To: Brown, Ryan[Brown.Ryan@epa.gov]
From: Flynn, Thomas
Sent: Mon 4/24/2017 5:44:01 PM
Subject: Draft Appendix U demonstration
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DRAFT Appendix U Demonstration 20170424.docx

Ryan,

Here is our really rough draft. I'm still working through the data substitution stuff as a result of our conversation. I have not put any of the theilsen regression stuff in yet. We are in the process of tweaking the code so that it will accept specific monitor pairings based on our conversation this morning. I am also in the process of updating the tables to reflect that we are using 5 years data to generate the monthly maximums. I think in a couple of areas I had used three years to try and get them to meet. Please treat everything in this document as subject to change. Once we get the document finalized we will share all code and data we used to calculate the results.

Tommy

Thomas J. Flynn, III
Program Manager
Bureau of Air Quality
S.C. Dept. of Health & Environmental Control
Office: (803) 898-3251
Connect: www.scdhec.gov Facebook Twitter

Incomplete Ozone Data Handling for the North Spartanburg Fire Station #2 and Ashton Ambient Air Monitoring Sites.

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Introduction

On October 1, 2015, the Administrator of the Environmental Protection Agency (EPA) signed a Final Rule setting the new primary and secondary ozone National Ambient Air Quality Standard (NAAQS) to 0.070 ppm, later published in 80 FR 65292. The previous ozone standard was 0.075 ppm. No changes to the form of the metric were promulgated, and it remains based on the maximum daily 8-hour average (MDA8). Promulgation of the NAAQS triggers Clean Air Act (CAA) Section 107(d)(1), requiring the Governor of each state (or his/her designee) to submit recommendations for the classification of each area within that state not later than one year after promulgation. If the EPA disagrees with the State's recommendations, a notification letter is sent detailing the proposed changes and inviting the State to submit further data and explanations in support of the original recommendations. This notification letter must be given no later than 120 days prior to the promulgation of the designation, and it is commonly referred to as the "120-day letter." The CAA requires area designation to be finalized by October 1, 2017, for the new NAAQS except, in a case in which there is insufficient information to make a designation, this deadline may be extended by one year at the Administrator's discretion (CAA 107(d)(1)(B)(i)).

The EPA has established criteria for air quality data collection, verification and evaluation. Appendix U to 40 CFR Part 50 was promulgated through publication on October 26, 2015 (80 FR 65458). This regulation sets forth requirements for ozone data selection, reporting, handling and comparisons to the new ozone NAAQS. Among these are requirements in Section 4(b) for data completeness for the purpose of calculating a valid 3-year ozone Design Value (see text of the section on page 4). Each annual 4th highest MDA8 must be based on valid data from at least 75% of the days during the ozone monitoring season, and the 3-year Design Value must be based on valid data from at least 90% of the days during the previous three ozone monitoring seasons. If either of these criteria is not met, there are two alternatives: 1) the Administrator may defer area designation for an additional year in order to meet the criterion, or 2) the state may demonstrate, in accordance with Section 4(c) and subject to EPA approval, that "meteorological conditions on missing days were not conducive to concentrations above the NAAQS." (See text of this section on page 5).

Table 1 presents the annual, and three-year data completion percentages for all monitoring which do not meet the minimum data completeness requirements found in 40 CFR Part 50, Appendix U.

Table 1: Annual and three year data completeness for sites with incomplete data

Site ID	Site Name	2014 Complete Days (% Complete)	2015 Complete Days (% Complete)	2016 Complete Days (% Complete)	Three year data completeness
450010001	Due West	136 (64%)	123 (57%)	163 (76%)	66%
450150002	Bushy Park	194 (91%)	186 (87%)	181 (85%)	87%
450190046	Cape Romain	175 (82%)	179 (84%)	143 (67%)	77%
450290002	Ashton	193 (90%)	147 (69%)	184 (86%)	82%
450370001	Trenton	136 (64%)	123 (57%)	205 (96%)	72%
450450016	Hillcrest	152 (71%)	193 (90%)	203 (95%)	85%
450510008	Coastal	NA	NA	75 (35%)	NA

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	Carolina				
450770002	Clemson CMS	210 (98%)	154 (72%)	206 (96%)	89%
450770003	Wolf Creek	205 (96%)	138 (64%)	208 (97%)	86%
450790007	Parklane	152 (71%)	182 (85%)	161 (75%)	77%
450790021	Congaree Bluff	181 (85%)	148 (69%)	196 (92%)	82%
450791001	Sandhill	180 (84%)	178 (83%)	211 (99%)	89%
450830009	North Spartanburg	200 (93%)	168 (79%)	168 (79%)	83%

In accordance with Appendix U to 40 CFR Part 50, Section 4(c), the following analysis is intended to demonstrate to the EPA that the missing 2013 - 2015 MDA8 data were from days when meteorological data would convince an informed observer that the 2015 Ozone NAAQS would not have been exceeded at the given site. Finally, our analysis will use a regression analysis of monitors near NSFS to predict ozone concentrations for the missing days to ensure that the three year design value meets the NAAQS. The Department is requesting concurrence from the EPA to count some of the missing days toward the minimum data completeness requirement in section 4(b). The Department is seeking concurrence with more dates than are necessary for the 2013 – 2015 period to ensure that there is sufficient data completeness available for the final designation decision based on data from 2014 – 2016. All computer programming code used to generate the analysis will be provided to the EPA Region 4 office to assist with their decision making.

Regulatory requirements for the treatment of data

The regulations in 40 CFR Part 50, Appendix U, Section 4(b) and (c) address missing data. It specifies:

> *(b) A design value greater than the level of the NAAQS is always considered to be valid. A design value less than or equal to the level of the NAAQS must meet minimum data completeness requirements in order to be considered valid. These requirements are met for a 3-year period at a site if valid daily maximum 8-hour average O_3 concentrations are available for at least 90% of the days within the O_3 monitoring season, on average, for the 3-year period, with a minimum of at least 75% of the days within the O_3 monitoring season in any one year.*
>
> *(c) When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the NAAQS. Missing days assumed less than the level of the NAAQS are counted for the purpose of meeting the minimum data completeness requirements, subject to the approval of the appropriate Regional Administrator.*

Identification of missing days

Data for the years 2013 - 2015 were used to calculate the Ashton and NSFS's 2015 3-year ozone design values. For the Ashton ozone monitor, data completeness was 94 percent for the

year 2013, 90 percent for 2014, and 82 percent for 2015. The data completeness for the 2013-2015 3-year ozone design value was 89 percent. For the NSFS ozone monitor, data completeness was 91 percent in 2013, 93 percent in 2014, and 82 percent in 2015. The data completeness for the 2013-2015 3-year ozone design value was 89 percent. Since neither Ashton nor NSFS met the 3-year ozone design value requirement of 90 percent data completeness, the Department has chosen to evaluate the meteorological conditions for the days of missing data to determine whether they can be counted for the purpose of meeting the minimum data completeness requirements.

Augusta-Richmond County, GA-SC MSA

Missing days for the Trenton ozone monitoring station

The Trenton ozone monitor had 78, 91, and 9 incomplete days for 2014, 2015, and 2016, respectively (Figure 1). The MDA8 (Figure 2) for each year comprising the design value show that there was only two exceedances of 70 ppb.

Figure 1: Trenton missing data by year and month

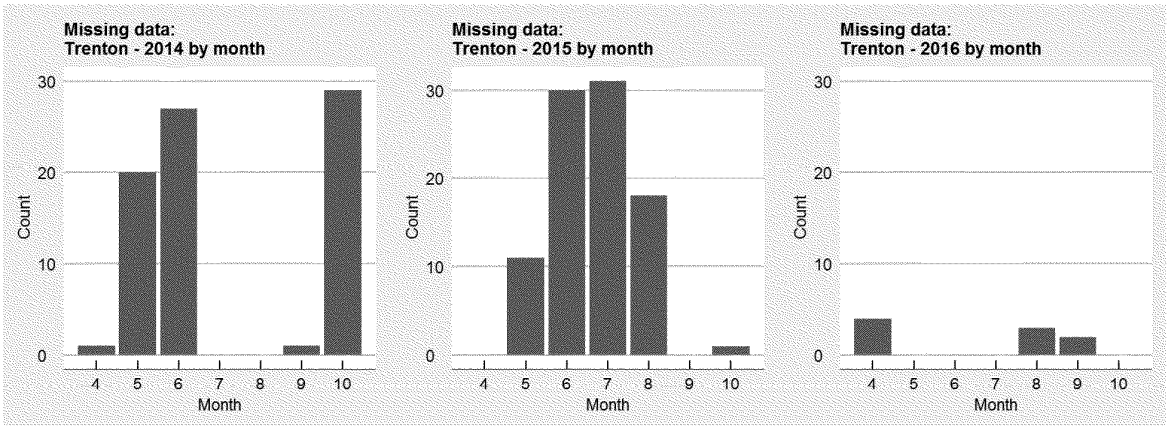
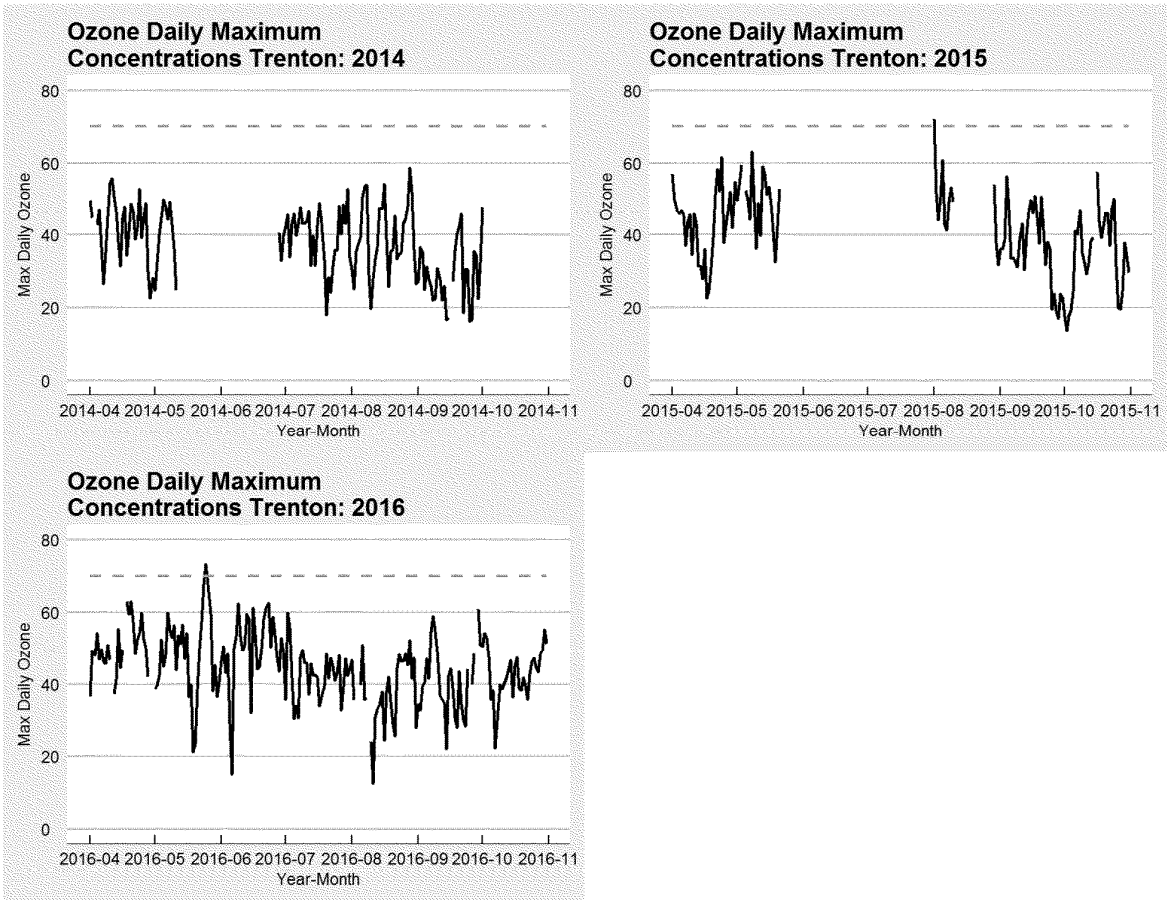


Figure 2: Trenton MDA8 by year



Charleston-North Charleston MSA

Missing days for the Bushy Park ozone monitoring station

The Bushy Park ozone monitor had 20, 28, and 33 incomplete days for 2014, 2015, and 2016, respectively (Figure 3). The MDA8 (Figure 4) for each year comprising the design value show that there no exceedances of 70 ppb.

Figure 3: Bushy Park missing data by year and month

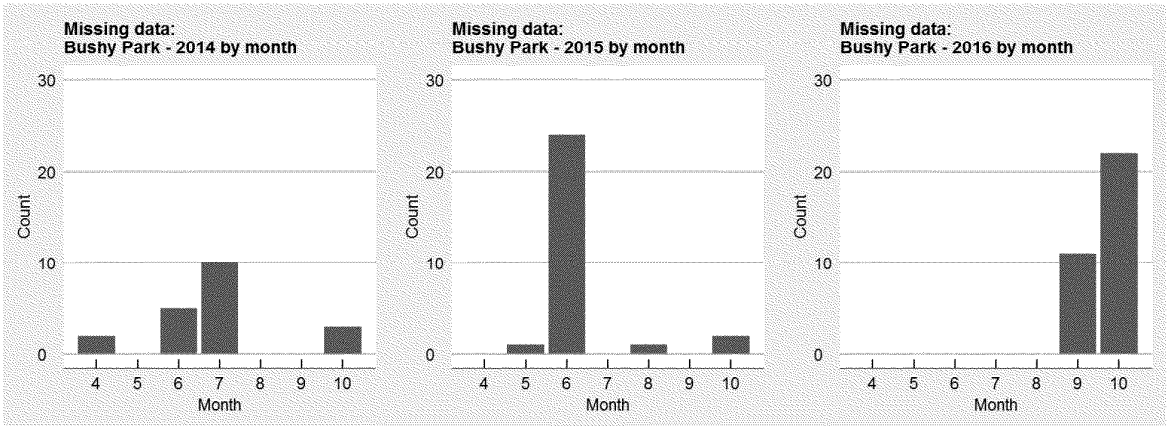
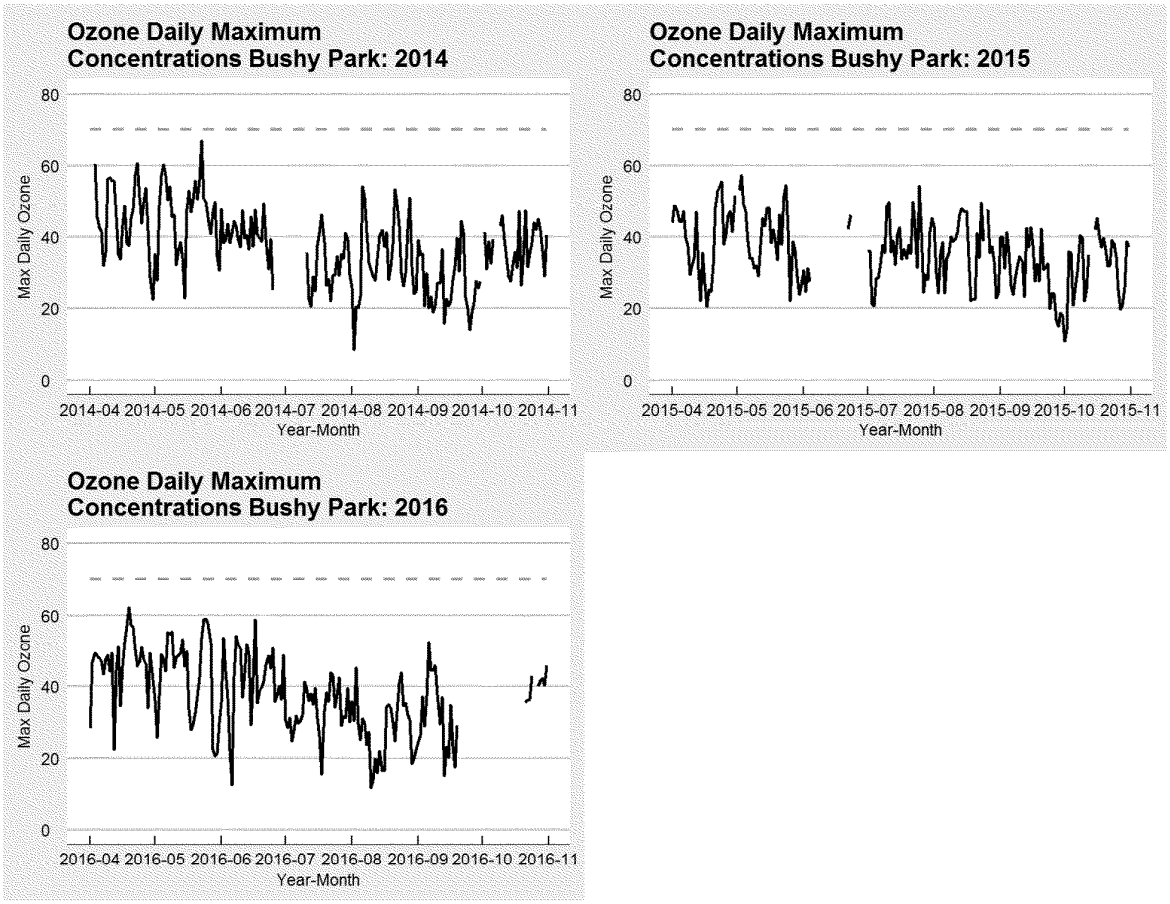


Figure 4: Bushy Park MDA8 by year



Missing days for the Cape Romain ozone monitoring station

The Cape Romain ozone monitor had 39, 35, and 71 incomplete days for 2014, 2015, and 2016, respectively (Figure 5). The MDA8 (Figure 6) for each year comprising the design value show that there no exceedances of 70 ppb.

Figure 5: Cape Romain missing data by year and month

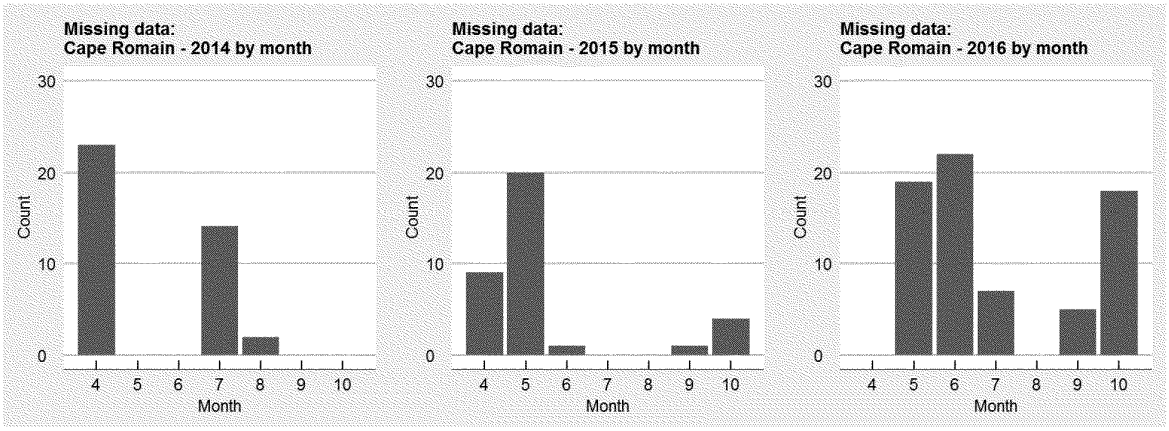
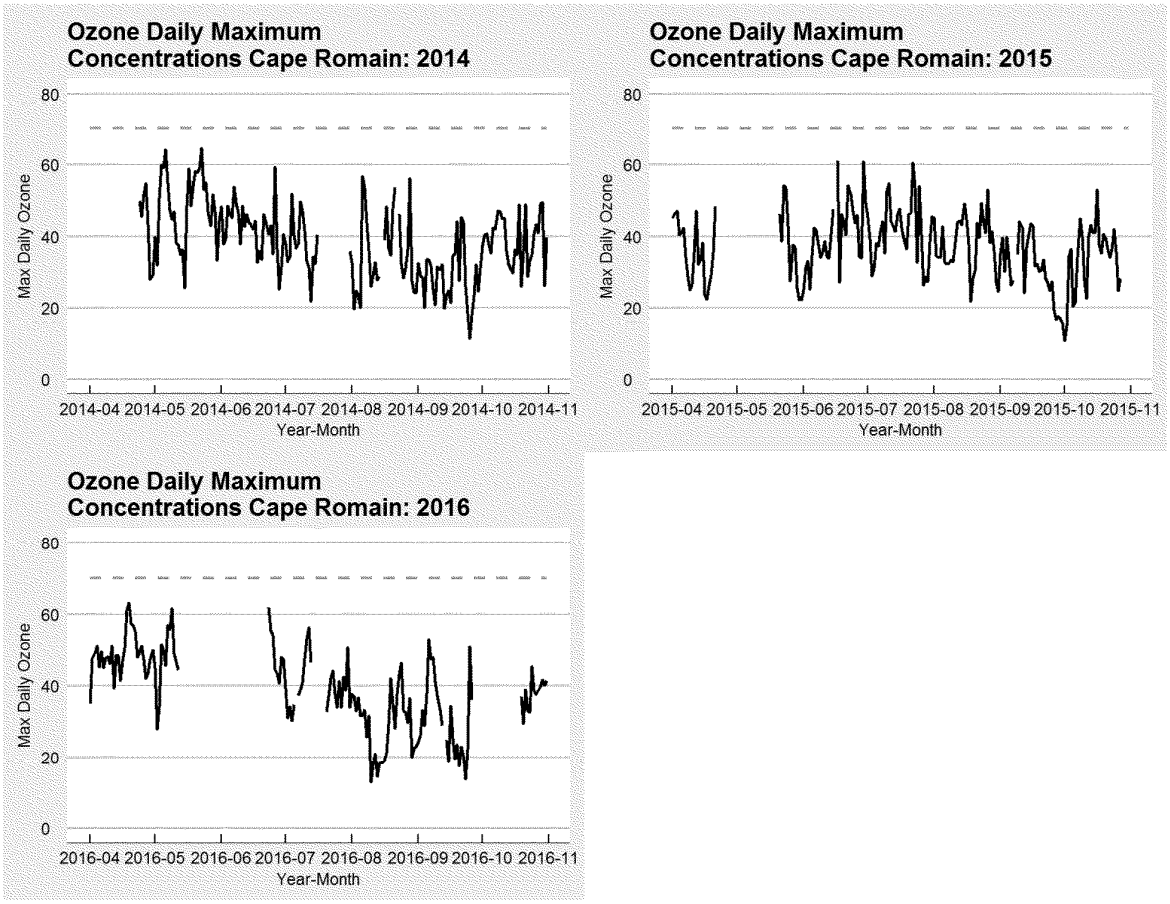


Figure 6: Cape Romain MDA8 by year



Columbia MSA

Missing days for the Parklane ozone monitoring station

The Parklane ozone monitor had 62, 32, and 53 incomplete days for 2014, 2015, and 2016, respectively (Figure 7). The MDA8 (Figure 8) for each year comprising the design value show that there were two exceedances of 70 ppb.

Figure 7: Parklane missing data by year and month

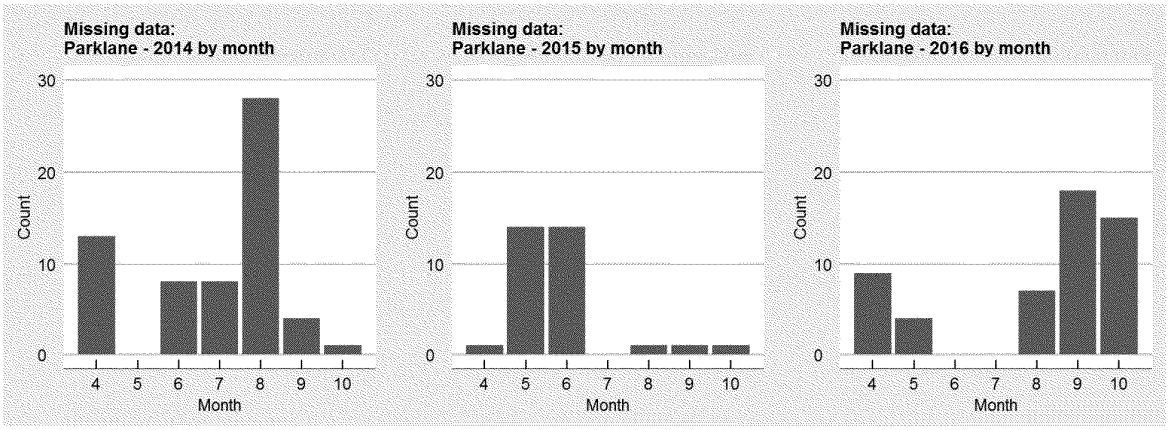
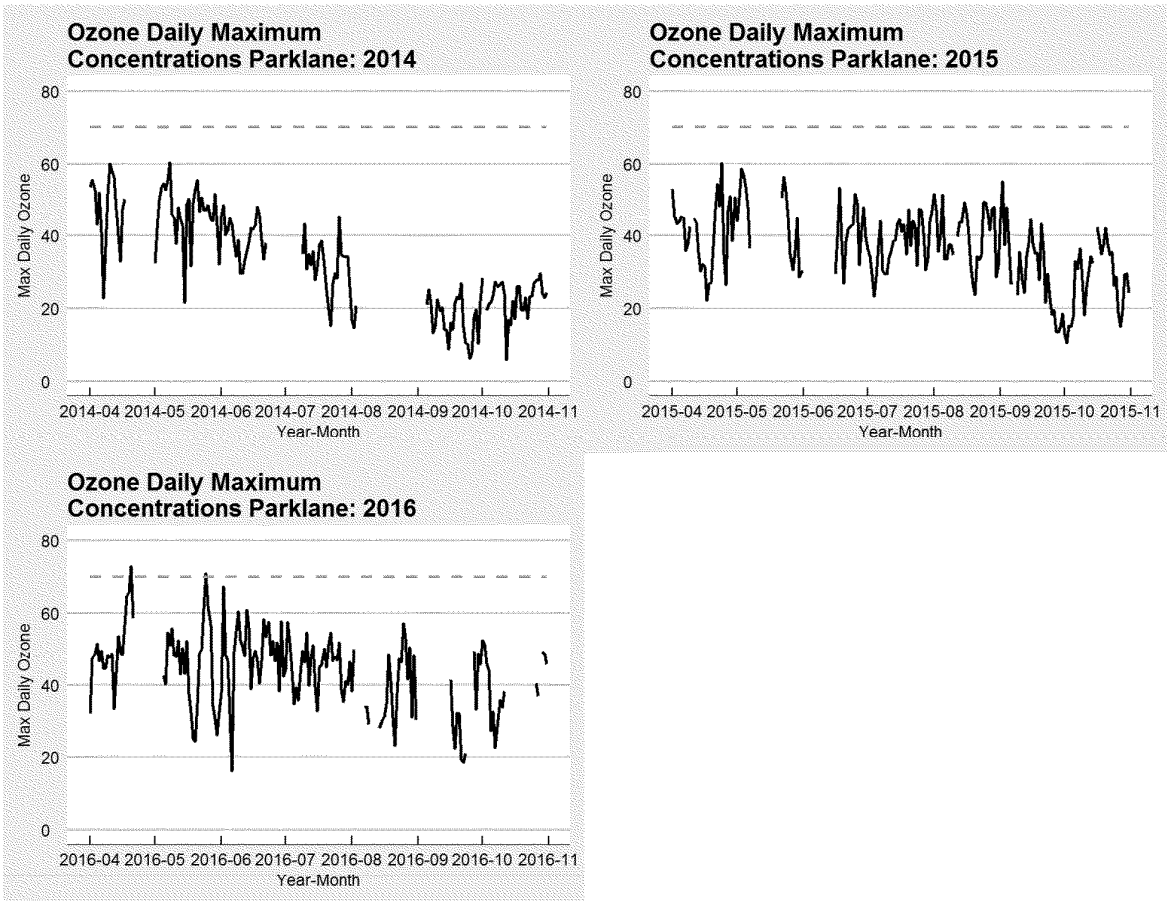


Figure 8: Parklane MDA8 by year



Missing days for the Congaree Bluff ozone monitoring station

The Congaree Bluff ozone monitor had 33, 66, and 18 incomplete days for 2014, 2015, and 2016, respectively (Figure 9). The MDA8 (Figure 10) for each year comprising the design value show that there were no exceedances of 70 ppb.

Figure 9: Congaree Bluff missing data by year and month

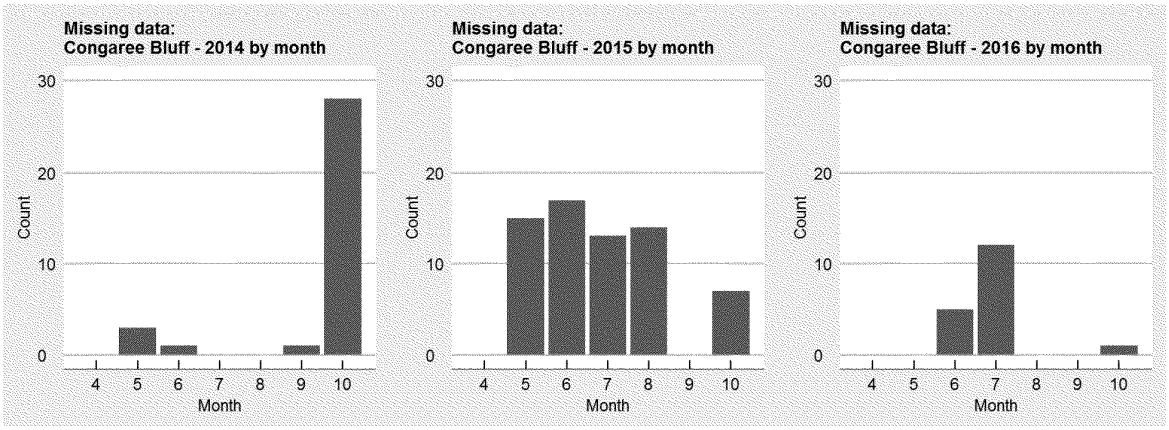


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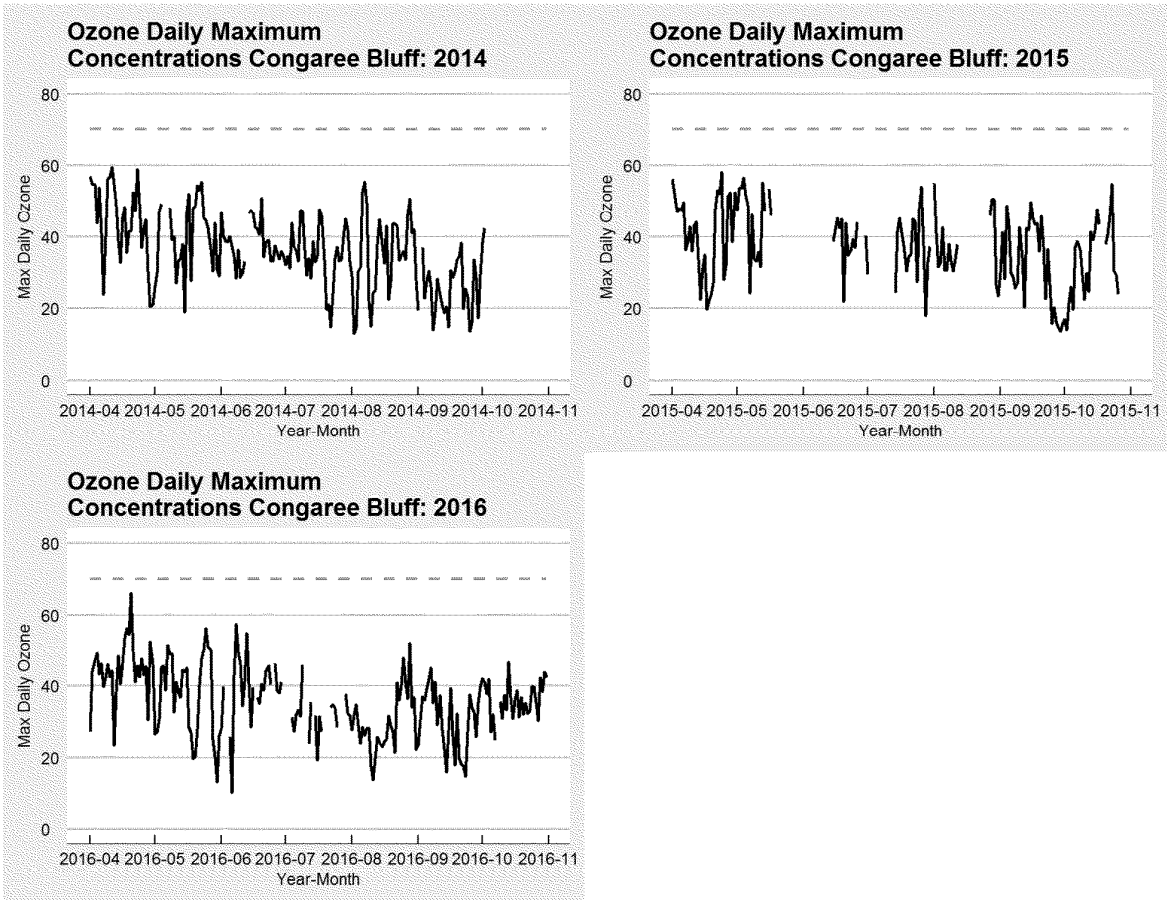
Figure 10: Congaree Bluff MDA8 by year



Missing days for the Sandhill ozone monitoring station

The Sandhill ozone monitor had 34, 36, and 3 incomplete days for 2014, 2015, and 2016, respectively (Figure 11). The MDA8 (Figure 12) for each year comprising the design value show that there were three exceedances of 70 ppb.

