Thunder Butte Petroleum Services, Inc.

AIR QUALITY MODELING PROTOCOL

Proposed Crude Oil Topping Plant

February 6, 2023, revised February 23, 2023, November 10, 2023, and December 15, 2023

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Acronyms and Abbreviations

$\mu g/m^3$	micrograms per cubic meter
AERMOD	AMS/EPA Regulatory Model
AQIA	air quality impacts analysis
AMS	American Meteorological Society
AST	above-ground storage tank
ATB	Atmospheric Tower Bottoms
AWOS	Automated Weather Observing System
BIA	Bureau of Indian Affairs
BPD	barrels per day
BPIP	Building Profile Input Program
BPIPPRM	"PRIME" version of BPIP
FBIR	Fort Berthold Indian Reservation
CO	Carbon Monoxide
dba	doing business as
EUI	emission unit identification
FLAG	Federal Land Manager's Air Quality Related Values Work Group
g/s	grams per second
GEP	Good Engineering Practice
H_2S	Hydrogen Sulfide
HAP	hazardous air pollutant
HCU	Hydro-Cracking Unit
ISHD	integrated surface hourly data
K	Kelvin
km	kilometers
LPG	liquefied petroleum gas
m	meters
m/s	meters per second
MERPs	Modeled Emission Rates for Precursors
MHA	Mandan, Hidatsa, and Arikara Nation
MSS	Maintenance, Startup, and Shutdown

NAAQS	National Ambient Air Quality Standards
NAD83	North American Datum of 1983
NED	National Elevation Dataset
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NSR	New Source Review
NWS	National Weather Service
Q	Annual Emissions
Q/D	Annual Emissions/Distance
PM	Particulate Matter
PM_{10}	Particulate Matter, less than 10 microns
$PM_{2.5}$	Particulate Matter, less than 2.5 microns
ppb	parts per billion
PSD	Prevention of Significant Deterioration
PTE	potential to emit
SER	Significant Emission Rate
SIL	Significant Impact Level
SMNSR	Synthetic Minor New Source Review
SO_2	Sulfur dioxide
TBPS	Thunder Butte Petroleum Services, Inc.
tpy	tons per year
UIC	underground injection control
ULS	ultra-low sulfur
USEPA	U.S. Environmental Protection Agency
UTM	Universal Transverse Mercator
VOC	Volatile Organic Compounds

1. Introduction

This modeling protocol was prepared to conduct modeling in support of the air permit application for a 40,000 barrel per day Topping Plant proposed for construction on the Fort Berthold Indian Reservation (FBIR) in Ward County, North Dakota by the Mandan, Hidatsa, and Arikara (MHA) Nation, doing business as (dba) Thunder Butte Petroleum Services, Inc. (TBPS). TBPS currently operates a Crude Storage and Loading Facility on the FBIR for which USEPA Region 8 issued Synthetic Minor New Source Review Permit to Construct number SMNSR-TAT-000781-2021.002B on July 6, 2022. The current air permit authorized construction of six (6) additional crude oil storage tanks at the Storage and Loading Facility. Construction of the additional tanks has not started and USEPA Region 8 has determined that tank construction should be included with the Topping Plant project. TBPS proposes to construct and operate the Topping Plant adjacent to the existing TBPS Crude Storage and Loading Facility. In addition to unit operations and other tanks, construction of the Topping Plant will include six (6) additional crude oil storage tanks at the Storage and Loading Facility. A Topping Plant is a small petroleum refinery that produces a limited number of products. The Topping Plant would process Bakken light sweet crude oil from the TBPS Crude Storage and Loading Facility to produce liquefied petroleum gas, Light Naphtha, Heavy Naphtha, Jet Fuel, Ultra-Low Sulfur #2 Diesel, and Atmospheric Tower Bottoms. Details on the Topping Plant are provided in Section 1.2, Project Description.

Under the Federal air permitting rules on Indian Lands at 40 CFR §49.154(d), if the U.S. Environmental Protection Agency (USEPA) has reason to be concerned that the construction of a source would cause or contribute to a violation of the National Ambient Air Quality Standards (NAAQS) or Prevention of Significant deterioration (PSD) increment, they may require an air quality impact analysis (i.e., modeling). In order for USEPA to issue the air permit for the facility, the modeling must demonstrate that emissions from the source will not cause or contribute to a NAAQS or PSD increment violation. Given that the proposed project is a petroleum Topping Plant with the potential to significantly increase air emissions on the Fort Berthold Reservation, Arcadis discussed the project with USEPA Region 8 to gather whether an air dispersion modeling demonstration should be included in the application package. The USEPA recommended that the application include an air dispersion modeling demonstration for the following reasons:

1. USEPA is currently developing a policy requiring modeling for sources that emit criteria pollutants over PSD significance levels. The proposed Topping Plant will meet this criterion.
2. A dispersion modeling demonstration conducted in accordance with current widely accepted methods used for major PSD sources will support the conclusion that the Topping Plant will not cause or contribute to a NAAQS or PSD increment violation, thus supporting USEPA's issuance of the permit.

This protocol provides the technical description of the methods and selected input parameters for preparing the air modeling demonstration for this proposed project. Specifically, this protocol provides the following elements for conducting the analysis:

- A project description, site location, and the layout of the proposed facility.
- The regulatory background for performing this air modeling analysis.
- A source description that identifies equipment and provides the estimated emission rates of regulated air pollutants. Key known parameters such as stack height, stack diameters, exit temperatures, and exit velocities are provided.

- A description of how the good engineering practice (GEP) stack height analysis will be conducted and how building/structure downwash parameters will be evaluated.
- A description of the air dispersion model selected for the analysis and the procedures for representing site-specific characteristics including background ambient concentrations, meteorology, surface roughness, and topography. The proposed receptor grid configuration is described.
- Methodology for conducting a preliminary and cumulative modeling analysis, including the USEPA recommended approach to account for ground-level contributions from off-site emissions sources if predicted impacts from PSD pollutants are greater than the significant impact levels (SILs).
- Description of the methodology for evaluating the potential for secondary impacts on ambient ozone and $PM_{2.5}$ concentrations.
- Discussion on Class I Area requirements.

1.1 Site Description

The TBPS Project site is located in Ward County, North Dakota. The MHA Nation owns the 468-acre parcel on which they intend to construct and operate the proposed Topping Plant. The property is on “Indian country” lands as defined at 18 U.S.C. § 1151. In mid-2012, the parcel was accepted into trust by the Bureau of Indian Affairs (BIA). The proposed Topping Plant would be on a 190-acre portion of the parcel west of County Road 366th Street SW and south of the existing Canadian Pacific Rail Easement. **Figure 1** presents a regional map of the project area.

The approximate Universal Transverse Mercator (UTM) North American Datum of 1983 (NAD83) coordinates for the Facility are 286,700 m (meters) E; 5,317,440 m N; Zone 14. The approximate graded elevation of the site will be 640 m.

1.2 Project Description

1.2.1 Topping Plant

The MHA Nation, dba TBPS, proposes to construct and operate a 40,000 barrel per day (BPD) Topping Plant on the FBIR in Ward County, North Dakota. The proposed Topping Plant would be adjacent to the existing TBPS Crude Storage and Loading Facility, would process up to 14,600,000 BOPY of Bakken light sweet crude oil, and operate up to 8,760 hours per year. Crude oil for processing in the Topping Plant would be provided directly from the adjacent TBPS Crude Storage and Loading Facility. The Topping Plant project includes construction of six (6) additional crude oil storage tanks at the existing Storage and Loading Facility. The Topping Plant would produce, store, and ship liquefied petroleum gas (LPG), Light Naphtha, Heavy Naphtha, Jet Fuel, Ultra-Low Sulfur (ULS) #2 Diesel, and Atmospheric Tower Bottoms (ATB). The LPG products would be stored in pressure vessels. The Light Naphtha and Heavy Naphtha would be stored in floating roof tanks and the remaining products would be stored in atmospheric storage tanks. For customer delivery, finished LPG would be loaded into tanker trucks and/or rail cars. The other products would be loaded into rail cars at the Topping Plant. Most of the natural gas for the Topping Plant heating needs (99%) would come from the North Dakota natural gas pipeline loop. The remaining 1% of natural gas demand for the Topping Plant would come from a 6 MMscfd on-site gas plant that is part of the Topping Plant operations to produce LPG. The Topping Plant natural gas-fired equipment would have Ultra-Low NOx burners or Low NOx burners and some equipment will have selective catalytic reduction. Diesel-fired engines would be Tier 4 engines and would burn Ultra-Low Sulfur Diesel. Process wastewater will be stored in a brine tank until it is trucked offsite for disposal in accordance with regulatory requirements. Topping Plant wastewater would not be discharged to surface water. Rainwater will be gathered into sumps and pumped to an oily water separator system and then discharged onto the surface via an energy dispersion system.

1.2.1.1 Preliminary Topping Plant Air Emissions

Based on preliminary design information at this time, the Topping Plant will include the following emissions sources:

- 40,000 BPD Crude Distillation Unit
- 14,500 BPD Naphtha Splitter
- 15,000 BPD Distillate Hydro Treater
- 25 MMscfd Steam Methane Reformer
- Assorted natural gas-fired heaters and furnaces, approximately 346 MMBtu/hr total heat input
- 6 ton per day Lo-Cat Sulfur Recovery Unit
- 6 MMscfd Gas Plant
- Approximately 20 intermediate and final product storage tanks
- 6 new crude oil storage tanks
- 2 LPG storage pressure vessels
- Truck Loading Racks for LPG
- Rail Car Loading Racks
- 3 Oil/Water Separators
- Emergency Process Flare (size to be determined)
- Emergency LPG Tank Flare (size to be determined)
- Rail Car Loading Combustor (size to be determined)
- 1 x 197-horsepower Diesel Fire Water Pump Engine
- 2,500-horsepower Emergency Diesel Generator Engine

The proposed source locations are shown on the site plan in **Figures 2a** and **2b**.

1.3 Criteria Pollutants

The Tribal Minor New Source Review (NSR) rule, 40 CFR 49.154(d) states that if the permitting authority has reason to be concerned that construction of new minor sources or modifications at existing minor sources would cause or contribute to a NAAQS or PSD increment violation, it may require an air quality impacts analysis (AQIA) using air dispersion modeling methods per the guidance described in 40 CFR part 51, Appendix W. It is our understanding that the USEPA considers several factors in determining whether an AQIA is necessary for a given project. In general, if the controlled potential to emit (PTE) emissions are less than the Minor NSR thresholds for attainment areas found in Table 1 of 40 CFR 49.153, the USEPA does not require a quantitative analysis (i.e., dispersion modeling) for those pollutants. In addition, if a project has controlled PTE emissions for criteria pollutants greater than the PSD significant emission rates (SER) found in 40 CFR 52.21, then the source will be required to conduct an air dispersion modeling analysis for those pollutants. Based on previous discussions with USEPA, sources/projects that fall in between the minor NSR thresholds and the PSD SERs are to be evaluated qualitatively using several factors to determine whether modeling is necessary. These factors may include items such as stack heights, background concentrations, close nearby development (includes schools, housing, industrial sources), complex terrain and proximity to the fence line.

Total Project potential emission rates are provided and compared to the above-mentioned thresholds in **Table 1**.

Table 1 Pollutants and PSD Review

Pollutant	Major Source Threshold[1] (ton/year)	Significant Emission Rate[2] (tons/year)	Minor NSR Thresholds[3]	Potential Emission Rate (tons/year)	Analysis Requested by EPA?
Carbon Monoxide (CO)	100	100	10	52.91	Yes
Nitrogen Oxides (NO_X)		40	10	42.73	Yes
Sulfur Dioxide (SO_2)		40	10	0.90	Yes
Particulate Matter (PM)		25	10	11.40	Yes
Particulate Matter less than 10 microns (PM_{10})		15	5	11.34	Yes
Particulate Matter less than 2.5 microns ($PM_{2.5}$)		10	3	11.33	Yes
Ozone as Volatile Organic Compounds (VOC)		40	5	84.94	Yes
Hydrogen Sulfide (H_2S)		10	2	0.01	No

Notes:

1 Major Source Threshold is 100 tpy or more of a regulated pollutant including fugitive emissions since Petroleum refineries is one of the listed stationary source categories in 40 CFR § 51.166(b)(1).

2 Per definition of 40 CFR § 51.166(b)(23).

3 Per definition found in Table 1 of 40 CFR 49.153.

Based on the total PTE presented in **Table 1**, the criteria pollutants VOCs, NOx, and $PM_{2.5}$ are greater than their respective SERs. Therefore, based on the recommendation from USEPA Region 8, the potential ambient air quality impacts from NO_x and primary $PM_{2.5}$ emissions will be evaluated via a dispersion modeling analysis. In addition, the potential for secondary $PM_{2.5}$ formation will be evaluated using the current Maximum Emission Rate for Precursors (MERPs) guidance as described in Section 7.2. In addition, ozone as VOCs will be evaluated using the MERPs guidance as discussed in Section 7.1.

The potential emissions of CO and PM_{10} are expected to fall in the range between the minor NSR and PSD SERs reference thresholds, and the potential emissions of SO_2 are expected to be below the minor NSR threshold. Most of the emissions from normal operations (except from haul road fugitives and emergency equipment) are designed and expected to be emitted from elevated release points, including stacks and flares with stack heights of 68-95 feet located in the center of the proposed site. In addition, the area around the proposed facility is mostly flat with the nearest complex terrain areas located approximately 15 kilometers (km) away (**Figure 3**). The proposed site is in a sparsely populated area with mostly agricultural lands. The nearest resident is located approximately 2 km to the east. The nearest populated areas are Makoti (3.7 km SE) and Plaza (9 km NW). No large industrial source exists in close proximity to the site. Background air quality for the region is considered good and is classified as attainment for all criteria pollutants. Section 5 presents the background monitoring concentrations. Per direction from USEPA

Region 8, CO, PM_{10}, and SO_2 will be evaluated quantitively through dispersion modeling rather than just qualitatively to ensure compliance with all ambient air standards.

Criteria pollutant NAAQS and SILs are listed in **Table 2**. Ward, Mountrail, and McLean Counties are designated as attainment/unclassifiable for all criteria pollutants.

