CORRESPONDENCE COVER SHEET
WASTE PERMITS DIVISION
TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Date: May 17, 2019
Facility Name: City of Kingsville Landfill
Permit or Registration No.: MSW 235-C

Nature of Correspondence:
☐ Initial/New
☒ Response/Revision*

*If Response/Revision, please provide previous TCEQ Tracking No.: 23301130, 23458984 and 24040819
(Previous TCEQ Tracking No. can be found in the Subject line of the TCEQ's response letter to your original submittal.)

This cover sheet should accompany all correspondences submitted to the Waste Permits Division and should be affixed to the front of your submittal as a cover page. Please check the appropriate box for the type of correspondence being submitted. For questions regarding this form, please contact the Waste Permits Division at (512) 239-2335.

Table 1 - Municipal Solid Waste

APPLICATIONS	REPORTS and RESPONSES
☐ New Notification	☐ Closure Report
☐ New Permit (including Subchapter T)	☐ Groundwater Alternate SRC Demonstration
☐ New Registration (including Subchapter T)	☐ Groundwater Corrective Action
☒ Major Amendment	☐ Groundwater Monitoring Report
☐ Minor Amendment	☐ Groundwater Statistical Evaluation
☐ Limited Scope Major Amendment	☐ Landfill Gas Corrective Action
☐ Notice Modification	☐ Landfill Gas Monitoring
☐ Non-Notice Modification	☐ Liner Evaluation Report
☐ Transfer/Name Change Modification	☐ Soil Boring Plan
☐ Temporary Authorization	☐ Special Waste Request
☐ Voluntary Revocation	☒ Other: Supplemental Information Response
☐ Subchapter T Workplan	
☐ Other:	

Table 2 - Industrial & Hazardous Waste

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

HANSON
Engineering | Planning | Allied Services

Hanson Professional Services Inc.
4501 Gollihar Road
Corpus Christi, TX 78411
(361) 814-9900
Fax: (361) 814-4401
www.hanson-inc.com

May 17, 2019

Ms. Mihaela Chilarescu
Municipal Solid Waste Section
Waste Permits Division (MC 124)
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087

Re: City of Kingsville Landfill – Kleberg County
Municipal Solid Waste (MSW) - Permit No. 235C
Permit Amendment Application – Supplemental Information
Tracking No. 23301130, 23458984, and 24040819; RN102334570/CN600674246

Dear Ms. Chilarescu,

On behalf of the City of Kingsville and in response to your May 10, 2019 and May 16, 2019 email requesting supplemental information, we hereby submit the enclosed response regarding the Permit Amendment Application for the above referenced MSW facility.

For your convenience, we have included the comments from the May 10, 2019 and May 16, 2019 email (numbered accordingly) followed by the corresponding responses in italics.

Where items from the original application have been noted as revised, a redline/strikeout version is included and a replacement copy ("clean copy") of the applicable section or attachment has been provided to allow you to substitute the items in the binders for the originally submitted application.

TCEQ May 10, 2019 Email Item #1:

ID	Checklist Item	Citation
15	Provide 4 copies for NOD responses including 1 copy with marked revisions (redline/strikeout)	330.57(g)(6)
Location	**NOD Type**	
	Incomplete	
NOD Description		
Provide redline version of Att 5, App G, page 1.		

Response:

A redline version of Attachment 5, Appendix G, page 1 is provided in the redline version of Part III, Attachment 5.

TCEQ May 10, 2019 Email Item #2:

ID	Checklist Item	Citation
143	Provide documentation of coordination for roadway improvements and documentation of coordination with TXDOT for traffic and location restrictions	330.61(i)(4)

Location	NOD Type
Volume 1, Part II, Section 9.2, Page: Part II, pg-13; Part II, Attachment 3, Page: Part II, Attachment 3A, pg-1-6 & Part II, Attachment 3B, pg-1-8	Incomplete

NOD Description
Revise Part II, Sec. 9.2 to include provisions addressing requirements outlined in TxDOT letter dated April 16, 2019, and procedures for compliance.

Response:

Part II, Sec. 9.2, page 13 has been revised to include provisions addressing requirements outlined in TxDOT letter dated April 16, 2019, and procedures for compliance.

TCEQ May 10, 2019 Email Item #3:

ID	Checklist Item	Citation
477	Provide a description of the generalized stratigraphic column in the facility area. Regional stratigraphic cross-sections should be provided and must include elements listed in 330.63(e)(1)(B).	330.63(e)(1)(B)

Location	NOD Type
Att 4, Table 2-1, p. 6; Att 4, App 1, Fig 4.5, p. 21-23	Incomplete

NOD Description
Provide revised replacement page for Table 2-1, showing with an arrow or other means the stratigraphic position of the site.

Response:

A revised replacement page for Table 2-1 on Attachment 4, page 5, showing the stratigraphic position of the site with an arrow has been provided.

TCEQ May 10, 2019 Email Item #4:

ID	Checklist Item	Citation
491	Provide for borings to be sufficiently deep to identify uppermost aquifer, hydraulically connected aquifers, and underlying aquiclude; See Figure: 30 TAC §330.63(e)(4)(B)	330.63(e)(4)(B)

Location	NOD Type
Att 4, App 1, Sec 5.0, p. 48-55; Att 4, App 3, Sec 2, p. 4	Inconsistent

NOD Description
Complete the labelling of all the lithologic units shown on Tolunay-Wong logs and Hanson cross sections in Att 4 to correlate the units with the stratigraphy described in the geology report narrative and FEE reports.

Response:

All the lithologic units shown on Tolunay-Wong logs and Hanson cross sections in Attachment 4 have been labeled to correlate the units with the stratigraphy described in the geology report narrative and FEE reports.

TCEQ May 10, 2019 Email Item #5:

ID	Checklist Item	Citation
496	Submit cross-sections prepared from the borings; depicting the generalized strata at the facility. For small waste management units, two perpendicular cross-sections will normally suffice	330.63(e)(4)(G)
Location	**NOD Type**	
Att 4, App 1, Sec 6.2.2, p. 64-79	Incomplete	
NOD Description		
Revise the Hanson cross sections in Att 4 to show existing and proposed groundwater monitor wells that are on or close enough to the lines to show on cross sections; include screened intervals. Also show existing and future landfill base grades.		

Response:

The Hanson cross sections in Attachment 4 have been revised to show existing and proposed groundwater monitor wells that are on or close enough to the lines to show on cross sections; screened intervals have been included. Existing and future landfill base grades have also been added.

TCEQ May 10, 2019 Email Item #6:

ID	Checklist Item	Citation
500	Provide permeability tests to be performed according to one of the standards on undisturbed soil samples. All test results shall indicate the type of tests used and the orientation of each tested sample.	330.63(e)(5)(B)
Location	**NOD Type**	
Att 4, App 1, App G, p. 288-400; Att 4, App 3, Ex II, App B, p. 31-59	Incomplete	
NOD Description		
Provide a table indicating which earlier borings and test results for hydraulic conductivity are representative of and can be used as proxies for hydraulic conductivity of the units encountered in the borings drilled under the March 2016 soil boring plan, where those tests were not performed.		

Response:

A table has been included in Part III, Attachment 4, Section 4.1, pages 11-14 indicating which earlier borings and test results for hydraulic conductivity are representative of and can be used as proxies for hydraulic conductivity of the units encountered in the borings drilled under the March 2016 soil boring plan, where those tests were not performed.

TCEQ May 10, 2019 Email Item #7:

ID	Checklist Item	Citation
511	Provide a topographic map delineating waste area, property boundary, point of compliance, & GW monitoring wells	330.63(f)(1)
Location	**NOD Type**	

Att 11, App A, Item 1	Ambiguous
NOD Description	
Highlight the point of compliance line on Figures III.11-A-1A and 1B to more clearly show its extent, and provide a schedule for monitor well installation.	

Response:

The point of compliance line on Figures III.11-A-1A and 1B has been highlighted with arrows to more clearly show its extent, and to provide a schedule for monitor well installation.

TCEQ May 10, 2019 Email Item #8:

ID	Checklist Item	Citation
694	Demonstrate that the alternative final cover will achieve equivalent reduction in infiltration as the clay-rich soil cover layer specified under 330.457(a)(1) or (2)	330.457(d)(1)
Location	**NOD Type**	
Att 5	Incomplete	
NOD Description		
Provide a step-by-step example of the alternative final cover equivalency calculation in Att 5, App G.1.		

Response:

Step-by-step examples of the alternative final cover equivalency calculation in Part III, Attachment 5, Appendix G.1 have been provided in Attachment5, Appendix G.1 on pages 1 and 2.

TCEQ May 10, 2019 Email Item #9:

ID	Checklist Item	Citation
695	Demonstrate that the alternative final cover will provide equivalent wind & water erosion protection as the erosion layer specified in 330.457(a)(3)	330.457(d)(2)
Location	**NOD Type**	
Att 5	Inconsistent	
NOD Description		
Revise thickness and description of erosion layer on Fig. III.5-D.2 for consistency with other parts of application.		

Response:

The thickness and description of the erosion layer on Fig. III.5-D.2 has been revised for consistency with other parts of application.

TCEQ May 10, 2019 Email Item #10:

ID	Checklist Item	Citation
810	Identify all unloading areas and specify maximum size of each unloading area.	330.133(a)
Location	**NOD Type**	
Vol 6, Sec 4.6, pg 31-33	Ambiguous	
NOD Description		

Revise Part II, Sec 2.1 to clarify which wastes are accepted for disposal, which are accepted for processing, and to clearly indicate that whole used or scrap tires and unprocessed grease and grit trap waste or other waste containing free liquids are prohibited from disposal.

Response:

Part II, Sec 2.1, page 3 has been revised to clarify which wastes are accepted for disposal, which are accepted for processing, and to clearly indicate that whole used or scrap tires and unprocessed grease and grit trap waste or other waste containing free liquids are prohibited from disposal.

TCEQ May 10, 2019 Email Item #11:

ID	Checklist Item	Citation
833	Indicate that no unloading, storage, disposal, or processing operations will occur within easements, buffer zones, or rights-of-way that crosses the site, and that no disposal shall occur within 25 feet of the center line of any utility line or pipeline easement, unless otherwise authorized by the executive director	330.141(a)

Location	NOD Type
Vol 6, Sec 4.10, pg 35	Incomplete

NOD Description
Show the location of the electric easement on Part I, Att 2, Fig I.2-5 (or remove the reference from the text).

Response:

The location of the electric easement was added to Part I, Attachment 2, Figure I.2-5 as part of the response to the 1st Technical Notice of Deficiency submitted on February 15, 2019. A copy of the Attachment 2, Figure I.2-5 submitted on February 15, 2019 is attached.

TCEQ May 16, 2019 Email Item #1:

NOD Description
Clarify the discrepancy between the maximum capacity indicated in Table 2 on Part I, Att. 1, pg. 3, as well as on Par III, pg.10 (17,994,286 cy) and the max capacity obtained by adding the 12,455,714 cy increase indicated on Part I, Att. 1, pg. 2 to the existing capacity (total capacity of 18,268,714 cy).

Response:

The increase in capacity provided on Part I, Attachment 1, Section 1.3 page 2 has been revised to 12,181,286 cubic yards (cy) the actual increase in capacity due to this expansion.

The maximum capacity indicated in Table 2 on Part I, Attachment 1, page 6, as well as on Part III, pg.10 of 17,994,286 cy is correct.

TCEQ May 16, 2019 Email Item #2:

NOD Description
Clarify the permit history regarding exclusion and addition back in of the PreD area, and what is included in the current increase in acreage and capacity.

Response:

Part I, Attachment 1, Section 1.2, page 1 and Part I, Attachment 1, Section 1.3, page 2 have been revised to clarify the permit history regarding exclusion and addition back in of the PreD area, and what is included in the current increase in acreage and capacity.

TCEQ May 16, 2019 Email Item #3:

NOD Description
Provide acceptance rate and storage capacity for the processing areas (liquid solidification and tires).

Response:

Part II, Section 2.2, page 4 has been revised to provide acceptance rate and storage capacity for the liquid waste solidification and tire processing and storage areas.

TCEQ May 16, 2019 Email Item #4:

NOD Description
Provide the lowest elevation of waste placement.

Response:

Part I, Attachment 1, page 6, Table 2 has been revised to provide the lowest elevation of waste placement.

Per your May 10, 2019 email, one (1) original and one (1) copy of the response with applicable application revisions are included and one (1) copy of the response with applicable application revisions has been sent to the TCEQ Corpus Christi Region Office, to the attention of the Waste Section Manager. As noted in the Part I form, the response documents will be posted to a publicly accessible internet web site. If, while reviewing this response, you have any questions or would like additional information, please don't hesitate to contact me.

Sincerely,
HANSON PROFESSIONAL SERVICES INC.

Jon M. Reinhard, P.E.
Project Engineer

cc: Waste Section Manager, TCEQ Corpus Christi Region Office
Bill Donnell, Kingsville Public Works Director (2 copies)

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THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION

Volume 1 of 6

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

September 2018
Revision 1 – November 2018
Revision 2 – February 2019
Revision 3 – April 2019
Revision 4 – May 2019

For Permitting Purposes Only

STATE OF TEXAS
JON M. REINHARD
64541
LICENSED PROFESSIONAL ENGINEER
05/16/19

TBPE Firm No. F-417

Prepared by

HANSON
Engineering | Planning | Allied Services

TBPE F-417

HANSON PROJECT NO. 16L0438-0003

THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

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HANSON PROJECT NO. 16L0438- 0003

VOLUME 1 of 6

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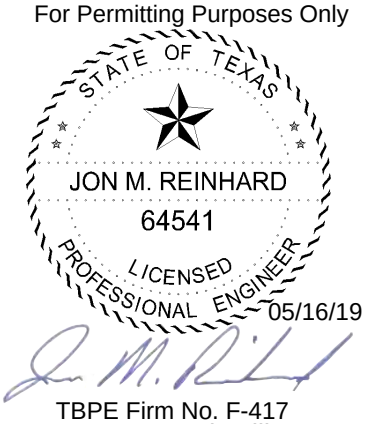
For Permitting Purposes Only



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Part II

Part II Attachments

Part III

Part IV Attachments

THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION

Part I

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

For Permitting Purposes Only

STATE OF TEXAS
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HANSON PROJECT NO. 16L0438-0003

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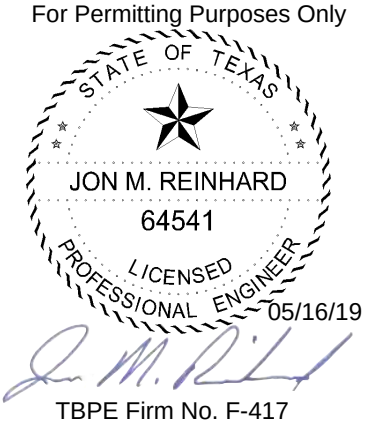
ATTACHMENTS

For Permitting Purposes Only



TBPE Firm No. F-417

Facility Name: City of Kingsville Landfill
Permittee/Registrant Name: City of Kingsville
MSW Authorization #:235C
Initial Submittal Date: September/2018
Revision Date: May/2019

Texas Commission on Environmental Quality

Part I Form for New Permit/Registration and Amendment Applications for an MSW Facility

1. Reason for Submittal

☐ Initial Submittal ☒ Notice of Deficiency (NOD) Response

2. Authorization Type

☒ Permit ☐ Registration

3. Application Type

☐ New ☒ Major Amendment

☐ Major Amendment (Limited Scope)

4. Application Fees

☐ Pay by Check ☒ Online Payment

If paid online, e-Pay Confirmation Number: **Trace Number: 582EA000315158, Voucher Number: 385823, Voucher Number: 385824**

5. Application URL

Is the application submitted for Type I Arid Exempt (AE) and/or Type IV AE facility?

☐ Yes ☒ No

If the answer is "No", provide the URL address of a publicly accessible internet web site where the application and all revisions to that application will be posted.
http://**www.cityofkingsville.com/departments/public-works/landfill/landfill-amendment-application/**

6. Application Publishing

Party Responsible for Publishing Notice:

☐ Applicant ☐ Agent in Service ☒ Consultant

Contact Name: **Scot Collins, P.G.** Title: **Project Manager**

Signature Page

I, William Donnell, Public Works Dir.,
(Site Operator (Permittee/Registrant)'s Authorized Signatory) (Title)

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.

Signature: WADonnell Date: 5-16-2019

TO BE COMPLETED BY THE OPERATOR IF THE APPLICATION IS SIGNED BY AN AUTHORIZED REPRESENTATIVE FOR THE OPERATOR

I, _____, hereby designate _____
(Print or Type Operator Name) (Print or Type Representative Name)

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.

_____
Printed or Typed Name of Operator or Principal Executive Officer

_____
Signature

SUBSCRIBED AND SWORN to before me by the said William A. Donnell
On this 16th day of May, 2019
My commission expires on the 1st day of November, 2022.
Monika Mascorro
Notary Public in and for
Kleberg County, Texas
(Note: Application Must Bear Signature & Seal of Notary Public)

MONIKA MASCORRO
My Notary ID # 131780973
Expires November 1, 2022

THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION

Part I

Attachment 1

Supplementary Technical Report

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

September 2018
Revision 1 – November 2018
Revision 2 - February 2019
Revision 3 - April 2019
Revision 4 - May 2019

For Permitting Purposes Only

STATE OF TEXAS
JON M. REINHARD
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LICENSED PROFESSIONAL ENGINEER
05/16/19

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HANSON PROJECT NO. 16L0438-0003

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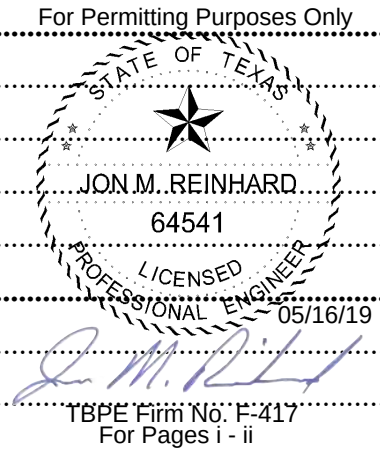

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1 SUPPLEMENTARY TECHNICAL REPORT

This supplementary technical report presents a detailed facility description, an overview of the project, as well as the types of waste that will be accepted at the facility.

1.1 Facility Description

The City of Kingsville Landfill (Kingsville Landfill) is an existing, Type I and Type IV municipal solid waste disposal facility (Permit No. MSW 235-B). The current permit boundary encompasses about 120 acres out of the 196.88 acre property boundary. In the current permit (235-B), approximately 90 acres are designated for Type I waste while 24 acres are designated for Type IV waste. Approximately 40 acres of the area designated for Type I waste have been developed. The existing lined areas correspond to Type I Sectors 1, 2, 3, and 4, all of which are still active. Sectors 1, 2 and 3 have intermediate covers while sector 4 is currently filling. Only about 10 acres of the area designated for Type IV waste have been developed.

Non-waste disposal areas included on the property include a scale house, office building and a maintenance shop.

1.2 Permit History

The site was originally permitted by the State of Texas in 1977. The initial facility was permitted (Permit No. 235) to receive 863,534 cubic yards (cy) of solid waste and initial filling operations began in February 1977. This original 40 acre site, began waste disposal operation at an approximate elevation of 40 MSL, progressed upwards in 4-feet layers, filled, and closed in March 1992. The floor soil of this sector was stabilized with bentonite. The original 40 acre sector, Permit 235, is closed and is not Subtitle D compliant.

The City of Kingsville received a permit amendment for an additional 34.85-acre lateral landfill expansion of the site in 1986 (Permit No. 235-A) increasing the permitted acreage to 74.85 acres. The approved Permit 235-A, was developed and the configuration of the approximately 20-acre Sector 1, received the first load of waste material in March 1992.

Permit No. 235-B was issued in 1999, removing the original 40 acre (235) closed portion and adding an additional 83.55 acres increasing the permitted acreage from 74.85 acres to approximately 118.4 acres and a maximum height of final cover of 125 feet-msl. Kingsville Landfill is currently operating under the 1999 permit requirements and subsequent permit modifications or authorizations. At the current gate rate, the estimated site life remaining is approximately 43 years.

The following table summarizes the list of permits obtained for the operation of Kingsville over the years.

TABLE 1: PERMIT HISTORY SUMMARY

PERMIT NUMBER	TYPE	DATES
235	I	1977 to 1992
235-A	I	1986 to 1999
235-B	I and IV	1999 to Present

1.3 Project Overview

The purpose of this permit amendment is to increase the capacity of the landfill site via a vertical and horizontal expansion. The existing active approximately 118.4 acre permitted area will be expanded to a total of 176.33-acres (121.3-acre waste disposal footprint). This increase will include approximately 19.45-acres to the northeast of the permitted boundary which is currently being used as a soil borrow pit and another approximately 38.45-acres to the southwest, in the area of the closed Pre-Subtitle D landfill area (Permit No. 235). The closed Pre-Subtitle D landfill area will be overlined with Subtitle D compliant liner and will receive additional waste to be placed over the previously deposited waste. The previously deposited waste in the closed Pre-Subtitle D landfill area will not be disturbed, the Subtitle D compliant overliner will be placed over the final cover the closed Pre-Subtitle D landfill area.

The vertical expansion will include; placing additional waste on top of the closed pre-subtitle D landfill area, increasing the depth of the landfill excavation in the areas that have not yet been lined, increasing the landfill's maximum elevation and modifying the slopes on top of the landfill. The revised elevation of the deepest excavation will be 22.5 feet-msl and the maximum final cover elevation will be increased from 125 feet-msl to 200 feet-msl. Details of the revised floor contours, as well as the modified final cover contours and cross sections are provided in Part III, Attachment 1, Figures III.1-3, III.1-4, III.2-1 and III.2-5.

The vertical and horizontal expansion will result in a capacity increase of 12,181,286 cubic yards of waste and daily cover, or approximately 5,150,438 tons of waste capacity. Making the total remaining waste disposal capacity 15,225,000 cubic yards of waste and daily cover, or approximately 6,295,538 tons of remaining waste disposal capacity. This landfill expansion will provide for the long-term disposal needs of Kleberg County, and surrounding communities.

Other parts of this permit amendment are to; convert the existing Type IV Sectors to Type I Sectors, request for approval to process and dispose of additional special wastes including liquid wastes and used tires (Refer to Part II, Section 2 and Part IV - Site Operating Plan, for a more detailed discussion), and to revise the floor contour and final contour plans to incorporate the modifications discussed in previous paragraphs.

The following table provides a summary of the current permitted conditions and proposed permit conditions.

TABLE 2: PERMIT CONDITION SUMMARY

	CURRENT CONDITIONS	**PROPOSED CONDITIONS**
Permitted Area	120 acres	176.33 acres
Total Permitted Capacity	Type I - 4,993,000 cy Type IV - 820,000 cy 5,813,000 cy	17,994,286 cy
Total Remaining Capacity	1,258,576 tons 3,043,714 cy	6,295,538 tons 15,225,000 cy
Remaining Projected Site Life	43	98
Maximum Elevation of Final Cover (msl)	125	200
Lowest Elevation of Waste Placement (msl)	46.5	26.5
Elevation of Deepest Excavation (msl)	42.5	22.5

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400 200 0 400

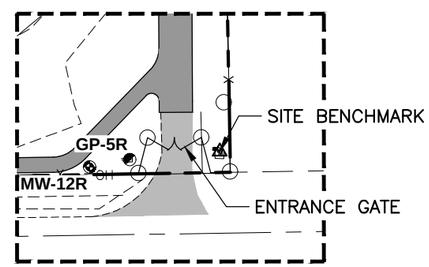
GRAPHIC SCALE IN FEET

C.R. 2120
MW-15
GP-13
MW-22R
GP-12
MW-6RA
GP-11R
MW-31
GP-10R
MW-21R
GP-9R
MW-14
STORMWATER RETENTION POND C
BRUSH STORAGE & PROCESSING AREA
400.0'
200.0'
STORMWATER DETENTION POND B
MW-23
SECTOR 7
SECTOR 6
SECTOR 5
SECTOR 4D
SECTOR 4C
SECTOR 4B (ACTIVE)
SECTOR 4A (ACTIVE)
563.0'
464.0'
548.0'
651.2'
369.0'
495.0'
383.0'
1195.0'
1195.0'
1251.0'
600.0'
506.6'
MW-32
MW-20
GP-8
20' ELECTRIAL EASEMENT
TIRE STORAGE & PROCESSING AREA
115.0'
130.0'
200.0'
65.0'
WHITE GOODS & METAL RECYCLABLES STORAGE AREA
GP-14
MW-30
MW-16
MW-13
LOCATION OF LEACHATE STORAGE TANKS
MAINTENANCE BUILDING
SUPPORT AREA (SEE FIGURE III.1–14)
SCALE HOUSE
GP-7R
MW-33
SECTOR 8A
SECTOR 3 (ACTIVE)
SECTOR 1 (ACTIVE)
SECTOR 2 (ACTIVE)
SECTOR 8B
640.2'
1097.6'
657.4'
527.0'
1286.4'
682.6'
605.0'
455.0'
539.3'
621.0'
GP-15
MW-27
MW-19
STORMWATER RETENTION POND A
FM 2619
GP-6R
MW-8
GP-16
MW-34
GP-17
MW-24
MW-29
MW-28
GP-1R
MW-1RA
GP-3R
C.R. 2130
SITE ENTRANCE (SEE INSET A)

LEGEND:

- MW-20 — MONITOR WELL LOCATION
- GP-8 — GAS PROBE LOCATION
- EXISTING FENCE CORNER
- EXISTING FENCE
- EXISTING PROPERTY BOUNDARY
- EXISTING ROAD
- PERMIT BOUNDARY LIMITS
- PROPOSED ROAD
- PROPOSED STORMWATER LETDOWN STRUCTURE
- PROPOSED STORMWATER PONDS
- PROPOSED LIMITS OF WASTE/WASTE FOOTPRINT

NOTE:
DIMENSIONS PROVIDED FOR THE ACTIVE SECTORS ARE BASED ON APPROVED GLERS AND HISTORICAL SECTOR CONSTRUCTION DOCUMENTS.



INSET A

NUMBER	REVISION	DATE	DRAWN	DESIGNED	REVIEWED

STATE OF TEXAS
JON M. REINHARD
64541
LICENSED PROFESSIONAL ENGINEER
02/12/19

Hanson No. 16L0438
Filename
Scale AS SHOWN
Date 02/12/2019

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DRAWN	DT	02/12/2019
REVIEWED	JMR	02/12/2019

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PART I, ATTACHMENT 2
FACILITY LAYOUT PLAN
CITY OF KINGSVILLE LANDFILL
MSW PERMIT No. 235-C
KINGSVILLE, TEXAS
KLEBERG COUNTY, TEXAS

FIGURE:
I.-2-5

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THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION

PART II

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

For Permitting Purposes Only

September 2018
Revision 1 – November 2018
Revision 2 - February 2019
Revision 3 - April 2019
Revision 4 - May 2019

STATE OF TEXAS
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05/16/19

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HANSON PROJECT NO. 16L0438-0003

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2 WASTE ACCEPTANCE PLAN §330.61(b)

2.0 Sources and Characteristics of Waste

The operational procedures and redesign described in the Permit Amendment Application, once approved, will allow the facility to: accept, store and dispose of municipal solid waste, construction and/or demolition waste, industrial waste non-hazardous Class 2 and Class 3 and some special wastes as defined by 30 TAC §330.3, 30 TAC §330.171, and 30 TAC §330.173; and accept, store, and process municipal solid waste, construction and/or demolition waste, whole and scrap tires, grease and grit trap waste, and liquid waste. The facility will accept for disposal the following special waste allowable under 30 TAC §330.171: special wastes from health care related facilities, dead animals and/or slaughterhouse waste, non-regulated asbestos-containing materials (non-RACM), empty containers which have been used for pesticides, herbicides, fungicides, or rodenticides, Municipal hazardous waste from a conditionally exempt small quantity generator (CESQG), sludge, grease trap waste, grit trap waste, soil contaminated by petroleum products, crude oils, or chemicals and liquid waste from oilfield activities. Procedures for accepting and processing all special waste are detailed in the Site Operating Plan (Part IV). In the event that the City of Kingsville Landfill elects to accept other special wastes in the future, TCEQ authorization will be sought and procedures for acceptance and processing will be provided. Other materials that will be received for processing and potentially beneficial reuse include scrap tires and unsorted mixed recyclables.

Consistent with 30 TAC §330.15, the City of Kingsville Landfill will not accept for disposal lead acid storage batteries, used motor vehicle oil, used oil filters, refrigerators, freezers, air conditioners or other items containing chlorinated fluorocarbons (CFC), regulated hazardous waste, polychlorinated biphenyls (PCB) waste, radioactive materials, or other wastes prohibited by TCEQ. Friable asbestos-containing materials, and empty containers, as well as industrial hazardous waste, and Non-hazardous Class 1industrial waste will not be accepted for disposal.

The Site Operating Plan in Part IV of the application contains a detailed description of the restrictions pertaining to waste acceptance procedures. The Applicant (City of Kingsville) reserves the right to reject any waste material, including those mentioned above, that contributes a constituent or characteristic that may impact or influence the design or operation of the facility.

2.1 Volume and Rate of Disposal

Kingsville Landfill received approximately 31,444 tons of incoming solid waste in 2017. The maximum annual waste acceptance rate is anticipated to increase at approximately one (1) percent per year which corresponds to the anticipated yearly population growth rate for Kleberg County (based on population projections from the Texas State Data Center).

Table 1 shows the estimated maximum annual waste acceptance rates for the facility projected for five years, together with the associated population equivalents represented by these quantities.

TABLE 1: ESTIMATED MAXIMUM ANNUAL WASTE ACCEPTANCE RATE

Year	Estimated Maximum Annual Waste Acceptance Rate (Tons)	Population Equivalent
1	31,758	34,745
2	32,076	35,092
3	32,397	35,443
4	32,721	35,798
5	33,048	36,156

Note that these figures are only estimates and should not be considered either as a firm commitment of quantities to be received or as a limitation on the amount of waste to be received in any of the years shown. Actual quantities accepted at the site will vary depending on changes in population, economic activity, and changes in waste collection and disposal practices in the region. The City of Kingsville will continue to maintain records to document the annual waste acceptance rate for the facility. If the rate exceeds the estimated rate and is not due to a temporary occurrence, the City of Kingsville will file a permit modification application consistent with 30 TAC §330.125(h).

Once expanded, the landfill will provide a total remaining waste disposal capacity of approximately 15,225,000 cubic yards of waste and daily cover. The estimated site life is 98 years (See Part III, Section 5 for the detailed site life calculation).

2.2 Waste Acceptance Rate and Storage Capacity of Processing Areas

Tire Storage and Processing Area

Kingsville Landfill is estimated to accept approximately 15 tires a day. The maximum storage capacity is 500 tires or weight equivalent tire pieces or any combination thereof on the ground or 2,000 tires or weight equivalent tire pieces or any combination thereof in enclosed and lockable containers.

Liquid Waste Solidification Area

Kingsville Landfill is estimated to accept approximately 19,500 gallons a day. The maximum storage capacity in the Liquid Waste Solidification Area is 19,151 gallons.

9 TRANSPORTATION §330.61(i)

9.1 Selected Routes

Vehicles entering the City of Kingsville Landfill include semi-trailers, dump trucks and trailers, and light duty trucks. E County Road 2130 (CR E 2130), Farm to Market Road 1717 (FM 1717), and Farm to Market Road 2169 (FM 2169) will provide access to the site. These routes are asphalt paved and are the same routes currently in use for the City of Kingsville Landfill. The transportation network used to access the landfill is presented as Part II, Attachment 1. Figure II.1-1.

9.2 Adequacy of Roads

The privately owned site entrance road is currently a two-lane, 24-foot wide road maintained by the City of Kingsville to ensure access to the facility. The Texas Department of Transportation is responsible for maintaining FM 2169 and FM 1717 while E CR 2130 is maintained by Kleberg County. All roads are adequate for use by vehicles up to the legal maximum of 58,420 pounds, including solid waste collection vehicles entering and exiting the facility. Periodic maintenance of the roads is routinely undertaken by the City and TXDOT as necessary to maintain availability of these routes to the landfill and to ensure that residents and businesses along the routes have continued access. Correspondence with TXDOT regarding the adequacy of roads used to access the facility is included in Part II, Attachment 3. TXDOT responded to the NORI with a memo, dated April 16, 2019, stating that the facility is subject to the Highway Beautification Act requirements (43 TAC Chapter 21, Subchapter H). The April 16, 2019 memo is included with Part II, Attachment 3–B. The facility will provide appropriate screening for a sanitary landfill in accordance with the screening requirements provided in the TxDOT ROW Beautification Manual - Manual Notice: 2018-1 dated June 15, 2018, Chapter 10: Control of Junkyards, Section 2: Screening Standards and as approved by the TXDOT District Engineer for Kleberg County.

9.3 Existing Traffic Volumes

All landfill traffic access the facility via the single site entrance road from E County Road 2130 (E CR 2130) and Farm to Market Road 2619 (FM 2619) which is in-turn accessed via Farm to Market Road 1717 (FM 1717). TXDOT records show the Annual Average Daily Traffic (2016 AADT) is approximately 731 on FM 2619 at the nearest traffic count northwest of the landfill and 1,218 on FM 1717 at the traffic count northwest of the landfill (Refer to Part II, Attachment 1. Figure II.1-1. There are no available traffic counts for E CR 2130. Approximately 46 City, commercial, and citizen waste hauling vehicles per day use the City of Kingsville Landfill.

9.4 Projected Volume of Vehicular Traffic

The proposed vertical and lateral expansion will not have an impact on vehicular traffic in the area as the rate at which municipal solid waste is received by the facility will not be affected. The traffic volume projection is calculated at the expected annual population growth rate of approximately one (1) percent. Traffic volumes and calculations are presented in the Table 3.