Figure 11: Sandhill missing data by year and month

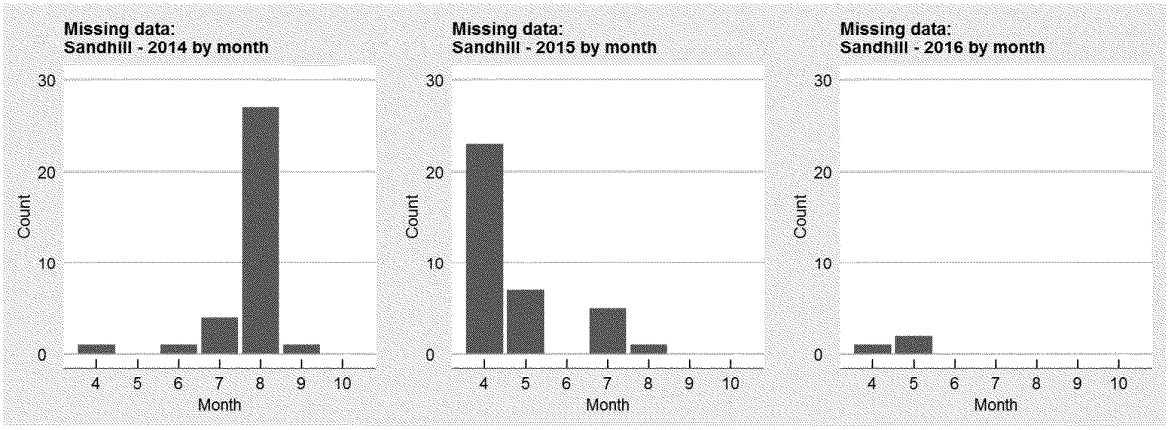
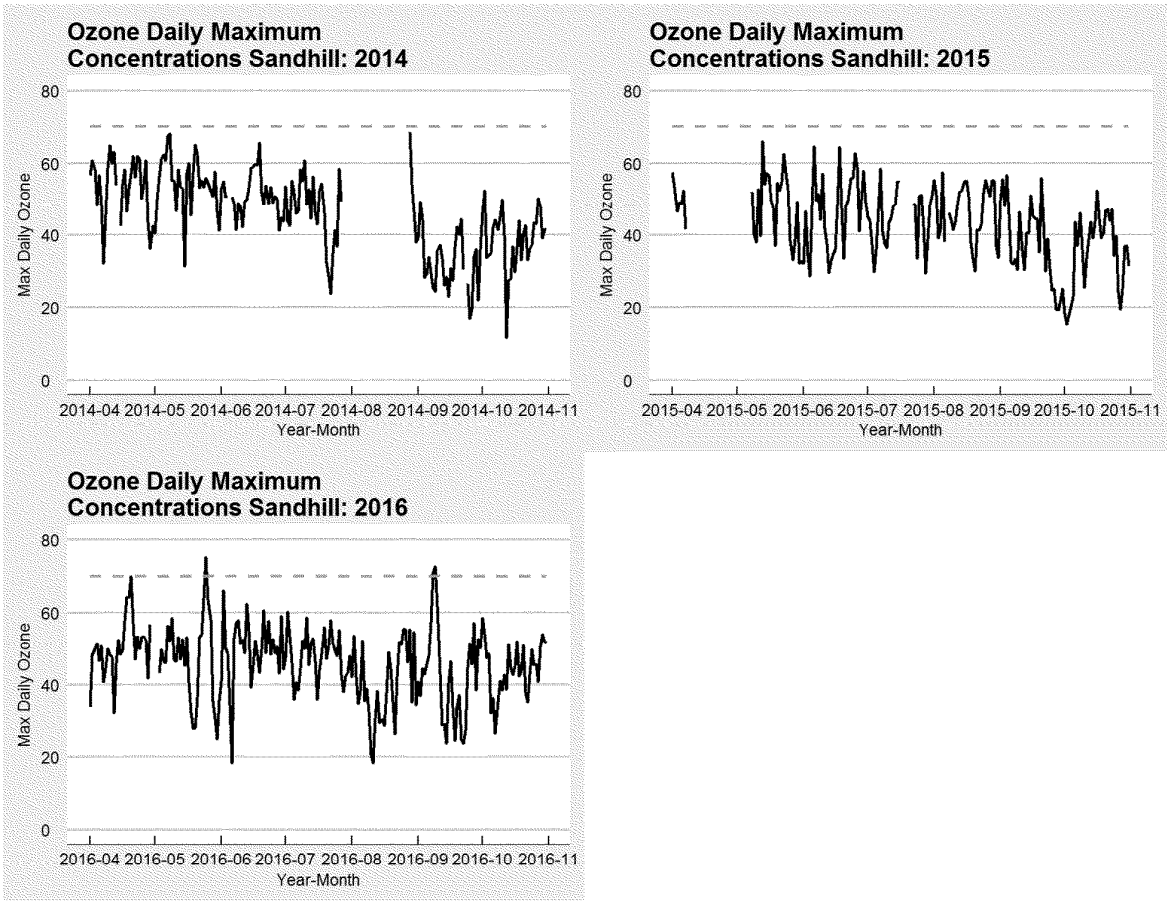


Figure 12: Sandhill MDA8 by year



Greenville-Anderson-Mauldin MSA

Missing days for the Hillcrest ozone monitoring station

The Hillcrest ozone monitor had 62, 21, and 11 incomplete days for 2014, 2015, and 2016, respectively (Figure 13). The MDA8 (Figure 14) for each year comprising the design value show

that there were three exceedances of 70 ppb.

Figure 13: Hillcrest missing data by year and month

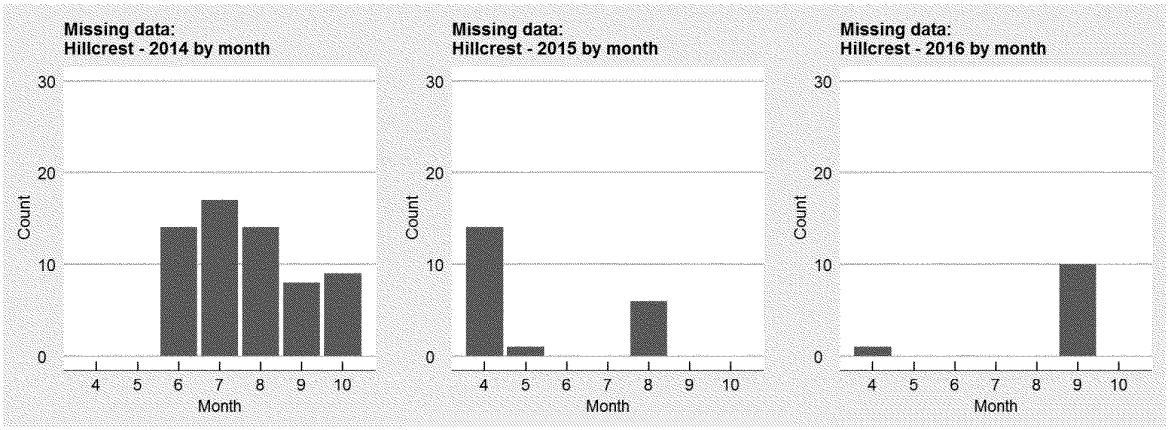
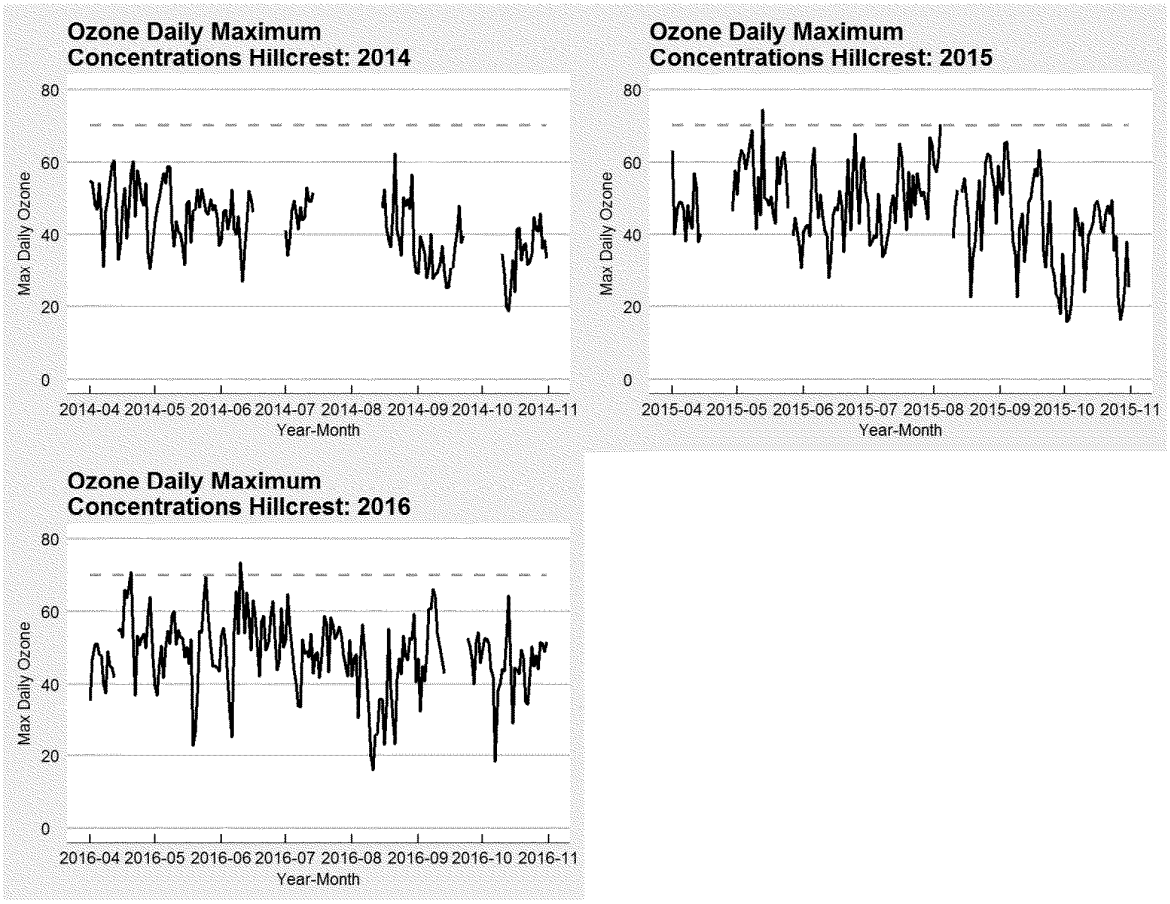


Figure 14: Hillcrest MDA8 by year



Missing days for the Clemson CMS ozone monitoring station

The Clemson CMS ozone monitor had 4, 60, and 8 incomplete days for 2014, 2015, and 2016, respectively (Figure 15). The MDA8 (Figure 16) for each year comprising the design value show that there was one exceedance of 70 ppb.

Figure 15: Clemson CMS missing data by year and month

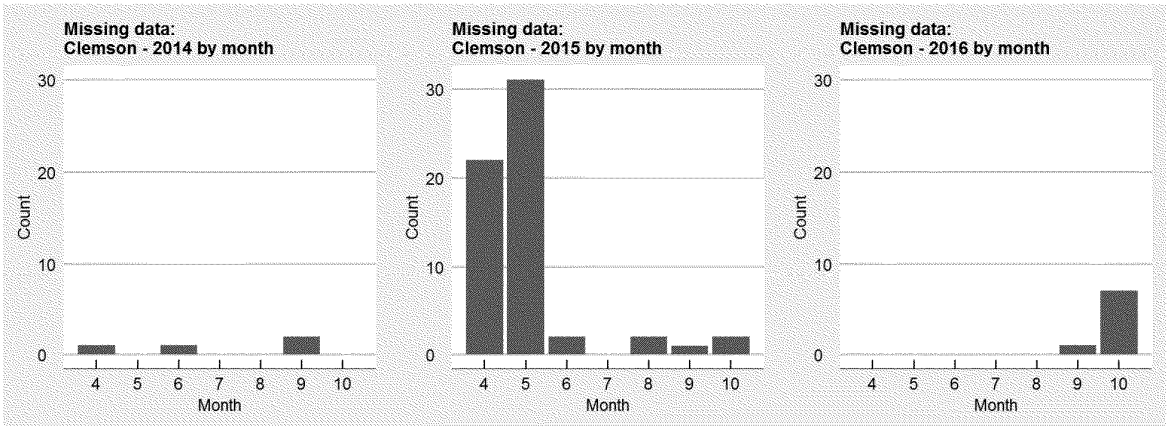
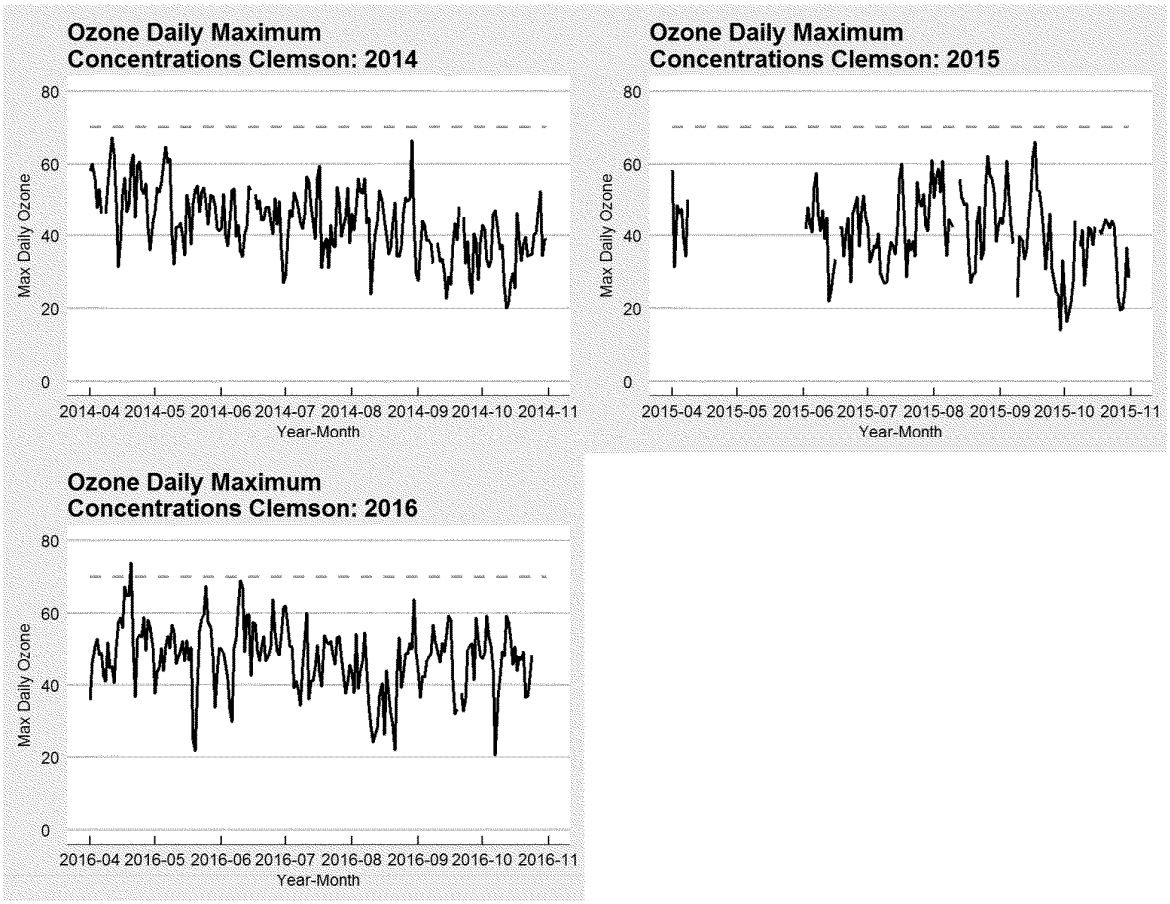


Figure 16: Clemson CMS MDA8 by year



Missing days for the Wolf Creek ozone monitoring station

The Wolf Creek ozone monitor had 9, 76, and 6 incomplete days for 2014, 2015, and 2016, respectively (Figure 17). The MDA8 (Figure 18) for each year comprising the design value show that there was one exceedance of 70 ppb.

Figure 17: Wolf Creek missing data by year and month

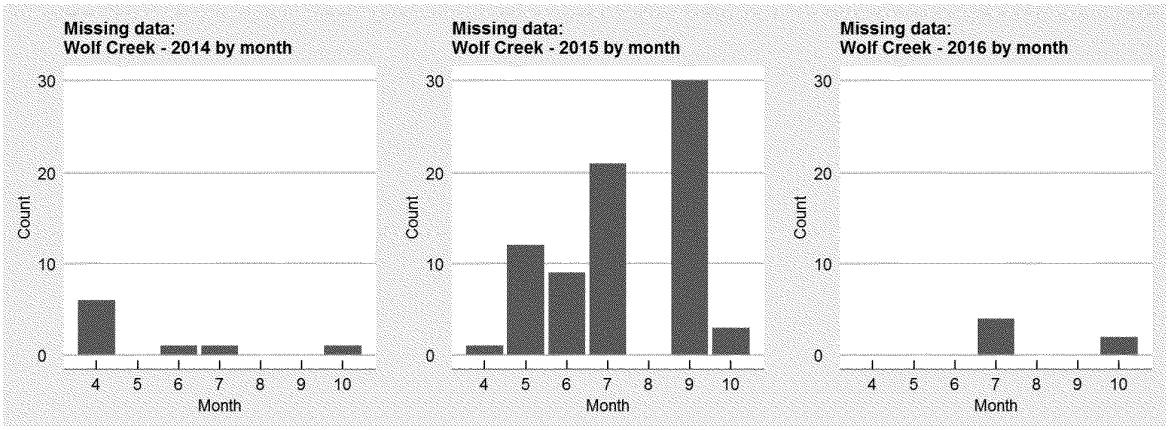


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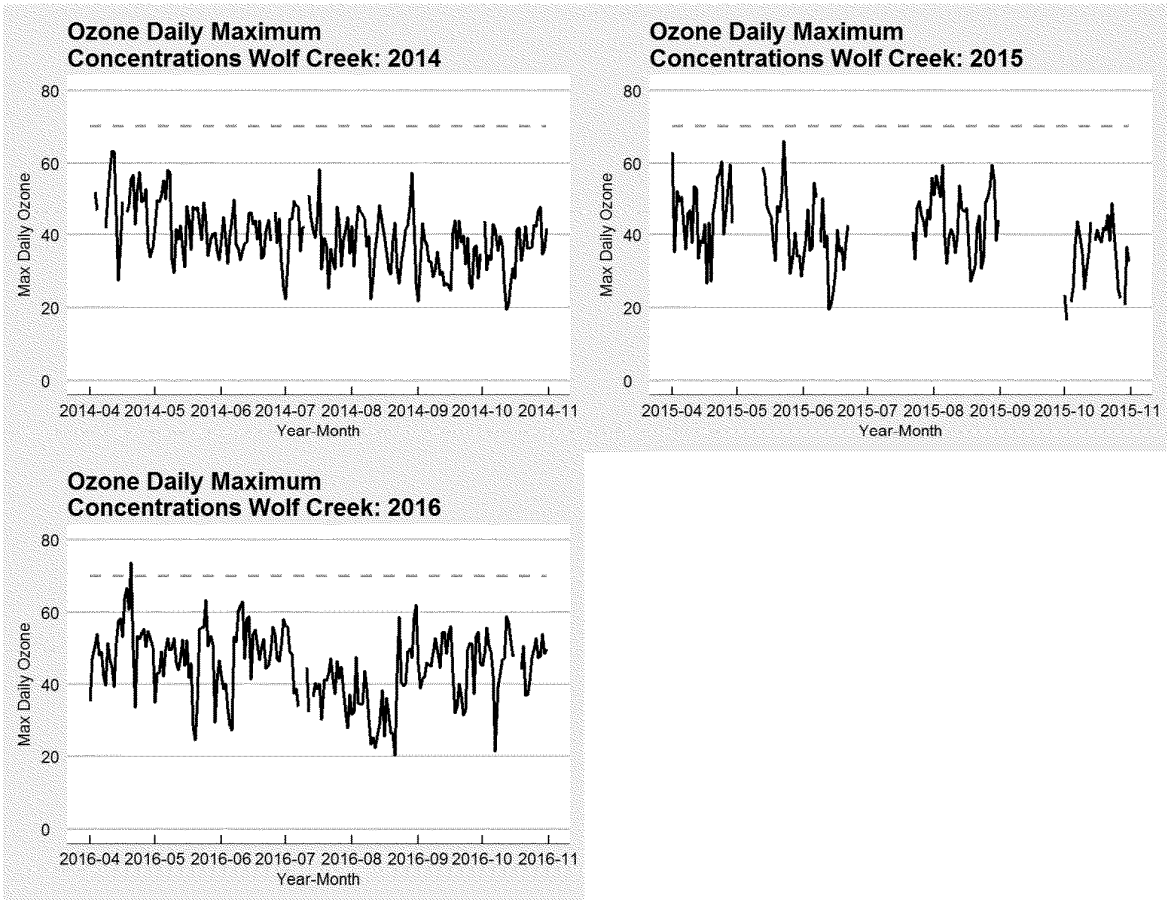
Figure 18: Wolf Creek MDA8 by year



Spartanburg MSA

Missing days for the NSFS ozone monitoring station

The North Spartanburg ozone monitor had 14, 46, and 46 incomplete days for 2014, 2015, and 2016, respectively (Figure 19). The MDA8 (Figure 20) for each year comprising the design value show that there were three exceedances of 70 ppb.

Figure 19: NSFS missing data by year and month

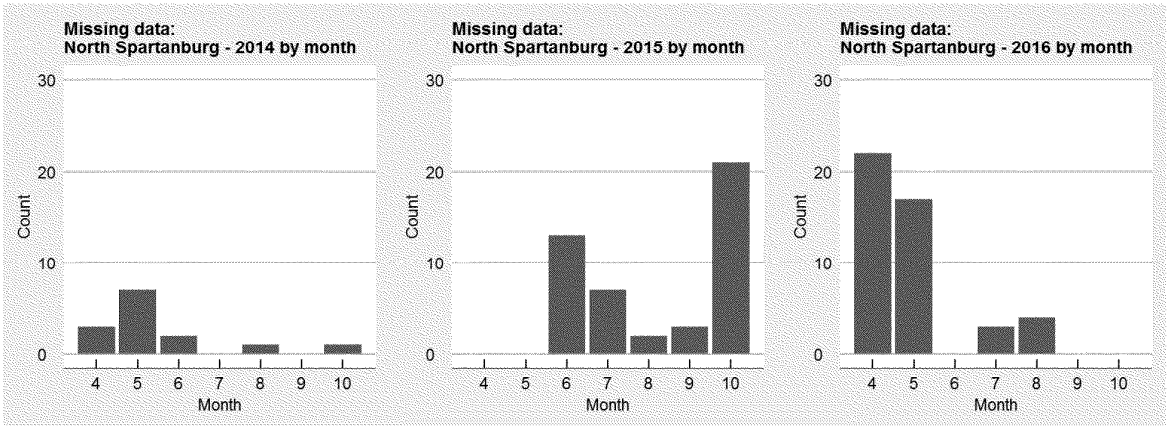
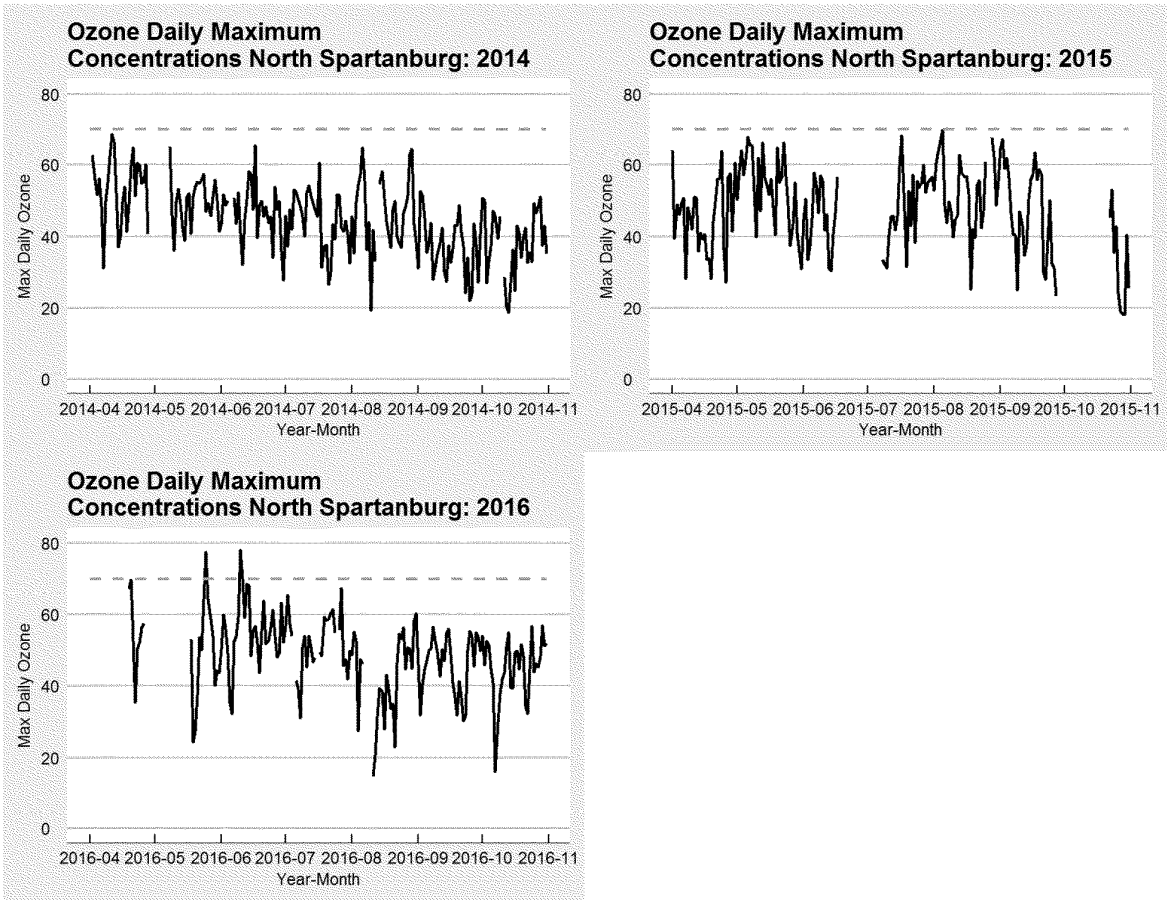


Figure 20: NSFS MDA8 by year



Remainder of the State

Missing days for the Due West ozone monitor

The Due West ozone monitor had 78, 91, and 51 incomplete days for 2014, 2015, and 2016, respectively (Figure 21). The MDA8 (Figure 22) for each year comprising the design value show that there were no exceedances of 70 ppb.

Figure 21: Due West missing data by year and month

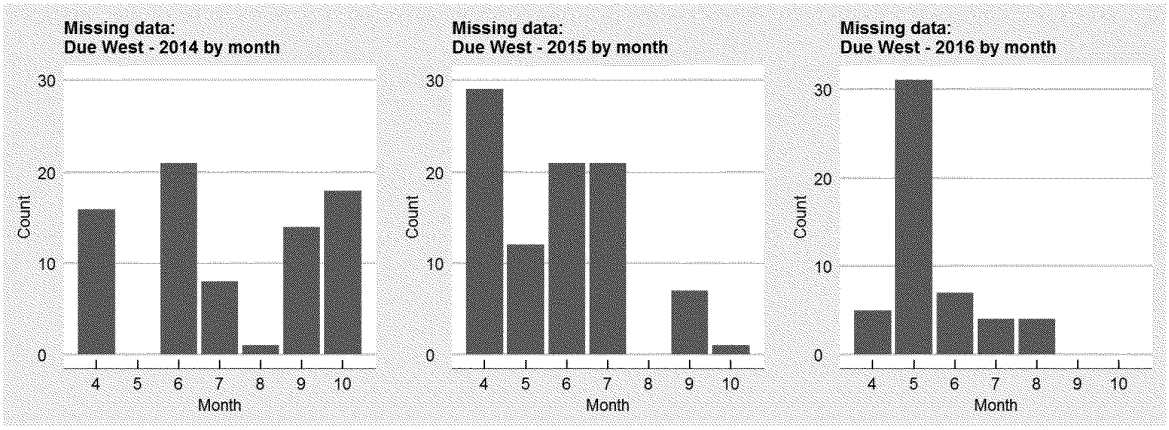


Figure 22: Due West MDA8 by year

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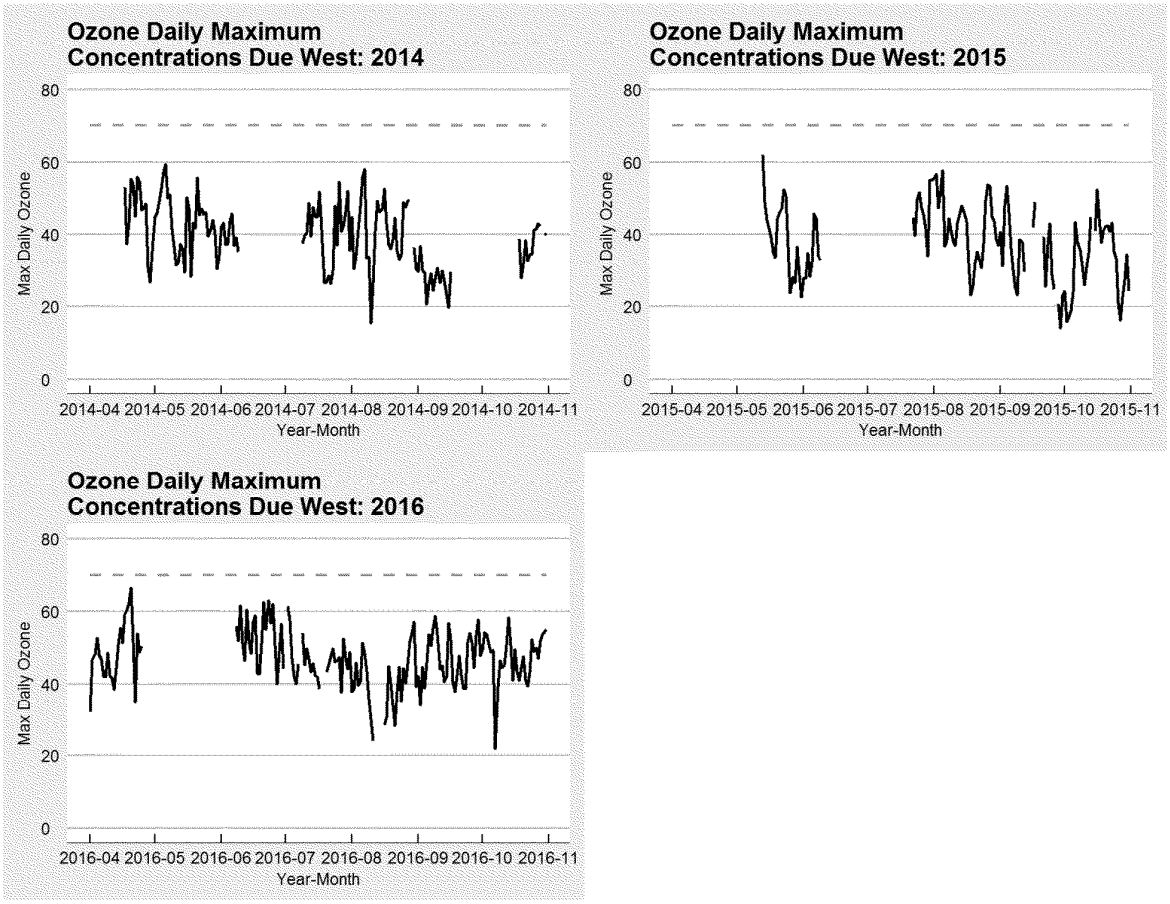


Missing days for the Ashton ozone monitor

The Ashton ozone monitor had 21, 67, and 30 incomplete days for 2014, 2015, and 2016, respectively (Figure 23). The MDA8 (Figure 24) for each year comprising the design value show that there were no exceedances of 70 ppb.

