City of Waco Landfill
McLennan and Limestone Counties
TCEQ Permit No. MSW-2400

October 2020 Technical Notice-of-Deficiency Response
Marked Version

Prepared for

City of Waco

Solid Waste Services
501 Schroeder Drive
Waco, Texas 76710

Prepared by:

SCS ENGINEERS

SCS Project No. 16216088.00
Revision 3 (Parts I/II) and Revision 1 (Part III/IV) – October 2020

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CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PARTS I/II
GENERAL APPLICATION REQUIREMENTS

Prepared for:

CITY OF WACO

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TABLE OF CONTENTS

SECTION **PAGE**

LIST OF ACRONYMS iv
SUPPLEMENTARY TECHNICAL REPORT v

SUPPLEMENTARY TECHNICAL REPORT v
1 INTRODUCTION 1-1
2 GENERAL INFORMATION 2-1
2.1 Project Overview 2-1
2.2 Waste Acceptance Plan (30 TAC §330.61(b)) 2-1
2.3 Easements and Buffer Zones 2-3
2.4 Agency Coordination 2-3
3 EXISTING CONDITIONS SUMMARY (30 TAC §330.61(a)) 3-1
4 MAPS (30 TAC §330.59(c)) 4-1
5 LANDOWNERS' MAP AND LIST 5-1
6 AERIAL PHOTOGRAPH 6-1
7 LAND-USE AND IMPACT ON SURROUNDING AREA (30 tac §330.61(g) & (h)) 7-1
7.1 Land Use Analysis (30 TAC §330.61(g) & (h)(1)-(4)) 7-1
7.2 Water Wells Within 500 Feet (30 tac §330.61(h)(5)) AND ONE-MILE (30 TAC 305.45(A)(6)(A) 7-1
7.3 Abandoned Oil and Water Wells (30 TAC §330.61(l)) 7-1
8 TRANSPORTATION (30 TAC §330.61(i)) 8-1
8.1 Traffic Information 8-1
8.2 Airports (30 TAC §330.619(c)(8) & §330.545) 8-2
9 GENERAL GEOLOGY AND SOILS STATEMENT (30 TAC §330.61(i)) 9-1
9.1 Regional Geologic Setting 9-1
9.2 Site Geology 9-1
9.3 On-Site Soils 9-1
9.4 Fault Areas 9-2
9.5 Seismic Impact Zones 9-2
9.6 Unstable Areas 9-3
10 GROUNDWATER AND SURFACE WATER STATEMENTS (30 TAC §330.(k)) 10-1
10.1 Groundwater Statement 10-1
10.2 Surface Water Statement 10-1
11 FLOODPLAIN AND WETLANDS STATEMENT (30 TAC §330.61(m)) 11-1
11.1 Floodplain Statement 11-1
11.2 Wetlands Statement 11-1
12 PROTECTION OF ENDANGERED or threatened SPECIES (30 TAC §330.61(n)) 12-1

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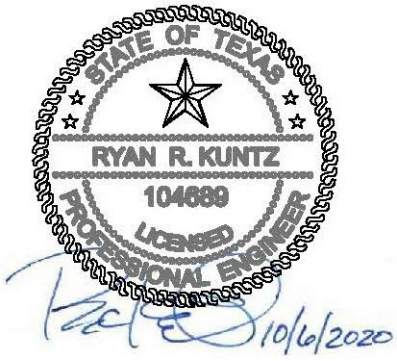
13 LEGAL DESCRIPTION (30 TAC §330.59(d)(1)) 13-1
14 PROPERTY OWNER AFFIDAVIT (30 TAC §330.59(d)(2)) 14-1
15 LEGAL AUTHORITY (30 TAC §330.59(e)) 15-1
16 EVIDENCE OF COMPETENCY (30 TAC §330.59(f)) 16-1
16.1 City of Waco 16-1
16.2 The City of Waco Key Personnel 16-1
16.3 Equipment to be Dedicated to this Landfill 16-2
16.4 Other Permits / Authorizations 16-4
17 APPOINTMENTS (30 TAC §330.59(g) 17-1

Drawings

Drawing I/II-1: Site Location Map
Drawing I/II-2: General Topographic Map (includes Wind Rose)
Drawing I/II-3: Landowner's Map
Drawing I/II-4: Aerial Photograph (9 inch X 9 inch)
Drawing I/II-5: Facility Layout Map
Drawing I/II-6: Regional Tectonic/Geology Map
Drawing I/II-7: Seismic Impact Map

Appendices

I/IIA Demonstration of Coordination
I/IIB Water, Oil, and Natural Gas Well Search
I/IIC Land-Use Analysis
I/IID Traffic Analysis
I/IID-1 TxDOT Waco District Traffic Map
I/IID-2 Traffic Impact Analysis
I/IIE Section 404 Jurisdictional Determination
I/IIF Certified City Charter
I/IIG Biological Assessment



SCS Engineers
TBPE Reg. # F-3407

2 GENERAL INFORMATION

2.1 PROJECT OVERVIEW

The proposed landfill will be a Type I MSW landfill with a permit boundary of 502.5 acres. The waste disposal footprint will encompass ~~175.7~~173.8 acres, separated into two (2) disposal areas, with the East Disposal Area comprised of ~~112.9~~112.2 acres and West Disposal Area comprised of ~~62.8~~61.6 acres, as shown on Drawing I/II-5 – Facility Layout Plan. The landfill will serve residences, businesses, and industries in the communities of McLennan and Limestone County and other nearby counties transported to the landfill by municipal, private, and public haulers. The landfill will accept waste as defined in Section 2.2.2, including municipal solid waste, Class 2 and Class 3 non-hazardous industrial wastes, and special wastes authorized by the TCEQ.

This permit application includes the TCEQ required information, in accordance with 30 TAC Chapter 330~~§330.59 and §330.61~~. The proposed landfill is consistent with the region's waste capacity needs, as noted by the Heart of Texas Council of Governments (HOTCOG) (see Appendix I/IIA for documentation of coordination with HOTCOG).

2.2 WASTE ACCEPTANCE PLAN (30 TAC §330.61(B))

2.2.1 Disposal Rate and Volume of Waste

This landfill is intended to serve a similar customer base as the City of Waco's current landfill (referred to as Site 948A, based on its Permit No. MSW-948A). As indicated in Site 948A's fiscal year 2017 Annual Report to the TCEQ, the remaining life for Site 948A is estimated to be 6.9 years as of September 2017. While the City of Waco expects to continue its recycling and waste diversion programs, it is conservatively estimated that this proposed landfill's waste acceptance rate will continue to increase consistent with the population growth in McLennan County. As described in Appendix I/IIC – Land-Use Analysis, growth trends in McLennan County have increased by 1.25% on average between 2010 through 2016. As such, assuming this continued population growth trend, it is anticipated that the proposed landfill will receive approximately 305,000 tons of solid waste per year in its initial year of operation, estimated to be 2024. This translates to an initial disposal rate of approximately 1,070 tons per day over a 286 day per year operating schedule. Assuming that the waste inflow volume will continue to increase at this same growth rate, the expected maximum annual waste acceptance rate is estimated to be approximately 325,000 tons per year after a five-year period of operation, which translates to a disposal rate of approximately 1,140 tons per day over a 286 day per year operating schedule. The above projections are based on current market conditions, and may vary as market conditions and recycling and waste diversion practices change.

Over the life of the landfill, it is anticipated that the population served by the landfill will change as warranted by the needs of the area and market conditions. Based on an estimated 6.7 pounds of waste generated daily per person (ref: HOTCOG Regional Solid Waste Plan, 2013 Update), assuming an initial disposal rate of 1,070 tons per day, the number of people served by the landfill will be approximately 319,000 persons. Based on the maximum acceptance rate of 1,140 tons per

day after a five-year period of operation, the number of people served by the landfill will be approximately 340,000 persons.

2.2.2 Properties and Characteristics of Waste

The major classifications of solid waste to be accepted at the landfill include household waste, yard waste, commercial waste, Class 2 and Class 3 non-hazardous industrial wastes, construction-demolition waste, and special wastes. Each classification of waste is defined in 30 TAC §330.3 and summarized below:

- **Household Waste:** Any solid waste (including garbage, trash, and sanitary waste in septic tanks) derived from households (including single and multiple residences, hotels, motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas) and does not include yard waste or brush that is completely free of any household wastes.

- **Yard Waste:** Yard waste includes leaves, grass clippings, yard and garden debris, and brush, including clean woody vegetative material not greater than 6 inches in diameter that results from landscaping maintenance and land-clearing operations. The term does not include stumps, roots, or shrubs with intact root balls.

- **Commercial ~~Solid~~ Waste:** Solid waste generated by stores, offices, restaurants, warehouses, and other non-manufacturing activities, excluding residential and industrial wastes.

- **Class 2 and Class 3 Industrial Waste (Nonhazardous):** Solid waste resulting from or incidental to any process of industry or manufacturing, mining or agricultural operations, classified as follows:

  - Class 2 Industrial Solid Waste - any individual solid waste or combination of industrial solid wastes that cannot be described as Class 1 or Class 3, as defined in 30 TAC §335.506 (relating to Class 2 waste determination).

  - Class 3 Industrial Solid Waste – any inert and essentially insoluble industrial solid waste, including materials such as rock, brick, glass, dirt, and certain plastics and rubber, etc., that are not readily decomposable as defined in 30 TAC §335.507 (relating to Class 3 waste determination).

- **Construction-Demolition Waste**: Waste resulting from construction or demolition projects; includes all materials that are directly or indirectly the by-products of construction work or that result from demolition of buildings and other structures, including, but not limited to, paper, cartons, gypsum board, wood, excelsior, rubber, and plastics.

- **Special Wastes:** Any solid waste or combination of solid wastes that because of its quantity, concentration, physical or chemical characteristics, or biological properties requires special handling and disposal to protect human health or the environment. If

improperly handled, transported, stored, processed, or disposed of, or otherwise managed, it may pose a present or potential danger to human health or the environment.

Any special waste accepted at the landfill will be in accordance with 30 TAC §330.171. Consistent with 30 TAC §330.15(e) the facility will not accept regulated hazardous waste, polychlorinated biphenyls (PCBs), and all other prohibited waste defined therein. Additionally, Class I industrial solid waste will not be accepted at this facility.

2.3 EASEMENTS AND BUFFER ZONES

2.3.1 Easement Protection (30 TAC §330.543(a))

Easements are described in Section 3 and shown on the metes and bound survey in Section 14, Attachment 14A. At the time of landfill development or cell construction, the waste disposal footprint will be located at least 25-feet from the centerline of the utility and pipeline easements, but no closer than the easement boundary, consistent with 30 TAC §330.543(a). All pipeline and utility easements shall be clearly marked with posts that extend at least six feet above ground level, spaced at intervals no greater than 300 feet. No solid waste unloading, storage, disposal, or processing operations will occur within any easement or right-of-way that crosses the facility, unless and until the easement has been abandoned or relocated.

2.3.2 Buffer Zones (30 TAC §330.543(b))

The Site will be developed with buffer zones of at least 125 feet between areas of solid waste disposal, storage, and processing (e.g. Type I waste disposal units, citizen's convenience center, etc.) and the permit boundary in accordance with 30 TAC §330.543(b)(2)(A). Buffer zones for the Site are depicted on Drawing I/II-5, which are greater than or equal to 125 feet. Access roads are provided in the buffer zones, which provide for safe passage for firefighting and other emergency vehicles. No solid waste unloading, storage, disposal, or processing operations will occur within any buffer zone.

2.4 AGENCY COORDINATION

Documentation of coordination with the following agencies is included in Appendix I/IIA.

- Texas Parks and Wildlife Department
- U.S. Department of the Interior, Fish and Wildlife Service
- Texas Historic Commission
- Texas Department of Transportation
- Heart of Texas Council of Governments (HOTCOG)
- Federal Aviation Administration
- U.S. Army Corps of Engineers

3 EXISTING CONDITIONS SUMMARY (30 TAC §330.61(a))

The existing site conditions are generally depicted on Drawing I/II-2 – General Topographic Map. The proposed landfill will be located on a 502.5-acre property (referred to herein as "the Site") that is located approximately 0.4 mile south of the intersection of State Highway 31 and FM 939 (see Drawing I/II-1). The Site, which is located in both McLennan and Limestone Counties, is currently comprised of rural native pasture land. The Site is relatively flat, and slopes gently to the center of the site towards Horse Creek. Surface water generally drains southeast from the western portion of the Site towards Horse Creek and generally drains south/southwest from the eastern portion of the Site towards Horse Creek and Packwood Creek. These creeks are tributaries of Soil Conservation Services Site 19 Reservoir, which discharges into Williams Creek located south of the Site and eventually flows into Tehuacana Creek about 11 miles southwest of the Site.

A portion of the Site is located in the 100-year floodplain, as described in Section 11.1. The waste disposal footprint is located entirely outside the limits of the 100-year floodplain (see Drawing I/II-5).

There are ~~four~~ three (~~4~~3) known easements on the Site, including a ~~fiber optic,~~ flowage, waterline, and electric line easement, as shown on the metes and bound survey in Section 14, Attachment 14A. The flowage easement is under the jurisdiction of the Tehuacana Creek Water Control and Improvement District Number One (1) of Leroy, Texas. No waste is proposed to be placed in the flowage easement. ~~The 10-foot fiber optic easement crosses the northern portion of the Site in northeast/southwest direction. No waste will be placed in the easement until either it is shown that the portion of the easement to receive waste has expired, or has been abandoned.~~ There is also a 20-foot electric line easement ~~on the west side of the property~~ and 15-foot waterline easement on the property on the west side of the property. No waste is proposed to be placed in either the electric line easement or the waterline easement. All easements and associated deed records are further identified on the metes and bound survey provided in Section 14, Attachment 14A.

5 LANDOWNERS' MAP AND LIST

In accordance with 30 TAC §330.59(c)(3)(B) and §305.45(a)(6)(D), the landowners' list presents the names and mailing addresses of the landowners of property within one-quarter (1/4) mile of the Site, as provided in Table 5-1. The numbering in the landowners list corresponds to the numbers on Drawing I/II-3, which depicts the locations of the landowners. The landowners' list and map are based on the McLennan, Limestone, and Hill County Appraisal Districts' property records, as of April 2018. Additionally, mineral interest owners shown in Table 5-2 were identified in the real property records for McLennan and Limestone Counties as provided by the Title company. Neither McLennan nor Limestone Counties identify mineral interests in their real property appraisal records.

Table 5-1 Landowners

1.	City of Waco 300 Austin Avenue Waco, TX 76702	7.	Te Kay Ranch*	13.	Confidential Owner – Prop ID 352815 4396 TK Pkwy Axtell, TX 76624 ~~Baugh Connally E~~ ~~4396 TK Pkwy~~ ~~Axtell, TX 76624~~
2.	City of Waco 300 Austin Avenue Waco, TX 76702	8.	Lee Mike Rex et al 3096 Happy Swaner Ln Axtell, TX 76624	14.	Rigby Steven William & Elisabeth Anne 4070 TK Pkwy Axtell, TX 76624 ~~Griffin Kids Collectables~~ ~~201 N 38th St~~ ~~Waco, TX 76710~~
3.	Dunlap Billie J 536 St Hwy 31 Mt. Calm, TX 76673	9.	Swaner Fred Lee Jr 4351 TK Pkwy Axtell, TX 76624	15.	Reed David L 3444 TK Pkwy Axtell, TX 76624
4.	Dunlap Joe W & Cynthia 211 State Hwy 31 Mt. Calm, TX 76673	10.	JWL Interests LLC - Series Ranch 1 3132 Lovers Lane Dallas, TX 75225 ~~Swaner Troy Don~~ ~~3132 Lovers Ln~~ ~~Dallas, TX 75225~~	16.	Jameson Mary Jo Grubbs Trustee et al 1910 Channing Park Dr Arlington TX 76013
5.	Trayler James F 796 LCR 114 Waco, TX 76705	11.	City of Waco 300 Austin Avenue Waco, TX 76702	17.	Coggin Mary Ruth 532 LCR 112 Axtell, TX 76624
6.	Unknown Right-of-Way Ownership*	12.	Powser Victoria & Cody 4418 TK Pkwy Axtell, TX 76624 ~~Foster Jayme L~~		

			~~4418 TK Pkwy~~ ~~Axtell, TX 76624~~		

*No information available per Kevin Fikes at the McLennan County Appraisal District

Table 5-2 Mineral Interest Owners

Joe Thompson*	St. Louis Southwestern Railway Company*	Jim B. Horn Rt. 1, Box 60 Axtell, TX 76624
Tant Horn 609 Norma Waco, TX 76705	Union Pacific Railroad Company*	Ridley and Locklin*
Sun Oil Company*	Paul Barenkamp 8233 Purdue Tyler, TX 75701	St. Louis Southwestern Railway Company*

*No address available in lease summaries.

8 TRANSPORTATION (30 TAC §330.61(i))

8.1 TRAFFIC INFORMATION

The proposed landfill will be located on FM 939, also known as T K Parkway. The primary access route to the landfill will be via State Highway (SH) 31 and FM 939. Currently, FM 939 is a two-lane asphalt-paved road. SH 31 is a concrete-paved four-lane divided highway that connects the City of Waco to FM 939. The landfill entrance will be located approximately 0.4 mile south of the intersection of SH 31 and FM 939. ~~These existing roadways provide adequate access to the proposed landfill.~~ The proposed access roads for the landfill within a one-mile radius are depicted on Drawing I/II-1 – Site Location Map. Confirmation of coordination with the Texas Department of Transportation (TxDOT), Waco District, is included in Appendix I/IIA.

According to the 2016 Waco District Traffic Map, the traffic counts on FM 939 adjacent to the proposed landfill entrance were 607 vehicles per day. Additionally, according to the same traffic map, traffic counts for SH 31 were 6,063 vehicles per day near the intersection of FM 939 and SH 31, approximately 0.4 mile north of the proposed landfill entrance. The 2016 Waco District Traffic Map is provided in Appendix I/IID-1.

A Traffic Impact Analysis (TIA) for the proposed site has been prepared by Lee Engineering, and is provided in Appendix I/IID-2. Based on the TIA, ~~T~~the maximum initial increase in vehicle traffic on FM 939 and SH 31 associated with the landfill is estimated to be ~~conservatively 450~~442 vehicles per day (884 vehicle trips per day, including employee vehicle trips)~~, based on the initial waste acceptance rate described in Section 2.2.1~~. Assuming that the waste inflow volume will continue to increase in accordance with growth trends in McLennan County (i.e., 1.25% as provided in Appendix I/IIC), the total vehicle traffic on FM 939 and SH 31 associated with the landfill is estimated to increase to ~~680~~ 679 vehicles per day (1,358 vehicle trips per day, including employee vehicle trips) over the life of the landfill. This may include transfer trucks, collection trucks and small vehicles, as well as landfill employee vehicles. This estimated increase in traffic is dependent on the method of waste transport (i.e., direct haul vs. use of transfer trailers), the use of the landfill by small vehicles, as well as market dynamics of the waste collection and hauling business. The following information is concluded or stated in the TIA:

- Adequate capacity for the surrounding roadways will be available to serve the additional traffic generated by the future operations of the proposed MSW facility along with assumed background growth.
- Area intersections are anticipated to operate at acceptable levels of service for predicted background and total traffic operations in 2024 through 2059.

Although the following improvements are not necessary for the surrounding roadways and intersections to serve the traffic to be generated by the landfill, to improve traffic safety, the City of Waco is funding the following improvements to FM 939, to be constructed by TxDOT in conjunction with the construction of an overpass at the intersection of SH 31 and FM 939, with an anticipated completion date of April, 2022, as stated in the March 25, 2020 letter from TxDOT (see Appendix I/IIA); prior to the anticipated opening of the landfill in 2024:

- A structural overlay on FM 939 between SH 31 and the landfill entrance;
- Adding eight-foot shoulders on both sides of FM 939 between SH 31 and the landfill entrance;
- Adding a southbound left-turn lane for vehicles entering the facility entrance; and
- Adding a northbound right-turn lane for vehicles entering the facility entrance.

The City is not planning to construct a westbound acceleration lane and yellow/red flashing beacons and intersection illumination on SH 31 (as discussed in the TIA) because they are not needed, and even if installed, would be removed when TxDOT constructs the overpass discussed above. Coordination with TxDOT, Waco District, related to review and approval of the TIA, dated March 25, 2020, is included in Appendix I/IIA.

~~Based on available information, the existing access roadways are considered to be adequate to handle the estimated increased traffic volumes associated with the proposed landfill. Nevertheless, to provide for enhanced efficiency of vehicle movement, the City is planning to improve the section of FM 939 between SH 31 and the landfill entrance. These proposed improvements include the following:~~

- ~~a structural overlay on the two-lane road;~~
- ~~adding eight-foot shoulders on both sides of the road; and~~
- ~~adding a turning lane for the southbound vehicles entering the landfill.~~

8.2 AIRPORTS (30 TAC §330.619(C)(8) & §330.545)

There are no airports as defined by 30 TAC § 330.3(5) located within a six mile radius of the landfill, as depicted on Drawing I/II-1. Coordination with the FAA is included in Appendix I/IIA. Based on the FAA's response to this coordination, the FAA has no objection to the proposed Type I landfill (see Appendix I/IIA).

9 GENERAL GEOLOGY AND SOILS STATEMENT (30 TAC §330.61(i))

9.1 REGIONAL GEOLOGIC SETTING

The Site is located in the Blackland Prairie subdivision of the Coastal Plain physiographic province. Soils derived from the underlying formation generally are low hydraulic conductivity geologic formations and are typically dark, clay-rich, and drain slowly.

The Site is primarily situated on the outcrop of the Wolfe City Formation, a Cretaceous age calcareous clay/marl/sand/shale. The Wolfe City Formation is described by the *Geologic Atlas of Texas, Waco Sheet* (1970) as:

> *Marl, sand, sandstone, and clay; marl, sandy, silty, dark gray to light gray and brown, interbedded with, thin sandstone lenses cemented by sparry fine to coarse grained calcite, grain size increases northward; uncemented sand increases northward; clay; glauconitic, phosphate and hematite nodules, dark gray to brown; thickness up to 300 feet, feathers out near southern edge of sheet.*

9.2 SITE GEOLOGY

Site geologic conditions encountered in field investigations were consistent with the Wolfe City Formation descriptions in relevant literature. Site geology is characterized by three ~~layers~~ units as follows, from the ground surface downward to a maximum drilled depth of 150~~100~~ feet.

- Unit~~Layer~~ 1: Overlying soil horizon, light brown to dark brown, soft, clay.
- Unit~~Layer~~ 2: Hard, brown to mottled grey, high plasticity, calcareous, fossil-bearing clay, with minor amounts of dark gray to brown, very fine-grained sand. The contact with the underlying unweathered shale (see below) is marked by a clear color change from lighter colors in Unit 2 ~~dark gray and brown~~ to dark gray and black in Unit 3.
- Unit~~Layer~~ 3: Hard, ~~fissile,~~ unweathered, dark gray to black, fossil bearing shale with small 1/8" to 1/2" lenses of sand and limestone (to bottom of borings).

Based on available information, including field investigation of the Site, the geology of the Site is considered suitable for landfill development.

9.3 ON-SITE SOILS

The Site is located in Limestone and McLennan counties and is composed of 11 soil types. The majority of the Site consists of Wilson clay loam, which consists of very deep, moderately well drained, very slowly permeable soils found on stream terraces and Axtell fine sandy loam, which consists of very deep, moderately well drained, very slowly permeable soils found on broad river terraces. Following are detailed results from the two County soil reports:

9.6 UNSTABLE AREAS

The location restriction criteria in 30 TAC §330.559 require engineering measures to be incorporated into the design of a disposal unit located in an unstable area to ensure that the integrity of the structural components of the disposal unit will not be disrupted. Unstable areas, by definition, are areas susceptible to natural or human-induced events or forces that are capable of impairing the integrity of some or all structural components (i.e., liners, leachate collection systems, final covers, etc.) of a disposal unit. Unstable areas can include poor foundation conditions, areas susceptible to mass movement, salt domes, or karst terrain.

Based on information from existing geological and geotechnical data (reference: Bureau of Economic Geology, University of Texas at Austin), unstable areas due to poor foundation conditions, areas susceptible to mass movement, salt domes, or karst terrain do not exist at, or immediately adjacent to the Site. Therefore, additional engineering measures for unstable areas do not need to be incorporated into the design of the landfill. This determination was made based on (1) none of the geological or geotechnical literature reviewed stated that the Wolfe City formation creates unstable areas, and (2) field observations made by experienced, certified professionals did not indicate the existence of unstable areas within the Site. Further information and documentation related to unstable areas ~~will be~~is provided in Part III of the application~~ that further substantiates this determination~~.

and eventually flows into Tehuacana Creek approximately 11 miles southwest of the property. Tehuacana Creek discharges into the Brazos River approximately 15 miles southwest of the property.

Liquids resulting from the operation of the landfill will be disposed of in a manner that will not cause adverse impacts to surface water. The landfill is being designed to prevent discharge of pollutants into waters of the State or waters of the United States, as defined by the Texas Water Code and the Federal Clean Water Act, §402, as amended, respectively. Consistent with TCEQ requirements, a Notice of Intent (NOI) will be submitted to the TCEQ and a Stormwater Pollution Prevention Plan will be developed prior to the commencement of landfill operations to obtain coverage under the Texas Pollutant Discharge Elimination System (TPDES) General Permit, TXR050000 for Stormwater Discharges associated with Industrial Activity. In addition, an NOI will be submitted to the TCEQ and a Stormwater Pollution Prevention Plan will be developed prior to construction to obtain coverage under the TPDES General Permit, TXR150000 for Stormwater Discharges Associated with Construction Activity.

The City will obtain appropriate approvals or permits that may be required by local agencies for connection to a sanitary sewer or installation of an on-site domestic wastewater management system.

For these reasons, the use of the site as a landfill is a compatible land-use with the Soil Conservation Services Site 19 Reservoir.

11 FLOODPLAIN AND WETLANDS STATEMENT (30 TAC §330.61(m))

11.1 FLOODPLAIN STATEMENT

A small portion of the Site is within the 100-year floodplain of Horse and Packwood Creeks as defined by FEMA. The floodplain limits were obtained from the current effective Flood Insurance Rate Maps (Panels 48309C0250~~C~~D and 48293C0125C) obtained from FEMA for portions of McLennan and Limestone County. The floodplain limits have been established as Zone A which indicates that no flood elevations have yet been determined along these creeks on the Site. The 100-year floodplain is shown on Drawings I/II-2, I/II-4, and I/II-5.

The proposed waste disposal footprint is located entirely outside the limits of the 100-year floodplain as defined by FEMA. In accordance with 30 TAC §330.547(a), no solid waste disposal operations will take place within the 100-year floodplain, and therefore no development is proposed in the 100-year floodplain. As such, no levee or other flood protection improvement is proposed. Additionally, in accordance with 30 TAC §330.547(b), site operations and development will not restrict the flow or reduce the temporary storage capacity of the 100-year floodplain; nor will the site operations result in washout of solid waste associated with the 100-year floodplain. Furthermore, in accordance with 30 TAC §330.547(c), all storage and processing facilities (e.g., onsite citizen's convenience center) will be located outside of the 100-year floodplain.

Additionally, the site will not require any levees or other improvements, including channel improvements, drainage works, or other projects on, along, or near any stream in the state that is subject to floods, freshets, or overflows, constructed so as to control, regulate, or otherwise change the floodwater of the stream. No portions of the landfill are located within a 100-year floodway. Therefore, the requirements of 30 TAC Chapter 301, Subchapter C, §301.31 to 301.46 relating to the Approval of Levees and Other Improvements, as referenced in 30 TAC §330.61(m)(1) and §330.63(c)(2)(D)(i), are not applicable.

Furthermore, as discussed in Part III, Attachment 6B, a site specific study of the 24-hour, 100-year storm event was performed. The proposed waste disposal footprint is completely outside of the area shown to be impacted by the 24-hour, 100-year storm event. Further, no waste processing is proposed in the area shown to be impacted by the 24-hour, 100-year storm event.

11.2 WETLANDS STATEMENT

See Appendix I/IIA for the coordination letter with the U.S. Army Corps of Engineers, and Section 404 Jurisdiction Determination report by C. Lee Sherrod of Horizon Environmental Services in Appendix I/IIE, which addresses the pertinent TCEQ regulations (30 §TAC 330.61(m)(2)) regarding wetlands. As noted in the coordination letter in Appendix I/IIA, "No wetlands will be impacted by the proposed landfill activity." Additionally, as noted in the jurisdiction determination report (see Appendix I/IIE), no wetlands exist within the two proposed disposal areas.

12 PROTECTION OF ENDANGERED OR THREATENED SPECIES (30 TAC §330.61(n))

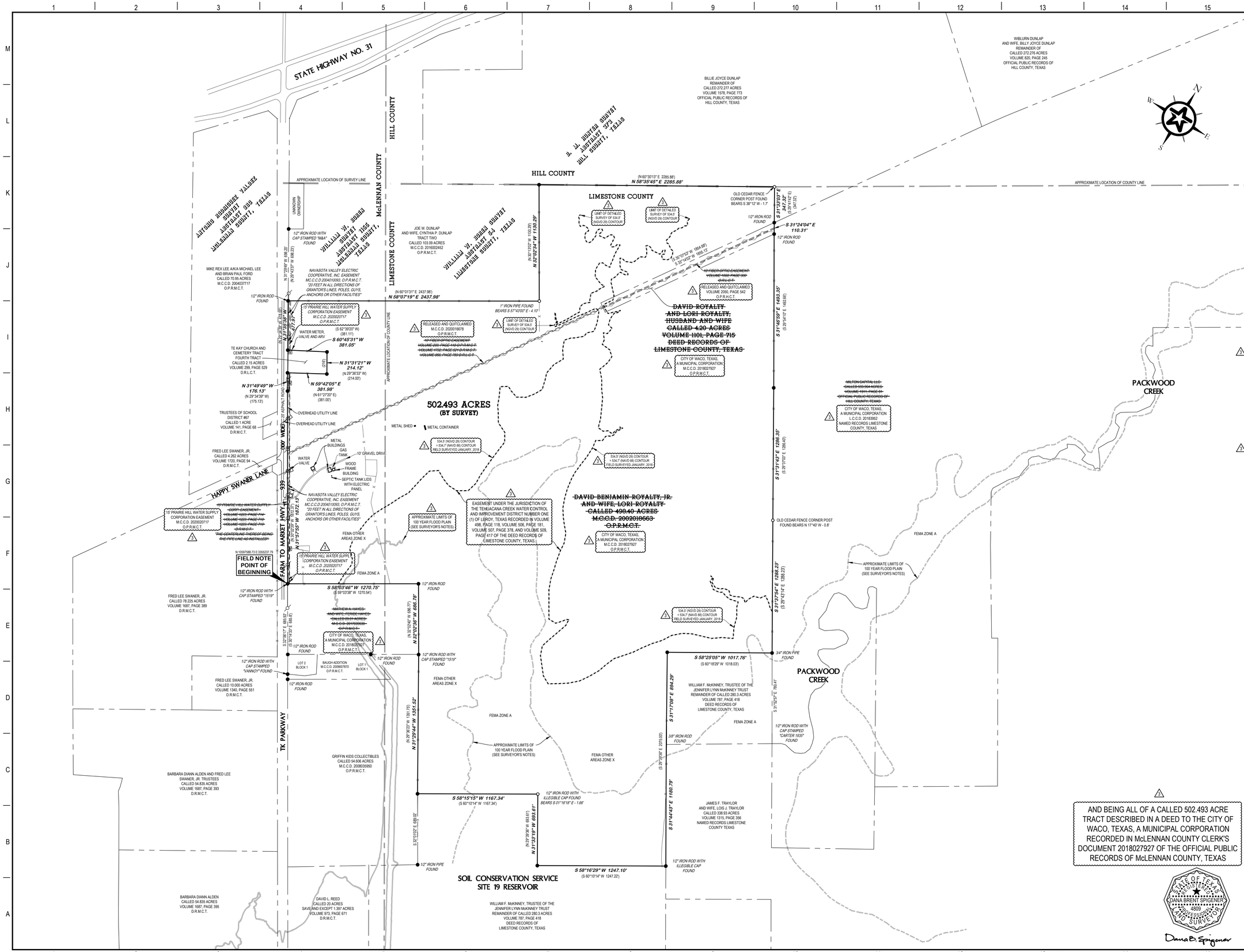
See coordination letters to the US Fish and the Texas Parks and Wildlife Department (with attachments) from C. Lee Sherrod of Horizon Environmental Services in Appendix I/IIA. These letters address the TCEQ regulations listed above, noting, "The site is not in an area designated as critical habitat for any listed threatened or endangered species, nor does the site provide suitable habitat for any federally-listed species." Based on the response from Texas Parks and Wildlife Department (see Appendix I/IIA), the "Wildlife Habitat Assessment Program does not anticipate significant adverse impacts to rare, threatened, or endangered species, or other fish and wildlife resources."

In addition, a Biological Assessment Report performed by Horizon Environmental Services, Inc., dated February, 2020 is included in Appendix I/IIG. This report includes a Management Plan for endangered or threatened species.

In view of the above, consistent with 30 TAC §330.61(n), it is concluded that the development and operation of this landfill will not result in the destruction or adverse modification of the critical habitat of endangered or threatened species, or cause or contribute to the taking of threatened or endangered species or result in adverse impact to critical habitat of threatened or endangered species.

ATTACHMENT 14A

METES AND BOUNDS SURVEY AND LEGAL DESCRIPTION



LEGEND

D.R.M.C.T.	= DEED RECORDS McLENNAN COUNTY, TEXAS
M.C.C.D.	= McLENNAN COUNTY CLERK'S DOCUMENT
O.P.R.M.C.T.	= OFFICIAL PUBLIC RECORDS McLENNAN COUNTY, TEXAS
D.R.L.C.T.	= DEED RECORDS LIMESTONE COUNTY, TEXAS
O.R.L.C.T.	= OFFICIAL RECORDS LIMESTONE COUNTY, TEXAS
( )	= DEED CALLS
○	= 1/2" IRON ROD WITH CAP STAMPED "WALKER PARTNERS" SET
●	= 1/2" IRON ROD WITH CAP STAMPED "4748" FOUND UNLESS LABELED OTHERWISE
— X —	= BARBED WIRE FENCE
⋈	= WATER VALVE
Ⓦ	= WATER METER
—○—	= UTILITY POLE
⟵	= GUY WIRE
— E —	= OVERHEAD ELECTRIC LINE

SURVEYOR'S NOTES

SURVEY DATE: JANUARY & FEBRUARY, 2018

RELEASE DATE: JULY 18, 2018

FIELD NOTES ATTACHED HERETO, MADE A PART HEREOF AND TITLED: 502.493 ACRES LOCATED IN THE WILLIAM W. BOREN SURVEY, ABSTRACT 1155 IN McLENNAN COUNTY, TEXAS AND THE WILLIAM W. BOREN SURVEY, ABSTRACT 54 IN LIMESTONE COUNTY, TEXAS

THE SURVEYOR DID NOT ABSTRACT THE SUBJECT TRACT. THIS SURVEY WAS PERFORMED WITH THE BENEFIT OF A TITLE REPORT PROVIDED BY STEWART TITLE GUARANTY COMPANY, FILE NO. 20173029, WHICH BEARS AN EFFECTIVE DATE OF DECEMBER 14, 2017. THE EASEMENT INFORMATION SHOWN HEREON IS BASED ON THE EASEMENTS IDENTIFIED IN SCHEDULE "B".

A FLOWAGE EASEMENT EXISTS ON THE SUBJECT PROPERTY THAT IS UNDER THE JURISDICTION OF THE TEHUACANA CREEK WATER CONTROL AND IMPROVEMENT DISTRICT NUMBER ONE (1) OF LEROY, TEXAS RECORDED IN VOLUME 498, PAGE 118, VOLUME 506, PAGE 181, VOLUME 507, PAGE 378, AND VOLUME 509, PAGE 417 OF THE DEED RECORDS OF LIMESTONE COUNTY, TEXAS.

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) NOTE: BY GRAPHIC PLOTTING ONLY THIS PROPERTY IS IN FEMA **"SPECIAL FLOOD HAZARD AREAS" ZONE A** AND FEMA **"OTHER AREAS" ZONE X** AS SHOWN ON THE FLOOD INSURANCE RATE MAP, LIMESTONE COUNTY, TEXAS, COMMUNITY PANEL 480910 0001 A, WHICH BEARS AN EFFECTIVE DATE OF JUNE 1, 1987. THIS FLOOD STATEMENT DOES NOT IMPLY THAT THIS TRACT WILL OR WILL NOT FLOOD, NOR DOES IT CREATE ANY LIABILITY IN SUCH EVENT ON THE PART OF THIS SURVEYOR OR COMPANY.

3 FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) NOTE:
BY GRAPHIC PLOTTING ONLY THIS PROPERTY IS IN FEMA **"SPECIAL FLOOD HAZARD AREAS" ZONE A** AND FEMA **"OTHER AREAS" ZONE X** AS SHOWN ON THE FLOOD INSURANCE RATE MAP, **LIMESTONE COUNTY**, TEXAS, COMMUNITY PANEL 48293C0125C, WHICH BEARS AN EFFECTIVE DATE OF SEPTEMBER 16, 2011.
BY GRAPHIC PLOTTING ONLY THIS PROPERTY IS IN FEMA **"SPECIAL FLOOD HAZARD AREAS" ZONE A** AND FEMA **"OTHER AREAS" ZONE X** AS SHOWN ON THE FLOOD INSURANCE RATE MAP, **McLENNAN COUNTY**, TEXAS, COMMUNITY PANEL 48309C0250D, WHICH BEARS AN EFFECTIVE DATE OF DECEMBER 20, 2019.

EXPLANATION OF FEMA ZONES:

FEMA **"SPECIAL FLOOD HAZARD AREAS" ZONE A** = NO BASE FLOOD ELEVATIONS DETERMINED.

FEMA **"OTHER AREAS" ZONE X** = AREAS DETERMINED TO BE OUTSIDE OF THE 0.2% ANNUAL CHANCE FLOODPLAIN.

THE BEARINGS AND GRID COORDINATES SHOWN HEREON ARE BASED UPON THE TEXAS STATE PLANE COORDINATE SYSTEM, NAD 83, TEXAS CENTRAL ZONE.

3 **THE SPECIFIC PURPOSE OF THIS UPDATED BOUNDARY SURVEY MAP IS TO IDENTIFY CURRENT OWNERSHIPS, DEED REFERENCES AND EASEMENTS THAT HAVE OCCURRED SINCE THE ORIGINAL RELEASE DATE OF JULY 18, 2018, AND THE TEHUACANA CREEK WATER CONTROL AND IMPROVEMENT DISTRICT NUMBER ONE (1) OF LEROY, TEXAS EASEMENT. THIS UPDATED BOUNDARY SURVEY MAP DOES NOT REPRESENT A CURRENT UPDATE OF THE ON THE GROUND FIELD SURVEY PERFORMED JANUARY & FEBRUARY, 2018.**

0 200 400 800
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE
3	UPDATED EASEMENTS AND OWNERSHIP. ADDED McLENNAN AND HILL COUNTIES TEHUACANA CREEK WATER CONTROL AND IMPROVEMENT DISTRICT NUMBER ONE (1) OF LEROY, TEXAS EASEMENT	09-10-2020
2	REVISED TITLE COMMITMENT NOTE	12-18-2018
1	CHANGED TITLE TO "BOUNDARY SURVEY"	08-06-2018

Walker Partners
engineers ★ surveyors
823 Washington Avenue ◆Waco, Texas 76701
Phone: 1-254-714-1402 ◆ T.B.P.E. Registration No. 8053
T.B.P.L.S. Registration No. 10032500

BOUNDARY SURVEY
502.493 ACRE TRACT

LOCATED IN THE WILLIAM W. BOREN SURVEY, ABSTRACT 1155 IN McLENNAN COUNTY, TEXAS AND THE WILLIAM W. BOREN SURVEY, ABSTRACT 54 IN LIMESTONE COUNTY, TEXAS, ~~AND BEING ALL OF A CALLED 498.40 ACRE TRACT DESCRIBED IN A DEED TO DAVID BENJAMIN ROYALTY, JR. AND WIFE, LORI ROYALTY RECORDED IN McLENNAN COUNTY CLERK'S DOCUMENT 2002018663 OF THE OFFICIAL PUBLIC RECORDS OF McLENNAN COUNTY, TEXAS, AND ALL OF A CALLED 4.20 ACRE TRACT DESCRIBED IN A DEED TO DAVID ROYALTY AND LORI ROYALTY RECORDED IN VOLUME 1101, PAGE 715 OF THE DEED RECORDS OF LIMESTONE COUNTY, TEXAS~~

3 AND BEING ALL OF A CALLED 502.493 ACRE TRACT DESCRIBED IN A DEED TO THE CITY OF WACO, TEXAS, A MUNICIPAL CORPORATION RECORDED IN McLENNAN COUNTY CLERK'S DOCUMENT 2018027927 OF THE OFFICIAL PUBLIC RECORDS OF McLENNAN COUNTY, TEXAS

STATE OF TEXAS
REGISTERED
DANA BRENT SPIGENER
4805
PROFESSIONAL
LAND SURVEYOR

Dana B. Spigener

PLAT NUMBER	D1-0508
PROJECT NUMBER	1-03063
DRAWN BY/CHECKED BY	DBS/KRH
FIELD NOTE NO.	FN-01
DRAWING NAME	1-03063BOUNDARY SURVEY 2020MARKUP 2.DWG
DRAFT DATE	07/11/2018
SHEET NUMBER	1 OF 1

Walker Partners
engineers ★ surveyors

823 Washington Ave.
Waco, Texas 76701

502.493 ACRES
LOCATED IN THE WILLIAM W. BOREN SURVEY, ABSTRACT 1155 IN McLENNAN COUNTY, TEXAS AND THE WILLIAM W. BOREN SURVEY, ABSTRACT 54 IN LIMESTONE COUNTY, TEXAS

FIELD NOTES FOR A 502.493 ACRE TRACT OF LAND LOCATED IN THE WILLIAM W. BOREN SURVEY, ABSTRACT 1155 IN McLENNAN COUNTY, TEXAS AND THE WILLIAM W. BOREN SURVEY, ABSTRACT 54 IN LIMESTONE COUNTY, TEXAS, AND BEING ALL OF A CALLED 502.493~~498.40~~ ACRE TRACT DESCRIBED IN A DEED TO THE CITY OF WACO, TEXAS, A MUNICIPAL CORPORATION~~DAVID BENJAMIN ROYALTY, JR. AND WIFE, LORI ROYALTY~~ RECORDED IN McLENNAN COUNTY CLERK'S DOCUMENT (M.C.C.D.) 2018027927~~2002018663~~ OF THE OFFICIAL PUBLIC RECORDS OF McLENNAN COUNTY, TEXAS (O.P.R.M.C.T~~.), AND ALL OF A CALLED 100 FEET WIDE (4.20 ACRE) TRACT DESCRIBED IN A DEED TO DAVID ROYALTY AND LORI ROYALTY, HUSBAND AND WIFE, RECORDED IN VOLUME 1101, PAGE 715 OF THE DEED RECORDS OF LIMESTONE COUNTY, TEXAS (D.R.L.C.T~~.). SAID 502.493 ACRE TRACT BEING MORE PARTICULARLY SHOWN ON THE ATTACHED BOUNDARY SURVEY DRAWING AND FURTHER DESCRIBED BY METES AND BOUNDS AS FOLLOWS:

BEGINNING AT A 1/2" IRON ROD WITH A CAP STAMPED "1519" FOUND IN THE EAST RIGHT-OF-WAY LINE OF FARM TO MARKET HIGHWAY 939, ALSO KNOWN AS TK PARKWAY (100' WIDE) MARKING THE NORTHWEST CORNER OF A CALLED 20.01 ACRE TRACT DESCRIBED IN A DEED TO THE CITY OF WACO, TEXAS,~~MATTHEW~~ A MUNICIPAL CORPORATION~~, HAYES AND WIFE, FERIDE HAYES~~ RECORDED IN M.C.C.D. 2018043939~~2017039630~~ OF THE O.P.R.M.C.T., SAME BEING AN OUTSIDE ELL CORNER OF SAID 502.493~~498.40~~ ACRE TRACT AND OF THE HEREIN DESCRIBED TRACT, FROM WHICH A 1/2" IRON ROD FOUND IN THE EAST RIGHT-OF-WAY LINE OF SAID FARM TO MARKET HIGHWAY 939 MARKING THE SOUTHWEST CORNER OF SAID 20.01 ACRE TRACT BEARS S 32°06'17" E – 685.92';

THENCE N 31°57'55" W – 1872.13' WITH THE COMMON LINE OF SAID 502.493~~498.40~~ ACRE TRACT AND SAID FARM TO MARKET HIGHWAY 939 TO A 1/2" IRON ROD WITH A CAP STAMPED "4748" FOUND MARKING AN ANGLE POINT OF THE WEST LINE OF THE 502.493~~498.40~~ ACRE TRACT AND OF THE HEREIN DESCRIBED TRACT;

THENCE N 31°49'49" W – 176.13' WITH THE COMMON LINE OF SAID 502.493~~498.40~~ ACRE TRACT AND SAID FARM TO MARKET HIGHWAY 939 TO A 1/2" IRON ROD WITH A CAP STAMPED "4748" FOUND MARKING THE SOUTHWEST CORNER OF THE TE KAY CHURCH AND CEMETERY TRACT (NO DEED FOUND OF RECORD BY THIS SURVEYOR) FOR AN OUTSIDE ELL CORNER OF THE HEREIN DESCRIBED TRACT;

THENCE WITH THE COMMON LINE OF SAID 502.493~~498.40~~ ACRE TRACT AND SAID TE KAY CHURCH AND CEMETERY TRACT THE FOLLOWING THREE CALLS:

1) **N 59°42'05" E – 381.98'** TO A 1/2" IRON ROD WITH A CAP STAMPED "4748" FOUND MARKING THE SOUTHEAST CORNER OF THE TE KAY CHURCH AND CEMETERY TRACT FOR AN INSIDE ELL CORNER OF THE HEREIN DESCRIBED TRACT,
2) **N 31°31'21" W – 214.12'** TO A 1/2" IRON ROD WITH A CAP STAMPED "4748" FOUND MARKING THE NORTHEAST CORNER OF THE TE KAY CHURCH AND CEMETERY TRACT FOR AN INSIDE ELL CORNER OF THE HEREIN DESCRIBED TRACT,
3) **S 60°45'31" W – 381.05'** TO A 1/2" IRON ROD WITH A CAP STAMPED "4748" FOUND IN THE EAST RIGHT-OF-WAY LINE OF SAID FARM TO MARKET HIGHWAY 939 MARKING THE NORTHWEST CORNER OF THE TE KAY CHURCH AND CEMETERY TRACT FOR AN OUTSIDE ELL CORNER OF THE HEREIN DESCRIBED TRACT;

THENCE N 31°35'38" W – 477.97' WITH THE COMMON LINE OF SAID 502.493~~498.40~~ ACRE TRACT AND SAID FARM TO MARKET HIGHWAY 939 TO A 1/2" IRON ROD FOUND MARKING THE SOUTHWEST CORNER OF A CALLED 103.09 ACRE TRACT DESCRIBED AS TRACT TWO IN A DEED TO JOE W. DUNLAP AND WIFE, CYNTHIA P. DUNLAP RECORDED IN M.C.C.D. 2016002452 OF THE O.P.R.M.C.T., FROM WHICH A 1/2" IRON ROD WITH A CAP STAMPED "M&A" FOUND IN THE EAST RIGHT-OF-WAY LINE OF FARM TO MARKET HIGHWAY 939 MARKING AN OUTSIDE ELL CORNER OF SAID 103.09 ACRE TRACT BEARS N 31°29'49" W – 698.20';

THENCE WITH THE COMMON LINE OF SAID 502.493~~498.40~~ ACRE TRACT AND SAID 103.09 ACRE TRACT THE FOLLOWING TWO CALLS:

1) **N 58°07'19" E – 2437.98'** TO A 1/2" IRON ROD WITH A CAP STAMPED "WALKER PARTNERS" SET FOR THE SOUTHEAST CORNER OF THE 103.09 ACRE TRACT AND AN INSIDE ELL CORNER OF THE HEREIN DESCRIBED TRACT, FROM WHICH A 1" IRON PIPE FOUND BEARS S 57°43'00" E – 4.10',
2) **N 32°02'34" W – 1130.29'** TO A 1/2" IRON ROD WITH A CAP STAMPED "4748" FOUND IN THE SOUTH LINE OF THE REMAINDER OF A CALLED 272.277 ACRE TRACT DESCRIBED IN A DEED TO BILLIE JOYCE DUNLAP RECORDED IN VOLUME 1578, PAGE 773 OF THE OFFICIAL PUBLIC RECORDS OF HILL COUNTY, TEXAS ~~(O.P.R.H.C.T.)~~ MARKING AN OUTSIDE ELL CORNER OF THE 103.09 ACRE TRACT AND AN OUTSIDE ELL CORNER OF THE 502.493~~498.40~~ ACRE TRACT AND OF THE HEREIN DESCRIBED TRACT;

THENCE N 58°35'45" E – 2285.88' WITH THE COMMON LINE OF SAID 502.493~~498.40~~ ACRE TRACT AND THE REMAINDER OF SAID 272.277 ACRE TRACT TO A 1/2" IRON ROD WITH A CAP STAMPED "WALKER PARTNERS" SET MARKING AN INSIDE ELL CORNER OF THE 272.277 ACRE TRACT, SAME BEING THE NORTHEAST CORNER OF THE 502.493~~498.40~~ ACRE TRACT AND OF THE HEREIN DESCRIBED TRACT;

THENCE S 31°33'03" E – 347.32' TO A 1/2" IRON ROD FOUND MARKING A SOUTH CORNER OF THE REMAINDER OF THE 272.277 ACRE TRACT, SAME BEING THE MOST WESTERLY NORTHWEST CORNER OF A CALLED 771.148~~593.964~~ ACRE TRACT DESCRIBED IN A DEED TO THE CITY OF WACO, TEXAS, A MUNICIPAL CORPORATION~~MILTON CAPITAL LLC~~ RECORDED IN LIMESTONE COUNTY CLERK'S DOCUMENT 20183952~~VOLUME 1911, PAGE 81 OF THE O.P.R.H.C.T., AND THE MOST NORTHERLY CORNER~~ OF THE NAMED RECORDS~~SAID 4.20 ACRE TRACT AND AN OUTSIDE CORNER~~ OF LIMESTONE COUNTY, TEXAS~~THE 498.40 ACRE TRACT, FROM WHICH A 1/2" IRON ROD WITH A CAP STAMPED "4748" FOUND MARKING THE MOST WESTERLY CORNER OF THE 4.20 ACRE TRACT BEARS S 33°14'02" W – 1855.13'~~;

THENCE ~~S 31°24'04" E – 110.31'~~ WITH THE COMMON LINE OF SAID 502.493~~4.20~~ ACRE TRACT AND SAID 711.148~~593.964 ACRE TRACT TO A 1/2" IRON ROD FOUND MARKING THE MOST EASTERLY CORNER OF THE 4.20 ACRE TRACT AND AN OUTSIDE CORNER OF THE 498.40 ACRE TRACT;~~

~~**THENCE** WITH THE COMMON LINE OF SAID 498.40 ACRE TRACT AND SAID 593.964~~ ACRE TRACT THE FOLLOWING FOUR~~THREE~~ CALLS:

1) **S 31°24'04" E – 110.31'** TO A 1/2" IRON ROD FOUND FOR AN ANGLE POINT,
2) **S 31°46'59" E – 1493.35'** TO A 1/2" IRON ROD WITH A CAP STAMPED "4748" FOUND FOR AN ANGLE POINT,
3) **S 31°31'43" E – 1286.35'** TO A 1/2" IRON ROD WITH A CAP STAMPED "WALKER PARTNERS" SET FOR AN ANGLE POINT,
4) **S 31°37'54" E – 1288.23'** TO A 3/4" IRON PIPE FOUND MARKING A NORTHEAST CORNER OF A REMAINDER OF A CALLED 280.3 ACRE TRACT DESCRIBED IN A DEED TO WILLIAM F. McKINNEY, TRUSTEE OF THE JENNIFER LYNN McKINNEY TRUST RECORDED IN VOLUME 787, PAGE 418 OF THE DEED RECORDS OF LIMESTONE COUNTY, TEXAS (D.R.L.C.T.), SAME BEING AN OUTSIDE ELL CORNER OF SAID 502.493~~498.40~~ ACRE TRACT AND OF THE HEREIN DESCRIBED TRACT, FROM WHICH A 1/2" IRON ROD WITH A CAP STAMPED "CARTER 1935" FOUND FOR REFERENCE IN THE COMMON LINE OF SAID 771.148~~593.964~~ ACRE TRACT AND THE REMAINDER OF SAID 280.3 ACRE TRACT BEARS S 31°52'57" E – 780.41';

THENCE S 58°25'05" W – 1017.76' TO A 1/2" IRON ROD WITH A CAP STAMPED "4748" FOUND MARKING A NORTHWEST CORNER OF THE REMAINDER OF SAID 280.3 ACRE TRACT, SAME BEING AN INSIDE ELL CORNER OF SAID 502.493~~498.40~~ ACRE TRACT AND OF THE HEREIN DESCRIBED TRACT;

THENCE S 31°17'08" E – 894.29' TO A 3/8" IRON ROD FOUND MARKING A SOUTHWEST CORNER OF THE REMAINDER OF SAID 280.3 ACRE TRACT, SAME BEING THE NORTHWEST CORNER OF A CALLED 338.93 ACRE TRACT DESCRIBED IN A DEED TO JAMES F. TRAYLOR AND WIFE, LOIS J. TRAYLOR RECORDED IN VOLUME 1315, PAGE 356 OF THE NAMED RECORDS OF LIMESTONE COUNTY, TEXAS;

THENCE S 31°44'43" E – 1180.79' WITH THE COMMON LINE OF SAID 502.493~~498.40~~ ACRE TRACT AND SAID 338.93 ACRE TRACT TO A 1/2" IRON ROD WITH AN ILLEGIBLE CAP FOUND MARKING THE SOUTHEAST CORNER OF THE 502.493~~498.40~~ ACRE TRACT AND OF THE HEREIN DESCRIBED TRACT AT A NORTHEAST CORNER OF ANOTHER REMAINDER OF SAID 280.3 ACRE TRACT;

THENCE WITH THE COMMON LINE OF SAID 502.493~~498.40~~ ACRE TRACT AND SAID 280.3 ACRE TRACT THE FOLLOWING THREE CALLS:

1) **S 58°16'29" W – 1247.10'** TO A 1/2" IRON ROD WITH A CAP STAMPED "4748" FOUND MARKING AN OUTSIDE ELL CORNER OF THE 502.493~~498.40~~ ACRE TRACT AND OF THE HEREIN DESCRIBED TRACT,
2) **N 31°33'19" W – 693.61'** TO A 1/2" IRON ROD WITH A CAP STAMPED "WALKER PARTNERS" SET FOR AN INSIDE ELL CORNER OF THE 502.493~~498.40~~ ACRE TRACT AND OF THE HEREIN DESCRIBED TRACT, FROM WHICH A 1/2" IRON ROD WITH AN ILLEGIBLE CAP FOUND BEARS S 01°16'18" E – 1.66',
~~3)~~ **S 58°15'15" W – 1167.34'** TO A 1/2" IRON ROD WITH A CAP STAMPED "4748" FOUND IN THE EAST LINE OF A CALLED 34.483~~54.606~~ ACRE TRACT DESCRIBED IN A DEED TO STEVEN WILLIAM RIGBY AND WIFE, ELISABETH ANNE RIGBY~~GRIFFIN KIDS COLLECTIBLES~~ RECORDED IN M.C.C.D. 201801795920~~08035950~~ OF THE O.P.R.M.C.T. AT AN OUTSIDE ELL CORNER OF THE REMAINDER OF THE 280.3 ACRE TRACT MARKING A SOUTHWEST CORNER OF THE 502.493~~498.40~~ ACRE TRACT AND OF THE HEREIN DESCRIBED TRACT, FROM WHICH A 1/2" IRON ROD FOUND MARKING THE SOUTHEAST CORNER OF SAID 34.483~~54.606~~ ACRE TRACT AT AN INSIDE ELL CORNER OF THE REMAINDER OF THE 280.3 ACRE TRACT BEARS
~~4)~~3) S 32°01'02" E – 689.02';

THENCE N 31°29'44" W – 1351.52' TO A 1/2" IRON ROD WITH A CAP STAMPED "1519" FOUND MARKING THE NORTHEAST CORNER OF SAID 34.483~~54.606~~ ACRE TRACT, SAME BEING THE SOUTHEAST CORNER OF SAID 20.01 ACRE TRACT;

THENCE N 32°02'36" W – 686.78' TO A 1/2" IRON ROD FOUND MARKING THE NORTHEAST CORNER OF SAID 20.01 ACRE TRACT AT AN INSIDE ELL CORNER OF THE 502.493~~498.40~~ ACRE TRACT AND OF THE HEREIN DESCRIBED TRACT;

THENCE S 58°03'46" W – 1270.75' WITH THE COMMON LINE OF THE SAID 502.493~~498.40~~ ACRE TRACT AND SAID 20.01 ACRE TRACT RETURNING TO THE **POINT OF BEGINNING** AND CONTAINING 502.493 ACRES OF LAND. AS SURVEYED~~**THIS DESCRIPTION IS BASED ON THE ATTACHED BOUNDARY SURVEY DRAWING MADE**~~ BY DANA B. SPIGENER, REGISTERED PROFESSIONAL LAND SURVEYOR, NO. 4809, IN JANUARY AND FEBRUARY, 2018.BEARINGS CITED WITHIN THIS DESCRIPTION ARE BASED ON TEXAS STATE PLANE COORDINATE SYSTEM, NAD 83, TEXAS CENTRAL ZONE ACQUIRED FROM GLOBAL POSITIONING SYSTEM OBSERVATIONS.

THE SPECIFIC PURPOSE OF THIS REVISED FIELD NOTE DESCRIPTION OF AUGUST 19, 2020 IS TO IDENTIFY CURRENT OWNERSHIPS AND DEED REFERENCES THAT HAVE OCCURRED SINCE THE ORIGINAL RELEASE DATE OF APRIL 6, 2018. THIS REVISED FIELD NOTE DESCRIPTION DOES NOT REPRESENT A CURRENT UPDATE OF THE ON THE GROUND FIELD SURVEY PERFORMED JANUARY AND FEBRUARY, 2018.

SURVEYED: JANUARY & FEBRUARY, 2018
RELEASED: APRIL 16, 2018
REVISED: JULY 2, 2018
REVISED: AUGUST 19, 2020

Dana B. Spigener

DANA B. SPIGENER, R.P.L.S. 4809

STATE OF TEXAS
REGISTERED
DANA BRENT SPIGENER
4809
PROFESSIONAL
LAND SURVEYOR

PROJ NO. 1-03063.01
PLAT NO. D1-0509~~0049~~
FIELD NOTE NO. 13~~01~~
MAP CHECKED 04/13/2018 DBS

16 EVIDENCE OF COMPETENCY (30 TAC §330.59(f))

16.1 CITY OF WACO

The applicant, the City of Waco, currently owns and operates a Type 1 MSW Landfill, TCEQ Permit No. MSW-948A (Site 948A). The existing landfill (Site 948A) was initially permitted under MSW Permit No. 948 on July 22, 1977, and subsequently a permit amendment was approved for MSW Permit 948A on September 21, 1987. While Site 948A is the only landfill that the City has operated in the last 10 years, the City previously operated the following MSW landfills, which have been closed in accordance with TCEQ requirements:

- City of Waco Closed Type 1 MSW Landfill, Permit No. 1419 issued on September 3 1981, located on FM 3400 southeast of Waco; stopped accepting waste on June 17, 1986.
- City of Waco Closed Type 1 MSW Landfill, Permit No. 1039 issued on July 22, 1977, located on FM 3400 southeast of Waco; stopped receiving waste on June 24, 1983.

The competency of the City of Waco to operate the proposed landfill is evidenced by the City's operating history, over 20 years of operating Site 948A. The City of Waco has no financial interest in any solid waste facilities in any other states, territories, or countries.

16.2 THE CITY OF WACO KEY PERSONNEL

As with Site 948A, the proposed landfill will be administered within the City's Public Works Department. Key personnel include the following: Director of Public Works, Landfill Manager, and Environmental Programs Manager.

- Charles Dowdell, the Director of ~~Public Works~~Solid Waste Services for the City, has over 45 years of experience in managing and operating landfills, including nine years with the City of Waco. His pertinent experience includes the following:
    - Two years as landfill manager of Site 948A, responsible for managing landfill staff, equipment maintenance, day-to-day operation of the landfill, regulatory compliance, community relations, and related activities.
    - ~~Seven~~ Nine years as either the Director of ~~the~~ Solid Waste Services ~~Department~~, ~~and more recently as the~~ Director of Public Works or Special Projects. In ~~both~~these positions, he has had the responsibility for the management of the landfill, which includes overseeing the landfill manager, assuring adequate budgets for landfill staff, equipment, and third-party consultants and contractors, and ultimate regulatory compliance for the landfill. Currently, Mr. Dowdell is the Director of Solid Waste Services for the City.
    - Forty years as a consulting engineer, including the design, permitting, construction, monitoring, and operation of landfills. In addition, Mr. Dowdell has a TCEQ MSW Class "A" license, as well as licensed as a Professional Geoscientist.

- David Rydl, Landfill Manager for Site 948A, has over 20 years of experience in managing and operating landfills, including six years with the City of Waco. In the capacity of Landfill

Manager for Site 948A, he is responsible for managing landfill staff, equipment maintenance, day-to-day operation and construction of the landfill consistent with TCEQ requirements, community relations, and related activities. In addition to his experience with the City of Waco, he has over 13 years of similar landfill management experience with other municipal governments. In addition, he has a TCEQ MSW Class "A" license as well as the Manager of Landfill Operations (MOLO) license through the Solid Waste Association of North America (SWANA).

- Anna Dunbar, ~~Environmental Programs Manager~~Solid Waste Administrator for the City of Waco, ~~Public Works~~Solid Waste Services Department, has been working with the City for approximately ~~six~~ eight years. Her prior experience includes the following:
    - Served as TCEQ Waco Regional Office Regional Director for 10 years.
    - Served as the Waste Program Manager in TCEQ Waco Regional Office for one year.
    - Served as an environmental scientist with Nalco Chemical Company over the stormwater, wastewater, and RCRA programs for two years.
    - Served as an Enforcement Coordinator and Assistant Section Chief of Enforcement at the Texas Water Commission in Austin for four years

The City of Waco will ensure that a landfill manager is employed, and serves as the Solid Waste Facility Supervisor as defined in 30 TAC 30.207(2). The landfill manager will have the requisite managerial and technical qualifications to assure that the City's proposed MSW facilities comply with TCEQ requirements and is trained in the practical aspects of the design, operation, maintenance and supervision of a solid waste facility according to standards, rules or orders established by the TCEQ. These qualifications include the following:

- **Education and/or Experience** – A minimum of five years related experience and/or training, or equivalent combination of education and experience, including a MSW Facility Class A License as a municipal solid waste facility supervisor.
- **Language Skills** – Ability to read and interpret documents such as safety rules, operating and maintenance instructions, and procedure manuals. Ability to write routine reports and correspondence.
- **Mathematical Skills** - Ability to calculate figures and amounts such as area, volume, disposal fees (per TCEQ rules), discounts, interest, and percentages.
- **Problem Solving Skills -** Ability to solve practical problems and deal with a variety of situations where only limited standardization exists.

Additionally, other landfill personnel will include customer services representatives (including gate attendants), maintenance workers (load inspectors/spotters), equipment operators, and ~~general~~ temporary laborers, as described in Part IV – Site Operating Plan, Section 2.

16.3 EQUIPMENT TO BE DEDICATED TO THIS LANDFILL

Sufficient equipment will be provided to conduct site operations in accordance with the landfill design and permit conditions. As this landfill is intended to replace the Site 948A, which has a remaining operating life of less than six years, it is assumed that the equipment needs at that time

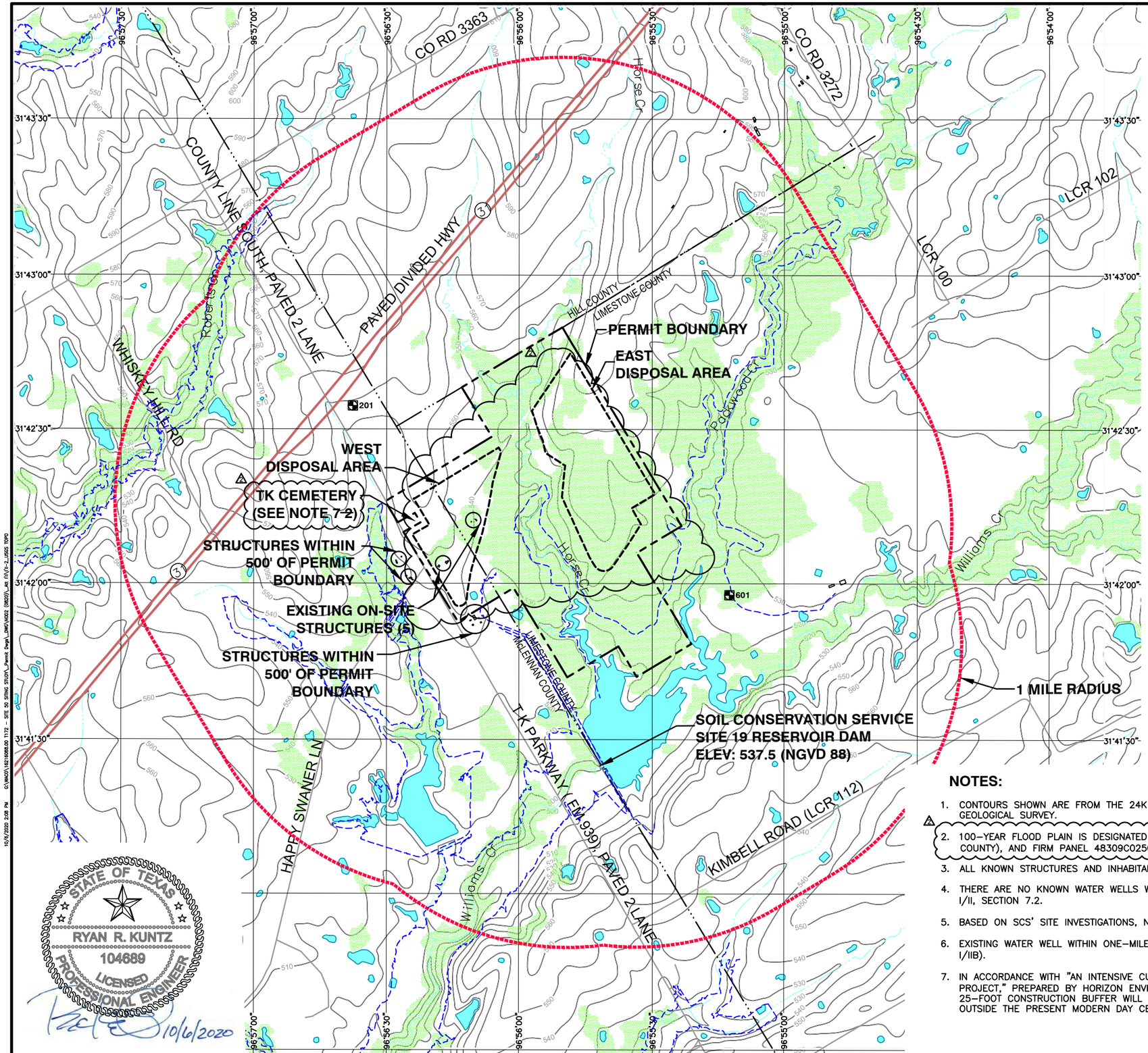
will be similar to those of Site 948A and will include the following minimum number and types of equipment:

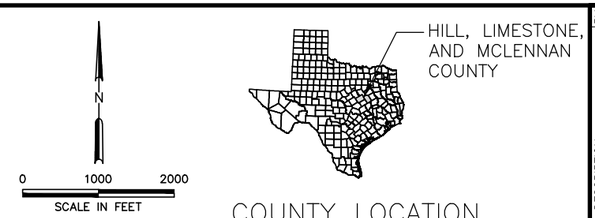
- 2 – Landfill Compactors (Caterpillar 826 or equivalent)
- 2 - Bulldozers (Caterpillar D8 or equivalent)
- 1 - Excavators
- 2 - Off-road dump trucks
- 1 - Motor grader
- 1 - Water truck (minimum 2,000 gallon capacity)

The equipment requirements for this landfill will be based on anticipated solid waste volume and field conditions consistent with 30 TAC §330.127. The Director of Public Works, with input from the Landfill Manager or his designee, will routinely assess the equipment needed to maintain compliance with the TCEQ regulations and make adjustments, as appropriate.

DRAWINGS

- Drawing I/II-1: Site Location Map
- Drawing I/II-2: General Topographic Map (includes Wind Rose)
- Drawing I/II-3: Landowner's Map
- Drawing I/II-4: Aerial Photograph (9 inch X 9 inch)
- Drawing I/II-5: Facility Layout Map
- Drawing I/II-6: Regional Tectonic/Geology Map
- Drawing I/II-7: Seismic Impact Map





COUNTY LOCATION

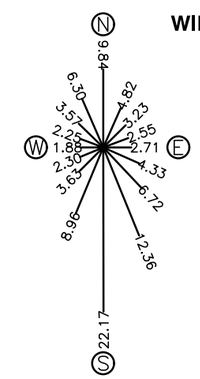
LEGEND

- PERMIT BOUNDARY
- 1 MILE RADIUS
- LIMITS OF WASTE
- COUNTY LINE
- 560 EXISTING CONTOURS (SEE NOTE 1)
- FLOOD PLAIN (SEE NOTE 2)
- 96°55'30" LATITUDE/LONGITUDE LINES
- 201 EXISTING WATER WELL (SEE NOTE 6)

ROAD CLASSIFICATION

Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

WIND ROSE



CALM 2.81%
WIND ROSE REPRESENTS AVERAGE PERCENT OF TIME WIND BLOWS FROM EACH OF THE 16 COMPASS POINTS SHOWN.

SOURCE:
TNRCC–EPA
STATION TX03927
AVERAGE VALUES
PERIOD ANALYZED: 1984–1992

NOTES:

1. CONTOURS SHOWN ARE FROM THE 24K QUAD MAP FOR AXTELL, TEXAS (2016) PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.
2. 100–YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
3. ALL KNOWN STRUCTURES AND INHABITABLE BUILDINGS WITHIN 500 FEET OF PERMIT BOUNDARY ARE SHOWN.
4. THERE ARE NO KNOWN WATER WELLS WITHIN 500 FT. OF THE PROPOSED PERMIT BOUNDARY IN ACCORDANCE WITH PARTS I/II, SECTION 7.2.
5. BASED ON SCS' SITE INVESTIGATIONS, NO SPRINGS WERE OBSERVED ON THE SITE.
6. EXISTING WATER WELL WITHIN ONE–MILE OF PERMIT BOUNDARY (SEE ATLAS ENVIRONMENTAL RESEARCH REPORT, APPENDIX I/IIB).
7. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25–FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	12/2018	REVISION FOR PART I/II NOD 1	RRK
2	10/2020	REVISED NOTE 2 AND WDA/EDA LIMIT OF WASTE BOUNDARIES	RRK

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: GENERAL TOPOGRAPHIC MAP

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
501 SHROEDER
WACO, TEXAS 76710

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1301 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16-216068.00 | DWN. BY: JLJ | Q/A RVW BY: KDY | DSN. BY: RRK | CHK. BY: KDY | APR. BY: RRK

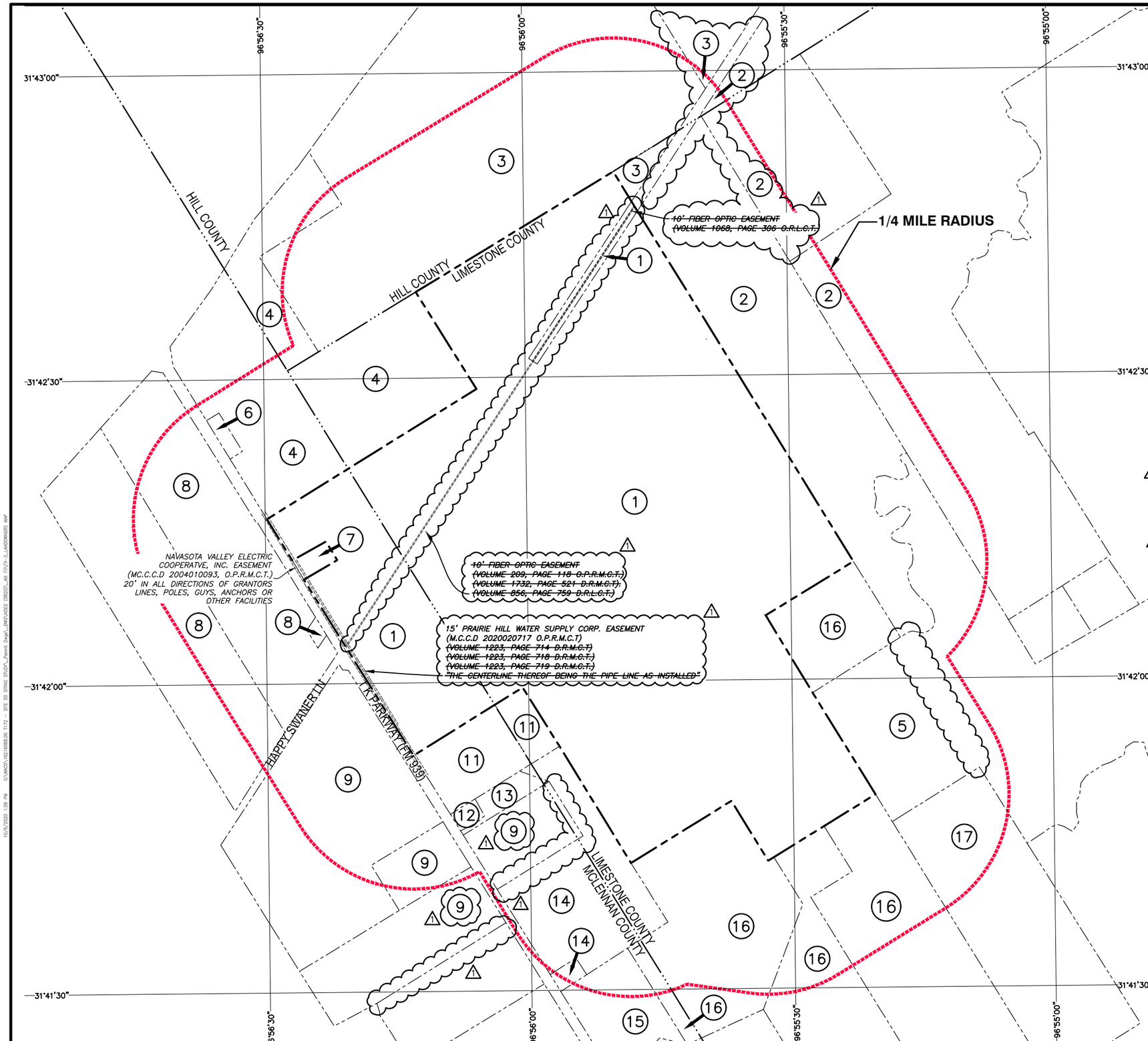
CADD FILE: 50-2_USGS TOPO

DATE: 08/2018

SCALE: AS SHOWN

DRAWING NO. I/II-2

10/6/2020 2:08 PM G:\WACO\162160680.00 1172 - SITE 50 SITING STUDY_Permit Dwgs_DWG\WCO2 (08203)_alt 01\I-2_USGS TOPO



N

0 500 1000
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- ADJACENT PROPERTY BOUNDARY
- COUNTY LINE
- 1/4 MILE RADIUS
- 96°55'30" LATITUDE/LONGITUDE LINES

NOTES:

1. (X) CORRESPONDS TO LANDOWNERS LISTED ON LANDOWNERS LIST.
2. PROPERTY OWNERS WITHIN 1/4 MILE OF THE PERMIT BOUNDARY ARE SHOWN.
3. LANDOWNER PROPERTY BOUNDARIES INDICATED ARE APPROXIMATE.
4. ~~FIBER OPTIC LINE EASEMENT, VOLUME 209, PAGE 118, MCLENNAN CO. RECORDS, IF EXISTING AT TIME OF LANDFILL DEVELOPMENT, WILL BE RELOCATED PRIOR TO CONSTRUCTION OF SECTORS 9 THROUGH 13 AND WILL BE VACATED. IF FIBER LINE IS NOT INSTALLED WITHIN EASEMENT, THEN EASEMENT IS ABANDONED ON ITS OWN TERMS.~~
4. 5. A FLOWAGE EASEMENT EXISTS ON THE PROPERTY THAT IS UNDER THE JURISDICTION OF THE TECHUACANA CREEK WATER CONTROL AND IMPROVEMENT DISTRICT NUMBER (1) OF LEROY, TEXAS SUBJECT TO THE EASEMENT RECORDED IN VOLUME 498, PAGE 118, VOLUME 506, PAGE 181, VOLUME 507, PAGE 378, AND VOLUME 509, PAGE 417 OF THE DEED RECORDS OF LIMESTONE COUNTY, TEXAS.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	UPDATED LANDOWNER LABELS AND PROPERTY BOUNDARIES, REMOVED FIBER OPTIC EASEMENT AND NOTE, UPDATED WATER LINE EASEMENT CALLOUT, CHANGES TO LAYOUT, AND RENUMBERED NOTES	RRK

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: **LANDOWNER'S MAP**

PROJECT TITLE: **CITY OF WACO LANDFILL**
TYPE I MSW - PERMIT APPLICATION

CLIENT: **CITY OF WACO**
501 SHROEDER
WACO, TEXAS 76710

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: RRK | DWN. BY: JLJ | CHK. BY: KDY | Q/A SVR BY: KDY | APP. BY: RRK

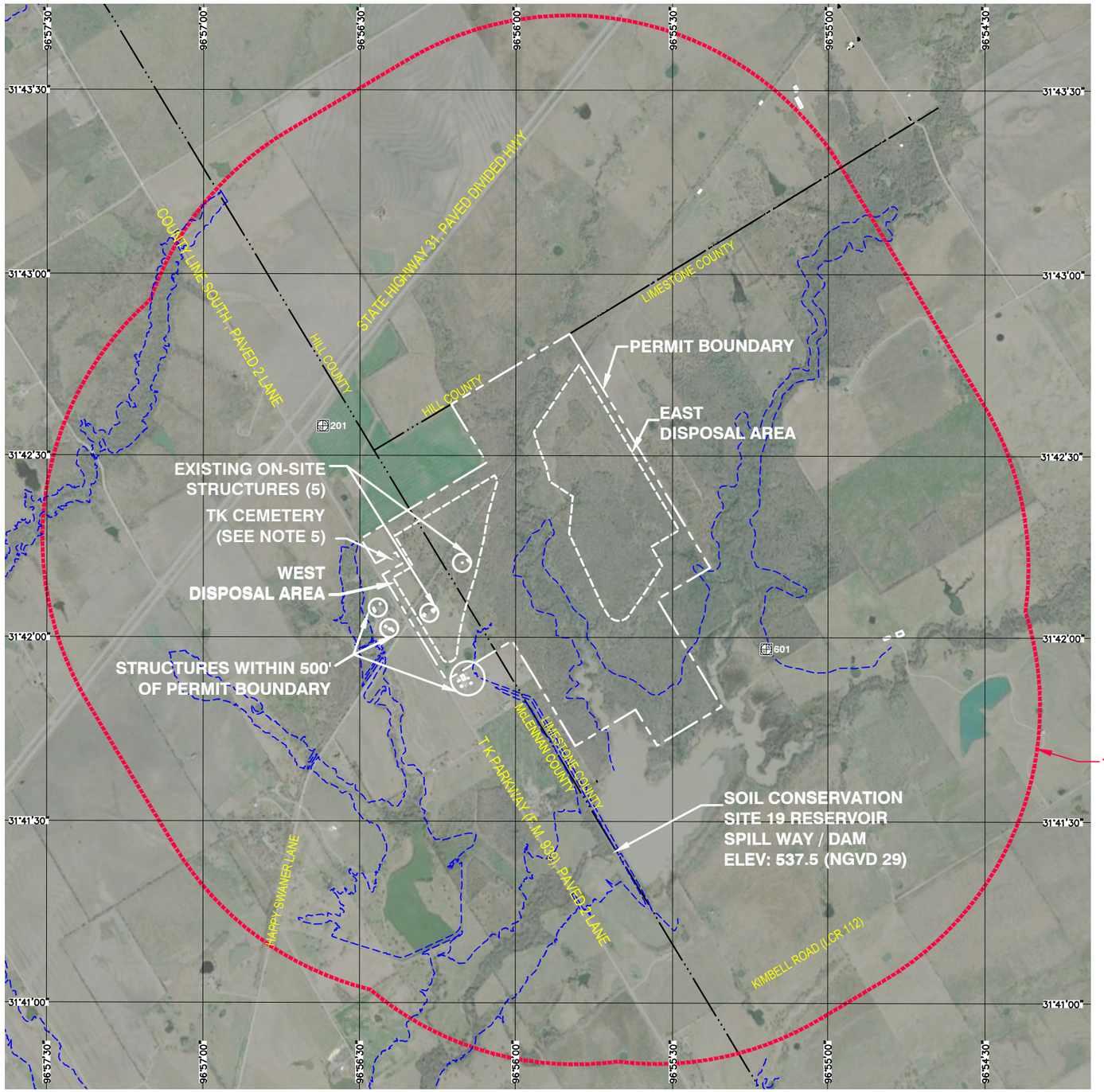
CADD FILE: I/II-3_LANDOWNERS MAP

DATE: 08/2018

SCALE: AS SHOWN

DRAWING NO. **I/II-3**

10/6/2020 1:29 PM C:\WACO\16216088.00 1172 - SITE SELECTION STUDY_Permit Dwgs_DRFT\WACO2 (2020)_A01 F1\I/II-3_LANDOWNERS MAP



N

0 1000 2000
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- COUNTY LINE
- 1 MILE RADIUS
- FLOOD PLAIN (SEE NOTE 2)
- 96°55'30" LATITUDE/LONGITUDE LINES

NOTES:

1. AERIAL SHOWN WAS SOURCED FROM GOOGLE EARTH, IMAGERY DATED 09/07/17.
2. 100–YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
3. ALL KNOWN STRUCTURES AND INHABITABLE BUILDINGS WITHIN 500 FEET OF PERMIT BOUNDARY ARE SHOWN.
4. EXISTING WATER WELL WITHIN ONE–MILE OF PERMIT BOUNDARY (SEE ATLAS ENVIRONMENTAL RESEARCH REPORT, APPENDIX I/IIB).
5. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25–FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	12/2018	REVISIONS FOR PART I/II NOD1	RRK
2	10/2020	REVISED FLOOD PLAIN AND NOTE 2	RRK
3			
4			
5			

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: AERIAL PHOTOGRAPH

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
501 SHROEDER
WACO, TEXAS 76710

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

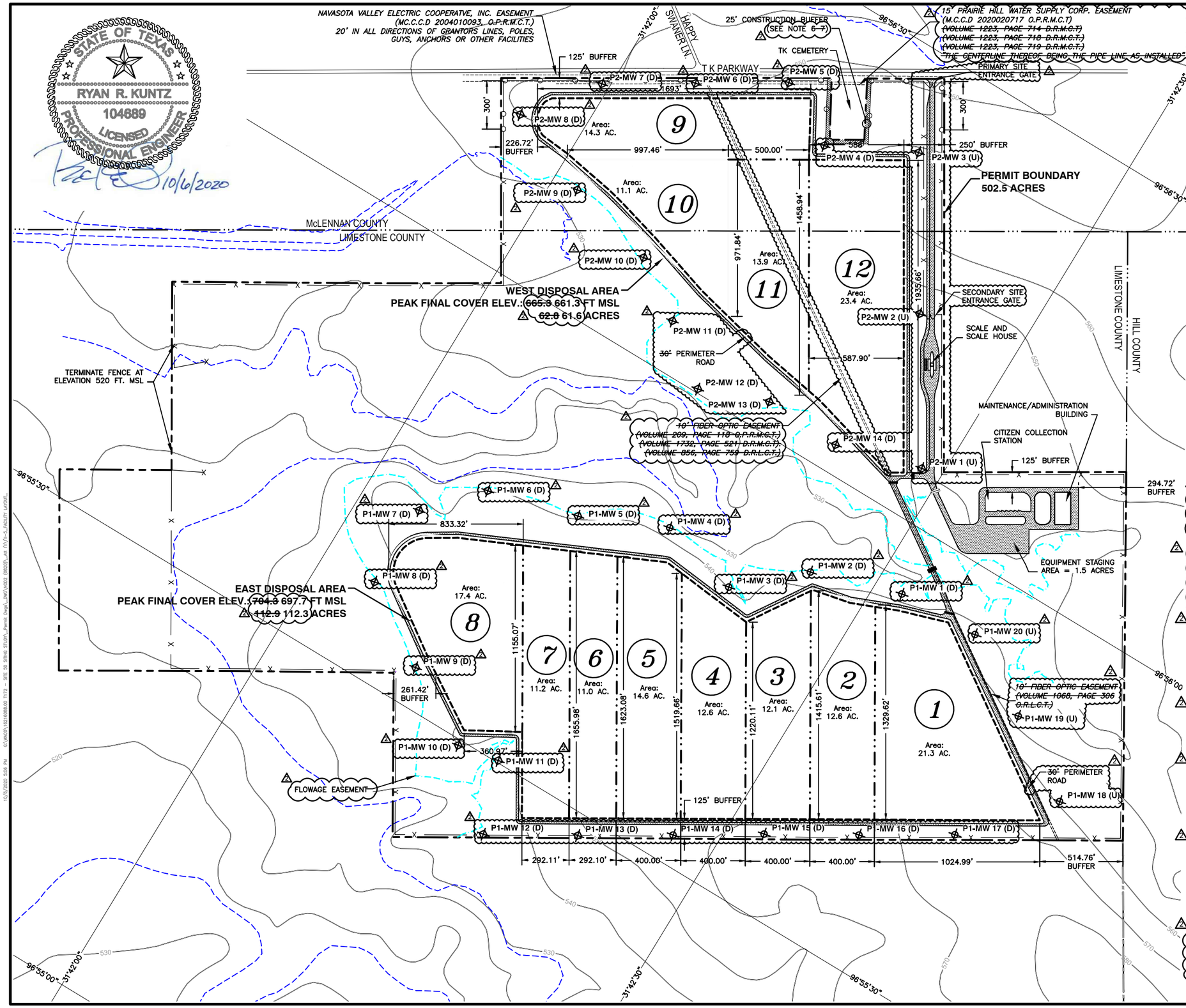
PROJ. NO. 16216088.00 | DSN. BY: RRK | DWN. BY: JLJ | CHK. BY: KDY | Q/A RVW BY: KDY | APP. BY: RRK

CADD FILE: I/II-4_AERIAL MAP

DATE: 08/2018

SCALE: AS SHOWN

DRAWING NO. I/II-4



0 300 600
SCALE IN FEET

LEGEND

- 560 — EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- COUNTY LINE
- 100–YEAR FLOOD PLAIN (SEE NOTE 2)
- FLOWAGE EASEMENT, ELEVATION 534.5 (NGVD 29) (SEE NOTE 3)
- 96°55'30" — LATITUDE/LONGITUDE LINES
- PERIMETER FENCE
- 8' PRIVACY FENCE
- ACCESS ROAD
- ~~GROUNDWATER MONITOR WELL (SEE NOTE 6)~~
- P1-MW 20 (U) — GMW INSTALLED PRIOR TO LANDFILL OPERATION (SEE NOTE 5)
- P2-MW 1 (U) — GMW INSTALLED WHEN WASTE < 1,000 FEET (SEE NOTE 5)
- X — SECTOR DESIGNATION (SEE NOTE ~~4~~ 5)

NOTES:

1. CONTOURS SHOWN ARE FROM THE 24K QUAD MAP FOR AXTELL, TEXAS (2016) PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.
2. 100–YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
3. ~~FIBER OPTIC LINE EASEMENT, VOLUME 209, PAGE 118 MCLENNAN CO. RECORDS, IF EXISTING AT TIME OF LANDFILL DEVELOPMENT, WILL BE RELOCATED PRIOR TO CONSTRUCTION OF SECTORS 9 THROUGH 13 AND WILL BE VACATED. IF FIBER LINE IS NOT INSTALLED WITHIN EASEMENT, THEN EASEMENT IS ABANDONED ON ITS OWN TERMS.~~
3. ~~4.~~ A FLOWAGE EASEMENT EXISTS ON THE PROPERTY THAT IS UNDER THE JURISDICTION OF THE TECHUACANA CREEK WATER CONTROL AND IMPROVEMENT DISTRICT NUMBER (1) OF LEROY, TEXAS SUBJECT TO THE EASEMENT RECORDED IN VOLUME 498, PAGE 118, VOLUME 506, PAGE 181, VOLUME 507, PAGE 378, AND VOLUME 509, PAGE 417 OF THE DEED RECORDS OF LIMESTONE COUNTY, TEXAS.
4. ~~5.~~ SECTOR DEVELOPMENT SEQUENCE REPRESENTED BY SECTOR NUMBER, MAY BE DEVELOPED IN SMALLER INCREMENTS (AKA SUBSECTORS OR CELLS) WITH LINER CERTIFICATIONS SUBMITTED SEPARATELY TO TCEQ.
5. ~~6.~~ SUBJECT TO THE APPROVAL OF THE TCEQ, THE ~~LOCATIONS OF~~ GROUNDWATER MONITORING WELL~~S~~ LOCATIONS ARE ~~WILL BE CONFIRMED OR ADJUSTED~~ BASED ON THE RESULTS OF THE SITE HYDROGEOLOGIC CHARACTERIZATION ~~TO BE~~ INCLUDED IN PART III ATTACHMENT 4 OF THE PERMIT APPLICATION, CONSISTENT WITH 30 TAC §330.61(D)(3) AND §330.403.
6. ~~7.~~ IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25–FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.

ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	12/2018	REVISIONS	RRK
2	10/2020	REVISION TO NOTE 2, WDA/EDA LIMITS OF WASTE, REMOVAL OF FIBER OPTIC EASEMENT, AND NOTE 3 REVISIONS TO SITE LAYOUT (PERIMETER ROAD, ENTRANCE), AND GMW SYSTEM, AND RENUMBERED NOTES.	RRK

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: FACILITY LAYOUT PLAN

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
501 SHROEDER
WACO, TEXAS 76710

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

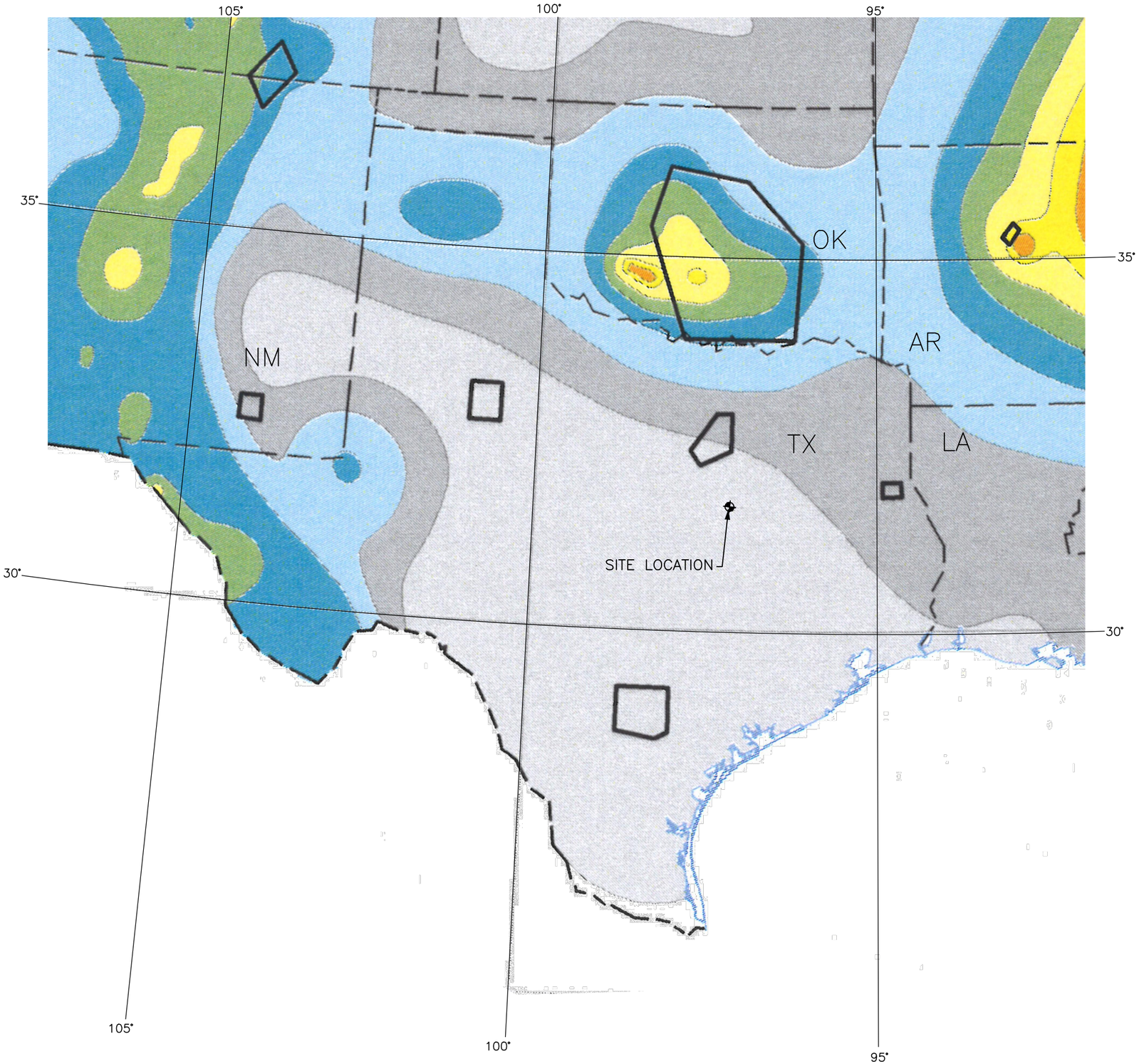
PROJ. NO. 16216068.00 | DSN. BY: RRK | DWN. BY: JLJ | CHK. BY: KDY | Q/A RVW BY: KDY | APP. BY: RRK

CADD FILE: I/II-5_FACILITY LAYOUT_

DATE: 08/2018

SCALE: AS SHOWN

DRAWING NO. I/II-5



N

0 50 100
SCALE IN MILES

LEGEND

Areas where suspected nontectonic earthquakes have been ~~deleted~~ **detected** 1

EXPLANATION

Peak acceleration, expressed as a fraction of standard gravity (g)

0.8
0.4
0.3
0.2
0.14
0.1
0.06
0.04
0.02
0

SOURCE:
SEISMIC IMPACT ZONE MAP TAKEN FROM THE U.S. GEOLOGICAL SURVEY, UPDATED 2014.

STATE OF TEXAS
James Lawrence
Discipline
License #
541
LICENSED
PROFESSIONAL GEOSCIENTIST

10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISED "DELETED" TO "DETECTED".	RRK

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
SEISMIC IMPACT MAP

PROJECT TITLE
CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO
PUBLIC WORKS DEPARTMENT
401 FRANKLIN AVENUE
WACO, TX 76701

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2198

PROJ. NO. 16216088.00
DSN. BY: JL
DWN. BY: JL
CHK. BY: TM
C/A RVW BY: TM
APP. BY: JL

CADD FILE: I/II-7_SEISMIC MAP

DATE: 04/2020

SCALE: AS SHOWN

FIGURE: **I/II-7**

10/6/2020 2:51 PM G:\WACO\16216088.00 1172 - SITE 50 SITING STUDY_Permit Dwgs_DWG\WG02 (0820)_Alt I\I/II-7_Seismic.mxp

APPENDIX I/IIA

DEMONSTRATION OF COORDINATION (30 TAC 330.~~5~~61~~(b)(5-10)~~)

- Coordination with Texas Parks and Wildlife Department
- Coordination with U.S. Department of the Interior, Fish and Wildlife Service
- Coordination with Texas Historic Commission
- Coordination with U.S. Army Corp of Engineers
- Coordination with Texas Department of Transportation
- Coordination with Heart of Texas Council of Governments
- Coordination with Federal Aviation Administration

COORDINATION WITH TEXAS PARKS AND WILDLIFE DEPARTMENT

Note: See Appendix I/IIG for the final "Biological Assessment" dated February 2020, prepared by Horizon Environmental Services, Inc., as referenced in the attached coordination correspondence. This assessment also includes a Management Plan for threatened and endangered species.

COORDINATION WITH U.S. DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE

Note: See Appendix I/IIG for the final "Biological Assessment" dated February 2020, prepared by Horizon Environmental Services, Inc., as referenced in the attached coordination correspondence. This assessment also includes a Management Plan for threatened and endangered species.

COORDINATION WITH U.S. ARMY CORP OF ENGINEERS

Note: See Appendix I/IIE for the "Section 404 Jurisdictional Determination," dated ~~August 2018~~October 2020, prepared by Horizon Environmental Services, Inc., as referenced in the attached coordination letter.

COORDINATION WITH
TEXAS DEPARTMENT OF TRANSPORTATION

Note: See Appendix I/IID-2 for a Traffic Impact Analysis, dated January 7, 2020, prepared by Lee Engineering, as referenced in the attached TxDOT approval letter, dated March 25, 2020.

APPENDIX I/IIC

LAND-USE ANALYSIS

APPENDIX I/IID

TRAFFIC ANALYSIS

APPENDIX I/IID-1

TxDOT WACO DISTRICT TRAFFIC MAP

APPENDIX I/IID-2

TRAFFIC IMPACT ANALYSIS

APPENDIX I/IIE

SECTION 404 JURISDICTIONAL DETERMINATION

APPENDIX I/IIG

BIOLOGICAL ASSESSMENT

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III
SITE DEVELOPMENT PLAN NARRATIVE

Prepared for:

CITY OF WACO

Solid Waste Services
501 Schroeder Drive
Waco, TX 76710

Prepared by:

SCS ENGINEERS
Texas Board of Professional Engineers, Reg. No. F-3407
Dallas/Fort Worth Office
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 0 – April 2020
Revision 1 – October 2020
SCS Project No. 16216088.00

TABLE OF CONTENTS

SECTION **PAGE**

LIST OF ACRONYMS ..... III-iii

1 INTRODUCTION (30 TAC §330.63) III-1-1
2 SOLID WASTE DATA (30 TAC §330.63(D)(4)(D)) III-2-1
2.1 POPULATION EQUIVALENT III-2-1
2.2 SITE OPERATING LIFE PROJECTION III-2-1
3 DESIGN DATA (30 TAC §330.63(B)) III-3-1
3.1 LANDFILL METHODS (30 TAC §330.63(D)(4)(B),(C),(E)) III-3-1
3.2 WET-WEATHER OPERATIONS (30 TAC §330.63(D)(4)(A) III-3-2
3.3 SITE ACCESS (30 TAC §330.63(B)(1)) III-3-2
3.4 GEOLOGY AND GEOTECHNICAL REPORTS (30 TAC §330.63(E)) III-3-3
3.5 GROUNDWATER PROTECTION (30 TAC §330.63(F) & §330.63(D)(4)(G)) III-3-4
3.6 SURFACE WATER PROTECTION (30 TAC §330.63(C)(1)) III-3-5
3.7 FLOODPLAIN PROTECTION (30 TAC §330.63(C)(2)) III-3-8
3.8 LANDFILL CLOSURE AND POST CLOSURE-CARE (30 TAC §330.63(H), (I) & (J)) III-3-9
3.9 LANDFILL GAS MANAGEMENT (30 TAC §330.63(G)) III-3-10
3.10 PROTECTION OF ENDANGERED SPECIES (30 TAC §330.63(B)(5)) III-3-11
3.11 CITIZENS' CONVENIENCE STATION METHODS III-3-11

Appendices

A Site Life Calculations

Attachments

1 Site Layout Plans
2 Fill Cross Sections
3 Landfill Completion Plan
4 Geology Report
5 Geotechnical/Stability Analysis
6A Surface Water Drainage Plan
6B Floodplain Evaluation
6C Groundwater Protection Plan
7 Groundwater Sampling and Analysis Plan
8 Closure and Post-Closure Cost Estimates
9 Final Closure and Post-Closure Care Plan
10 Soil and Liner Quality Control Plan
11 Landfill Gas Management Plan
12 Leachate and Contaminated Water Management Plan

SCS Engineers
TBPE Reg. # F-3407

1 INTRODUCTION (30 TAC §330.63)

The City of Waco (Owner) proposes to develop and operate a Type I Municipal Solid Waste (MSW) Landfill on 502.5 acres of land located in McLennan and Limestone Counties, Texas. The landfill entrance will be located approximately 0.4 miles south of the intersection of State Highway 31 and T K Parkway (also known as Farm-to-Market [FM] 939). The waste disposal footprint will encompass approximately ~~175.7~~173.8 acres, separated into two (2) disposal areas, with the East Disposal Area comprised of approximately ~~112.9~~112.2 acres and West Disposal Area comprised of approximately ~~62.8~~61.6 acres. Refer to Attachment 1 for drawings that depict the existing conditions, landfill permit boundary, waste footprint, and general site layout.

The landfill will serve residences, businesses, and industries in the communities of McLennan and Limestone County and other nearby counties transported to the landfill by municipal, private, and public haulers. The landfill will accept municipal solid waste, household waste, yard waste, commercial solid waste, Class 2 and Class 3 non-hazardous industrial wastes, construction-demolition waste, and special wastes as authorized by the Texas Commission on Environmental Quality (TCEQ). The categories of waste that will be accepted at the landfill are defined in Part I/II, Section 2.2.2 of this permit application. Any special waste accepted at the landfill will be in accordance with 30 TAC §330.171. Consistent with 30 TAC §330.15(e) the facility will not accept regulated hazardous waste, polychlorinated biphenyls (PCBs), and all other prohibited waste defined therein. Additionally, Class 1 industrial solid waste will not be accepted at this facility.

This permit application for the City of Waco Landfill has been prepared consistent with the Municipal Solid Waste Regulations (MSWR), Title 30 of the Texas Administrative Code (TAC), Chapter 330. This Site Development Plan (SDP) Narrative provides a brief overview of the contents of the permit application, including the attachments of the SDP. The SDP has been separated into Attachments 1 through 12, which were prepared consistent with 30 TAC §330.63.

2 SOLID WASTE DATA (30 TAC §330.63(D)(4)(D))

The landfill will serve residences, businesses, and industry in the communities of McLennan and Limestone Counties and other nearby counties. As discussed in Parts I/II, Section 2.2, the landfill is expected to initially receive approximately 305,000 tons per year of solid waste (1,070 tons per day based on a 286-day operating schedule). The initial year of operation is anticipated following completion of disposal operations at the existing City of Waco Landfill (Permit No. MSW-948A), which is estimated to be 2024. The waste inflow rate is estimated to increase at a rate of approximately 1.25 percent annually over the life of the landfill. Over the life of the landfill, it is anticipated that the waste rate received at the landfill may vary as warranted by the needs of the area, market conditions, and recycling and waste diversion practices.

Consistent with 30 TAC §330.63(d)(4)(D), the following subsections describe the population equivalent and site operating life for the landfill.

2.1 POPULATION EQUIVALENT

As discussed in Parts I/II, Section 2.2.1, it is anticipated that the population served by the landfill will change over the life of the landfill as warranted by the needs of the area and market conditions. Based on an estimated 6.7 pounds of waste generated daily per person (ref: HOTCOG Regional Solid Waste Plan, 2013 Update) and an initial disposal rate of 1,070 tons per day, the number of people served by the landfill initially will be approximately 319,000 persons.

The major classifications of solid waste to be accepted at the landfill include municipal solid waste, household waste, yard waste, commercial solid waste, Class 2 and Class 3 non-hazardous industrial wastes, construction-demolition waste, and special wastes. Consistent with 30 TAC §330.15(e), the facility will not accept regulated hazardous waste, polychlorinated biphenyls (PCBs), and other prohibited waste defined herein. Additionally, Class 1 industrial solid waste will not be accepted at this facility. Waste classifications and further information on types of wastes expected to be received at the facility are included in Parts I/II, Section 2.2.2 - Properties and Characteristics of Waste.

2.2 SITE OPERATING LIFE PROJECTION

The landfill configuration provides an approximate estimate of ~~33~~ 32 years of site operating life. Calculations and assumptions for the site operating life estimate are included in Appendix IIIA – Site Life Calculations.

3 DESIGN DATA (30 TAC §330.63(B))

In accordance with §330.639(b), this section summarizes the general facility design data, with detailed specifics of the facility design included in the various attachments of this Part III – Site Development Plan. General landfill methods are described in Section 3.1 and CCS methods are described in Section 3.11, while the remainder of this narrative summarizes the overall facility design, operations, and environmental protection.

Additionally, in accordance with §330.63(b)(2) a flow diagram for the waste movement through the facility is provided on Attachment 1, Drawing 1.6 – Waste Flow Diagram. As shown on this waste flow diagram, there are generally two operations that occur on the facility property, including the landfill and citizens' convenience station (CCS).

Part IV – Site Operating Plan describes the detailed operation of the facility, including the landfill and CCS.

3.1 LANDFILL METHODS (30 TAC §330.63(D)(4)(B),(C),(E))

The proposed landfill development method for the site is a combination of area excavation fill followed by aerial fill to the proposed landfill completion height. The landfill will be developed in two separate disposal areas, East Disposal Area and West Disposal Area. The East Disposal Area will be comprised of eight sectors, 1 through 8; and the West Disposal Area will be comprised of four sectors, 9 through 12. Each sector may be developed in multiple cells at the discretion of Owner.

The excavation sideslopes will be no steeper than 3H:1V, with an elevation of deepest excavation (EDE) of 505 feet mean sea level (ft MSL). The EDE will be achieved in the bottom of the leachate collection sump in Sector 8. Aerial fill sideslopes will be no steeper than 4H:1V and the aerial fill topslope will be no flatter than 5 percent (or 20H:1V). The maximum elevation of final cover will be no higher than 697.7 ft MSL and 661.3 ft MSL for East and West Disposal Areas, respectively. Final cover placement and closure of sectors will be in accordance with procedures set forth in the closure plan provided in Attachment 9 of this permit application.

Attachments to this application include drawings depicting the landfill development. Specifically, Attachment 1 through Attachment 3 include the following:

- **Attachment 1 –** Site Layout Plans, include existing site contours (July 3, 2018 topography, see Drawing 1.1), excavation, elevation of deepest excavation, disposal area layout, sector layout, and sequence of sector development.

- **Attachment 2 –** Fill Cross Sections, include cross-sections depicting the base grades, top of liner grades, maximum elevation of waste, maximum elevation of final cover, and geologic borings along the cross-sections.

- **Attachment 3 –** Landfill Completion Plan, include proposed final contours, surface water management system, and general facility layout at landfill completion.

3.2 WET-WEATHER OPERATIONS (30 TAC §330.63(D)(4)(A)

The landfill access roads (see Attachment 1 – Site Layout Plans), including perimeter roads and other constructed interior haul roads will be constructed of crushed stone, concrete rubble, masonry demolition debris, gravel, caliche, asphalt paving, or other suitable material and will provide access from the site entrance road to the disposal area(s). The landfill access roads will be passable under inclement weather conditions to allow access to the active disposal area. To enhance operating efficiency during wet weather, the Owner may reserve an active disposal area close to the all-weather roads for wet-weather operations where development sequence allows. Furthermore, the tracking of mud and trash onto public access roadways will be minimized by removing mud and associated debris from the landfill roads and site entrance, as described in Part IV – Site Operating Plan (SOP).

3.3 SITE ACCESS (30 TAC §330.63(B)(1))

3.3.1 Access from Highway

The main public roadways providing access to the site are State Highway (SH) 31 and T K Parkway (also known as Farm-to-Market [FM] 939). The landfill entrance will be located off FM 939, approximately 0.4 miles south of the intersection of SH 31 and FM 939. Refer to Parts I/II, Section 8 - Transportation for site access and other transportation information.

The site entrance is detailed on Attachment 1, Drawing 1.5 - Entrance Facility Plan. The site entrance consists of an all-weather road, site entrance gates, scale house, and scales (initially one inbound and one outbound scale). The site entrance will also include two inbound queue lanes that provide approximately 3,300 feet of queuing length from the scales back to FM 939. Furthermore, at some point in the future, an additional inbound scale may be installed to accommodate increases in the waste acceptance rate over the site operating life.

3.3.2 All-Weather Access

The site entrance road includes an asphalt or concrete paved roadway, or other suitable material that transitions into landfill access roads, either perimeter or interior haul roads, constructed of crushed stone, concrete rubble, masonry demolition debris, gravel, caliche, asphalt paving, or other suitable material and will provide access from the site entrance road to the waste disposal area(s). The site entrance road will serve as mud control for waste hauling vehicles prior to exiting the site and returning to public-access roads. The perimeter roads will be maintained for all-weather access by site personnel. Crushed stone, concrete rubble, masonry demolition debris, gravel, caliche, asphalt paving, or other similar material will be made available, as necessary, for use in maintaining passable perimeter roads. Grading equipment or other appropriate equipment will be used to control or remove mud accumulation at least once per day on days when mud and associated debris are being tracked onto FM 939, as specified in the SOP.

3.3.3 Access Control

Vehicle access to the landfill will be controlled at the site entrance by signs that direct all landfill traffic to the working face or ~~Citizens' Collection Station (~~CCS~~)~~ during site operating hours.

Personnel on duty at the scale house will regulate access to the landfill. The site entrance will be secured by two gates (primary and secondary entrance gates). The primary entrance gate will be opened at 5:30 AM on days that the facility is in operation to minimize queuing on FM 939, as described in the Transportation Impact Analysis (Part I/II, Appendix I/IID-2) The secondary entrance gate will remain locked outside operating hours to prevent unauthorized vehicle access to the landfill. A fence, either barbed wire, chain link, privacy, or a combination thereof will limit access around the perimeter of the landfill at the permit boundary, as described in the SOP.

The Owner will permit entry to the landfill to designated landfill personnel, solid waste haulers (including landfill customers) authorized to use the facility, TCEQ personnel, and properly identified persons whose entry is authorized by the Landfill Manager or designee. Owner reserves the right to deny access to the landfill to persons not demonstrating a legitimate purpose for visiting. Visitors will be allowed on the active disposal area of the landfill only when accompanied by the Landfill Manager or designee.

3.4 GEOLOGY AND GEOTECHNICAL REPORTS (30 TAC §330.63(E))

The regional and local stratigraphy and lithology for the proposed landfill are summarized in Parts I/II, Section 9 and described in detail in Attachment 4 – Geology Report, including depth, thickness, geometry, soil classifications, hydraulic conductivity, and depositional history of the local geological formations. In view of the depth of low-permeability clay and shale at the facility, the geologic setting of the site is considered suitable for landfill development.

Attachment 4 also includes the results of the subsurface investigation performed at the facility. Onsite geology is characterized by three layers as follows, from the ground surface downward to a maximum drilled depth of 100 feet:

- Unit 1: consists of surficial clayey and loamy alluvium overlying silty or sandy clays with small subrounded gravel. The transition from Unit I to the underlying Unit II is transitional, and marked by increasing hardness and increasing fissility.

- Unit 2: beneath Unit I, consists of weathered silty shale with varying calcareous content. Some publications use the term “marl” to describe calcareous shale. The Unit II silty shale has thin, interbedded limestone and sand/silt partings/lenses, calcite-filled joints, and marine shell fragment fossils. Above the Unit II/Unit III line, the stratigraphy is generally more variable in color but are generally lighter-colored and have evidence of oxidation such as various rust- and yellow/brown colors. Below the Unit II/Unit III line, the stratigraphy is a homogenous very dark color, trending to black. Unit III also is less fissile than Unit II.

- Unit 3: beneath Unit II, consists of unweathered dark gray to black calcareous shale bedrock with thin, interbedded limestone and sand/silt lenses, and marine shell fragment fossils.

Attachment 5, Geotechnical/Stability Analyses, addresses the geotechnical properties of the landfill, including evaluation of the geotechnical properties of the subsurface soils, stability of the soils and strata for development of the landfill, and slope stability of the landfill.

3.5 GROUNDWATER PROTECTION (30 TAC §330.63(F) & §330.63(D)(4)(G))

3.5.1 Groundwater Monitoring System

Attachment 4, Geology Report, includes the result of the subsurface investigation, including the groundwater depth, if encountered, in the soil borings and piezometers. Also, Attachment 4 includes the elevations and gradient of groundwater across the landfill property and a detailed description of the proposed groundwater monitoring system, which will be used to verify the integrity of the liner system. Details of the plan for performing groundwater sampling, analysis, and reporting are addressed in Attachment 7 - Groundwater Sampling and Analysis Plan.

3.5.2 Liner Design

Consistent with 30 TAC §330.331(b), a soil-geomembrane composite liner system for a Type I landfill, is proposed for the landfill. Beginning from the waste and working down, the bottom liner system will be comprised of the following components:

- 24-inch thick soil protective cover;
- Single-sided geocomposite (non-woven geotextile on the top side only of geonet);
- 60-mil high-density polyethylene (HDPE) geomembrane (smooth);
- 2-foot-thick compacted clay liner ($k \leq 1x10^{-7}$ cm/sec); and
- Prepared subgrade (excavation grade).

The sideslope liner system will be comprised of the following components (from waste and working down):

- 24-inch thick soil protective cover;
- Double-sided geocomposite (non-woven geotextile on both sides of geonet);
- 60-mil textured HDPE geomembrane (textured on both sides);
- 2-foot-thick compacted clay liner ($k \leq 1x10^{-7}$ cm/sec); and
- Prepared subgrade (excavation grade).

The proposed liner system for the landfill is designed to meet the requirements outlined in 30 TAC §330.331. Attachment 10 – Soil and Liner Quality Control Plan (SLQCP) contains the construction quality control and quality assurance requirements for construction of the composite liner for the landfill.

3.5.3 Leachate Collection System

A leachate collection system (LCS) has been designed to control the accumulation of leachate within the waste disposal area during the active periods of landfilling, and after landfill closure; including being designed to meet Type I landfill requirements (30 TAC §330.331(a)(2) and §330.333) and maintaining leachate head over the liner of less than 30 centimeters. The LCS layout is shown on drawings included in Attachments 1 and 12 of this permit application. Design of the LCS is discussed in Attachment 12 - Leachate and Contaminated Water Management Plan. Information regarding materials and construction quality control and quality assurance are included in the SLQCP. The following provides a summary description of the LCS and associated features. Additional description is provided in Attachment 12. Representative details of the LCS are presented on drawings included in Attachment 12.

The primary collection component of the LCS is the leachate drainage layer, which consists of a geonet-geotextile composite (referred to as geocomposite) placed directly over the bottom and sideslope liner systems. The geocomposite consists of a HDPE geonet with a non-woven geotextile heat bonded to one or both sides of the geonet, where single-sided geocomposite will be placed on the bottom, and double-sided geocomposite will be placed on the sideslopes of the landfill. The geocomposite will have hydraulic properties that will provide adequate drainage of leachate to the leachate collection piping and sump, thereby maintaining less than 30-cm leachate head above the bottom liner system. Calculations demonstrating the minimum required material properties for the geocomposite are presented in Attachment 12.

A 2-foot-thick protective cover will be placed over the geocomposite prior to waste placement. To facilitate drainage into the leachate collection system, chimney drains, comprised of aggregate wrapped in a non-woven geotextile, will be constructed over the leachate collection piping. Leachate entering the LCS piping will discharge into sumps located at the perimeter of the landfill. Leachate collected in the sumps will be removed via submersible pumps lowered into the sumps through a riser pipe extending up the cell sideslope.

Additional descriptions of the LCS piping and sumps, including but not limited to pipe spacing and grading; sump sizing calculations; and demonstration that pipes and perforations will be resistant to clogging and collapse, are presented in Attachment 12. Leachate and contaminated water management, including storage and disposal, is presented in Attachment 12, Sections 4 and 5, respectively.

3.6 SURFACE WATER PROTECTION (30 TAC §330.63(C)(1))

3.6.1 General

The proposed landfill is located within the drainage basin of the Brazos River. Surface water generally drains southeast from the western portion of the property towards Horse Creek and

generally drains south/southwest from the eastern portion of the property towards Horse Creek and Packwood Creek.

Stormwater runoff from the developed landfill will be conveyed through a surface water management system designed in accordance with 30 TAC §330.63(c), as described in Section 3.6.3. Stormwater will be conveyed from the landfill property into natural drainage features, including Horse and Packwood Creeks. These creeks are tributaries of Soil Conservation Services Site 19 Reservoir, which discharges into Williams Creek located south of the property and eventually flows into Tehuacana Creek approximately 11 miles southwest of the property. Tehuacana Creek discharges into the Brazos River approximately 15 miles southwest of the property.

In accordance with 30 TAC §330.15(h), the landfill has been designed to prevent discharge of pollutants into waters of the State or waters of the United States, as defined by the Texas Water Code (§26.121) and the Federal Clean Water Act (§404), respectively. As described in Part I/II, Section 10.2, the Owner will file a notice of intent (NOI) with the TCEQ and develop and implement a Stormwater Pollution Prevention Plan prior to the commencement of landfill operations to obtain coverage under the Texas Pollutant Discharge Elimination System (TPDES) General Permit, TXR050000 for Stormwater Discharges associated with Industrial Activity.

3.6.2 Site Drainage Patterns

Consistent with 30 TAC §330.63(c), the surface water management system design for the landfill complies with 30 TAC §330.303. A complete description of the site drainage patterns for both the pre- and post-development landfill conditions is presented in Attachment 6A – Surface Water Drainage Plan of this permit application. As presented in Attachment 6A, the surface water drainage features, aerial fill controls and perimeter drainage system, have been designed to avoid adversely altering existing drainage patterns, as a result of landfill development, in accordance with 30 TAC §330.63(c)(1)(D)(iii). This has been demonstrated by evaluating pre- and post-development peak discharge rates and total discharge volumes at off-site discharge locations. Furthermore, the post-development locations of off-site discharges have been designed to be consistent with the pre-development conditions. The pre- and post-development hydrologic and hydraulic analysis are presented in Attachment 6A, including a description of the methodology, calculations, and results of said calculations.

3.6.3 Perimeter Drainage System

The stormwater controls for the landfill have been designed consistent with the 30 TAC §330 requirements for Type I MSW landfills. The perimeter drainage system is comprised of final cover controls (described in Section 3.6.5), perimeter drainage channels and detention basins. The perimeter drainage system has been designed for a 25-year, 24-hour storm event. The drainage features will be installed concurrent with the construction of up-gradient landfill disposal cells, such that when the cell grades are above existing grade, down-gradient drainage features are in-place, as described in Attachment 6A. Details and sizing criteria for the perimeter drainage system and associated calculations, including peak velocities, flow depths, and discharge rates are included in Attachment 6A of this permit application.

3.6.4 Below Grade

Control of stormwater run-on and runoff within excavation areas will be achieved using temporary diversion berms, ditches, and containment areas as needed. The temporary stormwater control structures will be used to divert stormwater away from the working face, thus reducing the volume of contaminated water generated during a storm event. Uncontaminated stormwater will be discharged consistent with the requirements of the TPDES General Permit.

Contaminated stormwater consists of stormwater that has come into contact with waste. Control of contaminated stormwater will be provided through temporary containment berms. Water that infiltrates into the underlying waste will be managed as leachate. Contaminated stormwater will be contained and managed at the working face in accordance with the guidelines set forth in Attachment 12 of this permit application.

3.6.5 Aerial Fill Controls

Additional stormwater controls will be necessary as the site is brought above grade. Temporary diversion and containment berms, channels, and containment areas will be used to separate and control uncontaminated and contaminated stormwater run-on and runoff for the aerial fill portions of the landfill.

As intermediate and final cover are placed on the landfill, vegetation will be established to provide erosion protection, as described in Attachment 6A and the SOP. Furthermore, as intermediate and final cover are placed, drainage features will be installed to control erosion and convey stormwater run-on and run-off from the landfill cover to the perimeter drainage system, as described in Section 3.6.6. Drainage features installed on the intermediate and final cover have been designed to convey stormwater associated with the 25-year, 24-hour storm event. Design details and sizing calculations, including peak velocity, flow depth, and discharge rate, for intermediate and final cover drainage features are described in Attachment 6A. In all cases, surface water run-on and runoff will be managed consistent with the 30 TAC §330, Subchapter G.

Areas that have received waste, but will be inactive for longer than 180 days will receive intermediate cover. Consistent with 30 TAC §330.165(a) and (c), runoff from areas with intact daily and/or intermediate cover will be considered uncontaminated. Also, by implementing: (1) the site design and proper operating practices; and (2) ongoing placement of daily, intermediate and final cover (as further described in Attachment 9 - Final Closure and Post-Closure Plan), contaminated water and leachate will be minimized. Details of the final cover design are provided in Attachments 6C and 9 of this permit application.

3.6.6 Erosion and Sedimentation Control Plan

On-site erosion and sedimentation control will be provided as follows: (1) during construction activities; and (2) as part of the ongoing operation of the landfill. Erosion and sedimentation control includes structural and non-structural controls for the intermediate and final cover systems and the perimeter drainage system. An Erosion and Sedimentation Control Plan is presented in Attachment 6A – Surface Water Drainage Plan, Section 6. Landfill management will control erosion and offsite sedimentation by implementing interim controls, as specified in

§330.305(e)(2), as described in Attachment 6A, Section 6. Furthermore, permanent erosion and sedimentation controls have been incorporated into the design of the landfill at completion and the perimeter drainage system.

Additionally, in accordance with §330.305(d), the landfill design will provide effective erosional stability to top dome surfaces and embankment sideslopes during all phases of landfill operation, including the closure and post-closure care period. The Erosion and Sedimentation Control Plan (Attachment 6A, Section 6) describes and includes the following:

- Erosion calculations using the Universal Soil Loss Equation (USLE)/Revised Universal Soil Loss Equation (RUSLE) to demonstrate that erosion on intermediate and final cover will be below permissible soil losses.

