REPORT

Inflow Design Flood Control System Plan 5 Year Update

Martin Lake Steam Electric Station
Ash Pond Area and Permanent Disposal Pond No. 5
Rusk County, Texas

Submitted to:

Luminant Generation Company, LLC

6555 Sierra Drive
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Submitted by:

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October 2021

PROFESSIONAL CERTIFICATION

This document and all attachments were prepared by Golder Associates Inc. 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 Inflow Design Flood Control System Plan has been prepared in accordance with the requirements of 40 C.F.R. § 257.82 and 30 T.A.C. § 352.821.

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Principal Engineer
Golder Associates Inc.
Firm Registration No. F-2578

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1.0 INTRODUCTION

Luminant Generation Company, LLC (Luminant) owns and operates the Martin Lake Steam Electric Station (MLSES) located approximately five miles southwest of Tatum in Rusk County, Texas. The power plant and related support areas occupy approximately 700 acres on a peninsula on the southwest side of Martin Lake (Figure 1). The MLSES consists of three coal/lignite-fired units with a combined operating capacity of approximately 2,250 megawatts. Coal Combustion Residuals (CCR) including fly ash, bottom ash, and gypsum are generated as part of MLSES unit operation and managed in the Bottom Ash Ponds and New Scrubber Pond (referred to collectively as the Ash Pond Area) and in Permanent Disposal Pond No. 5.

The U.S. Environmental Protection Agency promulgated 40 C.F.R. Part 257, Subpart D (the CCR Rule) and the Texas Commission on Environmental Quality (TCEQ) promulgated 30 T.A.C. Chapter 352 (which largely adopts the federal CCR Rule by reference) to establish technical requirements for new and existing CCR landfills and surface impoundments. On June 28, 2021, USEPA approved the majority of TCEQ's CCR program, which will now operate in lieu of the federal regulations. The Bottom Ash Ponds (BAPs), New Scrubber Pond (NSP) and Permanent Disposal Pond No. 5 (PDP-5) have been identified as Existing CCR Surface Impoundments regulated under the CCR Rule. It should be noted that the New Scrubber Pond has been referred to in past CCR reports as both the SP and the NSP. This pond will be referred to as the NSP in this report and all subsequent reports.

Section 257.82 specifies that an Inflow Design Flood Control System Plan (IDFCSP) be designed, constructed, operated, and maintained for each existing CCR surface impoundment and 30 T.A.C. 352.821 adopts this requirement by reference. In accordance with § 257.82(c)(3), the initial IDFCSP for the Ash Ponds and PDP-5 was completed and placed in the facility operating record in October 2016 (PBW, 2016). As specified in §257.82(c)(4), the IDFCSP must be updated every five years from the completion date of the initial plan. Golder Associates Inc., a member of WSP (Golder), was retained by Luminant to prepare this updated IDFCSP for the Ash Pond Area and PDP-5.

1.1 CCR Surface Impoundment Inflow Design Flood Control System Plan Requirements

Section 257.82(a) specifies that an IDFCSP be designed, constructed, operated, and maintained for each existing CCR surface impoundment. The flood control system must adequately:

- Manage flow into the CCR impoundment during and following the peak discharge of the specified inflow design flood.
- Manage flow from the CCR impoundment to collect and control the peak discharge resulting from the specified inflow design flood.

The inflow design flood (IDF) for each CCR impoundment varies based on the hazard potential classification of the impoundment:

- High hazard potential impoundment: Probable Maximum Flood
- Significant hazard potential impoundment: 1,000-year flood
- Low hazard potential impoundment: 100-year flood

The IDFCSP must document how the inflow design flood control system has been designed and constructed to comply with the requirements of § 257.82 and must be certified by a qualified professional engineer.

1.2 MLSES Surface Impoundments Subject to Inflow Design Flood Control System Plan Requirements

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 IDFCSP requirements of the CCR Rule apply to surface impoundments that dispose or otherwise engage in solid waste management of CCRs.

The following surface impoundments at the MLSES have been identified as CCR Units subject to the IDFCSP requirements (Figure 2):

- West Ash Pond (WAP),
- East Ash Pond (EAP),
- New Scrubber Pond (SP), and
- PDP-5.

The WAP, EAP and SP are collocated in an area identified as the Ash Pond Area.

A simplified flow diagram for the MLSES impoundments is shown on Figure 3.

1.3 Description of Bottom Ash Ponds

The WAP and EAP (collectively "Bottom Ash Ponds" or "BAPs") are located approximately 2,000 feet east of the MLSES power plant (Figure 2). The WAP and EAP receive recovered sluice water from bottom ash dewatering bins and other MLSES process wastewater sources that typically include bottom ash fines. The ponds also act as surge basins for various water streams in the ash-water system. Process wastewater can be transferred from the MLSES impoundments to the SP and PDP-5 or used as makeup water to the bottom ash system. When sufficient ash has accumulated in either the WAP or EAP, the recovered sluice water is diverted to the other pond. Ash in the inactive pond is then removed and transported via rail car to the A1 Area Landfill. The BAPs were originally constructed in the 1977 and upgraded in 1988 (WAP) and 2010 (EAP).

The WAP and EAP are constructed partially above and partially below grade and are surrounded by engineered earthen embankments that extend above grade. The WAP and EAP share an interior embankment and cover areas of approximately 14.6 acres and 9.6 acres, respectively. The crest elevation of the BAP embankments is 330 feet above mean sea level (MSL) and the EAP borders Martin Lake (normal pool elevation 306 feet MSL).

The BAPs were originally constructed in the 1977 with an in-situ compacted clay liner. The WAP was removed from service in March 1988 and re-lined with a double 60-mil high density polyethylene (HDPE) liner system overlain with a concrete revetment mat. The EAP was dredged and removed from service in 1989, and a new south embankment was constructed to allow for an increase in the size of the SP. The EAP remained inactive until the installation of a new double 60-mil HDPE liner system with concrete revetment mat was completed in February 2010.

In 2020, the EAP was retrofitted with a new composite liner system meeting the requirements of 40 CFR § 257.70(b). The retrofitted liner system was installed on top of the existing liner system and consisted of the following (from bottom to top):

- A polymer-enhanced geosynthetic clay liner (GCL) and
- A 60-mil HDPE liner

The liner system in the WAP will be similarly retrofitted in 2021.

Based on available construction data, the BAPs were constructed to provide the following estimated storage capacities:

- WAP: 232.6 acre-feet; and
- EAP: 125.8 acre-feet.

