1-hour SO_2 Air Quality Dispersion Modeling Analysis for Pawnee Power Plant

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Air Pollution Control Division
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Contents

Introduction

The Data Requirements Rule (DRR) establishes an SO_2 emissions applicability threshold of 2,000 tons per year (tpy) that identifies priority sources subject to a source specific SO_2 designation process, referred to as "Round 3" designations. States have three options under the DRR to characterize current air quality in areas with large SO_2 sources (2,000 tpy or greater): establish federally enforceable emission limits (under 2,000 tpy) by January 13, 2017; conduct air quality modeling by January 13, 2017; or begin operating an appropriate monitoring network by January 1, 2017. Pursuant to a court order, the U.S. Environmental Protection Agency (EPA) will promulgate SO_2 designations no later than December 31, 2017.

This document provides the basis for the selection of air quality modeling for the Public Service Company's (Xcel Energy) Pawnee Power Plant (Pawnee). Per the DRR, the Colorado Department of Public Health and Environment's (CDPHE) Air Pollution Control Division (APCD) was required to submit a list of sources to EPA by January 15, 2016, identifying, "*all sources within its jurisdiction that have SO_2 emissions that exceeded the 2,000 tpy annual threshold during the most recent year for which emissions data for that source are available, plus any additional sources and their associated areas identified by the air agency or by the EPA as also warranting air quality characterization*"[1]. Pawnee exceeded the applicability threshold of 2,000 tpy SO_2 in 2014, the most recent year for which emissions data were available as of January 15, 2016 and was included in the January 15, 2016 submittal to EPA. Therefore, air quality modeling must be conducted by January 13, 2017 for this facility.

Per the Data Requirements Rule (DRR), the APCD must "*submit a modeling protocol for each such source to the EPA by July 1, 2016, for review and consultation with the EPA Regional Office. The modeling analysis must then be submitted to the EPA by January 13, 2017.*" The following report provides the required modeling analysis for Pawnee, submitted to EPA by January 13, 2017.

Facility Details

The Pawnee Power Plant is a coal-fired, steam-electric generating station located near Brush, Colorado that reported actual 2014 SO_2 emissions of 5,508 tpy for the main coal-fired boiler (rated at 5,346 MMBtu/hour) and minimal emissions (<0.01 tpy) for the auxiliary boiler. In addition, there are two natural gas turbines, one diesel generator, and one fuel heater for the Manchief Power Plant (Manchief) located on Pawnee Station property (owned by Capital

[1] Data Requirements Rule for the 2010 1-hour Sulfur Dioxide (SO2) Primary National Ambient Air Quality Standard (NAAQS), 80 Fed. Reg. 51051 (to be codified at C.F.R. Part 51).

Power Income LP) with actual SO_2 emissions less than 1 tpy each. Xcel Energy purchases the electric output of Manchief.

Land Use

The APCD performs land use classifications with AERGIS sector tool. AERGIS was developed by the APCD following methodologies described in AERMOD Implementation Guide updated January 9, 2008. This was done so that newer versions of the National Land Cover Data sets could be used than what is used in AERSURFACE.

The APCD, using the AERGIS sector tool, creates a study called LC Sector Analysis_ (site name) in an Excel workbook. This study contains six different worksheets. The first worksheet is a readme page. This page provides information about the analyses to include what meteorological data is being evaluated, the period of observation, the reason for the land cover analysis, when the analysis was completed and procedures used to complete the following worksheets: AERMET, Location, Site Info, Aerial, and CVM 2002 worksheets. The worksheets describe surface characteristics, location, precipitation, aerial photo, and land cover in the area around the meteorological tower.

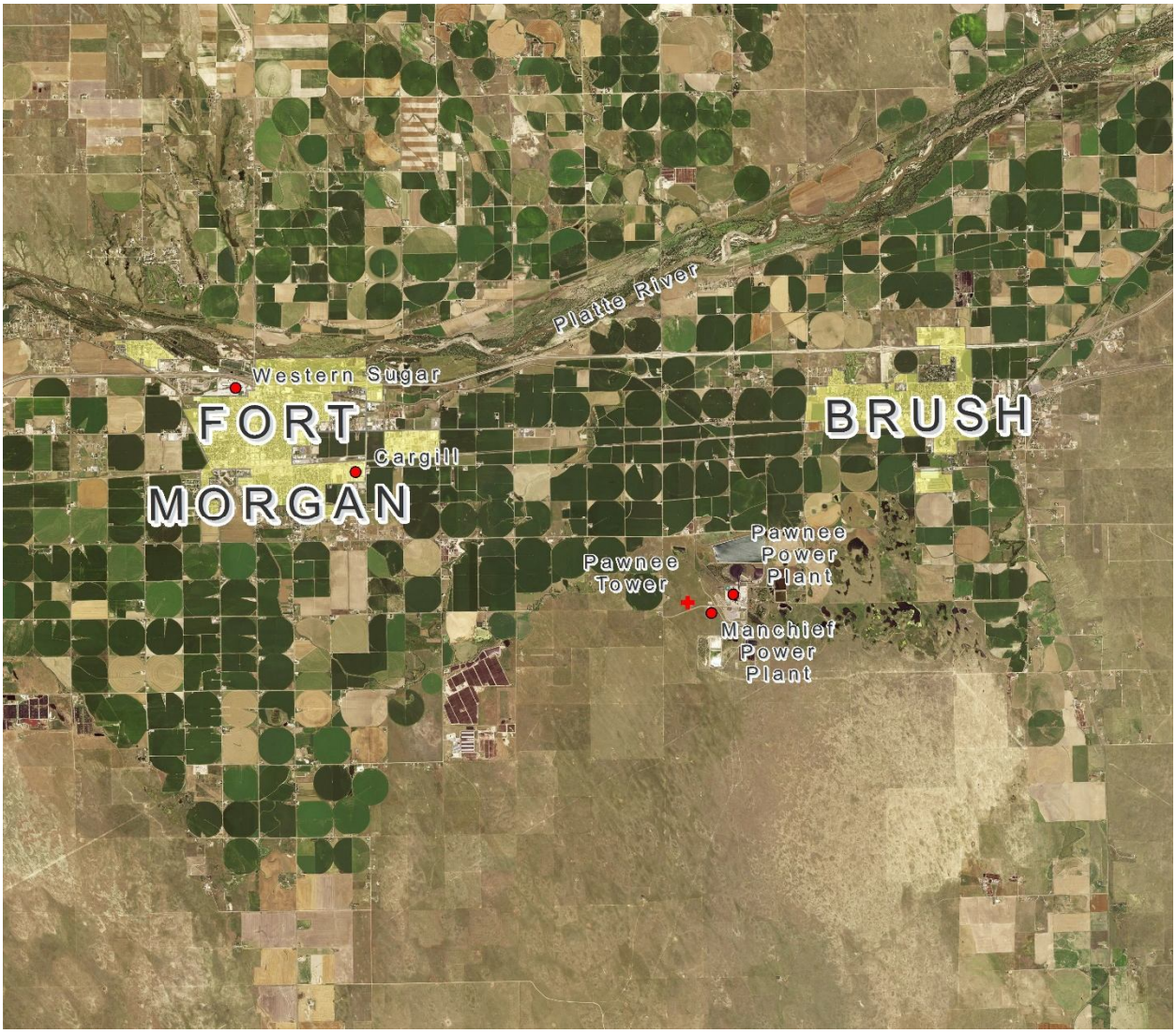
The AERMET worksheet contains the AERGIS computed Albedo, Bowen, and Roughness values in a format that can be put into the AERMET stage 3 file.

The Location worksheet has a topographical map with the location of the meteorological tower placed on it. The meteorological tower is labeled with the name of the tower, the period of meteorological data being evaluated, UTM coordinates, and the projection for the coordinates.

The Site Info worksheet contains the precipitation information needed by AERGIS. The average precipitation data is based on U.S. Department of Commerce, National Oceanic and & Atmospheric Administration, National Environmental Satellite, Data, and Information Service Monthly Station Climate Summaries. The actual precipitation data is based on the most representative National Centers for Environmental Information, Cooperative Observer Network location for the observation period.

The Aerial worksheet contains two NAIP images. One image has 30^o/1 km sectors centered on the meteorological tower. The second image shows the 10 km x 10 km domain centered on the meteorological tower. The final worksheet is labeled using the year of the land cover file used in AERGIS. This page has two images like the Aerial worksheet except the background is land cover data. A key for the land cover is also provided. The LC Sector Analysis_Pawnee is in Appendix A. The facility, meteorological tower, and nearby sources are shown in Figure 1.

Figure 1: Pawnee Station, Meteorological Tower, and Neighboring Sources Aerial View



The worksheets in the Appendix A - LC Sector Analysis_Pawnee show that Pawnee is in a rural area and classified as "rural" for the modeling analysis. The primary industry in the area is farming and ranching. In the Aerial worksheet the Aerial Photo of Meteorological Tower Location and 30°/1 km sectors (NAIP 2005) figure shows the meteorological tower to be about one km to the west of Pawnee. The terrain is dominated by the South Platte River Valley. The South Platte River flows east out of the Rocky Mountains to the west of Pawnee Power Plant and the valley walls slope up to the Cheyenne Ridge to the north and up to Monument Ridge to the south. These features dominate the local winds. As seen in the Site Info worksheet in Appendix A, annual precipitation in the vicinity of Pawnee is light, in the 12 to 14 inches range because the area is in the rain shadow of the Rocky Mountains.

Model Selection

U.S. EPA preferred air quality model, AERMOD modeling system, will be used along with the PRIME plume rise and building downwash model, BPIPPRM. The following versions will be utilized:
AERMOD version 15181
AERMAP version 11103
AERMET version 15181
BPIPPRM version 04274

Modeling Domain

The modeling domain will be centered over Pawnee. Consistent with Appendix W, all sources expected to cause a significant concentration gradient in the vicinity of the source of Pawnee Swill be explicitly modeled. The coordinate system is Universal Transverse Mercator, North American Datum 27, zone 13.

The following on-property sources will be modeled in this analysis:

- Pawnee Power Plant: Main boiler
- Manchief Power Plant: Two Turbines

Surrounding sources expected to cause a significant concentration gradient in the vicinity of Pawnee are summarized below:

- Western Sugar Cooperative: sugar and sugar by-product manufacturer located approximately 12 kilometers northwest of Pawnee; two coal-fired steam boilers exhausted through a single stack (source 001).
- Cargill Meat Solutions: meat processing facility located approximately 8.6 km northwest of Pawnee; three natural gas/biogas boilers (sources 004, 008, and 012), one flare for biogas combustion (source 011). There are two additional natural gas-only boilers and two natural gas-only dryers at this facility with negligible SO_2 emissions not included in the analysis (< 0.12 tpy each).

Receptor Network

The receptor network will have discrete Cartesian grid receptors beginning at Pawnee ambient air boundary (fenceline) at 50 meter (m) intervals. Additional receptors will be placed as follows:

- From ambient air boundary to 2 kilometers (km) – 100 m intervals
- From 2 km to 5 km – 250 m intervals

- From 5 km to 12 km – 500 m intervals

Due to the expected impacts from the nearby source, Western Sugar Cooperative, the receptor network will also include discrete receptors from the ambient air boundary of Western Sugar Cooperative to 2.5 km at 250 m intervals. Any overlapping receptors between the two grids will be removed. An additional receptor network was also placed around the nearby source, Western Sugar Cooperative with receptors spaced at 250 m intervals extending from the center of this facility up to 2.5 km. Overlapping receptors between the two grids were be removed. Receptors were removed within the property of Pawnee that includes Manchief, but otherwise there are no other areas excluded from ambient air. The receptor grid and zoomed in views around Pawnee and Western Sugar Cooperative are shown in Figure 2Figure 3, and Figure **4**.

