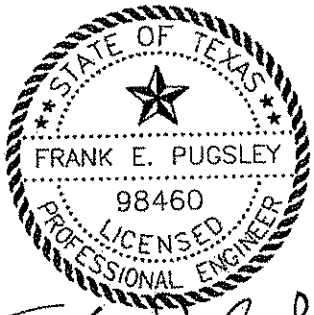
CITY OF LAREDO

MUNICIPAL SOLID WASTE LANDFILL

LAREDO, TEXAS

WEBB COUNTY



6-18-2015

CLOSURE PLAN

ATTACHMENT III.12

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

PERMIT NO.: 1693B

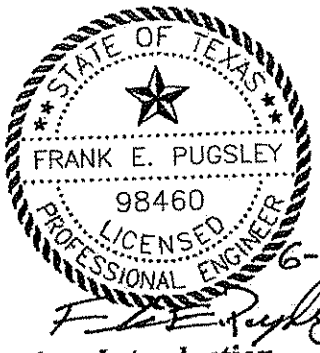
Applicant:

City of Laredo Municipal Solid Waste Landfill
Solid Waste Services Department
6912 Highway 359
Laredo, TX 78044

Revised June 2015

Prepared by:

CP&Y, Inc.
1820 Regal Row
Dallas, TX 75235
F-1741



CLOSURE PLAN

CITY OF LAREDO

MUNICIPAL SOLID WASTE LANDFILL

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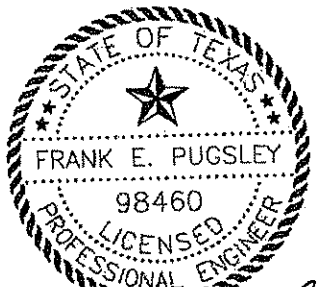


F. E. Pugsley, P.E.
6-16-2015

1. Introduction

The following closure requirements were written to comply with TCEQ Municipal Solid Waste Management Regulations in 30 TAC §330.63(h) and Subchapter K (relating to Closure and Post Closure) and with EPA's RCRA Subtitle D regulations. The City of Laredo Municipal Solid Waste Landfill must comply with §330.457 - Closure Requirements for Solid Waste Landfill Units that Receive Waste on or after October 9, 1993.

2. Final Cover Design, Methods, and Procedures for Installation §330.457(e)(1)

The landfill shall install a final cover system that is designed and constructed to minimize infiltration and erosion. The final cover system shall be composed of no less than two feet of soil and consist of a clay-rich soil cover layer overlain by an erosion layer as follows.

- For landfill phases with a synthetic bottom liner, a synthetic membrane that has a permeability less than or equal to the permeability of any bottom liner system overlain by a clay-rich soil cover layer (barrier layer) consisting of a minimum of 18 inches of earthen material with a coefficient of permeability no greater than 1×10^{-5} centimeters/second (cm/sec). The minimum thickness of the synthetic membrane shall be 20 mils, or 60 mils in the case of high-density polyethylene, in order to ensure proper seaming of the synthetic membrane.

- For landfill phases with no synthetic bottom liner, the clay-rich soil cover layer (barrier layer) shall consist of a minimum of 18 inches of earthen material with a coefficient of permeability less than or equal to the permeability of any constructed bottom liner or natural subsoil present. The coefficient of permeability of the infiltration layer shall in no case exceed 1×10^{-5} cm/sec, even though the coefficient of permeability of the constructed bottom liner or natural subsoil is greater than 1×10^{-5} cm/sec or no data exist for the value(s) of the coefficient of permeability of the constructed bottom liner or natural subsoil.

- The erosion layer shall consist of a minimum of six inches of earthen material that is capable of sustaining native plant growth and shall be seeded or sodded immediately following the application of the final cover in order to minimize erosion. In addition to the prescriptive covers described in §330.457(a)(1),(2), and (3), which require MSW landfills to utilize final cover systems designed and constructed to minimize infiltration and erosion, composed of no less than two feet of soil, and consisting of a clay-rich soil cover (infiltration layer) with a coefficient of permeability no greater than that of the constructed bottom liner system (less than or equal to 1×10^{-5} cm/sec) overlain by an erosion layer.

In addition to the prescriptive covers described in §330.457(a)(1),(2), and (3), the following currently approved alternative final cover systems may be used at the Landfill.

2.1. Currently Approved Alternative Final Cover Systems

As required by §330.457(d), the following final cover systems achieve an equivalent reduction in infiltration and protection from wind and water erosion as the standard covers described in 330.457(a)(1). Calculations to determine equivalency of infiltration and protection from wind and water erosion is provided in Attachment A and B of this Plan.

2.1.1. Alternative Final Cover with Composite Bottom Liner

This final cover system has previously been approved in 1999 by TCEQ during a major Permit amendment to the 1986 original permit. There are no changes proposed to the following alternative final cover system. This alternative final cover system is for disposal areas with a composite geomembrane bottom liner system (Subtitle D). A geosynthetic clay liner (GCL) with a hydraulic conductivity less than or equal to 5×10^{-9} cm/sec will serve as the barrier layer. The GCL is overlain by a 60 mil minimum HDPE geomembrane or equivalent. Double-sided textured material is required on the 4:1 slopes. The geomembrane is overlain by a drainage layer consisting of a geonet with a minimum 6 oz/sy non-woven geotextile heat bonded to each side (geocomposite). The geocomposite is then covered by a protective layer consisting of 18-in. of cover soil and an erosion layer consisting of 6-in of topsoil capable of supporting vegetation. See Appendix C for Figures. It shall be seeded, sodded, or covered in 2 to 4 inch thick angular rock armor immediately following the application of the final cover in order to minimize erosion. Other erosion prevention techniques may be used and are discussed in more detail in Section 2.3.6.

An infiltration equivalency demonstration is presented in Section 2.1 of Appendix A to this Attachment (Appendix III.12A).

2.1.2. Alternative Final Cover with Soil Bottom Liner

This final cover system has previously been approved by TCEQ during a major permit amendment in 1999. There are no changes proposed to the following alternative final cover system. This alternative final cover system is for disposal areas that contain only a constructed clay liner, in-situ liner (pre-Subtitle D), or a Type IV liner. The cover system consists of a GCL having a hydraulic conductivity less than or equal to 3×10^{-9} cm/sec will serve as the barrier layer. The GCL is overlain by a protective layer consisting of 12-in. of cover soil and an erosion layer consisting of 12-in of topsoil capable of supporting vegetation. See Appendix C for Figures. It shall be seeded, sodded, or covered in 2 to 4 inch thick angular rock armor immediately following the application of the final cover in order to minimize erosion. Other erosion prevention techniques may be used and are discussed in more detail in Section 2.3.6.

2.2. Water Balance Alternative Cover System

The City also proposes the use of a water balance (WB) cover system. This cover system has been designed in accordance with 30 TAC 330.457(d) and TCEQ's "Guidance for Requesting a Water Balance Alternative Cover for a Municipal Solid Waste Landfill" revised January 2012.

This alternative cover may be utilized over any portion of the landfill regardless of the bottom liner system. The WB final cover system will consist of a 24" monolithic soil layer, compacted to 85% Standard Proctor, overlain by a 6" erosion layer, and be capable of supporting native vegetation. See Appendix C for Figures. All soil used in the construction of the landfill cover shall be excavated from an area near the landfill or shall meet the requirements discussed in Section 2.3. It shall be seeded, sodded, or covered with 2 to 4 inch thick angular rock armor immediately following the application of the final cover in order to minimize erosion. Other erosion prevention techniques may be used and are discussed in more detail in Section 2.3.6. See Appendix A – Alternative Final Cover Demonstration for further discussion.

2.3. Final Cover Installation §330.457(e)(1)

When a portion of a disposal area is completed to within an elevation appropriate to the thickness of final cover required, the area will be prepared for the placement of final cover. The daily/intermediate cover will be graded smooth and any protruding objects will be removed. The installation procedures, as applicable to the type of final cover system being used, are discussed in the following sections.

2.3.1. Barrier Layer

Installation of a soil barrier layer (soil where the permeability must be 1×10^{-5} cm/sec or less) will be performed by placing 8 in. thick loose lifts of cohesive soil that is free of foreign material. Methods of construction will be as described in Part III, Attachment 10, Section 2 of the Soil Liner Quality Control Plan (SLQCP). The lifts will be uniformly compacted. In instances where a GCL is used as the barrier layer, the surface of the daily/intermediate cover will be prepared in the same manner and the GCL panels will be deployed in accordance with the requirements outlined in Part III, Attachment 10C, Section 2.3 of the SLQCP for installation of GCL's.

2.3.2. Geomembrane Layer

The geomembrane layer, if included in the final cover system configuration, will be installed over the soil or the GCL barrier layer. The installation surface will be smooth and free of any loose rocks, protrusions, or void areas. Panels of the geomembrane will be deployed, welded, and leak-tested in accordance with the CQA and installation requirements outlined in Part III, Attachment 10A, Section III of the SLQCP.

2.3.3. Drainage Layer

The drainage layer (geocomposite) will be installed above the geomembrane. The geocomposite will be deployed and seamed or tied, as applicable, in accordance with the CQA and installation requirements outlined in Part III, Attachment 10A, Section IV of the SLQCP.

2.3.4. Erosion Layer

The erosion layer shall consist of a 6-in. or 12-in. soil layer, consisting of earthen material capable of supporting grass or vegetative cover.

2.3.5. Water Balance Monolithic Layer

The 24" monolithic soil layer consisting of onsite borrow soil capable of supporting vegetative cover shall have the following properties.

- Plasticity Index 16 < PI < 28
- Passing #4 Greater than 79% Passing
- Passing #40 59% - 99% Passing
- Passing #200 26% - 52% Passing
- Soil Classification CL or SC
- In-place hydraulic conductivity < $2x10^{-7}$

The cover shall be placed at or near 85% standard proctor density. The cover will be constructed, installed, and CQA tested in accordance with Section 2.4 of this Attachment. See Appendix A – Alternative Final Cover Demonstration for further discussion of the water balance cover system including model simulation descriptions and results.

2.3.6. Erosion Control

The completed cover will be seeded or sodded following placement of the top soil. Bermuda or Buffalo grasses are recommended for permanent vegetative cover. Native or adapted grasses and wildflowers may also be used. A temporary cover of rye grass, winter wheat or other cool weather vegetation may also be used if final cover is installed during the winter.

During the early stages of vegetative growth, mulching, slope regrading, and mowing will be performed to complete vegetative coverage and effective erosion control. Soil loss calculations are provided in Attachment B of this Plan. A summary of the calculations are provided in Table 1. As shown for all cases, the soil loss for both the top slope and sideslope is less than the permissible soil loss of 50 tons/acre/year for intermediate cover and less than 3 tons/acre/year for final cover.

Due to the climate at the Laredo Landfill, it may be difficult to establish a 80% vegetative cover immediately after final cover installation. It may require up to 5 years to establish permanent vegetation. During that time, periodic inspection and maintenance of the final cover system shall be required to prevent excessive erosion on the side slopes. Eroded soil which accumulates in ditches and ponds will be removed and used in repair of erosion damage.

If permanent vegetation cannot be established, a 4 inch thick rock armor layer may be installed to help prevent erosion in the absence of vegetation.

TABLE 1
SOIL LOSS SUMMARY

Case		A (tons/acre/year)
Interim	5% Slope	2.97
	25% Vegetated	
Interim	4H:1V Slope	32.06
	25% Vegetated	
Final	5% Slope	0.22
	75% Vegetated	
Final	4H:1V Slope	2.38
	80% Vegetated	
Final	4H:1V Slope	2.75
	Rock armor	

2.4. Quality Control

Hydraulic conductivity testing of undisturbed samples of the cover material will be performed by the construction quality assurance (CQA) monitor at a frequency of not less than one test per surface acre of final cover. Portions of the soil barrier layer that do not exhibit the required hydraulic conductivity will be reworked and retested. The final cover will be bored to verify thickness and collect soil samples for analysis or surveyed prior to and following placement of final cover. Such borings will be backfilled with a soil/bentonite mixture. Permeability data shall be submitted to the Executive Director in a format stipulated in technical guidelines furnished by the executive director. Construction quality control of the barrier layer, drainage layer, geomembrane layer, and protective cover shall be governed by the SLQCP. CQA details are provided in the following sections.

TABLE 2
CQA REQUIREMT LOCATIONS

Cover Layer	CQA Location
Clay Liner (Barrier Layer)	SLQCP – Attachment 10 - Section II
Geocomposute Clay Liner (Barrier Layer)	SLQCP – Attachment 10 – Appendix D
Geomembrane	SLQCP – Attachment 10 - Section III
Drainage Geocomposite Layer (Drainage Layer)	SLQCP – Attachment 10 - Section IV
Protective Cover	SLQCP – Attachment 10 - Section VI

2.5. Largest Area §330.457(e)(2)

The largest area of the MSWLF unit or MSW site ever requiring a final cover at one time during the active life of the unit is approximately 155.59 acres. This area is depicted on Figure 1.

FIGURE 1
LARGEST AREA EVER REQUIRING FINAL COVER

2.6. Maximum Inventory of Waste §330.457(e)(3)

The design of the Landfill, as amended, will have an estimated total capacity of 25.25 million cubic yards. The West Phase will have a capacity of 12.5 million cubic yards and the East Phase will have a capacity of 12.75 million cubic yards. This volume represents the total airspace volume above the bottom liner and below the final cover system and is inclusive of waste and daily/intermediate cover. The supporting calculations are included in Part III.

2.7. Schedule for Closure Activities §330.457(e)(4)

The final cover elements shall be placed as follows:

- Place the barrier layer.
- If applicable, place the geomembrane layer (60 mil HDPE or equivalent).
- If applicable, place the geocomposite layer
- Place protective soil layer.
- Place erosion layer capable of sustaining native plant growth.
- Immediately seed or sod the erosion layer or place 4" rock armor.

2.8. Required Figures §330.457(e)(5)

- A final contour map depicting the proposed final contours, establishing top slopes and side slopes, and proposed surface drainage features is shown in Part III, Attachment 7.
- Fill cross sections are shown in Figures III.2.1 through III.2.5.
- No fill areas of the landfill are subject to flooding due to a 100-year frequency flood. A map showing the 100-year frequency flood is shown in Part II, Attachment 1, Figure II.1.15.

3. Implementation of Closure Plan §330.457(f)

Implementation of the Final Closure Plan shall be as follows:

- §330.457(f)(1) – A copy of the Closure plan shall be placed into the Operating Record immediately upon approval.
- §330.457(f)(2) – The City of Laredo shall provide written notification to the Executive Director of the intent to close the MSW site and place this notice of intent in the operating record no later than 45 days prior to the initiation of final closure activities for the site.
- §330.461(a) – No later than 90 days prior to the initiation of a final facility closure, the City of Laredo shall, through a public notice in the newspaper of largest circulation in the vicinity of the facility, provide public notice for final facility closure. This notice shall provide the name, address, and physical location of the facility, the permit number, and the last date of intended receipt of waste. The City shall also make available an adequate number of copies of the approved final closure and port-closure plans for public access and review. The City shall provide written notification to the Executive Director of the intent to close the facility and place this notice in the Operating Record.

- §330.457(f)(3) – The City shall begin final closure activities for each unit of the site no later than 30 days after the date on which the unit receives the known final receipt of wastes or, if the unit has remaining capacity and there is a reasonable likelihood that the unit will receive additional wastes, no later than one year after the most recent receipt of wastes. A request for an extension beyond the one-year deadline for the initiation of final closure may be submitted to the Executive Director for review and approval and shall include all applicable documentation necessary to demonstrate that the site has the capacity to receive additional waste and that the City has taken and will continue to take all steps necessary to prevent threats to human health and the environment from the unclosed site.
- §330.459 – Any recyclable materials remaining on site at the beginning of final closure activities will either be disposed of in the remaining waste cells, or transported off site as the property of a recycling contractor within 180 days of the last receipt of such materials.
- §330.459 – The City shall dispose of all on site processed and unprocessed greenwaste.
- §330.457(f)(4) – The City shall complete final closure activities for the landfill unit in accordance with the approved final closure plan within 180 days following the initiation of final closure activities as specified in above. A request for an extension for the completion of final closure activities may be submitted to the Executive Director for review and approval, and shall include all applicable documentation necessary to demonstrate that final closure will, of necessity, take longer than 180 days, and all steps have been taken and will continue to be taken to prevent threats to human health and the environment from the unclosed MSW site.
- §330.457(f)(5) and §330.461(c)(2) – Following completion of all final closure activities for the MSW site, the City shall comply with the post closure care requirements specified in §330.463(b), and submit to the Executive Director, by registered mail, for review and approval a document, signed by an independent registered professional engineer, verifying that final closure has been completed in accordance with the approved final closure plan. The submittal to the Executive Director shall include all applicable documentation necessary for certification of final closure. Once approved, this certification shall be placed in the operating record.
- §330.461(b) – Upon notification to the Executive Director as specified in §330.461(a) , the City shall post a minimum of one sign at the main entrance and all other frequently used points of access for the facility notifying all persons who may utilize the facility or site of the date of closing for the entire facility or site and the prohibition against further receipt of waste materials after the stated date. Further, suitable barriers or locked gates shall be installed at all access points to adequately prevent the unauthorized dumping of solid waste at the closed site.
- §330.457(f)(6) – Following receipt of the required final closure documents, as applicable, and an inspection report from the Commission's district office verifying proper closure of the Landfill or site according to the approved final closure plan, the Executive Director may acknowledge the termination of operation and closure of the facility or site and deem it properly closed.
- §330.457(g) – Within 10 days after completion of final closure activities of the site, the City shall submit to the Executive Director, by registered mail, a certified copy of an "Affidavit to the Public" in accordance with the requirements of §330.19 of the TCEQ

Solid Waste Management Regulations, and place a copy of the affidavit in the operating record. In addition, the City shall record a certified notation on the deed to the facility or site property, or on some other instrument that is normally examined during title search, that will in perpetuity notify any potential purchaser of the property that the land has been used as a landfill facility and use of the land is restricted according to the provisions specified in 30 TAC §330.465. The City shall submit a certified copy of the modified deed to the Executive Director and place a copy of the modified deed in the operating record within the time frame specified in this paragraph.

4. Closure Cost Estimate §330.63(j)

In accordance to Title 30 Chapter 37, Subchapter R relating to Financial Assurance for MSW facilities, the City shall provide continuous financial assurance coverage for closure until the facility is officially placed under the post-closure maintenance period and all requirements of the final closure plan have been approved as evidenced in writing by the Executive Director. In addition, the City shall provide continuous financial assurance coverage for post-closure care until the facility is officially released in writing by the executive director from the post-closure care period in accordance with all requirements of the Post Closure Plan (Attachment III.13).

A detailed written estimate, in current dollars (2015), of the cost of hiring a third party to close the largest area (see Section 2.5 – Largest Area) of all MSWLF units ever requiring a final cover at any time during the active life is presented as Table 2. The Landfill shall review the permit conditions on an annual basis and verify that the current active areas match the areas on which closure cost estimates are based. An increase or decrease in the closure cost estimate shall be made if changes to the final closure plan or the landfill conditions dictate.

The following Closure Cost Estimate includes costs associated with the closure of all waste storage, processing, and disposal units at the City of Laredo Landfill.

- The landfill closure costs includes engineering and construction costs associated with the installation of a prescriptive cover system. Engineering costs include survey procurement, site evaluation and development of design plans, contract administration assistance, and inspection and CQA testing during construction of the cover system. Construction costs include material and labor costs associated with the installation of the final cover system and erosion protection.
- The tire chipping and storage unit includes costs associated with the removal of all stored tires, cleaning of the site, and disposing of all solids resulting from the cleanup. Soil sampling and analysis costs and final closure report is also included.
- The white goods and metal storage areas closure costs associated with the removal of all recyclable material, cleaning of the site, and disposing of all solids resulting from the cleanup. Soil sampling and analysis costs and final closure report is also included.

TABLE 3
CLOSURE COST ESTIMATE

The following closure cost estimate, in current dollars, shows the cost of hiring a third party to close the waste storage, processing and disposal facilities at the City of Laredo Landfill

Landfill

The following landfill closure cost estimate, in current dollars, shows the cost of 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 in accordance with the final closure plan. The Facility shall review the permit conditions on an annual basis and verify that the current active areas match the areas on which closure cost estimates are based. An increase or decrease in the closure cost estimate shall be made if changes to the final closure plan or the landfill conditions dictate.

	Quantity	Unit	Cost ($/unit)	Total Cost (qty x disposal cost)
Engineering				
Topographic survey	156	Acre	$ 100.00	$ 15,559.00
Boundary Survey	1	Lump Sum	$ 4,000.00	$ 4,000.00
Site Evaluation	156	Acre	$ 250.00	$ 38,897.50
Development of Final Closure Plans	156	Acre	$ 280.00	$ 43,565.20
Contract, Administration, Bidding & Award	1	Lump Sum	$ 10,000.00	$ 10,000.00
Administrative Costs	1	Lump Sum	$ 5,000.00	$ 5,000.00
Inspection & Testing (Subtitle D Area)	43	Acre	$ 5,000.00	$ 217,000.00
Inspection & Testing (Pre-Subtitle D Area)	49	Acre	$ 3,200.00	$ 157,120.00
Construction				
Pre-Subtitle D Area (43 Acres)				
Erosion Layer - 6" (sourced on-site)	34,687	CY	$ 4.00	$ 138,746.67
Infiltration Layer - 18"	104,060	CY	$ 4.00	$ 416,240.00
Subtitle D Area (49 Acres)				
Erosion Layer - 6" (sourced on-site)	158,107	CY	$ 4.00	$ 632,426.67
Geocomposite	2,134,440	SF	$ 0.55	$ 1,173,942.00
Flexible Membrane Liner (textured)	2,134,440	SF	$ 0.50	$ 1,067,220.00
Infiltration Layer (18")	118,580	CY	$ 4.00	$ 474,320.00
Seeding or Rock Armor	156	AC	$ 2,000.00	$ 312,000.00
Site Grading & Drainage	156	AC	$ 1,000.00	$ 156,000.00
Total Landfill Closure Cost				**$ 4,862,037.03**

Tire Chipping and Storage Unit

	*Quantity	Unit	**Disposal Cost ($/unit)	Total Cost (qty x disposal cost)
Whole Tire Storage	100	TON	$ 26.15	$ 2,615.00
Chipped Tire Storage	50	TON	$ 26.15	$ 1,307.50
Labor (Washdown, Cleanup)	1	LS	$ 1,500.00	$ 1,500.00
Solids from Cleanup	500	LBS	$ 0.30	$ 150.00
Soil Sampling & Analytics	1	LS	$ 1,200.00	$ 1,200.00
Closure Report Preparation	1	LS	$ 2,000.00	$ 2,000.00
Total Tire Chipping and Storage Unit Closure Cost				**$ 8,772.50**

*Quantity represents the maximum amount of material stored during the life of the facility

**Disposal cost include loading, transport to, and disposal cost at the nearest authorized disposal facility.

TABLE 3 - CONTINUED
CLOSURE COST ESTIMATE

White Goods and Metals Storage Area

	*Quantity	Unit	**Disposal Cost ($/unit)	Total Cost (qty x disposal cost)
White Goods Storage	5	TON	$ 36.20	$ 181.00
Recyclable Metals Storage	20	TON	$ 27.20	$ 544.00
Labor (Washdown, Cleanup)	1	LS	$ 1,500.00	$ 1,500.00
Solids from Cleanup	500	LBS	$ 0.30	$ 150.00
Soil Sampling & Analytics	1	LS	$ 1,200.00	$ 1,200.00
Closure Report Preparation	1	LS	$ 2,000.00	$ 2,000.00
Total White Goods and Metal Storage Area Closure Cost				**$ 5,575.00**

*Quantity represents the maximum amount of material stored during the life of the facility

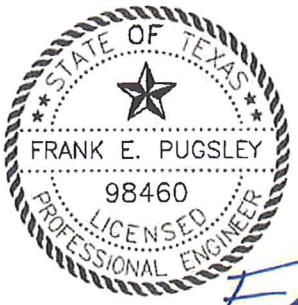
**Disposal cost include loading, transport to, and disposal cost at the nearest authorized disposal facility.

Total Closure Cost Estimate

	Closure Cost
Landfill	$ 4,862,037.03
Tire Chipping and Storage Unit	$ 8,772.50
White Goods and Metals Storage Area	$ 5,575.00
Total Closure Cost Estimate	**$ 4,876,384.53**

APPENDIX A – ALTERNATIVE FINAL COVER DEMONSTRATION

APPENDIX B – SOIL EROSION CALCULATIONS



F. E. Pugsley, P.E.
6-18-2015

1820 Regal Row
Dallas, Texas 75235
214-638-0500

Project # LARE1301

Client	Laredo Municipal Solid Waste Landfill	Prepared By	BW	on 8/30/2013
Project	Permit Amendment Application	Reviewed By	FP	on 4/28/2015
Subject	Soil Loss Calculations	Approved By	FP	on 4/28/2015

A Required

Evaluate the expected soil loss from the Final Cover consistent with 30 TAC §330.305(d)(2).

B Method

The expected soil loss is calculated using the RUSLE. The annual soil loss is calculated for each slope configuration. This total annual soil loss is compared to the permissible soil loss of 3 tons/acre/year for final cover and 50 tons/acre/year for intermediate cover; as referenced from the TCEQ's "Guidance for Addressing Erosional Stability During all Phases of Landfill Operation", as prepared March, 2013.

C References

1 United States Department of Agriculture, Agricultural Handbook No. 703
2 TCEQ, Guidance for Addressing Erosional Stability During all Phases of Landfill Operation, as prepared March, 2013

D Input

$$A = RKLSCP$$

Where:
- A = Soil Loss (tons/acre/year)
- R = Rainfall/Runoff Factor
- K = Soil Erodibility Factor
- LS = Slope Length/Steepness Factor
- C = Cover Management Factor
- P = Erosion Control Practice Factor

Rainfall Factor

The R factor represents the average storm erosive index value over a 22-year record. R is an indication of the two most important characteristics of a storm determining its erosivity: amount of rainfall and peak intensity sustained over an extended period. Using Exhibit 1 - Average annual R factor, The applicable R factor for Webb County, Texas is:

$$R = 225$$

Soil Eroidiblity Factor

The K factor is soil erodibility factor which represents both susceptibility of soil to erosion as a function of the soils physical and chemical properties. Using Exhibit 1, Table 1 - K Factor, Rock free - Webb County, Texas, the applicable K factor for the Laredo Landfill area is:

$K = 0.21$

Slope Length and Steepness Factors

The slope length factor, L, and the slope steepness factor, S, represent the erosion of the soil due to both slope length and degree of slope.

