



RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN
5 YEAR UPDATE

Property:
San Miguel Electric Cooperative Power Plant
Ash Pile
Atascosa County, Texas

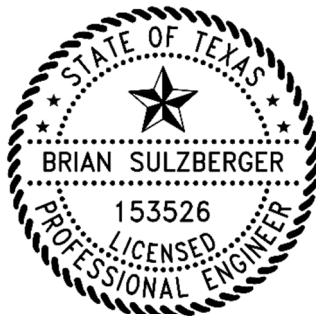
October 16, 2026

Ensolum Project No.: 10A2616009

Prepared for:
San Miguel Electric Cooperative, Inc.
6200 FM 3387
Christine, Texas 78012

Professional Certification

This document and all attachments were prepared by Ensolum, LLC under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I hereby certify that the Run-on and Run-off Control System Plan has been prepared in accordance with the requirements of Section 257.81 of the CCR Rule.



A handwritten signature in cursive script that reads "Brian Sulzberger".

10/16/2026

Brian L. Sulzberger, PE
Associate Principal
Ensolum, LLC
Firm Registration No. F-21843

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1.0 INTRODUCTION

San Miguel Electric Cooperative, Inc. (SMECI) owns and operates the San Miguel Power Plant (SMPP) located approximately 6 miles south of Christine, Texas in Atascosa County, Texas (Figure 1). The SMPP is a 440-megawatt, lignite-fired electric power plant that was placed into service in 1982. Coal Combustion Residuals (CCR) including fly ash, bottom ash and flue gas desulfurization (FGD) wastewater/solids are generated as part of SMPP operation. Fly ash and FGD solids are temporarily stored in the Ash Pile prior to transportation off-site for management in the adjacent SMECI Surface Lignite Mine. The Ash Pile is located adjacent to the SMPP generating unit (Figure 2).

The U.S. Environmental Protection Agency promulgated 40 C.F.R. Part 257, Subpart D (the CCR Rule) to establish technical requirements for new and existing CCR landfills and surface impoundments. The Ash Pile has been identified as an Existing CCR Landfill regulated under the CCR Rule.

Section 257.81(c) of the CCR Rule requires that a Run-On/Run-Off Control System Plan (RRCSP) be developed for all CCR Landfills. In accordance with Section 257.81(c)(3) of the CCR Rule, the initial RRCSP for the Ash Pile was completed and placed in the facility operating record in October 2016 (ERM, 2016). As specified in Section 257.81(c)(4), the RRCSP must be updated every five years from the completion date of the initial plan. Ensolum, LLC, was retained by SMECI to prepare this updated RRCSP for the Ash Pile.

1.1 CCR Landfill Run-on and Run-off Control System Plan Requirements

Section 257.81(c) of the CCR Rule specifies that a written run-on and run-off control system plan be prepared for each existing CCR landfill that describes the systems that have been designed and constructed to control run-on to and run-off from the landfill consistent with the requirements of the CCR Rule and recognized and generally accepted good engineering practices. The RRCSP must include, at a minimum, design, construction, operation, and maintenance information for the following:

- A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and
- A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm. Run-off from the active portion of the CCR unit must be managed in accordance with the requirements of 40 CFR 257.3–3 (prohibition against pollution of waters of the United States).

The RRCSP must be supported by appropriate engineering calculations and must be certified by a qualified professional engineer. The RRCSP must document how the run-on and run-off control system has been designed and constructed to comply with the requirements of Section 257.81 of the CCR Rule.

1.2 Description of Ash Pile

The CCR Rule defines CCR's such as fly ash, bottom ash, boiler slag, flue gas desulfurization (FGD) materials (gypsum), and related solids generated from burning coal for the purpose of generating electricity by electric utilities and independent power producers. The Ash Pile is a temporary storage area used to stage a stabilized mixture of fly ash and FGD solids until the mixture can be transported off-site. The Ash Pile was designated as the "FGD Stacking Area" in the original plant construction documents (T&G, 1980). The Ash Pile covers an area of approximately one acre.

The Ash Pile is a non-containerized accumulation of solid CCR that is placed on the land that began receiving CCR before October 19, 2015 and currently receives CCR. As a result, the Ash Pile meets the definition of an existing “CCR Pile” under Section 257.53. Under the CCR Rule, an existing CCR Pile is classified as an existing CCR landfill and must comply with the technical requirements for existing CCR Landfills, including preparation of an updated RRCSP.

1.3 SMPP TPDES Permit

The SMPP is authorized to discharge stormwater run-off from the Ash Pile, Lignite Storage Pile and adjacent areas under Texas Pollutant Discharge Elimination System (TPDES) Permit No. WQ0002601000 which was issued on November 2, 2023 and expires on November 2, 2028. Stormwater run-off from these areas is collected and conveyed to the Lignite Yard Retention Pond (Retention Pond) located south of the Lignite Storage Pile (see Figure 2). The Retention Pond is designed to retain/evaporate most stormwater that drains to the Pond; however, in the event of elevated water levels in the Pond associated with a significant storm event, the TPDES Permit authorizes water from the Retention Pond to be discharged to a tributary of Souse Creek through Outfall 001.

The volume of water discharged through Outfall 001 is described in the TPDES Permit as “intermittent and flow-variable” and the permit does not include a discharge flow limitation.

1.4 Previous RRCSP for Ash Pile

The Initial RRCSP for the Ash Pile was completed and placed in the facility operating record in October 2016 (ERM, 2016). A figure showing the drainage area upstream of the Retention Pond (including the Ash Pile) from the Initial RRCSP is reproduced in Appendix A.

Key Findings from the Initial RRCSP can be summarized as follows:

- The drainage area upstream of the Retention Pond covers approximately 68.5 acres and consists of the following surface areas that generate stormwater run-off:
 - Ash or Lignite: 16.5 acres
 - Unpaved Areas: 46.4 acres
 - Paved Areas: 5.6 acres

For the purposes of the Initial RRCSP, the drainage area was further divided into the following drainage subareas (see Appendix A):

Sub Area No.	Ash or Lignite Area (acres)	Unpaved Area (acres)	Paved Area (acres)
1	0.1	0.0	1.3
2	0.1	0.2	0.1
3	0.0	6.4	3.7
5	0.1	1.3	0.0
7	2.5	6.8	0.3
9	5.5	18.6	0.1
10	8.2	13.1	0.1

- Run-off from the drainage area is conveyed to the Retention Pond through a series of ditches and culverts. The Initial RRCSP estimated peak stormwater flows from the various drainage subareas resulting from a 24-hour, 25-year storm and compared the peak flows

to the estimated capacities of the ditches and culverts. Peak stormwater flows were calculated using the Rational Method with the following assumed run-off coefficients:

- Ash or Lignite: 0.35 (for Ash Pile or Lignite Storage Pile areas)
- Light Industrial: 0.65 (for unpaved areas/roads and grass-covered areas)
- Pavement/Roof: 0.90 (for paved roads and roof area run-off).

Tables summarizing drainage area hydrologic data, ditch/culvert hydraulic data and calculation results from the Initial RRCSP are reproduced in Appendix B.

- Hydraulic and hydrologic analysis of the drainage areas around and upstream of the Ash Pile indicated that there was no stormwater run-on to the Ash Pile due to peak stormwater flow resulting from the 24-hour, 25-year storm. Consequently, the Ash Pile stormwater run-on controls were in compliance with the requirements of Section 257.81(a)(1) of the CCR Rule.
- Hydraulic and hydrologic analysis of the drainage areas, drainage channels, and culverts upstream and downstream of the Ash Pile showed that peak stormwater run-off from the Ash Pile resulting from the 24-hour, 25-year storm was adequately conveyed to the Retention Pond in accordance with the SMPP TPDES Permit. Consequently, the Ash Pile stormwater run-off controls were in compliance with the requirements of Section 257.81(a)(2) of the CCR Rule.

2.0 UPDATED RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN

The Updated RRCSP for the Ash Pile is described in this section as required under Section 257.81(c) of the CCR Rule.