It should be noted that Manchief is co-located with Pawnee for Title V and PSD purposes as stated in Colorado Operating Permit #01OPMR236:
"Since the two facilities are located on contiguous and adjacent property, belong to the same industrial grouping (first two digits of the SIC code are the same) and are under common control (via power purchase agreement with PSCo [Xcel Energy]), they are considered a single stationary source for purposes of major stationary source new source review and Title V operating permit applicability."

A 12 km receptor network radius will satisfy U.S. EPA's recommendation that a receptor network defines the significant impact area for the source under review.

Initial modeling runs will be used to determine areas of significant concentration gradients. In areas of significant concentration gradients, the receptor grid will be refined to 100 m intervals. If a significant concentration gradient exists at the edge of the 12 km network, the network will be extended. The area of 100 m intervals will be large enough to capture the maximum impact in the significant concentrations gradient areas.

The AERMOD pre-processor AERMAP will be used to generate receptor elevations and hill height scales. The base elevation of buildings and sources were provided by the corresponding facilities either directly for the 1-hr SO_2 designation modeling or previously for permit applications. The receptor and elevation hill height elevations will be based on 1/3 arc-second National Elevation Dataset (NED) from the USGS. The coordinate system is Universal Transverse Mercator, North American Datum 27, zone 13.

Figure 2: Full Receptor Network Grid

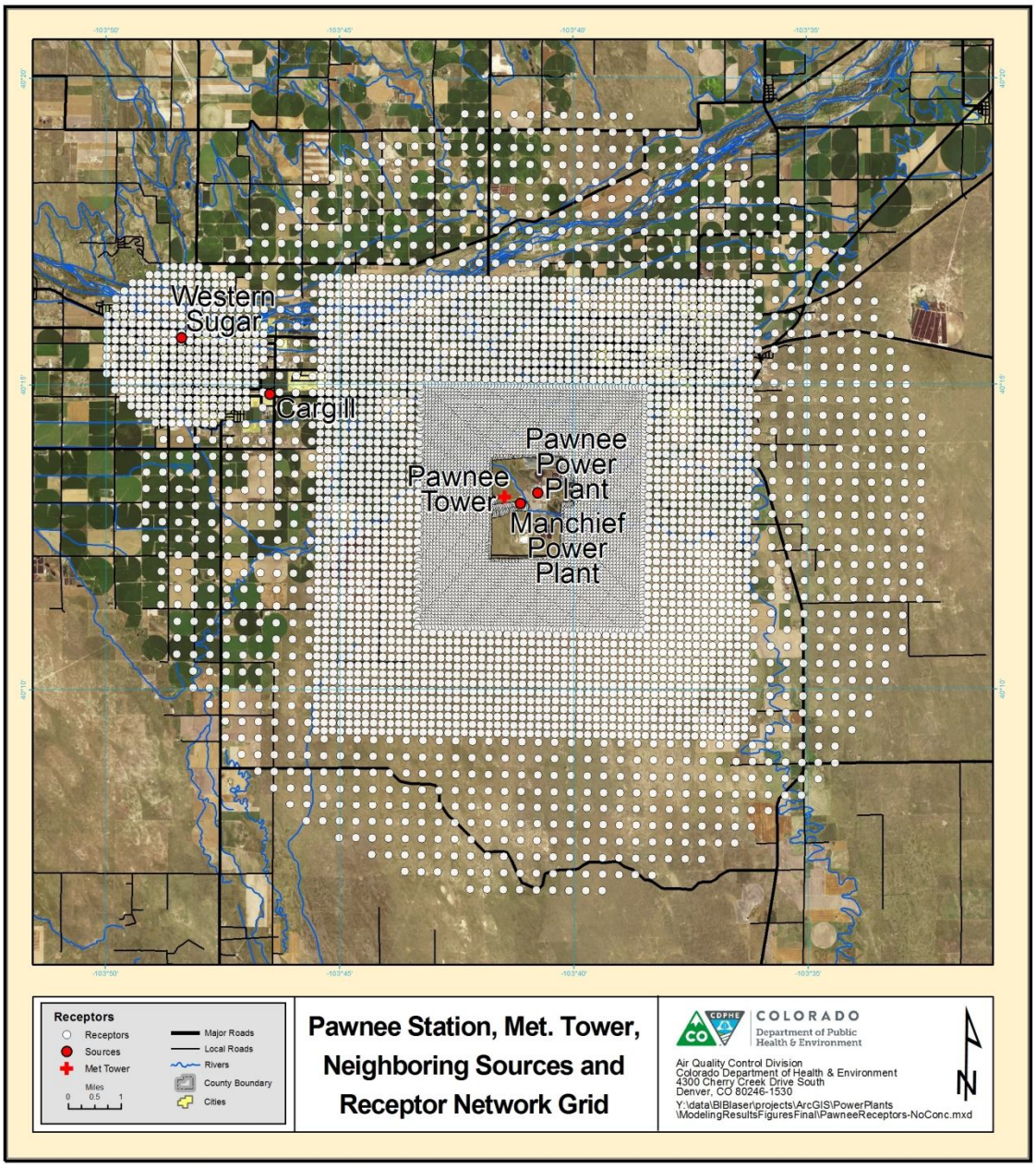


Figure 3: Pawnee Power Plant Receptor Grid Section

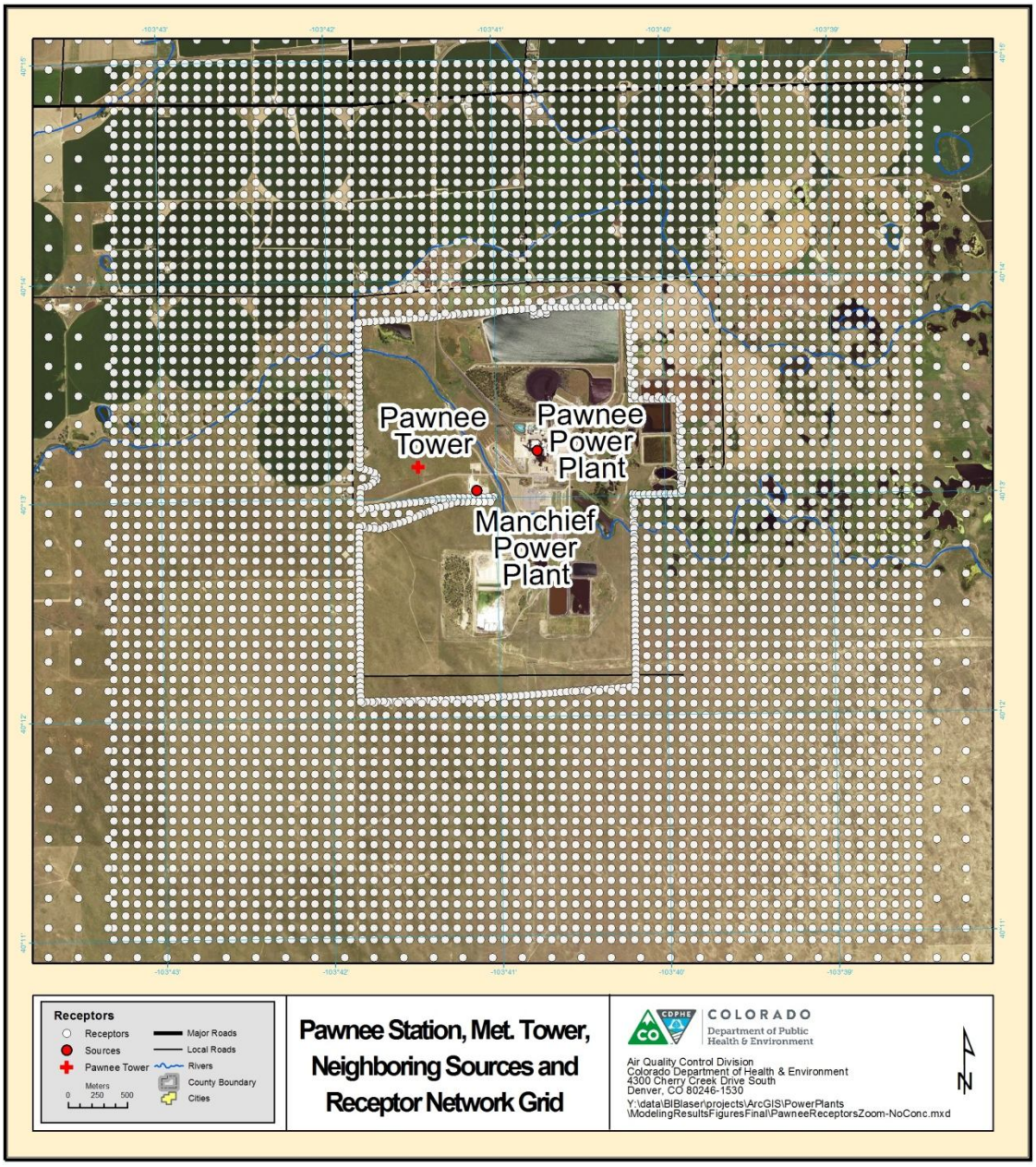
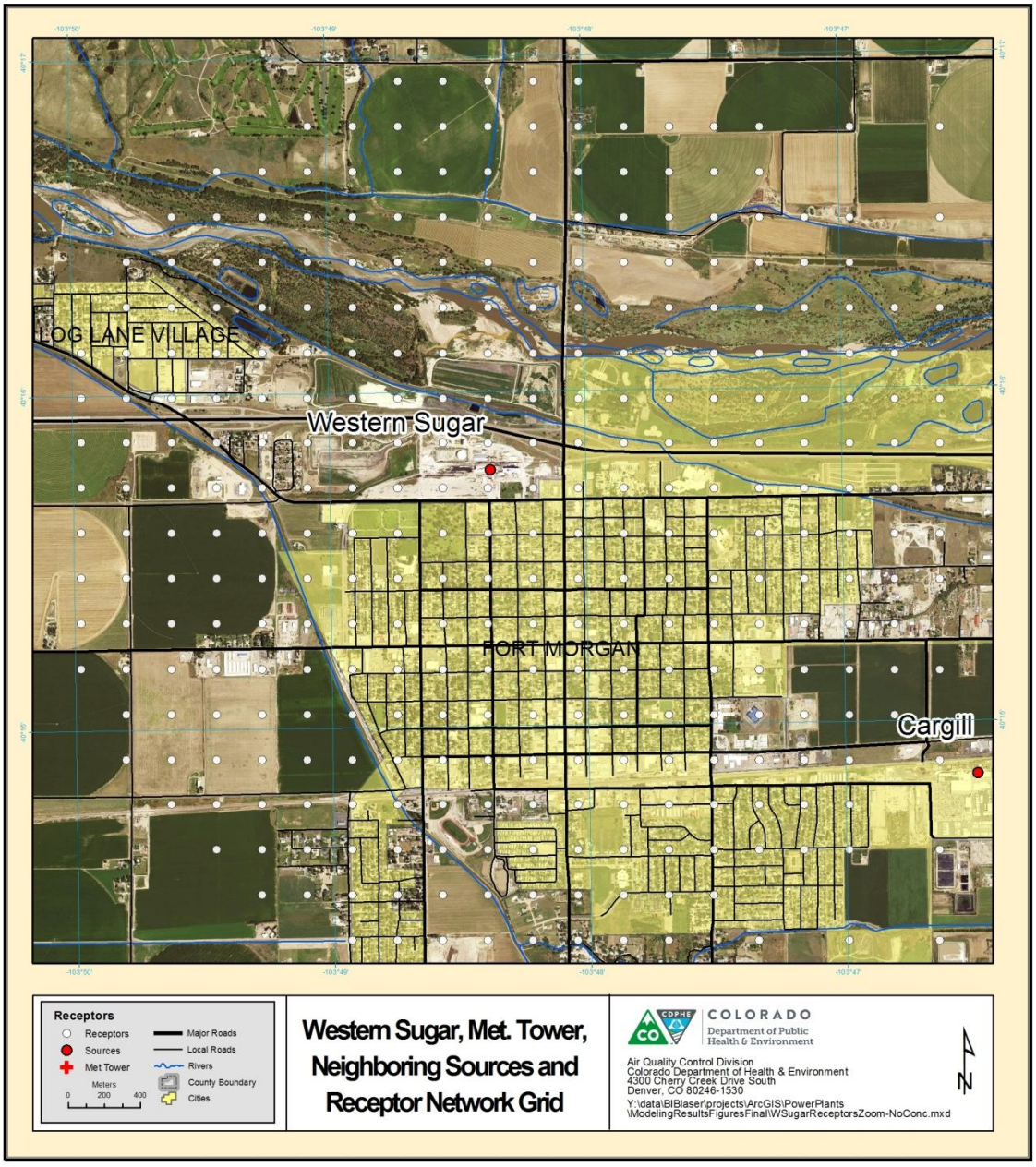