Figure 23: Ashton missing data by year and month

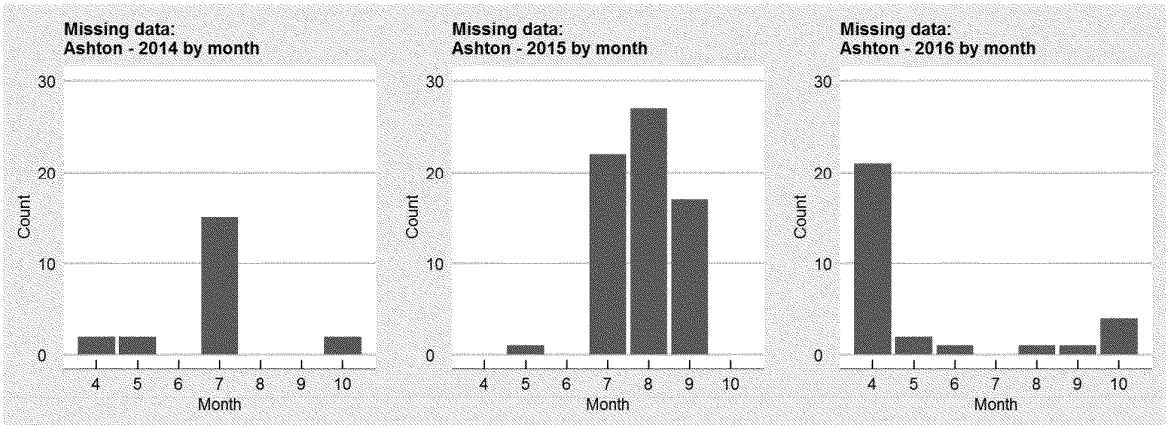
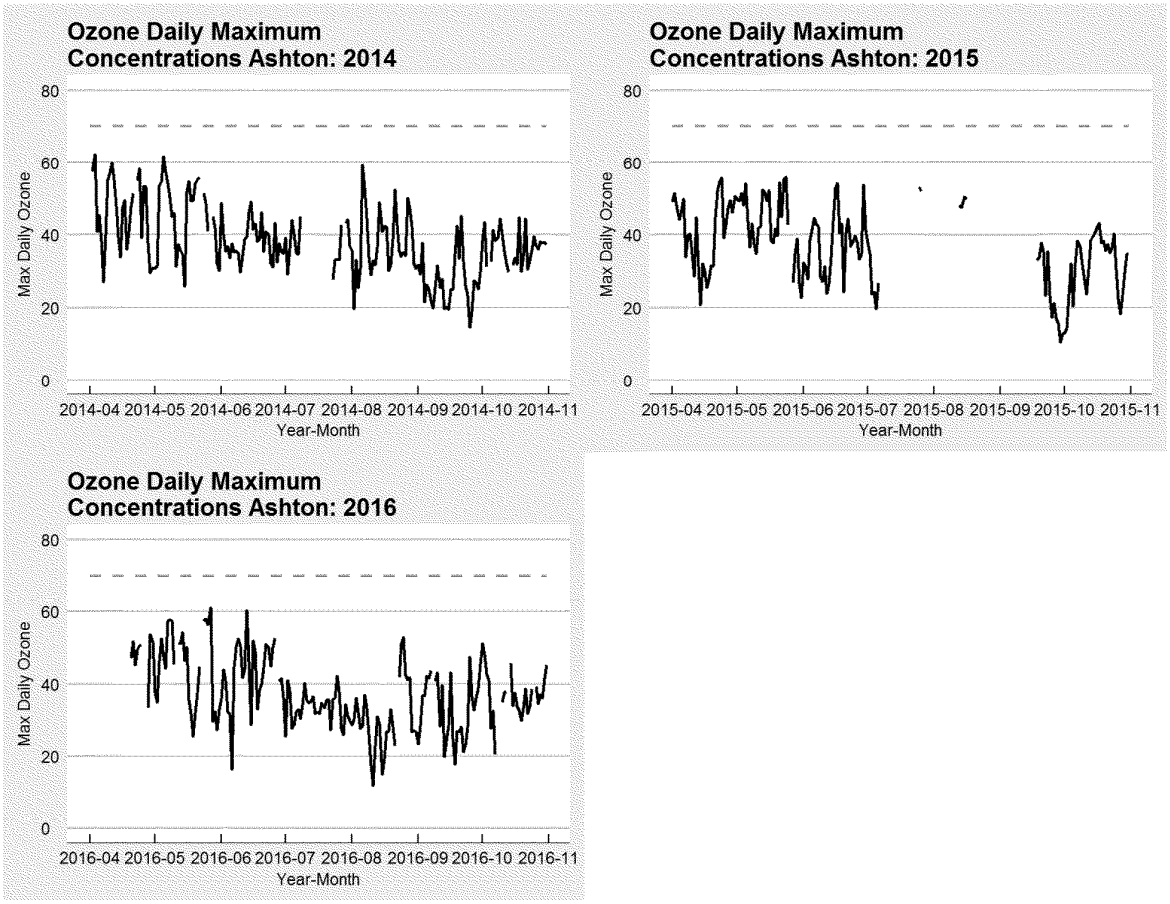


Figure 24: Ashton MDA8 by year



Selection of Days to waive

The Department first looked to see which meteorological conditions are not conducive to ozone formation to demonstrate that missing days occurred on days not conducive to ozone formation. The most important meteorological conditions to ozone formation in South Carolina are maximum daily temperature, mid-day (1000 – 1600 EST) relative humidity, temperature difference (daily maximum-daily minimum), and afternoon (1300 – 1600 EST) wind speed. These parameters were selected based on a paper (Cox & Chu, 1996) used to develop the EPA's Trends in Ozone Adjusted for Weather Conditions (US EPA, n.d.)

After identification of meteorological conditions, a prediction of the incomplete design values was conducted to further demonstrate that both monitors would continue to meet the Ozone NAAQS. Due to a lack of nearby monitors close to the Ashton site, a "brute-force" technique was used by substituting 100 percent of the missing days with the highest monthly MDA8 over the last five years and recalculating the design value. Since there were many nearby monitors near the NSFS site, a nonparametric linear regression was used to develop substituted values for 100 percent of the missing data. A bootstrap analysis was used to estimate the variability in

the predictions and to ensure that the design value remained below the level of the Ozone NAAQS.

Meteorological conditions

To understand meteorological conditions that are conducive to ozone formation for the NSFS monitor, the Department obtained the MDA8 ozone concentrations for each monitoring station with incomplete data. The Department selected meteorological data from the nearby airports for 2012 – 2016. The monitoring station, meteorological station pairings can be found in Table 2.

Table 2: Monitoring/Meteorological site pairings for analysis

Site Name	Site ID	Meteorological Station
Due West	450010001	KAND
Bushy Park	450150002	KCHS
Cape Romain	450190046	KCHS
Ashton	450290002	KOGB
Congaree Bluff	450790021	KCAE
Hillcrest	450450016	KGSP
North Spartanburg	450830009	KGSP
Parklane	450790007	KCAE
Trenton	450370001	KCAE
Wolf Creek	450770003	KGSP
Sandhill	450791001	KCAE
Clemson	450770002	KGSP

Augusta-Richmond County, GA-SC MSA

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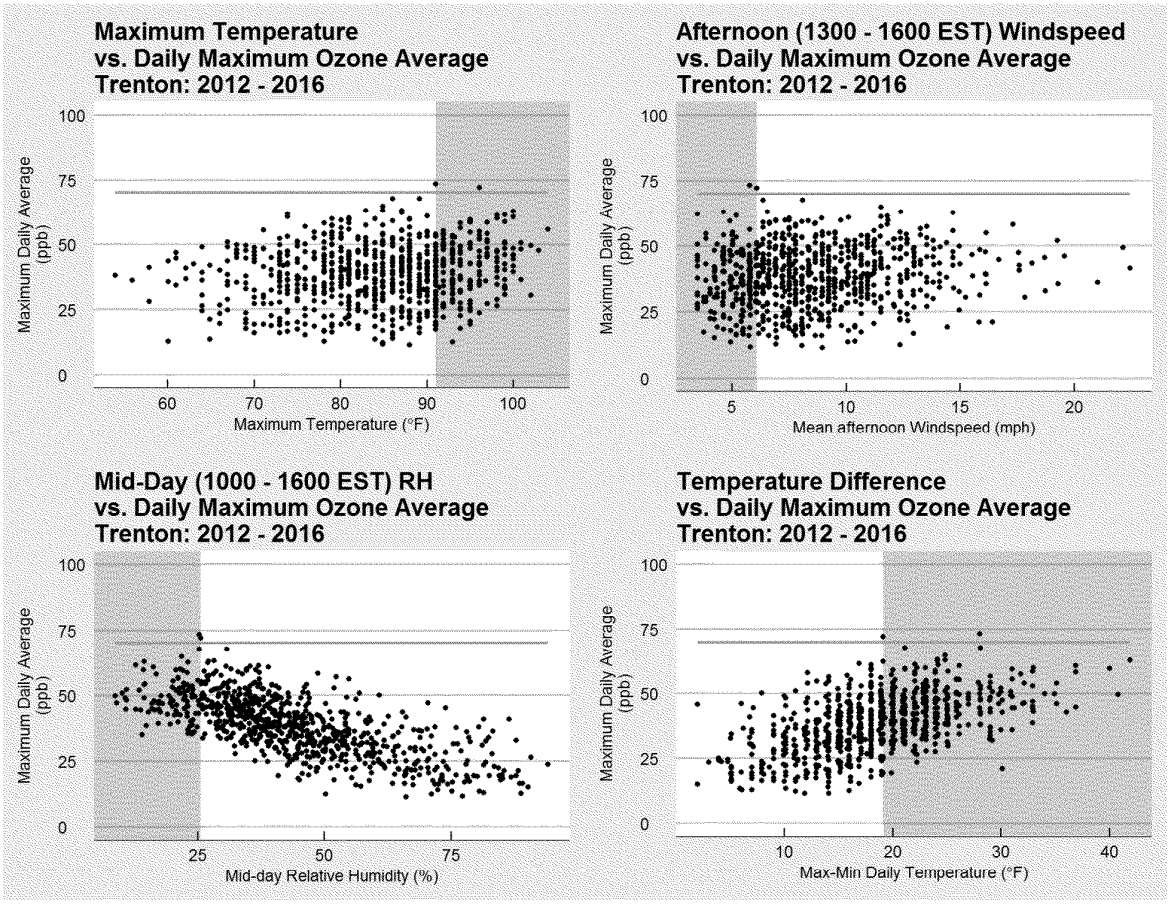
Meteorological conditions and missing data for the Trenton ozone monitor

Scatterplots between the MDA8 at the monitoring sites and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 91ºF, mid-day relative humidity is less than 25.5%, afternoon wind speed is less than 6 mph, and temperature difference (between daily low and high temperatures) is greater than 19ºF at the Trenton ozone monitor (Figure 25). In the preceding 5 years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions. Table 2 shows the missing days at Trenton were outside of these parameters and could be assumed to have occurred on days not conducive to ozone formation.

Figure 25: Trenton meteorological conditions vs. ozone



The Department applied a “brute-force” technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at the Trenton site would not have exceeded the ozone NAAQS.

Data from 2012 – 2016 at the Trenton ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 3).

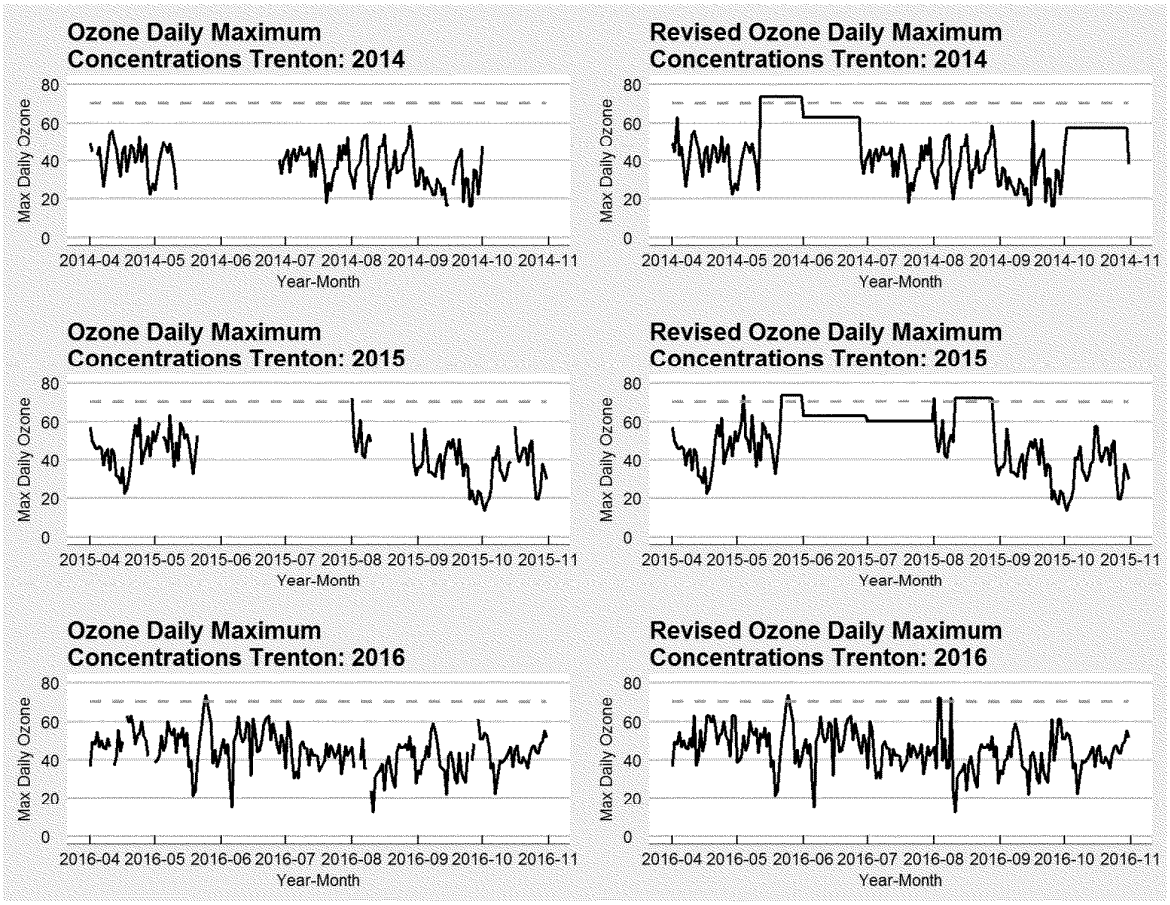
Table 3: Trenton highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	63
May	73
June	63
July	60
August	72

Septembe r	61
October	57

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 26). The time series graphic of the pre- and post-substitution show occasional exceedances of the NAAQS from 2014 - 2016.

Figure 26: Trenton MDA8 pre and post data substitution



The design values were then recalculated for Trenton for all missing days. This conservative approach shows that under the worst-case scenario, Trenton design values are expected to slightly exceed the ozone NAAQS with a recalculated design value of 72 ppb (Table 4). Since this data is above the level of the NAAQS, the Department will further evaluate the potential of the missing data exceeding the level of the NAAQS in the next section. Based on this information, the Department is seeking concurrence from EPA on the dates listed in Table 4 as not being conducive to ozone formation and furthermore, these dates waived for data completeness purposes.

Table 4: Pre- and post-data substitution design value calculation for Trenton

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	54	64	73	100
2015	60	57	73	100
2016	62	96	72	100
DV	58	72	72	100

Table 5: Trenton dates requested for waiver

Date		

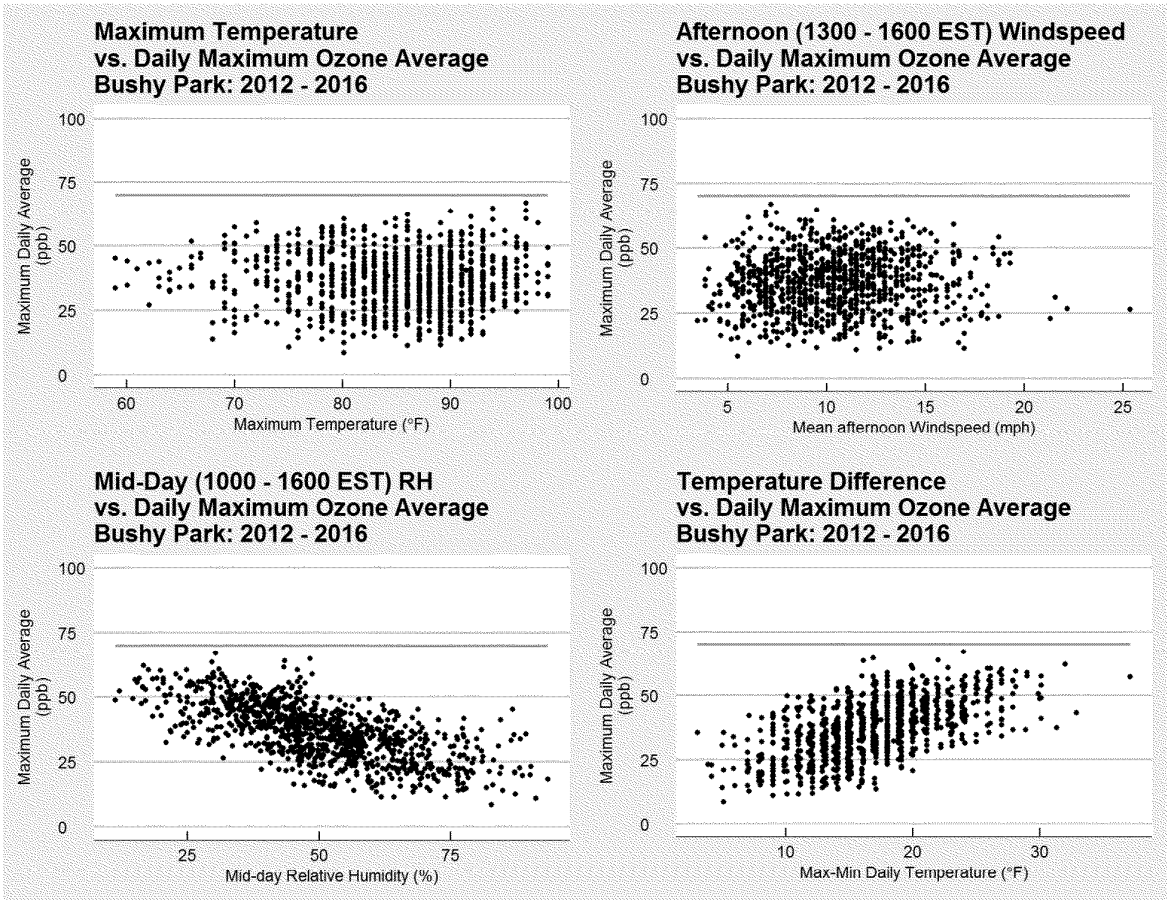
Charleston-North Charleston MSA

DRAFT

Meteorological conditions and missing data for the Bushy Park ozone monitor

The Department used Bushy Park ozone data and meteorological data from the Charleston International Airport (KCHS) to examine meteorological conditions that were conducive to ozone formation (Figure 27). There were no exceedances of the ozone NAAQS from 2012 – 2016. However, some ozone is formed under similar meteorological conditions as other sites (high maximum temperatures, low afternoon wind speeds, and low mid-day relative humidity).

Figure 27: KCHS meteorological conditions vs. ozone



The Department applied a “brute-force” technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at the Bushy Park would not have exceeded the ozone NAAQS.

Data from 2012 – 2016 at the Bushy Park ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 6).

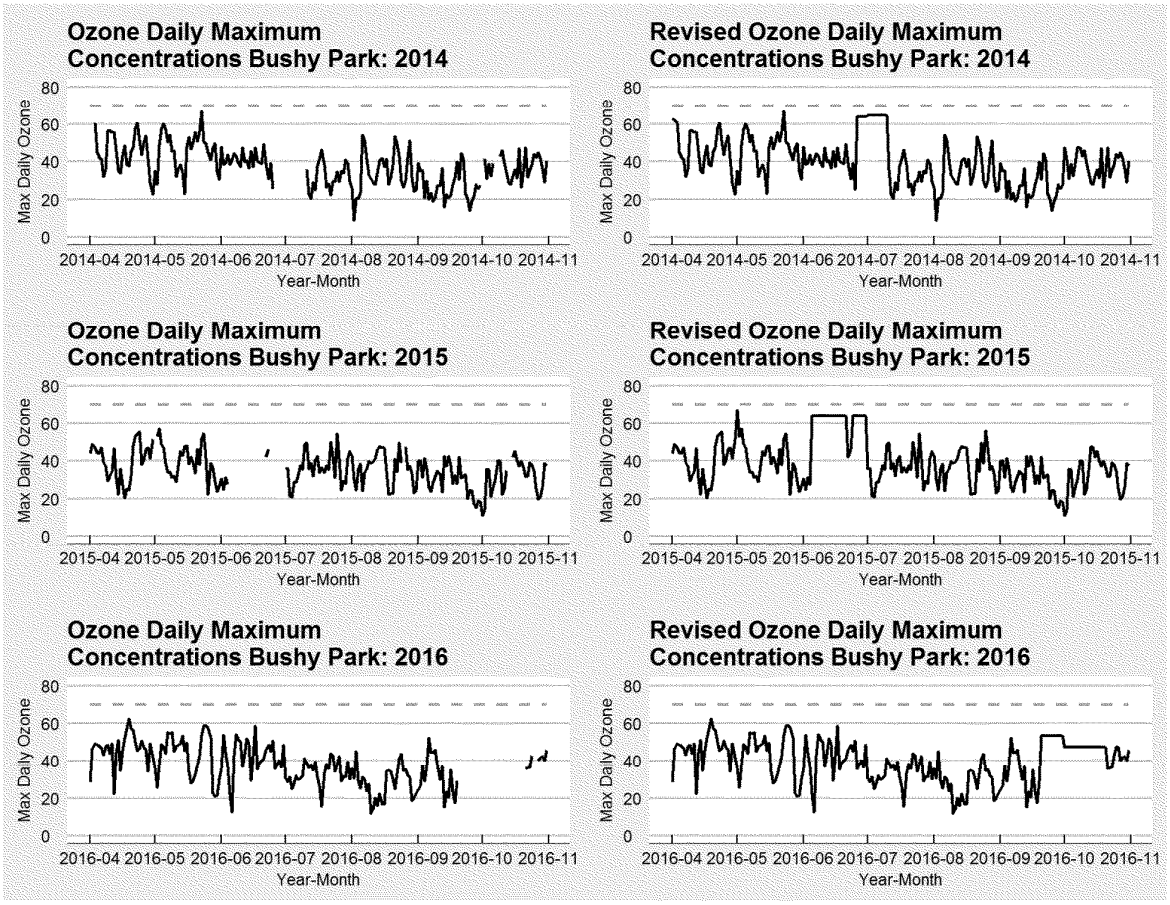
Table 6: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	62
May	67
June	64
July	65

August	56
September	53
October	47

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 28). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 28: Bushy Park MDA8 pre and post data substitution



The design values were then recalculated for Bushy Park for all missing days. This conservative approach shows that under the worst-case scenario, Bushy Park design values are expected to still meet the ozone NAAQS with a recalculated design value of 62 ppb (Table 7). Based on this information, the Department is seeking concurrence from EPA on the dates listed in Table 8 as not being conducive to ozone formation and furthermore, these dates waived for data completeness purposes.

Table 7: Pre- and post-data substitution design value calculation for Bushy Park

Year	Pre-	Data	Post-	Data

	substituted 4th high (ppb)	Completeness (%)	substituted 4th high (ppb)	Completeness
2014	60	91	65	100
2015	54	87	64	100
2016	58	85	59	100
DV	57	87	62	100

Table 8: Bushy Park dates requested for waiver

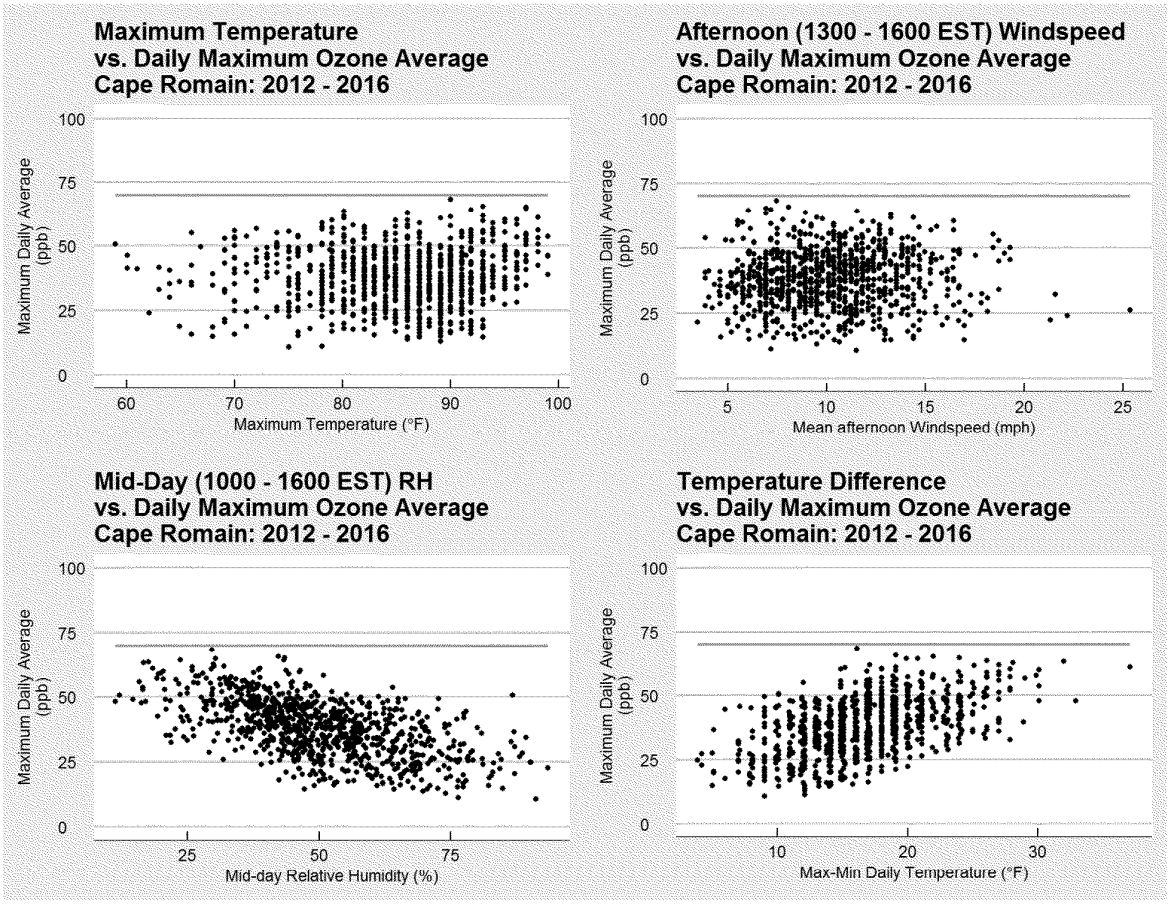
Date		

Meteorological conditions and missing data for the Cape Romain ozone monitor

The Department used Cape Romain ozone data and meteorological data from the Charleston International Airport (KCHS) to examine meteorological conditions that were conducive to ozone formation (Figure 29). There were no exceedances of the ozone NAAQS from 2012 – 2016. However, some ozone is formed under similar meteorological conditions as other sites (high maximum temperatures, low afternoon wind speeds, and low mid-day relative humidity).

DRAFT

Figure 29: KCHS meteorological conditions vs. ozone



The Department applied a “brute-force” technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Cape Romain would not have exceeded the ozone NAAQS.

Data from 2012 – 2016 at the Cape Romain ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 9).

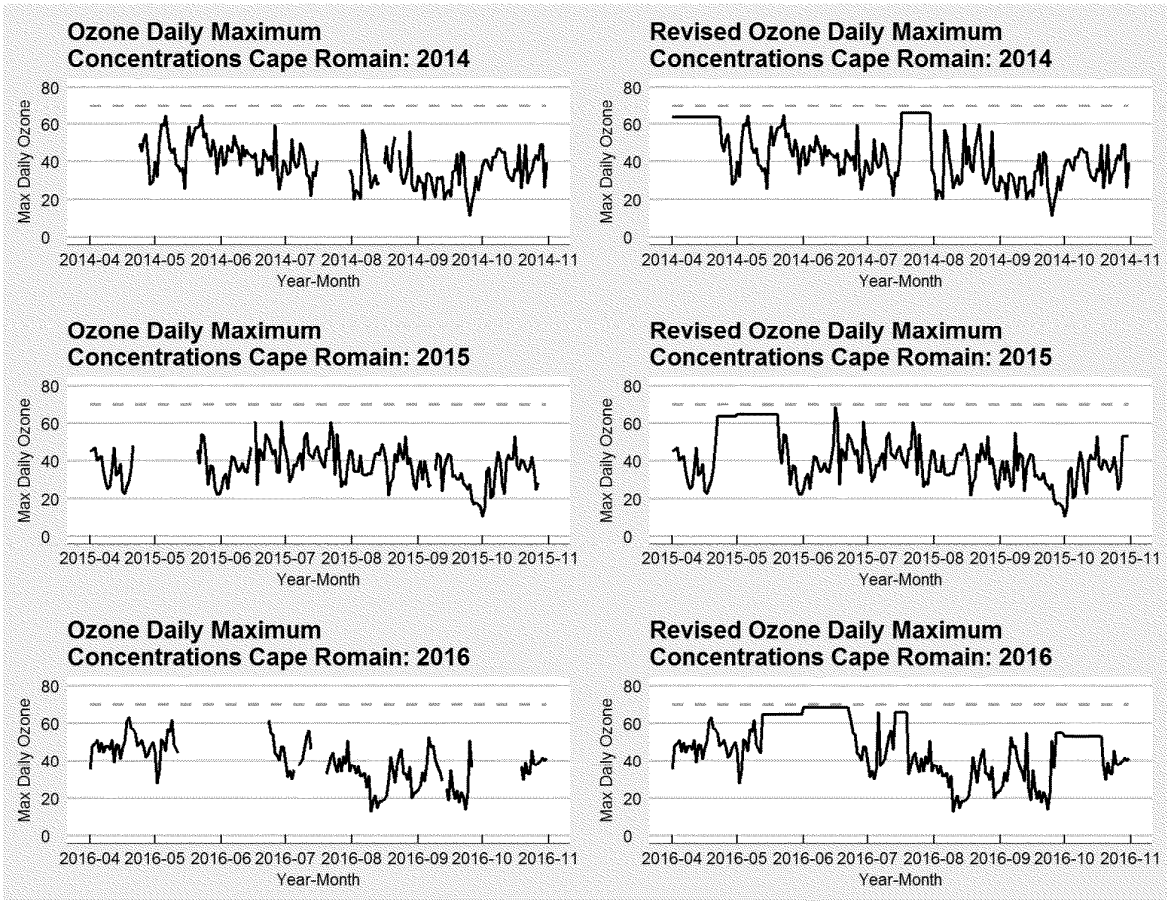
Table 9: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	64
May	65
June	68
July	66

August	60
Septembe r	55
October	53

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 30). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 30: Cape Romain MDA8 pre and post data substitution



The design values were then recalculated for Cape Romain for all missing days. This conservative approach shows that under the worst-case scenario, Cape Romain design values are expected to still meet the ozone NAAQS with a recalculated design value of 66 ppb (Table 10). Based on this information, the Department is seeking concurrence from EPA on the dates listed in Table 11 as not being conducive to ozone formation and furthermore, these dates waived for data completeness purposes.

Table 10: Pre- and post-data substitution design value calculation for Cape Romain

Year	Pre-	Data	Post-	Data

	substituted 4th high (ppb)	Completeness (%)	substituted 4th high (ppb)	Completeness
2014	59	82	66	100
2015	54	84	65	100
2016	60	67	68	100
DV	57	77	66	100

Table 11: Cape Romain dates requested for waiver

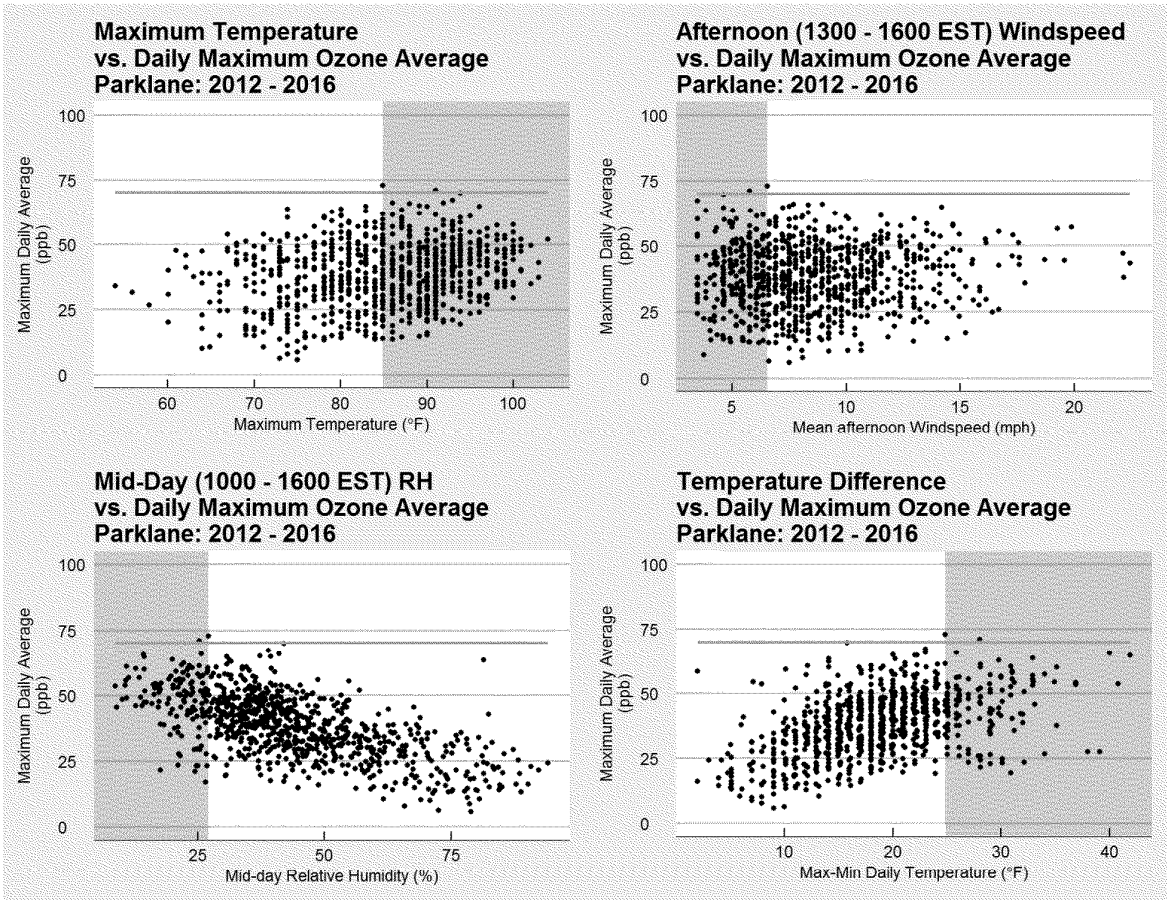
Date		

Columbia MSA

Meteorological conditions and missing data for the Parklane ozone monitor

The Department used the Parklane ozone data and meteorological data from the Columbia Metropolitan Airport (KCAE) to examine meteorological conditions that were conducive to ozone formation (Figure 31). Scatterplots between the MDA8 at the monitoring sites and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 85ºF, mid-day relative humidity is less than 27.1%, afternoon wind speed is less than 6 mph, and temperature difference is greater than 24ºF. In the preceding 5 years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions.