1.4 Description of New Scrubber Pond

The New Scrubber Pond (SP) is located immediately south of the EAP and east of the WAP (Figure 2). The SP is an approximately 12.5 acre surface impoundment that is used to manage FGD wastes as well as discharge from the sludge thickener sumps, the plant yard sumps, and storm water management areas. Solids present in the FGD wastewater settle within the pond and are periodically removed and managed similar to the ash solids from the WAP and EAP. Process wastewater can be transferred from the SP to the BAPs and PDP-5, or used as makeup water to the scrubber systems. The SP was originally constructed in the 1977 and was expanded to its current size in 1989.

The SP is constructed partially above and partially below grade and is surrounded by engineered earthen embankments that extend above grade. The west embankment of the SP is an internal/shared embankment with the WAP and a portion of the northern embankment is an internal/shared embankment with the EAP. The crest elevation of the SP embankments is 330 feet MSL. Martin Lake (normal pool elevation 306 feet MSL) adjoins portions of the north and south embankments of the SP.

The SP was originally constructed in 1977 with an in-situ compacted clay liner and was expanded to its current size in 1989. The SP was relined in 1989 with a double 60-mil HDPE liner system, overlain with a concrete revetment mat.

In 2022, Luminant anticipates retrofitting the SP with a new composite liner system meeting the requirements of 40 CFR § 257.70(b). The retrofitted liner system will be installed on top of the existing liner system and will consist of the following (from bottom to top):

- A polymer-enhanced geosynthetic clay liner (GCL) and
- A 60-mil HDPE liner

Based on available construction data, the SP was constructed to provide an estimated storage capacity of 198.9 acre-feet.

1.5 Description of PDP-5

Permanent Disposal Pond No. 5 (PDP-5) is located approximately 3,000 feet west-northwest of the MLSES power plant (Figure 2). PDP-5 is an approximately 40-acre surface impoundment that was constructed in 2010 over three closed PDPs. PDP-5 is primarily used to manage excess liquids, including storm water from large precipitation events and excess process wastewater from both the FGD and bottom ash loops. Recovered CCR wastewaters are received in PDP-5 during cleaning cycles for the BAPs and SP. Process wastewater can be transferred between the BAPs, SP, or used as makeup water for specific CCR related systems. Process wastewater can be transferred from PDP-5 to the BAPs and the SP.

PDP-5 is constructed above grade and is surrounded by engineered earthen embankments. The crest elevation of the PDP-5 embankments is 405.5 feet MSL, and the embankments are approximately 10 to 15 feet above surrounding grade. The liner system for the PDP-5 consists of the following:

- a six-inch thick soil layer over the closed PDPs (in-place permeability of $1x10^{-5}$ cm/sec);
- two-foot thick compacted clay liner (in-place permeability of $1x10^{-7}$ cm/sec); and
- three-foot thick compacted clay interior/exterior embankment liner (minimum in-place permeability of $1x10^{-7}$ cm/sec).

Based on available construction data, PDP-5 was constructed to provide an estimated storage capacity of 190.3 acre-feet.

1.6 USACE Size Classification for BAPs, NSP and PDP-5

The US Army Corps of Engineers (USACE) classifies the relative size of dams based on the height of the dam and the storage capacity of the impounded area behind the dam as follows (USACE, 1979):

USACE Dam Size Classification		
Size Category	**Impoundment Capacity (acre-ft)**	**Impoundment Height (ft)**
Small	50 and < 1,000	25 and < 40
Intermediate	1,000 and < 50,000	40 and < 100
Large	> 50,000	> 100

Based on the dike heights and operating capacities of the BAPs, NSP and PDP-5, these ponds are categorized as small impoundments based on the USACE dam size classification criteria.

1.7 Hazard Potential Classification of BAPs, NSP and PDP-5

The BAPs, NSP and PDP-5 are classified as low hazard potential impoundments in accordance with the requirements of § 257.73(a)(2) (Golder, 2021).

1.8 Previous Hydraulic Capacity Evaluations of BAPs, NSP and PDP-5

The BAPs, NSP and PDP-5 were previously subjected to the following Hydraulic Capacity Evaluations:

- **Initial Inflow Design Flood Control System Plan, 2016**. As required under § 257.82(c)(3), the initial Inflow Design Flood Control System Plan for the BAPs, NSP and PDP-5 was completed and placed in the MLSES operating record in October 2016 (PBW, 2016). The initial IDFCSP concluded that the BAPs, NSP and PDP-5 were adequately designed to manage the 100-year, 24-hour inflow design flood in accordance with § 257.82.
- **EPA Hydraulic Capacity Evaluation, 2014**. In 2009, the EPA initiated a program to assess the stability and functionality of coal ash impoundments at coal-fired electric generating plants across the United States. The assessment of the stability and functionality of the MLSES BAPs, NSP and PDP-5 was performed in 2012 by Dewberry Consultants, LLC (Dewberry) on behalf of EPA. The results of the Dewberry assessment were presented in *Coal Combustion Residue Impoundment Round 12 - Dam Assessment Report, Martin Lake Steam Electric Plant Coal Combustion Residuals Impoundments, Luminant*, Tatum, Texas, Dewberry Consultants LLC, March 2014 (Dewberry, 2014).

As part of the assessment, Dewberry evaluated the “Hydrologic/Hydraulic Safety” of the BAPs and concluded the following:

- The BAPs, NSP and PDP-5 only receive water pumped into the units at a controlled rate.
- The normal pool elevation of the BAPs and NSP is managed to a relatively constant elevation of 328 feet, providing a 2-foot freeboard.
- The normal elevation of the PDP-5 is managed to a relatively constant elevation of 404 feet, providing a 2-foot freeboard.
- Dewberry examined the 100-year rainfall event and compared the data with the available freeboard. The freeboard should be adequate to contain the one-percent probability, 24- hour precipitation event (10.6 inches) without overtopping the impoundment embankments.

Based on the information reviewed, the BAPs, NSP and PDP-5 were given the highest rating of “Satisfactory” for hydrologic and hydraulic safety.

2.0 UPDATED HYDRAULIC CAPACITY EVALUATION OF BAPs, NSP AND PDP-5

The CCR Rule defines the inflow design flood (IDF) as “the flood hydrograph that is used in the design or modification of the CCR surface impoundment and its appurtenant works.” From an engineering design standpoint, the IDF is the rate of water coming into a surface impoundment over time that the impoundment must be able to safely pass or contain using a combination of outlet works and surcharge storage (freeboard).

