Modeling Results for the Initial Designation of the 2010 1-Hour SO_2 Standard Pursuant to the Data Requirements Rule

Colstrip Steam Electric Station, Rosebud County, Montana

Public Comment Date: October 21, 2016

Estimated EPA Submittal Date: January 13, 2017

DEQ

Montana Department of Environmental Quality

Table of Contents

Table of Tables

Table of Figures

Acronyms

µg/m^3	Micrograms Per Cubic Meter
AERMOD	American Meteorological Society/EPA Regulatory Model Regulatory Model
Appendix W	Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions; Final Rule. Appendix W of 40 CFR Part 51
ASOS	Automated Surface Observing Systems
BPIPPRM	Building Profile Input Program – Plume Rise Model Enhancement
CELP	Colstrip Energy Limited Partnership
CEMS	Continuous Emissions Monitoring Systems
CFR	Code of Federal Regulations
Colstrip	Colstrip Steam Electric Station
DRR	Data Requirements Rule
DV	Design Value
EPA	U.S. Environmental Protection Agency
FR	Federal Register
ft.	Foot (Feet)
GEP	Good Engineering Practice
g/s	Grams Per Second
Hg	Mercury
hr(s)	Hour(s)
K	Temperature in Kelvin Degrees
km	Kilometer(s)
lb/hr	Pound Per Hour
m	Meter(s)
MAQP	Montana Air Quality Permit
MDEQ	Montana Department of Environmental Quality
mi.	Mile(s)
mph	Miles Per Hour
m/s	Meters Per Second
MT	Montana
MW	Megawatt
NAAQS	National Ambient Air Quality Standard(s)
NAD83	North American Datum 1983
NCIR	Northern Cheyenne Indian Reservation
NED	National Elevation Dataset
NLCD	National Land Cover Dataset, National Land Cover Database
NWS	National Weather Service
P_{act}	Actual Pressure
PM	Particulate Matter
P_{std}	Standard Pressure (29.92" Hg)
ppb	Parts Per Billion
R	Racine Temperature
Rosebud	Rosebud Power Plant, CELP

Acronyms (continued)

SO_2	Sulfur Dioxide
State	State of Montana
T_{act}	Actual Temperature
TAD	Technical Assistance Document
Talen	Talen Energy, LLC
tpy	Tons Per Year
T_{std}	Standard Temperature (527.7 ^{0}R)
USGS	United States Geological Society
UTM	Universal Transverse Mercator
WBAN	Weather Bureau Army Navy
WY	Wyoming

Introduction

On June 22, 2010, based on its review of the air quality criteria for the primary sulfur dioxide (SO_2) National Ambient Air Quality Standards (NAAQS), U. S. Environmental Protection Agency (EPA) revised the primary SO_2 NAAQS to provide requisite protection of public health with an adequate margin of safety. Specifically, EPA established a new 1-hour SO_2 NAAQS at a level of 75 parts per billion (ppb) (196.5 microgram per cubic meter ($\mu g/m^3$)), based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations (75 Federal Register, FR, 35520).

On August 21, 2015, the EPA finalized the "Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS); Final Rule" (80 FR 51051)[1]. This document established the timeline and requirements for characterizing air quality in areas with large sources of SO_2 emissions. Per the Data Requirements Rule (DRR), the Colstrip Steam Electric Station (Colstrip) is an "applicable source" because it exceeds the 2,000 tons per year (tpy) applicability threshold. Applicable sources are subject to an air quality review by either air dispersion modeling, air quality monitoring, or adoption of a federally enforceable SO_2 facility emission limit of 2,000 tpy.

In a January 15, 2016 letter to Carl Daly, EPA Air Program Director Region 8, the State of Montana (State) provided an inventory of all sources of SO_2 in Montana illustrating that Colstrip, with 10,110 tons of SO_2 during the 2014 calendar year, was the only facility with emissions greater than the 2,000 tpy source applicability threshold. EPA Region 8 concurred with the State's source categorization in a March 21, 2016 letter from Carl Daly. In a July 1, 2016 letter to Monica Morales, EPA Acting Air Program Director Region 8, the State indicated its election to conduct air dispersion modeling to evaluate and provide an initial 1-hour SO_2 NAAQS designation for Rosebud County, Montana (MT). EPA Region 8 accepted and concurred with Montana's protocol in an email from Rebecca Matichuck to Kristen Martin on August 31, 2016. The State worked in coordination with Talen Energy, LLC (Talen), the current operator of Colstrip, to develop this modeling demonstration following available EPA guidance documents. This demonstration is meant to fulfill the requirements in the DRR for submission by January 13, 2017 for approval from EPA.

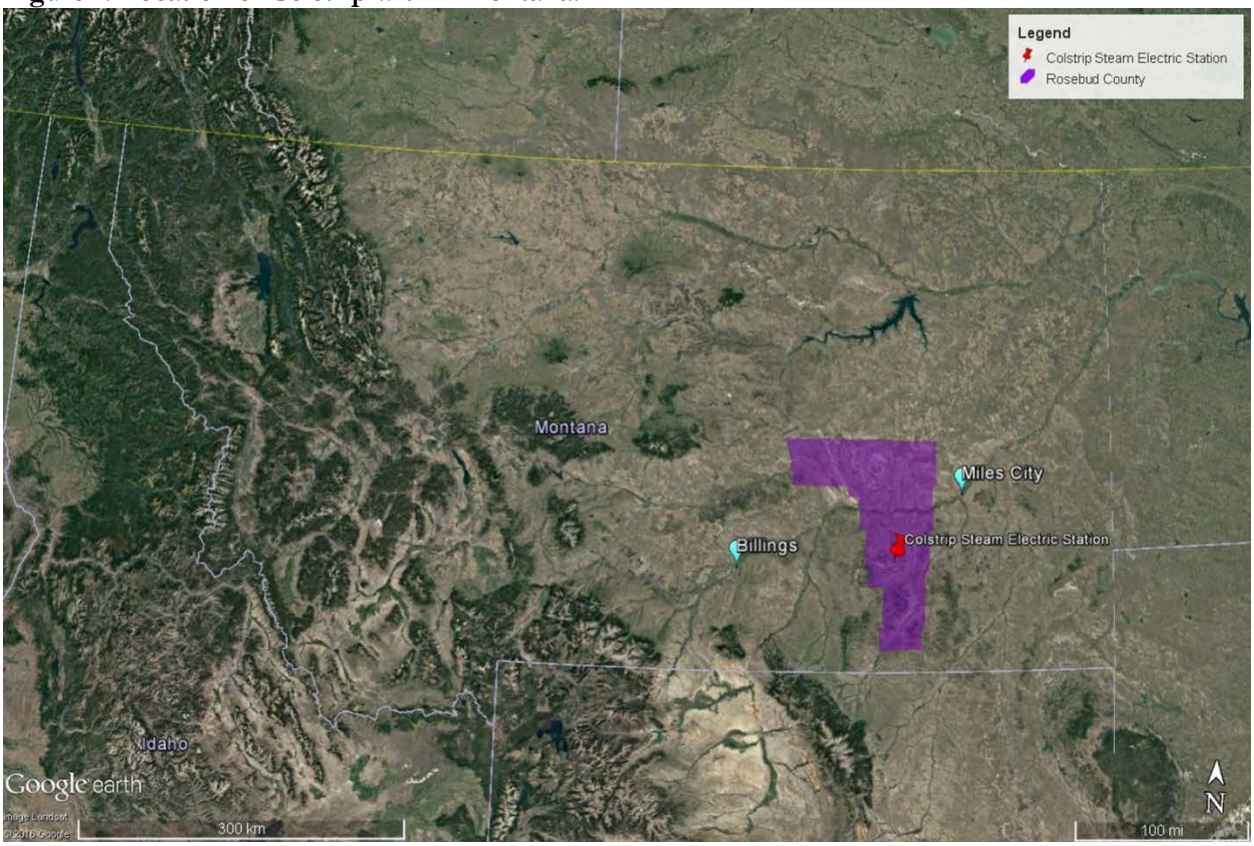
EPA outlined a number of guidance documents to consider for this modeling protocol. On March 24, 2011, EPA issued "Modeling Guidance for SO_2 NAAQS Designations" as part of the "Area Designations for the 2010 Revised Primary Sulfur Dioxide National Ambient Air Quality Standard"[2] and subsequently issued the DRAFT SO_2 NAAQS Designations Modeling Technical Assistance Document (Modeling TAD)[3] in December 2013 and February 2016; and "Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standard" (March 20, 2015)[4]. In addition, the "Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions; Final Rule. Appendix W of 40 CFR Part 51"[5] was used to support this modeling demonstration.

Source Description

Geographical and Political Features

The Colstrip Steam Electric Station (Montana Air Quality Permit, MAQP, 0513-13) is located in the town of Colstrip (2010 U.S. Census population 2,214) within Rosebud County, MT, in the southeast corner of Montana. The facility is located approximately (~) 144 kilometers (km) (90 miles, mi.) to the east of Billings, MT (2010 U.S. Census population 104,170) and ~ 80 km (50 mi.) to the southwest of Miles City, MT (2010 U.S. Census population 8,410). Figure 1 shows the location of Colstrip within the State of Montana.

Figure 1. Location of Colstrip within Montana.



Rosebud County is a high plains area with terrain gently decreasing from west to east to a low point of 762 meters (m) (2,500 feet, ft.) at the Yellowstone River. Within 30 km (19 mi.) to the south of Colstrip, the terrain rises to over 1,219 m (4,000 ft.) in the Northern Cheyenne Indian Reservation (NCIR). The Colstrip Energy Limited Partnership (CELP) operates the Rosebud Power Plant (Rosebud) approximately 11 km (7 mi.) north of the Colstrip facility (Figure 2). Figure 3 shows the terrain between Colstrip and Rosebud is generally flat, as both facilities are located within a creek valley.

Figure 2. Rosebud County.

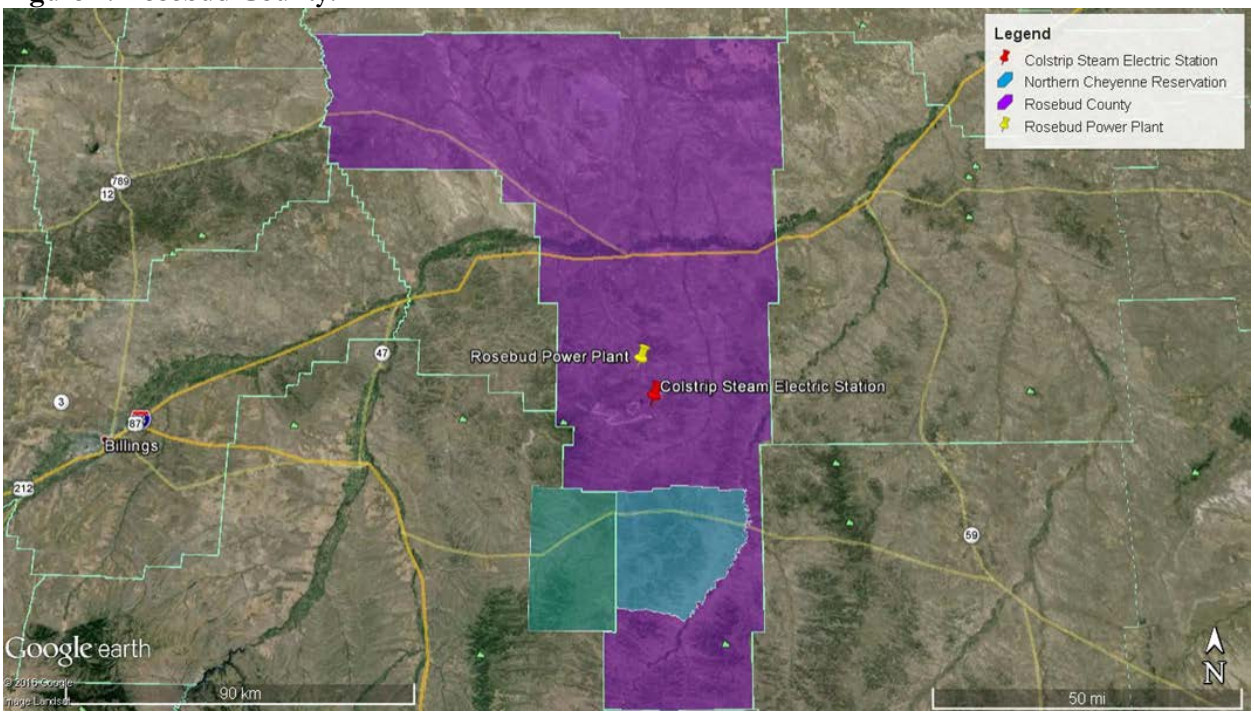
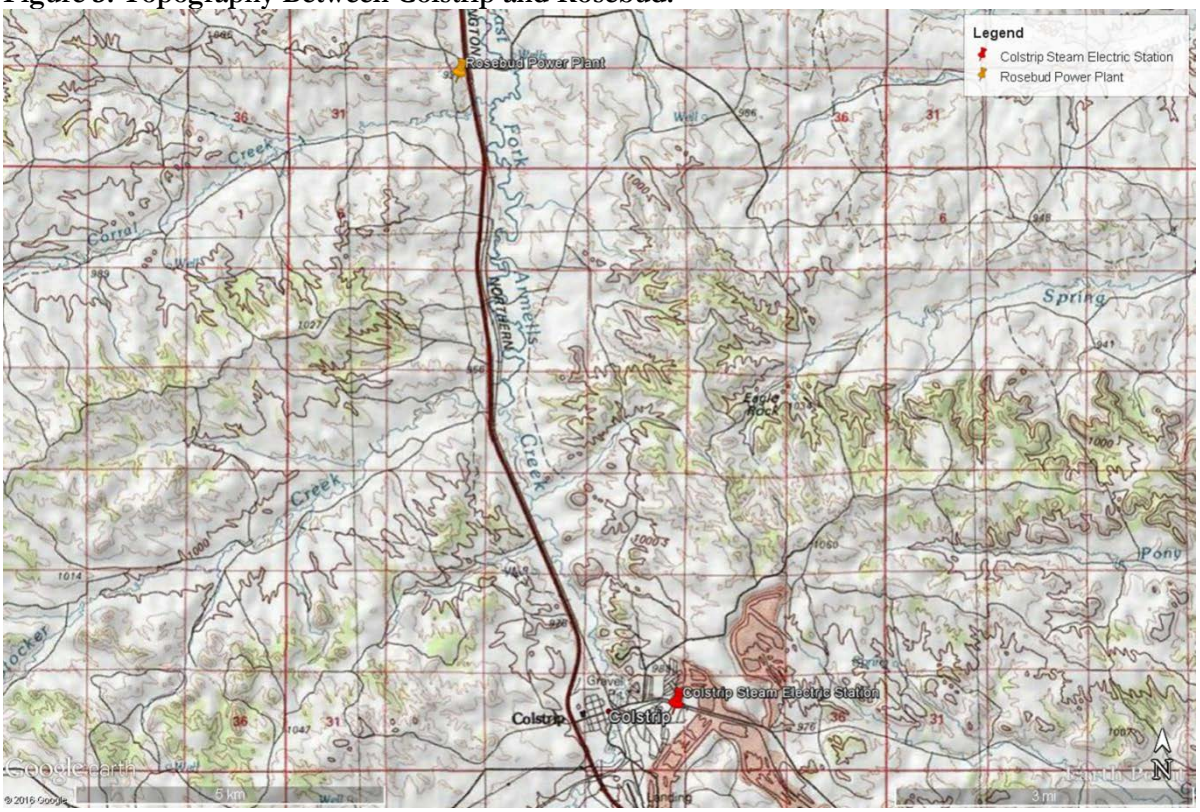


Figure 3. Topography Between Colstrip and Rosebud.



Colstrip facility is located in an area with less than 60 m (200 ft.) change in elevation within a few kilometers of the facility. The elevation in the vicinity of the facility is roughly 975 m (3,200 ft.) above sea level. Roughly

24 km (15 mi.) to the west of the facility the terrain increases in elevation to 988 m (3,240 ft.). Coal mines are located to the west and south of the town and facility. The facility itself is located to the east of the main population center as shown in Figure 4.

Figure 4. Aerial View of Colstrip Surrounding Area.

Facility Characteristics

Colstrip has four tangential coal-fired units (Units 1-4, EU001-EU004) as well as a building heating boiler (EU006) and emergency generators (EU010). Units 1 and 2 are 333 megawatt (MW) sub-bituminous coal-fired boilers with a name plate fuel input of 3,419.5 million British thermal units per hour (MMBtu/hr) each, as reported by Talen. Units 3 and 4 are 805 MW sub-bituminous coal fired boilers with a name plate fuel input of 8,000 MMBtu/hr each, as reported by Talen. Figure 5 is a more detailed aerial view of the Colstrip facility.

The building heating boiler (EU006) is in non-operational status, did not operate during the 2012-2014 period, and therefore had zero emissions. Furthermore, the building heating boiler has not operated for over 20 years and there are no plans to operate it in the foreseeable future. The emergency diesel generators (EU010) are restricted to less than 100 hours per year of non-emergency use (e.g., periodic testing) per year. The March 2011 Memorandum titled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard"[6] states that the EPA "recommends that compliance demonstrations for the 1-hour NO_2 NAAQS address emission scenarios that can logically be assumed to be relatively continuous or which occur frequently enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations based on existing modeling guidelines, which provide sufficient discretion for reviewing authorities to not include intermittent emissions from emergency generators or startup/shutdown operations from compliance demonstrations..." The March 2011 "Area Designations for the 2010 Revised Primary Sulfur Dioxide National Ambient Air Quality Standards"[2] states that the NO_2 modeling guidance is applicable to the SO_2 standards.

Figure 5. Colstrip Facility.

Model Selection

The Modeling TAD cites Appendix W for model selection. The American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) is recommended as the preferred model for the near-field air dispersion modeling; near-field is generally considered as distances less than or equal to 50 km (31 mi.) from the source. Alternative models may be applied, but would require site specific justification and EPA approval. The most recent version of AERMOD (version number 15181), issued by EPA, together with its various preprocessor programs were used for this analysis and are listed in Table 1.

Table 1. AERMOD Preprocessors.

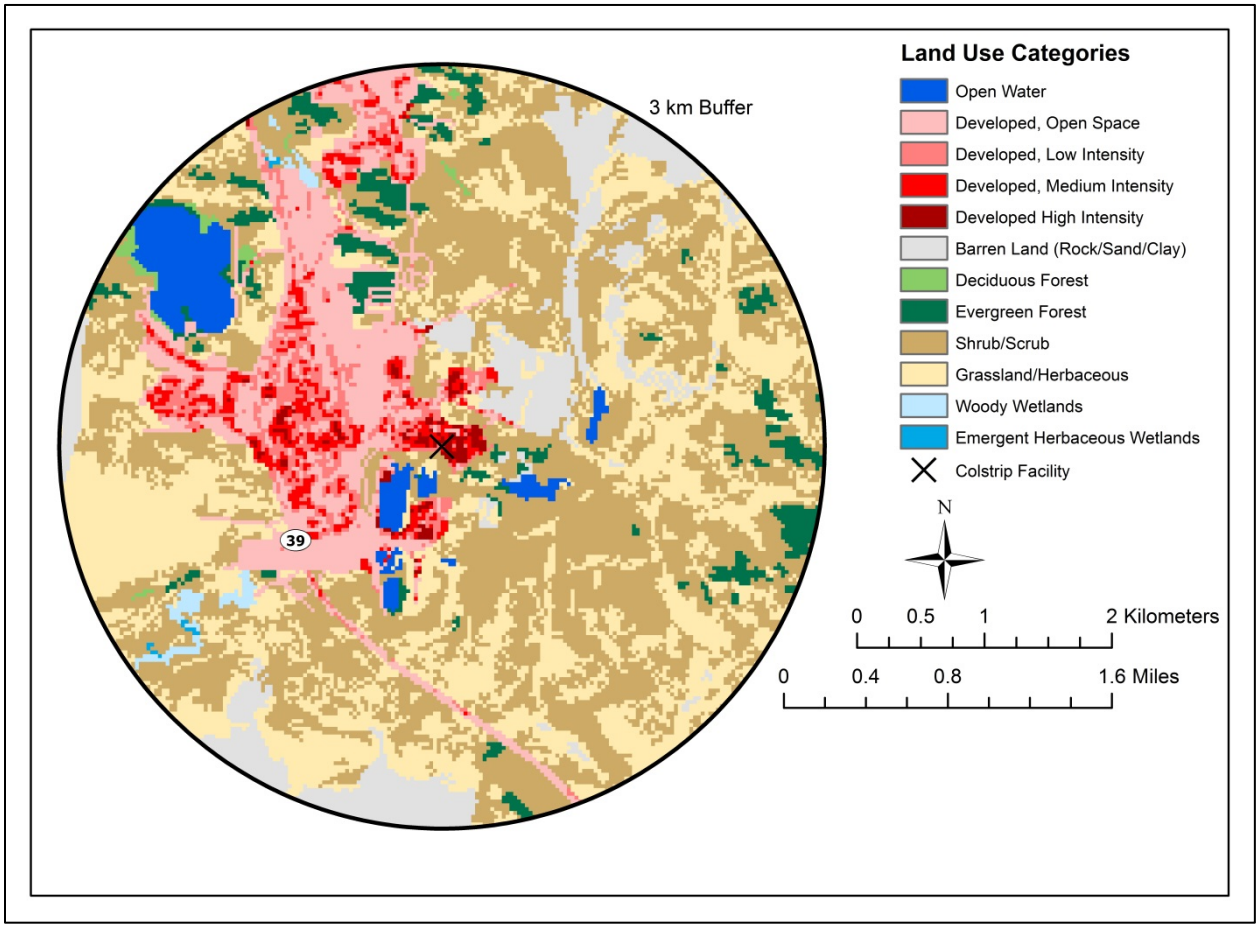
Preprocessor	Version	Function
AERMAP	11103	Terrain preprocessor
AERSURFACE	13016	Determines surface characteristics surrounding surface meteorological station
AERMINUTE	15272	Reduces the number of hours with calm and variable low wind speeds
AERMET	15181	Main meteorological preprocessor
BPIPPRM	04274	Evaluates building downwash effects and determines good engineering stack height

For the urban/rural classification within AERMOD, the site location was classified as rural using the land use procedure specified in Appendix W. The 2011 National Land Cover Database (NLCD)[7] layer was clipped to a 3 km (2 mi.) ring around the Colstrip facility. The percent of land classified as developed within this radius was less than 20% (Table 2). By the definition in Appendix W, land that contains less than 50% of developed land use categories should be considered rural. Figure 6 shows the land cover within a 3 km radius of the Colstrip facility.