2.1 Design Storm Event

In accordance with Sections 257.81(a)(1) and 257.81(a)(2) of the CCR Rule, the run-on and run-off control systems for the Ash Pile must be designed to prevent run-on into the Ash Pile and control run-off from the Ash Pile during the peak discharge from a 25-year, 24-hour storm. The 25-year, 24-hour storm for the Ash Pile and vicinity remains 7.89 inches based on the Point Precipitation Frequency Estimate Table from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 for Jourdanon, TX (NOAA, 2026, see Appendix C).

2.2 Updated Stormwater Drainage Area - Ash Pile and Vicinity

As described in Section 1.4 of this Report, a detailed evaluation of the stormwater drainage area in the vicinity of the Ash Pile was performed as part of the Initial RRCSP. Previous updates to the RRCSP incorporated minor revisions to the mapped drainage subareas associated with the Ash Pile and Lignite Storage Pile area. The resulting drainage area information is presented on Figure 3. Based on those revisions, the total drainage area upstream of the Retention Pond is approximately 68.3 acres (from 68.5 acres in the initial RRCSP) and consists of the following surface areas that generate stormwater run-off:

- Ash or Lignite: 16.5 acres (unchanged)
- Unpaved Areas: 46.7 acres (increased from 46.4 acres)
- Paved Areas: 5.1 acres (reduced from 5.6 acres)

Updated aerial imagery, 2026 drone survey data of the lignite pile, and observations made during the September 2026 site reconnaissance were reviewed to evaluate current drainage conditions. The review included an evaluation of site grading, drainage patterns, stormwater conveyance features, and the contributing drainage area to the Retention Pond.

No significant changes to drainage patterns, stormwater conveyance features, contributing drainage areas, or site conditions affecting stormwater runoff management were identified. No evidence of overtopping, significant erosion, or drainage deficiencies was observed during the site reconnaissance.

Based on this review, the drainage area assumptions, hydrologic conditions, and stormwater management features evaluated in the previous RRCSP remain applicable. Therefore, no additional updates to the hydraulic or hydrologic calculations were considered necessary.

2.3 Run-on Control System

The Initial RRCSP concluded that there was no stormwater run-on to the Ash Pile due to peak stormwater flow resulting from the 25-year, 24-hour storm. Based on Ensolum's review of the Initial RRCSP, the Ash Pile stormwater run-on controls are in compliance with the requirements of Section 257.81(a)(1) of the CCR Rule.

2.4 Run-off Control System

The Initial RRCSP concluded that peak stormwater run-off from the Ash Pile resulting from the 25-year, 24-hour storm was adequately conveyed to the Retention Pond in accordance with the SMPP TPDES Permit. Based on Ensolum's review of the Initial RRCSP, this conclusion is representative of stormwater run-off conditions for the Ash Pile and vicinity.

In addition, Ensolum evaluated the potential effect of run-off from the Ash Pile and vicinity resulting from the 25-year, 24-hour storm on water levels in the Retention Pond. The evaluation was based on the following assumptions:

- The design operating level in the Retention Pond is managed to maintain a minimum 2-foot freeboard in the pond under normal operating conditions.
- The surface area of the Retention Pond that is available for water storage with a 2-foot freeboard is approximately 10 acres.
- The SMPP TPDES Permit authorizes water from the Retention Pond to be discharged through Outfall 001 in the event of elevated water levels in the Pond associated with a significant storm event.
- Evaporation from the Retention Pond is assumed to be negligible during the design storm event.

The water balance equation for the Retention Pond was assumed to be as follows:

$V_{RO} + V_P = SC + \text{Discharge}$, where:

V_{RO} = Estimated Run-off Volume

V_P = Estimated Direct Precipitation on Retention Pond

SC = Storage Capacity in Retention Pond Freeboard

Discharge = Discharge through Outfall 001 if Storage Capacity is Exceeded

Stormwater run-off volumes were calculated using the Rational Method:

$V_{RO} = CiA$, where:

V_{RO} = Estimated Run-off Volume (cf)

C = Rational Method Run-off Coefficient. Assumed Run-off Coefficients:

- Ash or Lignite: 0.35
- Unpaved Areas: 0.65
- Pavement/Roof: 0.90

i = Rainfall (ft). Assumed to be 7.98 inches (0.66 feet) for the 25-year, 24-hr design storm.

A = Stormwater Drainage Areas (sf). Assumed Drainage Areas:

- Ash or Lignite: 718,740 sf (16.5 acres)
- Unpaved Areas: 2,034,252 sf (46.7 acres)
- Paved Areas: 222,156 sf (5.1 acres)

The stormwater run-off volume from the Ash Pile and vicinity to the Retention Pond during the 25-year, 24-hr design storm (V_{RO}) is estimated to be:

$$\begin{aligned} V_{RO} &= (0.67 \text{ ft}) \times ((718,740 \text{ sf} \times 0.35) + (2,034,252 \text{ sf} \times 0.65) + (222,156 \text{ sf} \times 0.90)) \\ &= (0.67 \text{ ft}) \times (251,559 \text{ sf} + 1,322,264 \text{ sf} + 199,940 \text{ sf}) \\ &= 1,188,421 \text{ cf} \end{aligned}$$

The volume of precipitation that falls directly on the Retention Pond during the 25-year, 24-hr design storm (V_P) is estimated to be:

$$\begin{aligned} V_P &= 0.67 \text{ ft} \times 10 \text{ acres} \times 43,560 \text{ sf/acre} \\ &= 291,852 \text{ cf} \end{aligned}$$

Hydraulic and hydrologic analysis of the drainage areas, drainage channels, and culverts upstream and downstream of the Ash Pile shows that stormwater runoff from the Ash Pile due to the peak stormwater flow during the design 24-hour, 25-year storm is conveyed to the design containment, the Lignite Yard Retention Pond (LYRP). Stormwater from these areas is allowed to drain into the LYRP in accordance with the San Miguel Plant TPDES Permit and 40 CFR §257.81(a).

Based on this evaluation, the Ash Pile stormwater run-off controls are in compliance with the requirements of Section 257.81(a)(2) of the CCR Rule.

2.5 Updates to Run-on and Run-off Control System Plan

In accordance with Section 257.81(c)(3) of the CCR Rule, this Updated RRCSP must be placed in the operating record for the SMPP no later than October 17, 2026. Subsequent RRCSPs must be completed every five years.