Table 2 National Ambient Air Quality Standards and Significant Impact Levels

Applicable Regulatory Limits				
Pollutant	**Averaging Period**	**Significant Impact Levels (µg/m³)[a,b]**	**Regulatory Limit (µg/m³)**	**Modeled Design Value Used**
PM_{10}[c]	24-hour	5.0	150	Maximum 6th highest[g]
$PM_{2.5}$[e]	24-hour	1.2[j]	35[f]	Avg. of maximum 8th highest[g]
	Annual	0.2[j]	12[h]	Avg. of maximum 1st highest[i]
Carbon monoxide (CO)	1-hour	2,000	40,000[d,i]	Maximum 2nd highest[i]
	8-hour	500	10,000[d,i]	Maximum 2nd highest[i]
Sulfur Dioxide (SO_2)	1-hour	3 ppb (7.8 µg/m³)	75 ppb[k] (196 µg/m³)	Avg. of maximum 4th highest[l]
	3-hour	25	1,300[d]	Maximum 2nd highest[k]
Nitrogen Dioxide (NO_2)	1-hour	4 ppb (7.5 µg/m³)	100 ppb[n] (188 µg/m³)	Avg. of maximum 8th highest[o]
	Annual	1.0	100[m]	Maximum 1st highest
Ozone (O_3)	8-hour	1 ppb	70 ppb	3-yr Avg of 4th High

Notes:

a µg/m³ = micrograms/cubic meter.

b The maximum 1st highest modeled value is always used for the significant impact analysis unless indicated otherwise. Modeled design values are calculated for each ambient air receptor.

c Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers.

d Not to be exceeded more than once per year on average over 3 years.

e Particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.

f 3-year average of the upper 98th percentile of the annual distribution of 24-hour concentrations.

g 5-year average of the 8th highest modeled 24-hour concentrations at the modeled receptor for each year of meteorological data modeled. For the SIL analysis, the 5-year mean of the 1st highest modeled 24-hour impacts at the modeled receptor for each year.

h 3-year average of annual concentration.

i Not to be exceeded more than once per year.

j Interim SIL established by USEPA policy memorandum.

k 3-year mean of the upper 99th percentile of the annual distribution of maximum daily 1-hour concentrations.

l 5-year mean of the 4th highest daily 1-hour maximum modeled concentrations for each year of meteorological data modeled. For the significant impact analysis, the 5-year mean of 1st highest modeled 1-hour impacts for each year is used.

m Not to be exceeded in any calendar year.

n 3-year mean of the upper 98th percentile of the annual distribution of maximum daily 1-hour concentrations.

o 5-year mean of the 8th highest daily 1-hour maximum modeled concentrations for each year of meteorological data modeled. For the significant impact analysis, the 5-year mean of maximum modeled 1-hour impacts for each year is used.

1.4 Hazardous Air Pollutants

To determine if hazardous air pollutants (HAPs) should be evaluated in this air quality impact analysis, USEPA Region 8 requested a preliminary draft emissions inventory for review (provided on November 23, 2022, via email). TBPS does not expect HAPs to require modeling under the conditions that the PTE of the HAPs is well developed, and that enforceable conditions will be requested for the minor source permit to avoid MACT applicability for the project. Therefore, no modeling analysis for potential HAPs emissions is expected.

2. Model Description/Justification

2.1 Screening and Refined Modeling

There are two levels of modeling analyses typically used for regulatory issues such as permitting of new or modified emission sources - screening and refined dispersion modeling. Screening-level models produce conservative estimates of ambient impacts in order to ensure the maximum ambient concentrations will not be underestimated. If the resulting estimates from a screening model indicate a violation or a threat to the NAAQS, the applicant typically must use a refined model to estimate ambient air concentrations. A refined dispersion model requires more detailed input data than a screening model but can provide more realistic estimates of a source's potential impact on ambient air concentrations.

In this analysis, no screening modeling will be performed; refined dispersion modeling methods will be used.

2.2 Model Selection

The selected model was created by the American Meteorological Society (AMS) and the USEPA AMS/EPA Regulatory Model, (AERMOD), which will be used for refined dispersion analysis for the NAAQS analysis. The AERMOD model (recently revised to version 23132) is a steady-state Gaussian plume model that simultaneously simulates pollutant concentrations from a variety of sources. The AERMOD model was designed to specifically support the USEPA regulatory modeling programs. The *Guideline on Air Quality Models* (USEPA 2017) recommends the use of AERMOD for operating conditions such as those at the proposed TBPS Project, i.e., multiple sources, rural area, possible building downwash, and 1-hour to annual averaging times. The AERMOD Modeling System includes preprocessor programs AERSURFACE (20060; USEPA 2008), AERMET (23132), and AERMAP (18081) to create the required input files for meteorology and receptor terrain elevations. AERMET will be used to process the necessary meteorological data per the methodology described in Section 4.

3. Emissions and Source Data

3.1 Sources to be Permitted

Preliminary estimates of the potential air emission rates for the proposed facility are expected to be below the 100 tons per year (tpy) PSD Major Source threshold. Therefore, the permit application and modeling analysis will be completed for the Project operating as a minor source facility.

3.1.1 Existing TBPS Crude Storage and Loading Facility

The existing TBPS Crude Storage and Loading Facility currently operates the following equipment at the site:

- two (2) 140,000-barrel nominal capacity above-ground storage tanks (ASTs),
- truck-to-tank off-loading,
- one (1) firewater pump engine, and
- crude oil shipping from the facility by pipeline only.

The facility is authorized to operate 8,760 hours per year.

3.1.2 Proposed Topping Plant Facilities

As described in Section 1.2.1.1, the MHA Nation proposes to construct and operate a 40,000 BPD Topping Plant on the FBIR in Ward County, North Dakota.

The proposed project has the following emissions sources:

- 17 fixed-roof storage tanks;
- 13 internal floating roof storage tanks (including six (6) new crude oil storage tanks);
- Six (6) heaters;
- One (1) boiler;
- Two (2) emergency engines (emergency generator and fire water pump);
- Two (2) emergency flares;
- One (1) combustor for railcar loading;
- Three (3) oil/water separators;
- Truck loading fugitive emissions;
- Truck road dust fugitive emissions;
- Maintenance, start-up, and shutdown (MSS) emissions;
- Fugitives from process piping and equipment;

3.2 Emissions Inventory

A draft emissions inventory was submitted to USEPA Region 8 on November 23, 2022, for feedback on pollutants to model, specifically pollutants below the SER but above the minor NSR thresholds. Based on the project emission totals shown in **Table 1**, TBPS proposes modeling be conducted for NO_x, CO, PM_{10}, and $PM_{2.5}$. SO_2 project emissions are expected to be minimal and under the minor source thresholds; however, are included in this analysis per EPA request as a completeness demonstration. The final emissions inventory will be included in the permit application and as an appendix in the air quality modeling report. The emissions rates in the emission inventory analysis will be the same rates used for the modeling analysis. Modeled emissions for non-continuous operating sources may be adjusted for 24-hour and annual averaging periods based on equipment and pollutant modeled (i.e., PM_{10}/$PM_{2.5}$). **Table 3** summarizes the short-term emission rates for the criteria pollutants being modeled.

Table 3 Short-term Emission Rates

EUI	Model ID	Source Description	NO_X (g/s)	CO (g/s)	SO_2 (g/s)	PM_{10} (g/s)	$PM_{2.5}$ (g/s)
F-590	F_590	Crude Oil Heater	0.096	0.462	0.009	0.119	0.119
F-810	F_810	ATB Storage Tank Heater	0.031	0.023	<0.001	0.005	0.005
F-3490	F_3490	Kerosene Diesel Charge Heater	0.041	0.199	0.004	0.051	0.051
F-5490	F_5490	SMR Auxiliary Boiler	0.049	0.037	0.001	0.008	0.008
47-H01A / 47-H01B	47_H01AB	SMR Reformer Heater	0.939	0.707	0.011	0.143	0.143
FPE-2	[a]	Fire Water Pump Engine - Topping Plant	0.155	0.143	<0.001	0.008	0.008
EMGEN-1	EMGEN1	Emergency Generator Engine	3.149	1.813	0.006	0.104	0.104
C-7210	C_7210	Rail Car Loading Combustor	0.056	0.111	<0.001	--	--
F-8960	F_8960	Emergency LPG Flare	0.006	0.012	<0.001	--	--
F-8950	F_8950	Emergency Process Flare	0.006	0.012	<0.001	--	--
MSS-F8950	F8950MSS	MSS Emissions - Degassing to Flare	2.508	5.007	--	--	--
MSS-DEGAS	F8960MSS	MSS Emissions - Tank Degassing Losses	0.002	0.004	<0.001	--	--
RD-1[b,c]	RD1A, RD1B	Road Dust – Crude Truck Unloading, Storage Facility	--	--	--	0.064	0.016
RD-2[c]	RD2A, RD2B	Road Dust – Propane Truck Loading	--	--	--	0.003	0.001
RD-3	RD3	Road Dust - Process Water Truck Loading	--	--	--	0.002	<0.001

Notes:

a FPE-2 is not proposed to be modeled but included for evaluation. See Section 3.4 for discussion of modeling exclusion.

b Proposed project schedule expects that the crude truck unloading operations will be reduced to 10 trucks per day once the Makoti pipeline comes online. Emission rate shown reflects current storage facility permit conditions.

c Emissions represented in table are for total road path, but paths may be split up into segments for modeling purposes.

.g/s = grams per second

3.3 Source Parameters

Table 4 lists all proposed sources in the emissions inventory for the proposed Topping Plant project.

Table 4 Emissions Source Locations

Emission Unit Identification (EUI)	Model ID	Source Description	Source Type	UTM X Coordinate (m)	UTM Y Coordinate (m)	Base Elevation (m)
F-590	F_590	Crude Oil Heater	Point	286494.6	5317370.9	640
F-810	F_810	ATB Storage Tank Heater	Point	286484.6	5317371.3	640
F-3490	F_3490	Kerosene Diesel Charge Heater	Point	286494.4	5317400.3	640
F-5490	F_5490	SMR Auxiliary Boiler	Point	286494.8	5317471.3	640
47-H01A/ 47-H01B	47_H01AB	SMR Reformer Heaters	Point	286506.4	5317479.1	640
FPE-2	[a]	Fire Water Pump Engine – Topping Plant	Point	286152.6	5317440.1	640
EMGEN-1	EMGEN1	Emergency Generator Engine	Point	286152.2	5317434.6	640
C-7210	C_7210	Rail Car Loading Combustor	Point	286404.5	5317261.4	640
F-8960	F_8960	Emergency LPG Flare	Flare	287209.8	5317388.2	640
F-8950	F_8950	Emergency Process Flare	Flare	286157.3	5317362.0	640
MSS-DEGAS	F8960MSS	MSS Emissions - Tank Degassing Losses	Flare	287209.8	5317388.2	640
MSS-F8950	F8950MSS	MSS Emissions - Degassing to Flare	Flare	286157.3	5317362.0	640
RD-1	RD1A, RD1B	Road Dust – Crude Truck Unloading, Storage Facility	Volume	*Varies based on proposed path*		
RD-2	RD2A, RD2B	Road Dust – Propane Truck Loading	Volume	*Varies based on proposed path*		
RD-3	RD3	Road Dust - Process Water Truck Loading	Volume	*Varies based on proposed path*		

Notes:

a Proposed Fire Water Pump, FPE-2 is not included in modeling demonstration. See Section 3.4 for discussion of modeling exclusion.

3.3.1 Point Source Parameters

For each modeled point source, AERMOD requires stack coordinates, height, diameter, emission rates, exit temperature and exit flow rate. The point sources for this project consist of process heaters, emergency engines, and combustors.

Table 5 lists the model input parameters for the emission sources classified as Point sources.

Table 5 Point Source Model Input Parameters

Model ID	Source Description	Stack Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
F_590	Crude Oil Heater	27.04	616.5	9.03	1.77
F_810	ATB Storage Tank Heater	8.84	810.9	9.36	0.40
F_3490	Kerosene Diesel Charge Heater	29.14	616.5	9.08	1.16
F_5490	SMR Auxiliary Boiler	7.32	422.0	9.15	0.37
47_H01AB	SMR Reformer Heater	20.73	422.0	9.14	1.13
[a]	Fire Water Pump Engine 2	2.59	780.4	27.06	0.15
EMGEN1	Emergency Generator Engine	4.57	768.2	17.37	0.41
C_7210	Rail Car Loading Combustor	5.00	810.9	12.74	0.56

Notes:
a Proposed Fire Water Pump, FPE-2 is not included in modeling demonstration. See Section 3.4 for discussion of modeling exclusion.
K = Kelvin
m/s – meters per second

3.3.2 Flare Source Parameters

There are two flares planned for the Topping Plant, one emergency LPG flare used to control IFR tank landing losses, and one emergency process flare used to control plant degassing events. The flare source parameters were calculated using the USEPA flare guidance provided in the AERSCREEN Users Guide (EPA-454/B-16-004, USEPA 2016a). AERMOD does not include a parameterization like AERSCREEN for flares, therefore, the input parameters for the flares were calculated outside of AERMOD using the equations given in the User's Guide (USEPA 2016b). These parameters used to calculate the stack effective diameter and height are listed in **Table 6**.

Table 6 Flare Source Stack Parameters

Model ID	Source Description	Stack Height (m)	Heat Release (MMBTU/hr)	Total Heat Release, HR (cal/s)	Net Heat Release (cal/s)
F_8960	Emergency LPG Flare	30.48	0.34	23,562	10,603
F_8950	Emergency Process Flare	30.48	0.34	23,562	10,603
F8960MSS	Emergency LPG Flare- Tank Degassing Losses (MSSDEGAS)	30.48	0.11	7,582	3,412
F8950MSS	MSS Emissions - Degassing to Flare	30.48	144.23	10,096,298	4,543,334

Abbreviations:
MMBTU/hr = 1 million British thermal units
cal/s = calorie per second

The net heat release, Q, is the total heat release with a reduction factor of 55 percent which accounts for heat loss due to entrainment of ambient air. With this, the effective stack height and effective stack diameter is calculated using the respective equations from the AERSCREEN User's guide (USEPA 2016a).

$$D = 9.88\times10^{-4} \times\sqrt{(HR \times(1-HL))}$$

$$H_{eff} = H_s + 4.56\times10^{-3} \times HR^{0.478}$$

Where:

D = effective stack diameter;

HR = heat release rate;

HL = heat loss fraction;

H_{eff} = effective stack height;

H_s = actual stack height.