- Hydraulic calculations using standard engineering principles to demonstrate that velocities in drainage swales and downchutes and on intermediate and final cover slopes will be below permissible velocities.

- Operational requirements and guidelines for implementing erosion and offsite sedimentation controls, such as non-structural and structural best management practices (BMPs) for daily cover and soil stockpiles, intermediate cover, and final cover.

These features include perimeter drainage channels that have been designed with non-erosive velocities, or in areas where erosive velocities are anticipated, erosion protection or armoring of the channels in the form of rip rap, turf reinforcement matting, rock ditch checks, gabions, dissipation blocks, or other suitable structures will be provided, as needed. Permanent drainage and erosion protection measures for the final cover system (e.g., drainage swales and downchutes) are shown in Attachment 3 - Landfill Completion Plan. Erosion control practices for daily and intermediate cover are discussed in detail in Attachment 6A. Establishing vegetation on the intermediate and final cover, drainage swales, perimeter drainage system, and buffer zones will be ongoing as the site is developed (see Part III, Attachment 9 - Final Closure and Post-Closure Plan).

3.6.7 Wetlands

Information regarding wetlands is provided in Parts I/II, Section 11.2 and Appendix I/IIE – Section 404 Jurisdictional Determination in accordance with 30 TAC §330.553(b).

3.7 FLOODPLAIN PROTECTION (30 TAC §330.63(C)(2))

A portion of the Site is within the 100-year floodplains of Horse and Packwood Creeks. The floodplain limits were obtained from the currently effective Flood Insurance Rate Maps (Panels ~~48309C0250C~~ 48309C0250D dated ~~September 26, 2008~~December 20, 2019, and 48293C0125C dated September 16, 2011) obtained from FEMA for portions of McLennan and Limestone Counties. The floodplain limits have been designated by FEMA as Zone A, which indicates that no flood elevations have yet been determined along these creeks on the Site. The proposed waste disposal footprint is located entirely outside the limits of the 100-year floodplain. In

accordance with 30 TAC §330.547(a), no solid waste disposal operations will take place within the 100-year floodplain, and therefore no development is proposed in the 100-year floodplain.

Because the floodplain for the project area has been classified as Zone A, an additional flood study was performed to confirm that the proposed landfill and perimeter drainage system will not be impacted by a 100-year storm event. This 100-year flood study is presented in Attachment 6B – Floodplain Evaluation. As presented in this attachment, the waste disposal limits are not located within the 100-year flood study area, and will not be impacted by a water surface generated by a 100-year storm event. Additionally, the landfill has been designed with a perimeter berm above existing grade, which prevents washout from the 100-year storm event. Furthermore, the landfill has been designed such that there will be no surface water run-on from Horse and Packwood Creeks into the perimeter drainage system associated with a 100-year storm event. Therefore, the landfill and perimeter drainage system will not be impacted by the 100-year storm event.

Additionally, in accordance with 30 TAC §330.547(b), site operations and development will not restrict the flow or reduce the temporary storage capacity of the 100-year floodplain; nor will the site operations result in washout of solid waste associated with the 100-year floodplain, since construction within the 100-year floodplain is not proposed. Therefore, §330.63(c)(2)(D) is not applicable to this application. Furthermore, in accordance with 30 TAC §330.547(c), all storage and processing facilities (e.g., onsite ~~citizen's collection station~~CCS) will be located outside of the 100-year floodplain as delineated by FEMA and will not be impacted by the 100-year storm event, as shown in Attachment 6B.

Furthermore, the site will not require any levees or other improvements, including channel improvements, drainage works, or other projects on, along, or near any stream in the state that is subject to floods, freshets, or overflows, constructed so as to control, regulate, or otherwise change the floodwater of the stream. No portions of the landfill are located within a 100-year floodway. Therefore, the requirements of 30 TAC Chapter 301, Subchapter C, §301.31 to 301.46 relating to the Approval of Levees and Other Improvements, as referenced in 30 TAC §330.61(m)(1) and §330.63(c)(2)(D)(i), are not applicable.

3.8 LANDFILL CLOSURE AND POST CLOSURE-CARE (30 TAC §330.63(H), (I) & (J))

3.8.1 Final Cover Design

The final cover system will be a soil-geomembrane composite meeting the requirements of 30 TAC §330.457. Beginning from the surface and working down, the final cover system on the landfill topslopes will be comprised of the following components:

- Vegetation (native and/or introduced grasses);
- 24-inch thick (minimum) soil erosion layer, with the top six inches capable of sustaining vegetation;
- Single-sided geocomposite (non-woven geotextile on the top side only of geonet);

- 60-mil HDPE or 40-mil linear low density polyethylene (LLDPE) geomembrane (smooth);
- 18-inch thick (minimum) clayey soil infiltration layer ($k \leq 1x10^{-5}$ cm/sec); and
- 6-inch-thick daily cover or 12-inch-thick intermediate cover.

Beginning from the surface and working down, the final cover system on the landfill sideslopes will be comprised of the following components:

- Vegetation (native and/or introduced grasses);
- 24-inch thick soil erosion layer, with the top six inches capable of sustaining vegetation
- Double-sided geocomposite (non-woven geotextile on both sides of geonet);
- 60-mil HDPE or 40-mil LLDPE geomembrane (textured on both sides);
- 18-inch thick (minimum) clayey soil infiltration layer ($k \leq 1x10^{-5}$ cm/sec); and
- 6-inch-thick daily cover or 12-inch-thick intermediate cover.

The Final Closure and Post-Closure Care Plan, which is provided in Attachment 9, includes the final closure schedule, certification of closure, and an estimate of the largest area that will ever require final cover at the landfill in the year to follow closure. The final closure cost estimate for this area is provided in Attachment 8 – Closure and Post-Closure Care Cost Estimates.

3.8.2 Post Closure Care

At the time of closure, consistent with 30 TAC Subchapter K, the landfill will enter the 30-year post-closure care period. A description of the activities required during post-closure care are described in Attachment 9 of this application. A post-closure care cost estimate is provided in Attachment 8.

3.9 LANDFILL GAS MANAGEMENT (30 TAC §330.63(G))

Attachment 11 – Landfill Gas Management Plan provides procedures for monitoring landfill gas at the landfill perimeter and within onsite structures, layout or the perimeter landfill gas monitor probes, frequency for landfill gas monitoring, and procedures to be implemented in the event landfill gas is detected above regulatory limits. Drawing 11.1 – Landfill Gas Monitoring Probe Plan, provided in Attachment 11, depicts the layout of the perimeter landfill gas monitoring probe system.

3.10 PROTECTION OF ENDANGERED SPECIES (30 TAC §330.63(B)(5))

Information regarding the protection of endangered species in accordance with 30 TAC §330.157 is provided in Parts I/II, Section 12 – Protection of Endangered or Threatened Species.

3.11 CITIZENS' CONVENIENCE STATION METHODS

The Owner will construct a CCS on the facility property at the location shown on Attachment 1, Drawing 1.2. The CCS will be used to reduce traffic at the working face of the landfill, specifically associated with traffic from citizens with small or light vehicles. This CCS will be used for the acceptance and storage of waste, which will be disposed at the working face, and acceptance and storage of recyclables (i.e., aluminum, glass, plastic, cardboard/newspaper, scrap metal, large items and/or white goods, and whole used or scrap tires) for transport to an authorized recycling or disposal facility.

The CCS will be comprised of an elevated deck area (unloading area) with an all-weather surface, with collection containers situated behind a retaining wall for unloading of waste and recyclables into the containers. The retaining wall will be designed with a straight or z-pattern configuration for staging the containers behind the wall. The retaining wall will be constructed from either stackable reinforced concrete blocks, reinforced concrete, or other suitable materials, as designed by a professional engineer licensed in the State of Texas. The design of the CCS retaining wall and elevated unloading area will be maintained in the Site Operating Record of the landfill.

Waste and recyclable materials will be stored in separate containers (roll-offs) or locations (i.e., tires and large items and/or white goods) at the CCS. Each container or location will be properly identified for the types of waste or recyclable to be received. The type of container or storage mechanism will be based on the individual waste stream (see Part IV – Site Operating Plan for specifics on containers and storage locations).

Access to the CCS will be through the site entrance and all-weather landfill access roads, as described in Section 3.3. The Gate Attendant will direct citizens with small or light vehicles to unload waste at the CCS. Specifics on waste acceptance, waste unloading, fire protection, and overall operations of the CCS are provided in Part IV.

APPENDIX IIIA

SITE LIFE CALCULATIONS

SCS Engineers
TBPE Reg. # F-3407

Inclusive of pages III-A-1 to III-A-3

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW - 2400
WASTE DISPOSAL CAPACITY AND SITE OPERATING LIFE CALCULATIONS

Required: **Perform Disposal Capacity and Site Operating Life Calculations for Landfill**

1. Estimate Capacity of East Disposal Area.
2. Estimate Capacity of West Disposal Area
3. Estimate Total Waste Capacity of Landfill
4. Estimate Site Operating Life of Landfill

Solution: 1. Estimate Capacity of East Disposal Area.

a.	Gross airspace from AutoCAD volume calculation =					~~18,619,819~~	18,541,083	cy
b.	Airspace consumed by final cover (cy) =							
	~~112.9~~	112.7	acres	at	3.5 feet thick =	~~-637,509~~	-636,379	cy
c.	Airspace consumed by Bottom Liner and Protective Cover =							
	~~112.9~~	112.7	acres	at	4 feet thick =	~~-728,581~~	-727,291	cy
d.	Adjusted Gross Airspace Volume =					~~17,253,729~~	17,177,413	cy
e.	Percent of airspace consumed by Daily and Intermediate cover =						20	percent
f.	Net Airspace Available for Waste Disposal =					~~13,802,983~~	13,741,930	cy
g.	In-place waste density =						1,200	lb/cy
h.	Total East Waste Disposal Capacity =					~~8,281,790~~	8,245,158	tons

Available East Waste Disposal Capacity (tons) = 8,245,158 ~~8,281,790~~ tons

2. Estimate Capacity of West Disposal Area

a.	Total airspace from AutoCAD volume calculation =					~~8,489,129~~	8,229,389	cy
b.	Airspace consumed by final cover (cy) =							
	~~62.8~~	61.6	acres	at	3.5 feet thick =	~~-354,611~~	-347,835	cy
c.	Airspace consumed by Bottom Liner and Protective Cover (assume 4' liner, Sideslopes Only) =							
	~~62.8~~	61.6	acres	at	4 feet thick =	~~-405,269~~	-397,525	cy
d.	Adjusted Airspace Volume =					~~7,729,249~~	7,484,029	cy
e.	Percent of Airspace Consumed by Daily and Intermediate Cover =						20	percent [(1)]
f.	Net Total Airspace Available for Waste Disposal =					~~6,183,399~~	5,987,223	cy
g.	In-place Waste Density =						1,200	lb/cy
h.	Total West Waste Disposal Capacity =					~~3,710,040~~	3,592,334	tons

Available West Waste Disposal Capacity (tons) = 3,592,334 ~~3,710,040~~ tons

3. Estimate Total Waste Capacity of Landfill

From above:

Available East Waste Disposal Capacity (tons) =	~~8,281,790~~	8,245,158	tons
Available West Waste Disposal Capacity (tons) =	~~3,710,040~~	3,592,334	tons

Maximum Inventory of Waste at Time of Closure = 11,837,492 ~~11,991,829~~ tons

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW - 2400
WASTE DISPOSAL CAPACITY AND SITE OPERATING LIFE CALCULATIONS

4. Estimate Site Operating Life of Landfill

For the Site operating life calculations, the Waste Acceptance Rate is based on the following assumptions:

Days of operation per year =	286	days
Initial Daily Waste Acceptance Rate =	1,070	tpd
Assumed Growth Rate (Life of Landfill) =	1.25	% (annually)
Initial Annual Waste Acceptance Rate =	305,000	tpy
Maximum Inventory of Waste at Time of Closure =	11,837,492	tons

The following table calculates the waste stream growth, assuming the growth rates describe above, and the projected cumulative airspace consumed.

Year	MSW Inflow (tons/yr)	Cumulative Disposal Capacity Consumed (tons)	Disposal Capacity Remaining (tons)	Disposal Year
2024	305,000	305,000	11,532,492	1
2025	308,813	613,813	11,223,680	2
2026	312,673	926,485	10,911,007	3
2027	316,581	1,243,066	10,594,426	4
2028	320,538	1,563,605	10,273,888	5
2029	324,545	1,888,150	9,949,343	6
2030	328,602	2,216,751	9,620,741	7
2031	332,709	2,549,461	9,288,031	8
2032	336,868	2,886,329	8,951,163	9
2033	341,079	3,227,408	8,610,084	10
2034	345,343	3,572,751	8,264,741	11
2035	349,659	3,922,410	7,915,082	12
2036	354,030	4,276,440	7,561,052	13
2037	358,456	4,634,896	7,202,596	14
2038	362,936	4,997,832	6,839,660	15
2039	367,473	5,365,305	6,472,187	16
2040	372,066	5,737,371	6,100,121	17
2041	376,717	6,114,088	5,723,404	18
2042	381,426	6,495,515	5,341,978	19
2043	386,194	6,881,708	4,955,784	20
2044	391,021	7,272,730	4,564,762	21
2045	395,909	7,668,639	4,168,853	22
2046	400,858	8,069,497	3,767,995	23
2047	405,869	8,475,366	3,362,127	24
2048	410,942	8,886,308	2,951,184	25
2049	416,079	9,302,387	2,535,106	26
2050	421,280	9,723,666	2,113,826	27
2051	426,546	10,150,212	1,687,280	28
2052	431,878	10,582,090	1,255,402	29
2053	437,276	11,019,366	818,126	30
2054	442,742	11,462,108	375,384	31
2055	448,276	11,910,384	-72,892	32
~~2056~~	~~453,880~~	~~12,364,264~~	~~-526,772~~	~~33~~

Remaining available capacity will be consumed during 2056
Site life is projected to be approximately ~~33~~32 years.

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III
SITE DEVELOPMENT PLAN
ATTACHMENT 1
SITE LAYOUT PLANS

Prepared for:

CITY OF WACO

Solid Waste Services
501 Schroeder Drive
Waco, TX 76710

Prepared by:

SCS ENGINEERS
Texas Board of Professional Engineers, Reg. No. F-3407
Dallas/Fort Worth Office
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

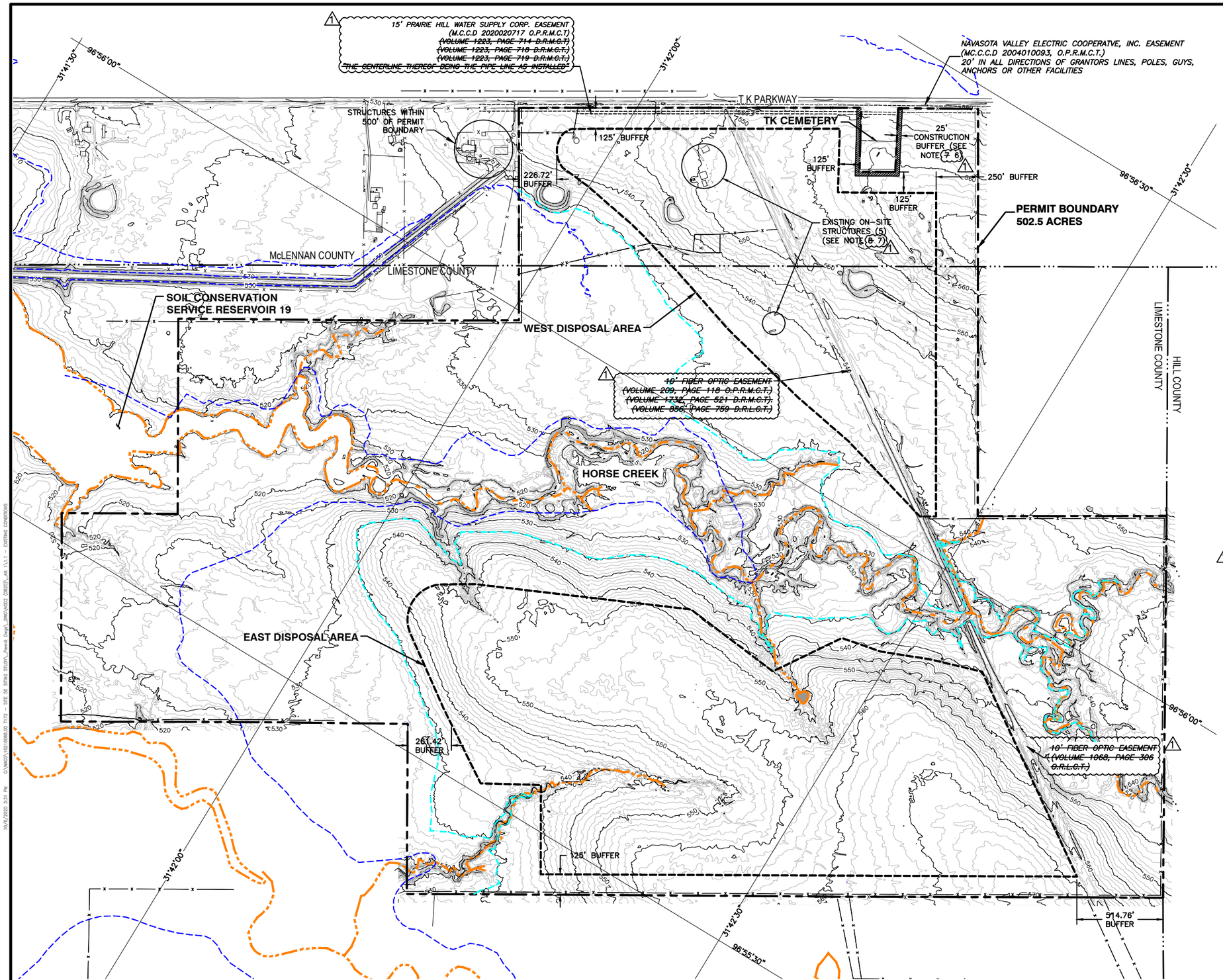
Revision 0 – April 2020
Revision 1 – October 2020
SCS Project No. 16216088.00

TABLE OF CONTENTS

Drawings

1.1 Existing Conditions Plan
1.2 Detailed Facility Layout and Sequence Plan
1.3 East Disposal Area Excavation Plan
1.4 West Disposal Area Excavation Plan
1.5 Entrance Facility Plan
1.6 Waste Flow Diagram

SCS Engineers
TBPE Reg. # F-3407



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- COUNTY LINE
- EXISTING FENCE
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- POTENTIAL JURISDICTIONAL WATER LOCATION (SEE NOTE 4)
- 96°55'30" LATITUDE/LONGITUDE LINES
- SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR, REFER TO NOTE 5)

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100-YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
3. CONSISTENT WITH TCEQ REGULATIONS A MINIMUM BUFFER ZONE OF 125' WILL BE MAINTAINED BETWEEN THE WASTE LIMIT BOUNDARY AND PERMIT BOUNDARY.
4. THE LOCATION OF THE POTENTIAL JURISDICTIONAL WATERS ARE REFERENCED FROM THE REPORT GENERAL JURISDICTION DETERMINATION PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC. (SEE APPENDIX I/IIA, AGENCY COORDINATION WITH THE COE).
5. ~~FIBER OPTIC LINE EASEMENT, VOLUME 209, PAGE 118 MCLENNAN CO. RECORDS, IF EXISTING AT TIME OF LANDFILL DEVELOPMENT, WILL BE RELOCATED PRIOR TO CONSTRUCTION OF SECTORS 9 THROUGH 13 AND WILL BE VACATED. IF FIBER LINE IS NOT INSTALLED WITHIN EASEMENT, THEN EASEMENT IS ABANDONED ON ITS OWN TERMS.~~
6. ~~5.~~ A FLOWAGE EASEMENT EXISTS ON THE PROPERTY THAT IS UNDER THE JURISDICTION OF THE TECHUACANA CREEK WATER CONTROL AND IMPROVEMENT DISTRICT NUMBER (1) OF LEROY, TEXAS SUBJECT TO THE EASEMENT RECORDED IN VOLUME 498, PAGE 118, VOLUME 506, PAGE 181, VOLUME 507, PAGE 378, AND VOLUME 509, PAGE 417 OF THE DEED RECORDS OF LIMESTONE COUNTY, TEXAS.
7. ~~7.~~ IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25-FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
8. ~~8.~~ 7. THE EXISTING STRUCTURES WITHIN THE BOUNDARY OF WASTE DISPOSAL AREA (WDA) WILL BE ABANDONED AND DEMOLISHED PRIOR TO DEVELOPMENT OF THE RESPECTIVE SECTORS (I.E. SECTORS 10 AND 11) OF THE WDA WHERE THE EXISTING STRUCTURE IS LOCATED.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, WATER SUPPLY EASEMENT, FIBER OPTIC EASEMENT, LIMITS OF WASTE, NOTE 2, AND RENUMBERED NOTES.	RRK

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: **EXISTING CONDITIONS PLAN**

PROJECT TITLE: **CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION**

CLIENT: **CITY OF WACO SOLID WASTE SERVICES**

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
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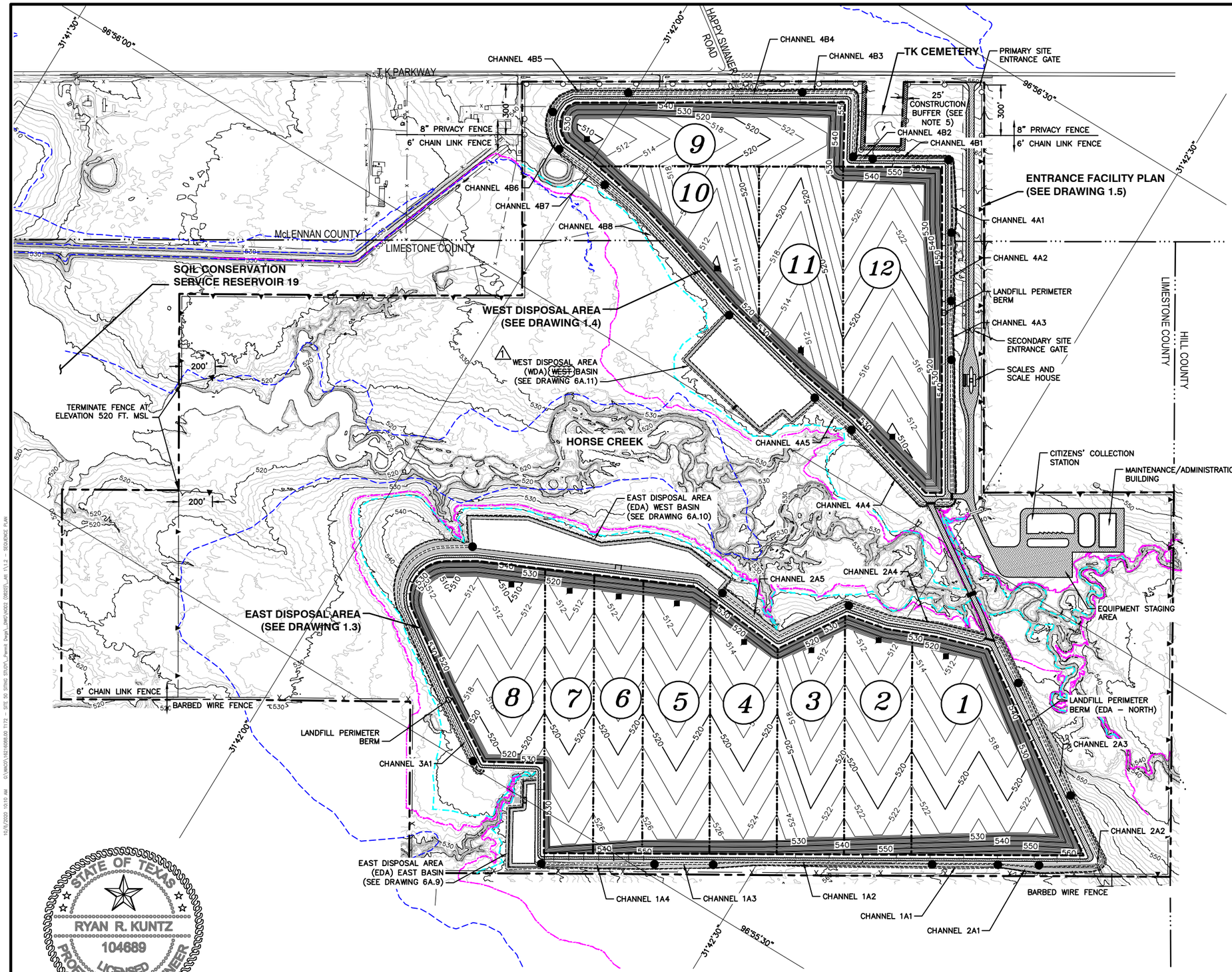
PROJ. NO. 16216088.00 | DSN. BY: BG | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 1.1 – EXISTING CONDITIONS

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. **1.1**



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100–YEAR FLOOD PLAIN (SEE NOTE 2)
- 100–YEAR STORM EVENT WATER SURFACE (SEE NOTE 6)
- X PROPOSED/EXISTING BARBED WIRE FENCE
- PROPOSED 6' CHAIN LINK FENCE
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- 510 EXCAVATION GRADE TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- 96°55'30" LATITUDE/LONGITUDE LINES
- X SECTOR DESIGNATION (SEE NOTE 4)
- CHANNEL SECTION
- 1 SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100–YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
3. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE EXCAVATION GRADES (BOTTOM OF LINER) ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
4. SECTOR DEVELOPMENT SEQUENCE REPRESENTED BY NUMBERING. SECTORS MAY BE DEVELOPED IN SMALLER INCREMENTS (AKA SUBSECTORS OR CELLS) WITH LINER CERTIFICATIONS SUBMITTED SEPARATELY TO TCEQ FOR REVIEW. IF SECTORS ARE DEVELOPED AS SMALLER CELLS, THE DOWN–GRADIENT CELLS WITH LEACHATE COLLECTION SUMP WILL BE DEVELOPED FIRST.
5. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25–FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
6. 100–YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC–HMS AND HEC–RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.

1 ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, BASIN CALLOUT, LIMITS OF WASTE, NOTE 2.	RRK

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: DETAILED FACILITY LAYOUT AND SEQUENCE PLAN

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
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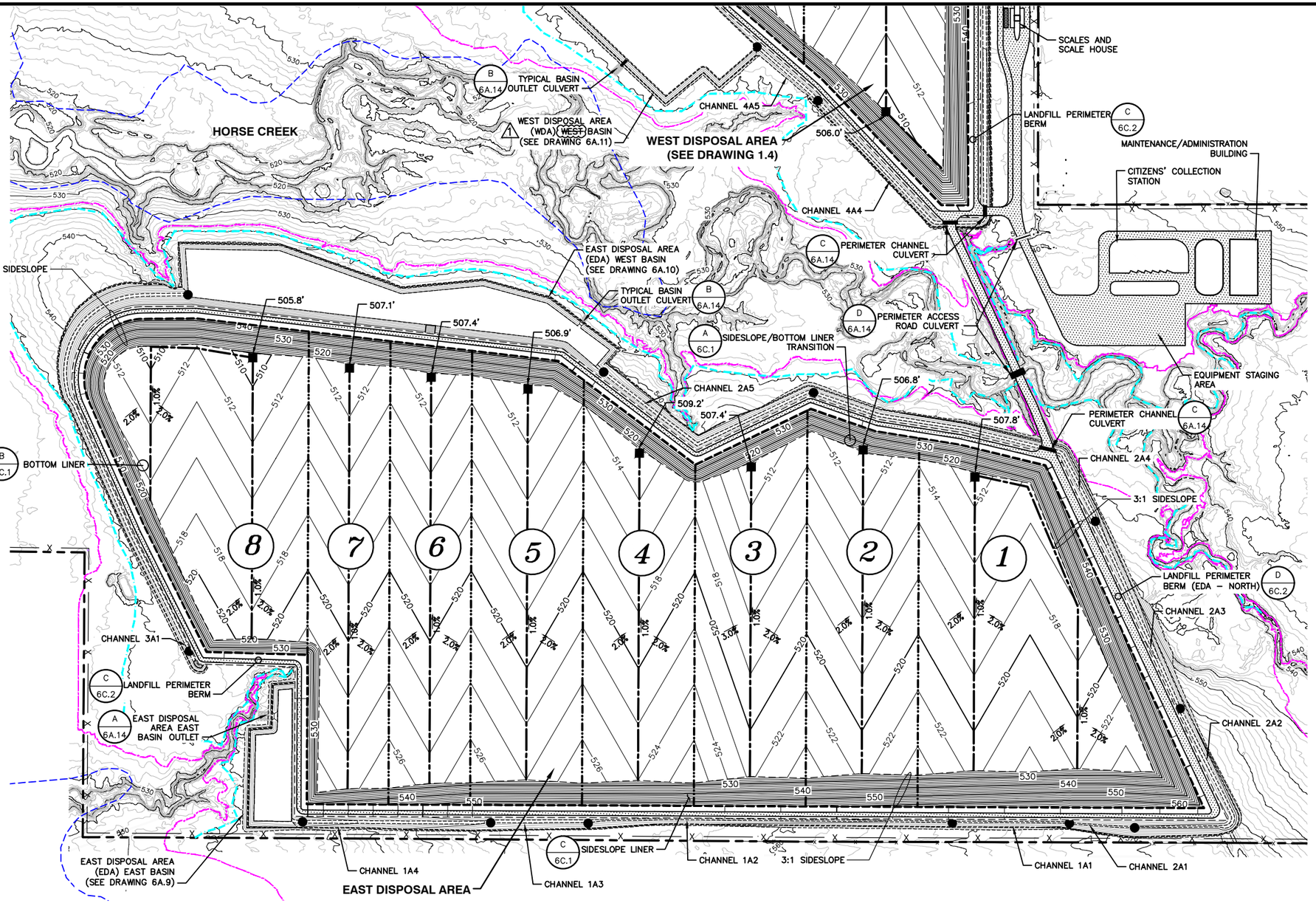
PROJ. NO. 16216088.00 | DSN. BY: BG/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 1.2 – SEQUENCE PLAN

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 1.2



0 200 400
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100–YEAR FLOOD PLAIN (SEE NOTE 2)
- 100–YEAR STORM EVENT WATER SURFACE (SEE NOTE 5)
- X PROPOSED/EXISTING PERIMETER FENCE (CHAIN LINK OR BARBED WIRE)
- ACCESS ROAD
- 510 EXCAVATION GRADE TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- LEACHATE COLLECTION TRENCH
- TOE/TOP OF SLOPE
- X SECTOR DESIGNATION (SEE NOTE 4)
- CHANNEL SECTION
- 506.0' BOTTOM OF SUMP ELEVATION
- SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100–YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
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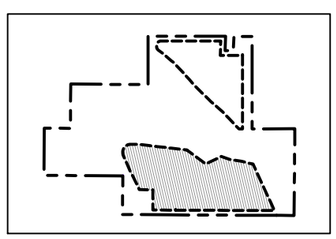
4. SECTOR DEVELOPMENT SEQUENCE REPRESENTED BY NUMBERING. SECTORS MAY BE DEVELOPED IN SMALLER INCREMENTS (AKA SUBSECTORS OR CELLS) WITH LINER CERTIFICATIONS SUBMITTED SEPARATELY TO TCEQ FOR REVIEW. IF SECTORS ARE DEVELOPED AS SMALLER CELLS, THE DOWN–GRADIENT CELLS WITH LEACHATE COLLECTION SUMP WILL BE DEVELOPED FIRST.
5. 100–YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC–HMS AND HEC–RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.



KEY MAP

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, BASIN CALLOUT, LIMITS OF WASTE, NOTE 2.	RRK

DRAWING TITLE: EAST DISPOSAL AREA EXCAVATION PLAN

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
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1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: BG/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

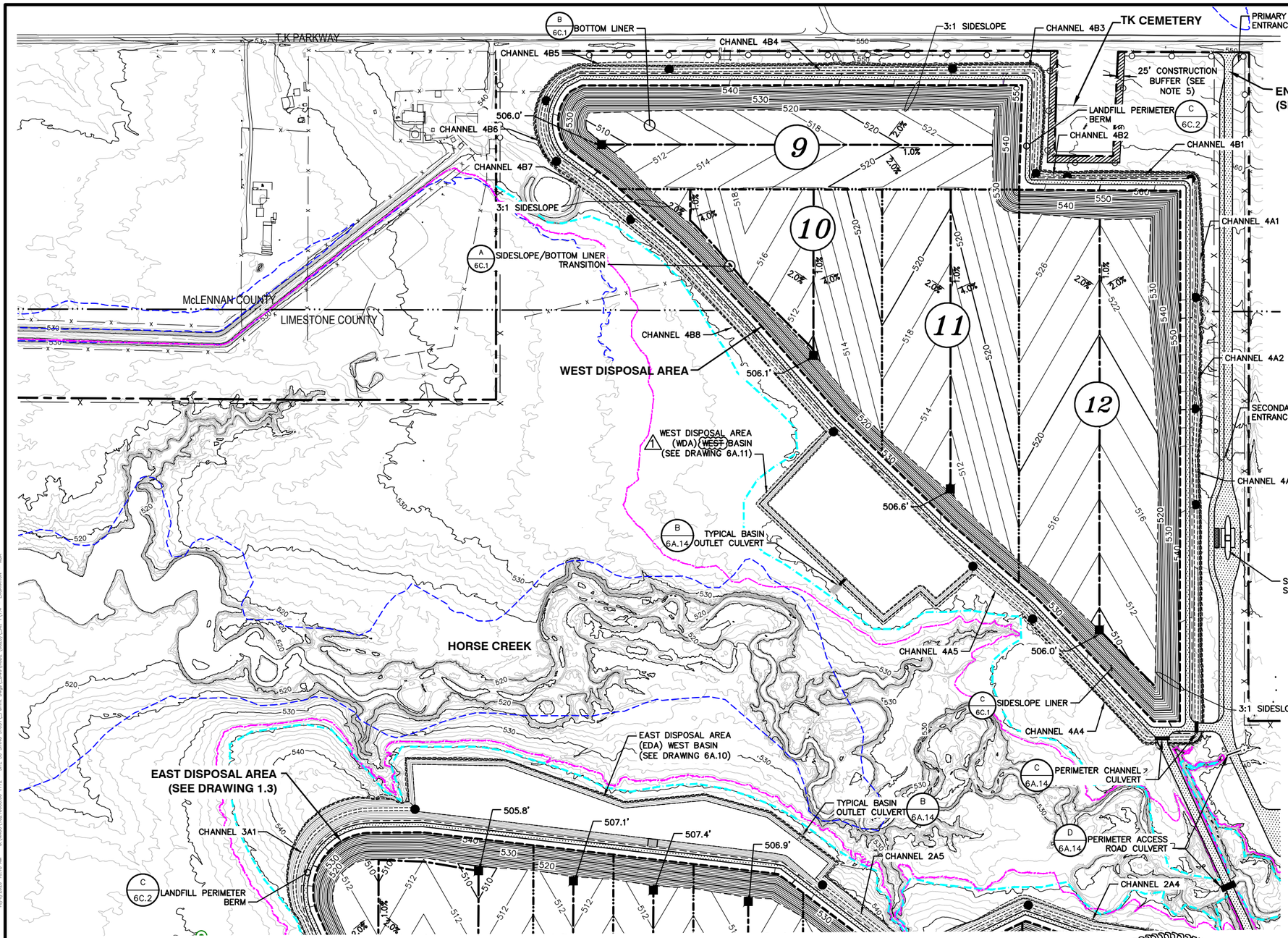
CADD FILE: 1.3 – EXCAVATION – EDA

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 1.3

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407



LEGEND

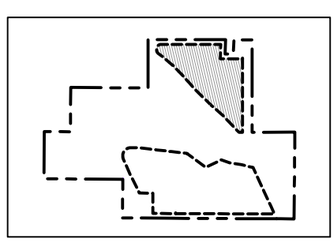
- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100–YEAR FLOOD PLAIN (SEE NOTE 2)
- 100–YEAR STORM EVENT WATER SURFACE (SEE NOTE 6)
- X PROPOSED PERIMETER FENCE (CHAIN LINK)
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- 510 EXCAVATION GRADE TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- LEACHATE COLLECTION TRENCH
- TOE/TOP OF SLOPE
- X SECTOR DESIGNATION (SEE NOTE 4)
- CHANNEL SECTION
- 506.0' BOTTOM OF SUMP ELEVATION
- SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

0 200 400
SCALE IN FEET

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100–YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
3. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE EXCAVATION GRADES (BOTTOM OF LINER) ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
4. SECTOR DEVELOPMENT SEQUENCE REPRESENTED BY NUMBERING. SECTORS MAY BE DEVELOPED IN SMALLER INCREMENTS (AKA SUBSECTORS OR CELLS) WITH LINER CERTIFICATIONS SUBMITTED SEPARATELY TO TCEQ FOR REVIEW. IF SECTORS ARE DEVELOPED AS SMALLER CELLS, THE DOWN–GRADIENT CELLS WITH LEACHATE COLLECTION SUMP WILL BE DEVELOPED FIRST.
5. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25–FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
6. 100–YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC–HMS AND HEC–RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.

1 ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.



KEY MAP

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, BASIN CALLOUT, LIMITS OF WASTE, NOTES 2.	RRK

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: WEST DISPOSAL AREA EXCAVATION PLAN

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

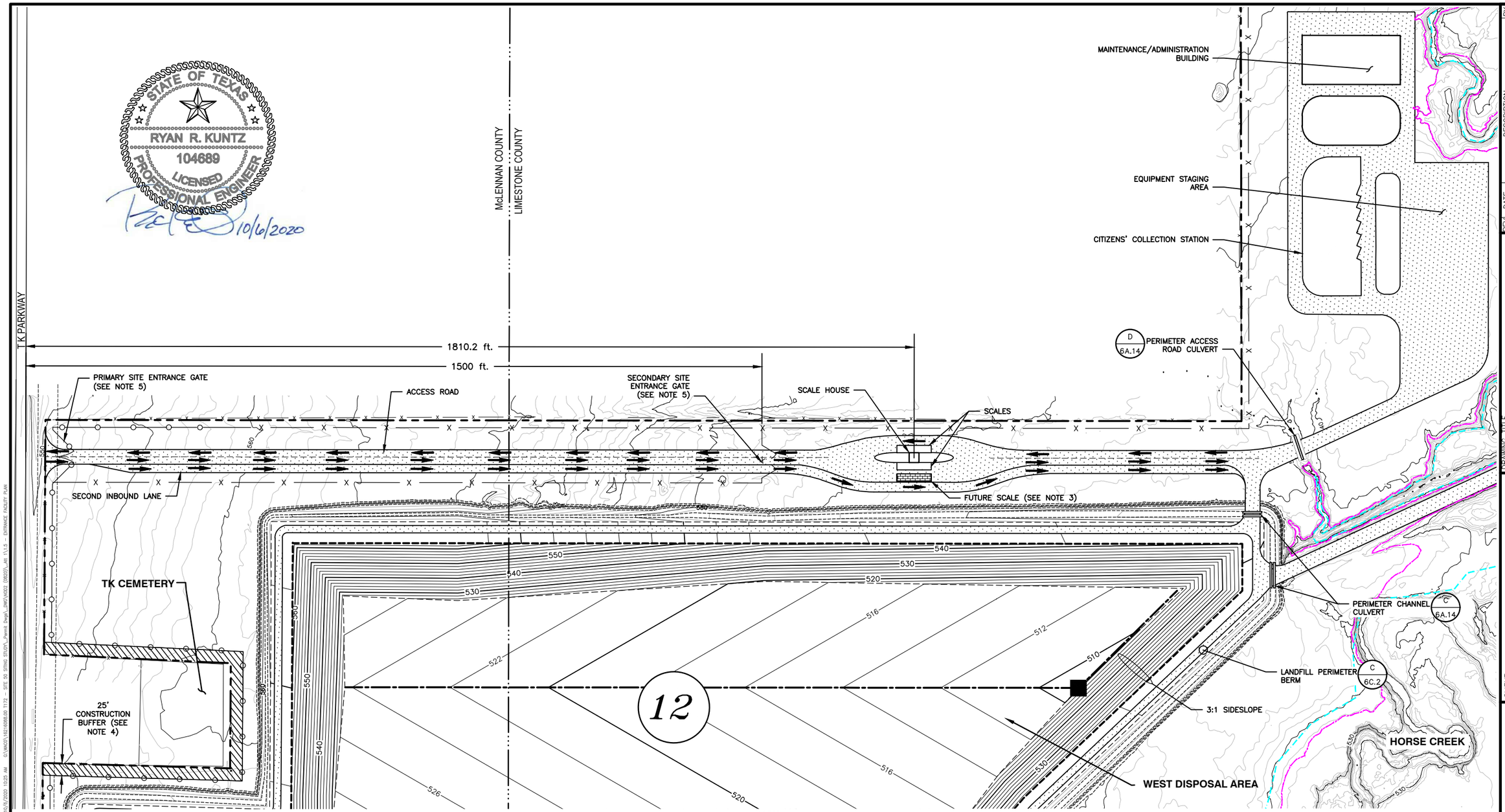
PROJ. NO. 16216088.00 | DSN. BY: BG/RRK | DWN. BY: NR | CHK. BY: BJD | C/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 1.4 – EXCAVATION – WDA

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 1.4



LEGEND

N

0 100 200
SCALE IN FEET

- PERMIT BOUNDARY
- 1 LIMITS OF WASTE
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100-YEAR STORM EVENT WATER SURFACE (SEE NOTE 6)
- X PROPOSED PERIMETER FENCE (CHAIN LINK)
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- 520 EXCAVATION GRADE TOPOGRAPHIC CONTOURS (SEE NOTE 2)
- LEACHATE COLLECTION TRENCH
- TOE/TOP OF SLOPE
- TRAFFIC FLOW ARROW
- 1 SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE EXCAVATION GRADES (BOTTOM OF LINER) ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
3. FUTURE INBOUND SCALE WILL BE INSTALLED AS NEEDED TO ACCOMMODATE INCREASES IN THE WASTE ACCEPTANCE RATE OVER THE SITE OPERATING LIFE.
4. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25-FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
5. THE PRIMARY ENTRANCE GATE WILL BE OPENED AT 5:30 AM ON DAYS THE SITE IS IN OPERATION TO ALLOW VEHICLE QUEUING PRIOR TO OPENING THE SITE FOR WASTE ACCEPTANCE.
6. 100-YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC-HMS AND HEC-RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.

1 ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOWAGE EASEMENT AND LIMITS OF WASTE.	RRK

DRAWING TITLE: **ENTRANCE FACILITY PLAN**

PROJECT TITLE: **CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION**

CLIENT: **CITY OF WACO SOLID WASTE SERVICES**

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
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PROJ. NO. 16216088.00 | DSN. BY: BG/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 1.5 – ENTRANCE FACILITY PLAN

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. **1.5**

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CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III
SITE DEVELOPMENT PLAN
ATTACHMENT 2
FILL CROSS SECTIONS

Prepared for:

CITY OF WACO

Solid Waste Services
501 Schroeder Drive
Waco, TX 76710

Prepared by:

SCS ENGINEERS
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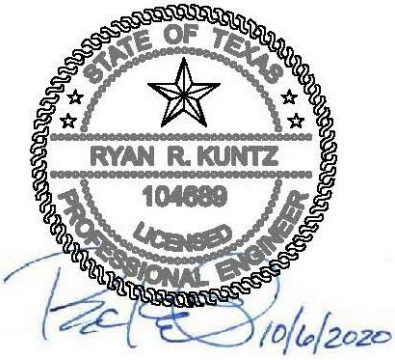
Bedford, Texas 76021
817/571-2288

Revision 0 – April 2020
Revision 1 – October 2020
SCS Project No. 16216088.00

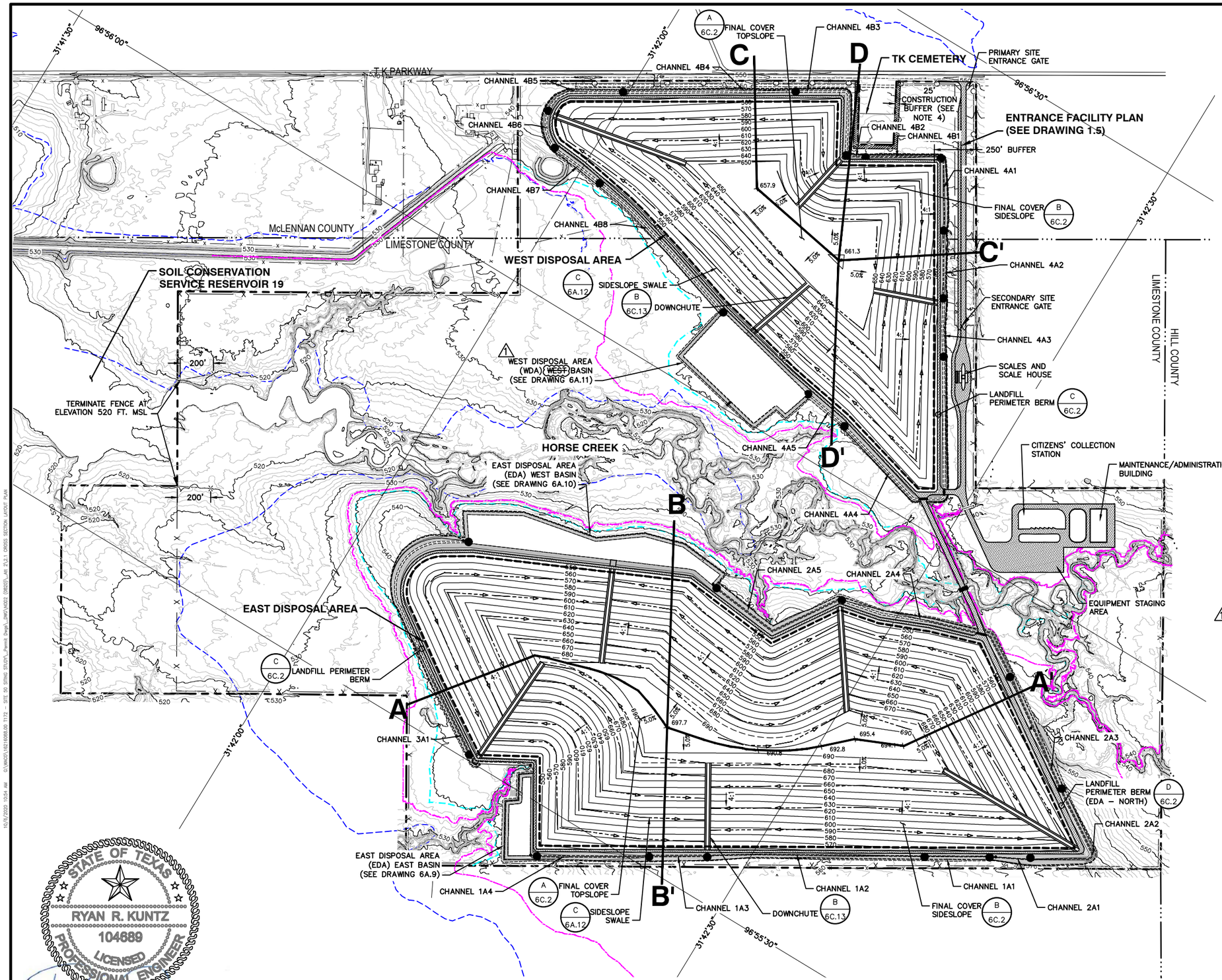
TABLE OF CONTENTS

Drawings

2.1 Cross Section Layout Plan
2.2 East Disposal Area Cross Section A-A'
2.3 East Disposal Area Cross Section B-B'
2.4 West Disposal Area Cross Sections C-C' and D-D'



SCS Engineers
TBPE Reg. # F-3407



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- 100-YEAR STORM EVENT WATER SURFACE (SEE NOTE 5)
- 650 FINAL COVER TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- X PROPOSED/EXISTING PERIMETER FENCE (CHAIN LINK OR BARBED WIRE)
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- DRAINAGE SWALES
- DOWNCHUTES
- CHANNEL SECTION
- A - A' CROSS-SECTION LOCATIONS
- 1 SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 1 100-YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
3. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE TOP OF FINAL COVER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
4. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX 1/IIA), A 25-FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
5. 100-YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC-HMS AND HEC-RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.

1 ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, BASIN CALLOUT, LIMITS OF WASTE, AND NOTE 2.	RRK

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: CROSS SECTION LAYOUT PLAN

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

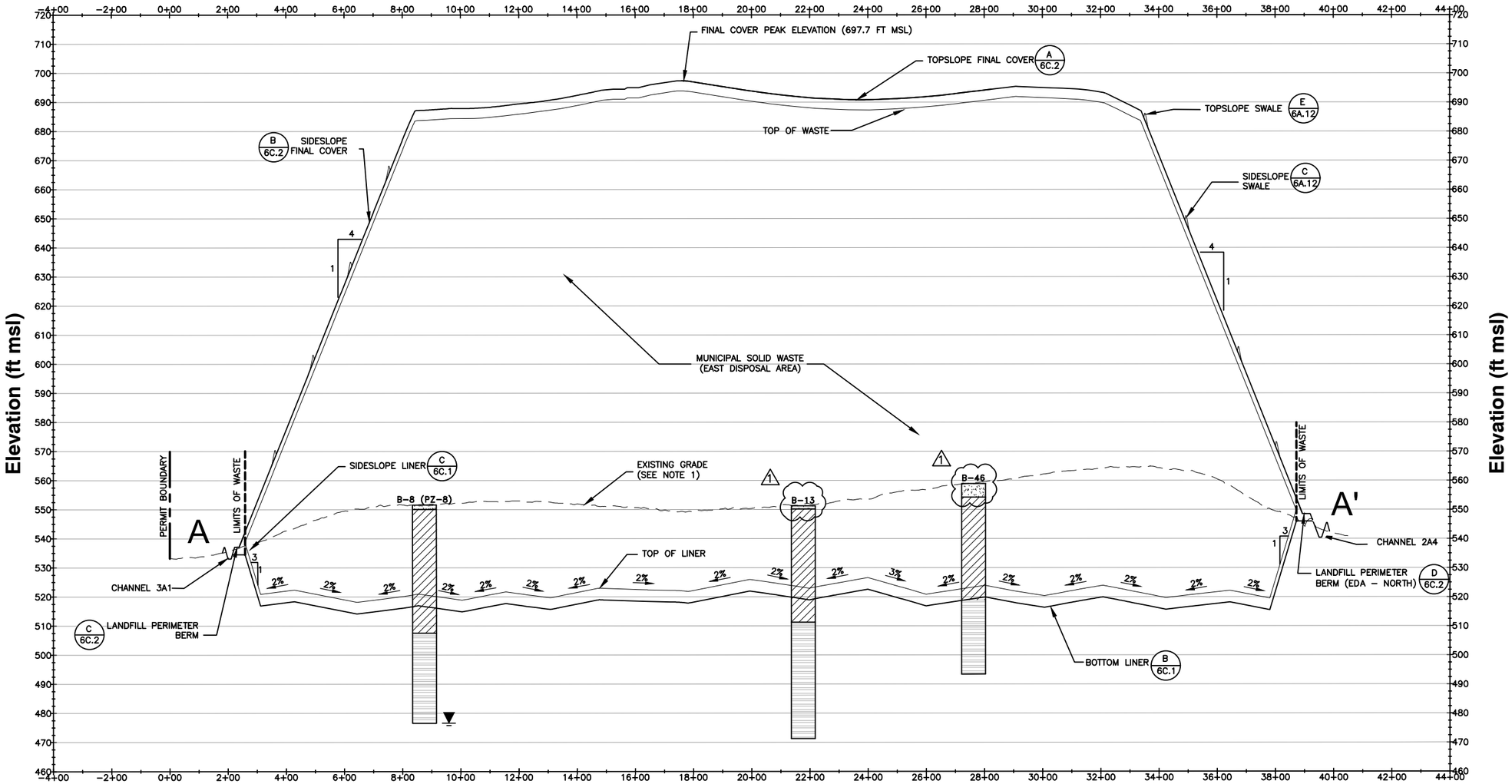
PROJ. NO. 16216088.00 | DSN. BY: BG/RRK | DWN. BY: NR | CHK. BY: BJD | S/A SVR BY: RRK | APP. BY: RRK

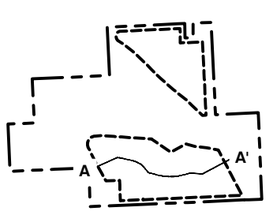
CADD FILE: 2.1 CROSS SECTION LAYOUT PLAN

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 2.1





KEY MAP

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SOIL (BROWN/BLACK CLAY)
- WEATHERED SHALE
- UNWEATHERED SHALE
- WATER LEVEL IN PIEZOMETER (05/01/2019)

0 200 400
HORIZONTAL SCALE IN FEET

0 20 40
VERTICAL SCALE IN FEET

NOTE:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS TO SOIL LAYER	RRK

DRAWING TITLE: EAST DISPOSAL AREA CROSS SECTION A-A'

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: BG/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

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DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 2.2

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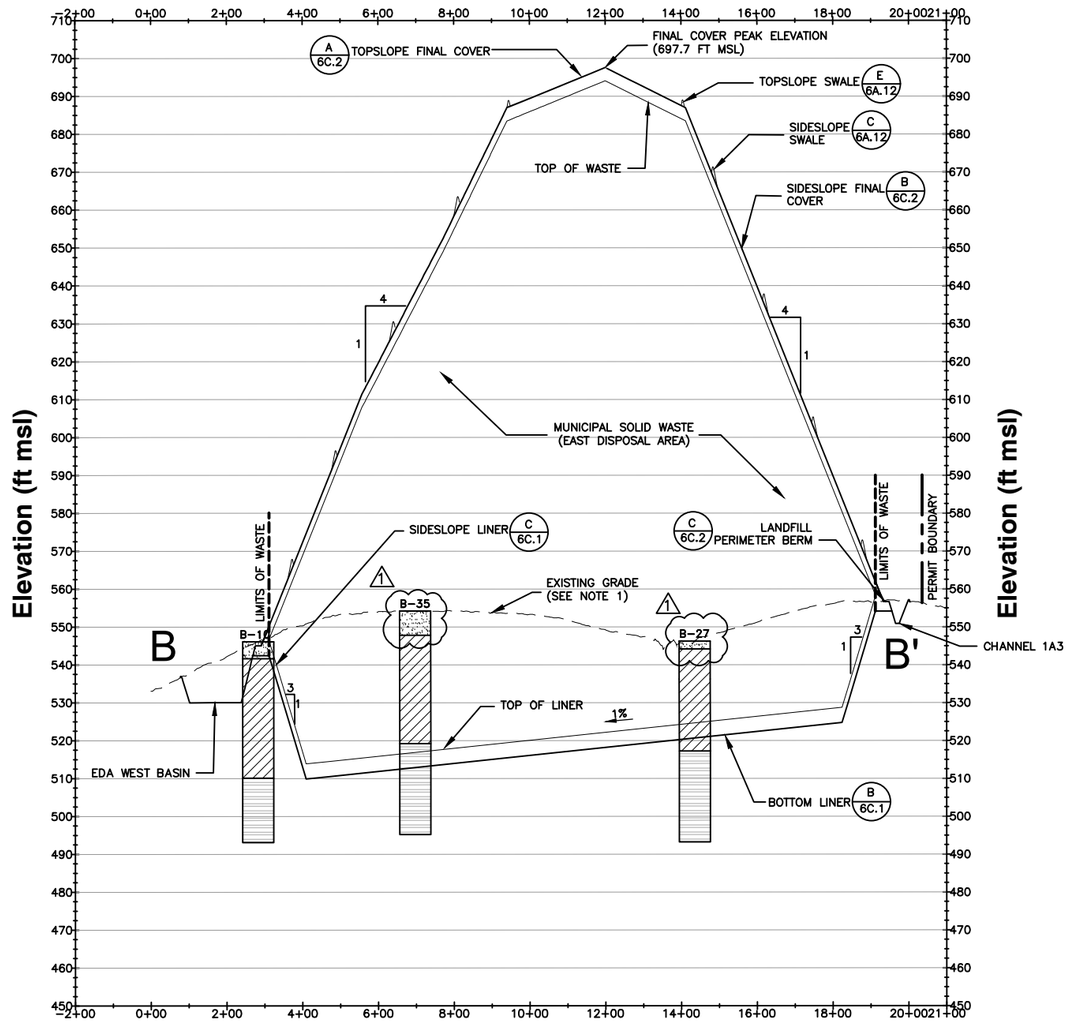

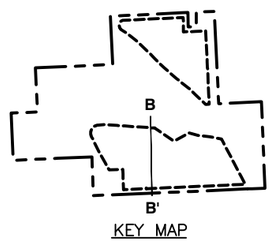

KEY MAP

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SOIL (BROWN/BLACK CLAY)
- WEATHERED SHALE
- UNWEATHERED SHALE

0 200 400
HORIZONTAL SCALE IN FEET

0 20 40
VERTICAL SCALE IN FEET

NOTE:

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STATE OF TEXAS
RYAN R. KUNTZ
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PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS TO SOIL LAYER	RRK

DRAWING TITLE: **EAST DISPOSAL AREA CROSS SECTION B-B'**

PROJECT TITLE: **CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION**

CLIENT: **CITY OF WACO SOLID WASTE SERVICES**

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: BG/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 2.2 ~ 2.4 CROSS SECTIONS EAST AND WEST DISPOSAL AREAS

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. **2.3**

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

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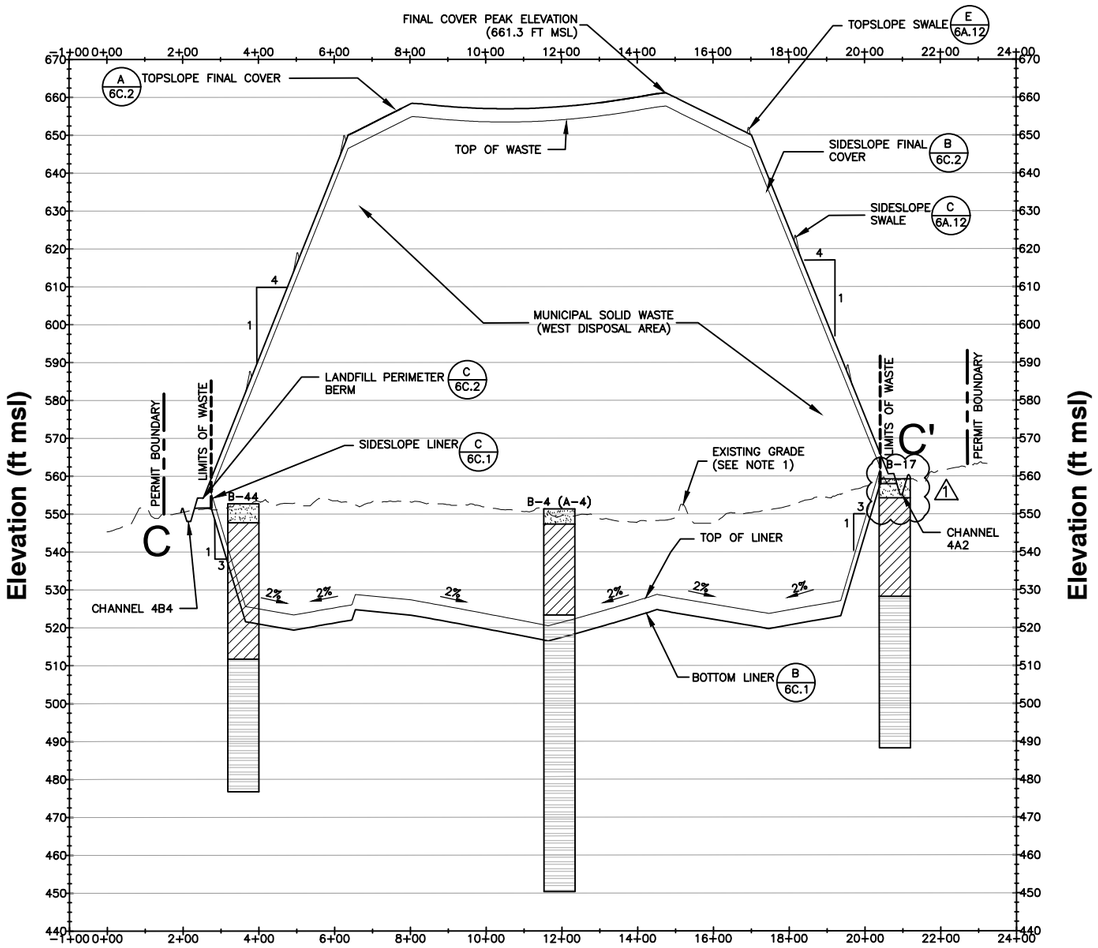
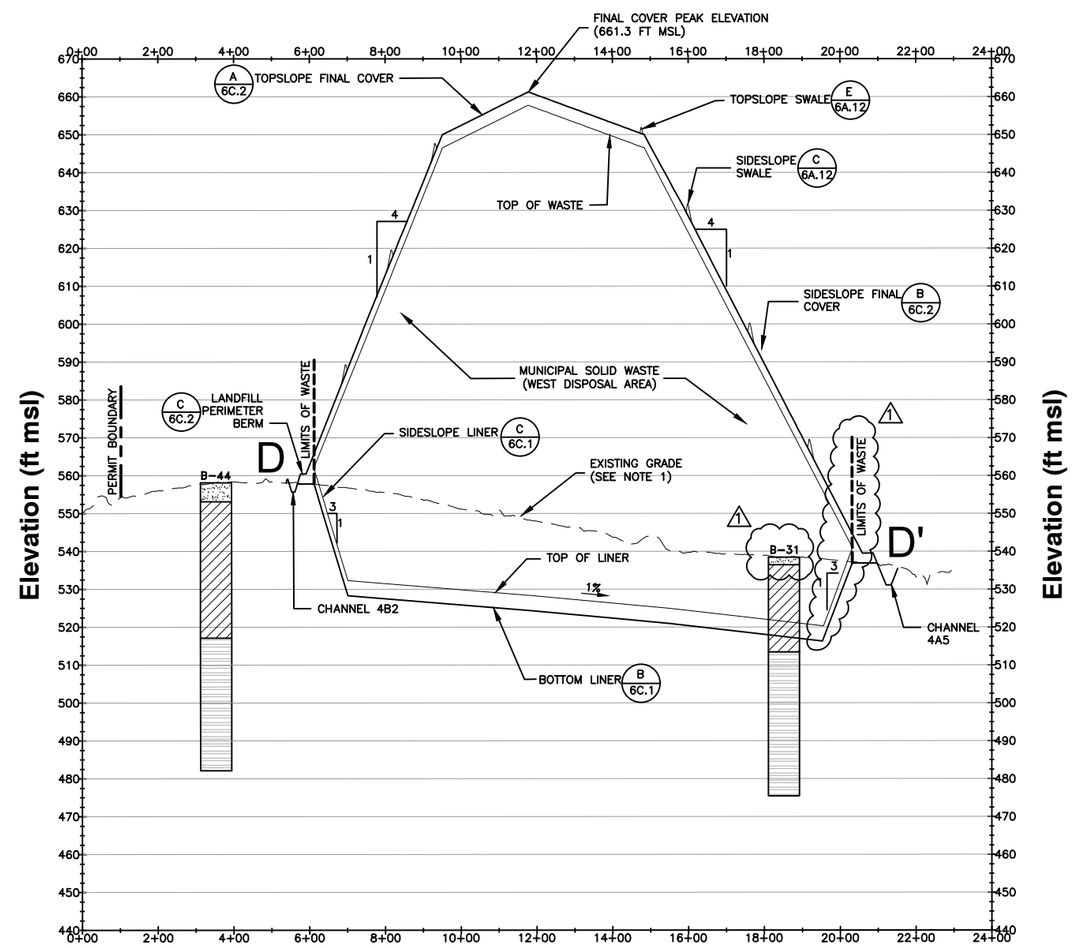
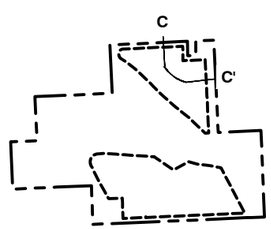
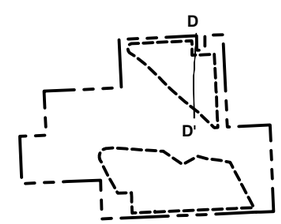






KEY MAP



KEY MAP

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SOIL (BROWN/BLACK CLAY)
- WEATHERED SHALE
- UNWEATHERED SHALE

0 200 400
HORIZONTAL SCALE IN FEET

0 20 40
VERTICAL SCALE IN FEET

NOTE:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS TO SOIL LAYER AND LIMITS OF WASTE	RRK

DRAWING TITLE: **WEST DISPOSAL AREA CROSS SECTIONS C-C' AND D-D'**

PROJECT TITLE: **CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION**

CLIENT: **CITY OF WACO SOLID WASTE SERVICES**

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: BG/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

CADD FILE: 2.2 – 2.4 CROSS SECTIONS EAST AND WEST DISPOSAL AREAS

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. **2.4**

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CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III
SITE DEVELOPMENT PLAN
ATTACHMENT 3
LANDFILL COMPLETION PLAN

Prepared for:

CITY OF WACO

Solid Waste Services
501 Schroeder Drive
Waco, TX 76710

Prepared by:

SCS ENGINEERS
Texas Board of Professional Engineers, Reg. No. F-3407
Dallas/Fort Worth Office
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

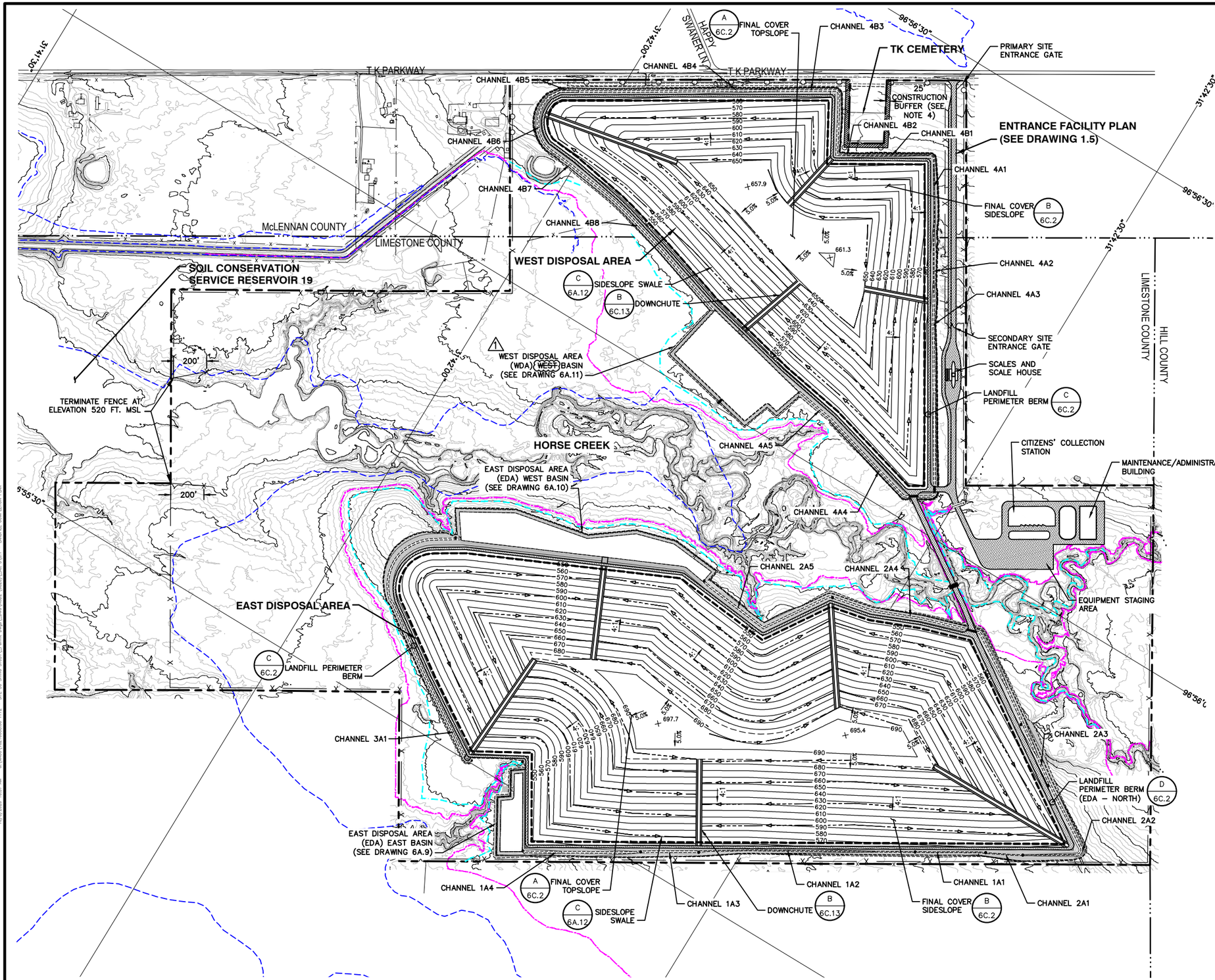
Revision 0 – April 2020
Revision 1 – October 2020
SCS Project No. 16216088.00

TABLE OF CONTENTS

Drawings

3.1 Landfill Completion Plan
3.2 East Disposal Area Landfill Completion Plan
3.3 West Disposal Area Landfill Completion Plan

SCS Engineers
TBPE Reg. # F-3407



LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100–YEAR FLOOD PLAIN (SEE NOTE 2)
- 100–YEAR STORM EVENT WATER SURFACE (SEE NOTE 5)
- 650 FINAL COVER TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- X PROPOSED/EXISTING PERIMETER FENCE (CHAIN LINK OR BARBED WIRE)
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- DRAINAGE SWALES
- DOWNCHUTES
- CHANNEL SECTION
- SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTES:

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1 ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, BASIN CALLOUT, LIMITS OF WASTE, NOTE 2.	

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: LANDFILL COMPLETION PLAN

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

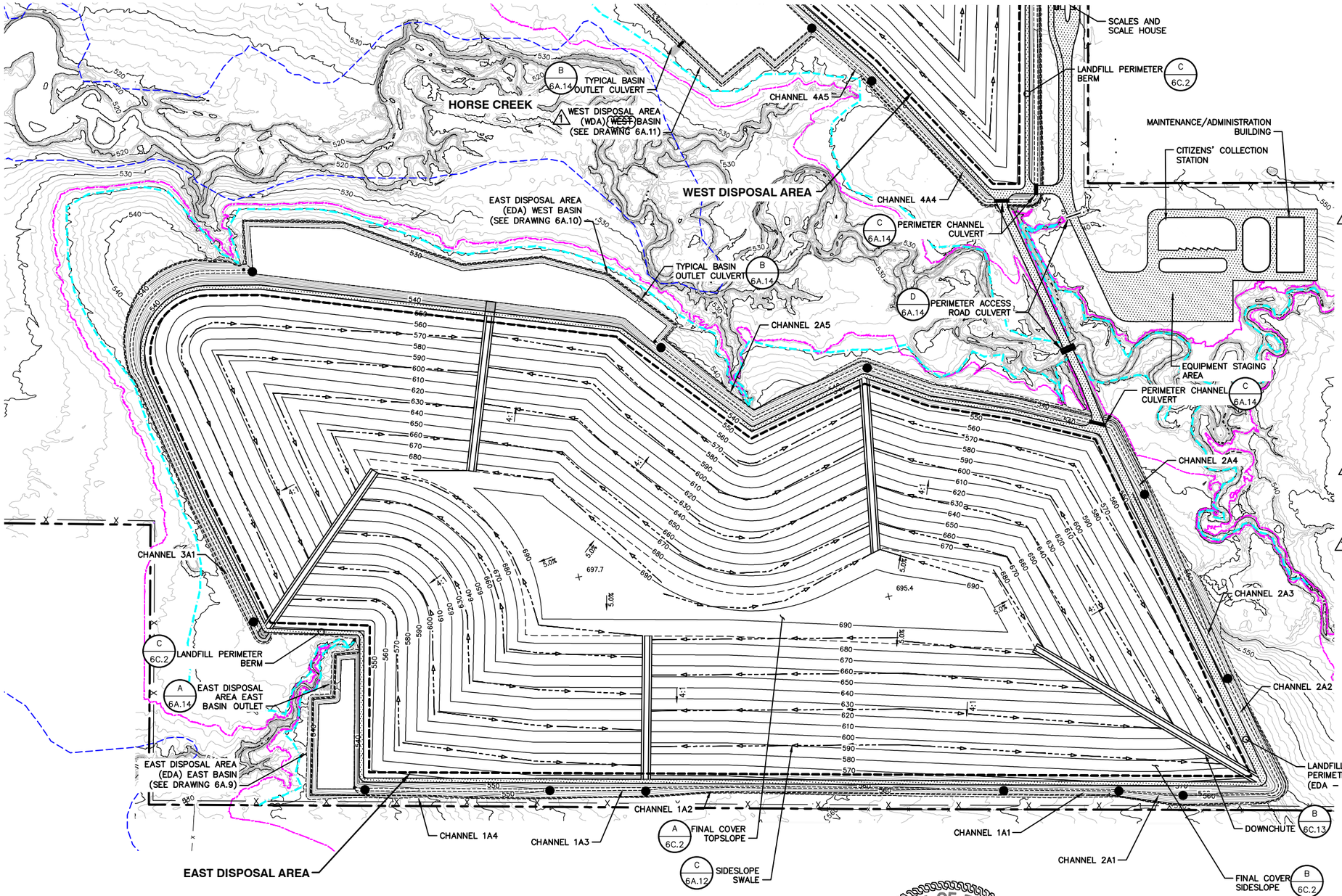
PROJ. NO. 16416068.00 | DSN. BY: BG/RRK | DWN. BY: NR | CHK. BY: BJD | S/A SVR BY: RRK | APP. BY: RRK

CADD FILE: 3.1 – LANDFILL COMPLETION PLAN

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 3.1



0 200 400
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- 100-YEAR STORM EVENT WATER SURFACE (SEE NOTE 5)
- 650 FINAL COVER TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- X PROPOSED/EXISTING PERIMETER FENCE (CHAIN LINK OR BARBED WIRE)
- ACCESS ROAD
- DRAINAGE SWALES
- DOWNCHUTES
- CHANNEL SECTION
- SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

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4. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE TOP OF FINAL COVER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
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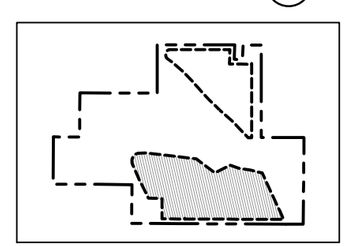
STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020



KEY MAP

1. ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, BASIN CALLOUT, LIMITS OF WASTE, AND NOTE 2.	RRK

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: EAST DISPOSAL AREA LANDFILL COMPLETION PLAN

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216068.00 | DSN. BY: BG/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

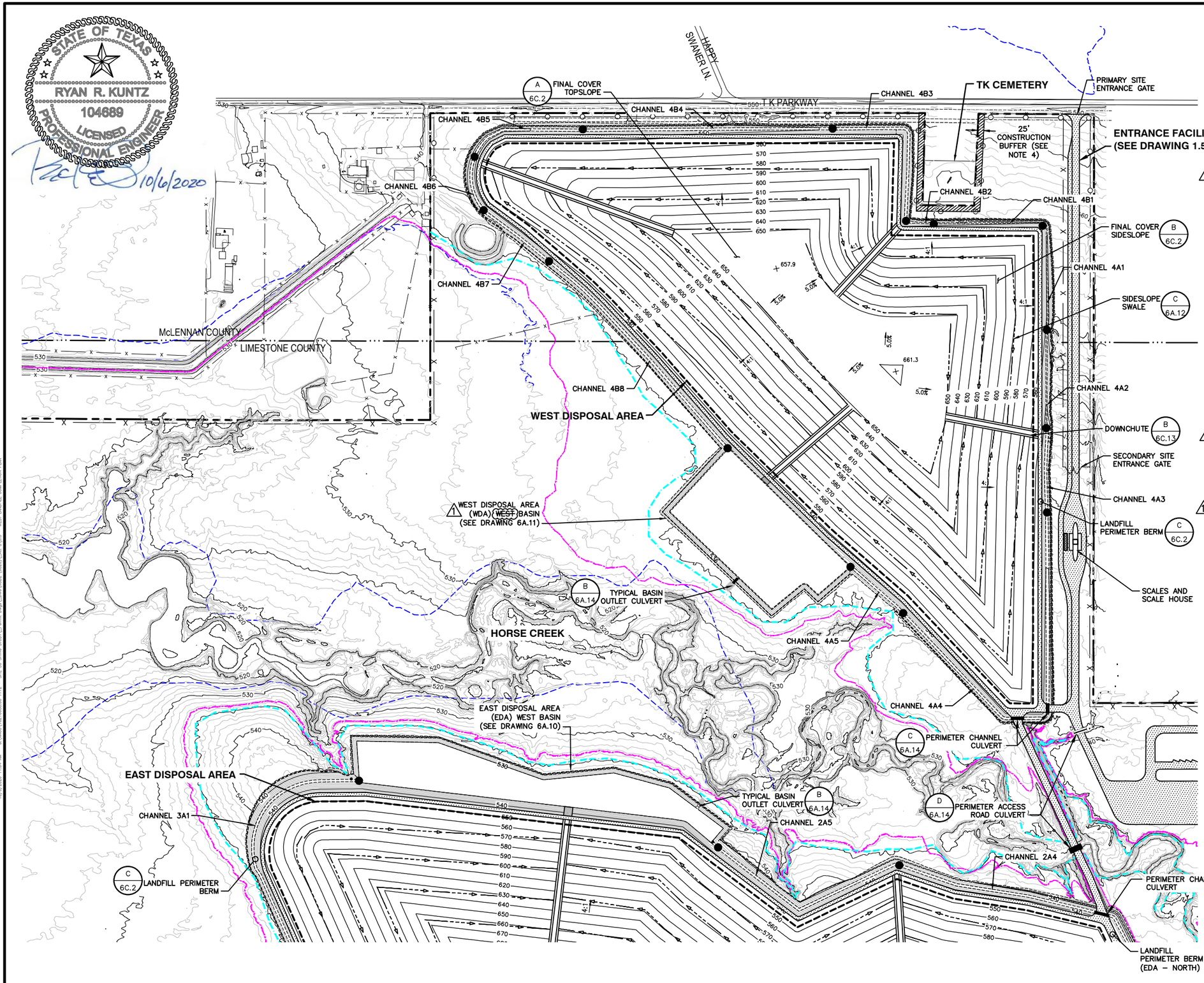
CADD FILE: 3.2 – EAST LANDFILL COMPLETION PLAN

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 3.2

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020



LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- 100-YEAR STORM EVENT WATER SURFACE (SEE NOTE 6)
- 650 FINAL COVER TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- PROPOSED PERIMETER FENCE (CHAIN LINK)
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
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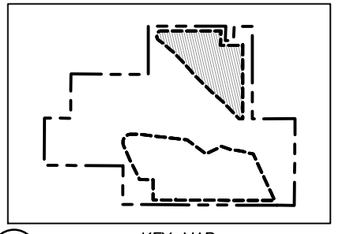


KEY MAP

1. ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, BASIN CALLOUT, LIMITS OF WASTE, AND NOTE 2.	RRK

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: WEST DISPOSAL AREA LANDFILL COMPLETION PLAN

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: SS | DWN. BY: SS | CHK. BY: RRK | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 3.3 – WEST LANDFILL COMPLETION PLAN

DATE: 04/2020

SCALE: AS SHOWN

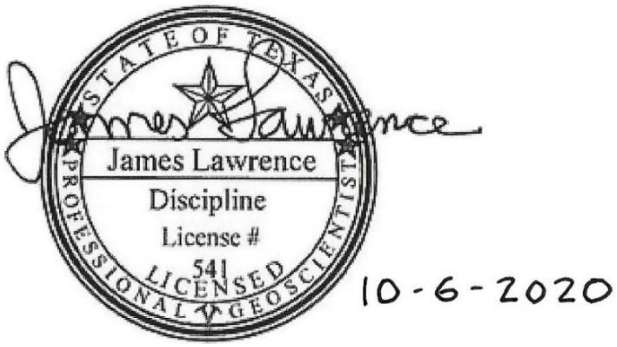
DRAWING NO. 3.3

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III - SITE DEVELOPMENT PLAN
ATTACHMENT 4
GEOLOGY AND GROUNDWATER REPORT

Prepared for:

CITY OF WACO



Solid Waste Services
501 Schroeder Drive
Waco, TX 76710

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TABLE OF CONTENTS

SECTION **PAGE**

1 INTRODUCTION 4-1-1
2 REGIONAL PHYSIOGRAPHY, TOPOGRAPHY, AND CLIMATE 4-2-1
2.1 PHYSIOGRAPHY AND TOPOGRAPHY 4-2-1
2.2 CLIMATE 4-2-1
3 GEOLOGY 4-3-1
3.1 GEOLOGIC SETTING 4-3-1
4 HYDROGEOLOGY 4-4-1
4.1 REGIONAL HYDROGEOLOGY 4-4-1
4.2 LOCAL GROUNDWATER USE 4-4-1
5 SUBSURFACE INVESTIGATION REPORT 4-5-1
5.1 PREVIOUS INVESTIGATION PROGRAMS 4-5-1
5.2 SITE STRATIGRAPHY 4-5-2
5.3 SOIL ENGINEERING PROPERTIES 4-5-3
6 GROUNDWATER INVESTIGATION REPORT 4-6-1
6.1 STANDPIPE PIEZOMETERS 4-6-1
6.2 VIBRATING WIRE PIEZOMETERS 4-6-1
6.3 GROUNDWATER INVESTIGATION RESULTS 4-6-2
7 POLLUTANT PATHWAYS 4-7-1
7.1 LOCAL HYDROGEOLOGY 4-7-1
8 GROUNDWATER QUALITY CHARACTERIZATION 4-8-1
8.1 OVERVIEW OF THE EXISTING GROUNDWATER MONITORING SYSTEM 4-8-1
8.2 GROUNDWATER MONITORING DATA 4-8-1
8.3 REGIONAL GROUNDWATER QUALITY 4-8-1
9 GROUNDWATER MONITORING PLAN 4-9-1
9.1 EXISTING GROUNDWATER MONITORING SYSTEM 4-9-1
9.2 PROPOSED GROUNDWATER MONITORING SYSTEM 4-9-1
9.3 GROUNDWATER MONITORING SYSTEM CERTIFICATION 4-9-3
10 GROUNDWATER SAMPLING AND ANALYSIS REQUIREMENTS 4-10-1
11 SUMMARY 4-11-1
12 REFERENCES 4-12-1

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Figures

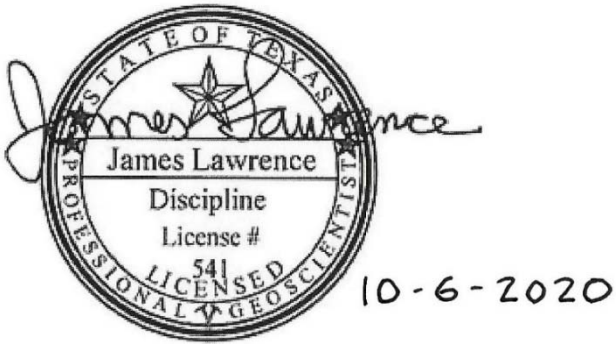
Figure - 4.1 Site Location Map
Figure - 4.2 Physiographic Map of Texas
Figure - 4.3 General Topographic Map
Figure - 4.4 Geologic Map
Figure - 4.5 Structural Cross Sections of Regional Geology and the Trinity Aquifer
Figure - 4.6 Seismic Impact Zone Map
Figure - 4.7 Tectonic Map of Texas
Figure - 4.8 Trinity Aquifer
Figure - 4.9 Boring Location Map
Figure - 4.10 Geologic Cross Section A-A'
Figure - 4.11 Geologic Cross Section B-B'
Figure - 4.12 Geologic Cross Section C-C'
Figure - 4.13 Geologic Cross Section D-D'
Figure - 4.14 Geologic Cross Section E-E'
Figure - 4.15 Geologic Cross Section F-F'
Figure - 4.16 Piezometer Location Map
Figure - 4.17 VWP Location Map
Figure - 4.18 Piezometer/Shallow VWP Potentiometric Map
Figure – 4.19 Deep VWP Potentiometric Map
Figure - 4.20~~19~~ Proposed GWM System Map
Figure - 4.21~~0~~ Typical Monitoring Well Detail

Tables

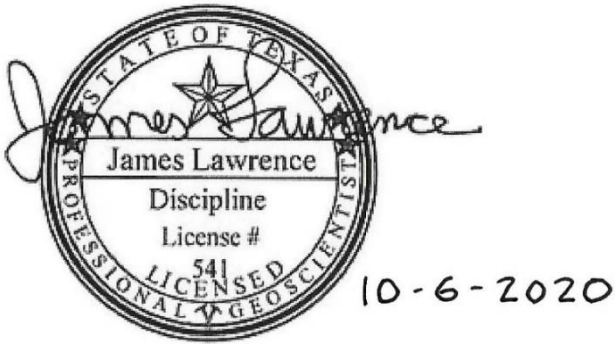
Table III-4.1 Regional Physiography
Table III-4.2 Waco Average Monthly Rainfall
Table III-4.3 Geologic Units and their Water-Bearing Properties
Table III-4.4 Recorded Wells within 1 Mile
Table III-4.5 Coordinates and Elevations of Borings
Table III-4.6 Properties of Unit I
Table III-4.7~~6~~ Properties of Unit II
Table III-4.8~~7~~ Properties of Unit III
Table III-4.9~~8~~ Existing Piezometer Completion Data
Table III-4.10~~9~~Summary Initial and Static Water Level Data
Table III-4.11~~0~~Vibrating Wire Piezometer Completion Data
Table III-4.12~~1~~Vibrating Wire Piezometer Inferred Groundwater Elevation Data
Table III-4.13~~2~~Summary of Aquifer (Slug) Tests Performed by SCS Engineers
Table III-4.14~~3~~Summary of Horizontal Flow Rate Calculation Data
Table III-4.15~~4~~Proposed Monitoring Well Information

Appendices

Appendix III-4.A Soil Resource Report
Appendix III-4.B Well Search Data
Appendix III-4.C Soil Boring Plan
Appendix III-4.D Boring Logs
Appendix III-4.E State Well Reports



Appendix III-4.F	Geotechnical Investigation Reports
Appendix III-4.G	Vibrating Wire Piezometer Manual and Calibration Forms
Appendix III-4.H	Standpipe Piezometer Completion Data
Appendix III-4.I	Vibrating Wire Piezometer Completion Data
Appendix III-4.J	Precipitation and Groundwater Elevation Data
Appendix III-4.K	Standpipe Piezometer Historic Water Level Data
Appendix III-4.L	Vibrating Wire Piezometer Historic Water Level Data
Appendix III-4.M	Slug Test Data



5 SUBSURFACE INVESTIGATION REPORT

5.1 PREVIOUS INVESTIGATION PROGRAMS

A soil boring plan for the Landfill was submitted September 7, 2018 and approved by the TCEQ in a letter dated October 4, 2018. Soil boring investigations of the Landfill began with drilling conducted in January 2018. A total of 5 borings (A-1 through A-5) were completed at that time, with depths ranging from 48 feet to 101 feet-bgs. A second phase of drilling occurred during October 2018 through January 2019, in which an additional 42 borings (B-6 through B-47) were advanced between 28 to 80 feet in depth (see Appendix III-4.C – Soil Boring Plan). In December 2019, additional deep borings were drilled adjacent to B-9 and B-43 to depths of 135 feet and 150 feet, respectively. Conventional standpipe piezometers were installed in the following ten borings: B-1 (PZ-1), B-3 (PZ-3), B-8 (PZ-8), B-9 (PZ-9), B-18 (PZ-18), B-20 (PZ-20), B-33 (PZ-33), B-41 (PZ-41), B-43 (PZ-43), and B-47 (PZ-47). Boring logs are included in Appendix III-4.D. State well reports are included in Appendix III-4.E.

Water level measurements obtained in the ten conventional standpipe piezometer installations described above indicated groundwater was observed in five~~our~~ out of ten piezometers. In order to obtain additional groundwater data, Vibrating Wire Piezometers [VWPs] were installed in 24 locations. VWPs are further described in Section 6.2. Initially, 17 shallow VWPs were installed at locations correlating to the existing conventional standpipe piezometers [10 VWPs] and seven other locations of interest corresponding to existing borings. Subsequently, in order to observe deeper Unit III conditions, an additional seven deep VWPs were installed at locations corresponding to existing conventional standpipe piezometers, for a total of 24 VWPs installed during the investigation.

The number and depth of borings were included in the determination to meet the requirements of 30 TAC §330.63(e)(4)(A) and (B) for the Landfill, as described in the boring plan that was approved by the TCEQ (Appendix III-4.C). A summary of borings with elevations and coordinates is provided in Table III-4.5. The Elevation of Deepest Excavation (EDE) is 505 ft-msl. As listed, 22 borings were advanced to an elevation 30 feet below the EDE and 2 borings [9D and 43D] were advanced to an elevation 100 feet below the EDE, whereas the total depth of the remaining 23 borings were generally drilled to an elevation 5-10 feet below the EDE. The locations of all the Landfill borings are shown on Figure-4.9.

The borings were advanced using hollow stem augers and were either completed as piezometers to provide groundwater elevation data or were plugged in accordance with 16 TAC §76.702 and §76.1004. Soil samples were collected during auger advancement utilizing Shelby tubes, two-foot split spoons (also used to collect standard penetration tests for geotechnical purposes), or five-foot NX continuous split barrels.

The boring logs from the site investigations are attached as Appendix III-4.D. Laboratory data on soil samples obtained during the investigations are found in Appendix III-4.F and summarized in Part III, Attachment 5, Geotechnical/Stability Analysis.

5.2 SITE STRATIGRAPHY

Site stratigraphy is consistent with the regional geologic setting described in Section 3.1. Site stratigraphy is illustrated through a series of 6 cross-sections (A-A' to F-F'), as shown on Figure-4.10 through Figure-4.15. These cross-sections utilize the borings completed by SCS Engineers.

Various parts of this application use the terms "shale" and "clay". Shale is classified by geologists as a rock-like material consisting primarily of the mineral clay. In shallower [near-surface] stratigraphy, where the lithology is a softer, more plastic material, the term "clay" is used as the descriptor. In deeper sections, the clay lithifies (hardens) due to overburden pressures and transitions to a more rock-like, fissile material termed "shale". This change from overlying clay to underlying shale is often transitional.

The geology observed in the site exploration program consisted primarily of clay and shale, with minor amounts of larger grain sizes. Three stratigraphic units have been identified at the Landfill:

- Unit I consists of surficial clayey and loamy sediments~~alluvium~~ overlying silty or sandy clays with small subrounded gravel, and also exhibits organic material in the uppermost horizon due to vegetation. The Unit I thickness ranged between 0.5~~1.5~~ and 7~~29~~ feet. The transition from Unit I to the underlying Unit II is transitional, and marked by increasing hardness and increasing fissility.
- Unit II, beneath Unit I, consists of weathered silty shale with varying calcareous content. Some publications use the term "marl" to describe calcareous shale. The Unit II silty shale has thin, interbedded limestone and sand/silt partings/lenses, calcite-filled joints, and marine shell fragment fossils. The top of Unit II was encountered at elevations ranging from approximately 485~~503.3~~ feet-msl to 559~~8.1~~ feet-msl. The thickness of Unit II ranged between 11.8~~7~~ and 49~~37.5~~ feet. The transition from Unit II to the underlying Unit III is marked by a color change caused by the downward limit of oxidation. Above the Unit II/Unit III line, the stratigraphy is generally more variable in color but are generally lighter-colored and have evidence of oxidation such as various rust- and yellow/brown colors. Below the Unit II/Unit III line, the stratigraphy is a homogenous very dark color, trending to black. Unit III also is less fissile than Unit II.
- Unit III, beneath Unit II, consists of unweathered dark gray to black calcareous shale bedrock with thin, interbedded limestone and sand/silt lenses, and marine shell fragment fossils. The top of Unit III was encountered at elevations ranging from approximately 492.0 feet-msl to 531.85 feet-msl. Landfill borings did not encounter the bottom of Unit III.

The bottom of the landfill excavation will be founded in Unit II or Unit III, depending on the location and depth of the cell excavation. Laboratory testing has been completed on samples of all three units, in accordance with the requirements of 30 TAC §330.63(e)(5). The geotechnical evaluation of Landfill materials and slope/waste stability is included in Part III, Attachment 5, Geotechnical/Stability Analysis. This design report presents the geotechnical summary and engineering evaluations and analyses. These analyses indicate that the soils at the Landfill are suitable for the intended purpose.

5.3 SOIL ENGINEERING PROPERTIES

Table III-4.6 summarizes the engineering properties of Unit I, based on the results from geotechnical investigations conducted by SCS Engineers in September 2020. The test method utilized during the investigation is listed in the table.

Table III-4.7~~6~~ summarizes the engineering properties of Unit II, based on the results from geotechnical investigations conducted by SCS Engineers. The test method utilized during the investigation is listed in the table. No piezometers were screened exclusively in Unit II. Hydraulic conductivity values obtained during the investigation [see Section 6.3] by slug test represent values at the screened interval at the Unit II/Unit III interface.

Table III-4.8~~7~~ summarizes the properties of Unit III, based on the results from geotechnical investigations conducted by SCS Engineers. The test method utilized during the investigation is listed in the table. Hydraulic conductivity results obtained during the investigation are based on EM 1110-2-1906 lab results and slug test results performed on the piezometers screened in Unit III.

6 GROUNDWATER INVESTIGATION REPORT

6.1 STANDPIPE PIEZOMETERS

Subsurface soil borings have been drilled at the landfill for geological and hydrogeological characterization. Standpipe piezometers were installed in ten of these borings, as described in Section 5.1. A map of standpipe piezometer locations is provided in Figure-4.16. Piezometer completion information is tabulated in Table III-4.9~~8~~. Stabilized water level data are tabulated in Table III-4.10~~9~~. Five~~Six~~ of ten existing standpipe piezometers did not have groundwater present. To provide additional data, vibrating wire piezometers were installed as further detailed below.

6.2 VIBRATING WIRE PIEZOMETERS

Vibrating wire piezometers (VWP) are pressure transducers that measure pore-water pressure. VWPs can detect pore-water pressure faster than conventional standpipe piezometers in low-permeability materials, because a newly installed standpipe piezometer may fill with water very slowly as it comes to equilibrium with groundwater. A newly installed VWP has a relatively much smaller cavity to fill with water, and therefore comes to equilibrium faster.

The VWP system consists of a pressure transducer, signal cable, and a readout device. It is installed as a dedicated instrument using a conventional drilling rig. After a borehole is drilled, the device is placed at the desired depth in filter media sand, and grouted from there to the ground surface.

After installation, pore-water enters the transducer through a filter and presses upon a diaphragm. This causes the diaphragm to deflect. This deflection is measured as a change in tension and frequency of vibration of the vibrating wire element. The square of the vibration frequency is directly proportional to the pressure applied to the diaphragm. The resulting pressure reading is a measure of water head pressure at that location. This water head pressure can be converted to a calculated groundwater elevation using device calibration information supplied for each device by the manufacturer. The Geokon 4500 VWP device was used for this investigation. The User Manual for the Geokon 4500 series and the calibration forms for each device are provided in Appendix III-4.G.

Seventeen VWP installations occurred in July 2019 through August 2019, two VWP installations occurred in October 2019, and five VWP installations occurred in December 2019; for a total of 24 VWP installations. Piezometer and VWP completion data are included in Appendix III-4.H and Appendix III-4.I, respectively. A summary of the VWP installations is provided in Table III-4.11~~0~~. A map of VWP locations is provided in Figure-4.17. State well reports are the driller's responsibility. The driller stated that the VWP installations do not meet the State definition of a well, and therefore do not require reporting.

6.2.1 Shallow VWPs

From July 2019 through August 2019, 17 VWPs were installed at various depths to provide a spatial distribution of these VWPs to characterize the weathered/unweathered shale formation. Results showed that 5 of 17 VWPs (VWP-1, VWP-3, VWP-18, VWP-30, and VWP-44) indicated the presence of water, resulting in calculated groundwater elevations shown in Table III-4.12~~1~~. Therefore, the data indicate the remaining 13 VWPs and the six adjacent dry standpipe piezometers were completed above any saturated zone.

Initial readings from VWP-20 indicated a small amount of water may have been carried down the borehole during drilling, but this dissipated to the in situ condition of no water indicated at this location.

6.2.2 Deep VWPs

In October 2019, to verify whether a continuous zone of saturation was located below existing dry standpipe piezometers and VWPs, two additional VWPs (VWP 41D and VWP 47D) were installed to a target elevation of 400 feet msl. Both VWPs indicated the presence of water, resulting in calculated groundwater elevations of 434~~22~~ ft-msl (VWP-41D) and 425~~16~~ ft-msl (VWP-47D) (see Table III-4.12~~1~~). These data provide evidence of an existing continuous lower groundwater system.

To verify data from VWP-41D and VWP-47D, in December 2019, five additional deep VWPs (VWP-8D, VWP-9D, VWP-18D, VWP-33D, VWP-43D) were installed to the same target elevation of 400 feet msl. All five VWPs indicated the presence of water, resulting in calculated groundwater elevations ranging from approximately 420~~08~~ feet to 519~~8~~ feet (see Table III-4.12~~1~~).

Due to shallow groundwater indicated by adjacent groundwater elevation readings of 519 feet at PZ-18 and 523 feet at VWP-18, casing was used during the installation of VWP-18D to eliminate infiltration from the upper groundwater system to the lower system within the borehole (Appendix III-4.I). Casing was set to an elevation of 461 feet. VWP-18D exhibits a stabilized calculated groundwater elevation of approximately 503~~484~~ feet.

VWP-8D and VWP-9D both exhibited calculated groundwater elevations above the elevations of adjacent shallow VWPs (VWP-8 and VWP-9) and elevations of the bottom of screen elevation for adjacent standpipe piezometers (PZ-8 and PZ-9) at their corresponding locations. VWP-8 and VWP-9 transducers have zero water pressure, and PZ-8 and PZ-9 have both remained dry. The higher calculated groundwater elevations of VWP-8D and VWP-9D are attributed to being under elevated pore pressure not propagated to the elevations of the adjacent [higher] shallow VWPs and standpipe piezometers, due to the very low hydraulic conductivity and resulting slow travel/equilibration time. These observations indicate that shallower groundwater may occur in isolated pods.

6.3 GROUNDWATER INVESTIGATION RESULTS

Two groundwater zones were identified as a result of site field investigations, classified by elevation as “shallow” and “deep” zones that are not marked by significant changes in lithology. The shallow zone is considered unconfined and consists of isolated “pods” of saturation that are not always present everywhere at the site. The unconfined nature of this shallow saturation is due to the shallow occurrence and proximity to the ground surface. These zones of shallow saturation are discontinuous and do not appear to be connected to each other or to the deep zone. The deep zone is considered confined and is continuously saturated. The confined nature of this deep saturation zone is due to the depth, isolation from the atmosphere, and elevated pressure readings of some of the deep VWPs [see Section 6.2.2].

A comparison of precipitation records and water level data from newly installed piezometers in the east and west units of the Landfill is presented as Appendix III-4.J. Tabulated historic water level data, collected from piezometers from October 2018 to July~~February~~ 2020, are provided in

Appendix III-4.K. Tabulated historic water level data, collected from VWPs from July 2019 to July~~February~~ 2020, are provided in Appendix III-4.L. Using ~~the deep~~piezometer and shallow VWP data, a potentiometric map of the upper groundwater flow system present on the Landfill was prepared and is included as Figure-4.18. Using the deep VWP data, a potentiometric map of the lower groundwater flow system present on the Landfill was prepared and is included as Figure-4.19. The slug test results from the Landfill piezometers are provided in Appendix III-4.M.

Upper g~~G~~roundwater flow direction was determined using piezometer/shallow VWP data and lower groundwater flow direction was determined using deep VWP data. The Landfill groundwater flows towards the south-southeast (Figure-4.18 and Figure-4.19), consistent with local and regional topography. ~~Shallow VWP and piezometer data were excluded from the flow direction interpretation because of the limited, disconnected nature of isolated pockets of groundwater at higher elevations.~~

6.3.1 Slug Testing

Slug testing was implemented in piezometers to determine hydraulic properties (Appendix III-4.M). The shale of lower Unit II and uppermost Unit III contains isolated pockets of groundwater. In limited locations, this is the uppermost water bearing unit below the landfill. The slug testing was conducted in piezometers with groundwater from the shallow zone, which is considered unconfined [see Section 6.3]. Seven of the ten piezometers installed were screened in the lower Unit II/upper Unit III zone. Slug tests were performed on PZ-1, PZ-3, PZ-18, and PZ-20 in the east and west areas to determine hydraulic conductivity. Results are summarized in Table III-4.13~~2~~; Appendix III-4.M provides slug test data. A summary of hydraulic conductivity calculations is presented in Table III-4.13~~2~~.

Slug tests performed at PZ-1 and PZ-18 used both the falling and rising head methods. The falling head method is implemented by introducing a “slug” into the water column, causing a temporary rise in head. The rising head method requires removing the “slug” from the water column, causing a temporary fall in head. The drop or rise in water level was then monitored with respect to time to determine hydraulic conductivity, using a logging pressure transducer. The results were analyzed using the Bouwer and Rice method.

An alternative falling head method was employed at PZ-3 and PZ-20 because the well screens were not fully submerged. Ten gallons of potable water were introduced into each well, such that the well screen was fully submerged. As the water level fell, a logging transducer recorded the falling head. The results were calculated using the Bouwer and Rice method.

6.3.2 Horizontal Flow Calculation

Horizontal travel velocities were estimated for the Unit II/III interface using the following formula:

$V_a = (K*I)/(7.5*N)$ (Driscoll, 1986)

where: V_a = actual travel velocity
K = hydraulic conductivity of the aquifer (geometric mean)
I = hydraulic gradient
N = effective porosity (5%) (Driscoll, 1986)

The hydraulic gradient was measured as the difference in water elevations between VWP-18D (503.6~~483.9~~ feet-msl) and VWP-33D (419.7~~408.1~~ feet-msl) divided by the distance between the two VWPs in feet (3,120 feet). Measurements were taken from the July~~February~~ 2020 deep VWP potentiometric map (see Figure-4.19~~8~~).

Horizontal travel times of the uppermost groundwater (Unit II/Unit III interface) were determined to represent (1) the overall Landfill area, (2) the overall Landfill area regarding Unit II, (3) the eastern area of the Landfill, and (4) the western area of the Landfill. An upper and lower bound predicted horizontal flow rate was also determined using the highest and lowest hydraulic conductivities recorded from SCS performed slug tests. Values used for horizontal flow calculations and horizontal flow rates are as shown in Table III-4.14~~3~~.

The highest hydraulic conductivity value was recorded at PZ-3. The predicted upper horizontal flow rate from this location was 0.0395 feet per year.

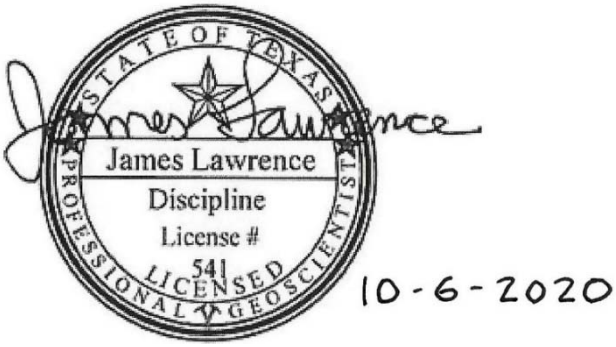
The lowest hydraulic conductivity value was recorded at PZ-18. The predicted lower horizontal flow rate from this location was 0.0087 feet per year.

The horizontal travel time of the uppermost groundwater (Unit II/Unit III interface) across the entire Landfill area (PZ-1, PZ-3, PZ-18, PZ-20) was determined to be approximately 0.013~~2~~ feet per year.

The horizontal travel time of the uppermost water across the Landfill area for Unit II (PZ-1, PZ-3, and PZ-20) was determined to be approximately 0.0164 feet per year.

The horizontal travel time of the uppermost groundwater (lower Unit II/upper Unit III interface) in the eastern area of the Landfill (PZ-18, PZ-20) was approximately 0.01~~09~~ feet per year.

The horizontal travel time of the uppermost groundwater (Unit II/Unit III interface) in the western area of the Landfill (PZ-1, PZ-3) was approximately 0.0164 feet per year.



7 POLLUTANT PATHWAYS

Regionally, the groundwater generally flows in a southeast direction towards the Gulf of Mexico. Locally, the groundwater flows in a similar south to southeast direction. Excavation in the area of the Landfill will likely alter the groundwater flow path by creating a depression in the water table, and a resulting inward gradient. This may cause shallow groundwater in the eastern unit of the Landfill to flow west, and the western unit to flow east.

The sidewalls of the Landfill will be excavated partly in the weathered shale (Unit II), and partly in the underlying unweathered shale (Unit III). The base is generally in the unweathered shale. A potential release to the weathered shale zone would be expected to generally follow flow paths shown in Figure-4.18, moving downgradient to the south-southeast. Any potential leachate release in the unweathered shale is expected to also generally follow flow paths shown in Figure-4.19~~8~~, moving down-gradient to the south-southeast. Potential leachate releases to the weathered zone or shallow unweathered zone (beneath the base of the Landfill) would be expected to move laterally and down-gradient. Potential releases are not expected to migrate downward into the lower-permeability zones of the unweathered shale because this is a lower-permeability, higher-resistance flow path. The predicted lateral flow of groundwater along bedding planes is due to horizontal hydraulic conductivity being generally greater than vertical hydraulic conductivity in flat lying sedimentary rocks, as hydraulic conductivity decreases with increasing depth (Heath, 1983; Harlow and Lecain, 1993). The Landfill groundwater monitoring system is designed to monitor the uppermost formation capable of yielding significant quantities of ground water (sufficient groundwater present in a well that can be sampled) encountered below the Landfill. Section 9.0 addresses the design of the proposed groundwater monitoring system.

The Facility will promptly notify, in writing, the Texas Commission on Environmental Quality (TCEQ), and any local pollution agency with jurisdiction that has requested to be notified, of future changes in facility construction or operation or changes in adjacent properties 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.

7.1 LOCAL HYDROGEOLOGY

The Trinity Aquifer [see Section 4.1], which underlies the Landfill property, all of McLennan County, and the northwest corner of Limestone County, produces the majority of the total groundwater used in the area surrounding the Landfill (STGCD, 2015). In the Landfill area, Gulfian and Upper Comanche Series deposits (Table III-4.3) represent the upper most stratigraphy and are not considered hydrogeologic/aquifer type units due to their low permeability. The shallow stratigraphy in the Landfill vicinity does contain water, but is not considered a regional or local aquifer due to the inability to deliver enough usable water to a water supply well. The shallow clay/shale stratigraphy primarily transmit fluids via higher weathered zones with increased fissility/joints. The shallowest groundwater at the Landfill is at the base of Unit II. In the Landfill area, the deeper unweathered shale-marl stratigraphy of Unit III will act as an aquitard that inhibits vertical movement of groundwater due to decreased fissility and increased hardness, and resulting lower permeability.

9 GROUNDWATER MONITORING PLAN

9.1 EXISTING GROUNDWATER MONITORING SYSTEM

No groundwater monitoring wells currently exist at the Landfill.

9.2 PROPOSED GROUNDWATER MONITORING SYSTEM

The locations and depths of the monitoring wells are designed to determine the quality of groundwater passing the point of compliance and to detect groundwater impact from the waste units, and prior to any contaminants entering deeper portions of the stratigraphy interpreted as the Wolfe City Formation (30 TAC §330.403(a)(2)). The potential pathways for contaminant movement from the waste units are expected to be lateral [horizontal] via shale fractures that develop primarily horizontally as the overlying sediments unload over geologic time due to erosion.

Site drilling indicates that groundwater was generally not initially observed upon completion of a boring. Due to the sporadic distribution of site groundwater, two monitoring wells will be installed at each location, one with a specified shallow depth ("A" series) and the other with a specified deep depth ("B" series). Each well will be installed with a 40-foot monitoring well screen due to the sporadic distribution of groundwater. A map of the proposed groundwater monitoring system is provided in Figure-4.20~~19~~.

Based on the groundwater conditions shown on Figure-4.18 and Figure 4.19, the proposed monitoring system will consist of twelve upgradient wells and fifty-six downgradient wells (Figure-4.20~~19~~).

Initial proposed monitoring well installations will begin at the eastern disposal area of the Landfill, where waste will first be disposed. The eastern side monitoring well names begin with the designation 'P1'; western side well names begin with 'P2'. The letter 'A' denotes a shallow well and the letter 'B' denotes a deep well. Ten~~Fourteen~~ proposed monitoring wells will be installed prior to landfill operation (P1-MW 1 A/B, ~~P1-MW 2 A/B, P1-MW 16 A/B,~~ P1-MW 17 A/B, P1-MW 18 A/B, P1-MW 19 A/B, P1-MW 20 A/B). The remaining proposed monitoring wells will be installed when waste is within 1,000 feet of the proposed monitoring well location. Installation details for proposed monitoring wells are described below and in Table III-4.15~~4~~. The new monitoring wells will be sampled for background data for eight quarters in accordance with the Groundwater Sampling and Analysis Plan (GWSAP, see Attachment 7). Semiannual detection monitoring will then be implemented in accordance with GWSAP.

Monitoring wells will be constructed in accordance with the Proposed Monitoring Well Construction Details indicated in Figure-4.21~~0~~, which is in conformance with requirements outlined within 30 TAC §330.421(a)(2). In accordance with 30 TAC §330.421(a)(2)(B), no glue, solvents, field-cut slots, or field cloths will be used during the construction of the monitoring well screen. A qualified Texas-licensed driller will drill and install monitoring wells using equipment and methods that are appropriate for the Landfill conditions. A licensed professional geoscientist or engineer who is familiar with the geology of the area will supervise drilling, develop a detailed lithologic description of the boring, monitor well installation, and oversee well development (30 TAC §330.421(a)(1)(A)). The boring will be at least 4-inches larger than the outer diameter of the well casing and screen. If water is used in drilling, it will be from a potable source, and a current

chemical analysis will be provided with the monitoring well installation report. A licensed professional geoscientist or engineer who is familiar with the geology of the area will supervise or make a boring log for each monitoring well and shall seal, sign, and date the boring log.

In accordance with TAC §330.421(b), where monitoring wells are installed in unusual conditions, all aspects of the installation shall be approved in writing in advance by the executive director.

After a monitoring well is installed, it will be developed until excessive turbidity due to drilling/installation has been removed and field measurements of pH, specific conductance, and temperature have stabilized in accordance with 30 TAC §330.421(c). Development may be accomplished through the use of pumping and/or bailing.

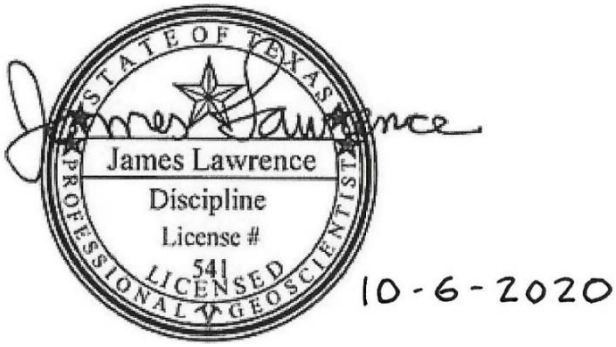
Upon completion of well installation activities, a registered professional surveyor will survey the locations with vertical measurements to the nearest 0.01-foot and referenced to mean sea level (with year of the sea-level datum shown). Survey points for each well will include the top of PVC casing (with referenced point marked), top of protective cap, and ground surface adjacent to the well pad. Horizontal locations will be determined to the nearest tenth of a second for latitude and longitude or accurately located relative to the Landfill grid system (30 TAC §330.421(d)).

Within 60 days of well completion, well installation and construction information will be submitted to the TCEQ on current forms. The report will include a detailed geologic log, any test results, a description of development procedures, and a site map (to scale) showing the location of all monitoring wells and the point of compliance (30 TAC §330.421(e)). Any monitoring well that is damaged to the extent that it is no longer suitable for sampling will be reported to the TCEQ with a recommendation to repair or replace the well (30 TAC §330.421(f)). Any monitoring well that is no longer used shall be properly abandoned and plugged in accordance with 16 TAC §76.702 and 76.1004 with prior authorization in writing from the TCEQ.

The wells will be operated and maintained so that they will yield representative groundwater samples for the appropriate hydrogeologic unit throughout the life of the groundwater monitoring program (30 TAC §330.421(a) and (e) and §330.403(d)). Groundwater monitoring will be conducted throughout the active life and the closure and post-closure care period of the Landfill.

9.3 GROUNDWATER MONITORING SYSTEM CERTIFICATION

I, James Lawrence, Texas P.G. #541, have reviewed the groundwater monitoring well system installation plan for the Landfill. In my professional opinion, the proposed groundwater monitoring system has been designed in accordance with 30 TAC §330.63(f) and §330.401(e).

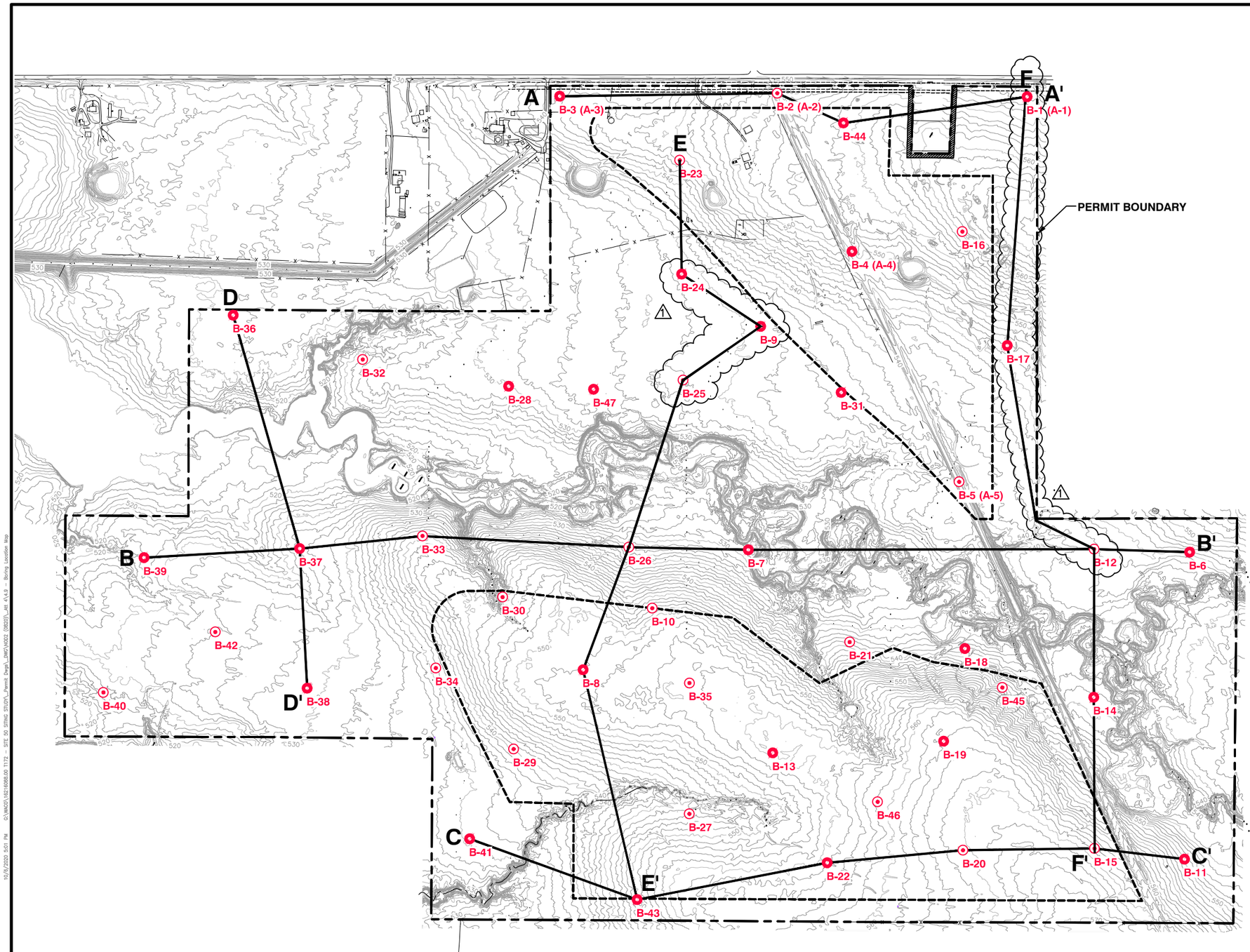


Signature of Qualified Groundwater Scientist

Seal

FIGURES

- Figure - 4.1 Site Location Map
- Figure - 4.2 Physiographic Map of Texas
- Figure - 4.3 General Topographic Map
- Figure - 4.4 Geologic Map
- Figure - 4.5 Structural Cross Sections of Regional Geology and the Trinity Aquifer
- Figure - 4.6 Seismic Impact Zone Map
- Figure - 4.7 Tectonic Map of Texas
- Figure - 4.8 Trinity Aquifer
- Figure - 4.9 Boring Location Map
- Figure - 4.10 Geologic Cross Section A-A'
- Figure - 4.11 Geologic Cross Section B-B'
- Figure - 4.12 Geologic Cross Section C-C'
- Figure - 4.13 Geologic Cross Section D-D'
- Figure - 4.14 Geologic Cross Section E-E'
- Figure - 4.15 Geologic Cross Section F-F'
- Figure - 4.16 Piezometer Location Map
- Figure - 4.17 VWP Location Map
- Figure - 4.18 Piezometer/Shallow VWP Potentiometric Map
- Figure - 4.19 Deep VWP Potentiometric Map
- Figure - 4.20~~19~~ Proposed GWM System Map
- Figure - 4.21~~0~~ Typical Monitoring Well Detail



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE (1)
- 535 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- B-9 EXISTING BORING LOCATION – I (SEE NOTE 2)
- B-14 EXISTING BORING LOCATION – II (SEE NOTE 2)
- A—A' CROSS–SECTION LOCATIONS

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. EXISTING BORING LOCATIONS – I INDICATE SOIL BORINGS WHICH WERE DRILLED TO A DEPTH OF 5–FEET BELOW EDE (I.E., 500 FT MSL) AND EXISTING BORING LOCATIONS – II INDICATE SOIL BORINGS WHICH WERE DRILLED TO A DEPTH OF 30 FEET BELOW EDE (I.E., 475 FT MSL).