Figure 31: KCAE meteorological conditions vs. ozone



The Department applied a “brute-force” technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Parklane would not have exceeded the ozone NAAQS.

Data from 2012 – 2016 at the Parklane ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 12).

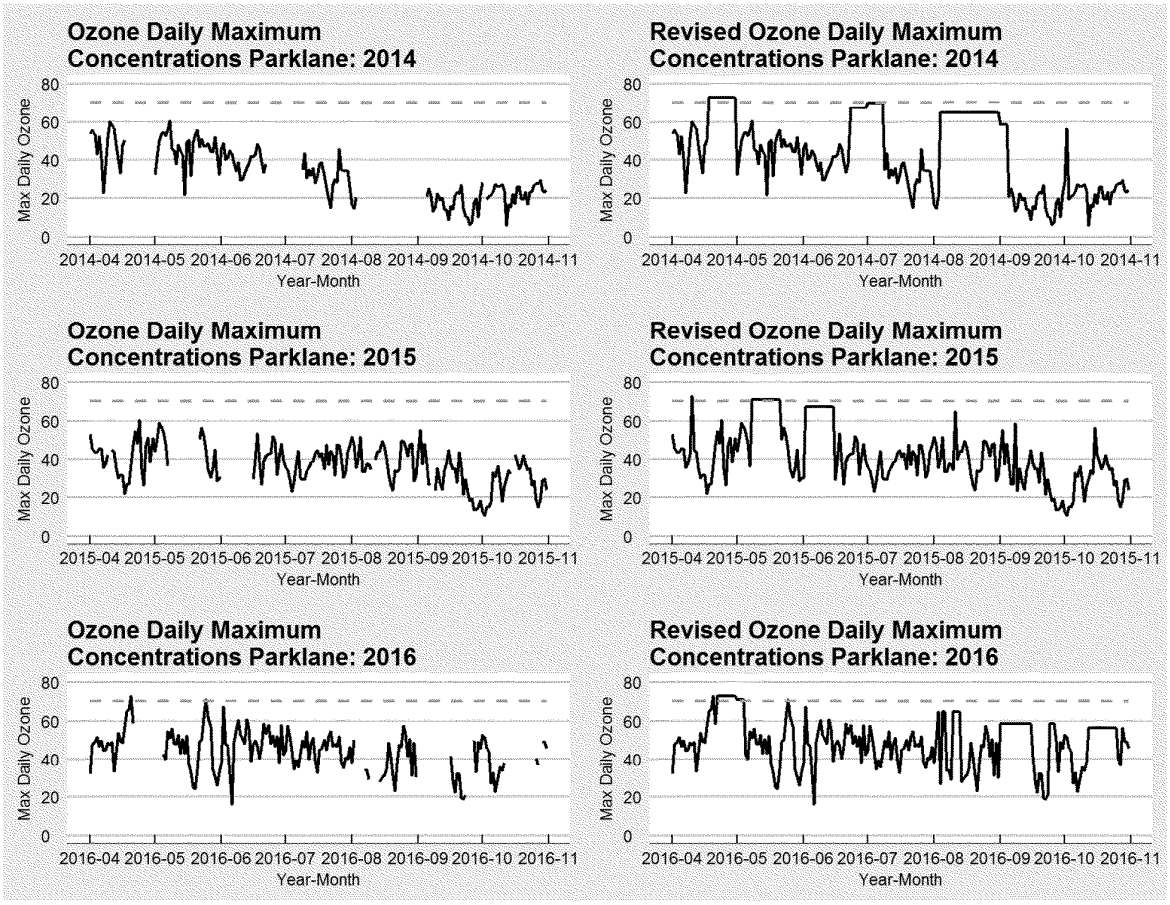
Table 12: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	73
May	71
June	67
July	70

August	65
September	58
October	56

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 32). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 32: Parklane MDA8 pre and post data substitution



The design values were then recalculated for Parklane for all missing days. This conservative approach shows that under the worst-case scenario, Parklane design values are expected to slightly the ozone NAAQS with a recalculated design value of 72 ppb (Table 13). Since this data is above the level of the NAAQS, the Department will further evaluate the potential of the missing data exceeding the level of the NAAQS in the next section. Based on this information, the Department is seeking concurrence from EPA on the dates listed in Table 14 as not being conducive to ozone formation and furthermore, these dates waived for data completeness purposes.

Table 13: Pre- and post-data substitution design value calculation for Parklane

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	56	71	73	100
2015	56	85	71	100
2016	65	75	73	100
DV	59	77	72	100

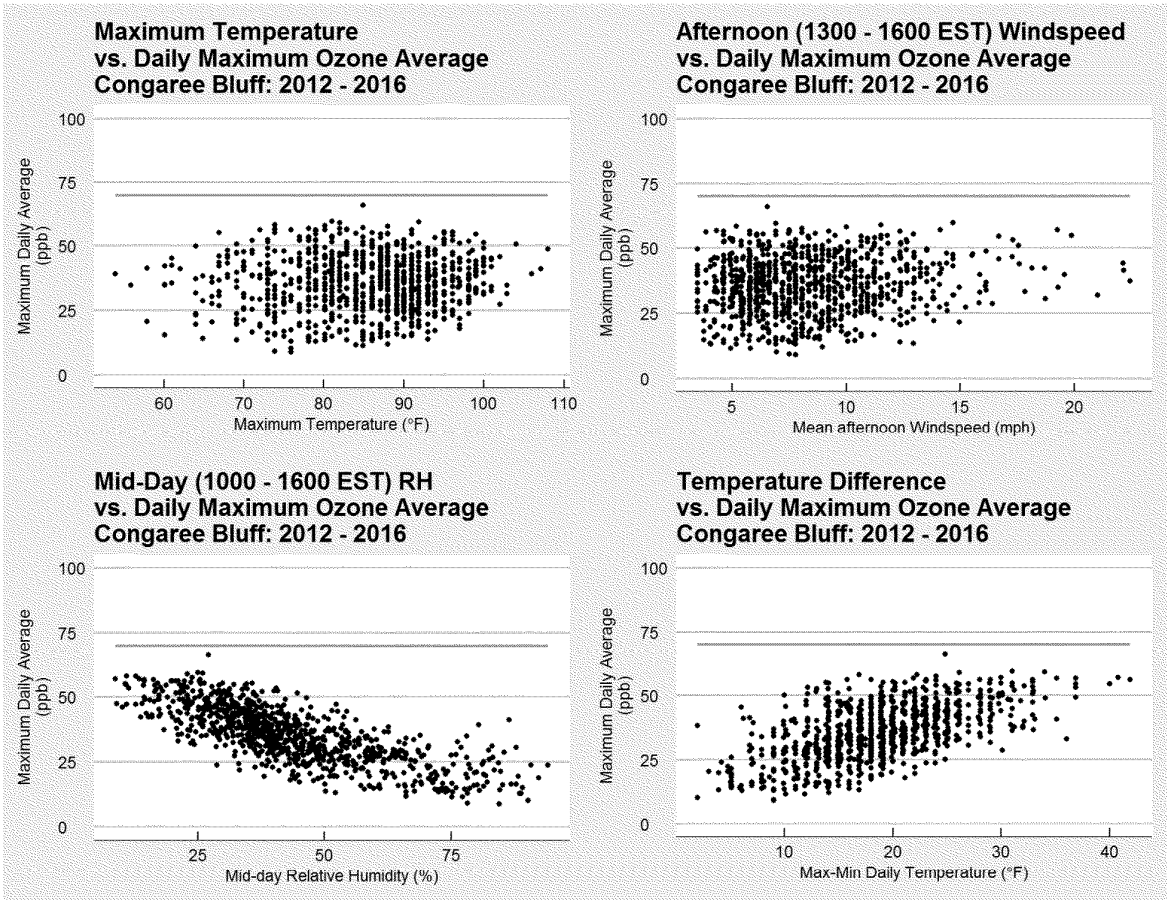
Table 14: Parklane dates requested for waiver

Date		

Meteorological conditions and missing data for the Congaree Bluff ozone monitor

The Department used Congaree Bluff ozone data and meteorological data from the Columbia Metropolitan Airport (KCAE) to examine meteorological conditions that were conducive to ozone formation (Figure 33). There were no exceedances of the ozone NAAQS from 2012 – 2016. However, some ozone is formed under similar meteorological conditions as other sites (high maximum temperatures, low afternoon wind speeds, and low mid-day relative humidity).

Figure 33: KCAE meteorological conditions vs. ozone



The Department applied a “brute-force” technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Congaree Bluff would not have exceeded the ozone NAAQS.

Data from 2012 – 2016 at the Congaree Bluff ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 15).

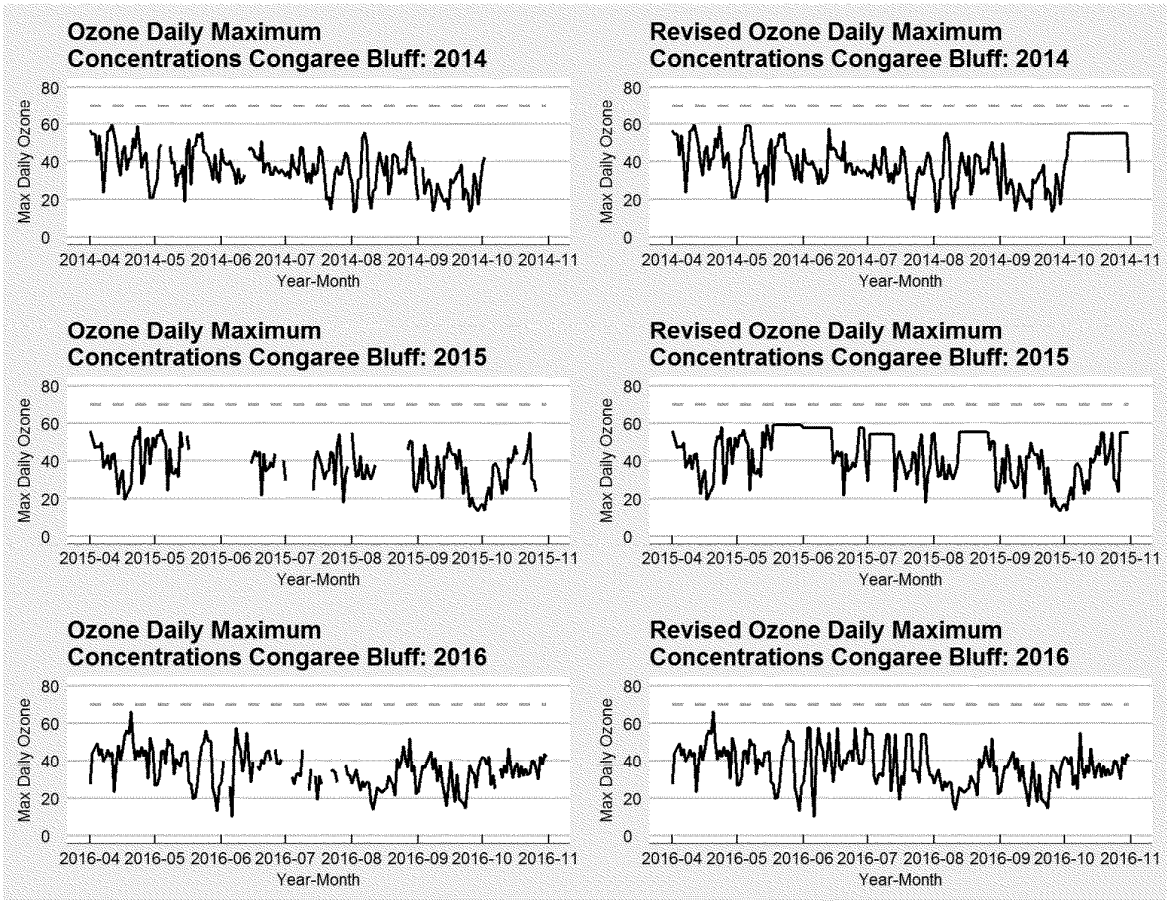
Table 15: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	66
May	59
June	57
July	54

August	55
September	50
October	55

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 34). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 34: Congaree Bluff MDA8 pre and post data substitution



The design values were then recalculated for Congaree Bluff for all missing days. This conservative approach shows that under the worst-case scenario, Congaree Bluff design values are expected to still meet the ozone NAAQS with a recalculated design value of 58 ppb (Table 16). Based on this information, the Department is seeking concurrence from EPA on the dates listed in Table 17 as not being conducive to ozone formation and furthermore, these dates waived for data completeness purposes.

Table 16: Pre- and post-data substitution design value calculation for Congaree Bluff

Year	Pre-	Data	Post-	Data

	substituted 4th high (ppb)	Completeness (%)	substituted 4th high (ppb)	Completeness
2014	56	85	59	100
2015	55	69	59	100
2016	56	92	57	100
DV	55	82	58	100

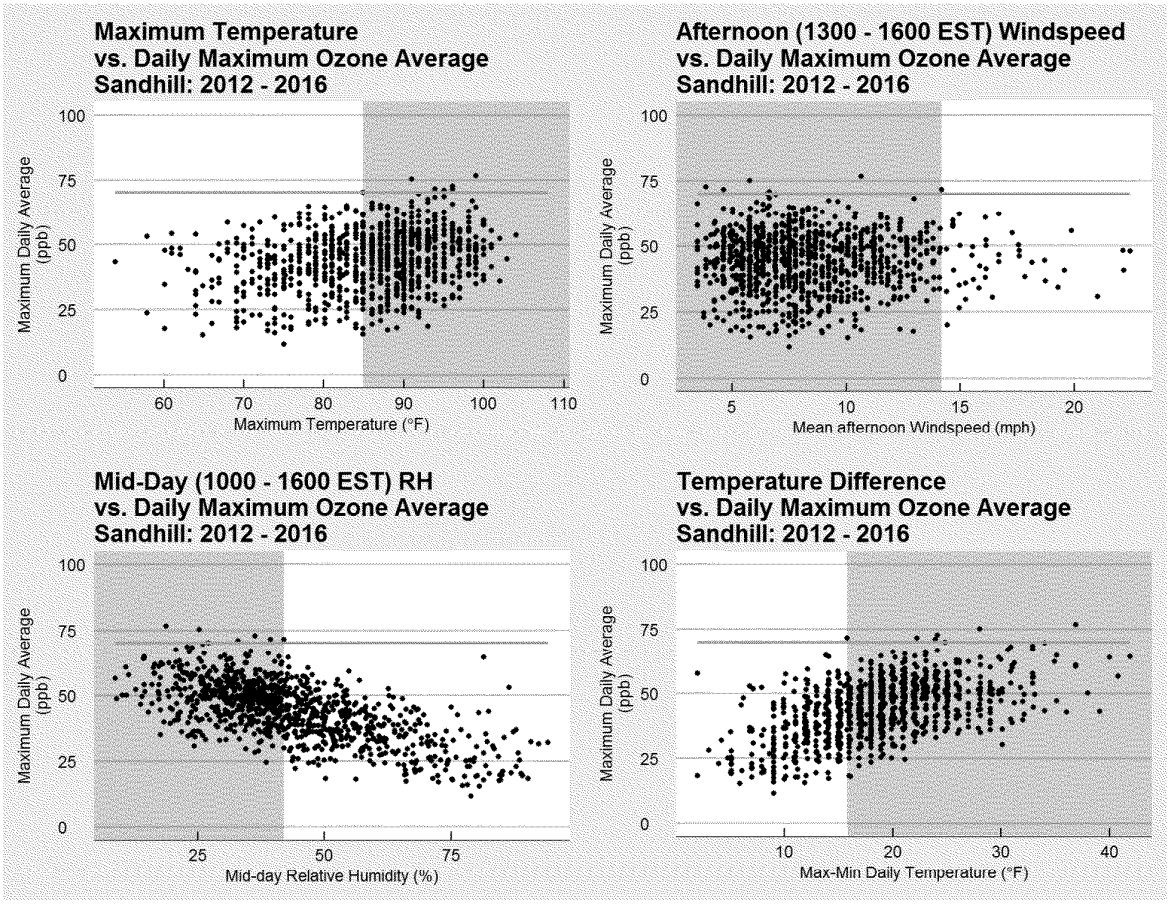
Table 17: Congaree Bluff dates requested for waiver

Date		

Meteorological conditions and missing data for the Sandhill ozone monitor

The Department used the Sandhill ozone data and meteorological data from the Columbia Metropolitan Airport (KCAE) to examine meteorological conditions that were conducive to ozone formation (Figure 35). Scatterplots between the MDA8 at the monitoring sites and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 85ºF, mid-day relative humidity is less than 42.1%, afternoon wind speed is less than 14 mph, and temperature difference is greater than 16ºF. In the preceding 5 years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions.

Figure 35: KCAE meteorological conditions vs. ozone



The Department applied a “brute-force” technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Sandhill would not have exceeded the ozone NAAQS.

Data from 2012 – 2016 at the Sandhill ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 18).

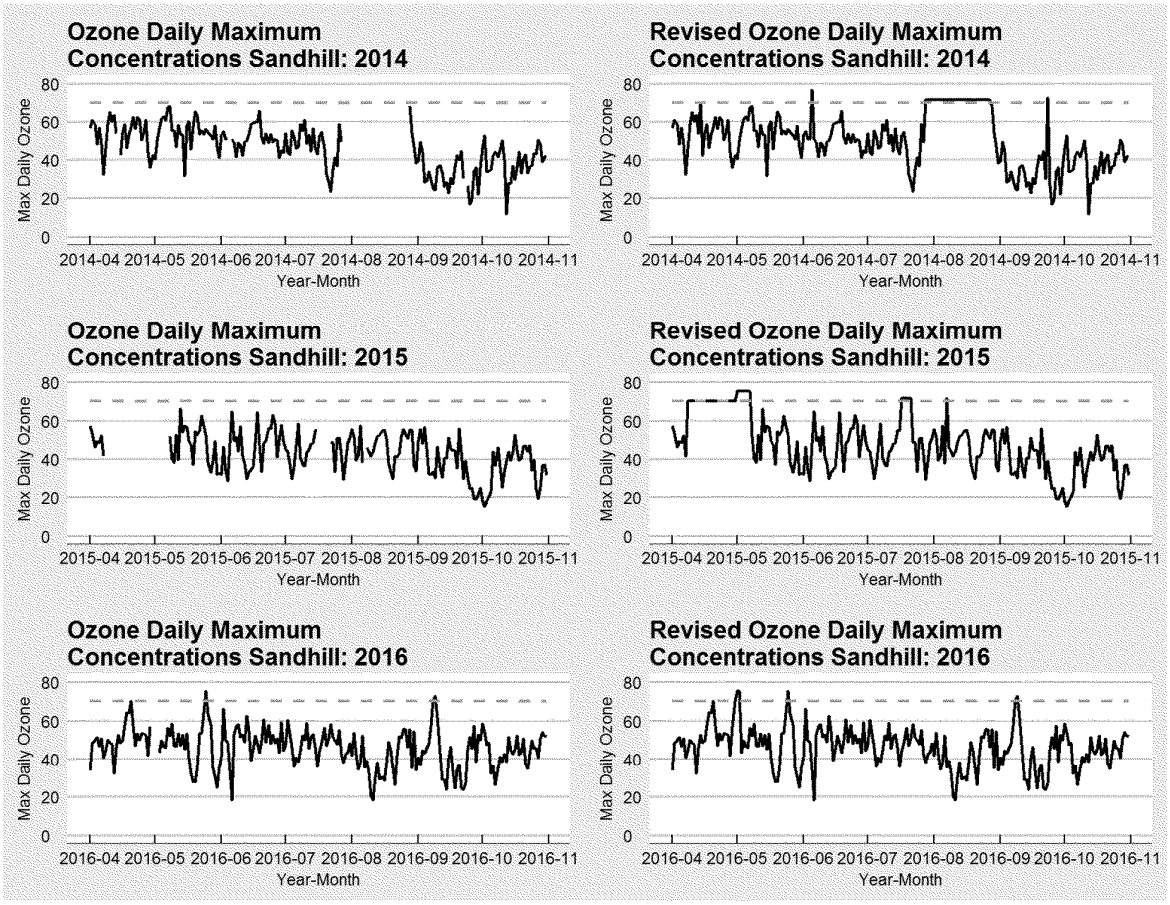
Table 18: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	70
May	75
June	77
July	72

August	72
September	73
October	58

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 36). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 36: Sandhill MDA8 pre and post data substitution



The design values were then recalculated for Sandhill for all missing days. This conservative approach shows that under the worst-case scenario, Sandhill design values are expected to slightly exceed the ozone NAAQS with a recalculated design value of 73 ppb (Table 19). Since this data is above the level of the NAAQS, the Department will further evaluate the potential of the missing data exceeding the level of the NAAQS in the next section. Based on this information, the Department is seeking concurrence from EPA on the dates listed in Table 20 as not being conducive to ozone formation and furthermore, these dates waived for data completeness purposes.

Table 19: Pre- and post-data substitution design value calculation for Sandhill

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	65	84	72	100
2015	62	83	75	100
2016	70	99	73	100
DV	65	89	73	100

Table 20: Sandhill dates requested for waiver

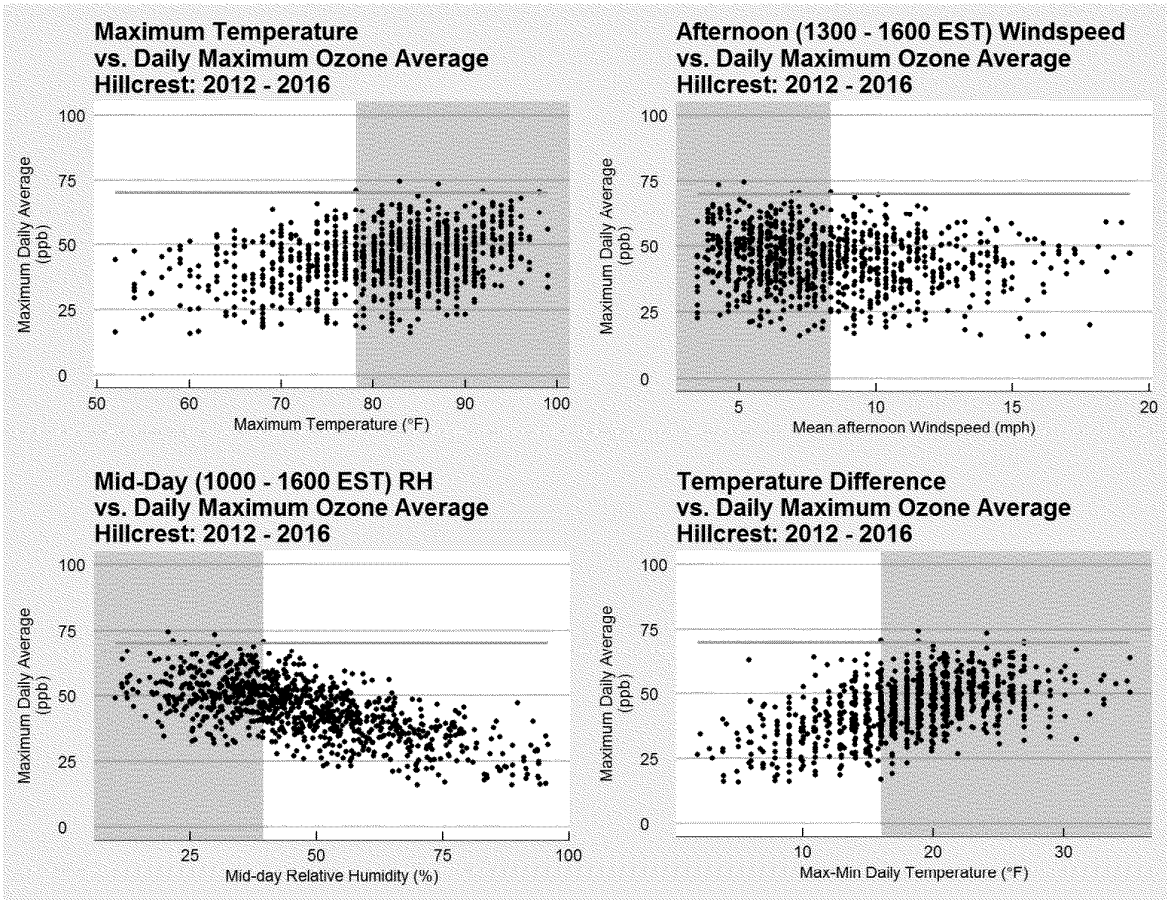
Date		

Greenville-Anderson-Mauldin MSA

Meteorological conditions and missing data for the Hillcrest ozone monitor

The Department used the Hillcrest ozone data and meteorological data from the Greenville Spartanburg International Airport (KGSP) to examine meteorological conditions that were conducive to ozone formation (Figure 37). Scatterplots between the MDA8 at the monitoring sites and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 78ºF, mid-day relative humidity is less than 39.6%, afternoon wind speed is less than 8 mph, and temperature difference is greater than 16ºF. In the preceding 5 years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions.

Figure 37: KGSP meteorological conditions vs. ozone



The Department applied a “brute-force” technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Sandhill would not have exceeded the ozone NAAQS.

Data from 2014 – 2016 at the Hillcrest ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 21).

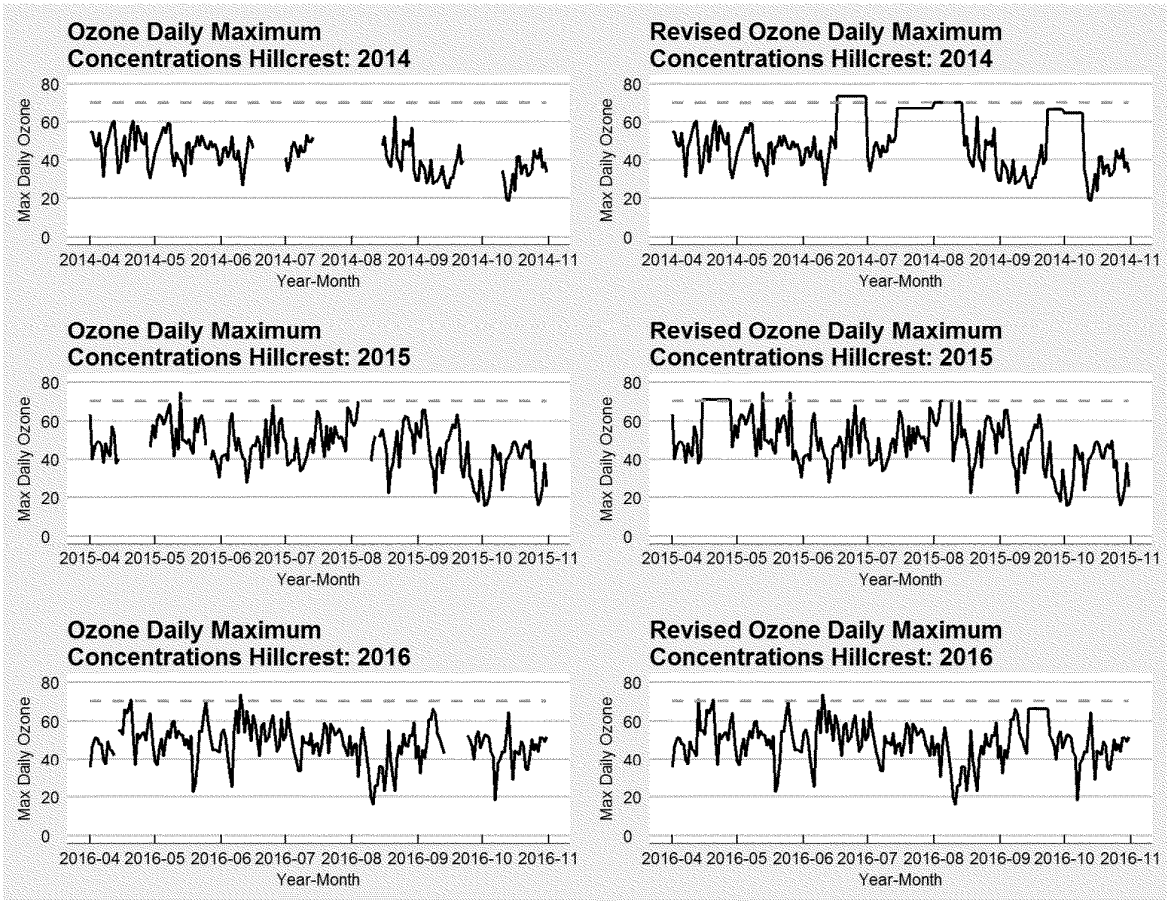
Table 21: Highest monthly MDA8 2007 - 2016

Month	Highest Daily Maximum Average (ppb)
April	71
May	74
June	73
July	67

August	70
September	66
October	64

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 38). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 38: Hillcrest MDA8 pre and post data substitution



The design values were then recalculated for Hillcrest for all missing days. This conservative approach shows that under the worst-case scenario, Hillcrest design values are expected to still meet the ozone NAAQS with a recalculated design value of 71 ppb (Table 22). Based on this information, the Department is seeking concurrence from EPA on the dates listed in Table 23 as not being conducive to ozone formation and furthermore, these dates waived for data completeness purposes.

Table 22: Pre- and post-data substitution design value calculation for Hillcrest

Year	Pre-	Data	Post-	Data

	substituted 4th high (ppb)	Completeness (%)	substituted 4th high (ppb)	Completeness
2014	58	71	73	100
2015	67	90	71	100
2016	66	95	70	100
DV	63	85	71	100

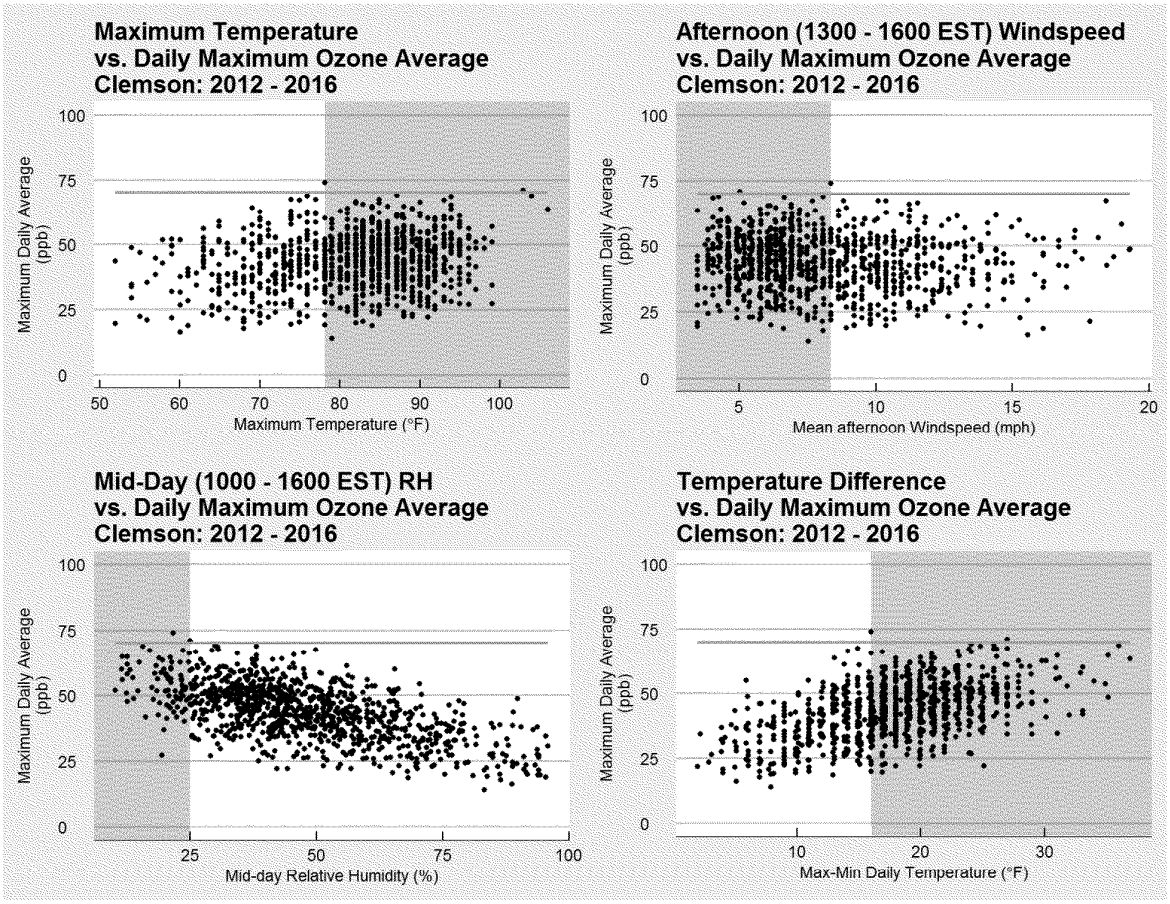
Table 23: Hillcrest dates requested for waiver

Date		

Meteorological conditions and missing data for the Clemson CMS ozone monitor

The Department used the Clemson CMS ozone data and meteorological data from the Greenville Spartanburg International Airport (KGSP) to examine meteorological conditions that were conducive to ozone formation (Figure 39). Scatterplots between the MDA8 at the monitoring sites and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 78ºF, mid-day relative humidity is less than 25.0%, afternoon wind speed is less than 8 mph, and temperature difference is greater than 16ºF. In the preceding 5 years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions.

Figure 39: KGSP meteorological conditions vs. ozone



The Department applied a “brute-force” technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Sandhill would not have exceeded the ozone NAAQS.