Table 2. Land Use Category, 2011 NLCD.

Land Category	Type	Description	Percent
11	Rural	Open Water	3
21	Urban	Developed, Open Space	10
22	Urban	Developed, Low Intensity	4
23	Urban	Developed, Medium Intensity	2
24	Urban	Developed High Intensity	1
31	Rural	Barren Land (Rock/Sand/Clay)	8
41	Rural	Deciduous Forest	0
42	Rural	Evergreen Forest	4
52	Rural	Shrub/Scrub	38
71	Rural	Grassland/Herbaceous	29
90	Rural	Woody Wetlands	1
95	Rural	Emergent Herbaceous Wetlands	0
		Rural Total	**83**
		Urban Total	**17**

Figure 6. 2011 Land Use Categories for Rural Designation.



Emissions Characterization

In accordance with the Modeling TAD for the DRR, three years of actual emissions data were used to conduct the SO_2 designation modeling for Rosebud County. Actual SO_2 emission rate data from representative years were available from continuous emissions monitoring systems (CEMS) at all four Colstrip generating units. Hourly continuous data were used for the 2012 to 2014 calendar years for Units 1-4 which were supplied by Talen as model inputs; CEMS data were measured according to the requirements of 40 CFR Part 60 (SO_2 concentration) and 40 CFR Part 75 (mass rate). Actual flow and temperature data were also measured by the CEMS and were used to vary the stack temperature and velocity on an hourly basis. The CEMS data capture rates during the unit operating hours (excluding shutdown periods) were 98.5%, 99.7% 99.4%, and 99.7% for Units 1, 2, 3, and 4, respectively, over the three year period. The amount of data capture by unit and year are presented in Table 3. Table 4 summarizes the total number of hours each unit was not in operation for each calendar year. More information about these shutdown periods is available in Appendix A.

Table 3. Total Hours with Valid CEMS Emissions Data by Unit and Year.

Year (annual hours)	Hours of Valid CEMS data (percent of year)			
	Unit 1	Unit 2	Unit 3	Unit 4
2012 (8,784)	8,768 (99.8)	8,782 (99.9)	8,705 (99.1)	8,724 (99.3)
2013 (8,760	8,447 (96.4)	8,709 (99.4)	8,727 (99.6)	8,753 (99.9)
2014 (8,760)	8,695 (99.3)	8,725 (99.6)	8,726 (99.6)	8,752 (99.9)
Total (26,304)	**25,910 (98.5)**	**26,216 (99.7)**	**26,158 (99.4)**	**26,229 (99.7)**

Table 4. Total Shutdown Hours by Unit and Year.

Year (annual hours)	Hours of Shutdown (percent of year)			
	Unit 1	Unit 2	Unit 3	Unit 4
2012 (8,784)	3,221 (36.7)	3,230 (36.8)	874 (9.9)	216 (2.5)
2013 (8,760)	341 (3.9)	303 (3.5)	219 (2.5)	5,630 (64.3)
2014 (8,760)	502 (5.7)	326 (3.7)	1,877 (21.4)	918 (10.5)
Total (26,304)	**4,064 (15.5)**	**3,859 (14.7)**	**2,970 (11.3)**	**6,764 (25.7)**

When hourly CEMS data were missing, the following protocol was developed to estimate appropriate emission rates, stack temperatures or exit velocities. If CEMS data were missing and the unit was shut down, a value of zero (0) was used for each emission rate, temperature and velocity value. If the unit was operational and the missing CEMS data occurred over four consecutive hours or less, then data were linearly interpolated from the valid two hourly data before and after the missing data. If the unit was operational and the missing CEMS data covered more than four continuous hours, then the permitted hourly emission limits were used with the full load stack temperatures and stack velocities, averaged from three stack tests to represent maximum load conditions. Tables 5 and 6 summarize how the missing CEMS data were addressed for each unit at Colstrip. Since Units 3 and 4 share a permitted SO_2 emission limit, the combined total emissions for periods when both units were operating and one or both CEMS were down shall never exceed the shared permitted limit as shown in Table 6.

Table 5. Units 1 and 2 Methodology for Replacing Missing CEMS Data.

Unit Shutdown?	Missing Period	Emission Rate Substitution	Stack Temperature Substitution	Exit Velocity Substitution
Y	Any	0 (No emission rate)	0	0
N	≤ 4 hours	Emission rate(s) will be linearly interpolated from the valid hour of data immediately before and after the missing data	Temperature(s) will be linearly interpolated from the valid hour of data immediately before and after the missing data	Velocity(ies) will be linearly interpolated from the valid hour of data immediately before and after the missing data
N	> 4 hours	Hourly SO_2 permitted emission limit = 4,103 lb/hr	Representative full load PM stack test Unit 1 = 362.3 K Unit 2 = 362.7 K	Representative full load PM stack test Unit 1 = 31.5 m/s Unit 2 = 31.3 m/s

lb/hr = pounds per hour; PM= particulate matter; K = Kelvin degrees; PM= particulate matter; m/s = meters per second.

Table 6. Units 3 and 4 Methodology for Replacing Missing CEMS Data.

Unit Shutdown?	Missing Period	Emission Rate Substitution	Stack Temperature Substitution	Exit Velocity Substitution
Y	Any	0 (No emission rate)	0	0
N	≤ 4 hours	Emission rate(s) will be linearly interpolated from the valid hour of data immediately before and after the missing data	Temperature(s) will be linearly interpolated from the valid hour of data immediately before and after the missing data	Velocity(ies) will be linearly interpolated from the valid hour of data immediately before and after the missing data
N	> 4 hours	*(A) If both units were operating with both missing CEMS:* Each unit will be modeled at 2,070 lb/hr (half of combined hourly permitted emission limit). *(B) If both units were operating and one unit had missing CEMS:* The difference between in-service CEMS and 4,140 lb/hr permitted emission limit will be used for missing unit.	Representative full load PM stack test Unit 3 = 359.9 K Unit 4 = 360.2 K	Representative full load PM stack test Unit 3 = 37.4 m/s Unit 4 = 36.9 m/s

lb/hr = pounds per hour; K = Kelvin degrees; PM= particulate matter; m/s = meters per second.

As discussed previously, actual stack temperatures and velocities were used in the modeling from the valid CEMS data. The CEMS data reported standard volumetric flow rates which were converted to actual flow rates using the following equation as reported by Talen:

Actual Flow (m/s) = Standard Flow (m/s) / [(P_{act}/P_{std}) x (T_{std}/T_{act})]

Where:

P_{act}, Actual pressure: assumed to be 26.0" Mercury (Hg) for all units
P_{std}, Standard pressure: 29.92"Hg
T_{act}, Actual temperature: assumed to be 652.2^{0}Rankine (R) for Units 1 and 2 and 653.8^{0}R for Units 3 and 4.
T_{std}, Standard temperature: 527.7^{0}R

A time series of monthly emissions data, 2012 – 2014, for each unit are available in Appendix B. Additional stack parameters that were used in modeling are provided in Table 7; Talen provided the coordinates, stack heights, stack base elevations, and stack inside diameters. A spreadsheet of hourly emissions, stack temperatures, and velocities from January 2012 through December 2014 was submitted to EPA in July 2016 with the modeling protocol.

Table 7. Stack Parameters for Colstrip Steam Electric Station.

Stack ID #	NAD83 Zone 13 UTM Coordinates		Stack Height	Base Elevation	Stack Diameter	Gas Exit Velocity	Exit Temperature
	Easting	Northing					
	km	km	m	m	m	m/s	K
Unit 1	374.7065	5082.327	152.4	988	5.03	varies	varies
Unit 2	374.7749	5082.326	152.4	988	5.03	varies	varies
Unit 3	374.8787	5082.221	210.9	988	7.32	varies	varies
Unit 4	374.9696	5082.218	210.9	988	7.32	varies	varies

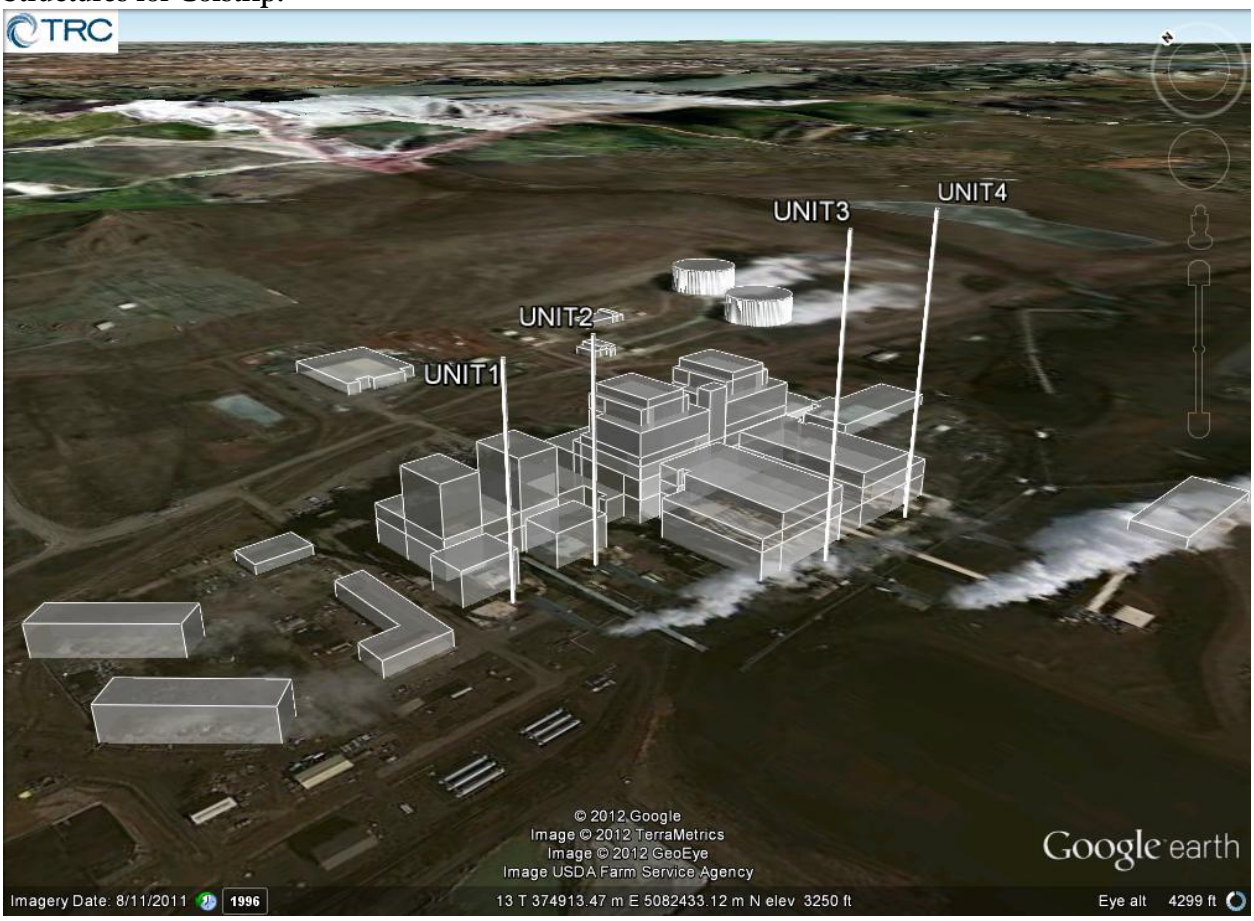
NAD83 = North American Datum 1983; UTM = Universal Transverse Mercator; km = kilometers; m = meters; m/s = meters per second; K = Kelvin degrees.

As noted above, the building heater boiler (EU006) reported zero emissions during the 2012 - 2014 modeling period and therefore was not included in the modeling analysis. The emergency diesel generators (EU010) also were not modeled as emission sources due to the highly restricted operating hours and use of ultra-low sulfur diesel fuel as required by the New Source Performance Standards.

Building Downwash

The plant structures, buildings and tanks, were included for AERMOD downwash calculations; Talen provided the structure locations, elevations, and dimensions. Figure 7 presents the structures and stacks superimposed on an aerial photograph of the Colstrip facility. The BPIPPRM input file was submitted to EPA in July 2016 along with the modeling protocol.

Figure 7. Building Profile Input Program for PRIME (BPIPPRM) Analysis of Stacks and Building Structures for Colstrip.



Rosebud Power Plant

As noted in the site description, CELP operates the Rosebud Power Plant (Rosebud, Title V #OP 2035-03) about 11 km (7 mi.) north of the Colstrip facility. Rosebud is not an "applicable source" under the DRR since the facility emissions were below the 2,000 tpy applicability threshold during the 2014 calendar year. Rosebud has a single circulating fluidized bed coal-fired boiler (EU006) with a nameplate capacity of 41.5 MW per Rosebud's Title V permit. This facility is designed to burn low-Btu waste coal from nearby mining operations. Sulfur dioxide emissions are controlled by limestone injection into a fluidized bed. The boiler has a permitted SO_2 emission limit of 72.3228 grams per second (574 pounds per hour, lb/hr) and a required stack height of 60.96 m (200 ft.) per Rosebud's Title V permit. In addition, the facility has a diesel-fired emergency boiler feed pump (EU014) and a fire water pump (EU015), as well as a diesel-fired portable welder (EU016). EU014 and EU015 are limited to 500 hours per year of operation each. Due to the intermittent operations, these sources were not modeled in this assessment. EU016 is a mobile non-road source and did not report any emissions during the modeling period (2012-2014), therefore it was not included in this assessment.

Due to the close proximity of the Rosebud and Colstrip power plants, the Rosebud Power Plant (EU006) was included as a nearby source in this modeling demonstration. Actual emissions, stack temperatures, and stack velocities were provided by CELP. Table 8 below summarizes other modeling parameters used in this demonstration.

Table 8. Stack Parameters for Rosebud Power Plant.

Stack ID #	NAD83 Zone 13 UTM Coordinates		Stack Height	Base Elevation	Stack Diameter	Gas Exit Velocity	Exit Temperature
	Easting	Northing					
	km	km	m	m	m	m/s	K
Rosebud	371.7687	5092.6564	60.96	952.16	2.51	varies	varies

NAD83 = North American Datum 1983; UTM = Universal Transverse Mercator; km = kilometers; m = meters; m/s = meters per second; K = Kelvin degrees.

Meteorological Data

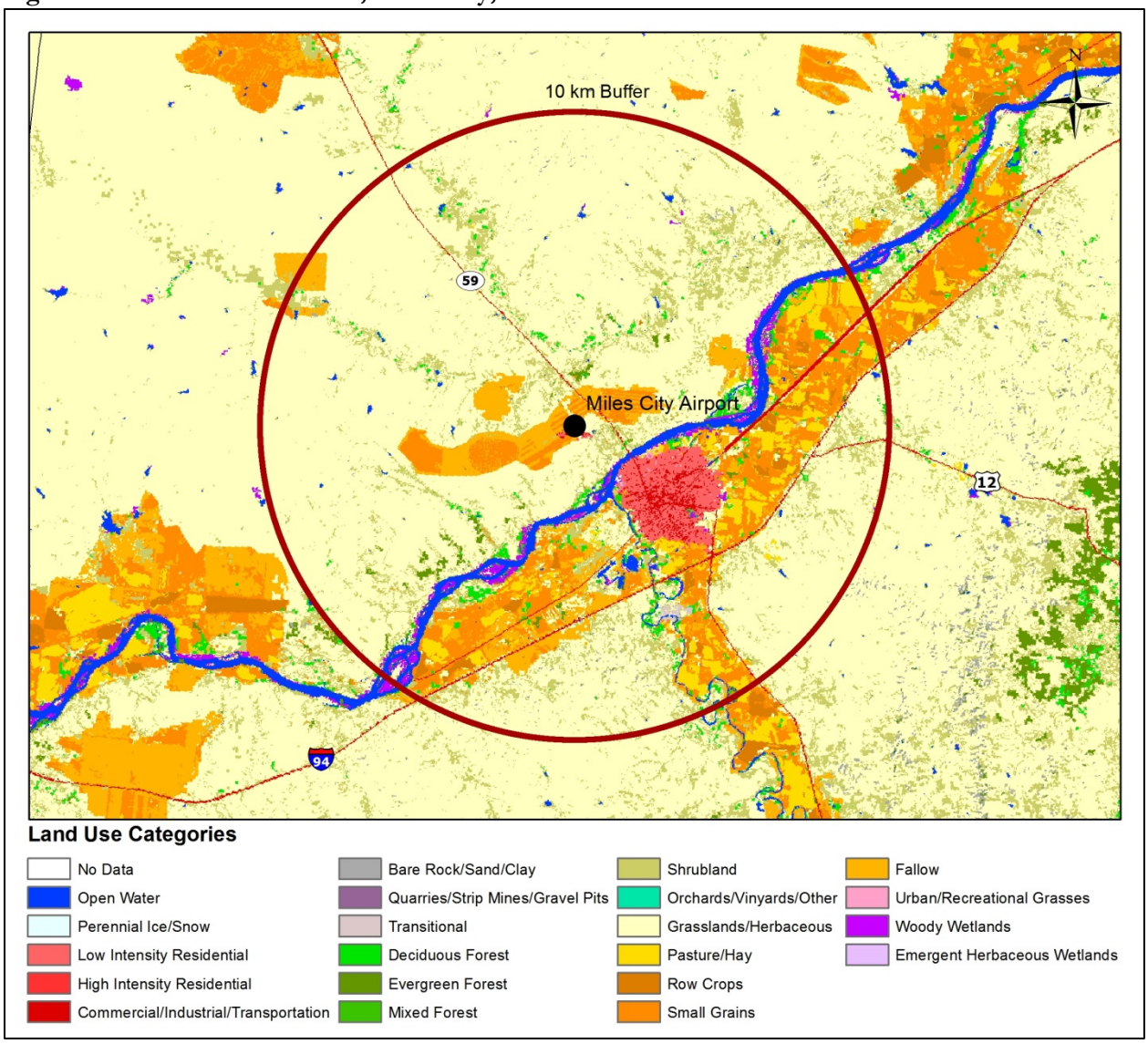
On-site meteorological data were not available at the Colstrip facility, so three years (2012-2014) of recent available National Weather Service (NWS) data were used. The Miles City Frank Wiley Field Airport surface station (Weather Bureau Army Navy (WBAN): 24037) and the Glasgow International Airport upper air station (WBAN: 94008) were selected as the closest representative stations. Table 9 summarizes the potential stations and the rational for the stations selected.

Table 9. Meteorological Station Selection Justification.

Location	Distance and Direction to Facility	Notes
Surface Data		
Miles City, MT (Frank Wiley Field Airport)	**80 km (50 mi.) to the Northeast**	**Closest to facility with similar terrain and both areas are influenced by similar eastern Montana weather patterns.**
Billings, MT (Logan International Airport)	134 km (85 mi.) to the West	Similar terrain and weather patterns but further from the facility.
Sheridan, WY (Sheridan County Airport)	120 km (75 mi.) to the South	Larger influence from mountainous terrain to the west.
Upper Air Data		
Glasgow, MT (Glasgow International Airport)	**250 km (155 mi.) to the North**	**Closest to facility with similar terrain and both areas are influenced by eastern Montana weather patterns.**
Great Falls, MT (Great Falls International Airport)	386 km (240 mi.) to the Northwest	Larger influence from mountain terrain to the west and further from the facility.
Riverton, WY (Riverton Regional Airport)	337 km (210 mi.) to the Southwest	Larger influence from mountain terrain to the west and further from the facility.

AERSURFACE (version 13016) was used to calculate the surface characteristics values, including albedo, Bowen ratio, and surface roughness length, at the surface meteorological observing site for input into AERMET. The 1992 National Land Cover Dataset (NLCD92) file for input into AERSURFACE was downloaded from the United States Geological Society (USGS) website (http://www.mrlc.gov/nlcd1992.php)[8] and shown in Figure 8.

Figure 8. 1992 NLCD Land Use, Miles City, MT.



Surface roughness for the site was determined in 30 degree sectors for a 1 km (0.6 mi.) radius circle around the observing site. The Bowen ratio and albedo was determined based on the average characteristics over a 10 by 10 km (6 mi. by 6 mi.) square centered on the observing site. The surface parameters were determined on a monthly basis using default season assignments. One-minute ASOS (Automated Surface Observing System) wind data was processed using AERMINUTE (version 15272) into hourly data for input into AERMET (15181).

To characterize the surface moisture conditions, annual precipitation data between 1987 and 2014 from the National Weather Service (http://w2.weather.gov/climate/xmacis.php?wfo=byz) at the Mile City Frank Wiley Field Airport were tabulated and percentiles (30th, 50th and 70th) were calculated. If the annual precipitation was below the 30th percentile, the year was characterized as "dry". If annual precipitation was above the 70th percentile, the year was categorized as "wet" otherwise, the classification was "average" (Tables 10 and 11).

Table 10. Summary of Precipitation Data for Miles City, MT, 1987-2014.