The model input parameters proposed for the flares are listed in **Table 7**. For the exit temperature and exit velocity, default values of 1,273 K and 20 m/s, respectively, will be used. The final air quality report will provide the flare parameter calculations for the effective stack height and diameter.

Table 7 Flare Source Model Input Parameters

Model ID	Source Description	Effective Stack Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Effective Stack Diameter (m)
F_8960	Emergency LPG Flare - pilot	31.04	1273	20	0.102
F_8950	Emergency Process Flare - pilot	31.04	1273	20	0.102
F8960MSS	Emergency LPG Flare- Tank Degassing Losses (MSSDEGAS)	30.81	1273	20	0.057
F8950MSS	MSS Emissions - Degassing to Flare	40.64	1273	20	2.106

3.3.3 Volume Sources

Emission sources characterized as volume sources are those that disperse in three dimensions with little plume rise, such as emissions from vents and roads. The emissions inventory estimates road dust emissions from tank trucks traveling through the facility's main entrance and along a paved road to the truck loading racks. There are three haul road routes planned at the facility;

- One route for the existing crude oil unloading operations which will occur until the Makoti pipeline is in operation. A maximum of 100 trucks per day is planned.
- One route for the Topping Plant propane truck loading in winter, where the trucks will travel to the propane loading racks and out of the facility. A maximum of 3 trucks per day during the winter months only.
- One route for the Topping Plant process water trucks which will enter the site, travel to the water truck loading rack, and exit the facility. Three trucks per day are planned for this route.

The Makoti pipeline is expected to come online before the Topping Plant is projected to startup operations. The haul road fugitive PM emissions from existing crude oil unloading operations (RD-1) will be reduced to 10 trucks per day once the Makoti pipeline is in operation. However, the scenario of 100 crude trucks per day is represented in the model as a worst-case scenario.

Following the guidance of USEPA's 2012 Memorandum titled "Haul Road Workgroup Final Report Submission to EPA-OAQPS" (USEPA 2012), the paved road dust emissions will be modeled as volume source parameters with the recommended volume source configuration as adjacent volume sources. See the following parameters configuration as recommended by USEPA.

- Top of Plume Height – 1.7 x VH
- Volume Source Release Height – 0.5 x Top of Plume height
- Width of Plume – VW + 6m for single lane roadways / Road Width + 6m for two lane roadways.
- Initial Sigma Z – Top of Plume / 2.15 (AERMOD User's Guide, Table 3-1 for use when modeling multiple volumes.)
- Initial Sigma Y – Width of Plume / 2.15 (AERMOD User's Guide, Table 3-1)
- Emissions input as g/s

Where;

VH = Vehicle Height

VW = Vehicle Width

Table 8 lists the volume source input parameters calculated for paved road dust modeling.

Table 8 Volume Source Model Input Parameters

Model ID	Source Description	Top of Plume Height (m)	Release Height (m)	Lane Type	Y length (m)	Initial Lateral Dimension (m)	Initial Vertical Dimension (m)
RD1A	Road Dust – Crude Truck Unloading, Storage Facility	5.1	2.55	Two lanes	12	5.58	2.37
RD1B		5.1	2.55	Single lane	9	4.19	2.37
RD2A	Road Dust – Propane Truck Loading	5.1	2.55	Single lane	9	4.19	2.37
RD2B		5.1	2.55	Single lane	9	4.19	2.37
RD3	Road Dust - Process Water Truck Loading	5.1	2.55	Single lane	9	4.19	2.37

3.4 Modeled Operating Conditions

Maximum short-term emissions will be evaluated for the heaters, combustors, and flares assuming they operate continuously throughout the modeled short-term period (1-hour, 3-hour, etc.). Annual impacts will be evaluated using annual emission rates based on each specific activity or equipment if the operations are not continuous (8,760 hours/year).

The use of annualized emissions to evaluate the 1-hour NO_2 NAAQS is proposed for the emergency equipment. The intermittent or infrequent 1-hour NO_2 emissions will be evaluated using guidance from the USEPA (USEPA 2011). Emissions from emergency generators and firewater pump are expected to be intermittent and infrequent. The Facility plans to conduct maintenance testing on the emergency generator and fire water pump engines approximately once per month. Maintenance test for each engine is expected to be 30 minutes to 1 hour in duration. The engines associated with the emergency generator and fire water pump are subject to the Standards of Performance for Stationary Compression Ignition Internal Combustion Engines (aka NSPS Subpart IIII) which limits non-emergency use of the engines to 100 hours per year. For the air quality modeling, TBPS proposes to annualize the emergency generator emissions (NO_X and $PM_{2.5}$) per USEPA intermittent source guidance.

In addition, for PM_{10} and $PM_{2.5}$, an emission rate normalized over a 24-hour period will be used in the air quality modeling for the emergency generators. The emission rate accounts for a maximum maintenance testing duration of 30 minutes to 1 hour to cover any longer testing that may occur during facility maintenance activities. Refer to **Table 9** for the proposed annualized (PM, NO_x) and 24-hour emission rates (PM).

Table 9 Emergency and MSS Equipment Emission Rates

Model ID	Source Description	NOx (Annual) (g/s)	SO_2 (Annual) (g/s)	PM10 (24-Hr) (g/s)	PM2.5 (24-Hr) (g/s)	PM2.5 (Annual) (g/s)
EMGEN1	Emergency Generator Engine	0.036	6.55E-05	0.009	0.009	1.18E-03
F8950MSS[b]	MSS Emissions - Degassing to Flare	2.93E-03	--	--	--	--
F8960MSS[c]	MSS Emissions - Tank Degassing Losses	3.01E-06	--	--	--	--

Notes:

a Assumes 100 hours/year and up to 2 hours per 24-hour period. Typical maintenance testing duration will be between 30 minutes and one hour.

b Assumes approximately 10 hours per year for plant degassing to process flare.

c Assumes approximately 14 hours per year for tank degassing losses to LPG flare.

The proposed firewater pump (FPE-2) is expected to be the same engine size as the existing firewater pump (FPE-1) that was permitted in the latest permit amendment. During the permitting evaluation of FPE-1, USEPA determined that modeling was not required for the firewater pump emissions based on further clarification on the intermittent source memo from USEPA headquarters, and review of the size and expected usage of the engine. Therefore, TBPS requests USEPA's concurrence that modeling of the emissions from FPE-2 is not required in the impact analysis for the Project.

4. Meteorological Data

4.1 Climate and Meteorology

North Dakota's location at the geographic center of North America results in a typical continental climate. Primarily because of continental location, the climate of the state is characterized by wide annual and day-to-day fluctuations in temperature; light to moderate precipitation, which tends to be irregular in time and coverage; low relative humidity; plentiful sunshine; and nearly continuous air movement. The Rocky Mountains act as a barrier to the prevailing westerly flow of air in the atmosphere. This mountain barrier modifies the temperature and moisture characteristics of air masses originating over the Pacific Ocean when they flow over the mountains in ways that reinforce the continental characteristics of the climate. Conversely, there are no mountainous barriers to air mass originating in the polar areas to the north or the Gulf of Mexico to the south. Therefore, air masses originating in these regions easily overflow North Dakota, sometimes with only minor changes in the basic weather pattern.

North Dakota has varied weather in all seasons based on cold and dry air masses that originate in the polar regions; warm and moist air masses from tropical regions; or mild and dry air from the northern Pacific (Jensen 1998). The rapid progression of these air masses over North Dakota from the different source regions usually results in frequent and rapid changes of weather patterns. In Ward County, the occurrence of precipitation varies seasonally. Most of the annual precipitation occurs during the April to September growing season. The more limited precipitation that occurs during the rest of the year may fall as rain or snow. Snowfall typically occurs during October through April averaging around of 40+ inches a year (~34 days/year).

Temperature data from the weather stations also show a seasonal pattern that is characteristic of a continental climate. Average high temperatures peak at 83° during July and August. In contrast, January is the coldest month with an average high of 15°. The difference between the average temperatures for January and July is more than 60°F. The highest temperature ever recorded at nearby Parshall station was 107°F on August 7, 1949, and the lowest temperature recorded was -45°F on January 18, 1950.

4.2 Meteorological Input Data and Processing

In the absence of actual meteorological measurements collected at the site as input data to the AERMOD model for a project, five years of representative surface data collected at a nearby national weather service (NWS) station at a nearby airport is typically used.

A figure of the proposed facility and its surrounding nearby meteorological stations was provided to USEPA on November 23, 2022 for preliminary review. This updated figure based on USEPA input is provided for reference; see **Figure 4**. USEPA's response on the recommended Meteorology approach included the following (provided via email correspondence) on December 8, 2022):

EPA's air quality modeling guidance recommends that ASOS data be used if the meteorological station collects that data. However, a meteorological dataset that does not have ASOS data can still be used if it is the most representative. After providing Given the meteorological datasets available for this area, we recommend considering one of the following two meteorological stations: Foxtrot/Ryder (721016) or Golf/Plaza (721017). These sites do not have ASOS data but these sites appear to be the most representative of the available sites given the sites location and surrounding terrain relative to the project area. To have a complete five years of model results, it also appears that the model simulations would need to start in August 2016 and end in August 2021. We also recommend using upper air data from the Bismarck meteorological station. We have attached *processed meteorological datasets using these sites and default configuration options for your consideration. However, please propose your preferred option in the protocol.*

As recommended by USEPA, a non-ASOS meteorological dataset can also be used if it is the most representative of the proposed project site. Based on the direction from USEPA Region 8, TBPS is considering the use of the provided preprocessed meteorological datasets (via email on December 8, 2022) for use with AERMOD. USEPA processed the surface data with AERMET (v22112) using processing options to substitute for missing cloud cover (CCVR_sub) and/or temperature (TEMP_sub) by linear interpolation across 1 or 2-hour gaps. In addition, the ADJ_U* option was used. ADJ_U* adjusts the surface friction velocity (u*) to address issues with AERMOD over-prediction under stable, low wind speed conditions.

TBPS has reviewed the processed AERMET datasets for the two provided meteorological station recommended by USEPA. Both meteorological stations are relatively close in proximity to the facility compared to other regional sites. Foxtrot/Ryder2 (Station 721016) is 16.5 km (10.3 miles) southeast of the facility while Golf/Plaza (Station 721017) is 17.6 km (~11 miles) to the north. Both stations have similar ground elevation to the proposed facility site. The AERMOD evaluation runs using the USEPA processed Ryder2 station data set (Aug 19, 2016 to Aug 18, 2021) identified 21% cloud-cover values missing (and ~19% wind data) while the Golf Plaza Station data set for the same time period identified 17% cloud cover values missing (and ~7 % wind data) even after the AERMET substitution methods. Arcadis/TBPS evaluated the predicted impacts from the two processed AERMET datasets using preliminary model setup runs. The preliminary model setup runs showed that the Golf-Plaza data set predicted slightly higher offsite impacts than the Ryder data set.

TBPS recommends using the meteorological station for Golf-Plaza (Station ID 721017) for this project because of the conservatively higher impacts and less missing data. Therefore, the proposed AERMET dataset with meteorological surface data (2016-2021) from Golf/Plaza (48.12 N, 101. 96 W) and upper air radiosonde data from Bismarck, ND (46.77 N, 100.75 W) processed by USEPA will be used in the air dispersion analysis to support the permit application.

For the permit application resubmittal, USEPA Region 8 reviewed the most recent available meteorological data (through early 2023) and concurred that the previous Gulf-Plaza data (August 2016 to August 2021 period) is representative for the area and that the more recent data contained data gaps that did not meet the completeness requirement for a continuous 5-year period. Therefore, USEPA reprocessed the Gulf-Plaza data using AERMET version 23132 and provided the data for the project's air quality impact analysis.

This discussion of the data set incorporated in the modeling analysis will be included in the permit application modeling report. The 5-year wind rose for this data set (2016-2021) is shown in **Figure 4** and will be provided with the air quality analysis report.

5. Background Air Quality Concentrations

The NAAQS Analysis must account for background concentrations due to emissions from off-property sources to evaluate the cumulative effects of modeled concentrations with respect to the NAAQS. In the final assessment of impacts, the background concentrations obtained through monitoring data will be combined with the modeled offsite concentrations for the proposed project planned sources.

USEPA's guidelines recommend that background concentrations should use the most recent quality-assured air quality monitoring data collected in the vicinity of the source for the averaging times of concern. In most cases, the monitor closest to and upwind of the project area should be used to determine the background concentrations to be used in the modeling demonstration. If several monitors are available, preference should be given to the monitor located in an area with characteristics that are more similar to the project study area. If there are no monitors located in the vicinity of the new or modifying source, a "regional site" may be used to determine background concentrations. A regional site is one that is located away from the area of interest but is impacted by similar or adequately representative sources.

After consulting with USEPA, nearby source data may be difficult to obtain for the model. For a preliminary analysis, USEPA has recommended using an average of four regional background monitors to represent the area's air quality due to the nearby sources contributions to criteria pollutants and associated averaging periods that may require a cumulative impact analysis. If any of the model results following this recommendation show cumulative impacts close to the NAAQS, TBPS will work with USEPA to refine or reassess this approach to ensure the analysis accounts for nearby sources accurately. The four regional monitors proposed by USEPA are Lostwood (ID: 38-013-0004), Lake LLO (ID: 38-025-0004), TRNP (ID: 38-053-0002), and Ryder (ID: 38-101-0003), as shown in **Figure 7**. The final modeling report will include the full table of background values provided by USEPA. TBPS proposes to use the averaged background concentrations listed in **Table 10** provided by USEPA Region 8 for the area around the Fort Berthold reservation. On October 26, 2023, USEPA provided an updated background dataset that includes the most recent 3-year period (2020-2022).