Figure 4: Western Sugar Cooperative Receptor Grid Section


LOG LANE VILLAGE
Western Sugar
FORT MORGAN
Cargill
Receptors
Receptors
Sources
Met Tower
Meters
0 200 400
Major Roads
Local Roads
Rivers
County Boundary
Cities
Western Sugar, Met. Tower, Neighboring Sources and Receptor Network Grid
COLORADO
Department of Public Health & Environment
Air Quality Control Division
Colorado Department of Health & Environment
4300 Cherry Creek Drive South
Denver, CO 80246-1530
Y:\data\BlBlaser\projects\ArcGIS\PowerPlants\ModelingResultsFiguresFinal\WSugarReceptorsZoom-NoConc.mxd
N

Emissions Inputs/Sources

As noted in the SO_2 NAAQS Designations Modeling Technical Assistance Document, August 2016 (Modeling TAD), a mix of chronologically different emissions is allowed. The source mix around Pawnee is comprised of a variety of EGU and non-EGU sources. The emission inputs for each source are described in this section. Table 1 outlines the modeled emissions for each source. Due to the complex nature of the modeled emissions, APCD commits to sending EPA an annual SO_2 emission report for Pawnee Power Plant[2] and Western Sugar Company[3] to demonstrate emissions have not changed significantly or if they have changed significantly, a new modeling analysis will be submitted.

Table 1: Emission Sources Included in Modeling Analysis

Facility Name	Source ID	Modeled Emissions (grams/sec)	Annual Emissions (tpy)	Emission Type
Pawnee Power Plant	Unit 1	131.75	4,580 (modeled equivalent maximum) 1,810 (2015 CAMD reported)	Short-term allowable
Manchief Power Plant	MPP	0.10 (2 stacks)	3.50	Permit Limit (PTE)
Cargill Meat Solutions	CMS	0.35 (4 stacks)	12.14	Permit Limit (Allowable – BACT)
Western Sugar Cooperative	WSC	3.42 (single stack)	119.2 (modeled maximum) 58.3 (2012 APEN)	2016 Stack Test (Actual)

Pawnee Power Plant – Unit 1

As part of the Colorado Regional Haze State Implementation Plan (federally enforceable approved by EPA on December 31, 2012) requirements, Pawnee Unit 1 was required to meet an emission limit of 0.12 pounds (lbs)/MMBtu (30-day rolling average) by December 31, 2014 using an assumed control technology of a lime spray dryer. As a result, there are not three years of actual representative emissions data available. Even the most recent emission year (2015) has a high degree of variability in emissions that are not representative of the maximum short-term or hourly emission rate for input into AERMOD. The most conservative scenario is to use allowable emissions in lieu of actual emissions as permitted in the Modeling

[2] EPA CAMD reported values
[3] Sulfur weight content for each delivery of coal, annual average

TAD. To properly account for short-term emissions spikes that can impact a one-hour rate but be smoothed out over a 30-day rate, the EPA recommends that an adjustment factor be applied to the modeled hourly emissions rate (see EPA's April 23, 2014 Nonattainment Area Guidance at 25-37, and Appendices B, C and D)[4]. Short-term emissions are calculated using Table 1 (page D-2) in Appendix D (Review of Relationships Among SO_2 Emissions Data with Various Averaging Times) of EPA's Guidance for 1-Hour SO_2 Nonattainment Area SIP Submissions Memorandum (issued April 23, 2014). This table shows an average ratio of 99th percentile 30-day average SO_2 emission values versus 99th percentile 1-hour average SO_2 emission values for sources with dry scrubbers, such as Pawnee Power Plant, to be 0.63. The calculation is as follows:

Pawnee Unit 1 30-day Allowable Emission Limit = 0.12 lbs/MMBtu

The design firing rate of Unit 1 is 5,346 MMBtu/hour (hr).

The resultant emission rate is 0.12 lbs/MMBtu x 5,346 MMBtu/hr = 641.52 lbs/hr.

Incorporating the ratio to account for 30-day to 1-hour fluctuations, the resultant emission rate becomes 641.52 lbs/hr + (0.63 x 641.52 lbs/hr) = 1,045.68 lbs/hr. This converts into 131.75 grams/second. This approach is appropriately conservative since the maximum design firing rate of the unit is used in conjunction with the current allowable emission rate that is equivalent to an annual value of 4,580 tons per year, referenced in Table 1. Corresponding operating parameters at this rate will be used from actual 2015 data (temperature and velocity), shown in Table 2. This approach was discussed with EPA Region 8 and OAQPS and accepted.

Manchief Power Plant

Manchief has a Title V federally enforceable permit (Operating Permit Number 01OPMR236) with a 12-month rolling SO_2 emission limit of 3.50 tpy for each turbine at the facility. This emission rate converts to 0.10 grams/second for each turbine with individual stacks.

Cargill Meat Solutions

Cargill Meat Solutions has a Title V federally enforceable permit (Operating Permit 99OPMR210) with an annual SO_2 emission limit of 12.14 tpy for the entire facility. Emissions were assumed to be the maximum for each of the four stacks (three boilers and one flare) since the emissions originate from biogas combustion dispensed throughout the facility during the year. The permit requires Best Available Control Technology (BACT) for these units, which is the use of low sulfate water in the plant process. The flare is also subject to 40 CFR

[4] See page 10 of Final Technical Support Document of North Dakota Area Designations for the 2010 SO2 Primary National Ambient Air Quality Standard

Part 60, Subpart A, which requires no visible emissions and pilot flame at all times as well as a minimum stack height. The permit also contains other biogas control provisions that help reduce SO_2 emissions from the use of biogas. The annual emission limit of 12.14 tpy converts directly to 0.35 grams/second; each stack will be modeled at this maximum value, which is a conservative assumption.

Western Sugar Cooperative

Western Sugar Coorperative has a Title V federally enforceable permit (Operating Permit 95OPMR050) with a SO_2 limit of 1.8 lbs/MMBtu (Colorado Regulation No. 1, Section VI.A.3.a(i)). The design rate of the boilers is 392 MMBtu/hour. Therefore, the maximum SO_2 emission rate based on this limit is 3,090.5 tpy. However, Western Sugar Cooperative operates at a fraction of this grandfathered limit and in 2014, reported 26.04 tpy SO_2 emissions. These lower emissions are due to Western Sugar Cooperative operating about 50% of the year on average as an agricultural cooperative (4,392 hours in 2012)[5] and using low-sulfur coal. Western Sugar Cooperative used to combust bituminous coal and in recent years, has shifted to sub-bituminous Power River Basin coal. APCD requested that Western Sugar Cooperative conduct a new stack test in an effort to gather the most recent data for modeling under the DRR[6]. Western Sugar Cooperative has been diligent; its' consultant conducted three stack test runs in February 2016, which will also fulfill Title V permitting requirements. The first run produced the highest emission results at 27.17 lbs/hr (which converts to 3.42 grams/second); this number will be used in the modeling analysis as the most representative actual value. This number assumes 8,760 hours of operation which is overly conservative. Fuel composition (sulfur weight percent) is required to be tracked per fuel shipment in the Title V permit (Condition 1.4) and represents the most accurate way to track emissions. The sulfur weight percent for the February 2016 stack test was 0.21%. Table 2 details stack parameters for each source to be used in the modeling analysis. Refer to pages 27-30 of this protocol to refer to the methods used to determine the stack heights.

[5] The 2012 APEN is attached to this analysis for reference.
[6] The Coal Fired Boilers Performance Test Report is attached to this protocol for reference; boiler results are listed on page 1. Only Run #1 results will be used in the modeling analysis.

Table 2: Stack Parameters

Stack ID	Description	UTM Z13 NAD27		Base Elevation (meters)	Stack Height (meters)	Stack Diameter (meters)	Exhaust Temp (K)	Exhaust Exit Velocity (m/s)	Type of Stack Height Used
		EAST	NORTH						
Pawnee Power Plant – All sources at this facility are permitted to operate 8760 hr/yr.									
Unit 1	Coal-fired boiler	612390.50	4452817.50	1,311	167.6	7.16	307.93	24.14	Actual
Manchief Power Plant – All sources at this facility are permitted to operate 8760 hr/yr.									
Stack1	Nat Gas Turbine 1	611891.41	4452492.03	1,322	27.43	6.1	807.59	42.09	Actual
Stack2	Nat Gas Turbine 2	611894.33	4452438.58	1,322	27.43	6.1	807.59	42.09	Actual
Cargill Meat Solutions - All sources at this facility are permitted to operate 8760 hr/yr.									
B9	Flare (actual parameters)	604154	4455156	1,313	16.46	0.1524	810.93	---	Effective
	Flare (effective parameters)	604154	4455156	1,313	23.53	1.44	1273	20	
B1	Biogas Boiler	604153	4455742	1,313	18.9	0.71	491.48	5.79	Actual
B3	Biogas Boiler	604175	4455769	1,313	18.59	0.74	491.48	3.96	Actual
B5	Biogas Boiler	604153	4455742	1,313	13.1	0.61	499.82	16.46	Actual
Western Sugar Cooperative – All sources at this facility are permitted to operate 8760 hr/yr.									
WSUG	Coal-fired boilers	601587	4457394	1318	28.04	3.05	328.71	7.92	Actual

Building Downwash

The effects of building downwash will be considered in this modeling analysis through the parameters calculated with the latest version available of the Building Profile Input Program for the Plume Rise Model Enhancement algorithm (BPIPPRM v04274).

A single downwash analysis was conducted for Pawnee and Manchief because both facilities are located within very close proximity of each other and within the same ambient air boundary. However, the other two facilities, Western Sugar Cooperative and Cargill Meat Solutions, are located at enough distance from each other and from the Pawnee-Manchief complex to ensure that the buildings/structures of one site will not cause downwash effect on the stacks of the other two sites. Thus, separate downwash analyses were conducted for the stacks and buildings of each of the other two facilities.

Building dimensions and coordinates were available for Manchief and for the Cargill Meat Solutions facilities from old permit modeling analyses submitted to the APCD with the ISC model. While this information was provided by the corresponding companies at that time, some errors and missing structures were found when the coordinates were overlaid on satellite images, so some corrections were needed and made with estimated dimensions based on those satellite images. For Pawnee and Western Sugar Cooperative, the building dimensions and coordinates were submitted recently by the corresponding companies. A summary of the building dimensions for all four facilities is provided in Table 3, Table ***4***, andTable ***5***. Figure 5, Figure 6, and Figure 7 show the layout of the buildings and structures at each of the sites.