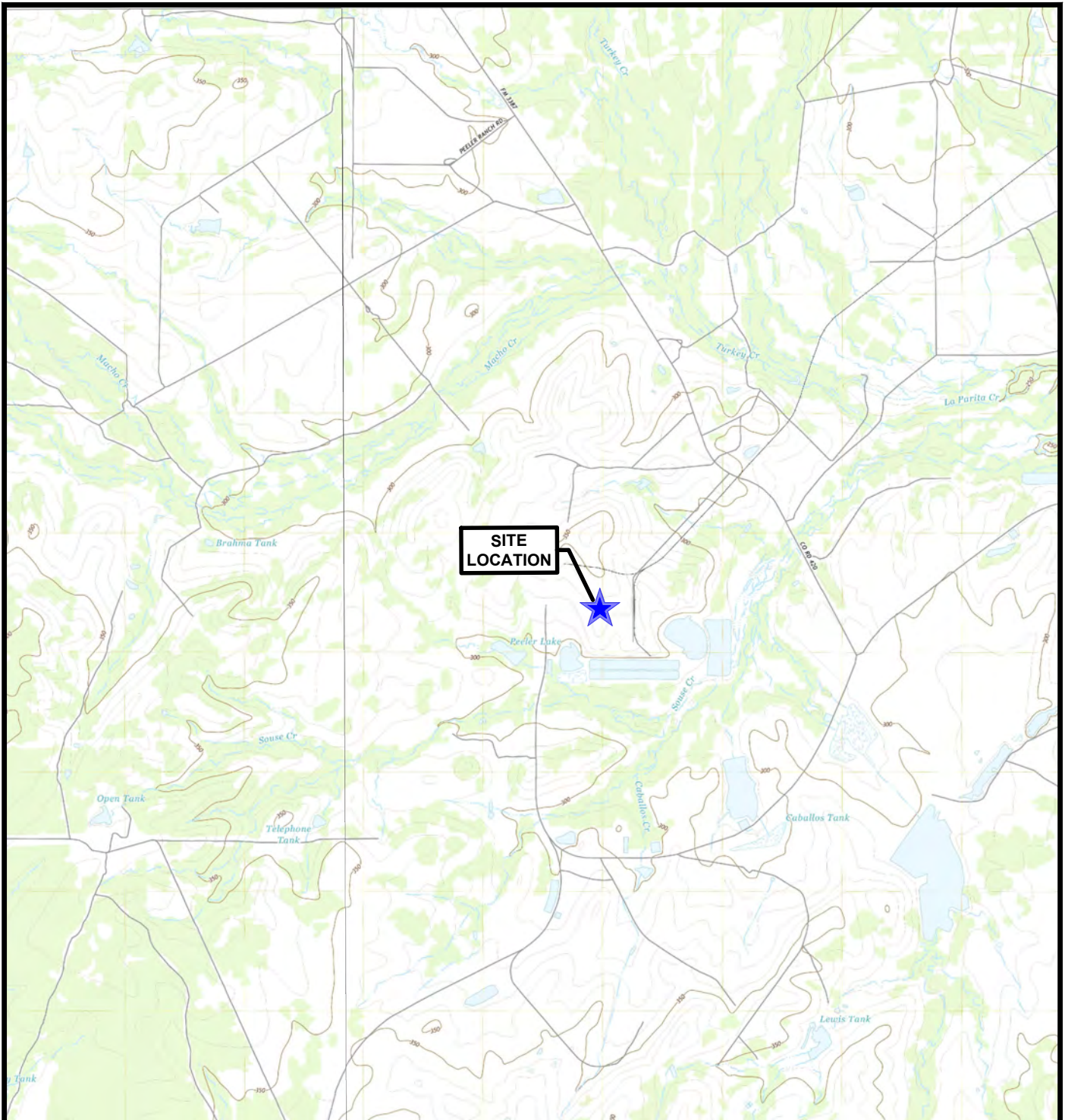
3.0 REFERENCES

Environmental Resources Management (ERM), 2016. Ash Pile Stormwater Run-On and Run-Off Control System Plan, San Miguel Electric Cooperative, Inc., Atascosa County, Texas, October 14.

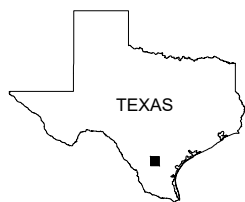
National Oceanic and Atmospheric Administration (NOAA), 2026. Atlas 14 – Point Precipitation Frequency Estimates Website, Jourdanon, Texas. September.

Tippet & Gee, Inc (T&G), 1980. Site Plan Section No. 6, San Miguel Plant Unit No. 1, Drawing No, 1-C-35 Rev 16, April 1, 1977, revised August 6, 1980.

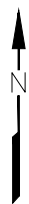
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REFERENCES:
BASE MAP TAKEN FROM USGS.GOV, CROSS NE AND CABALLOS CREEK, TX 7.5 MIN. USGS
QUADRANGLE DATED 2019.



QUADRANGLE LOCATIONS



Scale in Feet



SAN MIGUEL ELECTRIC COOPERATIVE ATASCOSA COUNTY, TEXAS

Figure 1 Site Location Map Ash Pile

Run-on and Run-off Control System Plan Update

PROJECT: 10A2616009

BY: HLS

REVISIONS

DATE: SEP 2026

CHECKED: ECM



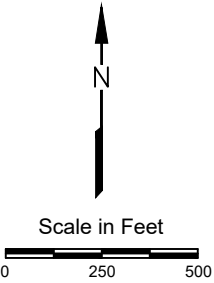
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LEGEND:

--- APPROX. PLANT BOUNDARY

CCR UNIT



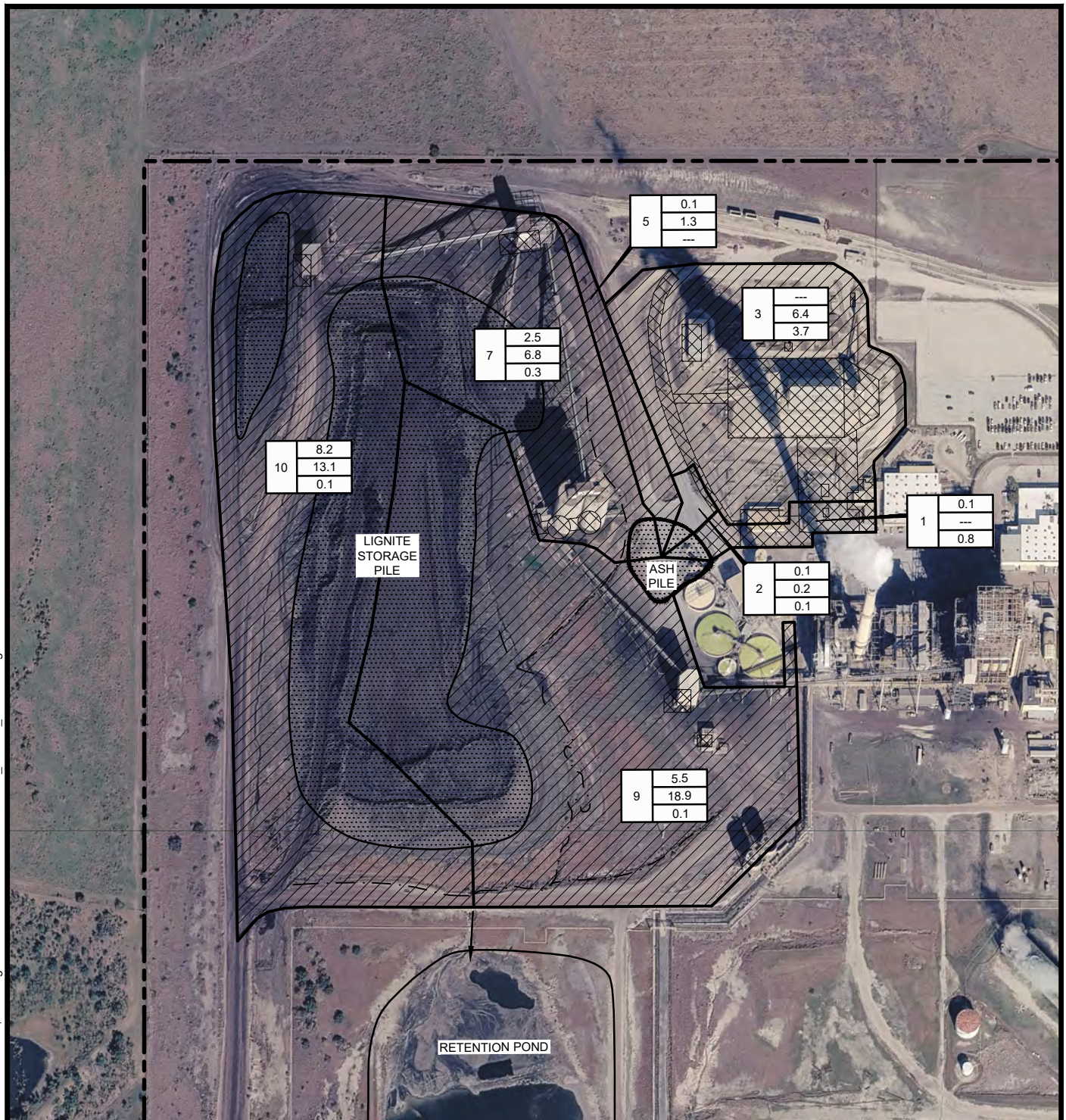
SAN MIGUEL ELECTRIC COOPERATIVE
ATASCOSA COUNTY, TEXAS

