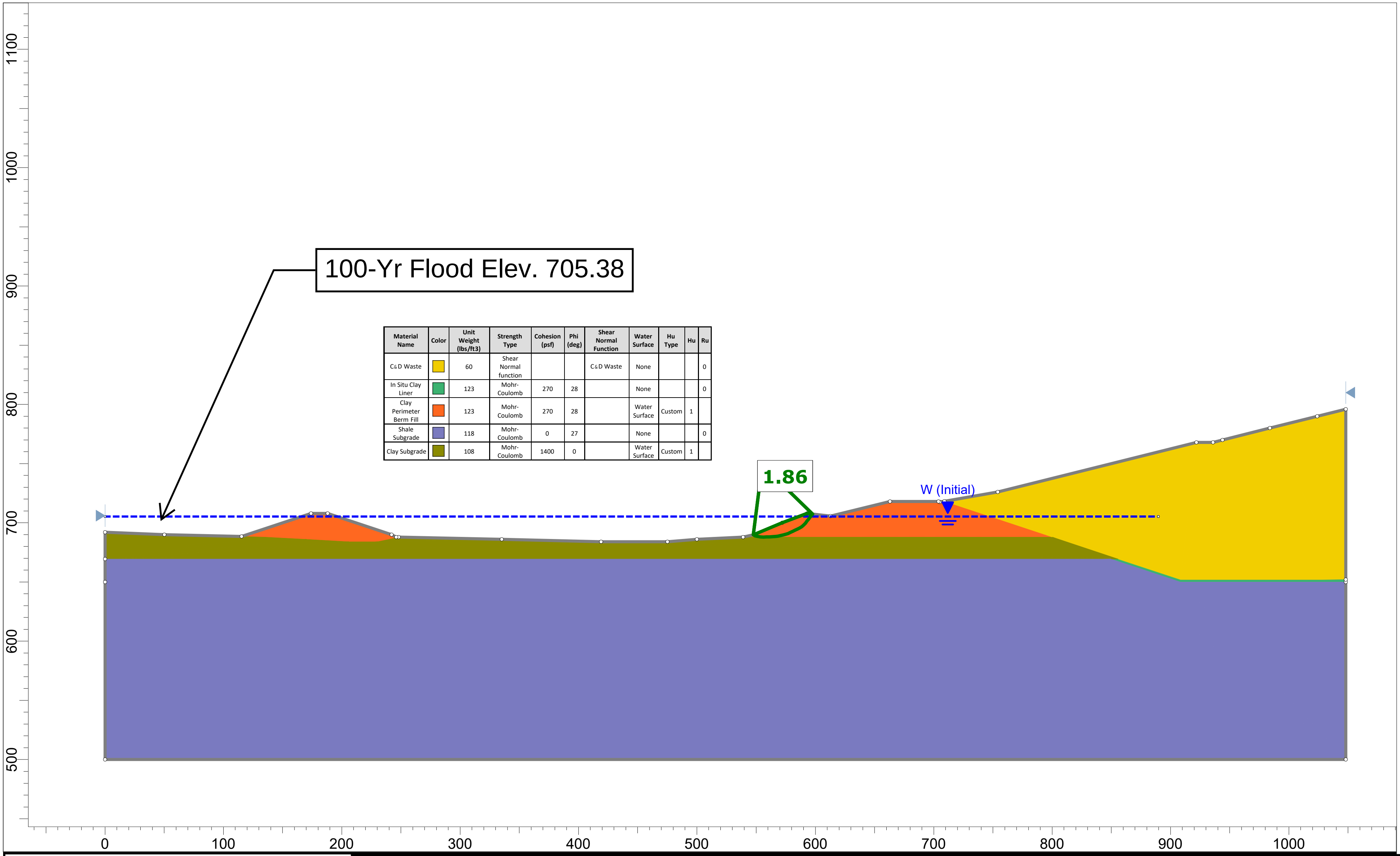
X	Y
849.796	669.5
855.809	669.5

Material Boundary

X	Y
794.183	688
800.196	688

CROSS-SECTION C

RAPID DRAWDOWN NON-CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
C&D Waste	🟨	60	Shear Normal function			C&D Waste	None			0
In Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28		None			0
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28		Water Surface	Custom	1	
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27		None			0
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0		Water Surface	Custom	1	

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section C, Non-Circular Rapid Drawdown

Created By: EDC	Checked By: EDC	Civil & Environmental Consultants, Inc.
Created Date12-20-22	Checked Date: 12-20-22	

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:07.318s
Date Created:	3/24/2022, 9:28:32 AM

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	Rapid Drawdown
Rapid Drawdown Method:	Effective Stress using B-Bar

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

C&D Waste	
Color	🟨
Strength Type	Shear Normal function
Unit Weight [lbs/ft3]	60
Water Surface	None
Ru Value	0
In Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	Water Table
Hu Value	1
Rapid Drawdown Undrained Behaviour	Yes
RD Shear Strength Envelope Properties	CR: 0PhiR: 0
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1
Rapid Drawdown Undrained Behaviour	Yes
RD Shear Strength Envelope Properties	CR: 0PhiR: 0

Shear Normal Functions

Name: C&D Waste

Effective Normal (psf)	Shear (psf)
0	0
2000	1400
10000	6169

Global Minimums

Method: gle/morgenstern-price

FS	1.857390
Axis Location:	555.104, 748.766
Left Slip Surface Endpoint:	547.582, 689.907
Right Slip Surface Endpoint:	597.678, 707.433
Resisting Moment:	1.6452e+06 lb-ft
Driving Moment:	885758 lb-ft
Resisting Horizontal Force:	24316.1 lb
Driving Horizontal Force:	13091.6 lb
Total Slice Area:	677.233 ft2
Surface Horizontal Width:	50.0958 ft
Surface Average Height:	13.5188 ft

Global Minimum Coordinates

Method: gle/morgenstern-price

X	Y
547.582	689.907
548.962	689.125
550.342	688.632
551.585	688.397
553.417	688.079
556.115	688
558.7	688.033
561.284	688.106
563.884	688.205
566.483	688.405
568.12	688.69
569.757	689.021
571.394	689.352
573.032	689.761
574.952	690.263
576.873	690.829
578.826	691.765
580.779	692.7
582.732	693.636
584.685	694.571
586.567	695.514
588.45	696.649
590.027	698.074
591.603	699.764
592.835	701.32
594.067	702.875
595.3	704.43
596.532	705.986
597.678	707.433

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.85739

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.37997	103.506	-29.5543	Clay Perimeter Berm Fill	270	28	188.956	350.966	190.316	38.0419	152.274	83.1731	45.1312
2	1.38	307.21	-19.6323	Clay Perimeter Berm Fill	270	28	205.04	380.84	321.387	112.927	208.46	248.245	135.318
3	1.24299	415.875	-10.7193	Clay Perimeter Berm Fill	270	28	215.654	400.554	415.263	169.726	245.537	374.44	204.714
4	0.916099	379.412	-9.85549	Clay Perimeter Berm Fill	270	28	230.765	428.621	508.424	210.101	298.323	468.334	258.233
5	0.916099	440.356	-9.85549	Clay Perimeter Berm Fill	270	28	244.804	454.696	591.213	243.851	347.362	548.684	304.833
6	1.34891	743.18	-1.67955	Clay Perimeter Berm Fill	270	28	245.169	455.375	628.135	279.495	348.64	620.946	341.451
7	1.34891	842.995	-1.67955	Clay Perimeter Berm Fill	270	28	259.718	482.398	716.498	317.035	399.463	708.883	391.848
8	0.0223231	14.789	0.736016	Clay Perimeter Berm Fill	270	28	262.192	486.993	744.189	336.086	408.103	747.557	411.471
9	1.28105	890.158	0.736016	Clay Perimeter Berm Fill	270	28	268.289	498.318	781.912	352.508	429.404	785.358	432.85
10	1.28105	971.671	0.736016	Clay Perimeter Berm Fill	270	28	280.171	520.386	855.696	384.788	470.908	859.296	474.508
11	1.29221	1061.12	1.62504	Clay Perimeter Berm Fill	270	28	289.384	537.499	919.674	416.583	503.091	927.884	511.301
12	1.29221	1140.87	1.62504	Clay Perimeter Berm Fill	270	28	300.214	557.615	988.822	447.893	540.929	997.339	549.446
13	1.29971	1226.95	2.17378	Clay Perimeter Berm Fill	270	28	308.935	573.812	1050.29	478.905	571.387	1062.02	583.113
14	1.29971	1305.64	2.17378	Clay Perimeter Berm Fill	270	28	318.674	591.902	1115.03	509.619	605.409	1127.12	617.506
15	1.29972	1380.3	4.39153	Clay Perimeter Berm Fill	270	28	319.865	594.114	1148.33	538.758	609.571	1172.89	634.136
16	1.29972	1450.91	4.39153	Clay Perimeter Berm Fill	270	28	327.131	607.61	1201.28	566.323	634.954	1226.4	660.077
17	0.818577	946.021	9.89393	Clay Perimeter Berm Fill	270	28	312.653	580.718	1170.67	586.292	584.375	1225.2	638.908
18	0.818577	965.987	9.89393	Clay Perimeter Berm Fill	270	28	314.725	584.567	1190.28	598.665	591.615	1245.17	646.509

19	0.818578	984.813	11.4258	Clay Perimeter Berm Fill	270	28	311.206	578.03	1189.65	610.332	579.321	1252.55	642.217
20	0.818578	1002.5	11.4258	Clay Perimeter Berm Fill	270	28	312.597	580.614	1205.47	621.292	584.176	1268.64	647.353
21	0.818577	1020.18	11.4258	Clay Perimeter Berm Fill	270	28	313.919	583.07	1221.05	632.252	588.795	1284.49	652.239
22	0.818577	1037.86	11.4258	Clay Perimeter Berm Fill	270	28	315.179	585.41	1236.41	643.211	593.199	1300.11	656.898
23	0.818579	1053.48	14.029	Clay Perimeter Berm Fill	270	28	306.855	569.95	1217.01	652.89	564.124	1293.69	640.796
24	0.818579	1065.09	14.029	Clay Perimeter Berm Fill	270	28	307.025	570.266	1224.8	660.085	564.715	1301.52	641.43
25	0.960327	1262.65	14.648	Clay Perimeter Berm Fill	270	28	304.842	566.211	1224.1	667.015	557.088	1303.78	636.766
26	0.960327	1276.21	14.648	Clay Perimeter Berm Fill	270	28	304.753	566.045	1230.96	674.181	556.783	1310.62	636.437
27	0.960326	1287.87	16.4315	Clay Perimeter Berm Fill	270	28	298.365	554.181	1214.81	680.342	534.469	1302.8	622.461
28	0.960326	1297.63	16.4315	Clay Perimeter Berm Fill	270	28	297.961	553.43	1218.56	685.497	533.06	1306.43	620.932
29	0.976509	1318.71	25.595	Clay Perimeter Berm Fill	270	28	267.156	496.213	1110.53	685.088	425.444	1238.5	553.415
30	0.976509	1307.21	25.595	Clay Perimeter Berm Fill	270	28	265.307	492.778	1098.1	679.113	418.988	1225.19	546.073
31	0.97651	1295.71	25.595	Clay Perimeter Berm Fill	270	28	263.679	489.754	1086.44	673.137	413.298	1212.74	539.604
32	0.97651	1284.21	25.595	Clay Perimeter Berm Fill	270	28	262.266	487.13	1075.53	667.162	408.366	1201.16	533.995
33	0.976508	1272.7	25.595	Clay Perimeter Berm Fill	270	28	261.06	484.89	1065.33	661.187	404.147	1190.38	529.198
34	0.976508	1261.2	25.595	Clay Perimeter Berm Fill	270	28	260.052	483.018	1055.84	655.212	400.627	1180.41	525.196
35	0.976508	1249.7	25.595	Clay Perimeter Berm Fill	270	28	259.234	481.498	1047	649.236	397.765	1171.18	521.941
36	0.976508	1238.2	25.595	Clay Perimeter Berm Fill	270	28	258.594	480.31	1038.8	643.261	395.539	1162.67	519.409
37	0.941227	1181.41	26.5867	Clay Perimeter Berm Fill	270	28	255.504	474.571	1021.51	636.764	384.744	1149.38	512.616
38	0.941227	1168.38	26.5867	Clay Perimeter Berm Fill	270	28	255.74	475.009	1012.81	627.244	385.57	1140.8	513.561
39	0.941243	1149.77	31.1071	Clay Perimeter Berm Fill	270	28	249.168	462.803	960.547	597.938	362.609	1110.9	512.959
40	0.941243	1125.53	31.1071	Clay Perimeter Berm Fill	270	28	254.168	472.09	942.572	562.497	380.075	1095.94	533.442
41	0.78836	912.584	42.1029	Clay Perimeter Berm Fill	270	28	231.682	430.323	824.074	522.55	301.524	1033.44	510.885
42	0.78836	872.625	42.1029	Clay Perimeter Berm Fill	270	28	234.349	435.278	788.939	478.096	310.843	1000.71	522.615
43	0.788364	826.236	46.9898	Clay Perimeter Berm Fill	270	28	224.648	417.259	706.455	429.501	276.954	947.275	517.774

44	0.788364	773.409	46.9898	Clay Perimeter Berm Fill	270	28	226.105	419.966	658.811	376.766	282.045	901.193	524.427
45	1.23206	1085.13	51.6149	Clay Perimeter Berm Fill	270	28	215.53	400.324	546.978	301.872	245.106	819.054	517.182
46	1.23206	885.366	51.6149	Clay Perimeter Berm Fill	270	28	208.691	387.62	426.032	204.821	221.211	689.474	484.653
47	1.23207	627.877	51.6149	Clay Perimeter Berm Fill	270	28	190.316	353.49	264.792	107.77	157.022	505.039	397.269
48	0.752228	256.335	51.6149	Clay Perimeter Berm Fill	270	28	173.502	322.262	127.907	29.6171	98.29	346.929	317.312
49	0.479842	113.21	51.6149	Clay Perimeter Berm Fill	270	28	158.061	293.582	44.3505	0	44.3505	243.881	243.881
50	1.14645	111.837	51.6149	Clay Perimeter Berm Fill	270	28	128.27	238.248	-59.7169	0	-59.7169	102.206	102.206

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.85739

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	547.582	689.907	0	0	0
2	548.962	689.125	409.673	11.2702	1.57582
3	550.342	688.632	850.841	46.6392	3.13755
4	551.585	688.397	1216.61	96.1901	4.52063
5	552.501	688.238	1508.93	145.818	5.51973
6	553.417	688.079	1827.29	208.109	6.49739
7	554.766	688.039	2182.85	302.531	7.89061
8	556.115	688	2561.52	415.756	9.21919
9	556.138	688	2567.16	417.655	9.24057
10	557.419	688.016	2897.99	533.579	10.4325
11	558.7	688.033	3242.82	662.708	11.55
12	559.992	688.07	3583.05	800.61	12.5955
13	561.284	688.106	3934.74	948.504	13.5531
14	562.584	688.156	4284.45	1101.88	14.4228
15	563.884	688.205	4643.63	1261.18	15.1946
16	565.183	688.305	4944.75	1405.32	15.8654
17	566.483	688.405	5250.02	1548.38	16.4323
18	567.302	688.547	5338.81	1605.28	16.735
19	568.12	688.69	5426.5	1658.56	16.9953
20	568.939	688.856	5484.43	1699.06	17.2128
21	569.757	689.021	5540.88	1735.05	17.3872
22	570.576	689.186	5595.85	1766.32	17.5182
23	571.394	689.352	5649.3	1792.7	17.6059
24	572.213	689.556	5651.56	1798.2	17.6499
25	573.032	689.761	5652.37	1798.51	17.6504
26	573.992	690.012	5637.86	1787.92	17.5952
27	574.952	690.263	5621.55	1770.33	17.4802
28	575.913	690.546	5564.03	1733.57	17.3053
29	576.873	690.829	5505.06	1690.53	17.071
30	577.849	691.297	5246.48	1581.23	16.7722
31	578.826	691.765	4991.91	1470.43	16.413
32	579.802	692.233	4741.2	1358.97	15.9939
33	580.779	692.7	4494.22	1247.7	15.5159
34	581.755	693.168	4250.83	1137.42	14.98
35	582.732	693.636	4010.89	1028.9	14.3876
36	583.708	694.104	3774.29	922.869	13.7401
37	584.685	694.571	3540.9	820.024	13.0391
38	585.626	695.042	3300.2	720.442	12.3146
39	586.567	695.514	3063.82	625.81	11.5443
40	587.509	696.081	2752.8	521.662	10.7304
41	588.45	696.649	2456.7	427.678	9.87545
42	589.238	697.362	2052.27	329.811	9.12968
43	590.027	698.074	1674.98	246.107	8.35873
44	590.815	698.919	1255.04	166.669	7.5646
45	591.603	699.764	876.527	103.73	6.74911
46	592.835	701.32	291.358	27.732	5.43714
47	594.067	702.875	-114.131	-8.15515	4.08708
48	595.3	704.43	-291.483	-13.7872	2.70808
49	596.052	705.38	-282.428	-9.15207	1.85602
50	596.532	705.986	-233.447	-5.33748	1.30977
51	597.678	707.433	0	0	0

Discharge Sections

Entity Information

Water Table

X	Y
0	705.38
889.805	705.38

External Boundary

X	Y
612.738	705.608
593	708
572	700
548	690
539	688
500	686
475	684
419	684
335	686
248	688
246	688
242	690
188	708
174	708
115.227	688.465
50	690
0	692
0	669.5
0	650
0	500
1048	500
1048	650
1048	652
1048	796
1024	790
984	780
944	770
936	768
922	768
754	726
709.141	718.29
705.177	717.609
704	718
663	718

Material Boundary

X	Y
115.227	688.465
135	688
170	686
206	684
230	684
240	686
248	688

Material Boundary

X	Y
705.177	717.609
794.183	688
849.796	669.5
908.416	650

Material Boundary

X	Y
908.416	650
1048	650

Material Boundary

X	Y
539	688
794.183	688

Material Boundary

X	Y
908.416	652
1048	652

Material Boundary

X	Y
709.141	718.29
794.183	690
800.196	688
855.809	669.5
908.416	652

Material Boundary

X	Y
0	669.5
849.796	669.5

Material Boundary

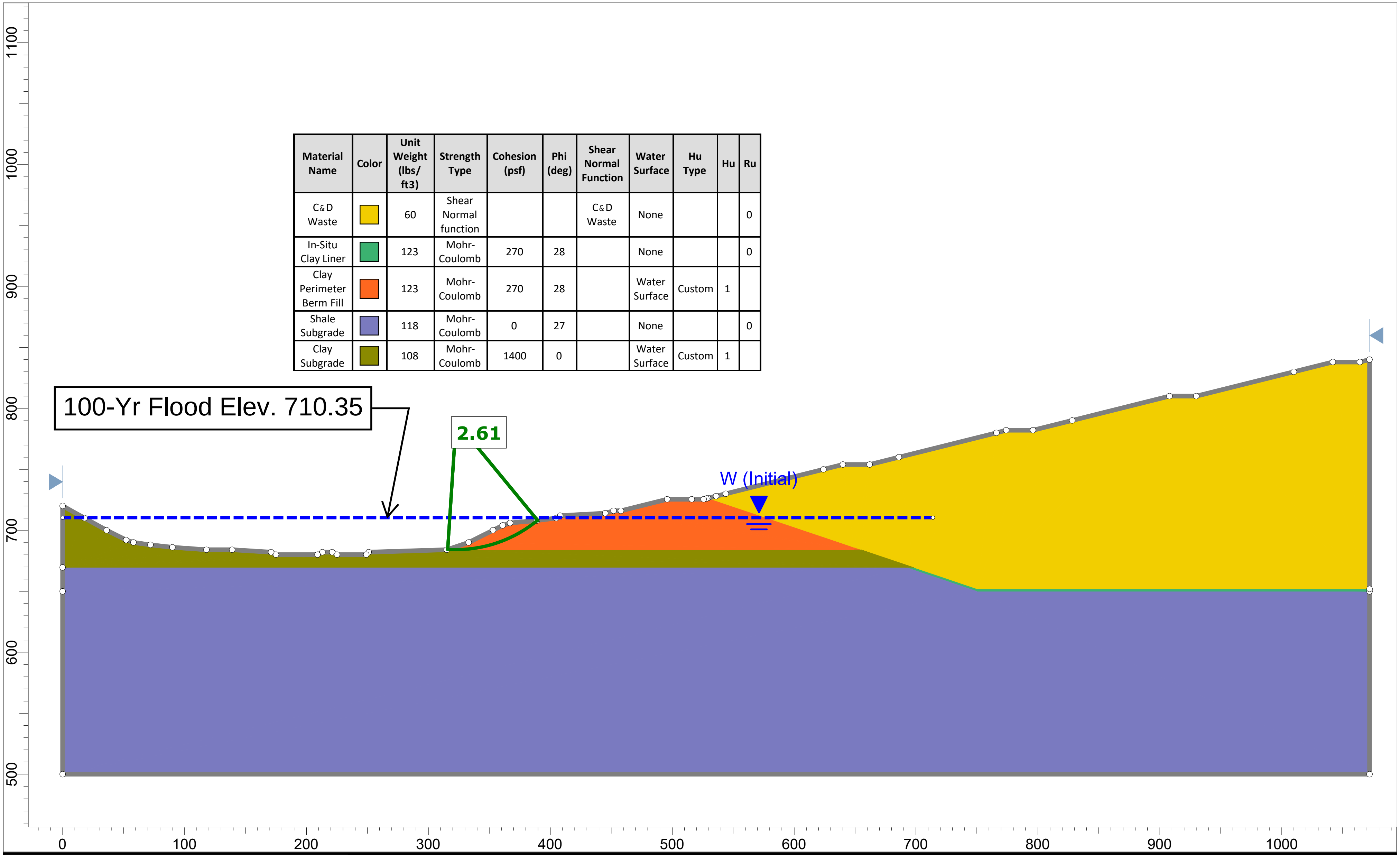
X	Y
849.796	669.5
855.809	669.5

Material Boundary

X	Y
794.183	688
800.196	688

CROSS-SECTION D

RAPID DRAWDOWN CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
C&D Waste	🟨	60	Shear Normal function			C&D Waste	None			0
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28		None			0
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28		Water Surface	Custom	1	
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27		None			0
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0		Water Surface	Custom	1	

rocscience

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section D, Circular Rapid Drawdown

Created By: EDC

Checked By: EDC

Created Date12-20-22

Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Date Created:	3/24/2022, 9:28:32 AM

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	Rapid Drawdown
Rapid Drawdown Method:	Effective Stress using B-Bar

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

C&D Waste	
Color	🟨
Strength Type	Shear Normal function
Unit Weight [lbs/ft3]	60
Water Surface	None
Ru Value	0
In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0
Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	Water Table
Hu Value	1
Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

Name: C&D Waste

Effective Normal (psf)	Shear (psf)
0	0
2000	1400
10000	6169

Global Minimums

Method: gle/morgenstern-price

FS	2.610180
Center:	322.738, 789.410
Radius:	105.380
Left Slip Surface Endpoint:	315.780, 684.260
Right Slip Surface Endpoint:	389.768, 708.096
Resisting Moment:	5.94445e+06 lb-ft
Driving Moment:	2.27741e+06 lb-ft
Resisting Horizontal Force:	52772.5 lb
Driving Horizontal Force:	20218 lb
Total Slice Area:	1436.19 ft2
Surface Horizontal Width:	73.9878 ft
Surface Average Height:	19.4111 ft

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.61018

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.47976	52.849	-3.38305	Clay Perimeter Berm Fill	270	28	112.534	293.733	44.6359	0	44.6359	37.9836	37.9836
2	1.47976	156.648	-2.57738	Clay Perimeter Berm Fill	270	28	127.704	333.331	119.109	0	119.109	113.36	113.36
3	1.47976	256.653	-1.77221	Clay Perimeter Berm Fill	270	28	142.435	371.78	191.42	0	191.42	187.013	187.013
4	1.47976	352.871	-0.967403	Clay Perimeter Berm Fill	270	28	156.676	408.952	261.331	0	261.331	258.685	258.685
5	1.47976	445.304	-0.162783	Clay Perimeter Berm Fill	270	28	170.381	444.724	328.608	0	328.608	328.124	328.124
6	1.47976	533.955	0.641806	Clay Perimeter Berm Fill	270	28	183.502	478.973	393.021	0	393.021	395.076	395.076
7	1.47976	618.822	1.44652	Clay Perimeter Berm Fill	270	28	195.996	511.584	454.353	0	454.353	459.302	459.302
8	1.47976	699.904	2.25152	Clay Perimeter Berm Fill	270	28	207.821	542.45	512.404	0	512.404	520.575	520.575
9	1.47976	777.194	3.05697	Clay Perimeter Berm Fill	270	28	218.942	571.477	566.995	0	566.995	578.688	578.688
10	1.47976	850.686	3.86302	Clay Perimeter Berm Fill	270	28	229.326	598.581	617.971	0	617.971	633.456	633.456
11	1.47976	920.369	4.66983	Clay Perimeter Berm Fill	270	28	238.947	623.695	665.204	0	665.204	684.722	684.722
12	1.47976	989.19	5.47758	Clay Perimeter Berm Fill	270	28	248.195	647.833	710.601	0	710.601	734.402	734.402
13	1.47976	1087	6.28642	Clay Perimeter Berm Fill	270	28	261.156	681.664	774.229	0	774.229	802.998	802.998
14	1.47976	1190.06	7.09652	Clay Perimeter Berm Fill	270	28	274.513	716.528	839.799	0	839.799	873.974	873.974
15	1.47976	1289.26	7.90805	Clay Perimeter Berm Fill	270	28	286.997	749.113	901.08	0	901.08	940.945	940.945
16	1.47976	1384.56	8.72118	Clay Perimeter Berm Fill	270	28	298.6	779.401	958.041	0	958.041	1003.85	1003.85
17	1.47976	1475.95	9.53609	Clay Perimeter Berm Fill	270	28	309.326	807.397	1010.7	0	1010.7	1062.66	1062.66
18	1.47976	1563.39	10.3529	Clay Perimeter Berm Fill	270	28	319.182	833.122	1059.08	0	1059.08	1117.39	1117.39

19	1.47976	1646.86	11.1719	Clay Perimeter Berm Fill	270	28	328.182	856.615	1103.26	0	1103.26	1168.08	1168.08
20	1.47976	1726.32	11.9932	Clay Perimeter Berm Fill	270	28	336.348	877.928	1143.35	0	1143.35	1214.8	1214.8
21	1.47976	1801.74	12.8171	Clay Perimeter Berm Fill	270	28	343.704	897.13	1179.46	0	1179.46	1257.65	1257.65
22	1.47976	1873.08	13.6436	Clay Perimeter Berm Fill	270	28	350.282	914.298	1211.75	0	1211.75	1296.77	1296.77
23	1.47976	1940.3	14.473	Clay Perimeter Berm Fill	270	28	356.113	929.518	1240.37	0	1240.37	1332.29	1332.29
24	1.47976	2003.35	15.3055	Clay Perimeter Berm Fill	270	28	361.233	942.884	1265.51	0	1265.51	1364.37	1364.37
25	1.47976	2062.18	16.1414	Clay Perimeter Berm Fill	270	28	365.681	954.493	1287.34	0	1287.34	1393.18	1393.18
26	1.47976	2116.75	16.9808	Clay Perimeter Berm Fill	270	28	369.494	964.446	1306.06	0	1306.06	1418.89	1418.89
27	1.47976	2167	17.824	Clay Perimeter Berm Fill	270	28	372.71	972.841	1321.85	0	1321.85	1441.69	1441.69
28	1.47976	2212.86	18.6712	Clay Perimeter Berm Fill	270	28	375.368	979.777	1334.89	0	1334.89	1461.74	1461.74
29	1.47976	2254.27	19.5226	Clay Perimeter Berm Fill	270	28	377.502	985.348	1345.37	0	1345.37	1479.22	1479.22
30	1.47976	2291.16	20.3786	Clay Perimeter Berm Fill	270	28	379.147	989.643	1353.45	0	1353.45	1494.3	1494.3
31	1.47976	2319.1	21.2393	Clay Perimeter Berm Fill	270	28	379.805	991.36	1356.68	0	1356.68	1504.3	1504.3
32	1.47976	2308.86	22.1051	Clay Perimeter Berm Fill	270	28	375.995	981.415	1337.98	0	1337.98	1490.69	1490.69
33	1.47976	2286.84	22.9763	Clay Perimeter Berm Fill	270	28	370.986	968.34	1313.39	0	1313.39	1470.68	1470.68
34	1.47976	2259.98	23.8531	Clay Perimeter Berm Fill	270	28	365.638	954.382	1287.13	0	1287.13	1448.8	1448.8
35	1.47976	2223.3	24.7358	Clay Perimeter Berm Fill	270	28	359.381	938.048	1256.42	0	1256.42	1421.99	1421.99
36	1.47976	2133.45	25.6249	Clay Perimeter Berm Fill	270	28	347.106	906.008	1196.16	0	1196.16	1362.65	1362.65
37	1.47976	2026.14	26.5207	Clay Perimeter Berm Fill	270	28	333.078	869.393	1127.29	0	1127.29	1293.51	1293.51
38	1.47976	1913.55	27.4235	Clay Perimeter Berm Fill	270	28	318.724	831.927	1056.83	0	1056.83	1222.21	1222.21
39	1.47976	1795.55	28.3337	Clay Perimeter Berm Fill	270	28	304.007	793.514	984.587	0	984.587	1148.51	1148.51
40	1.47976	1672	29.2518	Clay Perimeter Berm Fill	270	28	288.885	754.042	910.348	0	910.348	1072.14	1072.14
41	1.47976	1542.75	30.1783	Clay Perimeter Berm Fill	270	28	273.306	713.377	833.868	0	833.868	992.797	992.797
42	1.47976	1407.65	31.1135	Clay Perimeter Berm Fill	270	28	257.212	671.369	754.863	0	754.863	910.106	910.106
43	1.47976	1266.52	32.058	Clay Perimeter Berm Fill	270	28	240.538	627.848	673.012	0	673.012	823.656	823.656

44	1.47976	1119.17	33.0124	Clay Perimeter Berm Fill	270	28	223.21	582.619	587.951	0	587.951	732.974	732.974
45	1.47976	965.404	33.9773	Clay Perimeter Berm Fill	270	28	205.145	535.465	499.268	0	499.268	637.522	637.522
46	1.47976	805.004	34.9532	Clay Perimeter Berm Fill	270	28	186.25	486.147	406.513	0	406.513	536.701	536.701
47	1.47976	637.731	35.9409	Clay Perimeter Berm Fill	270	28	166.423	434.395	309.182	0	309.182	429.834	429.834
48	1.47976	463.327	36.9411	Clay Perimeter Berm Fill	270	28	145.55	379.913	206.717	0	206.717	316.163	316.163
49	1.47976	281.511	37.9546	Clay Perimeter Berm Fill	270	28	123.507	322.376	98.504	0	98.504	194.841	194.841
50	1.47976	93.2102	38.9823	Clay Perimeter Berm Fill	270	28	100.302	261.806	-15.4112	0	-15.4112	65.7603	65.7603

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.61018

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	315.78	684.26	0	0	0
2	317.26	684.173	170.362	3.36717	1.13229
3	318.74	684.106	367.193	14.4864	2.25925
4	320.219	684.06	586.644	34.6018	3.37554
5	321.699	684.035	824.925	64.576	4.47605
6	323.179	684.031	1078.33	104.89	5.55573
7	324.659	684.048	1343.25	155.65	6.60971
8	326.138	684.085	1616.18	216.607	7.63352
9	327.618	684.143	1893.78	287.179	8.62282
10	329.098	684.222	2172.82	366.477	9.57364
11	330.578	684.322	2450.29	453.351	10.4823
12	332.057	684.443	2723.33	546.42	11.3454
13	333.537	684.585	2989.62	644.195	12.16
14	335.017	684.748	3249.71	745.678	12.9234
15	336.497	684.932	3501.05	849.136	13.6331
16	337.976	685.138	3740.36	952.509	14.2871
17	339.456	685.365	3964.57	1053.67	14.8835
18	340.936	685.613	4170.88	1150.49	15.4209
19	342.416	685.884	4356.7	1240.86	15.8978
20	343.895	686.176	4519.72	1322.78	16.3131
21	345.375	686.49	4657.83	1394.4	16.666
22	346.855	686.827	4769.16	1454.04	16.9556
23	348.335	687.186	4852.05	1500.24	17.1815
24	349.814	687.568	4905.04	1531.8	17.3431
25	351.294	687.973	4926.88	1547.79	17.4402
26	352.774	688.401	4916.46	1547.57	17.4726
27	354.254	688.853	4872.84	1530.82	17.4403
28	355.733	689.329	4795.23	1497.51	17.3431
29	357.213	689.829	4682.97	1447.97	17.1816
30	358.693	690.353	4535.49	1382.8	16.9556
31	360.173	690.903	4352.34	1302.95	16.666
32	361.653	691.478	4133.87	1209.86	16.3132
33	363.132	692.079	3885.89	1106.76	15.8978
34	364.612	692.707	3610.63	995.949	15.4209
35	366.092	693.361	3309.31	879.524	14.8836
36	367.572	694.043	2984.36	759.99	14.2871
37	369.051	694.752	2648.79	642.432	13.6331
38	370.531	695.491	2309.03	529.83	12.9234
39	372.011	696.259	1969.04	424.284	12.16
40	373.491	697.057	1633.13	327.679	11.3455
41	374.97	697.885	1305.98	241.631	10.4823
42	376.45	698.746	992.71	167.435	9.57366
43	377.93	699.639	698.985	105.997	8.62287
44	379.41	700.566	431.076	57.7746	7.63353
45	380.889	701.527	195.976	22.7089	6.60972
46	382.369	702.524	1.52486	0.148324	5.55572
47	383.849	703.559	-143.449	-11.2293	4.47603
48	385.329	704.632	-228.962	-13.5048	3.37555
49	386.808	705.744	-243.679	-9.61352	2.25924
50	388.288	706.898	-174.686	-3.45263	1.13229
51	389.768	708.096	0	0	0

Discharge Sections

Entity Information

Water Table

X	Y
0	710.35
713.955	710.35

External Boundary

X	Y
458	716
452	716
445	714
408	712
405	710
389	708
367	706
361	704
353	700
333	690
315	684
251	682
249	680
225	680
221	682
213	682
209	680
175	680
171	682
139	684
118	684
90	686
72	688
58	690
52	692
36	700
18	710
0	720
0	669.5
0	650
0	500
1072	500
1072	650
1072	652
1072	840

1064	838
1042	838
1010	830
930	810
908	810
828	790
796	782
774	782
766	780
686	760
662	754
640	754
624	750
544	730
536	728
529.283	726.321
528	726
525.829	725.483
515.993	725.483
495.921	725.483

Material Boundary

X	Y
525.829	725.483
649.093	684
692.179	669.5
750.122	650

Material Boundary

X	Y
750.122	650
1072	650

Material Boundary

X	Y
315	684
649.093	684

Material Boundary

X	Y
750.122	652
1072	652

Material Boundary

X	Y
529.283	726.321
649.093	686
655.036	684
698.122	669.5
750.122	652

Material Boundary

X	Y
0	669.5
692.179	669.5

Material Boundary

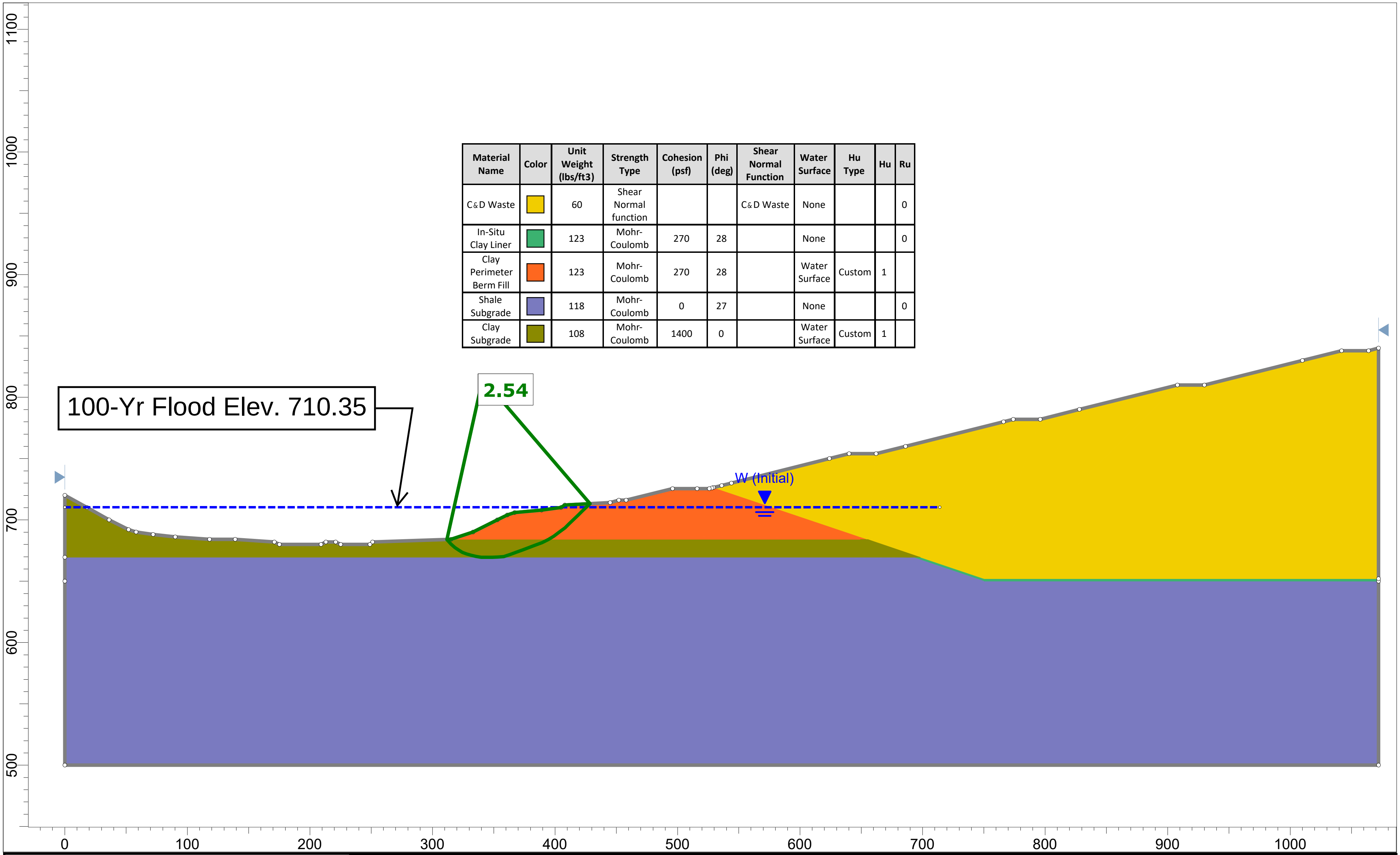
X	Y
649.093	684
655.036	684

Material Boundary

X	Y
692.179	669.5
698.122	669.5

CROSS-SECTION D

RAPID DRAWDOWN NON-CIRCULAR FAILURE SURFACE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
C&D Waste	🟨	60	Shear Normal function			C&D Waste	None			0
In-Situ Clay Liner	🟩	123	Mohr-Coulomb	270	28		None			0
Clay Perimeter Berm Fill	🟧	123	Mohr-Coulomb	270	28		Water Surface	Custom	1	
Shale Subgrade	🟪	118	Mohr-Coulomb	0	27		None			0
Clay Subgrade	🟫	108	Mohr-Coulomb	1400	0		Water Surface	Custom	1	

rocscience

SLIDEINTERPRET 9.026

Project: 311-653 Beck Landfill Vertical Expansion

Analysis Description: Section D,Non- Circular Rapid Drawdown

Created By: EDC	Checked By: EDC
Created Date12-20-22	Checked Date: 12-20-22

Civil & Environmental Consultants, Inc.

Slide2 Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

Slide2 Modeler Version:	9.026
Compute Time:	00h:00m:08.890s
Date Created:	3/24/2022, 9:28:32 AM

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	Rapid Drawdown
Rapid Drawdown Method:	Effective Stress using B-Bar

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Materials

C&D Waste	
Color	🟨
Strength Type	Shear Normal function
Unit Weight [lbs/ft3]	60
Water Surface	None
Ru Value	0

In-Situ Clay Liner	
Color	🟩
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	None
Ru Value	0

Clay Perimeter Berm Fill	
Color	🟧
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	123
Cohesion [psf]	270
Friction Angle [deg]	28
Water Surface	Water Table
Hu Value	1

Shale Subgrade	
Color	🟪
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	118
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0

Clay Subgrade	
Color	🟫
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	108
Cohesion [psf]	1400
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

Name: C&D Waste

Effective Normal (psf)	Shear (psf)
0	0
2000	1400
10000	6169

Global Minimums

Method: gle/morgenstern-price

FS	2.540700
Axis Location:	340.921, 815.380
Left Slip Surface Endpoint:	311.699, 683.897
Right Slip Surface Endpoint:	428.574, 713.112
Resisting Moment:	2.32703e+07 lb-ft
Driving Moment:	9.15899e+06 lb-ft
Resisting Horizontal Force:	148643 lb
Driving Horizontal Force:	58504.8 lb
Total Slice Area:	3479.21 ft2
Surface Horizontal Width:	116.875 ft
Surface Average Height:	29.7685 ft

Global Minimum Coordinates

Method: gle/morgenstern-price

X	Y
311.699	683.897
314.947	680.368
318.195	677.474
321.444	675.214
324.339	673.347
327.84	672.112
331.664	671.059
335.487	670.154
339.683	669.517
344.482	669.5
348.829	669.521
353.175	669.607
358.134	669.965
363.502	671.747
368.48	673.545
373.457	675.394
378.753	677.401
384.048	679.408
389.343	681.415
394.425	683.823
398.946	686.697
403.466	690.07
408.107	693.543
411.494	696.77
415.162	700.28
418.83	703.79
422.499	707.299
425.536	710.206
428.574	713.112

Global Minimum Support Data

No Supports Present

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.5407

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.24799	636.655	-47.3696	Clay Subgrade	1400	0	551.029	1400	822.109	0	822.109	223.507	223.507
2	3.24822	1990.95	-41.7053	Clay Subgrade	1400	0	551.029	1400	1192.48	0	1192.48	701.437	701.437
3	3.24878	3328.27	-34.826	Clay Subgrade	1400	0	551.029	1400	1557.12	0	1557.12	1173.77	1173.77
4	2.8949	3975.39	-32.8084	Clay Subgrade	1400	0	551.029	1400	1945.23	0	1945.23	1590	1590
5	3.50181	5854.45	-19.4262	Clay Subgrade	1400	0	551.029	1400	2095.81	0	2095.81	1901.48	1901.48
6	1.91162	3589.92	-15.4068	Clay Subgrade	1400	0	551.029	1400	2281.36	0	2281.36	2129.52	2129.52
7	1.91162	3848.51	-15.4068	Clay Subgrade	1400	0	551.029	1400	2441.12	0	2441.12	2289.27	2289.27
8	1.9117	4102.97	-13.3124	Clay Subgrade	1400	0	551.029	1400	2563.71	0	2563.71	2433.32	2433.32
9	1.9117	4402.82	-13.3124	Clay Subgrade	1400	0	551.029	1400	2742.35	0	2742.35	2611.97	2611.97
10	2.09794	5177.76	-8.63923	Clay Subgrade	1400	0	551.029	1400	2846.5	0	2846.5	2762.78	2762.78
11	2.09794	5520.66	-8.63923	Clay Subgrade	1400	0	551.029	1400	3024.9	0	3024.9	2941.18	2941.18
12	2.384	6644.09	-0.200631	Clay Subgrade	1400	0	551.029	1400	3037.23	0	3037.23	3035.3	3035.3
13	2.384	6995.77	-0.200631	Clay Subgrade	1400	0	551.029	1400	3184.74	0	3184.74	3182.81	3182.81
14	0.0311726	93.8045	-0.200631	Clay Subgrade	1400	0	551.029	1400	3258.87	0	3258.87	3256.94	3256.94
15	2.1733	6685.99	0.278207	Clay Subgrade	1400	0	551.029	1400	3315.52	0	3315.52	3318.19	3318.19
16	2.1733	6974	0.278207	Clay Subgrade	1400	0	551.029	1400	3444.31	0	3444.31	3446.99	3446.99
17	2.17329	7258.12	1.13999	Clay Subgrade	1400	0	551.029	1400	3551.43	0	3551.43	3562.39	3562.39
18	2.17329	7538.45	1.13999	Clay Subgrade	1400	0	551.029	1400	3672.74	0	3672.74	3683.7	3683.7
19	2.47935	8925.07	4.12428	Clay Subgrade	1400	0	551.029	1400	3726.26	0	3726.26	3766	3766
20	2.47935	9255.25	4.12428	Clay Subgrade	1400	0	551.029	1400	3844.12	0	3844.12	3883.86	3883.86
21	2.68395	10290.1	18.3665	Clay Subgrade	1400	0	551.029	1400	3592.74	0	3592.74	3775.69	3775.69
22	2.68395	10410.6	18.3665	Clay Subgrade	1400	0	551.029	1400	3612.79	0	3612.79	3795.74	3795.74
23	2.4888	9677.38	19.8548	Clay Subgrade	1400	0	551.029	1400	3566.19	0	3566.19	3765.17	3765.17
24	2.4888	9657.14	19.8548	Clay Subgrade	1400	0	551.029	1400	3541.45	0	3541.45	3740.42	3740.42
25	2.48883	9496.61	20.384	Clay Subgrade	1400	0	551.029	1400	3453.67	0	3453.67	3658.42	3658.42
26	2.48883	9317.3	20.384	Clay Subgrade	1400	0	551.029	1400	3373.72	0	3373.72	3578.47	3578.47

27	5.29536	19216.1	20.7552	Clay Subgrade	1400	0	551.029	1400	3242.23	0	3242.23	3451.05	3451.05
28	2.64766	9295.2	20.7552	Clay Subgrade	1400	0	551.029	1400	3119.99	0	3119.99	3328.81	3328.81
29	2.64766	9086.67	20.7552	Clay Subgrade	1400	0	551.029	1400	3040.89	0	3040.89	3249.71	3249.71
30	2.64766	8878.14	20.7552	Clay Subgrade	1400	0	551.029	1400	2963.38	0	2963.38	3172.2	3172.2
31	2.64766	8669.86	20.7552	Clay Subgrade	1400	0	551.029	1400	2887.39	0	2887.39	3096.21	3096.21
32	2.54103	8108.45	25.357	Clay Subgrade	1400	0	551.029	1400	2715.27	0	2715.27	2976.41	2976.41
33	2.54103	7877.24	25.357	Clay Subgrade	1400	0	551.029	1400	2634.83	0	2634.83	2895.98	2895.98
34	0.278319	848.067	32.4507	Clay Subgrade	1400	0	551.029	1400	2442.85	0	2442.85	2793.23	2793.23
35	2.12104	6305.97	32.4507	Clay Perimeter Berm Fill	270	28	600.146	1524.79	2359.93	0	2359.93	2741.53	2741.53
36	2.12104	6023.29	32.4507	Clay Perimeter Berm Fill	270	28	578.569	1469.97	2256.82	0	2256.82	2624.7	2624.7
37	2.26037	6073.21	36.7205	Clay Perimeter Berm Fill	270	28	537.517	1365.67	2060.65	0	2060.65	2461.6	2461.6
38	2.26037	5682.99	36.7205	Clay Perimeter Berm Fill	270	28	510.808	1297.81	1933.02	0	1933.02	2314.05	2314.05
39	2.32019	5447.27	36.8181	Clay Perimeter Berm Fill	270	28	484.81	1231.76	1808.8	0	1808.8	2171.73	2171.73
40	2.32019	5314.24	36.8181	Clay Perimeter Berm Fill	270	28	477.844	1214.06	1775.52	0	1775.52	2133.22	2133.22
41	3.38695	7057.35	43.6138	Clay Perimeter Berm Fill	270	28	425.62	1081.37	1525.97	0	1525.97	1931.48	1931.48
42	1.83414	3291.69	43.7342	Clay Perimeter Berm Fill	270	28	381.853	970.173	1316.84	0	1316.84	1682.18	1682.18
43	1.83414	2918.16	43.7342	Clay Perimeter Berm Fill	270	28	350.753	891.159	1168.23	0	1168.23	1503.82	1503.82
44	1.83414	2544.62	43.7342	Clay Perimeter Berm Fill	270	28	319.184	810.952	1017.38	0	1017.38	1322.77	1322.77
45	1.83414	2171.1	43.7342	Clay Perimeter Berm Fill	270	28	287.102	729.441	864.081	0	864.081	1138.77	1138.77
46	1.83414	1797.58	43.7342	Clay Perimeter Berm Fill	270	28	254.465	646.519	708.129	0	708.129	951.592	951.592
47	1.83414	1424.05	43.7342	Clay Perimeter Berm Fill	270	28	221.234	562.089	549.341	0	549.341	761.009	761.009
48	3.03779	1536.95	43.7342	Clay Perimeter Berm Fill	270	28	176.072	447.345	333.537	0	333.537	501.997	501.997
49	0.150857	49.6201	43.7342	Clay Perimeter Berm Fill	270	28	145.986	370.907	189.779	0	189.779	329.454	329.454
50	2.88693	462.697	43.7342	Clay Perimeter Berm Fill	270	28	116.691	296.477	49.7961	0	49.7961	161.442	161.442

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.5407

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	311.699	683.897	0	0	0
2	314.947	680.368	4690.47	89.3035	1.09074
3	318.195	677.474	9932.05	376.772	2.17247
4	321.444	675.214	15241.5	861.83	3.23634
5	324.339	673.347	20467	1489.35	4.16198
6	327.84	672.112	24984.8	2293.52	5.24486
7	329.752	671.586	27240	2774.42	5.81558
8	331.664	671.059	29579.3	3302.14	6.36995
9	333.575	670.607	31792.4	3850.96	6.9065
10	335.487	670.154	34086.3	4441.44	7.42381
11	337.585	669.835	36149.6	5059.81	7.96785
12	339.683	669.517	38269.8	5709.55	8.48549
13	342.067	669.508	39608.8	6301.6	9.03976
14	344.451	669.5	40949.1	6893.63	9.55593
15	344.482	669.5	40966.6	6901.36	9.56244
16	346.655	669.51	42129.2	7426.8	9.99774
17	348.829	669.521	43290.4	7944.15	10.3986
18	351.002	669.564	44334.3	8428.15	10.7637
19	353.175	669.607	45373	8895.46	11.0923
20	355.655	669.786	46073.1	9307.63	11.4211
21	358.134	669.965	46752	9681.82	11.6999
22	360.818	670.856	45029.5	9525.56	11.9443
23	363.502	671.747	43289.1	9302.46	12.1279
24	365.991	672.646	41455.5	8995.85	12.2434
25	368.48	673.545	39644.2	8647.9	12.3056
26	370.968	674.469	37821.6	8256.46	12.3145
27	373.457	675.394	36073	7845.35	12.2699
28	378.753	677.401	32484.5	6903.75	11.9982
29	381.4	678.404	30812.9	6422.1	11.7732
30	384.048	679.408	29220.6	5939.54	11.4897
31	386.696	680.411	27706.1	5460.31	11.149
32	389.343	681.415	26267.9	4988.15	10.7522
33	391.884	682.619	24398.3	4442.83	10.3202
34	394.425	683.823	22625.5	3924.33	9.8399
35	394.704	684	22346.5	3853.66	9.78444
36	396.825	685.349	20436.7	3362.6	9.34358
37	398.946	686.697	18620.1	2906.42	8.87174
38	401.206	688.383	16360.7	2397.35	8.33628
39	403.466	690.07	14256	1944.96	7.76895
40	405.787	691.806	12239.2	1536.51	7.15548
41	408.107	693.543	10264.1	1171.76	6.51275
42	411.494	696.77	6781.47	656.213	5.52705
43	413.328	698.525	5171	449.885	4.9723
44	415.162	700.28	3764.27	289.947	4.40457
45	416.996	702.035	2564.35	171.461	3.82529
46	418.83	703.79	1574.61	89.0256	3.23595
47	420.664	705.544	798.676	36.7996	2.63808
48	422.499	707.299	240.447	8.53618	2.03322
49	425.536	710.206	-194.095	-3.45683	1.02033
50	425.687	710.35	-199.464	-3.3764	0.969774
51	428.574	713.112	0	0	0

Discharge Sections

Entity Information

Water Table

X	Y
0	710.35
713.955	710.35

External Boundary

X	Y
458	716
452	716
445	714
408	712
405	710
389	708
367	706
361	704
353	700
333	690
315	684
251	682
249	680
225	680
221	682
213	682
209	680
175	680
171	682
139	684
118	684
90	686
72	688
58	690
52	692
36	700
18	710
0	720
0	669.5
0	650
0	500
1072	500
1072	650
1072	652
1072	840

1064	838
1042	838
1010	830
930	810
908	810
828	790
796	782
774	782
766	780
686	760
662	754
640	754
624	750
544	730
536	728
529.283	726.321
528	726
525.829	725.483
515.993	725.483
495.921	725.483

Material Boundary

X	Y
525.829	725.483
649.093	684
692.179	669.5
750.122	650

Material Boundary

X	Y
750.122	650
1072	650

Material Boundary

X	Y
315	684
649.093	684

Material Boundary

X	Y
750.122	652
1072	652

Material Boundary

X	Y
529.283	726.321
649.093	686
655.036	684
698.122	669.5
750.122	652

Material Boundary

X	Y
0	669.5
692.179	669.5

Material Boundary

X	Y
649.093	684
655.036	684

Material Boundary

X	Y
692.179	669.5
698.122	669.5

MUNICIPAL SOLID WASTE PERMIT MAJOR AMENDMENT

PART III-ATTACHMENT D6
CONTAMINATED WATER PLAN

BECK
COMPANIES

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: Revised January 2023

Prepared by:

CEC
Civil & Environmental Consultants, Inc.

Texas Registration Number F-38
3711 S MoPac Expressway
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(512) 329-0006

STATE OF TEXAS
ADAM W. MEHEVEC
84736
LICENSED
PROFESSIONAL ENGINEER
1-2-2023

Contents

30 TAC §§330.65(c), 330.177, 330.207, 330.227, 330.331(a)(2), 330.333, 330.337(d)

List of Appendices

APPENDIX D6-A
Run-On/Run-Off Berm Design

ADAM W. MEHEVEC
84736
1-2-2023

1 INTRODUCTION

30 TAC§§330.65(c), 330.177, 330.207, 330.227, 330.331(a)(2), 330.333, 330.337(d)

1.1 Purpose

This Leachate and Contaminated Water Management Plan has been prepared for Beck Landfill consistent with 30 TAC §§330.65(c), 330.177, 330.207, 330.227, 330.331(a) (2), 330.333, and 330.337(d). Beck Landfill is a Type IV landfill and only accepts construction and demolition, and other inert wastes. The entire footprint of the landfill has been previously constructed and there is no requirement for a leachate collection system at this facility. This plan provides the details of the management of contaminated water that is generated during normal site operations.

1.2 Definitions

Contaminated water is defined in §330.3(36) as leachate, gas condensate, or water that has come into contact with waste.

2 CONTAMINATED WATER MANAGEMENT

30 TAC§330.207

2.1 Contaminated Water Generation

Surface water that comes into contact with waste, leachate, or gas condensate is considered to be contaminated water. Best management practices will be used to minimize contaminated water generation. Temporary diversion berms may be constructed around areas of exposed waste to minimize the amount of surface water that comes into contact with waste. Design calculations and typical details for temporary diversion berms are presented in Appendix D6-A -Containment/Diversion Berm Design. Daily cover and intermediate cover will be placed over filled areas to minimize the area of exposed waste. Procedures for verifying the adequacy of daily and intermediate cover placement are provided in Part IV -Site Operating Plan. If waste is exposed in areas where daily or intermediate cover has been previously placed, runoff from these areas will be considered contaminated water.

2.2 Contaminated Water Collection, Containment, and Storage

Temporary containment berms will be constructed as needed around the active face to collect and contain surface water that has come into contact with waste. In addition to the planned containment berms around the active face, temporary containment berms will be constructed wherever needed to collect contaminated water. The design calculations and typical details for containment berms for a 25-year, 24-hour storm event are provided in Appendix D6-A. Primary contaminated water storage will be provided by the containment berms, which will provide storage for the 25-year, 24-hour storm event. Containment berms will be maintained until the contaminated water is removed.

Stormwater diversion and containment berms will also be placed around the processing and recovery areas to control run-on and run-off. The diversion and containment berms will be sized based off the calculations shown on Figure D6-A. The typical size for these areas is 150’x150’ and this area is included in the berm sizing chart shown on the drawing.

Any spills that occur at the processing and recovery areas will be collected and managed as contaminated water. Any soil impacted by the spill will be excavated and analyzed to determine the proper waste classification and sent to an offsite permitted disposal facility.

2.3 Contaminated Water Disposal

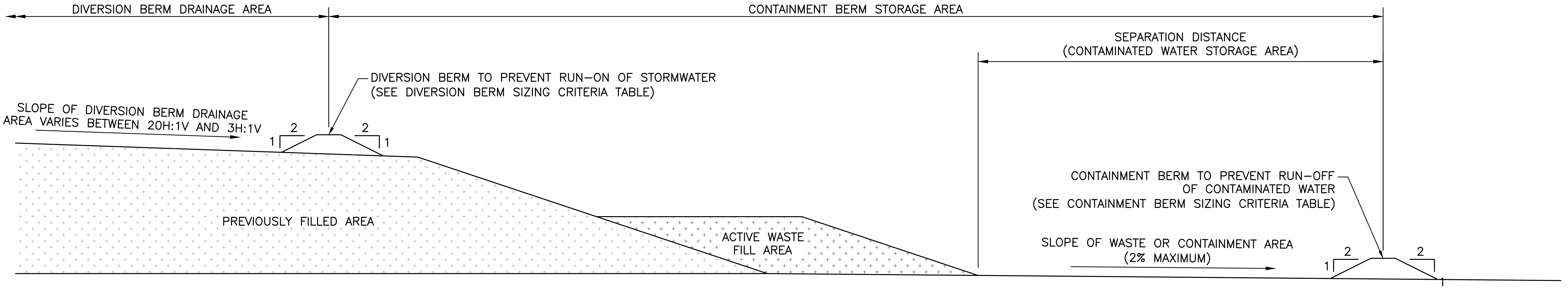
Contaminated water will not be allowed to discharge into waters of the United States. Contaminated water will be transported to an offsite POTW for treatment and disposal in accordance with §330.207. Sampling and analysis will meet the individual disposal facilities requirements.

BECK LANDFILL

APPENDIX D6-A
RUN-ON/RUN-OFF BERM DESIGN

Includes page D6-A-1

ADAM W. MEHEVEC
84736
1-2-2023



CONTAINMENT BERM SIZING CRITERIA

Active Area Length (ft.)	Active Area Width (ft.)	Separation Distance (ft.)	Runoff Volume (ft^3)	Depth (ft.)	Design Berm Height (ft.)
100	100	45	10343	2.3	2.5
150	150	45	20865	3.1	3.5
200	200	45	34953	3.9	4.0
250	250	45	52608	4.7	5.0
300	300	45	73830	5.5	5.5
325	325	45	85778	5.9	6.0
100	100	50	10700	2.1	2.5
150	150	50	21400	2.9	3.0
200	200	50	35667	3.6	4.0
250	250	50	53500	4.3	4.5
300	300	50	74900	5.0	5.0
325	325	50	86938	5.4	5.5
100	100	55	11057	2.0	2.5
150	150	55	21935	2.7	3.0
200	200	55	36380	3.3	3.5
250	250	55	54392	4.0	4.0
300	300	55	75970	4.6	5.0
325	325	55	88097	4.9	5.0
100	100	60	11413	1.9	2.0
150	150	60	22470	2.5	2.5
200	200	60	37093	3.1	3.5
250	250	60	55283	3.7	4.0
300	300	60	77040	4.3	4.5
325	325	60	89256	4.6	5.0

25-Year, 24-Hour Depth=	8.56 in.
Percent Run-off of Rainfall=	100.0 %

Notes:

1. Separation distance refers to the length between the inside toe of the active area berm and the waste face.
2. Run-off is assumed to pond along the length of the active area, within the separation distance between waste and berm.
3. Percent Run-off conservatively assumed to be 100% of rainfall.
4. Using the same methodology, other options for the active area lengths, widths, and separation distances will yield acceptable design berm heights.

DIVERSION BERM SIZING CRITERIA

DIVERSION BERM DRAINAGE AREA (ACRES)	MINIMUM 5 % FLOW RATE (CFS)	MINIMUM 5 % FLOW DEPTH (FEET)	MINIMUM 5 % REQ'D MIN. DIVERSION BERM HEIGHT (FEET)	MAXIMUM 33 % FLOW RATE (CFS)	MAXIMUM 33 % FLOW DEPTH (FEET)	MAXIMUM 33 % REQ'D MIN. DIVERSION BERM HEIGHT (FEET)
0.5	3.2	0.3	1.5	3.2	0.6	1.5
1.0	6.4	0.4	1.5	6.4	0.7	2.0
1.5	9.5	0.5	1.5	9.5	0.8	2.0

NOTES:

1. FLOW RATE CALCULATED USING RATIONAL METHOD ASSUMING 10 MINUTE TIME OF CONCENTRATION, 0.7 RUN-OFF COEFFICIENT, AND INTENSITY CURVES FROM TxDOT HYDRAULIC MANUAL.
2. FLOW DEPTHS ALONG BERM CALCULATED USING FLOWMASTER SOFTWARE.
3. ONE FOOT MINIMUM FREEBOARD PROVIDED FOR BERMS.

SAMPLE CALCULATION FOR CONTAINMENT BERM HEIGHT

GIVEN: L=100', W=100', SEPARATION DISTANCE (SD)=45', RUNOFF DEPTH (RD)=8.56 INCHES
RUN-OFF VOLUME (FT^3) = (L+SD)*W*(RD/12)
RUN-OFF VOLUME = 10,343 FT^3

DEPTH= RUN-OFF VOLUME/L/SD
DEPTH= 10,343 FT^3/ 100 FT / 45 FEET
DEPTH=2.3 FT (ROUND UP TO 2.5 FEET)

ADAM W. MEHEVEC
84736
1-2-2023

PERMIT DRAWINGS

REVISION RECORD

NO	DATE	DESCRIPTION
△1	1/2/2022	TECHNICAL NOD 1
△		
△		
△		

REV. NO.	DATE	DESCRIPTION	DR. BY	APP. BY
1	--	--		

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BECK COMPANIES
BECK LANDFILL
LANDFILL 1848-A
GUADALUPE COUNTY, TEXAS

CEC REFERENCE NO. 311-653
DATE: AUGUST 2022
FILE: D6-A BERM SIZING

CONTAMINATED WATER RUN-ON\ RUN-OFF BERMS

D6-A

P:\310-000\311-653\-CADD\Dwg\SW01\APPENDIX D6-A BERM SIZING.dwg{LAYOUT1} LS:(12/23/2022 - amehevec) - LP: 12/23/2022 9:50 AM

MUNICIPAL SOLID WASTE PERMIT
MAJOR AMENDMENT

PART III-ATTACHMENT D7
LINER QUALITY CONTROL PLAN

BECK
COMPANIES

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: Revised January 2023

Prepared by:

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STATE OF TEXAS
ADAM W. MEHEVEC
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LICENSED PROFESSIONAL ENGINEER
1-2-2023

Contents

30 TAC §§330.63(d)(4)(G), 330.331, 330.337, 330.339, 330.341

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1-2-2023

STATE OF TEXAS
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1-2-2023

1 INTRODUCTION

1.1 Purpose

This Liner Quality Control Plan (LQCP) has been prepared in accordance with 30 TAC §330.339 to establish procedures for the design, construction, testing, and documentation of the liner system for the landfill. Beck Landfill is a Type IV landfill and only accepts construction and demolition, and other inert wastes. The entire footprint of the landfill has been previously constructed utilizing an in-situ clay liner, so no additional liner construction is anticipated. However, if any liner construction becomes necessary in the future, it will be constructed in accordance with the provision in this section.

1.2 Definitions

Specific terms and acronyms that are used in this LQCP are defined below.

- ASTM- American Society for Testing and Material
- Construction Quality Assurance (CQA) - CQA is a planned system of activities that provides the owner and permitting agency assurance that the facility was constructed as specified in the design. CQA includes the observations, evaluations, and testing necessary to assess and document the quality of the constructed facility. CQA includes measures taken by the CQA organization to assess whether the work is in compliance with the plans, specifications, and permit requirements for a project
- Geotechnical Professional (GP) - The GP is the authorized representative of the operator who is responsible for all CQA activities for the project. The GP must be registered as a Professional Engineer in Texas. Experience and education should include geotechnical engineering, engineering geology, soil mechanics, geotechnical laboratory testing, construction quality assurance and quality control testing, and hydrogeology. The GP must also have competency and experience in certifying similar projects. The GP may also be known in applicable regulations and guidelines as the CQA engineer, resident project representative, geotechnical quality control/quality assurance professional (GQCP), or professional of record (POR).

- CQA Monitors - CQA monitors are representatives of the GP who work under direct supervision of the GP. The CQA monitor is responsible for quality assurance monitoring and performing on-site tests and observations. The CQA monitor must be NICET- certified at Level 2 for soils and geosynthetics, an engineering technician with a minimum of four years of directly related experience, or a graduate engineer or geologist with one year of directly related experience.
- Quality Assurance- Quality assurance is a planned program that is designed to assure that the work meets the requirements of the plans, specifications, and permit for a project. Quality assurance includes procedures, quality control activities, and documentation that are performed by the GP and CQA monitor.
- Quality Control - Quality control includes the activities that implement the quality assurance program. The GP, CQA monitor, and contractor will perform quality control.
- Seasonal High Water Table - The seasonal high water table is the highest measured water level within the construction area.
- SLER- Soil Liner Evaluation Report

1.3 Sequence of Construction Activities

Generally, construction of any new lined areas at Beck Landfill will proceed in the following sequence of activities:

- The area will be excavated to the proposed subgrade elevations.
- The subgrade elevations will be verified.
- The compacted soil liner will be constructed, tested, and verified in accordance with Section 4.
- The Soils Liner Evaluation Report will be submitted to the TCEQ.

2 LINER SYSTEM

2.1 Soil Liner

As stated in Section 1.0, there is no anticipated construction of additional liner at the Beck landfill, because the entire footprint has previously been constructed with an in-situ soil liner. The in-situ liner has at least four feet of in-situ soil between the deposited waste and groundwater. The in-situ soil constitutes an in-situ liner and meets all the physical properties for a constructed liner as detailed in §330.339(c)(5). The In-situ liner was excavated to the depth necessary to ensure that it did not exhibit primary or secondary physical features such as jointing, fractures, bedding planes, solution cavities, root holes, desiccation shrinkage cracks etc., that have a coefficient of permeability greater than 1 x 10^{-7} cm/sec. Along the sidewalls a soil berm was constructed that has a slurry wall and/or clay core that penetrates a minimum of five feet into the unweathered shale layer. See Figures D-2 and D3.1 for details of the sidewall berm.

However, if an unforeseen condition requires the replacement of a portion of the liner system, the following provisions will be utilized. The optional soil liner, if required, will consist of 36 inches minimum of compacted clay with a maximum hydraulic conductivity of $1\text{x}10^{-7}$ cm/sec. The compacted clay liner will be overlain by a minimum of one foot of protective cover soil. A detail for the optional sidewall liner system is included on Figure D3.1.

An additional compacted soil berm is proposed to be constructed above the existing berm to provide protection and adequate freeboard from the 100-year floodplain. See Figure D-2 for the proposed dimensions of the soil berm.

2.2 Construction Monitoring

Continuous on-site monitoring is necessary to assure that the components of the liner system are constructed in accordance with this LQCP. In accordance with 30 TAC §330.339(a)(2), the CQA monitor shall provide on-site observation and field sampling and testing as required during the following construction activities:

- Subgrade preparation
- Compacted soil liner placement, processing, compaction, and testing
- Any work that could damage the installed components of the liner system

The GP will document and certify that the liner system was constructed in accordance with this LQCP. The GP shall make sufficient site visits to observe critical construction activities and to verify that the construction and quality assurance activities are performed in accordance with this LQCP.

All field sampling and testing, both during construction and after completion, shall be performed by a person acting in compliance with the provisions of the Texas Engineering Practice Act and other applicable state laws and regulations. The professional of record who signs the soil liner evaluation report or his representative will be on site during all liner construction. Quality control of construction and quality assurance of sampling and testing procedures will follow the latest technical guidelines of the executive director.

3 EARTHWORK

3.1 General

Earthwork activities and testing will be documented in the SLER in accordance with Section 6.2.

3.2 Materials

The following material classifications will be encountered in excavations or will be required for landfill construction.

General Fill

General fill consists of soil that is free from debris, rubbish, solid waste, organic matter, and particles larger than four inches in diameter.

Compacted Soil Liner

Compacted soil liner materials consist of soil that is free from debris, rubbish, solid waste, organic matter, and meets the requirements of Section 4.2.

Operational and Intermediate Cover

Operational and intermediate cover materials consist of soil that has not been previously mixed with solid waste.

Topsoil

Topsoil consists of soil that is capable of sustaining vegetation and is free of debris, rubbish, and solid waste.

Unsuitable Materials

Unsuitable materials consist of any material that is determined by the GP to not be suitable for use as classified above.

3.3 Construction Below Groundwater

All cells have been excavated and no construction below the groundwater level was performed.

3.4 Excavation

A description of the materials that will be encountered in the excavations is provided in Attachment D5 -Geotechnical Design.

The slope stability analyses were performed for 3H:1V excavation and liner slopes, and 4H:1V final waste slopes. Any changes to the excavation plan, liner system, final cover system, or landfill completion plan will necessitate that the slope stability analyses be revised to reflect the changed conditions. Waste must be placed and properly compacted in horizontal lifts that are typically 20 feet thick. Temporary construction slopes should not be steeper than the final slopes and concentrated loadings such as heavy equipment and soil stockpiles will not be placed near the crest of slopes unless the permit is revised.

4 COMPACTED SOIL LINER

4.1 General

The compacted soil liner component of the composite liner system consists of a 36-inch thick layer of compacted, relatively homogeneous, cohesive material. The CQA monitor shall provide continuous on-site observation during compacted soil liner placement, compaction, and testing in accordance with 30 TAC §330.339(a)(2). The GP shall make sufficient site visits during compacted soil liner construction to document the construction activities, testing, and thickness verification in the SLER, in accordance with Section 6.2.

4.2 Materials

Compacted soil liner material shall consist of soil that is free from debris, rubbish, frozen materials, foreign objects, and organic material. The required compacted soil liner material properties are summarized in Table D7-1.

Table D7-1
Beck Landfill
Compacted Soil Liner Material Properties

Test	Standard	Required Property
Plasticity Index	ASTM D 4318	15 or Greater
Liquid Limit	ASTM D 4318	30 or Greater
Percent Passing No. 200 Mesh Sieve	ASTM D 1140	30% or Greater
Percent Passing 1-inch Sieve	ASTM D 422	100%
Coefficient of Permeability	ASTM D 5084 or COE EM 1110-2-1906 Appendix VII	1 x 10^{-7} cm/sec or less

Preconstruction testing procedures and frequencies for compacted soil liner materials are listed in Section 4.8.1.

4.3 Subgrade Preparation

Prior to placing soil liner material, the subgrade should be proof-rolled with heavy, rubber-tired construction equipment to detect soft areas. The GP or CQA monitor must observe the proof-rolling operation. Soft areas should be undercut to firm material, then backfilled with compacted general fill.

The subgrade elevations shall be verified in accordance with the requirements of Section 4.8.3 prior to the placement of compacted soil liner.

4.4 Placement and Processing

The compacted soil subgrade and surface of each lift should be roughened prior to placement of the next lift of compacted soil liner. The soil liner material should be placed in maximum eight-inch loose lifts to produce compacted lift thickness of approximately six inches. The material should be processed to a maximum particle size of one inch or less before water is added. Rocks and clods less than one inch in diameter should not total more than 10 percent by weight. The surface of the top lift shall contain no material larger than 3/8 inch.

If additional water is necessary to adjust the moisture content, it should be applied after initial processing, but prior to compaction. Water should be applied evenly across the lift and worked into the material. Water used for the soil liner compaction must not be contaminated by waste or any objectionable material.

4.5 Compaction

The soil liner shall be compacted with a pad/tamping-foot or prong-foot roller. A footed roller is necessary to bond the lifts, to distribute the water, and to blend the soil matrix through kneading action. Soil liner shall not be compacted with a bulldozer, rubber-tired roller, flat-wheel roller, scraper, truck, or any track equipment unless it is used to pull a footed roller. The lift thickness shall be controlled to achieve penetration into the top of the previously compacted lift; therefore, the lift thickness should not be greater than the pad or prong length. Cleaning devices on the roller must be in place and maintained to prevent the prongs or pad feet from becoming clogged to the point that they cannot achieve full penetration. The minimum weight of the compactor shall be 1,500 lbs/ft of drum length.

The compactor should make the required passes across the area being compacted to reach the required density. A pass is defined as one pass of the compactor, front and rear drums. The material should be compacted to a minimum of 95 percent of the maximum dry density determined by standard Proctor (ASTM D 698) at a moisture content at or above optimum moisture. Areas with failing tests shall be reworked, re-compacted, and retested, and passing tests must be achieved before another lift is added.

After a lift is compacted, it must be watered to prevent drying and excessive desiccation until the next lift can be placed. If desiccation occurs, the GP must determine if the lift can be rehydrated by surface application of water or if the lift must be scarified, watered, and re-compacted. Following compaction and fine grading of the final lift, the surface of the compacted soil liner shall be smooth drum rolled.

4.6 Protection

The completed compacted soil liner must be protected from drying, excessive desiccation, rutting, erosion, and ponded water until waste is placed. Areas that undergo excessive desiccation or damage shall be reworked, re-compacted, and retested as directed by the GP.

4.7 Tie in to Existing Liners

The edge of existing compacted soil liners shall be cut back on either a slope or steps to prevent the formation of a vertical joint. The slope will be a maximum of 3:1 and the steps will be three feet wide by one foot thick.

4.8 Testing and Verification

4.8.1 Preconstruction Testing

Table D7-2 lists the minimum testing required for material proposed for use as compacted soil liner.

Table D7-2
Beck Landfill
Compacted Soil Liner Material Preconstruction Tests

Test	Standard	Frequency
Plasticity Index	ASTM D 4318	1 per material type
Liquid Limit	ASTM D 4318	1 per material type
Percent Passing No. 200 Mesh Sieve	ASTM D 1140	1 per material type
Percent Passing 1-inch Sieve	ASTM D 0422	1 per material type
Standard Proctor Test	ASTM D 698	1 per material type
Coefficient of Permeability	ASTM D 5084 or COE EM 1110-2-1906 Appendix VII	1 per moisture/density relationship
Unified Soil Classification	ASTM 2487	1 per material type

After the moisture density relationship has been determined for a material type, a soil sample should be remolded to about 95 percent of the maximum dry density at the optimum moisture content. This sample will be tested to determine if the soil can be compacted to achieve the required coefficient of permeability. Either falling head or constant head laboratory permeability tests may be performed to determine the coefficient of permeability. The permeant fluid for testing must be tap water or 0.005N calcium sulfate solution. Distilled or deionized water shall not be used as the permeant fluid.

4.8.2 Construction Testing

All quality control testing will be performed during construction of the liner, except for testing that is required after individual lifts are constructed. Table D7-3 lists the minimum testing required for material used as compacted soil liner.

Table D7-3
Beck Landfill
Compacted Soil Liner Material Construction Tests

Test	Standard	Frequency
Field Density	ASTM D 2922	1/8,000 ft^2 per 6” parallel lift; one per 100 lineal ft per 12” sidewall horizontal lift
Plasticity Index	ASTM D 4318	One per 100,000 ft^2 per 6” parallel lift; one per 2,000 lineal ft per 12” sidewall horizontal lift
Liquid Limit	ASTM D 4318	
Percent Passing No. 200 Mesh Sieve	ASTM D 1140 ASTM D 422	
Percent Passing 1-inch Sieve	ASTM D 0422	
Coefficient of Permeability	ASTM D 5084 or COE EM 1110-2-1906 Appendix VII	
Thickness	Surveyor	1/5,000 SF

The Atterberg limits of the in-place compacted soil liner must be compared to the Atterberg limits of the Proctor curve sample to assure that the Proctor curve represents the in-place material. Any variance of more than 10 points between the liquid limit or plasticity index of the in-place soil and those of the Proctor curve sample will require that a new Proctor curve be developed. Permeability testing will be performed as described in Section 4.8.1 and all test data will be reported.

4.8.3 Thickness Verification

The as-built thickness of the compacted soil liner shall be determined by standard survey methods. Prior to the placement of liner material, the subgrade elevations will be determined at a minimum rate of one survey point per 5,000 sf of lined area. After the compacted soil liner is completed, the top of the liner elevations will be determined at the same locations as the subgrade elevations.

5 PROTECTIVE COVER

5.1 General

The protective cover component of the liner system will consist of a 12-inch- thick layer of soil placed over the compacted clay layer after completion of all required soil testing and verification. The CQA monitor shall provide continuous on-site observation during protective cover placement to assure that protective cover placement does not damage underlying soil liners. The GP shall make sufficient site visits during protective cover placement to document the construction activities, testing, and thickness verification.

5.2 Materials

Protective cover material shall consist of soil that is free from debris, rubbish, frozen materials, foreign objects, and organic material.

5.3 Preparation

Prior to placing the protective cover material, the top of compacted soil liner elevations shall be verified.

5.4 Placement

The protective cover shall be placed in a manner that minimizes the potential to damage the underlying soil liner. Hauling equipment shall be restricted to haul roads of sufficient thickness to protect the underlying liner. The protective cover shall be dumped from the haul road and spread by low ground pressure equipment. On sidewalls, protective cover shall be placed from the bottom to the top, not across or down.

5.5 Testing and Verification

The as-built thickness of the protective cover shall be determined by standard survey methods. Prior to the placement of protective cover, the top of compacted soil liner elevations will be determined at a minimum rate of 1 survey point per 5,000 sf of lined area. After the protective cover is completed, the top of the protective cover elevations will be determined at the same locations as the top of compacted soil liner elevations.

6 DOCUMENTATION

6.1 Reports

Each report shall be submitted in triplicate to the Municipal Solid Waste Division and shall be prepared in accordance with the methods and procedures contained in this LQCP. The evaluated area should not be used for the receipt of solid waste until acceptance is received from the executive director. The executive director may respond to the permittee either verbally or in writing within 14 days from the date on which the Soils and Liner Evaluation Report is date-stamped by the Municipal Solid Waste Division. Verbal acceptance may be obtained from the executive director, which will be followed by written concurrence. If no response, either written or verbal, is received within 14 days, the SLER shall be considered accepted and the owner or operator may continue facility construction or operations. Each report must be signed and, where applicable, sealed by the individual performing the evaluation and countersigned by the site operator or his authorized representative.

Markers will be placed to identify all disposal areas for which a SLER has been submitted and accepted by the executive director. These markers shall be located so that they are not destroyed during operations.

The surface of a liner should be covered with a layer of solid waste within a period of six months to mitigate the effects of surface erosion and rutting due to traffic. Liner surfaces not covered with waste within six months shall be checked by the SLER evaluator, who shall then submit a letter report on his findings to the executive director. Any required repairs shall be performed properly. A new SLER shall be submitted on the new construction for all liners that need repair due to damage.

6.2 Soils and Liner Evaluation Report

After construction of the compacted soil liner, the GP will submit a SLER to the TCEQ on behalf of the owner. No area may be used for the receipt of solid waste until the TCEQ has accepted the SLER or 14 days from the date of receipt of the SLER by the TCEQ, if the executive director has not provided a verbal or written response.

Preparation and submission of the SLER shall be in accordance with TCEQ MSWR. The purpose of the SLER is to document that the construction methods and test procedures are consistent with this LQCP, the TCEQ MSWR, and the project specifications.

At a minimum, the SLER will contain the following:

- A summary of all construction activities
- A summary of all laboratory and field test results
- Sampling and testing location drawings
- A description of significant construction problems and the resolution of these problems
- Record drawings
- A statement of compliance with the LQCP
- The seal and signature of the GP and assistant GP, if applicable, in accordance with the Texas Engineering Practice Act

MUNICIPAL SOLID WASTE PERMIT MAJOR AMENDMENT

PART III-ATTACHMENT D8
FINAL COVER QUALITY CONTROL PLAN

BECK
COMPANIES

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: Revised January 2023

Prepared by:

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84736
1-2-2023

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4 INFILTRATION

4.1 General

The infiltration layer consists of compacted, relatively homogeneous, cohesive material. The CQA monitor shall provide continuous on-site observation during infiltration layer placement, processing, compaction, and testing. The GP shall make sufficient site visits during infiltration layer construction to document the construction activities, testing, and thickness verification in the Final Cover System Report, in accordance with Section 8.

4.2 Materials

Infiltration layer material shall consist of soil that is free from debris, rubbish, frozen materials, foreign objects, and organic material. The required infiltration layer material properties are summarized in Table D8-1.

Table D8-1
Beck Landfill
Infiltration Material Properties

Test	Standard	Required Property
Plasticity Index	ASTM D 4318	15 or Greater
Liquid Limit	ASTM D 4318	30 or Greater
Percent Passing No. 200 Mesh Sieve	ASTM D 1140	30% or Greater
Percent Passing 1-inch Sieve	ASTM D 422	100%
Coefficient of Permeability	ASTM D 5084 or COE EM 1110-2-1906 Appendix VII	$\leq 1 \times 10^{-5}$ cm/sec

Preconstruction testing procedures and frequencies for infiltration layer materials are listed in Section 4.8.1.

4.3 Subgrade Preparation

Prior to placing infiltration layer material, the subgrade should be proof rolled with heavy, rubber-tired construction equipment to detect soft areas. The GP or CQA monitor must observe the proof-rolling operation. Soft areas should be compacted and then be proof rolled again.

The subgrade elevations shall be verified in accordance with the requirements of Section 4.8.3

prior to the placement of infiltration layer.

4.4 Placement and Processing

The infiltration layer subgrade and surface of each lift should be scarified to a minimum depth of six inches prior to placement of the next lift of the infiltration layer. The infiltration layer material should be placed in maximum eight-inch loose lifts to produce a compacted lift thickness of approximately six inches. The material should be processed to a maximum particle size of one inch or less before water is added. Rocks and clods less than one inch in diameter should not total more than about 10 percent by weight. The surface of the top lift shall contain no material larger than 3/8 inch.

If additional water is necessary to adjust the moisture content, it should be applied after initial processing but prior to compaction. Water should be applied evenly across the lift and worked into the material. Waste or any objectionable material must not contaminate compaction water.

4.5 Compaction

The infiltration layer shall be compacted with a pad/tamping-foot or prong-foot roller. A footed roller is necessary to bond the lifts, distribute the water, and blend the soil matrix through kneading action. The infiltration layer shall not be compacted with a bulldozer, rubber-tired roller, flat-wheel roller, scrapers, or any track equipment unless it is used to pull a footed roller. The lift thickness shall be controlled to achieve total penetration into the top of the previously compacted lift; therefore, the lift thickness must not be greater than the pad or prong length. Cleaning devices on the roller must be in place and maintained to prevent the prongs or pad feet from becoming clogged to the point that they cannot achieve full penetration.

The compactor shall make at least two passes across the area being compacted. A pass is defined as one pass of the compactor, front and rear drums. The material should be compacted to a minimum of 95 percent of the maximum dry density determined by standard Proctor (ASTM D 698) at a moisture content at or above optimum moisture in order to achieve the required permeability. Areas with failing tests shall be reworked and recompacted, and then retested with passing tests before another lift is added.

After a lift is compacted, it must be watered to prevent drying and desiccation until the next lift can be placed. If desiccation occurs, the GP must determine if the lift can be rehydrated by surface application of water or if the lift must be scarified, watered, and then recompacted. Following compaction and fine grading of the final lift, the surface of the infiltration layer shall be smooth drum rolled.

4.6 Protection

The completed infiltration layer must be protected from drying, desiccation, rutting, erosion and ponded water until the FMC is installed. Areas that undergo excessive desiccation or damage shall be reworked, recompacted, and retested as directed by the GP.

4.7 Tie In to Existing Covers

The edge of existing infiltration layers shall be cut back on either a slope or step to prevent the formation of a vertical joint. The slope will be a maximum of 3:1 and the steps will be three feet wide by one foot thick.

4.8 Testing and Verification

4.8.1 Preconstruction Testing

Table D8-2 lists the minimum testing required for material proposed for use as the infiltration layer.

Table D8-2
Beck Landfill
Infiltration Layer Material Preconstruction Tests

Test	Standard	Frequency
Plasticity Index	ASTM D 4318	1 per material type
Liquid Limit	ASTM D 4318	1 per material type
Percent Passing No. 200 Mesh Sieve	ASTM D 1140	1 per material type
Percent Passing 1-inch Sieve	ASTM D 0422	1 per material type
Standard Proctor Test	ASTM D 698	1 per material type
Coefficient of Permeability	ASTM D 5084 or COE EM 1110-2-1906 Appendix VII	1 per material type

After the moisture density relationship has been determined for a material type, a soil sample should be remolded to about 85 percent of the maximum dry density at the optimum moisture content. This sample will be tested to determine if the soil can be compacted to achieve a suitable coefficient of permeability. Either falling head or constant head laboratory permeability tests may be performed to determine the coefficient of permeability. The permeant fluid for testing must be tap water or 0.005N calcium sulfate solution. Distilled or deionized water shall not be used as the permeant fluid.

4.8.2 Construction Testing

Table D8-3 lists the minimum testing required for material used as the infiltration layer.

Table D8-3
Beck Landfill
Infiltration Layer Material Construction Tests

Test	Standard	Frequency
Field Density	ASTM D 2922	1/8,000 sf per 6-inch lift
Plasticity Index	ASTM D 4318	1 per acre
Liquid Limit	ASTM D 4318	1 per acre
Percent Passing No. 200 Mesh Sieve	ASTM D 1140	1 per acre
Standard Proctor Test	ASTM D 698	1 per material type
Coefficient of Permeability	ASTM D 5084 or COE EM 1110-2-1906 Appendix VII	1 per acre

The Atterberg limits of the in-place infiltration layer must be continually compared to the Atterberg limits of the Proctor curve sample to assure that the Proctor curve accurately represents the in-place material. Any variance of more than 10 points between the liquid limit or plasticity index of the in-place soil and those of the Proctor curve sample will require that a new Proctor curve be developed. Areas with failing permeability tests shall be reworked and recompacted, and then retested with passing tests before another lift is added.

4.8.3 Thickness Verification

The as-built thickness of the infiltration layer shall be determined by standard survey methods. Prior to the placement of infiltration layer material, the subgrade elevations will be determined at a minimum rate of one survey point per 5,000 square feet of lined area. After the infiltration layer is completed, the top of infiltration layer elevations will be determined at the same locations as the subgrade elevations.

MUNICIPAL SOLID WASTE PERMIT
MAJOR AMENDMENT

PART III-ATTACHMENT E
GEOLOGY REPORT

STATE OF TEXAS
Juliana C. Morelli
Geology
10670
LICENSED
PROFESSIONAL GEOSCIENTIST

Juliana Morelli
1-3-22

BECK
COMPANIES

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: September 2022

Prepared by:

POWER
ENGINEERS

PROJECT NUMBER: 150051.05.01

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Juliana C. Morelli
Geology
10670
Licensed
Professional Geoscientist

Juliana Morelli
1-3-22

1.0 Geology Report (§330.63(e))

This portion of the application applies to owners or operators of MSW landfills, compost units, and if otherwise requested by the executive director. The geology report has been prepared and signed by a qualified groundwater scientist. The previously prepared permit documents relating to Geology, Aquifers, Groundwater, etc. are included as Appendices to this Report for continuity with prior permitting actions. The following prior documents are included by reference to this report:

- Appendix E-1 - Snowden, 1989, Attachment 11 and Supplements
- Appendix E-2 – Snowden, 1989, Attachment 3C – Water Wells
- Appendix E-3 – Supplemental Boring Plan
- Appendix E-4 – Cross Sections

1.1 Regional Geology (§330.63(e)(1))

The regional geology described herein includes from the ground surface to the base of the lowermost aquifer capable of providing usable groundwater within Guadalupe County, Texas. Those regional formations and structural features of significance to the Beck Landfill site are discussed below. **Figure 3-1** shows the surface geology of the subject area of Guadalupe County and adjoining counties and mapped fault lines of the Balcones Fault Zone. **Figure 3-2** is a generalized stratigraphic column of the region that indicates the geologic age, range of thickness, formation lithology and water supply usage.

Quaternary, Tertiary and Cretaceous System formations outcrop within the region of review. These formations are mainly comprised of sand, sandstone, gravel, clay, mudstone, shale, and marl. The stratigraphic sequence of formations that outcrop in the review region from the land surface to the base of the lowermost aquifer capable of providing usable groundwater is shown on the generalized stratigraphic column on **Figure 3-2**.

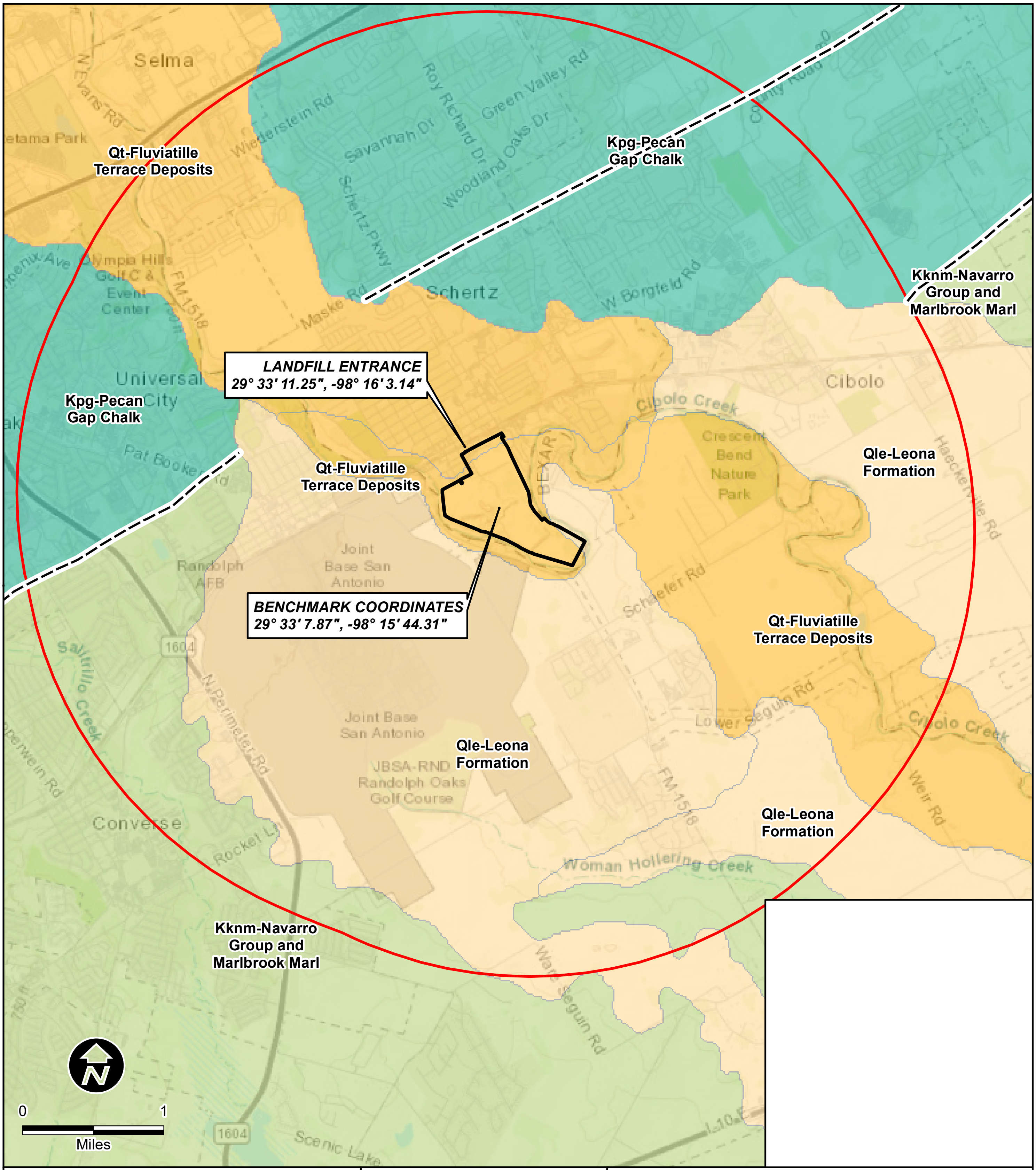
As indicated on the stratigraphic column, the youngest formation that outcrops in the area is the Holocene Series alluvium consisting of clay, silt, sand, and gravel deposited in the floodplain along major stream channels in the southern portion of the subject region. The Holocene Series alluvium is documented to be as much as 25 feet in thickness. The Holocene alluvium lies unconformably over the older Pleistocene Series Leona Formation, and Tertiary and Cretaceous series formations where Leona Formation beds have been eroded away.

Two Pleistocene Series formations outcrop within the mapped region. From youngest to oldest these are the fluviatile terrace deposits and Leona Formation. The fluviatile terrace deposits in the region of review are comprised of sand, silt, clay, and some gravel that were laid down as point bars, oxbows and abandoned channel fill. These fluviatile terrace deposits generally occupy a positioned above the Holocene floodplains of entrenched streams and may obtain a thickness of up to 30 feet based on a review of State Water Well Reports for wells drilled in Guadalupe County. The Pleistocene Series terrace unconformably overlie the older Pleistocene Series Leona Formation, where not eroded away, or Tertiary and Cretaceous system formations where the Leona was removed by erosion.

The Leona Formation of the review region consist of gravel, sand, silt, and caliche deposited as wide fluviatile terraces. The gravel and sand beds of the Leona are stratified and partly cross bedded with lenses of caliche and silt. The Leona is believed to obtain a maximum thickness of about 60 feet. The Leona Formation rests unconformably on top of Tertiary and Cretaceous system formations.

The youngest of the Tertiary System formations that outcrops within the review region is the Pliocene Series Uvalde Gravel; the deposition of which may have also occurred during the early Pleistocene. This formation is comprised of caliche-cemented gravel, cobbles, and some small boulders. Uvalde Gravel sediments were deposited as terraces and occupies topographically high areas that are not associated with present-day drainage. The thickness of this formation ranges from several feet to about 20 feet plus or minus. In the review region, the Uvalde Gravel unconformably overlies Tertiary and Cretaceous system formations.

Eocene and Paleocene series formations of the Tertiary System outcrop at the southeastern portion of the review region. These formations from youngest to oldest are:



Legend

▭	Permit Boundary	**GDbT Rock Unit**	
○	3 Mile Radius		Kknm
╌	Geologic Fault		Kpg
			Qle
			Qt

NIDO, LTD
BECK LANDFILL

FIGURE 3-1
REGIONAL GEOLOGY MAP

SCHERTZ, GUADALUPE
COUNTY, TEXAS

POWER ENGINEERS

Date: 1/3/2023
Rev. 0

Map Sources: Geologic Database of Texas, ESRI World Topo Basemap
Path: G:\Projects\0_Beck\150051 Landfill GIS_Maps_TypeIV_Landfill\3_1_Surface_Geology.mxd

GENERALIZED STRATIGRAPHIC COLUMN

System	Series	Group	Formation	Thickness (feet)	Lithology	Water Supply
Quaternary	Holocene		Alluvium	Up to 25	Clay, silt, sand, and gravel	Not known to supply water to wells. May be hydraulically connected to Pleistocene formations
	Pleistocene		Fluviatile Terrace Deposits	Up to 30	Sand, silt, clay, and some gravel	Not known to supply water to wells. May be hydraulically connected to Holocene Alluvium and Leona Formatoin
			Leona Formation	Up to 60	Gravel and sand with lenses of caliche and silt	Yield small to large quantities[1] of water to wells for domestic, public supply, livestock and irrigation
Tertiary	Pliocene and Pleistocene (?)		Uvalde Gravel	Up to 20	caliche-cemented gravel, cobbles, and some small boulders	Not known to supply water to wells
	Eocene	Wilcox		1420	Mostly mudstone with some silt and very fine sand laminae and variable amounts of sandstone and lignite	Yield small to large quantities of water to wells for domestic, livestock and public supply
	Paleocene	Midway		500	Mostly clay and silt with some lenses of sand and limestone	Not known to supply water to wells
Cretaceous	Gulf	Navarro-Upper Taylor	Navarro Group and Marlbrook Marl undivided	Up to 580	Marl, clay, and siltstone with discontinuous sandstone beds	Not known to supply water to wells
		Lower Taylor	Pecan Gap Chalk	100 to 400	Chalk and chalky marl	Not known to supply water to wells
		Austin	Austin Chalk	350 to 580	Chalk and marl	Yield small to moderate quantities of water to wells for domestic, livestock and some public supply
		Eagle Ford		30 to 75	Shale, siltstone and flaggy limestone	Not known to supply water to wells
	Comanche	Washita	Buda Limestone	60 to 100	Fine grained to nodular limestone	Not known to supply water to wells
			Del Rio Clay	60 to 120	Calcareous and gypsiferous clay with some thin lenticular beds of calcareous siltstone	Not known to supply water to wells
		Fredericksburg	Edwards Limestone undivided	300 to 500	Fine to coarse grained massive limestone with abundant chert and solution zones	Yield small to moderate quantities of water to wells for public supply, domestic and livestock

1 - Small = <50 gallons per minute, Moderate = 50 to 500 gallons per minute and Large = >500 gallons per minute

NIDO, LTD
BECK LANDFILL

FIGURE 3-2
STRATIGRAPHIC COLUMN

SCHERTZ, GUADALUPE
COUNTY, TEXAS

POWER ENGINEERS

Date: 1/3/2023
Rev. 0

Path: G:\Projects\0_Beck\150051 Landfill GIS_Maps_TypeIV_Landfill\3_2_Stratigraphic_Column.mxd

- The Eocene Series Wilcox Group; and,
- The Paleocene Series Midway Group.

Both groups outcrop in the southeastern portion of the review region.

Within the review region, the Wilcox Group outcrops as a wide belt trending from the northeastward to the southwest. The Wilcox strata consists mostly of mudstone with some silt and very fine sand laminae. Variable amounts of sandstone and lignite also occur within the Wilcox Group. The sediments that comprise the Wilcox Group were deposited in palustrine and fluvial environments. The maximum thickness of this group is around 1,420 feet. The Wilcox Group grades vertically into the Midway Group resulting in a conformable contact.

The sediments that make up the Midway Group were deposited in coastal and marine environments. This group is predominately comprised of clay and silt with some lenses of sand and limestone. The Midway Group is about 500 feet thick and unconformably overlies the undivided Cretaceous System Navarro Group and Marlbrook Marl.

Gulf and Comanche series formations of the Cretaceous System outcrop throughout the majority of the review region. These formations from youngest to oldest are:

- Gulf Series
    - Navarro Group and Marlbrook Marl (upper Taylor Group) undivided
    - Pecan Gap Chalk (Lower Taylor Group)
    - Austin Chalk
    - Eagle Ford Group
    - Del Rio Clay
- Comanche Series
    - Buda Limestone
    - Del Rio Clay

- Edwards Limestone undivided

The Navarro Group and Marlbrook Marl undivided outcrops through the middle of the review region. The lithology of this undivided assemblage of formations includes marl, clay, sandstone, and siltstone. The sandstone beds are discontinuous and of limited lateral extent. This undivided assemblage is thought to be deposited in a shallow water, marginal marine environment. The Navarro-Marlbrook Marl is up to 580 feet in thickness and may rest conformably upon the Pecan Gap Chalk. This undivided assemblage of formations is unconformably overlain by Holocene and Pleistocene series formations at the Beck Landfill site and is the formation into which the landfill excavation will terminate.

The Pecan Gap Chalk outcrops in the northwestern portion of the review region, well within the Balcones Fault Zone. This formation is composed of chalk and chalky marl deposited in shallow shelf, shoreface and transgressive marine environments. The Pecan Gap ranges from 100 feet to 400 feet in thickness and unconformably overlies the Austin Chalk.

The Austin Chalk further northwest of beck Landfill site in a highly faulted area of the Balcones Fault Zone. The lithology of this formation includes chalk and marl with localized occurrences of bentonitic seams. The Austin carbonates accumulated in a low-energy shallow to open – shelf and shoal environment. The Austin Chalk thickness ranges from 350 feet to 580 feet and unconformably overlies the Eagle Ford Group.

The oldest formation of the Gulf Series is the Eagle Ford Group which is also referred to as the Eagle Ford Shale. Outcroppings of the Eagle Ford Group are limited to the highly faulted portion of the Balcones Fault Zone in the northwestern area of the review region. The Eagle Ford lithology includes shale, siltstone and flaggy limestone deposited as deltaic and marine sediment. The Eagle Ford Group contact with the underlying Buda Limestone is unconformable and is 30 feet to 75 feet thick.

The Buda Limestone is the upper formation of the Comanche Series. As with the Austin Chalk and Eagle Ford Group, outcroppings of Buda Limestone are mostly restricted to the highly faulted portion of the Balcones Fault Zone within the northwestern limits of the review region. Sediments for this limestone formation were deposited in an open-shelf marine environment. The formation lithology is fine grained poorly bedded to nodular limestone that becomes argillaceous near its upper contact. The contact between the Buda Limestone and the Del Rio Clay is unconformable. The thickness of the Buda strata ranges from 60 feet to 100 feet within the review region.

Outcroppings of the Del Rio Clay, formally called the Grayson Formation, are restricted to the highly faulted area of the Balcones Fault Zone within the northwestern portion of the review region. The depositional environment for Del Rio sediments were lagoonal and nearshore shallow marine. Calcareous and gypsiferous clay with some thin lenticular beds of calcareous siltstone make up the Del Rio lithology. The thickness of this formation ranges from 60 feet to 120 feet. The Del Rio Clay conformably overlies the undivided Edwards Group.

The undivided Edwards Group outcrops in the far northwestern portion of the review region and is within the northwestern extent of the Balcones Fault Zone. The lithology of this undivided formation consists of fine to coarse grained massive limestone with abundant chert and solution zones deposited in a shallow water marine environment. The undivided Edwards Group ranges from 300 feet to 500 feet.

3.1.1 Local Geological Processes (§330.63(e)(2))

30 TAC 330.559 defines an unstable area as a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all landfill structural components responsible for preventing releases from the landfill. Unstable areas can include poor foundation conditions, areas susceptible to mass movement, and karst terrains. The Beck Landfill was excavated through alluvial materials (sand and gravel) to the undivided Navarro Group and Marlbrook Marl, which consist of clay and shale material (impermeable). Evidence of active detrimental on-site geologic activity has not been documented within the landfill area. No on-site or local human-made features or events were observed to have created unstable conditions.

The Beck Landfill is located within the Balcones Fault Zone as show on **Figure 3-4.** The Balcones Fault Zone is a system of normal faults that traverses the review region from the northeast to the southwest. This fault zone is associated with the Paleozoic-age Ouachita Fold Belt, a remnant of an ancient highly eroded mountain range which is buried beneath the Balcones Fault Zone. Movement along the Balcones faults took place mainly during the Miocene Epoch. Data contained within the USGS Quaternary Fault and Fold Database indicates that no Holocene displacement of faults within the Balcones Fault Zone has occurred.

The Ouachita Fold Belt caused regional tilting and uplifting of Paleozoic rocks that underlie the review region. Pre-Cretaceous erosion of the uplifted Paleozoic rocks created a southeast dipping regional erosional surface or unconformity upon which Cretaceous System sediments were deposited. This regional unconformity and extensive faulting are the most significant structural features affecting the Cretaceous System and Paleocene Series formations within the review region. The Ouachita Fold Belt regional unconformity affected the deposition of both Cretaceous and Tertiary system sediments bringing about the creation of wedge-shaped formation bodies that thicken southeastward towards the Gulf Coast. **Figure 3-3** is a simplified down-the-coast oriented regional stratigraphic cross-section through central Guadalupe County which illustrates the geometry and dip of the review region formations.

The Beck Landfill and adjacent areas is documented to be devoid of Holocene displacement along those faults of the Balcones Fault Zone or active land surface subsidence and does not appear to meet the definition of an “unstable area”. **Figure 3-4** shows the landfill location in relation to areas of known Holocene fault displacement.

3.1.2 Regional Aquifers (§330.63(e)(3))

Four aquifers are utilized for water supplies within the review region. The four aquifers that outcrop and/or subcrop the review region are: the Carrizo – Wilcox, Edwards, Austin, and the Leona aquifers. The Carrizo – Wilcox and Edwards aquifers are classified by the Texas Water Development Board (TWDB) as major aquifers, with the Leona and Austin being classified as “other” by the TWDB. No aquifers classified as minor outcrop or subcrop the review region. A map depicting the location of the Beck Landfill relative to the Carrizo – Wilcox, zones of the

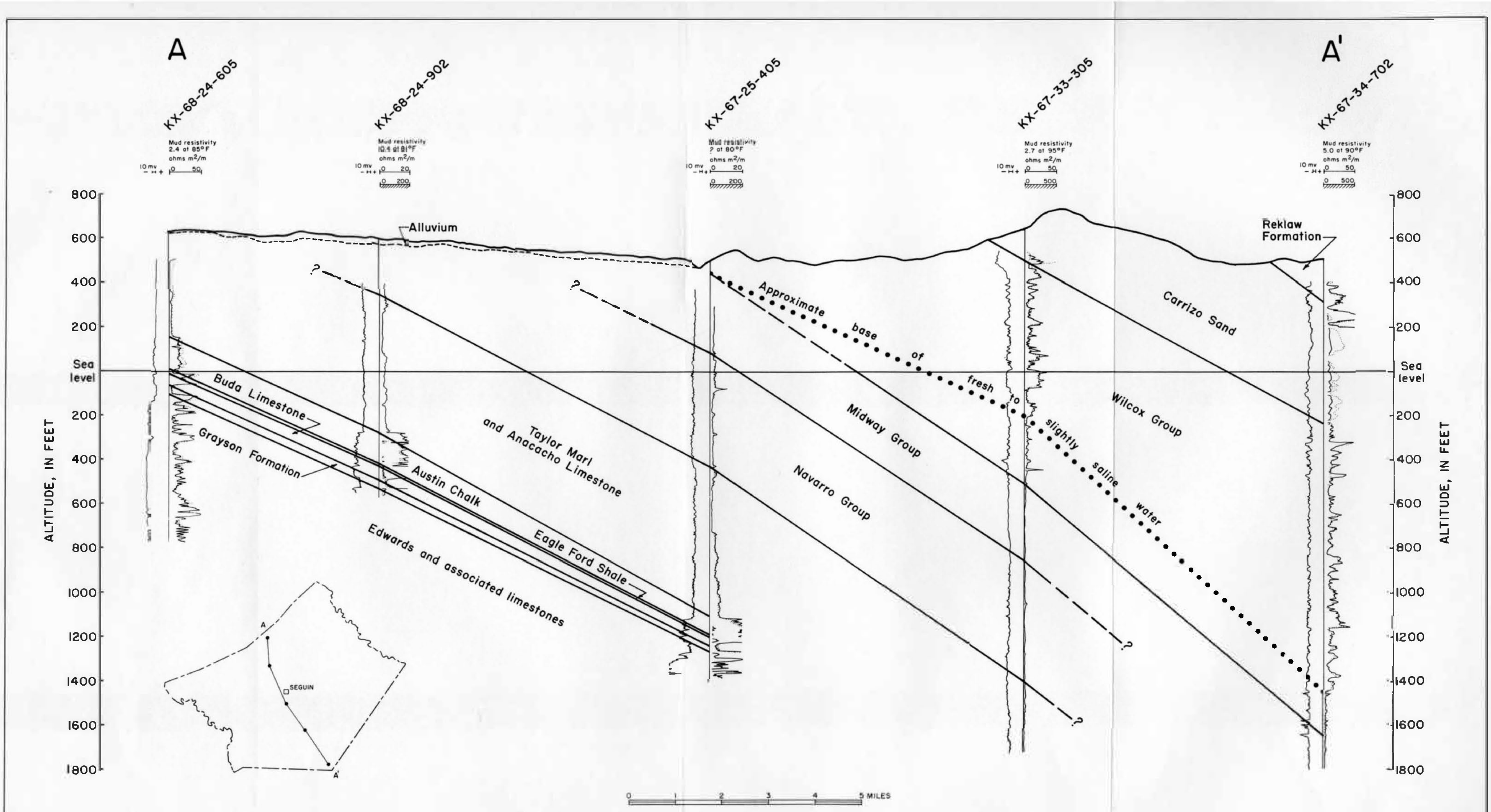


Plate 2

Geologic Section A - A'

U.S. Geological Survey in cooperation with the Texas Water Development Board and Others

Source: Shafer, G.H., 1966, Ground-Water Resources of Guadalupe County, Texas, U.S. Geological Survey, Texas Water Development Board, Report 19

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FIGURE 3-3
REGIONAL STRATIGRAPHIC CROSS-SECTION

SCHERTZ, GUADALUPE COUNTY, TEXAS

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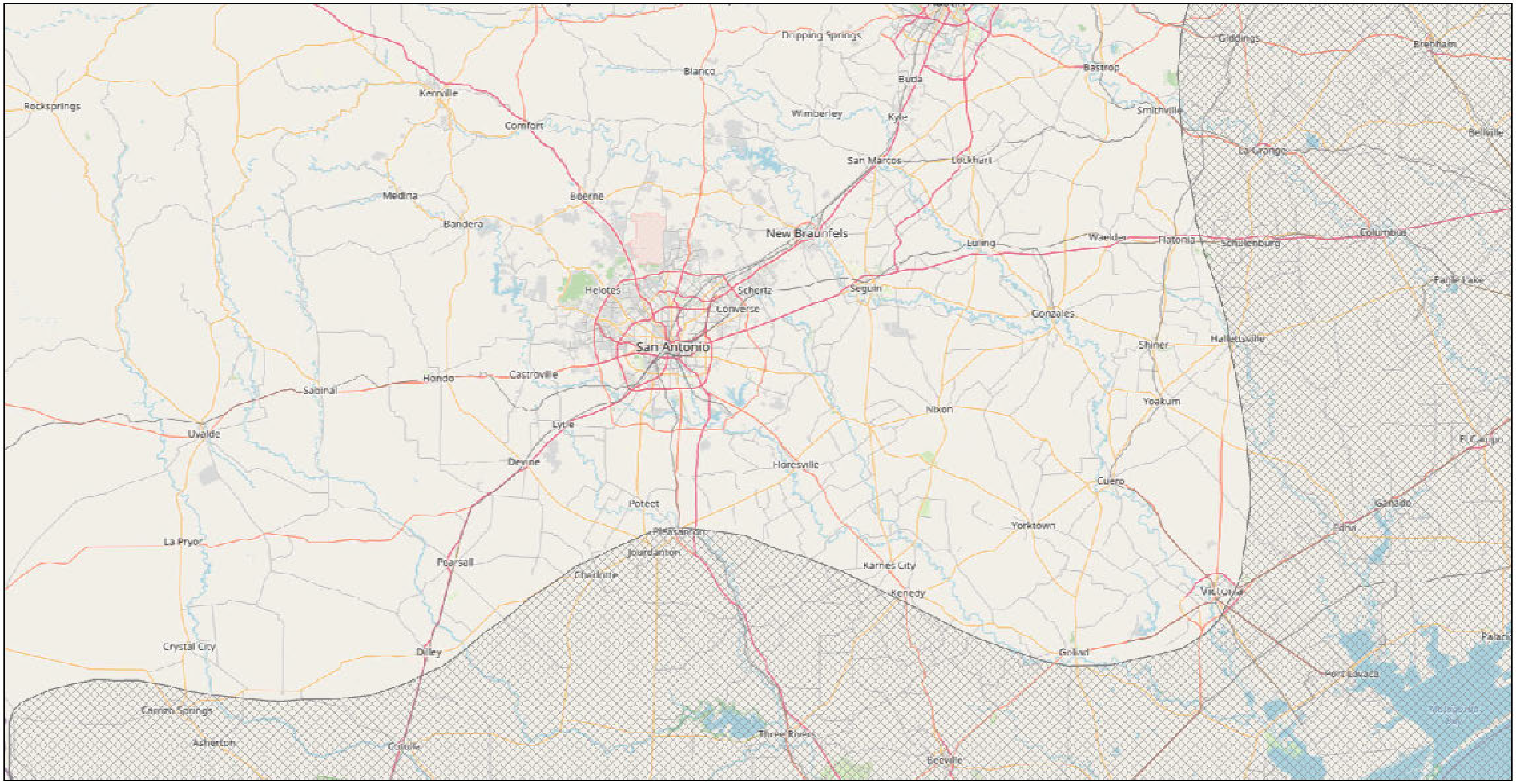
U.S. Geological Survey Quaternary Faults



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1:1,155,581

0	12.5	25	50 mi
0	20	40	80 km

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Fault Areas
- ▨ Class B
- ▨ historic
- ▨ late Quaternary
- ▨ latest Quaternary
- ▨ middle and late Quaternary

National Database
- — Historic (< 150 years), well constrained location
- - - Historic (< 150 years), moderately constrained location
- ⋯ Historic (< 150 years), inferred location
- — Latest Quaternary (<15,000 years), well constrained location
- - - Latest Quaternary (<15,000 years), moderately constrained location
- ⋯ Latest Quaternary (<15,000 years), inferred location
- — Late Quaternary (< 130,000 years), well constrained location
- - - Late Quaternary (< 130,000 years), moderately constrained location
- ⋯ Late Quaternary (< 130,000 years), inferred location
- — Middle and late Quaternary (< 750,000 years), well constrained location
- - - Middle and late Quaternary (< 750,000 years), moderately constrained location
- ⋯ Middle and late Quaternary (< 750,000 years), inferred location

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FIGURE 3-4
QUATERNARY FAULT MAP

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Edwards, Austin and Leona aquifers is provided as **Figure 3-5**. Those geologic formations and groups associated with the above referred aquifers and the rock/sediment makeup of each aquifer are listed from youngest to oldest in geologic age in Table 3-1 below.

Table 3-1 Regional Aquifers

Aquifer Name	Associated Geologic Formation or Group	Rock/Sediment Makeup
Leona	Leona Formation	Gravel and sand with lenses of caliche and silt
Carrizo – Wilcox	Wilcox Group within the Review Region	Mostly mudstone with some silt and very fine sand laminae and variable amounts of sandstone and lignite
Austin	Austin Chalk	Chalk and marl
Edwards	Edwards and Associated Limestones	Fine to coarse grained massive limestone with abundant chert and solution zones

Of these four aquifers, the Leona, Austin, and Edwards either outcrop near the Beck Landfill site boundary or underlie it. The Carrizo – Wilcox outcrops approximately 7.75 miles southeast of the landfill site and it highly unlikely to be affected by landfill activities. Therefore, no further discussion regarding the Carrizo – Wilcox follows this text. **Figure 3-5** shows the outcrop areas of the above referenced aquifers in relation to the landfill location.

As shown in table above, the Leona Aquifer is comprised of gravel and sand with lenses of caliche and silt. Hydraulic properties data for the Leona Aquifer within the review region and Guadalupe County appears to be nonexistent in readily available State groundwater reports. However, data pertaining to the range of the average hydraulic conductivity for the Leona Aquifer in neighboring Caldwell County was obtained. According to the source, the average Leona hydraulic conductivity ranged from 37 feet/day to 397 feet/day. Yields for water well producing from the Leona range from 1 gallon/minute (gpm) to 500 gpm are reported on State Water Well Reports obtained from the TWDB for wells producing for the Leona Aquifer and State groundwater reports.

The Leona Aquifer is under water table conditions. Recharge to this aquifer occurs where precipitation infiltrates Leona strata that outcrops within the review region. Additional recharge may also be received from streams entrenched in the Leona outcrop area during flood events. The Leona may provide some recharge to the Carrizo Willcox where Leona strata directly rest upon the Wilcox Group outcrop area in the southeastern corner of the review region. Recharge from the Leona to the Austin Aquifer is impeded by two aquitards that separate the Leona and Austin. These two aquicludes are the Cretaceous Series Pecan Gap Chalk and undivided Navarro Group and Marlbrook Marl, which underlie the Leona at the Beck Landfill site.

Maps showing the regional Leona water table surface were not identified during a review of readily available regional hydrogeologic literature. Being unconfined and assuming the absence of pumping well interference, the Leona water table surface most likely mimics the land surface topography flowing in the direction of lower topographical elevations and entrenched stream channels. Historical water table elevation measurements taken at the Beck Landfill site during groundwater monitoring events indicate groundwater flow in the Leona is towards Cibolo Creek supporting the regional flow direction conclusion. Regional rates of groundwater flow through the Leona Aquifer were not found in the reviewed readily available regional hydrogeologic literature. Using the range of average Leona hydraulic conductivities presented earlier, an estimated effective porosity of 0.25 for sand and gravel and an assumed hydraulic gradient of 0.003feet/foot (based on Beck Landfill historical water table elevation measurements), the estimated groundwater flow rate would range from 0.44 feet/day to 4.8 feet/day.