THE CITY OF KINGSVILLE LANDFILL
TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION
PART III
SITE DEVELOPMENT PLAN

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

For Permitting Purposes Only

STATE OF TEXAS
JON M. REINHARD
64541
LICENSED PROFESSIONAL ENGINEER
05/16/19

September 2018
Revision 1 – November 2018
Revision 2 - February 2019
Revision 3 - April 2019
Revision 4 - May 2019

Prepared by

TBPE Firm No. F-417

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HANSON PROJECT NO. 16L0438-000

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THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION

Volume 2 of 6

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

For Permitting Purposes Only

STATE OF TEXAS
JON M. REINHARD
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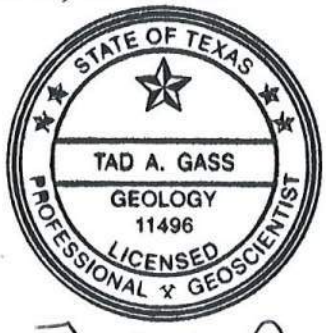
THE CITY OF KINGSVILLE LANDFILL
TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION
PART III, ATTACHMENT 4
GEOLOGY REPORT

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

September 2018
Revision 1 – November 2018
Revision 2 – February 2019
Revision 3 – April 2019
Revision 4 – May 2019



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Stratigraphic Position of Site

Table 2-1
Geologic Formations for Kleberg County

Period	Epoch	Geologic Formation	Approximate Maximum Thickness (FT)	Litholgy	Water-Bearing Properties
Quaternary		Alluvium	?	Mostly very fine to fine sand, silt, and calcareous clay	Not significant as an aquifer. Not known to be tapped by wells.
		Barrier Island Deposits	50	Tan to gray, fossiliferous, medium sand containing wood fragments; interbedded tan sand and gray clay, locally gypseous; and gray, fossiliferous sandy clay	Capable of yielding small quantities of fresh water to shallow wells on Padre Island.
	Holocene and Pleistocene (?)	South Texas Eolian Plain Deposits	60+	Tan to white, unfossiliferous, massive, fine to very fine sand, greenish gray sandy clay, highly calcareous clay or marl, and thin-bedded clayey sand.	Yields small quantities of sl ightly saline water to a few stock wells in Kenedy County. in sofne areas in Kenedy County the sand contains brine
	Pleistocene	Barrier Island and Beach Deposits	1,400	Barrier island and beach deposits mostly light gray, massive, crossbedded fine sand about 60 feet thick; contains some shell fragments.	Barrier island and beach deposits yield small quantities of fresh to probably moderately saline water to a few stock wells in eastern Kleberg County near Laguna Madre.
		Beaumont Clay and Lissie Formation, Undifferentiated		Beaumont Clay and Lissie Formation mostly very calcareous, slightly carbonaceous, blue and yellow clay and a few lenticular beds of sand.	Beaumont Clay and Lissie Formation yield small quantities of slightly to moderately saline water to a few mostly stock wells in eastern part of Kleberg and Kenedy Counties.
Tertiary	Pliocene	Goliad Sand	1,100	Fine to coarse, mostly gray calcareous sand interbedded with sandstone and varicolored calcareous clay. Sand beds or sandstone compose from 40 to 60 percent of the formation.	Principal aquifer. Yields small to large quantities of fresh to slightly saline water to public supply, industrial, and irrigation wells as well as to numerous rural domestic and stock wells. Many of the wells tapping the Goliad in Kleberg and Kenedy Counties flow.
	Miocene	Lagarto Clay	1,200+	Mostly stiff, compact, gray, calcareous clay and some thin lenticular beds of gray sand.	Not known to be tapped by wells, but capable of yielding small quantities of slightly saline water in Kenedy and Jim Wells Counties.
		Oakville Sandstone	600	Very fine to coarse, brown to gray sand and sandstone interbedded with silt and a considerable amount of clay.	Yields small to moderate quantities of sl ightly saline water to industrial and stock wells in southern Jim Wells County.

*(Source) Texas Water Development Board, Report 173, Ground-Water Resources of Kleberg, Kenedy, and Southern Jim Wells Counties, Texas, July 1973. (Shafer, 1973)
The site overlies the South Texas Eolian Plain Deposits. The hydrogeologic units below the site consist of the Chicot Aquifer within the Lissie Formation followed by the Evangeline Aquifer within the Goliad Sand (Principal Aquifer of the site).

number and depth at a minimum. Soil test borings were visually logged in the field and boring logs have been provided in Appendices 1, 2, and 3.

3.3 Site Stratigraphy

As seen on Figure 4.4 and 4.4a (Page 19-20), the primary geologic formations exposed at the surface of the site are silt sheet deposits, clay dune, and clay-sand dune deposits. The topsoil consists of clay which is black, silty, and contains humic material. Sediments encountered in borings at the site are Holocene and Pleistocene in age and consist of clays, silts, sands, and caliche deposited in two (2) separate and distinct environments of deposition. The subsurface geology is presented on cross sections A–A' through I–I' included in Appendix 1 beginning on page 67. Additional cross sections (A–A' through E–E') developed from soil borings installed during Tolunay-Wong Engineers, Inc.'s investigation have been provided in Appendix 3 (Soil Boring Report) Exhibit IV.

The site is underlain by sediments that can be divided into five discontinuous units and one continuous unit. The discontinuous units are caliche bearing channel unit (I), sand filled channel unit (II), clayey sand unit (clay dune, III), clayey sand unit (clay dune IV), and sandy silty clay unit. The continuous unit consists of the light olive green to gray clay unit which is an aquiclude present below the site. Several borings installed by Tolunay-Wong (B-30, B32, and B-39) located a clayey sand layer below the light olive green to gray clay unit. The water bearing zone is made up of the five discontinuous units which are all in communication. The average ground water level is at approximately 35 feet National Geodetic Vertical Datum (NGVD).

3.3.1 Body I- Caliche Bearing Channel

As stated in Appendix 1 (Page 59), this is the youngest, most extensive, sand containing body that can be correlated across the site. This body consists of interbeds of caliche, clays, and sands which, in themselves, are noncorrelative. The individual beds within this body appear to be of limited extent and probably represent braided deposits within a single channel approximately ½ mile in width. The base of this channel is placed at the base of the lowest caliche encountered in the borings at the site. When grouped together, it can be shown via cross section and isopach mapping that the body can obtain a maximum thickness of 40 feet and, as a whole, cuts downward into underlying beds. This body was deposited as a channel system which trends in a down dip direction, southwest to northeast, across the City of Kingsville Landfill site. Much of the caliche contained within this body has been previously removed from the site by mining operations. The Caliche Bearing Channel can be seen in Tolunay-Wong borings B-31, B-37, B-33, B-36, and B-39 as seen on cross section B-B' of Exhibit IV of the Soil Boring Report. The Clayey Sand (SC) layer of this cross section has mention of calcareous nodules, trace gravel, and trace caliche in the respective boring logs. Samples from this stratum indicated an average horizontal permeability of $3.0x10^{-4}$ cm/sec.

3.3.2 Body II- Sand Filled Channel

As stated in Appendix 1 (Page 59), Body II was deposited as a channel filled with a homogeneous, well sorted, very fine grained to fine grained, clean, unconsolidated sand. The fill sediment in Body II is much simpler than the fill sediment in Body I. The preserved length and width of this channel sand is less than one half mile due to truncation and incisement by the overlying Body I channel. Body II is interpreted as being a channel due to down cutting evident on the cross sections. This channel sand is apparent in borings 10 and 17. Body II (seen as SM on Cross Sections A–A', B–B', C–C', and D–D' on Exhibit IV of the Soil Boring Report in B-34, B-37, and B-40) was also

evident in borings 37, 34, and 40 which were installed in the most recent geotechnical investigation by Tolunay-Wong Engineers, Inc. B-37 penetrated approximately 14.5 feet of the silty sand (SM), B-34 penetrated approximately 21.5 feet of the silty sand (SM), and B-40 penetrated approximately 14.5 feet of the silty sand (SM). Deposition of the Body II channel sand was oriented in a dip direction, southwest to northeast across the site. Permeability tests performed on samples from this stratum indicated an average vertical and horizontal permeability of $1.0x10^{-4}$ cm/sec and $3.0x10^{-5}$ cm/sec respectively.

3.3.3 Body III- Clayey Sand (Clay Dune)

As stated in Appendix 1 (Page 59-60), the Clayey Sand (Clay Dune) Body III lies under the eastern edge of the City of Kingsville Landfill site and is composed of a homogeneous, very fine grained, well sorted, clayey sand. Well 13 was previously the only known penetration of the sand encountering a thickness of 17'. Boring 39, installed by Tolunay-Wong Engineers, Inc., also penetrated Body III (seen as SP-SC on Cross Sections B–B' on Exhibit IV of the Soil Boring Report in B-39) at approximately 44.5 feet below a ground elevation of 60.26 feet respectively. At it's base, the sand appears to be conformable with the underlying "orange" sand which is interpreted as a near shore or beach sand. Body III is interpreted as a clay dune based on clay content, sorting, and stratigraphic position within an overall regression section. Permeability tests performed on this layer indicated vertical and horizontal permeabilities of $2.3x10^{-5}$ and $1.75x10^{-5}$ cm/sec, respectively.

3.3.4 Body IV- Clayey Sand (Clay Dune)

As stated in Appendix 1 (Page 60), the Clayey Sand (Clay Dune) Body IV is believed to be a time and stratigraphic equivalent of Body III, described above, and underlies a portion of the western edge of the City of Kingsville Landfill site. Borings 16 and 23 penetrated 18 feet and 12 feet respectively, immediately above the underlying "orange" sand. Boring 31 installed by Tolunay-Wong Engineers, Inc., also penetrated Body IV (seen as SP-SC on Cross Section B–B' of Exhibit IV of the Soil Boring Report in B-31) at approximately 14.5 feet below surface elevation of 58.37 feet. Body IV sand is similar in all respects to the homogeneous, very fine grained, well sorted, clayey sand which comprises Body III above. Cross section G-G' included in Appendix 1 (wells 16 and 23) illustrates the top of Body IV as being concave downward with a flat base, indicating deposition as a "buildup" or clay dune. Again, Body IV appears conformable with the underlying "orange" which is interpreted as a near shore or beach sand. Bodies III and IV are typical of the QCD deposits seen on the Geologic Atlas of Texas Corpus Christi Sheet. QCD is comprised of clay due and clay-sand dune deposits and possess physical properties similar to those of the sandy and silty Beaumont Formation as indicated in the Geologic Atlas of Texas. Vertical permeability of this layer was $3.3x10^{-6}$ cm/sec.

3.3.5 Sandy Silty Clay Bed

As stated in Appendix 1 (Page 60), the sandy clay bed was deposited in conjunction with Bodies I through IV and is composed of a homogeneous, tan, sandy clay containing abundant decomposed organic material. Thickness of this clay ranged from 40 to 60 feet under the City of Kingsville Landfill site with the above described Sand Bodies deposited within or adjacent to this clayey interval. The basal contact is abrupt with the underlying "orange" Sand. Several borings installed by Tolunay-Wong Engineers, Inc., penetrated the Sandy Silty Clay bed unit seen as CL-ML and CL on Cross Sections A–A', B–B', C–C', and D–D' of Exhibit IV of the Soil Boring Report in B-

31, B-32, B-33, B-34 and B-37. The average vertical and horizontal permeabilities were $1.0x10^{-5}$ cm/sec and $2.75x10^{-6}$ cm/sec, respectively.

3.3.6 "Orange" Sand

As stated in Appendix 1 (Page 60), the "orange" sand appears to have been deposited in a near shore or beach environment. The sand is extremely well sorted and clean and the grains are well rounded and composed of approximately 90% fine quartz grains and 10% fine multicolored shell fragments giving the overall sand color an orange cast. The thin (<5 feet), sheet-like nature of the sand represents a beach environment of short duration developed at the top of the Beaumont clay (Light Olive Green to Gray Clay). It is present in all wells of sufficient depth.

3.3.7 Light Olive Green to Gray Clay

As stated in Appendix 1 (Page 61), tops of the Light Olive Green to Gray Clay are necessary to make the above interpretations of shallower beds in that it is the most definitive, planar marker bed under the City of Kingsville Landfill site. This clay is pure and therefore exhibits characteristic low permeabilites with a proven thickness of at least 38 feet as seen in Boring 21 (boring log included in Appendix 1). The light olive green clay layer begins at approximately 46 feet below the ground surface elevation of 52.41 feet in boring 21, and the boring was terminated at approximately 84 feet below the surface elevation (bottom elevation of -36.5 feet). The clay layer is also evidenced in boring B-23 with an approximate thickness of 50 feet. The layer begins at approximately 36 feet below the surface elevation of 49.50 feet, and the boring terminates at approximately 86 feet below the surface elevation (bottom elevation of -36.5 feet). All borings of sufficient depth installed by Tolunay-Wong Engineers, Inc., penetrated the Light Olive Green to Gray Clay unit seen as CH on Cross Sections A–A', B–B', C–C', D–D', and E–E' of Exhibit IV of the Soil Boring Report. The vertical permeability of this clay averaged $3.3x10^{-8}$ cm/sec. The vertical permeability ranged from $1.33x10^{-9}$ cm/sec to $6.18x10^{-8}$ cm/sec.

3.3.8 Clayey Sand

Borings B-30, B-32, and B-39 installed during the Tolunay-Wong Engineers, Inc. investigation located a clayey sand (SC) layer below the light olive green to gray clay unit. The SC layer consist of light gray to tan clayey sand with calcareous nodules and some ferrous staining, and can be seen on Cross Sections B-B', C-C', and D-D'. In accordance with TAC §330.63(e)(5)(A), no permeability samples were collected.

3.4 Geologic Fault and Seismicity Assessment

A geologic fault and seismicity assessment was performed by FEE. Sections 3.3.1 (Page 26-27) and 3.3.4 (Page 28) in Appendix 1 discusses faults and faulting, and seismic impact zones at the City of Kingsville Landfill. Conclusions from FEE are as follows:

"An evaluation of potential faults or fault zones does not indicate the presence of *active* faults. Topographic Maps, literature searches, aerial photographs, Petroleum Industry maps and a field survey were used in this evaluation. The field survey combined with topographic maps did not *reveal* structural damage to buildings, ground scarps, or unusual surface depressions. Changes in drainage or vegetation patterns which are also associated with faulting were not present. Data presented by Algermissen, et al, 1990 suggests a low probability of major seismic activity in the vicinity of the site." FEE also stated that, "An updip projection of the regional Frio growth fault passes below the landfill site at approximate depths of 6,000 to 7,000 feet, but the fault is buried below the Miocene age Oakville formation and therefore does not influence shallower beds."

In-situ moisture contents of selected cohesive clay samples ranged from 18% to 34%. Results of Atterberg Limits tests on selected clay samples indicated liquid limits (LL) ranging from 31 to 81 with plasticity indices (PI) ranging from 18 to 58. The amount of materials finer than the No. 200 sieve on the selected samples ranged from 55% to 100%. In-situ moisture contents of selected silty sand samples ranged from 23% to 24%. The amount of materials finer than the No. 200 sieve on the selected samples tested for grain size distribution ranged from 14% to 38%.

Undrained shear strengths derived from field pocket penetrometer readings ranged from 0.25-tsf to 4.50-tsf. Undrained shear strengths derived from laboratory unconfined compressive (UC) strength testing ranged from 0.16-tsf to 3.41-tsf with corresponding total unit weights of 86-pcf to 105-pcf. Shear strength of cohesive soils inferred from SPT blow counts generally were similar. Based on this undrained shear strength data, the consistency of the cohesive soils encountered in the project borings is considered to be very soft to very stiff. Tabulated laboratory test results at the recovered sample depths are presented on the boring logs in Appendix B of Appendix 2 beginning on page 31.

Hydraulic conductivity tests were not performed during the Tolunay-Wong Engineers, Inc. geotechnical investigation due to values already being established under previous evaluations. Table 4-2 below shows hydraulic conductivity values compiled from Finch Energy & Environmental Services Inc.'s geotechnical investigation results, as discussed further in section 8.0 of Appendix 1 beginning on page 87. Borings from the FEE report were used as proxies for hydraulic conductivity of the units encountered in the borings drilled during the Tolunay-Wong investigation.

TABLE 4-2 – HYDRAULIC CONDUCTIVITY SUMMARY

Soil Boring ID	Soil Type	Unit	Permeability		Proxy Borings
			Vertical (cm/sec)	Horizontal (cm/sec)	
B-30	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-30	Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-30	Clayey Sand	CLAYEY SAND	---	---	---
B-30	Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-31	Clayey Sand	BODY I		3.0x10-4	B-5
B-31	Poorly Graded Sand with Clay	BODY IV	$4x10^{-6}$ to $1.2x10^{-5}$		B-16
B-31	Sandy Lean Silty Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-31	Sandy Lean Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-31	Fat Clay with Sand	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-32	Sandy Lean Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-32	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5

B-32	Fat Clay with Sand	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-32	Clayey Sand	CLAYEY SAND	---	---	---
B-33	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-33	Poorly Graded Sand with Silt	BODY II	$1x10^{-4}$	$3x10^{-5}$	B-17
B-33	Clayey Sand	BODY II	$1x10^{-4}$	$3x10^{-5}$	B-17
B-33	Lean Clay with Sand	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-33	Lean Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-33	Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-33	Fat Clay with Sand	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-34	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-34	Sandy Lean Silty Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-34	Silty Sand	BODY II	$1x10^{-4}$	$3x10^{-5}$	B-17
B-34	Lean Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-35	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-35	Sandy Lean Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-35	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-35	Fat Clay with Sand	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-35	Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-36	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-36	Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-37	Silty Sand	BODY II	$1x10^{-4}$	$3x10^{-5}$	B-17
B-37	Sandy Lean Silty Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-37	Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-38	Sandy Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-38	Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-39	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-39	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-39	Sandy Lean Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24

B-39	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-39	Poorly Graded Sand with Clay	BODY III	$3.4x10^{-7}$ to $4.6x10^{-5}$	$5x10^{-6}$ to $3x10^{-5}$	B-13
B-39	Fat Clay with Sand	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-39	Clayey Sand	CLAYEY SAND	---	---	---
B-40	Silty Sand	BODY II	$1x10^{-4}$	$3x10^{-5}$	B-17
B-40	Fat Clay with Sand	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-40	Sandy Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-40	Clayey Sand	BODY II	$1x10^{-4}$	$3x10^{-5}$	B-17
B-41	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-41	Sandy Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-41	Fat Clay with Sand	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25

Note:*Hydraulic Conductivity value taken from B-13 from 25-26 ft bgs (approximate elevation of 33-34 NGVD) with Unified Soil Classification System CH classification (Inorganic clays of high plasticity, fat clays).

4.2 Geotechnical Analysis

4.2.1 Settlement Analysis

One-dimensional consolidation tests were performed by Tolunay-Wong Engineers, Inc. using select samples from the soil borings to evaluate the compressibility characteristics of the foundation soils. The results of the consolidation tests are presented in Appendix D of Appendix 2 (Page 65-67). The predicted settlements resulting from consolidation settlement of the foundation soils due to the weight of the overlying landfill material are on the order of 1 foot.

Mr. Ralph N. Lewis of PSI also performed a settlement analysis during PSI's previous geotechnical analysis, and his calculations are shown in Appendix H.2 of Appendix 1 (Page 539). His calculations show that conservatively the final landfill cover will settle 3.0 inches at the center and 1.5 inches at the edges of the landfill. These calculations were based on previous landfill designs and capacities.

4.2.2 Slope Stability

A slope stability analysis was conducted by FEE. The objective of the analysis was to determine the local sliding stability of the liner system and cover as well as the overall stability of the embankment slope. The proposed embankments have a 4 (horizontal) to 1 (vertical) slope. FEE determined that a maximum allowable landfill height to satisfy a minimum factor of safety of 2.0 under static loading conditions was approximately 125 NGVD. Further discussion of the results from these analyses can be seen in Appendix 1 Section 8.3- Engineering Analyses beginning on page 120. Tolunay-Wong Engineers, Inc. also performed a waste mass stability analysis during their geotechnical engineering study. Tolunay determined that the calculated factor of safety for peak shear strength conditions exceeded 1.5 for their assumed strength and unit weight parameters, the analyzed cross sections, and assumed failure geometry. The calculated factor of safety for large displacement condition exceeds 1.5, which in their judgement, and based on published

THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION

Volume 3 of 6

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

For Permitting Purposes Only

STATE OF TEXAS
JON M. REINHARD
64541
LICENSED PROFESSIONAL ENGINEER
05/16/19

September 2018
Revision 1 – November 2018
Revision 2 – February 2019
Revision 3 – April 2019
Revision 4 – May 2019

Prepared by

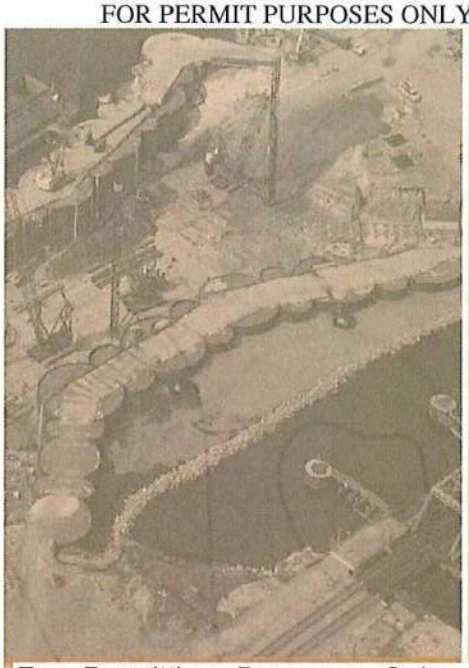
TBPE Firm No. F-417

HANSON
Engineering | Planning | Allied Services

TBPE F-417

HANSON PROJECT NO. 16L0438-0003

FOR PERMIT PURPOSES ONLY



Tolunay-Wong Engineers, Inc.

GEOTECHNICAL ENGINEERING STUDY
CITY OF KINGSVILLE MUNICIPAL SOLID WASTE LANDFILL EXPANSION
KINGSVILLE, TEXAS

For Permitting Purposes Only. Applies to boring logs in Appendix B of Tolunay-Wong Engineers, Inc. Geotechnical Engineering Study, City of Kingsville Municipal Solid Waste Landfill Expansion, Kingsville, Texas – Report No. 12788R1, sealed by Don R. Rokohl, P.E. on 8-30-18 altered to provide text showing surface elevations, the elevations of all contacts between soil and rock layers, and unit identifiers in the soil boring logs. No information or data was altered or changed from the original report other than the addition of text showing these elevations and unit identifiers in Appendix B.

Prepared for:

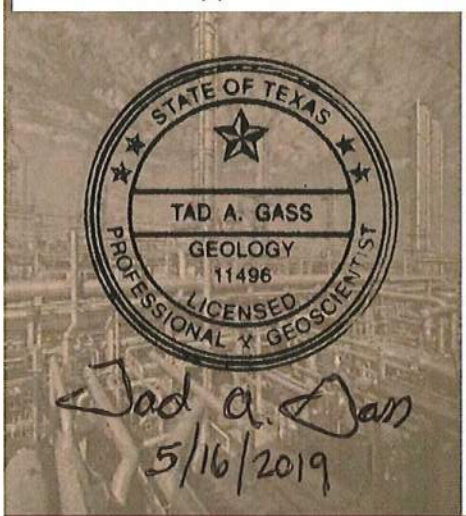
Naismith/Hanson
Corpus Christi, Texas

Prepared by:

Tolunay-Wong Engineers, Inc.
826 South Padre Island Drive
Corpus Christi, Texas 78416

August 30, 2018

Project No. 16.53.042 / Report No. 12788R1



GEOTECHNICAL ENGINEERING, DEEP FOUNDATIONS TESTING, ENVIRONMENTAL SERVICES, CONSTRUCTION MATERIALS TESTING

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LOG OF BORING B-30

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 44.0"
W 97° 49' 23.1"
SURFACE ELEVATION: 45.99' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 82.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Dense to very dense tan and gray CLAYEY SAND (SC) with gypsum crystals BODY I		11/6" 23/6" 50/5"	16		42	17				37	
5			-color changes to tan with ferrous staining		34/6" 50/3"									
			-with sand partings		13/6" 50/3"									
10														
					7/6" 12/6" 20/6"	35							33	
15			-color changes to reddish tan and light gray		6/6" 15/6" 20/6"									
20			25.49' AMSL Very stiff to hard reddish tan and light gray FAT CLAY (CH) with gypsum crystals LIGHT OLIVE GREEN TO GRAY CLAY		10/6" 17/6" 26/6"									
25			-color changes to reddish tan and tan		10/6" 18/6" 30/6"	25		50	28				92	
			-color changes to tan and reddish brown		8/6" 11/6" 16/6"									
30			-color changes to tan and gray		8/6" 12/6" 18/6"									
35														

COMPLETION DEPTH: 82.5 ft
DATE BORING STARTED: 07/22/2016
DATE BORING COMPLETED: 07/23/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 21' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 10'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-30

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 44.0"
W 97° 49' 23.1"
SURFACE ELEVATION: 45.99' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 82.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
70			Very stiff to hard tan and reddish brown FAT CLAY (CH) with calcareous nodules -26.01' AMSL											
			Very dense tan CLAYEY SAND (SC) with calcareous nodules		16/6" 43/6" 50/5"	17							17	
75			-30.01' AMSL											
			Very stiff to hard tan and gray FAT CLAY (CH) with ferrous staining LIGHT OLIVE GREEN TO GRAY CLAY		10/6" 11/6" 17/6"									
80			-becomes slickensided with ferrous staining -36.51' AMSL	(P) 4.50+										
			Bottom @ 82.5'											
85														
90														
95														
100														
105														

COMPLETION DEPTH: 82.5 ft
DATE BORING STARTED: 07/22/2016
DATE BORING COMPLETED: 07/23/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 21' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 10'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-31

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 50.1"
W 97° 49' 24.3"
SURFACE ELEVATION: 58.37' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 68-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense to very dense gray CLAYEY SAND (SC) BODY I		4/6" 5/6" 7/6"									
			-with calcareous nodules and sand pockets		10/6" 22/6" 18/6"									
5					4/6" 5/6" 6/6"	11							46	
					5/6" 6/6" 8/6"									
					6/6" 8/6" 12/6"									
10			-with cemented sand layers		8/6" 27/6" 29/6"	27							22	
			-color changes to tan		18/6" 32/6" 39/6"									
			43.87' AMSL											
15			Very dense tan POORLY GRADED SAND with CLAY (SP-SC) and sand partings BODY IV		36/6" 50/5"									
					12/6" 50/5"	15							9	
					45/6" 50/5"									
20					35/6" 50/4"									
					17/6" 26/6" 50/5"									
					17/6" 38/6" 38/6"									
			34.87' AMSL											
25			Hard reddish tan and light gray SANDY LEAN SILTY CLAY (CL-ML) with sand partings SANDY SILTY CLAY BED		13/6" 20/6" 31/6" 23/6" 34/6" 50/4" 12/6" 17/6" 50/5"	26		29	7				66	
			-color changes to reddish tan and tan with ferrous stains		13/6" 32/6" 50/5" 7/6" 36/6" 39/6" 10/6" 21/6" 36/6" 10/6" 18/6" 35/6"	25							62	
30														
35														

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 07/20/2016
DATE BORING COMPLETED: 07/21/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 23' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 21'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-31

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 50.1"
W 97° 49' 24.3"
SURFACE ELEVATION: 58.37' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 68-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Hard reddish tan and tan SANDY LEAN CLAY (CL) with ferrous stains and laminated sands		17/6" 25/6" 35/6"									
			SANDY SILTY CLAY BED		17/6" 13/6" 19/6"									
			18.87' AMSL		7/6" 16/6" 17/6"									
40			Very stiff to hard reddish tan and tan FAT CLAY with SAND (CH) and ferrous stains		3/6" 7/6" 10/6"	37		59	36				76	
			LIGHT OLIVE GREEN TO GRAY CLAY		9/6" 20/6" 27/6"									
45			-with trace gypsum crystals and ferrous stains		5/6" 14/6" 17/6" 10/6" 18/6" 21/6" 18/6" 23/6" 30/6" 6/6" 20/6" 21/6"	30							83	
50					9/6" 17/6" 19/6" 9/6" 18/6" 23/6" 11/6" 23/6"									
			-with calcareous nodules and ferrous stains	(P) 4.50+	26/6"	32	91	83	50	4.14	2		87	
55				(P) 4.50+										
				(P) 4.50+										
				(P) 4.50+		34	87			2.88	2		83	
60			-with trace gypsum crystals and ferrous stains	(P) 4.50+										
				(P) 4.50+										
65				(P) 4.50+										
			-9.63' AMSL	(P) 4.50+										
			Bottom @ 68'											
70														

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 07/20/2016
DATE BORING COMPLETED: 07/21/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 23' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 21'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-32

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 49.7"
W 97° 49' 17.0"
SURFACE ELEVATION: 48.46' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 82.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Stiff to hard tan and gray SANDY LEAN CLAY (CL) with gypsum crystals and trace organics		3/6" 5/6" 6/6"	9		34	18				54	
			SANDY SILTY CLAY BED											
5					6/6" 21/6" 23/6"									
10					11/6" 26/6" 50/3"									
			35.96' AMSL											
15			Medium dense to dense reddish tan and gray CLAYEY SAND (SC) with gypsum crystals		17/6" 50/6"	28							34	
			BODY I											
			-color changes to tan and gray with sand partings		10/6" 17/6" 22/6"									
20			-with ferrous stains		4/6" 8/6" 13/6"									
25			-color changes to reddish tan		10/6" 18/6" 21/6"	22		31	10				29	
			-color changes to reddish brown and tan		6/6" 8/6" 12/6"									
30					8/6" 8/6" 12/6"									
35														

COMPLETION DEPTH: 82.5 ft
DATE BORING STARTED: 07/27/2016
DATE BORING COMPLETED: 07/28/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 18' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 14'-7". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

Page 1 of 3

TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-33

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 55.9"
W 97° 49' 11.3"
SURFACE ELEVATION: 64.51' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 86-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense to very dense tan CLAYEY SAND (SC) with gypsum crystals BODY I		2/6" 7/6" 9/6"									
5			-color changes to dark gray and gray with trace gravel		7/6" 11/6" 9/6"	16							47	
10			-color changes to tan and light gray sand partings		27/6" 50/6"									
15			-color changes to tan and white with trace caliche		50/5"									
			48.01' AMSL											
20			Dense to very dense tan and white POORLY GRADED SAND with SILT (SP-SM), and trace caliche BODY II		17/6" 48/6" 50/3"	11		35	8				12	
25			-color changes to light gray and tan with gypsum crystals and ferrous stains		17/6" 21/6" 27/6" 15/6" 17/6" 32/6"									
			36.01' AMSL											
30			Medium dense to dense gray and white CLAYEY SAND (SC) with gypsum crystals BODY II		14/6" 22/6" 26/6"	42							20	
35			-color changes to tan		13/6" 21/6" 22/6"									

COMPLETION DEPTH: 86 ft
DATE BORING STARTED: 08/05/2016
DATE BORING COMPLETED: 08/05/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 32'-6" below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 28'-2". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-33

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 55.9"
W 97° 49' 11.3"
SURFACE ELEVATION: 64.51' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 86-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Medium dense to dense reddish tan CLAYEY SAND (SC) with gypsum crystals and ferrous stains		6/6" 9/6" 12/6"									
			BODY II											
40			-color changes to tan and reddish tan		8/6" 16/6" 18/6"									
			20.01' AMSL											
45			Stiff to very stiff reddish tan LEAN CLAY with SAND (CL), slickensided, with ferrous stains		9/6" 12/6" 18/6"	29		43	24				79	
			SANDY SILTY CLAY BED											
50			-color changes to reddish tan and tan with gypsum crystals		5/6" 6/6" 9/6"									
			12.51' AMSL											
			Stiff to very stiff LEAN CLAY (CL), slickensided, with ferrous stains	(P) 2.00		40	79			1.06	3		96	
55			SANDY SILTY CLAY BED											
			-color changes to reddish brown and tan with gypsum crystals	(P) 3.50										
60				(P) 4.00		34	87							
			-0.51' AMSL											
65			Very stiff to hard tan FAT CLAY (CH), slickensided, with gypsum crystals and ferrous stains	(P) 4.50+		32	42	64	33	2.57	2		95	
			LIGHT OLIVE GREEN TO GRAY CLAY											
			-color changes to tan and reddish brown		7/6" 12/6" 14/6"									
70														

COMPLETION DEPTH: 86 ft
DATE BORING STARTED: 08/05/2016
DATE BORING COMPLETED: 08/05/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 32'-6" below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 28'-2". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-34

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 43.4"
W 97° 49' 11.4"
SURFACE ELEVATION: 61.14' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 30 ft.
Wash Bored: 30 ft. to 43 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense dark gray, gray, and light gray CLAYEY SAND (SC) with trace of organics BODY I	(P) 4.50+	2/6" 5/6" 6/6"	15	112			2.53	6		42	
			57.14' AMSL											
5			Very stiff to hard gray and light gray SANDY LEAN SILTY CLAY (CL-ML) with calcareous nodules	(P) 4.50+		15	115	21	7				59	
			SANDY SILTY CLAY BED	(P) 4.50+		14	114			6.13	4		62	
			-color changes to light gray											
10			-color changes to light gray and tan		4/6" 12/6" 16/6"									
			-color changes to white and light gray		11/6" 18/6" 16/6"									
			-becomes stiff		5/6" 6/6" 8/6"									
			46.64' AMSL											
15			Medium dense to dense white and light gray SILTY SAND (SM) with calcareous nodules BODY II		4/6" 6/6" 8/6"	17		38	7				31	
					4/6" 10/6" 19/6"									
			-color changes to light gray and tan with ferrous stains		23/6" 50/5"									
20					23/6" 50/4"									
			-color changes to light gray		27/6" 35/6" 50/4"	22							25	
25					5/6" 37/6" 45/6"									
					20/6" 39/6" 37/6"									
			-becomes medium dense		8/6" 12/6" 9/6"	26		39	2				28	
30					4/6" 12/6" 10/6"	33							39	
					5/6" 6/6" 10/6"									
			-color changes to tan and marine green		3/6"									
35														

COMPLETION DEPTH: 43 ft
DATE BORING STARTED: 06/22/2016
DATE BORING COMPLETED: 06/22/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 31' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 28'-4". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-35

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 50.5"
W 97° 48' 57.2"
SURFACE ELEVATION: 64.50' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 72.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense tan and brown CLAYEY SAND (SC) with trace caliche BODY I		5/6" 8/6" 7/6"									
5			-color changes to reddish brown with ferrous stains		5/6" 8/6" 5/6"	12		31	17				38	
			56.50' AMSL											
10			Very stiff to hard reddish tan SANDY LEAN CLAY (CL) with gypsum crystals SANDY SILTY CLAY BED	(P) 4.50+		14	117			2.22	3		52	
15			-color changes to reddish tan and tan with ferrous stains		5/6" 10/6" 12/6"									
20			-color changes to reddish tan	(P) 4.50+		17	109	42	25					
			-color changes to reddish tan and tan	(P) 4.50+										
			40.50' AMSL											
25			Medium dense to dense reddish tan and tan CLAYEY SAND (SC) with gypsum crystals and ferrous stains BODY I	(P) 4.50+		17	104			1.29	3		40	
30			-color changes to reddish tan		4/6" 7/6" 9/6"									
35					8/6" 13/6" 20/6"									