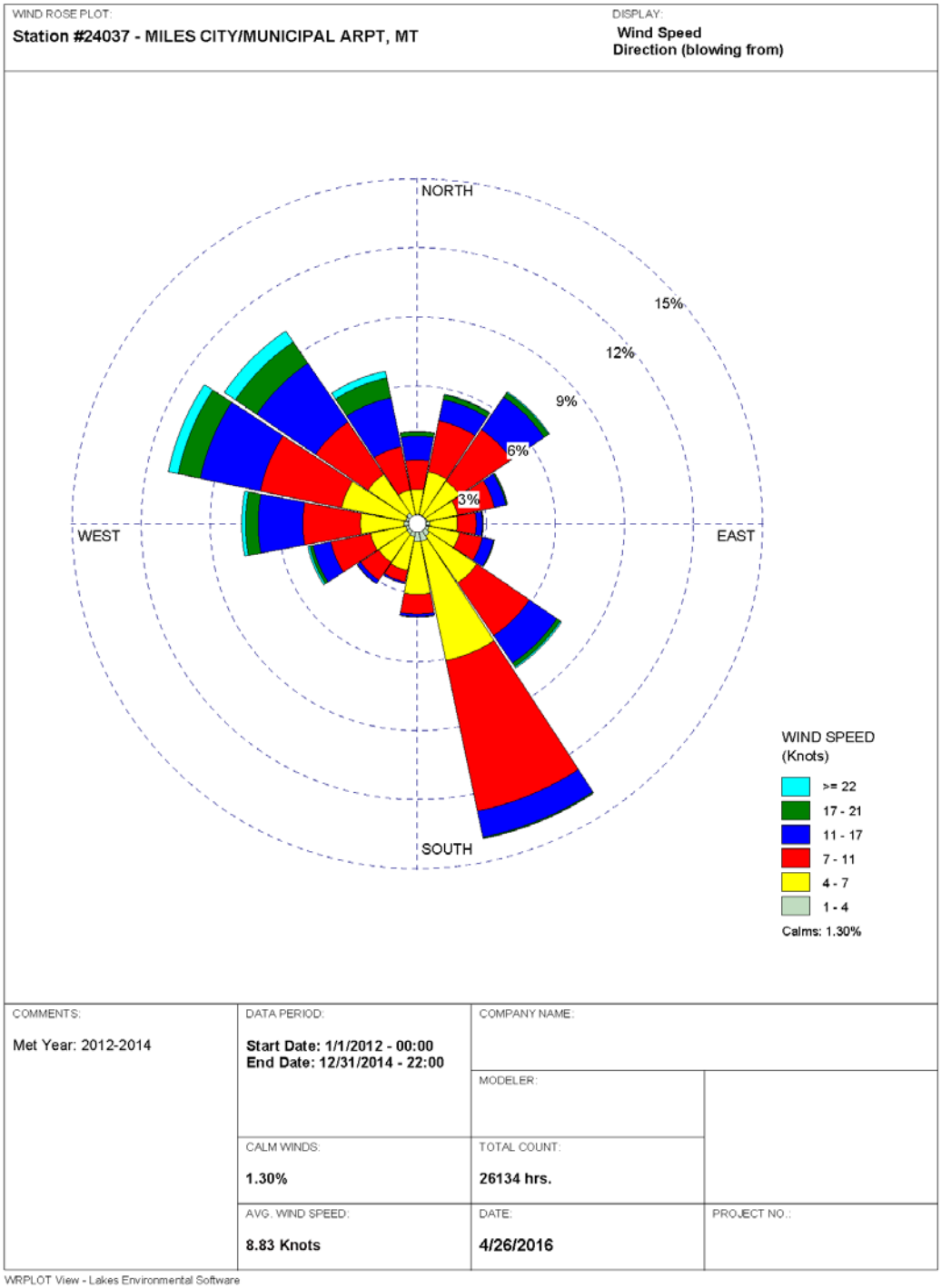
Variable	Precipitation (inches)
Minimum =	5.27
30th Percentile =	10.44
Average =	12.60
70th Percentile =	14.30
Maximum =	19.94

Table 11. Annual Total Precipitation for Miles City, MT, 1987-2014.

Year	Annual Precipitation (inches)	AERSURFACE Designation
2012	6.16	Dry
2013	17.11	Wet
2014	13.29	Average

A wind rose for the entire proposed modeling time period is shown in Figure 9 showing the directions the wind is blowing from; the wind directions are primarily from the northwest and south-southeast. Appendix C displays the wind roses for each year, 2012 – 2014.

Figure 9. Wind Rose for Miles City Frank Wiley Field, MT, 2012-2014.



Receptor Array

A Cartesian modeling receptor array was established to capture the 99th percentiles of the maximum daily one-hour average SO_2 impacts from Colstrip. The receptor grid is a relatively dense receptor array with the following spacing beyond the fence line:

- 50 m (164 ft.) spacing along fence line to at least 1 km from the fence line;
- 100 m (328 ft.) spacing between 1 and 2 km from the fence line; and
- 250 m (820 ft.) spacing between 2 and at least 10 km from the fence line.

No receptors were located within the facility fence line. Figure 10 shows the near-field receptor array and Figure 11 shows the far-field receptor array. Colstrip consists of the main generating facility and two evaporation ponds, one about 3.2 km (2.2 mi.) northwest of the main plant site and one about 4.8 km. (3.0 mi.) southeast of the main plant site. Access to these areas is controlled at all times. The evaporation pond areas are fenced, signed as private property with no trespassing allowed, and patrolled routinely (at least twice per day) by plant Security personnel. All access roads are controlled with lockable gates.

At the main plant, access is by Talen-issued badge only and all visitors must sign in at the Security Guard Shack. The plant is fenced, signed as private property with no trespassing allowed, and patrolled routinely (at least twice per day) by plant Security personnel. All access roads are controlled with lockable gates. The main plant entrance is staffed at all times by Talen Security personnel.

The main plant site shares a boundary and roadway to the south with the Rosebud Mine. Access to this roadway is controlled by the mine. It is within lockable gates, fences which are signed as private property with no trespassing allowed, and patrolled routinely by the Rosebud Mine Security Department. Access to this road is only allowed by passage through staffed security stations.

Due to private ownership, presence of facility operations, and controlled nature of access to the plant areas, per guidance they do not need to contain modeling receptors. Additionally, the evaporation ponds store liquid and solid scrubbing byproducts. It is not feasible to site an ambient monitor in areas covered by these byproduct ponds and per guidance. All areas where access was controlled either by fence line or security personnel do not represent ambient. Therefore, they do not need to contain modeling receptors pre the Modeling TAD[3].

The receptor locations were processed through the current version of the AERMAP preprocessor (version 11103) for a total of 19,382 receptors.

Figure 10. Colstrip Near-Field Receptor Array.

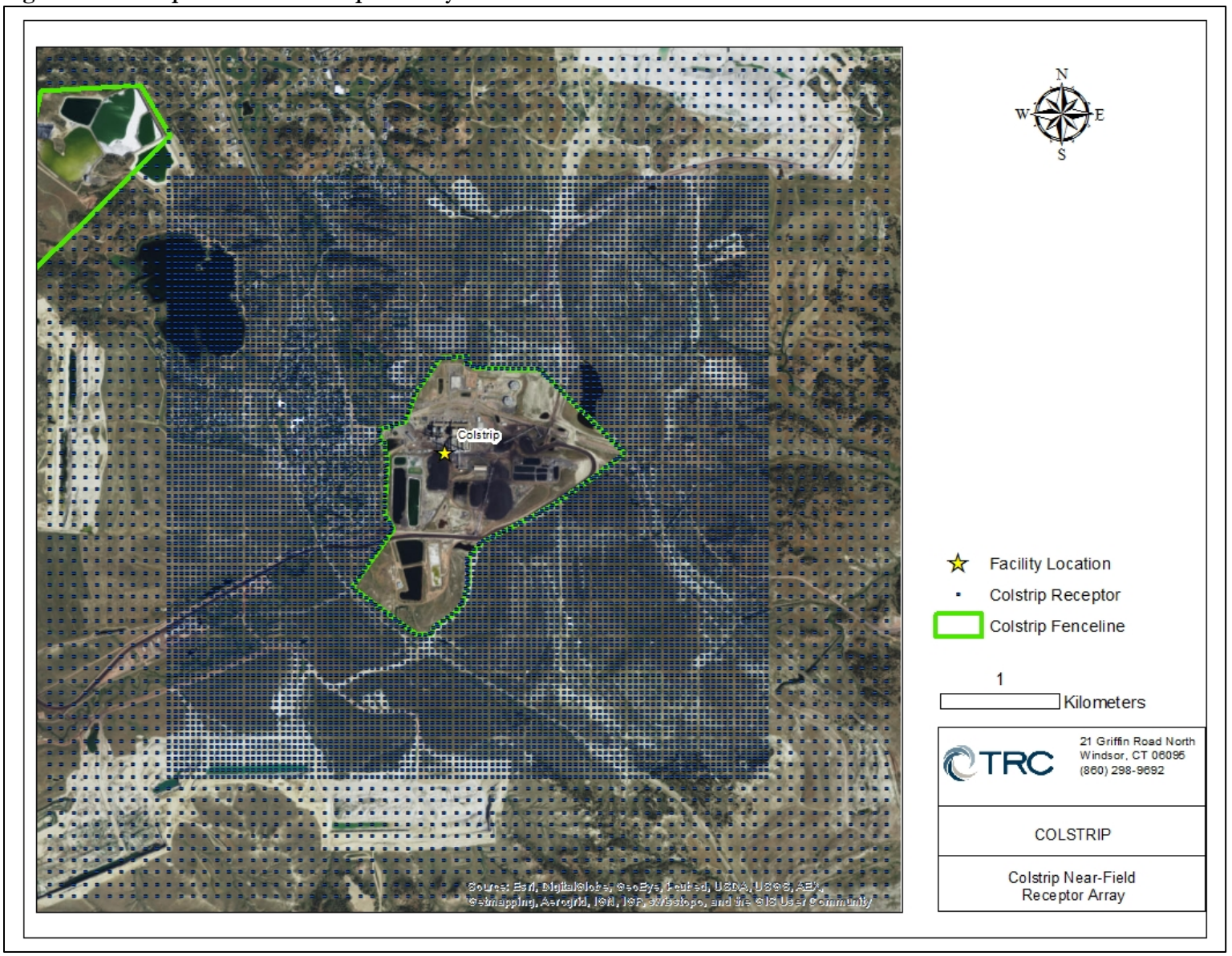
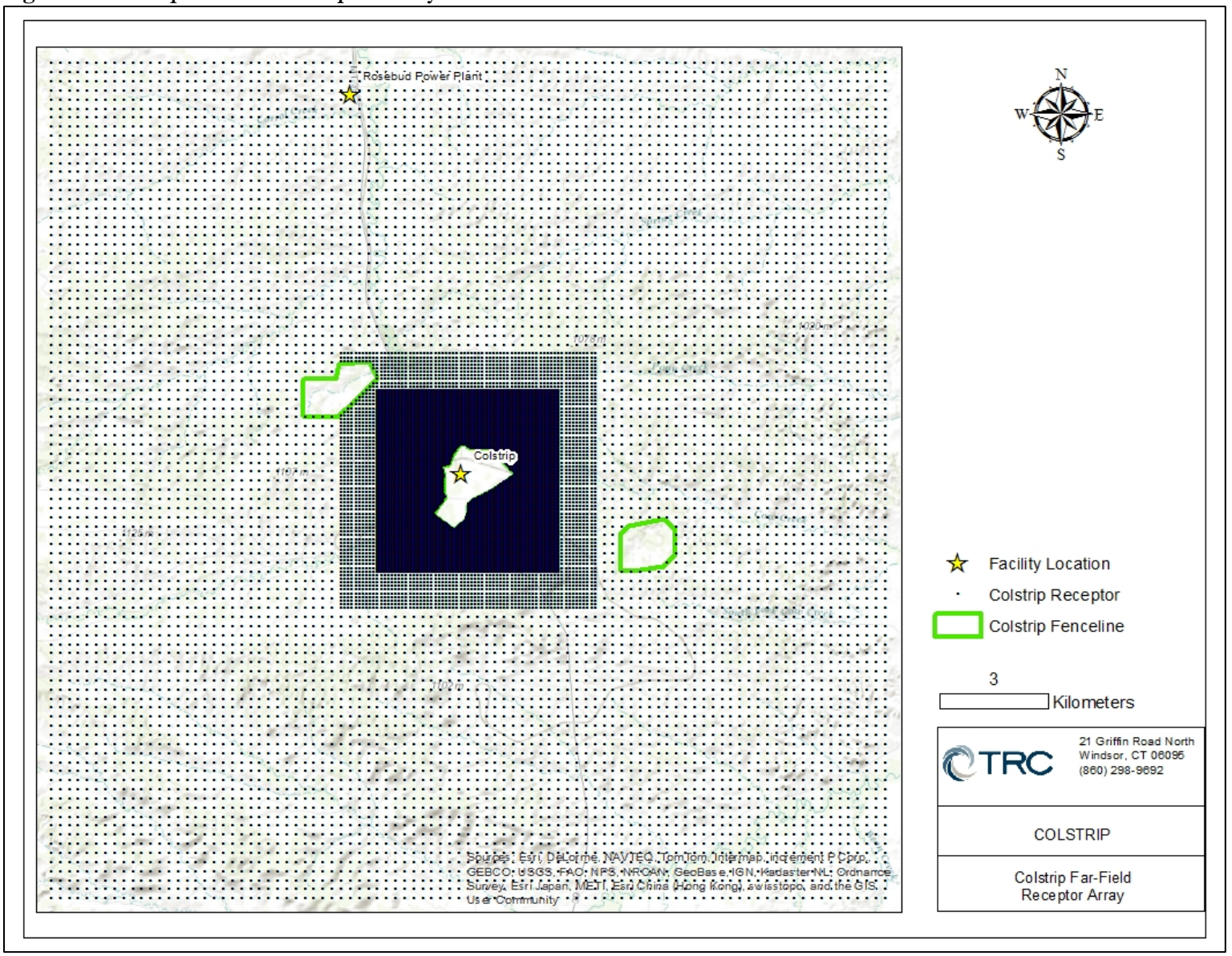


Figure 11. Colstrip Far-Field Receptor Array.



Background Concentrations

Sulfur dioxide background data from the NCIR Morningstar monitor (Site ID 30-087-0760), was used to determine the appropriate one-hour background concentrations to add to the model predicted concentrations. The location of the Morningstar monitor relative to Colstrip and Rosebud facilities is shown in Figure 12. The daily one-hour maximum SO_2 concentrations for 2012 and 2013 were available through the EPA AirData Website (https://www.epa.gov/outdoor-air-quality-data) for the Morningstar monitor, but data were not available for 2014. The 2014 hourly SO_2 monitor data was acquired directly from the Northern Cheyenne Department of Environmental Protection and Natural Resources. A 90 degree wedge centered on a 335 degree wind direction was removed to exclude data from the Colstrip facility. All three years of data was reformatted and the 99th percentile daily one-hour maximum SO_2 concentration was calculated for each season based on guidance in the Modeling TAD. The same seasons that were used in AERSURFACE were used in this analysis (Winter = December – February; Spring = March – May; Summer = June – August; and Fall = September - November). The 2012-2014 three-year average hourly seasonal design value (DV), which is the three year average of the 99th percentile daily one-hour maximum SO_2 concentrations within each season for each hour, was used in AERMOD using the BACKGRND command in the AERMOD Source pathway. Figure 13 shows the seasonal and hourly background values in micrograms per cubic meter (µg/m^3), the NAAQS (196.5 µg/m^3), and other relevant information.

Figure 12. Rosebud County with Facilities and Monitoring Locations.

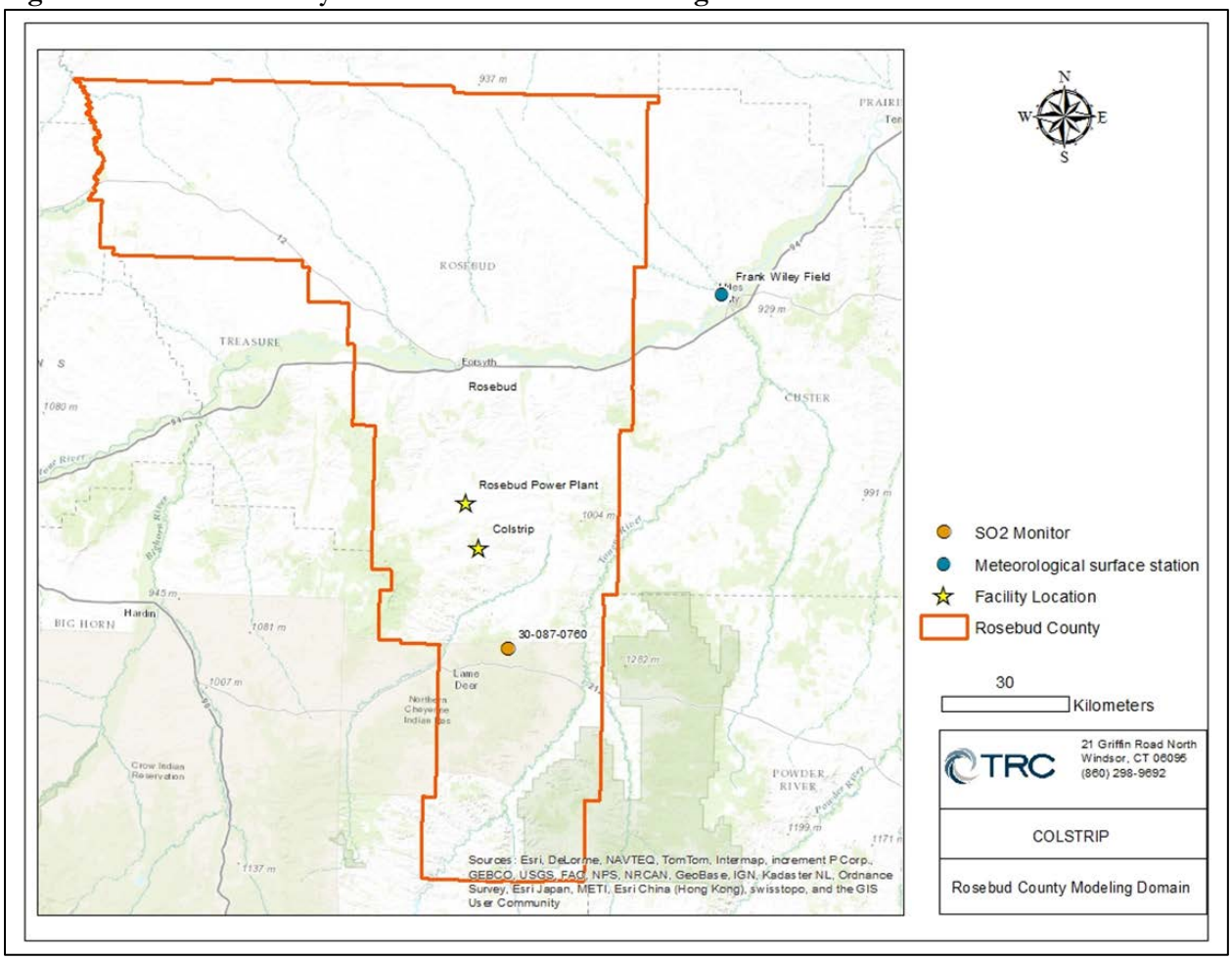
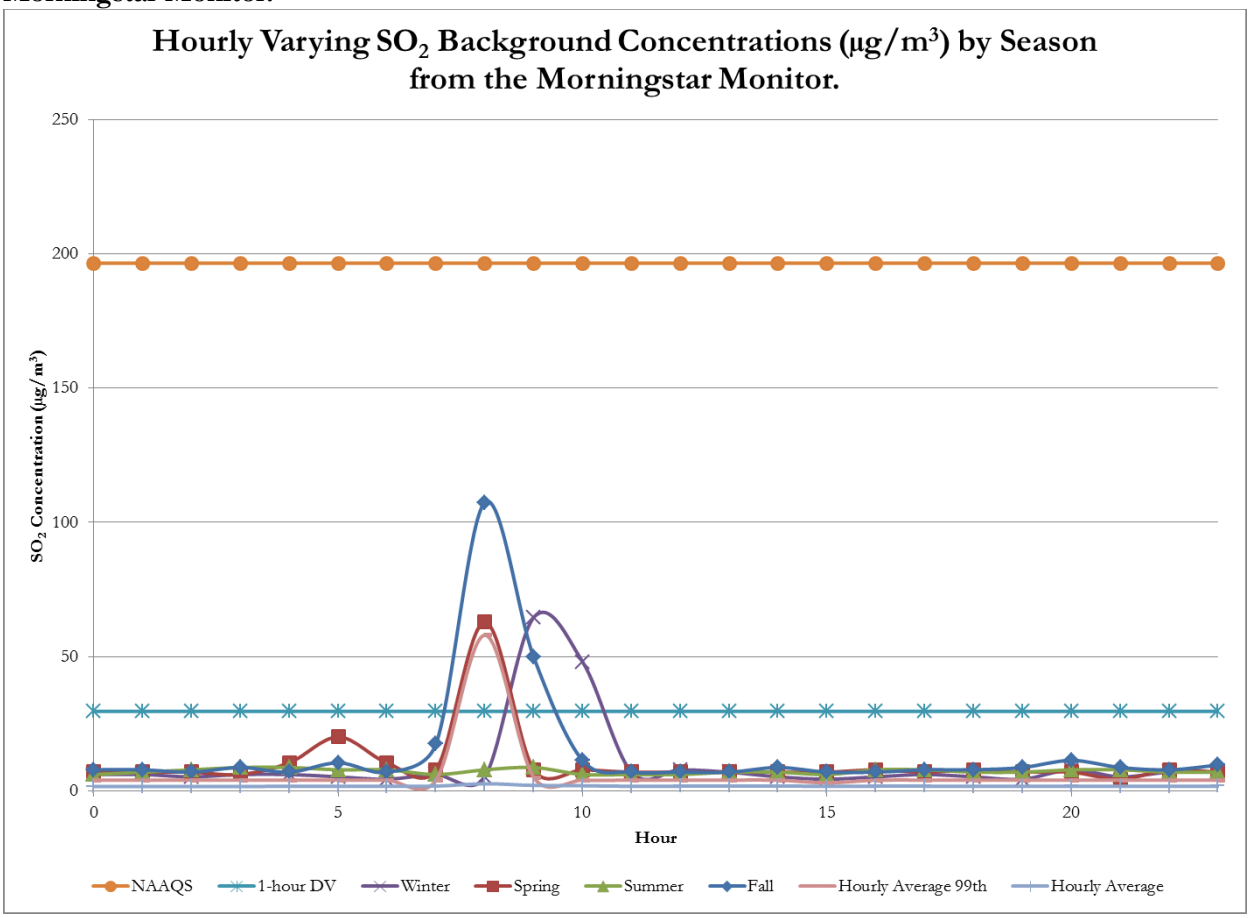


Figure 13. Hourly Varying SO2 Background Concentrations (µg/m3) by Season from the Morningstar Monitor.