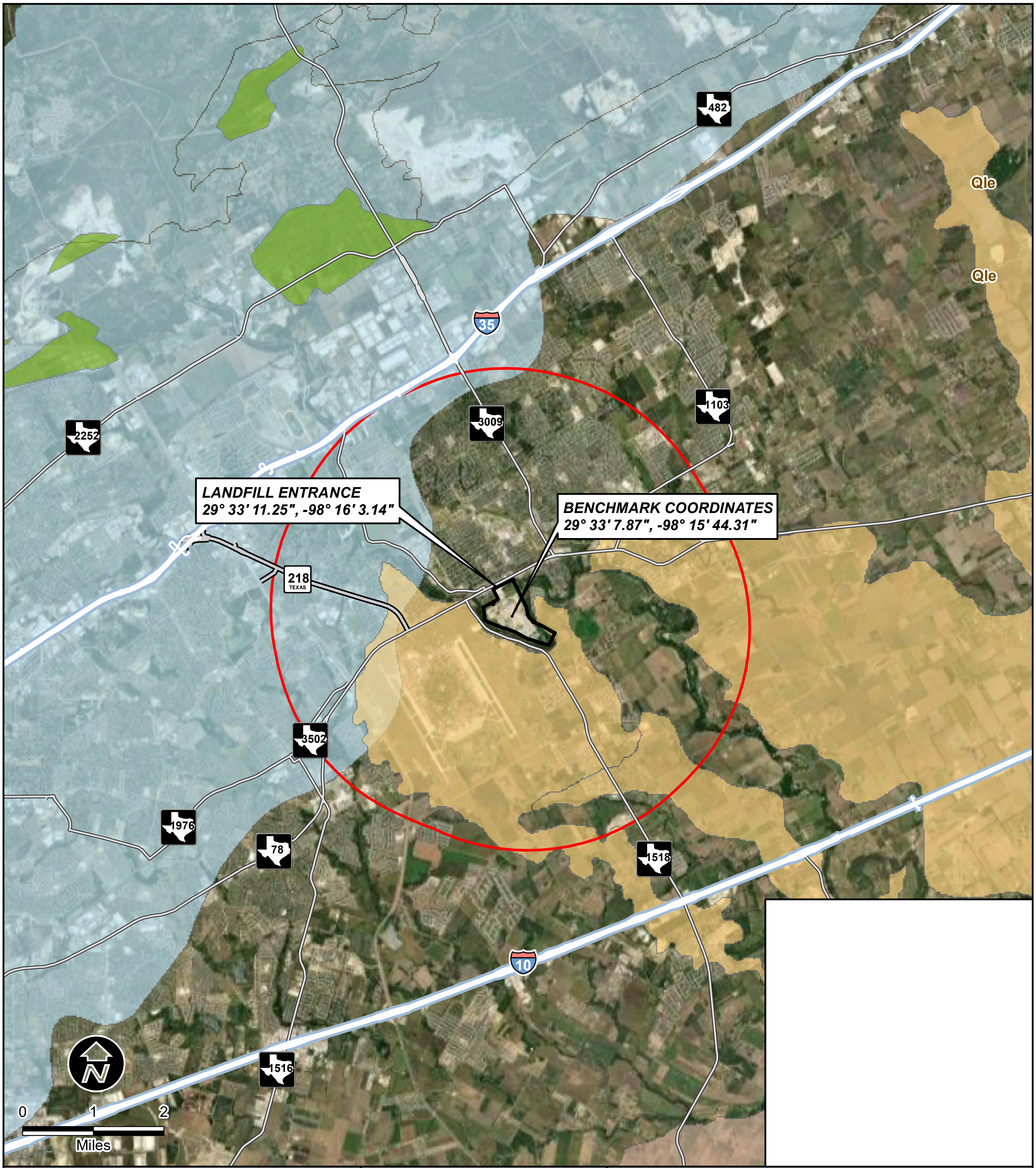
A review of State Water Well Reports for those water wells producing from the Leona Aquifer within the review region showed total dissolved solids (TDS) concentrations to be less than 500 mg/L. Historical groundwater monitoring data for the Beck Landfill shows TDS concentrations ranged from 502 mg/L to 3460 mg/L. These TDS concentrations indicate that groundwater in the Leona Aquifer can be categorized as fresh to moderately saline. Groundwater withdrawn from the Leona Aquifer is utilized for public supply, domestic, irrigation and livestock purposes.

The Austin Aquifer is comprised of chalk and marl, which outcrop west and northwest of the Beck Landfill site within the Balcones Fault zone. These outcrop areas are highly faulted and of limited extent in the review region. Recharge to the Austin Aquifer occurs by direct infiltration of precipitation on its outcrop area and by limited seepage from streams that cross the outcrop areas. The Austin is most likely under water table conditions in its outcrop area but goes to a confined (artesian) condition southeast (downdip) of its outcrop areas where it is overlain by the Pecan Gap Chalk and undivided Navarro Group and Marlbrook Marl strata that form aquitards hydraulically separating it from the overlying Leona Aquifer. The Austin is underlain by strata belonging to the Eagle Ford Group, Buda Limestone and Del Rio Clay which form aquitards that separate it from the deeper Edwards Aquifer.

Maps showing the Austin Chalk regional water table surface and potentiometric surface, where confined, were not included in the reviewed, readily available regional hydrogeologic literature. However, the regional hydrogeologic literature reviewed did state that the predominate direction of groundwater flow within the Austin Aquifer is southeastward toward the Gulf Coast. The regional hydrogeologic literature also pointed out that localized variations in flow direction occur due to fault barriers or withdrawals of groundwater by pumping water wells. Where groundwater movement comes under the influence of pumping water wells, groundwater flow is towards the wells from all directions.

Hydraulic properties data for the Austin Aquifer within the review region was not found in readily available State groundwater reports or other hydrogeologic literature. However, data regarding well yield for water well producing from the Austin Aquifer were obtained from State Water Well Reports and one TWDB groundwater report. According to these sources, well yields range from 2 gpm to 60 gpm.

Data pertaining to TDS concentrations in groundwater withdrawn from the Austin Aquifer were obtained from State Water Well Reports for water wells producing from the Austin within the review region and reviewed TWDB groundwater reports. According to this data, TDS concentrations in Austin Aquifer groundwater range from 385 mg/L to 1,528 mg/L. These TDS concentrations indicate that groundwater in the Austin Aquifer mostly fresh but can be moderately



LANDFILL ENTRANCE
29° 33' 11.25", -98° 16' 3.14"

BENCHMARK COORDINATES
29° 33' 7.87", -98° 15' 44.31"

Legend

▭ Permit Boundary ○ 3 Mile Radius

Major Aquifer
- Carrizo-Wilcox
- Edwards

Local Aquifer
- Leona
- Austin Chalk

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FIGURE 3-5
REGIONAL AQUIFER OUTCROP AREAS

SCHERTZ, GUADALUPE
COUNTY, TEXAS

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Rev. 0

Map Sources: Geologic Database of Texas, TWDB, ESRI World Imagery 2021
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saline at some locations. Groundwater withdrawn from the Austin is used for public supply, domestic and livestock purposes.

As previously stated, the Edwards Aquifer is classified by the TWDB as a major aquifer and underlies the Beck Landfill site. This major aquifer is comprised of fine to coarse grained massive limestone with abundant chert and solution zones. The Edwards outcrops northwest of the Beck Landfill site within the Balcones Fault zone. Recharge to the Edwards Aquifer occurs by direct infiltration of precipitation on its outcrop area and some seepage from streams that cross its outcrop area. The Edwards is under water table conditions in its outcrop area but becomes confined southeast of it outcrop area being overlain by strata of the Eagle Ford Group, Buda Limestone and Del Rio Clay which form aquitards that hydraulically separate it from the overlying Austin Aquifer.

Figure 3-6 shows the regional water table surface and potentiometric surfaces of the Edwards Aquifer in July 1974. As shown on this figure, the direction of groundwater flow within the unconfined portion of the Edwards is southeastward toward the Gulf Coast, then turning to the northeast upon transitioning to confined conditions. Where groundwater movement locally comes under the influence of pumping water wells, groundwater flow is towards the wells from all directions.

The hydraulic conductivity of the Edwards Aquifer is documented as ranging from 2 feet/day to 31 feet/day, with transmissivities ranging from "negligible" to 2 million feet^2/day. Well yield for water well producing from the Edwards Aquifer within the review region range from 15 gpm to 160 gpm. The estimated rates of groundwater flow through the Edwards range from 2 feet/day to 31 feet/day.

TDS concentrations data for groundwater withdrawn from the Edwards Aquifer were taken from State Water Well Reports for water wells producing from the Edwards within the review region and reviewed TWDB groundwater reports. This data shows that TDS concentrations in Edwards Aquifer groundwater range from 247 mg/L to 8,249 mg/L. The distribution of these TDS concentrations across the review region show that Edwards groundwater at the northwestern half

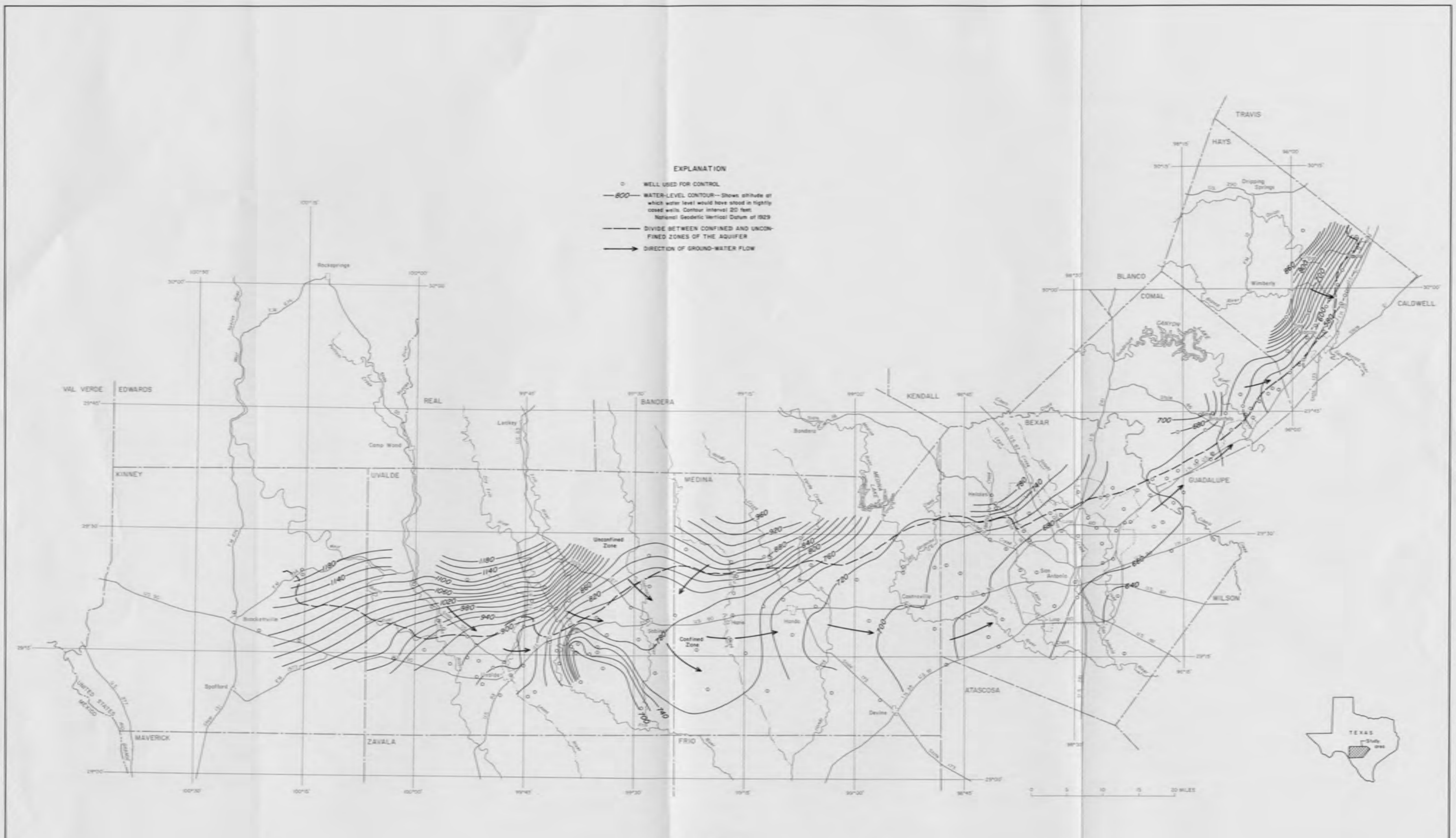

Figure 23
Regional Direction of Ground-Water Flow and
Water Levels in the Edwards Aquifer in July 1974

Source: Maclay, R. W. and Small, T. A., 1986, Carbonate Geology and Hydrology of the Edwards Aquifer in the San Antonio Area, Texas, U.S. Geological Survey, Texas Water Development Board, Report 296

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FIGURE 3-6
EDWARDS WATER TABLE POTENTIOMETRIC SURFACE MAP

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Rev. 0

Path: G:\Projects\0_Beck\150051 Landfill GIS_Maps_TypeIV_Landfill\3_2_Stratigraphic_Column.ai of the review region can be categorized as be fresh to slightly saline and moderately saline in the southern half of the review region. Groundwater withdrawn from the Edwards is used for public supply, domestic and livestock purposes.

A list of all water wells located within one mile of the Beck Landfill from which groundwater is withdrawn of use is provided in Table 3-2 below. The locations of these water wells are shown of **Figure 3-7**.

Table 3-2 Water Wells within One Mile of the Beck Landfill Boundaries

TWDB Well Report Number	Location	Bore Depth (ft.)	Use	Aquifer Name
297428	29.531667°, -98.259445°	35	Domestic	Leona
297432	29.532222°, -98.257778°	34	Domestic	Leona
288275	29.53334°, -98.265834°	41	Domestic	Leona
268534	29.565556° -98.256111°	380	Domestic	Austin Chalk
6830603	29.558612°, -98.260001°	550	Irrigation	Edwards
6830605	29.567778°, -98.261667°	116	Domestic	Austin Chalk
6830606	29.565834°, -98.266944°	295	Domestic	Austin Chalk
6831702	29.535° -98.245278°	35	Public Supply	Leona
68306A	29.550161° -98.273573°	35	Domestic	Leona
68306C	29.550643° -98.268175°	390	Domestic	Edwards
68306D	29.550645° -98.268163°	75	Domestic	Leona
68314	29.555336° -98.264186°	55	Domestic	Leona
68317	29.536302°	33	Domestic	Leona

TWDB Well Report Number	Location	Bore Depth (ft.)	Use	Aquifer Name
	-98.247536°			

Sources: Texas Water Development Board (TWDB) Groundwater Data Viewer and Texas Commission on Environmental Quality (TCEQ) Water Well Report Viewer, Accessed on April 19, 2021

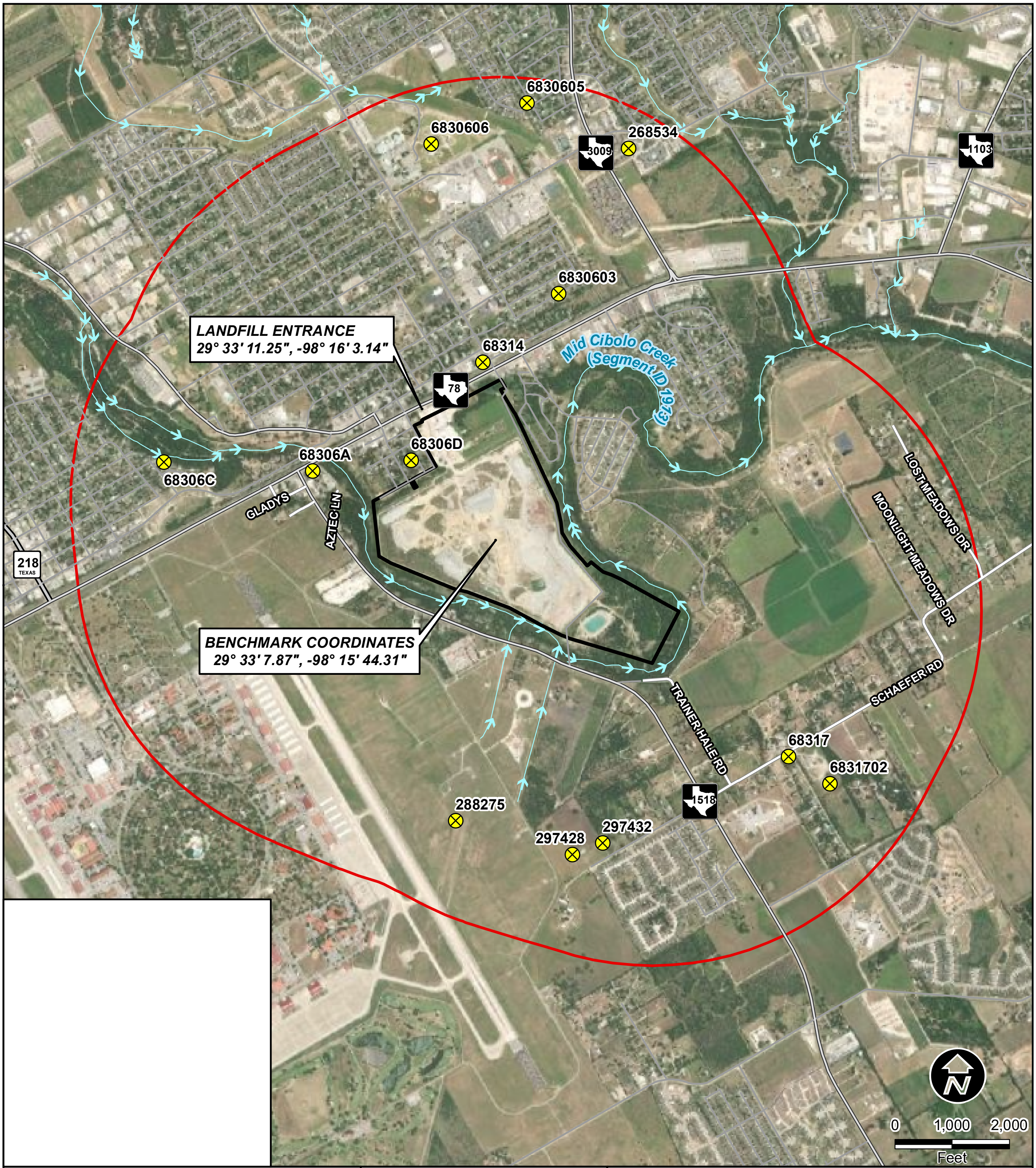
3.1.3 Subsurface Conditions (§330.63(e)(4))

The original geotechnical analysis and supplemental borings are presented under Part III, Attachment D-5. Additional geotechnical information is provided in that attachment in support of this application. The information provided below synthesizes information submitted with the original application (Snowden, 1989) as relevant to this rule requirement, as supplemented by borings advanced in 2020.

Per Snowden (Subsurface Conditions, 1989), a series of borings, along a 400 foot grid layout within the confines of the project area was proposed to the Texas Department of Health (TDH). The TDH approved the investigative proposal with the understanding that some individual boring locations were subject to equipment accessibility and thus may be delated. Omission of boring could not however compromise the development of an adequate subsurface stratigraphic relationship.

A total of fifty-four (54) borings were advanced. Each of the proposed boring locations is indicated on the original boring plan, but only those designated by grid numbers were actually drilled. A continuous flight auger system, either of a solid or hollow stem type, was employed in the advancement of the borings. An updated cross-sectional analysis of this boring plan and boring lot set is provided as **Appendix E-4** of this Report. The locations and elevations are approximated based on best available information today. A Table is provided for references.

Representative samples of the subsurface sediments were obtained from selected borings. Undisturbed or Shelby tube samples were recovered to represent much of the clay-shale penetration as recorded on the accompanying logs. Auger samples were generally recovered to represent the stream deposited stratum. All samples were immediately sealed to preserve in-situ



Legend

▭	Permit Boundary
⟿	Stream
▭	1-Mile Radius
⊗	TWDB Groundwater Well

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FIGURE 3-7:
WATER WELLS WITHIN 1 MILE

SCHERTZ, GUADALUPE
COUNTY, TEXAS

POWER ENGINEERS

Date: 1/3/2023
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Map Sources: TWDB Groundwater Wells, ESRI World Imagery 2021
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states and moisture conditions as near as possible.

The analysis of the soil samples was performed in a soils laboratory. Testing generally conformed to an appropriate A.S.T.M specification as per the soil property being determined. The values of permeability, each expressed as centimeters per second, were derived by a constant head method utilizing flexible wall permeameters. The recompacted samples were also tested by the same method. Permeability was determined for selected clay samples from six (6) widely spaced borings. The samples were chosen as to be representative of the entirety of the clay formation underlying the proposed site and/or to confirm the impermeable nature of the natural clay. Atterberg Limits were determined from un-tested portions of the permeability samples, in order to formulate a basis of comparison, with the plasticity indexes, as determined from other sampled borings. A comparison of this nature should support the suitability of the particular natural clay, as relevant to the proposed site usage. Sieve and Hydrometer analysis were not performed, as the majority of the laboratory investigation was concentrated on materials predominantly of clay minerals. Such clay materials would generally pass the #200 sieve.

The conclusions of the laboratory testing are given on the tables included in Part III, Attachment D-5. The findings of the exploratory borings as depicted by the boring logs, along with the other aspects of the field accumulated datum, allowed an analysis of the subsurface conditions existing at the proposed site.

A supplemental geotechnical investigation was conducted by Terracon in the southeast portion of the landfill in September 2020 to revisit the findings of the original investigation. The investigation was conducted in accordance with 30 TAC §330.63(e)(4) and §330.63(e)(5). A total of eight borings were advanced in the approximately 12-acre area, consistent with the guidance of 6-10 borings in 30 TAC §330.63(e)(4)(B) for a study area of 10-20 acres. A boring plan detailing the proposed investigation was submitted by POWER Engineers, Inc. to the TCEQ Municipal Solid Waste Permits section on August 17, 2020. No changes to the proposed number and depth of the borings were requested due to site conditions in the proposed boring plan. No geophysical methods, such as electrical resistivity, were proposed for use as part of this study to reduce the number of required borings. The TCEQ received the boring plan for review on August 31, 2020, and issued an approval letter dated September 3, 2020. A copy of the approved boring plan and TCEQ approval letter are included with this submittal as Appendix E-3.

The Terracon Geotechnical Data Report indicates that borings were advanced with a truck-mounted drill rig utilizing continuous flight augers. Samples were obtained by Terracon continuously in the upper 10 ft. if each soil boring and at intervals of 5 ft. thereafter. A thin-wall tube or split-barrel tube was utilized. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge was pushed hydraulically into the soil to obtain a relatively undisturbed soil sample. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was utilized by Terracon and 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 was recorded by Terracon as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the Terracon boring logs at the test depths. Terracon observed and recorded groundwater levels during drilling and sampling. Terracon backfilled all borings with bentonite chips after their completion.

Table 3-3 below summarizes the subsurface findings at each boring location. The Terracon Geotechnical Data Report with detailed information presented for each boring, including Unified Soil Classification System findings is included in Part III Attachment D-5. A discussion of the laboratory soil tests and findings by Terracon following boring activities is presented below. Cross-sections prepared from the findings are attached as **Appendix E-4** to this Report.

Table 3-3 Summary of Subsurface Soil Findings

Boring No.	Generalized Soil Findings and Depths Below Ground Surface					
FB-1 (Terminated at 45 ft.)	0-4 ft. Fill -Fat Clay (CH)	4-13 ft. Fill- Fat Clay (Reworked Clay-Shale)	13-23 ft. Fill- Clayey Sand (SC)	23-33 ft. Clayey Gravel (GC)	33.0-38 ft. Lean Clay (CL)	38-45 ft. Clay-Shale

Boring No.	Generalized Soil Findings and Depths Below Ground Surface					
FB-2 (Terminated at 45 ft.)	0-3 ft. Fill-Fat Clay (CH)	3.0-13.0 ft. Fill- Fat Clay (Reworked Clay-Shale) (CH)	13.0-38.0 ft. Fat Clay (CH)	38.0-45.0 ft. Clay-Shale	N/A	N/A
FB-3 (Terminated at 50 ft.; Groundwater encountered at 38 ft.)	0-6 ft. Fill-Lean Clay (CL)	6-18 ft. Fill-Fat Clay (Reworked Clay-Shale) (CH)	18-20 ft. Lean Clay (CL)	20-35 ft. Clayey Gravel (GC)	35-43 ft. Fat Clay (CH)	43-50 ft. Clay-Shale
FB-4 (Terminated at 35 ft.)	0-35 ft. Clay-Shale	N/A	N/A	N/A	N/A	N/A
FB-5 (Terminated at 35 ft.)	0-35 ft. Clay-Shale	N/A	N/A	N/A	N/A	N/A
FB-6 (Terminated at 35 ft.)	0-35 ft. Clay-Shale	N/A	N/A	N/A	N/A	N/A
FB-7 (Terminated at 50 ft.; Groundwater Encountered at 9ft. and stabilized at 12 ft.)	0-4. ft. Fill - Lean Clay (CL)	4.0-14.0 ft. Fill – Clayey Gravel (GC)	14-50 ft. Clay-Shale	N/A	N/A	N/A
FB-8 (Terminated at 50 ft.)	0-18 ft. Fat Clay (CH)	18-50 ft. Clay-Shale	N/A	N/A	N/A	N/A

3.1.4 Geotechnical Data (§330.63(e)(5))

The original geotechnical analysis and supplemental borings are presented under Part III, Attachment D-5. Additional geotechnical information is provided in that attachment in support of this application. The information provided below synthesizes information submitted with the original application (Snowden, 1989) as relevant to this rule requirement, as supplemented by borings advanced in 2020.

The various soil layers identified in the soil borings were tested and evaluated to determine their index properties and their in situ undisturbed permeabilities. Clause 325.74 (b) (5) (I) (iii) of the TDH Municipal Solid Waste Regulations was used as a guide for these evaluations. This clause states as follows:

A laboratory report of soil characteristics shall be submitted consisting of a minimum of one sample from each soil layer that will form the bottom and sides of the proposed excavation. The design engineer should have as many additional tests performed as necessary to provide a typical profile of the soil stratifications within the site. No laboratory work need be performed on highly permeable soil layers which obviously will require lining. The soil samples shall be tested by a competent soils laboratory. The soil tests shall consist of the following:

1. *Permeability tests, to be performed according to one of the following standards on undisturbed soil samples. Where excavations already exist on the site that are to be used for waste disposal, undisturbed samples shall be taken from the sidewalls of those excavations and said permeability tests made on the horizontal axis. All test results shall indicate the type of test used and the orientation of each sample.*

   Constant Head—ABTM D 2434; or

   Falling Head—Appendix VII of the Corps of Engineers Manual EM 1110-2-1906, 30 Nov. 70, Laboratory Soils Testing.

2. *Sieve analysis and hydrometer analysis: No.4, No.10, No.40, No.200, —200, and hydrometer analysis on —200 fraction—ASTM D422.*

3. *Atterberg Limits—ASTM D 423 and D 424.*

4. *Moisture - Density Relations—ASTM D 69B.*

5. *Moisture Content—ASTM D 2216.*

All soils bounded within the following range of values shall be tested in a soils laboratory for the coefficient of permeability. Normally all soils below the range of values stated in this subclause are very sandy and will require lining, unless additional test data support a deviation. Those soils which exceed the range of values are high in clay and do not require additional testing to prove their adequacy for sanitary landfill purposes. The physical parameters stated are to be considered as guidelines for soil sample testing. Engineering judgement must be used on those samples which exhibit some but not all of the boundary limits stated.

Plasticity Index 15 to 25, Liquid Limit 30 to 50, Percent Passing 30 to 50, No.200 Mesh Sieve (-200)

The sandy clays exhibit Liquid Limits (LL) of 26 to 46 and Plasticity Indices (PI) of 11 to 30. This soil layer requires testing to determine the coefficient of permeability. Samples from the silty clays were tested for permeability and were found to be well within required characteristic qualities when mixed with clays and bentonite as proposed as for use in the dike.

The clay and shale deposits exhibit Liquid Limits of 53 to 72 and Plasticity Indices of 37 to 52. This soil layer does not require additional permeability testing and is considered suitable for use as a natural liner.

The permeability test results from this project are presented in the Geotechnical Investigation Attachment 11 (Snowden, 1989 presented in Part III, Attachment D-5). It should be noted that soils with a high Plasticity Index may also exhibit substructures of seams or joints which may have an effect upon permeability. The gray shale beneath this project was not however observed to have significant permeable substructure. Based on our observations and the permeability test results, the Navarro & Taylor Deposits are expected to be suitable as natural liners provided that the slurry trench key is extended a minimum of five (5) feet into this shale.

The design as proposed for this project then will require the establishment of the soil bentonite slurry trench keyway to be excavated a minimum of 5 feet into the underlying shale, to insure against any substructure permeability and afford the greatest degree of integrity.

A supplemental Geotechnical Investigation was conducted by Terracon at the southeast portion of the Beck Landfill in September 2020. A general overview of the geotechnical data associated with the investigation is presented below. The full Terracon Geotechnical Data Report is attached as **Appendix E-2**.

330.63(e)(5)(A) – Overview of Laboratory Investigation and Findings

Samples collected by Terracon during the field exploration were taken to the laboratory for further observation by the Terracon project geotechnical engineer and were classified in accordance with the United Soil Classification System (USCS). The following laboratory test methods were conducted by Terracon on selected soil samples from this investigation:

- Moisture Content (ASTM D2216);
- Atterberg Limits (ASTM D4318);
- Gradation of Soils using Sieve Analysis (ASTM D422);
- Percent Passing No. 4 and No. 200 Mesh Sieves (ASTM D1140); and
- Permeability Tests (ASTM D5084).

A grain size analysis through the use of ASTM D422 and ASTM D1140 was conducted for each boring location, including that represent the side and bottom of the landfill. A summary of grain size analysis findings is presented in Tables 3-4 to 3-12 below. Terracon runs all the sieves on the first portion of sample and then for the other two, they run the #4 and #200 screens, only. Any unreported percentages are larger than the #4 screen but are not listed as a size because they are not "graded". Further information on the grain size analysis is available in the Terracon Geotechnical Data Report. Cross sections are provided in **Appendix E-4**.

Table 3-4 – Summary of Boring FB-1 Grain Size Analysis (Side of Landfill)

Boring Depth (ft. below ground surface)	% Cobbles	% Gravel	% Sand	% Silt	% Fines	% Clay	% No. 4 Sieve	% No. 200 Sieve
4-5	N/A	N/A	4.4	N/A	95.4	N/A	99.74	95.37
6-7	N/A	N/A	7.1	N/A	91.7	N/A	98.88	91.73
13.5-15	N/A	N/A	34.8	N/A	46.5	N/A	81.3	46.51
23.5-25	0.0	44.7	37.4	N/A	17.9	N/A	55.33	17.93

Table 3-5 – Summary of Boring FB-2 Grain Size Analysis (Side of Landfill)

Boring Depth (ft. below ground surface)	% Cobbles	% Gravel	% Sand	% Silt	% Fines	% Clay	% No. 4 Sieve	% No. 200 Sieve
0-1.5	N/A	N/A	18.4	N/A	50.2	N/A	68.61	50.22
5-6	N/A	N/A	4.5	N/A	92.0	N/A	96.52	92.02
13-15	N/A	N/A	13.7	N/A	57.8	N/A	71.55	57.84
23.5-25	N/A	N/A	28.2	N/A	66.7	N/A	94.83	66.67
38-40	N/A	N/A	N/A	N/A	99.7	N/A	N/A	99.69

Table 3-7 – Summary of Boring FB-3 Grain Size Analysis (Side of Landfill)

Boring Depth (ft. below ground surface)	% Cobbles	% Gravel	% Sand	% Silt	% Fines	% Clay	% No. 4 Sieve	% No. 200 Sieve
2-3	N/A	N/A	17.5	N/A	69.9	N/A	87.4	69.94
9-10	N/A	N/A	7.1	N/A	91.4	N/A	98.57	91.43
23.5-25	0.0	36.4	36.6	N/A	27.0	N/A	63.56	26.97

Table 3-8 – Summary of Boring FB-4 Grain Size Analysis (Bottom of Landfill)

Boring Depth (ft. below ground surface)	% Cobbles	% Gravel	% Sand	% Silt	% Fines	% Clay	% No. 4 Sieve	% No. 200 Sieve
1-2	N/A	N/A	N/A	N/A	99.0	N/A	N/A	99.02
5-6	0.0	0.0	1.1	N/A	98.9	N/A	100.0	98.93
18.5-19.7	0.0	0.0	3.9	N/A	96.1	N/A	100.0	96.12

Table 3-9 – Summary of Boring FB-5 Grain Size Analysis (Bottom of Landfill)

Boring Depth (ft. below ground surface)	% Cobbles	% Gravel	% Sand	% Silt	% Fines	% Clay	% No. 4 Sieve	% No. 200 Sieve
0-1.4	0.0	0.0	3.2	N/A	96.8	N/A	100.0	96.84
6.5-7	0.0	0.0	2.7	N/A	97.3	N/A	100.0	97.35
23.5-24.8	0.0	0.0	1.2	N/A	98.8	N/A	100.0	98.84

Table 3-10 – Summary of Boring FB-6 Grain Size Analysis (Bottom of Landfill)

Boring Depth (ft. below ground surface)	% Cobbles	% Gravel	% Sand	% Silt	% Fines	% Clay	% No. 4 Sieve	% No. 200 Sieve
2-4	0.0	0.0	1.5	N/A	98.5	N/A	100.0	98.54
6-8	N/A	N/A	N/A	N/A	98.0	N/A	N/A	98.01
18.5-19.5	N/A	N/A	1.1	N/A	98.2	N/A	99.31	98.23

Table 3-11 – Summary of Boring FB-7 Grain Size Analysis (Bottom of Landfill)

Boring Depth (ft. below ground surface)	% Cobbles	% Gravel	% Sand	% Silt	% Fines	% Clay	% No. 4 Sieve	% No. 200 Sieve
4.5-6	N/A	N/A	28.6	N/A	17.8	N/A	46.47	17.82
8.5-10	N/A	N/A	20.1	N/A	38.9	N/A	58.97	38.89
18-20	N/A	N/A	N/A	N/A	95.7	N/A	N/A	95.74
38.5-39.8	0.0	0.0	2.0	N/A	98.0	N/A	100.0	97.97

Table 3-12 – Summary of Boring FB-8 Grain Size Analysis (Bottom of Landfill)

Boring Depth (ft. below ground surface)	% Cobbles	% Gravel	% Sand	% Silt	% Fines	% Clay	% No. 4 Sieve	% No. 200 Sieve
6.5-8	N/A	N/A	17.2	N/A	68.9	N/A	86.11	68.86
33.5-34	0.0	N/A	3.6	N/A	68.9	N/A	100.0	96.43
49-50	0.0	0.0	1.6	N/A	98.4	N/A	100.0	98.43

330.63(e)(5)(B) – Overview of Permeability, Atterberg Limits and Moisture Content Test Results

An analysis for soil moisture content (ASTM D2216), Atterberg Limits (ASTM D4318) and permeability tests (ASTM D5084) was conducted on samples obtained by Terracon during this investigation. Borings from the landfill side wall were tested on the horizontal axis and those from the bottom were tested on the vertical axis. A summary of findings for each test is presented in the tables below. Further information detailing these findings is available in the Terracon Geotechnical Data Report in **Appendix E-2**.

Table 3-13 - Summary of Boring FB-1 Soil Moisture Content, Atterberg Limits, and Permeability

Boring Depth (ft. below ground surface)	Water Content %	Atterberg Limits (LL-PL-PI)[1]	Coefficient of Permeability (cm/sec)
0-1.5	16.4	50-19-31	
2.5-4	12.6	N/A	
4-5	17.1	N/A	
5-6	17.7	N/A	N/A
6-7	17.8	52-20-32	N/A
7-8	19.5	N/A	N/A
8-9	20.6	N/A	N/A
9-10	23.2	N/A	N/A
13.5-15	11.6	N/A	N/A
18.5-20	19.5	N/A	N/A
23.5-25	6.0	N/A	N/A
28.5-30	3.6	N/A	N/A
33.5-34.5	3.9	N/A	N/A
38.5-40	19.6	N/A	N/A
43.5-45	16.1	N/A	N/A

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[1] LL- Liquid Limit; PL – Plastic Limit; PI – Plasticity Index

Table 3-14 - Summary of Boring FB-2 Soil Moisture Content, Atterberg Limits, and Permeability

Boring Depth (ft. below ground surface)	Water Content %	Atterberg Limits (LL-PL-PI)	Coefficient of Permeability (cm/sec)
0-1.5	13.8	N/A	N/A
2-3	14.4	54-21-33	N/A
3-4	12.8	N/A	N/A
4-5	14.7	N/A	N/A
5-6	19.0	N/A	N/A
6-7	18.4	N/A	N/A
7-8	18.7	61-23-38	N/A
8.5-10	18.9	N/A	N/A
13-15	17.5	N/A	N/A
18.5-20	25.3	54-22-32	N/A
23.5-25	17.5	N/A	N/A
28.5-30	16.3	N/A	N/A
33.5-35	15.4	N/A	N/A
38-40	18.6	62-17-45	$1.8E^{-09}$
43.5-45	18.0	N/A	N/A

Table 3-15 - Summary of Boring FB-3 Soil Moisture Content, Atterberg Limits, and Permeability

Boring Depth (ft. below ground surface)	Water Content %	Atterberg Limits (LL-PL-PI)	Coefficient of Permeability (cm/sec)
0-1.5	14.6	N/A	N/A
2-3	11.8	N/A	N/A
3-4	12.5	40-18-22	N/A
4-5	13.4	N/A	N/A
5-6	12.5	46-18-28	N/A
6-7	16.2	N/A	N/A
7-8	16.2	N/A	N/A
8-9	15.1	N/A	N/A
9-10	14.0	N/A	N/A
13-15	10.1	N/A	N/A
18-20	7.4	33-16-17	N/A
23.5-25	10.2	N/A	N/A
28.5-30	9.5	N/A	N/A
33.5-34	3.9	N/A	N/A
37-39.5	34.4	54-19-35	N/A
43.5-45	18.6	N/A	N/A
49.5-50	14.9	N/A	N/A

Table 3-16 - Summary of Boring FB-4 Soil Moisture Content, Atterberg Limits, and Permeability

Boring Depth (ft. below ground surface)	**Water Content %**	**Atterberg Limits (LL-PL-PI)**	**Coefficient of Permeability (cm/sec)**
0-1	18.4	N/A	N/A
1-2	19.0	59-17-42	$2.5E^{-09}$
2-3	19.8	N/A	N/A
3-4	20.2	N/A	N/A
4-5	19.8	N/A	N/A
5-6	18.7	61-24-37	N/A
6.5-8	18.3	N/A	N/A
8.5-10	17.6	N/A	N/A
13.5-14	14.6	N/A	N/A
18.5-19.5	14.8	47-21-26	N/A
23.5-24.5	10.1	N/A	N/A
28.5-29.5	9.4	N/A	N/A
35-36	7.7	N/A	N/A

Table 3-17 - Summary of Boring FB-5 Soil Moisture Content, Atterberg Limits, and Permeability

Boring Depth (ft. below ground surface)	**Water Content %**	**Atterberg Limits (LL-PL-PI)**	**Coefficient of Permeability (cm/sec)**
0-1.5	14.3	52-18-34	N/A
2.5-3.5	12.3	N/A	N/A
6.5-7.5	11.3	64-15-49	N/A
8.5-10	13.5	N/A	N/A
13.5-15	11.3	N/A	N/A
18.5-20	14.2	N/A	N/A
23.5-25	14.9	N/A	N/A
28.5-30	14.3	N/A	N/A
34-35	15.8	63-21-42	N/A

Table 3-18 - Summary of Boring FB-6 Soil Moisture Content, Atterberg Limits, and Permeability

Boring Depth (ft. below ground surface)	**Water Content %**	**Atterberg Limits (LL-PL-PI)**	**Coefficient of Permeability (cm/sec)**
0-1.5	15.6	N/A	N/A

Boring Depth (ft. below ground surface)	Water Content %	Atterberg Limits (LL-PL-PI)	Coefficient of Permeability (cm/sec)
2-4	14.9	55-17-38	N/A
4-6	14.7	N/A	N/A
6-8	14.4	48-16-32	$4.3E^{-09}$
8.5-10	15.6	N/A	N/A
13.5-14.5	13.2	N/A	N/A
18.5-19.5	12.4	N/A	N/A
23.5-24.5	15.1	53-19-34	N/A
28.5-29.5	15.9	N/A	N/A
34.5-35	14.7	N/A	N/A

Table 3-19 - Summary of Boring FB-7 Soil Moisture Content, Atterberg Limits, and Permeability

Boring Depth (ft. below ground surface)	Water Content %	Atterberg Limits (LL-PL-PI)	Coefficient of Permeability (cm/sec)
0-1.5	9.5	N/A	N/A
2.5-3.5	7.5	35-15-20	N/A
4.5-6	2.8	N/A	N/A
6.5-8	3.7	N/A	N/A
8.5-10	19.0	N/A	N/A
13.5-15	23.2	N/A	N/A
18-20	18.1	56-17-39	$3.0E^{-09}$
23.5-25	17.4	N/A	N/A
28.5-29.5	22.4	N/A	N/A
33.5-34.5	18.4	N/A	N/A
38.5-40	21.8	57-20-37	N/A
43.5-44.5	20.1	N/A	N/A
49.5-50	20.9	N/A	N/A

Table 3-20 - Summary of Boring FB-8 Soil Moisture Content, Atterberg Limits, and Permeability

Boring Depth (ft. below ground surface)	Water Content %	Atterberg Limits (LL-PL-PI)	Coefficient of Permeability (cm/sec)
0-1.5	8.4	N/A	N/A
2.5-4	8.6	N/A	N/A
4.5-6	15.4	49-19-30	N/A
6.5-8	13.2	N/A	N/A
8-9	21.8	62-23-39	N/A

Boring Depth (ft. below ground surface)	**Water Content %**	**Atterberg Limits (LL-PL-PI)**	**Coefficient of Permeability (cm/sec)**
9-10	16.6	N/A	N/A
13-15	21.4	58-22-36	N/A
18-20	15.3	N/A	N/A
23.5-25	17.7	N/A	N/A
28-30	17.3	N/A	N/A
33.5-34.5	14.0	43-17-26	N/A
43.5-44.5	12.3	N/A	N/A
49-50	13.9	N/A	N/A

330.63(e)(5)(C) – Overview of Encountered Groundwater

As noted in the Snowden, 1989 application, groundwater was encountered by the exploratory borings in the alluvium terrace deposits. Water levels proved to be the equivalent of the static water level. An exception would be the few borings in which clay cuttings sealed off the water bearing zone. Generally, the static water level stabilized in the open bore holes within minutes of completion. As exploratory borings are small diameter excavations, and the thickness of the water bearing stratum was typically just a few feet, only low yield bailers could be used. In those borings in which bailing was attempted, the removal of water, equivalent to a bore volume, reflected no change in the static water elevation. The elevation of the ground water shortly after completion, was thus established as the static water elevation.

In 1989, recorded water well datum, as available at the Texas Water Commission, indicated two domestic wells to have been completed within an Alluvial aquifer in the proximity of the project area. The two wells (see **Appendix E-2**) are not within 500 feet of the project area. It is probable that these wells could be completed in a Pleistocene deposit rather than the predominate Holocene deposits as encountered beneath this project. The geologic structure of the two deposits would normally indicate an interconnection of any saturated zones. The potential for recharge and/or discharge along Cibolo Creek, which generally separates the two age deposits, would make it difficult to verify the interconnection of saturated zones.

The perched ground water table, or Alluvial aquifer, though of significance to this proposed development, is not considered the primary use aquifer of the immediate area. The majority of the recorded water wells within a five mile radius of the project are producing from the Edwards aquifer. The Edwards aquifer should be in excess of approximately 500 feet beneath the site of this investigation. Seventy (70) feet of Navarro shale and an underlying 110 feet of Taylor shale is indicated by the log of well Kx 68-30-603. Equivalent shales should extend beneath this project and thus preclude any connection between the Edwards aquifer and the development of this project. The Navarro Shale was shown by the laboratory portion of this investigation to be relatively impermeable.

Groundwater was encountered during the supplemental field investigation at borings FB-3 and FB-7 as noted in the Terracon Geotechnical Data Report in **Appendix E-3**. Groundwater level information is presented in the below table. A cross-section of the investigation area, including groundwater information is included with this report as **Appendix E-4**.

Table 3-21 – Groundwater Levels at Borings FB-3 and FB-7

Boring Number	Groundwater Level	Comment
FB-3	38 ft. below ground surface	Groundwater level remained static from initial detection to completion of drilling
FB-7	9 ft. below ground surface (initial) 12 ft. below ground surface (completion)	N/A

330.63(e)(5)(D) – Records of Groundwater Level Measurements in Wells

Five monitoring wells are in use at the Beck Landfill and are tested annually. Table 3-22 below presents historic water-level measurements from past annual groundwater monitoring events.

Table 3-22 - Historic Groundwater Monitoring Data at the Beck Landfill

Year	MW-A Water Elevation (ft. above msl)	MW-C Water Elevation (ft. above msl)	MW-D Water Elevation (ft. above msl)	MW-F Water Elevation (ft. above msl)	MW-G Water Elevation (ft. above msl)
2020	680.71	675.55	671.90	667.22	672.19
2019	682.73	676.89	673.46	667.69	671.68
2018 (resample)	680.47	678.14	Not sampled	Not sampled	671.22
2018	679.36	675.17	671.12	667.37	670.74
2017	679.79	676.34	672.23	667.22	670.53
2016	681.32	680.03	677.10	672.68	670.15
2015	681.05	680.34	678.17	672.75	670.39
2014	679.94	675.96	672.72	668.62	338.95
2013	678.43	675.4	674.99	666.71	670.06
2012	679.22	678.11	674.99	668.04	670.06
2011	673.80	673.65	669.33	670.23	669.66

330.63(e)(5)(E) – Records of Groundwater Monitoring Data

Historical annual groundwater monitoring data from 2005 to 2022 for the Beck Landfill at each monitoring well is presented in the table in Attachment F.

330.63(e)(5)(F) – Identification of Uppermost Aquifer

The uppermost aquifer at the Beck Landfill site may have been the Leona Aquifer which is comprised of gravel and sand with lenses of caliche and silt of the Pleistocene Series Leona Formation. The identification of the Leona as the uppermost aquifer at the site is based on review of region groundwater reports published by the Texas Water Development Board (TWDB), surface geology maps and monitoring well logs. However, due to the similarity between the Holocene alluvial terrace deposits and the Leona Formation and the intervening Cibolo Creek, it is likely that the Holocene alluvial deposits contained perched water from infiltrated rainwater and early communication with the Cibolo Creek. The Beck Landfill as constructed has an impermeable slurry trench to prevent hydraulic connection with the Cibolo Creek and the Holocene alluvial deposits are removed.

The Leona Aquifer is not hydraulically connected to the deeper Austin Aquifer due to the presence of two aquitards separating these two aquifers. These aquitards consist of undivided Navarro Group and Marlbrook Marl and Pecan Gap Chalk strata.

A review of historical groundwater elevation measurements taken from the landfill monitoring wells show that groundwater in the uppermost aquifer typically flows from the northwest to the southeast toward Cibolo Creek. The site-specific hydraulic conductivity of the uppermost aquifer has not been measured; therefore, the rate of groundwater flow cannot be calculated at this time.

3.1.5 Groundwater Certification Process for Arid Exemption (§330.63(e)(6))

Not applicable - Beck is not seeking an arid exemption for the landfill, therefore this section does not apply.

APPENDIX E-1
ATTACHMENT 11 AND GEOLOGY (SNOWDEN, 1989)

GEOTECHNICAL INVESTIGATION

Beck Ready Mix, Inc.

F.M. 78

Schertz, Texas

Job #5108

August - December, 1985

ATTACHMENT 11

SNOWDEN, INC.

WALTER L. SNOWDEN
20019

Walter L. Snowden, P.E.

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INVESTIGATION

The exploration and analysis of the subsurface stratum, as relevent to a future usage as a landfill site for Beck Ready Mix, Inc., formulates the basis of this publication. The investigation was conducted in such a manner as to allow the development of datum, both as pertaining to the applicable sections of the 325.74 (b) (5) requirements provided by the Texas Department of Health, and as appropriate to the existing conditions of the site.

The locality of the site, and the Geologic Atlas of Texas, San Antonio Sheet, indicated that the site would likely be surficially underlain by recent terrace type deposits and at greater depths by a clay and/or shale of the Navarro Formation. The upper deposits, as such would be of a stream depositional nature, were invisioned as being highly permeable. The deposits of the Navarro Formation, were by contrast, invisioned as retaining very low permeability values. These specific geologic conditions indicated a likelihood for the existance of a perched water table beneath the site. The construction of a vertical cut-off or confining type of wall, surrounding the site, was invisioned as a possible method of facilitating the proposed land usage, given the theorized geologic conditions. The subsurface investigation was thus guided somewhat by this assumption.

The current land use and surface condtions of this specific tract of land is quite variable. The site could generally be described as being located within an oxbow bend of Cibolo Creek. Portions of the site correspondantly, were somewhat low topographically and supported the heavy vegetation growth common to south Texas streams. Higher portions of the site were, or had been under cultivation. The primary land usage, which had been in effect for many years, included the removal of sand and gravel to support a concrete batch plant located on a portion of the property. Excavated soil was also being sold commercially. Portions of the site, where previous excavations had been discontinued, were semi-reconstructed through the placement of buried waste materials.

An investigative program, appropriate to the datum requirements, subsurface geology and current land usage, was thus developed. A series of borings, along a 400 foot grid layout within the confines of the project area, was felt adequate and thus proposed. The Texas Department of Health approved the investigative proposal with the understanding that some individual boring locations were subject to equipment accessability and thus may be delated. Ommission of boring could not however compromise the development of an adequate subsurface stratagraphic relationship.

A total of fifty-four (54) borings were excavated. Each of the proposed boring locations is indicated on the boring plan, but only those designated by grid numbers were actually drilled. A continous flight auger system, either of a solid or hollowstem type, was employed in the advancement of the borings.

Representative samples of the subsurface sediments were obtained from selected borings. Undisturbed or Shelby tube samples were recovered to represent much of the clay-shale penetration as recorded on the accompanying logs. Auger samples were generally recovered to represent the stream deposited stratum. All samples were immediately sealed to preserve in-situ states and moisture conditions as near as possible.

The analysis of the soil samples was performed in a soils laboratory. Testing generally conformed to an appropriate A.S.T.M specification as per the soil property being determined. The values of permeability, each expressed as centimeters per second, were derived by a constant head method utilizing flexible wall permeameters. The recompacted samples were also tested by the same method. Permeability was determined for selected clay samples from six (6) widely spaced borings. The samples were chosen as to be representative of the entirity of the clay formation underlying the proposed site and/or to confirm the impermeable nature of the natural clay. Atterberg Limits were determined from un-tested portions of the permeability samples, in order to formulate a basis of comparison, with the plasticity indexes, as determined from other sampled borings. A comparison of this nature should support the suitibility of the particular natural clay, as relevent to the proposed site usage. Sieve and Hydrometer analysis were not performed, as the majority of the laboratory investigation was concentrated on materials predominatly of clay minerals. Such clay materials would generally pass the #200 sieve.

The conclusions of the laboratory testing are given on the tables included in this report. The findings of the exploratory borings as depicted by the boring logs, along with the other aspects of the field accumulated datum, allowed an analysis of the subsurface conditions existing at the proposed site. The conclusions of the analysis are addressed "Geology and Hydrology" section of the report.

GEOLOGY & HYDROLOGY

The exploratory borings proved the theorized existance of recent terrace type deposits overlying clay and shale of the Navarro Group. The two deposits afford drastically different characteristics and thus are addressed separately.

The terrace deposits could be divided into areas of high and low tributary alluvial stratum. The ancient meanderings of Cibolo Creek have however reworked and thus isolated the deposits numerous times. Defining the separate stratum, though possible, would prove lengthy and not necessarily of great significance to an investigation of this nature.

Previous flood plain environments resulted in the occurance of the terrace stratum. The sediments generally consist of silty clay, sand, and gravel. Each of the constituants generally relate to a particular environment or water velocity. As typical of many flood plain deposits, the subsurface stratigraphy is variable both vertically and laterally. The included geologic cross-sections (figures 1, 2, 3), though greatly distorted along the horizontal axis, depict the variable subsurface stratigraphy. Several older channels of Cibolo Creek are also depicted by the cross-sections.

All of the stream deposited stratum is considered of the Quaternary Period, which extends through recent geologic times. It is possible that some of the higher gravel deposits are remnants of the older Pleistocene Epoch terraces. The generally low topographic condition would however indicate that the majority if not all of the deposits, are of the recent or Holocene Epoch.

The terrace deposits, as originally theroized, were found to contain a perched ground water table. As the center line of Cibolo Creek forms two portions of the property lines that define the investigated tract, it is quite reasonable to assume considerable recharge is occuring from the creek. The influx of waters through the permeable terrace stratum was not however found to be as dramatic as the potential would suggest. The groundwater as shown by the geologic cross-sections, generally parallels the top of the impervious clay and flows along ancient creek channels erroded into such clays. Evidence of capillary action, in response to sediment types and surface features, is also depicted by the static, water elevations. Generally, the ground water migration or subsurface flow beneath the project area, is towards the Northeast, or in a direction basically parallel to the immediate thurst of Cibolo Creek.

The volume or availibility of ground water, for most portions of the site, should be considered significant. The initial depth at which ground water was encountered by the exploratory borings, proved to be the equivalent of the static water level. An exception would be the few borings in which clay cuttings sealed off the water bearing zone. Generally, the static water level stabilized in the open bore holes within minutes of completion. As exploratory borings are small diameter excavations, and the thickness of the water bearing stratum was typically just a few feet, only low yield bailers could be used. In those borings in which bailing was attempted, the removal of water, equivelent to a bore volume, reflected no change in the static water elevation. The elevation of the ground water shortly after completion, was thus established as the static water elevation.

The high permeability and a considerable porosity, were also confirmed by this datum, as originally invisioned for the terrace stratum.

The ground water encountered by the exploratory borings, was found to possibly correspond with the completion aquifer of some recent domestic water wells. Recorded water well datum, as available at the Texas Water Commission, indicated two recent domestic wells to have been completed within an Alluvial aquifer in the proximity of the project area. The two wells (see Appendix A) are not felt to be within 500 feet of the project area. Should the two recorded wells, as theorized, be in excess of 500 feet beyond the project area, it is also probable that each such well could be completed in a Pleistocene deposit rather than the predominate Holocene deposits as encountered beneath this project. The geologic structure of the two deposits would normally indicate an interconnection of any saturated zones. The potential for recharge and/or discharge along Cibolo Creek, which generally separates the two age deposits, would make it difficult to verify the interconnection of saturated zones.

The perched ground water table, or Alluvial aquifer, though of significance to this proposed development, is not considered the primary use aquifer of the immediate area. The majority of the recorded water wells within a five mile radius of the project are producing from the Edwards aquifer. The Edwards aquifer should be in excess of approximatly 500 feet beneath the site of this investigation. Seventy (70) feet of Navarro shale and an underlying 110 feet of Taylor shale is indicated by the log of well Kx 68-30-603 (Appendix A). Equivalent shales should extend beneath this project and thus preclude any connection between the Edwards aquifer and the development of this project. The Navarro Shale was shown by the laboratory portion of this investigation to be relatively impermeable.

The Navarro deposit as it immediatly underlies the terrace type deposits with the perched ground water table, is of considerable significance to the proposed development. The Navarro Group, consisting of the upper Kemp Formation and the lower Corsicana Formation, represent the youngest of the Cretaceous age deposits in the central Texas vicinity. Generally, the Navarro deposit could be described as a gray calcareous clay shale. At least two beds of the Navarro, are indicated by geologic sources, to contain limey sandstones and concretionary siltstones. Neither of these beds were encountered by the exploratory borings. The uppermost portion of the deposit has weathered to produce an expansive tan-gray clay. The depth of weathering, as indicated by the borings, was somewhat variable beneath this site. This variation is primarilly due to the natural joint structure and development of gypsum type deposits within such joints. Areas for greater and/or lesser potential moisture migration are thus expressed within the upper deposits. The determined values of permeability, however indicate all of the Navarro deposit, reguardless of the state of weathering, to likely retain characteristics favorable to the proposed development.

The thickness and position of the Navarro Group deposits could not be accurately determined by the shallow depth exploratory borings performed. The site is approximately along the extreme southeastern edge of the northeast trending Balcones fault system. The system generally comprises a series of slip-dip normal faults with downward displacements to the southeast. The faulting associated with the system, which altered the

Cretaceous age stratum of the general area, occured primarilly during the Miocene Epoch. No movement has been detected within the system in recent times.

Past erosion and the mantle of alluvial materials, obscures any evidence of fault traces within the immediate area of the project. sources must thus be depended upon rather heavilly for an evaluation of the structural geology. While no faults are though to exist beneath the proposed project, it is felt that the course of Cibolo Creek is somewhat controlled by a secondary geologic joint. Such a joint would connect the extensions of two separate fault traces as masked by the alluvial deposits. The known trend patterns, of joints associated with the Balcones fault system, and the fact that the entire site was found to be underlain by Navarro deposits, suggests, that a joint potentially occurs along or generally parallel to Cibolo Creek, as it flows northward away from the project area.

The theorized joint and/or trend, basically coincides with a slight subsurface delineation depicted by the exploratory borings. Wheather of not a joint occurs beneath the site, is felt to be irrelevent to the proposed development. Joints are typically, a break in the geologic stratum along which no relative movement has occurred. Similar deposits were found to exist on either side of the theorized joint. Permeabilities, as determined both on opposite sides and along the theorized joint, indicate little to no effect relevent to the potential joint. Additional deep subsurface exploration and subsequent expenses were thus not warranted relevent to the proposed future land usage.

Recorded Water Well Datum[1]

A. Water Wells (located)[2]

1. Kx 68 - 30 - 603 (Guadalupe Co.)
   - a. location: ½ mi. east of Schertz
   - b. date drilled: September, 1959
   - c. depth: 550 feet
   - d. completetion aquifer: Edwards (535' to 550')
   - e. static water level: 84 feet
   - f. pumping datum: 171' draw down @ 55 gpm

B. Water Wells (plotted)[3]

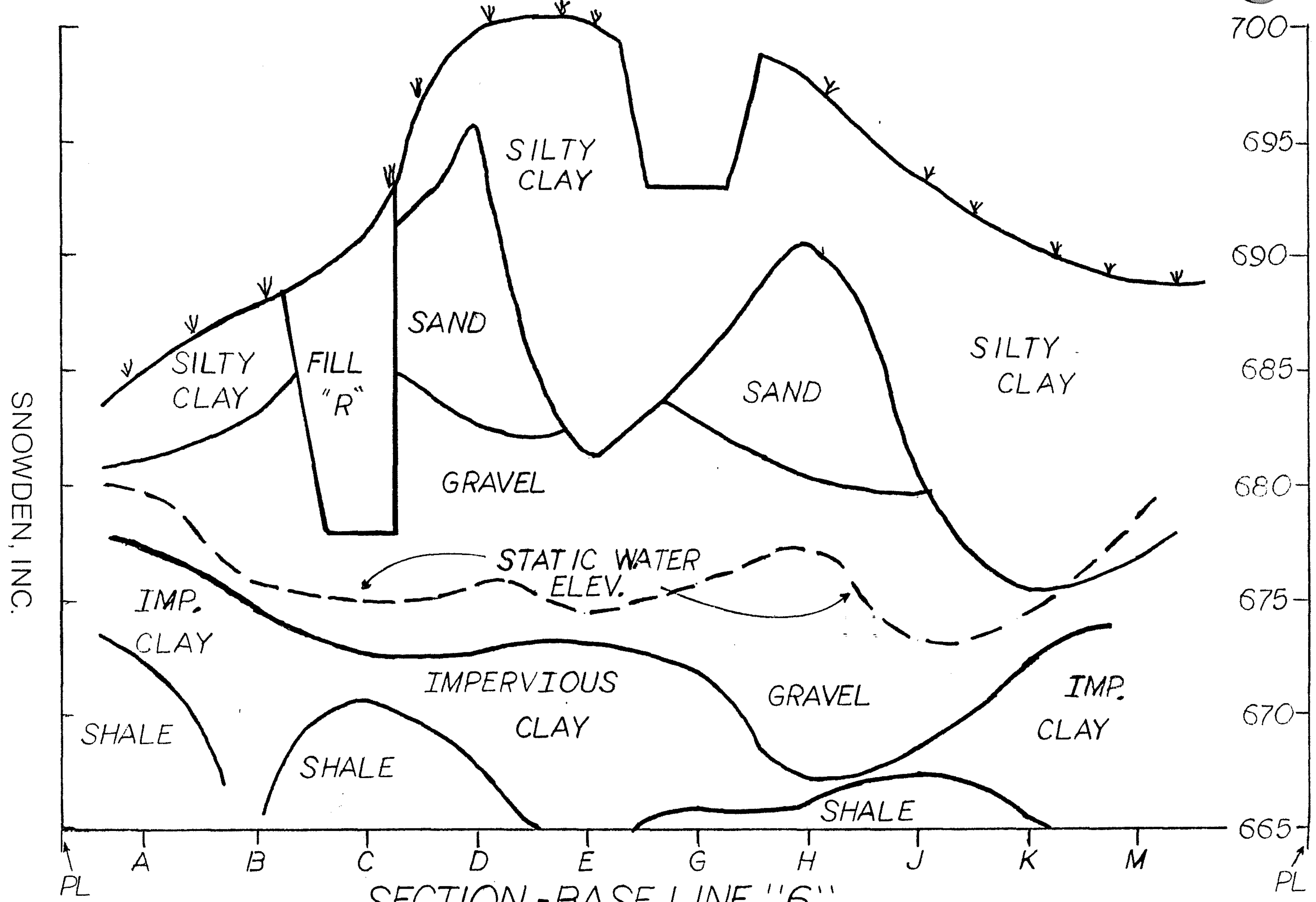
1. Kx 68 - 30 - 6A (Bexar Co.)
   - a. location: 1 mile south of Schertz
   - b. depth: 35 feet
   - c. completion aquifer: Alluvial
   - d. static water level: 20 feet
   - e. pumping datum: 4' draw down @ 12 gpm

2. Kx 68 - 30 - 9A (Bexar Co.)
   - a. location: ½ mile south of Schertz
   - b. depth: 37 feet
   - c. completion aquifer: Alluvial
   - d. static water level 22 feet
   - e. pumping datum: Test 4 gpm with bailer

[1] The above information was derived from the records of the Texas Department of Water Resources, now known as the Texas Water Commission (T.W.C.). No water wells are recorded as being within the boundaries of the project. The wells listed, thus represent the only recorded wells potentially within a reasonable proximity of this project site.

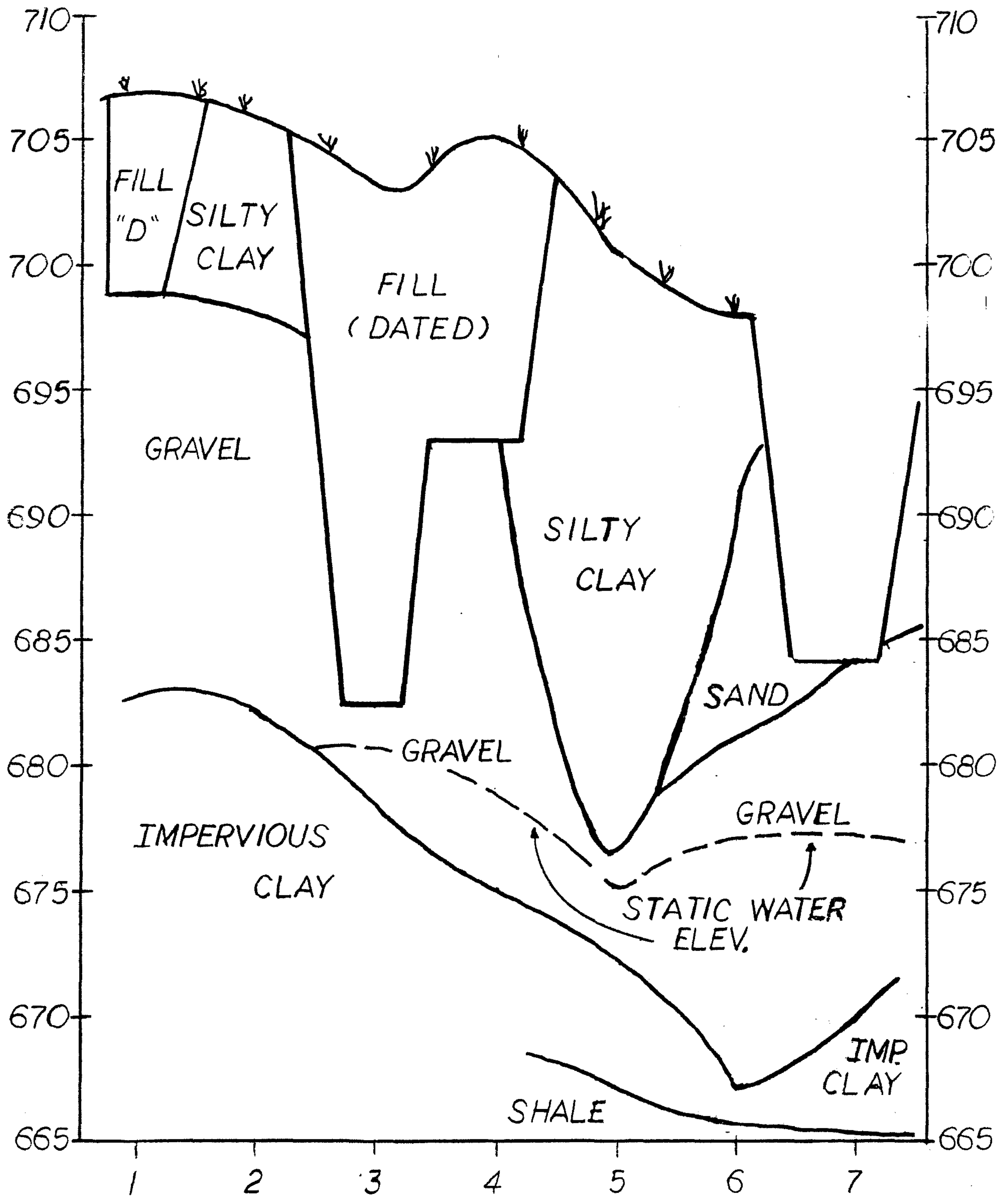
[2] The water well designated within this catagory, has reportedly been field located by T.W.C. personel. The well, Kx 68 - 30 - 603, is indicated to be on the opposite side of F.M. 78 approximately 1000 feet from the property line of this project.

[3] The water wells designated by this catagory, are each recently completed wells, as plotted but not field located by T.W.C. personel. The records indicate the wells to be located in Bexar County, or on the opposite side of Cibolo Creek from this project site. The current land uses of the Bexar County properties, as adjoining this project site, are such that the wells, Kx 68 - 30 - 6A and Kx 68 - 30 - 9A, are in all likelyhood located in excess of 500 feet from the boundries of this project site.



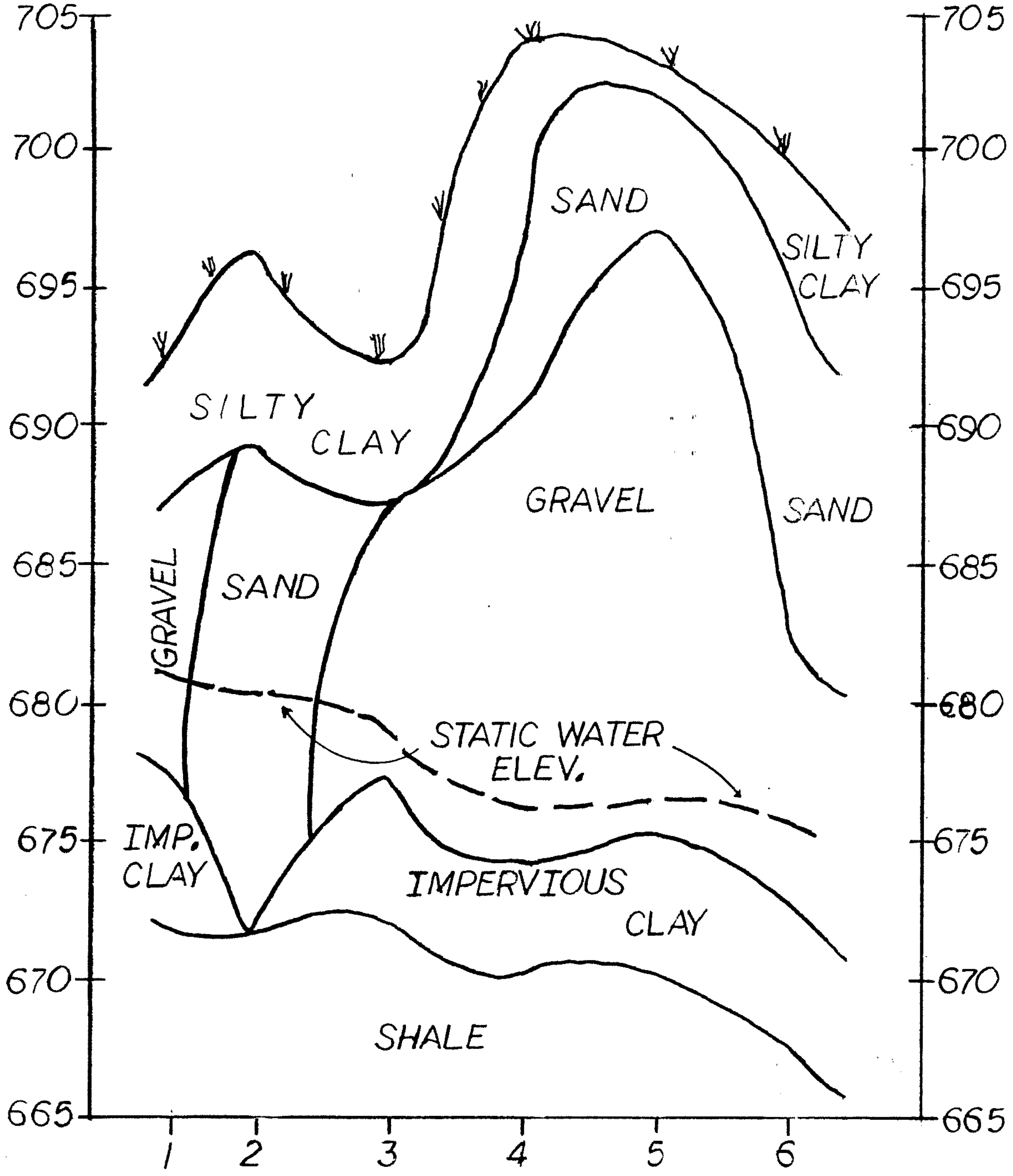
SECTION - BASE LINE "6"

FIGURE I



SECTION - BASE LINE "H"

FIGURE 2



SECTION - BASE LINE "D"

FIGURE 3

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	permeability	Classif.	qu
A-4	2'	17.9						
	4'	12.4	29	16	13		CL	
	6'	11.5						
	8'	16.3	26	14	12		CL	
	10'	3.9						
	12'	26.3	57	17	40		CH	
	14'	20.4						
	16'	20.8						
	20'	26.6						
A-6	10 to 11.5'		72	24	48	2.0×10^{-9}	CH	
	10 to 11.5'		"	"	"	*3.0×10^{-9}	CH	
B-6	2'	7.2						
	4'	8.9						

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System
* permeability of sample recompacted to: 93 PCF/17.0% moisture

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	permeability	Classif.	qu
B-6	6'	6.1						
	8'	6.1						
	10'	13.8						
	12'	12.1						
	14'	22.8	59	18	41		CH	
	16'	19.4						
	18'	21.1						
	20'	22.5						
C-3	2'	32.1						
	4'	19.9						
	6'	19.2						
	8'	17.1						
	10'	29.2						
	12'	29.1						

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	permeability	Classif.	qu
C-3	14'	16.6						
	16'	11.3						
	18'	9.2						
	20'	9.6						
	24'	22.8	52	19	33		CH	
D-1	2'	21.6						
	4'	6.0						
	6'	1.4						
	8'	3.9						
	10'	5.5						
	12'	20.6						
	14'	22.8						
	16'	22.6						
	18 to 19'	22.1	63	18	45	1.0×10^{-9}	CH	

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	permeability	Classif.	qu
D-1	20'	18.6						
	22'	18.4	69	19	50		CH	
D-5	2'	5.4						
	4'	6.2						
	6'	4.7						
	8'	2.2						
	10'	3.3						
	12'	2.8						
	14'	4.1						
	16'	0.8						
	18'	0.8						
	20'	0.8						
	22'	1.2						
	24'	1.4						

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	permeability	Classif.	qu
D-5	26'	9.8						
	28'	10.7						
	30'	25.8	57	16	41		CH	
	32'	26.6						
	34'	25.4						
E-4	17 to 18'		71	19	52	2.0×10^{-9}	CH	
E-7	2'	1.9						
	4'	6.5						
	6'	27.9	58	17	41		CH	
	8'	24.1						
	10'	23.3	56	17	39		CH	
	12'	24.6						
	14'	21.2	53	16	37		CH	

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	permeability	Classif.	qu
E-7	16'	21.8						
	18'	21.3						
	20'	18.9						
G-1	2'	13.7						
	4'	7.8						
	6'	6.6	27	15	12		CL	
	8'	2.3						
	10'	1.6						
	12'	26.2						
	14'	21.2						
	16'	6.7						
	18'	8.5						
	20'	16.0						
	22'	26.3						

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	permeability	Classif.	qu
G-1	24'	19.0						
	26'	17.9						
	28'	16.0						
	34'	14.9	41	14	27		CL	
G-5	2'	14.4	26	15	11		CL	
	4'	13.5						
	6'	12.2						
	8'	14.6						
	10'	16.6	32	14	18		CL	
	12'	11.3						
	14'	8.5						
	16'	14.0						
	18'	14.3						
	20'	15.3	33	14	19		CL	

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	permeability	Classif.	qu
G-5	22'	15.0						
	24'	16.3						
	26'	17.7						
	28'	19.4						
	30'	20.2						
	32'	22.6	56	17	39		CH	
	34'	23.8						
G-7	10.5 to 11.3'		56	17	39	1.0×10^{-9}	CH	
H-6	2'	8.0						
	4'	8.6						
	6'	9.8						
	8'	7.3						
	10'	8.1						

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	permeability	Classif.	qu
H-6	12'	6.4						
	14'	6.7						
	16'	5.6						
	18'	1.8						
	20'	2.5						
	22'	3.6						
	24'	8.6						
	26'	7.8						
	28'	8.5						
	30'	12.3						
	32'	18.6	57	17	40		CH	
	34'	19.2	56	18	38		CH	
J-1	2 to 3.5'	18.7	66	18	48	7.0×10^{-10}	CH	
	2 to 3.5'	"	"	"	"	*2.0×10^{-9}	CH	

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System
* permeability of sample recompacted to: 98 PCF/20.5% moisture

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	permeability	Classif.	qu
J-1	4'	19.1						
	5 to 6.5'	19.8	63	18	45	8.0×10^{-10}		
	10'	20.1						
	15'	19.4						
	20'	14.3						
J-2	5'	13.4						
	10'	3.2						
	15'	4.0						
	20'	3.5						
	25'	6.3						
J-3	2'	3.4						
	4'	10.6						
	6'	14.7						

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	permeability	Classif.	qu
J-3	8'	18.1						
	10'	27.0						
	12'	19.4						
	14'	17.9						
	16'	16.4						
	18'	14.8						
	20'	15.5						
	22'	16.5						
	26'	23.0						
	28'	21.0	58	17	41		CH	
	30'	25.6						
	32'	22.5						
J-7	6'		48	17	31		CL	
	12'		29	16	13		CL	

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	permeability	Classif.	qu
J-7	18'		58	17	41		CH	
	28'		49	16	33		CL	
K-5	2'	12.8						
	4'	14.8						
	6'	16.8						
	8'	16.1						
	10'	15.9	33	17	16		CL	
	12'	12.0						
	14'	11.6						
	18'	5.4						
	20'	14.9						
	22'	21.1						
	24'	23.4	57	18	39		CH	
	26.5 to 27.5		59	19	40	2.0×10^{-7}	CH	

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	permeability	Classif.	qu
M-4	2'	9.1						
	4'	11.8						
	6'	13.1						
	8'	15.7						
	10'	15.0						
	12'	14.3						
	14'	12.3						
	16'	12.9						
	18'	9.7						
	20'	8.2						
	22'	2.5						
	24'	8.2						
	26'	21.5						
	28'	20.9	60	20	40		CH	
	30'	22.4						

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	permeability	Classif.	qu
M-4	32'	20.7						
	34'	12.8	46	16	30		CL	
M-7	2'	21.6						
	4'	20.5						
	6'	20.7	45	18	27		CL	
	8'	21.1						
	10'	22.0	43	19	24		CL	
	12'	21.4						
	14'	3.4						
	16'	6.5						
	18'	27.0						
	20'	32.2	60	20	40		CH	
	22'	21.9						
	24'	18.4	61	18	43		CH	

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System

SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	-#200 (%)	Classif.	qu
M-7	30'	18.1						
G-0	2'	13.6						
	4'	3.9						
	6'	5.1						
	8'	3.9						
	10'	5.7						
	12'	7.7						
	14'	7.5						
	16'	24.6	65	18	47		CH	
	18'	22.3						
H-0	2'	6.8						
	4'	5.2						
	6'	3.7						

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System

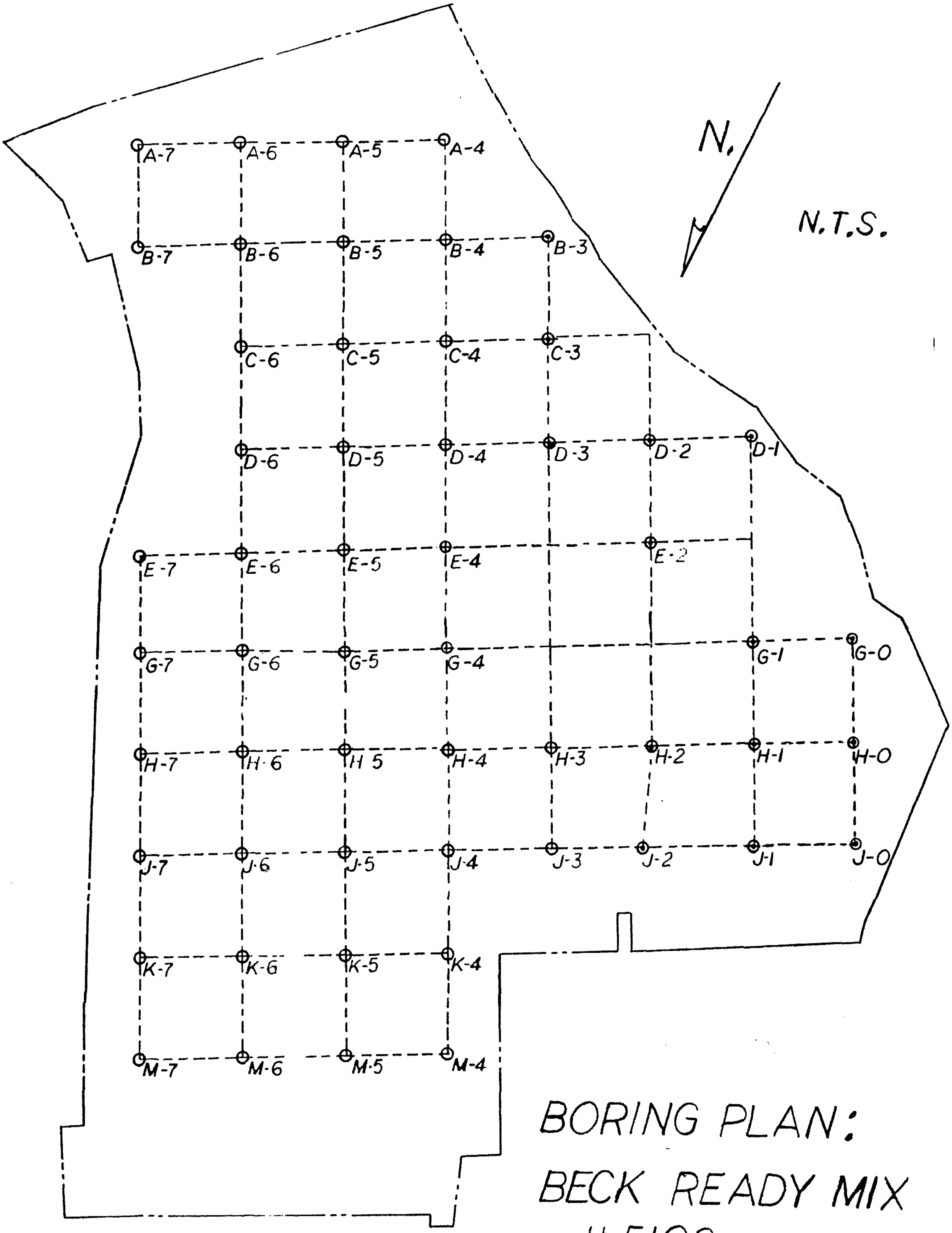
SUMMARY OF LABORATORY TEST RESULTS

Job Name: Beck Ready Mix, Inc.
Job Number: 5108

Boring	Depth ft.	M.C.	Lw	Pw	Iw	-#200 (%)	Classif.	qu
H-0	8'	5.1						
	10'	14.3						
	12'	9.2						
	14'	8.2						
	16'	20.9	56	17	39		CH	
	18'	17.4						
J-0	2'	10.9						
	4'	22.6						
	6'	20.4						
	8'	18.2						
	10'	16.4						
	15'	14.8						

M.C. = Moisture Content in place (%)
Lw = Liquid Limit
Pw = Plastic Limit
Iw = Plasticity Index

qu = Unconfined Compressive Strength (tons per square foot)
Classif: = Casagrande Classification System



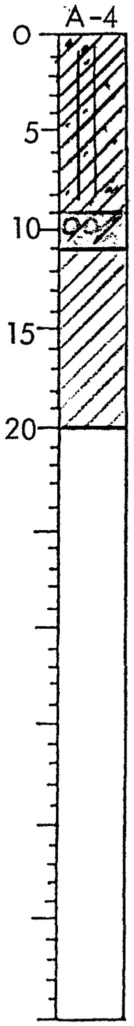
BORING PLAN:
BECK READY MIX
5108

F.M. - 78

SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 1, 1985

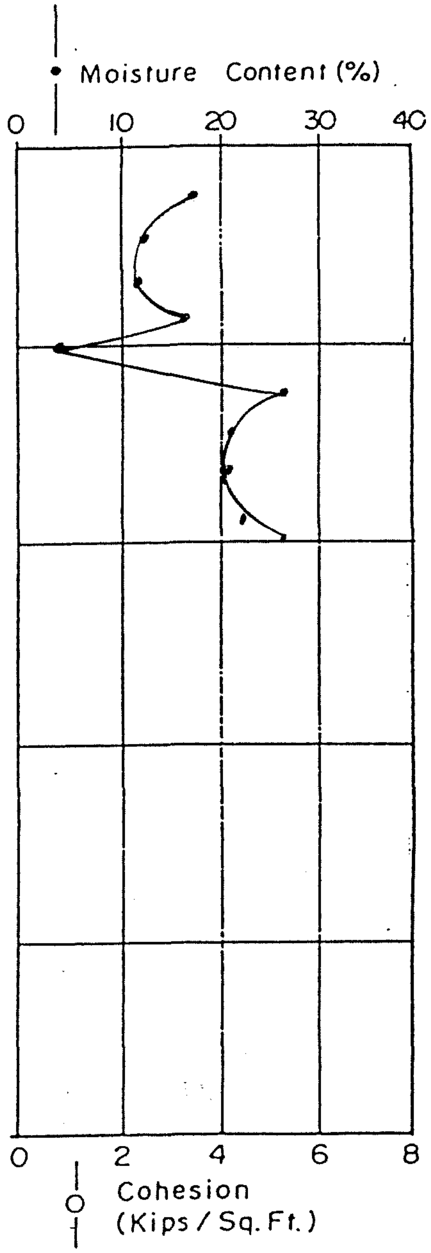


G.S.E. 679.2

Clay, sl. silty, sl. sandy, brown	CH/CL
... silty, sandy, lt. brown	CL
Gravel, clayey, lt. brown	GC
Clay, stiff w/gypsum & pyrite stain seams tan & gray	CH
... gray & green tan	

Discontinued @ 20'

Static Water Elev. 660.2



SNOWDEN, INC.

LOG OF BORING

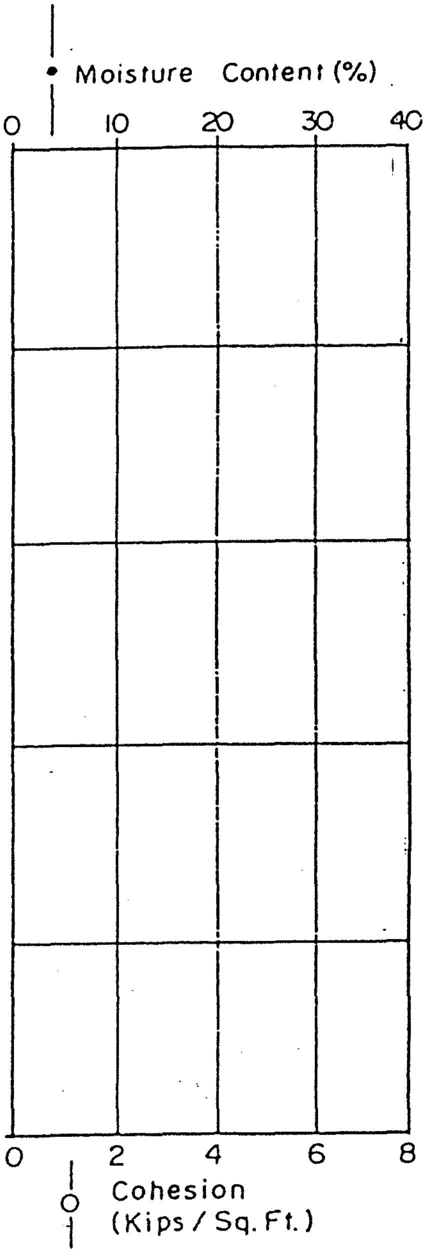
Project Name: Beck Ready Mix, Inc.
Date Drilled: November 1, 1985

G.S.E. 689.8

Gravel, sandy, sl. clayey, tan	GC/GW
... v. clayey	GC
Clay, stiff w/pyrite stain seams	CH
tan & gray ... gray & green tan	
Shale, clayey, dk. gray	CH
... sl. clayey	

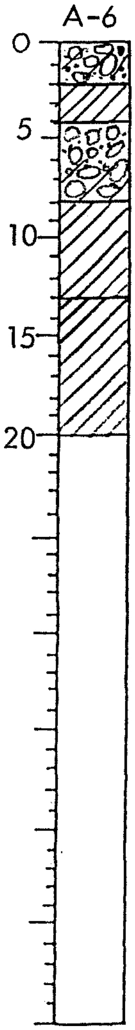
Discontinued @ 20'

Static Water Elev. Boring Dry



LOG OF BORING

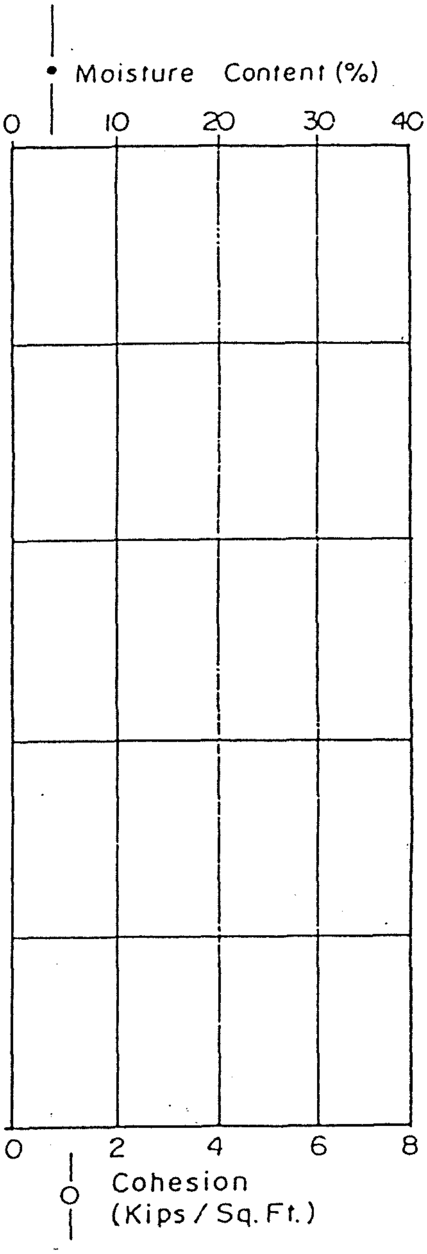
Project Name: Beck Ready Mix, Inc.
Date Drilled: October 31, 1985



G.S.E. 684.6	
Gravel, fill, sandy, clayey, tan	GC
Clay, sl. silty, dk. brown	CL
Gravel, sandy w/cobbles, tan	GP
... clayey brown	GC
Clay, stiff w/pyritic seams tan & gray	CH
... gray & green tan	
Shale, sl. clayey dk. gray	CH

Discontinued @ 20'

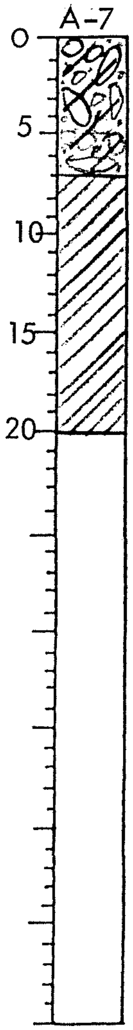
Static Water Elev. 678.6



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 1, 1985



G.S.E. 682.4

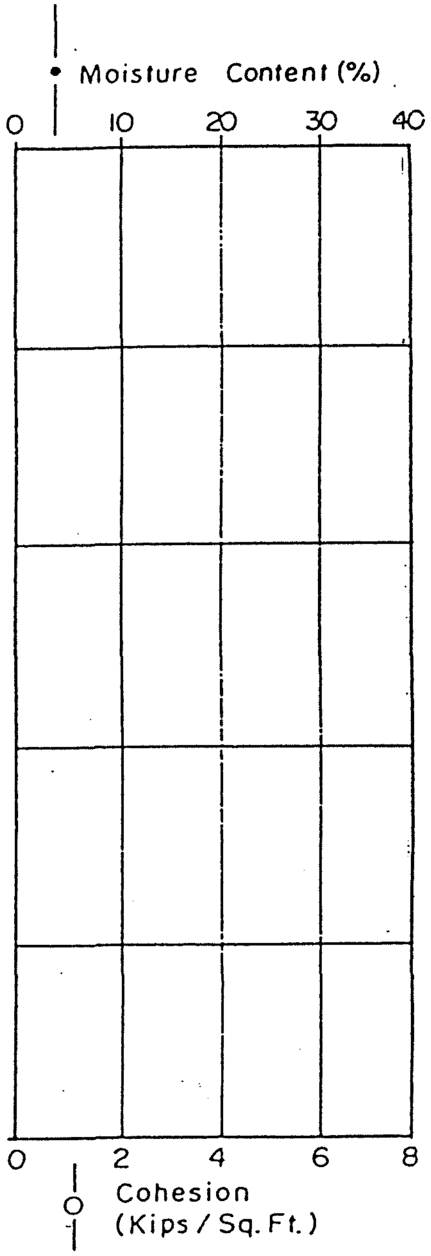
Gravel, sandy, sl. clayey, tan GC

Shale, clayey, dk. gray CH

... sl. clayey

Discontinued @ 20'

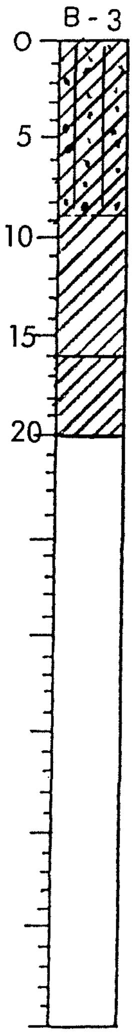
Static Water Elev. 680.9



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 7, 1985

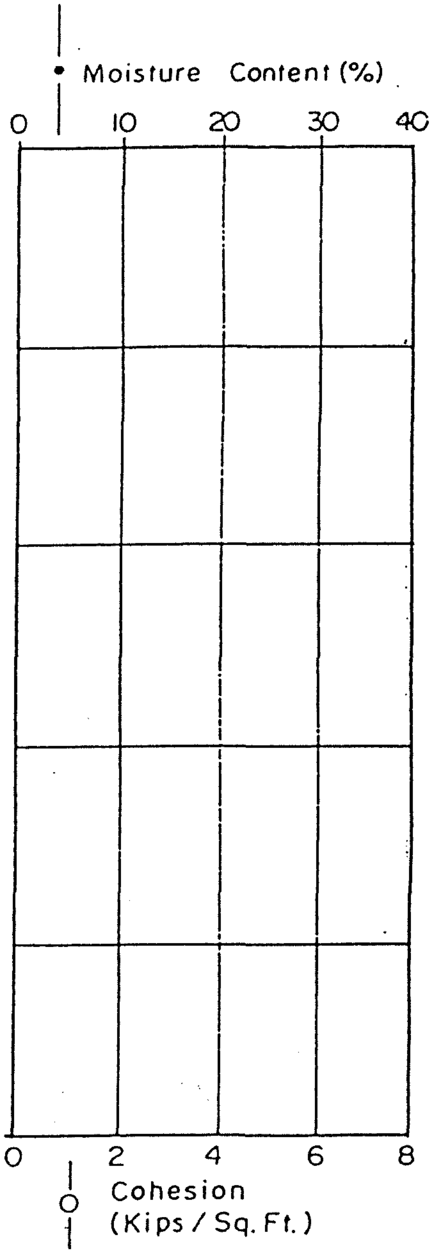


G.S.E. 687.3

Clay, sl. silty, dk. brown	CH
... silty, sandy, lt. brown	CL
... stiff w/gypsum & pyrite stain seams, tan & gray	CH
Shale, clayey, dk. gray	CH

Discontinued @ 20'

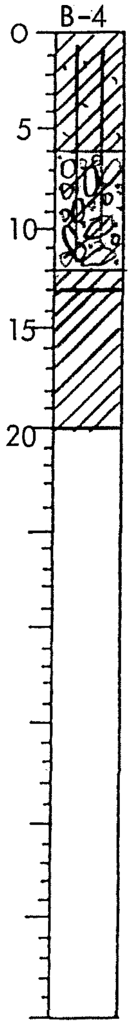
Static Water Elev. 680.3



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 7, 1985



G.S.E. 684.42

Clay, silty, sl. sandy, lt. brown CL

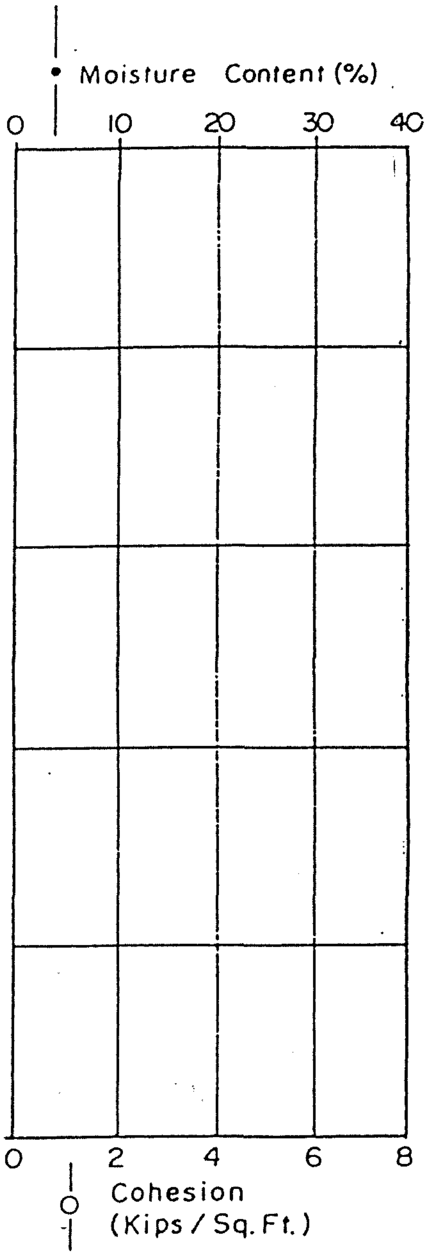
Gravel, sandy, silty, clayey, tan GC

Clay, stiff, tan & gray CH

Shale, clayey, dk. gray CH
... sl. clayey

Discontinued @ 20'

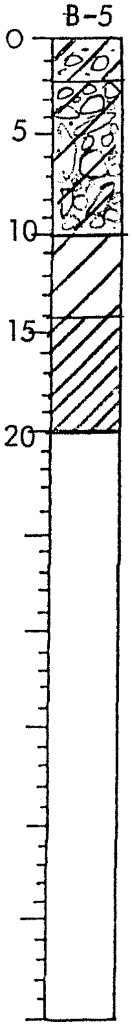
Static Water Elev. 676.4



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: October 8, 1985

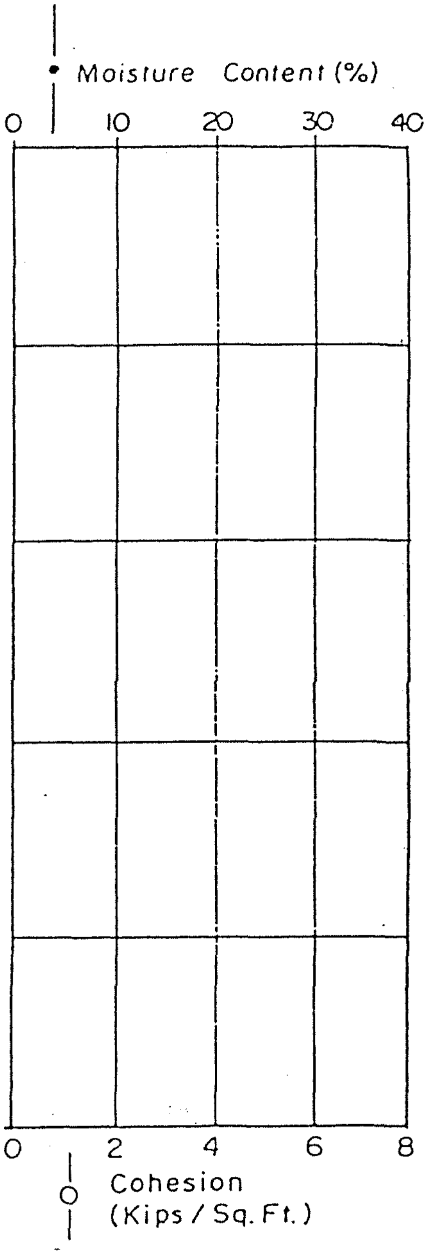


G.S.E. 682.41

Clay, sandy, gravelley, lt. brown	CL
Gravel, sandy, clayey, w/cobbles tan	GC/GW
... v. clayey	GC
Clay, stiff, trace silt, gray & green tan	CH
Shale, clayey, dk. gray	CH
... sl. clayey	

Discontinued @ 20'

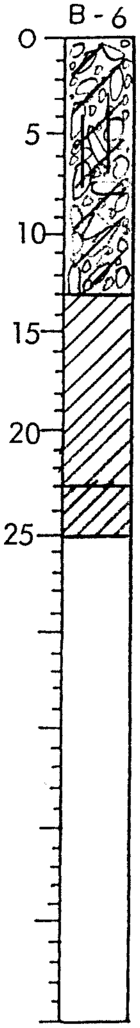
Static Water Elev. 675.4



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 1, 1985



G.S.E. 687.58

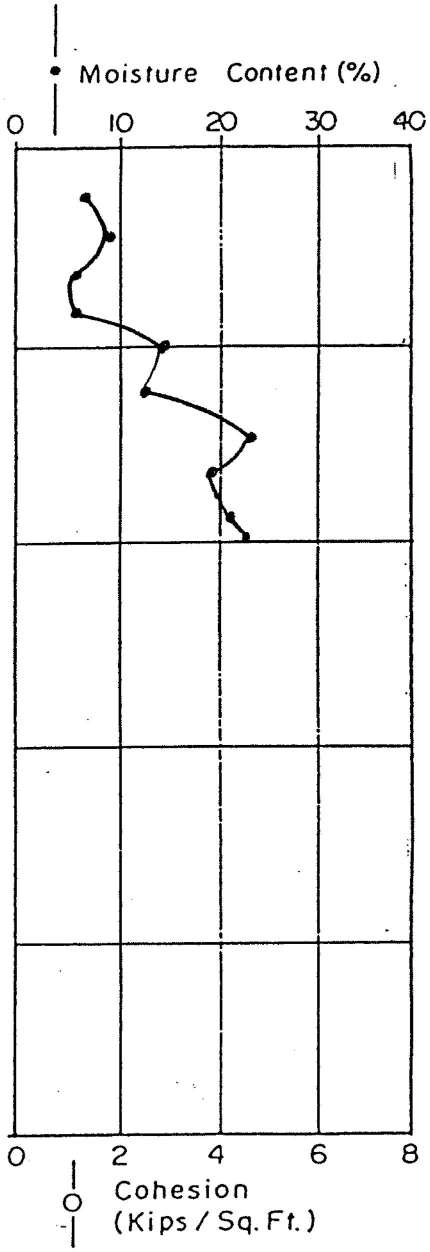
Gravel, sandy, clayey, tan GC
... silty, clayey GM/GC
... clayey w/cobbles GC
... v. clayey

Clay, stiff, w/pyrite stained seams tan & gray CH

Shale, clayey, dk. gray CH

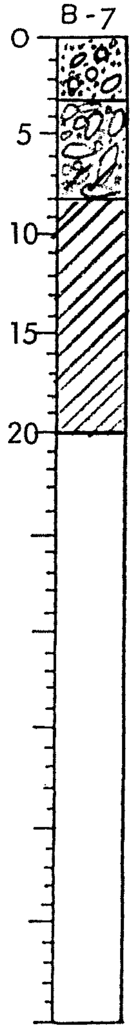
Discontinued @ 25'

Static Water Elev. 675.9



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 1, 1985

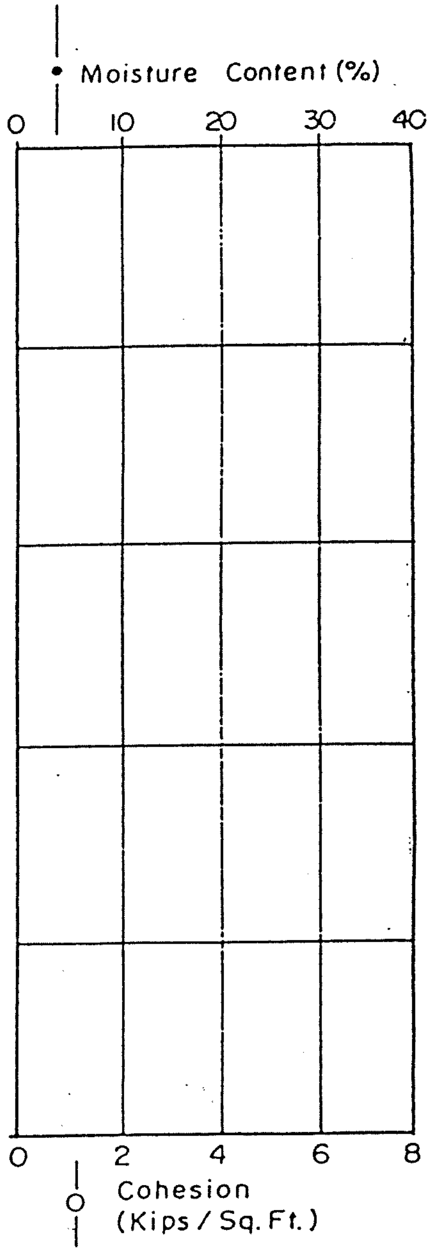


G.S.E. 676.8

Sand, trace gravel, tan	SP
Gravel, sandy, tan ... trace clay	GP
Shale, clayey, dk. gray ... sl. clayey	CH

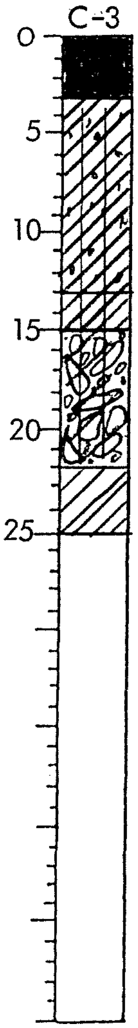
Discontinued @ 20'

Static Water Elev. 675.3



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 7, 1985



G.S.E. 697.76

Trash (recent) w/clay, dk. gray

Clay, fill, silty, sandy, w/trash (recent) lt. brown CL

... dk. gray

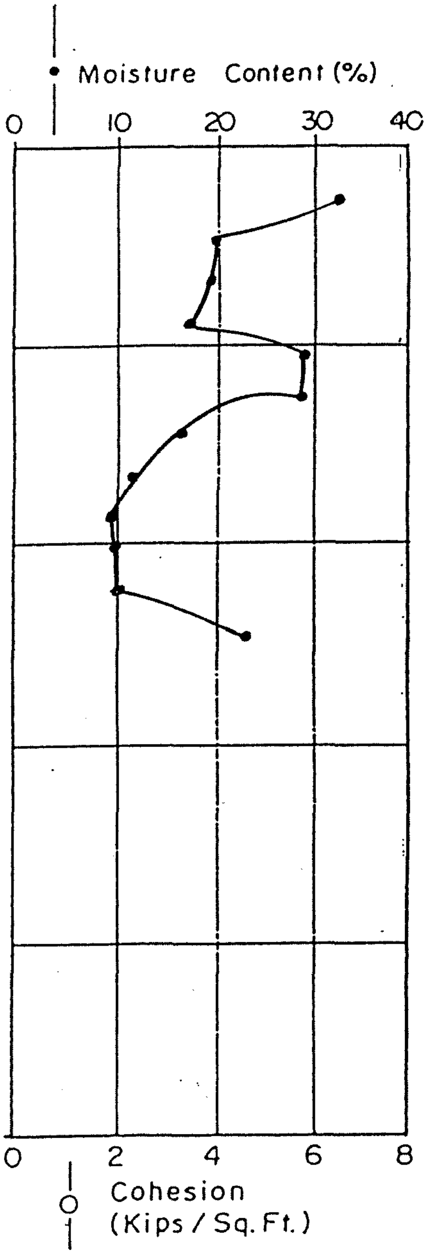
Clay, silty, brown CL

Gravel, silty, clayey, brown GC/GM

Clay, stiff, w/pyrite stain seams tan & gray CH

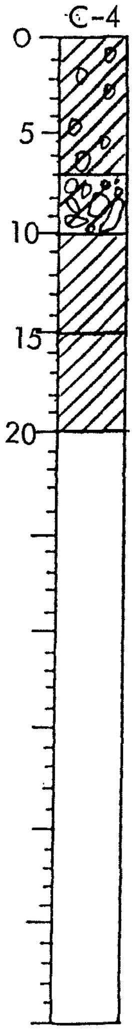
Discontinued @ 25'

Static Water Elev. 675.8



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 7, 1985



G.S.E. 685.31

Clay, fill, trace gravel w/trash (recent) dk. gray CH

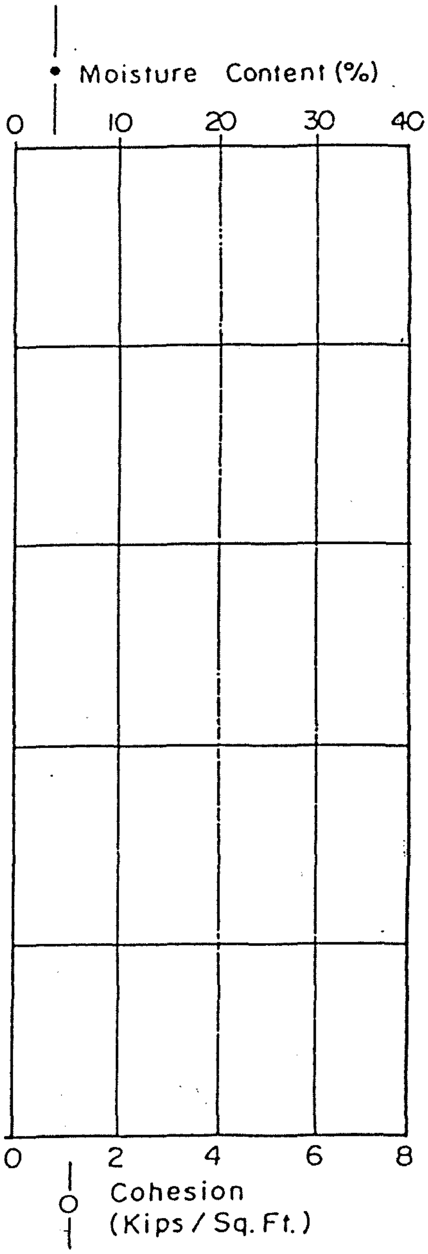
Gravel, clayey, tan GC

Clay, stiff w/gypsum seams, tan & gray CH
... tan & dk. gray

Shale, clayey, dk. gray CH
... sl. clayey

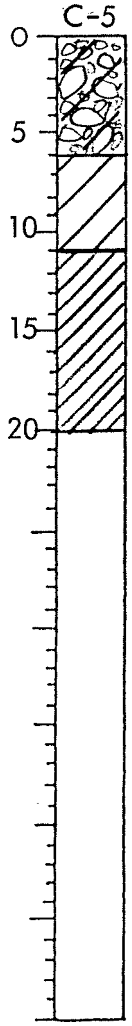
Discontinued @ 20'

Static Water Elev. 676.3



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: October 8, 1985



G.S.E. 681.51

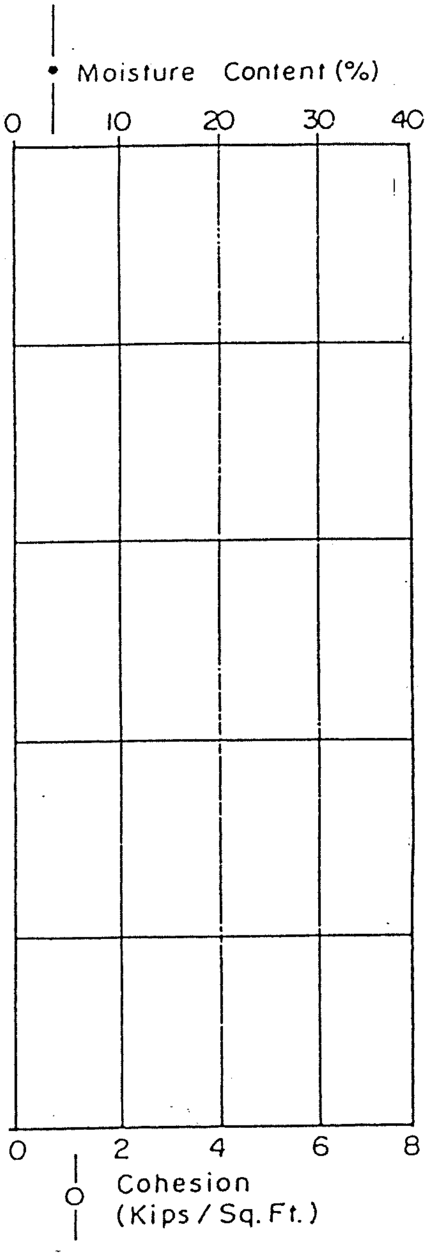
Gravel, sandy, clayey, w/cobbles lt. brown — GC
... v. clayey, tan

Clay, stiff, trace silt, tan & gray — CH
... gray & green tan

Shale, clayey, dk. gray — CH
... sl. clayey

Discontinued @ 20'

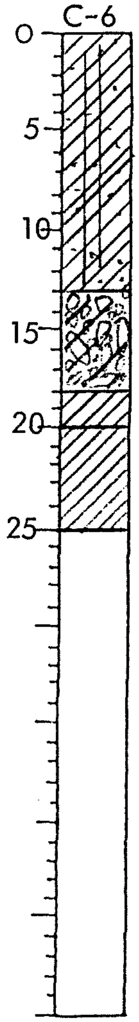
Static Water Elev. Boring Dry



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 1, 1985

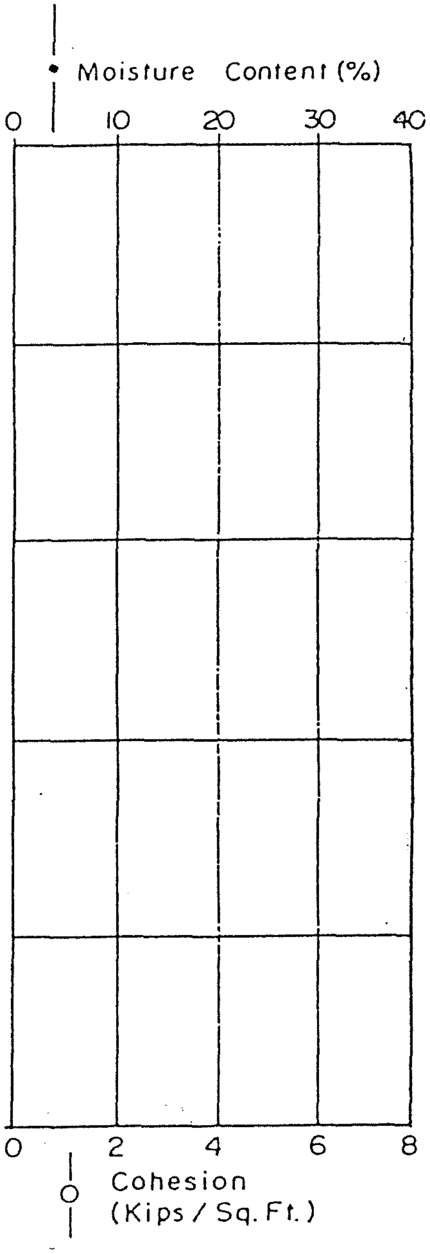


G.S.E. 690.60

Clay, fill, silty, sandy brown	CL
... w/trash (recent) black	CL
Gravel, clayey, gray	GC
Clay, stiff, tan & gray	CH
Shale, clayey dk. gray	CH
... sl. clayey	

Discontinued @ 25'

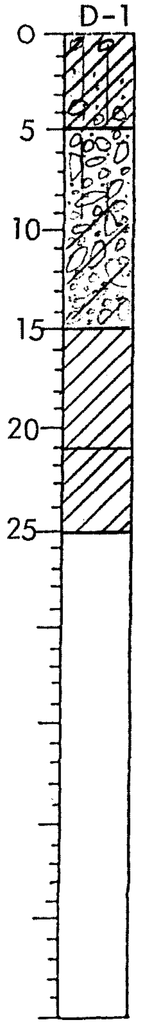
Static Water Elev. 675.1



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: October 31, 1985

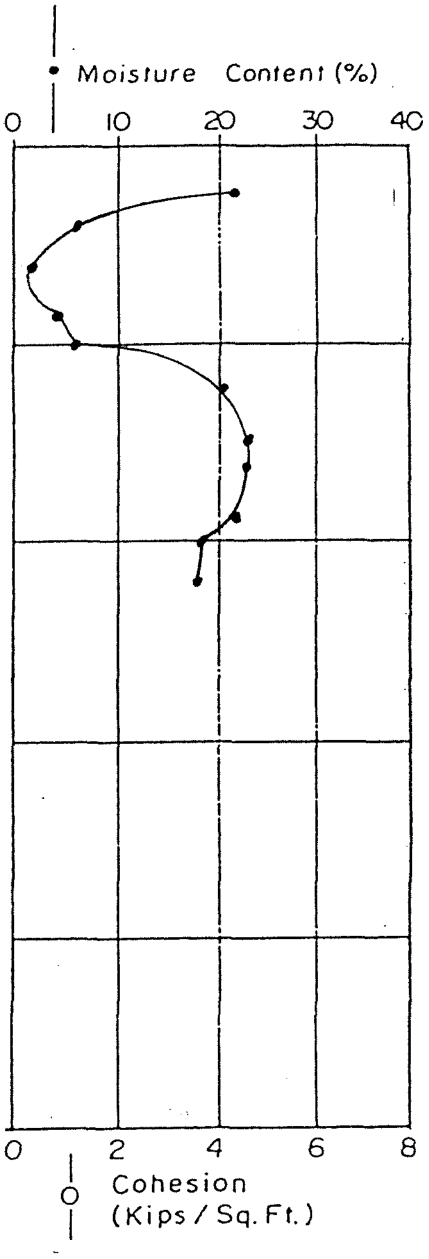


G.S.E. 692.4

Clay, silty, gravelley, brown	CL
... sl. silty, trace sand	CH/CL
... silty, gravelley lt. brown	CL
Gravel, sl. silty, tan	GM/GW
... sl. silty, sl. clayey brown	GM/GC
... clayey w/cobbles, brown	GC
Clay, stiff w/pyritic seams, tan & dk. gray	CH
... w/gypsum seams, tan & gray	
Shale sl. clayey, dk. gray	CH

Discontinued @ 25'

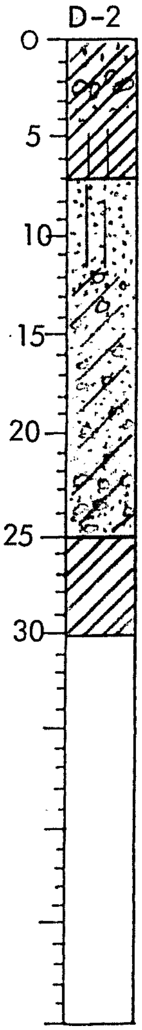
Static Water Elev. 680.9



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: October 31, 1985

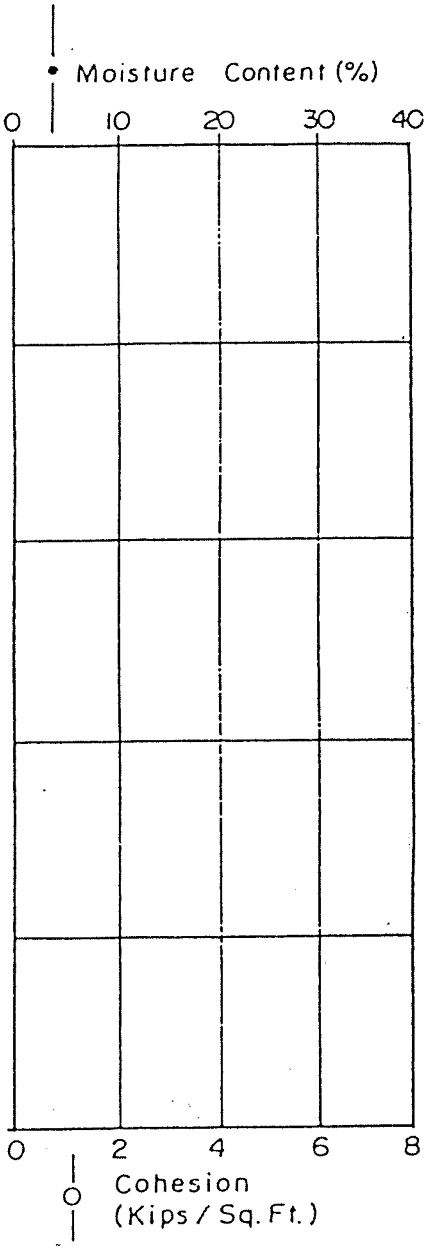


G.S.E. 696.40

Clay, sandy, brown	CL
... gravelley, tan	
... sl. sandy brown	
... v. silty, lt. brown	
Sand, trace silt, tan	SP
... sl. clayey, w/gravel	SC/SP
... clayey, sl. gravelley brown	SC
... v. clayey w/cobbles	
Shale, clayey, dk. gray	CH
... sl. clayey	

Discontinued @ 30'