(1) ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

STATE OF TEXAS
James Lawrence
Discipline
License #
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PROFESSIONAL GEOSCIENTIST
10/6/2020

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REV	DATE	DESCRIPTION	BY
1	10/2020	UPDATE LIMITS OF WASTE, ADD NOTE 3 AND ADD ADDITIONAL INFORMATION TO CROSS SECTION E–E' AND F–F'	JL

DRAWING TITLE: BORING LOCATION MAP

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. T6216088.00 | DSN. BY: AB/JL | DWN. BY: JL/NR | CHK. BY: BJD/AB | Q/A RVW BY: RRK | APP. BY: JL

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

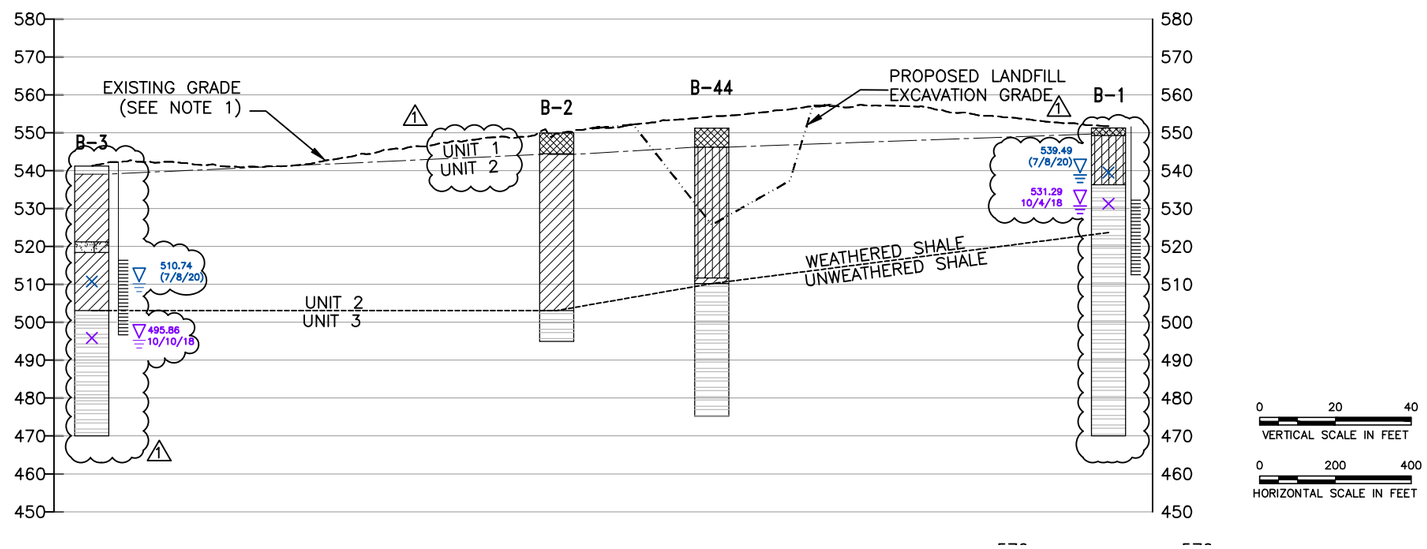
CADD FILE: 4.9 – BORING LOCATION MAP

DATE: 05/2020

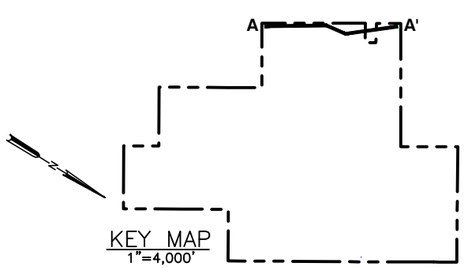
SCALE: AS SHOWN

FIGURE: 4.9

10/6/2020 5:01 PM G:\WACO\T6216088.00 TITLE - SITE 50 SITING STUDY_Permit Dwgs_DWG\4.0G2 (08020)_AB 4.1-4.9 - Boring Location Map



CROSS SECTION A-A'



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PROFESSIONAL GEOSCIENTIST
10/6/2020

LEGEND:

- EXISTING GRADE (SEE NOTE 1)
- UNIT 1/UNIT 2 CONTACT
- WEATHERED/UNWEATHERED SHALE TRANSITIONAL CONTACT
- PROPOSED LANDFILL EXCAVATION GRADE
- 510.74 (7/8/20) — STATIC WATER LEVEL IN PIEZOMETER (DATE OF WATER LEVEL READING)
- 539.49 (7/8/20) — INITIAL WATER LEVEL IN PIEZOMETER (DATE OF WATER LEVEL READING)

NOTES:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.
2. SEE APPENDIX III-4.D FOR SUBSURFACE MATERIAL LEGEND.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: WATER LEVEL READINGS AND EXTEND DEPTHS OF B-3 AND B-1; ADD UNIT 1/UNIT 2 CONTACT	JL
2			
3			
4			
5			

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: CROSS SECTION A-A'

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: AB/JL | DWN. BY: JL-J/NR | CHK. BY: BJD/AB | Q/A RVW BY: RRK | APP. BY: JL

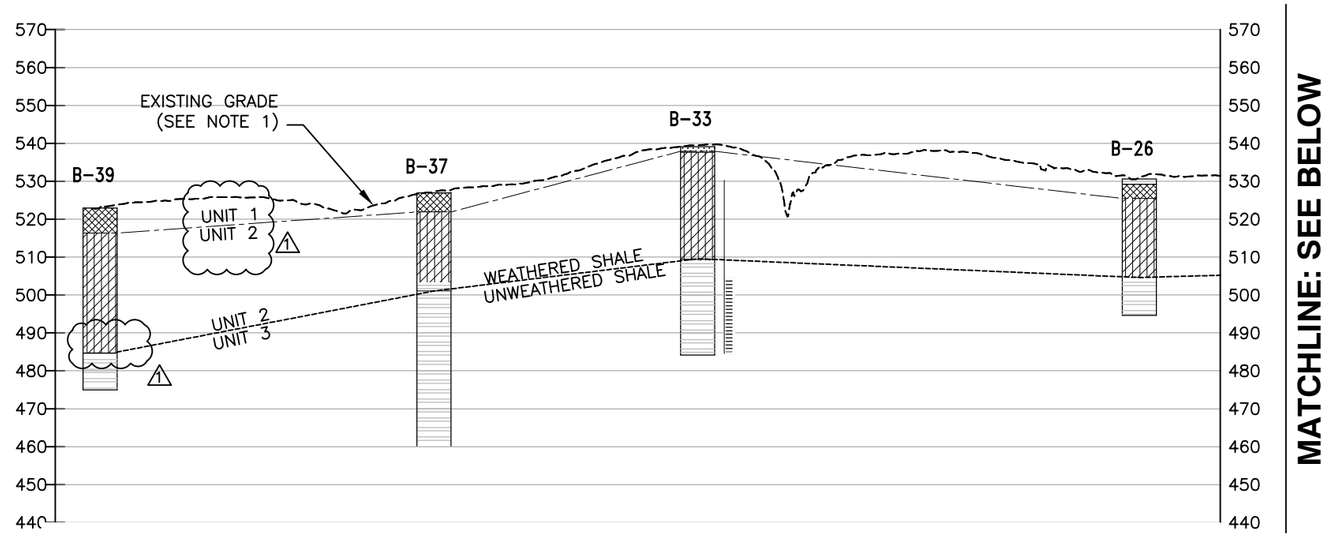
CADD FILE: 4.10-4.15 - GEOLOGIC CROSS SECTIONS

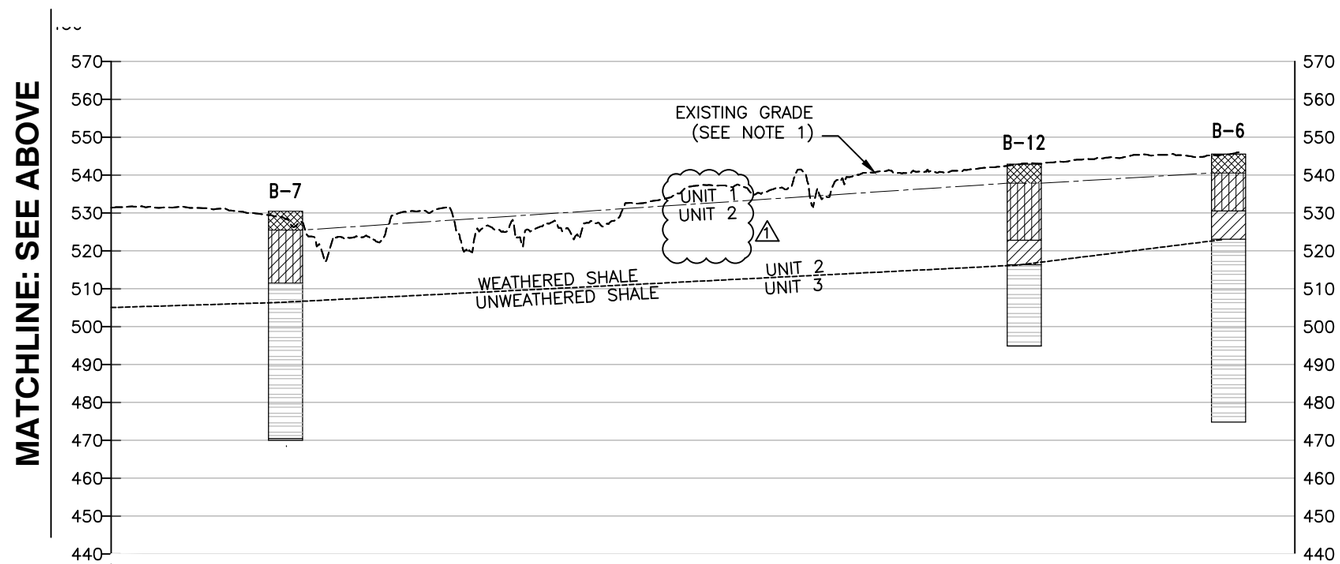
DATE: 05/2020

SCALE: AS SHOWN

FIGURE: 4.10

10/6/2020 5:55 PM C:\WACO\16216088.00 TITLE - SITE SPECIFIC STUDY_Permit Dwgs_DWG\WD02 (0820)_AB 4.10-4.15 - Geologic Cross Sections





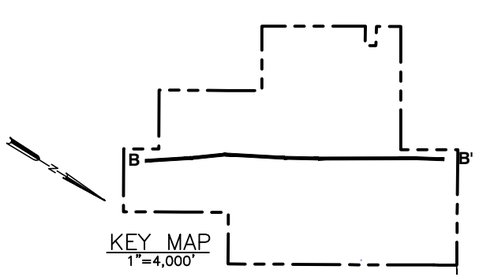
CROSS SECTION B-B'

0 20 40
VERTICAL SCALE IN FEET

0 200 400
HORIZONTAL SCALE IN FEET

LEGEND:

- EXISTING GRADE (SEE NOTE 1)
- UNIT 1/UNIT 2 CONTACT 1
- WEATHERED/UNWEATHERED SHALE TRANSITIONAL CONTACT



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James Lawrence
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PROFESSIONAL GEOSCIENTIST
10/6/2020

NOTES:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.
2. SEE APPENDIX III-4.D FOR SUBSURFACE MATERIAL LEGEND.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: CORRECT SHALE CONTACT IN B-39; ADD UNIT1/UNIT 2 CONTACT	JL
2			
3			
4			
5			
6			

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
CROSS SECTION B-B'

PROJECT TITLE
CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00
DSN. BY: AB/JL
DWN. BY: JL/NR
CHK. BY: BJD/AB
S/A SVR BY: RRK
APP. BY: JL

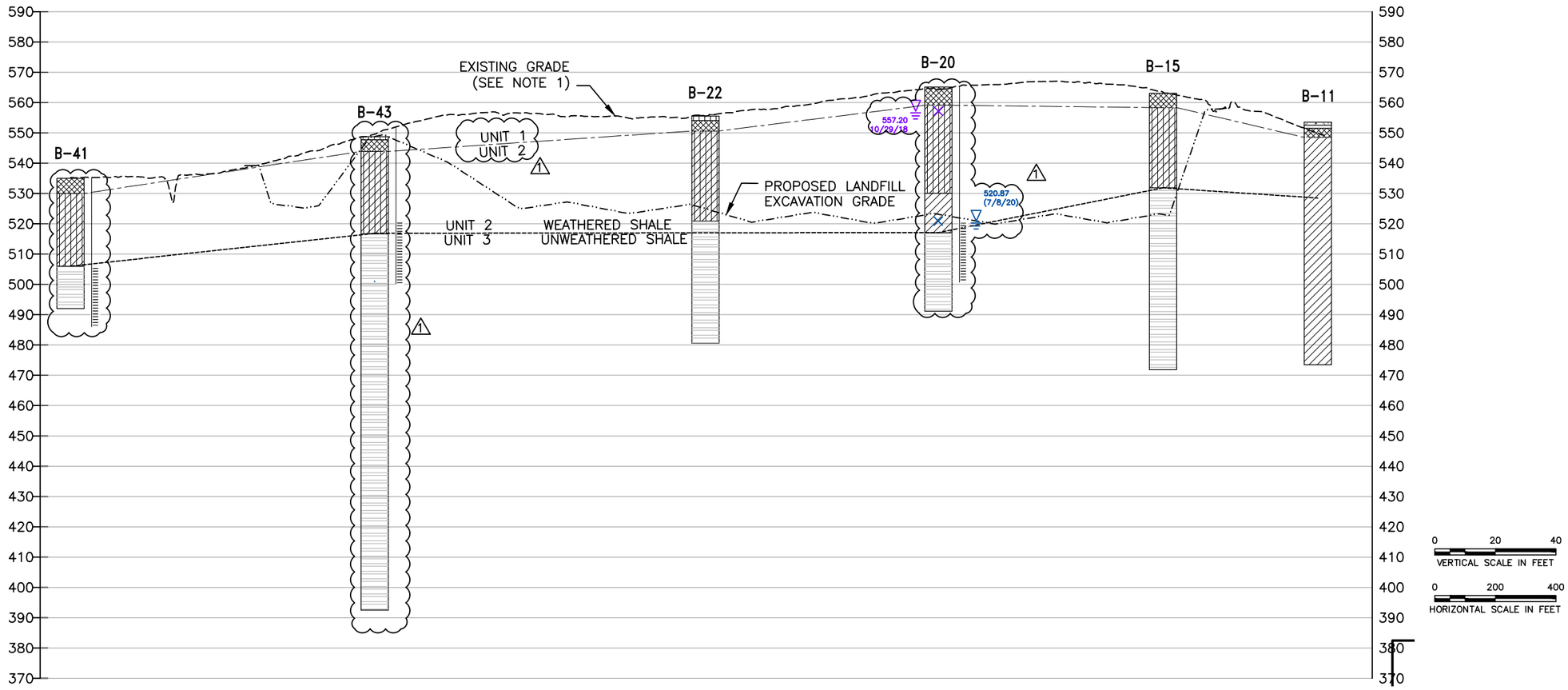
CADD FILE: 4.10-4.15 - GEOLOGIC CROSS SECTIONS

DATE: 05/2020

SCALE: AS SHOWN

FIGURE: **4.11**

10/6/2020 5:06 PM



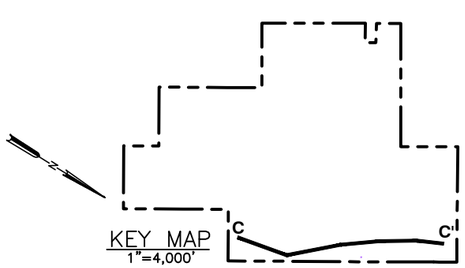
CROSS SECTION C-C'

LEGEND:

- EXISTING GRADE (SEE NOTE 1)
- UNIT 1/UNIT 2 CONTACT (1)
- WEATHERED/UNWEATHERED SHALE TRANSITIONAL CONTACT
- PROPOSED LANDFILL EXCAVATION GRADE
- 510.74 (7/8/20) — STATIC WATER LEVEL IN PIEZOMETER (DATE OF WATER LEVEL READING)
- 539.49 (7/8/20) — INITIAL WATER LEVEL IN PIEZOMETER (DATE OF WATER LEVEL READING)

NOTES:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.
2. SEE APPENDIX III-4.D FOR SUBSURFACE MATERIAL LEGEND.



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10/6/2020

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REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: CORRECT SHALE CONTACT IN B-41, B-43; EXTEND DEPTH OF B-43; ADD UNIT 1/UNIT 2 CONTACT	JL

DRAWING TITLE: CROSS SECTION C-C'

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: AB/JL | DWN. BY: JL/NR | CHK. BY: BJD/AB | Q/A RVW BY: RRK | APP. BY: JL

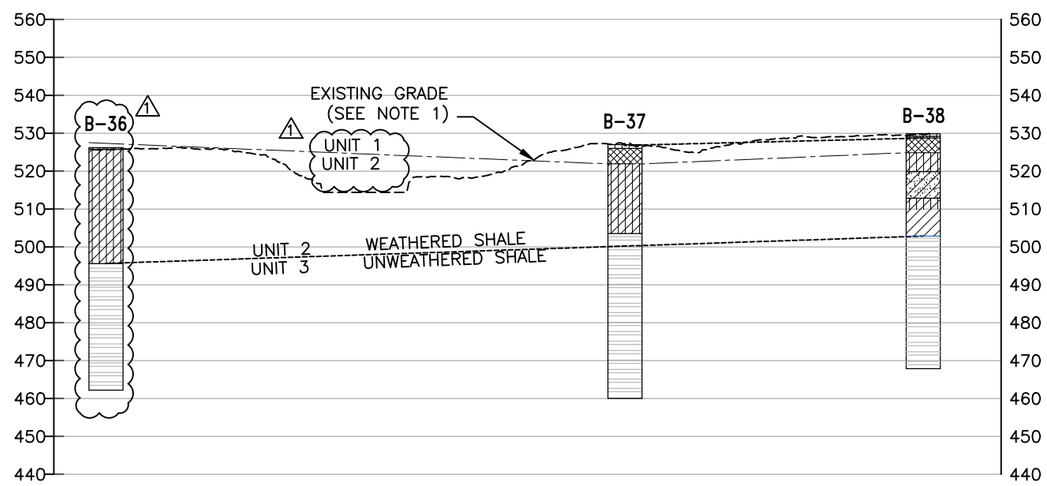
CADD FILE: 4.10-4.15 - GEOLOGIC CROSS SECTIONS

DATE: 05/2020

SCALE: AS SHOWN

FIGURE: 4.12

10/6/2020 5:05 PM G:\WACO\16216088.00 1172 - SITE 50 STRID 35120_Permit Dwgs_UWD\A002 (05020)_MR 4.4.10-4.15 - Geologic Cross Sections



CROSS SECTION D-D'

0 20 40
VERTICAL SCALE IN FEET

0 200 400
HORIZONTAL SCALE IN FEET

LEGEND:

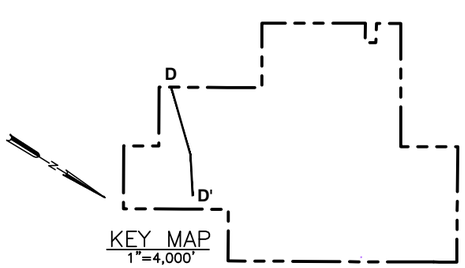
EXISTING GRADE (SEE NOTE 1)

UNIT 1/UNIT 2 CONTACT

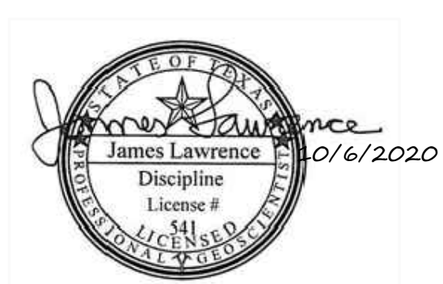
WEATHERED/UNWEATHERED SHALE TRANSITIONAL CONTACT

NOTES:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.
2. SEE APPENDIX III–4.D FOR SUBSURFACE MATERIAL LEGEND.



KEY MAP
1"=4,000'



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REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FIX GRADE LEVEL AT B-36; ADD UNIT1/UNIT 2 CONTACT	JL

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
CROSS SECTION D-D'

PROJECT TITLE
CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DWN. BY: JLL/AIR | Q/A RVW BY: RRK
DSN. BY: AB/JL | CHK. BY: BJD/AB | APP. BY: JL

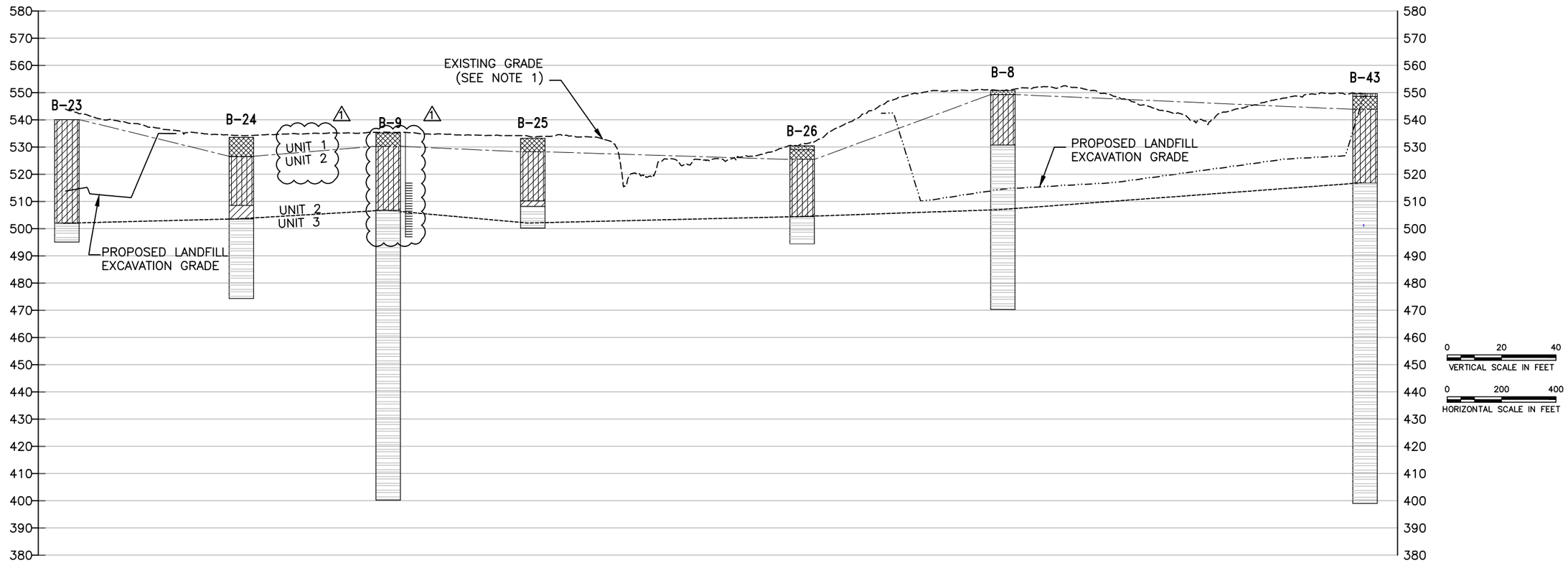
CADD FILE: 4.10–4.15 – GEOLOGIC CROSS SECTIONS

DATE: 05/2020

SCALE: AS SHOWN

FIGURE: 4.13

10/6/2020 5:05 PM G:\WACO\16216088.00 TTZ – SITE 50 STRIC 3TUDY_Permit Dwgs_DWG\WACZ (05020)_MR 4\4.10–4.15 – Geologic Cross Sections



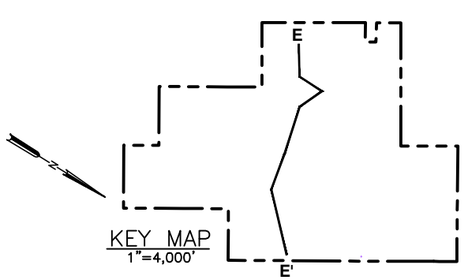
CROSS SECTION E-E'

LEGEND:

- EXISTING GRADE (SEE NOTE 1)
- UNIT 1/UNIT 2 CONTACT (1)
- WEATHERED/UNWEATHERED SHALE TRANSITIONAL CONTACT
- PROPOSED LANDFILL EXCAVATION GRADE
- 510.74 (7/8/20) — STATIC WATER LEVEL IN PIEZOMETER (DATE OF WATER LEVEL READING)
- 539.49 (7/8/20) — INITIAL WATER LEVEL IN PIEZOMETER (DATE OF WATER LEVEL READING)

NOTES:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.
2. SEE APPENDIX III–4.D FOR SUBSURFACE MATERIAL LEGEND.



KEY MAP
1"=4,000'

STATE OF TEXAS
James Lawrence
Discipline
License #
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LICENSED
PROFESSIONAL GEOSCIENTIST
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: ADD B-9 TO CROSS SECTION; EXTEND DEPTH OF B-43; CORRECT SHALE CONTACT IN B-43; ADD UNIT 1/UNIT 2 CONTACT	JL

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
CROSS SECTION E-E'

PROJECT TITLE
CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: AB/JL | DWN. BY: JL/NR | CHK. BY: BJD/AB | Q/A RVW BY: RRK | APP. BY: JL

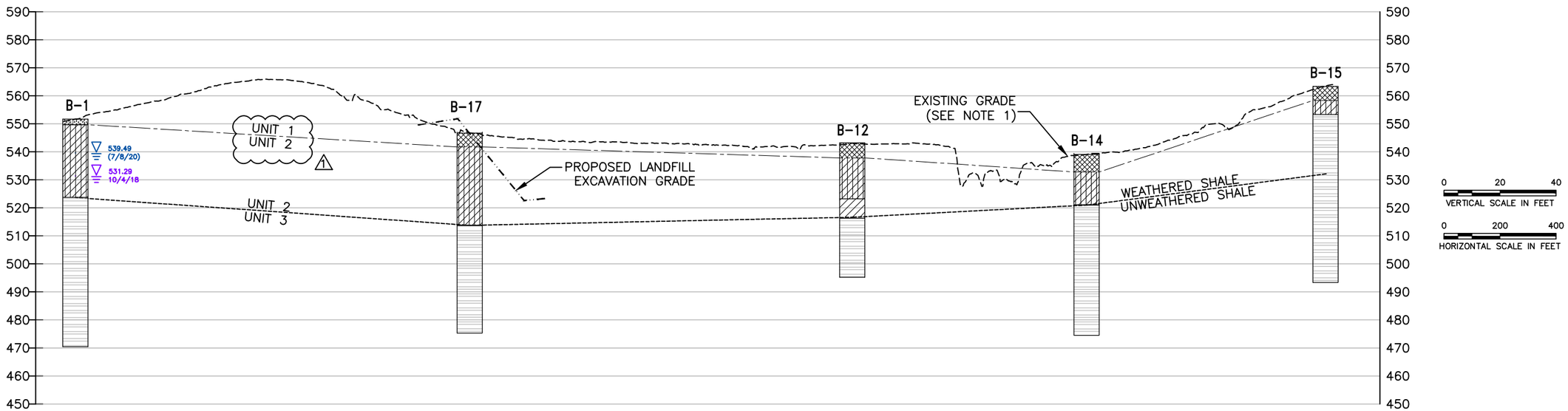
CADD FILE: 4.10–4.15 – GEOLOGIC CROSS SECTIONS

DATE: 05/2020

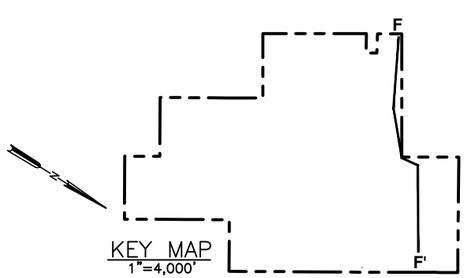
SCALE: AS SHOWN

FIGURE: 4.14

10/6/2020 5:07 PM G:\WACO\16216088.00 1172 - SITE SO SITING STUDY_Permit Dwgs_DWG\AD022 (05020)_AB 4\4.10-4.15 - Geologic Cross Sections



CROSS SECTION F-F'



STATE OF TEXAS
James Lawrence
Discipline
License #
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PROFESSIONAL GEOSCIENTIST
10/6/2020

LEGEND:

- EXISTING GRADE (SEE NOTE 1)
- UNIT 1/UNIT 2 CONTACT (1)
- WEATHERED/UNWEATHERED SHALE TRANSITIONAL CONTACT
- PROPOSED LANDFILL EXCAVATION GRADE

NOTES:

1. EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL, FLOWN ON JULY 03, 2018.
2. SEE APPENDIX III-4.D FOR SUBSURFACE MATERIAL LEGEND.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: ADD B-1 AND B-17, ADD UNIT 1/UNIT 2 CONTACT	JL

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: CROSS SECTION F-F'

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: AB/JL | DWN. BY: JL/JNR | CHK. BY: BJD/AB | Q/A RVW BY: RRK | APP. BY: JL

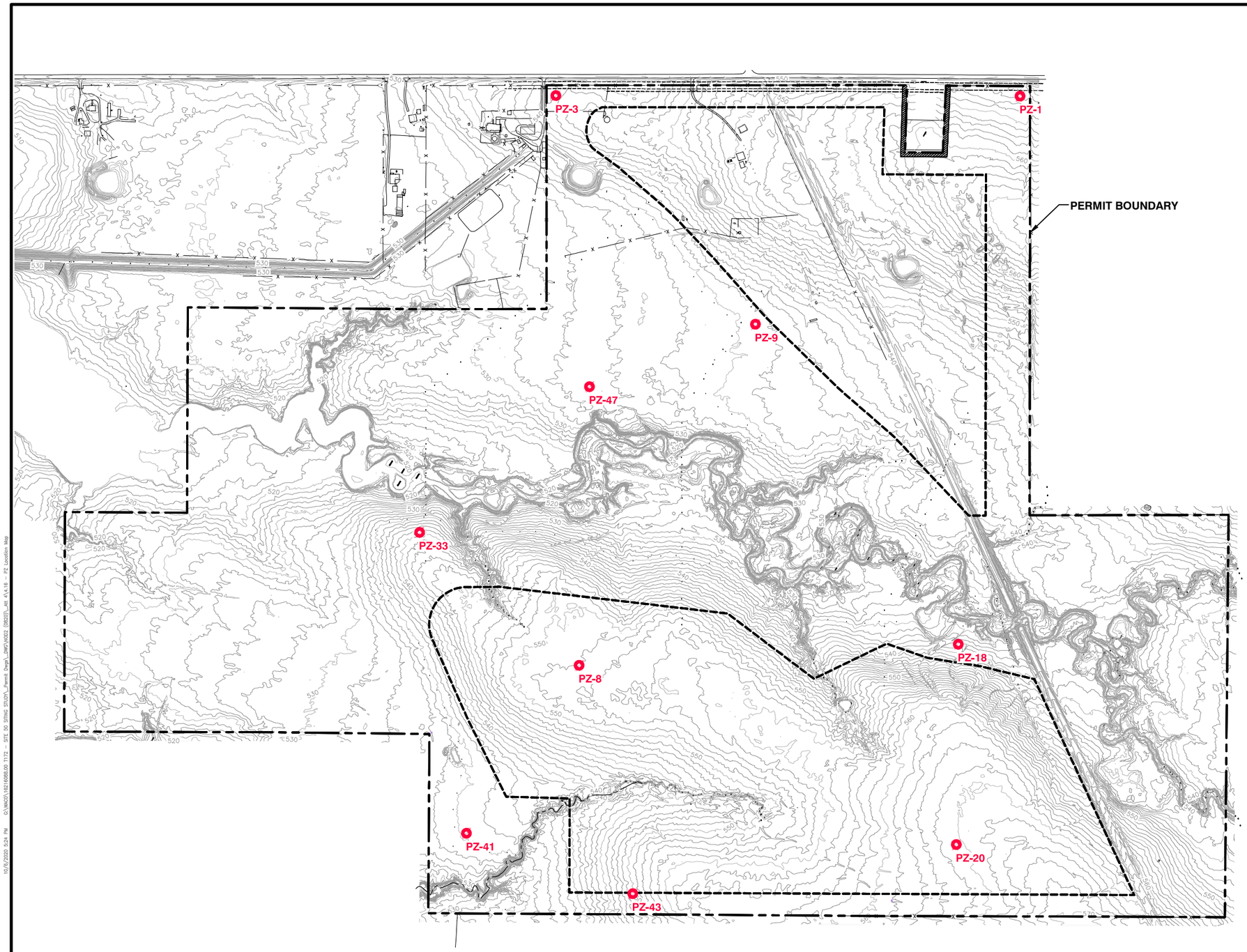
CADD FILE: 4.10-4.15 - GEOLOGIC CROSS SECTIONS

DATE: 05/2020

SCALE: AS SHOWN

FIGURE: 4.15

10/6/2020 5:07 PM G:\WACO\16216088.00 1172 - SITE 90 STING STUDY_Permit_Dwgs_DWG\WCO2 (GEOS)_alt 4\4.10-4.15 - Geologic Cross Sections



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE 1
- 535 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- PZ-1 EXISTING PIEZOMETER LOCATION

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. SHALLOW AND/OR DEEP VWPS ARE LOCATED ADJACENT TO CONVENTIONAL PIEZOMETERS AS SHOWN ON FIGURE 4.17.

STATE OF TEXAS
James Lawrence
Discipline
License #
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LICENSED
PROFESSIONAL GEOSCIENTIST
10/6/20

1 ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: LIMITS OF WASTE	JL

DRAWING TITLE
PIEZOMETER LOCATION MAP

PROJECT TITLE
CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00
DWN. BY: JLJ/NR
Q/A RVW BY: RRK
DSN. BY: AB/JL
CHK. BY: BJD/AB
APP. BY: JL

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

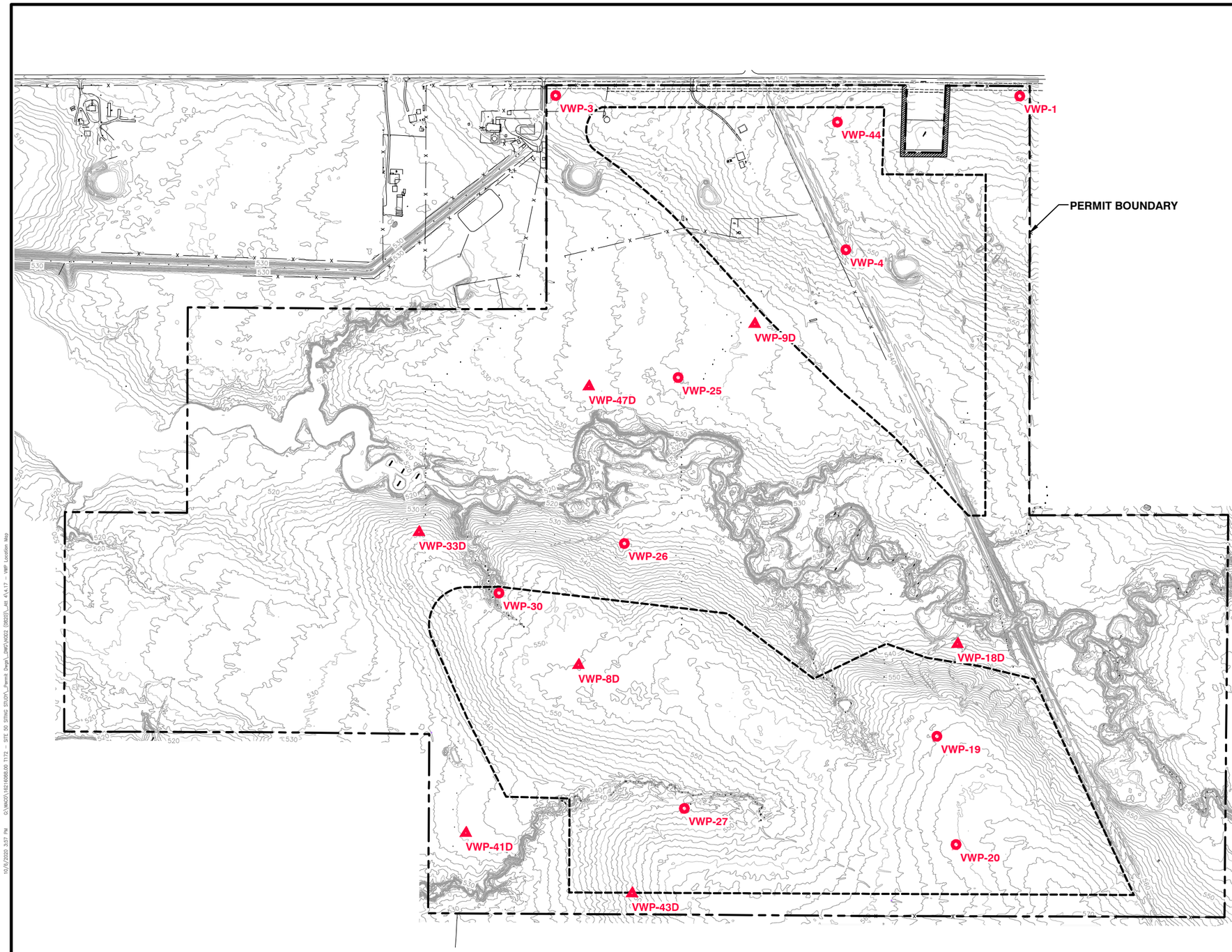
CADD FILE: 4.16 – PZ LOCATION MAP

DATE: 05/2020

SCALE: AS SHOWN

FIGURE: **4.16**

10/6/2020 5:24 PM G:\WACO\16216088.00 1172 - SITE 50 SITING STUDY_Permit Dwgs_UPDATA\DCC (DECO)_Alt 4.14.18 - PZ Location Map



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE (1)
- 535 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- VWP-1 VWP LOCATION – SHALLOW
- VWP-8D VWP LOCATION – SHALLOW/DEEP

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.

(1) ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

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10/6/2020

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REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: LIMITS OF WASTE AND NOTE 2.	JL

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: VWP LOCATION MAP

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

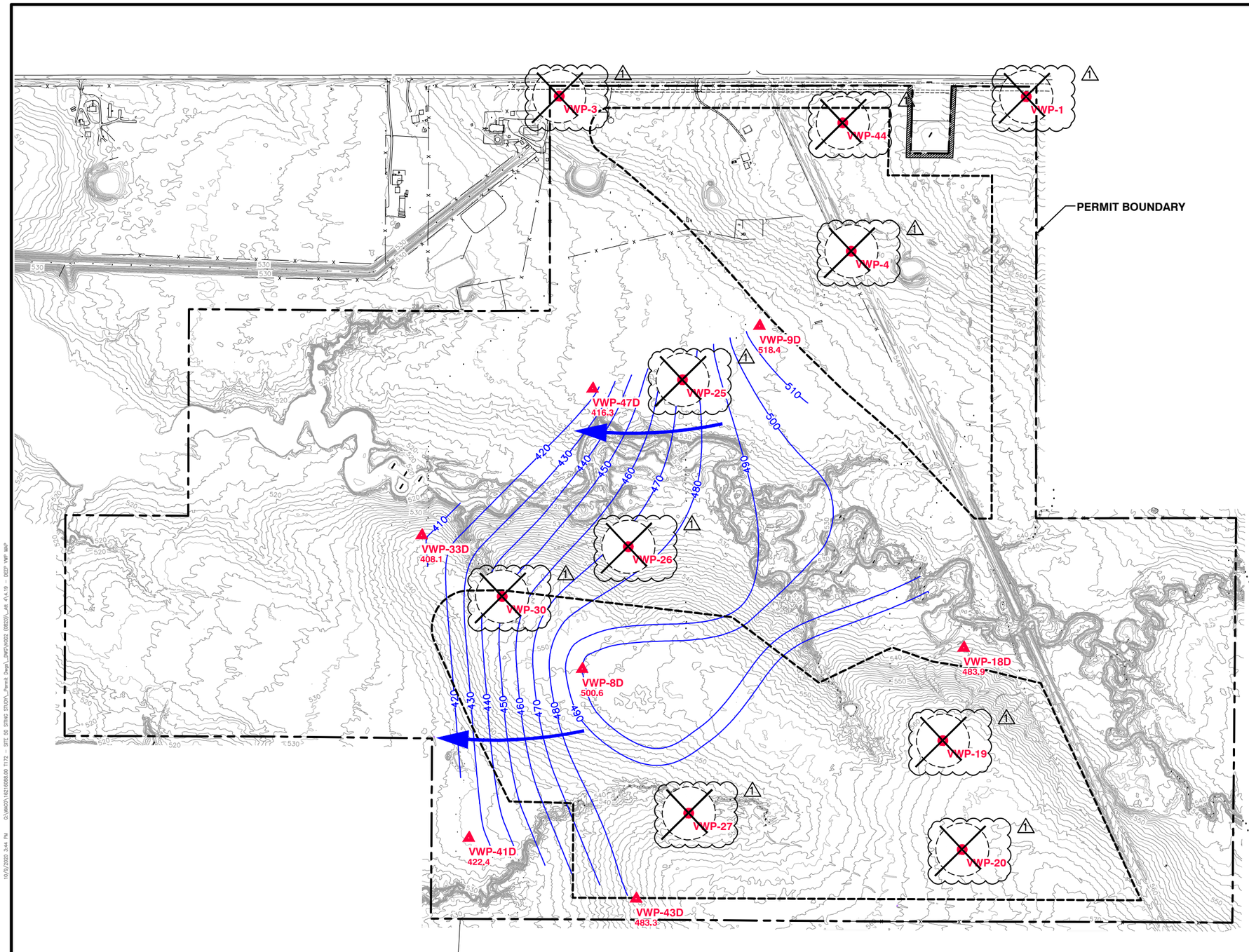
PROJ. NO. 16216088.00
DSN. BY: AB/JL
DWN. BY: JL/NR
CHK. BY: BJD/AB
Q/A RVW BY: RRK
APP. BY: JL

CADD FILE: 4.17 – VWP LOCATION MAP

DATE: 05/2020

SCALE: AS SHOWN

4.17



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE 1
- 535 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 510 POSITIVE PRESSURE CONTOURS
- VWP-1 VWP LOCATION – SHALLOW
- VWP-8D VWP LOCATION – DEEP
- 517.0 CALCULATED GROUNDWATER MSL ELEVATION
- 1 VWP-25 VWP LOCATION WITH NO WATER OBSERVED
- INFERRED GROUNDWATER FLOW DIRECTION

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.

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1 ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: ORIGINALLY 4.18; DEEP VWP POTENTIOMETRIC MAP; NEW GW ELEVATION VALUES; REMOVE SHALLOW VWP'S	JL

DRAWING TITLE: DEEP VWP POTENTIOMETRIC MAP

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
SOLID WASTE SERVICES

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PROJ. NO. T6216088.00 | DWN. BY: JL/NR | Q/A RVW BY: RRK
DSN. BY: AB/JL | CHK. BY: BJD/AB | APP. BY: JL

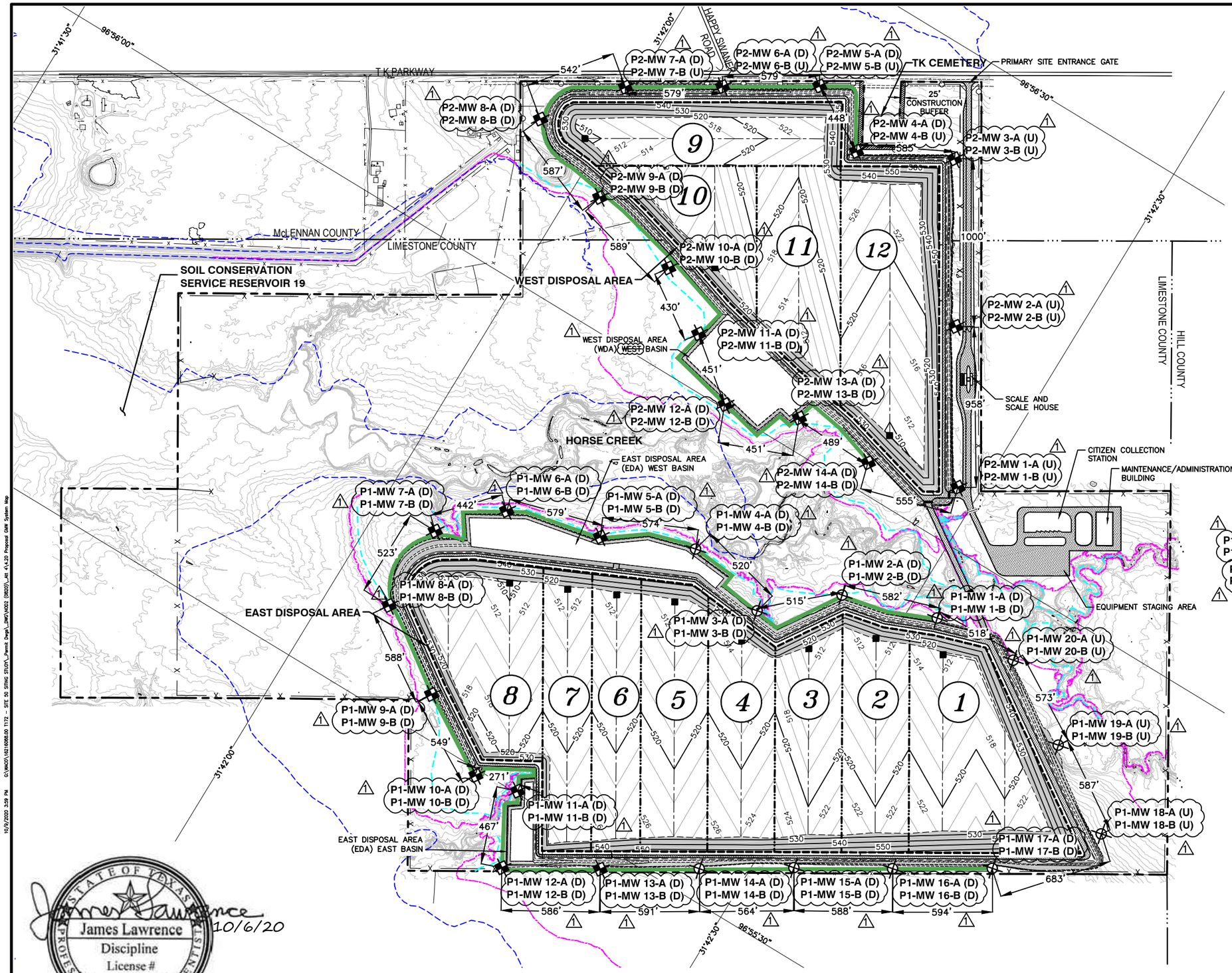
CADD FILE: 4.19 – DEEP VWP MAP

DATE: 05/2020

SCALE: AS SHOWN

FIGURE: 1 ~~4.18~~ 4.19

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100–YEAR FLOOD PLAIN (SEE NOTE 2)
- 100–YEAR STORM EVENT WATER SURFACE (SEE NOTE 4)
- EXISTING UNDERGROUND WATER LINE
- X PROPOSED PERIMETER FENCE
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- 510 EXCAVATION GRADE TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- 96°55'30" LATITUDE/LONGITUDE LINES
- TOE/TOP OF SLOPE
- LEACHATE COLLECTION TRENCH
- POINT OF COMPLIANCE
- P1-MW 20-A (U), P1-MW 20-B (U) — GMW INSTALLED PRIOR TO LANDFILL OPERATION (SEE NOTES 5, 6)
- P2-MW 1-A (U), P2-MW 1-B (U) — GMW INSTALLED WHEN WASTE < 1,000 FEET (SEE NOTES 5, 6)
- X SECTOR DESIGNATION
- SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100–YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
3. ELEVATIONS SHOWN ON THIS DRAWING ARE EXCAVATION GRADES OR BOTTOM OF LINER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
4. 100–YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC–HMS AND HEC–RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.
5. ALL GROUND MONITORING WELLS DEPICTED IN THIS FIGURE WILL INCLUDE A SHALLOW WELL (DENOTED BY "A") AND DEEP WELL (DENOTED BY "B") AS DEFINED IN ATTACHMENT 4, SECTION 9.
6. A "(U)" IN THE MONITORING WELL LABEL INDICATES A UPGRADIENT WELL AND "(D)" INDICATES A DOWNGRADIENT WELL.

ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

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FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: ORIGINALLY 4.19; INDICATE DISTANCE BETWEEN EACH POINT OF COMPLIANCE WELL; LIST BOTH WELL NAMES AT EACH WELL LOCATION; NOTES 2 AND 5.	JL

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: **PROPOSED GWM SYSTEM MAP**

PROJECT TITLE: **CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION**

CLIENT: **CITY OF WACO SOLID WASTE SERVICES**

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
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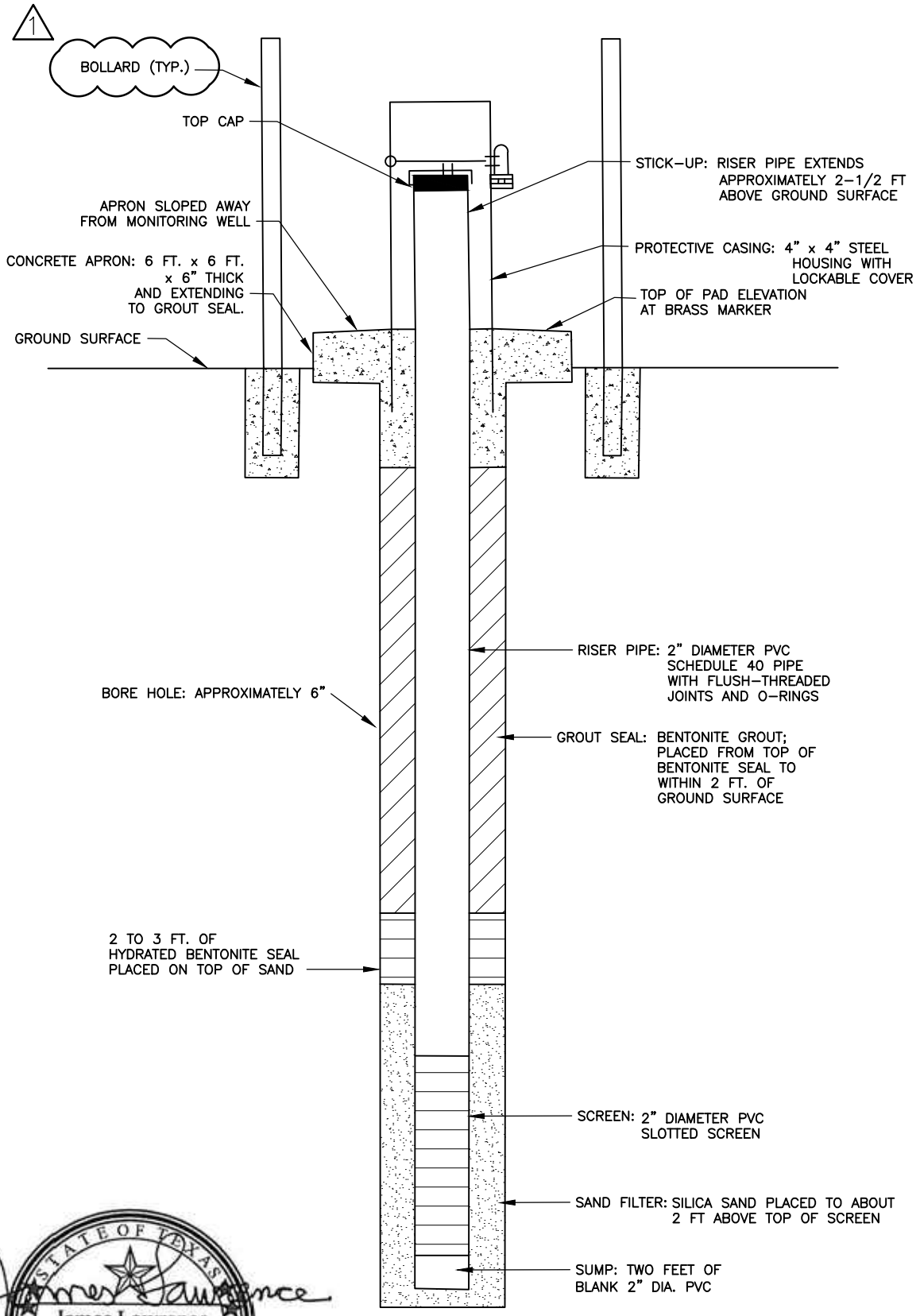
CADD FILE: 4.20 PROPOSAL GMW SYSTEM MAP

DATE: 05/2020

SCALE: AS SHOWN

FIGURE: ~~4.19~~ 4.20

TYPICAL MONITORING WELL DETAIL



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James Lawrence 10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISED DRAWING NUMBER AND LABEL	

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
TYPICAL MONITORING WELL DETAIL

PROJECT TITLE
CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
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PROJ. NO. 16216088.00 | DWN. BY: JLU/NR | Q/A RVW BY: RRK
DSN. BY: AB/JL | CHK. BY: BJD/AB | APP. BY: JL

CADD FILE: 4.21 – MONITOR WELL DTL

DATE: 04/2020

SCALE: AS SHOWN

FIGURE: ~~4.20~~ 4.21

10/9/2020 3:06 PM G:\WACO\16216088.00 1172 - SITE 50 SITING STUDY_Permit Dwgs_DWG\N022 (0820)_Att 4\4.21 - monitor well dtl

TABLES

- Table III-4.1 Regional Physiography
- Table III-4.2 Waco Average Monthly Rainfall
- Table III-4.3 Geologic Units and their Water-Bearing Properties
- Table III-4.4 Recorded Wells within 1 Mile
- Table III-4.5 Coordinates and Elevations of Borings
- Table III-4.6 Properties of Unit I
- Table III-4.7~~6~~ Properties of Unit II
- Table III-4.8~~7~~ Properties of Unit III
- Table III-4.9~~8~~ Existing Piezometer Completion Data
- Table III-4.10~~9~~ Summary Initial and Static Water Level Data
- Table III-4.11~~0~~ Vibrating Wire Piezometer Completion Data
- Table III-4.12~~1~~ Vibrating Wire Piezometer Inferred Groundwater Elevation Data
- Table III-4.13~~2~~ Summary of Aquifer (Slug) Tests Performed by SCS Engineers
- Table III-4.14~~3~~ Summary of Horizontal Flow Rate Calculation Data
- Table III-4.15~~4~~ Proposed Monitoring Well Information

Table III-4.5 Coordinates and Elevations of Borings Advanced at the Site by SCS Engineers

Boring Number	Easting	Northing	Hollow Stem Auger Type	Ground Elevation (ft-msl)	Depth Drilled (ft-bgs)	Elevation of Bottom (ft-msl)
B-1	3353867.3	10599904.81	7 ¼	551.67	82.0	469.7
B-1 (PZ-1)	3353867.3	10599904.81	7 ¼	551.74	39.5	512.24
B-2	3354595.81	10598697.6	7 ¼	549.78	55.0	494.78
B-3	3355259.69	10597665.32	7 ¼	541.1	72.0	469.1
B-3 (PZ-3)	3355259.69	10597665.32	7 ¼	541.20	45.0	496.2
B-4	3355130.33	10599528	7 ¼	550.04	101.0	449.04
B-5	3355913.87	10600728.3	7 ¼	541.38	47.0	494.38
B-6	3355562.96	10602041.9	7 ¼	545.55	70.7	474.85
B-7	3356670.83	10599929.6	8 ¼	530.50	55.5	475
B-8 (PZ-8)	3357935.82	10599489.18	8 ¼	550.34	75.0	475.34
B-9 (PZ-9)	3355762.31	10599314.37	8 ¼	535.30	40.0	495.30
B-9 cont.	3355762.31	10599314.37	8 ¼	535.30	135.0	400.30
B-10	3356199.16	10602404.1	8 ¼	545.40	53.0	492.4
B-11	3357048	10602933.5	7 ¼	553.50	78.5	475
B-12	3355833.07	10601575	8 ¼	542.85	48.0	494.85
B-13	3357768.09	10600645.6	8 ¼	555.15	80.0	475.15
B-14	3356543.77	10602016.3	8 ¼	539.20	65.5	473.7
B-15	3357265.27	10602471.1	7 ¼	563.35	70.0	493.35
B-16	3354706.01	10599996.8	8 ¼	560.25	61.0	499.25
B-17	3355568.96	10600519.6	7 ¼	546.75	71.0	475.75
B-18 (PZ-18)	3356694.76	10601254.04	8 ¼	534.84	56.0	478.84
B-19	3357202	10601429	7 ¼	562.05	87.0	475.05
B-20 (PZ-20)	3357666.42	10601846.53	7 ¼	564.68	73.0	491.68
B-21	3357008	10600682	8 ¼	538.75	45.0	493.75
B-22	3358132.03	10601234	8 ¼	555.00	80.0	475
B-23	3355207.68	10598431	8 ¼	540.08	45.7	494.38
B-24	3355746.69	10598780.1	7 ¼	533.63	59.2	474.43
B-25	3356251.06	10599102.9	7 ¼	533.25	33.0	500.25
B-26	3356929.04	10599457.3	8 ¼	530.45	36.0	494.5
B-27	3358308.89	10600427.7	8 ¼	546.65	53.0	493.65
B-28	3356800.71	10598286.7	8 ¼	529.6	55.0	474.6
B-29	3358523.03	10599393	8 ¼	540.25	45.0	495.25
B-30	3357828.13	10598886.4	8 ¼	543.05	48.0	495.05
B-31	3355837.8	10599897	8 ¼	537.55	63.0	474.55
B-32	3357077.27	10597864.5	8 ¼	526.3	32.0	494.3
B-33 (PZ-33)	3357774.62	10598320.64	8 ¼	539.20	55.0	484.2
B-34	3358367.31	10598778.6	8 ¼	535.65	41.0	494.65
B-35	3357682.18	10600037.4	8 ¼	553.3	59.0	494.3
B-36	3357239.12	10596730.2	8 ¼	532.5	58.0	474.5
B-37	3358201.19	10597770.6	8 ¼	526.9	52.0	474.9
B-38	3358847.64	10598223.2	8 ¼	529.85	55.0	474.85
B-39	3358709.87	10597052.3	8 ¼	522.95	48.0	475
B-40	3359476.22	10597259.9	8 ¼	522.80	28.0	494.8
B-41 (PZ-41)	3359083.91	10599450.64	8 ¼	534.62	60.0	474.62
B-42	3358523.73	10597484.3	8 ¼	527.00	32.0	495.0
B-43 (PZ-43)	3358875.54	10600433.69	8 ¼	548.86	75.0	473.86
B-43 cont.	3358875.54	10600433.69	8 ¼	548.86	150	398.86

Boring Number	Easting	Northing	Hollow Stem Auger Type	Ground Elevation (ft-msl)	Depth Drilled (ft-bgs)	Elevation of Bottom (ft-msl)
B-44	3354540.62	10599103.1	7 ¼	551.20	76.0	475.20
B-45	3356769.83	10601549.1	8 ¼	545.50	51.0	494.5
B-46	3357689.45	10601293.2	8 ¼	559.25	65.4	493.85
B-47 (PZ-47)	3356561.53	10598701.96	8 ¼	532.48	57.4	475.08

msl = mean sea level
b.g.s indicates depth is measured from below ground surface

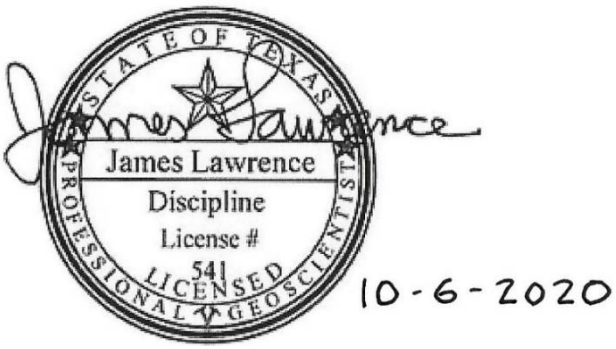
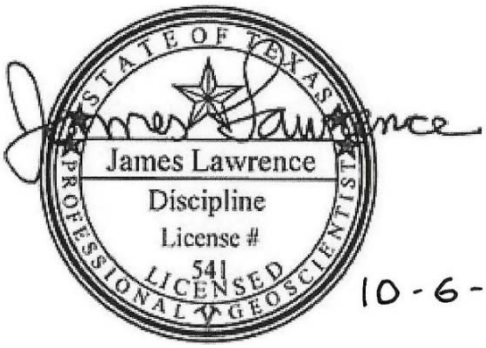


Table III-4.6 Properties of Unit I

Lab Test	East Disposal Area		West Disposal Area		Test Method
	Average	Number of Tests	Average	Number of Tests	
Moisture Content	17	3	24	5	ASTM D2216
Liquid Limit	57	3	70	5	ASTM D4318
Plasticity Index	37	3	47	5	ASTM D4318
Permeability (cm/s)	4.54×10^{-9}	1	4.36×10^{-9}	1	EM 1110-2-1906
Hydraulic Conductivity (cm/s)	4.54×10^{-9}	1	4.36×10^{-9}	1	EM 1110-2-1906
Hydraulic Conductivity (cm/s) (geometric mean)	n/a	n/a	n/a	n/a	Slug Test

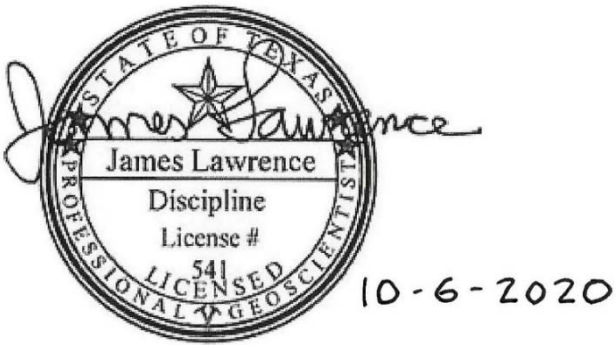


10-6-2020

~~Table III-4.6~~Table III-4.7 Properties of Unit II

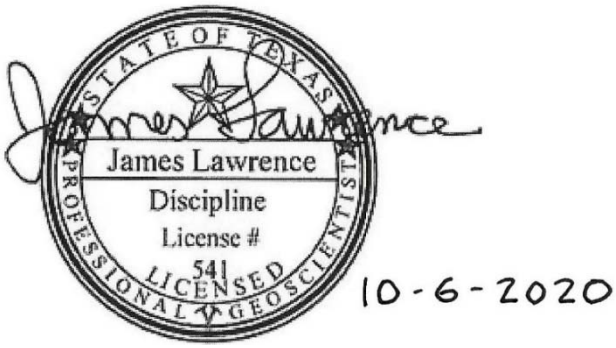
Lab Test	East Disposal Area		West Disposal Area		Test Method
	Average	Number of Tests	Average	Number of Tests	
Moisture Content	18~~17~~	24~~19~~	21~~19~~	29~~16~~	ASTM D2216
Liquid Limit	64~~63~~	24~~21~~	70~~68~~	33~~18~~	ASTM D4318
Plasticity Index	42~~42~~	24~~21~~	47~~46~~	33~~18~~	ASTM D4318
Permeability (cm/s)	5.02×10^{-8} ~~1.94×10^{-8}~~	4~~1~~	2.24×10^{-8} ~~1.94×10^{-8}~~	4~~1~~	EM 1110-2-1906
Hydraulic Conductivity (cm/s)~~**~~	5.02×10^{-8} ~~2.14×10^{-8}~~	4~~2~~	2.24×10^{-8} ~~2.31×10^{-8}~~	4~~2~~	EM 1110-2-1906
Hydraulic Conductivity (cm/s) (geometric mean)	2.05×10^{-8}	1	3.07×10^{-8}	3	Slug Test

~~** Both arithmetic (a) and geometric (g) mean used in calculating average.~~



~~Table III-4.7~~Table III-4.8 Properties of Unit III

Lab Test	East Disposal Area		West Disposal Area		Test Method
	Average	Number of Tests	Average	Number of Tests	
Moisture Content	14~~14~~	21~~17~~	15~~16~~	20~~10~~	ASTM D2216
Liquid Limit	59~~58~~	21~~17~~	66~~65~~	20~~10~~	ASTM D4318
Plasticity Index	39~~38~~	21~~17~~	45~~43~~	20~~10~~	ASTM D4318
Permeability (cm/s)	9.25×10^{-9}~~n/a~~	1~~n/a~~	6.71×10^{-6}~~n/a~~	1~~n/a~~	EM 1110-2-1906
Hydraulic Conductivity (cm/s)~~**~~	9.25×10^{-9}~~n/a~~	1~~n/a~~	6.71×10^{-6}~~n/a~~	1~~n/a~~	EM 1110-2-1906
Hydraulic Conductivity (cm/s) (geometric mean)	1.84×10^{-8}	2	n/a	n/a	Slug Test

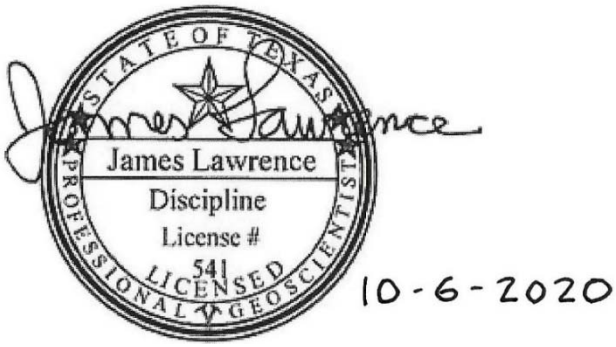


~~** Both arithmetic (a) and geometric (g) mean used in calculating average.~~

~~Table III-4.8~~Table III-4.9 Existing Piezometers Completion Data

Monitor Well No.	Drilled Depth (ft b.g.s)	Ground Surface Elevation (ft-msl)	Top of Pipe Elevation (ft-msl)	Screen		Filter Pack	
				Depth to Top (ft)	Depth to Base (ft)	Depth to Top (ft)	Depth to Base (ft)
PZ-1	39.5	551.7	555.12	19.19	39.19	16.00	39.47
PZ-3	45.0	541.2	544.21	24.53	44.53	21.5	44.76
PZ-8	75.0	550.3	553.39	54.47	74.47	52.70	74.70
PZ-9	40.0	535.3	539.44	18.28	38.28	15.90	38.48
PZ-18	56.0	534.8	537.80	25.18	45.18	22.80	45.50
PZ-20	73.0	564.7	567.77	44.00	64.00	42.00	64.00
PZ-33	55.0	539.2	542.49	34.63	54.63	33.00	54.90
PZ-41	60.0	534.6	538.04	28.58	48.58	24.00	48.77
PZ-43	75.0	548.9	551.31	28.20	48.20	24.00	48.45
PZ-47	57.4	532.5	536.16	10.00	30.00	8.00	30.00

Notes:
Ground-surface elevations are to the nearest tenth of a foot above mean sea level (msl) and are based on as-built monitoring well and piezometer survey elevations. Top of casing elevations are to the nearest hundredth of a foot.
b.g.s indicates depth is measured from below ground surface.



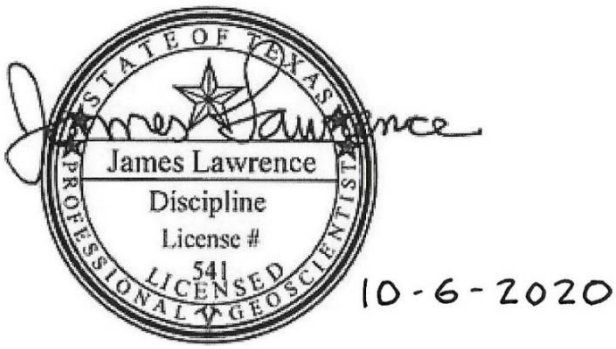
~~Table III-4.9~~Table III-4.10 Summary of Initial and Static Water Level Data

Boring/Well Number	Initial Water Level (ft-msl)	Static Water Level (ft-msl)	Date of Static Water Level Reading
B-1 (PZ-1)*	531.29	539.49~~539.04~~	7/8/2020~~2/25/2020~~
B-3 (PZ-3)*	495.86 (dry)	510.74~~510.65~~	7/8/2020~~2/25/2020~~
B-8 (PZ-8)*	476.30 (dry)	476.30 (dry)	7/8/2020~~2/25/2020~~
B-9 (PZ-9)*	510.05	501.45 (dry)	7/8/2020~~2/25/2020~~
B-18 (PZ-18)*	511.25	519.72~~519.4~~	7/8/2020~~2/25/2020~~
B-20 (PZ-20)*	557.20	520.87~~512.27~~	7/8/2020~~1/30/2020~~
B-33 (PZ-33)*	484.95 (dry)	484.95 (dry)	7/8/2020~~2/25/2020~~
B-41 (PZ-41)*	486.41 (dry)	492.8~~486.41 (dry)~~	7/8/2020~~2/25/2020~~
B-43 (PZ-43)*	501.37 (dry)	500.86 (dry)	7/8/2020~~2/25/2020~~
B-47 (PZ-47)*	502.15 (dry)	502.18 (dry)	7/8/2020~~2/25/2020~~

* = Piezometer installed in bore hole.

Notes:

1. Initial water level information shown in this table was taken from the piezometers following installation.
2. PZ-1, PZ-3, PZ-9, and PZ-47 are piezometers in the west disposal area.
3. PZ-8, PZ-18, PZ-20, PZ-33, PZ-41, and PZ-43 are piezometers in the east disposal area.
4. PZ-1, PZ-3, PZ-9, PZ-20, PZ-41, and PZ-43 are screened in the weathered and unweathered shale-marl zones and across the interface.
5. PZ-8, PZ-18, PZ-33 are screened in the unweathered shale-marl zone, below the interface.
6. PZ-47 is screened in the weathered shale-mark zone, above the interface.



~~Table III-4.10~~Table III-4.11 Summary of Vibrating Wire Piezometers Completion Data

VWP No.	Drilled Depth (ft b.g.s)	Ground Surface Elevation (ft-msl)	VWP Elevation (ft-msl)	VWP Depth (ft)	Bentonite Backfill Depth to Top (ft)	Filter Pack Depth to Top (ft)	Bentonite Seal Depth to Top (ft)
VWP-1	35.0	551.4	522.5	28.9	29.0	27.9	24.9
VWP-3	38.0	540.9	506.6	34.3	34.5	33.3	30.3
VWP-4	28.7	549.6	527.0	22.6	22.8	21.6	18.6
VWP-8	68.0	550.9	486.3	64.6	64.8	63.6	60.6
VWP-8D	160.0	551.0	400.0	151.0	--	150.0	147.0
VWP-9	35.0	535.3	506.9	28.4	28.5	27.3	24.3
VWP-9D	145.0	535.0	400.0	135.0	--	134.0	131.0
VWP-18	37.0	534.6	499.6	35.0	35.2	34.2	31.0
VWP-18D	145.0	535.0	400.0	135.0	--	134.0	131.0
VWP-19	53.0	562.1	511.0	51.1	51.3	50.3	47.0
VWP-20	56.5	564.6	510.1	54.5	54.7	53.7	51.0
VWP-25	32.0	533.8	505.0	28.8	29.0	27.8	24.8
VWP-26	24.8	530.5	506.0	24.5	--	23.5	20.5
VWP-27	30.0	546.7	520.0	26.7	27.0	25.7	23.0
VWP-30	40.0	544.0	506.0	38.0	38.1	37.0	34.0
VWP-33	48.0	538.6	494.8	43.8	44.0	42.8	39.8
VWP-33D	150.0	539.0	401.0	138.0	--	137.0	134.0
VWP-41	39.0	534.8	496.4	38.4	38.7	37.5	34.5
VWP-41D	145.0	535.0	402.0	133.0	--	132.0	129.0
VWP-43	40.0	549.5	511.5	38.0	38.3	37.0	34.0
VWP-43D	160.0	549.0	400.0	149.0	--	148.0	145.0
VWP-44	55.0	554.4	505.2	49.2	49.3	48.2	45.2
VWP-47	23.5	532.6	512.4	20.2	20.4	19.2	16.2
VWP-47D	142.0	532.0	400.0	132.0	--	131.0	128.0

Notes:
Ground-surface and VWP elevations are to the nearest tenth of a foot above mean sea level (msl) and are based on piezometer survey elevations. b.g.s indicates depth is measured from below ground surface.

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~~Table III-4.11~~Table III-4.12 Summary of Vibrating Wire Piezometers Calculated Groundwater Elevations

VWP No.	Ground Surface Elevation (ft-msl)	VWP Elevation (ft-msl)	Temperature (°C)	Pressure (PSI)	Pressure Head (feet H_2O)	Calculated Groundwater Elevation (ft-msl)	Date of Reading
VWP-1	551.4	522.5	21.4~~21.5~~	8.1~~7.9~~	18.65~~18.2~~	541.2~~540.7~~	7/8/2020~~2/25/2020~~
VWP-3	540.9	506.6	21.4~~21.5~~	2.6~~2.5~~	6.07~~6.0~~	512.7~~512.6~~	7/8/2020~~2/25/2020~~
VWP-4	549.6	527.0	20.6~~21.4~~	-0.1	-0.3~~-0.2~~	526.8 (dry)	7/8/2020~~2/25/2020~~
VWP-8	550.9	486.3	20.0	0.0	-0.1~~0.0~~	486.3 (dry)	7/8/2020~~2/25/2020~~
VWP-8D	551.0	400.0	21.7~~21.8~~	45.9~~43.5~~	106.13~~100.64~~	506.1~~500.6~~	7/8/2020~~2/25/2020~~
VWP-9	535.3	506.9	21.2~~21.5~~	-0.1~~0.0~~	-0.2~~0.0~~	506.9 (dry)	7/8/2020~~2/25/2020~~
VWP-9D	535.0	400.0	22.3~~22.5~~	51.6~~51.2~~	119.39~~118.4~~	519.4~~518.4~~	7/8/2020~~2/25/2020~~
VWP-18	534.6	499.6	20.7~~20.8~~	10.3~~10.1~~	23.92~~23.4~~	523.5~~523.0~~	7/8/2020~~2/25/2020~~
VWP-18D	535.0	400.0	22.2	44.8~~36.3~~	103.56~~83.9~~	503.6~~483.9~~	7/8/2020~~2/25/2020~~
VWP-19	562.1	511.0	21.6	-0.5~~-0.4~~	-1.1~~-1.0~~	510.0 (dry)	7/8/2020~~2/25/2020~~
VWP-20	564.6	510.1	21.6~~21.7~~	-0.1~~0.0~~	-0.2~~0.0~~	510.1 (dry)	7/8/2020~~2/25/2020~~
VWP-25	533.8	505.0	19.6~~19.7~~	-0.1~~0.0~~	-0.2~~0.0~~	505.0 (dry)	7/8/2020~~2/25/2020~~
VWP-26	530.5	506.0	20.0~~20.5~~	-0.1	-0.4~~-0.3~~	505.7 (dry)	7/8/2020~~2/25/2020~~
VWP-27	546.7	520.0	20.8~~21.4~~	-0.2~~-0.1~~	-0.5~~-0.3~~	519.7 (dry)	7/8/2020~~2/25/2020~~
VWP-30	544.0	506.0	20.3~~20.2~~	0.0~~1.5~~	-0.2~~3.4~~	505.8 (dry)~~509.4~~	7/8/2020~~2/25/2020~~
VWP-33	538.6	494.8	21.4~~21.5~~	-0.1~~0.0~~	-0.3~~0.0~~	494.8 (dry)	7/8/2020~~2/25/2020~~
VWP-33D	539.0	401.0	22.1	8.1~~3.1~~	18.7~~7.1~~	419.7~~408.1~~	7/8/2020~~2/25/2020~~
VWP-41	534.8	496.4	19.8~~19.7~~	0.0	-0.1~~0.0~~	496.4 (dry)	7/8/2020~~2/25/2020~~
VWP-41D	535.0	402.0	21.2~~21.3~~	13.9~~8.8~~	32.29~~20.3~~	434.3~~422.4~~	7/8/2020~~2/25/2020~~
VWP-43	549.5	511.5	20.4~~20.3~~	-0.1~~0.0~~	-0.2~~0.0~~	511.5 (dry)	7/8/2020~~2/25/2020~~
VWP-43D	549.0	400.0	21.7~~21.8~~	41.5~~36.0~~	95.95~~83.3~~	496.0~~483.3~~	7/8/2020~~2/25/2020~~
VWP-44	554.4	505.2	22.0	3.3~~3.5~~	7.8~~8.1~~	513.0~~513.3~~	7/8/2020~~2/25/2020~~
VWP-47	532.6	512.4	21.1	0.1~~0.0~~	-0.2~~0.0~~	512.4 (dry)	7/8/2020~~2/25/2020~~
VWP-47D	532.0	400.0	21.1	11.0~~7.1~~	25.62~~16.3~~	425.6~~416.3~~	7/8/2020~~2/25/2020~~

Notes:
Ground-surface and VWP elevations are to the nearest tenth of a foot above mean sea level (msl) and are based on piezometer survey elevations.

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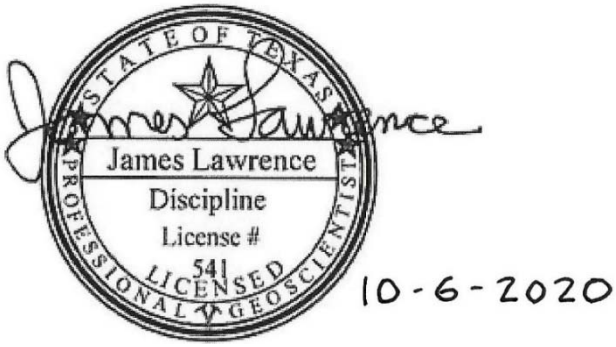
~~Table III-4.12~~Table III-4.13 Summary of Aquifer (Slug) Tests Performed by SCS Engineers

Piezometer Designation	Unit Tested	Slug Test Method	Hydraulic Conductivity (cm/sec)
PZA-1	II/III	Bouwer-Rice	Slug in: 2.03 x 10^{-8} cm/sec
			Slug out: 2.04 x 10^{-8} cm/sec
PZA-3	II/III	Bouwer-Rice	Slug in: 6.97 x 10^{-8} cm/sec
PZ-18	III	Bouwer-Rice	Slug in: 1.44 x 10^{-8} cm/sec
			Slug out: 2.36 x 10^{-8} cm/sec
PZ-20	II/III	Bouwer-Rice	Slug in: 2.05 x 10^{-8} cm/sec
Geometric Mean Hydraulic Conductivity = 2.42 x 10^{-8} cm/sec			
Arithmetic Mean Hydraulic Conductivity = 2.82 x 10^{-8} cm/sec			



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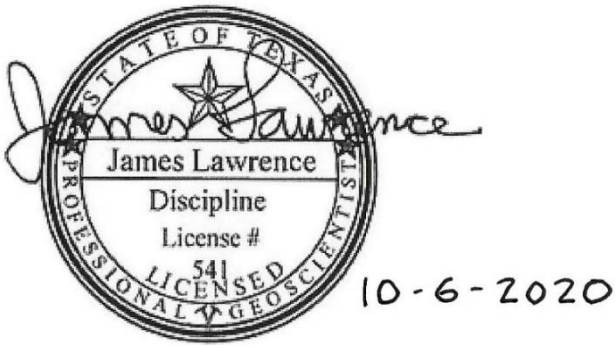
~~Table III-4.13~~Table III-4.14 Estimated Ground Water Velocities

Location	Hydraulic Conductivity (k)* (cm/sec) (Geometric Mean)	Hydraulic Gradient (i)**	Average Effective Porosity (n)***	Velocities (v) ft/day	Velocity (v) ft/year
Entire Area (PZA-1, PZA-3, PZ-18, PZ-20)	2.42×10^{-8}	0.02~~7~~4	0.05	3.6~~2~~ $\times 10^{-5}$	0.013~~2~~
Unit II (PZA-1, PZA-3, PZ-20)	2.77×10^{-8}	0.02~~7~~4	0.05	4.32~~3.84~~ x 10^{-5}	0.016~~4~~
West Disposal Area (PZA-1, PZA-3)	3.07×10^{-8}	0.02~~7~~4	0.05	4.32~~3.84~~ x 10^{-5}	0.016~~4~~
East Disposal Area (PZ-18, PZ-20)	1.91×10^{-8}	0.02~~7~~4	0.05	2.88~~56~~ x 10^{-5}	0.010~~9~~
PZA-3 (High)	6.97×10^{-8}	0.02~~7~~4	0.05	1.08~~9.6~~ x 10^{-4}~~5~~	0.039~~5~~
PZ-18 (Low)	1.44×10^{-8}	0.02~~7~~4	0.05	2.16~~1.92~~ x 10^{-5}	0.008~~7~~

* Hydraulic conductivity estimated from slug test results.
** Gradient estimated from July~~February~~ 2020 deep VWP potentiometric map (Figure III-4.19~~7~~)
*** Typical porosity for shale (Driscoll, 1986)



~~Table III-4.14~~Table III-4.15 Proposed Monitoring Well Information

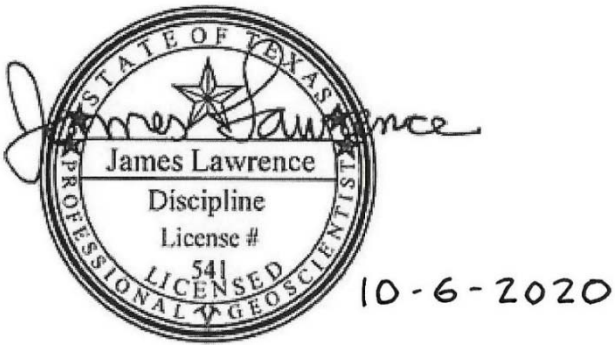
Monitor Well No.	Cell Location	Installation	Northing	Easting	Estimated Ground Surface Elevation (ft-msl)	Proposed Well Bottom Elevation (ft-msl)	Proposed Screen Elevation (ft-msl)	Expected Water Elevation (ft-msl)
P1-MW 1-A (D)	East	Prior to Landfill Operation	10601388.5'	3356636.7'	537.3	482	482-522	520
P1-MW 1-B (D)	East	Prior to Landfill Operation	10601388.5'	3356636.7'	537.3	400	400-440	520
P1-MW 2-A (D)	East	Waste < 1,000 feet~~Prior to Landfill Operation~~	10600835.2'	3356820.8'	534.9	500	480-520	520
P1-MW 2-B (D)	East	Waste < 1,000 feet~~Prior to Landfill Operation~~	10600835.2'	3356820.8'	534.9	400	400-440	520
P1-MW 3-A (D)	East	Waste < 1,000 feet	10600455.1'	3357167.6'	539.9	500	485-525	515
P1-MW 3-B (D)	East	Waste < 1,000 feet	10600455.1'	3357167.6'	539.9	400	400-440	515
P1-MW 4-A (D)	East	Waste < 1,000 feet	10599949.8'	3357049.5'	535.5	480	480-520	510
P1-MW 4-B (D)	East	Waste < 1,000 feet	10599949.8'	3357049.5'	535.5	400	400-440	500
P1-MW 5-A (D)	East	Waste < 1,000 feet	10599428.7'	3357289.6'	535.5	480	480-520	510
P1-MW 5-B (D)	East	Waste < 1,000 feet	10599428.7'	3357289.6'	535.5	400	400-440	480
P1-MW 6-A (D)	East	Waste < 1,000 feet	10598871.8'	3357451.8'	536.9	482	482-522	500
P1-MW 6-B (D)	East	Waste < 1,000 feet	10598871.8'	3357451.8'	536.9	400	400-440	440
P1-MW 7-A (D)	East	Waste < 1,000 feet	10598575.5'	3357780.2'	541.0	486	486-526	500
P1-MW 7-B (D)	East	Waste < 1,000 feet	10598575.5'	3357780.2'	541.0	400	400-440	410
P1-MW 8-A (D)	East	Waste < 1,000 feet	10598576.0'	3358302.8'	534.4	479	479-519	500
P1-MW 8-B (D)	East	Waste < 1,000 feet	10598576.0'	3358302.8'	534.4	400	400-440	410
P1-MW 9-A (D)	East	Waste < 1,000 feet	10599071.8'	3358618.2'	534.9	480	480-520	500
P1-MW 9-B (D)	East	Waste < 1,000 feet	10599071.8'	3358618.2'	534.9	400	400-440	420
P1-MW 10-A (D)	East	Waste < 1,000 feet	10599550.5'	3358887.5'	536.5	481	481-521	500
P1-MW 10-B (D)	East	Waste < 1,000 feet	10599550.5'	3358887.5'	536.5	400	400-440	430

Monitor Well No.	Cell Location	Installation	Northing	Easting	Estimated Ground Surface Elevation (ft-msl)	Proposed Well Bottom Elevation (ft-msl)	Proposed Screen Elevation (ft-msl)	Expected Water Elevation (ft-msl)
P1-MW 11-A (D)	East	Waste < 1,000 feet	10599811.3'	3358835.5'	537.2	482	482-522	510
P1-MW 11-B (D)	East	Waste < 1,000 feet	10599811.3'	3358835.5'	537.2	400	400-440	460
P1-MW 12-A (D)	East	Waste < 1,000 feet	10599973.5'	3359272.3'	535.2	480	480-520	510
P1-MW 12-B (D)	East	Waste < 1,000 feet	10599973.5'	3359272.3'	535.2	400	400-440	480
P1-MW 13-A (D)	East	Waste < 1,000 feet	10600475.2'	3358969.8'	548.7	494	494-534	510
P1-MW 13-B (D)	East	Waste < 1,000 feet	10600475.2'	3358969.8'	548.7	400	400-440	480
P1-MW 14-A (D)	East	Waste < 1,000 feet	10600975.4'	3358654.1'	557.9	503	503-543	515
P1-MW 14-B (D)	East	Waste < 1,000 feet	10600975.4'	3358654.1'	557.9	400	400-440	480
P1-MW 15-A (D)	East	Waste < 1,000 feet	10601450.3'	3358350.5'	559.1	504	504-544	520
P1-MW 15-B (D)	East	Waste < 1,000 feet	10601450.3'	3358350.5'	559.1	400	400-440	500
P1-MW 16-A (D)	East	Waste < 1,000 feet~~Prior to Landfill Operation~~	10601952.9'	3358044.6'	562.9	508	508-548	520
P1-MW 16-B (D)	East	Waste < 1,000 feet~~Prior to Landfill Operation~~	10601952.9'	3358044.6'	562.9	400	400-440	520
P1-MW 17-A (D)	East	Prior to Landfill Operation	10602455.6'	3357728.7'	568.7	514	514-554	520
P1-MW 17-B (D)	East	Prior to Landfill Operation	10602455.6'	3357728.7'	568.7	400	400-440	520
P1-MW 18-A (U)	East	Prior to Landfill Operation	10602898.2'	3357210.8'	557.1	502	502-542	520
P1-MW 18-B (U)	East	Prior to Landfill Operation	10602898.2'	3357210.8'	557.1	400	400-440	520
P1-MW 19-A (U)	East	Prior to Landfill Operation	10602401.2'	3356897.4'	539.8	485	485-525	520
P1-MW 19-B (U)	East	Prior to Landfill Operation	10602401.2'	3356897.4'	539.8	400	400-440	520
P1-MW 20-A (U)	East	Prior to Landfill Operation	10601906.1'	3356610.0'	539.5	485	485-525	520

Monitor Well No.	Cell Location	Installation	Northing	Easting	Estimated Ground Surface Elevation (ft-msl)	Proposed Well Bottom Elevation (ft-msl)	Proposed Screen Elevation (ft-msl)	Expected Water Elevation (ft-msl)
P1-MW 20-B (U)	East	Prior to Landfill Operation	10601906.1'	3356610.0'	539.5	400	400-440	520
P2-MW 1-A (U)	West	Waste < 1,000 feet	10601080.1'	3355911.8'	541.3	486	486-526	520
P2-MW 1-B (U)	West	Waste < 1,000 feet	10601080.1'	3355911.8'	541.3	400	400-440	520
P2-MW 2-A (U)	West	Waste < 1,000 feet	10600561.9'	3355105.9'	546.9	492	492-532	535
P2-MW 2-B (U)	West	Waste < 1,000 feet	10600561.9'	3355105.9'	546.9	400	400-440	535
P2-MW 3-A (U)	West	Waste < 1,000 feet	10600028.3'	3354261.3'	561.9	507	507-547	540
P2-MW 3-B (U)	West	Waste < 1,000 feet	10600028.3'	3354261.3'	561.9	400	400-440	540
P2-MW 4-A (D)	West	Waste < 1,000 feet	10599509.0'	3354533.4'	558.2	503	503-543	525
P2-MW 4-B (D)	West	Waste < 1,000 feet	10599509.0'	3354533.4'	558.2	400	400-440	525
P2-MW 5-A (D)	West	Waste < 1,000 feet	10599116.9'	3354318.4'	553.8	499	499-539	515
P2-MW 5-B (D)	West	Waste < 1,000 feet	10599116.9'	3354318.4'	553.8	400	400-440	515
P2-MW 6-A (D)	West	Waste < 1,000 feet	10598627.3'	3354628.1'	549.0	494	494-534	515
P2-MW 6-B (D)	West	Waste < 1,000 feet	10598627.3'	3354628.1'	549.0	400	400-440	515
P2-MW 7-A (D)	West	Waste < 1,000 feet	10598137.9'	3354937.1'	541.7	487	487-527	515
P2-MW 7-B (D)	West	Waste < 1,000 feet	10598137.9'	3354937.1'	541.7	400	400-440	515
P2-MW 8-A (D)	West	Waste < 1,000 feet	10597808.8'	3355366.0'	542.7	488	488-528	515
P2-MW 8-B (D)	West	Waste < 1,000 feet	10597808.8'	3355366.0'	542.7	400	400-440	515
P2-MW 9-A (D)	West	Waste < 1,000 feet	10598355.8'	3355575.5'	534.7	480	480-520	515
P2-MW 9-B (D)	West	Waste < 1,000 feet	10598355.8'	3355575.5'	534.7	400	400-440	500
P2-MW 10-A (D)	West	Waste < 1,000 feet	10598926.3'	3355714.8'	534.9	480	480-520	515
P2-MW 10-B (D)	West	Waste < 1,000 feet	10598926.3'	3355714.8'	534.9	400	400-440	500
P2-MW 11-A (D)	West	Waste < 1,000 feet	10599286.1'	3355952.6'	535.1	480	480-520	515
P2-MW 11-B (D)	West	Waste < 1,000 feet	10599286.1'	3355952.6'	535.1	400	400-440	440

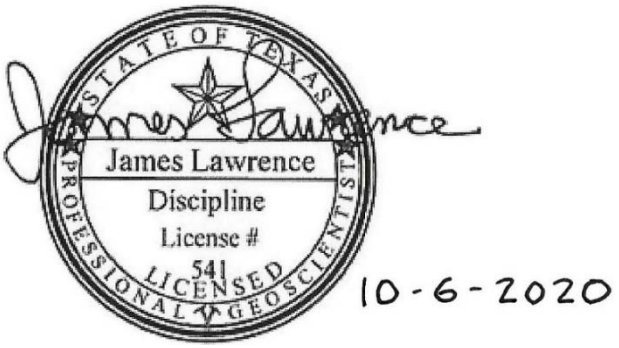
Monitor Well No.	Cell Location	Installation	Northing	Easting	Estimated Ground Surface Elevation (ft-msl)	Proposed Well Bottom Elevation (ft-msl)	Proposed Screen Elevation (ft-msl)	Expected Water Elevation (ft-msl)
P2-MW 12-A (D)	West	Waste < 1,000 feet	10599642.5'	3356227.9'	535.5	480	480-520	515
P2-MW 12-B (D)	West	Waste < 1,000 feet	10599642.5'	3356227.9'	535.5	400	400-440	440
P2-MW 13-A (D)	West	Waste < 1,000 feet	10600060.5'	3356061.2'	535.3	480	480-520	515
P2-MW 13-B (D)	West	Waste < 1,000 feet	10600060.5'	3356061.2'	535.3	400	400-440	490
P2-MW 14-A (D)	West	Waste < 1,000 feet	10600549.7'	3356070.2'	536.9	482	482-522	515
P2-MW 14-B (D)	West	Waste < 1,000 feet	10600549.7'	3356070.2'	536.9	400	400-440	490

Notes:
Proposed shallow well bottom elevations are 55 feet below ground surface elevations. Proposed deep well bottom elevations will all be set at 400 ft-msl.



APPENDIX III-4.D

BORING LOGS



KEY TO SYMBOLS

SCS Engineers
1901 Central Drive, Ste. 550
Bedford, Texas
Telephone: 817-571-2288

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)

- CH: USCS High Plasticity Clay
- CL: USCS Low Plasticity Clay
- CL-ML: USCS Low Plasticity Silty Clay
- CLS: USCS Low Plasticity Sandy Clay
- UNIT 1
- MH: USCS Elastic Silt
- NO CORE
- SC: USCS Clayey Sand
- SHALE: Shale
- SP: USCS Poorly-graded Sand
- SP-SC: USCS Poorly-graded Sand with Clay

SAMPLER SYMBOLS

- Standard Penetration Test
- Split Spoon
- Shelby Tube

NOTE: If no symbol for sample type is shown: Sample Type = NXCB

WELL CONSTRUCTION SYMBOLS

- Bentonite Seal: 1 pipe group, 1 pipe
- Slotted Pipe: 1 pipe group, 1 pipe
- Top Cap: 1 pipe group, 1st pipe

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
-200 - PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)
TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UC - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION
Water Level at Time Drilling, or as Shown
Water Level at End of Drilling, or as Shown
Water Level After Drilling, or as Shown

SYMBOLS2 - GINT STD US LAB.GDT - 10/2/20 13:36 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

SCS ENGINEERS
SCS Engineers
1901 Central Drive, Ste. 550
Bedford, Texas
Telephone: 817-571-2288

BORING NUMBER B-1 (A-1)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 1/25/18 **COMPLETED** 1/26/18
GROUND ELEVATION 551.67 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow stem auger/air rotary
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING ---
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
	ST1	75	PP = 3.5 tsf 0-16 feet logged from previous drilling in January 2018	SC		(SC) 2.0 (From previous log drilled 1/25/2018)	549.7
	ST2	50	PP = 4.5+ tsf	CH		(CH) Clay, dark brown, hard, moist, calcareous Pebbles 2-4 ft	
5	ST3	50	PP = 4.5+ tsf			Color change to light brown at 6 ft	
	ST4	75	PP = 4.5+ tsf			Color change to brown-grey at 8 ft Color change to reddish brown at 10 ft	
	ST5	80	PP = 4.5+ tsf				
10	ST6	85	PP = 4.5+ tsf MC = 31% LL = 83 PL = 58			12.0	539.7
	ST7	95	PP = 4.5+ tsf	CH		(CH) Clay, reddish brown, with gray sand, soft, moist	
15	ST8	95	PP = 4.5+ tsf MC = 30% LL = 89 PL = 63			16.0	535.7
	ST9	80	PP = 4.5+ tsf	CH		(CH) Clay, grey to brown, with silty sand lenses, hard, moist Fossil fragments 16-18 ft	
20	ST10	90	PP = 4.5+ tsf MC = 22% LL = 79 PL = 56			20.0	531.7
	ST11	50	PP = 4.5+ tsf	SC		(SC) Clayey sand, grey to dark grey, clay is reddish brown, soft, slightly saturated Quartz and calcite pebbles throughout	
	ST12	70	PP = 4.5+ tsf			24.0	527.7
25	ST13	80	PP = 4.5+ tsf	CH		(CH) Clay, mottled red/grey/brown, with sand lenses, hard, moist Sand lenses are saturated 26.0 Calcite and quartz pebbles throughout	525.7
	ST14	70	PP = 4.5+ tsf	CH		(CH) Clay, reddish brown, with grey sand, soft, saturated 28.0	523.7
30	ST15	50	PP = 4.5+ tsf			Calcite and quartz throughout Weathered shale begins at 28 ft	
35		100	PP = 4.5+ tsf MC = 14% LL = 66 PL = 43			Silty Clay Shale, gray to dark gray, very stiff to hard, hard, calcareous Fossil fragments throughout Silty sand lenses throughout	

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:40 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-1 (A-1)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						Silty Clay Shale, gray to dark gray, very stiff to hard, hard, calcareous
		100	PP = 4.5+ tsf			Fossil fragments throughout Silty sand lenses throughout *(continued)*
40						
		98	PP = 4.5+ tsf MC = 14% LL = 73 PL = 52			
45						
		35	PP = 4.5+ tsf			
50						
		94	PP = 4.5+ tsf			
55						
		81	PP = 4.5+ tsf			
60						
		85	PP = 4.5+ tsf MC = 18% LL = 72 PL = 52			
65						
		100	PP = 4.5+ tsf			
70						
		92	PP = 4.5+ tsf			
75						

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:40 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-1 (A-1)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75						
		27	PP = 4.5+ tsf			Silty Clay Shale, gray to dark gray, very stiff to hard, hard, calcareous Fossil fragments throughout Silty sand lenses throughout *(continued)*
80						
		100	PP = 4.5+ tsf			82.0 469.7

Bottom of borehole at 82.0 feet.

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WELL NUMBER B-1 (PZ-1)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/4/18 **COMPLETED** 10/4/18
GROUND ELEVATION 551.7 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING ---
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING 20.41 ft / Elev 531.29 ft
NOTES
AFTER DRILLING 12.21 ft / Elev 539.49 ft

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0						Silty Clay, dark brown, slightly moist to moist, soft (2.0 – 549.7)	
5				CL-ML		(CL-ML) Silty Clay, red/orange to brown, slightly moist to moist, firm to stiff, with orange staining in joints	
10							
15						(15.0 – 536.7)	
20		12	PP = 3.25 tsf MC = 23% LL = 75 PL = 22 Fines = 93%			Silty Clay Shale, orange-brown mottled brown, slightly moist, stiff, non-calcareous, very weathered Color change to orange-brown mottled tan to light gray and calcareous at 20 feet	
25		90	PP = 3.0-3.25 tsf				
30		32	PP = 3.0-3.5 tsf Weathered to Unweathered zone			(28.0 – 523.7) Silty Clay Shale, gray to dark gray, very stiff to hard, slightly moist to dry, calcareous, unweathered Slight orange staining in joints 30-39 feet.	
35		60	PP = 4.5+ tsf				

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WELL NUMBER B-1 (PZ-1)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35		107	PP = 4.5+ tsf MC = 19% LL = 69 PL = 24 Fines = 97%			Silty Clay Shale, gray to dark gray, very stiff to hard, slightly moist to dry, calcareous, unweathered Slight orange staining in joints 30-39 feet. *(continued)*	
						39.3	512.4

Bottom of borehole at 39.3 feet.

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BORING NUMBER B-2 (A-2)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 1/22/18 **COMPLETED** 1/23/18
GROUND ELEVATION 549.78 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow stem auger/air rotary
AT TIME OF DRILLING --- No water
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No water
NOTES
AFTER DRILLING ---

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0	ST1	100		PP = 0 tsf	SC		(SC) Topsoil, dark brown, soft, dry	
							2.0	547.8
							No Recovery	
							4.0	545.8
5	SS1	100	4-5-7 (12)	PP = 4.5+ tsf	GW-GM		(GW-GM) Gravel, with dark brown silt, loose, moist	
							5.5	544.3
	SS2	100	6-8-11 (19)	PP = 4.5+ tsf			2 inch limestone layer at 5.5 feet (CH) Clay, dark gray, hard, moist, calcareous	
10	ST2	100		PP = 4.5+ tsf	CH		Color change to mottled gray/brown at 6 feet	
	ST3	100		PP = 4.5+ tsf			Color change to brown at 8 feet Limestone pebbles 8-12 ft	
							12.0	537.8
	ST4	100		PP = 4.5+ tsf			(CH) Clay, brown, with fine sand, hard, moist	
15	ST5	100		PP = 4.5+ tsf			Color change to reddish brown @ 14 ft Color change to brown @ 16 ft Limestone pebbles 16-18 ft	
	ST6	100		PP = 4.5+ tsf	CH			
20	ST7	100		PP = 4.5+ tsf				
	ST8	100		PP = 4.5+ tsf				
							22.0	527.8
	ST9	100		PP = 4.5+ tsf			(CH) Sandy Clay, brown/grey, hard, moist, calcareous	
25	ST10	100		PP = 4.5+ tsf			Calcite and quartz throughout 24-26 ft	
	ST11	100		PP = 4.5+ tsf			Color change to brown at 32 feet Color change to dark brown at 36 feet	
30	ST12	100		PP = 4.5+ tsf	CH		Shale pieces throughout 36-38 feet	
	ST13	100		PP = 4.5+ tsf				
	ST14	100		PP = 4.5+ tsf				
35								

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BORING NUMBER B-2 (A-2)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							
	ST15	100		PP = 4.5+ tsf	CH		
	ST16	100		PP = 4.5+ tsf			38.0 511.8
40	ST17	188		PP = 4.5+ tsf weathered/unweathered zone			Shale, dark grey, with limestone lenses throughout, hard, calcareous
45		90		PP = 4.5+ tsf			
50		100		PP = 4.5+ tsf			
55		100		PP = 4.5+ tsf			55.0 494.8

Bottom of borehole at 55.0 feet.

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BORING NUMBER B-3 (A-3)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 1/31/18 **COMPLETED** 1/31/18
GROUND ELEVATION 541.1 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow stem auger/air rotary
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	
0	ST1	50	PP = 4.5+ tsf		Topsoil	
				2.0		539.1
	ST2	100	PP = 4.5+ tsf		Clay, brown/redbrown, with chalk layers, moist, hard Pebbles 2-4 ft	
5	ST3	80	PP = 4.5+ tsf			
	ST4	90	PP = 4.5+ tsf			
				8.0		533.1
	ST5	100	PP = 4.5+ tsf		Clay, mottled red/gray/brown, with saturated fine sand layers, hard, moist Increasing hardness with depth	
10	ST6	90	PP = 4.5+ tsf		Shale pieces at 30 ft Mineral deposits at 26 ft	
	ST7	100	PP = 4.5+ tsf			
15	ST8	100	PP = 4.5+ tsf			
	ST9	100	PP = 4.5+ tsf			
20	ST10	80	PP = 4.5+ tsf			
	ST11	100	PP = 4.5+ tsf			
	ST12	70	PP = 4.5+ tsf			
25						
	ST13	90	PP = 4.5+ tsf			
30	ST14	100	PP = 4.5+ tsf			
	ST15	100	PP = 4.5+ tsf			
				32.0		509.1
	ST16	100	PP = 4.5+ tsf		Sand, brown/gray, with minor clay and mineral deposit layers, saturated, soft	
				34.0		507.1
35					No Recovery	

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:40 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-3 (A-3)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
35					No Recovery *(continued)*
					38.0 — 503.1
40	ST17	100	PP = 4.5+ tsf Weathered to unweathered zone		Shale, dark gray to black, hard, dry, calcareous, with limestone and fine sand layers up to 1/8" thick
45		98	PP = 4.5+ tsf		Very little sand 40-45 feet. Limestone layer 1/2 thick at 45 feet. More sand layers 1/8" thick throughout at 65 feet. Fossil fragments 70-72 feet.
50		97	PP = 4.5+ tsf		
55		100	PP = 4.5+ tsf		
60		100	PP = 4.5+ tsf		
65		98	PP = 4.5+ tsf		
70		98	PP = 4.5+ tsf		
		100	PP = 4.5+ tsf		
					72.0 — 469.1

Bottom of borehole at 72.0 feet.

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WELL NUMBER B-3 (PZ-3)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/10/18 **COMPLETED** 10/10/18
GROUND ELEVATION 541.2 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING 30.46 ft / Elev 510.74 ft No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0			0-20 feet logged from previous drilling in January 2018			Topsoil (2.0 – 539.2)	
5				CL		(CL) Clay, brown/redbrown, with chalk layers, moist, hard Pebbles 2-4 ft (8.0 – 533.2)	
10				CL		(CL) Clay, mottled red/gray/brown, with saturated fine sand layers, hard, moist Increasing hardness with depth Shale pieces at 30 ft Mineral deposits at 26 ft (20.0 – 521.2)	
15							
20							
25		52	PP <1-4.5+ tsf	SP-SC		(SP-SC) Sand, brown, soft, moist to wet, with traces of clay, fine to medium grained (22.6 – 518.6)	
				CL		Silty Clay, dark brown, hard to stiff, moist (22.8 – 518.4) (CL) Silty Clay, orange-brown mottled brown, hard, slightly moist, calcareous, with weathered shale (27.0 – 514.2)	
30		78	PP = 4.5+ tsf MC = 18% LL = 60 PL = 24 Fines = 93%			Silty Clay Shale, gray with orange-brown staining, very hard, slightly moist, calcareous, with mineral desposits in fractures, weathered No mineral deposits 35-39 feet	
35		74	PP = 4.5+ tsf				

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:40 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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WELL NUMBER B-3 (PZ-3)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35							
		56	PP = 4.5+ tsf Weathered to Unweathered zone			Silty Clay Shale, gray with orange-brown staining, very hard, slightly moist, calcareous, with mineral desposits in fractures, weathered No mineral deposits 35-39 feet *(continued)*	
40						39.0 / 502.2 Silty Clay Shale, dark gray, very hard, slightly moist to dry, calcareous, unweathered	
		70	PP = 4.5+ tsf MC = 16% LL = 63 PL = 20 Fines = 96%				
45						45.0 / 496.2	

Bottom of borehole at 45.0 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:40 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-4 (A-4)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 1/23/18 **COMPLETED** 1/23/18
GROUND ELEVATION 550.04 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow stem auger/air rotary
AT TIME OF DRILLING 48.77 ft / Elev 501.27 ft
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING 96.59 ft / Elev 453.45 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0								
	ST1	75		PP = 0 tsf MC = 24% LL = 67 PL = 46 Fines = 71%	SC		(SC) Topsoil/Fill material	
							2.0	548.0
	SPT1	75	2-3-5 (8)				Topsoil/Fill material, with dakr brown clay, soft, moist	
				PP = 4.0 tsf			4.0	546.0
5	ST2	50		PP = 4.5+ tsf	CH		(CH) Clay, dark brown, hard, moist, calcareous Color change to light brown at 8 feet.	
	ST3	75		PP = 4.5+ tsf			Pebbles throughout 8-10 ft	
	ST4	50		PP = 4.5+ tsf			Color change to mottled brown/grey at 16 feet Sand lenses throughout 18-20 feet	
10	ST5	50		PP = 4.5+ tsf MC = 21% LL = 75 PL = 51				
	ST6	70		PP = 4.5+ tsf				
15	ST7	60		PP = 4.5+ tsf				
	ST8	80		PP = 4.5+ tsf				
	ST9	75		PP = 4.5+ tsf				
20	ST10	80		PP = 4.5+ tsf MC = 18%				
	ST11	80		PP = 4.5+ tsf MC = 21% LL = 74 PL = 53				
25	ST12	80		PP = 4.5+ tsf				
	ST13	80		PP = 4.5+ tsf			28.0	522.0
30	ST14	50		PP = 4.5+ tsf Weathered to unweathered zone			Clayey shale, dark grey, fissile, calcareous 30.0	520.0
		100		PP = 4.5+ tsf			Shale, dark grey to black, with limestone lenses, hard, calcareous	
	ST15	85		PP = 4.5+ tsf MC = 13% LL = 55 PL = 37			Sand lenses throughout Fossil fragments throughout	
35								

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/6/20 16:30 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-4 (A-4)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35				MC = 14%			Shale, dark grey to black, with limestone lenses, hard, calcareous
40		98		PP = 4.5+ tsf			Sand lenses throughout Fossil fragments throughout *(continued)*
45		98		PP = 4.5+ tsf			
50		98		PP = 4.5+ tsf MC = 13% LL = 62 PL = 44			∇
55		98		PP = 4.5+ tsf			
60		98		PP = 4.5+ tsf			
65		97		PP = 4.5+ tsf			
70		98		PP = 4.5+ tsf			
75		98		PP = 4.5+ tsf			

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/6/20 16:30 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-4 (A-4)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75							Shale, dark grey to black, with limestone lenses, hard, calcareous Sand lenses throughout Fossil fragments throughout *(continued)*
80		100		PP = 4.5+ tsf			
85		98		PP = 4.5+ tsf			
90		99		PP = 4.5+ tsf MC = 14% LL = 74 PL = 53			
95		100		PP = 4.5+ tsf			
100		99		PP = 4.5+ tsf			101.0 449.0

Bottom of borehole at 101.0 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/6/20 16:30 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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Bedford, Texas
Telephone: 817-571-2288

BORING NUMBER B-5 (A-5)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 1/25/18 **COMPLETED** 1/25/18
GROUND ELEVATION 541.38 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow stem auger/air rotary
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater, but muddy probe
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0								
	SS1	90	4-11-10 (21)		SC		(SC) Topsoil/ Fill Material No recovery 1.5-2 feet	2.0 / 539.4
	SS2	60	4-7-8 (15)				Fill Material No recovery 3.5-4	4.0 / 537.4
5	SS3	50	4-6-8 (14)				Fill material, dark brown, with clay, hard, moist No reocvery 5.5-6 feet	6.0 / 535.4
	ST1	60			CH		(CH) Clay, light brown, with fill material, hard, moist, calcareous Color change to mottled brown/grey at 8 feet	
10	ST2	40						10.0 / 531.4
	ST3	70			CH		(CH) Clay, mottled light brown/grey, with fine sand, hard, moist, calcareous Color change to light reddish brown at 14 feet	
	ST4	100		MC = 16% LL = 62 PL = 41				
15	ST5	40						
	ST6	40						18.0 / 523.4
	ST7	60			CH		(CH) Clay, reddish brown, with grey sand, hard, moist, calcareous Calcite and Quartz throughout	
20	ST8	95						
	ST9	80		MC = 18% LL = 66 PL = 46				
25	ST10	60						26.0 / 515.4
	ST11	70		Weathered to unweathered zone			Shale, dark grey to black, with limestone lenses, hard, calcareous Silty sand lenses throughout	
30	ST11	50					Fossil fragments 30-35 feet	
35		93		MC = 17% LL = 63 PL = 42				

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:40 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-5 (A-5)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							Shale, dark grey to black, with limestone lenses, hard, calcareous
		100					Silty sand lenses throughout
							Fossil fragments 30-35 feet *(continued)*
40							
		95					
45							
		100					
						47.8	493.6

Bottom of borehole at 47.8 feet.

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BORING NUMBER B-6

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/25/18 **COMPLETED** 10/26/18
GROUND ELEVATION 545.55 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
		50	PP = 2.0-3.5 tsf	CL-ML		(CL-ML) Silty Clay, brown to reddish brown with orange-brown staining, soft to stiff, moist, with traces of gravel, organic	
5						5.0	540.6
	ST1	50	PP = 4.5 tsf	CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray, hard, slightly moist, slightly calcareous Chalk in fractures/joints 5-10 feet Silty lenses 10-15 feet	
		45					
10							
	ST2	50	PP = 4.0 tsf				
		50					
15						15.0	530.6
	ST3	38	PP = 4.5 tsf	CL		(CL) Silty Clay, orange-brown mottled brown-tan with some gray, hard, slightly moist, slightly calcareous, with weathered shale	
		66					
20							
	ST4	29	PP = 4.5+ tsf Weathered to Unweathered zone			22.5	523.1
		70				Silty Shale, gray to dark gray, very hard, slightly moist, calcareous Orange-brown staining at 22.5-23.5 feet Thin limestone layers in fractures at 30-50 feet Shells at 50-51 feet	
25							
	ST5	21	PP = 4.5+ tsf				
		84					
30							
	ST6	21	PP = 4.5+ tsf				
		84					
35							

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BORING NUMBER B-6

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						Silty Shale, gray to dark gray, very hard, slightly moist, calcareous
	ST7	17 / 98	PP = 4.5+ tsf			Orange-brown staining at 22.5-23.5 feet
						Thin limestone layers in fractures at 30-50 feet
40						Shells at 50-51 feet *(continued)*
		80	PP = 4.5+ tsf			
45						
	ST8	21 / 84	PP = 4.5+ tsf			
50						
		80	PP = 4.5+ tsf			
55						
	ST9	17 / 100	PP = 4.5+ tsf			
60						
		94	PP = 4.5+ tsf			
65						
		80	PP = 4.5+ tsf			
70						
	ST10	29				

70.7 474.9

Bottom of borehole at 70.0 feet.

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BORING NUMBER B-7

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 1/9/19 **COMPLETED** 1/9/19
GROUND ELEVATION 530.5 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING 31.00 ft / Elev 499.50 ft

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
5		62	PP = 1.5-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, dark brown to olive brown, soft to hard, moist, with trace gravel	
						5.0	525.5
10		100	PP = 2.0-3.0 tsf	CL-ML		(CL-ML) Silty Clay, olive brown to brown with some orange-brown and gray mottling, firm to stiff, moist, with trace sub-angular gravel and pebbles	
						10.0	520.5
15		50	PP = 3.5-4.0 tsf	CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray and brown, stiff, slightly moist to moist, calcareous	
20		52	PP = 4.0-4.5 tsf				
						19.0	511.5
25		60	PP = 4.5+ tsf Weathered to Unweathered zone			Shale Marl, dark gray with trace of orange-brown mottling, hard to stiff, slightly moist, with silty/limey lenses, calcareous Weathered to unweathered transition zone	
						24.0	506.5
30		60	PP = 4.5+ tsf			Shale Marl, dark gray, hard, slightly moist, with silty/limey lenses and fossils, calcareous, unweathered Very wet zones 31-32 feet	
35		86	PP = 4.5+ tsf				

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BORING NUMBER B-7

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						
40		60	PP = 4.5+ tsf			Shale Marl, dark gray, hard, slightly moist, with silty/limey lenses and fossils, calcareous, unweathered Very wet zones 31-32 feet *(continued)*
45		50	PP = 4.5+ tsf			
50		80	PP = 4.5+ tsf			
55		50	PP = 4.5+ tsf			55.0 475.5

Bottom of borehole at 55.0 feet.

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WELL NUMBER B-8 (PZ-8)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/27/18 **COMPLETED** 11/28/18
GROUND ELEVATION 550.8 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Clayey Silt, dark brown, firm, moist, with roots and organics (1.5 – 549.3)	
5		100		PP = 2.0-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, gray to light gray, stiff to hard, moist to slightly moist, with white calcareous chalky material Trace of light gravel and orange-brown staining 6.5-10 feet	
10	ST1 SS1	38 100 100	11-20-23 (43)	PP = 4.0-4.5+ tsf			(10.0 – 540.8)	
15	ST2	50 63		PP = 3.5 tsf LL = 67 PL = 17 Fines = 85%	CL-ML		(CL-ML) Silty Clay, orange-brown stained gray and brown, stiff to hard, slighty moist, calcareous, with white chalky material and silty gray interbeds	
20	ST3 SS2	33 100 93	20-26-35 (61)	PP = 4.0-4.5 tsf			(20.0 – 530.8)	
25	ST4	21 56		PP = 4.5 tsf			Silty Clay (Weathered Shale Marl), orange-brown mottled gray and brown, hard, slighty moist, calcareous White chalky material and silty gray interbeds 20-25 feet Crystalline material in joints/bedding 35-43.8 feet	
30	ST5 SS3	29 100 64	18-29-43 (72)	PP = 4.5-4.5+ tsf				
35	ST6	21 67		PP = 4.5 tsf				

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WELL NUMBER B-8 (PZ-8)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35							Silty Clay (Weathered Shale Marl), orange-brown mottled gray and brown, hard, slighty moist, calcareous	
	ST7	21	15-24-28 (52)					
		100						
	SS4	100		PP = 4.0-4.5+ tsf			White chalky material and silty gray interbeds 20-25 feet	
40							Crystalline material in joints/bedding 35-43.8 feet *(continued)*	
	ST8	25		PP = 4.5+ tsf MC = 16% DD = 106 pcf LL = 58 PL = 20 Fines = 92% Weathered to Unweathered zone				
		68						
							43.8 507.0	
45							Silty Clay Shale Marl, gray, hard, slightly moist, calcareous, with silty/micaceous lenses and fossil remnants in interbeds, unweathered	
	ST9	17	28-50					
		78						
	SS5	100		PP = 4.5+ tsf			Orange-brown staining 47-55 feet	
50								
	ST10	17		PP = 4.5+ tsf MC = 14% DD = 116 pcf LL = 58 PL = 20 Fines = 97%				
		70						
55								
	ST11	17						
		93		PP = 4.5+ tsf				
60								
		100		PP = 4.5+ tsf				
65								
	ST12	17						
		61		PP = 4.5+ tsf				
70								
		70		PP = 4.5+ tsf				
75							75.0 475.8	

Bottom of borehole at 75.0 feet.

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BORING NUMBER B-9 (new/ continued)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/12/19 **COMPLETED** 12/13/19
GROUND ELEVATION 535.3 ft **HOLE SIZE** 1.9 inches
DRILLING CONTRACTOR BEST Drilling; West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING ---
LOGGED BY A. Boudreaux **CHECKED BY** J. Lawrence
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
5		92	LL = 60 PL = 39 Fines = 82% PP = 2.0-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, dark brown to gray, stiff, slightly moist to moist, organic rich, with limestone fragments and shells Color change to gray at 2.5 feet	530.3
10	ST1	40 78	PP = 4.5+ tsf MC = 15% LL = 53 PL = 18 Fines = 75%	CL-ML		(CL-ML) Silty Clay, light gray/tan mottled orange-brown, hard, slightly moist, with minor sub-round gravel	525.3
15	ST2	36 44	PP = 4.5+ tsf			Silty Clay Shale, gray and orange-brown mottled yellow-brown, hard, slightly moist to dry, calcareous, with trace of gravel Chalk/limestone in joints 15-20 feet Color change to orange-brown mottled gray at 20 feet	
20	ST3	24 57	PP = 4.5+ tsf			Limestone lenses in fracture	
25	ST4	24 57	PP = 4.5+ tsf MC = 20% LL = 67 PL = 20 Fines = 91%				
30	ST5	20 67	PP = 4.5+ tsf Weathered to Unweathered zone				506.8
35	ST6	20 67	PP = 4.5+ tsf			Silty Clay Shale, very hard, dry, calcareous, with carbonate rich lenses in fractures Orange-brown staining in joints 28.5-20 feet	

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/6/20 16:30 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-9 (new/ continued)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						
	ST7	16 87	PP = 4.5+ tsf MC = 15% LL = 62 PL = 20 Fines = 89%			Silty Clay Shale, very hard, dry, calcareous, with carbonate rich lenses in fractures Orange-brown staining in joints 28.5-20 feet *(continued)*
40						40.0 495.3
						40-45' no sample recovery
45						45.0 490.3
						Shale, minor fine sand, dark gray, hard to very hard, damp to moist, laminated
50						
55			MC = 15% LL = 63 PL = 41 Fines = 99%			
60						
65						
70						
75						

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/6/20 16:30 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-9 (new/ continued)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75						Shale, minor fine sand, dark gray, hard to very hard, damp to moist, laminated *(continued)*
			MC = 14% LL = 64 PL = 42 Fines = 93%			Small fossils present from 75-80'
80						becoming harder with depth
85						
90						fewer laminations with depth
95						
100						
105						
			LL = 73 PL = 51 Fines = 97%			
110						very hard, moist, trace of laminations
115						

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/6/20 16:30 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-9 (new/ continued)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
115						Shale, minor fine sand, dark gray, hard to very hard, damp to moist, laminated *(continued)*
120						becoming harder with depth
125						fewer laminations with depth
130			MC = 16% LL = 74 PL = 49 Fines = 89%			very hard, moist, scarce laminations
135						135.0 400.3

Bottom of borehole at 135.0 feet.

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WELL NUMBER B-9 (PZ-9)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/9/18 **COMPLETED** 10/10/18
GROUND ELEVATION 535.3 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING 25.10 ft / Elev 510.20 ft
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	MATERIAL DESCRIPTION
0		92	LL = 60 PL = 39 Fines = 82% PP = 2.0-4.5+ tsf	CL-ML	(CL-ML) Silty Clay, dark brown to gray, stiff, slightly moist to moist, organic rich, with limestone fragments and shells Color change to gray at 2.5 feet
5	ST1	40 78	PP = 4.5+ tsf MC = 15% LL = 53 PL = 18 Fines = 75%	CL-ML	(CL-ML) Silty Clay, light gray/tan mottled orange-brown, hard, slightly moist, with minor sub-round gravel
10	ST2	36 44	PP = 4.5+ tsf		Silty Clay Shale, gray and orange-brown mottled yellow-brown, hard, slightly moist to dry, calcareous, with trace of gravel Chalk/limestone in joints 15-20 feet
15	ST3	24 57	PP = 4.5+ tsf		Color change to orange-brown mottled gray at 20 feet Limestone lenses in fractures 25-28.5 feet
20	ST4	24 57	PP = 4.5+ tsf MC = 20% DD = 105 pcf LL = 67 PL = 20 Fines = 91%		
25	ST5	20 67	PP = 4.5+ tsf Weathered to Unweathered zone		
30	ST6	20 67	PP = 4.5+ tsf		Silty Clay Shale, very hard, dry, calcareous, with carbonate rich lenses in fractures Orange-brown staining in joints 28.5-20 feet
35					

5.0 — 530.3
10.0 — 525.3
28.5 — 506.8

WELL DIAGRAM

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/6/20 16:30 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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WELL NUMBER B-9 (PZ-9)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35							
40	ST7	16 87	PP = 4.5+ tsf MC = 15% DD = 116 pcf LL = 62 PL = 20 Fines = 89%			Silty Clay Shale, very hard, dry, calcareous, with carbonate rich lenses in fractures Orange-brown staining in joints 28.5-20 feet *(continued)* 40.0 495.3	

Bottom of borehole at 40.0 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/6/20 16:30 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-10

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/13/18 **COMPLETED** 12/13/18
GROUND ELEVATION 548 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					MH		1.0 (MH) Clayey Silt to Silty Clay, brown, soft to firm, moist, with roots and organics — 547.0
		80		PP = 1.0-4.5 tsf	CL-ML		(CL-ML) Silty Clay, brown, stiff, moist, with traces of sub-rounded gravel and roots
5							4.5 — 543.5
	ST1	33	15-20-26 (46)				(CL-ML) Silty Clay, orange-brown mottled brown and gray, stiff, moist, with silty to very fine sand lenses and white chalky material
		94					
	SS1	100		PP = 4.0-4.5 tsf			Crystalline pockets 30-34 feet
10							
	ST2	33		PP = 4.5 tsf MC = 19% LL = 65 PL = 24 Fines = 90%			
		71					
15							
	ST3	21	20-30-37 (67)				
		100					
	SS2	100		PP = 4.0-4.5 tsf	CL-ML		
20							
	ST4	21					
		56		PP = 4.0-4.5 tsf			
25							
	ST5	21	17-27-34 (61)	PP = 4.0-4.5 tsf MC = 15% DD = 108 pcf LL = 54 PL = 21 Fines = 94%			
		100					
	SS3	100					
30							
	ST6	21					
		78		PP = 4.5 tsf			
							34.0 — 514.0
35							

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-10

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							
	ST7	21 28	50	Weathered to Unweathered zone			36.0 Shale Marl, gray, hard, slightly moist, with occasional orange-brown staining and silty lenses, calcareous, weathered 512.0
	SS4	100		PP = 4.5+ tsf			Transition zone *(continued)*
40							Shale Marl, gray, hard, slightly moist, with fossil remnants and silty/limey lenses, calcareous, unweathered
	ST8	17		PP = 4.5+ tsf MC = 14% LL = 59 PL = 20 Fines = 92%			
45		87					
	SS5	17	34-50				
50		95		PP = 4.5+ tsf			
		33		PP = 4.5+ tsf			53.0 495.0

Bottom of borehole at 53.0 feet.

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BORING NUMBER B-11

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/5/18 **COMPLETED** 11/5/18
GROUND ELEVATION 553.5 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY A. Valerio **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
		95	PP = 1.5-3.5 tsf	CL		Topsoil, dark brown (1.0)	552.5
5						(CL) Clay, dark brown to orange-tan, medium firm, with some organic material (5.0)	548.5
	ST1	100	PP = 0-4.5+ tsf	CL		(CL) Clay, orange brown, very soft to very hard, dry, with minor silt (10.0)	543.5
10							
	ST2	100	PP = 2.5-4.5+ tsf	CL		(CL) Clay, medium brown, firm to hard, dry, with minor orange silt	
15							
	ST3	75	PP = 2.5-4.0 tsf				
20						(20.0)	533.5
	ST4	50	PP = 1.0-3.5 tsf MC = 21% DD = 95 pcf LL = 75 PL = 26 Fines = 89%	CL		(CL) Clay, medium to dark brown, firm to moderately firm, dry, with minor orange and gray silt	
25						(25.0)	528.5
	ST5	93	PP = 0.5-4.5+ tsf Weathered to Unweathered zone	CL		(CL) Clay, dark gray, soft to very firm, dry, with minor orange silt	
30						(30.0)	523.5
	ST6	75	PP = 4.0-4.5+ tsf	CL		(CL) Clay, very dark gray, very firm, with minor light gray silt and pebbles Sand/Silt parting at 33 feet	
35						(35.0)	518.5

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BORING NUMBER B-11

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						(CL) Clay, very dark gray, medium firm to very firm, dry, with some very dark gray weathered shale
	ST7	75	PP = 2.0-4.5+ tsf			Minor silty sand 40-45 feet
						Limey, white, calcareous, pebbles up to 1/2" at 54 feet
40						Minor calcareous silt with few pebbles up to 1/8" at 58 feet
		95	PP = 3.5-4.5+ tsf			Minor limey pebbles <1/8" at 67 feet
						Minor calcareous silt and pebbles <1/8" 70-75 feet
45						
	ST8	95	PP = 3.5-4.5+ tsf MC = 13% DD = 120 pcf LL = 55 PL = 22 Fines = 86%			
50						
		75	PP = 0.5-4.5+ tsf			
55				CL		
	ST9	95	PP = 0.5-4.5 tsf			
60						
		98	PP = 1.5-4.5+ tsf			
65						
	ST10	95	PP = 1.0-4.5+ tsf			
70						
		99	PP = 0.5-4.5+ tsf			
75						

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BORING NUMBER B-11

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75						
80		99	PP = 0.5-4.5+ tsf	CL		80.0 473.5

Bottom of borehole at 80.0 feet.