Figure 2
Site Plan
Ash Pile
Run-On And Run-Off Control System Plan Update

PROJECT: 10A2616009	BY: HLS	REVISIONS
DATE: SEP 2026	CHECKED: ECM	



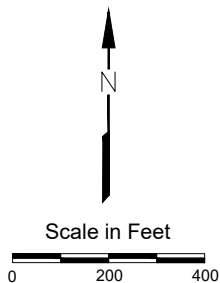
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LEGEND:

- DRAINAGE AREA BOUNDARY
- ASH OR LIGNITE
- LIGHT INDUSTRIAL (UNPAVED)
- PAVEMENT/ROOF (PAVED)

DRAINAGE AREA NO.	
•	ASH OR LIGNITE AREA (ACRES)
•	UNPAVED AREA (ACRES)
•	PAVED AREA (ACRES)



SAN MIGUEL ELECTRIC COOPERATIVE ATASCOSA COUNTY, TEXAS

Figure 3 Updated Storm Drainage Area Map Ash Pile Run-on and Run-off Control System Plan Update

PROJECT: 10A2616009

BY: HLS

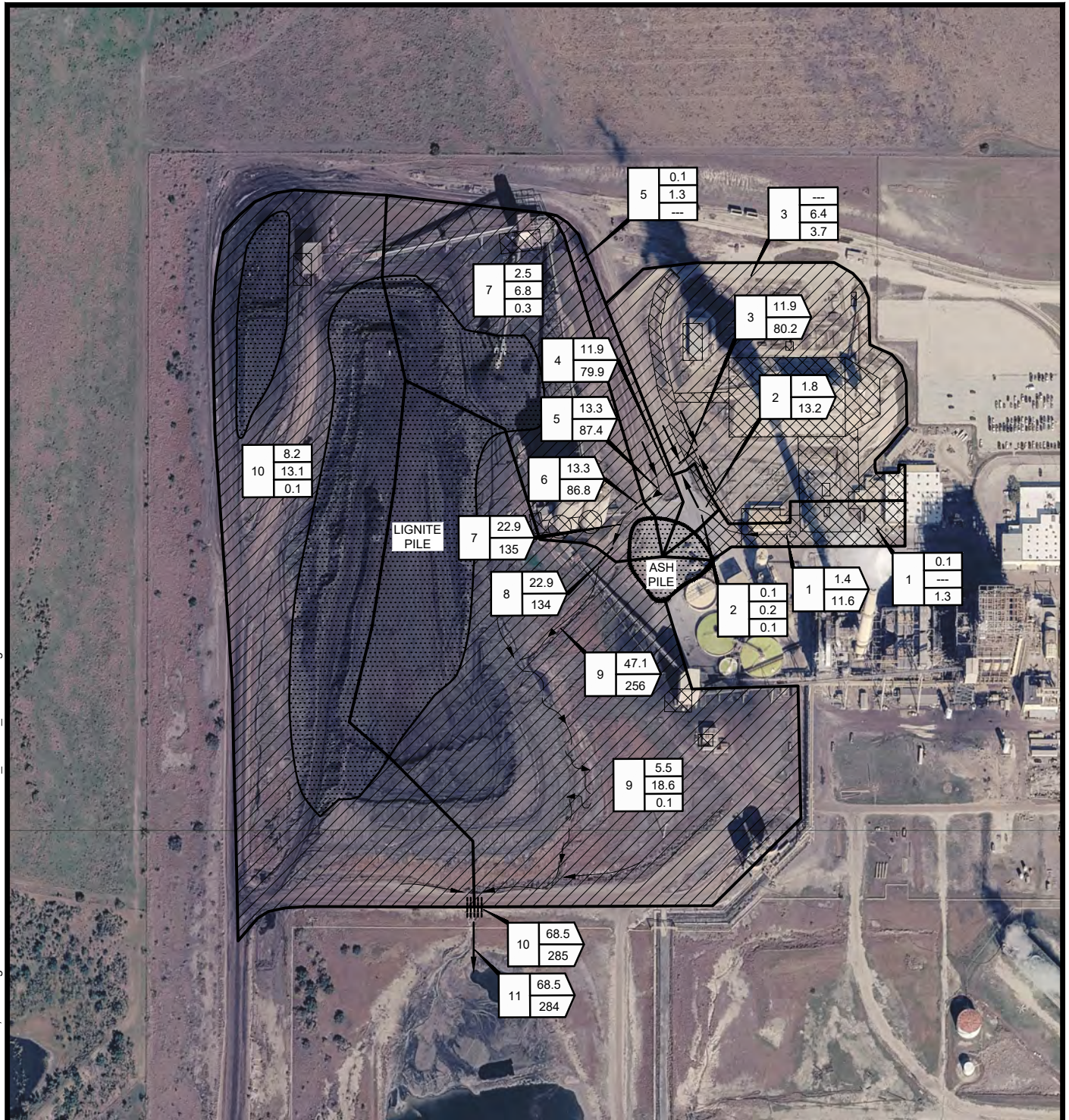
REVISIONS

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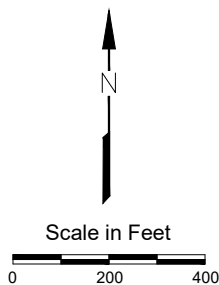


LEGEND:

- DRAINAGE AREA BOUNDARY
- ASH OR LIGNITE
- LIGHT INDUSTRIAL (UNPAVED)
- PAVEMENT/ROOF (PAVED)

- DRAINAGE AREA NO.
- ASH OR LIGNITE AREA (ACRES)
- UNPAVED AREA (ACRES)
- PAVED AREA (ACRES)

- CHANNEL OR CULVERT NO.
- CUMULATIVE AREA (ACRES)
- DESIGN PEAK RUNOFF (CFS)