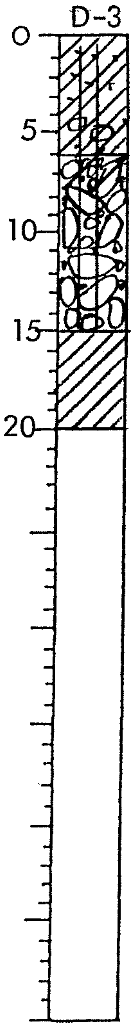
Static Water Elev. 680.4



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 7, 1985



G.S.E. 692.26

Clay, silty, sandy, brown CL

... w/gravel

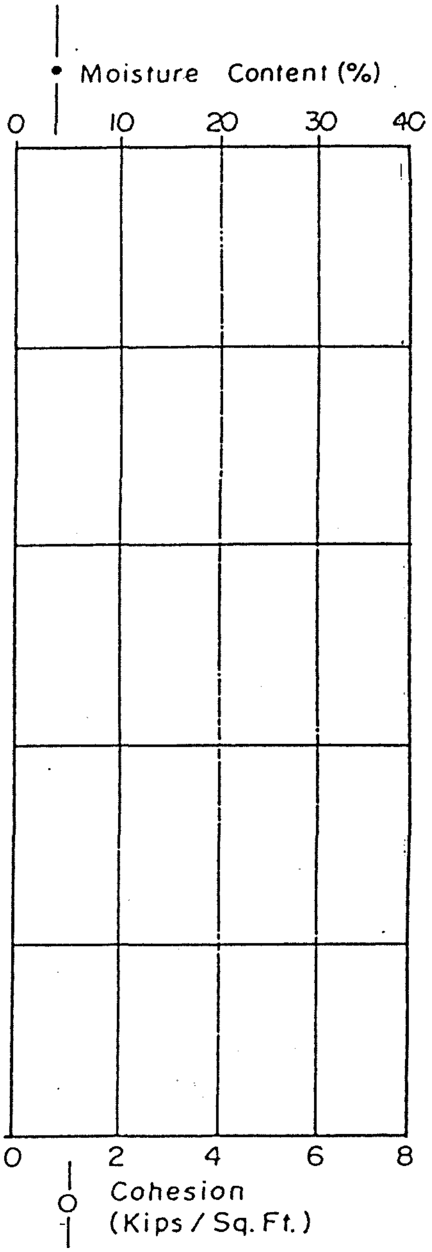
Gravel, silty, sandy, clayey brown GM/GC

... silty w/cobbles, lt. brown GM

Clay, stiff w/gypsum & pyrite stain seams, tan & gray CH

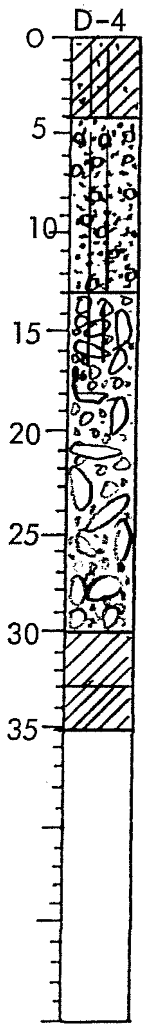
Discontinued @ 20'

Static Water Elev. 679.4



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 7, 1985



G.S.E. 704.06

Clay, sl. silty, sl. sandy, dk. brown CL

Sand, sl. gravelley, v. silty lt. brown SM

Gravel, sandy, silty, lt. brown GM

... trace silt, lt. tan GW

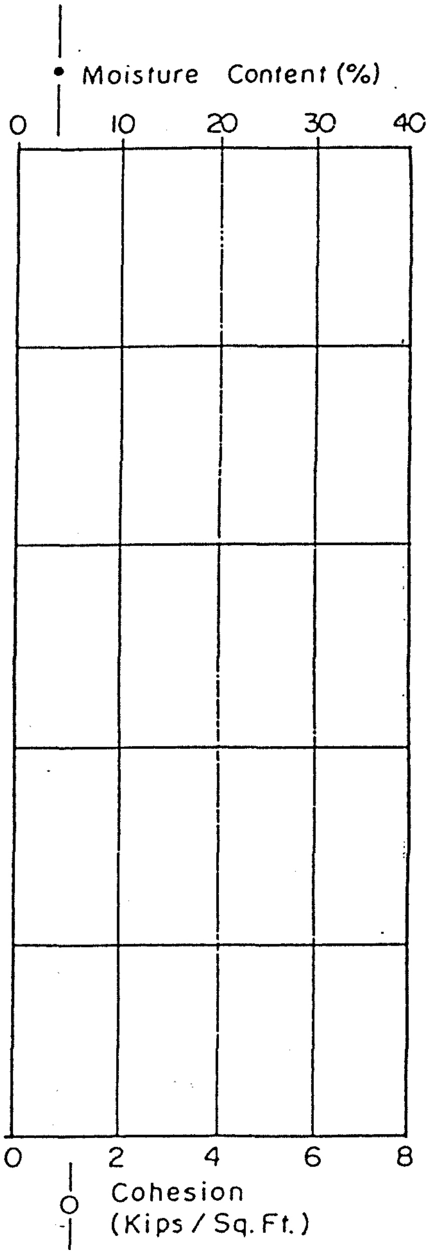
... w/cobbles

Clay, stiff, w/gypsum seams tan & gray CH

Shale, clayey, dk. gray CH

Discontinued @ 35'

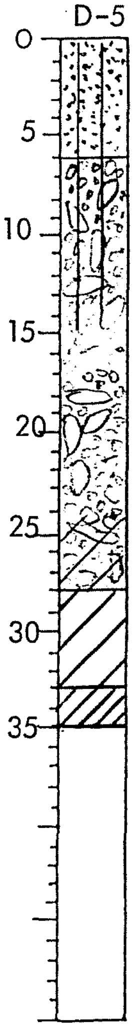
Static Water Elev. 676.0



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: October 7, 1985

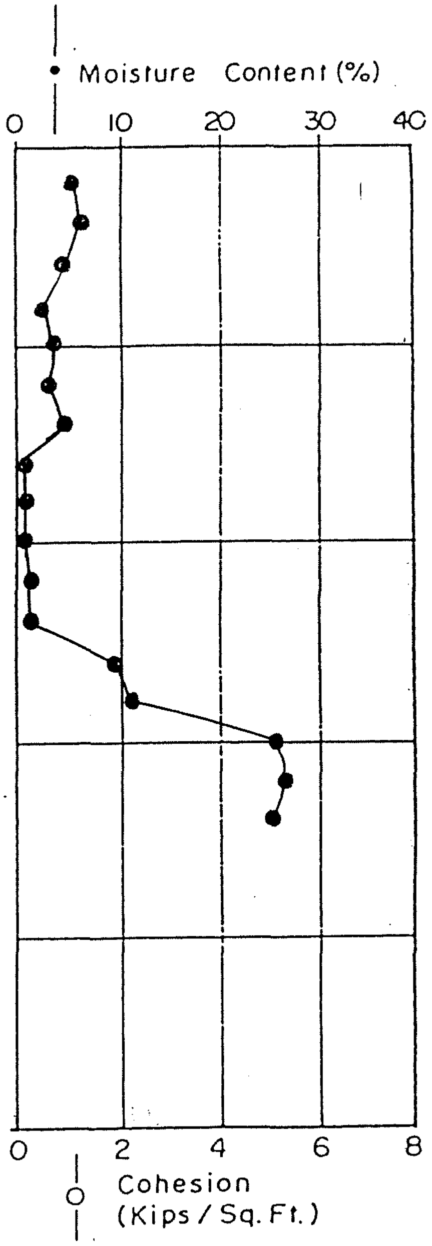


G.S.E. 703.25

Sand, v. silty, lt. brown	SM
Gravel, sandy, silty, lt. brown	GM/GP
... silty, v. sandy	GM
... w/cobbles	
... trace silt, lt. tan	GP
clayey, tan	GC
Clay, stiff, trace silt, tan & gray	CH
... gray & green tan	
Shale, clayey, dk. gray	CH

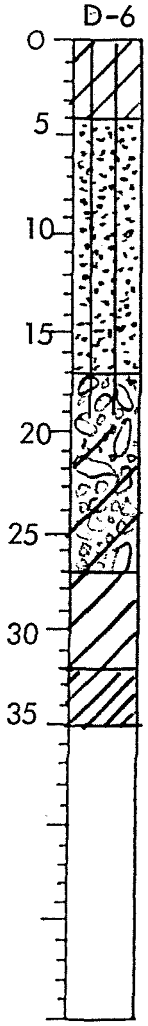
Discontinued @ 35'

Static Water Elev. 676.3



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: October 8, 1985

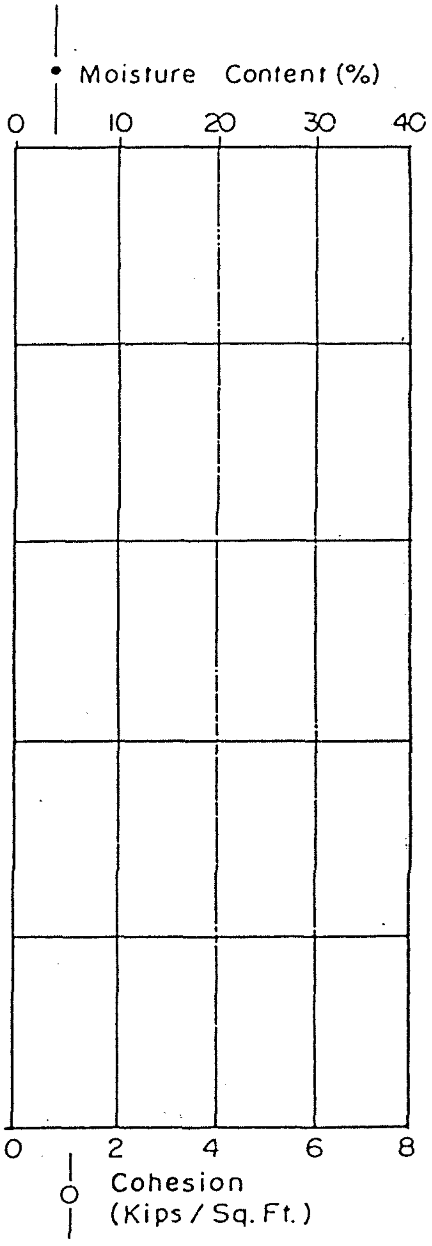


G.S.E. 699.80

Clay, silty, sl. sandy, brown ... lt. brown	CL
Sand, silty, lt. brown ... sl. silty	SM
Gravel, sandy, sl. silty, tan	*GM/GW*
... clayey w/cobbles ... v. clayey	GC
Clay, stiff, trace silt, gray & green tan	CH
Shale, clayey, dk. gray	CH

Discontinued @ 35'

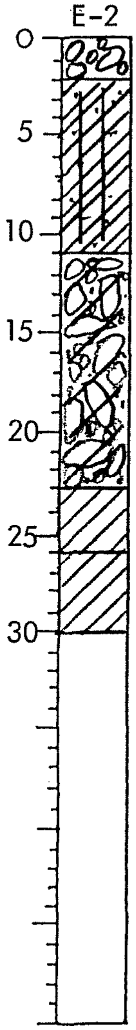
Static Water Elev. 675.8



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 7, 1985



G.S.E. 702.60

Gravel, fill, clayey, brown GC

Clay, fill, silty sandy w/trash (dated) dk. gray CL

Gravel, sandy, clayey, gray GC

... w/cobbles, brown

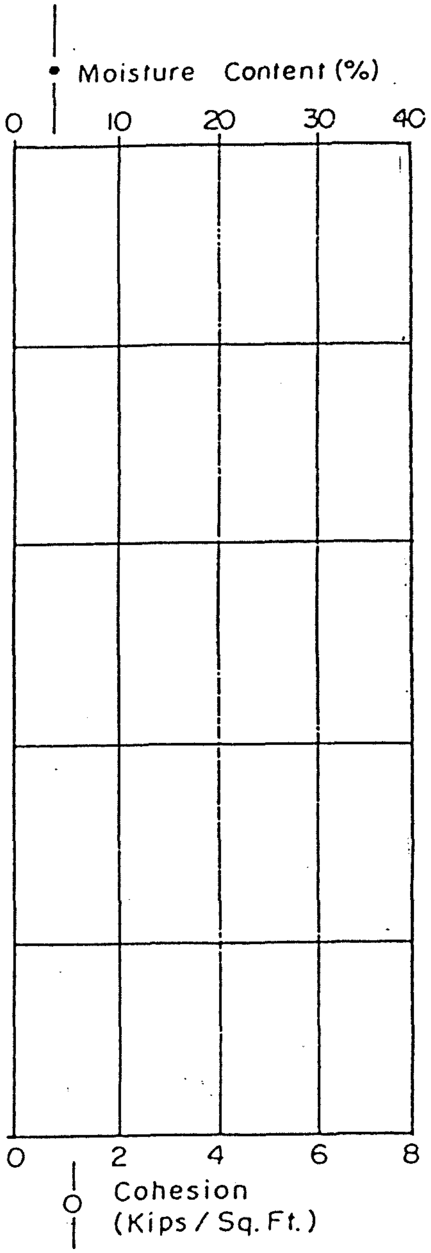
... tan

Clay, stiff w/gypsum & pyrite stain seams tan & gray CH

Shale, clayey, dk. gray CH

Discontinued @ 30'

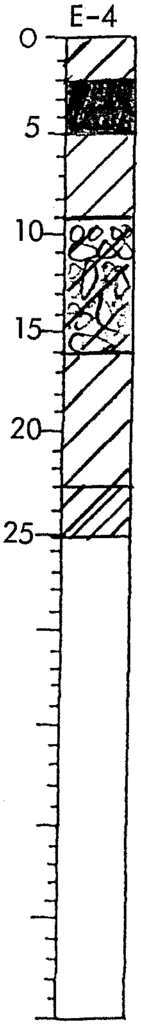
Static Water Elev. 680.6



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: October 8, 1985

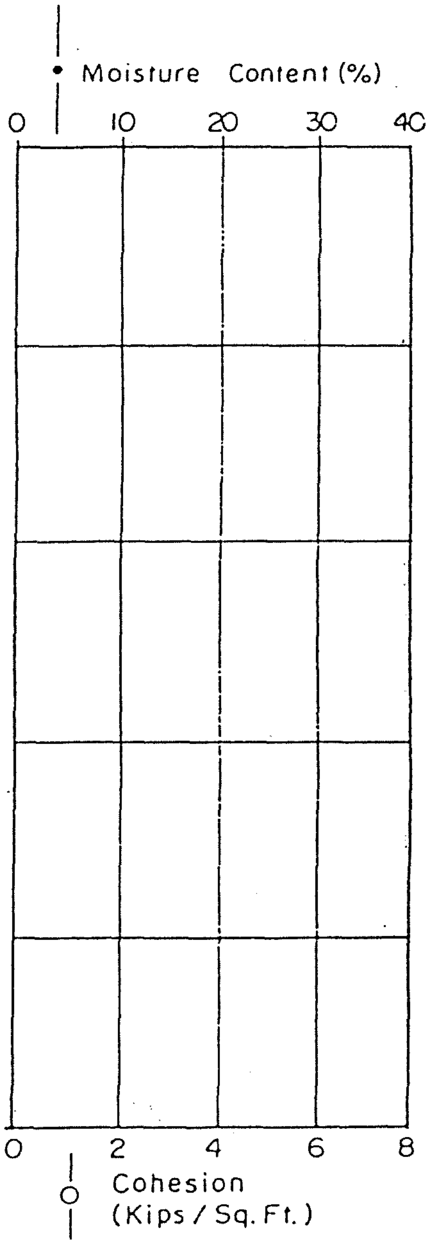


G.S.E. 693.26

Clay, fill, silty, sandy, brown	CL
Wood, fill (recent), clayey, dk. gray	
Clay, fill, w/waste, dk. gray	CH
Gravel, fill, w/waste, clayey, dk. gray	GC
... gravel, clayey, tan	GC
Clay, stiff, plastic, tan & gray	CH
... trace silt, gray & green tan	CH
Shale, clayey, dk. gray	CH

Discontinued @ 25'

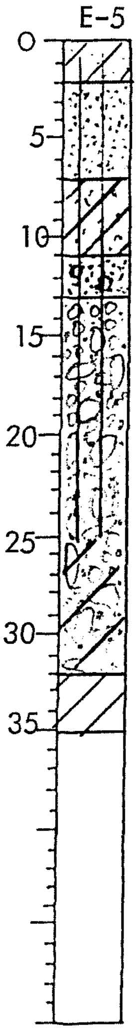
Static Water Elev. 677.3



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: October 7, 1985

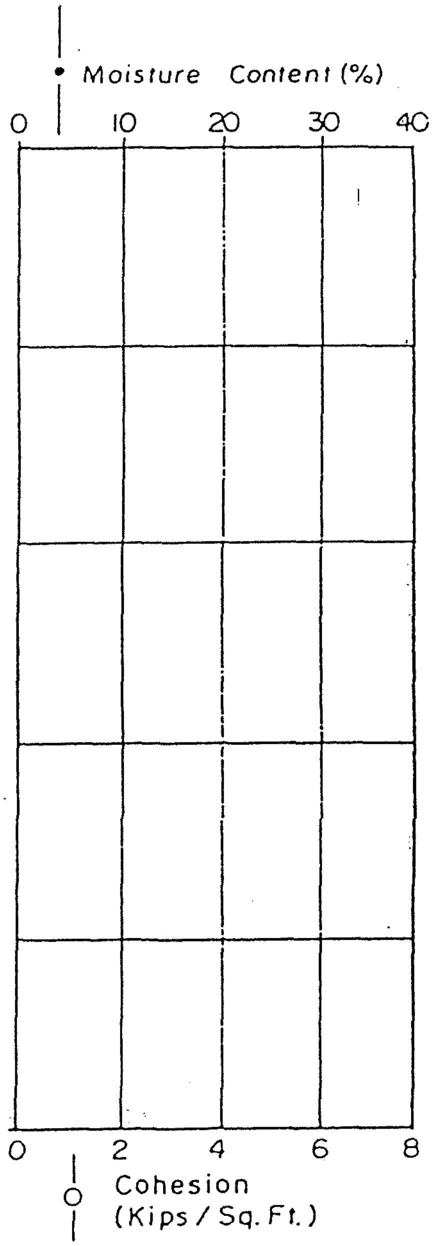


G.S.E. 703.25

Clay, silty, sandy, brown	CL
Sand, v. silty, lt. brown	SM
Clay, silty, sandy lt. brown	CL
Sand, v. silty, gravelley, lt. brown	SM
Gravel, sandy, sl. silty, lt. brown	GM/GP
... sl. sandy, sl. silty, tan	GW
... sl. clayey, sl. sandy, lt. brown	GC
... v. clayey, tan	
Clay, stiff, tan & gray	CH
gray & green tan	CH

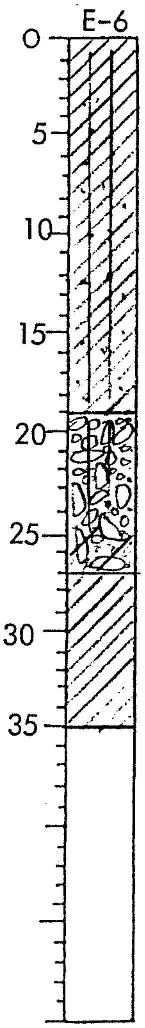
Discontinued @ 35'

Static Water Elev. 676.3



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 1, 1985

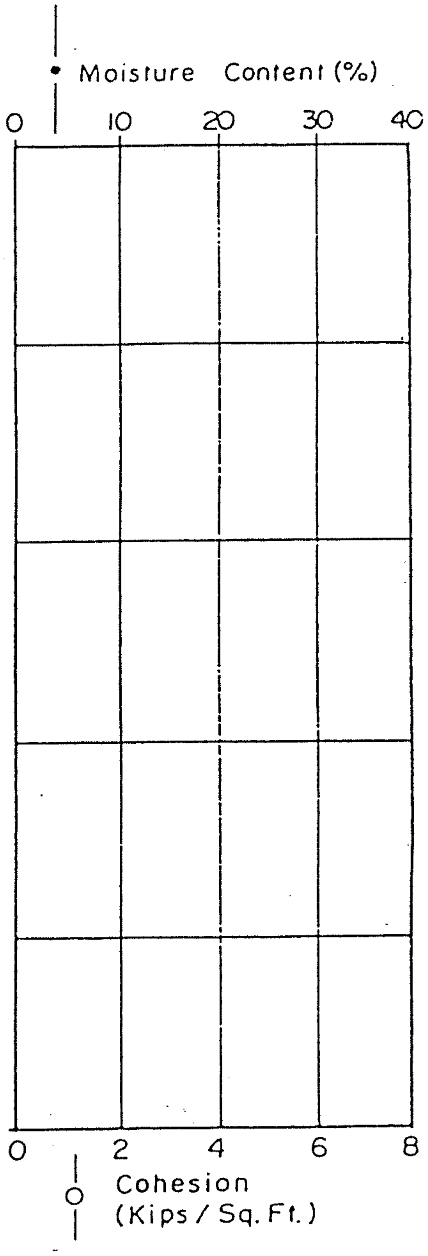


G.S.E. 700.08

Clay, sl. silty, dk. brown	CH
... silty, sl. sandy, lt. brown	CL
Gravel, v. silty, tan	GM
... sl. silty lt. brown	GM/GW
... clayey w/cobbles	GC
Clay, stiff w/pyritic seams, tan & gray	CH

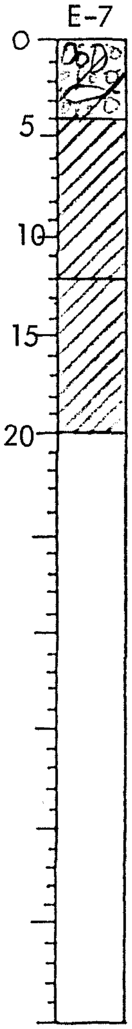
Discontinued @ 35'

Static Water Elev. 674.5



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 1, 1985

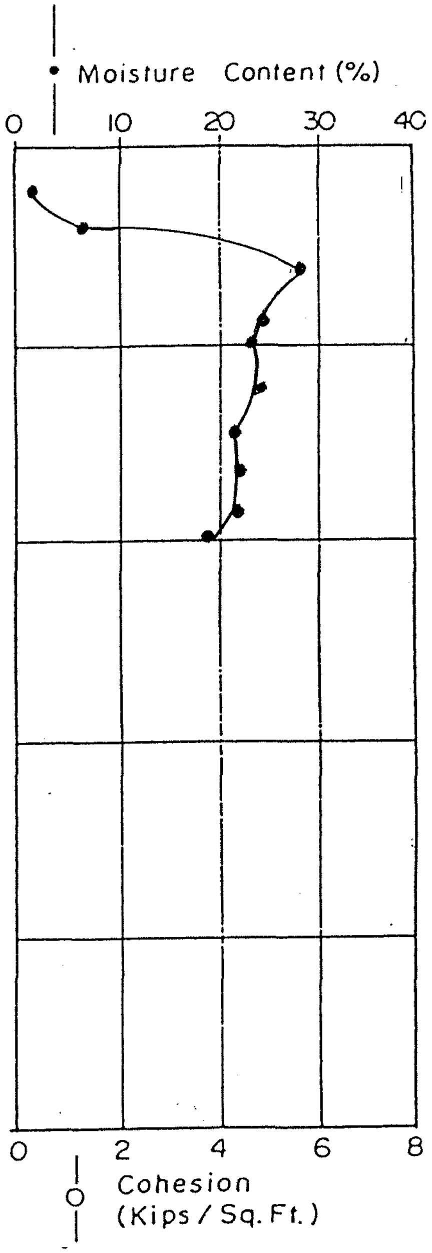


G.S.E. 675.9

Gravel, sandy, clayey, tan	GC
Clay, stiff w/gypsum & pyrite stain seams, tan & gray	CH
Shale, clayey, dk. gray	CH
... sl clayey	

Discontinued @ 20'

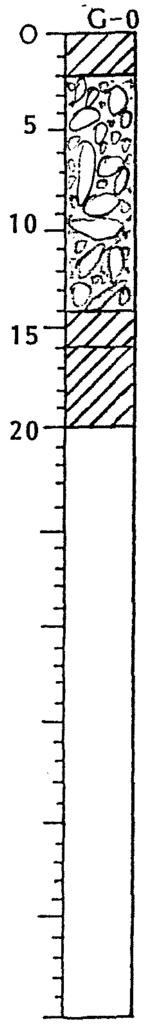
Static Water Elev. 673.9



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: December 10, 1985



G.S.E. 693.7

Clay, sandy, gravelley, dk. brown CL

Gravel, v. sandy, sl. clayey lt. brown GW/GC

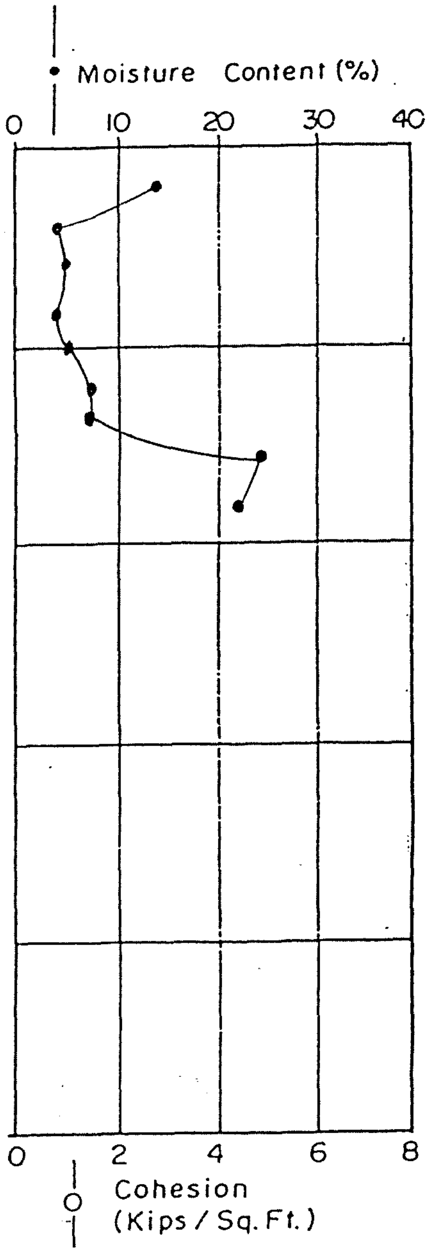
... sl. sandy, clayey GC

Clay, stiff, tan & gray CH

Shale, clayey, dk. gray CH

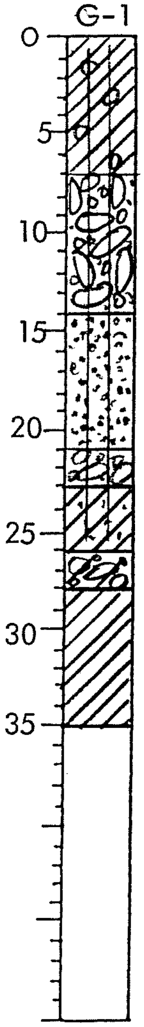
Discontinued @ 20'

Static Water Elev. 680.7



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 7, 1985



G.S.E. 702.0

Clay, sl. silty, sl. gravelley dk. brown CL

... silty, gravelley, brown

Gravel v. silty, sl. clayey brown GM

Sand, v. silty, sl. clayey, brown SM

Gravel, silty, brown GM

Clay, silty, sandy brown CL

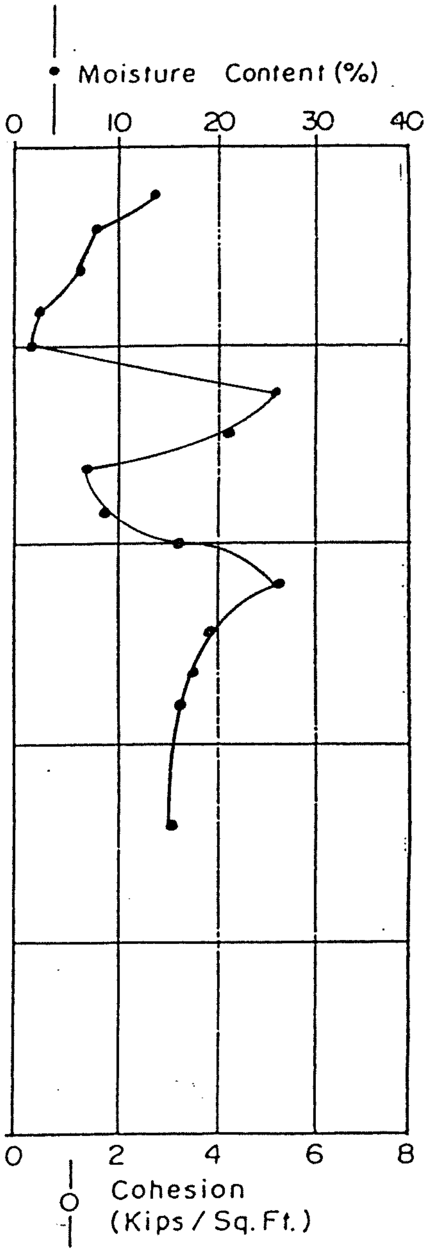
Gravel, clayey, tan GC

Shale, clayey, dk. gray CH

... sl. clayey

Discontinued @ 35'

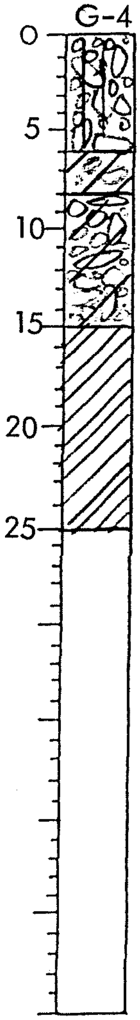
Static Water Elev. 680.0



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: October 8, 1985

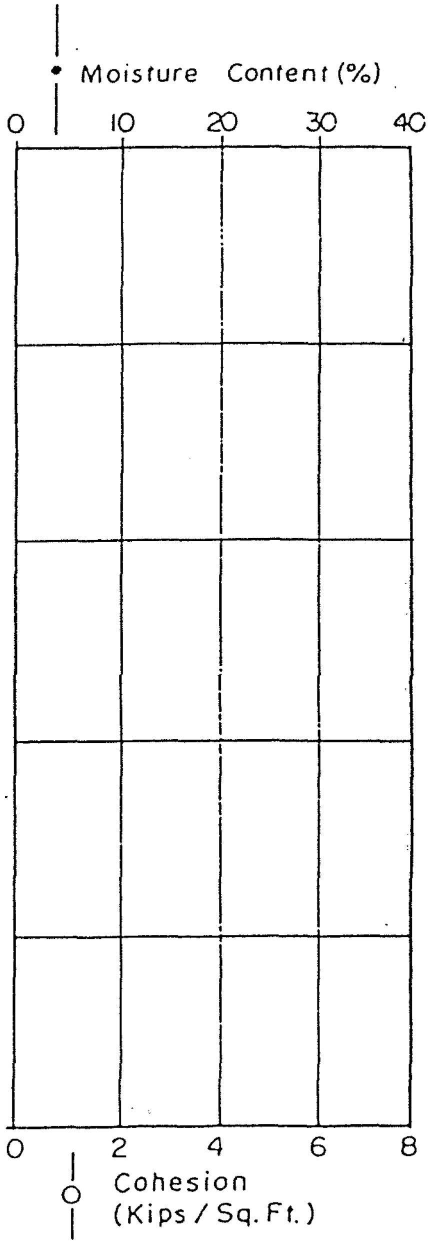


G.S.E. 679.4

Gravel, trace silt, tan	GP
Clay, gravelley, lt. brown	CL
Gravel, clayey, lt. brown	GC
Shale, clayey, dk. gray	CH

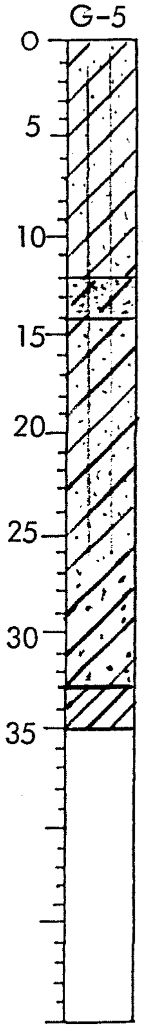
Discontinued @ 25'

Static Water Elev. 669.4



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: October 7, 1985

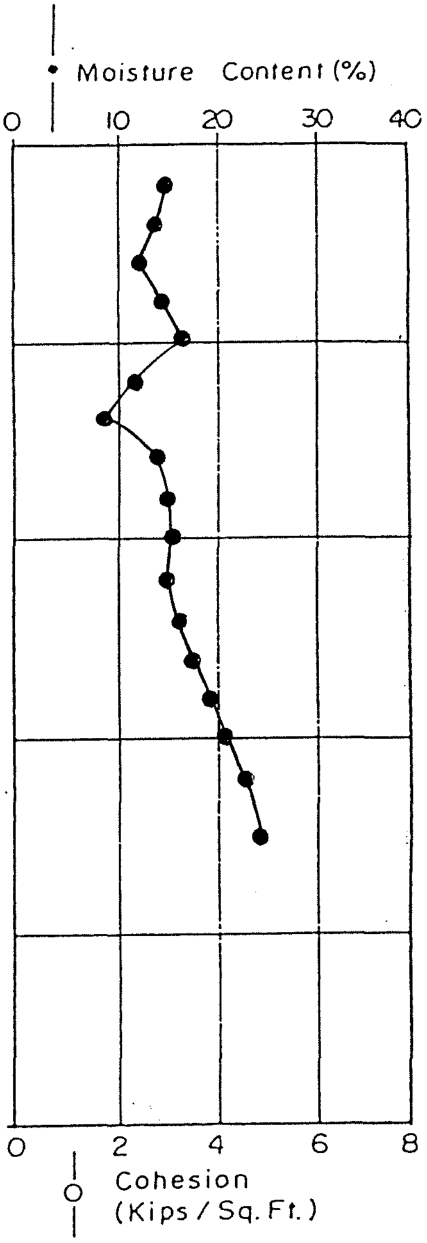


G.S.E. 700.66

Clay, sl. silty, sl. sandy brown	CH/CL
... silty, sandy, lt. brown	CL
... sl. silty, sl. sandy, brown	
... silty, sandy, lt. brown	
Sand, silty, sl. clayey, lt. brown	SM
Clay, silty, sandy, lt. brown	CL
... sl. sandy, tan & gray	CH/CL
... w/calc. sand	CH
... gray & green tan	
Shale, clayey, dk. gray	CH

Discontinued @ 35'

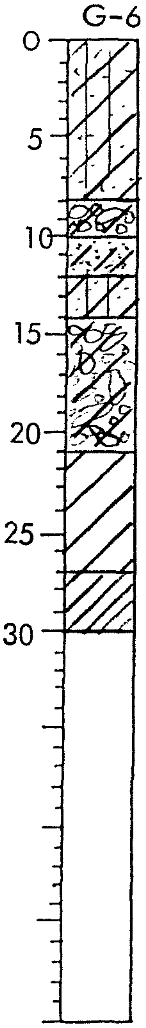
Static Water Elev. 675.7



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: October 7, 1985

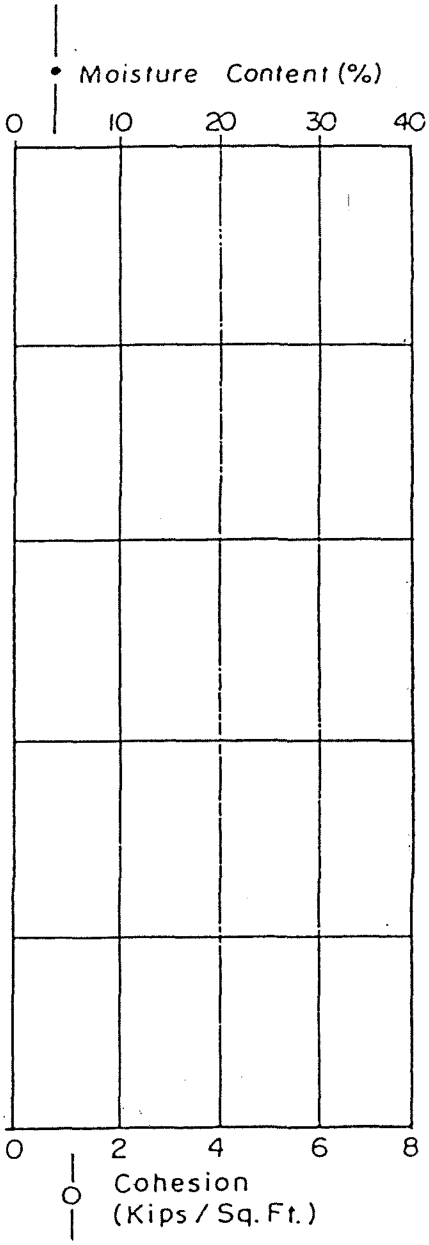


G.S.E. 692.68

Clay, silty, sandy, lt. brown	CL
Gravel, clayey, lt. brown	GC
Sand, clayey, lt. brown	SC
Clay, silty, sandy, lt. brown	CL
Gravel, v. clayey w/cobbles, lt. brown	GC
Clay w/calc. sand, gray & green tan	CH
... v. stiff, gray	CH
Shale, sl. clayey, dk. gray	CH

Discontinued @ 30'

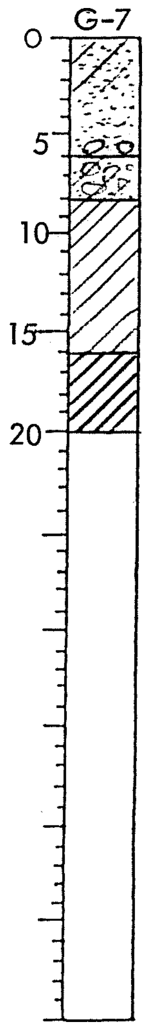
Static Water Elev. 675.7



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: August 29, 1985

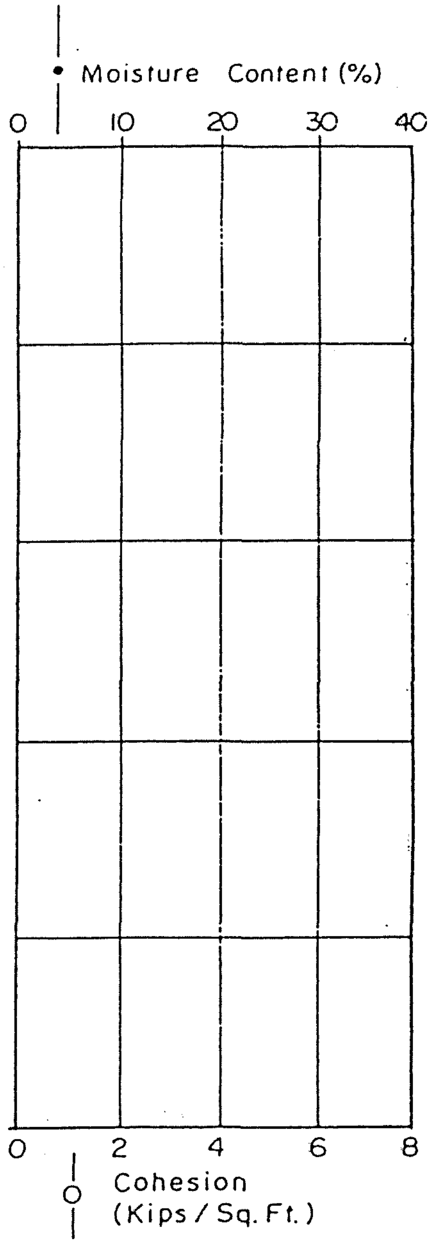


G.S.E. 677.28

Sand, med. gr. w/clay tan	SC
... f. grain lt. gray ... gravelley	SP
Gravel, clayey, w/cobbles, tan	GC
Clay, stiff, plastic, tan & gray	CH
Shale, clayey, dk. gray	CH

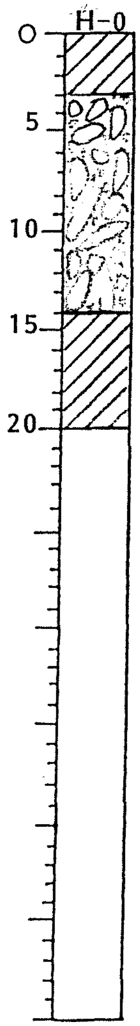
Discontinued @ 20'

Static Water Elev. 674.3



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: December 10, 1985



G.S.E. 691.0

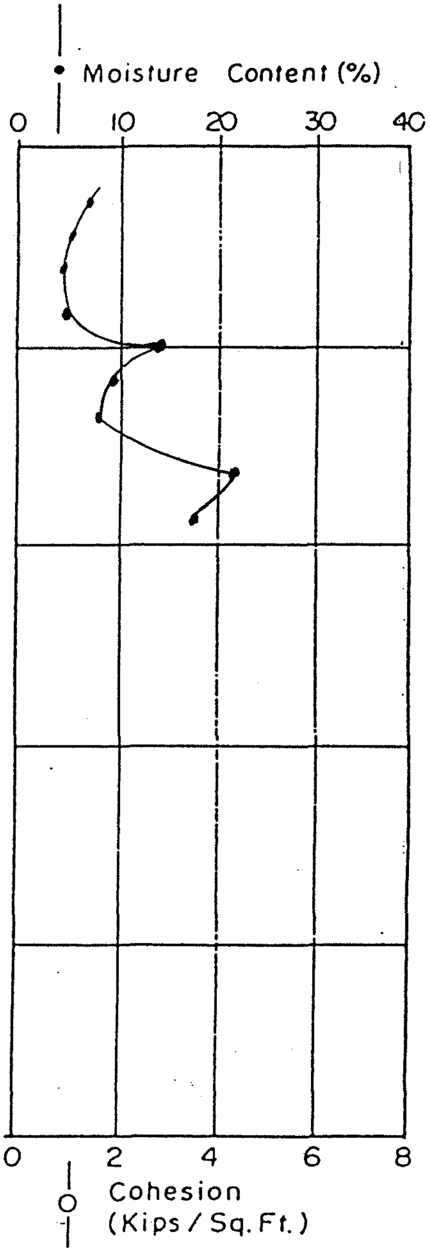
Clay, sandy, gravelley, dk. brown CL
... brown

Gravel, sandy, clayey brown GC
... lt. brown
... v. sandy, trace clay, tan GW

Shale, v. clayey dk. gray CH
... sl. clayey

Discontinued @ 20'

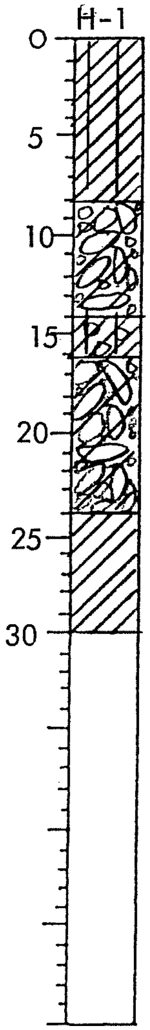
Static Water Elev. 682.7



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 7, 1985

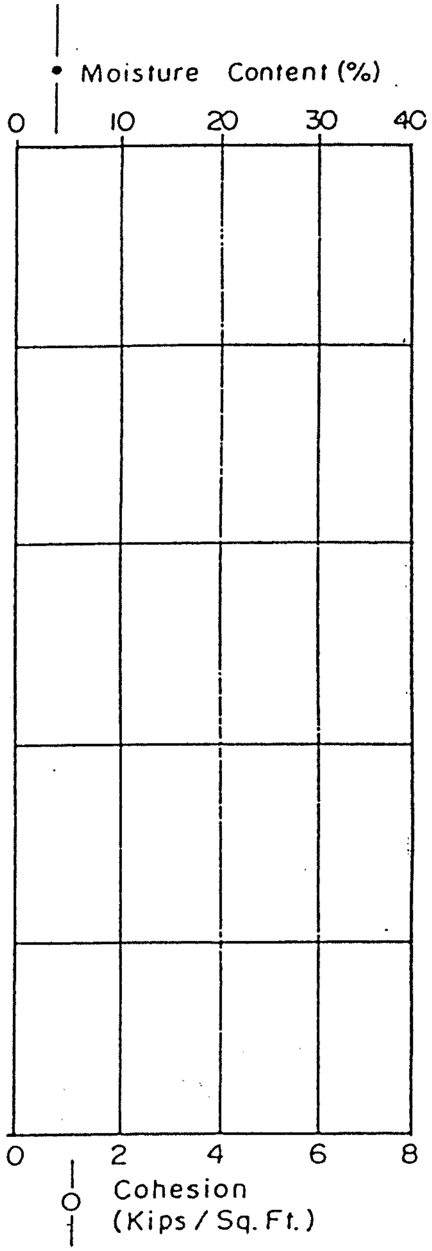


G.S.E. 706.60

Clay, fill, silty w/trash (dated) brown	CL
... dk. gray	
Gravel, clayey, gray	GC
... brown	
Clay, silty, gravelley, brown	CL
Gravel, clayey w/cobbles brown	GC
... sl. clayey, tan	
Clay, stiff w/gypsum & pyrite stain seams, tan & gray	CH

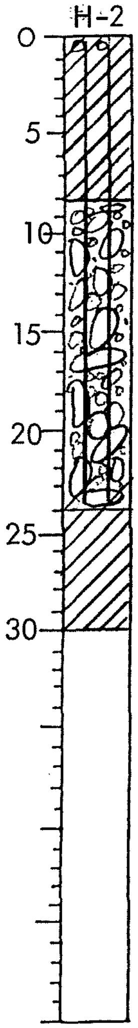
Discontinued @ 30'

Static Water Elev. Boring Dry



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: November 7, 1985

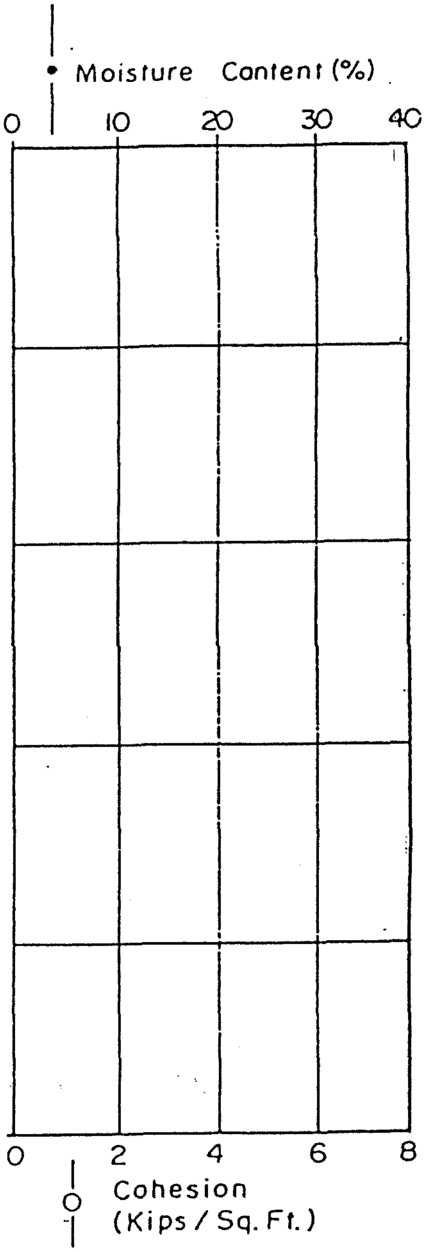


G.S.E. 705.96

Clay, gravelley brown	CL
... sl. silty dk. brown	CH
... sl. silty, sl. sandy lt. brown	CL
... v. silty	
Gravel, silty, lt. brown	GM
... w/cobbles	
... silty, clayey	GC
Clay, sl. stiff w/gypsum & pyrite stain seams, tan & gray	CH

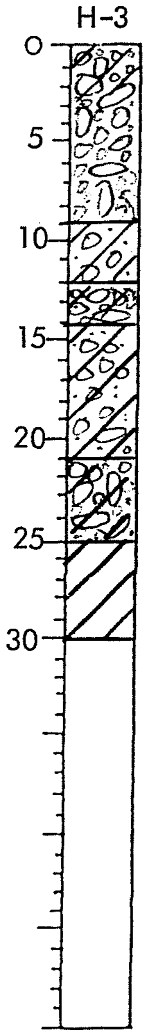
Discontinued @ 30'

Static Water Elev. Boring Dry



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: September 24, 1985

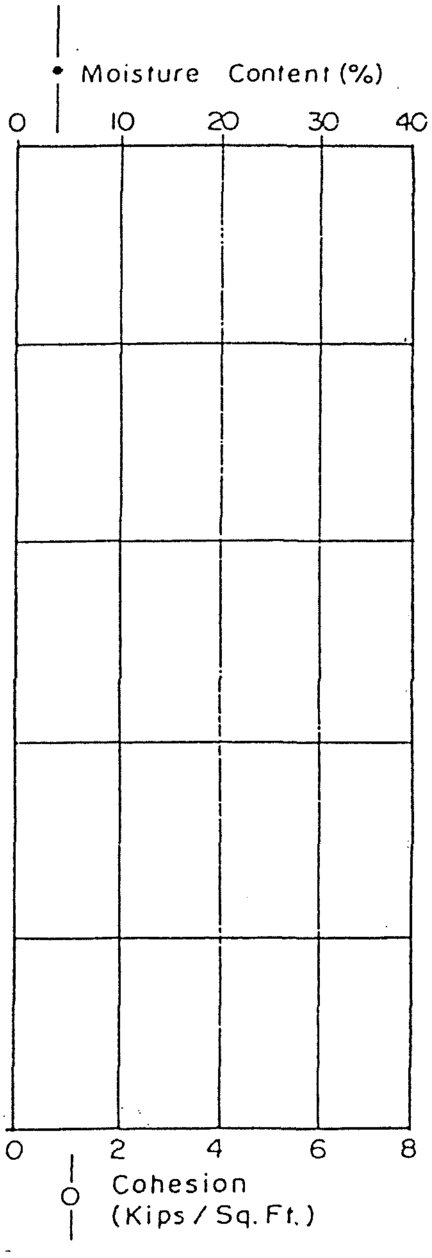


G.S.E. 703.06

Gravel, fill, clayey, brown	GC
... w/broken concrete (dated)	GP
Clay, fill w/trash (dated), sandy, gravelley, brown	CL
Gravel, fill, clayey, lt. tan	GC
Clay, fill, sandy, gravelley, brown	CL
Gravel, clayey w/cobbles, tan	GC
Clay, stiff w/gypsum seams, tan & dk. gray	CH

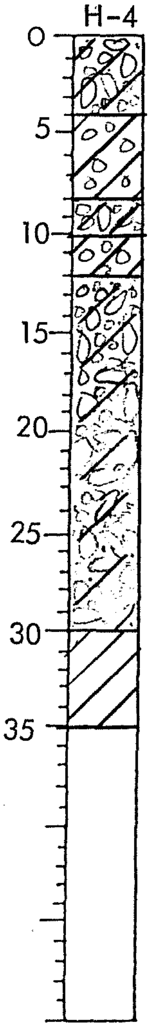
Discontinued @ 30'

Static Water Elev. 680.1



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: October 7, 1985

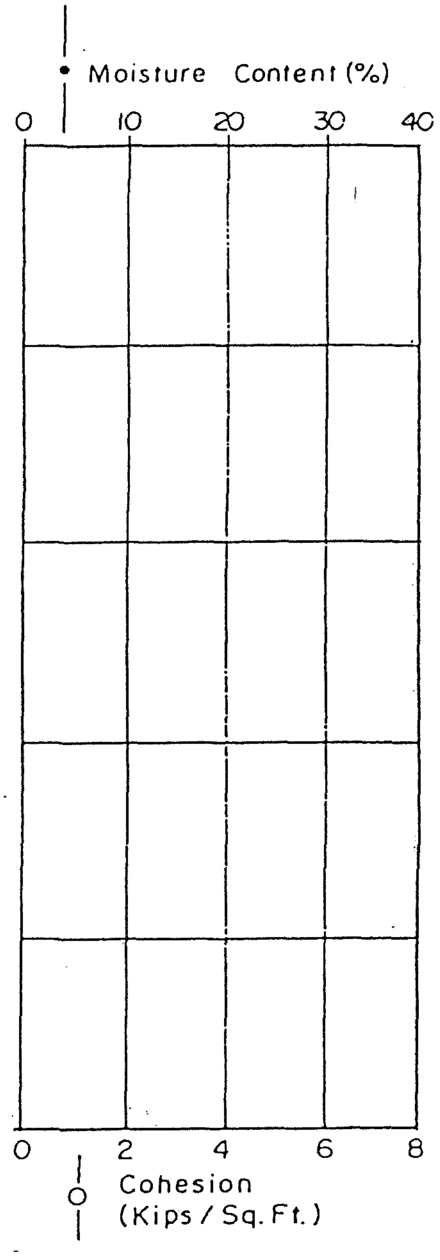


G.S.E. 704.96

Gravel, fill, v. clayey, brown	GC
Clay, fill, w/waste (dated) gravelley, brown	CL
Gravel, fill, w/waste, clayey	GC
Clay, fill, w/waste, brown	CL
Gravel, sl. sandy, sl. clayey, tan ... w/cobbles	GP/GC
Clay, stiff, plastic, tan & gray	CH

Discontinued @ 35'

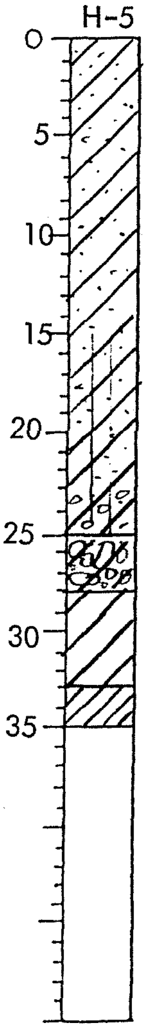
Static Water Elev. 679.0



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: September 24, 1985

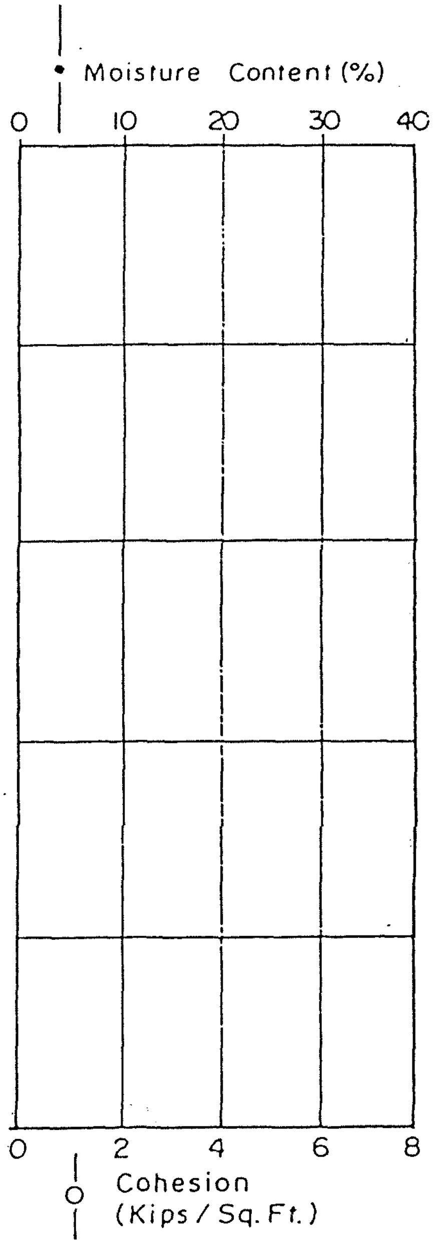


G.S.E. 699.97

Clay, trace sand, dk. brown	CH
... sl. silty, sl. sandy, brown	CL
... sandy, lt. brown	CL
... v. sandy	
... silty, sl. sandy	
... w/trace gravel	
Gravel, silty, clayey, tan	GC
Clay, stiff w/gypsum seams tan & gray	CH
Shale, sl. clayey, dk. gray	CH

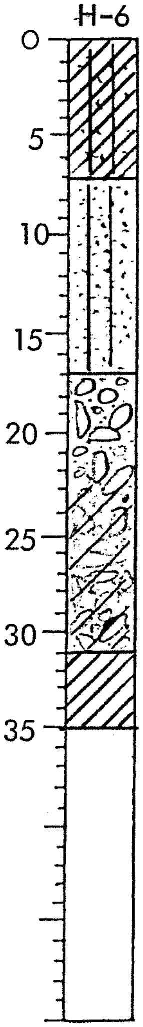
Discontinued @ 35'

Static Water Elev. 674.5



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: September 6, 1985

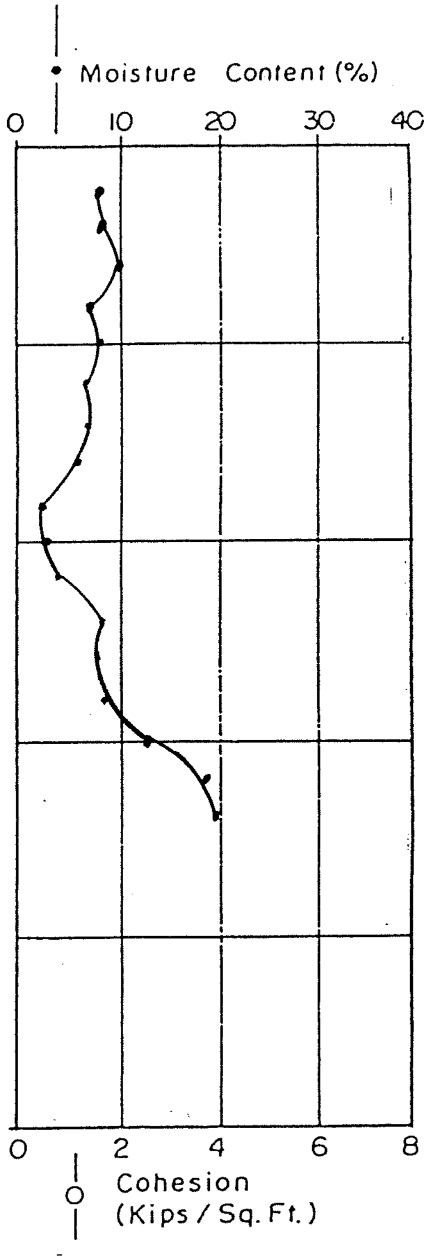


G.S.E. 697.97

Clay, silty w/f. gr. sand, lt. brown	CL
Sand, v. silty, trace clay, lt. brown	SM
... v. sl. silty tan	SP
Gravel, sandy, trace silt, tan	GW
... sandy, clayey	GC
... w/cobbles	
Shale, clayey dk. gray	CH

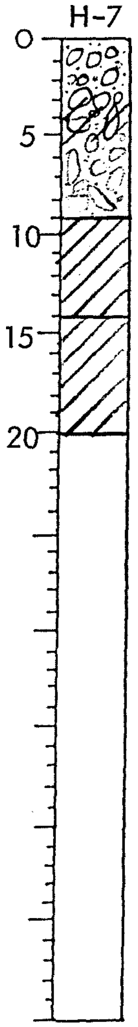
Discontinued @ 35'

Static Water Elev. 677.0



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: September 4, 1985

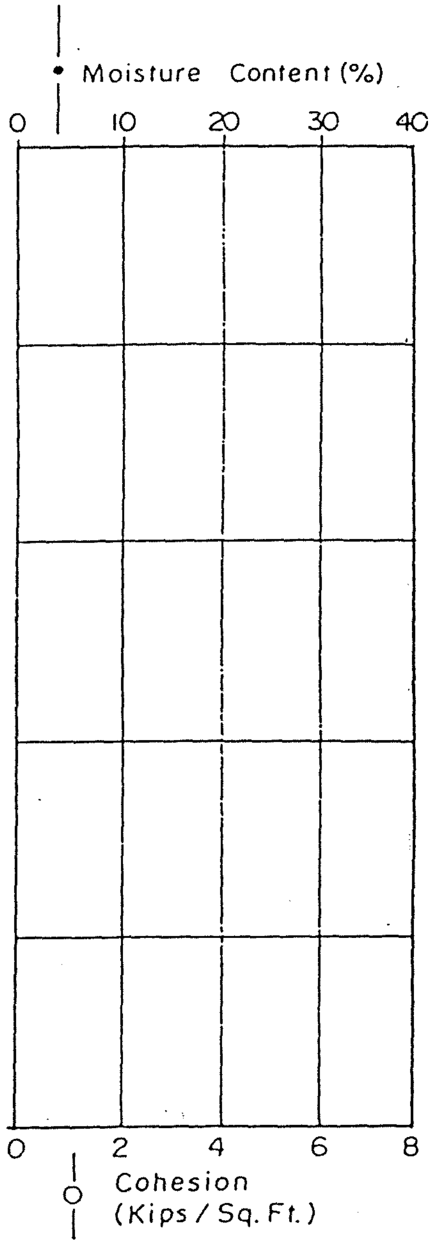


G.S.E. 679.18

Gravel, sandy, tan	GW
... clayey	GC
... sl. sandy w/cobbles	GP
Clay, v. stiff w/gypsum seams tan & gray	CH
Shale, clayey, dk. gray	CH

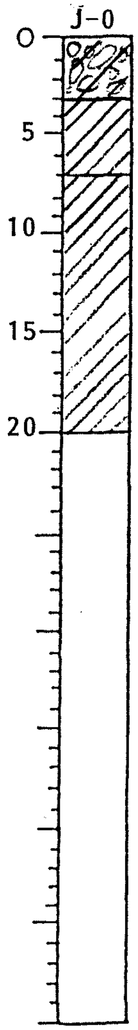
Discontinued @ 20'

Static Water Elev. 672.2



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: December 10, 1985



G.S.E. 686.4

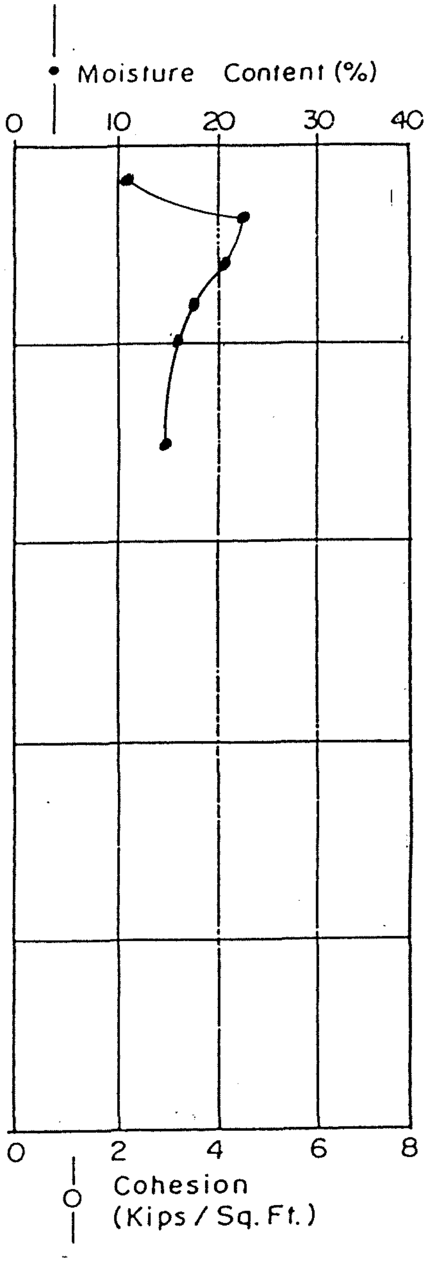
Gravel, sl. clayey brown ... tan GC

Clay, stiff w/gypsum seams tan & gray CH

Shale, clayey, dk. gray ... sl. clayey CH

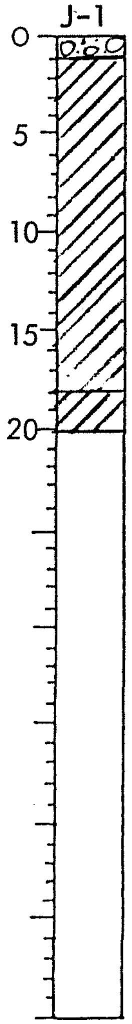
Discontinued @ 20'

Static Water Elev. Boring Dry



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: August 29, 1985



G.S.E. 689.7

Gravel, sandy, clayey, tan GC

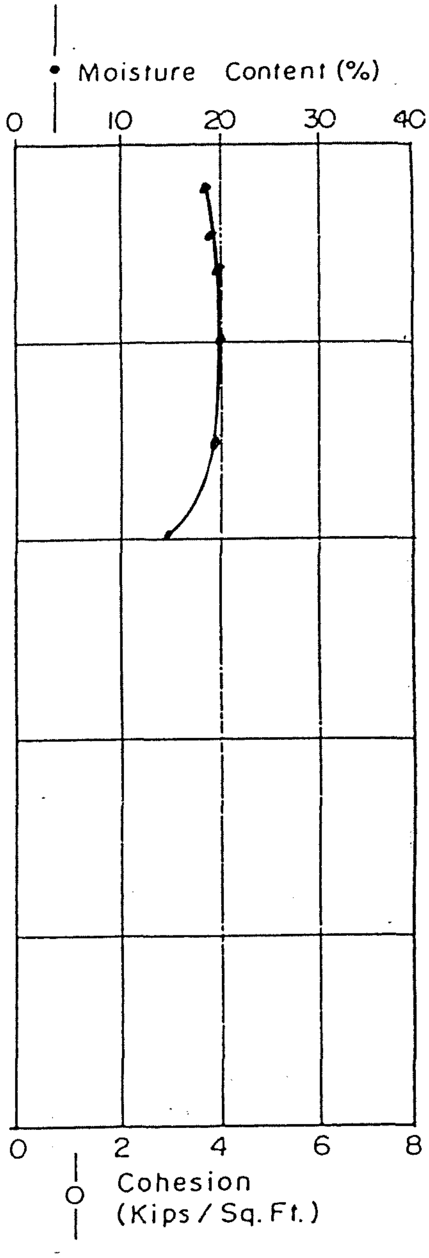
Clay, stiff w/gypsum seams
tan & gray CH

... w/pyritic staining

Shale, clayey, dk. gray CH

Discontinued @ 20'

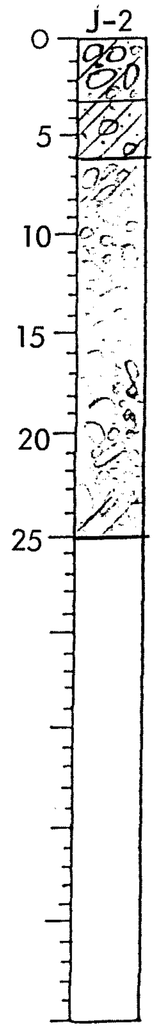
Static Water Elev. Boring Dry



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: August 30, 1985

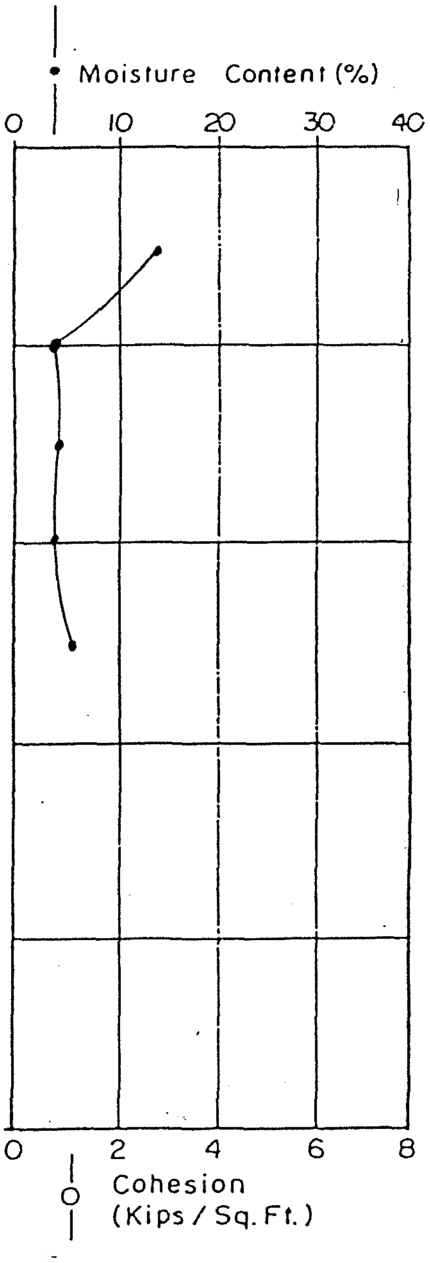


G.S.E. 709.04

Gravel, sandy, clayey, brown	GC
Clay, sandy, gravelley brown	CL
Gravel, sandy, sl. clayey, tan sandy, trace clay	GW/GC GW
... w/occasional cobble	
... sandy w/cobbles, sl. clayey	GW/GC

Discontinued @ 25'

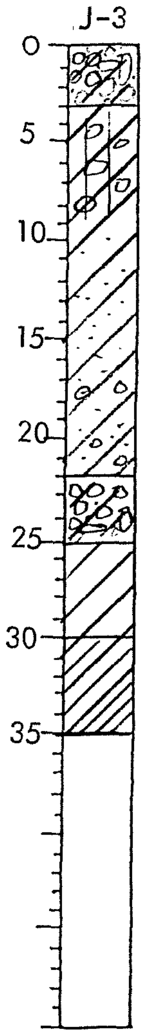
Static Water Elev. 678.1 (approx.)



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: September 24, 1985



G.S.E. 701.14

Gravel, fill, clayey, lt. brown GC/GP

Clay, fill, w/trash (dated), silty, gravelley lt. brown CL

... sandy, gray

Clay, sandy, sl. gravelley, lt. brown CL

Gravel, clayey, tan GC

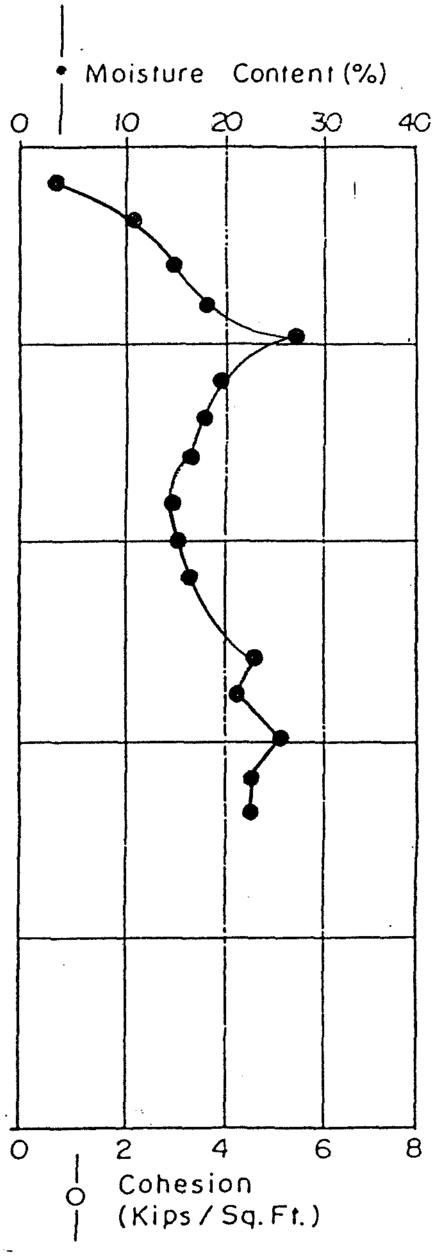
Clay, stiff w/gypsum seams, tan & gray CH

... tan w/dk. gray

Shale, clayey, dk. gray CH

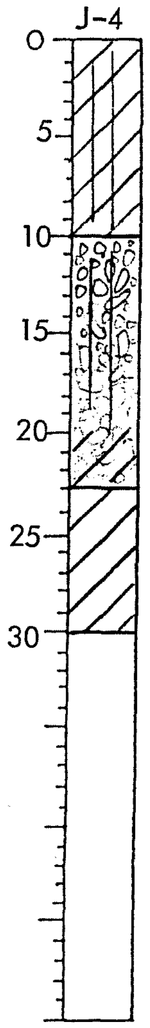
Discontinued @ 35'

Static Water Elev. 680.1



LOG OF BORING

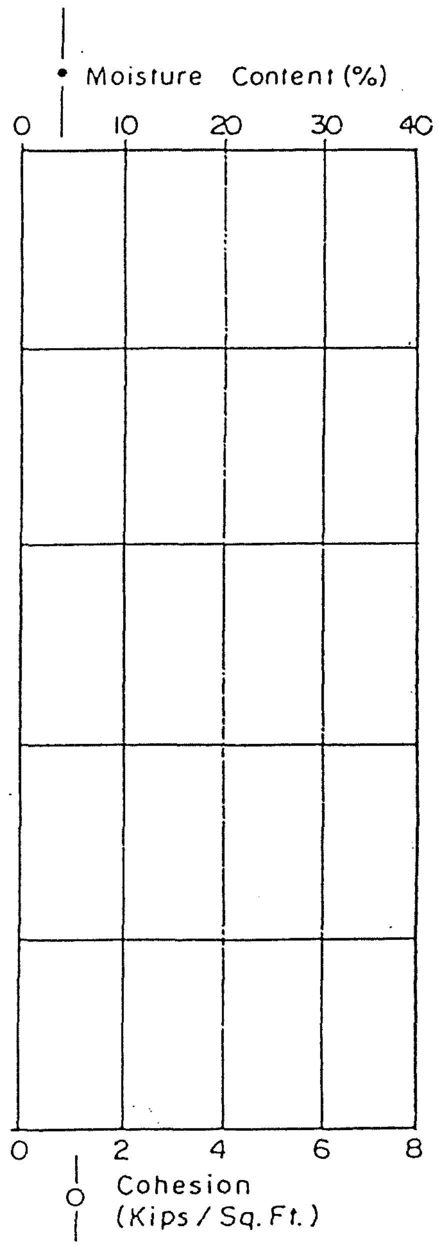
Project Name: Beck Ready Mix, Inc.
Date Drilled: September 24, 1985



G.S.E. 699.34	
Clay, silty, sl. sandy, brown	CL
... v. silty, lt. brown	
Gravel, silty, tan	GM/GP
... sl. silty	GM/GW
... sl. clayey, tan	GC
Clay, stiff w/gypsum seams, tan & gray	CH

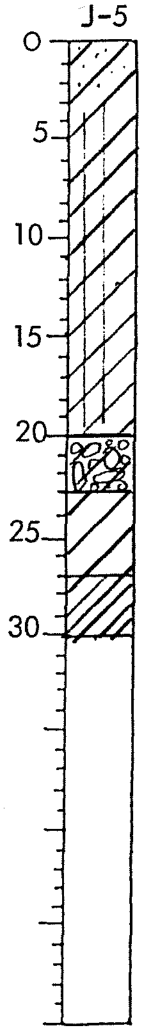
Discontinued @ 30'

Static Water Elev. 678.3



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: September 24, 1985

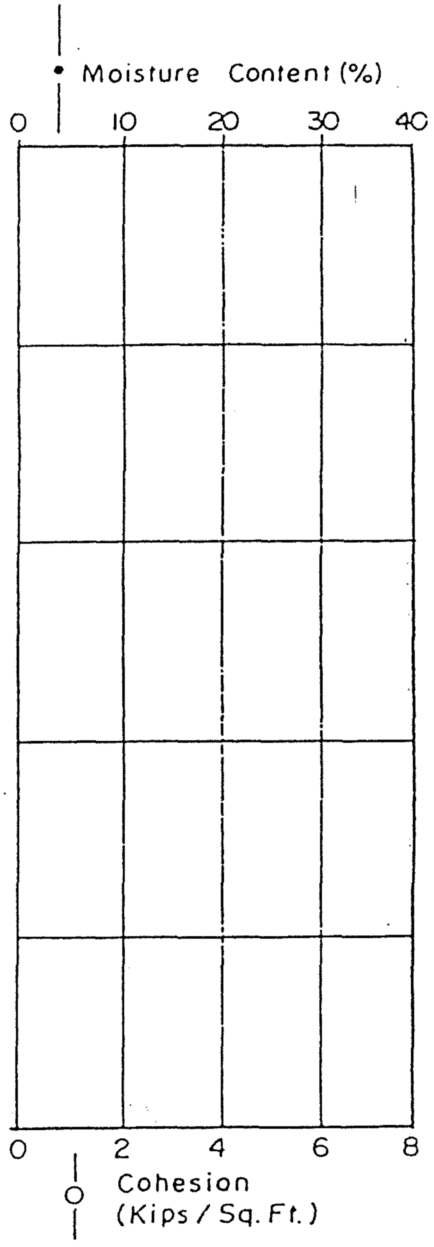


G.S.E. 695.65

Clay, trace sand, dk. brown	CH
... sl. silty, brown	CH/CL
... silty, lt. brown	CL
Gravel, clayey, tan	GC
Clay, Stiff w/gypsum seams, tan & gray	CH
Shale, sl. clayey, dk. gray	CH

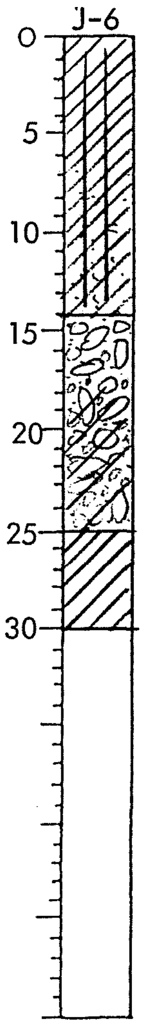
Discontinued @ 30'

Static Water Elev. 673.7



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: September 6, 1985

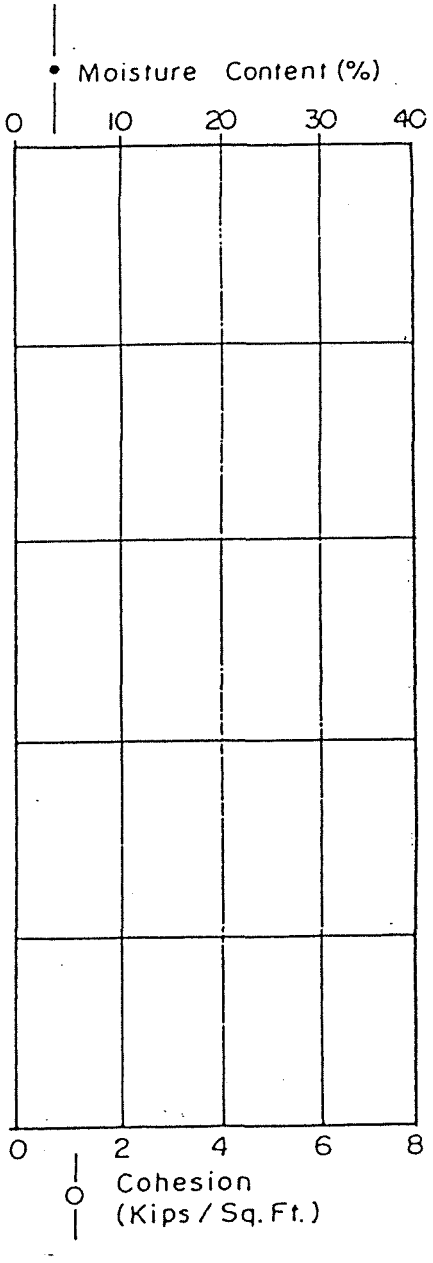


G.S.E. 693.25

Clay, sl. silty, dk. brown	CH
... silty w/trace f. gr. sand brown	CL
... silty, sandy, lt. brown	
Gravel, sandy, tan	GW
... sandy, clayey	GC
... clayey w/cobbles	
Shale, clayey dk. gray	CH

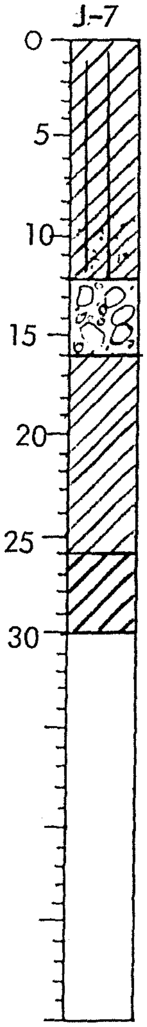
Discontinued @ 30'

Static Water Elev. 673.3



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: September 6, 1985

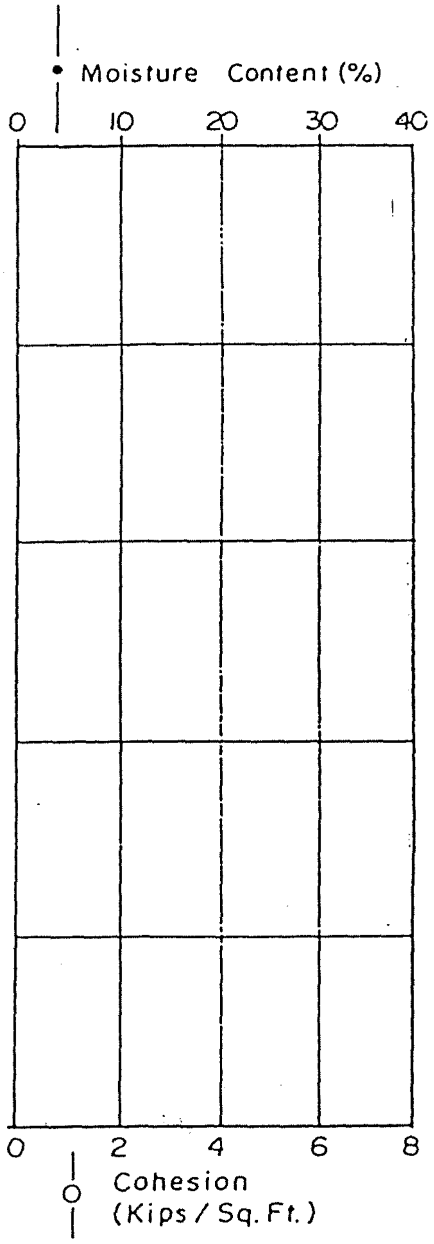


G.S.E. 691.25

Clay, sl. silty, dk. brown	CH
... sl. silty, brown	CH/CL
... silty, sl. sandy, lt. brown	CL
Gravel, sandy w/cobbles, tan	GW
Clay, stiff w/gypsum seams tan & gray	CH
Shale, clayey, dk. gray	CH

Discontinued @ 30'

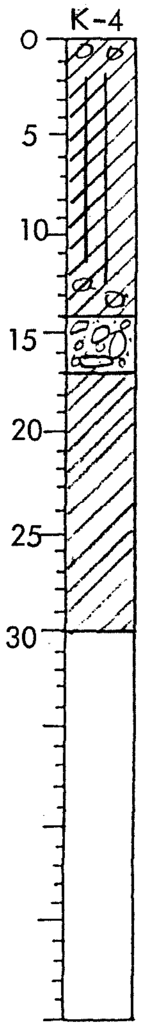
Static Water Elev. Boring Dry



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: September 6, 1985

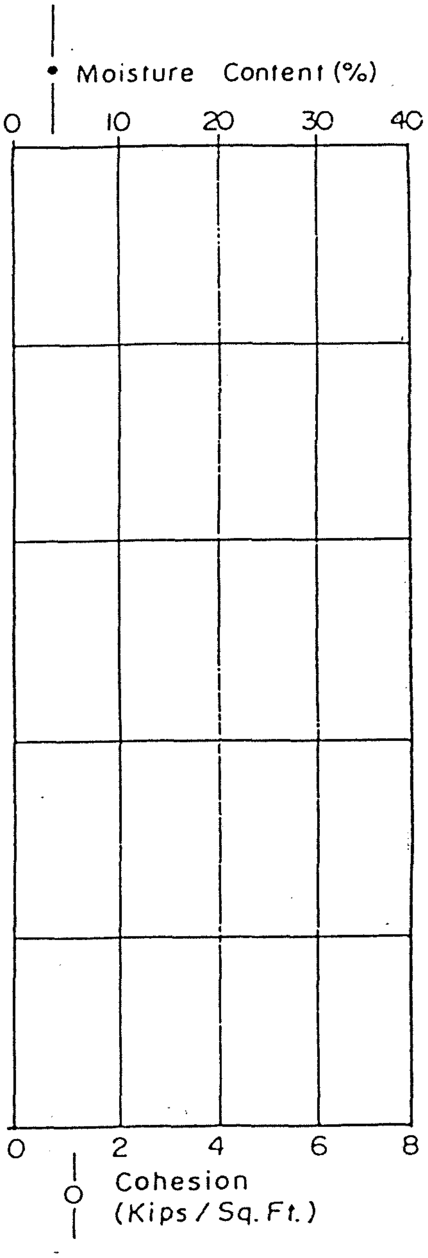


G.S.E. 695.25

Clay, gravelley, brown	CL
... sl. silty, brown	CH/CL
... silty w/trace f. gr. sand	CL
... silty, sandy, gravelley, tan	
Gravel, sandy, silty, clayey, tan	GC
Clay, stiff w/gypsum seams tan & gray	CH

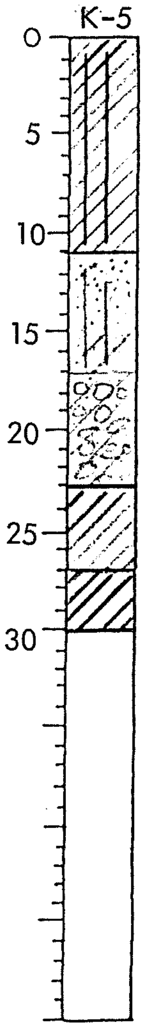
Discontinued @ 30'

Static Water Elev. 682.3



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: September 4, 1985

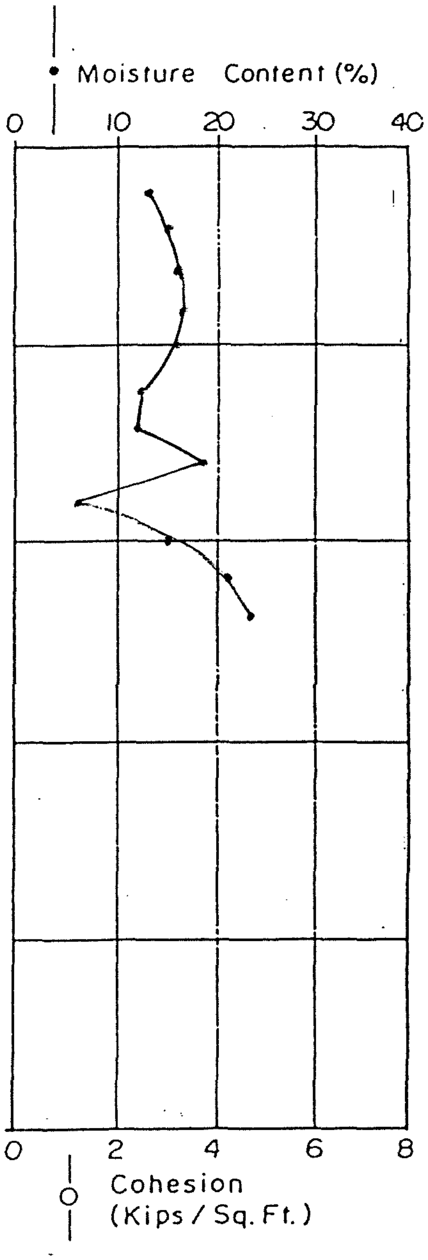


G.S.E. 692.35

Clay, v. silty, brown	CL
... v. silty w/f. gr. sand, lt. brown	
Sand, sl. silty, tan	SM/SP
... silty, sl. clayey	SM/SC
Gravel, sandy, sl. clayey, tan	GW/GC
... sandy, clayey w/cobbles	GC
Clay, stiff w/pyritic stained gypsum seams, tan & gray	CH
Shale, clayey, dk. gray	CH

Discontinued @ 30'

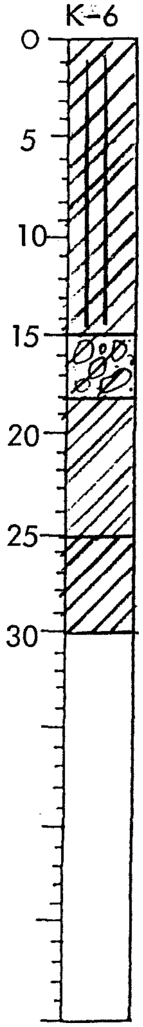
Static Water Elev. 673.4



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: September 6, 1985

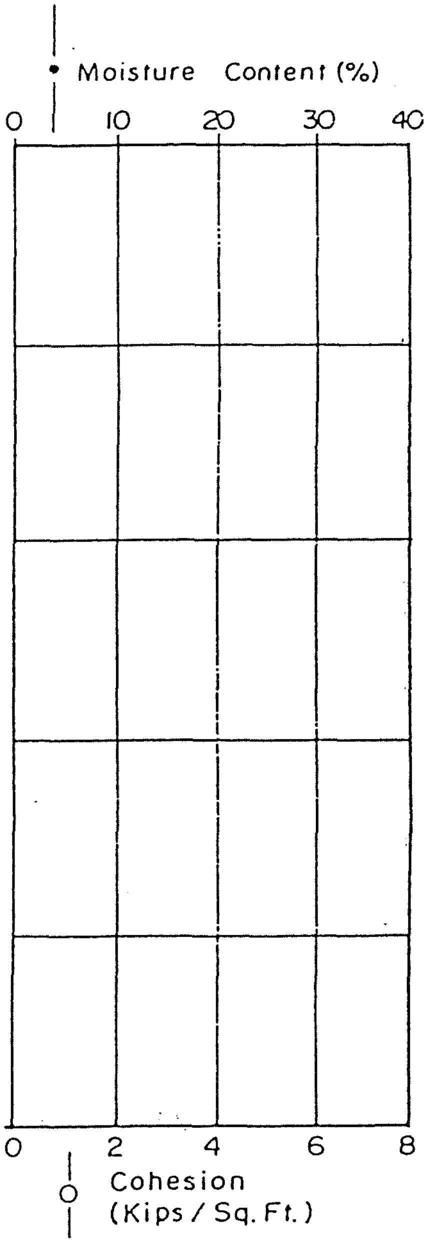


G.S.E. 690.15

Clay, sl. silty, dk. brown	CH
... sl. silty w/trace f. gr. sand	CH/CL
... silty, lt. brown	CL
Gravel, clayey, tan	GC
Clay, stiff, w/gypsum seams tan & gray	CH
Shale, clayey, dk. gray	CH

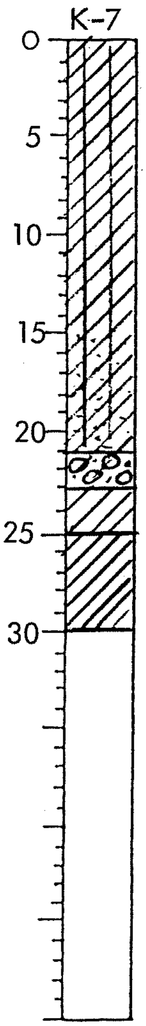
Discontinued @ 30'

Static Water Elev. 674.2



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: September 6, 1985

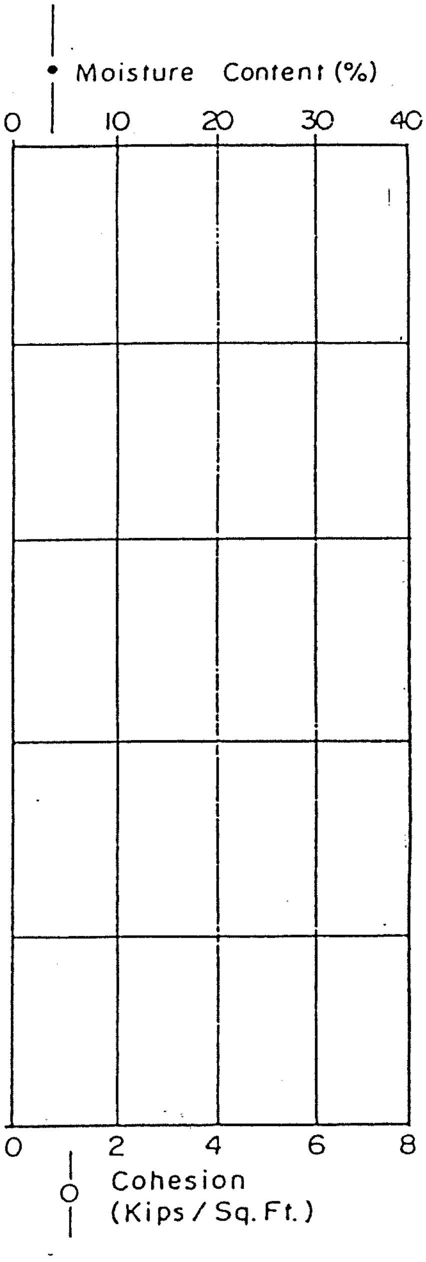


G.S.E. 687.45

Clay, sl. silty, dk. brown	CH
... w/trace f. gr. sand	CH/CL
... silty, lt. brown	CL
... silty, v. sandy, tan	
Gravel, sandy, clayey, tan	GC
Clay, stiff, tan & gray	CH
Shale, clayey, dk. gray	CH

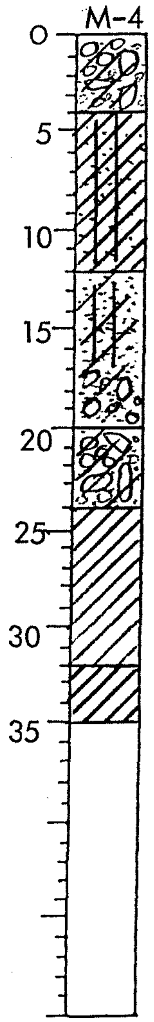
Discontinued @ 30'

Static Water Elev. 670.5



LOG OF BORING

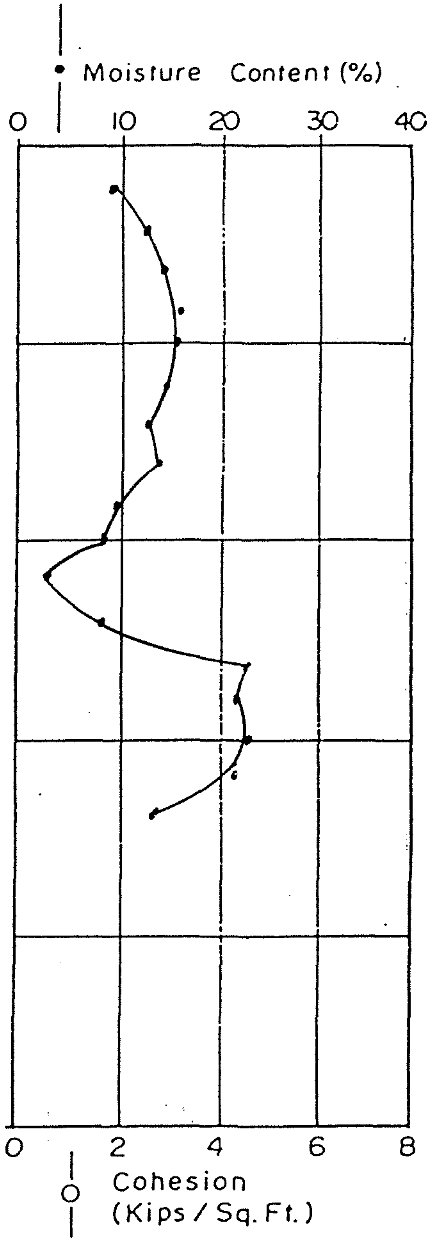
Project Name: Beck Ready Mix, Inc.
Date Drilled: August 29, 1985



G.S.E. 699.44	
Gravel, clayey, brown	GC
sandy, sl. clayey, tan	GP
Clay, silty, sandy, brown	CL
... v. silty, sandy, lt. brown	
... v. silty, v. sandy, tan	CL/SM
Sand, v. silty, sl. clayey, tan	SM
... sl. silty, sl. clayey	SM/SC
... clayey, gravelley	SW/SC
Gravel, sandy, clayey, tan	GC
Clay, stiff, w/gypsum seams, tan & gray	CH
... trace pyritic staining	
Shale, clayey, dk. gray	CH

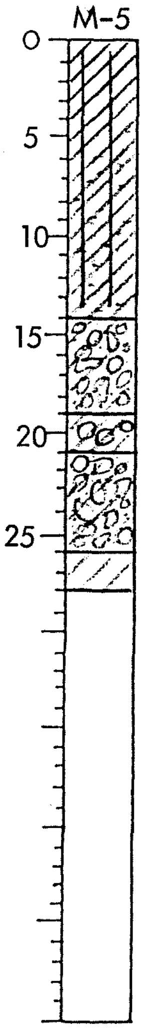
Discontinued @ 35'

Static Water Elev. Boring Dry



LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: September 4, 1985

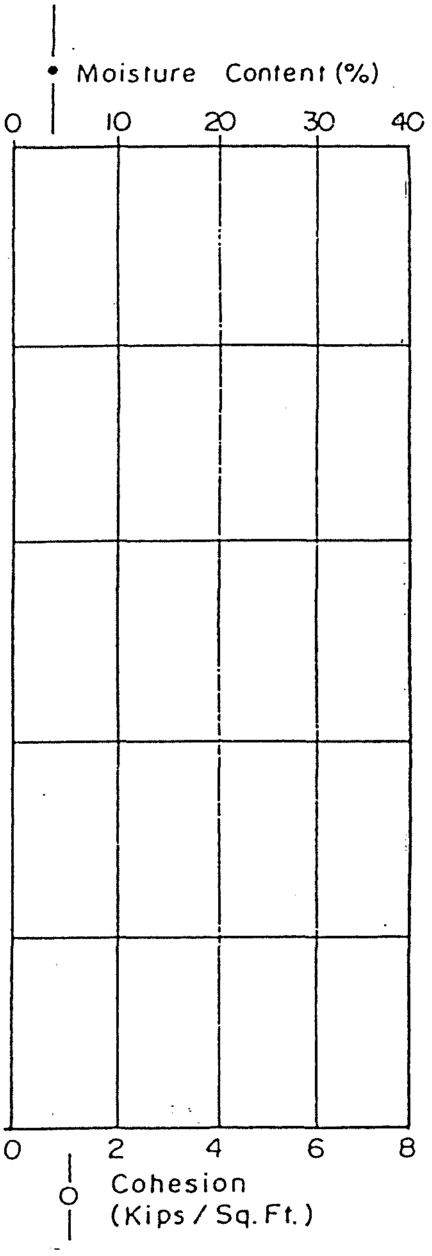


G.S.E. 690.14

Clay, sl. silty, dk. brown	CH/CL
... silty, brown	CL
... silty w/f. gr. sand	
... lt. brown	
Gravel, sandy clayey, tan	GC
... w/cobbles	
Clay, gravelley, tan	CL
Gravel v. clayey w/cobbles	GC
... sandy, sl. clayey tan	GW/GC
Clay, stiff, tan & gray	CH

Discontinued @ 28'

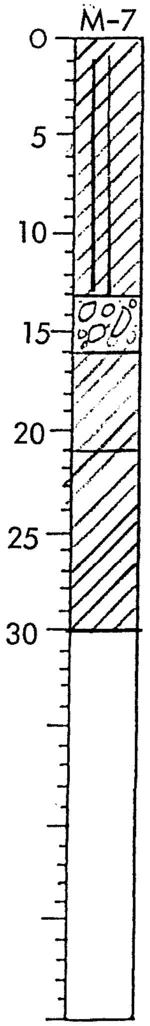
Static Water Elev. 671.1



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Ready Mix, Inc.
Date Drilled: September 4, 1985

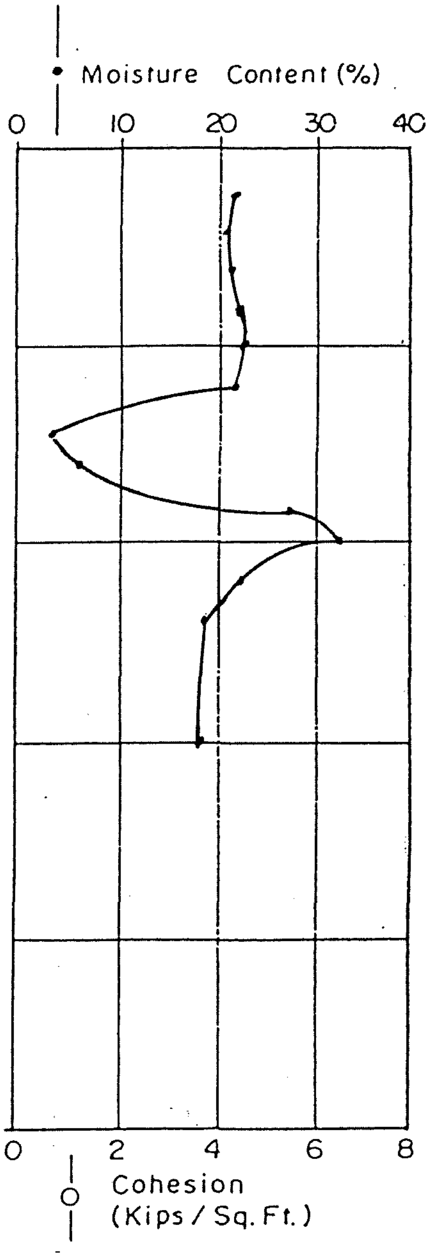


G.S.E. 685.74

Clay, sl. silty, dk. brown	CH
... sl. silty, brown	CH/CL
... silty	CL
... sl. silty	CH/CL
Gravel, sandy, tan	GW
Clay, stiff w/gypsum seams tan & gray	CH
Shale, clayey, dk. gray	CH

Discontinued @ 30'

Static Water Elev. 669.7



UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions			Group Symbols	Typical Names
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	SILTS & CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clay of low plasticity
	SILTS & CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomacous fine sands or silts, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

* Based on the material passing the 3 in. (75 mm) sieve

SUPPLEMENTAL
GEOTECHNICAL INVESTIGATION
BECK READYMIX CONCRETE COMPANY
F.M. 78
SCHERTZ, TEXAS
PROJECT #5108
DECEMBER, 1987
ATTACHMENT 11 SUPPLEMENT

INVESTIGATION

Supplemental soil borings have been excavated to enhance the initial Attachment 11 Geotechnical Investigation. The borings were each for one of three purposes, 1.) To define the aerial extent of known solid waste deposits, 2.) To provide additional soil data along the projected slurry trench wall alignment, or 3.) Deepened into shale strata at certain locations.

All additional investigation conformed to the requirements of the original investigation, and are intended only to provide a greater degree of subsurface condition comprehension. No conditions differing from or discrepancies from the original investigation were noted.

The additional borings have been overlayed upon the original Boring Plan as included within this supplement preceeding the additional boring logs. A graphic depiction of the aerial extent, of both the Randolph Fill and the Beck Fill as of the end of November, 1987, is also included.

HYDROLOGY AND GROUNDWATER GRADIENT

The discussion within is not derived necessarily from the excavation of supplemental soils borings but is rather an enhanced dissertation for clerical consideration. It thus does not replace the original text or any specific circumstances as stated there in, but simply facilitates greater informational availability.

The alluvial aquifer as referenced in the original report, is comprised primarily of the sand and gravel deposits that overlie the clays and shales beneath this site. The current groundwater gradient is generally to the north east with all subsurface waters migrating to the eastern property line with concentration along previous channels and/or historic paths of Cibolo Creek.

Cibolo Creek, as it currently exists, serves as a type of groundwater divide within the alluvial aquifer. Pleistocene segments of the aquifer south of the project site are primarily recharged by Cibolo Creek and other sources as is the Halocene segment immediately beneath the site and extending eastward parallel to F.M. 78. The alluvial aquifer beneath this project and the continuation which extends eastward approximately 1200 to 1500 feet to the next downstream oxbow bend of Cibolo Creek, are thus considered as an isolated and largely independent Halocene unit. The water of Cibolo Creek that recharge the saturated zone beneath this site, though not the sole source of recharge, migrate from recharge at Cibolo Creek, to discharge at Cibolo Creek, and are within predominate Halocene age deposits. Any existing water wells within the proximity of the project would be completed in Pleistocene age deposits and thus be unrelated to the water beneath this project.

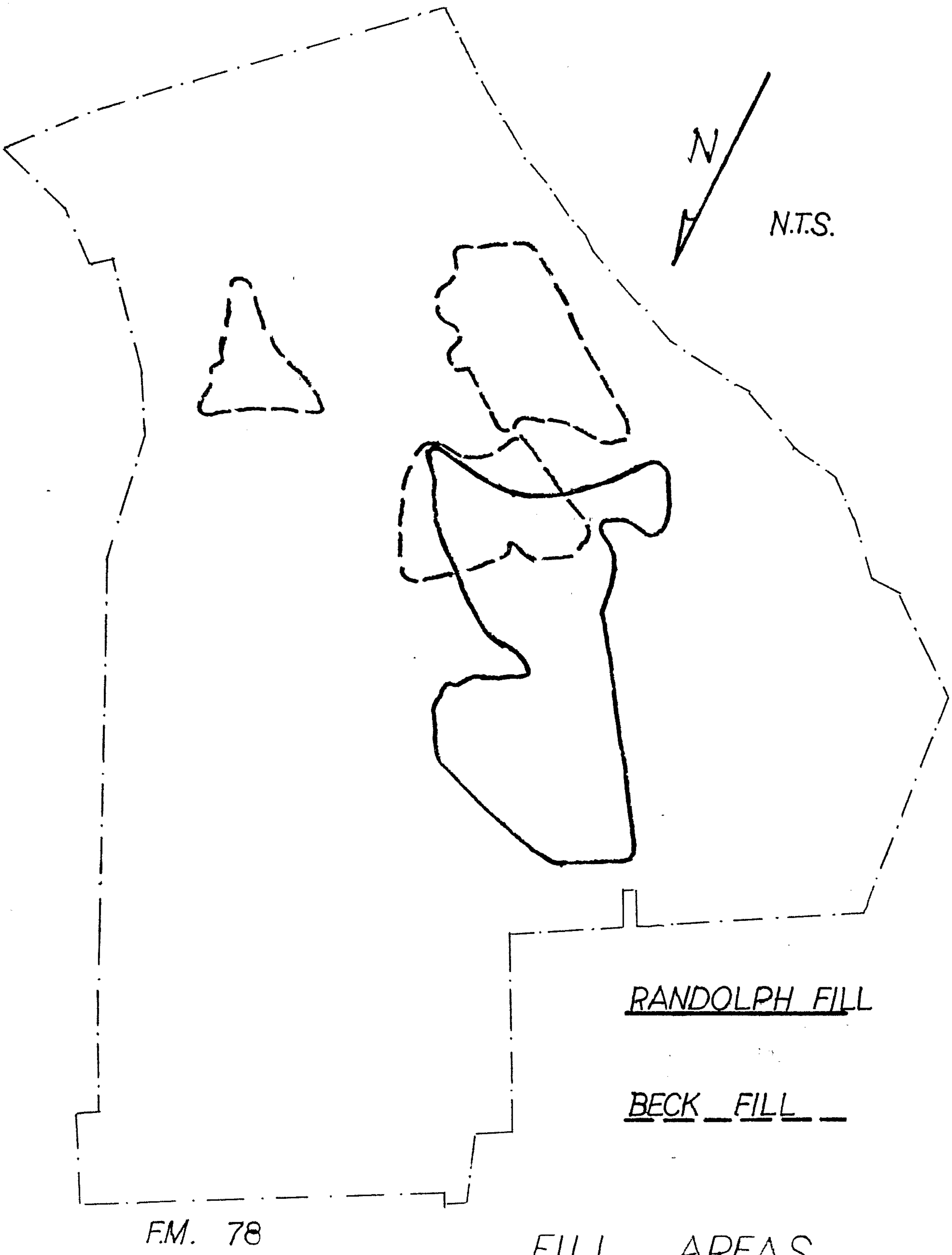
As with most alluvial aquifers, permeability and porosity are each rather high. Flood water along Cibolo Creek as well as some basil flow, is transmitted to the gravel deposits. Discharge immediately following a flood state will occasionally within upper storage limits, reverse gradational flow and discharge back to their source as such affords less resistance, other waters being transmitted by the gravel deposits basically enter the deposits along the south and western property lines and migrate to the eastern property line. Saturation limits of the gravel deposits and basil flows predominately within creek channels cut into clay and shale deposits, dictate much of the flow associated with Cibolo Creek to remain within the creek proper for the majority of the year. Dynamic head characteristics thus do not exist though some static level variations will occur corresponding to periods of flood condition.

The implementation of the soil-bentonite slurry trench wall and groundwater monitoring programs as detailed within other attachments and/or the Site Development Plan, are provisions to insure the integrity of the existing alluvial aquifer by disallowing any contact between current subsurface waters and the deposited solid waste. The slurry wall containment design precludes the infiltration and/or exfiltration of subsurface water in or out of the waste body. The implementation of the slurry trench will however impact to some extent the subsurface migration of water.

Those waters of Cibolo Creek that currently recharge gravel deposits along the southern and western portion of the site will be redirected by contact with the slurry wall when constructed. As recharge predominately occurs during a flood stage, the accompanying flood control dike will disallow contact with the receiving bodies of gravel thus affording a positive or favorable condition. The typical migration and recharge/discharge of groundwater, as currently occurring, will be detered by the slurry wall back to Cibolo Creek affording

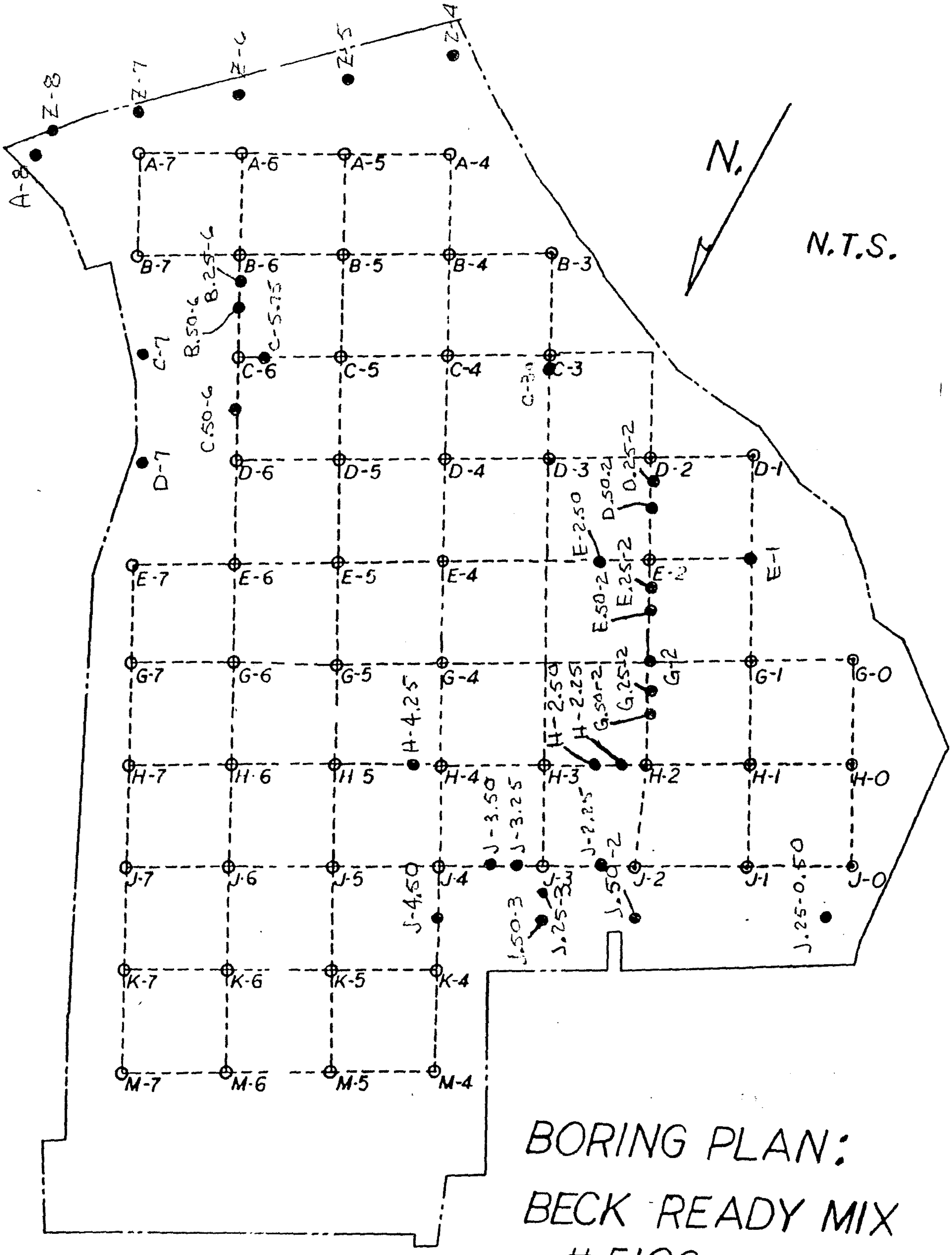
affording only a negliable increase of typical flow and well within basil levels. A slightly increased zone of saturation and/or enhanced subsurface flow parallel to the northern slurry trench wall outside of the waste body is possible. A monitor well is proposed for this northern area as a provision of quality assurance.

The installation of the slurry trench and development of the landfill as proposed, will additionally eliminate leachate migration that may possibly be occurring from the existing Randolph fills. In terms of groundwater and aquifer protection, the landfill development should be viewed as not creating any detectable changes with in the existing subsurface water systems.



FILL AREAS
NOVEMBER 1987

SNOWDEN, INC.

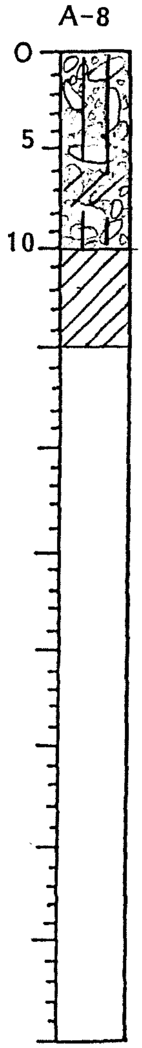


BORING PLAN:
BECK READY MIX
#5108

SNOWDEN, INC.

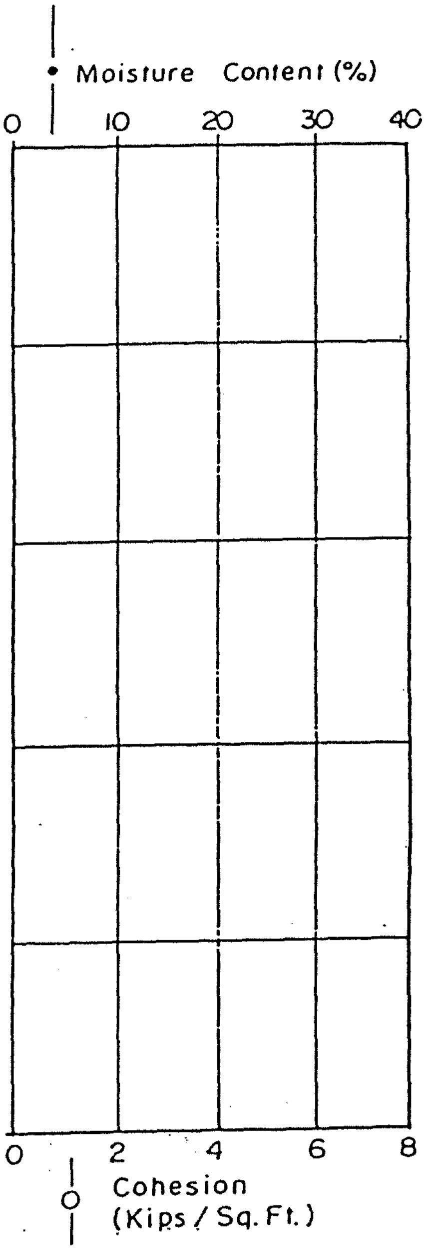
LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: September 28, 1987



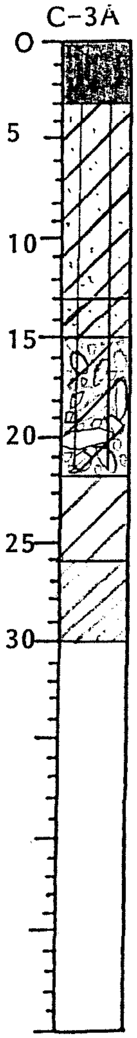
Gravel, silty, sandy, brown	GM
...sandy, clayey, dk. brown	GC
...silty, sandy, tan	GP/GM
Shale, clayey, dk. gray	CH

Discontinued @ 15'



LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: September 28, 1987



Trash (recent) w/clay, dk. gray

Clay, fill, silty, sandy, lt. brown CL

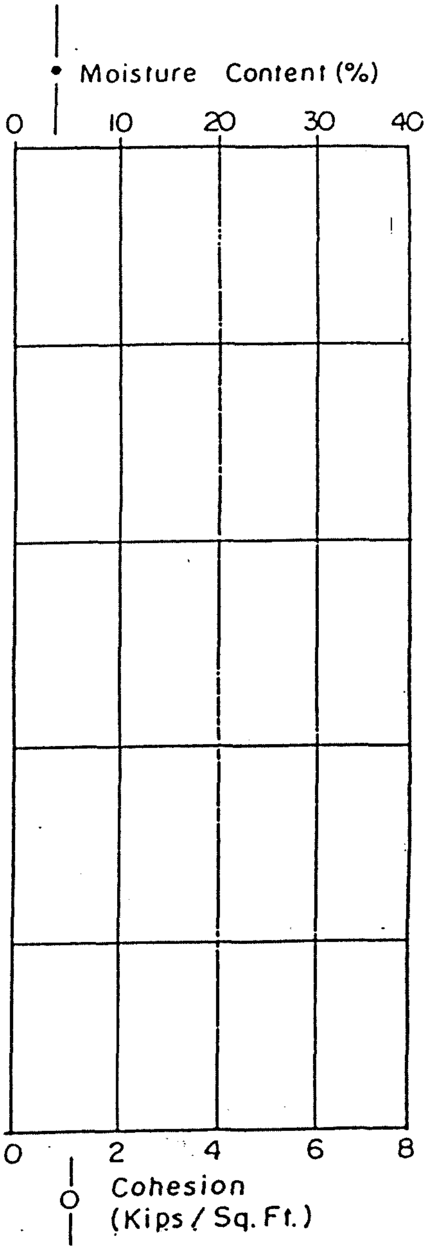
Clay, silty, brown CL

Gravel, silty, clayey, brown GC/GM

Clay, stiff w/pyrite stain seams
tan & gray CH

Shale, clayey, dk. gray CH

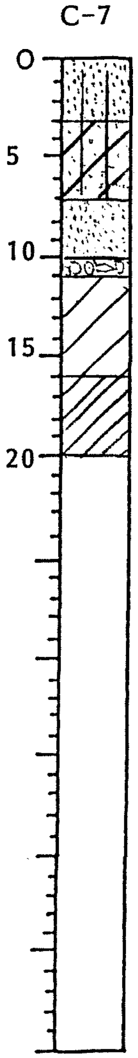
Discontinued @ 30'
Static Water Elevation ± 675.8



SNOWDEN, INC.