- L = Slope Length Factor
  $(\lambda/72.6)^m$
- λ = Horizontal Projection of the Slope
- m = Slope-Length Exponent
  $\beta/(1+\beta)$
- β = Ratio of Rill to Interrill Erosion
  $(\sin\theta/0.0896) / [3*(\sin\theta)^{0.8} + 0.56]$
- θ = Slope Angle in Degrees

	Case	Slope	θ	β	m	λ_{max}	L
1	Top Slope	5%	2.9	0.67	0.40	130	1.26
2	Sideslope	25%	14.0	1.78	0.64	155	1.63

S = Slope Steepness Factor

$S = 10.8 \sin\theta + 0.03$ for slope $< 9\%$

$S = 16.8 \sin\theta - 0.50$ for slope $\geq 9\%$

	Slope	Slope	θ	S
1	Top Slope	5%	2.86	0.569
2	Sideslope	25%	14.04	2.649

Cover Management Factor

The C factor represents the effects of plants, soil cover, soil biomass, and soil disturbing activities on erosion. For intermediate cover the City will seed or sod the cover. A conservative 25% vegetative cover was assumed. For final cover the City will seed or sod after installation. A conservative 80% vegetative cover was assumed. Since vegetation is hard to grow and sustain at the Laredo Landfill and optional rock armor (minimum 4" thick) on the final cover side slopes may be used for erosion control. The top surface will remain 80% vegetated.

C = 0.175 25% vegetated cover (interpolated from Table 1 - Page 8)

C = 0.013 80% vegetated cover (from Table 1 - Page 8)

C = 0.015 Rock armor cover

Table 2 - Page 8 provides C values for crushed stone mulch (1/4" to 1-1/2"). The maximim application rate defined as 240 tons/acre (approximately 1" thick) has a C factor of 0.02 . The proposed application rate of 700 tons/acre is approximatley 3 times the amount shown on Table 2. A C factor of 0.015 was used.

Erosion Control Practice Factor

The erosion control practice factor, P, measures the effect of control practices that reduce the erosion potential of the runoff by influencing drainage patterns, runoff concentration, and runoff velocity. For purposes of calculating soil loss, the P factor is:

P = 0.5 Landslope 2% to 7%
P = 0.9 Landslope 19% to 24%

E Calculation

Case		R	K	L	S	C	P	A (tons/acre/year)
Interim	5% Slope 25% Vegetated	225	0.21	1.26	0.569	0.175	0.5	2.97
Interim	4H:1V Slope 25% Vegetated	225	0.21	1.63	2.649	0.175	0.9	32.06
Final	5% Slope 75% Vegetated	225	0.21	1.26	0.569	0.013	0.5	0.22
Final	4H:1V Slope 75% Vegetated	225	0.21	1.63	2.649	0.013	0.9	2.38
Final	4H:1V Slope Rock armor	225	0.21	1.63	2.649	0.015	0.9	2.75

F Conclusion

The above soil loss calculations represent the all scenarios in which erosion may happen on a landfill cover system. As shown for all cases, the soil loss for both the top slope and sideslope is less than the permissible soil loss of 50 tons/acre/year for intermediate cover and less than 3 tons/acre/year for final cover.

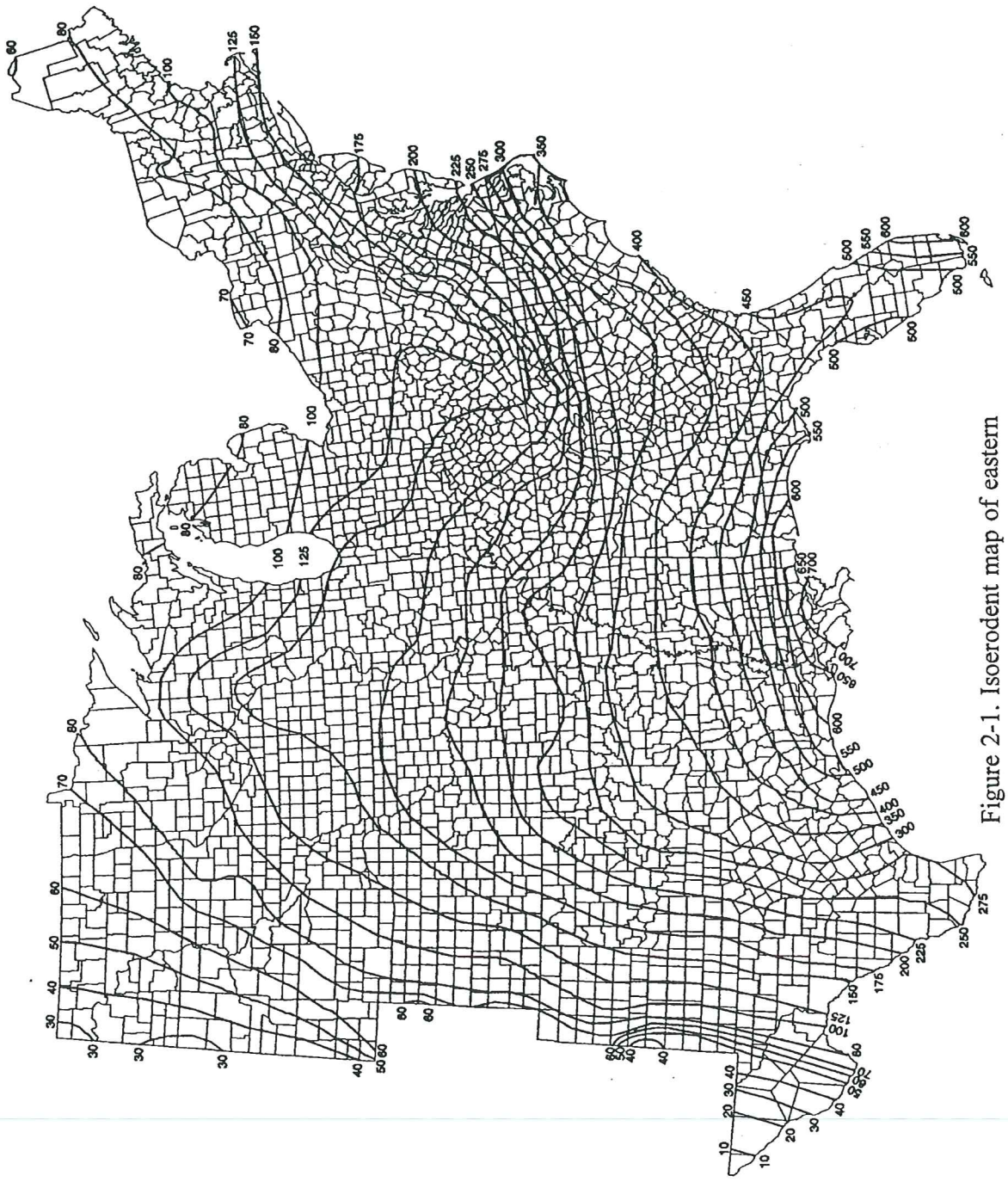


Figure 2-1. Isoerodent map of eastern United States. Units are hundreds ft·tonf·in(ac·h·yr)$^{-1}$.

K Factor, Whole Soil—Webb County, Texas
(Laredo Landfill)

Map Scale: 1:8,320 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 14N WGS84

Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

9/19/2013
Page 1 of 3

ATT.12B-5

ATT.12B-6

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Soil Rating Lines
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Soil Rating Points
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:31,700.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Webb County, Texas
Survey Area Data: Version 9, Sep 21, 2012

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 12, 2010—Jan 22, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

K Factor, Whole Soil

K Factor, Whole Soil— Summary by Map Unit — Webb County, Texas (TX479)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CaB	Catarina clay, 0 to 2 percent slopes	.32	25.4	9.3%
CfA	Catarina clay, occasionally flooded	.32	25.1	9.2%
JQD	Jimenez-Quemado complex, undulating	.10	133.9	49.0%
MCE	Maverick-Catarina complex, gently rolling	.32	89.1	32.6%
Totals for Area of Interest			**273.5**	**100.0%**

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

C FACTOR

Table 1 - Cover Factor C Values for Established Plants (data from NEH chapter 3 and Wischmeier and Smith 1978)

			Percentage of surface covered by residue in contact with the soil:					
	Percent cover[1]	Plant type	0%	20	40	60	80	95+
C factor for grass, grasslike plants, or decaying compacted plant litter.	0	Grass	0.45	0.2	0.1	0.042	0.013	0.003
C factor for broadleaf herbaceous plants (including most weeds with little lateral root networks), or undecayed residues.	0	Weeds	0.45	0.24	0.15	0.091	0.043	0.011
Tall weeds or short brush with average drop height[2] of ≥20 inches	25	Grass	0.36	0.17	0.09	0.038	0.013	0.003
		Weeds	0.36	0.2	0.13	0.083	0.041	0.011
	50	Grass	0.26	0.13	0.07	0.035	0.012	0.003
		Weeds	0.26	0.16	0.11	0.076	0.039	0.011
	75	Grass	0.17	0.1	0.06	0.032	0.011	0.003
		Weeds	0.17	0.12	0.09	0.068	0.038	0.011
Mechanically prepared sites, with no live vegetation and no topsoil, and no litter mixed in.	0	None	0.94	0.44	0.3	0.2	0.1	Not given

1 percent cover is the portion of the total area surface that would be hidden from view by canopy if looking straight downward.

Table 2 - Site Mulching C Factors for Different Slopes (Wischmeier and Smith 1978)

Type of Mulch	Mulch Rate (tons per acre)	Land Slope (%)	Mulching C Factor
None	0	all	1.0
Straw or hay, tied down by anchoring and tacking equipment	1.0	1-5	0.20
	1.0	6-10	0.20
	1.5	1-5	0.12
	1.5	6-10	0.12
	2.0	1-5	0.06
	2.0	6-10	0.06
	2.0	11-15	0.07
	2.0	16-20	0.11
	2.0	21-25	0.14
	2.0	26-33	0.17
	2.0	34-50	0.20
Crushed stone, 1/4" to 1-1/2 inch	135	<16	0.05
	135	16-20	0.05
	135	21-33	0.05
	135	34-50	0.05
	240	<21	0.02
	240	21-33	0.02
	240	34-50	0.02
Wood chips	7	<16	0.08
	7	16-20	0.08
	12	<16	0.05
	12	16-20	0.05
	12	21-33	0.05
	25	<16	0.02
	25	16-20	0.02
	25	21-33	0.02
	25	34-50	0.02

CITY OF LAREDO

MUNICIPAL SOLID WASTE LANDFILL

LAREDO, TEXAS

WEBB COUNTY

CLOSURE PLAN FIGURES

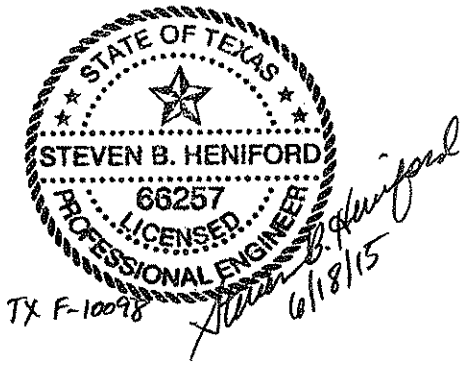
ATTACHMENT III.12 – APPENDIX C

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

PERMIT NO.: 1693B

Applicant:
City of Laredo Municipal Solid Waste Landfill
Solid Waste Services Department
6912 Highway 359
Laredo, TX 78044

September 2014
Revised June 2015



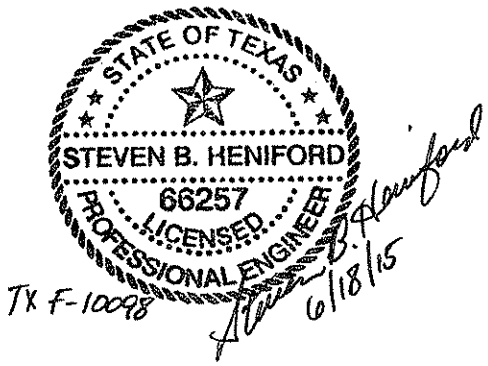
Prepared by:

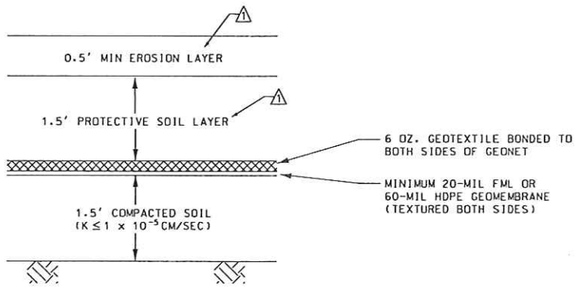
Arredondo, Zeoeda & Brunz, LLC
11355 McCree Road
Dallas, TX 75238
F-10098

LAREDO LANDFILL
PART III
Attachment 12, Appendix C
Closure Plan Figures

TABLE OF CONTENTS

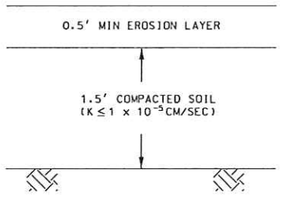
List of Figures





STANDARD FINAL COVER PROFILE (SUBTITLE D AREAS) — 1 / 12.1

NTS



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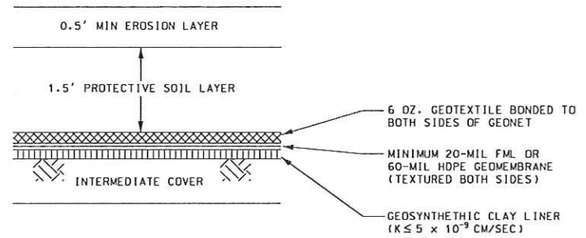

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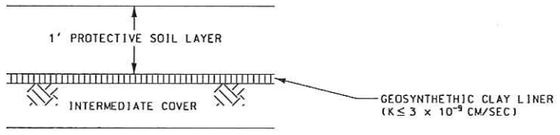

ALTERNATE FINAL COVER PROFILE (PRE-SUBTITLE D & TYPE IV AREAS) — 4 / 12.1

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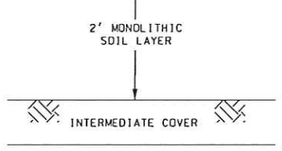

ALTERNATE FINAL COVER PROFILE (WATER BALANCE) — 5 / 12.1

NTS

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STATE OF TEXAS — STEVEN B. HENIFORD — 66257 — REGISTERED PROFESSIONAL ENGINEER — 4/18/15

ARREDONDO, ZEPEDA & BRUNZ, LLC
TBPE FIRM REG. # F-10058
CIVIL · ENVIRONMENTAL · SURVEYING
CONSTRUCTION MANAGEMENT · MUNICIPAL

REV	DATE	DESCRIPTION	DES BY	APP BY
1	6/18/15	NOD NO. 1	SBH	SBH

CITY PROJ. No.	
AZB PROJ. No. 212029	
DATE: AUGUST 2014	
DES BY	SH
DRN BY	AZB
CHK BY	SH
APP BY	MC

LAREDO LANDFILL VERTICAL EXPANSION
PERMIT AMENDMENT APPLICATION No. MSW-1693B
WEBB COUNTY, TEXAS

FINAL COVER DETAILS
FIGURE III-12.1

CITY OF LAREDO

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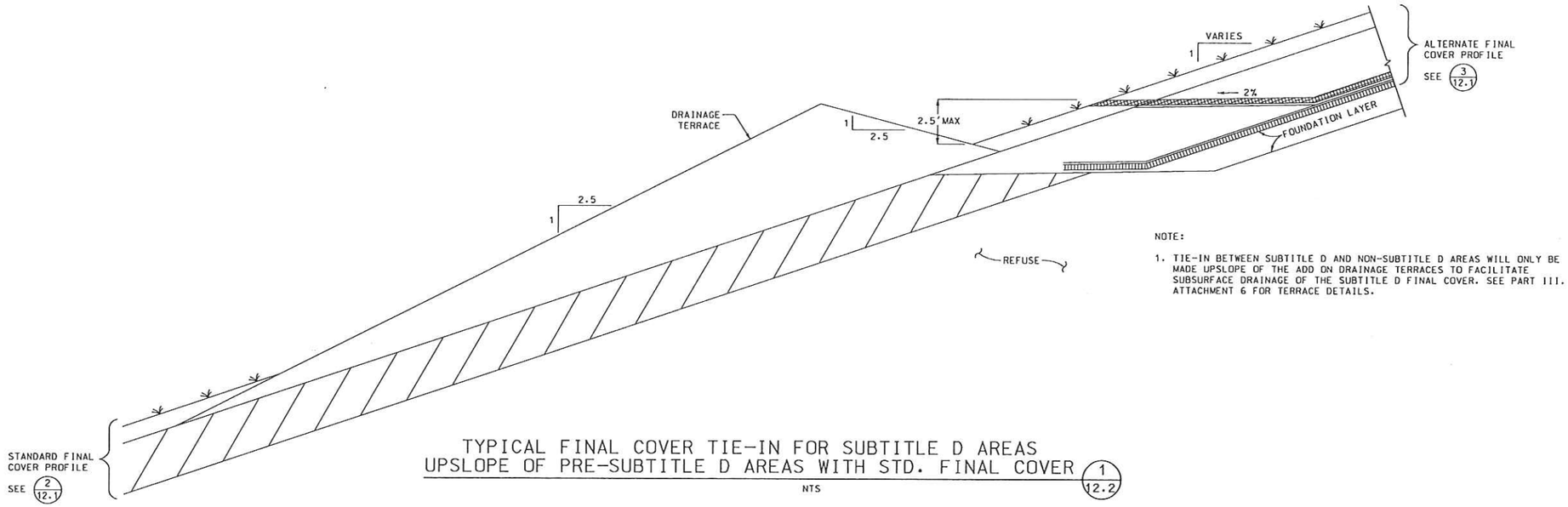
ATTACHMENT: III-12



NOTE:

1. TIE-IN BETWEEN SUBTITLE D AND NON-SUBTITLE D AREAS WILL ONLY BE MADE UPSLOPE OF THE ADD ON DRAINAGE TERRACES TO FACILITATE SUBSURFACE DRAINAGE OF THE SUBTITLE D FINAL COVER. SEE PART III. ATTACHMENT 6 FOR TERRACE DETAILS.

TYPICAL FINAL COVER TIE-IN FOR SUBTITLE D AREAS
UPSLOPE OF PRE-SUBTITLE D AREAS WITH STD. FINAL COVER (1/12.2)

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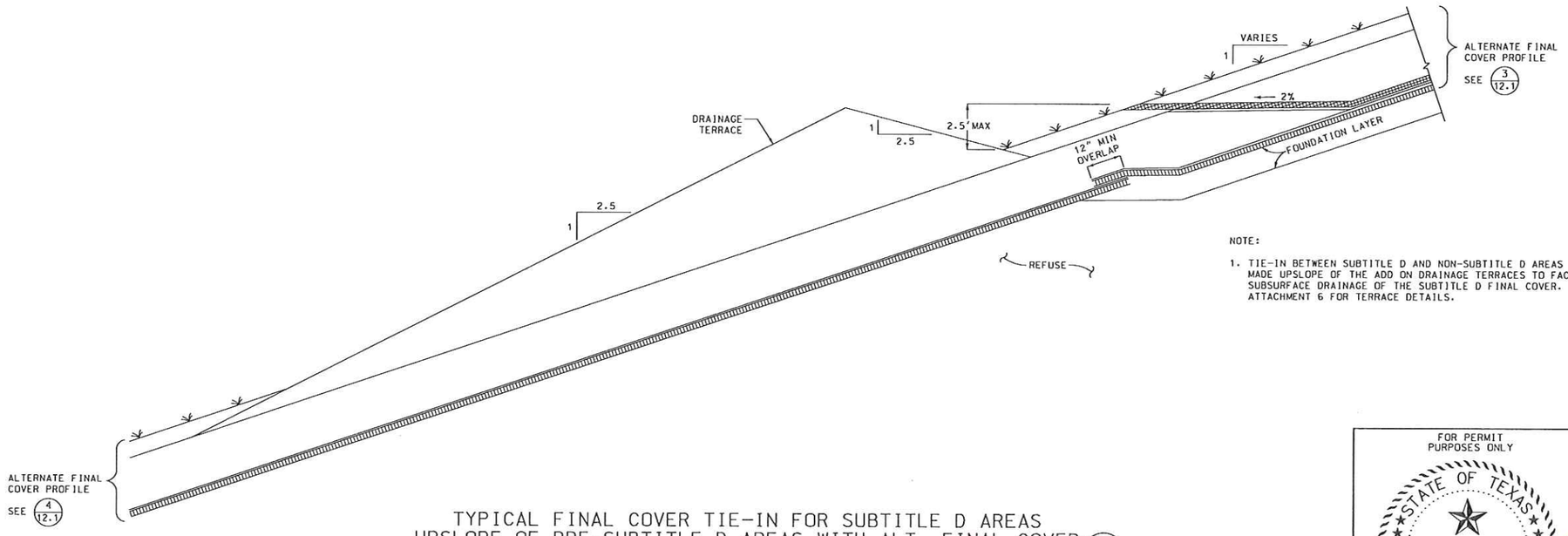

NOTE:

1. TIE-IN BETWEEN SUBTITLE D AND NON-SUBTITLE D AREAS WILL ONLY BE MADE UPSLOPE OF THE ADD ON DRAINAGE TERRACES TO FACILITATE SUBSURFACE DRAINAGE OF THE SUBTITLE D FINAL COVER. SEE PART III. ATTACHMENT 6 FOR TERRACE DETAILS.

TYPICAL FINAL COVER TIE-IN FOR SUBTITLE D AREAS
UPSLOPE OF PRE-SUBTITLE D AREAS WITH ALT. FINAL COVER (2/12.2)

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APP BY	MC

LAREDO LANDFILL VERTICAL EXPANSION
PERMIT AMENDMENT APPLICATION No. MSW-1693B
WEBB COUNTY, TEXAS

FINAL COVER
TIE-IN DETAILS 1
FIGURE III-12.2

CITY OF LAREDO

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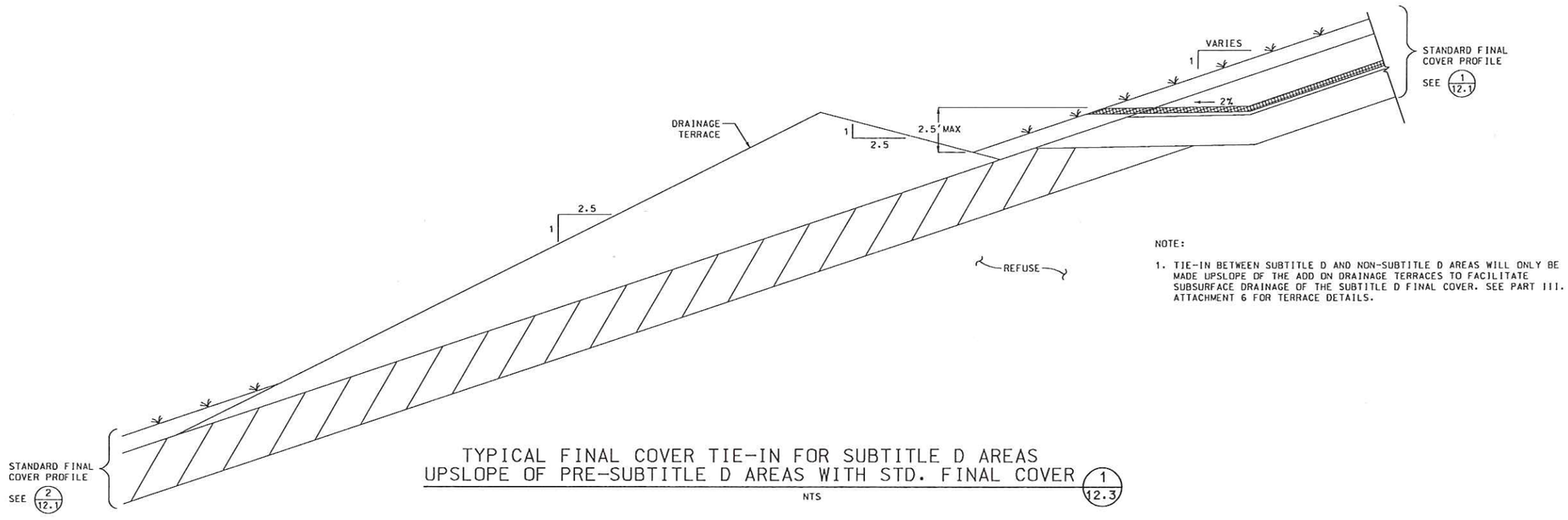

NOTE:

1. TIE-IN BETWEEN SUBTITLE D AND NON-SUBTITLE D AREAS WILL ONLY BE MADE UPSLOPE OF THE ADD ON DRAINAGE TERRACES TO FACILITATE SUBSURFACE DRAINAGE OF THE SUBTITLE D FINAL COVER. SEE PART III. ATTACHMENT 6 FOR TERRACE DETAILS.