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ATASCOSA COUNTY, TEXAS

Figure 3
25-Year Peak Design Storm
Drainage Area Map

Ash Pile CCR Landfill
Run-on and Run-off Control System Plan

PROJECT: 10A2616009

BY: HLS

REVISIONS

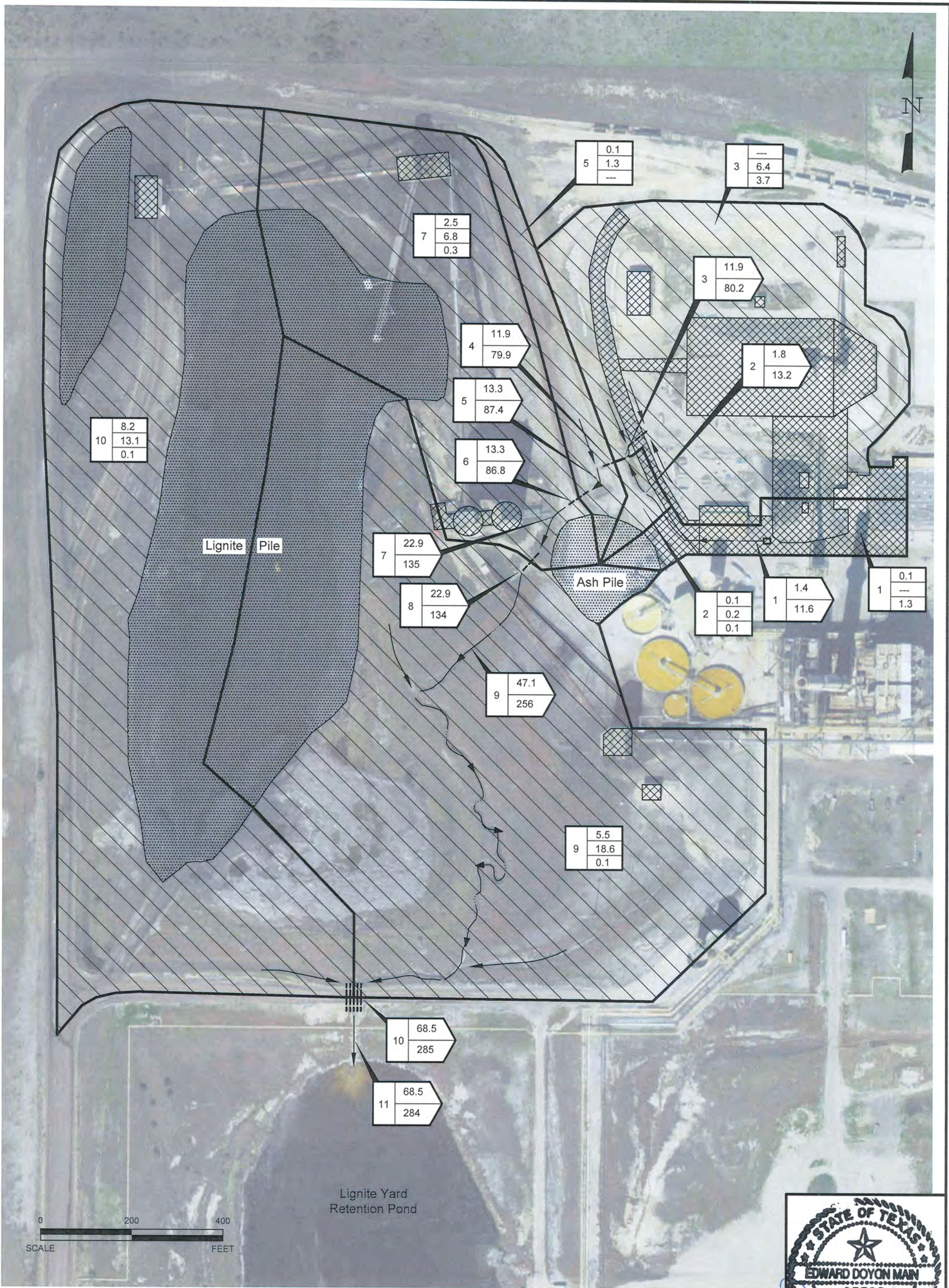
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Appendix A
Drainage Area Map from
2016 Initial RRCSP

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AERIAL SOURCE: ESRI.

LEGEND

- DRAINAGE AREA BOUNDARY
- ASH OR LIGNITE
- LIGHT INDUSTRIAL (UNPAVED)
- PAVEMENT/ROOF (PAVED)

- DRAINAGE AREA NO.
- ASH OR LIGNITE AREA (ACRES)
- UNPAVED AREA (ACRES)
- PAVED AREA (ACRES)
- CHANNEL OR CULVERT SEGMENT NO.
- CUMULATIVE AREA (ACRES)
- DESIGN PEAK RUNOFF (CFS)



Environmental Resources Management

FIGURE 1
25-YEAR PEAK DESIGN STORM DRAINAGE AREA MAP
Ash Pile CCR Landfill Run-On and
Run-Off Control System Plan
San Miguel Electric Cooperative, Inc.
Atascosa County, Texas

DESIGN: COJ DRAWN: CAK CHKD.: EDM
DATE: 10/11/2016 SCALE: AS SHOWN REV.:



Appendix B

Hydrologic and Hydraulic Calculations from 2016 Initial RRCSP

TABLE 1

25-Year Peak Stormwater Runoff Hydrology

Ash Pile Stormwater Run-On and Run-Off Control System Plan
 San Miguel Electric Cooperative, Inc., Atascosa County, Texas

Reach No.	Input		Reach If	Fixed Input			Initial Only	Input				Input			Input				Hydr	
	Upstream Sta.	Dnstream Sta.		Run-Off Coefficient			Upstream Tc	i 24-hr/25-yr (Atascosa Co., Texas)				Increment Area			Cumulative Area				Calc	Calc
	100-ft Sta.	100-ft Sta.		Paved in/in	Unpaved in/in	Ash in/in		b in.	d min	e -----	i in/hr	Ash ac	Unpaved ac	Paved ac	Ash ac	Unpaved ac	Paved ac	Total ac	Peak Q cfs	Peak V fps
1	22 + 55	20 + 15	240	0.90	0.65	0.35	10.0	127.14	12.24	0.83	9.65	0.1	0.0	1.3	0.1	0.0	1.3	1.4	11.6	2.3
2	20 + 15	19 + 55	60	0.90	0.65	0.35	11.8	127.14	12.24	0.83	9.06	0.1	0.2	0.1	0.2	0.2	1.4	1.8	13.2	3.1
3	19 + 55	19 + 25	30	0.90	0.65	0.35	12.1	127.14	12.24	0.83	8.96	0.0	6.4	3.7	0.2	6.6	5.1	11.9	80.2	5.7
4	19 + 25	18 + 70	55	0.90	0.65	0.35	12.2	127.14	12.24	0.83	8.93				0.2	6.6	5.1	11.9	79.9	8.1
5	18 + 70	18 + 10	60	0.90	0.65	0.35	12.3	127.14	12.24	0.83	8.90	0.1	1.3	0.0	0.3	7.9	5.1	13.3	87.4	4.3
6	18 + 10	17 + 10	100	0.90	0.65	0.35	12.5	127.14	12.24	0.83	8.83				0.3	7.9	5.1	13.3	86.8	9.2
7	17 + 10	16 + 50	60	0.90	0.65	0.35	12.7	127.14	12.24	0.83	8.77	2.5	6.8	0.3	2.8	14.7	5.4	22.9	135.1	4.9
8	16 + 50	15 + 50	100	0.90	0.65	0.35	12.9	127.14	12.24	0.83	8.71				2.8	14.7	5.4	22.9	134.1	11.8
9	15 + 50	1 + 50	1,400	0.90	0.65	0.35	13.0	127.14	12.24	0.83	8.67	5.5	18.6	0.1	8.3	33.3	5.5	47.1	255.8	3.0
10	1 + 50	1 + 0	50	0.90	0.65	0.35	20.7	127.14	12.24	0.83	6.96	8.2	13.1	0.1	16.5	46.4	5.6	68.5	285.2	5.9
11	1 + 0	0 + 0	100	0.90	0.65	0.35	20.8	127.14	12.24	0.83	6.94				16.5	46.4	5.6	68.5	284.2	4.5

ABBREVIATIONS AND ACRONYMS

ac	acres	e	(variable)	in/hr	inches per hour	Sta.	calculated
b	(variable)	fps	feet per second	in/in	inches per inch	Tc	time of concentration
cfs	cubic feet per second	hr	hours	lf	linear feet	V	velocity
d	(variable)	i	intensity	min	minutes	yr	years
Dnstream	downstream	in.	inches	Q	flow rate		

TABLE 2

25-Year Peak Stormwater Runoff Hydraulics

Ash Pile Stormwater Run-On and Run-Off Control System Plan
San Miguel Electric Cooperative, Inc., Atascosa County, Texas