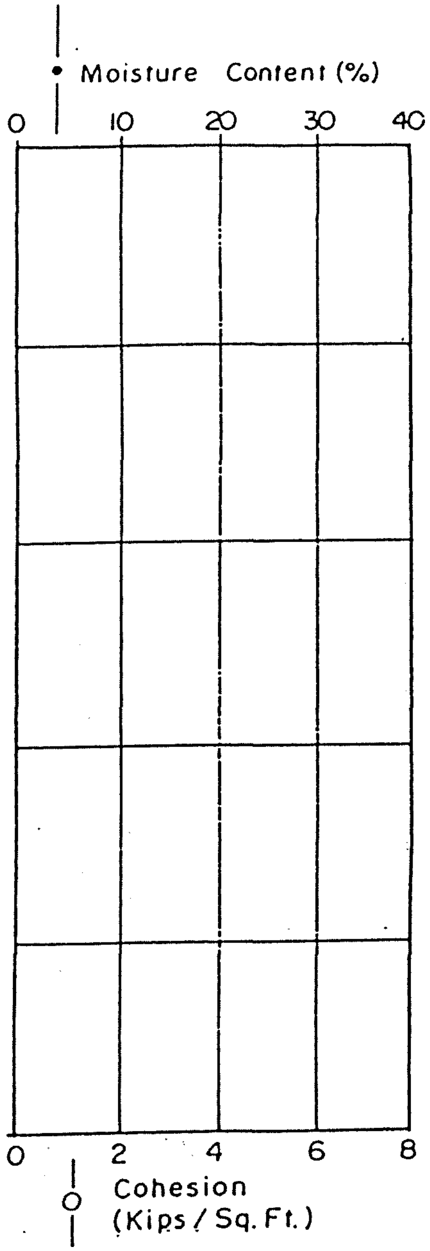
LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: September 28, 1987



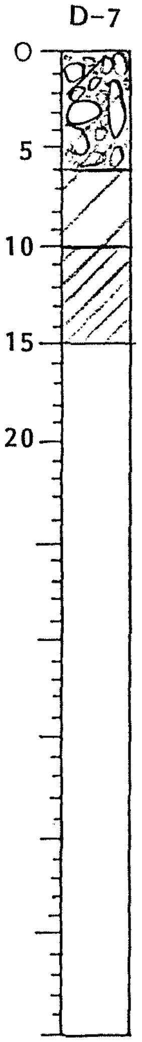
Sand, silty, tan	SM
Clay, silty, sandy, brown	CL
Sand, f. grain, tan	SP
Gravel, sandy, clayey, tan	GC
Clay, stiff, w/gypsum seams tan & gray	CH
Shale, clayey, dk. gray	CH

Discontinued @ 20'
Boring Dry



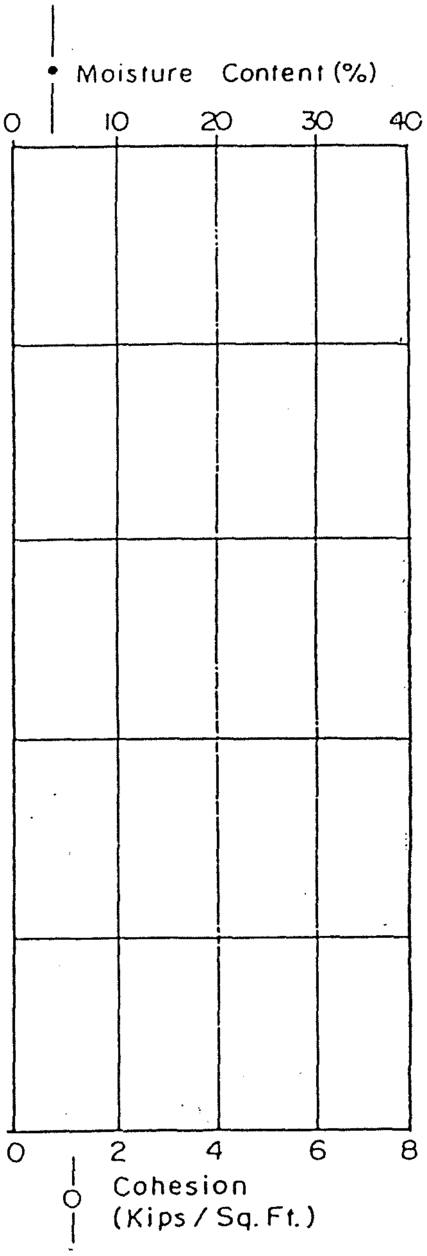
LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: September 28, 1987



Gravel, sl. clayey, tan	GC/GP
Clay, stiff, tan & gray ...tan & dk. gray	CH
Shale, clayey, dk. gray	CH

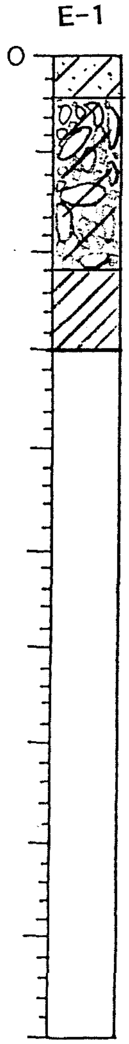
Discontinued @ 15'
Boring Dry



SNOWDEN, INC.

LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: September 28, 1987

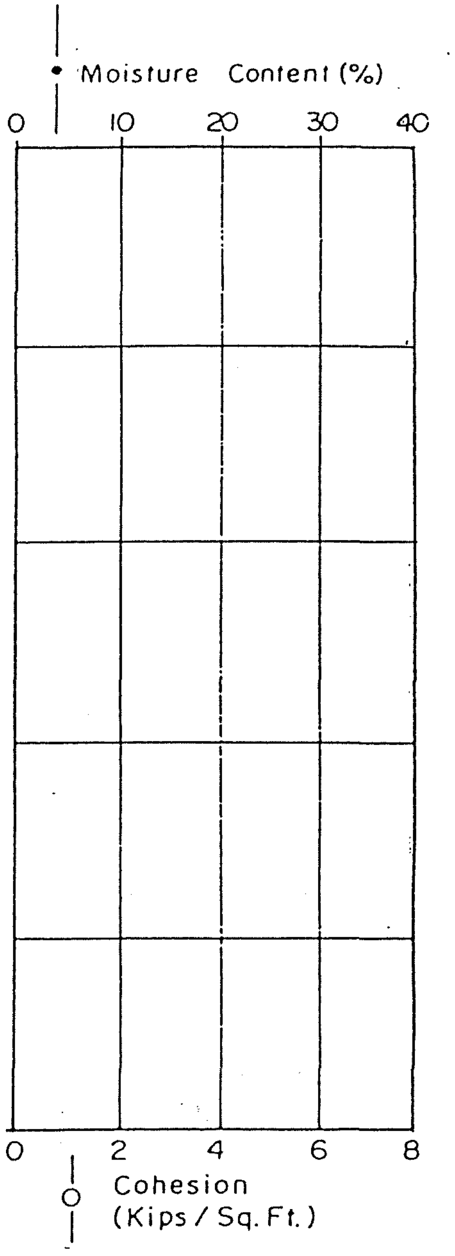


Clay, sandy, dk. brown CL

Gravel, sl. clayey, tan GC/GP

Shale, clayey, dk. gray CH

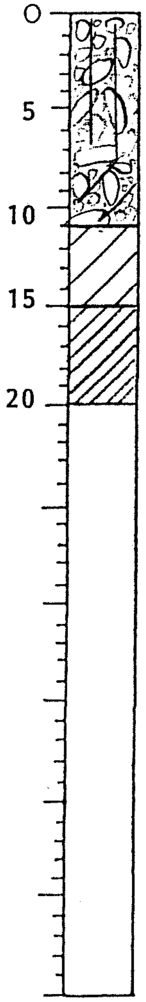
Discontinued @ 15'



LOG OF BORING

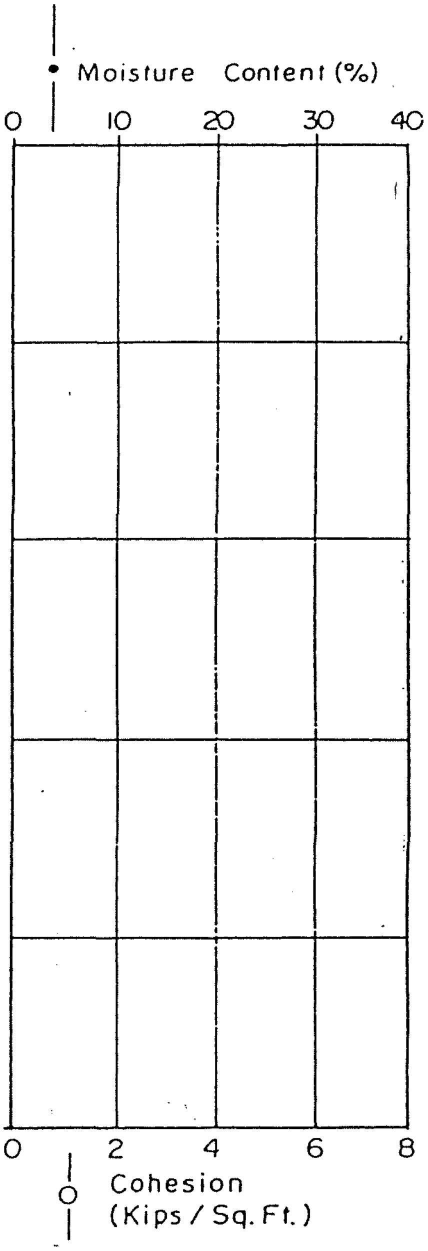
Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: September 28, 1987

J.25-0.50



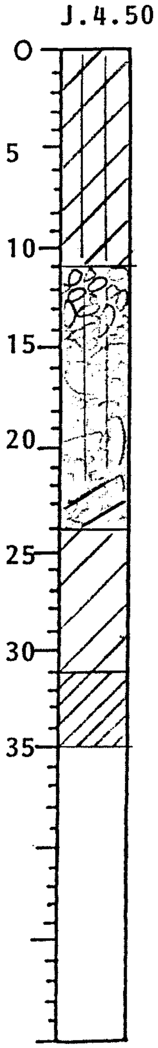
Gravel, sl. silty w/cobbles, lt. brown	GM/GP
...sl. clayey, brown	GC
Clay, stiff, tan & gray	CH
...tan & dk. gray	
Shale, clayey, dk. gray	CH

Discontinued @ 20'



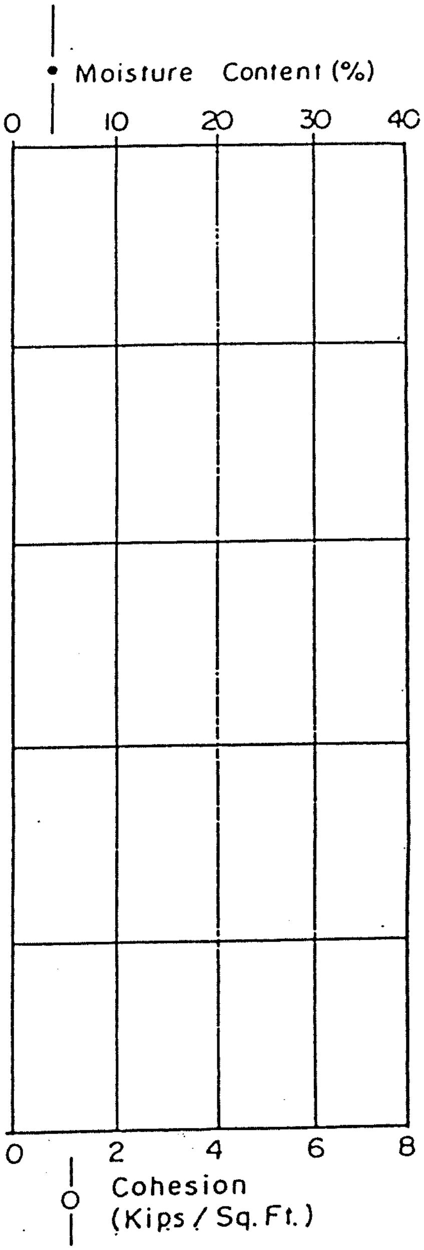
LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: September 28, 1987



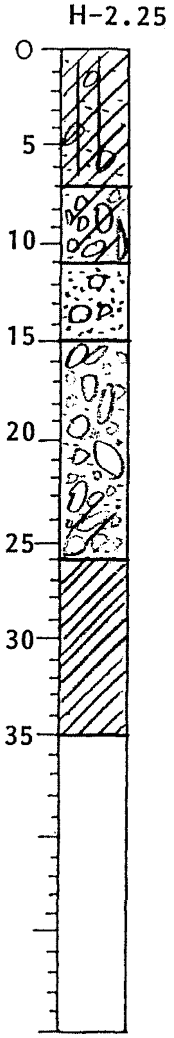
Clay, silty, sl. sandy, brown	CL
...v. silty, lt. brown	CL
Gravel, silty, tan	GM/GP
...sl. clayey, tan	GC
Clay, stiff w/gypsum seams tan & gray	CH
...tan & dk. gray	
Shale, clayey, dk. gray	CH

Discontinued @ 35'
Static Water Elevation ± 678.3



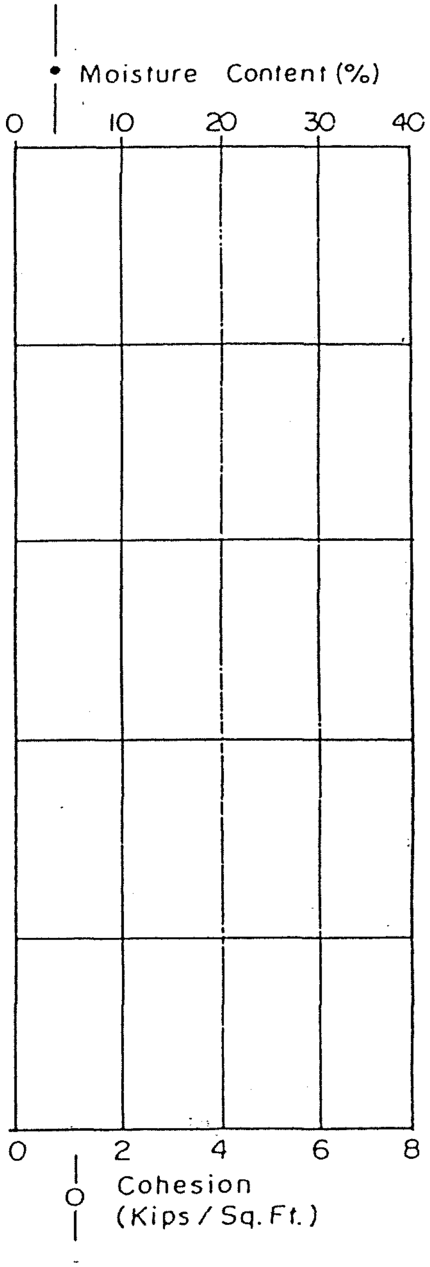
LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 10, 1987



Clay, silty, sandy, gravelley, brown	CL
Gravel, sandy, clayey, lt. brown	GC/GP
Sand, gravelley, tan	SW
Gravel, sandy, w/cobbles, tan	GP
...clayey, lt. brown	GC
Clay, w/gypsum seams & pyrite stain, tan & gray	CH

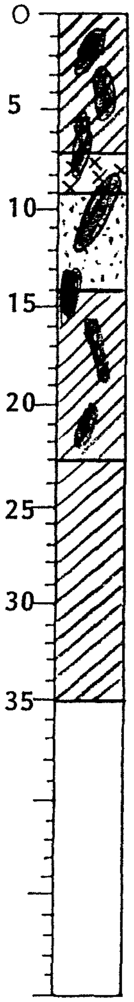
Discontinued @ 35'



LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 10, 1987

H-2.50



Clay, fill w/brick & concrete, dk. brown — CH

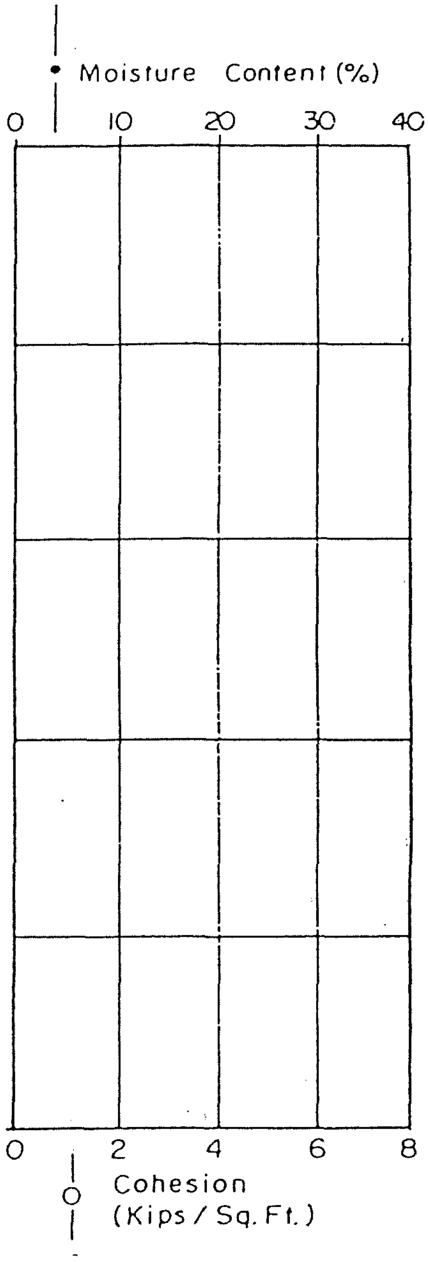
Gypsum w/wire, white — ML

Sand, fill w/metal & tile, tan — SP

Clay, fill w/wood, dk. gray — CH/CL

Clay w/gypsum seams & pyrite stain joint, tan & gray — CH

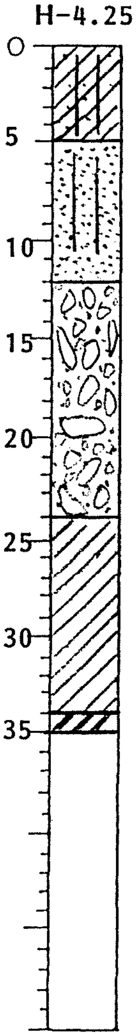
Discontinued @ 35'



SNOWDEN, INC.

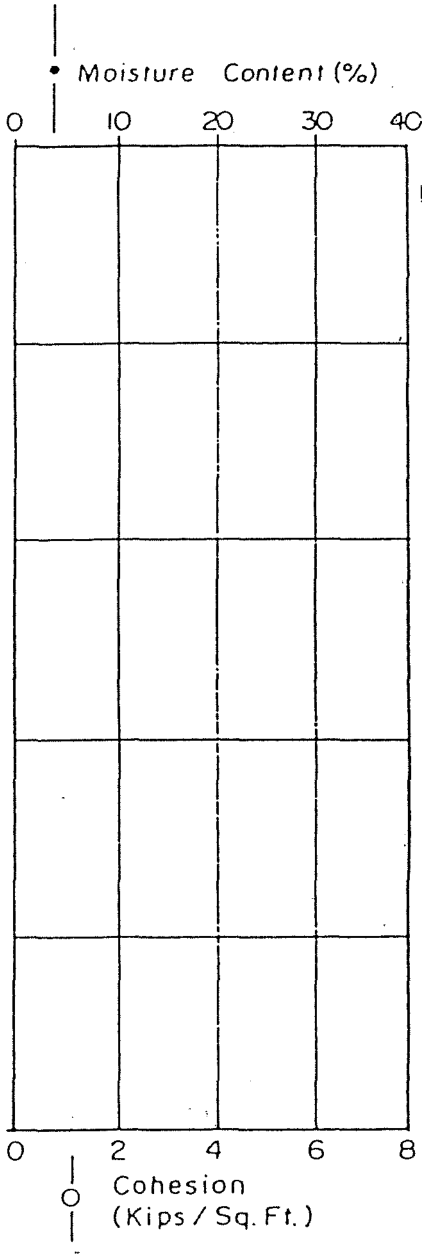
LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 10, 1987



Clay, silty, sandy, brown ...lt. brown	CL
Sand, silty, lt. red, tan	SM
Gravel, sandy w/cobbles, lt. brown	GP
Clay w/gypsum seams & pyrite stain joint, tan & gray	CH
Shale, clayey, dk. gray	CH

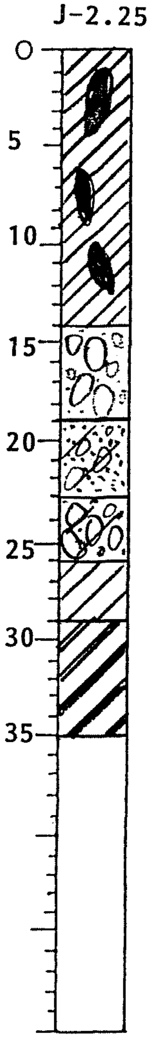
Discontinued @ 35'



SNOWDEN, INC.

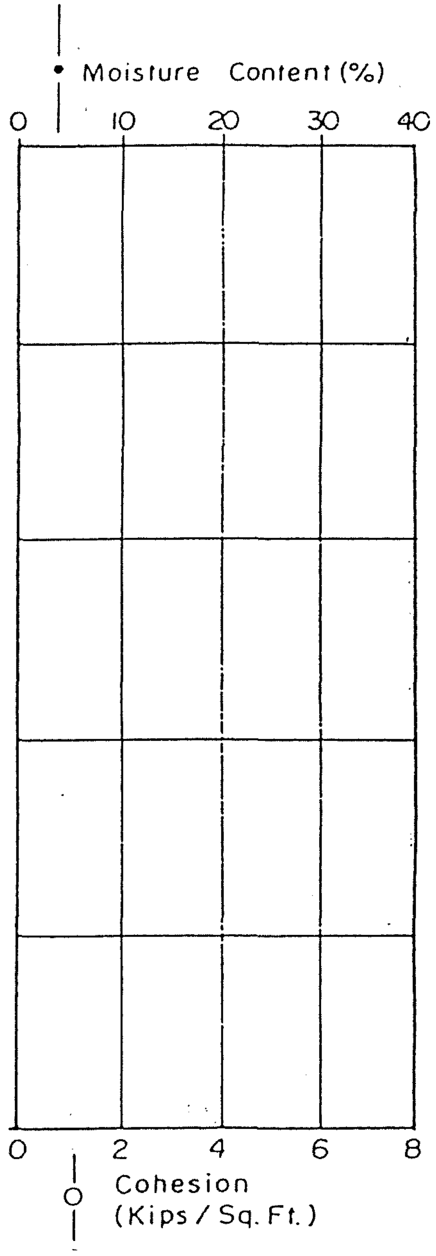
LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 10, 1987



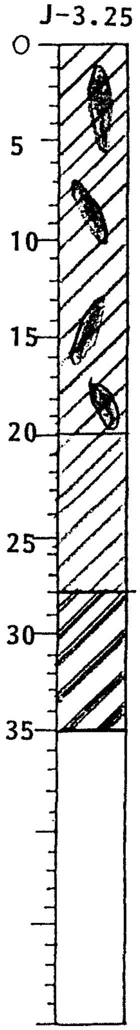
Clay, fill w/organics & metal, brown	CL
...w/glass, dk. gray	CH/CL
...v.sandy w/organics	CH/SC
Gravel, sandy, clayey w/cobbles lt. brown	GC/GP
Sand, v. clayey, gravelley, tan	SC
Gravel, v. clayey w/cobbles, tan	GC
Clay, jointed, tan & gray	CH
Shale, clayey, dk. gray	CH

Discontinued @ 35'



LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 10, 1987



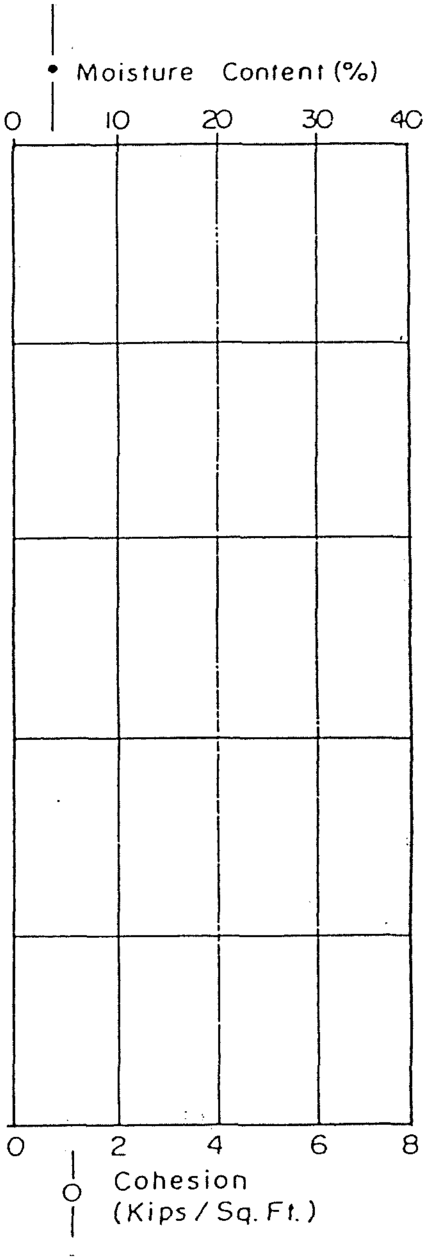
Clay, fill w/metal, brown CL

...w/organics, dk. brown
...dk. gray CH/CL

Clay w/gypsum seams & pyrite stain joint, tan & gray CH

Shale, clayey, dk. gray CH
...sl. clayey

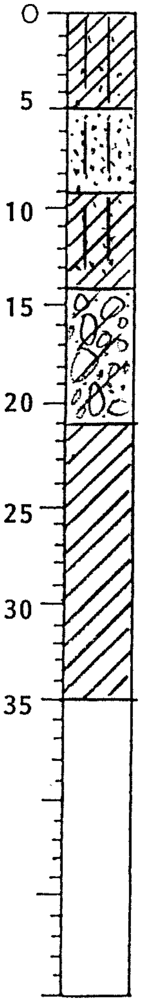
Discontinued @ 35'



LOG OF BORING

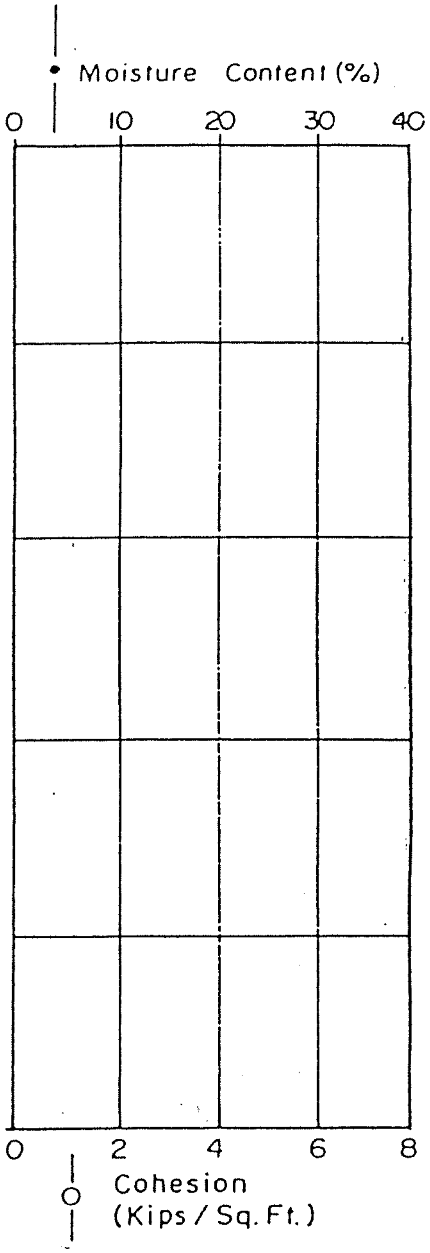
Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 10, 1987

J-3.50



Clay, silty, sandy, brown	CL
Sand, silty, clayey, lt. brown	SM/SC
Clay, silty, sandy, lt. brown	CL
Gravel, sandy, clayey w/cobbles, lt. brown	GC
Clay w/gypsum seams & pyrite stain joint, tan & gray	CH

Discontinued @ 35'

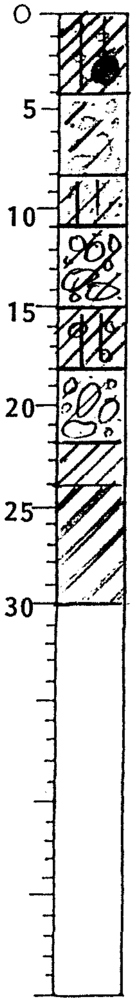


SNOWDEN, INC.

LOG OF BORING

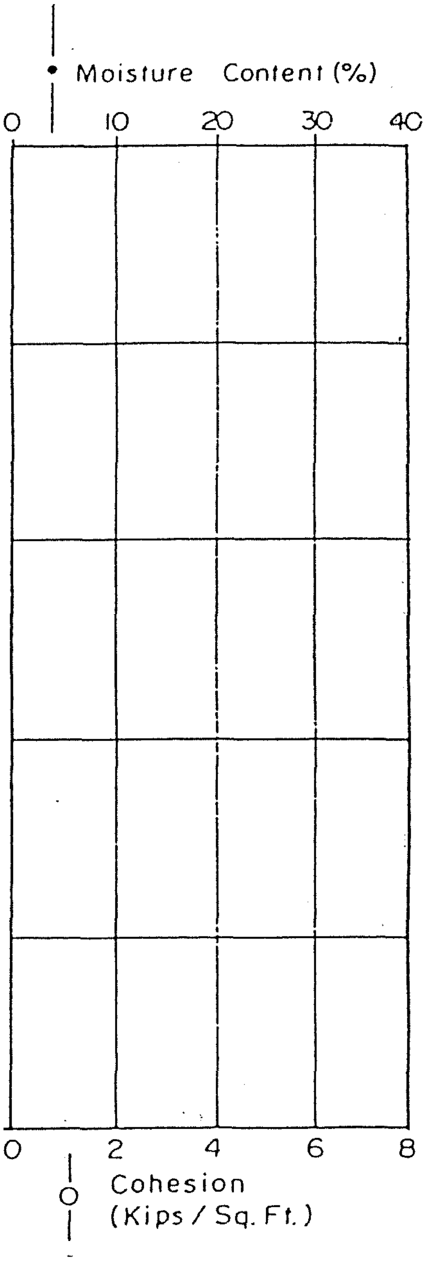
Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 10, 1987

D.25-2



Clay, fill w/some trash bags, brown	CL
Gravel, clayey, lt. brown	GC
Sand, sl. clayey, lt. brown	SP/SC
Gravel, clayey w/cobbles, tan	GC
Clay, silty, gravelley, lt. brown	CL
Gravel, clayey, w/cobbles, tan	GC
Clay, jointed, tan & gray	CH
Shale, sl. clayey, dk. gray	CH

Discontinued @ 30'

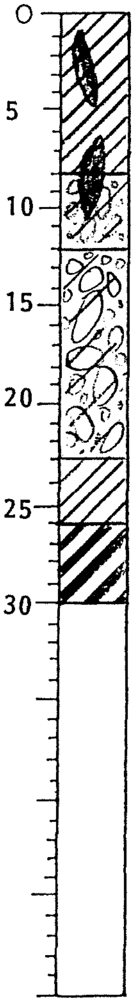


SNOWDEN, INC.

LOG OF BORING

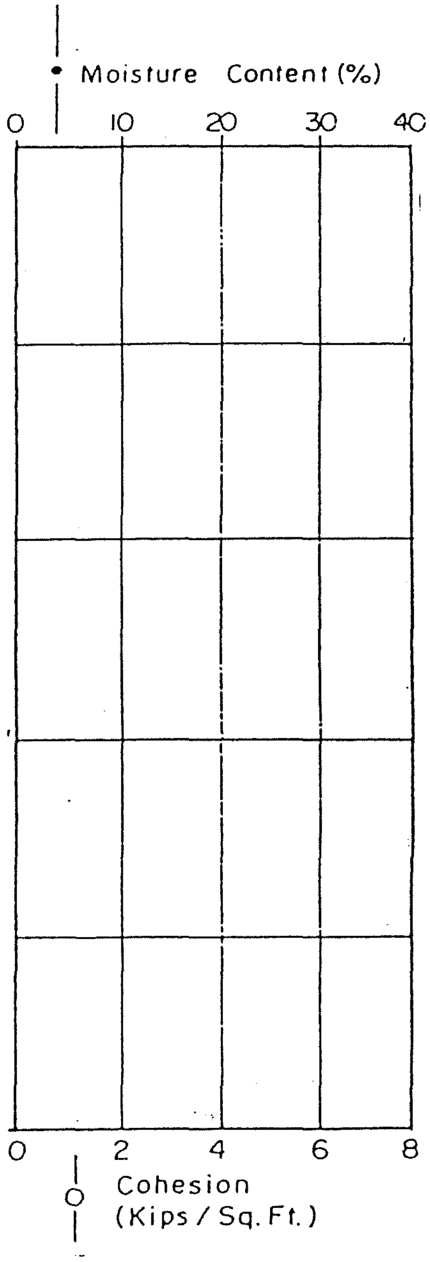
Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 10, 1987

D.50-2



Clay, fill w/plaster, lt. tan	CL
...w/incinerated wood & metal dk. gray	CH/CL
Gravel, fill, clayey w/metal, gray	GC
Gravel, sandy, clayey w/cobbles tan	GP/GC
...	GC
Clay, jointed, tan & gray	CH
Shale, clayey, dk. gray	CH

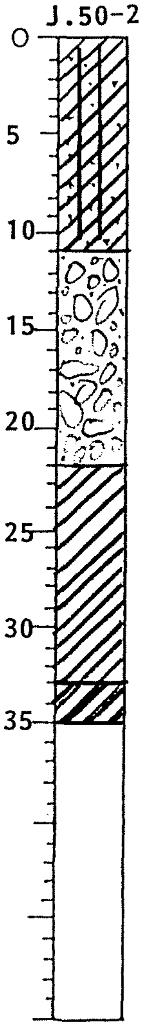
Discontinued @ 30'



SNOWDEN, INC.

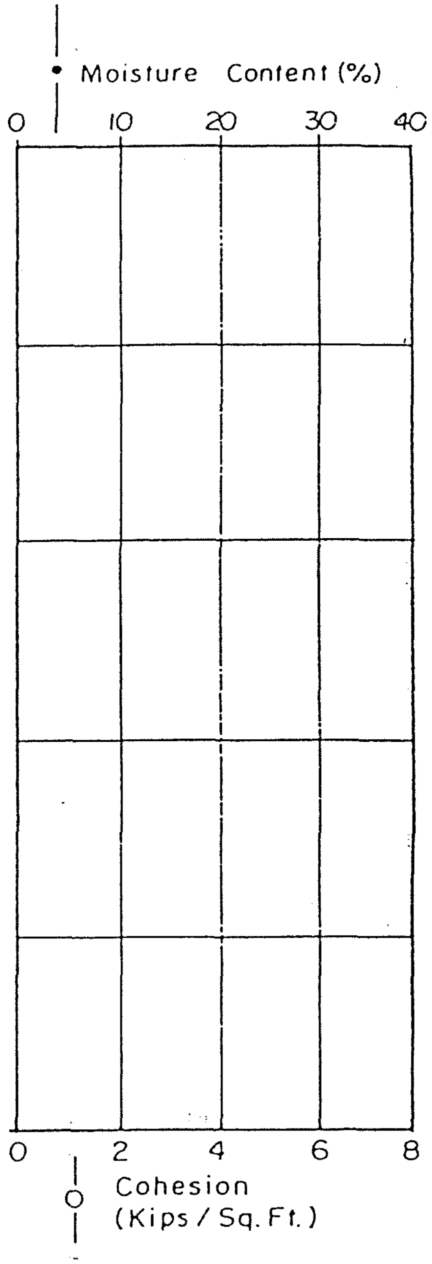
LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987



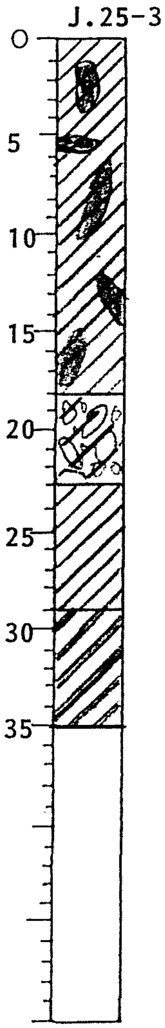
Clay, silty, sandy, brown	CL
...v. silty, lt. brown	CL/ML
...silty, sandy	CL
Gravel, sandy, w/cobbles, tan	GP
...clayey w/cobbles	GC
Clay w/gypsum seams & pyrite stain joint, tan & gray	CH
...tan & dk. gray	
Shale, sl. clayey, dk. gray	CH

Discontinued @ 35'



LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987



Clay, fill, w/broken asphalt CL
...w/metal & glass, brown
...w/organics & wire, dk. gray

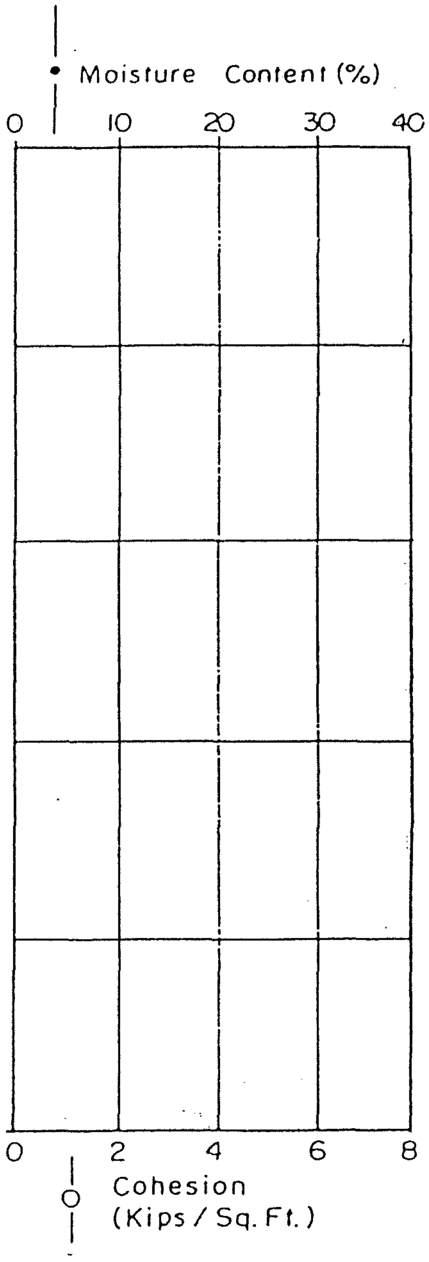
...w/wood & metal CH/CL

Gravel, clayey, tan GC

Clay, w/gypsum seams & pyrite stain joints, tan & gray CH

Shale, clayey, dk. gray CH
...sl. clayey

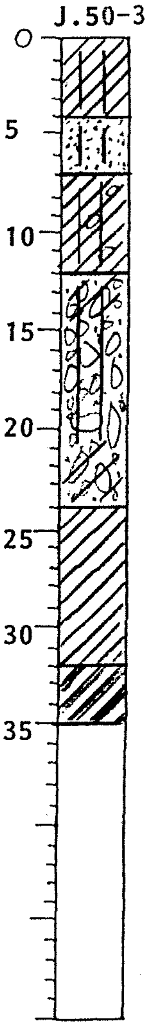
Discontinued @ 35'



SNOWDEN, INC.

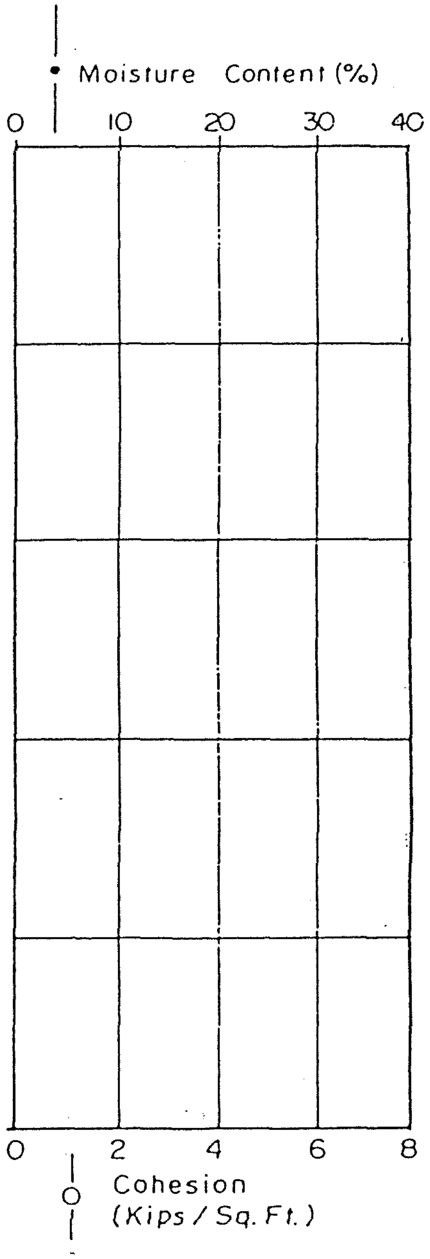
LOG OF BORING

Project Name: Beck Ready Mix Concrete Co., #5108
Date Drilled: November 11, 1987



Clay, silty, sandy, brown	CL
Sand, silty, lt. brown	SM
Clay, silty, trace gravel, lt. brown	CL
Gravel, silty, sandy, clayey lt. brown	GC
...w/cobbles, tan	GM/GP
...clayey w/cobbles, tan	GP/GC
Clay w/gypsum seams & pyrite stain joint, tan & gray	CH
Shale, clayey, dk. gray	CH

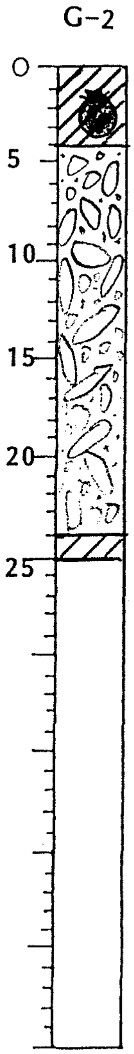
Discontinued @ 35'



SNOWDEN, INC.

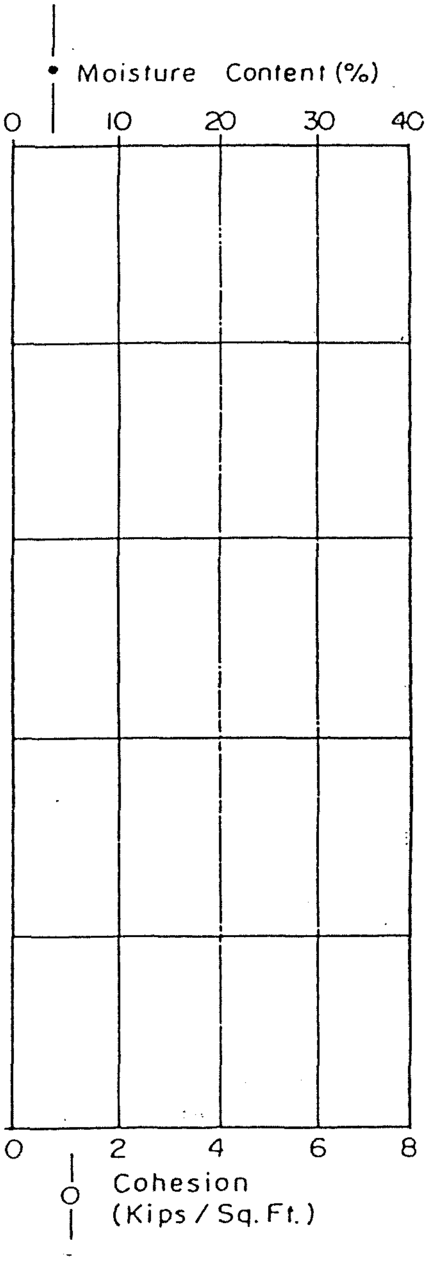
LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987



Clay, fill w/trash bags, brown	CL
Gravel, silty w/cobbles brown ...silty, sandy, tan	GM
...sandy w/cobbles	GW
...sl. clayey w/cobbles	GC/GP
Clay, jointed, tan & gray	CH

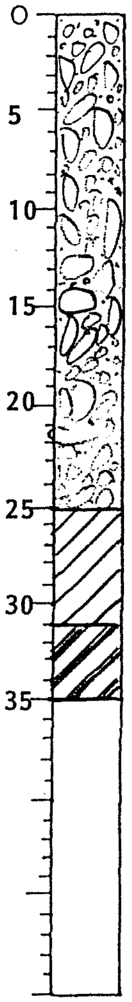
Discontinued @ 25'



LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987

G.25-2



Gravel, silty, sandy w/cobbles lt. brown GM

...tan

...sl. clayey GC/GW

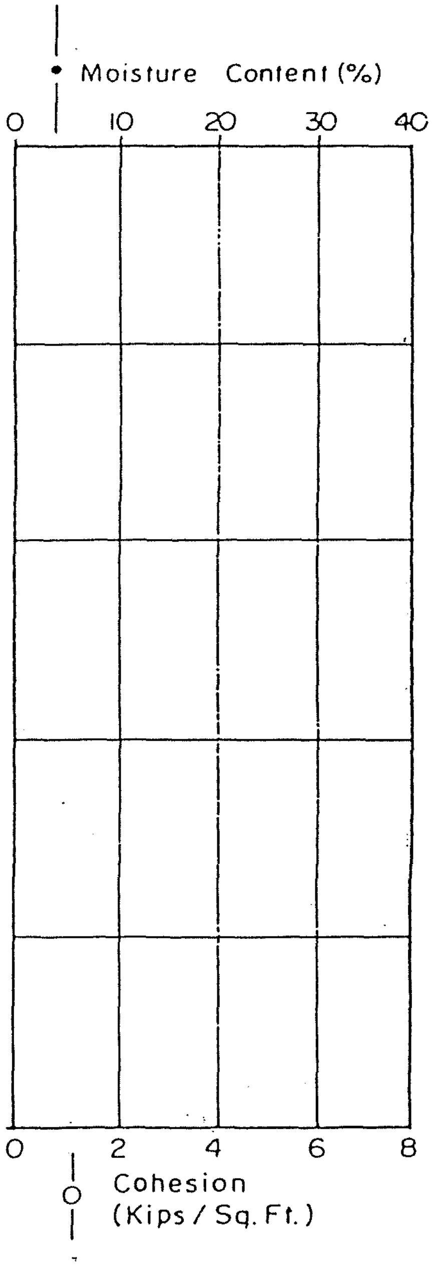
...sandy w/cobbles GW

...clayey w/cobbles GC

Clay w/gypsum seams & pyrite stain joint, tan & gray CH

Shale, sl. clayey, dk. gray CH

Discontinued @ 35'

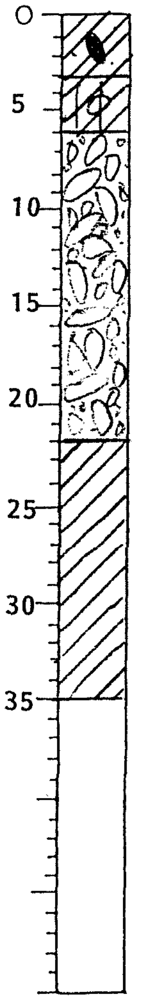


SNOWDEN, INC.

LOG OF BORING

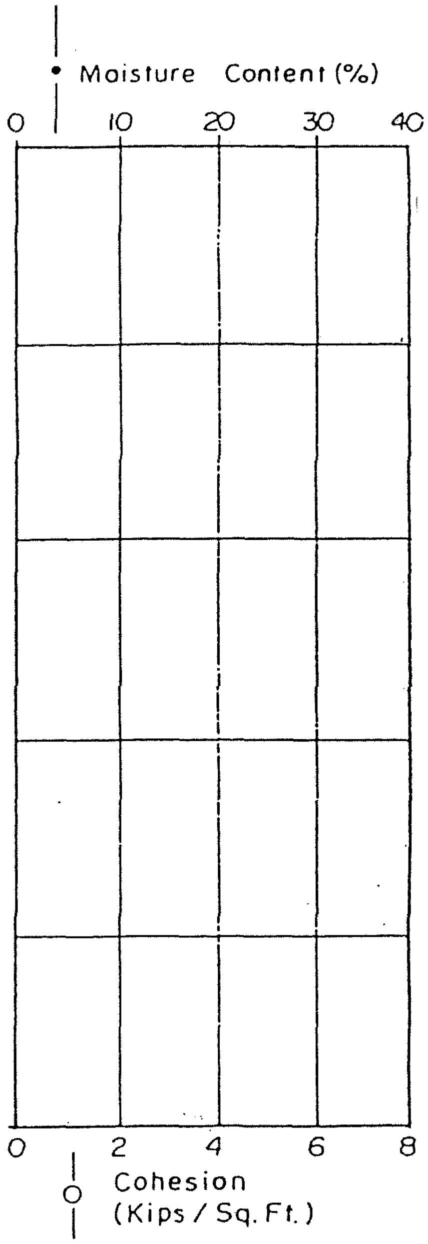
Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987

G.50-2



Clay, fill w/wood, brown	CL
Clay, silty, w/cobbles, lt. brown	CL
Gravel, silty, sandy w/cobbles lt. brown	GM/GP
...sl. clayey, tan	GC/GW
...clayey, tan	GC
...sandy w/cobbles	GW
Clay w/gypsum seams & pyrite stain joint, tan & gray	CH

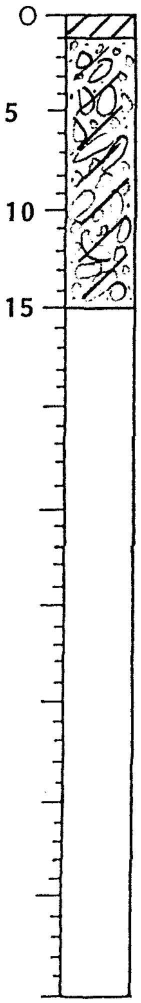
Discontinued @ 35'



LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987

E.25-2

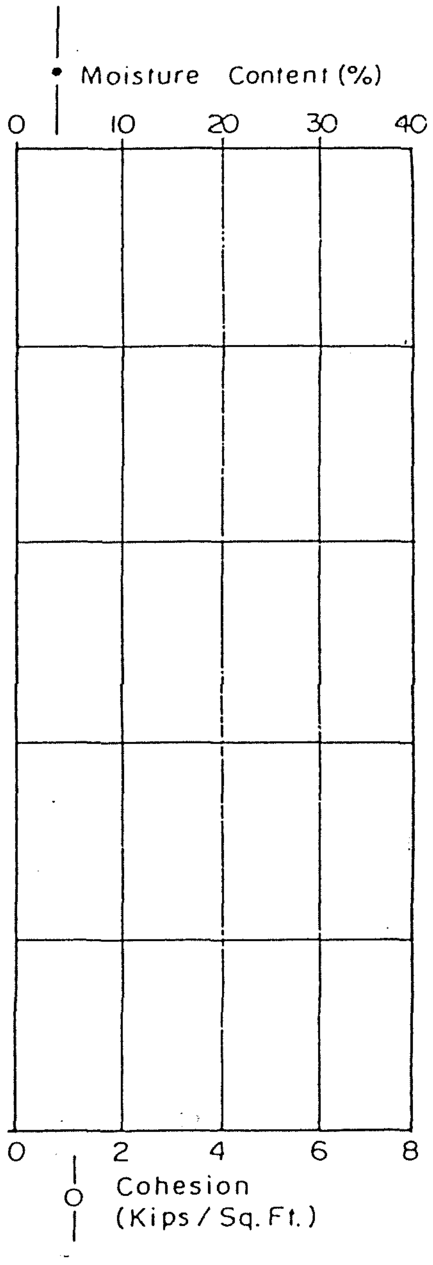


Clay, sandy, lt. brown CL

Gravel, sandy, clayey w/cobbles
lt. brown GC
...sandy, tan GW

...sl. clayey GW/GC

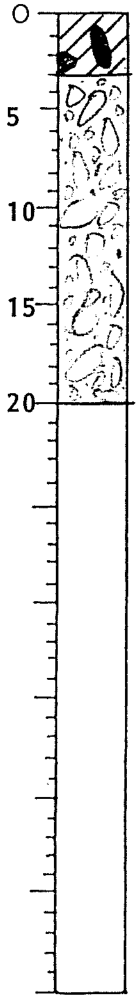
Discontinued @ 15'



LOG OF BORING

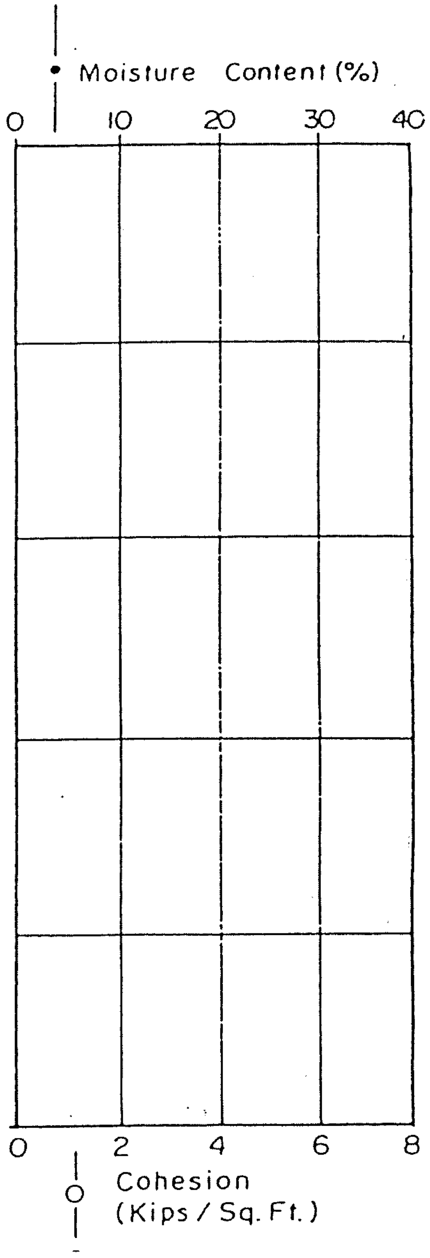
Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987

E.50-2



Clay, fill w/plastic & metal, brown	CL
Gravel, sandy, clayey w/cobbles brown	GC/GW
...sandy w/cobbles, tan	GW

Discontinued @ 20'

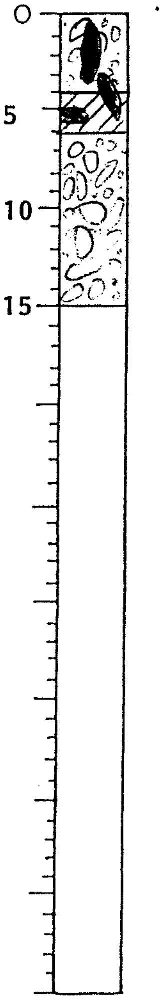


SNOWDEN, INC.

LOG OF BORING

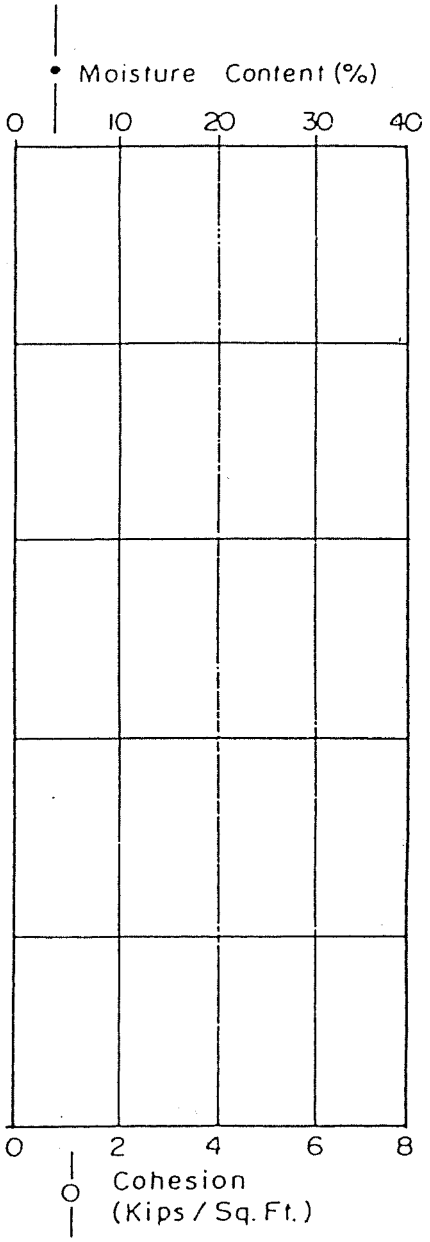
Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987

E-2.50



Gravel, fill w/building materials lt. brown	CL
Clay, fill, dk. gray	CH/CL
Gravel, sandy w/cobbles, tan	GW

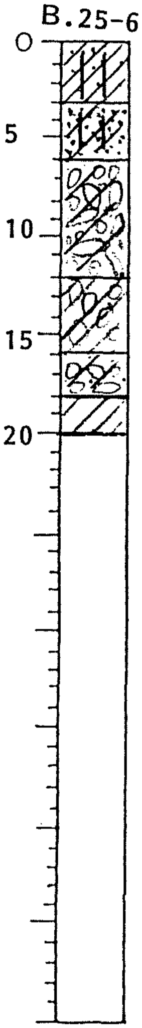
Discontinued @ 15'



SNOWDEN, INC.

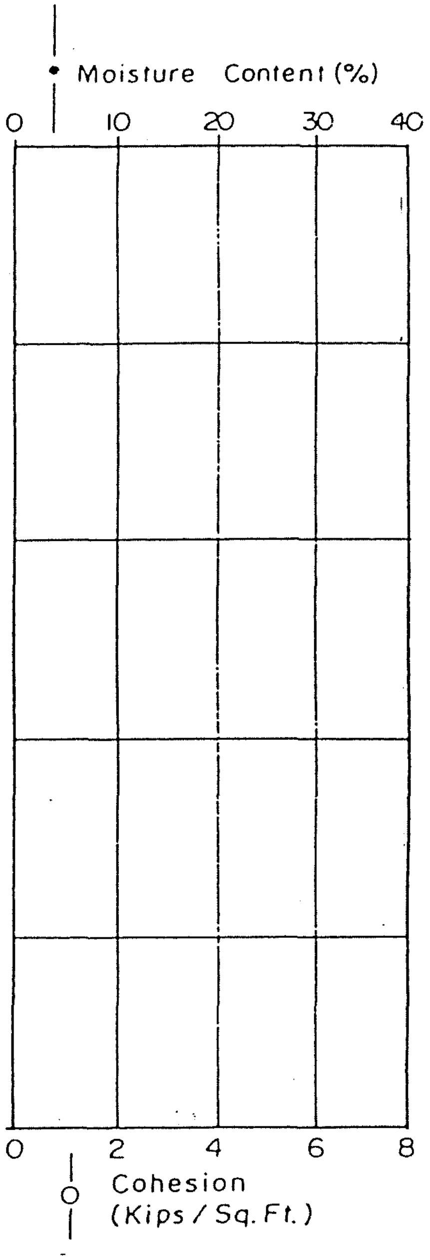
LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987



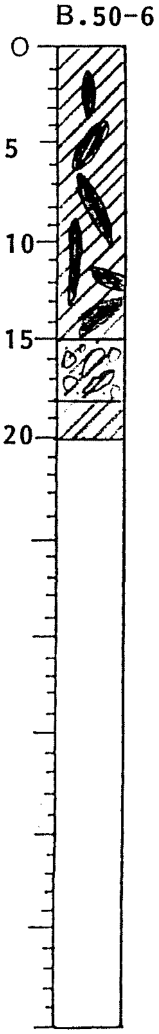
Clay, silty, sandy, lt. brown	CL
Sand, silty, clayey, brown	SC
Gravel, clayey w/cobbles, brown	GC
Clay, gravelley, tan	CL
Gravel, clayey, tan	GC
Clay, jointed, tan & gray	CH

Discontinued @ 20'



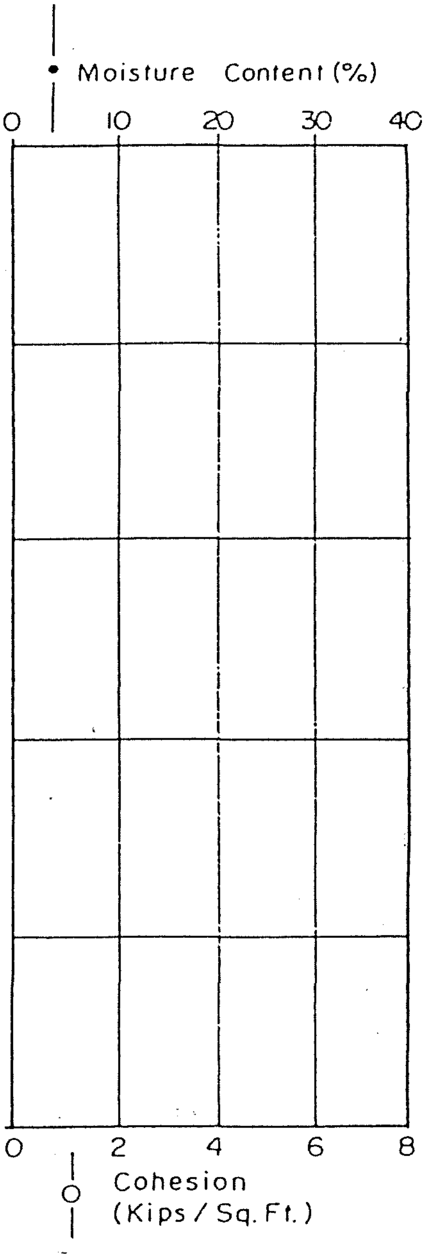
LOG OF BORING

Project Name: **Beck Readymix Concrete Co., #5108**
Date Drilled: **November 11, 1987**



Clay, fill w/building materials, brown	CL
...w/broken concrete, dk. gray	CH/CL
Gravel, clayey, brown	GC
Clay & jointed, tan & gray	CH

Discontinued @ 20'

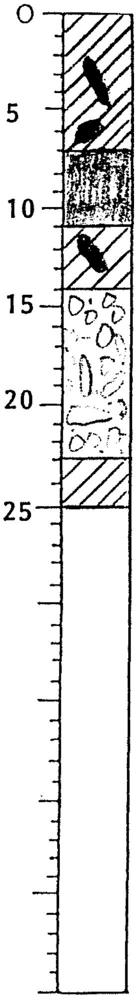


SNOWDEN, INC.

LOG OF BORING

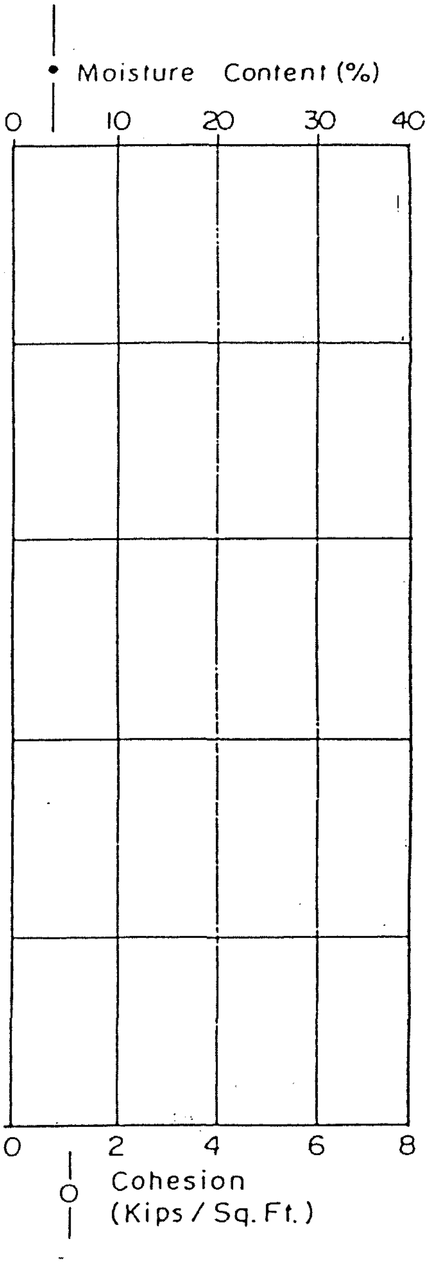
Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987

C.50-6



Clay, fill w/building materials, lt. gray	CL
Debris, trace clay, brown	
Clay, fill w/bldg. materials, dk. gray	CL
Gravel, sl. sandy, tan ...w/cobbles	GW
Clay, jointed, tan & gray	CH

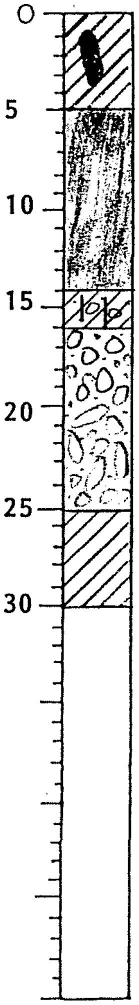
Discontinued @ 25'



LOG OF BORING

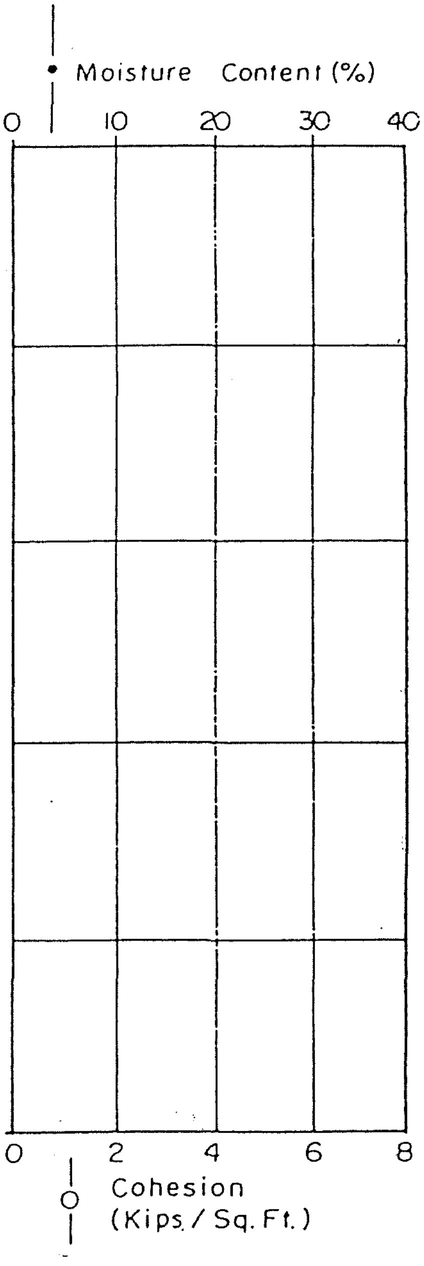
Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987

C-5.75



Clay, fill w/building material, brown	CL
Debris, trace clay, black	
...gray	
Clay, silty, gravelley, lt. brown	CL
Gravel, clayey w/cobbles	GC
...sandy w/cobbles	GW
Clay, jointed, tan & gray	CH

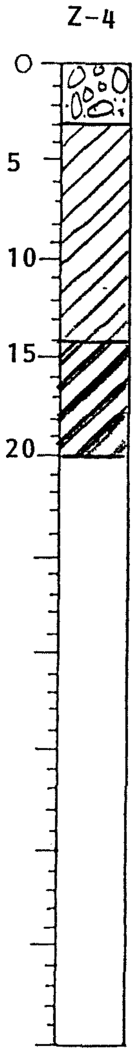
Discontinued @ 30'



SNOWDEN, INC.

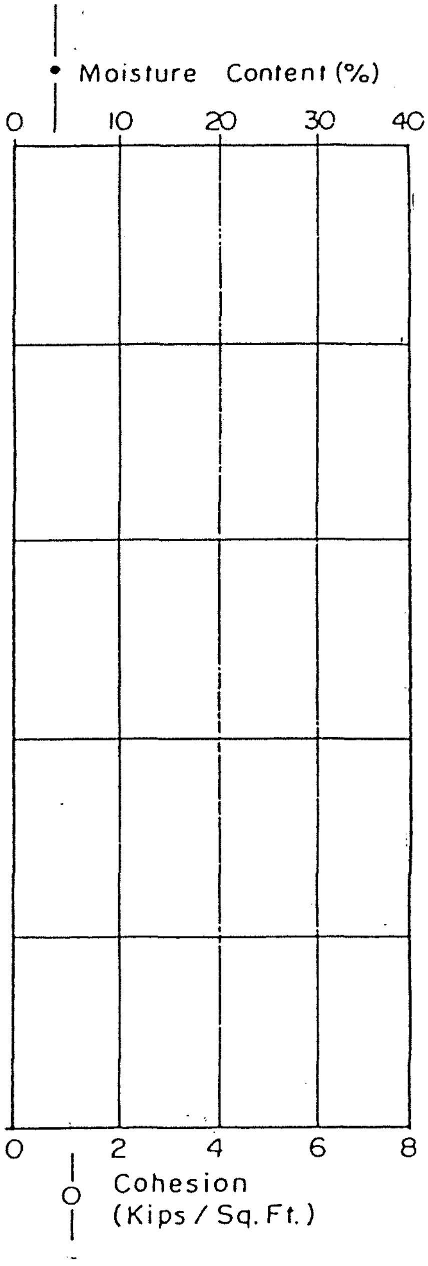
LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987



Gravel, sandy w/cobbles, tan	GW/GC
Clay w/gypsum seams & pyrite stain joint, tan & gray	CH
Shale, sl. clayey, dk. gray	CH

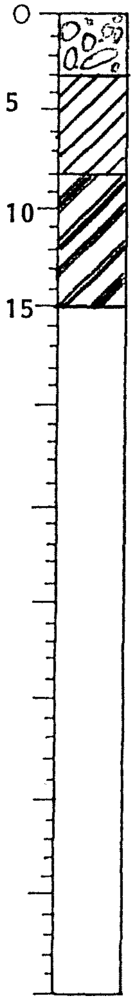
Discontinued @ 20'



LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987

Z-5

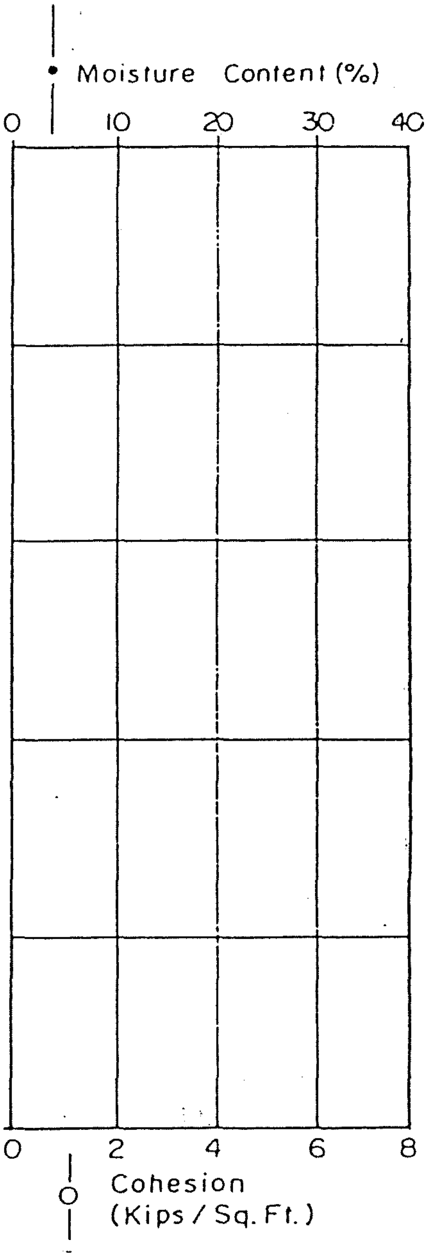


Gravel, sandy, clayey w/cobbles, tan GW/GC

Clay, jointed, tan & gray CH

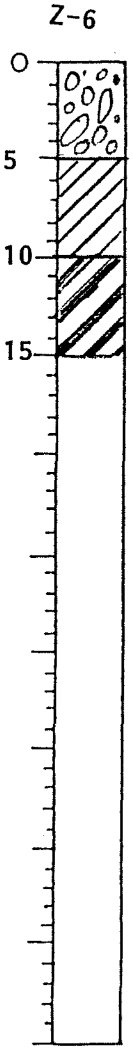
Shale, clayey, dk. gray CH
...sl. clayey

Discontinued @ 15'



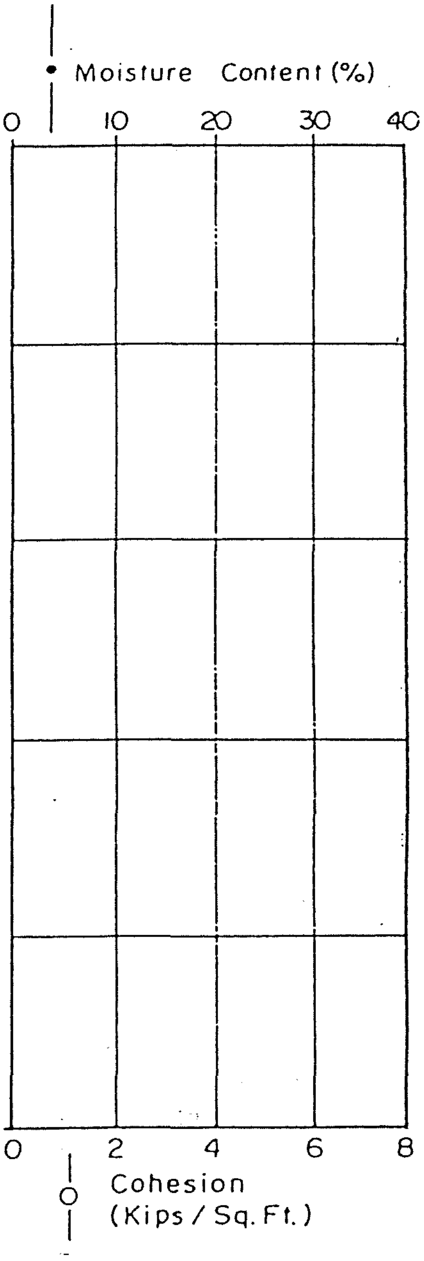
LOG OF BORING

Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987



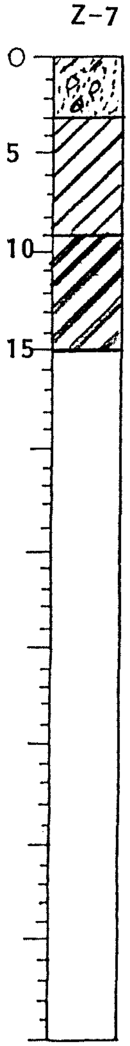
Gravel, sandy, clayey w/cobbles, tan	GW/GC
Clay, jointed, tan & gray	CH
Shale, clayey, dk. gray ...sl. clayey	CH

Discontinued @ 15'



LOG OF BORING

Project Name: **Beck Readymix Concrete Co., #5108**
Date Drilled: **November 11, 1987**

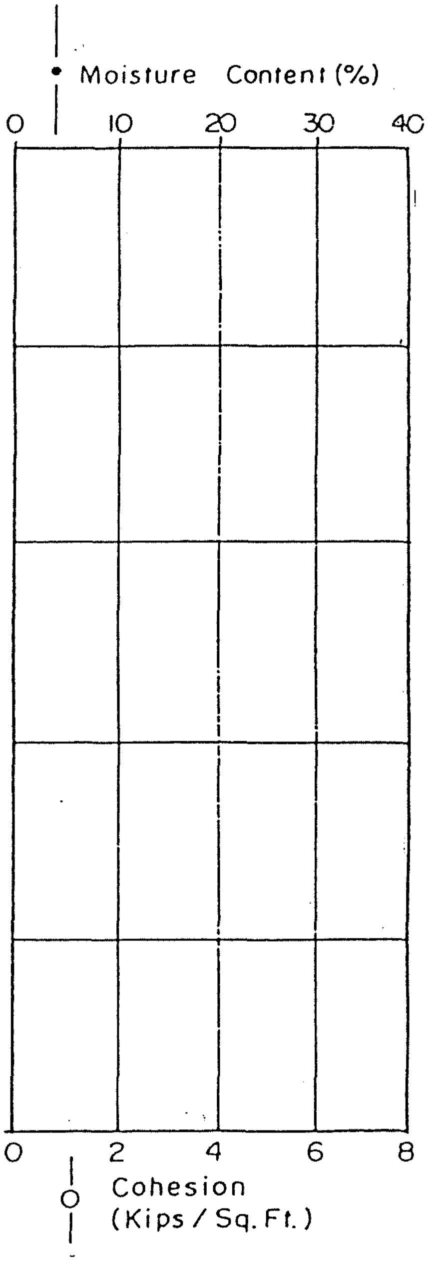


Sand, gravelley, clayey, tan SW/SC

Clay, jointed, tan & gray CH

Shale, med. hard, gray

Discontinued @ 15'

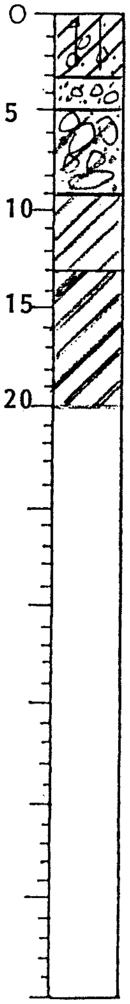


SNOWDEN, INC.

LOG OF BORING

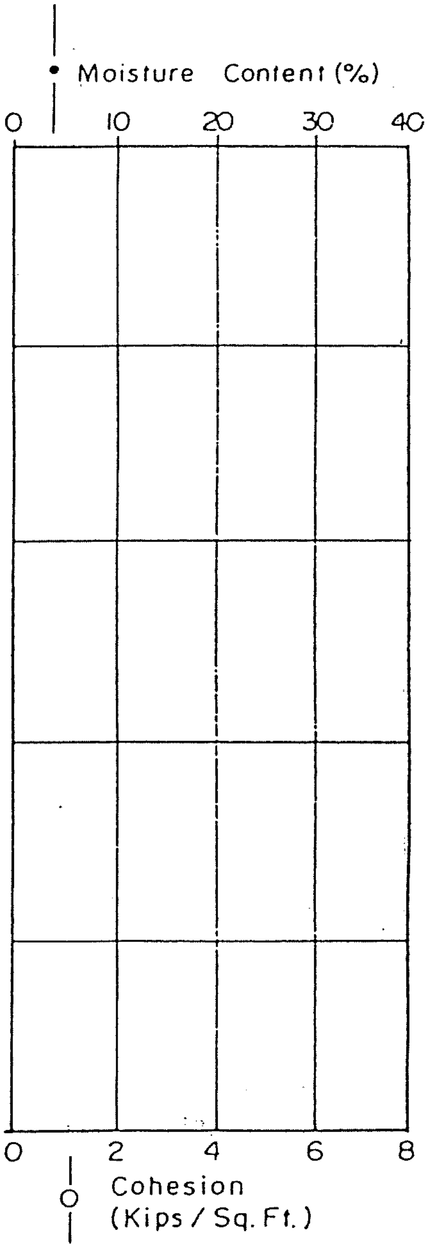
Project Name: Beck Readymix Concrete Co., #5108
Date Drilled: November 11, 1987

Z-8



Clay, silty, sandy, gravelley, lt. brown CL
Sand, silty, brown SM
Gravel, clayey w/cobbles, tan GC
Clay, jointed, tan & gray CH
Shale, sl. clayey, dk. gray CH

Discontinued @ 20'



UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions			Group Symbols	Typical Names
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	SILTS & CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clay of low plasticity
	SILTS & CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomacous fine sands or silts, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

* Based on the material passing the 3 in. (75 mm) sieve

APPENDIX E-2
ATTACHMENT 3-C WATER WELLS (SNOWDEN, 1989)

Recorded Water Well Datum[1]

A. Water Wells (located)[2]

1. Kx 68 - 30 - 603 (Guadalupe Co.)
   - a. location: ½ mi. east of Schertz
   - b. date drilled: September, 1959
   - c. depth: 550 feet
   - d. completetion aquifer: Edwards (535' to 550')
   - e. static water level: 84 feet
   - f. pumping datum: 171' draw down @ 55 gpm

B. Water Wells (plotted)[3]

1. Kx 68 - 30 - 6A (Bexar Co.)
   - a. location: 1 mile south of Schertz
   - b. depth: 35 feet
   - c. completion aquifer: Alluvial
   - d. static water level: 20 feet
   - e. pumping datum: 4' draw down @ 12 gpm
2. Kx 68 - 30 - 9A (Bexar Co.)
   - a. location: ½ mile south of Schertz
   - b. depth: 37 feet
   - c. completion aquifer: Alluvial
   - d. static water level 22 feet
   - e. pumping datum: Test 4 gpm with bailer

[1] The above information was derived from the records of the Texas Department of Water Resources, now known as the Texas Water Commission (T.W.C.). No water wells are recorded as being within the boundaries of the project. The wells listed, thus represent the only recorded wells potentially within a reasonable proximity of this project site.

[2] The water well designated within this catagory, has reportedly been field located by T.W.C. personel. The well, Kx 68 - 30 - 603, is indicated to be on the opposite side of F.M. 78 approximately 1000 feet from the property line of this project.

[3] The water wells designated by this catagory, are each recently completed wells, as plotted but not field located by T.W.C. personel. The records indicate the wells to be located in Bexar County, or on the opposite side of Cibolo Creek from this project site. The current land uses of the Bexar County properties, as adjoining this project site, are such that the wells, Kx 68 - 30 - 6A and Kx 68 - 30 - 9A, are in all likelyhood located in excess of 500 feet from the boundries of this project site.

ATTACHMENT 3-C

APPENDIX E-3
SUPPLEMENTAL BORING PLAN

POWER ENGINEERS

POWER ENGINEERS, INC.

85 Northeast Loop 410
Suite 207
San Antonio, TX 78216

PHONE 210-954-6421
FAX 210-223-5783

MEMORANDUM

DATE: August 17, 2020

TO: MSW Section, TCEQ

Cc: Ben Davis, Grant Norman

FROM: Julie Morelli, PG, REM (POWER Engineers, Inc.)

SUBJECT: 2020 Beck Landfill: Boring Plan

MESSAGE

Boring and testing requirements for Site Development Plans are outlined in 30 Texas Administrative Code (TAC) §330.63(e)(4) and 330.63(e)(5). This memorandum includes an overview of proposed boring activities including the required number of borings, boring depth, testing methods, boring plan requirements, and boring report requirements for inclusion in a potential permit amendment. **Figure 1** includes a depiction of proposed boring locations within the area of interest.

Background

The Beck Landfill is an existing Type IV landfill facility located at 550 Farm-to-Market Road 78 in Schertz, Guadalupe County, Texas. The Beck Landfill is owned and operated by Nido, LTD and is permitted under the Texas Commission on Environmental Quality (TCEQ) Municipal Solid Waste (MSW) Permit No. 1848. The Beck Landfill has been continuously operated under MSW Permit No. 1848 since October 1990. In an effort to bring the permit application in line with modern format and content, and as part of a potential major amendment to MSW Permit 1848, Beck proposes to advance additional borings within areas where no trash has yet been placed. These borings would be advanced in accordance Part III of the Permit and Registration Application for the Beck Landfill permit modification, as described in 30 TAC §330.63 and will supplement the existing information provided in the original application provided by Snowden in 1989.

Contents of the Boring Plan and Investigation Procedures

This boring plan, including the locations and depths of proposed borings, must be approved by the TCEQ Executive Director prior to the initiation of work. The boring plan must outline borings in a sufficient quantity to establish subsurface stratigraphy and to determine the geotechnical properties of the soils and rocks beneath the area of interest. The boring plan includes, at a minimum, the number of borings specified in 30 TAC §330.63(e)(4)(B) and summarized in **Table 1** below.

Table 1 – Summary of Table of Borings per 30 TAC §330.63(e)(4)(B)

Size of Area in Acres	Number of Borings	Min. Number of Borings 30 Feet Below the Elev. Of Deepest Excavation
10-20	6-10	5

The exact number and locations of borings have been determined through an analysis of the general characteristics of the site during the preparation of the boring plan. Proposed borings are depicted on **Figure 1**. Locations determined to have complex stratigraphy such as non-uniform beds that pinch out, vary significantly in thickness, coalesce, or grade into other units, may require a greater degree of subsurface investigation. Additional borings, if required due to these subsurface features, will be included in the boring plan, as needed.

The borings will be sufficiently deep enough to allow the identification of the uppermost aquifer and any underlying hydraulically interconnected aquifers by penetrating the uppermost aquifer and deeper hydraulically connected aquifers.:

- The alluvium and Leona Formation are estimated to occur between 680' and 670' above mean seal level (msl)

They will be sufficiently deep to identify the aquiclude at the lower boundary.

- The Taylor Marl and Navarro Formation are estimated to occur between 670' and 660' above msl.

Each boring will be advanced to a minimum of five feet deeper than the elevation of the deepest planned excavation in the area of interest.

- Excavations are typically estimated to reach 665' above msl (into the Taylor Marl and Navarro Formation.

At a minimum, five (5) of borings specified in **Table 1** will be advanced to at least 30 feet deeper than that deepest planned excavation at the area of interest, unless a different depth is approved by the TCEQ Executive Director.

- Five borings must be advanced to 635' above msl.

If no aquifers are encountered within 50 feet of the elevation of the deepest excavation, at least one test hole will be drilled to the top of the first perennial aquifer beneath the site, unless other data provides for the accurate location of the aquifer.

- Not applicable. The perennial aquifer will be encountered much shallower than 50 feet, so this test hole need not be advanced.

The TCEQ Executive Director may accept data equivalent to a deep boring to determine information for aquifers more than 50 feet below the planned excavation in the area of interest. Aquifers that are greater than 300 feet below the lowest planned excavation and where the estimated travel time for constituents to the aquifer is in excess of 30 years plus the estimated life of the landfill do not need to be identified through borings.

- Not applicable. The aquifer is greater than 300 feet below the lowest planned excavation.

All borings will be advanced in accordance with established field exploration methods.

- Boring will be conducted via hollow-stem auger or coring, depending on the subsurface material encountered.
- Borings outlined in the approved boring plan may be modified because of site conditions with the approval of the TCEQ Executive Director.
- All borings will be installed, plugged, and abandoned in accordance with applicable rules and regulations.

- Geophysical methods, such as electric resistivity may be used with the authorization of the TCEQ Executive Director to reduce the number of borings needed or to provide information on areas between borings.
- Cross sections of each boring location and the investigator's interpretations must be included in the boring report, as described in the *Contents of the Boring Report* section of this memorandum.

Sample Testing and Laboratory Report Requirements

All geotechnical tests to be performed on collected boring samples will be done in accordance with industry practice and recognized procedures as described in 30 TAC §330.63(e)(5). A third-party soils laboratory must prepare a laboratory report of soil characteristics determined from at least one sample from each soil layer or stratum that will form the bottom and size of the proposed excavation area and from those that are less than 30 feet below the lowest elevation of the proposed excavation. Additional testing will be performed as needed to provide a typical profile of soil stratification within the site. Laboratory testing is not necessary for highly permeable soil layers identified, such as gravel or sand. Soil permeability tests will be performed on undisturbed soils in accordance with one of the below standards:

- Constant head with back pressure per Appendix VII of the U.S. Army Corps of Engineers Manual EM1110-2-1906 "Laboratory Soils Testing;" ASTM D5084 "Saturated Porous Materials Using a Flexible Wall Permeameter";
- Falling head per Appendix VII of the U.S. Army Corps of Engineers Manual EM1110-2-1906, "Laboratory Soils Testing" (if appropriate);
- Sieve analysis for the 200; and less than 200 fractions per ASTM D1140;
- Atterberg limits per ASTM D4318; and
- Moisture content per ASTM D2216.

Permeability tests will be conducted using tap water or 0.05 normal solution of calcium sulfate as the permeant. Distilled water may not be used as the permeant. Samples that represent the sidewall of the proposed pit, cell(s), or excavation will be tested for the coefficient of permeability on the sample's in-situ horizontal axis. Other samples will be tested on the in-situ vertical axis. The laboratory report will indicate the type of test performed and orientation for each sample and all calculations for the final coefficient of permeability will be included.

Contents of the Boring Investigation Report

30 TAC §330.63(e)(4) requires the preparation of a report detailing the results of the investigation of subsurface conditions in the area of interest, including the investigator's interpretations of subsurface stratigraphy, as well as a summary of the investigation procedures. The report will:

- describe all borings drilled on-site to test soils and characterize groundwater;
- contain a scaled site map indicating the surveyed locations and elevations of each boring
- contain the boring logs collected during the investigation will be included as an attachment to the report. The boring logs will:
    - include a detailed description of materials encountered, including discontinuities such as fractures, fissures, slickensides, lenses, or seams. The boring log for each boring will contain the boring number, surface elevation of the boring, location coordinates, and a columnar section with text depicting the elevation of all contacts between soil and rock layers, a description of each layer using the unified soil classification, soil color, degree of compaction, and moisture content.

  - include a key to explain the symbols used on each boring log and classification terminology for the soil type, consistency, and structure.
  - note the level that groundwater is first encountered and the level of groundwater after equilibrium is reached or just prior to plugging the bore hole, whichever is later.
- include the depth that groundwater was encountered and records of after-equilibrium measurements for all boring locations in accordance with 30 TAC §330.63(e)(5)(C). This water level information will be presented in a table format in the report.

Figure 1. Proposed Boring Locations

BECK LANDFILL

FIGURE 1: SITE DEVELOPMENT PLAN AMENDMENT: PROPOSED BORING PLAN

SCHERTZ,
GUADALUPE COUNTY, TEXAS

Legend

▭ Area of Interest

● Potential Boring Location

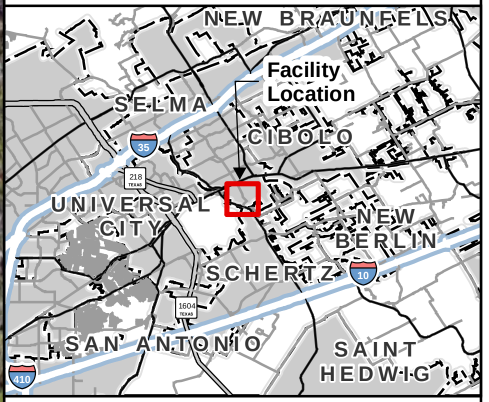
River/Stream

Proposed Boring Depth:

S-1 to S-8: 30'

Notes:
1. Proposed boring locations are shown.

2. Per 30 TAC §330.63(e)(4)(B), a minimum of 6-10 borings must be advanced during the investigation. At least 5 borings must be advanced to 30 feet below the lowest planned elevation of the future excavation.



0 250 500
Feet

POWER ENGINEERS

Date: 7/14/2020

Path: H:\Beck\GIS\150051 Landfill GIS_Maps_Borings\1_Site_Develop_Plan.mxd

October 20, 2020

Mr. Ali Abazari
Jackson-Walker
100 Congress Ave., Suite 1100
Austin, TX 78701

Re: Geotechnical Data Report
Beck Landfill - Southeast Section
550 FM 78
Schertz, Texas
Terracon Project No.: 90205235

Dear Mr. Abazari:

Terracon Consultants, Inc. is pleased to submit this data report for the proposed Beck Landfill - Southeast Section in Schertz, Texas. The scope of services for this project was outlined in Proposal No. P90205235, dated August 27, 2020. The purposes of this data report are to describe the subsurface conditions observed in the borings drilled for this study and report the laboratory test data.

PROJECT INFORMATION

Project Description

Item	Description
Site layout	Refer to Appendix A; Exhibit A-1: Site Location Plan and Exhibit A-2: Boring Location Plan.
Project description	This study was performed to evaluate the existing soil conditions at the top of the southeastern berm and also inside the berm (floor area).

Site Location and Description

Item	Description
Location	The project is located at 550 FM 78 in Schertz, Texas.
Existing improvements	Existing landfill.
Current ground cover	Bare soil and grass.

SUBSURFACE CONDITIONS

Conditions encountered at the boring locations are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual. Details of the borings can be found on the boring logs in Appendix A of this report.

Groundwater

Groundwater generally appears as either a permanent or temporary water source. Permanent groundwater is generally present year-round, which may or may not be influenced by seasonal and climatic changes. Temporary groundwater is also referred to as a “perched” water source, which generally develops as a result of seasonal and climatic conditions.

The borings were advanced to the required depths using dry drilling techniques to evaluate groundwater conditions at the time of our field program. The boreholes were observed for the presence of groundwater during and after completion of drilling. The water levels observed in the borings can be found on the attached boring logs and are summarized in the table below.

Boring Number	Approximate Depth to Water from Existing Grade while Drilling (feet)	Approximate Depth to Water from Existing Grade after Drilling (feet)
FB-3	38	38
FB-7	9	12

Seasonal variations such as amount of rainfall and runoff, climatic conditions and other factors generally result in fluctuations of the groundwater level over time. The granular strata can easily transmit water. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The foundation contractor should check the groundwater conditions just before foundation excavation activities.

GENERAL COMMENTS

The subsurface conditions presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur across the site, or due to the modifying effects of construction or weather. Prospective contractors should familiarize themselves with the conditions at the site and retain their own experts to interpret the data in this report and perform additional testing and/or inspection as they deem necessary prior to bidding.

The scope of services for this project 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.

This data report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made.

We appreciate the opportunity of working with you on this phase of the project. Should you have any questions or if we could be of further assistance, please do not hesitate to contact us.

Sincerely,
Terracon Consultants, Inc.
(Firm Registration: TX F-3272)

Carlos Cotilla
Staff Engineer

Gregory P. Stieben, P.E., D. GE
Senior Consultant

GREGORY P STIEBEN
59536

CC/GPS/mhb – 90205235

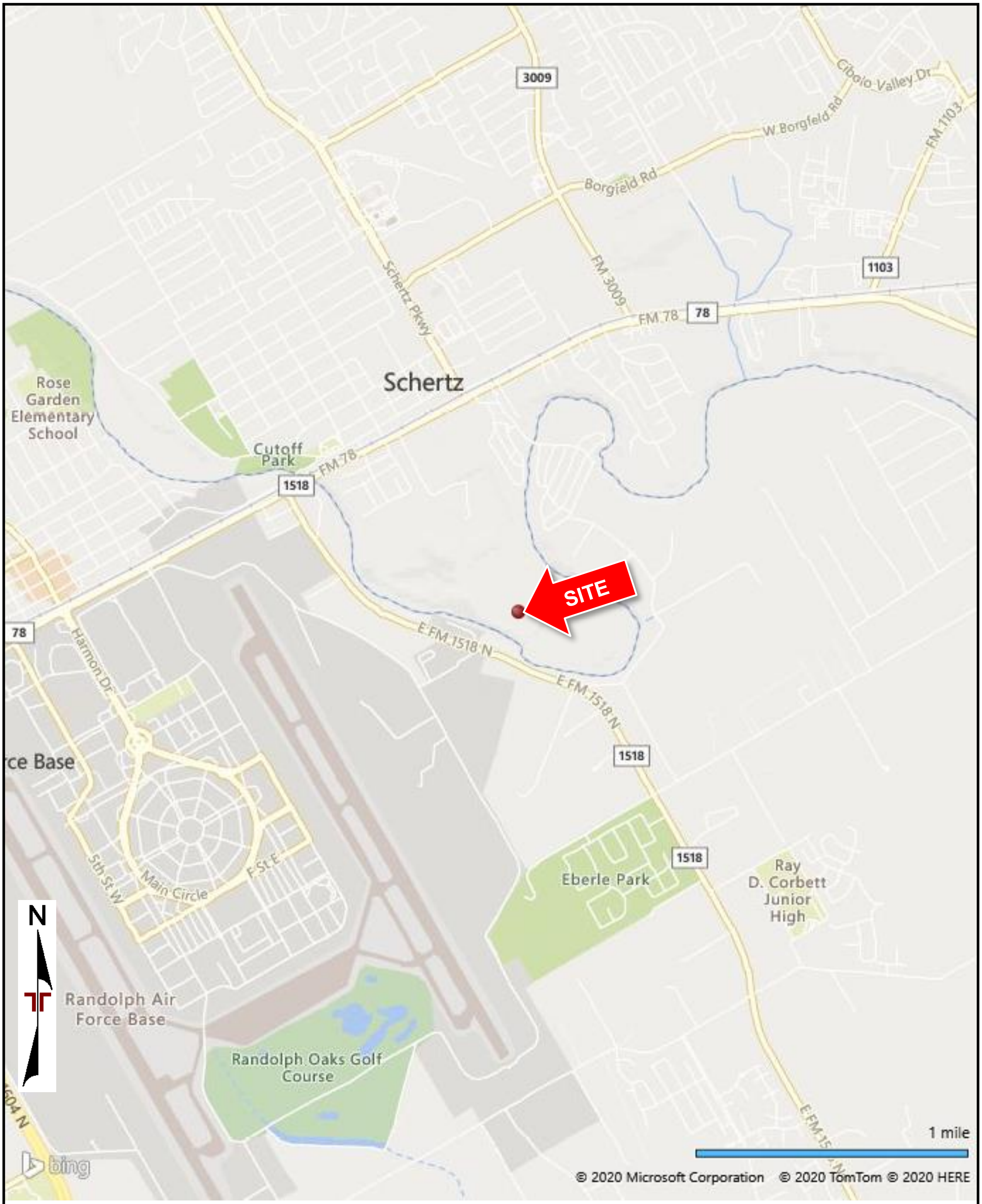
Attachments:

Appendix A – Field Exploration
- Exhibit A-1 – Site Location Plan
- Exhibit A-2– Boring Location Plan
- Exhibit A-3 – Field Exploration Description
- Exhibits A-4 thru A-11 – Boring Logs

Appendix B – Laboratory Testing
- Exhibit B-1 – Laboratory Testing Description
- Exhibit B-2 – Atterberg Limits Graph
- Exhibit B-3 – Grain Size Distribution Graphs
- Exhibit B-4 – Permeability Tests

Appendix C – Supporting Documents
- Exhibit C-1 – General Notes
- Exhibit C-2 – Unified Soil Classification System

APPENDIX A



ROAD MAP PROVDED BY MICROSOFT BING MAPS

Project Manager: CC
Drawn by: CC
Checked by: GPS
Approved by: GPS

Project No. 90205235
Scale: AS SHOWN
File Name: exhibits
Date: 10/19/2020

Terracon
6911 Blanco Rd
San Antonio, TX 78216-6164

SITE LOCATION PLAN

Beck Landfill - Southeast Section
550 FM 78
Schertz, TX

Exhibit
A-1

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

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

Project Manager: CC	Project No. 90205235
Drawn by: CC	Scale: AS SHOWN
Checked by: GPS	File Name: exhibits
Approved by: GPS	Date: 10/19/2020

Terracon
6911 Blanco Rd
San Antonio, TX 78216-6164

BORING LOCATION PLAN

Beck Landfill - Southeast Section
550 FM 78
Schertz, TX

Exhibit
A-2

Field Exploration Description

Boring locations were selected by the client. We advanced the soil borings with a truck-mounted drill rig using continuous flight augers. Samples were obtained continuously in the upper 10 feet of each boring and at intervals of 5 feet thereafter. Soil sampling was performed using thin-wall tube and/or split-barrel sampling procedures. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge was pushed hydraulically into the soil to obtain a relatively undisturbed sample. In the split barrel sampling procedure, a standard 2-inch outer diameter split barrel sampling spoon was 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 was 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. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with bentonite chips after their completion.

Our field representative prepared the field logs as part of the drilling operations. The field logs included visual classifications of the materials encountered during drilling and our field representative interpretation of the subsurface conditions between samples. The boring logs included with this report represents the engineer’s/geologist’s interpretation of the field logs and include modifications based on visual observations and testing of the samples in the laboratory.

BORING LOG NO. FB-1

PROJECT: Beck Landfill - Southeast Section

CLIENT: Nido Ltd
San Antonio, TX

SITE: 550 FM 78
Schertz, TX

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 29.5437° Longitude: -98.2628° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨	**FILL - FAT CLAY (CH)**, brownish gray, stiff to very stiff			☒	3-4-7 N=11	16.4	50-19-31	
	4.0			☒	8-13-14 N=27	12.6		
▨	**FILL - FAT CLAY (REWORKED CLAY-SHALE) (CH)**, gray, hard	5		■	4.5+ (HP)	17.1		95
				■	4.5+ (HP)	17.7		
				■	4.5+ (HP)	17.8	52-20-32	92
				■	4.5+ (HP)	19.5		
				■	4.5+ (HP)	20.6		
	13.0	10		■	4.5+ (HP)	23.2		
▨	**FILL - CLAYEY SAND (SC)**, brown, stiff to very stiff	15		☒	7-7-8 N=15	11.6		47
	- encountered plastics, paper, and cloth material at 18 feet 23.0	20		☒	2-6-7 N=13	19.5		
▨	**CLAYEY GRAVEL (GC)**, tan, dense to very dense	25		☒	12-19-27 N=46	6.0		18
	33.0	30		☒	25-43-50/5"	3.6		
▨	**LEAN CLAY (CL)**, light brown, hard, marly 38.0	35		☒	24-50/4"	3.9		
▤	**CLAY-SHALE**, gray, hard	40		☒	14-16-20 N=36	19.6		
	45.0			☒	33-39-50/5"	16.1		
	Boring Terminated at 45 Feet	45						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-23-2020	Boring Completed: 09-23-2020
Drill Rig: CME 75	Driller: Ramco
Project No.: 90205235	Exhibit: A-4

BORING LOG NO. FB-2

Page 1 of 1

PROJECT: Beck Landfill - Southeast Section

CLIENT: Nido Ltd
San Antonio, TX

SITE: 550 FM 78
Schertz, TX

LOCATION See Exhibit A-2

Latitude: 29.5431° Longitude: -98.2615°

GRAPHIC LOG	DEPTH	DESCRIPTION
🟩	3.0	**FILL - FAT CLAY (CH)**, brownish gray, very stiff to hard
🟩	13.0	**FILL - FAT CLAY (REWORKED CLAY-SHALE) (CH)**, gray, very stiff to hard
🟩	38.0	**FAT CLAY (CH)**, brownish gray, very stiff to hard, with gravel
☰	45.0	**CLAY-SHALE**, gray, hard
		Boring Terminated at 45 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5-2		☒	25-11-11 N=22	13.8		50
2-3		■	4.5+ (HP)	14.4	54-21-33	
3-4		■	4.5+ (HP)	12.8		
4-5		■	4.5+ (HP)	14.7		
5-6		■	4.5+ (HP)	19.0		92
6-7		■	4.5+ (HP)	18.4		
7-8		■	4.5+ (HP)	18.7	61-23-38	
8.5-10		☒	7-11-13 N=24	18.9		
13-15		■	4.5+ (HP)	17.5		58
18.5-20		☒	9-12-15 N=27	25.3	54-22-32	
23.5-25		☒	14-23-12 N=35	17.5		67
28.5-30		☒	5-6-20 N=26	16.3		
33.5-35		☒	11-11-13 N=24	15.4		
38-40		■	4.5+ (HP)	18.6	62-17-45	100
43.5-45		☒	22-31-49 N=80	18.0		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-23-2020	Boring Completed: 09-23-2020
Drill Rig: CME 75	Driller: Ramco
Project No.: 90205235	Exhibit: A-5

BORING LOG NO. FB-3

Page 1 of 1

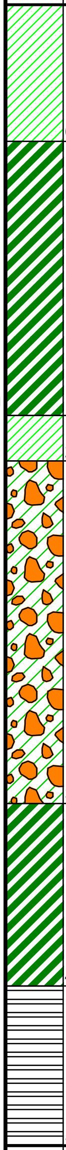
PROJECT: **Beck Landfill - Southeast Section**

CLIENT: **Nido Ltd**
San Antonio, TX

SITE: **550 FM 78**
Schertz, TX

LOCATION See Exhibit A-2

Latitude: 29.5425° Longitude: -98.2602°



DEPTH	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FILL - LEAN CLAY (CL), brownish gray, very stiff to hard, with gravel		☒	25-11-11 N=22	14.6		
		■	4.5+ (HP)	11.8		70
		■	4.5+ (HP)	12.5	40-18-22	
		■	4.5+ (HP)	13.4		
6.0		■	4.5+ (HP)	12.5	46-18-28	
FILL - FAT CLAY (REWORKED CLAY-SHALE) (CH), gray, hard		■	4.5+ (HP)	16.2		
		■	4.5+ (HP)	16.2		
		☒	4.5+ (HP)	15.1		
		■	4.5+ (HP)	14.0		91
18.0		■	4.5+ (HP)	10.1		
LEAN CLAY (CL), brownish gray, hard, with gravel 20.0		■	4.5+ (HP)	7.4	33-16-17	
CLAYEY GRAVEL (GC), brown, medium dense to very dense		☒	37-6-20 N=26	10.2		27
		☒	10-11-13 N=24	9.5		
- Lean Clay (CL), marly, below 33 feet 35.0		☒	50/5"	3.9		
FAT CLAY (CH), brownish gray, hard 43.0	▽	☒	15-21-30 N=51	34.4	54-19-35	
CLAY-SHALE, gray, hard		☒	27-41-50/5"	18.6		
50.0		☒	50/5"	14.9		
Boring Terminated at 50 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

Notes:

WATER LEVEL OBSERVATIONS

▽ *38 feet while drilling*

▽ *38 feet at completion of drilling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-23-2020	Boring Completed: 09-23-2020
Drill Rig: CME 75	Driller: Ramco
Project No.: 90205235	Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90205235 BECK LANDFILL - S.GPJ TERRACON_DATATEMPLATE.GDT 10/20/20

BORING LOG NO. FB-4

PROJECT: Beck Landfill - Southeast Section

CLIENT: Nido Ltd
San Antonio, TX

SITE: 550 FM 78
Schertz, TX

LOCATION See Exhibit A-2

Latitude: 29.5453° Longitude: -98.261°

DEPTH

CLAY-SHALE, gray, hard

35.0

Boring Terminated at 35 Feet

SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
■	4.5+ (HP)	18.4		
■	4.5+ (HP)	19.0	59-17-42	99
■	4.5+ (HP)	19.8		
■	4.5+ (HP)	20.2		
■	4.5+ (HP)	19.8		
■	4.5+ (HP)	18.7	61-24-37	99
☒	21-23-32 N=55	18.3		
☒	16-26-40 N=66	17.6		
☒	32 50/6"	14.6		
☒	31-44-50/2"	14.8	47-21-26	96
☒	50/6"	10.1		
☒	50/3"	9.4		
☒	50/2"	7.7		

DEPTH (Ft.): 5, 10, 15, 20, 25, 30, 35

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

Notes:

WATER LEVEL OBSERVATIONS
No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-24-2020	Boring Completed: 09-24-2020
Drill Rig: CME 75	Driller: Ramco
Project No.: 90205235	Exhibit: A-7

BORING LOG NO. FB-5

PROJECT: Beck Landfill - Southeast Section

CLIENT: Nido Ltd
San Antonio, TX

SITE: 550 FM 78
Schertz, TX

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 29.5446° Longitude: -98.26° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAY-SHALE, gray, hard			☒	17-25-50/5"	14.3	52-18-34	97
				☒	30-50/3"	12.3		
		5		☒	34-50/5"			
				☒	50/6"	11.3	64-15-49	97
		10		☒	43-46-50/5"	13.5		
		15		☒	47-48-50/3"	11.3		
		20		☒	45-52-50/5"	14.2		
		25		☒	31-45-50/4"	14.9		99
		30		☒	29-50	14.3		
	35.0	35		☒	33-50	15.8	63-21-42	
	Boring Terminated at 35 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-23-2020	Boring Completed: 09-23-2020
Drill Rig: CME 75	Driller: Ramco
Project No.: 90205235	Exhibit: A-8

BORING LOG NO. FB-6

Page 1 of 1

PROJECT: **Beck Landfill - Southeast Section**

CLIENT: **Nido Ltd**
San Antonio, TX

SITE: **550 FM 78**
Schertz, TX

LOCATION See Exhibit A-2

Latitude: 29.5443° Longitude: -98.2597°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▤	**CLAY-SHALE**, gray, hard			⊠	11-18-31 N=49	15.6		
				■	4.5+ (HP)	14.9	55-17-38	99
		5		■	4.5+ (HP)	14.7		
				■	4.5+ (HP)	14.4	48-16-32	98
		10		⊠	32-39-44 N=83	15.6		
		15		⊠	29 50/6"	13.2		
		20		⊠	32 50/6"	12.4		98
		25		⊠	28-41-50/4"	15.1	53-19-34	
		30		⊠	47-50/4"	15.9		
	35.0	35		⊠	40-50/3"	14.7		
	Boring Terminated at 35 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-24-2020	Boring Completed: 09-24-2020
Drill Rig: CME 75	Driller: Ramco
Project No.: 90205235	Exhibit: A-9

BORING LOG NO. FB-7

Page 1 of 1

PROJECT: **Beck Landfill - Southeast Section**

CLIENT: **Nido Ltd**
San Antonio, TX

SITE: **550 FM 78**
Schertz, TX

LOCATION See Exhibit A-2

Latitude: 29.5437° Longitude: -98.2613°

GRAPHIC LOG	DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨		**FILL - LEAN CLAY (CL)**, brownish gray, hard			☒	5-18-35 N=53	9.5		
▨	4.0				☒	28-50	7.5	35-15-20	
▨		**FILL - CLAYEY GRAVEL (GC)**, light brown, dense to very dense	5		☒	8-18-20 N=38	2.8		18
▨					☒	23-27-32 N=59	3.7		
▨			10	▽	☒	14-17-23 N=40	19.0		39
▨	14.0			▽					
▤		**CLAY-SHALE**, gray, hard	15		☒	11-13-27 N=40	23.2		
▤			20		■	4.5+ (HP)	18.1	56-17-39	96
▤			25		☒	18-21-28 N=49	17.4		
▤			30		☒	21-50/5"	22.4		
▤			35		☒	28-50	18.4		
▤			40		☒	32-41-50/4"	21.8	57-20-37	98
▤			45		☒	37-50/4"	20.1		
▤	50.0		50		☒	47-50/2"	20.9		
		Boring Terminated at 50 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

Notes:

WATER LEVEL OBSERVATIONS

▽ *9 feet while drilling*

▽ *12 feet at completion of drilling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-24-2020	Boring Completed: 09-24-2020
Drill Rig: CME 75	Driller: Ramco
Project No.: 90205235	Exhibit: A-10

BORING LOG NO. FB-8

Page 1 of 1

PROJECT: Beck Landfill - Southeast Section

CLIENT: Nido Ltd
San Antonio, TX

SITE: 550 FM 78
Schertz, TX

LOCATION See Exhibit A-2

Latitude: 29.5441° Longitude: -98.2608°

DEPTH	Description
0.0–18.0	**FAT CLAY (CH)**, brownish gray, very stiff to hard, with gravel - with calcareous deposits below 2 feet
18.0–50.0	**CLAY-SHALE**, gray, hard
50.0	***Boring Terminated at 50 Feet***

SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
☒	12-18-27 N=45	8.4		
☒	12-19-13 N=32	8.6		
☒	5-8-14 N=22	15.4	49-19-30	
☒	14-16-20 N=36	13.2		69
■	4.5+ (HP)	21.8	62-23-39	
■	4.0 (HP)	16.6		
■	4.5+ (HP)	21.4	58-22-36	
■	4.5+ (HP)	15.3		
☒	22-29-36 N=65	17.7		
■	4.5+ (HP)	17.3		
☒	50/6"	14.0	43-17-26	96
☒	28-42-50 N=92			
☒	50/4"	12.3		
☒	38-50	13.9		98

DEPTH (Ft.): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-24-2020	Boring Completed: 09-24-2020
Drill Rig: CME 75	Driller: Ramco
Project No.: 90205235	Exhibit: A-11

APPENDIX B

Laboratory Testing

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in Appendix A. The field descriptions were modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil samples. The laboratory test results are presented on the boring logs next to the respective samples in Appendix A. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

- Moisture Content (ASTM D 2216)
- Atterberg Limits (ASTM D 4318)
- Gradation of Soils using Sieve Analysis (ASTM D 422)
- Percent Passing No. 4 and No. 200 Mesh Sieves (ASTM D 1140)
- Permeability Tests

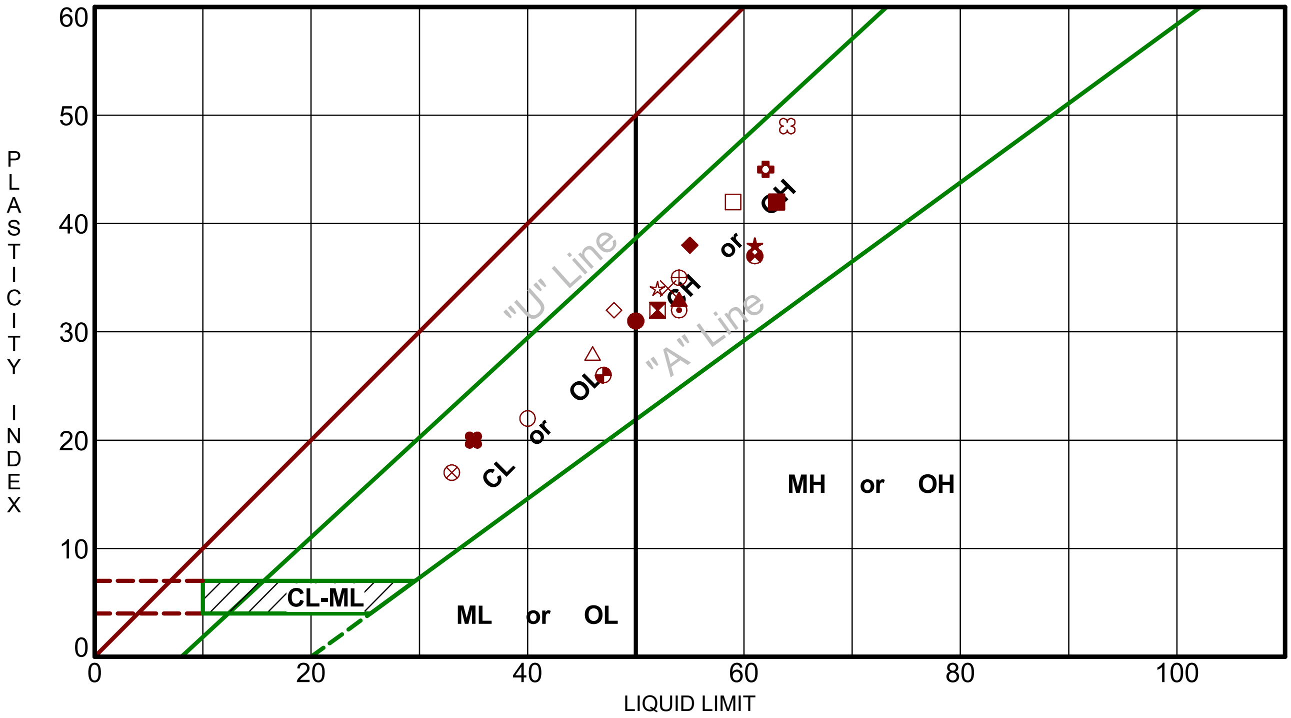
Procedural standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Sample Disposal

All samples were returned to our laboratory. The samples not tested in the laboratory will be stored for a period of 30 days subsequent to submittal of this report and will be discarded after this period, unless other arrangements are made prior to the disposal period.