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BORING NUMBER B-12

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/12/18 **COMPLETED** 10/12/18
GROUND ELEVATION 542.85 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
		93	PP = 1.5-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, brown, soft to firm, slightly moist to moist Organic 0-5 feet Shell fragments 3-5 feet Minor amounts of small sub-rounded gravel 3-10 feet	
5						5.0 Mineral deposits in joints/bedding 5-10 feet	537.9
	ST1	38 / 68	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, brown, soft to firm, slightly moist to moist Organic 0-5 feet Shell fragments 3-5 feet Minor amounts of small sub-rounded gravel 3-10 feet	
10						10.0 Mineral deposits in joints/bedding 5-10 feet	532.9
	ST2	29 / 50	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray, hard, slightly moist, with traces of roots/organics, calcareous Mineral desposits in fractures and traces of gravel 10-15 feet Very fine sandy lenses in fractures 15-20 feet	
15							
	ST3	21 / 50	PP = 4.5+ tsf				
20						20.0	522.9
	ST4	21 / 60	PP = 4.5+ tsf	CL		(CL) Silty Clay, orange-brown mottled brown to light gray, hard, slightly moist, calcareous, with weathered shale Very fine sandy lenses 20-25 feet	
25							
	ST5	38 / 60	Weathered to Unweathered zone PP = 4.5+ tsf			26.5	516.4
30						Silty Clay Shale, dark gray, moderately to very hard, slightly moist, calcareous Sandy lenses 26.5-30 feet Trace of shell fragments 30-35 feet Much softer and more calcareous 40-45 feet Very hard 45-48 feet	
	ST6	17 / 100	PP = 4.5+ tsf				
35							

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BORING NUMBER B-12

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						Silty Clay Shale, dark gray, moderately to very hard, slightly moist, calcareous
	ST7	21	PP = 3.5-4.5+ tsf			Sandy lenses 26.5-30 feet
		50				Trace of shell fragments 30-35 feet
						Much softer and more calcareous 40-45 feet
40						Very hard 45-48 feet *(continued)*
		66	PP = 1.5-2.5 tsf			
45						
	ST8	100 25	PP = 4.5+ tsf			
					48.0	494.9

Bottom of borehole at 48.0 feet.

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BORING NUMBER B-13

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/29/18 **COMPLETED** 12/4/18
GROUND ELEVATION 555.15 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							0.5 Silt, brown, soft, slightly moist, organic 554.7
		56		PP = 2.5-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, brown to orange-brown stained brown and gray, firm, with traces of sub-rounded gravel and chalk
5							5.0 550.2
	ST1	100	9-14-21 (35)	PP = 3.5-4.0 tsf	CL-ML		(CL-ML) Silty Clay, orange-brown stained brown and gray, stiff to hard, slightly moist, calcareous, with silty lenses in interbeds, weathered
		76					White chalky material 5-10 feet
10							Weathered shale throughout 33-39.9 feet
	ST2	100		PP = 3.5-4.5+ tsf			
		45					
15							
	ST3	100	16-23-25 (48)	PP = 4.5+ tsf			
		73					
20							
	ST4	100		PP = 4.5+ tsf			
		54					
25							
	ST5	100	21-30-37 (67)	PP = 4.5+ tsf			
		80					
30							
	ST6	100		PP = 4.5+ tsf			
		100					
35							

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BORING NUMBER B-13

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							
	ST7	100	20-29-43 (72)	PP = 4.5+ tsf MC = 20% DD = 109 pcf LL = 66 PL = 23 Fines = 94% Weathered to Unweathered zone	CL-ML		(CL-ML) Silty Clay, orange-brown stained brown and gray, stiff to hard, slightly moist, calcareous, with silty lenses in interbeds, weathered
		100					White chalky material 5-10 feet Weathered shale throughout 33-39.9 feet *(continued)*
40							39.9 — 515.3
	ST8	100					Silty Clay Shale, gray, hard, slightly moist to moist, calcareous, unweathered
		56		PP = 4.5+ tsf			Orange-brown staining in joints at 40-41 feet Fossil/shell fragments 45-50 feet
45							
	ST9	100	50	PP = 4.5+ tsf MC = 15% DD = 112 pcf LL = 51 PL = 18 Fines = 95%			
		60					
50							
	ST10	100		PP = 4.5+ tsf			
		60					
55							
	ST11	100	50	PP = 4.5+ tsf			
		100					
60							
		50		PP = 4.5+ tsf			
65							
	ST12	100		PP = 4.5+ tsf			
		43					
70							
		40		PP = 4.5+ tsf			
75							

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BORING NUMBER B-13

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75							
80		60		PP = 4.5+ tsf		80.0	Silty Clay Shale, gray, hard, slightly moist to moist, calcareous, unweathered Orange-brown staining in joints at 40-41 feet Fossil/shell fragments 45-50 feet *(continued)* 475.2

Bottom of borehole at 80.0 feet.

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BORING NUMBER B-14

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/5/18 **COMPLETED** 11/6/18
GROUND ELEVATION 539.2 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						
		98	PP = 1.5-4.5 tsf	CL-ML		(CL-ML) Silty Clay, dark brown to brown, firm to stiff, moist to very moist, organic, with some small to medium sized sub-rounded gravel and chalk in fractures/joints
5						
	ST1	50	PP = 2.5-3.5 tsf			6.4 — 532.8
		65		CL-ML		(CL-ML) Silty Clay, orange-brown mottled brown and gray, stiff to hard, slightly moist, calcareous, weathered Fossil fragments and silty lenses in bedding 10-15 feet
10						
	ST2	58	PP = 4.5 tsf			
		66				
15						
	ST3	50	PP = 3.0-4.5+ tsf MC = 19% DD = 104 pcf LL = 58 PL = 23 Fines = 65% Weathered to Unweathered zone			
		60				18.5 — 520.7
20						Silty Shale, gray, hard, slightly moist, calcareous, unweathered Fossil fragments in bedding 20-35 feet Silty lenses in bedding 18.5-45 feet
	ST4	21	PP = 4.5+ tsf			
		82				
25						
	ST5	21	PP = 4.5+ tsf			
		56				
30						
		60	PP = 4.5+ tsf			
35						

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BORING NUMBER B-14

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						Silty Shale, gray, hard, slightly moist, calcareous, unweathered
	ST6	17	PP = 4.5+ tsf MC = 15% LL = 58 PL = 19 Fines = 94%			Fossil fragments in bedding 20-35 feet Silty lenses in bedding 18.5-45 feet *(continued)*
		70				
40						
		64	PP = 4.5+ tsf			
45						
	ST7	13	PP = 4.5+ tsf			
		58				
50						
		60	PP = 4.5+ tsf			
55						
	ST8	21	PP = 4.5+ tsf			
		80				
60						
		60	PP = 4.5+ tsf			
65						65.0 474.2
	ST9	21				Bottom of borehole at 65.0 feet.

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BORING NUMBER B-15

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/26/18 **COMPLETED** 10/26/18
GROUND ELEVATION 563.35 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
		96	PP = 2.5 tsf	CL-ML		(CL-ML) Silty Clay, dark brown to brown with orange-brown staining, firm to stiff, moist, with trace of white gravel, organics in top 1-2 feet	
5						5.0	558.4
	ST1	63 / 76	PP = 4.0-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange-brown mottled brown and gray, stiff to hard, slightly moist, with weathered shale	
10						10.0	553.4
	ST2	63 / 46	PP = 4.5+ tsf			Silty Shale, orange-brown mottled brown and gray, hard, slightly moist Silty lenses in interbeds 10-15 feet Crystalline lenses in interbeds 15-25 feet	
15							
	ST3	75 / 83	PP = 4.5+ tsf				
20							
	ST4	75 / 89	PP = 4.5+ tsf				
25						25.0	538.4
	ST5	75 / 72	PP = 4.5+ tsf			Silty Shale, brown and gray stained orange-brown, hard, slightly moist, with crystalline lenses in interbeds, weathered	
30							
	ST6	83 / 100	Weathered to Unweathered zone PP = 4.5+ tsf			31.5	531.9
						Silty Shale, gray, hard, slightly moist, calcareous Minor shell fragments 45-50 feet	
35							

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BORING NUMBER B-15

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						Silty Shale, gray, hard, slightly moist, calcareous
	ST7	38	PP = 4.5+ tsf			Minor shell fragments 45-50 feet *(continued)*
		100				
40						
		84	PP = 4.5+ tsf			
45						
	ST8	25	PP = 4.5+ tsf			
		100				
50						
		100	PP = 4.5+ tsf			
55						
	ST9	25	PP = 4.5+ tsf MC = 11% DD = 116 pcf LL = 57 PL = 20 Fines = 91%			
		100				
60						
		100	PP = 4.5+ tsf			
65						
	ST10	29	PP = 4.5+ tsf			
		100				
70						70.0 493.4

Bottom of borehole at 70.0 feet.

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BORING NUMBER B-16

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/4/18 **COMPLETED** 10/4/18
GROUND ELEVATION 560.25 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0								
		80		LL = 75 PL = 51 Fines = 85%			Organic material	558.8
1.5					CH		(CH) Clay, dark gray, slightly moist, hard, non-calcareous to slightly calcareous, with trace of sub-rounded small gravel	556.3
4.0					CH		(CH) (CH) Silty Clay, olive green/ mustard brown, slightly moist, hard, very calcareous Color change to yellow-brown at 6 feet with chalk/limestone in joints and trace of sub-rounded to angular gravel	550.3
5								
	ST1	25		PP = 4.5+ tsf				
		50						
10								
	ST2	54		PP = 4.5+ tsf MC = 19% DD = 105 pcf LL = 78 PL = 26 Fines = 91%			Shaley Clay, yellow to orange brown, slightly moist to dry, hard, calcareous, weathered Chalk/limestone intrusions 10-15 feet Tan to orange-brown at 15-20 feet Orange-brown mottled brown 20-25 feet Orange-brown staining in joints 30-34.5 feet	
		50						
15								
	ST3	54		PP = 4.5+ tsf				
		50						
20								
	ST4	25		PP = 4.5+ tsf				
		53						
25								
	ST5	54		PP = 4.5+ tsf MC = 15% DD = 116 pcf LL = 60 PL = 22 Fines = 77%				
		60						
30								
	ST6	29		PP = 4.5+ tsf				
		60						
				Weathered to				
35								525.3

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BORING NUMBER B-16

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35				Unweathered zone			Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered
	ST7	33		PP = 4.5+ tsf			Orange-brown staining in joints 35-45 feet
		60					Shells in interbeds 60 feet
40							
	ST8	29		PP = 4.5+ tsf			
		60					
45							
		50		PP = 4.5+ tsf			
50							
	ST9	25		PP = 4.5+ tsf MC = 17% DD = 115 pcf LL = 64 PL = 21 Fines = 94%			
		60					
55							
		69		PP = 4.5+ tsf			
60							
	SS1	50	21-50			61.0	499.3

Bottom of borehole at 61.0 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/6/20 16:30 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-17

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/8/18 **COMPLETED** 10/9/18
GROUND ELEVATION 546.75 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						0.5 Limestone, white, hard, dry — 546.3
		40	PP = 4.5+ tsf	CL		(CL) Clay, dark gray, slightly moist, hard, with sub-angular gravel <1/8-2"
5						5.0 — 541.8
	ST1	40	PP = 4.5+ tsf	CL		(CL) Clay, yellow-brown mottled gray, slightly moist, hard
10						
	ST2	80	PP = 4.5+ tsf			
15						15.0 — 531.8
	ST3	60	PP = 4.5+ tsf MC = 19% DD = 106 pcf LL = 66 PL = 25 Fines = 91%	CL		(CL) Shaley Clay, tan to gray mottled orange, slightly moist to dry, hard, calcareous, weathered Color change to tan to brown mottled orange at 20 feet. Mineral deposits in fractures 20-22 feet.
20						
	ST4	40	PP = 4.5+ tsf			
25						
	ST5	40	PP = 4.5+ tsf LL = 67 PL = 23			
30						31.0 — 515.8
	ST6	100	PP = 4.5+ tsf Weathered to Unweathered zone			Silty Clay Shale, dark gray, hard, dry, calcareous, weathered
						33.0 — 513.8
35						

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BORING NUMBER B-17

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered
	ST7	60	PP = 4.5+ tsf			Limestone/chalk in fractures and joints 60-65 feet.
40						Weathered zones throughout from 60-71 feet. *(continued)*
	ST8	60	PP = 4.5+ tsf			
45						
	ST9	60	PP = 4.5+ tsf MC = 15% DD = 120 pcf LL = 60 PL = 19 Fines = 83%			
50						
	ST10	100	PP = 4.5+ tsf			
55						
	ST11	100	PP = 4.5+ tsf			
60						
	ST12	100	PP = 0-4.5+ tsf			
65						
		100	PP = 0-4.5+ tsf			
70						
	ST13					71.0 475.8 Bottom of borehole at 71.0 feet.

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WELL NUMBER B-18 (PZ-18)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/29/18 **COMPLETED** 10/30/18
GROUND ELEVATION 534.75 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING 23.50 ft / Elev 511.25 ft
NOTES
AFTER DRILLING 15.03 ft / Elev 519.72 ft

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							
		88	PP = 1.5-4.5 tsf	CL-ML		(CL-ML) Silty Clay Topsoil, dark brown, soft to firm, moist, organic	
						2.7 / 532.1	
5				CL-ML		(CL-ML) Silty Clay, brown, firm to stiff, moist, with traces of small to medium gravel and chalk in fractures/joints	
	ST1	25					
		100	PP = 4.5+ tsf			6.8 / 528.0	
10				CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray, hard, slightly moist, calcareous Silty lenses in bedding 10-14.5 feet	
	ST2	25	PP = 4.5+ tsf MC = 19% DD = 105 pcf LL = 66 PL = 21 Fines = 92% Weathered to Unweathered zone				
		77					
15						14.5 / 520.3	
	ST3	17				Silty Shale, gray, hard, slightly moist, calcareous, unweathered Slight orange-brown staining 14.5-30 feet Trace of shells 30-56 feet Silty lenses in bedding 30-35 feet	
		93	PP = 4.5+ tsf				
20							
	ST4	21					
		78	PP = 4.5+ tsf				
25							
	ST5	25					
		80	PP = 4.5+ tsf				
30							
		70	PP = 4.5+ tsf				
35							

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WELL NUMBER B-18 (PZ-18)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35							
	ST6	21	PP = 4.5+ tsf			Silty Shale, gray, hard, slightly moist, calcareous, unweathered Slight orange-brown staining 14.5-30 feet Trace of shells 30-56 feet Silty lenses in bedding 30-35 feet *(continued)*	
		80					
40							
		76	PP = 4.5+ tsf				
45							
	ST7	21	PP = 4.5+ tsf MC = 13% DD = 109 pcf LL = 57 PL = 19 Fines = 90%				
		76					
50							
		80	PP = 4.5+ tsf				
55							
	ST8	17				56.0 478.8 Bottom of borehole at 56.0 feet.	

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BORING NUMBER B-19

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/30/18 **COMPLETED** 10/30/18
GROUND ELEVATION 562.05 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0		100	LL = 55 PL = 35 Fines = 82% PP = 1.0 tsf	CL-ML		(CL-ML) Silty Clay, dark brown, soft, moist, calcareous
4.0						558.1
5						(CL-ML) Silty Clay, gray/tan mottled orange, hard, slightly moist, calcareous Chalk in fractures/joints 4-20 feet Very weathered zones 15-20 feet
10	ST1	100	PP = 4.5+ tsf			
15	ST2	50	PP = 0-4.5+ tsf LL = 83 PL = 24			
20	ST3	100	PP = 4.5+ tsf	CL-ML		
25	ST4	100	PP = 4.5+ tsf			
30	ST5	100	PP = 0-4.5+ tsf			
35	ST6	100	PP = 0-4.5+ tsf			

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BORING NUMBER B-19

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						
40	ST7	100	PP = 0-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, gray/tan mottled orange, hard, slightly moist, calcareous Chalk in fractures/joints 4-20 feet Very weathered zones 15-20 feet *(continued)*
45	ST8	100	PP = 0-4.5+ tsf	CL		40.0 522.1 (CL) Clay, dark gray with orange to tan mottling, dry, hard, calcareous, with soft weathered shale zones
50		100	PP = 4.5+ tsf			49.0 513.1 Silty Clay Shale, dark gray, hard, dry, calcareous, with chalk in joints/fractures, weathered
55	ST9	100	PP = 4.5+ tsf MC = 14% DD = 117 pcf LL = 63 PL = 19 Fines = 91% Weathered to Unweathered zone			53.0 509.1 Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Chalk in fractures/joints 53-65 feet Intermittent weathered zones from 50-87 feet
60		100	PP = 0-4.5+ tsf			
65	ST10	100	PP = 0-4.5+ tsf			
70		100	PP = 4.5+ tsf			
75	ST11	100	PP = 0-4.5+ tsf MC = 15% LL = 57 PL = 19 Fines = 95%			

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BORING NUMBER B-19

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75						Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Chalk in fractures/joints 53-65 feet Intermittent weathered zones from 50-87 feet *(continued)*
		100	PP = 0-4.5+ tsf			
80						
	ST12	100	PP = 0-4.5+ tsf			
85						
		100	PP = 4.5+ tsf			
					87.0	475.1

Bottom of borehole at 87.0 feet.

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WELL NUMBER B-20 (PZ-20)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/29/18 **COMPLETED** 10/29/18
GROUND ELEVATION 564.1 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING 6.90 ft / Elev 557.20 ft
NOTES
AFTER DRILLING 43.23 ft / Elev 520.87 ft

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							
5		100	LL = 56 PL = 38 Fines = 74% PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, gray mottled tan, hard, dry, with <1/8" pebbles and chalk in fractures/joints, calcareous 5.0 559.1	
10	ST1	60	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, tan/gray mottled orange, hard, dry, calcareous <1/8" pebbles 5-10 feet Chalk in joints/fractures 5-10 feet Very unconsolidated/weathered 15-35 feet Mineral deposits 24-25 feet	
15	ST2	50	PP = 4.5+ tsf	CL-ML			
20	ST3	50	PP = 0 tsf	CL-ML			
25	ST4	50	PP = 0 tsf	CL-ML			
30	ST5	50	PP = 0 tsf	CL-ML			
35	ST6	50	PP = 0 tsf LL = 61 PL = 41 Fines = 91%	CL-ML		35.0 529.1	

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WELL NUMBER B-20 (PZ-20)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35							
	ST7	100	PP = 4.5+ tsf	CL		(CL) Clay, dark gray with orange/tan mottling, hard, dry, calcareous, with weathered shale Mineral deposits in fractures 25-35 feet	
40							
	ST8	100	PP = 4.5+ tsf			43.0 521.1	
45						Silty Clay Shale, dark gray, hard, dry, calcareous, weathered	
	ST9	100	Weathered to Unweathered zone PP = 4.5+ tsf MC = 13% DD = 116 pcf LL = 59 PL = 23 Fines = 95%			47.0 517.1	
50						Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Orange-brown oxidation staining 50-55 feet Chalk/limestone in fractures 50-55 feet No oxidation staining beginning at 57.5 feet	
		100	PP = 0-4.5+ tsf				
55							
	ST10	100	PP = 4.5+ tsf MC = 13% DD = 109 pcf LL = 58 PL = 21 Fines = 96%				
60							
		100	PP = 4.5+ tsf				
65							
	ST11						
70							
						73.0 491.1	

Bottom of borehole at 73.0 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/7/20 09:06 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-21

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/29/18 **COMPLETED** 10/29/18
GROUND ELEVATION 538.75 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				CL-ML		(CL-ML) Silty Clay, dark brown to brown, firm, moist, organic, with traces of small gravel and shells
		66	PP = 3.0-4.0 tsf			2.3 — 536.5
				CL-ML		(CL-ML) Silty Clay, orange-brown mottled brown and gray, hard, slightly moist, calcareous Shell fragments 2.3-15 feet Mineral deposits in fractures 5-10 feet
5						
	ST1	29	PP = 4.5+ tsf			
		88				
10						
	ST2	25	PP = 4.5+ tsf			
		80				
15						
	ST3	33	PP = 4.5+ tsf MC = 19% LL = 69 PL = 25 Fines = 97%			
		43				
20						
	ST4	29	PP = 4.5+ tsf			
		56				
25			Weathered to Unweathered zone			24.9 — 513.9
						Silty Shale, gray, slightly moist to moist, hard, calcareous Orange-brown staining in fractures 24.9-35 feet Shell fragments 30-35 feet Fossil remnants 35-45 feet
	ST5	21	PP = 4.5+ tsf			
		89				
30						
	ST6	21	PP = 4.0-4.5+ tsf			
		100				
35						

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BORING NUMBER B-21

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						
		90	PP = 4.5+ tsf MC = 15% DD = 108 pcf LL = 57 PL = 18 Fines = 94%			Silty Shale, gray, slightly moist to moist, hard, calcareous Orange-brown staining in fractures 24.9-35 feet Shell fragments 30-35 feet Fossil remnants 35-45 feet *(continued)*
40						
	ST7	17 98	PP = 4.5+ tsf MC = 14% LL = 61 PL = 21 Fines = 88%			
45						45.0 493.8

Bottom of borehole at 45.0 feet.

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BORING NUMBER B-22

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/18/18 **COMPLETED** 12/19/18
GROUND ELEVATION 555.5 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							Clayey Silt, brown, soft, moist, with some subrounded gravel and roots
							1.5 — 554.0
		46		PP <0.5-4.5 tsf			Silty Clay, brown, soft to firm, moist, with subrounded gravel and roots
5							4.9 — 550.6
	ST1	33	9-16-22 (38)	PP = 3.5-4.5 tsf			Silty Clay, brown-gray stained orange-brown, firm, moist, with white chalky material and silty micaceous lenses, calcareous
		83					Stiff to hard 10-34.7 feet
	SS1	66					No white chalky material 10-34.7 feet
10							Minor crystalline pockets 27-34.7 feet
	ST2	38		PP = 4.0-4.5 tsf			
		61					
15							
	ST3	50	15-26-29 (55)	PP = 4.0 tsf			
		100					
	SS2	100					
20							
	ST4	17		PP = 4.0 tsf			
		48					
25							
	ST5	25	18-24-35 (59)	PP = 4.0 tsf			
		100					
	SS3	86					
30							
	ST6	29		PP = 4.5+ tsf MC = 20% LL = 74 PL = 27 Fines = 84%			
		70					
35							34.7 — 520.8

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BORING NUMBER B-22

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35					CH		(CH) Shale Marl, dark gray with orange-brown staining in joints, stiff to hard, slightly moist, with silty to very fine sand micaceous lenses and fossil remnants, calcareous
	ST7	25	21-27-50 (77)		CH		
		100					
	SS4	100		PP = 4.5+ tsf Weathered to Unweathered zone			Transition zone *(continued)* 38.5 517.0
40							Shale Marl, dark gray, hard, slightly moist, with silty micaceous lenses and fossil remnants, calcareous, unweathered
	ST8	21					
		100		PP = 4.5+ tsf			
45							
	ST9	17	50	PP = 4.5+ tsf MC = 17% LL = 64 PL = 25 Fines = 92%			
		22					
	SS5	100					
50							
		100		PP = 4.5+ tsf			
55							
	ST10	17					
		76		PP = 4.5+ tsf			
60							
		76		PP = 4.5+ tsf			
65							
		90		PP = 4.5+ tsf			
70							
		80		PP = 4.5+ tsf			
75							

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BORING NUMBER B-22

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75							
80		80		PP = 4.5+ tsf			Shale Marl, dark gray, hard, slightly moist, with silty micaceous lenses and fossil remnants, calcareous, unweathered *(continued)*
							80.0 475.5

Bottom of borehole at 80.0 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-23

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/5/18 **COMPLETED** 10/5/18
GROUND ELEVATION 540.1 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING ---
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0		94	MC = 32% LL = 96 PL = 66 Fines = 69% PP = 3.5-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, dark gray, slightly moist to moist, stiff, with some gravel, non-calcareous Some fossil/shell fragments
4.0						Color change to orange/brown mottled tan/brown and slightly moist to dry with calcareous material in joints at 10 ft — 536.1
5	ST1	28	PP = 3.0-4.0 tsf	CL-ML		(CL-ML) Silty Clay, dark gray, slightly moist to moist, stiff, with some gravel, non-calcareous
		49				Some fossil/shell fragments
10.0						Color change to orange/brown mottled tan/brown and slightly moist to dry with calcareous material in joints at 10 ft — 530.1
10	ST2	36	PP = 2.0-2.75 tsf MC = 20% DD = 108 pcf LL = 73 PL = 23 Fines = 98%	CL-ML		(CL-ML) Silty Clay, orange-brown mottled tan and gray, stiff to hard, slightly moist to dry, calcareous
		49				Chalk in joints 10-20 feet Shells in bedding 15-20 feet Sandy lenses 30-38 feet
15	ST3	36	PP = 4.0-4.5+ tsf			
		46				
20	ST4	24	PP = 4.5+ tsf			
		52				
25	ST5	24	PP = 4.5+ tsf			
		55				
30	ST6	28	PP = 4.5+ tsf MC = 18% DD = 108 pcf LL = 74 PL = 23 Fines = 85%			
		77				
35						

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/7/20 16:32 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

(Continued Next Page)

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Telephone: 817-571-2288

BORING NUMBER B-23

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						
	ST7	24	PP = 4.5+ tsf MC = 20% DD = 101 pcf LL = 77 PL = 22 Fines = 89% Weathered to Unweathered zone	CL-ML		38.0 — 502.1
		80				Silty Clay Shale, dry, very hard, calcareous, unweathered, with sandy lenses in interbeds
40						
	ST8	12	PP = 4.5+ tsf MC = 15% LL = 70 PL = 20 Fines = 96%			
		96				
45	ST9	28				45.0 — 495.1

Bottom of borehole at 45.7 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/7/20 16:32 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-24

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/11/18 **COMPLETED** 10/11/18
GROUND ELEVATION 533.62 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						
5		100	PP = 2.0-4.5 tsf	CH		(CH) Clay, dark gray, hard, dry, non-calcareous, with sub-angular calcareous pebbles <1/8" Color change to light grayand slightly moist at 5 feet
10	ST1	80	PP = 3-4.5+ tsf MC = 15% DD = 112 pcf LL = 51 PL = 18 Fines = 73%			7.0 526.6
15	ST2	40	PP = 3.0 tsf	CL-ML		(CL-ML) Silty Clay, orange-tan mottled gray, dry, hard, with chalk/limestone in joints and sand in fractures, slightly calcareous, weathered/crumbled Sub-angular calcareous pebbles 7-10 feet
20	ST3	60	PP = 2.0-4.5+ tsf MC = 21% DD = 99 pcf LL = 74 PL = 22 Fines = 98%			
25	ST4	100	PP = 3.0-4.5+ tsf			25.0 508.6
30	ST5	80	PP = 2.0 tsf MC = 19% DD = 103 pcf LL = 69 PL = 25 Fines = 89%	CL		(CL) Shaley Clay, dark gray with brown staining, soft, dry, calcareous, very weathered 30.0 503.6
35	ST6	80	PP = 4.5+ tsf Weathered to Unweathered zone			Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Limestone lenses in fractures 40-45 feet Intermittent weathered zones 35-59 feet Limestone lenses in fractures 50-59.2 feet

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-24

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered
	ST7	80	PP = 4.5+ tsf			Limestone lenses in fractures 40-45 feet Intermittent weathered zones 35-59 feet Limestone lenses in fractures 50-59.2 feet *(continued)*
40						
	ST8	100	PP = 4.5+ tsf			
45						
	ST9	100	PP = 4.5+ tsf LL = 59 PL = 26			
50						
		80	PP = 4.5+ tsf			
55						
	ST10	100	PP = 4.5+ tsf			
					59.2	474.4
						Bottom of borehole at 59.0 feet.
	ST11					

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BORING NUMBER B-25

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/11/18 **COMPLETED** 10/11/18
GROUND ELEVATION 533.25 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
		100	PP = 1.5-4.5 tsf	CL-ML		(CL-ML) Silty Clay, dark gray, soft to hard, slightly moist to dry, calcareous, with chalk in joints Color change to light gray 4-5 feet	
5						5.0	528.3
	ST1	80	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange/gray/tan mottled, hard, slightly moist to dry, calcareous, with chalk in joints and sub-rounded pebbles 1/8" No pebbles 15-20 feet Silty Sand lenses in fractures 15-23 feet	
10							
	ST2	80	PP = 3.0-4.5+ tsf				
15							
	ST3	80	PP = 3.0-4.5+ tsf				
20							
	ST4	100	PP = 1.0-3.0 tsf			23.0	510.3
				CL		(CL) Shaley Clay, dark gray, medium hard to soft, dry, calcareous, weathered	
25						25.0	508.3
	ST5	100	PP = 1.0-3.0 tsf Weathered to Unweathered zone			Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Intermittent weathered zones 25-33 feet	
30							
	ST6	100	PP = 1.0-3.0 tsf			33.0	500.3

Bottom of borehole at 33.0 feet.

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BORING NUMBER B-26

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/18/18 **COMPLETED** 11/18/18
GROUND ELEVATION 530.45 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							Top Soil, black, soft, moist, with roots and small gravel	
1.4								529.1
		36		PP = 1.5-4.0 tsf	CL-ML		(CL-ML) Silty Clay, llight brown, hard, slightly moist, with small round to sub-rounded gravel up to 1/4", slightly calcareous	
5.0								525.5
5	ST1	33	14-25-35 (60)	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, tan to light brown mottled orange and gray, very hard, dry, slightly calcareous Orange staining 10-15 feet	
		83						
	SS1	93						
10	ST2	35		PP = 4.5+ tsf				
		37						
15.0								515.5
15	ST3	35	18-26-37 (63)	PP = 3.0-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, tan/brown with orange staining, hard to very hard, calcareous Color change to dark gray at 20 feet	
		100						
	SS2	75						
20.0								510.5
20	ST4	28		PP = 0.5-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, dark gray to gray with orange staining, very soft to very hard, dry, slightly to moderately calcareous Transition zone into weathered shale	
		51						
26.0								504.5
25	ST5	24	28-50	Weathered to Unweathered zone PP = 1.5-4.5+ tsf			Clay (Shale), dark gray, very soft to very hard, dry, with fossil remnants, slightly calcareous, unweathered Trace of orange staining 25-30 feet	
		33						
	SS3	63						
30	ST6	26		PP = 2.5-4.0 tsf				
		47						
35								

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BORING NUMBER B-26

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							
							36.0 494.5

Bottom of borehole at 36.0 feet.

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BORING NUMBER B-27

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/14/18 **COMPLETED** 11/14/18
GROUND ELEVATION 546.65 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0								
		90		LL = 59 PL = 38 Fines = 64% PP = 0.5-4.5 tsf	MH		(MH) Clayey Silt, dark brown, soft to firm, very moist, organic	
							2.5	544.2
5					MH		(MH) Clayey Silt, brown, stiff to hard, moist to slightly moist, with white chalk and fossil fragments, calcareous	
	ST1	33						
		40		PP = 4.5+ tsf				
10							10.0	536.7
	ST2	50	18-34-44 (78)				(CL-ML) Silty Clay, orange-brown mottled brown and gray, hard, slightly moist, calcareous	
		100						
	SS1	60		PP = 4.5+ tsf	CL-ML			
15							15.0	531.7
	ST3	38					Silty Shale, orange-brown mottled brown and light gray, hard, slightly moist, calcareous, weathered	
	SS2	72 60	49-50	PP = 4.5+ tsf			White crystalline lenses in interbeds 17.7-21.4 feet Orange-brown and crystalline in interbeds 25-29 feet	
20								
	ST4	29						
	SS3	78 93	25-36-50 (86)	PP = 4.5+ tsf				
25								
	ST5	21 100	26-27-40 (67)	PP = 4.5+ tsf MC = 18% DD = 108 pcf LL = 68 PL = 21 Fines = 87% Weathered to Unweathered zone				
	SS4	68						
							29.0	517.7
30							Silty Shale, gray, hard, slightly moist, calcareous, micaceous, unweathered	
	SS5	53 13	26-50				Orange-brown staining in joints/bedding 29-40 feet	
	ST6	80		PP = 4.5+ tsf			Occasional fossil fragments 33-38 feet Fossil fragments 40.8-53 feet	
35								

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/6/20 16:30 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-27

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							Silty Shale, gray, hard, slightly moist, calcareous, micaceous, unweathered
		60		PP = 4.5+ tsf			Orange-brown staining in joints/bedding 29-40 feet
							Occasional fossil fragments 33-38 feet
40							Fossil fragments 40.8-53 feet *(continued)*
	ST7	17 33	50	PP = 4.5+ tsf MC = 15% DD = 118 pcf LL = 61 PL = 21 Fines = 97%			
	SS6	100					
45							
		100		PP = 4.5+ tsf			
50							
	ST8	17 33	50	PP = 4.5+ tsf			
	SS7	167					
							53.0 493.7

Bottom of borehole at 53.0 feet.

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BORING NUMBER B-28

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/11/18 **COMPLETED** 10/11/18
GROUND ELEVATION 529.6 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						
		98	PP = 1.5-4.5+ tsf	CL		(CL) Silty Clay, gray, soft to firm, moist, organic, with traces of small to large gravel and chalk material
5						5.0 — 524.6
	ST1	21 / 51	PP = 4.5+ tsf			Silty Clay, orange-brown mottled gray and brown, very hard, slightly moist, with some weathered shale, weathered Chalky material interbedded 5-10 feet Sub-rounded, small to large gravel 5-6 feet Shell fragments 10-15 feet
10						
	ST2	54 / 64	PP = 4.5+ tsf			Crystalline/mineral deposits 15-25 feet
15						
	ST3	33 / 100	PP = 4.5+ tsf			
20						
	ST4	25 / 100	PP = 4.5+ tsf			
25						25.0 — 504.6
	ST5	29 / 100	PP = 4.5+ tsf Weathered to Unweathered zone			Silty Clay Shale, orange-brown mottled brown and gray, very hard, slightly moist, with shell fragments, weathered 28.0 — 501.6
30						Silty Clay Shale, gray to dark gray, very hard, slightly moist to dry, calcareous, unweathered Mineral deposits 28-30 feet Shell fragments 30-35 feet Orange-brown staining 28-35 feet
	ST6	13 / 100	PP = 4.5+ tsf			
35						

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BORING NUMBER B-28

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						Silty Clay Shale, gray to dark gray, very hard, slightly moist to dry, calcareous, unweathered Mineral deposits 28-30 feet Shell fragments 30-35 feet Orange-brown staining 28-35 feet *(continued)*
	ST7	21	PP = 4.5+ tsf			
		66				
40						
		58	PP = 4.5+ tsf			
45						
	ST8	21	PP = 4.5+ tsf			
		71				
50						
		66	PP = 4.5+ tsf			
55						55.0 474.6

Bottom of borehole at 55.0 feet.

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BORING NUMBER B-29

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/16/18 **COMPLETED** 11/16/18
GROUND ELEVATION 540.25 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							
		73		PP = 0.5-4.5+ tsf	MH		(MH) Clayey Silt, dark brown, soft, moist, with organics
					CL-ML		2.0 — 538.3 (CL-ML) Silty Clay, brown to yellow-brown, hard to stiff, slightly moist to moist, with traces of sub-rounded gravel
5							5.0 — 535.3
	ST1	25	10-16-21 (37)	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay (Weathered Shale/Marl), orange-brown stained gray and brown, hard to stiff, slightly moist, with white chalky material, calcareous, weathered
	SS1	89 / 67					Traces of gravel 5-15 feet
10							Black iron staining and limey lenses 15-25 feet
	ST2	25		PP = 4.5+ tsf			Color transitioning into mostly gray at 20 feet
		40					
15							
	ST3	29	10-24-36 (60)	PP = 4.5+ tsf			
	SS2	94 / 80					
20							
	ST4	21		PP = 4.5+ tsf			
		50					
25							25.0 — 515.3
	SS3	78	25-50	Weathered to Unweathered zone PP = 4.5+ tsf MC = 16% DD = 113 pcf LL = 60 PL = 21 Fines = 95%			26.5 — 513.8 Shale Marl, gray with some orange-brown staining, very hard, slightly moist, calcareous, weathered
		13					Crystalline material in spots 25-26 feet
	ST5	92					Silty Clay Shale Marl, gray with some orange-brown staining, very hard, slightly moist, calcareous, unweathered
30							
	ST6	13					Orange-brown limey/micaceous lenses 30-45 feet
		92		PP = 4.5+ tsf			Fossil remnants 25-45 feet
35							

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-29

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							
	SS4	28	50	PP = 4.5+ tsf MC = 11% DD = 116 pcf LL = 51 PL = 17 Fines = 90%			Silty Clay Shale Marl, gray with some orange-brown staining, very hard, slightly moist, calcareous, unweathered
		8					
	ST7	72					Orange-brown limey/micaceous lenses 30-45 feet
40							Fossil remnants 25-45 feet *(continued)*
		90		PP = 4.5+ tsf			
45						45.0	495.3

Bottom of borehole at 45.0 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-30

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/17/18 **COMPLETED** 11/18/18
GROUND ELEVATION 543.05 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							Top Soil, dark brown to black, very soft, with organic material and silt 2.0 541.1
	51.6	86		PP = 2.0-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, gray, medium to very hard, slightly moist, with some round to sub-rounded pebles and chalky white material 5.0 538.1
5	ST1 SS1 57.6	72 96	8-12-16 (28)	PP = 3.0-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, gray mottled orange and brown, moderately hard, slightly moist, with some round to sub-rounded pebbles up to 1/2" and white chalky material, calcareous 10.0 533.1
10	ST2 31.8	35 53		PP = 2.0 tsf	CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray and orange, medium soft, slightly moist, with white chalky material, calcareous Minor pebbles less than 1/8" 10-15 feet No pebbles or chalky white material 15-20 feet Turning gray 15-20 feet Crystalline deposits and very hard 20-25 feet
15	ST3 SS2	23 100 66	15-25-37 (62)	PP = 0-3.0 tsf MC = 18% DD = 115 pcf LL = 61 PL = 20 Fines = 90%	CL-ML		
20	ST4	18 36		PP = 4.5+ tsf	CL-ML		
25	ST5 SS3	19 100 58	18-31-39 (70)	PP = 2.0-4.5+ tsf	CL-ML		25.0 518.1 (CL-ML) Silty Clay, light brown/orange to gray, medium hard to very hard, dry, calcareous, weathered Red-brown staining along fractures, medium soft to hard, and crystalline deposits 30-35 feet
30	ST6	45 78		PP = 1.5-3.5 tsf MC = 18% LL = 62 PL = 21 Fines = 94%	CL-ML		
35							

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-30

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							
	ST7	25 55	31-50	weathered/unweathered zone PP = 1.5-4.5+ tsf	CL-ML		37.3 505.8
	SS4	100					Silty Clay Shale Marl, gray to dark gray, very hard, dry, with orange-brown staining, calcareous unweathered
40							Less orange staining 40-45 feet
	ST8	15					Some orange mottling and hard to very hard 45-48 feet
		72		PP = 4.5+ tsf			
45							
	ST9	20 36	50	PP = 3.0-4.5 tsf			
	SS5	100					48.0 495.1

Bottom of borehole at 48.0 feet.

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BORING NUMBER B-31

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/8/18 **COMPLETED** 10/9/18
GROUND ELEVATION 537.55 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						
		100	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, gray to dark gray, slightly moist to dry, stiff to hard, with trace of gravel, calcareous
						2.0 — 535.6
						Organic rich 0-2 feet
						Color change to orange-brown mottled yellow-brown and chalk/limestone in joints 7.5-11.5 feet
5						
	ST1	84	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, gray to dark gray, slightly moist to dry, stiff to hard, with trace of gravel, calcareous
						Organic rich 0-2 feet
						Color change to orange-brown mottled yellow-brown and chalk/limestone in joints 7.5-11.5 feet
10						
	ST2	85	PP = 4.5+ tsf			11.5 — 526.1
						(CL-ML) Silty Clay, orange/brown/gray mottled brown, hard, slightly moist to dry, calcareous, with traces of sub-rounded gravel
						Shell fragments at 20 feet
15						
	ST3	85	PP = 4.5+ tsf LL = 66 PL = 27	CL-ML		
20						
	ST4	64	PP = 4.0-4.5+ tsf			
25						25.0 — 512.6
	ST5	80	PP = 4.5+ tsf Weathered to Unweathered zone			Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered
						Orange-brown staining in fractures 25-30 feet
						Limestone lenses in fractures 35-55 feet
30						
	ST6	87	PP = 4.0 tsf MC = 18% DD = 103 pcf LL = 74 PL = 22 Fines = 90%			
35						

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BORING NUMBER B-31

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Orange-brown staining in fractures 25-30 feet Limestone lenses in fractures 35-55 feet *(continued)*
	ST7	53	PP = 4.5+ tsf			
40		90	PP = 4.5+ tsf			
45						
	ST8	67	PP = 4.5+ tsf			
50		84	PP = 4.5+ tsf			
55						
	ST9	89	PP = 4.5+ tsf MC = 14% LL = 60 PL = 23 Fines = 96%			
60		67	PP = 4.5+ tsf			
					63.0	474.6

Bottom of borehole at 63.0 feet.

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BORING NUMBER B-32

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/11/18 **COMPLETED** 10/12/18
GROUND ELEVATION 526.3 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0				MH		0.5 (MH) Clayey Silt, brown, slightly moist to moist, soft to hard, organic	525.8
		60	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange-brown mottled brown and gray, slightly moist to dry, hard, calcareous, with weathered shale Traces of small sub-rounded gravel 2.5-5 feet Chalk in joints 5-10 feet	
5	ST1	50 / 50	PP = 4.5+ tsf				
10	ST2	25 / 56	PP = 4.5+ tsf				
15	ST3	25 / 47	PP = 4.5+ tsf				
20	ST4	29 / 58	PP = 4.5+ tsf Weathered to Unweathered zone			24.5	501.8
25	ST5	25 / 68	PP = 4.5+ tsf			Silty Clay Shale, dark gray to gray, very hard, slightly moist, with orange-brown staining in joints, weathered 29.0	497.3
30	ST6	100 / 25	PP = 4.5+ tsf			Silty Clay Shale, dark gray to gray, very hard, slightly moist, calcareous, with lighter colored material, unweathered 32.0	494.3

Bottom of borehole at 32.0 feet.

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WELL NUMBER B-33 (PZ-33)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/19/18 **COMPLETED** 11/20/18
GROUND ELEVATION 539.4 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Clayey Silt Topsoil, dark brown, soft to firm, moist, with roots and organics (1.5 / 537.9)	
5		60		PP = 1.0-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange-brown mottled brown/tan, hard, moist to slightly moist, with white chalky material, calcareous Silty/micaceous interbeds 5-15 feet	
10	ST1 SS1	33 89 100	13-29-37 (66)	PP = 4.5+ tsf				
15	ST2 SS2	33 67 43	22-50	PP = 4.5+ tsf			(15.0 / 524.4)	
20	ST3	21 89		PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange-brown mottled brown and light gray, hard, slightly moist, with black iron staining, fossil remnants, and silty/micaceous interbeds, calcareous Weathered shale marl transition zone and mostly gray color at 25 feet	
25	ST4	21 49		PP = 4.5+ tsf				
30	ST5 SS3	25 94 100	20-40-50 (90)	PP = 4.5+ tsf Weathered to Unweathered zone			(28.0 / 511.4) (CL-ML) Silty Clay Shale Marl, gray, hard, slightly moist, calcareous, unweathered	
35	ST6	17 100		PP = 4.5+ tsf	CL-ML		(30.0 / 509.4) Orange-brown staining at 28.2 and 29.7 feet Shale Marl, gray, very hard, slightly moist, with fossil remnants, calcareous, unweathered	

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WELL NUMBER B-33 (PZ-33)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35							Shale Marl, gray, very hard, slightly moist, with fossil remnants, calcareous, unweathered *(continued)*	
	ST7	17 28	50					
	SS4	100		PP = 4.5+ tsf				
40								
		74		PP = 4.5+ tsf				
45								
	ST8	21 28	50					
	SS5	90		PP = 4.5+ tsf				
50								
		76		PP = 4.5+ tsf				
55							55.0 484.4	

Bottom of borehole at 55.0 feet.

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BORING NUMBER B-34

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/17/18 **COMPLETED** 11/17/18
GROUND ELEVATION 535.65 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Millbrand **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							Topsoil, dark brown to black, very soft, with roots, organic material, and silt	
2.0								533.7
		50		PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, light brown mottled white, very hard, dry, with some chalky material, calcareous	
5.0								530.7
5	ST1	23	14-22-34 (56)	PP = 4.0-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, brown-orange, very hard, dry to slightly moist, with some sub-round to round pebbles, calcareous	
		83						
	SS1	20						
10.0								525.7
10	ST2	28		PP = 0.5-3.0 tsf MC = 14% LL = 57 PL = 19 Fines = 82%	CL-ML		(CL-ML) Silty Clay, light brown to white mottled gray, medium soft to medium hard, dry, with some orange staining and chalky white material, calcareous	
		32						
15.0								520.7
15	ST3	75		PP = 2.0-3.0 tsf	CL-ML		(CL-ML) Silty Clay, light brown to orange mottled gray, medium hard, dry, calcareous Less chalky white material throughout Transition zone	
	SS2	60	13-20-29 (49)					
		133						
20.0								515.7
20	ST4	15		PP = 3.0-4.5+ tsf MC = 16% DD = 111 pcf LL = 63 PL = 20 Fines = 95%			Clayey Shale, gray with orange-brown staining, moderately hard to very hard, dry, calcareous, weathered	
		31						
26.0								509.7
25	ST5	15	24-50	Weathered to Unweathered zone PP = 4.5+ tsf			Clayey Shale, light gray with some orange-brown, very hard, dry, with some crystalline mineral deposits, calcareous	
		33						
	SS3	100						
30.0								505.7
30	ST6	15		PP = 4.5+ tsf			Shale Marl, dark gray with very little orange staining, very hard, dry, with minor fossil fragments, slightly calcareous	
		100						
35								

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BORING NUMBER B-34

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							Shale Marl, dark gray with very little orange staining, very hard, dry, with minor fossil fragments, slightly calcareous *(continued)*
	ST7	15 33	50	PP = 4.5+ tsf			
	SS4	92					
40							
		100		PP = 4.5+ tsf			41.0 494.7
	ST8	50					

Bottom of borehole at 42.1 feet.

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BORING NUMBER B-35

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/12/18 **COMPLETED** 12/12/18
GROUND ELEVATION 553.3 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							Clayey Silt (top 0.5') to Silty Clay, brown, soft to firm, moist to very moist, with roots and organics	
		100		PP = 2.0-4.5+ tsf			2.0	551.3
5							Silty Clay, brown, stiff, moist, with traces of sub-rounded gravel and roots	
							5.5	547.8
	ST1	33	15-18-18 (36)				Silty Clay, orange-brown stained gray and brown, stiff, moist, weathered	
		78					White chalky zone 6.5-7 feet	
	SS1	74		PP = 4.5 tsf			Sandy zone (gray to brown) at 9 feet	
							White chalky material 9-10 feet	
10							10.0	543.3
	ST2	38					(CH) Silty Clay Shale Marl, orange-brown stained gray and brown, stiff to hard, slightly moist to moist, calcareous, weathered	
		85		PP = 4.5 tsf			Traces of white gravel	
15							Gray silty lenses 15-34.8 feet	
	ST3	33	19-24-34 (58)					
		100						
	SS2	85		PP = 4.5 tsf				
20								
	ST4	29						
		46		PP = 3.0-4.5 tsf	CH			
25								
	ST5	21	21-36-40 (76)					
		117						
	SS3	100		PP = 4.5 tsf				
30								
	ST6	21						
		56		PP = 4.5-4.5+ tsf				
				Weathered to				
35							34.8	518.5

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BORING NUMBER B-35

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							
	SS4	28	50	Unweathered zone PP = 4.5+ tsf			Silty Shale Marl, gray, hard, slightly moist, calcareous, unweathered
		13					Orange-brown stained zone 37.5-38 feet
	ST7	90		PP = 4.5+ tsf			Trace of fossil remnants and silty/limey lenses 40-59 feet *(continued)*
40							
		76					
45							
	ST8	17	50	PP = 4.5+ tsf MC = 13% DD = 109 pcf LL = 54 PL = 21 Fines = 75%			
		28					
	SS5	70					
50							
		73		PP = 4.5+ tsf			
55							
		108		PP = 4.5+ tsf			
							59.0 494.3

Bottom of borehole at 59.0 feet.

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BORING NUMBER B-36

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 1/8/19 **COMPLETED** 1/9/19
GROUND ELEVATION 532.5 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0					MH		0.5 (MH) Clayey Silt, brown, soft, moist, with roots and organics	532.0
5		100			CL-ML		(CL-ML) Silty Clay, brown grading to light gray, firm to stiff, moist, with organics in top layer and trace of subrounded gravel in bottom layer	5.0 527.5
10	ST1 SS1	58 94 100	10-14-19 (33)		CL-ML		(CL-ML) Silty Clay, light gray, stiff, slightly moist to moist, with some orange-brown staining, white chalky material, and some gravel, calcareous Color change to orange-brown mottled gray and brown at 7.5 feet	
15	ST2	50 100						15.0 517.5
20	ST3 SS2	29 94 71	15-24-31 (55)	MC = 18% LL = 56 PL = 21 Fines = 91%			Silty Clay Shale Marl, orange-brown stained gray and brown, stiff to hard, slightly moist, with very fine sandy laminate layers Crystalline material in joints at 25 feet Color change to mostle dark gray at 27 feet	
25	ST4	25 40						
30	ST5 SS3	17 94 71	7-15-50 (65)					
35	ST6	25 68		MC = 17% DD = 115 pcf LL = 64 PL = 26 Fines = 93% Weathered to				34.0 498.5

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BORING NUMBER B-36

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35				Unweathered zone			Shale Marl, dark gray, hard, slightly moist, calcareous, unweathered
	ST7	17 50	35-50				Occasional orange-brown staining 34-40 feet
	SS4	54					Silty/limey laminate layers 42-58 feet *(continued)*
40							
	ST8	21					
		44					
45							
	ST9	25 50	33-50				
	SS5	100					
50							
		100					
55							
	ST10	21 28 60	50				
	SS6						
							58.0 474.5

Bottom of borehole at 58.0 feet.

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BORING NUMBER B-37

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/6/18 **COMPLETED** 12/11/18
GROUND ELEVATION 526.9 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
		86	PP <0.5-4.5 tsf	ML		(ML) Silt, gray, soft, moist, with a trace of clay and roots/organics	525.9
				CL-ML		(CL-ML) Silty Clay, light gray, firm to stiff, slightly moist to moist, with white chalky material in areas, trace of gravel, and roots	
5							521.9
		56	PP = 4.0-4.5 tsf	CL-ML		(CL-ML) Silty Clay, light gray to brown, stiff, slightly moist to moist, with white chalky areas and trace of sub-rounded gravel	
10							516.9
		90	PP = 2.0-4.5 tsf	CL-ML		(CL-ML) Sandy Silty Clay, light brown to tan, firm, slightly moist to moist, trace of gravel	515.9
				CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray and brown, hard, slightly moist to moist, with white chalky material in joints/bedding, calcareous, weathered	
15							
		90	PP = 4.5 tsf				
20							
		90	PP = 4.5+ tsf				
25							503.4
						Shale Marl (Silty Clay), gray with trace of orange-brown staining, hard, slightly moist, calcareous, weathered	
		98	Weathered to Unweathered zone PP = 4.5+ tsf			Transition zone	500.9
						Shale Marl (Silty Clay), gray, hard, slightly moist, with fossil remnants, calcareous, unweathered	
30							
		84	PP = 4.5+ tsf				
35							

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BORING NUMBER B-37

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						Shale Marl (Silty Clay), gray, hard, slightly moist, with fossil remnants, calcareous, unweathered *(continued)*
40		96	PP = 4.5+ tsf			
45		90	PP = 4.5+ tsf			
50		100	PP = 4.5+ tsf			
		100	PP = 4.5+ tsf			52.0 474.9

Bottom of borehole at 52.0 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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SCS Engineers
1901 Central Drive, Ste. 550
Bedford, Texas
Telephone: 817-571-2288

BORING NUMBER B-38

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/4/18 **COMPLETED** 12/5/18
GROUND ELEVATION 529.85 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0					ML		0.7 (ML) Silt, brown, dry to slightly moist, soft	529.2
5		66		PP = 0.5-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, dark brown to brown, firm to hard with depth, slightly moist to moist, with roots/organics and trace gravel 5.0	524.9
10	ST1 / SS1	29 / 94 / 63	15-25-25 (50)	PP = 2.0-3.5 tsf	CL-ML		(CL-ML) Silty Clay, light gray with orange-brown staining, slightly moist, firm to stiff, with white chalky material and trace sub-rounded gravel 10.0	519.9
15		36		PP = 3.0-3.5 tsf			Sandy Clay, brown, firm to stiff, slightly moist, with trace of white chalky spots and trace sub-rounded gravel at top, calcareous Fossil remnants 15-17 ft	
20		22		PP = 3.0-4.0 tsf	CL-ML		17.0 (CL-ML) Silty Clay, brown, stiff, slightly moist, with trace of white chalky material and gravel, calcareous 20.0	512.9 / 509.9
25		40		PP = 4.0 tsf			Silty Clay Shale Marl, brown and gray, stiff, slightly moist to moist, with orange-brown staining and trace fossil remnants, calcareous, weathered	
30		66		Weathered to Unweathered zone PP = 4.5+ tsf			27.0 Shale Marl (Silty Clay), gray, hard, slightly moist to moist, with fossil remnants, calcareous Orange-brown staining 28-28.2 feet	502.9
35		48		PP = 4.5+ tsf			Light gray limey lenses 40-55 feet	

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BORING NUMBER B-38

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							
40		54		PP = 4.5+ tsf			Shale Marl (Silty Clay), gray, hard, slightly moist to moist, with fossil remnants, calcareous Orange-brown staining 28-28.2 feet Light gray limey lenses 40-55 feet *(continued)*
45		66		PP = 4.5+ tsf			
50		60		PP = 4.5+ tsf			
55		44		PP = 4.5+ tsf			55.0 474.9

Bottom of borehole at 55.0 feet.

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BORING NUMBER B-39

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/5/18 **COMPLETED** 12/6/18
GROUND ELEVATION 522.95 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0				ML		0.6 (ML) Silt, dark brown to brown, soft, moist, with a trace of clay and roots	522.4
5	ST1	84	PP = 0.5-4.5 tsf	CL-ML		(CL-ML) Silty Clay, brown to gray, firm to stiff, slightly moist to moist, with trace gravel, roots, fossil remnants, and white chalky material Color change to orange-brown mottled gray and brown at 5 feet Sandy from 5-7 feet	
10	ST2	100	PP = 4.5-4.5+ tsf			8.6	514.4
15	ST3	60	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray and brown, hard, slightly moist, with trace of white chalky material and gravel, calcareous	
20	ST4	76	PP = 4.5+ tsf				
25	ST5	52	PP = 4.5+ tsf				
30	ST6	70	PP = 4.5+ tsf			29.0	494.0
35	ST7	66	PP = 4.5+ tsf			Shale Marl, mostly gray with orange-brown staining, hard, slightly moist, with trace chalky white material, fossil remnants, and limey lenses, calcareous Transition zone from weathered to unweathered	

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-39

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						Shale Marl, mostly gray with orange-brown staining, hard, slightly moist, with trace chalky white material, fossil remnants, and limey lenses, calcareous Transition zone from weathered to unweathered *(continued)* 38.0 485.0
40	ST8	100	PP = 4.5+ tsf Weathered to Unweathered zone			Shale Marl, gray, hard, slightly moist, with limey lenses, calcareous, unweathered
45	ST9	80	PP = 4.5+ tsf			
	ST10	100	PP = 4.5+ tsf			48.0 475.0

Bottom of borehole at 48.0 feet.

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BORING NUMBER B-40

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/5/18 **COMPLETED** 12/5/18
GROUND ELEVATION 522.8 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
5		40	PP = 2.0-4.5 tsf	CL-ML		(CL-ML) Silty Clay, brown, firm to stiff, slightly moist to moist, with trace sub-rounded gravel, fossil remnants, roots Sandy at 5 feet	
		100	PP = 3.0-4.0 tsf			7.0	515.8
10				CL-ML		(CL-ML) Silty Clay, orange-brown mottled brown and gray, stiff, slightly moist to moist, with white chalky material/gravel and fossil remnants, calcareous Crystalline pockets 10-19 feet	
15		88	PP = 3.5-4.5 tsf				
20		76	PP = 4.5-4.5+ tsf			19.0	503.8
25		54	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, gray with trace of orange-brown staining, hard, slightly moist, with fossil remnants, calcareous, unweathered Transition zone	
		100	Weathered to Unweathered zone PP = 4.5+ tsf			26.0	496.8
						Shale Marl, gray, hard, slightly moist, with fossil remnants, calcareous, unweathered	
						28.0	494.8

Bottom of borehole at 28.0 feet.

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WELL NUMBER B-41 (PZ-41)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/17/18 **COMPLETED** 12/18/18
GROUND ELEVATION 534.62 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING 41.82 ft / Elev 492.80 ft

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							
5		72	PP = 1.0-4.5 tsf	CL-ML		(CL-ML) Silty Clay, dark brown to gray, soft to stiff, moist to very moist, with a trace of gravel and roots/organics	
10		44	PP = 4.5 tsf	CL-ML		(CL-ML) Silty Clay, gray grading to brown and orange-brown stained, stiff, moist, with trace of small to large sub-rounded gravel and white chalky material Color change to orange-brown stained brown at 10 feet	
15		34	PP = 4.5-4.5+ tsf			(CL-ML) Silty Clay Shale Marl, orange-brown stained brown and gray, stiff to hard, moist, with white crystalline lenses in bedding, calcareous	
20		82	PP = 4.5+ tsf				
25		44	PP = 4.5+ tsf	CL-ML			
30		54	PP = 4.5+ tsf weathered/unweathered zone from 29 ft to 43 ft			Shale Marl, dark gray with orange-brown stainining in joints, hard, slightly moist to moist, calcareous, unweathered Trace of crystalline areas 29-30 feet	
35		56	PP = 4.5+ tsf				

5.0 — 529.6
12.0 — 522.6
29.0 — 505.6

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WELL NUMBER B-41 (PZ-41)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35							
40		56	PP = 4.5+ tsf			Shale Marl, dark gray with orange-brown stainining in joints, hard, slightly moist to moist, calcareous, unweathered Trace of crystalline areas 29-30 feet *(continued)*	
45		100	PP = 4.5+ tsf			43.0 491.6 Shale Marl, gray to dark gray, hard, slightly moist, with lighter limey/silty lenses, fossil remnants, and crystalline areas, unweathered	
50		100	PP = 4.5+ tsf				
55		100	PP = 4.5+ tsf				
60		50	PP = 4.5+ tsf			60.0 474.6	

Bottom of borehole at 60.0 feet.

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BORING NUMBER B-42

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 12/6/18 **COMPLETED** 12/6/18
GROUND ELEVATION 527 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0				ML		0.5 (ML) Silt, gray, soft, moist, with roots and organics	526.5
5		100	PP = 0.5-4.5 tsf	CL-ML		(CL-ML) Silty Clay, brown-gray, firm to stiff, moist, with a trace of gravel, roots, and white spots 5.0	522.0
10		72	PP = 0.5-4.5 tsf	CL-ML		(CL-ML) Silty Clay, gray, stiff, moist, with white chalky material and trace of sub-rounded gravel Orange-brown staining at 9-10 feet 10.0	517.0
15		86	PP = 4.0-4.5 tsf	CL-ML		(CL-ML) Silty Clay, gray and brown with orange-brown staining, stiff to hard, slightly moist to moist, with white chalky material/spots, weathered 15.0	512.0
20		80	PP = 3.5-4.0 tsf	CL-ML		(CL-ML) Silty Clay (Shale Marl), gray and brown with orange-brown staining, stiff to hard, slightly moist to moist, with white chalky material/spots, weathered More gray 28-30 feet (transition zone)	
25		84	PP = 4.0-4.5 tsf				
30		80	PP = 4.5 tsf				
		100	PP = 4.5 tsf Weathered to Unweathered zone			31.0	496.0
						Shale Marl, gray, hard, slightly moist, with white chalky material/specs, calcareous 32.0	495.0

Bottom of borehole at 32.0 feet.

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BORING NUMBER B-43 (new/continued)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED ____ **COMPLETED** ____
GROUND ELEVATION ____ **HOLE SIZE** inches
DRILLING CONTRACTOR ____
GROUND WATER LEVELS:
DRILLING METHOD ____
AT TIME OF DRILLING ---
LOGGED BY A. Boudreaux **CHECKED BY** J. Lawrence
AT END OF DRILLING ---
NOTES ____
AFTER DRILLING ---

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							
					MH		(MH) Clayey Silt, dark brown, soft, very moist, with trace of gravel and organics (1.0)
		47		PP = 0.5-4.5 tsf	CL-ML		(CL-ML) Silty Clay, dark brown, hard, moist, with trace of gravel and organics (5.0)
5							
	ST1	29	15-27-50 (77)				(CL-ML) Silty Clay, orange-brown mottled gray and brown, stiff to hard, slightly moist to moist, with white chalky material in interbeds, calcareous
		93					
	SS1	67		PP = 4.5 tsf	CL-ML		
10							(10.0)
	ST2	29		PP = 4.5 tsf MC = 18% DD = 111 pcf LL = 60 PL = 20 Fines = 95%			(CL-ML) Silty Clay (weathered shale/marl), orange-brown stained light gray and brown, stiff to hard, slightly moist, calcareous, weathered White chalky material in interbeds 10-16 feet Black iron staining in joints/interbeds 20-24 feet Weathered to unweathered transition at 25 feet
		28					
15							
	ST3	25	21-39-50 (89)				
		93					
	SS2	67		PP = 4.5 tsf	CL-ML		
20							
	ST4	25					
		80		PP = 4.5+ tsf			
25							(25.0)
	ST5	17	26-50	PP = 4.5+ tsf MC = 16% DD = 117 pcf LL = 61 PL = 19 Fines = 94%			(CL-ML) Silty Clay, (shale/marl) gray with some orange-brown staining, hard, calcareous, with white fossil remnants
		72					
	SS3	70			CL-ML		
30							
	ST6	21		Weathered to Unweathered zone PP = 4.5+ tsf			(32.0)
		60					
35							

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BORING NUMBER B-43 (new/continued)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35							Silty Shale Marl, gray, hard, slightly moist, calcareous, unweathered
	ST7	19					
		50					Occasional orange-brown staining and fossil remnants in beds 32-43 feet
							White crystalline material in bedding/joints at 35 feet
40							Micaceous interbeds and traces of fossil remnants 45-70 feet *(continued)*
	ST8	17					
		80		PP = 4.5+ tsf			
45							
	ST9	21	50	PP = 4.5+ tsf MC = 16% DD = 108 pcf LL = 63 PL = 23 Fines = 95%			
		28					
	SS4	70					
50							
		60		PP = 4.5+ tsf			
55							
	ST10	17	50				
		22					
	SS5	43		PP = 4.5+ tsf			
60							
		87		PP = 4.5+ tsf			
65							
	ST11	17					
		67		PP = 4.5+ tsf			
70							
		83		MC = 15% LL = 60 PL = 40 Fines = 91% PP = 4.5+ tsf			
75							

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-43 (new/continued)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75							Silty Shale Marl, gray, hard, slightly moist, calcareous, unweathered
							Occasional orange-brown staining and fossil remnants in beds 32-43 feet
							White crystalline material in bedding/joints at 35 feet
80							Micaceous interbeds and traces of fossil remnants 45-70 feet *(continued)* minor, very fine sand, dark gray, very hard, moist, laminated small fossils harder with depth, small mica flakes from 80-85' fewer laminations with depth
85							some fossils from 85-90'
90							
95							
100							
105							
110							large bivalve fossil
							trace of laminations
115							

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BORING NUMBER B-43 (new/continued)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
115							Silty Shale Marl, gray, hard, slightly moist, calcareous, unweathered
				MC = 12% LL = 68 PL = 46 Fines = 81%			Occasional orange-brown staining and fossil remnants in beds 32-43 feet
							White crystalline material in bedding/joints at 35 feet
120							Micaceous interbeds and traces of fossil remnants 45-70 feet *(continued)* becoming hard with depth
125							trace of sands transitioning to no sands below 125'
130							scarce laminations
135							featureless
140							
145							
				MC = 15% LL = 75 PL = 50 Fines = 99%			no laminations
150							150.0

Bottom of borehole at 150.0 feet.

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WELL NUMBER B-43 (PZ-43)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/15/18 **COMPLETED** 11/16/18
GROUND ELEVATION 548.86 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING ---

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0								
		47		PP = 0.5-4.5 tsf	MH CL-ML		1.0 547.9 (MH) Clayey Silt, dark brown, soft, very moist, with trace of gravel and organics (CL-ML) Silty Clay, dark brown, hard, moist, with trace of gravel and organics	
5							5.0 543.9	
	ST1 SS1	29 93 67	15-27-50 (77)	PP = 4.5 tsf	CL-ML		(CL-ML) Silty Clay, orange-brown mottled gray and brown, stiff to hard, slightly moist to moist, with white chalky material in interbeds, calcareous	
10							10.0 538.9	
	ST2	29 28		PP = 4.5 tsf MC = 18% DD = 111 pcf LL = 60 PL = 20 Fines = 95%	CL-ML		(CL-ML) Silty Clay (weathered shale/marl), orange-brown stained light gray and brown, stiff to hard, slightly moist, calcareous, weathered White chalky material in interbeds 10-16 feet Black iron staining in joints/interbeds 20-24 feet Weathered to unweathered transition at 25 feet	
15								
	ST3 SS2	25 93 67	21-39-50 (89)	PP = 4.5 tsf	CL-ML			
20								
	ST4	25 80		PP = 4.5+ tsf				
25							25.0 523.9	
	ST5 SS3	17 72 70	26-50	PP = 4.5+ tsf MC = 16% DD = 117 pcf LL = 61 PL = 19 Fines = 94%	CL-ML		(CL-ML) Silty Clay, (shale/marl) gray with some orange-brown staining, hard, calcareous, with white fossil remnants	
30								
	ST6	21 60		Weathered to Unweathered zone PP = 4.5+ tsf			32.0 516.9	
35								

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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WELL NUMBER B-43 (PZ-43)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35								
	ST7	19					Silty Shale Marl, gray, hard, slightly moist, calcareous, unweathered	
		50					Occasional orange-brown staining and fossil remnants in beds 32-43 feet	
40							White crystalline material in bedding/joints at 35 feet	
	ST8	17					Micaceous interbeds and traces of fossil remnants 45-70 feet *(continued)*	
		80		PP = 4.5+ tsf				
45								
	ST9	21	50	PP = 4.5+ tsf MC = 16% DD = 108 pcf LL = 63 PL = 23 Fines = 95%				
		28						
	SS4	70						
50								
		60		PP = 4.5+ tsf				
55								
	ST10	17	50					
		22						
	SS5	43		PP = 4.5+ tsf				
60								
		87		PP = 4.5+ tsf				
65								
	ST11	17						
		67		PP = 4.5+ tsf				
70								
		83		PP = 4.5+ tsf				
75							75.0 473.9	

Bottom of borehole at 75.0 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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Bedford, Texas
Telephone: 817-571-2288

BORING NUMBER B-44

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/10/18 **COMPLETED** 10/10/18
GROUND ELEVATION 551.2 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						
5		100	PP = 4.5+ tsf	CL		(CL) Clay, dark brown to black, hard, moist, non-calcareous Calcareous 4-5 feet. 5.0 546.2
10	ST1	100	PP = 3.75-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange-tan mottled gray, hard, slightly moist, with chalk/limestone deposits in joints and fractures, calcareous No chalk/limestone in fractures 15-25 feet Minor sand and silt in fractures (gray) 15-39.5 feet
15	ST2	80	PP = 4.5+ tsf MC = 20% DD = 108 pcf LL = 71 PL = 22 Fines = 91%			
20	ST3	80	PP = 4.5+ tsf			
25	ST4	60	PP = 4.5+ tsf MC = 21% DD = 105 pcf LL = 79 PL = 24 Fines = 84%			
30	ST5	50	PP = 3.0-4.5+ tsf			
35	ST6	60	PP = 3.0-4.5+ tsf MC = 25% DD = 97 pcf LL = 72 PL = 21 Fines = 97%			

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-44

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						
	ST7	100	PP = 3.0-4.5+ tsf Weathered to Unweathered zone	CL-ML		(CL-ML) Silty Clay, orange-tan mottled gray, hard, slightly moist, with chalk/limestone deposits in joints and fractures, calcareous No chalk/limestone in fractures 15-25 feet Minor sand and silt in fractures (gray) 15-39.5 feet *(continued)* 39.5 511.7
40						Shaley Clay, dark gray, hard, dry, slightly calcareous, weathered 41.0 510.2
	ST8	100	PP = 4.5+ tsf			Silty Clay Shale, dark gray, hard, dry, calcareous, with limestone intrusions in fractures No limestone intrusions in fractures 55-76 feet
45						
	ST9	90	PP = 4.5+ tsf			Interbedded heavily weathered zones 65-76 feet
50						
	ST10	100	PP = 4.5+ tsf LL = 60 PL = 25			
55						
		100	PP = 4.5+ tsf			
60						
	ST11	100	PP = 4.5+ tsf			
65						
		100	PP = 4.5+ tsf			
70						
	ST12	100	PP = 4.5+ tsf			
75						

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-44

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
75						
		100				76.0 475.2
						Bottom of borehole at 76.0 feet.
	ST13					

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-45

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/31/18 **COMPLETED** 10/31/18
GROUND ELEVATION 545.5 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0		100	PP = 3.0-3.75 tsf	CL-ML		(CL-ML) Silty Clay, dark brown, medium hard, moist, slightly calcareous, organic
4.0						541.5
5	ST1	50	PP = 0-4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange/tan mottled gray hard, slightly moist to dry, slightly calcareous Very dry and weathered zones 5-26 feet
10	ST2	50	PP = 0-4.5+ tsf			
15	ST3	100	PP = 0-4.5+ tsf			
20	ST4	100	PP = 0-4.5+ tsf			
25	ST5	100	Weathered to Unweathered zone PP = 0-4.5+ tsf MC = 21% DD = 107 pcf LL = 66 PL = 20 Fines = 90%			
26.0						519.5
				CL		(CL) Shaley Clay, dark gray with orange/tan mottling, dry, hard, calcareous, with weathered shale
28.0						517.5
30	ST6	100	PP = 4.5+ tsf			Silty Clay Shale, dark gray, hard, dry, slightly calcareous, unweathered
35						

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-45

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						Silty Clay Shale, dark gray, hard, dry, slightly calcareous, unweathered *(continued)*
40		100	PP = 4.5+ tsf			
45	ST7	100	PP = 4.5+ tsf MC = 15% LL = 58 PL = 20 Fines = 92%			
50		100	PP = 4.5+ tsf			
	ST8					51.0 494.5

Bottom of borehole at 51.0 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-46

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 11/1/18 **COMPLETED** 11/1/18
GROUND ELEVATION 559.25 ft **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR BEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY T. Derstine **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						
		58	PP = 1.0-4.5+ tsf	MH		(MH) Clayey Silt, brown, soft to firm, moist, organic, with a trace of gravel and white chalky material (1.0 – 558.3)
				CL-ML		(CL-ML) Silty Clay, orange-brown mottled brown, stiff to hard, slightly moist, with some gravel
5						5.0 – 554.3
	ST1	33 / 76	PP = 4.5+ tsf	CL-ML		(CL-ML) Silty Clay, orange-brown mottled brown, hard, slightly moist, calcareous, with chalk in joints and fossil fragments
10						10.0 – 549.3
	ST2	29 / 100	PP = 4.5+ tsf			Silty Shale, orange-brown mottled brown and gray, hard, slightly moist, calcareous, weathered Chalk in joints 10-11.5 feet More moist and softer 25-35 feet
15						Silty lenses and crystalline deposits in interbeds 15-35 feet
	ST3	33 / 100	PP = 4.5+ tsf			
20						
	ST4	33 / 56	PP = 4.5+ tsf			
25						
	ST5	33 / 71	PP = 3.0 tsf			
30						
	ST6	38 / 61	PP = 1.0-4.0 tsf			
35						

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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BORING NUMBER B-46

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

DEPTH (ft)	NUMBER	RECOVERY %	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						
	ST7	33	PP = 3.0-4.5 tsf			
		71				
40						40.0 519.3
	ST8	21	PP = 4.5+ tsf Weathered to Unweathered zone			Silty Shale, gray, hard, slightly moist, calcareous, with silty lenses in interbeds Traces of orange-brown staining 40-65 feet Shell/fossil fragments 45-65 feet
		96				
45						
	ST9	21	PP = 4.5+ tsf MC = 13% DD = 110 pcf LL = 62 PL = 21 Fines = 94%			
		96				
50						
		74	PP = 4.5+ tsf			
55						
	ST10	25	PP = 4.5+ tsf			
		95				
60						
		80	PP = 4.5+ tsf			
65						65.4 493.9
	ST11	17				Bottom of borehole at 65.0 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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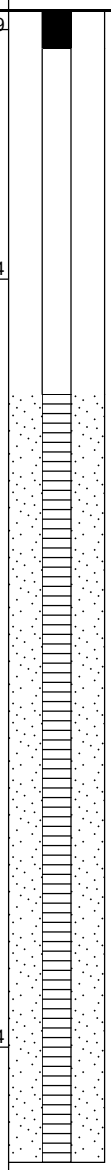
WELL NUMBER B-47 (PZ-47)

CLIENT City of Waco
PROJECT NAME City of Waco Landfill MSW-2400
PROJECT NUMBER 16216088.00
PROJECT LOCATION Waco, Texas
DATE STARTED 10/11/18 **COMPLETED** 10/12/18
GROUND ELEVATION 532.4 ft **HOLE SIZE** 7.25 inches
DRILLING CONTRACTOR West Drilling
GROUND WATER LEVELS:
DRILLING METHOD Continuous Flight Auger
AT TIME OF DRILLING --- No Groundwater
LOGGED BY V. Wooters **CHECKED BY** J. Lawrence
AT END OF DRILLING --- No Groundwater
NOTES
AFTER DRILLING --- No Groundwater

DEPTH (ft)	NUMBER	RECOVERY %	REMARKS	U.S.C.S.	MATERIAL DESCRIPTION	
0				ML	0.5 (ML) Silt, dark brown, soft, moist	531.9
5		100		CL	(CL) Clay, light gray, hard, dry, calcareous, with chalk in fractures	
10	ST1	100			7.0	525.4
15	ST2	40		CL-ML	(CL-ML) Silty Clay, orange-tan mottled gray, hard, dry, calcareous, with chalk in fractures/joints Trace of sub-angular gravel 1/8" at 7-10 feet	
20	ST3	80				
25	ST4	80				
30	ST5	100			27.0	505.4
35		80	Weathered to Unweathered zone	CL	(CL) Clay, gray with orange-brown mottling, hard, slighty moist to dry, calcareous, with weathered shale, weathered 33.0	499.4

WELL DIAGRAM



GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

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WELL NUMBER B-47 (PZ-47)

CLIENT City of Waco **PROJECT NAME** City of Waco Landfill MSW-2400

PROJECT NUMBER 16216088.00 **PROJECT LOCATION** Waco, Texas

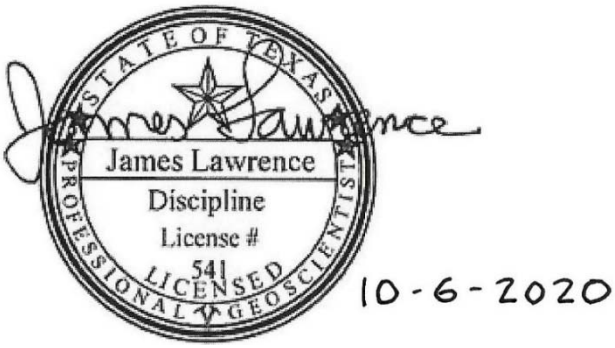
DEPTH (ft)	NUMBER	RECOVERY %	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35							
		100				Silty Clay Shale, dark gray, hard, dry, calcareous, unweathered Limestone lenses in fractures 38-57 *(continued)*	
40							
		80					
45							
	ST6	80					
50							
		80					
55							
	ST7	100				57.0 475.4	

Bottom of borehole at 57.5 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/2/20 13:41 - Z:\GIL\GINT FILES\WACO LANDFILL\SITE 50 WACO REV.GPJ

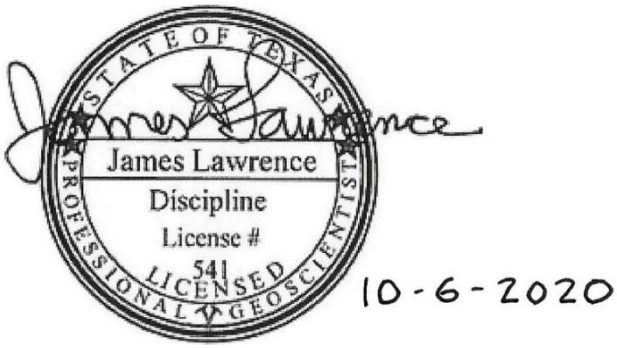
APPENDIX III-4.F

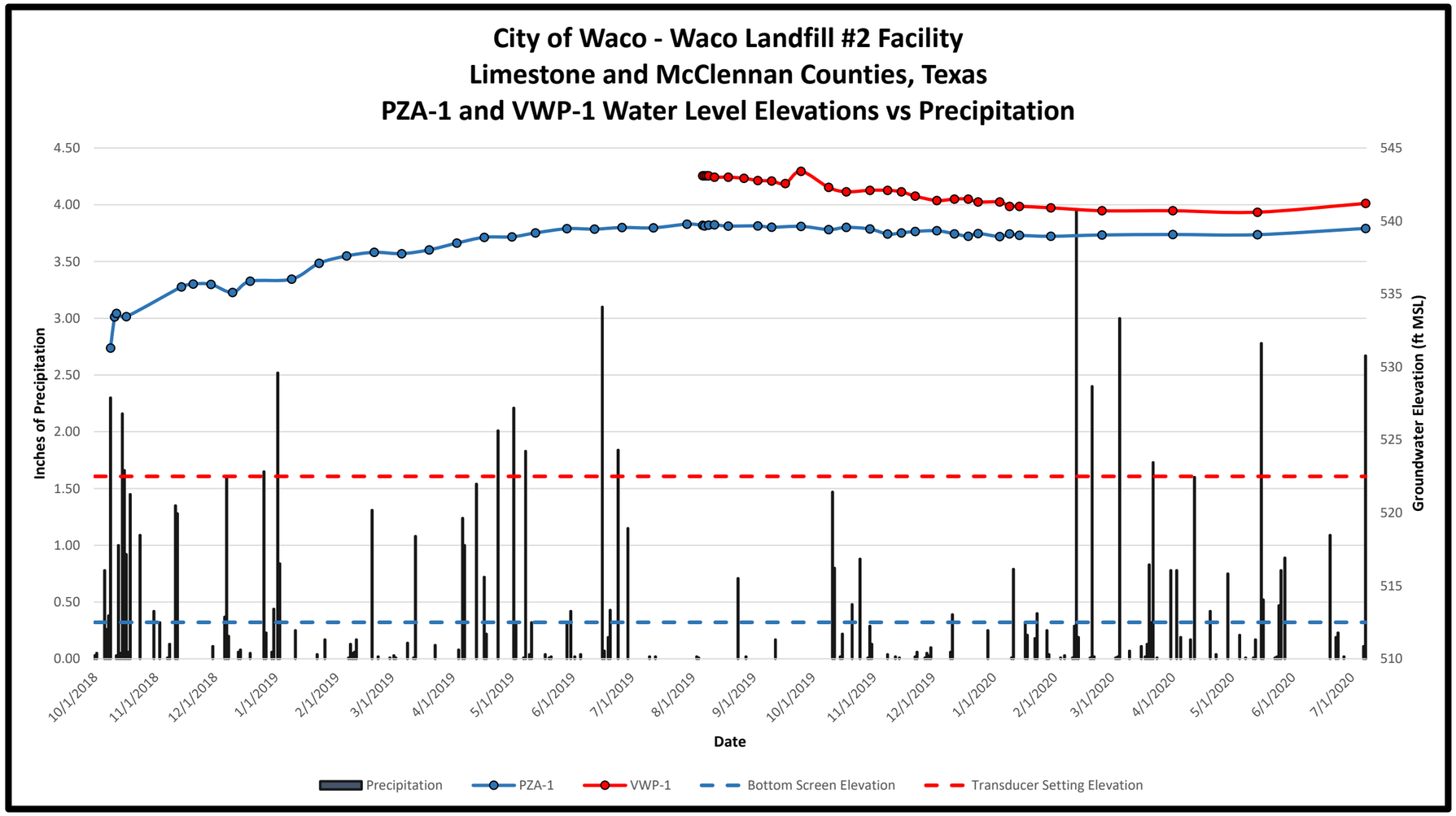
GEOTECHNICAL INVESTIGATION REPORTS

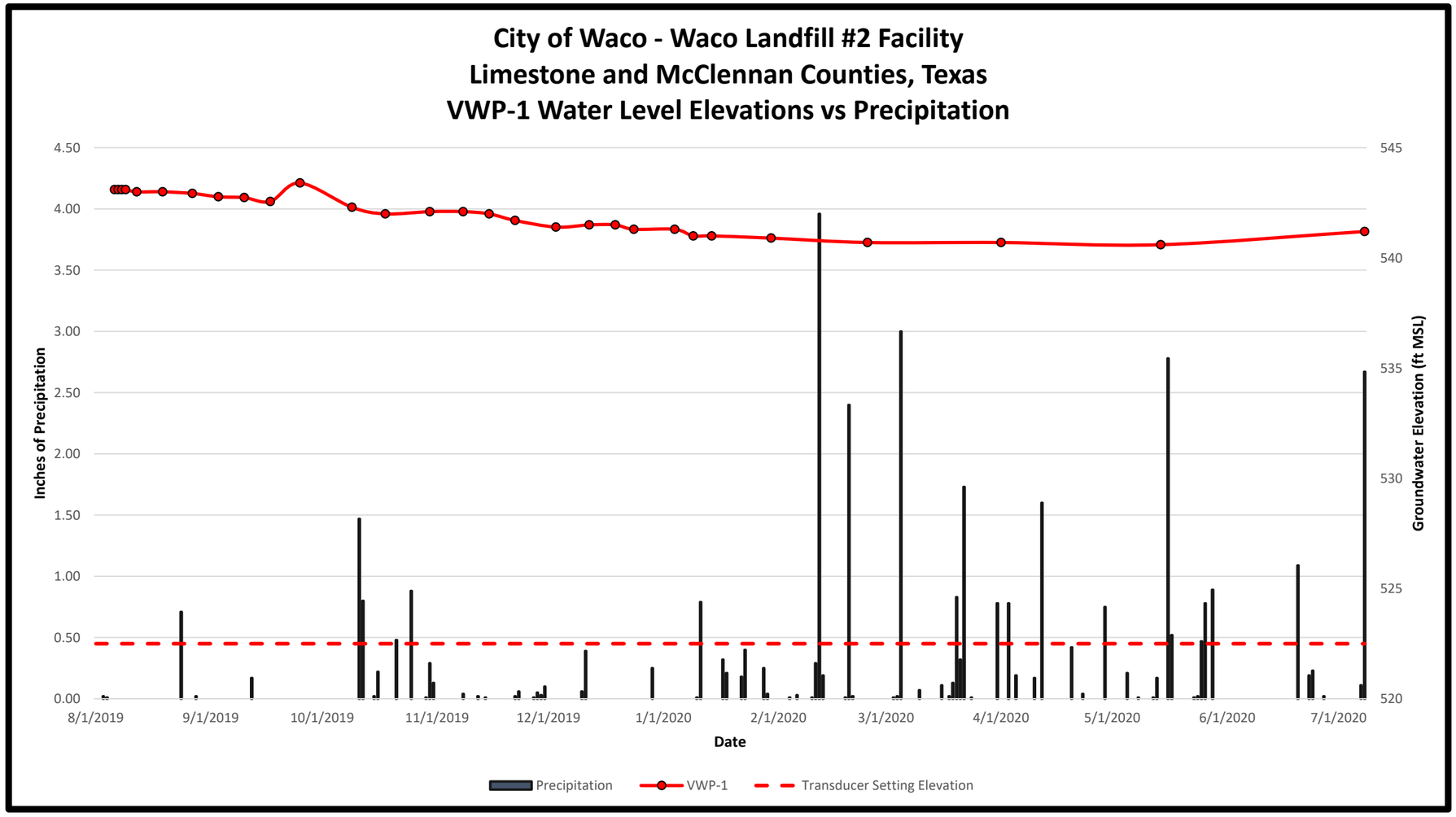


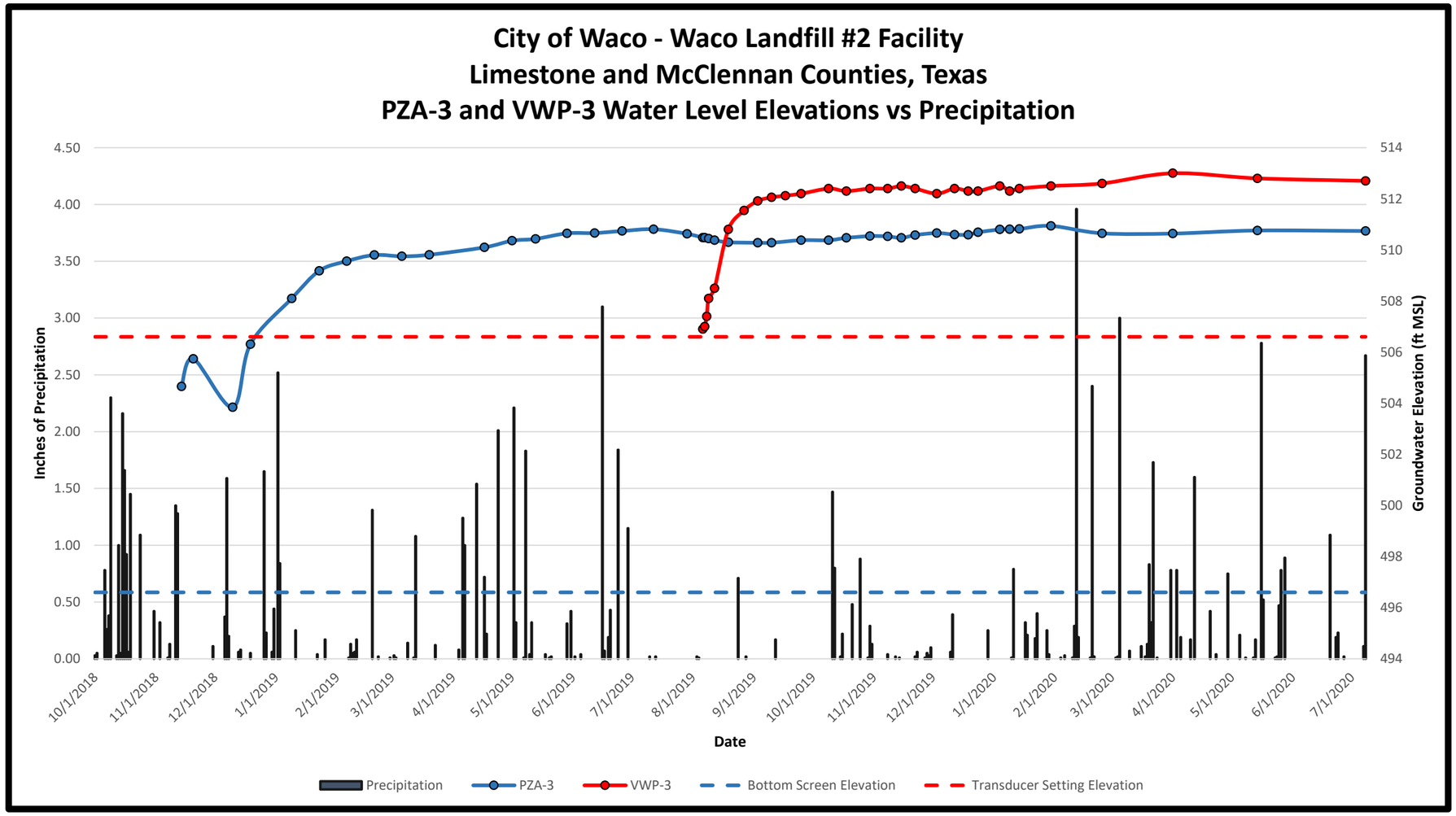
APPENDIX III-4.J

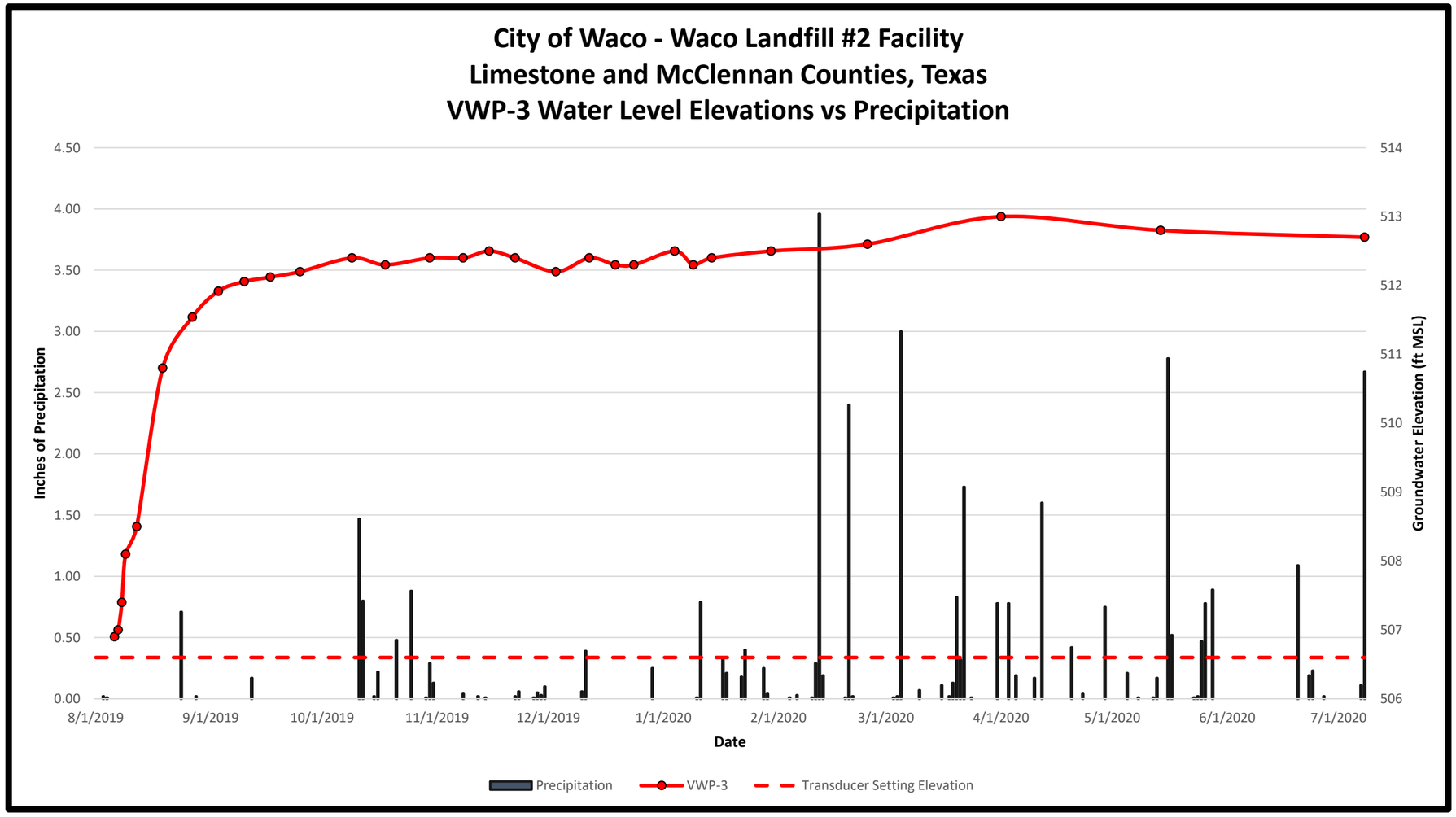
PRECIPITATION AND GROUNDWATER ELEVATION DATA




City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
PZA-1 and VWP-1 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
545
540
535
530
525
520
515
510
10/1/2018
11/1/2018
12/1/2018
1/1/2019
2/1/2019
3/1/2019
4/1/2019
5/1/2019
6/1/2019
7/1/2019
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
3/1/2020
4/1/2020
5/1/2020
6/1/2020
7/1/2020
Precipitation
PZA-1
VWP-1
Bottom Screen Elevation
Transducer Setting Elevation


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-1 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
545
540
535
530
525
520
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
3/1/2020
4/1/2020
5/1/2020
6/1/2020
7/1/2020
Date
Precipitation
VWP-1
Transducer Setting Elevation


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
PZA-3 and VWP-3 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
514
512
510
508
506
504
502
500
498
496
494
10/1/2018
11/1/2018
12/1/2018
1/1/2019
2/1/2019
3/1/2019
4/1/2019
5/1/2019
6/1/2019
7/1/2019
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
3/1/2020
4/1/2020
5/1/2020
6/1/2020
7/1/2020
Precipitation
PZA-3
VWP-3
Bottom Screen Elevation
Transducer Setting Elevation


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-3 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
514
513
512
511
510
509
508
507
506
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
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4/1/2020
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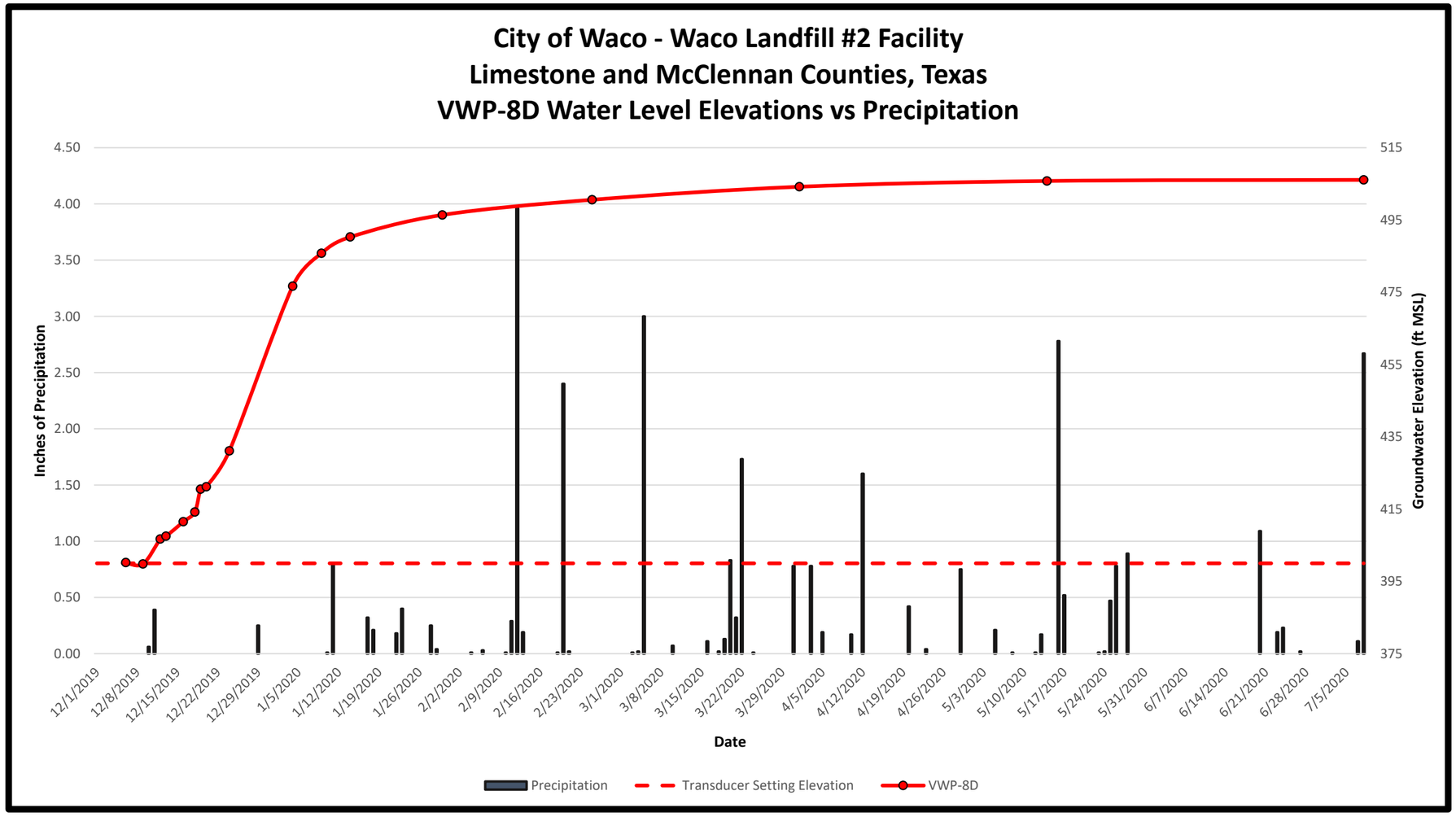
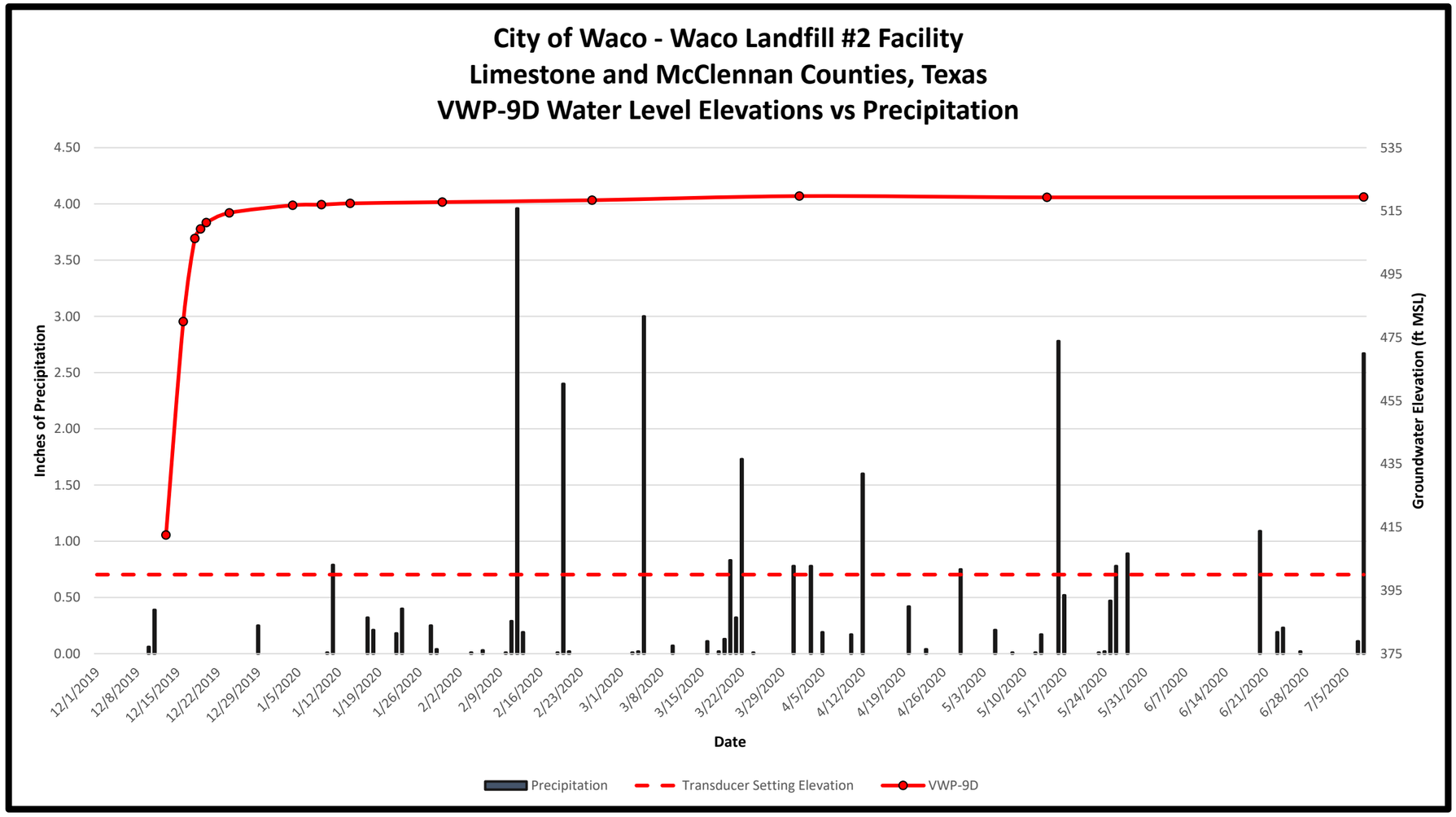
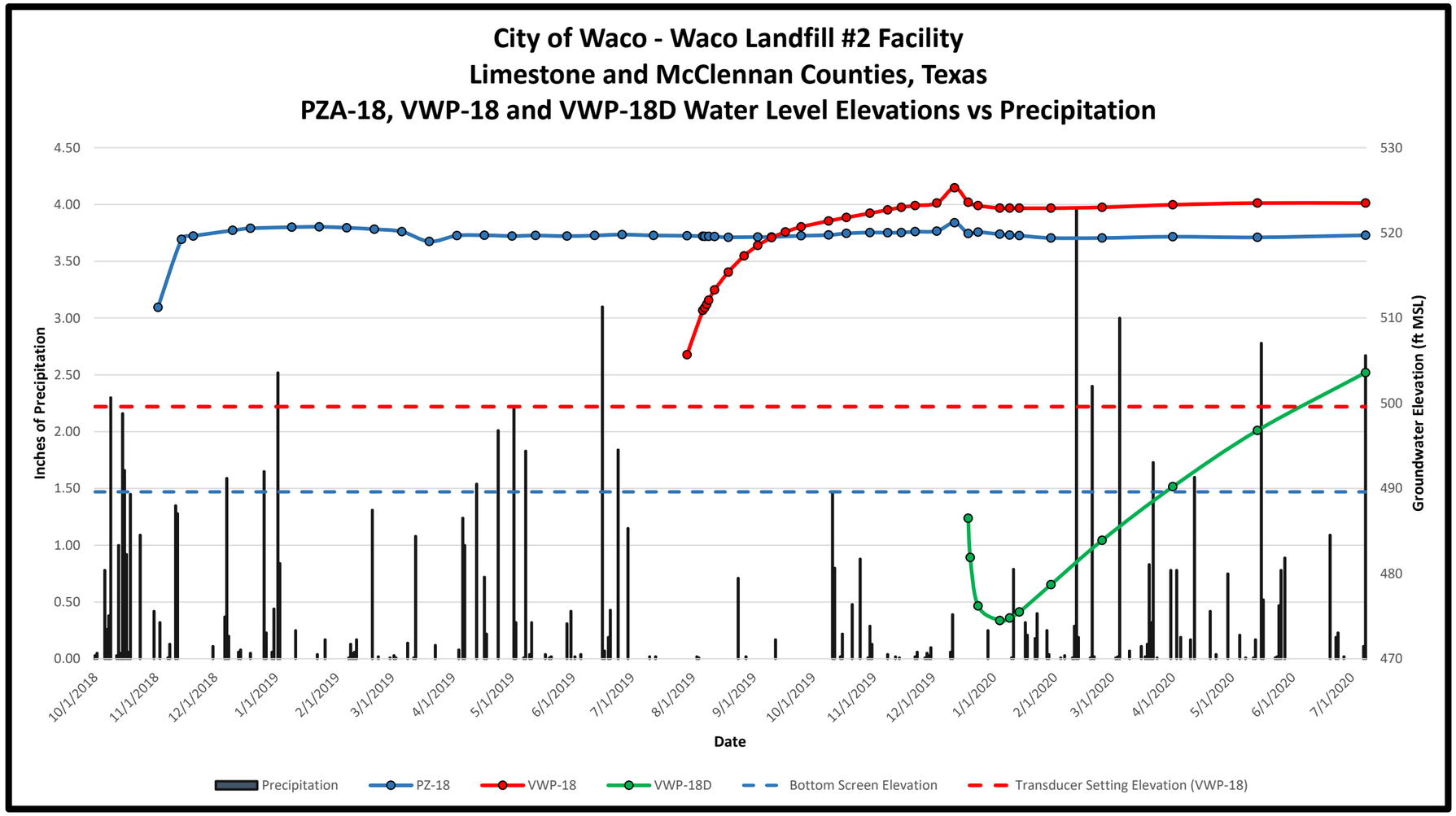
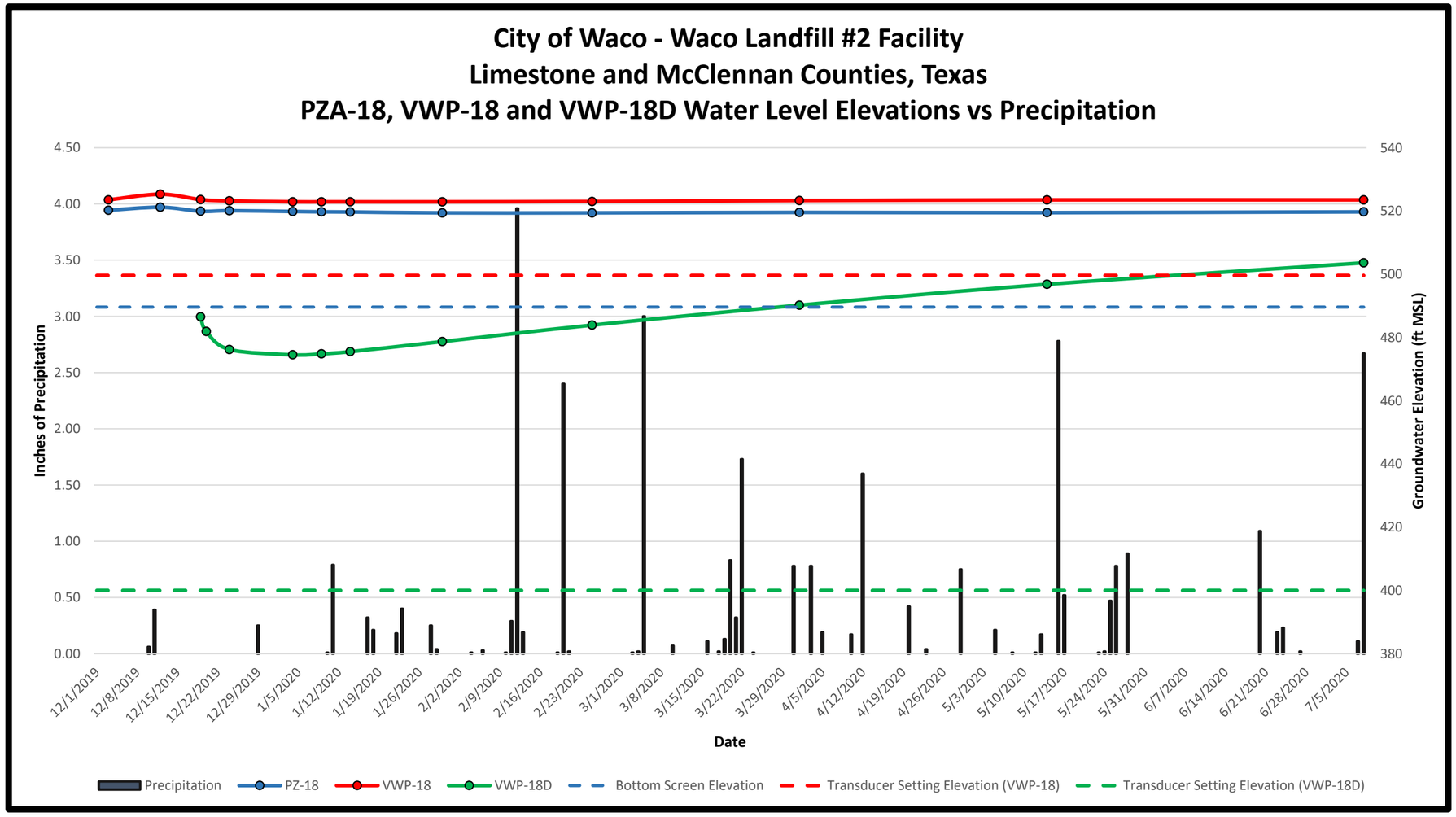
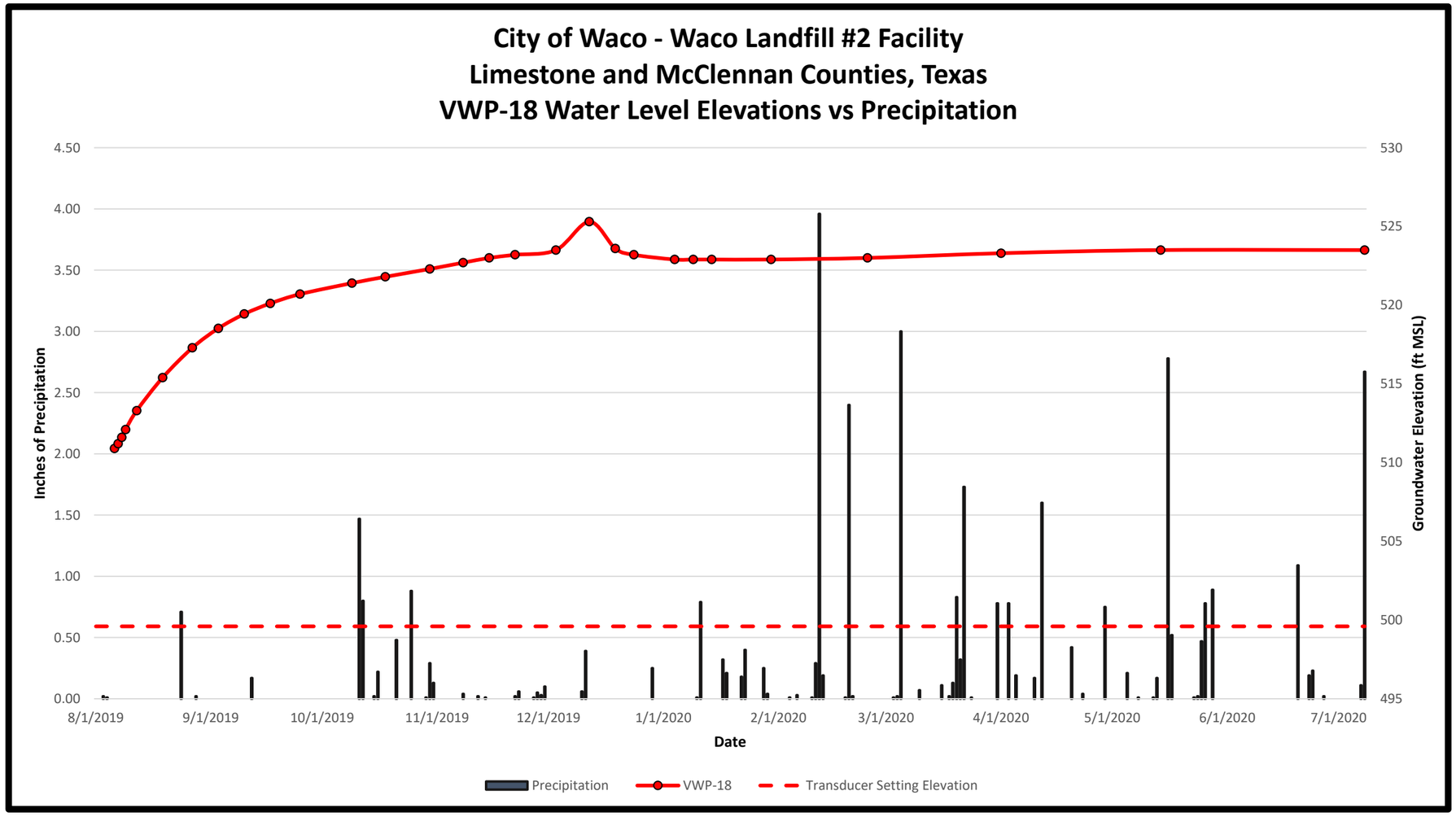
6/1/2020
7/1/2020
Date
Precipitation
VWP-3
Transducer Setting Elevation

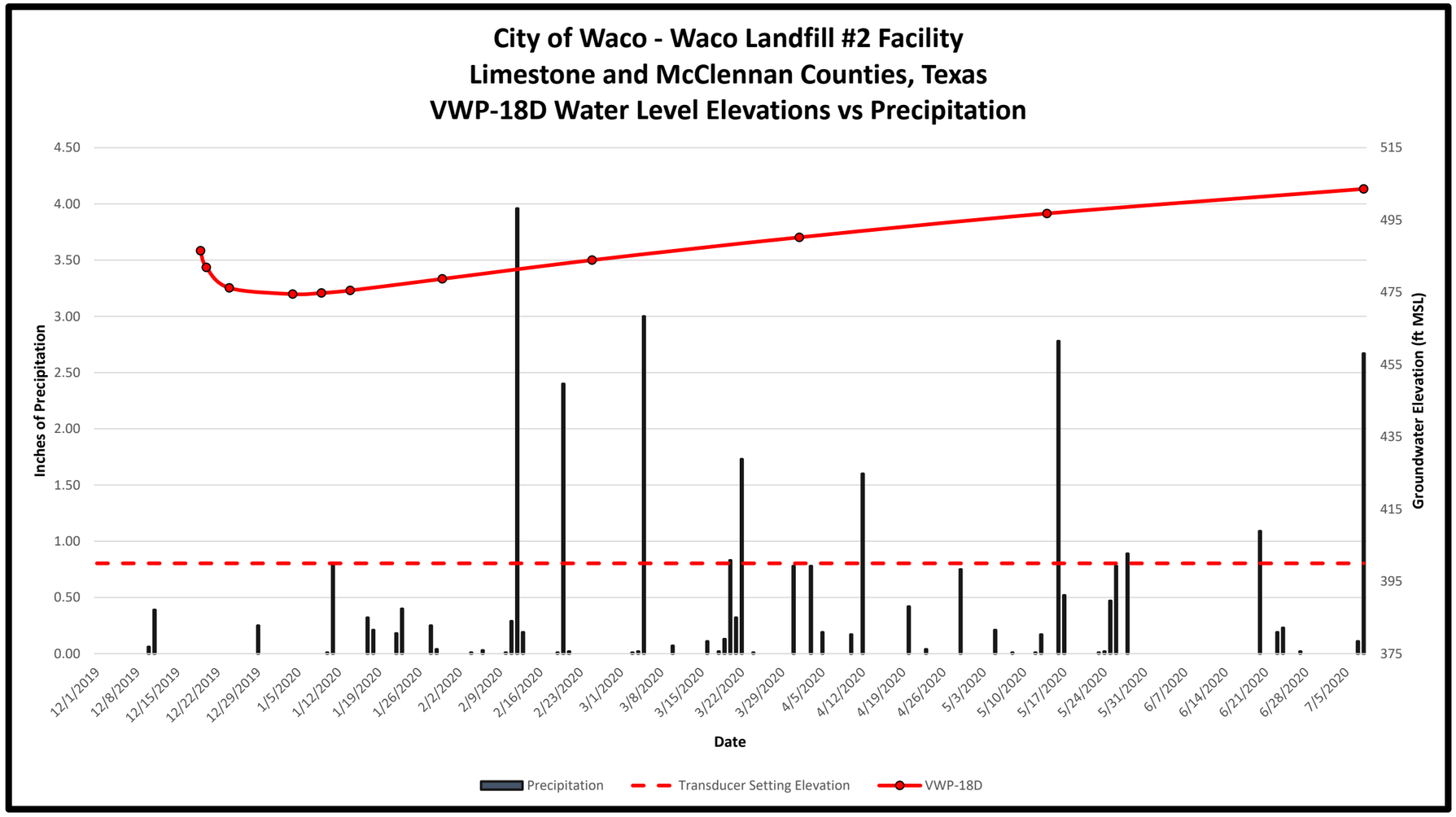

City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-8D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
Precipitation
Transducer Setting Elevation
VWP-8D

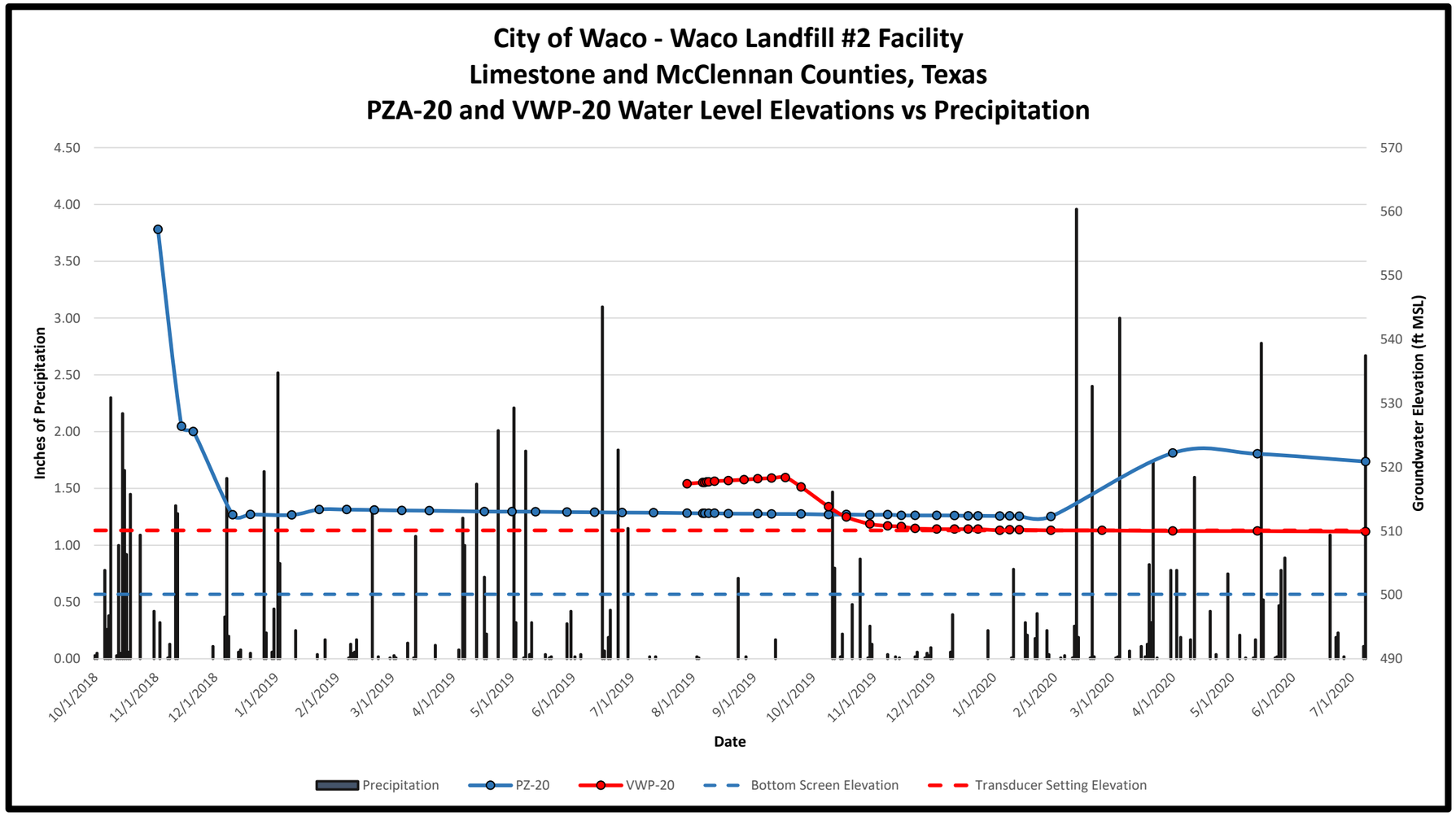

City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-9D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
Precipitation
Transducer Setting Elevation
VWP-9D