Modeling Results

The 99th percentile maximum (4th highest) daily 1-hour SO_2 modeled value from Colstrip and the nearby Rosebud Power Plant was added to the seasonal hourly varying background concentration for comparison to the NAAQS to demonstrate compliance. The results from the air dispersion modeling are displayed in Table 12. Table 13 breaks down the design value into each year, split out between source and background contribution.

Table 12. Summary of Modeling Results.

Pollutant	Modeled Concentration with Background (µg/m³)	1-hour SO2 NAAQS (µg/m³)	Percent of NAAQS (%)
SO_2	151.7	196.5	77.4

µg/m³ = microgram per cubic meter.

Table 13. Summary of 99th Percentile Maximum Receptor by Year and Contribution.

Date	Background Concentration ($\mu g/m^3$)	Source Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)
3/28/2012	7.9	134.9	142.8
11/4/2013	9.6	149.1	158.7
8/20/2014	7.0	146.8	153.8
Average	8.1	143.6	151.7

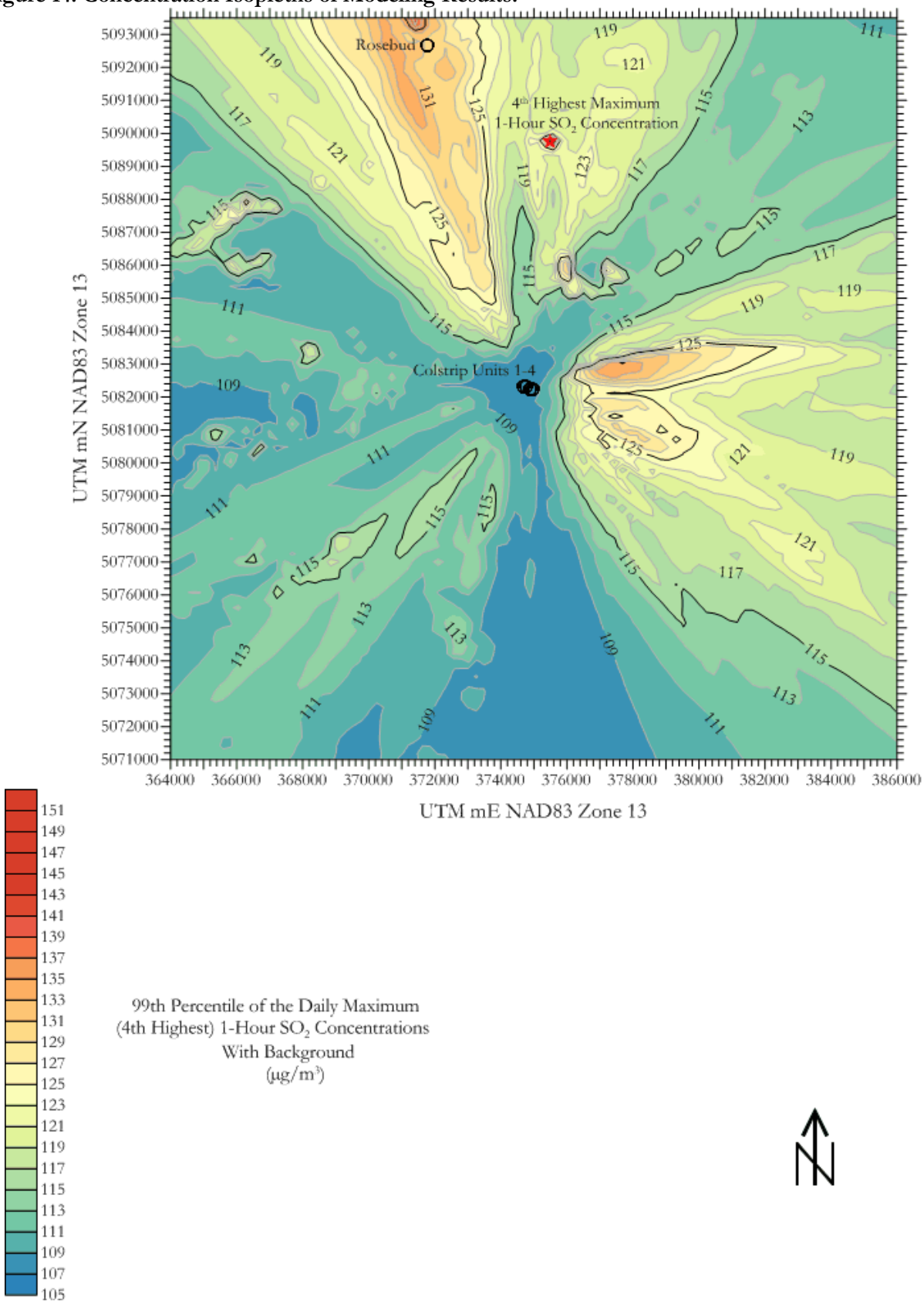
$\mu g/m^3$ = microgram per cubic meter

The SO_2 emissions from Colstrip, Rosebud, and the seasonal hourly background value consumed about 77% of the 1-hour SO_2 NAAQS. Figure 14 displays the results as concentration isopleths. The receptor with the highest 99th percentile design value is located approximately 7.5 km (4.6 mi.) north of the Colstrip facility.

The calculated 2012-2014 design value, resulting from the modeled ambient impacts of the Colstrip and Rosebud Power Plant's actual SO_2 emissions in sum with the background SO_2 concentrations, is below the NAAQS, therefore Rosebud County should be designated "attainment".

All computer generated modeling result files as well as all model (including preprocessors) input and output files will be submitted electronically to the EPA with this document, and are available upon request.

Figure 14. Concentration Isopleths of Modeling Results.



References

1) EPA, 2015: Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO_2). EPA Docket Number: EPA-HQ-OAR-2013-0711-0001. U.S. Environmental Protection Agency. August 2015. https://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2013-0711-0001

2) EPA, 2011: Area Designations for the 2010 Revised Primary Sulfur Dioxide National Ambient Air Quality Standards. Stephen D. Page Memorandum dated March 24, 2011, Research Triangle Park, North Carolina 27711. https://www.epa.gov/sites/production/files/2016-06/documents/so2d-r2-notice-6-29-16.pdf

3) EPA, 2016: DRAFT SO2 NAAQS Designations Modeling Technical Assistance Document. U.S. EPA. Office of Air and Radiation. Office of Air Quality and Standards. Air Quality Assessment. February 2016. https://www.epa.gov/sites/production/files/2016-06/documents/so2modelingtad.pdf

4) EPA 2015: Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standard. Stephen D. Page Memorandum dated March 20, 2015, Research Triangle Park, North Carolina 27711. https://www.epa.gov/sites/production/files/2016-06/documents/20150320so2designations.pdf

5) EPA, 2005: Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions; Final Rule. Appendix W of 40 CFR Part 51, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. November 9, 2005. https://www3.epa.gov/scram001/guidance/guide/appw_05.pdf

6) EPA, 2011: Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard. Tyler Fox Memorandum dated March 1, 2011, Research Triangle Park, North Carolina 27711. https://www3.epa.gov/scram001/guidance/clarification/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf

7) NLCD 2011. National Land Cover Database 2011 (NLCD 2011). Accessed May 5, 2016. http://www.mrlc.gov/nlcd11_data.php

8) NLCD 1992. National Land Cover Database 1992 (NLCD 1992). Accessed May 5, 2016. http://www.mrlc.gov/nlcd1992.php

Appendix A

Unit shutdowns by event

The shutdown periods provided in the following table below were reported by Talen Energy, LLC. Due to partial hour shutdowns, the total hours of shutdown modeled may differ slightly from what was reported here for the total hours. If emissions data were available during a partial hour shutdown, the actual emissions reported by the CEMS were used. For hours where no CEMS data were available and a shutdown was reported by Talen, zero emissions were modeled. Shading was used in this table to differentiate the various units.

Table A-1. Colstrip Shutdown Periods.

Year	Unit	Date(s)	Total Hours	Reason
2012	1	3/6-5/30	2040	Scheduled Maintenance Shutdown
2012	1	5/30-7/10	964	Reserve shutdown
2012	1	7/10-7/12	47	Boiler Tube Leak
2012	1	7/23	2	Electrical Malfunction
2012	1	8/4-8/6	54	Scheduled Maintenance Shutdown
2012	1	9/7-9/9	63	Boiler Tube Leak
2012	1	9/23	1	Safety Interlock Shutdown
2012	1	9/28-9/29	25	Scheduled Maintenance Shutdown
2012	1	10/5-10/6	10	Other (control valves)
2012	1	11/23-11/25	36	Boiler Tube Leak
2012	2	1/6-1/8	26	Other (gasket leak)
2012	2	3/8-5/11	1593	Scheduled Maintenance Shutdown
2012	2	5/11-7/7	1370	Reserve Shutdown
2012	2	7/7	1	Safety Interlock Shutdown
2012	2	7/10-7/20	233	Other (water leak)
2012	2	8/10-8/11	9	Electrical Malfunction
2012	2	8/19	3	Electrical Malfunction
2012	2	8/20	2	Safety Interlock Shutdown
2012	2	9/25-9/27	63	Boiler Tube Leak
2012	2	10/5	1.7	Operator Error Causing Shutdown
2012	3	2/23-2/24	27	Boiler Tube Leak
2012	3	5/5-6/4	740	Scheduled Maintenance Shutdown
2012	3	7/7-7/9	53	Scheduled Maintenance Shutdown
2012	3	9/12-9/12	1	Other (water leak)
2012	3	9/16-9/16	3	Electrical Malfunction
2012	3	10/1-10/1	1	Safety Interlock Shutdown
2012	3	10/11-10/13	49	Boiler Tube Leak
2012	3	12/14-12/17	79	Scheduled Maintenance Shutdown
2012	4	1/8-1/13	109	Other (cooling leak)
2012	4	5/4	14	Safety Interlock Shutdown
2012	4	5/8	2	Safety Interlock Shutdown
2012	4	6/19-6/23	106	Scheduled Maintenance Shutdown
2012	4	7/6-7/7	6	Other (auxiliary system leak)
2013	1	3/1-3/3	50	Boiler Tube Leak
2013	1	4/29	1	Electrical Malfunction
2013	1	5/16	2	Safety Interlock Shutdown
2013	1	6/7-6/11	90	Boiler Tube Leak
2013	1	8/4	1	Operator Error Causing Shutdown
2013	1	8/17-8/18	35	Boiler Tube Leak

Year	Unit	Date(s)	Total Hours	Reason
2013	1	8/19-8/20	10	Electrical Malfunction
2013	1	8/21-8/22	12	Electrical Malfunction
2013	1	8/25-8/26	20	Boiler Tube Leak
2013	1	8/28	18	Safety Interlock Shutdown
2013	1	9/5-9/7	48	Boiler Tube Leak
2013	1	9/16	4	Safety Interlock Shutdown
2013	1	11/14-11/16	60	Boiler Tube Leak
2013	1	11/16-11/17	31	Electrical Malfunction
2013	1	11/26	12	Operator Error Causing Shutdown
2013	2	2/21-2/25	88	Boiler Tube Leak
2013	2	6/11	1	Operator Error Causing Shutdown
2013	2	8/3-8/4	10	Safety Interlock Shutdown
2013	2	8/7-8/10	71	Boiler Tube Leak
2013	2	10/10-10/13	79	Boiler Tube Leak
2013	2	12/16-12/19	67	Boiler Tube Leak
2013	3	3/31	1	Other (Testing)
2013	3	5/1	8	Electrical Malfunction\Safety Interlock Shutdown
2013	3	5/17-5/18	12	Malfunction\Safety Interlock Shutdown
2013	3	6/29-7/1	46	Boiler Tube Leak
2013	3	10/25-10/28	85	Boiler Tube Leak
2013	3	11/10-11/14	74	Boiler Tube Leak
2013	3	12/9	2	Electrical Malfunction
2013	4	3/24-3/27	72	Boiler Tube Leak
2013	4	4/29	3	Electrical Malfunction
2013	4	5/10-6/24	1069	Scheduled Maintenance Shutdown
2013	4	6/24-6/27	87	Boiler Tube Leak/Startup Delays
2013	4	6/29	15	Safety Interlock Shutdown
2013	4	7/1-12/31	4394	Electrical Malfunction
2014	1	2/20-2/24	88	Other (Remove Slagging)
2014	1	3/1-3/7	142	Boiler Tube Leak
2014	1	4/15	6	Electrical Malfunction
2014	1	5/16-18	62	Boiler Tube Leak
2014	1	5/25	2	Safety Interlock Shutdown
2014	1	8/23-8/25	36	Other (hydraulic system filters)
2014	1	9/25	3	Safety Interlock Shutdown
2014	1	10/23-10/26	61	Boiler Tube Leak
2014	1	11/12-11/13	21	Safety Interlock Shutdown
2014	1	12/20-12/24	97	Boiler Tube Leak
2014	2	2/15-2/18	89	Boiler Tube Leak
2014	2	4/15	5	Electrical Malfunction
2014	2	7/11-7/15	84	Boiler Tube Leak
2014	2	7/28	1	Safety Interlock Shutdown
2014	2	8/12	3	Safety Interlock Shutdown
2014	2	8/28	1	Operator Error Causing Shutdown
2014	2	9/27-9/29	68	Boiler Tube Leak
2014	2	10/10	1	Operator Error Causing Shutdown
2014	2	11/12-11/15	75	Safety Interlock Shutdown
2014	2	12/11-12/12	7	Safety Interlock Shutdown

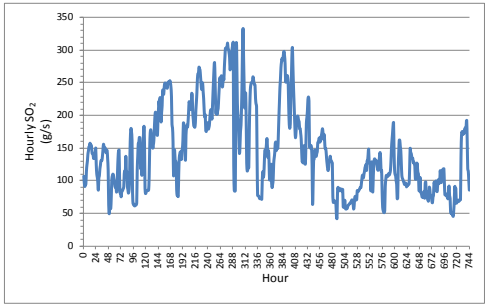
Year	Unit	Date(s)	Total Hours	Reason
2014	3	2/13-2/16	73	Boiler Tube Leak
2014	3	3/22-3/25	66	Boiler Tube Leak
2014	3	4/11-4/12	18	Electrical Malfunction
2014	3	4/15	13	Electrical Malfunction
2014	3	5/9-7/1	1249	Scheduled Maintenance Shutdown
2014	3	7/1-7/4	91	Scheduled Maintenance Shutdown
2014	3	7/4-7/5	19	Safety Interlock Shutdown/Start-up delays
2014	3	7/7-7/8	10	Safety Interlock Shutdown
2014	3	8/23-8/24	27	Safety Interlock Shutdown
2014	3	9/18	7	Electrical Malfunction
2014	3	9/19-9/20	2	Other (testing)
2014	3	9/24	4	Safety Interlock Shutdown
2014	3	9/25	2	Safety Interlock Shutdown
2014	3	10/18	3	Electrical Malfunction
2014	3	10/26-10/27	15	Electrical Malfunction
2014	3	11/6-11/9	71	Boiler Tube Leak
2014	3	12/12-12/21	213	Other (generator seal)
2014	3	12/26-12/28	31	Other (water pump)
2014	4	1/1-1/23	529	Electrical Malfunction
2014	4	4/8	5	Electrical Malfunction
2014	4	4/15	8	Electrical Malfunction
2014	4	4/23-4/28	120	Boiler Tube Leak
2014	4	5/24-5/30	153	Other (valve repair)
2014	4	7/3	2	Safety Interlock Shutdown
2014	4	7/23	3	Electrical Malfunction
2014	4	7/24-7/25	23	Electrical Malfunction
2014	4	7/31-8/3	63	Boiler Tube Leak
2014	4	8/23	17	Electrical Malfunction
2014	4	10/18	14	Electrical Malfunction

Appendix B

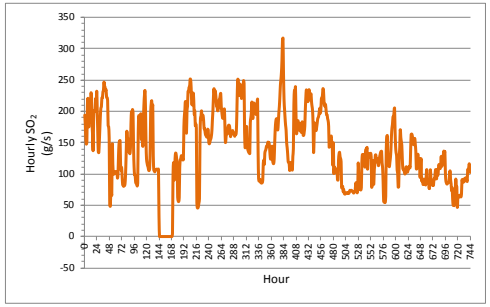
Hourly SO_2 emissions by unit and month, 2012 - 2014