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	**FB-1**	**0 - 1.5**	**50**	**19**	**31**			
⊠	**FB-1**	**6 - 7**	**52**	**20**	**32**	**91.7**	**CH**	**FAT CLAY**
▲	**FB-2**	**2 - 3**	**54**	**21**	**33**			
★	**FB-2**	**7 - 8**	**61**	**23**	**38**			
⊙	**FB-2**	**18.5 - 20**	**54**	**22**	**32**			
✤	**FB-2**	**38 - 40**	**62**	**17**	**45**	**99.7**	**CH**	**FAT CLAY**
○	**FB-3**	**3 - 4**	**40**	**18**	**22**			
△	**FB-3**	**5 - 6**	**46**	**18**	**28**			
⊗	**FB-3**	**18 - 20**	**33**	**16**	**17**			
⊕	**FB-3**	**38 - 39.5**	**54**	**19**	**35**			
□	**FB-4**	**1 - 2**	**59**	**17**	**42**	**99.0**	**CH**	**FAT CLAY**
◉	**FB-4**	**5 - 6**	**61**	**24**	**37**	**98.9**	**CH**	**FAT CLAY**
◕	**FB-4**	**18.5 - 19.7**	**47**	**21**	**26**	**96.1**	**CL**	**LEAN CLAY**
☆	**FB-5**	**0 - 1.4**	**52**	**18**	**34**	**96.8**	**CH**	**FAT CLAY**
✧	**FB-5**	**6.5 - 7**	**64**	**15**	**49**	**97.3**	**CH**	**FAT CLAY**
■	**FB-5**	**34 - 35**	**63**	**21**	**42**			
◆	**FB-6**	**2 - 4**	**55**	**17**	**38**	**98.5**	**CH**	**FAT CLAY**
◇	**FB-6**	**6 - 8**	**48**	**16**	**32**	**98.0**	**CL**	**LEAN CLAY**
×	**FB-6**	**23.5 - 24.8**	**53**	**19**	**34**			
✖	**FB-7**	**2.5 - 3.5**	**35**	**15**	**20**			

PROJECT: Beck Landfill - Southeast Section

SITE: 550 FM 78
Schertz, TX

Terracon
6911 Blanco Rd
San Antonio, TX

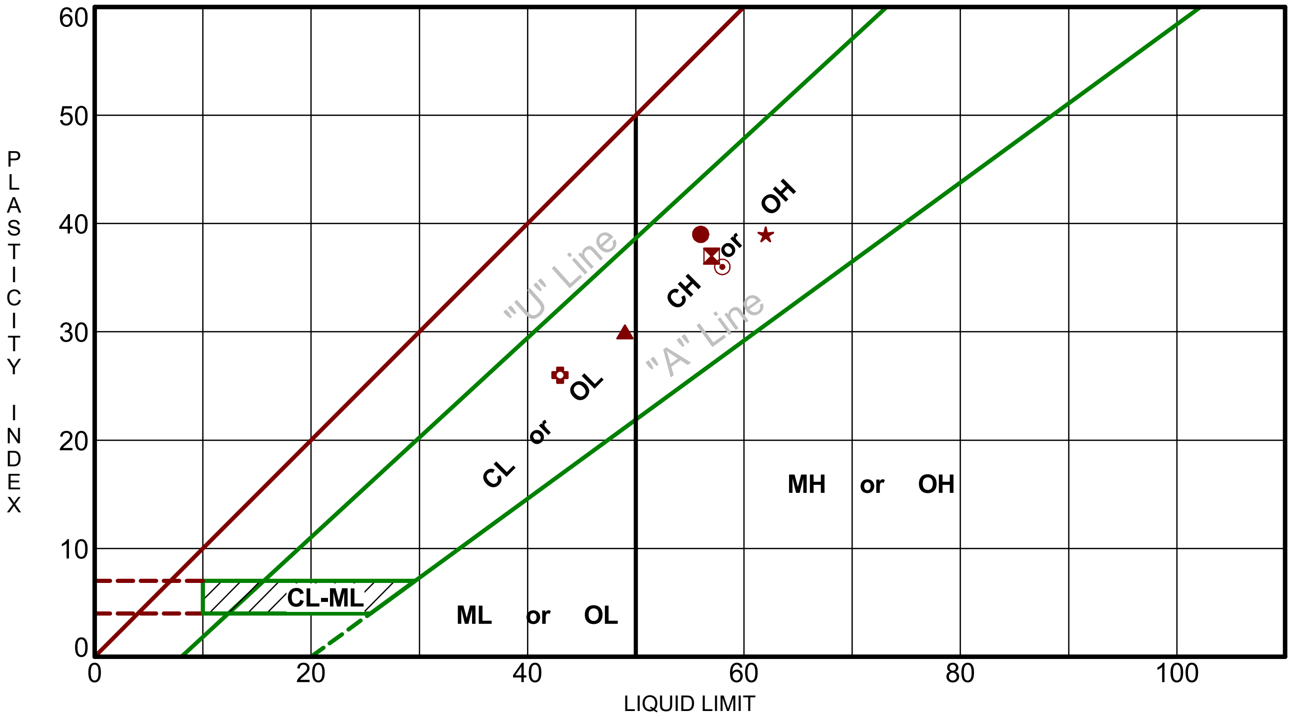
PROJECT NUMBER: 90205235

CLIENT: Nido Ltd
San Antonio, TX

EXHIBIT: B-2

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
● FB-7	18 - 20	56	17	39	95.7	CH	FAT CLAY
⊠ FB-7	38.5 - 39.8	57	20	37	98.0	CH	FAT CLAY
▲ FB-8	4.5 - 6	49	19	30			
★ FB-8	8 - 9	62	23	39			
⊙ FB-8	13 - 15	58	22	36			
✿ FB-8	33.5 - 34	43	17	26	96.4	CL	LEAN CLAY

PROJECT: Beck Landfill - Southeast Section

SITE: 550 FM 78
Schertz, TX

Terracon
6911 Blanco Rd
San Antonio, TX

PROJECT NUMBER: 90205235

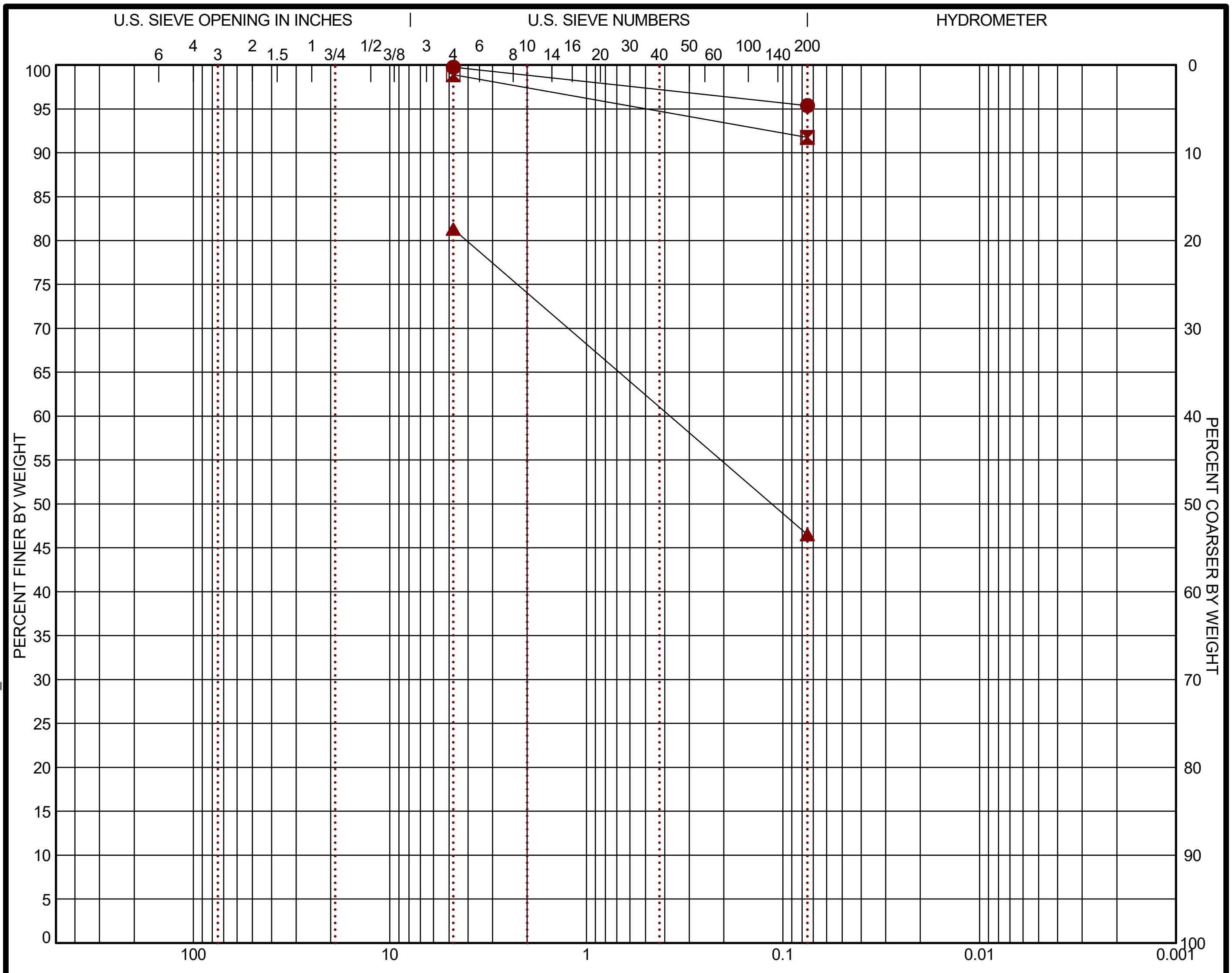
CLIENT: Nido Ltd
San Antonio, TX

EXHIBIT: B-2

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS 90205235 BECK LANDFILL - S.GPJ TERRACON_DATATEMPLATE.GDT 10/20/20

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**FB-1**	**4 - 5**			**4.4**		**95.4**		
☒	**FB-1**	**6 - 7**			**7.1**		**91.7**		**CH**
▲	**FB-1**	**13.5 - 15**			**34.8**		**46.5**		

	GRAIN SIZE		
	●	☒	▲
D_{60}			**0.375**
D_{30}			
D_{10}			
	COEFFICIENTS		
C_C			
C_U			

●		☒		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4 **#200**	**99.74** **95.37**	**#4** **#200**	**98.88** **91.73**	**#4** **#200**	**81.3** **46.51**

SOIL DESCRIPTION

●

☒ FAT CLAY (CH)

▲

REMARKS

●

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▲

PROJECT: Beck Landfill - Southeast Section

SITE: 550 FM 78
Schertz, TX

Terracon
6911 Blanco Rd
San Antonio, TX

PROJECT NUMBER: 90205235

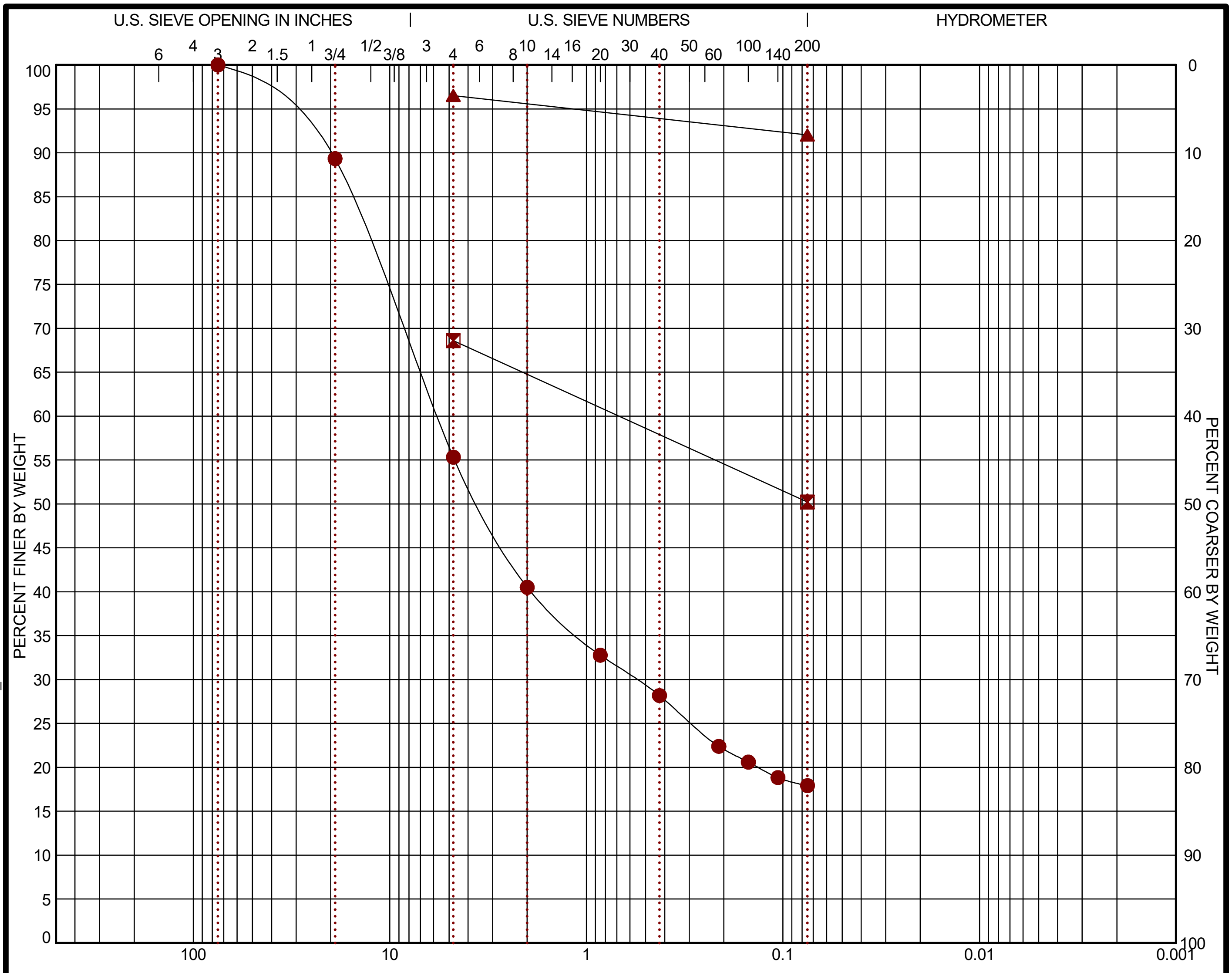
CLIENT: Nido Ltd
San Antonio, TX

EXHIBIT: B-3

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 90205235 BECK LANDFILL - S.GPJ TERRACON_DATATEMPLATE.GDT 10/20/20

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**FB-1**	**23.5 - 25**	**0.0**	**44.7**	**37.4**		**17.9**		
☒	**FB-2**	**0 - 1.5**			**18.4**		**50.2**		
▲	**FB-2**	**5 - 6**			**4.5**		**92.0**		

	GRAIN SIZE		
	●	☒	▲
D_{60}	**5.747**	**0.681**	
D_{30}	**0.559**		
D_{10}			
	COEFFICIENTS		
C_C			
C_U			

●		☒		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3"	**100.0**	**#4**	**68.61**	**#4**	**96.52**
3/4"	**89.33**	**#200**	**50.22**	**#200**	**92.02**
#4	**55.33**				
#10	**40.51**				
#20	**32.77**				
#40	**28.18**				
#70	**22.4**				
#100	**20.6**				
#140	**18.84**				
#200	**17.93**				

SOIL DESCRIPTION
●
☒
▲

REMARKS
●
☒
▲

PROJECT: Beck Landfill - Southeast Section

SITE: 550 FM 78
Schertz, TX

Terracon
6911 Blanco Rd
San Antonio, TX

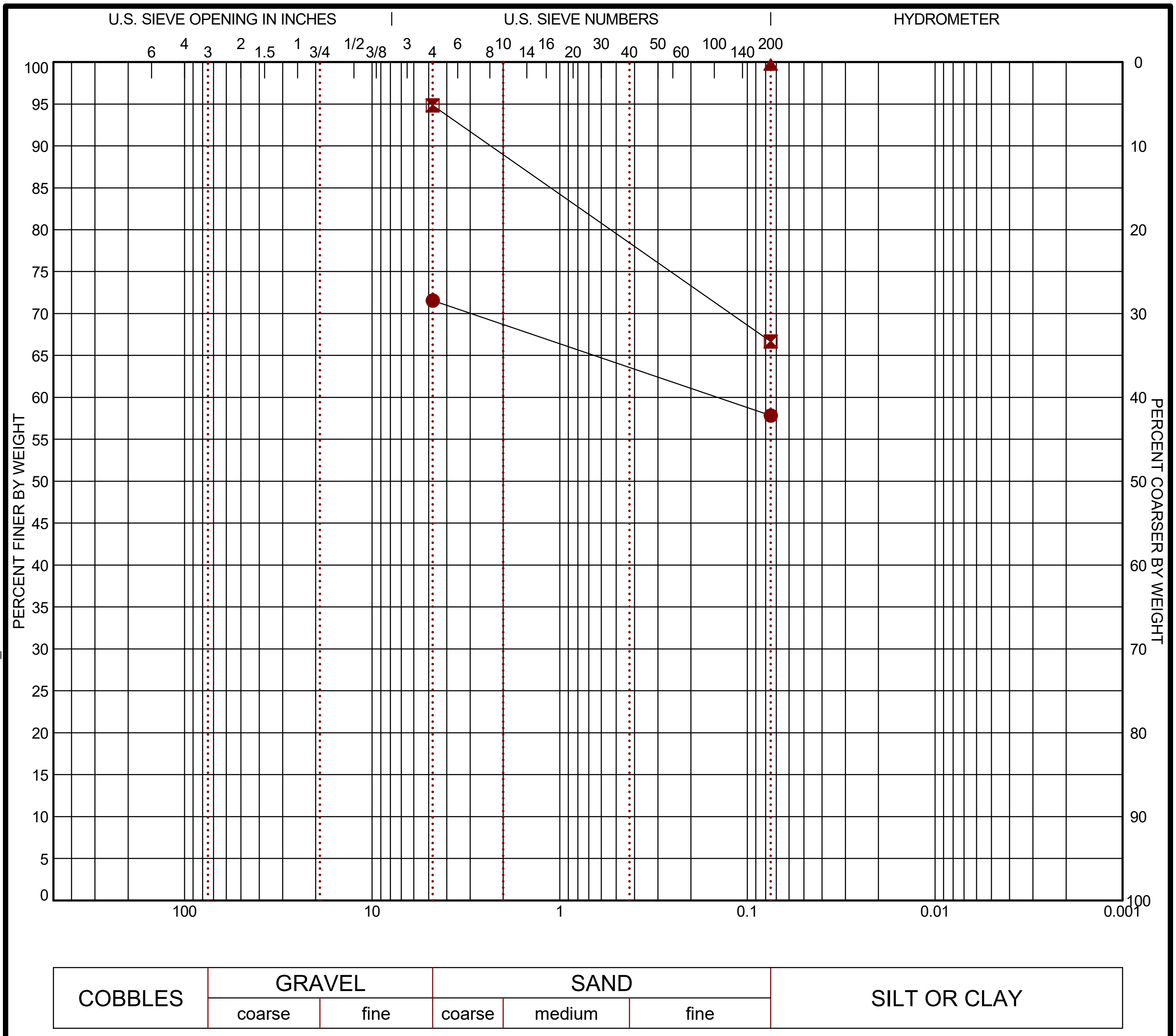
PROJECT NUMBER: 90205235

CLIENT: Nido Ltd
San Antonio, TX

EXHIBIT: B-3

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**FB-2**	**13 - 15**			**13.7**		**57.8**		
☒	**FB-2**	**23.5 - 25**			**28.2**		**66.7**		
▲	**FB-2**	**38 - 40**					**99.7**		**CH**

	GRAIN SIZE		
	●	☒	▲
D_{60}	**0.144**		
D_{30}			
D_{10}			
	COEFFICIENTS		
C_C			
C_U			

●		☒		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4 **#200**	**71.55** **57.84**	**#4** **#200**	**94.83** **66.67**	**#200**	**99.69**

SOIL DESCRIPTION

●

☒

▲ FAT CLAY (CH)

REMARKS

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PROJECT: Beck Landfill - Southeast Section

SITE: 550 FM 78
Schertz, TX

Terracon
6911 Blanco Rd
San Antonio, TX

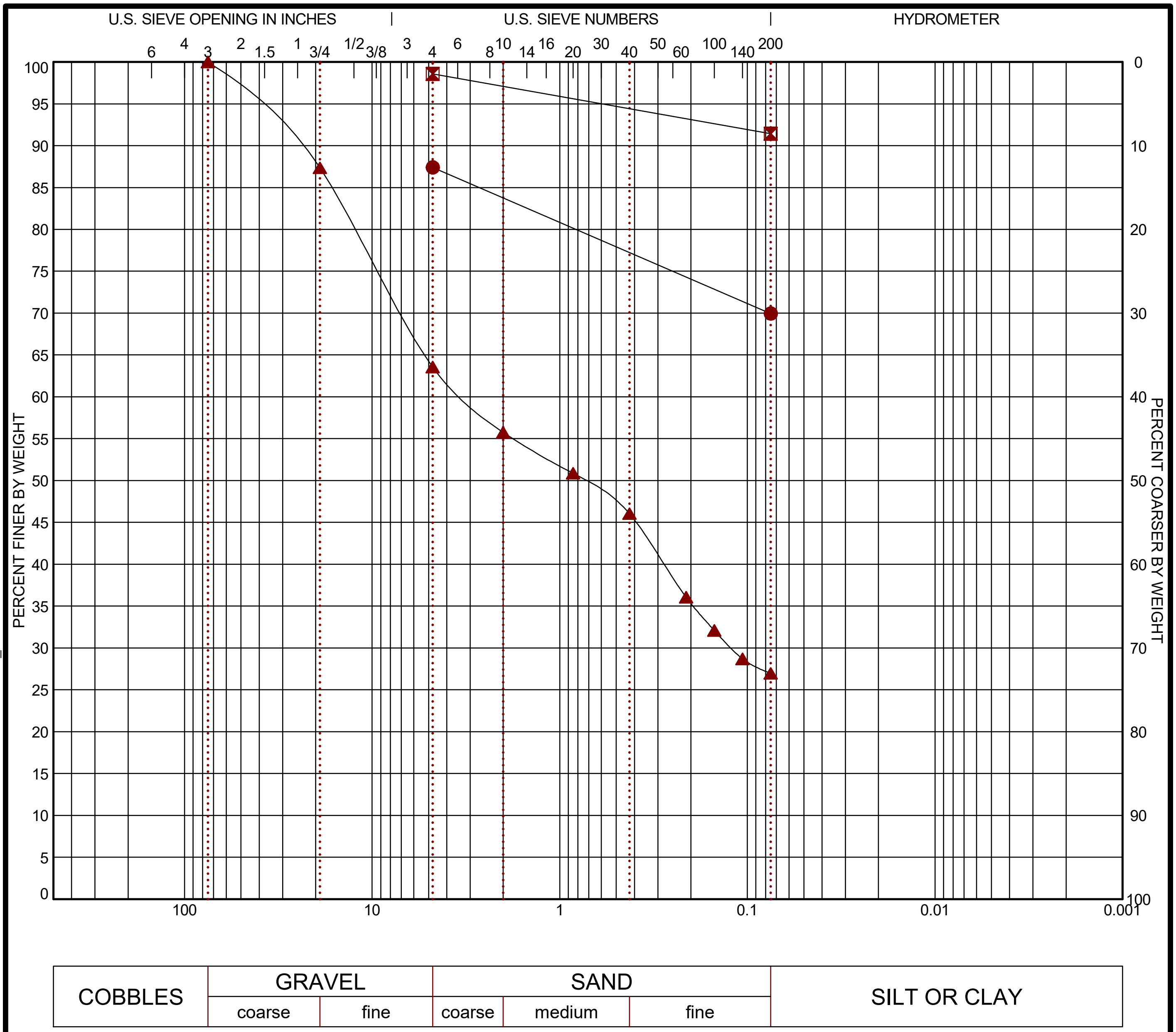
PROJECT NUMBER: 90205235

CLIENT: Nido Ltd
San Antonio, TX

EXHIBIT: B-3

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**FB-3**	**2 - 3**			**17.5**		**69.9**		
☒	**FB-3**	**9 - 10**			**7.1**		**91.4**		
▲	**FB-3**	**23.5 - 25**	**0.0**	**36.4**	**36.6**		**27.0**		

GRAIN SIZE	●	☒	▲
D_{60}			**3.203**
D_{30}			**0.121**
D_{10}			
COEFFICIENTS			
C_C			
C_U			

●		☒		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4	**87.4**	**#4**	**98.57**	**3"**	**100.0**
#200	**69.94**	**#200**	**91.43**	**3/4"**	**87.35**
				#4	**63.56**
				#10	**55.75**
				#20	**50.87**
				#40	**46.05**
				#70	**36.06**
				#100	**32.1**
				#140	**28.7**
				#200	**26.97**

SOIL DESCRIPTION

●

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▲

REMARKS

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PROJECT: Beck Landfill - Southeast Section

SITE: 550 FM 78
Schertz, TX

Terracon
6911 Blanco Rd
San Antonio, TX

PROJECT NUMBER: 90205235

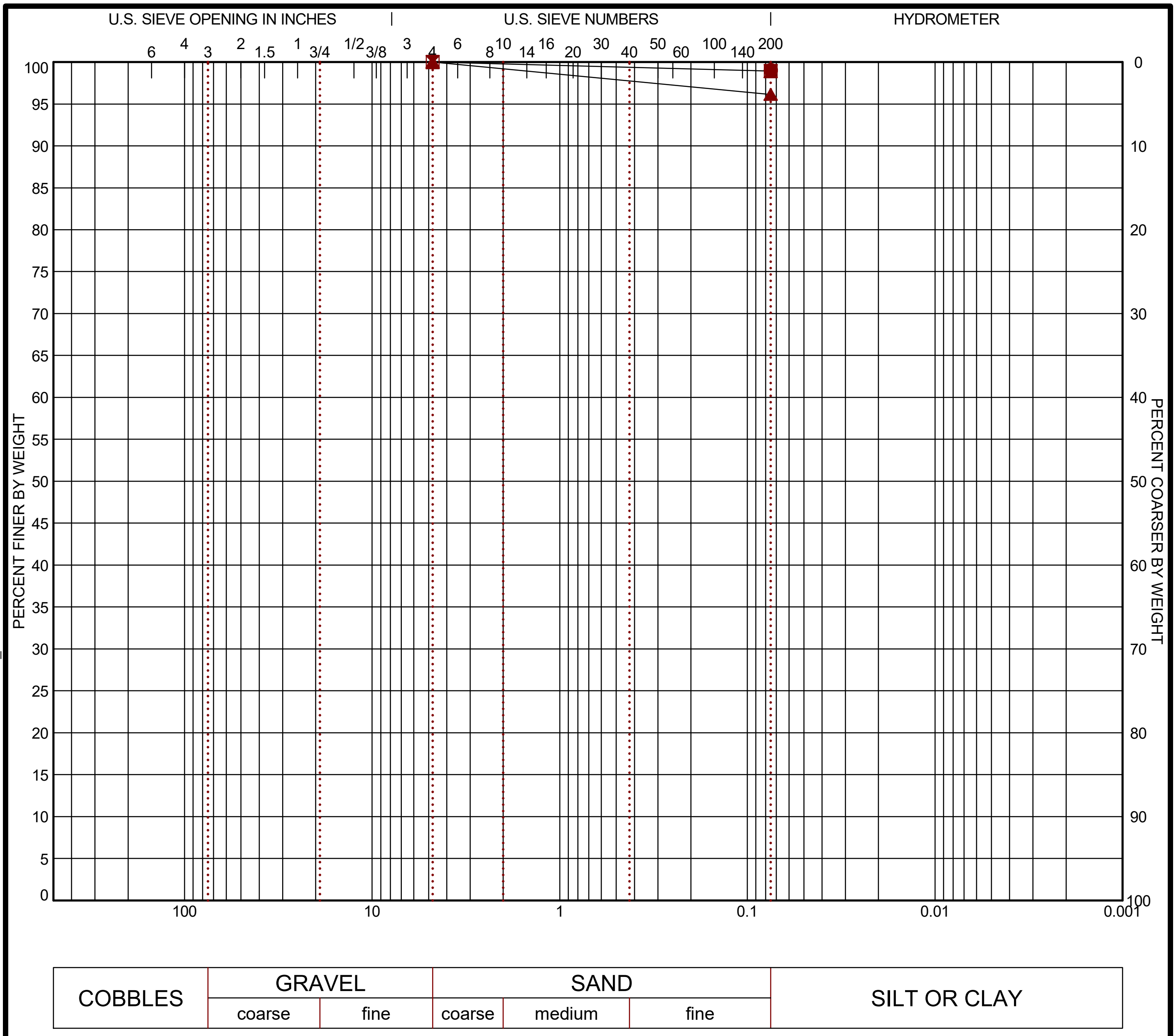
CLIENT: Nido Ltd
San Antonio, TX

EXHIBIT: B-3

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 90205235 BECK LANDFILL - S.GPJ TERRACON_DATATEMPLATE.GDT 10/20/20

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**FB-4**	**1 - 2**					**99.0**		**CH**
☒	**FB-4**	**5 - 6**	**0.0**	**0.0**	**1.1**		**98.9**		**CH**
▲	**FB-4**	**18.5 - 19.7**	**0.0**	**0.0**	**3.9**		**96.1**		**CL**

●		☒		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#200	**99.02**	**#4** **#200**	**100.0** **98.93**	**#4** **#200**	**100.0** **96.12**

	GRAIN SIZE		
	●	☒	▲
D_{60}			
D_{30}			
D_{10}			
	COEFFICIENTS		
C_C			
C_U			

SOIL DESCRIPTION

● FAT CLAY (CH)

☒ FAT CLAY (CH)

▲ LEAN CLAY (CL)

REMARKS

●

☒

▲

PROJECT: Beck Landfill - Southeast Section

SITE: 550 FM 78
Schertz, TX

Terracon
6911 Blanco Rd
San Antonio, TX

PROJECT NUMBER: 90205235

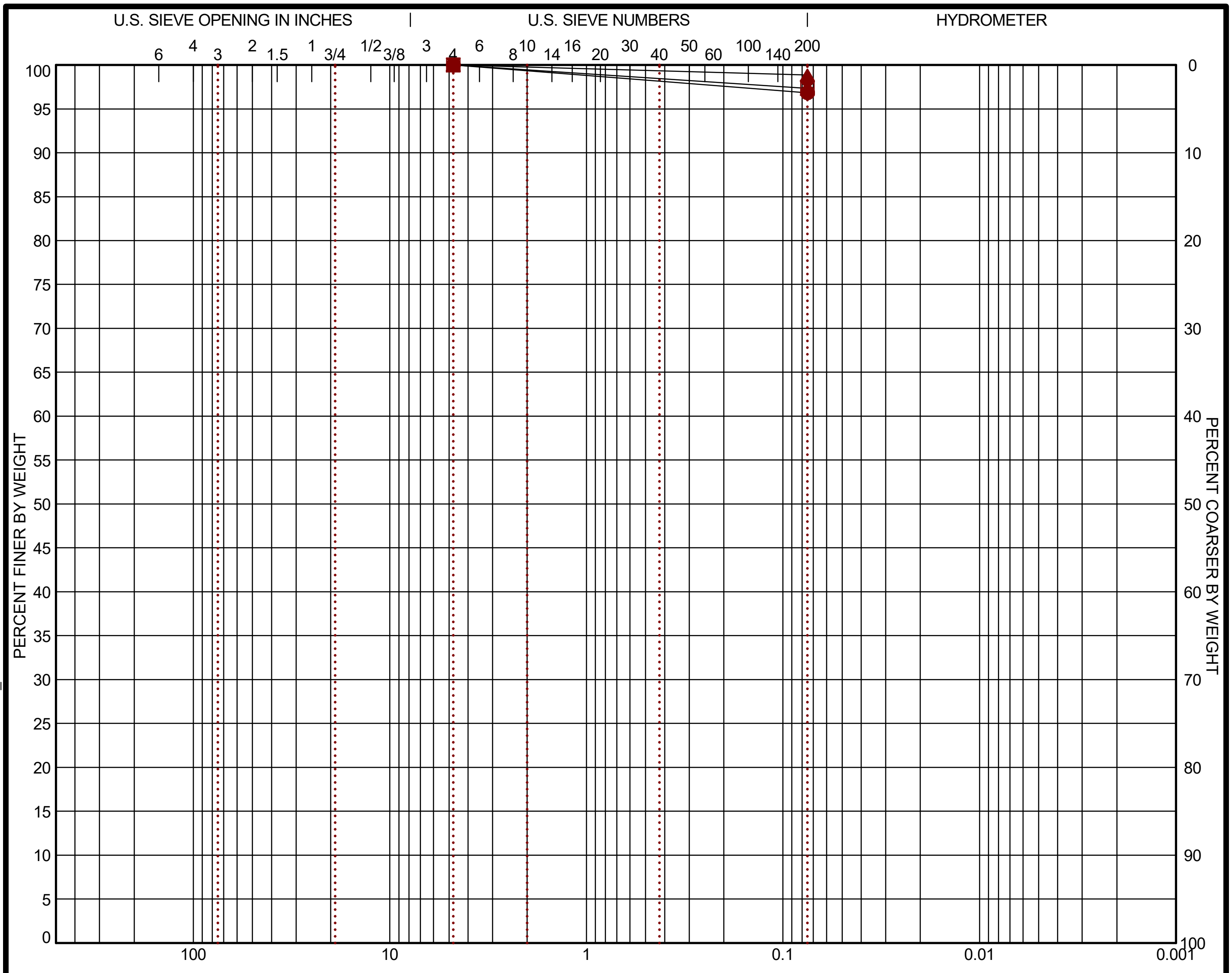
CLIENT: Nido Ltd
San Antonio, TX

EXHIBIT: B-3

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 90205235 BECK LANDFILL - S.GPJ TERRACON_DATATEMPLATE.GDT 10/20/20

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**FB-5**	**0 - 1.4**	**0.0**	**0.0**	**3.2**		**96.8**		**CH**
☒	**FB-5**	**6.5 - 7**	**0.0**	**0.0**	**2.7**		**97.3**		**CH**
▲	**FB-5**	**23.5 - 24.8**	**0.0**	**0.0**	**1.2**		**98.8**		

	GRAIN SIZE		
	●	☒	▲
D_{60} D_{30} D_{10}			
	COEFFICIENTS		
C_C C_U			

●		☒		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4 **#200**	**100.0** **96.84**	**#4** **#200**	**100.0** **97.35**	**#4** **#200**	**100.0** **98.84**

SOIL DESCRIPTION
- ● FAT CLAY (CH)
- ☒ FAT CLAY (CH)
- ▲

REMARKS
- ●
- ☒
- ▲

PROJECT: Beck Landfill - Southeast Section

SITE: 550 FM 78
Schertz, TX

Terracon
6911 Blanco Rd
San Antonio, TX

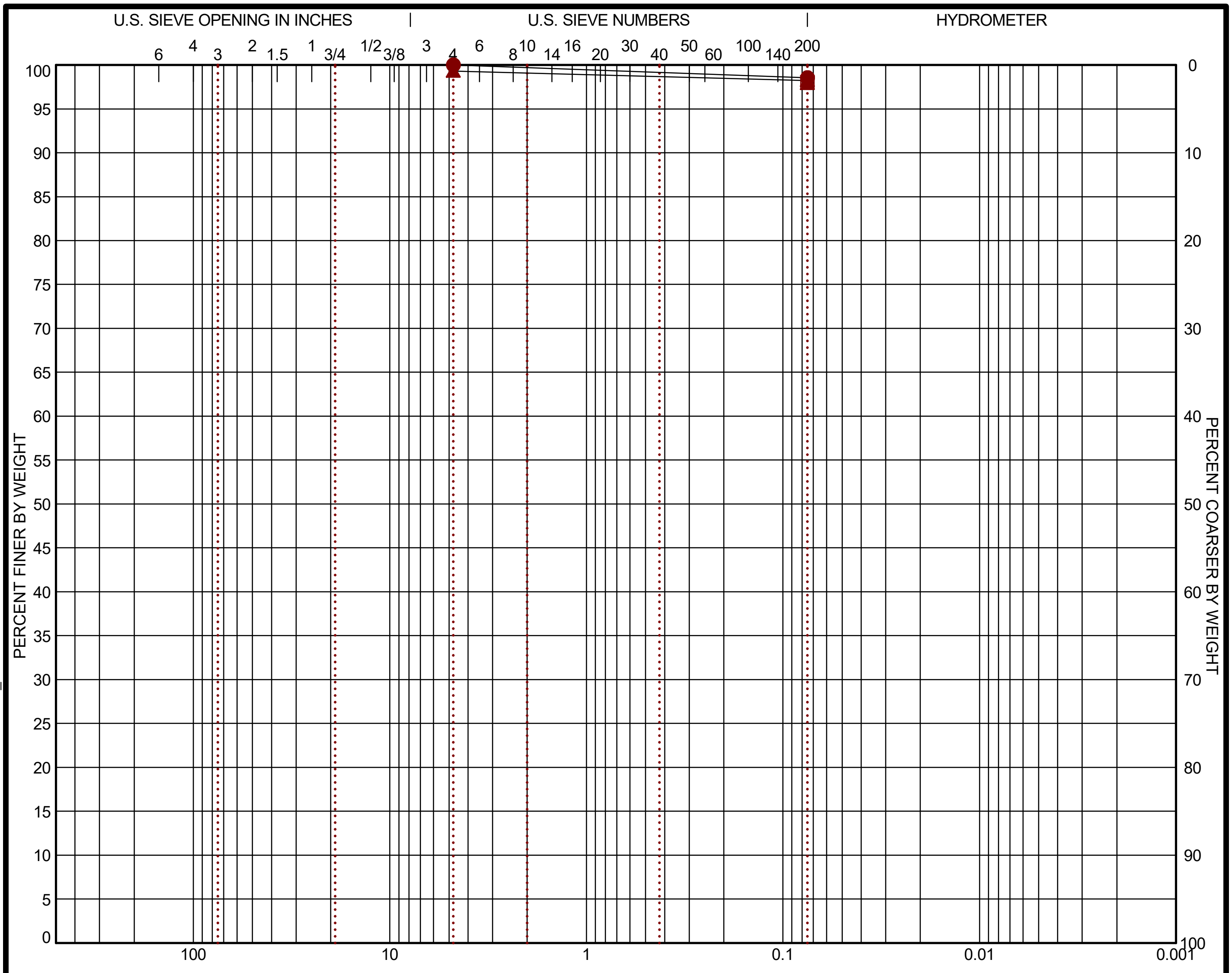
PROJECT NUMBER: 90205235

CLIENT: Nido Ltd
San Antonio, TX

EXHIBIT: B-3

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**FB-6**	**2 - 4**	**0.0**	**0.0**	**1.5**		**98.5**		**CH**
☒	**FB-6**	**6 - 8**					**98.0**		**CL**
▲	**FB-6**	**18.5 - 19.5**			**1.1**		**98.2**		

	GRAIN SIZE		
	●	☒	▲
D$_{60}$			
D$_{30}$			
D$_{10}$			
	COEFFICIENTS		
C$_C$			
C$_U$			

●		☒		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4 **#200**	**100.0** **98.54**	**#200**	**98.01**	**#4** **#200**	**99.31** **98.23**

SOIL DESCRIPTION

● FAT CLAY (CH)

☒ LEAN CLAY (CL)

▲

REMARKS

●

☒

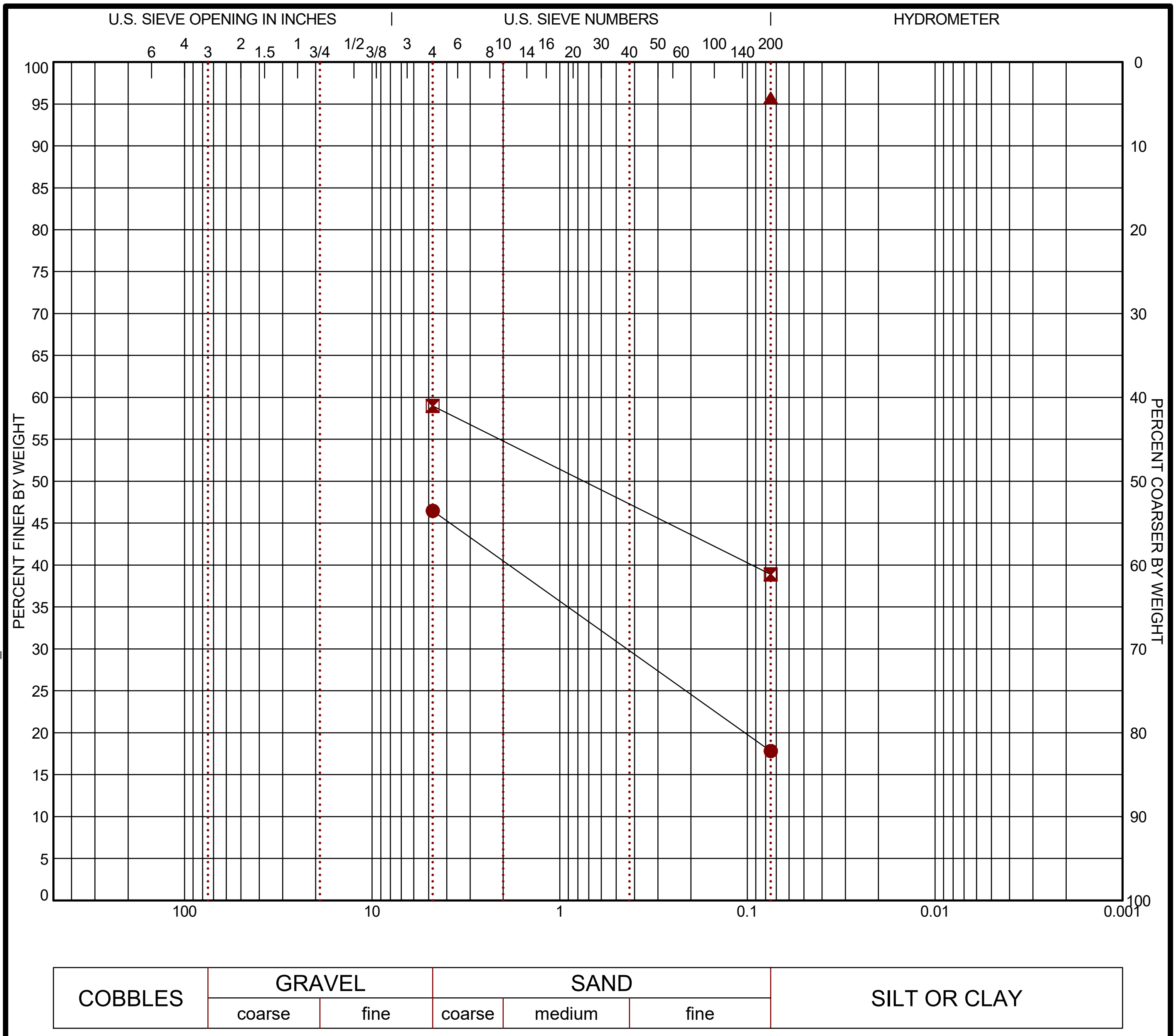
▲

PROJECT: Beck Landfill - Southeast Section	PROJECT NUMBER: 90205235
SITE: 550 FM 78 Schertz, TX	CLIENT: Nido Ltd San Antonio, TX
	EXHIBIT: B-3

Terracon
6911 Blanco Rd
San Antonio, TX

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**FB-7**	**4.5 - 6**			**28.6**		**17.8**		
☒	**FB-7**	**8.5 - 10**			**20.1**		**38.9**		
▲	**FB-7**	**18 - 20**					**95.7**		**CH**

	GRAIN SIZE		
	●	☒	▲
D_{60}			
D_{30}	**0.437**		
D_{10}			
	COEFFICIENTS		
C_C			
C_U			

●		☒		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4 **#200**	**46.47** **17.82**	**#4** **#200**	**58.97** **38.89**	**#200**	**95.74**

SOIL DESCRIPTION
- ●
- ☒
- ▲ FAT CLAY (CH)

REMARKS
- ●
- ☒
- ▲

PROJECT: Beck Landfill - Southeast Section

SITE: 550 FM 78
Schertz, TX

Terracon
6911 Blanco Rd
San Antonio, TX

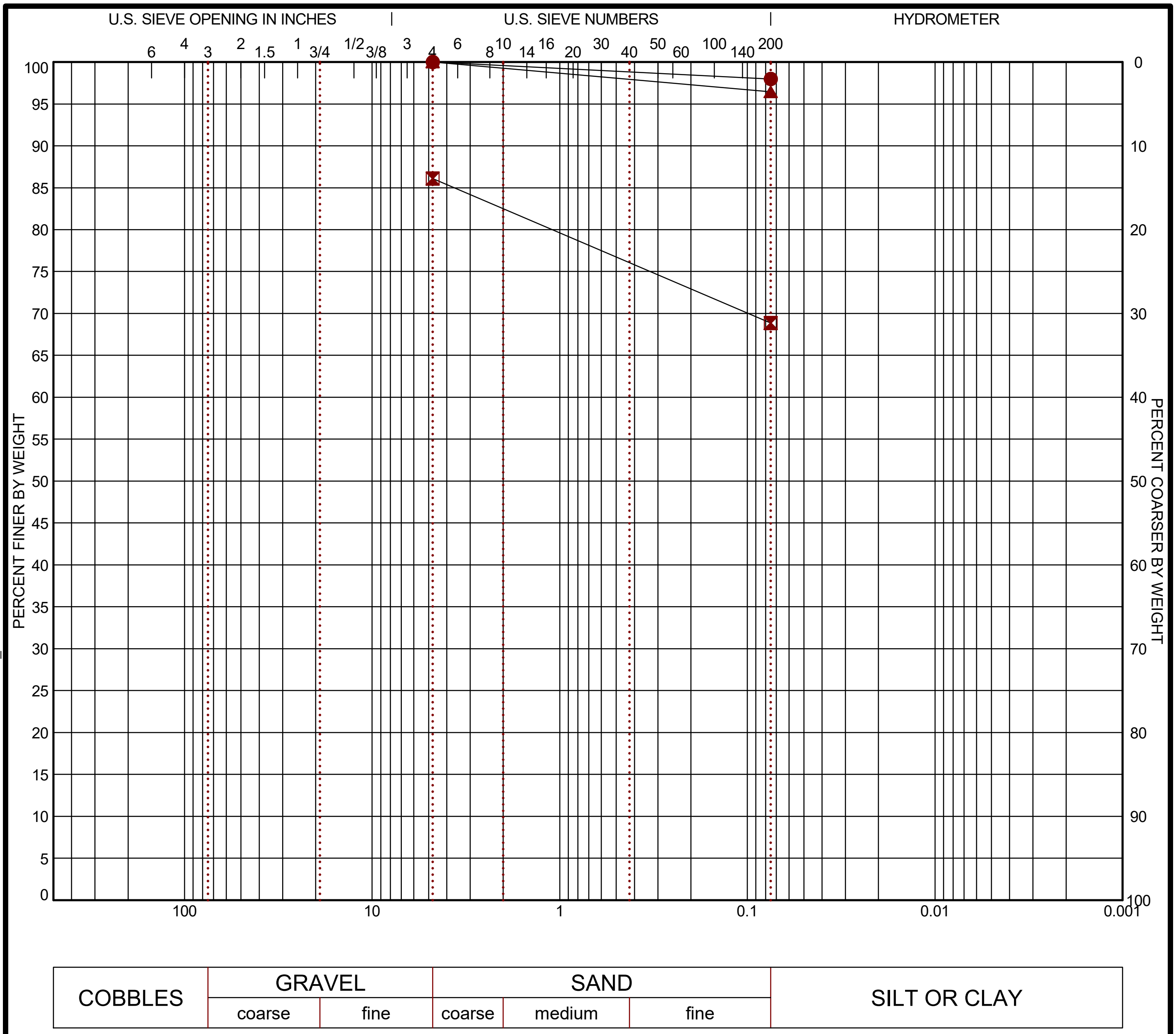
PROJECT NUMBER: 90205235

CLIENT: Nido Ltd
San Antonio, TX

EXHIBIT: B-3

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**FB-7**	**38.5 - 39.8**	**0.0**	**0.0**	**2.0**		**98.0**		**CH**
☒	**FB-8**	**6.5 - 8**			**17.2**		**68.9**		
▲	**FB-8**	**33.5 - 34**	**0.0**	**0.0**	**3.6**		**96.4**		**CL**

	GRAIN SIZE		
	●	☒	▲
D_{60}			
D_{30}			
D_{10}			
	COEFFICIENTS		
C_C			
C_U			

●		☒		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4 **#200**	**100.0** **97.97**	**#4** **#200**	**86.11** **68.86**	**#4** **#200**	**100.0** **96.43**

SOIL DESCRIPTION

● FAT CLAY (CH)

☒

▲ LEAN CLAY (CL)

REMARKS

●

☒

▲

PROJECT: Beck Landfill - Southeast Section

SITE: 550 FM 78
Schertz, TX

Terracon
6911 Blanco Rd
San Antonio, TX

PROJECT NUMBER: 90205235

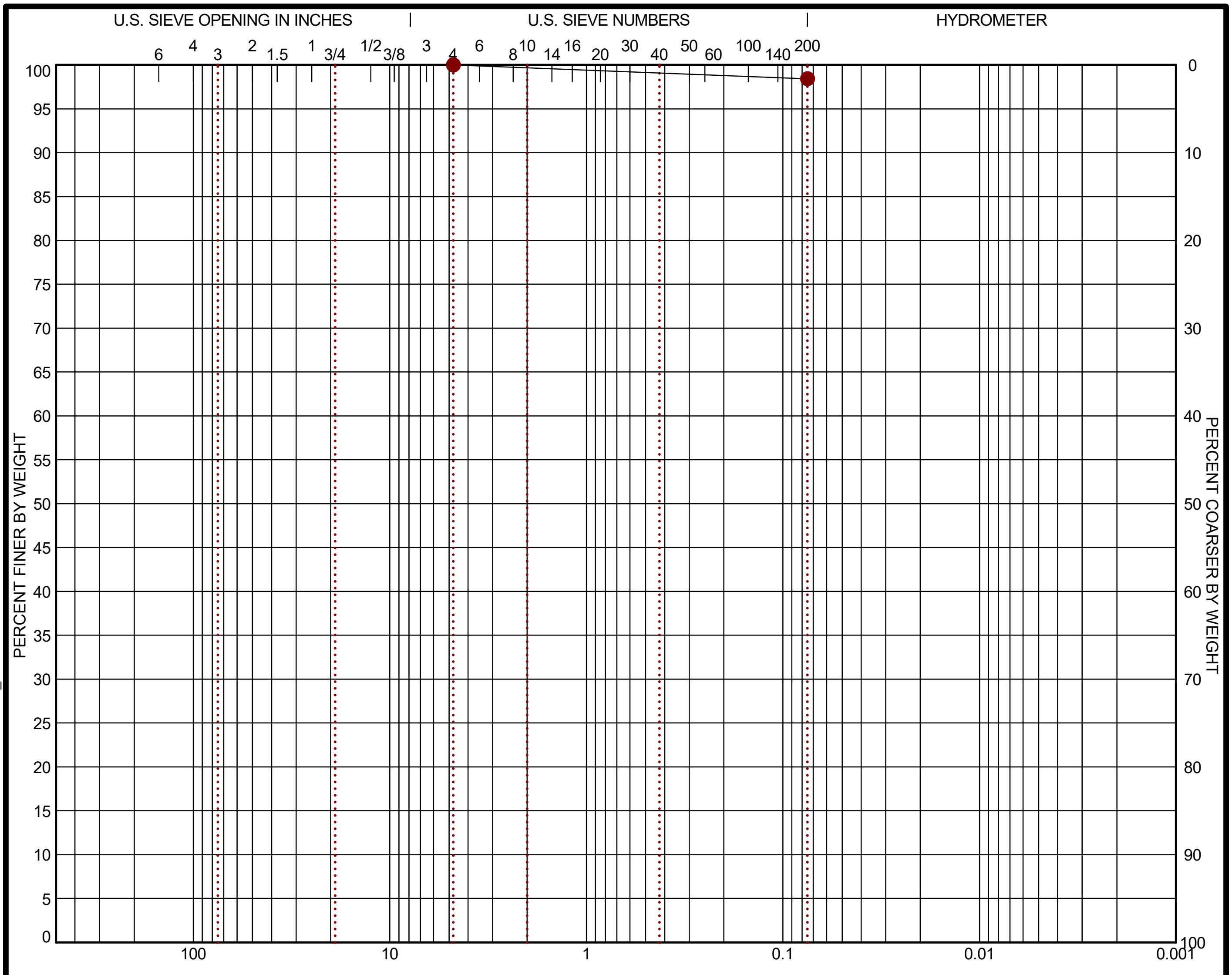
CLIENT: Nido Ltd
San Antonio, TX

EXHIBIT: B-3

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 90205235 BECK LANDFILL - S.GPJ TERRACON_DATATEMPLATE.GDT 10/20/20

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**FB-8**	**49 - 50**	**0.0**	**0.0**	**1.6**		**98.4**		

	GRAIN SIZE		
	●		
D_{60}			
D_{30}			
D_{10}			
	COEFFICIENTS		
C_C			
C_U			

●					
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4 **#200**	**100.0** **98.43**				

SOIL DESCRIPTION
●

REMARKS
●

PROJECT: Beck Landfill - Southeast Section

SITE: 550 FM 78
Schertz, TX

Terracon
6911 Blanco Rd
San Antonio, TX

PROJECT NUMBER: 90205235

CLIENT: Nido Ltd
San Antonio, TX

EXHIBIT: B-3

Terracon

Permeability Test
ASTM D 5084

EXHIBIT B-4

Project Number: 90205235 Undisturbed
Project : Beck Landfill - Southeast Section
Description: Gray Clay-Shale

Date: 10-15-2020
Location : FB-2, 38-40 ft.
Tested by: MM/Sam

Before Test

Specimin Data		
Length(in)	2.60	
Diameter(in)	2.76	
Length(cm)	6.60	
Diameter(cm)	7.00	
Specific Gravity	2.78	Assumed
Wet Weight(gm)	527.38	
Area(cm^2)	38.51	
Volume(cc)	254.29	
Moisture Data	E5	
Wet Wt.+Tare(gm)	161.75	
Dry Wt.+Tare(gm)	143.99	
Tare Weight(gm)	48.63	
Moisture(%)	18.62	
Weight/Volume Data		
Wet Weight(pcf)	129.5	
Dry Weight(pcf)	109.1	
Vol.Voids(cc)	94.0	
Void Ratio	0.587	
Saturation(%)	88.3	
Cell(psi)	90	
Backpressure(psi)	60	

After Test

Specimin Data	
Length(in)	2.60
Diameter(in)	2.78
Length(cm)	6.60
Diameter(cm)	7.06
Wet Weight(gm)	548.10
Area(cm)	39.16
Volume(cc)	258.62
Moisture Data	L1
Wet Wt. + Tare	205.42
Dry Wt. + Tare	197.73
Tare Weight	164.47
Moisture(%)	23.12
Weight/Volume Data	
Wet Weight(pcf)	132.3
Dry Weight(pcf)	107.5
Vol.Voids(cc)	98.8
Void Ratio	0.619
Saturation(%)	100.0
a-in (cm^2)	0.7671
a-out (cm^2)	0.0314

BEFORE		
DIA	LENGTH	
2.78	2.60	
2.73	2.60	
2.76	2.60	
2.76	2.60	Average
AFTER		
DIA	LENGTH	
2.78	2.60	
2.78	2.60	
2.78	2.60	
2.78	2.60	Average

Test Constants	
M1=	0.03018
M2=	1.040953
S=	0.16864
G=	12.542
C=	4.058E-04

Actual Date (mm/dd/yy)	Actual Time (hh:mm:ss)	Elapsed Time (seconds)	Temperature (Fahren.)	(Cels)	a - in Outflow (mm)	a - out Inflow (mm)	Gradient	Trial Constant T	Hydraulic Conductivity (20C,cm/sec)
10/12/2020	**5:00:00 PM**	**0**	**73.4**	**23.0**	**225.5**	**8.46**	**44.5**		
10/13/2020	**9:00:00 AM**	**57600**	**73.4**	**23.0**	**172.5**	**10.63**	**33.2**	**0.04796**	**1.9E-09**
10/13/2020	**9:00:00 AM**	**0**	**73.4**	**23.0**	**172.5**	**10.63**	**33.2**		
10/13/2020	**4:00:00 PM**	**25200**	**73.4**	**23.0**	**153**	**11.43**	**29.0**	**0.06431**	**2.0E-09**
10/13/2020	**4:00:00 PM**	**0**	**73.4**	**23.0**	**153**	**11.43**	**29.0**		
10/14/2020	**9:00:00 AM**	**61200**	**73.4**	**23.0**	**120.5**	**12.76**	**22.1**	**0.07353**	**1.7E-09**
10/14/2020	**9:00:00 AM**	**0**	**73.4**	**23.0**	**120.5**	**12.76**	**22.1**		
10/14/2020	**4:00:00 PM**	**25200**	**73.4**	**23.0**	**110.5**	**13.17**	**20.0**	**0.09662**	**1.5E-09**

Coefficient of permeability, $k_{20°}$ (cm/sec) **1.8E-09**

Permeability Test
ASTM D 5084

EXHIBIT B-4

Project Number: 90205235 Undisturbed
Project : Beck Landfill - Southeast Section
Description: Gray Clay-Shale

Date: 10-15-2020
Location : FB-4, 1-2 ft.
Tested by: MM/Sam

Before Test

Specimin Data		
Length(in)	**2.51**	
Diameter(in)	**2.74**	
Length(cm)	**6.38**	
Diameter(cm)	**6.95**	
Specific Gravity	2.78	Assumed
Wet Weight(gm)	516.55	
Area(cm^2)	**37.95**	
Volume(cc)	**241.94**	
Moisture Data	2T	
Wet Wt.+Tare(gm)	161.61	
Dry Wt.+Tare(gm)	143.50	
Tare Weight(gm)	48.39	
Moisture(%)	**19.04**	
Weight/Volume Data		
Wet Weight(pcf)	**133.3**	
Dry Weight(pcf)	**112.0**	
Vol.Voids(cc)	**85.5**	
Void Ratio	**0.547**	
Saturation(%)	**96.8**	
Cell(psi)	65	
Backpressure(psi)	60	

After Test

Specimin Data	
Length(in)	**2.51**
Diameter(in)	**2.76**
Length(cm)	**6.38**
Diameter(cm)	**7.02**
Wet Weight(gm)	532.26
Area(cm)	**38.69**
Volume(cc)	**246.68**
Moisture Data	201
Wet Wt. + Tare	130.82
Dry Wt. + Tare	117.04
Tare Weight	60.01
Moisture(%)	**24.16**
Weight/Volume Data	
Wet Weight(pcf)	**134.7**
Dry Weight(pcf)	**108.5**
Vol.Voids(cc)	**92.8**
Void Ratio	**0.603**
Saturation(%)	**100.0**
a-in (cm^2)	**0.7671**
a-out (cm^2)	**0.0314**

BEFORE		
DIA	LENGTH	
2.74	2.51	
2.73	2.51	
2.74	2.51	
2.74	**2.51**	Average

AFTER		
DIA	LENGTH	
2.78	2.51	
2.76	2.51	
2.75	2.51	
2.76	**2.51**	Average

Test Constants	
M1=	**0.03018**
M2=	**1.040953**
S=	**0.164772**
G=	**12.542**
C=	**3.965E-04**

Actual Date (mm/dd/yy)	Actual Time (hh:mm:ss)	Elapsed Time (seconds)	Temperature (Fahren.)	Temperature (Cels)	a - in Outflow (mm)	a - out Inflow (mm)	Gradient	Trial Constant T	Hydraulic Conductivity (20C,cm/sec)
10/12/2020	**8:00:00 AM**	**0**	**73.4**	**23.0**	**119**	**12.82**	**22.6**		
10/12/2020	**10:00:00 AM**	**7200**	**73.4**	**23.0**	**113.5**	**13.05**	**21.3**	**0.09804**	**2.8E-09**
10/12/2020	**10:00:00 AM**	**0**	**73.4**	**23.0**	**113.5**	**13.05**	**21.3**		
10/12/2020	**12:00:00 PM**	**7200**	**73.4**	**23.0**	**109**	**13.23**	**20.3**	**0.10363**	**2.4E-09**
10/12/2020	**12:00:00 PM**	**0**	**73.4**	**23.0**	**109**	**13.23**	**20.3**		
10/12/2020	**2:00:00 PM**	**7200**	**73.4**	**23.0**	**104.5**	**13.42**	**19.3**	**0.10869**	**2.6E-09**
10/12/2020	**2:00:00 PM**	**0**	**73.4**	**23.0**	**104.5**	**13.42**	**19.3**		
10/12/2020	**4:00:00 PM**	**7200**	**73.4**	**23.0**	**101**	**13.56**	**18.6**	**0.11428**	**2.1E-09**

Coefficient of permeability, k_{20° (cm/sec) **2.5E-09**

Terracon

Permeability Test
ASTM D 5084

EXHIBIT B-4

Project Number: 90205235 Undisturbed
Project : Beck Landfill - Southeast Section
Description: Gray Clay-Shale

Date: 10-15-2020
Location FB-6, 6-8
Tested by: MM/Sam

Before Test

Specimin Data		
Length(in)	2.50	
Diameter(in)	2.74	
Length(cm)	6.35	
Diameter(cm)	6.97	
Specific Gravity	2.78	Assumed
Wet Weight(gm)	540.54	
Area(cm^2)	38.13	
Volume(cc)	242.15	
Moisture Data	E12	
Wet Wt.+Tare(gm)	164.27	
Dry Wt.+Tare(gm)	149.78	
Tare Weight(gm)	48.88	
Moisture(%)	14.36	
Weight/Volume Data		
Wet Weight(pcf)	139.4	
Dry Weight(pcf)	121.9	
Vol.Voids(cc)	71.8	
Void Ratio	0.421	
Saturation(%)	94.8	
Cell(psi)	65	
Backpressure(psi)	60	

After Test

Specimin Data	
Length(in)	2.51
Diameter(in)	2.79
Length(cm)	6.38
Diameter(cm)	7.09
Wet Weight(gm)	563.54
Area(cm)	39.44
Volume(cc)	251.46
Moisture Data	R
Wet Wt. + Tare	124.85
Dry Wt. + Tare	113.6
Tare Weight	61.24
Moisture(%)	21.49
Weight/Volume Data	
Wet Weight(pcf)	139.9
Dry Weight(pcf)	115.2
Vol.Voids(cc)	85.0
Void Ratio	0.510
Saturation(%)	100.0
a-in (cm^2)	0.7671
a-out (cm^2)	0.0314

BEFORE		
DIA	LENGTH	
2.75	2.50	
2.74	2.50	
2.74	2.50	
2.74	2.50	Average
AFTER		
DIA	LENGTH	
2.79	2.51	
2.79	2.51	
2.79	2.51	
2.79	2.51	Average

Test Constants	
M1=	0.03018
M2=	1.040953
S=	0.161637
G=	12.542
C=	3.890E-04

Actual Date (mm/dd/yy)	Actual Time (hh:mm:ss)	Elapsed Time (seconds)	Temperature (Fahren.)	Temperature (Cels)	a - in Outflow (mm)	a - out Inflow (mm)	Gradient	Trial Constant T	Hydraulic Conductivity (20C,cm/sec)
10/12/2020	8:00:00 AM	0	73.4	23.0	120.5	12.76	22.9		
10/12/2020	10:00:00 AM	7200	73.4	23.0	111	13.15	20.8	0.09662	4.8E-09
10/12/2020	10:00:00 AM	0	73.4	23.0	111	13.15	20.8		
10/12/2020	12:00:00 PM	7200	73.4	23.0	103	13.48	19.0	0.10638	4.5E-09
10/12/2020	12:00:00 PM	0	73.4	23.0	103	13.48	19.0		
10/12/2020	2:00:00 PM	7200	73.4	23.0	96	13.76	17.5	0.11628	4.3E-09
10/12/2020	2:00:00 PM	0	73.4	23.0	96	13.76	17.5		
10/12/2020	4:00:00 PM	7200	73.4	23.0	90.5	13.99	16.3	0.12658	3.6E-09

Coefficient of permeability, k_{20° (cm/sec) **4.3E-09**

Terracon

Permeability Test
ASTM D 5084

EXHIBIT B-4

Project Number: 90205235 Undisturbed
Project : Beck Landfill - Southeast Section
Description: Gray Clay-Shale

Date: 10-15-2020
Location : FB-7, 18-20 ft.
Tested by: MM/Sam

Before Test

Specimin Data		
Length(in)	2.51	
Diameter(in)	2.78	
Length(cm)	6.38	
Diameter(cm)	7.05	
Specific Gravity	2.78	Assumed
Wet Weight(gm)	537.06	
Area(cm^2)	39.07	
Volume(cc)	249.06	
Moisture Data	E16	
Wet Wt.+Tare(gm)	179.64	
Dry Wt.+Tare(gm)	159.46	
Tare Weight(gm)	48.2	
Moisture(%)	18.14	
Weight/Volume Data		
Wet Weight(pcf)	134.6	
Dry Weight(pcf)	113.9	
Vol.Voids(cc)	85.2	
Void Ratio	0.520	
Saturation(%)	97.0	
Cell(psi)	72	
Backpressure(psi)	60	

After Test

Specimin Data	
Length(in)	2.51
Diameter(in)	2.78
Length(cm)	6.38
Diameter(cm)	7.06
Wet Weight(gm)	550.70
Area(cm)	39.16
Volume(cc)	249.66
Moisture Data	B-1
Wet Wt. + Tare	242.73
Dry Wt. + Tare	226.45
Tare Weight	158.28
Moisture(%)	23.88
Weight/Volume Data	
Wet Weight(pcf)	137.7
Dry Weight(pcf)	111.2
Vol.Voids(cc)	90.1
Void Ratio	0.565
Saturation(%)	100.0
a-in (cm^2)	0.7671
a-out (cm^2)	0.0314

BEFORE		
DIA	LENGTH	
2.78	2.51	
2.77	2.51	
2.78	2.51	
2.78	2.51	Average
AFTER		
DIA	LENGTH	
2.78	2.51	
2.78	2.51	
2.78	2.51	
2.78	2.51	Average

Test Constants	
M1=	0.03018
M2=	1.040953
S=	0.162802
G=	12.542
C=	3.918E-04

Actual Date (mm/dd/yy)	Actual Time (hh:mm:ss)	Elapsed Time (seconds)	Temperature (Fahren.)	(Cels)	a - in Outflow (mm)	a - out Inflow (mm)	Gradient	Trial Constant T	Hydraulic Conductivity (20C,cm/sec)
10/12/2020	**5:00:00 PM**	**0**	**73.4**	**23.0**	**240**	**7.87**	**49.3**		
10/13/2020	**9:00:00 AM**	**57600**	**73.4**	**23.0**	**147.5**	**11.65**	**28.9**	**0.04484**	**3.4E-09**
10/13/2020	**9:00:00 AM**	**0**	**73.4**	**23.0**	**147.5**	**11.65**	**28.9**		
10/13/2020	**4:00:00 PM**	**25200**	**73.4**	**23.0**	**121**	**12.74**	**23.0**	**0.07663**	**3.3E-09**
10/13/2020	**4:00:00 PM**	**0**	**73.4**	**23.0**	**121**	**12.74**	**23.0**		
10/14/2020	**9:00:00 AM**	**61200**	**73.4**	**23.0**	**82**	**14.34**	**14.4**	**0.09615**	**2.8E-09**
10/14/2020	**9:00:00 AM**	**0**	**73.4**	**23.0**	**82**	**14.34**	**14.4**		
10/14/2020	**4:00:00 PM**	**25200**	**73.4**	**23.0**	**71**	**14.79**	**11.9**	**0.15384**	**2.7E-09**

Coefficient of permeability, k_{20° (cm/sec) **3.0E-09**

APPENDIX C

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

▯ **Auger**	☒ **Split Spoon**
▮ **Shelby Tube**	▥ **Macro Core**
▯ **Ring Sampler**	▮ **Rock Core**
✋ **Grab Sample**	⧄ **No Recovery**

WATER LEVEL

▽	**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.

FIELD TESTS

(HP)	**Hand Penetrometer**
(T)	**Torvane**
(b/f)	**Standard Penetration Test (blows per foot)**
(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 Includes gravels, sands and silts.			**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.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, tsf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 0.25	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	0.25 to 0.50	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	0.50 to 1.00	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	1.00 to 2.00	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	2.00 to 4.00	15 - 30	19 - 42
			Hard	> 4.00	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	**Percent of Dry Weight**
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	**Particle Size**
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	**Percent of Dry Weight**
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	**Plasticity Index**
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Terracon

Exhibit C-1

UNIFIED SOIL CLASSIFICATION SYSTEM

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]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [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]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [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" line [J]		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.

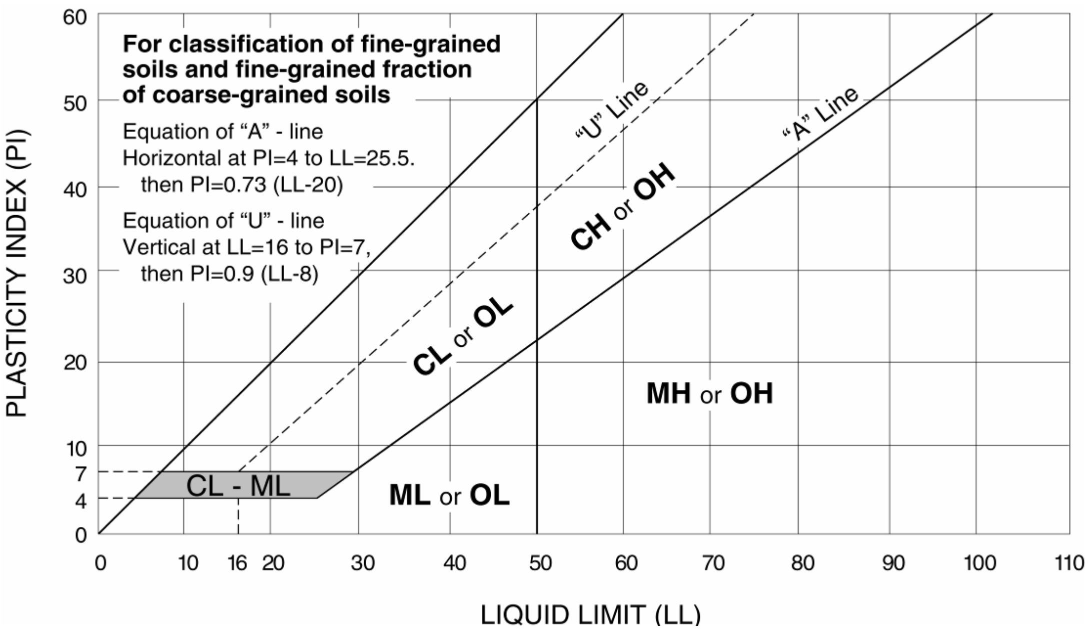
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] $PI \geq 4$ 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.


For classification of fine-grained soils and fine-grained fraction of coarse-grained soils

Equation of "A" - line
Horizontal at PI=4 to LL=25.5.
then PI=0.73 (LL-20)

Equation of "U" - line
Vertical at LL=16 to PI=7,
then PI=0.9 (LL-8)

Terracon

Exhibit C-2

APPENDIX E-4
CROSS-SECTIONS

Pending Update by POWER Engineers, Inc.

MUNICIPAL SOLID WASTE PERMIT MAJOR AMENDMENT

Groundwater Sampling and Analysis Plan

(TAC Title 30 Rule §330.63(f))

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: September 2022

Prepared by:

PROJECT NUMBER: 150051.05.01

PROJECT CONTACT: *Julie Morelli*

EMAIL: *Julie.Morelli@powereng.com*

PHONE: 210-951-6424

Groundwater Sampling and Analysis Plan

OVERVIEW

The following Groundwater Sampling and Analysis Plan (GWSAP) is prepared for the Beck Landfill, Nido, LTD. Type IV Landfill (Beck Landfill), MSW Permit No. 1848A, located in Schertz,, Guadalupe County, Texas in accordance with the regulations in 30 TAC §330.417 (relating to Groundwater Monitoring at Type IV Landfills).

This GWSAP is included as Attachment F, Appendix F-2 of Part III of the Beck Landfill permit application submitted in September 2022. It is intended to provide a consistent sampling and analysis procedure and is designed to ensure that ground-water data accurately represents actual groundwater quality and can be used to reliably evaluate the groundwater conditions at this site.

Table of Contents

Beck Landfill, Nido, LTD.
Type IV Landfill
Schertz, Guadalupe County, Texas
MSW Permit No. 1848
Groundwater Sampling and Analysis Plan (GWSAP)

Beck Landfill, Nido, LTD. has developed the following Groundwater Sampling and Analysis Plan (GWSAP) for the Guadalupe County Landfill in Schertz, MSW Permit No. 1848, in accordance with the regulations in 30 TAC §330.417 (relating to Groundwater Monitoring at Type IV Landfills). This GWSAP is submitted as a modification to the Site Operating Plan and is intended to provide a consistent sampling and analysis procedure. It is designed to ensure that ground-water data accurately represents actual groundwater quality and can be used to reliably evaluate the groundwater conditions at this site.

PROCEDURES:

I *Timing and Order of Purging or Sampling*

The elapsed time between well purging and sample collection should be as short as possible to avoid temporal variations in water levels and water chemistry. Sampling should be done preferably within 24 hours of purging. If a well is very slow to recharge, it should be sampled as soon as practicable; a maximum of seven days may be acceptable with prior TCEQ approval.

The wells will be sampled from the up-gradient well to the down-gradient well, sequentially beginning with the well on Line A and proceeding as follows: Line A to Line C to Line D to Line F to Line G. See gradient map attached directly behind this page.

If contamination is known to be present, sampling should proceed from the monitoring well least or not contaminated to the well with the most contamination.

II *Well Inspection*

Inspect the integrity of the monitoring well prior to commencement of purging and/or sampling the well. The inspection of the well should be documented on a Field Log Data Sheet.

- Check the casing and concrete pad for cracks or fissures. Be sure that vandalism, animals, heavy equipment, etc have not damaged the well.
- Check that the cap is locked.
- Check that the well plug cap is tightened to prevent surface runoff infiltration into the well.
- Note the proximity of the well to potential sources of contamination on a Field Log Data Sheet.
- If insects are found in or on the well casing, do NOT use organic sprays or other potential contaminants to remove them.
- Similarly, organic lubricants should not be used on well components such as locks.

III *Water-Level Measurements*

Prior to purging or sampling of a well, measure the depth to water to determine water level and to be sure that enough water is present for sampling. Follow these steps for proper measurements.

- Decontaminate the measurement probe prior to use in each well by washing with a phosphate-free soap and rinsing with reagent grade water, obtained from the laboratory, or commercially distilled water.
- Calibrate measurement probes regularly to determine the stretch of suspended measuring tapes, wires, or cables.
- Measure from the top of the well casing, identified on the Monitor Well Data Sheets, for each well. Record the depth to water to the nearest hundredth of a foot.
- Calculate the elevation of the water level with respect to mean sea level (msl) and record it to the nearest hundredth of a foot.

IV *Well Purging*

- Wells should be purged of stagnant water with a bailer (or a pump) 24 hours prior to sampling to obtain a chemically representative ground water sample from each well.
- To assure comparability of the ground-water samples collected from the site, the same type of purging equipment should generally be used in each of the site wells.
- Each well will be purged with a disposable bailer or using a submersible pump and disposable tubing, so that the well does not become contaminated during sampling.
- Bailers should be bottom-emptying devices, so that the bailer can be emptied slowly, with minimum aeration.
- Care should be taken during purging to avoid introducing contaminants to the water in the well. Use disposable, plastic or vinyl gloves, changed between each well, to avoid cross-contamination. Latex gloves can cause contamination.
- Purging should be performed in such a way as to minimize the stirring of sediments with the waters in the well. Lower the bailer (or pump) gently. Do NOT drop the bailer (or pump) to the bottom of the screen in the well. Pull the bailer (or pump) to the surface slowly. (If a pump is used, pump intakes should not be set too close to the bottom of the well.)
- If possible, purge at least three times the total volume of water determined to be in the well casing from the measurements made in Section II.

Example: Volume = pi * r2 * h

Where -
pi = 3.14159265
r = radius of the casing
h = height of the water column in the well

V = pi * (.17')2 * (4') = .36 cu. ft.

Conversion to gallons (7.48052 gallons per cubic foot)
0.36 cu. ft * 7.48052 = 2.7 gallons Volume *
3 = 8.1 gallons

Note: The casing volume is the amount of water in the casing itself prior to purging and does not include the volume of water in the filter pack.

These wells recharge very slowly. If insufficient water is available to be removed from the well, purging to dryness is sufficient to remove stagnant water.

Allow the well to recover enough to allow collection of samples. Where possible, the water level should be allowed to recover to within 90% of the water level established prior to purging.

Record the following data collected on a Field Log Data Sheet (See Attachment 1):

- The initial depth to water (DTW),
- measured well depth (total depth (TD)),
- height of the water column,
- well purging time,
- volume of water purged from the well,
- purging discharge rate, and
- information from the well inspection.

Purged water should be containerized and may be returned to the landfill or disposed of through the local POTW, with written permission. Purged water should be placed inside the landfill perimeter, such that it will not commingle with or discharge via surface runoff.

V *Sample Collection and Preservation*

Sample collection, preservation and shipment to the laboratory are important steps in the sampling process. Physical or chemical changes occur in ground-water samples no matter how carefully sampling is done. Inappropriate sampling devices, collection procedures, preservatives and temperature controls, or inadequate shipment can damage sample quality, giving inaccurate results.

V.1 Sample Collection and Preparation

The need to minimize turbulence and aeration of the sample can not be overemphasized.

- Fill sample containers directly from the bailer (or pump tubing) when possible. Transfer containers are not recommended for sample collection because of the likelihood of cross-contamination.

- Do not reuse soiled sample containers, bailers and bailer rope, disposable tubing, or plastic (or vinyl) gloves.
- Where possible, keep clean equipment off the ground to prevent contamination once the equipment is cleaned.
- Handle water removed during sampling and not saved in the same way as purged water.
- Do not allow the sampling device to touch the sampling container, but hold the two as close as possible to reduce aeration.
- Check the area around the sampling point for possible sources of air contamination.

V.2 Field Measurements

- The equipment used for field measurements should be calibrated at least daily during sampling.
- Slowly pour an unfiltered portion into a clean container for field measurement of temperature, specific conductance, and pH.
- Measure and record the temperature immediately.
- Measure and record the specific conductance of the sample to avoid any effect on the sample from salts from the pH probe.
- Measure and record the pH.
- Record the color, odor, foaming, presence of more than one phase of liquid, and turbidity of the sample.

V.3 Sample Containers

The volume of samples and types of sample containers needed are described in Table 1 below. Volumes and containers have been selected in accordance with methods specified in “Test Methods for Evaluating Solid Waste, Physical/Chemical Methods” (United States Environmental Protection Agency (EPA) Publication Number SW-846). To avoid confusion, the number of containers collected from each well will be minimized.

Label all sample containers with indelible ink for identification purposes. Alternatively, cover the sample label with clear packing tape and place the sample container inside a ziplock bag before placing on ice. The label information should include:

- sample number,
- well number,
- site identification,
- analysis to be performed,
- preservatives used,
- date and time of sample collection, and
- name of sampler.

Fill the sample containers in the following order:

1) Non-Purgeable Organics (NPOC)
2) Metals
3) Other Inorganic Parameters

Fill replicate sample containers for NPOC from a single bailer to improve homogeneity in the samples.

V.4 Sample Containers, Preservation and Holding Times

Holding times and sample volumes required for each analysis have been reviewed with the laboratory. Sample preservation is intended to 1) retard biological action, 2) retard hydrolysis, and 3) reduce sorption effects. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and protection from light. Specific preservation methods presented in Table 1, below, are in accordance with the EPA requirements of SW-846, "Test Methods for Evaluating Solid Waste", 3rd Edition as revised and updated or Standard Methods for the Examination of Water and Wastewater, 21st Edition as revised and updated.

Table 1

Parameter	Sample Container	Preservative	Replicates	Holding Time
pH	1 Liter Glass Bottle	Ice	No	Analyze Immediately
Specific Conductance	1 Liter Plastic Bottle	Ice	No	28 days
Non-Purgeable Organics (TOC)	100 mL Amber VOA	Ice, HCL or H2SO4	Three	2 hours (28 days if acidified)
Total Dissolved Solids	1 Liter Plastic Bottle	Ice	No	7 days
Chloride	1 Liter Plastic Bottle	Ice	No	28 Days
Iron (dissolved)	1 Liter Plastic Bottle	Ice, (HNO3 if filtered)	No	6 Months
Manganese (dissolved)	1 Liter Plastic Bottle	Ice, (HNO3 if filtered)	No	6 Months
Cadmium (dissolved)	1 Liter Plastic Bottle	Ice, (HNO3 if filtered)	No	6 Months
Zinc (dissolved)	1 Liter Plastic Bottle	Ice, (HNO3 if filtered)	No	6 Months

Note: See Table 4 at the end of this report for Background Parameters

V.5 QC Samples (Trip Blanks, Field Blanks, Replicates)

- One field blank will be used during each sampling event to identify possible sources of air pollutant contamination originating at the onsite ready mix plant.
- Three Replicate samples will be collected during each sampling event for analysis of Non-Purgeable Organic Compounds.
- One sample duplicate will be collected for analysis of Volatile Organic Compounds during Background Sampling.

V.6 Sample Storage and Transport

- All samples should be kept cold, ideally at 4°C, and transported to the laboratory within 2 days of sampling.
- Samples should be kept in re-sealable bags, then in an ice chest and packed with sufficient ice or re-freezeable materials to keep then as near 4°C as possible. DON'T USE DRY ICE TO CHILL THE SAMPLES BECAUSE THE SAMPLES WILL FREEZE AND THE CONTAINERS
- WILL BREAK.
- If the samples are shipped, they and the insulated container should first be chilled with ice. Pour off the ice and water, and keep cold during shipment with frozen packages of re-freezeable materials such as "blue ice."
- The insulated container needs to be packed inside with foam, newspaper, or an absorbent material such as vermiculite to prevent or minimize the likelihood of container breakage, then thoroughly sealed with cloth tape or reinforced shipping tape.
- Inexpensive foam chests are NOT suitable for shipping.
- Under NO circumstances, should water, ice, or dry ice be used for samples shipped via public transportation (i.e. the bus).

V.7 Chain-of-Custody Documentation

- A suitable chain-of-custody (COC) document must accompany the samples at every step from field to laboratory and must be signed by each party handling the samples, from sampler through transporter to the laboratory, to document the possession of the samples at all times. Proper COC procedures are essential to ensure sample integrity and to provide legally and technically defensible data.
- The person collecting the sample starts the COC procedure.
- Individuals relinquishing and receiving the samples sign, date, and note the time of the transfer on the COC form (see attachment 2).
- Packages sent by mail should be certified with return receipt requested to document shipment.
- For packages sent by common carrier, a copy of the bill of lading will suffice.

- Copies of the return receipt or bill of lading should be attached to the COC document.
- The COC document must accompany the sample during transport and shipping, and should be protected from moisture using sealable plastic bags.

V.8 Documentation of Sampling

- Information related to a sampling event should be recorded in a bound, permanent field log book or on Field Log Data Sheets.
- All entries should be legible and made in indelible ink.
- Entry errors should be crossed out with a single line, dated, and initialed by the person making corrections.
- Record sufficient information so that the sampling situation can be reconstructed without relying on the sampler's memory.
- Location, date, time, weather conditions, name and identity of sampling personnel, all field measurements, including numerical values and units, comments about the integrity of the well, etc., should be recorded.
- These records may be the only acceptable record for legal purposes. Protect it and keep it in a safe place.

VI Sample Filtration

As stated in §330.405(c), samples shall not be field filtered prior to laboratory analysis. Laboratory filtering of samples for metals analysis is permitted if necessary to protect analytical equipment. Because of chemical or physical changes that may occur during shipping or transport, the interpretation of “total” metals is questionable if the samples are filtered in the laboratory. It is the Commission's opinion that dissolved metals are better indicators than "total" metals, and owners and operators are encouraged to analyze samples for both "total" and dissolved metals, especially for sites that have large amounts of suspended sediments in the samples. If dissolved metals are to be analyzed, the samples should be properly filtered in the field. If field filtering is not practical, the samples should be filtered in the lab as soon as possible. Samples to be analyzed for inorganic parameters other than metals may also be filtered for the sake of consistency. A note indicating whether or not the samples were filtered and the place where they were filtered must accompany the results of the ground-water analyses.

- The dissolved metals (Fe, Mn, Cd, and Zn) to be analyzed at this site will be filtered in the laboratory.
- When samples are to be filtered, acid preservatives should be added after filtration to avoid breaking down clay molecules or placing adsorbed ions into solution, which could result in the generation of artificially high concentrations of metals.
- Neither field nor lab filtering is permitted for samples that are to be analyzed for NPOC. Many organic compounds are attached to solid particles, and filtering would remove them, yielding false, negative results.

- A note indicating whether or not the samples were filtered and the place where they were filtered must accompany the results of ground-water analyses.

VII *Analytical Parameters*

Ground-water sampling and analysis requirements shall be in accordance with §330.417 of this title (relating to Ground-Water Monitoring at Type IV Landfills).
The following constituents will be tested for: chloride, iron (dissolved), manganese (dissolved), cadmium (dissolved), zinc (dissolved), total dissolved solids, specific conductance (field and laboratory measurements), pH (field and laboratory measurements), and non-purgeable organic compounds (analysis of three replicate samples).

Not later than 60 days after each sampling event, the owner or operator shall submit to the Executive Director for review and approval a report containing the results of the analyses. If the facility is found to have contaminated or be contaminating the shallow water-bearing zones, the Executive Director may order corrective action appropriate to protect human health and the environment up to and including that in §§330.411, 330.412, and 333.415 of this title (relating to Assessment of Corrective Measures; Selection of Remedy; and Implementation of Corrective Action Program). See Section XI of this report for a discussion of Corrective Action.

VIII *Analytical Methods*

This ground-water monitoring program will incorporate appropriate analytical methods that accurately measure monitoring parameters in ground-water samples.
Among acceptable analytical methods are those in Standard Methods for the Examination of Water and Wastewater, 21st Edition, or those listed in SW-846.

- EPA Method 8270 may be used to analyze samples for Non-Purgeable Organic Compounds
- Most heavy metals can be analyzed by inductively coupled plasma-atomic emission spectrometry (ICP).
- Other metals will be analyzed using anion chromatography.
- Attachment 3 contains the Laboratory Standard Operating Procedures for methods employed.

See Table 2 for the methods and reporting limits (RL).

Parameter	Method	RL (mg/L)
chloride	Method E300	1
iron (dissolved)	Method E200.7	0.03
manganese (dissolved)	Method E200.7	0.005
Cadmium (dissolved)	Method E200.7	0.003
Zinc (dissolved)	Method E200.7	0.02
total dissolved solids	Method E160.1	10
specific conductance	Method E120.1	1 umhos/cm
pH	Method E150.1	1
non-purgeable organic compounds	Method E415.1	0.5

IX *Background Samples – Not Revised during January 2008 Updates*

A minimum of four background samples, one per calendar quarter will be taken, for one year. If possible, 45 days shall exist between sampling events. The following table lists the background parameters that will be analyzed for during this first year.

Table 3: Background Sampling Parameters

Parameter	Total or Dissolved	Method	MDL mg/L	RL mg/L
Cobalt	Total	219.1	0.04	0.10
Arsenic	Total	206.2	0.01	0.02
Mercury	Total	245.1	*	0.0005
Barium	Total	208.1	*	1.0
Silver	Total	272.1	0.02	0.10
Chromium	Total	218.1	0.05	0.10
Zinc	Total	289.1	0.05	0.10
Lead	Total	239.2	0.004	0.015
Cadmium	Total	213.2	0.001	0.005
Selenium	Total	270.2	0.01	0.02
Copper	Total	220.1	*	0.10
Manganese	Dissolved	243.1	0.02	0.05
Iron	Dissolved	236.1	0.14	0.3
Alkalinity	N/A	310.1	NA	5
Carbonate	N/A	310.1	NA	5
Hardness	N/A	Calculation	NA	10
Potassium	N/A	258.1	*	1.0
Phenophthalein alkalinity	N/A	310.1	NA	5
bicarbonate	N/A	310.1	NA	5

Table 3: Background Sampling Parameters

Parameter	**Total or Dissolved**	**Method**	**MDL mg/L**	**RL mg/L**
anion-cation ration	N/A	Calc.	NA	NA
calcium	N/A	215.1	*	1.0
magnesium	N/A	242.1	0.24	1.0
sulfate	N/A	375.4	0.84	5.0
total dissolved solids	N/A	160.1	NA	10
chloride	N/A	4500-Cl- B	5.4	15
sodium	N/A	273.1	2.3	5.0
fluoride	N/A	340.2	0.02	0.10
pH (field & lab)	N/A	Meter	NA	1.0 S.U.
Specific Conductance (field & lab)	N/A	Meter	NA	10umhos /cm
nitrate as nitrogen or ammonia as nitrogen	N/A	353.3	0.02	0.10
total organic carbon (3 replicates)	N/A	5310 C	See LSOP	See LSOP
VOCs	N/A	Best Available	**	**

*Current MDL not available.
**See Table 5: VOC Breakdown and Reporting Limits

X *Detection Monitoring*

Twelve months after the completion of the last quarterly background sampling event, annual monitoring will begin. Analysis will be in accordance with the requirements of 30 TAC §330.417. The monitoring parameters are discussed in Section VII.

The goal of detection monitoring is finding specific constituents that may be leaking from the site. If a breach is suspected, leachate may be analyzed for the detection monitoring parameters. Leachate analysis data can be helpful in supporting a reduction of the number of parameters monitored from the monitoring wells and may be crucial in showing that an anomalous reading was probably not from the landfill.

XI *Corrective Action*

The Executive Director may require additional sampling, analyses of additional constituents, installation of additional monitoring wells or other sampling points, and/or other hydro-geological investigations if the facility appears to be contaminating the shallow water-bearing zone(s).

If the facility is found to have contaminated or be contaminating the shallow water-bearing zone(s), the Executive Director may order corrective action appropriate to protect human health and the environment up to and including that in §§§§330.411, 330.412, and 333.415 of this title (relating to Assessment of Corrective Measures; Selection of Remedy; and Implementation of Corrective Action Program).

XII *Quality Assurance and Quality Control (QA/QC)*

All analytical data submitted under the requirements of this permit will be examined by the owner and/or operator to ensure that the data quality objectives are considered and met prior to submittal for the commission to review. The owner or operator will determine if the results representing the sample are accurate and complete. The quality control results, supporting data, and data review by the laboratory must be included when the owner/operator reviews the data. Any potential impacts will be reported such as the bias on the quality of the data, footnotes in the report, and anything of concern that was identified in the laboratory case narrative.

The owner or operator will ensure that the laboratory documents and reports all problems observed anomalies associated with the analysis. If analysis of the data indicates that the data fails to meet the quality control goals for the laboratory's analytical data analysis program, the owner or operator will determine if the data is usable. If the owner and/or operator determines the analytical data may be utilized, any and all problems and corrective action that the laboratory identified during the analysis will be included in the report submitted to the TCEQ.

A Laboratory Case Narrative (LCN) report for all problems and anomalies observed must be submitted by the owner and/or operator. The LCN will report the following information:

1. The exact number of samples, testing parameters and sample matrix.
2. The name of the laboratory involved in the analysis. If more than one laboratory is used, all laboratories shall be identified in the case narrative.
3. The test objectives regarding samples.
4. Explanation of each failed precision and accuracy measurement determined to be outside of the laboratory and/or method control limits.
5. Explanation if the effect of the failed precision and accuracy measurements on the results induces a positive or negative bias.

6. Identification and explanation of problems associated with the sample results, along with the limitations these problems have on data usability.
7. A statement on the estimated uncertainty of analytical results of the samples when appropriate and/or when requested.
8. A statement of compliance and/or non-compliance with the requirements and specifications. Exceedance of holding times and identification of matrix interferences must be identified. Dilutions shall be identified and if dilutions are necessary, they must be done to the smallest dilution possible to effectively minimize matrix interferences and bring the sample into control for analysis.
9. Identification of any and all applicable quality assurance and quality control samples that will require special attention by the reviewer.
10. A statement on the quality control of the analytical method of the permit and the analytical recoveries information shall be provided when appropriate and/or when requested.

The San Antonio Testing LabLaboratory Quality Assurance Plan (QAP) and Standard Operating Procedures (SOPs) are included as Attachment 3 to this GWSAP.

XIII *Reporting and Submittals*

The results of the analyses of ground-water samples collected during detection monitoring will be submitted to the Commission that includes all information required by §330.417(b)(5)(A)-(E). Not later than 60 days after each sampling event, Beck Landfill shall determine whether the landfill has released contaminants to the uppermost aquifer. . Triplicate copies of the results are to be submitted.

In addition to the LCN, the following information must be submitted for all analytical data:

1. A table identifying the field sample name with the sample identification in the laboratory report.
2. Chain of custody.
3. An analytical report that documents the results and methods for each sample and analyte to be included for every analytical testing event. These test reports must document the reporting limit/method detection limit the laboratory used.
4. A release statement must be submitted from the laboratory. This statement must state, "I am responsible for the release of this laboratory data package. This data package has been reviewed by the laboratory and is complete and technically compliant with the requirements of the methods used, except where noted by the laboratory in the attached exception reports. By my signature below, I affirm to the best of my knowledge, all problems/anomalies, observed by the laboratory as having the potential to affect the quality of the data, have been identified by the laboratory in the Laboratory Review Checklist, and no information or data have been knowingly withheld that would affect the quality of the data."
5. A laboratory checklist. For every response of "No, NA, or NR" that is reported on the checklist, the permittee will ensure the laboratory provides a detailed description of the "exception report" in the summary of the LCN. The permittee will

require that the laboratory use the checklist and do an equivalent of an EPA level 3 review regarding quality control analysis.

The submittal, including a cover letter, will be in triplicate (one original and two copies). The original is to be filed in TCEQ Central Records in Austin, one copy is sent to the appropriate Regional office, and one copy is used as a work copy by the Commission staff.

XIV *Safety Plan*

Beck Readymix Concrete Company, Inc. and/or all of its subcontractors performing functions specific to activities associated with and identified in the GWSAP will establish, implement, and maintain appropriate health and safety plans.

- When sampling at the site, avoid the introduction of contaminants into the body by ingestion, absorption, or respiration.
- Smoking, chewing, drinking, and eating are all prohibited at a waste site.
- Monitor-well water should not be allowed to come in contact with the eyes, mouth, or skin.
- Special care is necessary when handling sample containers, some cleaning solutions, and sample preservatives.
- Combination of reagents may result in a violent reaction.
- Read all warning labels carefully.
- Walk carefully and be aware of steep slopes, unstable ground, poison ivy, fire ant mounds, debris piles, poisonous snakes and spiders, stinging insects, ticks, and mosquitoes.
- Wear proper garments such as boots, hats, gloves, and safety glasses, to protect from exposure.
- Watch out for heavy equipment moving around the site.
- Bring a partner who can help with sampling and transport and will be ready to render aid to the second person or go for help if it becomes necessary.

Table 4: Background Sampling

Parameter	Sample Container	Preservative	Replicates	Holding Time
Cobalt	1 Liter Plastic Bottle	Ice (HNO3 if filtered)	No	6 Months
Arsenic	1 Liter Plastic Bottle	Ice (HNO3 if filtered)	No	6 Months
Mercury	1 Liter Plastic Bottle	Ice (HNO3 if filtered)	No	28 Days
Barium	1 Liter Plastic Bottle	Ice (HNO3 if filtered)	No	6 Months
Silver	1 Liter Plastic Bottle	Ice (HNO3 if filtered)	No	6 Months
Chromium	1 Liter Plastic Bottle	Ice (HNO3 if filtered)	No	6 Months
Zinc	1 Liter Plastic Bottle	Ice (HNO3 if filtered)	No	6 Months
Lead	1 Liter Plastic Bottle	Ice (HNO3 if filtered)	No	6 Months
Cadmium	1 Liter Plastic Bottle	Ice (HNO3 if filtered)	No	6 Months
Selenium	1 Liter Plastic Bottle	Ice (HNO3 if filtered)	No	6 Months
Copper	1 Liter Plastic Bottle	Ice (HNO3 if filtered)	No	6 Months
Manganese	1 Liter Plastic Bottle	Ice (HNO3 if filtered)	No	6 Months
Iron	1 Liter Plastic Bottle	Ice (HNO3 if filtered)	No	6 Months
Alkalinity	1 Liter Plastic Bottle	Ice	No	200 mL
Carbonate	1 Liter Plastic Bottle	Ice	No	6 Months
Hardness	1 Liter Plastic Bottle	Ice	No	28 Days
Potassium	1 Liter Plastic Bottle	Ice	No	28 Days
Phenophthtalein alkalinity	1 Liter Plastic Bottle	Ice	No	28 Days
bicarbonate	1 Liter Plastic Bottle	Ice	No	28 Days

Table 4: Background Sampling

Parameter	Sample Container	Preservative	Replicates	Holding Time
anion-cation ration	1 Liter Plastic Bottle	Ice	No	28 Days
calcium	1 Liter Plastic Bottle	Ice	No	28 Days
magnesium	1 Liter Plastic Bottle	Ice	No	28 Days
sulfate	1 Liter Plastic Bottle	Ice	No	28 Days
total dissolved solids	1 Liter Plastic Bottle	Ice	No	7 Days
chloride	1 Liter Plastic Bottle	Ice	No	28 Days
sodium	1 Liter Plastic Bottle	Ice	No	28 Days
fluoride	1 Liter Plastic Bottle	Ice	No	28 Days
pH (field & lab)	25 mL Plastic Bottle	None	No	Immediately
Specific Conductance (field & lab)	100 mL Plastic Bottle	None	No	Immediately
nitrate as nitrogen or ammonia as nitrogen	100 mL Plastic Bottle	Ice	No	48 Hours
total organic carbon (3 replicates)	100 mL Amber Glass	Ice, (HCl, if filtered)	One	48 Hours (28 Days if acidified)
VOCs	40 mL glass, Teflon lined septa	Ice, (HCl, if filtered)	Two	48 Hours (28 Days if acidified)

Table 5: VOCs and Reporting L imits

Analysis:	**Reporting Limit ug/L**
1,1,1,2 Tetrachloroethane	5
1,1 ,1-Trichloroethane	5
1,1 ,2,2-Tetrachloroethane	5
1,1 ,2-Trichloroethane	5
1 ,1-Dichloroethane	5
1 ,1-Dichloroethene	5
1,2 Dichloropropane	5
1 ,2,3-Trichloropropane	5
1 ,2-Dibromo-3-Chloropropane	2*
1 ,2-Dibromoethane	2*
1 ,2-Dichlorobenzene	5
1 ,2-Dichloroethane	5
1 ,4-Dichlorobenzene	5
2-Butanone (MEK)	10
2-hexanone	10
4-Methyl-2pentanone	10
Acetone	10
Acrylonitrile	30
Benzene	5
Bromochloromethane	5
Bromodichloromethane	5
Bromoform	5
Bromomethane	10
Carbon Disulfide	5
Carbon tetrachloride	5
Chlorobenzene	5
Chlorodibromomethane	5
Chloroethane (Ethyl Chloride)	10
Chloroform	5
Chloromethane	10
cis-1 ,2-Dichloroethene	5
cis-1 ,3-Dichloropropene	5
Dibromomethane	5
Dichloromethane	5
Ethylbenzene	5
Iodomethane	5
Styrene	5

Table 5: VOCs and Reporting Limits

Analysis:	Reporting Limit ug/L
Tetrachloroethene	5
Toluene	5
trans-1 ,2-Dichloroethene	5
trans-1 ,3-Dichloropropene	5
trans-1 ,4-Dichloro-2-Butene	10
Trichloroethene	5
Trichlorofluoromethane	5
Vinyl Acetate	5
Vinyl Chloride	2*
Xylene	10*

* Lower reporting limits are available using a purge volume of 25mL (Cost of analysis will increase) J-Flags (Data Flag) are also possible to indicate the compound is present but below reporting limit.

Attachment 1 – Purging and Sampling Worksheets

Beck Landfill, Nido, LTD.
Type IV Landfill
MSW Permit 1848
Well Purging Field Data Collection Form

Date:______________________ Monitor Well No. MW-A

Names:______________________ ______________________

Well Inspection:

Concrete Pad (cracks, fissures, etc.)______________________

Casing: ______________________

Stick Up Locked?______________ Well Cap Locked?______________

Plug Cap Tightened?______________ Insects/Other Issues?______________

Proximity and direction to sources of contamination:______________________

____

Water Level Meter: ______________________

Decontamination Method: ______________________

Data Collection: (From top of well casing)

(A) Depth to Water (nearest 0.01'): (32.98')

(B) Depth to Bottom (nearest 0.01'): (38.82')

Calculations:

(C) DEPTH OF WATER COLUMN (FT) = (B) – (A) ______________

(D) CUBIC FEET OF WATER IN CASING = PI *R2*(C)

= $(3.14 * (0.17')^2) * (C)$ = **0.0872 SFT** *(C) = ______________

(E) CONVERSION TO GALLONS =(D) * 7.48 ______________

(F) PURGE VOLUME = 3 X (E) ______________

Purge Rate:

Start Time:______________ End Time:______________ Total Time:______________

(G) PURGE RATE = (F)/TOTAL TIME ______________

Purged Dry? Yes or No

21st Annual Sampling Event - 2022

Beck Landfill, Nido, LTD.
Type IV Landfill
MSW Permit 1848
Well Purging Field Data Collection Form

Date:____________________ Monitor Well No. MW-C

Names:____________________ ____________________

Well Inspection:

Concrete Pad (cracks, fissures, etc.)____________________

Casing: ____________________

Stick Up Locked?____________________ Well Cap Locked?____________________

Plug Cap Tightened?____________________ Insects/Other Issues?____________________

Proximity and direction to sources of contamination:____________________

____

Water Level Meter: ____________________

Decontamination Method: ____________________

Data Collection: (From top of well casing)

(A) Depth to Water (nearest 0.01'): (35.32')

(B) Depth to Bottom (nearest 0.01'): (47.71')

Calculations:

(C) DEPTH OF WATER COLUMN (FT) = (B) – (A) ____________________

(D) CUBIC FEET OF WATER IN CASING = PI *R2*(C)

= (3.14 *(0.17')^2) * (C) = **0.0872 SFT** *(C) = ____________________

(E) CONVERSION TO GALLONS =(D) * 7.48 ____________________

(F) PURGE VOLUME = 3 X (E) ____________________

Purge Rate:

Start Time:____________________ End Time:____________________ Total Time:____________________

(G) PURGE RATE = (F)/TOTAL TIME ____________________

Purged Dry? Yes or No

21st Annual Sampling Event - 2022

Beck Landfill, Nido, LTD.
Type IV Landfill
MSW Permit 1848
Well Purging Field Data Collection Form

Date:__________________ Monitor Well No. MW-D

Names:__________________ __________________

Well Inspection:

Concrete Pad (cracks, fissures, etc.)__________________

Casing: __________________

Stick Up Locked?__________________ Well Cap Locked?__________________

Plug Cap Tightened?__________________ Insects/Other Issues?__________________

Proximity and direction to sources of contamination:__________________

Water Level Meter: __________________

Decontamination Method: __________________

Data Collection: (From top of well casing)

(A) Depth to Water (nearest 0.01’): (33.94’)

(B) Depth to Bottom (nearest 0.01’): (42.60’)

Calculations:

(C) DEPTH OF WATER COLUMN (FT) = (B) – (A) __________________

(D) CUBIC FEET OF WATER IN CASING = PI *R2*(C)

= (3.14 *(0.17’)^2) * (C) = **0.0872 SFT** *(C) = __________________

(E) CONVERSION TO GALLONS =(D) * 7.48 __________________

(F) PURGE VOLUME = 3 X (E) __________________

Purge Rate:

Start Time:____________ End Time:____________ Total Time:____________

(G) PURGE RATE = (F)/TOTAL TIME __________________

Purged Dry? Yes or No

Beck Landfill, Nido, LTD.
Type IV Landfill
MSW Permit 1848
Well Purging Field Data Collection Form

Date:__________ Monitor Well No. MW-F

Names:__________ __________

Well Inspection:

Concrete Pad (cracks, fissures, etc.)__________

Casing: __________

Stick Up Locked?__________ Well Cap Locked?__________

Plug Cap Tightened?__________ Insects/Other Issues?__________

Proximity and direction to sources of contamination:__________

Water Level Meter: __________

Decontamination Method: __________

Data Collection: (From top of well casing)

(A) Depth to Water (nearest 0.01'): (31.68')

(B) Depth to Bottom (nearest 0.01'): (36.65')

Calculations:

(C) DEPTH OF WATER COLUMN (FT) = (B) – (A) __________

(D) CUBIC FEET OF WATER IN CASING = PI *R2*(C)

= (3.14 *(0.17')^2) * (C) = **0.0872 SFT** *(C) = __________

(E) CONVERSION TO GALLONS =(D) * 7.48 __________

(F) PURGE VOLUME = 3 X (E) __________

Purge Rate:

Start Time:__________ End Time:__________ Total Time:__________

(G) PURGE RATE = (F)/TOTAL TIME __________

Purged Dry? Yes or No

Beck Landfill, Nido, LTD.
Type IV Landfill
MSW Permit 1848
Well Purging Field Data Collection Form

Date:____________________ Monitor Well No. MW-G

Names:____________________ ____________________

Well Inspection:

Concrete Pad (cracks, fissures, etc.)____________________

Casing: ____________________

Stick Up Locked?____________________ Well Cap Locked?____________________

Plug Cap Tightened?____________________ Insects/Other Issues?____________________

Proximity and direction to sources of contamination:____________________

____

Water Level Meter: ____________________

Decontamination Method: ____________________

Data Collection: (From top of well casing)

(A) Depth to Water (nearest 0.01’): (28.06’)

(B) Depth to Bottom (nearest 0.01’): (37.04’)

Calculations:

(C) DEPTH OF WATER COLUMN (FT) = (B) – (A) ____________________

(D) CUBIC FEET OF WATER IN CASING = PI *R2*(C)

= (3.14 *(0.17’)^2) * (C) = **0.0872 SFT** *(C) = ____________________

(E) CONVERSION TO GALLONS =(D) * 7.48 ____________________

(F) PURGE VOLUME = 3 X (E) ____________________

Purge Rate:

Start Time:__________ End Time:__________ Total Time:__________

(G) PURGE RATE = (F)/TOTAL TIME ____________________

Purged Dry? Yes or No

Beck Landfill, Nido, LTD.
Type IV Landfill
MSW Permit 1848
Well Sampling Field Data Collection Form

Date:______________________ Monitor Well No. MW-A

Names:______________________ ______________________

Water Level Meter: ______________________

Decontamination Method: ______________________

Water Quality Meter: ______________________

Decontamination Method: ______________________

Calibration Date and Results (attach results if necessary): ______________________

Data Collection: (From top of well casing)

(A) Depth to Water (nearest 0.01'): (33.02')

(B) Depth to Bottom (nearest 0.01'): (38.82')

Calculations:

(C) DEPTH OF WATER COLUMN (FT) = (B) – (A) ______________

(D) CUBIC FEET OF WATER IN CASING = PI *R2*(C)

= (3.14 *(0.17')^2) * (C) = **0.0872 SFT** *(C) = ______________

(E) CONVERSION TO GALLONS =(D) * 7.48 ______________

Field Measurements:

Sample Collection Start Time:______________ End Time:______________

pH (s.u.) ______________

Specific Conductivity (umhos/sec) ______________

Temperature (ºF) ______________

Field Duplicate: Yes or No

Beck Landfill, Nido, LTD.
Type IV Landfill
MSW Permit 1848
Well Sampling Field Data Collection Form

Date:____________________ Monitor Well No. MW-C

Names:____________________ ____________________

Water Level Meter: ____________________

Decontamination Method: ____________________

Water Quality Meter: ____________________

Decontamination Method: ____________________

Calibration Date and Results (attach results if necessary): ____________________

Data Collection: (From top of well casing)

(A) Depth to Water (nearest 0.01’): (35.46’)

(B) Depth to Bottom (nearest 0.01’): (46.24’)

Calculations:

(C) DEPTH OF WATER COLUMN (FT) = (B) – (A) ____________________

(D) CUBIC FEET OF WATER IN CASING = PI *R2*(C)

= (3.14 *(0.17’)^2) * (C) = **0.0872 SFT** *(C) = ____________________

(E) CONVERSION TO GALLONS =(D) * 7.48 ____________________

Field Measurements:

Sample Collection Start Time:____________________ End Time:____________________

pH (s.u.) ____________________

Specific Conductivity (umhos/sec) ____________________

Temperature (ºF) ____________________

Field Duplicate: Yes or No

Beck Landfill, Nido, LTD.
Type IV Landfill
MSW Permit 1848
Well Sampling Field Data Collection Form

Date:____________________ Monitor Well No. MW-D

Names:____________________ ____________________

Water Level Meter: ____________________

Decontamination Method: ____________________

Water Quality Meter: ____________________

Decontamination Method: ____________________

Calibration Date and Results (attach results if necessary): ____________________

Data Collection: (From top of well casing)

(A) Depth to Water (nearest 0.01'): (34.05')

(B) Depth to Bottom (nearest 0.01'): (42.43')

Calculations:

(C) DEPTH OF WATER COLUMN (FT) = (B) – (A) ____________________

(D) CUBIC FEET OF WATER IN CASING = PI *R2*(C)

= (3.14 *(0.17')^2) * (C) = **0.0872 SFT** *(C) = ____________________

(E) CONVERSION TO GALLONS =(D) * 7.48 ____________________

Field Measurements:

Sample Collection Start Time:__________ End Time:__________

pH (s.u.) ____________________

Specific Conductivity (umhos/sec) ____________________

Temperature (ºF) ____________________

Field Duplicate: Yes or No

Beck Landfill, Nido, LTD.
Type IV Landfill
MSW Permit 1848
Well Sampling Field Data Collection Form

Date:____________________ Monitor Well No. MW-F

Names:____________________ ____________________

Water Level Meter: ____________________

Decontamination Method: ____________________

Water Quality Meter: ____________________

Decontamination Method: ____________________

Calibration Date and Results (attach results if necessary): ____________________

Data Collection: (From top of well casing)

(A) Depth to Water (nearest 0.01’): (35.05’)

(B) Depth to Bottom (nearest 0.01’): (36.55’)

Calculations:

(C) DEPTH OF WATER COLUMN (FT) = (B) – (A) ____________________

(D) CUBIC FEET OF WATER IN CASING = PI *R2*(C)

= (3.14 *(0.17’)^2) * (C) = **0.0872 SFT** *(C) = ____________________

(E) CONVERSION TO GALLONS =(D) * 7.48 ____________________

Field Measurements:

Sample Collection Start Time:____________________ End Time:____________________

pH (s.u.) ____________________

Specific Conductivity (umhos/sec) ____________________

Temperature (ºF) ____________________

Field Duplicate: Yes or No

Beck Landfill, Nido, LTD.
Type IV Landfill
MSW Permit 1848
Well Sampling Field Data Collection Form

Date:______________________________ Monitor Well No. MW-G

Names:______________________________ ______________________________

Water Level Meter: ______________________________

Decontamination Method: ______________________________

Water Quality Meter: ______________________________

Decontamination Method: ______________________________

Calibration Date and Results (attach results if necessary): ______________________________

Data Collection: (From top of well casing)

(A) Depth to Water (nearest 0.01'): (28.02')

(B) Depth to Bottom (nearest 0.01'): (37.04')

Calculations:

(C) DEPTH OF WATER COLUMN (FT) = (B) – (A) ____________

(D) CUBIC FEET OF WATER IN CASING = PI *R2*(C)

= (3.14 *(0.17')^2) * (C) = **0.0872 SFT** *(C) = ____________

(E) CONVERSION TO GALLONS =(D) * 7.48 ____________

Field Measurements:

Sample Collection Start Time:____________ End Time:____________

pH (s.u.) ____________

Specific Conductivity (umhos/sec) ____________

Temperature (ºF) ____________

Field Duplicate: Yes or No

Beck Landfill, Nido, LTD.
Type IV Landfill
Schertz, Guadalupe County, Texas
MSW Permit No. 1848
Groundwater Sampling and Analysis Plan (GWSAP)

Attachment 2 – Chain of Custody Form

SAN ANTONIO TESTING LABORATORY, LLC

1610 S. Laredo Street, San Antonio, Texas 78207
(210) 229-9920 • Fax (210) 229-9921
www.satestinglab.com

CHAIN-OF-CUSTODY RECORD

REPORT TO:	INVOICE TO:	P.O. #
COMPANY	COMPANY	REPORT NUMBER
ADDRESS	ADDRESS	
CITY STATE ZIP	CITY STATE ZIP	E-MAIL
ATTN: PHONE #	ATTN: PHONE #	

REQUESTED TURNAROUND TIME IN BUSINESS DAYS & SURCHARGE ☐ 7-10 Days REG ☐ 5 Days +25% ☐ 4 Days +50% ☐ 3 DAYS +75% ☐ 2 DAYS +100% ☐ Next Day +150% ☐ SAME DAY WHEN POSSIBLE +300%

PROJECT NAME/LOCATION/SITE

THE TURNAROUND TIME FOR SAMPLES RECEIVED AFTER 3:00 PM SHALL BEGIN AT 8:00 AM THE FOLLOWING BUSINESS DAY / SPECIAL REQ.:

FOR STATE COMPLIANCE ☐ YES ☐ NO

PROJECT NO.

SAMPLE TEMPERATURE WITHIN COMPLIANCE (> 0°C ≤ 6°C) ☐ YES ☐ NO
PROPER CONTAINERS ☐ YES ☐ NO

INITIAL TO AUTHORIZE BULK ANALYSIS____________
IF NO, INITIAL HERE TO AUTHORIZE ANALYSIS ____________

INSUFFICIENT SAMPLE AMOUNT: ☐ YES ☐ NO AUTHORIZE TO PROCEED________

SAMPLED BY

OBSERVED TEMP. / CORRECTED TEMP. / TEMP. I.R. GUN #_______ / SAMPLE ICED ☐ YES ☐ NO

TRRP 13 ☐ LPST PCLS ☐ PST ☐ TSDF Class 2 ☐

SAMPLE NUMBER	COLLECTED DATE	COLLECTED TIME	MATRIX: DRINKING WATER	MATRIX: NON-POTABLE WATER	MATRIX: PAINT CHIPS	MATRIX: OIL	MATRIX: ORGANIC LIQUID	MATRIX: SOLID	MATRIX: SLUDGE	MATRIX: OTHER	SAMPLING METHOD: COMPOSITE	SAMPLING METHOD: GRAB	SAMPLING METHOD: CORE	SAMPLING METHOD: OTHER	SAMPLE IDENTIFICATION	NUMBER OF CONTAINERS	SAMPLE AMOUNT	CONTAINER SIZE	ANALYSIS REQUESTED: BTEX/MTBE 8260 / TPH TX1005/TX1006	Metals 8 / 11 / 12 / 13 / TCLP / SPLP / Total	PAH / SVOC / 8270 / 625 / TCLP / SPLP / Total	VOC / 8260 / 624 / TCLP / SPLP / Total	Water Quality - Drinking / Livestock / Irrigation	Coli / TC / FC / HPC / EColi / Enterococci / Q-Tray	Br / Cl / F / N03 / N02/O-P / S04	PCB / 608 / 8082A	OC Pest / 608 / 8081A / TCLP / SPLP / Total						PRESERVED WITH: HCl	HNO3	H2SO4	NaOH	Na2S2O3	ICE	NONE	PRESERVED IN THE LAB	COMPOSITED IN THE LAB	FILTERED IN THE LAB	FILTERED IN THE FIELD	REMARKS

RELINQUISHED BY (SIGNATURE) DATE / TIME	RECEIVED BY (SIGNATURE) DATE / TIME	RELINQUISHED BY (SIGNATURE) DATE / TIME	RECEIVED BY (SIGNATURE) DATE / TIME
RELINQUISHED BY (PRINT NAME) DATE / TIME	RECEIVED BY (PRINT NAME) DATE / TIME	RELINQUISHED BY (PRINT NAME) DATE / TIME	RECEIVED BY (PRINT NAME) DATE / TIME
RELINQUISHED BY (SIGNATURE) DATE / TIME	RECEIVED BY (SIGNATURE) DATE / TIME	METHOD OF SHIPMENT	SUBCONTRACTED ☐ YES ☐ NO
RELINQUISHED BY (PRINT NAME) DATE / TIME	RECEIVED BY (PRINT NAME) DATE / TIME	SAMPLED IN 5035 CONTAINERS ☐ YES ☐ NO ☐ N/A	CUSTODY SEAL IN PLACE & INTACT ☐ YES ☐ NO

FORM: COC REV 02/2018 **WHITE - LAB** **CANARY - CLIENT**

Attachment 3 – QAPP and SOP

Quality Assurance Manual (QAM) Rev. 5 Training

Contents of Quality Assurance Manual Rev. 4.1

- Section 1: Cover pages
- Section 2: Table of Contents
- Sections 3-29
- Appendices A-G

Section 3: Introduction and Scope

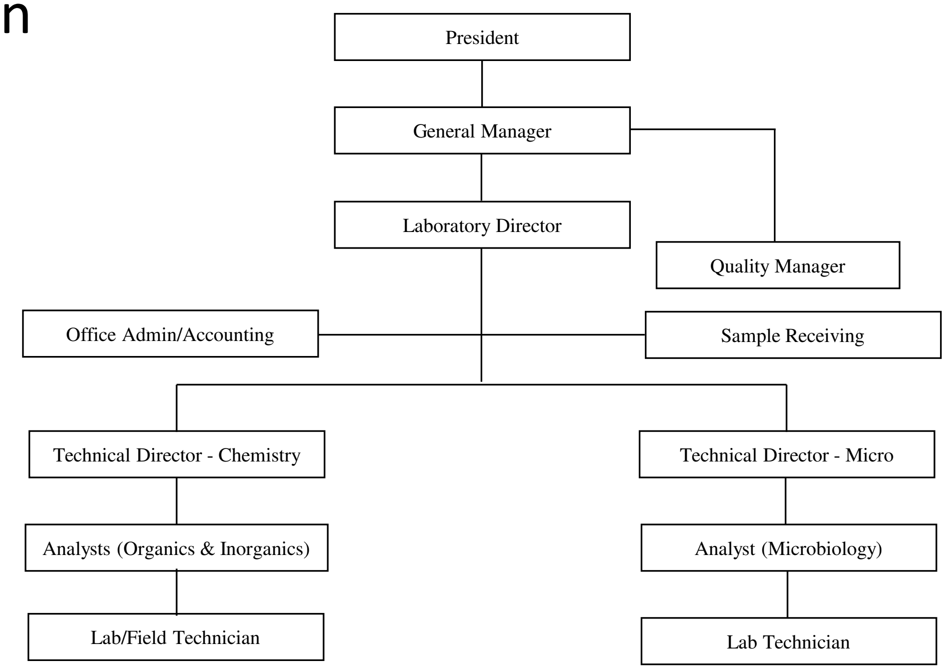
- Purpose: Outline the quality system for SATL to provide clients with data of known and documented quality
- Policy: Understand and meet regulatory requirements while providing clients with independent, reliable, accurate, legally defensible analytical services with fast turnaround times
- Reference: Modules 1, 2, 4 and 5 of the 2016 TNI Environmental Laboratory Sector Standard
- Acronyms provided
- The QA Manager maintains the current version of the QA Manual
- The QA Manual is reviewed at least once every 2 years

Section 4: Organization

- SATL is organized into 4 departments:
  - Administrative
  - Organics
  - Inorganics (metals & wet chemistry)
  - Microbiology
- The laboratory assures that it is impartial and that personnel are free from undue commercial, financial or other undue pressures that might influence their technical judgement
- Ethics and data integrity policies (Appendix E and Sections 5 and 19) ensure that personnel do not engage in activities that diminish confidence in the laboratory's capabilities
- All employees must sign a Conflict of Interest statement form (Appendix F) and the Ethics Policy (Appendix E)

SATL Organization

SATL Organization



President

General Manager

Laboratory Director

Quality Manager

Office Admin/Accounting

Sample Receiving

Technical Director - Chemistry

Technical Director - Micro

Analysts (Organics & Inorganics)

Analyst (Microbiology)

Lab/Field Technician

Lab Technician

Section 5: Management

- Laboratory Director has overall responsibility and authority for technical operations of the laboratory
- QA Manager has overall responsibility for required quality of laboratory operations
- Management is responsible for meeting the requirement of the TNI Standard 2016 and the needs of the client
- Technical Director has education and experience requirements (see Section 5.2.6.1 of the TNI V1M2-2016 standard)
- Quality Policy: The objective of the quality system, and the commitment of management is to consistently provide customers with data of known and documented quality that meets their requirements (see page 15 of QAM for full policy)

Section 5: Management (cont.)