Table 3: Building Parameters for Pawnee and Manchief Power Plants

Building ID	Description	Coordinates UTM Z13 NAD 27		Base Elevation (meters)	Length x Width x Height (meters)	Comments
		X	Y			
CTower	Cooling Tower	612047.9 612060.4 612200.7 612188.2	4452837 4452851 4452708 4452695	1316.0	161.24 x 22.25 x 18.29	Located at Pawnee Power Plant
FFDC	Fabric Filter Dust Collectors	612363.8 612363.8 612423.8 612423.8	4452864 4452924 4452924 4452864	1311.0	59.44 x 58.52 x 29.26	Located at Pawnee Power Plant
Whouse	Warehouse	612503 612503 612533.7 612533.7	4452711 4452782.02 4452782.02 4452711	1311.0	70.83 x 30.61 x 9.75	Located at Pawnee Power Plant
Admin	Administration Building at Pawnee	612497.4 612528.1 612528.1 612497.4	4452687 4452687 4452650 4452650	1311.0	37 x 30.65 x 19.20	Located at Pawnee Power Plant
Boiler	Boiler Building	612445.88 612445.88 612479.41 612479.41	4452729.36 4452758.62 4452758.62 4452729.36	1311.0	33.53 x 29.26 x 79.25	Located at Pawnee Power Plant
Turbine	Turbine Building at Pawnee	612442 612442 612533.7 612533.7	4452688 4452711 4452711 4452687	1311.0	91.73 x 23 x 30.17	Located at Pawnee Power Plant

WaterTBu	Water Treatment Building	612340.88 612414.88 612414.88 612427.88 612427.88 612340.88	4452969.36 4452969.36 4452986.36 4452986.36 4452997.36 4452997.36	1311.0	87.17 x 13.1 x 14.63	Located at Pawnee Power Plant
SCR-A	Selective Catalytic Reduction Building A	612448.88 612464.73 612464.73 612448.88	4452829.36 4452829.36 4452852.52 4452852.52	1311.0	23.16 x 15.85 x 56.69	Located at Pawnee Power Plant
SCR-B	Selective Catalytic Reduction Building B	612470.88 612486.73 612486.73 612470.88	4452829.36 4452829.36 4452852.52 4452852.52	1311.0	23.16 x 15.85 x 56.69	Located at Pawnee Power Plant
SDRYER8A	New Spray Dryer Absorber A at Pawnee Power Plant	612442.88	4452865.36	1311.0	Radius = 9.9 meters, Height = 51.82 meters	Circular building. Coordinates are for the center of the circle.
SDRYER8B	New Spray Dryer Absorber B at Pawnee Power Plant	612442.88	4452896.36	1311.0	Radius = 9.9 meters Height = 51.82 meters	Circular building. Coordinates are for the center of the circle.
WWATERBU	Waste Water Concentrator Building	612443.88 612468.57 612468.57 612443.88	4452971.36 4452971.36 4452988.12 4452988.12	1311.0	24.69 x 16.76 x 9.75	Located at Pawnee Power Plant
GWHOUSE1	Warehouse Building 1	611845.88 611858.88 611858.88 611845.88	4452545.3 4452545.3 4452508.3 4452508.3	1322	36.98 x 13 x 4.33	Located at Manchief Power Plant
GWHOUSE2	Warehouse Building 2	611871.88 611871.88 611889.88 611889.88	4452521.3 4452531.3 4452531.3 4452521.3	1322	18 x 10.25 x 3.67	Located at Manchief Power Plant
GSILO1	Silo 1 Located at Manchief Power Plant	611898.88	4452527.30	1322	Radius = 4.86 meters Height = 12.32 meters	Circular building. Coordinates are for the

						center of the circle.
GSILO2	Silo 2 Located at Manchief Power Plant	611923.88	4452532.30	1322	Radius = 4.86 meters Height = 12.32 meters	Circular building. Coordinates are for the center of the circle.
GWHOUSE3	Warehouse Building 3	611905.88 611905.88 611917.88 611917.88	4452520.3 4452531.3 4452531.3 4452520.3	1322	12 X 11.3 X 3.62	Located at Manchief Power Plant
GCTOWER1	Cooling Tower 1	611892.88 611892.88 611905.88 611905.88	4452501.3 4452509.3 4452509.3 4452501.3	1322	13 x 8 x 4.14	Located at Manchief Power Plant
GBLDG1	Gas Turbine Building 1	2-tiered building with polygon shape. See BPIPPRM input file (attached) for coordinates.		1322	2-tiered building with polygon shape.	Located at Manchief Power Plant
GBLDG3	Gas Turbine Building 3	611947.88 611947.88 611957.88 611957.88	4452478.3 4452488.3 4452488.3 4452478.3	1322	10 x 10 x 6.32	Located at Manchief Power Plant
GBLDG4	Gas Turbine Building 4	611947.88 611947.88 611957.88 611957.88	4452457.3 4452467.3 4452467.3 4452457.3	1322	10 x 10 x 6.32	Located at Manchief Power Plant
GBLDG5	Gas Turbine Building 5	611947.88 611947.88 611957.88 611957.88	4452444.3 4452454.3 4452454.3 4452444.3	1322	10 x 10 x 6.32	Located at Manchief Power Plant
GBLDG2	Gas Turbine Building 2	2-tiered building with polygon shape. See BPIPPRM input file for coordinates.		1322	2-tiered building with polygon shape.	Located at Manchief Power Plant
GCTOWER2	Cooling Tower 2	611893.88 611893.88 611906.88 611906.88	4452449.3 4452457.3 4452457.3 4452449.3	1322	13 x 8 x 4.14	Located at Manchief Power Plant

GWHOUSE4	Warehouse Building 4	611866.88 611866.88 611876.88 611876.88	4452422.3 4452427.3 4452427.3 4452422.3	1322	10 x 5 x 2.07	Located at Manchief Power Plant

Figure 5: Layout of Buildings and Structures of Pawnee and Manchief Power Plants

Table 4: Building Parameters for the Cargill Meat Solutions Facility

Building ID	Description	Coordinates UTM Z13 NAD 27		Base Elevation (meters)	Length x Width x Height (meters)	Comments
		X	Y			
BoxStor	Box Storage	604307.8	4455503.3	1315	64.5 x 44.5 x 11.58	Southwest corner Coordinates
Freezer	Freezer	604324.8	4455548.3	1315	Polygon-shaped building Height = 8.53 meters	Southwest corner Coordinates
SPIRALF	---	604317.8	4455671.3	1315	9 X 8 X 9.6	Southwest corner Coordinates
Hi-Rise	Hirise Storage	604334.8	4455682.3	1315	56 x 36 x 27.43	Southwest corner Coordinates
FAB-TC	Fabrication	604229.8	4455707.3	1315	103 x 31.6 x 12.19	Southwest corner Coordinates
FAB-S	Fabrication	604271.8	4455683.3	1315	61.44 x 29 x 7.9	Southwest corner Coordinates
Gr-Beef	Ground Beef Processing	604270.8	4455632.3	1315	54 x 47 x 9.45	Southwest corner Coordinates
CHCOOLR	Surge Cooler	604228.8	4455631.3	1315	40.5 x 25 x 7.9	Southwest corner Coordinates
Cafeter	Cafeteria	604229.8	4455657.9	1315	52 x 42 x 11.58	Southwest corner Coordinates
HotBoxs	Hot Boxes	604106.8	4455606.3	1315	124 x 71 x 10.1	Southwest corner Coordinates

SalesClr	Sales Cooler	604173.8	4455679.3	1315	45.6 x 37.6 x 7.9	Southwest corner Coordinates
East-K	East Kill Building	604148.8	4455691.3	1315	37 x 25 x 10.67	Southwest corner Coordinates
West-K	West Kill Building	604043.8	4455703.3	1315	105 x 16 x 10.67	Southwest corner Coordinates
HideBld	Hide Building	604038.8	4455678.3	1315	110 x 21 x 6.096	Southwest corner Coordinates
In-Rend	Inedible Rendering Building	604145.8	4455765.3	1315	Polygon-shaped building Height = 7.01 meters	Northwest corner Coordinates
Gelbone	Bone Meal Storage	604235.8	4455756.3	1315	20.6 x 6.4 x 6.096	Southwest corner coordinates
Ed-Rend	Edible Rendering Building	604257.8	4455747.3	1315	24.7 x 15.6 x 6.096	Southwest corner coordinates
Warehse	Warehouse Building	604185.8	4455526.3	1315	60 x 25 x 6.096	Southwest corner coordinates
Office	Office Building	604187.8	4455504.3	1315	21.75 x 21.75 x 6.096	Southwest corner coordinates
WsteWtr	Waste Water Treatment Building	604110.8	4455741.3	1315	24.81 x 18 x 8.23	Southwest corner coordinates
Lab	Laboratory	604154.8	4455677.3	1315	19.78 x 13 x 6.096	Southwest corner coordinates
CardiacP	---	604228.8	4455609.3	1315	104.42 x 3 x 11.58	Southwest corner coordinates

AerLag1	Anaerobic Lagoon 1	604033.8	4455089.3	1316	87 x 87 x 3.66	Southwest corner coordinates
AerLag2	Anaerobic Lagoon 2	604033.8	4455180.3	1316	87 x 87x 10.67	Southwest corner coordinates
WAS-Tnk	Tank at Wastewater Treatment Plant	604143.8	4455135.3	1316	Radius = 9.14 meters Height = 4.57 meters	Circular building. Coordinates are for the center of the circle
BioGas	Biogas Storage	604130.8	4455164.3	1316	9.3 x 7.5 x 6.096	Southwest corner coordinates
Operatn	Operations Building	604142.8	4455186.3	1316	31.39 x 9.14 x 6.096	Southwest corner coordinates
FLRHOUSE	Flare House	604142.8	4455147.3	1316	7.62 X 6 X 3.67	Southwest corner coordinates
TANK1	Tank1 at wastewater treatment building	604100.8	4455734.3	1315	Radius = 4.13 meters Height = 12.1 meters	Circular building. Coordinates are for the center of the circle
TANK2	Tank2 at wastewater treatment building	604115.8	4455735.3	1315	Radius = 4.13 meters Height = 12.1 meters	Circular building. Coordinates are for the center of the circle
Square	---	604132.8	4455760.3	1315	3.5 x 3 x 11.77	Southwest corner coordinates
Train	Train Loadout	604150.8	4455773.3	1315	12 x 6.42 x 13.88	Southwest corner coordinates

LOWRISE	Lowrise Storage	604346.8	4455739.3	1315	49 x 20 x 7.01	Southwest corner coordinates
3silos	3 Silos					Southwest corner coordinates