COMPLETION DEPTH: 72.5 ft
DATE BORING STARTED: 07/29/2016
DATE BORING COMPLETED: 07/29/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 34' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 30'-9". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-38

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 03.76"
W 97° 49' 12.19"
SURFACE ELEVATION: 41.64' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 10 ft.
Wash Bored: 10 ft. to 58 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Very stiff to hard light gray SANDY FAT CLAY (CH) with ferrous stains and trace calcareous nodules		10/6" 18/6" 31/6"	17		50	19				55	
			LIGHT OLIVE GREEN TO GRAY CLAY		20/6" 45/6" 50/4"									
5					3/6" 33/6" 50/5"									
					12/6" 27/6" 37/6"									
					17/6" 36/6" 50/3"	30							66	
10					18/6" 35/6" 50/3"									
					13/6" 33/6" 50/2"									
15			-color changes to light gray and tan		8/6" 14/6" 20/6"									
					7/6" 12/6" 19/6"									
					6/6" 10/6" 14/6"	28		60	40				57	
20					6/6" 11/6" 15/6"									
			-becomes stiff		5/6" 7/6" 8/6"									
25					6/6" 8/6" 13/6"									
					4/6" 9/6" 9/6"									
				(P) 4.50+		25	92	47	29					
30				(P) 4.50+										
			-color changes to brown and light gray and becomes stiff with sand layers		4/6" 5/6" 8/6"									
35					9/6"									

COMPLETION DEPTH: 58 ft
DATE BORING STARTED: 06/23/2016
DATE BORING COMPLETED: 06/23/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 11' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 5'-5". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-38

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 03.76"
W 97° 49' 12.19"
SURFACE ELEVATION: 41.64' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 10 ft.
Wash Bored: 10 ft. to 58 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Very stiff to hard reddish brown and light gray SANDY FAT CLAY (CH) with sand seams and layers	(P) 4.50+	8/6" 10/6"									
			LIGHT OLIVE GREEN TO GRAY CLAY 3.64' AMSL											
			Stiff to hard light gray FAT CLAY (CH), slickensided, with calcareous nodules and ferrous stains	(P) 4.50+		42	78	100	72	2.95	2		93	
40			-color changes to reddish brown and light gray	(P) 4.50+										
			LIGHT OLIVE GREEN TO GRAY CLAY	(P) 4.50+										
45			-color changes to tannish brown and light gray with trace organics	(P) 4.50+										
			-color changes to light gray		5/6" 6/6" 8/6"									
				(P) 4.50+		30	91			2.14	3		87	
50					6/6" 7/6" 7/6"									
					4/6" 5/6" 8/6"									
55			-color changes to tannish brown and light gray		5/6" 7/6" 9/6"									
			-color changes to light gray -16.36' AMSL		6/6" 7/6" 9/6"									
			Bottom @ 58'											
60														
65														
70														

COMPLETION DEPTH: 58 ft
DATE BORING STARTED: 06/23/2016
DATE BORING COMPLETED: 06/23/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 11' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 5'-5". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-39

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 01.3"
W 97° 48' 57.3"
SURFACE ELEVATION: 60.26' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 26 ft.
Wash Bored: 26 ft. to 68 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense to dense tan and light gray CLAYEY SAND FILL with trace gravel BODY I		8/6" 9/6" 6/6"	18							33	
			-color changes to brown		40/6" 27/6" 19/6"									
			55.76' AMSL											
5			Medium dense to dense brown and reddish brown CLAYEY SAND (SC) BODY I		6/6" 7/6" 8/6"									
			-color changes to tan and gray with calcareous nodules		4/6" 5/6" 6/6"									
					5/6" 6/6" 8/6"	11		36	20				49	
10			-color changes to tan and light gray		4/6" 6/6" 7/6"									
			-color changes to light gray		7/6" 8/6" 11/6"									
15			-color changes to light gray and tan with ferrous stains		6/6" 12/6" 19/6"									
			-color changes to light gray		11/6" 19/6" 22/6"									
			41.76' AMSL											
20			Stiff to hard light gray SANDY LEAN CLAY (CL) with calcareous nodules and ferrous stains SANDY SILTY CLAY BED		3/6" 4/6" 5/6"	19							65	
					6/6" 9/6" 13/6"									
					8/6" 11/6" 20/6"									
25			-color changes to light tan and light gray	(P) 4.50+										
			-color changes to light gray	(P) 4.00										
					7/6" 11/6" 13/6"									
30			-color changes to light gray and tan	(P) 4.50+		19	102			1.14	7		50	
					12/6" 16/6" 20/6"									
35					8/6"									

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 06/20/2016
DATE BORING COMPLETED: 06/24/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 27' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 26'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-39

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 01.3"
W 97° 48' 57.3"
SURFACE ELEVATION: 60.26' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 26 ft.
Wash Bored: 26 ft. to 68 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Stiff to hard light gray and tan SANDY LEAN CLAY (CL) with ferrous stains 23.76' AMSL		12/6" 16/6"									
			Medium dense to dense light gray CLAYEY SAND (SC) with ferrous stains BODY I		7/6" 8/6" 11/6"									
40					6/6" 11/6" 12/6"									
					7/6" 10/6" 13/6"	25		69	51				45	
					13/6" 19/6" 21/6"									
			15.76' AMSL											
45			Dense light gray POORLY GRADED SAND with CLAY (SP- SC) BODY III		12/6" 21/6" 20/6"									
					11/6" 16/6" 16/6"									
			12.26' AMSL											
			Hard reddish brown and light gray FAT CLAY with SAND (CH) LIGHT OLIVE GREEN TO GRAY CLAY	(P) 4.50+										
50				(P) 4.50+		28	93			0.85	1		72	
			-becomes slickensided with calcareous nodules	(P) 4.50+										
			-with ferrous stains	(P) 4.50+										
55				(P) 4.50+										
				(P) 4.50+										
				(P) 4.50+										
60				(P) 4.50+										
			-becomes stiff		7/6" 7/6" 7/6"									
65			-6.24' AMSL											
			Medium dense light gray CLAYEY SAND (SC) with calcareous nodules and ferrous stains -7.74' AMSL		6/6" 10/6" 13/6"	20	102	61	45	1.91	5		46	
			Bottom @ 68'											
70														

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 06/20/2016
DATE BORING COMPLETED: 06/24/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 27' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 26'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-40

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 09.97"
W 97° 49' 11.18"
SURFACE ELEVATION: 52.31' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 22 ft.
Wash Bored: 22 ft. to 33.75 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Loose to very dense light gray and gray SILTY SAND (SM) with trace caliche BODY II		4/6" 4/6" 6/6"									
			-color changes to light gray and tan with ferrous stains		5/6" 7/6" 11/6"	16		35	10				31	
5					7/6" 17/6" 17/6"									
			-color changes to light gray with calcareous nodules		12/6" 21/6" 34/6"									
			-color changes to light gray and white		12/6" 27/6" 50/3"	18							34	
10			-color changes to white		15/6" 50/3"									
			-color changes to light gray and white 37.81' AMSL		25/6" 50/4"									
15			Hard light gray FAT CLAY with SAND (CH), calcareous nodules, and ferrous stains LIGHT OLIVE GREEN TO GRAY CLAY		7/6" 26/6" 50/5"	22		70	41				80	
					5/6" 17/6" 28/6"									
20			31.81' AMSL		10/6" 30/6" 35/6"									
			Hard light gray SANDY FAT CLAY (CH) with calcareous nodules and ferrous stains LIGHT OLIVE GREEN TO GRAY CLAY		9/6" 25/6" 35/6"	31							59	
					16/6" 32/6" 50/5"									
25			25.81' AMSL		16/6" 31/6" 50/5"									
			Dense to very dense light gray CLAYEY SAND (SC) with calcareous nodules BODY II		8/6" 18/6" 27/6"	30		53	32				49	
					6/6" 18/6" 50/6"									
30					6/6" 20/6" 50/5"									
			18.81' AMSL		3/6" 40/6" 50/3"	16							30	
			Bottom @ 33.5'											
35														

COMPLETION DEPTH: 33.5 ft
DATE BORING STARTED: 06/21/2016
DATE BORING COMPLETED: 06/22/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 21' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 19'. At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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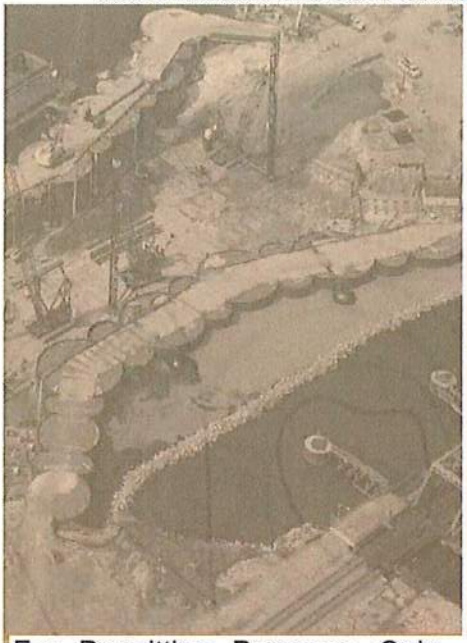
TOLUNAY-WONG ENGINEERS, INC.

FOR PERMIT PURPOSES ONLY



Tolunay-Wong Engineers, Inc.

GEOTECHNICAL ENGINEERING STUDY
CITY OF KINGSVILLE MUNICIPAL SOLID WASTE LANDFILL EXPANSION
KINGSVILLE, TEXAS

For Permitting Purposes Only. Applies to boring logs in Appendix B of Tolunay-Wong Engineers, Inc. Geotechnical Engineering Study, City of Kingsville Municipal Solid Waste Landfill Expansion, Kingsville, Texas – Report No. 12788R1, sealed by Don R. Rokohl, P.E. on 8-30-18 altered to provide text showing surface elevations, the elevations of all contacts between soil and rock layers, and unit identifiers in the soil boring logs. No information or data was altered or changed from the original report other than the addition of text showing these elevations and unit identifiers in Appendix B.

Prepared for:

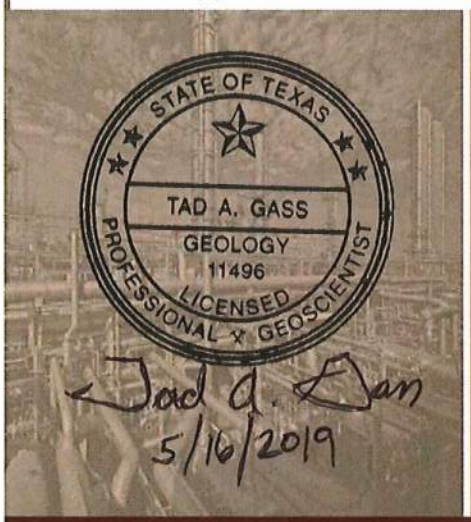
Naismith/Hanson
Corpus Christi, Texas

Prepared by:

Tolunay-Wong Engineers, Inc.
826 South Padre Island Drive
Corpus Christi, Texas 78416

August 30, 2018

Project No. 16.53.042 / Report No. 12788R1



GEOTECHNICAL ENGINEERING, DEEP FOUNDATIONS TESTING, ENVIRONMENTAL SERVICES, CONSTRUCTION MATERIALS TESTING

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LOG OF BORING B-30

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 44.0"
W 97° 49' 23.1"
SURFACE ELEVATION: 45.99' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 82.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Dense to very dense tan and gray CLAYEY SAND (SC) with gypsum crystals		11/6" 23/6" 50/5"	16		42	17				37	
			BODY I											
5			-color changes to tan with ferrous staining		34/6" 50/3"									
			-with sand partings		13/6" 50/3"									
10			▼											
					7/6" 12/6" 20/6"	35							33	
15			-color changes to reddish tan and light gray		6/6" 15/6" 20/6"									
20			▽ 25.49' AMSL											
			Very stiff to hard reddish tan and light gray FAT CLAY (CH) with gypsum crystals		10/6" 17/6" 26/6"									
			LIGHT OLIVE GREEN TO GRAY CLAY											
25			-color changes to reddish tan and tan		10/6" 18/6" 30/6"	25		50	28				92	
			-color changes to tan and reddish brown		8/6" 11/6" 16/6"									
30			-color changes to tan and gray		8/6" 12/6" 18/6"									
35														

COMPLETION DEPTH: 82.5 ft
DATE BORING STARTED: 07/22/2016
DATE BORING COMPLETED: 07/23/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 21' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 10'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-30

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 44.0"
W 97° 49' 23.1"
SURFACE ELEVATION: 45.99' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 82.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
70			Very stiff to hard tan and reddish brown FAT CLAY (CH) with calcareous nodules -26.01' AMSL											
75			Very dense tan CLAYEY SAND (SC) with calcareous nodules -30.01' AMSL		16/6" 43/6" 50/5"	17							17	
80			Very stiff to hard tan and gray FAT CLAY (CH) with ferrous staining LIGHT OLIVE GREEN TO GRAY CLAY -becomes slickensided with ferrous staining -36.51' AMSL	(P) 4.50+	10/6" 11/6" 17/6"									
			Bottom @ 82.5'											
85														
90														
95														
100														
105														

COMPLETION DEPTH: 82.5 ft
DATE BORING STARTED: 07/22/2016
DATE BORING COMPLETED: 07/23/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 21' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 10'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-31

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 50.1"
W 97° 49' 24.3"
SURFACE ELEVATION: 58.37' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 68-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense to very dense gray CLAYEY SAND (SC)		4/6" 5/6" 7/6"									
			BODY I											
			-with calcareous nodules and sand pockets		10/6" 22/6" 18/6"									
5					4/6" 5/6" 6/6"	11							46	
					5/6" 6/6" 8/6"									
					6/6" 8/6" 12/6"									
10			-with cemented sand layers		8/6" 27/6" 29/6"	27							22	
			-color changes to tan		18/6" 32/6" 39/6"									
			43.87' AMSL											
15			Very dense tan POORLY GRADED SAND with CLAY (SP-SC) and sand partings		36/6" 50/5"									
			BODY IV		12/6" 50/5"	15							9	
					45/6" 50/5"									
20					35/6" 50/4"									
					17/6" 26/6" 50/5"									
					17/6" 38/6" 38/6"									
			34.87' AMSL											
25			Hard reddish tan and light gray SANDY LEAN SILTY CLAY (CL-ML) with sand partings		13/6" 20/6" 31/6" 23/6" 34/6" 50/4" 12/6" 17/6" 50/5"	26		29	7				66	
			SANDY SILTY CLAY BED											
			-color changes to reddish tan and tan with ferrous stains		13/6" 32/6" 50/5" 7/6" 36/6" 39/6" 10/6" 21/6" 36/6" 10/6" 18/6" 35/6"	25							62	
30														
35														

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 07/20/2016
DATE BORING COMPLETED: 07/21/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 23' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 21'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-31

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 50.1"
W 97° 49' 24.3"
SURFACE ELEVATION: 58.37' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 68-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Hard reddish tan and tan SANDY LEAN CLAY (CL) with ferrous stains and laminated sands		17/6" 25/6" 35/6"									
			SANDY SILTY CLAY BED		17/6" 13/6" 19/6"									
			18.87' AMSL		7/6" 16/6" 17/6"									
40			Very stiff to hard reddish tan and tan FAT CLAY with SAND (CH) and ferrous stains		3/6" 7/6" 10/6"	37		59	36				76	
			LIGHT OLIVE GREEN TO GRAY CLAY		9/6" 20/6" 27/6"									
45			-with trace gypsum crystals and ferrous stains		5/6" 14/6" 17/6" 10/6" 18/6" 21/6" 18/6" 23/6" 30/6" 6/6" 20/6" 21/6"	30							83	
50					9/6" 17/6" 19/6" 9/6" 18/6" 23/6" 11/6" 23/6"									
			-with calcareous nodules and ferrous stains	(P) 4.50+	26/6"	32	91	83	50	4.14	2		87	
55				(P) 4.50+										
				(P) 4.50+										
				(P) 4.50+		34	87			2.88	2		83	
60			-with trace gypsum crystals and ferrous stains	(P) 4.50+										
				(P) 4.50+										
65				(P) 4.50+										
			-9.63' AMSL	(P) 4.50+										
			Bottom @ 68'											
70														

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 07/20/2016
DATE BORING COMPLETED: 07/21/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 23' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 21'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-32

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 49.7"
W 97° 49' 17.0"
SURFACE ELEVATION: 48.46' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 82.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Stiff to hard tan and gray SANDY LEAN CLAY (CL) with gypsum crystals and trace organics		3/6" 5/6" 6/6"	9		34	18				54	
			SANDY SILTY CLAY BED											
5					6/6" 21/6" 23/6"									
10					11/6" 26/6" 50/3"									
			35.96' AMSL											
			Medium dense to dense reddish tan and gray CLAYEY SAND (SC) with gypsum crystals		17/6" 50/6"	28							34	
			BODY I											
15			-color changes to tan and gray with sand partings		10/6" 17/6" 22/6"									
20			-with ferrous stains		4/6" 8/6" 13/6"									
25			-color changes to reddish tan		10/6" 18/6" 21/6"	22		31	10				29	
30			-color changes to reddish brown and tan		6/6" 8/6" 12/6"									
35					8/6" 8/6" 12/6"									

COMPLETION DEPTH: 82.5 ft
DATE BORING STARTED: 07/27/2016
DATE BORING COMPLETED: 07/28/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 18' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 14'-7". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-33

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 55.9"
W 97° 49' 11.3"
SURFACE ELEVATION: 64.51' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 86-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense to very dense tan CLAYEY SAND (SC) with gypsum crystals BODY I		2/6" 7/6" 9/6"									
5			-color changes to dark gray and gray with trace gravel		7/6" 11/6" 9/6"	16							47	
10			-color changes to tan and light gray sand partings		27/6" 50/6"									
15			-color changes to tan and white with trace caliche		50/5"									
			48.01' AMSL											
20			Dense to very dense tan and white POORLY GRADED SAND with SILT (SP-SM), and trace caliche BODY II		17/6" 48/6" 50/3"	11		35	8				12	
25			-color changes to light gray and tan with gypsum crystals and ferrous stains		17/6" 21/6" 27/6" 15/6" 17/6" 32/6"									
			36.01' AMSL											
30			Medium dense to dense gray and white CLAYEY SAND (SC) with gypsum crystals BODY II		14/6" 22/6" 26/6"	42							20	
35			-color changes to tan		13/6" 21/6" 22/6"									

COMPLETION DEPTH: 86 ft
DATE BORING STARTED: 08/05/2016
DATE BORING COMPLETED: 08/05/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 32'-6" below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 28'-2". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-33

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 55.9"
W 97° 49' 11.3"
SURFACE ELEVATION: 64.51' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 86-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Medium dense to dense reddish tan CLAYEY SAND (SC) with gypsum crystals and ferrous stains		6/6" 9/6" 12/6"									
			BODY II											
40			-color changes to tan and reddish tan		8/6" 16/6" 18/6"									
			20.01' AMSL											
45			Stiff to very stiff reddish tan LEAN CLAY with SAND (CL), slickensided, with ferrous stains		9/6" 12/6" 18/6"	29		43	24				79	
			SANDY SILTY CLAY BED											
50			-color changes to reddish tan and tan with gypsum crystals		5/6" 6/6" 9/6"									
			12.51' AMSL											
			Stiff to very stiff LEAN CLAY (CL), slickensided, with ferrous stains	(P) 2.00		40	79			1.06	3		96	
			SANDY SILTY CLAY BED											
55			-color changes to reddish brown and tan with gypsum crystals	(P) 3.50										
60				(P) 4.00		34	87							
			-0.51' AMSL											
65			Very stiff to hard tan FAT CLAY (CH), slickensided, with gypsum crystals and ferrous stains	(P) 4.50+		32	42	64	33	2.57	2		95	
			LIGHT OLIVE GREEN TO GRAY CLAY											
			-color changes to tan and reddish brown		7/6" 12/6" 14/6"									
70														

COMPLETION DEPTH: 86 ft
DATE BORING STARTED: 08/05/2016
DATE BORING COMPLETED: 08/05/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 32'-6" below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 28'-2". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-34

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 43.4"
W 97° 49' 11.4"
SURFACE ELEVATION: 61.14' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 30 ft.
Wash Bored: 30 ft. to 43 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense dark gray, gray, and light gray CLAYEY SAND (SC) with trace of organics		2/6" 5/6" 6/6"									
			BODY I	(P) 4.50+		15	112			2.53	6		42	
			57.14' AMSL											
5			Very stiff to hard gray and light gray SANDY LEAN SILTY CLAY (CL-ML) with calcareous nodules	(P) 4.50+		15	115	21	7				59	
			SANDY SILTY CLAY BED	(P) 4.50+		14	114			6.13	4		62	
			-color changes to light gray											
			-color changes to light gray and tan		4/6" 12/6" 16/6"									
10			-color changes to white and light gray		11/6" 18/6" 16/6"									
			-becomes stiff		5/6" 6/6" 8/6"									
			46.64' AMSL											
15			Medium dense to dense white and light gray SILTY SAND (SM) with calcareous nodules		4/6" 6/6" 8/6"	17		38	7				31	
			BODY II		4/6" 10/6" 19/6"									
			-color changes to light gray and tan with ferrous stains		23/6" 50/5"									
20					23/6" 50/4"									
			-color changes to light gray		27/6" 35/6" 50/4"	22							25	
25					5/6" 37/6" 45/6"									
					20/6" 39/6" 37/6"									
			-becomes medium dense		8/6" 12/6" 9/6"	26		39	2				28	
30					4/6" 12/6" 10/6"	33							39	
					5/6" 6/6" 10/6"									
			-color changes to tan and marine green		3/6"									
35														

COMPLETION DEPTH: 43 ft
DATE BORING STARTED: 06/22/2016
DATE BORING COMPLETED: 06/22/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 31' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 28'-4". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-35

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 50.5"
W 97° 48' 57.2"
SURFACE ELEVATION: 64.50' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 72.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense tan and brown CLAYEY SAND (SC) with trace caliche BODY I		5/6" 8/6" 7/6"									
5			-color changes to reddish brown with ferrous stains		5/6" 8/6" 5/6"	12		31	17				38	
			56.50' AMSL											
10			Very stiff to hard reddish tan SANDY LEAN CLAY (CL) with gypsum crystals SANDY SILTY CLAY BED	(P) 4.50+		14	117			2.22	3		52	
15			-color changes to reddish tan and tan with ferrous stains		5/6" 10/6" 12/6"									
			-color changes to reddish tan	(P) 4.50+		17	109	42	25					
20			-color changes to reddish tan and tan	(P) 4.50+										
			40.50' AMSL											
25			Medium dense to dense reddish tan and tan CLAYEY SAND (SC) with gypsum crystals and ferrous stains BODY I	(P) 4.50+		17	104			1.29	3		40	
30			-color changes to reddish tan		4/6" 7/6" 9/6"									
35					8/6" 13/6" 20/6"									

COMPLETION DEPTH: 72.5 ft
DATE BORING STARTED: 07/29/2016
DATE BORING COMPLETED: 07/29/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 34' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 30'-9". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-38

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 03.76"
W 97° 49' 12.19"
SURFACE ELEVATION: 41.64' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 10 ft.
Wash Bored: 10 ft. to 58 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Very stiff to hard light gray SANDY FAT CLAY (CH) with ferrous stains and trace calcareous nodules		10/6" 18/6" 31/6"	17		50	19				55	
			LIGHT OLIVE GREEN TO GRAY CLAY		20/6" 45/6" 50/4"									
5					3/6" 33/6" 50/5"									
					12/6" 27/6" 37/6"									
					17/6" 36/6" 50/3"	30							66	
10					18/6" 35/6" 50/3"									
					13/6" 33/6" 50/2"									
15			-color changes to light gray and tan		8/6" 14/6" 20/6"									
					7/6" 12/6" 19/6"									
					6/6" 10/6" 14/6"	28		60	40				57	
20					6/6" 11/6" 15/6"									
			-becomes stiff		5/6" 7/6" 8/6"									
25					6/6" 8/6" 13/6"									
					4/6" 9/6" 9/6"									
				(P) 4.50+		25	92	47	29					
30				(P) 4.50+										
			-color changes to brown and light gray and becomes stiff with sand layers		4/6" 5/6" 8/6"									
35					9/6"									

COMPLETION DEPTH: 58 ft
DATE BORING STARTED: 06/23/2016
DATE BORING COMPLETED: 06/23/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 11' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 5'-5". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-38

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 03.76"
W 97° 49' 12.19"
SURFACE ELEVATION: 41.64' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 10 ft.
Wash Bored: 10 ft. to 58 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Very stiff to hard reddish brown and light gray SANDY FAT CLAY (CH) with sand seams and layers	(P) 4.50+	8/6" 10/6"									
			LIGHT OLIVE GREEN TO GRAY CLAY 3.64' AMSL											
			Stiff to hard light gray FAT CLAY (CH), slickensided, with calcareous nodules and ferrous stains	(P) 4.50+		42	78	100	72	2.95	2		93	
40			-color changes to reddish brown and light gray	(P) 4.50+										
			LIGHT OLIVE GREEN TO GRAY CLAY	(P) 4.50+										
			-color changes to tannish brown and light gray with trace organics	(P) 4.50+										
45			-color changes to light gray		5/6" 6/6" 8/6"									
				(P) 4.50+		30	91			2.14	3		87	
50					6/6" 7/6" 7/6"									
					4/6" 5/6" 8/6"									
55			-color changes to tannish brown and light gray		5/6" 7/6" 9/6"									
			-color changes to light gray -16.36' AMSL		6/6" 7/6" 9/6"									
			Bottom @ 58'											
60														
65														
70														

COMPLETION DEPTH: 58 ft
DATE BORING STARTED: 06/23/2016
DATE BORING COMPLETED: 06/23/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 11' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 5'-5". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

Page 2 of 2

TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-39

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 01.3"
W 97° 48' 57.3"
SURFACE ELEVATION: 60.26' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 26 ft.
Wash Bored: 26 ft. to 68 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense to dense tan and light gray CLAYEY SAND FILL with trace gravel BODY I		8/6" 9/6" 6/6"	18							33	
			-color changes to brown		40/6" 27/6" 19/6"									
			55.76' AMSL											
5			Medium dense to dense brown and reddish brown CLAYEY SAND (SC) BODY I		6/6" 7/6" 8/6"									
			-color changes to tan and gray with calcareous nodules		4/6" 5/6" 6/6"									
					5/6" 6/6" 8/6"	11		36	20				49	
10			-color changes to tan and light gray		4/6" 6/6" 7/6"									
			-color changes to light gray		7/6" 8/6" 11/6"									
15			-color changes to light gray and tan with ferrous stains		6/6" 12/6" 19/6"									
			-color changes to light gray		11/6" 19/6" 22/6"									
			41.76' AMSL											
20			Stiff to hard light gray SANDY LEAN CLAY (CL) with calcareous nodules and ferrous stains SANDY SILTY CLAY BED		3/6" 4/6" 5/6"	19							65	
					6/6" 9/6" 13/6"									
					8/6" 11/6" 20/6"									
25			-color changes to light tan and light gray	(P) 4.50+										
			-color changes to light gray	(P) 4.00										
					7/6" 11/6" 13/6"									
30			-color changes to light gray and tan	(P) 4.50+		19	102			1.14	7		50	
					12/6" 16/6" 20/6"									
35					8/6"									

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 06/20/2016
DATE BORING COMPLETED: 06/24/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 27' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 26'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

Page 1 of 2

TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-39

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 01.3"
W 97° 48' 57.3"
SURFACE ELEVATION: 60.26' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 26 ft.
Wash Bored: 26 ft. to 68 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Stiff to hard light gray and tan SANDY LEAN CLAY (CL) with ferrous stains 23.76' AMSL		12/6" 16/6"									
			Medium dense to dense light gray CLAYEY SAND (SC) with ferrous stains BODY I		7/6" 8/6" 11/6"									
40					6/6" 11/6" 12/6"									
					7/6" 10/6" 13/6"	25		69	51				45	
					13/6" 19/6" 21/6"									
			15.76' AMSL											
45			Dense light gray POORLY GRADED SAND with CLAY (SP- SC) BODY III		12/6" 21/6" 20/6"									
					11/6" 16/6" 16/6"									
			12.26' AMSL											
			Hard reddish brown and light gray FAT CLAY with SAND (CH) LIGHT OLIVE GREEN TO GRAY CLAY	(P) 4.50+										
50				(P) 4.50+		28	93			0.85	1		72	
			-becomes slickensided with calcareous nodules	(P) 4.50+										
			-with ferrous stains	(P) 4.50+										
55				(P) 4.50+										
				(P) 4.50+										
				(P) 4.50+										
60				(P) 4.50+										
			-becomes stiff		7/6" 7/6" 7/6"									
65			-6.24' AMSL											
			Medium dense light gray CLAYEY SAND (SC) with calcareous nodules and ferrous stains -7.74' AMSL		6/6" 10/6" 13/6"	20	102	61	45	1.91	5		46	
			Bottom @ 68'											
70														

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 06/20/2016
DATE BORING COMPLETED: 06/24/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 27' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 26'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

Page 2 of 2

TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-40

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 09.97"
W 97° 49' 11.18"
SURFACE ELEVATION: 52.31' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 22 ft.
Wash Bored: 22 ft. to 33.75 ft.

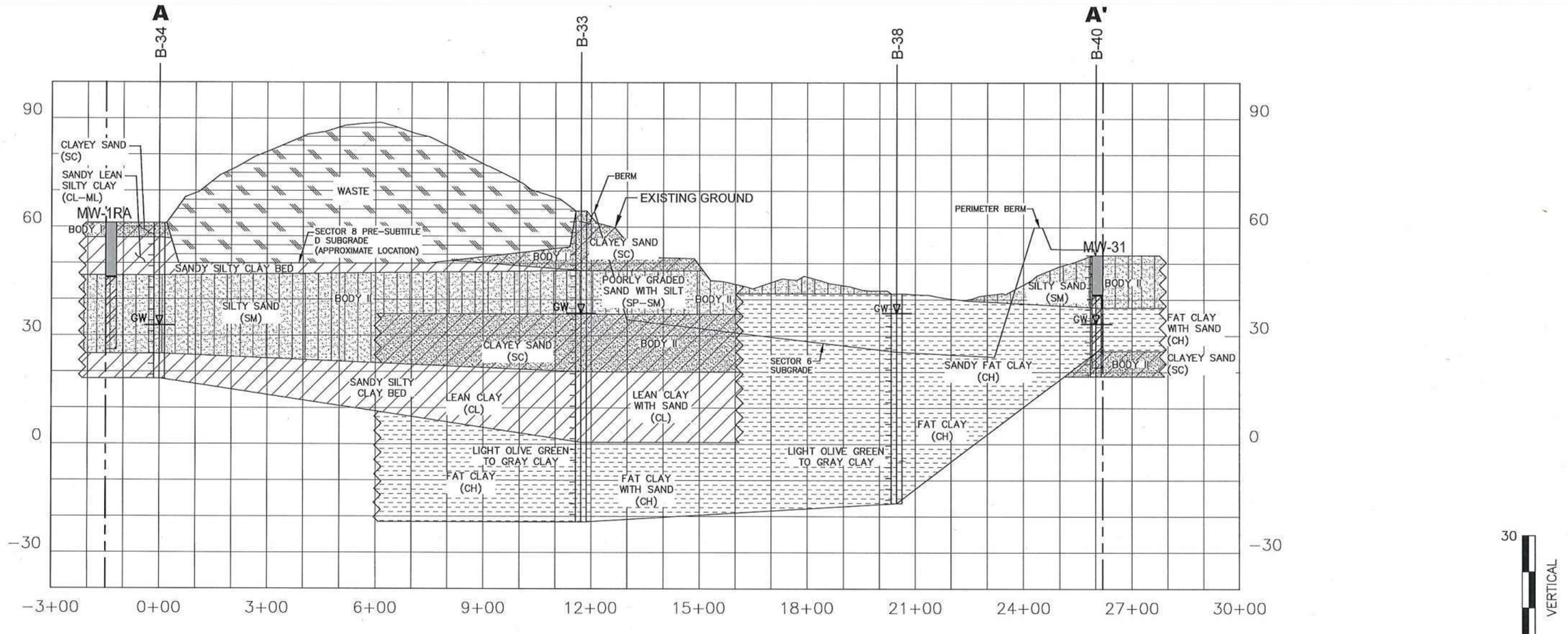
DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Loose to very dense light gray and gray SILTY SAND (SM) with trace caliche BODY II		4/6" 4/6" 6/6"									
			-color changes to light gray and tan with ferrous stains		5/6" 7/6" 11/6"	16		35	10				31	
5					7/6" 17/6" 17/6"									
			-color changes to light gray with calcareous nodules		12/6" 21/6" 34/6"									
			-color changes to light gray and white		12/6" 27/6" 50/3"	18							34	
10			-color changes to white		15/6" 50/3"									
			-color changes to light gray and white		25/6" 50/4"									
			37.81' AMSL											
15			Hard light gray FAT CLAY with SAND (CH), calcareous nodules, and ferrous stains LIGHT OLIVE GREEN TO GRAY CLAY		7/6" 26/6" 50/5"	22		70	41				80	
					5/6" 17/6" 28/6"									
20					10/6" 30/6" 35/6"									
			31.81' AMSL											
			Hard light gray SANDY FAT CLAY (CH) with calcareous nodules and ferrous stains LIGHT OLIVE GREEN TO GRAY CLAY		9/6" 25/6" 35/6"	31							59	
					16/6" 32/6" 50/5"									
25					16/6" 31/6" 50/5"									
			25.81' AMSL											
			Dense to very dense light gray CLAYEY SAND (SC) with calcareous nodules BODY II		8/6" 18/6" 27/6"	30		53	32				49	
					6/6" 18/6" 50/6"									
30					6/6" 20/6" 50/5"									
			18.81' AMSL		3/6" 40/6" 50/3"	16							30	
			Bottom @ 33.5'											
35														

COMPLETION DEPTH: 33.5 ft
DATE BORING STARTED: 06/21/2016
DATE BORING COMPLETED: 06/22/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 21' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 19'. At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

Page 1 of 1

TOLUNAY-WONG ENGINEERS, INC.