- The Ethics Policy is documented in Appendix E. The Ethics and Data Integrity program, training and investigation is documented in QAM Section 19.
- The quality system is documented in the QA Manual and written SOPs.
- There are technical and general SOPs
  - Technical SOPs are divided into Inorganics-Wet Chemistry, Inorganics-Metals, Organics-Semivolatiles, Organics-Volatiles and Microbiology
  - General SOPs are for front office and disposal
- In the event of a conflict or discrepancy, the order of Precedence is: TNI Modules, QA Manual, Methods and SOPs and Policies

Section 6: Document Control

- SATL has 3 types of documents:
    - Controlled (QA Manual, SOPs, Forms and Methods)
    - Approved (Work Orders, Test Reports)
    - Obsolete (Documents superseded by more recent version or those no longer in use needed)
- Controlled documents are reviewed at least every 2 years or as needed
- Controlled documents are available on the Q drive/Controlled Documents/SOPs (pdf versions) or Forms
- Document changes are approved by President, Technical Directors and QA Manager
- Electronic signatures are used on laboratory documents, quality system documents and test reports

Section 7: Review of Requests, Tenders and Contracts

- The Lab Director determines if the laboratory has the necessary accreditations, resources and personnel to meet work requests
- The President makes the decision whether to accept or forego the work
- For new, complex or large projects, the proposed contract is given to the President and Lab Director for review
- Records are maintained for every contract or work request
- Records of all project-related communication with clients is kept in the final report folder for each client

Section 8: Subcontracting Environmental Tests

- When subcontracting analytical services, the lab assures that work requiring accreditation is sent to an appropriately accredited lab
- The certificate of accreditation is reviewed by the QA Manager and/or Lab Director and/or President to ensure that the subcontracting lab has the appropriate accreditation to do the work
- Subcontractor accreditation certificates are available on the Q drive/Accreditation and Certifications/Subcontractors
- Approved subcontractors are in Q drive/Controlled Documents/Quality Manual/QAM Appendices
- Subcontract details are documented on the COC and the Sample Receipt Checklist
- The lab performing subcontracting is identified in the final report

Section 9: Purchasing Services and Supplies

- SATL ensures that purchased supplies and services that affect quality of environmental tests are of the required or specified quality by using approved suppliers and products
- The Lab Director reviews and approves suppliers and approves the technical content of purchasing documents prior to ordering
- Approved vendors are in Q drive/Controlled Documents/Quality Manual/QAM Appendices
- Supplies received are inspected for breakage, leaks or damages. Supplies are checked in (dated and initialed) on the packing slip
- Certificates of Analysis (COAs) are kept with the department and scanned into Element
- Supplies are stored according to the manufacturer's instructions, laboratory SOP or test method specifications
- Chemicals, standards and reagents are logged into the Element LIMS database which creates a unique ID which is used on the containers and logbooks.

Section 10: Service to the Client

- SATL collaborates with clients in clarifying their requests and in monitoring laboratory performance related to their work
- The SATL client confidentiality policy is to not divulge or release any information to a third party with proper authorization
- A confidentiality statement accompanies all electronic mail to clients
- Communication with clients is maintained to provide proper instruction and modification for testing; delays or major deviations are communicated to the client immediately by President or Lab Director
- SATL seeks both positive and negative feedback following completion of projects and may use a survey request; negative feedback is documented as a customer complaint

Section 11: Complaints

- Complaints by customers or other parties are reviewed by SATL management (President and Lab Director) and an appropriate action is determined
- All customer complaints are documented by the person receiving the complaint and addressed to the responsible manager
- Initial evaluation of the complaint may result in using the Customer Complaint form
- Complaints are resolved as soon as practically possible
- If it is determined that the complaint has merit, then corrective action will be utilized
- A complaint such as a concern that data is repeatedly late is reviewed for preventive action to minimize a future occurrence

Section 12 – Control of Nonconforming Work

- Non-conforming work is work that does not meet acceptance criteria or requirements
- Non-conforming work can come through customer complaints, QA, instrument data, calibration data, staff observation, final report reviews, management reviews and internal and external audits
- The procedure for investigating and taking appropriate corrective action on non-conforming work is described in Section 14
- Employees shall notify the QA Manager or Technical Director of any nonconformance as soon as it is noticed/observed/detected
- The QA Manager/Laboratory Director/Technical Director reviews the nonconformance and determines a course of action
- A Stop Work Order may be used if a method is restricted or not used until modifications are implemented

Section 13: Improvement

- Improvement in the overall effectiveness of the lab’s quality system may result from implementation of the lab’s management system:
  - Quality policy and objectives
  - Corrective action
  - Preventive action
  - Internal auditing
  - Ethics and data integrity program
  - Review and analysis of data
  - Annual management review of the quality management system

Section 14: Corrective Action

- Corrective action is the action taken to eliminate the cause of an existing nonconformance, defect or other undesirable situation
- Deficiencies cited in external assessments, internal audits, data reviews, customer feedback/complaints, control of nonconforming work or managerial reviews are documented and require corrective action
- Corrective Action Form is used to document and track corrective action
- Root cause analysis is used to determine the cause of the nonconformance
- Corrective action needs to be appropriate to correct the problem and prevent recurrence
- QA Manager will monitor the implementation and effectiveness of the corrective action

Section 15: Preventive Action

- Preventive action is a proactive process to identify opportunities for improvement
- All personnel have the authority to offer suggestions for improvement
- Preventive action includes
  - Review of QC data to identify trends
  - Regularly scheduled staff quality meetings to ensure staff is knowledgeable in quality procedures
  - Annual budget and managerial reviews
  - Review of proficiency testing data to identify near misses
  - Scheduled instrument maintenance

Section 16: Control of Records

- Records include data recordings, laboratory forms, list, spreadsheets, analyst notes; Records are electronic and hard copy.
- SATL records all laboratory activities in order to establish an audit trail
- SATL retains all original observations, calculations and derived data, calibration records and test reports for a minimum of 5 years
- Sample records are organized by year and client name
- A backup of electronic data is performed on a weekly basis and an automatic incremental backup is done on a daily basis

Section 17: Audits

- Audits measure laboratory performance and verify compliance with accreditation and project requirements. Audits can be internal, external, performance and system
- Internal
  - Conducted at least annually
  - May be conducted by a consultant
- External audits
  - Accreditation or client audits
- Performance audits
  - Proficiency test samples
- System audits
  - Annual management review meetings
- Audit findings are handled through the corrective action process

Section 18: Management Reviews

- Management reviews are conducted in the first quarter of the year and review the following for suitability and effectiveness:
  - Policies and procedures
  - Reports from managerial and supervisory personnel
  - Outcome of recent internal audits
  - Corrective and preventive actions
  - Assessments by external bodies
  - Results of proficiency tests
  - Customer feedback and complaints
  - Recommendations for improvement
  - Review of data integrity procedure
  - Quality control activities, resources, facility and staff training
  - Ethics and data integrity program

Section 19: Data Integrity Investigations

- Ethics and Data Integrity Program
  - Documented data integrity procedures
  - Ethics Policy signed by all management and staff annually
  - Ethics and data integrity training is provided for new employees within 3-5 days of hire and annually for all personnel
  - Procedures for confidential reporting of alleged data integrity issues
  - Audit program that monitors data integrity
  - Procedures for handling data integrity investigations and client notifications

Section 19: Data Integrity Investigations (cont.)

- Examples of unethical behavior
  - Fabricating results
  - Altering instrument settings
  - Altering the Chain of Custody record
  - Altering calculations
  - Altering approved SOPs
  - Lack of reporting unethical behavior by others

Section 19: Data Integrity Investigations (cont.)

- Data integrity training includes:
  - SATL organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting
  - How and when to report data integrity issues
  - Recordkeeping
  - Data integrity procedures
  - Data integrity training documentation
  - In-depth data monitoring and data integrity procedure documentation
  - Specific examples of breaches of unethical conduct, such as improper data manipulations, adjustments of instrument time clocks, inappropriate changes in concentrations of standards

Section 19: Data Integrity Investigations (cont.)

- Confidential reporting of ethics and data integrity issues is assured through:
    - Unrestricted access to senior management
    - Assurance that personnel will not be treated unfairly for reporting instances of ethics and data integrity issues
    - Anonymous reporting
- Investigations
    - Documented and conducted confidentially
    - Allegations are investigated
    - Affected clients notified

Section 20: Personnel

- All personnel are responsible for complying with all quality and data integrity policies and procedures relevant to their area of responsibility
- Initial, ongoing and refresher training is provided as needed
- Personnel are qualified to perform tasks they are responsible for based on education, training, experience and demonstrated skills
- The Laboratory Director is responsible for the laboratory operations and staff supervision
- The QA Manager is responsible for ensuring that the quality system is implemented and followed
- The Technical Director is responsible for day to day supervision of technical laboratory operations

Section 20: Personnel - Training

- Training for new staff
  - All associated documentation with the task must be read and understood
  - Hands on training will be provided under the direct supervision of a qualified senior analyst or Laboratory Director
  - The trainee must demonstrate competency in the new task before they can operate independently
  - Approval of competency is documented by the Technical/Laboratory Director on the training form

Section 20: Personnel – Training (cont.)

- Ongoing training
  - The analyst attests that they have read, understood and agree to perform according to the latest version of the Quality Manual and method SOPs
  - Semiannually, the analyst will show continued proficiency by analyzing PT samples for the tests that they are responsible for
  - Proof of acceptable on-going training is documented by annual demonstrations of capability by each analyst and each method
- Refresher training
  - Will be provided as needed based on nonconformances, audit findings, PT study failures or customer complaints

Section 21: Accommodations and Environmental Conditions

- Environmental conditions that are controlled and monitored include temperature, humidity, voltage, biological sterility, dust, light, sound and vibration levels
- Access to areas affecting the quality of results such as sample storage, records, laboratory facility, LIMS system is restricted to authorized personnel only
- Chemicals are stored in appropriate areas; acids are stored in cabinets under fume hoods, solvents are stored in metal cabinets, standards and reference materials are stored in separate refrigerators from sample extracts

Section 21: Accommodations and Environmental Conditions (cont.)

- Laboratory space is arranged to minimize cross-contamination; microbiology, volatiles, semivolatiles and metals are in separate areas
- Electric balances are kept away from drafts and vibrations
- A janitorial service is used for general housekeeping
- Periodic cleanup days are used to help clean up clutter
- Each employee is responsible for housekeeping in their work area at the end of the day
- Smoking/eating/drinking are prohibited in the laboratory area
- Building security includes locks, alarm system and cameras

Section 22: Environmental Methods and Method Validation

- Reference methods and/or procedures are available for all activities associated with the preparation and analysis of samples
- Reference methods are validated by a **demonstration of capability (DOC)** which is a procedure to establish the ability of the analyst to generate data of acceptable precision and accuracy
- A DOC is performed whenever the method, analyst or instrument type is changed
- DOC: 4 replicates prepared at the mid-point of the calibration or LCS spike level from a certified reference standard (QC sample) purchased from an approved vendor. The QC sample is prepared in a clean matrix such as DI water, Ottawa sand or clean sodium sulfate

Section 22: Environmental Methods and Method Validation (cont.)

- The analysis of 4 DOC replicates is compared to established control limits and checked for precision and accuracy
  - If the results of 4 replicate analyses fall within the method control limits, then the analyst has demonstrated their capability in that method
  - If 1 or more analytes fail to meet the acceptance criteria, then the replicate analyses are repeated. A second failure indicates a potential problem that needs corrective action
  - In the case of microbiology, presence/absence is demonstrated using a set of 10 replicate samples
  - For enumeration techniques, 4 samples inoculated with microorganisms of known CFU range are analyzed or commercially available enumeration QC samples are used
- The DOC results are documented in the training file for each analyst
- After the initial DOC is completed, on-going proficiency is demonstrated by analysis of single blind samples, performing another DOC or using 4 consecutive LCSs

Section 22: Environmental Methods and Method Validation (cont.) NEW

- **Method Detection Limit (MDL)** is an estimate of the minimum amount of an analyte that an analytical process can reliably detect.
- MDL values are generated in accordance with 40 CFR Part 136 Appendix B Revision 2 which includes a minimum of 7 spiked samples at 2-10 times the estimated MDL and a minimum of 7 method blank samples.
- The samples used for the initial MDL must be prepared in at least 3 batches on 3 separate calendar days and analyzed on 3 separate calendar days (preparation and analysis may be on the same day).
- If any result for any individual analyte does not provide a numerical result greater than 0, then repeat the spiked samples at a higher concentration.
- See attachment for the MDL_s and MDL_b calculations. Select the greater of MDL_s and MDL_b as the initial MDL.

Section 22: Environmental Methods and Method Validation (cont.) NEW

MDL

- **During each quarter**, prepare and analyze a minimum of 2 spiked samples on each instrument, in separate batches, using the same spiked concentration as the initial MDLs.
- Ensure that at least 7 spiked samples and 7 method blanks are completed for the annual verification.
- **At least once per year**, reevalute the spiking level – if more than 5% of the spiked samples do not yield results greater than 0, then the spiking level must be increased and the initial MDL redetermined.
- **At least once every 13 months**, recalculate MDL_s and MDL_b.

Section 22: Environmental Methods and Method Validation (cont.)

- The Limit of Quantitation (LOQ) or Practical Quantitation Limit (PQL) is an estimate of the minimum amount of an analyte that can be reported with a specified degree of confidence
- The lowest calibration standard is equal to the LOQ
- The LOQ/PQL is always greater than the LOD/MDL
- Precision is the degree to which a set of measurements of the same property obtained under similar conditions conform the themselves.
- Bias is the systematic error that contributes to the difference between the mean of a significant number of test results and the accepted reference value
- Precision and bias are determined through performance of a DOC

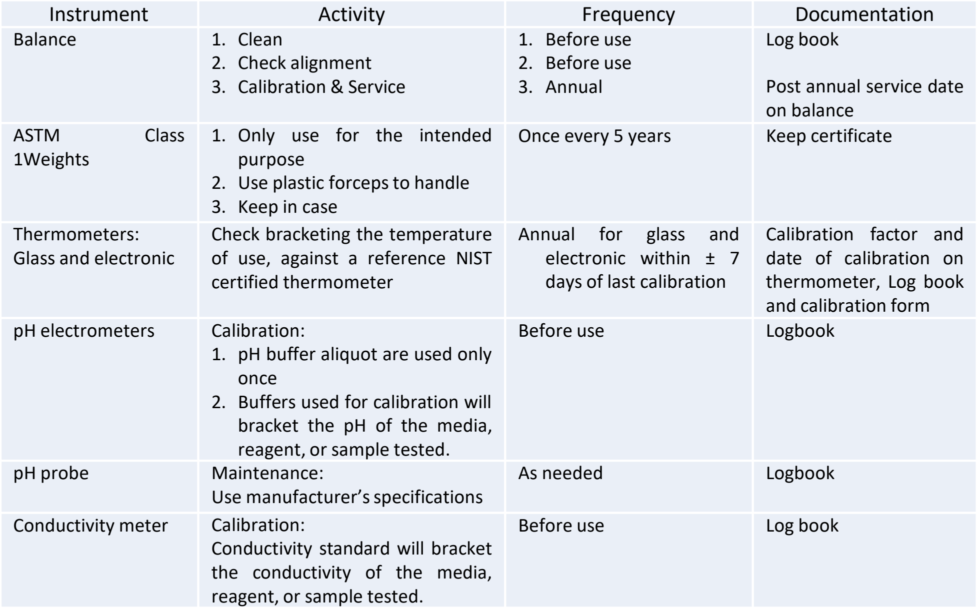
Section 22: Environmental Methods and Method Validation (cont.)

- Selectivity is the capability of a test method or instrument to respond to targeted analytes in the presence of non-target analytes
- Estimation of uncertainty is sum of the uncertainties of the numerous steps of the analytical process
- Control of Data
    - Automated and manual procedures are used to check calculations and data transfers
    - Excel spreadsheet formulas are validated and locked
    - Commercial off-the-shelf software is used and is considered validated
    - Access to application software is by a user name and password
    - Access to the building is by means of a key and security code

Section 22: Environmental Methods and Method Validation (cont.)

- Control of Data (continued)
  - Most instruments the laboratory uses have the capability to export data out of the instrument software and into the LIMS software
  - All reports to clients and quality control measures are reviewed prior to reporting to clients through the use of a Final Review Checklist
- Procedure for Minimizing Errors
  - Transcription errors are minimized by secondary review
  - Calculation errors are minimized by the use of automated spreadsheets
  - Manual integration criteria are addressed in SOP003D

Section 23: Calibration Requirements



Instrument	Activity	Frequency	Documentation
Balance	1. Clean 2. Check alignment 3. Calibration & Service	1. Before use 2. Before use 3. Annual	Log book Post annual service date on balance
ASTM Class 1Weights	1. Only use for the intended purpose 2. Use plastic forceps to handle 3. Keep in case	Once every 5 years	Keep certificate
Thermometers: Glass and electronic	Check bracketing the temperature of use, against a reference NIST certified thermometer	Annual for glass and electronic within ± 7 days of last calibration	Calibration factor and date of calibration on thermometer, Log book and calibration form
pH electrometers	Calibration: 1. pH buffer aliquot are used only once 2. Buffers used for calibration will bracket the pH of the media, reagent, or sample tested.	Before use	Logbook
pH probe	Maintenance: Use manufacturer's specifications	As needed	Logbook
Conductivity meter	Calibration: Conductivity standard will bracket the conductivity of the media, reagent, or sample tested.	Before use	Log book

Support equipment such as balances, ovens, refrigerators, freezers and water baths are verified with an NIST traceable reference, each day prior to use, to ensure operation is within the expected range.

Section 23: Calibration Requirements (cont.)

Spectrophotometer	1. Keep cells clean	As needed	Logbook
Automatic or digital type pipettes	Calibrate for accuracy and precision using reagent water and analytical balance	Quarterly	Logbook
Refrigerators, Freezers, and BOD incubators	1. Thermometers are immersed in liquid to the appropriate immersion line 2. The thermometers are graduated in increments of 1°C or less	Temperatures are recorded each day in use by an analysts. The min/max digital thermometer is use to record temperatures for units containing samples or reagents used for analytical procedures during the weekend and holidays.	Logbook
Sterilizer [microbiology]	1. Use a maximum-temperature-registering thermometer 2. Use spore strips or ampules. 3. Service contract	1. Each cycle 2. One sterilizing cycle per month 3. As needed	Logbook
Microbiological incubators, and water baths	1. Thermometers in each unit are immersed in liquid to the appropriate immersion line 2. The thermometers will be graduated in increments of 0.5°C (0.2°C increments for tests which are incubated at 44.5°C) or less	Temperature of incubators and water baths will be recorded twice a day for each day in use with readings separated by at least four hours	Logbook
DO probe	Maintenance as specified by manufacturer	As needed	Logbook
TKN Digestion Block	Internal thermocouple is checked at the programmed temperatures of 225°C and 380°C	Annually	Log book
COD Digester Block	Internal thermocouple is checked at the end of analytical cycle at 150°C.	Annually	Log book

Section 23: Calibration Requirements (cont.) NEW

- For regression or average response /calibration factor calibrations, the following minimum number of non-zero calibration standards shall be used, in accordance with Section 1.7.1.1.f the TNI 2016 standard:

Type of Calibration Curve	Minimum Number of Calibration Standards
Threshold testing	1
Average response	4
Linear fit	5
Quadratic fit	6

The lowest calibration standard shall be at or below the lowest concentration for which quantitative data are reported without qualification. The highest calibration standard shall be at or above the highest concentration for which quantitative data are reported without qualification.

Section 23: Calibration Requirements (cont.) NEW

As per Volume 1, Module 4, Section 1.7.1.1.e of the TNI 2016 standard, the following is the **policy on removal and replacement of calibration standards**:

- i. The laboratory may remove individual analyte calibration levels from the lowest and/or highest levels of the curve. Multiple levels may be removed, but removal of interior levels is not permitted.
- ii. The laboratory may remove an entire single standard calibration level from the interior of the calibration curve when the instrument response demonstrates that the standard was not properly introduced to the instrument, or an incorrect standard was analyzed. A laboratory that chooses to remove a calibration standard from the interior of the calibration shall remove that particular standard calibration level for all analytes. Removal of calibration points from the interior of the curve is not to be used to compensate for lack of maintenance or repair to the instrument.
- iii. The laboratory shall adjust the LOQ/reporting limit and quantitation range of the calibration based on the concentration of the remaining high and low calibration standards.
- iv. The laboratory shall ensure that the remaining initial calibration standards are sufficient to meet the minimum requirements for number of initial calibration points as mandated by this Standard, the method, or regulatory requirements.
- v. The laboratory may replace a calibration standard provided that:
- a. the laboratory analyzes the replacement standard within twenty-four (24) hours of the original calibration standard analysis for that particular calibration level;
- b. the laboratory replaces all analytes of the replacement calibration standard if a standard within the interior of the calibration is replaced; and
- c. the laboratory limits the replacement of calibration standards to one calibration standard concentration.
- vi. The laboratory shall document a technically valid reason for either removal or replacement of any interior calibration point.

Section 23: Calibration Requirements (cont.) NEW

- The laboratory shall use and document a measure of **relative error in the calibration**.
- i. for calibrations evaluated using an average response factor, the determination of the relative standard deviation (RSD) is the measure of the relative error;
- ii. for calibrations evaluated using correlation coefficient or coefficient of determination, the laboratory shall evaluate relative error by either:
- a. measurement of the Relative Error (%RE). See attachment for the calculation.
- This calculation shall be performed for two (2) calibration levels: the standard at or near the mid-point of the initial calibration and the standard at the lowest level.
- The RE at both of these levels shall meet the criteria specified in the method. If no criterion for the lowest calibration level is specified in the method, the criterion and the procedure for deriving the criterion shall be specified in the laboratory SOP.

or,

- b. measurement of the Relative Standard Error (%RSE). See attachment for the calculation.
- The RSE shall meet the criterion specified in the method. If no criterion is specified in the method, the maximum allowable RSE shall be numerically identical to the requirement for RSD in the method. If there is no specification for RSE or RSD in the method, then the RSE shall be specified in the laboratory SOP.

Section 23: Calibration Requirements (cont.)

- Continuing Calibration Verification (CCV): The validity of the initial calibration shall be verified prior to sample analysis by a CCV with each analytical batch
- The CCV concentration shall be equal to or less than half of the highest level of calibration
- Instrument CCV shall be performed at the beginning and end of each analytical batch, and at frequency defined in the method
- If routine corrective action for an instrument CCV fails to produce an acceptable CCV, then a new initial calibration shall be performed

Section 24: Measurement Traceability

- Measurement quality comes in part from traceability of standards to certified materials/standards
- All equipment is calibrated and traceable to national standards of measurement where available
- All equipment that affects the quality of test results is calibrated according to the minimum frequency specified by the manufacturer, regulation or method
- **Reference standards** are standards of the highest quality available, such as ASTM Class 1 weights or NIST reference thermometers (weights are calibrated every 5 years and NIST thermometers are calibrated every 2 years)

Section 24: Measurement Traceability (cont.)

- **Reference materials** are traceable to national standards of measurement or to Certified Reference Materials, by a Certificate of Analysis (CoA)
- Reference standards and materials are tracked from purchase, receipt and storage through disposal
- Records for all standards, reagents, reference materials and media shall include the vendor name, the CoA, date of receipt, date of preparation, expiration date and recommended storage conditions
- *******All containers of standards, reagents or materials, whether original or prepared shall be logged into Element and assigned a unique ID – this unique ID is used in all associated data, logs, and spreadsheets *******
- **CoAs shall be labeled with the unique ID and scanned and uploaded in Element**

Section 24: Measurement Traceability (cont.)

- Records for prepared standards, reagents, reference materials and media shall include:
  - Traceability to purchased stock or neat analytes
  - The manufacturer’s CoA or purity
  - The date of receipt
  - Reference to the method of preparation
  - Date of preparation
  - Recommended storage conditions
  - Expiration date
  - Preparer’s initials

Section 25: Collection of Samples

- SATL provides sampling services including sampling containers
- Sample kits include:
  - Appropriate container with preservative, if required
  - Sample labels
  - Chain of Custody forms
  - Custody seals
  - Cooler
- Sampling records include:
  - Sampling procedure
  - Date and time of sampling
  - Matrix type
  - Identification of the sample and sampler
  - Sampling location and environmental conditions

Section 26: Handling Samples and Test Items

- When samples are received at the lab:
  - Their condition is documented on the Chain of Custody form
  - They are assigned a unique report number and sample identifier (2 digits for year, 2 digits for month and 3 digits for sequential number, i.e., 2010203)
  - The work orders are logged in a logbook and into Element
  - A Sample Receipt Checklist is completed
- Clients will be notified of any deviations and they will need to sign the COC or send email authorization to proceed
- COCs and any additional records received with the samples are maintained electronically (P drive) as well as in a client file folder

Section 26: Handling Samples and Test Items (cont.)

- Sample Preservation Checks
  - Thermal preservation – checked for samples requiring temperature preservation (>0 ºC to ≤ 6 ºC); record temperature on the Sample Receipt Checklist and note if ice was present
  - Chlorine checks – chlorine is checked on potable water samples
  - pH checks – performed by the analyst for samples requiring acid/base preservation and documented in the logbook, electronic spreadsheet or benchsheet
- Sample Identification
  - All samples, including subsamples, extracts and digestates are uniquely identified in a permanent chronological record
- Sample Storage
  - Samples are held secure in temperature controlled refrigerators and/or freezers. The temperature is monitored and recorded daily. Limits are >0 to 6 degrees C.

Section 26: Handling Samples and Test Items (cont.)

- Sample disposal
  - Samples are disposed of according to Federal, State and local regulations
  - Waste is segregated into 3 main categories (liquid waste, solid waste and organic waste) with subcategories based on the process it was generated from and stored in various sized drum
  - The waste list and codes are in form SATL MISC004

Section 27: Quality Assurance for Environmental Testing

- Quality control measurements:
  - Blanks
  - Laboratory control samples (LCS)
  - Matrix spikes (MS)
  - Duplicates
  - Surrogates and internal standards
- Proficiency testing samples also assess laboratory performance
  - Water Pollution (WP) – 2x/year in March-May and Sept.-Nov.
  - Water Supply (WS) – 2x/year in March-May and Sept.-Nov
  - Hazardous Waste (HW) – 2x/year in March-May and Sept.-Nov
  - Two out of three PT studies in a row must pass to be in compliance with TCEQ & TNI

Section 27: Quality Assurance for Environmental Testing – for Chemistry

Item	Frequency	Acceptance Criteria	Corrective Action
Method blank (negative control)	Every 20 samples or 1/batch	Method specific or Reporting limit	Qualify data and take corrective action
LCS (positive control)	Every 20 samples or 1/batch	Method specific or as determined by the lab	Reprocess, reanalyze or qualify data
MS/MSD	Every 20 samples or per method requirement	Method specific or as determined by the lab	Qualify data and take corrective action
Duplicates	Every 20 samples or per method of SOP requirement	Method specific or as determined by the lab	Qualify data and take corrective action
Surrogates	Every organic sample and QC sample	Method specific or as determined by the lab	Qualify data and take corrective action
ICV	Initially and on CCV failure	Method specific or as determined by the lab	Reanalyze standard and take corrective action
CCV	Per test method or SOP requirement	Method specific or as determined by the lab	Reanalyze standard and take corrective action

Section 27: Quality Assurance for Environmental Testing – for Microbiology

Item	Frequency	Acceptance Criteria	Corrective Action
Sterility check	Each lot of media prior to use	No growth	Investigate cause
Sterility check containers	One container for each lot or batch sterilized	No growth	Investigate cause
Sterility check dilution water	One per batch of dilution water	No growth	Investigate cause
Positive control	Prior to first use of medium	Positive reaction	Investigate cause. If necessary, reject medium
Negative control	Prior to first use of medium	Negative reaction	Investigate cause. If necessary, reject medium
Duplicate MPN counts	Monthly on one positive sample for each month	Same analyst <5%D between counts (2 analysts 10%D)	Investigate cause Qualify data
Quanti-tray seal check	Once per month	No leaks	Investigate cause

Section 28: Reporting the Results

- The result of each test performed must be reported accurately, clearly, unambiguously and objectively to comply with all specific instructions contained in the test method
- Laboratory results are reported in a test report that includes all information requested by the client and necessary for interpretation of the test results
- Test results are reported with the analyte, result, units, PQL, batch, method, date, analyst and notes
- Reports include the sample information, client information, NELAC certification and authorization by SATL management
- Reports are transmitted electronically to the client
- Amended test reports include a new date and time and comment describing the reason for the revision

Appendices

- Appendix A – Analytical Methods, Sample Preparation and Holding Times
- Appendix B – Sample Receipt Checklist
- Appendix C – Final Report Review Checklist
- Appendix D – Laboratory Qualifiers
- Appendix E – Laboratory Ethics Policy
- Appendix F – Conflict of Interest Form
- Appendix G – Client Confidentiality

STANDARD OPERATING PROCEDURE

Title

Analysis of Total Metals By ICP – AES

Method No.:

EPA 200.7 and EPA 6010B

Matrix/Matrices:

Liquid/Solid

Document Control Number/Revision Number

SOP003B/Revision 5.1

Charles R. Morrow
Approved By: Quality Assurance Manager
09/14/21
Date

Richard Hank
Approved By: General Manager
09/14/21
Date

Approved By: Laboratory Director
09/14/21
Date

Standard Operating Procedures shall be reviewed at least once in two years or as needed to determine their continued suitability, compliance with applicable requirements, and to ensure that they reflect actual procedures being performed.

1.0 SCOPE AND APPLICATION

1.1 This Standard Operating Procedure describes the analysis and determination of metals by ICP – AES.

1.2 This method is applicable to most matrices including ground water, liquids, and digestate of TCLP, waste, soil, sludge, sediment, and other solid wastes.

2.0 REPORTING LIMIT

2.1 This procedure yields reporting limits for various elements; typical limits are as shown in the following table.

2.2 Lower limits of quantitation may be possible when a lower calibration point is included as part of the calibration curve.

TABLE – A

Elements	CAS No.	Water (mg/L)	Soil (mg/Kg)
Aluminum	7429-90-5	0.05	5.0
Antimony	7440-36-0	0.01	1.0
Arsenic	7440-38-2	0.01	1.0
Barium	7440-39-3	0.01	1.0
Beryllium	7440-41-7	0.004	0.5
Boron	7440-42-8	0.01	1.0
Cadmium	7440-43-9	0.005	0.5
Calcium	7440-70-2	1.0	100
Chromium	7440-45-1	0.01	1.0
Cobalt	7440-47-3	0.01	1.0
Copper	7440-48-4	0.02	1.0
Iron	7440-50-8	0.05	5.0
Lead	7439-89-6	0.01	1.0
Magnesium	7439-92-1	0.05	5.0
Phosphorus	7723-14-0	0.01	1.0
Manganese	7439-96-5	0.01	1.0

Elements	CAS No.	Water (mg/L)	Soil (mg/Kg)
Molybdenum	7439-98-7	0.01	1.0
Nickel	7440-02-0	0.01	1.0
Potassium	7440-09-7	1.0	100
Selenium	7782-49-2	0.01	1.0
Silicon	7440-21-3	0.05	5
Silver	7440-22-4	0.01	0.45
Sodium	7440-23-5	1.0	100
Strontium	7440-24-6	0.01	1.0
Thallium	7440-28-0	0.01	1.0
Titanium	7440-32-6	0.01	1.0
Tin	7440-31-5	0.01	1.0
Vanadium	7440-62-2	0.01	1.0
Zinc	7440-66-6	0.01	1.0

2.3 A linear dynamic range has been established for each element and shall be verified annually.

2.4 Lower limits of quantitation may be possible when a lower calibration point is included as part of the calibration curve

3.0 SUMMARY

3.1 Prior to analysis, samples are prepared and digested; refer to SATL#SOP004B for preparation and digestion of samples.

3.1.1 When samples have been properly preserved with acid and the turbidity is <1 NTU, the sample can be analyzed directly for certain metal and metalloid contaminants; with the exception of silver.

3.2 Digested samples in solution are introduced into the instrument through a nebulizer as an aerosol and are transported to the Plasma.

3.3 Element specific emission spectra are generated by a radio frequency Inductively Coupled Plasma [ICP].

3.4 Spectral line intensities are monitored by a photosensitive device, such as a camera, and are converted into digital signals and further into elemental concentrations.

3.5 Due to the nature of the technique, background noise is corrected by measuring the background levels on either side of the elemental lines during sample analysis.

4.0 DEFINITIONS

4.1 **ICP–AES** – Inductively Coupled Plasma – Atomic Emission Spectrometer.

4.2 **Calibration Blank –** A volume of reagent water acidified with the same acid matrix as in the calibration standards. The calibration blank is a zero standard and is used to auto-zero the instrument.

4.3 **Initial Calibration Blank (ICB)** – Analyzed immediately following instrument calibration. This blank monitors instrument baseline drift as well as any contamination that may be introduced from the laboratory environment.

4.4 **Interference Check Standard–A (ICS-A) –** High purity Standard, commercially obtained with known concentrations of Calcium, Magnesium, Iron, and Silver [See Table II, Appendix – B].

4.5 **Interference Check Standard–AB (ICS-AB) –** High purity Standard commercially obtained with known concentrations of various elements [See Table II, Appendix – B].

4.6 **Initial Calibration Verification (ICV)** – Analyzed immediately following instrument calibration. This verification confirms the accuracy of the instrument calibration and to monitor instrument drift and overall instrument performance.

4.7 **Continuing Calibration Blank (CCB)** – Analyzed at prescribed intervals throughout the entire run of samples. This blank monitors instrument baseline drift as well as any contamination that may be introduced from the laboratory environment.

4.8 **Continuing Calibration Verification (CCV)** – Analyzed at prescribed intervals throughout the entire run of samples. This verification confirms the continued accuracy of the instrument calibration and to monitor instrument drift and overall instrument performance.

4.9 **Laboratory Reagent Blank [LRB] –** For this method, the LRB is synonymous to a method blank. An aliquot of reagent water or other blank matrix [such as analyte-free solid reagent, for soils] treated exactly as a sample including exposure to all glassware, equipment, and reagents that are used with other samples. The LRB is used to determine if any method analytes or other interferences are present in the laboratory environment, reagents, or apparatus. An analyte-free reagent must be used [spiked] that mimics the matrix of the associated environmental samples.

4.10 **Blank Spike [BS] –** Although the laboratory uses the term Blank Spike, this quality control measure is synonymous with the industry term "Laboratory Fortified Blank/Laboratory Control Sample". The BS is an aliquot of LRB spiked with a known concentration of one or more of method analytes are added in the laboratory. The BS is analyzed exactly like a sample, and its purpose is to determine whether the methodology is in control and whether the laboratory is capable of making accurate and precise measurements. An aliquot of reagent water may be used for aqueous samples, while analyte-free solid reagent, must be used for soils.

4.11 **Blank Spike Duplicate [BSD] –** Although the laboratory uses the term Blank Spike/Blank Spike Duplicate, this quality control measure is synonymous with the industry terms "Laboratory Fortified Blank Duplicate/Laboratory Control Sample Duplicate." The BSD is a second aliquot or sample that is treated the same as the original sample in order to determine the precision of the analytical method.

4.12 **Laboratory Duplicates –** Two aliquots of the same sample taken in the laboratory and analyzed separately with identical procedures. Analyses of duplicates indicate precision associated with laboratory procedures, but not with sample collection, preservation, or storage procedures.

4.13 **Laboratory Fortified Matrix [LFM] –** The LFM is synonymous with a matrix spike**.** An aliquot of an environmental sample to which a known quantity of the method analyte is added in the laboratory. The LFM is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the LFM corrected for background concentrations.

4.14 **Laboratory Fortified Matrix Duplicate [LFMD] –** A second aliquot or sample that is treated the same as the original sample in order to determine the precision of the analytical method.

4.15 **Linear Dynamic Range [LDR] –** The concentration range over which the instrument response to an analyte is linear.

4.16 **Method Detection Limit [MDL] –** The method detection limit (MDL) is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results. For purposes of this method, the MDL is equivalent to NELAC's Limit of Detection [LOD]. See Section 19.0 METHOD PERFORMANCE for more information regarding LOD.

4.17 **Limit of Detection [LOD]** – See Method Detection Limit.

4.18 **Practical Quantitation Limit [PQL]** – The lowest concentration that can be reliably measured within specified limits of precision and accuracy for a specific laboratory analytical method during routine laboratory operating conditions. The laboratory uses the NELAC term of Limit of Quantitation [LOQ] to establish the lowest Reporting Limit [RL] that a concentration of an analyte can be reported without qualification.

4.19 **Limit of Quantitation [LOQ]** – For purposes of this method, the LOQ is equal to the low standard used for initial calibration for an analytical method, and is equal to the Reporting Limit [RL], which is the lowest limit an analyte's concentration can be reported without qualification.

5.0 INTERFERENCES

5.1 Spectral interferences are caused by background emission, stray light from the line emission of high concentration elements, overlap of a spectral line from another element, or unresolved overlap of molecular band spectra.

5.1.1 Utilizing a computer correction of the raw data, which requires the monitoring and measurement of the interfering elements, can compensate for the overlap of spectral lines of elements. Any unresolved overlap of molecular band spectra may require selection of an alternate wavelength. Interferences caused by background emission, stray light from the line emission of high concentration elements can usually be compensated by a background correction adjacent to the analyte line.

5.2 Physical interferences are effects associated with the sample nebulization and transport processes. Changes in viscosity and surface tension can cause significant inaccuracies, especially in samples containing high dissolved solids or high acid concentrations. If physical interferences are present, they must be reduced by diluting the sample, by using a peristaltic pump, by using an internal standard, or by using a high solids nebulizer.

5.3 Buildup of salt from high dissolved solids at the tip of the nebulizer can affect aerosol flow rate and causing instrumental drift. This problem can be controlled by wetting the argon prior to nebulization, or by using a high solids nebulizer, or by diluting the sample.

5.4 Fluctuations in Argon flow it has been reported that better control of the argon flow rate, especially to the nebulizer, improves instrument performance. This may be accomplished with the use of mass flow controllers.

5.5 Chemical interferences include molecular compound formation, ionization effects, and solute vaporization effects. Normally, these effects are not significant with the ICP technique, but if observed, can be minimized by careful selection of operating conditions (incident power, observation position, and so forth), by buffering of the sample, by matrix matching, and by standard addition procedures. Chemical interferences are highly dependent on matrix type and the specific analyte element.

5.6 The ICP is extremely sensitive to temperature fluctuations. It is important to ensure that the instrument is not in contact with direct sunlight and that the temperature in the laboratory does not fluctuate drastically during the day.

5.7 Once the plasma is lit, it is imperative that there is always a solution flowing through the plasma. If the torch is allowed to run dry, severe damage may occur to the nebulizer/torch assembly. If the instrument is left unattended, ensure that an adequate amount of solution is available for nebulization.

6.0 SAFETY

6.1 Safety glasses and laboratory coats must be worn at all times while in the laboratory. In addition gloves and a face shield or goggles must be worn when dealing with toxic, caustic, and/or flammable chemicals.

6.2 A partial facemask should be worn when working with samples suspected to contain high levels of volatile organics, such solvents, and samples contaminated with gasoline, etc.

6.3 All chemical compounds should be treated as potential health hazards.

6.4 The toxicity and/or carcinogenicity of each sample will most likely not be known. Therefore, it is imperative that each sample be handled as a potential health hazard.

6.5 The analyst should familiarize themselves with all Safety Data Sheets [SDS], safety facilities, and equipment prior to beginning this procedure.

6.6 Please address any and all health and safety concerns to management before beginning this procedure.

7.0 EQUIPMENT AND SUPPLIES

7.1 ICP-AES Thermo-Scientific, iCAP 6500, or equivalent

7.2 Volumetric Flask, 100mL, Fisher Scientific, Catalog No. 10-209H, or Equivalent.

7.3 Pipetter, 10-100 µL, Fisher Scientific, Catalog No. NC9929298, or Equivalent.

7.4 Pipetter, 100-1000 µL, Fisher Scientific, Catalog No. NC9929299, or Equivalent.
7.5 Pipetter, 1000-5000 µL, Fisher Scientific, Catalog No. NC9012869, or Equivalent.
7.1 Pipette Tip, 1-200µL, BVA Scientific, Catalog No. P38K-3YB, or Equivalent.
7.2 Pipette Tip, 200-1000µL, BVA Scientific, Catalog No. P38K-15BB, or Equivalent.
7.3 Pipette Tip, 1000-5000µL, BVA Scientific, Catalog No. P38-MPT5, or Equivalent.
7.4 Spoonula, Fisher Scientific, Catalog No. 14-375-10, or Equivalent.
7.5 Filter Paper, 15cm, BVA Scientific, Catalog No. F8J-150, or Equivalent.
7.6 Pall Magnetic Filter Holder and Funnel, Hach Product No. 1352900, or Equivalent.
7.7 Balance, Top Loading, Accurate to 0.01g, Denver Instruments, or Equivalent.
7.8 Digestion Tubes, 68mL Capacity, Environmental Express, Catalog No. SC475.
7.9 pH Paper, Fisher Scientific, Catalog No. 14-850-11B, or Equivalent.

8.0 REAGENTS AND STANDARDS

8.1 Ultra-Pure Water, San Antonio Testing Laboratory, Wet Chemistry
8.2 Hydrochloric Acid [HCl], 2.5L, Concentrated Trace Metal Grade, Fisher Scientific, Catalog No. A508SK212, or Equivalent
8.3 Nitric Acid [HNO_3], 2.5L, Concentrated Trace Metal Grade, Fisher Scientific, Catalog No. A509SK212, or Equivalent
8.4 Hydrogen Peroxide, 30% [H_2O_2], Trace Metal Grade, Fisher Scientific, Catalog No.524004, or Equivalent
8.5 Quality Control Standard #1, AccuStandard Reference Standard, ICP Multi-Element Standard, 500mL, Catalog No. QCS-01-5, or Equivalent
8.6 Quality Control Standard #2, AccuStandard Reference Standard, ICP Multi-Element Standard, 500mL, Catalog No. QCS-02-5, or Equivalent
8.7 Quality Control Standard, Second Source #1, AccuStandard Reference Standard, ICP Multi-Element Standard, 500mL, Catalog No. QCS-ASL-21-5, or Equivalent
8.8 Quality Control Standard, Second Source #2, AccuStandard Reference Standard, ICP Multi-Element Standard, 500mL, Catalog No. QCS-ASL-7-5, or Equivalent
8.9 **Standard Stock Solutions:** Commercial stock solutions containing the compounds of interest are purchased from approved vendors at concentrations ranging from 100µg/mL to 1000µg/mL.
8.10 **Spike Solutions:** Known amounts of the reference standards are directly spiked into the samples prior to digestion procedure. All metals except Silicon, Silver and Potassium, have a final concentration of 2µg/mL. The latter have 10µg/mL, 1µg/mL, and 20µg/mL respectively. The following table lists the amounts of spiking standards to be used in this SOP. The spiking amounts may vary based upon client project requirements.

TABLE – B

Spike Solution		Stock Conc. [µg/mL]	Final Vol. [mL]	Stock Vol. [mL]	Final Conc. [µg/mL]
Liquid Matrix	BS	50 / 100 / 500 / 1000	50	1.0	1 / 2 / 10 / 20
	BSD	50 / 100 / 500 / 1000	50	1.0	1 / 2 / 10 / 20
	LFM	50 / 100 / 500 / 1000	50	1.0	1 / 2 / 10 / 20
	LFMD	50 / 100 / 500 / 1000	50	1.0	1 / 2 / 10 / 20

Solid Matrix	BS	50 / 100 / 500 / 1000	50	1.0	1 / 2 / 10 / 20
	BSD	50 / 100 / 500 / 1000	50	1.0	1 / 2 / 10 / 20
	LFM	50 / 100 / 500 / 1000	50	1.0	1 / 2 / 10 / 20
	LFMD	50 / 100 / 500 / 1000	50	1.0	1 / 2 / 10 / 20

9.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

9.1 Sample Collection

9.1.1 Aqueous Samples

9.1.1.1 Aqueous/liquid samples are collected in plastic or glass bottles. At least 250mL of sample is required for digestion and analysis.

9.1.2 Solid Samples

9.1.2.1 Solid [soils and sediment] samples are collected in 4oz wide mouth borosilicate glass jars or plastic. A minimum of 200 grams of sample is required for digestion & analysis of metals.

9.1.2.2 Solid samples must be homogenized in the field and further homogenized in the laboratory prior to digestion and analysis.

9.1.3 Waste Characterization Samples

9.1.3.1 Waste characterization samples are collected similar to the solid samples and transported to the laboratory for analysis.

9.2 Preservation

9.2.1 Aqueous Samples

9.2.1.1 Samples for dissolved metals need to be filtered in the field and pH adjusted to <2.

9.2.1.1.1 Client may request that the laboratory perform the filtration; sample is filtered using filter paper (7.5) with Pall magnetic filter holder and funnel (7.6).

9.2.1.2 Aqueous samples are preserved with approximately 2mL of 1:1–HNO_3: H_2O to a pH of 2.0 or less and it is recommended that the samples be kept on ice during transport and refrigerated until digestion and analysis.

9.2.2 Solid Samples

9.2.2.1 Solid samples do not required preservation with acid but recommended to be kept on ice after collection to prevent loss of extremely volatile organics.

9.3 Holding Times

9.3.1 Aqueous Samples

9.3.1.1 Aqueous samples preserved with acid as described in 9.2.1.1 have a holding time of 180 days from the time of collection until the time of analysis.

9.3.2 Solid Samples

9.3.2.1 Solid and Waste samples also have a holding time of 180 days from the time of collection until the time of analysis.

10.0 STORAGE

10.1 Aqueous samples are stored until the time of analysis in a refrigerator at >0°C but ≤ 6°C.

10.2 Solid samples are stored at >0°C but ≤ 6°C in a refrigerator until the time of digestion and analysis.

11.0 SAMPLE IDENTIFICATION

11.1 Samples are received from Sample Receiving with an In-House Chain of Custody form generated from the Laboratory Information Management System [LIMS]. This includes client identification, sample number, and test to be performed.

11.2 Each sample is assigned a unique number and a container number if more than one container is received.

12.0 CALIBRATION AND STANDARDIZATION

12.1 **BALANCES:** All balances used for this procedure must be checked with S-Class weights and monitored to be within tolerance limits on each day of use.

12.2 **PIPETTES:** All mechanical pipettes must be checked using a calibrated analytical balance. Checks are to be performed quarterly. Pipette checks are to be noted in the Pipette Calibration electronic spreadsheet.

12.3 The calibration of the instrument (iCAP) includes the analysis of a Calibration Blank, a Low Standard, a Mid Standard, and a High Standard, followed by the analysis of additional QC standards.

12.4 The typical analytical sequence includes the calibration, ICV, ICB, ICS-AB, ICS-A, Rinse Blank, Samples 1-10, Rinse Blank, CCV, CCB, and Samples 11-20, Rinse Blank CCV, CCB, any additional samples, and finally an ending CCV and CCB.

12.5 Prior to the analysis of samples the ICP instrument must be calibrated each day of use. The calibration curve consists of: Calibration Blank, Low Standard (0.01 ppm), Mid Standard (0.5 ppm), and High Standard (2 ppm). Such calibration standards are prepared according to table III, found in Appendix B (at the end of this SOP).

12.6 The calibration is verified by using a standard spiked at 0.5 ppm from a second source (ICV) and interferences are monitored by running an ICS-A and ICA-AB, which are spiked with known interferants and analytes.

12.7 Correlation coefficient of each of the elements of interest must be ≥ 0.995. All other standards follow the acceptance criteria cited in Table IV.

12.8 Calculate the Relative Standard Error (%RSE) of the calibration curve for analytes with linear or quadratic fits. Determine the %RSE using the equation below.

$$\%\,RSE = 100 \times \sqrt{\sum_{i=1}^{n}\left[\frac{x'_i - x_i}{x_i}\right]^2 \Big/ (n-p)}$$

Where,

x_i = True value for the calibration standard
x'_i = Measured concentration of the calibration standard
n = Number of calibration points
p = Number of terms in the fitting equation
(Average = 1, Linear = 2, Quadratic = 3)

12.9 Coefficient of determination must be >0.920 (which approximately corresponds to the 15% RSD limit set forth in the reference method). If this cannot be achieved, the calibration is unacceptable and recalibration is necessary after remedial action to correct the problem.

12.10 Calculate the Relative Error (%RE) for those analytes are calibrated using linear or quadratic curve fits and determine the coefficient of determination using the following equation.

$$\%Relative\ Error = \frac{x'_i - x_i}{x_i} \times 100$$

Where,

x_i = True value for the calibration standard
x'_i = Measured concentration of the calibration standard

12.11 The relative error percent must be calculated for two of the calibration levels, i.e., the low calibration standard and the mid-point calibration standard. The acceptance criteria for low standard is 30% and the mid-point standard is 15%.

12.12 Initial/Continuing calibration verification

12.12.1 All initial instrument calibrations must be verified with an ICV. The ICV must be prepared from a standard obtained from a second manufacturer or lot if the lot can be demonstrated from the manufacturer as prepared independently from other lots. The ICV recovery must be within ±5% and ±10% of the stated concentration (for EPA 200.7 and for EPA 6010B respectively).

12.12.2 Calibration of the ICP-AES system is verified by analyzing a continuing calibration verification standard [CCV]. If the CCV standard meets acceptance criteria of ≤10% Difference [%D] for elements of interest, then the initial calibration is deemed valid.

12.12.3 If the CCV fails to meet the acceptance criteria, refer to Appendix B, Table-IV for recommended corrective actions.

12.12.4 If the ICV and CCV fail to meet the criteria in the above-mentioned tables, system check/ maintenance may be required as described in the next section.

12.13 Recommended system maintenance

12.13.1 In cases where the initial calibration does not meet the acceptance criteria or the CCV does not meet the %D criteria, system maintenance is required. A short list of the remedial actions is given below:

a. Check the Argon gas flow to the ICP-AES system.
b. Clean and/or replace the nebulizer.
c. Check all pressure gauges and bulk gas supply.
d. Clean and/or replace the Plasma Torch.
e. Check and replace all pump tubing once a week or as necessary.
f. Flush all tubing including the auto-sampler tubing.
g. Analyze reagent water blanks containing 2% HNO_3.
h. If none of these maintenance tasks resolve the problems, contact the manufacturer for either technical help or service call.

13.0 PROCEDURE

13.1 Instrument preparation

13.1.1 Prior to any analysis check Argon and Nitrogen bulk tank levels and pressure. The gauges located in the metals room should read about 80-85psi.

13.1.2 Be sure that waste collection containers are not near capacity. If so, dispose of the waste before proceeding.

13.1.3 Check that all pump tubing is attached and in good condition. It may be necessary to replace the tubing.

13.2 Instrument Operation

13.2.1 From the computer desktop, click the iTEVA icon to open instrument software. This will initiate the instrument settings.

13.2.2 In the iTEVA Software window, click on the plasma icon [candle like] at the bottom of the screen to open the Plasma Control Panel window. Allow the instrument to warm up for 15 minutes prior to the start of calibration.

13.2.3 Once the instrument has been started up, ignite the plasma by clicking on the ‘Plasma on’ located at the bottom of the plasma status screen and allow the instrument to warm up for at least 15 minutes prior to the start of calibration.

13.2.4 On the Plasma Control Panel, the instrument parameters should be set as below (may be adjusted as needed for optimal performance of the instrument:

RF Power	1150 W
Pump Rate	50 RPM
Auxiliary Gas Flow	0.5 L/min
Nebulizer Gas Flow	0.95 L/min
Coolant Gas Flow	12 L/min
Purge Gas Flow	Normal

13.3 Sample preparation

13.3.1 All samples except those that are analyzed only for dissolved metals or direct analysis are digested prior to analysis. Refer to SATL#SOP004B for sample preparation. For drinking water samples, check the turbidity of the preserved sample and record results in the logbook as either >1.0 or <1.0. If turbidity is <1.0 NTU, direct analysis can be performed. If turbidity is >1.0 NTU, samples will be digested prior to analysis.

13.3.1.1 ***Soils:*** Must be centrifuged for 10 minutes, filtered, or allowed to settle overnight.

13.3.1.2 ***Liquids:*** Allow settling overnight if suspended solids are present

13.3.1.3 Samples may be filtered if necessary, with a Whatman 42 filter or equivalent.

13.4 Auto-Sampler and Sample Sequence

13.4.1 From the iTEVA control center, click on the ‘Analyst’ icon. Choose a desired method by clicking on the method name for the Sequence, click ‘OK’.

13.4.2 Click on the ‘Sequence’ tab located on the lower left-hand side. Then, go to the upper left-hand side and click on ‘Auto-session’. From the drop-down menu click on ‘New Autosampler’.

13.4.3 Once the New Automation Session opens up, click on the ‘New’ button, this will prompt the new Sequence screen. Once there, enter the number of samples to be added to the sequence and click 'OK'. Click 'OK" on the previous screen (New Automation Sequence) so as to close it as well.

13.4.4 Click on the grid-like button located at the upper-center of the screen, the workspace will now be in 'List-view'. On this screen, analyst may name the samples to be run by simply clicking in each sample line and typing in the sample identification with any other pertinent information.

13.4.5 After entering the sample run sequence, click on the 'Auto-session' tab and save the sequence (usually the date of the run).

13.4.6 Right-click on the newly created sequence located on the left side of the screen and click 'Auto-locate all'. This will allow the autosampler to find each sample location.

13.4.7 Once all Standards, QC standards, and Samples have been loaded onto the appropriate racks on the autosampler, the sequence can be started by simply clicking 'Play' button (yellow-side ways triangle) found on the upper portion of the workspace.

13.4.8 The instrument begins by performing the calibration, followed by running the QC check standards, and the samples as well as running a CCV and CCB after the analysis of every ten samples and the ending CCV and CCB.

13.4.9 Click the "Auto Sampler Rack" icon to open the sample setup diagram.

13.4.10 If the instrument continues to run after work hours, then select "Shut down Plasma" option to shut the instrument down at the end of sample analysis.

13.5 Editing a Sequence

13.5.1 The analyst may edit the sequence by going to 'List View' and using the 'test-tube+' for adding and the 'test-tube-' for deleting samples. Delete the sample by highlighting the sample row and click 'test-tube-'.

13.5.2 The analyst may also opt to set runtime and actions such as: sound an audible alarm once the sequence has been run or to set the instrument to shut-down by extinguishing the plasma following the completion of a sequence.

13.5.3 To set the shutdown, right-click on the sequence on the left portion of the screen and click 'Modify'. Under the conclusions heading click on the desired action and save the changes.

13.6 Pause and Stop Actions During a Sequence Run

13.6.1 To pause the sequence, such as when more samples need to be added or the order of the run is to be altered, click on the 'Pause' tab (two yellow bars) in the upper center of the list-view screen. If the instrument is running a sample at that moment, the analysis of that sample will be completed and the auto-sampler will go into pause mode immediately after that.

13.6.2 Once the changes have been made and saved, click on the 'pause' button once more to continue running the sequence.

13.6.3 In order to stop a run, locate the 'halt autosession' button located in the upper center (Yellow Square) of the screen and click on it. This will stop the analysis and return the sipper to the home position. To abort a sequence, click on the abort autosession button (red square).

13.6.4 To resume the analysis click on '+' button to the left of the sequence name, then click on the '+' button to the left of the Method name, click on the '+' button to the left of the samples. Once, the list of samples is displayed, right-click on the sample at which you wish to start running the sequence.

13.6.5 Verify that the instrument calibration is valid and subsequent QC samples meet the acceptance criteria. Sample data may be released with qualification on the analytical report for any QC failures observed.

13.6.6 Review the instrument data and export into LIMS system for reporting.

14.0 DATA ANALYSIS AND CALCULATIONS

14.1 *Data Analysis:*

14.1.1 Percent Relative Standard Deviation:

$$\%\mathrm{RSD} = \frac{\mathrm{SD}}{\overline{\mathrm{RF}}} \times 100$$

Where:

SD = Standard Deviation; $\overline{\mathrm{RF}}$ = Average Response Factor

14.2 *Calculation of the Unknowns:*

14.2.1 Concentration of each element in a **Water** Sample:

$$\text{Concentration (mg/L)} = \left[(I_R) \times (DF)\right]$$

Where:

DF = Dilution Factor
I_R = Result from Instrument analysis in [µg/mL]

14.2.2 Concentration of each analyte in a **Soil/Waste** Sample:
(Sediment and Soil Sludge Based On Dry Wt.; Waste Based On Wet Wt.)

$$\text{Concentration (mg/kg)} = \frac{(I_R) \times (FV) \times (DF)}{W_S \times D}$$

Where:

I_R = Result from Instrument analysis in [µg/mL]
FV = Final digestate volume [mL]
W_S = Weight Of Sample Extracted [g]
D = (% Dry Weight of Sample/100) or 1 For Wet Weight Basis

14.2.3 LFM (Matrix Spike) Recovery

$$\text{Matrix Spike Recovery} = \frac{\mathrm{MSR} - \mathrm{SR}}{\mathrm{SA}} \times 100$$

Where:

MSR = Element Spike from Sample Result
SR = Element from Sample Result
SA = Spike Added to the Sample

14.2.4 Relative Percent Difference:

$$RPD = \left| \frac{MSR - MSDR}{\left(\frac{MSR + MSDR}{2} \right)} \right| \times 100$$

Where:

RPD = Relative Percent Difference.
MSR = LFM [Matrix Spike] Recovery.
MSDR = LFMD [Matrix Spike Duplicate] Recovery.

15.0 QUALITY CONTROL

15.1 Acceptance limits for quality control measures are listed in Table IV.

15.2 Initial calibration is verified initially with a second source ICV and after every 10 samples and at the end of the run using the primary source CCV versus acceptance criteria provided in Table IV.

Note: *A second source ICV may also be used after every ten samples to verify calibration.*

15.2.1 The instrument's Linear Dynamic Range must be established as per the manufacturer recommendations.

15.3 Each batch of samples requires the analysis of a LRB, BS, BSD, LFM and LFMD. LFM/LFMD (however named) must be performed with each batch of samples regardless of matrix type, at a frequency of 10% for aqueous samples, and 5% for soils. Sample duplicates are optional based on client requests.

15.4 Recommended matrix interference checks for LFM/LFMD and Sample and Sample Dilution

15.4.1 ***Liquids***

15.4.1.1 ***Dilution test:*** If an analyte concentration is above the high standard for the calibration curve but within the LDR, the analyte may be reported with data qualifier or diluted and re-analyzed. If the analyte concentration is sufficiently high (by a factor of 50 above the instrument detection limit in the original solution but <90% of the linear limit), an analysis of a 1:5 dilution should agree (after correction for the fivefold dilution) within ±10% of the original determination. If not, a chemical or physical interference effect should be suspected and the associated data flagged accordingly.

Example: *If the concentration of Arsenic in a sample is 0.5mg/L at the instrument level [this is equal to a factor of 50 above the IDL (0.01mg/L, for example)], in the dilution analysis the concentration of Arsenic should fall between 0.45mg/L and 0.55mg/L [after taking into account a dilution factor or 5×] at the instrument level. If not an interference effect, either physical or chemical is suspected.*

15.4.1.2 ***Post Digestion Spike:*** An analyte(s) standard of known concentration added to a portion of a digested and prepared sample, or its dilution, should be recovered to within 85% to 115% of the known value.

15.4.1.3 The analyte(s) addition should produce a minimum level of 20 times and a maximum of 100 times the instrument detection limit. If recovery of the analyte(s) is not within the specified limits, a matrix effect should be suspected, and the associated data flagged accordingly.

> ***Example:*** *The concentration of Lead in a sample is 0.5mg/L at the instrument level [this equals a factor of 50 above the IDL (0.01mg/L)], and a spike of 2mg/L is added to the sample. The recovery of in the post digestion spike should fall between 2.125mg/L and 2.875mg/L at the instrument level. If not a matrix effect is suspected and the data is flagged accordingly on the report.*

15.4.2 ***Solids***

15.4.2.1 ***Dilution test:*** If an analyte concentration is above the high standard for the calibration curve but within the LDR, the analyte may be diluted and re-analyzed or reported with qualification. If the analyte concentration is sufficiently high (minimally, a factor of 10 above the instrumental detection limit after dilution), an analysis of a 1:5 dilution should agree within ± 10% of the original determination. If not, a chemical or physical interference effect should be suspected.

> ***Example:*** *The concentration of Arsenic in a sample is 0.5mg/L at the instrument level [this equals to a factor of 25 above the IDL (0.02mg/L for example)], in the dilution analysis the concentration of Arsenic should fall between 0.45mg/L and 0.55mg/L [after taking into account a dilution factor or 5×] at the instrument level. If not an interference effect, either physical or chemical is suspected.*

15.4.3 ***Post Digestion Spike***: An analyte spike added to a portion of a prepared sample, or its dilution, should be recovered to within 75% to 125% of the known value. The spike added should produce a minimum level of 10 times and a maximum of 100 times the instrumental detection limit. For instance, if the instrument detection limit for Lead is 0.02mg/L then the spike added should be between 0.2mg/L to 2mg/L. If the spike recovered is not within the specified limits of 75% – 125%, a matrix effect is suspected.

> ***Example:*** *The concentration of Lead in a sample is 0.2mg/L at the instrument level [this equals a factor of 50 above the IDL (0.02mg/L for example)], and a spike of 2mg/L is added to the sample. The recovery of the post digestion spike should fall between 1.65mg/L and 2.75mg/L at the instrument level. If not a matrix effect is suspected and the data is flagged accordingly on the report.*

15.4.4 All pertinent information such as: calibration standards/equipment identification numbers, unique identification numbers for stock and working standards/solutions, and balance/thermometer serial numbers must be recorded in log books/bench sheets.

> *Note: All working calibration standards and solutions prepared daily must also be assigned a unique identification number in Element.*

16.0 ACCEPTANCE CRITERIA

16.1 Refer to Appendix B, Table IV for acceptance criteria.

16.2 The acceptance limits for Demonstration of Capability (DOC) by this method are %RSD <15 (precision) of 4 QC replicates, and an average recovery range of 85-115% (accuracy) of the true concentration, for water. For soil, %RSD <20, and an average recovery range of 80-120%. DOCs must take into account all sample preparation steps, must be performed per analyst, per matrix, and must be prepared from a secondary source.

17.0 CORRECTIVE ACTIONS FOR NON-CONFORMANCE DATA

17.1 Refer to Appendix B, Table IV for corrective actions.

17.2 When QC does not fall within the acceptable range, the QC must be reanalyzed, along with the associated samples. If the QC continues to fail, identify the root of the problem and correct. A Corrective Action Form may be required per the determination of the Quality Assurance Manager.

18.0 HANDLING NON-CONFORMANCE DATA

18.1 Non-conformance is monitored and is resolved by classifying into categories such as system based, method based, preparative method based, etc., and are resolved once the problem areas are identified.

19.0 METHOD PERFORMANCE

19.1 The minimum level of quantitation is equivalent to NELAC's Limit of Quantitation [LOQ] and must be verified at least annually with a second source material as compared to the initial calibration.

19.1.1 The LOQ is equal to the low standard used for initial calibration.

19.2 A method detection limit study is performed, initially and verified quarterly thereafter for analyte that is listed in this method.

19.3 During the beginning of each quarter, two replicate samples of organic free reagent water are spiked with a known amount of target analytes at the concentration used in the initial determination of the MDL and analyzed on the ICP/AES.

19.4 If any analytes are repeatedly not detected in the quarterly spiked sample analyses, or do not meet the qualitative identification criteria of the method, then this is an indication that the spiking level is not high enough and should be adjusted.

19.5 Prepare and analyze seven spike replicates and seven method blanks on at least three different days carried out through sample preparation steps. Existing routine method blanks can be used for this study.

19.6 A minimum of seven MDL replicate samples and seven method blanks are used to calculate the MDL values. For purposes of this method, the MDL is equivalent to TNI's Limit of Detection (LOD).

Calculate the MDL_S (MDL spiked samples) value using the following formula:

$$MDL_S = t_{[n-1,\ 1-\infty = 0.99]}\ S_s$$

Where,

$t_{[n-1,\ 1-\infty = 0.99]}$ = Student's t value for the 99% confidence level with n-1 degrees of freedom,
n = number of replicates.

S_s = the standard deviation of the replicate analyses.

Calculate the MDL_B (MDL blank samples) values using the following formula:

$$MDL = t_{[n-1,\ 1\text{-alpha} = 0.99]}\ S_b$$

Where,

$t_{[n-1,\ 1\text{-alpha} = 0.99]}$ = Student's t value for the 99% confidence level with n-1 degrees of freedom,
n = number of replicates.
S_b = the standard deviation of the replicate method blank sample analyses.

Number of Replicates	Degrees (degrees of freedom)	$t_{(n-1,\ 0.99)}$
7	6	3.143
8	7	2.998
9	8	2.896
10	9	2.821
11	10	2.764

19.7 Current MDL values for method analytes in this SOP can be found in the SATLMDL.xls spreadsheet.

20.0 POLLUTION PREVENTION

20.1 No solvents are utilized in this method. However, various acids are used throughout the method and are disposed of by diluting with Di-ionized water.

20.2 Solutions used to prepare calibration standards are purchased only at levels required to prepare dilute working standards and at the smallest possible amounts possible.

20.3 Only the amount of chemical that is actually needed is purchased, to eliminate the pollution and cost of disposal later.

21.0 WASTE MANAGEMENT

21.1 Toxic waste must never be disposed of down the drain.

21.2 Waste generated from sample analysis must be segregated if the process knowledge indicates the presence of any of the hazardous components listed in Table–1, 40 CFR 261.24 and exceed the limits set in the table.

21.3 When disposing samples the analyst must follow current revision of the "Laboratory Waste Handling and Disposal" SOP (SATL#007G) for detailed disposal procedures.

21.4 All chemicals and containers must be properly identified and labeled at all times to eliminate ambiguity and cost of disposal of unknowns. If an unknown chemical or container is discovered, label it as 'unknown' and attach a note detailing any information about what the chemical may be, what test it may have been used for, and where it was found. If you find an unlabeled chemical that has crystallized or there is any other indication that it may be unstable, notify management immediately.

21.5 Generally, empty chemical containers are not considered hazardous waste. Check with management if one such container is found and in doubt. To dispose of the container in the regular trash the container must be completely empty and triple.

21.6 The waste drums are picked up upon notification and a copy of the report is submitted to the waste management company.

22.0 REFERENCES

22.1 "Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma – Atomic Emission Spectrometry," Method 200.7, Revision 4.4, May 1994. U.S. Environmental Protection Agency.

22.2 "Inductively Coupled Plasma Atomic Emission Spectroscopy," Method 6010B, Revision 2, December 1996, SW-846 Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency.

22.3 Operational Manual, TJA ICP–AES, Model # ICAP. ThermoElectron Corporation.

22.4 The TNI Standard, 2016.

23.0 REVISION HISTORY

23.1 New revision of the method.

23.2 Revision 2 from Revision 1: changes stemming from an annual review, and the most recent TCEQ on-site assessment.

23.3 Revised section 12.0 and 13.0.

23.4 Annual revision 2012, Rev 2.0.2 – No changes made

23.5 Annual Revision 2014, Rev 2.1.0 – Updated Tables in Appendix B (calibration curve standard preparation), revised sections: 4.0, 6.0, 12.0, 13.0, and 15.0.

APPENDIX A

SOP History and Version Control

Version	Date of Reviewed/Revision	Review/Revision Approved by	Brief Description
2.2	11/23/2015	M. Bernard	Addition of Appendix A to reflect SOP history and version control. Revised to clarify ICS QC requirements per reference method. Change Appendix I to Appendix B.
2.3	07/08/16	M. Bernard	Revision of title page and clarification on procedure for direct analysis (13.3.1).
2.4	2/27/17	M. Bernard	Revision of procedure prior to assessment.
3.0	06/15/2017	M. Bernard	Biennial review; revision of waste management protocol.
3.1	10/31/2018	M. Bernard	Revised to update internal standard protocol and Appendix B QC acceptance criteria.
4.0	04/15/2019	M. Bernard	Biennial review; general grammatical corrections.
5.0	03/05/2021	A.Rosecrance	Biennial review; update title page; change MSDS to SDS.
5.1	09/13/2021	C. Morrow	Revised the following: Update title page. Section 2 – Update quantitation limit requirements. Section 4 – Update definitions. Section 19 – Update MDL/LOD procedure.

APPENDIX – B

1. List of Tables

a. **Table I – Typical Wavelengths** used [nm] (other wavelengths may be used in order to optimize response and adhere to required quality control acceptance limits).

Element	**λ**	**Element**	**λ**	**Element**	**λ**	**Element**	**λ**
Ag	328.068	Co	228.616	Mo	202.030	Sn	189.989
Al	308.215	Cr	267.716	Na	588.995	Sr	421.552
As	189.042	Cu	324.754	Ni	231.604	Ti	334.941
Ba	493.409	Fe	259.940	Pb	220.353	Tl	190.864
Be	313.042	K	766.490	Sb	206.833	V	292.402
Ca	315.887	Mg	279.079	Se	196.090	Zn	213.856
Cd	226.502	Mn	257.610	Si	251.612	Y*	224.306
B	249.678	P	177.4			Y*	371.030
						In*	224.606

* Yittrium – Internal Standard. *Indium – Internal Standard.

b. **Table II – ICS-A and ICS-AB Solution Elements and Concentrations**

Elements	ICS-A (PPM)	ICS-AB (mg/L)	Elements	ICS-A (PPM)	ICS-AB (mg/L)
Aluminum	250	250	Manganese	0	0.05
Antimony	0	0	Molybdenum	0	0
Arsenic	0	0	Nickel	0	0.10
Barium	0	0.05	Potassium	0	0
Beryllium	0	0.05	Selenium	0	0
Cadmium	0	0.10	Silver	0	0.10
Calcium	250	250	Sodium	0	0
Chromium	0	0.05	Strontium	0	0
Cobalt	0	0.05	Thallium	0	0
Copper	0	0.05	Tin	0	0
Iron	100	100	Vanadium	0	0.05
Lead	0	0.10	Zinc	0	0.10
Magnesium	250	250	B	250	-

c. Table III: Calibration Curve Standards Preparation

Calibration Blank	50 mL 4%/2% (HNO_3/HCl) Rinse water
Standard 1 (Low Standard)	250 µL Standard 3 + 49.75 mL 4%/2% (HNO_3/HCl) Rinse water
Standard 2 (Mid Standard)	250 µL of each ICP stock standards + 49.5 mL 4%/2% (HNO_3/HCl) Rinse water
Standard 3 (High Standard)	1 mL of each ICP stock standards + 48 mL 4%/2% (HNO_3/HCl) Rinse water
ICV	1 mL of each ICP (second source) stock standards + 48 mL 4%/2% (HNO_3/HCl) Rinse water
CCB	50 mL 4%/2% (HNO_3/HCl) Rinse water
ICS-A	2.5 mL of Primary Interferants Standard + 47.5 mL 50 mL 4%/2% (HNO_3/HCl) Rinse water
ICS-AB	2.5 mL of Primary Interferants Standard + 50 µL Primary Analytes Standard + 47.45 mL 4%/2% (HNO_3/HCl) Rinse water
CCV	250 µL of each ICP stock standards + 49.5 mL 4%/2% (HNO_3/HCl) Rinse water

d. Table IV – Quality Control Acceptance Criteria

i. Liquids (EPA 200.7)

QC Standard	Acceptance Limits	Corrective Action
Initial Calibration prior to sample analysis: High Std., Low Std. and Calibration Blk.	Correlation coefficient of ≥ 0.995.	Determine root cause of problem and re-calibrate.
Calibration Blank	≤ IDL and > lower 3 Sigma of Calibration blank data	Cross Contamination – Check for possible reagent contamination and replace and re-analyze the batch of samples.
LRB	≤ 10% the analyte's conc. in associated samples, or ≤ 2.2 × the MDL	If not met, re-digest and re-analyze.
ICB & CCB	≤ IDL and > lower 3 Sigma of Calibration blank data	Cross Contamination – Check for possible reagent contamination and replace and re-analyze the batch of samples.
ICV CCV	(ICV) 95-105% (CCV) 90-110%	Re-analyze ICV/CCV. If still fail to meet the acceptance criteria, then prepare fresh standards and re-analyze.
ICS-A, ICS-AB	± 10% of actual conc.	Identify issue and correct, then recalibrate, and reanalyze all associated samples.
BS, BSD	85-115%; ≤ 20% RPD	Re-analyze sample batch; Further failure warrants re-digestion and reanalysis.

LFM, LFMD	75-125%; ≤ 20% RPD every 10 samples	Analyze post-digestion spike as per section 15.4 of this SOP.
Post Digestion Spike	85-115%	Flag data accordingly, If section 15.4 is indicative of matrix problems.
Serial Dilution	90-110%	Flag data accordingly, If section 15.4 is indicative of matrix problems.

ii. Solids/TCLP/SPLP (EPA 6010B)

QC Standard	Acceptance Limits	Corrective Action
Initial Calibration prior to sample analysis: High Std., Low Std. and Calibration Blk.	Correlation coefficient of ≥ 0.995.	Determine root cause of problem and re-calibrate.
Calibration Blank & ICB	≤ IDL and > lower 3 Sigma of Calibration blank data	Cross Contamination – Check for possible reagent contamination and replace and re-analyze the batch of samples.
LRB	≤ 10% the analyte's conc. in associated samples, or ≤ 2.2 × the MDL	If not met, re-digest and re-analyze.
CCB	≤ ½ R.L	Cross Contamination – Check for possible reagent contamination and replace and re-analyze the batch of samples.
ICV CCV	(ICV) 90-110% (CCV) 90-110%	Re-analyze ICV/CCV. If still fail to meet the acceptance criteria, then prepare fresh standards and re-analyze.
ICS-A, ICS-AB	± 10% of actual conc.	Identify issue and correct, then recalibrate, and reanalyze all associated samples.
BS, BSD	85-115%; ≤ 20% RPD	Re-analyze sample batch; Further failure warrants re-digestion and reanalysis.
LFM, LFMD	75-125%; ≤ 20% RPD, every 20 samples	Analyze post-digestion spike as per section 15.4 of this SOP.
Post Digestion Spike	75-125%	Flag data accordingly, If section 15.4 is indicative of matrix problems.
Serial Dilution	90-110%	Flag data accordingly, If section 15.4 is indicative of matrix problems.

e. Example Analysis Sequence

* Calibration Blank
* Low Standard (*equal to the concentration of the LOQ and*
* Mid Standard
* High Standard
ICV
ICB
ICS-AB
ICS-A
Rinse Blank
LRB
BS
BSD
Sample 1
Sample Duplicate [for liquid samples]
Sample 1 LFM
Sample 1 LFMD [for solid and TCLP/SPLP samples]
Sample 1 A (Post Digestion Spike)
Sample 1 DL (Serial Dilution)
Sample 2 Sample 10
Rinse Blank
CCV
CCB
Next 10 Samples Rinse Blank
CCV – End of Analysis
CCB – End of Analysis

f. Table V – Inter-Elemental Spectral Interferences

Interferants at 100mg/L level.

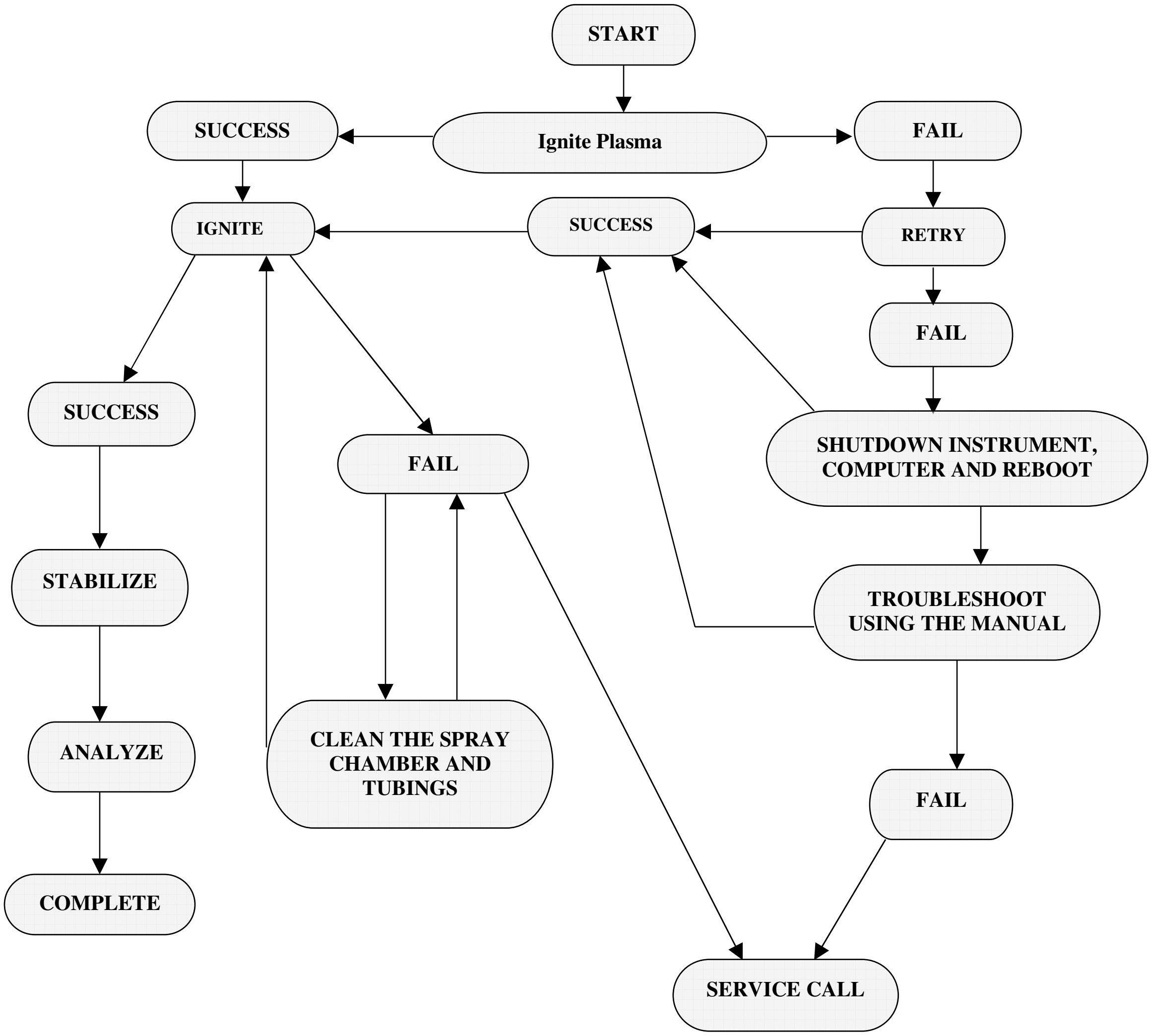
Analyte	WL (nm)	Interferant*						
Ag	328.068	Ce,	Ti,	Mn				
Al	308.215	V,	Mo,	Ce,	Mn			
As	193.759	V,	Al,	Co,	Fe,	Ni		
B	249.678	None						
Ba	493.409	None						
Be	313.042	V,	Ce					
Ca	315.887	Co,	Mo,	Ce				
Cd	226.502	Ni,	Ti,	Fe,	Ce			

Analyte	WL (nm)	Interferant*						
Mg	279.079	Ce						
Mn	257.610	Ce						
Mo	203.844	Ce						
Na	588.995	None						
Ni	231.604	Co,	Tl					
P	214.914	Cu,	Mo					
Pb	220.353	Co,	Al,	Ce,	Cu,	Ni,	Ti,	Fe
Sb	206.833	Cr,	Mo,	Sn,	Ti,	Ce,	Fe	

Ce	413.765	None						
Co	228.616	Ti,	Ba,	Cd,	Ni,	Cr,	Mo,	Ce
Cr	205.552	Be,	Mo,	Ni				
Cu	324.754	Mo,	Ti					
Fe	259.940	None						
Hg	194.227	V,	Mo					
K	766.491	None						
Li	670.784	None						

Se	196.099	Fe						
SiO	251.611	None	2					
Sn	189.980	Mo	Ti	Fe	Mn	Si		
Sr	421.552	None						
Tl	190.864	Ti,	Mo,	Co,	Ce,	Al,	V,	Mn
Ti	334.941	None						
V	292.402	Mo,	Ti,	Cr,	Fe,	Ce		
Zn	213.856	Ni,	Cu,	Fe				

g. Flow Chart – I



STANDARD OPERATING PROCEDURE

Title

Analysis of Ammonia [Nitrogen]

Method No.:

SM4500-NH_3–N [B & C] (23rd Edition, 2017)
& EPA 350.2

Matrix/Matrices:

Liquid/Solid

Document Control Number/Revision Number

SOP006A/Revision 5.1

Charles R. Morrow
Approved By: Quality Assurance Officer 09/14/21 **_Date_**

Approved By: General Manager 09/14/21 **_Date_**

Approved By: Laboratory Director 09/14/21 **_Date_**

Standard Operating Procedures shall be reviewed at least once in two years or as needed to determine their continued suitability, compliance with applicable requirements, and to ensure that they reflect actual procedures being performed.

1.0 SCOPE AND APPLICATION

1.1 This Standard Operating Procedure describes the determination of ammonia-nitrogen exclusive of total kjeldahl nitrogen, in drinking, surface and saline waters, solids/sediments, domestic and industrial wastes.

1.2 This SOP is applicable to liquid/solid matrices by distillation and subsequent determination of ammonia-N by titrimetry.

2.0 REPORTING LIMIT

2.1 The method covers the range from 1.0 to 25 mg/L for the titrimetric procedure with a practical quantitation limit of 1.0mg/L and 10mg/L for solids.

3.0 SUMMARY

3.1 A representative sample is buffered at a pH of 9.5 with a borate buffer in order to decrease hydrolysis of cyanates and organic nitrogen compounds, and is then distilled into a solution of boric acid.

3.2 The ammonia in the distillate is then determined by titration with standard sulfuric acid in the presence of an indicator.

4.0 DEFINITIONS

4.1 **Method Blank –** Reagent water that is carried through the entire analytical procedure. The method blank is used to define the level of laboratory background and reagent contamination.

4.2 **Duplicate (DUP) –** A separate aliquot of the same sample from the same sample container.

4.3 **Laboratory Fortified Blank/Laboratory Control Sample (LFB/LCS)** – Reagent water matrix, spiked with a solution containing method analyte[s] of known concentration. It is used to check analytical technique and sample preparation and method performance.

4.4 **Laboratory Fortified Blank Duplicate/Laboratory Control Sample Duplicate (LFBD/LCSD)** – LCSD is same as LCS and is used to check instrument performance as well as to determine the precision of the analytical method.

4.5 **Laboratory Fortified Matrix (LFM)** – An aliquot of a sample from the analytical batch spiked with a solution containing a mixture of anions of interest at known concentration. An LFM is used to check the effect of matrix on the analytes of interest.

4.6 **Practical Quantitation Limit/Reporting Limit (PQL/RL)** – The lowest concentration that can be reliably measured within specified limits of precision and accuracy for a specific laboratory analytical method during routine laboratory operating conditions.

4.7 **Working Standard Solution (WSS)** – A working standard solution is one that is an intermediate standard prepared by diluting the commercially purchased stock solution. A WSS is used to prepare standard solutions to calibrate the instrument.

5.0 INTERFERENCES

5.1 Residual chlorine, Cyanates, Urea, etc., may cause interferences with the sample analysis. Residual chlorine may be removed by treatment with a solution of sodium thiosulfate prior to distillation and titration if the sample is known to contain residual chlorine.

6.0 SAFETY

6.1 Care should be exercised when handling the distillation equipment due to heat and possible pressure build up.

6.2 Safety glasses and laboratory coats must be worn at all times while in the laboratory. In addition gloves and a face shield or goggles must be worn when dealing with toxic, caustic, and/or flammable chemicals.

6.3 A partial facemask should be worn when working with samples suspected to contain high levels of volatile organics, such solvents, and samples contaminated with gasoline, etc.

6.4 All chemical compounds should be treated as potential health hazards.

6.5 The toxicity and/or carcinogenicity of each sample will most likely not be known. Therefore, it is imperative that each sample be handled as a potential health hazard.

6.6 The analyst should familiarize themselves with all Safety Data Sheets (SDS), safety facilities, and equipment prior to beginning this procedure.

6.7 Please address any and all health and safety concerns to management before beginning this procedure.

7.0 EQUIPMENT AND SUPPLIES

7.1 Distillation apparatus such as RAPID STILL II, Labconco or equivalent.
7.2 Distillation flasks, collection vessels, etc.
7.3 Balance, Top Loading, Accurate to 0.001g, Denver, Sartorius, American Scientific, or Equivalent.
7.4 Beakers/Erlenmeyer flasks, 125-250mL, Fisher Scientific, or Equivalent.
7.5 Graduated Cylinders, 100mL Fisher Scientific, or Equivalent.
7.6 Pipetter, 100–1000–5000µL, Fisher Scientific, or Equivalent.
7.7 Pipette Tips, 200–1000–5000µL, BVA Scientific, or Equivalent.
7.8 Volumetric flasks, 100, 1000mL, with ground-glass stoppers.
7.9 Spatulas – Stainless steel.
7.10 Whatman No. 42 filter papers.
7.11 Aluminum dishes.
7.12 Reciprocating shaker.
7.13 Clean Ottawa sand.
7.14 Teflon boiling chips.

8.0 REAGENTS AND STANDARDS

8.1 Ultra-Pure Water, San Antonio Testing Laboratory, or equivalent.

8.2 Ammonium chloride, stock solution – commercially purchased at 1000mg/L of NH_3-N.

8.3 When commercial stock is unavailable then prepare in the laboratory a stock solution as below

8.3.1 Dissolve 3.819 g NH_4Cl in distilled water and bring to volume in a 1-liter volumetric flask. The concentration of this solution is 1000mg/L of NH_3-N [or 1,216mg/L of NH_3].

8.4 Mixed indicator solution: Prepare as described below and combine solutions. Prepare monthly.

8.4.1 Methyl Red indicator: Dissolve 200mg methyl red indicator in 100mL of 95% ethyl or isopropyl alcohol.

8.4.2 Methylene blue indicator: Dissolve 100mg of methylene blue in 50mL of 95% ethyl or isopropyl alcohol. Alternatively measure 10mL of a 1% aqueous solution of Methylene Blue and mix with 40mL of 95% ethyl or isopropyl alcohol.

8.5 Indicating Boric acid solution: Dissolve 20 g of H_3BO_3 in distilled water, add 10mL of the mixed indicator solution [8.4] and dilute to 1 liter. Prepare monthly.

8.6 Absorbent Boric acid [plain] solution: Dissolve 20g of H_3BO_3 in distilled water and dilute to 1 liter. DO NOT add the mixed indicator solution, and prepare fresh monthly.

8.7 Borate buffer solution: Add 88 mL of 0.1 N NaOH solution to 500 mL of approximately 0.025 M sodium tetraborate solution (5.0 g anhydrous $Na_2B_4O_7$, or 9.5 g $Na_2B_4O_7$ $10H_2O$ per liter) and dilute to 1 liter.

8.8 Sulfuric acid:

8.8.1 1N: Prepare by adding 28 mL of Conc. H_2SO_4 [18N] to 1 liter with reagent water.

8.8.2 0.1N: Prepare by diluting 2.8mL of Conc. H_2SO_4 [18N] to 1 liter with reagent water.

8.8.3 0.02N: Purchase commercially available solution or prepare by diluting 0.56mL of Conc. H_2SO_4 [18N] to 1L with laboratory reagent water.

8.9 Sodium hydroxide:

8.9.1 10N: Dissolve 400 g NaOH in laboratory reagent water and dilute to 1 liter.

8.9.2 6N: Dissolve 240g NaOH in laboratory reagent water and dilute to 1 liter.

8.9.3 1N: Dissolve 40g NaOH in laboratory reagent water and dilute to 1 liter.

8.9.4 0.1N: Dissolve 4g NaOH in laboratory reagent water and dilute to 1 liter.

8.10 Sodium Carbonate Solution [0.05N]: Dissolve 2.5g ±0.2g of Na_2CO_3 100mL of water, transfer into a 1L volumetric flask and dilute to the mark with reagent water. Do not use after 1 week and prepare weekly or as needed.

8.11 De-chlorinating reagent: Dissolve 3.5 g $Na_2S_2O_3.5H_2O$ in water and dilute to 1 liter or 1.75g in 500mL of reagent water. One mL of this solution will remove 1 mg/L of residual chlorine in 500 mL of sample.

9.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

9.1 Solid Sample Collection

9.1.1 Solid [soil, sludge, and sediment] samples are collected in 4oz wide mouth borosilicate glass jars with PTFE lined lids.

9.1.2 Solid samples do not require preservation with H_2SO_4, but must be kept on ice after collection and during transport to the lab to preserve sample integrity.

9.2 Liquid Sample Collection

9.2.1 Representative [grab or composite] samples may be collected in 500mL–1000mL plastic or glass containers with screw cap lids.

9.2.2 Preserve sample collection bottles with 2mL/500mL of sample with 1:1 H_2SO_4 prior to sampling, to adjust pH to <2. Samples may be collected unpreserved, however, in such cases un-acidified samples must be refrigerated ≤6°C and analyzed within 24 hours of sample collection. If samples are not going to be analyzed within 24 hours, pH must be adjusted to <2.0

9.2.3 When dealing with samples subjected to or suspected of chlorination, add 1-2mL of dechlorinating solution to the sample container to remove 1-2mg/L of residual chlorine.

9.2.4 Transport of samples to the laboratory for ammonia-N analysis on wet ice to maintain the temperature >0°C and ≤6°C is recommended.

9.3 Holding Time

9.3.1 The holding time for Ammonia-N analysis is 28 days for preserved samples and 24 hours for unpreserved samples, from the time of collection until the time of analysis.

10.0 STORAGE

10.1 Samples must be stored until the time of analysis in a refrigerator at >0°C but ≤ 6°C to preserve sample integrity.

11.0 SAMPLE IDENTIFICATION

11.1 Samples are received from Sample Receiving with a work order form generated from the Laboratory Information Management System (LIMS). This includes client identification, sample number, and tests to be performed under each department.

11.2 Each sample is assigned a unique number and a container number if more than one container is received.

12.0 CALIBRATION AND STANDARDIZATION

12.1 Balance must be checked using S Class weights on each day of use.

12.2 *Standardization of sulfuric acid is only necessary when commercially purchased stock is not available.* Standardize sulfuric acid titrant if prepared in the laboratory with standard Na_2CO_3 solution prepared as in section 8.10.

12.2.1 Transfer 40mL of standard Na_2CO_3 solution [0.025N] into a beaker or other suitable container and mix with 60mL of reagent water.

12.2.2 Insert pH electrode into the beaker and titrate with sulfuric acid titrant [8.8.3] until a pH of approximately 5. Stop the titration at this point.

12.2.3 Remove and rinse electrodes into the same beaker and gently heat the solution, covered with a watch glass over the beaker for 3–5 minutes, cool to room temperature. Rinse the watch glass into the beaker.

12.2.4 Continue the titration very slowly to a pH of 4.5. Repeat two more times and calculate the normality of the standard sulfuric acid solution using the following formula:

$$Normality\ of\ H_2SO_4, N = \frac{A \times B}{53.00 \times C}$$

Where:

A = g of Na_2CO_3 weighed into 1L volumetric flask
B = mL of Na_2CO_3 solution taken for titration
C = mL of sulfuric acid used.

12.2.5 Use the true normality of the acid titrant thus prepared in the calculations for NH_3-N, when laboratory prepared acid titrant is used in the analysis.

12.2.6 Prepare a working standard solution using dilute NH_4Cl stock prepared as in section 8.3.1 or use purchased ready to use stock solution.

13.0 PROCEDURE

13.1 Solid Sample Extraction

13.1.1 Weigh 5.00g field-moist soil sample into a kjeldahl (distillation) flask.

13.1.2 Measure 50mL laboratory reagent water using graduated cylinder and pour it into the kjeldahl flask containing the soil sample. (If the sample is limited, it can be reduced to a minimum of 1.00g).

13.1.3 Rinse the sides of kjeldahl flask with small amounts water to wash the soil down to the bottom of the flask.

13.1.4 Prepare a laboratory control sample (LCS) using clean sand or boiling chips and spike with 1mL of a 1000 mg/L NH_3-N stock solution, this will yield a final concentration of 20mg/L of Ammonia-N.

13.1.5 Prepare a matrix spike (MS) sample using a field sample as described in above section (13.1.1–13.1.3) and spike with 1mL of a 1000 mg/L NH_3-N stock solution, this will yield a final concentration of 20mg/L of Ammonia-N.

13.1.6 Carry a method blank through the procedure using clean sand or boiling chips.

13.1.7 Proceed as described in the sections below (13.3 and 13.4).

13.2 Liquid Sample Preparation

13.2.1 Remove samples from the refrigerator holding area and allow to come to room temperature. Mix the contents of the sample container to obtain a representative sample for analysis and confirm that pH is <2.0 with pH strip. Record the pH results, pH paper Element ID and acid Element ID used to adjust pH in logbook.

13.2.2 Prepare a sample duplicate by transferring an additional aliquot of a well-mixed representative field sample from the sample batch.

13.2.3 Treat the field samples known to be subjected to or suspected of chlorination using the dechlorinating solution prior to distillation and reagent addition.

13.2.4 Prepare a method blank, and LCS [Duplicate if necessary] using laboratory reagent water. Spike the LCS sample with 1mL of a 1000mg/L NH_3-N stock solution, this will yield a final concentration of 20mg/L of Ammonia-N.

13.3 Sample Distillation

13.3.1 Set the Rapid Still II distillation unit according the manufacturer's instructions and follow all safety protocols described. Check the water level of the steam generation flask located at the back of the distillation unit and fill if necessary prior to initiating the distillation step.

13.3.2 Using a graduated cylinder measure a 50mL portion of the well-mixed sample into the ammonia kjeldahl distillation flask. Neutralize the samples if necessary to approximately pH 7 with dilute base or acid.

13.3.3 Add 2.5mL of borate buffer solution to all the samples and adjust the pH to 9.5 with 2 mL 6N NaOH and mix the contents. Add 1 mL de-chlorinating reagent. Attach the distillation flask to the unit.

13.3.4 Add 25mL of Boric acid with 2 drops mixed indicator solution into a 250mL Erlenmeyer collection flask or a beaker or other suitable collection container.

13.3.5 Start the unit and distill the samples at a rate of about 6–8mL per minute making sure that the tip of the delivery tube is below the liquid surface of the collection beaker.

13.3.6 Collect ~75mL of the distillate into an Erlenmeyer flask or a collection beaker containing indicating boric acid solution.

13.3.7 Lower the distillation receiver so that the end of the delivery tube is free of contact with the liquid and continue distillation for two more minutes to clean the condenser and delivery tube.

13.3.8 Collect all distilled samples and set aside for analysis of ammonia by titration as described below.

13.4 Analysis of Ammonia and Ammonia-N by Titration

13.4.1 Determination by titration is done only after the samples have been distilled as in section 13.3. The presence of ammonia and ammonia-N thereof is indicated by a pale green color in the distillate.

13.4.2 Titrate the distilled samples from section 13.3 with standard H_2SO_4 [0.02N or thereof] titrant prepared or purchased as in section 8.9.3 and 12.2.

13.4.3 Titrate slowly as the end point is approached and continue until the pale green color turns into a pale lavender color.

13.4.4 Record the initial and final burette reading and calculate the volume of titrant used to reach end point (in titration logbook).

13.4.5 Carry a method blank, LCS [Dup], samples, sample duplicate, etc., through all steps of the procedure from preliminary distillation through titration. Apply any corrections derived from blank analysis to the results.

14.0 DATA ANALYSIS AND CALCULATIONS

14.1 Sample Calculations

Calculate the concentration of Ammonia-N in liquid sample as follows:

$$NH_3\text{ - }N\ mg/L = \frac{[A - B] \times [N] \times 14.007 \times 1000}{Sample\ Vol.\ [mL]}$$

Calculate the concentration of Ammonia in liquid sample as follows:

$$NH_3\ mg/L = \frac{[A - B] \times [N] \times 17.031 \times 1000}{Sample\ Vol.\ [mL]}$$

Calculate the concentration of Ammonia-N in solid sample as follows:

$$NH3\text{-}N\ mg/Kg = \frac{[A - B] \times [N] \times 14.007 \times 1000}{Sample\ Wt.\ (g)}$$

Where:
A = Volume of H_2SO_4 [mL] titrated for sample.
B = Volume of H_2SO_4 [mL] titrated for Blank.
N = Normality of H_2SO_4 used for titration.

14.2 Laboratory Control Sample [Dup] Recovery

$$LCS\ \%\ Recovery = \frac{LCSR}{LCSA} \times 100$$

Where:

LCSR = LCS Spike Result
LCSA = Spike Added

14.3 Relative Percent Difference

$$\text{RPD} = \left| \frac{\text{SR} - \text{SDR}}{\left(\frac{\text{SR} + \text{SDR}}{2} \right)} \right| \times 100$$

Where:

RPD = Relative Percent Difference
SR = Spike Recovery [or Sample Result]
SDR = Spike Duplicate Recovery [or Sample Duplicate Result]

15.0 QUALITY CONTROL

15.1 The Practical Quantitation Limit/Reporting Limit (PQL/RL) for this method is 1mg/L for liquids and 10mg/kg for solids.

15.2 At a minimum, a method blank, LCS/LCS-Duplicate, field sample duplicate, and a matrix spike if volume permits, should be analyzed of a batch of 20 samples or less for liquid.

15.3 For solid/sediment samples, at a minimum a method blank, LCS/LCS-Duplicate, field sample duplicate of a batch of 20 samples or less. A Matrix Spike and matrix spike duplicate should be analyzed when sample amount permits the use of such MS/MSD sample.

15.4 Chemicals and standards must be entered upon receipt into the LIMS and assigned a number. The containers must be dated when first opened and discarded by the expiration date. Any chemical or standard that fails to meet Quality Control requirements should be returned to the manufacturer for replacement.

15.5 Working standards must be entered and assigned a number from the Chemical and Standards Database when prepared. All working standards must be discarded by the expiration date. Any working standard that fails to meet Quality Control requirements must be discarded and re-prepared. If the working standard continues to fail, contact the manufacturer of the chemicals, and if necessary order new supplies.

16.0 ACCEPTANCE CRITERIA

16.1 Determine the blank concentration; the acceptance limit for the blank is ≤ 0.56

16.2 Calculate the LCS recovery. The acceptable range for the LCS is 80-120%.

16.3 Determine the RPD for the sample and sample duplicate or LCS/LCS-Duplicate. The acceptance limit for the RPD is <20.

17.0 CORRECTIVE ACTIONS FOR NON-CONFORMANCE DATA

17.1 Should a sample become contaminated or compromised, the preparation shall be terminated and repeated with a fresh sample aliquot. A Corrective Action must be completed to document the actions taken.

17.2 When Quality Control measures fail, and the client's results are affected, the client will be advised that the results may not be reliable. It may be necessary based on client's needs to recollect the sample and submit at a later time. If the client is unable to recollect a sample, the data will be released with the appropriate documentation. The laboratory staff will complete a Corrective Action form to document this occurrence.

17.3 When QC samples do not fall within the acceptable range, the analyst shall review the data for obvious errors such as calculations, preparation errors, or inadvertent spiking errors or other such causes that are not resultant of a systemic failure. The data may be released with a qualifying statement after concurring with the quality manager. A Corrective Action must be completed documenting the actions taken when the root cause identified is deemed detrimental to the analysis.

18.0 HANDLING NON-CONFORMANCE DATA

18.1 Non-conformance data are monitored and resolved by identifying categories such as system based, methods based, preparative method based, etc., and are resolved once the problematic areas are identified.

19.0 METHOD PERFORMANCE

19.1 One-hundred and two laboratory reagent water samples [analyzed between January 2020 and December 2020] spiked with 20mg/L of ammonia-N standard had an average recovery of 99.8% with a standard deviation of 5.16.

20.0 POLLUTION PREVENTION

20.1 Each method is evaluated prior to use in order to minimize waste volume and toxicity.

20.2 A non-hazardous or less toxic substitute may be used whenever possible.

20.3 Purchase only the amount of chemical that is actually needed or that will be used to eliminate the cost of disposal later.

21.0 WASTE MANAGEMENT

21.1 Toxic waste must never be disposed of down the drain.

21.2 Waste generated from sample analysis must be segregated if the process knowledge indicates the presence of any of the hazardous components listed in Table–1, 40 CFR 261.24 and exceed the limits set in the table.

21.3 When disposing samples the analyst must follow current revision of the "Laboratory Waste Handling and Disposal" SOP (SATL#007G) for detailed disposal procedures.

21.4 All chemicals and containers must be properly identified and labeled at all times to eliminate ambiguity and cost of disposal of unknowns. If an unknown chemical or container is discovered, label it as 'unknown' and attach a note detailing any information about what the chemical may be, what test it may have been used for, and where it was found. If you find an unlabeled chemical that has crystallized or there is any other indication that it may be unstable, notify management immediately.

21.5 Generally, empty chemical containers are not considered hazardous waste. Check with management if one such container is found and in doubt. To dispose of the container in the regular trash the container must be completely empty and triple rinsed several times.

21.6 The waste drums are picked up upon notification and a copy of the report is submitted to the waste management company.

22.0 REFERENCES

22.1 "Determination of Ammonia-Nitrogen SM4500-NH_3 [B&C]", Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

22.2 "Determination of Ammonia-Nitrogen SM4500-NH_3 [B&C]", Standard Methods for the Examination of Water and Wastewater, 21st Edition, 2005.

22.3 "Determination of Ammonia-Nitrogen SM4500-NH_3 [B&C]", Standard Methods for the Examination of Water and Wastewater, 22nd Edition, 2011.

22.4 "Determination of Ammonia-Nitrogen SM4500-NH_3 [B&C]", Standard Methods for the Examination of Water and Wastewater, 23rd Edition, 2017.

22.5 "Determination of Nitrogen, Ammonia, [Distillation, and Titration]", Method 350.2, US Environmental Protection Agency, 1974.

22.6 Carter, 1993. Soil Sampling and Methods of Analysis, Florida: Lewis Publishers.

23.0 REVISION HISTORY

23.1 New revision of the method.
23.2 Annual revision of the method.
23.3 Annual revision 2012, Rev 2.0.0 – revised for language, redundancy and formatting.
23.4 Annual revision 2014. Revised sections: 8.0, 9.0, 12.2.6, 13.0, 13.2, 13.3 15.0, and 19.0.
23.5 Post assessment revision to provide reference method edition on title page.
23.6 Annual revision 2019, Revised sections: 7.0, 8.0, 13.1, 14.0, and 19.0.

APPENDIX A

SOP History and Version Control

Version	Date of Review/Revision	Review/Revision Approved by	Brief Description
2.3	05/17/2016	M. Bernard	Revised title page, update method performance data, clarification of reagents and amounts used for distillation. Addition of Appendix A to reflect SOP history and version control.
3.0	06/19/2017	M. Bernard	Biennial review; confirm pH adjustments, method performance update and waste disposal protocol.
4.0	03/05/2019	S. Abburu	Biennial review; Procedural change for solids; calculations updated; method performance data updated.
5.0	02/05/2021	A.Rosecrance	Biennial review; update cover page; add dechlorination reagent to sample distillation procedure; change color from distinct yellow to pale green
5.1	09/13/2021	C. Morrow	Revised the following: Section 2 – Quantitation limit. Section 4 – Update definitions. Section 15 – Update QC requirements. Section 19 – Update method performance data. Section 22 – Update reference method information. Added Appenix B – Quality acceptance criteria.

APPENDIX B
Quality Acceptance Criteria

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Method Blank (MB)	Every batch of 20 samples or less	If MB > ½ PQL but < PQL and sample results are > PQL, then qualify results to indicate that analyte was detected in the reagent blank. If reagent blank is > PQL, then further action and qualification is required	Take remedial action(s) as defined in 17, repeat measurement and/or qualify data.
Laboratory-fortified blank (LFB)/Laboratory-fortified blank duplicate (LFBD)	Daily, before sample analysis.	Within control limits. If outside control limits, take corrective action.	Take remedial action(s) as defined in 17, repeat measurement and/or qualify data.
Laboratory-fortified matrix (LFM)/Laboratory-fortified matrix duplicate (LFMD)	If a LFM is feasible, one LFB every batch of 20 samples or less.	Within control limits. If outside control limits, qualify data.	Qualify data.

STANDARD OPERATING PROCEDURE

Title

Total Dissolved Solids (TDS)

Filterable Residue

Reference Method No.:

EPA 160.1/SM2540C (23rd Edition, 2017)

Matrix/Matrices:

Liquid/Drinking Water

Document Control Number/Revision Number

SOP007A/Revision 5.1

Charles R. Morrow	09/14/2021
Approved By: Quality Assurance Manager	***Date***
Richard Hawk	09/14/2021
Approved By: General Manager	***Date***
	09/14/2021
Approved By: Laboratory Director	***Date***

Standard Operating Procedures shall be reviewed at least once in two years or as needed to determine their continued suitability, compliance with applicable requirements, and to ensure that they reflect actual procedures being performed.

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes.

2.0 REPORTING LIMIT

2.1 The practical range of the determination is 2.5 mg/L to 20,000 mg/L, however the working range is 2.5 to 200 mg of residue.

3.0 SUMMARY

3.1 A well-mixed sample is filtered through a standard glass fiber filter. The filtrate is evaporated and dried to constant weight at 180°C and dissolved solids are calculated by the gravimetry.

4.0 DEFINITIONS

4.1 **Filterable Residue** – Solids capable of passing through a glass fiber filter and dried to constant weight at 180°C.

4.2 **Batch** –The batch is a set of up of the same matrix processed using the same procedures and reagents within the same time period. Batches are defined at the sample preparation stage. Batches should be kept together through the whole analytical process to the extent possible.

4.3 **Method Blank –** Reagent water, which are carried through the entire analytical procedure. The method blank is used to define the level of laboratory background and reagent contamination.

4.4 **Laboratory Fortified Blank/Laboratory Control Sample (LRB/LCS)** – Reagent water spiked with a solution containing a known concentration of total dissolved solids. LCS sample is optional in this method and can be analyzed when suitable standard is available from external vendors. LCS data may be used to generate precision and method performance.

4.5 **Laboratory Fortified Blank Duplicate/Laboratory Control Sample Duplicate (LFBD/LCSD)** – LCSD is same as LCS and is used to check instrument performance as well as to determine the precision of the analytical method.

4.6 **Duplicate (DUP) –** A separate aliquot of the same sample from the same sample container.

4.7 **Practical Quantitation Limit/ Reporting Limit (PQL/RL)** – The lowest concentration that can be reliably measured within specified limits of precision and accuracy for a specific laboratory analytical method during routine laboratory operating conditions. The laboratory uses the NELAC term of Limit of Quantitation (LOQ) to establish the lowest Minimum Reporting Limit (MRL) that a concentration of an analyte can be reported without qualification.

4.8 **Limit of Quantitation (LOQ)** – For purposes of this method, the LOQ is equal to the Reporting Limit (RL), which is the lowest limit an analyte’s concentration can be reported without qualification.

5.0 INTERFERENCES

5.1 Highly mineralized waters containing significant concentrations of calcium, magnesium, chloride, and/or sulfate may be hygroscopic and will require prolonged drying, desiccation and rapid weighing.
5.2 Too much residue in the evaporating dish will crust over and entrap water that will not be driven off during drying. Total residue should be limited to about 200 mg.
5.3 If process knowledge is known or historical data suggest high TDS values, a smaller amount of sample volume may be used.
5.4 Drying time and temperature should be monitored.

6.0 SAFETY

6.1 Safety glasses and laboratory coats must be worn at all times while in the laboratory. In addition gloves and a face shield or goggles must be worn when dealing with toxic, caustic, and/or flammable chemicals.
6.2 A partial facemask should be worn when working with samples suspected to contain high levels of volatile organics, such solvents, and samples contaminated with gasoline, etc.
6.3 All chemical compounds should be treated as potential health hazards.
6.4 The toxicity and/or carcinogenicity of each sample will most likely not be known. Therefore, it is imperative that each sample be handled as a potential health hazard.
6.5 The analyst should familiarize themselves with all Safety Data Sheets (SDS), safety facilities, and equipment prior to beginning this procedure.
6.6 Please address any and all health and safety concerns to management before beginning this procedure.

7.0 EQUIPMENT AND SUPPLIES

7.1 Balance, Top Loading, Accurate to 0.0001g, Denver Instruments, or Equivalent
7.2 Mechanical Convection Drying Oven, Precision, or Equivalent
7.3 Vacuum Pump, With Safety Trap Flask, Filter Manifold, and Waste Flask
7.4 Buchner Funnel with Fixed Perforated Plate, Fisher Scientific, Catalog No. 10-356C, or Equivalent
7.5 Glass Fiber Filters, Fisher Scientific, Catalog No. 09-790-46J, or Equivalent
7.6 Porcelain Evaporation Dish, Fisher Scientific, Catalog No. S33705, or Equivalent
7.7 Desiccators, Fisher Scientific, Catalog No.08-615B, or Equivalent
7.8 Graduated Cylinder, 100mL, Fisher Scientific, Catalog No. 08-549-11C, or Equivalent

8.0 REAGENTS AND STANDARDS

8.1 Ultra-Pure Water, [<1µmho/cm conductivity] San Antonio Testing Laboratory or equivalent.
8.2 Solids Standard, AccuStandard, Catalog No. WC-SOL, or Equivalent.

9.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

9.1 Samples must be collected in plastic or glass bottles. At least 100mL is required to complete the analysis. Analysis should begin as soon as practically possible.
9.2 The maximum holding time for Total Dissolved Solids is 7 days from collection to analysis.

10.0 STORAGE

10.1 Samples are stored until the time of analysis in a refrigerator at >0°C but ≤ 6°C to preserve sample integrity.

11.0 SAMPLE IDENTIFICATION

11.1 Samples are received from Sample Receiving with a work order form generated from the Laboratory Information Management System (LIMS). This includes client identification, sample number, and tests to be performed under each department.

11.2 Each sample is assigned a unique number and a container number if more than one container is received.

12.0 CALIBRATION AND STANDARDIZATION

12.1 Balance must be QC checked using S-Class weights prior to each day of use.

12.2 Oven and refrigerator temperatures are verified and recorded each day in the Daily Laboratory QC Log book located in the laboratory.

13.0 PROCEDURE

13.1 Preparation of Evaporation Dish For Filterable Residue
- **13.1.1** Heat a clean porcelain-evaporating dish to 180 ± 2°C for approximately 1 hour.
- **13.1.2** Remove and store in a desiccator until needed.
- **13.1.3** Weigh evaporation dish immediately before use. Record initial weight as tare weight.

13.2 Preparation of Glass Fiber Filter.
- **13.2.1** Place a glass fiber filter on the Buchner funnel. Turn the vacuum on.
- **13.2.2** Wash the filter three times with approximately 20mL portions of ultra pure water.
- **13.2.3** Continue to vacuum until all traces of water have passed through.
- **13.2.4** Leave glass fiber filter in place and discard washings.

13.3 Remove field samples from refrigerator and warm to room temperature.

13.4 Shake the sample container well to mix and measure a 100mL representative sample using a graduated cylinder. However, the sample amount used may need to be adjusted in order to yield a dried residue between 2.5 and 200 mg as per reference method.

> *Note: Samples can be screened for either conductivity or TDS using a conductivity/TDS probe to aid in estimating the sample volume required for analysis. However, this may not be enough to judge the proper sample volume required but may provide a rough estimate. Use caution while screening samples containing high TDS values as probes may give lower than actual value. Upon the completion of the gravimetric analysis, it may be required to use higher sample volume to obtain a residue between 20-200mg.*

13.5 Turn on the vacuum and slowly pour the sample over the glass fiber filter in the Buchner funnel.

13.6 Filter the sample through the glass fiber filter. Rinse the graduate cylinder with three successive 10mL portions of reagent water and pour into the Buchner funnel while allowing each 10mL volume to completely drain.

13.7 Continue to apply vacuum for approximately 3 minutes after filtration is complete to remove as much water as possible.

13.8 Transfer the total filtrate from the flask to a pre-weighed evaporation dish prepared in 13.1.

Note: In rare cases the filtrate volume may exceed the holding capacity of the dish. In such cases do not pour the excess into another evaporation dish. Dry the sample dish to evaporate the filtrate and add the filtrate to the same evaporation dish to accommodate the remaining filtrate volume.

13.9 Evaporate sample in a drying oven at 104°C ± 1°C until all the sample has evaporated to dryness. This may take 6-8 hours. Alternately, dry the samples in the drying oven at 104°C ± 1°overnight to dryness.

13.10 Adjust temperature of the oven to 180 ± 2°C or transfer dish to oven set at 180 ± 2°C and dry the evaporating dish for at least 1 hour. After drying for at least 1 hour, remove the dish and cool in a desiccator.

13.11 Weigh the evaporating dish. The drying cycle must be repeated at least once and further if necessary until a constant weight is obtained or until the weight loss between two successive measurements is less than 0.5 mg.

13.12 Record the initial and final weights of the dish in the electronic spreadsheet.

14.0 DATA ANALYSIS AND CALCULATIONS

14.1 Filterable Residue

$$Filterable\ Residue\ [TDS]\ (mg/L) = \frac{(A - B) \times 1000}{Vs}$$

Where:

A = Weight of dried residue [g] + Weight of dish [g]
B = Weight of dish [g]
V_s = Sample volume [mL]

14.2 Laboratory Control Sample Recovery

$$Spike\ Recovery\ [\%] = \frac{LCSR}{LCSA} \times 100$$

Where:

LCSR = LCS Spike Result
LCSA = Spike Added

14.3 Relative Percent Difference

$$\mathrm{RPD} = \left| \frac{\mathrm{SR} - \mathrm{SDR}}{\left(\frac{\mathrm{SR} + \mathrm{SDR}}{2} \right)} \right| \times 100$$

Where:

RPD = Relative Percent Difference
SR = Spike Recovery
SDR = Spike Duplicate Recovery

15.0 QUALITY CONTROL

15.1 The Practical Quantitation Limit/Reporting Limit (PQL/RL) for this method is 2.5mg/L from a 1 liter sample volume.

15.2 Perform a minimum of one method blank, one fortified reagent blank, and one sample duplicate for every 20 field samples or less. Duplicate sample results should agree within 5%.

15.3 Chemicals and standards must be entered upon receipt into the LIMS and assigned a number. The containers must be dated when first opened and discarded by the expiration date. Any chemical or standard that fails to meet Quality Control requirements should be returned to the manufacturer for replacement.

15.4 Working standards must be entered and assigned a number from the Chemical and Standards Database when prepared. All working standards must be discarded by the expiration date. Any working standard that fails to meet Quality Control requirements must be discarded and re-prepared. If the working standard continues to fail, contact the manufacturer of the chemicals, and if necessary order new supplies.

15.5 All Certificates of Analysis should be retained.

16.0 ACCEPTANCE CRITERIA

16.1 Method blanks must yield a value below the established reporting limit.

16.2 Duplicate determinations should agree within 5% of their average weight. When samples containing high dissolved solids are analyzed as field duplicates, the RPD values may exceed the 5% requirement. In such cases the data shall be flagged on the analytical report.

16.3 The acceptance limits for spike standard recovery (LCS/D) are 80-120% (accuracy) of the true concentration.

17.0 CORRECTIVE ACTIONS FOR NON-CONFORMANCE DATA

17.1 When QC samples do not fall within the acceptable range, the analyst shall review the data for obvious errors such as calculations, preparation errors, or inadvertent spiking errors or other such causes that are not resultant of a systemic failure. The data may be released with a qualifying statement after concurring with the quality manager A Corrective Action must be completed documenting the actions taken when the root cause identified is deemed detrimental to the analysis.

17.2 Should a sample become contaminated or compromised, the preparation shall be terminated and repeated with a fresh sample aliquot. A Corrective Action must be completed to document the actions taken.

18.0 HANDLING NON-CONFORMANCE DATA

18.1 Non-conformance data are monitored and resolved by identifying categories such as system based, methods based, preparative method based, etc., and are resolved once the problematic areas are identified.

19.0 METHOD PERFORMANCE

19.1 Two hundred and ten reagent water samples spiked with 100mg/L of TDS standard analyzed January 2020 – December 2020, had an average recovery of 99.1% with a standard deviation of 9.9. Method Detection Limit studies, or NELAC's Limit of Detection (LOD), are not applicable to this gravimetric procedure.

19.2 The Reporting Limit (RL) of quantitation is equivalent to NELAC's Limit of Quantitation (LOQ).

20.0 POLLUTION PREVENTION

20.1 Each method is evaluated prior to use in order to minimize waste volume and toxicity.

20.2 A non-hazardous or less toxic substitute may be used whenever possible.

20.3 Purchase only the amount of chemical that is actually needed or that will be used to eliminate the cost of disposal later.

21.0 WASTE MANAGEMENT

21.1 Toxic waste must never be disposed of down the drain.

21.2 Waste generated from sample analysis must be segregated if the process knowledge indicates the presence of any of the hazardous components listed in Table–1, 40 CFR 261.24 and exceed the limits set in the table.

21.3 When disposing samples the analyst must follow current revision of the "Laboratory Waste Handling and Disposal" SOP (SATL#007G) for detailed disposal procedures.

21.4 All chemicals and containers must be properly identified and labeled at all times to eliminate ambiguity and cost of disposal of unknowns. If an unknown chemical or container is discovered, label it as 'unknown' and attach a note detailing any information about what the chemical may be, what test it may have been used for, and where it was found. If you find an unlabeled chemical that has crystallized or there is any other indication that it may be unstable, notify management immediately.

21.5 Generally, empty chemical containers are not considered hazardous waste. Check with management if one such container is found and in doubt. To dispose of the container in the regular trash the container must be completely empty and tripled rinsed.

21.6 The waste drums are picked up upon notification and a copy of the report is submitted to the waste management company.

22.0 REFERENCES

22.1 "Filterable Residue," Storet No. 70300, EPA Method 160.1, 1971

22.2 Standard Methods for the Examination of Water and Wastewater, 22nd Edition, 2011

22.3 Standard Methods for the Examination of Water and Wastewater, 23rd Edition, 2017

22.4 The TNI Standard, 2016

22.5 EPA/600/R-04/003, March 2012

23.0 REVISION HISTORY

23.1 The following sections of this SOP were revised for Revision 1.9.0, as a result of an annual review and the last TCEQ on-site assessment: sections 13.4, 15.2, 16.1, and 16.2

23.2 Annual revision 2.0, added Drinking Water matrix to this SOP.

23.3 Annual revision 2.0.0 – Revised for general language and removed redundancies in section 17.0, and updated method performance data in 19.0

23.4 Annual revision 2014. Revised sections: 5.0, 6.0, 12.0, 13.0, and 14.0, 16.0 and 19.0

23.5 Post assessment revision to provide reference method edition on the title page.

APPENDIX A
SOP History and Version Control

Version	Date of Review/Revision	Review/Revision Approved by	Brief Description
2.3	07/08/2016	M. Bernard	Revision of cover page, update of method performance data and addition of Appendix A to reflect SOP history and version control.
3.0	06/19/2017	M. Bernard	Biennial review; method performance update and waste disposal protocol.
4.0	02/18/2019	M. Bernard	Biennial review; revised cover page, (2.1) clarify PQL, (13.9, 13.11) clarify drying protocol and recording of weights, (15.1) clarify QC range, (19.1) method performance update and (22.0) reference update.
5.0	04/16/2021	A. Rosecrance	Biennial review; update cover page; change MSDS to SDS.
5.1	09/13/2021	C. Morrow	Revised the following: Section 15 – Update QC requirements. Section 19 – Update method performance. Section 22 – Update reference information. Add Appendix B – QC acceptance criteria.