Figure 6: Layout of Buildings and Structures of Cargill Meat Solutions

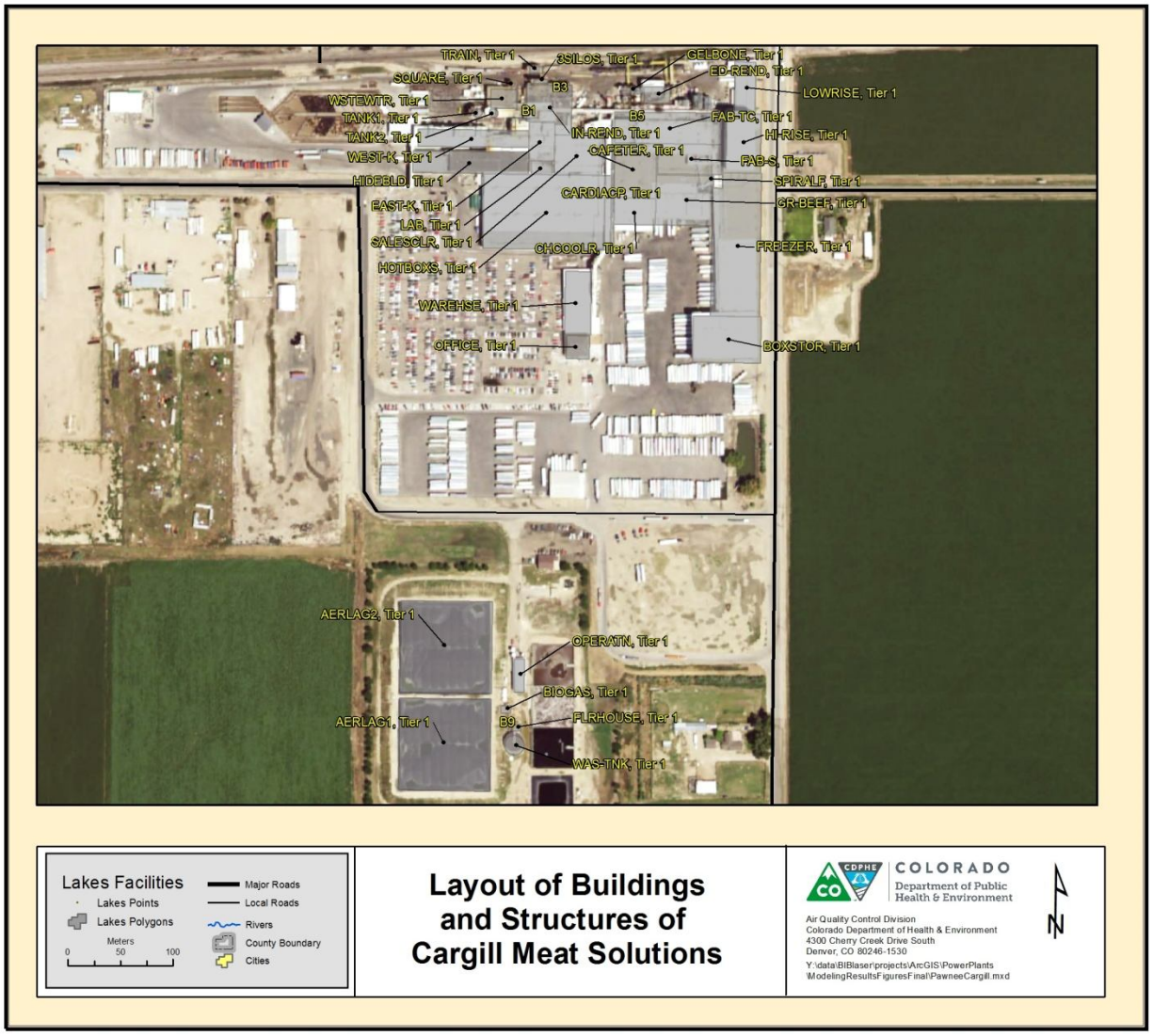


Table 5: Building Parameters for the Western Sugar Cooperative Facility

Building ID	Description	Coordinates UTM Z13 NAD 27		Base Elevation (meters)	Length x Width x Height (meters)	Comments
		X	Y			
SUGBIN1	Sugar Bin 1	601641.24	4457380.1	1318.0	27.43 x 22.86 x 35.86	
SUGBIN2	Sugar Bin 2	601668.74	4457380.2	1318.0	27.43 x 22.86 x 54.85	
SUGBIN3	Sugar Bin 3	601696.24	4457380.2	1318.0	27.43 x 22.86 x 67.46	
THCKJCE	Thick Juice Tank	601397.23	4457474.4	1318	Radius = 24.38 meters Height = 12.19 meters	Circular building. Coordinates are for the center of the circle
CLRIFR	Clarifier	601461.43	4457543.8	1318	Radius = 14.3 meters Height = 4.54 meters	Circular building. Coordinates are for the center of the circle
MOLTNK8	Molasses Tank 8	601527.2	4457392.1	1318	Radius = 11 meters Height = 7 meters	Circular building. Coordinates are for the center of the circle
MOLTNK9	Molasses Tank 9	601506.2	4457392.1	1318	Radius = 7.5 meters Height = 5.2 meters	Circular building. Coordinates are for the center of the circle
MOLTNK7	Molasses Tank 7	601658.1	4457480.2	1318	Radius = 9.8 meters Height = 9.81 meters	Circular building. Coordinates are for the center of the circle

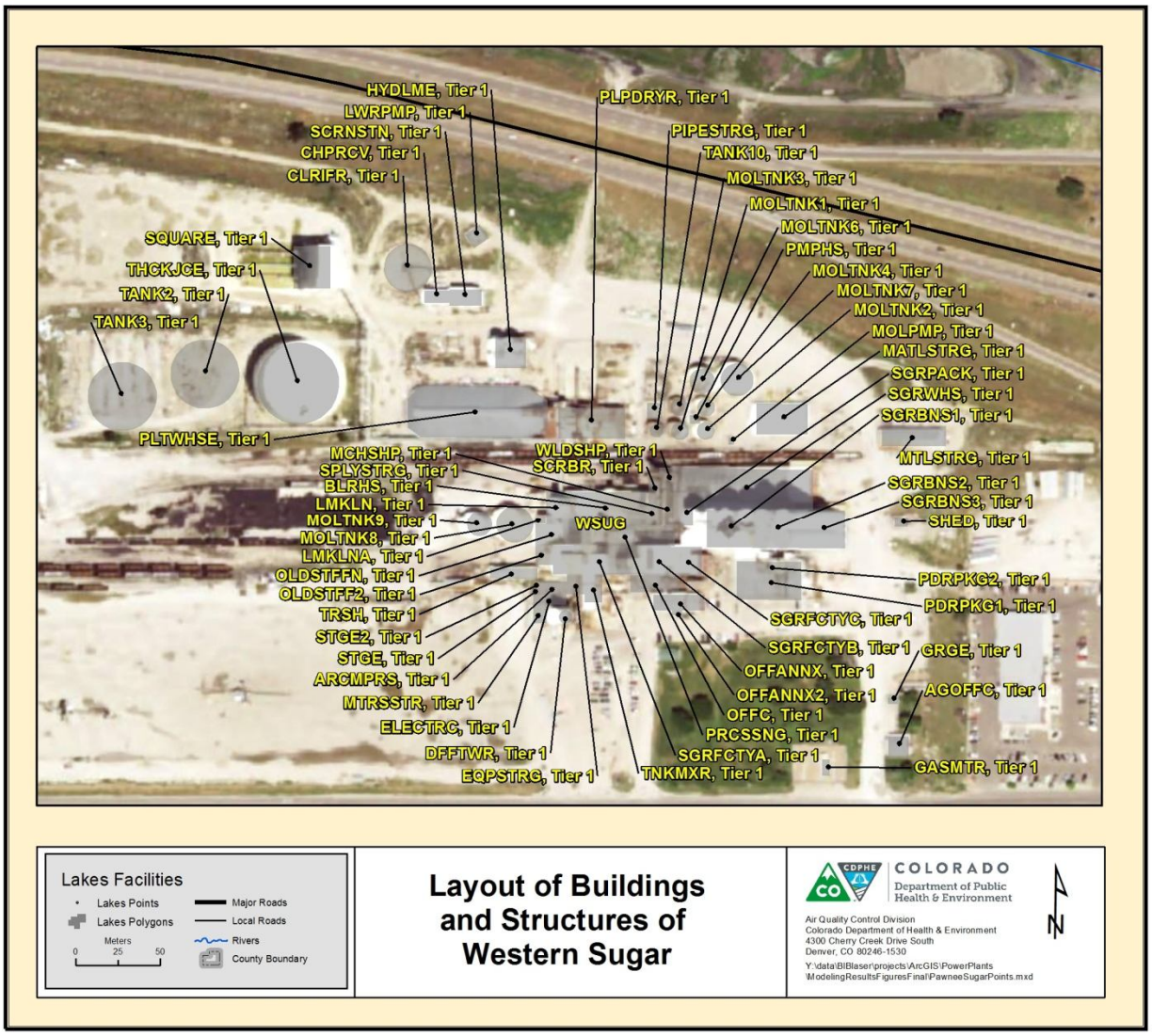
MOLTNK6	Molasses Tank 6	601637.3	4457479.0	1318	Radius = 7.5 meters Height = 10.94 meters	Circular building. Coordinates are for the center of the circle
MOLTNK4	Molasses Tank 4	601640.0	4457463.4	1318	Radius = 5.3 meters Height = 8.32 meters	Circular building. Coordinates are for the center of the circle
MOLTNK2	Molasses Tank 2	601640.0	4457449.6	1318	Radius = 5.3 meters Height = 7.96 meters	Circular building. Coordinates are for the center of the circle
MOLTNK3	Molasses Tank 3	601624.1	4457463.4	1318	Radius = 5.3 meters Height = 8.26 meters	Circular building. Coordinates are for the center of the circle
MOLTNK1	Molasses Tank 1	601624.7	4457449.4	1318	Radius = 5.3 meters Height = 11.61 meters	Circular building. Coordinates are for the center of the circle
DFFTWR	Diffusing Tower	601558.2	4457337.4	1318	Radius = 4 meters Height = 30.2 meters	Circular building. Coordinates are for the center of the circle
LWRPMP	Lower Pump House	601500.7	4457556.2	1318	10.67 x 9.75 x 0.85	Rotated -35 degrees
PLPDRYR	Pulp Dryer Building	601552.2	4457444.0	1318	39.6 x 18.29 x 17.95	
PLTWHSE	Pellet Warehouse	See BPIPRM input files for coordinates		1318	Polygon-shaped building	

					Height = 17.74 meters	
SGRWHS	Sugar Warehouse	See BPIPRM input files for coordinates		1318	Polygon-shaped building Height = 14.69 meters	
WLDSHP	Welding Shop	See BPIPRM input files for coordinates		1318	Polygon-shaped building Height = 14.69 meters	
PDRPKG1	Powder Packaging Building	See BPIPRM input files for coordinates		1318	Polygon-shaped building Height = 14.69 meters	
PMPHS	Pump House	601628.5	4457453.5	1318	6.1 x 5.18 x 4.6	
MATLSTRG	Material Storage	601669.9	4457448.1	1318	30.48 x 18.29 x 7.77	
MOLPMP	Molasses Pump House	601653.6	4457441.7	1318	3.35 x 3.96 x 1.77	
PIPESTRG	Pipe Storage	601605.0	4457456.1	1318	8.8 x 9.75 x 4.2	
BLRHS	Boiler House	601560.8	4457392.6	1318	43.89 x 19.81 26.66	
LMKLN	Lime Kiln Building	601545.6	4457392.6	1318	15.24 x 19.8 x 30.58	
PRCSSNC	Processing	601562.2	4457380.1	1318	60.05 x 12.5 x 9.72	
OLDSTFFN	Old Steffens Plant	601539.5	4457380.1	1318	22.56 x 12.5 x 17.68	
LMKLNA	Lime Kiln Building Annex	601539.5	4457392.6	1318	6.1 x 4.57 x 30.58	
SPLYSTRG	Supply Storage Building	601604.7	4457392.6	1318	10.97 x 13.72 x 9.72	
SCRBR	Scrubber Building	601606.5	4457406.3	1318	9.1 x 14.33 x 9.72	

MCHSHP	Machine Shop	601615.7	4457392.6	1318	7.62 x 18.59 x 9.72	
SGRPACK	Sugar Packing Building	601623.5	4457392.7	1318	9.45 x 14.33 x 9.72	
OFFANNX	Office Annex	601610.2	4457342.2	1318	30.48 x 9.1 x 32.0	
OFFANNX2	Office Annex 2	601621.4	4457339.1	1318	6.1 x 3.05 x 5.03	
TRSH	Trash Catcher	601513.0	4457359.7	1318	28.04 x 6.09 x 9.32	
SGRFCTYC	Sugar Factory C	601620.2	4457363.0	1318	18.69 x 17.07 x 22.8	
EQPSTRG	Equipment Storage	601558.7	4457350.8	1318	10.36 x 12.19 x 7.01	
TNKMXR	Cossette Tank Mixer	601569.1	4457346.3	1318	10.68 x 16.76 x 27	
ARCMPRS	Air Compressor	601543.5	4457350.8	1318	15.24 x 7.32 x 4.36	
ELCTRC	Electric Shop	601538.7	4457344.7	1318	19.82 x 6.1 x 4.36	
MTRSSTR	Motor Storage	601538.8	4457333.4	1318	7.92 x 11.28 x 14	
STGE	Storage	601539.03	4457350	1318	4.57 x 3.66 x 4.36	
STGE2	Storage 2	601540.5	4457354.4	1318	3.05 X 3.66 X 4.36	
GASMTR	Gas Meter	601712.04	4457245.1	1318	4.27 x 9.75 x 14	
AGOFFC	AG OFFICE	601751.14	4457257.01	1318	12.19 X 12.19 X 22	
GRGE	Garage	601750.54	4457288.21	1318	6.4 X 3.96 X 15	
CHPRCV	Chip Recovery	601471.7	4457523.2	1318	14.63 x 7.32 x 13.2	