January 2012

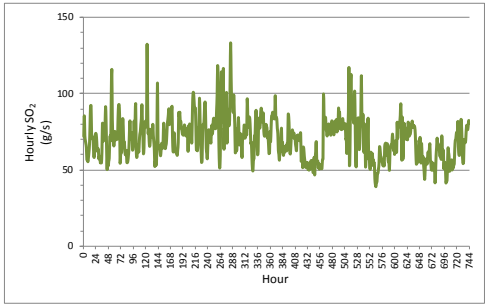
Unit 1



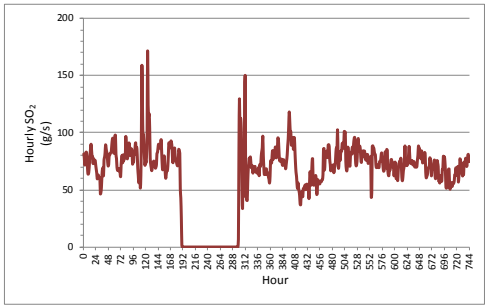
Unit 2



Unit 3

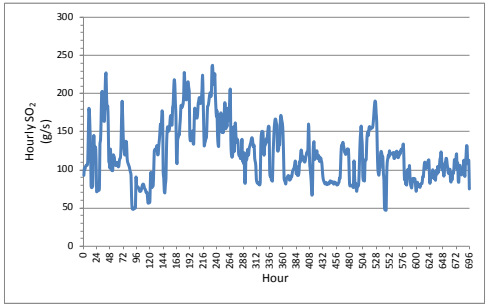


Unit 4

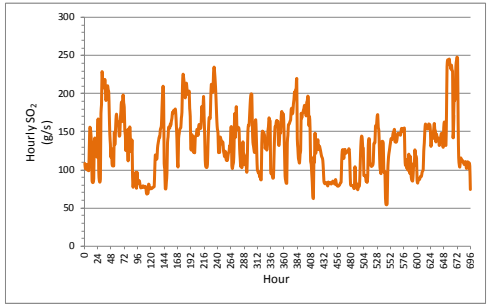


February 2012

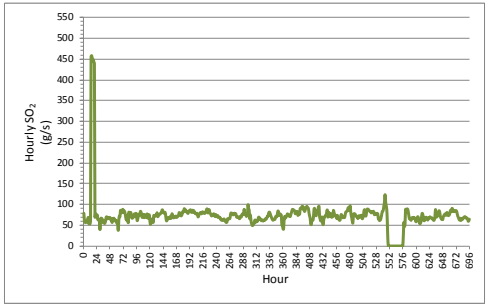
Unit 1



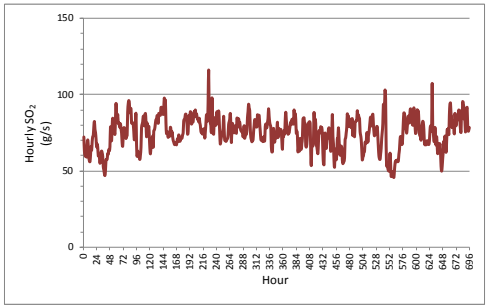
Unit 2



Unit 3

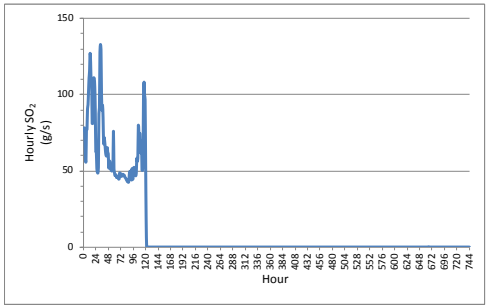


Unit 4

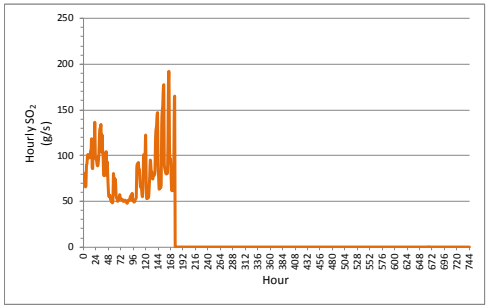


March 2012

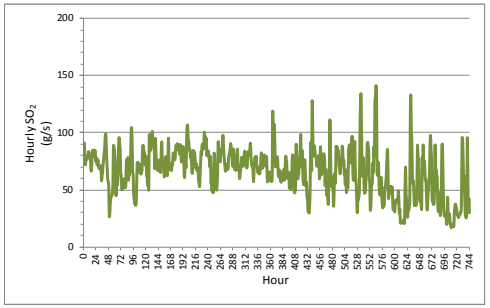
Unit 1



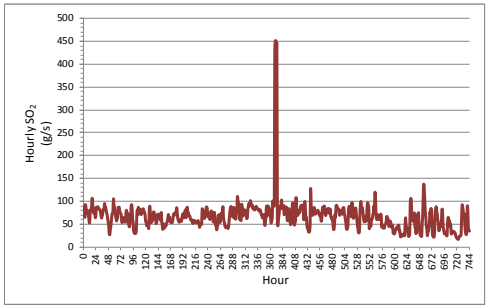
Unit 2



Unit 3

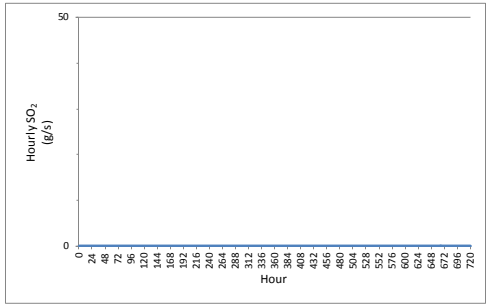


Unit 4

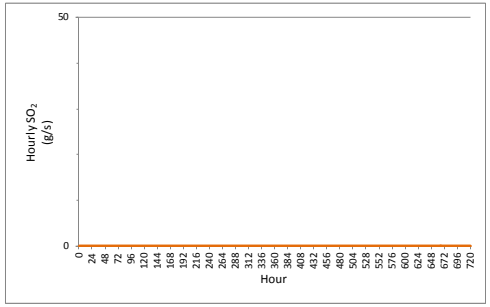


April 2012

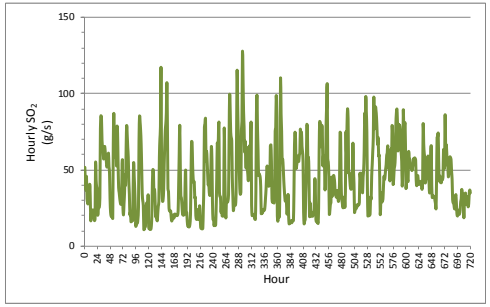
Unit 1



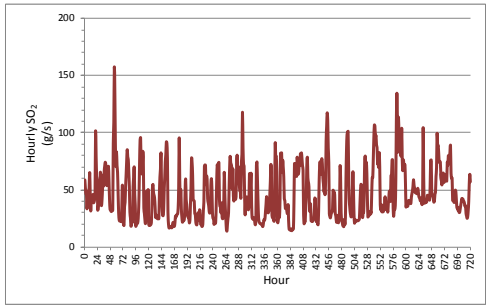
Unit 2



Unit 3

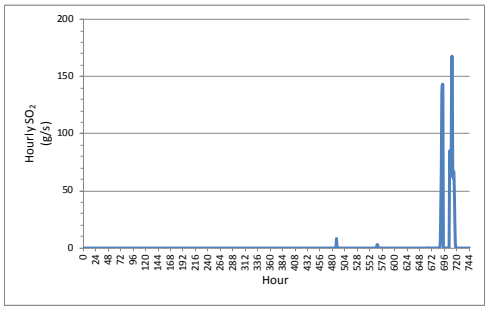


Unit 4

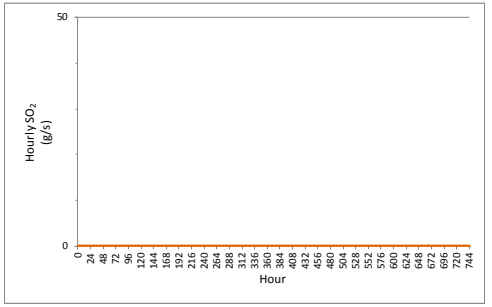


May 2012

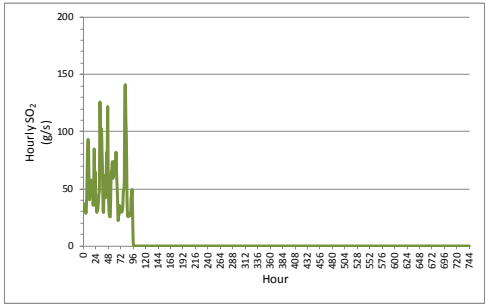
Unit 1



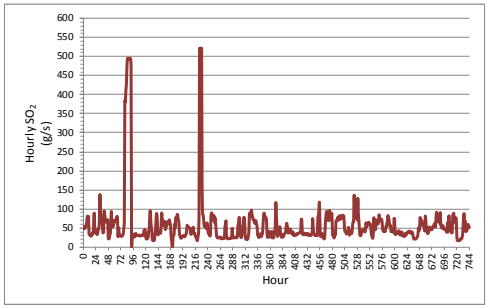
Unit 2



Unit 3

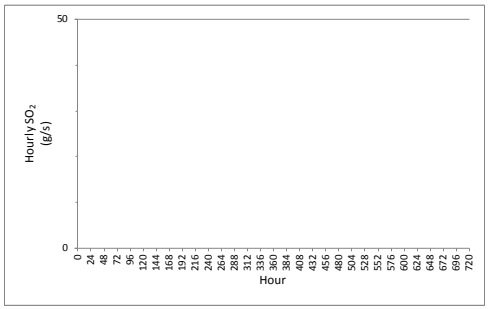


Unit 4

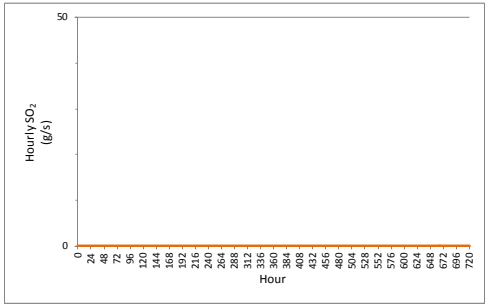


June 2012

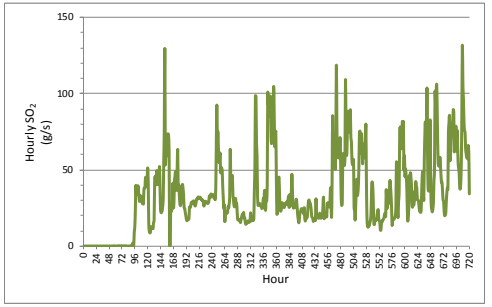
Unit 1



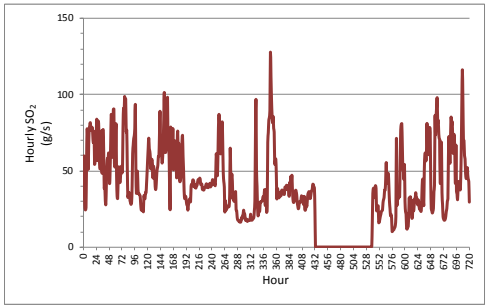
Unit 2



Unit 3

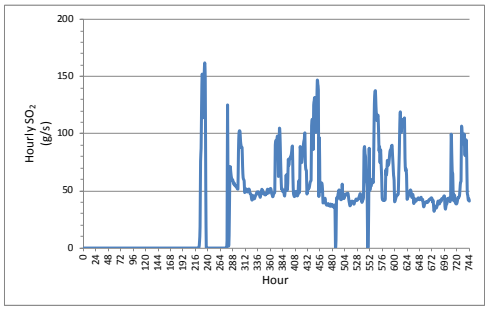


Unit 4

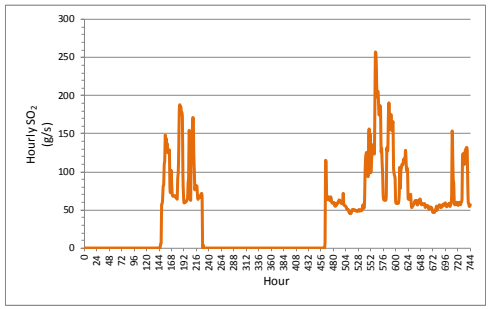


July 2012

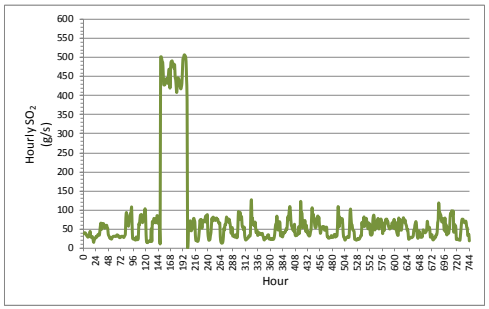
Unit 1



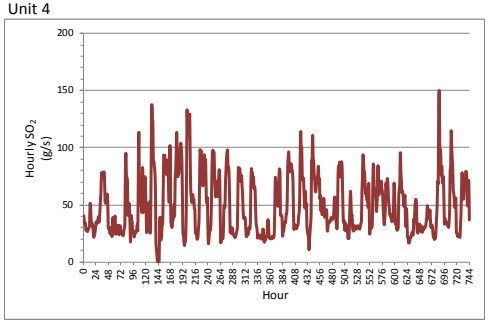
Unit 2



Unit 3

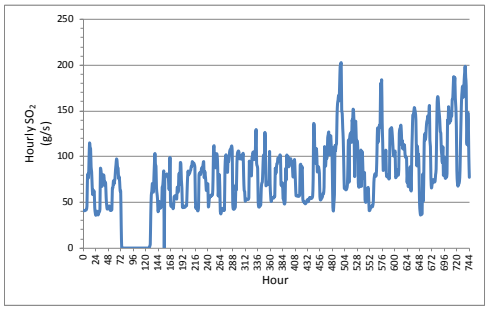


Unit 4

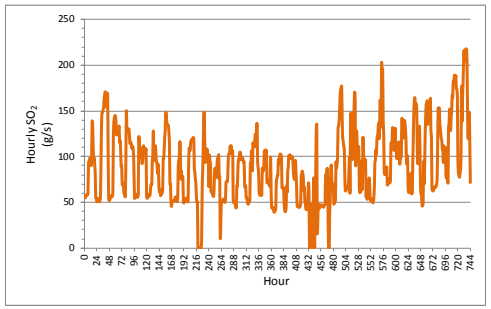


August 2012

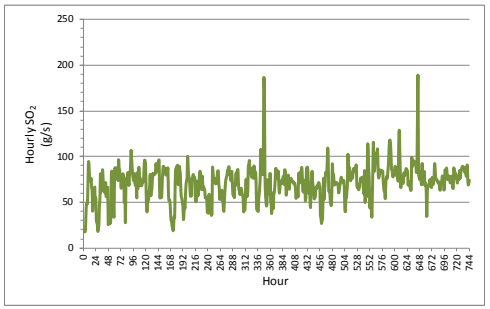
Unit 1



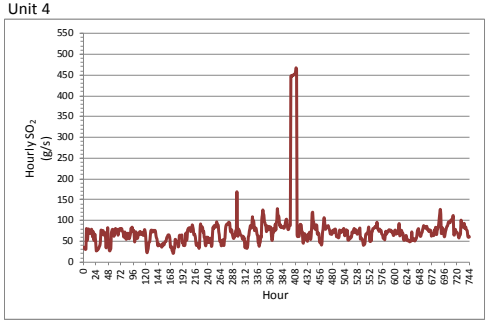
Unit 2



Unit 3

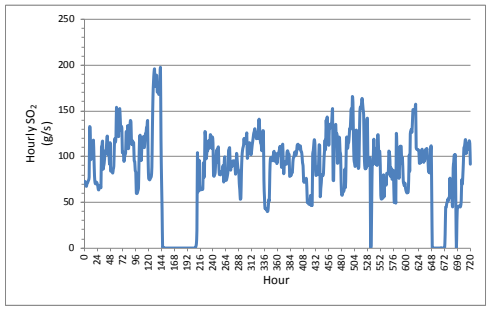


Unit 4

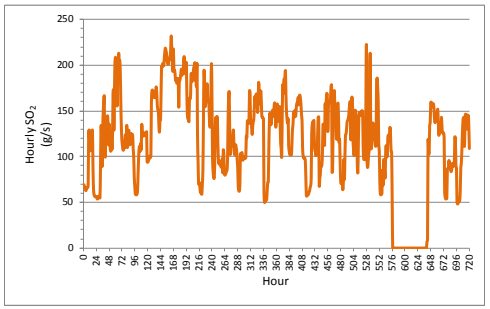


September 2012

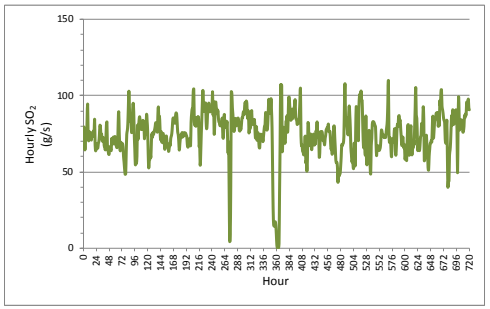
Unit 1



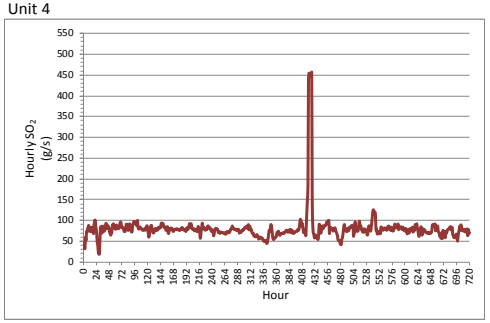
Unit 2



Unit 3

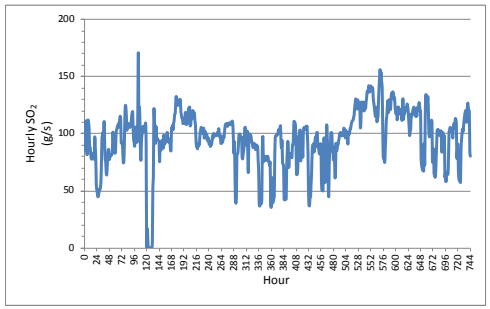


Unit 4

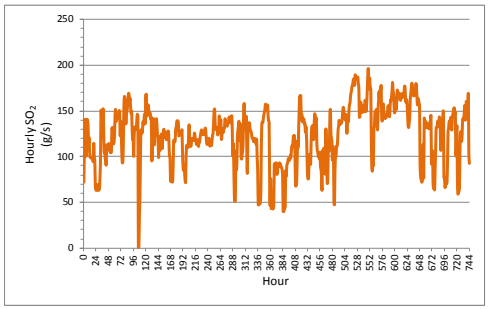


October 2012

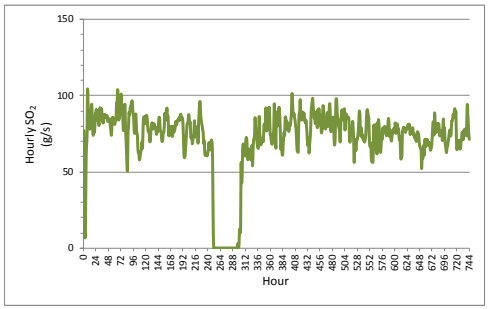
Unit 1



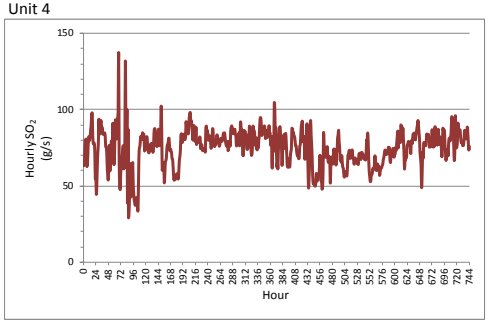
Unit 2



Unit 3

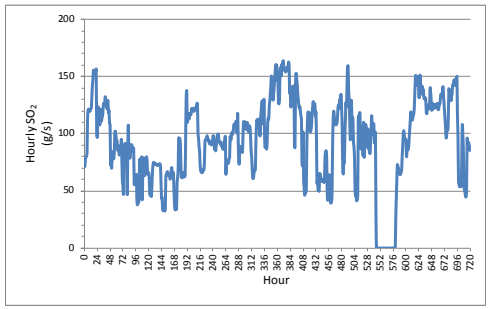


Unit 4

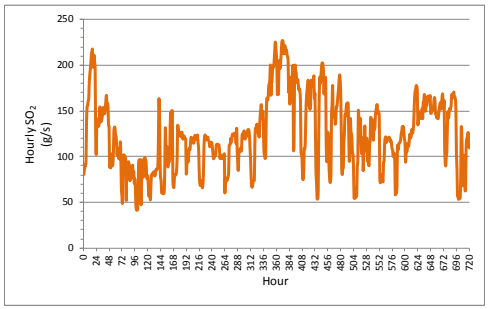


November 2012

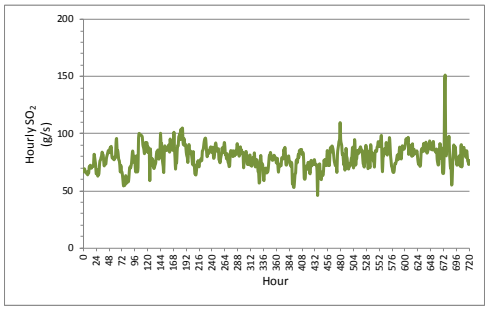
Unit 1



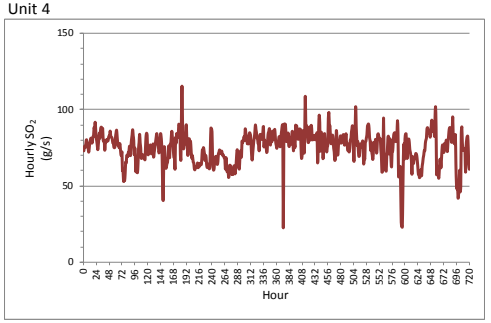