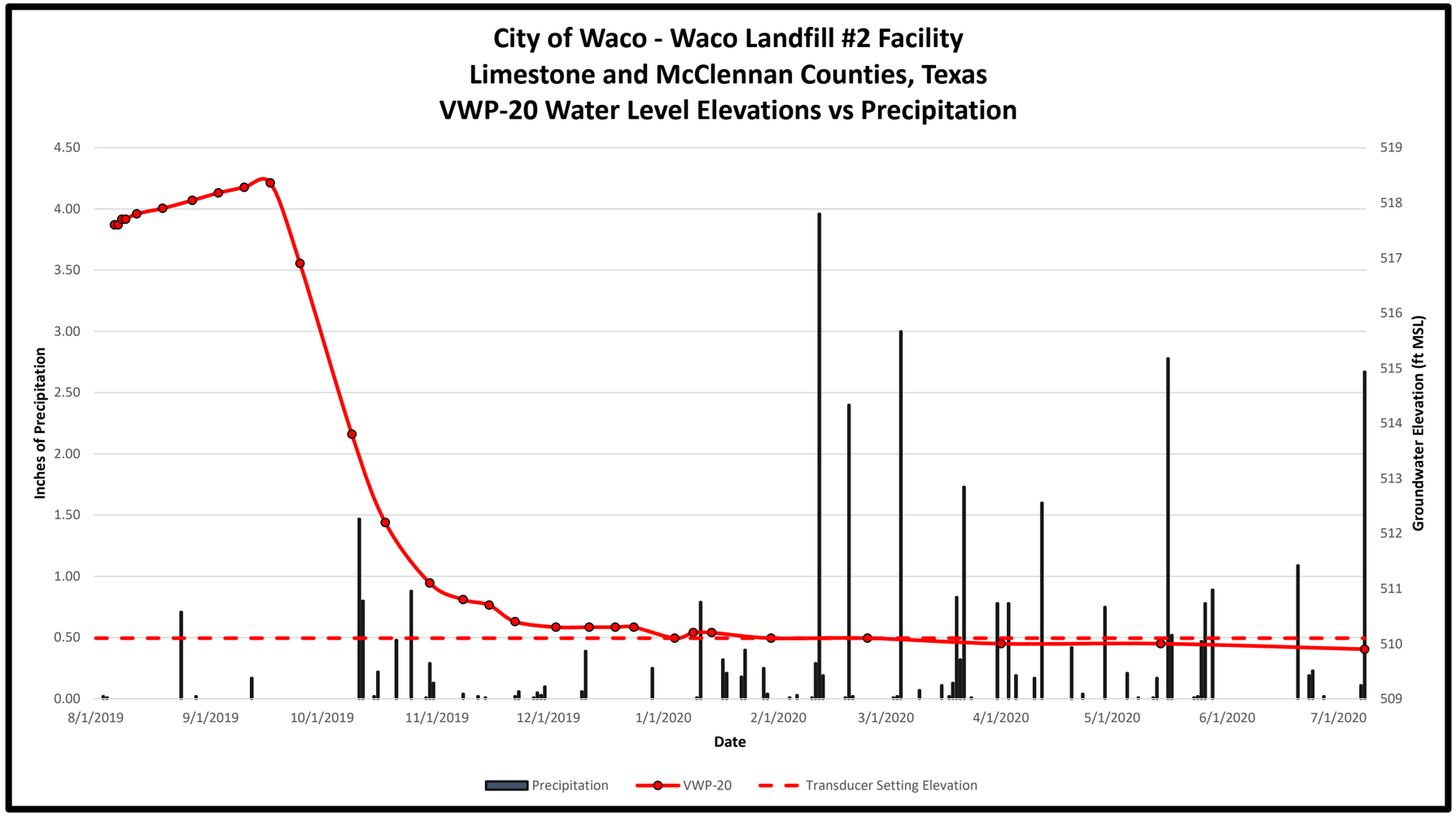

City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
PZA-18, VWP-18 and VWP-18D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
530
520
510
500
490
480
470
10/1/2018
11/1/2018
12/1/2018
1/1/2019
2/1/2019
3/1/2019
4/1/2019
5/1/2019
6/1/2019
7/1/2019
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
3/1/2020
4/1/2020
5/1/2020
6/1/2020
7/1/2020
Precipitation
PZ-18
VWP-18
VWP-18D
Bottom Screen Elevation
Transducer Setting Elevation (VWP-18)

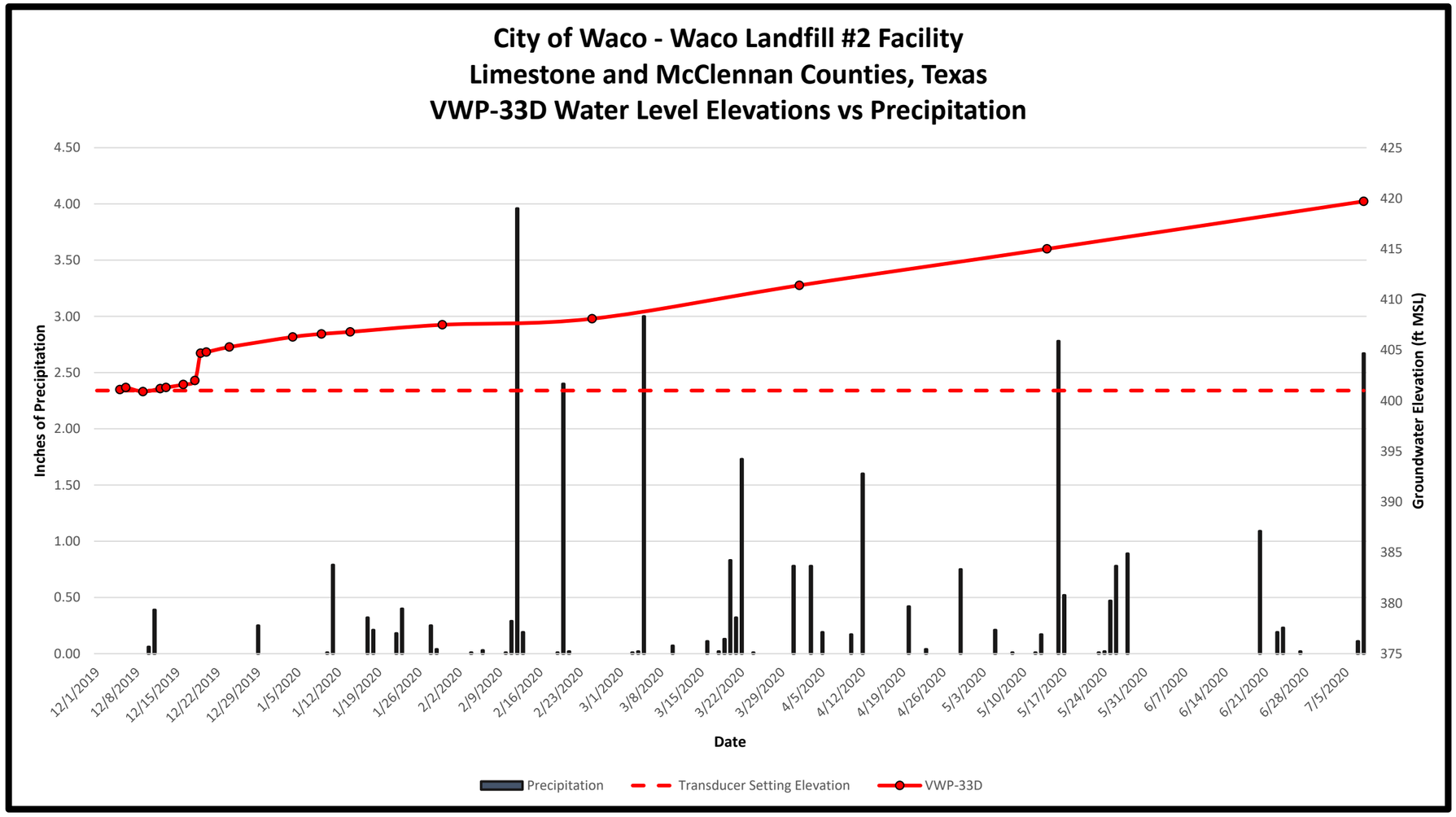

City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
PZA-18, VWP-18 and VWP-18D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
Precipitation
PZ-18
VWP-18
VWP-18D
Bottom Screen Elevation
Transducer Setting Elevation (VWP-18)
Transducer Setting Elevation (VWP-18D)

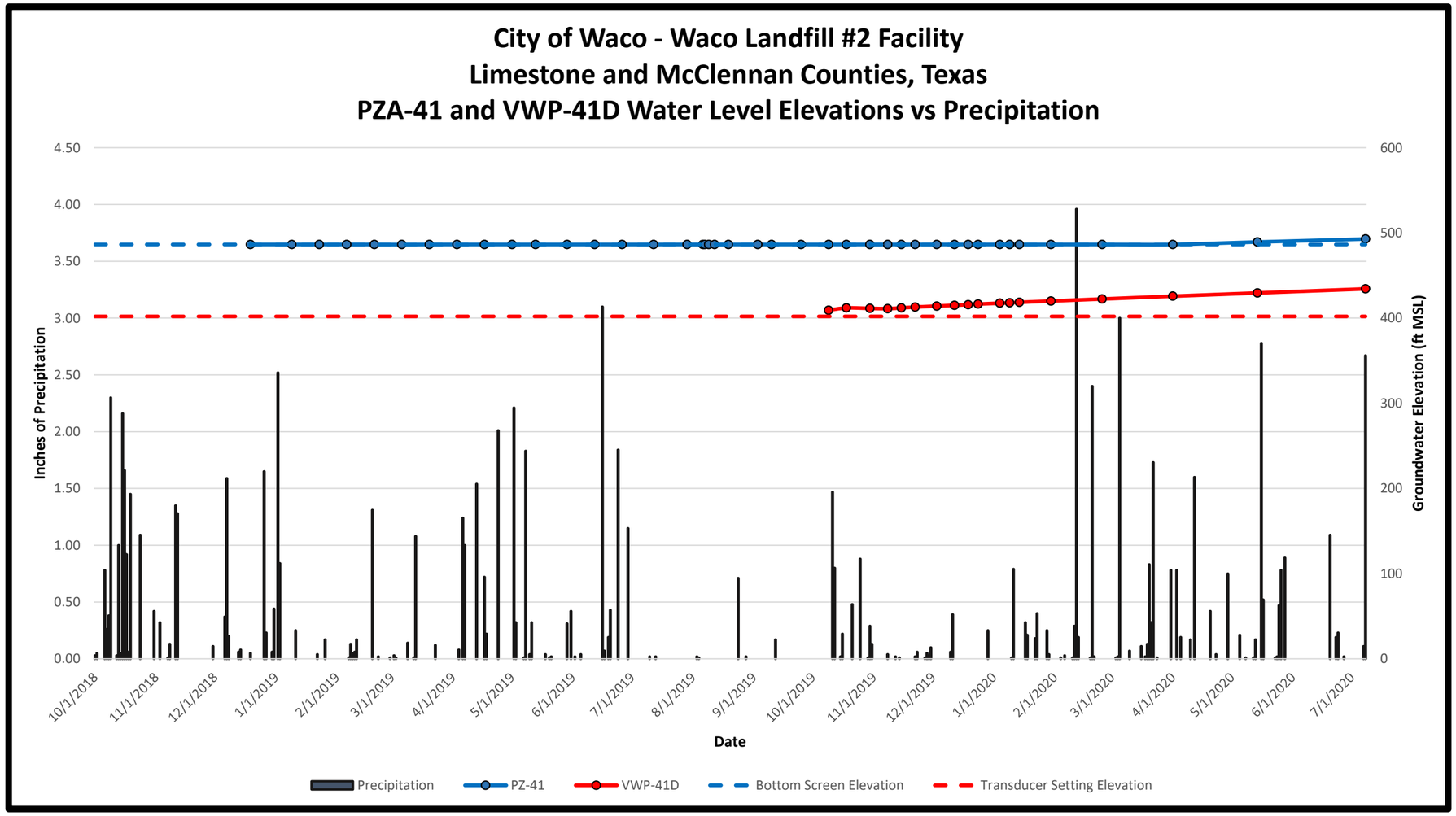

City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-18 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
530
525
520
515
510
505
500
495
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
3/1/2020
4/1/2020
5/1/2020
6/1/2020
7/1/2020
Date
Precipitation
VWP-18
Transducer Setting Elevation

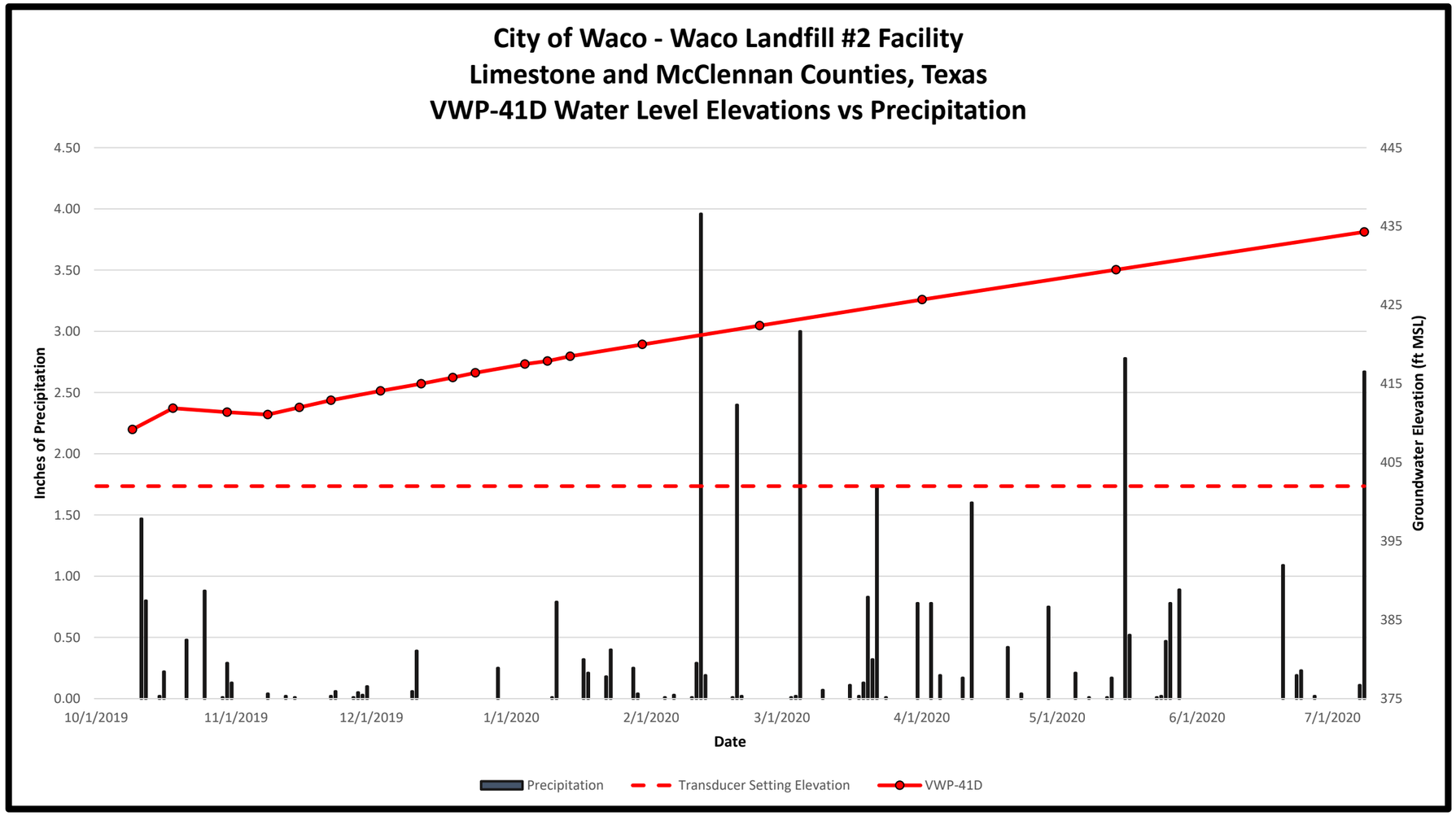

City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-18D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
515
495
475
455
435
415
395
375
12/1/2019
12/8/2019
12/15/2019
12/22/2019
12/29/2019
1/5/2020
1/12/2020
1/19/2020
1/26/2020
2/2/2020
2/9/2020
2/16/2020
2/23/2020
3/1/2020
3/8/2020
3/15/2020
3/22/2020
3/29/2020
4/5/2020
4/12/2020
4/19/2020
4/26/2020
5/3/2020
5/10/2020
5/17/2020
5/24/2020
5/31/2020
6/7/2020
6/14/2020
6/21/2020
6/28/2020
7/5/2020
Date
Precipitation
Transducer Setting Elevation
VWP-18D

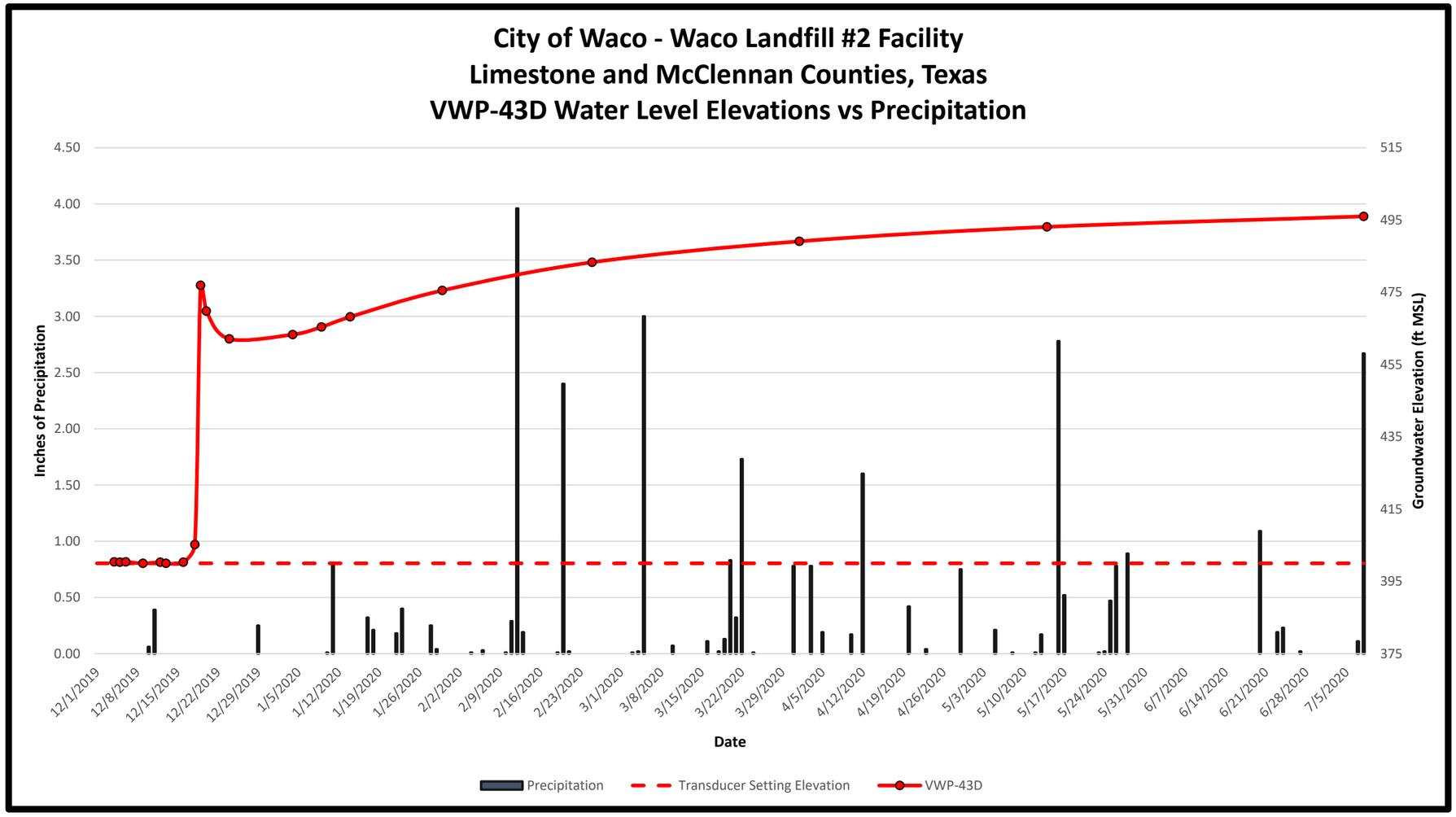

City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
PZA-20 and VWP-20 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
570
560
550
540
530
520
510
500
490
10/1/2018
11/1/2018
12/1/2018
1/1/2019
2/1/2019
3/1/2019
4/1/2019
5/1/2019
6/1/2019
7/1/2019
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
3/1/2020
4/1/2020
5/1/2020
6/1/2020
7/1/2020
Precipitation
PZ-20
VWP-20
Bottom Screen Elevation
Transducer Setting Elevation

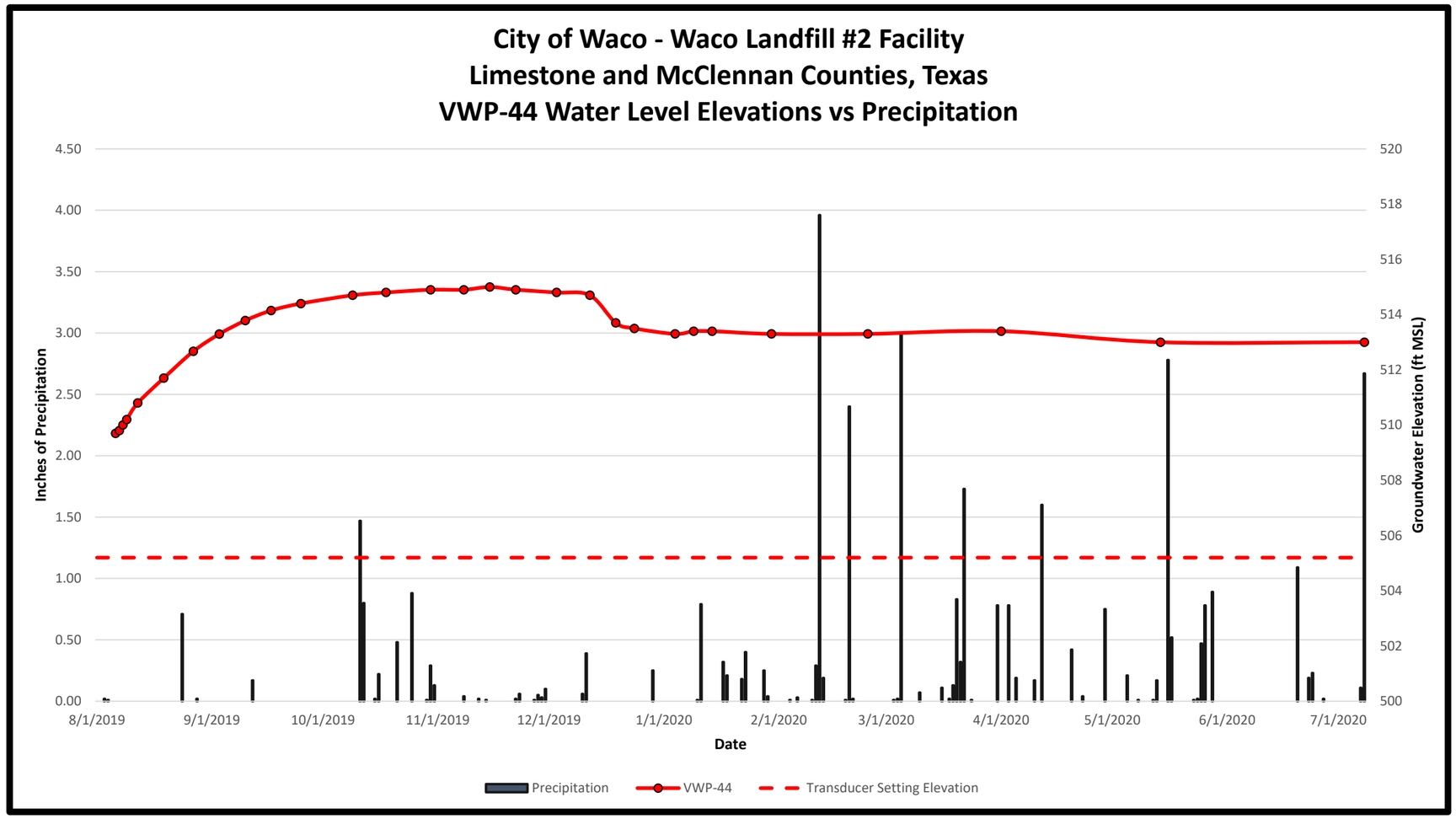

City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-20 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
519
518
517
516
515
514
513
512
511
510
509
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
3/1/2020
4/1/2020
5/1/2020
6/1/2020
7/1/2020
Date
Precipitation
VWP-20
Transducer Setting Elevation

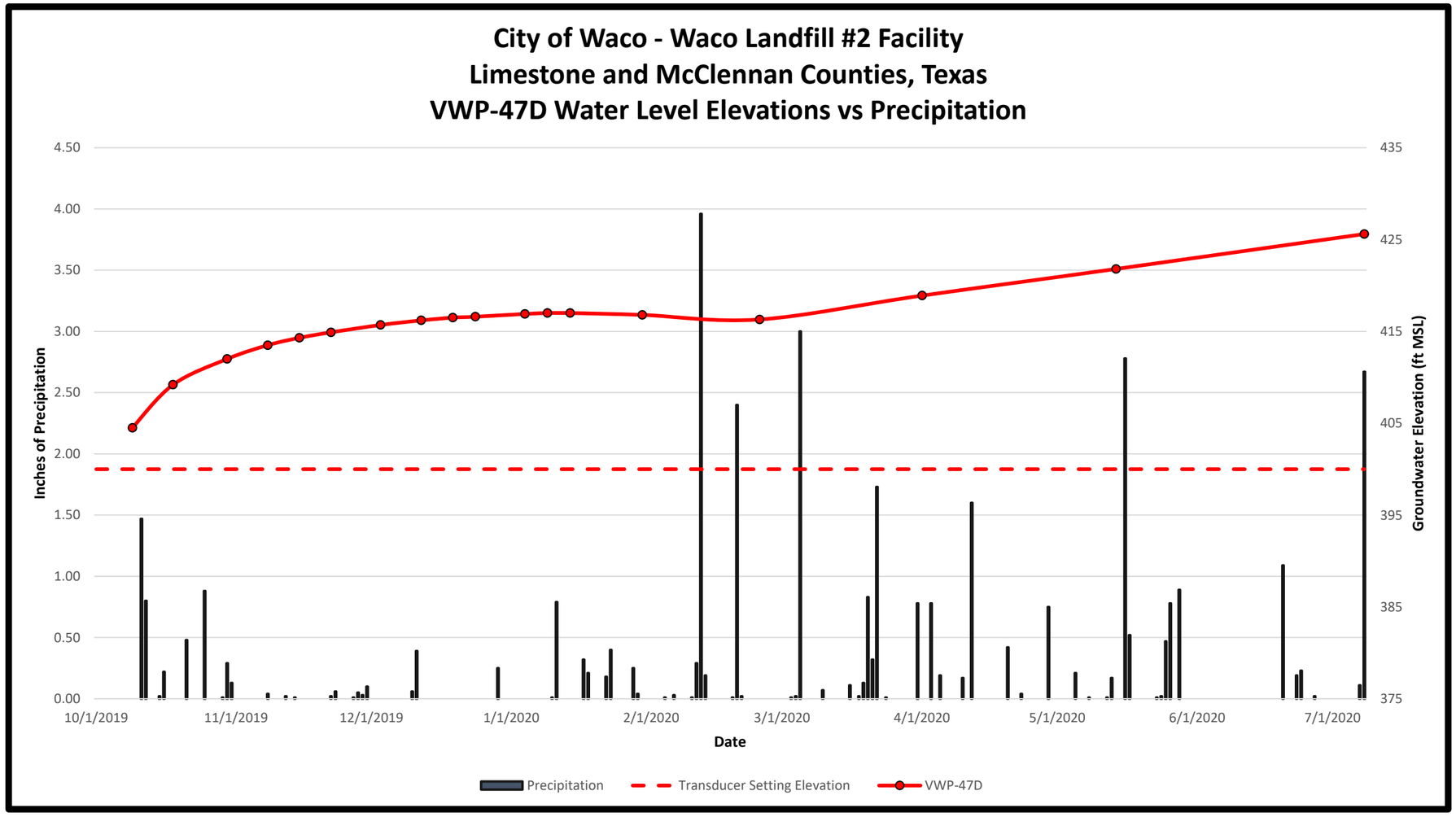

City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-33D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
Precipitation
Transducer Setting Elevation
VWP-33D


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
PZA-41 and VWP-41D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
600
500
400
300
200
100
0
10/1/2018
11/1/2018
12/1/2018
1/1/2019
2/1/2019
3/1/2019
4/1/2019
5/1/2019
6/1/2019
7/1/2019
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
3/1/2020
4/1/2020
5/1/2020
6/1/2020
7/1/2020
Precipitation
PZ-41
VWP-41D
Bottom Screen Elevation
Transducer Setting Elevation


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-41D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
445
435
425
415
405
395
385
375
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
3/1/2020
4/1/2020
5/1/2020
6/1/2020
7/1/2020
Date
Precipitation
Transducer Setting Elevation
VWP-41D

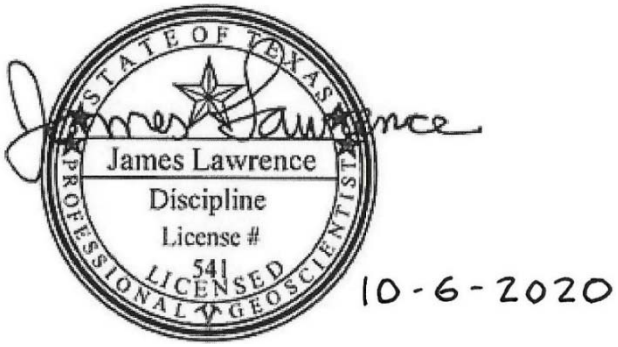

City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-43D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
Date
Precipitation
Transducer Setting Elevation
VWP-43D


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-44 Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
520
518
516
514
512
510
508
506
504
502
500
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
3/1/2020
4/1/2020
5/1/2020
6/1/2020
7/1/2020
Date
Precipitation
VWP-44
Transducer Setting Elevation


City of Waco - Waco Landfill #2 Facility
Limestone and McClennan Counties, Texas
VWP-47D Water Level Elevations vs Precipitation
Inches of Precipitation
Groundwater Elevation (ft MSL)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
435
425
415
405
395
385
375
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
3/1/2020
4/1/2020
5/1/2020
6/1/2020
7/1/2020
Date
Precipitation
Transducer Setting Elevation
VWP-47D

APPENDIX III-4.K

STANDPIPE PIEZOMETER HISTORIC WATER LEVEL DATA



Appendix III-4.K: Standpipe Piezometer Historic Water Level Data

Depth to water (ft, TOC)

Well I.D.	1/23/2019	2/6/2019	2/20/2019	3/6/2019	3/20/2019	4/3/2019	4/17/2019	5/1/2019	5/13/2019	5/29/2019	6/12/2019	6/26/2019	7/12/2019	7/29/2019	8/6/2019	8/7/2019	8/9/2019	8/12/2019	8/19/2019	9/3/2019	9/10/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019	12/3/2019	12/12/2019	12/19/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020	4/1/2020	5/14/2020	7/8/2020
PZ-1	18.02	17.52	17.27	17.36	17.10	16.64	16.24	16.21	15.94	15.65	15.68	15.57	15.59	15.34	15.42	15.46	15.41	15.38	15.47	15.46	15.55	15.49	15.71	15.56	15.67	16.02	15.94	15.84	15.79	16	16.17	15.98	16.19	16	16.1	16.17	16.08	16.05	16.06	15.63
PZ-3	35.03	34.65	34.41	34.46	34.40	n/a	34.11	33.85	33.78	33.56	33.55	33.47	33.40	33.58	33.73	33.73	33.77	33.83	33.91	33.93	33.93	33.83	33.83	33.74	33.67	33.68	33.74	33.63	13.55	33.61	33.62	33.52	33.41	33.4	33.39	33.27	33.56	33.57	33.45	33.47
PZ-8	DRY	77.17	77.19	77.56	77.57	DRY	DRY	77.53	77.54	DRY	77.55	77.54	77.57	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	77.55	77.58	77.56	77.57	77.58	77.57	77.56	77.57	77.57	DRY	DRY	DRY	DRY	DRY	DRY
PZ-9	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-18	17.09	17.20	17.37	17.65	18.81	18.12	18.08	18.17	18.11	18.18	18.11	18.00	18.10	18.14	18.20	18.21	18.21	18.23	18.32	18.28	18.28	18.14	18.05	17.86	17.76	17.78	17.76	17.66	17.59	16.61	17.88	17.71	17.96	18.07	18.12	18.4	18.4	18.25	18.33	18.08
PZ-20	54.40	54.41	54.48	54.55	54.59	n/a	54.72	54.73	54.75	54.80	54.84	54.88	54.90	54.97	55.00	55.01	54.99	54.97	55.05	55.06	55.10	55.11	55.19	55.18	55.25	55.21	55.32	55.33	55.33	55.34	55.4	55.39	55.42	55.41	55.44	55.5	N/A	45.55	45.69	46.9
PZ-33	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-41	DRY	DRY	51.64	51.75	DRY	DRY	51.63	51.64	51.64	51.65	51.63	51.65	51.64	DRY	DRY	DRY	DRY	DRY	DRY	51.63	51.63	DRY	DRY	DRY	DRY	51.63	DRY	51.64	51.65	51.63	51.64	51.64	51.62	51.63	DRY	DRY	DRY	DRY	48.75	45.24
PZ-43	DRY	50.41	50.41	50.44	DRY	DRY	DRY	DRY	50.44	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	50.46	50.46	50.46	50.46	50.45	50.43	50.45	DRY	DRY	DRY	DRY	DRY	DRY
PZ-47	33.50	33.49	33.44	33.89	DRY	DRY	DRY	DRY	33.93	DRY	DRY	33.92	33.90	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY

Water Level Elevation (ft msl, from T.O.C)

Well I.D.	1/23/2019	2/6/2019	2/20/2019	3/6/2019	3/20/2019	4/3/2019	4/17/2019	5/1/2019	5/13/2019	5/29/2019	6/12/2019	6/26/2019	7/12/2019	7/29/2019	8/6/2019	8/7/2019	8/9/2019	8/12/2019	8/19/2019	9/3/2019	9/10/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019	12/3/2019	12/12/2019	12/19/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020	4/1/2020	5/14/2020	7/8/2020
PZ-1	537.10	537.60	537.85	537.76	538.02	538.48	538.88	538.91	539.18	539.47	539.44	539.55	539.53	539.78	539.70	539.66	539.71	539.74	539.65	539.66	539.57	539.63	539.41	539.56	539.45	539.1	539.18	539.28	539.33	539.12	538.95	539.14	538.93	539.12	539.02	538.95	539.04	539.07	539.06	539.49
PZ-3	509.18	509.56	509.80	509.75	509.81	n/a	510.10	510.36	510.43	510.65	510.66	510.74	510.81	510.63	510.48	510.48	510.44	510.38	510.30	510.28	510.28	510.38	510.38	510.47	510.54	510.53	510.47	510.58	510.66	510.60	510.59	510.69	510.80	510.81	510.82	510.94	510.65	510.64	510.76	510.74
PZ-8	DRY	476.22	476.20	475.83	475.82	DRY	DRY	475.86	475.85	DRY	475.84	475.85	475.82	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	475.84	475.81	475.83	475.82	475.81	475.82	475.83	475.82	475.82	475.82	DRY	DRY	DRY	DRY	DRY
PZ-9	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-18	520.71	520.60	520.43	520.15	518.99	519.68	519.72	519.63	519.69	519.62	519.69	519.80	519.70	519.66	519.60	519.59	519.59	519.57	519.48	519.52	519.52	519.66	519.75	519.94	520.04	520.02	520.04	520.14	520.21	521.19	519.92	520.09	519.84	519.73	519.68	519.4	519.4	519.55	519.47	519.72
PZ-20	513.37	513.36	513.29	513.22	513.18	n/a	513.05	513.04	513.02	512.97	512.93	512.89	512.87	512.80	512.77	512.76	512.78	512.80	512.72	512.71	512.67	512.66	512.58	512.59	512.52	512.56	512.45	512.44	512.44	512.43	512.37	512.38	512.35	512.36	512.33	512.27	N/A	522.22	522.08	520.87
PZ-33	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-41	DRY	DRY	486.40	486.29	DRY	DRY	486.41	486.40	486.40	486.39	486.41	486.39	486.40	DRY	DRY	DRY	DRY	DRY	DRY	486.41	486.41	DRY	DRY	DRY	DRY	486.41	DRY	486.4	486.39	486.41	486.4	486.4	486.42	486.41	DRY	DRY	DRY	DRY	489.29	492.8
PZ-43	DRY	500.90	500.90	500.87	DRY	DRY	DRY	DRY	500.87	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	500.85	500.85	500.85	500.85	500.86	500.88	500.86	DRY	DRY	DRY	DRY	DRY	DRY
PZ-47	502.66	502.67	502.72	502.27	DRY	DRY	DRY	DRY	502.23	DRY	DRY	502.24	502.26	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY

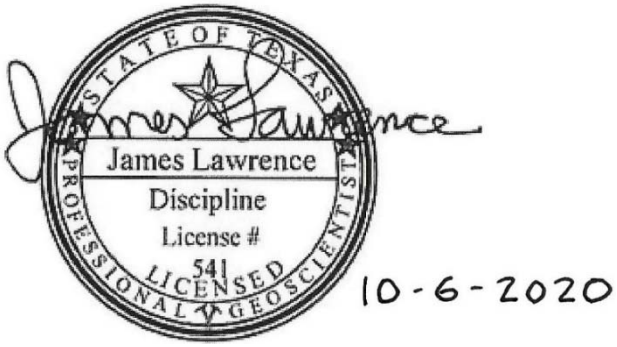
Height of Water Column (ft)

Well I.D.	1/23/2019	2/6/2019	2/20/2019	3/6/2019	3/20/2019	4/3/2019	4/17/2019	5/1/2019	5/13/2019	5/29/2019	6/12/2019	6/26/2019	7/12/2019	7/29/2019	8/6/2019	8/7/2019	8/9/2019	8/12/2019	8/19/2019	9/3/2019	9/10/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019	12/3/2019	12/12/2019	12/19/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020	4/1/2020	5/14/2020	7/8/2020
PZ-1	24.92	25.42	25.67	25.58	25.84	26.30	26.70	26.73	27.00	27.29	27.26	27.37	27.35	27.60	27.52	27.48	27.53	27.56	27.47	27.48	27.39	27.45	27.23	27.38	27.27	26.92	27	27.1	27.15	26.94	26.77	26.96	26.75	26.94	26.84	26.77	26.86	26.89	26.88	27.31
PZ-3	12.97	13.35	13.59	13.54	13.60	N/A	13.89	14.15	14.22	14.44	14.45	14.53	14.60	14.42	14.27	14.27	14.23	14.17	14.09	14.07	14.07	14.17	14.17	14.26	14.33	14.32	14.26	14.37	34.45	14.39	14.38	14.48	14.59	14.6	14.61	14.73	14.44	14.43	14.55	14.53
PZ-8	DRY	0.59	0.57	0.20	0.19	DRY	DRY	0.23	0.22	DRY	0.21	0.22	0.19	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	0.21	0.18	0.2	0.19	0.18	0.19	0.2	0.19	0.19	DRY	DRY	DRY	DRY	DRY	DRY
PZ-9	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-18	31.72	31.61	31.44	31.16	30.00	30.69	30.73	30.64	30.70	30.63	30.70	30.81	30.71	30.67	30.61	30.60	30.60	30.58	30.49	30.53	30.53	30.67	30.76	30.95	31.05	31.03	31.05	31.15	31.22	32.23	30.93	31.1	30.85	30.74	30.69	30.41	30.41	30.56	30.48	30.73
PZ-20	12.64	12.63	12.56	12.49	12.45	DRY	12.32	12.31	12.29	12.24	12.20	12.16	12.14	12.07	12.04	12.03	12.05	12.07	11.99	11.98	11.94	11.93	11.85	11.86	11.79	11.83	11.72	11.71	11.71	11.7	11.64	11.65	11.62	11.63	11.6	11.54	N/A	21.49	21.35	20.14
PZ-33	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
PZ-41	DRY	DRY	0.16	0.05	DRY	DRY	0.17	0.16	0.16	0.15	0.17	0.15	0.16	DRY	DRY	DRY	DRY	DRY	DRY	0.17	0.17	DRY	DRY	DRY	DRY	0.17	DRY	0.16	0.15	0.17	0.16	0.16	0.18	0.17	DRY	DRY	DRY	DRY	3.05	6.56
PZ-43	DRY	0.16	0.16	0.13	DRY	DRY	DRY	DRY	0.13	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	0.11	0.11	0.11	0.11	0.12	0.14	0.12	DRY	DRY	DRY	DRY	DRY	DRY
PZ-47	0.47	0.48	0.53	0.08	DRY	DRY	DRY	DRY	0.04	DRY	DRY	0.05	0.07	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY

Well I.D.	Latitude	Longitude	Ground Surface Elevation (ft msl)	Concrete Slab Elevation (ft msl)	Top of PVC Pipe (ft msl)	Top of Steel Casing Elevation (ft msl)	Total Well Depth (ft below TOC)
PZ-1	31° 42' 16.86706" N	96° 55' 59.13570" W	551.74	552.12	555.12	555.49	42.94
PZ-3	31° 41' 54.27334" N	96° 55' 43.84234" W	541.20	541.58	544.21	545.05	48.00
PZ-8	31° 42' 11.59335" N	96° 55' 12.20821" W	550.34	550.89	553.39	553.74	77.76
PZ-9	31° 42' 10.45884" N	96° 55' 37.43147" W	535.30	535.58	539.44	539.94	37.45
PZ-18	31° 42' 28.96389" N	96° 55' 26.98650" W	534.84	535.23	537.80	538.26	48.81
PZ-20	31° 42' 34.92848" N	96° 55' 14.44772" W	564.68	565.05	567.77	568.35	67.04
PZ-33	31° 42' 00.00182" N	96° 55' 14.53975" W	539.20	539.57	542.49	542.89	57.59
PZ-41	31° 42' 10.66572" N	96° 54' 59.07613" W	534.62	535.03	538.04	538.39	51.80
PZ-43	31° 42' 20.55019" N	96° 55' 01.03302" W	548.86	549.20	551.31	552.07	50.57
PZ-47	31° 42' 04.14903" N	96° 55' 28.39274" W	532.48	532.89	536.16	536.59	33.97

APPENDIX III-4.L

VIBRATING WIRE PIEZOMETER HISTORIC WATER LEVEL DATA



Appendix III-4.L: Vibrating Wire Piezometer Historic Water Level Data

Reading (Dg)

VWP ID	7/29/2019	8/6/2019	8/7/2019	8/8/2019	8/9/2019	8/12/2019	8/19/2019	8/27/2019	9/3/2019	9/10/2019	9/17/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019	12/3/2019	12/4/2019	12/5/2019	12/6/2019	12/9/2019	12/12/2019	12/13/2019	12/16/2019	12/18/2019	12/19/2019	12/20/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020	4/1/2020	5/14/2020	7/8/2020
VWP-1	——	7948.2	7948.7	7949.2	7950.2	7952.6	7952.7	7954.5	7959.1	7960.2	7965.5	7941.4	7973.3	7981.3	7980.2	7978.7	7982.5	7990.5	7999.3	——	——	——	——	7998.3	——	——	——	7996.6	——	8004.3	8003.8	8011.9	8011.7	8016.0	8020.7	8022.2	8025.5	8007.9
VWP-3	——	8684.3	8682.5	8673.1	8652.7	8642.8	8583.1	8562.5	8552.5	8548.8	8547.2	8545.2	8539.6	8541.9	8539.0	8540.1	8538.3	8540.4	8543.8	——	——	——	——	8538.7	——	——	——	8541.3	——	8542.3	8537.1	8541.3	8539.9	8537.6	8535.5	8524.6	8528.2	8532.7
VWP-4	——	8716.0	8717.2	8717.8	8718.8	8720.7	8717.0	8718.1	8717.5	8715.1	8718.6	8720.3	8713.6	8723	8716.2	8708.5	8708.8	8717	8717.5	——	——	——	——	8714.4	——	——	——	8708	——	8714.9	8709.9	8719.1	8716.7	8716.7	8719.3	8718.6	8725.5	8723.1
VWP-8	——	8690.2	8691.1	8691.3	8692.6	8694.8	8689.9	8691.3	8690.0	8687.3	8690.7	8693.3	8686.8	8696.6	8688.4	8681.2	8681.9	8689.2	8690.4	——	——	——	——	8687.6	——	——	——	8681.4	——	8689.1	8682.5	8693.2	8690.1	8689.2	8692.4	8690.8	8697.9	8695.8
VWP-8D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	8929.3	8942.3	8762.4	8739.4	8637	8563.8	8399.3	8380.9	8121.1	6927.9	6688.5	6570.0	6411.4	6299.4	6206.3	6165.2	6155.5
VWP-9	——	8599.6	8600.6	8601.4	8601.7	8603.9	8600.8	8599.5	8600.4	8598.3	8600.9	8603.2	8597.4	8605.5	8599.2	8591.1	8591.9	8600.3	8600.3	——	——	——	——	8592.7	——	——	——	8590.7	——	8598.2	8593.2	8601.1	8599.0	8599.5	8601.5	8600.8	8607.7	8605.3
VWP-9D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	8712.3	6743.6	5978.5	5890.9	5830.6	5739.9	5669.8	5664.2	5654.6	5642.3	5625.6	5586.0	5597.8	5595.9
VWP-18	8599.2	8467.5	8458.0	8449.0	8435.3	8404.8	8351.2	8303.2	8271.7	8248.4	8231.2	8217	8199.5	8187.3	8174.3	8163.9	8157.1	8152.1	8144.3	——	——	——	——	8098.2	——	——	——	8143.3	——	8151.6	8160.2	8160.4	8160.9	8160.2	8157.1	8150.7	8145.8	8144.2
VWP-18D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	6433.5	6572.6	6743.7	6796.6	6784.6	6764.6	6669.5	6514.2	6324.0	6128.6	5925.0
VWP-19	8812.8	8814.8	8815.0	8815.2	8815.5	8815.8	8816.2	8816.9	8815.5	8815.3	8814.8	8815.8	8815.1	8815.6	8815.6	8811.7	8809.9	8813.7	8814	——	——	——	——	8811.1	——	——	——	8809.3	——	8812.2	8812.2	8813.8	8813.7	8814.2	8816.8	8816.1	8821.2	8819.9
VWP-20	8576.4	8570.1	8569.5	8568.8	8568.2	8566.3	8561.8	8558.6	8555.0	8552.3	8550.1	8587.9	8672.3	8715.2	8743.6	8751.9	8754.9	8763.4	8766.3	——	——	——	——	8765.3	——	——	——	8765.9	——	8764.8	8770.7	8767.4	8768.5	8769.5	8769.4	8773.2	8774.1	8776.7
VWP-25	——	8766.4	8767.7	8768.4	8768.5	8770.5	8766.6	8765.5	8766.7	8764.3	8767.4	8769.5	8762.9	8771.3	8765.0	8757.5	8758.2	8765.6	8765.8	——	——	——	——	8758.3	——	——	——	8756.2	——	8763.7	8758.5	8767.6	8764.5	8764.8	8766.6	8766.8	8772.9	8770.2
VWP-26	8645.4	8648.0	8648.4	8648.6	8649.7	8651.7	8647.0	8648.0	8646.8	8644.3	8646.8	8649.4	8643.0	8652.7	8644.4	8637.4	8637.9	8645.1	8646	——	——	——	——	8642.8	——	——	——	8637.1	——	8644.1	8637.8	8647.8	8644.9	8644.6	8647.4	8645.7	8652.7	8651.7
VWP-27	8618.6	8620.8	8621.4	8622.0	8622.6	8624.6	8619.4	8620.7	8619.8	8617.5	8620.5	8622.5	8616.5	8625.7	8618.4	8610.7	8611.2	8619.1	8619.8	——	——	——	——	8617.2	——	——	——	8610.7	——	8617.8	8611.6	8621.4	8618.9	8618.8	8621.4	8620.7	8627.8	8625.7
VWP-30	8779.3	8692.9	8691.1	8690.5	8689.6	8689.8	8689.9	8688.8	8688.6	8686.6	8689.5	8691.2	8684.8	8692.9	8688.4	8679.3	8679.8	8686.8	8687.5	——	——	——	——	8684.6	——	——	——	8679.2	——	8686	8680.8	8689.7	8687.5	8685.2	8599.3	8443.6	8635.1	8688.8
VWP-33	——	8625.2	8626.2	8627.3	8629.9	8633.5	8630.3	8634.2	8634.6	8633.5	8638.6	8639.5	8620.7	8631.7	8622.5	8614.3	8614.6	8624.1	8624.6	——	——	——	——	8621.6	——	——	——	8614.3	——	8622.9	8616.4	8627.5	8624.8	8624.3	8627.3	8625.6	8633.6	8631.3
VWP-33D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	8958	8953.7	8965.7	8957	8955.5	8945	8935.6	8860.3	8856.3	8844.5	8817.3	8808.1	8801.7	8783.2	8765.6	8674.4	8574.5	8444.6
VWP-41	8628.6	8631.7	8632.7	8632.9	8633.8	8636.3	8631.5	8632.6	8631.8	8629.4	8632.9	8635.3	8629.0	8638.4	8630.8	8623.8	8624.3	8631.7	8632.7	——	——	——	——	8629.5	——	——	——	8624.1	——	8630.8	8625.6	8634.9	8632.4	8632.1	8635.2	8633.2	8639.8	8637.6
VWP-41D	——	——	——	——	——	——	——	——	——	——	——	——	8788.2	8717.3	8730.9	8739.7	8715.6	8692.4	8660.7	——	——	——	——	8634.7	——	——	——	8613.9	——	8599.5	8570.7	8558.2	8544.1	8504.1	8441.0	8354.1	8252.6	8127.0
VWP-43	8641.7	8643.8	8644.3	8645.2	8645.4	8647.1	8643.8	8644.0	8643.8	8641.8	8644.6	8646.3	8640.6	8648.4	8642.4	8634.7	8635.4	8643.5	8644.1	——	——	——	——	8641.1	——	——	——	8635.1	——	8642.5	8636.3	8645.4	8643.8	8643.3	8645.5	8644.3	8650.8	8648.7
VWP-43D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	8871.2	8874.3	8870.9	8881.9	8872.7	8883.1	8874.7	8736.7	6716.3	6916.7	7132.4	7099.7	7039.9	6961.8	6755.9	6534.9	6372.5	6259.0	6179.1
VWP-44	——	8661.3	8656.4	8652.5	8646.3	8633.6	8609.6	8585.6	8569.9	8557.7	8548.5	8542.1	8535.2	8532.3	8529.8	8528.5	8528.4	8529	8531.6	——	——	——	——	8534.5	——	——	——	8560.7	——	8565.9	8569.3	8566.3	8567.1	8569.3	8568.7	8566.6	8576.8	8577.3
VWP-47	——	8718.1	8718.9	8719.1	8719.9	8722.8	8718.9	8718.8	8718.7	8716.3	8719.2	8721.1	8715.4	8723	8716.7	8709	8709.3	8717.2	8717.5	——	——	——	——	8709.6	——	——	——	8708.2	——	8715.7	8710.3	8719.4	8716.5	8717.5	8719.6	8719.7	8726.2	8723.8
VWP-47D	——	——	——	——	——	——	——	——	——	——	——	——	8801.7	8673.1	8596.5	8556.3	8534.6	8517.5	8495.5	——	——	——	——	8482.8	——	——	——	8474	——	8470.2	8463.2	8461.7	8461.5	8466.1	8479.8	8409.5	8328.2	8224.9

Temperature (˚C)

VWP ID	7/29/2019	8/6/2019	8/7/2019	8/8/2019	8/9/2019	8/12/2019	8/19/2019	8/27/2019	9/3/2019	9/10/2019	9/17/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019	12/3/2019	12/4/2019	12/5/2019	12/6/2019	12/9/2019	12/12/2019	12/13/2019	12/16/2019	12/18/2019	12/19/2019	12/20/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020	4/1/2020	5/14/2020	7/8/2020
VWP-1	——	21.5	21.5	21.5	21.5	21.5	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.3	21.3	21.3	21.4	21.4	21.5	——	——	——	——	21.4	——	——	——	21.4	——	21.4	21.5	21.4	21.4	21.5	21.5	21.6	21.5	21.4
VWP-3	——	21.5	21.6	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.5	21.4	——	——	——	——	21.4	——	——	——	21.4	——	21.5	21.5	21.5	21.5	21.4	21.5	21.5	21.5	21.4
VWP-4	——	20.8	20.8	20.8	20.8	20.7	20.8	20.8	20.8	20.8	20.8	20.9	21.0	21	21.1	21.2	21.2	21.3	21.3	——	——	——	——	21.3	——	——	——	21.4	——	21.4	21.5	21.4	21.4	21.4	21.4	21.2	20.9	20.6
VWP-8	——	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20	20.0	20	20.0	20	20.0	20	20.0	——	——	——	——	20	——	——	——	20	——	20	20	20.0	20.0	20.0	20.0	20.0	20.0	20.0
VWP-8D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	22.7	22	21.9	21.9	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.7	21.8	21.8	21.7	21.7
VWP-9	——	21.2	21.1	21.2	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.2	21.2	21.1	21.2	21.4	——	——	——	——	21.2	——	——	——	21.3	——	21.3	21.3	21.3	21.3	21.4	21.5	21.5	21.4	21.2
VWP-9D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	22.4	22.5	22.4	22.5	22.5	22.4	22.5	22.5	22.5	22.5	22.5	22.4	22.3	22.3
VWP-18	20.8	20.8	20.8	20.7	20.7	20.8	20.8	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.6	20.7	20.7	——	——	——	——	20.7	——	——	——	20.7	——	20.7	20.7	20.7	20.8	20.8	20.8	20.8	20.8	20.7
VWP-18D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	22.7	22.4	22.4	22.2	22.3	22.3	22.2	22.2	22.2	22.2	22.2
VWP-19	21.7	21.6	21.7	21.7	21.7	21.7	21.6	21.7	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	——	——	——	——	21.6	——	——	——	21.6	——	21.6	21.6	21.5	21.7	21.6	21.6	21.6	21.5	21.6
VWP-20	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	——	——	——	——	21.8	——	——	——	21.7	——	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.6	21.6
VWP-25	——	19.5	19.4	19.5	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.5	19.5	19.6	——	——	——	——	19.5	——	——	——	19.5	——	19.6	19.6	20.2	19.7	19.6	19.7	19.7	19.7	19.6
VWP-26	19.7	19.7	19.6	19.7	19.7	19.7	19.7	19.7	19.7	19.7	19.7	19.8	19.9	20	20.0	20.1	20.1	20.1	20.2	——	——	——	——	20.3	——	——	——	20.3	——	20.3	20.4	20.4	20.5	20.5	20.5	20.4	20.2	20.0
VWP-27	20.8	20.8	20.8	20.8	20.8	20.7	20.8	20.7	20.8	20.8	20.8	20.8	20.8	20.9	20.9	21	21.0	21.1	21.1	——	——	——	——	21.2	——	——	——	21.2	——	21.3	21.4	21.3	21.3	21.4	21.4	21.3	21.0	20.8
VWP-30	20.3	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.1	20.1	20.1	20.2	20.1	20.1	——	——	——	——	20.1	——	——	——	20.1	——	20.1	20.1	20.2	20.2	20.2	20.2	20.3	20.2	20.3
VWP-33	——	21.6	21.6	21.6	21.5	21.5	21.5	21.4	21.5	21.5	21.5	21.5	21.4	21.4	21.5	21.5	21.4	21.5	21.4	——	——	——	——	21.4	——	——	——	21.5	——	21.5	21.5	21.5	21.5	21.4	21.5	21.5	21.5	21.4
VWP-33D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	23.5	22.7	22.4	22.3	22.3	22.2	22.3	22.2	22.2	22.2	22.1	22.2	22.2	22.1	22.1	22.1	22.1	22.1
VWP-41	19.7	19.7	19.7	19.6	19.7	19.7	19.7	19.7	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.7	19.6	19.6	19.6	——	——	——	——	19.6	——	——	——	19.6	——	19.6	19.7	19.6	19.6	19.6	19.7	19.7	19.8	19.8
VWP-41D	——	——	——	——	——	——	——	——	——	——	——	——	21.7	21.4	21.4	21.3	21.3	21.4	21.4	——	——	——	——	21.3	——	——	——	21.2	——	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.2
VWP-43	20.4	20.4	20.3	20.3	20.3	20.3	20.3	20.2	20.2	20.3	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	——	——	——	——	20.2	——	——	——	20.2	——	20.2	20.2	20.2	20.2	20.3	20.3	20.4	20.4	20.4
VWP-43D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	22.4	22.1	22	21.9	21.9	21.9	21.8	21.9	21.8	21.9	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.7
VWP-44	——	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.0	22.1	22.1	22.1	22.1	22.1	22	22.0	22.1	22.0	——	——	——	——	22.1	——	——	——	22	——	22	22	22.0	22.0	22.0	22.0	22.0	22.0	22.0
VWP-47	——	19.4	19.4	19.4	19.4	19.4	19.5	19.6	19.6	19.9	20.0	20.2	20.5	20.7	20.9	21.1	21.1	21.3	21.3	——	——	——	——	21.3	——	——	——	21.3	——	21.3	21.2	21.2	21.0	20.8	20.5	20.0	19.6	19.6
VWP-47D	——	——	——	——	——	——	——	——	——	——	——	——	22.1	21.3	21.2	21.2	21.2	21.2	21.1	——	——	——	——	21.2	——	——	——	21.1	——	21.2	21.1	21.2	21.2	21.1	21.1	21.1	21.1	21.1

Pressure (PSI)

VWP ID	7/29/2019	8/6/2019	8/7/2019	8/8/2019	8/9/2019	8/12/2019	8/19/2019	8/27/2019	9/3/2019	9/10/2019	9/17/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019	12/3/2019	12/4/2019	12/5/2019	12/6/2019	12/9/2019	12/12/2019	12/13/2019	12/16/2019	12/18/2019	12/19/2019	12/20/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020	4/1/2020	5/14/2020	7/8/2020
VWP-1	——	8.929532	8.922337	8.915142	8.900752	8.866216	8.8653932	8.8394912	8.7732972	8.7574682	8.6812012	9.0280002	8.5689592	8.4544554	8.4702844	8.4918694	8.4365712	8.3214512	8.194203	——	——	——	——	8.2092092	——	——	——	8.2336722	——	8.1228692	8.129448	8.0135052	8.0163832	7.95389	7.886257	7.8640558	7.817185	8.0710652
VWP-3	——	0.148887	0.176508	0.331783	0.664915	0.826582	1.801483	2.137881	2.301181	2.361602	2.389503	2.422163	2.513611	2.476052	2.523409	2.505446	2.53484	2.498774	2.445025	——	——	——	——	2.528308	——	——	——	2.48585	——	2.467747	2.552663	2.484077	2.506939	2.546271	2.578791	2.756788	2.698	2.626288
VWP-4	——	-0.033429	-0.053193	-0.063075	-0.079545	-0.109845	-0.049899	-0.068016	-0.058134	-0.018606	-0.076251	-0.105243	0.004113	-0.150705	-0.039702	0.086124	0.081183	-0.054864	-0.063099	——	——	——	——	-0.012042	——	——	——	0.092373	——	-0.02127	0.060087	-0.090444	-0.050916	-0.050916	-0.093738	-0.080223	-0.190887	-0.14838
VWP-8	——	0.027982	0.013627	0.010437	-0.010298	-0.045388	0.032767	0.010437	0.031172	0.074237	0.020007	-0.021463	0.082212	-0.074098	0.056692	0.171532	0.160367	0.043932	0.024792	——	——	——	——	0.069452	——	——	——	0.168342	——	0.045527	0.150797	-0.019868	0.029577	0.043932	-0.007108	0.018412	-0.094833	-0.061338
VWP-8D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	0.108153	-0.088872	2.883792	3.263522	4.956661	6.165193	8.881088	9.184872	13.47417	33.173902	37.126396	39.082831	41.703832	43.550437	45.087518	45.768594	45.928741
VWP-9	——	-0.017939	-0.033995	-0.049025	-0.052992	-0.090986	-0.037449	-0.014998	-0.030541	0.005726	-0.039176	-0.078897	0.021269	-0.118618	-0.011031	0.128856	0.116254	-0.030028	-0.032456	——	——	——	——	0.101224	——	——	——	0.13455	——	0.005025	0.091375	-0.045058	-0.008791	-0.01864	-0.054394	-0.042305	-0.160254	-0.116378
VWP-9D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	5.41438	34.627304	45.983972	47.281372	48.176224	49.524796	50.562496	50.6456	50.788064	50.970596	51.218424	51.808672	51.636144	51.66434
VWP-18	2.640668	4.871666	5.032596	5.186319	5.418397	5.933804	6.841788	7.656171	8.189781	8.584483	8.875851	9.116399	9.412849	9.619517	9.839737	10.015913	10.132368	10.215805	10.347937	——	——	——	——	11.128871	——	——	——	10.364877	——	10.224275	10.078591	10.075203	10.06547	10.077328	10.129842	10.238258	10.321264	10.349631
VWP-18D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	37.45382	35.451316	32.978921	32.21951	32.390413	32.679413	34.056105	36.30019	39.04858	41.87211	44.81413
VWP-19	-0.39417	-0.42593	-0.430932	-0.434274	-0.439287	-0.4443	-0.449324	-0.462681	-0.437627	-0.434285	-0.42593	-0.44264	-0.430943	-0.439298	-0.439298	-0.374129	-0.344051	-0.407549	-0.412562	——	——	——	——	-0.364103	——	——	——	-0.334025	——	-0.382484	-0.382484	-0.40756	-0.409209	-0.415904	-0.45935	-0.447653	-0.531214	-0.511151
VWP-20	3.149094	3.25128	3.261012	3.272366	3.282098	3.312916	3.385906	3.43781	3.496202	3.539996	3.57568	2.962564	1.593596	0.897758	0.43711	0.302484	0.253824	0.115954	0.068916	——	——	——	——	0.083276	——	——	——	0.075404	——	0.093246	-0.002452	0.051074	0.033232	0.017012	0.018634	-0.043002	-0.05574	-0.097912
VWP-25		-0.041373	-0.062892	-0.075833	-0.076676	-0.111136	-0.043939	-0.024986	-0.045662	-0.00431	-0.057723	-0.093906	0.019812	-0.12492	-0.016371	0.112854	0.099913	-0.027589	-0.031915	——	——	——	——	0.09819	——	——	——	0.134373	——	0.004268	0.093864	-0.068209	-0.010396	-0.014685	-0.046579	-0.050025	-0.155128	-0.107727
VWP-26	-0.0795304	-0.123938	-0.130313	-0.134186	-0.152974	-0.1871344	-0.1068584	-0.1239384	-0.103442	-0.0607424	-0.1034424	-0.148308	-0.0394536	-0.2055872	-0.0638232	0.0552792	0.0467392	-0.0762368	-0.0920664	——	——	——	——	-0.037868	——	——	——	0.059488	——	-0.060072	0.0470744	-0.123726	-0.0746512	-0.0695272	-0.1173512	-0.087858	-0.2065024	-0.1885072
VWP-27	-0.097272	-0.133506	-0.143388	-0.15327	-0.163152	-0.194625	-0.110448	-0.130392	-0.117036	-0.079155	-0.128565	-0.161505	-0.062685	-0.215676	-0.095445	0.029907	0.021672	-0.109908	-0.121437	——	——	——	——	-0.080082	——	——	——	0.026973	——	-0.091431	0.009216	-0.150723	-0.109548	-0.109368	-0.15219	-0.139194	-0.25173	-0.214209
VWP-30	-1.67265	-0.162999	-0.131571	-0.121095	-0.105381	-0.108873	-0.110619	-0.091413	-0.087921	-0.053001	-0.103635	-0.133317	-0.021573	-0.161892	-0.083322	0.075564	0.065727	-0.055386	-0.067608	——	——	——	——	-0.016974	——	——	——	0.07731	——	-0.041418	0.049374	-0.107127	-0.068715	-0.028557	1.471257	4.188672	0.846189	-0.09252
VWP-33	——	-0.05623	-0.07105	-0.087352	-0.125089	-0.1784412	-0.1310172	-0.1880208	-0.194743	-0.1784412	-0.2540232	-0.2673612	0.0120492	-0.1509708	-0.0154212	0.1061028	0.1024512	-0.0391332	-0.0457488	——	——	——	——	-0.0012888	——	——	——	0.1061028	——	-0.0213492	0.0749808	-0.089521	-0.0495072	-0.0413028	-0.0865572	-0.061363	-0.1799232	-0.1450428
VWP-33D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	0.063913	0.13962	-0.044481	0.092399	0.115814	0.280792	0.426453	1.602959	1.665399	1.849597	2.275262	2.417801	2.517705	2.807563	3.082299	4.505931	6.06537	8.093109
VWP-41	0.087249	0.035634	0.018984	0.017043	0.000669	-0.040956	0.038964	0.020649	0.035358	0.075318	0.017043	-0.022917	0.081978	-0.074532	0.052008	0.167169	0.160233	0.037023	0.020373	——	——	——	——	0.073653	——	——	——	0.163563	——	0.052008	0.137199	-0.016257	0.025368	0.030363	-0.022641	0.010659	-0.10062	-0.06399
VWP-41D	——	——	——	——	——	——	——	——	——	——	——	——	3.121894	4.289133	4.066093	3.923266	4.318506	4.697493	5.217373	——	——	——	——	5.645266	——	——	——	5.987879	——	6.222546	6.694866	6.899866	7.131106	7.787106	8.821946	10.247106	11.911706	13.973039
VWP-43	-0.001269	-0.036486	-0.04332	-0.058413	-0.061767	-0.090276	-0.034935	-0.036738	-0.033384	-0.001395	-0.0468	-0.075309	0.02028	-0.110526	-0.009906	0.119223	0.107484	-0.028353	-0.038415	——	——	——	——	0.011895	——	——	——	0.112515	——	-0.011583	0.092391	-0.060216	-0.033384	-0.02655	-0.063444	-0.044871	-0.153876	-0.118659
VWP-43D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	0.15444	0.114825	0.169716	0.003423	0.144735	-0.015009	0.116682	2.233695	33.269706	30.188895	26.87841	27.380682	28.29921	29.498826	32.66145	36.05601	38.550474	40.293834	41.523765
VWP-44	——	1.9263516	2.0108766	2.0781516	2.1851016	2.4041766	2.8181766	3.2321766	3.5030016	3.7140882	3.8721516	3.9825516	4.1015766	4.1516016	4.1947266	4.2177882	4.2195132	4.2085266	4.1643132	——	——	——	——	4.1136516	——	——	——	3.6623382	——	3.5726382	3.5139882	3.5657382	3.5519382	3.5139882	3.5243382	3.5605632	3.3846132	3.3759882
VWP-47	——	-0.017259	-0.030883	-0.034289	-0.047913	-0.0973	-0.032353	-0.03212	-0.030417	0.006045	-0.044812	-0.080109	0.012552	-0.119816	-0.015467	0.112724	0.107615	-0.029862	-0.034971	——	——	——	——	0.099566	——	——	——	0.123408	——	-0.004317	0.089115	-0.065858	-0.013531	-0.027621	-0.058974	-0.053327	-0.158142	-0.11727
VWP-47D	——	——	——	——	——	——	——	——	——	——	——	——	1.938147	3.987437	5.201709	5.838075	6.181586	6.452279	6.802233	——	——	——	——	7.00158	——	——	——	7.142578	——	7.201038	7.313542	7.335593	7.338759	7.267635	7.050764	8.163613	9.450592	11.085831

Pressure Head (feet H_2O)

VWP ID	7/29/2019	8/6/2019	8/7/2019	8/8/2019	8/9/2019	8/12/2019	8/19/2019	8/27/2019	9/3/2019	9/10/2019	9/17/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019	12/3/2019	12/4/2019	12/5/2019	12/6/2019	12/9/2019	12/12/2019	12/13/2019	12/16/2019	12/18/2019	12/19/2019	12/20/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020	4/1/2020	5/14/2020	7/8/2020
VWP-1	——	20.63	20.62	20.60	20.57	20.49	20.49	20.43	20.27	20.24	20.06	20.86	19.80	19.54	19.57	19.62	19.50	19.23	18.94	——	——	——	——	18.97	——	——	——	19.03	——	18.77	18.79	18.52	18.52	18.38	18.22	18.17	18.06	18.65
VWP-3	——	0.34	0.41	0.77	1.54	1.91	4.16	4.94	5.32	5.46	5.52	5.60	5.81	5.72	5.83	5.79	5.86	5.77	5.65	——	——	——	——	5.84	——	——	——	5.74	——	5.70	5.90	5.74	5.79	5.88	5.96	6.37	6.23	6.07
VWP-4	——	-0.08	-0.12	-0.15	-0.18	-0.25	-0.12	-0.16	-0.13	-0.04	-0.18	-0.24	0.01	-0.35	-0.09	0.20	0.19	-0.13	-0.15	——	——	——	——	-0.03	——	——	——	0.21	——	-0.05	0.14	-0.21	-0.12	-0.12	-0.22	-0.19	-0.44	-0.34
VWP-8	——	0.06	0.03	0.02	-0.02	-0.10	0.08	0.02	0.07	0.17	0.05	-0.05	0.19	-0.17	0.13	0.40	0.37	0.10	0.06	——	——	——	——	0.16	——	——	——	0.39	——	0.11	0.35	-0.05	0.07	0.10	-0.02	0.04	-0.22	-0.14
VWP-8D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	0.25	-0.21	6.66	7.54	11.45	14.25	20.52	21.22	31.14	76.66	85.79	90.31	96.37	100.64	104.19	105.76	106.13
VWP-9	——	-0.04	-0.08	-0.11	-0.12	-0.21	-0.09	-0.03	-0.07	0.01	-0.09	-0.18	0.05	-0.27	-0.03	0.30	0.27	-0.07	-0.07	——	——	——	——	0.23	——	——	——	0.31	——	0.01	0.21	-0.10	-0.02	-0.04	-0.13	-0.10	-0.37	-0.27
VWP-9D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	12.51	80.02	106.26	109.26	111.33	114.44	116.84	117.03	117.36	117.78	118.36	119.72	119.32	119.39
VWP-18	6.10	11.26	11.63	11.98	12.52	13.71	15.81	17.69	18.92	19.84	20.51	21.07	21.75	22.23	22.74	23.14	23.41	23.61	23.91	——	——	——	——	25.72	——	——	——	23.95	——	23.63	23.29	23.28	23.26	23.29	23.41	23.66	23.85	23.92
VWP-18D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	86.55	81.92	76.21	74.45	74.85	75.52	78.70	83.88	90.23	96.76	103.56
VWP-19	-0.91	-0.98	-1.00	-1.00	-1.02	-1.03	-1.04	-1.07	-1.01	-1.00	-0.98	-1.02	-1.00	-1.02	-1.02	-0.86	-0.80	-0.94	-0.95	——	——	——	——	-0.84	——	——	——	-0.77	——	-0.88	-0.88	-0.94	-0.95	-0.96	-1.06	-1.03	-1.23	-1.18
VWP-20	7.28	7.51	7.54	7.56	7.58	7.66	7.82	7.94	8.08	8.18	8.26	6.85	3.68	2.07	1.01	0.70	0.59	0.27	0.16	——	——	——	——	0.19	——	——	——	0.17	——	0.22	-0.01	0.12	0.08	0.04	0.04	-0.10	-0.13	-0.23
VWP-25	——	-0.10	-0.15	-0.18	-0.18	-0.26	-0.10	-0.06	-0.11	-0.01	-0.13	-0.22	0.05	-0.29	-0.04	0.26	0.23	-0.06	-0.07	——	——	——	——	0.23	——	——	——	0.31	——	0.01	0.22	-0.16	-0.02	-0.03	-0.11	-0.12	-0.36	-0.25
VWP-26	-0.18	-0.29	-0.30	-0.31	-0.35	-0.43	-0.25	-0.29	-0.24	-0.14	-0.24	-0.34	-0.09	-0.48	-0.15	0.13	0.11	-0.18	-0.21	——	——	——	——	-0.09	——	——	——	0.14	——	-0.14	0.11	-0.29	-0.17	-0.16	-0.27	-0.20	-0.48	-0.44
VWP-27	-0.22	-0.31	-0.33	-0.35	-0.38	-0.45	-0.26	-0.30	-0.27	-0.18	-0.30	-0.37	-0.14	-0.50	-0.22	0.07	0.05	-0.25	-0.28	——	——	——	——	-0.19	——	——	——	0.06	——	-0.21	0.02	-0.35	-0.25	-0.25	-0.35	-0.32	-0.58	-0.49
VWP-30	-3.87	-0.38	-0.30	-0.28	-0.24	-0.25	-0.26	-0.21	-0.20	-0.12	-0.24	-0.31	-0.05	-0.37	-0.19	0.17	0.15	-0.13	-0.16	——	——	——	——	-0.04	——	——	——	0.18	——	-0.10	0.11	-0.25	-0.16	-0.07	3.40	9.68	1.96	-0.21
VWP-33	——	-0.13	-0.16	-0.20	-0.29	-0.41	-0.30	-0.43	-0.45	-0.41	-0.59	-0.62	0.03	-0.35	-0.04	0.25	0.24	-0.09	-0.11	——	——	——	——	0.00	——	——	——	0.25	——	-0.05	0.17	-0.21	-0.11	-0.10	-0.20	-0.14	-0.42	-0.34
VWP-33D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	0.15	0.32	-0.10	0.21	0.27	0.65	0.99	3.70	3.85	4.27	5.26	5.59	5.82	6.49	7.12	10.41	14.02	18.70
VWP-41	0.20	0.08	0.04	0.04	0.00	-0.09	0.09	0.05	0.08	0.17	0.04	-0.05	0.19	-0.17	0.12	0.39	0.37	0.09	0.05	——	——	——	——	0.17	——	——	——	0.38	——	0.12	0.32	-0.04	0.06	0.07	-0.05	0.02	-0.23	-0.15
VWP-41D	——	——	——	——	——	——	——	——	——	——	——	——	7.21	9.91	9.40	9.07	9.98	10.85	12.06	——	——	——	——	13.05	——	——	——	13.84	——	14.38	15.47	15.94	16.48	17.99	20.39	23.68	27.53	32.29
VWP-43	0.00	-0.08	-0.10	-0.13	-0.14	-0.21	-0.08	-0.08	-0.08	0.00	-0.11	-0.17	0.05	-0.26	-0.02	0.28	0.25	-0.07	-0.09	——	——	——	——	0.03	——	——	——	0.26	——	-0.03	0.21	-0.14	-0.08	-0.06	-0.15	-0.10	-0.36	-0.27
VWP-43D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	0.36	0.27	0.39	0.01	0.33	-0.03	0.27	5.16	76.88	69.76	62.11	63.27	65.39	68.17	75.47	83.32	89.08	93.11	95.95
VWP-44	——	4.45	4.65	4.80	5.05	5.56	6.51	7.47	8.09	8.58	8.95	9.20	9.48	9.59	9.69	9.75	9.75	9.73	9.62	——	——	——	——	9.51	——	——	——	8.46	——	8.26	8.12	8.24	8.21	8.12	8.14	8.23	7.82	7.80
VWP-47	——	-0.04	-0.07	-0.08	-0.11	-0.22	-0.07	-0.07	-0.07	0.01	-0.10	-0.19	0.03	-0.28	-0.04	0.26	0.25	-0.07	-0.08	——	——	——	——	0.23	——	——	——	0.29	——	-0.01	0.21	-0.15	-0.03	-0.06	-0.14	-0.12	-0.37	-0.27
VWP-47D	——	——	——	——	——	——	——	——	——	——	——	——	4.48	9.21	12.02	13.49	14.28	14.91	15.72	——	——	——	——	16.18	——	——	——	16.51	——	16.64	16.90	16.95	16.96	16.79	16.29	18.86	21.84	25.62

Inferred Groundwater Elevation (ft MSL)

VWP ID	7/29/2019	8/6/2019	8/7/2019	8/8/2019	8/9/2019	8/12/2019	8/19/2019	8/27/2019	9/3/2019	9/10/2019	9/17/2019	9/25/2019	10/9/2019	10/18/2019	10/30/2019	11/8/2019	11/15/2019	11/22/2019	12/3/2019	12/4/2019	12/5/2019	12/6/2019	12/9/2019	12/12/2019	12/13/2019	12/16/2019	12/18/2019	12/19/2019	12/20/2019	12/24/2019	1/4/2020	1/9/2020	1/14/2020	1/30/2020	2/25/2020	4/1/2020	5/14/2020	7/8/2020
VWP-1	——	543.1	543.1	543.1	543.1	543.0	543.0	542.9	542.8	542.7	542.6	543.4	542.3	542.0	542.1	542.1	542.0	541.7	541.4	——	——	——	——	541.5	——	——	——	541.5	——	541.3	541.3	541.0	541.0	540.9	540.7	540.7	540.6	541.2
VWP-3	——	506.9	507.0	507.4	508.1	508.5	510.8	511.5	511.9	512.1	512.1	512.2	512.4	512.3	512.4	512.4	512.5	512.4	512.2	——	——	——	——	512.4	——	——	——	512.3	——	512.3	512.5	512.3	512.4	512.5	512.6	513.0	512.8	512.7
VWP-4	——	526.9	526.9	526.9	526.8	526.7	526.9	526.8	526.9	527.0	526.8	526.8	527.0	526.7	526.9	527.2	527.2	526.9	526.9	——	——	——	——	527.0	——	——	——	527.2	——	527.0	527.1	526.8	526.9	526.9	526.8	526.8	526.6	526.7
VWP-8	——	486.4	486.3	486.3	486.3	486.2	486.4	486.3	486.4	486.5	486.3	486.3	486.5	486.1	486.4	486.7	486.7	486.4	486.4	——	——	——	——	486.5	——	——	——	486.7	——	486.4	486.6	486.3	486.4	486.4	486.3	486.3	486.1	486.2
VWP-8D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	400.2	399.8	406.7	407.5	411.5	414.2	420.5	421.2	431.1	476.7	485.8	490.3	496.4	500.6	504.2	505.8	506.1
VWP-9	——	506.9	506.8	506.8	506.8	506.7	506.8	506.9	506.8	506.9	506.8	506.7	506.9	506.6	506.9	507.2	507.2	506.8	506.8	——	——	——	——	507.1	——	——	——	507.2	——	506.9	507.1	506.8	506.9	506.9	506.8	506.8	506.5	506.6
VWP-9D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	412.5	480.0	506.3	509.3	511.3	514.4	516.8	517.0	517.4	517.8	518.4	519.7	519.3	519.4
VWP-18	505.7	510.9	511.2	511.6	512.1	513.3	515.4	517.3	518.5	519.4	520.1	520.7	521.4	521.8	522.3	522.7	523.0	523.2	523.5	——	——	——	——	525.3	——	——	——	523.6	——	523.2	522.9	522.9	522.9	522.9	523.0	523.3	523.5	523.5
VWP-18D	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	486.5	481.9	476.2	474.5	474.8	475.5	478.7	483.9	490.2	496.8	503.6
VWP-19	510.1	510.0	510.0	510.0	510.0	510.0	510.0	509.9	510.0	510.0	510.0	510.0	510.0	510.0	510.0	510.1	510.2	510.1	510.0	——	——	——	——	510.2	——	——	——	510.2	——	510.1	510.1	510.1	510.1	510.0	509.9	510.0	509.8	509.8
VWP-20	517.4	517.6	517.6	517.7	517.7	517.8	517.9	518.0	518.2	518.3	518.4	516.9	513.8	512.2	511.1	510.8	510.7	510.4	510.3	——	——	——	——	510.3	——	——	——	510.3	——	510.3	510.1	510.2	510.2	510.1	510.1	510.0	510.0	509.9
VWP-25	——	504.9	504.9	504.8	504.8	504.7	504.9	504.9	504.9	505.0	504.9	504.8	505.0	504.7	505.0	505.3	505.2	504.9	504.9	——	——	——	——	505.2	——	——	——	505.3	——	505.0	505.2	504.8	505.0	505.0	504.9	504.9	504.6	504.8
VWP-26	505.8	505.7	505.7	505.7	505.6	505.6	505.8	505.7	505.8	505.9	505.8	505.7	505.9	505.5	505.9	506.1	506.1	505.8	505.8	——	——	——	——	505.9	——	——	——	506.1	——	505.9	506.1	505.7	505.8	505.8	505.7	505.8	505.5	505.6
VWP-27	519.8	519.7	519.7	519.6	519.6	519.6	519.7	519.7	519.7	519.8	519.7	519.6	519.9	519.5	519.8	520.1	520.1	519.7	519.7	——	——	——	——	519.8	——	——	——	520.1	——	519.8	520.0	519.7	519.7	519.7	519.6	519.7	519.4	519.5

VWP-30	502.1	505.6	505.7	505.7	505.8	505.7	505.7	505.8	505.8	505.9	505.8	505.7	506.0	505.6	505.8	506.2	506.2	505.9	505.8	--	--	--	--	506.0	--	--	--	506.2	--	505.9	506.1	505.8	505.8	505.9	509.4	515.7	508.0	505.8
VWP-33	--	494.7	494.6	494.6	494.5	494.4	494.5	494.4	494.3	494.4	494.2	494.2	494.8	494.5	494.8	495.0	495.0	494.7	494.7	--	--	--	--	494.8	--	--	--	495.0	--	494.8	495.0	494.6	494.7	494.7	494.6	494.7	494.4	494.5
VWP-33D	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	401.1	401.3	400.9	401.2	401.3	401.6	402.0	404.7	404.8	405.3	406.3	406.6	406.8	407.5	408.1	411.4	415.0	419.7
VWP-41	496.6	496.5	496.4	496.4	496.4	496.3	496.5	496.4	496.5	496.6	496.4	496.3	496.6	496.2	496.5	496.8	496.8	496.5	496.4	--	--	--	--	496.6	--	--	--	496.8	--	496.5	496.7	496.4	496.5	496.5	496.3	496.4	496.2	496.3
VWP-41D	--	--	--	--	--	--	--	--	--	--	--	--	409.2	411.9	411.4	411.1	412.0	412.9	414.1	--	--	--	--	415.0	--	--	--	415.8	--	416.4	417.5	417.9	418.5	420.0	422.4	425.7	429.5	434.3
VWP-43	511.5	511.4	511.4	511.4	511.4	511.3	511.4	511.4	511.4	511.5	511.4	511.3	511.5	511.2	511.5	511.8	511.7	511.4	511.4	--	--	--	--	511.5	--	--	--	511.8	--	511.5	511.7	511.4	511.4	511.4	511.4	511.4	511.1	511.2
VWP-43D	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	400.4	400.3	400.4	400.0	400.3	400.0	400.3	405.2	476.9	469.8	462.1	463.3	465.4	468.2	475.5	483.3	489.1	493.1	496.0
VWP-44	--	509.7	509.8	510.0	510.2	510.8	511.7	512.7	513.3	513.8	514.1	514.4	514.7	514.8	514.9	514.9	515.0	514.9	514.8	--	--	--	--	514.7	--	--	--	513.7	--	513.5	513.3	513.4	513.4	513.3	513.3	513.4	513.0	513.0
VWP-47	--	512.4	512.3	512.3	512.3	512.2	512.3	512.3	512.3	512.4	512.3	512.2	512.4	512.1	512.4	512.7	512.6	512.3	512.3	--	--	--	--	512.6	--	--	--	512.7	--	512.4	512.6	512.2	512.4	512.3	512.3	512.3	512.0	512.1
VWP-47D	--	--	--	--	--	--	--	--	--	--	--	--	404.5	409.2	412.0	413.5	414.3	414.9	415.7	--	--	--	--	416.2	--	--	--	416.5	--	416.6	416.9	417.0	417.0	416.8	416.3	418.9	421.8	425.6

*** Pressure (P, in psi) calculated using the following linear equation provided by Geokon:**

$P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$

where:

G = Linear Gauge Factor (psi/digit)

R_1 = Instrument Reading (digits)

R_0 = Initial Zero Instrument Reading (digits)

T_1 = Temperature Reading (˚C)

T_0 = Initial Zero Temperature Reading (˚C)

K = Thermal Factor (psi/˚C)

S_1 = Measured Barometric pressure (psi)

S_0 = Intiial Zero Barometric pressure (psi)

Note: Barometric corrections not performed as VWPs are installed in sealed boreholes, per Geokon Model 4500 Series Instruction Manual, p. 6.

***Note:** Values in **red** represent a zero pressure head. Elevation values in **red** are associated with the subsurface location of the transducer and should **not** be considered an inferred groundwater elevation.

MSW-2400 Vibrating Wire Piezometer (VWP) Reference Information										
VWP ID	Surface Elevation (ft MSL)	VWP Elevation (ft MSL)	VWP Depth	Serial Number	Factory Zero Reading (digits)	Factory Zero Temperature (˚C)	Field Zero Reading (digits)	Field Zero Temperature (˚C)	Linear Gauge Factor G (psi/digit)	Thermal Factor K (psi/˚C)
VWP-1	551.40	522.50	28.90	1921455	8572	21.2	8562.1	37.0	-0.01439	-0.006162
VWP-3	540.90	506.60	34.30	1921444	8695	22.2	8678.0	35.7	-0.01633	-0.01773
VWP-4	549.59	527.00	22.59	1921438	8717	22.2	8707.7	31.2	-0.01647	-0.00993
VWP-8	550.90	486.30	64.60	1921442	8691	21.9	8679.2	31.8	-0.01595	-0.01724
VWP-8D	551.00	400.00	151.00	1943860	8928	21.6	8945.6	16.3	-0.01651	-0.02515
VWP-9	535.25	506.90	28.35	1921447	8599	22.2	8593.5	28.4	-0.01727	-0.01214
VWP-9D	535.00	400.00	135.00	1943862	9086	21.9	9082.2	19.5	-0.01484	-0.02584
VWP-18	534.60	499.60	35.00	1921452	8748	21.6	8743.9	35.8	-0.01694	-0.01263
VWP-18D	535.00	400.00	135.00	1943861	9040	21.6	9034.1	17.7	-0.01445	-0.02497
VWP-19	562.10	511.00	51.10	1921454	8816	21.7	8775.8	35.2	-0.01671	-0.01660
VWP-20	564.55	510.10	54.45	1921440	8772	21.7	8756.1	34.3	-0.01622	-0.01860
VWP-25	533.80	505.00	28.80	1921450	8766	21.4	8759.3	28.7	-0.01723	-0.00880
VWP-26	530.50	506.00	24.50	1921453	8649	21.5	8637.1	33.3	-0.01708	-0.004576
VWP-27	546.70	520.00	26.70	1921446	8632	22.0	8610.2	23.6	-0.01647	-0.01467
VWP-30	544.05	506.00	38.05	1921451	8690	22.5	8676.4	31.5	-0.01746	-0.01107
VWP-33	538.60	494.80	43.80	1921439	8627	21.9	8617.6	28.7	-0.01482	-0.00794
VWP-33D	539.00	401.00	138.00	1943866	8963	21.9	8965.6	18.4	-0.01561	-0.01073
VWP-41	534.80	496.40	38.40	1921443	8631	22.0	8627.5	27.3	-0.01665	-0.01389
VWP-41D	535.00	402.00	133.00	1933662	8996	23.2	8975.1	25.5	-0.01640	-0.01493
VWP-43	549.50	511.50	38.00	1921441	8642	21.9	8637.0	25.4	-0.01677	-0.01551
VWP-43D	549.00	400.00	149.00	1943859	8879	22.0	8888.2	18.4	-0.01536	-0.02667
VWP-44	554.35	505.20	49.15	1921448	8781	21.4	8767.4	37.2	-0.01725	-0.006366
VWP-47	532.60	512.40	20.20	1921449	8718	21.6	8708.8	29.0	-0.01703	-0.0147
VWP-47D	532.00	400.00	132.00	1933663	8931	23.2	8923.6	22.6	-0.01583	-0.01694

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III - SITE DEVELOPMENT PLAN
ATTACHMENT 5
GEOTECHNICAL/STABILITY ANALYSES

Prepared for:

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TABLE OF CONTENTS

SECTION **PAGE**

1 INTRODUCTION 5-1-1
2 GEOTECHNICAL TESTING 5-2-1
2.1 GENERAL 5-2-1
2.2 SOIL CLASSIFICATION TESTS 5-2-2
2.3 CONSOLIDATED UNDRAINED (CU) TESTS 5-2-2
2.4 UNCONFINED COMPRESSION TESTS 5-2-2
2.5 HYDRAULIC CONDUCTIVITY TESTS 5-2-2
2.6 TEST CORRELATIONS AND SUMMARIES 5-2-2
3 GEOTECHNICAL CONSTRUCTION MATERIALS 5-3-1
3.1 MATERIAL REQUIREMENTS 5-3-1
3.2 SUITABILITY OF SOILS FOR GEOTECHNICAL CONSTRUCTION 5-3-1
4 SLOPE AND FOUNDATION STABILITY 5-4-1
4.1 GENERAL 5-4-1
4.2 SECTIONS SELECTED FOR ANALYSIS 5-4-2
4.3 INPUT PARAMETERS AND ASSUMPTIONS 5-4-2
4.4 RESULTS OF ANALYSES – EXCAVATION, INTERIM, AND FINAL CONDITIONS 5-4-6
4.5 VENEER SLOPE ANALYSES OF LINER SYSTEM 5-4-7
4.6 VENEER SLOPE ANALYSES OF FINAL COVER SYSTEM 5-4-8
4.7 ANCHOR TRENCH DESIGN 5-4-8
5 SETTLEMENT ANALYSES 5-5-1
5.1 GENERAL 5-5-1
5.2 FOUNDATION SETTLEMENT 5-5-1
5.3 FINAL COVER SETTLEMENT 5-5-2
6 CONCLUSIONS AND RECOMMENDATIONS 5-6-1
7 REFERENCES 5-7-1

Drawings

Drawing 5.1 Stability Sections Location Map 1
Drawing 5.2 Stability Sections Location Map 2
Drawing 5.3 East Disposal Area Stability Cross Section A-AA'
Drawing 5.4 East Disposal Area Stability Cross Section B-BB'
Drawing 5.5 East Disposal Area Stability Cross Section C-CC'
Drawing 5.6 East Disposal Area Stability Cross Section D-DD'
Drawing 5.7 West Disposal Area Stability Cross Section E-EE'

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Appendices

5A Slope Stability Analyses
5B Veneer Stability Analyses
5C Settlement Analyses

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2 GEOTECHNICAL TESTING

2.1 GENERAL

Geotechnical testing was done on soil samples obtained during the site subsurface exploration conducted from October 2018 to January 2019 (see Attachment 4). During this site exploration, 42 borings were advanced between 28 to 80 feet in depth. Soil samples were collected during auger advancement utilizing thick walled Shelby tubes, two-foot split spoons, or five-foot continuous split barrels. Select soil samples from each stratum were used for geotechnical testing. The geotechnical tests were performed to evaluate physical and engineering properties of the different soil strata in accordance with 30 TAC §330.63(e)(5). Two additional borings were drilled in December 2019 (B-9 and B-43) to depths of 135 feet and 150 ft, respectively. The site exploration is discussed in detail in Attachment 4, Section 5. In Attachment 5, for the evaluation of the tests results, soil samples were grouped as West Disposal Area Samples, East Disposal Area Samples, and Other Samples (i.e., samples from borings outside the respective waste footprints).

Test parameters, the ASTM Test Methods, and the location within this report where test results are presented are shown in Table 5-2-1. The test results are summarized on Tables 5-2-2 to 5-2-~~6~~ 7 for reference and individual testing results are shown in Attachment 4, Appendix 4.F.

Table 5-2-1. Laboratory Test Parameters

Test Parameter	Test Results	ASTM Test Method
Standard Proctor	Table 5-2-6~~Attachment 4~~ Appendix 4.F	D 698~~A~~
Sieve Analysis (Passing No. 200)	Table 5-2-2 to 5-2-4~~Boring Logs~~ Appendix 4.F~~D~~	D 1140
Atterberg Limits (Liquid and Plastic Limit, Plasticity Index)	Table 5-2-2 to 5-2-4~~Boring Logs~~ Appendix 4.F~~D~~	D 4318
Moisture Content & Unit Weight	Table 5-2-2 to 5-2-4~~Boring Logs~~ Appendix 4.F~~D~~	D 2216
Hydraulic Conductivity (Remolded to 95% Standard Proctor) Hydraulic Conductivity (Undisturbed Sample, K_H and K_V)	Table 5-2-6 Appendix 4.F Table 5-2-7 Appendix 4.F	USACE EM 1110-2-1906, Appendix VII USACE EM 1110-2-1906, Appendix VII
Consolidated Undrained Triaxial Test	Table 5-2-5 Appendix 4.F	D 4767
Unconfined Compression Test	Table 5-2-~~7~~ 8 Appendix 4.F	D 2166

4, Appendix 4B and 4C, the landfill excavation will typically encounter predominantly high plasticity clays (CH).

As described in Attachment 4, site lithology as determined by the drilling exploration program is quite homogenous both horizontally and vertically. Site lithology has been divided into surficial alluvial (Unit I), upper "weathered" calcareous shale-marl (Unit II) and lower "unweathered" calcareous shale-marl (Unit III) horizons based on field observations. Uppermost Unit 1 soil horizon generally ranges from zero to three feet in thickness. This thin uppermost soil layer (Unit I) will mostly be used as topsoil and, due to its thickness and similarity to other layers, will not be used for landfill development to the extent of the lower layers (Units II and III).

2.6.2 Laboratory Test Results

The geotechnical laboratory test results are summarized in the sections below for the West Disposal Area, East Disposal Area, and areas outside the waste footprints. The boring location map and geotechnical laboratory reports are presented in Attachment 4. Laboratory test results including Liquid Limit (LL), Plasticity Index (PI), percent fines, percent sand, percent gravel, water content, dry unit weight, unconfined compressive strength and Unified Soil Classification System (UCSC) classification are presented in Tables 5-2-2 to 5-2-4.

Results of the CU tests are presented in Attachment 4 (Appendix 4.F) and summarized in Table 5-2-5. Results of the hydraulic conductivity tests of the samples remolded at 95% Standard Proctor are presented in Attachment 4 and summarized in Table 5-2-6. Results of the hydraulic conductivity tests in both horizontal and vertical directions of undisturbed samples obtained from each soil unit are presented in Attachment 4 and summarized in Table 5-2-7.

Table 5-2-2. Summary of Geotechnical Material Property Test Results – West Disposal Area

Boring Number	Sample Depth (ft)	Soil Layer	LL	PI[1]	Fines (%)	Sand (%)	Gravel (%)	Water Content (%)	Dry Unit Weight (pcf)	q_u Strength (tsf)	USCS[4]
B-1	15-20	Unit II	75	53	93	5	2	23			CH
	35-38	Unit III	69	45	97	3	0	19			CH
B-3	25-30	Unit II	60	36	93	7	0	18			CH
	40-45	Unit III	63	43	96	4	0	16			CH
B-4	1-2	Unit I	67	46	71.2	27.6	1.2	24.2			CH
B-9	1-2	Unit I	60	39	81.9	18	0.1	22.2			CH
	5-7	Unit II	53	35	75	23	2	15			CH
	20-22	Unit II	67	47	91	6	3	20	105	12.32	CH
	35-37	Unit III	62	42	89	8	3	15	116		CH
B-16	1-2	Unit I	75	51	84.5	14.9	0.6	26.3~~2~~			CH
	10-12	Unit II	78	52	91	9	0	19	105		CH
	25-27	Unit II	60	38	77	18	5	15	116	17.76	CH
	50-52	Unit III	64	43	94	6	0	17	115		CH
B-17	15-17	Unit II	66	41	91	9	0	19	106	8.09	CH
	25-27[2]	Unit II	67	44							CH
	45-47	Unit III	60	41	83	17	0	15	120	23.36	CH
B-23	1-2	Unit I	96	66	68.6	25.9	5.5	31.7	86.8		CH
	10-12	Unit II	73	50	98	2	0	20	108		CH
	30-32	Unit II	74	51	85	12	3	18	108		CH
	35-37	Unit II	77	55	89	11	0	20	101		CH
	40-42	Unit III	70	50	96	4	0	15			CH
B-24	5-7	Unit ~~III~~	51	33	73	24	3	15	112	14.94	CH
	15-17	Unit II	74	52	98	2	0	21	99	7.94	CH
	25-27	Unit II	69	44	89	11	0	19	103		CH
	45-47[2]	Unit III	59	33							CH
B-31	15-17[2]	Unit II	66	39							CH
	30-32	Unit III	74	52	90	7	3	18	103	5.37	CH
	55-57	Unit III	60	37	96	3	1	14			CH
B-44	10-12	Unit II	71	49	91	6	3	20	108		CH
	20-22	Unit II	79	55	84	11	5	21	105		CH
	30-32	Unit II	72	51	97	3	0	25	97	4.44	CH
	50-52	Unit III	60	35							CH

[1] PI = LL – PL
[2] See Table 5-2-5 for CU test results.

Table 5-2-3. Summary of Geotechnical Material Property Test Results – East Disposal Area

Boring Number	Sample Depth (ft)	Soil Layer	LL	PI[1]	Fines (%)	Sand (%)	Gravel (%)	Water Content (%)	Dry Unit Weight (pcf)	q_u Strength (tsf)	USCS[4]
B-15	55-57	Unit III	57	37	91	7	2	11	116	1.61	CH
B-14	15-17	Unit II	58	35	65	30	5	19	104		CH
	35-37	Unit III	58	39	94	5	1	15			CH
B-18	10-12	Unit II	66	45	92	7	1	19	105	4.26	CH
	45-47	Unit III	57	38	90	10	0	13	109	3.59	CH
B-45	25-27	Unit II	66	46	90	8	2	21	107	6.21	CH
	40-42	Unit III	58	38	92	8	0	15			CH
B-21	15-17	Unit II	69	44	97	3	0	19			CH
	35-37	Unit III	57	39	94	6	0	15	108	10.49	CH
	40-42	Unit III	61	40	88	8	4	14			CH
B-19 [2]	1-2	Unit I	55	35	81.7	17	1.3	18.5			CH
	10-12	Unit II	83	59	92						CH
	50-52	Unit II	63	44	91	7	2	14	117		CH
	70-72	Unit III	57	38	95	5	0	15			CH
B-46	45-47	Unit III	62	41	94	6	0	13	110		CH
B-20	2	Unit I	56	38	74.2	24.5	1.3	11.7	123.1		CH
	30	Unit II	61	41	91.1	8.9	0	18.9	108		CH
	45-47	Unit II	59	36	95	5	0	13	116	18.68	CH
	55-57	Unit III	58	37	96	3	1	13	118	16.82	CH
B-13	35-37	Unit II	66	43	94	6	0	20			CH
	45-47	Unit III	51	33	95	5	0	15			CH
B-27	1-2	Unit I	64.4	59	38	35	0.6	20.3			CH
	25-27	Unit II	68	47	87	10	3	18	108		CH
	45-47	Unit III	61	40	97	3	0	15	118		CH
B-43	10-12	Unit II	60	40	95	5	0	18	111	7.12	CH
	25-27	Unit II	61	42	94	5	1	16	117		CH
	45-47	Unit III	63	40	95	5	0	16			CH
B-8	10-12	Unit II	67	50	85						CH
	40-42	Unit II	58	38	92	8	0	16	106	4.02	CH
	50-52	Unit III	58	38	97	2	1	14	116		CH

[1] PI = LL – PL
[2] See Table 5-2-5 for CU test results.

Table 5-2-5. Summary of Consolidated Undrained (CU) Triaxial Test Results

Area	Boring Number	Sample Depth (ft)	Sampled Layer	CU test Results	
				c′ (psi)	ϕ′ (°)
East Disposal Area	B-19	50-51	Unit II	7.4	24.0
West Disposal Area	B-17	25-26	Unit II	1.6	26.2
West Disposal Area	B-31	15-16	Unit II	5.5	25.9
West Disposal Area	B-24	45-46	Unit III	10.0	34.0
West Disposal Area	B-44	50-51.5	Unit III	1.7	19.2

Table 5-2-6. Summary of Standard Proctor & Hydraulic Conductivity Tests – Remolded Samples

Area	Boring Number	Sample Depth (ft)	Sampled Layer	Standard Proctor		Hydraulic Conductivity (Remolded) (cm/s)
				MDD (pcf)	OMC (%)	
West Disposal Area	B-16	10-12	Unit II	97.6	24.0	1.94×10^{-8}
West Disposal Area	B-23	10-12	Unit II	96.0	25.1	2.69×10^{-8}
East Disposal Area	B-8	10-12	Unit II	97.9	23.6	2.23×10^{-8}
East Disposal Area	B-19	10-12	Unit II	93.9	26.6	2.05×10^{-8}

Table 5-2-7. Summary of Hydraulic Conductivity Tests – Undisturbed Samples

Area	Boring Number	Sample Depth (ft)	Sampled Layer	Hydraulic Conductivity (Undisturbed) (cm/s)	
				K_H	K_V
West Disposal Area	B-23	1-2	Unit I	4.36×10^{-9}	5.01×10^{-9}
	B-4	10-20'	Unit II[1]	2.16×10^{-8}	5.80×10^{-9}
		35'	Unit III	6.71×10^{-6}	1.76×10^{-9}
East Disposal Area	B-20	1-2	Unit I	4.54×10^{-9}	3.82×10^{-9}
		15-30'	Unit II[1]	7.90×10^{-8}	3.40×10^{-9}
		50'	Unit III	9.25×10^{-9}	1.30×10^{-9}

[1] Hydraulic Conductivity presented is the average of test results calculated at depth range shown.

2.6.3 Material Properties

The geotechnical laboratory test results presented in the previous section are compiled in Table 5-2-~~7~~8. Test results obtained from areas outside the waste limits are not included in this table since these areas will mostly be undisturbed during landfill construction. The landfill excavation will typically encounter predominantly high plasticity clays (CH) in the West Disposal Area and East Disposal Area, where all samples taken were classified as high plasticity clays (CH).

Site lithology has been divided into a surficial alluvial (Unit I), an upper "weathered" (Unit II) and a lower "unweathered" (Unit III) horizons based on field observations, and the engineering properties of these units confirmed by geotechnical laboratory testing are generally very similar (see Table 5-2-~~7~~8). In addition to this similarity, engineering properties of soil samples (surficial alluvial, weathered and/or unweathered) from the West Disposal Area are very similar to the samples from the East Disposal Area. Therefore, for slope stability analyses and settlement analyses, foundation soils, which consist of Strata II and III, are modeled as one uniform layer for the landfill (including the West and East Disposal Areas). The engineering properties of this soil layer are estimated by the weighted average of all test results of these two units.

The results of the drained shear strength tests performed on the undisturbed samples are presented in Attachment 4. As seen in Table 5-2-5, similar shear strength properties were obtained for Units II~~2~~ and III~~3~~. As discussed in Section 4, in addition to these test results, empirical relationships are also used to calculate the shear strength properties.

Table 5-2-6 shows the remolded hydraulic conductivities obtained through laboratory testing. The remolded hydraulic conductivities values for Unit II range between 1.9×10^{-8} and 2.7×10^{-8} cm/sec (four test results). Table 5-2-7 shows the undisturbed horizontal and vertical hydraulic conductivities obtained through laboratory testing for each of the three units. The horizontal hydraulic conductivities (K_H) values for Unit II range between 2.16×10^{-8} and 7.90×10^{-8} cm/sec. The vertical hydraulic conductivities (K_V) values for Unit II range between 3.40×10^{-9} and 5.80×10^{-9} cm/sec. These results indicated that the undisturbed Unit II below the bottom of the landfill would have in-situ hydraulic conductivity of less than 1.0×10^{-7} cm/sec. in either direction. One outlier data point of K_H for the Unit III in the West Disposal Area might be due to disturbance during sample preparation and should be disregarded. Generally, the undisturbed samples exhibit low hydraulic conductivities. Unit II hydraulic conductivity reported for the West Disposal Area and East Disposal Area were very similar, with little variability. The results as shown in Table 5-2-6 and Table 5-2-7 confirm~~s~~ that on-site soils will be suitable for use as liner materials. Although hydraulic conductivity is low enough for liner construction, gravel chimney drains will likely be needed to promote leachate flow through the protective cover. These gravel chimney drains are included in the design (see Attachment 12 – Leachate and Contaminated Water Management Plan).

Table 5-2-~~7~~8. Typical Properties of On-Site Materials

Laboratory Test	West Disposal Area						East Disposal Area						Foundation Soils (3)
	Surficial Alluvial Unit I		Weathered Clay Unit II		Unweathered Clay Unit III		Surficial Alluvial Unit I		Weathered Clay Unit II		Unweathered Clay Unit III		
	Average Value	No. of Tests	Average Value	No. of Tests	Average Value	No. of Tests	Average Value	No. of Tests	Average Value	No. of Tests	Average Value	No. of Tests	
Liquid Limit	75	4	68	18	65	10	57	3	63	21	58	17	63
Plastic Limit	24	4	22	18	22	10	20	3	21	21	20	17	21
Plasticity Index	51	4	46	18	43	10	37	3	42	21	38	17	42
Moisture Content	26.1	4	19	16	16	10	16.8	3	17	19	14	17	16.5
% Passing No. 200 Sieve	76.6	4	88	16	93	8	73.5	3	90	21	92	17	91
Dry Unit Weight (pcf)	86.8	1	105.6	13	113.5	4	123.1	1	110	14	112	10	109.4
Unit Weight (2) (pcf)	109.5	N/A	125.6	N/A	131.2	N/A	143.8	N/A	128.7	N/A	127.7	N/A	127.7
CU Test – Cohesion (c) (psi)			3.55	2	5.9	2			7.4	1	N/A	N/A	5.4
CU Test – Friction Angle (ϕ) (°)			26.0	2	26.6	2			24	1	N/A	N/A	25.9
q_u Test – Unconfined Compressive Strength (psf) (4)			10.9	6	14.4	2			8.1	5	9.8	5	10,530
Hydraulic Conductivity (remolded) (cm/s)	N/A	N/A	2.31×10^{-8}	2	N/A	N/A	N/A	2	2.14×10^{-8}	2	N/A	N/A	2.23×10^{-8}
Hydraulic Conductivity (Undisturbed) (cm/s)	$K_H = 4.36 \times 10^{-9}$ $K_V = 5.01 \times 10^{-9}$	1	$K_H = 2.16 \times 10^{-8}$ $K_V = 5.80 \times 10^{-9}$	1	$K_H = 6.71 \times 10^{-6}$ $K_V = 1.76 \times 10^{-9}$	1	$K_H = 4.54 \times 10^{-9}$ $K_V = 3.82 \times 10^{-9}$	1	$K_H = 7.90 \times 10^{-8}$ $K_V = 3.36 \times 10^{-9}$	1	$K_H = 9.25 \times 10^{-9}$ $K_V = 1.30 \times 10^{-9}$	1	N/A

Notes:
1. West Disposal Area and East Disposal Area averages are arithmetic.
2. Unit Weight is calculated using the dry unit weight, water content (WC), and the following formula: $\gamma = \gamma_d \times (1 + WC)$
3. For foundation soil properties, weighted averages of Units II and III test results are compiled in this column.
4. Average of 10 lowest q_u values.

Cross sections selected for analyses, input parameters and assumptions, and results of the analyses are presented in the following sections. PCSTABL5M output files of the excavation stability, stability under interim and final conditions are presented in Appendix 5A.

Stability of the proposed liner system during construction is evaluated in the veneer mode. The limit equilibrium method of Koerner and Soong (1998) is used to analyze the stability of the liner system on the 3 Horizontal:1 Vertical (3H:1V) sideslopes. Using Koerner and Soong (1998) method, the minimum required interface friction angle that can achieve a target factor of safety is estimated. The result is presented in Appendix 5B.

Stability of the proposed final cover system is also evaluated using the same method used for liner system stability in veneer mode. The result is also presented in Appendix 5B.

4.2 SECTIONS SELECTED FOR ANALYSIS

Slope stability analyses were performed for selected cross-sections of the landfill. The locations of these cross sections were selected based on review of the proposed excavation grades and the final grading plan. A critical slope section is considered to have a maximum waste height, a maximum exterior slope angle, and a shallow perimeter berm. All slope sections except the interim slopes are virtually buttressed by the excavation and the landfill perimeter, including a perimeter berm of various heights.

Please refer to Drawings 5.1 and 5.2 at the end of this attachment (prior to the Appendices) for plan views of the landfill showing where the various sections were cut. Drawings 5.3 through 5.7 show the various sections. Profiles of the sections can also be seen on the model outputs provided in Appendix 5A.

One cross section was selected for excavation stability analysis close to the north corner of the East Disposal Area (Section AA′). This cross section was selected as the most critical because the excavation cut is deepest in this area (including West Disposal Area and East Disposal Area).

Interim fill condition was analyzed using one cross section (Section BB′) with the tallest potential interim waste slope that would be constructed from an intercell berm to the maximum waste height with a slope inclination of 3H:1V.

Slope stability analyses under final conditions (waste stability, foundation soils stability, and liner stability) were performed for three slopes at final grade (Sections CC′, DD′, and EE′). The analyses were performed on cross-sections assuming that the landfill has reached its maximum height.

4.3 INPUT PARAMETERS AND ASSUMPTIONS

Table 5-2-~~7~~ 8 compiles the results of the geotechnical tests performed on the foundation soils. In addition to the CU tests and unconfined compression strength tests, long-term and short-term shear strength parameters for foundation soils are also estimated using (i) the available empirical relationships in the literature and/or (ii) shear strength properties reported in the literature for CH type soils. These estimations are presented in Appendix 5A.

Based on Table 5-4-3, interface friction angles of 11 degrees and 15 degrees were used in the block-type stability analyses for the cell floor and side slope liner systems, respectively. The unit weight of the soil/geosynthetic and geosynthetic/geosynthetic interface layer is assumed to have a typical value of 100 pcf (Attachment 5, Appendix 5A, Page 5-A-20, table showing Layer 4 or 5). Since this layer is relatively thin and when computing the driving force of each slice column above a failure pane, it has no significant contribution in calculating the factor of safety against slope sliding.

To be conservative, no adhesion value was used in the analysis; however, adhesion is typically considered to determine the effective shear strength of the critical interface.

Table 5-4-3. Summary of Liner Interface Properties

Interface	Peak Friction Angle ϕ_{peak} (°)	Residual Friction Angle $\phi_{residual}$ (°)
Smooth HDPE GM /Compacted Clay Liner (Saturated)	11	11
Smooth HDPE GM /SS Geocomposite (Geonet)	**11**	9
NW GT/Cohesive Soil	30	21
Textured HDPE GM /Compacted Clay Liner (Saturated)	18	16
Textured HDPE GM /DS Geocomposite	26	**15**
Geocomposite/ Protective Cover	18	18

1. Polyethylene; GM: geomembrane; SS: single-sided; DS: double-sided; NW GT: non-woven geotextile.
2. Interface friction angle for each interface considered is based on 2005 GRI Report #30, "Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces" by G. R. Koerner and D. Narejo (2005).
3. Textured HDPE liner will be used on all sideslopes as well as 5 feet from the toe of the slope.

- The compacted clay liner interface with the HDPE liner was assumed to be in a saturated condition for conservativeness, since the cell excavation extends below the seasonal high groundwater table (see Attachment 10 – Soil and Liner Quality Control Plan for more information).

- According to Federal guidance on the application of Subtitle D regulations, an acceptable factor of safety for long-term global static slope stability analyses is 1.5. For the temporary short-term slope stability condition such as the interim waste slope, a factor of safety of 1.3 is considered acceptable. An acceptable factor of safety for a static veneer stability analysis is 1.5 for the final cover system and 1.3 for the liner system (i.e., interim conditions).

- The ground water table was assumed 1 foot below lowest subgrade elevations for these stability analyses. It is assumed that either the ground water controls will be installed at the time of construction or that sufficient ballast will be in place prior to hydrostatic uplift on the liner in accordance with Attachment 10.

4.4 RESULTS OF ANALYSES – EXCAVATION, INTERIM, AND FINAL CONDITIONS

The results of the global static slope stability analyses for the various scenarios considered are presented in Tables 5-4-4 to 5-4-6. The locations of the critical failure surfaces for each cross-section are presented in Appendix 5A, in which detailed computer graphical printouts and output files for each model run are presented.

The calculated FS for excavation stability analysis and interim conditions are greater than the minimum acceptable value of 1.3.

The calculated FS for the global static slope stability analysis (final conditions) are greater than the minimum acceptable value of 1.5. The most critical section of all those considered, Section CC′ yielded a FS of 1.64 under block-type failure mode, with the failure surface located within the bottom liner system.

Interface friction angles used in the block-type failure mode are considered typical and conservative for the existing interfaces. Should there be a different interface present due to selection of materials not considered before, the global slope stability analyses should be reevaluated during construction in order to validate the requirements of the FS values.

Under circular failure surface mode (final conditions), the calculated factors of safety are greater than 2.5 with a failure surface located within the waste mass. From the results of the analysis, it is anticipated that the block-type failure mode is more critical than the circular failure mode.

The results of the stability analyses indicate that the proposed excavation, interim waste fill slopes and the final waste fill slopes are stable under the conditions analyzed.

Table 5-4-4. Stability Analyses Results – Excavation Stability

Cross Section	Output File Name	Slope Stability Analysis	Calculated Factor of Safety	Target Factor of Safety
AA′	Waco XS A - Undrained	Circular	3.94	1.30

Table 5-4-5. Stability Analyses Results – Interim Conditions

Cross Section	Output File Name	Slope Stability Analysis	Calculated Factor of Safety	Target Factor of Safety
BB′	Waco XS B - Circular	Circular	2.11	1.30
BB′	Waco XS B - Block	Block	1.40	1.30

As described previously in this section, site lithology has been divided into upper "weathered" and lower "unweathered" horizons based on field observations. For foundation settlement calculations, unweathered soil layer is assumed to be incompressible and weathered soil layer remaining following cell excavation is considered the compressible layer. As shown on the landfill cross-sections, the subgrade is very close to the top of the unweathered soil layer. The thickness of remaining weathered soil layer varies from zero to 14 feet within the West Disposal Area and East Disposal Area cell floors. To be conservative, this remaining weathered foundation soil layer is assumed to be normally consolidated. Due to very low thickness of the compressible soil layer, secondary compression is assumed to be negligible.

Potential heave (rebound) due to excavation of overburden above the excavation base grades was built into the foundation settlement spreadsheet when calculating the initial overburden stress of the soil layers.

Settlement of the foundation soils was calculated using the EXCEL spreadsheets as presented in Appendix 5C. Material property assumptions are also summarized in these spreadsheets. Unit weight of MSW is assumed to be 60 pcf for settlement calculations. Compression index (Cc) was estimated with empirical relationships using average moisture contents and liquid limits of the foundation soils, which are summarized in Table 5-2-~~7~~8.

Two cross sections (Section 1 and 2) were analyzed for the proposed East Disposal Area and West Disposal Area, respectively. Both of these cross sections were located along the leachate corridor of the cells, which has the flattest slope on the cell floor (i.e., 1%). Leachate corridors with thicker underlying compressible foundation soils (i.e., weathered zone) were selected for settlement analyses. The locations of the cross sections on the excavation and final cover grading plans are presented in Figures 1 to 4 of Appendix 5C. The geometries of the cross sections are presented in Figures 5 and 6 of Appendix 5C.

The minimum calculated post-settlement leachate corridor slope is 0.9%, as compared to the original pre-settlement slope of 1%. Therefore, positive drainage of leachate towards the leachate collection sumps will be maintained. Maximum calculated tensile strain in the liner system is less than 0.1%, which is less than the allowable tensile strain for typical liner system geosynthetic components and compacted clay liners. As shown in Appendix 5C, the liner system will be relaxing (i.e., no tension) and therefore not impacted by settlement.

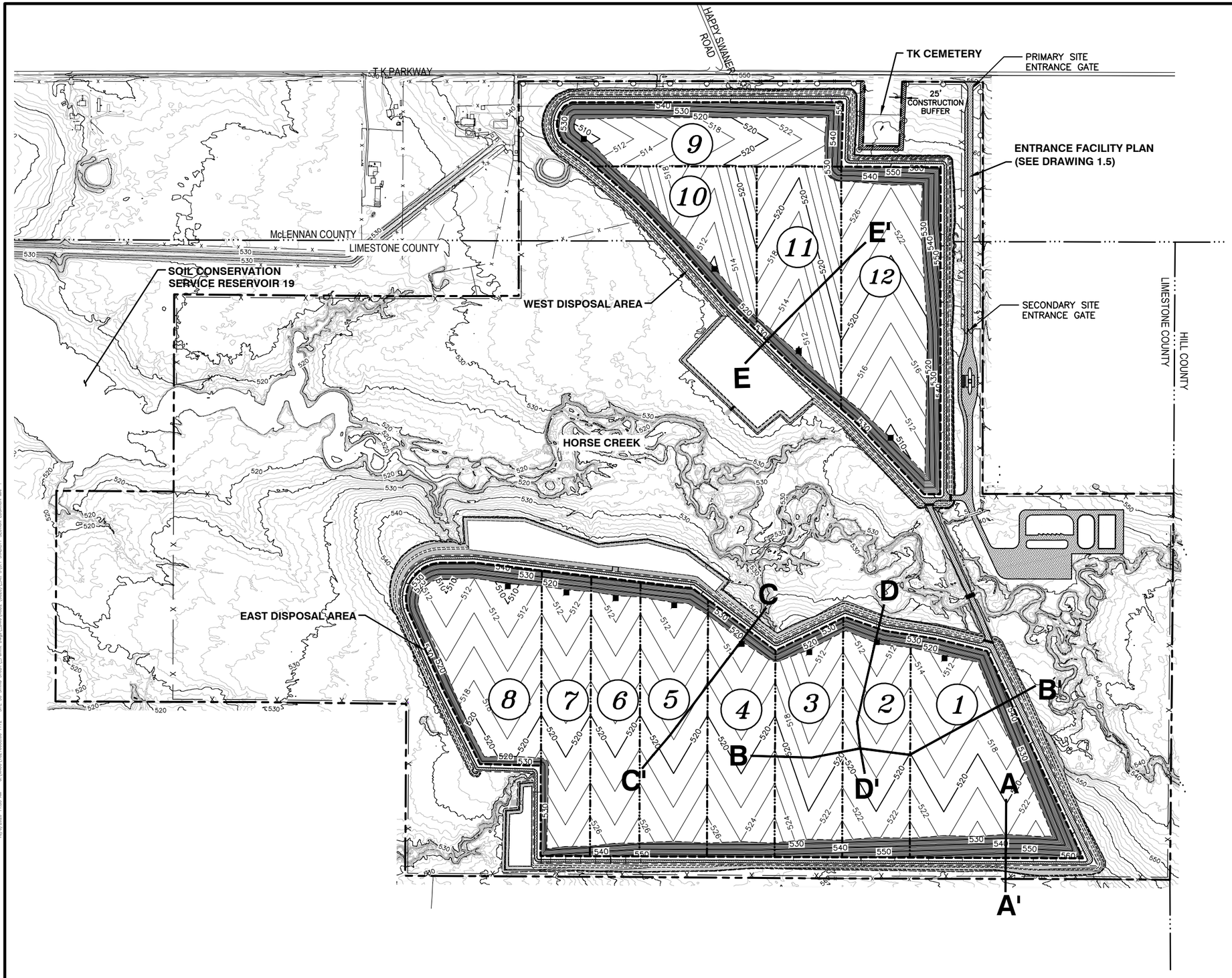
It is therefore concluded that foundation settlement and associated strain will not adversely affect the performance of the bottom liner system.

5.3 FINAL COVER SETTLEMENT

Settlement of the final cover system due to consolidation of MSW is evaluated in this section. The final cover system settles due to primary consolidation of MSW with the construction of the final cover system (i.e., increase in vertical stress), and secondary compression due to waste

DRAWINGS

- Drawing 5.1 Stability Sections Location Map 1
- Drawing 5.2 Stability Sections Location Map 2
- Drawing 5.3 East Disposal Area Stability Cross Section A-AA'
- Drawing 5.4 East Disposal Area Stability Cross Section B-BB'
- Drawing 5.5 East Disposal Area Stability Cross Section C-CC'
- Drawing 5.6 East Disposal Area Stability Cross Section D-DD'
- Drawing 5.7 West Disposal Area Stability Cross Section E-EE'



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- X PROPOSED/EXISTING PERIMETER FENCE (CHAIN LINK OR BARBED WIRE)
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- 510 EXCAVATION GRADE TOPOGRAPHIC CONTOURS (SEE NOTE 2)
- X SECTOR DESIGNATION
- B - B' STABILITY–SECTION LOCATIONS

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE EXCAVATION GRADES (BOTTOM OF LINER) ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).

STATE OF TEXAS
HARTUAN JAMES LAW
135755
LICENSED PROFESSIONAL ENGINEER
10/06/2020

1 ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISION INCLUDES: LIMITS OF WASTE.	HJL

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: STABILITY SECTIONS LOCATION MAP 1

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

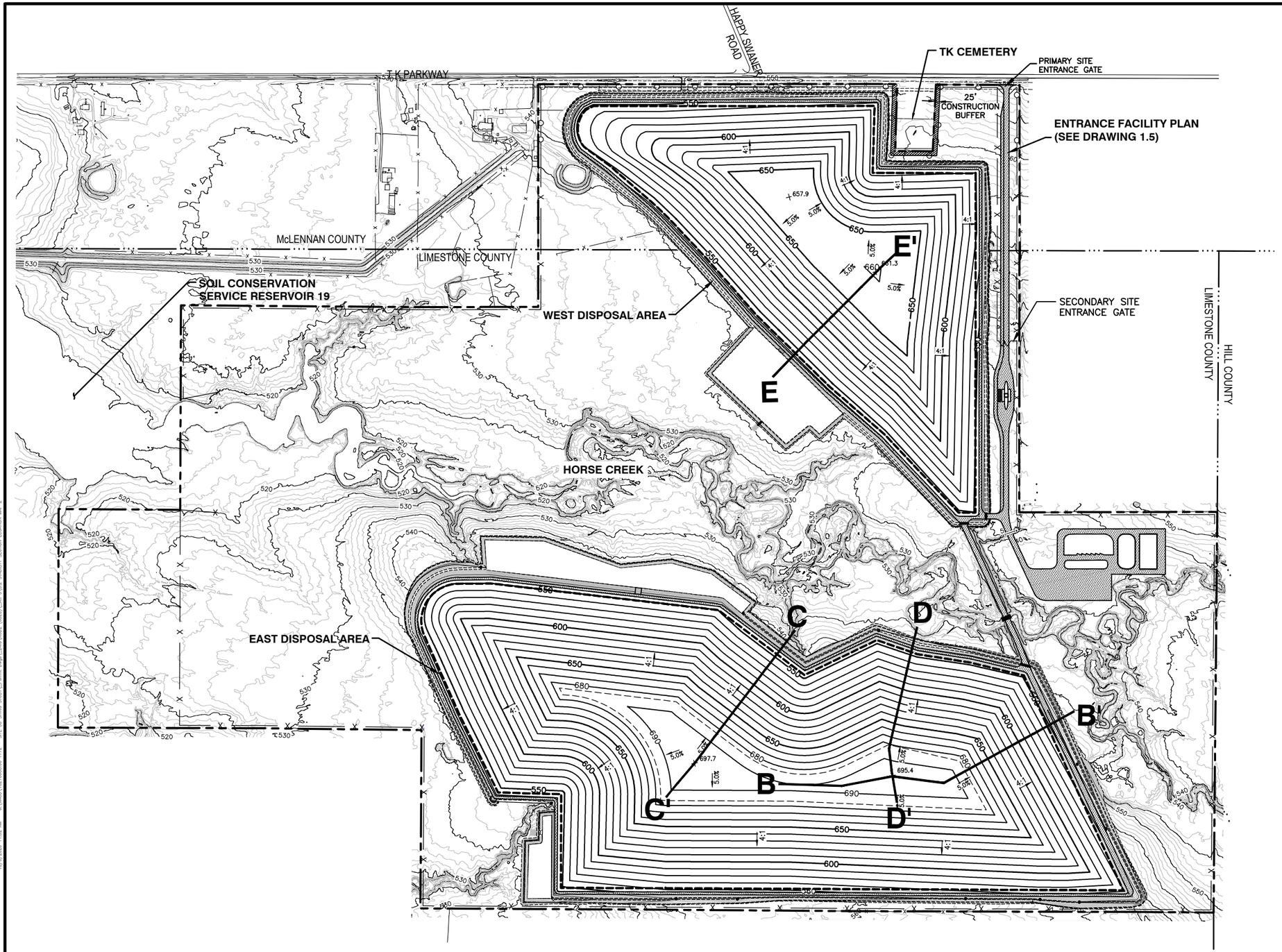
PROJ. NO. 16-216068.00 | DWN. BY: NR | Q/A RVW BY: RRK
DSN. BY: BG/RRK | CHK. BY: BJD | APP. BY: RRK

CADD FILE: 5.1 STABILITY SECTION LOCATION MAP

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 5.1



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 650 FINAL COVER TOPOGRAPHIC CONTOURS (SEE NOTE 2)
- X PROPOSED/EXISTING PERIMETER FENCE (CHAIN LINK OR BARBED WIRE)
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- B - B' STABILITY-SECTION LOCATIONS

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE TOP OF FINAL COVER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).