SCRNSTN	Screening Station	601486.4	4457522.1	1318	19.2 X 9.45 X 13.2	
HYDLME	Hydrated Lime Bins	601514.13	4457485.2	1318	18.29 x 18.29 x 25.02	
MTLSTRG	Materials Storage Building	601744.44	4457442.2	1318	38.1 X 12.19 X 7.74	
SHED	Shed	601753.14	4457393.7	1318	7.62 x 5.79 x 3.54	
PDRPKG2	Powder Packaging Bldg2	601671.54	4457364.3	1318	15.24 X 7.62 X 19.96	
SGRFCTYA	Sugar Factory A	601550.33	4457363.0	1318	54.25 X 17.07 X 20.56	
SGRFCTYB	Sugar Factory B	601604.43	4457363.0	1318	15.92 X 17.07 X 25.78	
TANK2	Tank 2	601341.73	4457479.20	1318	Radius = 20.57 meters Height = 12.19 meters	Circular building. Coordinates are for the center of the circle
TANK3	Tank 3	601292.7	4457465.2	1318	Radius = 20.57 meters Height = 12.19 meters	Circular building. Coordinates are for the center of the circle

Figure 7: Layout of Buildings and Structures of Western Sugar Cooperative



Good Engineering Practice (GEP) with respect to stack heights is defined in Section 123 of the Clean Air Act as "*the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies or wakes which may be created by the source itself, nearby structures or nearby terrain obstacles.*"

40CFR51.100(ii) further defines GEP stack height as "*the greater of:*
(1) 65 meters, measured from the ground-level elevation at the base of the stack;
(2)(i) For stacks in existence on January 12, 1979, and for which the owner or operator had obtained all applicable permits or approvals required under 40 CFR parts 51 and 52.

Hg = 2.5H,
provided the owner or operator produces evidence that this equation was actually relied on in establishing an emission limitation;
(ii) For all other stacks,
Hg = H + 1.5L
where:
Hg = good engineering practice stack height, measured from the ground-level elevation at the base of the stack,
H = height of nearby structure(s) measured from the ground-level elevation at the base of the stack.
L = lesser dimension, height or projected width, of nearby structure(s)
provided that the EPA, State or local control agency may require the use of a field study or fluid model to verify GEP stack height for the source; or
(3) The height demonstrated by a fluid model or a field study approved by the EPA State or local control agency, which ensures that the emissions from a stack do not result in excessive concentrations of any air pollutant as a result of atmospheric downwash, wakes, or eddy effects created by the source itself, nearby structures or nearby terrain features."

In applying these regulations to the four facilities under assessment, the first step is to determine which of the equations in 40CFR51.100(ii)(2) should be used or whether the 65 meters GEP in 40CFR51.100(ii)(1) is applicable. For that purpose, the term "stack in existence" is defined in 40CFR51.100(gg) as: *"A stack in existence means that the owner or operator had (1) begun, or caused to begin, a continuous program of physical on-site construction of the stack or (2) entered into binding agreements or contractual obligations, which could not be cancelled or modified without substantial loss to the owner or operator, to undertake a program of construction of the stack to be completed within a reasonable time."*

For Pawnee, the owner Xcel Energy provided information that supports the fact that the Pawnee stack was in existence prior to January 12, 1979 and that the equation in 40CFR51.100(ii)(2)(i) should be used to determine GEP stack height[7].

The construction of the Pawnee stack was part of the overall contract to construct the entire plant and events occurred according to the following timeline:
- 4/14/1977: Entered into a binding contract with Ebasco Services to construct Pawnee Station. This contract included the construction of the stack.

[7] Statement of Public Service Company of Colorado Before the Air Pollution Control Commission, Morgan County, Colorado. May 06, 1976.

- 7/19/1977: Site surcharge activities completed. Pawnee is constructed on what is called a spread footer that required the entire site to be excavated, then compacted by placing a mountain of soil on top of the compacted base then removing that mountain to pour footings. This would include the area under the stack base.
- 9/6/1977: Concrete batch plant erected
- 10/26/1977: First concrete poured for the plant.

All these activities took place prior to the in-existence date of January 12, 1979 defined in 40CFR51.100(ii)(2)(i). In addition, Xcel Energy provided documentation to demonstrate that the formula defined in 40CFR51.100(ii)(2)(i) was relied upon to establish an emission limitation[1] therefore meeting all the requirements to use the following formula to calculate GEP stack height:

Hg = 2.5H
where
Hg = good engineering practice stack height, measured from the ground-level elevation at the base of the stack,
H = height of nearby structure(s) measured from the ground-level elevation at the base of the stack.

The dominant building for Pawnee is the boiler building, which is 79.25 meters tall. Thus, Hg = 2.5 x 79.25 = 198.13 meters.

The actual physical height of the Pawnee stack is of 167.6 meters, which is 30.53 meters shorter than GEP stack height and consequently the use of the actual stack height for the 1-hr SO_2 NAAQS attainment demonstration modeling is consistent with Section 6.1 of the Modeling Technical Assistant Document in what pertains to the use of GEP stack height policy when using allowable emissions.

For Manchief, which was modeled with allowable emissions, the actual physical height of the stacks are 27.43 meters tall each. This value is 37.57 meters shorter than the GEP stack height of 65 meters defined in 40CFR51.100(ii)(1) and consequently the use of the actual stack height for the 1-hr SO_2 NAAQS attainment demonstration modeling for this facility is also consistent with Section 6.1 of the Modeling TAD in what pertains to the use of GEP stack height policy when using allowable emissions.

For the Cargill Meat Solutions facility, which was modeled with allowable emissions, the actual physical heights of the stacks are 18.9, 18.59, and 13.10 meters for each of the three biogas boilers. These values are significantly shorter than the GEP stack height of 65 meters defined in 40CFR51.100(ii)(1), therefore the actual stack heights were used.

For the Cargill Meat Solutions flare, the actual physical height is of 16.46 meters. However, although flares are modeled as point sources, when modeling these type of units some adjustments need to be made to account for the effects of the flame in the plume of gases (i.e. lifting and expanding of the plume). These effects are accounted for by calculating an effective stack height and diameter and then modeling the flare as a regular point source using these effective parameters instead of the actual ones.

EPA has issued guidance to calculate these effective parameters for modeling flares in the SCREEN3 Model User's Guide and in the AERSCREEN User's Guide. To calculate the effective stack height for this flare, Equation (2) of Section 2.1.2 of the AERSCREEN User's Guide was used:

$Heff = Hs + 4.56X10^{-3} \times HR^{0.478}$

where:

Heff = effective stack height,

Hs = actual stack height, and

HR = heat release rate of the flare.

HR was provided by the flare manufacturer as 4724906.25 cal/sec

Thus, the effective stack height is $Heff = 16.46 + (4.56X10^{-3} \times (4724906.25)^{0.478}) = 23.53$ meters, which is significantly shorter than the GEP stack height of 65 meters defined in 40CFR51.100(ii)(1).

Consequently, the use of the actual stack heights for the 3 biogas boiler stacks and the flare at the Cargill Meat Solutions facility for the 1-hr SO_2 NAAQS attainment demonstration modeling is also consistent with Section 6.1 of the Modeling Technical Assistant Document in what pertains to the use of GEP stack height policy when using allowable emissions.

Finally, for the Western Sugar Cooperative facility, the actual physical height of the coal-fired boiler stack is 28 meters, which is significantly shorter than the GEP stack height of 65 meters defined in 40CFR51.100(ii)(1), therefore the actual stack height was used.

Meteorological Data

One year of on-site meteorological data from Pawnee will be used along with upper air data from the Denver National Weather Service station. The surface data was collected in the period from 04/21/2007 through 04/20/2008, and it was processed with concurrent Denver RAOB upper-air data using AERMET V15181 with the BULRN option by the APCD. The Bulk Richardson scheme was the method selected in AERMET to estimate heat fluxes under stable conditions.

The Pawnee meteorological data set is considered representative of the dispersion conditions at the Pawnee Power Plant as it is considered on-site data. The 60m meteorological tower is located 1 km to the west of the power plant. Section 3.1.1 of the AERMOD Implementation Guide (U.S. EPA August 3, 2015) states that: "Site-specific meteorological data are assumed by definition to be representative of the application site. The location of the meteorological tower and the location of the power plant have no significant differences in surface characteristics.

Data collected includes wind direction (degrees), speed (m/s), and sigma theta at 10 m, 30 m, and 60 m, temperature (°C) at 2 m, 10 m, and 60 m, delta T (10 m – 2 m), relative humidity (%) at 2 m, solar radiation (W/m2) at 2 m, net radiation (W/m2) at 2 m, barometric pressure (millibar) at 1 m, and ground level precipitation (0.01 inches). Completeness of the raw data was verified by quarter per parameter and the data is 100% complete.

Outside of one year of meteorological data measured at Pawnee, APCD does not know of any other meteorological data that satisfies quality assurance requirements and contains the necessary parameters for AERMOD use. Additionally, this area lacks representative meteorological datasets for additional years. One year of data was collected at the Brush Cogeneration Partners (Brush) located 5 miles to the northeast of Pawnee but due to the completeness issues with the Brush data, it is not adequately representative for modeling Pawnee with AERMOD. The Brush data was collected for ISC (previous dispersion model that was replaced by AERMOD) and is missing data necessary for the application of AERMOD. The Fort Morgan Municipal Airport (Fort Morgan) National Weather Service (NWS) Station is located 10 miles northwest of Pawnee and would be the only source of weather data to make substitutions for the missing data in the Brush data; however, since there is no archive of the Ft Morgan NWS Station data, it is not possible to make substitutions. Therefore, the Brush data is not adequately representative for modeling Pawnee with AERMOD and the Fort Morgan Municipal Airport data is unavailable; subsequently, neither station is considered. There are no other meteorological tower sites that would capture dispersion and transport conditions at Pawnee. This approach was discussed with EPA Region 8 and OAQPS and accepted. The meteorological tower location relative to the sources is shown in Figure 1.

There are two major influences on the wind/dispersion at Pawnee, terrain and synoptic weather systems. The differential heating and cooling of the terrain surrounding Pawnee site drives the local wind most days. When a synoptic weather system that is strong enough to override the effects of heating and cooling of the local terrain, moves across the area the local winds will be driven by it. The main terrain features that affect the Pawnee location are the South Platte River Valley, Beaver Creek Valley, Cheyenne Ridge, Monument Ridge and the Front Range Mountains.

The Pawnee Annual Wind Roses at 10 m, 30 m, and 60 m are in Appendix B. Each wind rose has three spikes. The spike from the west captures the night drainage winds in the South Platte River Valley along with the winds associated with down sloping winds off the Front Range. The north spike captures the winds due to Cheyenne Ridge and the northerly winds associated with the winds behind a strong synoptic weather system. The southerly spike captures the winds due to Monument Ridge, Beaver Creek Valley and the prefrontal winds ahead of a strong synoptic weather system.

The worst case dispersion will occur during conditions found in the Night (8 PM – 6 AM) Wind Roses found in Appendix B. Much like the Annual Wind Roses they have spikes from the west, north, and south. Because of the consistency of each spike in both the Night and Annual Wind Roses it is believed that the worst case dispersion conditions are captured in the Pawnee meteorological data set, and additional years of meteorological data will not change the modeled impacts significantly. In summary, the APCD notes that one year of site-specific data will result in accurate modeling results and is on par with other regulatory applications of dispersion modeling.