TYPICAL FINAL COVER TIE-IN FOR SUBTITLE D AREAS
UPSLOPE OF PRE-SUBTITLE D AREAS WITH STD. FINAL COVER (1/12.3)

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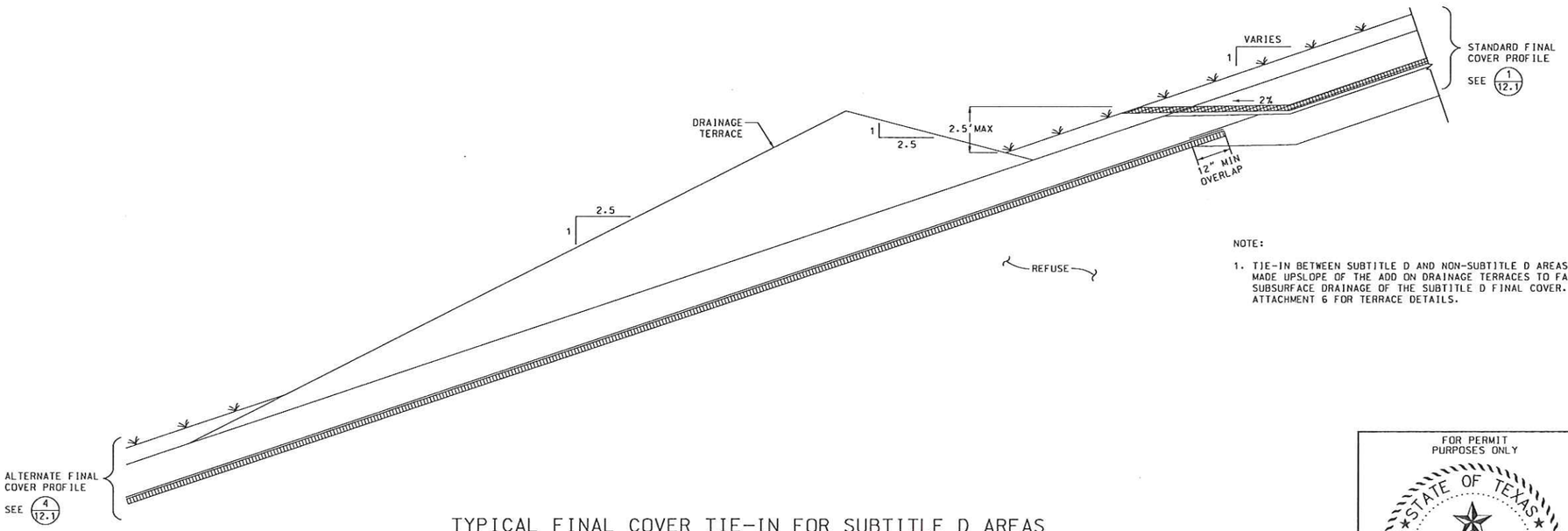

NOTE:

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TYPICAL FINAL COVER TIE-IN FOR SUBTITLE D AREAS
UPSLOPE OF PRE-SUBTITLE D AREAS WITH ALT. FINAL COVER (2/12.3)

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FINAL COVER
TIE-IN DETAILS 2
FIGURE III-12.3

CITY OF LAREDO

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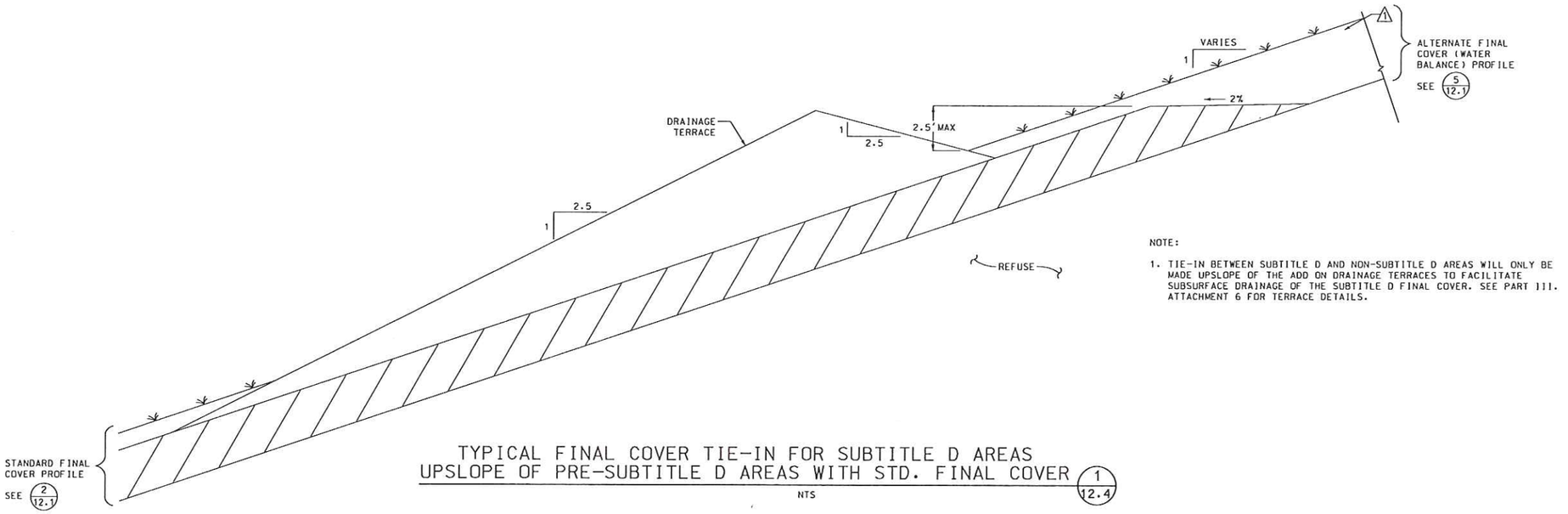
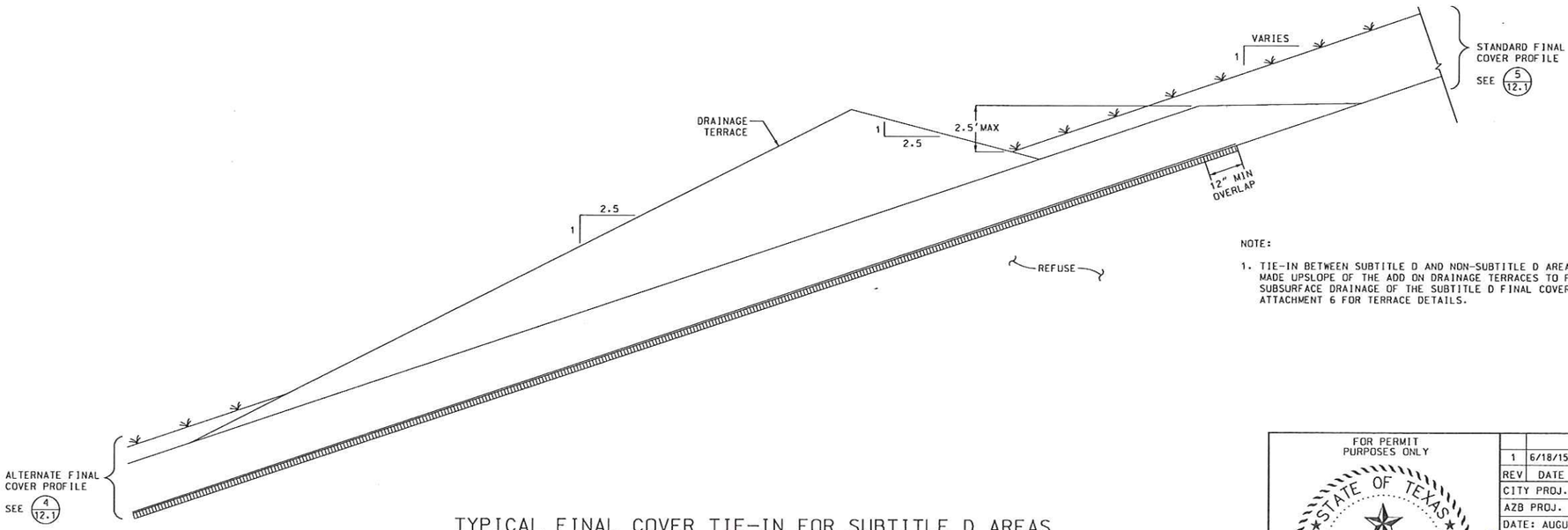


TYPICAL FINAL COVER TIE-IN FOR SUBTITLE D AREAS
UPSLOPE OF PRE-SUBTITLE D AREAS WITH STD. FINAL COVER (1/12.4)

NTS

NOTE:

1. TIE-IN BETWEEN SUBTITLE D AND NON-SUBTITLE D AREAS WILL ONLY BE MADE UPSLOPE OF THE ADD ON DRAINAGE TERRACES TO FACILITATE SUBSURFACE DRAINAGE OF THE SUBTITLE D FINAL COVER. SEE PART III. ATTACHMENT 6 FOR TERRACE DETAILS.



TYPICAL FINAL COVER TIE-IN FOR SUBTITLE D AREAS
UPSLOPE OF PRE-SUBTITLE D AREAS WITH ALT. FINAL COVER (2/12.4)

NTS

NOTE:

1. TIE-IN BETWEEN SUBTITLE D AND NON-SUBTITLE D AREAS WILL ONLY BE MADE UPSLOPE OF THE ADD ON DRAINAGE TERRACES TO FACILITATE SUBSURFACE DRAINAGE OF THE SUBTITLE D FINAL COVER. SEE PART III. ATTACHMENT 6 FOR TERRACE DETAILS.

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CITY PROJ. No.	LAREDO LANDFILL VERTICAL EXPANSION
AZB PROJ. No. 212029	PERMIT AMENDMENT APPLICATION No. MSW-1693B
DATE: AUGUST 2014	WEBB COUNTY, TEXAS

DES BY	SH	
DRN BY	AZB	
CHK BY	SH	
APP BY	MC	

FINAL COVER
TIE-IN DETAILS 3
FIGURE III-12.4

CITY OF LAREDO

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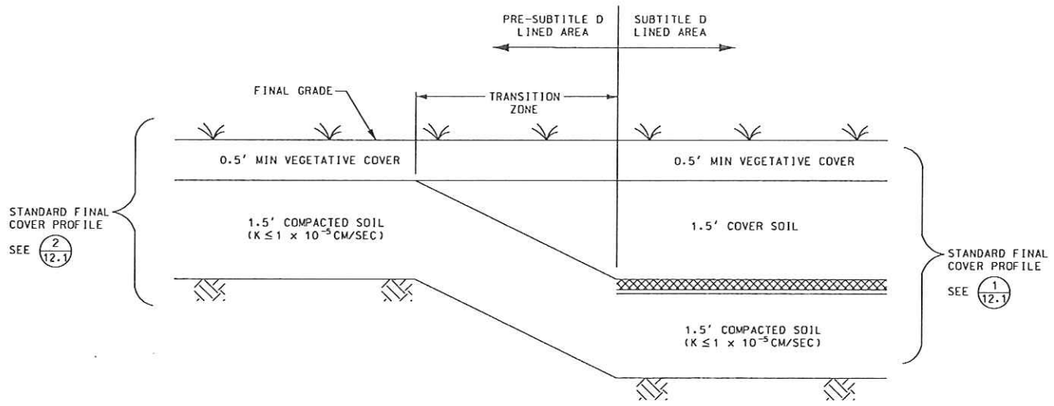

TYPICAL FINAL COVER TIE-IN FOR PRE-SUBTITLE D CROSS-SLOPE AREA (1/12.5)

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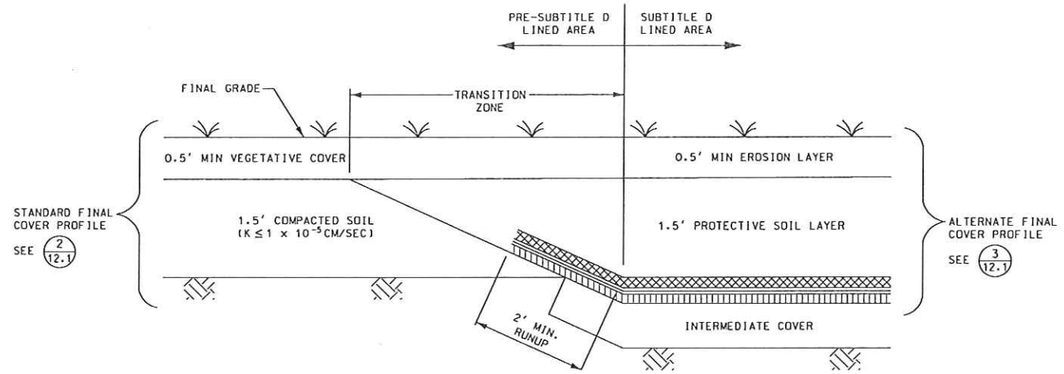

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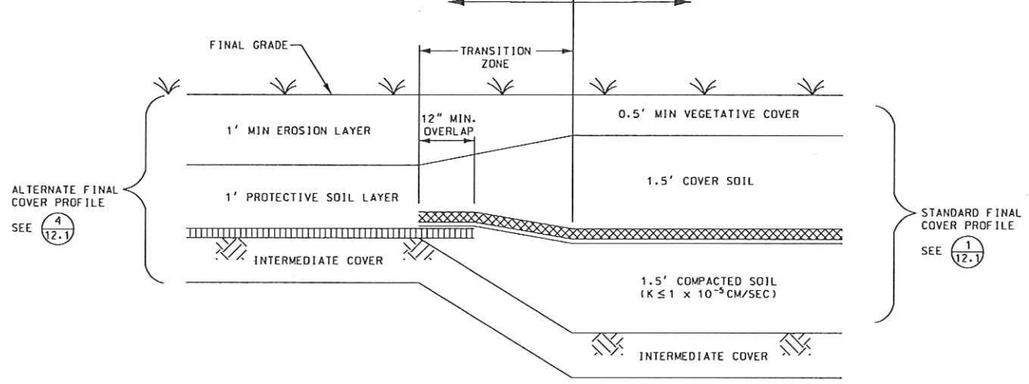

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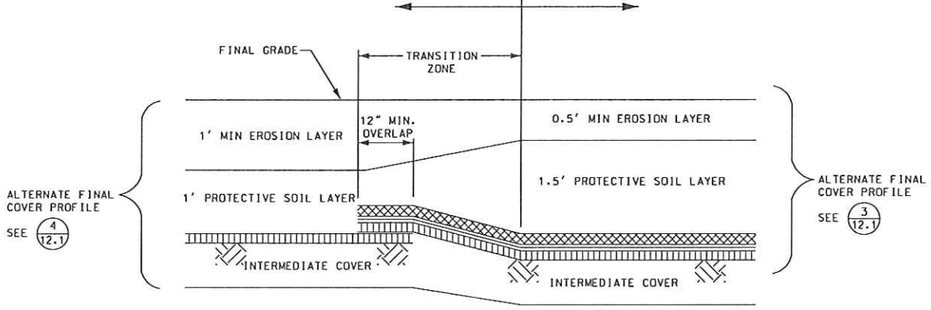

TYPICAL FINAL COVER TIE-IN FOR PRE-SUBTITLE D CROSS-SLOPE AREA (4/12.5)

NTS

FOR PERMIT PURPOSES ONLY

STATE OF TEXAS
STEVEN B. HENIFORD
66257
REGISTERED
PROFESSIONAL ENGINEER
6/18/15

REV	DATE	DESCRIPTION	DES BY	APP BY
1	6/18/15	NOD NO. 1	SBH	SBH

CITY PROJ. No.
AZB PROJ. No. 212029
DATE: AUGUST 2014

DES BY	SH
DRN BY	AZB
CHK BY	SH
APP BY	MC

LAREDO LANDFILL VERTICAL EXPANSION
PERMIT AMENDMENT APPLICATION No. MSW-1693B
WEBB COUNTY, TEXAS

FINAL COVER TIE-IN DETAILS 4 FIGURE III-12.5

CITY OF LAREDO

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ATTACHMENT: III-12

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TBPE FIRM REG. # F-10098
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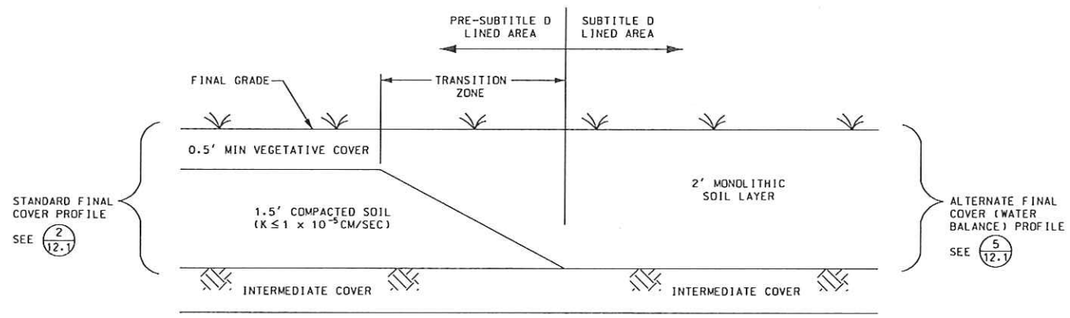
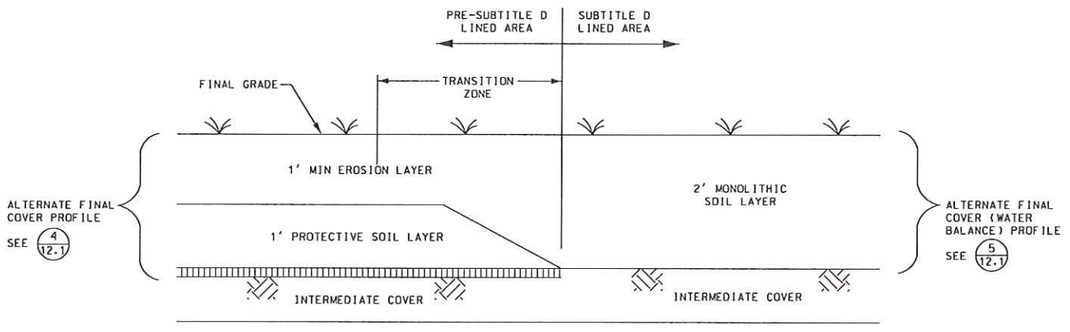


TYPICAL FINAL COVER TIE-IN FOR PRE-SUBTITLE D CROSS-SLOPE AREA 1/12.6

NTS



TYPICAL FINAL COVER TIE-IN FOR PRE-SUBTITLE D CROSS-SLOPE AREA 2/12.6

NTS

FOR PERMIT PURPOSES ONLY

STATE OF TEXAS
STEVEN B. HENIFORD
66257
REGISTERED
PROFESSIONAL ENGINEER
6/18/15

REV	DATE	DESCRIPTION	DES BY	APP BY
1	6/18/15	NOD NO. 1	SBH	SBH

CITY PROJ. No.
AZB PROJ. No. 212029
DATE: AUGUST 2014
DES BY SH
DRN BY AZB
CHK BY SH
APP BY MC

LAREDO LANDFILL VERTICAL EXPANSION
PERMIT AMENDMENT APPLICATION No. MSW-1693B
WEBB COUNTY, TEXAS

FINAL COVER TIE-IN DETAILS 5 FIGURE III-12.6

CITY OF LAREDO

SHEET OF
FILE:
ATTACHMENT: III-12

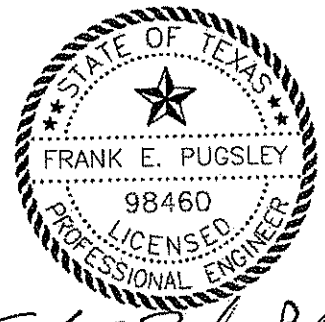
ARREDONDO, ZEPEDA & BRUNZ, LLC
TBPE FIRM REG. # F-10058
CIVIL · ENVIRONMENTAL · SURVEYING
CONSTRUCTION MANAGEMENT · MUNICIPAL

CITY OF LAREDO

MUNICIPAL SOLID WASTE LANDFILL

LAREDO, TEXAS

WEBB COUNTY



F. E. Pugsley, P.E.
6-18-2015

POST CLOSURE PLAN

ATTACHMENT III.13

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

PERMIT NO.: 1693B

Applicant:

City of Laredo Municipal Solid Waste Landfill
Solid Waste Services Department
6912 Highway 359
Laredo, TX 78044

Revised June 2015

Prepared by:

CP&Y, Inc.
1820 Regal Row
Dallas, TX 75235
F-1741

POST CLOSURE PLAN

CITY OF LAREDO

MUNICIPAL SOLID WASTE LANDFILL

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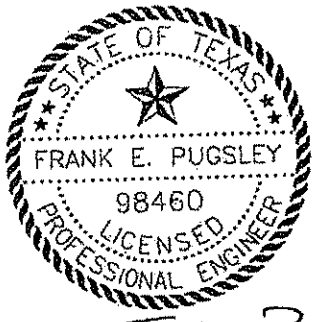


F.E. Pugsley, P.E.
6-18-2015

1. Introduction

The following closure requirements were written to comply with TCEQ Municipal Solid Waste Management Regulations in 30 TAC §330.63(i), §330.463, §330.465, and with EPA's RCRA Subtitle D regulations.

The City of Laredo will be responsible for a total post-closure care period of 30 years, except as specified by Section 3 of this Post Closure Plan. Provisions include a regularly scheduled program to monitor groundwater, landfill gas, maintain berms, cover, vegetation, and site aesthetics; and to repair erosion and subsidence problems promptly. Annual inspection will be in accordance with the Site Operating Plan. The TCEQ and the City shall retain right of entry for the post closure period for inspections, maintenance and/or remediation activities as needed to maintain the integrity of the closed facility.

2. Post Closure Care Requirements

In accordance with §330.463, the City of Laredo shall meet the following requirements during post closure.

2.1. Post Closure Care Requirements §330.463(b)

After a licensed Professional Engineer has certified the completion of closure requirements for the Landfill and it has been accepted by the Executive Director, the City of Laredo shall conduct post-closure care maintenance for the unit or facility for 30 years, except as specified by Section 3 of this Post Closure Plan. Post-closure care maintenance shall consist, at a minimum, of the following.

- The City shall retain the right of entry to and maintain all rights-of-way to the Landfill and conduct maintenance and/or remediation activities as needed in order to maintain the integrity and effectiveness of all final cover, facility vegetation and drainage control systems, to correct any effects of settlement, subsidence, ponded water, erosion or other events or failures detrimental to the integrity of the closed unit and to prevent any surface run-on and run-off from eroding or otherwise damaging the final cover system.
- The City will continue to maintain and operate the leachate collection system in accordance with the regulations in §330.331 and §330.333. The Executive Director may allow the City to stop managing leachate if the City can demonstrate that leachate no longer poses a threat to human health and the environment.
- The City shall monitor groundwater in accordance the Groundwater Sampling and Analysis Plan (GWSAP) Attachment III-11)
- The City shall maintain and operate the gas monitoring system in accordance with the requirements of §330.371(e).

3. Length of Post Closure Care §330.463(b)(2)

The length of the post-closure care period may be

- decreased by the Executive Director if the owner or operator submits to the Executive Director for review and approval a documented certification, signed by a licensed Professional Engineer and including all applicable documentation necessary to support the certification, that demonstrates that the reduced period is sufficient to protect human health and the environment; or,
- increased by the Executive Director if it is determined that the lengthened period is necessary to protect human health and the environment. If there is evidence of a release of leachate from a municipal solid waste unit, the Executive Director may require an investigation into the nature and extent of the release and an assessment of measures necessary to correct any impact to groundwater.

4. Monitoring and Maintenance Activities §330.463(b)(3)(A)

The City shall place a copy of the Post Closure Plan in the operating record immediately upon approval by TCEQ. For the complete post closure maintenance period the City shall perform the following:

- Maintain and operate the leachate collection system until such time as the Executive Director determines that leachate no longer poses a threat to human health and the environment.
- Make semiannual visits to the site to monitor the groundwater in accordance with the GWSAP.
- Make Quarterly visits to the site to monitor the landfill gas.
- During the first 5 years make monthly visits to:
    - Inspect the site for erosion of the final cover, lack of appropriate vegetative growth, any ponding of water on the closed unit, and any evidence of gas or leachate migration;
    - Correct any deficiencies noted; and
    - Prepare a report of the site visit and actions taken and place it in the facility records.
- For the remaining twenty five years, inspection visits shall be semiannually for all monitoring and inspection activities, with the exception of gas monitoring, which shall remain quarterly.

5. Post Closure Care Contact Information §330.463(b)(3)(B)

The name, address, and telephone number of the office or person responsible for overseeing and/or conducting the post-closure care maintenance activities at the closed unit or facility during the post-closure period. Currently, the person responsible for post closure maintenance is:

Manager, Solid Waste Services
City of Laredo
P.O. Box 1965
Laredo, Texas 78044
(956) 795-2510

6. Planned Uses §330.463(b)(3)(C)

In accordance with §330.465, portions of the site may be used as public parkland, or other suitable land uses during or after the post closure period. Post-closure uses shall not in any way jeopardize the integrity of the landfill cover, liner, stormwater systems, leachate systems, or gas systems.

7. Post Closure Cost Estimate §330.463(b)(3)(D)

A detailed written estimate, in current dollars (2015), of the cost of post-closure care maintenance and any corrective action as described in the post-closure care plan, required by the Executive Director of the TCEQ, is presented in Table 1.

The largest area requiring post-closure care is 200acres. In accordance with §330.507(a)(1) & (2), an increase in post-closure care cost estimate shall be made if changes in the post-closure care plan or unit conditions increase the maximum costs of post closure care. Additionally, a reduction in post-closure cost estimate may be allowed if the cost estimate exceeds the maximum costs of post-closure care remaining over the post-closure care period, and the City has provided written notice to the executive director of the detailed justification. The City may request a reduction in the cost estimate and the financial assurance as a permit modification.

TABLE 1
POST CLOSURE CARE COST ESTIMATE

Post Closure Care Cost Estimate

The folowing is a detailed estimate, in current dollars (2015), of the cost of post-closure care maintenance and any corrective action as described in the post-closure care plan as required by §330.463(b)(3)(D). The largest area requiring post-closure care is 200 acres.