Open Channel	From Hydro				Input	Input	Input				Input	Input	Input	Trial		Trial Calc												Hydro	Goal = 0			
					Manning's n	Channel Slope	Slope dh					Left Side Slope	Bottom Width	Right Side Slope	Wetted Area	Wetted Perimeter	Sum of km	Trial Dn	Trial EGL Slope	Q at Trial HGL	V at Trial Dn	hv at Trial Dn	hm at Trial Dn	hf at Trial Dn	EGL Slope	Trial Calc Peak Q						
	Reach No.	Upstream Sta. 100-ft Sta.	Dnstream Sta. 100-ft Sta.	Reach lf																							Calc Peak Q cfs	Delta Q cfs	Calc Peak V fps			
		1	22 + 55	20 + 15	240	0.035	0.0250	6.00					33.0	0.0	33.0	5.12	26.01	0.0	0.39	0.0250	11.6	2.3	0.08	0.00	6.00	0.0250	11.6	11.6	0.0	2.3		
Open Channel	From Hydro				Input	Input	Input				Input		Trial	Trial Calc												Hydro	Goal = 0					
					Manning's n	Channel Slope	Slope dh					Left Side Slope	Bottom Width	Right Side Slope	Wetted Area	Wetted Perimeter	Sum of km	Trial Dn	Trial EGL Slope	Q at Trial HGL	V at Trial Dn	hv at Trial Dn	hm at Trial Dn	hf at Trial Dn	EGL Slope	Trial Calc Peak Q						
	Reach No.	Upstream Sta. 100-ft Sta.	Dnstream Sta. 100-ft Sta.	Reach lf																							Calc Peak Q cfs	Delta Q cfs	Calc Peak V fps			
		2	20 + 15	19 + 55	60	0.035	0.0250	1.50					3.0	12.0	3.0	4.33	14.11	0.0	0.33	0.0250	13.2	3.1	0.14	0.00	1.50	0.0250	13.2	13.2	0.0	3.1		
Open Channel	From Hydro				Input	Input	Input				Input		Trial	Trial Calc												Hydro	Goal = 0					
					Manning's n	Channel Slope	Slope dh					Left Side Slope	Bottom Width	Right Side Slope	Wetted Area	Wetted Perimeter	Sum of km	Trial Dn	Trial EGL Slope	Q at Trial HGL	V at Trial Dn	hv at Trial Dn	hm at Trial Dn	hf at Trial Dn	EGL Slope	Trial Calc Peak Q						
	Reach No.	Upstream Sta. 100-ft Sta.	Dnstream Sta. 100-ft Sta.	Reach lf																							Calc Peak Q cfs	Delta Q cfs	Calc Peak V fps			
		3	19 + 55	19 + 25	30	0.035	0.0250	0.75					3.0	12.0	3.0	14.07	17.99	0.0	0.95	0.0250	80.2	5.7	0.50	0.00	0.75	0.0250	80.2	80.2	0.0	5.7		
Culvert	From Hydro				Input	Input	Input		Input	Input	Input	Input		Trial	Trial Calc												Input	Hydro	Goal = 0			
	Reach No.	Upstream Sta. 100-ft Sta.	Dnstream Sta. 100-ft Sta.	Reach lf	Manning's n	Culvert Slope	Slope dh	Culvert Barrels	Culvert Diameter in. I.D.	Outlet Subm. vf	Outlet km ft/ft	Wetted Area sf	Wetted Perimeter lf	Inlet km ft/ft	Upstream Subm. vf	Trial EGL Slope ft/ft	Q at Culv S cfs	V at Peak Q fps	hv at Peak Q ft	hm at Peak Q ft	hf at Peak Q ft	EGL Peak Q ft/ft	Culvert Peak Q cfs	Overflow Subm. vf	Overflow Depth vf	Overflow Width ft W	Overflow Peak Q cfs	Total Trial Peak Q cfs	Calc Peak Q cfs	Delta Q cfs	Calc Peak V fps	
		4	19 + 25	18 + 70	55	0.035	0.0182	1.00	2	30	0.0	1.0	4.91	7.85	0.5	2.78	0.0688	40.0	8.1	1.03	1.54	3.78	0.0688	79.9	3.00	0.00	50.0	0.0	79.9	79.9	0.0	8.1
	From Hydro				Input	Input	Input		Input	Input	Input	Input		Trial	Trial Calc												Hydro	Goal = 0				
Open Channel					Manning's n	Channel Slope	Slope dh					Left Side Slope	Bottom Width	Right Side Slope	Wetted Area	Wetted Perimeter	Sum of km	Trial Dn	Trial EGL Slope	Q at Trial HGL	V at Trial Dn	hv at Trial Dn	hm at Trial Dn	hf at Trial Dn	EGL Slope	Trial Calc Peak Q						
	Reach No.	Upstream Sta. 100-ft Sta.	Dnstream Sta. 100-ft Sta.	Reach lf																							Calc Peak Q cfs	Delta Q cfs	Calc Peak V fps			
		5	18 + 70	18 + 10	60	0.035	0.0100	0.60					3.0	12.0	3.0	20.41	20.14	0.0	1.29	0.0100	87.4	4.3	0.28	0.00	0.60	0.0100	87.4	87.4	0.0	4.3		
	From Hydro				Input	Input	Input		Input	Input	Input	Input		Trial	Trial Calc												Input	Hydro	Goal = 0			
Culvert					Manning's n	Culvert Slope	Slope dh	Culvert Barrels	Culvert Diameter in. I.D.	Outlet Subm. vf	Outlet km ft/ft	Wetted Area sf	Wetted Perimeter lf	Inlet km ft/ft	Upstream Subm. vf	Trial EGL Slope ft/ft	Q at Culv S cfs	V at Peak Q fps	hv at Peak Q ft	hm at Peak Q ft	hf at Peak Q ft	Net EGL Peak Q ft/ft	Culvert Peak Q cfs	Overflow Subm. vf	Overflow Depth vf	Overflow Width ft W	Overflow Peak Q cfs	Total Trial Peak Q cfs	Calc Peak Q cfs	Delta Q cfs	Calc Peak V fps	
		6	18 + 10	17 + 10																												100
	From Hydro				Input	Input	Input		Input	Input	Input	Input		Trial	Trial Calc												Hydro	Goal = 0				
					Manning's n	Channel Slope	Slope dh					Left Side Slope	Bottom Width	Right Side Slope	Wetted Area	Wetted Perimeter	Sum of km	Trial Dn	Trial EGL Slope	Q at Trial HGL	V at Trial Dn	hv at Trial Dn	hm at Trial Dn	hf at Trial Dn	EGL Slope	Trial Calc Peak Q						
Reach No.	Upstream Sta. 100-ft Sta.	Dnstream Sta. 100-ft Sta.	Reach lf																								Calc Peak Q cfs	Delta Q cfs	Calc Peak V fps			
	7	17 + 10	16 + 50	60	0.035	0.0100	0.60					3.0	12.0	3.0	27.61	22.33	0.0	1.63	0.0100	135.1	4.9	0.37	0.00	0.60	0.0100	135.1	135.1	0.0	4.9			
Culvert	From Hydro				Input	Input	Input		Input	Input	Input	Input		Trial	Trial Calc												Input	Hydro	Goal = 0			
	Reach No.	Upstream Sta. 100-ft Sta.	Dnstream Sta. 100-ft Sta.	Reach lf	Manning's n	Culvert Slope	Slope dh	Culvert Barrels	Culvert Diameter in. I.D.	Outlet Subm. vf	Outlet km ft/ft	Wetted Area sf	Wetted Perimeter lf	Inlet km ft/ft	Upstream Subm. vf	Trial EGL Slope ft/ft	Q at Culv S cfs	V at Peak Q fps	hv at Peak Q ft	hm at Peak Q ft	hf at Peak Q ft	Net EGL Peak Q ft/ft	Culvert Peak Q cfs	Overflow Subm. vf	Overflow Depth vf	Overflow Width ft W	Overflow Peak Q cfs	Total Trial Peak Q cfs	Calc Peak Q cfs	Delta Q cfs	Calc Peak V fps	
		8	16 + 50	15 + 50	100	0.020	0.0100	1.00	1	30	0.0	1.0	4.91	7.85	0.5	3.69	0.0469	57.8	27.3	11.60	17.39	4.69	0.0469	57.8	3.00	0.69	50.0	76.4	134.1	134.1	0.0	11.8
	From Hydro				Input	Input	Input		Input	Input	Input	Input		Trial	Trial Calc												Hydro	Goal = 0				
Open Channel					Manning's n	Channel Slope	Slope dh					Left Side Slope	Bottom Width	Right Side Slope	Wetted Area	Wetted Perimeter	Sum of km	Trial Dn	Trial EGL Slope	Q at Trial HGL	V at Trial Dn	hv at Trial Dn	hm at Trial Dn	hf at Trial Dn	EGL Slope	Trial Calc Peak Q						
	Reach No.	Upstream Sta. 100-ft Sta.	Dnstream Sta. 100-ft Sta.	Reach lf																							Calc Peak Q cfs	Delta Q cfs	Calc Peak V fps			
		9	15 + 50	1 + 50	1,400	0.050	0.0050	7.00					6.0	16.0	6.0	83.97	48.09	0.0	2.64	0.0050	255.8	3.0	0.14	0.00	7.00	0.0050	255.8	255.8	0.0	3.0		