LEGEND

- WASTE
- LEAN CLAY, LEAN CLAY WITH SAND, SANDY LEAN SILTY CLAY (CL, CL–ML)
- CLAYEY SAND (SC)
- SILTY SAND, POORLY GRADED SAND WITH SILT (SM, SP–SM)
- FAT CLAY, SANDY FAT CLAY FAT CLAY WITH SAND (CH)
- GROUND WATER AFTER EQUILIBRIUM (GW)
- PERMIT BOUNDARY
- MW-31 — RISER / SCREEN — MONITOR WELL

CROSS SECTION A-A'

STATE OF TEXAS
TAD A. GASS
GEOLOGY
11496
LICENSED
PROFESSIONAL GEOSCIENTIST

Tad A. Gass
5/16/2019

HANSON
Hanson Professional Services Inc.
TBPE F-417 / TBPLS F-10039500
TBAE F-BR 2458 / TBPG F-50556

CITY OF KINGSVILLE LANDFILL

SOIL BORING REPORT
CROSS SECTION A-A'
KLEBERG COUNTY, TEXAS

16L0438 EXHIBIT IV

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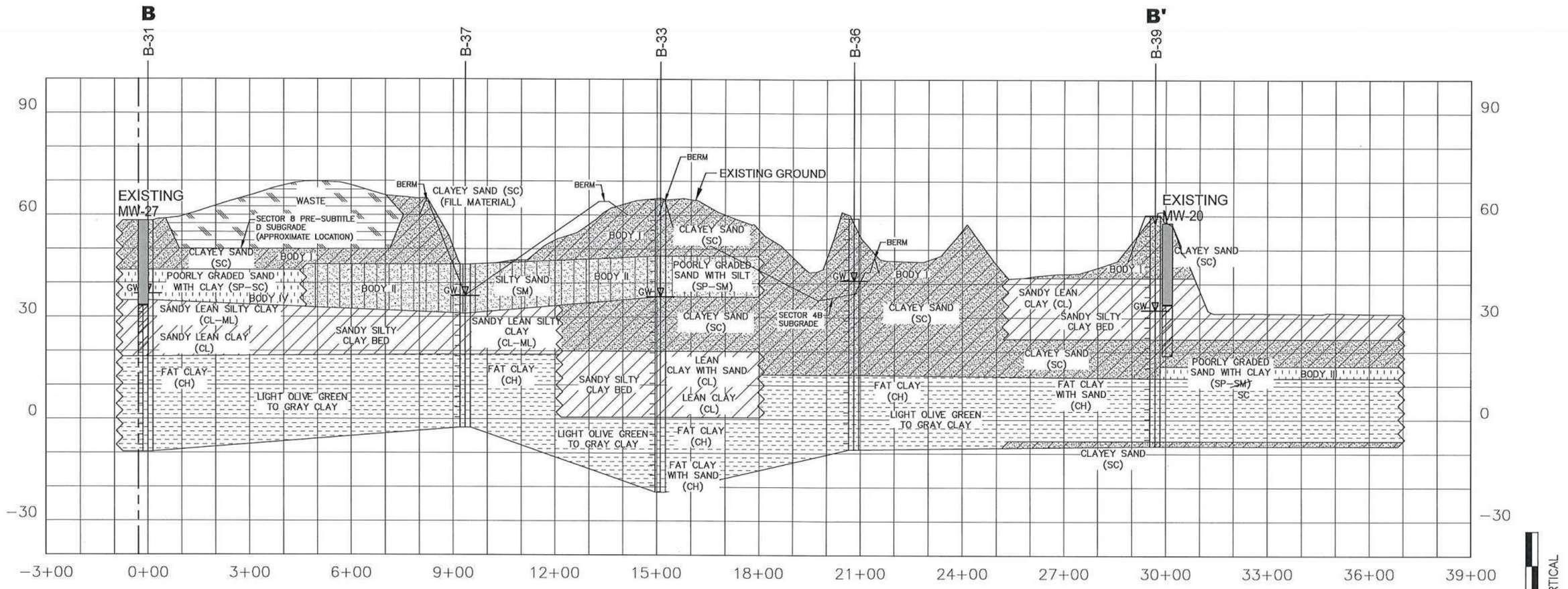

CROSS SECTION B-B'

LEGEND

- WASTE
- LEAN CLAY, LEAN CLAY WITH SAND, SANDY LEAN SILTY CLAY (CL, CL-ML)
- CLAYEY SAND (SC)
- SILTY SAND, POORLY GRADED SAND WITH SILT (SM, SP-SM)
- FAT CLAY, SANDY FAT CLAY FAT CLAY WITH SAND (CH)
- POORLY GRADED SAND WITH CLAY (SP-SC)
- GROUND WATER AFTER EQUILIBRIUM (GW)
- PERMIT BOUNDARY
- MW-20 RISER / SCREEN — MONITOR WELL

STATE OF TEXAS
TAD A. GASS
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Tad A. Gass
5/16/2019

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CITY OF KINGSVILLE LANDFILL

SOIL BORING REPORT
CROSS SECTION B-B'
KLEBERG COUNTY, TEXAS

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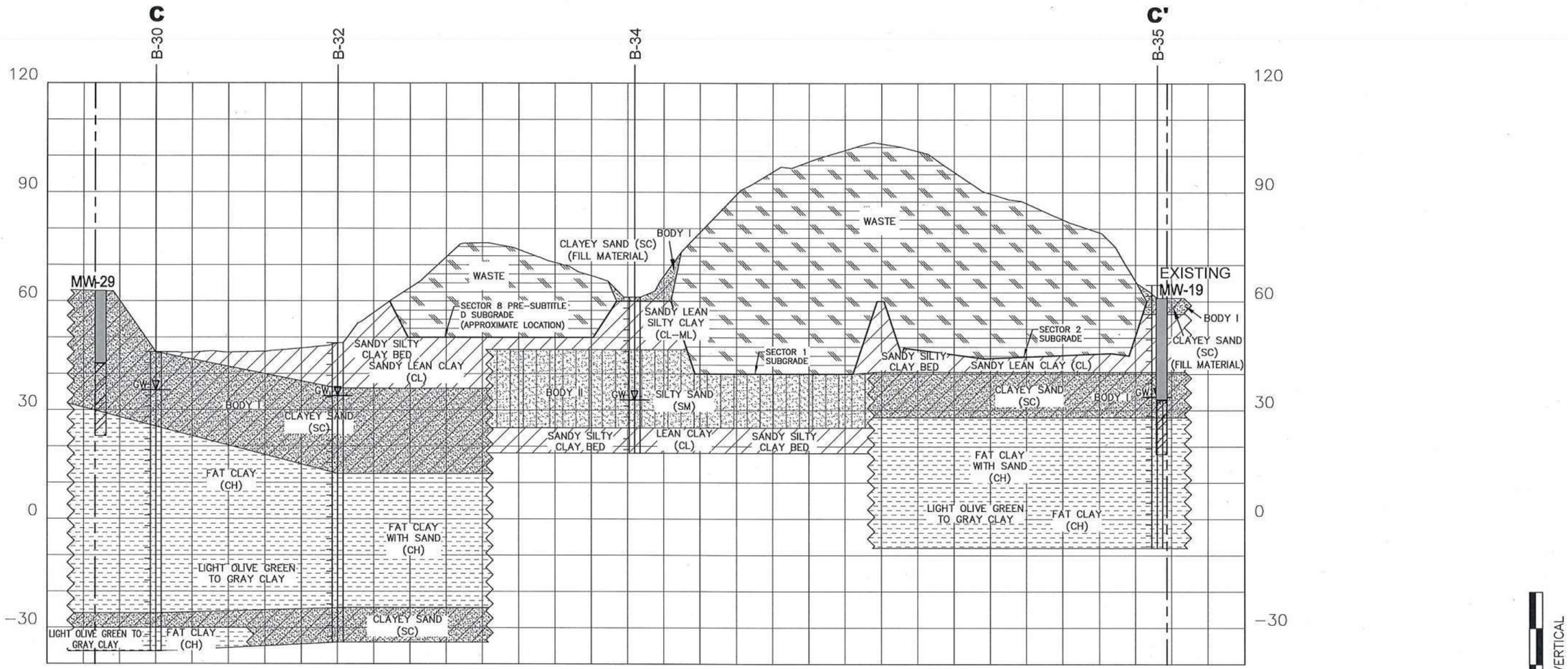

LEGEND

- WASTE
- LEAN CLAY, LEAN CLAY WITH SAND, SANDY LEAN SILTY CLAY (CL, CL-ML)
- CLAYEY SAND (SC)
- SILTY SAND, POORLY GRADED SAND WITH SILT (SM, SP-SM)
- FAT CLAY, SANDY FAT CLAY (CH)
- GROUND WATER AFTER EQUILIBRIUM (GW)
- PERMIT BOUNDARY
- MW-29 RISER / SCREEN — MONITOR WELL

CROSS SECTION C-C'

STATE OF TEXAS
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CITY OF KINGSVILLE LANDFILL

SOIL BORING REPORT
CROSS SECTION C-C'
KLEBERG COUNTY, TEXAS

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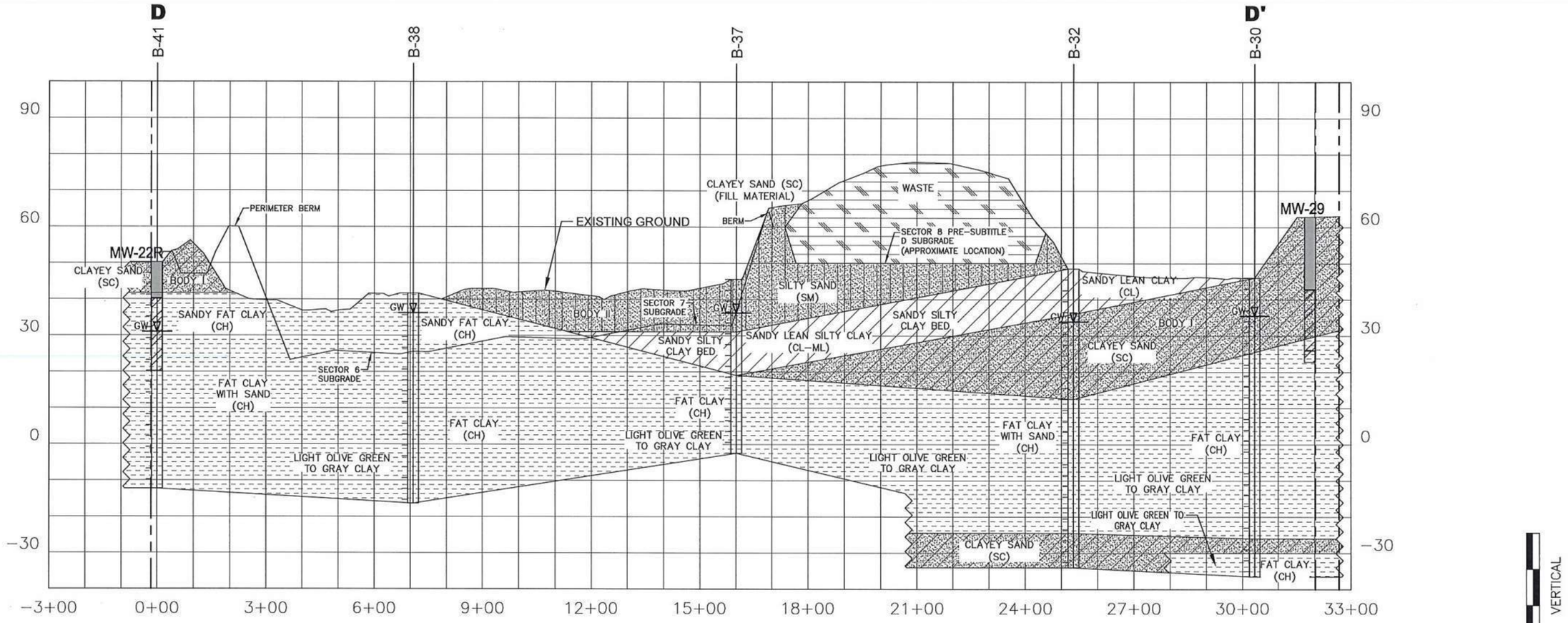

CROSS SECTION D-D'

LEGEND

- WASTE
- LEAN CLAY, LEAN CLAY WITH SAND, SANDY LEAN SILTY CLAY (CL, CL-ML)
- CLAYEY SAND (SC)
- SILTY SAND, POORLY GRADED SAND WITH SILT (SM, SP-SM)
- FAT CLAY, SANDY FAT CLAY (CH)
- GROUND WATER AFTER EQUILIBRIUM (GW)
- PERMIT BOUNDARY
- MW-29 (RISER / SCREEN) MONITOR WELL

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CITY OF KINGSVILLE LANDFILL

SOIL BORING REPORT
CROSS SECTION D-D'
KLEBERG COUNTY, TEXAS

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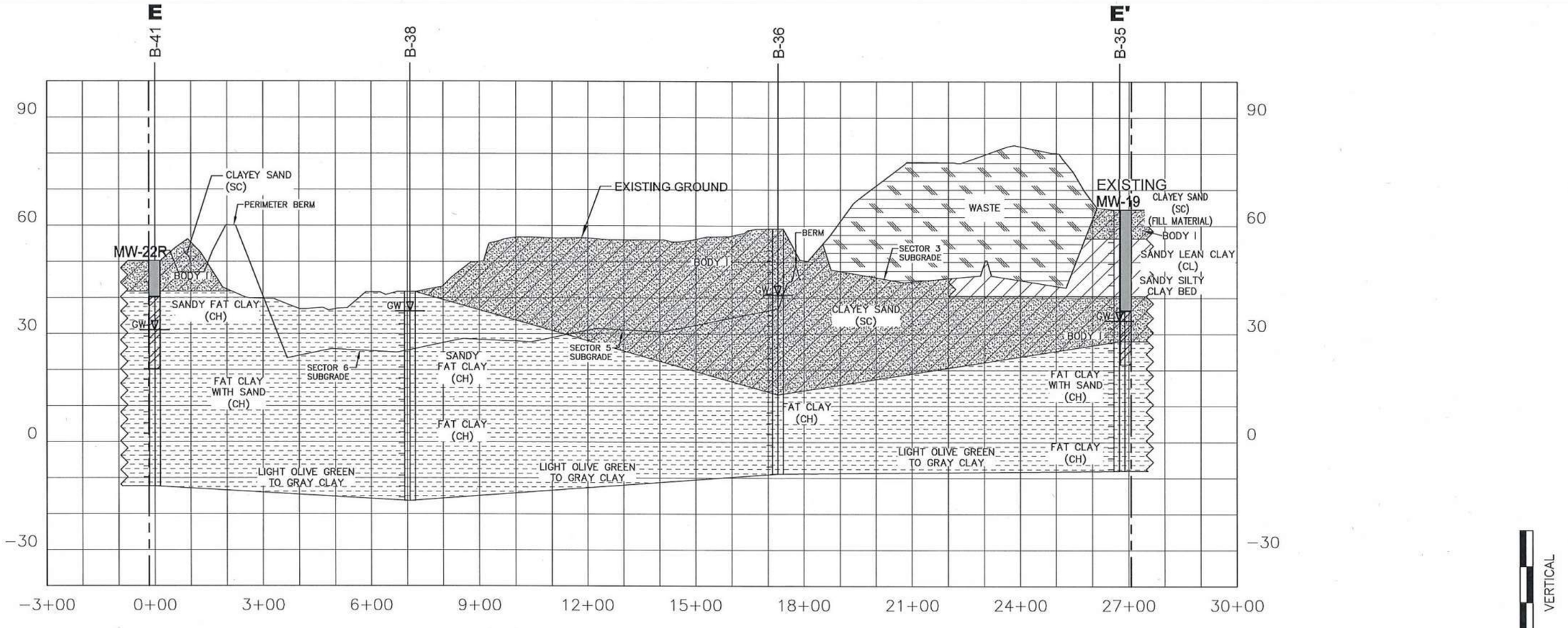

LEGEND

- WASTE
- LEAN CLAY, LEAN CLAY WITH SAND, SANDY LEAN SILTY CLAY (CL, CL–ML)
- CLAYEY SAND (SC)
- FAT CLAY, SANDY FAT CLAY (CH)
- GROUND WATER AFTER EQUILIBRIUM (GW)
- PERMIT BOUNDARY
- MW-19 RISER / SCREEN — MONITOR WELL

CROSS SECTION E-E'

STATE OF TEXAS
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Tad A. Gass
5/16/2019

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CITY OF KINGSVILLE LANDFILL

SOIL BORING REPORT
CROSS SECTION E-E'
KLEBERG COUNTY, TEXAS

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THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION

Volume 4 of 6

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

For Permitting Purposes Only

STATE OF TEXAS
JON M. REINHARD
64541
LICENSED PROFESSIONAL ENGINEER
05/16/19

TBPE Firm No. F-417

September 2018
Revision 1 – November 2018
Revision 2 – February 2019
Revision 3 – April 2019
Revision 4 – May 2019

Prepared by

HANSON
Engineering | Planning | Allied Services

TBPE F-417

HANSON PROJECT NO. 16L0438-0003

ATTACHMENT 5

ALTERNATIVE LINER AND OVERLINER DESIGN AND POINT OF COMPLIANCE DEMONSTRATIONS

For Permitting Purposes Only

05/16/19

Jose C. Garza, P.E.

TBPE Firm No. F-417

CONTENTS

For Permitting Purposes Only

05/16/19

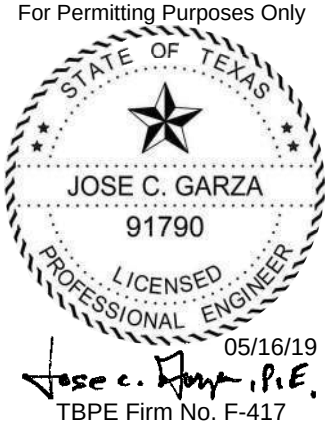
Jose C. Garza, P.E.

TBPE Firm No. F-417
For Pages i and iv

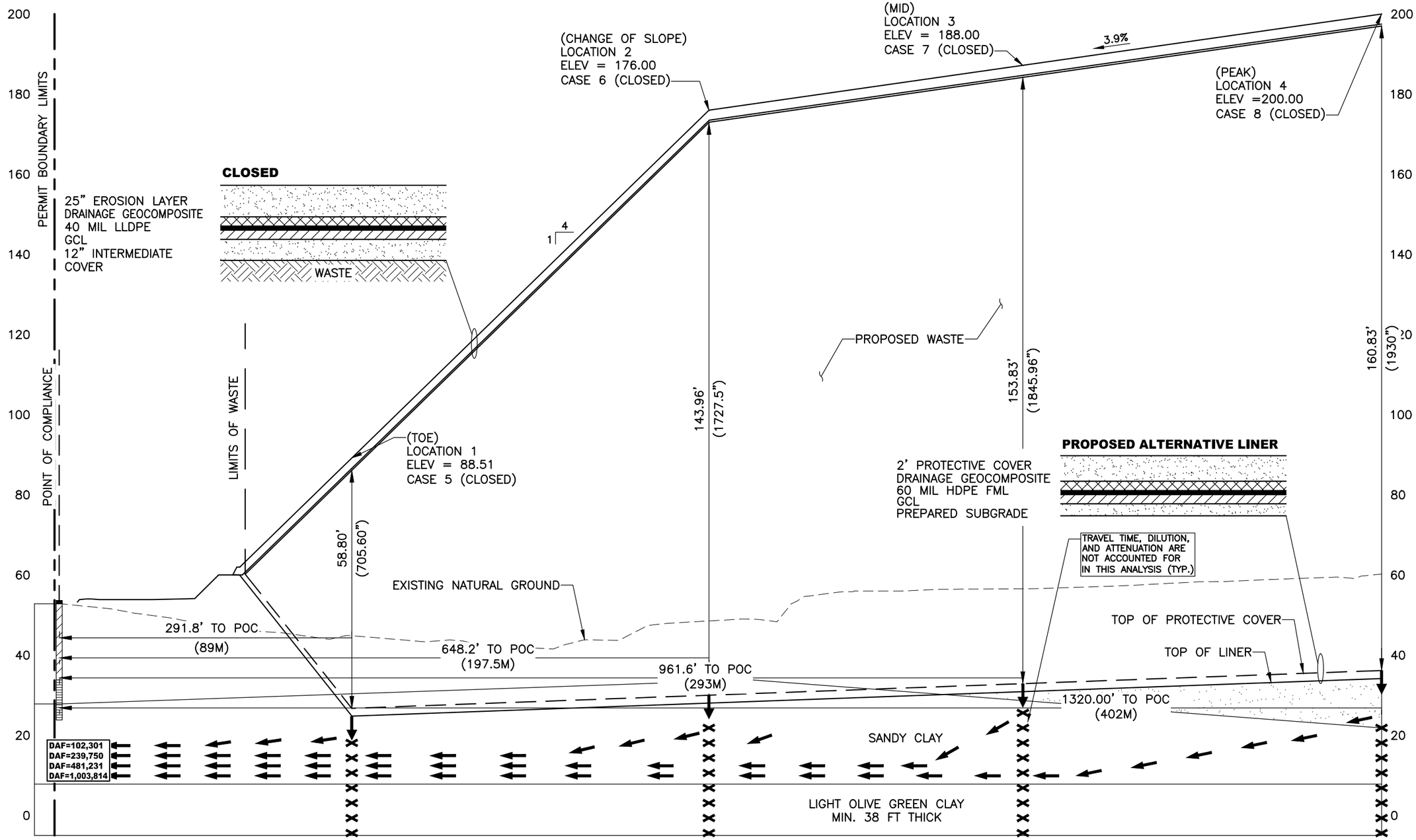
APPENDIX D.2

TYPICAL PROFILE-ALTERNATIVE LINER CLOSED LANDFILL DAF

For Permitting Purposes Only



TBPE Firm No. F-417



ALTERNATIVE LINER DEMONSTRATION – CLOSED LANDFILL CONDITION

1. USE HELP TO MODEL PERCOLATION THROUGH THE ALTERNATIVE LINER.
2. USE MULTIMED TO CALCULATE THE DILUTION ATTENUATION FACTOR (DAF).

MULTIMED INFORMATION

AVERAGE AQUIFER THICKNESS = 32.81FT (10M)
HYDRAULIC CONDUCTIVITY = 4.12×10^{-4} CM/SEC OR 130 M/YR
HYDRAULIC GRADIENT = i = 0.003125

NOTES:

1. EVANGELINE AQUIFER (500 FT BELOW GROUND SURFACE) (FRESH)
2. CHICOT AQUIFER (220 FT BELOW GROUND SURFACE)

NUMBER	REVISION	DATE	DRAWN	DESIGNED	REVIEWED

STATE OF TEXAS
JOSE C. GARZA
91790
LICENSED PROFESSIONAL ENGINEER
05/17/19
Jose C. Garza, P.E.

Hanson No. 16L0438
Filename
Scale AS SHOWN
Date 05/17/2019

LAYOUT	DT	05/17/2019
DRAWN	DT	05/17/2019
REVIEWED	JCG	05/17/2019

HANSON
Hanson Professional Services Inc.
4501 Gollihar Rd.
Corpus Chrisiti, Texas 78411

TBPE F-417
TBPLS F-10039500
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TBAE F-BR 2458

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(800) 677-2831
www.hanson-inc.com
Offices Nationwide

PART III, ATTACHMENT 5, APPENDIX D
TYPICAL PROFILE-ALTERNATIVE LINER
CLOSED LANDFILL DAF
CITY OF KINGSVILLE LANDFILL
MSW PERMIT No. 235-C
KINGSVILLE, TEXAS
KLEBERG COUNTY, TEXAS

FIGURE:
III.5-D.2

APPENDIX G

ALTERNATE COMPOSITE FINAL COVER DESIGN DEMONSTRATION

For Permitting Purposes Only

05/16/19

Jose C. Garza, P.E.

TBPE Firm No. F-417

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List of Appendices

For Permitting Purposes Only

STATE OF TEXAS
JOSE C. GARZA
91790
LICENSED PROFESSIONAL ENGINEER

05/16/19

Jose C. Garza, P.E.

TBPE Firm No. F-417

1.0 INTRODUCTION

This alternate composite final cover design demonstration will demonstrate that the use of a geosynthetic clay liner (GCL) will provide equivalent infiltration and protection from wind and water erosion as the conventional composite final cover defined in 30 TAC §330.457 (a).

1.1 Alternative Composite Liner System

The GCL Alternative Final Cover System is as follows from top to bottom:

25 - inch thick erosion layer
Double-sided geocomposite drainage layer
40-mil LLDPE textured geomembrane
GCL

GCLs are frequently used in liner systems. GCLs are geocomposite materials of low hydraulic conductivity and are readily available by several manufacturers. The GCLs have varying characteristics. They are generally manufactured by placing powdered or granulated bentonite on a geotextile or geomembrane substrate. The bentonite layer is typically 6 to 10 mm thick (following hydration) and is placed at a unit weight of approximately 0.8 pounds per square feet (lb/ft^2). The GCLs with a geotextile substrate also have a covering geotextile, which is often needle-punched, connecting the underlying geotextile to increase the structural integrity. Non-woven and woven geotextiles of various weights are used.

Generally, the permeability of the bentonite component of GCLs ranges from less than 1×10^{-9} to 5×10^{-9} cm/sec.

2.0 EQUIVALENCY

2.1 Leakage Rate Estimates

The leakage through composite liners can be estimated using the “Giroud equation”, as illustrated in Appendix G.1. The method requires assumptions regarding the characteristics of the composite liner. It is assumed that permeation through the full area of the geomembrane is insignificant in comparison to rapid leakage through isolated defects or holes. Also, assumptions need to be made regarding the extent to which intimate contact has been made. A composite liner that has intimate contact has been constructed such that the geomembrane lies flush with the surface of the underlying clay component, with few or no gaps between two liners. When intimate contact has been achieved, the effective area of leakage is very small, and the total liner system leakage is minimized. This phenomenon is referred to as “composite action.”

The equation used in the analysis is derived both from theoretical models of fluid flow and from empirical analyses of actual composite liner systems. Flow through a circular defect in a composite liner is calculated as follows:

$$Q = C[1+0.1(h/t_s)^{0.95}]a^{0.1}h^{0.9}k_s^{0.74}$$ [Ref 1] in Appendix G.1

Where:

Q = rate of leakage through a defect (m^3/sec)

C = Dimensionless constant related to the quality of the intimate contact between the geomembrane and the underlying soil component

h = hydraulic head on the geomembrane (m)

t_s = thickness of the low-permeability soil component (compacted clay liner or GCL) (m)

a = area of geomembrane defect (m^2)

k_s= permeability of soil component (compacted clay liner or GCL) (m/s)

Using the above equation, the conventional composite final cover system was compared to the alternative composite final cover system for both "good' and "poor" intimate contact and for circular holes with an area of 0.1 and 1.0 cm^2.

As shown in Appendix G.1, Infiltration Rate Comparison-GCL Alternate Final Cover for each condition, the alternative composite final cover had calculated leakage rates approximately 1/373 that of the geomembrane/compacted clay liner system.

2.2 Wind and Water Erosion

The alternative composite final cover surface will be seeded.

3.0 SUMMARY

The analysis demonstrates that substituting a GCL for an 18-inch thick compacted clay rich earthen material with a hydraulic conductivity of 1 x 10^{-5} cm/sec provides a level of infiltration reduction and wind and water protection that is greater than or equal to the level of protection provided by the conventional composite final cover system.

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05/16/19

Jose C. Garza, P.E.

TBPE Firm No. F-417
For calculations on
Pages 1 and 2

APPENDIX G.1

INFILTRATION RATE COMPARISON-GCL ALTERNATE FINAL COVER

For Permitting Purposes Only

05/16/19

Jose C. Garza, P.E.

TBPE Firm No. F-417

ALTERNATE COMPOSITE FINAL COVER DESIGN DEMONSTRATION
INFILTRATION RATE COMPARISON-GCL ALTERNATE FINAL COVER

OBJECTIVE:
Comparison between the infiltration rate through a conventional composite final cover system and the infiltration rate through the alternative composite final cover system.

GIVEN:
The conventional composite final cover system consists of a 40-mil geomembrane overlying an 18-inch thick compacted clay rich material with a maximum hydraulic conductivity of 1 x 10-5 cm/sec. In the alternative composite final cover system, the compacted clay rich infiltration layer material will be replaced with a geosynthetic clay liner (GCL). Both final covers include a geocomposite drainage layer above the geomembrane (GM).

Infiltration Layer Properties

k=	1.00E-05	cm/s
	1.00E-07	m/s
t=	1.5	ft
	0.4572	m
h=	0.2	inches
	0.005079752	m

(sized to prevent head > 0.2 inches when cover soil saturated)

GCL Properties

k=	3.00E-09	cm/s
	3.00E-11	m/s
t=	6	mm
	0.006	m
h=	0.2	inches
	0.005079752	m

(geocomposite drainage layer sized to prevent head > 0.2 inches when cover soil saturated)

METHOD:
Estimate the infiltration rate through each final cover system using the Giroud Equation (Ref. 1). Compare the infiltration rate through composite final cover systems consisting of a geomembrane(GM)/clay rich material and a GM/GCL.

Infiltration through composite geomembrane/GCL liner:

$Q = C[1+0.1(h/t_s)^{0.95}]a^{0.1}h^{0.9}K_s^{0.74}$ Ref 1

where: C = 0.21 good contact
1.15 poor contact
h = head (m)
t_s = thickness of low permeability soil component (clay material or GCL) (m)
a = area of hole (m^2)
0.1 cm^2
0.00001 m^2
1 cm^2
0.0001 m^2
k_s = hydraulic conductivity of clay material or GCL (m/s)

Example Calculation for Good Contact GM/GCL & 0.1 cm^2 hole: $0.21[1+0.1(0.00508/.006)^{0.95}] \times 0.00001^{0.1} \times 0.00508^{0.9} \times 3.0E\text{-}11^{0.74} = 1.01E\text{-}11$

RESULTS:

Leakage Rate Per Defect

Intimate Contact		Good		Poor	
Composite Cover System		GM/Clay	GM/GCL	GM/Clay	GM/GCL
Leakage (m^3/sec)	0.1 cm^2 hole	3.79E-09	1.01E-11	2.07E-08	5.55E-11
	1 cm^2 hole	4.77E-09	1.28E-11	2.61E-08	6.99E-11

Comparison

Intimate Contact	$Q_{GM/Clay}/Q_{GM/GCL}$	
	0.1 cm^2 hole	1 cm^2 hole
Good	373	373
Poor	373	373

Example Calculation for Poor Contact $Q_{GM/Clay}/Q_{GM/GCL}$ & 0.1 cm^2 hole: 2.07E-08/5.55E-11 = 373

CONCLUSION:

Based on this analysis, the infiltration rate through an alternative composite final cover system with a GCL will be approximately 1/373 that of the conventional composite final system with a clay rich infiltration layer.

REFERENCE:

1. Giroud, J.P., "Equations for Calculating the Rate of Liquid Migration Through Composite Liners Due to Geomembrane Defects", Geosynthetics International, Vol. 4, Nos. 3-4, pp. 335-348, 1997.

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05/16/19

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For calculations on
Pages 1 and 2

THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION

Volume 5 of 6

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

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JON M. REINHARD
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Revision 4 – May 2019

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Engineering | Planning | Allied Services

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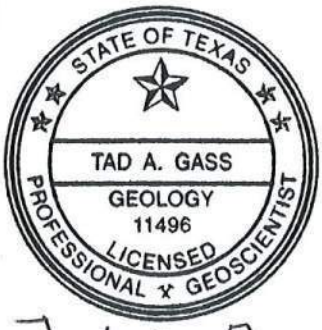
HANSON PROJECT NO. 16L0438-0003

THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235-C

PERMIT AMENDMENT APPLICATION
PART III, ATTACHMENT 11
GROUNDWATER SAMPLING AND ANALYSIS PLAN

CITY OF KINGSVILLE, TEXAS



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Item 1 – Municipal Solid Waste Groundwater Monitoring Flow Chart
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Item 3 – Chain-of-Custody Form
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Item 5 – Laboratory Review Checklist
Item 6 – Laboratory Quality Assurance/Quality Control Manual

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(when physical obstacles preclude installation of the groundwater monitoring wells at the point of compliance), as defined in 30 TAC §330.3, that will ensure detection of groundwater contamination of the uppermost aquifer. The average ground water level is at approximately 35 feet National Geodetic Vertical Datum (NGVD). The target groundwater monitoring zone typically consists of clayey sand, silty sand, and poorly graded clay with sand. All parts of the groundwater monitoring system shall be operated and maintained so that they perform at least to design specifications. The design of the monitoring system is based on site specific technical information gathered during multiple site investigations and further discussed in the site Geology Report included as Part III Attachment 4 of this permit, Part III Attachment 4 Appendix 1, and the Groundwater Characterization Report included as Part III Attachment 4, Appendix 1 beginning on page 752. The City of Kingsville Landfill will promptly notify the executive director, and any local pollution agency with jurisdiction that has requested to be notified, in writing of changes in facility construction or operation or changes in adjacent property that affect or are likely to affect the direction and rate of groundwater flow and the potential for detecting groundwater contamination from a solid waste management unit and that may require the installation of additional monitoring wells or sampling points and that such additional wells or sampling points require a modification of the site development plan.

A topographic and Groundwater Contour map identifying the existing and proposed monitor well locations, installed depths, property boundary, a delineation of the waste management area, and the point of compliance line has been included in Appendix A-Item 1A and B Site Layout Maps. All monitoring wells will be constructed in accordance with 30 TAC §330.421. Monitor well installation and construction details will be provided on form TCEQ-10308, or current appropriate TCEQ reporting form, upon completion. The Groundwater Monitoring System Design Certification has been included as Appendix A-Item 2.

2.0 HEALTH AND SAFETY

Personnel performing water level measurements, well purging, or sampling will, at a minimum, wear latex or other equivalent non-powdered gloves. The gloves will be changed when they become damaged and when activities begin at a different well location. All personnel that are associated with the purging and sample collections from monitor wells will wear other appropriate Personal Protective Equipment (PPE) such as eye protection, safety vests, chemical resistant clothing and/or aprons, and air purifying respirators, as necessary.