Engineering Costs

Cost Item	Unit	Cost	Quantity	Total Cost
Post Closure Plan	Acre	$100.00	200	$20,000.00
Site Inspection & Record Keeping	Lump Sum	$4,000.00	1	$4,000.00
Correctional Plans & Specifications	Acre	$250.00	200	$50,000.00
Subtotal				$74,000.00
10% Contingency				$7,400.00
Engineering Total				**$81,400.00**

Site Monitoring Costs

Cost Item	Unit	Cost	Quantity	Total Cost
Ground Water Monitoring (12 Wells, Annual)	Each	$2,500.00	12	$30,000.00
Gas Monitoring (21 Probes Quarterly)	Per Quarter	$1,500.00	4	$6,000.00
Leachate Disposal (50 gallons/day/acre)	Per Gallon	$0.05	31,250	$1,562.50
Final Cover Inspection for Vegetation (5 Years)	Quarterly	$500.00	20	$10,000.00
Subtotal				$47,562.50
10% Contingency				$4,756.25
Site Monitoring Total				**$52,318.75**

Construction Costs

Cost Item	Unit	Cost	Quantity	Total Cost
Site Maintenance, Correctional Construction	Acre	$130.00	200	$26,000.00
Subtotal				$26,000.00
10% Contingency				$2,600.00
Construction Total				**$28,600.00**

Annual Cost for Post Closure Care	**$162,318.75**
Total Cost 30-year	**$4,869,562.50**

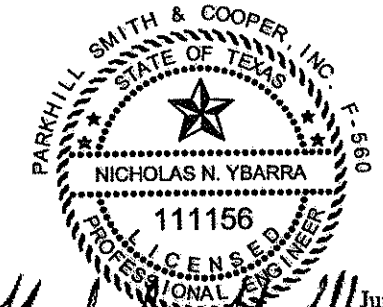
8. Certification of Completion of Post Closure §330.465

In accordance with §330.465, Following completion of the post-closure care maintenance period, the City of Laredo shall submit to the Executive Director for review and approval a certification signed by an independent, licensed Professional Engineer, verifying that post closure care has been completed in accordance with the approved post closure care plan. The submittal to the Executive Director shall include all applicable documentation necessary for the certification of completion of post closure care.

Upon completion of the post closure care period for the final unit at the facility, the City shall also submit to the Executive Director a request for voluntary revocation of the facility permit.

City of Laredo Landfill Permit Amendment 1693B
City of Laredo, Texas
Permit Amendment MSW Permit 1693B
Laredo, Texas
Webb County, Texas
August 2014

PART III
Attachment 14
Gas Management Plan



June 19, 2015

LAREDO LANDFILL
Gas Management Plan

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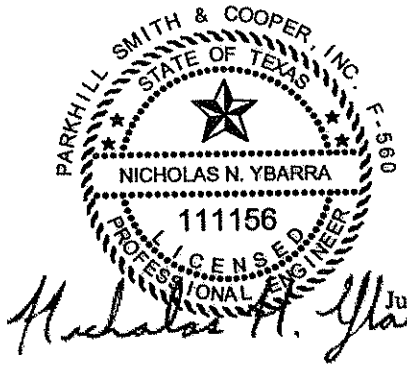

June 19, 2015

1.0 INTRODUCTION

The purpose of this Landfill Gas Management Plan (LGMP) is to provide a management guide for monitoring and controlling landfill gas generated by the City of Laredo's Landfill ("Landfill"). The LGMP specifically addresses background information related to gas generation including site specific information; gas generation characteristics; landfill gas monitoring procedures; and a contingency plan to manage gas when generation exceeds safe levels.

This plan has been prepared in accordance with the requirement of the Texas Commission on Environmental Quality (TCEQ) as prescribed in 30 TAC §330.371- Landfill Gas Management.

The monitoring and management programs described in this plan will ensure that the concentration of methane generated by facility (i) does not exceed 25% (1.25% by volume) of the lower explosive limit for methane in the facility structures (excluding gas control or recovery system components); and (ii) does not exceed the lower explosive limit (the lowest percent by volume or 5% by volume of a mixture of explosive gases in air that will propagate a flame at 25 degrees Celsius and atmospheric pressure) for methane at the facility property boundary.

2.0 BACKGROUND INFORMATION

2.1 General

The Landfill is a 203.12 acre site located north of SH 359 and is approximately 2 miles East of the SH 359 and Loop 20 intersection in Webb County. The Landfill is located within Laredo's city limits.

2.1.1 Pre-2013 Permit Amendment Conditions

The Landfill has been in operation since March 10, 1986 (Permit No. MSW-1693) and is constructed as an area fill. Portions of the Landfill were constructed prior to Subtitle D regulations. The Landfill has areas constructed with a compacted clay liner only; with a clay liner and geosynthetic liner; and with a geosynthetic clay liner (gcl) and geosynthetic liner. The areas of the Landfill that have a Subtitle D liner also have leachate collection systems installed. The fourth phase of the original design is a construction/ demolition fill area. This area was constructed with a compacted clay liner and only one third of the area has been filled. It is the City's intent as part of this permit amendment to convert this Type IV area to a Type I areas.

Three phases of the original Landfill design were permitted as Type I areas authorized to accept municipal solid waste. Wastes authorized to be accepted in this phase include municipal solid waste resulting from or incidental to municipal, community, commercial, institutional, and recreational activities; MSW resulting from construction or demolition projects; Class 2 industrial solid waste; Class 3 industrial solid waste; and special waste that has been properly defined. The acceptance of Class 2 industrial solid waste and/or special waste is contingent upon waste being handled in accordance with the City's permit. Wastes that are prohibited at the site include Class 1 Industrial Solid Waste until it complies with the requirements of 30 TAC §

330.171. Regulated hazardous waste, except for waste from conditionally exempt small quantity generators, are not accepted at the facility. Polychlorinated Biphenyls (PCBs) wastes as defined in 30 §TAC 330.3, Class 2 and Class 3 industrial solid waste that interferes with the site operations, radioactive wastes, lead-acid batteries, Chlorofluorocarbon (CFC) - containing equipment, whole tires, and used oil and oil filters are not be accepted at the facility.

In 1999, a permit amendment was approved that increased the height of the landfill elevation from 548 feet to 640.5 feet. Approximately 150 acres out of 200 acres are designated as disposal operation landfill area.

A 345kv electric power line easement intersects the landfill in a north/south direction and an abandoned gas pipeline easement intersects the property in an east/west direction. Operations are currently taking place in Phase 2 of the landfill. Phase 3 is scheduled for construction in 2014. Operations in Phase 3 will take place in either 2014 or 2015.

2.1.2 Proposed Amendment Site Configuration

Future Landfill cells will be constructed with either Subtitle D liners (or equivalent) and leachate collection systems to protect groundwater and surface water resources. The liner may include either a standard Subtitle D liner system or may use geosynthetic clay liner in place of clay. Leachate collected from the system will be treated at the City's waste water treatment facility or recirculated over areas where there is a standard Subtitle D liner, or hauled to another publicly owned treatment works (POTW).

The height of the landfill will be increased as previously mentioned. In areas where the vertical expansion occurs over non-Subtitle D lined areas, the City will install a liner to direct leachate generated from waste that is put in place above the 1999 permitted elevations permitted to a leachate collection system.

2.1.2.1 Landfill Liner

Prior to changes in state and federal landfill regulations going into effect in 1988, it was Laredo's practice, consistent with industry standards of the time, to utilize compacted in-situ material for the landfill liner. Cells constructed in Phase I and one cell in Phase II were constructed prior to the implementation of Subtitle D regulations. Table III-14.1 presents a summary of liner configurations for the four currently permitted phases of the Landfill. The existing Phase 4 (Type IV cell) utilizes an approved liner consisting of a geosynthetic clay liner (GCL). Construction is underway in Phase 3 which will be a GCL with 60 mil HDPE. Refer to Attachment 15, Leachate Collection Plan for a detailed discussion of liner systems.

Table III-14.1
Cell Dimensions

Cell Identification	Size (square acres)	Liner Design	Status (2013)
Phase 1			
Cell 1	3.91	In-situ compacted clay	Constructed
Cell 2	3.2	In-situ compacted clay	Constructed
Cell 3	2.96	In-situ compacted clay	Constructed
Cell 4	2.62	In-situ compacted clay	Constructed
Cell 5	2.15	In-situ compacted clay	Constructed
Cell 6	2.15	In-situ compacted clay	Constructed
Cell 7	2.15	In-situ compacted clay	Constructed
Cell 8	2.15	In-situ compacted clay	Constructed
Cell 9	2.15	In-situ compacted clay	Constructed
Cell 10	2.15	In-situ compacted clay	Constructed
Cell 11	2.15	In-situ compacted clay	Constructed
Cell 12	2.15	In-situ compacted clay	Constructed
Cell 13	2.90	In-situ compacted clay	Constructed
Cell 14	2.75	In-situ compacted clay	Constructed
Cell 15	2.69	In-situ compacted clay	Constructed
Cell 16	2.58	In-situ compacted clay	Constructed
Cell 17	7.90	GCL, 60 mil HDPE	Constructed
Cell 18	9.86	GCL, 60 mil HDPE	Constructed
Phase 2			
Cell 1	5.24	In-situ compacted clay	Constructed
Cell 2	5.24	GCL, 60 mil HDPE	Constructed
Cell 3	3.58	2’ clay, 60 mil HDPE	Constructed
Cell 4	2.75	2’ clay, GCL, 60 mil HDPE	Constructed
Cell 5/6	7.94	GCL, 60 mil HDPE	Constructed
Cell 7/8	6.25	GCL, 60 mil HDPE	Constructed
Cell 9/10	6.42	GCL, 60 mil HDPE	Constructed
Cell 11/12	6.48	GCL, 60 mil HDPE	Constructed
Cell 13/14	18.90	GCL, 60 mil HDPE	Constructed
Phase 3			
Cell 1	9.2	GCL, 60 mil HDPE	Completed in 2015 – Accepting waste
Cell 2	13.56	GCL, 60 mil HDPE	Not constructed – construction will be initiated after permit amendment

Phase 4			
Cell 1	6.56	GCL (existing waste to be overlain with GCL and Geocomposite)	Constructed with the exception of overlay liner
Cell 2	2.51	GCL, 60 mil HDPE	Not constructed
Cell 3	6.19	GCL, 60 mil HDPE	Not constructed
Phase 5			
Cell 1	3.77	GCL, 60 mil HDPE	Not constructed

The temporary leachate storage tank is relocated to an area on the west side of the CPL electric easement, where Phase 4 is located. A permanent leachate storage tank will be located on the additional 3.1 acres that is being added to the permitted area. The relocation of the leachate storage tank was approved as part of a 2014 permit modification.

2.1.2.2 Landfill Final Cover

Once areas have been filled, a final cover system will be constructed. The final cover options available to the City will include: (i) a Standard Subtitle D final cover system; (ii) the use of GCL as an alternative to clay; and (iii) a "water balance" cover that provides sufficient cover with soil versus the use of plastic material to enhance long-term slope stability. The City will maintain vegetation to the extent practical given Laredo's lack of rainfall and poor soils or use a rock armor option in place of vegetation. The City will continuously monitor the site's slopes, through closure and post-closure care for erosion, and make necessary improvements to maintain the integrity of the final cover. Refer to the Final Cover Plan for more details.

2.2 Site Operations

Since its initial opening, the City has continuously upgraded its operations to meet state and federal rule changes in the construction of liners, leachate collection systems, intermediate and final cover and landfill gas management plans. In 1999, the Landfill Permit was amended to increase the height of the landfill. The design and the operation of the Landfill meet existing TCEQ and federal standards.

This additional capacity will increase the landfill from roughly 4.8 million cubic yards to 8.9 million cubic yards. The newly developed area will be identified as an expanded Phase 2 (between original Phases 2 and 3) and Phase 5 (between original Phases 1 and 4).

2.2.1 Current Gas Management System

The Landfill operates under Title V Air Permit Number 02371 and holds a TCEQ general operating permit (GOP) number 517. The Laredo Landfill is considered a Category -2 MSWLF which is defined as follows.

- A design capacity greater than or equal to 2.5 million megagrams,
- A design capacity greater than or equal to 2.5 million cubic meters, and
- A calculated uncontrolled non-methane organic compound (NMOC) emission rate less than 50 megagrams per year that is operated in accordance with 40 CFR Part 60, Subpart WWW or Chapter 113, Subchapter D of this title 30 of the TAC

Because the Landfill is subject to the requirements of 40 CFR 60 Subpart WWW (Standards of Performance for Municipal Solid Waste Landfills) it is also required to have a Title V permit in accordance with 40 CFR Parts 70 and 71. Since the Landfill's capacity exceeds 2.5 megagrams (MMg), it is subject to 40 CFR 60.752(b) which requires the Landfill to determine annually if its uncontrolled nonmethane organic compounds (NMOC) emission rate exceeds 50 MMg per year. The NMOC may be determined by calcuations using the Tier I approach or by measurement of NMOC using the Tier II approach if the value exceeds 50 MMg per year.

In accordance with Title 30 of the TAC Sections 330.371 (landfill gas management) and 330.159 (landfill gas control), and the City's 1999 gas management plan the City monitors landfill gas around the perimeter of the Landfill. In 2003, the City identified methane gas above the state regulatory limit of 5% by volume in air along the north permit boundary of the Landfill. In response, the City submitted a permit modification which was approved by the TCEQ on August 8, 2003 to mitigate the migration of the landfill gas via the installation of landfill gas extraction wells. The installation of additional wells was completed in 2004. The current landfill gas management system includes a total of 20 gas collection wells that are located on the northern section of the site (refer to Figure 14.1). These wells are connected to a pipeline which transports the gas to a flare facility located on the north side of the Landfill. There are also a total of 18 gas monitoring probes located around the perimeter of the site (refer to Figure 14.1)

Figure 14-1 - Original Cell and Phase Layout with Monitoring Gas Probes Location

2.3 Site Information

2.3.1 Geology

The landfill facility is located on an outcrop of the Laredo Formation. The Laredo Formation is a geologic unit occurring in the Claibome Group of the Eocene Series within the Tertiary System. The Geologic Atlas of Texas, Laredo Sheet, 1976, characterizes the Laredo Formation as sandstone and clay with thick sandstone members in the upper and lower surface. The formation is described as very fine to fine-grained, in part glauconitic, micaceous, ferruginous, cross-bedded, dominantly red and brown with clay in the middle. It weathers to an orange-yellow color with dark gray limestone layers and concretions, some of which are fossiliferous with abundant marine megafossils. The average thickness beneath the facility is about 620 feet. The site geology has been previously described in various site investigation reports, Huntingdon, 1994, F. G. Bryant, 1983, and Rust E&I (REI), 1997.

The upper Laredo Formation beneath the facility was further informally subdivided into four hydrogeologic units known as Layers I-IV during the 1997 subsurface investigation conducted by REI.

2.3.2 Hydrogeologic Conditions

Ground-water conditions at the Laredo facility have been described in a total of four reports prepared as part of three subsurface investigations and on-going monitoring events. First, the ground-water conditions were studied by Frank G. Bryant and Associates, Inc. in September 1983. It indicates that ground water was not present above the 40 feet below ground surface. The further investigation shows the ground water range between 40.5 feet to 48.8 feet below ground surface. In January 1999, ground water was measured and ranged from 423.15'msl near the southeastern corner of the facility, to 475.60' msl, near the southwestern corner of the facility. However, groundwater generally flows from the southwest corner to the north and northeast. In a July 2014 ground water monitoring event, groundwater was measured at between 430 to 472.

2.3.3 Hydraulic Conditions

Topography at the site shows the highest elevation is approximately 540' msl in the southwest corner, and the lowest elevation of approximately 470' msl is near the northeast corner. The maximum elevation change across the site is approximately 94'. The highest proposed final contour would be 664' msn at the west landfill and 652' msl at the east landfill as shown on Figure III.1.2 – Overall Site Development Plan.

2.3.4 On-site Structure

The gatehouse and the flare building are the only onsite structures at the landfill. The gatehouse is occupied whenever the Landfill is in operation; the flare building is only occupied periodically during inspection and routine maintenance. Neither of these structures is located over filled areas; no waste is planned to be filled at these locations in the future. On-site structures and any other area where potential gas buildup would be of concern will be monitored continuously by a

device such as the Sierra Model 4101-28 Combustion Gas Monitoring, or equivalent; to ensure concentrations do not exceed 1.25% by volume in facility structures. Gatehouse and flare building are to be monitored as well as any additional structures that may be constructed. Areas within the structures to be monitored include corners, baseboards, crawl spaces, attics, and utility services.

2.3.5 Easement, Right-of-Way and Utilities

There is one easement recorded within the Laredo facility permit boundary. The easement owners and descriptions follows.

- Central Power & Light P.O. Box 2121Corpus Christi, TX 78403. Tel: 1-800-274-2611

  The 70 foot wide overhead electric transmission line easement bisects the site in a north-south direction. Disposal operations will not occur within 25 feet of the easement.

2.3.6 Drainage

The newly modified onsite detention ponds will be at the southeast corner, the northwest corner and north part of the Landfill along the utility easement to capture the increasing runoff from the newly developed Laredo Landfill. The location of easement and detention ponds are depicted in Attachments III-1 and III-6.

2.3.7 Surrounding Land Use

The Landfill Gas Management Plan (LGMP) also identifies surrounding land use as it relates to the Landfill. There is currently a mixture of ranch land, vacant property, commercial, light industrial and residential uses within a 1-mile radius of the site. A description of each surrounding quadrant is detailed below:

- Northeast Side: This area consists of ranch land with the Texas Mexican Railroad right-of-way. There are also 13 stock tanks in this area.
- East Side: This area is primarily ranch land with 7 stock tanks, 3 businesses, and 5 residences.
- West Side: This area includes a mixture of residential, commercial, and industrial land. The Larga Vista Subdivision consists of approximately 120 homes, including the Larga Vista Head Start School. There is also an industrial park situated in this area that consists of approximately 20 businesses. Lastly, there are a few additional scattered businesses and 6 stock tanks in this area.
- Southwest Side: This area includes a mixture of ranch land, commercial (Bordertown Flea Market), industrial (Enron, Chevron, and Leckendeyer Oil), and scattered residential. This area also includes 9 stock tanks.

2.3.8 Off-site Structures Within 1,000 Feet of Facility Boundary

There are off-site structures within 1,000 feet of the landfill facility boundary. According to Section 2.2.8 Surrounding Land Use, the ranch land with the Texas Mexican Railroad right-of-way is approximately 250 feet north of the northern boundary of the site. Moreover, there are 2 oil and/or gas production facilities located to the north and south of the landfill within 500 feet as identified by Texas Railroad Commission (TRC).

3.0 LANDFILL GAS (LFG)

As waste decomposes gas is generated within a landfill. Landfill gas (LFG) is a by-product of this decomposition or in this case, biodegradation process of municipal solid waste. There are two stages of decomposition. The first stage transforms complex materials into simple organic materials. During the second stage, the simple organics are consumed by bacteria and converted into methane (CH_4) and carbon dioxide (CO_2). Although two primary components of LFG are methane and carbon dioxide, there are also trace amounts of oxygen (O_2), water (H_2O), nitrogen (N_2), hydrogen sulfide (H_2S) and small amount of non-methane organic compounds (NMOC) in LFG. However, when gas generation reaches steady-state conditions at disposal facilities, typical LFG consists of approximately equal amounts of methane (CH4) and carbon dioxide (CO2); and only trace amounts of NMOC (normally, less than two percent) according to AP-42 dated September 2008.

Landfill gas generation rates depend on the rate of decomposition for which the characteristics are affected by the following conditions.

- Moisture content of the waste
- Temperature
- Permeability of soil cover and cover material
- Amount of precipitation
- Composition of the refuse
- Refuse particle size
- Compaction and amount of the refuse
- Age of refuse
- PH of the waste
- Landfilling practices

The landfill gas can vary according to the site specific conditions. However, the general landfill gas compositions of 45% to 60% methane and 40% to 60% carbon dioxide are not uncommon.

Landfill gas that is produced within the MSW landfill will generally drift from the landfill. Landfill gasses can migrate through the soils or through ambient air (dispersion). The production of landfill gas results in pressure gradients (advection) and concentration gradients (diffusion) between the landfill and the surrounding environment. Landfill gas will migrate from the source area (landfill) along the path of least resistance due to pressure, density, and concentration gradients. Methane is lighter than air and carbon dioxide is heavier than air. However, they will not separate by their individual density but rather move as a mass in accordance with the density of the mixture and other gradients such as temperature and partial pressure. This usually results in landfill gas moving upward through the landfill surface into the landfill gas collection system

or through the surface soils into ambient air. The upward movement of landfill gas can be inhibited by compacted waste or landfill cover materials. This can result in landfill gas migrating horizontally through the waste mass into surrounding soils, utility conduits or structures if an adequate gas collection system is not designed and constructed.

Due to primary health and safety concerns with off-site migration of landfill gas, the Texas Commission on Environmental Quality (TCEQ) has published the regulation, particularly 30 TAC §330.371 - Landfill Gas Management, in order to eliminate the potential gas hazard. The regulation requires the monitoring and testing of the facility gas and permitted boundary of the landfill.

The city of Laredo Landfill will demonstrate compliance with the TCEQ 30 TAC - 330.371 requirement through this site specific Landfill Gas Management Plan (LGMP).
The key items incorporated in this guideline are as follows:

- Gas Monitoring Procedure
- Permanent Probe and Bar-hole Probe Design and Operation
- Data Record and Report
- Contingency Plan
- Safety Plan

4.0 LANDFILL GAS MONITORING

4.1 Proposed Landfill Gas Monitoring Procedure

Due to the explosive nature of landfill gas (LFG) it is necessary to monitor areas within the landfill boundary. In order to eliminate the potential hazards from LFG, the City will implement a monitoring procedure to meet the monitoring requirement of the Texas Commission on Environmental Quality (TCEQ) as listed in 30 § TAC 330.371(b)(2). The procedure will include the use of either soil gas vapor probes (SGVP) or permanent monitoring probes, or both, to monitor and measure any subsurface migration of methane gas. SGVPs may be used as an initial screening device for determining the optimal location boring locations and identify permanent probe locations.

TCEQ requires quarterly monitoring at individual, permanent monitoring gas probe locations. If necessary, bar-hole probes can also be used to help determine the location and size of any migration limits of landfill gas. The bar-hole probes will also aid in the determination of the effectiveness of any implemented landfill gas control measures.

The Laredo landfill has an existing permanent monitoring gas probe (GP) network already in place. There are 18 permanent probes around the site's boundary to detect the explosive gas concentrations. Refer to figure III.14.1.

The first installation of 13 gas probes began monitoring methane levels around the early 1990s. The other 8 permanent gas probes at the site with Subtitle D permit modification were placed around 2004. These additional 8 probes were installed in order to reach the proposed top of liner

depths and to supplement information provided by the first 13 probes. This will ensure the monitoring achieves less distance for gas migration. Locations of these existing 21 monitoring gas probes (GP) were based upon the proximity of habitable structures, depth and location of solid waste and easements, access, site geology, and groundwater depths. A revision to the Gas Plan, dated March 2006, reduced the number of probes from 21 to 18. GP 15, GP 16 and GP 17 are no longer being monitored on a quarterly basis. GP 8R, GP 7, GP 14, and GP 6 are located along the eastern perimeter of the landfill. GP 8R is located at the location of the abandoned pipeline to monitor possible migration through this area. GP 13 and GP 20 are located at the western end of the abandoned pipeline. GP 9, GP 10, and GP 18 are located along the southern boundary of the landfill. GP 10 is located near the scale house to monitor possible migration to this facility. GP 19, GP 12, GP 20, GP 13, GP 21, and GP 1 are located on the western perimeter of the landfill. The probes will identify possible migration to sites to the west of the landfill. GP 2, GP 3, GP 4, and GP 5R monitor possible gas migration on the northern perimeter.

The existing permanent 18 MP locations indicated above are shown on Figure III-14.1.

4.1.1 SGVP and Permanent Probe Design and Installation

The existing 21 permanent monitoring gas probes have 2 components; 1) riser pipe and 2) screened section. Screened section is made from 1-inch diameter schedule 40 PVC pipe. The riser section consists of a 2-inch diameter schedule 40 PVC solid pipe 3-5 feet above the ground and extents to 5 feet below the ground surface. The tip of the underground riser pipe is connected with the screened section to reach the final depth of each GP. The existing GPs location is detailed in Table 15-2 - Existing GP Elevation Detail in Laredo Landfill.

The final design depth of the initial permanent GP installation will be determined by the depth of nearby existing probes, the depth of base of the nearby waste cell, and the highest measured groundwater elevation at that location. If necessary, a field change for each GP will be made and recorded on-site. A typical single screen probe is shown in Figure 14.2 - Typical Landfill Gas Probe Detail. Copies of the record drawings and associated information will be submitted to the TCEQ, when the Laredo landfill needs to install the new permanent GP.

Table 14.2
Existing GP Elevation Detail in Laredo Landfill

Monitoring Gas Probe ID	Total GP Depth (ft)	Depth to Top of Screen (ft)	Length of Screen (ft)
GP-1	26.0	5	19.9
GP-2	30.9	5	24.8
GP-3	31.8	5	25.7
GP-4	31.0	5	24.9
GP-5R	32.2	5	26.1
GP-6	26.5	5	20.4
GP-7	18.1	5	12.0
GP-8R	47.0	5	40.9
GP-9	30.0	5	23.9
GP-10	31.4	5	25.3
GP-11	31.0	5	24.9
GP-12	29.0	5	22.9
GP-13	29.0	5	22.9
GP-14	35.0	5	28.9
GP-18	45.0	5	38.9
GP-19	70.0	5	63.9
GP-20	40.0	5	33.9
GP-21	NA		
Scale House			

In the event additional GPs are needed, the guidelines in this section should be used for design and installation.

A licensed Professional Engineer (PE) must review all applicable test procedures, shop drawings, reports, manufacturer instructions and the manufacture's certificates to verify that methane monitoring system equipment conforms to the manufacturing requirement and industry standard prior to SGVP construction. Typical SGVP construction leaves probe tips embedded at the desired sampling depth together with sampling tubes connected to the tips which runs to the surface for sample collection. During construction, a qualified system inspector will inspect the probe installation to prevent failure of the system. The SGVP can be used as the site permit boundary monitoring system instead of permanent GP. However, when any such SGVP location detects methane gas above 5%, a permanent GP must be installed.