Data from 2014 – 2016 at the Clemson CMS ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 24).

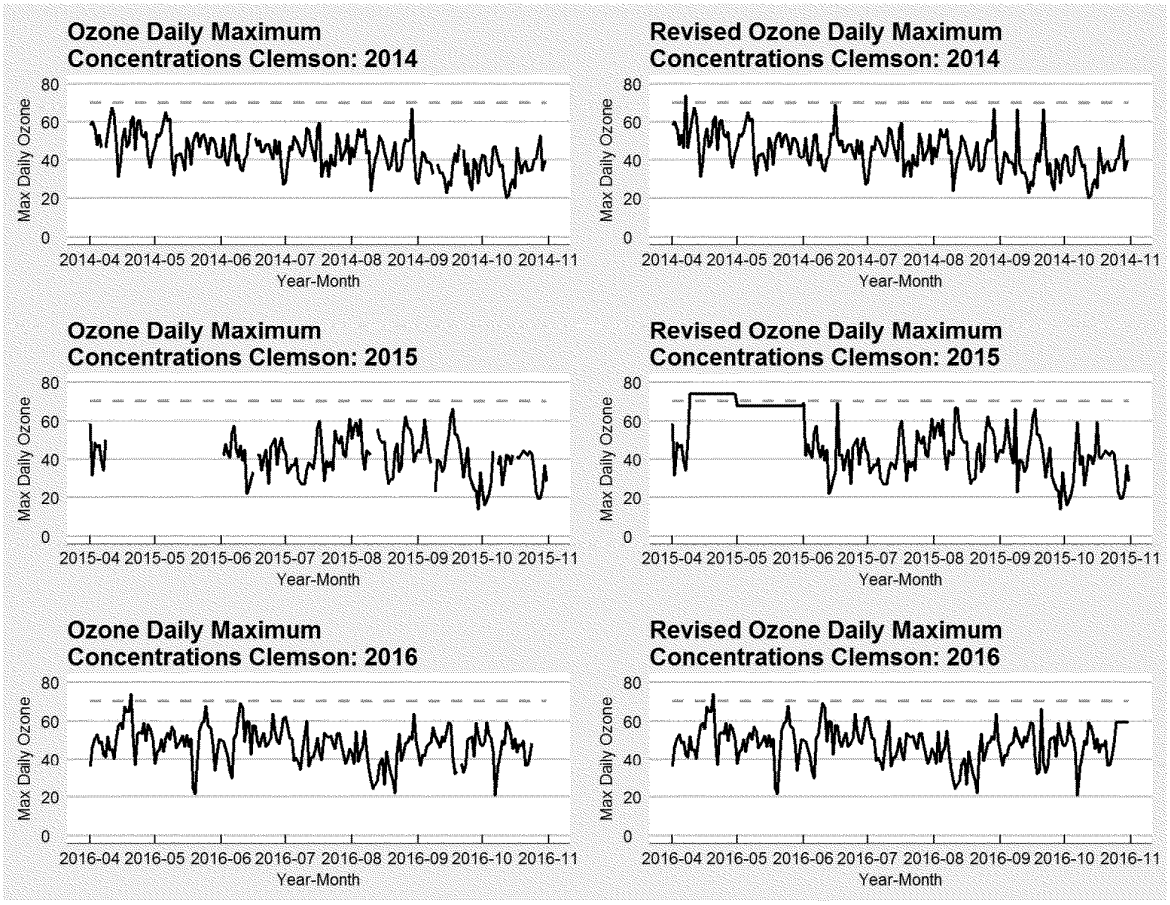
Table 24: Highest monthly MDA8 2007 - 2016

Month	Highest Daily Maximum Average (ppb)
April	74
May	67
June	69
July	62

August	66
September	66
October	59

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 40). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 40: Clemson CMS MDA8 pre and post data substitution



The design values were then recalculated for Clemson CMS for all missing days. This conservative approach shows that under the worst-case scenario, Clemson CMS design values are expected to still meet the ozone NAAQS with a recalculated design value of 69 ppb (Table 25). Based on this information, the Department is seeking concurrence from EPA on the dates listed in Table 26 as not being conducive to ozone formation and furthermore, these dates waived for data completeness purposes.

Table 25: Pre- and post-data substitution design value calculation for Clemson CMS

Year	Pre-	Data	Post-	Data

	substituted 4th high (ppb)	Completeness (%)	substituted 4th high (ppb)	Completeness
2014	62	98	66	100
2015	60	72	74	100
2016	67	96	67	100
DV	63	89	69	100

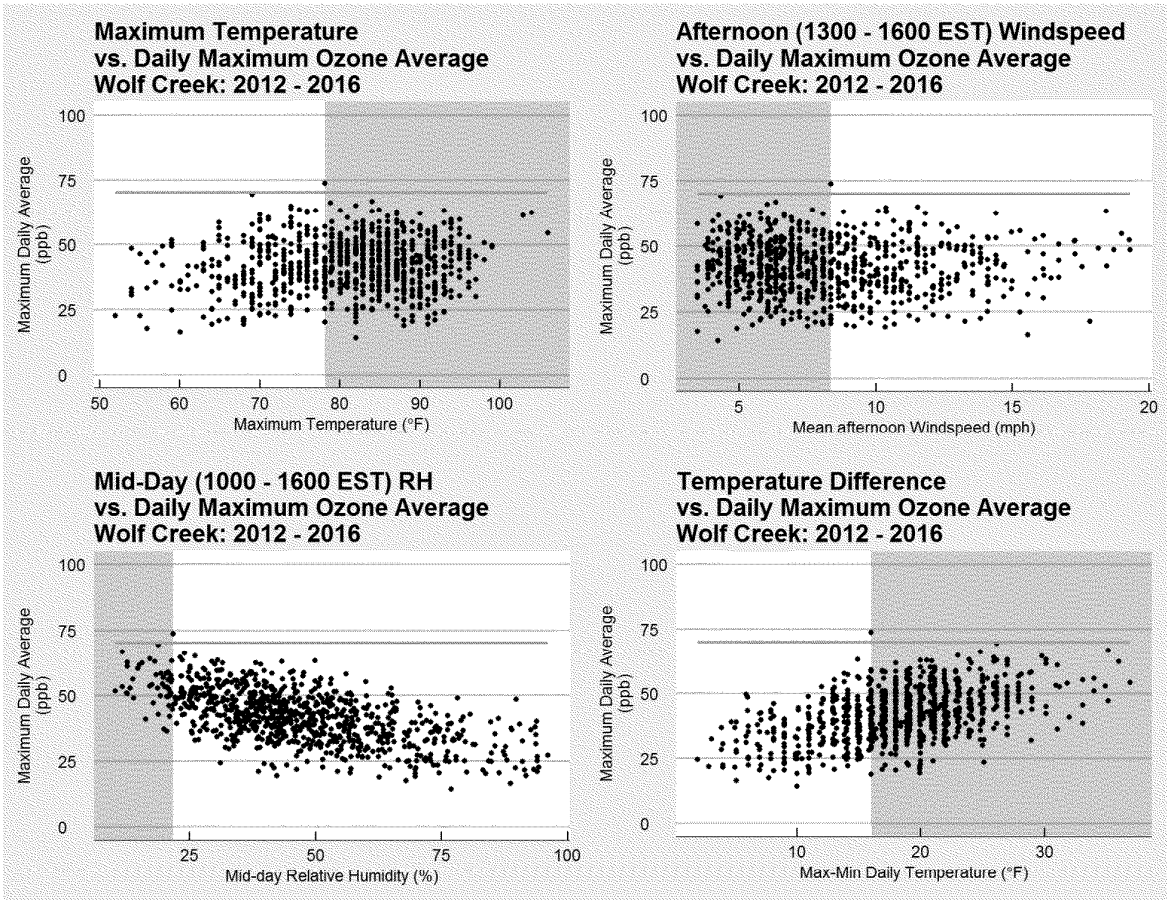
Table 26: Clemson CMS dates requested for waiver

Date		

Meteorological conditions and missing data for the Wolf Creek ozone monitor

The Department used the Wolf Creek ozone data and meteorological data from the Greenville Spartanburg International Airport (KGSP) to examine meteorological conditions that were conducive to ozone formation (Figure 41). Scatterplots between the MDA8 at the monitoring sites and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 78ºF, mid-day relative humidity is less than 21.7%, afternoon wind speed is less than 8 mph, and temperature difference is greater than 16ºF. In the preceding 5 years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions.

Figure 41: KGSP meteorological conditions vs. ozone



The Department applied a “brute-force” technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Sandhill would not have exceeded the ozone NAAQS.

Data from 2014 – 2016 at the Wolf Creek ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 27).

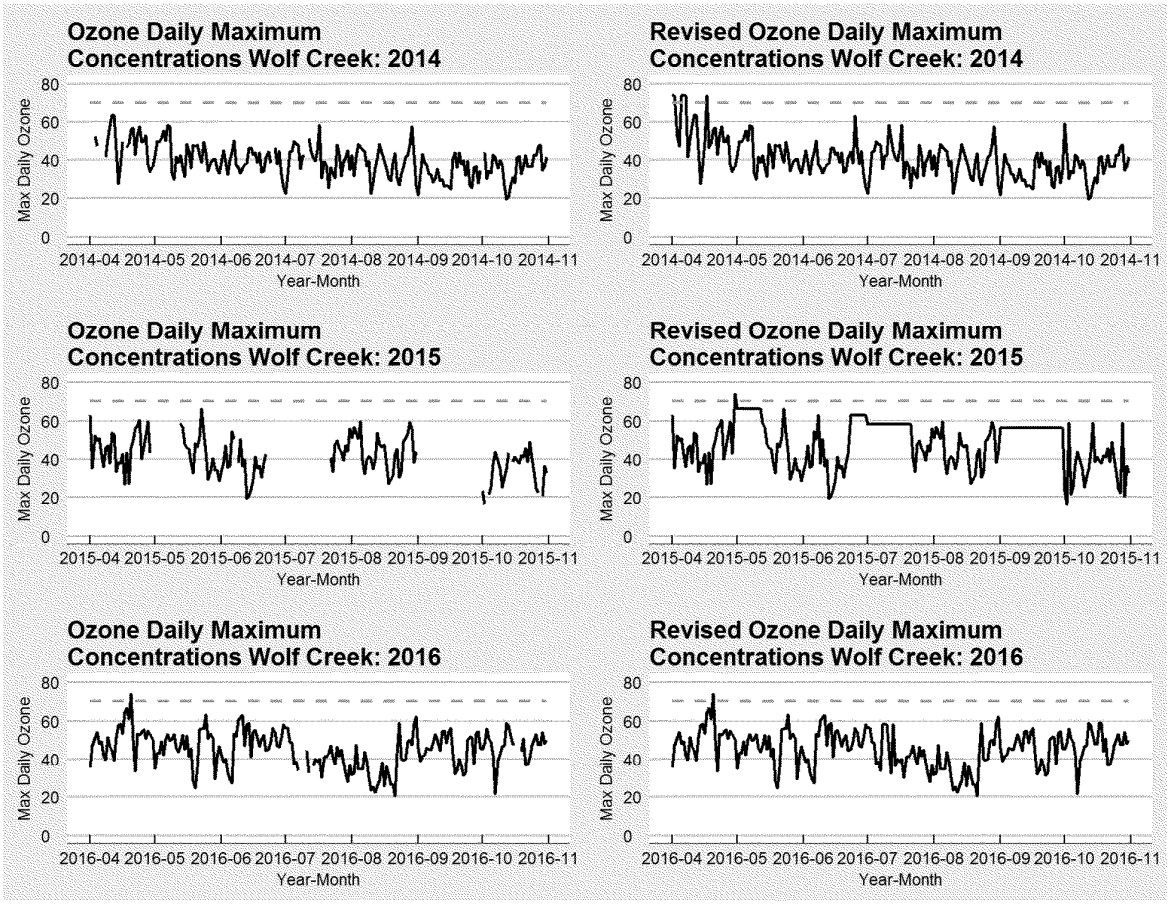
Table 27: Highest monthly MDA8 2007 - 2016

Month	Highest Daily Maximum Average (ppb)
April	74
May	66
June	63
July	58

August	62
September	54
October	59

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 42). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 42: Wolf Creek MDA8 pre and post data substitution



The design values were then recalculated for Wolf Creek for all missing days. This conservative approach shows that under the worst-case scenario, Wolf Creek design values are expected to still meet the ozone NAAQS with a recalculated design value of 67 ppb (Table 28). Based on this information, the Department is seeking concurrence from EPA on the dates listed in Table 29 as not being conducive to ozone formation and furthermore, these dates waived for data completeness purposes.

Table 28: Pre- and post-data substitution design value calculation for Wolf Creek

Year	Pre-	Data	Post-	Data

	substituted 4th high (ppb)	Completeness (%)	substituted 4th high (ppb)	Completeness
2014	58	96	74	100
2015	59	64	66	100
2016	63	97	63	100
DV	60	86	67	100

Table 29: Wolf Creek dates requested for waiver

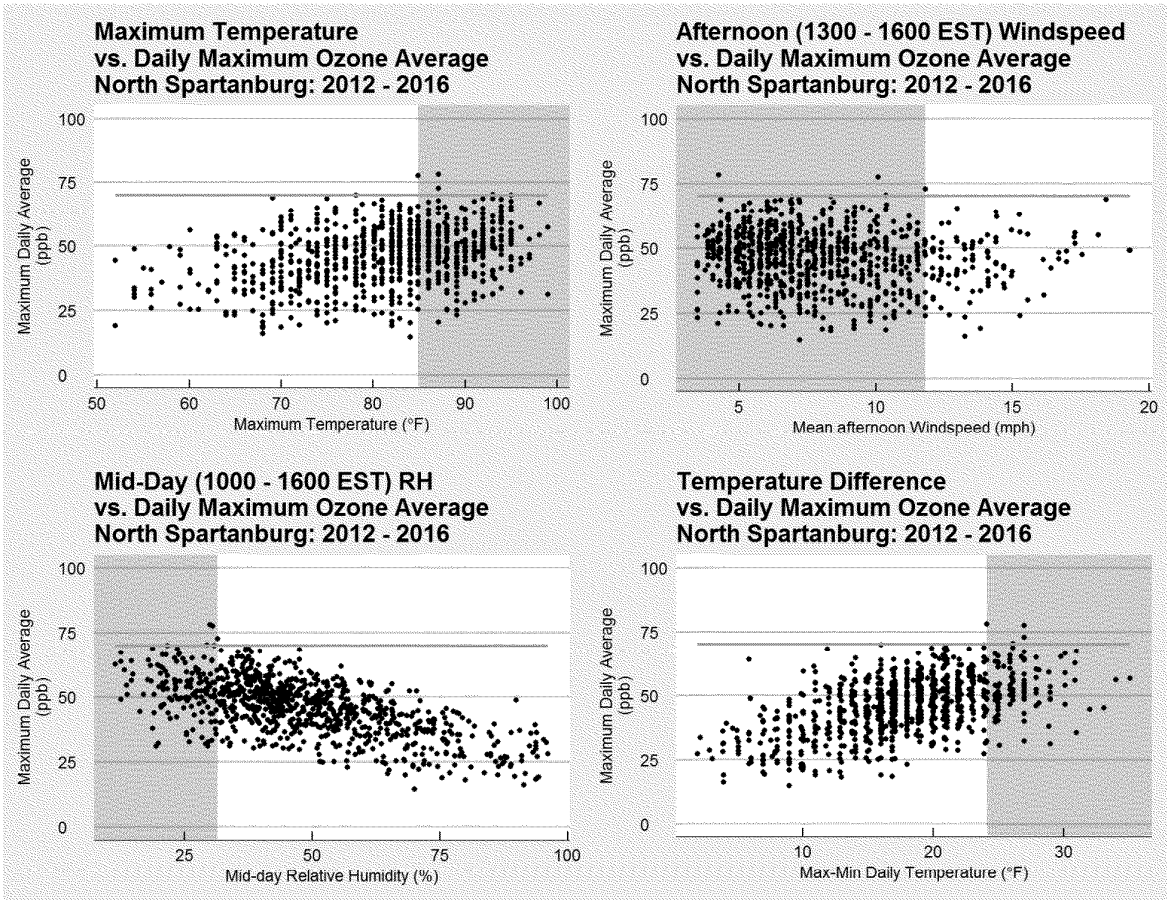
Date		

Spartanburg MSA

Meteorological conditions and missing data for the North Spartanburg Fire Station #2 ozone monitor

The Department used the North Spartanburg ozone data and meteorological data from the Greenville Spartanburg International Airport (KGSP) to examine meteorological conditions that were conducive to ozone formation (Figure 43). Scatterplots between the MDA8 at the monitoring sites and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 85ºF, mid-day relative humidity is less than 31.6%, afternoon wind speed is less than 12 mph, and temperature difference is greater than 24ºF. In the preceding 5 years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions.

Figure 43: KGSP meteorological conditions vs. ozone



The Department applied a “brute-force” technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Sandhill would not have exceeded the ozone NAAQS.

Data from 2014 – 2016 at the North Spartanburg ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 30).

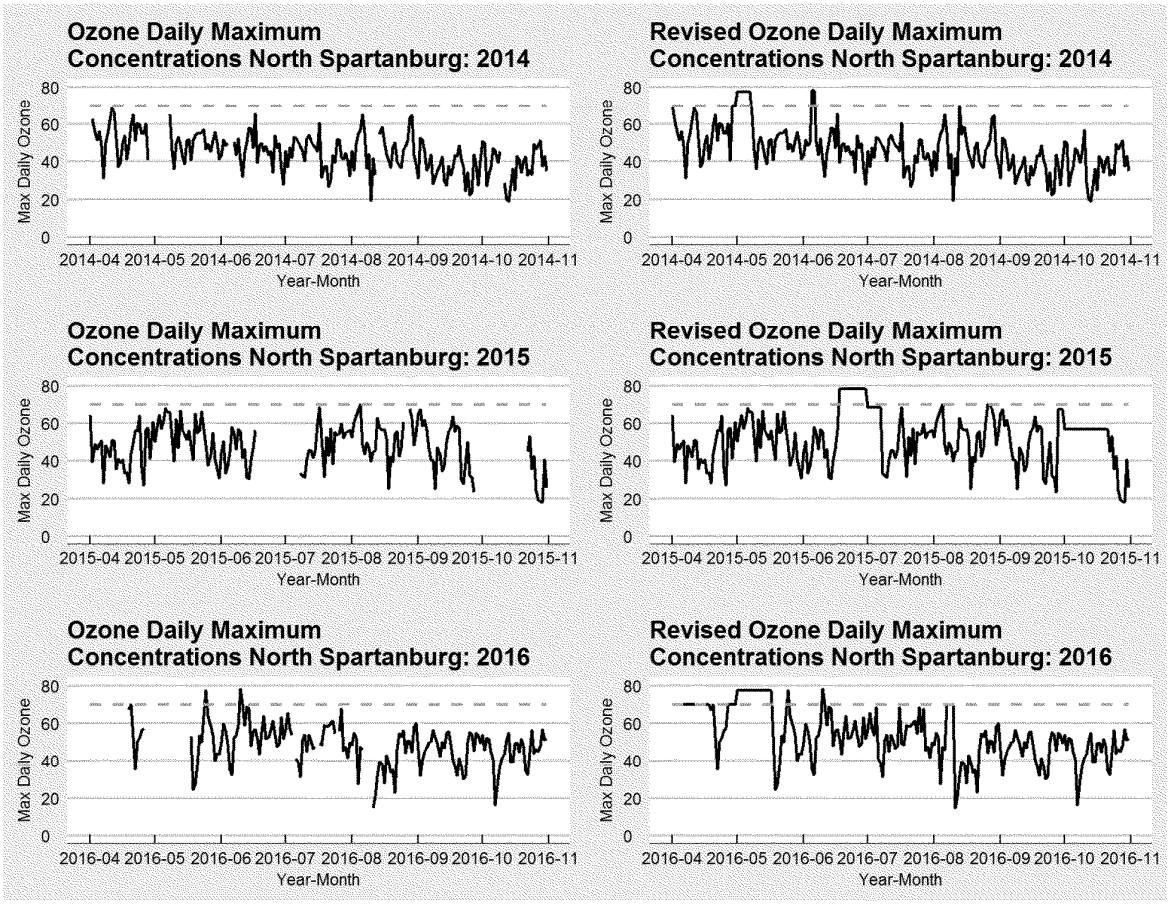
Table 30: Highest monthly MDA8 2007 - 2016

Month	Highest Daily Maximum Average (ppb)
April	70
May	78
June	78
July	68

August	70
September	67
October	57

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 44). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 44: North Spartanburg MDA8 pre and post data substitution



The design values were then recalculated for North Spartanburg for all missing days. This conservative approach shows that under the worst-case scenario, North Spartanburg design values are expected to still meet the ozone NAAQS with a recalculated design value of 77 ppb (Table 31). Based on this information, the Department is seeking concurrence from EPA on the dates listed in Table 32 as not being conducive to ozone formation and furthermore, these dates waived for data completeness purposes.

Table 31: Pre- and post-data substitution design value calculation for North Spartanburg

Year	Pre-	Data	Post-	Data

	substituted 4th high (ppb)	Completeness (%)	substituted 4th high (ppb)	Completeness
2014	65	93	77	100
2015	67	79	78	100
2016	69	79	78	100
DV	67	83	77	100

Table 32: North Spartanburg dates requested for waiver

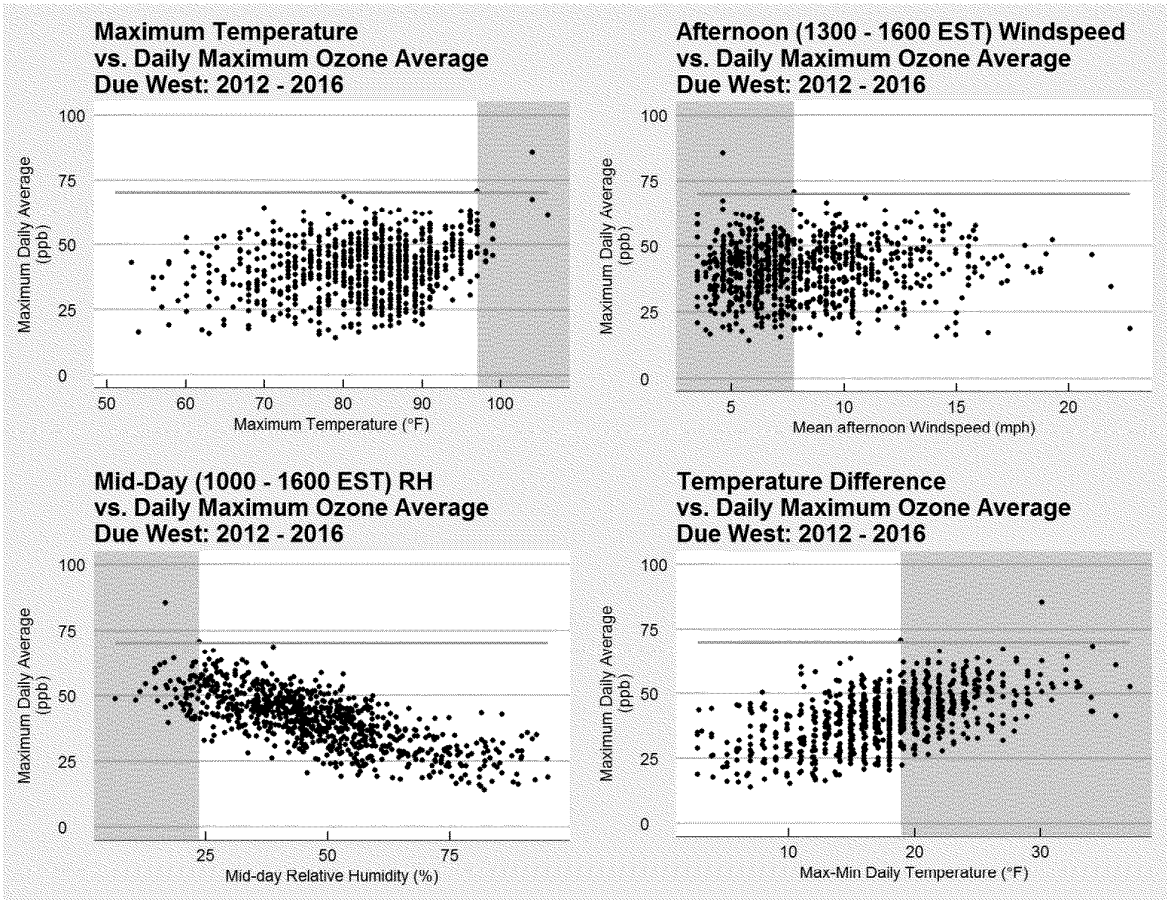
Date		

Remainder of the State

Meteorological conditions and missing data for the Due West ozone monitor

The Department used the Due West ozone data and meteorological data from the Anderson Regional Airport (KAND) to examine meteorological conditions that were conducive to ozone formation (Figure 45). Scatterplots between the MDA8 at the monitoring sites and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 97ºF, mid-day relative humidity is less than 23.7%, afternoon wind speed is less than 8 mph, and temperature difference is greater than 19ºF. In the preceding 5 years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions.

Figure 45: KAND meteorological conditions vs. ozone



The Department applied a “brute-force” technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Sandhill would not have exceeded the ozone NAAQS.

Data from 2014 – 2016 at the Due West ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 33).

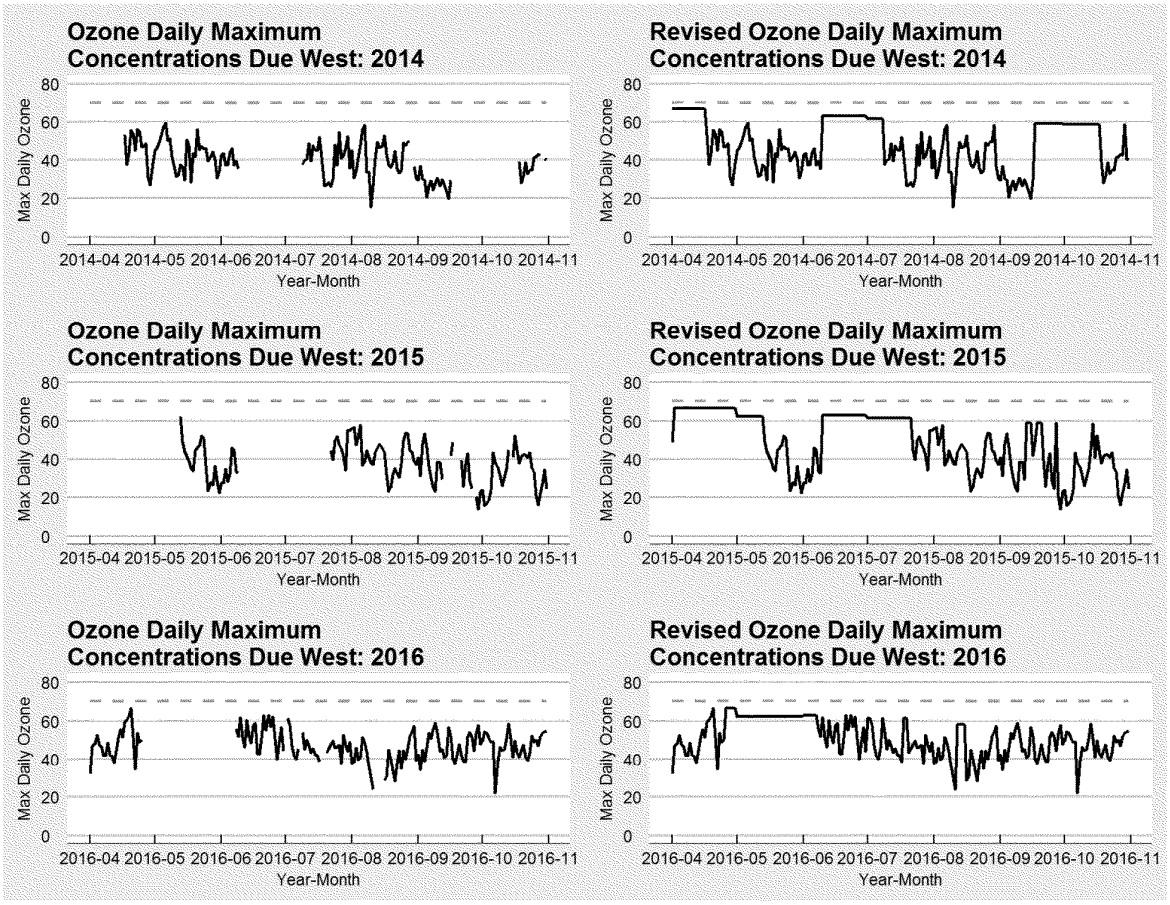
Table 33: Highest monthly MDA8 2007 - 2016

Month	Highest Daily Maximum Average (ppb)
April	67
May	62
June	63
July	61

August	58
September	59
October	58

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 46). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 46: Due West MDA8 pre and post data substitution



The design values were then recalculated for Due West for all missing days. This conservative approach shows that under the worst-case scenario, Due West design values are expected to still meet the ozone NAAQS with a recalculated design value of 66 ppb (Table 34). Based on this information, the Department is seeking concurrence from EPA on the dates listed in Table 35 as not being conducive to ozone formation and furthermore, these dates waived for data completeness purposes.

Table 34: Pre- and post-data substitution design value calculation for Due West

Year	Pre-	Data	Post-	Data

	substituted 4th high (ppb)	Completeness (%)	substituted 4th high (ppb)	Completeness
2014	57	64	67	100
2015	55	57	67	100
2016	62	76	67	100
DV	58	66	67	100

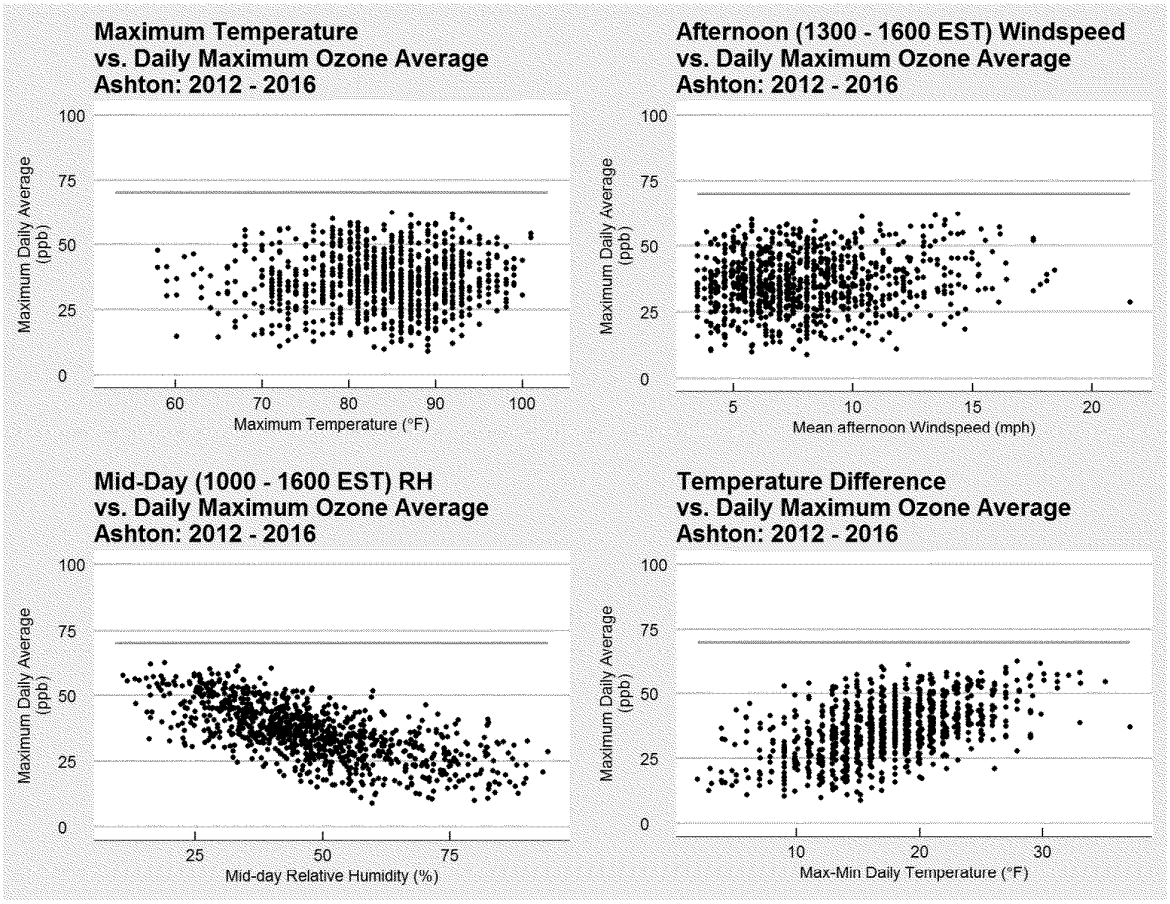
Table 35: Due West dates requested for waiver

Date		

Meteorological conditions and missing data for the Ashton ozone monitor

The Department used Ashton ozone data and meteorological data from the Orangeburg Municipal Airport (KOGB) to examine meteorological conditions that were conducive to ozone formation (Figure 47). There were no exceedances of the ozone NAAQS from 2012 – 2016. However, some ozone is formed under similar meteorological conditions as other sites (high maximum temperatures, low afternoon wind speeds, and low mid-day relative humidity).

Figure 47: KOGB meteorological conditions vs. ozone



The Department applied a “brute-force” technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Ashton would not have exceeded the ozone NAAQS.

Data from 2014 – 2016 at the Ashton ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 36).