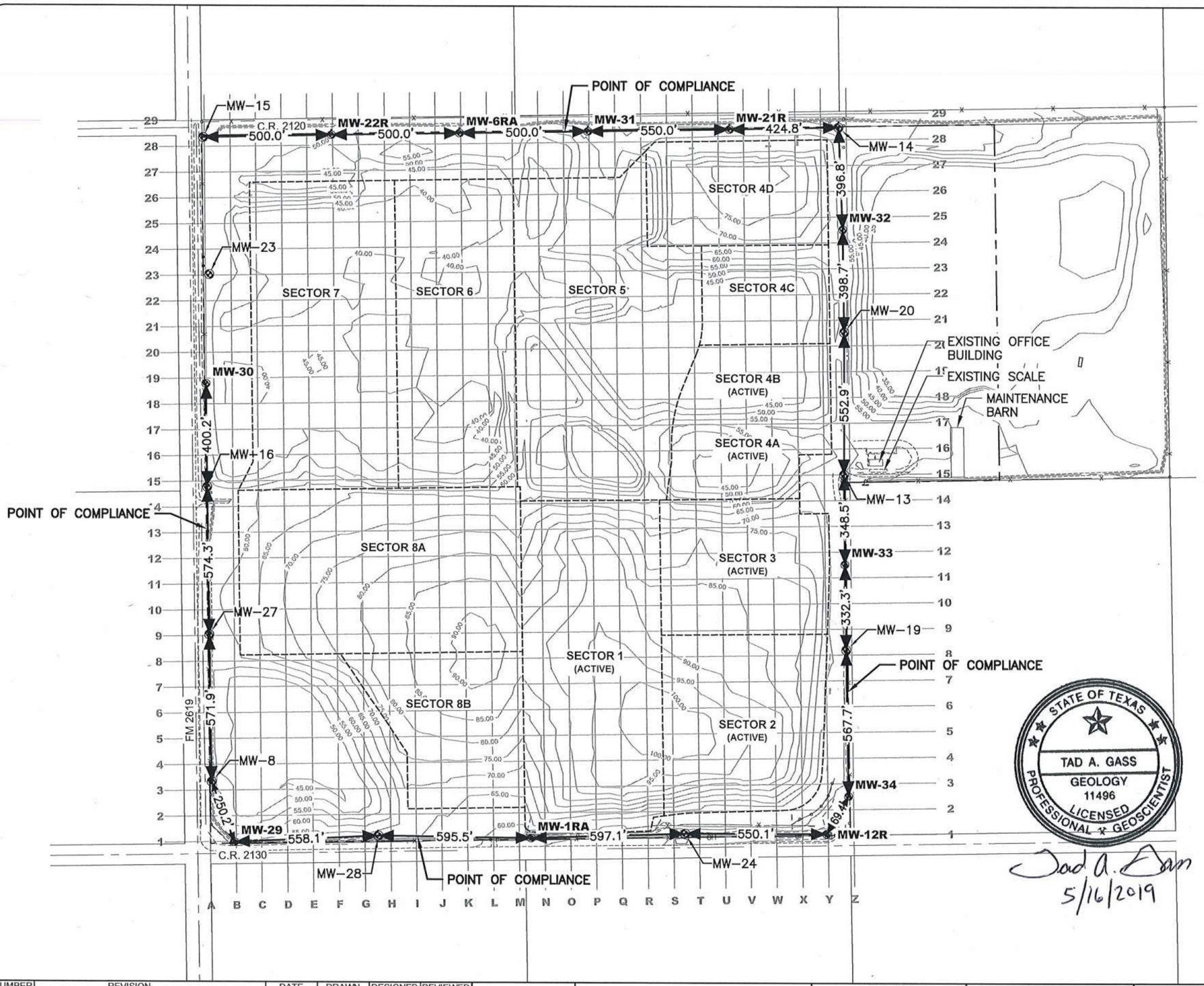
3.0 GROUNDWATER SAMPLING FREQUENCY

3.1 Background Monitoring

At least eight (8) statistically independent background groundwater samples will be obtained on a quarterly basis prior to commencing with Detection Monitoring for each groundwater monitor well at the facility (see Appendix A, Table 1, for parameters). Background monitoring events should allow approximately 90 days between each monitoring event to allow the collection of groundwater data over the different seasons of the year.

3.2 Detection Monitoring

After establishment of background groundwater quality, detection monitoring will be performed on a semi-annual basis at approximately 6-month intervals during the remaining operational life and post-closure care period for this facility. Detection monitoring will begin on the first semi-



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GRAPHIC SCALE IN FEET

LEGEND:

- ⊗ MW-20 — MONITOR WELL LOCATION
- x — EXISTING FENCE
- 65.00 — EXISTING SURFACE CONTOUR (2015)
- SECTOR OUTLINE
- PERMIT BOUNDARY (175.89 ACRES)
- 400.2' — POINT OF COMPLIANCE

SITE COORDINATES MONITOR WELL LOCATIONS				
MW	Northing	Easting	DEPTH (FT BGS)	STATUS
MW-8	17051473.78	1203673.74	43	EXISTING
MW-13	17052672.16	1206127.95	40	EXISTING
MW-14	17054020.04	1206103.02	35	EXISTING
MW-15	17053976.10	1203628.61	33	EXISTING
MW-16	17052619.76	1203651.21	40	EXISTING
MW-19	17051991.35	1206137.50	43	EXISTING
MW-20	17053225.01	1206127.20	39	EXISTING
MW-23	17053444.05	1203654.88	35	EXISTING
MW-24	17051277.99	1205512.42	33	EXISTING
MW-27	17052045.52	1203661.75	40	EXISTING
MW-28	17051266.46	1204320.24	43	EXISTING
MW-1RA	17051258.70	1204915.66	35	PROPOSED
MW-32	17053623.64	1206120.29	31	PROPOSED
MW-6RA	17053994.38	1204628.44	30	PROPOSED
MW-12RA	17051277.38	1206062.51	35	PROPOSED
MW-21R	17054011.48	1205678.30	32	PROPOSED
MW-22R	17053986.24	1204128.51	30	PROPOSED
MW-29	17051239.92	1203762.81	40	PROPOSED
MW-30	17053019.90	1203644.60	30	PROPOSED
MW-31	17054002.53	1205128.38	31	PROPOSED
MW-33	17052323.65	1206132.04	35	PROPOSED
MW-34	17051423.79	1206147.64	35	PROPOSED

NOTE: ALL MONITORING WELLS WILL BE INSTALLED AND MONITORED THROUGHOUT THE ACTIVE LIFE AND POST-CLOSURE CARE PERIOD OF THIS SITE.

STATE OF TEXAS
TAD A. GASS
GEOLOGY
11496
LICENSED
PROFESSIONAL GEOSCIENTIST

Tad A. Gass
5/16/2019

NUMBER	REVISION	DATE	DRAWN	DESIGNED	REVIEWED

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Filename B514-03-APPENDIX-SITE-LAYOUT
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Date 05/17/2019

LAYOUT	DT	05/17/2019
DRAWN	DT	05/17/2019
REVIEWED	TAG	05/17/2019

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PART III, ATTACHMENT 11
APPENDIX A
ITEM - 1A
SITE LAYOUT MAP
GROUNDWATER SAMPLING AND ANALYSIS PLAN
CITY OF KINGSVILLE LANDFILL
PA. MSW 235-C
KINGSVILLE, TEXAS, KLEBERG COUNTY, TEXAS

FIGURE:
III.11-A-1A

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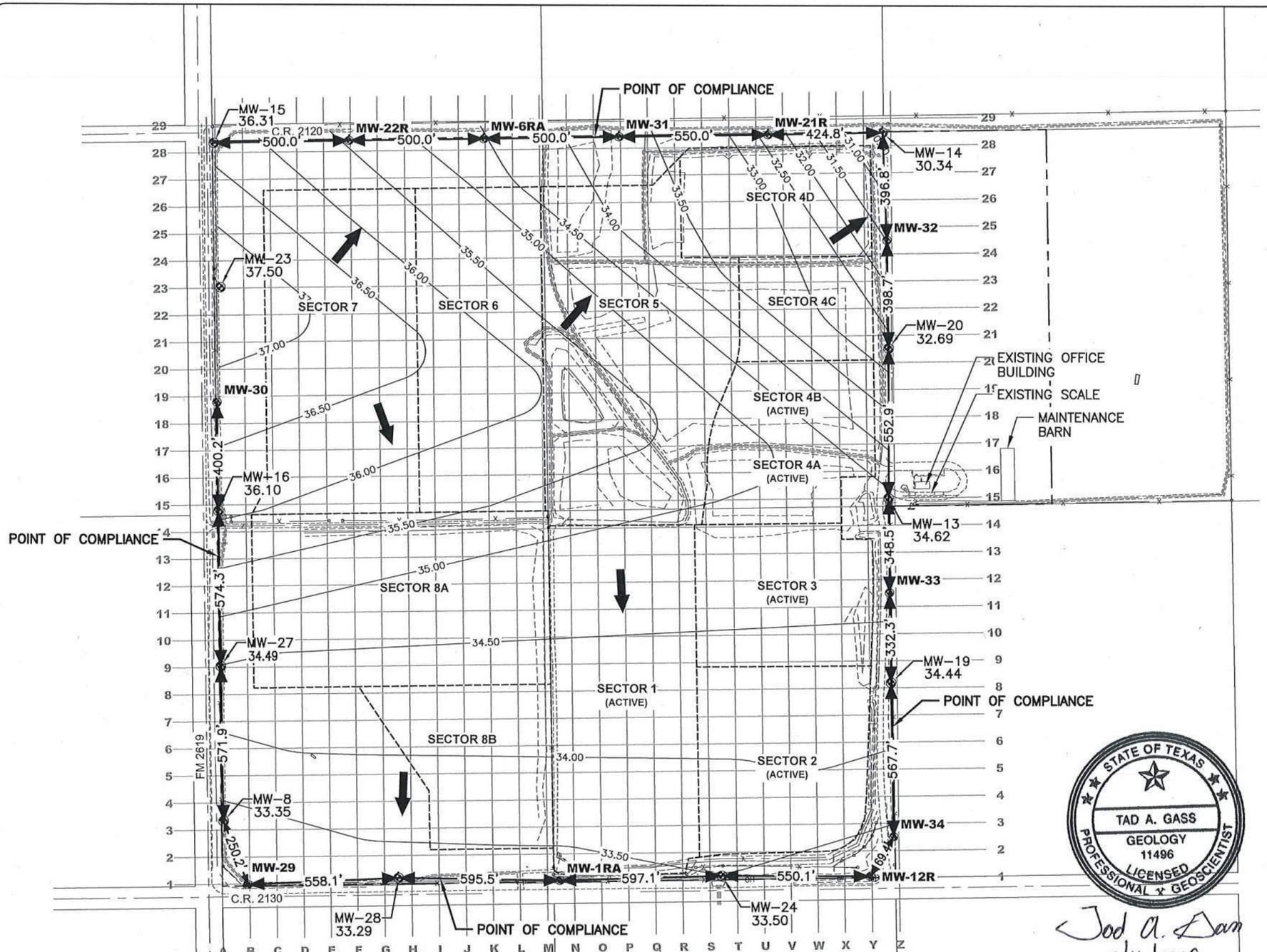

LEGEND:

- MW-20 — MONITOR WELL LOCATION
- x — EXISTING FENCE
- 35.00 — GROUNDWATER CONTOURS (FEET AMSL)
- SECTOR OUTLINE
- PERMIT BOUNDARY (175.89 ACRES)
- 400.2' — POINT OF COMPLIANCE
- GROUNDWATER DIRECTIONAL FLOW ARROW

SITE COORDINATES MONITOR WELL LOCATIONS				
MW	Northing	Easting	DEPTH (FT BGS)	STATUS
MW-8	17051473.78	1203673.74	43	EXISTING
MW-13	17052672.16	1206127.95	40	EXISTING
MW-14	17054020.04	1206103.02	35	EXISTING
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MW-29	17051239.92	1203762.81	40	PROPOSED
MW-30	17053019.90	1203644.60	30	PROPOSED
MW-31	17054002.53	1205128.38	31	PROPOSED
MW-33	17052323.65	1206132.04	35	PROPOSED
MW-34	17051423.79	1206147.64	35	PROPOSED

NOTES:
1. GROUNDWATER ELEVATIONS FROM JANUARY 2017.
2. ALL MONITORING WELLS WILL BE INSTALLED AND MONITORED THROUGHOUT THE ACTIVE LIFE AND POST-CLOSURE CARE PERIOD OF THIS SITE.

STATE OF TEXAS
TAD A. GASS
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11496
LICENSED
PROFESSIONAL GEOSCIENTIST

Tad A. Gass
5/16/2019

NUMBER	REVISION	DATE	DRAWN	DESIGNED	REVIEWED

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Date 05/17/2019

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PA. MSW 235-C
KINGSVILLE, TEXAS, KLEBERG COUNTY, TEXAS

FIGURE:
III.11-A-1B

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THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION

Volume 1 of 6

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

September 2018
Revision 1 – November 2018
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Revision 3 – April 2019
Revision 4 – May 2019

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Part I

Attachment 1

Supplementary Technical Report

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

September 2018
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1 SUPPLEMENTARY TECHNICAL REPORT

This supplementary technical report presents a detailed facility description, an overview of the project, as well as the types of waste that will be accepted at the facility.

1.1 Facility Description

The City of Kingsville Landfill (Kingsville Landfill) is an existing, Type I and Type IV municipal solid waste disposal facility (Permit No. MSW 235-B). The current permit boundary encompasses about 120 acres out of the 196.88 acre property boundary. In the current permit (235-B), approximately 90 acres are designated for Type I waste while 24 acres are designated for Type IV waste. Approximately 40 acres of the area designated for Type I waste have been developed. The existing lined areas correspond to Type I Sectors 1, 2, 3, and 4, all of which are still active. Sectors 1, 2 and 3 have intermediate covers while sector 4 is currently filling. Only about 10 acres of the area designated for Type IV waste have been developed.

Non-waste disposal areas included on the property include a scale house, office building and a maintenance shop.

1.2 Permit History

The site was originally permitted by the State of Texas in 1977. The initial facility was permitted (Permit No. 235) to receive 863,534 cubic yards (cy) of solid waste and initial filling operations began in February 1977. This original 40 acre site, began waste disposal operation at an approximate elevation of 40 MSL, progressed upwards in 4-feet layers, filled, and closed in March 1992. The floor soil of this sector was stabilized with bentonite. The original 40 acre sector, Permit 235, is closed and is not Subtitle D compliant.

The City of Kingsville received a permit amendment for an additional ~~40~~34.85-acre lateral landfill expansion of the site in 1986 (Permit No. 235-A) increasing the permitted acreage to 74.85 acres. The approved Permit 235-A, was developed and the configuration of the approximately 20-acre Sector 1, received the first load of waste material in March 1992.

Permit No. 235-B was issued in 1999, removing the original 40 acre (235) closed portion and adding an additional 83.55 acres increasing the permitted acreage from ~~80~~ 74.85 acres to approximately ~~120~~ 118.4 acres and a maximum height of final cover of 125 feet-msl. Kingsville Landfill is currently operating under the 1999 permit requirements and subsequent permit modifications or authorizations. At the current gate rate, the estimated site life remaining is approximately 43 years.

The following table summarizes the list of permits obtained for the operation of Kingsville over the years.

TABLE 1: PERMIT HISTORY SUMMARY

PERMIT NUMBER	TYPE	DATES
235	I	1977 to 1992
235-A	I	1986 to 1999
235-B	I and IV	1999 to Present

1.3 Project Overview

The purpose of this permit amendment is to increase the capacity of the landfill site via a vertical and horizontal expansion. The existing active approximately 118.4 acre permitted area will be expanded to a total of 176.33-acres (121.3-acre waste disposal footprint). This increase will include approximately 19.45-acres to the northeast of the permitted boundary which is currently being used as a soil borrow pit and another approximately 38.45-acres to the southwest, in the area of the closed Pre-Subtitle D landfill area (Permit No. 235). The closed Pre-Subtitle D landfill area will be overlined with Subtitle D compliant liner and will receive additional waste to be placed over the previously deposited waste. The previously deposited waste in the closed Pre-Subtitle D landfill area will not be disturbed, the Subtitle D compliant overliner will be placed over the final cover the closed Pre-Subtitle D landfill area.

The vertical expansion will include; placing additional waste on top of the closed pre-subtitle D landfill area, increasing the depth of the landfill excavation in the areas that have not yet been lined, increasing the landfill's maximum elevation and modifying the slopes on top of the landfill. The revised elevation of the deepest excavation will be 22.5 feet-msl and the maximum final cover elevation will be increased from 125 feet-msl to 200 feet-msl. Details of the revised floor contours, as well as the modified final cover contours and cross sections are provided in Part III, Attachment 1, Figures III.1-3, III.1-4, III.2-1 and III.2-5.

The vertical and horizontal expansion will result in a capacity increase of 12,~~455,714~~181,286 cubic yards of waste and daily cover, or approximately 5,150,438 tons of waste capacity. Making the total remaining waste disposal capacity 15,225,000 cubic yards of waste and daily cover, or approximately 6,295,538 tons of remaining waste disposal capacity. This landfill expansion will provide for the long-term disposal needs of Kleberg County, and surrounding communities.

Other parts of this permit amendment are to; convert the existing Type IV Sectors to Type I Sectors, request for approval to process and dispose of additional special wastes including liquid wastes and used tires (Refer to Part II, Section 2 and Part IV - Site Operating Plan, for a more detailed discussion), and to revise the floor contour and final contour plans to incorporate the modifications discussed in previous paragraphs.

The following table provides a summary of the current permitted conditions and proposed permit conditions.

TABLE 2: PERMIT CONDITION SUMMARY

	CURRENT CONDITIONS	**PROPOSED CONDITIONS**
Permitted Area	120 acres	176.33 acres
Total Permitted Capacity	Type I - 4,993,000 cy Type IV - 820,000 cy 5,813,000 cy	17,994,286 cy
Total Remaining Capacity	1,258,576 tons 3,043,714 cy	6,295,538 tons 15,225,000 cy
Remaining Projected Site Life	43	98
Maximum Elevation of Final Cover (msl)	125	200
Lowest Elevation of Waste Placement (msl)	46.5	26.5
Elevation of Deepest Excavation (msl)	42.5	22.5

THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION

PART II

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

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2 WASTE ACCEPTANCE PLAN §330.61(b)

2.0 Sources and Characteristics of Waste

The operational procedures and redesign described in the Permit Amendment Application, once approved, will allow the facility to: accept, store , ~~process~~ and~~/or~~ dispose of municipal solid waste, construction and/or demolition waste, ~~whole and scrap tires, grease and grit trap waste, liquid waste,~~ industrial waste non-hazardous Class 2 and Class 3 and some special wastes as defined by 30 TAC §330.3, 30 TAC §330.171, and 30 TAC §330.173; and accept, store, and process municipal solid waste, construction and/or demolition waste, whole and scrap tires, grease and grit trap waste, and liquid waste.

The facility will accept for disposal the following special waste allowable under 30 TAC §330.171: special wastes from health care related facilities, dead animals and/or slaughterhouse waste, non-regulated asbestos-containing materials (non-RACM), empty containers which have been used for pesticides, herbicides, fungicides, or rodenticides, Municipal hazardous waste from a conditionally exempt small quantity generator (CESQG), sludge, grease trap waste, grit trap waste, soil contaminated by petroleum products, crude oils, or chemicals and liquid waste from oilfield activities. Procedures for accepting and processing all special waste are detailed in the Site Operating Plan (Part IV). In the event that the City of Kingsville Landfill elects to accept other special wastes in the future, TCEQ authorization will be sought and procedures for acceptance and processing will be provided. Other materials that will be received for processing and potentially beneficial reuse include scrap tires and unsorted mixed recyclables.

Consistent with 30 TAC §330.15, the City of Kingsville Landfill will not accept for disposal lead acid storage batteries, used motor vehicle oil, used oil filters, refrigerators, freezers, air conditioners or other items containing chlorinated fluorocarbons (CFC), regulated hazardous waste, polychlorinated biphenyls (PCB) waste, radioactive materials, or other wastes prohibited by TCEQ. Friable asbestos-containing materials, and empty containers, as well as industrial hazardous waste, and Non-hazardous Class 1industrial waste will not be accepted for disposal.

The Site Operating Plan in Part IV of the application contains a detailed description of the restrictions pertaining to waste acceptance procedures. The Applicant (City of Kingsville) reserves the right to reject any waste material, including those mentioned above, that contributes a constituent or characteristic that may impact or influence the design or operation of the facility.

2.1 Volume and Rate of Disposal

Kingsville Landfill received approximately 31,444 tons of incoming solid waste in 2017. The maximum annual waste acceptance rate is anticipated to increase at approximately one (1) percent per year which corresponds to the anticipated yearly population growth rate for Kleberg County (based on population projections from the Texas State Data Center).

Table 1 shows the estimated maximum annual waste acceptance rates for the facility projected for five years, together with the associated population equivalents represented by these quantities.

TABLE 1: ESTIMATED MAXIMUM ANNUAL WASTE ACCEPTANCE RATE

Year	Estimated Maximum Annual Waste Acceptance Rate (Tons)	Population Equivalent
1	31,758	34,745
2	32,076	35,092
3	32,397	35,443
4	32,721	35,798
5	33,048	36,156

Note that these figures are only estimates and should not be considered either as a firm commitment of quantities to be received or as a limitation on the amount of waste to be received in any of the years shown. Actual quantities accepted at the site will vary depending on changes in population, economic activity, and changes in waste collection and disposal practices in the region. The City of Kingsville will continue to maintain records to document the annual waste acceptance rate for the facility. If the rate exceeds the estimated rate and is not due to a temporary occurrence, the City of Kingsville will file a permit modification application consistent with 30 TAC §330.125(h).

Once expanded, the landfill will provide a total remaining waste disposal capacity of approximately 15,225,000 cubic yards of waste and daily cover. The estimated site life is 98 years (See Part III, Section 5 for the detailed site life calculation).

2.2 Waste Acceptance Rate and Storage Capacity of Processing Areas

Tire Storage and Processing Area

Kingsville Landfill is estimated to accept approximately 15 tires a day. The maximum storage capacity is 500 tires or weight equivalent tire pieces or any combination thereof on the ground or 2,000 tires or weight equivalent tire pieces or any combination thereof in enclosed and lockable containers.

Liquid Waste Solidification Area

Kingsville Landfill is estimated to accept approximately 19,500 gallons a day. The maximum storage capacity in the Liquid Waste Solidification Area is 19,151 gallons.

9 TRANSPORTATION §330.61(i)

9.1 Selected Routes

Vehicles entering the City of Kingsville Landfill include semi-trailers, dump trucks and trailers, and light duty trucks. E County Road 2130 (CR E 2130), Farm to Market Road 1717 (FM 1717), and Farm to Market Road 2169 (FM 2169) will provide access to the site. These routes are asphalt paved and are the same routes currently in use for the City of Kingsville Landfill. The transportation network used to access the landfill is presented as Part II, Attachment 1. Figure II.1-1.

9.2 Adequacy of Roads

The privately owned site entrance road is currently a two-lane, 24-foot wide road maintained by the City of Kingsville to ensure access to the facility. The Texas Department of Transportation is responsible for maintaining FM 2169 and FM 1717 while E CR 2130 is maintained by Kleberg County. All roads are adequate for use by vehicles up to the legal maximum of 58,420 pounds, including solid waste collection vehicles entering and exiting the facility. Periodic maintenance of the roads is routinely undertaken by the City and TXDOT as necessary to maintain availability of these routes to the landfill and to ensure that residents and businesses along the routes have continued access. Correspondence with TXDOT regarding the adequacy of roads used to access the facility is included in Part II, Attachment 3. TXDOT responded to the NORI with a memo, dated April 16, 2019, stating that the facility is subject to the Highway Beautification Act requirements (43 TAC Chapter 21, Subchapter H). The April 16, 2019 memo is included with Part II, Attachment 3–B. ~~Further communication with TXDOT is required to determine if the facility is subject to the Highway Beautification Act requirements or not. If it is determined that the facility is subject to the Highway Beautification Act requirements (43 TAC Chapter 21, Subchapter H), the~~ The facility will provide appropriate screening for a sanitary landfill in accordance with th~~os~~e screening requirements provided in the TxDOT ROW Beautification Manual - Manual Notice: 2018-1 dated June 15, 2018, Chapter 10: Control of Junkyards, Section 2: Screening Standards and as approved by the TXDOT District Engineer for Kleberg County.

9.3 Existing Traffic Volumes

All landfill traffic access the facility via the single site entrance road from E County Road 2130 (E CR 2130) and Farm to Market Road 2619 (FM 2619) which is in-turn accessed via Farm to Market Road 1717 (FM 1717). TXDOT records show the Annual Average Daily Traffic (2016 AADT) is approximately 731 on FM 2619 at the nearest traffic count northwest of the landfill and 1,218 on FM 1717 at the traffic count northwest of the landfill (Refer to Part II, Attachment 1. Figure II.1-1. There are no available traffic counts for E CR 2130. Approximately 46 City, commercial, and citizen waste hauling vehicles per day use the City of Kingsville Landfill.

9.4 Projected Volume of Vehicular Traffic

The proposed vertical and lateral expansion will not have an impact on vehicular traffic in the area as the rate at which municipal solid waste is received by the facility will not be affected. The traffic

THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION
PART III
SITE DEVELOPMENT PLAN

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

September 2018
Revision 1 – November 2018
Revision 2 - February 2019
Revision 3 - April 2019
Revision 4 - May 2019

Prepared by

HANSON
Engineering | Planning | Allied Services
TBPE F-417

HANSON PROJECT NO. 16L0438-000

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THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION

Volume 2 of 6

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

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HANSON PROJECT NO. 16L0438-0003

THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION
PART III, ATTACHMENT 4
GEOLOGY REPORT

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

September 2018
Revision 1 – November 2018
Revision 2 – February 2019
Revision 3 – April 2019
Revision 4 – May 2019

Prepared by

HANSON
Engineering | Planning | Allied Services
TBPE F-417

HANSON PROJECT NO. 16L0438-0003

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Stratigraphic Position of Site

Table 2-1
Geologic Formations for Kleberg County

Period	Epoch	Geologic Formation	Approximate Maximum Thickness (FT)	Litholgy	Water-Bearing Properties
Quaternary		Alluvium	?	Mostly very fine to fine sand, silt, and calcareous clay	Not significant as an aquifer. Not known to be tapped by wells.
		Barrier Island Deposits	50	Tan to gray, fossiliferous, medium sand containing wood fragments; interbedded tan sand and gray clay, locally gypseous; and gray, fossiliferous sandy clay	Capable of yielding small quantities of fresh water to shallow wells on Padre Island.
	Holocene and Pleistocene (?)	South Texas Eolian Plain Deposits	60+	Tan to white, unfossiliferous, massive, fine to very fine sand, greenish gray sandy clay, highly calcareous clay or marl, and thin-bedded clayey sand.	Yields small quantities of sl ightly saline water to a few stock wells in Kenedy County. in sofne areas in Kenedy County the sand contains brine
	Pleistocene	Barrier Island and Beach Deposits	1,400	Barrier island and beach deposits mostly light gray, massive, crossbedded fine sand about 60 feet thick; contains some shell fragments.	Barrier island and beach deposits yield small quantities of fresh to probably moderately saline water to a few stock wells in eastern Kleberg County near Laguna Madre.
		Beaumont Clay and Lissie Formation, Undifferentiated		Beaumont Clay and Lissie Formation mostly very calcareous, slightly carbonaceous, blue and yellow clay and a few lenticular beds of sand.	Beaumont Clay and Lissie Formation yield small quantities of slightly to moderately saline water to a few mostly stock wells in eastern part of Kleberg and Kenedy Counties.
Tertiary	Pliocene	Goliad Sand	1,100	Fine to coarse, mostly gray calcareous sand interbedded with sandstone and varicolored calcareous clay. Sand beds or sandstone compose from 40 to 60 percent of the formation.	Principal aquifer. Yields small to large quantities of fresh to slightly saline water to public supply, industrial, and irrigation wells as well as to numerous rural domestic and stock wells. Many of the wells tapping the Goliad in Kleberg and Kenedy Counties flow.
	Miocene	Lagarto Clay	1,200+	Mostly stiff, compact, gray, calcareous clay and some thin lenticular beds of gray sand.	Not known to be tapped by wells, but capable of yielding small quantities of slightly saline water in Kenedy and Jim Wells Counties.
		Oakville Sandstone	600	Very fine to coarse, brown to gray sand and sandstone interbedded with silt and a considerable amount of clay.	Yields small to moderate quantities of sl ightly saline water to industrial and stock wells in southern Jim Wells County.

*(Source) Texas Water Development Board, Report 173, Ground-Water Resources of Kleberg, Kenedy, and Southern Jim Wells Counties, Texas, July 1973. (Shafer, 1973)
The site overlies the South Texas Eolian Plain Deposits. The hydrogeologic units below the site consist of the Chicot Aquifer within the Lissie Formation followed by the Evangeline Aquifer within the Goliad Sand (Principal Aquifer of the site).

number and depth at a minimum. Soil test borings were visually logged in the field and boring logs have been provided in Appendices 1, 2, and 3.

3.3 Site Stratigraphy

As seen on Figure 4.4 and 4.4a (Page 19-20), the primary geologic formations exposed at the surface of the site are silt sheet deposits, clay dune, and clay-sand dune deposits. The topsoil consists of clay which is black, silty, and contains humic material. Sediments encountered in borings at the site are Holocene and Pleistocene in age and consist of clays, silts, sands, and caliche deposited in two (2) separate and distinct environments of deposition. The subsurface geology is presented on cross sections A–A' through I–I' included in Appendix 1 beginning on page 67. Additional cross sections (A–A' through E–E') developed from soil borings installed during Tolunay-Wong Engineers, Inc.'s investigation have been provided in Appendix 3 (Soil Boring Report) Exhibit IV.

The site is underlain by sediments that can be divided into five discontinuous units and one continuous unit. The discontinuous units are caliche bearing channel unit (I), sand filled channel unit (II), clayey sand unit (clay dune, III), clayey sand unit (clay dune IV), and sandy silty clay unit. The continuous unit consists of the light olive green to gray clay unit which is an aquiclude present below the site. Several borings installed by Tolunay-Wong (B-30, B32, and B-39) located a clayey sand layer below the light olive green to gray clay unit. The water bearing zone is made up of the five discontinuous units which are all in communication. The average ground water level is at approximately 35 feet National Geodetic Vertical Datum (NGVD).

3.3.1 Body I- Caliche Bearing Channel

As stated in Appendix 1 (Page 59), this is the youngest, most extensive, sand containing body that can be correlated across the site. This body consists of interbeds of caliche, clays, and sands which, in themselves, are noncorrelative. The individual beds within this body appear to be of limited extent and probably represent braided deposits within a single channel approximately ½ mile in width. The base of this channel is placed at the base of the lowest caliche encountered in the borings at the site. When grouped together, it can be shown via cross section and isopach mapping that the body can obtain a maximum thickness of 40 feet and, as a whole, cuts downward into underlying beds. This body was deposited as a channel system which trends in a down dip direction, southwest to northeast, across the City of Kingsville Landfill site. Much of the caliche contained within this body has been previously removed from the site by mining operations. The Caliche Bearing Channel can be seen in Tolunay-Wong borings B-31, B-37, B-33, B-36, and B-39 as seen on cross section B-B' of Exhibit IV of the Soil Boring Report. The Clayey Sand (SC) layer of this cross section has mention of calcareous nodules, trace gravel, and trace caliche in the respective boring logs. Samples from this stratum indicated an average horizontal permeability of $3.0x10^{-4}$ cm/sec.

3.3.2 Body II- Sand Filled Channel

As stated in Appendix 1 (Page 59), Body II was deposited as a channel filled with a homogeneous, well sorted, very fine grained to fine grained, clean, unconsolidated sand. The fill sediment in Body II is much simpler than the fill sediment in Body I. The preserved length and width of this channel sand is less than one half mile due to truncation and incisement by the overlying Body I channel. Body II is interpreted as being a channel due to down cutting evident on the cross sections. This channel sand is apparent in borings 10 and 17. Body II (seen as SM on Cross Sections A–A', B–B', C–C', and D–D' on Exhibit IV of the Soil Boring Report in B-34, B-37, and B-40) was also

evident in borings 37, 34, and 40 which were installed in the most recent geotechnical investigation by Tolunay-Wong Engineers, Inc. B-37 penetrated approximately 14.5 feet of the silty sand (SM), B-34 penetrated approximately 21.5 feet of the silty sand (SM), and B-40 penetrated approximately 14.5 feet of the silty sand (SM). Deposition of the Body II channel sand was oriented in a dip direction, southwest to northeast across the site. Permeability tests performed on samples from this stratum indicated an average vertical and horizontal permeability of $1.0x10^{-4}$ cm/sec and $3.0x10^{-5}$ cm/sec respectively.

3.3.3 Body III- Clayey Sand (Clay Dune)

As stated in Appendix 1 (Page 59-60), the Clayey Sand (Clay Dune) Body III lies under the eastern edge of the City of Kingsville Landfill site and is composed of a homogeneous, very fine grained, well sorted, clayey sand. Well 13 was previously the only known penetration of the sand encountering a thickness of 17'. Borings ~~35 and~~ 39, installed by Tolunay-Wong Engineers, Inc., also penetrated Body III (seen as SP-SC on Cross Sections B–B' ~~and C–C'~~ on Exhibit IV of the Soil Boring Report in ~~B-35 and~~ B-39) at approximately ~~24 feet and 36~~44.5 feet below a ground elevations of ~~64.5 and~~ 60.26 feet respectively. At it's base, the sand appears to be conformable with the underlying "orange" sand which is interpreted as a near shore or beach sand. Body III is interpreted as a clay dune based on clay content, sorting, and stratigraphic position within an overall regression section. Permeability tests performed on this layer indicated vertical and horizontal permeabilities of $2.3x10^{-5}$ and $1.75x10^{-5}$ cm/sec, respectively.

3.3.4 Body IV- Clayey Sand (Clay Dune)

As stated in Appendix 1 (Page 60), the Clayey Sand (Clay Dune) Body IV is believed to be a time and stratigraphic equivalent of Body III, described above, and underlies a portion of the western edge of the City of Kingsville Landfill site. Borings 16 and 23 penetrated 18 feet and 12 feet respectively, immediately above the underlying "orange" sand. Boring 31 installed by Tolunay-Wong Engineers, Inc., also penetrated Body IV (seen as SP-SC on Cross Section B–B' of Exhibit IV of the Soil Boring Report in B-31) at approximately 14.5 feet below surface elevation of 58.37 feet. Body IV sand is similar in all respects to the homogeneous, very fine grained, well sorted, clayey sand which comprises Body III above. Cross section G-G' included in Appendix 1 (wells 16 and 23) illustrates the top of Body IV as being concave downward with a flat base, indicating deposition as a "buildup" or clay dune. Again, Body IV appears conformable with the underlying "orange" which is interpreted as a near shore or beach sand. Bodies III and IV are typical of the QCD deposits seen on the Geologic Atlas of Texas Corpus Christi Sheet. QCD is comprised of clay due and clay-sand dune deposits and possess physical properties similar to those of the sandy and silty Beaumont Formation as indicated in the Geologic Atlas of Texas. Vertical permeability of this layer was $3.3x10^{-6}$ cm/sec.