The process prior to installation of the permanent GP is similar to the SGVP installation. A permanent GP is drilled by the qualified drilling contractor. The following characteristics will be considered in the design and installation of the new permanent GP:

- Geology
- Proximity of on-site and nearby structures
- Permanent low seasonal underground water table
- Depth of the solid waste

4.1.2 Monitoring SGVPs and Permanent Gas Monitoring Probes

Methane monitoring will be conducted by means of testing GPs. The monitoring frequency of each permanent probe will be increased if explosive gas exceeds 5% explosive gas by volume. The equipment to monitor the gas probe should be able to measure methane gas pressure and atmospheric pressure, methane gas temperature and ambient air temperature, methane gas level, and water depth in the probe. The minimum parameters needed to monitor explosive gas probes are:

- Static Gas Pressure - A suitable pressure gauge such as the Dwyer Series 2000 Magnehelic Gauge (Appendix B), or equivalent
- Explosive Gas - A suitable monitoring device must have a Dual Range Methane Monitoring with the ability to measure the combustible explosive gas indicator (CGI) and infrared gas detection device or equivalent.

The result of the pressure measured in the gas probe can fluctuate, causing inaccuracies if venting has occurred during the monitoring.

Figure III-14-2 - Typical Landfill Gas Probe and Multi Level Probe Detail

A Landtec Gem™ 2000 natural gas indicator or equivalent may be used as an alternative when the present oxygen is monitored and measured in the GP to ensure the adequate oxygen level for the precise reading result. The Landtec Gem™ 2000 also requires that the GP shall have at least 30 seconds constant methane gas level by using the hand pump to sufficiently evacuate the GP. This device measures a wide range (0 to 100% by volume of methane in air) first. If the device shows a result of methane below 5% by volume, then a second test will be performed. Its range is much smaller (0 to 5% by volume of methane in air). The second test is required to obtain an accurate methane reading.

The monitoring information, including the GP location, date, time, condition of GP, GP pressure, methane level, ambient air temperature and ambient air pressure is recorded at each test on the field data form as shown on the Appendix 14A - Field Data Form. If methane gas in any location is above the TCEQ limit (LEL) the data is immediately verified and reported as described in Section 5.0 CONTINGENCY PLAN.

The City will sample for specific trace gases if required by the ED.

4.1.3 Bar-hole Probe Installation and Monitoring Procedure

The City will use bar-hole probes as a support mechanism to obtain the additional methane gas migration data at shallow areas. This probe will help to determine any tracking or distance of methane migration after the permanent GP at the Landfill's point of compliance detects the methane gas. The monitoring bar-hole probe activities are performed under the supervision of the Landfill Site Manager or Site Supervisor.

Prior to bar-hole probing, staff will prevent the metal plunger bar contacting and possibly damaging any subsurface utilities especially around the structure (gatehouse) on site. Only the person with good knowledge of the site will perform this task. A review of utility maps showing clearly any marked utilities will be conducted prior to bar-hole probing. If the water or mud covers the bar-hole probe location, a nearby dry location should be selected or the probing procedure should stop temporarily for that particular probing location until it is dried out. All precaution shall be taken to eliminate the moisture in the monitoring instrument. Any unusual or abnormal probe location should be noted in the field data form as shown on Appendix 14A - Field Data Form.

The bar-hole sampling procedure will involve pushing the metal plunger bar with a half or three-quarter inch diameter probe into two to three feet below the ground surface to ensure the reading is from the ground atmosphere versus surface atmosphere. Upon removal the plunger bar, a probe connected to a MDU 420 Data logging monitor dual range natural gas indicator, or equivalent, will be inserted into the bar-hole and sealed to prevent the ambient air getting into the sample. The methane level and any necessary data from each desired bar-hole probe location will be taken and recorded into the field data form as show on Appendix A - Field Data Form. Prior to measuring the lower range (0%-5% of methane in air), the equipment will measure the higher range (0% to 100% of methane in air) to prevent damage to the sensor if a high amount of methane is present. The bar-hole probe hole will be covered with native soil, after the monitoring is completed.

If explosive gas concentration is detected at or above the LEL at any bar-hole location, the additional bar-holes will be used to check the distance of the gas migration. The additional probe locations will be added in the pattern, at 5 foot increments, to detect the methane level. The 5 feet incremental monitoring must be continued until the reading shows 0% methane level. Information obtained from this procedure will be plotted to determine the extent of gas migration. If no methane gas migrates beyond the permit area, the information will be detailed in the Quarterly Report. If the above LEL methane migration is detected off-site, the detailed information along with the proposed mitigation measurement will be addressed as described in section 5.0 CONTINGENCY PLAN.

4.1.4 Continuous Monitoring of On-site Structures

The gatehouse is the only occupied structure at the Landfill. The gatehouse is not located over a current or planned disposal area. This only permanent on-site occupied structure will be monitored for the potential migration of explosive gas by the using the hand-held explosive gas indicators such as Thermo GasTech Innova Model LS or equivalent. On-site structures and any other area where potential gas buildup would be of concern will be monitored continuously by a device such as the Sierra Model 4101-28 Combustion Gas Monitoring, or equivalent; to ensure concentrations do not exceed 1.25% by volume in facility structures. Gatehouse and flare building are to be monitored as well as any additional structures that may be constructed. Areas within the structures to be monitored include corners, baseboards, crawl spaces, attics, and utility services. The gatehouse or any future structures will be monitored routinely on a quarterly basis.

Any verifiable detection of methane in the gatehouse above the TCEQ requirement will be immediately addressed and reported as described in section 5.0 CONTINGENCY PLAN. In additional the monitoring information such as date, time and condition of each area in gatehouse will be recorded on the field data form as shown on the Appendix 14A - Field Data Form.

4.1.5 Utility Vent Installation and Monitoring

Permanent gas vents will be installed on any future subsurface utility that crosses the permit boundary of the Landfill. Both monitoring and installation activities will be under the supervision of site manager or site supervisor in order to comply with City and TCEQ requirements. A typical utility vent detail drawing will be prepared at the time of installation. The drawing will include all underground utilities and ground surface either near or at the utility vent. In additional, the City will need to obtain the approval from utility owners before utility vent installation.

Utility vents will be monitored quarterly in conjunction with the regularly monitored gas probes around the perimeter site and conform with TCEQ requirements. The exceeding explosive gas level will be addressed and reported in accordance with section 5.0 CONTINGENCY PLAN.

4.1.6 Reporting of Data and Record Keeping

All quarterly monitoring data acquired during the monitoring will be recorded and noted on the field data form as show on Appendix 14A - Field Data Form and kept in the site's operating record. The excess explosive gas level in any location will be reported to TCEQ and necessary organization or personnel. The methane versus time chart will be updated and included in the quarterly report and placed within the seven days after the detecting of above methane gas concentration in the Site Operating Record (SOR) at any monitoring locations.

Documentation of the exceed methane limit required by TCEQ will be submitted to:

- Municipal Solid Waste Permit Section, MC 124
  Texas Commission on Environmental Quality (TCEQ)
  P.O. Box 13087
  Austin, TX 78711-3087
  (512) 239-2335

The report will also include all the information related to the methane gas migration and control as well as records of any contingency plans that were implemented as a result of migration as explained in section 5.0 CONTINGENCY PLAN. Photocopies of completed quarterly reports will be placed in the SOR for the life of the facility, including post closure care.

A separate calibration log for each device will be placed on-site and will include the following information:

- Location of equipment with serial number and model number
- Date and time of calibration
- Name of personnel who calibrates the equipment according to the manufacturing manual
- Type of calibration
- Results of calibration

4.2 Schedule for Installation of Monitoring Elements

The existing 18 permanent GP are already installed as explained in Section 4.1 Proposed Landfill Gas Monitoring Procedure. No additional GP are required at this time. If the City determines that the additional permanent GP, beyond 18 GP shown on Figure 14.1 - Original Cell and Phase Layout with Monitoring Gas Probes Location, are needed, a permit modification request will be prepared and submitted to the TCEQ showing probe recorded drawing, location and installation schedule. After approval from TCEQ, the City will install the probes and submit the as-built documentation after the installation completion.

4.3 Plan Implementation Schedule

The City is at present implementing this Landfill Gas Management Plan as approved with the 1999 permit amendment and since modified. The existing gas control system will continue to serve the landfill and implement this LGMP unless the requirement of Federal New Source Performance Standards and Emission Guidelines modify to different standard.

4.4 Maintenance and Calibration of Monitoring Elements

The City will implement the following maintenance schedule and calibration procedures for the GP elements at the landfill. Training of personnel will be conducted to ensure the integrity of the system.

4.4.1 Maintenance of Permanent Monitoring Probes

A visual inspection of the permanent probes will be conducted on a quarterly basis during the monitoring schedule as required by TCEQ. The frequency of the inspection will increase when the above explosive gas level is detected during the GP monitoring events to prevent the explosive and human health. The visual inspection will include: a) GP label, b) lock, c) condition of protection cover, and d) GP surrounding such as water and stress vegetation.

Any abnormalities or damage to the GP will immediately be calibrated according to the manufacturer's manual and repaired as needed. If the GP is beyond repair, the GP replacement will be installed as described in section 4.1.1 SGVP and Permanent Probe Design and Installation. All the activities will be noted and reported on the field data log for the further determination.

4.4.2 Maintenance of Bar-hole Probe Equipment

The bar-hole probe equipment will be maintained and visually inspected during the monitoring schedule. The visual inspection will be similar to the GP inspection in Section 4.4.1 Maintenance of Permanent Monitoring Probes. The visual inspection and maintenance of bar-hole probe monitoring will include the following tasks: a) plunger bar is clean, b) plunger bar is in good condition with out any damage, and c) the gas monitoring is free of damage and calibrated to conform with manufacturing manual as described in Section 4.4.3 Calibration of Monitoring Instruments.

4.4.3 Calibration of Monitoring Instruments

- ***Continuous Monitoring Devices***
  Continuous monitoring devices such as the Sierra Model 4101-28 Combustion Gas Monitoring, or equivalent, will be maintained and calibrated according to manufacturer's recommendation (Appendix 14C). Maintenance will be conducted quarterly as the monitoring period and will include the following listed below:

  - Verification of power connection to the monitor
  - Ensuring that the outside air does not flow into the monitor
  - Correct Calibration – The manufacturer's instruction manual recommends exposing the sensor to a sample of calibration gas.

- ***Portable Monitoring Devices***
  Portable monitoring equipment such as the Thermo GasTech Innova Model LS gas indicator, or equivalent, will be maintained and according to manufacturer's manual (Appendix 14C). This device calibration will be also conducted during the monitoring period or quarterly basis.

- ***Dwyer Series 2000 Magnehelic Gauge***
  Maintenance of the mahnehelic gauge will consist of a visual inspection of the gauge and inlet lines for damage. The gauge will also be set to zero with the external zero

adjustment screw as required. Calibration of the instrument against a second pressure gauge shall be conducted quarterly or more frequently if methane gas is detected above LEL in any location. This calibration must be performed according to the manufacturer's manual and recommendation (Appendix 14D).

4.5 Post-Closure Landfill Gas Management

The City will maintain the Landfill Gas Monitoring and Control Plan for 30 years following certification of the final closure. The City may request a reduction in monitoring events should no gas migration beyond the property boundary or into on-site structures be demonstrated.

The gas monitoring and control system may be revised as needed. No post-closure land use will interfere with the gas monitoring system and all utility trenches within the facility shall be vented and monitored.

5.0 CONTINGENCY PLAN

The Laredo Landfill will implement the following contingency plan if the landfill gas at any monitoring location exceeds the allowable limits set by the TCEQ (30 § TAC 330.371(a)(2)). The explosive gas reading that is below level of the regulation limit will be recorded in the SOR as the record log for future determination. These records do not have to report to MSW Permit Section.

The immediate action in the event of the explosive gases routine monitoring at the dangerous levels (excess 5% methane by volume) is to protect human health, notify the Commission, local and county officials, emergency officials and the public as necessary. The specific response depends on the circumstances of the situation.

- *Building/Structure*. If monitoring the structure (gatehouse) in the Landfill indicates that 1.25% methane by volume has been exceeded, then the gatehouse will be evacuated by all personnel immediately. City personnel will not be allowed to reenter the gatehouse until additional measures are taken as described in Section 5.2 Verification Procedure below.
- *Property Boundary*. If the explosive gases are identified as exceeding the Lower Explosive Limit (LEL) or above 5% methane by volume at the boundary in any monitoring probes, the immediate emergency response for evacuation procedure will start for all personnel, except the individual performing the monitoring, to leave the vicinity immediately. The site manager and monitoring personnel will determine whether the gatehouse, off-site structure, off-site ranch or off-site facility are at risk and need to start the evacuation procedure.

Location of existing and proposed landfill gas probes, as indicated in Section 4.0, become the relative point of compliance with respect to landfill gas monitoring.

5.1 Contingency Plan Guidelines

This contingency plan guideline will outline the procedure if the methane gas is detected above the allowable maximum limits required by TCEQ for both the boundary (at any landfill gas probes) exceed 5% methane by volume and gatehouse exceed 1.25% methane by volume. The City of Laredo landfill plan will follow these 3 actions required by 30 TAC §330.371(c) as described below:

Action 1: Immediately take all necessary steps to ensure protection of human health and notify the executive director, local and county officials, emergency officials, and the public;

Action 2: Within 7 days of detection, place in the operating record the concentration of methane gas levels detected and a description of the steps taken to protect human health; and

Action 3: Within 60 days of detection implement a remediation plan for the methane gas releases, place a copy of the plan in the operating record, provide a copy to the executive director, and notify the executive director that the plan has been implemented. The plan shall describe the nature and extent of the problem and the proposed remedy. After review, the executive director may require additional remedial measures.

Consistent with the above requirements, notification will be made either in person or by telephone followed by facsimile transmission or certified mail, return receipt requested within 72 hours of the incident. The applicable contact persons are listed below:

- Municipal Solid Waste Permit Section, MC 124
  Texas Commission on Environmental Quality (TCEQ)
  P.O. Box 13087
  Austin, TX 78711-3087
  (512) 239-2335

- The Section Manager, Compliance & Enforcement Section
  Enforcement Division/Waste Enforcement Section, MC 128
  Texas Commission on Environmental Quality (TCEQ)
  P.O. Box 13087
  Austin, TX 78711-3087
  (512) 239-3308

- Texas Commission on Environmental Quality
  Region 16 - Waste Program Manager
  707 E. Calton Rd., Ste. 304
  Laredo, Texas 78041-3887
  (956) 791-6611

- City of Laredo Fire Department
  Station 2
  (956) 795-2522

- Owners of the utilities within approximately 1000 ft of the affected location(s) at the landfill facility. The utilities which cross or within 1000 ft of the landfill is only the Central Power & Light. If the detection happens near the overhead electric line, Central Power & Light will be contact at Central Power & Light P.O. Box 2121 Corpus Christi, TX 78403. Tel: 1-800-274-2611

- Neighboring residents within approximately 1,000 ft of the affected location(s) at the landfill facility. The city of Laredo landfill will maintain a list of property owners and residences within 1000 ft of the permit boundary.

- The fire department, police department, and/or ambulance will be informed/called if necessary.

5.2 Verification Procedures

Once emergency measures have been taken to protect human health, monitoring personnel will immediately begin verification procedures. This procedure is intended to confirm the corrected reading of the excessive gases level at the detected location.

- *Buildings/Structures*. Verification of detected excessive levels in the only structure (gatehouse) will be accomplished by following procedure:

    - Calibrated portable gas detection equipment will be used to measure the explosive gas level throughout the gatehouse. The measuring will be taken in the entire perimeter of the building and each room, especially confined spaces and utility connections.

If the exceeded level of the explosive gases are no longer detected, the City of Laredo personnel may return to the gatehouse as determined by the site manager and engineer. If a malfunction or incorrect measurements and readings are suspected, the monitoring personnel may need to check the equipment and ensure the calibration is correct. However, to set aside the suspicion of human error or malfunctioning equipment, daily follow-up readings by the portable gas detection equipment will be taken daily for one week after the incident as determined by the site manager and engineer. If the daily reading for one week shows the result of the explosive gas level less than 25% of LEL, daily monitoring can be stopped with approval from the site manager and engineer. Then the quarterly routine monitoring as required by TCEQ will resume.

- *Property Boundary*. Location of existing and proposed landfill gas probes, as indicated in Section 4.0 and shown in Figure 14.1 - Original Cell and Phase Layout with Monitoring Gas Probes Location effectively become the relevant point of compliance with respect to landfill gas monitoring. Verification of detected excessive levels in monitoring gas probes will be accomplished by following procedure:

    - Recalibrate gas detection equipment according to manufacturer's recommended procedures.

- Immediately re-measure the explosive gas concentration in the monitoring probe and one more time during the 12 hour period of the original detection.

If the exceed level of the explosive gases is not detected during the verification procedures, the daily follow-up reading by the portable gas detection equipment will be taken daily for one week after the incident as determined by the site manager and engineer. If the daily reading for one week shows the result of explosive gas levels less than LEL, daily monitoring can be stopped with the approval from the site manager and engineer. Then the quarterly routine monitoring as required by TCEQ will resume.

In the event that exceeded levels of explosive gases is detected during the verification procedures or during the follow-up procedures, notification and remediation procedures will be implemented to the 2 major areas of the landfill using 3 actions as previously mentioned in Section 5.1 Contingency Plan Guidelines.

5.3 Property Boundary at Landfill Gas Probes

The City of Laredo landfill's proposed contingency plan is described in the following.

5.3.1 Immediate Action

Immediate action will start as soon as the monitoring personnel detect the exceeded explosive gas level at the existing and proposed gas probes. The detail actions are described as following:

- The landfill operation and personnel working within the vicinity will be evacuated
- The site manager, landfill supervisor, engineer, the personnel listed in Section 5.1 of this LFGMP, the utility owners and neighboring residents within 1,000 ft of the exceed gas limit location will be informed
- The daily follow-up measure at the above gas limit location will be monitored for the period of one week to confirm the accuracy original reading.
- After the confirmed reading for exceed explosive gas, the area around the affected location such as property boundary, utility trench, on and off-site building and any structure shall be tested to determine the explosive gas migration by appropriate personnel using handheld gas detector or barhole sampling as suitable.

5.3.2 Action Within 7 Days

The site manager, landfill supervisor or engineer will prepare a brief report within 7 days of the original detection of explosive gas above the limit level. The report will be placed into the on-site record to minimally include the following information:

- Date, location and gas level at the original exceed gas limit
- Result of the additional monitoring
- Summary of the immediate actions as described in Section 5.3.1

5.3.3 Action Within 60 Days

Within 60 days of the original detected location, the remediation plan and implementation will be prepared and addressed to be placed into the on-site record including the following information:

- Nature and extent of the methane gas migration problem
- Proposed permanent remedial action(s) may include installation of passive or active gas control system
- A copy of the remediation plan will be provided to the necessary personnel/organization involved with the issue such as TCEQ
- The concerned officials will be informed and all the important actions will be taken and implemented to eliminate the problem in the timely manner.

5.4 On-Site Structures

5.4.1 Immediate Action

Immediate action will start as soon as the monitoring personnel detect the exceed explosive gas level at gatehouse or property boundary. The action is described as the following:

- The affected building would be vacated until it is safe to return to the building which will be determined by the site manager and engineer
- The appropriate personnel as listed in Section 5.1 will be informed
- The appropriate personnel from the city of Laredo landfill will determine the source of the excessive gas immediately following the evacuation. The source can be at the utility connection, crack or the crawl space
- After the remedial action has been taken, the gatehouse would be monitored on a daily basis for one week. This monitoring is to confirm the migration of explosive gas around the structure.

5.4.2 Action Within 7 Days

The site manager, landfill supervisor or engineer will prepare a brief report within 7 days of the original detection of explosive gas above the limit level. The report will be placed into the on-site record to minimally include the following information:

- Date, location and gas level at the original exceed gas limit
- Result of the additional monitoring
- Summary of the immediate actions as described in Section 5.4.1

5.4.3 Action Within 60 Days

Within 60 days of the original detected location, the remediation plan and implementation will be prepared and addressed to be placed into the on-site record including the following information:

- Nature and extent of the methane gas migration problem
- Proposed permanent remedial action(s) may include installation of passive or active gas control system
- A copy of the remediation plan will be provided to the necessary personnel/organization involved with the issue such as TCEQ
- The concerned officials will be informed and all the important actions will be taken and implemented to eliminate the problem in the timely manner.

5.5 Underground Utility Trench Vent Monitoring

The City's proposed contingency plan is to install the utility trench vent to monitor the methane gas for the future underground utilities. This contingency plan is similar to the property boundary in Section 5.3 Property Boundary at landfill gas probes.

The future of the trench vent monitoring including the record drawing will need the approval from TCEQ before installation. The sampling of the future vent will also conducted quarterly as same as the monitoring probes.

If the methane gas exceeds the LEL level during the quarterly monitoring of these vents, the obtained samples will be sent for analysis and to determine the source. The utility owner will be informed within one business day of the methane gas detection for assistance in determining the source.

6.0 LFG CONTROL SYSTEM INSTALLATION AND MONITORING

Landfill gas will generally move away from the landfill area. Landfill gasses can migrate through the soils or through ambient air to the least resistance due to pressure, density, and concentration gradients. This usually results in landfill gas moving upward through the landfill surface into the landfill gas collection system or through the surface soils into ambient air, surrounding soils, utility conduits or structures if an adequate gas collection system is not designed and constructed. The LFG control system can be categorized to two basic types.

6.1 Passive Gas Control System

A passive gas control system is to control subsurface migration in small sections of the landfill by using the venting system. Passive gas control systems rely on the natural LFG pressure within the landfill that creates a sufficient pressure so LFG flows from the landfill into the gas collection wells. Then, the passive vents release some pressure of landfill gas within the waste to reduce the build-up gas to the atmosphere. This type of system is appropriate for the areas where few residential and commercial establishments are located.

There are three methods to determine the location of the passive gas control vents.

1) **Surface monitoring and observations**
   The best location for installing the passive vents is to observe the typical landfill surface and compare this with unusual landfill sites such as venting cracks, stressed vegetation and odors.
2) **Subsurface pressure**
   Passive gas vents can be installed to release the pressure where the increased pressure has been detected.
3) **Location**
   Passive vents may be installed near the permanent probe, barhole probe, or gas house that contained the excessive explosive gas

6.1.1 Monitoring

The monitoring of any passive gas system will be performed at least on the quarterly basis as set by the TCEQ (30 § TAC 330.371). This frequency of monitoring will be increased to a monthly basis if the reading results show the gas accumulation or gas migration to ensure the level of explosive gas. Monitoring methods will be conformed to Section 4.0 Landfill Gas Monitoring. The gas odor will be monitored on the landfill site with the monitoring of the gas system. If the methane odors are at the higher level, the appropriate methods to protect the human health will be taken such as use the odor masking, order neutralizing agent or installation of additional active gas control vent.

However, when the pressure in the landfill is inadequate to push the gas to the venting, passive gas control systems fail to remove landfill gas effectively. Therefore, passive gas control systems are not considered reliable enough for use in areas with a high risk of gas migration, especially where methane can collect to explosive levels in buildings and confined spaces.

6.2 Active Gas Control System

An active gas control system is considered the most effective means of landfill gas collection. The active gas control system includes vertical and horizontal gas collection wells similar to passive collection systems. This system is more complex to design, operate and maintain than a passive gas system.

An active gas control system consists of a collection system plus a utilization or control system. The City of Laredo landfill was designed with and currently operates this type of system on the northern area of the landfill near GP-3, GP-4 and GP-5 as described and shown in the letter "Certification Statement to Texas Commission on Environmental Quality Pertaining to Permit Modification" dated June 6, 2003. These systems consist of 20 LFG Collection Wells. In addition, the letter to the TCEQ dated Sept 1, 2005, states the City of Laredo landfill installed 8 vacuum curtain well system to the gas control system to migrate the accumulated methane concentration from GP-5 as required by TCEQ. A total of 20 LFG collection wells and vacuum curtain well system are shown in the Figure III-14-1- Gas Collection System Layout. Figure 14.3 illustrates a typical landfill gas collection well.

The future design of the system components to connect the existing system or stand alone system depends upon the site specific conditions. If an additional active gas control system is required, the City of Laredo landfill will secure all necessary authorization prior to installation, including but not limited to a standard air permit pursuant to Title 30 § TAC Chapter 116, Subchapter F and Title 30 § TAC section 305.70(j)(21).

The main components of active gas control system for the City of Laredo landfill consist of 2 parts; 1) Gas Collection and 2) Gas Control system.

Figure 14.3

6.2.1 Gas Collection System

The main components of a gas collection system are typically vertical gas wells, valves to regulate gas flow, multiple gas collection headers with appropriate fittings and supports, and the moisture/condensate removal and collection system. The location of the vertical wells is determined in a manner similar to locating the passive gas control system as discussed in Section 6.1 Passive Gas Control System.

6.2.2 Gas Control System

The two common types of gas control or utilization systems are:

- Landfill gas flare system
- Co-generation systems

Selection of the control system depends on several factors including landfill gas flow rates, quantity, and the cost benefit analysis. In order to determine the appropriate control system, the methane should have an economical collection system and/or be utilized as a fuel source.

If feasible, a co-generation system may be installed. Typically, this type of system includes a gas treatment plant, gas turbine(s) or internal combustion engine(s) and generating set(s), and other ancillary equipment. Any co-generation system will be registered separately as a Type IX municipal solid waste facility prior to implementation. Permit modification or registration would be filed depending on the type of system and selected ownership arrangement if the facility converts from a passive to and active gas collection system.

If the methane cannot be collected and utilized economically, a system consisting of one or more open gas flare unit will be installed as similar to the existing system located at the northern area of the city of Laredo landfill site. A flare system consists of gas blower(s), flares, moisture separators, and a detailed safety system. If an additional flare is required, a permit modification will be obtained. The City will continue to monitor gas generation and if it appears technically feasible, the City may incorporate a gas cogeneration system into the gas collection system.

6.2.3 Gas Control System Back Up Plan

As required by 30 TAC 330.371(g)(3), If the main active gas control system breaks down or becomes ineffective the system will become a passive gas control system until repairs or necessary construction is completed to ensure the main system is functioning effectively.

7.0 SAFETY

Methane is a gas in the sub-surface, common in many residential developments where organic material, such as grass, leaves, wood, manure, etc., is present in the soil. Methane is a colorless, odorless gas and is widely found in nature. It is non-toxic. However, it is combustible and potentially explosive at concentrations above 55,000 parts per million (ppm).