APPENDIX B
Quality Control Acceptance Criteria

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Method Blank (MB)	Every batch of 20 samples or less	If MB > ½ PQL but < PQL and sample results are > PQL, then qualify results to indicate that analyte was detected in the reagent blank. If reagent blank is > PQL, then further action and qualification is required	Take remedial action(s) as defined in Section 17, repeat measurement and/or qualify data.
Laboratory-fortified blank (LFB)/Laboratory-fortified blank duplicate (LFBD)	Daily, before sample analysis.	Within control limits. If outside control limits, take corrective action.	Take remedial action(s) as defined in Section 17, repeat measurement and/or qualify data.

STANDARD OPERATING PROCEDURE

Title

Analysis of Specific Conductance

Reference Method No.:

EPA 120.1/SM2510B (23rd Edition, 2017)

Matrix/Matrices:

Liquid/Drinking Water/Solids

Document Control Number/Revision Number

SOP008A/Revision 5.1

Charles R. Morrow	09/14/2021
Approved By: Quality Assurance Manager	***Date***
	09/14/2021
Approved By: General Manager	***Date***
	09/14/2021
Approved By: Laboratory Director	***Date***

Standard Operating Procedures shall be reviewed at least once in two years or as needed to determine their continued suitability, compliance with applicable requirements, and to ensure that they reflect actual procedures being performed.

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to drinking, surface, and saline water, domestic and industrial wastes waters.

2.0 REPORTING LIMIT

2.1 Bench top meter has an accuracy of 1 µmhos/cm.

3.0 SUMMARY

3.1 The specific conductance of a sample is measured by use of a self-contained conductivity meter.

3.2 A representative sample is collected in a digestion cup and the specific conductance is measured directly from the conductivity meter, and reported as µmhos/cm.

4.0 DEFINITIONS

4.1 **Conductivity:** is a measure of the ability of an aqueous solution to carry an electric current, which depends on the presence of ions, their total concentration, mobility and valence, and on temperature of measurement.

4.2 **Batch** –The batch is a set of samples of the same matrix processed using the same procedures and reagents within the same time period. Batches are defined at the sample preparation stage. Batches should be kept together through the whole analytical process to the extent possible.

4.3 **Duplicate (DUP) –** A separate aliquot of the same sample from the same sample container.

4.4 **Laboratory Fortified Blank/Laboratory Control Sample (LFB/LCS)** – A solution, such as 0.01M KCl, having a known specific conductance value.

4.5 **Practical Quantitation Limit/Reporting Limit (PQL/RL)** – The lowest concentration that can be reliably measured within specified limits of precision and accuracy for a specific laboratory analytical method during routine laboratory operations.

5.0 INTERFERENCES

5.1 Electrode fouling and inadequate sample circulation are the most common reasons for inaccurate data.

5.2 Temperature variations also represent a large source of potential error; meter equipped with ATC [automatic temperature compensation] probe is recommended to reduce errors.

5.3 Dissolved carbon dioxide in liquid matrices interferes with conductivity measurements.

6.0 SAFETY

6.1 Safety glasses and laboratory coats must be worn at all times while in the laboratory. In addition gloves and a face shield or goggles must be worn when dealing with toxic, caustic, and/or flammable chemicals.

6.2 A partial face mask should be worn when working with samples suspected to contain high levels of volatile organics, such solvents, and samples contaminated with gasoline, etc.

6.3 All chemical compounds should be treated as potential health hazards.

6.4 The toxicity and/or carcinogenicity of each sample will most likely not be known. Therefore, it is imperative that each sample be handled as a potential health hazard.

6.5 The analysts should familiarize themselves with all Safety Data Sheets (SDS), safety facilities, and equipment prior to beginning this procedure.

6.6 Please address any and all health and safety concerns to management before beginning this procedure.

7.0 EQUIPMENT AND SUPPLIES

7.1 Orion Five Star Benchtop meter, Thermo-Electron Corporation, or Equivalent

7.2 Conductivity Probe, Thermo-Electron , Fisher Scientific, or Equivalent

7.3 Digestion Cups, ~50mL Capacity, Environmental Express, Catalog No. SC475 or Equivalent.

7.4 Graduated Cylinder, 100mL, Class A, Fisher Scientific, Catalog No. 08-549-11C, or Equivalent

8.0 REAGENTS AND STANDARDS

8.1 Ultra-Pure Water [<1µmho/cm], San Antonio Testing Laboratory, or Equivalent.

8.2 Conductivity Standards (1409 µmhos/com, 12,856 µmho/cm, 1000 µmhos/com) LabChem Catalog No. LC187802, LC187792, LC187712, or Equivalent.

9.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

9.1 Samples can be collected in plastic, Teflon, or glass containers and refrigerated upon collection.

9.2 Sample bottles must be filled as full as possible and kept tightly closed.

9.3 No chemical preservation is required for specific conductance.

9.4 Properly preserved samples stored under conditions described below have a holding time of 28 days from the time of collection.

10.0 STORAGE

10.1 Analysis should begin as soon as practically possible once the samples are received at the laboratory.

10.2 If analysis cannot be started immediately, samples must be stored until the time of analysis in a refrigerator at >0°C but ≤ 6°C to preserve sample integrity.

11.0 SAMPLE IDENTIFICATION

11.1 Samples are received from Sample Receiving with a work order form generated from the Laboratory Information Management System (LIMS). This includes client identification, sample number, and tests to be performed under each department.

11.2 Each sample is assigned a unique number and a container number if more than one container is received.

12.0 CALIBRATION AND STANDARDIZATION

12.1 Follow instrument manufacturer's recommended calibration procedure.

13.0 PROCEDURE

13.1 Liquid Samples

13.1.1 Allow samples to reach room temperature prior to analysis.

13.1.2 Ultra-pure water serves as a method blank. Place the electrode in a digestion cup with ultra-pure water and press the measure button on the conductivity meter. If reading is less than the reporting limit of 1 µmhos/cm, proceed to read the LCS.

13.1.3 Prepare the LCS by adding 25 ± 1mL of Conductivity Standard to a digestion cup. Concentration of Conductivity Standard is 1000µmhos/cm.

13.1.4 Place the electrode in the sample in the digestion cup and press the measure button on the conductivity meter.

> *Note: Conductivity meter is capable of automatically switching between units depending on the conductivity of the sample. Typical units are µS/cm, mS/cm, µmhos/cm and/or mmhos/cm. Ensure that correct units are recorded in the laboratory logbook and entered into the Element system.*

13.1.5 While the meter is in the measuring mode, the "Read" symbol will blink. Wait until the meter shows a constant reading and record the value in the logbook.

13.1.6 Repeat steps 13.1.4 and 13.1.5 for each sample, using 25 ± 1mL of a representative sample in a digestion cup.

13.1.7 If samples are saturated with dissolved salts are being measured, dilute the sample appropriately and measure. Record dilution used in the logbook. A dilution factor of 10–20 is recommended to minimize errors due to high dilutions.

13.1.8 Report final results from dilution analysis, by multiplying the dilution factor with meter reading.

13.2 Solid/Soil Samples

13.2.1 Allow samples to reach room temperature prior to analysis.

13.2.2 For solid samples, prepare a 5 g sample in 25 mL deionized water in a digestion cup and shake for 2 minutes. For soil samples, prepare a 5 g sample in 5 mL deionized water in a digestion cup and shake for a few seconds.

13.2.3 Analyze samples as in steps 13.1.4 and 13.1.5.

13.2.4 Report results in µmhos/cm without a dilution factor.

14.0 DATA ANALYSIS AND CALCULATIONS

14.1.1 Laboratory Control Sample [Dup] Recovery

$$Spike\ Recovery = \frac{LCSR}{LCSA} \times 100$$

Where:

LCSR = LCS Spike Result
LCSA = Spike Added

14.1.2 Relative Percent Difference

$$RPD = \left| \frac{SR - SDR}{\left(\frac{SR + SDR}{2} \right)} \right| \times 100$$

Where:

RPD = Relative Percent Difference
SR = Spike Recovery
SDR = Spike Duplicate Recovery

15.0 QUALITY CONTROL

15.1 The Practical Quantitation Limit (PQL)/Reporting Limit (RL) for this method is 1umho/cm or 1µS/cm.

15.2 A minimum of a method blank, a sample duplicate every 20 samples or less, and one Laboratory Control Sample (LCS) must be analyzed for a batch of 20 samples or less.

15.3 Chemicals and standards must be entered upon receipt into the LIMS and assigned a number. The containers must be dated when first opened and discarded by the expiration date. Any chemical or standard that fails to meet Quality Control requirements should be returned to the manufacturer for replacement.

15.4 Working standards must be entered and assigned a number from the Chemical and Standards Database when prepared. All working standards must be discarded by the expiration date. Any working standard that fails to meet Quality Control requirements must be discarded and re-prepared. If the working standard continues to fail, contact the manufacturer of the chemicals, and if necessary order new supplies.

15.5 All Certificates of Analysis should be retained.

16.0 ACCEPTANCE CRITERIA

16.1 Calculate the LCS recovery. The acceptable range for the LCS is 80-120%.

16.2 Analyze a sample duplicate for every 10 samples.

16.3 Determine the RPD for the sample and sample duplicate. The acceptable range for the RPD is <20%.

17.0 CORRECTIVE ACTIONS FOR NON-CONFORMANCE DATA

17.1 When QC samples do not fall within the acceptable range, the analyst shall review the data for obvious errors such as calculations, preparation errors, or inadvertent spiking errors or other such causes that are not resultant of a systemic failure. The data may be released with a qualifying statement after concurring with the quality manager A Corrective Action must be completed documenting the actions taken when the root cause identified is deemed detrimental to the analysis.

17.2 Should a sample become contaminated or compromised, the preparation shall be terminated and repeated with a fresh sample aliquot. A Corrective Action must be completed to document the actions taken.

18.0 HANDLING NON-CONFORMANCE DATA

18.1 Non-conformance data are monitored and resolved by identifying categories such as system based, methods based, preparative method based, etc., and are resolved once the problematic areas are identified.

19.0 METHOD PERFORMANCE

19.1 Precision of the method is dependent on the instrument and conductivity probe recommended by the manufacturer.

19.2 One hundred sixty-five reagent water samples with 1000µmho/cm of Conductivity standard analyzed form January 2020 -December 2020, had an average recovery of 102% with a standard deviation of 4.9.

20.0 POLLUTION PREVENTION

20.1 Each method is evaluated prior to use in order to minimize waste volume and toxicity.

20.2 A non-hazardous or less toxic substitute may be used whenever possible.

20.3 Purchase only the amount of chemical that is actually needed or that will be used to eliminate the cost of disposal later.

21.0 WASTE MANAGEMENT

21.1 Toxic waste must never be disposed of down the drain.

21.2 Waste generated from sample analysis must be segregated if the process knowledge indicates the presence of any of the hazardous components listed in Table–1, 40 CFR 261.24 and exceed the limits set in the table.

21.3 When disposing samples the analyst must follow current revision of the “Laboratory Waste Handling and Disposal” SOP (SATL#007G) for detailed disposal procedures.

21.4 All chemicals and containers must be properly identified and labeled at all times to eliminate ambiguity and cost of disposal of unknowns. If an unknown chemical or container is discovered, label it as ‘unknown’ and attach a note detailing any information about what the chemical may be, what test it may have been used for, and where it was found. If you find an unlabeled chemical that has crystallized or there is any other indication that it may be unstable, notify management immediately.

21.5 Generally, empty chemical containers are not considered hazardous waste. Check with management if one such container is found and in doubt. To dispose of the container in the regular trash the container must be completely empty and triple rinsed.

21.6 The waste drums are picked up upon notification and a copy of the report is submitted to the waste management company.

22.0 REFERENCES

22.1 EPA 120.1, Conductance (Specific Conductance µmhos at 25°C)

22.2 Standard Methods for the Examination of Water and Wastewater, 21st Edition 2005.

22.3 Standard Methods for the Examination of Water and Wastewater, 22nd Edition 2011.

22.4 Standard Method for the Examination of Water and Wastewater, 23rd Edition, 2017.

23.0 REVISION HISTORY

23.1 New revision (# 1.0.0) of the method.
23.2 Annual revision # 1.0.1, added Drinking Water matrix to the SOP.
23.3 Annual revision - 2.0.0 – Revised for language and redundancy.
23.4 Annual revision 2014. revised sections:4.0, 5.0, 13.0, and 19.0
23.5 Post assessment revision to provide performance criteria for method blank and to include reference method edition on the title page.

APPENDIX A
SOP History and Version Control

Version	Date of Review/Revision	Review/Revision Approved by	Brief Description
2.3	07/11/2016	M. Bernard	Revision of cover page, update of method performance data and addition of Appendix A to reflect SOP history and version control.
3.0	06/19/2017	M. Bernard	Biennial review; method performance update and waste disposal protocol.
4.0	08/02/2019	M. Bernard	Biennial review; revision of title page, method performance update and reference update.
5.0	04/16/2021	A.Rosecrance	Biennial review; revision of title page; change MSDS to SDS; added procedure for solid/soil samples
5.1	09/13/2021	C. Morrow	Revised the following: Section 2 – Update quantitation limit. Section 15 – Update QC requirements. Section 19 – Update method performance. Section 22 – Update reference information. Add Appendix B – QC acceptance criteria.

APPENDIX B
Quality Control Acceptance Criteria

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Method Blank (MB)	Every batch of 20 samples or less	If MB > ½ PQL but < PQL and sample results are > PQL, then qualify results to indicate that analyte was detected in the reagent blank. If reagent blank is > PQL, then further action and qualification is required	Take remedial action(s) as defined in Section 17, repeat measurement and/or qualify data.
Laboratory-fortified blank (LFB)/Laboratory-fortified blank duplicate (LFBD)	Daily, before sample analysis.	Within control limits. If outside control limits, take corrective action.	Take remedial action(s) as defined in Section 17, repeat measurement and/or qualify data.

STANDARD OPERATING PROCEDURE

Title

Analysis of Anions By Ion Chromatography

Reference Method No.:

EPA 300.0/EPA 300.0 B/SM 4110 B (23rd Edition, 2017)

Matrix/Matrices:

Liquid/Drinking Water/Solid

Document Control Number/Revision Number

SOP012A/Revision 5.1

Charles R. Morrow
Approved By: Quality Assurance Manager
09/14/2021
Date

Richard Hauk
Approved By: General Manager
09/14/2021
Date

Approved By: Laboratory Director
09/14/21
Date

Standard Operating Procedures shall be reviewed at least once in two years or as needed to determine their continued suitability, compliance with applicable requirements, and to ensure that they reflect actual procedures being performed.

STANDARD OPERATING PROCEDURE
ANALYSIS OF ANIONS BY ION CHROMATOGRAPHY

1.0 SCOPE AND APPLICATION

1.1 This SOP describes the procedure for the determination of anions by Ion Chromatography in drinking water, solids (after extraction), leachates (when no acetic acid is used), ground, surface and saline waters as well as industrial and domestic aqueous wastes.

2.0 REPORTING LIMIT

2.1 The Reporting Limit (RL) varies for individual anions and ranges from 0.25 mg/L to 1.0 mg/L in liquid as shown in the following table.

2.2 Lower RLs may be achieved by utilizing a larger sample loop size for analytes that require a lower reporting limit for compliance purposes.

Table – I

Anion	Liquid RL [mg/L]	Soil RL [mg/Kg]
Fluoride	0.25	2.5
Chlorate	1.00	10.0
Chloride	1.00	10.0
Chlorite	1.00	10.0
Nitrite as Nitrogen	0.50	5.0
Bromide	0.50	5.0
Nitrate as Nitrogen	0.50	5.0
ortho-Phosphate as P	1.00	10.0
Sulfate	0.50	5.0

3.0 SUMMARY

3.1 A well-mixed homogeneous sample is filtered through a 0.45µm membrane filter and introduced into the Ion Chromatograph.

3.2 A fixed volume of the filtered sample is then carried by a Carbonate–Bicarbonate eluent through an analytical column into a conductivity detector. The resulting analyte peaks are quantified using a calibration curve.

3.3 Solid samples are extracted using laboratory reagent water and the extract is filtered and analyzed by Ion Chromatography.

4.0 DEFINITIONS

4.1 **Laboratory Reagent Blank/Method Blank (LRB/MBLK) –**An aliquot of reagent water that is treated exactly as a sample. The blank is exposed to all glassware, equipment, and reagents, etc. The method blank is used to define the level of laboratory background and reagent contamination.

4.2 **Duplicate (DUP) –** A separate aliquot of the same sample from the same sample container.

4.3 **Laboratory Fortified Blank/Laboratory Control Sample (LFB/LCS)** – A clean matrix spiked with a solution containing a mixture of seven anions of known concentration. An LFB is used to check extraction and/or method performance. For this test procedure, the LFB is equivalent to a Laboratory Control Sample (LCS).

4.4 **Laboratory Fortified Blank Duplicate/ Laboratory Control Sample Duplicate (LFBD/LCSD)** – LFBD/LCSD is the same as LFB/LCS and is used to check precision of the analytical method.

4.5 **Laboratory Fortified Matrix (LFM)** – An aliquot of a sample from the analytical batch spiked with a solution containing a mixture of anions of interest at known concentration. An LFM is used to check the effect of matrix on the analytes of interest.

4.6 **Limit of Detection (LOD)** – An estimate of the minimum amount of a substance that an analytical process can reliably detect (qualitatively). LOD is analyte and matrix specific. For purposes of this test procedure, the LOD is equivalent to the MDL.

4.7 **Method Detection Limit (MDL) –** The method detection limit (MDL) is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results. For purposes of this method, the MDL is equivalent to NELAC's Limit of Detection [LOD]. See Section 19.0 METHOD PERFORMANCE for more information regarding LOD.

4.8 **Practical Quantitation Limit/Reporting Limit (PQL)/RL** – The lowest concentration that can be reliably measured within specified limits of precision and accuracy for a specific laboratory analytical method during routine laboratory operating conditions.

4.9 **Limit of Quantitation (LOQ)** – For purposes of this method, the LOQ is equal to the low standard used for initial calibration for an analytical method, and is equal to the Reporting Limit (RL).

5.0 INTERFERENCES

5.1 Interferences resulting from co-elution of analytes that elute closely to one another.

5.2 Ionic overloading can result in the saturation of the analytical column and/or detector may result in retention shifting of the analytes of interest. A sample dilution may eliminate or mitigate this type of interference problem.

5.3 Sample matrices with high mineral content or hardness may influence the separation efficiency of the analytical column.

5.4 Contaminated reagent water, eluent, reagents, glassware and other sample processing equipment may yield artifacts in the chromatogram resulting in elevated baseline or false positives.

5.5 Acetate elutes early and may interfere with the analytes of interest. Disinfection byproducts can also be problematic in certain situations. These should be evaluated on a case-by-case basis when detected.

5.6 Presence of chlorine dioxide in the sample may result in the formation of Chlorite and may pose interference problems in identifying the anions. Sample should be purged with an inert gas such as Argon or Helium, for about 5 minutes or longer if necessary, if prior knowledge of the process generating the sample is available.

5.7 Proper glassware washing is essential to ensure reliable results. Refer to SATL#SOP003G for glassware washing, especially when making eluent and/or calibration standards.

5.8 Samples consisting of complex matrices containing substances such as particulates and detergents, which may interfere with the sample analysis, may require a smaller volume to be analyzed.

5.9 Very late eluting ions, from chlorinated & ozonated matrices may carry over into the subsequent analytical run in the sequence. This should be monitored when obvious abnormal chromatographic responses are observed.

6.0 SAFETY

6.1 Safety glasses and laboratory coats must be worn at all times while in the laboratory. In addition gloves and a face shield or goggles must be worn when dealing with toxic, caustic, and/or flammable chemicals.

6.2 All chemical compounds should be treated as potential health hazards. The toxicity and/or carcinogenicity of each sample will most likely not be known. Therefore, it is imperative that each sample be handled as a potential health hazard.

6.3 The analyst should familiarize themselves with all Safety Data Sheets (SDS), safety facilities, and equipment prior to beginning this procedure.

6.4 Address any and all health and safety concerns to management before beginning this procedure.

7.0 EQUIPMENT AND SUPPLIES

7.1 Ion Chromatograph equipped with anion separator analytical and guard columns, and conductivity detector – Dionex Corporation, or equivalent.

7.2 Anion Suppressor device – Dionex Corp. or equivalent. Suppressor device to minimize the background noise.

7.3 Poly Vial Sample cups – 5mL capacity to hold samples, QC standards, etc. Dionex, or Environmental Express, or equivalent.

7.4 Poly Vial Filter caps with 0.2µm filters – Dionex, Environmental Express, or equivalent.

7.5 Automated Sampler Cassettes – 5 mL capacity poly vial holder, Dionex, Environmental Express, or equivalent.

7.6 Nylon filters 0.45µm syringe filters – Environmental express, BVA scientific or equivalent.

7.7 Sample bottles – Glass or plastic 500 mL or 1000 mL capacity to hold sufficient volume to allow replicate sample analyses – BVA Scientific or equivalent.

7.8 Disposable Pasteur pipettes – Fisher Scientific, or equivalent.

7.9 Digestion tubes – Environmental Express, or Equivalent (for use in centrifuge).

7.10 Filter Paper – Whatman No. 40 – Fisher Scientific, or Equivalent.

7.11 Argon or Nitrogen gas, Industrial Grade- Matheson Tri-Gas, or Equivalent.

7.12 100 mL and 1 L Graduated Cylinder – Fisher Scientific, or Equivalent.

7.13 5 mL, 10 mL Class–A pipettes.

7.14 Balance, Top Loading, Accurate to 0.0001g, Denver Instruments, or Equivalent.

8.0 REAGENTS AND STANDARDS

8.1 Ultra-Pure Water, San Antonio Testing Laboratory, or Equivalent.

8.2 Ion Chromatography Eluent solution – Eluent with Carbonate–Bicarbonate at 4.5mM and 1.4mM mixture respectively, Dionex or equivalent.

8.2.1 Prepare working standard eluent according to manufacturer's instructions if purchased as a concentrate from a commercial supply vendor.

8.2.1.1 Dilute 20 mL of the concentrated eluent to 2000 mL of ultrapure reagent water to obtain the working eluent concentration.

8.2.2 When eluent is not commercially available, prepare eluent as ***concentrate*** in the laboratory by mixing Sodium Carbonate and Sodium Bicarbonate salts as follows:

8.2.2.1 Accurately weigh 0.954 g of Sodium Carbonate, and 0.235 g of Sodium Bicarbonate into reagent water and dilute to 2000 mL.

8.3 Stock solutions such as those shown below may be prepared as described in section 12.3:

8.3.1 Fluoride [F^-] 1000 mg/L
8.3.2 Chlorate [ClO_3^-] 1000 mg/L
8.3.3 Chloride [Cl^-] 1000 mg/L
8.3.4 Chlorite [ClO_2^-] 1000 mg/L
8.3.5 Nitrite as Nitrogen [NO_2^-–N] 1000 mg/L
8.3.6 Bromide [Br^-] 1000 mg/L
8.3.7 Nitrate as Nitrogen [NO_3^-–N] 1000 mg/L
8.3.8 Phosphate [$PO_4^{\equiv}$–P] 1000 mg/L
8.3.9 Sulfate [$SO_4^{=}$] 1000 mg/L

9.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

9.1 Collect a representative sample in a clean 1-Liter, plastic or glass container for liquid sample and 4oz jar for solids.

9.2 Preservation and holding time requirements for the anions being analyzed by this procedure are shown in the table below.

Table – II

Anion	Preservation	Holding Time
Fluoride	None required *	28 days
Chlorate	50 mg/L EDA	28 days
Chloride	None required *	28 days
Chlorite	50 mg/L EDA Cool to ≥0° C ≤6°C	14 days
Bromide	None required *	28 days
Nitrite-N	Cool to ≥0° C ≤6°C	48 hours
Nitrate-N	Cool to ≤6°C	48 hours
Combined [Nitrate–N/Nitrite–N]	to a pH < 2 [Conc. H_2SO_4]	28 days
ortho-Phosphate-P	Cool to ≥0° C ≤6°C	48 hours; Filter <15mins of collection**
Sulfate	Cool to ≥0° C ≤6°C	28 days

* It is recommended that all samples be cooled to ≤6°C and analyzed as soon as possible.

** qualify data if not filtered within 15mins of collection.

10.0 STORAGE

10.1 Store samples until the time of analysis in a refrigerator at >0°C and ≤ 6°C to preserve sample integrity.

10.2 Preserved samples have a maximum holding time of 28 days from the time of collection until analysis unless otherwise stated for specific analytes.

11.0 SAMPLE IDENTIFICATION

11.1 Samples are received from Sample Receiving with an In-House Chain of Custody form generated from the Laboratory Information Management System (LIMS). This includes client identification, sample number, and test to be performed.

11.2 Each sample is assigned a unique number and a container number if more than one container is received.

12.0 CALIBRATION AND STANDARDIZATION

12.1 Balance must be QC checked using S Class weights on each day of use.

12.2 Ion Chromatograph must be calibrated prior to sample analysis either on the day of analysis or calibration verified on the day of analysis prior to sample analysis.

12.3 Calibration Standards may be purchased where commercially available or prepared in the laboratory using Sodium and/or potassium salts as described below. Use two separate lots to prepare stock standards. Use one set to calibrate the instrument and use second to verify the instrument calibration.

12.3.1 Bromide [Br^-] 1000 mg/L: Dissolve 0.1288 g Sodium Bromide [NaBr, CAS No. 7647-15-6] in reagent water and dilute to 100 mL in a volumetric flask.

12.3.2 Chlorate [ClO_3^-] 1000 mg/L: Dissolve 0.1275 g Sodium Chlorate [$NaClO_3^-$, CAS No. 7775-09-9] in reagent water and dilute to 100 mL in a volumetric flask.

12.3.3 Chloride [Cl^-] 1000 mg/L: Dissolve 0.1649 g Sodium Chloride [NaCl, CAS No. 7647-14-5] in reagent water and dilute to 100 mL in a volumetric flask.

12.3.4 Chlorite [ClO_2^-] 1000 mg/L: Dissolve 0.1676 g Sodium Chlorite [Na ClO_2^-, CAS No. 7758-19-2] in reagent water and dilute to 100 mL in a volumetric flask.

12.3.5 Fluoride [F^-] 1000 mg/L: Dissolve 0.2210 g Sodium Fluoride [NaF, CAS No. 7681-49-4] in reagent water and dilute to 100 mL in a volumetric flask.

12.3.6 Nitrate [NO_3^- –N] 1000 mg/L: Dissolve 0.6068 g Sodium Nitrate [$NaNO_3$, CAS No. 7631-99-4] in reagent water and dilute to 100 mL in a volumetric flask.

12.3.7 Nitrite [NO_2^- –N] 1000 mg/L: Dissolve 0.4926 g Sodium Nitrite [$NaNO_2$, CAS No. 7632-00-0] in reagent water and dilute to 100 mL in a volumetric flask.

12.3.8 Phosphate [$PO_4^{\equiv}$–P] 1000 mg/L: Dissolve 0.4394 g Potassium Dihydrogenphosphate [KH_2PO_4, CAS No. 7778-77-0] in reagent water and dilute to 100 mL in a volumetric flask.

12.3.9 Sulfate [$SO_4^{=}$] 1000 mg/L: Dissolve 0.1814 g Potassium Sulfate [K_2SO_4, CAS No. 7778-80-5] in reagent water and dilute to 100 mL in a volumetric flask.

12.3.10 To prepare a mix of seven anions in a single working stock – add standard volumes of each of the stock solutions [12.3.1 – 12.3.7] as shown in Table – III, into a CLEAN 100mL volumetric flask and bring up to volume with reagent water.

> ***Note:*** *Stability of the standards – Stock standards stable for a minimum of 1 month and up to 3 months when stored at ≥0°C ≤6°C. Diluted working standards should be prepared weekly.*

Table – III

WORKING STANDARDS PREPARATION FROM STOCK SOLNs.				
Anion	**Initial Conc.**	**Initial Vol.**	**Working Std. Final Vol.**	**Cal. Std. Conc.**
Fluoride	1000 mg/L	2.0 mL	100 mL	20 mg/L
Chlorate	1000 mg/L	10.0 mL	100 mL	100 mg/L

Chloride	1000 mg/L	10.0 mL	100 mL	100 mg/L
Chlorite	1000 mg/L	10.0 mL	100 mL	100 mg/L
Nitrite-N	1000 mg/L	10.0 mL	100 mL	100 mg/L
Bromide	1000 mg/L	10.0 mL	100 mL	100 mg/L
Nitrate-N	1000 mg/L	10.0 mL	100 mL	100 mg/L
ortho-Phosphate-P	1000 mg/L	20.0 mL	100 mL	200 mg/L
Sulfate	1000 mg/L	10.0 mL	100 mL	100 mg/L

12.4 Refer to Table–A, Appendix B of this SOP for instructions on the preparation of the calibration curve with varied concentrations of individual anions.

12.5 Prior to sample analysis on the Ion Chromatograph, a set of calibration standards is analyzed following the guidelines in Table–A, Appendix B.

12.5.1 Refer to section 13.1 for IC operating conditions and eluent concentration.

12.6 Calculate the Relative Standard Error (%RSE) of the calibration curve for analytes with linear or quadratic fits. Determine the %RSE using the equation below.

$$\% RSE = 100 \times \sqrt{\sum_{i=1}^{n} \left[\frac{x'_i - x_i}{x_i}\right]^2 \Big/ (n-p)}$$

Where,

x_i = True value for the calibration standard
x'_i = Measured concentration of the calibration standard
n = Number of calibration points
p = Number of terms in the fitting equation
(Average = 1, Linear = 2, Quadratic = 3)

12.7 Coefficient of determination must be >0.920 (which approximately corresponds to the 35% RSD limit set forth in the reference method). If this cannot be achieved, the calibration is unacceptable and recalibration is necessary after remedial action to correct the problem.

12.8 Calculate the Relative Error (%RE) for those analytes are calibrated using linear or quadratic curve fits and determine the coefficient of determination using the following equation.

$$\%Relative\ Error = \frac{x'_i - x_i}{x_i} \times 100$$

Where,

x_i = True value for the calibration standard
x'_i = Measured concentration of the calibration standard

12.9 The relative error percent must be calculated for two of the calibration levels, i.e., the low calibration standard and the mid-point calibration standard. The acceptance criteria for low standard is 50% and the mid-point standard is 35%.

12.10 Retention Time windows

12.10.1 Retention time windows are established by analyzing a mid-point calibration standard [5 mg/L] initially. Retention time is inversely proportional to concentration, use caution when establishing RT windows.

12.10.2 A suggested method of establishing RT windows is to calculate three times the standard deviation of the actual retention time of the anion of interest, measured over the course of a day.

12.10.3 Retention time windows should be re-assessed every time a new IC column is installed and/or new eluent is prepared, or after high concentration samples have been analyzed and integration parameters adjusted to reflect the correct RT windows.

12.10.4 Analyte elution order in an IC run is shown in the table below with approximate retention times corresponding to IC conditions described in section 13.1. Retention time may shift with aging column or other conditions described in the above sections and should be updated as needed.

Table IV

Peak No.	Anion	Retention Time [min]
1	Fluoride	3.120
2	Chlorite	3.624
3	Chloride	4.374
4	Nitrite-N	5.190
5	Chlorate	5.244
6	Bromide	6.054
7	Nitrate-N	6.820
8	ortho-Phosphate-P	9.0637
9	Sulfate	11.070

12.11 Initial Calibration

12.11.1 Prior to sample analysis, the IC system is calibrated using multiple calibration points. The standards may be prepared as described in the appendix of this SOP or are purchased from approved vendors.

12.11.2 Refer to Table A, Appendix B for initial calibration curve points for varied concentrations of individual anions of interest. Standards typically range from 0.25 mg/L to 40 mg/L for water and solid matrices.

12.11.3 Analyze all calibration standards as type "Standards" and save the results file on the computer.

12.11.4 A calibration curve with a correlation coefficient of 0.995 or greater for individual anions of interest is deemed valid and sample analysis may begin.

12.11.4.1 When using a non-linear curve, a linear calibration range is not applicable.

12.12 Calibration Verification – Initial and Continuing [ICV/CCV]

12.12.1 The initial calibration is verified at the beginning of each working day or a batch of 10 samples using a second source calibration verification standard.

12.12.2 Initial calibration of the IC system is verified by analyzing a single point calibration standard [CCV] at a mid-calibration level.

12.12.2.1 Prepare 50 mL of CCV standard fresh on the day of analysis. Dilute 2.5 mL of the working stock standard (section 12.3.8) to 50 mL in ultrapure water to obtain a 5 mg/L concentration standard. The source of this standard may be the same as the initial calibration stock solution.

12.12.2.2 Prepare 50 mL of ICV standard on the day of initial calibration using working stock standard prepared from a source (section 12.3) other than that used for preparing the initial calibration curve. Dilute 2.5 mL of the second source working stock to 50mL in ultrapure water. The concentration of this verification standard is 5 mg/L.

12.12.3 In this SOP, the mid-point standard used is 5mg/L [except 1.0 mg/L for Fluoride]. The acceptance criteria for the ICV [or CCV] standard is ±10% of true value.

12.12.4 If the ICV standard meets acceptance criteria of ±10% deviation [%D] then the initial calibration is deemed valid and the calibration factor can be used to quantitate the field samples.

12.12.4.1 If the ICV exceeds ±10% the expected value, then evaluate for possible spiking errors, calculation errors, injection malfunction, etc. If no obvious problems are identified, the stock solution may be suspect. Prepare fresh stock solution, re-analyze and verify calibration. Recalibration of the instrument is necessary if the second attempt of ICV still exceeds expected range.

12.12.4.2 Failure of the ICV to meet the ±10% expected value requires instrument recalibration.

12.12.5 A continuing calibration verification standard must be analyzed every 10 samples and at the end of the analytical sequence (ending CCV) and must meet the acceptance criteria of ±10% deviation. An instrument blank must be run before the ending CCV.

12.12.6 If the CCV fails to meet the acceptance criteria, reanalyze the CCV one more time after performing routine maintenance on the analytical system before recalibrating the instrument. If the CCV fails the second time, then the initial calibration is deemed invalid and system must be recalibrated as in section 12.7.

12.12.6.1 Further corrective actions such as cleaning the IC system, preparing new eluent, conditioning the analytical column, and/or suppressor, etc. may be performed. However, after major maintenance is done on the system, two consecutive CCV standards must be analyzed and both must meet the acceptance criteria. If both consecutive CCV standards meet the acceptance criteria then samples can be analyzed on the system without recalibrating the system as in section 12.7.

12.12.6.2 If any one of the two CCV standards fail to meet the acceptance criteria then a new initial calibration curve must be analyzed and processed prior to sample analysis.

12.13 Column overloading [separation capacity] may result in non–linear response. In such cases system maintenance may be required after the evaluation is determined to be column related and not related to calibration standard solution.

12.14 When capacity [i.e., column overloading] of analytical [separator] column is exceeded non-linear responses may result at which time the analytical column should be replaced.

12.15 Recommended system maintenance

12.15.1 In cases where the initial calibration does not meet the acceptable correlation coefficient criteria of 0.995 or better or the CCV is not within ±10% deviation criteria, system maintenance is required. A short list of the remedial actions is given below:

a. Check system backpressure for clogging and air bubbles and clean as necessary.
b. Check the sample and system tubing.
c. Prime the pump and check pump valves and clean if necessary.
d. Check the concentration of the eluent and fill the reservoir if necessary.
e. Refer to the operational manual for other maintenance and suggested troubleshooting techniques.
f. If none of these maintenance tasks resolve the problems, replace the column, or contact the manufacturer for either technical help or service call.

13.0 PROCEDURE

13.1 Analytical System

13.1.1 Analytical system is comprised of an Ion Chromatograph equipped with a suppressor device and a conductivity cell. The IC system has an analytical column for anion separation and a guard column to protect the analytical column and extend the life of the analytical column.

13.1.2 Software for data acquisition and data processing: refer to and follow manufacturer’s instructions on the operation of the IC system and software.

13.1.2.1 The following are typical settings in IC program. These values may be adjusted to achieve better resolution and/or sensitivity toward the instrument.

Parameter	Value
Analytical Column	IonPac AS 22 [4x250mm]
Guard Column	IonPac AG 22 [4x50mm]
Suppressor Type	ASRS 4mm
Suppressor Current	31–34 [mA]
Pressure Lower Limit	0 [PSI]
Pressure Upper Limit	3000 [PSI]
Pump Inject Valve State	Load Position
Data Collection Rate	5.0 [Hz]
Cell Temperature Nominal	35.0 [°C]
Column Temperature Nominal	40.0 [°C]
Pump ECD Carbonate [Eluent]	4.5 mM
Pump ECD Bicarbonate [Eluent]	1.4 mM
Pump ECD Recommended Current	31–34 [mA]
Pump Flow	1.20 [ml/min]
Sample Loop Size	10 µL
Expected background Conductivity	20 – 23µS

13.2 Sample Preparation and Equipment

13.2.1 Samples are collected and preserved as per sections 9.0 and 10.0.

13.2.2 Allow samples to equilibrate to room temperature before starting the analysis. Do not allow samples to sit at room temperature for more than 6 cumulative hours.

13.2.3 Samples must be filtered through a 0.45µm anion free filter prior to taking a sample aliquot, to prevent clogging of the analytical system.

13.2.4 Solid Sample Extraction

13.2.4.1 Weigh a 5.0 +/- 0.1g of a well homogenized sample into a suitable container such as a 50 mL digestion cup. Add 50 mL of ultrapure reagent to the digestion cup and shake the container with hand for one minute.

13.2.4.2 Place the sample containers on a mechanical shaker with lids closed tightly and shake for 15 minutes at high speed.

13.2.4.3 Remove samples from the shaker and allow samples to settle or centrifuge to settle suspended material. Filter the slurry using 0.45µm membrane syringe filter.

13.2.5 Transfer 5 mL of the filtered sample into an auto-sampler sample cup equipped with a filter cap for analysis. Follow manufacturer's instructions for setting up the auto-sampler and loading sample cassettes.

13.2.6 Power on the IC and allow the system to equilibrate by priming the pump and allowing the eluent to pump through the system for 30 minutes.

13.2.7 Set-up a sample sequence on the Chromeleon software and perform "Ready Checks" built into the Dionex software prior to initiating sample run.

13.2.8 Analyze a reagent water blank, calibration verification standard at the beginning of each sequence on each day of use. Instrument [re] calibration may be required depending on the CCV standard result. If CCV fails to meet the acceptance criteria, follow the procedure described in section 12.0.

13.2.9 Analyze calibration standards from low concentration to high concentration to avoid carry over issues between standards.

13.2.10 Field samples may be analyzed immediately following calibration standards and after the calibration curve has been established and verified to meet acceptance criteria.

13.2.11 Prepare a laboratory reagent blank [LRB], laboratory fortified blank [LFB/LCS], laboratory fortified matrix [LFM/MS], duplicate [Dup], etc., along with field samples in a batch.

13.2.12 Using peak areas of the analytes of interest, sample concentration is calculated via initial calibration responses as in section 14.0.

13.2.13 When sample concentration exceeds the calibration range of a particular anion, sample must be diluted appropriately so that the concentration will fall within the calibration range.

13.2.14 When doubt exists over the identification of a peak in the chromatogram, then sample dilution and fortification may be used for confirmation.

13.3 Data review and Data processing

13.3.1 All raw data must be reviewed for integration errors by the software to ensure that peaks are correctly assigned.

13.3.2 Use peak area responses of the detected analytes of interest to compute the concentration of the field and QC samples.

13.3.3 Report values that fall within the lowest and highest calibration points. Sample concentrations that fall beyond the highest calibration point must be diluted and re-analyzed.

13.3.4 Report all results in mg/L for liquid and mg/Kg for solid matrices.

13.3.5 Report results for Nitrate, Nitrite, and Phosphate as Nitrate as Nitrogen, Nitrite as Nitrogen, and ortho-Phosphate as Phosphorus respectively in the analytical report.

13.3.6 Refer to section 14.0 for the calculation of sample concentrations and LFB, LFM, etc., recoveries.

14.0 DATA ANALYSIS AND CALCULATIONS

14.1 Report the concentrations of anions of interest in field samples directly from the instrument generated data in mg/L taking into account any sample factors such as dilutions, extraction factor, etc.

14.1.1 Calculate the analyte concentration

Liquid/Water Samples:

$$Anion\ (mg/L) = Instrument\ Reading \times DF$$

Solid Samples:

$$Anion\ (mg/kg) = \frac{Instrument\ Reading \times DF \times FV}{Sample\ Wt\ (g)}$$

Where:

DF – Dilution factor
FV – Final extract volume

14.2 Laboratory Fortified Blank/Laboratory Control Sample [LFB/LCS] Recovery

$$Spike\ Recovery = \frac{LFBR}{LFBA} \times 100$$

Where:

LFBR = LFB Spike Result
LFBA = Spike Added

14.3 Laboratory Fortified Matrix/Matrix Spike [LFM/MS] Recovery

$$Spike\ Recovery = \frac{LFMR - SR}{LFM\ SA} \times 100$$

Where:

LFMR = LFM Result
SR = Sample Result [Un-spiked field sample]
LFMSA = LFM Spike Added

14.4 Relative Percent Difference – Duplicate samples

$$\text{RPD} = \left| \frac{\text{SR} - \text{SDR}}{\left(\frac{\text{SR} + \text{SDR}}{2} \right)} \right| \times 100$$

Where:

RPD = Relative Percent Difference

SR = Sample Result
SDR = Sample Duplicate Result

15.0 QUALITY CONTROL

15.1 Laboratory's initial demonstration of capability is documented by performing an MDL study and a Quality Control Check sample [purchased from a source external to the lab].

15.2 The Limit of Quantitation (LOQ) for this method is 0.5 mg/L for all anions except Fluoride and orthophosphate, which are at 0.1 mg/L, and 1.0 mg/L respectively for liquid samples. LOQ for solids is 5mg/kg for all except fluoride and orthophosphate, which are at 1mg/kg and 10mg/kg respectively.

15.3 A minimum of one method blank and one Laboratory Fortified Blank (LFB) and Laboratory Fortified Blank (LFB-DUP) must be analyzed for every batch of not more than 10 samples for liquid and solid samples

15.4 Chemicals and standards must be entered upon receipt into the LIMS and assigned a number. The containers must be dated when first opened and discarded by the expiration date. Any chemical or standard that fails to meet Quality Control requirements should be returned to the manufacturer for replacement.

15.5 Working standards including those prepared/used daily must be entered and assigned a number in LIMS when prepared. All working standards must be discarded by the expiration date.

15.6 Any working standard that fails to meet Quality Control requirements must be discarded and re-prepared. If the working standard continues to fail, contact the manufacturer of the chemicals, and if necessary order new supplies.

15.7 All Certificates of Analysis must be retained.

15.8 All analytical records must be backed up monthly as a minimum.

16.0 ACCEPTANCE CRITERIA

16.1 Laboratory Reagent Blank concentration of any anion of interest must be less than the corresponding MDL value.

16.2 Calculate the LFB recovery. The acceptable range for the LFB is 90-110%.

16.3 Calculate the LFM recovery. The acceptable range for the LFM is 90%-110%. If the concentration of un-spiked sample is ≥4 times the LFM spike concentration, the matrix spike recovery is not required to be calculated and reported.

16.4 Determine the RPD for the sample and sample duplicate. The acceptable range for the RPD is <20.

16.5 Refer to Table–C for QC acceptance criteria.

16.6 The acceptance limits for Demonstration of Capability (DOC) by this method are %RSD <10 (precision) of 4 QC replicates, and an average recovery range of 90-110% (accuracy) of the true concentration. DOCs must take into account all sample preparation steps.

17.0 CORRECTIVE ACTIONS FOR NON-CONFORMANCE DATA

17.1 Should a sample become contaminated or compromised, the preparation and analysis shall be terminated and repeated with a fresh sample aliquot. A Corrective Action must be completed to document the actions taken.

17.2 When Quality Control measures fail, and the clients' results are affected, the client will be advised that the results may not be reliable. It may be necessary based on clients' needs to recollect the sample and submit at a later time. If the client is unable to recollect a sample, the data will be released with the appropriate documentation. The laboratory staff will complete a Corrective Action form to document this occurrence.

17.3 When QC samples do not fall within the acceptable range, the analyst shall review the data for obvious errors such as calculations, preparation errors, or inadvertent spiking errors or other such causes that are not resultant of a systemic failure. The data may be released with a qualifying statement after concurring with the quality manager. A Corrective Action must be completed documenting the actions taken when the root cause identified is deemed detrimental to the analysis.

18.0 HANDLING NON-CONFORMANCE DATA

18.1 Non-conformance data are monitored and resolved by identifying categories such as system based, methods based, preparative method based, etc., and are resolved once the problematic areas are identified.

19.0 METHOD PERFORMANCE

19.1 A method detection limit study is performed, initially and verified quarterly thereafter for all analytes that are listed in **TABLE I** of this method.

19.2 During the beginning of each quarter, two replicate samples of organic free reagent water are spiked with a known amount of target analytes at the concentration used in the initial determination of the MDL and analyzed on the GC/FID analytical system.

19.3 If any analytes are repeatedly not detected in the quarterly spiked sample analyses, or do not meet the qualitative identification criteria of the method, then this is an indication that the spiking level is not high enough and should be adjusted.

19.4 Prepare and analyze seven spike replicates and seven method blanks on at least three different days carried out through sample preparation steps. Existing routine method blanks can be used for this study.

19.5 The validity of the MDL shall be confirmed by qualitative identification of the analyte.

19.6 A minimum of seven MDL replicate samples and seven method blanks are used to calculate the MDL values. For purposes of this method, the MDL is equivalent to TNI's Limit of Detection (LOD).

Calculate the $\mathrm{MDL_S}$ (MDL spiked samples) value using the following formula:

$$\mathrm{MDL_S} = t_{[n-1,\ 1-\infty = 0.99]}\ S_S$$

Where,

$t_{[n-1,\ 1-\infty = 0.99]}$ = Student's t value for the 99% confidence level with n-1 degrees of freedom,
n = number of replicates.
S_S = the standard deviation of the replicate analyses.

Calculate the $\mathrm{MDL_B}$ (MDL blank samples) values using the following formula:

$$MDL = t_{[n-1,\ 1-alpha = 0.99]}\ S_b$$

Where,

$t_{[n-1,\ 1-alpha = 0.99]}$ = Student's t value for the 99% confidence level with n-1 degrees of freedom,
n = number of replicates.
S_b = the standard deviation of the replicate method blank sample analyses.

Number of Replicates	Degrees (degrees of freedom)	$t_{(n-1,\ 0.99)}$
7	6	3.143
8	7	2.998
9	8	2.896
10	9	2.821
11	10	2.764

19.7 Current MDL values for method analytes in this SOP can be found in the SATLMDL.xls spreadsheet.

20.0 POLLUTION PREVENTION

20.1 Each method is evaluated prior to use in order to minimize waste volume and toxicity.
20.2 A non-hazardous or less toxic substitute may be used whenever possible.
20.3 Purchase only the amount of chemical that is actually needed or that will be used to eliminate the cost of disposal later.

21.0 WASTE MANAGEMENT

21.1 Toxic waste must never be disposed of down the drain.
21.2 Waste generated from sample analysis must be segregated if the process knowledge indicates the presence of any of the hazardous components listed in Table–1, 40 CFR 261.24 and exceed the limits set in the table.
21.3 When disposing samples the analyst must follow current revision of the "Laboratory Waste Handling and Disposal" SOP (SATL#007G) for detailed disposal procedures.
21.4 All chemicals and containers must be properly identified and labeled at all times to eliminate ambiguity and cost of disposal of unknowns. If an unknown chemical or container is discovered, label it as 'unknown' and attach a note detailing any information about what the chemical may be, what test it may have been used for, and where it was found. If you find an unlabeled chemical that has crystallized or there is any other indication that it may be unstable, notify management immediately.
21.5 Generally, empty chemical containers are not considered hazardous waste. Check with management if one such container is found and in doubt. To dispose of the container in the regular trash the container must be completely empty and tripled rinsed
21.6 The waste drums are picked up upon notification and a copy of the report is submitted to the waste management company.

22.0 REFERENCES

22.1 Method 300.0, "Determination of Inorganic Anions by Ion Chromatography", Environmental Monitoring Systems Laboratory, Office of Research and Development, United States EPA, Revision 2.1, August 1993.

22.2 "Anions by Ion Chromatography" Method 4110B, Standard Methods for the Examination of Water and Wastewater, 20th Edition, Standard Methods 1998.

22.3 "Anions by Ion Chromatography" Method 4110B, Standard Methods for the Examination of Water and Wastewater, 23rd Edition, Standard Methods 2017.

22.4 EPA 9056A, Determination of Inorganic Anions by Ion Chromatography, Revision 1, February 2007.

23.0 REVISION HISTORY

23.1 New revision of the method.

23.2 Revision 2 from Revision 1: changes stemming from an annual review, and the most recent TCEQ on-site assessment.

23.3 Annual method revision # 2.1, added Drinking Water and Solid matrices in this SOP.

23.4 Annual revision #2.1.0 – revised for language and redundancy. Deleted the preparation of intermediate range eluent concentrate from section 8.2. Added clarity on eluent preparation.

23.5 Annual Revision 2014: revised section 6.0 and minor language changes throughout SOP. Included recommendations from NELAC and internal audits.

APPENDIX A
SOP History and Version Control

Version	Date of Review/Revision	Review/Revision Approved by	Brief Description
2.1.3	08/14/2015	M. Bernard	Revised to reflect change in procedure for calibration curve (12.7.4.1). Addition of Appendix A to reflect SOP history and version control. Change Appendix 1 to Appendix B.
2.5	07/25/2016	M. Bernard	Revision of title page.
3.0	06/19/2017	M. Bernard	Biennial review and waste disposal protocol.
3.1	10/13/2017	M. Bernard	Addition of chlorate and chlorite.
4.0	07/12/2019	M. Bernard	Biennial review; revision of title page, reference method update.
5.0	04/16/2021	A.Rosecrance	Biennial review; update title page; change MSDS to SDS
5.1	09/14/2021	C. Morrow	Revised the following: Section 4 – Definition for MDL Section 12 – Add details to calibration process to include %RE. Section 19 – Update MDL procedure. Section 22 – Update reference method information.

STANDARD OPERATING PROCEDURE
ANALYSIS OF ANIONS BY ION CHROMATOGRAPHY

APPENDIX – B

Table– A (a)

Example preparation of initial calibration curve for Ion Chromatograph: **Liquid/Solid**

CAS No.:	7681-49-4		Anion :	**Fluoride**	
ICAL Pnt	Final Conc.	Final vol	Init Conc	Init. Vol [mL]	Init Vol [uL]
1	0.1	50	20		250
2	0.2	50	20		500
3	1	50	20	2.5	
4	2	50	20	5	
5	4	50	20	10	
6	8	50	20	20	

CAS No.:	7647-14-5		Anion :	**Chloride**	
ICAL Pnt	Final Conc.	Final vol	Init Conc	Init. Vol [mL]	Init Vol [uL]
1	0.5	50	100		250
2	1	50	100		500
3	5	50	100	2.5	
4	10	50	100	5	
5	20	50	100	10	
6	40	50	100	20	

CAS No.:	7632-00-0		Anion :	**Nitrite-N**	
ICAL Pnt	Final Conc.	Final vol	Init Conc	Init. Vol [mL]	Init Vol [uL]
1	0.5	50	100		250
2	1	50	100		500
3	5	50	100	2.5	
4	10	50	100	5	
5	20	50	100	10	
6	40	50	100	20	

CAS No.:	7647-15-6		Anion :	**Bromide**	
ICAL Pnt	Final Conc.	Final vol	Init Conc	Init. Vol [mL]	Init Vol [uL]
1	0.5	50	100		250
2	1	50	100		500
3	5	50	100	2.5	
4	10	50	100	5	
5	20	50	100	10	
6	40	50	100	20	

CAS No.:	7631-99-4		Anion :	**Nitrate-N**	
ICAL Pnt	Final Conc.	Final vol	Init Conc	Init. Vol [mL]	Init Vol [uL]
1	0.5	50	100		250
2	1	50	100		500
3	5	50	100	2.5	
4	10	50	100	5	
5	20	50	100	10	
6	40	50	100	20	

CAS No.:	7778-77-0		Anion :	**Phosphate-P**	
ICAL Pnt	Final Conc.	Final vol	Init Conc	Init. Vol [mL]	Init Vol [uL]
1	1.0	50	200		250
2	2.0	50	200		500
3	10	50	200	2.5	
4	20	50	200	5	
5	40	50	200	10	
6	80	50	200	20	

CAS No.:	7778-80-5		Anion :	**Sulfate**	
ICAL Pnt	Final Conc.	Final vol	Init Conc	Init. Vol [mL]	Init Vol [uL]
1	0.5	50	100		250
2	1	50	100		500
3	5	50	100	2.5	
4	10	50	100	5	
5	20	50	100	10	
6	40	50	100	20	

STAGGERED CALIBRATION CURVE FOR 7 ANIONS [mg/L]

Anion	**Ical-1**	**Ical-2**	**Ical-3**	**Ical-4**	**Ical-5**	**Ical-6**
Fluoride	0.10	0.2	1.0	2.0	4.0	8.0
Chloride	0.50	1.0	5.0	10	20	40
Nitrate-N	0.50	1.0	5.0	10	20	40
Bromide	0.50	1.0	5.0	10	20	40
Nitrite-N	0.50	1.0	5.0	10	20	40
Phosphate-P	1.00	2.0	10	20	40	80
Sulfate	0.50	1.0	5.0	10	20	40

Calibration Standard Solutions:

Calibration Curve Point	**1**	**2**	**3**	**4**	**5**	**6**
DI Water [mL]	49.75	49.50	47.50	45.00	40.00	30.00
Stock Standards Volume [mL]:	0.25	0.50	2.50	5.00	10.00	20.00
Final Calibration Standand Volume [mL]:	50.00	50.00	50.00	50.00	50.00	50.00

STANDARD OPERATING PROCEDURE

Title

Analysis of pH (Electrometric)

Method No.:

EPA 150.1/EPA 9045D/SM4500–H^+ B (23rd Edition, 2017)

Matrix/Matrices:

Liquid/Solid

Document Control Number/Revision Number

SOP014A/Revision 5.2

Charles R. Morrow	09/07/2021
Approved By: Quality Assurance Manager	***Date***
Richard Hawk	09/07/2021
Approved By: General Manager	***Date***
	09/07/2021
Approved By: Laboratory Director	***Date***

Standard Operating Procedures shall be reviewed at least once in two years or as needed to determine their continued suitability, compliance with applicable requirements, and to ensure that they reflect actual procedures being performed.

1.0 SCOPE AND APPLICATION

1.1 This SOP describes the measurement of pH of liquids, solids, and wastes from domestic and industrial sources.

1.2 Method SM 4500–H^+ and 150.1 are used to measure the pH of drinking water, surface water, saline water, domestic and industrial wastewater.

1.3 Method 9040C is used to measure the pH of aqueous wastes and multiphase wastes with at least 20% of the total volume being aqueous.

1.4 Method 9045D is a procedure for measuring the pH in soil and waste samples. Waste samples may be solids, sludges, or non-aqueous liquids. When water is present, it must be less than 20% of the total volume of the sample.

2.0 REPORTING LIMIT

2.1 The pH meter/electrode reads pH values from 0 – 14.

3.0 SUMMARY

3.1 The pH of a sample is determined electrometrically using a combination electrode.

3.2 The pH meter is calibrated using a series of standard buffer solutions of known pH.

3.3 Solid and waste samples are mixed with reagent water and the pH of the resulting aqueous solution is measured.

4.0 DEFINITIONS

4.1 **pH:** is a measure, at a given temperature, of the intensity of the acidic or basic character of a solution.

4.2 **Batch –** The batch is a set of samples of the same matrix processed using the same procedures and reagents within the same time period. Batches are defined at the sample preparation stage. Batches should be kept together through the whole analytical process to the extent possible.

4.3 **Duplicate (DUP) –** A separate aliquot of the same sample from the same sample container that is analyzed separately with identical procedures. Analyses of a duplicate indicate precision associated with laboratory procedures, but not with sample collection, preservation, or storage procedures.

4.4 **Laboratory Control Sample (LCS)/Verification Buffer Standard (VBS) –** A buffer solution of known pH with different lot number or different vendor is used as an LCS/VBS.

5.0 INTERFERENCES

5.1 Generally, solution interferences from: color, turbidity, colloidal matter, oxidants, reductants, and/or high salinity are not a concern for the glass electrode.

5.2 Samples with very low or very high pH levels may yield incorrect reading.

5.3 Particulate matter or oily materials adhering to the electrode may also hinder electrode function. Usually, gentle wiping or detergent washing followed by rinsing with distilled water can remove such coatings. Additional treatment with 1.17 N hydrochloric acid (1:10 concentrated acid) may be needed to thoroughly clean the electrode.

5.4 Temperature fluctuations will cause measurement errors. The use of an instrument that has automatic temperature compensation is recommended.
5.5 During calibration, pH buffers should be used only once.
5.6 Never use a filling solution that contains silver with electrodes that require filling solutions.

6.0 SAFETY

6.1 Safety glasses and laboratory coats must be worn at all times while in the laboratory. In addition gloves and a face shield or goggles must be worn when dealing with toxic, caustic, and/or flammable chemicals.
6.2 A partial facemask should be worn when working with samples suspected to contain high levels of volatile organics, such solvents, and samples contaminated with gasoline, etc.
6.3 All chemical compounds should be treated as potential health hazards.
6.4 The toxicity and/or carcinogenicity of each sample will most likely not be known. Therefore, it is imperative that each sample be handled as a potential health hazard.
6.5 The analyst should familiarize themselves with all Safety Data Sheets (SDS), safety facilities, and equipment prior to beginning this procedure.
6.6 Please address any and all health and safety concerns to management before beginning this procedure.

7.0 EQUIPMENT AND SUPPLIES

7.1 Orion Five Star pH/ISE meter, Thermo-Fisher, or equivalent.
7.2 Digestion Cups, 50mL Capacity, Environmental Express, Catalog No. SC475
7.3 Polystyrene Beakers, 5mL, Fisher Scientific, Catalog No. 08-732-119, or Equivalent
7.4 Electrode Storage Solution, Fisher Scientific, Catalog No. SE40-1, or Equivalent
7.5 Reference Electrode Filling Solution, Fisher Scientific, Catalog No. 13-641-755
7.6 Beakers of various sizes from 50mL onwards.
7.7 Balance, Top Loading, Accurate to 0.01g, Denver Instruments, or Equivalent.
7.8 Stir plate – Fisher scientific or equivalent.

8.0 REAGENTS AND STANDARDS

8.1 Ultra Pure Water, ASTM Type II, San Antonio Testing Laboratory.
8.2 Buffer Solution, 4.00, Fisher Scientific, Catalog No. SB101-500, or Equivalent
8.3 Buffer Solution, 7.00, Fisher Scientific, Catalog No. SB107-500, or Equivalent
8.4 Buffer Solution, 10.00, Fisher Scientific, Catalog No. SB115-500, or Equivalent
8.5 Buffer Solution, 7.00, Hach Company, Catalog No. 22834-49, or Equivalent

9.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

9.1 Sample Collection and Holding Times[1]

9.1.1 Aqueous Samples

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[1] pH measurements should be made in the field when collecting samples as it may vary with various environmental factors such as temperature, dissolved carbon dioxide, etc.

9.1.1.1 Sample may be collected in a plastic or glass containers with screw cap lids.

9.1.1.2 No preservation is required for the pH analysis; however, samples must be analyzed as soon as practically possible.

9.1.2 Solid Samples

9.1.2.1 Bulk Solid (soils and sediment) samples are collected in wide mouth borosilicate glass jars.

9.1.2.2 No preservation is required for the pH analysis; however, samples must be analyzed as soon as practically possible.

10.0 STORAGE

10.1 Aqueous and solid [soils and sediment] samples are stored until the time of analysis in a refrigerator at >0°C but ≤ 6°C to preserve sample integrity if analysis cannot begin soon after sample receipt.

11.0 SAMPLE IDENTIFICATION

11.1 Samples are received from Sample Receiving with a work order form generated from the Laboratory Information Management System (LIMS). This includes client identification, sample number, and tests to be performed under each department

11.2 Each sample is assigned a unique number and a container number if more than one container is received.

12.0 CALIBRATION AND STANDARDIZATION

12.1 The pH meter must be calibrated each day of use.

12.1.1 To calibrate the pH meter:

12.1.1.1 Fill three disposable digestion tubes with approximately 10 mL of the appropriate buffer solutions that will bracket the pH of interest. Buffer Solutions with a pH of 4.00, 7.00, and 10.00 are used to calibrate the pH meter. All buffer solutions must be placed on a magnetic stir plate and gently stirred during the procedure.

Note: the buffer solutions from different manufacturers may have a pH value of 4.01, 7.01, 10.01, these may also be used in this procedure.

12.1.1.2 Turn the meter on, and allow to equilibrate for at least 15 minutes.

12.1.1.3 Press the “CAL” button on the meter to enter into calibration mode.

12.1.1.4 Place the electrode in the buffer solution “4.00” and wait for the meter to read the value and record internally. Follow the on-screen instruction of the meter.

12.1.1.5 Place the electrode in the buffer solution “7.00” and repeat the step above.

12.1.1.6 Place the electrode in the third buffer solution “10.00” and wait for the meter to finish calibration using all three buffer solutions.

12.1.1.7 Press “Enter” button to go to the next step to read the slope of the calibration and record the slope value in the logbook.

12.1.1.8 Press the “Enter” button again to exit out of the calibration mode and enter into measuring mode.

12.1.1.9 After calibration is accepted, ensure that the meter is properly calibrated by measuring the pH of a buffer solution such as a buffer of pH 7.00su. This verification buffer solution must be from a different manufacturer or from a different lot number if from same manufacturer.

12.1.1.10 Record the slope and the VBS value in the pH calibration Logbook. If the slope is not between the ranges of 98-102%, recalibrate the pH meter using fresh buffer solutions after a thorough cleaning of the electrode.

13.0 PROCEDURE

13.1 Liquids

13.1.1 Remove the samples from the refrigerator and allow to reach room temperature.

13.1.2 Gently invert the sample container and mix to homogenize the sample.

13.1.3 Pour approximately 25 mL of a representative sample into a digestion cup and place a small magnetic stirring bar and place the cup on a magnetic stir plate and gently stir at a slow rate to avoid vortexing of the sample.

13.1.4 Thoroughly rinse the pH electrode with ultrapure water and gently blot dry with a Kim-wipe to remove excess water.

13.1.5 Insert the pH electrode into the sample solution in the digestion cup and press the measurement button on the meter.

Allow the meter to stabilize and wait for the ‘pH’ symbol to stop blinking. The pH meter is equipped with an automatic temperature compensation unit and will display the temperature at which the sample pH is measured.

13.1.6 Record the pH and the temperature of the sample in the pH analysis logbook.

13.1.7 Once a stable pH has been reached, remove the electrode from the sample and rinse the pH electrode with ultra-pure water before placing back in the electrode storage solution.

13.2 Sludges

13.2.1 When sludge samples (mixture of solid and liquids) are to be measured for pH, gently mix the sample by inverting the container.

13.2.2 Immediately obtain a representative portion of the sample and pour into a digestion cup.

13.2.3 Thoroughly rinse the pH electrode with ultrapure water and gently blot dry with a Kim-wipe to remove excess water.

13.2.4 Insert the pH electrode into the sample, being careful to position the electrode only in the liquid portion of the sample. Allow the instrument to stabilize and place a small magnetic stirring bar to gently stir at a slow rate so as to avoid vortexing the sample.

13.2.5 Follow steps 13.1.4 through 13.1.6 above to measure sample pH.

13.3 Soils and Wastes

13.3.1 Remove samples from the refrigerator and allow to reach room temperature. Weigh about 10g of a representative sample into a plastic digestion cup. Samples are analyzed using a 1:1 soil:water ratio. If adequate soil to solution ratio is not obtained, 1:2 or 1:5 soil to water ratio can be used.

13.3.2 Add 10mL of ultrapure water and cover, if the solution is not enough add an additional 10mL of water to the soil. Cap the digestion cup and shake by hand for 2 minute at 10min intervals until the soil and liquid portions are mixed.

13.3.3 A mechanical shaker is suitable for mixing the soil and water to obtain a uniform slurry, if a mechanical shaker is used, shake the container for 15 minutes.

13.3.4 Allow the sample to stand for 1 hour before proceeding to measure the pH.

Note: Alternatively, the sample may be filtered or centrifuged to separate the solids from the aqueous phase. If the sample absorbs all the liquid, additional dilution is acceptable up to 1:5 ratio.

13.3.5 Thoroughly rinse the pH electrode with ultrapure water and blot dry with a Kim-wipe.

13.3.6 Insert the pH electrode into the sample and adjust the electrode in the electrode holder, being careful to submerge the electrode into the liquid portion of the sample. Allow the electrode to stabilize. Follow the steps 13.1.3 through 13.1.6

13.3.7 Once a stable pH has been reached, remove the electrode from the sample and rinse the pH electrode with ultra-pure water before placing back in the electrode storage solution. Record the pH and the temperature in the pH analysis logbook.

14.0 DATA ANALYSIS AND CALCULATIONS

14.1 Report pH values to the nearest 0.1 units.

14.2 Laboratory Control Sample [Dup] Recovery

$$Spike\ Recovery = \frac{LCSR}{LCSA} \times 100$$

Where:

LCSR = LCS Spike Result
LCSA = Spike Added

14.3 Relative Percent Difference

$$\mathrm{RPD} = \left| \frac{\mathrm{SR} - \mathrm{SDR}}{\left(\frac{\mathrm{SR} + \mathrm{SDR}}{2} \right)} \right| \times 100$$

Where:

RPD = Relative Percent Difference
SR = Spike Recovery
SDR = Spike Duplicate Recovery

15.0 QUALITY CONTROL

15.1 Buffer solutions must be entered and assigned a number from the Chemical and Standards Database upon receipt. The containers must be dated when first opened. Buffers must be discarded by the expiration date.

15.2 The instrument and electrode must be calibrated every day before any samples are processed.

15.3 Thoroughly rinse the pH electrode between samples.

15.4 A minimum of one sample duplicate must be analyzed for every batch of not more than 10 samples for liquid and 20 samples for solid (soil, waste and sludge).

15.5 On a quarterly basis, the temperature probe is to be calculated against a NIST calibrated thermometer.

16.0 ACCEPTANCE CRITERIA

16.1 Duplicate samples must have a Relative Percent Difference (RPD) of <10%.

16.2 Laboratory Control Sample/Verification Buffer Standard (LCS/VBS) recoveries must be within the stated pH values below.

16.2.1

16.2.2 The acceptance criteria for 7.0 buffer range is between 6.83 and 7.17 pH units.

17.0 CORRECTIVE ACTIONS FOR NON-CONFORMANCE DATA

17.1 When Quality Control measures fail, and the clients' results are affected, the client will be advised that the results may not be reliable. It may be necessary based on clients' needs to recollect the sample and submit at a later time. If the client is unable to recollect a sample, the data will be released with the appropriate documentation. The laboratory staff will complete a Corrective Action Report to document this occurrence.

17.2 Should a sample become contaminated or compromised, the preparation shall be terminated and repeated with a fresh sample aliquot. A Corrective Action Report must be completed to document the actions taken.

17.3 When QC samples do not fall within the acceptable range, the analyst shall review the data for obvious errors such as calculations, preparation errors, or inadvertent spiking errors or other such causes that are not resultant of a systemic failure. The data may be released with a qualifying statement after concurring with the quality manager. A Corrective Action Report must be completed documenting the actions taken when the root cause identified is deemed detrimental to the analysis.

18.0 HANDLING NON-CONFORMANCE DATA

18.1 Non-conformance data are monitored and resolved by identifying categories such as system based, methods based, preparative method based, etc., and are resolved once the problematic areas are identified.

19.0 METHOD PERFORMANCE

19.1 41 samples were analyzed between May 1, 2021 and July 19, 2021. The mean recovery was 100% with a standard deviation of 0.027 SU.

20.0 POLLUTION PREVENTION

20.1 No solvents are utilized in this method. Use of acids is very limited.

20.2 Only the amount of chemical that is actually needed is purchased, to eliminate the pollution and cost of disposal.

21.0 WASTE MANAGEMENT

21.1 Toxic waste must never be disposed of down the drain.

21.2 Waste generated from sample analysis must be segregated if the process knowledge indicates the presence of any of the hazardous components listed in Table–1, 40 CFR 261.24 and exceed the limits set in the table.

21.3 When disposing samples the analyst must follow current revision of the "Laboratory Waste Handling and Disposal" SOP (SATL#007G) for detailed disposal procedures.

21.4 All chemicals and containers must be properly identified and labeled at all times to eliminate ambiguity and cost of disposal of unknowns. If an unknown chemical or container is discovered, label it as 'unknown' and attach a note detailing any information about what the chemical may be, what test it may have been used for, and where it was found. If you find an unlabeled chemical that has crystallized or there is any other indication that it may be unstable, notify management immediately.

21.5 Generally, empty chemical containers are not considered hazardous waste. Check with management if one such container is found and in doubt. To dispose of the container in the regular trash the container must be completely empty and triple rinsed.

21.6 The waste drums are picked up upon notification and a copy of the report is submitted to the waste management company.

22.0 REFERENCES

22.1

22.2 Standard Methods for the Examination of Water and Wastewater, 23rd Edition.

22.3 EPA 150.1 – pH (Electrometric), Storet No. 00400 & 00403

22.4 EPA SW-846, 9040C, November 2004

22.5 EPA SW-846, 9045D, November 2004

23.0 REVISION HISTORY

23.1 New revision of the method.

23.2 Annual method revision # 1.0.1, added Solid matrix in this SOP.

23.3 Annual revision, Rev 2.0.0 – Revised for language, redundancy and formatting.

23.4 Annual revision 2014. Revised sections: 1.0, 4.0, 12.0, 13.0, and 16.0, 19.0. Removed the Appendix and incorporated the slope information within the procedure (section 12.0).

23.5 Post assessment revision to provide reference method edition on title page.

APPENDIX A
SOP History and Version Control

Version	Date of Review/Revision	Review/Revision Approved by	Brief Description
2.3	07/13/2016	M. Bernard	Revision of cover page, update of method performance data and addition of Appendix A to reflect SOP history and version control.
3.0	06/19/2017	M. Bernard	Biennial review; method performance update and waste disposal protocol.
4.0	04/10/2019	M. Bernard	Biennial review; clarity on acceptance criteria and method performance update.
5.0	04/16/2021	A.Rosecrance	Biennial review; update cover page; change MSDS to SDS.
5.1	07/19/2021	C. Morrow	Revised the following: Section 7.0 – Added stir plate to equipment and supply list. Section 12.1.1.1 – Include the requirement to gently stir calibration buffers. Section 13.1.3 – Include the requirement to gently stir samples.
5.2	09/07/2021	C. Morrow	Revised the following: Section 19 – Update method performance data. Section 22 - Update reference for SM 23rd edition.

STANDARD OPERATING PROCEDURE

Title

Analysis of Total Organic Carbon
by Heated–Persulfate Oxidation

Reference Method No.:

EPA 415.1 / SM 5310C (23rd Edition, 2017)

Matrix/Matrices:

Liquid/Drinking Water

Document Control Number/Revision Number

SOP030A/Revision 2.1

Charles R. Morrow
Approved By: Quality Assurance Manager

09/14/21
Date

Richard Hauk
Approved By: General Manager

09/14/21
Date

Approved By: Laboratory Director

09/14/21
Date

Standard Operating Procedures shall be reviewed at least once in two years or as needed to determine their continued suitability, compliance with applicable requirements, and to ensure that they reflect actual procedures being performed.

1.0 SCOPE AND APPLICATION

1.1 This SOP describes the procedure for the determination of Total Organic Carbon (TOC) by heated-persulfate oxidation method in drinking water, ground, surface water as well as industrial and domestic aqueous wastes.

2.0 REPORTING LIMIT

2.1 The Reporting Limit (RL) for TOC by heated-persulfate oxidation method is 0.05 mg/L.

3.0 SUMMARY

3.1 Organic carbon is oxidized by persulfate in the presence of heat and the resulting carbon dioxide (CO_2) is purged, dried and transferred to and measured by nondispersive infrared detector (NDIR).

3.1.1 Inorganic carbon present in the sample is removed by acidification (pH <2) and subsequent purging of the sample in the reaction vessel.

3.1.2 Persulfate is added to the sample in the reaction vessel which is then heated to approximately 95ºC ± 2ºC and organic carbon is oxidized to carbon dioxide (CO_2).

3.1.3 The CO_2 generated is transferred to the NDIR detector and is reported as mg/L of total organic carbon using calibration curve.

4.0 DEFINITIONS

4.1 **Reagent Blank/Reagent Water Blank (RB/RWB) –** Reagent blank is the water used to prepare the reagents used in the analysis to determine the organic carbon contribution in the water source.

4.2 **Total Organic Carbon (TOC) –** Total organic carbon is the derived from all carbon atoms from the organic components in a sample.

4.3 **Total Inorganic Carbon (TIC)** – Total inorganic carbon is the fraction that is a result of inorganic components i.e., carbonate, bicarbonate, dissolved CO_2, etc.

4.4 **Total Carbon (TC)** – Total carbon is a combination of all fractions of carbon in a sample

4.5 **Dissolved Organic Carbon (DOC)** – Fraction of the organic carbon is sample that has been filtered through a 0.45µm pore diameter filter.

4.6 **Purgeable Organic Carbon (POC)** – Fraction of organic carbon that can be measured by removing the carbon using an inert gas.

4.7 **Non-Purgeable Organic Carbon (NPOC)** – Fraction of organic carbon that can measure by removing the carbon using an inert gas.

4.8 **Method Blank (MBLK) –**An aliquot of reagent water that is treated exactly as a sample. The blank is exposed to all glassware, equipment, and reagents, etc. The method blank is used to define the level of laboratory background and reagent contamination.

4.9 **Duplicate (DUP) –** A separate aliquot of the same sample from the same sample container.

4.10 **Laboratory Fortified Blank/Laboratory Control Sample (LFB/LCS)** – A clean matrix spiked with a solution containing organic carbon at a known concentration. An LCS is used to check extraction and/or method performance.

4.11 **Laboratory Fortified Blank Duplicate/Laboratory Control Sample Duplicate (LFBD/LCSD)** – LCSD is the same as LCS and is used to check precision of the analytical method.

4.12 **Laboratory Fortified Matrix/Matrix Spike (LFM/MS)** – An aliquot of a sample from the analytical batch spiked with a known amount of organic carbon standard. An MS is used to check the effect of matrix on the analyte of interest.

4.13 **Limit of Detection (LOD)** – An estimate of the minimum amount of a substance that an analytical process can reliably detect (qualitatively). LOD is analyte and matrix specific. For purposes of this test procedure, the LOD is equivalent to the MDL.

4.14 **Method Detection Limit (MDL) –** The method detection limit (MDL) is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results. For purposes of this method, the MDL is equivalent to NELAC's Limit of Detection [LOD]. See Section 19.0 METHOD PERFORMANCE for more information regarding LOD.

4.15 **Practical Quantitation Limit (PQL)/Minimum Reporting Limit (MRL)** – The lowest concentration that can reliably be measured within specified limits of precision and accuracy for a specific laboratory analytical method during routine laboratory operating conditions.

4.16 **Limit of Quantitation (LOQ)** – For purposes of this method, the LOQ is equal to the low standard used for initial calibration for the analytical method, and is equal to the minimum reporting limit (MRL or PQL).

5.0 INTERFERENCES

5.1 Waters with high alkalinities or those that are laden with high carbonate and bicarbonates may interfere with TOC determination if acidification is incomplete.

5.2 Highly saline waters and waters with high chloride content (typically >500 mg/L) may impede the oxidation of organic molecules due to preferential oxidation of chloride. Extended reaction time may minimize this interference to generate accurate results.

5.3 Organic carbon due to volatiles present may be lost during sample preparation and/or acidification process.

5.4 Large particulates present in the sample may interfere with sample delivery/injection.

5.5 Large organic molecules such as lignins, tannins, humic acid, etc., oxidize slowly by persulfate and may not oxidize completely.

5.6 Contamination of samples during handling and preparation is another likely source of interference, especially with reagent water used.

6.0 SAFETY

6.1 Safety glasses and laboratory coats must be worn at all times while in the laboratory. In addition gloves and a face shield or goggles must be worn when dealing with toxic, caustic, and/or flammable chemicals.

6.2 All chemical compounds should be treated as potential health hazards. The toxicity and/or carcinogenicity of each sample will most likely not be known. Therefore, it is imperative that each sample be handled as a potential health hazard.

6.3 The analyst should familiarize themselves with all Safety Data Sheets (SDS), safety facilities, and equipment prior to beginning this procedure.

6.4 Address any and all health and safety concerns to management before beginning this procedure.

7.0 EQUIPMENT AND SUPPLIES

7.1 Total Organic Carbon Analyzer (TOC) – OI Analytical, Aurora 1030.
7.2 Nylon filters 0.45 µm syringe filters – BVA scientific or equivalent.
7.3 Sample bottles – Glass or plastic 250 mL or 125 mL capacity to hold sufficient volume to allow replicate sample analyses – BVA Scientific or equivalent.
7.4 Glass VOA vials 40 mL – CG Containers or equivalent.
7.5 Disposable Pasteur pipettes – Fisher Scientific, or equivalent.
7.6 Digestion tubes – Environmental Express, or Equivalent.
7.7 100 mL and 1 L Graduated Cylinder – Fisher Scientific, or Equivalent.
7.8 Balance, Top Loading, Accurate to 0.0001 g, Denver Instruments, or Equivalent.

8.0 REAGENTS AND STANDARDS

8.1 Reagent Water used in this method is also referred to as TOC reagent water – SATL Ultrapure, or Equivalent.

8.1.1 Reagent water is generated from SATL's water generation system located in the main laboratory area. This reagent water is of Type II – Medium Reagent Water with Conductivity values ranging from 0.25-0.55 µmho/cm and Resistivity values ranging from 4 MΩ to 2 MΩ on freshly generated water.

8.1.2 An aliquot of this water, when used for TOC analysis, must be analyzed as "Reagent Water Blank" part of the sequence to evaluate and monitor the organic carbon content of the water. The TOC content of this water should be less than 2× the MDL value (of TOC).

8.2 Acids
8.2.1 Hydrochloric Acid [HCl], ACS grade or equivalent.
8.2.2 Phosphoric acid [H_3PO_4], ACS grade or equivalent.
8.2.3 Sulfuric acid [H_2SO_4], ACS grade or equivalent.

8.3 Sodium persulfate (Sodium peroxydisulfate) 10% – dissolve 100 g reagent in 1 L or TOC reagent water.
8.3.1 Alternative to Sodium persulfate: Ammonium peroxydisulfate (Ammonium persulfate) 15% – Dissolve 150 g in 1L of TOC water
8.3.2 Alternative to sodium persulfate: Potassium peroxydisulfate (Potassium persulfate) 2% – Dissolve 20 g in 1 L of TOC reagent water.

8.4 Potassium biphthalate – (>99% pure) reagent – Acros, Sigma-Aldrich, Fisher scientific or equivalent.
8.5 Sodium carbonate (for inorganic carbon measurement if needed) – Fisher scientific or equivalent.
8.6 Sodium bicarbonate (for inorganic carbon measurement if needed) – Fisher scientific or equivalent.
8.7 Purge Gas – Nitrogen (>99%)
8.8 Carrier Gas – Oxygen (>99%)

9.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

9.1 Collect a representative grab or composite sample in a clean 125 mL, plastic or 40 mL glass VOA vials.
9.2 All samples must be preserved to pH <2 using HCl or H_2SO_4 or H_3PO_4.
9.3 Preservation should begin preferably at the time of collection in bottles containing one of the above acid preservatives.

9.4 Samples may be preserved at the laboratory if field preservation is not possible or considered hazardous due to transport using the acids indicated above.

10.0 STORAGE

10.1 Store samples until the time of analysis in a refrigerator at >0°C and ≤ 6°C to preserve sample integrity.

10.2 Unpreserved samples must be analyzed as soon as practically possible to produce accurate & representative data.

10.3 Preserved samples have a maximum holding time of 28 days from the time of collection until analysis unless otherwise stated to meet specific project objectives. Preserved samples should be analyzed preferably within 7 days of collection to minimize changes in TOC concentration.

11.0 SAMPLE IDENTIFICATION

11.1 Samples are received from Sample Receiving with an In-House Chain of Custody form generated from the Laboratory Information Management System (LIMS). This includes client identification, sample number, and test to be performed.

11.2 Each sample is assigned a unique number and a container number if more than one container is received.

12.0 CALIBRATION AND STANDARDIZATION

12.1 Balance must be QC checked using S Class weights on each day of use.

12.2 The TOC analyzer must be calibrated prior to sample analysis either on the day of analysis or calibration verified using a mid-point calibration standard on the day of analysis prior to sample analysis.

12.3 Calibration Standards may be purchased where commercially available or prepared in the laboratory using Potassium biphthalate ($C_8H_5KO_4$) as described below. The same lot of the salt may be used to prepare stock standards as long as they are independently prepared from each other. Use one set to calibrate the instrument and use second to verify the instrument calibration.

12.3.1 Total Organic Carbon [CS – Calibration stock solution] (TOC) 1000 mg/L: Dissolve 2.1254 g anhydrous potassium biphthalate [$C_8H_5KO_4$, CAS No. 877-24-7] in reagent water and dilute to 1000 mL in a volumetric flask. Acidify the stock solution with HCl or H_3PO_4 or H_2SO_4 to pH ≤2 and store in a refrigerator.

12.3.2 Total Organic Carbon [SS – Second source stock solution] (TOC) 1000 mg/L: Dissolve 2.1254 g anhydrous potassium biphthalate [$C_8H_5KO_4$, CAS No. 877-24-7] in reagent water and dilute to 1000 mL in a volumetric flask. Acidify the stock solution with HCl or H_3PO_4 or H_2SO_4 to pH ≤2 and store in a refrigerator.

Note: The same reagent [$C_8H_5KO_4$] can be used as second source stock as long as it is prepared independently of the calibration stock solution.

12.3.3 Alternatively, commercially available stock solution (1000 mg/L) may be purchased from approved vendors.

Note: If stock solution is purchased ensure that the lot numbers of the stock are different to satisfy the second source requirement.

12.3.3.1 Working Standard Solution–I [WSS-I] (100 mg/L): Transfer 10mL of the stock solution (12.3.1 or 12.3.2) to a 100 mL volumetric flask and dilute to volume with organic carbon free reagent water. Acidify the solution with HCl or H_3PO_4 or H_2SO_4 to pH ≤2 and store in a refrigerator.

12.3.3.2 Working Standard Solution–II [WSS-II] (10 mg/L): Transfer 10 mL of the stock solution (12.3.2.1) to a 100 mL volumetric flask and dilute to volume with organic carbon free reagent water. Acidify the solution with HCl or H_3PO_4 or H_2SO_4 to pH ≤2 and store in a refrigerator.

12.3.4 Total Inorganic Carbon (TIC) 1000 mg/L: Dissolve 4.4122 g of anhydrous sodium carbonate in 400 mL of TOC reagent water and add 3.497 g of anhydrous sodium bicarbonate and dilute to 1000 mL of TOC reagent water. Transfer to an air tight bottle and store in a refrigerator to prevent degradation.

12.3.4.1 Inorganic Carbon Working Standard Solution–I (100 mg/L): Transfer 10 mL of the stock solution (12.3.3) to a 100 mL volumetric flask and dilute to volume with organic carbon free reagent water.

12.3.4.2 Inorganic Carbon Working Standard Solution–II (10 mg/L): Transfer 10 mL of the stock solution (12.3.3.1) to a 100 mL volumetric flask and dilute to volume with organic carbon free reagent water.

Note: *Do not add any acid to the TIC standards prepared above.*

Note: *Store all stock and working standards in a refrigerator at ≥0°C ≤6°C. It is recommended that diluted working standards be prepared monthly.*

12.4 Refer to Table–A, Appendix B of this SOP for instructions on the preparation of the calibration curve.

12.5 Prior to sample analysis on the TOC analyzer, a set of calibration standards is analyzed following the guidelines in Table–A, Appendix B.

12.5.1 Refer to section 13.1 for manufacturer's recommended TOC analyzer operating conditions.

Note: Please ensure that the TOC analyzer is properly connected to the PC system prior to beginning analysis. Refer to Appendix D, for more information regarding the network connectivity.

12.6 Calculate the Relative Standard Error (%RSE) of the calibration curve for analytes with linear or quadratic fits. Determine the %RSE using the equation below.

$$\% RSE = 100 \times \sqrt{\sum_{i=1}^{n} \left[\frac{x'_i - x_i}{x_i}\right]^2 \Big/ (n-p)}$$

Where,

x_i = True value for the calibration standard
x'_i = Measured concentration of the calibration standard

n = Number of calibration points
p = Number of terms in the fitting equation
(Average = 1, Linear = 2, Quadratic = 3)

12.7 Coefficient of determination must be >0.920. If this cannot be achieved, the calibration is unacceptable and recalibration is necessary after remedial action to correct the problem.

12.8 Calculate the Relative Error (%RE) for those analytes are calibrated using linear or quadratic curve fits and determine the coefficient of determination using the following equation.

$$\%Relative\ Error = \frac{x'_i - x_i}{x_i} \times 100$$

Where,
x_i = True value for the calibration standard
x'_i = Measured concentration of the calibration standard

12.9 The relative error percent must be calculated for two of the calibration levels, i.e., the low calibration standard and the mid-point calibration standard. The acceptance criteria for low standard is 50% and the mid-point standard is 10%.

12.10 Initial Calibration

12.10.1 Prior to sample analysis, the TOC system is calibrated using multiple calibration points. The standards may be prepared as described in the appendix of this SOP or are purchased from approved vendors.

12.10.2 Prepare a set of calibration points as shown in Table A, Appendix B and analyze as per routine instrument conditions.

12.10.3 Inject the calibration standards (and samples) in triplicate and verify that the precision is within ±10% (%RSD) between the triplicate injections.

12.10.4 A calibration curve with a correlation coefficient of ≥0.995 is considered valid and sample analysis may begin after calibration is verified using a mid-point standard.

12.11 Calibration Verification – Initial and Continuing [ICV& CCV]

12.11.1 The initial calibration is verified at the beginning of each working day or a batch of 10 samples using a calibration verification standard.

12.11.2 Initial calibration of the TOC system is verified by analyzing a single point calibration standard (ICV) at 5mg/L once before sample analysis can begin.

12.11.2.1 Prepare 50 mL of ICV standard fresh on the day of calibration. This standard (ICV) must be prepared from a source stock that is other than the one used for initial calibration.

12.11.2.2 Dilute 2.5 mL of the working stock standard 100 mg/L (WSS–I section 12.3.2.1) to 50 mL in TOC reagent water to obtain 5 mg/L standard (refer to Table A, Appendix B on how to prepare this standard).

12.11.2.3 The ICV standard must be within ±15% of the true concentration in order for the calibration to be valid.

12.11.2.4 If the ICV exceeds ±15% the expected value, then evaluate for possible spiking errors, calculation errors, injection malfunction, change in instrument conditions, etc. If no obvious problems are identified, the stock solution may be suspect.

12.11.2.5 Prepare fresh stock solution, re-analyze the single ICV standard and verify calibration. If the ICV meets the acceptance criteria, sample analysis may begin.

12.11.2.6 Failure of the ICV to meet ±15% of the expected value mandates instrument recalibration using freshly prepared calibration stock solution(s).

12.11.3 A single point continuing calibration verification standard [CCV] at 5 mg/L must be analyzed on each day prior to sample analysis to verify that instrument calibration is still valid.

12.11.4 Reference method requires that a laboratory control sample (LCS) be prepared from a source other than the calibration stock solution and analyzed after every 10 injections. Therefore, it is recommended that the CCV standard be prepared from a second source stock to meet this requirement. In this procedure ICV/CCV and LCS are used interchangeably and they are prepared at the same level.

Note: *Avoid redundancy and prepare the CCV and LCS from the second source stock solution to meet the method requirement.*

12.11.4.1 The CCV standard must be within ±15% of the true concentration before sample analysis can begin.

12.11.4.2 If the CCV exceeds ±15% of the expected value, then evaluate for possible spiking errors, calculation errors, injection malfunction, etc. If no obvious problems are identified, the stock solution may be suspect.

12.11.4.3 Prepare fresh stock solution, re-analyze the single CCV standard and verify calibration.

12.11.4.4 Failure of the CCV to meet ±15% of the expected value second time mandates instrument recalibration. Prepare calibration stock solution(s) and calibration verification standard(s) and repeat the procedure as described above.

12.11.4.4.1 Perform any required instrument maintenance before recalibrating the instrument.

12.11.4.5 Further corrective actions such as cleaning the TOC system, replacing reagent water, preparing new reagents, etc. may be performed.

12.11.4.6 After major maintenance is done on the system, two consecutive CCV standards may be analyzed to re-evaluate the calibration and both must meet the acceptance criteria. If both consecutive CCV standards meet the acceptance criteria then samples may begin on the system without recalibrating the instrument as in section 12.7.

12.11.4.7 If any one of the two CCV standards fail to meet the acceptance criteria then a new calibration curve must be analyzed and evaluated prior to any sample analysis.

12.12 Recommended system maintenance

12.12.1 In cases where the initial calibration does not meet the acceptable correlation coefficient criteria of ≥0.995 or if the ICV/CCV is not within ±15% of the expected value, system maintenance is required. A short list of the remedial actions is given below:

a. Clean the system by running the "CleanUp" routine built into the instrument.
b. Check the sample and system tubing.
c. Check needle for any clogging clean/replace if necessary.
d. Check all reagent containers for any biological growth and clean as necessary.
e. Refer to the operational manual for other maintenance and suggested troubleshooting techniques.
f. If none of these maintenance tasks resolve the problems, replace the column, or contact the manufacturer for either technical help or service call.

13.0 PROCEDURE

13.1 Analytical System

13.1.1 Analytical system is comprised of a Carbon analyzer equipped with an autosampler and a nondispersive infrared detector (NDIR).

13.1.2 The main external components of the system consist of a digestion/oxidation vessel that is heated by an electrode, sample pump for reagent delivery to the vessel, injection syringe, halide scrubber and drying column.

13.1.3 Additional internal components consist of various valves, such as electronic flow control (EFC), electronic pressure control (EPC) and gas drying membrane filter and an integrated NDIR.

13.1.4 In addition to the heated persulfate method components, the TOC system is also capable of analyzing TOC by high temperature combustion, as such it is equipped with a combustion chamber.

13.1.5 Software for data acquisition and data processing: refer to and follow manufacturer's instructions on the operation of the TOC system and software.

13.1.6 The following are typical settings recommended by the manufacturer set into TOC software for instrument control. These values may be optimized to achieve better sensitivity toward the instrument. (Refer to Appendix C for screen shots of the instrument software).

Parameter	Value
Acid Volume	0.50 mL
Persulfate Volume	1.00 mL
Reagent water rinse Volume	15 mL
System Pressure	20 PSI
Drain Time	15 Sec
Reaction Time (TIC)	1:30 min
Reaction Time (TOC/TC)	3:00 min
Reaction Temp (TIC)	70ºC
Reaction Time (TOC/TC)	95ºC ±5ºC
Sample Volume	7mL
Sparge Time	2:00 min

13.2 Sample Preparation and Equipment

13.2.1 Samples are collected in preserved containers as per sections 9.0 and 10.0.

13.2.2 Allow samples to equilibrate to room temperature before starting the analysis. Do not allow samples to sit at room temperature in open container.

13.2.3 Samples must NOT be filtered through a 0.45 µm filter prior to taking a sample aliquot, if not analyzing for DOC.

13.2.4 If samples contain large amounts of particulate matter, use smaller aliquot and perform diluted analysis to prevent syringe clogging.

13.2.5 If samples are collected in 40 mL VOA vials, direct analysis can be performed by loading the samples into the autosampler trays.

13.2.6 If samples are collected in containers other than VOA vials, then draw a well homogenized aliquot by mixing the contents by gently inverting the container several times.

13.2.7 Program the sequence (refer to Appendix C) on the instrument control panel and initiate the run. Typical sample volume optimized for this method for individual calibration ranges must be used when analyzing samples and standards.

Note: *Detailed optimal conditions for each calibration range can be found in Appendix C of this procedure.*

13.2.8 Field samples may be analyzed following calibration standards and after the calibration curve has been established and verified to meet acceptance criteria.

13.2.9 Prepare a laboratory reagent blank [LRB], laboratory control sample [LCS], matrix spike [MS], sample duplicate [Dup], etc., along with field samples in a batch.

13.2.10 Using peak areas sample concentration is calculated via calibration curve response.

13.2.11 Read and report measured TOC values directly from the instrument and calculate according to section 14.0 below.

13.2.12 When sample concentration exceeds the calibration range, sample must be diluted appropriately so that the concentration will fall within the calibration range.

13.3 Data review and Data processing

13.3.1 All raw data must be reviewed for integration errors by the software to ensure that peaks are correctly integrated.

13.3.2 Use peak area responses to compute the concentration of the field and QC samples.

13.3.3 Report values that fall within the lowest and highest calibration points. Sample concentrations that fall beyond the highest calibration point must be diluted and re-analyzed.

13.3.4 Refer to section 14.0 for the calculation of sample concentrations and LCS, MS, etc., recoveries.

14.0 DATA ANALYSIS AND CALCULATIONS

14.1 Report total organic carbon concentrations in field samples directly from the instrument generated data in mg/L taking into account any dilution factor.

14.1.1 Calculate the analyte concentration:

Liquid/Water Samples:

$$\text{TOC (mg/L)} = \text{Instrument Reading} \times \text{DF}$$

14.2 Laboratory Fortified Blank/Laboratory Control Sample [LCS] Recovery

$$\text{Spike Recovery} = \frac{\text{LCSR}}{\text{LCSA}} \times 100$$

Where:

LCSR = LCS Spike Result
LCSA = LCS Spike Added

14.3 Laboratory Fortified Matrix/Matrix Spike [MS] Recovery

$$\text{Spike Recovery} = \frac{\text{MSR} - \text{SR}}{\text{MSA}} \times 100$$

Where:

MSR = MS Result
SR = Sample Result [Un-spiked field sample]

MSA = Matrix Spike Added

14.4 Relative Percent Difference – Duplicate samples

$$\text{RPD} = \left| \frac{\text{SR} - \text{SDR}}{\left(\frac{\text{SR} + \text{SDR}}{2} \right)} \right| \times 100$$

Where:

RPD = Relative Percent Difference
SR = Sample Result
SDR = Sample Duplicate Result

15.0 QUALITY CONTROL

15.1 Laboratory's initial demonstration of capability is documented by the analysis of 4 quality control sample spiked with 4 times the LOQ of TOC established.

15.2 The Limit of Quantitation (LOQ) for this procedure is 0.05 mg/L.

15.3 Each batch must include a Blank and CCV/LCS (source other than calibration stock) after every 20^{th} sample or less in the sequence.

15.4 A routine batch of sample analysis must include a reagent water blank, method blank, laboratory control sample (and duplicate) and a sample duplicate. Optionally a matrix spike sample may be analyzed in cases where sample matrix effects need to be evaluated/monitored or project objectives mandate such requirement.

15.5 Chemicals and standards must be entered upon receipt into the LIMS and assigned a number. The containers must be dated when first opened and discarded by the expiration date. Any chemical or standard that fails to meet Quality Control requirements should be returned to the manufacturer for replacement.

15.6 Working standards including those prepared/used daily must be entered and assigned a number in LIMS when prepared. All working standards must be discarded by the expiration date.

15.7 Any working standard that fails to meet Quality Control requirements must be discarded and re-prepared. If the working standard continues to fail, contact the manufacturer of the chemicals, and if necessary, order new supplies.

15.8 All Certificates of Analysis must be retained.
15.9 All analytical records must be backed up monthly as a minimum.

16.0 ACCEPTANCE CRITERIA

16.1 Individual QC/Field sample injections analyzed in triplicate must have ≤10% RSD.
16.2 Reagent Water Blank's TOC concentration must be less than 2× MDL value.
16.3 Calculate the LCS recovery as in section14.0. The acceptable range for the LCS is ±15% of true concentration.
16.4 Calculate the MS recovery if a matrix spike sample is analyzed. The acceptable range for the LFM is 80%-120% until such time there is sufficient data becomes available.
16.5 Determine the RPD for the sample and sample duplicate. The acceptable range for the RPD between sample and sample duplicate is ≤10%.
16.6 Refer to Appendix B, Table–B for QC acceptance criteria.

17.0 CORRECTIVE ACTIONS FOR NON-CONFORMANCE DATA

17.1 Should a sample become contaminated or compromised, the preparation and analysis shall be terminated and repeated with a fresh sample aliquot. A Corrective Action must be completed to document the actions taken.
17.2 When Quality Control measures fail, and the clients' results are affected, the client will be advised that the results may not be reliable. It may be necessary based on clients' needs to recollect the sample and submit at a later time. If the client is unable to recollect a sample, the data will be released with the appropriate documentation. The laboratory staff will complete a Corrective Action form to document this occurrence.
17.3 When QC samples do not fall within the acceptable range, the analyst shall review the data for obvious errors such as calculations, preparation errors, or inadvertent spiking errors or other such causes that are not resultant of a systemic failure. The data may be released with a qualifying statement after concurring with the quality manager. A Corrective Action must be completed documenting the actions taken when the root cause identified is deemed detrimental to the analysis.

18.0 HANDLING NON-CONFORMANCE DATA

18.1 Non-conformance data are monitored and resolved by identifying categories such as system based, methods based, preparative method based, etc., and are resolved once the problematic areas are identified.

19.0 METHOD PERFORMANCE

19.1 Fourty-seven reagent water samples spiked with 5 mg/L of TOC standard analyzed between January 1, 2020 and December 31, 2020 had an average recovery of 96.8% with a standard deviation of 2.51.
19.2 A method detection limit study is performed, initially and verified quarterly thereafter for all analytes that are listed for this method.

19.2.1 All sample processing steps of the analytical method shall be included in the determination of the MDL.

19.2.2 The Minimum Reporting Limit (MRL) of quantitation is equivalent to NELAC's Limit of Quantitation (LOQ). The concentration of the LOQ is equal to the low standard used for initial calibration.

19.3 During the beginning of each quarter, two replicate samples of organic free reagent water are spiked with a known amount of target analytes at the concentration used in the initial determination of the MDL and analyzed on the TOC analyzer.

19.4 If the analyte is repeatedly not detected in the quarterly spiked sample analyses, or do not meet the qualitative identification criteria of the method, then this is an indication that the spiking level is not high enough and should be adjusted.

19.5 Prepare and analyze seven spike replicates and seven method blanks on at least three different days carried out through sample preparation steps. Existing routine method blanks can be used for this study.

19.6 The validity of the MDL shall be confirmed by qualitative identification of the analyte.

19.7 A minimum of seven MDL replicate samples and seven method blanks are used to calculate the MDL values. For purposes of this method, the MDL is equivalent to TNI's Limit of Detection (LOD).

Calculate the $\mathrm{MDL_S}$ (MDL spiked samples) value using the following formula:

$$\mathrm{MDL_s} = t_{[n-1,\ 1-\infty = 0.99]}\ S_s$$

Where,

$t_{[n-1,\ 1-\infty = 0.99]}$ = Student's t value for the 99% confidence level with n-1 degrees of freedom,
n = number of replicates.
S_s = the standard deviation of the replicate analyses.

Calculate the $\mathrm{MDL_B}$ (MDL blank samples) values using the following formula:

$$\mathrm{MDL} = t_{[n-1,\ 1-\mathrm{alpha} = 0.99]}\ S_b$$

Where,

$t_{[n-1,\ 1-\mathrm{alpha} = 0.99]}$ = Student's t value for the 99% confidence level with n-1 degrees of freedom,
n = number of replicates.
S_b = the standard deviation of the replicate method blank sample analyses.

Number of Replicates	Degrees (degrees of freedom)	$t_{(n-1,\ 0.99)}$
7	6	3.143
8	7	2.998
9	8	2.896
10	9	2.821
11	10	2.764

19.8 Current MDL values for method analytes in this SOP can be found in the SATLMDL.xls spreadsheet.

20.0 POLLUTION PREVENTION

20.1 Each method is evaluated prior to use in order to minimize waste volume and toxicity.
20.2 A non-hazardous or less toxic substitute may be used whenever possible.
20.3 Purchase only the amount of chemical that is actually needed or that will be used to eliminate the cost of disposal later.

21.0 WASTE MANAGEMENT

21.1 Toxic waste must never be disposed of down the drain.
21.2 Waste generated from sample analysis must be segregated if the process knowledge indicates the presence of any of the hazardous components listed in Table–1, 40 CFR 261.24 and exceed the limits set in the table.
21.3 When disposing samples, the analyst must follow current revision of the “Laboratory Waste Handling and Disposal” SOP (SATL#007G) for detailed disposal procedures.
21.4 All chemicals and containers must be properly identified and labeled at all times to eliminate ambiguity and cost of disposal of unknowns. If an unknown chemical or container is discovered, label it as ‘unknown’ and attach a note detailing any information about what the chemical may be, what test it may have been used for, and where it was found. If you find an unlabeled chemical that has crystallized or there is any other indication that it may be unstable, notify management immediately.
21.5 Generally, empty chemical containers are not considered hazardous waste. Check with management if one such container is found and in doubt. To dispose of the container in the regular trash the container must be completely empty and tripled rinsed.
21.6 The waste drums are picked up upon notification and a copy of the report is submitted to the waste management company.

22.0 REFERENCES

22.1 Total Organic Carbon – Heated–Persulfate Oxidation Method, SM5310C, Standard Methods for the Examination of Water and Wastewater, 22nd Edition, 2011.
22.2 Total Organic Carbon – Heated–Persulfate Oxidation Method, SM5310C, Standard Methods for the Examination of Water and Wastewater, 23rd Edition, 2017.
22.3 Organic Carbon, Total (Combustion or Oxidation) – EPA 415.1, 1974.

23.0 REVISION HISTORY

23.1 New SOP of the method.

APPENDIX A
SOP History and Version Control

Version	Date of Review/Revision	Review/Revision Approved by	Brief Description of changes
1.0	02/11/2019	S. Abburu	New SOP
1.1	06/12/2019	S. Abburu	Updated– Section 12.0; Section 13.0; Section 16.0 Appendix B; levels for calibration curve. Appendix D – added.
1.2	08/08/2019	M. Bernard	Corrected Section 15.1, LOQ
2.0	02/26/2021	A.Rosecrance	Biennial review; update title page; change MSDS to SDS.
2.1	09/13/2021	C. Morrow	Revised he following. Update Title Page and headers Section 4 – Update definition. Section 12 – Added details to calibration process to include %RE. Section 15 – Update quality assurance requirements. Section 19 – Update method performance data and update MDL procedure. Section 22 – Update reference method information.

APPENDIX B

Table– A

Preparation of Calibration curve(s)

Cal Pt.	Stock Conc	Std. Conc. (mg/L)	Final Std. Vol	Vol Req. (mL)	Vol Req. (µL)
1	10	0.05	50	0.250	250
2	10	0.10	50	0.500	500
3	100	0.50	50	0.250	250
4	100	1.0	50	0.500	500
5	1000	5.0	50	0.250	250
6	1000	10.0	50	0.500	500
7	1000	20.0	50	1.000	1000
8	1000	30.0	50	1.500	1500

* Concentration (point) to be used as daily calibration check standard (CCV).

APPENDIX B *cont'd*

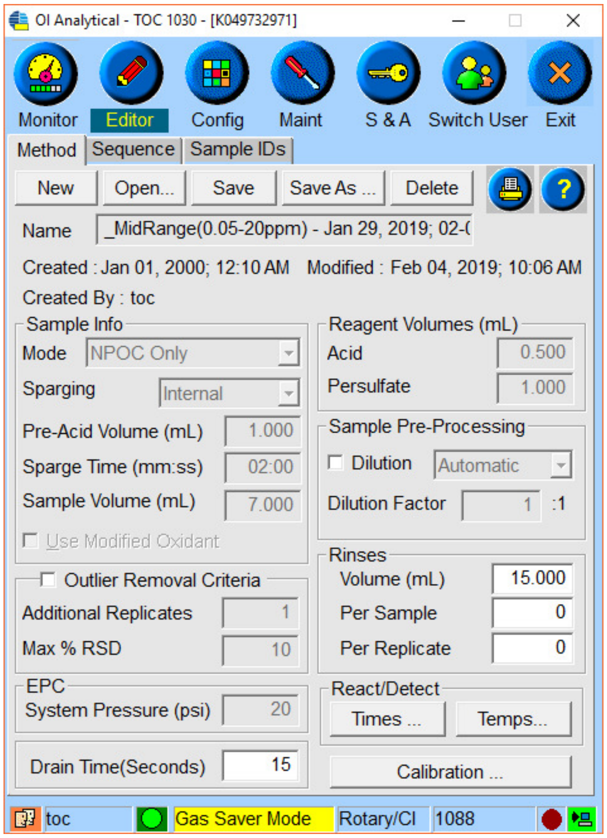
Table– B

Quality Control Acceptance Criteria

QC Element	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial calibration for all analytes	Initial calibration prior to analysis	A correlation coefficient of ≥0.995.	Correct problem then repeat initial calibration
Second source calibration verification	Once after initial calibration	Analyte concentration must be within ±15% of the expected value.	If concentration is >15%, correct problem and reanalyze. Second failure repeat initial calibration.
Continuing calibration verification (Second source stock solution).	Daily, before sample analysis and every 10th injection.	Analyte concentration within 15%.	Samples after the last verification standard and before the failed verification standard must be rejected/re-analyzed. Data may be reported if the check standard fails high and sample concentration is non-detect. Data may be reported if the check standard fails low and sample concentration is detected above the reporting limit. Any data reported as such must be qualified indicating that the check concentration is outside the limits on the analytical reports.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of QC check samples at 1-4 times the reporting limit (LOQ).	Once initially, before analysis can begin by the analyst.	Recoveries within acceptable limits, and RPD <10%.	Recalculate results. Locate and fix problem with system and the rerun demonstration for those analytes that did not meet criteria.
Reagent Blank	Daily, before sample analysis and every 10th injection.	TOC concentration detected <2x MDL	Correct problem then re-prepare and reanalyze, method blank and all samples processed using this reagent water.
Method Blank	Once per analytical batch of 10 or fewer.	No analytes detected < RL.	Correct problem then re-prepare and reanalyze method blank and associated samples in the batch.
LCS/LCSD	One LCS/LCSD pair per 10 samples per matrix.	Based on control chart limits established over a period of time and updated in ELEMENT LIMS.	Correct problem then re-prepare and reanalyze the LCS and all samples in the affected analytical batch. Qualify data on the analytical report.
MS	One MS per 10 samples per matrix.	Based on control chart limits established over a period of time and updated in ELEMENT LIMS.	Qualify data on the analytical report for the sample batch.
Sample Duplicates	One per 10 samples per matrix.	Based on control chart limits established over a period of time and updated in ELEMENT LIMS.	Qualify data on the analytical report for the sample batch.

APPENDIX C

Example method settings – the method can be edited as necessary to adjust the volumes, reaction times, reaction temperatures, sparing time, etc., when a new method need to be optimized.



Name _MidRange(0.05-20ppm) - Jan 29, 2019; 02-(

Created : Jan 01, 2000; 12:10 AM Modified : Feb 04, 2019; 10:06 AM

Created By : toc

Sample Info

Mode NPOC Only

Sparging Internal

Pre-Acid Volume (mL) 1.000

Sparge Time (mm:ss) 02:00

Sample Volume (mL) 7.000

☐ Use Modified Oxidant

Reagent Volumes (mL)

Acid 0.500

Persulfate 1.000

Sample Pre-Processing

☐ Dilution Automatic

Dilution Factor 1 :1

☐ Outlier Removal Criteria

Additional Replicates 1

Max % RSD 10

Rinses

Volume (mL) 15.000

Per Sample 0

Per Replicate 0

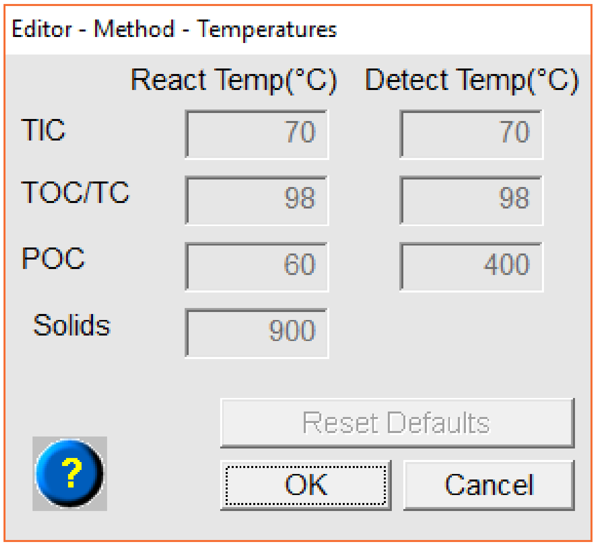
EPC

System Pressure (psi) 20

React/Detect

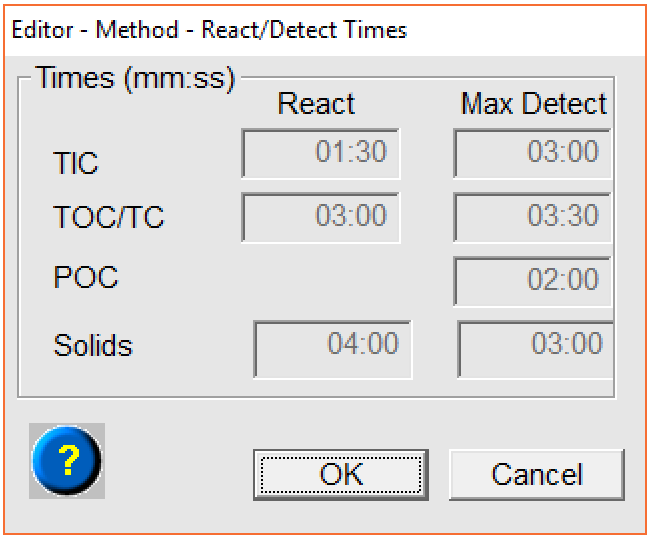
Drain Time(Seconds) 15

toc | Gas Saver Mode | Rotary/CI | 1088



Editor - Method - Temperatures

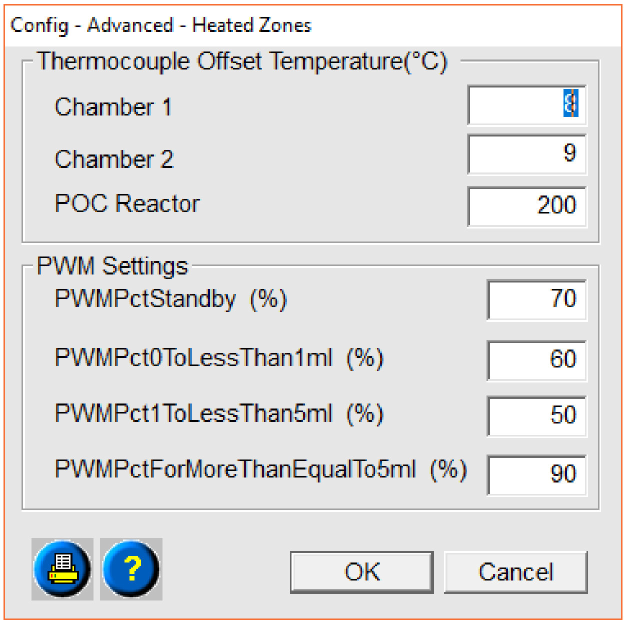
	React Temp(°C)	Detect Temp(°C)
TIC	70	70
TOC/TC	98	98
POC	60	400
Solids	900	



Editor - Method - React/Detect Times

Times (mm:ss)

	React	Max Detect
TIC	01:30	03:00
TOC/TC	03:00	03:30
POC		02:00
Solids	04:00	03:00



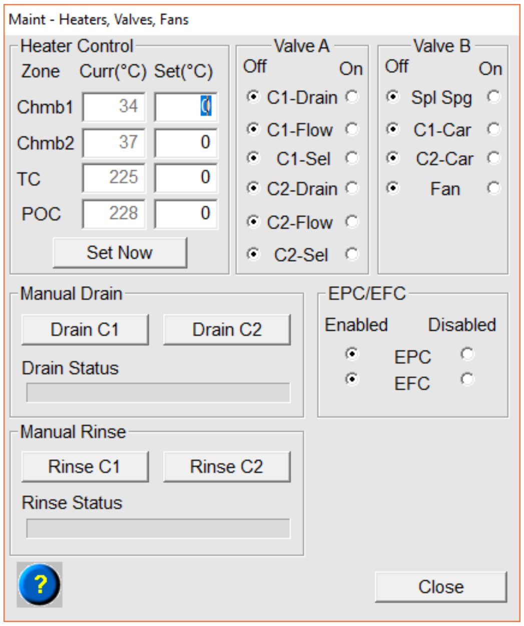
Config - Advanced - Heated Zones

Thermocouple Offset Temperature(°C)

Chamber 1	8
Chamber 2	9
POC Reactor	200

PWM Settings

PWMPctStandby (%)	70
PWMPct0ToLessThan1ml (%)	60
PWMPct1ToLessThan5ml (%)	50
PWMPctForMoreThanEqualTo5ml (%)	90



Maint - Heaters, Valves, Fans

Heater Control

Zone	Curr(°C)	Set(°C)
Chmb1	34	0
Chmb2	37	0
TC	225	0
POC	228	0

Valve A

Off		On
●	C1-Drain	○
●	C1-Flow	○
●	C1-Sel	○
●	C2-Drain	○
●	C2-Flow	○
●	C2-Sel	○

Valve B

Off		On
●	Spl Spg	○
●	C1-Car	○
●	C2-Car	○
●	Fan	○

Manual Drain

Drain Status

EPC/EFC

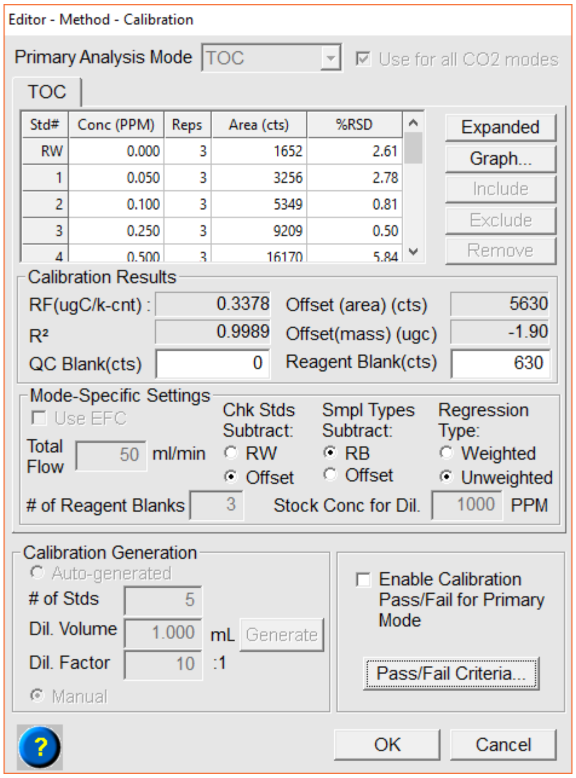
Enabled		Disabled
●	EPC	○
●	EFC	○

Manual Rinse

Rinse Status

Example Calibration screen with calibration parameter

STANDARD OPERATING PROCEDURE
ANALYSIS OF TOTAL ORGANIC CARBON BY HEATED–PERSULFATE OXIDATION


Editor - Method - Calibration

Primary Analysis Mode: TOC ☑ Use for all CO2 modes

TOC

Std#	Conc (PPM)	Reps	Area (cts)	%RSD
RW	0.000	3	1652	2.61
1	0.050	3	3256	2.78
2	0.100	3	5349	0.81
3	0.250	3	9209	0.50
4	0.500	3	16170	5.84

Calibration Results

RF(ugC/k-cnt): 0.3378
Offset (area) (cts): 5630
R²: 0.9989
Offset(mass) (ugc): -1.90
QC Blank(cts): 0
Reagent Blank(cts): 630

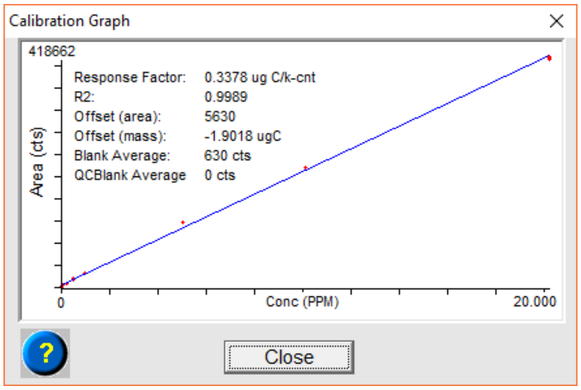
Mode-Specific Settings

☐ Use EFC
Total Flow: 50 ml/min
Chk Stds Subtract: ○ RW ● Offset
Smpl Types Subtract: ● RB ○ Offset
Regression Type: ○ Weighted ● Unweighted
# of Reagent Blanks: 3
Stock Conc for Dil.: 1000 PPM

Calibration Generation

○ Auto-generated
# of Stds: 5
Dil. Volume: 1.000 mL
Dil. Factor: 10 :1
● Manual

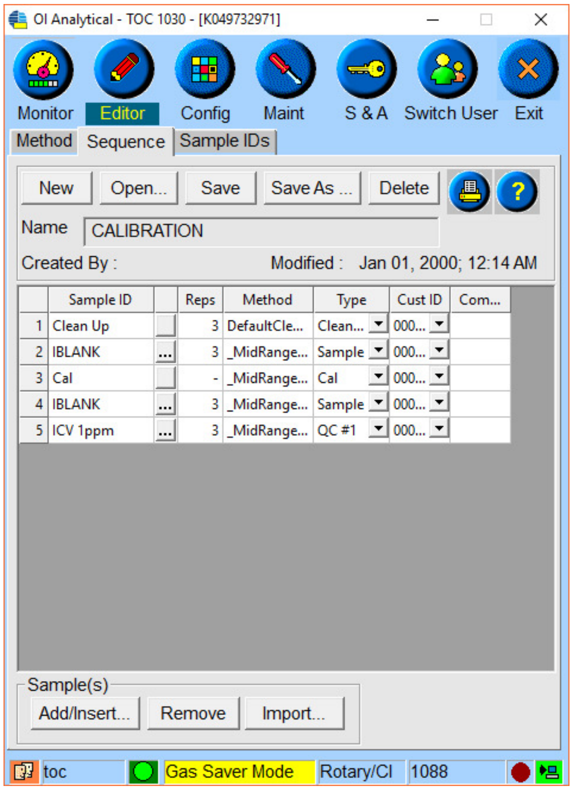
☐ Enable Calibration Pass/Fail for Primary Mode


Calibration Graph

Response Factor: 0.3378 ug C/k-cnt
R2: 0.9989
Offset (area): 5630
Offset (mass): -1.9018 ugC
Blank Average: 630 cts
QCBlank Average 0 cts

Example Calibration sequence

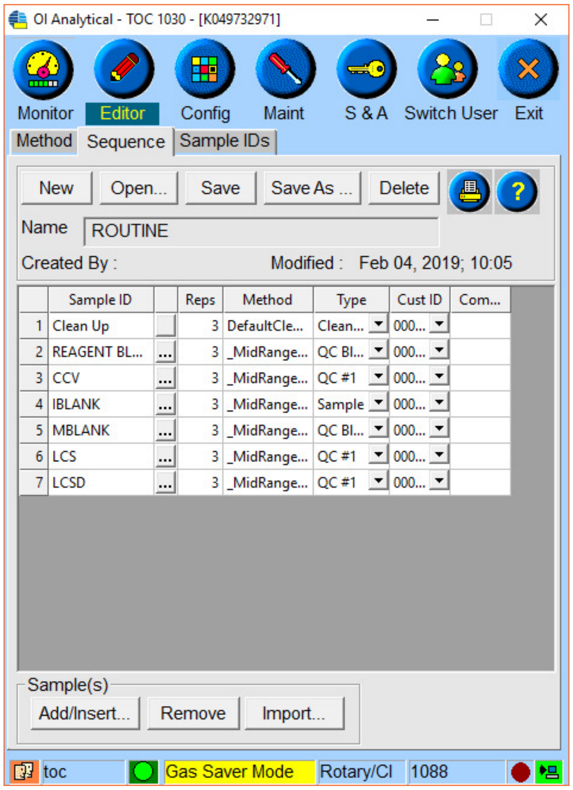
Example daily routine sequence



Name CALIBRATION

Created By :   Modified : Jan 01, 2000; 12:14 AM

	Sample ID		Reps	Method	Type	Cust ID	Com...
1	Clean Up		3	DefaultCle...	Clean...	000...	
2	IBLANK	...	3	_MidRange...	Sample	000...	
3	Cal		-	_MidRange...	Cal	000...	
4	IBLANK	...	3	_MidRange...	Sample	000...	
5	ICV 1ppm	...	3	_MidRange...	QC #1	000...	