The updated IDFCSP for the BAPs, NSP and PDP-5 must demonstrate that the impoundments are designed to manage flow into and out of the units during and following the peak discharge of the specified inflow design flood. This demonstration will be accomplished through calculation of a water balance for the BAPs, NSP and PDP-5. The basic equation for the water balance is as follows:

Inflows = Outflows + Change in Pond Storage

For the water balance to demonstrate compliance with CCR requirements, the rate of inflows into the BAPs, NSP and PDP-5 (the inflow design flood) must not be greater than the rate of outflows from the BAPs, NSP and PDP-5 plus the maximum allowable storage in the impoundment.

2.1 Inflows to BAPs, NSP and PDP-5

The BAPs, NSP and PDP-5 are located partially above and partially below grade and inflows that enter the impoundment are pumped into the units under controlled conditions – there are no gravity or uncontrolled discharges to the BAPs, NSP and PDP-5. As shown on Figure 3, water coming into the BAPs consists of the following:

- bottom ash process water,
- miscellaneous plant sumps, and
- makeup water/process wastewater transfers from NSP and/or PDP-5.

Water coming into the NSP consists of:

- FGD scrubber wastewater,
- Boiler feed water treatment,
- Discharge from the sludge thickener sumps, and
- Makeup water/process wastewater transfers from BAPs and/or PDP-5.

Water coming into the PDP-5 consists of the following:

- excess process wastewater and transfers from BAPs and/or NSP, and
- stormwater from large precipitation events.

Most of the sources of inflow to the BAPs, NSP and PDP-5 are process units that generate water at controlled rates. With the exception of the miscellaneous plant process sumps, the rates at which these inflows are pumped into the BAPs, NSP, and PDP-5 are not significantly affected by variations in precipitation intensity and associated flood conditions. In accordance with Luminant operating procedures, stormwater is allowed to accumulate to the extent practicable and the transfer of stormwater collected by the plant sumps is regularly monitored and regulated to ensure adequate freeboard is maintained in each of the CCR impoundments during a storm event.

Stormwater runoff generated from lignite storage areas is also pumped into the BAPs, NSP and PDP-5. The quantity of stormwater runoff generated from the lignite storage areas varies depending on precipitation; however, runoff from the lignite storage areas is allowed to accumulate in these areas and is pumped into the BAPs, NSP and PDP-5 at a controlled rate. As a result, the rate at which this inflow is pumped into the BAPs, NSP and PDP-5 is not significantly affected by variations in precipitation intensity and associated flood conditions.

In addition, the BAPs, NSP and PDP-5 receive water from direct precipitation on the impoundments themselves. This inflow is affected by variations in precipitation intensity and associated flood conditions.

2.2 Outflows From BAPs, NSP and PDP-5

The BAPs and PDP-5 act as surge basins for various water streams in the ash water system. Process wastewater can be transferred to and from the BAPs to the NSP and PDP-5. The NSP is used to manage FGD wastes as well as discharge from the sludge thickener sumps, plant yard sumps and stormwater management areas. Process wastewater from the NSP can be transferred to the BAPs and PDP-5, or can be used as makeup water to the scrubber systems. The rate of outflow from the BAPs and NSP is controlled to maintain the normal operating level of the impoundment at an approximate elevation 328 feet or less. Based on a crest elevation of approximately 330 feet for the earthen embankments around the BAPs and SP, a minimum 2-foot freeboard is maintained in the BAPs and NSP under normal operating conditions.

PDP-5 is primarily used to manage excess liquids, including stormwater from large precipitation events and excess process wastewater from both the FGD and BAPs. Process wastewater can be transferred from PDP-5 to the BAPs and NSP. The rate of outflow from PDP-5 is controlled to maintain the normal operating level of the impoundment at an approximate elevation of 403.5 feet MSL. Based on a crest elevation of approximately 405.5 feet MSL for the earthen embankments around the PDP-5, a minimum 2-foot freeboard is maintained in PDP-5 under normal operating conditions.

It should be noted that water is also removed from the BAPs, NSP and PDP-5 through natural evaporation; however, evaporation from the BAPs, NSP and PDP-5 was not considered as part of this evaluation.

2.3 Inflow Design Flood for BAPs, NSP and PDP-5

As described in Section 1.7, the BAPs, NSP and PDP-5 are classified as a low hazard potential CCR Impoundments. In accordance with § 257.82(a)(3), the inflow design flood for a low hazard potential CCR impoundment is the 100-year flood event. Direct precipitation on the BAPs, NSP and PDP-5 is the only inflow source that is affected by the inflow design flood.

The 100-year, 24-hour storm for the BAPs, NSP and PDP-5 is estimated to be 10.9 inches based on the Point Precipitation Frequency Estimate Table from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 for Tatum, TX (NOAA, 2021, see Appendix A).

2.4 Hydraulic Capacity Evaluation for BAPs, NSP and PDP-5

A hydraulic capacity evaluation was performed on the BAPs, NSP and PDP-5 for the inflow design flood as part of the development of the IDFCSP. The evaluation was based on the water balance equation described above and the following assumptions:

- The design operating level in the BAPs and NSP is an approximate elevation 328 feet MSL and the crest elevation of the earthen embankments around the BAPs and NSP is approximately 330 feet MSL. As a result, a minimum 2-foot freeboard is maintained in the BAPs and NSP under normal operating conditions.
- The design operating level in the PDP-5 is an approximate elevation of 403.5 feet MSL and the crest elevation of the earthen embankments around the PDP-5 is approximately 405.5 feet MSL. As a result, a minimum 2-foot freeboard is maintained in the PDP-5 under normal operating conditions.
- Inflows to and outflows from the BAPs, NSP and PDP-5 considered as part of the evaluation are as described in Sections 2.1 and 2.2 of this report.
- The rate of water decanted from the BAPs and NSP (process outflow) is assumed to be equivalent to the inflow of process water to the impoundment (except for direct precipitation on the BAPs and NSP) during the design flood event so that the design operating level of 328 feet MSL is maintained in the BAPs and NSP.
- The rate of water decanted from the PDP-5 (process outflow) is assumed to be equivalent to the inflow of process water to the impoundment (except for direct precipitation on the PDP-5) during the design flood event so that the design operating level of 403.5 feet MSL is maintained in the PDP-5.
- Stormwater runoff from the lignite storage areas is not pumped to the BAPs, NSP and PDP-5 during the design flood event. As a result, the lignite storage areas will accumulate stormwater.
- Evaporation from the BAPs, NSP and PDP-5 is assumed to be negligible during the design flood event.