Table 10 Background Concentrations for Fort Berthold Area in North Dakota

Criteria Pollutant	Averaging Period	Monitoring Site	Monitoring Period	Background Concentration (µg/m³)
$PM_{2.5}$ [a,b]	24-hr	[d]	2020-2022	24.8
	Annual	[d]	2020-2022	6.0
PM_{10}	24-hr	[d]	2020-2022	75.8
NO_2 [a,b]	1-hr	[d]	2020-2022	20.7
	Annual	[d]	2020-2022	4.5
SO_2	1-hr	[d]	2020-2022	24.9
	3-hr	[d]	2020-2022	29.9
Ozone [c]	8-hr	[d]	2020-2022	56.8 ppb

Notes:
a 3-year average of 98th percentile
b Annual mean averaged over 3 years
c 3-year average of annual fourth-highest daily maximum 8-hr
d An average of 4 regional monitors is recommended by USEPA

ppb = parts per billion

6. Modeling Approach

Dispersion modeling will be performed to support the TBPS permit application. The modeling evaluations will include a Significance Analysis and NAAQS Analysis.

6.1 AERMOD Model Input Defaults/Options

For the refined dispersion model operation on this Project, several dispersion model options are available. The model options selected for this demonstration will be based on the regulatory default selections, which include:

- Final plume rise;
- Stack-tip downwash;
- Buoyancy-induced dispersion;
- Default wind profile exponents;
- Default vertical potential temperature gradients; and,
- Calms processing.

Modeling for the 1-hour NO_2 SILs/NAAQS will follow the recommended three tier screening approach provided in the latest version of Appendix W. Tier 1 is identified as full conversion of NO_X to NO_2. According to Appendix W, Tier 2 is when the "Ambient Ratio Method 2 (ARM2) is used, which provides estimates of representative equilibrium ratios of NO_2/NO_X value based on ambient levels of NO_2 and NO_X derived from a national dataset. With the use of ARM2 (default option), special attention will be necessary for handling source grouping if different operational scenarios are evaluated. The Tier 2 method uses the national default values including a minimum ambient NO_2/NO_X of 0.5 and a maximum of 0.9. Tier 2 is proposed for this analysis.

If the analysis determines that a Tier 3 (use of OLM or PVMRM) is necessary to show compliance with the air quality standards, TBPS will follow USEPA's provided guidance for the proposed approach and use the provided Ryder, ND monitor site (38-101-003) hourly ozone data for the NO_2 chemistry. The proposed Tier 3 analysis approach and any refinements to the ozone data will be provided to USEPA for review prior to submittal of the air quality analysis.

6.2 Land Use Classification

The selection of rural or urban dispersion coefficients for use in a specific modeling exercise should follow either a land use procedure or a population density procedure. The land use procedure is considered more effective. The land use classification scheme proposed by A.H. Auer in *Correlation of Land Use and Cover with Meteorological Anomalies, Journal of Applied Meteorology*, (Auer 1978), is the method recommended by the USEPA. It includes the following categories:

I1 – Heavy industrial (urban) – major chemical, steel, and fabrication industries;

I2 – Light (urban) – moderate industrial rail yards, truck depots, warehouses, minor fabrication;

C1 – Commercial (urban) – office and apartment buildings, hotels;

R1 – Common residential (rural) – single family dwellings with normal easements;

R2 – Compact residential (urban) – single, some multiple family dwellings with close spacing;

R3 – Compact residential (urban) – old multi-family dwellings with close spacing;

R4 – Estate residential (rural) – expansive family dwelling on multi-acre plots;

A1 – Metropolitan natural (rural) – major municipal, state or federal parks, golf courses, cemeteries, campuses;

A2 – Agricultural (rural) – crops;

A3 – Undeveloped (rural) – uncultivated, grasses/weeds;

A4 – Undeveloped (rural) – heavily wooded; and

A5 – Water surfaces (rural) – rivers, lakes.

If the land use types I1, I2, C1, R2, and R3 account for 50 percent or more of the total area inside a 3-km radius circle centered at the site, then urban coefficients should be used. Otherwise, a rural classification is acceptable.

Figure 1 contains a map that shows the area surrounding the proposed site with the 3-km radius circle marked (inner radius). The area inside the circle was evaluated through an aerial photo review. Based on the aerial review, surrounding area is classified as rural because it is comprised primarily of cropland, uncultivated fields and undeveloped (rural) parcels. According to the available aerial and topographic maps, the only populated area (Makoti, 3.7 km to SE) is outside the 3-km radius of the proposed project. Therefore, rural dispersion coefficients will be applied in the dispersion modeling.

6.3 Significance Analysis

The Significance Analysis will consider the emissions associated only with the proposed TBPS Project in order to assess whether the potential emissions could have a significant (above de-minimis) impact upon the area surrounding the Project. For each pollutant, the highest predicted modeled concentrations over 5 years of meteorological data will be compared to the corresponding modeling significance impact levels (SILs), as presented in **Table 1**. A multi-year average of the maximum modeled concentration of each year modeled will be used for the probabilistic standards for 24-hour $PM_{2.5}$, annual $PM_{2.5}$, 1-hour NO_2, and 1-hour SO_2. For the NO_2 analysis, the current USEPA-approved ambient ratio method (ARM2) for predicting 1-hour NO_2 concentrations will be used. If the Significance Analysis reveals that a specific pollutant exceeds its modeling significance level, then further dispersion modeling analyses are required leading to a NAAQS Analysis. If the Significance Analysis indicates the off-site impacts are below the respective SILs, no further modeling of that pollutant for that specific averaging time will be necessary.

6.4 NAAQS Analysis

If the Significance Analysis shows a pollutant exceeding its respective SIL, a NAAQS analysis may be necessary to evaluate all permitted emission sources, including Project sources. The selected refined dispersion model, AERMOD, will be used in this analysis. The results of this refined modeling analysis will be combined with the appropriate monitored background concentrations and the combined total will be compared to the NAAQS presented in **Table 2**.

A review of the surrounding area indicates that there are some small potential emission sources present (i.e., well pads, grain loading and storage facilities, etc.). Since these nearby emission sources are small, USEPA believes that source data may be difficult to obtain for the model. Therefore, for a preliminary analysis, the USEPA has recommended using an average of four regional background monitors to cover the nearby sources pollutants and averaging periods that may require a cumulative impact analysis. The proposed background monitoring concentrations are presented in Section 5. If model results for these analyses (project plus regional background concentrations) shows offsite impacts close to the NAAQS, TBPS will work with USEPA to refine or reassess this approach to ensure the analysis accounts for nearby sources accurately.

6.5 Ambient Air Boundary

Figure 2a (Plot Plan) presents the Ambient Air Boundary at the TBPS facility. The ambient air boundary is the area around the facility where the general public (non-TBPS personnel and hired contractors) is excluded. TBPS proposes the following methods by which the facility intends to preclude access to the area of property excluded from the air dispersion modeling analysis. The facility property will be protected by an eight-foot metal chain link security fence placed around the entire property to restrict public access to the facility. The chain link fence will be topped with three strands of barbed wire and a concertina coil.

TBPS proposes to construct and maintain fencing on the north, south, east, and west sides of the property. There will be four points of access to the property controlled by sliding gates:

1. The main access road into the plant location in the northern portion of the proposed layout.
2. The truck exit point on the eastern portion of the proposed layout.
3. The rail car entrance on the eastern portion of the proposed layout.
4. The rail car exit on the eastern portion of the proposed layout.

These access points will be monitored by site personnel in the administration building. No other gates will be present along the fence line. The facility operations allow for monitoring in the front gate area and the exit gate area. “Private Property/No Trespassing” signs will be posted on multiple locations along the fence. The main entrance and the truck exit gates will be opened by remote controls. The facility will restrict access using the gates that will require keycard or access code for entrance. Any visitors are required to register at reception.

The rail car entrance and exit will be monitored by operating personnel during regular business hours and will be open and closed by remote controls. Only operating personnel will have access to the rail car gate controls. Figure 2a depicts the fence with above mentioned access facility points with remotely controlled gates.

An external security company will perform a facility check in the event of an alarm or as the need arises. The facility will also operate and maintain video surveillance equipment.

6.6 Receptor Network

A Cartesian receptor network will be designed to identify the location of maximum off-site concentrations for each pollutant. The tiered receptor grid includes fine, medium and course spaced receptors as follows:

- 25-m spaced receptors along the Project ambient air boundary (proposed fence line),
- 50-m spaced receptors extending out 300 m from the boundary,
- 100-m spaced receptors extending one km from the fence line,
- 250-m spaced receptor extending 2.5 km from the fence line, and
- 500-m spaced receptors extending out to 10 km from the site.

The proposed receptor grid may be modified once preliminary modeling is conducted. If a modeled concentration is located within the medium or coarse grids, a receptor grid with 100-m spacing extending out 500 m in all directions will be added and placed around the location of the maximum point. This grid will ensure the maximum concentration location is captured by the fine grid resolution (100-m spacing). The proposed receptor grids are presented in **Figures 5** and **6**.

6.7 Terrain Elevations

For all receptor locations, actual elevations will be used. Digitalized terrain data (National Elevation Dataset (NED) developed by the USGS) will be obtained for the area covered by the receptor grid. 1/3 arc-sec NED data will be used if available for the area. The NED data will be used for determining receptor heights. The proposed source locations and structures for the Topping Plant operations will be based on the proposed site grade (approximately 2100 ft, 640 m). The site is located in an area ranging from 2,070 ft (631 m) to 2,112 ft (644 m). The most recent version of AERMAP (18081; USEPA 2004) will be used to process the receptor elevation data. The base elevations for the existing and proposed sources and structures will be based on the design elevation for the site. AERMAP files and NED data will be provided to USEPA with the modeling analysis.

6.8 Building Downwash

The presence of structures results in zones of air turbulence referred to as wake effects that influence dispersive forces. The building wake is estimated to extend a distance of five times L downwind from the trailing edge of the structure, where L is the lesser of the building height or maximum projected building width. This wake effect influence can result in high-ground level air concentrations if the emission source plume is influenced by building wake effects. The direction-specific area of influence changes as the wind rotates full circle. A stack that is located within the 5L radius of influence is potentially affected by wake effects.

The Building Profile Input Program (BPIP) was designed by the USEPA to incorporate the concepts and procedures of building downwash into a program that calculates effective building heights (BH) and projected building widths for use by AERMOD. The BPIP incorporates the Huber-Snyder algorithm (stack height between 1.5 BH and 2.5 BH) or the Schulman-Scire algorithm (stack height less than 1.5 BH) when appropriate.

Since each of the stacks is found to be below what is considered to be Good Engineering Practice (GEP) stack height defined in 40 CFR 51, the BPIP Program (USEPA 1995) will be used to compute the model input parameters necessary for AERMOD to account for building wake effects. BPIP execution relies on the dimensions of buildings near the stacks. The “PRIME” version of BPIP (BPIPPRM) (Schulman et al. 1997) is used with AERMOD. BPIPPRM is designed to use a digitized representation of the facility’s buildings and stacks as well as other nearby structures. The position and height of buildings relative to the stack locations must be evaluated in the building downwash analysis. Coordinates for each building/structure will be identified using geo-referenced CADD and GIS shapefiles of the proposed site.

Downwash effects will be taken into account by AERMOD for wind directions that place these structures upwind or downwind of the stacks. Structures that are solid and large enough to affect air flow should be included in the modeling setup. Structures that may influence downwash may include existing and proposed tanks, process units, and other solid structures. Based on this understanding and the elevated release heights of the proposed sources, the pipe racks and equipment process units associated with the refining area may allow wind to flow though the lattice structure and therefore will not be included in the BPIP analysis. In addition, based on previous pre-protocol discussions with USEPA Region 8, the inclusion of the proposed skinny tall process columns and towers will not need to be required in the downwash analysis. The main structures included in the BPIP analysis are the existing and proposed tanks and the enclosure associated with the emergency equipment. See **Tables 11** and **12** for building downwash structure dimensions.

Table 11 Building Downwash Structures - Circular

Model Building ID	Description	UTM X Coordinate (m)	UTM Y Coordinate (m)	Tier 1 Height (m)	Tank Diameter (m)
T_A-801	Fixed Roof Tank - ATB	286550.8	5317316.4	9.75	27.44
T_A-802	Fixed Roof Tank - ATB	286549.6	5317282.7	9.75	27.44
T_A-803	Fixed Roof Tank - ATB	286597.5	5317314.9	9.75	27.44
T_A-804	Fixed Roof Tank - ATB	286597.3	5317281.2	9.75	27.44
T_D-701	Fixed Roof Tank - ULSD No. 2	286563.8	5317470.5	9.75	33.52
T_D-702	Fixed Roof Tank - ULSD No. 2	286562.2	5317423.3	9.75	33.52
T_D-703	Fixed Roof Tank - ULSD No. 2	286678.6	5317466.1	9.75	33.52
T_D-706	Fixed Roof Tank - ULSD No. 2	286677.6	5317312.2	9.75	27.44
T_D-707	Fixed Roof Tank - Jet JP8 Fuel	286676.9	5317417.9	9.75	33.52
T_D-708	Fixed Roof Tank - Jet Fuel (Test)	286676.4	5317278.1	9.75	27.44
T_J-501	Fixed Roof Tank - Jet Fuel (Test)	286777.6	5317388.5	9.75	30.48