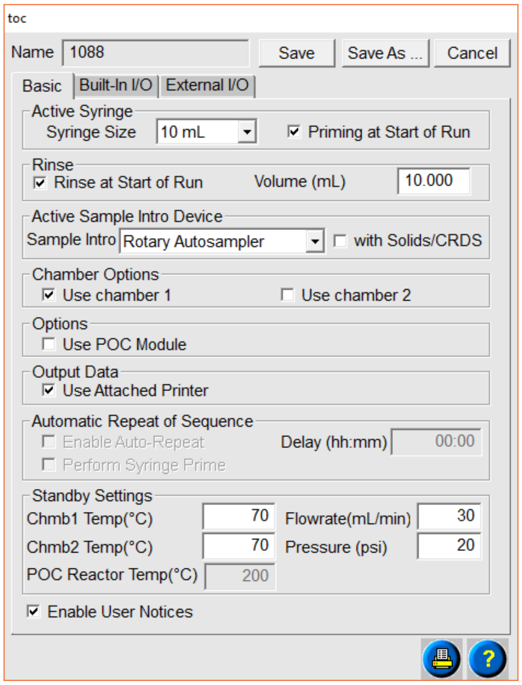


Name ROUTINE

Created By :   Modified : Feb 04, 2019; 10:05

	Sample ID		Reps	Method	Type	Cust ID	Com...
1	Clean Up		3	DefaultCle...	Clean...	000...	
2	REAGENT BL...	...	3	_MidRange...	QC Bl...	000...	
3	CCV	...	3	_MidRange...	QC #1	000...	
4	IBLANK	...	3	_MidRange...	Sample	000...	
5	MBLANK	...	3	_MidRange...	QC Bl...	000...	
6	LCS	...	3	_MidRange...	QC #1	000...	
7	LCSD	...	3	_MidRange...	QC #1	000...	

Auto Sampler settings



Name 1088

Active Syringe
Syringe Size 10 mL   ☑ Priming at Start of Run

Rinse
☑ Rinse at Start of Run   Volume (mL) 10.000

Active Sample Intro Device
Sample Intro Rotary Autosampler   ☐ with Solids/CRDS

Chamber Options
☑ Use chamber 1   ☐ Use chamber 2

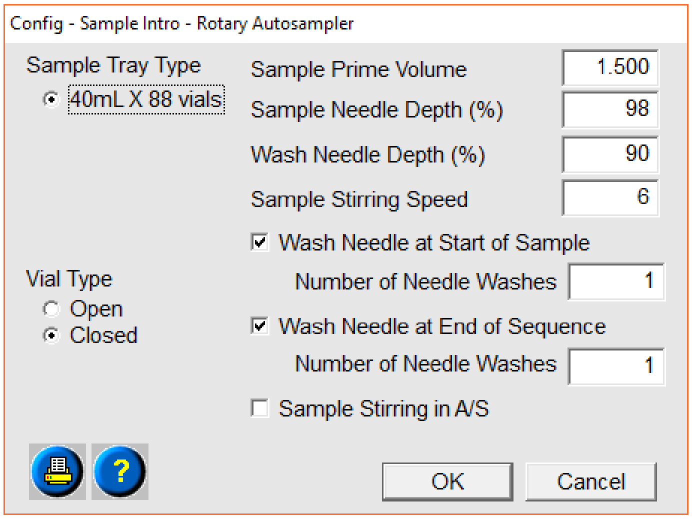
Options
☐ Use POC Module

Output Data
☑ Use Attached Printer

Automatic Repeat of Sequence
☐ Enable Auto-Repeat   Delay (hh:mm) 00:00
☐ Perform Syringe Prime

Standby Settings
Chmb1 Temp(°C) 70   Flowrate(mL/min) 30
Chmb2 Temp(°C) 70   Pressure (psi) 20
POC Reactor Temp(°C) 200

☑ Enable User Notices



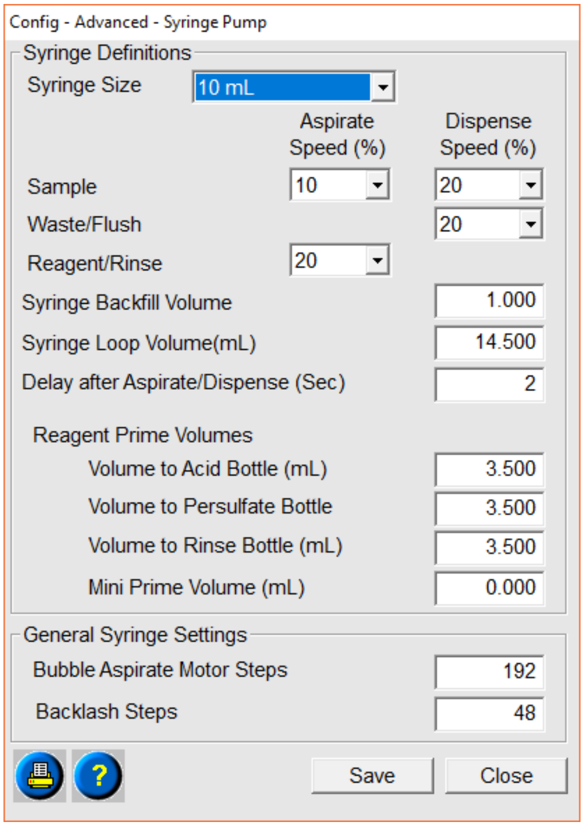
Sample Tray Type
● 40mL X 88 vials

Sample Prime Volume 1.500
Sample Needle Depth (%) 98
Wash Needle Depth (%) 90
Sample Stirring Speed 6
☑ Wash Needle at Start of Sample
Number of Needle Washes 1

Vial Type
○ Open
● Closed

☑ Wash Needle at End of Sequence
Number of Needle Washes 1
☐ Sample Stirring in A/S

STANDARD OPERATING PROCEDURE
ANALYSIS OF TOTAL ORGANIC CARBON BY HEATED–PERSULFATE OXIDATION



Config - Advanced - Syringe Pump

Syringe Definitions

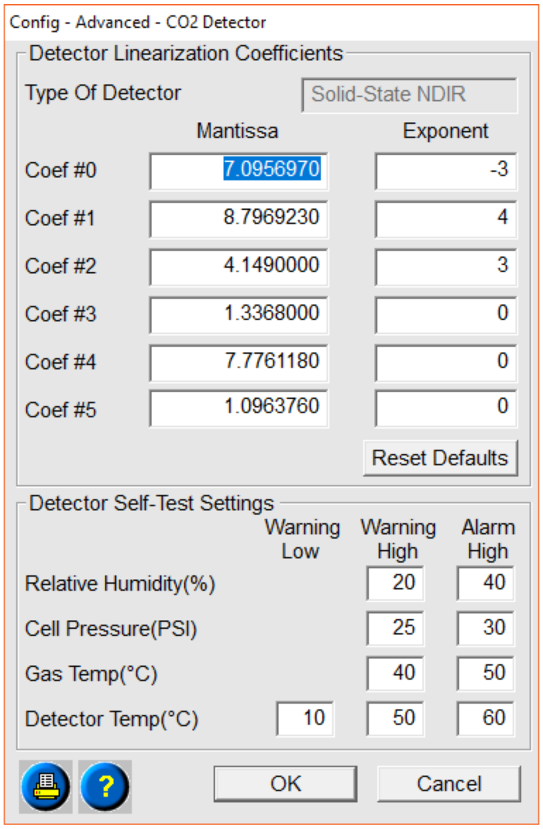
Syringe Size: 10 mL

	Aspirate Speed (%)	Dispense Speed (%)
Sample	10	20
Waste/Flush		20
Reagent/Rinse	20	

Syringe Backfill Volume: 1.000
Syringe Loop Volume(mL): 14.500
Delay after Aspirate/Dispense (Sec): 2

Reagent Prime Volumes
Volume to Acid Bottle (mL): 3.500
Volume to Persulfate Bottle: 3.500
Volume to Rinse Bottle (mL): 3.500
Mini Prime Volume (mL): 0.000

General Syringe Settings
Bubble Aspirate Motor Steps: 192
Backlash Steps: 48



Config - Advanced - CO2 Detector

Detector Linearization Coefficients

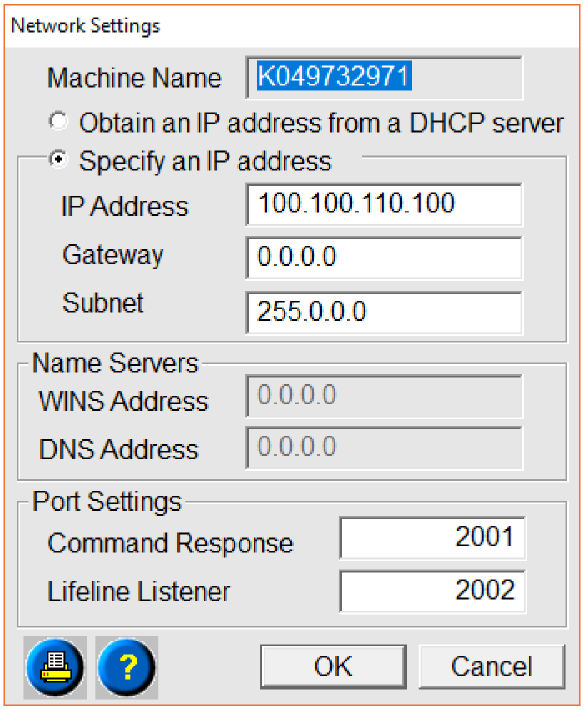
Type Of Detector: Solid-State NDIR

	Mantissa	Exponent
Coef #0	7.0956970	-3
Coef #1	8.7969230	4
Coef #2	4.1490000	3
Coef #3	1.3368000	0
Coef #4	7.7761180	0
Coef #5	1.0963760	0

Detector Self-Test Settings

	Warning Low	Warning High	Alarm High
Relative Humidity(%)		20	40
Cell Pressure(PSI)		25	30
Gas Temp(°C)		40	50
Detector Temp(°C)	10	50	60

Data Transfer Service and Network Settings

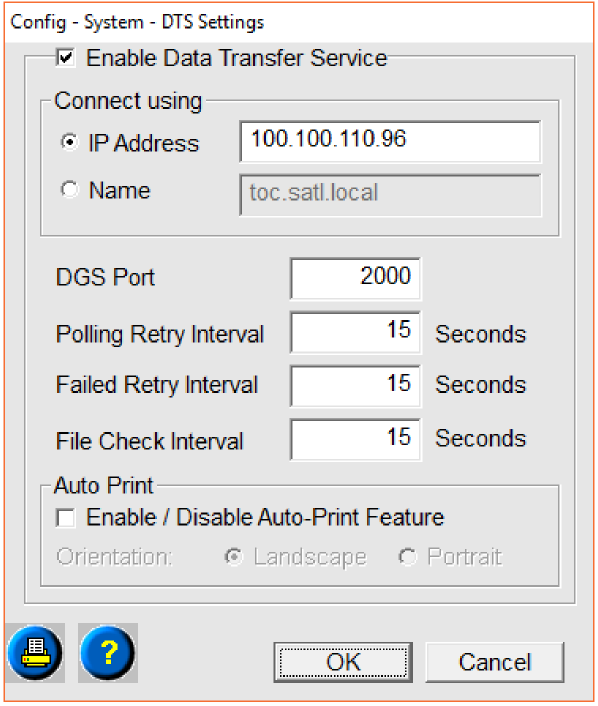


Network Settings

Machine Name: K049732971
○ Obtain an IP address from a DHCP server
● Specify an IP address
IP Address: 100.100.110.100
Gateway: 0.0.0.0
Subnet: 255.0.0.0

Name Servers
WINS Address: 0.0.0.0
DNS Address: 0.0.0.0

Port Settings
Command Response: 2001
Lifeline Listener: 2002



Config - System - DTS Settings

☑ Enable Data Transfer Service

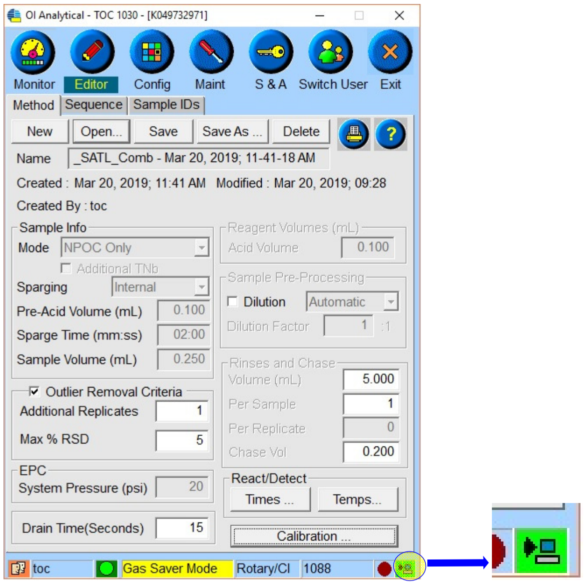
Connect using
● IP Address: 100.100.110.96
○ Name: toc.satl.local

DGS Port: 2000
Polling Retry Interval: 15 Seconds
Failed Retry Interval: 15 Seconds
File Check Interval: 15 Seconds

Auto Print
☐ Enable / Disable Auto-Print Feature
Orientation: ● Landscape ○ Portrait

APPENDIX D

PC – TOC Instrument Connectivity troubleshooting – The TOC Data Gathering Service (DGS) must be enabled and running on the instrument and the PC for the data to be available on the PC. The picture below indicates a green icon with an arrow pointing toward the PC. If this is not seen then the system is not connected to the PC and therefore no data will be available to review or print on the PC. The data will only be available on the instrument hard drive and cannot be downloaded. This icon below indicates that the instrument is connected and ready to send data to the PC system.



Name _SATL_Comb - Mar 20, 2019; 11-41-18 AM
Created : Mar 20, 2019; 11:41 AM Modified : Mar 20, 2019; 09:28
Created By : toc

Sample Info
Mode NPOC Only
☐ Additional TNb
Sparging Internal
Pre-Acid Volume (mL) 0.100
Sparge Time (mm:ss) 02:00
Sample Volume (mL) 0.250

☑ Outlier Removal Criteria
Additional Replicates 1
Max % RSD 5

EPC
System Pressure (psi) 20

Drain Time(Seconds) 15

Reagent Volumes (mL)
Acid Volume 0.100

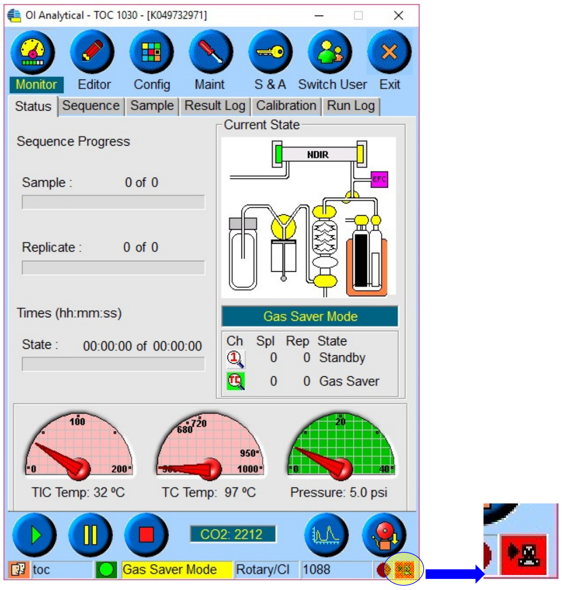
Sample Pre-Processing
☐ Dilution Automatic
Dilution Factor 1 :1

Rinses and Chase
Volume (mL) 5.000
Per Sample 1
Per Replicate 0
Chase Vol 0.200

toc | Gas Saver Mode | Rotary/CI | 1088

Proper Connection

The following two scenarios indicate that there is nonconnectivity



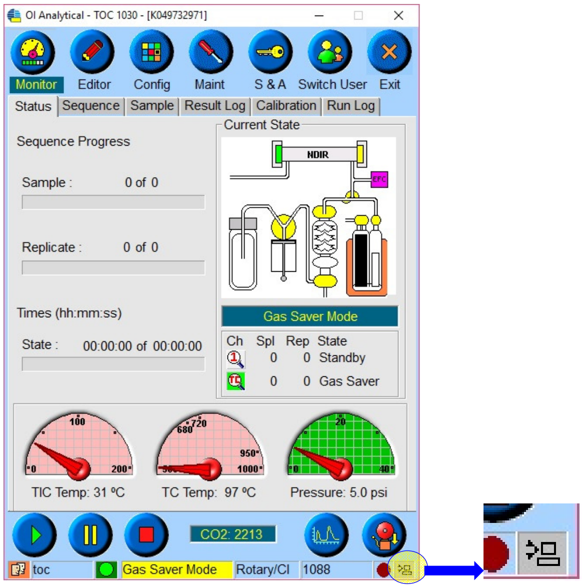
Sequence Progress
Sample : 0 of 0
Replicate : 0 of 0
Times (hh:mm:ss)
State : 00:00:00 of 00:00:00

Gas Saver Mode

Ch	Spl	Rep	State
①	0	0	Standby
TC	0	0	Gas Saver

TIC Temp: 32 °C
TC Temp: 97 °C
Pressure: 5.0 psi
CO2: 2212

toc | Gas Saver Mode | Rotary/CI | 1088



Sequence Progress
Sample : 0 of 0
Replicate : 0 of 0
Times (hh:mm:ss)
State : 00:00:00 of 00:00:00

Gas Saver Mode

Ch	Spl	Rep	State
①	0	0	Standby
TC	0	0	Gas Saver

TIC Temp: 31 °C
TC Temp: 97 °C
Pressure: 5.0 psi
CO2: 2213

toc | Gas Saver Mode | Rotary/CI | 1088

DGS enabled but not connected.

DGS disabled, no connection exists, no data gathered

If this is the case, to connect to the instrument do the following to connect the instrument to the PC prior to beginning the sequence.

- Click on Windows Start button
- Type “Services” in the windows search bar
- This will open the – Services Window
- Scroll down the items and locate – “TOCDatagatheringService” and ensure this service is running. If it is stopped, click the “start” button to initiate the service.
- Exit the “Services” by closing the window.
- Return to the TOC instrument control screen
- The PC icon should turn green and ready to acquire and download data.
- Sometimes it may be necessary to restart the computer and/or the instrument or both to establish the connection.

MUNICIPAL SOLID WASTE PERMIT
MAJOR AMENDMENT

PART III-ATTACHMENT G
LANDFILL GAS MANAGEMENT PLAN

BECK
COMPANIES

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848A

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: September 2022
Revision2-January 2023

Prepared by:

CEC
Civil & Environmental Consultants, Inc.

Texas Registration Number F-38
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Building 1 Suite 550,
Austin, Texas 78746
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STATE OF TEXAS
ADAM W. MEHEVEC
84736
LICENSED
PROFESSIONAL ENGINEER
1-2-2023

Contents

30 TAC§§330.159, 330.125, 330.371

List of Appendices

APPENDIX G-A
Gas Probe Installation Report

ADAM W. MEHEVEC
84736

1-2-2023

1.0 Introduction

30 TAC§§330.159, 330.125, 330.371

The site manager is responsible for executing the Landfill Gas Management Plan in order to ensure that the concentration of methane gas generated by the facility does not exceed 1.25% by volume in facility structures (excluding gas control or recovery system components, if any), and the concentration of methane gas does not exceed 5% by volume in monitoring points, probes, subsurface soils, or other matrices at the facility boundary defined by the legal description in the permit.

Type and Frequency of Monitoring

Beck LF determined the type and frequency of monitoring based upon the factors described herein.

Soil Conditions: Within the LF perimeter flood control dike and along Lines D, E, F, G, and the northeastern side of A, the dominant soil type is mapped as Sunev loam, 0 to 1 percent slopes. This well drained soil may be up to 72 inches deep, comprised of up to 70% calcium carbonate, and is defined as Hydrologic Soil Group B. Along the northwestern side of Line A, the dominant soils type is the Barbarosa silty clay (0 to 1 percent slopes). This well drained soil may be up to 72 inches deep, comprised of clayey alluvium, and is defined as Hydrologic Soil Group C. Along Lines B and C, the dominant soil type is the Bosque and Seguin soils, frequently flooded. This well drained soil is typical of floodplains and may be up to 62 inches deep, comprised of up to 20% calcium carbonate, and defined as Hydrologic Soil Group B. These soils are not hydric.

Hydraulic and Hydrologic Conditions: The Landfill is constructed within an oxbow of the Cibolo Creek. The floor of the landfill is keyed into the Taylor-Navarro Shale, a clay formation that acts as a natural, impermeable liner. The landfill is enclosed by a slurry trench within a compacted clay embankment. The embankment and slurry trench were designed to isolate the landfill from communication with shallow, perched groundwater associated with the surrounding Cibolo Creek.

Location of Facility Structures and Property Boundaries: There are only three, permanent, enclosed structures within the facility boundary: the readymix plant office located approximately

885 feet from the toe of the embankment; the scalehouse located approximately 610 feet from the toe of the embankment, and an uninhabited house located approximately 1,030 feet from the perimeter embankment. These structures are shown on Figure D1-1 in Attachment D. All other structures at the facility are temporary. Monitoring of these enclosed structures is not proposed at this time. If the concentration of methane in the landfill gas monitoring probes approaches the LEL monitoring of these enclosed structures will be considered.

Utility Lines and Pipelines: There are two utility lines that approximately parallel the northwest side of the landfill (along Lines B and C). One is an old wastewater line, constructed of clay pipe, the other is a cast-iron water line. The clay pipe wastewater line is approximately 75 feet northwest of the toe of the flood-control dike along which the landfill gas monitoring probes will be installed. The water line is about 150 to 200 feet northwest of the toe of the flood control dike. The exact locations of these utility lines are unknown, even to the City of Schertz. Neither landfill gas monitoring probes nor vents along the utility lines are proposed at this time. These will be considered only if the concentration of methane in the landfill gas monitoring probes approaches the LEL.

2.0 Landfill Gas Management Plan

Introduction

This Landfill Gas Management Plan ("Plan") has been developed for the Beck Landfill, a Type IV landfill in Schertz, Texas, as required by 30 Tex. Admin. Code (TAC) §330.63(g). This Plan addresses the requirements set forth in 30 TAC §330.371. The Plan describes the proposed system, including installation procedures, monitoring procedures, and procedures to assess the need for maintenance, repair, or replacement; and backup plans to be used if the monitoring system becomes ineffective or must be expanded. This Plan also outlines notification procedures and possible remediation activities, if required.

The requirements of this landfill gas management plan will be in effect through the remainder of the operating life of the landfill, landfill closure, and will continue for a period of 5 years after certification of final closure of the facility, unless altered by TCEQ. Any revisions to this plan will be submitted to TCEQ for review and approval. Information may be submitted to the Executive Director, to reduce gas monitoring and control. The information must demonstrate no potential for gas migration beyond the property boundary or into on-site structures. Gas monitoring shall be revised & maintained as needed; post-closure land use shall not interfere with the gas monitoring system and all utility trenches crossing the facility shall be vented & monitored.

Facility Boundary Monitoring Network

Six landfill gas monitoring probes are to be installed along the northwest exterior toe of the flood control dike surrounding the landfill opposite grid markers 5, 10, 15, 20, 25 and 30 (Fig. 8). The nominal spacing between the landfill gas monitoring probes is 500 feet as measured along the top of the flood control dike. The probes will be labeled as MM-1 through MM-6 in the order presented above. A single probe is specified at each location to accommodate the heterogeneity of the alluvial deposits through which landfill gas might migrate,

Gas Monitoring Probe Installation

The landfill gas monitoring probes will be drilled and installed by driller registered in the state of Texas under the supervision of a licensed professional geoscientist or engineer. The borings will be advanced using hollow-stem augers with samples visually classified and logged in accordance with the Unified Soil Classification System (ASTM No. D-2487). If in the opinion of the supervising geologist or engineer, the materials encountered are too impermeable to allow migration of landfill gas emissions, the borings may be moved left or right along the toe of the flood control dike to find more suitable subsurface conditions for potential gas migration through the vadose zone.

The probes (Fig. 9) will be screened with factory fabricated 1/2-inch diameter 0.010 inch Schedule 80 PVC screen from the total depth of the probe, less an end cap, to no less than 4 or 5 feet below the ground surface (Fig 8). A solid Schedule 80 PVC riser will extend upward from the screen to approximately 3 feet above the ground surface capped with a quick-connect device to allow purging and monitoring with the gas monitoring meter. All joints will either be threaded or use compression fittings; no glue or solvent-based welding is permitted.

A 20-40 mix of silica sand or concrete sand (ASTM C-33), as available, will be tremied around the probe screen to a minimum of 6 inches above the top of the screen. Followed by hydrated bentonite pellets to 6 inches below the ground surface. A lockable steel well-head protector will be installed over the riser and a 4-foot by 4-foot by 6-inch thick reinforced concrete pad poured around the steel well-head protector to stabilize and protect the well head. Pea gravel, or the equivalent, will be placed around the riser within the steel well-head protector to stabilize the monitoring probe, and one or more weep holes will be drilled into the bottom of the steel well-head protector to allow drainage of excess moisture. Concrete filled steel bollards will be installed around the surface pad as deemed necessary to provide additional protection to the well-head.

Boring/completion logs for the landfill gas monitoring robes will be prepared, submitted to TCEQ and to the Texas Department of Licensing and Regulation (DLR), and retained in the site operating record.

Installation of landfill gas monitoring probes around the remainder of the landfill is unnecessary. Should any landfill gas penetrate the slurry wall and flood control dike, it would either be discharged to the atmosphere or enter the vadose zone, which terminates at Cibolo Creek. The creek, then, is a barrier to landfill gas migration. Other than on the northwest side of the landfill, there are no structures in which landfill gas could accumulate between the landfill and the creek.

Fig. 8 Proposed locations of landfill gas monitoring probes shown on aerial photo;

BECK LANDFILL MSW Permit #1848
Methane Monitoring Well Locations

Notes

STATE OF TEXAS
Juliana C. Morelli
Geology
10670
LICENSED
PROFESSIONAL GEOSCIENTIST

Vertical Datum: Local
Horizontal Datum: NAD83

This drawing is for illustration only and not for permitting, bidding or construction

BECK COMPANIES

Prepared For:

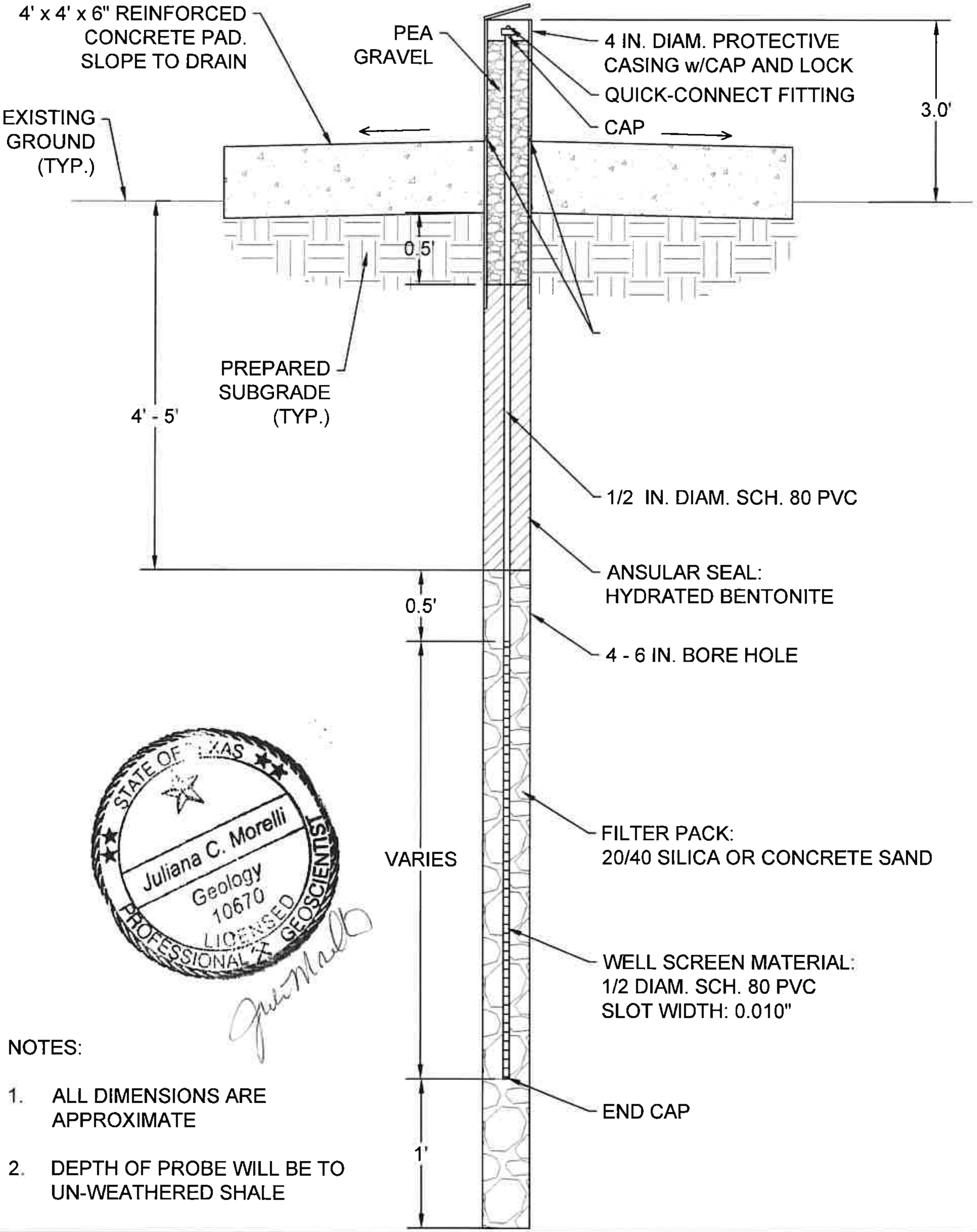
Beck Companies
550 FM 78
Schertz, TX 78154

Landfill Aerial and Grid
Beck Companies - Schertz Landfill
Flight Date: December 5, 2018

FIRMATEK
3D MAPPING SOLUTIONS
www.Firmatek.com 210.651.4990

Fig. 9 [Schematic drawing of landfill gas monitoring probe]

REV1	ISSUE_FOR_CONSTRUCTION	08/20/19	SMT	JCM	JCM	
REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD



Juliana C. Morelli
Geology
10670

NOTES:

1. ALL DIMENSIONS ARE APPROXIMATE
2. DEPTH OF PROBE WILL BE TO UN-WEATHERED SHALE

POSTOAK_GASPROBE.DWG

		DSGN	JCM	08/19/19	
		DRN	SMT	08/19/19	
		CKD	JCM	08/19/19	
		SCALE:	NONE		
N/A	N/A				
REFERENCE DRAWINGS		FOR 8.5x11 DWG ONLY			

POWER ENGINEERS

BECK LANDFILL	JOB NUMBER	REV.
SCHERTZ, GUADALUPE COUNTY, TX	150051	1
PROPOSED LANDFILL GAS WELL DESIGN	DRAWING NUMBER	

3.0 Landfill Gas Monitoring Procedures

The concentration of methane in the landfill gas monitoring probes will be measured on a quarterly basis per calendar year, with two of those monitoring times, to the extent possible, corresponding with sampling of the ground water monitoring wells at the landfill. More frequent monitoring at locations where gas migration is occurring or accumulating. The integrity and labelling of the monitoring probes, including the integrity of the steel, well-head protectors, locks, and concrete pads, will be inspected during or before each monitoring event and repairs or replacement made as needed. Repair or replacement of any landfill gas monitoring probes will be documented and retained in the site operating record. Sampling for specified trace gases, may be required by the executive director when there is a possibility of acute or chronic exposure due to carcinogenic or toxic compounds.

Beck Landfill uses a four-gas monitoring instrument, -- carbon monoxide, hydrogen sulfide, and oxygen in addition to methane and the LEL. This instrument is suitable for surface monitoring and for sampling the landfill gas monitoring probes. Operation of the device should be in accordance with the instrument manual. If at any time the instrument fails, it will be repaired or replaced, TCEQ will be informed in writing, and the repair or replacement noted in the site operating record. Results of all methane monitoring events, including purge volumes, will be retained in the site operating record.

Landfill Gas Monitoring Exceedance Record Keeping and Reporting

Results of landfill gas monitoring will be kept in the site operating record; however, if during any monitoring event, the volumetric methane concentration in any landfill gas monitoring probe or structure exceeds the levels stated in 30TAC§330.371(a) (1.25% in a facility structure or 5% at the facility boundary)., the probe will be resampled within 24-hours, and again within 7 days to confirm the exceedance. Reporting will be in accordance with 30 TAC §330.371(c). Notifications will be as follows:

MSW Permits Section, MC-124
Texas Commission on Environmental Quality
PO Box 13087

Austin, TX 78711-3087
512-239-6784 (O); 512-239-6000 (Fax)

TCEQ Region 13 – San Antonio Waste Section
14250 Judson Road
San Antonio, TX 78233-4480
210-490-3096 (O); 210-545-4329 (Fax)

Guadalupe County EMS at 911

Schertz EMS
1400 Schertz Parkway, Building 7
Schertz, TX
830-619-1400

The records of the concentrations detected and description of steps to be taken to protect human health will be placed in the operating record within 7 days of detection. A plan to address the exceedance will be formulated and implemented, with TCEQ approval, if possible within 60 days. The remediation plan will describe the nature, extent of the problem, and the proposed remedy, the Executive Director may require additional remedial measures. The precise nature of the plan will depend on which probes show exceedances; those opposite near-by residences or those opposite of commercial businesses. The potential remedial actions may include precisely locating the utility trenches to install monitoring probes and/or vents, sampling the nearest residences, and installation of additional gas monitoring probes or vents. An alternative schedule may be implemented by the Executive Director in accordance with 30 TAC §330.371(d).

PART IV

MUNICIPAL SOLID WASTE PERMIT MAJOR AMENDMENT

Part IV Application for Permit Amendment

(TAC Title 30 Rule §330.65))

NAME OF PROJECT: Beck Landfill

MSW PERMIT APPLICATION NO.: 1848AA

OWNER: Nido, LTD (CN603075011)

OPERATOR: Beck Landfill (RN102310968)

CITY, COUNTY: Schertz, Guadalupe County

Major Amendment: September 2022

Prepared by:

PROJECT NUMBER: 150051.05.01

PROJECT CONTACT: Julie Morelli

EMAIL: Julie.Morelli@powereng.com

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1.0 INTRODUCTION

1.1 Introduction (§330.127)

The Beck Landfill Site Operating Plan (SOP), in accordance with 30 TAC §330.127, includes provisions for site management and site operating personnel to meet the general and site- specific requirements of for the day-to-day operation of the Beck Landfill. This SOP will be retained onsite throughout the active life of the Beck Landfill and throughout the post-closure care maintenance period. This SOP also includes provisions for site management and site operating personnel to meet the general and site-specific requirements for the waste acceptance rate established in the SOP.

The operational requirements for Beck Landfill, including the existing Site Development Plan (SDP), Site Operating Plan (SOP), Final Closure Plan, Post-Closure Maintenance Plan (PCMP) and all other documents and plans required by this chapter are defined in the previously approved TCEQ Permit No. 1848A. Additional TCEQ approved revisions and/or required documents shall be incorporated into the operational requirements and shall be considered a part of the operating record of the Beck Landfill.

1.2 General Information

Beck Landfill is an existing Type IV landfill (TCEQ Permit No. MSW-1848A) operated by Beck Landfill, Nido, LTD. (Beck Landfill or BLF). Beck Landfill is a privately owned and operated Type IV landfill that provides Type IV acceptable waste disposal capacity primarily for Guadalupe and Bexar Counties, and surrounding areas. Beck Landfill is located in southwestern Guadalupe County, Texas. The facility is located at 550 FM 78, Schertz, TX 78154, primarily within the south part of the City of Schertz, 1,400 feet southeast of the junction of FM 1518 and FM 78.

1.3 Wastes Authorized for Disposal

Beck Landfill is a Type IV landfill unit and may only accept brush, construction and/or demolition waste (C&D waste), and/or rubbish, as described in 30 TAC §330.5(a)(2).

In accordance with 30 TAC §330.171 (Disposal of Special Wastes) and §330.173 (Disposal of Industrial Wastes) Beck Landfill may also accept special wastes consistent with the limitations of 30 TAC §330.5(a)(2) and the Waste Acceptance Plan required by §330.61(b). Special wastes must be handled in accordance with waste-specific provisions, as described in the Waste Acceptance Plan. Special wastes may include, but are not limited to:

- Non-regulated asbestos-containing materials (non-RACM)
- Soils contaminated by petroleum products ,crude oils, or chemicals in concentrations of greater than 1,500 milligrams per kilogram (mg/kg) total petroleum hydrocarbons; or contaminated by constituents of concern that exceed the concentrations listed in Table 1, §335.521(a)(1) (subject to provisions of 30 TAC §330.171(b)(4))
- Class 2 industrial solid waste
- Class 3 industrial solid waste

1.4 Pre-Operation Notice (§330.123)

Beck Landfill will provide ongoing cell construction notification to the TCEQ MSW Permits Section, in the form of a "30-DAY NOTICE OF CELL COMPLETION" letter. This notification will include a site layout map identifying the area(s) being excavated, along with acknowledgement that the cell has been excavated into the gray shale formation. The notification submittal will be in triplicate (one original and two copies), one copy being sent to the appropriate TCEQ Regional Office. The executive director has 14 days to provide a verbal or written response. If no response has been received by the end of the fourteenth day following the executive director's receipt of the report, the operator may begin placing waste in the new cell areas.

2.0 RECORDKEEPING REQUIREMENTS (30 TAC §330.125)

During the operating life of the landfill, Beck Landfill will maintain a written site operating record (SOR). This record will be retained for the life of the facility including the post-closure care period. The SOR is a complete collection of facility permit documents, designs, operating procedures, monitoring data and waste receipt information as required by 30 TAC §330.125.

2.1 Documents (§330.125(a))

Beck Landfill will maintain the SOR on site. Consistent with §330.125(a), copies of documents that are part of the approved permitting process that are considered part of the SOR are listed in **Table 2-1**.

2.2 Analytical Data (§330.125(b))

Beck Landfill, in accordance with §330.125(b), within seven working days following completion or receipt of analytical data, will record and retain in the SOR those items as listed in **Table 2-1**.

2.3 Notification (§330.125(c))

Beck Landfill, in accordance with §330.125(c), will place the items included in **Table 2-1** into the SOR within the specified time period. Beck Landfill will maintain the SOR in an organized format, where information is easily locatable and retrievable. The SOR will be furnished to the executive director upon request, and will be made available on site for inspection by the authorized TCEQ representatives.

2.4 Record Retention (§330.125(d))

Beck Landfill, in accordance with §330.125(d), will retain all information contained within the SOR and all plans required for the life of the site, including the post-closure care period.

2.5 Personnel Training Records and Licenses (§330.125(e)(f))

In accordance with §330.125(e), Beck Landfill will maintain personnel training records in accordance with §335.586(d) and (e). Personnel training requirements will be consistent with Section 3.1 of this SOP, "Personnel and Training". Personnel training records for current Beck Landfill personnel will be maintained until closure of the site. Records of former employees will be maintained for three years from the date the employee last worked at the Beck Landfill. Records for each personnel will include name, job title, job description, introductory training, continuing training, and documentation of training. In accordance with §330.125(f), the Beck Landfill will maintain personnel operator licenses issued in accordance with Chapter 30,

Subchapter F, relating to Municipal Solid Waste Facility Supervisors. Personnel training records and operator licenses will be maintained in the SOR.

2.6 Annual Waste Acceptance Rate (§330.125(h))

Beck Landfill will maintain, as part of the SOR, documentation of the annual waste acceptance rate for Beck Landfill in accordance with §330.125(h). Records will include maintaining the quarterly solid waste summary reports and the annual solid waste summary report as required by §330.675. The annual waste acceptance rate, as established by the sum of the previous four quarterly summary reports, will be evaluated by Beck Landfill to determine if the waste acceptance rate exceeds the rate estimated in the approved permit and SDP. Should an increase in waste acceptance be established, the Beck Landfill will determine if the increase is due to a temporary occurrence. Should the waste acceptance rate exceed that established in the approved permit, a permit modification will be prepared in accordance with the current applicable TCEQ regulations to propose changes, if required, to manage the increased waste acceptance rate.

Beck Landfill anticipates that the site's waste acceptance rate will increase during the life of the site. Based on the volumes submitted for inclusion in the Beck Landfill TCEQ "FY 2011 MSW Annual Report", Beck Landfill accepted 182,267 tons for FY 2011.

This SOP includes variable provisions to manage the increased waste acceptance rate to protect public health and the environment.

3.0 PERSONNEL AND TRAINING (30 TAC §330.127)

Beck Landfill will provide on-site management of the landfill operations. The level of employment at the landfill will be determined by the waste acceptance volume, and shall be sufficient to comply with the requirements of the site-operating plan and with the provisions of the site permit.

3.1 Personnel (§330.127(1))

Beck Landfill will be staffed with qualified individuals experienced with municipal solid waste disposal operations and/or earthmoving construction projects. See Table 3.1,which outlines landfill staffing levels.

3.1.1 Landfill Facility Manager (LFM)

The LFM is the individual having managerial oversight of the landfill and is responsible for management of the entire site. The LFM is responsible for assuring that adequate personnel and equipment are available to provide for site operations in accordance with SDP, SOP, and TCEQ regulations. The LFM will, at a minimum, have a high school diploma or equivalent, experience in municipal solid waste disposal operations.

Table 3.1
Landfill Staffing Levels

Table 3.1
Landfill Staffing Levels

Landfill Position	Min #	Max #
Landfill Facility Manager (LFM)	1	1
Landfill Supervisor (LS)	1	1
Equipment Operators	3	5
Gate Attendants	1	2
Landfill Spotters	2	5
Other Personnel (laborers)	1	3

3.1.2 Landfill Supervisor (LS)

Under the general direction of the LFM, the Landfill Supervisor (LS), is responsible for daily operations, site personnel, administration of the SOP, and will also serve as the emergency coordinator. The LS may designate other personnel to assist with the daily site operating requirements. The LS will designate an individual to fulfill his duties in the event that they are unavailable during waste acceptance hours. When the LS is unavailable during waste acceptance hours, the LS's designee will have the same basic on-site training as required for the LS. The LS and his alternate, at a minimum, will have experience in earthmoving operations, and experience in municipal solid waste disposal operations. The LS and his alternate will obtain and maintain a license consistent with the requirements of §§30.201, 30.207, 30.210, and 30.212.

3.1.3 Equipment Operators

Equipment operators are responsible for the safe operation of their equipment, and depending on their job responsibility, may be trained to recognize unauthorized waste. Equipment operators, when necessary, will monitor and direct the unloading of vehicles, and they may also perform random load inspections, general site maintenance, construction, litter abatement, and general site cleanup. Equipment operators will participate as necessary to prevent accidents and report unsafe conditions to the LS.

At a minimum, all applicable equipment operators shall be qualified to safely and effectively operate equipment normally operated at Type IV landfills, have the ability to be trained to operate other heavy equipment on-site, and have the ability to receive and comprehend on the job training in landfill operations, health and safety, and waste identification.

3.1.4 Gate Attendants

Gate attendant(s) stationed at the gatehouse, under the direction of the LS, are primarily responsible for maintaining records of vehicles and solid waste entering the landfill. Gate attendants will be trained in site safety procedures, to visually check for unauthorized wastes, to determine waste volumes, and to collect disposal fees. A gate attendant will be present during hours that the landfill is open to the public. Gate attendants will report to the Landfill Supervisor, and at a minimum, will have a basic understanding of landfill related accounting principles, and communication skills.

3.1.5 Landfill Spotters

Landfill Spotters may be employed at the landfill working face. These personnel shall responsible for the directing of trucks backing up for unloading. The spotters will also be responsible for visually screening each load as it is unloaded. In the event that unauthorized or prohibited waste is observed, procedures outlined in section 5.0 of this SOP will be followed by applicable site personnel.

3.1.6 Other Personnel

Other site personnel and/or laborer(s) may be employed from time to time in other categories such as maintenance, construction, litter abatement, and general site cleanup. These personnel must have appropriate training for the tasks to which they are assigned. Site personnel may be permanent, part-time or temporary employees.

3.2 Training (§330.127(4))

Beck Landfill personnel will be trained consistent with the applicable training requirements as defined in §335.586(a) and (c). Personnel will receive training through a combination of on-the- job training, company-provided training and classroom instruction as necessary. The training program will be directed by a person trained in waste management procedures and will include instruction that teaches facility personnel waste management procedures, including contingency plan implementation, relevant to the position(s) in which they are employed.

At a minimum, the training program will be designed to ensure that personnel are able to respond effectively to emergencies by familiarizing site personnel with emergency procedures, emergency equipment, and emergency systems.

Facility personnel must successfully complete the program required within six months after the date of their employment or assignment to a new position at the facility, whichever is later. Employees must not work in unsupervised positions until they have completed the training requirements.

Beck Landfill will ensure that facility personnel take part in an annual review of the initial training as required.

4.0 EQUIPMENT (§330.127)(2)

Sufficient equipment will be provided to conduct site operations in accordance with the site design and permit conditions. Equipment requirements may vary in accordance with landfill operations and/or the waste acceptance rate at any given time. Other equivalent types of equipment may be substituted on an as-needed basis. A description, including the minimum number, size, type, and function, of the equipment to be utilized at the facility based on the estimated waste acceptance rate and other operational requirement is listed in Table 4.1. Provisions for back-up equipment during periods of breakdown or maintenance of equipment listed in Table 4.1 include the onsite availability of a comparable or alternately acceptable piece of equipment to ensure the continuation of site operations in accordance with permit conditions. As a back-up provision, in the case that such equipment is not readily available, appropriate equipment will be rented until such a time that company owned or leased equipment is available.

5.0 DETECTION AND PREVENTION OF DISPOSAL OF PROHIBITED WASTES (30 TAC §330.127(5))

5.1 General Procedures

Beck Landfill, in accordance with 30 TAC §330.127(5), has established procedures for the detection and prevention of the disposal of unauthorized or prohibited wastes, including regulated hazardous waste, and polychlorinated biphenyls (PCB) wastes. The detection and prevention program will include training of site personnel to recognize and reject prohibited wastes, how to perform a random inspection, how to control site access, what training will be provided for site personnel, and what procedures are required in the event of identification of prohibited wastes.

Table 4.1
Landfill Equipment List

Table 4.1
Beck Landfill Equipment List

Equipment Description	Number of Units per		Equipment Size	Equipment Function
	≤ 1.5 million cubic yards/yr	> 1.5 million cubic yards/yr		
Landfill Compactor	1	2	Minimum weight of 50,000 pounds	Waste compaction and fire protection
Bulldozer	1	1	Caterpillar D6 or Equivalent	Waste spreading, waste compaction, cover soil spreading, slope maintenance and fire protection
Excavator	1	1	Minimum weight of 20,000 pounds	Cover soil excavation, cell excavation construction and fire protection
Front End Loader	1	2	John Deere 544 Equivalent or Larger	Loading of soil, fire protection, retrieval of recyclable materials and removal of non-conforming wastes from working face, road maintenance
Dump Truck	1	2	Minimum heaped capacity of 10 cubic yards	Hauling of cover soil, Hauling of excavated cell materials and fire protection
Motor Grader/Maintainer	1	1	Minimum weight of 10,000 pounds	Site road maintenance, slope maintenace
Water Pump	1	1	4" or 6" Pump	Removal of below grade stormwater and perched groundwater
Water Truck	1	1	Minimum 1500-gallon tank capacity	Site maintenance, dust control, and fire protection
Sweeper	1	1	Minimum 4-ft broom width	Site maintenance, hard surface sweeping, dust and mud control

The detection and prevention program includes the following steps:

- Observation of each load that is disposed of at the active face.
- Random inspections of incoming loads.
- Records of inspections.
- Training for appropriate landfill personnel to recognize unauthorized, prohibited waste, regulated hazardous waste, and PCB waste.
- Notification to the TCEQ Executive Director of any incident involving the receipt or disposal of regulated hazardous waste or PCB waste.
- Provisions for remediation of the incident in accordance with applicable regulations.
- Signs prohibiting the receipt of unauthorized and prohibited wastes including hazardous waste and PCB waste will be posted on-site.
- Informing waste haulers of wastes unauthorized and/or prohibited for acceptance and disposal at the site.

5.2 Load Inspection at the Active Face (§330.127(5)(A))

Loads at the active working face of the landfill will be directed by a trained landfill spotter or equipment operator. These personnel will visually inspect waste as it is unloaded from vehicles. Should any indication of unauthorized and/or prohibited waste be detected, appropriate landfill personnel will stop the unloading of the vehicle to allow for a thorough inspection of the load. The driver will be directed to a load inspection area located near the working face, where the load will be discharged from the vehicle. The load inspector will break up the waste pile and inspect the material for any unauthorized, prohibited and/or regulated hazardous waste.

5.3 Random Inspections (§330.127(5)(A))

Beck Landfill will perform documented random inspections as required by §330.127(5)(A) on a minimum of 1% of incoming loads. Loads selected for random inspections will be directed to a specified area close to but separate from the active waste disposal area. The load will be inspected by the Landfill Supervisor and/or qualified landfill personnel. The random load inspector(s) will manually and visually inspect the load and take appropriate action(s) based on the inspection findings. Conforming loads that have been randomly inspected will be sent for final disposal at the landfill active face. In the event that non-conforming materials are discovered during the random inspection, those materials will be properly and safely segregated and handled appropriately as detailed in section 5.7 of the SOP. The random inspection will be documented on a Random Inspection Form as specified in Figure 5-1.

5.4 Recordkeeping (§330.127(5)(B))

The LS is required to maintain and include in the SOR the following:

- Load inspection reports
- Records of regulated hazardous or PCB waste notifications
- Personnel training records

Load inspection reports will be completed for each inspected load. The reports will include at a minimum, the date and time of inspection, the name and address of the hauling company, driver name, the type of vehicle, the size and source of the load, contents of the load, indicators of unauthorized and/or prohibited waste, and results of the inspection.

5.5 Training (§330.127(5)(C))

The LFM, LS, equipment operators, and gate attendants will maintain a thorough understanding of waste screening procedures and will be trained as necessary in the following areas:

- Load inspection procedures
- Identification of unauthorized, prohibited and regulated hazardous and/or PCB wastes
- Waste handling procedures
- Health and safety procedures
- Recordkeeping

Documentation of this training will be placed in the SOR.

5.6 Notification (§330.127(5)(D))

TCEQ notification is required if regulated hazardous waste or PCB waste is received or disposed of in the landfill. When notification is required, records of the notifications will be kept in the SOR and will include the date and time of notification, the individual contacted, and the information reported.

5.7 Managing Prohibited Wastes (§330.127(5)(E))

Unauthorized and/or prohibited waste detected during inspections will be returned immediately to the waste hauler. If the waste hauler is not available, the prohibited waste will be stored in such a manner to protect human health and the environment until provisions for proper removal can be arranged.

In the event that regulated hazardous or PCB wastes are detected, the TCEQ will be notified and as soon as is practical, the hauler will be required to properly contain and remove the hazardous or PCB waste from the site.

In the case of putrescible waste being detected, the putrescible waste may either be returned to the waste hauler at time of unloading or if hauler is unavailable, the putrescible waste may be temporarily managed in an appropriate Type I waste container onsite Putrescible waste will not be disposed of onsite and will be removed from the facility and disposed of at a facility authorized to accept such waste within 24 hours.

5.8 Special Procedures for Waste in Enclosed Containers or Enclosed Vehicles

As indicated in 30 TAC §330.169, stationary compactors permitted in accordance with 30 TAC §330.7 and municipal transporter routes permitted in accordance with 30 TAC §330.103 are exempt from the requirements identified in 30 TAC §330.169(1)-(3) and transporters will be allowed to discharge waste from these stationary compactors at the Beck Landfill. However, the landfill will obtain, from the transporter, load documentation for a municipal transporter route or a stationary compactor, as appropriate, prior to allowing discharge of the waste at the landfill. The load documentation will be maintained as a part of the SOR.

Other waste received in enclosed containers or enclosed vehicles will only be accepted per provisions identified in 30 TAC §330.169(1)-(3).

6.0 SITE SAFETY (30 TAC §330.127(6))

6.1 General Site Safety

Site safety will be promoted by properly trained personnel using well-maintained equipment to perform standard work procedures. Site safety will be enhanced by limiting access to the active areas only to authorized personnel. In the event of an emergency, planned emergency response procedures will be followed.

All site personnel will receive site-specific training consisting, but not limited to, the following:

- Safe work practices
- Nature of anticipated hazards
- Equipment and vehicle safety
- Site access controls
- Hazardous material identification and communication
- Fire safety
- Emergency response
- Employee rights and responsibilities

A record of training will be maintained in each employee's personnel file to confirm that each employee has received the proper training.

In the event of an emergency, site personnel will assess the situation, notify the LS or designated supervisor, and take appropriate actions. Emergency numbers will be posted in the landfill gatehouse as indicated below.

Emergency Numbers

Office	Phone
Ambulance	911or 210-619-1400
Schertz Fire Department	911 or 210-619-1300
Schertz Police Department	911 or 210-619-1200
Guadalupe County Sheriff's Office	911 or 830-379-1224

6.2 Preparedness and Prevention Measures

Preparedness and prevention measures have been developed to minimize both frequency and severity of accidents and emergency situations. These measures depend on the attentiveness and state of readiness of site personnel. Preparedness and prevention measures have been developed for one general category and two specific areas of the site: the gatehouse and the onsite access routes. These preparedness and prevention measures are detailed in the following sections.

6.2.1 General

General preparedness and prevention measures that will be followed shall include:

- Employee breaks or rest periods will be provided to minimize fatigue, improve alertness, and thereby reduce accident potential.
- Access controls will provide for the safety of non-landfill personnel.
- Routine preventive maintenance of equipment will be provided.
- Daily and weekly site inspections of the working areas will be performed by the Landfill Supervisor or designated employee.
- Appropriate personal protection equipment (PPE) will be kept onsite and maintained in good repair.
- Adequate turning area for hauling vehicles will be provided.
- Scavenging and unauthorized salvaging will not be allowed.
- Waste unloading will be restricted to designated areas only.
- Site personnel will be alert for possible hazardous or other unauthorized wastes.
- Unauthorized and/or prohibited wastes will be controlled or contained and removed as necessary.

6.2.2 Gatehouse

Preventative measures that will be followed in the gatehouse include the following:

- Verbally and/or visually screen all incoming waste loads for unauthorized wastes.
- Monitor to see that all incoming wastes loads are adequately covered, or otherwise protected or contained.
- Visually observe incoming vehicles for evidence of improper operation, faulty equipment, or other conditions that could be hazardous to personnel or other persons onsite.
- Maintain access to appropriate emergency equipment and first-aid materials.
- Display signs warning transporters that wastes including regulated hazardous wastes and other non-allowable wastes are prohibited.

6.2.3 Landfill Entrance Road, Haul Road, and Access Road

Landfill haul road and access road preventative measures include the following:

- Display speed limit, directional, and other precautionary signs.

- Provide road passable for two-way traffic.
- Maintain roadway free from obstructions.

7.0 FIRE PROTECTION PLAN (30 TAC §330.129)

A Fire Protection Plan (FPP) shall be established and followed as shown in the following subsections.

7.1 Fire Prevention Procedures

The following steps will be taken regularly by designated landfill personnel to prevent fires:

- Open burning of waste is prohibited at all times.
- Burning waste from incoming waste loads will be prevented from being dumped in the active area of the landfill. The gate attendant and equipment operators will be alert for signs of burning waste such as smoke, steam, or heat being released from incoming waste loads.
- Fuel spills will be contained and cleaned up immediately.
- Landfill equipment will not remain directly on the active working face of the site overnight.
- Dead trees, brush, or vegetation adjacent to the active waste disposal area will be removed, and grass and weeds managed so that forest, grass, or brush fires cannot easily spread to the landfill.
- Smoking is not allowed on the active areas of the landfill.
- Waste material will be properly compacted and covered with compacted earthen material.

The site will be equipped with fire extinguishers of a type, size, location, and number as recommended by the local fire department. Each fire extinguisher will be fully-charged and ready for use at all times. Each extinguisher will be inspected on an annual basis and recharged as necessary. These inspections will be performed by a qualified service company, and all extinguishers will display a current inspection tag. Inspection and recharging will be performed following each use. At a minimum, the gatehouse, equipment and maintenance area, and all landfill equipment and vehicles will be equipped with fire extinguishers.

A soil stockpile and site equipment (e.g., front-end loaders, haul trucks, excavators) will be maintained at all times to extinguish an onsite fire. A soil stockpile will be provided within 1,000 feet of the active working face and any other areas actively receiving materials for disposal, processing, temporary storage or recycling. Loaders and haul trucks will be used together to deliver sufficient soil to extinguish the file. The stockpile(s) of earthen material available will be sized to cover the working face with a minimum six-inch layer of earthen material within one hour as shown in table 7-1.

The Fire Suppression Calculations below are based upon the use of: Two (2)

five cubic yard loaders = 10 cubic yards transfer capacity
15 cubic yard haul truck and 25 cubic yard haul truck = 35 cubic yards haul capacity

Table 7-1 – Fire Suppression Soil Requirements

Length (feet)	Height (feet)	Depth (feet)	Volume of Soil (cubic yards (CY))
100	**50**	**0.5**	**93**
150	**100**	**0.5**	**278**
200	**150**	**0.5**	**556**

Response Time Calculation Scenarios Assumptions: Front
End Loader Capacity is 10 CY Haul Truck
Capacity is 35 CY
Haul Truck Speed is 10 MPH
Distance to soil stockpile is 1,000 feet (0.19 miles) Load time
for trucks is 2 minutes

Therefore:
Travel time = 0.19 miles / 10 miles per hour = 1.14 minutes per load (one way)
= 1.14 minutes round trip + 2 minute load time = 3.14 minutes per load
93 CY / 35 CY/Load = 2.7 Loads x 3.14 minutes = 8.3 minutes
278 CY/35 CY/Load = 7.9 Loads x 3.14 minutes = 24.7 minutes
556 CY/35 CY/Load = 15.9 Loads x 3.14 minutes =49.9 minutes

7.2 Specific Fire-Fighting Procedures

The following procedures will be followed in the event of a fire:

If a fire occurs on a vehicle or piece of equipment, the equipment operator should bring the vehicle or equipment to a safe stop. If safety of personnel will allow, the vehicle must be parked away from fuel supplies, uncovered solid wastes, and other vehicles. The engine should be shut off and the brake engaged to prevent movement of the vehicle or piece of equipment. Fire extinguishers should be used to extinguish fire, if possible, without undue risk to the equipment operator.

If a fire is in the working face, the working face should immediately be covered with earthen material from the stockpile to smother the fire.

Firefighting methods include smothering with soil, separating burning material from other waste, and spraying with water from the water truck or water pumped from nearby water sources. If detected soon enough, a small fire may be fought with a hand-held fire extinguisher. A fire extinguisher will be located at the gatehouse and on each piece of equipment.

7.3 General Rules for Fires

The following rules will be implemented in the event of a fire at Beck Landfill:

- Contact the City of Schertz Fire Department by calling 911.
- Immediately contact the gatehouse and LS.
- Equipment operators will be equipped with two-way radios or cell phones.
- Alert other site personnel.
- Assess extent of fire, possibilities for the fire to spread, and alternatives for extinguishing the fire.
- If it appears that the fire can be safely fought with available fire fighting devices until arrival of the Fire Department, attempt to contain or extinguish the fire.

- Upon arrival of Fire Department personnel, direct them to the fire and provide assistance as appropriate.
- Do not attempt to fight the fire alone.
- Do not attempt to fight the fire without adequate personal protective equipment.
- Be familiar with the use and limitations of firefighting equipment available onsite.

7.4 Fire Protection Training

Landfill personnel will be trained in the contents of the FPP. The following topics will be addressed:

- Fire prevention
- Fire safety
- Fire fighting procedures

7.5 TCEQ Notification

Beck Landfill will make every reasonable effort to contact the TCEQ regional office immediately upon detection of a fire, if the fire is not extinguished within ten minutes of detection. At a minimum, the TCEQ regional office will be contacted no later than four hours by phone, and in writing within 14 days of the fire. The notification will include a description of the fire and resulting response.

8.0 OPERATIONAL PROCEDURES (30 TAC §330.127(3))

8.1 Access Control (§330.131)

Various measures are in place to control access to the Beck Landfill and other operations located within the facility boundary. Access controls are designed to prevent unauthorized access to operational areas in an effort to protect human health and safety and the environment. Additionally, site security measures are in place in an effort to reduce vandalism or disruption of Beck Landfill operations caused by unauthorized site entry.

Public access to the landfill is permitted via a gated entrance from Farm to Market Road (FM) 78. This gate will remain closed and locked when the facility is closed for business. Chain link fencing is installed parallel to FM 78. The Beck Landfill direct entrance is located approximately 630 feet southeast of FM 78, south of the co-located ready mix concrete facility. A scale and office are positioned such that all traffic entering and exiting the Beck Landfill can be monitored by site personnel.

No other public roadway intersects the Beck Landfill facility boundary. The operational areas of the landfill are located approximately 1,230 feet south of FM78. The site is surrounded by Cibolo Creek to the southwest and south. Zuehl Road parallels Line A of the landfill perimeter. Barbed wire fencing, expanded metal fencing and debris screens provide limited access controls from Zuehl Road to the northwest of the operational area. Barbed wire fencing is also currently installed around the entire perimeter of the active areas of the Beck Landfill.

8.1.1 Site Security

Unauthorized entry into the site is minimized by controlling access to the landfill site with perimeter fencing and a lockable steel security gate at the entrance.

Entrance to the landfill is monitored by a gatehouse attendant during site operating hours. Outside of normal operating hours, the site access gate will be locked and/or monitored by onsite personnel. Security cameras are installed to record vehicle traffic at the scalehouse.

Entry to the active disposal area of the site is restricted to designated personnel, approved waste haulers, and properly identified persons whose entry is authorized by appropriate site personnel. Visitors may be allowed in active areas only when accompanied by a site representative.

8.1.2 Traffic Control

Public access to the landfill site is provided via the main public entrance road from FM 78. Signs are located along the entrance road, directing traffic to the gatehouse. The gate attendant will restrict site access to authorized vehicles and direct vehicles appropriately. To minimize incoming landfill traffic from queuing on FM 78, landfill personnel may direct traffic to form multiple lines upon entering the main access gate, prior to ticket processing at the gatehouse.

Authorized waste haulers will be directed to the appropriate waste disposal area by signs located along the designated landfill haul road and/or access road. Authorized waste transporters will deposit their loads as directed and depart the site via the main site entrance/exit road. Site personnel will provide traffic directions as necessary to facilitate safe movement of vehicles.

Roads not being used for access to disposal areas will be blocked or otherwise marked for no entry.

8.1.3 Inspection and Maintenance Schedule

The LFM and the LS conduct daily perimeter inspections along the perimeter of the operational areas of the Beck Landfill. Maintenance is conducted, as necessary, to ensure the effectiveness of perimeter controls.

8.1.4 Access Breach

Breaches to perimeter fencing or road barricades will be repaired as soon as practicable. Temporary repairs will be installed within 24 hours of detection. If a permanent repair can not be completed within 8 hours, the TCEQ Region 13 office (and any local pollution agency with jurisdiction that has requested notification) will be notified and a timeline for corrective action proposed. Permanent repairs that can be completed within 8 hours of detection do not need to be reported to the TCEQ Region 13 office.

8.2 Unloading of Waste (§330.133)

Trained personnel will monitor the incoming waste on the trucks at the gatehouse, prior to unloading. A trained staff person shall also be on duty during operating hours at each area where waste is being unloaded to direct and observe the unloading of solid waste. These personnel will be familiar with the rules and regulations governing the various types of waste that can or cannot be accepted for disposal.

The unloading of waste in unauthorized areas is prohibited. Waste unloading will be controlled to prevent disposal in locations other than those specified by site management. Any otherwise acceptable waste deposited in an unauthorized area will be promptly removed and properly disposed of at the working face. Signs with directional arrows and portable traffic barricades will help to restrict traffic to designated disposal locations.

Written procedures for the unloading of waste, in accordance with 30 TAC §330.133(f), will be retained onsite and made available for review by the executive director.

Refer to Section 5.0 of this SOP, "Detection and Prevention of Disposal of Prohibited Wastes" for additional waste handling procedures. The owner or operator is not required to accept any solid waste that the owner or operator determines will cause or may cause problems in maintaining full and continuous compliance with these sections.

8.2.1 Landfill Working Face (§330.133)

The unloading of solid waste shall be confined to as small an area as practical. The active landfill working face will be confined to an area consistent with the rate of incoming waste, while allowing for safe and efficient operation. The active landfill working face will be maintained not to exceed a maximum size of 150 feet by 150 feet.

8.2.2 Other Possible Unloading Areas

Designated Wet Weather Area
Designated Public Drop Off Area
Designated Asphalt Shingle Recycling Area
Designated C&D Recycling Area Designated
Wood Recycling Area

8.2.3 Transporter Requirements (§330.133(h))

As a requirement, it is the responsibility of all transporters to secure all incoming loads to prevent to occurrence of windblown wastes and to provide properly executed documentation, as necessary, for all incoming loads. This documentation includes, but is not limited to the following;

- Manifests for authorized Special Wastes
- Manifests for Non-Regulated Asbestos Containing Materials.
- Permits for enclosed containers

Penalties may, at the discretion of the operator, be imposed in the event transporters do not meet these requirements.

8.3 Hours of Operation (§330.135)

The waste acceptance hours for Beck Landfill will be from 7:00 a.m. to 7:00 p.m., Monday through Friday and 7:00am to 12:00pm on Saturday. The site is closed to the public on Sunday. Beck Landfill will post the authorized waste acceptance hours on the site sign as specified in §330.137.

There is no individual hourly limitation on conducting waste acceptance, filling, construction, earthmoving, or other activities that take place within the landfill waste acceptance hours. Operations separate from actual waste acceptance activity may be conducted as necessary except for between the hours of 9:00pm and 5:00am, seven days a week.

As allowed in 30 TAC §330.135(c), temporary waste acceptance hours may be established for emergencies at the executive directors discretion. In the event of temporary waste acceptance hours are established, adequate records will be maintained per the requirements of 30 TAC §330.135(d)

Alternate operating hours for special occasions, special purpose events, holidays, or other special occurrences may be designated (up to five days per year).

8.4 Site Sign (§330.137)

A sign will be displayed at the gated entrance to the site. This sign will measure at least 4 feet by 4 feet, and have lettering of at least 3 inches in height. The sign will state the name of the site, type of site, hours and days of operation, and the TCEQ permit number. An emergency 24-hour contact phone number and the local emergency fire department phone number will also be included. The emergency contact phone number will reach an individual with the authority to obligate the Beck Landfill at all times the landfill is closed. The site sign will be readable from the site's main entrance.

Signs prohibiting receipt of prohibited wastes including putrescible waste, hazardous waste and PCB waste, closed drums, smoking, and un-tarped loads will be posted at the gatehouse.

8.5 Control of Windblown Solid Waste and Litter (§330.139)

The site will be operated in such a way as to minimize windblown material. The working face will be maintained and operated in a manner to control windblown solid waste. Windblown material and litter will be collected and properly managed to control unhealthy, unsafe, or unsightly conditions by the following methods:

- Waste transportation vehicles using this Beck Landfill will be required to use adequate covers or other means of covering and securing loads. The adequacy of covers or securing of incoming wastes will be checked at the gatehouse. A sign will be prominently displayed at the gatehouse stating that all loads shall be properly covered and secured.

- The active working face will be limited to as small an area as practical for the safe operation of the incoming waste hauling vehicles, and operation of compaction equipment, and delivery and placement of weekly cover soil.

- Excess working face area will be covered as frequently as needed, to assist with the control of windblown waste.

- The Beck Landfill will provide litter control fences, as necessary, at appropriate locations near the working face and elsewhere. The litter control fences will be constructed of wire or plastic mesh screens attached to portable or permanent frames or temporary fences. The litter control fence will be of sufficient height and will be located as close as practical to the active area to control windblown waste and litter.

- Windblown waste and litter along the entrance road, the gatehouse area, within the permit boundary, and that has accumulated along the permit boundary will be collected once a day and returned to the active working face. Should windblown waste cross the permit boundary onto adjacent property, landfill personnel, with landowner permission, will access the property and conduct litter pickup. Some adjacent properties around the landfill permit boundary is owned by Beck Landfill related companies, therefore permission is not required for personnel to enter those adjacent properties for litter pick- up,

- Adjacent filled areas and the landfill flood control dike system will provide protection from the prevailing winds. If additionally necessary, earthen berms will be used to assist in control of windblown wastes by providing a windbreak against prevailing winds.

8.6 Easements and Buffer Zones (§330.141)

8.6.1 Easements (§330.141(a))

Solid waste unloading, storage, disposal, or landfill operations will not occur within any easement, buffer zone, or right-of-way that crosses the site. No solid waste disposal will occur within 25 feet of the centerline of any utility line or pipeline easement, unless otherwise authorized by TCEQ. All easements will be clearly marked as specified in Section 8.7 of this SOP. Pipelines and utility easements will be marked with posts extending a minimum of six feet above ground surface at intervals that do not exceed 300 feet. There are currently no easements or right-of-ways located within the permit boundary.

8.6.2 Buffer Zones (§330.141(b))

The buffer zone is defined as the area between the permit boundary and the limit of waste disposal. The limit of waste is located along the inside edge of the perimeter road. No solid waste unloading, storage, disposal, or processing operations will occur within any buffer zone. The buffer zones will provide for safe passage for fire-fighting and other emergency vehicles. The buffer zones vary around the perimeter of the site, but in no case are they less than 50 feet. All buffer zones will be clearly marked as specified in Section 8.7 of this SOP.

8.7 Landfill Markers and Benchmark (§330.143)

Landfill markers will be installed to clearly identify significant features. The markers will be steel, wooden, or other durable material posts, and will extend at least 6-ft above the ground surface. The markers will not be obscured by vegetation and will be placed in sufficient numbers to clearly show the required boundaries. Markers will be inspected on a monthly basis and markers that are removed or destroyed will be replaced within 15 calendar days of discovering a marker does not meet regulatory requirements. A permanent concrete set benchmark monument, as required by 30 TAC §330.143(8) and indicated in Figure 8.3 will be installed and maintained within the landfill permit boundary. Records of all marker and benchmark inspections will be maintained at the facility. Markers will also be repainted as needed to retain visibility. Guidelines for type, placement, and color-coding of markers are outlined below.

1. **Site Boundary:** Site boundary markers will be installed and will be painted black. The markers are placed at each corner of the site and along the permit boundary at intervals no greater than 300 ft.

2. **Buffer Zone:** Buffer zone markers will be painted yellow. Markers identifying the buffer zone will be placed a minimum of 50 ft from the permit boundary and at the buffer zone corners and along the buffer zone boundary at intervals of no greater than 300 ft.

3. **Easement and Right-of-Way:** If and where applicable, easement and right-of-way markers will be painted green. The markers will be placed along the boundary of easement and right-of-way. Markers will be placed at each corner within the site and at the intersection of the site boundary.

4. **Landfill Grid System:** Landfill grid system markers will be painted white. The grid system will consist of black lettered markers along two opposite sides and numbered

markers along the other two sides. The markers will be spaced no greater than 100 ft apart measured along perpendicular lines. Intermediate markers will be installed in the case where markers cannot be seen from opposite boundaries.

5. **Flood Protection Markers:** If and where applicable, flood protection markers will be painted blue. The markers identifying the flood protection zone will be placed at each corner of the site and along the limits of the zone, at intervals of no greater than 300 ft.

6. **Point of Compliance for Groundwater Monitoring System (§330.403(a)(2)**: The Beck Landfill consists of individual waste cells situated within an elevated bermed perimeter. Impermeable slurry-walls constructed within the elevated bermed perimeter, creating a continuous barrier between the contents of the landfill and the surrounding environment. In order to determine whether the landfill has released contaminants to the uppermost aquifer, five (5) monitoring wells are installed along the exterior of the dike line perimeter and associated piezometer wells are installed along the interior of the dike line perimeter. Annual water quality testing is conducted in each of the monitoring wells and the results are compared to historical data collected at these points. If an anomaly is detected from historical results, monitor wells are re-tested and additional testing may be performed at each of the associated piezometer wells to determine whether constituents of concern are detectable within the dike line. Additional sampling may be conducted in the Cibolo Creek, which surrounds the landfill on three sides to determine if constituents of concern are detectable in surrounding surface water.

8.8 Material along the Route to the Site (§330.145)

Beck Landfill will take steps to ensure that vehicles hauling waste to the site are covered with a tarp, net, or other means to properly secure the load. These steps are necessary to prevent the escape of any part of the load. Signs are posted at the landfill entrance gate and gatehouse notifying haulers of this requirement. Enforcement of this rule may include 1) reporting offenders to proper law enforcement officers, 2) adding surcharges, or 3) prohibiting haulers access to the landfill.

Beck Landfill will provide for the cleanup of Type IV compatible waste materials spilled along and within the right-of-way of FM 78 (or any future entrance to the landfill from a public access road) for a distance of 2 miles in either direction from the entrance road connection to FM 78. Cleanup for the spilled materials will be performed once per day. The LFM or LS will consult with TxDOT officials concerning cleanup of state highways and right-of-ways consistent with
§330.145.

8.9 Disposal of Large Items (§330.147)

Most non-recyclable large items can be placed and compacted during normal site disposal operations. Large items that cannot be recycled may require crushing with a landfill compactor or bulldozer to reduce the potential for voids within the waste cell. If the handling and crushing of large items interferes with normal operations, the items shall be temporarily stored near the working face until scheduling allows for their proper disposal. Such items will be removed often enough to prevent the items from becoming a nuisance and to avoid an excessive accumulation of the items. All such temporarily stored items shall also be stored in an area so as to minimize interference with the working face operations.

Refrigerators, freezers, air conditioning units, or other items that may contain chlorinated fluorocarbon (CFC) refrigerant will be handled in accordance with 40 CFR §82.156(f).. Refrigerators, freezers, air conditioning units, or other items containing CFC will not be accepted unless the CFC contained in the item has been captured and sent to an approved CFC disposal or recycling facility and the generator or transporter provides written certification that the CFC has been evacuated from the unit. Items such as electrical equipment, which may contain PCBs, will not be knowingly accepted for disposal or recycling.

8.10 Odor Management Plan (§330.149)

The Beck Landfill will implement an odor management plan (OMP) to control odors resulting from site operations. This OMP addresses the identification of potential sources of odors and includes methods to minimize odors or sources of odors.
Sources of Odor

Sources of odor that emanate from a landfill can vary considerably and may include the wastes being delivered to the landfill, the open working face, ponded water, or contaminated water. Since putrescible waste is not accepted at site, the potential generation of odors is limited.

8.10.1 Odor Minimization

The primary objective of this Odor Management Plan is to minimize odor generation and odor emissions. Methods used to achieve this objective include waste handling procedures, the placement of cover materials, contaminated water handling procedures, and the elimination of ponded water.

8.10.2 Waste Handling Procedures

Wastes are to be deposited at the working face, spread into layers that can be readily compacted and covered. While weekly cover is required at the site, wastes with odors may be placed at the working face in a manner that allows for immediate cover.

8.10.3 Cover

Weekly cover will limit odor generation by preventing air and water from further impacting the wastes. If odors persist, soil covers may be placed more frequently than weekly. If odors persist after placement of 6 inches of soil cover, additional cover soils may be placed.

8.10.4 Contaminated Water Handling Procedures

Contaminated water may become a source of odors and will be segregated from clean storm water. See section 8.23 of this SOP for details regarding the management of contaminated water.

8.10.5 Ponded Water

Water ponded over waste disposal areas may become a source of odors and should be eliminated prior to the occurrence of odors. Ponded water areas will be filled in and re- graded within 7 days of the detection, weather permitting.

8.11 Disease Vector Control (§330.151)

Type IV landfills, with proper compaction and adequate intermediate and monthly cover, will typically require minimal vector control under normal circumstances. Landfill personnel will be constantly appraising site conditions as they perform their regular duties and should report unusual circumstances or areas requiring maintenance to the landfill operator. The regular basis in order to appraise all circumstances ranging from windblown litter and the condition of drainage features to quality of buffers and fences.

Pest populations primarily including rodents, and mosquitoes, shall be an additional vector item. Currently such species exist at the site but are held within reasonable balance by natural conditions.

Landfill personnel will monitor ongoing operations and be prepared to take additional action should it be required.

These actions may include:

- Temporarily applying cover more frequently than weekly;
- Temporarily applying a thicker layer of weekly cover;
- Use of non-lethal bird control measures such as pyrotechnics, baiting, decoys, etc. to discourage birds at the site and scare them away if they become a nuisance; and
- Contracting with professional exterminators, if necessary, to control rodents or other pests that may appear at the site.

8.12 Site Access Roads (§330.153)

The main public landfill entrance road from FM 78 will consist of approximately 1200 feet of concrete surfaced road, from the entrance to the gatehouse, continuing to the main landfill dike- line entrance point. The main internal access roads beyond the end of the concrete surfaced road will be surfaced with crushed rock and secondary internal access roads will be constructed of and maintained with sand and gravel. Disposal operations may be suspended during periods of heavy rain at the discretion of the LFM and/or LS depending on the safe and efficient accessibility of the active disposal area.

Equipment utilized within the site will also be utilized to maintain roadways allowing proper grading and drainage as well as to minimize rutting. The landfill operator shall also be responsible for inspecting Highway78 on a daily basis and during periods of inclement weather and will promptly clear any mud which has been tracked onto FM 78.

Dust control will similarly be the responsibility of the landfill operator. During periods of dry weather, the LS shall direct personnel to utilize a water truck as necessary to wet site roads.
Landfill haul roads, and access roads will be maintained in a reasonably dust-free condition by periodic spraying from a water truck. Grading equipment will be used as needed to control or remove mud accumulations on internal roads including the entrance road. Stockpiles of crushed stone, concrete rubble, used asphalt, masonry demolition debris, or other similar material may be utilized in maintaining passable internal access roads including re-grading to minimize depressions, ruts, and potholes. The site entrance road, landfill haul road, and access roads will be maintained in a clean and safe condition. Litter and debris along site access roads will be picked up daily and returned to the active working face.

8.13 Salvaging and Scavenging (§330.155)

Salvaging may be performed by landfill personnel under the direction of landfill management, and shall not be allowed to interfere with prompt sanitary disposal of solid waste or to create public health nuisances. Salvaged materials will be considered as potentially recyclable materials and will be stored in a safe and secure manner. All salvaged material shall be removed from the site as necessary to prevent an excessive accumulation to the material at the site. Salvaged material will be removed often enough to preclude the discharge of any pollutants from the area in accordance with 30 TAC §330.155.

Scavenging will be prohibited at all times.

8.14 Endangered Species Protection (§330.157)

No known endangered or threatened species were present at the site during the permitting process. Workers will be instructed to report the sighting of possible endangered species to the Landfill Supervisor, who shall contact the U.S. Fish and Wildlife Service to help identify any potentially endangered species.

8.15 Landfill Gas Control and Management (§330.159 and §330.371)

The LS is responsible for executing the Landfill Gas Management Plan in order to ensure that the concentration of methane gas generated by the facility does not exceed 1.25% by volume in facility structures (excluding gas control or recovery system components, if any), and the concentration of methane gas does not exceed 5% by volume in monitoring points, probes, subsurface soils, or other matrices at the facility boundary defined by the legal description in the permit.

Type and Frequency of Monitoring
Beck LF determined the type and frequency of monitoring based upon the factors described herein.

Soil Conditions: Within the LF perimeter flood control dike and along Lines D, E, F, G, and the northeastern side of A, the dominant soil type is mapped as Sunev loam, 0 to 1 percent slopes. This well drained soil may be up to 72 inches deep, comprised of up to 70% calcium carbonate, and is defined as Hydrologic Soil Group B. Along the northwestern side of Line A, the dominant soils type is the Barbarosa silty clay (0 to 1 percent slopes). This well drained soil may be up to 72 inches deep, comprised of clayey alluvium, and is defined as Hydrologic Soil Group C. Along Lines B and C, the dominant soil type is the Bosque and Seguin soils, frequently flooded. This well drained soil is typical of floodplains and may be up to 62 inches deep, comprised of up to 20% calcium carbonate, and defined as Hydrologic Soil Group B. These soils are not hydric.

Hydraulic and Hydrologic Conditions: The Landfill is constructed within an oxbow of the Cibolo Creek. The floor of the landfill is keyed into the Taylor-Navarro Shale, a clay formation that acts as a natural, impermeable liner. The landfill is enclosed by a slurry trench within a compacted clay embankment. The embankment and slurry trench were designed to isolate the landfill from communication with shallow, perched groundwater associated with the surrounding Cibolo Creek.

Location of Facility Structures and Property Boundaries: There are only three, permanent, enclosed structures within the facility boundary: the readymix plant office located approximately 885 feet from the toe of the embankment; the scalehouse located approximately 610 feet from the toe of the embankment, and an uninhabited house located approximately 1,030 feet from the perimeter embankment. All other structures at the facility are temporary. Monitoring of these enclosed structures is not proposed at this time. If the concentration of methane in the landfill gas monitoring probes approaches the LEL monitoring of these enclosed structures will be considered.

Utility Lines and Pipelines: There are two utility lines that approximately parallel the northwest side of the landfill (along Lines B and C). One is an old wastewater line, constructed of clay pipe, the other is a cast-iron water line. The clay pipe wastewater line is approximately 75 feet northwest of the toe of the flood-control dike along which the landfill gas monitoring probes will be installed. The water line is about 150 to 200 feet northwest of the toe of the flood control dike. The exact locations of these utility lines are unknown, even to the City of Schertz. Neither landfill gas monitoring probes nor vents

along the utility lines are proposed at this time. These will be considered only if the concentration of methane in the landfill gas monitoring probes approaches the LEL.

8.16 Landfill Gas Management Plan

INTRODUCTION

This Landfill Gas Management Plan ("Plan") has been developed for the Beck Landfill, a Type IV landfill in Schertz, Texas, as required by 30 Tex. Admin. Code (TAC) §330.63(g). This Plan addresses the requirements set forth in 30 TAC §330.371. The Plan describes the proposed system, including installation procedures, monitoring procedures, and procedures to assess the need for maintenance, repair, or replacement; and backup plans to be used if the monitoring system becomes ineffective or must be expanded. This Plan also outlines notification procedures and possible remediation activities, if required.

The requirements of this landfill gas management plan will be in effect through the remainder of the operating life of the landfill, landfill closure, and will continue for a period of 5 years after certification of final closure of the facility, unless altered by TCEQ. Any revisions to this plan will be submitted to TCEQ for review and approval.

Facility Boundary Monitoring Network
Six landfill gas monitoring probes are to be installed along the northwest exterior toe of the flood control dike surrounding the landfill opposite grid markers 5, 10, 15, 20, 25 and 30 (Fig. 8). The nominal spacing between the landfill gas monitoring probes is 500 feet as measured along the top of the flood control dike. The probes will be labeled as MM-1 through MM-6 in the order presented above. A single probe is specified at each location to accommodate the heterogeneity of the alluvial deposits through which landfill gas might migrate,

Gas Monitoring Probe Installation
The landfill gas monitoring probes will be drilled and installed by driller registered in the state of Texas under the supervision of a licensed professional geoscientist or engineer. The borings will be advanced using hollow-stem augers with samples visually classified and logged in accordance with the Unified Soil Classification System (ASTM No. D-2487). If in the opinion of the supervising geologist or engineer, the materials encountered are too impermeable to allow migration of landfill gas emissions, the borings may be moved left or right along the toe of the flood control dike to find more suitable subsurface conditions for potential gas migration through the vadose zone.

The probes (Fig. 9) will be screened with factory fabricated 1/2-inch diameter 0.010 inch Schedule 80 PVC screen from the total depth of the probe, less an end cap, to no less than 4 or 5 feet below the ground surface (Fig 8). A solid Schedule 80 PVC riser will extend upward from the screen to approximately 3 feet above the ground surface capped with a quick-connect device to allow purging and monitoring with the gas monitoring meter. All joints will either be threaded or use compression fittings; no glue or solvent-based welding is permitted.

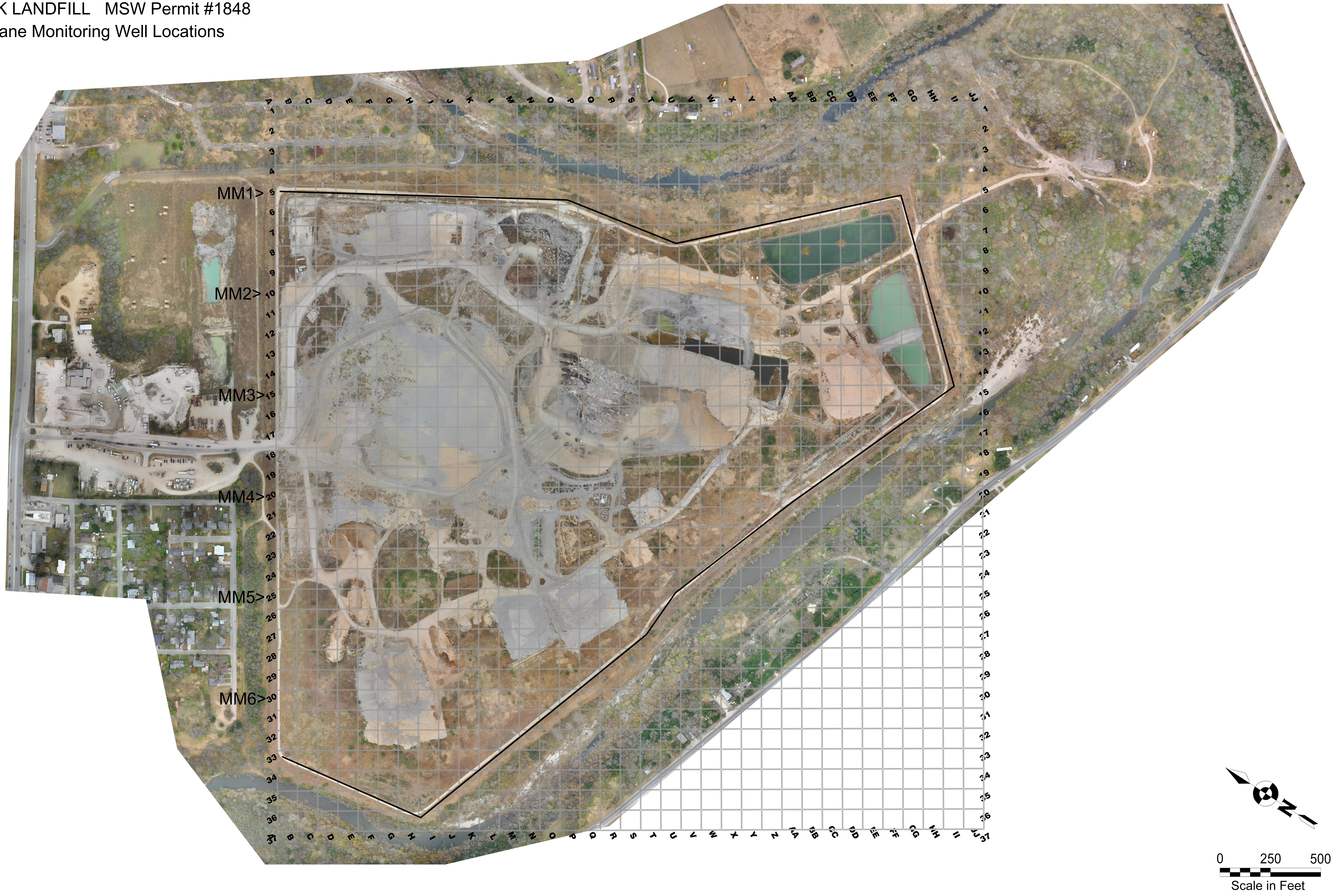
A 20-40 mix of silica sand or concrete sand (ASTM C-33), as available, will be tremied around the probe screen to a minimum of 6 inches above the top of the screen. Followed by hydrated bentonite pellets to 6 inches below the ground surface. A lockable steel well-head protector will be installed over the riser and a 4-foot by 4-foot by 6-inch thick reinforced concrete pad poured around the steel well-head protector to stabilize and protect the well head. Pea gravel, or the equivalent, will be placed around the riser within the steel well-head protector to stabilize the monitoring probe, and one or more weep holes will be drilled into the bottom of the steel well-head protector to allow drainage of excess moisture. Concrete filled steel bollards will be installed around the surface pad as deemed necessary to provide additional protection to the well-head.

Boring/completion logs for the landfill gas monitoring robes will be prepared, submitted to TCEQ and to the Texas Department of Licensing and Regulation (DLR), and retained in the site operating record.

Installation of landfill gas monitoring probes around the remainder of the landfill is unnecessary. Should any landfill gas penetrate the slurry wall and flood control dike, it would either be discharged to the atmosphere or enter the vadose zone, which terminates at Cibolo Creek. The creek, then, is a barrier to landfill gas migration. Other than on the northwest side of the landfill, there are no structures in which landfill gas could accumulate between the landfill and the creek.

Fig. 8 Proposed locations of landfill gas monitoring probes shown on aerial photo;

BECK LANDFILL MSW Permit #1848
Methane Monitoring Well Locations



Notes

Vertical Datum: Local
Horizontal Datum: NAD83

This drawing is for illustration only and not for permitting, bidding or construction

Prepared For:

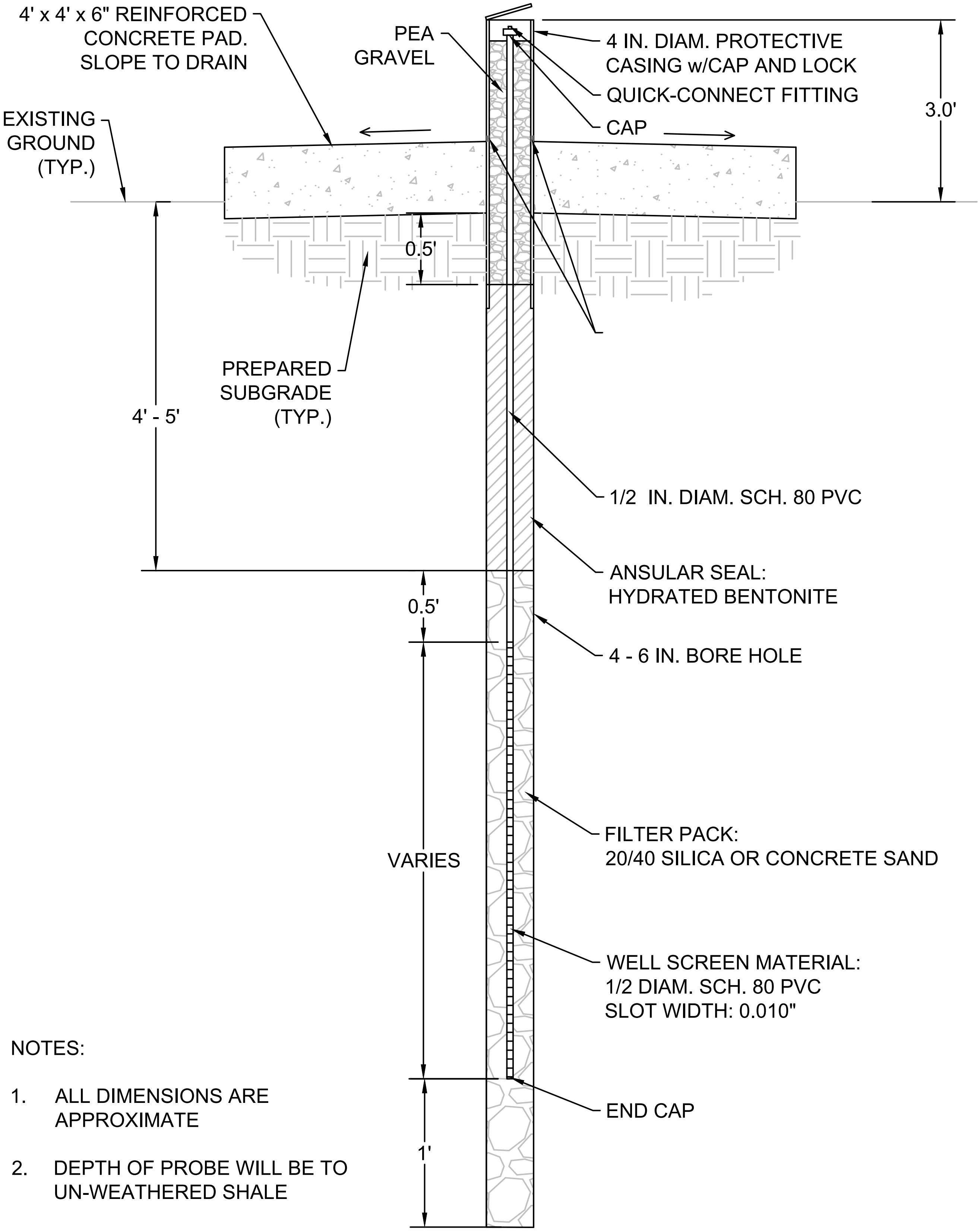
Beck Companies
550 FM 78
Schertz, TX 78154

Landfill Aerial and Grid
Beck Companies - Schertz Landfill
Flight Date: December 5, 2018

FIRMATEK
3D MAPPING SOLUTIONS
www.Firmatek.com 210.651.4990

Fig. 9 [Schematic drawing of landfill gas monitoring probe]

REV1	ISSUE_FOR_CONSTRUCTION	08/20/19	SMT	JCM	JCM	
REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD



NOTES:

1. ALL DIMENSIONS ARE APPROXIMATE

2. DEPTH OF PROBE WILL BE TO UN-WEATHERED SHALE

POSTOAK_GASPROBE.DWG

		DSGN	JCM	08/19/19
		DRN	SMT	08/19/19
		CKD	JCM	08/19/19
		SCALE:	NONE	
N/A	N/A			
REFERENCE DRAWINGS		FOR 8.5x11 DWG ONLY		

POWER ENGINEERS

BECK LANDFILL

SCHERTZ, GUADALUPE COUNTY, TX

PROPOSED LANDFILL GAS WELL DESIGN

JOB NUMBER	REV
150051	1
DRAWING NUMBER	

Landfill Gas Monitoring Procedures

The concentration of methane in the landfill gas monitoring probes will be measured on a quarterly basis per calendar year, with two of those monitoring times, to the extent possible, correspondingwith sampling of the ground water monitoring wells at the landfill. The integrity and labelling of the monitoring probes, including the integrity of the steel, well-head protectors, locks, and concrete pads, will be inspected during or before each monitoring event and repairs or replacement made as needed. Repair or replacement of any landfill gas monitoring probes will be documented and retained in the site operating record.

Beck Landfill uses a QRAE 3 wireless four-gas monitoring instrument, -- carbon monoxide, hydrogen sulfide, and oxygen in addition to methane and the LEL. This instrument is suitable for surface monitoring and for sampling the landfill gas monitoring probes. Operation of the device should be in accordance with the instrument manual. If at any time the instrument fails, it will be repaired or replaced, TCEQ will be informed in writing, and the repair or replacement noted in the site operating record. Results of all methane monitoring events, including purge volumes, will be retained in the site operating record.

Landfill Gas Monitoring Exceedance Record Keeping and Reporting

Results of landfill gas monitoring will be kept in the site operating record; however, If during any monitoring event, the volumetric methane concentration in any landfill gas monitoring probe exceeds the LEL, the probe will be resampled within 24-hours, and again within 7 days to confirm the exceedance. Reporting will be in accordance with 30 TAC §330.371(c). Notifications will be as follows:

MSW Permits Section, MC-124
Texas Commission on Environmental Quality
PO Box 13087
Austin, TX 78711-3087
512-239-6784 (O); 512-239-6000 (Fax)

TCEQ Region 13 – San Antonio Waste Section
14250 Judson Road
San Antonio, TX 78233-4480
210-490-3096 (O); 210-545-4329 (Fax)

Guadalupe County EMS at 911

Schertz EMS
1400 Schertz Parkway, Building 7
Schertz, TX
830-619-1400

A plan to address the exceedance will be formulated and implemented, with TCEQ approval, if possible within 60 days. The precise nature of the plan will depend on which probes show exceedances; those opposite near-by residences or those opposite of commercial businesses. . The potential remedial actions may include precisely locating the utility trenches to install monitoring probes and/or vents, sampling the nearest residences, and installation of additional gas monitoring probes or vents. An alternative schedule may be implemented in accordance with 30 TAC §330.371(d).

8.17 Oil, Gas, and Water Wells (§330.161)

8.17.1 Water Wells (§330.161(a))

There are no known water wells located within the landfill permit boundary. In the event that a water well is discovered within the landfill permit boundary, Beck Landfill shall provide written notification to the executive director of the location of any and all existing or abandoned water wells situated within the facility upon discovery during the course of facility development. The facility operator shall, within 30 days of such a discovery, provide the executive director with such notification and written certification that such wells have been capped, plugged, and closed in accordance with all applicable rules and regulations of the commission or other state agency. Any water or other type of wells under the jurisdiction of the commission must be plugged in accordance with all applicable state requirements or additional requirements imposed by the executive director. A copy of the well plugging report required to be submitted to the appropriate state agency must also be submitted to the executive director within 30 days after the well has been plugged.

8.17.2 Oil and Gas Wells (§330.161(b))

There are no known crude oil or natural gas wells or other wells associated with mineral recovery within the landfill permit boundary. If crude oil or natural gas wells, or other wells associated with mineral recovery are located, the landfill will provide written notification to the TCEQ executive director of their location within 30 days of their discovery. For crude oil or natural gas wells, or other wells associated with mineral recovery, the Landfill Supervisor will provide the executive director of the TCEQ with written certification that all such wells have been properly capped, plugged, and closed in accordance with all applicable rules and regulations of the Railroad Commission of Texas. A copy of the well plugging report to be submitted to the appropriate state agency will also be submitted to the executive director of the TCEQ within 30 days after the well has been plugged. A permit modification will be submitted to the executive director if revisions to the liner installation plan are required as the result of well abandonment.

8.18 Compaction (§330.163)

Compaction of waste material will be accomplished by a landfill compactor, dozer or similar equipment. The site dozer will be used to compact waste should the primary landfill compactor be temporarily out of service. Adequate compaction will be accomplished to minimize future consolidation and settlement and provide for the proper application of intermediate and final cover. Incoming waste will be spread in layers and thoroughly compacted.

8.19 Landfill Cover (§330.165)

8.19.1 Soil Management

Management of soil for use in and around the landfill area will be an ongoing process. In general, soil for use as weekly cover, intermediate cover, final cover, and other uses will be available onsite. This onsite soil will be obtained from excavation that is ongoing as part of the excavation and development of landfill cells.

In addition to this available material located on the landfill property, a stockpile of material will be kept available on site. The stockpile will consist of soil that has not previously come in contact with waste, and will be of sufficient volume to provide at least one day's application of 6 inches of weekly cover over the working face. As this stockpile is used, it will be replenished as soon as practical. The soil may also be used in emergency situations for fire control.

8.19.2 Weekly Cover (§330.165(b))

Weekly cover of waste is necessary to control disease vectors, windblown waste, odors, fires, scavenging, and to promote runoff from the fill area. At least 6 inches of well- compacted soil cover material that has not been previously mixed with garbage, rubbish, or other solid waste will be placed over all solid waste received during that same day.

To ensure that the weekly cover soil will be adequate (i.e., minimize vectors, contaminated storm-water runoff, odors, etc.) the following procedures will be followed:

- Cover will be sloped to drain.
- Cover will be compacted with a minimum of two passes with the dozer tracks to minimize infiltration of storm water.

The LS will document weekly cover location and visually inspect during placement that a minimum of 6 inches of cover soil has been placed and that no waste is exposed. The LS shall document, as cover is necessary, on at least a weekly basis, the daily cover placement area and indicate that he has visually verified the thickness and condition in the Cover Inspection Record, After each rainfall event, the Landfill Supervisor will inspect cover areas for erosion, exposed waste or other damage, and repair as necessary.

8.19.3 Intermediate Cover (§330.165(c))

Areas that receive waste and subsequently become inactive for longer than 180 days will receive intermediate cover. Intermediate cover must include an additional 6 inches of suitable earthen material, for a total cover thickness of at least 12 inches, capable of sustaining native plant growth. This additional earthen material will be seeded or sodded following application in accordance with 30 TAC §330.165(c). The intermediate cover will be graded to prevent erosion and ponding of water. Storm water runoff from areas that have received intermediate cover are considered to have not come into contact with waste material and are to be managed as necessary as uncontaminated storm water runoff.

8.18.4 Final Cover (§330.165(f))

Final cover placement will occur as areas of the site are filled to the maximum waste fill grades. Final cover placement over individual areas will be in accordance with Beck Landfill's existing Final Closure Plan. Surface water will be managed throughout the active life of the site to minimize infiltration into the filled areas and to minimize contact with solid waste. Erosion of final or intermediate cover will be repaired promptly by restoring the cover material, grading, compacting, and seeding it as necessary. Such periodic inspections and restorations are required during the entire operational life and for the post closure maintenance period.

In general, final cover placement over completed portions of the site will consist of the following steps:

- Survey controls will be implemented to control the filling of solid waste to the bottom level of the intermediate cover layer elevation.
- The final cover system layers will be constructed. Testing of the various components of the final cover system will be performed in accordance with the site's existing Final Closure Plan.
- A final cover certification report complete with an as-built survey will be prepared by an independent registered professional engineer and submitted to the TCEQ for approval.
- The TCEQ-approved final cover certification report will be maintained in the SOR. The cover inspection record will be updated to reflect areas where final cover has been placed.

8.18.5 Erosion of Cover (§330.165(g))

The LS will inspect intermediate cover at the site on a weekly basis. The final cover system, including erosion control structures will be maintained during and after construction. During the active life of the site, the LS will inspect the final cover system on a weekly basis. During post- closure care, the final cover system will be visually inspected on a monthly basis. In accordance with 30 TAC §330.165(g), eroded or washed-out areas of intermediate or final cover which are deep enough to jeopardize the intermediate or final cover, defined as exceeding four inches in depth as measured from the vertical plane from the erosion feature and the 90 degree intersection of this plane with the horizontal slope face or surface, will be repaired within 5 days of detection. Repair of final cover includes restoring cover, grading, compacting, and seeding as required by 30 TAC §330.165(g) In addition, all cover areas will be visually inspected following significant rainfall events. Documentation of weather delays for the repairs will be included in the cover inspection record. Weekly inspections and restorations are required for the active life of the landfill.

8.18.6 Cover Inspection Record (§330.165(h))

A cover inspection record will be maintained and be readily available for inspection in accordance with §330.165(h). For weekly and intermediate cover, the record will specify the date cover was accomplished (no exposed waste), area covered (by use of the grid system), how it was placed, and when it was completed. When applicable, dates of erosion detection and dates of completion of repair will be identified in the cover inspection record. For final cover, the record will show the final cover area completed, date cover was applied and thickness of final cover. The final cover certification report for each area will be referenced in the record. Each entry in the record will be certified by the signature of the Landfill Supervisor that the work was accomplished as stated in the record.

8.19 Ponded Water (§330.167)

Beck Landfill will prevent ponding of water over areas that have received waste through site operation practices such as grading and maintenance. The Ponded Water Plan (PWP) provides direction to the landfill operations for the prevention and elimination of ponded water.

The Ponded Water Plan is as follows:

- The landfill will place daily cover, intermediate cover, and final cover in accordance with requirements established in Section 8.18 – Landfill Cover.
- The landfill will inspect the surface of areas that have received waste and landfill cover consistent with Section 8.18 – Landfill Cover and Section 8.24 –Site Inspection and Maintenance Schedule.
- Site grading and maintenance as required by Section 8.18 will minimize the ponding of water over areas containing waste.
- Should ponding of water occur, the ponded water will be removed and the depressions filled within 7 days, weather permitting. Landfill cover will be repaired consistent with procedures specified in Section 8.18.
- If the ponded water has come into contact with waste, or waste-contaminated soils, it will be treated as leachate and handled accordingly

8.20 Disposal of Special Wastes (§330.171)

Beck Landfill may accept Special Wastes, as defined in §330.3, assuming their physical nature meets the definition of wastes acceptable for disposal at a Type IV landfill as defined in §330.5(a)(2). Special Wastes may require TCEQ authorization for disposal on a case by case basis. Requests for approval to accept special waste shall include those items specified in §330.171(b)(2)(A), (C) and (D). Requests must be submitted and certified by the generator to the TCEQ executive director or to Beck Landfill for submittal to the TCEQ executive director.

The request must include the following:

A complete description of the chemical and physical characteristics of each waste and the quantity and rate at which each waste is produced and/or the expected frequency of disposal, including a statement that the waste is not a Class I industrial waste as defined in §330.3.

The approval for acceptance and disposal of Type IV landfill compatible special wastes at Beck Landfill will be waste-specific consistent with §330.171(b)(1). The executive director may authorize the receipt of special waste with a written concurrence from Beck Landfill. The landfill is not required to accept the waste.

In addition to authorized special wastes, Beck Landfill may accept non-regulated asbestos- containing materials (NRACM) as follows:

> *Non-regulated asbestos-containing materials may be accepted for disposal provided the wastes are placed on the active working face and covered in accordance with §330.171(c)(4) and Section 8.18 of this SOP. Under no circumstances shall any material containing non-RACM be placed on any surface or roadway which is subject to vehicular traffic or disposed of by any other means by which the material could be crumbled into a*

friable state.

8.21 Disposal of Industrial Wastes (§330.173)

Industrial waste (nonhazardous) is defined by §330.3 as solid waste resulting from or incidental to any process of industry or manufacturing, or mining or agricultural operations. Class I wastes will not be accepted at the Beck Landfill. Class II and Class III industrial solid wastes may be accepted at the Beck Landfill, consistent with the limitations of §330.5(a)(2) and provided that disposal of these wastes does not interfere with proper operation of the Beck Landfill.

8.22 Visual Screening of Deposited Wastes (§330.175)

The nature of land use immediately adjacent to the site, and the flood control dike will screen disposal areas from any reasonable site line. The south and west sides of the site border on Cibolo Creek and undeveloped land. The east side and the north side of the site are bordered by the Beck Readymix concrete plant. The site partially borders Zuehl Street on the northeast border of the site. Sufficient separating distance and natural vegetation will be adequately maintained to screen ongoing disposal operations from residences along Zuehl Street. Additional visual screening will be provided if the executive director determines a need for such.

8.23 Contaminated Water Discharge

Run-off, which has come into contact with the working face, will be collected in a bermed area near the base of the working face and used for improved compaction of waste and/or for dust control within the permit boundary of the landfill.

If the volume of contaminated water is greater than can be used for improved waste compaction and or dust control as described above, a retention pond located outside the active disposal area, but within the permitted landfill has been designated to receive water for storage. The retention pond will be sized to handle water volume received during the three wettest consecutive months of the year. Any berms around the active working face and/or around the retention pond will be a minimum height of 3 feet with a crest width of 2 feet.

Beck Landfill will take all steps necessary to control and prevent the discharge of contaminated water from the site. Should the discharge of contaminated water become necessary, the LFM will obtain specific written authorization from the TCEQ prior to discharge. All water coming in direct contact with waste will be treated as leachate. The landfill will be operated consistent with §330.15(h)(1)-(4) regarding discharge of solid wastes or pollutants into waters of the United States.

8.24 Site Inspection and Maintenance Schedule

Beck Landfill will periodically perform inspections of the site, including landfill operations. Inspections will be performed as indicated in Table 8.2. The LS or designee is responsible for performing the inspections. Records of site inspections will be maintained as part of the SOP.

9.0 SEQUENCE OF DEVELOPMENT (30 TAC §330.127(2))

Beck Landfill is divided into 41 individual cell areas as shown in Figure 9.1, located in the Attachments section of this SOP. Per Section 1.4 of this SOP, Beck Landfill, as an attachment to the "30-DAY NOTICE OF CELL COMPLETION" letter sent to the TCEQ MSW Permits Section, includes a continually updated site layout map identifying the cell area(s) being excavated and utilized per site operating requirements. This procedure serves as the mechanism for informing the TCEQ of the landfill's sequence of development.

10.0 Recycling Activities

Beck Landfill includes this Addendum to the Site Operating Plan (SOP) to address management practices to be followed when diverting specific recyclable materials from the solid waste stream received at the facility. These management practices are written in conformance with the Waste Minimization and Recycling rules (30 TAC 328), Composting rules (30 TAC 332), and the Operational Standards for Permitted Solid Waste Landfill Facilities (30 TAC 330).

In accordance with 30 TAC 330.155, scavenging is not allowed and the salvaging of material from the solid waste stream will not be allowed to interfere with the prompt sanitary disposal of solid waste or to create a public health nuisance. Salvaged items will be removed from active areas often enough to prevent the items from becoming a nuisance, to preclude the discharge of any pollutants from the area, and to prevent an excessive accumulation of the material at the facility.

10.1 Purpose

Beck Landfill will divert certain recyclable materials from the solid waste stream to promote the economic recovery and reuse of materials, and to support the development of markets for recycled, remanufactured, or environmentally sensitive products or services in a sustainable manner that protects the environment, public health, and safety. This Addendum provides management practices for the temporary storage and processing of recyclable materials.

10.2 Scrap Tires

Per 30 TAC 328.53 (relating to Management of Used or Scrap Tires), Beck Landfill (MSW Permit No. 1848) may store or process whole tires or tire pieces in an unused portion of the property within its permit boundary dedicated to tires only. Scrap tires may not be disposed of within the Beck Landfill unless the tire has been quartered, shredded or split (the sidewalls removed from the tires).

Authorization for this storage and/or processing activities is conferred through the approval of the Site Development Plan, including this Addendum of the Site Operating Plan. The tire storage and/or processing activity shall not be conducted in a manner that will adversely affect operations of the municipal solid waste disposal site, or otherwise endanger human health or the environment.

Beck Landfill may store up to 500 tires for processing, reuse or sale at any given time.. Processing may include splitting, quartering or shredding of the tires.

The following management practices will be followed:

10.2.1 Tire Storage Criteria

1. Scrap tire storage areas are designed so that the health, welfare, and safety of operators, transporters, and others who may utilize the site are maintained.
2. No more than three (3) piles of whole or scrap tires will be stored on the ground (stockpiles).
3. A fire lane (40-feet buffer) must encircle the tire piles and be usable as an all-weather road.
4. The roadway must provide a minimum 25-foot turning radii.
5. The Site Layout Plan shall include this area with appropriate design notes.
6. Indoor storage piles or bins shall not exceed 12,000 cubic feet with a 10-foot aisle space between piles or bins.
7. Outdoor piles and entire buildings used to store scrap tires or tire pieces shall not be within 40 feet of the property line or easements. This setback will be maintained free of rubbish, equipment, tires, or other materials.
8. Outdoor storage of used or scrap tires or tire pieces at the processing location will be monitored for vector control, and appropriate vector control measures shall be applied when needed, but in no event less than once every two weeks.
9. Scrap tires or tire pieces may be stored in trailers provided the trailer is totally enclosed and lockable.

10.2.2 Fire Prevention and Suppression

Dry chemical fire extinguishers are located on the LS and the LFM trucks, as well as on mobile equipment working on or near the tire storage area.

Firewater may also be accessed from on-site ponds through the use of pumps and water trucks.

10.2.3 Access Controls

The scrap tire storage area(s) is within the fully-fence perimeter of Beck Landfill. The gate is locked when the facility is closed.

10.2.4 Water Quality Protection

Drainage away from the scrap tire storage location will flow into Beck Landfill and be retained in ponds, allowed to infiltrate, or will evaporate. No discharge of water is anticipated from the storage site.

10.3Asphalt Shingles

Asphalt shingles may be received at Beck Landfill for the purpose of disposal or processing for reuse. Only residential roof tear-off asphalt shingles or sized asphalt shingles may be received for processing and end-use in the production of hot mix asphalt. The feed stocks will be managed for processing. Non-conforming shingles and associated debris will be disposed in Beck Landfill.

At least 50% of shingles accumulated within a six-month period will be recycled or transferred to a different site for recycling. Recycled materials, including processed shingles, are not subject to this time limitation, but should be covered or otherwise protected to prevent degradation, contamination, or loss of value as recyclable material.

The following management practices will be followed:

10.3.1 Recordkeeping and Reporting

10. Shingles must not contain asbestos or asbestos containing materials (ACM). Analysis or other documentation demonstrating that no asbestos or ACM may be found in shingles proposed for recycling or disposal at Beck Landfill must be maintained.
11. Proof of financial assurance sufficient to cover closure costs.
12. Records indicating the volume of shingles processed for reuse versus volume of shingles land disposed at Beck Landfill. (Note: Follow Air Permit)

10.3.2 Shingle Storage Criteria

13. Shingle storage areas are designed so that the health, welfare, and safety of operators, transporters, and others who may utilize the site are maintained.
14. Incoming loads will be inspected by a person trained to identify asbestos containing shingles. Any material suspected of containing asbestos will be rejected.
15. All visible materials which are not part of the shingle will be removed before grinding, including excess wood, paper, metal, and plastics.
16. A fire lane (40-feet buffer) must encircle the shingle piles and be usable as an all-weather road.
17. The roadway must provide a minimum 25-foot turning radius.
18. Shingle storage piles shall not be within 50 feet of the property line or easements. This setback will be maintained free of rubbish, equipment, tires, or other materials.
19. Shingle piles will be maintained with a pile height no greater than 25 feet.

10.3.3 Fire Prevention and Suppression

Dry chemical fire extinguishers are located on the LS and the LFM trucks, as well as on mobile equipment working on or near the tire storage area.

Firewater may also be accessed from on-site ponds through the use of pumps and water trucks.

10.3.4 Access Controls

Shingle storage areas will be wholly located within the fully-fenced perimeter of Beck Landfill. The gate is locked when the facility is closed.

10.3.5 Water Quality Protection

Drainage away from shingle storage area(s) will flow within the Beck Landfill permitted area and be directed to and retained in detention ponds, allowed to infiltrate, or will evaporate. No off-site discharge of water is anticipated from the shingle storage area(s)..

10.4Wood Materials

Wood, brush and other vegetative debris may be received at Beck Landfill for the purpose of disposal or processing for reuse. Beck Landfill will compost or mulch materials considered to be exempt in 30 TAC §332.3.

The following management practices will be followed:

10.4.1 Recordkeeping and Reporting

20. Only untreated lumber and woody debris will be utilized for the manufacture of mulch or compost material. Treated lumber may be disposed in Beck Landfill.
21. Proof of financial assurance sufficient to cover closure costs.

10.4.2 Woody Debris Storage Criteria

22. Composting, mulching, and land application of material shall be conducted in a sanitary manner that shall prevent the creation of nuisance conditions as defined in §330.2 of this title (relating to Definitions) and as prohibited by the Texas Health and Safety Code, Chapters 341 and 382 (relating to Minimum Standards of Sanitation and Health Protection Measures; and Clean Air Act), the Texas Water Code, Chapter 26 (relating to Water Quality Control), §101.4 of this title (relating to Nuisance), and any other applicable regulations or statutes.
23. Operations shall be conducted in such a manner to ensure that no unauthorized or prohibited materials are processed at the facility. All unauthorized or prohibited materials received by the facility shall be disposed of at an authorized facility in a timely manner.
24. The setback distance from all property boundaries to the edge of the area receiving, processing, or storing feedstock or finished product must be at least 50 feet.
25. All permanent in-plant roads and vehicle work areas shall be watered, treated with dust-suppressant chemicals, or paved and cleaned as necessary to achieve maximum control of dust emissions.
26. Vehicular speeds on non-paved roads shall not exceed ten miles per hour.
27. A fire lane (40-feet buffer) must encircle the woody debris piles and be usable as an all-weather road.
28. The roadway must provide a minimum 25-foot turning radii.

10.4.3 Fire Prevention and Suppression

Dry chemical fire extinguishers are located on the LS and the LFM trucks, as well as on mobile equipment working on or near the tire storage area.

Firewater may also be accessed from on-site ponds through the use of pumps and water trucks.

10.4.4 Access Controls

Compost, mulch, and woody debris storage areas will be wholly located within the fenced perimeter of Beck Landfill. The main facility gate is locked when the facility is closed.

10.4.5 Water Quality Protection

Drainage away from the woody debris/compost/mulch storage areas will flow within the Beck Landfill permitted area and be directed to and retained in detention ponds, allowed to infiltrate, or will evaporate. No off-site discharge of water is anticipated from the wood storage or operation area(s).