Based on these assumptions, the general water balance equation for the BAPs, NSP and PDP-5 can be modified as follows:

Process Inflows + Direct Precipitation = Process Outflows + Change in BAP, NSP and PDP-5 Storage

Since the rate of water decanted from the BAPs, NSP and PDP-5 (process outflow) is assumed to be equivalent to the process water inflows to the impoundment, the BAP, NSP and PDP-5 water balance equation becomes:

Direct Precipitation = Change in BAPs, SP and PDP-5 Storage

For the 100-year, 24-hour design flood event, direct precipitation on the BAPs and NSP is estimated to be 10.9 inches. Based on the above equation, the water surface in the BAPs and NSP would rise 10.9 inches (approximately 0.9 feet) to accommodate this precipitation. Since the design operating level for the BAPs and NSP is an elevation of 328 feet MSL and the crest elevation of the earthen embankments around the BAPs and NSP is approximately 330 feet MSL, the resulting water surface elevation of 328.9 feet MSL would still allow for approximately 1.1 feet of freeboard to remain in the BAPs and NSP. As a result, the BAPs and NSP are adequately designed to manage the inflow design flood in accordance with § 257.82.

For the 100-year, 24-hour design flood event, direct precipitation on PDP-5 is estimated to be 10.9 inches. Based on the above equation, the water surface in the PDP-5 would rise 10.9 inches (approximately 0.9 feet) to accommodate this precipitation. Since the design operating level for the PDP-5 is an elevation of 403.5 feet MSL and the crest elevation of the earthen embankments around the PDP-5 is approximately 405.5 feet MSL, the resulting water surface elevation of 404.4 feet MSL would still allow for approximately 1.1 feet of freeboard to remain in the PDP-5. As a result, the PDP-5 is adequately designed to manage the inflow design flood in accordance with § 257.82.

3.0 UPDATED INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN FOR BAPs, NSP AND PDP-5

The BAPs, NSP and PDP-5 are adequately designed to manage the 100-year, 24-hour inflow design flood in accordance with § 257.82. The BAPs, NSP and PDP-5 should be operated in accordance with the following Inflow Design Flood Control System Plan to maintain adequate freeboard in the impoundment to manage the design flood conditions:

- The operating level in the BAPs and NSP should be maintained at an approximate elevation of 328 feet MSL to provide approximately 2 feet of freeboard in the impoundment under normal operating conditions.
- The operating level in PDP-5 should be maintained at an approximate elevation of 403.5 feet MSL to provide approximately 2 feet of freeboard in the impoundment under normal operating conditions.
- The rate of water decanted from the BAPs and NSP (process outflow) should be equivalent to the inflows of process water pumped to the impoundment during the design flood event so that the design operating level of 328 feet MSL is maintained in the BAPs and NSP.
- The rate of water decanted from the PDP-5 (process outflow) should be equivalent to the inflows of process water pumped into the impoundment during the design flood event so that the design operating level of 403.5 feet MSL is maintained in the PDP-5.
- Stormwater managed by MLSES sumps should be allowed to accumulate to the extent practicable and the transfer of stormwater collected by the plant sumps should be regularly monitored and regulated to ensure adequate freeboard is maintained in each of the CCR impoundments during a storm event.
- Stormwater runoff from the lignite storage areas should not be pumped to the BAPs, NSP and PDP-5 during heavy precipitation events until Luminant personnel document through visual inspection that adequate freeboard is available in the BAPs, NSP and PDP-5. As a result, the lignite storage areas will accumulate stormwater during periods of heavy precipitation until such time as the water can be pumped to the BAPs, NSP and PDP-5 or otherwise managed.

In accordance with § 257.82(c)(4), this updated IDFCSP must be placed in the operating record for the MLSES no later than October 12, 2021. Subsequent periodic IDFCSPs must be completed every five years. In addition, the IDFCSP must be amended whenever there is a change in conditions that would substantially affect the plan.

4.0 REFERENCES

Dewberry Consultants, LLC (Dewberrry), 2014. Final Coal Combustion Residue Impoundment Round 12 - Dam Assessment Report, Martin Lake Steam Electric Station Bottom Ash Pond, Tatum, Texas, EP-09W001727, March.

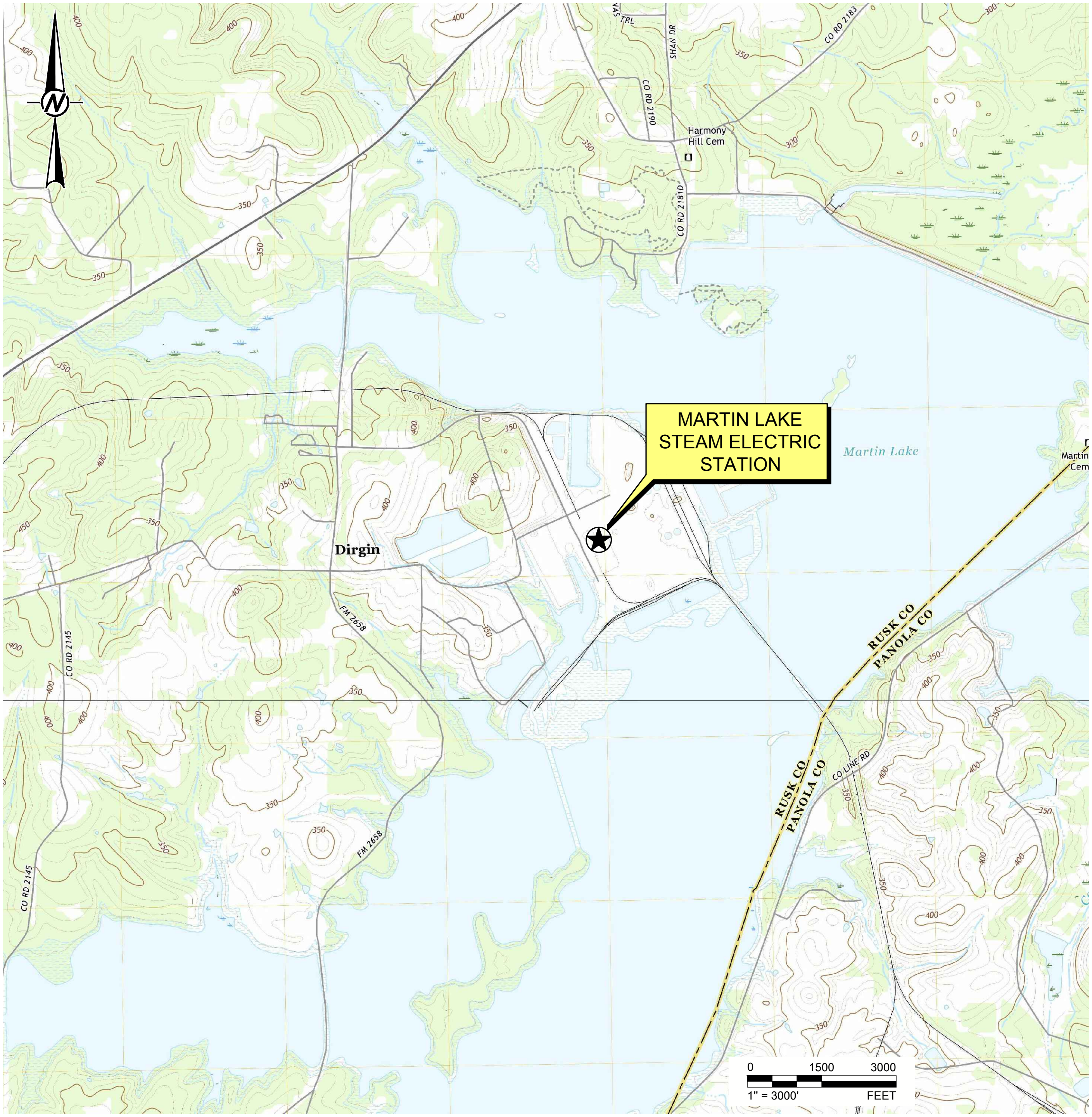
Pastor, Behling & Wheeler, LLC (PBW), 2016. Inflow Design Flood Control System Plan – Martin Lake Steam Electric Station Ash Pond Area and Permanent Disposal Pond No. 5, Rusk County, Texas. October.