Background Concentration

Figure 8 shows the Evraz - Rocky Mountain Steel Mill Facility (RMSM) with the two nearby off-site SO_2 monitoring stations previously maintained by RMSM, as well as the additional SO_2 sources within 12 km of the RM Reservoir monitor. As shown in the map, the RMSM Print Shop monitor is located within the city of Pueblo, near the highway. The RM Reservoir monitor is located south of the city, and is isolated from the city's impacts. The RM Reservoir location is believed to be the most representative location for an estimate of SO_2 background in the area of Pawnee. SO_2 sources are shown as green circles on the map.

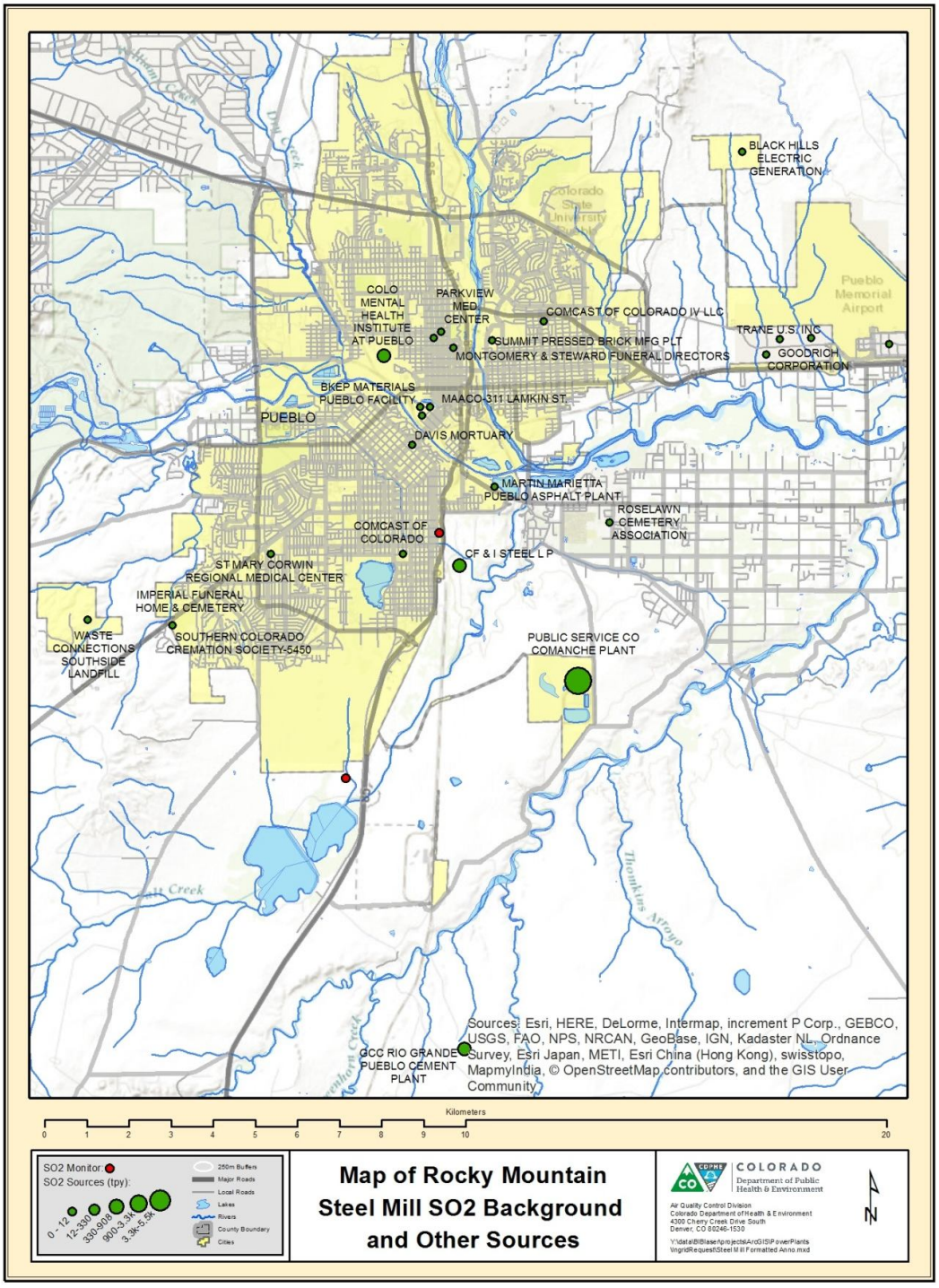


Figure 8: Map of RM Reservoir Air Monitoring Station and Nearby SO_2 Sources

Other than Comanche Generating Station and the RMSM facility, which are the most significant sources of SO_2 in Pueblo county, the majority of nearby SO_2 sources are very small (less than 5 tpy). Annual emissions from the nineteen facilities located within 12 km of the RM Reservoir monitor are presented in Table 6.

Table 6: Annual SO_2 Emissions from sources within 12 km of the RM Reservoir SO_2 Monitor

	2013	2014	2015
PUBLIC SERVICE CO COMANCHE PLT	3496.0 tpy	3157.3 tpy	3294.7 tpy
EVRAZ – ROCKY MOUNTAIN STEEL MILL FACILITY	311.2 tpy	310.7 tpy	310.7 tpy
COLORADO MENTAL HEALTH INSTITUTE AT PUEBLO	30.3 tpy	30.3 tpy	19.9 tpy
GCC RIO GRANDE - PUEBLO CEMENT PLANT	12.8 tpy	12.8 tpy*	9.3 tpy
SUMMIT PRESSED BRICK MANUFACTURING PLANT	5.1 tpy*	5.1 tpy*	5.1 tpy*
PARKVIEW EPISCOPAL MEDICAL CENTER	3.4 tpy*	3.4 tpy*	2.5 tpy
MARTIN MARIETTA - PUEBLO ASPHALT PLANT	2.7 tpy*	2.7 tpy*	2.7 tpy*
WASTE CONNECTIONS - SOUTHSIDE LANDFILL	1.3 tpy*	1.3 tpy*	1.3 tpy
ST MARY CORWIN REGIONAL MEDICAL CENTER10	1.2 tpy	1.2 tpy	1.2 tpy*
MONTGOMERY & STEWARD FUNERAL DIRECTORS	0.3 tpy*	0.3 tpy*	0.3 tpy*
ROSELAWN CEMETERY ASSOCIATION	0.2 tpy*	0.2 tpy*	<0.1 tpy
SOUTHERN COLORADO CREMATION SOCIETY-5450**	--	--	0.2 tpy
BLACK HILLS ELECTRIC- PUEBLO POWER PLANT	<0.1 tpy*	<0.1 tpy	<0.1 tpy*
DAVIS MORTUARY	<0.1 tpy*	<0.1 tpy*	<0.1 tpy*
COMCAST OF COLORADO IV LLC	<0.1 tpy	<0.1 tpy*	<0.1 tpy*
BKEP MATERIALS - PUEBLO FACILITY	<0.1 tpy	<0.1 tpy*	<0.1 tpy*
PARKVIEW MEDICAL CENTER	<0.1 tpy*	<0.1 tpy	<0.1 tpy
COMCAST OF COLORADO IV LLC	<0.1 tpy	<0.1 tpy*	<0.1 tpy*
MAACO-311 LAMKIN ST.**	--	--	<0.1 tpy*
Totals	**3,865 tpy**	**3,525 tpy**	**3,648 tpy**

*These sources did not submit revised Air Pollution Emission Notices to the APCD in the indicated years, indicating that their emissions did not change significantly as defined by the APCD. Thus the values reflected above represent the most recent data year reported.
**These sources commenced operation in 2015.

The State of Colorado has very limited ambient SO_2 data available because compared to the past National Ambient Air Quality Standards, the state has had very low ambient concentrations. Therefore, ambient monitoring of SO_2 was rarely required and a "regional site" (one that is located away from the area of interest but is impacted by similar natural and distant man-made sources) will be used to determine an appropriate background concentration (USEPA's *Guideline on Air Quality Models,* Section 8.2.2.c).

APCD has 1-hr SO_2 monitoring data that were collected from sites in Denver, Colorado Springs, Pueblo, a remote western slope site (Williams Energy Willow Creek), the Holcim Cement facility near Florence, a Tri-State monitoring location outside of Holly, Southwest Generation south of Colorado Springs, RMSM on-site and the RM Reservoir site. APCD used best professional judgment to determine that data from large urban areas would not be representative of the area around Pawnee since Pawnee is located of outside two smaller urban areas. Similarly, the Southwest Generation data has a value of 0.045 ppm, which is an extremely high value that is non-representative. The Holly data are from a location on the plains of eastern Colorado, and are not representative of conditions near Pawnee. The Williams Willow Creek data were collected in a remote area on the western slope and the Holcim data were collected in a rural area of central Colorado, both of which are less representative of the area around Pawnee. Therefore, APCD determined that the RM Reservoir monitor data are the most appropriate and most representative for use in this case based on the criteria listed below.

The RM Reservoir monitor is the most representative monitor for characterizing background concentrations of SO_2 at Pawnee due the following factors:

1. Both Pawnee and the RM Reservoir monitor are located near urban centers in rural areas of the state. Pawnee is located within 12 km of Fort Morgan and Brush, while the RM Reservoir monitor is located within 12 km of Pueblo, Colorado. The combined population of Fort Morgan and Brush is approximately 16,800; the population of Pueblo is approximately 106,600.
2. Both Pawnee and the RM Reservoir monitor are located on the eastern side of Colorado in areas of similar topography and elevation.

Furthermore, APCD believes that the RM Reservoir monitor provides a conservative estimate of background SO_2 concentrations at Pawnee because of the nearby industrial sources of SO_2 emissions. There are nineteen industrial sources of SO_2 emissions within 12 km of the RM Reservoir monitor totaling approximately 3,650 tpy (as shown in the table above), including Comanche and RMSM. By contrast, there are ten sources of SO_2 emissions within 12 km of Pawnee totaling approximately 108 tpy (excluding SO_2 emissions from Pawnee itself for background concentration comparison purposes). The location of Pawnee is shown in Figure 9.