STATE OF TEXAS
HARTUAN JAMES LAW
135755
LICENSED PROFESSIONAL ENGINEER
10/06/2020

1 ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISION INCLUDES: LIMITS OF WASTE.	HJL

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: STABILITY SECTIONS LOCATION MAP 2

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
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PROJ. NO. 16216088.00 | DWN. BY: NR | Q/A RVW BY: RRK
DSN. BY: BG/RRK | CHK. BY: BJD | APP. BY: RRK

CADD FILE: 5.2 STABILITY SECTION LOCATION MAP

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 5.2

APPENDIX 5C

SETTLEMENT ANALYSES

- **Liner System Settlement Analysis**
- **Final Cover Settlement Analysis**

SCS Engineers
TBPE Reg. # F-3407

Inclusive of Pages 5-C-1 to 5-C-13(7)

LINER SYSTEM

SETTLEMENT ANALYSIS

HAND CALCULATION ON PRIMARY SETTLEMENT

FINAL COVER SYSTEM

SETTLEMENT ANALYSIS

HAND CALCULATION ON PRIMARY AND SECONDARY SETTLEMENT

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III – SITE DEVELOPMENT PLAN
ATTACHMENT 6A
SURFACE WATER DRAINAGE PLAN

Prepared for:

CITY OF WACO

Solid Waste Services
501 Schroeder Drive
Waco, TX 76710

Prepared by:

SCS ENGINEERS
Texas Board of Professional Engineers, Reg. No. F-3407
Dallas/Fort Worth Office
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 0 – April 2020
Revision 1 – October 2020
SCS Project No. 16216088.00

TABLE OF CONTENTS

SECTION **PAGE**

1 INTRODUCTION 6A-1-1
2 METHODOLOGY 6A-2-1
2.1 HYDROLOGIC ANALYSIS METHODS 6A-2-1
2.2 HYDRAULIC ANALYSIS METHODS 6A-2-5
2.3 SOIL LOSS ANALYSIS METHODS 6A-2-10
3 PRE-DEVELOPMENT CONDITIONS 6A-3-1
4 POST-DEVELOPMENT CONDITIONS 6A-4-1
4.1 PERIMETER CHANNEL DESIGN 6A-4-1
4.2 DETENTION BASIN DESIGN 6A-4-1
4.3 BASIN OUTLET STRUCTURE DESIGN 6A-4-2
5 IMPACT TO EXISTING DRAINAGE PATTERNSPOINT OF DEMONSTRATION 6A-5-1
5.1 POINT OF DEMONSTRATION 6A-5-1
5.2 PRE-DEVELOPMENT CONDITIONS 6A-5-1
5.3 POST-DEVELOPMENT CONDITIONS 6A-5-1
5.4 COMPARISON OF PRE- AND POST-DEVELOPMENT DISCHARGE RATES 6A-5-1
6 EROSION AND SEDIMENTATION CONTROL PLAN 6A-6-1
6.1 INTRODUCTION 6A-6-1
6.2 GENERAL EROSION AND SEDIMENTATION CONTROLS 6A-6-2
6.3 SOIL STOCKPILES AND DAILY COVER EROSION CONTROL PRACTICES 6A-6-6
6.4 INTERMEDIATE COVER EROSION CONTROL PRACTICES 6A-6-7
6.5 FINAL COVER EROSION CONTROL PRACTICES 6A-6-7
6.6 SEQUENCE OF DEVELOPMENT - PERIMETER DRAINAGE SYSTEM 6A-6-8
6.7 STORMWATER SYSTEM INSPECTION AND MAINTENANCE PLAN 6A-6-8

Drawings

6A.1A Pre-Development Conditions (On-Site)
6A.1B Pre-Development Conditions (Off-Site)
6A.2 Post-Development Conditions
6A.3 Landfill Completion Plan
6A.4 Channel Profile - Channel 1A1 to Channel 1A4
6A.5 Channel Profile - Channel 2A1 to Channel 2A5
6A.6 Channel Profile - Channel 3A1
6A.7 Channel Profile - Channel 4A1 to Channel 4A5
6A.8 Channel Profile - Channel 4B1 to Channel 4B7
6A.9 East Disposal Area (EDA) East Basin Plan
6A.10 East Disposal Area (EDA) West Basin Plan
6A.11 West Disposal Area (WDA) Basin Plan
6A.12 Drainage Swale Details

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6A.13 Downchute Details
6A.14 Basin Outlet Details
6A.15 Specifications for Silt Fences and Hay Bales
6A.16 Specifications for Sediment Traps and Check Dams
6A-E.1 Final Cover – Drainage Swale Areas
6A-E.2 Final Cover – Downchute Areas
6A-E.3 Intermediate Cover – Typical Swale/Downchute Layout – I
6A-E.4 Intermediate Cover – Typical Swale/Downchute Layout – II
6A-E.5 Intermediate Cover – Downchute Areas

(Drawings 6A-E.1 through 6A-E.5 are provided in Appendix 6A-E)

Appendices

6A-A HEC-HMS Input Parameters
6A-B HEC-HMS Pre-Development Output Files
6A-C HEC-HMS Post-Development Input/Output Files
6A-D Discharge Hydrographs
6A-E Hydraulic Analysis
6A-F Soil Loss Analysis
6A-G Erosion and Sedimentation Control Inspection and Maintenance Form

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Pre-development conditions, including on- and off-site drainage areas and subsequent POD locations are depicted on Drawings 6A.1A and 6A.1B. Pre-development PODs and contributing drainage areas are summarized below:

East PODs (POD-1 through POD-4):

The following drainage areas convey runoff in a southeasterly direction from the northeastern portion of the property across the east and southeast permit boundaries at the respective PODs:

- PRE-1, PRE-2, PRE-3, and PRE-4 discharge runoff at POD-1, POD-2, POD-3, and POD-4, respectively.

Surface water discharged across the east and southeast property boundaries flow into Packwood Creek, which then discharges into Reservoir 19.

South PODs (POD-5 through POD-9):

The following drainage areas convey runoff in a southerly direction from the approximate center of the property across the southern permit boundaries at the respective PODs:

- PRE-5, PRE-6, and PRE-7 discharge at POD-5, POD-6, and POD-7, respectively.
- PRE-8A, PRE-8B, PRE-8C, PRE-8D, OS-1, ~~and~~ OS-2, and OS-3 contribute runoff to and discharge at POD-8.
- PRE-9~~A~~ contributes runoff to ~~onto OS-3, which flows back on-site to PRE-9B~~ and discharges at POD-9.

All surface water runoff discharged across the southern property boundaries ultimately flows into Horse Creek, or directly into Reservoir 19.

West PODs (POD-10 and POD-11):

The following drainage areas convey runoff in a southwest direction from the southwestern portion of the property across the southwest permit boundaries at the respective PODs:

- PRE-10A and PRE-10B contribute runoff to and discharge runoff at POD-10.
- PRE-11 discharges at POD-11.

Surface water discharged across the southwest property boundaries flow downstream of the Reservoir 19 dam.

floor. The WDA Basin was modeled using culverts, in HEC-HMS as a wet basin, assuming the basins were over excavated to either contain water, sediment, or a combination of both. Sediment will be removed from the detention basins on a regular basis during inspection and maintenance, as described in Subsection 6.7. The outlet structure of the WDA Basin will be comprised of two 21-inch diameter concrete culverts discharging to POD-8. Additionally, each detention basin has been designed with a minimum 1-foot of freeboard to prevent overtopping during the design storm event.

Elevation-area-discharge relationships for the basins are presented in Appendix 6A-A. HEC-HMS output for the detention basins, including the peak discharge, storage, and pool depth associated with the 25-year, 24-hour storm event is presented in Appendix 6A-C. This information also has been summarized in Table 6A-4-1. Detention basin layout plans are depicted on Drawings 6A.13 through 6A.18.

4.3 BASIN OUTLET STRUCTURE DESIGN

Peak discharge rates were calculated for each detention basin outlet structure, as described in Subsection 2.2.4 of this attachment. As described in this section, the standard orifice and weir equations were used for calculation of discharge rates through weep holes and concrete weirs. As previously described, the peak discharge rates were incorporated into the elevation-area-discharge relationships used in the HEC-HMS model, as provided in Appendix 6A-A. Design details for the culvert and concrete weir configurations are shown on Drawing 6A.14. Additionally, Table 6A-4-2 and Table 6A-4-3 describes the respective weir and culvert outlet dimensions/elevations.

Table 6A-4-1. Detention Basin Peak Storage and Discharge

Detention Basin	Discharge Points	Peak Storage (acre-feet)	Peak Pool Depth (ft msl)	Peak Discharge (cfs)
EDA East Basin	POD-1	4.7	537.7	106.3
EDA West Basin	POD-8	36.3~~6~~	535.9	41.8
WDA Basin	POD-8	31.1~~5~~	536.5~~6~~	22.5

Table 6A-4-2. Detention Basin Peak Storage and Discharge

Detention Basin	Discharge Points	Basin Invert Elevation (ft msl)	Number of Weep Holes	Weir Elevation (ft msl)	Weir Length (ft)
EDA East Basin	POD-1	534.0	5	535.5	10.0
EDA West Basin	POD-8	530.0	3	534.5	7.0

Location: POD-4

Condition	Peak Discharge Rate (cfs)	Time of Peak Discharge (hours)	Discharge Volume (ac-ft)
Pre-development	11.2	12:20	1.4
Post-development	10.9	12:20	1.4
Percent Change	-2.7	N/A	0.0

Location: POD-5

Condition	Peak Discharge Rate (cfs)	Time of Peak Discharge (hours)	Discharge Volume (ac-ft)
Pre-development	55.0	12:40	10.6
Post-development	53.8~~2~~	12:30	9.0 ~~8.9~~
Percent Change	-3.3	N/A	-16.0

Location: POD-6

Condition	Peak Discharge Rate (cfs)	Time of Peak Discharge (hours)	Discharge Volume (ac-ft)
Pre-development	6.9	12:30	1.1
Post-development	6.9	12:30	1.1
Percent Change	0.0	N/A	0.0

Location: POD-7

Condition	Peak Discharge Rate (cfs)	Time of Peak Discharge (hours)	Discharge Volume (ac-ft)
Pre-development	33.9	12:40	5.9
Post-development	33.4~~0~~	12:30	5.7~~6~~
Percent Change	-2.7	N/A	-5.1

Location: POD-8

Condition	Peak Discharge Rate (cfs)	Time of Peak Discharge (hours)	Discharge Volume (ac-ft)
Pre-development	2030.2	13:40	619.7
Post-development	2059.8 ~~2060.3~~	13:20	621.1 ~~621.8~~
Percent Change	1.5	N/A	0.3

Location: POD-9

Condition	Peak Discharge Rate (cfs)	Time of Peak Discharge (hours)	Discharge Volume (ac-ft)
Pre-development	4.1	12:40	0.7
Post-development	4.1	12:40	0.7
Percent Change	0.0	N/A	0.0

Location: POD-10

Condition	Peak Discharge Rate (cfs)	Time of Peak Discharge (hours)	Discharge Volume (ac-ft)
Pre-development	36.9	12:30	6.5
Post-development	7.8	12:40	1.3
Percent Change	-78.9	N/A	-80.0

Location: POD-11

Condition	Peak Discharge Rate (cfs)	Time of Peak Discharge (hours)	Discharge Volume (ac-ft)
Pre-development	21.9	12:20	3.1
Post-development	21.0	12:40	3.0
Percent Change	-4.1	N/A	-3.2

Notes

1. Values obtained from HEC-HMS output files (Appendices 6A-B and 6A-C).
2. Time of Peak Discharge in hours from beginning of 24-hour storm period.

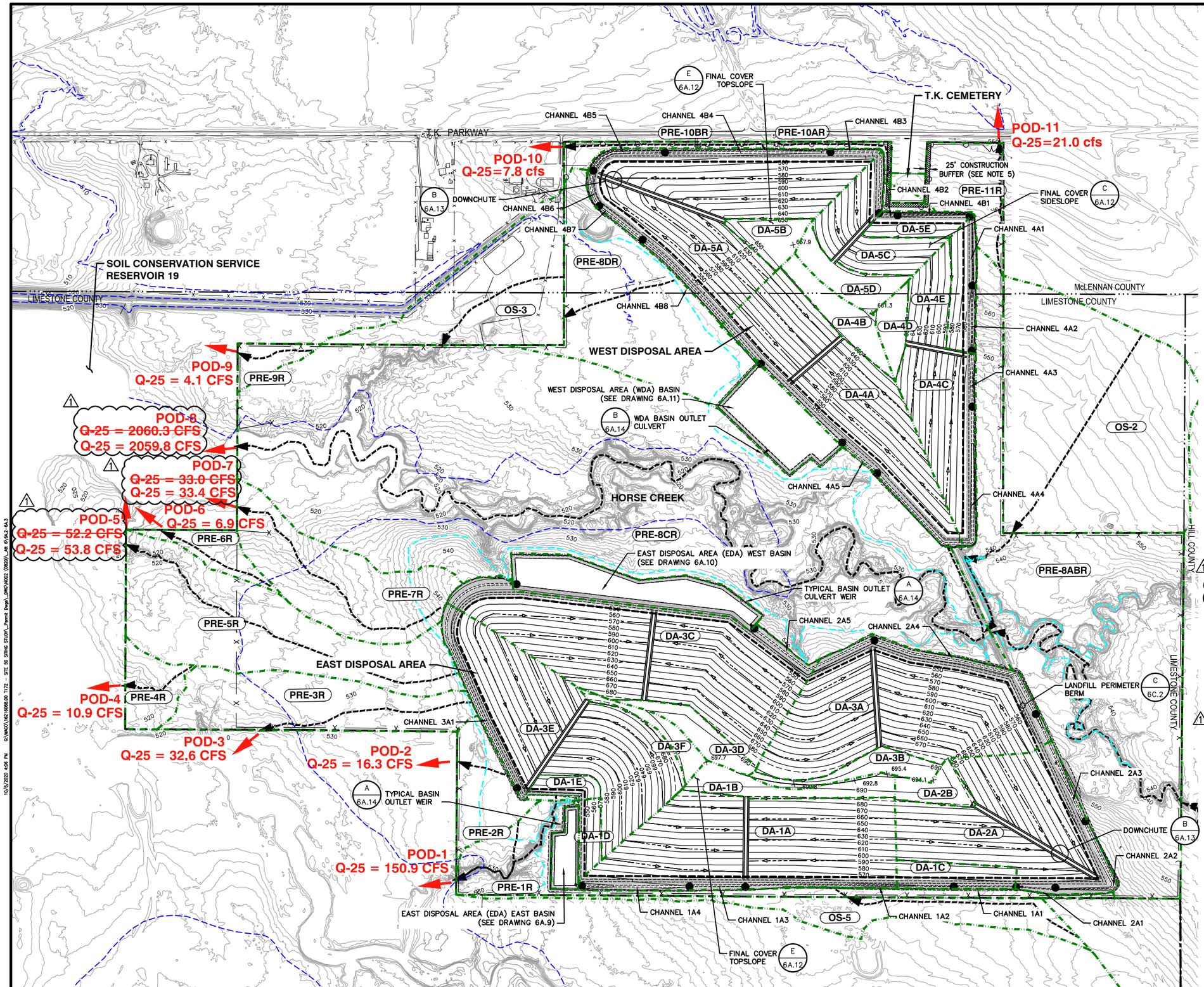
Table 6A-5-2. Comparison of Reservoir 19 Pre- and Post-Development Conditions Peak Discharge Rate and Volume

Location: Reservoir 19

Condition	Peak Discharge Rate (cfs)	Discharge Volume (ac-ft)
Pre-development	2366.9	682.5
Post-development	2368.7~~2~~	671.6 ~~672.1~~
Percent Change	0.1	-1.5

DRAWINGS

6A.1A through 6A.16



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SCALE IN FEET

LEGEND

- EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- COUNTY LINE
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- EXISTING FENCE (SCREENED)
- FINAL COVER CONTOURS (SEE NOTE 3)
- PROPOSED/EXISTING PERIMETER FENCE (CHAIN LINK OR BARBED WIRE)
- PROPOSED 8' PRIVACY FENCE
- DRAINAGE SWALES
- DOWNCHUTES
- CHANNEL SECTION
- DRAINAGE AREA BOUNDARY
- POINT-OF-DEMONSTRATION (POD)
- ASSUMED CHANNEL LENGTH
- DA-9B POST-DEVELOPMENT DRAINAGE AREA
- SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTE:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPACIAL FROM AERIAL PHOTOGRAPHY FLOWN JULY 03, 2018.
2. 100-YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
3. ELEVATIONS SHOWN ON THIS DRAWING ARE TOP OF FINAL COVER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
4. USGS MAP AXTELL, TEXAS (1956) IS SHOWN ON THIS EXHIBIT.
5. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25-FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
6. FOR INFORMATION ON DRAINAGE AREA OS-1, SEE DRAWING 6A.1B.

ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

STATE OF TEXAS
JAMES ROY MURRAY III
73860
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, BASIN CALLOUT, LIMITS OF WASTE, NOTES 2 AND 6.	JRM

DRAWING TITLE: POST-DEVELOPMENT CONDITIONS

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
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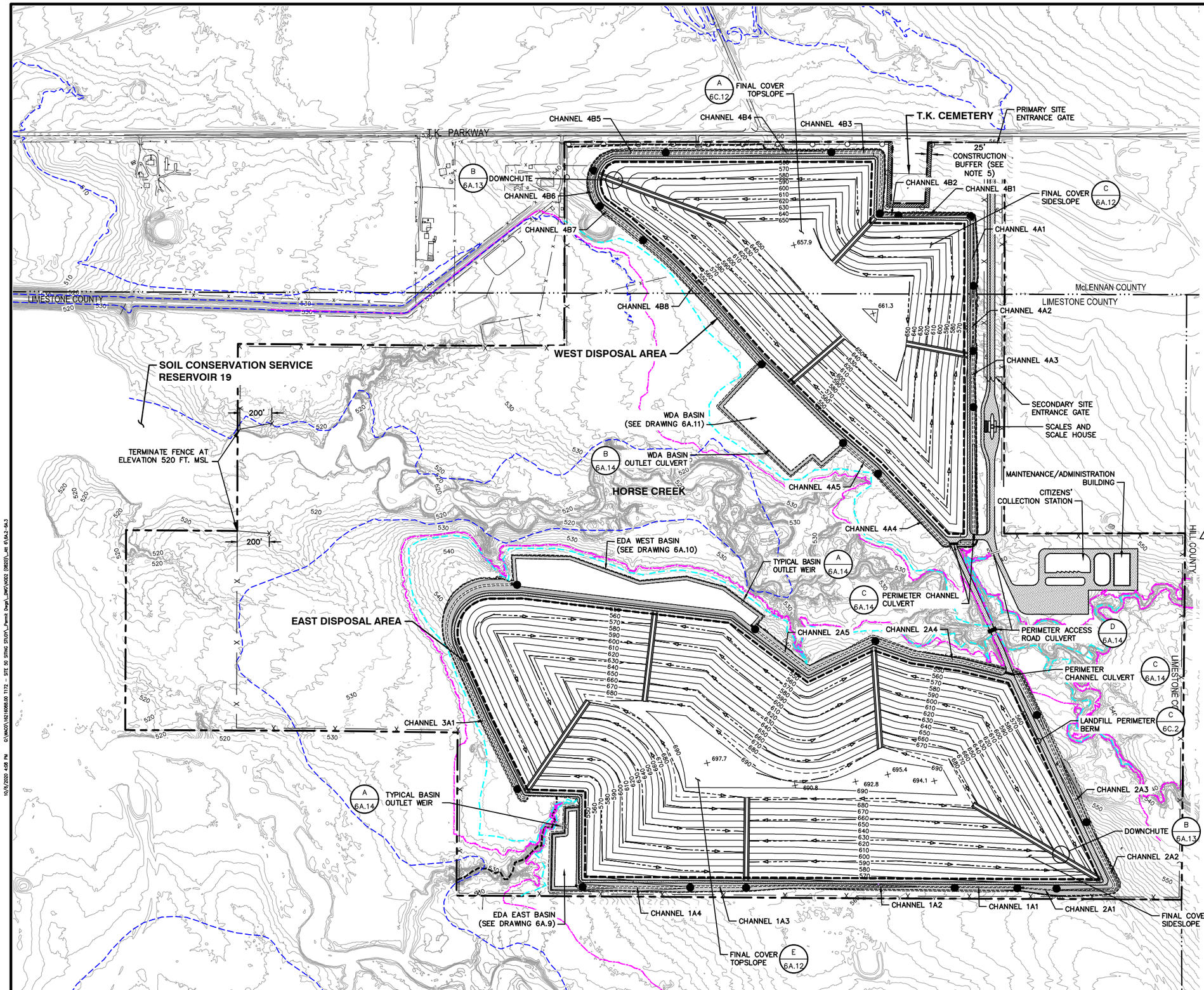
PROJ. NO. 16216088.00 | DSN. BY: RG/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 6A.2–6A.3

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 6A.2



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SCALE IN FEET

LEGEND

- EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- COUNTY LINE
- EXISTING FENCE (SCREENED)
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- 100-YEAR STORM EVENT WATER SURFACE (SEE NOTE 6)
- FINAL COVER TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- PROPOSED/EXISTING PERIMETER FENCE (CHAIN LINK OR BARBED WIRE)
- PROPOSED 8' PRIVACY FENCE
- DRAINAGE SWALES
- DOWNCHUTES
- CHANNEL SECTION
- SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTE:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPACIAL FROM AERIAL PHOTOGRAPHY FLOWN JULY 03, 2018.
2. 100-YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
3. ELEVATIONS SHOWN ON THIS DRAWING ARE TOP OF FINAL COVER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
4. USGS MAP AXTELL, TEXAS (1956) IS SHOWN ON THIS EXHIBIT.
5. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25-FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
6. 100-YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC-HMS AND HEC-RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.

1 ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

STATE OF TEXAS
JAMES ROY MURRAY III
73860
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, LIMITS OF WASTE, AND NOTE 2.	JRM

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: LANDFILL COMPLETION PLAN

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DWN. BY: NR | CK'D. BY: BJD | C/A RVW BY: RRK | APP. BY: RRK | DSN. BY: BG/RRK

CADD FILE: 6A.2-6A.3

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 6A.3

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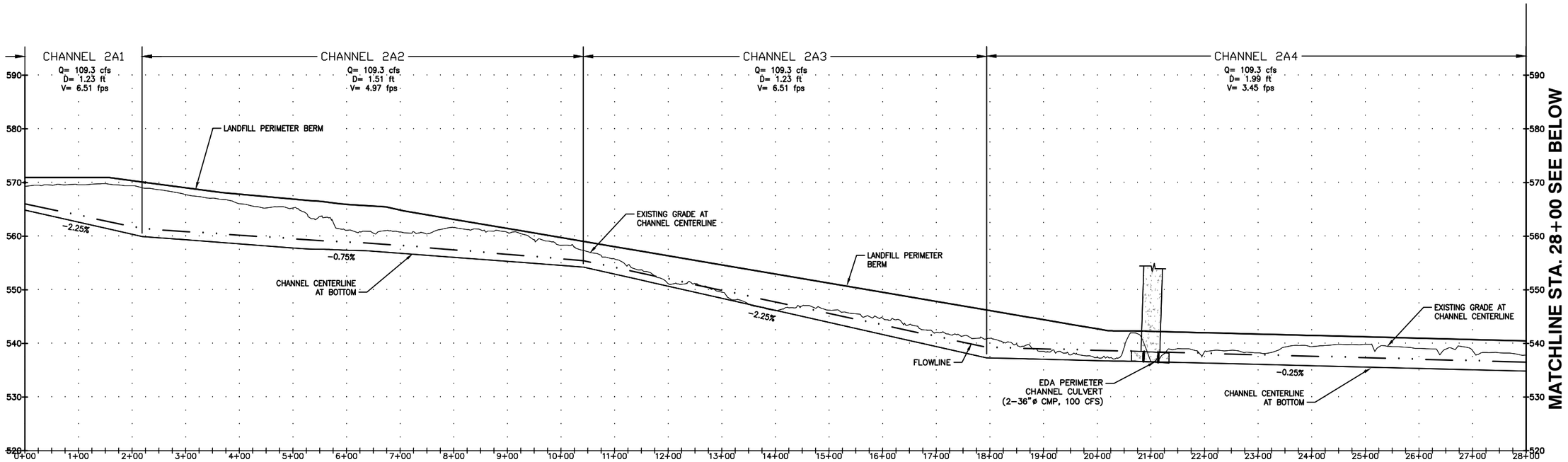
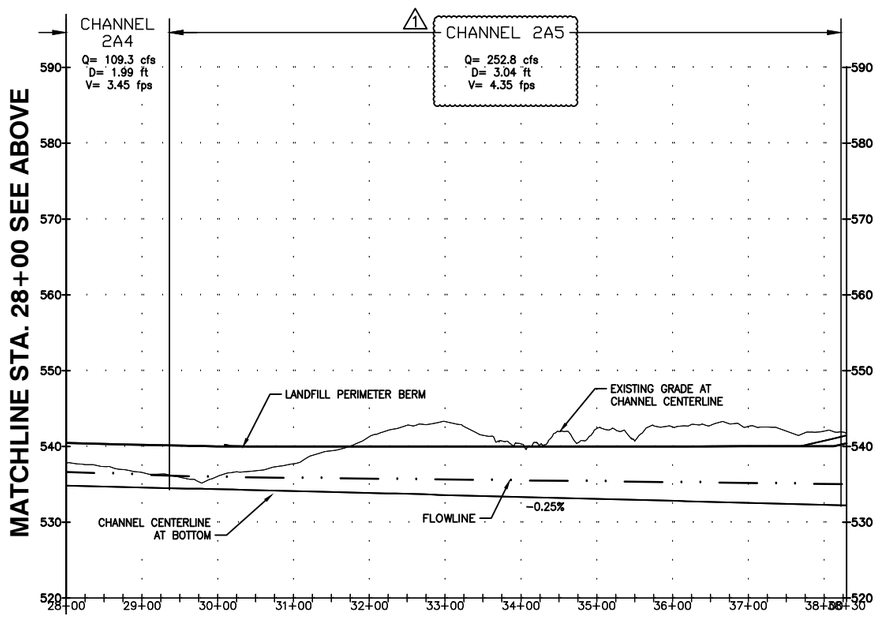
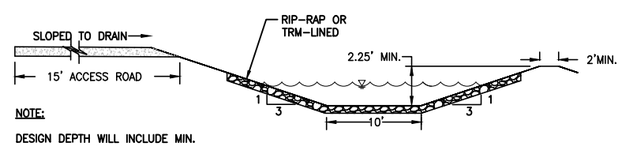


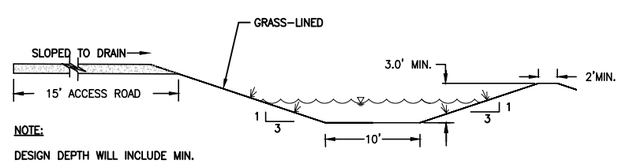




NOTE:

DESIGN DEPTH WILL INCLUDE MIN. 1-FOOT FREEBOARD ABOVE D_{25} (DEPTH AT 25-YEAR, 24-HOUR STORM EVENT).

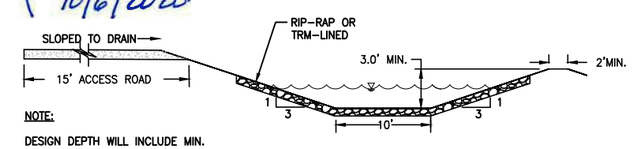
CHANNEL 2A1
TYPICAL CROSS-SECTION
NOT TO SCALE



NOTE:

DESIGN DEPTH WILL INCLUDE MIN. 1-FOOT FREEBOARD ABOVE D_{25} (DEPTH AT 25-YEAR, 24-HOUR STORM EVENT).

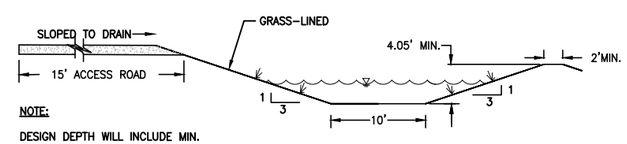
CHANNEL 2A2, AND 2A4
TYPICAL CROSS-SECTION
NOT TO SCALE



NOTE:

DESIGN DEPTH WILL INCLUDE MIN. 1-FOOT FREEBOARD ABOVE D_{25} (DEPTH AT 25-YEAR, 24-HOUR STORM EVENT).

CHANNEL 2A3
TYPICAL CROSS-SECTION
NOT TO SCALE



NOTE:

DESIGN DEPTH WILL INCLUDE MIN. 1-FOOT FREEBOARD ABOVE D_{25} (DEPTH AT 25-YEAR, 24-HOUR STORM EVENT).

CHANNEL 2A5
TYPICAL CROSS-SECTION
NOT TO SCALE

STATE OF TEXAS
JAMES ROY MURRAY III
73860
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

0 100 200
HORIZONTAL SCALE IN FEET

0 10 20
VERTICAL SCALE IN FEET

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOW, VELOCITY, AND DEPTH. UPDATES	
2			
3			
4			
5			
6			

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
CHANNEL PROFILE
CHANNEL 2A1 TO CHANNEL 2A5

PROJECT TITLE
CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00
DSN. BY: BG/RRK
DWN. BY: NR
CHK. BY: BJD
Q/A RVW BY: RRK
APP. BY: RRK

CADD FILE: 6A.A4 - CHANNEL PROFILES

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 6A.5

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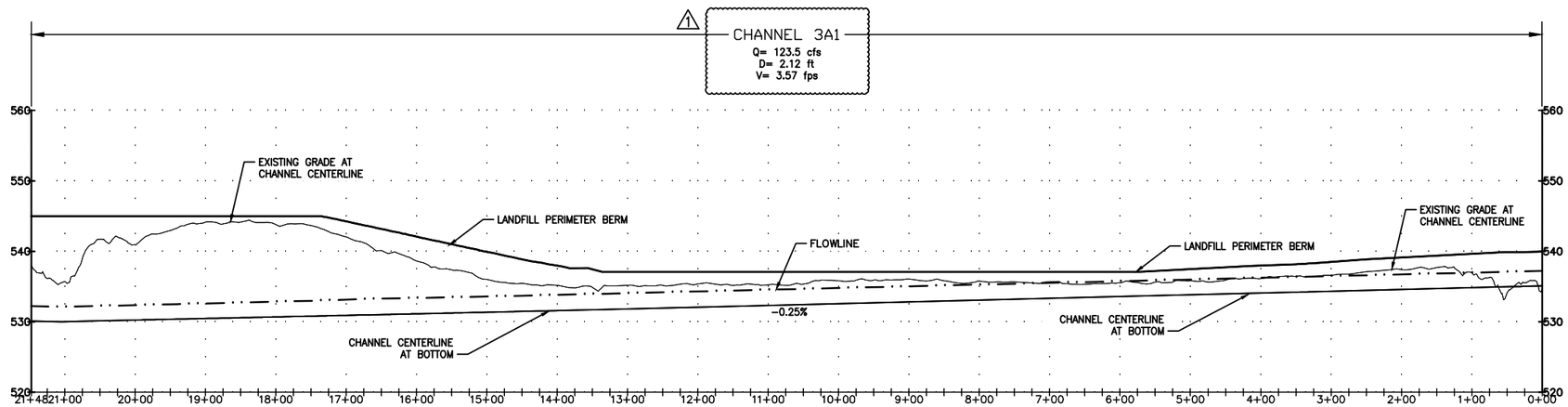
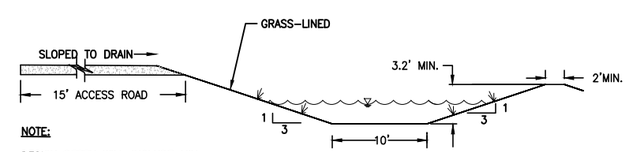


0 100 200
HORIZONTAL SCALE IN FEET

0 10 20
VERTICAL SCALE IN FEET

STATE OF TEXAS
JAMES ROY MURRAY III
73860
LICENSED
PROFESSIONAL ENGINEER
10/6/2020



NOTE:

DESIGN DEPTH WILL INCLUDE MIN. 1-FOOT FREEBOARD ABOVE D_{25} (DEPTH AT 25-YEAR, 24-HOUR STORM EVENT).

CHANNEL 3A1
TYPICAL CROSS-SECTION
NOT TO SCALE

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOW, VELOCITY, AND DEPTH UPDATES	

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
CHANNEL PROFILE
CHANELL 3A1

PROJECT TITLE
CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT
CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1301 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216068.00
DSN. BY: RG/RRK
DWN. BY: NR
CHK. BY: BJD
Q/A RVW BY: RRK
APR. BY: RRK

CADD FILE: 6A.A4 – CHANNEL PROFILES

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO.
6A.6

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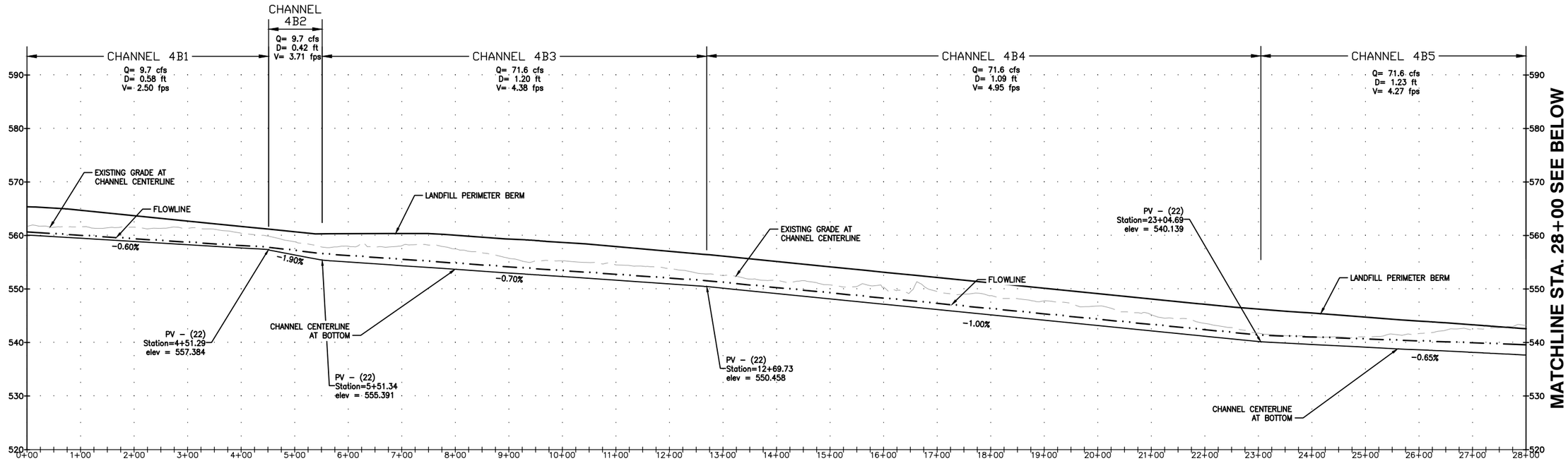
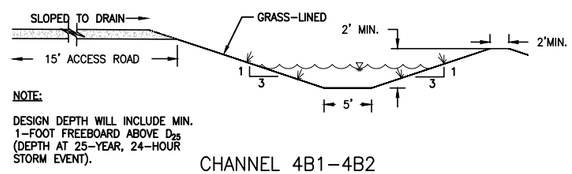
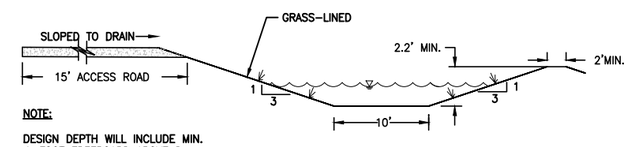




NOTE:

DESIGN DEPTH WILL INCLUDE MIN. 1-FOOT FREEBOARD ABOVE D_{25} (DEPTH AT 25-YEAR, 24-HOUR STORM EVENT).

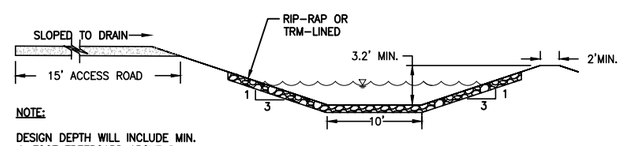
CHANNEL 4B1-4B2
TYPICAL CROSS-SECTION
NOT TO SCALE



NOTE:

DESIGN DEPTH WILL INCLUDE MIN. 1-FOOT FREEBOARD ABOVE D_{25} (DEPTH AT 25-YEAR, 24-HOUR STORM EVENT).

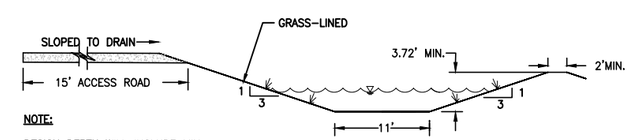
CHANNEL 4B3-4B6
TYPICAL CROSS-SECTION
NOT TO SCALE



NOTE:

DESIGN DEPTH WILL INCLUDE MIN. 1-FOOT FREEBOARD ABOVE D_{25} (DEPTH AT 25-YEAR, 24-HOUR STORM EVENT).

CHANNEL 4B7
TYPICAL CROSS-SECTION
NOT TO SCALE

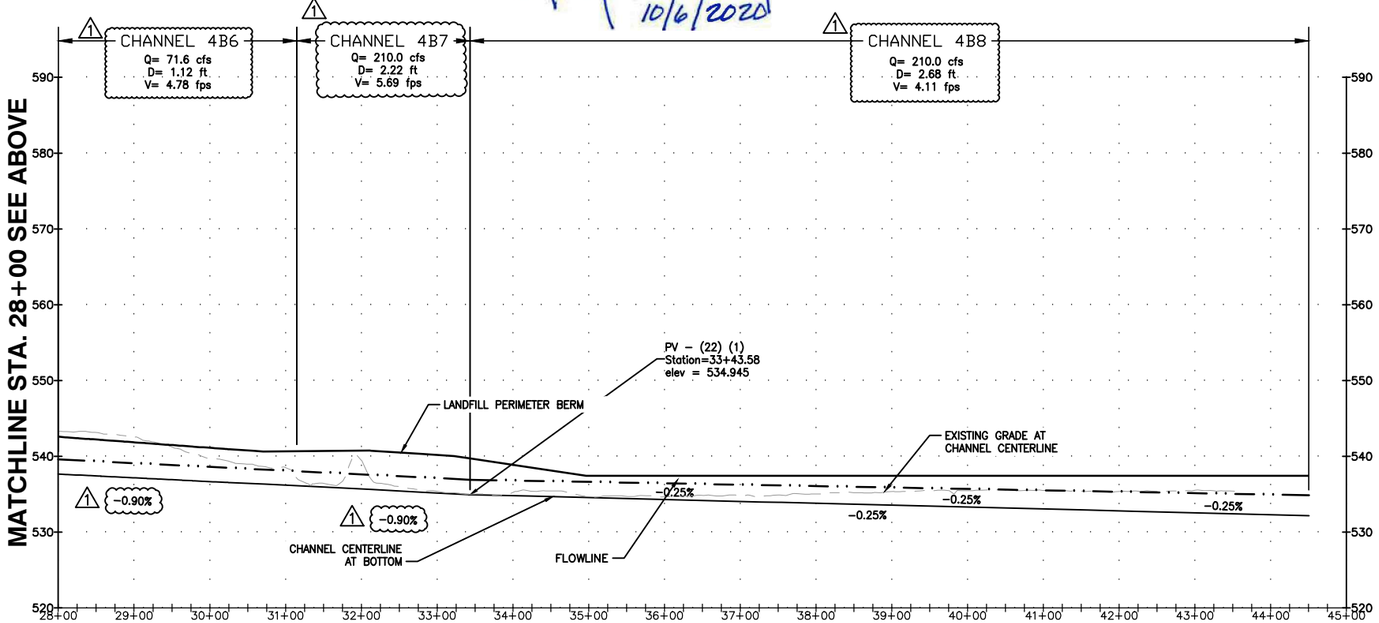


NOTE:

DESIGN DEPTH WILL INCLUDE MIN. 0.4-FOOT FREEBOARD ABOVE D_{25} (DEPTH AT 25-YEAR, 24-HOUR STORM EVENT).

CHANNEL 4B8
TYPICAL CROSS-SECTION
NOT TO SCALE

STATE OF TEXAS
JAMES ROY MURRAY III
73860
LICENSED
PROFESSIONAL ENGINEER
10/6/2020



FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: SLOPE, FLOW, VELOCITY, AND DEPTH UPDATES	

DRAWING TITLE: CHANNEL PROFILE CHANNEL 4B1 TO CHANNEL 4B7

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: BG/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

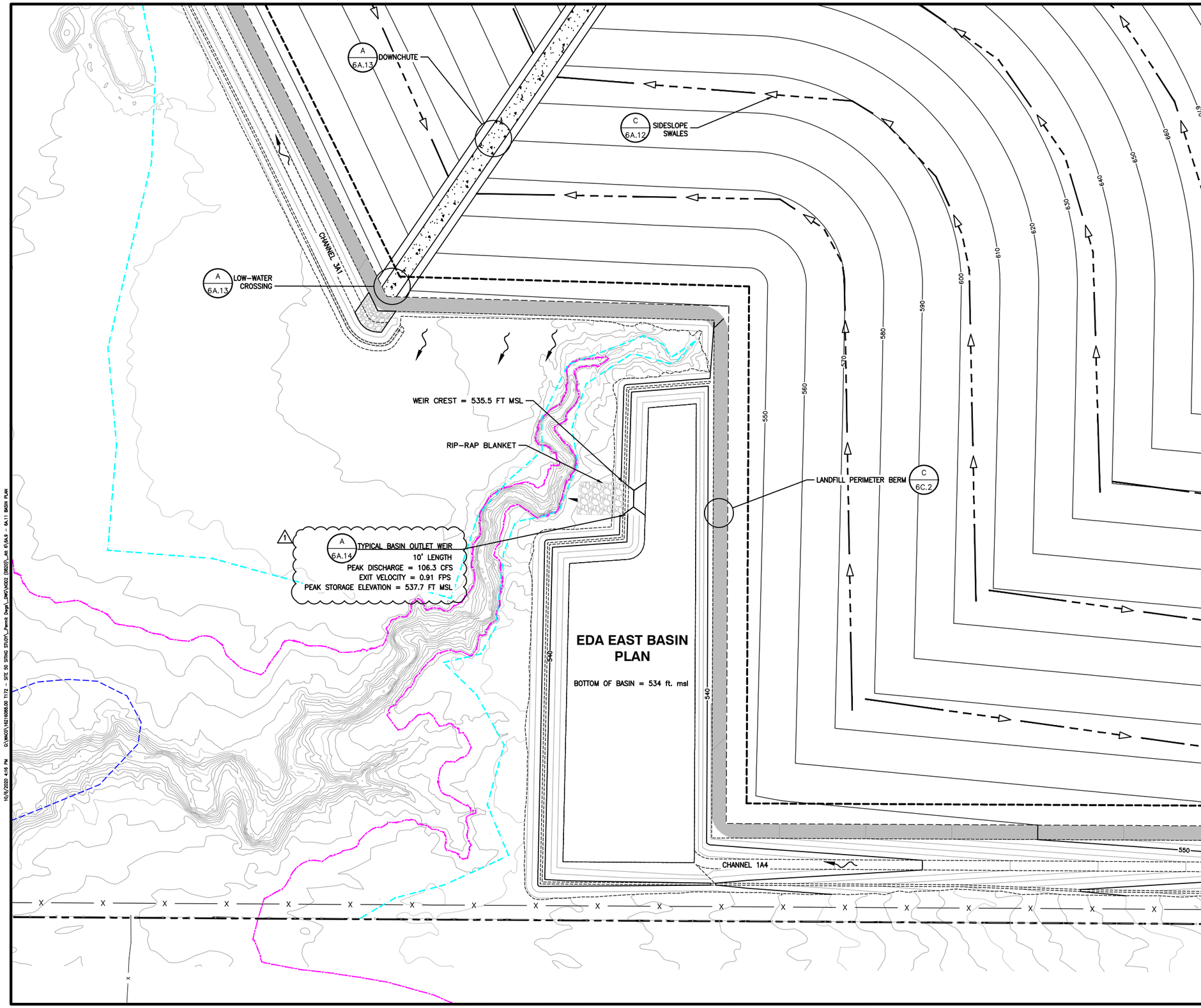
CADD FILE: 6A.A4 - CHANNEL PROFILES

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 6A.8

10/6/2020 7:28 PM G:\WACO\16216088.00 1172 - SITE 50 SITING STUDY_Permit Dwgs_DWG\V002 (0820)_AR 6\6A.A4 - CHANNEL PROFILES



0 50 100
SCALE IN FEET

LEGEND

LEGEND

- 560 — EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- PERMIT BOUNDARY
- LIMITS OF WASTE
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- 100-YEAR STORM EVENT WATER SURFACE (SEE NOTE 3)
- 650 — FINAL COVER TOPOGRAPHIC CONTOURS (SEE NOTE 4)
- X — PROPOSED/EXISTING PERIMETER FENCE (BARBED WIRE)
- DRAINAGE SWALES
- DOWNCHUTES
- PERIMETER CHANNEL AND SURFACE FLOW DIRECTION
- 1 SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTE:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPACIAL FROM AERIAL PHOTOGRAPHY FLOWN JULY 03, 2018.
2. 1 100-YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
3. 100-YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC-HMS AND HEC-RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.
4. ELEVATIONS SHOWN ON THIS DRAWING ARE TOP OF FINAL COVER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).

1 ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

STATE OF TEXAS
JAMES ROY MURRAY III
73860
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, LIMITS OF WASTE, EXIT VELOCITY, AND NOTE 2.	JRM

DRAWING TITLE: EDA EAST BASIN PLAN

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: BG/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 6A.9 - 6A.11 BASIN PLAN

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 6A.9

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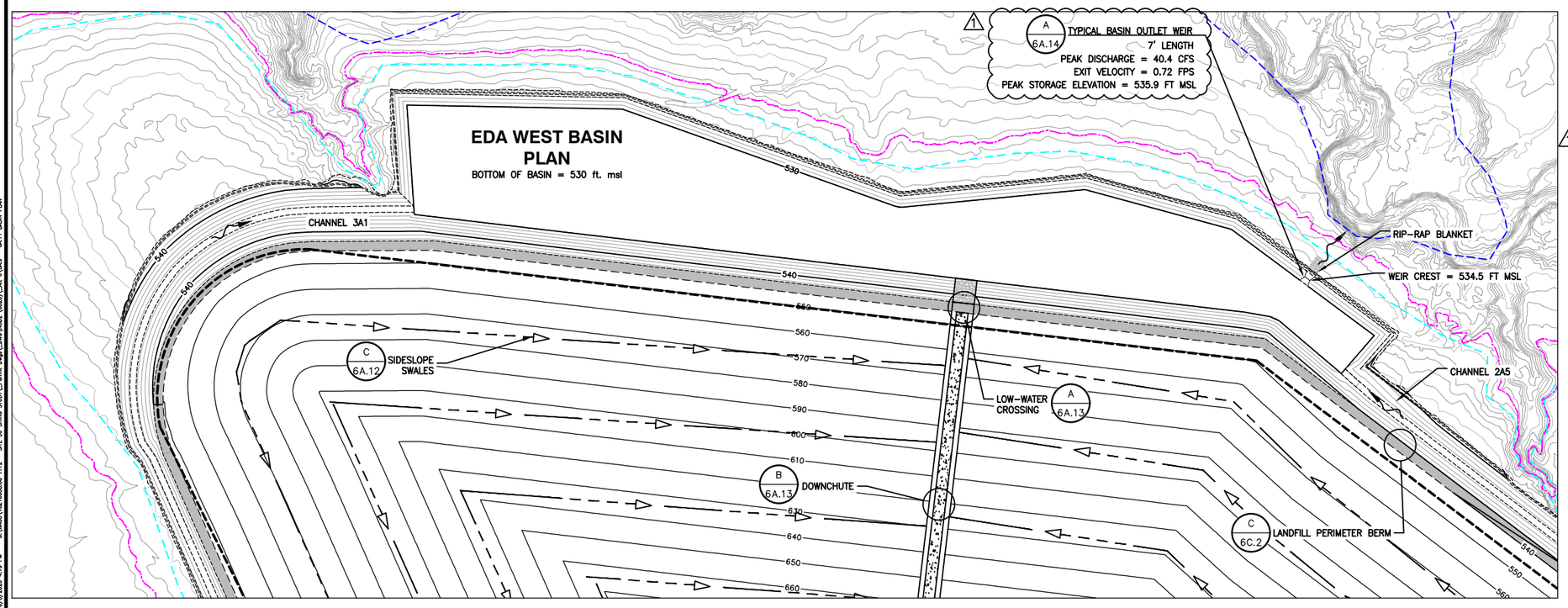

0 100 200
SCALE IN FEET

LEGEND

- 560 — EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 1 — LIMITS OF WASTE
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- 100-YEAR STORM EVENT WATER SURFACE (SEE NOTE 3)
- 650 — FINAL COVER TOPOGRAPHIC CONTOURS (SEE NOTE 4)
- DRAINAGE SWALES
- DOWNCHUTES
- PERIMETER CHANNEL AND SURFACE FLOW DIRECTION
- 1 — SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTE:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPACIAL FROM AERIAL PHOTOGRAPHY FLOWN JULY 03, 2018.
2. 100-YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
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4. ELEVATIONS SHOWN ON THIS DRAWING ARE TOP OF FINAL COVER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).

1 ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

STATE OF TEXAS
JAMES ROY MURRAY III
73860
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, LIMITS OF WASTE, EXIT VELOCITY, AND NOTE 2.	JRM

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: EDA WEST BASIN PLAN

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DWN. BY: NR | Q/A RVW BY: RRK
DSN. BY: RG/RRK | CHK. BY: BJD | APP. BY: RRK

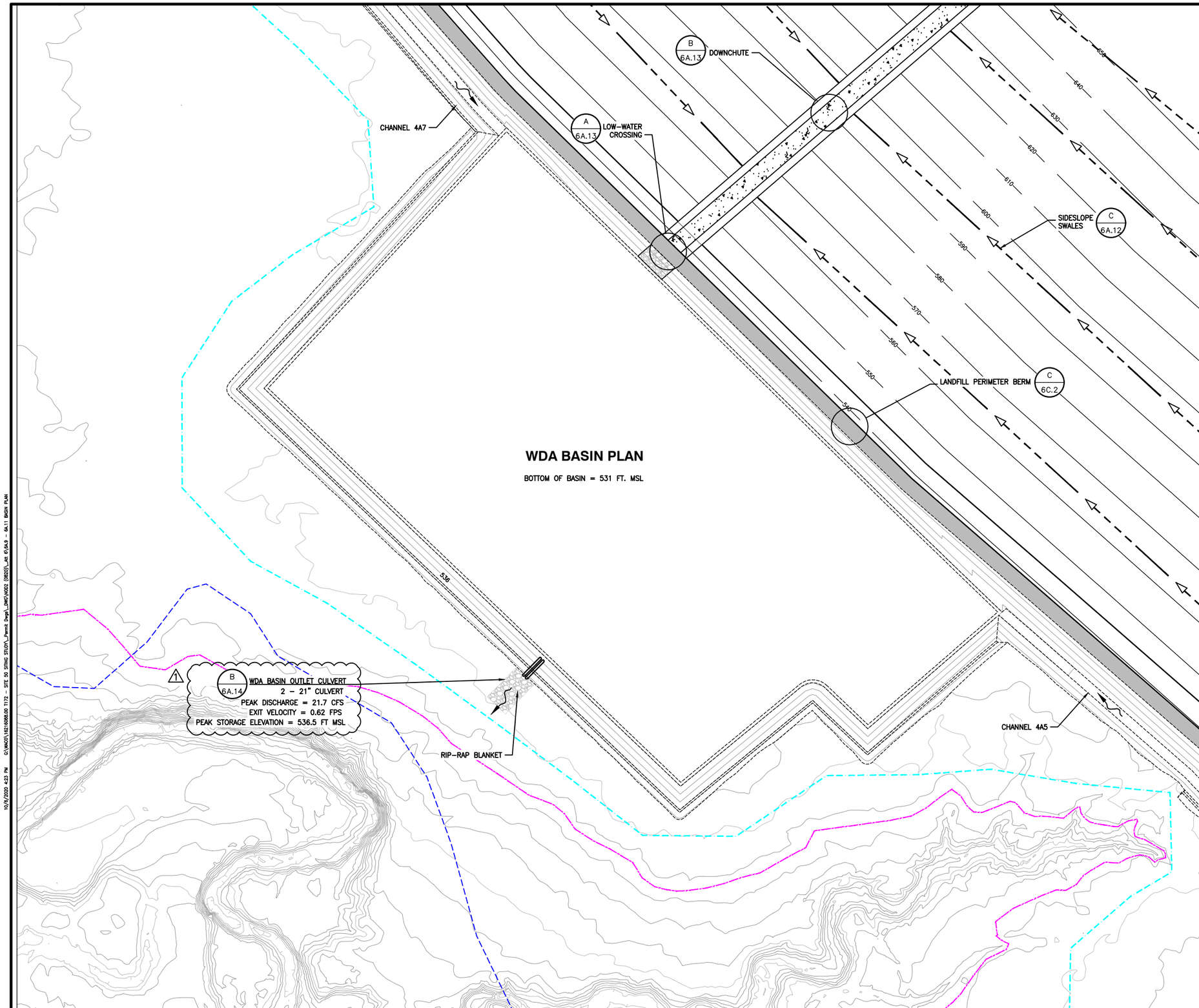
CADD FILE: 6A.9 – 6A.11 BASIN PLAN

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 6A.10

10/6/2020 4:19 PM G:\WACO\16216088.00 1172 - SITE 50 SITING STUDY_Permit Dwgs_DWG\WCO2 (0620)_A6 6A.9 - 6A.11 BASIN PLAN



0 50 100
SCALE IN FEET

LEGEND

- 560 — EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- PERMIT BOUNDARY
- LIMITS OF WASTE
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- 100-YEAR STORM EVENT WATER SURFACE (SEE NOTE 3)
- 650 — FINAL COVER TOPOGRAPHIC CONTOURS (SEE NOTE 4)
- DRAINAGE SWALES
- DOWNCHUTES
- PERIMETER CHANNEL AND SURFACE FLOW DIRECTION
- SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTE:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPACIAL FROM AERIAL PHOTOGRAPHY FLOWN JULY 03, 2018.
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3. 100-YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC-HMS AND HEC-RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.
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STATE OF TEXAS
JAMES ROY MURRAY III
73860
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, LIMITS OF WASTE, EXIT VELOCITY, AND NOTE 2.	JRM

DRAWING TITLE: WDA BASIN PLAN

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DWN. BY: NR | CHK. BY: BJD | DSN. BY: BG/RRK | QA SVR BY: RRK | APP. BY: RRK

CADD FILE: 6A.9 – 6A.11 BASIN PLAN

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 6A.11

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

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APPENDIX 6A-A

HEC-HMS INPUT PARAMETERS

- Reservoir 19 (Elevation-Area-Discharge Relationship)
- Pre-development Subbasins
- Post-development Subbasins
- Post-development Perimeter Drainage Channels
- Post-Development Detention Basins (Elevation-Area-Discharge Relationships)
- Precipitation Data
- SCS Curve Numbers
- Manning's Coefficients
- Kinematic Wave Method – Roughness Factors

SCS Engineers
TBPE Reg. # F-3407

Inclusive of pages 6A-A-1 to 6A-A-29

POST-DEVELOPMENT SUBBASINS

CITY OF WACO LANDFILL
KINEMATIC WAVE INPUT PARAMETERS
- POST-DEVELOPMENT CONDITIONS -

Discharge Study Point	Contributing Drainage Areas	Drainage Plane			Collector							Main Channel					Area (sq. mi.)	Curve Number (CN)	SCS Method				
		Length	Slope	Roughness	Area	No. of Collectors	Length	Slope	Manning's Coefficient	Width	Sideslope	Length	Slope	Manning's Coefficient	Width	Sideslope			Stream Length	Slope	Manning n	Sheet Flow T_c	Lag Time
		(ft)	(ft/ft)		(sq. mil.)		(ft)	(ft/ft)		(ft)	xH:1V	(ft)	(ft/ft)		(ft)	xH:1V			(ft)	(ft/ft)		(min)	(min)
POD-1	DA-1A	130	0.25	0.15	0.00395	9	847	0.01	0.027	0	3	536	0.25	0.033	15	2	0.0355	85.0	-	-	-	-	-
	DA-1B	189	0.05	0.15	-	-		-	-	-	-	906	0.01	0.027	0	3	0.0055	85.0	-	-	-	-	-
	*DA-1C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0042	85.0	179	0.0100	0.15	17.87	11
	*DA-1D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0023	85.0	138	0.0100	0.15	14.52	9
	**DA-1E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0019	85.0	179	0.2500	0.15	4.92	5
POD-8	DA-2A	130	0.25	0.15	0.00353	8	757	0.01	0.027	0	3	950	0.25	0.033	15	2	0.0282	85.0	-	-	-	-	-
	DA-2B	117	0.05	0.15	-	-	-	-	-	-	-	496	0.01	0.027	0	3	0.0030	85.0	-	-	-	-	-
	DA-3A	130	0.25	0.15	0.00370	10	793	0.01	0.027	0	3	634	0.25	0.033	15	2	0.0370	85.0	-	-	-	-	-
	DA-3B	179	0.05	0.15	-	-	-	-	-	-	-	808	0.01	0.027	0	3	0.0040	85.0	-	-	-	-	-
	DA-3C	130	0.25	0.15	0.00417	10	895	0.01	0.027	0	3	568	0.25	0.033	15	2	0.0417	85.0	-	-	-	-	-
	DA-3D	161	0.05	0.15	-	-	-	-	-	-	-	822	0.01	0.027	0	3	0.0040	85.0	-	-	-	-	-
	DA-3E	130	0.25	0.15	0.00371	9	796	0.01	0.027	0	3	693	0.25	0.033	15	2	0.0334	85.0	-	-	-	-	-
	DA-3F	181	0.05	0.15	-	-	-	-	-	-	-	866	0.01	0.027	0	3	0.0027	85.0	-	-	-	-	-
	DA-4A	130	0.25	0.15	0.00368	8	789	0.01	0.027	0	3	438	0.25	0.033	15	2	0.0294	85.0	-	-	-	-	-
	DA-4B	236	0.05	0.15	-	-	-	-	-	-	-	566	0.01	0.027	0	3	0.0050	85.0	-	-	-	-	-
	DA-4C	130	0.25	0.15	0.00324	6	694	0.01	0.027	0	3	387	0.25	0.033	15	2	0.0194	85.0	-	-	-	-	-
	DA-4D	218	0.05	0.15	-	-	-	-	-	-	-	368	0.01	0.027	0	3	0.0027	85.0	-	-	-	-	-
	*DA-4E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0047	85.0	104	0.0100	0.15	11.54	7
	DA-5A	130	0.25	0.15	0.00517	7	1109	0.01	0.027	0	3	844	0.25	0.033	15	2	0.0362	85.0	-	-	-	-	-
	DA-5B	176	0.05	0.15	-	-	-	-	-	-	-	554	0.01	0.027	0	3	0.0036	85.0	-	-	-	-	-
	DA-5C	130	0.25	0.15	0.00199	5	427	0.01	0.027	0	3	370	0.25	0.033	15	2	0.0099	85.0	-	-	-	-	-
	DA-5D	242	0.05	0.15	-	-	-	-	-	-	-	491	0.01	0.027	0	3	0.0048	85.0	-	-	-	-	-
	*DA-5E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0033	85.0	96	0.0100	0.15	10.87	7

Total Area = 0.32 **sq. miles**
Waste Diposal Total Area = 205 **acres**

Note:
1. *, Drainage areas indicated with an asterisk, include areas modeled using the Velocity method, as described in Attachment 6A, Section 2.2.
1. **, Drainage area DA-1E indicated with two asterisks, open channel was included into lag time calculation.

Open Channel Flow								
Surface Description	Length	Slope (ft/ft)	Manning n	Cross-sectional Area	Wetted Perimeter	Hydraulic Radius	Avg. Velocity	Channel Flow T_c
	(feet)	(ft/ft)		(ft2)	(ft)	(ft)	(ft/s)	(min)
Grass	1006	0.013	0.027	5.8	9.0	0.6	4.6	4

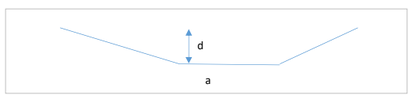
	a (ft)	d (ft)	left slope (%)	right slope (%)	Area (ft2)	Wetted P (ft)
DA-1E	2.85	1.0	32.0	37.0	5.8	9.0

CITY OF WACO LANDFILL
VELOCITY METHOD INPUT PARAMETERS
- POST-DEVELOPMENT CONDITIONS -

2-yr, 24-hr Rainfall Depth = 4.25 imches

Discharge Study Point	Contributing Drainage Areas	Area (sq. mi.)	Curve Number (CN)	Sheet Flow				Shallow Concentrated Flow				Open Channel Flow								Time of Concentration (Tc)				Total Lag Time
				Surface Description	Length	Slope	Manning n	Surface Description	Length	Slope	Avg. Velocity	Surface Description	Length	Slope (ft/ft)	Manning n	Cross-sectional Area	Wetted Perimeter	Hydraulic Radius	Avg. Velocity	Sheet Flow T_c	Shallow Concentrated Flow T_c	Channel Flow T_c	Total T_c	
					(feet)	(ft/ft)			(feet)	(ft/ft)	(ft/s)		(feet)	(ft/ft)		(ft2)	(ft)	(ft)	(ft/s)	(min)	(min)	(min)	(min)	(min)
POD-1	PRE-1R	0.0149	74.7	Grass	262	0.021	0.15	-	-	-	-	Grass	472	0.028	0.027	5.8	9.0	0.6	6.9	18	-	1	19	11
	OS-5	0.0131	80.0	Grass	300	0.008	0.15	Grass	2149	0.010	0.7	-	-	-	-	-	-	-	-	29	51	-	81	48
	EDA East	0.0030	99.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
POD-2	PRE-2R	0.0086	73.0	Grass	300	0.009	0.15	-	-	-	-	-	-	-	-	-	-	-	-	28	-	-	28	17
POD-3 & 4	PRE-3R	0.0207	73.0	Grass	300	0.014	0.15	Grass	1050	0.014	0.8	-	-	-	-	-	-	-	-	24	21	-	45	27
	PRE-4R	0.0056	73.0	Grass	300	0.013	0.15	Grass	172	0.017	0.9	-	-	-	-	-	-	-	-	24	3	-	27	16
POD-5 & 6	PRE-5R	0.0356	73.0	Grass	300	0.017	0.15	Grass	1302	0.017	0.9	Grass	760	0.013	0.027	5.1	10.5	0.5	3.8	22	24	3	49	29
	PRE-6R	0.0043	73.0	Grass	300	0.007	0.15	Grass	458	0.009	0.7	-	-	-	-	-	-	-	-	31	12	-	43	26
POD-7	PRE-7R	0.0226	73.0	Grass	300	0.028	0.15	Grass	1416	0.010	0.7	-	-	-	-	-	-	-	-	18	34	-	52	31
POD-8	PRE-8ABR	0.0847	73.8	Grass	300	0.005	0.15	Grass	-	-	-	Grass	3100	0.001	0.027	22.7	15.3	1.5	2.3	36	-	23	59	35
	PRE-8CR	0.1912	73.1	-	-	-	-	Grass	613	0.018	0.9	Grass	8832	0.001	0.027	40.6	24.3	1.7	2.9	-	11	51	62	37
	PRE-8DR	0.0325	73.7	Grass	300	0.010	0.15	Grass	1501	0.012	0.8	-	-	-	-	-	-	-	-	27	33	-	60	36
	OS-1	1.5800	79.7	Grass	300	0.013	0.15	Grass	2460	0.013	0.8	Grass	11834	0.006	0.027	137.1	110.4	1.2	5.1	24	52	39	115	69
	OS-2	0.0580	80.0	Grass	300	0.017	0.15	Grass	1133	0.016	0.9	Grass	920	0.011	0.027	6.8	9.3	0.7	4.6	22	22	3	47	28
	OS-3	0.0233	80.0	Grass	300	0.005	0.15	Grass	611	0.015	0.8	-	-	-	-	-	-	-	-	37	12	-	49	29
	EDA WEST	0.0120	99.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	WDA	0.0100	99.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
POD-9	PRE-9R	0.0029	73.0	Grass	300	0.002	0.15	Grass	164	0.004	0.5	-	-	-	-	-	-	-	-	48	6	-	54	33
POD-10	PRE-10AR	0.0016	80.0	Grass	300	0.014	0.15	Grass	678	0.008	0.6	-	-	-	-	-	-	-	-	23	18	-	42	25
	PRE-10BR	0.0032	80.0	Grass	300	0.007	0.15	Grass	946	0.009	0.7	-	-	-	-	-	-	-	-	32	23	-	55	33
POD-11	PRE-11R	0.0100	80.0	Grass	300	0.015	0.15	Grass	516	0.021	1.0	-	-	-	-	-	-	-	-	23	9	-	31	19

Channel Section:



Total Area = 2.15 **sq. miles**
Total Area = 1374 **acres**
Permit Property Total Area = 293 **acres**

	a (ft)	d (ft)	left slope (%)	right slope (%)	Area (ft2)	Wetted P (ft)	2-year, 24 hour		
PRE-1R Channel Section:	2.85	1.0	32.0	37.0	5.8	9.0	Q2yr :	16.9	cfs
PRE-5R Channel Section:	3.19	0.8	15.5	31.0	5.1	10.5	Q2yr:	16.2	cfs
PRE-8ABR Channel Section:	2.75	2.5	54.0	32.0	22.7	15.3	Q2 yr:	44.2	cfs
PRE-8CR Channel Section:	4.65	2.9	22.5	50.0	40.6	24.3	Q2 yr:	94.5	cfs
OS-1 Channel Section:	42.00	1.8	7.7	4.0	137.1	110.4	Q2 yr:	710.3	cfs
OS-2 Channel Section:	0.75	1.6	27.1	85.1	6.8	9.3	Q2 yr:	44.6	cfs

Note:
1. Drainage Areas Pre-10A, Pre-10B, and Pre-11 were not included in the HEC-HMS Model due to the following: (1) these areas will not be disturbed during development of the landfill; and (2) these areas due not contribute run-on/runoff to the post-development perimeter

Methodology:

Reference: United States Department of Agriculture. Hydrology National Engineering Handbook, Part 630 (May 2010). Chapter 15, Time of Concentration.

Sheet Flow T_c

$$T_t = \frac{0.007(nl)^{0.8}}{(P_2)^{0.5}S^{0.4}} \quad \text{(eq. 15-8)}$$

where:
T_t = travel time, h
n = Manning's roughness coefficient (0.15, short-grass prairie)
l = sheet flow length, ft
P_2 = 2-year, 24-hour rainfall, in (4.25 inches)
S = slope of land surface, ft/ft

Shallow Concentrated Flow T_c

$$V = 6.962\,(s)^{0.5}$$

where:
V = Average velocity, ft/s
s = slope of the hydraulic grade line, ft/ft

(Table 15-3 for Short-grass pasture flow type)

Channel Flow T_c

$$V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n} \quad \text{(eq. 15-10)}$$

where:
V = Average velocity, ft/s
r = hydraulic radius, ft
$= \frac{a}{P_w}$
a = cross-sectional flow area, ft2
P_w = Wetted perimeter, ft
s = slope of the hydraulic grade line, ft/ft
n = Manning's n value for open channel flow (0.027, grass)

Lag time

$$V = 0.6\,T_c \quad \text{(eq. 15-3)}$$

where:
L = lag, h
T_c = time of concentration, h

POST-DEVELOPMENT PERIMETER DRAINAGE CHANNELS

Channel Name	Receiving Basin	Receiving POD	Channel Length (ft)	Bottom Slope (ft/ft)	Bottom Width (ft)	Sideslope (XH:1V)	Depth (ft)	Mannings Coefficient	Lining Material
1A1	EDA EAST BASIN	POD 1	404	0.0100	5	3	2.00	0.027	Grass
1A2	EDA EAST BASIN	POD 1	1,274	0.0080	5	3	2.00	0.027	Grass
1A3	EDA EAST BASIN	POD 1	348	0.0025	10	3	3.50	0.027	Grass
1A4	EDA EAST BASIN	POD 1	711	0.0220	10	3	3.00	0.033	TRM/Rip Rap
2A1	EDA WEST BASIN	POD 8	223	0.0225	10	3	2.25	0.033	TRM/Rip Rap
2A2	EDA WEST BASIN	POD 8	818	0.0070	10	3	3.00	0.027	Grass
2A3	EDA WEST BASIN	POD 8	762	0.0225	10	3	3.00	0.033	TRM/Rip Rap
2A4	EDA WEST BASIN	POD 8	1,159	0.0025	10	3	3.00	0.027	Grass
2A5	EDA WEST BASIN	POD 8	852	0.0025	10	3	4.05	0.027	Grass
3A1	EDA WEST BASIN	POD 8	2,037	0.0025	10	3	3.20	0.027	Grass
4A1	WDA BASIN	POD 8	434	0.0025	5	3	2.00	0.027	Grass
4A2	WDA BASIN	POD 8	416	0.0300	5	3	2.00	0.027	Grass
4A3	WDA BASIN	POD 8	338	0.0150	10	3	2.30	0.033	TRM/Rip Rap
4A4	WDA BASIN	POD 8	1,636	0.0060	10	3	2.50	0.027	Grass
4A5	WDA BASIN	POD 8	240	0.0025	10	3	3.00	0.027	Grass
4B1	WDA BASIN	POD 8	448	0.0060	5	3	2.00	0.027	Grass
4B2	WDA BASIN	POD 8	104	0.0190	5	3	2.00	0.027	Grass
4B3	WDA BASIN	POD 8	714	0.0070	10	3	2.20	0.027	Grass
4B4	WDA BASIN	POD 8	341	0.0100	10	3	2.20	0.027	Grass
4B5	WDA BASIN	POD 8	699	0.0065	10	3	2.23	0.027	Grass
4B6	WDA BASIN	POD 8	495	0.0090	10	3	2.20	0.027	Grass
4B7	WDA BASIN	POD 8	245	0.0090	10	3	3.70	0.033	TRM/Rip Rap
4B8	WDA BASIN	POD 8	1,406	0.0025	11	3	3.74	0.027	Grass

Note: TRM = Turf Reinforcing Mat, a permanent reinforcing mat placed below vegetation layer to increase resistance to erosion.

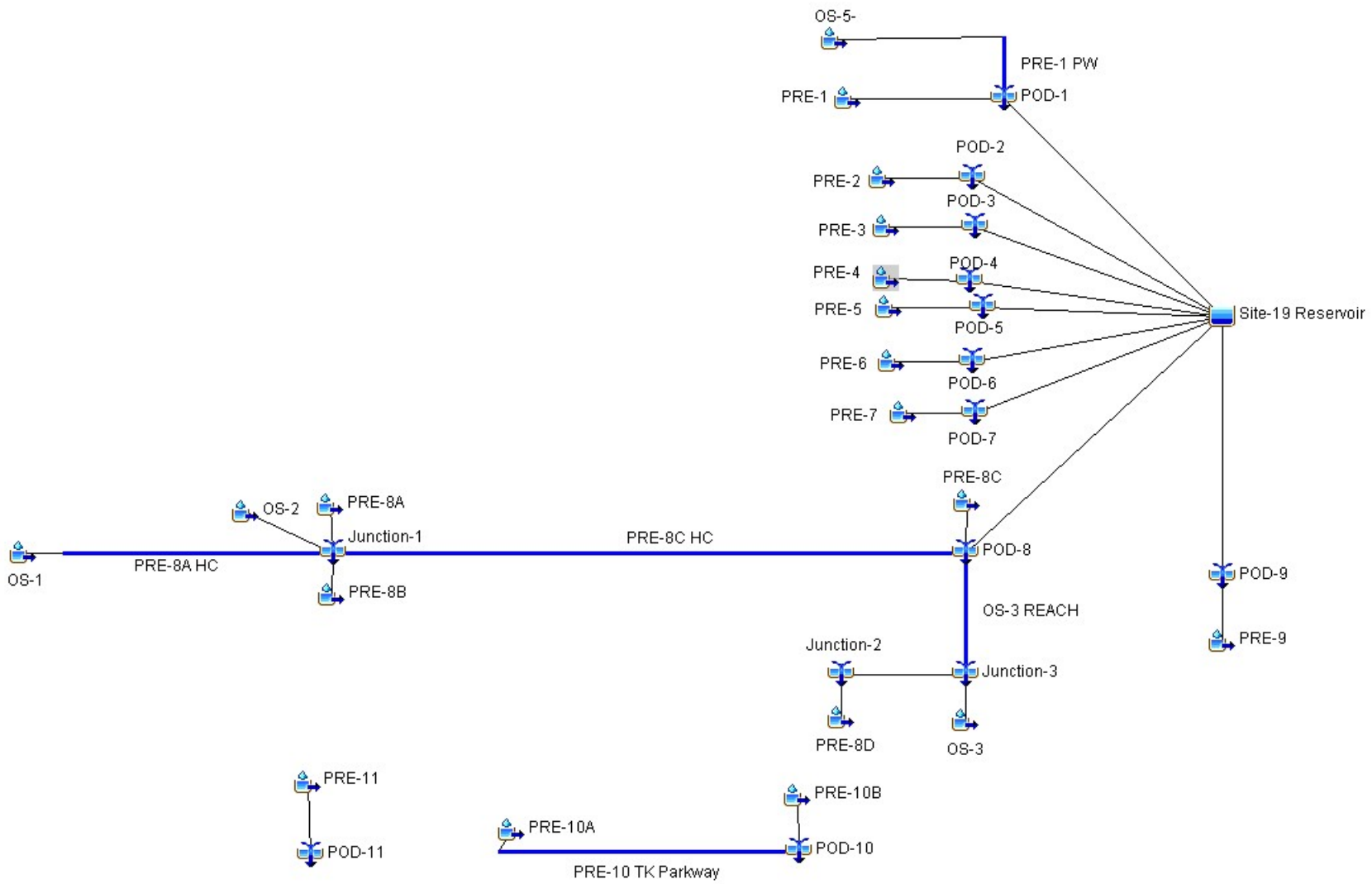
APPENDIX 6A-B

HEC-HMS PRE-DEVELOPMENT INPUT/OUTPUT FILES

SCS Engineers
TBPE Reg. # F-3407

Inclusive of pages 6A-B-1 to 6A-B-61

BLOSSOM PRAIRIE LANDFILL
HEC-HMS INPUT SCHEMATIC
PRE-DEVELOPMENT CONDITIONS



PRE-DEVELOPMENT INPUT FILES

```
Basin: Pre-Development
     Last Modified Date: 29 September 2020
     Last Modified Time: 23:45:09
     Version: 4.0
     Filepath Separator: \
     Unit System: English
     Missing Flow To Zero: No
     Enable Flow Ratio: No
     Compute Local Flow At Junctions: No

     Enable Sediment Routing: No

     Enable Quality Routing: No
End:

Subbasin: OS-1
     Canvas X: -11792.89026275116
     Canvas Y: 46.367851622875605
     Area: 1.58
     Downstream: PRE-8A HC

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 79.7

     Transform: SCS
     Lag: 69
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: PRE-8A HC
     Canvas X: -6537.867078825348
     Canvas Y: -602.782071097372
     From Canvas X: -10494.590417310661
     From Canvas Y: -602.7820710973729
     Label X: -61.0
     Label Y: -12.0
     Downstream: Junction-1

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 3400
     Energy Slope: 0.001
```

```
     Width: 33
     Side Slope: 2.33
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: PRE-8A
     Canvas X: -6461.380716767375
     Canvas Y: 1118.5989395770412
     Area: 0.0873
     Downstream: Junction-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73.8

     Transform: SCS
     Lag: 35
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: OS-2
     Canvas X: -8404.210453927497
     Canvas Y: -1972.2665513595166
     Area: 0.058
     Downstream: Junction-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 28
     Unitgraph Type: STANDARD

     Baseflow: None
End:
```

```
Subbasin: PRE-8B
     Canvas X: -6255.323017371606
     Canvas Y: -1942.829737160122
     Area: 0.0510
     Downstream: Junction-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 77.4

     Transform: SCS
     Lag: 39
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: Junction-1
     Canvas X: -6537.867078825348
     Canvas Y: -602.782071097372
     Downstream: PRE-8C HC
End:

Reach: PRE-8C HC
     Canvas X: 6012.364760432767
     Canvas Y: -1313.755795981453
     From Canvas X: -6537.867078825348
     From Canvas Y: -602.782071097372
     Label X: -30.0
     Label Y: 9.0
     Downstream: POD-8

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 8902
     Energy Slope: 0.001
     Width: 28.8
     Side Slope: 2.33
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: PRE-8C
```

```
     Canvas X: 6043.276661514687
     Canvas Y: -448.22256568778903
     Label X: -72.0
     Label Y: -4.0
     Area: 0.3085
     Downstream: POD-8

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73.1

     Transform: SCS
     Lag: 60
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: PRE-8D
     Canvas X: 3323.0293663060293
     Canvas Y: -6383.307573415765
     Area: 0.0770
     Downstream: Junction-2

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 74.8

     Transform: SCS
     Lag: 34
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: Junction-2
     Canvas X: 3415.7650695517805
     Canvas Y: -4992.27202472952
     Downstream: Junction-3
End:
```

```
Subbasin: OS-3
     Canvas X: 5950.540958268935
     Canvas Y: -6476.043276661514
     Area: 0.024
     Downstream: Junction-3

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 29
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: Junction-3
     Canvas X: 5919.6290571870195
     Canvas Y: -4992.27202472952
     Downstream: OS-3 REACH
End:

Reach: OS-3 REACH
     Canvas X: 6012.364760432767
     Canvas Y: -1313.755795981453
     From Canvas X: 5919.6290571870195
     From Canvas Y: -4992.27202472952
     Downstream: POD-8

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 2039
     Energy Slope: 0.0030
     Width: 5
     Side Slope: 10
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Junction: POD-8
     Canvas X: 6012.364760432767
     Canvas Y: -1313.755795981453
```

```
     Downstream: Site-19 Reservoir
End:

Subbasin: PRE-1
     Canvas X: 3519.037333836861
     Canvas Y: 6583.142084592149
     Area: 0.1022
     Downstream: POD-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 75.3

     Transform: SCS
     Lag: 39
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: OS-5
     Canvas X: 4241.577318731119
     Canvas Y: 8188.786495468284
     Area: 0.013
     Downstream: PRE-1 PW

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 48
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: PRE-1 PW
     Canvas X: 6676.804675226589
     Canvas Y: 6556.38134441088
```

```
     From Canvas X: 6757.086895770395
     From Canvas Y: 7814.136132930518
     Downstream: POD-1

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 2364
     Energy Slope: 0.011
     Width: 38.9
     Side Slope: 4.44
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Junction: POD-1
     Canvas X: 6676.804675226589
     Canvas Y: 6556.38134441088
     Downstream: Site-19 Reservoir
End:

Subbasin: PRE-5
     Canvas X: 4374.03400309119
     Canvas Y: 2272.0247295208665
     Label X: -69.0
     Label Y: -4.0
     Area: 0.0422
     Downstream: POD-5

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73

     Transform: SCS
     Lag: 39
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-5
     Canvas X: 6136.012364760434
     Canvas Y: 2055.641421947451
     Downstream: Site-19 Reservoir
End:
```

```
Subbasin: PRE-2
     Canvas X: 3252.7679690332334
     Canvas Y: 5445.810626888221
     Label X: -78.0
     Label Y: -5.0
     Area: 0.0248
     Downstream: POD-2

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73

     Transform: SCS
     Lag: 29
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-2
     Canvas X: 6059.654631083202
     Canvas Y: 4976.4521193092605
     Label X: -1.0
     Label Y: -1.0
     Downstream: Site-19 Reservoir
End:

Subbasin: PRE-3
     Canvas X: 4374.03400309119
     Canvas Y: 3879.4435857805265
     Label X: -67.0
     Label Y: 1.0
     Area: 0.0235
     Downstream: POD-3

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73
```

```
     Transform: SCS
     Lag: 31
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-3
     Canvas X: 5888.717156105104
     Canvas Y: 3724.8840803709436
     Downstream: Site-19 Reservoir
End:

Subbasin: PRE-7
     Canvas X: 4404.94590417311
     Canvas Y: 46.367851622875605
     Label X: -68.0
     Label Y: -4.0
     Area: 0.0233
     Downstream: POD-7

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73

     Transform: SCS
     Lag: 31
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-7
     Canvas X: 6012.364760432767
     Canvas Y: 200.92735703245853
     Downstream: Site-19 Reservoir
End:

Subbasin: PRE-4
     Canvas X: 4250.386398763527
     Canvas Y: 2952.086553323031
     Label X: -68.0
     Label Y: 2.0
     Area: 0.0056
     Downstream: POD-4
```

```
     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73

     Transform: SCS
     Lag: 13
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-4
     Canvas X: 5857.805255023184
     Canvas Y: 2982.9984544049466
     Downstream: Site-19 Reservoir
End:

Subbasin: PRE-6
     Canvas X: 4343.122102009274
     Canvas Y: 1406.4914992272043
     Label X: -67.0
     Label Y: -4.0
     Area: 0.0043
     Downstream: POD-6

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73

     Transform: SCS
     Lag: 26
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-6
     Canvas X: 5981.452859350851
     Canvas Y: 1375.5795981452866
```

```
     Downstream: Site-19 Reservoir
End:

Subbasin: PRE-9
     Canvas X: 11112.828438948996
     Canvas Y: -4497.6816074188555
     Area: 0.0029
     Downstream: POD-9

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73

     Transform: SCS
     Lag: 33
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-9
     Canvas X: 11051.004636785165
     Canvas Y: -3013.9103554868616
     Downstream: Site-19 Reservoir
End:

Reservoir: Site-19 Reservoir
     Canvas X: 11078.880026809653
     Canvas Y: 2178.486595174264

     Route: Modified Puls
     Routing Curve: Elevation-Area-Outflow
     Initial Elevation: 520.69
     Elevation-Area Table: Site 19 Reservoir
     Elevation-Outflow Table: Site 19 Reservoir
     Primary Table: Elevation-Outflow
End:

Subbasin: PRE-11
     Canvas X: -7275.352395672336
     Canvas Y: -7176.199381761979
     Label X: -1.0
     Label Y: 1.0
     Area: 0.0104
     Downstream: POD-11
```

```
     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 19
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-11
     Canvas X: -7217.928902627511
     Canvas Y: -8639.876352395671
End:

Subbasin: PRE-10B
     Canvas X: 2550.2318392581146
     Canvas Y: -7434.312210200927
     Area: 0.0135
     Downstream: POD-10

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 79.6

     Transform: SCS
     Lag: 35
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: PRE-10A
     Canvas X: -3508.500772797526
     Canvas Y: -7743.431221020093
     Area: 0.0085
     Downstream: PRE-10 TK Parkway
```

```
     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 10
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: PRE-10 TK Parkway
     Canvas X: 2581.1437403400305
     Canvas Y: -8547.140649149924
     From Canvas X: -3477.5888717156104
     From Canvas Y: -8330.757341576505
     Label X: -69.0
     Label Y: -18.0
     Downstream: POD-10

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1215.664
     Energy Slope: 0.008
     Width: 17.8
     Side Slope: 0.12
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Junction: POD-10
     Canvas X: 2581.1437403400305
     Canvas Y: -8547.140649149924
End:

Basin Schematic Properties:
     Last View N: 5000.0
     Last View S: -5000.0
     Last View W: -5000.0
     Last View E: 5000.0
     Maximum View N: 5000.0
     Maximum View S: -5000.0
     Maximum View W: -5000.0
     Maximum View E: 5000.0
```

```
    Extent Method: Elements
    Buffer: 0
    Draw Icons: Yes
    Draw Icon Labels: Name
    Draw Map Objects: No
    Draw Gridlines: No
    Draw Flow Direction: No
    Fix Element Locations: No
    Fix Hydrologic Order: No
End:
```

```
Basin Schematic Properties:
     Last View N: 5000.0
     Last View S: -5000.0
     Last View W: -5000.0
     Last View E: 5000.0
     Maximum View N: 5880.5970149253735
     Maximum View S: -3971.33220910624
     Maximum View W: -6264.755480607084
     Maximum View E: 4915.682967959527
     Extent Method: Elements
     Buffer: 0
     Draw Icons: Yes
     Draw Icon Labels: Name
     Draw Map Objects: No
     Draw Gridlines: No
     Draw Flow Direction: No
     Fix Element Locations: No
     Fix Hydrologic Order: No
End:
```

PRE-DEVELOPMENT OUTPUT FILES

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (pre)

Start of Run: 02Oct2018, 00:00 Basin Model: Pre-Development
End of Run: 04Oct2018, 00:00 Meteorologic Model: 25-year, 24-hour
Compute Time: 30Sep2020, 10:47:32 Control Specifications: 48-HOUR

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
OS-1	1.58	1709.8	02Oct2018, 13:10	463.2
PRE-8A HC	1.58	1677.8	02Oct2018, 13:20	462.5
PRE-8A	0.0873	123.7	02Oct2018, 12:40	22.4
OS-2	0.058	104.2	02Oct2018, 12:30	17.1
PRE-8B	0.0510	73.6	02Oct2018, 12:40	14.2
Junction-1	1.7763	1820.9	02Oct2018, 13:20	516.3
PRE-8C HC	1.7763	1729.7	02Oct2018, 13:40	514.5
PRE-8CR	0.3085	314.9	02Oct2018, 13:10	77.9
PRE-8D	0.0770	113.1	02Oct2018, 12:40	20.2
Junction-2	0.0770	113.1	02Oct2018, 12:40	20.2
OS-3	0.024	42.3	02Oct2018, 12:30	7.0
Junction-3	0.1010	153.7	02Oct2018, 12:40	27.3
OS-3 REACH	0.1010	150.6	02Oct2018, 12:50	27.4
POD-8	2.1858	2030.2	02Oct2018, 13:40	619.7
PRE-1	0.1022	140.7	02Oct2018, 12:40	27.2
OS-5-	0.013	17.7	02Oct2018, 12:50	3.8
PRE-1 PW	0.013	17.4	02Oct2018, 13:10	3.8
POD-1	0.1152	153.9	02Oct2018, 12:50	31.0
PRE-5	0.0422	55.0	02Oct2018, 12:40	10.6
POD-5	0.0422	55.0	02Oct2018, 12:40	10.6
PRE-2	0.0248	37.5	02Oct2018, 12:30	6.2
POD-2	0.0248	37.5	02Oct2018, 12:30	6.2
PRE-3	0.0235	34.2	02Oct2018, 12:40	5.9
POD-3	0.0235	34.2	02Oct2018, 12:40	5.9
PRE-7	0.0233	33.9	02Oct2018, 12:40	5.9
POD-7	0.0233	33.9	02Oct2018, 12:40	5.9
PRE-4	0.0056	11.2	02Oct2018, 12:20	1.4
POD-4	0.0056	11.2	02Oct2018, 12:20	1.4
PRE-6	0.0043	6.9	02Oct2018, 12:30	1.1
POD-6	0.0043	6.9	02Oct2018, 12:30	1.1
PRE-9	0.0029	4.1	02Oct2018, 12:40	0.7

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
POD-9	0.0029	4.1	02Oct2018, 12:40	0.7
Site-19 Reservoir	2.4276	66.6	03Oct2018, 01:40	176.5
PRE-10B	0.0135	21.6	02Oct2018, 12:40	3.9
PRE-10A	0.0085	21.2	02Oct2018, 12:10	2.5
PRE-11 TK Parkway	0.0085	20.0	02Oct2018, 12:20	2.5
POD-10	0.0220	36.9	02Oct2018, 12:30	6.5
PRE-11	0.0104	21.9	02Oct2018, 12:20	3.1
POD-11	0.0104	21.9	02Oct2018, 12:20	3.1

Project: City of Waco Landfill Simulation Run: 25 yr, 24 hr (pre)

Reservoir: Site 19 - North Reservoir

Start of Run:	02Oct2018, 00:00	Basin Model:	PRE-DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	06Apr2020, 22:23:59	Control Specifications:	48-hour

Volume Units: AC-FT

Computed Results

Peak Inflow:	229.2 (CFS)	Date/Time of Peak Inflow:	02Oct2018, 12:40
Peak Discharge:	5.3 (CFS)	Date/Time of Peak Discharge:	03Oct2018, 00:30
Inflow Volume:	44.6 (AC-FT)	Peak Storage:	39.6 (AC-FT)
Discharge Volume:	13.9 (AC-FT)	Peak Elevation:	520.9 (FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (pre)
Reservoir: Site-19 Reservoir

Start of Run:	02Oct2018, 00:00	Basin Model:	Pre-Development
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:02:00	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Inflow:	2169.9 (CFS)	Date/Time of Peak Inflow:	02Oct2018, 13:30
Peak Discharge:	66.6 (CFS)	Date/Time of Peak Discharge:	03Oct2018, 01:40
Inflow Volume:	682.6 (AC-FT)	Peak Storage:	615.2 (AC-FT)
Discharge Volume:	176.5 (AC-FT)	Peak Elevation:	523.2 (FT)

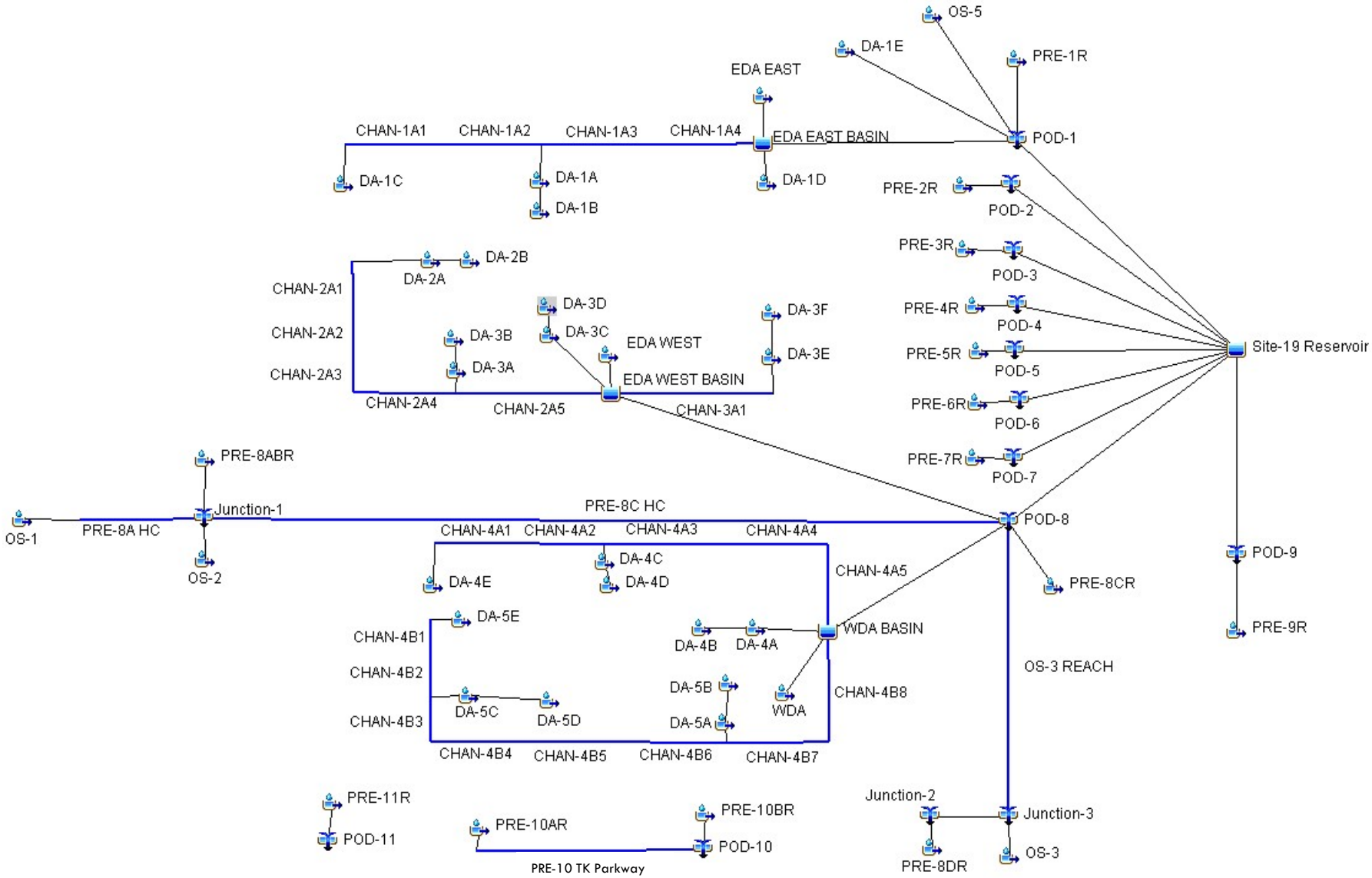
APPENDX 6A-C

HEC-HMS POST-DEVELOPMENT INPUT/OUTPUT FILES

SCS Engineers
TBPE Reg. # F-3407

Inclusive of pages 6A-C-1 to 6A-C-141

BLOSSOM PRAIRIE LANDFILL
HEC-HMS INPUT SCHEMATIC
PRE-DEVELOPMENT CONDITIONS



HEC-HMS POST-DEVELOPMENT INPUT FILES FOR EDA WEST BASIN, EDA EAST BASIN, & WDA BASIN / POD-1, POD-2, POD-3, POD-4, POD-5, POD-6, POD-7, POD-8, POD-9, POD-10, & POD-11

```
Basin: POST DEVELOPMENT
     Last Modified Date: 29 September 2020
     Last Modified Time: 21:39:14
     Version: 4.0
     Filepath Separator: \
     Unit System: English
     Missing Flow To Zero: No
     Enable Flow Ratio: No
     Compute Local Flow At Junctions: No

     Enable Sediment Routing: No

     Enable Quality Routing: No
End:

Subbasin: OS-1
     Canvas X: -15271.903323262839
     Canvas Y: -1933.5347432024173
     Label X: -27.0
     Label Y: -19.0
     Area: 1.57999
     Downstream: PRE-8A HC

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 79.7

     Transform: SCS
     Lag: 69
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: PRE-8A HC
     Canvas X: -11314.199395770393
     Canvas Y: -1933.5347432024173
     From Canvas X: -14029.333619727578
     From Canvas Y: -1962.2986874115732
     Label X: -61.0
     Label Y: -12.0
     Downstream: Junction-1

     Route: Muskingum Cunge
     Channel: Trapezoid
```

```
     Length: 558
     Energy Slope: 0.0912
     Width: 33
     Side Slope: 0.12
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: PRE-8ABR
     Canvas X: -11283.987915407855
     Canvas Y: -634.4410876132933
     Area: 0.0847
     Downstream: Junction-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73.8

     Transform: SCS
     Lag: 35
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: OS-2
     Canvas X: -11283.987915407855
     Canvas Y: -2839.8791540785514
     Label X: -27.0
     Label Y: -18.0
     Area: 0.058
     Downstream: Junction-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 28
```

```
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: Junction-1
     Canvas X: -11314.199395770393
     Canvas Y: -1933.5347432024173
     Label X: -4.0
     Label Y: 5.0
     Downstream: PRE-8C HC
End:

Reach: PRE-8C HC
     Canvas X: 6268.882175226587
     Canvas Y: -2024.169184290031
     From Canvas X: -11314.199395770393
     From Canvas Y: -1933.5347432024173
     Label X: -30.0
     Label Y: 9.0
     Downstream: POD-8

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 10612
     Energy Slope: 0.0048
     Width: 28.8
     Side Slope: 0.21
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: PRE-8CR
     Canvas X: 7265.861027190334
     Canvas Y: -3413.8972809667684
     Area: 0.1912
     Downstream: POD-8

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73.1

     Transform: SCS
     Lag: 37
```

```
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: DA-3B
     Canvas X: -5845.921450151056
     Canvas Y: 1993.9577039274918
     Area: 0.0040
     Downstream: DA-3A

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 179
     Plane 1 Slope: 0.05
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: Main
     Channel Length: 808
     Channel Slope: 0.01
     Channel Mannings N: 0.027
     Shape: Triangle
     Channel Side Slope: 3
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: DA-3A
     Canvas X: -5785.4984894259815
     Canvas Y: 1299.093655589124
     Area: 0.037
     Downstream: CHAN-2A5

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None
```

```
     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 130
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 793
     Collector Slope: 0.01
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00370
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 634
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5
     Route Upstream: Yes

     Baseflow: None
End:

Subbasin: DA-2B
     Canvas X: -5483.383685800603
     Canvas Y: 3716.0120845921447
     Area: 0.0030
     Downstream: DA-2A

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85
```

```
     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 117
     Plane 1 Slope: 0.05
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: Main
     Channel Length: 496
     Channel Slope: 0.01
     Channel Mannings N: 0.027
     Shape: Triangle
     Channel Side Slope: 3
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: DA-2A
     Canvas X: -6359.5166163141985
     Canvas Y: 3716.0120845921447
     Label X: -35.0
     Label Y: -18.0
     Area: 0.0282
     Downstream: CHAN-2A1

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 130
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 757
     Collector Slope: 0.01
```

```
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00342
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 950
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5
     Route Upstream: Yes

     Baseflow: None
End:

Reach: CHAN-2A1
     Canvas X: -8055.4539426682295
     Canvas Y: 2585.8946940795768
     From Canvas X: -8074.1556428227905
     From Canvas Y: 3693.612863459985
     Label X: -78.0
     Label Y: -5.0
     Downstream: CHAN-2A2

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 223
     Energy Slope: 0.0225
     Width: 10
     Side Slope: 3
     Mannings n: 0.033
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: CHAN-2A2
     Canvas X: -8055.453942668231
     Canvas Y: 1681.0211667141384
     From Canvas X: -8055.4539426682295
     From Canvas Y: 2585.8946940795768
     Label X: -80.0
     Label Y: -3.0
     Downstream: CHAN-2A3

     Route: Muskingum Cunge
     Channel: Trapezoid
```

```
     Length: 818
     Energy Slope: 0.0075
     Width: 10
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: CHAN-2A3
     Canvas X: -8055.4539426682295
     Canvas Y: 813.5374981905788
     From Canvas X: -8055.453942668231
     From Canvas Y: 1681.0211667141384
     Label X: -81.0
     Label Y: -4.0
     Downstream: CHAN-2A4

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 762
     Energy Slope: 0.0225
     Width: 10
     Side Slope: 3
     Mannings n: 0.033
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: CHAN-2A4
     Canvas X: -5807.27078031538
     Canvas Y: 800.7198784069633
     From Canvas X: -8055.4539426682295
     From Canvas Y: 813.5374981905788
     Label X: -44.0
     Label Y: -11.0
     Downstream: CHAN-2A5

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1029
     Energy Slope: 0.0025
     Width: 10
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: CHAN-2A5
```

```
     Canvas X: -2426.2734584450372
     Canvas Y: 804.289544235924
     From Canvas X: -5807.27078031538
     From Canvas Y: 800.7198784069633
     Label X: -45.0
     Label Y: -15.0
     Downstream: EDA WEST BASIN

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 852
     Energy Slope: 0.0025
     Width: 10
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: DA-3D
     Canvas X: -3820.3753351206433
     Canvas Y: 2707.774798927614
     Area: 0.0040
     Downstream: DA-3C

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 161
     Plane 1 Slope: 0.05
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: Main
     Channel Length: 822
     Channel Slope: 0.01
     Channel Mannings N: 0.027
     Shape: Triangle
     Channel Side Slope: 3
     Channel Number of Steps: 5
```

```
     Baseflow: None
End:

Subbasin: DA-3C
     Canvas X: -3761.3293051359506
     Canvas Y: 2084.5921450151054
     Area: 0.0417
     Downstream: EDA WEST BASIN

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 130
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 895
     Collector Slope: 0.01
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00417
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 568
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5
     Route Upstream: Yes

     Baseflow: None
End:
```

```
Subbasin: DA-3F
     Canvas X: 1102.7190332326281
     Canvas Y: 2567.9758308157097
     Area: 0.0027
     Downstream: DA-3E

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 181
     Plane 1 Slope: 0.05
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: Main
     Channel Length: 866
     Channel Slope: 0.01
     Channel Mannings N: 0.027
     Shape: Triangle
     Channel Side Slope: 3
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: DA-3E
     Canvas X: 1102.7190332326281
     Canvas Y: 1601.2084592145002
     Area: 0.0333
     Downstream: CHAN-3A1

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85
```

```
     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 130
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 789
     Collector Slope: 0.01
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00371
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 693
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5
     Route Upstream: Yes

     Baseflow: None
End:

Reach: CHAN-3A1
     Canvas X: -2426.2734584450372
     Canvas Y: 804.289544235924
     From Canvas X: 1115.5050942093594
     From Canvas Y: 790.6848650286765
     Label X: -26.0
     Label Y: -16.0
     Downstream: EDA WEST BASIN

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 2037
     Energy Slope: 0.0025
     Width: 10
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:
```

```
Subbasin: EDA WEST
     Canvas X: -2453.083109919571
     Canvas Y: 1662.1983914209122
     Label X: 2.0
     Label Y: 7.0
     Area: 0.011
     Downstream: EDA WEST BASIN

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 99

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reservoir: EDA WEST BASIN
     Canvas X: -2426.2734584450372
     Canvas Y: 804.289544235924
     Label X: -3.0
     Label Y: 9.0
     Downstream: POD-8

     Route: Modified Puls
     Routing Curve: Elevation-Area-Outflow
     Initial Elevation: 530
     Elevation-Area Table: EDA WEST BASIN
     Elevation-Outflow Table: EDA WEST BASIN
     Primary Table: Elevation-Outflow
End:

Subbasin: DA-5B
     Canvas X: 166.16314199395856
     Canvas Y: -5528.700906344413
     Label X: -61.0
     Label Y: -6.0
     Area: 0.0036
     Downstream: DA-5A

     Canopy 1: None
     Plant Uptake Method: None
```

```
     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 176
     Plane 1 Slope: 0.05
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: Main
     Channel Length: 554
     Channel Slope: 0.01
     Channel Mannings N: 0.027
     Shape: Triangle
     Channel Side Slope: 3
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: DA-5A
     Canvas X: 75.52870090634678
     Canvas Y: -6404.833836858008
     Label X: -58.0
     Label Y: -3.0
     Area: 0.0362
     Downstream: CHAN-4B7

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 130
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
```

```
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 1109
     Collector Slope: 0.01
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00517
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 844
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5
     Route Upstream: Yes

     Baseflow: None
End:

Subbasin: DA-5D
     Canvas X: -3761.3293051359506
     Canvas Y: -5921.450151057403
     Label X: -23.0
     Label Y: -19.0
     Area: 0.0048
     Downstream: DA-5C

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 242
     Plane 1 Slope: 0.05
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5
```

```
     Channel: Main
     Channel Length: 491
     Channel Slope: 0.01
     Channel Mannings N: 0.027
     Shape: Triangle
     Channel Side Slope: 3
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: DA-5C
     Canvas X: -5513.595166163141
     Canvas Y: -5800.604229607252
     Label X: -24.0
     Label Y: -16.0
     Area: 0.0099
     Downstream: CHAN-4B3

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 130
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 427
     Collector Slope: 0.01
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00199
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 370
     Channel Slope: 0.25
```

```
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5
     Route Upstream: Yes

     Baseflow: None
End:

Subbasin: DA-5E
     Canvas X: -5694.864048338368
     Canvas Y: -4138.972809667675
     Area: 0.0033
     Downstream: CHAN-4B1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: SCS
     Lag: 7
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: CHAN-4B1
     Canvas X: -6341.149871356063
     Canvas Y: -4830.626825179659
     From Canvas X: -6341.149871356061
     From Canvas Y: -4129.597570940945
     Label X: -76.0
     Label Y: -4.0
     Downstream: CHAN-4B2

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 448
     Energy Slope: 0.006
     Width: 5
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
```

```
End:

Reach: CHAN-4B2
     Canvas X: -6341.149871356061
     Canvas Y: -5830.675537105955
     From Canvas X: -6341.149871356063
     From Canvas Y: -4830.626825179659
     Label X: -79.0
     Label Y: -2.0
     Downstream: CHAN-4B3

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 104
     Energy Slope: 0.0190
     Width: 5
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: CHAN-4B3
     Canvas X: -6341.149871356063
     Canvas Y: -6819.1103302717165
     From Canvas X: -6341.149871356061
     From Canvas Y: -5830.675537105955
     Label X: -79.0
     Label Y: -5.0
     Downstream: CHAN-4B4

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 714
     Energy Slope: 0.007
     Width: 10
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: CHAN-4B4
     Canvas X: -4339.492031546952
     Canvas Y: -6819.110330271726
     From Canvas X: -6341.149871356063
     From Canvas Y: -6819.1103302717165
     Label X: -43.0
     Label Y: -12.0
     Downstream: CHAN-4B5
```

```
     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 341
     Energy Slope: 0.01
     Width: 10
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: CHAN-4B5
     Canvas X: -2124.206087123004
     Canvas Y: -6821.211592429854
     From Canvas X: -4339.492031546952
     From Canvas Y: -6819.110330271726
     Label X: -45.0
     Label Y: -14.0
     Downstream: CHAN-4B6

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 699
     Energy Slope: 0.0065
     Width: 10
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: CHAN-4B6
     Canvas X: 110.6455871159942
     Canvas Y: -6856.145878957961
     From Canvas X: -2124.206087123004
     From Canvas Y: -6821.211592429854
     Label X: -42.0
     Label Y: -13.0
     Downstream: CHAN-4B7

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 495
     Energy Slope: 0.01
     Width: 10
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
```

```
End:

Reach: CHAN-4B7
     Canvas X: 2357.9921692963544
     Canvas Y: -6836.1474759172015
     From Canvas X: 110.6455871159942
     From Canvas Y: -6856.145878957961
     Label X: -39.0
     Label Y: -15.0
     Downstream: CHAN-4B8

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 245
     Energy Slope: 0.01
     Width: 10
     Side Slope: 3
     Mannings n: 0.033
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: CHAN-4B8
     Canvas X: 2319.03485254692
     Canvas Y: -4396.7828418230565
     From Canvas X: 2357.9921692963544
     From Canvas Y: -6836.1474759172015
     Label X: -8.0
     Label Y: -7.0
     Downstream: WDA BASIN

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1406
     Energy Slope: 0.0025
     Width: 11
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: DA-4B
     Canvas X: -438.0664652567975
     Canvas Y: -4320.241691842901
     Label X: -35.0
     Label Y: -17.0
     Area: 0.005
     Downstream: DA-4A
```

```
     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 236
     Plane 1 Slope: 0.05
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: Main
     Channel Length: 566
     Channel Slope: 0.01
     Channel Mannings N: 0.027
     Shape: Triangle
     Channel Side Slope: 3
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: DA-4A
     Canvas X: 740.1812688821774
     Canvas Y: -4320.241691842901
     Label X: -29.0
     Label Y: -16.0
     Area: 0.0293
     Downstream: WDA BASIN

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 130
```

```
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 789
     Collector Slope: 0.01
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00368
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 438
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5
     Route Upstream: Yes

     Baseflow: None
End:

Subbasin: DA-4D
     Canvas X: -2432.0241691842893
     Canvas Y: -3383.685800604231
     Area: 0.0027
     Downstream: DA-4C

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 218
     Plane 1 Slope: 0.05
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5
```

```
     Channel: Main
     Channel Length: 368
     Channel Slope: 0.01
     Channel Mannings N: 0.027
     Shape: Triangle
     Channel Side Slope: 3
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: DA-4C
     Canvas X: -2552.87009063444
     Canvas Y: -2870.0906344410887
     Label X: -1.0
     Label Y: 0.0
     Area: 0.0194
     Downstream: CHAN-4A3

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 130
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 694
     Collector Slope: 0.01
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00324
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 387
     Channel Slope: 0.25
```

```
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5
     Route Upstream: Yes

     Baseflow: None
End:

Reach: CHAN-4A2
     Canvas X: -2574.128293728436
     Canvas Y: -2502.8588792334576
     From Canvas X: -4461.13090396298
     From Canvas Y: -2483.4938526408187
     Label X: -43.0
     Label Y: 8.0
     Downstream: CHAN-4A3

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 416
     Energy Slope: 0.030
     Width: 5
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: CHAN-4A3
     Canvas X: -193.66300891401806
     Canvas Y: -2502.8588792334576
     From Canvas X: -2574.128293728436
     From Canvas Y: -2502.8588792334576
     Label X: -39.0
     Label Y: 10.0
     Downstream: CHAN-4A4

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 338
     Energy Slope: 0.015
     Width: 10
     Side Slope: 3
     Mannings n: 0.033
     Use Variable Time Step: No
     Channel Loss: None
End:
```

```
Reach: CHAN-4A4
     Canvas X: 2327.7806889338244
     Canvas Y: -2502.8588792334613
     From Canvas X: -193.66300891401806
     From Canvas Y: -2502.8588792334576
     Label X: -33.0
     Label Y: 9.0
     Downstream: CHAN-4A5

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1636
     Energy Slope: 0.006
     Width: 10
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: CHAN-4A5
     Canvas X: 2319.03485254692
     Canvas Y: -4396.7828418230565
     From Canvas X: 2327.7806889338244
     From Canvas Y: -2502.8588792334613
     Label X: -7.0
     Label Y: 11.0
     Downstream: WDA BASIN

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 240
     Energy Slope: 0.0025
     Width: 10
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: WDA
     Canvas X: 1404.833836858008
     Canvas Y: -5740.181268882176
     Label X: -23.0
     Label Y: -17.0
     Area: 0.010
     Downstream: WDA BASIN

     Canopy: None
     Plant Uptake Method: None
```

```
     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 99

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reservoir: WDA BASIN
     Canvas X: 2319.03485254692
     Canvas Y: -4396.7828418230565
     Downstream: POD-8

     Route: Modified Puls
     Routing Curve: Elevation-Area-Outflow
     Initial Elevation: 531
     Elevation-Area Table: WDA BASIN
     Elevation-Outflow Table: WDA BASIN
     Primary Table: Elevation-Outflow
End:

Subbasin: PRE-8DR
     Canvas X: 4607.250755287012
     Canvas Y: -9123.867069486405
     Label X: -38.0
     Label Y: -18.0
     Area: 0.0325
     Downstream: Junction-2

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73.7

     Transform: SCS
     Lag: 35
     Unitgraph Type: STANDARD

     Baseflow: None
End:
```

```
Junction: Junction-2
     Canvas X: 4546.827794561934
     Canvas Y: -8459.214501510574
     Label X: -65.0
     Label Y: 15.0
     Downstream: Junction-3
End:

Subbasin: OS-3
     Canvas X: 6299.093655589124
     Canvas Y: -9305.135951661632
     Area: 0.02334
     Downstream: Junction-3

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 29
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: Junction-3
     Canvas X: 6268.882175226587
     Canvas Y: -8459.214501510574
     Downstream: OS-3 REACH
End:

Reach: OS-3 REACH
     Canvas X: 6268.882175226587
     Canvas Y: -2024.169184290031
     From Canvas X: 6268.882175226587
     From Canvas Y: -8459.214501510574
     Downstream: POD-8

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 2039
     Energy Slope: 0.0030
     Width: 5
     Side Slope: 10
```

```
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Junction: POD-8
     Canvas X: 6268.882175226587
     Canvas Y: -2024.169184290031
     Downstream: Site-19 Reservoir
End:

Subbasin: DA-1B
     Canvas X: -3972.809667673715
     Canvas Y: 4773.413897280966
     Area: 0.0055
     Downstream: DA-1A

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 189
     Plane 1 Slope: 0.05
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: Main
     Channel Length: 906
     Channel Slope: 0.01
     Channel Mannings N: 0.027
     Shape: Triangle
     Channel Side Slope: 3
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: DA-1A
     Canvas X: -3972.809667673715
     Canvas Y: 5468.277945619335
     Area: 0.0355
```

```
     Downstream: CHAN-1A3

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 130
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 847
     Collector Slope: 0.01
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00395
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 536
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5
     Route Upstream: Yes

     Baseflow: None
End:

Subbasin: DA-1C
     Canvas X: -8262.839879154079
     Canvas Y: 5377.643504531722
     Area: 0.0042
     Downstream: CHAN-1A1

     Canopy: None
     Plant Uptake Method: None
```

```
     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: SCS
     Lag: 11
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: CHAN-1A1
     Canvas X: -6017.365997842705
     Canvas Y: 6243.663060278207
     From Canvas X: -8236.427072038217
     From Canvas Y: 6228.240659827116
     Label X: -45.0
     Label Y: 9.0
     Downstream: CHAN-1A2

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 404
     Energy Slope: 0.01
     Width: 5
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: CHAN-1A2
     Canvas X: -3946.771527430814
     Canvas Y: 6230.052017912093
     From Canvas X: -6017.365997842705
     From Canvas Y: 6243.663060278207
     Label X: -41.0
     Label Y: 9.0
     Downstream: CHAN-1A3

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1274
     Energy Slope: 0.008
     Width: 5
     Side Slope: 3
     Mannings n: 0.027
```

```
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: CHAN-1A3
     Canvas X: -1410.2888371615236
     Canvas Y: 6237.710973724886
     From Canvas X: -3946.771527430814
     From Canvas Y: 6230.052017912093
     Label X: -40.0
     Label Y: 8.0
     Downstream: CHAN-1A4

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 348
     Energy Slope: 0.0025
     Width: 10
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: CHAN-1A4
     Canvas X: 921.4501510574046
     Canvas Y: 6253.776435045317
     From Canvas X: -1410.2888371615236
     From Canvas Y: 6237.710973724886
     Label X: -45.0
     Label Y: 8.0
     Downstream: EDA EAST BASIN

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 711
     Energy Slope: 0.022
     Width: 10
     Side Slope: 3
     Mannings n: 0.033
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: EDA EAST
     Canvas X: 921.4501510574046
     Canvas Y: 7311.1782477341385
     Label X: -39.0
     Label Y: 19.0
     Area: 0.003
```

```
     Downstream: EDA EAST BASIN

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 99

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: DA-1D
     Canvas X: 981.8731117824791
     Canvas Y: 5407.854984894259
     Area: 0.0023
     Downstream: EDA EAST BASIN

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: SCS
     Lag: 9
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reservoir: EDA EAST BASIN
     Canvas X: 921.4501510574046
     Canvas Y: 6253.776435045317
     Label X: -5.0
     Label Y: 3.0
     Downstream: POD-1

     Route: Modified Puls
     Routing Curve: Elevation-Area-Outflow
     Initial Elevation: 534
```

```
     Elevation-Area Table: EDA EAST BASIN
     Elevation-Outflow Table: EDA EAST BASIN
     Primary Table: Elevation-Outflow
End:

Subbasin: PRE-1R
     Canvas X: 6450.151057401814
     Canvas Y: 8096.676737160121
     Area: 0.0149
     Downstream: POD-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 74.7

     Transform: SCS
     Lag: 11
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: OS-5
     Canvas X: 4621.329211746524
     Canvas Y: 9072.642967542506
     Area: 0.01309
     Downstream: POD-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 48
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: DA-1E
```

```
     Canvas X: 2704.7913446676976
     Canvas Y: 8330.75734157651
     Area: 0.0019
     Downstream: POD-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: SCS
     Lag: 5
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-1
     Canvas X: 6450.151057401814
     Canvas Y: 6314.199395770393
     Downstream: Site-19 Reservoir
End:

Subbasin: PRE-5R
     Canvas X: 5634.441087613293
     Canvas Y: 1722.054380664651
     Label X: -72.0
     Label Y: -5.0
     Area: 0.0356
     Downstream: POD-5

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73

     Transform: SCS
     Lag: 29
     Unitgraph Type: STANDARD

     Baseflow: None
End:
```

```
Junction: POD-5
     Canvas X: 6419.939577039277
     Canvas Y: 1722.054380664651
     Label X: -29.0
     Label Y: -19.0
     Downstream: Site-19 Reservoir
End:

Subbasin: PRE-7R
     Canvas X: 5543.806646525682
     Canvas Y: -604.2296072507561
     Label X: -68.0
     Label Y: -4.0
     Area: 0.0226
     Downstream: POD-7

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73

     Transform: SCS
     Lag: 30
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-7
     Canvas X: 6389.728096676739
     Canvas Y: -634.4410876132933
     Label X: -30.0
     Label Y: -18.0
     Downstream: Site-19 Reservoir
End:

Subbasin: PRE-3R
     Canvas X: 5332.326283987917
     Canvas Y: 3957.7039274924464
     Label X: -67.0
     Label Y: 1.0
     Area: 0.0207
     Downstream: POD-3

     Canopy: None
```

```
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73

     Transform: SCS
     Lag: 27
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-3
     Canvas X: 6389.728096676739
     Canvas Y: 3897.280966767371
     Label X: -30.0
     Label Y: -22.0
     Downstream: Site-19 Reservoir
End:

Subbasin: PRE-2R
     Canvas X: 5271.903323262843
     Canvas Y: 5347.432024169184
     Label X: -78.0
     Label Y: -5.0
     Area: 0.0086
     Downstream: POD-2

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73

     Transform: SCS
     Lag: 17
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-2
     Canvas X: 6329.305135951665
     Canvas Y: 5347.432024169184
```

```
     Label X: -31.0
     Label Y: -23.0
     Downstream: Site-19 Reservoir
End:

Subbasin: PRE-4R
     Canvas X: 5543.806646525682
     Canvas Y: 2719.033232628398
     Label X: -71.0
     Label Y: -5.0
     Area: 0.0056
     Downstream: POD-4

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73

     Transform: SCS
     Lag: 16
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-4
     Canvas X: 6450.151057401814
     Canvas Y: 2719.033232628398
     Label X: -29.0
     Label Y: -19.0
     Downstream: Site-19 Reservoir
End:

Subbasin: PRE-6R
     Canvas X: 5604.229607250756
     Canvas Y: 604.2296072507543
     Label X: -67.0
     Label Y: -4.0
     Area: 0.0043
     Downstream: POD-6

     Canopy: None
     Plant Uptake Method: None

     Surface: None
```

```
     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73

     Transform: SCS
     Lag: 26
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-6
     Canvas X: 6510.574018126888
     Canvas Y: 634.4410876132915
     Label X: -33.0
     Label Y: -21.0
     Downstream: Site-19 Reservoir
End:

Subbasin: PRE-9R
     Canvas X: 11253.776435045318
     Canvas Y: -4380.664652567977
     Area: 0.0029
     Downstream: POD-9

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73

     Transform: SCS
     Lag: 33
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-9
     Canvas X: 11253.776435045318
     Canvas Y: -2749.244712990938
     Downstream: Site-19 Reservoir
End:

Reservoir: Site-19 Reservoir
     Canvas X: 11246.648793565684
     Canvas Y: 1769.436997319035
```

```
     Route: Modified Puls
     Routing Curve: Elevation-Area-Outflow
     Initial Elevation: 520.69
     Elevation-Area Table: Site 19 Reservoir
     Elevation-Outflow Table: Site 19 Reservoir
     Primary Table: Elevation-Outflow
End:

Subbasin: PRE-11R
     Canvas X: -8504.53172205438
     Canvas Y: -8126.888217522661
     Label X: -1.0
     Label Y: 1.0
     Area: 0.010
     Downstream: POD-11

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 19
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-11
     Canvas X: -8595.166163141994
     Canvas Y: -9033.232628398793
End:

Subbasin: DA-4E
     Canvas X: -6313.67292225201
     Canvas Y: -3378.016085790885
     Area: 0.0047
     Downstream: CHAN-4A1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
```

```
     Percent Impervious Area: 0.0
     Curve Number: 85

     Transform: SCS
     Lag: 7
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: CHAN-4A1
     Canvas X: -4461.130903962981
     Canvas Y: -2483.4938526408205
     From Canvas X: -6276.501614341445
     From Canvas Y: -2476.7606903386677
     Label X: -42.0
     Label Y: 8.0

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 434
     Energy Slope: 0.0025
     Width: 5
     Side Slope: 3
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: PRE-10BR
     Canvas X: -347.4320241691821
     Canvas Y: -8368.580060422963
     Area: 0.0029
     Downstream: POD-10

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 33
     Unitgraph Type: STANDARD

     Baseflow: None
End:
```

```
Subbasin: PRE-10AR
     Canvas X: -5271.903323262839
     Canvas Y: -8700.906344410876
     Area: 0.0016
     Downstream: PRE-11 TK Parkway

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 25
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: PRE-11 TK Parkway
     Canvas X: -407.85498489426027
     Canvas Y: -9184.290030211483
     From Canvas X: -5350.700654192953
     From Canvas Y: -9206.8902720901
     Label X: -67.0
     Label Y: -15.0
     Downstream: POD-10

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1215.664
     Energy Slope: 0.008
     Width: 17.8
     Side Slope: 0.12
     Mannings n: 0.033
     Use Variable Time Step: No
     Channel Loss: None
End:

Junction: POD-10
     Canvas X: -407.85498489426027
     Canvas Y: -9184.290030211483
End:

Basin Schematic Properties:
     Last View N: 5000.0
```

```
    Last View S: -5000.0
    Last View W: -5000.0
    Last View E: 5000.0
    Maximum View N: 5000.0
    Maximum View S: -5000.0
    Maximum View W: -5000.0
    Maximum View E: 5000.0
    Extent Method: Elements
    Buffer: 0
    Draw Icons: Yes
    Draw Icon Labels: Name
    Draw Map Objects: No
    Draw Gridlines: No
    Draw Flow Direction: No
    Fix Element Locations: No
    Fix Hydrologic Order: No
End:
```

```
     Canvas X: -93215.94344381365
     Canvas Y: -76451.69933840231
     From Canvas X: -63197.73402814632
     From Canvas Y: -71490.31052731218
     Label X: -67.0
     Label Y: -2.0
     Area: 0.010
     Downstream: POD-11

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80.0

     Transform: SCS
     Lag: 19
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-11
     Canvas X: -93215.94344381365
     Canvas Y: -86682.60408819266
     From Canvas X: -66253.37766246771
     From Canvas Y: -86828.97280601399
     Label X: -72.0
     Label Y: -3.0
End:

Basin Schematic Properties:
     Last View N: 5000.0
     Last View S: -5000.0
     Last View W: -5000.0
     Last View E: 5000.0
     Maximum View N: 53477.804796960794
     Maximum View S: -61263.896628055125
     Maximum View W: -117782.14367979346
     Maximum View E: 17236.009823300818
     Extent Method: Elements
     Buffer: 0
     Draw Icons: Yes
     Draw Icon Labels: Name
     Draw Map Objects: No
     Draw Gridlines: No
     Draw Flow Direction: No
```

```
    Fix Element Locations: No
    Fix Hydrologic Order: No
End:
```