Golder Associates, Inc. (Golder), 2021. Hazard Potential Classification Assessment – 5 Year Update, Martin Lake Steam Electric Station Ash Pond Area and Permanent Disposal Pond No. 5, Rusk County, Texas. October.

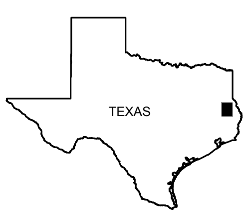
National Oceanic and Atmospheric Administration (NOAA), 2021. Atlas 14 – Point Precipitation Frequency Estimates Website, Tatum, Texas. September.

United States Army Corps of Engineers (USACE), 1979. Recommended Guidelines for Safety Inspections of Dams, ER 1110-2-106, September 26.

FIGURES



REFERENCE(S)
BASE MAP TAKEN FROM USGS.GOV TATUM AND FAIR PLAY, TEXAS 7.5 MIN. USGS QUADRANGLES, DATED 2019.



QUADRANGLE LOCATION

CLIENT
LUMINANT GENERATION COMPANY

PROJECT
MARTIN LAKE STEAM ELECTRIC STATION
ASH POND AREA AND PDP-5
INFLOW DESIGN FLOOD SYSTEM CONTROL PLAN UPDATE

TITLE
SITE LOCATION MAP

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-09-28
DESIGNED	AJD
PREPARED	AJD
REVIEWED	PJB
APPROVED	PJB

PROJECT NO.	CONTROL	REV.	FIGURE
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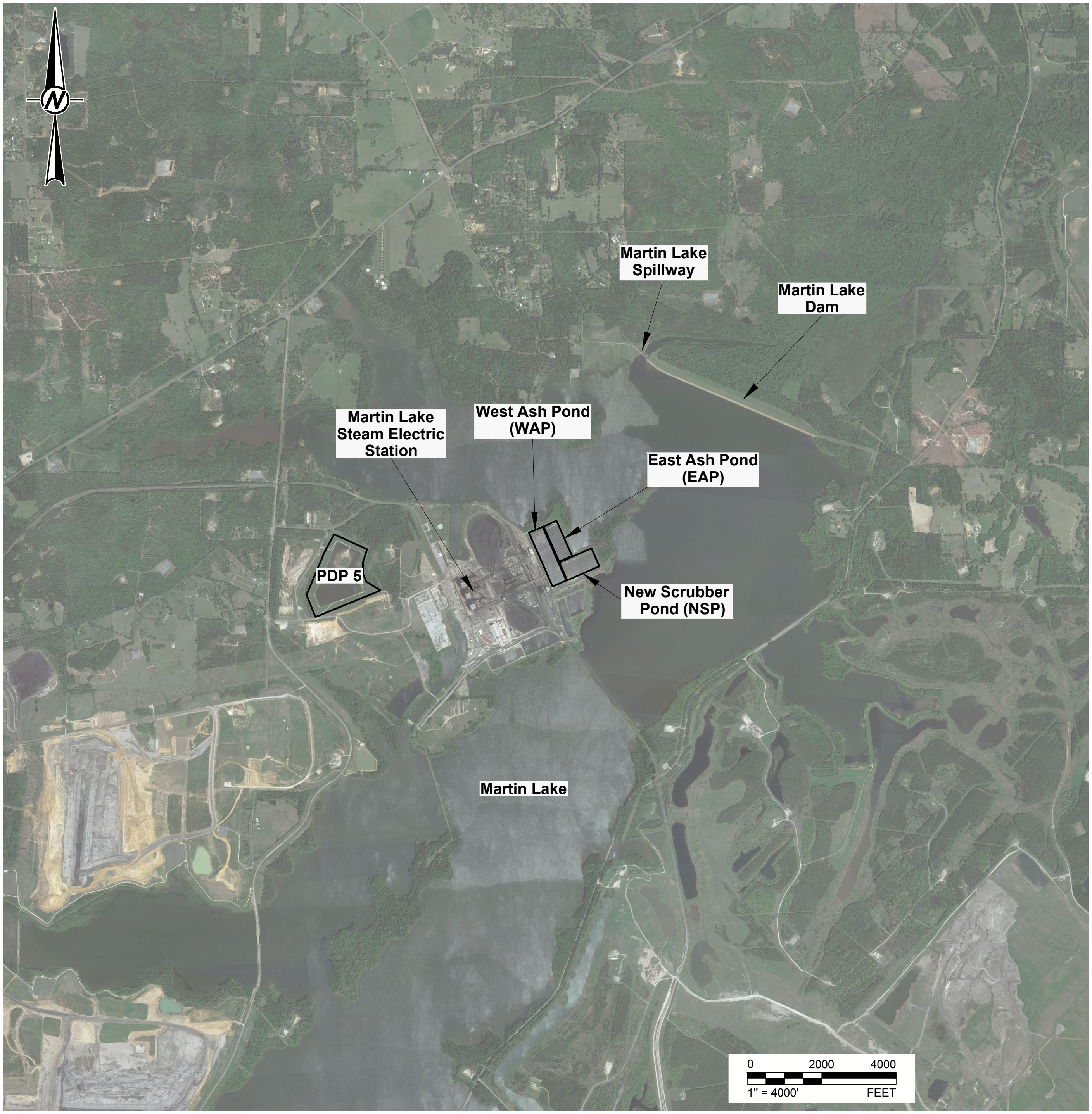