TABLE 2

25-Year Peak Stormwater Runoff Hydraulics
Ash Pile Stormwater Run-On and Run-Off Control System Plan
San Miguel Electric Cooperative, Inc., Atascosa County, Texas

Culvert	From Hydro				Input	Input		Input	Input	Input	Input					Input	Trial					Trial Calc					Input					Hydro	Goal = 0
	Reach No.	Upstream Sta.	Dnstream Sta.	Reach	Manning's n	Culvert Slope	Slope dh	Culvert Barrels	Culvert Diameter	Outlet Subm.	Outlet km	Wetted Area	Wetted Perimeter	Inlet km	Upstream Subm.	Trial EGL Slope	Q at Culv S	V at Peak Q	hv at Peak Q	hm at Peak Q	hf at Peak Q	Net EGL Peak Q	Culvert Peak Q	Overflow Subm.	Overflow Depth	Overflow Width	Overflow Peak Q	Total Trial Peak Q	Calc Peak Q	Delta Q	Calc Peak V		
		100-ft Sta.	100-ft Sta.	If	-----	ft/ft	ft	ea	in. I.D.	vf	ft/ft	sf	lf	ft/ft	vf	ft/ft	cfs	fps	ft	ft	ft	ft/ft	cfs	vf	vf	ft W	cfs	cfs	cfs	cfs	fps		
	10	1 + 50	1 + 0	50	0.013	0.0100	0.50	5	42	0.0	1.0	9.62	11.00	0.5	-0.34	0.0032	285.2	5.9	0.55	0.82	0.16	0.0032	285.2	4.00	0.00	50.0	0.0	285.2	285.2	0.0	5.9		
Open Channel	From Hydro				Input	Input			Input	Input	Input					Input	Trial					Trial Calc						Hydro	Goal = 0				
	Reach No.	Upstream Sta.	Dnstream Sta.	Reach	Manning's n	Channel Slope	Slope dh		Left Side Slope	Bottom Width	Right Side Slope	Wetted Area	Wetted Perimeter	Sum of km	Trial Dn	Trial EGL Slope	Q at Trial HGL	V at Trial Dn	hv at Trial Dn	hm at Trial Dn	hf at Trial Dn	EGL Slope	Trial Calc Peak Q					Calc Peak Q	Delta Q	Calc Peak V			
		100-ft Sta.	100-ft Sta.	If	-----	ft/ft	ft		H:V	ft W	H:V	sf	lf	ft/ft	vf	ft/ft	cfs	fps	ft	ft	ft	ft/ft	cfs					cfs	cfs	fps			
	11	1 + 0	0 + 0	100	0.035	0.0050	0.50		3.0	20.0	3.0	63.78	35.27	0.0	2.36	0.0050	284.2	4.5	0.31	0.00	0.50	0.0050	284.2					284.2	0.0	4.5			

ABBREVIATIONS AND ACRONYMS

Calc	calculated	Dnstream	downstream	H:V	horizontal-to-vertical ratio	in.	inches	Q	flow rate	vf	vertical feet
cfs	cubic feet per second	EGL	energy grade line	hf	friction head loss	km	sum of minor head loss coefficient	S	slope		
Culv	culvert	fps	feet per second	hm	minor head loss	lf	linear feet	sf	square feet		
dh	height difference	ft	feet	hv	velocity head	n	roughness coefficient	Sta.	station		
Dn	normal depth	ft W	feet width	I.D.	inside diameter	No.	number	Subm.	submergence		

Appendix C

NOAA Atlas Precipitation Data - Jourdanton, Texas



NOAA Atlas 14, Volume 11, Version 2
Location name: Jourdanton, Texas, USA*
Latitude: 28.7042°, Longitude: -98.4766°
Elevation: 325 ft**
* source: ESRI Maps
** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aerals](#)