3.3.5 Sandy Silty Clay Bed

As stated in Appendix 1 (Page 60), the sandy clay bed was deposited in conjunction with Bodies I through IV and is composed of a homogeneous, tan, sandy clay containing abundant decomposed organic material. Thickness of this clay ranged from 40 to 60 feet under the City of Kingsville Landfill site with the above described Sand Bodies deposited within or adjacent to this clayey interval. The basal contact is abrupt with the underlying "orange" Sand. Several borings installed by Tolunay-Wong Engineers, Inc., penetrated the Sandy Silty Clay bed unit seen as CL-ML and CL on Cross Sections A–A', B–B', C–C', and D–D' of Exhibit IV of the Soil Boring Report in B-

31, B-32, B-33, B-34 and B-37. The average vertical and horizontal permeabilities were $1.0x10^{-5}$ cm/sec and $2.75x10^{-6}$ cm/sec, respectively.

3.3.6 "Orange" Sand

As stated in Appendix 1 (Page 60), the "orange" sand appears to have been deposited in a near shore or beach environment. The sand is extremely well sorted and clean and the grains are well rounded and composed of approximately 90% fine quartz grains and 10% fine multicolored shell fragments giving the overall sand color an orange cast. The thin (<5 feet), sheet-like nature of the sand represents a beach environment of short duration developed at the top of the Beaumont clay (Light Olive Green to Gray Clay). It is present in all wells of sufficient depth.

3.3.7 Light Olive Green to Gray Clay

As stated in Appendix 1 (Page 61), tops of the Light Olive Green to Gray Clay are necessary to make the above interpretations of shallower beds in that it is the most definitive, planar marker bed under the City of Kingsville Landfill site. This clay is pure and therefore exhibits characteristic low permeabilites with a proven thickness of at least 38 feet as seen in Boring 21 (boring log included in Appendix 1). The light olive green clay layer begins at approximately 46 feet below the ground surface elevation of 52.41 feet in boring 21, and the boring was terminated at approximately 84 feet below the surface elevation (bottom elevation of -36.5 feet). The clay layer is also evidenced in boring B-23 with an approximate thickness of 50 feet. The layer begins at approximately 36 feet below the surface elevation of 49.50 feet, and the boring terminates at approximately 86 feet below the surface elevation (bottom elevation of -36.5 feet). All borings of sufficient depth installed by Tolunay-Wong Engineers, Inc., penetrated the Light Olive Green to Gray Clay unit seen as CH on Cross Sections A–A', B–B', C–C', D–D', and E–E' of Exhibit IV of the Soil Boring Report. The vertical permeability of this clay averaged $3.3x10^{-8}$ cm/sec. The vertical permeability ranged from $1.33x10^{-9}$ cm/sec to $6.18x10^{-8}$ cm/sec.

3.3.8 Clayey Sand

Borings B-30, B-32, and B-39 installed during the Tolunay-Wong Engineers, Inc. investigation located a clayey sand (SC) layer below the light olive green to gray clay unit. The SC layer consist of light gray to tan clayey sand with calcareous nodules and some ferrous staining, and can be seen on Cross Sections B-B', C-C', and D-D'. In accordance with TAC §330.63(e)(5)(A), no permeability samples were collected.

3.4 Geologic Fault and Seismicity Assessment

A geologic fault and seismicity assessment was performed by FEE. Sections 3.3.1 (Page 26-27) and 3.3.4 (Page 28) in Appendix 1 discusses faults and faulting, and seismic impact zones at the City of Kingsville Landfill. Conclusions from FEE are as follows:

"An evaluation of potential faults or fault zones does not indicate the presence of *active* faults. Topographic Maps, literature searches, aerial photographs, Petroleum Industry maps and a field survey were used in this evaluation. The field survey combined with topographic maps did not *reveal* structural damage to buildings, ground scarps, or unusual surface depressions. Changes in drainage or vegetation patterns which are also associated with faulting were not present. Data presented by Algermissen, et al, 1990 suggests a low probability of major seismic activity in the vicinity of the site." FEE also stated that, "An updip projection of the regional Frio growth fault passes below the landfill site at approximate depths of 6,000 to 7,000 feet, but the fault is buried below the Miocene age Oakville formation and therefore does not influence shallower beds."

In-situ moisture contents of selected cohesive clay samples ranged from 18% to 34%. Results of Atterberg Limits tests on selected clay samples indicated liquid limits (LL) ranging from 31 to 81 with plasticity indices (PI) ranging from 18 to 58. The amount of materials finer than the No. 200 sieve on the selected samples ranged from 55% to 100%. In-situ moisture contents of selected silty sand samples ranged from 23% to 24%. The amount of materials finer than the No. 200 sieve on the selected samples tested for grain size distribution ranged from 14% to 38%.

Undrained shear strengths derived from field pocket penetrometer readings ranged from 0.25-tsf to 4.50-tsf. Undrained shear strengths derived from laboratory unconfined compressive (UC) strength testing ranged from 0.16-tsf to 3.41-tsf with corresponding total unit weights of 86-pcf to 105-pcf. Shear strength of cohesive soils inferred from SPT blow counts generally were similar. Based on this undrained shear strength data, the consistency of the cohesive soils encountered in the project borings is considered to be very soft to very stiff. Tabulated laboratory test results at the recovered sample depths are presented on the boring logs in Appendix B of Appendix 2 beginning on page 31.

Hydraulic conductivity tests were not performed during the Tolunay-Wong Engineers, Inc. geotechnical investigation due to values already being established under previous evaluations. Table 4-2 below shows hydraulic conductivity values compiled from Finch Energy & Environmental Services Inc.'s geotechnical investigation results, as discussed further in section 8.0 of Appendix 1 beginning on page 87. Borings from the FEE report were used as proxies for hydraulic conductivity of the units encountered in the borings drilled during the Tolunay-Wong investigation.

TABLE 4-2 – HYDRAULIC CONDUCTIVITY SUMMARY

Soil Boring ID	Soil Type	Unit	Permeability		Proxy Borings
			Vertical (cm/sec)	Horizontal (cm/sec)	
B-30	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-30	Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-30	Clayey Sand	CLAYEY SAND	---	---	---
B-30	Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-31	Clayey Sand	BODY I		3.0x10-4	B-5
B-31	Poorly Graded Sand with Clay	BODY IV	$4x10^{-6}$ to $1.2x10^{-5}$		B-16
B-31	Sandy Lean Silty Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-31	Sandy Lean Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-31	Fat Clay with Sand	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-32	Sandy Lean Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-32	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5

B-32	Fat Clay with Sand	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-32	Clayey Sand	CLAYEY SAND	---	---	---
B-33	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-33	Poorly Graded Sand with Silt	BODY II	$1x10^{-4}$	$3x10^{-5}$	B-17
B-33	Clayey Sand	BODY II	$1x10^{-4}$	$3x10^{-5}$	B-17
B-33	Lean Clay with Sand	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-33	Lean Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-33	Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-33	Fat Clay with Sand	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-34	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-34	Sandy Lean Silty Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-34	Silty Sand	BODY II	$1x10^{-4}$	$3x10^{-5}$	B-17
B-34	Lean Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-35	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-35	Sandy Lean Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-35	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-35	Fat Clay with Sand	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-35	Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-36	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-36	Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-37	Silty Sand	BODY II	$1x10^{-4}$	$3x10^{-5}$	B-17
B-37	Sandy Lean Silty Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24
B-37	Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-38	Sandy Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-38	Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-39	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-39	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-39	Sandy Lean Clay	SANDY SILTY CLAY BED	$1.2x10^{-7}$ to $6.9x10^{-5}$	$5x10^{-7}$ to $5x10^{-6}$	B-2, B-13, B-14, B-15, B-18, B-24

B-39	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-39	Poorly Graded Sand with Clay	BODY III	$3.4x10^{-7}$ to $4.6x10^{-5}$	$5x10^{-6}$ to $3x10^{-5}$	B-13
B-39	Fat Clay with Sand	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-39	Clayey Sand	CLAYEY SAND	---	---	---
B-40	Silty Sand	BODY II	$1x10^{-4}$	$3x10^{-5}$	B-17
B-40	Fat Clay with Sand	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-40	Sandy Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-40	Clayey Sand	BODY II	$1x10^{-4}$	$3x10^{-5}$	B-17
B-41	Clayey Sand	BODY I		$3.0x10^{-4}$	B-5
B-41	Sandy Fat Clay	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25
B-41	Fat Clay with Sand	LIGHT OLIVE GREEN TO GRAY CLAY	$1.33x10^{-9}$ to $6.18x10^{-8}$	$5x10^{-6}$*	B-13, B-21, B-23, B-24, B-25

Note:*Hydraulic Conductivity value taken from B-13 from 25-26 ft bgs (approximate elevation of 33-34 NGVD) with Unified Soil Classification System CH classification (Inorganic clays of high plasticity, fat clays).

4.2 Geotechnical Analysis

4.2.1 Settlement Analysis

One-dimensional consolidation tests were performed by Tolunay-Wong Engineers, Inc. using select samples from the soil borings to evaluate the compressibility characteristics of the foundation soils. The results of the consolidation tests are presented in Appendix D of Appendix 2 (Page 65-67). The predicted settlements resulting from consolidation settlement of the foundation soils due to the weight of the overlying landfill material are on the order of 1 foot.

Mr. Ralph N. Lewis of PSI also performed a settlement analysis during PSI's previous geotechnical analysis, and his calculations are shown in Appendix H.2 of Appendix 1 (Page 539). His calculations show that conservatively the final landfill cover will settle 3.0 inches at the center and 1.5 inches at the edges of the landfill. These calculations were based on previous landfill designs and capacities.

4.2.2 Slope Stability

A slope stability analysis was conducted by FEE. The objective of the analysis was to determine the local sliding stability of the liner system and cover as well as the overall stability of the embankment slope. The proposed embankments have a 4 (horizontal) to 1 (vertical) slope. FEE determined that a maximum allowable landfill height to satisfy a minimum factor of safety of 2.0 under static loading conditions was approximately 125 NGVD. Further discussion of the results from these analyses can be seen in Appendix 1 Section 8.3- Engineering Analyses beginning on page 120. Tolunay-Wong Engineers, Inc. also performed a waste mass stability analysis during their geotechnical engineering study. Tolunay determined that the calculated factor of safety for peak shear strength conditions exceeded 1.5 for their assumed strength and unit weight parameters, the analyzed cross sections, and assumed failure geometry. The calculated factor of safety for large displacement condition exceeds 1.5, which in their judgement, and based on published

THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION

Volume 3 of 6

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

September 2018
Revision 1 – November 2018
Revision 2 – February 2019
Revision 3 – April 2019
Revision 4 – May 2019

Prepared by

HANSON
Engineering | Planning | Allied Services

TBPE F-417

HANSON PROJECT NO. 16L0438-0003

Tolunay-Wong Engineers, Inc.

GEOTECHNICAL ENGINEERING STUDY
CITY OF KINGSVILLE MUNICIPAL SOLID WASTE LANDFILL EXPANSION
KINGSVILLE, TEXAS

For Permitting Purposes Only. Applies to boring logs in Appendix B of Tolunay-Wong Engineers, Inc. Geotechnical Engineering Study, City of Kingsville Municipal Solid Waste Landfill Expansion, Kingsville, Texas – Report No. 12788R1, sealed by Don R. Rokohl, P.E. on 8-30-18 altered to provide text showing surface elevations, the elevations of all contacts between soil and rock layers, and unit identifiers in the soil boring logs. No information or data was altered or changed from the original report other than the addition of text showing these elevations and unit identifiers in Appendix B.

Prepared for:

Naismith/Hanson
Corpus Christi, Texas

Prepared by:

Tolunay-Wong Engineers, Inc.
826 South Padre Island Drive
Corpus Christi, Texas 78416

August 30, 2018

Project No. 16.53.042 / Report No. 12788R1

GEOTECHNICAL ENGINEERING, DEEP FOUNDATIONS TESTING,
ENVIRONMENTAL SERVICES, CONSTRUCTION MATERIALS TESTING

1-888-887-9932
WWW.TWEINC.COM

LOG OF BORING B-30

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 44.0"
W 97° 49' 23.1"
SURFACE ELEVATION: 45.99' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 82.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Dense to very dense tan and gray CLAYEY SAND (SC) with gypsum crystals BODY I		11/6" 23/6" 50/5"	16		42	17				37	
5			-color changes to tan with ferrous staining		34/6" 50/3"									
10			-with sand partings		13/6" 50/3"									
15					7/6" 12/6" 20/6"	35							33	
20			-color changes to reddish tan and light gray		6/6" 15/6" 20/6"									
			25.49' AMSL											
			Very stiff to hard reddish tan and light gray FAT CLAY (CH) with gypsum crystals LIGHT OLIVE GREEN TO GRAY CLAY		10/6" 17/6" 26/6"									
25			-color changes to reddish tan and tan		10/6" 18/6" 30/6"	25		50	28				92	
30			-color changes to tan and reddish brown		8/6" 11/6" 16/6"									
35			-color changes to tan and gray		8/6" 12/6" 18/6"									

COMPLETION DEPTH: 82.5 ft
DATE BORING STARTED: 07/22/2016
DATE BORING COMPLETED: 07/23/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 21' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 10'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

Page 1 of 3

TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-30

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 44.0"
W 97° 49' 23.1"
SURFACE ELEVATION: 45.99' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 82.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
70			Very stiff to hard tan and reddish brown FAT CLAY (CH) with calcareous nodules -26.01' AMSL											
75			Very dense tan CLAYEY SAND (SC) with calcareous nodules -30.01' AMSL		16/6" 43/6" 50/5"	17							17	
80			Very stiff to hard tan and gray FAT CLAY (CH) with ferrous staining LIGHT OLIVE GREEN TO GRAY CLAY -becomes slickensided with ferrous staining -36.51' AMSL	(P) 4.50+	10/6" 11/6" 17/6"									
85			Bottom @ 82.5'											
90														
95														
100														
105														

COMPLETION DEPTH: 82.5 ft
DATE BORING STARTED: 07/22/2016
DATE BORING COMPLETED: 07/23/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 21' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 10'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-31

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 50.1"
W 97° 49' 24.3"
SURFACE ELEVATION: 58.37' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 68-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense to very dense gray CLAYEY SAND (SC) BODY I		4/6" 5/6" 7/6"									
			-with calcareous nodules and sand pockets		10/6" 22/6" 18/6"									
5					4/6" 5/6" 6/6"	11							46	
					5/6" 6/6" 8/6"									
					6/6" 8/6" 12/6"									
10			-with cemented sand layers		8/6" 27/6" 29/6"	27							22	
			-color changes to tan		18/6" 32/6" 39/6"									
			43.87' AMSL											
15			Very dense tan POORLY GRADED SAND with CLAY (SP-SC) and sand partings BODY IV		36/6" 50/5"									
					12/6" 50/5"	15							9	
					45/6" 50/5"									
20					35/6" 50/4"									
					17/6" 26/6" 50/5"									
					17/6" 38/6" 38/6"									
			34.87' AMSL											
25			Hard reddish tan and light gray SANDY LEAN SILTY CLAY (CL-ML) with sand partings SANDY SILTY CLAY BED		13/6" 20/6" 31/6" 23/6" 34/6" 50/4" 12/6" 17/6" 50/5"	26		29	7				66	
			-color changes to reddish tan and tan with ferrous stains		13/6" 32/6" 50/5" 7/6" 36/6" 39/6" 10/6" 21/6" 36/6" 10/6" 18/6" 35/6"	25							62	
30														
35														

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 07/20/2016
DATE BORING COMPLETED: 07/21/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 23' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 21'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-31

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 50.1"
W 97° 49' 24.3"
SURFACE ELEVATION: 58.37' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 68-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Hard reddish tan and tan SANDY LEAN CLAY (CL) with ferrous stains and laminated sands		17/6" 25/6" 35/6"									
			SANDY SILTY CLAY BED		17/6" 13/6" 19/6"									
			18.87' AMSL		7/6" 16/6" 17/6"									
40			Very stiff to hard reddish tan and tan FAT CLAY with SAND (CH) and ferrous stains		3/6" 7/6" 10/6"	37		59	36				76	
			LIGHT OLIVE GREEN TO GRAY CLAY		9/6" 20/6" 27/6"									
45			-with trace gypsum crystals and ferrous stains		5/6" 14/6" 17/6" 10/6" 18/6" 21/6" 18/6" 23/6" 30/6" 6/6" 20/6" 21/6"	30							83	
50					9/6" 17/6" 19/6" 9/6" 18/6" 23/6" 11/6" 23/6"									
			-with calcareous nodules and ferrous stains	(P) 4.50+	26/6"	32	91	83	50	4.14	2		87	
55				(P) 4.50+										
				(P) 4.50+										
				(P) 4.50+		34	87			2.88	2		83	
60			-with trace gypsum crystals and ferrous stains	(P) 4.50+										
				(P) 4.50+										
65				(P) 4.50+										
			-9.63' AMSL	(P) 4.50+										
			Bottom @ 68'											
70														

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 07/20/2016
DATE BORING COMPLETED: 07/21/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 23' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 21'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-32

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 49.7"
W 97° 49' 17.0"
SURFACE ELEVATION: 48.46' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 82.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Stiff to hard tan and gray SANDY LEAN CLAY (CL) with gypsum crystals and trace organics		3/6" 5/6" 6/6"	9		34	18				54	
			SANDY SILTY CLAY BED											
5					6/6" 21/6" 23/6"									
10					11/6" 26/6" 50/3"									
			35.96' AMSL											
15			Medium dense to dense reddish tan and gray CLAYEY SAND (SC) with gypsum crystals		17/6" 50/6"	28							34	
			BODY I											
			-color changes to tan and gray with sand partings		10/6" 17/6" 22/6"									
20			-with ferrous stains		4/6" 8/6" 13/6"									
25			-color changes to reddish tan		10/6" 18/6" 21/6"	22		31	10				29	
30			-color changes to reddish brown and tan		6/6" 8/6" 12/6"									
35					8/6" 8/6" 12/6"									

COMPLETION DEPTH: 82.5 ft
DATE BORING STARTED: 07/27/2016
DATE BORING COMPLETED: 07/28/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 18' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 14'-7". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-33

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 55.9"
W 97° 49' 11.3"
SURFACE ELEVATION: 64.51' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 86-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense to very dense tan CLAYEY SAND (SC) with gypsum crystals BODY I		2/6" 7/6" 9/6"									
5			-color changes to dark gray and gray with trace gravel		7/6" 11/6" 9/6"	16							47	
10			-color changes to tan and light gray sand partings		27/6" 50/6"									
15			-color changes to tan and white with trace caliche 48.01' AMSL		50/5"									
20			Dense to very dense tan and white POORLY GRADED SAND with SILT (SP-SM), and trace caliche BODY II		17/6" 48/6" 50/3"	11		35	8				12	
25			-color changes to light gray and tan with gypsum crystals and ferrous stains 36.01' AMSL		17/6" 21/6" 27/6" 15/6" 17/6" 32/6"									
30			Medium dense to dense gray and white CLAYEY SAND (SC) with gypsum crystals BODY II		14/6" 22/6" 26/6"	42							20	
35			-color changes to tan		13/6" 21/6" 22/6"									

COMPLETION DEPTH: 86 ft
DATE BORING STARTED: 08/05/2016
DATE BORING COMPLETED: 08/05/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 32'-6" below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 28'-2". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-33

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 55.9"
W 97° 49' 11.3"
SURFACE ELEVATION: 64.51' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 86-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Medium dense to dense reddish tan CLAYEY SAND (SC) with gypsum crystals and ferrous stains BODY II		6/6" 9/6" 12/6"									
40			-color changes to tan and reddish tan		8/6" 16/6" 18/6"									
			20.01' AMSL											
45			Stiff to very stiff reddish tan LEAN CLAY with SAND (CL), slickensided, with ferrous stains SANDY SILTY CLAY BED		9/6" 12/6" 18/6"	29		43	24				79	
50			-color changes to reddish tan and tan with gypsum crystals		5/6" 6/6" 9/6"									
			12.51' AMSL											
55			Stiff to very stiff LEAN CLAY (CL), slickensided, with ferrous stains SANDY SILTY CLAY BED	(P) 2.00		40	79			1.06	3		96	
			-color changes to reddish brown and tan with gypsum crystals	(P) 3.50										
60				(P) 4.00		34	87							
			-0.51' AMSL											
65			Very stiff to hard tan FAT CLAY (CH), slickensided, with gypsum crystals and ferrous stains LIGHT OLIVE GREEN TO GRAY CLAY	(P) 4.50+		32	42	64	33	2.57	2		95	
70			-color changes to tan and reddish brown		7/6" 12/6" 14/6"									

COMPLETION DEPTH: 86 ft
DATE BORING STARTED: 08/05/2016
DATE BORING COMPLETED: 08/05/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 32'-6" below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 28'-2". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-34

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 43.4"
W 97° 49' 11.4"
SURFACE ELEVATION: 61.14' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 30 ft.
Wash Bored: 30 ft. to 43 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense dark gray, gray, and light gray CLAYEY SAND (SC) with trace of organics BODY I	(P) 4.50+	2/6" 5/6" 6/6"	15	112			2.53	6		42	
			57.14' AMSL											
5			Very stiff to hard gray and light gray SANDY LEAN SILTY CLAY (CL-ML) with calcareous nodules	(P) 4.50+		15	115	21	7				59	
			SANDY SILTY CLAY BED	(P) 4.50+		14	114			6.13	4		62	
			-color changes to light gray											
10			-color changes to light gray and tan		4/6" 12/6" 16/6"									
			-color changes to white and light gray		11/6" 18/6" 16/6"									
			-becomes stiff		5/6" 6/6" 8/6"									
			46.64' AMSL											
15			Medium dense to dense white and light gray SILTY SAND (SM) with calcareous nodules BODY II		4/6" 6/6" 8/6"	17		38	7				31	
			-color changes to light gray and tan with ferrous stains		4/6" 10/6" 19/6"									
20					23/6" 50/5"									
					23/6" 50/4"									
			-color changes to light gray		27/6" 35/6" 50/4"	22							25	
25					5/6" 37/6" 45/6"									
					20/6" 39/6" 37/6"									
			-becomes medium dense		8/6" 12/6" 9/6"	26		39	2				28	
30					4/6" 12/6" 10/6"	33							39	
					5/6" 6/6" 10/6"									
			-color changes to tan and marine green		3/6"									
35														

COMPLETION DEPTH: 43 ft
DATE BORING STARTED: 06/22/2016
DATE BORING COMPLETED: 06/22/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 31' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 28'-4". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-35

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 50.5"
W 97° 48' 57.2"
SURFACE ELEVATION: 64.50' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 72.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense tan and brown CLAYEY SAND (SC) with trace caliche BODY I		5/6" 8/6" 7/6"									
5			-color changes to reddish brown with ferrous stains		5/6" 8/6" 5/6"	12		31	17				38	
			56.50' AMSL											
10			Very stiff to hard reddish tan SANDY LEAN CLAY (CL) with gypsum crystals SANDY SILTY CLAY BED	(P) 4.50+		14	117			2.22	3		52	
15			-color changes to reddish tan and tan with ferrous stains		5/6" 10/6" 12/6"									
			-color changes to reddish tan	(P) 4.50+		17	109	42	25					
20			-color changes to reddish tan and tan	(P) 4.50+										
			40.50' AMSL											
25			Medium dense to dense reddish tan and tan CLAYEY SAND (SC) with gypsum crystals and ferrous stains BODY I ~~BODY III~~	(P) 4.50+		17	104			1.29	3		40	
30			-color changes to reddish tan		4/6" 7/6" 9/6"									
35					8/6" 13/6" 20/6"									

COMPLETION DEPTH: 72.5 ft
DATE BORING STARTED: 07/29/2016
DATE BORING COMPLETED: 07/29/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 34' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 30'-9". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-38

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 03.76"
W 97° 49' 12.19"
SURFACE ELEVATION: 41.64' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 10 ft.
Wash Bored: 10 ft. to 58 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Very stiff to hard light gray SANDY FAT CLAY (CH) with ferrous stains and trace calcareous nodules		10/6" 18/6" 31/6"	17		50	19				55	
			LIGHT OLIVE GREEN TO GRAY CLAY		20/6" 45/6" 50/4"									
5					3/6" 33/6" 50/5"									
					12/6" 27/6" 37/6"									
					17/6" 36/6" 50/3"	30							66	
10					18/6" 35/6" 50/3"									
					13/6" 33/6" 50/2"									
15			-color changes to light gray and tan		8/6" 14/6" 20/6"									
					7/6" 12/6" 19/6"									
					6/6" 10/6" 14/6"	28		60	40				57	
20					6/6" 11/6" 15/6"									
			-becomes stiff		5/6" 7/6" 8/6"									
					6/6" 8/6" 13/6"									
25					4/6" 9/6" 9/6"									
				(P) 4.50+		25	92	47	29					
30				(P) 4.50+										
			-color changes to brown and light gray and becomes stiff with sand layers		4/6" 5/6" 8/6"									
35					9/6"									

COMPLETION DEPTH: 58 ft
DATE BORING STARTED: 06/23/2016
DATE BORING COMPLETED: 06/23/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 11' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 5'-5". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-38

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 03.76"
W 97° 49' 12.19"
SURFACE ELEVATION: 41.64' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 10 ft.
Wash Bored: 10 ft. to 58 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Very stiff to hard reddish brown and light gray SANDY FAT CLAY (CH) with sand seams and layers	(P) 4.50+	8/6" 10/6"									
			LIGHT OLIVE GREEN TO GRAY CLAY 3.64' AMSL											
			Stiff to hard light gray FAT CLAY (CH), slickensided, with calcareous nodules and ferrous stains	(P) 4.50+		42	78	100	72	2.95	2		93	
40			-color changes to reddish brown and light gray	(P) 4.50+										
			LIGHT OLIVE GREEN TO GRAY CLAY	(P) 4.50+										
45			-color changes to tannish brown and light gray with trace organics	(P) 4.50+										
			-color changes to light gray		5/6" 6/6" 8/6"									
50				(P) 4.50+		30	91			2.14	3		87	
					6/6" 7/6" 7/6"									
					4/6" 5/6" 8/6"									
55			-color changes to tannish brown and light gray		5/6" 7/6" 9/6"									
			-color changes to light gray -16.36' AMSL		6/6" 7/6" 9/6"									
			Bottom @ 58'											
60														
65														
70														

COMPLETION DEPTH: 58 ft
DATE BORING STARTED: 06/23/2016
DATE BORING COMPLETED: 06/23/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 11' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 5'-5". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-39

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 01.3"
W 97° 48' 57.3"
SURFACE ELEVATION: 60.26' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 26 ft.
Wash Bored: 26 ft. to 68 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense to dense tan and light gray CLAYEY SAND FILL with trace gravel BODY I		8/6" 9/6" 6/6"	18							33	
			-color changes to brown		40/6" 27/6" 19/6"									
			55.76' AMSL											
5			Medium dense to dense brown and reddish brown CLAYEY SAND (SC) BODY I		6/6" 7/6" 8/6"									
			-color changes to tan and gray with calcareous nodules		4/6" 5/6" 6/6"									
					5/6" 6/6" 8/6"	11		36	20				49	
10			-color changes to tan and light gray		4/6" 6/6" 7/6"									
			-color changes to light gray		7/6" 8/6" 11/6"									
15			-color changes to light gray and tan with ferrous stains		6/6" 12/6" 19/6"									
			-color changes to light gray		11/6" 19/6" 22/6"									
			41.76' AMSL											
20			Stiff to hard light gray SANDY LEAN CLAY (CL) with calcareous nodules and ferrous stains SANDY SILTY CLAY BED		3/6" 4/6" 5/6"	19							65	
					6/6" 9/6" 13/6"									
					8/6" 11/6" 20/6"									
25			-color changes to light tan and light gray	(P) 4.50+										
			-color changes to light gray	(P) 4.00										
					7/6" 11/6" 13/6"									
30			-color changes to light gray and tan	(P) 4.50+		19	102			1.14	7		50	
					12/6" 16/6" 20/6"									
35					8/6"									

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 06/20/2016
DATE BORING COMPLETED: 06/24/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 27' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 26'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-39

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 01.3"
W 97° 48' 57.3"
SURFACE ELEVATION: 60.26' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 26 ft.
Wash Bored: 26 ft. to 68 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Stiff to hard light gray and tan SANDY LEAN CLAY (CL) with ferrous stains 23.76' AMSL		12/6" 16/6"									
			Medium dense to dense light gray CLAYEY SAND (SC) with ferrous stains ~~BODY III~~ BODY I		7/6" 8/6" 11/6"									
40					6/6" 11/6" 12/6"									
					7/6" 10/6" 13/6"	25		69	51				45	
					13/6" 19/6" 21/6"									
			15.76' AMSL											
45			Dense light gray POORLY GRADED SAND with CLAY (SP- SC) BODY III		12/6" 21/6" 20/6"									
					11/6" 16/6" 16/6"									
			12.26' AMSL											
50			Hard reddish brown and light gray FAT CLAY with SAND (CH) LIGHT OLIVE GREEN TO GRAY CLAY	(P) 4.50+										
				(P) 4.50+		28	93			0.85	1		72	
			-becomes slickensided with calcareous nodules	(P) 4.50+										
			-with ferrous stains	(P) 4.50+										
55				(P) 4.50+										
				(P) 4.50+										
60				(P) 4.50+										
			-becomes stiff		7/6" 7/6" 7/6"									
65			-6.24' AMSL											
			Medium dense light gray CLAYEY SAND (SC) with calcareous nodules and ferrous stains -7.74' AMSL		6/6" 10/6" 13/6"	20	102	61	45	1.91	5		46	
			Bottom @ 68'											
70														

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 06/20/2016
DATE BORING COMPLETED: 06/24/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 27' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 26'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-40

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 09.97"
W 97° 49' 11.18"
SURFACE ELEVATION: 52.31' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 22 ft.
Wash Bored: 22 ft. to 33.75 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Loose to very dense light gray and gray SILTY SAND (SM) with trace caliche BODY II		4/6" 4/6" 6/6"									
			-color changes to light gray and tan with ferrous stains		5/6" 7/6" 11/6"	16		35	10				31	
5					7/6" 17/6" 17/6"									
			-color changes to light gray with calcareous nodules		12/6" 21/6" 34/6"									
			-color changes to light gray and white		12/6" 27/6" 50/3"	18							34	
10			-color changes to white		15/6" 50/3"									
			-color changes to light gray and white 37.81' AMSL		25/6" 50/4"									
15			Hard light gray FAT CLAY with SAND (CH), calcareous nodules, and ferrous stains LIGHT OLIVE GREEN TO GRAY CLAY		7/6" 26/6" 50/5"	22		70	41				80	
					5/6" 17/6" 28/6"									
20			31.81' AMSL		10/6" 30/6" 35/6"									
			Hard light gray SANDY FAT CLAY (CH) with calcareous nodules and ferrous stains LIGHT OLIVE GREEN TO GRAY CLAY		9/6" 25/6" 35/6"	31							59	
					16/6" 32/6" 50/5"									
25					16/6" 31/6" 50/5"									
			25.81' AMSL											
			Dense to very dense light gray CLAYEY SAND (SC) with calcareous nodules BODY II		8/6" 18/6" 27/6"	30		53	32				49	
					6/6" 18/6" 50/6"									
30					6/6" 20/6" 50/5"									
			18.81' AMSL		3/6" 40/6" 50/3"	16							30	
			Bottom @ 33.5'											
35														

COMPLETION DEPTH: 33.5 ft
DATE BORING STARTED: 06/21/2016
DATE BORING COMPLETED: 06/22/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 21' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 19'. At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

Tolunay-Wong Engineers, Inc.

GEOTECHNICAL ENGINEERING STUDY
CITY OF KINGSVILLE MUNICIPAL SOLID WASTE LANDFILL EXPANSION
KINGSVILLE, TEXAS

For Permitting Purposes Only. Applies to boring logs in Appendix B of Tolunay-Wong Engineers, Inc. Geotechnical Engineering Study, City of Kingsville Municipal Solid Waste Landfill Expansion, Kingsville, Texas – Report No. 12788R1, sealed by Don R. Rokohl, P.E. on 8-30-18 altered to provide text showing surface elevations, the elevations of all contacts between soil and rock layers, and unit identifiers in the soil boring logs. No information or data was altered or changed from the original report other than the addition of text showing these elevations and unit identifiers in Appendix B.