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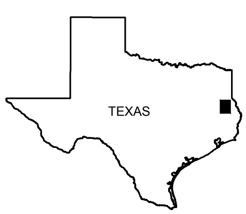

PHOTOGRAPH LOCATION

CLIENT

LUMINANT GENERATION COMPANY

PROJECT

MARTIN LAKE STEAM ELECTRIC STATION
ASH POND AREA AND PDP-5
INFLOW DESIGN FLOOD SYSTEM CONTROL PLAN UPDATE

TITLE

SITE VICINITY MAP

CONSULTANT

GOLDER MEMBER OF WSP

YYYY-MM-DD	2021-09-28
DESIGNED	AJD
PREPARED	AJD
REVIEWED	PJB
APPROVED	PJB

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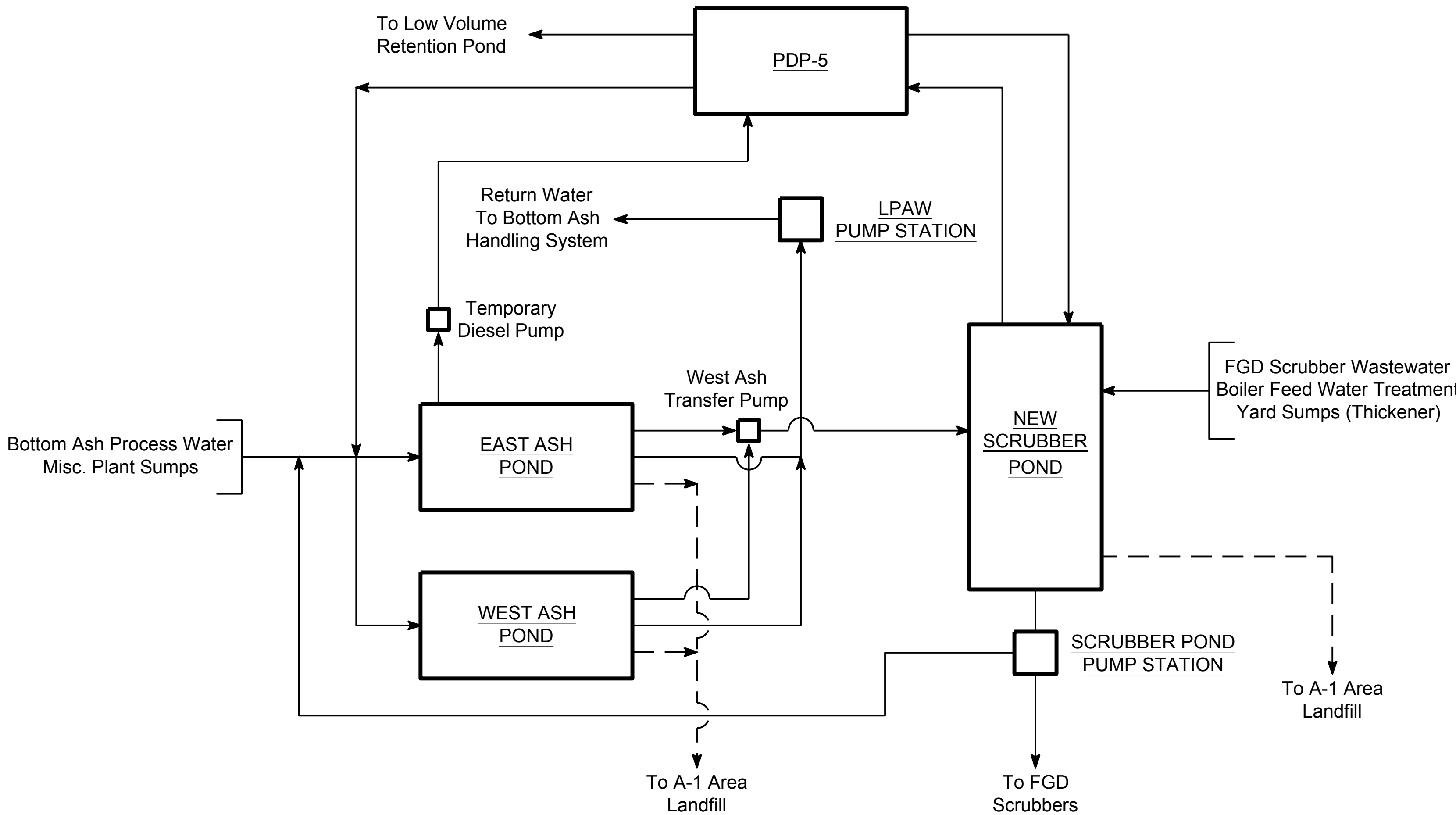