A landfill, by the nature of the wastes placed in it, generates landfill gas, comprised primarily of methane. This gas can pose serious health and safety risks for facility operators as well as the community. These risks occur both during the operation of the landfill and after it has been closed. For this reason a Safety Plan must be implemented to ensure overall safety.

The City of Laredo LFMP shall utilize this Safety Plan prior to implementing any gas monitoring procedure. All landfill monitoring personnel should have knowledge of the potential hazards of the landfill gas being monitored. Although methane gas is colorless and odorless, it can present several types of harms.

- Physiological Harms - Intoxication by certain gas components might cause vomiting, facial flushing, headache and ultimately suffocation when oxygen is displaced by landfill gas.
- Chemical Harms - Corrosion of components of the gas extraction system as piping, fittings, flanges etc.
- Sensorial Harms – Trace amounts of gas components such as hydrogen sulfide, organic sulfur components etc. can hamper breathing.
- Ecological Harms - The release of methane gas into the atmosphere has increased dramatically over the past century. Scientists have linked this release with global warming.

In addition to the site safety plan, landfill monitoring personnel at a minimum should have working knowledge of the following:

- Understanding of the danger of methane gas
- Utilization of the buddy system practice
- Personal Protection Equipment - Wearing the appropriate hard hat and safety glasses when entering the landfill for gas monitoring
- Locations of fire extinguishers, hoses and other safety equipment
- Determining whether or not additional safety systems and/or equipment are necessary; such as a gas mask or ventilation equipment
- Proper calibration and operation techniques for monitoring instruments
- Flammable Hazards - Smoking during gas monitoring is not permitted
- Knowledge of underground utilities prior to bar hole probing
- Communication Protocol - Informing the supervisor or site manger of any possible hazards

The site manager or landfill supervisor should include the above safety items in the Site Safety Plan and maintain the document(s) on-site.

APPENDIX 14A : Field Data Form

FIELD DATA FORM

FORM 1 - MONITORING GAS PROBE (GP) ON THE PERIMETER

Date:	Inspectors Name:		Instrument (ppm) - S/No.:			Instrument (%) - S/No.:		
			Instrument (ppm) - M/No.:			Instrument (%) -M/No.:		
Temperature at Start:			Weather Condition:		Legend: T = Trace, W = Water D = Destroyed, -1 = No Reading Taken			
Temperature at End:								
GP #	Time	Barometric Pressure	Pressure (In. of H_2O)	Methane (%/ppm)	Oxygen (%) Option	Background (ppm)	Sampled (Yes or No)	Remark
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								

12								
13								
14								
15								
16								
17								
18								
19								
20								
21								

Appendix 14B: Gas Monitoring Equipment Specifications

LANDTEC

GEM™2000

PORTABLE GAS ANALYZER INSTRUMENTATION

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

The GEM™2000 design specifically for use on landfills to monitor landfill gas (LFG) extraction systems, flares, and migration control systems. The GEM™2000 samples and analyzes the methane, carbon dioxide and oxygen content of landfill gas.

Features

- Measures % CH_4, CO_2 and O_2 Volume, static pressure and differential pressure
- Calculates balance gas, flow (SCFM) and calorific value (KW or BTU)
- Displays % LEL of CH_4, and user-defined comments
- Records site and well conditions
- Extended operation (10 - 14 hrs use from one charge)
- Certified intrinsically safe for landfill use
- Two instruments in one (GA and GEM mode)

Benefits

- Designed specifically for use on landfills to monitor landfill gas (LFG) extraction systems, flares, and migration control systems.
- No need to take more than one instrument to site
- Can be used for routine sub-surface migration monitoring of landfill site perimeter probes and for measuring gas composition, pressure and flow in gas extraction systems
- The user is able to set up comments and questions to record information at site and at each sample point
- Ensures consistent collection of data for better analysis
- Allows balancing of gas extraction systems

Applications

- Landfills
- Gas Extraction Wells
- Flare Monitoring
- Subsurface Migration Probes

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850 South Via Lata, Suite 112 Colton, CA 92324 Phone (800) LANDTEC (909) 783-3636
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Gases Measured	CH_4, CO_2, by dual wavelength infrared cell with reference channel. O_2 by internal electrochemical cell

CH_4	0-100% Reading		
CO_2	0-100% Reading	O_2	0-25%

Gas Accuracy	CH_4	CO_2	O_2
0-5%	±0.3%	±0.3%	±1.0%
5-15%	±1.0%	±1.0%	±1.0%
15% - Full Scale	±3.0%	±3.0%	±1.0%

Other Parameters	Unit	Resolution	Comments
Energy	BTU/hr	1000 BTU/hr	Calculated from specific parameters.
Static Pressure	in.H_2O	0.1 in.H_2O	Direct Measurement
Differential Pressure	in.H_2O	0.001 in.H_2O	Direct Measurement

Flow	Typically 300 cc/min
Flow with 5.9 in.Hg vacuum	Approximately 250 cc/min
Operating Temperature Range	32°F - 104°F
Operating Pressure	-100 in. H_2O, +100 in. H_2O
Relative Humidity	0-95% non condensing
Barometric Pressure	±5.9 in.Hg from calibration pressure
Barometric Pressure Accuracy	±1% typically
Battery Life	Typical use 10 hours from fully charged
Charge Time	Approximately 2 hours from complete discharge.
Certifications	UL- Certified to Class 1, Zone 1, AEx ib d IIa T1

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

LANDTEC South America
+55(11) 5181-6591 • Fax +55(11) 5181-6585
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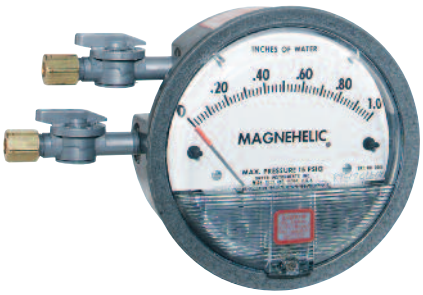
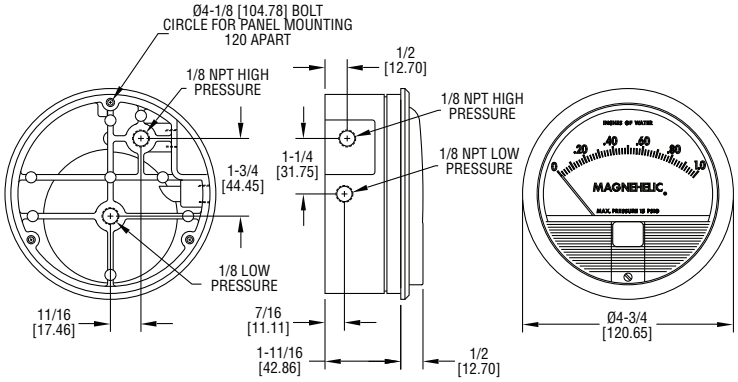
Product designs and specifications are subject to change without notice. User is responsible for determining suitability of product.
LANDTEC, GEM and LAPS are registered with the U.S. Patent and Trademark Office.

Series 2000 Magnehelic® Air Filter Gages

Specifications - Installation and Operating Instructions





The Magnehelic® gage consists of two pressure-tight compartments separated by a molded flexible diaphragm.

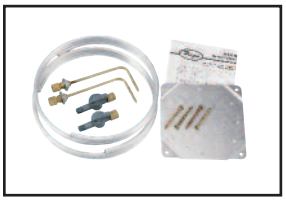
The interior of the gage case serves as the "high" pressure compartment and a sealed chamber behind the diaphragm serves as the "low" pressure compartment.

Differences in pressure between the "high" and "low" sides of the diaphragm cause the diaphragm to assume a balanced position between the two pressures. The front support plate of the diaphragm is linked to a leaf spring which is anchored at one end. The spring provides calibrated resistance to the diaphragm motion. Motion of the spring is transmitted through an exclusive magnetic linkage to the pointer.

The Magnehelic® gage requires no maintenance. The only field adjustment required is occasional zero setting of the pointer which is done by opening the plastic vent valves and turning the adjustment of the gage.

STANDARD ACCESSORIES FURNISHED

Two 1/8″ NPT plugs for duplicate pressure taps, two 1/8″ pipe thread to rubber tubing adapter and three flush mounting adapters with screws. (Mounting and snap ring retainer substituted for 3 adapters in MP & HP gage accessories.)



Air Filter accessories furnished are mounting panel with necessary screws, two static pressure tips with integral compression fittings, two five foot lengths of 1/4″ aluminum tubing and the two molded plastic vent valve with compression fittings.

The Magnehelic® gage with molded plastic vent valves for easy zeroing. Available with adjustable signal flag (not shown; option "ASF" at extra cost) for immediate visual reference to maximum allowable pressure drop; External front screw for zero adjustment. Red and green scale overlays to highlight safe and dangerous readings are also available.

FEATURES

- Easiest reading for personnel accustomed to dial type gages.
- Lowest cost pointer type gage.
- Easy zeroing with molded plastic vent valves.
- Sensitivity to 0.01″ w.c.
- Withstands vibration.
- Unaffected by over range pressure surges.

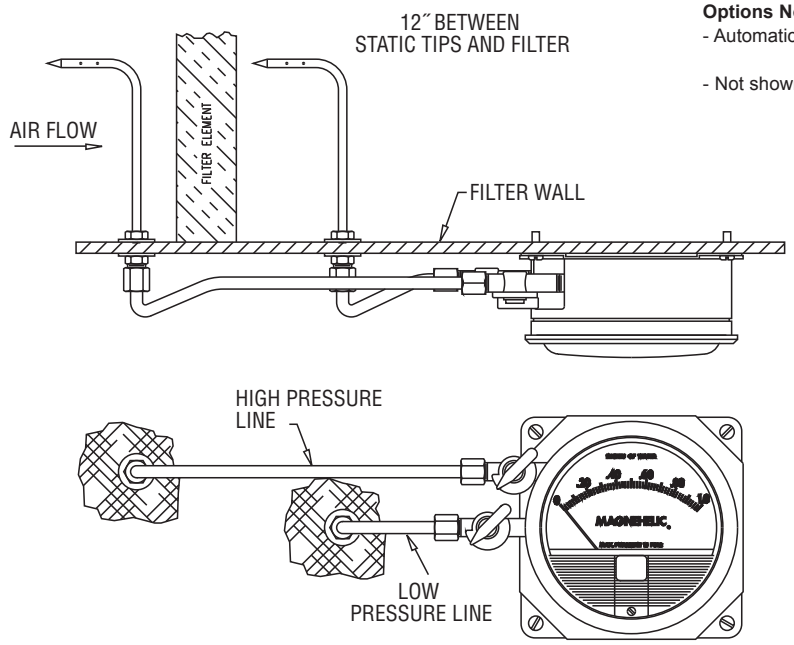
SPECIFICATIONS

Service: Air and non-combustible, compatible gases. (Natural Gas option available.)
Wetted Materials: Consult Factory.
Housing: Die cast aluminum case and bezel, with acrylic cover, Exterior finish is coated gray to withstand 168 hour salt spray corrosion test.
Accuracy: ±2% of full scale (±3% on - 0 and ±4% on - 00 ranges), throughout range at 70°F (21.1°C).
Pressure Limits: -20″ Hg. to 15 psig.† (-0.677 bar to 1.034 bar); MP option; 35 psig (2.41 bar), HP option; 80 psig (5.52 bar).
Overpressure: Relief plug opens at approximately 25 psig (1.72 kPa), standard gages only.
Temperature Limits: 20 to 140°F.* (-6.67 to 60°C).
Size: 4″ (101.6 mm) Diameter dial face.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Process Connections: 1/8″ female NPT duplicate high and low pressure taps - one pair side and one pair back.
Weight: 1 lb 2 oz (510 g), MP & HP 2 lb 2 oz (963 g).

* Low temperature models available as special option.
† For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at lower left.

Cutaway view of the Magnehelic® gage showing the actuating diaphragm, the leaf spring with magnet, the helix which turns the indicating pointer in response to the position of the magnet without mechanical linkages.

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
Phone: 219/879-8000
Fax: 219/872-9057
www.dwyer-inst.com
e-mail: info@dwyer-inst.com



Options Not Shown:
- Automatic signal flag integral with plastic gage cover

- Not shown Scale plate overlays in green and red

INSTALLATION PROCEDURE

1. Screw vent valves into side connections of gage. Be sure back connections of gage are sealed with plugs provided with the gage. Attach gage to mounting plate with three No. 6-32 screws provided.

2. Select a convenient location on filter wall and punch or drill four 1/8″ dia. max. holes for mounting plate as shown in drawing above. Attach mounting plate to filter wall with four self-tapping screws provided. If gage is to be flush mounted in control panel, refer to Bulletin No. A-27.

3. Drill two 7/16″ holes in the duct, one on each side of the filter and at least 12" distant*. Secure the static pressure tips as in the drawing above, with the tips directed into the air flow.

4. Connect 1/4″ metal tubing from the static pressure tips to the gage. The tip on the downstream side of the filter is connected to the vent valve in the low pressure connection of the gage. The tip on the upstream side is connected to the vent valve in the high pressure connection.

5. Turn both vent valves to "VENT" position and adjust the gage pointer to zero by means of the external adjustment screw in the face of the gage. After zeroing, turn vent valves to "LINE" position.

***NOTE On location of static pressure tips:** The location of static pressure tips is of primary importance in securing reliable readings. For maximum accuracy, it is essential that the influence of the velocity of the air be eliminated to permit sensing the true static pressure. Note that some installations do not provide a straight duct approach to the filter bank which may cause air to swirl and eddy.

Tips should be located as recommended by the specifying engineer or by the filter manufacturer. In the absence of such recommendations, locate the tips at least 12″ upstream and downstream from the filters in a zone of minimum turbulence.

INSTALLATION CHECK AND TROUBLE SHOOTING

Before putting your air filter gage into service or in the event of initial pressure drop readings that do not agree with the filter manufacturer's specified pressure drop, make the following checks:

1. Check zero adjustment of the gage as described above.
2. Check all tubing connections for tightness from the gage to the static tip or fitting connection.
3. Check plastic cover of gage to be sure it is securely in place and air tight.
4. Check static pressure tips or fittings to be sure they are not plugged.
5. Check installation of static tips or fittings*. Be sure static pressure tips point directly into the air stream. A velocity pressure error can be created if the air blows directly into the opening.

OPERATION

With vent valves in "LINE" position the gage will indicate pressure drop across the filter. If the reading varies substantially from the filter manufacturer's rating for a clean filter, check the system for proper setting of controls, air balancing of system, leakage in system and whether or not the correct filter has been installed.

When pressure drop across the filter reaches the minimum recommended by the manufacturer, the filter should be serviced or replaced.

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DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
Phone: 219/879-8000
Fax: 219/872-9057
www.dwyer-inst.com
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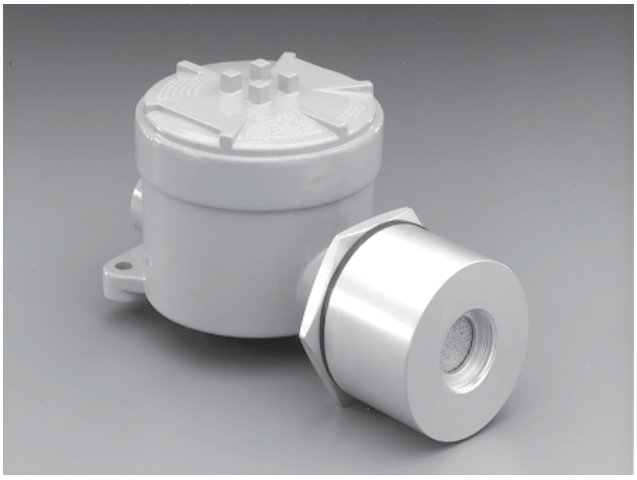
sierra monitor corporation

Model 4101 Series
Gas Sensor Modules

The Model 4101 Series Gas Sensor Modules feature accurate detection of the specified gas with linear 4-20 mA output.



The Sierra Monitor Model 4101 Series provides the user with the features needed in a stand-alone, fixed-point hazardous gas monitor system. Utilizing electrochemical sensor technology the Model 4101 provides accurate monitoring of hazardous gas conditions. Proven sensor design matched with reliable state-of-the-art electronics results in the ideal complete single channel package to protect your plant and personnel.

Automatic Low Sensitivity Check
Monitoring integrity is ensured with the automatic low sensitivity check. After calibration, a sensor sensivity check confirms that the sensor response to gas is sufficient to provide reliable operation without false indication. If the sensor has low sensitivity, an LED lights to indicate that sensor replacement is due.

False Alarm Avoidance
During Power-Up and Calibration, the transmitter output is locked at 4 mA. The output remains locked for five minutes directly after power is applied or after calibration gas is removed, allowing sufficient time to fully stabilize before coming on-line. This avoids erroneous readings during warm-up and prevents alarm caused by calibration gas.

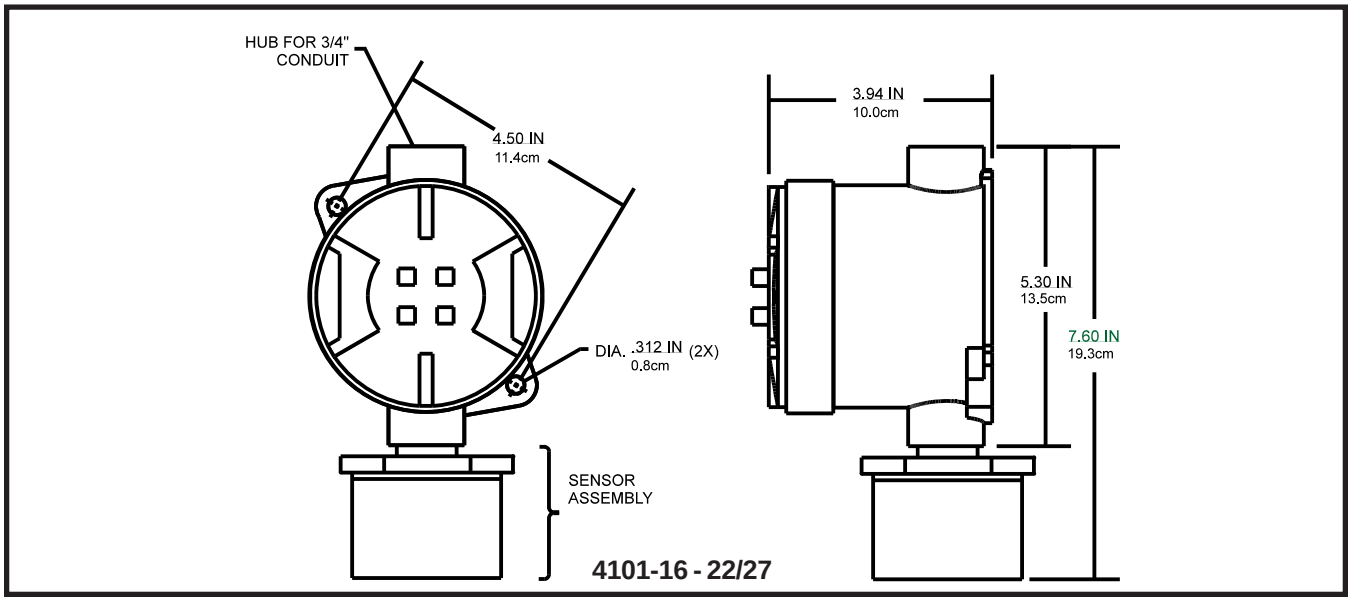
Convenient Diagnostic Measurements
Critical measurements are made at convenient jacks for a Volt Ohm Meter. Each measurement location is clearly marked. All modules have a signal output adjustment.

Simple Zero and Span Adjustments
Easily accessible potentiometers enable calibration adjustments to be made in minutes by non-technical personnel for reduced maintenance cost.

Flexible Alarm and Logging Options
The analog gas sensor modules can be used as part of a facility gas risk management plan. The 4-20 mA output signal is ideally suited to interface with a wide range of instrumentation for alarm annunciation and recording.

The sensor module is housed in a NEMA-7 enclosure rated for Class 1, Division 1, Groups C, D environments. An optional NEMA 4 Group B enclosure is available.

Be sure to also look at the 5100-XX-IT Series Intelligent Gas Sensor Modules for network-enabled hazardous gas monitoring.



Sierra Monitor Corp. 1991 Tarob Ct., Milpitas, CA 95035, USA, 408-262-6611, 800-727-4377, FAX: 408-262-9042
Web Site: http://www.sierramonitor.com E-Mail: sales@sierramonitor.com

Specifications

Gas Type	Model	Sensor	Std. Range [6]	Units	Resolution	Response Time [2]	Sensor Life [3]	Operating Range		
								°F	°C	RH
Oxygen	5100-03-IT [1]	EC	5-25	% Vol.	+/- 0.1%	<10 Sec.	2 Yrs.	5 to 122	-15 to 50	15-99%
Carbon Monoxide	5100-04-IT [1]	EC	0-500	PPM	0.5 PPM	<25 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-99%
Hydrogen Sulfide	5100-05-IT [1]	EC	0-100	PPM	0.1 PPM	<30 Sec.	2 Yrs.	-40 to 122	-40 to 50	15-99%
Chlorine	5100-06-IT [1]	EC	0-10	PPM	0.1 PPM	<60 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-99%
Sulfur Dioxide	5100-10-IT [1]	EC	0-100	PPM	0.5 PPM	<20 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-90%
Nitrogen Dioxide	5100-12-IT [1]	EC	0-20	PPM	0.2 PPM	<35 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-90%
Carbon Monoxide [4]	4101-16	EC	0-2000	PPM	0.1 PPM	<35 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-90%
Nitric Oxide	4101-19	EC	0-20	PPM	0.5 PPM	<15 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-90%
Hydrogen Chloride	4101-21	EC	0-20	PPM	0.1 PPM	<100 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-90%
Hydrogen Cyanide	4101-22	EC	0-20	PPM	0.1 PPM	<70 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-90%
Ammonia	5100-25-IT [1]	EC	0-50	PPM	1.0 PPM	<30 Sec.	[5]	14 to 122	-10 to 50	20-95%
Hydrogen Fluoride [5]	4101-26	EC	0-10	PPM	1.0 PPM	<30 Sec.	[5]	14 to 122	-10 to 50	20-95%
Ethylene Oxide	4101-27	EC	0-20	PPM	0.1 PPM	<90 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-90%

Notes:

[1] 5100-XX-IT Series provide intelligent network-enabled hazardous gas detection
[2] Response time to 90% full signal value for applied concentration
[3] Sensor life typical for use at standard temperature and pressure with occasional exposure to gas of interest
[4] Hydrogen tolerent
[5] Diffusion via memberane. Requires electrolyte
[6] Optional ranges available

Electrical Data

Loop Type:	3 wire
Loop Resistance:	800 Ohm with 28VDC
Input Voltage DC:	14-30 VDC
Input Current:	40 mA
Input Power Max:	1.4W
Signal Output:	4-20 mA DC linear (trouble 0 mA)
Operating Pressure:	+10% (variation from ambient)
Mounting:	3/4" NPT
Housing:	Explosion proof (NEMA 7) (Div. I, Class 1, 2, Groups C, D, E, F, G) Optional NEMA 4 Group B housing available

Construction:

Modules	Dimensions	Weight
4101-16-27	H: 8.0", D: 4.5", W: 4.0" (20.3 x 15.2 x 15.2 cm)	2.7 lb (1.3 Kg)
4101-26	H: 10.2", D: 6.0", W: 6.0" (25.9 x 15.2 x 15.2 cm)	2.7 lb (1.3 Kg)

Warrenty: Two year on non-consumables

ISO 9001 REGISTERED QUALITY SYSTEM

02/10

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CITY OF LAREDO

MUNICIPAL SOLID WASTE LANDFILL

LAREDO, TEXAS

WEBB COUNTY

LEACHATE AND CONTAMINATED WATER PLAN

ATTACHMENT III.15

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

PERMIT NO.: 1693B

Applicant:

City of Laredo Municipal Solid Waste Landfill
Solid Waste Services Department
6912 Highway 359
Laredo, TX 78044

Revised June 2015

Frank E. Pugsley, P.E.
6-18-2015

Prepared by:

CP&Y, Inc.
1820 Regal Row
Dallas, TX 75235
F-1741

LEACHATE AND CONTAMINATED WATER PLAN

CITY OF LAREDO

MUNICIPAL SOLID WASTE LANDFILL

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F.E. Pugsley, P.E.
6-18-2015

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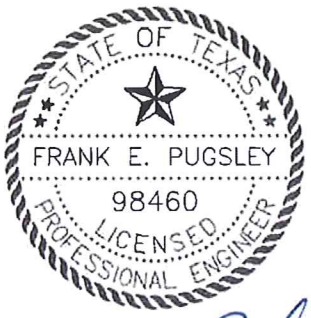


F. E. Pugsley, P.E.
6-18-2015

1. Introduction

This Leachate and Contaminated Water Management Plan has been prepared for the City of Laredo Municipal Solid Waste Landfill consistent with 30 TAC §§330.65(c), 330.207, 330.227, 330.331, and 330.333. This plan provides the details of the collection, storage, treatment, and disposal of contaminated water and leachate from the leachate collection system (LCS) and site operations.

1.1. Existing Conditions

The existing LCS consists of 6" PVC or HDPE leachate laterals that collect leachate from the bottom of all Subtitle D, Type I waste cells and direct it to collection sumps located at the low point of each cell. Pumps, located in 12" leachate riser pipes, pump the leachate from the sump into a forcemain that ultimately discharges into a leachate storage tank. Due to the proposed expansion of the landfill, modifications to the existing LCS will be made. The modifications include;

- Addition of five sumps to be located in Phases 3, 4, and 5;
- Relocation and extension of the sump and cleanout risers in Cell 17 and 18 of Phase 1;
- Removal and relocation of the existing leachate forcemain located within the footprint of the proposed Phase 5, and;
- Relocation of the leachate storage tank.

A plan of the existing LCS and the proposed modifications are provided in Part III, Figures III.15.1 and III.15.2, respectively.