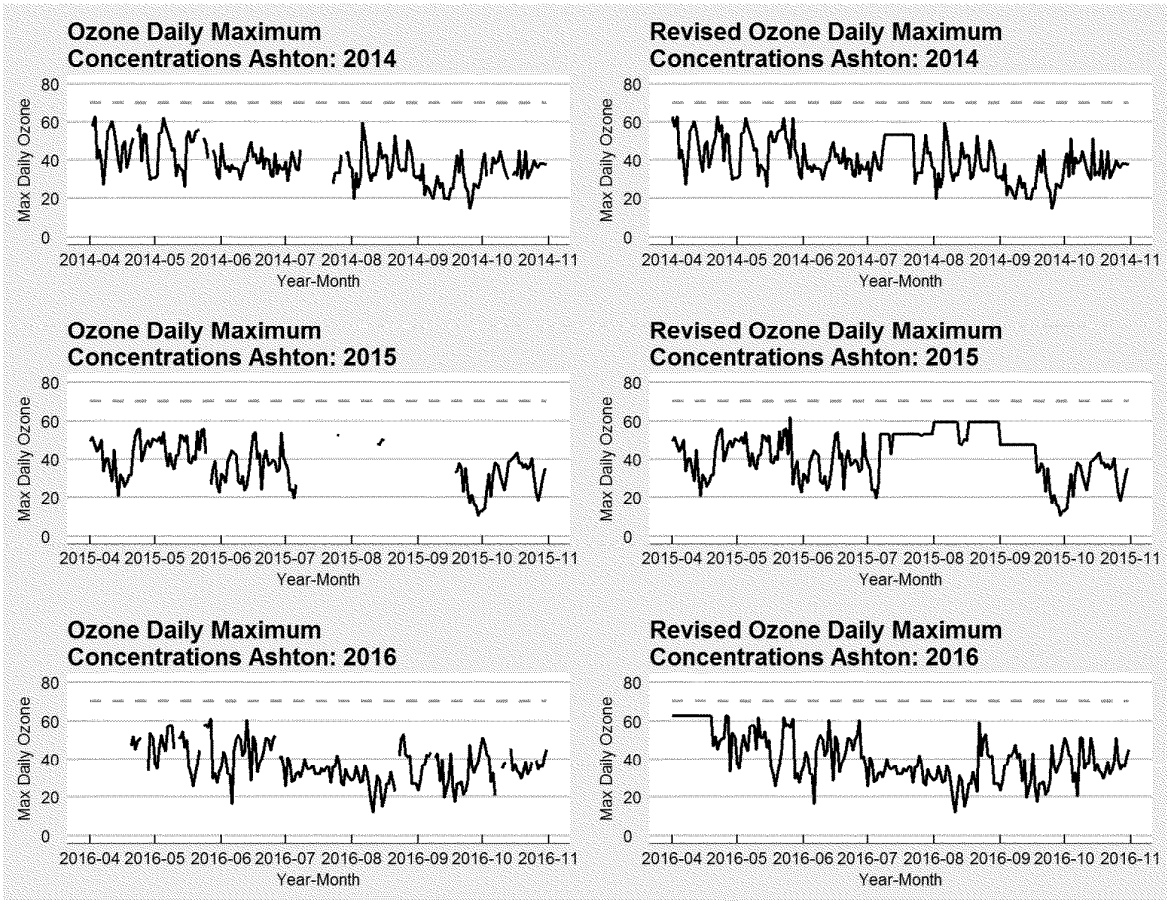
Table 36: Highest monthly MDA8 2007 - 2016

Month	Highest Daily Maximum Average (ppb)
April	62
May	62
June	60
July	53

August	59
September	47
October	51

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 48). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 48: Ashton MDA8 pre and post data substitution



The design values were then recalculated for Ashton for all missing days. This conservative approach shows that under the worst-case scenario, Ashton design values are expected to still meet the ozone NAAQS with a recalculated design value of 61 ppb (Table 37). Based on this information, the Department is seeking concurrence from EPA on the dates listed in Table 38 as not being conducive to ozone formation and furthermore, these dates waived for data completeness purposes.

Table 37: Pre- and post-data substitution design value calculation for Ashton

Year	Pre-	Data	Post-	Data

	substituted 4th high (ppb)	Completeness (%)	substituted 4th high (ppb)	Completeness
2014	59	90	62	100
2015	54	69	59	100
2016	57	86	62	100
DV	56	82	61	100

Table 38: Ashton dates requested for waiver

Date		

Ozone regression analysis

A linear regression analysis of missing data at the ozone monitoring sites listed in Table 1 was conducted to serve as an additional "weight of evidence" that the sites will attain the 2015 Ozone NAAQS based on data collected from 2014 – 2016. This analysis estimates the missing samples at the incomplete sites by using a linear regression model and bootstrapping to estimate the design value for a "complete" data set in 2016. See page 62 for more information about bootstrapping.

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Step 1: Organize data and perform linear regression between incomplete site and candidate sites

The Theil-Sen regression method was chosen to develop the statistical model (Team, R Core, 2016), (Maindonald & Braun, 2015), (Komsta, 2013) to predict missing ambient ozone concentrations at the incomplete site from monitoring conducted at other nearby candidate sites over the past five years. The Theil-Sen regression is a nonparametric linear model and is typically less likely to be influenced by outliers than a least squares linear regression (Hollander & Wolfe, 1999, pp. 415-457). Linear regressions were developed for all candidate sites which had at least 803 sample pairs (which is approximately 75% data completion over the five year period), a Spearman's Rank Correlation Coefficient of at least 0.80, and a minimum of 75% data completeness for the candidate site in 2016.

Step 2: Select the best candidate site as the predictor site

The best candidate site was selected based on an earlier analysis (EPA Region 4, 2015). Summary statistics for the models using each of the potential predictor sites are shown in Table 39, ranked by Spearman's Rank Correlation Coefficient and Root Mean Square Error (RMSE), with the best predictor site listed first in the table. Based on the criteria listed in Step 1, the correlation and RMSE results suggest that the Cowpens National Battlefield site (45-021-0002) is the best predictor site for NSFS (Spearman correlation: 0.94, RMSE=4.10 ppb). These results indicate a strong linear relationship between the two sites. A plot of the Theil-Sen regression model and paired data from both sites is in Figure 31.

Table 39: Model statistics

Incomplete Site	Predictor Site	n Sample Pairs	Minimum Pairs Met	Theil Slope	Theil Intercept	Spearman ρ	Theil RMSE (ppb)
450010001	450070005	699	No	0.96	1.01	0.86	5.29
450150002	450190046	796	No	0.94	0.33	0.91	4.35
450190046	450150002	796	No	0.92	4.48	0.91	4.40
450290002	450790021	801	No	0.91	4.03	0.88	5.07
450790021	450290002	801	No	0.90	2.70	0.88	5.08
450450016	450070005	827	Yes	1.04	1.36	0.94	3.62
450790007	450791001	790	No	1.00	-6.13	0.91	4.89
450370001	130730001	772	No	0.90	2.14	0.83	6.06
450770003	450770002	792	No	0.94	0.06	0.93	3.57
450791001	450790007	790	No	0.84	12.27	0.91	4.46
450770002	450770003	792	No	0.94	4.57	0.93	3.64
450830009	450210002	617	No	0.98	3.80	0.95	3.46

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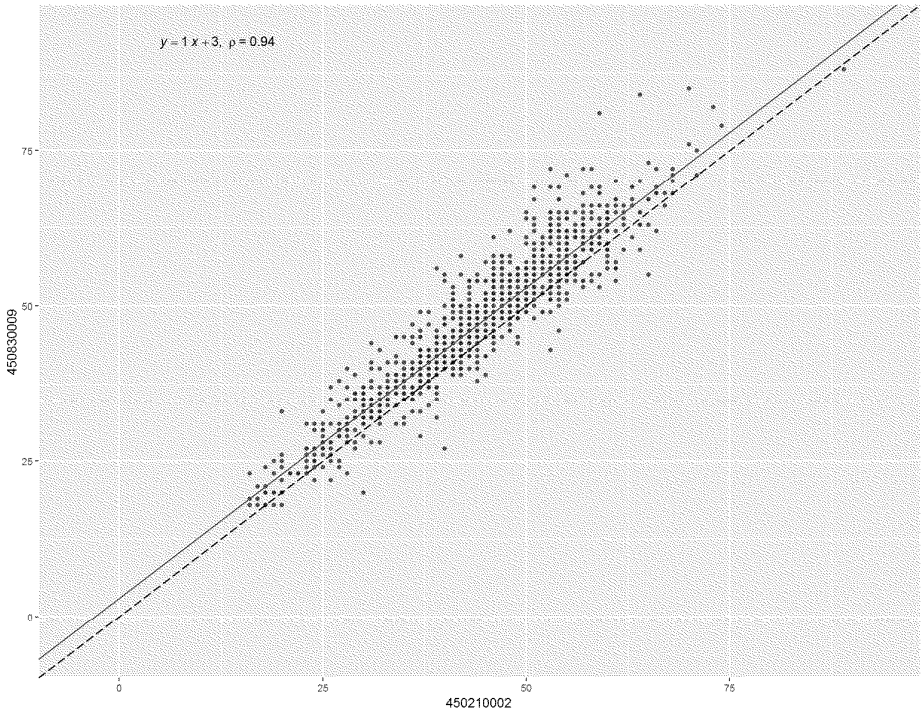
Figure 31: Correlation plot and Theil-Sen regression between Cowpens and NSFS) sites, using ozone data (ppb) from 2011-2015



Step 3: Calculate a test design value

Next, a test 2014 – 2016 design value was calculated using the combination of collected and estimated samples. This procedure produced a design value of 69 ppb, which is below the level of the 2015 Ozone NAAQS.

Step 4: Bootstrapping Analysis

A bootstrapping analysis was conducted to determine the variance around the predicted design value to provide further evidence that the design value would have been below the level of the 2015 Ozone NAAQS if the monitor had complete data. Bootstrapping is a statistical procedure that resamples a dataset to estimate the variance of a statistic, in this case the design value. The following procedure was used:

a. Residuals were calculated from the Theil-Sen regression model.
b. For each missing sample that was estimated in Step 2, a regression residual was randomly selected with replacement from the pool of residuals and added (or subtracted, in the case of a negative residual) to the estimated value.
c. Repeat (b) 10,000 times
d. For each of the 10,000 runs, the predicted 3-year design value was calculated as in Step 3.

The resulting 10,000 predicted design values are interpreted as an approximate probability distribution of the design values at the incomplete site, had it collected complete data. The distribution of the resulting bootstrap design values is show in Figure 32, and detailed in Table 11. None of the bootstrap runs show a design value greater than the level of the NAAQS. Based

on this evidence, the Department believes that the NSFS monitor would not have exceeded the level of the NAAQS had it collected complete data from 2013 – 2015.

Figure 32: Bootstrap results for modeled 2013-2015 design values

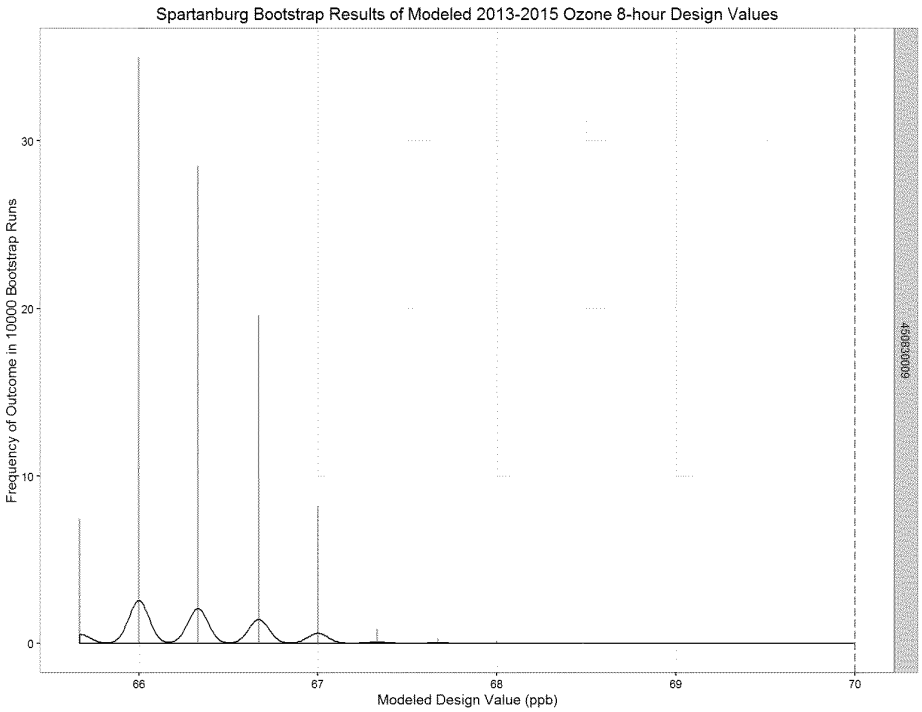


Table 12: Bootstrap results

Incomplete Site	Predictor Site	Bootstrap Runs	Predicted DV (ppb)	95% Confidence Interval (ppb)	Max Bootstrapped DV (ppb)
450830009	450210002	1,000	66	Lower: 64.34 Upper: 65.67	68.67

Conclusions and Recommendations

All monitors which operated in South Carolina between 2013 and 2015 and collected a complete data set attained the 2015 Ozone NAAQS. The Ashton and NSFS monitoring sites did not have sufficient data to have a complete design value. This analysis provides evidence that there was a minimal chance that the monitors could have exceeded the 2015 Ozone NAAQS. A “brute force” analysis at Ashton showed that under a worst-case scenario, the design value would have remained well below the level of the NAAQS. A meteorological analysis, combined with a regression analysis to predict an ozone design value, demonstrates that NSFS would have

attained the Ozone NAAQS. The Department recommends that EPA approve our request to deem the design values for Ashton and NSFS ozone monitors as complete by concurring with the dates selected in Tables 3 and 4 as occurring on days not conducive to ozone concentrations above the NAAQS in accordance with Appendix U to 40 CFR Part 50.

DRAFT

Works Cited

Cox, W. M., & Chu, S.-H. (1996). Assessment of interannual ozone variation in urban areas from a climatological perspective. *Atmospheric Environment*, 2615-2625.

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Team, R Core. (2016). R: A Language and Environment for Statistical Computing. Vienna, Austria.

US EPA. (n.d.). *Trends in Ozone Adjusted for Weather Conditions*. Retrieved September 14, 2016, from Trends in Ozone Adjusted for Weather Conditions Web site: https://www.epa.gov/air-trends/trends-ozone-adjusted-weather-conditions

DRAFT

To: Brown, Ryan[Brown.Ryan@epa.gov]; Garver, Daniel[Garver.Daniel@epa.gov]
Cc: Griffith, Ragan[Griffire@dhec.sc.gov]
From: Flynn, Thomas
Sent: Tue 4/18/2017 7:09:02 PM
Subject: Appendix U demonstration questions
removed.txt
Appendix U Demonstration Notes.docx

Ryan and Daniel,

I hope you guys are doing well. We've run into a bit of an obstacle with our Appendix U demonstration and would like your advice. I've attached a document that gives some specifics on what we've come up against. In short, we will need to modify our approach a little bit from what we did last October. Due to the amount of data we had to throw out, if we use the maximum monthly value to substitute for the missing data almost all of our monitors will have a test design value that exceeds the standard (some of the test design values are unrealistically high). We are proposing to modify this to use a five year lookback (covering 2012 – 2016 data) and the monthly 98th percentile value. This gets up reasonably close to the original design value and I think is a reasonable approach.

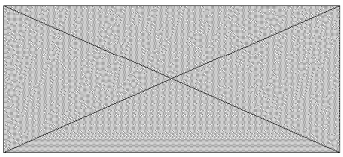
The other thing is that while all of our Theil-Sen predicted design values were below the level of the NAAQS, a very small number of bootstrap runs (for two sites) showed test design values above the level of the NAAQS. I think one of the monitors had 8 of 1000 runs above and the other had 6 of 1000 runs above.

I'm hoping you guys can take a look at the attached word document and perhaps the four of us can get on a call to see if this is a major issue, or is something that you guys might have a workaround for. I'm hoping to wrap up the document and have it to my management by the end of the month, so I'm on a little bit of a crunch. Would y'all be available to talk sometime Thursday or Friday (before lunch)?

Thanks,

Tommy

Thomas J. Flynn, III
Program Manager
Bureau of Air Quality
S.C. Dept. of Health & Environmental Control
Office: (803) 898-3251
Connect: www.scdhec.gov Facebook Twitter



Appendix U Demonstration Notes:

Not very many sites will show an "attaining" design value if we use the monthly maximum value to substitute for the missing data. If we relax the criteria to the 98th percentile concentration with a five-year data set then all sites will show "attainment". This should be reasonable because most of the test design values would be within ~15% of the original design value. If we go with a ten-year look back, then we would have to go down to the 95th percentile and we would still have one site in which the test design value would exceed the NAAQS. This is most likely due to the higher ambient ozone concentrations we measured in the past.

Ragan is working on a comparison of the five highest design value sites for NC, GA and SC. We hope to show that the data will show a relationship that we can point to as anecdotal evidence that the monitors in SC would not have exceeded the ozone NAAQS with the incomplete data in 2014 – 2016.

Brute-force approach substitution for 100% of missing data with monthly max (1st max), 99th percentile (~2nd max for months with 30 or 31 days), or 98th percentile over the previous five years (~3rd max for months with 30 or 31 days) (2012 – 2016).

Site Name	Original DV	Monthly Max (%d)	Monthly 99th ptile (%d)	Monthly 98th ptile (%d)
Trenton	58	72 (24%)	66 (14%)	65 (12%)
Bushy Park	57	62 (9%)	61 (7%)	59 (4%)
Cape Romain	57	66 (16%)	63 (11%)	62 (9%)
Parklane	59	72 (22%)	65 (10%)	64 (8%)
Congaree Bluff	55	58 (5%)	56 (2%)	56 (2%)
Sandhill	65	73 (12%)	68 (5%)	67 (3%)
Hillcrest	63	71 (13%)	67 (6%)	66 (5%)
Clemson	63	69 (10%)	67 (6%)	66 (5%)
Wolf Creek	60	67 (12%)	65 (8%)	63 (5%)
NSFS	67	77 (15%)	71 (6%)	68 (1%)
Due West	58	85 (47%)	71 (22%)	67 (16%)
Ashton	56	61 (9%)	58 (4%)	57 (2%)

DRAFT

Brute-force approach substitution for 100% of missing data with monthly max (1st max), 99th percentile (~3rd max for months with 30 or 31 days), 98th percentile (~6th max for months with 30 or 31 days), or 95th percentile (~15th max for months with 30 or 31 days) over previous the five years (2007 – 2016).

Site Name	Original DV	Monthly Max (%d)	Monthly 99th ptile (%d)	Monthly 98th ptile (%d)	Monthly 95th ptile (%d)
Trenton	58	78 (34%)	71 (22%)	69 (19%)	64 (10%)
Bushy Park	57	70 (23%)	63 (11%)	61 (7%)	59 (4%)
Cape Romain	57	78 (37%)	71 (25%)	68 (19%)	64 (12%)
Parklane	59	90 (53%)	77 (31%)	75 (27%)	69 (17%)
Congaree Bluff	55	73 (33%)	67 (22%)	64 (16%)	60 (9%)
Sandhill	65	82 (26%)	76 (17%)	74 (14%)	70 (8%)
Hillcrest	63	73 (16%)	69 (10%)	68 (8%)	66 (5%)
Clemson	63	77 (22%)	72 (14%)	69 (10%)	67 (6%)
Wolf Creek	60	72 (20%)	70 (17%)	67 (12%)	64 (7%)
NSFS	67	89 (33%)	81 (21%)	78 (16%)	71 (6%)
Due West	58	90 (55%)	79 (36%)	74 (28%)	68 (17%)
Ashton	56	74 (32%)	68 (21%)	65 (16%)	61 (9%)

Theil-Sen regression:

No site test design values exceeded the ozone NAAQS

The following sites show bootstrapped design values in excess of 70 ppb: Sandhill, NSFS

If using a minimum of 75% "completeness" (~803 valid days) over a five year period (as we did in the October 2016 analysis), then only two site comparisons will be valid. If we drop this requirement to 70% (~749 valid days), then all but two sites will meet. One of the comparisons (NSFS vs. Cowpens) will need to be revised because Cowpens was shut down towards the beginning of the 2016 ozone monitoring season.

Which is more important for this analysis…having >75% data completion (over the 5 year period), or the highest spearman r? If our highest spearman r is with a pair that doesn't meet the 75% completion, should we move to the next highest spearman r?

DRAFT

To: Garver, Daniel[Garver.Daniel@epa.gov]
Cc: McLane, Preston[Preston.McLane@dep.state.fl.us]; sandra.veazey@dep.state.fl.us[sandra.veazey@dep.state.fl.us]; Gaskin, Carla[Carla.Gaskin@dep.state.fl.us]; Thomas, Oriene (Saphique)[Oriene.Thomas@dep.state.fl.us]; Brown, Ryan[Brown.Ryan@epa.gov]; Bell, Tiereny[Bell.Tiereny@epa.gov]; Rinck, Todd[Rinck.Todd@epa.gov]
From: Himes, Brian
Sent: Fri 3/31/2017 7:37:21 PM
Subject: Ozone Reports
Ozone Monitoring Data Analysis 2013-2015.pdf
Ozone Monitoring Data Analysis 2014-2016.pdf

Daniel,

I have attached the Department's final analyses of the missing ozone monitoring data from 2013-2106 and the requests for Regional Administrator approval.

The associated data files as referenced in each report are available on the Ex. 6 - Personal Privacy using the password Ex. 6 - Personal Privacy

If you have any questions, please don't hesitate to contact us.

Sincerely,

- Brian

Brian Himes

Environmental Consultant

Division of Air Resource Management

Florida Department of Environmental Protection

2600 Blair Stone Road, MS 5500

Tallahassee, FL 32399

Office: (850) 717-9005

Brian.Himes@dep.state.fl.us

2013-2015 Ozone Monitoring Data Analysis: Broward, Columbia, Leon, and Palm Beach Counties

Florida Department of Environmental Protection
Division of Air Resource Management

March 31, 2017

2600 Blair Stone Road, MS 5500
Tallahassee, Florida 32399-2400
www.dep.state.fl.us

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1. Background

On October 1, 2015, the U.S. Environmental Protection Agency (EPA) revised the primary National Ambient Air Quality Standard (NAAQS) for ground-level ozone (O_3) from 0.075 parts per million (ppm) to 0.070 ppm (70 parts per billion [ppb]) (80 Fed. Reg. 65,452; codified at 40 C.F.R. Part 50.19).

Promulgation of a new NAAQS triggers a requirement under the Clean Air Act (CAA) for each state to submit to EPA area recommendations for attainment designations. Pursuant to CAA Section 107(d)(1)(A), on September 30, 2016, the Florida Department of Environmental Protection (Department) submitted a recommendation of attainment for the entire State of Florida. This recommendation was based on ambient monitoring data from Florida's network of 57 ozone monitors for the period of 2013 through 2015. EPA intends to finalize area designations for the 2015 ozone NAAQS by October 1, 2017, and these designations will be based on monitoring data for the period of 2014 through 2016.

2. Introduction

EPA has established criteria for the collection and verification of air quality data used to inform the Department's attainment recommendation. In October 2015, Appendix U to 40 C.F.R. Part 50 (Appendix U) was promulgated together with the revised ozone NAAQS. Section 4(b) of Appendix U sets forth monitoring data completeness requirements for ozone:

> A design value greater than the level of the NAAQS is always considered to be valid. A design value less than or equal to the level of the NAAQS must meet minimum data completeness requirements in order to be considered valid. These requirements are met for a 3-year period at a site if valid daily maximum 8-hour average O_3 concentrations are available for at least 90% of the days within the O_3 monitoring season, on average, for the 3-year period, with a minimum of at least 75% of the days within the O_3 monitoring season in any one year.

"Valid daily maximum 8-hour average O_3 concentration" is defined in Section 3(d) as follows:

> A daily maximum 8-hour average O_3 concentration shall be considered valid if valid 8-hour averages are available for at least 13 of the 17 consecutive 8-hour periods starting from 7:00 a.m. to 11:00 p.m. In addition, in the event that fewer than 13 valid 8-hour averages are available, a daily maximum 8-hour average O_3 concentration shall also be considered valid if it is greater than the level of the NAAQS.

All of Florida's 57 ozone monitors have design values below the level of the 2015 ozone NAAQS. The 90% completeness over three years and 75% annual completeness criteria apply, therefore, to all of Florida's ozone monitors. Nine of Florida's 57 ozone monitors do not, however, meet the minimum data completeness requirements for the period of 2013 through 2015.

Of these nine ozone monitors, the Department requests that the Regional Administrator for EPA Region 4 find that four do have valid design values for the period of 2013 through 2015 using the procedure specified in Section 4(c) of Appendix U:

> When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the NAAQS. Missing days assumed less than the level of the NAAQS are counted for the purpose of meeting the minimum data completeness requirements, subject to the approval of the appropriate Regional Administrator.

ED_001361_00002060

The Department's meteorological and ambient data analysis for these four ozone monitors demonstrates that meteorological conditions were "not conducive to concentrations above the level of the NAAQS" during many of the days with invalid or missing data. The Department is requesting EPA's approval to count those specified "missing days" towards the minimum data completeness requirements of Section 4(b) of Appendix U. If the Regional Administrator for EPA Region 4 were to agree with the Department's analysis, the Department would have sufficient data at those four monitors to meet the minimum data completeness requirements and have valid design values for area designations. [1]

3. Missing Days

Four ozone monitors with missing data are addressed in this report: (1) the Pompano monitor in Broward County; (2) the Lake City monitor in Columbia County; (3) the Lantana monitor in Palm Beach County; and (4) the St. Marks monitor in Wakulla County. These four monitors are missing data for varying periods in 2013 through 2015, with most events affecting data completeness occurring in 2014 and 2015. Missing data were attributable to a variety of issues, including equipment malfunctions and monitor relocation. A summary of data completeness percentages and the primary cause for the missing data is provided in **Table 1**.

Table 1: Florida ambient ozone monitors with missing data – 2013-2015.

Monitor Name	Monitor ID	County	Data Completeness		Data Loss Primary Cause
Pompano Highlands Fire House	12-011-2003	Broward	2013	98.0%	
			2014	98.8%	
			2015	70.2%	Lightning strike damage.
			2013-2015	89.0%	
Lake City Veteran's Domicile	12-023-0002	Columbia	2013	99.6%	
			2014	86.1%	Data logger malfunction.
			2015	79.6%	Data logger malfunction.
			2013-2015	88.4%	
Lantana Preserve	12-099-0021	Palm Beach	2013	94.7%	Monitor moved 260 meters east due to property being sold by the State. Closed 8/13/14 to 2/15/15.
			2014	55.1%	
			2015	65.7%	
			2013-2015	71.8%	
St. Marks Wildlife Refuge	12-129-0001	Wakulla	2013	99.6%	
			2014	71.8%	Equipment replacement.
			2015	95.5%	
			2013-2015	89.0%	

4. Monitored Trends

Ozone concentrations have been falling across the State for many years. No monitors have shown a violation of the NAAQS since 2009 (**Figure 1**). Outside of the Pensacola and Tampa metropolitan areas, all monitored design values are at least 10% below the 2015 ozone NAAQS (i.e., at or below 63 ppb). Monitoring data for 2014 through 2016 indicate a maximum statewide design value of 68 ppb, and only eight of the state's 57 monitors register design values above 63 ppb.

[1] Of the nine monitors that do not meet the minimum data completeness requirements for the 2013-2015 period, two have complete data for the 2014-2016 period and have valid design values for the purposes of area designations. A further three of the nine monitors are located in Duval County. Given the large amount of missing data at these monitors and lack of nearby monitors, an analysis could not be completed for that area.

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While the State of Florida as a whole enjoys very good air quality, the four monitors included in this analysis are each located in areas with exceptionally low ozone concentrations (**Figure 2**). The Lake City and St. Marks monitors are in rural North Florida, far from any metropolitan area in which the highest ozone concentrations are typically found. The Pompano and Lantana monitors are in the highly urbanized Miami-Fort Lauderdale-Pompano Beach Metropolitan Statistical Area (MSA) but benefit from prevailing winds from the Atlantic Ocean that help to regularly remove pollutants from the air. None of the 11 monitors located in the three MSAs containing the four monitors with missing data has had a design value above the new NAAQS since 2008 or above 65 ppb since 2012. The highest 2014-2016 design value for any of those 11 monitors is 62 ppb.

Given these data and the fact that ozone is a regional pollutant that does not vary significantly in concentration across small distances, the informed observer would not expect that the four monitors with missing data would have recorded concentrations above the level of the NAAQS during the 2013-2015 period.

Figure 1: Florida monitored ozone design value trends 1997-2016.

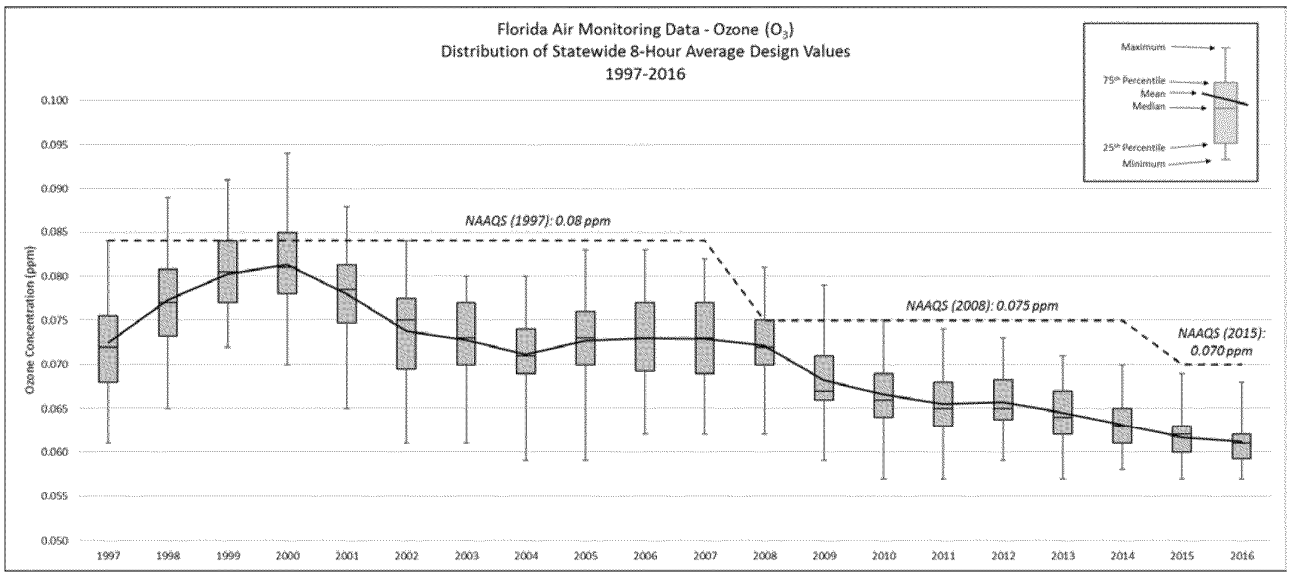

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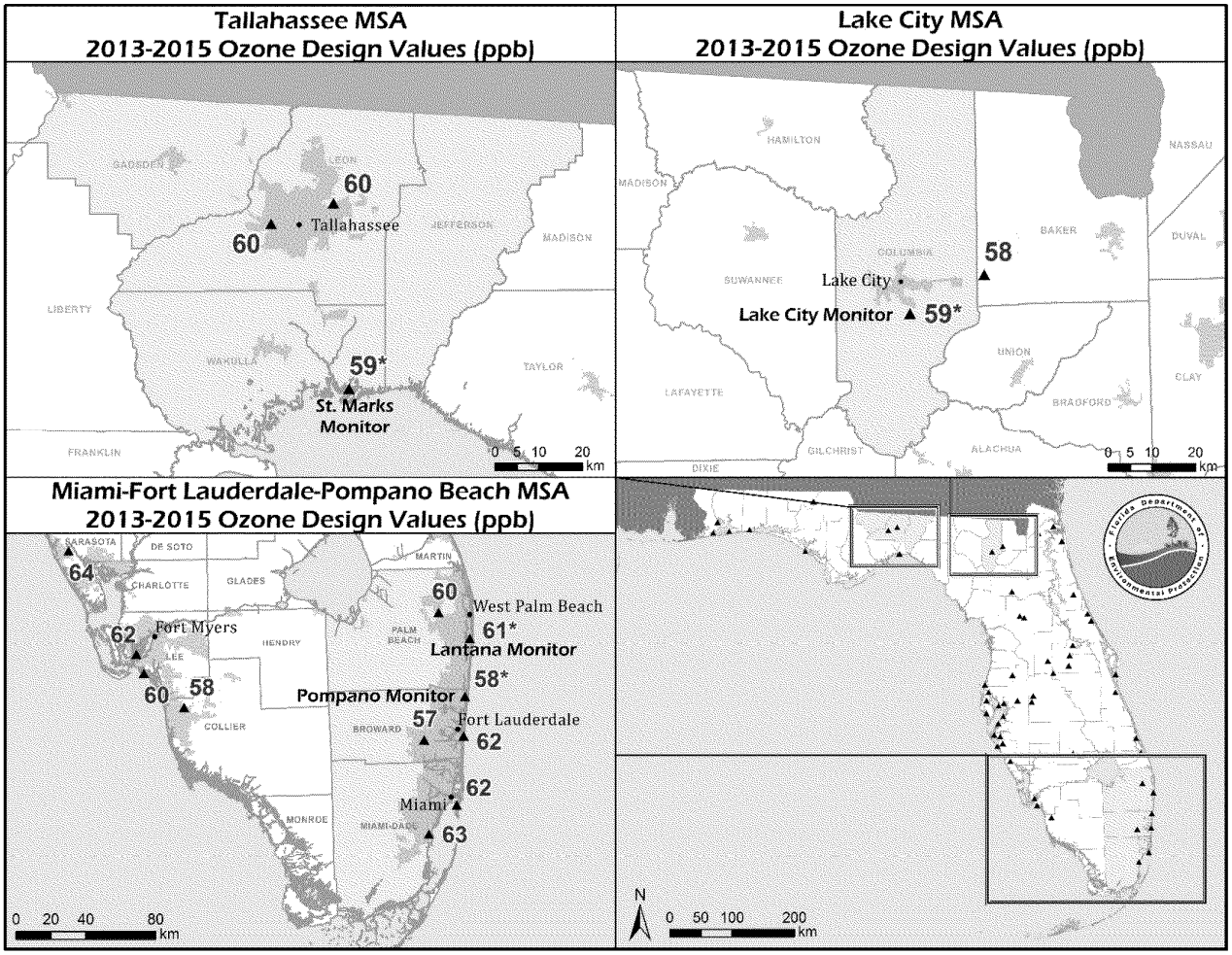
Figure 2: 2013-2015 ozone design values for monitors in the Florida MSAs containing monitors with missing data.