Prepared for:

Naismith/Hanson
Corpus Christi, Texas

Prepared by:

Tolunay-Wong Engineers, Inc.
826 South Padre Island Drive
Corpus Christi, Texas 78416

August 30, 2018

Project No. 16.53.042 / Report No. 12788R1

GEOTECHNICAL ENGINEERING, DEEP FOUNDATIONS TESTING,
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LOG OF BORING B-30

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 44.0"
W 97° 49' 23.1"
SURFACE ELEVATION: 45.99' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 82.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Dense to very dense tan and gray CLAYEY SAND (SC) with gypsum crystals BODY I		11/6" 23/6" 50/5"	16		42	17				37	
5			-color changes to tan with ferrous staining		34/6" 50/3"									
10			-with sand partings		13/6" 50/3"									
15					7/6" 12/6" 20/6"	35							33	
20			-color changes to reddish tan and light gray		6/6" 15/6" 20/6"									
			25.49' AMSL											
			Very stiff to hard reddish tan and light gray FAT CLAY (CH) with gypsum crystals LIGHT OLIVE GREEN TO GRAY CLAY		10/6" 17/6" 26/6"									
25			-color changes to reddish tan and tan		10/6" 18/6" 30/6"	25		50	28				92	
30			-color changes to tan and reddish brown		8/6" 11/6" 16/6"									
35			-color changes to tan and gray		8/6" 12/6" 18/6"									

COMPLETION DEPTH: 82.5 ft
DATE BORING STARTED: 07/22/2016
DATE BORING COMPLETED: 07/23/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 21' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 10'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-30

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 44.0"
W 97° 49' 23.1"
SURFACE ELEVATION: 45.99' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 82.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
70			Very stiff to hard tan and reddish brown FAT CLAY (CH) with calcareous nodules -26.01' AMSL											
75			Very dense tan CLAYEY SAND (SC) with calcareous nodules -30.01' AMSL		16/6" 43/6" 50/5"	17							17	
80			Very stiff to hard tan and gray FAT CLAY (CH) with ferrous staining LIGHT OLIVE GREEN TO GRAY CLAY -becomes slickensided with ferrous staining -36.51' AMSL	(P) 4.50+	10/6" 11/6" 17/6"									
			Bottom @ 82.5'											
85														
90														
95														
100														
105														

COMPLETION DEPTH: 82.5 ft
DATE BORING STARTED: 07/22/2016
DATE BORING COMPLETED: 07/23/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 21' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 10'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-31

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 50.1"
W 97° 49' 24.3"
SURFACE ELEVATION: 58.37' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 68-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense to very dense gray CLAYEY SAND (SC) BODY I		4/6" 5/6" 7/6"									
			-with calcareous nodules and sand pockets		10/6" 22/6" 18/6"									
5					4/6" 5/6" 6/6"	11							46	
					5/6" 6/6" 8/6"									
					6/6" 8/6" 12/6"									
10			-with cemented sand layers		8/6" 27/6" 29/6"	27							22	
			-color changes to tan		18/6" 32/6" 39/6"									
			43.87' AMSL											
15			Very dense tan POORLY GRADED SAND with CLAY (SP-SC) and sand partings BODY IV		36/6" 50/5"									
					12/6" 50/5"	15							9	
					45/6" 50/5"									
20					35/6" 50/4"									
					17/6" 26/6" 50/5"									
					17/6" 38/6" 38/6"									
			34.87' AMSL											
25			Hard reddish tan and light gray SANDY LEAN SILTY CLAY (CL-ML) with sand partings SANDY SILTY CLAY BED		13/6" 20/6" 31/6" 23/6" 34/6" 50/4" 12/6" 17/6" 50/5"	26		29	7				66	
			-color changes to reddish tan and tan with ferrous stains		13/6" 32/6" 50/5" 7/6" 36/6" 39/6" 10/6" 21/6" 36/6" 10/6" 18/6" 35/6"	25							62	
30														
35														

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 07/20/2016
DATE BORING COMPLETED: 07/21/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 23' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 21'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-31

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 50.1"
W 97° 49' 24.3"
SURFACE ELEVATION: 58.37' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 68-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Hard reddish tan and tan SANDY LEAN CLAY (CL) with ferrous stains and laminated sands		17/6" 25/6" 35/6"									
			SANDY SILTY CLAY BED		17/6" 13/6" 19/6"									
			18.87' AMSL		7/6" 16/6" 17/6"									
40			Very stiff to hard reddish tan and tan FAT CLAY with SAND (CH) and ferrous stains		3/6" 7/6" 10/6"	37		59	36				76	
			LIGHT OLIVE GREEN TO GRAY CLAY		9/6" 20/6" 27/6"									
45			-with trace gypsum crystals and ferrous stains		5/6" 14/6" 17/6" 10/6" 18/6" 21/6" 18/6" 23/6" 30/6" 6/6" 20/6" 21/6"	30							83	
50					9/6" 17/6" 19/6" 9/6" 18/6" 23/6" 11/6" 23/6"									
			-with calcareous nodules and ferrous stains	(P) 4.50+	26/6"	32	91	83	50	4.14	2		87	
55				(P) 4.50+										
				(P) 4.50+										
				(P) 4.50+		34	87			2.88	2		83	
60			-with trace gypsum crystals and ferrous stains	(P) 4.50+										
				(P) 4.50+										
65				(P) 4.50+										
			-9.63' AMSL	(P) 4.50+										
			Bottom @ 68'											
70														

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 07/20/2016
DATE BORING COMPLETED: 07/21/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 23' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 21'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-32

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 49.7"
W 97° 49' 17.0"
SURFACE ELEVATION: 48.46' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 82.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Stiff to hard tan and gray SANDY LEAN CLAY (CL) with gypsum crystals and trace organics		3/6" 5/6" 6/6"	9		34	18				54	
			SANDY SILTY CLAY BED											
5					6/6" 21/6" 23/6"									
10					11/6" 26/6" 50/3"									
			35.96' AMSL											
15			Medium dense to dense reddish tan and gray CLAYEY SAND (SC) with gypsum crystals		17/6" 50/6"	28							34	
			BODY I											
			-color changes to tan and gray with sand partings		10/6" 17/6" 22/6"									
20			-with ferrous stains		4/6" 8/6" 13/6"									
25			-color changes to reddish tan		10/6" 18/6" 21/6"	22		31	10				29	
30			-color changes to reddish brown and tan		6/6" 8/6" 12/6"									
35					8/6" 8/6" 12/6"									

COMPLETION DEPTH: 82.5 ft
DATE BORING STARTED: 07/27/2016
DATE BORING COMPLETED: 07/28/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 18' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 14'-7". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-33

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 55.9"
W 97° 49' 11.3"
SURFACE ELEVATION: 64.51' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 86-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense to very dense tan CLAYEY SAND (SC) with gypsum crystals BODY I		2/6" 7/6" 9/6"									
5			-color changes to dark gray and gray with trace gravel		7/6" 11/6" 9/6"	16							47	
10			-color changes to tan and light gray sand partings		27/6" 50/6"									
15			-color changes to tan and white with trace caliche 48.01' AMSL		50/5"									
20			Dense to very dense tan and white POORLY GRADED SAND with SILT (SP-SM), and trace caliche BODY II		17/6" 48/6" 50/3"	11		35	8				12	
25			-color changes to light gray and tan with gypsum crystals and ferrous stains 36.01' AMSL		17/6" 21/6" 27/6" 15/6" 17/6" 32/6"									
30			Medium dense to dense gray and white CLAYEY SAND (SC) with gypsum crystals BODY II		14/6" 22/6" 26/6"	42							20	
35			-color changes to tan		13/6" 21/6" 22/6"									

COMPLETION DEPTH: 86 ft
DATE BORING STARTED: 08/05/2016
DATE BORING COMPLETED: 08/05/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 32'-6" below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 28'-2". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-33

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 55.9"
W 97° 49' 11.3"
SURFACE ELEVATION: 64.51' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 86-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Medium dense to dense reddish tan CLAYEY SAND (SC) with gypsum crystals and ferrous stains		6/6" 9/6" 12/6"									
			BODY II											
40			-color changes to tan and reddish tan		8/6" 16/6" 18/6"									
			20.01' AMSL											
45			Stiff to very stiff reddish tan LEAN CLAY with SAND (CL), slickensided, with ferrous stains		9/6" 12/6" 18/6"	29		43	24				79	
			SANDY SILTY CLAY BED											
50			-color changes to reddish tan and tan with gypsum crystals		5/6" 6/6" 9/6"									
			12.51' AMSL											
			Stiff to very stiff LEAN CLAY (CL), slickensided, with ferrous stains	(P) 2.00		40	79			1.06	3		96	
			SANDY SILTY CLAY BED											
55			-color changes to reddish brown and tan with gypsum crystals	(P) 3.50										
60				(P) 4.00		34	87							
			-0.51' AMSL											
65			Very stiff to hard tan FAT CLAY (CH), slickensided, with gypsum crystals and ferrous stains	(P) 4.50+		32	42	64	33	2.57	2		95	
			LIGHT OLIVE GREEN TO GRAY CLAY											
			-color changes to tan and reddish brown		7/6" 12/6" 14/6"									
70														

COMPLETION DEPTH: 86 ft
DATE BORING STARTED: 08/05/2016
DATE BORING COMPLETED: 08/05/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 32'-6" below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 28'-2". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-34

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 43.4"
W 97° 49' 11.4"
SURFACE ELEVATION: 61.14' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 30 ft.
Wash Bored: 30 ft. to 43 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense dark gray, gray, and light gray CLAYEY SAND (SC) with trace of organics	(P) 4.50+	2/6" 5/6" 6/6"	15	112			2.53	6		42	
			BODY I											
			57.14' AMSL											
5			Very stiff to hard gray and light gray SANDY LEAN SILTY CLAY (CL-ML) with calcareous nodules	(P) 4.50+		15	115	21	7				59	
			SANDY SILTY CLAY BED	(P) 4.50+		14	114			6.13	4		62	
			-color changes to light gray											
10			-color changes to light gray and tan		4/6" 12/6" 16/6"									
			-color changes to white and light gray		11/6" 18/6" 16/6"									
			-becomes stiff		5/6" 6/6" 8/6"									
			46.64' AMSL											
15			Medium dense to dense white and light gray SILTY SAND (SM) with calcareous nodules		4/6" 6/6" 8/6"	17		38	7				31	
			BODY II											
			-color changes to light gray and tan with ferrous stains		4/6" 10/6" 19/6"									
20					23/6" 50/5"									
					23/6" 50/4"									
			-color changes to light gray		27/6" 35/6" 50/4"	22							25	
25					5/6" 37/6" 45/6"									
					20/6" 39/6" 37/6"									
			-becomes medium dense		8/6" 12/6" 9/6"	26		39	2				28	
30					4/6" 12/6" 10/6"	33							39	
					5/6" 6/6" 10/6"									
			-color changes to tan and marine green		3/6"									
35														

COMPLETION DEPTH: 43 ft
DATE BORING STARTED: 06/22/2016
DATE BORING COMPLETED: 06/22/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 31' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 28'-4". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-35

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 26' 50.5"
W 97° 48' 57.2"
SURFACE ELEVATION: 64.50' AMSL
DRILLING METHOD:
Dry Augered: 0-ft. to 72.5-ft.
Wash Bored: -- to --

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense tan and brown CLAYEY SAND (SC) with trace caliche BODY I		5/6" 8/6" 7/6"									
5			-color changes to reddish brown with ferrous stains		5/6" 8/6" 5/6"	12		31	17				38	
			56.50' AMSL											
10			Very stiff to hard reddish tan SANDY LEAN CLAY (CL) with gypsum crystals SANDY SILTY CLAY BED	(P) 4.50+		14	117			2.22	3		52	
15			-color changes to reddish tan and tan with ferrous stains		5/6" 10/6" 12/6"									
			-color changes to reddish tan	(P) 4.50+		17	109	42	25					
20			-color changes to reddish tan and tan	(P) 4.50+										
			40.50' AMSL											
25			Medium dense to dense reddish tan and tan CLAYEY SAND (SC) with gypsum crystals and ferrous stains BODY I ~~BODY III~~	(P) 4.50+		17	104			1.29	3		40	
30			-color changes to reddish tan		4/6" 7/6" 9/6"									
35					8/6" 13/6" 20/6"									

COMPLETION DEPTH: 72.5 ft
DATE BORING STARTED: 07/29/2016
DATE BORING COMPLETED: 07/29/2016
LOGGER: J. Gonzalez
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 34' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 30'-9". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-38

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 03.76"
W 97° 49' 12.19"
SURFACE ELEVATION: 41.64' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 10 ft.
Wash Bored: 10 ft. to 58 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Very stiff to hard light gray SANDY FAT CLAY (CH) with ferrous stains and trace calcareous nodules		10/6" 18/6" 31/6"	17		50	19				55	
			LIGHT OLIVE GREEN TO GRAY CLAY		20/6" 45/6" 50/4"									
5					3/6" 33/6" 50/5"									
					12/6" 27/6" 37/6"									
					17/6" 36/6" 50/3"	30							66	
10					18/6" 35/6" 50/3"									
					13/6" 33/6" 50/2"									
15			-color changes to light gray and tan		8/6" 14/6" 20/6"									
					7/6" 12/6" 19/6"									
					6/6" 10/6" 14/6"	28		60	40				57	
20					6/6" 11/6" 15/6"									
			-becomes stiff		5/6" 7/6" 8/6"									
25					6/6" 8/6" 13/6"									
					4/6" 9/6" 9/6"									
				(P) 4.50+		25	92	47	29					
30				(P) 4.50+										
			-color changes to brown and light gray and becomes stiff with sand layers		4/6" 5/6" 8/6"									
35					9/6"									

COMPLETION DEPTH: 58 ft
DATE BORING STARTED: 06/23/2016
DATE BORING COMPLETED: 06/23/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 11' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 5'-5". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-38

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 03.76"
W 97° 49' 12.19"
SURFACE ELEVATION: 41.64' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 10 ft.
Wash Bored: 10 ft. to 58 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Very stiff to hard reddish brown and light gray SANDY FAT CLAY (CH) with sand seams and layers	(P) 4.50+	8/6" 10/6"									
			LIGHT OLIVE GREEN TO GRAY CLAY 3.64' AMSL											
			Stiff to hard light gray FAT CLAY (CH), slickensided, with calcareous nodules and ferrous stains	(P) 4.50+		42	78	100	72	2.95	2		93	
40			-color changes to reddish brown and light gray	(P) 4.50+										
			LIGHT OLIVE GREEN TO GRAY CLAY	(P) 4.50+										
			-color changes to tannish brown and light gray with trace organics	(P) 4.50+										
45			-color changes to light gray		5/6" 6/6" 8/6"									
				(P) 4.50+		30	91			2.14	3		87	
50					6/6" 7/6" 7/6"									
					4/6" 5/6" 8/6"									
55			-color changes to tannish brown and light gray		5/6" 7/6" 9/6"									
			-color changes to light gray -16.36' AMSL		6/6" 7/6" 9/6"									
			Bottom @ 58'											
60														
65														
70														

COMPLETION DEPTH: 58 ft
DATE BORING STARTED: 06/23/2016
DATE BORING COMPLETED: 06/23/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 11' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 5'-5". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-39

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 01.3"
W 97° 48' 57.3"
SURFACE ELEVATION: 60.26' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 26 ft.
Wash Bored: 26 ft. to 68 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Medium dense to dense tan and light gray CLAYEY SAND FILL with trace gravel BODY I		8/6" 9/6" 6/6"	18							33	
			-color changes to brown		40/6" 27/6" 19/6"									
			55.76' AMSL											
5			Medium dense to dense brown and reddish brown CLAYEY SAND (SC) BODY I		6/6" 7/6" 8/6"									
			-color changes to tan and gray with calcareous nodules		4/6" 5/6" 6/6"									
					5/6" 6/6" 8/6"	11		36	20				49	
10			-color changes to tan and light gray		4/6" 6/6" 7/6"									
			-color changes to light gray		7/6" 8/6" 11/6"									
15			-color changes to light gray and tan with ferrous stains		6/6" 12/6" 19/6"									
			-color changes to light gray		11/6" 19/6" 22/6"									
			41.76' AMSL											
20			Stiff to hard light gray SANDY LEAN CLAY (CL) with calcareous nodules and ferrous stains		3/6" 4/6" 5/6"	19							65	
			SANDY SILTY CLAY BED		6/6" 9/6" 13/6"									
					8/6" 11/6" 20/6"									
25			-color changes to light tan and light gray	(P) 4.50+										
			-color changes to light gray	(P) 4.00										
					7/6" 11/6" 13/6"									
30			-color changes to light gray and tan	(P) 4.50+		19	102			1.14	7		50	
					12/6" 16/6" 20/6"									
35					8/6"									

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 06/20/2016
DATE BORING COMPLETED: 06/24/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 27' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 26'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

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TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-39

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 01.3"
W 97° 48' 57.3"
SURFACE ELEVATION: 60.26' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 26 ft.
Wash Bored: 26 ft. to 68 ft.

DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
35			Stiff to hard light gray and tan SANDY LEAN CLAY (CL) with ferrous stains 23.76' AMSL		12/6" 16/6"									
			Medium dense to dense light gray CLAYEY SAND (SC) with ferrous stains ~~BODY III~~ BODY I		7/6" 8/6" 11/6"									
40					6/6" 11/6" 12/6"									
					7/6" 10/6" 13/6"	25		69	51				45	
					13/6" 19/6" 21/6"									
			15.76' AMSL											
45			Dense light gray POORLY GRADED SAND with CLAY (SP- SC) BODY III		12/6" 21/6" 20/6"									
					11/6" 16/6" 16/6"									
			12.26' AMSL											
			Hard reddish brown and light gray FAT CLAY with SAND (CH) LIGHT OLIVE GREEN TO GRAY CLAY	(P) 4.50+										
50				(P) 4.50+		28	93			0.85	1		72	
			-becomes slickensided with calcareous nodules	(P) 4.50+										
			-with ferrous stains	(P) 4.50+										
55				(P) 4.50+										
				(P) 4.50+										
				(P) 4.50+										
60				(P) 4.50+										
			-becomes stiff		7/6" 7/6" 7/6"									
65			-6.24' AMSL											
			Medium dense light gray CLAYEY SAND (SC) with calcareous nodules and ferrous stains -7.74' AMSL		6/6" 10/6" 13/6"	20	102	61	45	1.91	5		46	
			Bottom @ 68'											
70														

COMPLETION DEPTH: 68 ft
DATE BORING STARTED: 06/20/2016
DATE BORING COMPLETED: 06/24/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 27' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 26'-6". At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

Page 2 of 2

TOLUNAY-WONG ENGINEERS, INC.

LOG OF BORING B-40

PROJECT: City of Kingsville
Municipal Solid Waste Landfill
Aerial Expansion

CLIENT: Naismith Engineering, Inc.

COORDINATES: N 27° 27' 09.97"
W 97° 49' 11.18"
SURFACE ELEVATION: 52.31' AMSL
DRILLING METHOD:
Dry Augered: 0 ft. to 22 ft.
Wash Bored: 22 ft. to 33.75 ft.

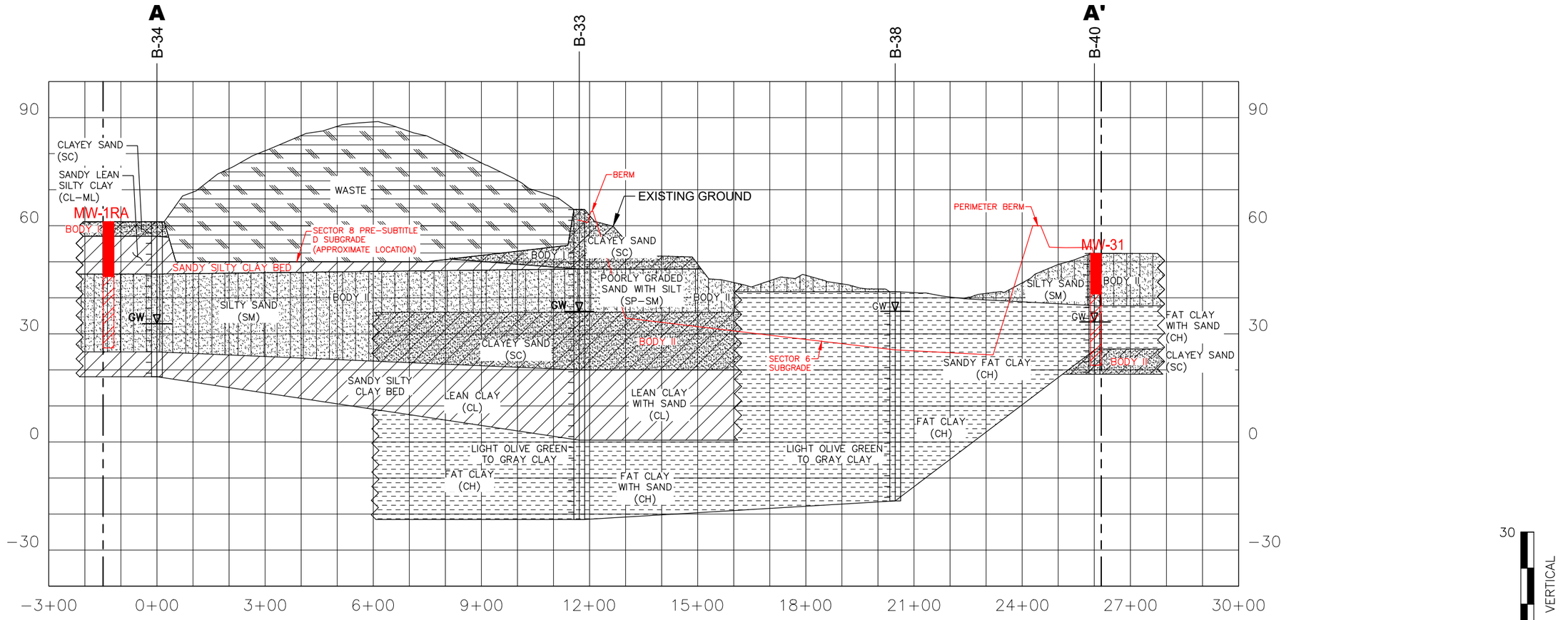
DEPTH (ft)	SAMPLE TYPE	SYMBOL/USCS	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (psf)	STD. PENETRATION TEST (blows/ft)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Loose to very dense light gray and gray SILTY SAND (SM) with trace caliche BODY II		4/6" 4/6" 6/6"									
			-color changes to light gray and tan with ferrous stains		5/6" 7/6" 11/6"	16		35	10				31	
5					7/6" 17/6" 17/6"									
			-color changes to light gray with calcareous nodules		12/6" 21/6" 34/6"									
			-color changes to light gray and white		12/6" 27/6" 50/3"	18							34	
10			-color changes to white		15/6" 50/3"									
			-color changes to light gray and white		25/6" 50/4"									
			37.81' AMSL											
15			Hard light gray FAT CLAY with SAND (CH), calcareous nodules, and ferrous stains LIGHT OLIVE GREEN TO GRAY CLAY		7/6" 26/6" 50/5"	22		70	41				80	
					5/6" 17/6" 28/6"									
20					10/6" 30/6" 35/6"									
			31.81' AMSL											
			Hard light gray SANDY FAT CLAY (CH) with calcareous nodules and ferrous stains LIGHT OLIVE GREEN TO GRAY CLAY		9/6" 25/6" 35/6"	31							59	
					16/6" 32/6" 50/5"									
25					16/6" 31/6" 50/5"									
			25.81' AMSL											
			Dense to very dense light gray CLAYEY SAND (SC) with calcareous nodules BODY II		8/6" 18/6" 27/6"	30		53	32				49	
					6/6" 18/6" 50/6"									
30					6/6" 20/6" 50/5"									
			18.81' AMSL		3/6" 40/6" 50/3"	16							30	
			Bottom @ 33.5'											
35														

COMPLETION DEPTH: 33.5 ft
DATE BORING STARTED: 06/21/2016
DATE BORING COMPLETED: 06/22/2016
LOGGER: J. Garcia
PROJECT NO.: 16.53.042

REMARKS: Free water was encounterd at an approximate depth of 21' below existing grade during drilling operations. After a 10 to 15-minute waiting period, water was at a depth of 19'. At the completion of the boring, the open bore-hole was backfilled with cement-bentonite grout.

Page 1 of 1

TOLUNAY-WONG ENGINEERS, INC.



LEGEND

- WASTE
- LEAN CLAY, LEAN CLAY WITH SAND, SANDY LEAN SILTY CLAY (CL, CL–ML)
- CLAYEY SAND (SC)
- SILTY SAND, POORLY GRADED SAND WITH SILT (SM, SP–SM)
- FAT CLAY, SANDY FAT CLAY FAT CLAY WITH SAND (CH)
- GROUND WATER AFTER EQUILIBRIUM (GW)
- PERMIT BOUNDARY
- MW-31 — RISER / SCREEN — MONITOR WELL

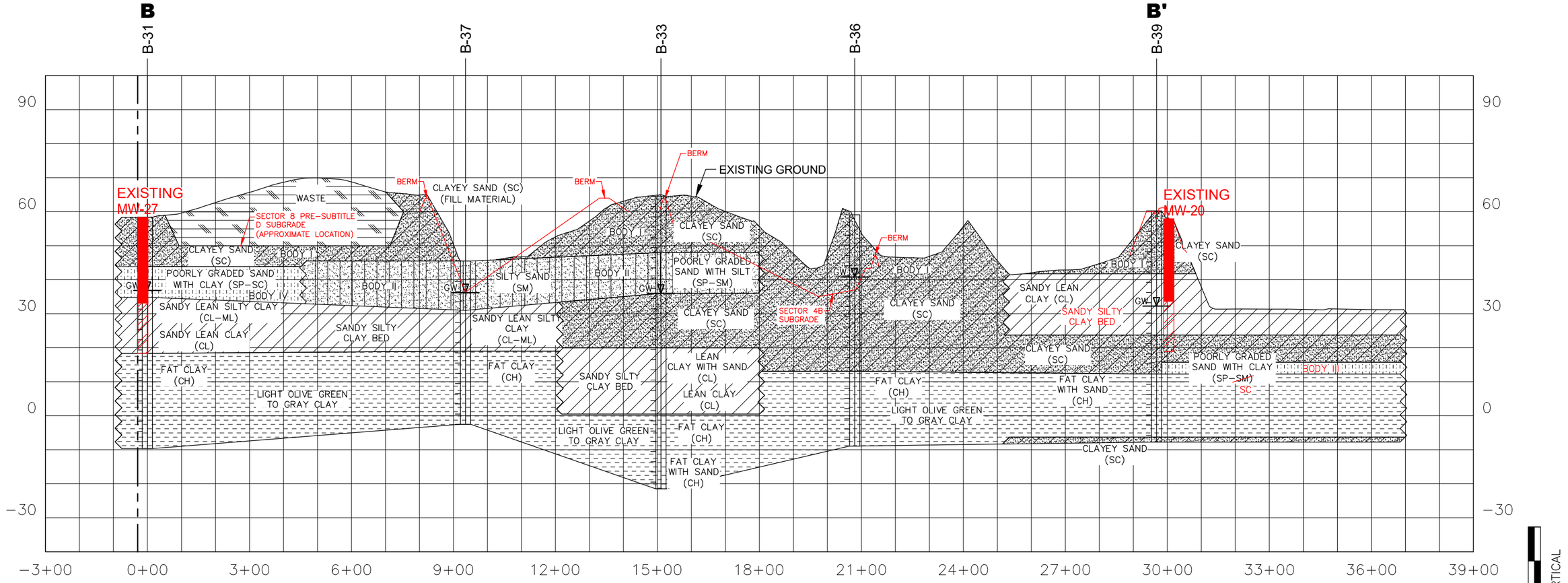
CROSS SECTION A-A'

HANSON
Hanson Professional Services Inc.
TBPE F-417 / TBPLS F-10039500
TBAE F-BR 2458 / TBPG F-50556

CITY OF KINGSVILLE LANDFILL

SOIL BORING REPORT
CROSS SECTION A-A'
KLEBERG COUNTY, TEXAS

16L0438 EXHIBIT IV



LEGEND

- WASTE
- LEAN CLAY, LEAN CLAY WITH SAND, SANDY LEAN SILTY CLAY (CL, CL-ML)
- CLAYEY SAND (SC)
- SILTY SAND, POORLY GRADED SAND WITH SILT (SM, SP-SM)
- FAT CLAY, SANDY FAT CLAY FAT CLAY WITH SAND (CH)
- POORLY GRADED SAND WITH CLAY (SP-SC)
- GROUND WATER AFTER EQUILIBRIUM (GW)
- PERMIT BOUNDARY
- MONITOR WELL (MW-20, RISER, SCREEN)

CROSS SECTION B-B'

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CITY OF KINGSVILLE LANDFILL

SOIL BORING REPORT
CROSS SECTION B-B'
KLEBERG COUNTY, TEXAS

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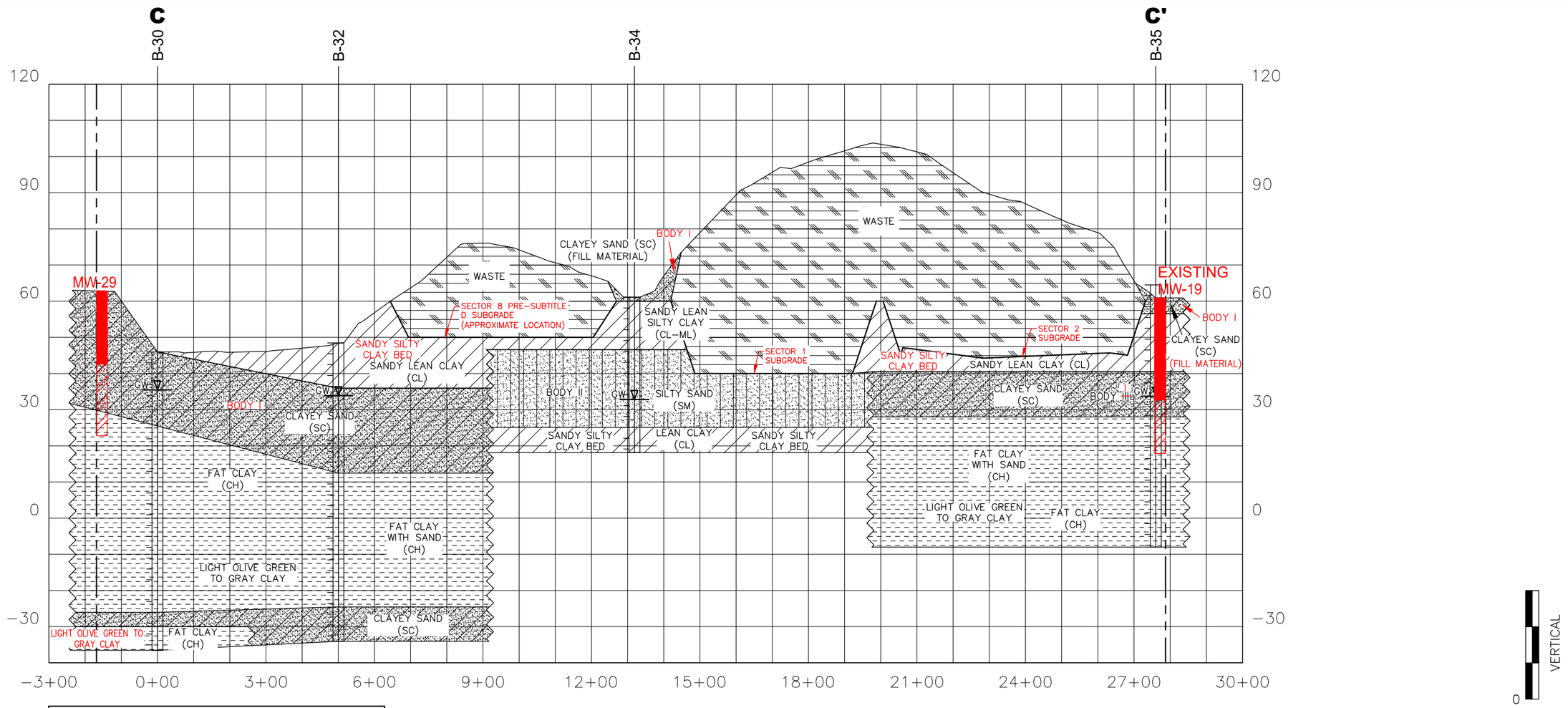

LEGEND

- WASTE
- LEAN CLAY, LEAN CLAY WITH SAND, SANDY LEAN SILTY CLAY (CL, CL-ML)
- CLAYEY SAND (SC)
- SILTY SAND, POORLY GRADED SAND WITH SILT (SM, SP-SM)
- FAT CLAY, SANDY FAT CLAY (CH)
- GROUND WATER AFTER EQUILIBRIUM (GW)
- PERMIT BOUNDARY
- MONITOR WELL (MW-29: RISER, SCREEN)

CROSS SECTION C-C'

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CROSS SECTION C-C'
KLEBERG COUNTY, TEXAS

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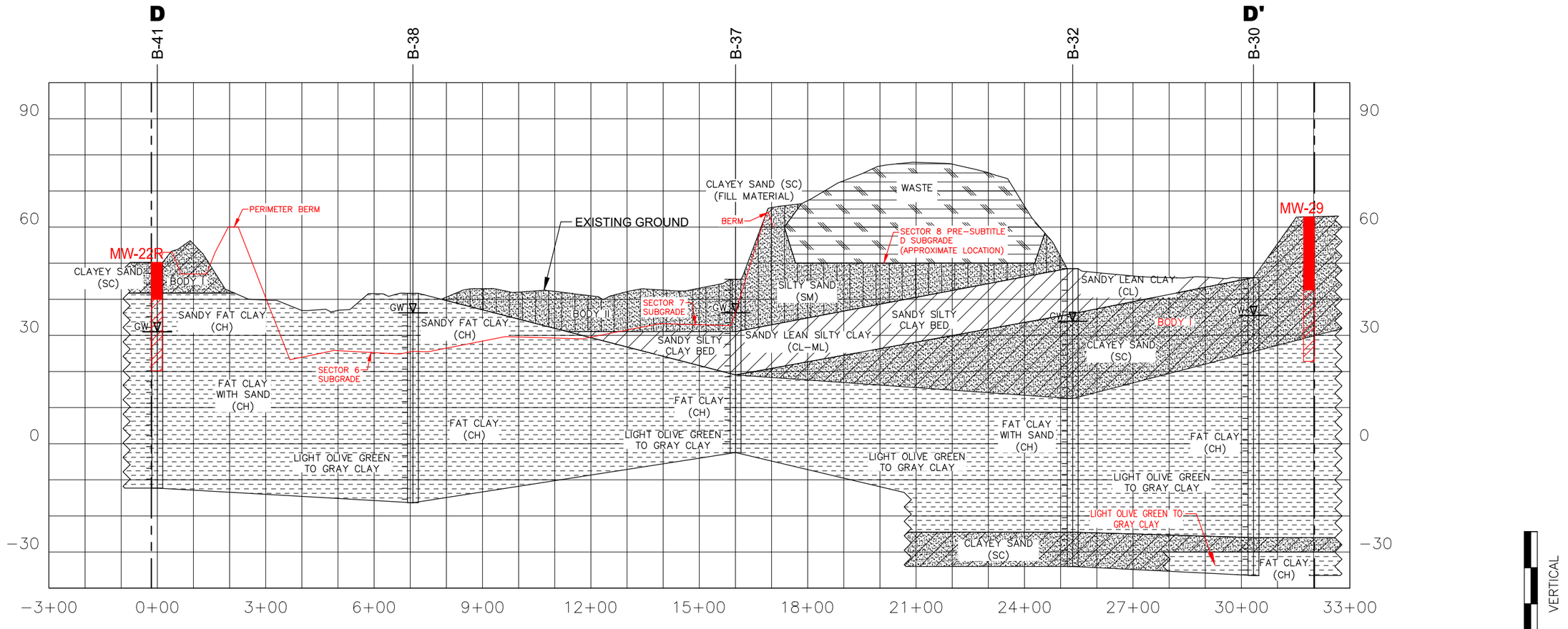

LEGEND

- WASTE
- LEAN CLAY, LEAN CLAY WITH SAND, SANDY LEAN SILTY CLAY (CL, CL-ML)
- CLAYEY SAND (SC)
- SILTY SAND, POORLY GRADED SAND WITH SILT (SM, SP-SM)
- FAT CLAY, SANDY FAT CLAY (CH)
- GROUND WATER AFTER EQUILIBRIUM (GW)
- PERMIT BOUNDARY
- MW-29 RISER / SCREEN — MONITOR WELL

CROSS SECTION D-D'