Table 11 Building Downwash Structures - Circular

Model Building ID	Description	UTM X Coordinate (m)	UTM Y Coordinate (m)	Tier 1 Height (m)	Tank Diameter (m)
T_J-502	Fixed Roof Tank - Jet Fuel (Test)	286819.6	5317387.0	9.75	30.48
T_J-503	Fixed Roof Tank - ATB	286820.8	5317420.0	9.75	12.2
T_J-504	Fixed Roof Tank - ATB	286856.7	5317418.7	9.75	12.2
T_L-301	Internal Floating Roof Tank - Light Naphtha	286762.6	5317333.6	9.75	30.48
T_L-302	Internal Floating Roof Tank - Light Naphtha	286804.0	5317332.1	9.75	27.44
T_H-401	Internal Floating Roof Tank - Heavy Naphtha	286744.1	5317279.1	9.75	27.44
T_H-402	Internal Floating Roof Tank - Heavy Naphtha	286779.8	5317278.1	9.75	27.44
T_H-403	Internal Floating Roof Tank - Heavy Naphtha	286815.5	5317276.8	9.75	27.44
T_H-404	Internal Floating Roof Tank - Heavy Naphtha	286851.7	5317275.5	17.07	33.52
T_S-805	Internal Floating Roof Tank - Slop	286855.6	5317385.8	17.07	33.52
T_C101	Crude Storage Tank	286735.1	5317574.2	17.07	40.92
T_C102	Crude Storage Tank	286794.8	5317571.7	17.07	40.92
T_C103	Crude Storage Tank	286852.9	5317569.9	17.07	40.92
T_C104	Crude Storage Tank	286911.6	5317567.6	17.07	40.92
T_C105	Crude Storage Tank	286797.3	5317635.3	17.07	40.92
T_C106	Crude Storage Tank	286737.6	5317637	17.07	40.92
T_C107	Crude Storage Tank	286678.7	5317638.8	17.07	40.92
T_C108	Crude Storage Tank	286619.3	5317641.1	17.07	40.92
T_H01A	SMR Reactor	286486.4	5317483.9	15.24	6.52
T_H01B	SMR Reactor	286486.1	5317474.3	15.24	6.52
T_F950	Firewater Tank	286128.0	5317431.0	9.75	13.72
T_F957	Firewater Tank	286128.9	5317453.9	9.75	13.72
T_SW960	Storm Water Tank	286147.2	5317411.7	9.75	13.72
T_SW962	Storm Water Tank	286127.6	5317412.4	9.75	13.72
T_SW964	Storm Water Tank	286107.7	5317412.8	9.75	13.72
T_SW966	Process Water Tank	286108.8	5317443.4	9.75	13.72
T_WT970	Ship Water Tank	286149.2	5317471.6	9.75	13.72
T_FW968	Fresh Water Tank	286109.9	5317473.3	9.75	13.72

Table 12 Building Downwash Structures - Rectangular

Model Building ID	Description	UTM X Coordinate	UTM Y Coordinate	Tier 1 Height (m)	X Length (m)	Y Length (m)
TOPWARE	Topping Plant Warehouse	286093.5	5317709.5	9.14	73.8	50.31
TOPSUP	Topping Plant Support Facility -Existing	286282.2	5317663.0	9.14	26.6	47.3
TOPMAIN	Topping Plant Maintenance Building	286589.7	5317566.7	9.14	30.61	62.29
CONTROL	Control Building by Loading	286474.3	5317598.8	2.44	7.31	22.39
B_FWP	Building for Firewater Pumps	286140.7	5317450.8	3.05	23.8	14.4
B_GAR	Garage Building	286275.6	5317658.8	3.66	8.9	6.59

Final structure dimensions will be provided in a table in the final air quality report. BPIPPRM input and output files will be provided with the modeling files as part of the report.

6.9 Class I Area Review

40 Code of Federal Regulations § 52.21(p) requires the permitting authority to provide written notice of any permit application for a proposed major stationary source which may affect a Class I area to the Federal land manager and the Federal official charged with direct responsibility for management of any lands within any such area. In the past the USEPA, through applicable guidance, has interpreted the meaning of the term “may affect” to include all major source or major modifications which propose to locate within 100 km of a Class I area or any source within 10 km of a Class I area. During our initial project discussions, USEPA thinks that these nearby Class I areas will not need to be assessed for potential impacts, but the agency may still need discussions with the appropriate area management groups. TBPS provides the following information as supporting information for those potential discussions.

The TBPS project is estimated to have potential emission rates below the major thresholds so a formal Class I analysis is not required. To support this determination, the FLAG (NPS 2010) screening method (Q/D<=10) is provided to evaluate and show that the proposed facility will not have any adverse impacts on the regional Class I areas.

The closest Class I area is Lostwood National Wildlife Refuge (NWR) North Dakota, which is approximately 46 miles (74 km) north northwest of the site. Other Class I areas within 300 km include: Theodore Roosevelt National Park (112 km), Medicine Lake NWR (183 km), and Fork Peck Indian Reservation (205 km). These Class I areas are present in **Figure 8**. The screening evaluation is provided in **Table 13**.

Table 13 Class I Screening Analysis

Class I Area	Distance, D (km)	Annual NO_X Emissions (tpy)	Annual SO_2 Emissions (tpy)	Annual PM Emissions (tpy)	Total Emissions (Q) (tpy)	Q/D (ratio)	Potential for Adverse Impacts? (<=10)
Lostwood NWR	74	42.7	0.9	11.4	55.0	0.74	No
Theodore Roosevelt NP	112					0.49	No
Medicine Lake NWR	183					0.30	No
Fork Peck Reservation	205					0.27	No

Acronyms:
Q = total annual emissions in tpy
Q/D = annual emissions / distance

Based on estimated potential emissions and distance from the Class I areas, a Class I Impact Analysis is not required.

7. Analysis of Ozone and Secondary PM2.5 Pollutants

Secondary $PM_{2.5}$ is formed within the atmosphere from precursor gases such as SO_2, NO_X and organics through gas-phase photochemical reactions or through liquid phase reactions in clouds and fog droplets. Secondary $PM_{2.5}$ and ozone formation may need to be analyzed for a SIL PSD increment and/or NAAQS analysis.

USEPA has developed guidance that provides recommendations to conduct air quality modeling analyses to satisfy compliance demonstration requirements for ozone and secondary $PM_{2.5}$ under the PSD Permitting Program. The recommendations support the methodology to estimate single source impacts on secondary pollutants under the Tier 1 approach presented in the GAQM (Appendix W to 40 CFR 51, 2017). As presented earlier, the project is below the PSD threshold of 100 tpy but the PTE for VOC, NO_X, and $PM_{2.5}$ is greater than the SERs. TBPS proposes to use the Tier 1 approach for assessing the project's impacts to ozone and secondary $PM_{2.5}$. The method is outlined in USEPA's guidance on Modeled Emission Rates for Precursors (MERPs), including EPA's interactive MERPs View Qlik webpage (https://www.epa.gov/scram/merps-view-qlik). The USEPA's guidance includes Revised DRAFT Guidance for Ozone and Fine Particulate Matter Permit Modeling (USEPA 2021) and Guidance on the Development of Modeled Emission Rates for Precursors (MERP) as a Tier 1 Demonstration Tool for Ozone and Fine Particulates in the PSD Permitting Program (USEPA 2019).

Even though this Project is not PSD, TBPS has outlined the methodology to account for the potential secondary formation of $PM_{2.5}$ and ozone from precursors in the following sections.

7.1 Ozone Impact Assessment

The impact on ozone formation is dependent on the contribution of ozone precursor emissions from single sources; the presence of precursor emissions in the airshed; and the transport of emissions and ozone from other areas. Ground-level ozone formation is the result of a complex cycle of chemical reactions, which require large increases in precursor emissions to influence short-term ozone concentrations. The USEPA Region 8 provided a background ozone value based on average concentration from the following regional ozone monitors: Lostwood (ID: 38-013-0004), Lake LLO (ID: 38-025-0004), TRNP (ID: 38-053-0002), and Ryder (ID: 38-101-0003) which is representative of the Fort Berthold Reservation area. As previously shown in **Table 13**, the current ozone design value is 56.8 ppb (2020-2022). The current 8-hour ozone NAAQS is 0.07 ppm (70 ppb) and 8-hour SIL is 1 ppb.

Since the Project will have proposed NO_X and VOC emissions greater than the 40 tpy SER along with the direction from USEPA Region 8, a Tier 1 demonstration using the MERPs guidance and interactive MERPs View Qlik webpage to evaluate the project's impacts on the area's current ozone concentrations is necessary. The proposed Topping Plant is located in the climatic zone identified as Northern Rockies and Plains. A demonstration using the lowest Regional and/or State-County (most conservative) MERP values for ozone precursors from all sources USEPA modeled for the Rockies/Plains and North Dakota region will be provided with the final Modeling Report. Initial evaluation of the regional MERPs data shows that the most conservative hypothetical source for both NO_X and VOCs in Morton County, North Dakota. Based on the initial analysis, calculated regional ozone levels were less than the ozone 8-hour SIL of 1 ppb (0.28 ppb) and therefore, the Project's proposed VOC and NOx emissions are not expected to significantly affect the nearby air quality.

7.2 Secondary $PM_{2.5}$ Formation

Secondary $PM_{2.5}$ can potentially occur as a result of atmospheric transformation of NO_X and SO_2 precursor emissions. Secondary formation of $PM_{2.5}$ occurs due to chemical reactions in the atmosphere generally downwind from the original emission source. The reactions occur gradually over a period of hours or days depending on atmospheric conditions and other variables. Following USEPA guidance, TBPS proposes to conduct a quantitative analysis to address precursors and their potential for increasing ambient levels of $PM_{2.5}$. As with the photochemical modeling guidance for ozone, USEPA has issued draft guidance on methodologies to determine whether modeling is necessary to assess the potential formation of secondary $PM_{2.5}$. USEPA issued guidance for using MERPs for precursor emissions for single source evaluations (Tier 1 Approach) to demonstrate that a Tier 2 Approach using Chemical Transport Modeling would not be required. The proposed Project expects to have direct $PM_{2.5}$ emissions greater than the 10 tpy SER as well as having NOx emissions greater than the 40 tpy SER, therefore a Tier 1 approach using the MERPs will be used to calculate the secondary $PM_{2.5}$ formation.

As with ozone, USEPA Region 8 provided background 24-hour and annual $PM_{2.5}$ values based on average concentration for from the following regional ozone monitors: Lostwood (ID: 38-013-0004), Lake LLO (ID: 38-025-0004), TRNP (ID: 38-053-0002), and Ryder (ID: 38-101-0003) Lostwood (ID 38-013-0004) which is representative of the Project area. TBPS will use the direct modeled $PM_{2.5}$ offsite concentration and the value of secondary formation of $PM_{2.5}$ to compare to the SILs and the direct modeled concentration, secondary formation of $PM_{2.5}$ and background data in comparing the cumulative results with the NAAQS.

Following the same methodology as ozone, a demonstration using the lowest (most conservative) MERP values for 24-hour and annual $PM_{2.5}$ precursors from all sources USEPA modeled for the Rockies/Plains region and the State of North Dakota will be provided with the final Modeling Report. Mercer County (ND) was determined to be the most conservative NO_X and SO_2 hypothetical MERP source during the initial review.

TBPS will provide the calculation sheets presenting the approaches for evaluating secondary formation of ozone and $PM_{2.5}$ from Project precursors with the final modeling report.

8. Modeling Report

The air quality modeling report and modeling submittal will include the following items:

- A narrative summary of the proposed project construction;
- Location of the project;
- Modeling applicability discussion;
- All appropriate State and Federal standards and averaging periods for each pollutant;
- All regulated criteria emitted by the proposed source and associated emission rates;
- Source parameter tables (including volume source parameters and their derivation);
- Models used (and versions) and the justification for using each model;
- Meteorological data discussion;
- Terrain data and discussion;
- Fence line coordinates and ambient air boundary;
- Building downwash;
- Ambient air boundary;
- Description of the receptor network;
- Background concentrations;
- Land use classification;
- Plot plan with scale;
- Significant impact and radius of impact (if applicable);
- Use of any special methods for modeling criteria pollutant emissions;
- Class I Area analysis applicability;
- NO2/NOX Ratio for NOX chemistry discussion (if necessary),
- Ozone and Secondary PM2.5 formation; and
- Modeling results (criteria pollutants) and compliance with applicable standards.

8.1 Electronic Copies of the Modeling Files

The modeling input/output files (including BPIP and meteorological data, and intermediate files generated by AERMET, AERMAP, and AERMOD) will be provided in electronic format to USPA Region 8 with the modeling report.

9. Protocol Development Guidance Documents

The following references, correspondence, and documents were used in developing the protocol:

Auer, August H. Jr. 1978. *Correlation of Land Use and Cover with Meteorological Anomalies*. Journal of Applied Meteorology, pp 636-643. May 1. 8 pp.

Jensen, R.E. 1998. Climate of North Dakota. Located at http://www.npwrc.usgs.gov/resource/othrdata/climate/climate.htm . Archived link, Accessed: April 6, 2004.

National Park Service (NPS). 2010. Federal Land Managers' Air Quality Related Values Work Group (FLAG), Phase I Report

Schulman, Lloyd L., David G. Strimaitis, and Joseph S. Scire. 1997. "The PRIME Plume Rise and Building Downwash Model," Addendum to ISC3 User's Guide. November. 13 pp.

U.S. Environmental Protection Agency (USEPA). 1995. User's Guide to The Building Profile Input Program. EPA-454/R-93-038. Revised February 8. 86 pp.

USEPA. 2004. User's Guide for The AERMOD Terrain Preprocessor (AERMAP). EPA-454/B-03-003. October. 106 pp.

USEPA. 2008. AERSURFACE User's Guide. EPA-454/B-08-001. OAQPS, Research Triangle Park, NC. January. 36 pp.

USEPA. 2011. Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard. Office of Air Quality Planning and Standards (OAQPS). Memorandum from Tyler Fox to Regional Air Division Directors dated March 1. 27 pp.

USEPA. 2012. Memorandum: Haul Road Workshop Final Report Submission to EPA-OAQPS. From Tyler Fox. March 2. 22 pp.

USEPA. 2016a. AERSCREEN User's Guide. EPA-454/B-16-004. OAQPS, Research Triangle. December. 115 pp.

USEPA. 2016b. User's Guide for the AMS/EPA Regulatory Model – AERMOD. EPA-454/B-16-011. December. 333 pp.