5. Meteorological Analysis

The formation of ground-level ozone is highly dependent on meteorological conditions. In particular, the formation of ozone at concentrations above the level of the NAAQS requires a warm, dry, stable air mass coincident with abundant sunshine. These conditions are generally not present in the marine air mass that dominates Florida for most of the ozone season (March-October). Mid-latitude cyclones bring in dry continental air masses from the north from about October to May. It is behind these frontal boundaries, during the months with sufficient solar insolation, that ozone concentrations tend to be at a maximum in the State resulting in a bi-modal distribution of ozone concentrations with the largest peak occurring in the spring (April-May) and a secondary peak in the fall (October-November).

5.1. Determination of Critical Values for Meteorological Parameters

Given that ozone formation requires certain meteorological conditions, it follows that there are "critical values" for different meteorological parameters that can serve as cutoff points for determining if the conditions present on a day with missing data were conducive to high levels of ozone. The Department used ambient ozone data from proximate monitors with complete data and meteorological data from nearby National Weather Service (NWS) automated surface observing system (ASOS) stations to

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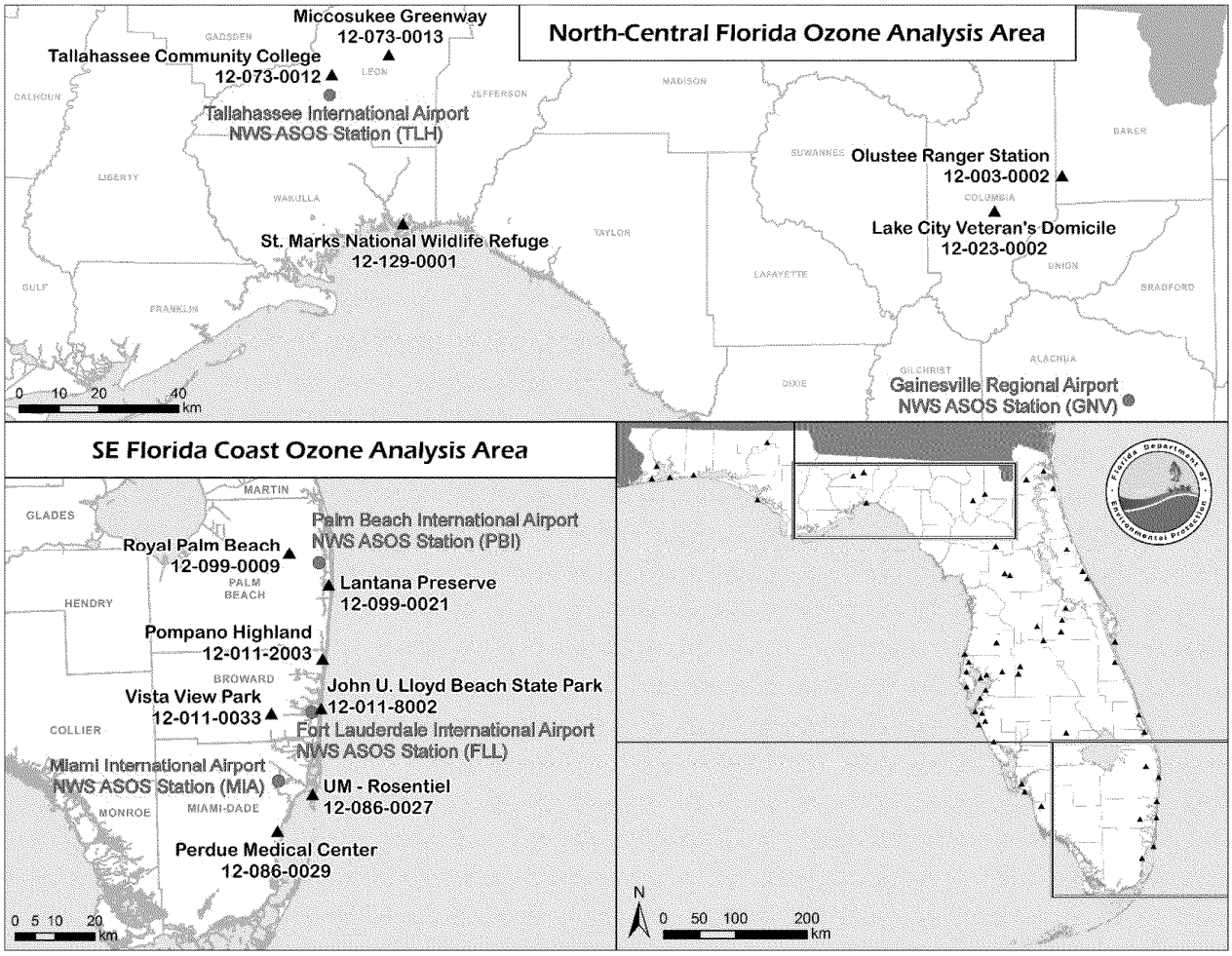
determine the critical values for the highest ozone concentrations for four meteorological parameters. The map below in **Figure 3** summarizes the monitors and ASOS stations used for this analysis.

Figure 3: Ambient ozone monitors and NWS ASOS stations used in the missing data meteorological analysis.



The Department compared maximum daily 8-hour average (MDA8) ozone concentrations at five monitors in North-Central Florida and seven monitors along the Southeast Florida Coast (including the monitors with missing data) with daily meteorological parameters from the nearest ASOS station for the period of 2011 through 2015 to determine the critical meteorological values for high ozone formation in each area. The MDA8 data were extracted from the Florida Air Monitoring and Assessment System (FAMAS) and the meteorological data was downloaded on an hourly basis from the National Climatic Data Center (NCDC). **Table 2** summarizes the monitors and ASOS stations used in the analysis.

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Table 2: Ozone monitors and ASOS stations used in the meteorological analysis.

Ozone Monitor	Paired ASOS Station	Analysis Area
12-003-0002	Gainesville	North-Central Florida
12-011-0033	Fort Lauderdale	SE Florida Coast
12-011-2003	Fort Lauderdale	SE Florida Coast
12-011-8002	Fort Lauderdale	SE Florida Coast
12-023-0002	Gainesville	North-Central Florida
12-073-0012	Tallahassee	North-Central Florida
12-073-0013	Tallahassee	North-Central Florida
12-086-0027	Miami	SE Florida Coast
12-086-0029	Miami	SE Florida Coast
12-099-0009	Palm Beach	SE Florida Coast
12-099-0021	Palm Beach	SE Florida Coast
12-129-0001	Tallahassee	North-Central Florida

MDA8 ozone concentration correlations were examined for daily maximum temperature, daily minimum relative humidity, average afternoon wind speed (the average of the five observations from 12:00 pm EST to 4:00 pm EST), and average afternoon cloud cover. Average afternoon cloud cover was calculated by assigning a value of 10 to an ASOS code of *OVC*, 5 to *BKN*, 3 to *SCT*, and 1 to *FEW*, then summing for the observation and averaging over the five hourly observations from 12:00 pm EST to 4:00 pm EST. As shown in **Figure 4** and **Figure 5**, the analysis indicated correlations with all parameters, but by far the strongest was found with the daily minimum humidity.

The 12 monitors included in this analysis have recorded very few ozone MDA8 concentrations above the 2015 ozone NAAQS since 2011 – of the nearly 8,800 valid monitoring days, only one MDA8 concentration above the limit was recorded at the five North-Central monitors and out of over 11,700 valid monitoring days just 13 such instances occurred at the seven SE Coast monitors. In light of these facts, and in an effort to increase the confidence and conservatism of the analysis, the critical values were determined for ozone concentrations above 65 ppb instead of the 70 ppb NAAQS. The critical values and correlation coefficients for each area and distribution are summarized in **Table 3** and **Table 4**. The Microsoft Excel spreadsheets used to perform the analyses are provided as **Appendix A** and **Appendix B** to this document.

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Figure 4: Maximum MDA8 ozone concentrations from the five North-Central Florida ozone monitors plotted against four meteorological parameters. The critical values are marked by vertical lines.

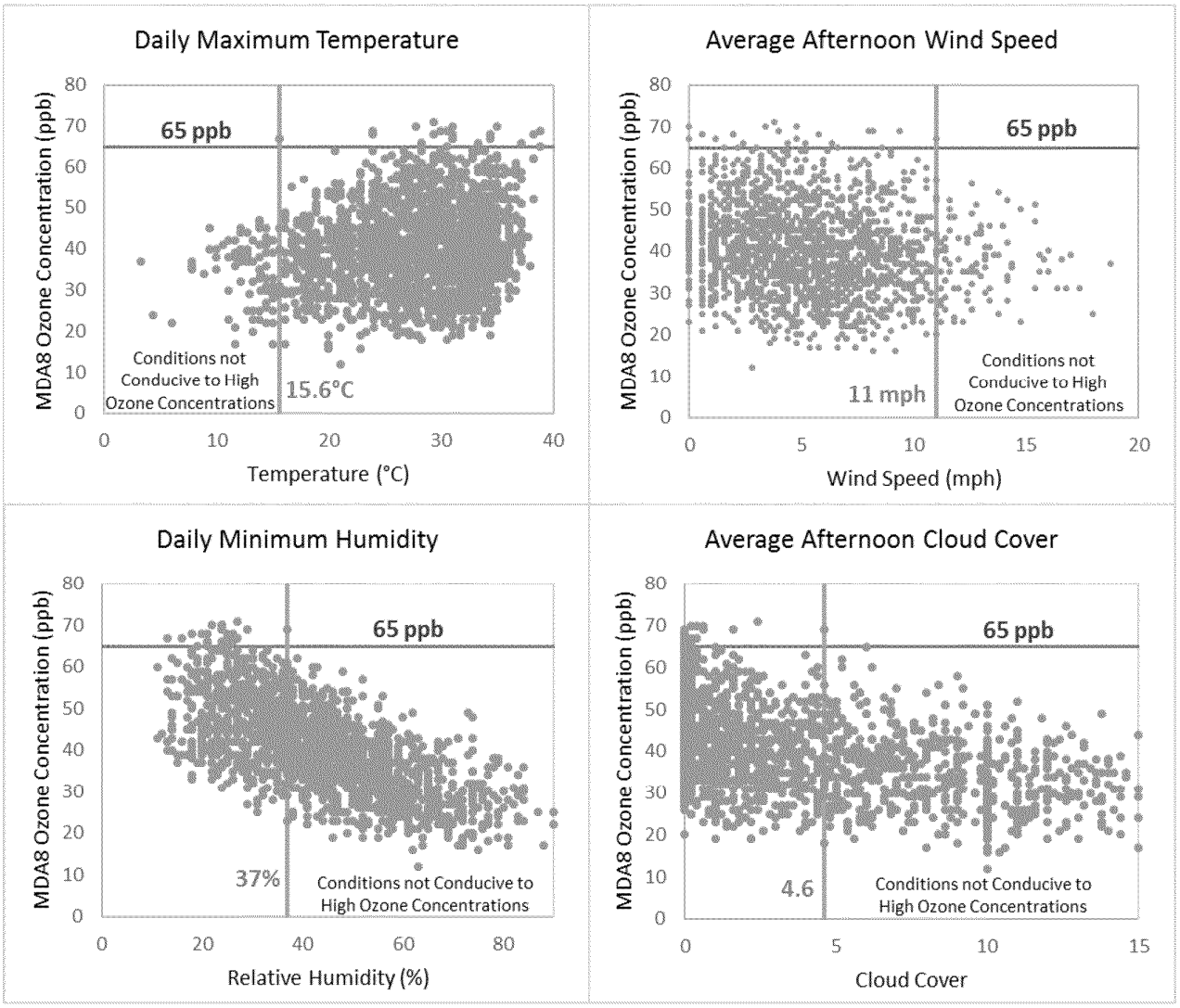

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Figure 5: Maximum MDA8 ozone concentrations from the seven Southeast Florida Coast ozone monitors plotted against four meteorological parameters. The critical values are marked by vertical lines.

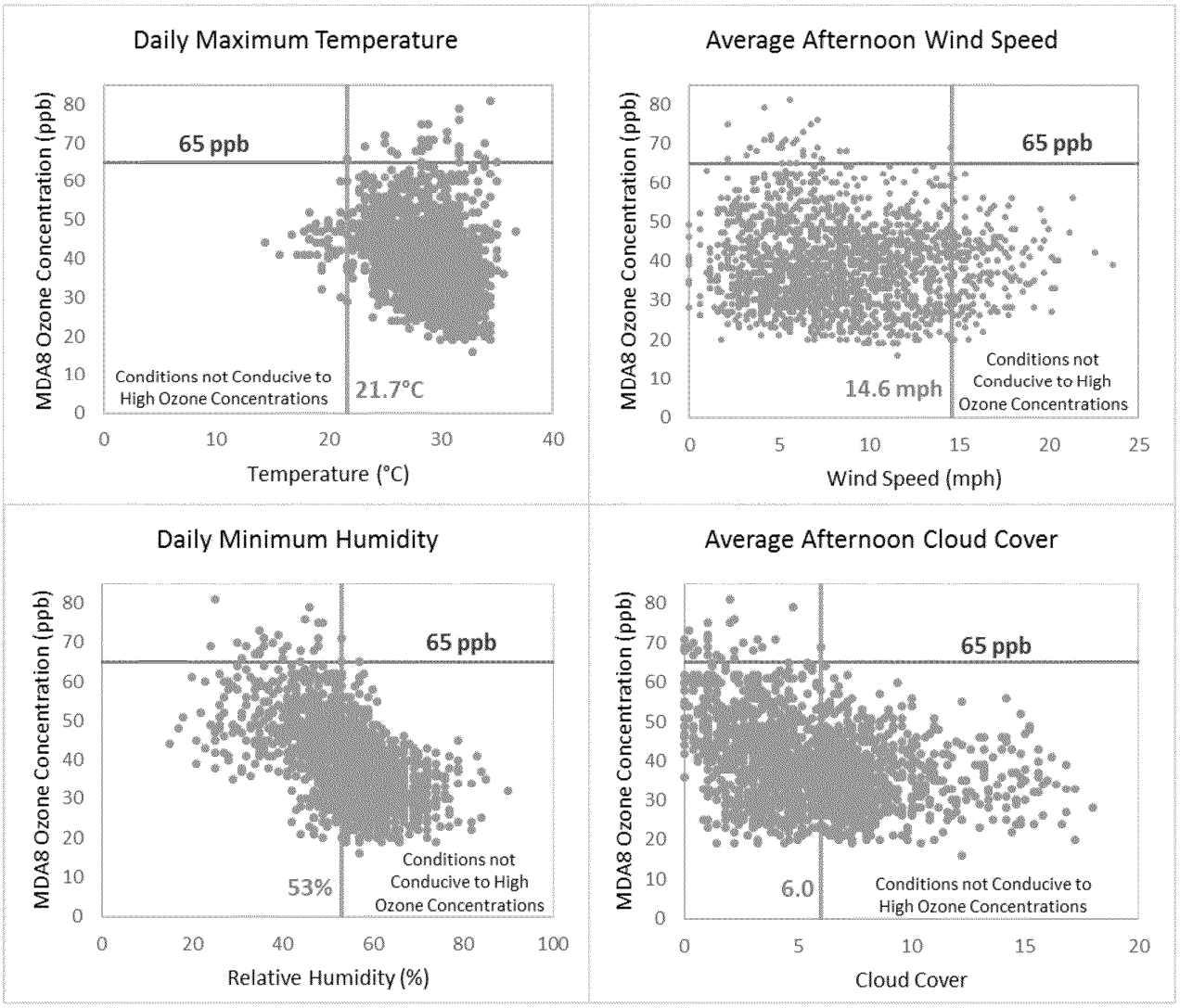

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Table 3: Critical meteorological values for ozone concentrations above 65 ppb for the meteorological analysis of days with missing ozone data and correlation coefficients for the associated distributions for the North-Central Florida analysis area.

North-Central Florida		
Meteorological Parameter	**Critical Value**	**Distribution Correlation Coefficient**
Maximum Daily Temperature	15.6°C	0.18
Average Afternoon Wind Speed	11.0 mph	-0.16
Minimum Daily Humidity	37%	-0.65
Average Afternoon Cloud Cover	4.6	-0.46

Table 4: Critical meteorological values for ozone concentrations above 65 ppb for the meteorological analysis of days with missing ozone data and correlation coefficients for the associated distributions for the Southeast Florida Coast analysis area.

Southeast Florida Coast		
Meteorological Parameter	**Critical Value**	**Distribution Correlation Coefficient**
Maximum Daily Temperature	21.7°C	-0.35
Average Afternoon Wind Speed	14.6 mph	-0.06
Minimum Daily Humidity	53%	-0.58
Average Afternoon Cloud Cover	6.0	-0.33

5.2. Determination of Days to Count Towards Minimum Data Completeness

The analysis of the meteorological data provided a set of critical values for four meteorological parameters that can be used to determine if the conditions on a day with missing monitoring data were conducive to ozone concentrations above the NAAQS. As previously discussed, the formation of high concentrations of ozone generally requires that multiple meteorological parameters fall within a certain range. Therefore, if any one of the four critical values are not met, the meteorological conditions on that day were not conducive to ozone concentrations above the NAAQS. The Department chose to use the daily minimum humidity as the determining factor because it is clear from the graphs provided in **Figure 5** that it is the parameter that is by far the most correlated with MDA8 ozone concentrations.

The Department is requesting concurrence that any day with missing ozone monitoring data can be counted towards the minimum data completeness requirements of Appendix U if the daily minimum relative humidity did not fall below 38% for the Lake City and St. Marks monitors or 54% for the Pompano and Lantana monitors based on meteorological observations from the nearest representative NWS ASOS station.

A summary by monitor of the number of missing days and the days that meet the humidity critical value is provided in **Table 5**, and the specific days requested to be counted towards the minimum data completeness requirements based on this analysis are provided in **Table 6**. This list includes significantly more days than are needed to meet the completeness requirements.

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Table 5: Summary of the number of missing days and days that met the relative humidity threshold for a determination of not conducive to concentrations above the level of the NAAQS along with the new data completeness for each monitor.

Monitor	Period	Total Missing Days	Days with Conditions Not Conducive to Ozone Concentrations over 65 ppb	New Data Completeness
Pompano 12-011-2003	2013	5	4	99.6%
	2014	3	3	100%
	2015	73	64	96.3%
	2013-2015	81	71	98.6%
Lake City 12-023-0002	2013	1	1	100%
	2014	34	25	96.3%
	2015	50	44	97.6%
	2013-2015	85	70	98.0%
Lantana 12-099-0021	2013	13	8	98.0%
	2014	110	85	89.8%
	2015	84	54	87.8%
	2013-2015	207	147	91.8%
St. Marks 12-129-0001	2013	1	0	99.6%
	2014	69	42	89.0%
	2015	11	10	99.6%
	2013-2015	81	52	96.1%

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Table 6: List of the days requested to be counted towards the minimum data completeness requirements for the four Florida ozone monitors with missing data based on an analysis of the meteorological conditions on each day.

Pompano (12-011-2003)		Lantana (12-099-0021)			Lake City (12-023-0002)		St. Marks (12-129-0001)	
7/26/13	9/20/15	9/11/13	9/3/14	4/30/15	3/23/13	6/28/15	4/15/14	7/23/14
8/20/13	9/21/15	9/12/13	9/4/14	5/5/15	3/3/14	6/29/15	6/10/14	7/24/14
9/20/13	9/22/15	9/13/13	9/5/14	5/6/15	3/23/14	6/30/15	6/11/14	7/25/14
10/1/13	9/23/15	9/14/13	9/6/14	5/10/15	3/29/14	7/2/15	6/13/14	7/26/14
9/19/14	9/24/15	9/15/13	9/7/14	5/11/15	4/15/14	7/3/15	6/14/14	7/27/14
10/28/14	9/25/15	9/16/13	9/8/14	5/12/15	4/17/14	7/4/15	6/15/14	7/28/14
11/13/14	9/26/15	9/17/13	9/10/14	5/13/15	4/18/14	7/5/15	6/19/14	8/3/14
3/3/15	9/27/15	9/18/13	9/11/14	5/15/15	4/19/14	7/6/15	6/22/14	8/4/14
8/6/15	9/28/15	6/9/14	9/12/14	5/16/15	4/20/14	7/7/15	6/23/14	8/7/14
8/7/15	9/29/15	6/10/14	9/13/14	5/17/15	5/3/14	7/12/15	6/24/14	8/9/14
8/10/15	9/30/15	6/14/14	9/14/14	5/18/15	5/24/14	7/13/15	6/25/14	8/10/14
8/11/15	10/2/15	6/15/14	9/15/14	5/22/15	5/25/14	7/14/15	6/26/14	8/11/14
8/27/15	10/5/15	6/17/14	9/16/14	5/24/15	5/26/14	7/16/15	7/1/14	8/12/14
8/28/15	10/7/15	6/18/14	9/17/14	5/25/15	6/14/14	7/23/15	7/2/14	8/13/14
8/29/15	10/8/15	6/19/14	9/18/14	5/26/15	6/15/14	7/24/15	7/3/14	8/14/14
8/30/15	10/9/15	6/20/14	9/19/14	5/29/15	6/21/14	7/25/15	7/10/14	8/15/14
8/31/15	10/10/15	6/21/14	9/20/14	5/31/15	6/22/14	7/26/15	7/11/14	6/4/15
9/1/15	10/14/15	7/9/14	9/21/14	6/2/15	6/25/14	7/30/15	7/12/14	6/30/15
9/2/15	10/15/15	7/10/14	9/22/14	6/3/15	6/28/14	7/31/15	7/13/14	7/1/15
9/3/15	10/16/15	7/11/14	9/23/14	6/4/15	6/29/14	8/4/15	7/14/14	7/2/15
9/4/15	10/17/15	7/12/14	9/24/14	6/5/15	7/4/14	8/7/15	7/15/14	7/3/15
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9/12/15	10/25/15	7/20/14	10/3/14	6/16/15	4/16/15	9/15/15		
9/13/15	10/26/15	7/21/14	10/4/14	6/17/15	4/19/15	9/24/15		
9/14/15	10/27/15	7/22/14	10/7/14	6/18/15	4/27/15	9/28/15		
9/15/15	10/28/15	7/23/14	10/8/14	6/21/15	4/28/15	10/3/15		
9/16/15	10/29/15	8/13/14	10/9/14	6/22/15	4/29/15	10/4/15		
9/17/15	10/30/15	8/14/14	10/10/14	9/3/15	5/19/15	10/5/15		
9/18/15	10/31/15	8/15/14	10/12/14	9/4/15	6/23/15	10/20/15		
9/19/15		8/16/14	10/13/14	9/5/15				
		8/17/14	10/14/14	9/6/15				
		8/18/14	10/15/14	9/7/15				
		8/20/14	10/21/14	9/8/15				
		8/21/14	10/22/14	9/9/15				
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		8/28/14	10/31/14	9/14/15				
		8/29/14	4/23/15	9/15/15				
		8/30/14	4/24/15	9/16/15				
		8/31/14	4/25/15	9/17/15				
		9/1/14	4/28/15	10/14/15				
		9/2/14	4/29/15	10/28/15				

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6. Ambient Monitoring Data Analysis

The meteorological analysis was sufficient to select enough days for each of the incomplete monitors to meet data completeness requirements. The Department is, however, providing additional evidence supporting this request in the form of a statistical analysis to determine the probability that any given day with missing data could have exceeded the NAAQS based on nearby ambient monitoring data. Florida has a dense ozone monitoring network with approximately 50% more monitors than required by federal law. None of the monitors with missing data is more than 45 kilometers from an ozone monitor with a valid design value. This high density of strongly correlated monitors lends itself to a robust analysis of the ambient conditions present on the days with missing data.

The probability analysis was performed by using the distribution of differences between the MDA8 data from monitors with missing data and each of those monitors' most correlated nearby monitor to determine the probability, based on historic performance, that each monitor could have recorded a concentration above the level of the NAAQS on a day with missing data. The following steps describe this process:

1. Find each incomplete monitor's most correlated nearby monitor.
   a. A monitor within 45 km with a correlation coefficient of at least 0.9, indicating a very strong correlation, was found for each of the four incomplete monitors (**Table 7** and **Figure 6**).
2. Develop the distribution of daily differences in MDA8 ozone concentration for each pair of monitors.
   a. Data points were calculated by taking the difference between the MDA8 recorded at the monitor with incomplete data and its paired monitor over the 2011-2015 period.
   b. Each of the four distributions had a at least 1375 data points providing for a very robust probability calculation.
3. Calculate the empirical approximation of the probability of each incomplete monitor recording a concentration exceeding 70 ppb on a given day with missing data based on the recorded, valid MDA8 concentration at each one's paired monitor using the following approach:
   a. Find the difference between the monitored value at the paired monitor and the NAAQS,
   b. Count the number of days in the distribution where the difference between the two monitors was equal to or greater than the value calculated in 3(a),
   c. Divide the number calculated in 3(b) by the total number of data points in the distribution.

A total of four days with missing data for all four monitors across the entire three-year period were found to have more than a 1% probability of exceeding the NAAQS. The probability analyses are provided as Microsoft Excel spreadsheets in **Appendix C** and **Appendix D** to this document.

Table 7: Summary of the monitors used and the results of the probability analysis of days with missing ozone data.

Incomplete Monitor	Most Correlated Monitor	Correlation Coefficient	Distance Apart	Data Points in Distribution	Days with Missing Data with More than a 1% Probability of Exceeding the NAAQS
12-011-2003	12-011-8002	0.951	22.6 km	1598	1
12-023-0002	12-003-0002	0.976	17.3 km	1696	0
12-099-0021	12-099-0009	0.924	23.2 km	1376	3
12-129-0001	12-073-0013	0.900	43.6 km	1691	0

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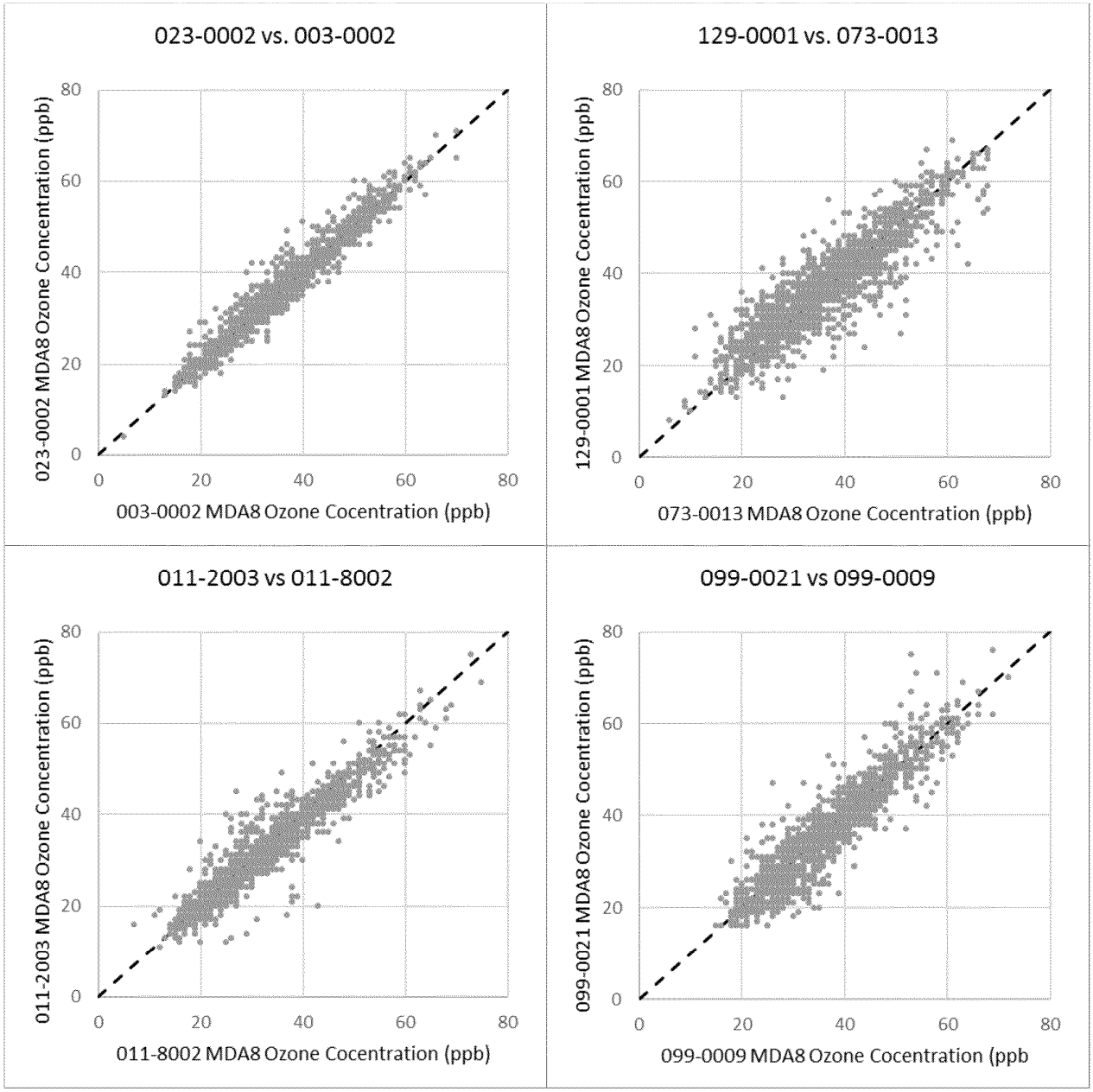
Figure 6: Daily paired MDA8 ozone concentrations for monitors with missing ozone data and the nearest, most correlated monitor.



7. Summary

All monitors in the State of Florida's ozone monitoring network recorded design values below the level of the 2015 revised ozone NAAQS. The Pompano, Lake City, St. Marks, and Lantana monitors did not have sufficient data to produce valid design values for the period of 2013 through 2015. Given the long-term trends in ozone concentrations across Florida, the exceptionally low concentrations found in the areas around these four monitors, and the historic concentrations recorded at each of these monitors, an informed observer would not expect that any of these monitors would have recorded concentrations above the level of the NAAQS on any day with missing data. The highly conservative meteorological

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analysis provided above has shown that the conditions on the vast majority of the days with missing data were not conducive to ozone concentrations above the level of the NAAQS, or even above 65 ppb. This analysis is further supported by the probability analysis indicating that there were just four total days at all four monitors across three years that had more than a 1% chance of exceeding the NAAQS.

Based on this evidence, the Department respectfully requests that EPA approve this analysis and determine that the conditions on the dates listed in **Table 5** were not conducive to concentrations of ozone above the level of the NAAQS. This will allow those specific dates to be counted toward the minimum data completeness requirements of Appendix U. As a result of this demonstration, the Pompano, St. Marks, Lantana, and Lake City ozone monitors will meet the minimum data completeness requirements of Section 4(b) of Appendix U for the period of 2013 through 2015 and have valid design values for area designation purposes.

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2014-2016 Ozone Monitoring Data Analysis: Manatee County

Florida Department of Environmental Protection
Division of Air Resource Management

March 31, 2017

2600 Blair Stone Road, MS 5500
Tallahassee, Florida 32399-2400
www.dep.state.fl.us

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1. Background

On October 1, 2015, the U.S. Environmental Protection Agency (EPA) revised the primary National Ambient Air Quality Standard (NAAQS) for ground-level ozone (O_3) from 0.075 parts per million (ppm) to 0.070 ppm (70 parts per billion [ppb]) (80 Fed. Reg. 65,452; codified at 40 C.F.R. Part 50.19).

Promulgation of a new NAAQS triggers a requirement under the Clean Air Act (CAA) for each state to submit to EPA area recommendations for attainment designations. Pursuant to CAA Section 107(d)(1)(A), on September 30, 2016, the Florida Department of Environmental Protection (Department) submitted a recommendation of attainment for the entire State of Florida. This recommendation was based on ambient monitoring data from Florida's network of 57 ozone monitors for the period of 2013 through 2015. EPA intends to finalize area designations for the 2015 ozone NAAQS by October 1, 2017, and these designations will be based on monitoring data for the period of 2014 through 2016.

2. Introduction

EPA has established criteria for the collection and verification of air quality data used to inform the Department's attainment recommendation. In October 2015, Appendix U to 40 C.F.R. Part 50 (Appendix U) was promulgated together with the revised ozone NAAQS. Section 4(b) of Appendix U sets forth monitoring data completeness requirements for ozone:

> A design value greater than the level of the NAAQS is always considered to be valid. A design value less than or equal to the level of the NAAQS must meet minimum data completeness requirements in order to be considered valid. These requirements are met for a 3-year period at a site if valid daily maximum 8-hour average O_3 concentrations are available for at least 90% of the days within the O_3 monitoring season, on average, for the 3-year period, with a minimum of at least 75% of the days within the O_3 monitoring season in any one year.