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CITY OF KINGSVILLE LANDFILL

SOIL BORING REPORT
CROSS SECTION D-D'
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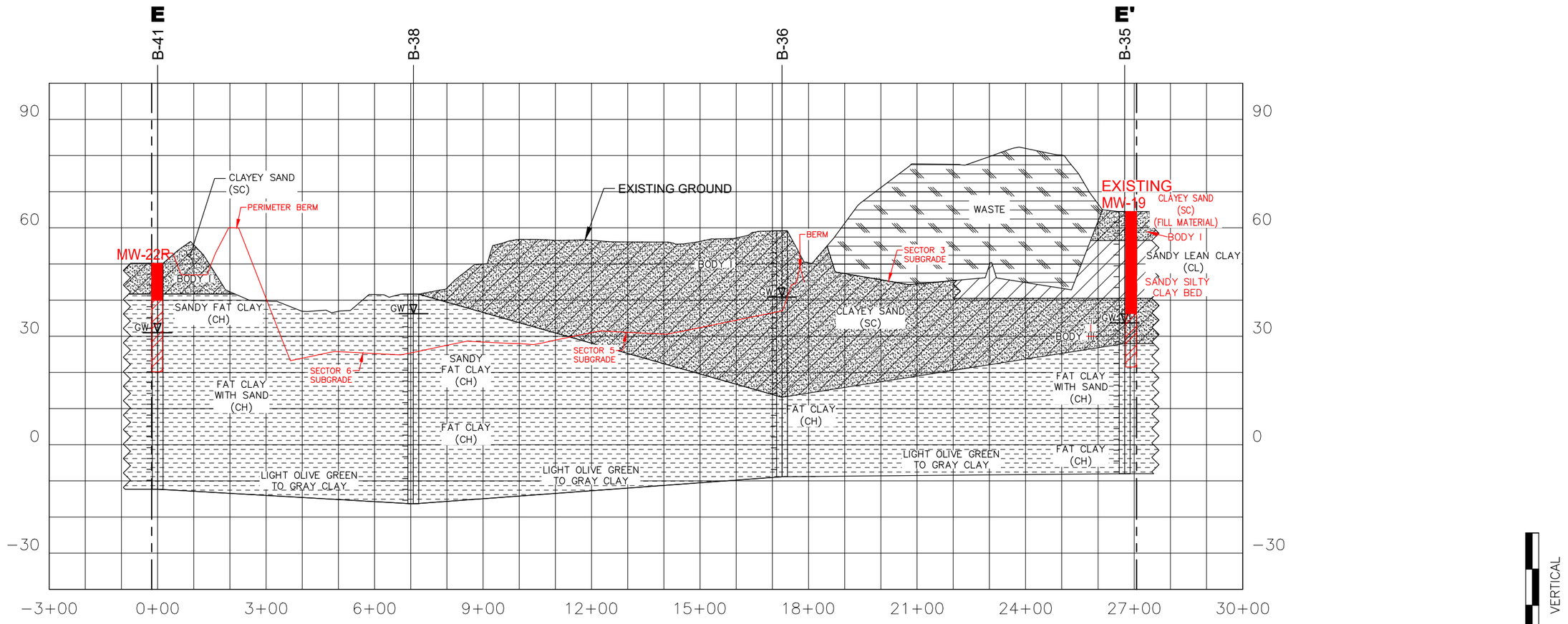

LEGEND

- WASTE
- LEAN CLAY, LEAN CLAY WITH SAND, SANDY LEAN SILTY CLAY (CL, CL–ML)
- CLAYEY SAND (SC)
- FAT CLAY, SANDY FAT CLAY (CH)
- GROUND WATER AFTER EQUILIBRIUM (GW)
- PERMIT BOUNDARY
- MW-19 RISER / SCREEN — MONITOR WELL

CROSS SECTION E-E'

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CITY OF KINGSVILLE LANDFILL

SOIL BORING REPORT
CROSS SECTION E-E'
KLEBERG COUNTY, TEXAS

16L0438 EXHIBIT IV

THE CITY OF KINGSVILLE LANDFILL

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PERMIT AMENDMENT APPLICATION

Volume 4 of 6

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

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Revision 4 – May 2019

Prepared by

HANSON
Engineering | Planning | Allied Services

TBPE F-417

HANSON PROJECT NO. 16L0438-0003

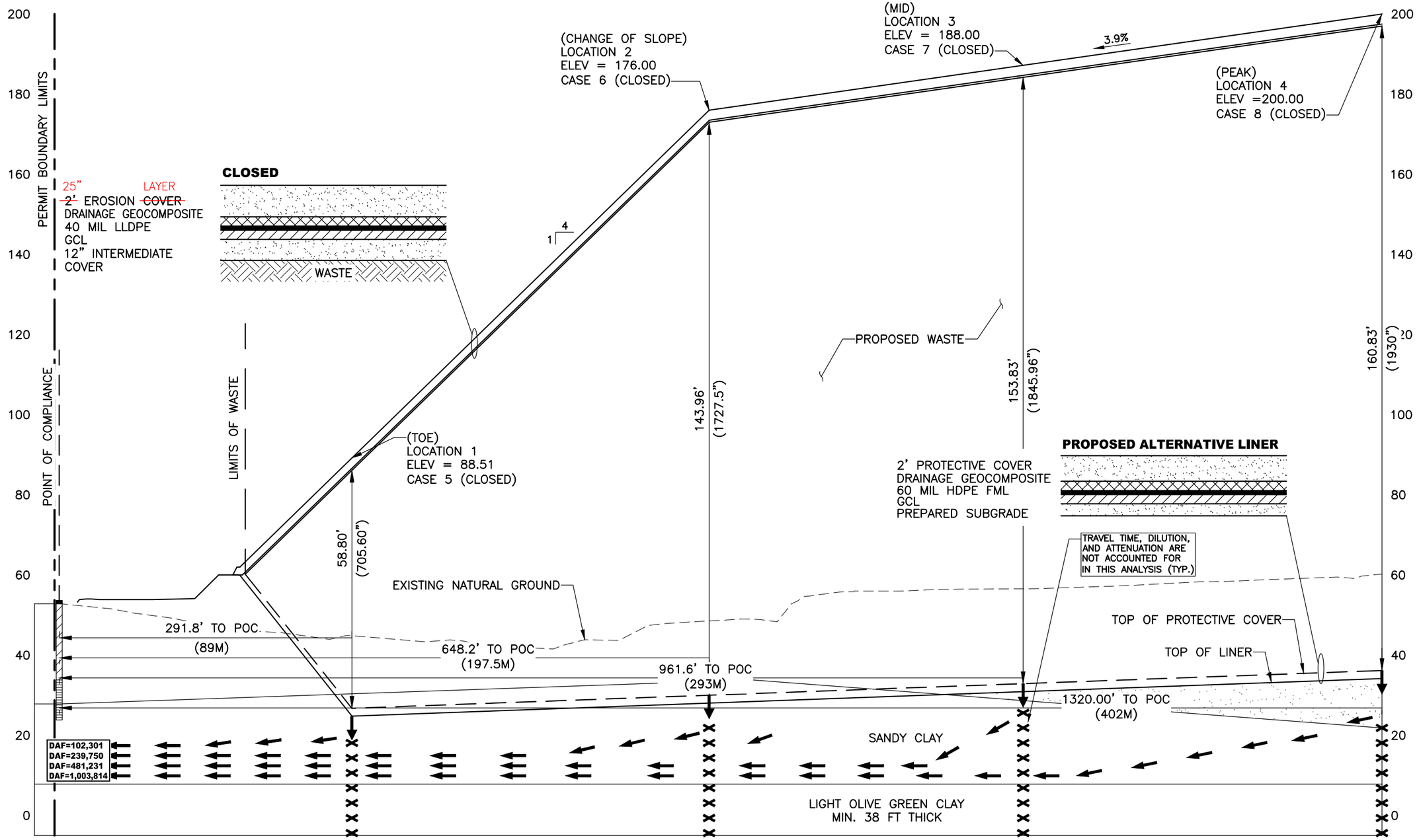
ATTACHMENT 5

ALTERNATIVE LINER AND OVERLINER DESIGN AND POINT OF COMPLIANCE DEMONSTRATIONS

CONTENTS

APPENDIX D.2

TYPICAL PROFILE-ALTERNATIVE LINER CLOSED LANDFILL DAF



ALTERNATIVE LINER DEMONSTRATION – CLOSED LANDFILL CONDITION

1. USE HELP TO MODEL PERCOLATION THROUGH THE ALTERNATIVE LINER.
2. USE MULTIMED TO CALCULATE THE DILUTION ATTENUATION FACTOR (DAF).

MULTIMED INFORMATION

AVERAGE AQUIFER THICKNESS = 32.81FT (10M)
HYDRAULIC CONDUCTIVITY = 4.12×10^{-4} CM/SEC OR 130 M/YR
HYDRAULIC GRADIENT = i = 0.003125

NOTES:

1. EVANGELINE AQUIFER (500 FT BELOW GROUND SURFACE) (FRESH)
2. CHICOT AQUIFER (220 FT BELOW GROUND SURFACE)

NUMBER	REVISION	DATE	DRAWN	DESIGNED	REVIEWED

STATE OF TEXAS
JOSE C. GARZA
91790
LICENSED PROFESSIONAL ENGINEER
05/17/19
Jose C. Garza, P.E.

Hanson No. 16L0438
Filename
Scale AS SHOWN
Date 05/17/2019

LAYOUT	DT	05/17/2019
DRAWN	DT	05/17/2019
REVIEWED	JCG	05/17/2019

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Phone: (361) 814-9900
(800) 677-2831
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PART III, ATTACHMENT 5, APPENDIX D
TYPICAL PROFILE-ALTERNATIVE LINER
CLOSED LANDFILL DAF
CITY OF KINGSVILLE LANDFILL
MSW PERMIT No. 235-C
KINGSVILLE, TEXAS
KLEBERG COUNTY, TEXAS

FIGURE:
III.5-D.2

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APPENDIX G

ALTERNATE COMPOSITE FINAL COVER DESIGN DEMONSTRATION

Table of Contents

List of Appendices

1.0 INTRODUCTION

This alternate composite final cover design demonstration will demonstrate that the use of a geosynthetic clay liner (GCL) will provide equivalent infiltration and protection from wind and water erosion as the conventional composite final cover defined in 30 TAC §330.457 (a).

1.1 Alternative Composite Liner System

The GCL Alternative Final Cover System is as follows from top to bottom:

~~24~~ 25 - inch thick erosion layer
Double-sided geocomposite drainage layer
40-mil LLDPE textured geomembrane
GCL

GCLs are frequently used in liner systems. GCLs are geocomposite materials of low hydraulic conductivity and are readily available by several manufacturers. The GCLs have varying characteristics. They are generally manufactured by placing powdered or granulated bentonite on a geotextile or geomembrane substrate. The bentonite layer is typically 6 to 10 mm thick (following hydration) and is placed at a unit weight of approximately 0.8 pounds per square feet (lb/ft^2). The GCLs with a geotextile substrate also have a covering geotextile, which is often needle-punched, connecting the underlying geotextile to increase the structural integrity. Non-woven and woven geotextiles of various weights are used.

Generally, the permeability of the bentonite component of GCLs ranges from less than 1×10^{-9} to 5×10^{-9} cm/sec.

2.0 EQUIVALENCY

2.1 Leakage Rate Estimates

The leakage through composite liners can be estimated using the “Giroud equation”, as illustrated in Appendix G.1. The method requires assumptions regarding the characteristics of the composite liner. It is assumed that permeation through the full area of the geomembrane is insignificant in comparison to rapid leakage through isolated defects or holes. Also, assumptions need to be made regarding the extent to which intimate contact has been made. A composite liner that has intimate contact has been constructed such that the geomembrane lies flush with the surface of the underlying clay component, with few or no gaps between two liners. When intimate contact has been achieved, the effective area of leakage is very small, and the total liner system leakage is minimized. This phenomenon is referred to as “composite action.”

The equation used in the analysis is derived both from theoretical models of fluid flow and from empirical analyses of actual composite liner systems. Flow through a circular defect in a composite liner is calculated as follows:

$$Q = C[1+0.1(h/t_s)^{0.95}]a^{0.1}h^{0.9}k_s^{0.74}$$ [Ref 1] in Appendix G.1

Where:

Q = rate of leakage through a defect (m^3/sec)

C = Dimensionless constant related to the quality of the intimate contact between the geomembrane and the underlying soil component

h = hydraulic head on the geomembrane (m)

t_s = thickness of the low-permeability soil component (compacted clay liner or GCL) (m)

a = area of geomembrane defect (m^2)

k_s= permeability of soil component (compacted clay liner or GCL) (m/s)

Using the above equation, the conventional composite final cover system was compared to the alternative composite final cover system for both "good' and "poor" intimate contact and for circular holes with an area of 0.1 and 1.0 cm^2.

As shown in Appendix G.1, Infiltration Rate Comparison-GCL Alternate Final Cover for each condition, the alternative composite final cover had calculated leakage rates approximately 1/~~405th~~ 373 that of the geomembrane/compacted clay liner system.

2.2 Wind and Water Erosion

The alternative composite final cover surface will be seeded.

3.0 SUMMARY

The analysis demonstrates that substituting a GCL for an 18-inch thick compacted clay rich earthen material with a hydraulic conductivity of 1 x 10^{-5} cm/sec provides a level of infiltration reduction and wind and water protection that is greater than or equal to the level of protection provided by the conventional composite final cover system.

APPENDIX G.1

INFILTRATION RATE COMPARISON-GCL ALTERNATE FINAL COVER

ALTERNATE COMPOSITE FINAL COVER DESIGN DEMONSTRATION
INFILTRATION RATE COMPARISON-GCL ALTERNATE FINAL COVER

OBJECTIVE:
Comparison between the infiltration rate through a conventional composite final cover system and the infiltration rate through the alternative composite final cover system.

GIVEN:
The conventional composite final cover system consists of a 40-mil geomembrane overlying an 18-inch thick compacted clay rich material with a maximum hydraulic conductivity of 1 x 10-5 cm/sec. In the alternative composite final cover system, the compacted clay rich infiltration layer material will be replaced with a geosynthetic clay liner (GCL). Both final covers include a geocomposite drainage layer above the geomembrane (GM).

Infiltration Layer Properties

k=	1.00E-05	cm/s
	1.00E-07	m/s
t=	1.5	ft
	0.4572	m
h=	0.2	inches
	0.005079752	m

(sized to prevent head > 0.2 inches when cover soil saturated)

GCL Properties

k=	3.00E-09	cm/s
	3.00E-11	m/s
t=	6	mm
	0.006	m
h=	0.2	inches
	0.005079752	m

(geocomposite drainage layer sized to prevent head > 0.2 inches when cover soil saturated)

METHOD:
Estimate the infiltration rate through each final cover system using the Giroud Equation (Ref. 1). Compare the infiltration rate through composite final cover systems consisting of a geomembrane(GM)/clay rich material and a GM/GCL.

Infiltration through composite geomembrane/GCL liner:

$Q = C[1+0.1(h/t_s)^{0.95}]a^{0.1}h^{0.9}K_s^{0.74}$ Ref 1

where: C = 0.21 good contact
1.15 poor contact
h = head (m)
t_s = thickness of low permeability soil component (clay material or GCL) (m)
a = area of hole (m^2)
0.1 cm^2
0.00001 m^2
1 cm^2
0.0001 m^2
k_s = hydraulic conductivity of clay material or GCL (m/s)

Example Calculation for Good Contact GM/GCL & 0.1 cm^2 hole: $0.21[1+0.1(0.00508/.006)^{0.95}] \times 0.00001^{0.1} \times 0.00508^{0.9} \times 3.0E\text{-}11^{0.74} = 1.01E\text{-}11$

RESULTS:

Leakage Rate Per Defect

Intimate Contact		Good		Poor	
Composite Cover System		GM/Clay	GM/GCL	GM/Clay	GM/GCL
Leakage	0.1 cm^2 hole	3.79E-09	1.01E-11 ~~9.35E-12~~	2.07E-08	5.55E-11 ~~5.12E-11~~
(m^3/sec)	1 cm^2 hole	4.77E-09	1.28E-11 ~~1.18E-11~~	2.61E-08	6.99E-11 ~~6.44E-11~~

Comparison

Intimate Contact	$Q_{GM/Clay}/Q_{GM/GCL}$	
	0.1 cm^2 hole	1 cm^2 hole
Good	~~405~~373	~~405~~373
Poor	~~405~~373	~~405~~373

Example Calculation for Poor Contact $Q_{GM/Clay}/Q_{GM/GCL}$ & 0.1 cm^2 hole: 2.07E-08/5.55E-11 = 373

CONCLUSION:

Based on this analysis, the infiltration rate through an alternative composite final cover system with a GCL will be approximately 1/~~405th~~ 373 that of the conventional composite final system with a clay rich infiltration layer.

REFERENCE:

1. Giroud, J.P., "Equations for Calculating the Rate of Liquid Migration Through Composite Liners Due to Geomembrane Defects", Geosynthetics International, Vol. 4, Nos. 3-4, pp. 335-348, 1997.

THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235C

PERMIT AMENDMENT APPLICATION

Volume 5 of 6

CITY OF KINGSVILLE, KLEBERG COUNTY, TEXAS

September 2018
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Revision 3 – April 2019
Revision 4 – May 2019

Prepared by

HANSON
Engineering | Planning | Allied Services

TBPE F-417

HANSON PROJECT NO. 16L0438-0003

THE CITY OF KINGSVILLE LANDFILL

TCEQ PERMIT MSW 235-C

PERMIT AMENDMENT APPLICATION
PART III, ATTACHMENT 11
GROUNDWATER SAMPLING AND ANALYSIS PLAN

CITY OF KINGSVILLE, TEXAS

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Revision 3 – April 2019
Revision 4 – May 2019

Prepared by

HANSON
Engineering | Planning | Allied Services
TBPE F-417

HANSON PROJECT NO. 16L0438-0003

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APPENDICES

Appendix A
Table 1 – Detection Monitoring Constituents
Table 2 – MSW-PQL Benchmark Concentrations
Table 3 – Monitor Well Designations
Item 1 – Site Layout Map
Item 2 – Groundwater Monitoring System Design Certification

Appendix B
Item 1 – Municipal Solid Waste Groundwater Monitoring Flow Chart
Item 2 – Sample Collection, Preservation, and Holding Times
Item 3 – Statistical Evaluation Procedure

Appendix C
Item 1 – Field Conditions Report
Item 2 – Monitor Well Field Data Sheet
Item 3 – Chain-of-Custody Form
Item 4 – TCEQ 0312 Ground Water Sampling Report
Item 5 – Laboratory Review Checklist
Item 6 – Laboratory Quality Assurance/Quality Control Manual

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(when physical obstacles preclude installation of the groundwater monitoring wells at the point of compliance), as defined in 30 TAC §330.3, that will ensure detection of groundwater contamination of the uppermost aquifer. The average ground water level is at approximately 35 feet National Geodetic Vertical Datum (NGVD). The target groundwater monitoring zone typically consists of clayey sand, silty sand, and poorly graded clay with sand. All parts of the groundwater monitoring system shall be operated and maintained so that they perform at least to design specifications. The design of the monitoring system is based on site specific technical information gathered during multiple site investigations and further discussed in the site Geology Report included as Part III Attachment 4 of this permit, Part III Attachment 4 Appendix 1, and the Groundwater Characterization Report included as Part III Attachment 4, Appendix 1 beginning on page 752. The City of Kingsville Landfill will promptly notify the executive director, and any local pollution agency with jurisdiction that has requested to be notified, in writing of changes in facility construction or operation or changes in adjacent property that affect or are likely to affect the direction and rate of groundwater flow and the potential for detecting groundwater contamination from a solid waste management unit and that may require the installation of additional monitoring wells or sampling points and that such additional wells or sampling points require a modification of the site development plan.

A topographic and Groundwater Contour map identifying the existing and proposed monitor well locations, installed depths, property boundary, a delineation of the waste management area, and the point of compliance line has been included in Appendix A-Item 1A and B Site Layout Maps. All monitoring wells will be constructed in accordance with 30 TAC §330.421. Monitor well installation and construction details will be provided on form TCEQ-10308, or current appropriate TCEQ reporting form, upon completion. The Groundwater Monitoring System Design Certification has been included as Appendix A-Item 2.

2.0 HEALTH AND SAFETY

Personnel performing water level measurements, well purging, or sampling will, at a minimum, wear latex or other equivalent non-powdered gloves. The gloves will be changed when they become damaged and when activities begin at a different well location. All personnel that are associated with the purging and sample collections from monitor wells will wear other appropriate Personal Protective Equipment (PPE) such as eye protection, safety vests, chemical resistant clothing and/or aprons, and air purifying respirators, as necessary.

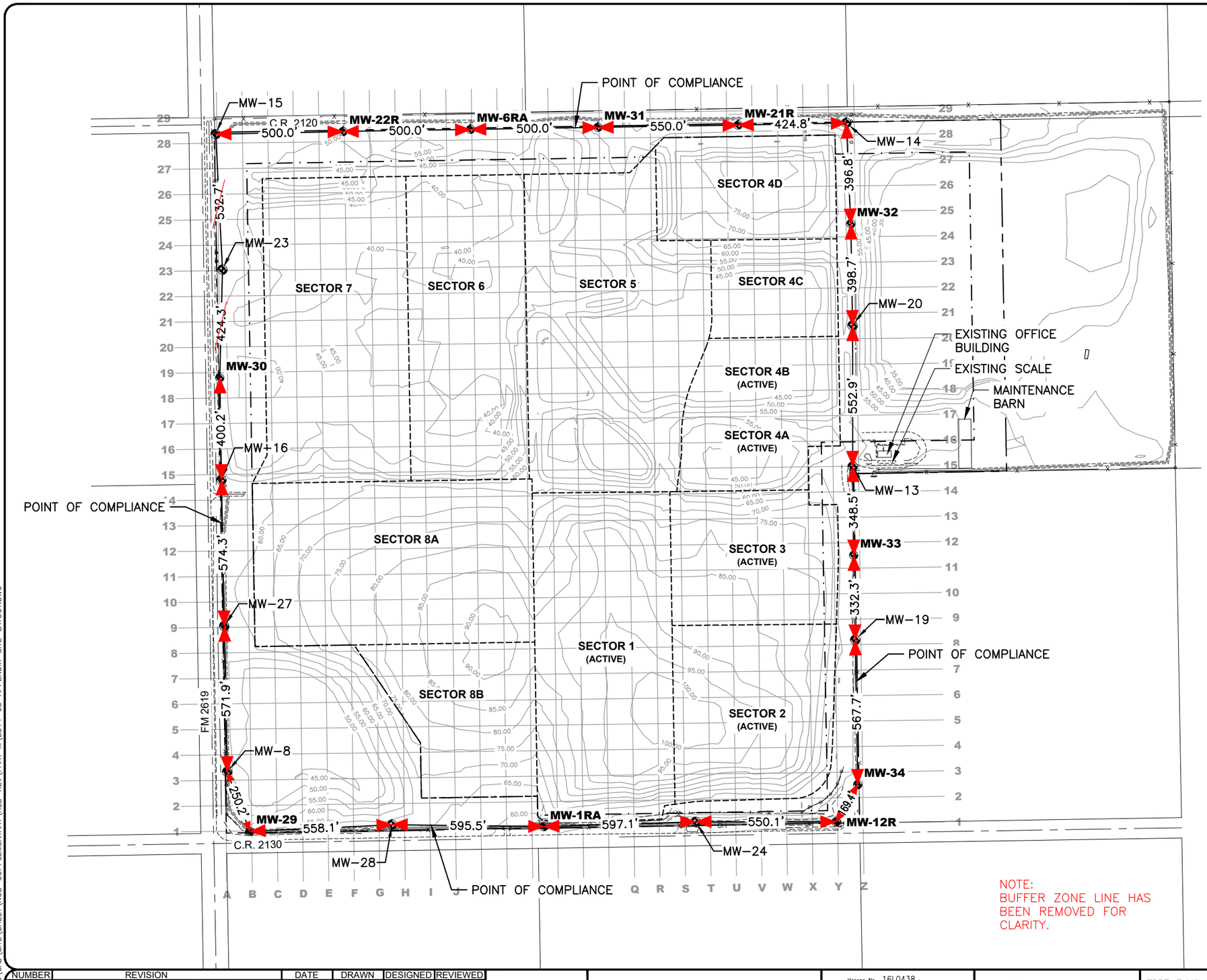
3.0 GROUNDWATER SAMPLING FREQUENCY

3.1 Background Monitoring

At least eight (8) statistically independent background groundwater samples will be obtained on a quarterly basis prior to commencing with Detection Monitoring for each groundwater monitor well at the facility (see Appendix A, Table 1, for parameters). Background monitoring events should allow approximately 90 days between each monitoring event to allow the collection of groundwater data over the different seasons of the year.

3.2 Detection Monitoring

After establishment of background groundwater quality, detection monitoring will be performed on a semi-annual basis at approximately 6-month intervals during the remaining operational life



NOTE:
BUFFER ZONE LINE HAS BEEN REMOVED FOR CLARITY.

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GRAPHIC SCALE IN FEET

LEGEND:

- MW-20 — MONITOR WELL LOCATION
- EXISTING FENCE
- EXISTING SURFACE CONTOUR (2015)
- SECTOR OUTLINE
- PERMIT BOUNDARY (175.89 ACRES)
- ~~BUFFER ZONE~~
- 400.2' — POINT OF COMPLIANCE

SITE COORDINATES				
MONITOR WELL LOCATIONS				
MW	Northing	Easting	DEPTH (FT BGS)	STATUS
MW-8	17051473.78	1203673.74	43	EXISTING
MW-13	17052672.16	1206127.95	40	EXISTING
MW-14	17054020.04	1206103.02	35	EXISTING
MW-15	17053976.10	1203628.61	33	EXISTING
MW-16	17052619.76	1203651.21	40	EXISTING
MW-19	17051991.35	1206137.50	43	EXISTING
MW-20	17053225.01	1206127.20	39	EXISTING
MW-23	17053444.05	1203654.88	35	EXISTING
MW-24	17051277.99	1205512.42	33	EXISTING
MW-27	17052045.52	1203661.75	40	EXISTING
MW-28	17051266.46	1204320.24	43	EXISTING
MW-1RA	17051258.70	1204915.66	35	PROPOSED
MW-32	17053623.64	1206120.29	31	PROPOSED
MW-6RA	17053994.38	1204628.44	30	PROPOSED
MW-12RA	17051277.38	1206062.51	35	PROPOSED
MW-21R	17054011.48	1205678.30	32	PROPOSED
MW-22R	17053986.24	1204128.51	30	PROPOSED
MW-29	17051239.92	1203762.81	40	PROPOSED
MW-30	17053019.90	1203644.60	30	PROPOSED
MW-31	17054002.53	1205128.38	31	PROPOSED
MW-33	17052323.65	1206132.04	35	PROPOSED
MW-34	17051423.79	1206147.64	35	PROPOSED

NOTE: ALL MONITORING WELLS WILL BE INSTALLED AND MONITORED THROUGHOUT THE ACTIVE LIFE AND POST-CLOSURE CARE PERIOD OF THIS SITE.

NUMBER	REVISION	DATE	DRAWN	DESIGNED	REVIEWED

Hanson No. 16L0438
Filename 8514-03-APPENDIX-SITE-LAYOUT
Scale AS SHOWN
Date 05/17/2019

LAYOUT	DT	05/17/2019
DRAWN	DT	05/17/2019
REVIEWED	TAG	05/17/2019

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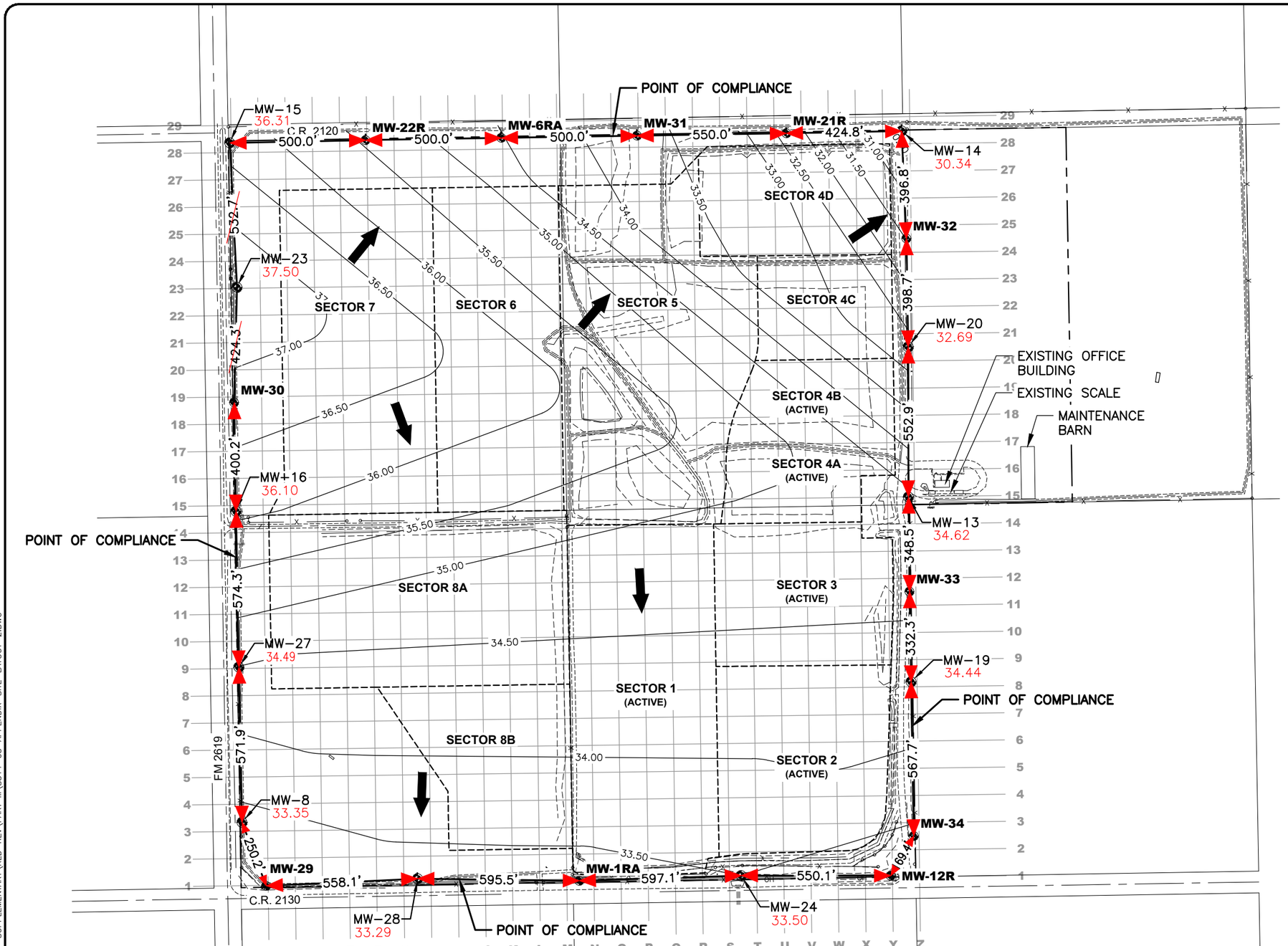
PART III, ATTACHMENT 11
APPENDIX A
ITEM - 1A
SITE LAYOUT MAP
GROUNDWATER SAMPLING AND ANALYSIS PLAN
CITY OF KINGSVILLE LANDFILL
PA. MSW 235-C
KINGSVILLE, TEXAS, KLEBERG COUNTY, TEXAS

FIGURE:
III.11-A-1A

MAY 13, 2019 6:06 PM TORRE01809
I:\16JOBS\16L0438B\CAD\SITE\SHEET\NOD-SUPPLEMENTARY\RED-REV\PART III\8514-03-APPENDIX-SITE-LAYOUT.DWG



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GRAPHIC SCALE IN FEET

LEGEND:

- MW-20 — MONITOR WELL LOCATION
- x — EXISTING FENCE
- 35.00 — GROUNDWATER CONTOURS (FEET AMSL)
- SECTOR OUTLINE
- PERMIT BOUNDARY (175.89 ACRES)
- BUFFER ZONE
- 400.2' — POINT OF COMPLIANCE
- GROUNDWATER DIRECTIONAL FLOW ARROW

SITE COORDINATES				
MONITOR WELL LOCATIONS				
MW	Northing	Easting	DEPTH (FT BGS)	STATUS
MW-8	17051473.78	1203673.74	43	EXISTING
MW-13	17052672.16	1206127.95	40	EXISTING
MW-14	17054020.04	1206103.02	35	EXISTING
MW-15	17053976.10	1203628.61	33	EXISTING
MW-16	17052619.76	1203651.21	40	EXISTING
MW-19	17051991.35	1206137.50	43	EXISTING
MW-20	17053225.01	1206127.20	39	EXISTING
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MW-12RA	17051277.38	1206062.51	35	PROPOSED
MW-21R	17054011.48	1205678.30	32	PROPOSED
MW-22R	17053986.24	1204128.51	30	PROPOSED
MW-29	17051239.92	1203762.81	40	PROPOSED
MW-30	17053019.90	1203644.60	30	PROPOSED
MW-31	17054002.53	1205128.38	31	PROPOSED
MW-33	17052323.65	1206132.04	35	PROPOSED
MW-34	17051423.79	1206147.64	35	PROPOSED

NOTES:
1. GROUNDWATER ELEVATIONS FROM JANUARY 2017.
2. ALL MONITORING WELLS WILL BE INSTALLED AND MONITORED THROUGHOUT THE ACTIVE LIFE AND POST-CLOSURE CARE PERIOD OF THIS SITE.

NUMBER	REVISION	DATE	DRAWN	DESIGNED	REVIEWED

Hanson No. 16L0438
Filename 8514-03-APPENDIX-SITE-LAYOUT-2
Scale AS SHOWN
Date 05/17/2019

LAYOUT	DT	05/17/2019
DRAWN	DT	05/17/2019
REVIEWED	TAG	05/17/2019

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PART III, ATTACHMENT 11
APPENDIX A
ITEM - 1B
SITE LAYOUT MAP
GROUNDWATER SAMPLING AND ANALYSIS PLAN
CITY OF KINGSVILLE LANDFILL
PA. MSW 235-C
KINGSVILLE, TEXAS, KLEBERG COUNTY, TEXAS

FIGURE:
III.11-A-1B

MAY 13, 2019 6:09 PM TORREO1809
I:\16JOBS\16L0438\CAD\SITE\SHEET\NOD-SUPPLEMENTARY\RED-REV\PART III\8514-03-APPENDIX-SITE-LAYOUT-2.DWG