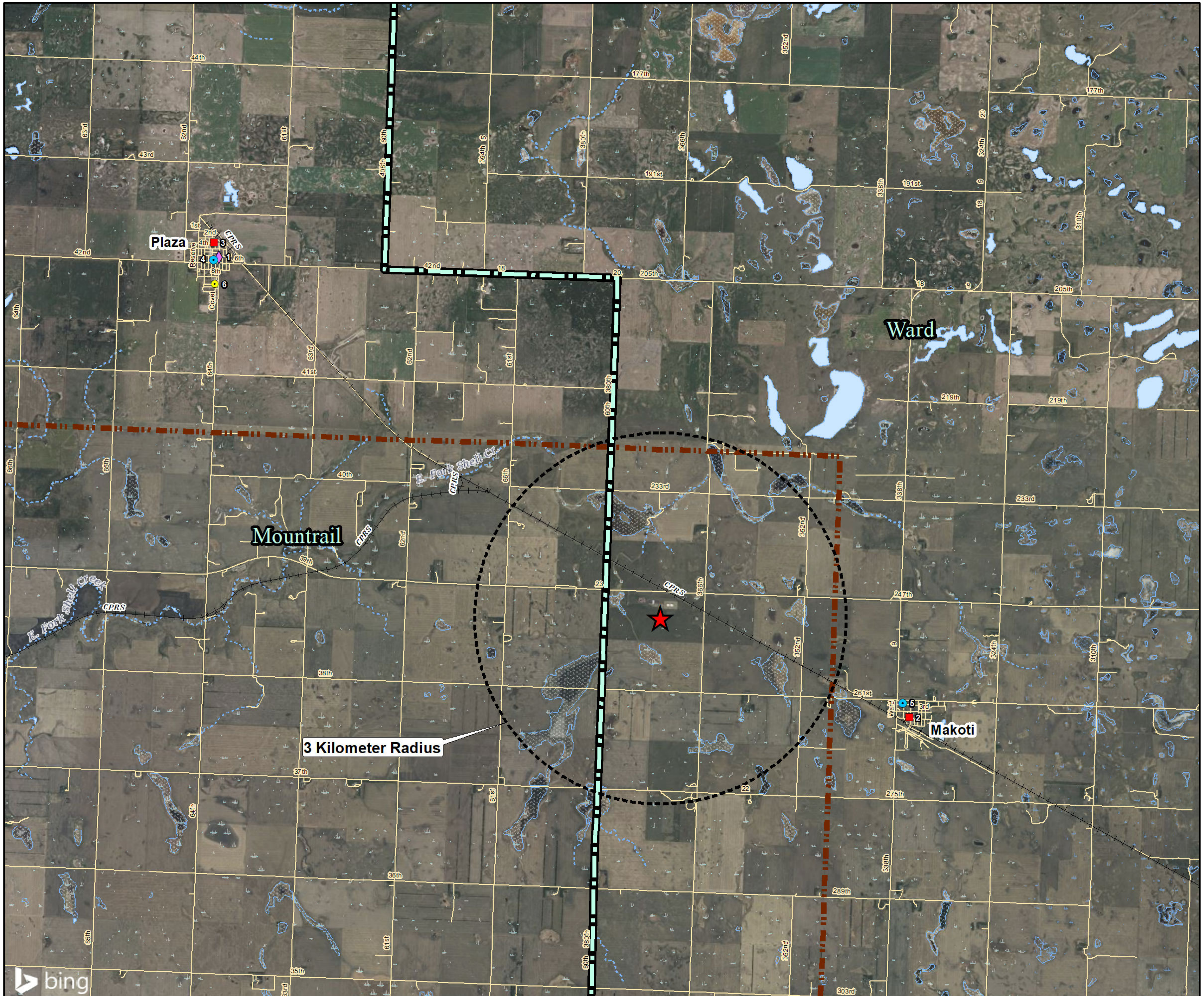
USEPA. 2017. Appendix W: Guideline on Air Quality Models. Federal Register Vol. 82, No. 10. January 17. 54 pp.

USEPA. 2018. Memorandum: Guidance on Significant Impact Levels for Ozone and Fine Particle in the Prevention of Significant Deterioration Permitting Program. From: Peter Tsirigotis. April 17. 21 pp

USEPA. 2019. Memorandum: Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program. April 30. 72 pp. (Update to 2016 Guidance)

USEPA. 2021. Memorandum: Revised DRAFT Guidance for Ozone and Fine Particulate matter Permit Modeling. EPA-454/P-21-001. September 2021.

Figures



0 1 2 Miles

Legend

- Daycare
- Post Office
- Place of Worship
- School
- Thunder Butte Facility Lat/Long: 47.974011, -101.859522
- County Boundary
- Fort Berthold Reservation

Feature ID	Description	Distance (Feet)
1	Daycare	30,220
2	Post Office	14,190
3	Post Office	30,910
4	Place of Worship	30,340
5	Place of Worship	13,610
6	School	29,490

THUNDER BUTTE PETROLEUM SERVICES, INC.
PLAZA, WARD COUNTY, NORTH DAKOTA

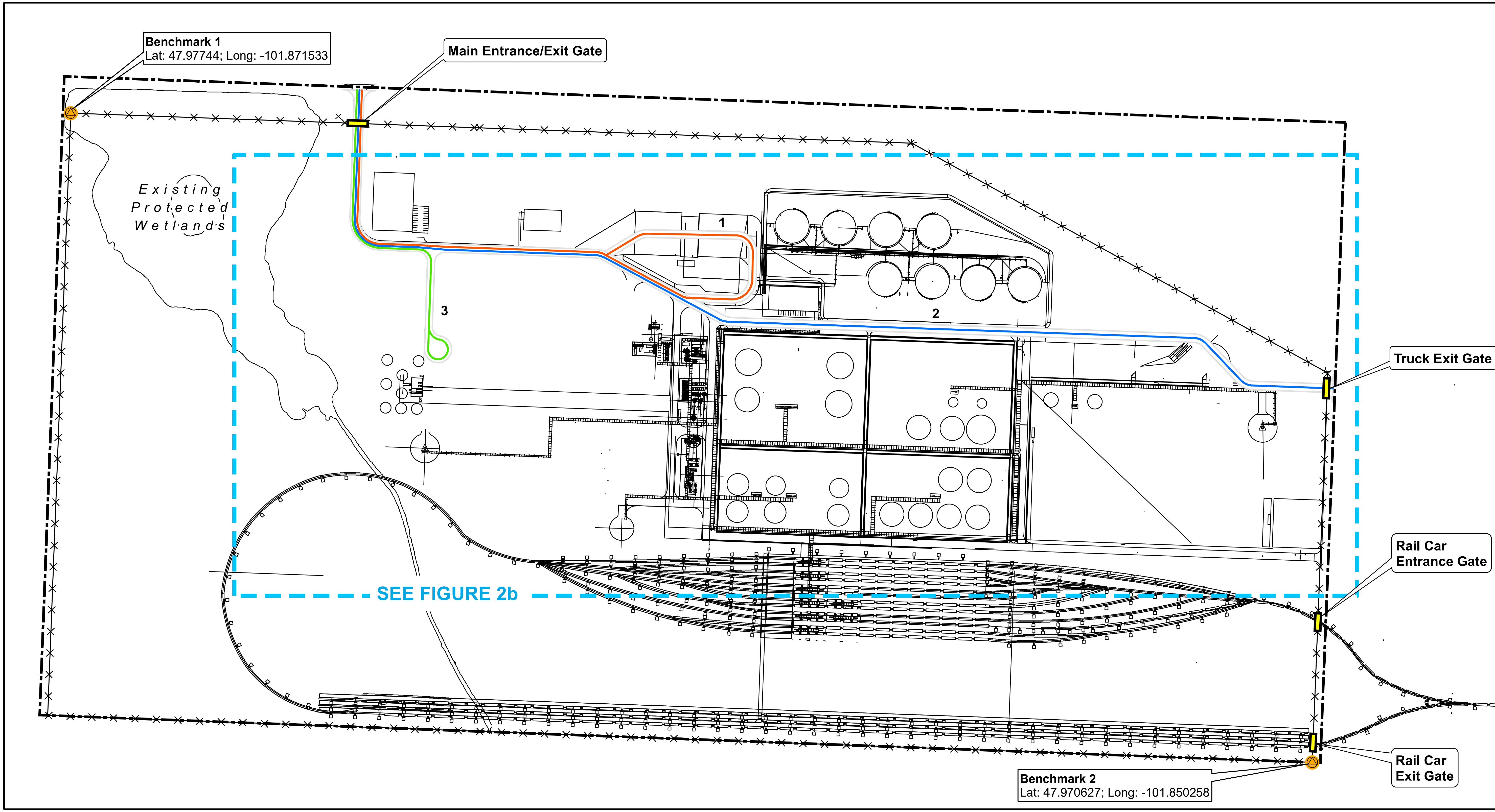
Location Map

December 2023

ARCADIS Design & Consultancy for natural and built assets

FIGURE 1

City: Houston Div/Group: Remediation West -Air Group Created By: W Berry Last Saved By: wberry ; Client (Project #)
D:_Arcadis\Air Services\Thunder_Butte\Fig1 -TB Location_Map Jan2023.mxd 2/1/2023 5:57:09 PM



LEGEND

- Benchmark
- Truck Traffic Route 1
- Truck Traffic Route 2
- Truck Traffic Route 3
- Lot Line
- Fenceline (Ambient Air Boundary)
  Eight-foot High Metal Chain Link Security Fence Topped with Three Strands of Barbed Wire and a Concertina Coil.
- Sliding Gate Entrance/Exit (Truck & Railcar) – Controlled Remotely

Benchmark	NAD 83 UTM Zone 14N	
	East (m)	North (m)
1	285,712.4	5,317,783.5
2	287,271.9	5,316,967.5

0 100 200 Meters

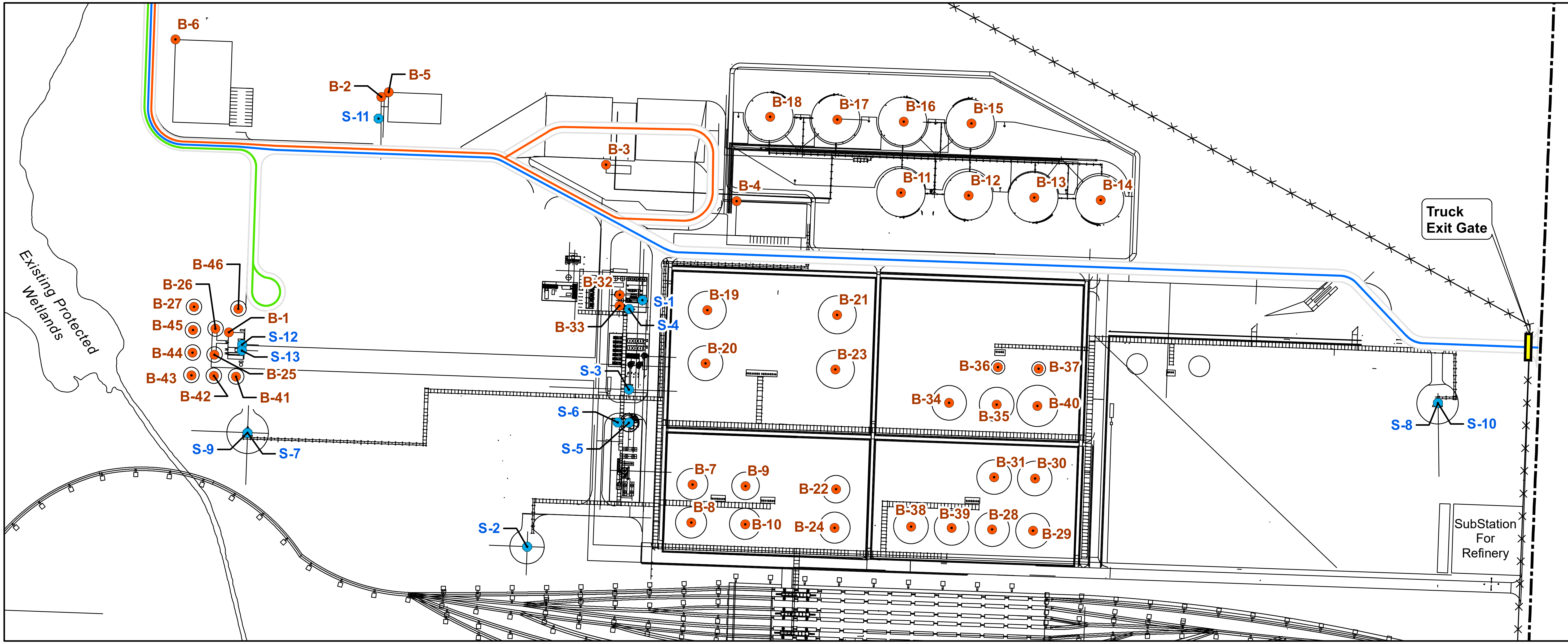
THUNDER BUTTE PETROLEUM SERVICES, INC.
PLAZA, WARD COUNTY, NORTH DAKOTA

PLOT PLAN

December 2023

ARCADIS Design & Consultancy for natural and built assets

FIGURE **2a**



Map ID	ID Building	Map ID	ID Building	Map ID	ID Building
B-1	B_FWP	B-17	T_C107	B-33	T_H01B
B-2	B_GAR	B-18	T_C108	B-34	T_J-501
B-3	CONTROL	B-19	T_D-701	B-35	T_J-502
B-4	REFMAIN	B-20	T_D-702	B-36	T_J-503
B-5	REFSUP	B-21	T_D-703	B-37	T_J-504
B-6	REFWARE	B-22	T_D-706	B-38	T_L-301
B-7	T_A-801	B-23	T_D-707	B-39	T_L-302
B-8	T_A-802	B-24	T_D-708	B-40	T_S-805
B-9	T_A-803	B-25	T_F950	B-41	T_SW960
B-10	T_A-804	B-26	T_F957	B-42	T_SW962
B-11	T_C101	B-27	T_FW968	B-43	T_SW964
B-12	T_C102	B-28	T_H-401	B-44	T_SW966
B-13	T_C103	B-29	T_H-402	B-45	T_SW968
B-14	T_C104	B-30	T_H-403	B-46	T_WT970
B-15	T_C105	B-31	T_H-404		
B-16	T_C106	B-32	T_H01A		

Map ID	ID Sources
S-1	47_H01AB
S-2	C_7210
S-3	F_3490
S-4	F_5490
S-5	F_590
S-6	F_810
S-7	F_8950
S-8	F_8960
S-9	F8950MSS
S-10	F8960MSS
S-11	FPE1
S-12	FPE2
S-13	EMGEN1