Unit 2



Unit 3

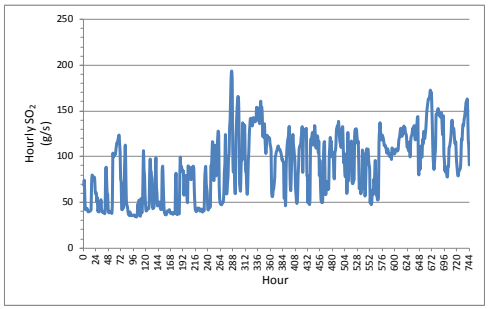


Unit 4

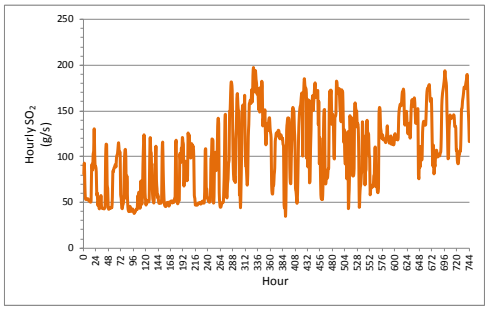


December 2012

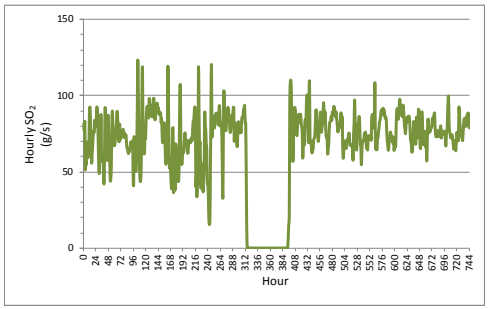
Unit 1



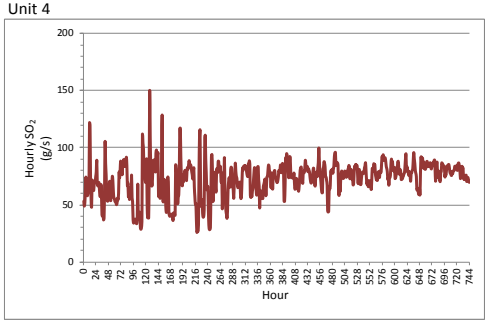
Unit 2



Unit 3

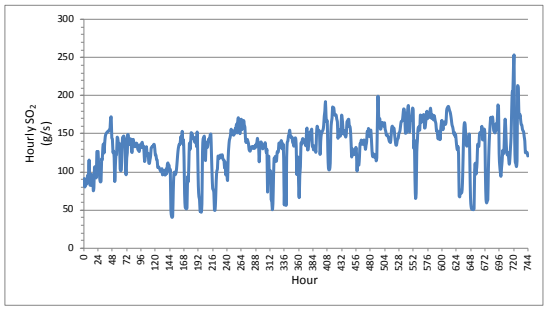


Unit 4

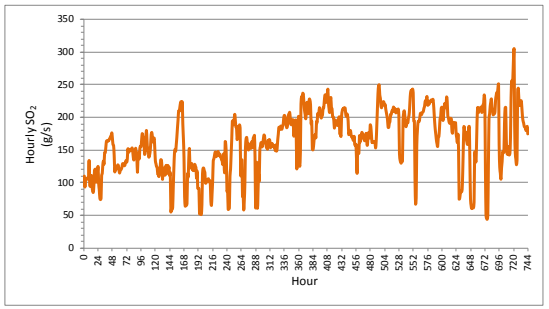


January 2013

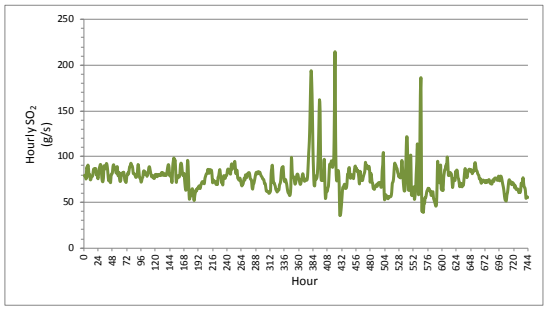
Unit 1



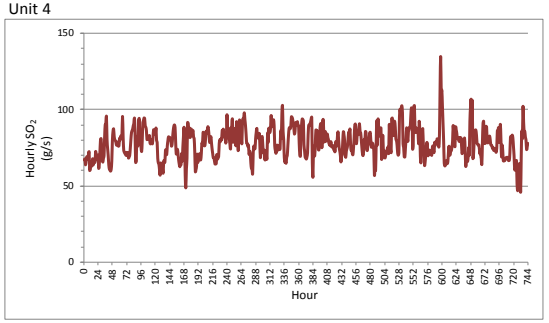
Unit 2



Unit 3

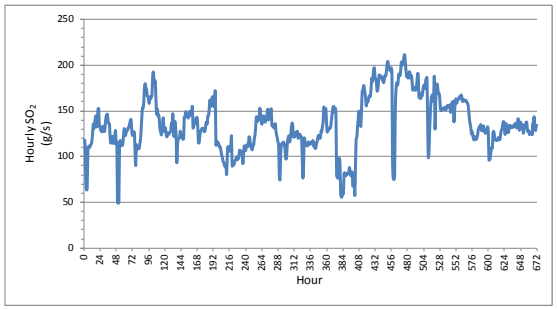


Unit 4

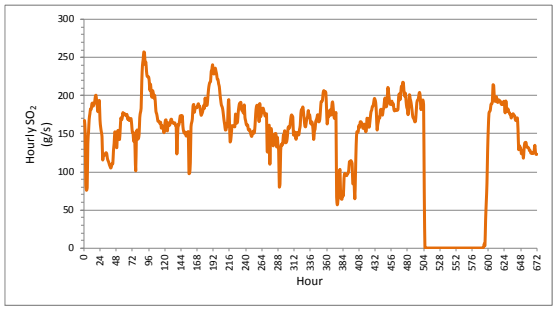


February 2013

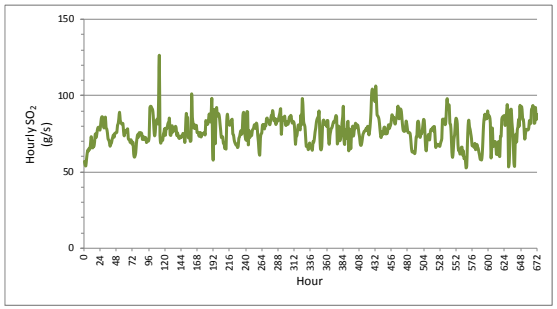
Unit 1



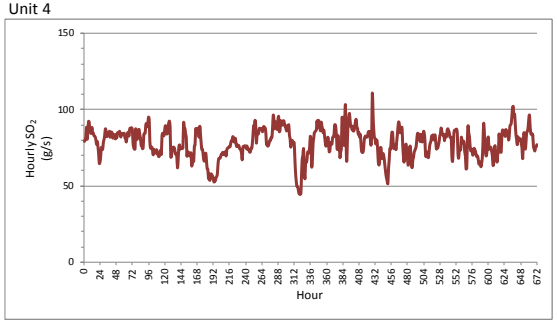
Unit 2



Unit 3

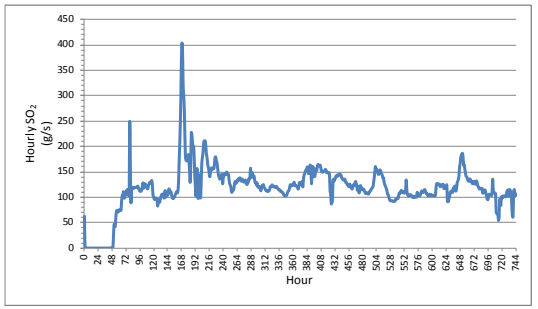


Unit 4

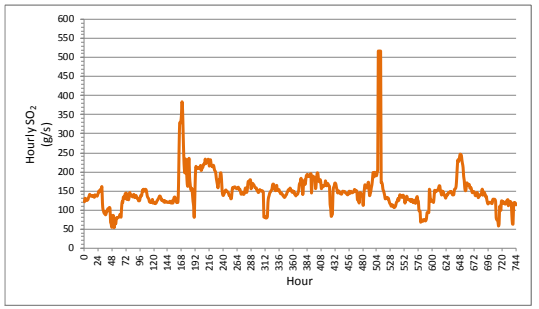


March 2013

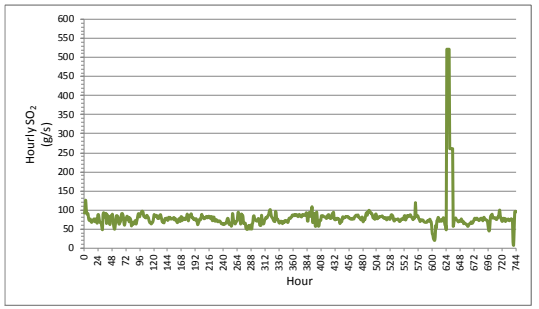
Unit 1



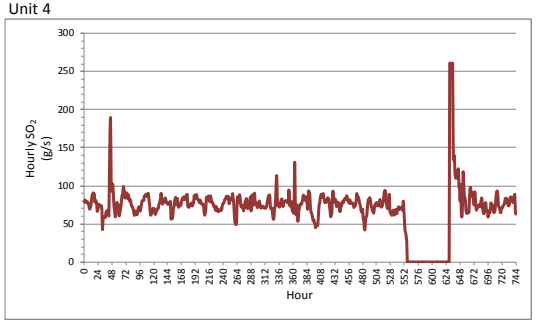
Unit 2



Unit 3

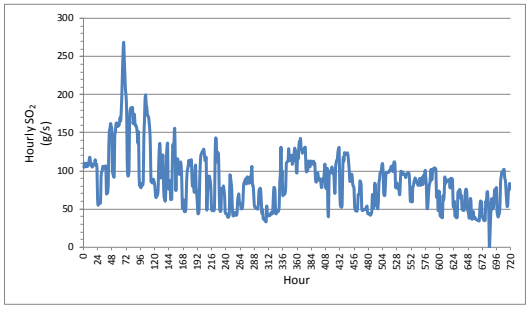


Unit 4

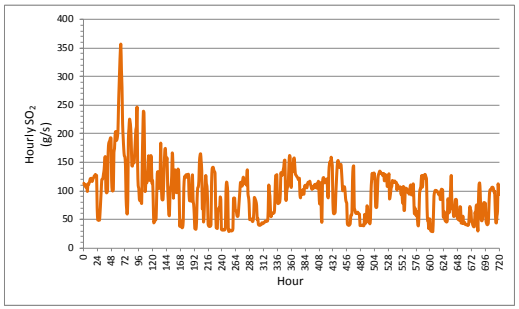


April 2013

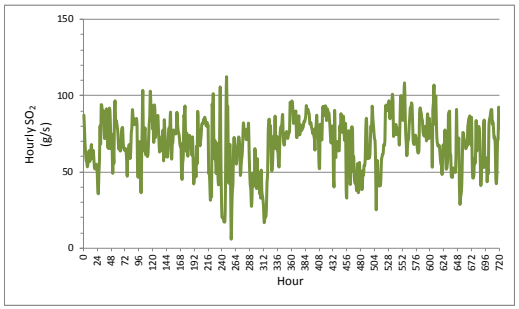
Unit 1



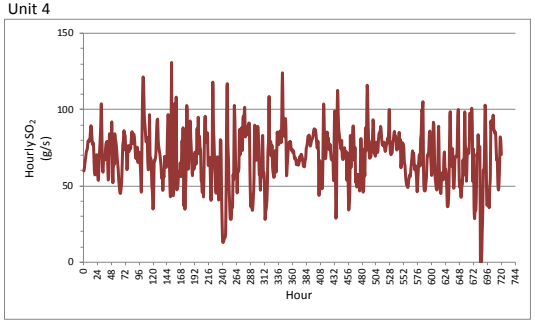
Unit 2



Unit 3

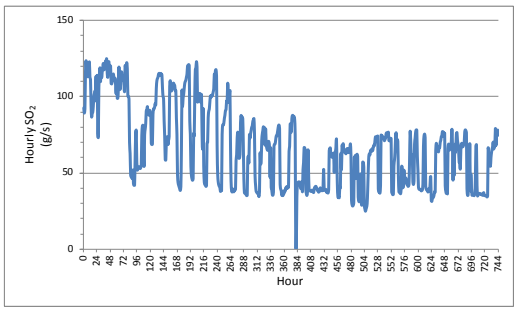


Unit 4

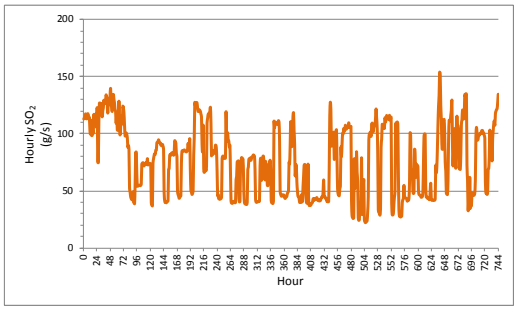


May 2013

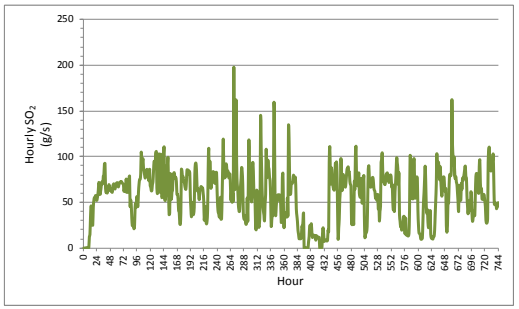
Unit 1



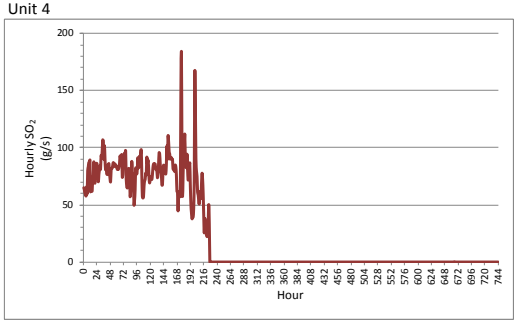
Unit 2



Unit 3

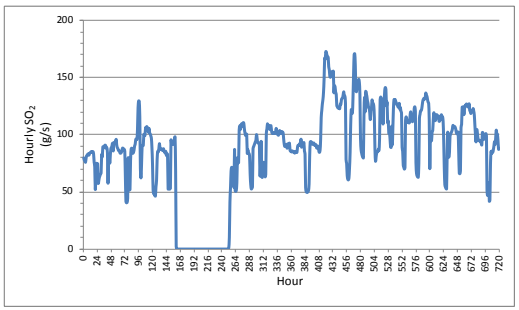


Unit 4

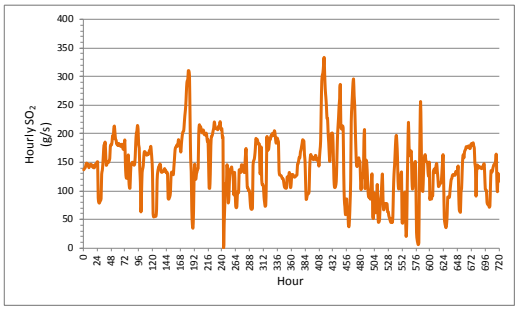


June 2013

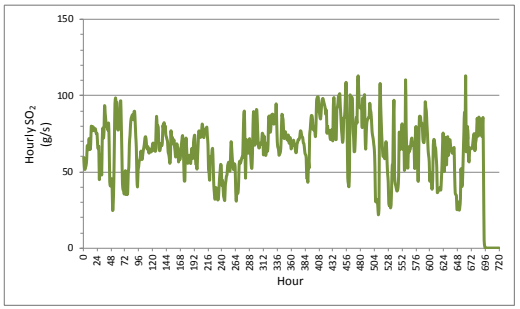
Unit 1



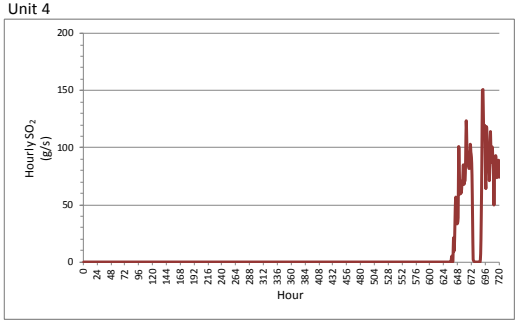
Unit 2



Unit 3

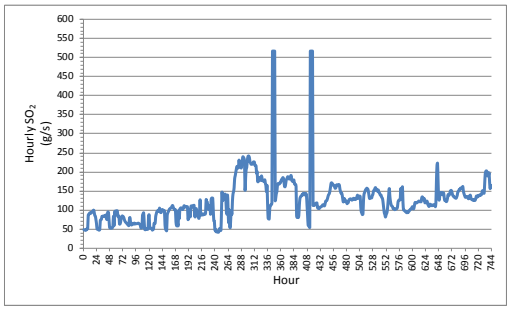


Unit 4

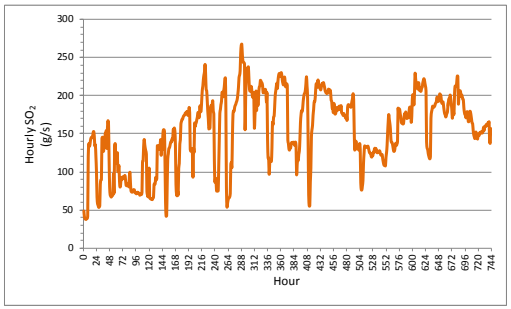


July 2013

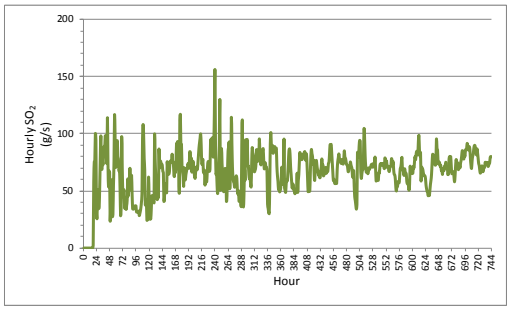
Unit 1



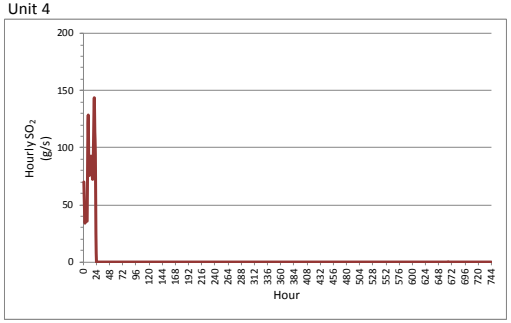
Unit 2



Unit 3

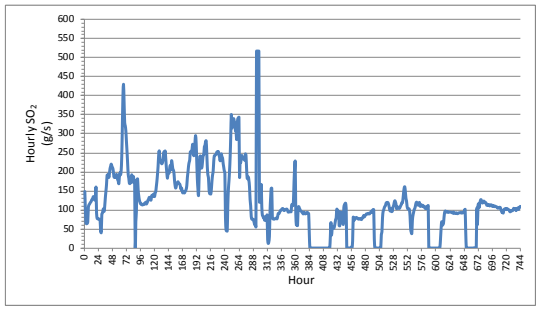


Unit 4

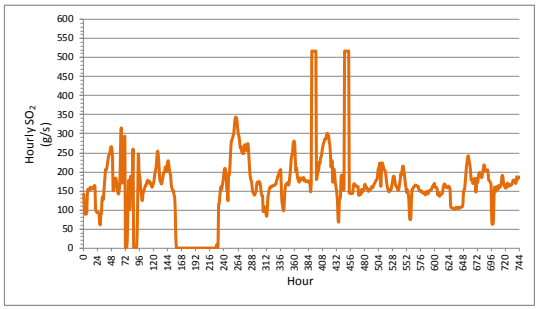


August 2013

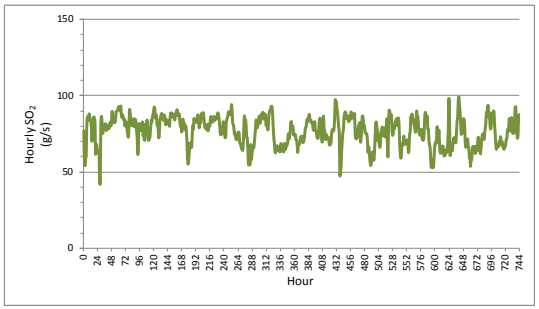
Unit 1



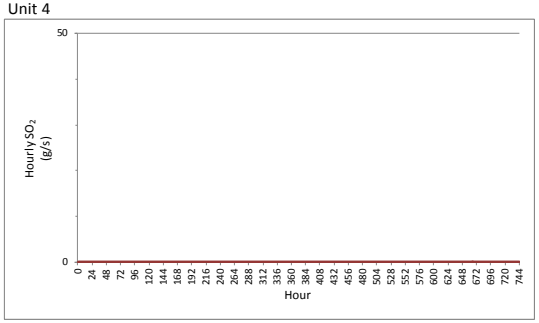
Unit 2



Unit 3

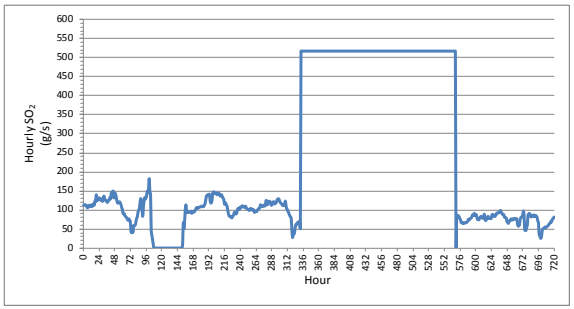


Unit 4

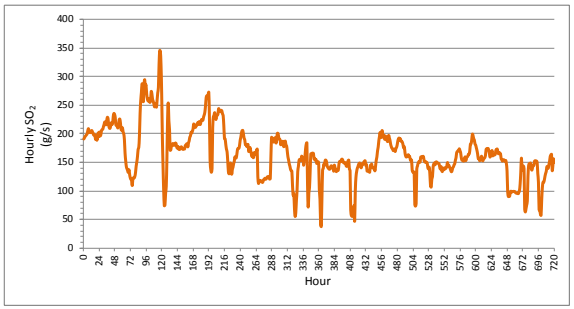


September 2013

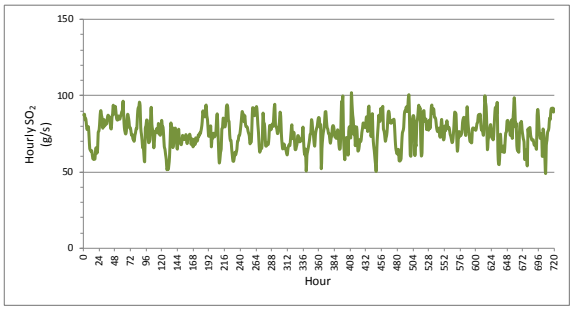
Unit 1



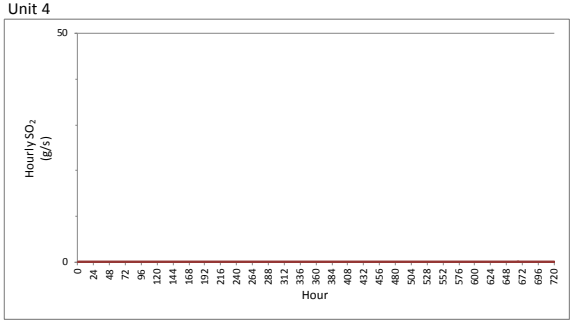
Unit 2



Unit 3

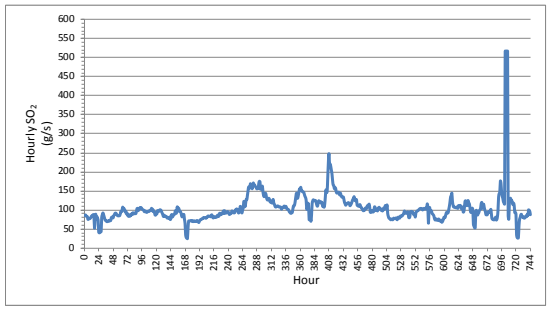


Unit 4