2. Leachate Management

2.1. Leachate Generation

Leachate is generated as water infiltrates and percolates through layers of solid waste and the field capacity, or the capacity of solid waste to absorb moisture, is exceeded. The quantity of leachate that is generated depends on the amount and characteristics of the waste, climatic conditions, cell size and phasing of the disposal area, operational techniques applied at the landfill, and the cover system. The Hydrologic Evaluation of Landfill Performance (HELP) model was used to predict the quantity of leachate that will be generated at the Laredo Municipal Solid Waste Landfill. The HELP model is a hydrologic model of water movement across, into, through and out of landfills. The model accepts weather, soil and design data and uses solution techniques that account for the effects of surface storage, runoff, infiltration, evapotranspiration, vegetative growth, lateral drainage, leachate recirculation, and unsaturated vertical drainage. Leachate generation was evaluated for both active and closed landfill conditions. The worst case used for design of the LCS is 20.64 gallons/acre/day during the Interim stage of landfill operations. A summary of the HELP model output is provided in Table 1. Detailed information on the HELP model input and output is included in Appendix A to this plan – HELP Model.

TABLE 1 – HELP MODEL OUTPUT SUMMARY

Landfill Operational Stage	Maximum Head on Liner (in)	Maximum Leachate Generation inches/acre/day	Maximum Leachate Generation gpd/acre
Active Stage - 20' of waste and daily cover	0.003	0.00015	4.07
Interim Stage - 140' of waste and intermediate cover	0.006	0.00076	20.64
Closed Stage - 203' of waste and final cover	0.001	0.00001	0.27

Please note that the HELP model is run as a worst case scenario for design of the LCS. At no time will the entire landfill footprint produce the maximum quantity of leachate. Any permanent part of the LCS collection system including leachate collection pipes, sumps, and force mains shall be designed to convey the worst case volume as calculated by the HELP model. Other items in the LCS including leachate pumps, storage tanks, and leachate disposal methods will be operated and sized as required by historical operational needs. These items may be replaced and resized if they become insufficient to control the quantity of leachate produced.

2.2. Leachate Collection System Requirements

There are three types of landfill cells at the City of Laredo Municipal Solid Waste Landfill. Each type of cell has different requirements for the collection of leachate. The following are the 3 types of Landfill Cells;

- Subtitle D Type I Landfill Cells
- Subtitle D Type IV Landfill Cells
- Pre-Subtitle D Landfill Cells

2.2.1. Subtitle D Type I Landfill Cells

In accordance with §330.331(a)(2) and §330.333, the LCS for Subtitle D, Type I landfill cells has been designed to meet the following requirements:

- Maintain less than 30 cm (12 inches) depth of leachate over the liner. (See Section 2.1, Table 2 of this Plan for information on leachate head on liner.)
- Be constructed of materials that are chemically resistant to the leachate expected to be generated. (The components of the LCS have been designed with materials that are inert to leachates typically produced by municipal solid waste facilities. Drainage nets will be high density polyethylene (HDPE) and pipes will be HDPE or Polyvinyl Chloride (PVC). Aggregates will be resistant to carbonate loss. Geotextiles have been designed with factors of safety for biological and chemical clogging.)

- Be of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes, waste cover materials, and by any equipment used at the landfill. *(See Appendix B – LCS Design Calculations).*
- Be designed and operated to function through the scheduled closure and post-closure care period of the landfill considering the following factors;

    - drainage media specifications and performance (see section 2.3.2)pipe material and strength (see section 2.3.4)
    - pipe network spacing and grading (see section 2.3.4)
    - capacity of sumps (see section 2.3.5)
    - collection sump materials and strength (see section 2.3.5)
    - estimated rate of leachate removal (see section 2.3.6), and
    - be resistant to clogging and capable of being cleaned (LCS cleanouts shall be placed to allow cleaning as necessary. They will be placed as shown on Figure III.15.2)

All previously constructed Subtitle D cells were constructed with a LCS; and sump riser pipes for leachate extraction. The existing waste pack elevation in these cells is past the interim height condition, or worst case operating condition in regards to maximum leachate head on liner; thus, leachate head over the liner in these cells will not increase by this proposed vertical expansion.

2.2.2. Subtitle D Type IV Landfill Cells

In accordance with §330.331(d) there is no requirement for a LCS in Type IV landfill cells. Currently, Cells 1, 2 and 3 of Phase 4 are designated as Type IV landfill cells. The proposed expansion modifies Cells 2 and 3 into Type I Cells. Cell 1 of Phase 4 will be the only remaining Type IV cell at the Laredo Landfill. However, this cell will be covered with a separation liner (see Figure III.15.3) and Type I waste will be filled over the entire Phase 4. The separation liner will be graded to allow leachate generated from the proposed fill to be collected in the proposed sumps located in Cells 2 and 3, and in Phase 5.

2.2.3. Pre-Subtitle D Landfill Cells

There is no requirement for a LCS in Pre-Subtitle D Landfill Cells. Cells 1 thru 16 of Phase 1 and Cell 1 of Phase 2 are constructed with Pre-Subtitle D liners. No leachate collection is provided in these areas.

Due to the vertical expansion, some areas of Phase 1, located above Pre-Subtitle D bottom liners will be filled. These areas (Cells 7,8,11, and 12) will be covered with a separation liner. The liner will be graded to the south to allow leachate from this fill to discharge into the existing sumps of Cells 17 and 18 of Phase 1, and the proposed sumps of Phase 5. Cells 17 and 18 of Phase 1 currently have an intermediate cover in place. The leachate flowing off the separation liner that does not infiltrate through the intermediate cover above Cells 17 and 18 will flow southward down the slope and into the Subtitle D lined area of Phase 5. See Figures III.15.7 and 7A for details of the separation liner.

2.3. Leachate Collection System Design

The LCS for Type I landfill cells will consist of the following items:

- Drainage Layer
- Leachate Aggregate
- Geotextile
- Leachate Collection Piping and Trenches
- Leachate Collection Sumps
- Sump and Cleanout Risers
- Leachate Forcemain and Pump
- Leachate Storage

2.3.1. Drainage Layer

The leachate drainage layer is placed above the composite liner to allow leachate to flow horizontally to perforated collection pipes. The leachate drainage layer will consist of a geonet system as shown on Figure III.15.3. A geonet layer is typically made of a polyethylene 3-dimensional grid which provides a zone for conveying the accumulated leachate to the perforated collection pipe. The geonet is overlaid by a geotextile (see section 2.3.3) to separate cover soil from the geonet and thus maintain an adequate hydraulic conductivity of the system. The geonet may also be a geocomposite which has the geotextile bonded both sides. The drainage layer is sloped a minimum of 2% to promote liquid flow toward the leachate collection pipes and ultimately to the sumps for extraction. Leachate collection design calculations are presented in Appendix B – LCS Design Calculations. The geocomposite properties are provided in Part III, Attachment 10 — Soils and Liner Quality Control Plan (SLQCP).

2.3.2. Leachate Aggregate

Leachate aggregate will be placed in the collection trenches and in the sumps. The aggregate shall consist of manufactured or natural materials having the properties listed in Part III, Attachment 10 – SLQCP.

2.3.3. Geotextile

The drainage aggregate will be covered by a geotextile to prevent migration of the protective cover soil into the LCS. The geotextile will be inert to commonly encountered chemicals, hydrocarbons, and mildew, and will be rot resistant. Geotextile design calculations are presented in Appendix B – LCS Design Calculations. The geotextile properties are provided in Part III, Attachment 10 – SLQCP.

2.3.4. Leachate Collection Piping and Trenches

The leachate piping includes perforated collection trench pipes and the solid sidewall riser pipes. Leachate collection trench pipes convey leachate from the drainage layer to the leachate sump. From the sump, sidewall risers will extend to the top of the perimeter berm to provide access for

cleaning the leachate collection pipes and for sump pump access. The leachate piping shall meet the criteria listed in Part III, Attachment 10 – SLQCP.

Each collection trench contains a perforated leachate collection pipe surrounded by drainage aggregate as noted above. A geotextile will wrap the drainage aggregate to provide control of sediment entering the collection drain. The collection pipes are 6-in diameter, perforated with 1/2 in. diameter holes. The perforated collection pipes shall slope a minimum of 1.0% to the sump. A 6" leachate collection pipe at 1.0% slope will convey a maximum of 363,468 gallons/day of leachate. The largest leachate producing area collected by one collection pipe is located in Cell 13 and 14 of Phase 2 (approximately 18 acres). This area would theoretically produce a maximum leachate flow of 11,250 gallons/day of leachate. A 6" collection pipe is sufficient, in all locations, to carry the maximum leachate flow produced by the Laredo Landfill.

Cleanouts are provided at the top of the sideslopes to allow access to the collection pipe network. Sump risers are also provided at the top of the sideslopes for sump pump access. The cleanouts and sump pump risers are constructed of non-perforated pipe with minimum diameters of 6-in and 12-in respectively. The non-perforated cleanout pipe is joined to the perforated collection pipe in the sump. The non-perforated sump riser is joined to a short perforated sump collector pipe in the sump which houses the sump pump.

The following table provides information about the existing and proposed leachate pipe materials.

TABLE 2
LEACHATE COLLECTION PIPE SIZE & MATERIAL

Phase	Pipe	Size	Material	Perforated
1 & 2 (Existing)	Leachate Collection	6"	PVC SCH 80	Yes
	Cleanout Riser	6"	PVC SCH 80	No
	Sump Collection	12"	PVC SCH 40	Yes
	Sump Riser	12"	PVC SCH 40	No
3, 4 & 5 (Future)	Leachate Collection	6"	PVC SCH 80 or HDPE SDR 11	Yes
	Cleanout Riser	6"	PVC SCH 80 or HDPE SDR 11	No
	Sump Collection	12"	PVC SCH 80 or HDPE SDR 11	Yes
	Sump Riser	12"	PVC SCH 80 or HDPE SDR 11	No

LCS details are provided in Figure III.15.3. Leachate collection pipe design calculations are provided in Attachment B – LCS Design Calculations.

2.3.5. Leachate Collection Sumps

Leachate entering the drainage layer and collection pipes is subsequently conveyed to leachate collection sumps. The sumps will be constructed to minimum dimensions shown on Figure III.15.8. In accordance with §330.333(3)(B), minimum sump capacity is approximately 11,000 gallons. The bottom of each sump is lined with an extra layer of geomembrane for added protection. The sump shall be backfilled with leachate drainage aggregate. The leachate drainage aggregate within the sump is identical to that specified in Section 2.3.2 of this plan. Additional geotextile is placed between the leachate drainage aggregate contained in the sump and the geomembrane liner, as shown on Figure III.15.3. The sumps will store the leachate until it is pumped into onsite leachate storage tank(s) and/or transported off-site for disposal. The pumps will be operated to prevent leachate levels from rising above the top of the sump. Sump pumps can be set to maintain leachate levels below the lip elevation of the sump or to limit maximum depth of the leachate to the geocomposite layer thickness. Brief excursions above the sump may occur, but never in excess of 12" above the lip of the sump. Sump capacity and material strength calculations are presented in Attachment B – LCS Design Calculations.

2.3.6. Sump and Cleanout Risers

Sump riser pipes are located along the disposal area perimeter directly up the sideslope from the sumps. Sump riser pipes provide means for lowering submersible pumps down the sideslope incline into the leachate collection sumps. The lower portion of the sump riser pipe within the sump is perforated to allow leachate to flow to the pumps. Cleanout risers, adjacent to the sump riser pipes on the side slopes, provide access to the leachate collection piping for cleaning purposes. The riser system will terminate at a concrete pad or vault designed to contain accidental spillage should the pump need to be serviced or the collection system be cleaned.

Due to the lateral expansion into proposed Phase 5, the sump and cleanout risers for existing Cells 17 and 18 of Phase 1 will be extended and routed to the proposed limits of waste at the edge of proposed Phase 5. A new pad or vault will be constructed at the end of the new riser. Care shall be taken when installing the pump as to not damage the interior of the riser pipe. See Figure III.15.4

Extraction of leachate from the collection sumps is accomplished by electric or pneumatic submersible pumps. Submersible pumps are operated manually or automatically, depending on what conveyance method is used; manually to load tanker trucks, or automatically with level switches to discharge to a storage or recirculation system. A delivery rate of 10 gpm to 200 gpm at operating head conditions is generally desirable. The pumping rate will be determined in the field based on actual leachate accumulations in the sump. For the first two months after installation, the sumps will be checked weekly to verify compliance. At least once a month, thereafter, leachate levels will be checked at all sumps. After twelve consecutive months of compliance, the manual verification may be modified to quarterly checks. Leachate levels will be checked using either a water level meter or pneumatic bubbler. A water level indicator, such as Slope Indicator model 51417402 or equivalent, has a probe attached to a tape indicating distance in ft. with units to 0.01 ft. This will be the method most likely to be used in recently constructed areas of the facility, or locations not provided with an automatic pump for extraction of leachate.

The probe may be lowered down the sideslope riser until it indicates that it has contacted liquid. In order to get the probe down the inclined riser, it may be necessary to place the probe on a small, wheeled device, or attach it to a small diameter PVC pipe and extend the pipe down the riser by attaching subsequent segments of pipe. By using the invert elevation of the top of the riser (determined by survey after construction), the measured distance along the riser to leachate, and the known angle of the riser pipe, it is possible to determine the elevation of the leachate.

The automated leachate removal system will either be controlled by a bubbler system or a transducer system. A typical pneumatic bubbler-system to determine leachate levels, such as QED Environmental Systems, Inc. Level Mate Model L375 or equivalent, is intended for use with automatic pumping systems, but may also be used without the pump. The system operates by sending a slow, steady stream of air down small diameter tubing (0.25 in. for the model stated) inserted in the riser. The last segment of the tubing is rigid and fixed at a known elevation. The instrument measures the pressure resisting the air leaving the tube and determines the depth of liquid above the tip of the tube, and displays this information on a gauge at the surface. Knowing the elevation of the tip, elevation of leachate may readily be determined and compared to elevation of adjacent liner as discussed above.

Pressure transducers may be used to control the automatic pumping system in the leachate sumps. The pressure transducers are calibrated prior to installation in the sump and are sensitive to the pressure applied as the level of leachate increases and decreases in the sump.

The system will be set up to automatically begin pumping prior to reaching the regulatory maximum level and will turn off prior to pumping the sump dry.

2.3.7. Leachate Forcemain

A forcemain may be installed to allow leachate to be pumped directly from the sump to a storage tank or recirculation system. The forcemain will consist of a single wall 4" PVC SCH 80 pipe with restrained joints or single wall 4" HDPE SDR 11 pipe with welded joints (or equivalent). The PVC pipe will contain UV inhibitors which allow the PVC to be exposed to sunlight with minimal degradation in mechanical properties. The integrity of the forcemain will be verified by leak testing. Leak testing will be performed by pressurizing the forcemain with water or leachate to at least a pressure of 30 psig. A volume loss of less than or equal to two gallons over a two hour test period will be considered a passing test. A failing leak test will result in the system being checked and retested until the source of leakage is corrected and a passing leak test is performed.

On a monthly basis, a visual inspection of the forcemain route will be performed. Visual inspections will seek evidence of leaks such as wet soil, exposed pipe, construction activity near the forcemain route, etc. If the visual inspection reveals evidence of leachate, the forcemain will be leak tested.
Due to the lateral expansion into proposed Phase 5, the existing leachate forcemain located south of existing Phase 1 and north of existing Phase 4 will be removed. The proposed replacement leachate forcemain will be installed as shown on Figure III.15.2 and per the details shown on Figure III.15.5.

2.3.8. Leachate Storage

Should the recirculation of leachate not be possible due to periods of excessive rainfall, excess leachate volumes, or for maintenance reasons, the leachate will be pumped into storage tanks, vacuum trucks or tanker trucks.

Storage tanks can be temporary or permanent and shall be suitable for the storage of leachate. Storage tanks typically range in size from 1,000 to 20,000 gallons. Secondary containment must be provided for the leachate storage tanks. Lined areas of the landfill provide secondary containment. If a tank is located in an unlined area, double wall tanks shall be used as available. Should double wall tanks not be available, a temporary containment area, consisting of but not limited to, an earthen floor and containment berms completely covered with a minimum 30 mil PVC or HDPE liner shall be installed. Secondary containment shall be sized to contain 100% of the tank volume plus one foot of freeboard.

Leachate may be transported in City of Laredo vacuum trucks or tanker trucks with capacities ranging from 1,000 to 11,000 gallons. The trucks may haul the leachate offsite for disposal at the city's treatment plant or to a recirculation point on site.

Transferring leachate to a vacuum or tanker truck requires close operator attention. The operator will adhere to all site, safety, and reporting requirements listed in Part IV – Site Operating Plan. A truck loading area will be provided at all permanent storage tanks. It shall be paved and graded to prevent stormwater run-on from entering the loading area. The loading area shall contain a sump to collect rainfall and any spills of leachate during transfer. The sump will be emptied using a submersible pump or vacuum truck. Liquids removed from the loading area sump will be treated as leachate.

If transfer of leachate into a truck is required at a location without a paved loading area, a portable trough, disposable or temporary spill pads, or other equivalent means shall be provided at the hose connection locations to minimize spills when leachate is being pumped.

Any soil contacted by leachate will be excavated and disposed of in the landfill.

2.4. Leachate Treatment and Disposal

The landfill utilizes three methods for the treatment and disposal of leachate. One method is the recirculation of leachate into the waste. If the recirculation of leachate is not possible, the leachate will be transferred to a wastewater treatment plant for disposal. Should the City construct a sanitary sewer line near the landfill, leachate may be pumped to and discharged into the sanitary sewer.

2.4.1. Leachate Recirculation.

Leachate can be managed through recirculation at the Laredo Landfill; however, there are certain constraints on where the recirculation can occur and the quantities which can be recirculated. As discussed in 30 TAC §330.177, leachate may only be recirculated to cells which have a

composite liner system consisting of a minimum two-foot thick clay liner and synthetic liner. Leachate may not be recirculated to cells with alternate liner designs.

The recirculation will be accomplished by reintroducing the collected leachate back into the disposal unit. Typical recirculation methods include but are not limited to spray application on the working face, saturation fields and drip irrigation. Clean surface water or groundwater will not be recirculated. The recirculation will be accomplished in a manner that prevents ponding or significant accumulations of leachate in any one area.

A typical approach for recirculation of leachate is as follows:

1. A tanker truck, such as a 3,000 gallon capacity water truck with a spray bar is filled either directly from the sump or from a temporary or permanent leachate storage tank;
2. The tanker truck sprays leachate within the active area;
3. The leachate truck is used to accept more leachate from sumps as necessary and process is repeated; and
4. Leachate truck is emptied so potential for leakage or spillage is nonexistent.

3. Contaminated Water Management

3.1. Contaminated Water Generation

Surfacewater that comes into contact with waste or leachate is considered to be contaminated water. Best management practices will be used to minimize contaminated water generation. These practices extend to surface water management, cell construction, cover practices, and waste acceptance.

The size of active disposal areas will be kept as small as practical and daily and intermediate cover will be placed over filled areas to minimize the area of exposed waste. Temporary diversion/containment berms will be constructed around areas of exposed waste to minimize the amount of surface water that comes into contact with the waste. The uncontaminated stormwater will be directed into the site's perimeter drainage system. Design calculations and typical details for temporary diversion/containment berms are presented in Part III – Attachment 6.

Procedures for verifying the adequacy of daily and intermediate cover placement are provided in Part IV — Site Operating Plan. If waste is exposed in areas where daily or intermediate cover has been previously placed, runoff from these areas will be considered to be contaminated water.

3.2. Contaminated Water Collection

The same temporary diversion/containment berms that prevent surface water from entering areas of exposed waste collect and contain surface water that has come into contact with waste. In addition to the planned containment berms around the active face, temporary containment berms will be constructed wherever needed to collect contaminated water. Design calculations and typical details for temporary diversion/containment berms are presented in Part III – Attachment

6. The calculations show the dimensions for typical conditions, but additional storage capacity will be provided as site operating conditions dictate.

3.3. Contaminated Water Disposal

Contaminated water will be transported to the City's off-site wastewater treatment plant, pumped into the leachate storage tank and treated as leachate, or managed through alternate methods as approved by TCEQ depending on the nature of the contaminated water.

4. Spill Response

Response to an emergency such as a spill of leachate or contaminated water shall include, as appropriate:

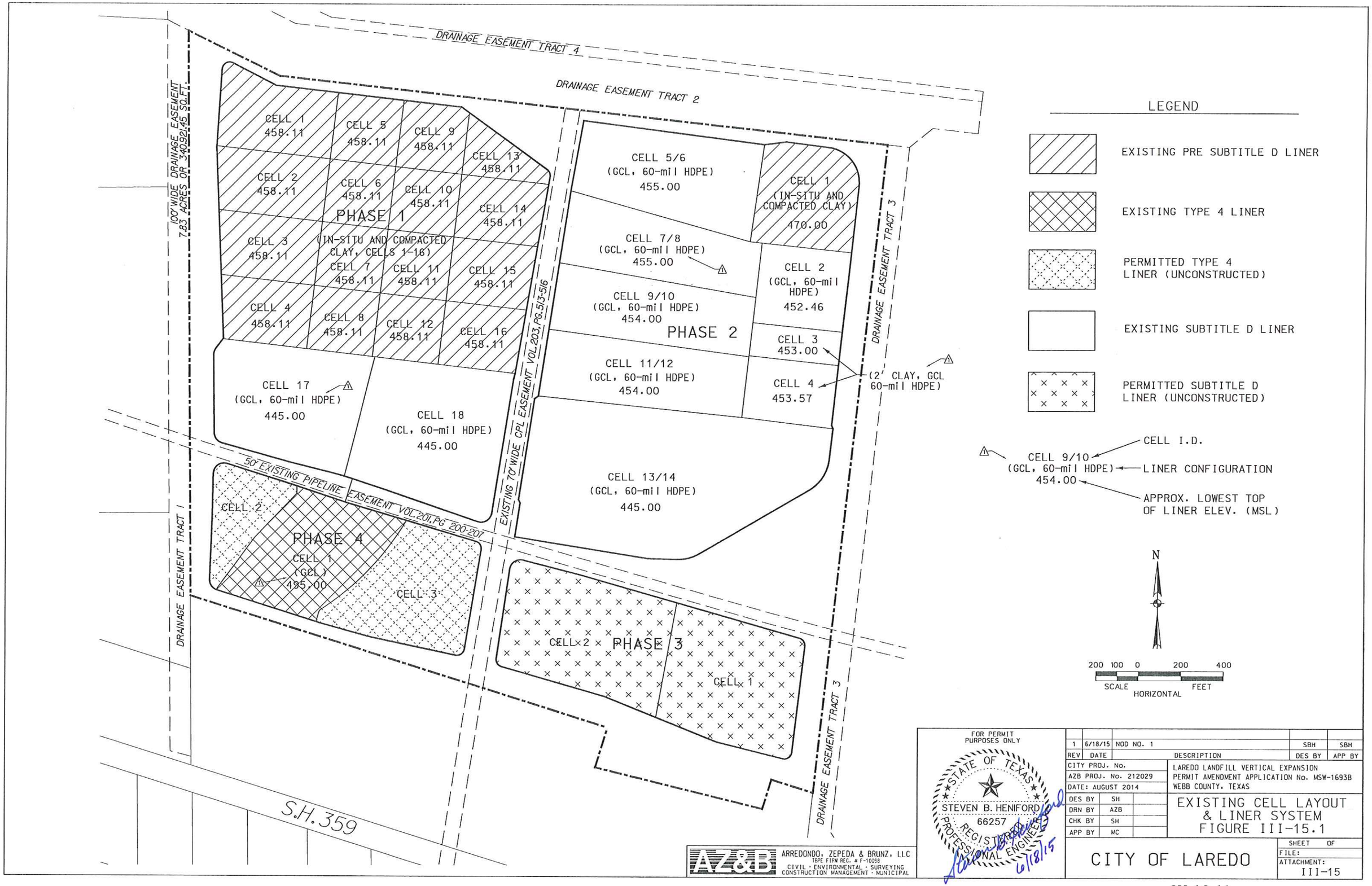
- Shutoff pumps as appropriate, perform temporary repairs to the storage tank, tanker truck, or vacuum truck;
- Construction of temporary soil berms to contain the leachate or contaminated waters;
- Use of pumps or vacuum trucks to collect spilled liquids;
- Solidification of the liquids with fly ash, flue dust, cement, or like materials followed by placement in the landfill;
- Excavation, removal, and landfilling of any impacted soils or materials; and
- Permanent repairs to storage tank, tanker truck, vacuum truck, or forcemain as necessary.

5. Maintenance

Maintenance performed on the leachate management system includes repairing or replacing leachate pumps as necessary to ensure leachate level conditions discussed in this plan, section 2.3.5. Leachate collection lines may need periodic flushing to dislodge biological mass or fines that have clogged the pipe perforations. This will typically be performed by an outside contractor with equipment sufficient to flush the entire length of leachate collection lines.

6. Monitoring

Leachate head levels will be measured on an as needed basis, but at a minimum, they will be measured as outlined in Section 2.3.6. Leachate removal will occur as necessary to maintain leachate level conditions discussed in section 2.5.3 in this plan. If excess head levels are encountered, the site will immediately begin actions to reduce the levels.