LEGEND

- Buildings
- Sources
- Truck Traffic Route 1
- Truck Traffic Route 2
- Truck Traffic Route 3
- Lot Line
- Fenceline (Ambient Air Boundary)
  Eight-foot High Metal Chain Link Security Fence Topped with Three Strands of Barbed Wire and a Concertina Coil.
- Sliding Gate Entrance/Exit (Truck & Railcar) – Controlled Remotely

0 75 150 Meters

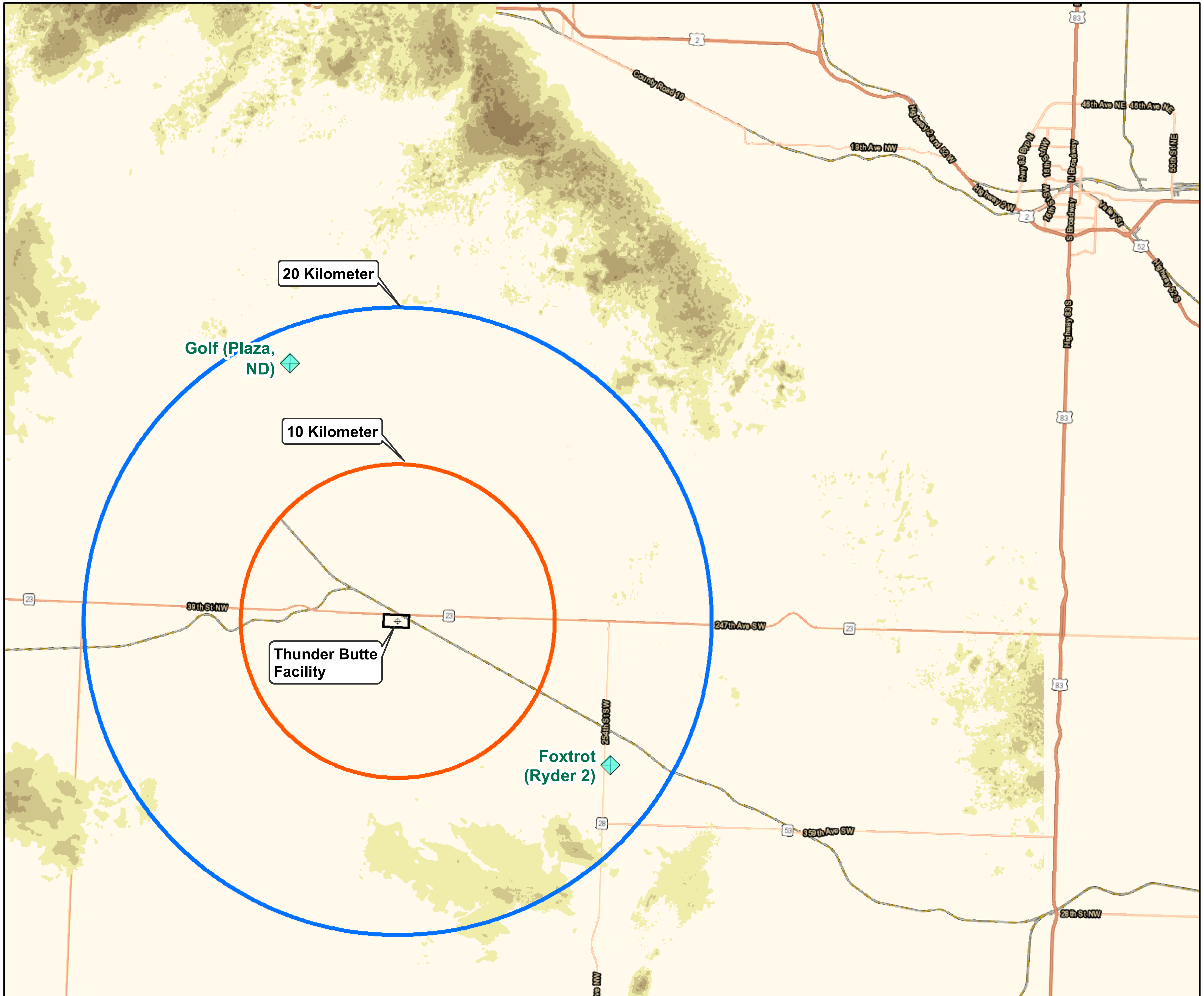
THUNDER BUTTE PETROLEUM SERVICES, INC.
PLAZA, WARD COUNTY, NORTH DAKOTA

PLOT PLAN (Close-in)

December 2023

ARCADIS Design & Consultancy for natural and built assets

FIGURE 2b



USGS NED 1/3 arc-second

Elevation in meters

- < 660 m
- 660 - 670
- 670 - 680
- 680 - 690
- 690 - 700
- 700 - 710
- Met Station

NOTES:

1. Proposed grade elevation for main emission sources 640.5 (m).
   Stack heights (m) range from 20.7 - 28.4 m (68 - 95 ft.)
2. Elevation data a composite of (4) tiles at 1/3 arc-second, resolution from the U.S.G.S. Date range: 2013 - 2017. Data is in geographic coordinates in units of decimal degrees, and in conformance with NAD 83. All elevations are in meters and NAVD 88.

THUNDER BUTTE PETROLEUM SERVICES, INC.
PLAZA, WARD COUNTY, NORTH DAKOTA

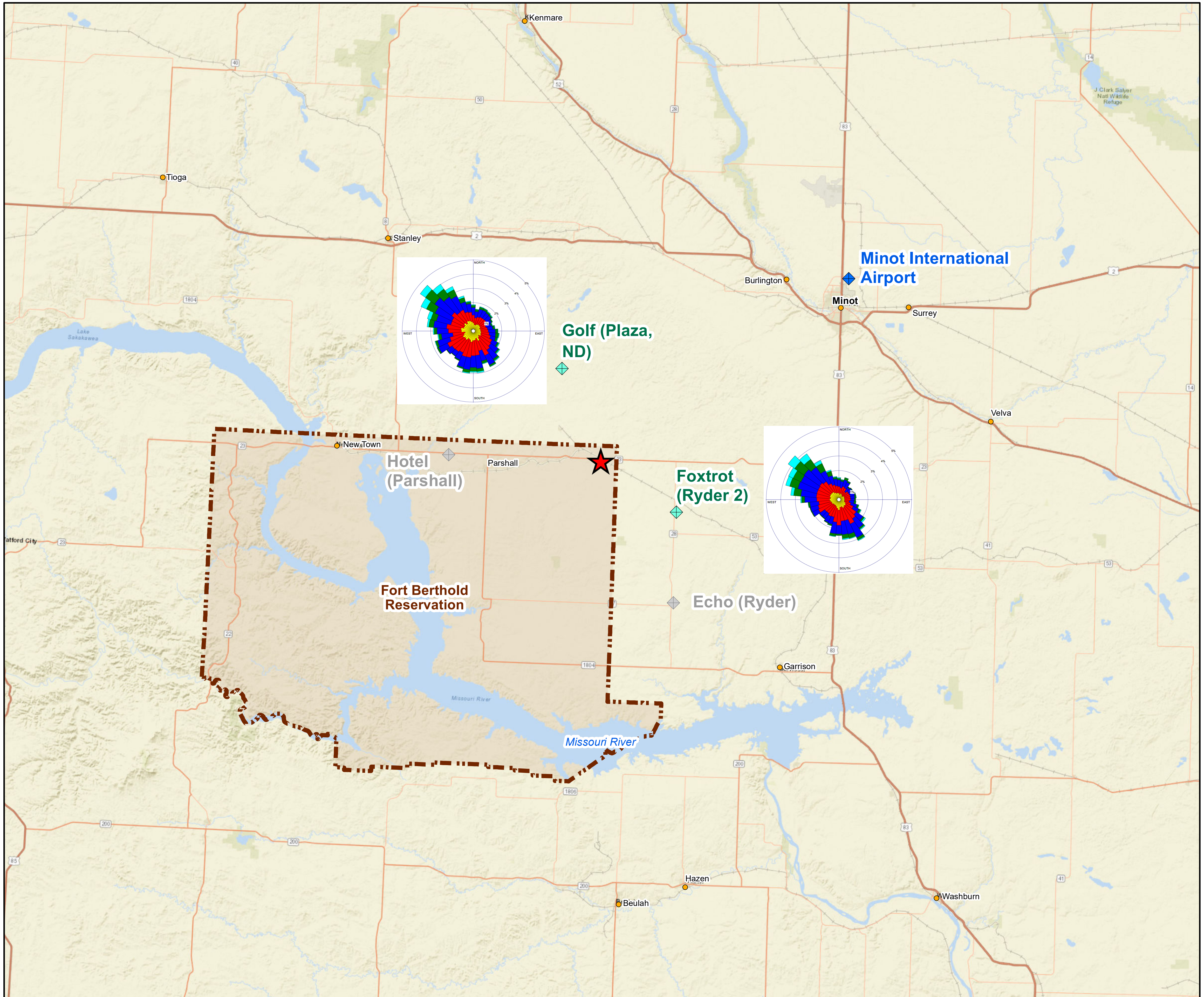
Nearby Terrain Features

December 2023

ARCADIS Design & Consultancy for natural and built assets

FIGURE 3

City: Houston Div/Group: Remediation West -Air Group Created By: W Berry Last Saved By: wberry ; Client (Project #)
D:_Arcadis\Air Services\Thunder_Butte\Fig3 - TB Nearby_Terrain Jan2023.mxd 1/27/2023 3:41:39 PM



0 7.5 15 22.5 30 Kilometers

Legend

- Met Station (NWS ASOS)
- Other MET Reporting Stations
- Proposed Topping Plant/ Existing Crude Storage and Loading Facility

WIND SPEED (m/s)

- >= 11.10
- 8.80 - 11.10
- 5.70 - 8.80
- 3.60 - 5.70
- 2.10 - 3.60
- 0.50 - 2.10

Golf Plaza ND Airport Calms" 4.89%

Ryder ND Airport Calms" 3.74%

NOTES:

1. Meteorological Station (Met) Source: National Weather Service and NOAA website
2. Sites identified using National Centers for Environmental Information (Hourly/Sub-Hourly Observational Data) website,Further evaluation of data completeness and quality for each site will be necessary.

THUNDER BUTTE PETROLEUM SERVICES, INC.
PLAZA, WARD COUNTY, NORTH DAKOTA

Location Map (Met Stations)

December 2023

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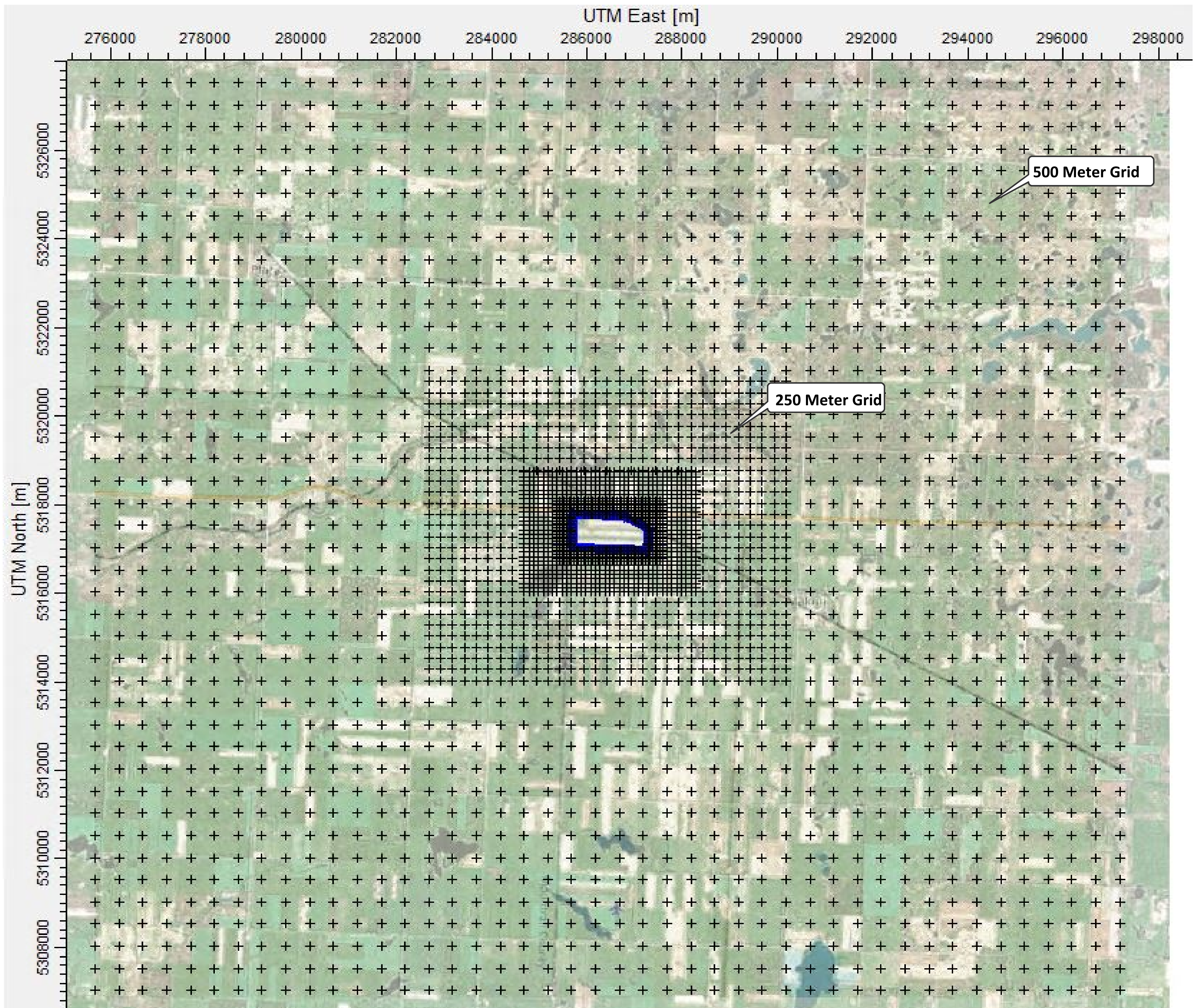
FIGURE 4

City: Houston Div/Group: Remediation West -Air Group Created By: W Berry Last Saved By: wberry : Client (Project #)
D:_Arcadis\Air Services\Thunder_Butte\Fig4 - TB Met Stations Jan2023.mxd 1/30/2023 4:44:56 PM



Legend

+ Proposed Receptor Grid

Fenceline

NOTES:

1. 250-m spaced grid extends out 3 km.
2. 500-m spaced grid extends out 10 km.