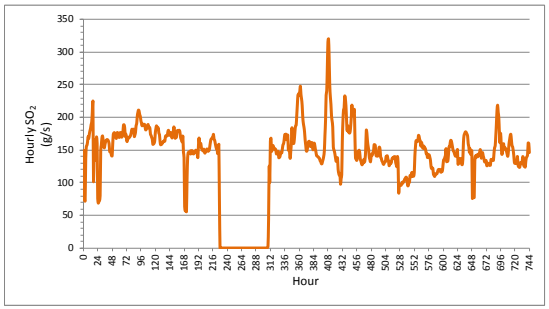


October 2013

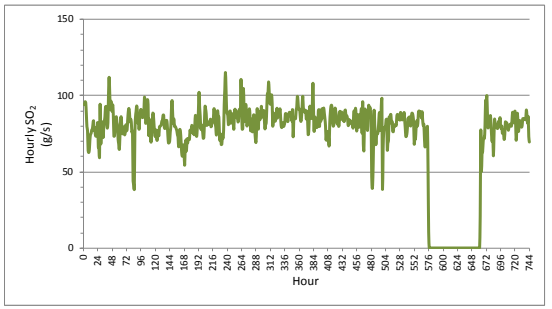
Unit 1



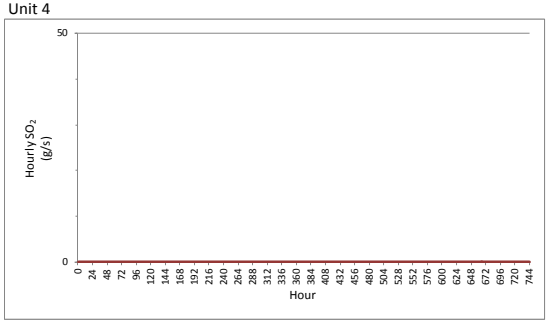
Unit 2



Unit 3

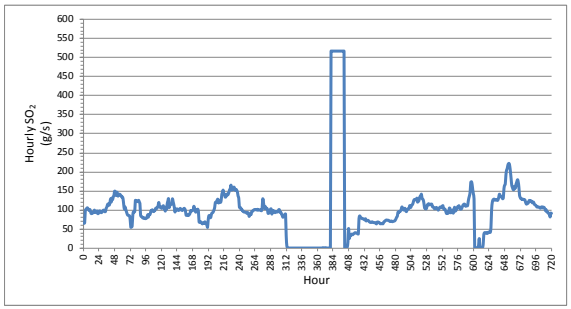


Unit 4

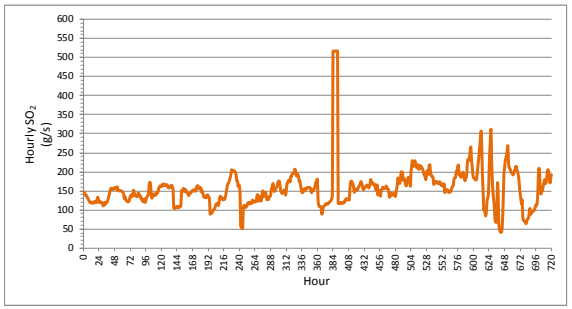


November 2013

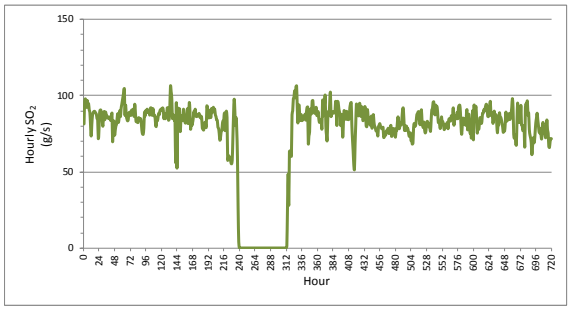
Unit 1



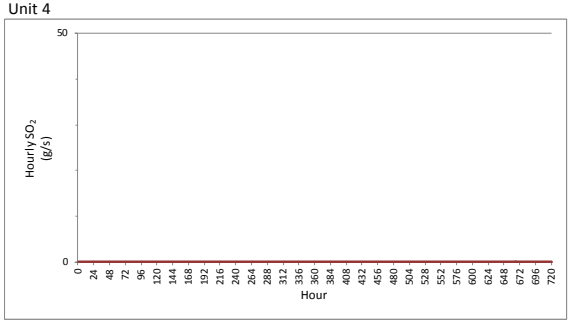
Unit 2



Unit 3

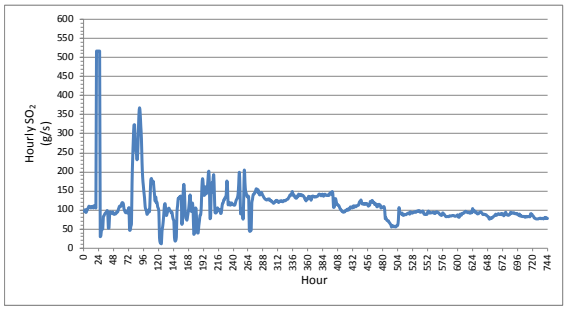


Unit 4

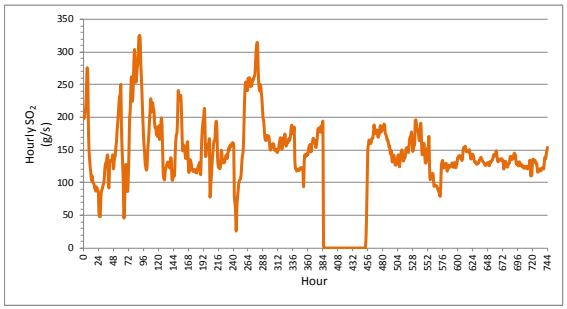


December 2013

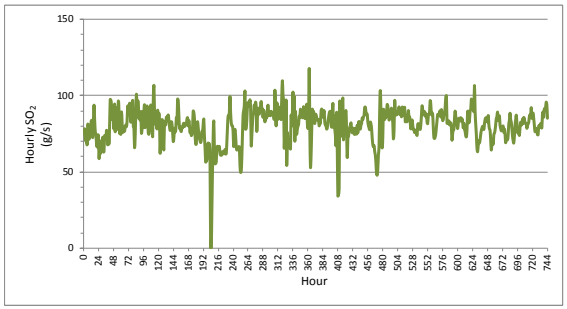
Unit 1



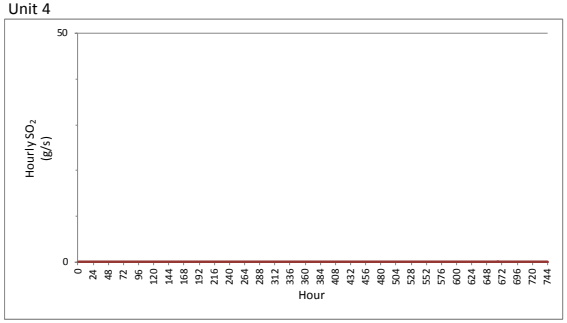
Unit 2



Unit 3

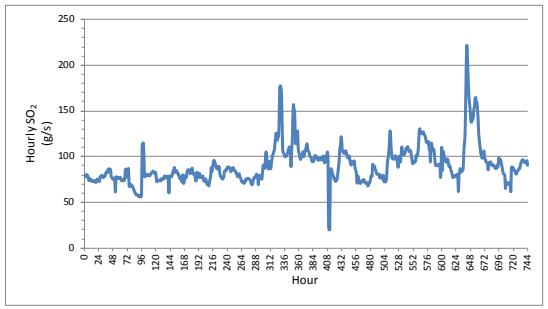


Unit 4

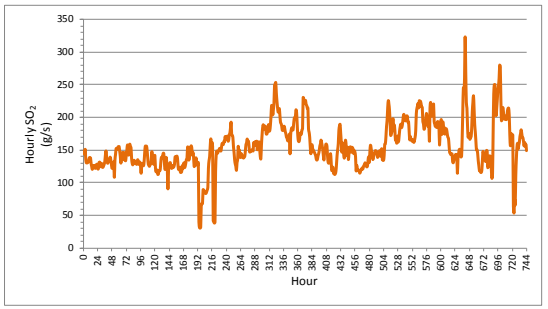


January 2014

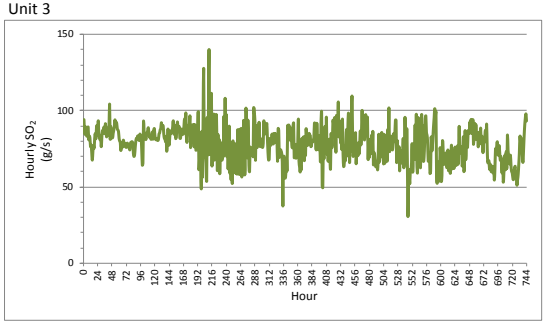
Unit 1



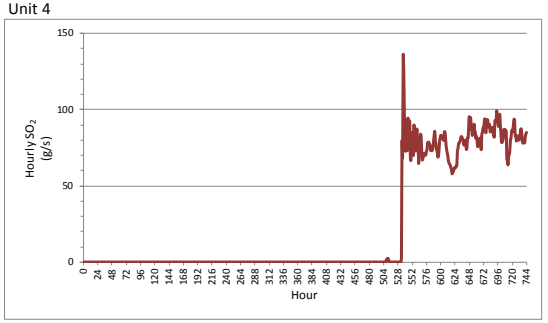
Unit 2



Unit 3

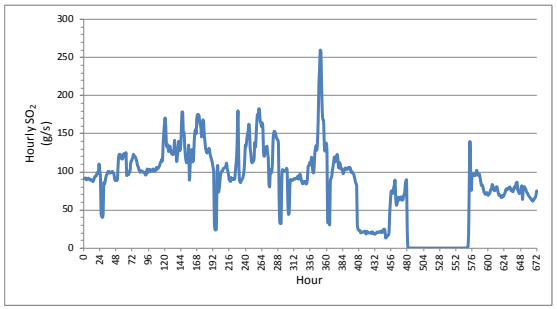


Unit 4

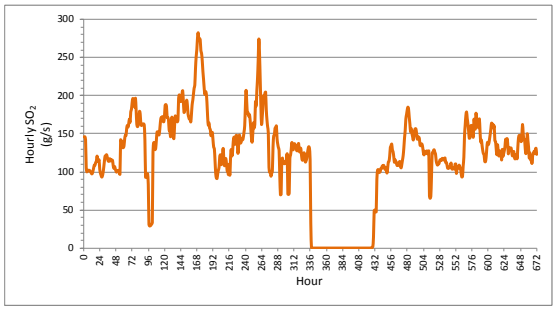


February 2014

Unit 1

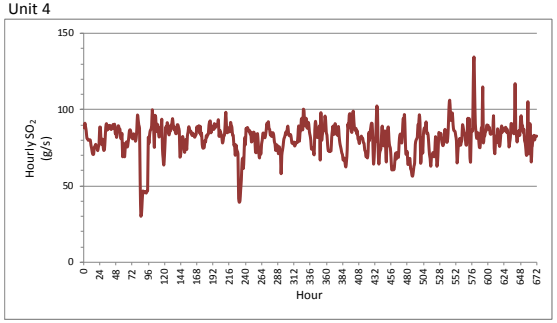


Unit 2



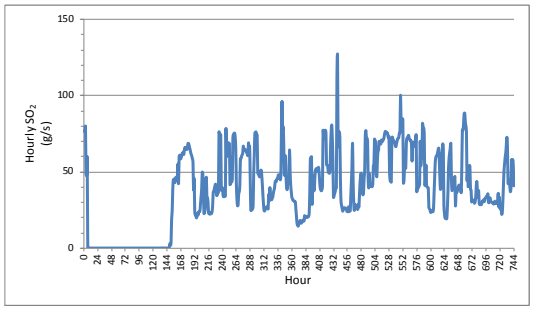
Unit 3

Unit 4

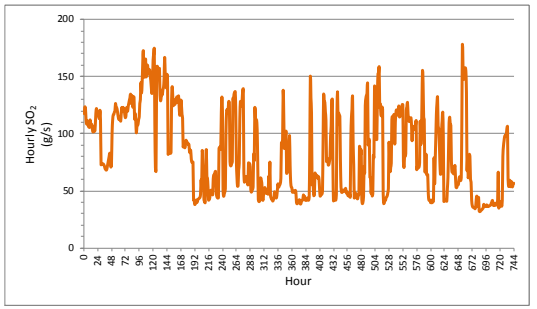


March 2014

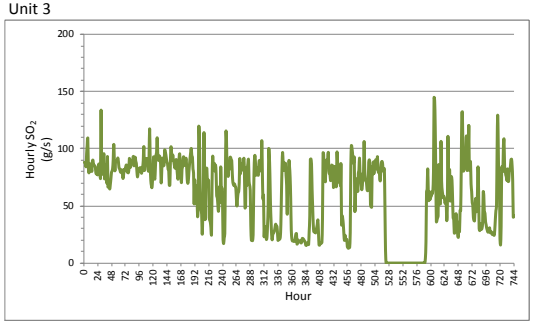
Unit 1



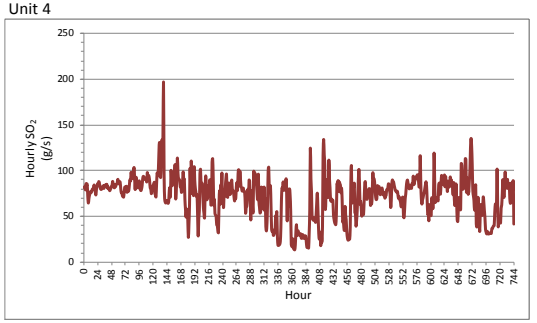
Unit 2



Unit 3

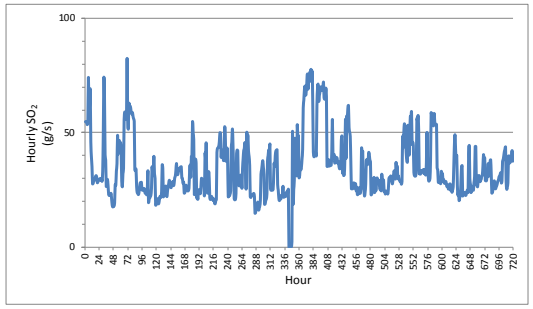


Unit 4

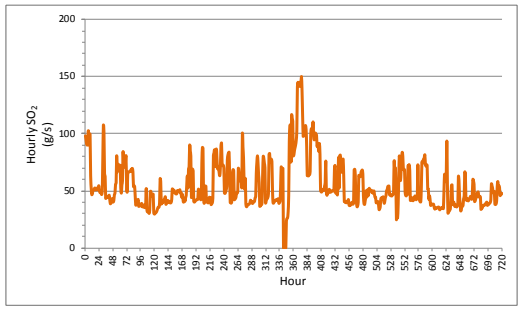


April 2014

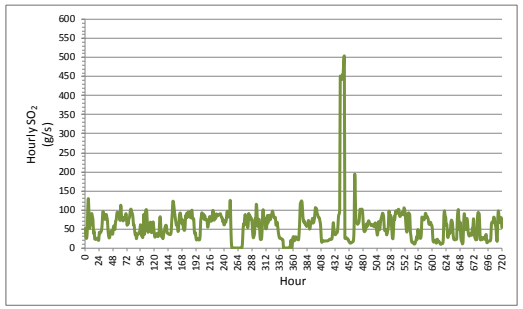
Unit 1



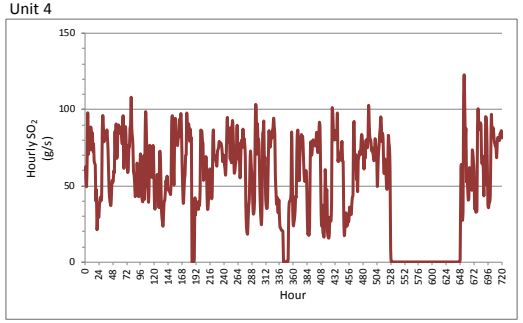
Unit 2



Unit 3

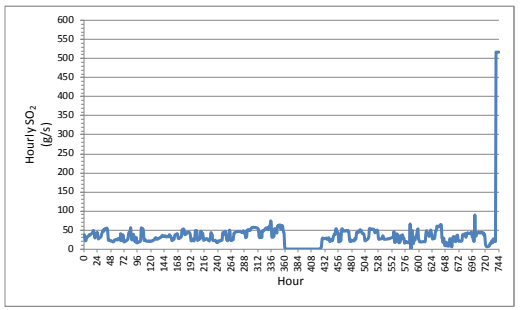


Unit 4

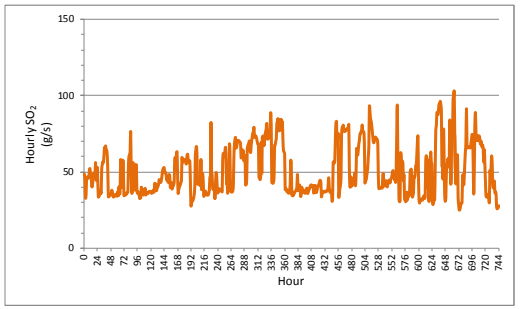


May 2014

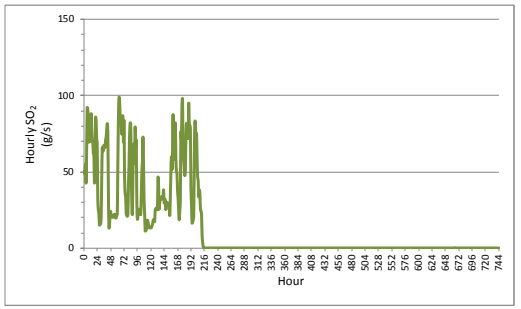
Unit 1



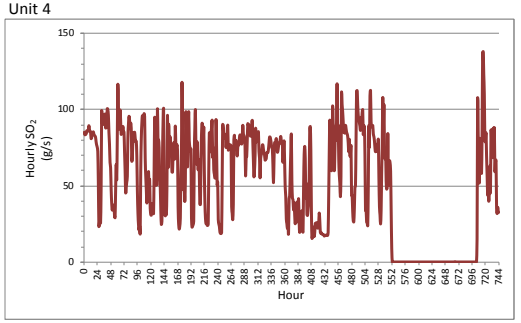
Unit 2



Unit 3

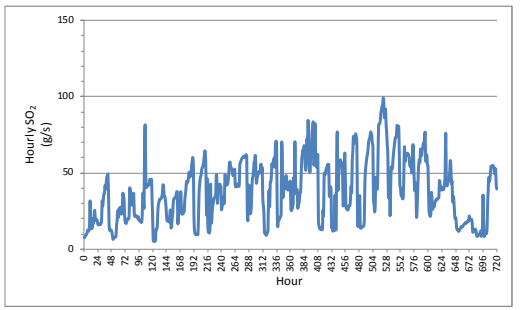


Unit 4

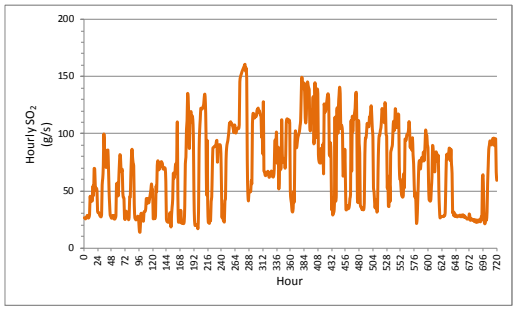


June 2014

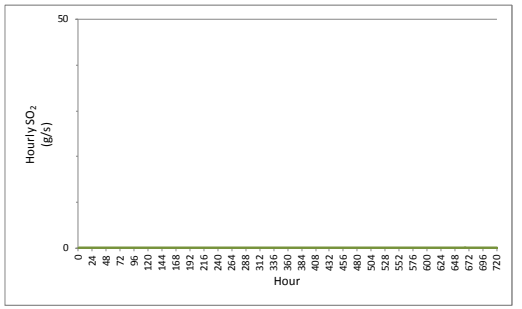
Unit 1



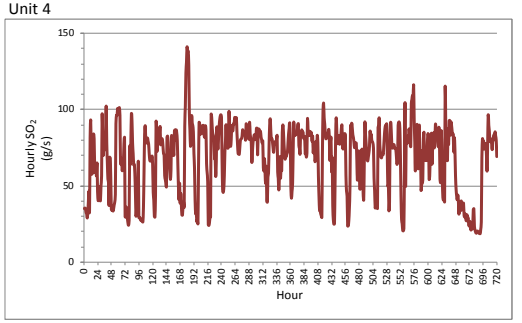
Unit 2



Unit 3

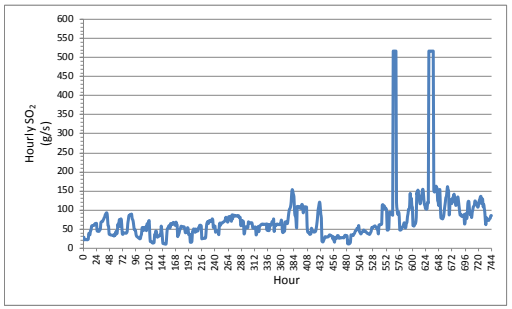


Unit 4

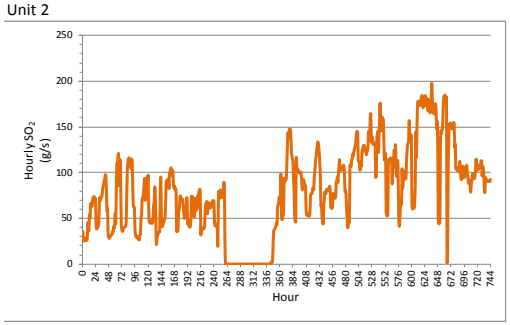


July 2014

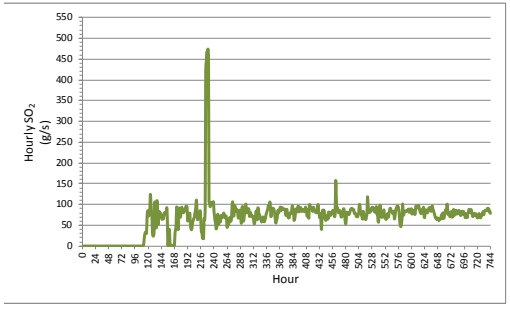
Unit 1



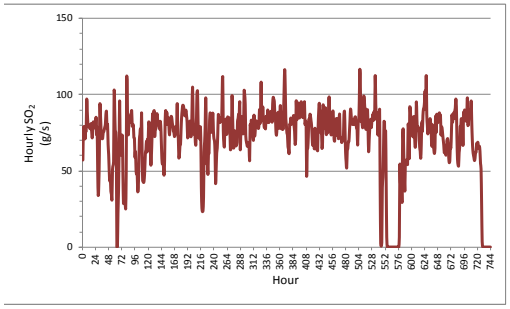
Unit 2



Unit 3

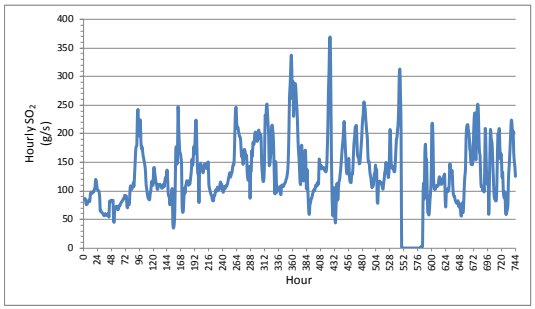


Unit 4

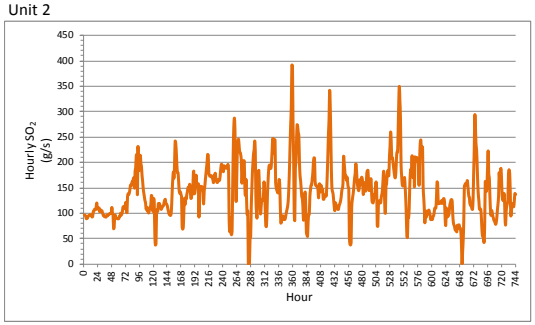


August 2014

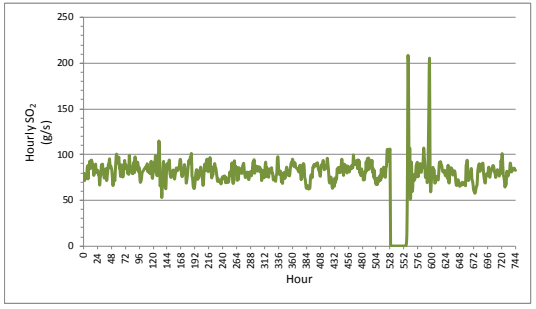
Unit 1



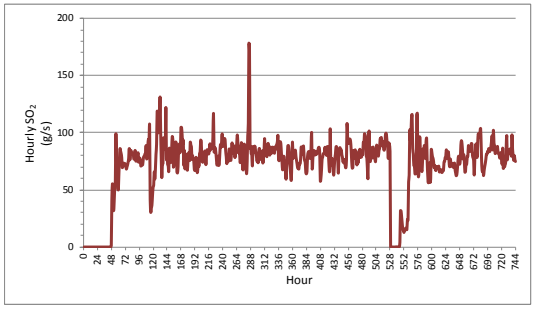
Unit 2