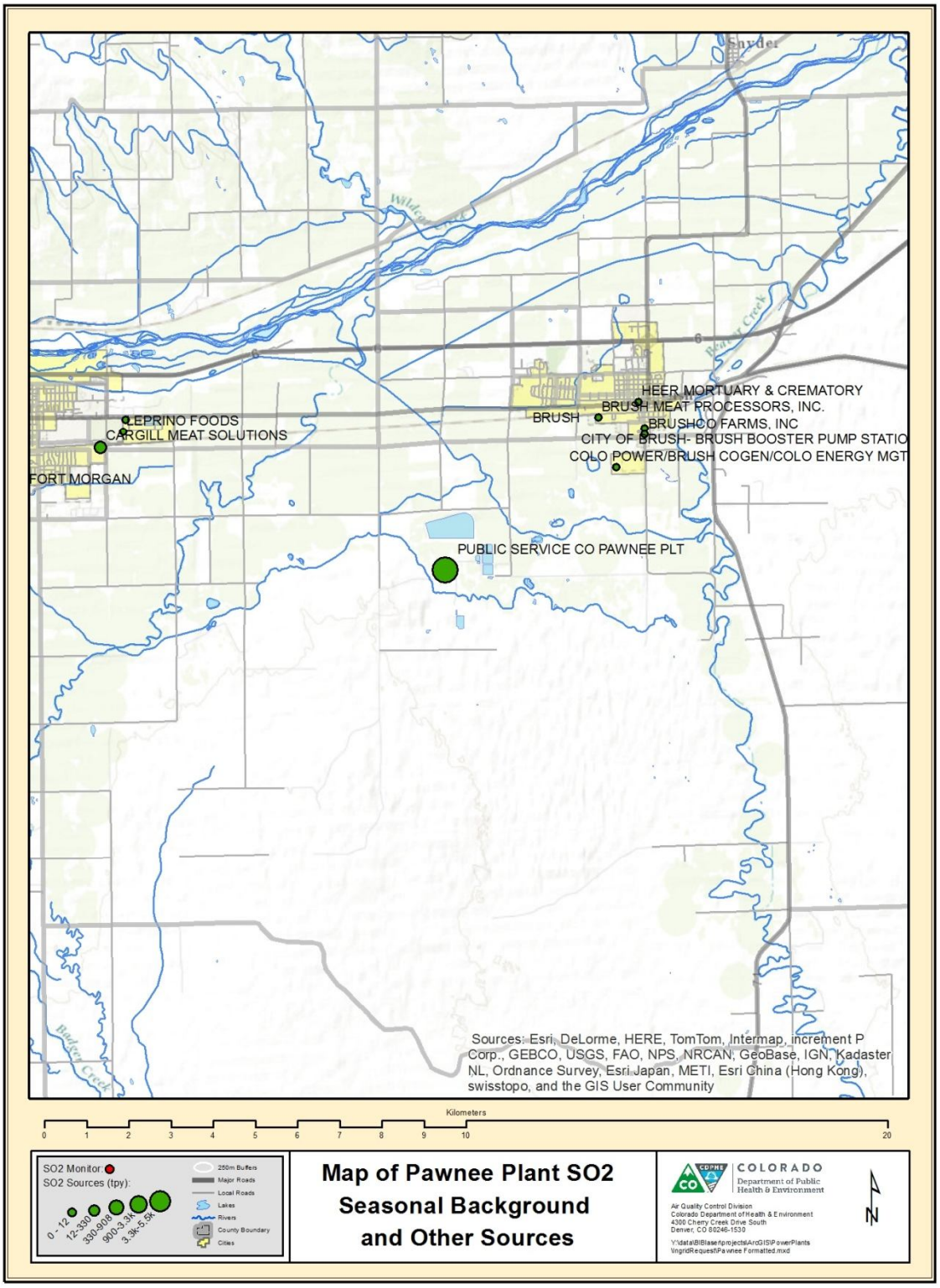


Figure 9: Map of Pawnee Power Plant and Nearby SO_2 Sources

Because of the significantly higher source emissions around the RM Reservoir monitor (3,650 tpy vs 108 tpy), the RM Reservoir monitoring data provides a conservative estimate of the background SO_2 emissions that could be found near Pawnee. In the absence of local data, APCD used best professional judgment to determine that this data is the best estimate of background concentrations at Pawnee. The RM Reservoir monitor could be overly conservative based on the above information and the fact that the Comanche Generating Station and the Rocky Mountain Steel Mill, large SO_2 sources, are located near the monitor.

APCD is using a 1-hour SO_2 background concentration of 10 ppb (based on the design value) that is representative of the background concentration in the vicinity of Pawnee. The design value is from the RM Reservoir Site, and is the 99th percentile two-year average (2014-2015). Note that this background concentration is conservative since the data were collected at or near the sources modeled in this analysis and likely includes contributions from these sources. Consistent with EPA air quality modeling guidance, the constant background concentration will be added to the modeling results and will not be explicitly included in the model.

Presentation of Modeling Results and Modeling Files

This final report compares the modeled ground-level concentrations (with the background concentration added) to the 1-hour SO_2 standard and include spatial contour plots of the modeled concentrations. All input and output files related to the modeling are provided with the final report, including all emissions information and spreadsheets, data associated with the background concentration, building specifications, and other relevant information used to support the assumptions in the modeling analysis.

1-hour SO_2 NAAQS Assessment

The modeled design concentration was calculated by AERMOD as 99th percentile of the annual distribution of the daily maximum 1-hr SO_2 concentration for the year of meteorological data used. This is equivalent to the highest fourth highest modeled daily maximum 1-hr concentration and the result can be seen in below.

Table 7: Summary of the Modeled Design Concentration

Ranked Value	Concentration (ppb)	Receptor Location (X, Y UTM Z13 NAD27)	Background Concentration (ppb)	Total Impact (ppb)	1-hr SO_2 NAAQS (ppb)
H4H	32.98	613589.10 E 4452765.40 N	10	42.98	75

As shown, the total impact is far below the corresponding 1-hr SO_2 NAAQS. The location of the highest impact is at the eastern part of the ambient air boundary and the overall distribution of concentration can be seen in Figure 10, Figure 11, and Figure 12.

Figure 10: Cumulative Modeled concentrations (µg/m^3) with background all domain

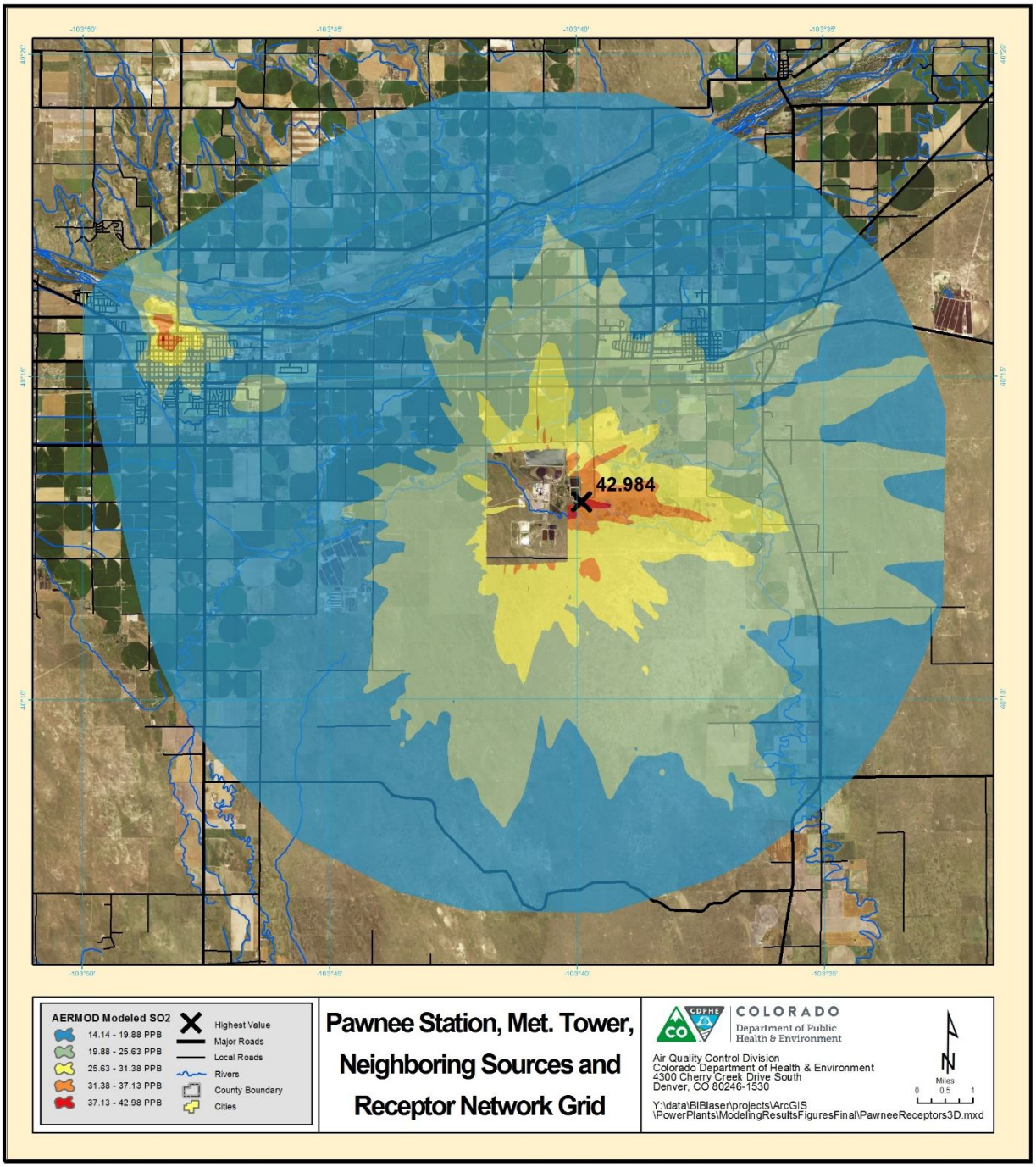


Figure 11: Cumulative modeled concentrations (µg/m^3) with background around the Pawnee Power Plant

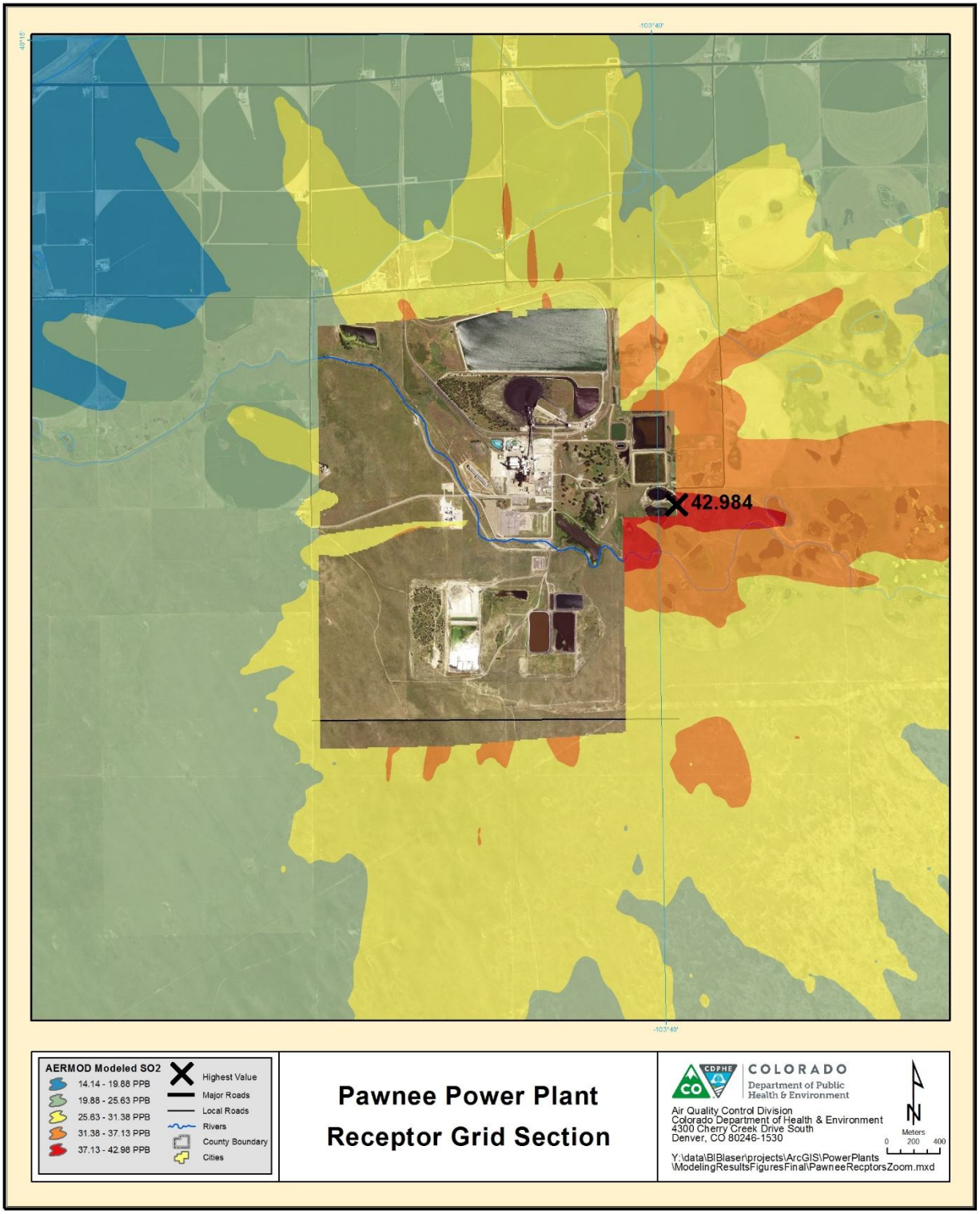


Figure 12: Cumulative modeled concentrations (µg/m^3) with background near Western Sugar Cooperative