THUNDER BUTTE PETROLEUM SERVICES, INC.
PLAZA, WARD COUNTY, NORTH DAKOTA

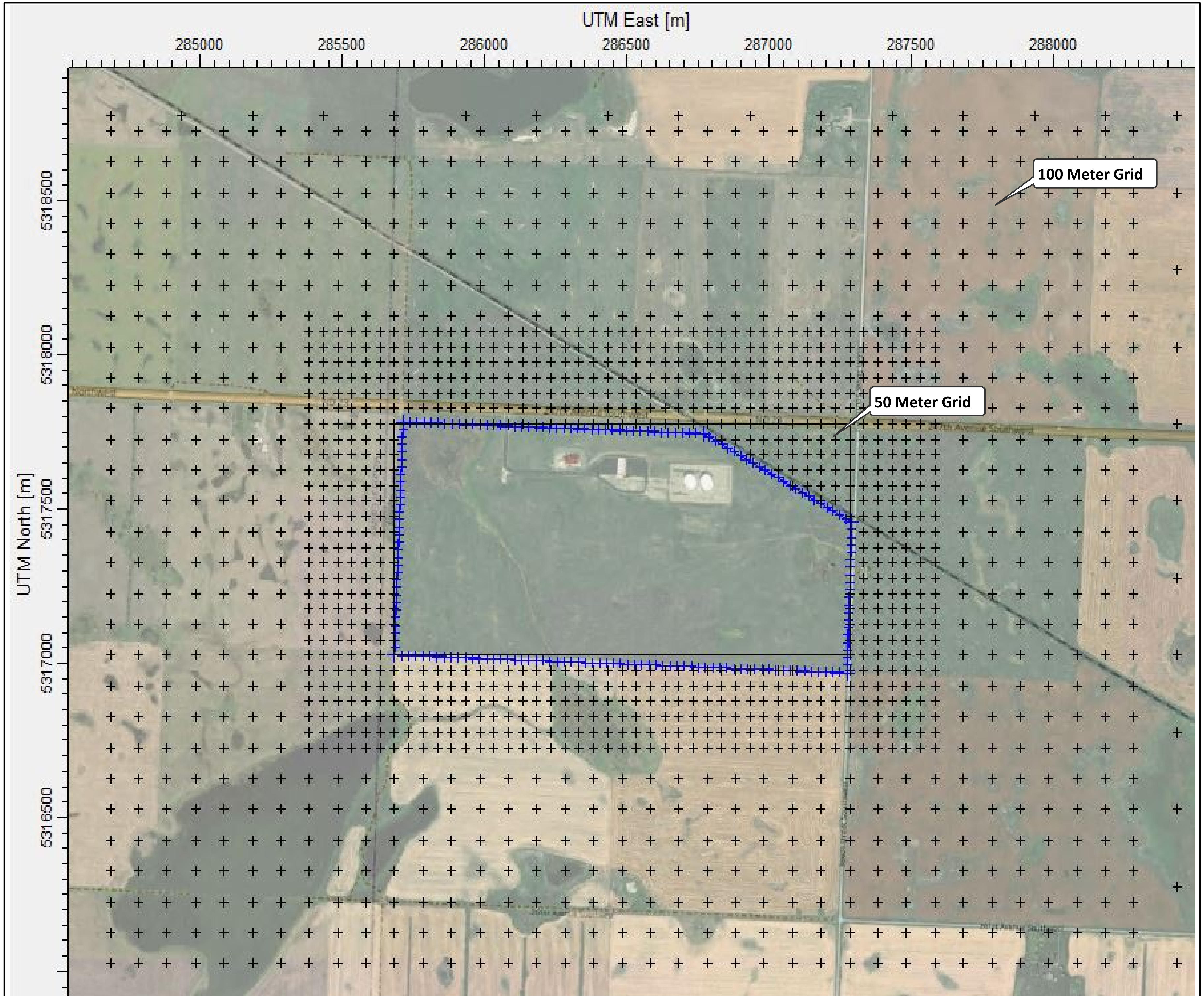
Proposed Receptor Locations

December 2023

ARCADIS Design & Consultancy for natural and built assets

FIGURE

5



Legend

+ Proposed Receptor Grid

Fenceline

NOTES:

1. 50-m spaced grid extends out 300 m.
2. 100-m spaced grid extends out 1 km.

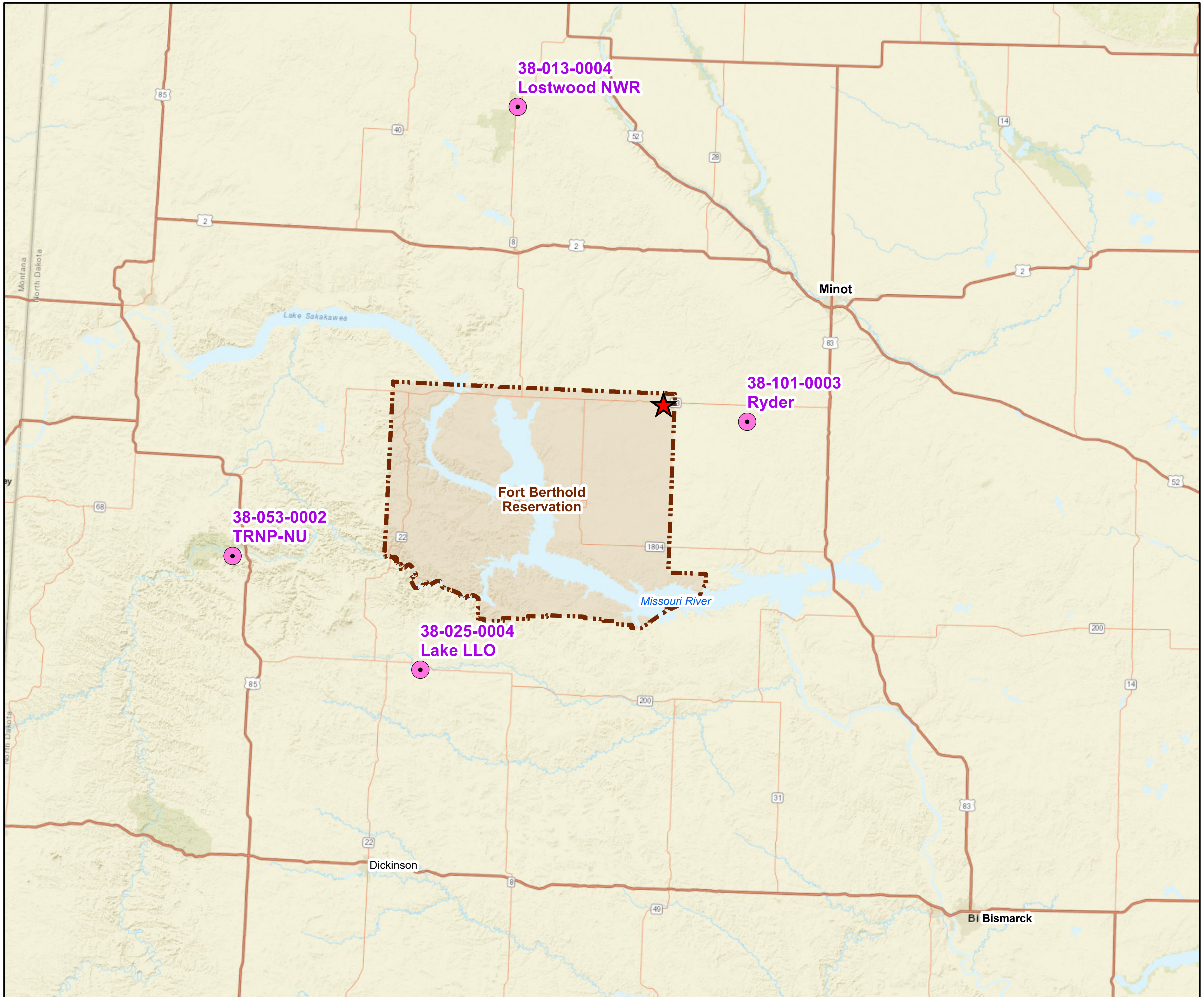
THUNDER BUTTE PETROLEUM SERVICES, INC.
PLAZA, WARD COUNTY, NORTH DAKOTA

Proposed Close-in Receptor Locations

December 2023

ARCADIS Design & Consultancy for natural and built assets

FIGURE 6



0 10 20 30 40 Kilometers

Legend

- Proposed Topping Plant/ Existing Crude Storage and Loading Facility
- EPA Air Quality Monitor(2)
- Fort Berthold Reservation

NOTES:

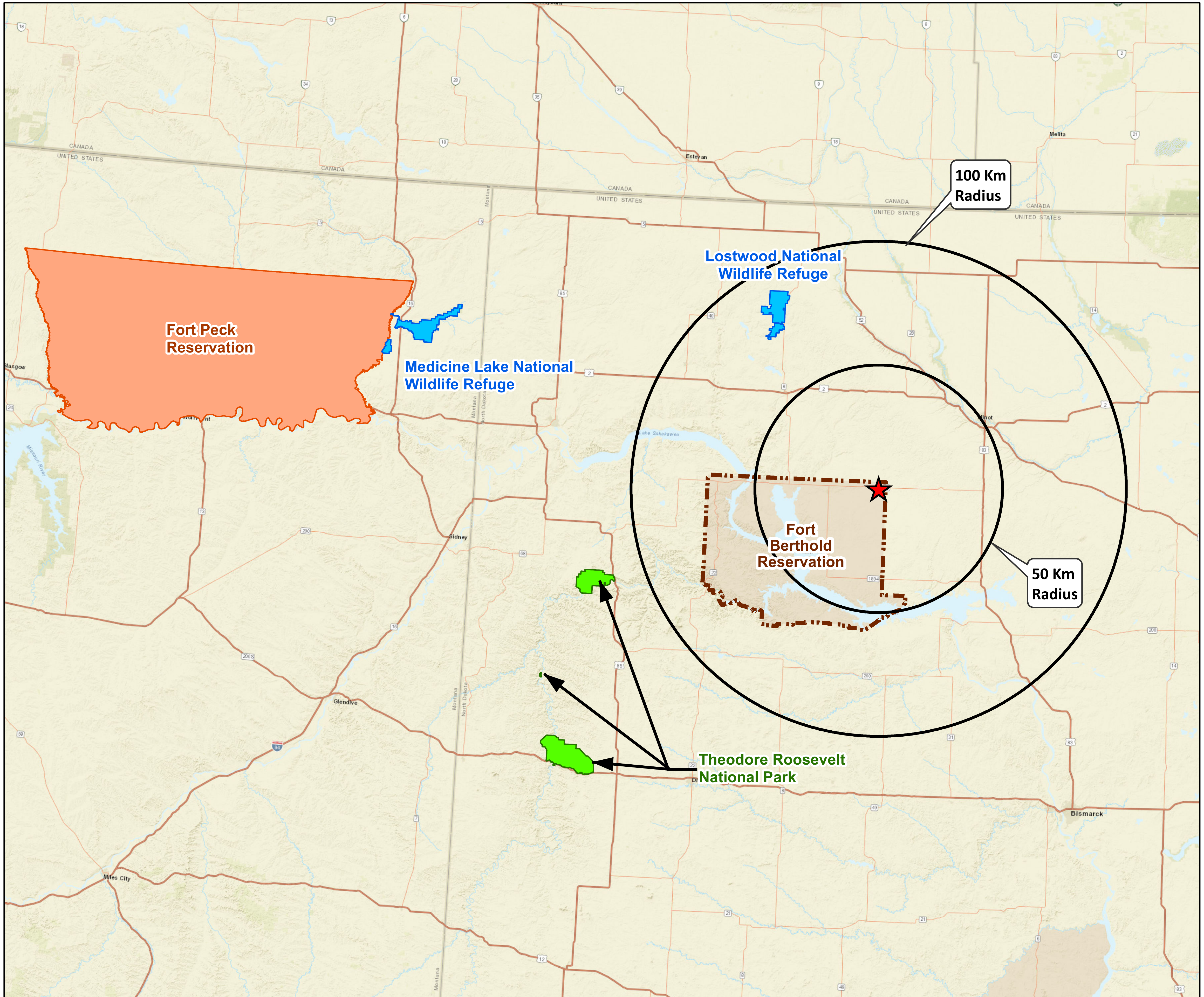
1. Air Monitors Source : EPA Interactive Map of Air Quality Monitors, attribute table data download.
2. Proposed Air Quality Monitors for EPA review

THUNDER BUTTE PETROLEUM SERVICES, INC.
PLAZA, WARD COUNTY, NORTH DAKOTA

Location Map (Air Quality Monitors)
December 2023

ARCADIS Design & Consultancy for natural and built assets

FIGURE 7



0 40 80 Kilometers

Legend

- Proposed Topping Plant/ Existing Crude Storage and Loading Facility
- National Park Service Class I Areas
- Fish and Wildlife Service Class I Units
- American Indian Class I Lands
- Fort Berthold Reservation

NOTES:

1. Locations provided by the Department of the Interior Bureaus Tribal Lands CONUS server https://services.arcgis.com/4OV0eRKiLAYkbH2J/arcgis/rest/services/DOI_Bureaus_Tribal_Lands_CONUS/FeatureServer

THUNDER BUTTE PETROLEUM SERVICES, INC.
PLAZA, WARD COUNTY, NORTH DAKOTA

Protected Lands

December 2023

ARCADIS Design & Consultancy for natural and built assets

FIGURE 8

City: Houston Div/Group: Remediation West -Air Group Created By: W Berry Last Saved By: wberry ; Client (Project #)
D:_Arcadis\Air Services\Thunder_Butte\Fig4 TB-EPA Protected Lands.mxd 11/18/2022 1:08:08 PM

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