HEC-HMS OUTPUT FILES
FOR
EDA WEST BASIN, EDA EAST BASIN, & WDA BASIN / POD-1, POD-2, POD-3, POD-4, POD-5, POD-6, POD-7, POD-8, POD-9, POD-10, & POD-11

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Start of Run: 02Oct2018, 00:00 Basin Model: POST DEVELOPMENT
End of Run: 04Oct2018, 00:00 Meteorologic Model: 25-year, 24-hour
Compute Time: 30Sep2020, 11:16:22 Control Specifications: 48-HOUR

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
OS-1	1.57999	1709.8	02Oct2018, 13:10	463.2
PRE-8A HC	1.57999	1707.8	02Oct2018, 13:10	463.2
PRE-8ABR	0.0847	120.0	02Oct2018, 12:40	21.7
OS-2	0.058	104.2	02Oct2018, 12:30	17.1
Junction-1	1.72269	1831.2	02Oct2018, 13:10	502.0
PRE-8C HC	1.72269	1811.1	02Oct2018, 13:20	501.9
PRE-8CR	0.1912	258.4	02Oct2018, 12:40	48.3
DA-3B	0.0040	12.7	02Oct2018, 12:10	1.3
DA-3A	0.0410	130.8	02Oct2018, 12:10	13.4
DA-2B	0.0030	9.6	02Oct2018, 12:10	1.0
DA-2A	0.0312	99.7	02Oct2018, 12:10	10.2
CHAN-2A1	0.0312	99.5	02Oct2018, 12:10	10.2
CHAN-2A2	0.0312	98.1	02Oct2018, 12:10	10.2
CHAN-2A3	0.0312	95.9	02Oct2018, 12:10	10.2
CHAN-2A4	0.0312	87.2	02Oct2018, 12:10	10.3
CHAN-2A5	0.0722	206.8	02Oct2018, 12:10	23.7
DA-3D	0.0040	12.7	02Oct2018, 12:10	1.3
DA-3C	0.0457	145.8	02Oct2018, 12:10	15.0
DA-3F	0.0027	8.6	02Oct2018, 12:10	0.9
DA-3E	0.0360	114.9	02Oct2018, 12:10	11.8
CHAN-3A1	0.0360	102.8	02Oct2018, 12:10	11.6
EDA WEST	0.011	37.7	02Oct2018, 12:10	4.6
EDA WEST BASIN	0.1649	40.4	02Oct2018, 14:10	34.7
DA-5B	0.0036	11.4	02Oct2018, 12:10	1.2
DA-5A	0.0398	127.0	02Oct2018, 12:10	13.0
DA-5D	0.0048	15.2	02Oct2018, 12:10	1.6
DA-5C	0.0147	46.7	02Oct2018, 12:10	4.8
DA-5E	0.0033	9.7	02Oct2018, 12:10	1.1
CHAN-4B1	0.0033	9.3	02Oct2018, 12:10	1.1
CHAN-4B2	0.0033	9.2	02Oct2018, 12:10	1.1
CHAN-4B3	0.0180	54.8	02Oct2018, 12:10	5.9

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
CHAN-4B4	0.0180	53.9	02Oct2018, 12:10	5.9
CHAN-4B5	0.0180	51.5	02Oct2018, 12:10	5.9
CHAN-4B6	0.0180	49.6	02Oct2018, 12:10	5.9
CHAN-4B7	0.0578	175.4	02Oct2018, 12:10	19.0
CHAN-4B8	0.0578	163.8	02Oct2018, 12:10	19.0
DA-4B	0.005	15.9	02Oct2018, 12:10	1.6
DA-4A	0.0343	109.3	02Oct2018, 12:10	11.2
DA-4D	0.0027	8.6	02Oct2018, 12:10	0.9
DA-4C	0.0221	70.5	02Oct2018, 12:10	7.2
DA-4E	0.0047	13.9	02Oct2018, 12:10	1.5
CHAN-4A1	0.0047	13.0	02Oct2018, 12:10	1.5
CHAN-4A2	0.0047	12.6	02Oct2018, 12:10	1.5
CHAN-4A3	0.0268	82.5	02Oct2018, 12:10	8.8
CHAN-4A4	0.0268	78.1	02Oct2018, 12:10	8.8
CHAN-4A5	0.0268	75.6	02Oct2018, 12:10	8.8
WDA	0.010	34.3	02Oct2018, 12:10	4.1
WDA BASIN	0.1289	21.7	02Oct2018, 15:30	21.0
PRE-8DR	0.0325	45.9	02Oct2018, 12:40	8.3
Junction-2	0.0325	45.9	02Oct2018, 12:40	8.3
OS-3	0.02334	41.1	02Oct2018, 12:30	6.9
Junction-3	0.05584	85.4	02Oct2018, 12:40	15.2
OS-3 REACH	0.05584	83.4	02Oct2018, 12:50	15.2
POD-8	2.26353	2059.8	02Oct2018, 13:20	621.1
DA-1B	0.0055	17.5	02Oct2018, 12:10	1.8
DA-1A	0.0410	130.8	02Oct2018, 12:10	13.4
DA-1C	0.0042	11.0	02Oct2018, 12:10	1.4
CHAN-1A1	0.0042	10.4	02Oct2018, 12:10	1.4
CHAN-1A2	0.0042	10.4	02Oct2018, 12:20	1.4
CHAN-1A3	0.0452	137.0	02Oct2018, 12:10	14.8
CHAN-1A4	0.0452	134.9	02Oct2018, 12:10	14.8
EDA EAST	0.003	10.3	02Oct2018, 12:10	1.2
DA-1D	0.0023	6.4	02Oct2018, 12:10	0.8
EDA EAST BASIN	0.0505	106.3	02Oct2018, 12:20	16.8
PRE-1R	0.0149	31.9	02Oct2018, 12:10	3.9
OS-5	0.01309	17.8	02Oct2018, 12:50	3.9

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
DA-1E	0.0019	5.8	02Oct2018, 12:10	0.6
POD-1	0.08039	150.9	02Oct2018, 12:20	25.2
PRE-5R	0.0356	53.8	02Oct2018, 12:30	9.0
POD-5	0.0356	53.8	02Oct2018, 12:30	9.0
PRE-7R	0.0226	33.4	02Oct2018, 12:30	5.7
POD-7	0.0226	33.4	02Oct2018, 12:30	5.7
PRE-3R	0.0207	32.6	02Oct2018, 12:30	5.2
POD-3	0.0207	32.6	02Oct2018, 12:30	5.2
PRE-2R	0.0086	16.3	02Oct2018, 12:20	2.2
POD-2	0.0086	16.3	02Oct2018, 12:20	2.2
PRE-4R	0.0056	10.9	02Oct2018, 12:20	1.4
POD-4	0.0056	10.9	02Oct2018, 12:20	1.4
PRE-6R	0.0043	6.9	02Oct2018, 12:30	1.1
POD-6	0.0043	6.9	02Oct2018, 12:30	1.1
PRE-9R	0.0029	4.1	02Oct2018, 12:40	0.7
POD-9	0.0029	4.1	02Oct2018, 12:40	0.7
Site-19 Reservoir	2.44422	64.8	03Oct2018, 01:30	173.7
PRE-11R	0.010	21.0	02Oct2018, 12:20	3.0
POD-11	0.010	21.0	02Oct2018, 12:20	3.0
PRE-10BR	0.0029	4.8	02Oct2018, 12:40	0.9
PRE-10AR	0.0016	3.0	02Oct2018, 12:30	0.5
PRE-10 TK Parkway	0.0016	3.0	02Oct2018, 12:40	0.5
POD-10	0.0045	7.8	02Oct2018, 12:40	1.3

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Subbasin: PRE-5R

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:14:22	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	53.8 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:30
Precipitation Volume:	15.0 (AC-FT)	Direct Runoff Volume:	9.0 (AC-FT)
Loss Volume:	6.0 (AC-FT)	Baseflow Volume:	0.0 (AC-FT)
Excess Volume:	9.0 (AC-FT)	Discharge Volume:	9.0 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Subbasin: PRE-7R

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:14:22	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	33.4 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:30
Precipitation Volume:	9.5 (AC-FT)	Direct Runoff Volume:	5.7 (AC-FT)
Loss Volume:	3.8 (AC-FT)	Baseflow Volume:	0.0 (AC-FT)
Excess Volume:	5.7 (AC-FT)	Discharge Volume:	5.7 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Subbasin: PRE-8CR

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:14:22	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	258.4 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:40
Precipitation Volume:	80.6 (AC-FT)	Direct Runoff Volume:	48.3 (AC-FT)
Loss Volume:	32.3 (AC-FT)	Baseflow Volume:	0.0 (AC-FT)
Excess Volume:	48.3 (AC-FT)	Discharge Volume:	48.3 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Subbasin: PRE-8DR

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:14:22	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	45.9 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:40
Precipitation Volume:	13.7 (AC-FT)	Direct Runoff Volume:	8.3 (AC-FT)
Loss Volume:	5.4 (AC-FT)	Baseflow Volume:	0.0 (AC-FT)
Excess Volume:	8.3 (AC-FT)	Discharge Volume:	8.3 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Reach: OS-3 REACH

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:14:22	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Inflow:	85.4 (CFS)	Date/Time of Peak Inflow	02Oct2018, 12:40
Peak Discharge:	83.4 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:50
Inflow Volume:	15.2 (AC-FT)	Discharge Volume:	15.2 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)
Junction: Junction-2

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:14:22	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	45.9 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:40
Volume:	8.3 (AC-FT)		

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)
Junction: Junction-3

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:14:22	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	85.4 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:40
Volume:	15.2 (AC-FT)		

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Reach: CHAN-2A5

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:14:22	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Inflow:	218.0 (CFS)	Date/Time of Peak Inflow	02Oct2018, 12:10
Peak Discharge:	206.8 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:10
Inflow Volume:	23.7 (AC-FT)	Discharge Volume:	23.7 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Reach: CHAN-3A1

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:14:22	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Inflow:	114.9 (CFS)	Date/Time of Peak Inflow	02Oct2018, 12:10
Peak Discharge:	102.8 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:10
Inflow Volume:	11.8 (AC-FT)	Discharge Volume:	11.6 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Reach: CHAN-4B6

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:36:32	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Inflow:	51.5 (CFS)	Date/Time of Peak Inflow	02Oct2018, 12:10
Peak Discharge:	49.5 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:10
Inflow Volume:	5.9 (AC-FT)	Discharge Volume:	5.9 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Reach: CHAN-4B7

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:36:32	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Inflow:	176.6 (CFS)	Date/Time of Peak Inflow	02Oct2018, 12:10
Peak Discharge:	175.1 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:10
Inflow Volume:	19.0 (AC-FT)	Discharge Volume:	19.0 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Reach: CHAN-4B8

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:36:32	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Inflow:	175.1 (CFS)	Date/Time of Peak Inflow	02Oct2018, 12:10
Peak Discharge:	163.0 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:10
Inflow Volume:	19.0 (AC-FT)	Discharge Volume:	19.0 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Subbasin: DA-3A

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:59:43	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	130.8 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:10
Precipitation Volume:	15.6 (AC-FT)	Direct Runoff Volume:	13.4 (AC-FT)
Loss Volume:	3.5 (AC-FT)	Baseflow Volume:	0.0 (AC-FT)
Excess Volume:	12.1 (AC-FT)	Discharge Volume:	13.4 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Subbasin: DA-3C

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 12:59:43	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	145.8 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:10
Precipitation Volume:	17.6 (AC-FT)	Direct Runoff Volume:	15.0 (AC-FT)
Loss Volume:	4.0 (AC-FT)	Baseflow Volume:	0.0 (AC-FT)
Excess Volume:	13.6 (AC-FT)	Discharge Volume:	15.0 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Subbasin: DA-3E

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 13:05:01	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	114.9 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:10
Precipitation Volume:	14.0 (AC-FT)	Direct Runoff Volume:	11.8 (AC-FT)
Loss Volume:	3.2 (AC-FT)	Baseflow Volume:	0.0 (AC-FT)
Excess Volume:	10.9 (AC-FT)	Discharge Volume:	11.8 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Subbasin: DA-4A

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 13:05:01	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	109.3 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:10
Precipitation Volume:	12.3 (AC-FT)	Direct Runoff Volume:	11.2 (AC-FT)
Loss Volume:	2.8 (AC-FT)	Baseflow Volume:	0.0 (AC-FT)
Excess Volume:	9.6 (AC-FT)	Discharge Volume:	11.2 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Subbasin: DA-4C

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 13:05:01	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	70.5 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:10
Precipitation Volume:	8.2 (AC-FT)	Direct Runoff Volume:	7.2 (AC-FT)
Loss Volume:	1.8 (AC-FT)	Baseflow Volume:	0.0 (AC-FT)
Excess Volume:	6.3 (AC-FT)	Discharge Volume:	7.2 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Subbasin: DA-5A

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 13:05:01	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	127.0 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:10
Precipitation Volume:	15.3 (AC-FT)	Direct Runoff Volume:	13.0 (AC-FT)
Loss Volume:	3.4 (AC-FT)	Baseflow Volume:	0.0 (AC-FT)
Excess Volume:	11.8 (AC-FT)	Discharge Volume:	13.0 (AC-FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Junction: POD-5

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 13:05:01	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	53.8 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:30
Volume:	9.0 (AC-FT)		

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)
Junction: POD-7

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 13:05:01	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	33.4 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 12:30
Volume:	5.7 (AC-FT)		

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Junction: POD-8

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 13:11:32	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Discharge:	2059.8 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 13:20
Volume:	621.0 (AC-FT)		

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Reservoir: EDA WEST BASIN

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 13:11:32	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Inflow:	493.1 (CFS)	Date/Time of Peak Inflow:	02Oct2018, 12:10
Peak Discharge:	40.4 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 14:10
Inflow Volume:	54.8 (AC-FT)	Peak Storage:	36.3 (AC-FT)
Discharge Volume:	34.7 (AC-FT)	Peak Elevation:	535.9 (FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Reservoir: WDA BASIN

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 13:11:32	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Inflow:	382.3 (CFS)	Date/Time of Peak Inflow:	02Oct2018, 12:10
Peak Discharge:	21.7 (CFS)	Date/Time of Peak Discharge:	02Oct2018, 15:30
Inflow Volume:	43.1 (AC-FT)	Peak Storage:	31.1 (AC-FT)
Discharge Volume:	21.0 (AC-FT)	Peak Elevation:	536.5 (FT)

Project: City of Waco Landfill Simulation Run: 25 yr, 24 hr (post)

Reservoir: Site 19 - North Reservoir

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	07Apr2020, 22:21:55	Control Specifications:	48-hour

Volume Units: AC-FT

Computed Results

Peak Inflow:	206.5 (CFS)	Date/Time of Peak Inflow:	02Oct2018, 12:20
Peak Discharge:	3.9 (CFS)	Date/Time of Peak Discharge:	03Oct2018, 00:30
Inflow Volume:	34.0 (AC-FT)	Peak Storage:	29.3 (AC-FT)
Discharge Volume:	10.5 (AC-FT)	Peak Elevation:	520.8 (FT)

Project: City of Waco Landfill 4.0 Simulation Run: 25 yr, 24 hr (post)

Reservoir: Site-19 Reservoir

Start of Run:	02Oct2018, 00:00	Basin Model:	POST DEVELOPMENT
End of Run:	04Oct2018, 00:00	Meteorologic Model:	25-year, 24-hour
Compute Time:	30Sep2020, 13:11:32	Control Specifications:	48-HOUR

Volume Units: AC-FT

Computed Results

Peak Inflow:	2164.4 (CFS)	Date/Time of Peak Inflow:	02Oct2018, 13:20
Peak Discharge:	64.8 (CFS)	Date/Time of Peak Discharge:	03Oct2018, 01:30
Inflow Volume:	671.5 (AC-FT)	Peak Storage:	594.8 (AC-FT)
Discharge Volume:	173.7 (AC-FT)	Peak Elevation:	523.1 (FT)

APPENDIX 6A-E

HYDRAULIC ANALYSIS

- **Overland Flow Velocity Analysis**
- **Drainage Swale Flow Analysis**
- **Downchute Flow Analysis**
- **Perimeter Channel Flow Analysis (HydroCalc Output Files)**
- **Hydraulic Analysis References**
- **Hydraulic Analysis Drawings 6A-E.1 through 6A-E.5**

SCS Engineers
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Inclusive of pages 6A-E-1 to 6A-E-77

INTERMEDIATE COVER – OVERLAND FLOW VELOCITY

Required: Calculate the flow velocity and normal depth for sizing drainage swales installed on intermediate cover.

Method:

1. Determine peak discharge rate associated with the 25 - year, 24 - hour storm event for the swale contributing drainage areas, as shown on Drawings 6A-E.3 and 6A-E.4, using the Rational Method (see Subsection 2.2 of Attachment 6A).
2. Determine Mannings "n" and runoff coefficient "C" (see Pages 6A-A-25 and 6A-E-71, respectively).
3. Using the specified channel geometry, evaluate the peak velocity and flow depth using HYDROCALC program.
4. Compare the worst case flow velocity with the permissible velocity of 5 fps.

Solution: **Rational Method Calculations for Typical Swale Contributing Areas**

Drainage Area [2]	Runoff Coef. C[3,5]	Rainfall Int. I, (in/hr)[4]	Area (acres)	Peak Discharge (cfs)
SW12	0.70	8.9	4.0	25.0
SW13	0.35	8.9	2.1	6.5
Example-1[5]	0.35	8.9	17.0	53.0
SW8	0.35	8.9	6.8	21.2
SW11	0.70	8.9	5.2	32.7
SW9	0.35	8.9	10.1	31.5
SW10	0.35	8.9	2.8	8.7
Example-2[5]	0.70	8.9	7.3	45.5
Example-3[5]	0.70	8.9	10.0	62.3

$$I = \frac{b}{(t_c + d)^e}$$

Where, I = Rainfall intensity, in/hr
b= 103.56

d= 11.0
e= 0.806
t_c = 10 min

(b, d, e are associated with a 25 - year, 24 - hour storm for Limestome Co., see Page 6A-E-73)

Solution (Con't): **Typical Swale Summary Calculations for Greatest Peak Discharge into a Topslope and Sideslope Swale[1]**

Drainage Area [2]	Flow Rate (cfs)	Bottom Slope(ft/ft)	Manning's n[3]	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
SW9	31.5	0.005	0.027	2	20	0.0	1.06	2.54
Example-1[5]	53.0	0.005	0.027	2	20	0.0	1.29	2.88
SW11	32.7	0.010	0.027	2	4	0.0	1.56	4.49
Example-2[5]	45.5	0.010	0.027	2	4	0.0	1.76	4.87
Example-3[5]	62.3	0.010	0.027	2	4	0.0	1.98	5.27

Conclusions:

From above drainage swale summary calculations, grass-lined topslope swales installed on intermediate cover will have peak velocities less than the permissible velocity of 5 fps. Therefore, topslope swales on installed on intermediate cover will be constructed with a minimum depth of 2.0 feet, provided the contributing area is less than or equal to 17 acres, as shown for Example-1.

Drainage swales installed on the intermediate cover sideslopes may exhibit peak velocities greater than 5 fps if the contributing area is greater than 7.3 acres (see Example 2). Therefore, sideslope swales installed on intermediate cover will be grass-lined and contructed with a minimum depth of 2.4 feet, provided the contributing area is less than or equal to 7.3 acres. Additionally, sideslope swales with contributing areas greater than 7.3 acres but less than 10 acres will be rip rap or TRM-lined and constructed with a minimum depth of 2.6 feet. Drainage swales installed on intermediate cover will be constructed with a minimum 0.5-foot of freeboard above calculated peak flow depth. See Drawing 6A.12 for drainage swale details.

Notes:

1. Calculations were performed using the HYDROCALC program developed by Dodson and Associates (Version 1.3, 1986).
2. Contributing drainage areas are depicted on Drawings 6A-E.3 and 6A-E.4.
3. Refer to Hydraulic Calculation References for Mannings "n" and runoff coefficient, C, references.
4. Rainfal Intensity (I) calculated for tc = 10 min, using equation for rainfall intensity shown above. Refer to Hydraulic Calculation References for coefficient b,d, and e references.
5. Example 1 represents the largest intermediate cover topslope drainage area to any one drainage swale. Example 2 represents the largest intermediate cover sideslope drainage area to any one grass-lined drainage swale. Exampke 3 represents the largest intermediate cover sideslope drainage area to any one rip rap or TRM lined drainage swale.

FINAL COVER – DRAINAGE SWALE FLOW

Required: Calculate the flow velocity and normal depth for sizing drainage swales installed on final cover.

Method:

1. Determine peak discharge rate associated with the 25 - year, 24 - hour storm event for the swale contributing drainage areas, as shown on Drawing 6A-E.1, using the Rational Method (see Subsection 2.2 of Attachment 6A).
2. Determine Mannings "n" and runoff coefficient "C" (see Pages 6A-A-25 and 6A-E-71, respectively).
3. Using the specified channel geometry, evaluate the peak velocity and flow depth using HYDROCALC program.
4. Compare the worst case flow velocity with the permissible velocity of 5 fps.

Solution: **Rational Method Calculations for Typical Swale Contributing Areas**

Drainage Area [2]	Runoff Coef. C[3,~~5~~]	Rainfall Int. I, (in/hr)[4]	Area (acres)	Peak Discharge (cfs)
SW1	0.70	8.9	3.7	22.8
SW2	0.70	8.9	3.2	20.0
SW3	0.35	8.9	2.1	6.4
SW4	0.70	8.9	3.0	18.7
SW5	0.70	8.9	3.3	20.8
SW6	0.35	8.9	2.4	7.4
SW7	0.35	8.9	2.1	6.4

$$I = \frac{b}{(t_c + d)^e}$$

Where, I = Rainfall intensity, in/hr
b= 103.56
d= 11.0
e= 0.806
t_c = 10 min

(b, d, e are associated with a 25 - year, 24 - hour storm for Limestone Co., see Page 6A-E-73)

Typical Swale Summary Calculations[1]

Drainage Area [2]	Flow Rate (cfs)	Bottom Slope(ft/ft)	Manning's n[3]	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
SW1	22.8	0.01	0.027	2	4	0.0	1.36	4.09
SW2	20.0	0.01	0.027	2	4	0.0	1.30	3.96
SW3	6.4	0.005	0.027	2	20	0.0	1.71	0.58
SW4	18.7	0.01	0.027	2	4	0.0	1.26	3.90
SW5	20.8	0.01	0.027	2	4	0.0	1.32	4.00
SW6	7.4	0.005	0.027	2	20	0.0	0.62	1.77
SW7	6.4	0.005	0.027	2	20	0.0	0.58	1.71

Conclusions: From above drainage swale summary calculations, the greatest calculated flow velocity in a sideslope swale is 4.09 fps and in a topslope swale is 0.62 fps, which are both less than the permissible velocity of 5 fps. Therefore, drainage swales installed on the final cover topslope and sideslope will be constructed with a minimum depth of 2.1 and 2.5 feet, respectively. Drainage swales will be constructed with a minimum 1-foot of freeboard above calculated peak flow depth. See Drawing ~~6A.19~~ 6A.12 for drainage swale details.

Notes:

1. Calculations were performed using the HYDROCALC program developed by Dodson and Associates (Version 1.3, 1986).
2. Contributing drainage areas are depicted on Drawing 6A-E.1.
3. Refer to Hydraulic Calculation References for Mannings "n" and runoff coefficient, C, references.
4. Rainfal Intensity (I) calculated for tc = 10 min, using equation for rainfall intensity shown above. Refer to Hydraulic Calculation References for coefficient b,d, and e references.

DOWNCHUTE FLOW ANALYSIS

INTERMEDIATE COVER – DOWNCHUTE FLOW

CITY OF WACO LANDFILL
INTERMEDIATE COVER - DOWNCHUTE FLOW ANALYSIS

Required: Calculate the peak flow depth for sizing downchutes installed on **intermediate cover**.

Method:

1. Determine peak discharge rate associated with the 25 - year, 24 - hour storm event for downchute contributing drainage areas using the Rational Method (see Subsection 2.2 of Attachment 6A).
2. Determine Mannings "n" and runoff coefficient "C" (see Page 6A-A-25 and 6A-E-71, respectively).
3. Using the specified channel geometry, evaluate the peak velocity and flow depth using HYDROCALC program.

Solution:

$$I = \frac{b}{(t_c + d)^e}$$

Where, I = Rainfall intensity, in/hr
b= 103.56
d= 11.0
e= 0.806
t_c = 10 min

(b, d, e are associated with a 25 - year, 24 - hour storm for Limestone Co., see Page 6A-E-73)

Rational Method Calculations for Typical Swale Contributing Areas

Drainage Area [2]	Runoff Coef. C[3,~~5~~]	Rainfall Int. I, (in/hr)[4]	Area (acres)	Peak Discharge (cfs)
DC3	0.70	8.9	9.0	56.2
DC4	0.70	8.9	10.5	65.2
Example DC[5]	0.70	8.9	35.0	218.1

Typical Swale Summary Calculations[1]

Drainage Area [2]	Flow Rate (cfs)	Bottom Slope(ft/ft)	Manning's n[3]	Sideslope (left)	Sideslope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
DC3	56.2	0.25	0.033	2	2	10.0	0.43	12.05
DC4	65.2	0.25	0.033	2	2	10.0	0.47	~~12.17~~ 12.71
Example DC[5]	218.1	0.25	0.033	2	2	10.0	0.95	19.31

Conclusions:

Based on the greatest contributing drainage area shown on Drawing 6A-E.5, downchutes installed on intermediate cover will be constructed 2 feet deep (assuming 1-foot of freeboard), with a 10-foot bottom width, and 2H:1V sideslopes. Gabions, rip rap, or dissipation blocks will be installed at the toe of the landfill berm with the perimeter channels to dissipate the peak velocity. Typcial details for downchutes are depcited on Drawing 6A.20.

Notes:

1. Calculations were performed using the HYDROCALC program developed by Dodson and Associates (Version 1.3, 1986).
2. Contributing drainage areas are depicted on Drawing 6A-E.5.
3. Refer to Hydraulic Calculation References for Mannings "n" and runoff coefficient, C, references.
4. Rainfal Intensity (I) calculated for tc = 10 min, using equation for rainfall intensity shown above. Refer to Hydraulic Calculation References for coefficient b,d, and e references.
5. Example DC represents the largest intermediate cover drainage area to any one downchute.

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

September 28, 2020

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	218.1
Channel Bottom Slope (ft/ft)	0.25
Manning's Roughness Coefficient (n-value)	0.033
Channel Left Side Slope (horizontal/vertical)	2.0
Channel Right Side Slope (horizontal/vertical)	2.0
Channel Bottom Width (ft)	10.0

COMPUTATION RESULTS

DESCRIPTION	VALUE
Normal Depth (ft)	0.95
Flow Velocity (fps)	19.31
Froude Number	3.762
Velocity Head (ft)	5.79
Energy Head (ft)	6.74
Cross-Sectional Area of Flow (sq ft)	11.3
Top Width of Flow (ft)	13.8

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FINAL COVER – DOWNCHUTE FLOW

CITY OF WACO LANDFILL
FINAL COVER - DOWNCHUTE FLOW ANALYSIS

Required: Calculate the peak flow depth for sizing downchutes installed on **final cover**.

Method:

1. Determine peak discharge rate associated with the 25 - year, 24 - hour storm event for downchute contributing drainage areas using the Rational Method (see Subsection 2.2 of Attachment 6A).
2. Determine Mannings "n" and runoff coefficient "C" (see Page 6A-A-25 and 6A-E-71, respectively).
3. Using the specified channel geometry, evaluate the peak velocity and flow depth using HYDROCALC program.

Solution:

$$I = \frac{b}{(t_c + d)^e}$$

Where, I = Rainfall intensity, in/hr

b=	103.56
d=	11.0
e=	0.806
t_c =	10 min

(b, d, e are associated with a 25 - year, 24 - hour storm for Limestone Co., see Page 6A-E-73)

Rational Method Calculations for Typical Swale Contributing Areas

	Drainage Area [2]	Runoff Coef. C[3,~~5~~]	Rainfall Int. I, (in/hr)[4]	Area (acres)	Peak Discharge (cfs)
East	DC1	0.70	8.9	21.7	135.2
West	DC2	0.70	8.9	15.1	93.8

Typical Swale Summary Calculations[1]

Drainage Area [2]	Flow Rate (cfs)	Bottom Slope(ft/ft)	Manning's n[3]	Sideslope (left)	Sideslope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
DC1	135.2	0.25	0.033	2	2	15.0	0.60	15.20
DC2	93.8	0.25	0.033	2	2	15.0	0.49	13.28

Conclusions: Based on the greatest contributing drainage areas shown on Drawing 6A-E.2, downchutes installed on final cover will be constructed 2 feet deep (assuming 1-foot of freeboard), with a 15-foot bottom width, and 2H:1V sideslopes. Gabions, rip rap, or dissipation blocks will be installed at the toe of the landfill berm with the perimeter channels to dissipate the peak velocity. Typcial details for downchutes are depcited on Drawing 6A.20.

Notes:

1. Calculations were performed using the HYDROCALC program developed by Dodson and Associates (Version 1.3, 1986).
2. Contributing drainage areas are depicted on Drawing 6A-E.2.
3. Refer to Hydraulic Calculation References for Mannings "n" and runoff coefficient, C, references.
4. Rainfal Intensity (I) calculated for tc = 10 min, using equation for rainfall intensity shown above. Refer to Hydraulic Calculation References for coefficient b,d, and e references.

DETENTION BASIN AND PERIMETER CHANNEL FLOW ANALYSIS (HYDROCALC OUTPUT FILES)

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

October 1, 2020

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	106.3
Channel Bottom Slope (ft/ft)	0.0001
Manning's Roughness Coefficient (n-value)	0.033
Channel Left Side Slope (horizontal/vertical)	3.0
Channel Right Side Slope (horizontal/vertical)	3.0
Channel Bottom Width (ft)	10.0

COMPUTATION RESULTS

DESCRIPTION	VALUE
Normal Depth (ft)	4.78
Flow Velocity (fps)	0.91
Froude Number	0.093
Velocity Head (ft)	0.01
Energy Head (ft)	4.79
Cross-Sectional Area of Flow (sq ft)	116.31
Top Width of Flow (ft)	38.67

HYDROCALC Hydraulics for Windows, Version 2.0.1, Copyright(c) 1996-2010
Dodson & Associates, Inc., 5629 FM 1960 West, Suite 314, Houston, TX 77069
Email:software@dodson-hydro.com, All Rights Reserved.

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

October 1, 2020

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	40.4
Channel Bottom Slope (ft/ft)	0.0001
Manning's Roughness Coefficient (n-value)	0.033
Channel Left Side Slope (horizontal/vertical)	3.0
Channel Right Side Slope (horizontal/vertical)	3.0
Channel Bottom Width (ft)	7.0

COMPUTATION RESULTS

DESCRIPTION	VALUE
Normal Depth (ft)	3.32
Flow Velocity (fps)	0.72
Froude Number	0.087
Velocity Head (ft)	0.01
Energy Head (ft)	3.33
Cross-Sectional Area of Flow (sq ft)	56.31
Top Width of Flow (ft)	26.92

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TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

October 1, 2020

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	21.7
Channel Bottom Slope (ft/ft)	0.0001
Manning's Roughness Coefficient (n-value)	0.033
Channel Left Side Slope (horizontal/vertical)	3.0
Channel Right Side Slope (horizontal/vertical)	3.0
Channel Bottom Width (ft)	5.0

COMPUTATION RESULTS

DESCRIPTION	VALUE
Normal Depth (ft)	2.69
Flow Velocity (fps)	0.62
Froude Number	0.084
Velocity Head (ft)	0.01
Energy Head (ft)	2.7
Cross-Sectional Area of Flow (sq ft)	35.23
Top Width of Flow (ft)	21.16

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CHANNEL-2A5

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

September 29, 2020

==========

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	252.8
Channel Bottom Slope (ft/ft)	0.0025
Manning's Roughness Coefficient (n-value)	0.027
Channel Left Side Slope (horizontal/vertical)	3.0
Channel Right Side Slope (horizontal/vertical)	3.0
Channel Bottom Width (ft)	10.0

==========

COMPUTATION RESULTS

DESCRIPTION	VALUE
Normal Depth (ft)	3.04
Flow Velocity (fps)	4.35
Froude Number	0.535
Velocity Head (ft)	0.29
Energy Head (ft)	3.33
Cross-Sectional Area of Flow (sq ft)	58.1
Top Width of Flow (ft)	28.24

==========

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CHANNEL-3A1

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

September 29, 2020

==========

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	123.5
Channel Bottom Slope (ft/ft)	0.0025
Manning's Roughness Coefficient (n-value)	0.027
Channel Left Side Slope (horizontal/vertical)	3.0
Channel Right Side Slope (horizontal/vertical)	3.0
Channel Bottom Width (ft)	10.0

==========

COMPUTATION RESULTS

DESCRIPTION	VALUE
Normal Depth (ft)	2.12
Flow Velocity (fps)	3.57
Froude Number	0.51
Velocity Head (ft)	0.2
Energy Head (ft)	2.31
Cross-Sectional Area of Flow (sq ft)	34.58
Top Width of Flow (ft)	22.69

==========

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CHANNEL-4B6

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

September 29, 2020

==========

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	71.6
Channel Bottom Slope (ft/ft)	0.009
Manning's Roughness Coefficient (n-value)	0.027
Channel Left Side Slope (horizontal/vertical)	3.0
Channel Right Side Slope (horizontal/vertical)	3.0
Channel Bottom Width (ft)	10.0

==========

COMPUTATION RESULTS

DESCRIPTION	VALUE
Normal Depth (ft)	1.12
Flow Velocity (fps)	4.78
Froude Number	0.891
Velocity Head (ft)	0.36
Energy Head (ft)	1.48
Cross-Sectional Area of Flow (sq ft)	14.98
Top Width of Flow (ft)	16.72

==========

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CHANNEL-4B7

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

September 29, 2020

==========

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	210.0
Channel Bottom Slope (ft/ft)	0.009
Manning's Roughness Coefficient (n-value)	0.033
Channel Left Side Slope (horizontal/vertical)	3.0
Channel Right Side Slope (horizontal/vertical)	3.0
Channel Bottom Width (ft)	10.0

==========

COMPUTATION RESULTS

DESCRIPTION	VALUE
Normal Depth (ft)	2.22
Flow Velocity (fps)	5.69
Froude Number	0.797
Velocity Head (ft)	0.5
Energy Head (ft)	2.72
Cross-Sectional Area of Flow (sq ft)	36.92
Top Width of Flow (ft)	23.3

==========

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CHANNEL-4B8

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

September 29, 2020

==========

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	210.0
Channel Bottom Slope (ft/ft)	0.0025
Manning's Roughness Coefficient (n-value)	0.027
Channel Left Side Slope (horizontal/vertical)	3.0
Channel Right Side Slope (horizontal/vertical)	3.0
Channel Bottom Width (ft)	11.0

==========

COMPUTATION RESULTS

DESCRIPTION	VALUE
Normal Depth (ft)	2.68
Flow Velocity (fps)	4.11
Froude Number	0.528
Velocity Head (ft)	0.26
Energy Head (ft)	2.94
Cross-Sectional Area of Flow (sq ft)	51.07
Top Width of Flow (ft)	27.09

==========

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CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III
SITE DEVELOPMENT PLAN
ATTACHMENT 6B
FLOODPLAIN EVALUATION

Prepared for:

CITY OF WACO

Solid Waste Services
501 Schroeder Drive
Waco, TX 76710

Prepared by:

SCS ENGINEERS
Texas Board of Professional Engineers, Reg. No. F-3407
Dallas/Fort Worth Office
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 0 – April 2020
Revision 1 – October 2020
SCS Project No. 16216088.00

TABLE OF CONTENTS

SECTION **PAGE**

1 INTRODUCTION 6B-1-1
2 FLOODPLAIN DELINEATION 6B-2-1
2.1 FLOODPLAIN EVALUATION 6B-2-1
2.2 100-YEAR FLOOD STUDY 6B-2-1
2.2.1 Methodology 6B-2-1
2.2.2 Computations using HEC-HMS 6B-2-4
2.2.3 Computations using HEC-RAS 6B-2-4
2.2.4 Findings of the 100-year Flood Study 6B-2-4
2.3 REGULATORY COMPLIANCE WITH FLOODPLAIN REQUIREMENTS 6B-2-4
2.3.1 Description of Floodplain [TAC §330.61(m)(1)] 6B-2-4
2.3.2 Freeboard Requirement [TAC §330.307(a) and (b)] 6B-2-4
2.3.3 Flood Control and Analysis [TAC §330.547(a) 6B-2-5
2.3.4 Floodplains [TAC §330.547] 6B-2-5

Drawings

Drawing 6B.1: FEMA Floodplain Map
Drawing 6B.2: Flood Study Drainage Areas
Drawing 6B.3: Proposed Limit of 100-year Flood Study

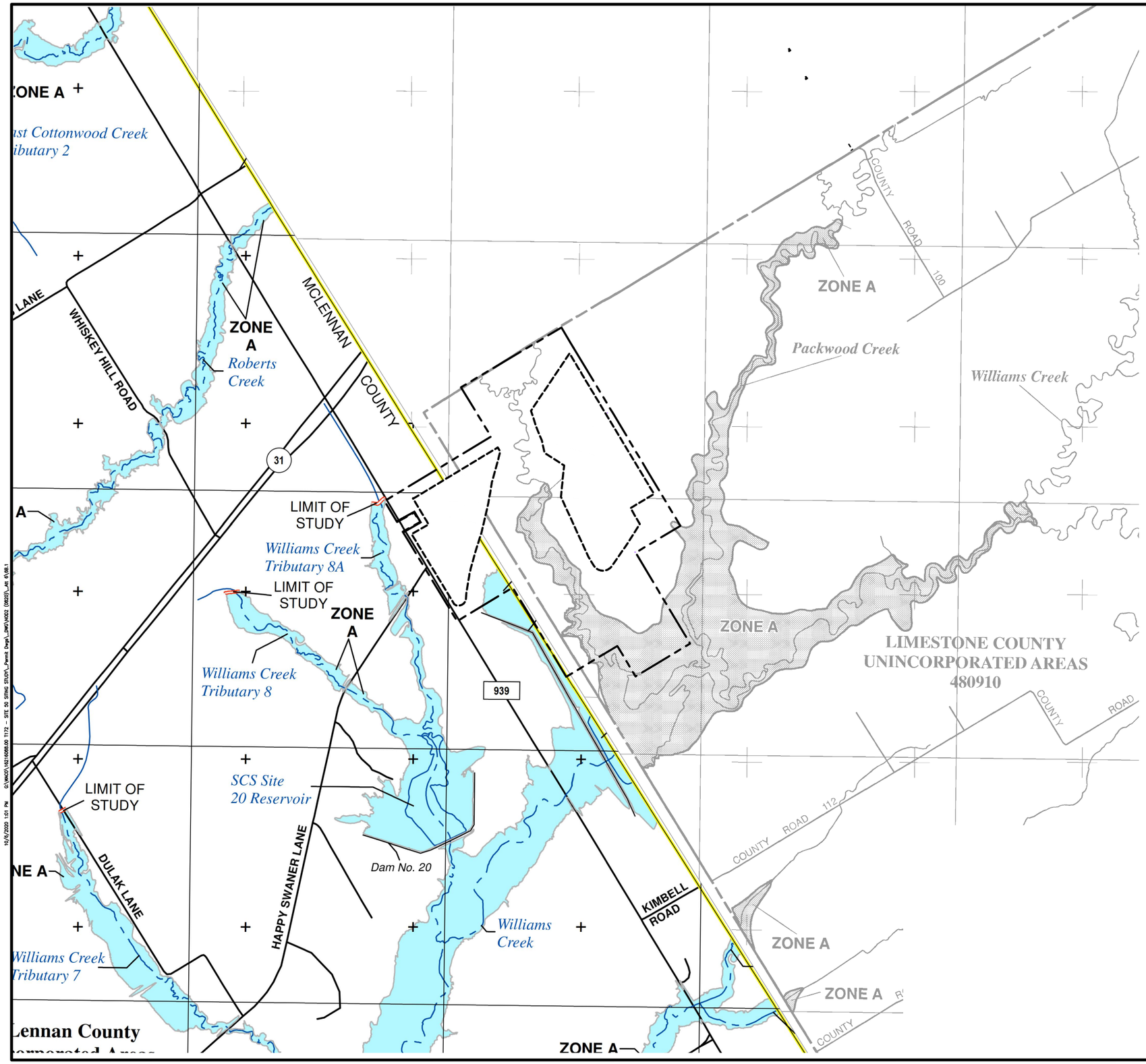
Appendices

6B-A HEC-HMS Input Parameters
6B-B HEC-HMS Input File
6B-C HEC-HMS Output File
6B-D HEC-RAS Output Summary

SCS Engineers
TBPE Reg. # F-3407

DRAWINGS

- Drawing 6B.1: FEMA Floodplain Map
- Drawing 6B.2: Flood Study Drainage Areas
- Drawing 6B.3: Proposed Limit of 100-year Flood Study



0 1000 2000
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- ZONE A — SPECIAL FLOOD HAZARD AREA
- OTHER SPECIAL FLOOD HAZARD AREA

NOTES:

1. THESE MAPS MAY NOT INCLUDE ALL SPECIAL FLOOD HAZARD AREAS IN THE COMMUNITY. AFTER A MORE DETAILED STUDY, THE SPECIAL FLOOD HAZARD AREAS SHOWN ON THESE MAPS MAY BE MODIFIED, AND OTHER AREAS ADDED.
2. ZONE A: AREAS WITH A 1% ANNUAL CHANCE OF FLOODING AND A 26% CHANCE OF FLOODING OVER THE LIFE OF A 30-YEAR MORTGAGE. BECAUSE DETAILED ANALYSES ARE NOT PERFORMED FOR SUCH AREAS; NO DEPTHS OR BASE FLOOD ELEVATIONS ARE SHOWN WITHIN THESE ZONES.
3. ZONE X: AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN.

BASE MAP SOURCES
FIRM

FLOOD INSURANCE RATE MAP LIMESTONE COUNTY,
TEXAS INCORPORATED AREA COMMUNITY –
PANEL 125 OF 625
MAP NUMBER: 48293C0125C
EFFECTIVE DATE: SEPTEMBER 16, 2011
U.S. DEPARTMENT OF HOUSING
AND URBAN DEVELOPMENT

1

FLOOD INSURANCE RATE MAP MCLENNAN COUNTY,
TEXAS INCORPORATED AREA COMMUNITY –
PANEL 250 OF 750
MAP NUMBER: 48309C0250D
EFFECTIVE DATE: DECEMBER 20, 2019
U.S. DEPARTMENT OF HOUSING
AND URBAN DEVELOPMENT

STATE OF TEXAS
JAMES ROY MURRAY III
73860
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	2019 UPDATE TO MCLENNAN COUNTY FRM MAP	JRM

DRAWING TITLE: **FEMA FLOODPLAIN MAP**

PROJECT TITLE: **CITY OF WACO LANDFILL**
TYPE I MSW - PERMIT APPLICATION

CLIENT: **CITY OF WACO**
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 78021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DWN. BY: JLJ | Q/A RVW BY: KDY
DSN. BY: RRK | CHK. BY: KDY | APP. BY: RRK

CADD FILE: 6B.1

DATE: 10/2020

SCALE: AS SHOWN

DRAWING NO. **6B.1**

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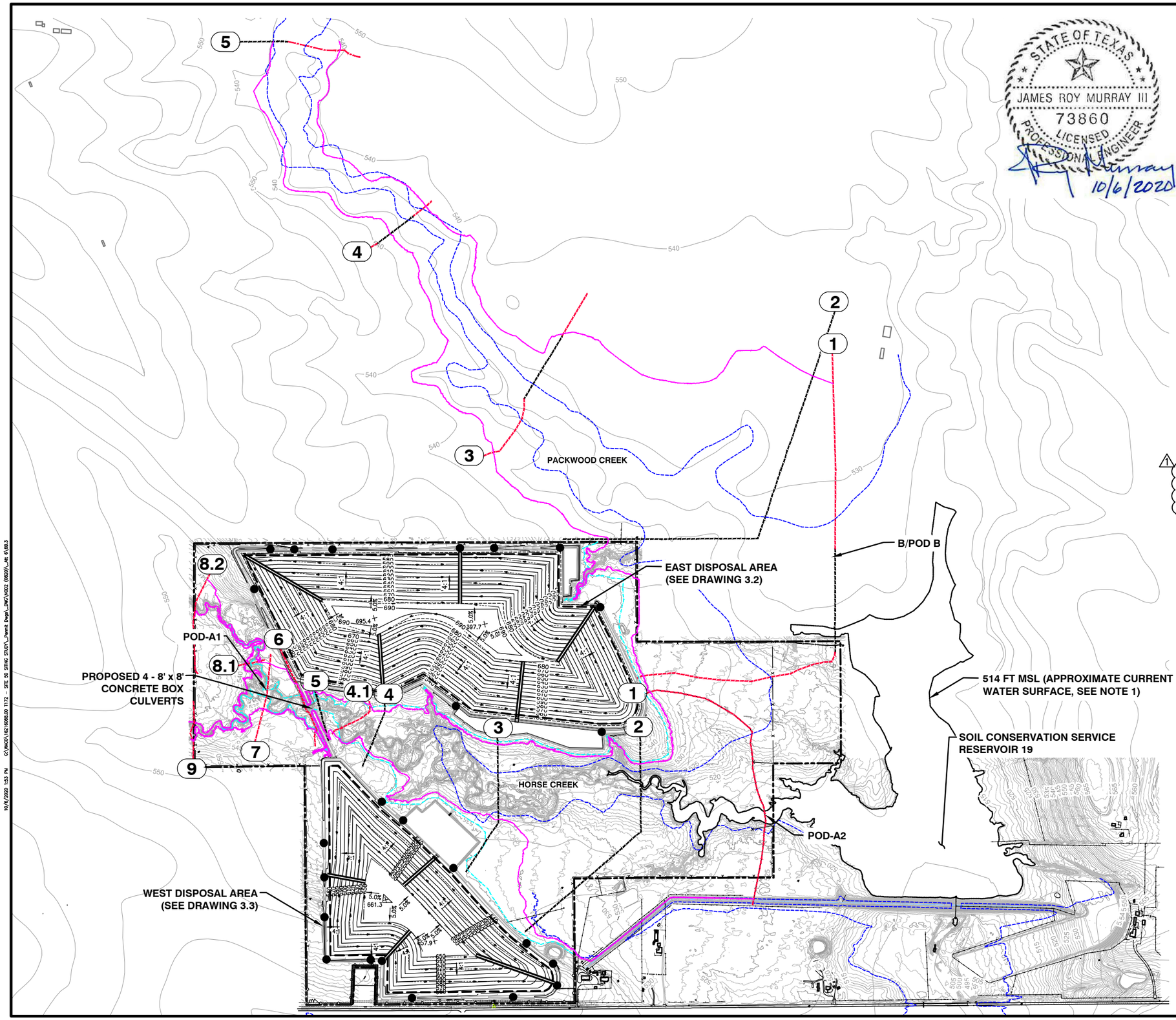

STATE OF TEXAS
JAMES ROY MURRAY III
73860
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

0 500 1000
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- 4 SURVEYED CROSS-SECTIONALS
- 7 TOPOGRAPHY CROSS-SECTIONALS
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- 100-YEAR STORM EVENT WATER SURFACE
- SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTE:

1. EXISTING TOPOGRAPHY IS A COMPOSITE OF 2016 AND 2018 SURVEYS.

   2016 TOPOGRAPHIC SURVEY FROM U.S. GEOLOGICAL SURVEY.

   2018 TOPOGRAPHIC SURVEY FROM AERIAL PHOTOGRAPHY PERFORMED BY UNITED GEO TECHNOLOGIES, INC. ON JULY 03, 2018.

2. 100-YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY). FOR ADDITIONAL INFORMATION, SEE DRAWING 6B1.

ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

HORSE CREEK 100-YEAR STORM EVENT WATER SURFACE ELEVATION (FT)	
CROSS SECTION 1	533.40
CROSS SECTION 2	533.41
CROSS SECTION 3	533.44
CROSS SECTION 4	533.78
CROSS SECTION 5	536.60
CROSS SECTION 6	538.43
CROSS SECTION 7	540.00
CROSS SECTION 8.1	537.46
CROSS SECTION 8.2	545.35
CROSS SECTION 9	541.87

THE 100-YEAR FLOOD STUDY IDENTIFIED THE 100-YEAR FLOOD LEVEL AND 100-YEAR FLOOD LIMITS. FOR ADDITIONAL INFORMATION, SEE APPENDIX 6B-D.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, LIMITS OF WASTE, NOTE 2, AND HORSE CREEK 100-YEAR STORM EVENT WATER SURFACE ELEVATION TABLE.	JRM

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: PROPOSED LIMIT OF 100-YEAR FLOOD STUDY

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: BG | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 6B.3

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 6B.3

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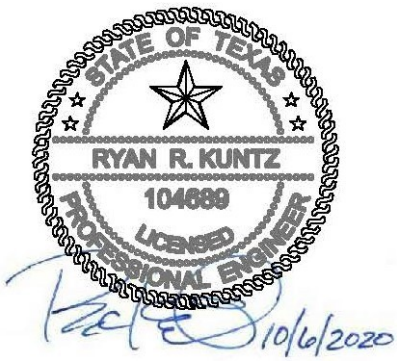
10/6/2020 1:53 PM

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
MCLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III - SITE DEVELOPMENT PLAN
ATTACHMENT 6C
GROUNDWATER PROTECTION PLAN

Prepared for:

CITY OF WACO



Solid Waste Services
501 Schroeder Drive
Waco, Texas 76710

Prepared by:

SCS ENGINEERS
Texas Board of Professional Engineers, Reg. No. F-3407
Dallas/Fort Worth Office
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 0 – April 2020
Revision 1 – October 2020
SCS Project No. 16216088.00

TABLE OF CONTENTS

SECTION **PAGE**

1 INTRODUCTION.....6C-1-1

2 GROUNDWATER PROTECTION DESIGN.....6C-2-1

2.1 LINER SYSTEM.....6C-2-1
2.2 LEACHATE COLLECTION SYSTEM.....6C-2-1
2.3 FINAL COVER SYSTEM.....6C-2-2

Drawings

6C.1 Bottom Liner Details
6C.2 Final Cover Details

SCS Engineers
TBPE Reg. # F-3407

Additional description is provided in Attachment 12. Drawings that depict the layout of the leachate collection system components, as well as selected details of the leachate collection system are also provided in Attachment 12.

The primary collection component of the LCS is the leachate drainage layer, which consists of a geonet-geotextile composite (referred to as geocomposite) placed directly over the geomembrane component of the liner system. The geocomposite will serve to collect and convey leachate to the LCS pipes and sumps. The geocomposite will consist of an HDPE geonet with a non-woven geotextile heat bonded to one or both sides of the geonet. The geocomposite will maintain less than 30 centimeters leachate head above the bottom liner system. Calculations demonstrating the required material properties for the geocomposite are presented in the Attachment 12, Appendix 12B.

A 2-foot thick protective soil cover will be placed over the geocomposite prior to waste placement. Chimney drains, comprised of aggregate wrapped in a non-woven geotextile, will be constructed over the leachate collection piping for both leachate drainage and pipe stability. The bottom liner system of each sector will slope to drain at a minimum 2 percent grade toward a perforated leachate collection pipe located in the center of each sector. The leachate collection piping will be sloped at a minimum 1 percent to drain leachate into leachate collection sumps located at the perimeter of the landfill. Additional discussion and calculations regarding pipe stability to prevent collapse, spacing and size for anticipated leachate flows, and perforations to prevent clogging are presented in Attachment 15, Appendix 12B.

Leachate collected in the sumps will be removed via submersible pumps lowered into the sumps through a riser extending up the sector sideslope. Additional description of the sumps, including sump sizing calculations, is also presented in Attachment 12, Appendix 12B.

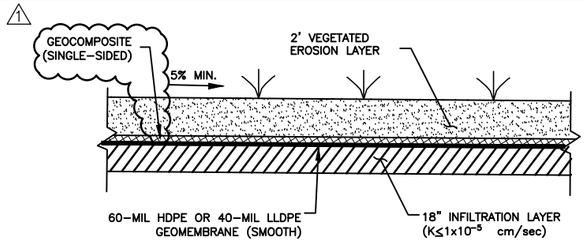
2.3 FINAL COVER SYSTEM

As shown on Drawing 6C.2, the final cover system will be a soil-geomembrane composite meeting the requirements of §330.457(a). Beginning from the surface and working down, the final cover system will be comprised of the following components:

- Vegetation (native and/or introduced grasses);
- 24-inch-thick vegetative erosion layer, with the upper 6 inches capable of sustaining vegetation;
- ~~Double-sided g~~Geocomposite (single-sided on the topslope and double-sided on the sideslopes~~ only~~);
- 60-mil HDPE geomembrane, or 40-mil linear low density polyethylene (LLDPE) geomembrane (smooth on the topslope and textured [both sides] on the sideslopes);
- 18-inch-thick clayey soil infiltration layer ($k \leq 1x10^{-5}$ cm/sec); and

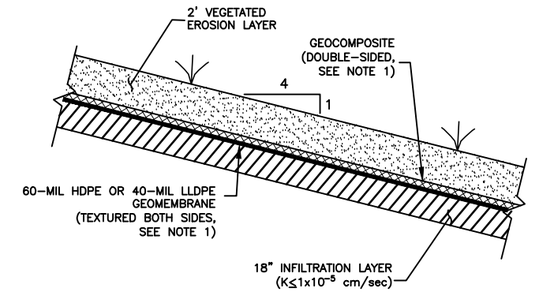
DRAWINGS

- Drawing 6C.1 Bottom Liner Details
- Drawing 6C.2 Final Cover Details



FINAL COVER – TOPSLOPE (A / 6C.2)

NTS

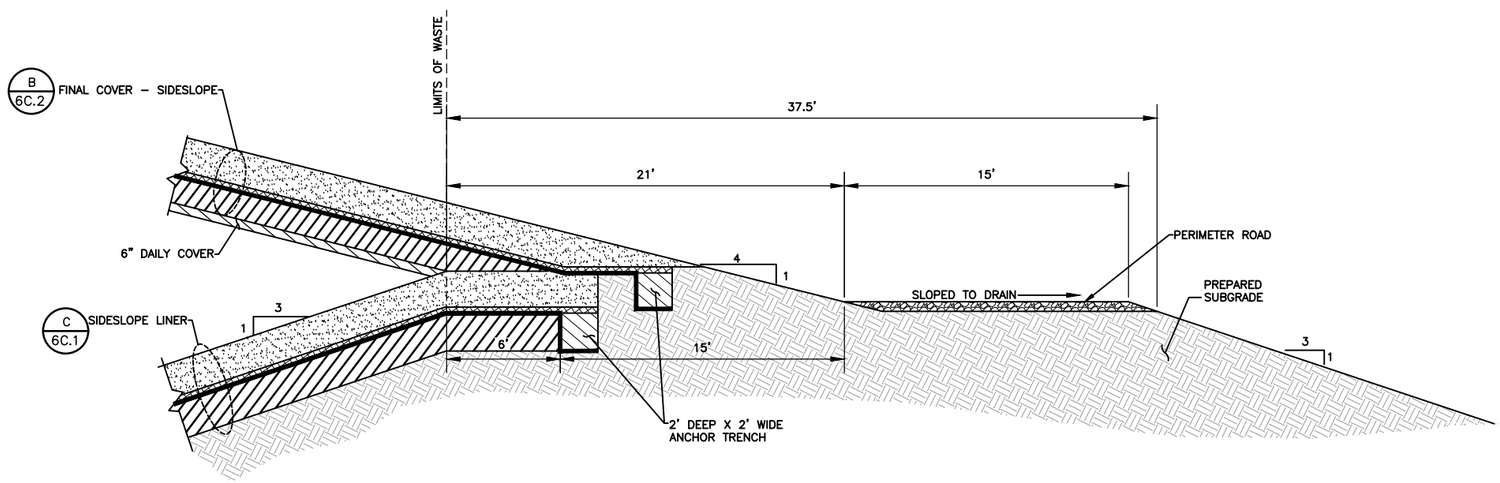


FINAL COVER – SIDESLOPE (B / 6C.2)

NTS

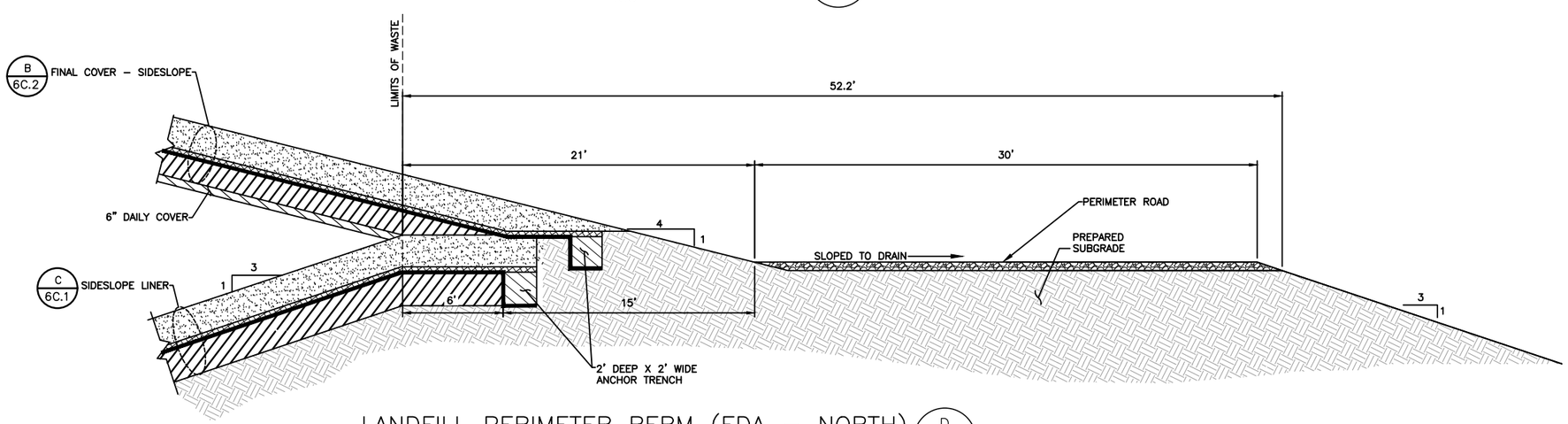
NOTE:

1. TEXTURED GEOMEMBRANE AND DOUBLE-SIDED GEOCOMPOSITE WILL EXTEND A MINIMUM OF 14 5 FEET ONTO THE LANDFILL TOPSLOPE.



LANDFILL PERIMETER BERM (C / 6C.2)

NTS



LANDFILL PERIMETER BERM (EDA – NORTH) (D / 6C.2)

NTS

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV.	DATE	DESCRIPTION	BY
1	10/2020	ADDED GEOCOMPOSITE ON TOPSLOPE OF FINAL COVER.	
2		REVISED NOTE 1 TO CHANGE GEOCOMPOSITE EXTENSION LENGTH TO 5 FEET. ON TOP SLOPE.	
3			
4			
5			
6			

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: FINAL COVER DETAILS

PROJECT TITLE: CITY OF WACO LANDFILL TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16-216088.00 | DSN. BY: EG/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 6C2 – FINAL COVER DETAIL-1

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 6C.2

10/10/2020 11:13 AM G:\WACO\16216088.00 1172 - SITE 60 SITING STUDY_Permit Dwgs_DWG\W002 (2020)_Alt 6\6C2 - Final Cover Detail-1

ITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III - SITE DEVELOPMENT PLAN
ATTACHMENT 7
GROUNDWATER SAMPLING AND ANALYSIS PLAN

Prepared for:

CITY OF WACO

Solid Waste Services
501 Schroeder Drive
Waco, TX 76710

Prepared by:

SCS ENGINEERS
Texas Board of Professional Engineers, Reg. No. F-3407
Dallas/Fort Worth Office
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 0 – May 2020
Revision 1 – October 2020
SCS Project No. 16216088.00

TABLE OF CONTENTS

SECTION **PAGE**

1 INTRODUCTION 7-1-1
2 GROUNDWATER SAMPLING PROCEDURES 7-2-1
2.1 PRELIMINARY WORK 7-2-1
2.2 WELL PURGING 7-2-1
2.3 STORAGE AND DISPOSAL OF PURGE WATER AND EXCESS SAMPLE WATER 7-2-3
2.4 SAMPLE COLLECTION 7-2-4
3 GROUNDWATER ANALYSIS 7-3-1
3.1 LABORATORY ACCREDITATION 7-3-1
3.2 GROUNDWATER SAMPLING AND ANALYSIS REQUIREMENTS 7-3-1
3.3 CONSTITUENTS REQUIRED FOR DETECTION MONITORING 7-3-1
3.4 TEST METHODS 7-3-1
3.5 REPORTING ANALYTICAL RESULTS 7-3-1
4 STATISTICAL EVALUATION OF MONITORING DATA 7-4-1
4.1 REGULATORY REQUIREMENTS 7-4-1
4.2 ESTABLISHING AND UPDATING BACKGROUND 7-4-1
4.3 SITE-WIDE FALSE POSITIVE RATES AND STATISTICAL POWER 7-4-3
4.4 STATISTICALLY SIGNIFICANT INCREASES DURING DETECTION MONITORING 7-4-3
4.5 STATISTICAL TESTS 7-4-4
5 MONITORING FREQUENCY AND REPORTING REQUIREMENTS 7-5-1
5.1 BACKGROUND MONITORING [30 TAC 330.407(A)(1)] 7-5-1
5.2 DETECTION MONITORING [30 TAC 330.407] 7-5-1
5.3 ASSESSMENT MONITORING [30 TAC 330.409] 7-5-2
5.4 ASSESSMENT OF CORRECTIVE MEASURES [30 TAC 330.411] 7-5-5
5.5 REPORTING REQUIREMENTS 7-5-5

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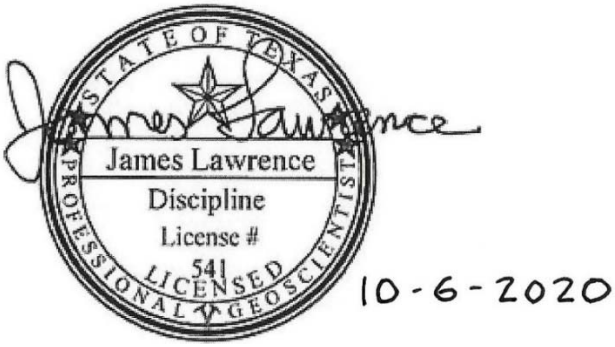
Tables

Table 7-2-1. Typical Collecting Frequencies for Blanks

Table 7-3-1. Measurement-Quality Objectives

Appendices

Appendix III-7-A List of Constituents for Detection Monitoring



- Transport off-site or discharge to an authorized wastewater treatment facility, or liquid waste processing facility, if the water quality is acceptable to the receiving facility.

If test results indicate levels of contaminants that cause the water to be classified as hazardous, the water shall be properly transported and disposed of at a hazardous waste facility.

2.4 SAMPLE COLLECTION

Physical or chemical changes can occur in groundwater samples if inappropriate or inadequate sampling devices, collection procedures, preservatives, temperature controls, or shipping methods are used. The sampler shall observe the following procedures when collecting samples.

2.4.1 Sample Collection Methods

2.4.1.1 Timing and Sequence of Sampling

The elapsed time between purging and sample collection shall be as short as practical, to avoid temporal variations in water levels and water chemistry. Preferably, sampling shall be done within 24 hours of purging. The sampler shall measure the water level in each well again before sampling to determine whether there is enough water for sampling, especially if the well went dry during purging. Where practicable, the water level in a well shall be allowed to recover to 90 percent of the level that existed prior to purging, before collecting a sample. To allow wells that purged dry to recover sufficiently to sample, or suspended sediments to settle, the sampler may have to wait several hours or several days between purging and sampling.

The sampler may allow up to seven days recovery time after purging a well before determining that the well is dry or has not recharged sufficiently to sample. If after seven days a slowly recharging well has not recovered sufficiently for a complete set of samples, the sampler shall collect a partial set of samples in the order specified in this GWSAP, or in another order if warranted by conditions and data needs, until no more samples for the set can be collected. If contamination is known to be present in one or more wells at an MSW landfill, the sampler shall begin the sampling at the well that is known to be the least contaminated and end with the most contaminated well. Where no contamination is known, the order shall generally be from the well with the highest water-level elevation to the one with the lowest elevation (that is, from upgradient to downgradient) for wells screened in the same water-bearing unit.

If low-flow purging is used, then low-flow sampling will also be used. Samples can be collected immediately at a flow rate less than 250 ml/minute, upon parameter and water level stabilization.

2.4.1.2 Cleaning and Decontaminating Field Equipment

If the sampler uses non-dedicated sampling devices, they shall clean and decontaminate them using appropriate procedures before sampling each well. Do not reuse sample bottles, bailer rope, rubber hoses, or disposable gloves. If a bailer is used, a bottom-emptying device is required, because it allows the bailer to be emptied slowly from the bottom, reducing turbulence and aeration, which could alter sample chemistry.

2.4.1.3 Calibrating Field Equipment

Field equipment, including devices for water quality indicator parameters, shall be calibrated in accordance with the manufacturer's instructions prior to sampling.

2.4.1.4 Water Quality Indicator Parameters

Before sample collection begins, the sampler shall measure and record water quality indicator parameters—including pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature, and turbidity—in addition to the measurements the sampler made during purging [if low-flow sampling is used].

2.4.1.5 Sample Filtering

Per 30 TAC §330.405(c), the sampler shall not filter any samples in the field.

2.4.2 Sample-Collection Procedure

Sampling with a bailer is the collection method of choice at this Facility. If for some reason a bailer is not available for use, a low-flow pump such as a Monsoon pump is an acceptable alternative.

2.4.2.1 Cleanliness

To prevent contamination, the sampler shall keep clean equipment on top of plastic sheeting and not in direct contact with the ground. The sampler shall check the area around the sampling point for possible sources of air contamination, particularly when sampling for VOCs. The sampler shall note any potential impacts in the field log. The sampler shall collect all water samples as close to the wellhead as practical. The sampler shall not allow the sampling device to touch the sampling container, but hold the two as close to each other as possible, to reduce aeration. Water removed during sampling and not utilized shall be handled in the same way as purge water.

2.4.2.2 Sample Volumes and Sampling Containers

The volume of samples and types of sample containers needed depends on the constituents to be analyzed. The sampler shall follow the following EPA recommendations:

- For volatile organic compounds (VOCs), use two [or three] 40 ml glass vials (or lab-specified alternate quantity or size) with special caps with Teflon® septa, pre-preserved by the lab. The septum shall be correctly placed, with the Teflon® side toward the sample (shiny side away from the sample).
- For semivolatile organic compounds (SVOCs), use a one-liter glass container.
- For metals, use laboratory-provided polyethylene or glass containers that already contain the necessary preservatives.
- For other inorganic constituents, use laboratory-provided polyethylene or glass containers (preservatives generally are not used, except for samples to be analyzed for ammonia).

2.4.2.3 Filling Sample Containers

The sampler shall fill sample containers in the following order, according to volatilization sensitivity (from most to least volatile):

- VOCs
- SVOCs
- Metals
- Other Inorganic Constituents

When filling containers for VOC samples, the sampler shall allow the water stream to flow down the inner wall of the vial to minimize formation of air bubbles. The sampler shall overflow the containers slightly so that the vial has a positive meniscus. The sampler shall screw the caps on carefully to avoid leaving any air space in the vials. If an air bubble forms in the bottle, the sampler shall not open the bottle to remove it, but collect an additional, separate sample. If the sampler uses bailers for sampling, the sampler shall discard the first part of the sample to remove any sludge or suspended solids, then fill both VOC vials from a single bailer to minimize differences in the samples.

2.4.2.4 Labeling Sample Containers

All sample containers shall be labeled for identification purposes. The labels shall include information such as sample number (with the well number as part of the sample number), site identification, analysis to be performed, preservatives used, date and time of sample collection, and name of sampler. The sampler shall write the information on the label with permanent ink and, if necessary, cover the label with transparent tape to protect the written data.

2.4.3 Quality Control Samples

The sampler is required to use appropriate trip blanks, field blanks, equipment blanks, and field duplicate samples for quality control (QC), as they can help determine whether samples have been contaminated from other sources. Typical collecting frequencies are as follows:

Table 7-2-1. Typical Collecting Frequencies for Blanks

Type of Blank Collection	Frequency
Trip Blanks	One for each sampling event
Field Blanks	One per day, or one for every 10 wells sampled, whichever is greater
Equipment Blanks	One per day or sampling event [if non-dedicated/non-disposable equipment is used]
Field Duplicates	One for every 20 wells sampled, with at least one per sampling event

The various types of QC samples are described below.

- Trip Blanks. A trip blank is a laboratory-prepared sample of reagent-grade or distilled water provided with a set of sample jars that is transported to and from the site in the same manner as the sample containers. The purpose of the trip blank is to determine if any of the sample bottles or collected samples have been contaminated before or during sampling, or if sample shipment, handling, and storage have had an impact on the integrity of the sample.

- Field Blanks. A field blank is prepared in the field by pouring laboratory reagent-grade or distilled water into clean sample containers opened in the field, then returned with the samples to the laboratory for analysis. It is used to check for incorrect sampling procedures or airborne contaminants at the sample-collection point. It is appropriate to collect the field blanks when sampling downgradient wells. If a well is contaminated, a field blank collected close to the contaminated well, in addition to the regular field blank, may help determine if there are other contaminant sources in the area of the well.

- Equipment Blanks. An equipment blank is a sample of laboratory reagent-grade or distilled water run through the well-sampling equipment in the same manner as the actual groundwater sample, to determine the effectiveness of the procedures for equipment decontamination. An equipment blank is not necessary if non-dedicated/non-disposable equipment is used.

- Field Duplicates. Analysis of field duplicate samples provides a check on the precision of the laboratory techniques. Field duplicates are two samples taken at the same time from the same well, and from the same bailer, if bailers are used. Field duplicates are labeled differently so that the laboratory is unaware that the samples are duplicates.

- Field duplicate samples shall be labeled as the sampler would regular samples, but with a sample name such as “Dup-1,” “Dup-2,” and so on, and with the sample time omitted, so there is no way for the laboratory to know which well the duplicate sample is from. The information about which well the duplicate is from shall be recorded in the field log book.

2.4.4 Chain-of-Custody Documentation

A suitable chain-of-custody (COC) document shall accompany the samples at every step from field to laboratory and shall be signed by each party (except commercial transporters) handling the samples, from the sampler to the laboratory representative. Usually laboratories provide their own blank COC forms with the empty sample-bottle shipment. Proper COC procedures are essential to ensure sample integrity and to provide legally and technically defensible data.

The person collecting the sample starts the COC procedure and fills in all the required information on the COC document, such as sample name, collection date and time, and requested analyses. Individuals relinquishing and receiving the samples shall sign, date, and note the time of transfer on the COC document. A completed COC document shall be placed inside a sealed plastic bag to prevent the ice or water in the cooler from damaging it. Mailed packages shall have tracking numbers to allow for locating shipments.

2.4.5 Sample Storage and Transport

All samples shall be kept cold, ideally at 4° C ± 2°, and transported to the laboratory as soon as possible, preferably within 48 hours of sampling. The samples shall be wrapped, put into resealable plastic bags, and placed in a hard-sided ice chest or other insulated container packed with sufficient ice or refreezable materials to keep them at the ideal temperature. Dry ice is not to be used to chill the samples because the samples could freeze and break their containers.

If the samples are to be shipped, they shall be kept chilled with ice in plastic bags while sampling is occurring. Then, just before shipping, the sampler shall pour out the excess melt water, and add more ice, if necessary. Coolers can also be kept cold with frozen packages of refreezable materials such as “blue ice.” The samples, blanks, and COC documents need to be well packed in the insulated cooler, with as little extra air space as possible, utilizing ice bags, foam, or bubble wrap to add padding, then thoroughly sealed with shipping tape. Flimsy, expanded-foam or soft-sided ice chests are not suitable for shipping.

2.4.6 Documentation of Sampling

This GWSAP requires that all information related to a sampling event be recorded in a bound, permanent field log book or equivalent. All the entries in the log book shall be legible and made in black, permanent ink. Entry errors shall be crossed out with a single line, dated, and initialed by the person making the corrections. An essential practice is to record sufficient information so that the sampling situation can be reconstructed without relying on the sampler's memory. Location, date, time, weather conditions, name and identity of sampling personnel, all field measurements including numerical values and units, comments about the integrity of the well, and so on shall be recorded. Because the field log book may be the only acceptable record for legal purposes, it shall be protected and kept in a safe place.

During assessment monitoring, the 95% lower confidence limit (LCL) for each constituent is compared against its GWPS to determine if a constituent is present at a statistically significant level above its GWPS. If an LCL exceeds a GWPS, corrective action is triggered, unless it is demonstrated that the statistically significant level resulted from error in sampling, analysis, statistical evaluation, or from natural variation in groundwater quality.

During corrective action monitoring, the 95% upper confidence limit (UCL) for each constituent is compared against its GWPS to determine if a constituent remains at a statistically significant level above its GWPS. A remedy under corrective action is considered complete when the UCLs for all assessment constituents have not exceeded GWPSs for a period of three consecutive years.

5.2.1.1 Alternate Source Demonstration [30 TAC §330.407(b)(3)]

If a statistically significant increase over a background limit of any tested constituent at any monitoring well has occurred and the owner or operator has reasonable cause to think that a source other than the Landfill caused the contamination or that the statistically significant increase resulted from error in sampling, analysis, or statistical evaluation, or from natural variation in groundwater quality, then the owner or operator may submit a report providing documentation to this effect. The report is commonly referred to as an "alternate source demonstration (ASD)," but may be a demonstration of an error or of natural variation, instead of a source other than the Landfill.

In making a demonstration under this paragraph, the owner or operator shall not filter the groundwater sample for constituents addressed by the demonstration prior to laboratory analysis. The executive director may also require the owner or operator to provide analyses of the landfill leachate to support the demonstration per 30 TAC §330.407(b)(3)(C).

The owner or operator pursuing an ASD shall first notify the executive director of the TCEQ (and any local pollution agency with jurisdiction that has requested to be notified) in writing, within 14 days of determining an SSI over a background limit, that the owner or operator intends to make the demonstration. The ASD shall be submitted within 90 days of determining an SSI.

If the ASD is satisfactory to the executive director, the facility may continue detection monitoring. If the ASD is not satisfactory, the Landfill shall proceed with assessment monitoring.

5.3 ASSESSMENT MONITORING [30 TAC §330.409]

Assessment monitoring is required if a facility determines there has been an SSI over a background limit for one or more of the constituents. Within 90 days of determining that an SSI has occurred, and not less than annually thereafter, the owner or operator shall sample and analyze each affected well and the two wells adjacent to each affected well for the full set of constituents listed in Appendix II to 40 CFR, Part 258. After sampling for the full set of Appendix II constituents, the executive director may delete any of the Appendix II constituents.

The executive director may specify an appropriate alternative frequency, in accordance with 30 TAC §330.409(c), for repeated sampling and analysis for the full set of 40 CFR Part 258, Appendix II constituents. During alternative frequency for repeated sampling, the following factors shall be considered~~established~~:

- ~~Background concentrations for any additional Appendix II constituents detected.~~lithology and hydraulic conductivity of the aquifer and unsaturated zone;
- groundwater flow rates;
- minimum distance of travel from the waste nearest to any point of compliance monitoring well;
- resource value of the uppermost aquifer; and

- nature (fate and transport) of any constituents detected in response to this section.~~A GWPS for all constituents in point of compliance wells detected.~~

  - ~~for constituents for which a maximum contaminant level (MCL) has been promulgated under 40 CFR Part 141, Safe Drinking Water Act (MCL).~~

  - ~~for constituents for which MCLs have not been promulgated.~~

  - ~~for constituents for which the background level is higher than the MCL or health based levels.~~

~~During alternative frequency repeat sampling, the executive director may establish an alternative GWPS in accordance with 30 TAC §330.409(i).~~

In accordance with TAC §330.409(d)(2), i~~I~~f any new constituents are detected in the well as a result of the Appendix II analysis, a background limit shall be established for the additional constituents. This background level consists of four statistically independent samples from each background well. Furthermore, groundwater protection standards shall be established for all constituents in point of compliance wells detected (TAC §330.409(d)(3)). The groundwater protection standards shall be established in accordance with TAC §330.409(h) or (i).

In accordance with TAC §330.409(h), the owner or operator shall establish a groundwater protection standard for each 40 CFR Part 258, Appendix II constituent detected in the point of compliance monitoring wells. The groundwater protection standard must be:

- for constituents for which a maximum contaminant level (MCL) has been promulgated under 40 CFR Part 141, Safe Drinking Water Act, the MCL for that constituent;

- for constituents for which MCLs have not been promulgated, the background concentration for the constituent established from wells in accordance with TAC §330.405(d);

- for constituents for which the background level is higher than the MCL promulgated under 40 CFR Part 141, Safe Drinking Water Act or health-based levels identified under TAC §330.409(i), the background concentration.

In accordance with TAC §330.409(i), the executive director may establish an alternative groundwater protection standard for 40 CFR Part 258, Appendix II constituents for which MCLs have not been established. These groundwater protection standards shall be appropriate health-based levels that satisfy either the criteria of paragraphs (1) - (4) of this subsection, inclusive or comply with paragraph (5) of this subsection:

1. the level is derived in a manner consistent with United States Environmental Protection Agency guidelines for assessing the health risks of environmental pollutants

2. the level is based on scientifically valid studies conducted in accordance with the Toxic Substances Control Act Good Laboratory Practice Standards (40 CFR Part 792) or equivalent;

3. for carcinogens, the level represents a concentration associated with an excess lifetime cancer risk level (due to continuous lifetime exposure) with the 1 x 10-4 to 1 x 10 -6 range; and

4. for systemic toxicants, the level represents a concentration to which the human population (including sensitive subgroups) could be exposed to on a daily basis that is likely to be without appreciable risk of deleterious effects during a lifetime. Systemic toxicants include toxic chemicals that cause effects other than cancer or mutation; or

5. the level is developed in accordance with TAC §350 (relating to Texas Risk Reduction Program).

If the concentration of any Appendix II constituent is above its respective background limit, but below its GWPS, the facility shall continue assessment monitoring. If the concentrations of all Appendix II constituents are shown to be at or below background values for two consecutive sampling events, the owner or operator may return the well to detection monitoring status, after notifying the executive director and receiving approval.

No later than 60 days after each sampling event a determination shall be made whether any Appendix II constituents were detected at statistically significant levels above the groundwater protection standard. If any Appendix II constituents were detected at statistically significant levels above the groundwater protection standard, the facility shall notify the executive director and appropriate local government officials within seven days of the determination.

In accordance with 30 TAC §330.409(g)(1), t~~T~~he owner or operator will also need to characterize the nature and extent of the release by installing additional monitoring wells as necessary; install at least one additional monitoring well between the monitoring well with the statistically significant level and the next adjacent wells along the point of compliance before the next sampling event and sample these wells in accordance with 30 TAC §330.409(d)(1);~~,~~ notify in writing all persons that own or occupy the land that directly overlies any part of the plume of contamination;~~,~~ and initiate an assessment of corrective measures within 90 days of the notice to the executive director.

The owner or operator may demonstrate an ASD in accordance with 30 TAC §330.409(g)(2). The executive director shall be notified within 14 days of exceedance determination an intent to submit an ASD. The ASD report shall be submitted within 90 days of exceedance determination. The owner or operator shall not filter the groundwater sample for constituents addressed by the demonstration prior to laboratory analysis. The executive director may also require the owner or operator to provide analyses of the landfill leachate to support the demonstration. The owner or operator shall continue to monitor in accordance with the assessment monitoring program. If a successful demonstration is made, the owner or operator shall continue monitoring in accordance with the assessment monitoring program.

If the owner or operator determines that the assessment monitoring program no longer satisfies the requirements of this section, the owner or operator shall, within 90 days, submit an application for a permit amendment or modification to make any appropriate changes to the program in accordance with 30 TAC §330.409(g)(4).

5.4 ASSESSMENT OF CORRECTIVE MEASURES [30 TAC §330.411]

Within 90 days of finding that any of the 40 CFR, Part 258, Appendix II constituents have been detected at a statistically significant level above a GWPS, the owner or operator shall initiate an assessment of corrective measures. This assessment shall be completed within 180 days of initiating the assessment.

The assessment shall analyze the effectiveness of potential corrective measures, including performance, reliability, ease of implementation, and potential impacts. The assessment shall also discuss the control of exposure to residual contamination, time required to begin and complete the remedy, costs of remedy implementation, and institutional requirements such as state or local permit requirements that may substantially affect implementation of the remedy or remedies.

Prior to selecting a remedy, the owner or operator shall discuss the results of the assessment of corrective measures in a public meeting with interested and affected parties. The owner or operator shall arrange the meeting and provide notice in accordance with the provisions of 30 TAC §39.501(e)(3).

5.4.1 Selection of Remedy [30 TAC §330.413]

Within 30 days of completing the assessment of corrective measures, the facility shall select a remedy and submit a report to the TCEQ for review and approval. The report shall describe the remedy or remedies proposed for selection and the way it meets the remedy standards in 30 TAC §330.413(b).

5.4.2 Implementation of the Corrective Action [30 TAC §330.415]

The facility shall implement a corrective action groundwater monitoring program following the schedule specified for the selected remedy. The corrective action is considered complete when the concentrations of all constituents are shown to be at or below GWPSs for a period of three consecutive years. The owner or operator shall also take any interim measures necessary to ensure the protection of human health and the environment. Interim measures shall, to the greatest extent practicable, be consistent with the objectives of and contribute to the performance of the approved remedy.

5.5 REPORTING REQUIREMENTS

5.5.1 Annual Detection Monitoring Report

The results from detection monitoring events shall be submitted to the TCEQ in an annual report within 90 days after the last groundwater monitoring event in a calendar year at the Landfill. The

last groundwater monitoring event refers to a second semiannual event. The annual detection monitoring report shall include the following information:

- A discussion regarding SSIs during the calendar year and a summary of the statistical calculations.
- A summary of the groundwater monitoring events with the monitoring status of each well.
- Results of all groundwater monitoring, resampling, and analytical work produced during the sampling events for the year, including all of the following:
- groundwater sampling results on form TCEQ-0312
- background statistical limits and statistical analyses
- a laboratory case narrative and laboratory review checklist
- the chain of custody for the samples
- A contour map of piezometric groundwater levels and groundwater flow direction for each sampling event. The map shall include all background wells and point-of-compliance wells.
- Recommendations for any changes or updates to the background data set or the monitoring program for the facility.
- Any other items requested by the executive director.
- Submit a permit amendment or modification, if the detection monitoring program no longer satisfies 30 TAC §330.407.

The entire laboratory report, which includes the laboratory quality assurance information and quality control data, and laboratory analytical data, shall be provided electronically in a PDF file on a CD or equivalent media acceptable to TCEQ.

5.5.2 Semiannual Report

A semiannual report covering the first half of the calendar year shall be submitted within 74 days after the first semiannual event. The annual report shall not duplicate information that was provided in the semiannual report (such as TCEQ-0312, forms, results of statistical evaluations, and laboratory checklist), but shall include a summary of the semiannual report.

5.5.3 Assessment Monitoring Report

The results from assessment monitoring events shall be submitted no later than 60 days after each sampling event. In addition, an annual assessment monitoring report shall be submitted within 60 days after the second semiannual groundwater monitoring event at a facility. The report shall include a statement documenting whether any constituent was present at a statistically significant

level above a GWPS during the calendar year. The annual detection monitoring report shall also include the following information:

- Results of all groundwater monitoring results, summary of background groundwater quality values, groundwater monitoring analyses, statistical calculations, graphs, and drawings.
- The groundwater flow rate and direction in the upper and lower~~most~~ aquifers based on data from sampling events with supporting documentation.
- A separate contour map of piezometric water levels for both~~in~~ the upper and lower~~most~~ aquifers based, at a minimum, upon concurrent measurement in all monitoring wells. All data or documentation used to establish the contour map should be included in the report.
- Recommendations for any changes.
- Any other items requested by the executive director.

5.5.4 Corrective Action Report

If the Landfill is performing corrective action, an annual corrective action report shall be submitted by March 1 of each year.

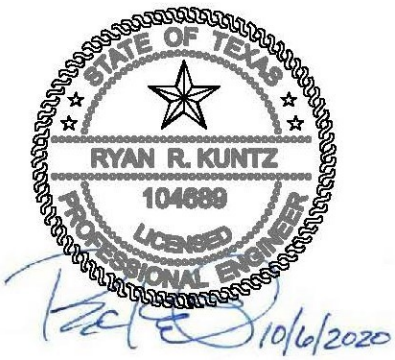
5.5.5 Additional Information about Reporting

Assessment monitoring reports may be combined with detection monitoring reports.

Further information about meeting the reporting requirements for groundwater monitoring [30 TAC §330.405 through §330.409] is provided in the document Guidelines for Groundwater Monitoring Reports, available on the TCEQ website at https://www.tceq.texas.gov/permitting/waste_permits/msw_permits/msw_gwmon_coract.html

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
MCLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III - SITE DEVELOPMENT PLAN
ATTACHMENT 8
CLOSURE AND POST-CLOSURE COST ESTIMATES



Prepared for:

CITY OF WACO

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Revision 0 – April 2020
Revision 1 – October 2020
SCS Project No. 16216088.00

TABLE OF CONTENTS

SECTION **PAGE**

1 INTRODUCTION 8-1-1

2 CLOSURE COST ESTIMATE 8-2-1

3 POST-CLOSURE CARE COST ESTIMATE 8-3-1

4 COST ESTIMATE ADJUSTMENTS 8-4-1

Appendices

8A Closure Cost Estimate Form for Municipal Solid Waste Type I Landfills
8B Closure Cost Estimate Calculations
8C Post-Closure Care Cost Estimate Form for Municipal Solid Waste Type I Landfills
8D Post-Closure Care Cost Estimate Calculations

SCS Engineers
TBPE Reg. # F-3407

APPENDIX 8A

CLOSURE COST ESTIMATE FORM
FOR MUNICIPAL SOLID WASTE TYPE I LANDFILLS

SCS Engineers
TBPE Reg. # F-3407
Inclusive of pages 8A-1 to 8A-15

Texas Commission on Environmental Quality

Closure Cost Estimate Form for Municipal Solid Waste Type I Landfills

This form is for use by applicants or site operators to provide cost estimates for closure of MSW Type I landfills to meet the requirements in 30 Texas Administrative Code (TAC) Chapter 330, Section 330.63(j) and 30 TAC Chapter 330 Subchapter L. The costs to be provided herein are cost estimates for hiring a third party to close the largest waste fill area that could potentially be open in the year to follow and those areas that have not received final cover. If you need assistance in completing this form, please contact the MSW Permits Section in the Waste Permits Division at (512) 239-2335.

Facility Name: City of Waco Landfill

MSW Permit No.: 2400

Site Operator/Permittee Name and Mailing Address: City of Waco

Total Closure Cost Estimate (2020 Dollar Amount): $2,147,642

I. Professional Engineer's Statement, Seal, and Signature

I am a licensed professional engineer in the State of Texas. To the best of my knowledge, this Closure Cost Estimate has been completed in substantial conformance with the facility Closure Plan and, in my professional opinion, is in compliance with Title 30 of the Texas Administrative Code, Chapter 330.

Name: Ryan Kuntz, P.E. Title: Vice President

Date:

Company Name: SCS Engineers Firm Registration Number: F-3407

Professional Engineer's Seal

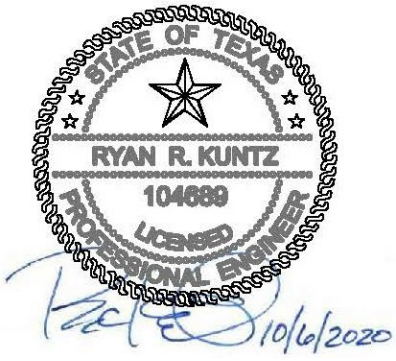
Professional Engineer's Signature

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III – SITE DEVELOPMENT PLAN
ATTACHMENT 9
FINAL CLOSURE AND POST-CLOSURE PLAN

Prepared for:

CITY OF WACO



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SCS Project No. 16216088.00

TABLE OF CONTENTS

SECTION **PAGE**

1 INTRODUCTION 9-1-1
2 FINAL COVER SYSTEM 9-2-1
2.1 INTRODUCTION 9-2-1
2.2 COVER SYSTEM DESIGN 9-2-1
2.3 FINAL COVER QUALITY CONTROL PLAN 9-2-1
2.4 FINAL COVER SYSTEM EVALUATION REPORT 9-2-9
3 CLOSURE PROCEDURES 9-3-1
3.1 SEQUENCE OF FINAL COVER PLACEMENT 9-3-1
3.2 CLOSURE DURING ACTIVE LIFE 9-3-1
4 CLOSURE SCHEDULE 9-4-1
4.1 FINAL CLOSURE REQUIREMENTS 9-4-1
4.2 PROVISIONS FOR EXTENDING CLOSURE PERIOD 9-4-2
5 CLOSURE COST ESTIMATE 9-5-1
6 POST-CLOSURE CARE ACTIVITIES 9-6-1
6.1 MONITORING AND MAINTENANCE 9-6-1
6.2 DECREASING POST-CLOSURE CARE PERIOD 9-6-2
6.3 INCREASING POST-CLOSURE CARE PERIOD 9-6-2
6.4 COMPLETION OF POST-CLOSURE CARE PERIOD 9-6-2
7 PERSON RESPONSIBLE FOR CONDUCTING POST-CLOSURE CARE ACTIVITIES 9-7-1
8 POST-CLOSURE LAND USE 9-8-1
8.1 INTENDED USE 9-8-1
8.2 CONSTRAINTS OF POST-CLOSURE CONSTRUCTION 9-8-1
9 POST-CLOSURE CARE COST ESTIMATE 9-9-1

Appendices

9A Closure Plan Form
9B Post-Closure Care Plan Form

Figures

9.1 Final Closure Schedule

SCS Engineers
TBPE Reg. # F-3407

employed by the manufacturer. Each quality control certificate will include roll identification numbers, testing procedures, and results of quality control tests. The quality control tests will be performed in accordance with project-specific testing methods and subject to one test per 100,000 square feet of material or a minimum of one test per resin lot, whichever is greater.

All geomembrane properties must meet the minimum values set forth in the most recent version of Geosynthetic Research Institute (GRI) standard GM-13 for 60-mil HDPE, or GM-17 for LLDPE. The GP will review the test results prior to acceptance of the geomembrane to assure that the certified minimum properties meet specified values.

2.3.2.2 Conformance Testing

Conformance testing shall be performed by a third-party independent laboratory. Conformance testing methods and frequencies will be performed in accordance with Table 9-2-3.

Table 9-2-3. Geomembrane Conformance Testing

TEST	METHOD	MINIMUM FREQUENCY
Thickness (laboratory)	ASTM D5199 (1) or D5994	1 per 100,000 ft^2 and every resin lot
Thickness (2) (field)		1 measurement per 5 feet along leading edge of each geomembrane panel
Density	ASTM D1505 or D792	1 per 100,000 ft^2 and every resin lot
Carbon black content	ASTM D1603	
Carbon black dispersion	ASTM D5596	
Tensile properties (3)	ASTM D638~~, Type IV~~ or D6693	

1. ASTM D5994 for textured geomembrane, D5199 for smooth.
2. No single measurement will be less than ten percent below the required nominal thickness in order for the panel to be acceptable. A minimum of 5 measurements will be made per panel.
3. 2-inch initial gauge length assumed for elongation at break at 2.0 in/min.

2.3.3 Installation Monitoring and Testing

Upon delivery of geosynthetic material, the CQA Monitor will observe that the materials are handled and stored in accordance with manufacturer's recommendations.

Field seaming of the geomembrane will be performed in strict accordance with methods approved by the manufacturer. This usually includes fusion welding or extrusion welding. Tack welds (if used) will use heat only. No double-sided tape, glue, or other method will be permitted when extrusion or fusion welding is used for bonding.

Each day prior to commencing field seaming, trial seams will be made on pieces of geomembrane material to verify that conditions are adequate for production seaming. Each trial test seam will be at least 3 feet long by 1-foot wide. Four adjoining one-inch wide specimens will be die-cut from the test seam sample. Two specimens will be tested in the field for shear and 2 for peel.

The failure criteria are the same as that for destructive seam testing as described below. The test specimens must exhibit a Film Tear Bond (FTB). If one test seam fails, the trial seam will be repeated. If this trial seam fails, then 2 more trial seams must be constructed and tested. This process must continue and no welding can begin for the machine or welder until all test seams are passing. Additional trial seams will be made for all of the following:

- At the beginning of each seaming period for each seaming apparatus used that day (the beginning of each seaming period is considered to be morning, and immediately after a break);
- Each occurrence of significantly different environmental conditions (i.e., temperature, humidity, dust, etc.);
- Any time the machine is turned off for more than 30 minutes; and
- When seaming different geomembranes (i.e. tie-ins and smooth to textured).

Both the welder and the machine must be tested for each new trial seam when extrusion welding. Only the machine needs to be tested for each new trial seam when fusion welding since the machine is not as operator dependent. Each individual seaming will make at least one test seam each day he/she actually performs seaming.

2.3.4 Non-Destructive Testing

Continuous, non-destructive testing will be performed on all seams by the installer. Air pressure testing on dual-track fusion welds and vacuum-box testing for extrusion welds are the only acceptable methods. All leaks must be isolated and repaired by the following procedures:

1. Air-Pressure Testing (GRI GM6) - The ends of the air channel of the dual-track fusion weld must be sealed and pressured to approximately 30 psi, if possible. The air pump must then be shut off and the air pressure observed after 5 minutes. A loss of less than 4 psi is acceptable if it is determined that the air channel is not blocked between the sealed ends. A loss of 4 psi or more indicates the presence of a seam leak that must then be isolated and repaired by following the procedures described under "Seam Failure Repairs and Retesting." The GP or his/her qualified representatives must observe and record all pressure gauge readings.

2. Vacuum-Box Testing (ASTM D4437) - A suction value of approximately 3 to 5 inches of gauge vacuum must be applied to all extrusion welded seams that can be tested in this manner. Examples of extrusion welded seams that do not easily lend themselves to vacuum testing would be around boots, appurtenances, etc. The seam must be observed for leaks at least ten seconds while subjected to this vacuum. The GP or his/her qualified representative must observe 100 percent of this testing.

2.3.5 Destructive Seam Testing

Destructive seam testing will be performed in accordance with ASTM ~~D4437~~D6392. Destructive samples will be taken at a minimum of one strategic location for every 1,000 linear feet of seaming

or major fraction thereof. The total footage of individual repairs of leaks of more than 10 feet in seaming length and individual repairs of more than 10 feet in seaming length for failed seams must also be counted and destructively tested using the same frequency of testing described above. At a minimum, a destructive test must be done for each welding machine used for seaming or repairs. A sufficient amount of the seam must be removed in order to conduct field testing, independent laboratory testing, and archiving of enough material in order to retest the seam, if necessary. Field testing will include at least 2 peel test specimens. Destructive seam-testing locations will be cap-stripped and the cap completely seamed by extrusion welding to the geomembrane. Capped sections will be non-destructively tested. Additional destructive test samples may be taken if deemed necessary by the GP or his/her qualified representative.

All field-tested specimens from a destructive-test location must be passing in both shear and peel for the seam to be considered as passing. Field tested specimens, are determined as passing if the specimen tested in peel fails in FTB and all test specimens meet the criteria listed in the Table 9-2-4 The independent laboratory testing must confirm these field results. The minimum passing criteria for independent laboratory testing are all three of the following:

- ~~At least four~~Five of five specimens tested in the peel mode must fail in FTB.
- ~~At least four~~Five of five specimens from each peel and shear determination must meet the minimum specified value in Table 9-2-4.
- ~~The average value from all five specimens from each peel and shear determination must meet the minimum specified value in Table 9-2-4.~~ All 5 specimens for shear determination should meet the minimum percent elongation at break value in Table 9-2-4.

The above criteria apply to both tracks from each dual-track fusion welded seam before it is considered as passing. It should be noted that geomembrane manufacturers may have differing values for their geomembrane sheets and therefore, the specific values are not meant to be minimum or maximum values as construction materials and specifications may vary between manufacturers and throughout the life of the site. Consequently, the manufacturer's sheet-strength values must be provided in order to determine if the test results are passing.

Table 9-2-4. Geomembrane Seam Strength

Property	Qualifier	Unit	Specified Value		Test
			60-mil HDPE	40-mil LLDPE	
Shear Strength	Min. Min.	lb/in %	120 50	60 50	ASTM ~~D4437~~D6392

Peel Strength:					
Fusion	Min	lb/in	91	50	ASTM ~~D4437~~D6392
Extrusion	Min.	lb/in	78	44	

2.3.6 Seam Failure Delineation

In the event failing tests are obtained at a destructive test location, new destructive test samples will be obtained, a minimum of 10 feet in either direction of the failing test. If one, but not both, of the additional tests fail, further additional destructive testing will be required until passing tests are obtained at both ends of the original destructive test location. A cap will be required for the areas subject to destructive testing, and testing of the cap will be placed in accordance with Section 2.3.7. If more than two failing destructive test locations are observed for a single seam, the CQA Monitor will have the alternative of requiring the entire seam be removed, and a new seam welded.

In the event more than one failing destructive test are observed for a single welding apparatus, new (passing) trial welds will be required prior to resuming geomembrane welding or seaming with the apparatus.

2.3.7 Seam Failure Repairs and Retesting

Any portion of the geomembrane with a detected flaw, or which fails a nondestructive or destructive test, or where destructive tests were cut, or where nondestructive tests left cuts or holes, must be repaired. The CQA Monitor will locate and record all repairs on the repair log. Repair techniques include the following:

- Patching - used to repair holes, tears, large panel defects, undispersed raw materials, contamination by foreign matter, and destructive sample locations.
- Extrusion - used to repair small defects in the panels and seams. In general, this procedure should be used for defects less than 3/8-inch in the largest dimension.
- Capping - used to repair failed welds or to cover seams where welds or bonded sections cannot be nondestructively tested.
- Removal - used to replace areas with large defects where the preceding methods are not appropriate. Also used to remove excess material (wrinkles, fishmouths, intersections, etc.) from the installed geomembrane. Areas of removal shall be patched or capped.

For any repair method, the following provisions will be satisfied:

- Surfaces of the geomembrane which are to be repaired using extrusion methods will be ground no more than one hour prior to the repair;
- All surface will be clean and dry at the time of repair;

- Patches or caps will extend at least 6 inches beyond the edge of the defect, and all corners of patches will be rounded with a radius of approximately 3 inches or more;
- All repairs will be nondestructively tested as previously described; and
- All seaming equipment, personnel, and operation procedures used in repair work will meet the same requirements as for new seaming operations.

The GP or his/her qualified representative will observe all destructive and non-destructive testing of repairs and will record the number of each repair, type, date and test outcome. Repairs that pass the non-destructive tests will be taken as an indication of an adequate repair. Repairs more than 150 ft long will also be required to have a destructive test performed. Repairs that fail the initial retest will be redone and retested until a passing test results. All work and testing of repairs will be fully documented in a repair log.

2.3.8 Geocomposite and Erosion Layer Testing

When placing overlying material on the geomembrane, every effort must be made to minimize wrinkle development and stress imparted to the geomembrane. If possible, cover should be placed during the coolest weather available. Small wrinkles should be isolated and covered as quickly as possible to prevent their growth. In no case will the geomembrane be allowed to fold over on itself.

2.3.8.1 Geocomposite

A single-sided and double-sided geocomposite will be installed over the geomembrane on the landfill topslope and sideslopes, respectively ~~only~~. The geocomposite will conform to the material and performance properties specified by the GP, consistent with project construction plans and technical specifications. The drainage geocomposite manufacturer (or supplier), will conduct quality control testing at a frequency of 1 per 100,000 square feet and certify that all materials delivered comply with project specifications. The material certifications shall be reviewed by the GP and approved for the project prior to acceptance of any of the material.

2.3.8.2 Erosion Layer

The erosion layer will consist of a 24-inch-thick soil layer, with the top 6 inches capable of sustaining vegetation in accordance with §330.457(a)(3). The required thickness of the layer will be verified by settlement plates or survey methods on an established grid system with not less than one verification point per 10,000 square feet of surface area. A minimum of two verification points is required. The selected grid will be the same for both beginning and finished elevations of the erosion layer, so that minimum thickness can be calculated and verified. All elevation calculations necessary for thickness determination will be included as part of the supporting documentation in the FCSER.

The erosion layer does not require compaction control; however, it should be stable for construction and disposal traffic. The erosion layer will be deployed in “fingers” along the geomembrane or geocomposite to control the amount of slack and minimize wrinkles and/or folds. Soil cover will generally be placed in an up-slope direction on sideslopes so that stress imparted

to the geocomposite and geomembrane is minimized. Care will be exercised in placement so as not to shift, wrinkle or damage any underlying geosynthetic layers, and the placement methods will be documented.

2.4 FINAL COVER SYSTEM EVALUATION REPORT

Upon completion of each area of final cover construction and evaluation, the GP will prepare and submit in triplicate the FCSER, prepared in accordance with this plan, to the TCEQ for review and approval. This report will be submitted along with a construction documentation report.

Each FCSER will include a discussion of the construction of the final cover elements, a cover placement map which shows the covered area being submitted for approval and areas covered by all previous FCSER submittals with the dates of acceptance by the TCEQ. The map should depict the site grid system, graphic scale, and north arrow. The FCSER will be signed and/or sealed by the GP performing the evaluation and a representative of the site operator.

The construction documentation will contain a narrative describing the work performed and the testing procedures performed prior to and during construction, record drawings, and results of field and laboratory testing. The FCSER will include the following:

- All field and laboratory test documentation for infiltration layer soils, including test and sample locations plotted on plan view drawings representing each 6 inch lift;
- Geomembrane manufacturer's certifications, documentation of all manufacturer's and independent testing, geomembrane seaming and repair logs, seam testing results, and a site map showing locations of panels, repairs, and tests;
- Geocomposite manufacturer's certification and testing documentation; and
- Survey documentation for the thickness of the infiltration layer and erosion layer.

- Consistent with the closure engineering plans, sections of the landfill that are above-grade will be regraded and reshaped, as needed, to provide the proper slope for positive drainage, consistent with closure engineering plans.

- The final cover system will be constructed in accordance with this attachment and closure engineering plans.

- Following application of final cover, the landfill will be seeded or sodded immediately with appropriate grasses to minimize erosion. The established grasses will provide a minimum of 90 percent coverage of the final cover system.

- Consistent with the closure engineering plans and with Attachment 6A – Surface Water Drainage Plan, a surface water drainage system will be constructed to minimize erosion.

- A closure certification will be prepared by an independent registered professional engineer and submitted to TCEQ for approval.

- All proper notices and documentation will be filed with the appropriate agencies.

3.2.1 Estimate of Largest Area Ever Requiring Final Cover

In accordance with §330.457(e)(2), the largest area ever requiring final cover in the year to follow landfill closing is estimated to be approximately 21.3 acres. The estimated largest area requiring final cover is expected to occur when waste is being placed in Sector 1 in the East Disposal Area. At the time of the Owner's annual review of the closure cost estimate, the Owner will also confirm that the estimated largest area ever requiring final cover is accurate. Based on this annual review, adjustments will be made, as appropriate.

In addition, the entire 502.5 acres of the site would also need to be administratively closed. Supporting calculations are presented in Part III, Attachment 8 - Cost Estimate for Closure and Post-Closure Care, Appendix 8A.

3.2.2 Estimate of Maximum Inventory of Waste Ever On Site

Consistent with §330.457(e)(3), the estimate of maximum inventory of waste (defined as waste and daily cover) ever on site over the active life of the facility is approximately ~~19,986,382~~24,661,442 cubic yards (based upon volumes computed from top of bottom liner protective cover and top final grade elevations less final cover thicknesses). Supporting calculations are included in Part III, SDP Narrative, Appendix IIIA - Site Life Calculations.

approval of (1) an alternative monitoring frequency, and (2) an alternative list of parameters to be monitored. Such requests will be based on supporting data available at the time of the request.

- Monitor the landfill perimeter LFG monitoring system in accordance with Chapter 330, Subchapter I. In accordance with Subchapter I, the minimum monitoring frequency will be quarterly. However, the Owner reserves the right to request TCEQ approval of an alternate monitoring frequency. Such a request will be based on supporting data available at the time of the request.

- If applicable, maintain and operate the LFG collection and/or control system in accordance with applicable regulations.

6.2 DECREASING POST-CLOSURE CARE PERIOD

The Owner may submit a request to decrease the length of the post-closure care maintenance period. This request will include a documented certification signed by an independent registered professional engineer. The certification will include all applicable documentation demonstrating that the reduced period is sufficient to protect human health and the environment. Applicable documentation may include data from monitoring of groundwater, surface water, leachate levels, and landfill gas. The certified documentation must be reviewed and approved by the TCEQ prior to decreasing the length of the post-closure care period.

6.3 INCREASING POST-CLOSURE CARE PERIOD

The length of the post-closure care period may be increased by the TCEQ if it is determined that the increased duration is necessary to protect human health and the environment. In accordance with 330.463(b)(2)(B), if there is evidence of a release from landfill activities, the executive director may require an investigation into the nature and extent of the release and an assessment of measures necessary to correct an impact to groundwater. It is understood that the Owner will receive appropriate notification of any such proposed changes prior to the TCEQ's final determination, thereby allowing the Owner to submit appropriate documentation for TCEQ's consideration.

6.4 COMPLETION OF POST-CLOSURE CARE PERIOD

Upon completion of the post-closure care period, the Owner will submit to the TCEQ a certification, signed by an independent professional engineer, verifying that Post-Closure care maintenance has been completed in accordance with this Post-Closure Care Plan, in accordance with §330.465(a). The submittal will include all documentation necessary for certification of completion of post-closure care maintenance. The certification will be placed in the Site Operating Record upon approval. Additionally, in accordance with §330.465(b), following completion of the post-closure care period, the Owner will submit to the TCEQ a request for voluntary revocation of the landfill permit.

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III - SITE DEVELOPMENT PLAN
ATTACHMENT 10
SOILS AND LINER QUALITY CONTROL PLAN

Prepared for:

CITY OF WACO

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TABLE OF CONTENTS

SCS Engineers
TBPE Reg. # F-3407

STATE OF TEXAS
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10/6/2020

SECTION **PAGE**

1 INTRODUCTION 10-1-1
1.1 PURPOSE 10-1-1
1.2 DEFINITIONS 10-1-2
2 SUBGRADE AND GENERAL FILL 10-1-1
2.1 SUBGRADE 10-2-1
2.2 GENERAL FILL 10-2-1
2.3 SURVEYING AND LANDFILL MARKERS 10-2-2
2.4 CONTROL OF SURFACE WATER 10-2-2
2.5 EXCAVATION BELOW THE SEASONAL HIGH GROUNDWATER TABLE 10-2-2
3 LOW PERMEABILITY SOIL LINER 10-3-1
3.1 INTRODUCTION 10-3-1
3.2 QUALITY ASSURANCE TESTING 10-3-1
3.3 CONSTRUCTION PROCEDURES 10-3-2
3.4 PROCEDURES FOR ADDRESSING FAILING TESTS 10-3-4
3.5 THICKNESS VERFICATION 10-3-6
3.6 HYDROSTATIC CONSIDERATIONS - BALLASTING 10-3-6
4 GEOMEMBRANE 10-4-1
4.1 INTRODUCTION 10-4-1
4.2 QUALITY CONTROL AND QUALITY ASSURANCE TESTING 10-4-1
4.3 INSTALLATION 10-4-2
4.4 SEAM TESTING 10-4-6
4.5 REPAIRS AND RETESTING 10-4-9
4.6 REPAIRS 10-4-9
4.7 GEOMEMBRANE ACCEPTANCE 10-4-11
5 DRAINAGE GEOCOMPOSITE 10-5-1
5.1 INTRODUCTION 10-5-1
5.2 DELIVERY 10-5-1
5.3 QUALITY CONTROL TESTING 10-5-1
5.4 INSTALLATION 10-5-2
5.5 REPAIRS 10-5-3

TABLE OF CONTENTS (CONTINUED)

SCS Engineers
TBPE Reg. # F-3407

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

SECTION **PAGE**

6 GEOTEXTILES 10-6-1
6.1 INTRODUCTION 10-6-1
6.2 DELIVERY 10-6-1
6.3 QUALITY CONTROL TESTING 10-6-1
6.4 INSTALLATION 10-6-1
6.5 REPAIRS 10-6-3
7 EQUIPMENT ON GEOSYNTHETIC MATERIALS 10-7-1
8 LEACHATE COLLECTION PIPING 10-8-1
8.1 INTRODUCTION 10-8-1
8.2 DELIVERY 10-8-1
8.3 QUALITY CONTROL TESTING 10-8-1
8.4 INSTALLATION 10-4-2
9 DRAINAGE AGGREGATE 10-9-1
9.1 MATERIALS 10-9-1
9.2 TESTING 10-9-1
10 PROTECTIVE COVER 10-10-1
10.1 MATERIALS 10-10-1
10.2 INSTALLATION 10-10-1
10.3 THICKNESS VERIFICATION 10-10-2
11 DOCUMENTATION 10-11-1
11.1 INTRODUCTION 10-11-1
11.2 LINER EVALUATION REPORTS 10-11-1
11.3 LINER EVALUATION REPORT (LER) FORMAT 10-11-1
11.4 INTERIM STATUS REPORT 10-11-2
11.5 BALLAST EVALUATION REPORT (BER) 10-11-2

Appendices

10A ~~Geosynthetic Research Institute Test Method GM13 (GRI-GM13)~~Material Testing Schedules
10B Seasonal High Groundwater Table Map
10C Sample Ballast Calculations
10D Typical Underdrain Design

1 INTRODUCTION

1.1 PURPOSE

The following Soil and Liner Quality Control Plan (SLQCP) has been prepared for the City of Waco Landfill (Landfill) in accordance with 30 TAC §330.339. This SLQCP is intended to provide the Owner, Design Engineer, Construction Quality Assurance (CQA) Professional of Record, Contractor, and Geosynthetics Contractor the needed guidance regarding CQA/control during construction of municipal solid waste disposal units at the Landfill. This SLQCP also will provide the CQA Professional of Record the needed guidance for preparing the soil liner and geomembrane liner evaluation reports for each individual cell.

This SLQCP addresses the testing methods and other requirements set forth in the 30 TAC §330.339 of the Texas Commission of Environmental Quality (TCEQ) regulations and current TCEQ guidance document, RG-534 (2017 version). The proposed bottom liner system is comprised of the following components (from top to bottom):

- 2-foot-thick soil protective cover;
- Single-sided geocomposite (non-woven geotextile on the top side only of geonet);
- 60-mil high density polyethylene (HDPE) geomembrane (smooth); and
- 2-foot-thick compacted clay liner ($k \leq 1x10^{-7}$ cm/sec); and
- Prepared subgrade (excavation grade).

On sideslopes the liner section will be as follows (from top to bottom):

- 2-foot-thick soil protective cover;
- Double-sided geocomposite (non-woven geotextile on both sides of geonet);
- 60-mil textured HDPE geomembrane (textured on both sides);
- 2-foot-thick compacted clay liner ($k \leq 1x10^{-7}$ cm/sec); and
- Prepared subgrade (excavation grade).

These bottom and sideslope liner systems are depicted on Drawing 6C.1 (Attachment 6C – Groundwater Protection Plan) as required by 30 TAC §330.339(a)(1) and §330.339(b)(2)(A). The design of the leachate collection system components are described in Attachment 12 – Leachate and Contaminated Water Management Plan. Additional guidance and technical requirements for the liner, leachate collection system, and related construction will also be presented in the construction plans and technical specifications prepared prior to construction of waste disposal cell.

This SLQCP includes the CQA requirements for the following:

- Subgrade and General Fill;
- Low Permeability Soil Liner;
- Geosynthetics (geomembrane, drainage geocomposite, and geotextiles);
- Leachate Collection Piping;
- Drainage Aggregate; and
- Protective Cover.

This SLQCP, which will be followed during liner construction, outlines materials selection and evaluation, laboratory test requirements, field test requirements, and treatment of problems for the components described above. Testing requirements for each component of the liner system are included in the individual sections throughout this SLQCP and summarized in Appendix 10A. This SLQCP also includes reporting requirements for soil liner and geomembrane liner evaluation reports for the CQA of soil liner and geomembrane liner components of the liner system.

1.2 DEFINITIONS

Whenever the terms listed below are used, the intent and meaning shall be interpreted as indicated.

1.2.1 ASTM

This means the American Society for Testing and Materials.

1.2.2 Construction Quality Assurance (CQA)

A planned system of activities that provides the owner and permitting agency assurance that the facility will be constructed as specified in the design (EPA, 1993). CQA includes observations and evaluations of materials and workmanship necessary to assess and document that construction has been performed consistent with the applicable contract and permit documents. CQA refers to measures taken by the CQA geotechnical professional and/or CQA monitor to assess if the bottom and sideslope liner systems construction has been in compliance with the permit drawings and this SLQCP for the site.

1.2.3 CQA Geotechnical Professional (GP)

The GP is an authorized representative of the Owner and has overall responsibility for CQA and confirming that the bottom and sideslope liner systems have been constructed in general accordance with the permit application, as approved by the TCEQ, and the construction plans and technical specifications. The GP must be a Professional Engineer licensed in Texas with

experience in either solid waste engineering and/or geotechnical engineering. Alternatively, a GP may be a geologist with experience in geotechnical testing and the evaluation of engineering properties of soils for liner systems which involve in-situ or compacted soil, provided the geologist is acting in compliance with the provisions of the Texas Engineering Practice Act.

The GP must show competency and experience in certifying similar installations and be presently employed by or practicing as a solid waste engineer, geotechnical engineer or as an engineering geologist in a geotechnical/environmental engineering organization. The credentials of the GP must meet or exceed the minimum requirements required by the TCEQ. The GP will be the professional of record, who signs the Soil Liner Evaluation Report (SLER) and Geomembrane Liner Evaluation Report (GLER) for the respective liner system construction.

1.2.4 CQA Monitors

These are representatives of the GP who work under direct supervision of the GP. The CQA Monitor is responsible for quality assurance monitoring and performing on-site tests and observations. A qualified Lead CQA Monitor shall have a minimum of two years of directly related experience; or be a graduate engineer or geologist with one year of directly related experience. A junior CQA Monitor may work under the direct supervision of the Lead CQA Monitor or the GP and may have less than one year of directly related experience. The CQA Monitor is onsite full-time during subgrade preparation, liner system construction, and leachate collection system construction and reports directly to the GP. Any references to monitoring, testing, or observations to be performed by the GP should be interpreted to mean the GP or CQA Monitor working under the GP's direction.

1.2.5 Construction Quality Control (CQC)

These actions provide a means to measure the characteristics of an item, material, or service to comply with the requirements of the contract or permit documents. CQC actions will be performed by the Contractor or manufacturer of materials. All quality control testing shall be performed prior to or during construction of the liner. In no instance shall quality control field or laboratory testing be undertaken after completion of liner construction.

1.2.6 Contract Documents

These are the official set of documents provided by the Owner. The documents include bidding requirements, contract forms, contract conditions, technical specifications, construction plans, addenda, and contract modifications.

1.2.7 Technical Specifications (or Specifications)

These are the qualitative requirements for products, materials, and workmanship upon which the construction contract is based.

1.2.8 Contractor

This is the person or persons, firm, partnership, corporation, or any combination, who as an independent contractor, has entered into a contract with the Owner.

the formations at the site was also calculated, as summarized in Attachment 4, Table III-4.~~13~~14. As indicated by this data, the highest recorded groundwater movement at the site is estimated to be approximately ~~0.035~~0.039 feet/year, which is consistent with groundwater movement through sediments with very low hydraulic conductivity. Based on this groundwater velocity value, the time for groundwater to travel one foot would be greater than ~~28~~ 25 years. Therefore, sufficient ballast will be placed prior to the liner system experiencing any potential hydrostatic uplift.

However, as indicated in Section 2.5.3, a SHWT map has been developed for an assumed potentiometric surface for designing an underdrain system and evaluating ballast, if needed, for short- and long-term groundwater control, respectively. The assumptions and calculations for the ballast evaluation and underdrain design are described in Section 11.5 (see also Appendix 10C) and Appendix 10D, respectively.

2.5.3 Seasonal High Groundwater Table

A SHWT map has been developed based on standard standpipe piezometers and vibrating wire piezometers (VWPs) installed at the site during the subsurface and groundwater investigation (see Attachment 4, Section 6). Based on the observations presented in Attachment 4, the shallow occurrences of groundwater do not appear to be uniform across the site and may occur in isolated pockets; there exists a continuously saturated groundwater zone that occurs at deeper elevations below the base of the proposed excavation grades; and the shallow and deep occurrences of groundwater do not appear to be hydraulically connected. However, as a conservative approach to sizing underdrain components for short-term groundwater control and evaluating long-term groundwater control (waste or soil ballast), if needed, the SHWT map was developed with a culmination of high water level readings from both the shallow standpipe piezometers/VWPs and deep VWPs installed at the site during the groundwater investigation. This SHWT map, provided in Appendix 10B, depicts the measurement points, including the seasonal high groundwater table (SHWT) levels, and future excavation grades. As shown on the map, portions of the excavation grades extend below this assumed SHWT.

As noted in this SLQCP, the SHWT map will be reviewed and updated, if necessary, prior to the design of each cell based on the most recent data available at the time of design. If the groundwater elevations at monitoring points has increased since the last cell construction, the SHWT map will be revised upward to reflect those increases. An updated SHWT map will be presented in the SLER and GLER. In addition, observations of the subgrade soil characteristics and indications of groundwater seepage (if any) and potential impacts to the dewatering and ballast calculations will also be documented in the SLER and GLER.

3 LOW PERMEABILITY SOIL LINER

3.1 INTRODUCTION

Construction of the soil liner will begin after excavation, embankment construction, subgrade preparation, and grading to excavation grades has been completed. For this landfill, the soil liner constructed for all waste disposal cells will be a 2-foot thick compacted soil (clay) liner, as described in Section 1.1.

Soil for the soil liner must achieve an installed permeability of $1x10^{-7}$ cm/s or less; a liquid limit (LL) of 30 or greater; a plasticity index (PI) of 15 or greater; percent passing the No. 200 sieve of 30 percent or greater; and 100 percent passing the 1-inch sieve (i.e., no particles greater than 1 inch in size) with no more than 10 percent rocks by weight. The final lift of the soil liner shall not contain rock or other deleterious materials that can cause damage to the overlying geomembrane.

3.2 QUALITY ASSURANCE TESTING

3.2.1 Pre-Construction Testing

Pre-construction testing will be performed for each liner material borrow source and for each identifiable change in material from an individual borrow source (i.e., change in color and plasticity or gradation based on visual observation by the GP or CQA Monitor). A change in color only (with same gradation and plasticity characteristics) will not be considered a change of material. Testing will be performed according in the laboratory according to the testing schedule set forth in Table 10-3-1. ~~Density test results will be reported as a percentage of the maximum dry density at a corresponding optimum moisture content.~~

For each borrow source, correlations will be developed based on moisture-density tests and permeability tests (performed on soil samples at a calculated density) of representative soil samples demonstrating that the soils will have the required permeability at the specified level of compaction. Soil density test results will be reported as a percentage of the maximum dry density at the corresponding optimum moisture content. Correlation testing will be provided to GP and CQA Monitor for use in the field during soil liner construction.