LEGEND

—➤—	WATER
– ➤ –	SOLIDS

CLIENT
LUMINANT GENERATION COMPANY

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-09-28
DESIGNED	AJD
PREPARED	AJD
REVIEWED	PJB
APPROVED	PJB

PROJECT
MARTIN LAKE STEAM ELECTRIC STATION
ASH POND AREA AND PDP-5
INFLOW DESIGN FLOOD SYSTEM CONTROL PLAN UPDATE

TITLE
SIMPLIFIED CCR SURFACE IMPOUNDMENT FLOW DIAGRAM

PROJECT NO.	CONTROL	REV.	FIGURE
21465177		0	3

APPENDIX A

NOAA Atlas 14 Precipitation Data – Tatum, Texas

NOAA Atlas 14, Volume 11, Version 2
Location name: Tatum, Texas, USA*
Latitude: 32.2589°, Longitude: -94.5721°
Elevation: 308.84 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min	**0.443** (0.336-0.585)	**0.512** (0.391-0.670)	**0.623** (0.475-0.819)	**0.716** (0.537-0.954)	**0.844** (0.613-1.16)	**0.942** (0.666-1.33)	**1.04** (0.718-1.51)	**1.15** (0.770-1.70)	**1.29** (0.836-1.98)	**1.40** (0.884-2.20)
10-min	**0.707** (0.535-0.934)	**0.817** (0.624-1.07)	**0.996** (0.759-1.31)	**1.15** (0.860-1.53)	**1.35** (0.983-1.86)	**1.51** (1.07-2.13)	**1.67** (1.15-2.42)	**1.83** (1.23-2.72)	**2.04** (1.33-3.14)	**2.20** (1.39-3.47)
15-min	**0.886** (0.671-1.17)	**1.02** (0.781-1.34)	**1.24** (0.948-1.64)	**1.43** (1.07-1.90)	**1.68** (1.22-2.30)	**1.87** (1.32-2.63)	**2.06** (1.42-2.99)	**2.27** (1.52-3.37)	**2.55** (1.65-3.91)	**2.76** (1.75-4.35)
30-min	**1.25** (0.943-1.65)	**1.43** (1.10-1.88)	**1.74** (1.32-2.29)	**1.99** (1.49-2.65)	**2.34** (1.69-3.20)	**2.60** (1.83-3.65)	**2.86** (1.97-4.14)	**3.15** (2.12-4.68)	**3.54** (2.30-5.45)	**3.86** (2.44-6.08)
60-min	**1.63** (1.23-2.15)	**1.88** (1.43-2.46)	**2.29** (1.74-3.01)	**2.63** (1.97-3.50)	**3.10** (2.25-4.24)	**3.45** (2.44-4.86)	**3.82** (2.63-5.53)	**4.22** (2.84-6.28)	**4.79** (3.12-7.37)	**5.25** (3.32-8.27)
2-hr	**1.99** (1.52-2.61)	**2.33** (1.78-3.02)	**2.88** (2.20-3.75)	**3.34** (2.52-4.43)	**4.00** (2.92-5.44)	**4.51** (3.21-6.30)	**5.06** (3.51-7.26)	**5.68** (3.83-8.34)	**6.56** (4.28-9.97)	**7.29** (4.63-11.3)
3-hr	**2.20** (1.68-2.88)	**2.61** (2.00-3.35)	**3.25** (2.49-4.21)	**3.80** (2.88-5.01)	**4.59** (3.36-6.22)	**5.23** (3.73-7.26)	**5.91** (4.11-8.43)	**6.69** (4.52-9.76)	**7.81** (5.11-11.8)	**8.75** (5.57-13.5)
6-hr	**2.58** (1.98-3.36)	**3.11** (2.38-3.94)	**3.90** (3.01-5.03)	**4.62** (3.51-6.05)	**5.66** (4.17-7.61)	**6.51** (4.67-8.98)	**7.45** (5.20-10.5)	**8.52** (5.79-12.3)	**10.1** (6.61-15.0)	**11.4** (7.27-17.3)
12-hr	**2.97** (2.30-3.84)	**3.63** (2.78-4.55)	**4.60** (3.56-5.88)	**5.48** (4.20-7.14)	**6.80** (5.05-9.10)	**7.91** (5.71-10.8)	**9.14** (6.41-12.8)	**10.5** (7.19-15.0)	**12.6** (8.29-18.5)	**14.3** (9.18-21.5)
24-hr	**3.42** (2.66-4.39)	**4.21** (3.23-5.23)	**5.36** (4.17-6.81)	**6.42** (4.94-8.30)	**8.02** (5.99-10.6)	**9.37** (6.80-12.7)	**10.9** (7.66-15.0)	**12.6** (8.60-17.7)	**15.0** (9.92-21.8)	**17.0** (11.0-25.2)
2-day	**3.96** (3.10-5.06)	**4.87** (3.77-6.02)	**6.20** (4.85-7.84)	**7.43** (5.75-9.54)	**9.25** (6.96-12.2)	**10.8** (7.89-14.6)	**12.5** (8.85-17.1)	**14.3** (9.85-20.0)	**16.9** (11.2-24.2)	**19.0** (12.3-27.8)
3-day	**4.37** (3.43-5.55)	**5.33** (4.15-6.60)	**6.77** (5.32-8.54)	**8.08** (6.27-10.3)	**10.0** (7.55-13.1)	**11.6** (8.51-15.6)	**13.4** (9.49-18.2)	**15.2** (10.5-21.1)	**17.9** (11.9-25.4)	**19.9** (12.9-28.9)
4-day	**4.71** (3.70-5.97)	**5.70** (4.47-7.07)	**7.21** (5.68-9.07)	**8.55** (6.66-10.9)	**10.5** (7.94-13.7)	**12.1** (8.90-16.2)	**13.9** (9.87-18.8)	**15.8** (10.9-21.7)	**18.4** (12.2-26.0)	**20.5** (13.3-29.5)
7-day	**5.55** (4.38-7.00)	**6.57** (5.20-8.17)	**8.17** (6.48-10.3)	**9.56** (7.48-12.1)	**11.5** (8.71-14.9)	**13.1** (9.62-17.3)	**14.8** (10.5-19.8)	**16.6** (11.5-22.7)	**19.2** (12.8-26.9)	**21.3** (13.9-30.4)
10-day	**6.24** (4.94-7.85)	**7.29** (5.82-9.08)	**8.98** (7.15-11.2)	**10.4** (8.16-13.2)	**12.4** (9.37-15.9)	**13.9** (10.2-18.2)	**15.5** (11.1-20.8)	**17.4** (12.1-23.6)	**19.9** (13.4-27.7)	**22.1** (14.4-31.2)
20-day	**8.33** (6.64-10.4)	**9.51** (7.68-11.9)	**11.5** (9.24-14.3)	**13.1** (10.3-16.4)	**15.2** (11.6-19.4)	**16.8** (12.4-21.8)	**18.4** (13.2-24.3)	**20.1** (14.1-27.0)	**22.5** (15.2-30.9)	**24.4** (16.0-34.0)
30-day	**10.0** (8.03-12.5)	**11.3** (9.22-14.2)	**13.6** (11.0-16.9)	**15.3** (12.1-19.2)	**17.6** (13.4-22.3)	**19.3** (14.2-24.8)	**20.8** (15.0-27.4)	**22.5** (15.8-30.0)	**24.8** (16.7-33.7)	**26.5** (17.4-36.6)
45-day	**12.4** (9.97-15.4)	**13.9** (11.3-17.3)	**16.4** (13.3-20.4)	**18.4** (14.6-23.0)	**21.0** (16.0-26.4)	**22.7** (16.9-29.1)	**24.4** (17.6-31.8)	**26.1** (18.3-34.5)	**28.2** (19.1-38.1)	**29.9** (19.6-40.8)
60-day	**14.5** (11.7-18.0)	**16.1** (13.2-20.1)	**19.0** (15.4-23.5)	**21.2** (16.9-26.3)	**23.9** (18.3-30.1)	**25.8** (19.2-33.0)	**27.6** (20.0-35.8)	**29.3** (20.6-38.6)	**31.4** (21.3-42.2)	**33.0** (21.7-44.8)