Unit 3

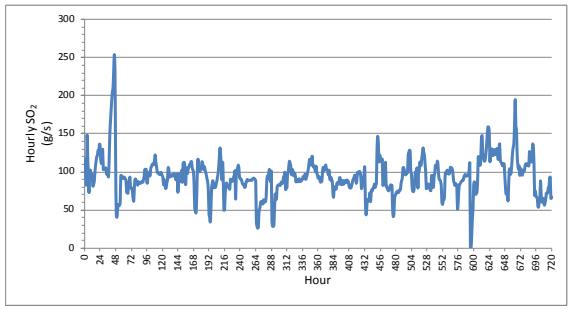


Unit 4

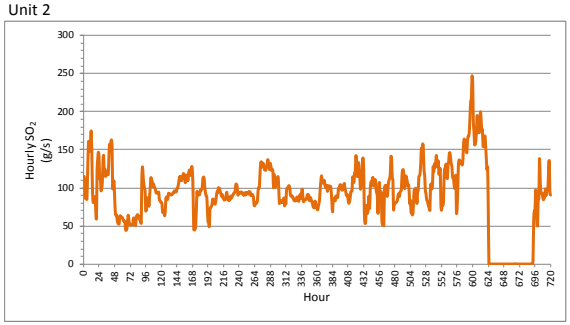


September 2014

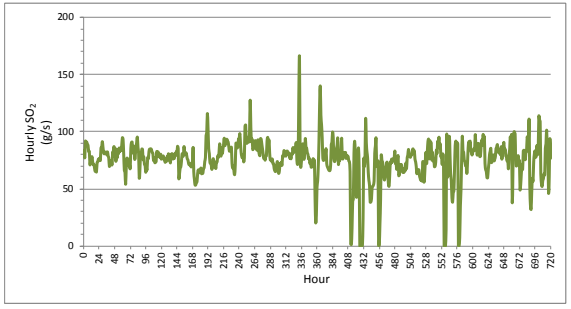
Unit 1



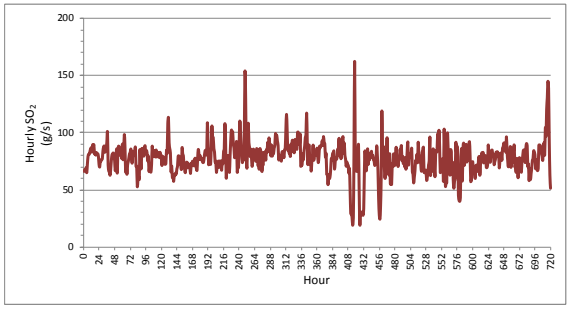
Unit 2



Unit 3

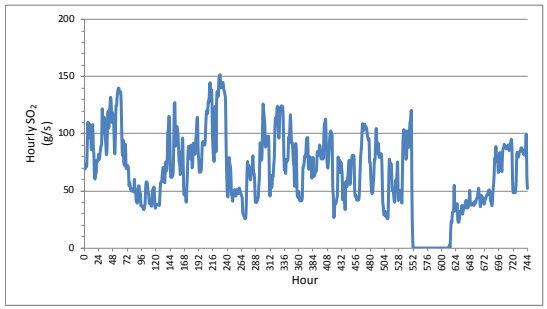


Unit 4

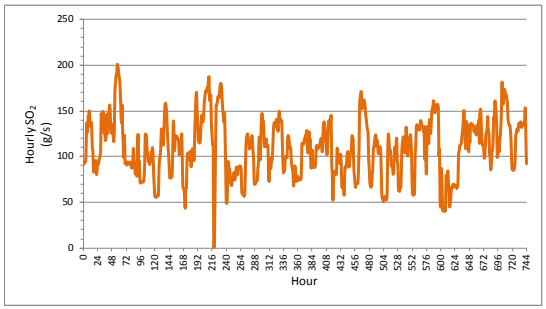


October 2014

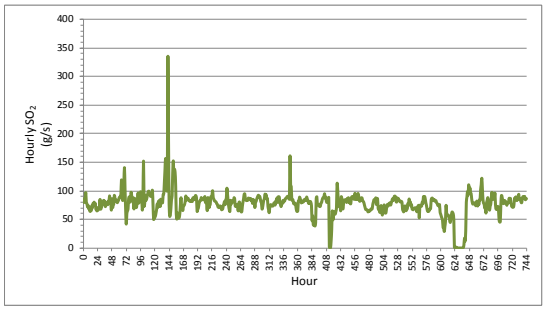
Unit 1



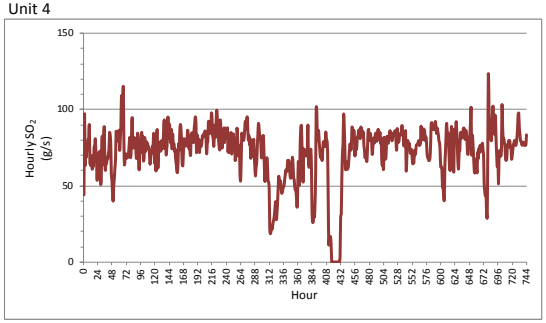
Unit 2



Unit 3

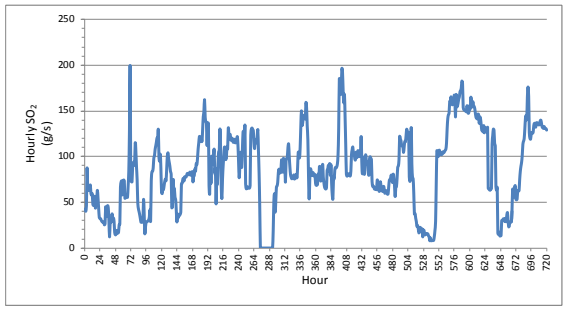


Unit 4

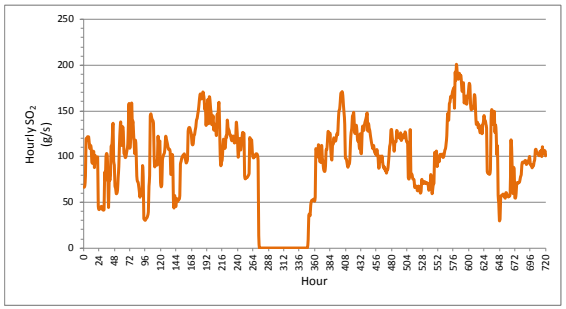


November 2014

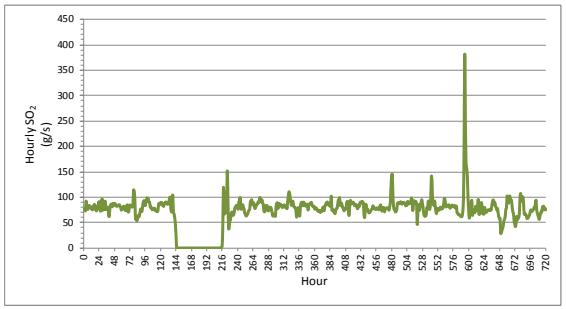
Unit 1



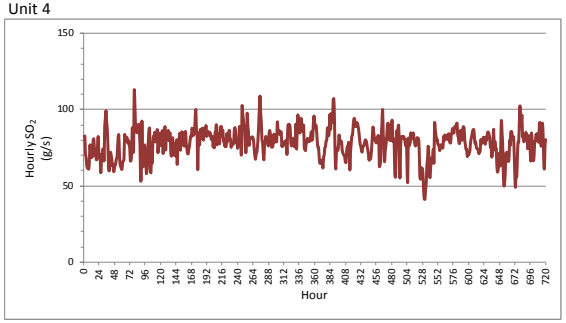
Unit 2



Unit 3

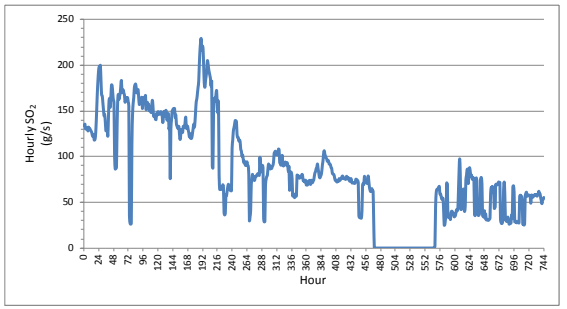


Unit 4

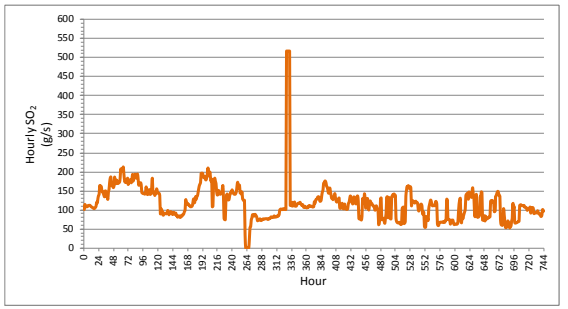


December 2014

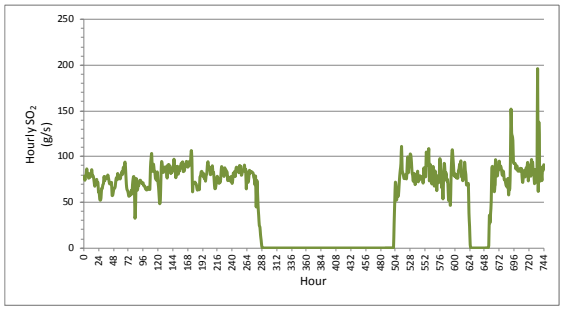
Unit 1



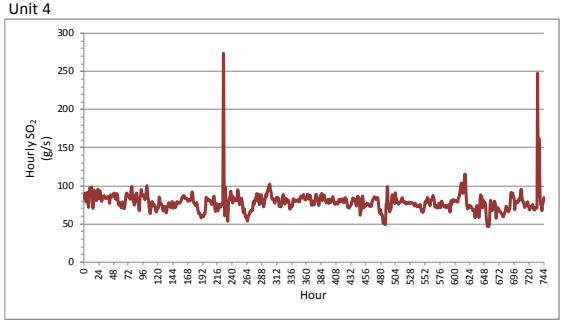
Unit 2



Unit 3



Unit 4

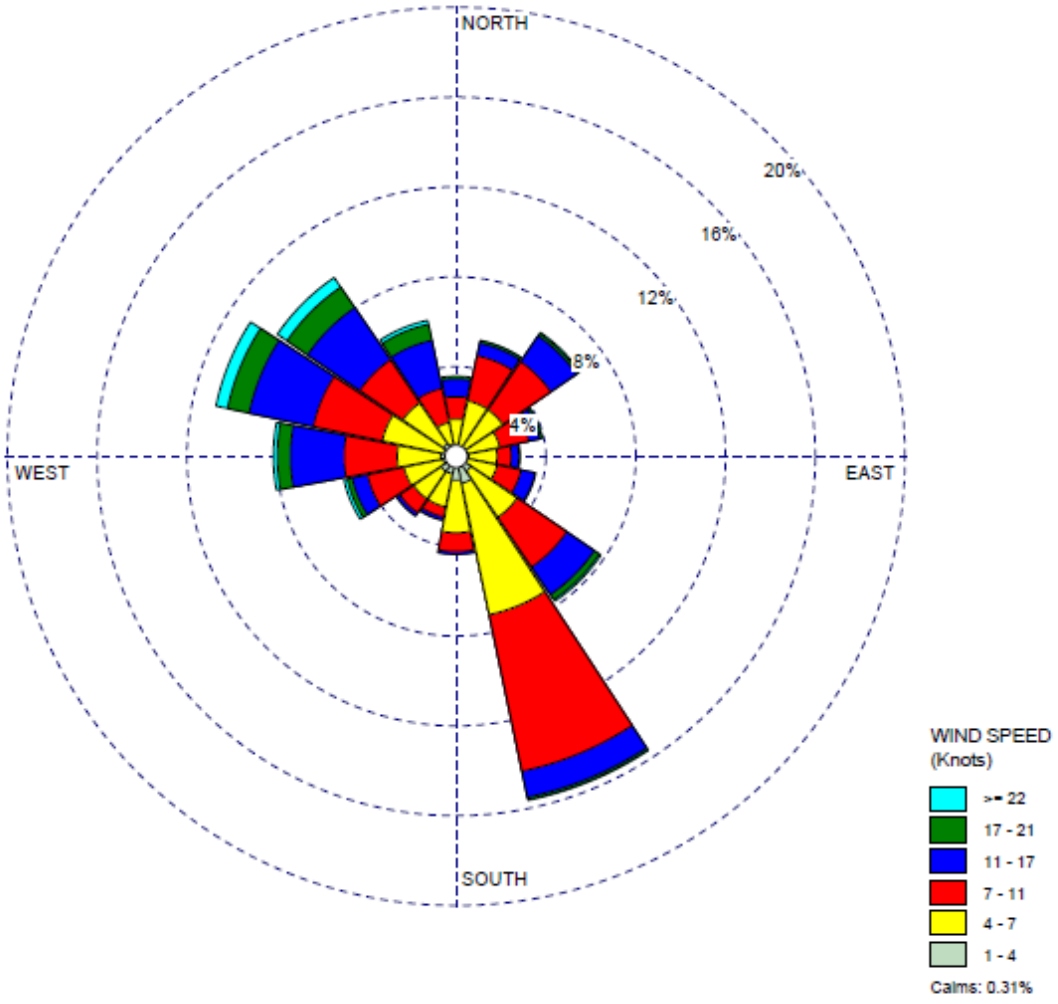


Appendix C

Annual wind roses with direction and speed data

WIND ROSE PLOT:
Station #24037 - MILES CITY/MUNICIPAL ARPT, MT

DISPLAY:
Wind Speed
Direction (blowing from)

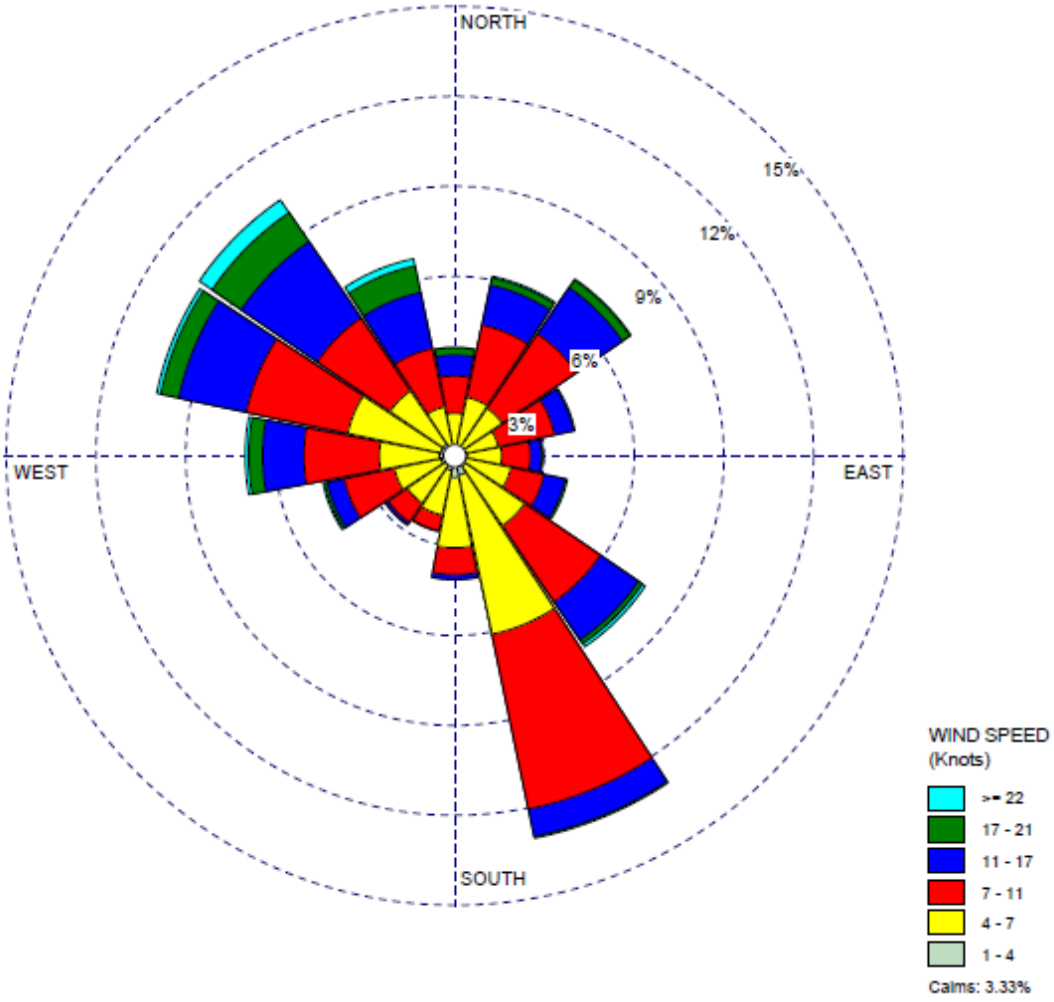


COMMENTS:	DATA PERIOD:	COMPANY NAME:	
Met Year: 2012	**Start Date: 1/1/2012 - 00:00** **End Date: 12/31/2012 - 23:00**	MODELER:	
	CALM WINDS: **0.31%**	TOTAL COUNT: **8782 hrs.**	
	AVG. WIND SPEED: **8.70 Knots**	DATE: **4/26/2016**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
Station #24037 - MILES CITY/MUNICIPAL ARPT, MT

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS: Met Year: 2013	DATA PERIOD: **Start Date: 1/1/2013 - 00:00** **End Date: 12/31/2013 - 23:00**	COMPANY NAME:	
		MODELER:	
	CALM WINDS: **3.33%**	TOTAL COUNT: **8609 hrs.**	
	AVG. WIND SPEED: **8.58 Knots**	DATE: **4/26/2016**	PROJECT NO.:

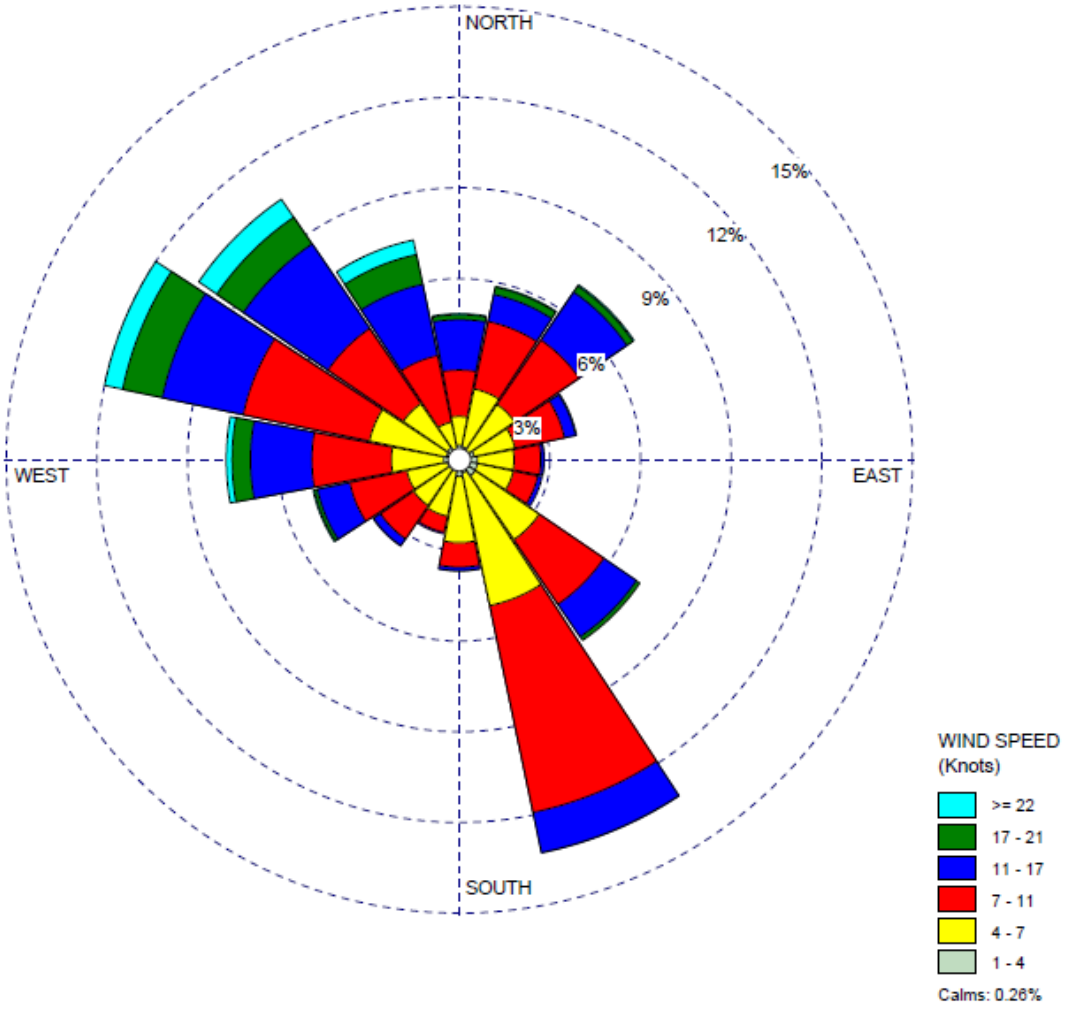
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Station #24037 - MILES CITY/MUNICIPAL ARPT, MT

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS: Met Year: 2014	DATA PERIOD: **Start Date: 1/1/2014 - 00:00** **End Date: 12/31/2014 - 22:00**	COMPANY NAME:	
		MODELER:	
	CALM WINDS: **0.26%**	TOTAL COUNT: **8743 hrs.**	
	AVG. WIND SPEED: **9.22 Knots**	DATE: **5/18/2016**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software