Table 10-3-1. Soil Liner Pre-Construction Testing Schedule

TEST	METHOD USED	FREQUENCY
Soil Classifications: USCS	ASTM D2487	1 per soil type / minimum 1 per borrow source
Sieve Analysis	ASTM D422 or D1140	
Atterberg Limits	ASTM D4318	
Moisture/Density Relationship	ASTM D698	
Hydraulic Conductivity (1)	ASTM D5084 (2)(3)	1 per Moisture-Density Relationship

1. Field testing of permeability (in accordance with ASTM D5093) is optional, and may be replaced by laboratory testing.

2. Testing procedures in Appendix VII of the Corps of Engineers Manual EM 1110-2-1906, November 30, 1970, Laboratory Soils Testing, may be used as an alternative method.
3. Permeability tests will be conducted with tap water or 0.05N solution of CaSO4. Distilled water will not be allowed.

3.2.2 Construction Testing

Construction quality assurance for the soil liner will consist of both laboratory and field testing. The minimum frequencies and test methods for testing soil liners during construction are presented on Table 10-3-2. The sampling and test methods used during liner construction will follow the latest technical guidelines of the TCEQ. In accordance with 30 TAC §330.339(a)(2), the GP or CQA Monitor will be on-site during all liner construction activities. Laboratory testing will be performed by an independent geotechnical laboratory.

All quality assurance testing of soil liners will be performed during the construction of the liner. In no instance will any quality assurance field or laboratory testing be undertaken after completion of liner construction, except for that testing which is required of the final constructed lift, confirmation of liner thickness, or cover material thickness. All soil testing and evaluation of the soil liner will be complete prior to installing the geomembrane and leachate collection system on the area under evaluation.

Table 10-3-2. Soil Liner Construction Testing Schedule

TEST	METHOD	MINIMUM FREQUENCY
Field Moisture/Density Test	ASTM D1556, D2167, or D6938	1 per 8,000 ft^2 per 6-inch lift (1)
Sieve Analysis	ASTM D422 or D1140	1 per 100,000 ft^2 per 6-inch lift (2)
Atterberg Limits	ASTM D4318	
Hydraulic Conductivity (3) (4)	ASTM D5084 or CoE EM 1110-2-1906 (5)	
Thickness	Survey	1 per 5,000 ft^2

1. A minimum of three tests must be conducted for each 6-inch lift, regardless of cover area.
2. A minimum of one test must be conducted for each lift, regardless of cover area.
3. Testing will be conducted on undisturbed samples.
4. Permeability tests will be run using tap water or a 0.05N solution of $CaSO_4$. Distilled water will not be allowed.
5. Field testing of permeability (in accordance with ASTM D5093) is optional, and may be replaced by laboratory testing.

3.3 CONSTRUCTION PROCEDURES

3.3.1 General Requirements

During placement of the soil liner following guidelines apply:

- The excavation grade surface should be scarified (roughened) prior to placing the first lift of the soil liner, thus providing adequate bonding between the liner and underlying foundation soils.

- Bottom and sideslope soil liners will be constructed in compacted lifts not exceeding 6 inches. The top of each subsequent lift should be scarified (roughened) to a shallow

depth prior to the spreading and compaction of successive lifts, thereby providing bonding between the lifts.

- The soil liners will not be compacted with a bulldozer or any track-mobilized equipment unless it is used to pull a pad-footed roller. The soil liner shall be compacted with a pad-footed or prong-footed roller only. The maximum clod size of the compacted liner soils shall be approximately one inch in diameter. In all cases soil clods shall be reduced to the smallest size necessary to achieve the coefficient of permeability reported by the testing laboratory and to destroy any macrostructure evidenced after the compaction of the clods under density-controlled conditions.

- No loose lift should be thicker than the pads of the compactor so that complete bonding with the top of the previous lift is achieved. The soil liner lifts will be compacted by a minimum 3 passes (back and forth) of the compaction equipment.

- At a minimum, soil liners will be compacted to 95 percent of the maximum dry density and at a moisture content of 0 to +4% above optimum, as determined by ASTM D698, in order to achieve a permeability of $1x10^{-7}$ cm/s, as specified in Section 3.1. Clay liner density test results will be reported as a percentage of the maximum dry density at the corresponding moisture content percentage. The CQA Monitor will inspect the adequacy of the scarification and compaction effort in providing good lift bonding (i.e., no smooth interface between lifts) during the initial stages of liner installation.

- Although not anticipated since design grades are not this steep, equipment and safety limitations prohibit finished grades with slopes greater than 3H:1V if the liner is constructed parallel to the surface. Compaction equipment placing sideslope liners on slopes steeper than 3H:1V results in reduced stability of compaction equipment, and reduction in compaction efficiency.

- The top surface of the completed soil liner must be sealed with a smooth-drummed roller prior to final liner thickness surveying and placement of the geomembrane liner.

- The surface of the soil liner will be sealed by smooth drumming when construction is to be shut down for more than 24 hours to mitigate the effects of desiccation and wetting from rainfall events. Additionally, smooth drum rolling to seal the surface will be required on a routine basis during the summer months at the end of each day's liner construction to reduce desiccation.

- Any liner perforations required for obtaining laboratory samples will be repaired by backfilling the hole with bentonite chips or 50/50 powdered/granulated bentonite/soil/sand mixture hand-tamped into place. If the hole is in the upper lift of soil liner, the upper 2 inches will be backfilled by clayey liner soil which will be hand-tamped sufficiently to blend the backfill into the adjacent soil liner lift.

- Soil liner construction shall be conducted in a systematic and timely manner, such that the soil liner is not left exposed for an extended period of time. The Contractor will be required to maintain any exposed soil liner in a condition acceptable to the CQA Monitor

through the completion and approval of the soil liner, and during placement of the geomembrane over the soil liner.

3.3.2 Liner Tie-ins

The leading 10 to 20 feet of the liner will **not** be covered with waste, but instead will be protected to facilitate tie-in with subsequent cell liners. Liners will not be constructed by "butting" the entire thickness of a new liner segment next to the previously constructed section of liner. Soil liner tie-ins will be performed using the following procedures:

- The edge of the previously installed liner will be uncovered, exposed, and cut back on a slope so that the entire existing liner edge is tied to new construction without superimposed construction joints.
- The surface of the existing liner will be scarified (roughened) prior to subsequent soil placement, to further reduce the possibility of construction joints.
- The length of the tie-in area should be at least 5 feet per foot thickness of liner.

3.3.3 Hydrating Liner Soil

Prior to attempting to hydrate (moisture condition by wetting) clayey soils, clod sizes will be reduced by disking, pulverizing, or other method of breaking clods as acceptable to the GP or CQA Monitor. The number of passes required for adequate clod size reduction will be determined in the field between the Contractor and GP, based on soil condition, equipment used, and equipment operation. After applying water, the soil will be mixed and stockpiled, if necessary, to allow adequate time for hydration to occur. The amount of moisture conditioning and time of hydration will be determined in the field by the GP. Water used in hydrating liner soils must be clean and will not have come into contact with waste or any objectionable material.

3.4 PROCEDURES FOR ADDRESSING FAILING TESTS

3.4.1 Failing Field Density Tests

As described in Table 10-3-2, field density tests will be performed at a frequency of 1 test per 8,000 square feet, per lift. In the event a test indicates field density less than specified, the Contractor will be required to moisture condition (either dry or moisten, if needed) the soil, and then re-compact and retest the soil. The entire 8,000 square foot area represented by the failing test will be required to be reworked.

Alternately, the contractor may perform a minimum of 3 additional field density tests spaced no less than 20 feet in a circular pattern surrounding the original failed test, and, if all tests pass field density, the rework area will be limited to the area inside of the circle formed by the passing tests. If one or more of the additional field tests fail, the entire 8,000 square foot area represented by the failed test will require reworking.

In the event of a second failed field density test, the GP will be immediately notified, and a field decision made by the GP regarding conducting a second rework of the area (as described above) or alternately, requiring that an additional Proctor test be performed on the soils comprising the failed test area. If an additional Proctor test is required, the GP will direct the contractor to either obtain soil samples from the failed area, or alternately, from the borrow source from which the failing soils were obtained. Reworking and retesting of the soils will not occur until after the additional laboratory testing has been completed, and the new Proctor test information submitted to the GP or CQA Monitor.

The results of both passing and failing tests will be recorded, and reported within the SLER.

3.4.2 Failing Gradation or Atterberg Limits Tests

As described in Table 10-3-2, gradation and Atterberg limits tests will be performed at a frequency of 1 test per 100,000 square feet, per lift of soil liner (concurrent with permeability tests). In the event of a failing test, the GP will immediately be notified, and the failing laboratory results provided to the GP. If either the LL or the PI varies by 10 or more points when compared against the appropriate moisture/density curve developed for that borrow source, the soil is considered as a separate soil borrow source and a new test series including moisture/density, compaction relationship, sieve analysis and coefficient of permeability should be determined and these results used for field construction control.

Additional test samples will be obtained at a minimum of 3 locations, spaced no less than 20 feet in a circular pattern surrounding the original failed test. If passing results are obtained for the additional test samples, the area defined by the passing tests will be removed, replaced, and retested. If one or more of the additional tests fail, a new sample will be obtained 30 feet (minimum) from the original failed test (along a line radiating from the original failed test through the failing additional test(s)), and in 10-foot (minimum) increments thereafter, until passing test results are obtained. The area requiring removal and replacement ultimately will be defined by passing test results. After removal and replacement, one additional passing test in the approximate center of the reworked area will be required.

3.4.3 Failing Permeability Tests

As described in Table 10-3-2, permeability tests will be performed at a frequency of 1 test per 100,000 square feet, per lift of soil liner (concurrent with gradation and Atterberg limits tests). In the event of a failing permeability test, the GP will immediately be notified, and the failing laboratory results provided to the GP.

Prior to requiring additional permeability sampling and testing, a field density test will be performed at the location of the failed test. If a failing field density test is obtained, the failed area will be defined as described in Section 3.4.1, above, except that additional field density testing will be performed until passing tests are obtained. After reworking and achieving passing field density tests, a new permeability sample will be obtained for testing.

If passing field density tests are obtained at the location of the failed permeability test location, additional Atterberg limits and gradation test samples will be obtained at a minimum of 3

locations, spaced no less than 20 feet in a circular pattern surrounding the original failed test. If passing results are obtained for the additional test samples (Atterberg limits and gradation tests), the area defined by the passing tests will be removed and replaced. If one or more of the additional tests fail, a new sample will be obtained 30 feet (minimum) from the original failed test (along a line radiating from the original failed test through the failing additional test(s)), and in 10-foot (minimum) increments thereafter, until passing test results are obtained. Passing Atterberg limits and gradation test results will be used to define the area requiring removal and replacement. After removal and replacement, a new permeability sample will be obtained and tested, and a passing test obtained prior to approval of the reworked area.

3.5 THICKNESS VERIFICATION

The thickness (minimum 2-foot) of constructed soil liners will be verified by surveying methods. As described in Table 10-3-2, at a minimum, one thickness verification will be performed for every 5,000 square feet of constructed soil liner. Survey locations will be based on pre-established survey grid in accordance with Section 2.3. A minimum of three (3) survey points shall be used for all constructed soil liners regardless of size. All elevation calculations necessary for thickness verification will be included in the SLER submittal.

3.6 HYDROSTATIC CONSIDERATIONS – BALLASTING

Hydrostatic considerations for excavation below the seasonal high groundwater table are described in Section 2.5 of this Attachment.

4 GEOMEMBRANE

4.1 INTRODUCTION

This section describes CQA procedures for the installation of 60-mil high-density polyethylene (HDPE) geomembrane. CQA procedures for drainage geocomposite, geotextiles, and leachate collection piping are discussed in Sections 5 through 8. The overall goal of the CQA procedures is to confirm (1) that proper materials, construction techniques and procedures are used; (2) that the Geosynthetic Contractor implements a quality control plan in accordance with this SLQCP; and (3) that the project is built in accordance with this SLQCP and the project construction plans and technical specifications. The quality assurance program is intended to identify and define problems that may occur during construction and to observe that these problems are avoided and/or corrected before construction is complete.

The GLER, prepared after completion of construction, will document that the constructed facility meets the design intent and technical specifications.

4.2 QUALITY CONTROL AND QUALITY ASSURANCE TESTING

CQC during installation of the geomembrane will be performed by the Geosynthetics Contractor. CQA during installation of geomembrane will be performed by the CQA Monitor to assure that the geomembrane is installed in accordance with this SLQCP and the project construction plans and technical specifications. To monitor compliance, a quality assurance program will include the following:

- A review of the geomembrane manufacturer's quality control submittals.
- Material conformance testing.
- CQA testing, both destructive and non-destructive.
- Construction monitoring and documentation.

Conformance testing refers to activities that take place prior to material installation. Construction testing includes activities that occur during geosynthetic installation. All quality control/assurance monitoring and testing will be conducted in accordance with this SLQCP and the project construction plans and technical specifications. The GP or CQA Monitor will be on-site, and observe all geomembrane installation and testing activities.

4.2.1 Manufacturer's Quality Control

Prior to the installation of the geomembrane, the manufacturer or installer will provide the GP with quality control certificates signed by a responsible party employed by the manufacturer. Each quality control certificate will include roll identification numbers, testing procedures, and results of quality control tests. The manufacturer's quality control tests will be performed in accordance with the test methods and frequencies provided in the most recent version of Geosynthetic Research Institute (GRI) standard GM-13~~project-specific testing methods and~~

~~subject to one test per 100,000 square feet of material or a minimum of one test per resin lot, whichever is greater~~. Additionally, testing for the geomembrane resin will be performed in accordance with the following:

- Specific Gravity/Density (ASTM D792 or D1505): 1 per batch and every resin lot; and
- Melt Flow Index (ASTM D1238): 1 per batch and every resin lot.

All geomembrane properties must meet the minimum values set forth in the most recent version of Geosynthetic Research Institute (GRI) standard GM-13. UV Resistance testing not required for HDPE that will be immediately covered. A copy of the current version of GRI-GM13 is included in Appendix 10A.

4.2.2 Conformance Testing

Conformance testing refers to testing (by a third-party independent laboratory) performed after manufacture of the geomembrane to verify it meets the required specifications. Conformance testing methods and required frequencies are presented in Table 10-4-1.

Table 10-4-1. Geomembrane Conformance Testing

TEST	METHOD	MINIMUM FREQUENCY
Thickness (laboratory)	ASTM D5199 (1) or D5994	1 per ~~100~~50,000 ft^2 and every resin lot
Thickness (2) (field)		1 measurement per 5 feet along leading edge of each geomembrane panel.
Density	ASTM D1505 or D792	1 per 100,000 ft^2 and every resin lot
Carbon black content	ASTM D1603	
Carbon black dispersion	ASTM D5596	
Tensile properties (3)	ASTM D638~~, Type IV~~ or D6693	

1. ASTM D5994 for textured geomembrane, D5199 for smooth.
2. No single measurement will be less than ten percent below the required nominal thickness in order for the panel to be acceptable. A minimum of 5 measurements will be made per panel.
3. 2-inch initial gauge length assumed for elongation at break at 2.0 in/min.

4.3 INSTALLATION

4.3.1 Delivery

Upon delivery of the geomembrane, the CQA Monitor will observe that:

- The geomembrane is delivered in rolls and is not folded. Any evidence of folding (other than from the manufacturing process) or other shipping damage is cause for rejection of the material.
- Equipment used to unload and store the rolls does not damage the geomembrane.

- The geomembrane is stored in an acceptable location and in accordance with the manufacturer's recommendations and specifications. The geomembrane must not be stored more than five (5) rolls high. During delivery and storage, the geomembrane must be protected from puncture, dirt, grease, water, mud, mechanical abrasions, excessive heat, or other potentially damaging elements. During storage, the geomembrane shall be raised off the floor/ground to minimize damage.

- All manufacturing documentation required by this SLQCP, as set forth in the technical specifications, has been received and reviewed for compliance with the specifications. This documentation will be included in the GLER.

- The geosynthetics receipt log form has been completed for all materials received.

Damaged geomembrane will be rejected and removed from the site or stored at a location separate from accepted geomembrane. Geomembrane that does not have proper identification or manufacturer's documentation must be stored at a separate location until all documentation has been received, reviewed, and accepted, and will not be incorporated into work until all required documentation is received and reviewed by the CQA Monitor for completeness.

4.3.2 Panel Placement

During panel placement, the CQA Monitor must perform the following:

- Record panel and roll numbers and lengths on the panel placement and/or panel seaming log. Develop field notes documenting panel deployment that depicts the locations of panels, seams, destructive test locations and repairs. These field notes will be used to produce a record drawing of the panel placement to be included in the GLER. Alternatively, the panel placement drawing may be developed from field surveying methods.

- Conduct thickness verification tests at 5 foot intervals along the leading edge, at a minimum of 5 locations per panel. No single thickness measurement will be less than 10% below the required normal thickness.

- Observe the geomembrane surface as it is deployed and record all panel defects and repair of the defects (panel rejected, patch installed) on the repair sheet. All repairs will be made in accordance with this SLQCP, supplemental technical specifications, and located on the record drawing of panel placement.

- Observe that heavy vehicular equipment is not allowed on the geomembrane during handling (low ground-pressure support equipment, such as generators, may be allowed with rub sheet protection, as applicable).

- Observe that there are no angular stones greater than 1 inch in size, construction debris, or other deleterious items immediately beneath the geomembrane within the compacted clay soil liner, which could cause damage to the geomembrane.

- Observe that the geomembrane is placed in a manner that provides good contact with the underlying materials, and that no bridging or stretching over surface features occurs. The subgrade (clay soil liner) under the geomembrane must be smooth-rolled, and maintained in a smooth, uniform, and compacted condition during geomembrane installation. Geomembrane placement methods must be conducted as not to rut or damage underlying clay soil liner.

- Observe that the geomembrane is not dragged across a surface that would damage the material. If the geomembrane is dragged across an unprotected surface, the geomembrane must be inspected for damages and repaired or rejected, as necessary. Record weather conditions including temperature. The geomembrane must not be deployed in the presence of excess moisture (fog, dew, mist, etc.), rain, or high wind. In addition, the geomembrane should not be placed when the air temperature is less than 40°F unless this requirement is waived by the design engineer in writing. Excessive wind is that which can lift and move the geomembrane panels.

- Observe that people working on the geomembrane do not smoke, wear shoes that could damage the geomembrane, or engage in activities that could damage the geomembrane.

- Observe that the method used to deploy the geomembrane minimizes wrinkles and that the geomembrane is anchored to prevent movement by the wind. Wrinkles should be walked-out or removed at the discretion of the CQA personnel. Confirm that the geomembrane is placed in a manner that provides good contact with the underlying soil liner materials, and that no bridging or stretching over surface features occurs.

- Observe that no more panels are deployed than can be seamed on that same day.

- Observe that there are no horizontal seams on sideslopes and that the textured material extends a minimum length beyond the toe of the slope as shown on the construction plans.

The CQA Monitor must inform both the contractor and the GP of any observed variances or unacceptable conditions from above. Note, however, that the CQA Monitor's failure to identify one or more of the above conditions does not relieve the Contractor of responsibility for installing and protecting the geomembrane installation in accordance with the construction plans and technical specifications.

4.3.3 Field Seaming

A seam numbering system must be agreed to by the GP and Contractor prior to the start of seaming operations. One procedure is to identify the seam by adjacent panels. For example, the seam located between Panels 306 and 401 would be Seam No. 306/401.

Trial seam testing will be performed for each of the following events:

- At the beginning of each seaming period per workday and for each seaming apparatus, including in the morning and immediately after each extended break throughout the day.

- After any major change in environmental condition, i.e., temperature, humidity, dust, etc.
- Any time the seaming apparatus is turned off for longer than 30 minutes.
- When seaming different geomembranes, i.e., smooth to textured.

Both the welder and the welding apparatus must be tested for extrusion welding. Only the apparatus must be tested according to the above schedule for fusion welding. Each welder or seamer, whether extrusion or fusion welding, must be tested at least once daily.

Each trial seam shall be at least three (3) feet in length, and 1 foot wide. A minimum of four (4) adjoining 1-inch wide coupons will be die-cut from the test seam. Two field samples will be tested for shear, and two samples tested for peel. The apparatus used for field testing must have a current certificate of calibration issued by the appropriate state or federal agency.

If one of the test seams fails, the trial seam will be repeated and testing performed on the trial seam samples. If the second trial seam fails, two additional trial seams will be performed and tested. Trial seaming and retesting will continue until two consecutive passing test series (i.e., two consecutive trial seams) are achieved for the apparatus, and welder, if applicable (extrusion welding only).

The CQA Monitor must observe all trial welding operations, quantitative testing of each trial weld for peel and shear, and recording of the results on the trial weld form. It is important that the trial welds or seams be completed under conditions similar to those under which the panels will be welded.

CQA documentation of trial seam procedures shall include, at a minimum, the following:

- Documentation that trial seams are performed by each welder and welding apparatus prior to commencement of welding and prior to commencement of the second half of the workday, or after extended break periods throughout the day.
- The welder, the welding apparatus number, time, date, ambient air temperature, welding machine temperatures and trial seam number for each trial seam.

During geomembrane welding operations, the CQA Monitor must observe the following:

- The contractor has the number of welding apparatuses and spare parts necessary to perform the work.
- Equipment used for welding will not damage the geomembrane.
- The extrusion welder is purged prior to beginning a weld until all the heat-degraded extrudate is removed.
- Seam grinding has been completed less than one hour before seam welding, and the upper geomembrane is beveled (extrusion welding only).

- The end of welds more than five (5) minutes old are ground to expose new material before restarting a weld (extrusion welding only).
- The ambient temperature, measured six (6) inches above the geomembrane surface, is between 41° and 104° Fahrenheit.
- The contact surfaces of the geomembrane are clean, free of dust, grease, dirt, debris, and moisture prior to welding.
- The seams are overlapped a minimum of three (3) inches for extrusion and hot wedge welding, or in accordance with manufacturer's recommendations, whichever is more stringent. Panels should be overlapped (shingled) in the down-grade direction.
- No solvents or adhesives are present in the seam area.
- The procedure used to temporarily hold the panels together does not damage the panels and does not preclude CQA testing.
- The panels are being welded in accordance with the plans and specifications. Seams should be oriented parallel to the line of maximum slope. In corners and odd-shaped geometric locations, the number of field seams should be minimized.
- There is no free moisture in the weld area.
- Observe that at the end of each day or installation segment, all unseamed panel edges are anchored with sandbags or other approved devices. Penetration anchors shall not be used to secure the geomembrane.
- If seaming operations are carried out at night, adequate illumination shall be provided and must be approved by the GP.

4.4 SEAM TESTING

During seam testing, the CQA Monitor will perform the following tasks:

- Review technical specifications regarding test procedures.
- Observe that equipment operators are properly trained and qualified to perform their work.
- Observe that test equipment meets project technical specifications.
- Observe that the entire length of each seam is tested in accordance with the specifications.
- Observe continuity testing and record results on the appropriate test log.

- Observe that all testing is completed in accordance with the technical specifications.
- Identify the failed areas by marking the area with a waterproof marker compatible with the geomembrane, and inform the contractor of any required repairs, then record the repair area on the repair log.
- Observe that all repairs are completed and tested in accordance with the project specifications.
- Record all completed and tested repairs on the repair log.

For destructive samples, the CQA Monitor will select locations where seam samples will be cut for laboratory testing. Sample locations should not be disclosed to the Contractor prior to completion of the seam.

Destructive samples must be shipped to the third-party laboratory for seam testing. Test methods and required frequencies are presented in Section 4.4.1. The third-party laboratory must provide test results within 24 hours, in writing or via telephone, to the GP. Certified test results are to be provided within 5 days. The CQA Monitor must immediately notify the GP in the event of a calibration discrepancy or failed test results.

4.4.1 Non-Destructive Testing

Continuous, non-destructive testing will be performed on all seams by the installer. Air pressure testing on dual-track fusion welds and vacuum-box testing for extrusion welds are the only acceptable methods. All leaks must be isolated and repaired by the following procedures:

1. Air-Pressure Testing (GRI GM6) - The ends of the air channel of the dual-track fusion weld must be sealed and pressured to approximately 30 psi, if possible. The air pump must then be shut off and the air pressure observed after five (5) minutes. A loss of less than 4 psi is acceptable if it is determined that the air channel is not blocked between the sealed ends. A loss of 4 psi or more indicates the presence of a seam leak that must then be isolated and repaired by following the procedures described under "Seam Failure Repairs and Retesting." The GP or his/her qualified representatives must observe and record all pressure gauge readings.

2. Vacuum-Box Testing (ASTM D4437) - A suction value of approximately 3 to 5 inches of gauge vacuum must be applied to all extrusion welded seams that can be tested in this manner. Examples of extrusion welded seams that do not easily lend themselves to vacuum testing would be around boots, appurtenances, etc. The seam must be observed for leaks at least ten seconds while subjected to this vacuum. The GP or his/her qualified representative must observe 100 percent of this testing.

4.4.2 Destructive Testing

Destructive seam testing will be performed in accordance with ASTM D6392. Destructive samples shall be taken at a minimum of one location for every 500 linear feet of field seam. The

total footage of individual repairs of leaks of more than 10 feet and individual repairs of more than 10 feet for failed seams must also be counted and destructively tested using the same frequency of testing described above. At a minimum, a destructive test must be done for each welding machine used for seaming or repairs. A sufficient amount of the seam must be removed in order to conduct field testing, independent laboratory testing, and archiving of enough material in order to retest the seam when necessary.

Field testing shall include at least two (2) peel test specimens (four (4) when possible for testing both tracks on dual-track fusion welded seams). Independent laboratory testing shall consist of five (5) shear test specimens and five (5) peel test specimens (10 when possible for both tracks of dual-track fusion welded seams). Destructive seam-testing locations shall be cap-stripped and the cap completely seamed by extrusion welding to the parent geomembrane. Capped sections shall be nondestructively tested. Additional destructive test samples may be taken if deemed necessary by the GP or CQA Monitor.

All field-tested specimens from a destructive test location must be passing in both shear and peel for the seam to be considered as passing. Field-tested specimens are determined as passing if the specimen tested in peel fails in film tear bond (FTB) and all test specimens meet the criteria listed in Table 10-4-2. Independent laboratory testing must confirm these field results. The minimum passing criteria for independent laboratory testing are all three of the following:

- ~~At least 4~~5 of 5 specimens tested in the peel mode must fail in FTB.
- ~~At least 4~~5 of 5 specimens from each peel and shear determination must meet the minimum specified values in Table 10-4-2.
- ~~The average value from all 5 specimens from each peel and shear determination must meet the minimum specified value in Table 10-4-2.~~All 5 specimens for shear determination should meet the minimum percent elongation at break value in Table 10-4-2.

The above criteria must be met by both tracks from each dual-track fusion welded seam before it is considered as passing.~~ It should be noted that geomembrane manufacturers may have differing values for their geomembrane sheets and, therefore, the required specific values are not provided herein. Consequently, the manufacturer's sheet strength values must be provided in order to determine if the test results are passing.~~

Table 10-4-2. Geomembrane Seam Strength

Property	Qualifier	Unit	Value
Shear Strength	Min.	lb/in	120
Shear elongation at break	Min.	%	50

Peel Strength:			
Fusion	Min	lb/in	91
Extrusion	Min.	lb/in	78

4.4.3 Seam Failure Delineation

In the event failing tests are obtained at a destructive test location, new destructive test samples will be obtained, a minimum of 10 feet in either direction of the failing test. If one, but not both, of the additional tests fail, further additional destructive testing will be required until passing tests are obtained at both ends of the original destructive test location. A cap will be required for the areas subject to destructive testing, and testing of the cap will be required as set forth in this SLQCP. If more than two failing destructive test locations are observed for a single seam, the CQA Monitor will have the alternative of requiring the entire seam be removed, and a new seam welded.

In the event more than one failing destructive test are observed for a single welding apparatus, new (passing) trial welds will be required prior to resuming geomembrane welding or seaming with the apparatus. All additional testing shall be at the Contractor's expense.

4.5 REPAIRS AND RETESTING

All seam leaks and destructive test locations shall be repaired for a distance of at least six (6) inches on each side of the leak or destructive test location. At a minimum, these repairs shall be non-destructively retested in accordance with Section 4.4.1. Destructive testing shall be performed in accordance with Section 4.4.2, or at the discretion of the CQA Monitor.

4.6 REPAIRS

Any portion of the geomembrane with a detected flaw, or which fails a non-destructive or destructive test, or where destructive tests were cut, or where non-destructive tests left cuts or holes, must be repaired in accordance with the specifications. The CQA Monitor must locate and record all repairs on the repair sheet. Repair techniques include the following:

- Patching - used to repair holes, tears, large panel defects, undispersed raw materials, contamination by foreign matter, and destructive sample locations.
- Extrusion - used to repair small defects in the panels and seams. In general, this procedure should be used for defects less than 3/8-inch in the largest dimension.
- Topping – used to repair inadequate seam areas, which have an exposed edge, for lengths of seams under five (5) feet. An extruded weld shall be permitted along the outside edge.

- Capping - used to repair failed welds or to cover seams, less than five (5) feet in length, where welds or bonded sections cannot be non-destructively tested. An extrusion weld or fusion weld shall be allowed.

- Spot welding and seaming – used to repair small tears, pinholes, or other minor, localized flaws.

- Removal - used to replace areas with large defects, greater than five (5) feet in length, where the preceding methods are not appropriate. Also used to remove excess material (wrinkles, fishmouths, intersections, etc.) from the installed geomembrane. Areas of removal shall be patched or capped.

Repair procedures will include the following:

- Abrade geomembrane surfaces to be repaired (extrusion welds only) no more than one hour prior to the repair.

- Clean and dry all surfaces at the time of repair.

- Extend patches or caps at least 6 inches beyond the edge of the defect, and round all corners of patches to a radius of at least 3 inches. Bevel the top edges of patches prior to extrusion welding.

- geomembrane below large caps should be approximately cut to avoid water or gas collection between the two sheets.

4.6.1 Wrinkles

During placement of cover materials over the geomembrane, temperature changes or creep can cause wrinkles to develop in the geomembrane. Any wrinkles which can fold over must be repaired either by cutting out the excess material or, if possible, by allowing the liner to contract by temperature reduction. In no case can material be placed over the geomembrane which could result in the membrane folding. The CQA Monitor must monitor the geomembrane for wrinkles and notify the contractor if wrinkles are being covered by soil. The CQA Monitor is then responsible for documenting corrective action to remove the wrinkles.

4.6.2 Folded Material

All folded geomembrane must be removed. Remnant folds evident after deployment of the roll which are due to manufacturing process are acceptable.

4.6.3 Bridging or Induced Tension

Bridging or Induced Tension: Bridging is defined as areas where the geomembrane is not in contact with the subgrade due to a void in the subgrade or the sheet is pulled in tension so as to span over depressions in the subgrade. Areas likely to promote bridging, i.e. trenches, toe of slopes, etc., shall be loaded with sandbags after deployment and after seaming. Induced tension is stress introduced into the geomembrane during installation or covering. These areas will likely

result in bridging. Areas with excessive bridging shall be identified and repaired by either of the following methods:

1. The geomembrane shall be cut, by the Contractor, so the tension is relieved and the geomembrane conforms to the subgrade contours. The cut geomembrane shall be repaired and tested according to the specifications regarding repairs and testing.

2. The geomembrane shall be cut, by the Contractor, and subgrade material shall be added and placed, in accordance with the contract specifications, so as bring the geomembrane in contact with the subgrade. The cut geomembrane shall be repaired and tested according to the specifications regarding repairs and testing.

4.6.4 Anchor Trench

An anchor trench will be constructed around all portions of the geomembrane where the leading edge(s) of the geomembrane will not be needed for future tie-in for expansion into the next lined cell. The anchor trench backfill material will be placed as outlined in the technical specifications. Care will be taken when backfilling and compaction to prevent damage to the underlying geomembrane. Slightly rounded corners will be provided in anchor trenches where the geomembrane enters the trench as to avoid sharp bends in the geomembrane.

The geomembrane anchor trench will be left open until seaming is completed. Expansion and contraction of the geomembrane should be accounted for in the liner placement. The anchor trench will be filled in the morning when temperatures are coolest to reduce bridging of the geomembrane.

The anchor trench backfill material will be placed in uniform lifts compacted to at least 90 percent of standard Proctor (ASTM D 698) density at a moisture content ranging from -2 to +4 percent of optimum. Compaction density and moisture of the anchor trench backfill will be visually verified by the CQA Monitor. Specific density and moisture testing of in-place anchor trench backfill will be at the discretion of the CQA Monitor.

4.7 GEOMEMBRANE ACCEPTANCE

The contractor retains all ownership and responsibility for the geomembrane until acceptance by the Owner. In the event the contractor is responsible for placing cover over the geomembrane, the contractor retains all ownership and responsibility for the geomembrane until all required documentation is complete, and the cover material is placed. After panels are placed, seamed, tested successfully, and any repairs are made, the completed installation will be inspected by the Owner's and Contractor's representatives. Any damage or defect found during this inspection will be repaired by the installer. The installation will not be accepted until it meets the requirements of both representatives. In addition, the geomembrane will be accepted by the GP only when the following has been completed:

- The installation is finished.

- All seams have been inspected and verified to be acceptable.

- All required laboratory and field tests have been completed and reviewed.
- All required contractor-supplied documentation has been received and reviewed.
- Record drawings of the panel placement, testing, and repairs have been completed and verified by the GP. The record drawings show the panel dimensions, the location of all panels, seams, destructive tests, and repairs.
- Acceptance of the GLER by TCEQ.

5 DRAINAGE GEOCOMPOSITE

5.1 INTRODUCTION

This section describes CQA procedures for the installation of drainage geocomposite in the liner. All quality control testing will be conducted in accordance with this SLQCP and the project construction plans and technical specifications. The GP or CQA Monitor will be on-site, and observe all geocomposite installation.

5.2 DELIVERY

Upon delivery, the CQA Monitor must observe the following:

- Unloading equipment will not damage the drainage geocomposite rolls.
- Drainage geocomposite rolls are wrapped in impermeable and opaque protection covers.
- Care is used when unloading the rolls.
- All documentation required by the SLQCP and technical specifications has been received and reviewed for compliance.
- Each roll is marked or tagged with the manufacturer's name, lot number, roll number, and roll dimensions.
- Materials are stored in a location that will protect the rolls from precipitation, mud, dirt, dust, puncture, cutting, impact forces, or any other damaging or deleterious conditions.

Any damaged rolls shall be rejected and removed from the site or stored at a location, separate from accepted rolls, designated by the Owner. All rolls which do not have proper manufacturer's documentation shall also be stored at a separate location until all documentation has been received and approved.

5.3 QUALITY CONTROL TESTING

The drainage geocomposite manufacturer (or supplier), will conduct quality control testing in accordance with the manufacturer's quality control program and certify that all materials delivered comply with technical specifications. The minimum frequencies and test methods for manufacturer's quality control testing for geocomposites are presented in Table 10-5-1. The material certifications shall be reviewed by the GP and approved for the project prior to acceptance of any of the material.

The geocomposite manufacturer also shall certify that geocomposite transmissivity meets or exceeds the transmissivity requirements set forth in the technical specifications (see Attachment 12 – Leachate and Contaminated Water Management Plan for transmissivity requirements). The manufacturer shall further certify that transmissivity results meet or exceed all requirements for the gradient and confining pressures listed in the technical specifications. If alternate gradient or

confining pressures are used for the certification, the geocomposite manufacturer shall certify that the material meets or exceeds the technical specification requirements. However, even with the manufacturer's certification, the GP reserves the right to reject any materials not meeting the transmissivity requirements, including gradient and confining pressure requirements.

Table 10-5-1. Manufacturer's Testing Schedule for Geocomposite

PRODUCT	TEST	METHOD	MINIMUM FREQUENCY
Resin	Density	ASTM D1505 or D792	1 per batch and every resin lot
	Melt Flow Index	ASTM D1238	
Geonet	Density	ASTM D1505 or D792	1 per 100,000 ft^2 and every resin lot
	Mass/Area	ASTM D1603	
	Thickness	ASTM D5199	
Geotextile	Mass/Area	ASTM D5261	1 per 100,000 ft^2 and every resin lot
	Grab Tensile Strength	ASTM D4632	
	Trapezoidal Tear Strength	ASTM D4533	
	Apparent Opening Size	ASTM D4751	
	Permittivity	ASTM D4491	
Geocomposite	Transmissivity	ASTM D4716	One test per product type

Additionally, conformance testing will be performed for transmissivity (ASTM D4716) and ply adhesion (D413) by an independent third-party laboratory chosen by the GP. Conformance testing for these parameters will be performed at least once per product type and project.

5.4 INSTALLATION

5.4.1 Surface Preparation

Prior to geocomposite installation, the CQA Monitor must observe the following:

- All lines and grades have been verified by the Contractor.
- All debris, soil, dust and other materials shall be removed from the geomembrane surface being prepared prior to deployment of the overlying geocomposite.
- When placed over a geomembrane, the geomembrane installation, including all required documentation, has been completed.
- The supporting surface does not contain stones that could damage the geocomposite or the geomembrane.

5.4.2 Placement

During placement, the CQA Monitor must perform the following:

- Observe the geocomposite as it is deployed and record all defects and disposition of the defects (panel rejected, patch installed, etc.). All repairs are to be made in accordance with the specifications.

- Verify that equipment used to deploy the geocomposite does not damage the geocomposite or underlying geomembrane by handling, trafficking, leakage of hydrocarbons, or by other means.

- Verify that people working on the geocomposite do not smoke, wear shoes that could damage the geocomposite, or engage in activities that could damage the geocomposite or underlying geomembrane.

- Verify that the geocomposite is anchored to prevent movement by the wind (the contractor is responsible for any damage resulting to or from wind blown geocomposite. Use sandbags, or equivalent, to prevent bridging).

- Verify that the geocomposite remains free of contaminants such as soil, grease, fuel, etc.

- Observe that the geocomposite is laid smooth and free of tension, stress, folds, wrinkles, or creases.

- Observe that on slopes the geocomposite is secured in the anchor trench and then rolled or lowered down the slope in a controlled fashion.

- Observe that adjacent rolls of geocomposite are overlapped, tied, and seamed in accordance with the manufacturer's recommendations and the specifications.

- Observe that the geonet components are tied at the specified interval with plastic fasteners. In the absence of other specifications, the adjoining geonet panels will be tied approximately every 5 feet along the roll length (edges) and every 1 foot along the roll width (ends).

- Observe that geotextile component is overlapped and either thermal bonded or sewn together.

- All seams should run parallel to the line of the slope. Seams shall be overlapped a minimum of four (4) inches. Typing material shall be white or yellow for easy inspection. Metallic material shall not be allowed. The geotextile shall then be overlapped and sewn.

5.5 REPAIRS

Repair procedures include the following:

- Holes or tears in the drainage geocomposite will be repaired by placing a geocomposite patch extending 2 feet beyond the edges of the hole or tear.

- Secure patch to the originally installed geocomposite by tying every 6 inches.

- Where the hole or tear width across the roll is more than 50 percent of the roll width, the damaged area will be removed and replaced across the entire roll width.

6 GEOTEXTILES

6.1 INTRODUCTION

This section describes CQA procedures for the installation of geotextiles for liner construction. All quality control testing will be conducted in accordance with this SLQCP and the project construction plans and technical specifications. The GP or CQA Monitor will be on-site, and observe all geotextile installation.

6.2 DELIVERY

During delivery the CQA Monitor must observe the following:

- Unloading equipment will not damage the geotextile rolls.
- Geotextile rolls are wrapped in impermeable and opaque protection covers.
- Care is used when unloading the rolls.
- All documentation required by the SLQCP and technical specifications has been received and reviewed for compliance.
- Each roll is marked or tagged with the manufacturer's name, lot number, roll number, and roll dimensions.
- Materials are stored in a location that will protect the rolls from precipitation, mud, dirt, dust, puncture, cutting, impact forces, or any other damaging or deleterious conditions.

Any damaged rolls must be rejected and removed from the site or stored at a location separate from accepted rolls, designated by the Owner. All rolls which do not have proper manufacturer's documentation must also be stored at a separate location until all documentation has been received and approved.

6.3 QUALITY CONTROL TESTING

The geotextile manufacturer (or supplier), will conduct quality control testing in accordance with the manufacturer's quality control program and certify that all materials delivered comply with technical specifications. The minimum frequencies and test methods for manufacturer's quality control testing for geotextiles are presented in Table 10-6-1. The material certifications shall be reviewed by the GP and approved for the project prior to acceptance of any of the material.

Table 10-6-1. Manufacturer's Testing Schedule for Geotextile

TEST	METHOD	MINIMUM FREQUENCY
Mass/Area	ASTM D5261	1 per 100,000 ft^2 and every resin lot
Grab Tensile Strength	ASTM D4632	
Trapezoidal Tear Strength	ASTM D4533	
Apparent Opening Size	ASTM D4751	
Permittivity	ASTM D4491	

6.4 INSTALLATION

6.4.1 Surface Preparation

Prior to geotextile installation, the CQA Monitor must observe the following:

- All lines and grades have been verified by the Contractor.
- Except where a geotextile is used as wrap around gravel (such as around chimney drains), all debris, soil, dust and other materials shall be removed from the surface being prepared for geotextile deployment.
- When placed over a geomembrane or geocomposite, the underlying material installation, including all required documentation, has been completed.

6.4.2 Placement

During placement, the CQA Monitor must observe the following:

- Observe the geotextile as it is deployed, and record all defects and disposition of the defects (panel rejected, patch installed, etc.). All repairs are to be made in accordance with the specifications.
- Observe that equipment used does not damage the geotextile by handling, equipment transit, leakage of hydrocarbons, or other means.
- Observe that people working on the geotextile do not smoke, wear shoes that could damage the material, or engage in activities that could damage the material.
- Observe that the geotextile is securely anchored as applicable.
- Observe that the geotextiles are temporarily anchored as necessary to prevent movement by the wind.
- Observe that the panels are overlapped in accordance with the construction plans, technical specifications and manufacturer's recommendations.

- Examine the geotextile after installation to confirm that no potentially harmful foreign objects are present.

- Observe that seams (where required) are continuously sewn or thermal bonded in accordance with the manufacturer's recommendations and project specifications.

The CQA Monitor must inform both the Contractor and GP if the above conditions are not met.

6.5 REPAIRS

Repair procedures include the following:

- Patching - used to repair holes, tears and large defects.

- Removal - used to replace areas with large defects where the preceding method is not appropriate.

Holes, tears, and defects must be repaired in the following manner. Soil or other material which may have penetrated the defect must be removed completely prior to repair. If located on a slope, the defect must be patched using the same type of material. On a sideslope, should any tear, hole, or defect exceed 10 percent of the width of the panel, the panel must be removed and replaced. If the defect is not located on a slope, the patch must be made using the same type of material and placed with a minimum of 24 inches overlap in all directions. All geotextile patches should be thermal bonded in place.

APPENDIX 10A

MATERIAL TESTING SCHEDULES

- **Geosynthetic Research Institute, Test Method GM13 (GRI-GM13)**

- **Liner Component Testing Schedules**
  - Testing Schedule for Compacted Clay Liner
  - Testing Schedule for Geomembrane
  - Testing Schedule for Geocomposite
  - Testing Schedule for Non-Woven Geotextile

GEOSYNTHETIC RESEARCH INSTITUTE
TEST METHOD GM13 (GRI-GM13)

LINER COMPONENT TESTING SCHEDULES

Table 10A-1. Testing Schedule for Compacted Clay Liner

TEST CATEGORY	TEST	METHOD USED	FREQUENCY
Borrow Source Materials	Soil Classifications: USCS	ASTM D2487	1 per soil type / minimum 1 per borrow source
	Sieve Analysis	ASTM D422 or D1140	
	Atterberg Limits	ASTM D4318	
	Moisture/Density Relationship	ASTM D698	
	Hydraulic Conductivity (1)	ASTM D5084 (2)(3)	1 per Moisture-Density Relationship
Constructed Liners	Field Moisture/Density Test	ASTM D1556, D2167, or D6938	1 per 8,000 ft^2 per 6-inch lift (4)
	Sieve Analysis	ASTM D422 or D1140	1 per 100,000 ft^2 per 6-inch lift (5)
	Atterberg Limits	ASTM D4318	
	Hydraulic Conductivity (6) (7)	ASTM D5084 or CoE EM 1110-2-1906 (8)	
	Thickness	Survey	1 per 5,000 ft^2

1. Field testing of permeability (in accordance with ASTM D5093) is optional, and may be replaced by laboratory testing.
2. Testing procedures in Appendix VII of the Corps of Engineers Manual EM 1110-2-1906, November 30, 1970, Laboratory Soils Testing, may be used as an alternative method.
3. Permeability tests will be conducted with tap water or 0.05N solution of CaSO4. Distilled water will not be allowed.
4. A minimum of three tests must be conducted for each 6-inch lift, regardless of area.
5. A minimum of one test must be conducted for each lift, regardless of cover area.
6. Testing will be conducted on undisturbed samples.
7. Permeability tests will be run using tap water or a 0.05N solution of CaSO4. Distilled water will not be allowed.
8. Field testing of permeability (in accordance with ASTM D5093) is optional, and may be replaced by laboratory testing.

Table 10A-2. Testing Schedule for Geomembrane

TEST CATEGORY	TEST	METHOD	MINIMUM FREQUENCY
Resin	Specific Gravity/Density	ASTM D792 or D1505	One per batch and every resin lot
	Melt Flow Index	ASTM D1238	
Geomembrane Manufacturer	Manufacturer Quality Control (MQC)	Testing per GRI Test Method GM13	Testing per GRI Test Method GM13
Conformance Testing by Third-Party Independent Laboratory	Thickness	ASTM D5199 (1) or D5994	1 per 50,000 ft^2 and every resin lot
	Thickness (2) (field)		1 measurement per 5 feet along leading edge of each geomembrane panel.
	Density	ASTM D1505 or D792	1 per 100,000 ft^2 and every resin lot
	Carbon black content	ASTM D1603	
	Carbon black dispersion	ASTM D5596	
	Tensile properties (3)	ASTM D638, Type IV	
Destructive Seam Field Testing	Shear	ASTM DD4437 or D6392	One per 500 linear feet of field seam
	Peel	ASTM D4437	
Non-destructive Seam Field Testing	Air Pressure	GRI GM-6 or ASTM D5820	All dual-track fusion
	Vacuum	ASTM D4437 or D5641	All non-air-pressure tested seams when possible

1. ASTM D5994 for textured geomembrane, D5199 for smooth.
2. No single measurement will be less than ten percent below the required nominal thickness in order for the panel to be acceptable. A minimum of 5 measurements will be made per panel.
3. 2-inch initial gauge length assumed for elongation at break at 2.0 in/min.

Table 10A-3. Testing Schedule for Geocomposite

TEST CATEGORY	TEST	METHOD	MINIMUM FREQUENCY
Manufacturer (Resin)	Density	ASTM D1505 or D792	1 per 100,000 ft^2 and every resin lot
	Melt Flow Index	ASTM D1238	
Manufacturer (Geonet)	Density	ASTM D1505 or D792	1 per 100,000 ft^2 and every resin lot
	Mass/Area	ASTM D1603	
Manufacturer (Geotextile)	Mass/Area	ASTM D5261	1 per 100,000 ft^2 and every resin lot
	Grab Tensile Strength	ASTM D4632	
	Trapezoidal Tear Strength	ASTM D4533	
	Apparent Opening Size	ASTM D4751	
	Permittivity	ASTM D4491	
Manufacturer (Geocomposite)	Transmissivity	ASTM D4716	One test per product type
Conformance Testing by Third-Party Independent Laboratory	Transmissivity	ASTM D4716	One test per product type
	Ply Adhesion	ASTM D413	One test per project

Table 10A-4. Testing Schedule for Non-woven Geotextile

TEST CATEGORY	TEST	METHOD	MINIMUM FREQUENCY
Manufacturer	Mass/Area	ASTM D5261	1 per 100,000 ft^2 and every resin lot
	Grab Tensile Strength	ASTM D4632	
	Trapezoidal Tear Strength	ASTM D4533	
	Apparent Opening Size	ASTM D4751	
	Permittivity	ASTM D4491	

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TCEQ PERMIT NO. MSW-2400
MCLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III - SITE DEVELOPMENT PLAN
ATTACHMENT 11
LANDFILL GAS MANAGEMENT PLAN

Prepared for:

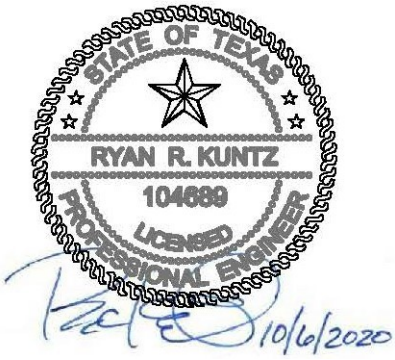

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TABLE OF CONTENTS

SECTION **PAGE**

1 INTRODUCTION 11-1-1
1.1 SCOPE 11-1-1
1.2 PURPOSE 11-1-1
2 SITE CHARACTERISTICS 11-2-1
2.1 INTRODUCTION 11-2-1
2.2 SOIL CONDITIONS 11-2-1
2.3 HYDROGEOLOGIC CONDITIONS 11-2-1
2.4 HYDRAULIC CONDITIONS 11-2-1
2.5 FACILITY STRUCTURES WITHIN THE PERMIT BOUNDARY 11-2-2
2.6 UNDERGROUND UTILITIES 11-2-2
2.7 OFF-SITE STRUCTURES 11-2-2
2.8 CHANGES TO MAINTAIN EFFECTIVE GAS MONITORING 11-2-3
3 MONITORING 11-3-1
3.1 PERIMETER MONITORING 11-3-1
3.2 MONITORING OF FACILITY STRUCTURES 11-3-3
3.3 RECORDKEEPING AND REPORTING 11-3-4
3.4 BACKUP PLAN FOR GMPS/UTILITY VENTS AND CONTINUOUS METHANE MONITORS 11-3-4
4 ACTION PLAN 11-4-1
4.1 INITIAL RESPONSE MEASURES 11-4-1
4.2 FOLLOW-UP NOTIFICATION PROCEDURES 11-4-3
5 REMEDIATION PLAN 11-5-1
6 PASSIVE LFG VENTING SYSTEM 11-6-1

Drawings

11.1 Gas Monitoring Plan
11.2 Typical Gas Monitoring and Vent Details

Appendices

11A Methane Monitoring and Recording Form

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If used, continuous methane monitors/alarms will be tested in accordance with the manufacturer's testing specifications and recommended frequency.

3.3 RECORDKEEPING AND REPORTING

Field monitoring data records for GMPs, on-site structures, and utility vents will be maintained for the methane monitoring and kept on-site as part of the Site Operating Record. Field data will be recorded on the Methane Monitoring and Recording Form (Appendix 11A) or similar form. Methane monitoring will be performed quarterly in accordance with 30 TAC §330.371(b)(2) during the following periods:

Methane Monitoring Quarters

First Quarter: January – March
Second Quarter: April - June
Third Quarter: July - September
Fourth Quarter: October – December

In accordance with §330.371(e), ~~T~~the methane monitoring and control program will continue for a period of 30 years after the certification of final closure or until the owner or operator receives written authorization from the TCEQ to revise or discontinue the program. Authorization to reduce gas monitoring and control shall be based on a demonstration that there is no potential for gas migration beyond the property boundary or into on-site structures. Demonstration of this proposal shall be supported by data collected and additional studies as required.

3.4 BACKUP PLAN FOR GMPS/UTILITY VENTS AND CONTINUOUS METHANE MONITORS

In accordance with 30 TAC §330.371(g)(3), the following is a backup plan to be used if stationary GMPs/utility trench vents or continuous methane monitors become unusable or inoperative.

3.4.1 Stationary GMPs/Utility Vents

1. Unusable or inoperative GMPs/utility vents will be repaired or replaced within 60 days of discovery of being unusable or in-operative.

2. Upon completion of a replacement GMP/utility vent, an installation report including boring logs and/or construction details will be maintained in the landfill Site Operating Record.

3. Should a monitoring event occur prior to the 60-day replacement of a damaged GMP/utility vent, barhole probing will be implemented next to the damaged probe using a portable gas monitor.

3.4.2 Stationary Continuous Methane Monitor/Alarm

1. Damaged or inoperative stationary continuous methane monitors/alarms will be repaired or replaced upon discovery of damage or malfunction.

2. Alternatively a portable combustible gas indicator calibrated to detect 1.25 percent methane by volume will be used during monitoring events.

4 ACTION PLAN

4.1 INITIAL RESPONSE MEASURES

This action plan has been prepared for the protection of human health in the event concentrations of methane exceed regulatory limits either at the permit boundary or within on-site structures. The appropriate emergency response is different for each situation; therefore, the plan will address the situations for structures and permit boundaries separately.

This action plan also recognizes that a single-event exceedance of allowable limits on a combustible gas indicator or continuous methane alarm does not necessarily mean that the concentration of methane has actually exceeded allowable levels. Therefore, a procedure, as described below, will be implemented to verify the validity of a single-event exceedance on a combustible gas indicator or continuous methane alarm.

4.1.1 Immediate Emergency Action

The initial action in the event methane is detected at levels above regulatory limits is to protect human health. Therefore, immediately following an exceedance, the TCEQ Austin Office, TCEQ regional office, local and county officials, emergency officials, and the public (defined as adjacent landowners within 1,000 feet of the exceedance) will be notified that a potential exceedance has occurred and that verification procedures are being implemented. The Landfill Manager will advise the ~~residence~~ landowner to consider evacuating any structure within 1,000 feet of the exceedance while further assessment of the potential for off-site migration is underway, as described in Section 4.1.2. Additionally, the following specific responses will also be implemented depending on the circumstances described below.

4.1.1.1 On-Site Structures

If an on-site structure is found to have methane concentrations that exceed 1.25 percent methane by volume, the structure is to be evacuated of all personnel immediately and the Landfill Manager will be notified. Personnel (except for qualified monitoring personnel) will not be allowed to re-enter the affected structure until additional measures have been taken, as described in Section 4.1.2 of this attachment.

4.1.1.2 Permit Boundary

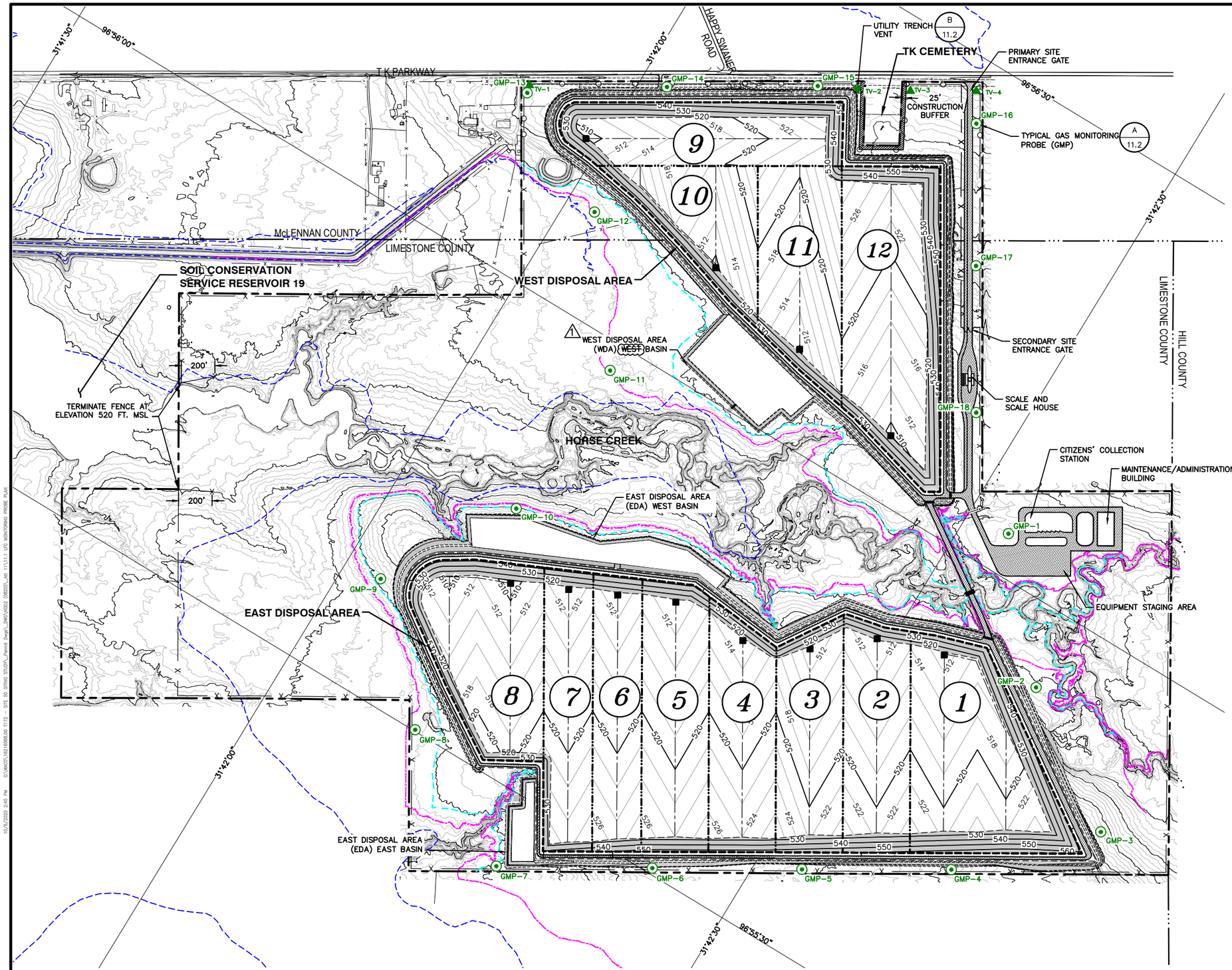
If methane concentration levels that exceed 5 percent methane by volume, are detected at the permit boundary in one of the GMPs or utility trench vents, the Landfill Manager will be notified.

4.1.2 Verification Procedures

Once immediate emergency measures have been taken to protect human health, the Landfill Manager will instruct monitoring personnel to begin verification procedures. Such procedures are intended to determine if the methane levels detected are accurate, or if erroneous levels have been detected due to equipment malfunction or other reasons.

DRAWINGS

- **Drawing 11.1 Gas Monitoring Plan**
- **Drawing 11.2 Typical Gas Monitoring and Vent Details**



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- COUNTY LINE
- 560 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- 100-YEAR STORM EVENT WATER SURFACE (SEE NOTE 5)
- EXISTING UNDERGROUND WATER LINE
- X PROPOSED/EXISTING PERIMETER FENCE (CHAIN LINK OR BARBED WIRE)
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- 510 EXCAVATION GRADE TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- 96°55'30" LATITUDE/LONGITUDE LINES
- TOE/TOP OF SLOPE
- LEACHATE COLLECTION TRENCH
- TV-1 PROPOSED UTILITY TRENCH VENTS
- GMP-13 PROPOSED LANDFILL GAS MONITOR PROBE (SEE NOTE 4)
- X SECTOR DESIGNATION
- 1 SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100-YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
3. ELEVATIONS SHOWN ON THIS DRAWING ARE EXCAVATION GRADES OR BOTTOM OF LINER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
4. LANDFILL GAS MONITORING PROBES WILL BE INSTALLED CONSISTENT WITH ATTACHMENT 11, SECTION 3.
5. 100-YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC-HMS AND HEC-RAS MODELING DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.

1 ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, BASIN CALLOUT, LIMITS OF WASTE, AND NOTE 2.	RRK

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: GAS MONITORING PLAN

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16216088.00 | DSN. BY: BG/RRK | DWN. BY: NR | CHK. BY: BJD | C/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 11.1 LFG MONITORING PROBE PLAN

DATE: 04/2020

SCALE: AS SHOWN

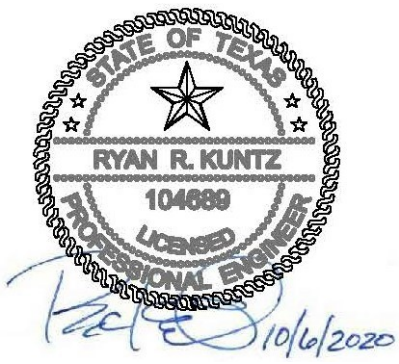
DRAWING NO. 11.1

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART III
SITE DEVELOPMENT PLAN -ATTACHMENT 12
LEACHATE AND CONTAMINATED WATER MANAGEMENT PLAN

Prepared for:

CITY OF WACO



Solid Waste Services
501 Schroeder Drive
Waco, TX 76710

Prepared by:

SCS ENGINEERS
Texas Board of Professional Engineers, Reg. No. F-3407
Dallas/Fort Worth Office
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 0 – April 2020
Revision 1 – October 2020
SCS Project No. 16216088.00

TABLE OF CONTENTS

SECTION **PAGE**

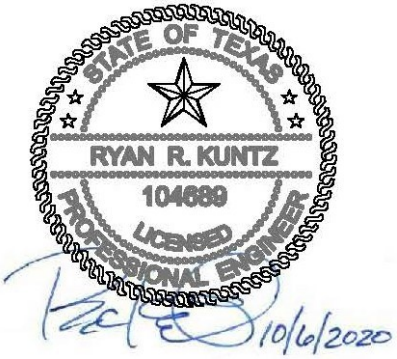
1 PURPOSE AND SCOPE 12-1-1
2 LEACHATE AND CONTAMINATED WATER GENERATION 12-2-1
2.1 GENERAL PROCESS 12-2-1
2.2 LEACHATE GENERATION 12-2-1
2.3 STORMWATER MANAGEMENT 12-2-1
3 LEACHATE COLLECTION SYSTEM 12-3-1
3.1 SYSTEM LAYOUT 12-3-1
3.2 LEACHATE DRAINAGE LAYER 12-3-1
3.3 LEACHATE COLLECTION PIPING 12-3-1
3.4 LCS DURABILITY AND LONG-TERM PERFORMANCE 12-3-2
3.5 LEACHATE COLLECTION SUMPS AND PUMPS 12-3-2
3.6 DRAINAGE AGGREGATE 12-3-3
4 LEACHATE AND CONTAMINATED WATER STORAGE 12-4-1
5 LEACHATE AND CONTAMINATED WATER DISPOSAL AND RECIRCULATION 12-5-1

Drawings

12.1 East Disposal Area - Leachate Collection System Layout Plan
12.2 West Disposal Area - Leachate Collection System Layout Plan
12.3 Bottom Liner Details
12.4 Leachate Collection System Details

Appendices

12A Leachate Generation Model
12B Leachate Collection System Design Calculations
12C Containment Berm and Diversion Berm Calculations
12D HDPE Pipe Corrosion Durability Literature



SCS Engineers
TBPE Reg. # F-3407

4 LEACHATE AND CONTAMINATED WATER STORAGE

As discussed in Section 3.5, leachate storage will be provided in the leachate collection sumps and above-ground leachate storage tank(s). Initial leachate storage will be provided in the leachate collection sumps. Each sump will provide approximately between 7,000 and 11,900 gallons of leachate storage, depending on sump size, which includes at least one day of storage time, assuming an average leachate generation rate. Sump volume calculations are provided in Appendix 12B. Leachate will be removed from the sumps by submersible pumps located within the sump riser pipes. The sump pumps will discharge leachate into above-ground leachate storage tank(s), as described below.

Additionally, contaminated water (surface water contacting waste) will be contained at the working face using containment berms, as described in Section 2.3 of this attachment. Water that infiltrates into the underlying waste will be managed as leachate. Through routine landfill operations contaminated water contained at the working face will be removed by the end of each working day, and discharged to an above-grade leachate storage tank.

Leachate and contaminated water will be stored in the storage tank(s) until it is hauled off for disposal at a local wastewater treatment plant (WWTP) or recirculated back into the landfill, as described in Section 5.

Actual leachate generation and recirculation rates will govern the ultimate number and capacity of above-ground leachate storage tank(s) required at the landfill. As the landfill is developed and leachate generation decreases/increases, the number and size of leachate storage tanks will also be decreased/increased. Storage of leachate and contaminated water will be conducted in one or a combination of the following two ways:

- Option 1 – Temporary leachate storage tanks will be located adjacent to the perimeter haul road and adjacent to one of the sector's leachate collection sump risers. There may be up to twelve (12) temporary leachate storage tanks corresponding to one per sector, with a minimum capacity of 2,500 gallons and maximum capacity of 10,000 gallons for each storage tank. At a minimum, the leachate storage tanks will be located in an area that is optimal for collection of leachate from multiple sectors and that is easily accessible to tanker or vacuum trucks for removal of leachate. Foundations will be compacted earth, gravel, concrete, or similar. The anchoring system will be in accordance with manufacturer's recommendations.

- Option 2 – Permanent leachate storage tank(s) will be located within the landfill permit boundary at the location depicted on Drawings 12.1 and 12.2. There may be up to four (4) permanent leachate storage tank(s), with a maximum aggregate capacity of no greater than 400,000 gallons; with a minimum capacity of 50,000 gallons and maximum capacity of 200,000 gallons for each tank. Leachate generated will be transported to the leachate storage tank(s) via a leachate forcemain serving both disposal areas. The permanent leachate storage tank(s) also will be installed to allow for easy access to tanker or vacuum trucks for removal of leachate. Foundations will be gravel, concrete, or similar and anchored in accordance with manufacture's recommendations.

Storage tanks will be either single or double-contained. In either event, the storage tanks used at the landfill will either be fabricated from steel, polyethylene, or fiberglass. Therefore, the storage tanks installed will be fabricated consistent with one of the following standards (i.e., depending on the material that the tank was fabricated from):

- AWWA D100 for welded carbon steel tanks;
- ASTM D1998 for upright polyethylene storage tanks; and
- ASTM D3299 for filament wound glass-fiber-reinforced thermoset resin chemical-resistant tanks (i.e., fiberglass).

If single-contained, secondary containment will be provided by construction of either geomembrane-lined or concrete-lined containment. The area encompassed and height of the containment will provide sufficient capacity to detain the capacity of the single largest tank and 7.9 inches of precipitation (i.e., 25-year, 24-hour storm event) while maintaining one-foot of freeboard over the detained volume. Secondary containment for double-contained tanks will be provided by a double wall of the same material, geosynthetic liner and/or bladder, or similar system. Double-contained tanks will also include an inspection port, site glass, or similar for monitoring the interior tank integrity for leaks. Additionally, each storage tank (single- and double-contained) will be equipped with level or tank float sensor(s) that communicates with each pump control panel when the tank is full and shuts down the pumps until sufficient leachate volume has been removed from the tank. Furthermore, each storage tank will be equipped with quick connects or control valves (size and type recommended by the manufacturer of the tank) that will allow tanker or vacuum trucks to connect to the tank without spilling leachate during transfer operations.

Landfill personnel will inspect leachate tanks, secondary containment system by visual inspection, related piping, and connections on a weekly basis. During these inspections, landfill personnel will also verify that a spill has not occurred. Records of these inspections and any maintenance as a result of the inspections will be maintained in the Site Operating Record.

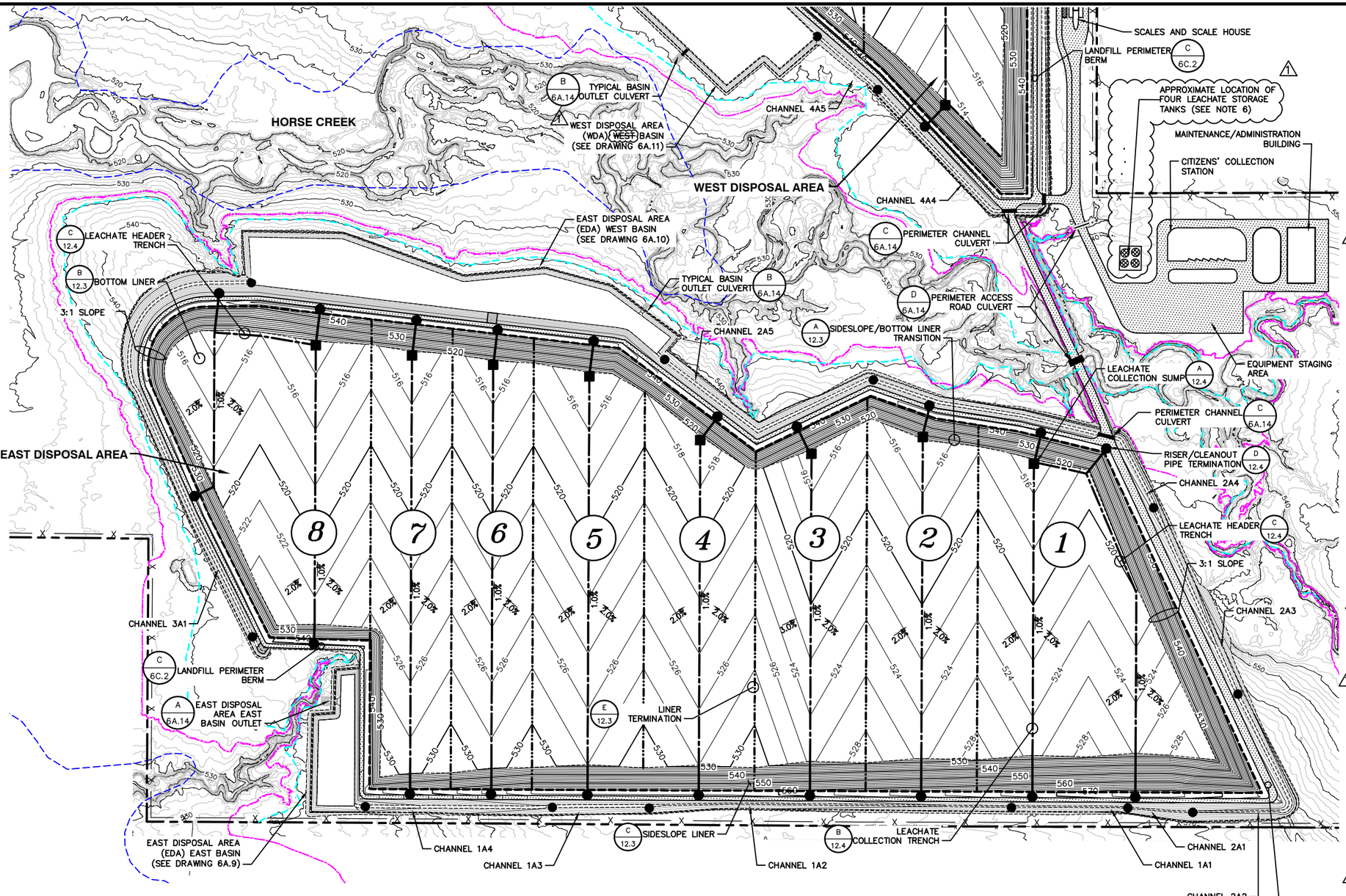
In the event a leachate or contaminated water spill occurs, these liquids will be treated as contaminated water and contained by either the tank secondary containment, construction of earthen berms, or placement of sorbent pads/socks, etc. surrounding the spill, and landfill personnel will implement the following spill response procedures:

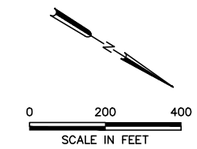
1. Immediately remove the leachate or contaminated water upon detection of the spill or leak by pumping the leachate or contaminated water to a secured tank.
2. The area subjected to the spill or leak will also be cleaned up by removing all soil or material showing any sign of contamination and disposed of at the working face of the landfill.
3. The resulting clean-up procedures will be documented in the Site Operating Record.

Additionally, potential spills and spill response efforts and cleanup, reporting, and recordkeeping related to the above-ground leachate storage tanks or any component of the leachate collection system will also be addressed in the Stormwater Pollution Prevention Plan (SWP3), which will be prepared and implemented prior to commencement of landfill operations. The SWP3 will be prepared consistent with the Texas Pollutant Discharge Elimination System (TPDES) General Permit TXR050000, including spill prevention and response measures, as required by Part III, Section A.4(e) 12D of the TPDES General Permit.

DRAWINGS

- Drawing 12.1: East Disposal Area - Leachate Collection System Layout Plan
- Drawing 12.2: West Disposal Area - Leachate Collection System Layout Plan
- Drawing 12.3: Bottom Liner Details
- Drawing 12.4: Leachate Collection System Details





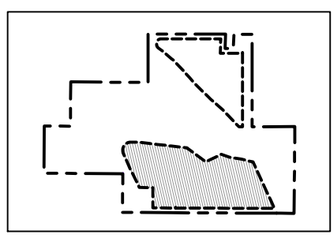
LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- 560 — EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100–YEAR FLOOD PLAIN (SEE NOTE 2)
- 100–YEAR STORM EVENT WATER SURFACE (SEE NOTE 5)
- X — PROPOSED/EXISTING PERIMETER FENCE (CHAIN LINK OR BARBED WIRE)
- ACCESS ROAD
- 520 — TOP OF PROTECTIVE COVER TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- LEACHATE COLLECTION SUMP
- LEACHATE COLLECTION PIPE
- TOE/TOP OF SLOPE
- CLEANOUT/SUMP RISER
- CHANNEL SECTION
- X — SECTOR DESIGNATION (SEE NOTE 4)
- 1 — SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
2. 100–YEAR FLOOD PLAIN IS DESIGNATED AS ZONE A, BASED ON FIRM PANEL 48293C0125C, DATED 09/16/11 (LIMESTONE COUNTY), AND FIRM PANEL 48309C0250D, DATED 12/20/19 (MCLENNAN COUNTY).
3. ELEVATIONS SHOWN ON THIS DRAWING WITHIN WASTE LIMITS ARE TOP OF PROTECTIVE COVER ELEVATIONS IN FEET MEAN SEA LEVEL (FT MSL).
4. SECTOR DEVELOPMENT SEQUENCE REPRESENTED BY NUMBERING. SECTORS MAY BE DEVELOPED IN SMALLER INCREMENTS (AKA SUBSECTORS OR CELLS) WITH LINER CERTIFICATIONS SUBMITTED SEPARATELY TO TCEQ FOR REVIEW. IF SECTORS ARE DEVELOPED AS SMALLER CELLS, THE DOWN–GRADIENT CELLS WITH LEACHATE COLLECTION SUMP WILL BE DEVELOPED FIRST.
5. 100–YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC–HMS AND HEC–RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.
6. APPROXIMATE LOCATION OF THE LEACHATE STORAGE TANKS DEPICTED REPRESENTS THE PERMANENT LEACHATE STORAGE TANKS LOCATION (OPTION 2). REQUIREMENTS RELATED TO THESE TANKS ARE DESCRIBED IN ATTACHMENT 12, SECTION 4. LOCATION OF LEACHATE STORAGE TANKS (OPTION 2) WILL BE MAINTAINED WITH A MINIMUM 125–FOOT BUFFER FROM THE PERMIT BOUNDARY.

1 ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.



KEY MAP

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, BASIN CALLOUT, LIMITS OF WASTE, LEACHATE COLLECTION TANKS, NOTES 2 AND 6.	RRK

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: EAST DISPOSAL AREA
LECAHTE COLLECTION SYSTEM LAYOUT PLAN

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

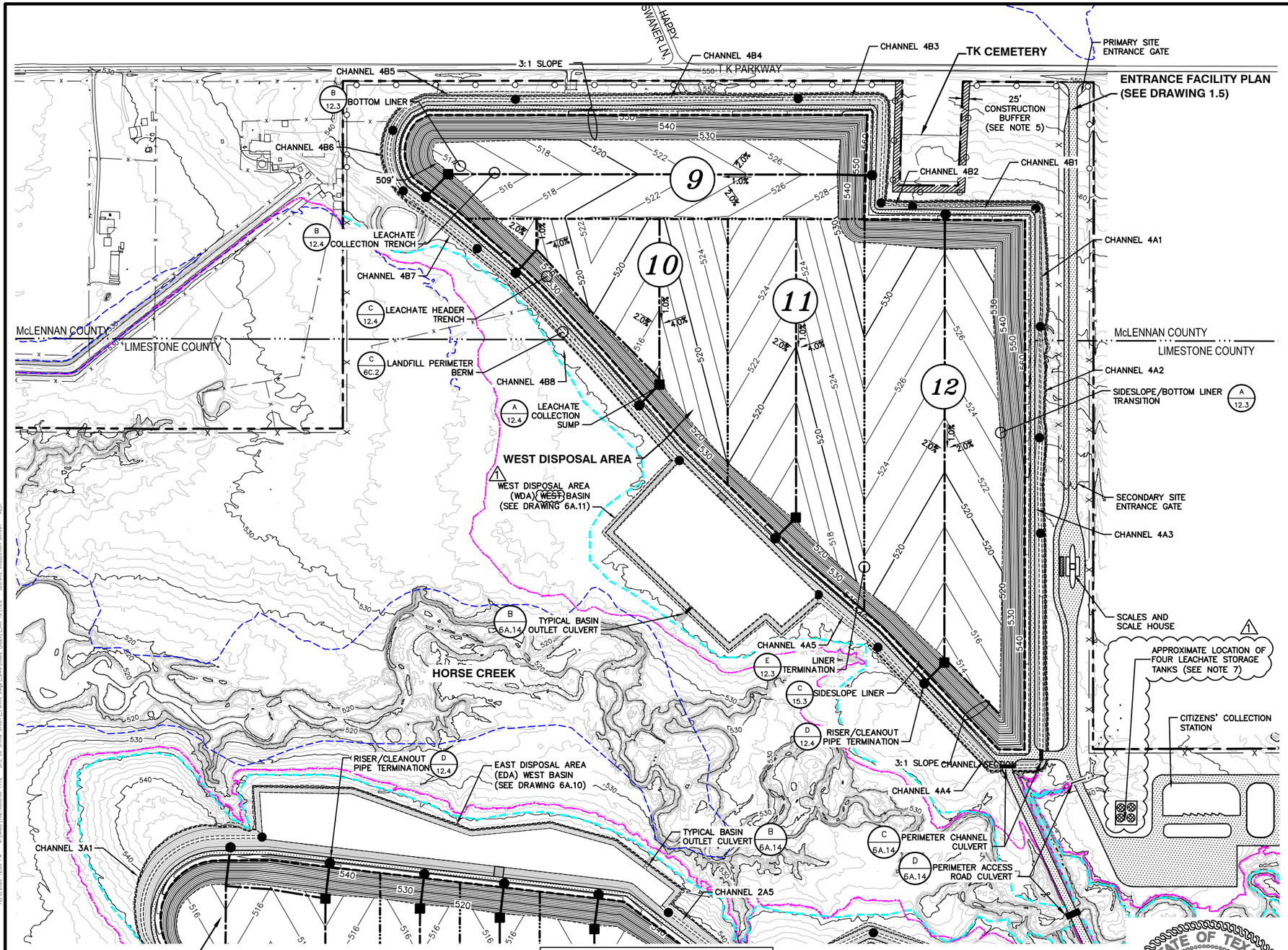
PROJ. NO. 16216088.00 | DSN. BY: BG/RRK | DWN. BY: NR | CHK. BY: RJD | Q/A RVW BY: RRK | APP. BY: RRK

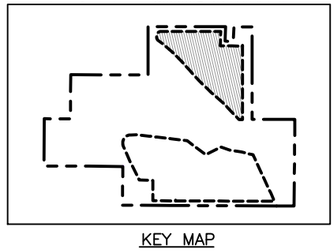
CADD FILE: 12.1 – LECHATE COLLECTION LAYOUT – EAST

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 12.1





KEY MAP

0 200 400
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- SECTOR BOUNDARY
- COUNTY LINE
- 560 — EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- 100-YEAR FLOOD PLAIN (SEE NOTE 2)
- 100-YEAR STORM EVENT WATER SURFACE (SEE NOTE 6)
- X — PROPOSED PERIMETER FENCE (CHAIN LINK)
- PROPOSED 8' PRIVACY FENCE
- ACCESS ROAD
- 520 — TOP OF PROTECTIVE COVER TOPOGRAPHIC CONTOURS (SEE NOTE 3)
- LEACHATE COLLECTION SUMP
- LEACHATE COLLECTION PIPE
- TOE/TOP OF SLOPE
- CLEANOUT/SUMP RISER
- CHANNEL SECTION
- X — SECTOR DESIGNATION (SEE NOTE 4)
- SURVEYED FLOWAGE EASEMENT (534.5' NGVD 29 CONTOUR)

NOTES:

1. THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS DEVELOPED BY DAS GEOSPATIAL FLOWN ON JULY 03, 2018.
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4. SECTOR DEVELOPMENT SEQUENCE REPRESENTED BY NUMBERING. SECTORS MAY BE DEVELOPED IN SMALLER INCREMENTS (AKA SUBSECTORS OR CELLS) WITH LINER CERTIFICATIONS SUBMITTED SEPARATELY TO TCEQ FOR REVIEW. IF SECTORS ARE DEVELOPED AS SMALLER CELLS, THE DOWN-GRADIENT CELLS WITH LEACHATE COLLECTION SUMP WILL BE DEVELOPED FIRST.
5. IN ACCORDANCE WITH "AN INTENSIVE CULTURAL RESOURCES SURVEY OF THE CITY OF WACO'S PROPOSED SITE 50 LANDFILL PROJECT," PREPARED BY HORIZON ENVIRONMENTAL SERVICES, INC., DATED NOVEMBER 2018 (SEE APPENDIX I/IIA), A 25-FOOT CONSTRUCTION BUFFER WILL BE MAINTAINED AROUND TK CEMETERY TO PROTECT ANY POTENTIAL UNMARKED GRAVES OUTSIDE THE PRESENT MODERN DAY CEMETERY BOUNDARIES AND FENCING.
6. 100-YEAR STORM EVENT WATER SURFACE WAS ESTIMATED USING HEC-HMS AND HEC-RAS MODELING AS DISCUSSED IN ATTACHMENT 6B OF THIS PERMIT APPLICATION.
7. APPROXIMATE LOCATION OF THE LEACHATE STORAGE TANKS DEPICTED REPRESENTS THE PERMANENT LEACHATE STORAGE TANKS LOCATION (OPTION 2). REQUIREMENTS RELATED TO THESE TANKS ARE DESCRIBED IN ATTACHMENT 12, SECTION 4. LOCATION OF LEACHATE STORAGE TANKS (OPTION 2) WILL BE MAINTAINED WITH A MINIMUM 125-FOOT BUFFER FROM THE PERMIT BOUNDARY.

ADJUSTED LIMITS OF WASTE ON EAST SIDE OF THE WDA AND EAST SIDE AND A PORTION OF THE SOUTH SIDE OF THE EDA TO AVOID ENCROACHMENT INTO FLOWAGE EASEMENT.

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/6/2020

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/2020	REVISIONS INCLUDE: FLOODPLAIN, FLOWAGE EASEMENT, BASIN CALLOUT, LIMITS OF WASTE, LEACHATE COLLECTION TANKS, NOTES 2 AND 7.	RRK

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: WEST DISPOSAL AREA
LECAHTE COLLECTION SYSTEM LAYOUT PLAN

PROJECT TITLE: CITY OF WACO LANDFILL
TYPE I MSW - PERMIT APPLICATION

CLIENT: CITY OF WACO
SOLID WASTE SERVICES

SCS ENGINEERS
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1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
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PROJ. NO. 16216088.00 | DSN. BY: BC/RRK | DWN. BY: NR | CHK. BY: BJD | Q/A RVW BY: RRK | APP. BY: RRK

CADD FILE: 12.2 - LECHATE COLLECTION LAYOUT - WEST

DATE: 04/2020

SCALE: AS SHOWN

DRAWING NO. 12.2

APPENDIX 12A

LEACHATE GENERATION MODEL (HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE (HELP) OUTPUT FILES)

- Leachate Generation Model Narrative
- Climatological Data
- Help Model Summary Sheets
- HELP Output Files (Without Leachate Recirculation)
- HELP Output Files (With Leachate Recirculation)

HELP MODEL SUMMARY SHEETS

SCS Engineers
TBPE Reg. # F-3407
Inclusive of pages 12A-14 to 12A-18

CITY OF WACO LANDFILL
HELP MODEL SUMMARY SHEET
(WITHOUT LEACHATE RECIRCULATION)

HELP MODEL INPUT PARAMETERS		ACTIVE (10' WASTE)	INTERIM (60' WASTE)	INTERIM (130' WASTE)	INTERIM (170' WASTE)	CLOSED (170' WASTE)
		CASE 1	CASE 2	CASE 3	CASE 4	CASE 5
PROTECTIVE COVER (Texture = 15)	Thickness (in)	24	24	24	24	24
	Porosity (vol/vol)	0.4750	0.4750	0.4750	0.4750	0.4750
	Field Capacity (vol/vol)	0.3780	0.3780	0.3780	0.3780	0.3780
	Wilting Point (vol/vol)	0.2650	0.2650	0.2650	0.2650	0.2650
	Hyd. Conductivity (cm/s)	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05
LEACHATE COLLECTION (Texture = 0)	Thickness (in)	0.24	0.22	0.20	0.19	0.19
	Porosity (vol/vol)	0.8500	0.8500	0.8500	0.8500	0.8500
	Field Capacity (vol/vol)	0.0100	0.0100	0.0100	0.0100	0.0100
	Wilting Point (vol/vol)	0.0050	0.0050	0.0050	0.0050	0.0050
	Hyd. Conductivity (cm/s)	10.00	7.80	4.80	3.00	3.00
	Slope (%)	2.0	2.0	2.0	2.0	2.0
	Slope Length (ft)	340	340	340	340	340
FLEXIBLE MEMBRANE LINER (Texture = 35)	Thickness (in)	0.06	0.06	0.06	0.06	0.06
	Hyd. Conductivity (cm/s)	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13
	Pinhole Density (holes/acre)	1	1	1	1	1
	Install. Defects (holes/acre)	4	4	4	4	4
	Placement Quality	GOOD	GOOD	GOOD	GOOD	GOOD
COMPACTED CLAY LINER (Texture =16)	Thickness (in)	24	24	24	24	24
	Porosity (vol/vol)	0.4270	0.4270	0.4270	0.4270	0.4270
	Field Capacity (vol/vol)	0.4180	0.4180	0.4180	0.4180	0.4180
	Wilting Point (vol/vol)	0.3670	0.3670	0.3670	0.3670	0.3670
	Hyd. Conductivity (cm/s)	1.0E-07	1.0E-07	1.0E-07	1.0E-07	1.0E-07
PRECIPITATION	Average Annual (in)	30.95	31.90	31.90	31.90	31.90
RUNOFF	Average Annual (in)	0.00	7.15	6.46	4.10	4.87
EVAPOTRANSPIRATION	Average Annual (in)	19.18	22.43	22.87	23.67	26.89
LATERAL DRAINAGE (LCS)	Average Annual (cf/year)	43,183	8,419	9,306	15,085	538
LATERAL DRAINAGE (LCS)	Average Annual (cf/day)	118.3	23.1	25.5	41.3	1.5
LATERAL DRAINAGE (LCS)	Peak daily (cf/day)	844	583	304	289	6
HEAD ON LINER	Average daily (in)	0.070	0.062	0.052	0.080	0.002
HEAD ON LINER	Peak daily (in)	0.138	0.123	0.105	0.159	0.014

CITY OF WACO LANDFILL
HELP MODEL SUMMARY SHEET
(WITH LEACHATE RECIRCULATION)

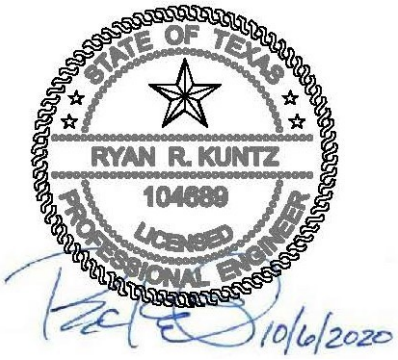
HELP MODEL INPUT PARAMETERS		ACTIVE (10' WASTE)	INTERIM (60' WASTE)	INTERIM (130' WASTE)	INTERIM (170' WASTE)
		CASE 1- RECIRCULATION	CASE 2- RECIRCULATION	CASE 3- RECIRCULATION	CASE 4- RECIRCULATION
FLEXIBLE	Thickness (in)	0.06	0.06	0.06	0.06
MEMBRANE	Hyd. Conductivity (cm/s)	2.0E-13	2.0E-13	2.0E-13	2.0E-13
LINER	Pinhole Density (holes/acre)	1	1	1	1
(Texture = 35)	Install. Defects (holes/acre)	4	4	4	4
	Placement Quality	GOOD	GOOD	GOOD	GOOD
COMPACTED	Thickness (in)	24	24	24	24
CLAY LINER	Porosity (vol/vol)	0.4270	0.4270	0.4270	0.4270
(Texture =16)	Field Capacity (vol/vol)	0.4180	0.4180	0.4180	0.4180
	Init. Moisture Content (vol/vol)	0.4270	0.4270	0.4270	0.4270
	Hyd. Conductivity (cm/s)	1.0E-07	1.0E-07	1.0E-07	1.0E-07
PRECIPITATION	Average Annual (in)	30.95	31.90	31.90	31.90
RUNOFF	Average Annual (in)	0.00	7.15	6.46	4.10
EVAPOTRANSPIRATION	Average Annual (in)	19.18	22.43	22.87	23.67
LATERAL DRAINAGE (LCS)	Average Annual (cf/year)	43,189	7,738	8,340	14,373
LATERAL DRAINAGE (LCS)	Average Annual (cf/day)	118.3	21.2	22.8	39.4
LATERAL DRAINAGE (LCS)	Peak daily (cf/day)	461	60	64	122
LEACHATE RECIRCULATION	Average Annual (cf/day)	80,207	69,639	47,259	26,692
LEACHATE RECIRCULATION	Peak daily (cf/day)	856	540	365	226
HEAD ON LINER	Average daily (in)	0.109	0.064	0.074	0.096
HEAD ON LINER	Peak daily (in)	0.215	0.126	0.147	0.189

CITY OF WACO LANDFILL
TCEQ PERMIT NO. MSW-2400
McLENNAN AND LIMESTONE COUNTIES, TEXAS

PART IV
SITE OPERATING PLAN

Prepared for:

CITY OF WACO



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Revision 0 - April 2020
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TABLE OF CONTENTS

SECTION **PAGE**

LIST OF ACRONYMS iv
1 INTRODUCTION IV-1-1
2 PERSONNEL AND TRAINING [30 TAC §330.127(1) and (4)] IV-2-1
2.1 PERSONNEL IV-2-1
2.2 TRAINING IV-2-4
3 EQUIPMENT [30 TAC §330.127(2)] IV-3-1
4 OPERATIONAL PROCEDURES IV-4-1
4.1 ACCESS CONTROL (30 TAC §330.131) IV-4-1
4.2 UNLOADING WASTES (30 TAC §330.133) IV-4-3
4.3 FACILITY OPERATION HOURS (30 TAC §330.135) IV-4-5
4.4 SITE SIGNS (30 TAC §330.137) IV-4-6
4.5 CONTROL OF WINDBLOWN WASTES AND LITTER (30 TAC §330.139) IV-4-6
4.6 EASEMENTS AND BUFFER ZONES (30 TAC §330.141) IV-4-7
4.7 LANDFILL MARKERS AND BENCHMARK (30 TAC §330.143) IV-4-8
4.8 CONTROL OF WASTE SPILLED EN ROUTE TO THE SITE (30 TAC §330.145) IV-4-9
4.9 DISPOSAL OF LARGE ITEMS (30 TAC §330.147) IV-4-9
4.10 AIR QUALITY CONTROL AND ODOR MANAGEMENT PLAN (30 TAC §330.149) IV-4-10
4.11 DISEASE VECTOR CONTROL (30 TAC §330.151) IV-4-12
4.12 MAINTENANCE OF SITE ACCESS ROADS (30 TAC §330.153) IV-4-12
4.13 SALVAGING AND SCAVENGING (30 TAC §330.155) IV-4-13
4.14 ENDANGERED SPECIES PROTECTION (30 TAC §330.157) IV-4-13
4.15 LANDFILL GAS MANAGEMENT (30 TAC §330.159) IV-4-13
4.16 TREATMENT OF ABANDONED OIL, GAS, AND WATER WELLS (30 TAC §330.161) IV-4-13
4.17 COMPACTION OF SOLID WASTE (30 TAC §330.163) IV-4-14
4.18 SOIL MANAGEMENT: PLACEMENT, AND COMPACTION OF DAILY, INTERMEDIATE, AND FINAL COVER (30 TAC §330.165) IV-4-14
4.19 PREVENTION OF PONDED WATER (30 TAC §330.167) IV-4-17
4.20 DISPOSAL OF SPECIAL WASTES (30 TAC §330.171) IV-4-17
4.21 VISUAL SCREENING OF DEPOSITED WASTE (30 TAC §330.175) IV-4-21
4.22 LEACHATE AND GAS CONDENSATE RECIRCULATION (30 TAC §330.177) IV-4-21
5 DETECTION AND PREVENTION OF DISPOSAL OF UNAUTHORIZED WASTES [30 TAC §330.127(5)] IV-5-1
5.1 GENERAL IV-5-1
5.2 LOAD INSPECTION PROCEDURE IV-5-2
5.3 RECORDKEEPING IV-5-3

SCS Engineers
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10/6/2020

5.4 TRAINING IV-5-4
5.5 MANAGING UNAUTHORIZED WASTES IV-5-4
6 FIRE PROTECTION PLAN (30 TAC §330.129) IV-6-1
6.1 FIRE PREVENTION PROCEDURES IV-6-1
6.2 GENERAL RULES FOR FIRES IV-6-2
6.3 SPECIFIC FIRE-FIGHTING PROCEDURES IV-6-3
7 RECORDKEEPING REQUIREMENTS (30 TAC §330.125) IV-7-1
7.1 SITE OPERATING RECORD (§330.125(b)) IV-7-1
7.2 ANNUAL WASTE ACCEPTANCE RATE [30 TAC §330.125(h)] IV-7-4
7.3 SLER/GLER SUBMITTALS (30 TAC §330.123) IV-7-5

Figures

IV2.1 Organizational Chart

Tables

IV2.1 Minimum Number of Personnel
IV2.2 Personnel Training Requirements
IV3.1 Equipment
IV4.1 Site Inspection and Maintenance Schedule
IV7.1 Recordkeeping Requirements

SCS Engineers
TBPE Reg. # F-3407

will be located as close as practical to the active area to control windblown waste and litter.

- Perimeter fencing, as described in Section 4.1.1.

- As part of the overall site maintenance program, facility personnel will collect daily the windblown waste materials that may have accumulated throughout the entire site, including but not limited to, fences and gates, onsite access roads and drainage channels throughout the site on days when the facility is in operation.

- Facility personnel will inspect public-access roads within two miles in either direction from the landfill entrance for waste spilled in route to the landfill on each day of operation, as described in Section 4.8 of this SOP.

All collected litter will be taken daily to the working face of the landfill for disposal.

4.6 EASEMENTS AND BUFFER ZONES (30 TAC §330.141)

4.6.1 Easements

In accordance with 30 TAC §330.141, solid waste unloading, storage, disposal, or facility operations will not occur within any easement or right-of-way that crosses the site. All easements will be clearly marked as specified in Section 4.7 of this SOP. At the time of landfill development or cell construction, the waste disposal footprint will be located at least 25-feet from the centerline of any utility and pipeline easement, but no closer than the easement boundary, consistent with 30 TAC §330.543(a). All pipeline and utility easements shall be clearly marked with posts that extend at least six feet above ground level, spaced at intervals no greater than 300 feet. No solid waste unloading, storage, disposal, or processing operations will occur within any easement or right-of-way that crosses the facility, unless and until the easement has been abandoned or relocated.

There are ~~four~~ three (~~4~~3) known easements on the landfill property, including a ~~fiber optic,~~ flowage, waterline, and electric line easement, as described in Parts I/II, Section 3 and shown on the metes and bound survey in Parts I/II, Section 14 of permit application.

4.6.2 Buffer Zones

The buffer zone for the waste disposal areas is generally located between the permit boundary and the limits of waste. No solid waste unloading, storage, disposal, or processing operations will occur within the buffer zone. However, perimeter drainage channels, detention basins, and onsite access roads may be installed within the buffer zone between the permit boundary and the limits of waste. Buffer zones may vary around the perimeter of the landfill, but in no case are they less than 125 feet in width. Access roads will be constructed within the buffer zones to allow the safe passage of fire-fighting and other emergency equipment.

Additionally, in accordance with "An Intensive Cultural Resources Survey of the City of Waco's Proposed Site 50 Landfill Property," prepared by Horizon Environmental Services, Inc., dated

November 2018 (see Appendix I/IIA), a 25-foot construction buffer will be maintained around TK Cemetery to protect any potential unmarked graves outside the present modern day cemetery boundaries and fencing. This construction buffer is depicted on Drawing I/II-5 and other site layout drawings contained in Part III – Site Development Plan.

Buffer zones will be clearly marked as specified in Section 4.7 of this SOP.

4.7 LANDFILL MARKERS AND BENCHMARK (30 TAC §330.143)

Landfill markers will be installed to clearly mark significant features~~ and visibility will be maintained~~ as described in 30 TAC §330.143(b). The Owner acknowledges that the executive director may modify specific marker requirements to accommodate unique site-specific conditions. The Owner will maintain visibility of all required landfill markers and benchmark prior to closure of the landfill.

The markers will be steel or wooden posts (or other TCEQ approved material) and will extend at least six feet above the ground surface. The markers will not be obscured by vegetation and will be placed in sufficient numbers to clearly show the required boundaries. Landfill markers will be inspected monthly and will be maintained and repaired as necessary. Markers that are removed, destroyed, or otherwise fail to meet regulatory requirements will be replaced within 15 days of discovering their deficiency. Refer to Table 4.1 of this SOP for site inspection and maintenance schedule. Documentation of inspections and maintenance will be maintained in the Site Operating Record of the landfill. Markers will be repainted as needed to retain visibility. Guidelines for type, placement, and color coding of markers are outlined below.

- Site Boundary - Site boundary markers will be painted black. The markers will be placed at each corner of the site and along each boundary line at intervals no greater than 300 feet. Fencing may be placed between these markers as required. In areas where the fence is located on the permit boundary, the fence posts may be painted black and used as site boundary markers.

- Buffer Zone - Buffer zone markers will be painted yellow. The markers will be placed along each buffer zone boundary at intervals of 300 feet. The buffer zones will be a minimum of 125 feet wide from the landfill permit boundary.

- Easements and Rights-of-Way - Easement and right-of-way markers will be painted green. The markers will be placed along the centerline of an easement and along the boundary of a right-of-way, at each corner within the site, and at the intersection of the permit boundary. Where it is impractical to place a marker, the marker will be offset from the easement right-of-way and the offset distance will be clearly painted on the marker.

- Landfill Grid System - Grid markers will be painted white. Markers will be spaced no greater than 100 feet apart measured along perpendicular lines. Where feasible, intermediate markers will be installed where markers cannot be seen from opposite boundaries. At a minimum, grid markers will delineate the area expected to receive

waste within the next 3 years. The grid markers will be maintained during the active life of the site, and throughout the post-closure period, as necessary.

- SLER/GLER Area – Soil liner evaluation report/geomembrane liner evaluation report (SLER/GLER) markers will be painted red. The markers will be placed so that all areas for which a SLER/GLER has been submitted are readily determinable. Such markers are to provide site workers immediate knowledge of the extent of approved disposal areas. These markers will be located and protected so that they are not destroyed during operations until operations extend into the next SLER/GLER area. The location of these markers will be tied into the landfill grid system and will be reported on each SLER/GLER submitted. SLER/GLER markers will not be placed inside the constructed areas.

- 100-Year Floodplain –100-Year floodplain protection markers will be painted blue. The markers will be installed for any area within the 100-year floodplain as delineated by FEMA. The area subject to flooding, including the 100-year storm event water surface boundary as defined in Attachment 6B, will be clearly marked by means of permanent post not more than 300 feet apart or closer if necessary to retain visual continuity.

The site will maintain at least one permanent benchmark at the site in an area readily accessible and will not be used for disposal. The benchmark(s) will be a bronze survey marker, stamped with the elevation and survey date and set in concrete. The benchmark elevation will be surveyed from a known US Coast and Geodetic survey benchmark or other reliable source.

4.8 CONTROL OF WASTE SPILLED EN ROUTE TO THE SITE (30 TAC §330.145)

The Landfill Manager or designee will take steps to assure that vehicles hauling waste to the site are enclosed or provided with a tarpaulin, net, or other means to effectively secure the load. The steps taken by the Owner will include, as necessary, the posting of signs requiring the loads to be covered, refusing acceptance of uncovered loads, reporting offenders to the police, adding disposal surcharges, or other necessary means.

On a daily basis when the landfill is in operation, landfill personnel will inspect SH 31 and FM 939 for spilled waste for a distance of two miles in either direction from the landfill entrance used for the delivery of waste to the landfill. If spilled waste is found on these public-access roads within 2 miles from the landfill, such waste will be cleaned up by landfill personnel and delivered to the landfill, assuming such waste is suitable for disposal at the landfill. The Landfill Manager or designee will consult with Texas Department of Transportation (TxDOT) officials and McLennan and Limestone Counties concerning cleanup of these public-access roads consistent with 30 TAC §330.145. Cleanup of these public-access roads will include cleanup of the respective rights-of-way as well.

4.9 DISPOSAL OF LARGE ITEMS (30 TAC §330.147)

A large item/white goods storage area will be provided at the CCS or other alternative location designated as the "large item salvage area." Alternatively, large item/white goods will be

diverted from the waste stream at the active working face, and routinely relocated to the storage area. Items that can be classified as large, heavy or bulky can include, but are not limited to, white goods (household appliances), air conditioner units, metal tanks, large metal pieces and automobiles. These items will be recycled as demand warrants but will not be stored in excess of 180 days. Large items that are not recycled will be disposed of at the working face. Care will be taken during disposal of large items such that: (1) large items are excluded from the initial 5 feet of waste over the liner protective cover, (2) large items are placed such that they do not interfere with continued waste filling, and (3) other, smaller municipal solid waste is placed and compacted around them.

The Owner will properly manage chlorinated fluorocarbon (CFC) refrigerant from refrigerators, freezers, air conditioning units, or other items in accordance with 40 CFR §82.156(f). CFCs will be evacuated from refrigerators, freezers, or air conditioners by a third-party vendor, or landfill personnel certified to perform this activity, prior to landfilling or recycling the units at an offsite facility. Electrical equipment, which contain PCBs, will not be accepted, as provided in Section 5.

4.10 AIR QUALITY CONTROL AND ODOR MANAGEMENT PLAN (30 TAC §330.149)

4.10.1 Air Quality

Municipal solid waste landfills are subject to TCEQ regulations concerning burning and air pollution control. The following procedures will be implemented at the landfill for control of air pollution:

- Open burning of waste will not be permitted at the facility.
- Control of dust emissions (i.e. particulate matter control) from onsite access roads, as described in Section 4.12.
- Obtaining coverage under and complying with either the Standard Air Permit in 30 TAC Subchapter U or an individual air permit.
- For the mulching operation obtaining coverage under and complying with the air quality standard permit in 30 TAC §332.8. In accordance with §332.8(b), mulching operations will be performed as follows in order to comply with the air quality standard permit:
    - The setback distance from the property boundary for brush, untreated wood waste, yard waste, or mulch will 50 feet.
    - Except for initial start-up and shut-down, the receiving chamber on all grinders will be adequately filled prior to commencement of grinding. The receiving chambers will also remain full during grinding operations to minimize emissions from the grinder or wood chipper. In addition, the Owner will have portable watering equipment available during the grinding operations.

- All conveyors which off-load materials from grinders will have available a water or mechanical dust suppression system.
- These controls will be utilized, as necessary, for maximum control of dust when stockpiling ground material.

- Implementation of an Odor Management Plan.
- Investigation of visible air emissions and implementation of controls as necessary.

4.10.2 Odor Management Plan

An Odor Management Plan will be implemented at the landfill and will include, but is not limited to, the following procedures:

- Incoming waste will be promptly landfilled.
- Identification of waste that require special attention, including septage, grease trap waste, dead animals, and leachate, and immediately cover and compact with daily cover or other waste.
- Identification of loads with significant odors by the Gate Attendant, and notification to the working face personnel. In the event waste is identified at the CCS with significant odors, landfill personnel will remove the roll-off from the CCS, and dispose of said waste at the working face.
- Freshly landfilled waste will be promptly covered with daily cover at the end of each operating day.
- Keeping the size of the working face to a minimum so waste can be covered quickly.
- Ponded water at the site will be controlled as detailed in Section 4.19 of this SOP.
- Damage or erosion of daily, intermediate, or final cover will be repaired within 5 days of detection (weather permitting) consistent with Section 4.18.5.
- Regular inspection of vapor-tight gaskets on leachate riser end caps. Damaged or deficient gaskets will be repaired, as soon as practicable following the inspection.
- Leachate will be disposed and handled as described in Attachment 12 – Leachate and Contaminated Water Plan.
- Control of landfill gas emissions as detailed in the Landfill Gas Management Plan.
- Clean up spills of odorous materials as soon as possible.

- Accidental fires will be controlled as outlined in Section 6 of this SOP.

4.11 DISEASE VECTOR CONTROL (30 TAC §330.151)

The need for vector control (control of rodents, flies, mosquitoes, etc.) will be minimized through proper daily site operations, which include the application of daily and intermediate cover. The extent of the working face will also be minimized, as described in Section 4.2.1. Landfill personnel will make weekly checks for insects and rodents and will report problems to the Landfill Manager or designee. Based on the results of the inspections, a licensed professional may apply pesticides or rodenticides to enhance vector control. Care will be taken to ensure that proper chemicals are used and that they are properly applied.

In addition, if birds become a nuisance at the landfill, pyrotechnics or other similar techniques may be used to manage the bird population at the landfill.

4.12 MAINTENANCE OF SITE ACCESS ROADS (30 TAC §330.153)

The site entrance road will be an asphalt or concrete paved roadway, or other suitable material that transitions into onsite access roads, including perimeter and interior haul roads. The landfill access roads (i.e., perimeter and other constructed interior haul roads) will be constructed of crushed stone, gravel, caliche, concrete paving, asphalt paving, or other suitable material and maintained in a clean and safe condition. All-weather landfill access roads will be maintained for access from the public roadway to the waste disposal area(s) and CCS during wet-weather operation. In addition to the all-weather roads, some portions of the onsite roads will be maintained for use during dry weather only.

The all-weather entrance road will be maintained in a manner to limit tracking of mud and associated debris onto FM 939. If mud and/or associated debris is tracked onto FM 939 at the landfill entrance, it will be removed at least once per day on days when mud and associated debris are being tracked onto FM 939. Mud and associated debris that has accumulated at the landfill entrance and this section of FM 939 will removed using a motor grader or other suitable equipment capable of removing the mud and debris accumulations.

Dust will be controlled on the onsite access roads by periodic spraying from a water truck or other means as-needed during periods of significantly dry weather. Dust from onsite access roads will not become a nuisance to surrounding areas. A water source and necessary equipment or other means of dust control approved by the TCEQ will be provided.

Grading equipment will be used, as necessary, to control or remove mud accumulations on onsite access roads. All onsite access roads will be inspected for damage due to traffic or erosion following significant rainfall events. In any instance, the minimum inspection frequency of the site access roads will be monthly. Crushed stone, concrete rubble, masonry demolition debris, or other similar material will be delivered to the site on an as-needed basis for use in maintaining passable onsite access roads during wet weather. All onsite access roads will be maintained in a clean and safe condition. Site access roads will be regraded on an as-needed basis, to minimize depressions, ruts and potholes. Refer to Table 4.1 of this SOP for the site inspection and maintenance schedule.

The date of detection of erosion and date of completion of repairs, including justification of delays, will be documented in the Cover Application Log. Cover inspections will be conducted throughout the operational life of the landfill and post-closure care period.

4.18.6 Cover Application Log

Throughout the landfill operation, a cover application log will be maintained and be readily available for inspection in accordance with 30 TAC §330.165(h). For daily cover and intermediate cover, the log will specify the area covered (by use of the grid system), how it was placed, and when it was completed. For final cover, the log will show the final cover area and refer to the final cover certification report for each area. Each entry will be certified by the signature of the Landfill Manager or designee that the work was accomplished as stated in the log. Repairs will be documented in the appropriate cover log, including inspections for erosion, the findings, and the action taken.

4.19 PREVENTION OF PONDED WATER (30 TAC §330.167)

The prevention of ponding water is necessary to control infiltration of water into the waste. Additionally, ponded water can be a source of odor and breeding grounds for vectors. This ponding water prevention plan to be implemented at the facility includes, but is not limited to, the following procedures:

Preventative Actions:

- Inspections of the landfill cover, consist with Section 4.18 of this SOP, following periods of wet weather, to identify potential ponding locations.
- Routine site grading and maintenance to provide drainage and minimize the ponding of water over areas containing waste.

Corrective Actions:

- Should ponding occur, the water will be removed and the depressions filled within seven days of detection.
- If the ponded water has come into contact with waste, leachate, or waste-contaminated soils, it will be treated as contaminated water and handled in accordance with Attachment 12 - Leachate and Contaminated Water Management Plan.

4.20 DISPOSAL OF SPECIAL WASTES (30 TAC §330.171)

Acceptance of special wastes, as defined in 30 TAC §330.3(148), will be performed in accordance with 30 TAC §330.171. The acceptance of a special waste not specifically identified in 30 TAC §330.171(c) and 30 TAC §330.171(d) requires prior written approval from the TCEQ. In accordance with §330.171(b), the following applies for special waste acceptance and disposal:

- Approvals will be waste-specific and/or site-specific and will be granted only to appropriate facilities operating in compliance with 30 TAC §330.

- Requests for approval to accept special wastes must be submitted by the generator to the executive director or to a facility with an approved acceptance plan and must include, but are not limited to, the following:

    - A complete description of the chemical and physical characteristics of each waste, a statement as to whether or not each waste is a Class 1 industrial waste as defined in §330.3 of this title, and the quantity and rate at which each waste is produced and/or the expected frequency of disposal;

    - An operational plan containing the proposed procedures for handling each waste and listing required protective equipment for operating personnel and on-site emergency equipment; and

    - A contingency plan outlining responsibility for containment and cleanup of any accidental spills occurring during the delivery and/or disposal operation.

- The executive director may authorize the receipt of special waste with a written concurrence from the Owner or Operator; however, the facility operator is not required to accept the waste.

- The executive director may revoke an authorization to accept special waste if the Owner or Operator does not maintain compliance with these rules or conditions imposed in the authorization to accept special waste.

The special wastes that will be accepted at the site are discussed in the following subsections.

4.20.1 Dead Animals and Slaughterhouse Waste

Dead animals and slaughterhouse wastes will be accepted at the landfill (including, but not limited to, hatchery waste, turkey eggs, chicken eggs, etc.) that are delivered to the site independent of other wastes. Dead animals and slaughterhouse wastes will be buried and covered with a minimum of 3 feet of other solid waste or a minimum of 2 feet of earthen material immediately upon receipt.

4.20.2 Regulated asbestos-containing material (RACM)

RACM as defined in 40 Code of Federal Regulations §61 may be accepted at the landfill. Prior to the receipt of RACM, the Landfill Manager or designee will dedicate a specific area or areas of the landfill that will receive RACM and will provide written notification to the TCEQ of the area or areas to be designated for receipt of RACM. After the initial authorization to receive RACM is issued, additional areas may be designated by providing written notice to the TCEQ of the location of the additional areas. The Landfill Manager will maintain the following records in the Site Operation Record related to disposal of RACM:

- The location of the area(s) designated to receive RACM must be surveyed and marked by a registered professional land surveyor and identified on a current site diagram. A copy of the current site diagram identifying the RACM area(s) will be submitted to the TCEQ immediately upon completion of the diagram.

- Each load of RACM that arrives on landfill will be documented. This documentation will include the volume of material, and the location and depth of its disposal.

- Delivery of RACM will be coordinated with the Landfill manager or his designee so that the RACM will arrive during times that it can be properly managed by landfill personnel.

- RACM will only be accepted at the landfill in tightly closed and unruptured containers or bags or will be wrapped with at least six-mil polyethylene.

- At a minimum, RACM will only be placed 20 feet or more inside (below) the final sideslope grades, and 10 feet or more below the topslope final grades.

- Bags of RACM will be carefully unloaded and placed in the disposal location. The bags will be promptly covered with 12 inches of clean soil or 3 feet of MSW containing no asbestos. Care will be taken that the bags are not ruptured.

- Upon closure of the landfill, a notation indicating that the landfill accepted RACM will be placed in the deed record. This notation will indicate where the RACM was disposed of on the property by showing its location on a site diagram. A copy of this documentation will be provided to the TCEQ.

- In the event RACM is spilled prior to proper disposal, the following procedures will be followed by the landfill personnel:

    - The Landfill Manager or his designee will immediately be notified of the spill.

    - The manifested owner of the RACM will be notified of the spill, and a request for trained personnel from the RACM owner will be made to assist in the cleanup, if appropriate.

    - A landfill employee trained in asbestos handling and disposal processes will lead the cleanup of the spilled RACM.

    - The RACM will be sprayed with water or other appropriate dust suppressant so that dust or windblown RACM is not generated. Spraying will be sufficient to control dust, without washing the spilled RACM away from the cleanup area.

    - Once dust has been suppressed, the RACM will be collected by shovel or scrapped into a front-end loader and transported to the disposal area. Care will be taken that all of the RACM is removed from the spill area.

- If the quantity of spilled RACM is too large for landfill personnel to address, landfill personnel will immediately contact a licensed RACM abatement company, so that the RACM can be contained by persons trained in RACM cleanup.

4.20.3 Nonregulated asbestos-containing material (non-RACM)

Nonregulated asbestos-containing materials (non-RACM) may be accepted for disposal at this landfill provided the wastes are placed on the active working face and covered in accordance with 30 TAC 330.171(c)(4). Under no circumstances may any material containing non-RACM be placed on any surface or roadway that is subject to vehicular traffic or disposed of by any other means by which the material could be crumbled into a friable state.

4.20.4 Empty Containers

Empty containers which have been used for pesticides, herbicides, fungicides, or rodenticides will be disposed at the site in accordance with the following:

- The containers are tripled rinsed prior to receipt at the landfill.
- The containers are rendered unusable prior to or upon receipt at the landfill.
- The containers are covered by the end of the same working day they are received.

Containers for which triple-rinsing is not feasible or practical (e.g., paper bags, cardboard containers) may be disposed at the landfill consistent with the provisions of Section 4.20.5.

4.20.5 Municipal Hazardous Waste from Conditionally Exempt Generators

Municipal hazardous waste from a conditionally exempt small quantity generator (CESQG) may be accepted at the landfill without further approval from the TCEQ provided the amount of waste does not exceed 220 pounds per month per generator, and provided the landfill owner or operator authorizes acceptance of the waste.

4.20.6 Sludge, Grease Trap, Grit Trap, or Municipal Liquid Wastes

Sludge, grease trap waste, grit trap waste, or liquid wastes from municipal sources will be accepted at the landfill for disposal only if the waste has been treated or processed and the treated/processed material has been tested, in accordance with Test Method 9095 (Paint Filter Liquids Test), as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (EPA Publication Number SW 846), as amended, and is certified to contain no free liquids.

4.20.7 Used Oil Filters

Used oil filters (to include filters that have been crushed and/or processed to remove free-flowing used oil) from non-household generators will not be accepted at the landfill. However, used oil

filters from internal combustion engines from household generators may be accepted at the landfill if the filter has been:

- Crushed to less than 20% of its original volume to remove all free-flowing used oil.
- Processed by a method other than crushing to remove all free-flowing used oil. A filter is considered to have been processed if:

  (i) the filter has been separated into component parts and the free-flowing used oil has been removed from the filter element by some means of compression in order to remove free-flowing used oil;

  (ii) the used filter element of a filter consisting of a replaceable filtration element in a reusable or permanent housing has been removed from the housing and pressed to remove free-flowing used oil; or

  (iii) the housing is punctured and the filter is drained for at least 24 hours.

4.21 VISUAL SCREENING OF DEPOSITED WASTE (30 TAC §330.175)

Methods for visually screening the working face and deposited waste include, but are not limited to, the following items consistent with 30 TAC §330.175:

- Orienting the working face away from FM 939, as feasible, and confining the working face to a minimum area, as described Section 4.2.1.
- Covering the working face daily with daily cover, and applying intermediate and final cover to the landfill, including applying vegetation to intermediate and final cover, as described in Section 4.18.
- Developing the aerial fill portion of the landfill from the exterior to the interior when warranted (i.e., by constructing landfill sideslopes prior to filling operations in the interior of the landfill).
- Providing an 8-foot privacy fence along the western permit boundary adjacent and parallel to FM 939, as depicted in Part III, Drawing 1.2.
- Maintaining existing trees and other vegetation near the landfill permit boundary that are adjacent to FM 939 to the extent practical for landfill development.

4.22 LEACHATE AND GAS CONDENSATE RECIRCULATION (30 TAC §330.177)

The Landfill Manager may recirculate leachate or gas condensate derived from the landfill into the areas of the landfill that have a leachate collection system and composite liner, as defined in 30 TAC §330.331(a)(2).

As described in Attachment 12 – Leachate and Contaminated Water Management Plan, leachate and/or gas condensate will be either recirculated back to the landfill or disposed at a local wastewater treatment plant (WWTP) permitted by the TCEQ. Recirculation may be performed by either injecting through vertical or horizontal pipes in the waste, or spraying leachate or gas condensate water onto the working face at the allowable annual rates per acre, as described in Attachment 12. Procedures for recirculating leachate or gas condensate are described in Attachment 12, Section 5. Consistent with §330.125(b)(4), the Landfill Manager will maintain records of the date, time, volume, and location (i.e., landfill unit or sector) that leachate or gas condensate is recirculated back into the landfill.

Table 4.1 Site Inspection and Maintenance Schedule

ITEM	TASK	SCHEDULE
Fence/Gates	Inspect perimeter fence and gates for damage, gaps, intrusions and the like. Make temporary repairs within 24-hours of detection (weather permitting) and permanent repairs within the timeframe approved by the TCEQ region office.	Monthly
Windblown Waste	Inspect working fence area, wind fences, access roads, entrance area, and perimeter fence for loose trash. Clean up upon detection.	Daily
Waste Spilled en Route to the Site	Inspect portions of SH 31 and FM 939 which are used for waste delivery at least two miles in either direction of the landfill entrance. Clean up upon detection.	Daily
Landfill Markers	Inspect all landfill markers for damage, color coding, and general location. Correct or replace damaged markers within 15 days of detection.	Monthly
Landfill Access Roads	Inspect landfill access roads for damage from vehicle traffic and erosion. Repair onsite access roads, as needed, based on inspections. Inspect FM 939 and landfill entrance for excessive mud and/or debris accumulation. Remove mud/debris accumulations daily using grading equipment or other road cleaning equipment.	Monthly Daily (Wet Weather) Weekly (Otherwise)
Daily Cover	Inspect for proper placement thickness, and compaction. Remedy deficiencies as needed.	Daily (Active) Weekly (Inactive)
Intermediate Cover	Inspect for proper placement, thickness, erosion, vegetation, compaction and for presence of waste or other contamination. Remedy deficiencies as needed within 5 days of detection, weather permitting.	Weekly
Final Cover	Inspect for proper placement, thickness, compaction, slope, settlement, vegetation, and erosion. Maintenance will be ongoing throughout post-closure care period. Remedy deficiencies as needed within 5 days of detection, weather permitting.	Monthly

Table 4.1 (Continued)

ITEM	TASK	SCHEDULE
Erosion Control	Inspect the intermediate and final cover for signs of erosion. Damaged areas will be repaired within 5 days (weather permitting) of detection by restoring cover material, grading, compaction, and/or seeding or sodding.	Weekly (Interim), Monthly (Final), and following wet weather.
Disease Vector Control	Inspect landfill facility for insects and rodent populations and report them to the Landfill Manager.	Weekly
Ponding Water	Inspect landfill cover for potential ponding water locations. Grade and compact potential areas within 7 days of detection, weather permitting.	Weekly (Following Wet Weather)
CCS Containers	Inspect the containers for spills and leaks, and repair or replace containers, if necessary, as a result of these inspections.	Daily

address of the hauling company and driver, the type of vehicle, the size and source of the load, contents of the load, indicators of unauthorized waste, and results of the inspection.

The TCEQ and local pollution agency with jurisdiction that has requested to be notified, will be notified whenever regulated hazardous or PCB waste is detected. Records of the notification will be kept in the Site Operating Record and will include the date and time of notification, the individual contacted, and the information reported.

Personnel training records will be maintained in the Site Operating Record and will include evidence of successful completion of the training, type of training received, and the name of the instructor.

5.4 TRAINING

Maintenance Workers, Equipment Operators, and Customer Service Representatives will maintain an understanding of this SOP and will be trained in the following areas:

- Load inspection procedures.
- Identification of unauthorized wastes, including regulated hazardous and PCB waste.
- Waste handling procedures.

The Landfill Manager or designee will maintain an understanding of this SOP and will be trained in the above areas as well as customer notification and recordkeeping. Documentation of training will be placed in the Site Operating Record.

5.5 MANAGING UNAUTHORIZED WASTES

Unknown wastes undergoing analysis must be properly segregated and protected against the elements, secured against unauthorized removal or accidental burial, and isolated from other wastes and activities. An effort will be made to identify the entity that deposited the suspected unauthorized waste and to have this entity return to the site and assume full responsibility for proper disposal of the waste.

Known unauthorized wastes detected during unloading of waste or an inspection will be returned immediately to the hauler. Unauthorized waste that is not discovered by landfill employees until after it is unloaded shall be returned to the vehicle that delivered the waste. If the hauler is not available or has left the site, the waste will be safely stored until provisions for removal by the hauler and/or disposal at an authorized facility can be arranged.

If regulated hazardous or PCB wastes are detected, the TCEQ Region office and local pollution agency with jurisdiction, will be notified via telephone within 24 hours and the TCEQ Austin Office MSW Section will be notified in writing with a copy to the TCEQ Region Office within 14 days. As soon as is practical, the hauler will be required to remove the hazardous waste from the site. Prior to removal, the hauler must demonstrate that he has an EPA identification number,

package the waste in accordance with TxDOT regulations, and properly manifest the waste designating a permitted facility to treat, store, or dispose of the hazardous waste.