PF tabular

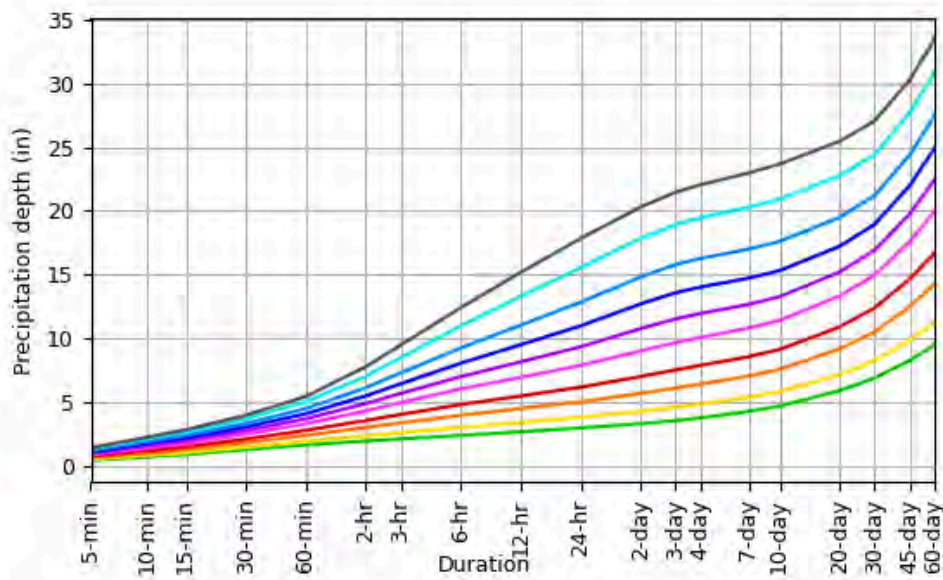
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.449 (0.340-0.593)	0.526 (0.404-0.691)	0.655 (0.499-0.861)	0.759 (0.570-1.01)	0.900 (0.655-1.24)	1.01 (0.713-1.42)	1.11 (0.765-1.60)	1.21 (0.813-1.79)	1.34 (0.868-2.05)	1.43 (0.903-2.24)
10-min	0.714 (0.540-0.943)	0.838 (0.642-1.10)	1.04 (0.796-1.37)	1.21 (0.910-1.62)	1.44 (1.05-1.98)	1.61 (1.14-2.27)	1.78 (1.23-2.57)	1.93 (1.30-2.86)	2.13 (1.38-3.26)	2.27 (1.43-3.56)
15-min	0.908 (0.688-1.20)	1.06 (0.810-1.39)	1.31 (0.996-1.72)	1.51 (1.13-2.01)	1.79 (1.30-2.46)	2.00 (1.42-2.82)	2.21 (1.52-3.20)	2.41 (1.62-3.57)	2.67 (1.73-4.08)	2.85 (1.81-4.48)
30-min	1.29 (0.974-1.70)	1.49 (1.14-1.96)	1.84 (1.40-2.42)	2.12 (1.59-2.82)	2.50 (1.82-3.43)	2.79 (1.97-3.92)	3.07 (2.12-4.44)	3.35 (2.25-4.96)	3.72 (2.41-5.69)	3.99 (2.52-6.26)
60-min	1.66 (1.26-2.19)	1.94 (1.49-2.55)	2.42 (1.84-3.18)	2.80 (2.10-3.74)	3.32 (2.41-4.55)	3.71 (2.62-5.22)	4.10 (2.83-5.92)	4.50 (3.03-6.67)	5.04 (3.28-7.73)	5.45 (3.45-8.57)
2-hr	1.97 (1.50-2.58)	2.37 (1.82-3.07)	3.02 (2.32-3.94)	3.57 (2.70-4.72)	4.32 (3.16-5.87)	4.90 (3.48-6.83)	5.50 (3.81-7.87)	6.15 (4.15-9.02)	7.06 (4.60-10.7)	7.78 (4.94-12.1)
3-hr	2.13 (1.63-2.78)	2.61 (2.01-3.36)	3.39 (2.60-4.39)	4.04 (3.07-5.32)	4.97 (3.64-6.72)	5.69 (4.06-7.89)	6.45 (4.48-9.18)	7.30 (4.94-10.6)	8.50 (5.56-12.8)	9.49 (6.04-14.6)
6-hr	2.40 (1.85-3.12)	3.02 (2.33-3.83)	3.98 (3.08-5.12)	4.82 (3.68-6.30)	6.03 (4.45-8.09)	7.00 (5.03-9.63)	8.06 (5.63-11.3)	9.25 (6.29-13.3)	11.0 (7.20-16.3)	12.4 (7.93-18.9)
12-hr	2.69 (2.08-3.46)	3.41 (2.62-4.25)	4.50 (3.50-5.74)	5.49 (4.22-7.12)	6.95 (5.17-9.26)	8.16 (5.90-11.1)	9.51 (6.68-13.2)	11.0 (7.53-15.7)	13.3 (8.75-19.5)	15.2 (9.73-22.8)
24-hr	2.98 (2.33-3.82)	3.82 (2.94-4.69)	5.04 (3.94-6.37)	6.18 (4.78-7.95)	7.89 (5.91-10.4)	9.34 (6.80-12.6)	11.0 (7.75-15.1)	12.8 (8.79-18.0)	15.6 (10.3-22.6)	17.8 (11.5-26.4)
2-day	3.32 (2.60-4.21)	4.29 (3.31-5.21)	5.69 (4.47-7.13)	7.01 (5.46-8.96)	9.02 (6.82-11.9)	10.8 (7.89-14.5)	12.7 (9.01-17.3)	14.8 (10.2-20.6)	17.8 (11.8-25.5)	20.3 (13.1-29.6)
3-day	3.56 (2.81-4.50)	4.60 (3.57-5.58)	6.12 (4.83-7.64)	7.54 (5.89-9.58)	9.68 (7.35-12.7)	11.5 (8.49-15.4)	13.6 (9.66-18.4)	15.8 (10.9-21.8)	18.9 (12.6-26.8)	21.5 (13.9-31.1)
4-day	3.77 (2.98-4.75)	4.85 (3.78-5.88)	6.42 (5.09-8.00)	7.88 (6.18-10.0)	10.1 (7.66-13.1)	12.0 (8.81-15.9)	14.0 (10.0-18.9)	16.3 (11.2-22.3)	19.5 (13.0-27.5)	22.0 (14.3-31.7)
7-day	4.28 (3.40-5.36)	5.39 (4.26-6.55)	7.06 (5.63-8.75)	8.57 (6.75-10.8)	10.8 (8.23-13.9)	12.7 (9.36-16.7)	14.7 (10.5-19.7)	17.0 (11.8-23.1)	20.3 (13.6-28.3)	23.0 (14.9-32.7)
10-day	4.70 (3.75-5.86)	5.84 (4.64-7.10)	7.58 (6.07-9.38)	9.14 (7.22-11.5)	11.4 (8.70-14.6)	13.3 (9.82-17.3)	15.3 (11.0-20.4)	17.6 (12.3-23.8)	20.9 (14.0-29.1)	23.7 (15.4-33.4)
20-day	5.91 (4.75-7.31)	7.17 (5.80-8.76)	9.18 (7.43-11.3)	10.9 (8.67-13.6)	13.3 (10.2-16.9)	15.2 (11.3-19.6)	17.2 (12.4-22.6)	19.5 (13.6-26.1)	22.8 (15.3-31.2)	25.4 (16.6-35.5)
30-day	6.90 (5.57-8.50)	8.28 (6.76-10.1)	10.5 (8.56-12.9)	12.4 (9.90-15.4)	15.0 (11.5-18.8)	16.9 (12.6-21.7)	18.9 (13.7-24.8)	21.2 (14.9-28.2)	24.4 (16.5-33.2)	27.0 (17.7-37.4)
45-day	8.27 (6.70-10.2)	9.86 (8.10-12.1)	12.5 (10.2-15.3)	14.6 (11.7-18.0)	17.6 (13.5-22.0)	19.7 (14.7-25.2)	22.0 (15.9-28.5)	24.4 (17.2-32.2)	27.6 (18.7-37.3)	30.2 (19.9-41.4)
60-day	9.49 (7.72-11.6)	11.3 (9.30-13.8)	14.2 (11.7-17.4)	16.7 (13.4-20.5)	20.0 (15.4-24.9)	22.4 (16.8-28.5)	24.9 (18.1-32.2)	27.4 (19.4-36.0)	30.8 (20.9-41.4)	33.5 (22.0-45.6)
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.										

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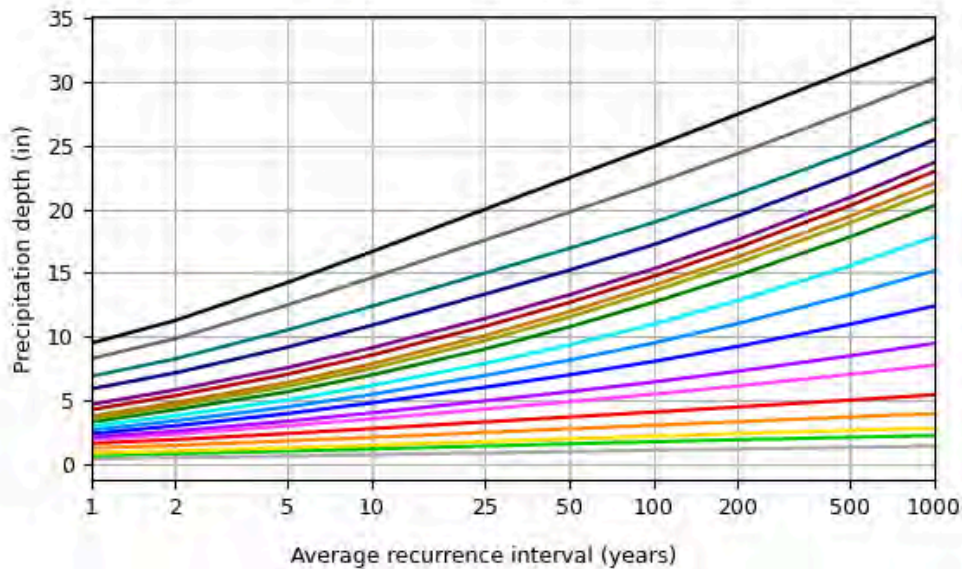
PF graphical

PDS-based depth-duration-frequency (DDF) curves

Latitude: 28.7042°, Longitude: -98.4766°



Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000



Duration	
5-min	2-day
10-min	3-day
15-min	4-day
30-min	7-day
60-min	10-day
2-hr	20-day
3-hr	30-day
6-hr	45-day
12-hr	60-day
24-hr	

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Maps & aerials

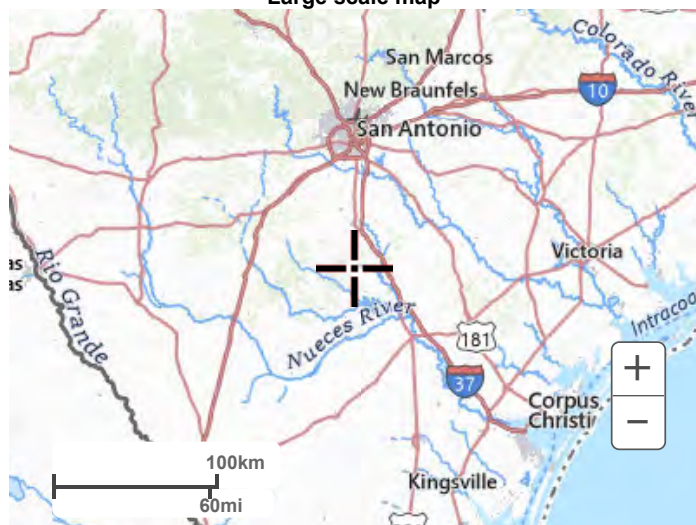
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



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