FOR PERMIT PURPOSES ONLY

STATE OF TEXAS
STEVEN B. HENIFORD
66257
REGISTERED PROFESSIONAL ENGINEER
6/18/15

ARREDONDO, ZEPEDA & BRUNZ, LLC
TBPE FIRM REG. # F-10058
CIVIL - ENVIRONMENTAL - SURVEYING
CONSTRUCTION MANAGEMENT - MUNICIPAL

REV	DATE	DESCRIPTION	DES BY	APP BY
1	6/18/15	NOD NO. 1	SBH	SBH

CITY PROJ. No.
AZB PROJ. No. 212029
DATE: AUGUST 2014

LAREDO LANDFILL VERTICAL EXPANSION
PERMIT AMENDMENT APPLICATION No. MSW-1693B
WEBB COUNTY, TEXAS

DES BY	SH	
DRN BY	AZB	
CHK BY	SH	
APP BY	MC	

EXISTING CELL LAYOUT & LINER SYSTEM
FIGURE III-15.1

CITY OF LAREDO

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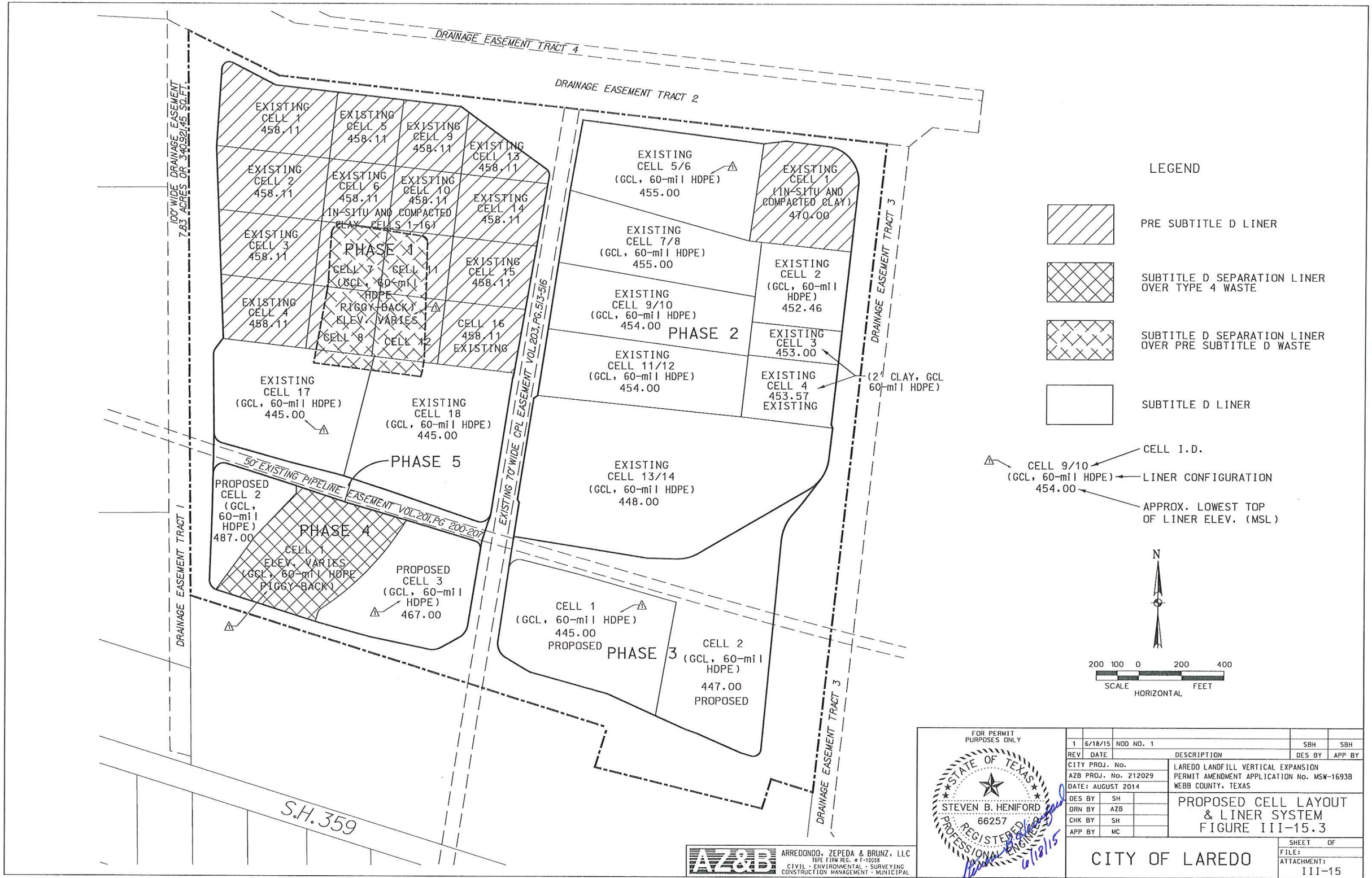

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LAREDO LANDFILL VERTICAL EXPANSION
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WEBB COUNTY, TEXAS

PROPOSED CELL LAYOUT & LINER SYSTEM
FIGURE III-15.3

CITY OF LAREDO

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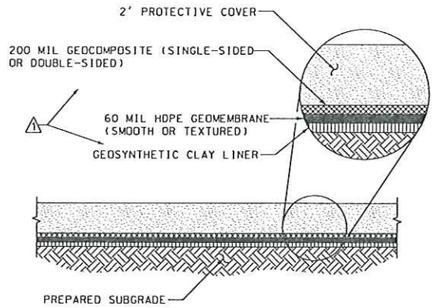
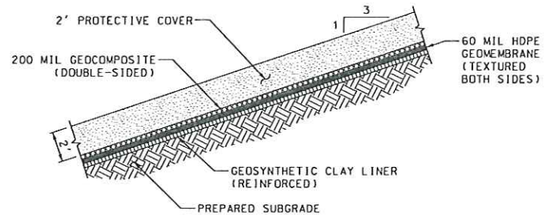


BOTTOM LINER (A / 15.5)
NTS



SIDESLOPE LINER (B / 15.5)
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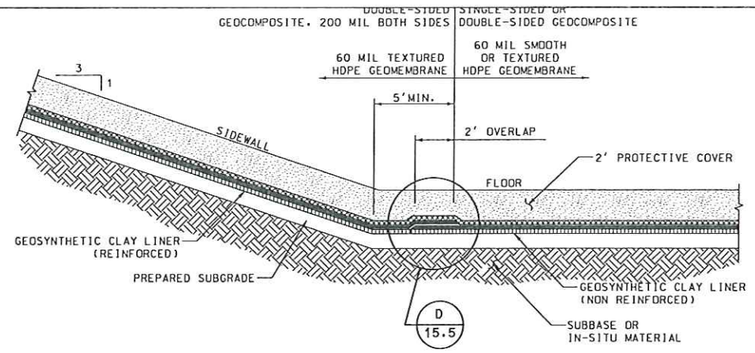
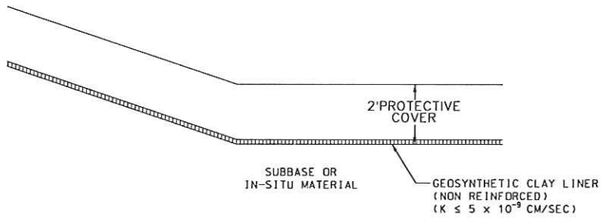


C / 15.5 TYPICAL TYPE I LINER SYSTEM
NTS



F / 15.5 TYPICAL TYPE IV LINER SYSTEM
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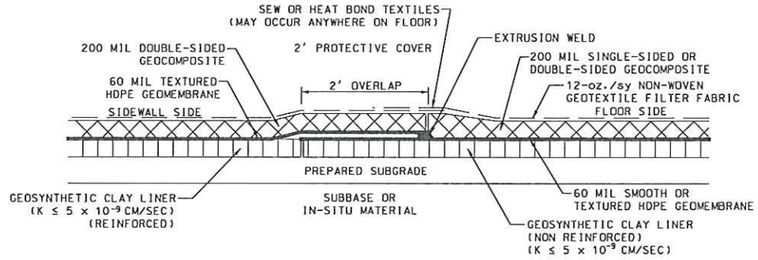
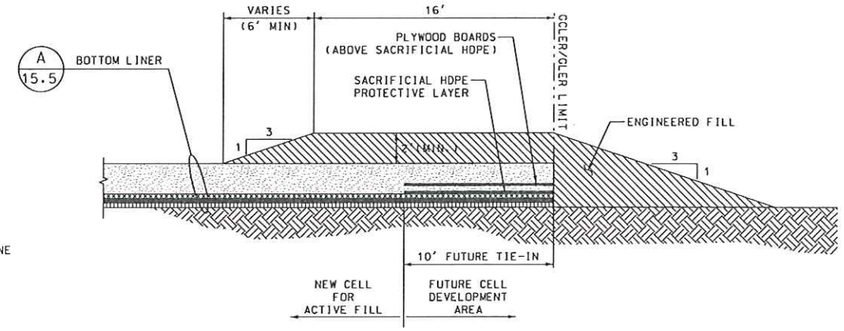
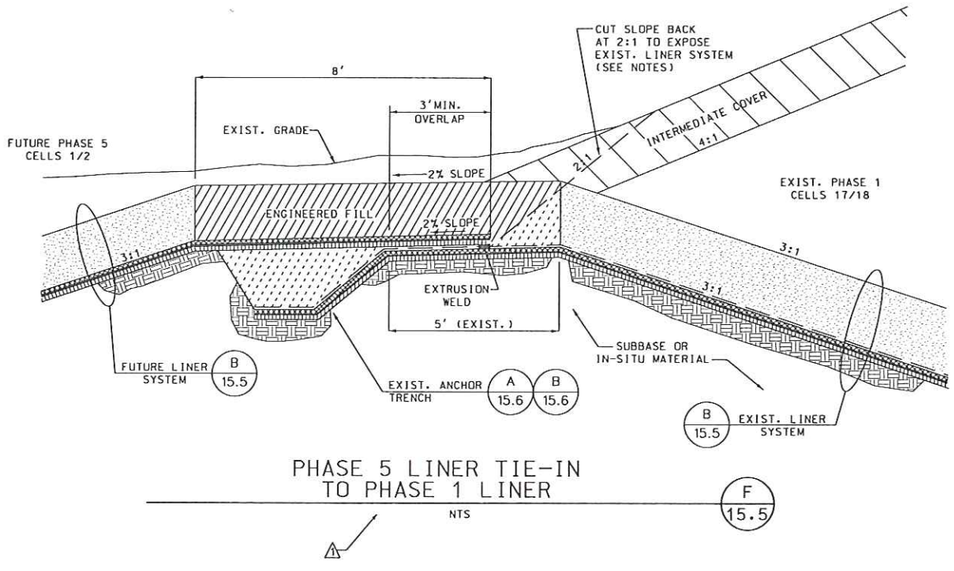


D / 15.5 TYPICAL TYPE I LINER TIE-IN
NTS



MID-CELL BERM-LINER TERMINATION (E / 15.5)
NTS

NOTE: ALTERNATES TO THE GCL INCLUDE A 3' SOIL LINER (K ≤ 1 x 10⁻⁷ CM/SEC) OR A GCL (K ≤ 3 x 10⁻⁹ CM/SEC) WITH A 6" SOIL SUBGRADE (K ≤ 1 x 10⁻⁷ CM/SEC)



PHASE 5 LINER TIE-IN TO PHASE 1 LINER (F / 15.5)
NTS

NOTES

1. CONTRACTOR MAY ENCOUNTER WASTE WHEN CUTTING SLOPE BACK AT 2:1 TO EXPOSE EXIST. LINER SYSTEM.
2. IF WASTE IS ENCOUNTERED, THE CONTRACTOR SHALL CONTACT THE CITY FOR EXCAVATION REQUIREMENTS.
3. CONTRACTOR SHALL PLACE A MINIMUM OF 12 INCHES OF SOIL OVER ANY WASTE EXPOSED DURING LINER TIE-IN OPERATION.

ARREDONDO, ZEPEDA & BRUNZ, LLC
TBPE FIRM REG. # F-1008
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STATE OF TEXAS
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CITY PROJ. No.	LAREDO LANDFILL VERTICAL EXPANSION
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DATE: AUGUST 2014	WEBB COUNTY, TEXAS

DES BY	SH	
DRN BY	AZB	
CHK BY	SH	
APP BY	MC	

LINER DETAILS
FIGURE III-15.5

CITY OF LAREDO

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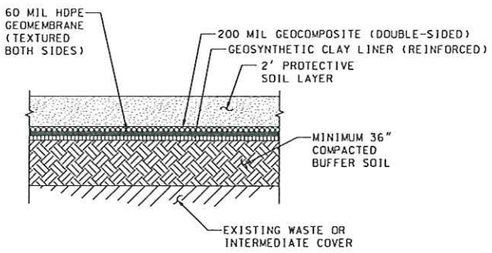
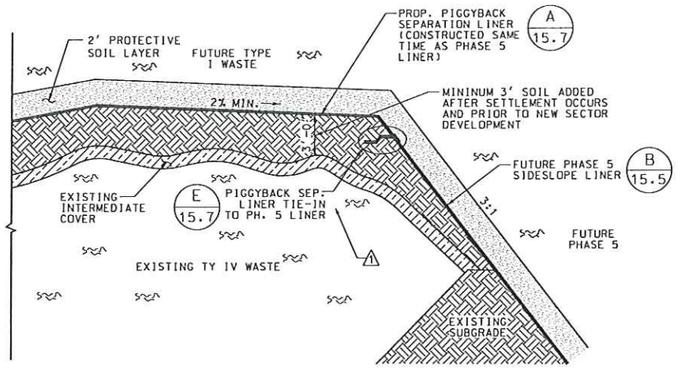
ATTACHMENT: III-15



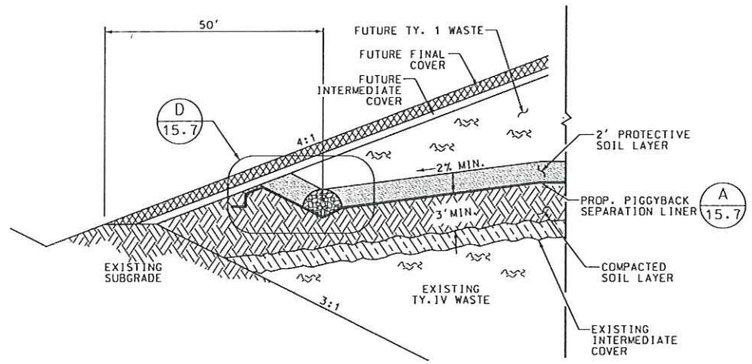
PIGGYBACK SEPARATION LINER (A 15.7)

NTS



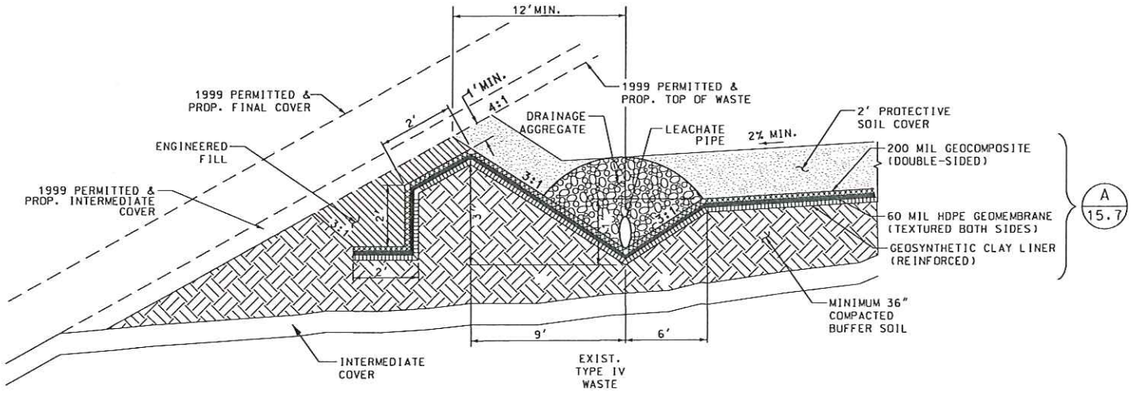
PIGGYBACK SEPARATION LINER OVER EXISTING TY.IV WASTE (PHASE 4 NORTH SIDE)

NTS (B 15.7)



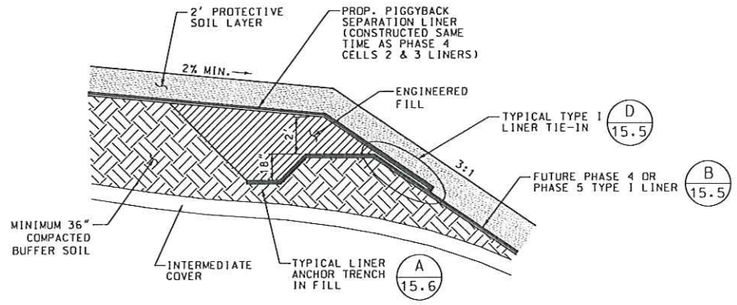
PIGGYBACK SEPARATION LINER OVER EXISTING TY.IV WASTE (PHASE 4 SOUTH SIDE)

NTS (C 15.7)



PIGGYBACK SEPARATION LINER TERMINATION ANCHOR OVER TYPE IV WASTE (SOUTH)

NTS (D 15.7)



PIGGYBACK SEPARATION LINER TIE-IN TO PHASE 4 & 5 SUBTITLE D LINERS (NORTH, EAST & WEST)

NTS (E 15.7)

FOR PERMIT PURPOSES ONLY

STATE OF TEXAS
STEVEN B. HENIFORD
66257
REGISTERED PROFESSIONAL ENGINEER
6/18/15

REV	DATE	DESCRIPTION	DES BY	APP BY
1	6/18/15	NOD NO. 1	SBH	SBH

CITY PROJ. No.
AZB PROJ. No. 212029
DATE: AUGUST 2014

DES BY	SH
DRN BY	AZB
CHK BY	SH
APP BY	MC

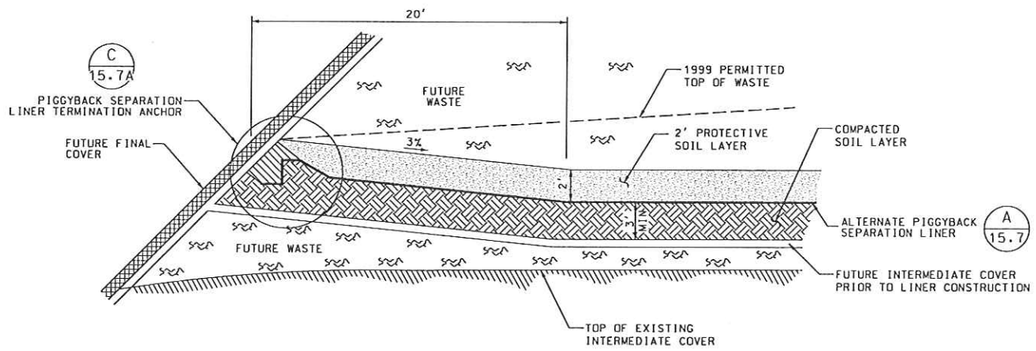
LAREDO LANDFILL VERTICAL EXPANSION
PERMIT AMENDMENT APPLICATION No. MSW-1693B
WEBB COUNTY, TEXAS

PIGGY-BACK SEPARATION LINER DETAILS
FIGURE III-15.7

CITY OF LAREDO

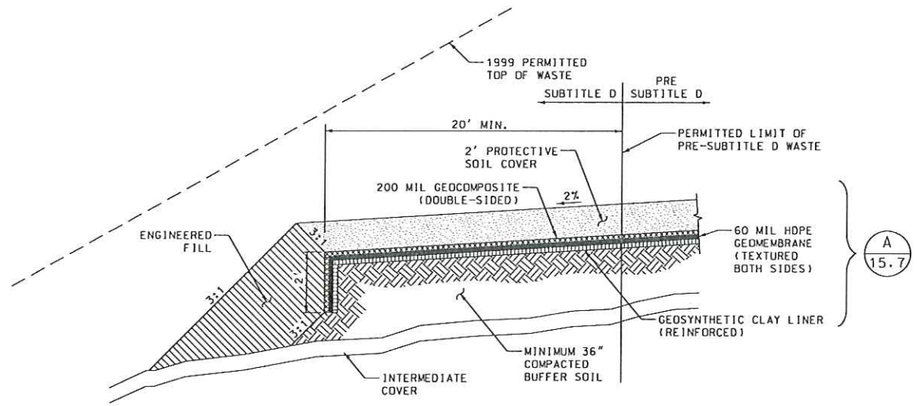
SHEET OF
FILE:
ATTACHMENT: III-15

ARREDONDO, ZEPEDA & BRUNZ, LLC
TBPE FIRM REG. # F-10098
CIVIL · ENVIRONMENTAL · SURVEYING
CONSTRUCTION MANAGEMENT · MUNICIPAL



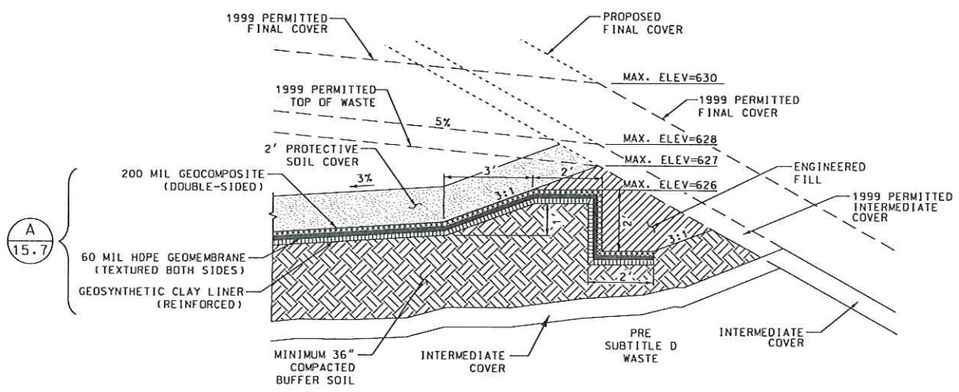
PIGGYBACK SEPARATION LINER OVER EXISTING PRE-SUB. D WASTE (PHASE 1) A 15.7A

NTS



PIGGYBACK SEPARATION LINER TERMINATION ANCHOR OVER TYPE 1 WASTE (SOUTH) B 15.7A

NTS



PIGGYBACK SEPARATION LINER TERMINATION ANCHOR OVER TYPE 1 WASTE (NORTH, EAST & WEST) C 15.7A

NTS

FOR PERMIT PURPOSES ONLY

STATE OF TEXAS
STEVEN B. HENIFORD
66257
REGISTERED
PROFESSIONAL ENGINEER
6/18/15

REV	DATE	DESCRIPTION	DES BY	APP BY
1	6/18/15	NOD NO. 1	SBH	SBH

CITY PROJ. No.
AZB PROJ. No. 212029
DATE: AUGUST 2014
DES BY SH
DRN BY AZB
CHK BY SH
APP BY MC

LAREDO LANDFILL VERTICAL EXPANSION
PERMIT AMENDMENT APPLICATION No. MSW-1693B
WEBB COUNTY, TEXAS

PIGGY-BACK LINER DETAILS 2 ⚠1
FIGURE III-15.7A

CITY OF LAREDO

SHEET OF
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ATTACHMENT: III-15

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ARREDONDO, ZEPEDA & BRUNZ, LLC
TBPE FIRM REG. # F-10058
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CONSTRUCTION MANAGEMENT · MUNICIPAL

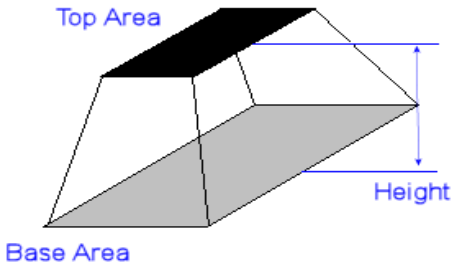
1820 Regal Row
Dallas, Texas 75235
214-638-0500

Project # LARE1301

Client	Laredo Municipal Solid Waste Landfill	Prepared By	BW	on	4/30/2013
Project	Permit Amendment Application	Reviewed By	FP	on	11/6/2013
Subject	LCS Sump Calculations	Approved By	FP	on	9/22/2014

A LCS Sump Sizing

$$Volume = (Top\ Area + Base\ Area + \sqrt{Top\ Area\ x\ Base\ Area}\ )x\frac{H}{3}$$



Minimum Sump Sizing

Sump Size	9 ft	x	9 ft
Side Slope	3	:	1
Sump Depth / Height	3 ft		
Top Area	729 sf		
Base Area	81 sf		
Total Volume	1053 cf		
Aggregate Void Space	40%		

Total Leachate Volume 421.2 cf = **3151 Gallons**
1 cf = 7.481 Gallons

1820 Regal Row
Dallas, Texas 75235
214-638-0500

Project # LARE1301

Client	Laredo Municipal Solid Waste Landfill	Prepared By	BW	on	4/30/2013
Project	Permit Amendment Application	Reviewed By	FP	on	11/6/2013
Subject	LCS Geocomposite Calculations	Approved By	FP	on	9/22/2014

Base / Design Geocomposite:

Transmissivity	T =	5.00E-04 m2/s	@	10,000	psf
Thickness	t =	0.18 in	@	unloaded	

Geocomposite Thickness

Assume the geocomposite will undergo linear compression due to the weight of soil and waste.

Unloaded geocomposite thickness =	0.18 in		
Compressibility at 20,000 psf =	50 %		
Unit weight of waste =	44.4 pcf =	1,200	lb/CY
Unit weight of soil =	120 pcf		

Fill Condition	d_w[1] (ft)	d_s[2] (ft)	P[3] (psf)	t[4] (in)
Active	20	3	1249	0.18
Interim	80	3	3916	0.17
Closed	203	3	9382	0.15

1. d_w is the depth of waste above the geocomposite
2. d_s is the depth of soil above the geocomposite
3. P is the pressure on the geocomposite due to the weight of the waste and soil.
4. t is the thickness of the geocomposite after being subjected to linear compression.

Factors of safety for Strength and Environmental Conditions.

	Fill Condition		
Factor of Safety	Active (40' Waste)	Interim (80' Waste)	Closed (120' Waste)
Geotextile Intrusion	1.0	1.20	1.40
Creep Deformation	1.0	1.00	1.00
Chemical Clogging	1.0	1.20	1.40
Biological Clogging	1.0	1.20	1.40
FS Factor	1.00	1.73	2.74

Compute the hydraulic conductivity under confined conditions.

Fill Condition	d_w (ft)	P (psf)	t (in)	T[1] (m^2/s)	FS	T_{FS}[2] (m^2/s)	k[3] (cm/s)
Active	20	1249	0.18	8.10E-04	1.00	8.10E-04	18.06
Interim	80	3916	0.17	5.76E-04	1.73	3.33E-04	7.75
Closed	203	9382	0.15	5.00E-04	2.74	1.82E-04	4.65

1. T is the rated geocomposite Transmissivity value.
2. T_{FS} is the geocomposite Transmissivity taking into account the FS.
3. k is the geocomposite hydraulic conductivity k = TFS/t