[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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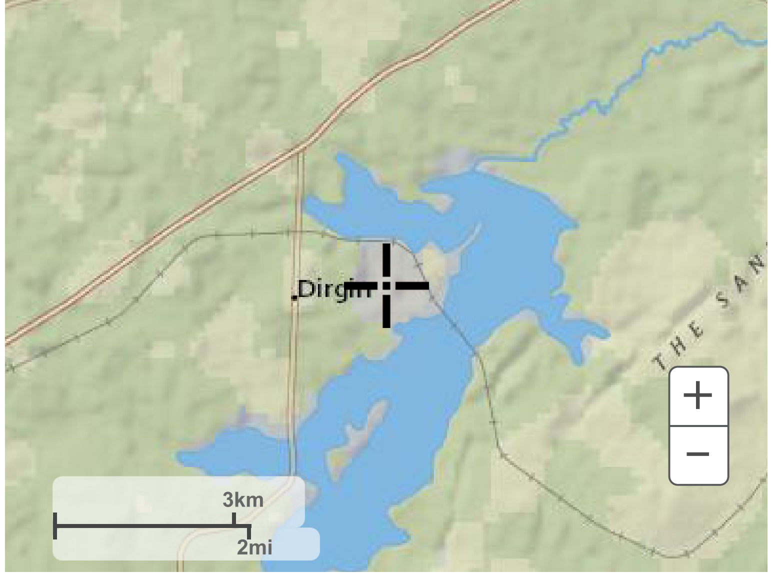
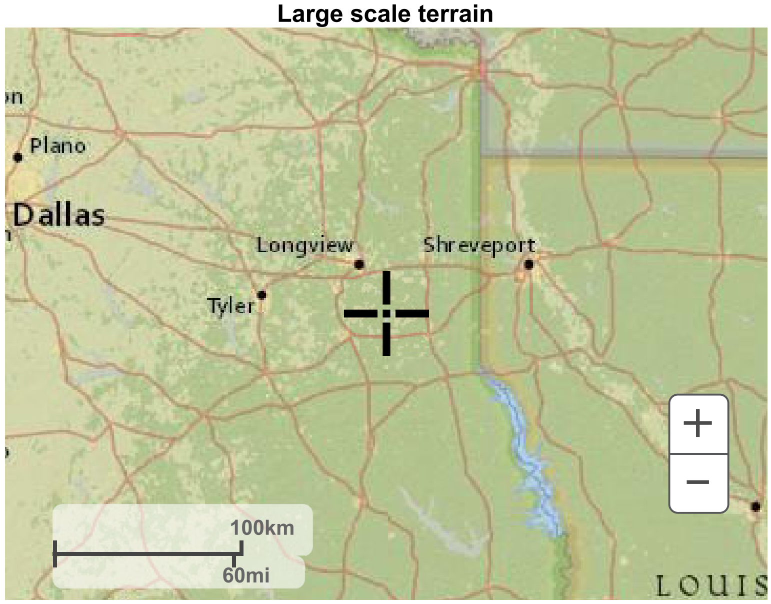
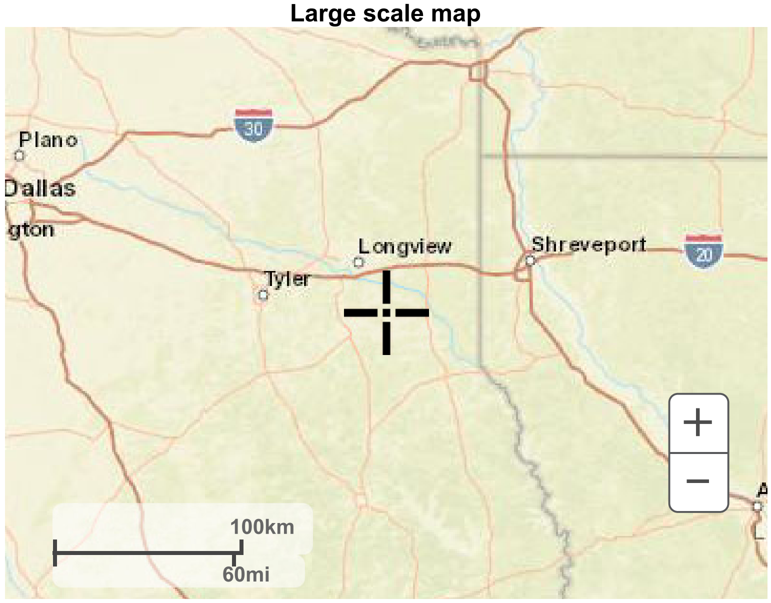
PF graphical



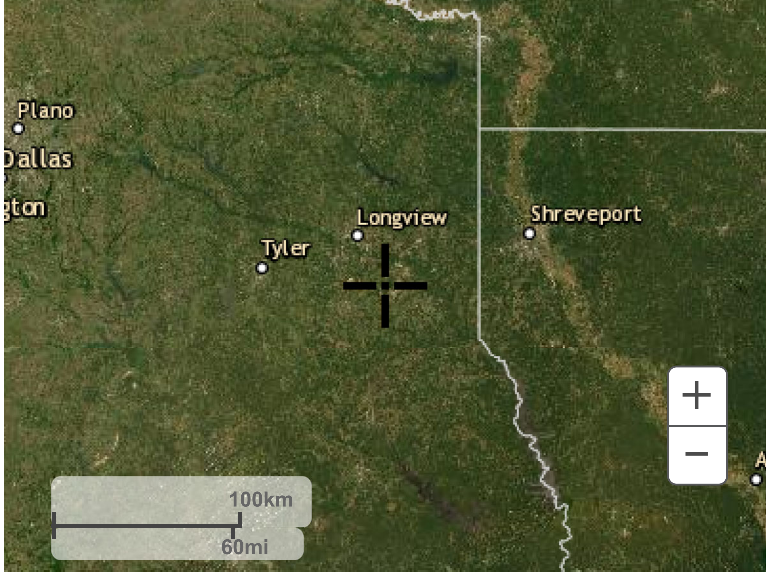
Large scale terrain



Large scale map



Large scale aerial



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