"Valid daily maximum 8-hour average O_3 concentration" is defined in Section 3(d) as follows:

> A daily maximum 8-hour average O_3 concentration shall be considered valid if valid 8-hour averages are available for at least 13 of the 17 consecutive 8-hour periods starting from 7:00 a.m. to 11:00 p.m. In addition, in the event that fewer than 13 valid 8-hour averages are available, a daily maximum 8-hour average O_3 concentration shall also be considered valid if it is greater than the level of the NAAQS.

All of Florida's 57 ozone monitors have design values below the level of the 2015 ozone NAAQS. The 90% completeness over three years and 75% annual completeness criteria apply, therefore, to all of Florida's ozone monitors. Four of Florida's 57 ozone monitors do not, however, meet the minimum data completeness requirements for the period of 2014 through 2016.

Of these four ozone monitors, the Department requests that the Regional Administrator for EPA Region 4 find that one monitor – the GT Bray Park monitor in Manatee County – does have a valid design value for the period of 2014 through 2016 using the procedure specified in Section 4(c) of Appendix U:

> When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the NAAQS. Missing days assumed less than the level of the NAAQS are counted for the purpose of meeting the minimum data completeness requirements, subject to the approval of the appropriate Regional Administrator.

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The Department's meteorological and ambient data analysis for the GT Bray Park ozone monitor demonstrates that meteorological conditions were "not conducive to concentrations above the level of the NAAQS" during many of the days with invalid or missing data. The Department is requesting EPA's approval to count those specified "missing days" towards the minimum data completeness requirements of Section 4(b) of Appendix U. If the Regional Administrator for EPA Region 4 were to agree with the Department's analysis, the Department would have sufficient data at that monitor to meet the minimum data completeness requirements and have a valid design value for area designations. [1]

3. Missing Days

The GT Bray Park ozone monitor is missing data for varying periods from 2014 through 2016. Most events affecting data completeness occurred in 2014 and 2016. A summary of data completeness percentages and the primary cause for the missing data is provided in **Table 1**.

Table 1: Missing ambient ozone monitoring data for monitor 081-4012 – 2014-2016.

Monitor Name	Monitor ID	County	Data Completeness		Data Loss Primary Cause
GT Bray Park	12-081-4012	Manatee	2014	86.1%	Instrument Failure
			2015	92.7%	
			2016	81.6%	Building/Shelter Repairs
			2014-2016	86.8%	

4. Monitored Trends

Ozone concentrations have been falling across the State for many years. No monitors have shown a violation of the NAAQS since 2009 (**Figure 1**). Outside of the Pensacola and Tampa metropolitan areas, all monitored design values are at least 10% below the 2015 ozone NAAQS (i.e., at or below 63 ppb). Monitoring data for 2014 through 2016 indicate a maximum statewide design value of 68 ppb, and only eight of the state's 57 monitors register design values above 63 ppb.

The State of Florida enjoys very good air quality, and the GT Bray Park monitor is in an area with exceptionally low ozone concentrations (**Figure 2**). None of the six monitors in the North Port-Bradenton-Sarasota MSA has had a design value above 70 ppb since 2013 or above 65 ppb since 2014. The highest 2014-2016 design value for any of those six monitors is 62 ppb.

Given these data and the fact that ozone is a regional pollutant that does not vary significantly in concentration across small distances, the informed observer would not expect that the GT Bray monitor would have recorded concentrations above the level of the NAAQS during the 2014-2016 period.

[1] Three of the four monitors with incomplete data for 2014-2016 are located in Duval County. Given the large amount of missing data at these monitors and lack of nearby monitors, an analysis could not be completed for that area. The Department has submitted to EPA Region 4 a separate report that includes an analysis of an additional four ozone monitors with incomplete data in the 2013-2015 period. If EPA approves the request to count certain days with missing data in 2013-2015 towards the minimum data completeness requirements for those four monitors, the 2014-2016 design values for those monitors will be valid as well and therefore do not require a separate analysis of that period.

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Figure 1: Florida monitored ozone design value trends 1997-2016.

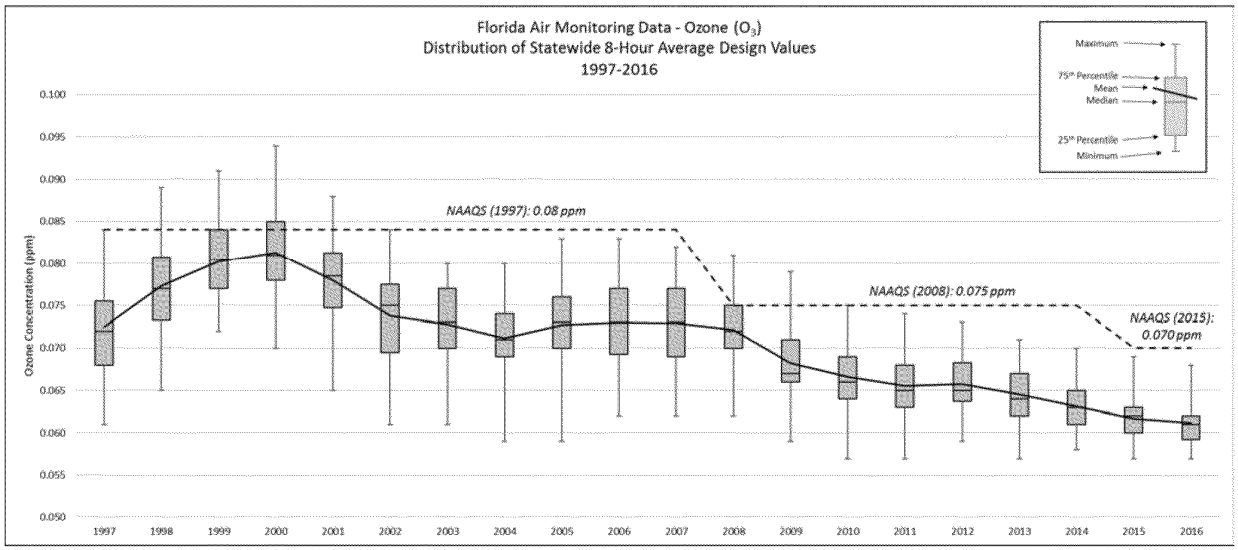
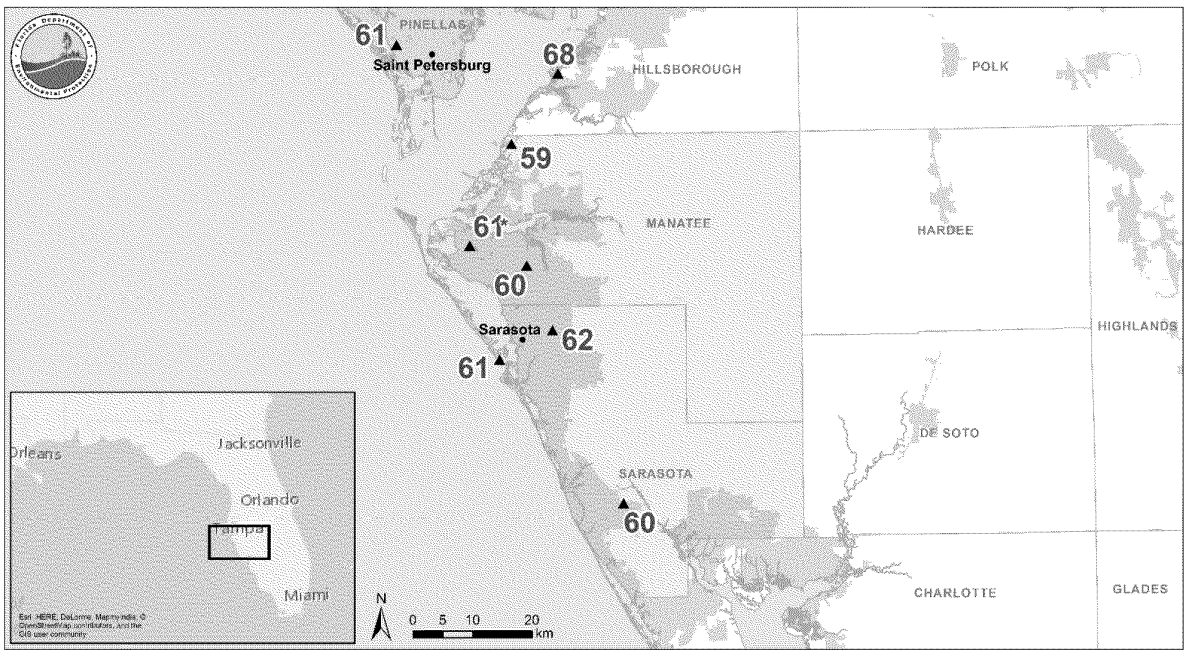


Figure 2: 2014-2016 ozone design values for monitors in the North Port-Bradenton-Sarasota MSA.



5. Meteorological Analysis

The formation of ground-level ozone is highly dependent on meteorological conditions. In particular, the formation of ozone at concentrations above the level of the NAAQS requires a warm, dry, stable air mass coincident with abundant sunshine. These conditions are generally not present in the marine air mass that dominates Florida for most of the ozone season (March-October). Mid-latitude cyclones bring in dry continental air masses from the north from about October to May. It is behind these frontal boundaries, during the months with sufficient solar insolation, that ozone concentrations tend to be at a maximum in the State resulting in a bi-modal distribution of ozone concentrations with the largest peak occurring in the spring (April-May) and a secondary peak in the fall (October-November).

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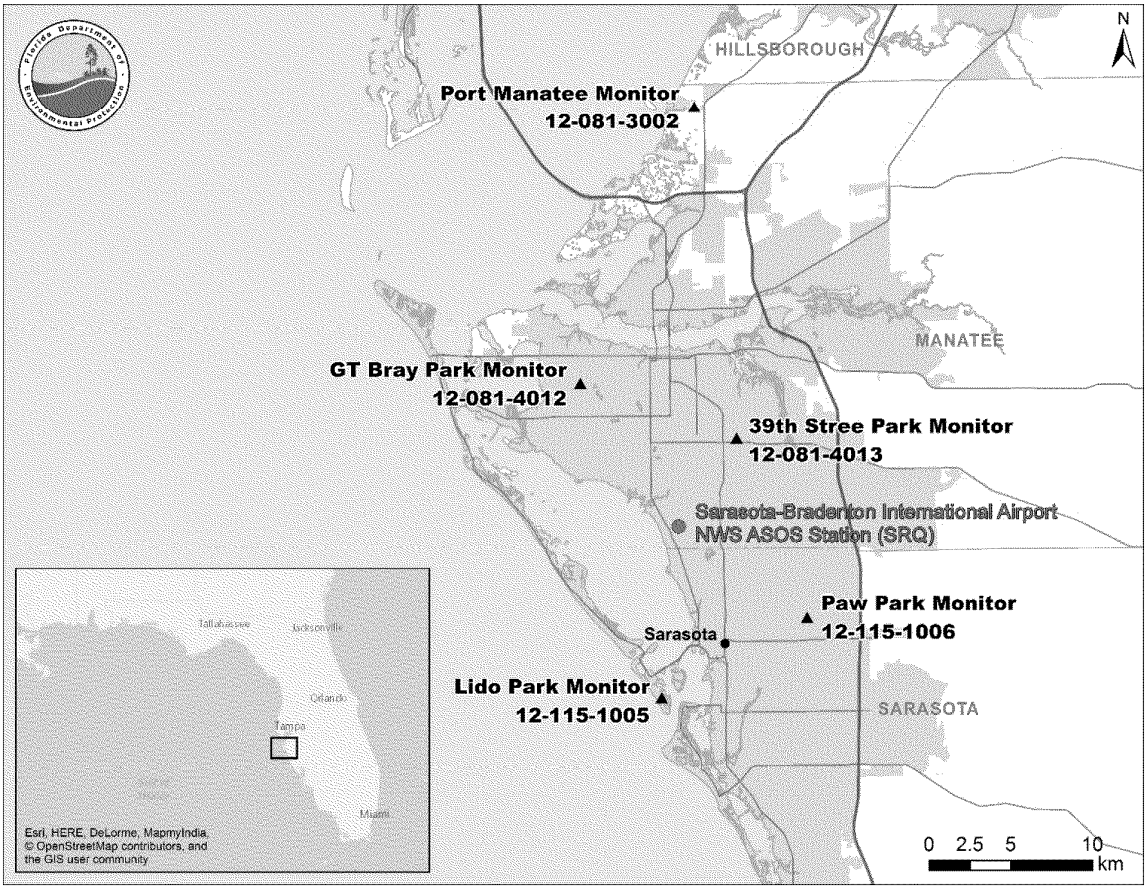
5.1. Determination of Critical Values for Meteorological Parameters

Ozone formation requires certain meteorological conditions. It follows that there are "critical values" for meteorological parameters that can serve as cutoff points for determining if conditions present on a day with missing data were conducive to high levels of ozone. The Department used ambient ozone data from proximate monitors with complete data and meteorological data from a nearby National Weather Service (NWS) automated surface observing system (ASOS) station to determine the critical values for the highest ozone concentrations for four meteorological parameters. The map in **Figure 3** identifies these monitors and the ASOS station used for this analysis.

Figure 3: Ambient ozone monitors and NWS ASOS station used in the missing data meteorological analysis.



The Department compared maximum daily 8-hour average (MDA8) ozone concentrations at five monitors in Sarasota and Manatee Counties (including the monitor with missing data) with daily meteorological parameters from the nearest ASOS station at the Sarasota-Bradenton International Airport for the period of 2012 through 2016 to determine the critical meteorological values for high ozone formation. The MDA8 data were extracted from the Florida Air Monitoring and Assessment System (FAMAS) and the meteorological data were downloaded on an hourly basis from the National Climatic Data Center (NCDC).

The Department examined MDA8 ozone concentration correlations for daily maximum temperature, daily minimum relative humidity, average afternoon wind speed (the average of the five observations from 12:00 pm EST to 4:00 pm EST), and average afternoon cloud cover. Average afternoon cloud

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cover was calculated by assigning a value of 10 to an ASOS code of *OVC*, 5 to *BKN*, 3 to *SCT*, and 1 to *FEW*, then summing for the observation and averaging over the five hourly observations from 12:00 pm EST to 4:00 pm EST. As shown in **Figure 4**, the analysis indicated correlations with all parameters, but by far the strongest was found with the daily minimum humidity.

The five monitors included in this analysis recorded just 9 days with concentrations above the 2015 ozone NAAQS since 2012. In light of this, and in an effort to increase the confidence and conservatism of the analysis, the critical values were determined for ozone concentrations above 65 ppb instead of the 70 ppb NAAQS. The critical values and correlation coefficients for each distribution are summarized in **Table 2**. The Microsoft Excel spreadsheet used to perform the analysis is provided as **Appendix A** to this document.

Figure 4: Maximum MDA8 ozone concentrations from the five ozone monitors plotted against four meteorological parameters. The critical values are marked by vertical lines.

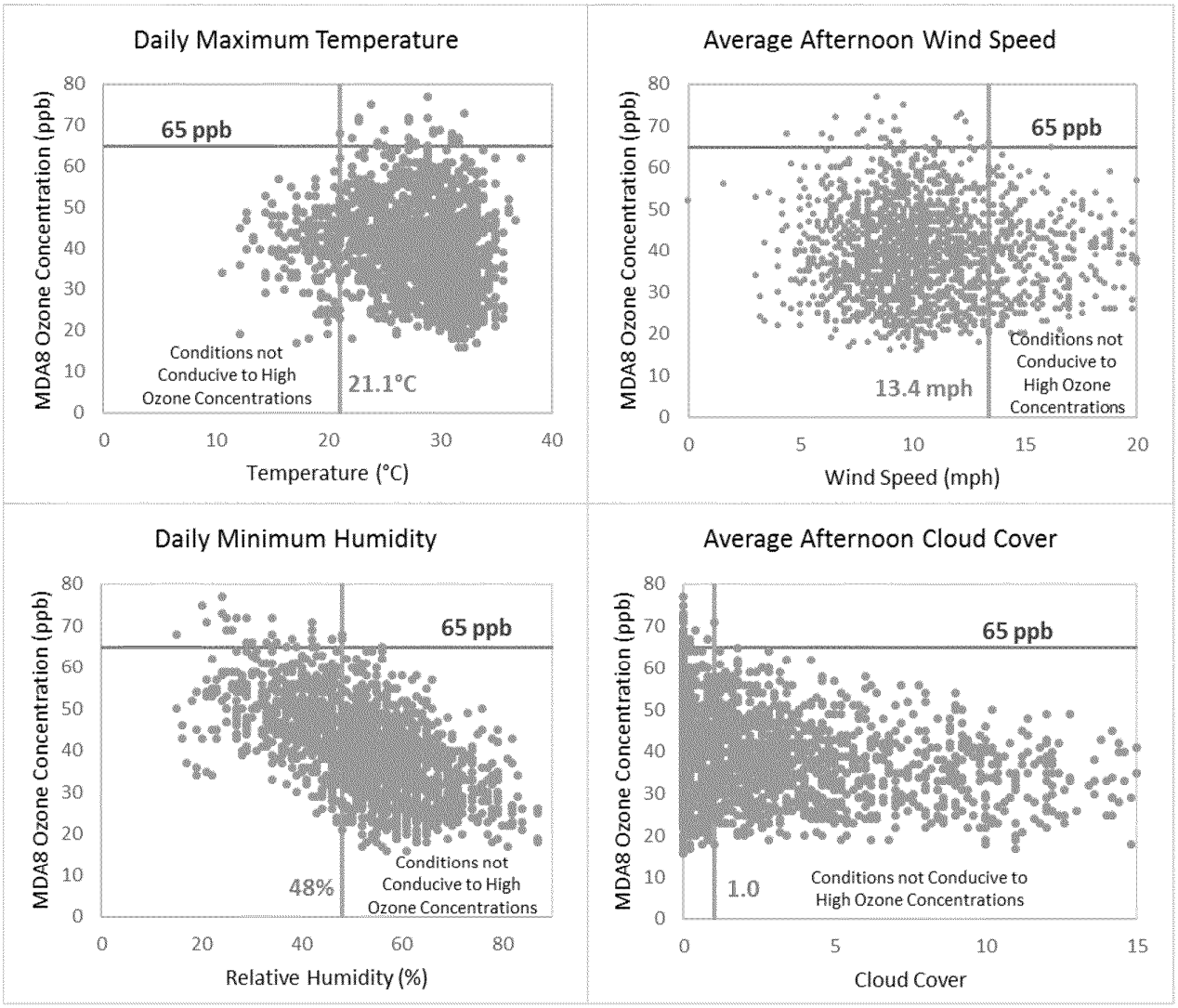

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Table 2: Critical meteorological values for ozone concentrations above 65 ppb for the meteorological analysis of days with missing ozone data and correlation coefficients for the associated distributions.

North-Port-Bradenton-Sarasota MSA		
Meteorological Parameter	**Critical Value**	**Distribution Correlation Coefficient**
Maximum Daily Temperature	21.1°C	-0.19
Average Afternoon Wind Speed	13.4 mph	-0.03
Minimum Daily Humidity	48%	**-0.60**
Average Afternoon Cloud Cover	1.0	-0.28

5.2. Determination of Days to Count Towards Minimum Data Completeness

The analysis of the meteorological data provided a set of critical values for four meteorological parameters that can be used to determine if the conditions on a day with missing monitoring data were conducive to ozone concentrations above the NAAQS. As previously discussed, the formation of high concentrations of ozone generally requires that multiple meteorological parameters fall within a certain range. Therefore, if any one of the four critical values are not met, the meteorological conditions on that day were not conducive to ozone concentrations above the NAAQS. The Department chose to use the daily minimum humidity as the determining factor because it is clear from the graphs provided in **Figure 4** that it is the parameter that is by far the most correlated with MDA8 ozone concentrations.

The Department is requesting concurrence that any day with missing ozone monitoring data at the GT Bray Park monitor can be counted towards the minimum data completeness requirements of Appendix U if the daily minimum relative humidity did not fall below 48% based on meteorological observations from the Sarasota-Bradenton International Airport NWS ASOS station.

A summary of the number of missing days and the days that meet the humidity critical value is provided in **Table 3**, and the specific days requested to be counted towards the minimum data completeness requirements based on this analysis are provided in **Table 4**. This list includes significantly more days than are needed to meet the completeness requirements.

Table 3: Summary of the number of missing days and days that met the relative humidity threshold for a determination of "not conducive to concentrations above the level of the NAAQS" along with the new data completeness percentage.

Monitor	Period	Total Missing Days	Days with Conditions Not Conducive to Ozone Concentrations over 65 ppb	New Data Completeness
GT Bray Park 12-081-4012	2014	34	21	94.7%
	2015	18	14	98.4%
	2016	45	16	88.2%
	2014-2016	97	51	93.1%

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Table 4: List of the days requested to be counted towards the minimum data completeness requirements for the GT Bray Park ozone monitor based on an analysis of the meteorological conditions on each day.

2014		2015		2016	
April 16	August 16	March 19	March 27	April 12	May 3
April 30	August 17	March 20	March 31	April 13	May 4
May 14	August 18	March 21	April 1	April 14	June 8
May 28	August 19	March 22	April 20	April 15	June 25
June 11	August 20	March 23	June 12	April 27	June 26
June 23	August 22	March 24	August 3	April 28	June 27
July 1	August 29	March 26	September 28	May 1	June 28
July 2	September 2			May 2	September 13
August 13	September 4				
August 14	October 2				
August 15					

6. Ambient Monitoring Data Analysis

The meteorological analysis was sufficient to select enough days for the GT Bray Park monitor to meet data completeness requirements. The Department is, however, providing additional evidence supporting this request in the form of a statistical analysis to determine the probability that any given day with missing data could have exceeded the NAAQS based on nearby ambient monitoring data. Florida has a dense ozone monitoring network with approximately 50% more monitors than required by federal law. The four ozone monitors with valid design values included in the meteorological analysis are all within 20 km of the GT Bray Park monitor. This high density of strongly correlated monitors lends itself to a robust analysis of the ambient conditions present on the days with missing data.

The probability analysis was performed by using the distribution of differences between the MDA8 data from the GT Bray Park monitor and the most correlated nearby monitor to determine the probability, based on historic performance, that the GT Bray Park monitor could have recorded a concentration above the level of the NAAQS on a day with missing data. The following steps describe this process:

1. Find the most correlated nearby monitor.
   a. All four monitors within 20 km had a correlation coefficient exceeding 0.92 based on valid monitoring data from 2012-2016, indicating a very strong correlation. The most correlated monitor was the Lido Park monitor in Sarasota County with a correlation coefficient of 0.955 (**Figure 5**).
2. Develop the distribution of differences in MDA8 ozone concentrations for the GT Bray Park and Lido Park monitors.
   a. Data points were calculated by taking the difference between the MDA8 recorded at the GT Bray Park monitor and the MDA8 recorded at the Lido Park monitor over the 2011-2015 period.
   b. The distribution had over 1600 data points providing for a very robust probability calculation.
3. Calculate the empirical approximation of the probability of the GT Bray Park monitor recording a concentration exceeding 70 ppb on a given day with missing data based on the recorded, valid MDA8 concentration at the Lido Park monitor using the following approach:
   a. Find the difference between the monitored value at the Lido Park monitor and the NAAQS,
   b. Count the number of days in the distribution where the difference between the two monitors was equal to or greater than the value calculated in 3(a),
   c. Divide the number calculated in 3(b) by the total number of data points in the distribution.

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Just one day with missing data for the entire three-year period was found to have more than a 1% probability of exceeding the NAAQS. The probability analysis is summarized in **Table 5** below and is provided as a Microsoft Excel spreadsheet in **Appendix B** to this document.

Figure 5: Daily paired MDA8 ozone concentrations for the incomplete GT Bray Park monitor and the nearest, most correlated monitor the Lido Park monitor.

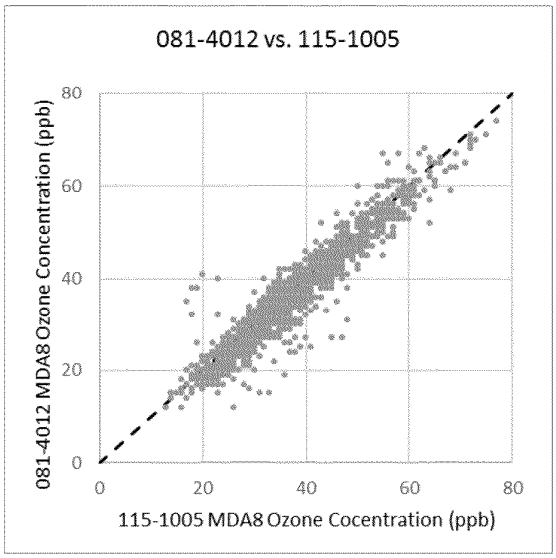

Table 5: Summary of the probability analysis of days with missing ozone data.

Incomplete Monitor	Most Correlated Monitor	Correlation Coefficient	Distance Apart	Data Points in Distribution	Days with Missing Data with More than a 1% Probability of Exceeding the NAAQS
12-081-4012	12-115-1005	0.955	19.8 km	1618	1

7. Summary

All monitors in the State of Florida's ozone monitoring network recorded design values below the level of the 2015 revised ozone NAAQS. The GT Bray Park monitor did not have sufficient data to produce a valid design value for the period of 2014 through 2016. Given the long-term trends in ozone concentrations across Florida, the exceptionally low concentrations found in the area around the monitor, and the historic concentrations recorded at the monitor, an informed observer would not expect that the GT Bray Park monitor would have recorded concentrations above the level of the NAAQS on any day with missing data. The highly conservative meteorological analysis provided above has shown that the conditions on the majority of the days with missing data were not conducive to ozone concentrations above the level of the NAAQS, or even above 65 ppb. This analysis is further supported by the probability analysis indicating that there was just one day across the three-year period that had more than a 1% chance of exceeding the NAAQS.

Based on this evidence, the Department respectfully requests that EPA approve this analysis and determine that the conditions on the dates listed in **Table 4** were not conducive to concentrations of ozone above the level of the NAAQS. This will allow those specific dates to be counted toward the minimum data completeness requirements of Appendix U. As a result of this demonstration, the GT Bray Park ozone monitor will meet the minimum data completeness requirements of Section 4(b) of Appendix U for the period of 2014 through 2016 and have a valid design value for area designation purposes.

To: Brown, Ryan[Brown.Ryan@epa.gov]
Cc: Garver, Daniel[Garver.Daniel@epa.gov]
From: Flynn, Thomas
Sent: Wed 5/17/2017 4:36:48 PM
Subject: Appendix U demonstration for South Carolina
appendix u cover letter 20170517.pdf
Appendix U Demonstration 20170517.pdf

Hi Ryan,

Please see the attached demonstration for handling missing data at various South Carolina ozone monitoring sites in accordance with Appendix U to 40 CFR Part 50. This letter is also being sent to the Acting Regional Administrator by post. Please feel free to share with anyone who needs to see this. I'm sending the cover letter only to Todd and Lynorae, but I'm sure that I may be missing some people. Please let me or Ragan know if you need to discuss the analysis. We'll send you the R code we used in a separate email.

Thanks,

Tommy

Thomas J. Flynn, III
Program Manager
Bureau of Air Quality
S.C. Dept. of Health & Environmental Control
Office: (803) 898-3251
Connect: www.scdhec.gov Facebook Twitter

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May 17, 2017

V. Anne Heard
Acting Regional Administrator
US EPA Region 4
Atlanta Federal Center
61 Forsyth Street, S.W.
Atlanta, GA 30303-8909

Re: Demonstration of Incomplete Ozone Data Not Occurring on Days Conducive to Ozone Formation

Dear Ms. Heard:

On September 30, 2016 the South Carolina Department of Health and Environmental Control (the Department) submitted recommendations of the 2015 Ozone NAAQS Area Designation. As part of that submission an additional analysis was conducted to address incomplete data at two monitoring stations which attained the Ozone National Ambient Air Quality Standards (NAAQS), but did not meet minimum data completeness requirements as outlined in Title 40, Code of Federal Regulations (CFR), Part 50, Appendix U (Appendix U).

On January 25, 2017, US Environmental Protection Agency (EPA) Region 4 informed the Department that additional ozone monitoring data covering the years 2012 – 2016 was required to be revalidated to be consistent with EPA established guidance. As a result of this revalidation twelve ozone monitoring sites had less than complete data.

In accordance with section 4(c) of Appendix U, the Department respectfully submits the attached analysis to provide evidence that the missing data occurred on days that were not conducive to ozone concentrations above the level of the NAAQS. We ask that the EPA approve the attached analysis and waive monitoring for the days indicated.

S.C. Department of Health and Environmental Control
2600 Bull Street, Columbia, SC 29201 (803) 898-3432 www.scdhec.gov

Should you have any questions regarding our analysis, please contact Robert J. Brown, Jr. at (803) 898-4105 or by email at brownrj@dhec.sc.gov.

Sincerely,

Rhonda B. Thompson, PE, Chief
Bureau of Air Quality
SC DHEC

ec: (w/attachment)
Ryan Brown, US EPA Region 4
ec: (w/o attachment)
Todd Rinck, US EPA Region 4
Lynorae Benjamin, US EPA Region 4
Micheal Mattocks, SCDHEC
Robert J. Brown, Jr. SCDHEC

Incomplete Ozone Data Handling for VariousSouth CarolinaAmbient Air Monitoring Sites

May 17, 2017

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Introduction

On October 1, 2015, the Administrator of the Environmental Protection Agency (EPA) signed a Final Rule setting the new primary and secondary ozone National Ambient Air Quality Standard (NAAQS) to 0.070 ppm, later published in 80 FR 65292. The previous ozone standard was 0.075 ppm. No changes to the form of the metric were promulgated, and it remains based on the maximum daily 8-hour average (MDA8). Promulgation of the NAAQS triggers Clean Air Act (CAA) Section 107(d)(1), requiring the Governor of each state (or his/her designee) to submit recommendations for the classification of each area within that state not later than one year after promulgation. If the EPA disagrees with the State's recommendations, a notification letter is sent detailing the proposed changes and inviting the State to submit further data and explanations in support of the original recommendations. This notification letter must be given no later than 120 days prior to the promulgation of the designation, and it is commonly referred to as the "120-day letter." The CAA requires area designation to be finalized by October 1, 2017, for the new NAAQS, except in a case in which there is insufficient information to make a designation, this deadline may be extended by one year at the Administrator's discretion (CAA 107(d)(1)(B)(i)).

The EPA has established criteria for air quality data collection, verification and evaluation. 40 CFR Appendix U to Part 50 was promulgated through publication on October 26, 2015 (80 FR 65458). This regulation sets forth requirements for ozone data selection, reporting, handling and comparisons to the new ozone NAAQS. Among these are requirements in Section 4(b) for data completeness for the purpose of calculating a valid three year ozone design value (see text of the section on page 3). Each annual 4th highest MDA8 must be based on valid data from at least 75% of the days during the ozone monitoring season, and the three year design value must be based on valid data from at least 90% of the days during the previous three ozone monitoring seasons. If either of these criteria is not met, there are two alternatives: 1) the Administrator may defer area designation for an additional year in order to meet the criterion, or 2) the state may demonstrate, in accordance with Section 4(c) and subject to EPA approval, that "meteorological conditions on missing days were not conducive to concentrations above the NAAQS." (See text of this section on page 3).

Table 1 presents the annual, and three-year data completion percentages for all monitoring which do not meet the minimum data completeness requirements found in 40 CFR Appendix U to Part 50. This analysis will not include the Coastal Carolina (450510008) site because it has only operated for a portion of one ozone monitoring season.

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Table 1: Annual and three year data completeness for sites with incomplete data

Site ID	Site Name	2014 Complete Days (% Complete)	2015 Complete Days (% Complete)	2016 Complete Days (% Complete)	Three year data completeness
450010001	Due West	136 (64%)	123 (57%)	163 (76%)	66%
450150002	Bushy Park	194 (91%)	186 (87%)	181 (85%)	87%
450190046	Cape Romain	175 (82%)	179 (84%)	143 (67%)	77%
450290002	Ashton	193 (90%)	147 (69%)	184 (86%)	82%
450370001	Trenton	136 (64%)	123 (57%)	205 (96%)	72%
450450016	Hillcrest	152 (71%)	193 (90%)	203 (95%)	85%
450510008	Coastal Carolina	NA	NA	75 (35%)	NA
450770002	Clemson CMS	210 (98%)	154 (72%)	206 (96%)	89%
450770003	Wolf Creek	205 (96%)	138 (64%)	208 (97%)	86%
450790007	Parklane	152 (71%)	182 (85%)	161 (75%)	77%
450790021	Congaree Bluff	181 (85%)	148 (69%)	196 (92%)	82%
450791001	Sandhill	180 (84%)	178 (83%)	211 (99%)	89%
450830009	North Spartanburg	200 (93%)	168 (79%)	168 (79%)	83%

Methodology

In accordance with 40 CFR Appendix U to Part 50, Section 4(c), the following analysis is intended to demonstrate to the EPA that the missing 2014 - 2016 MDA8 data were from days when meteorological data would convince an informed observer that the 2016 ozone NAAQS would not have been exceeded at the given site.

First, this analysis identifies the frequency of missing days by month along with determining the number of exceedances at all monitoring stations with less than complete data. Next, meteorological conditions conducive to ozone exceedances are analyzed. After this step, a prediction of the incomplete design values is conducted to demonstrate that monitors would continue to meet the ozone NAAQS. A "brute-force" technique is used by substituting 100 percent of the missing days with the highest monthly MDA8 over the last five years and recalculating the design value. This "brute-force" technique is being used as a screening technique for the likelihood that a monitoring site would have exceeded the ozone NAAQS if it had collected complete data. If the test design value from this technique is less than or equal to the level of the ozone NAAQS, the Department is confident that

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there is almost no chance that the monitor would have exceeded the standard and further analysis of the missing days will stop for those monitors. If a monitoring site shows a test design value greater than the level of the ozone NAAQS, then an additional statistical analysis is conducted to predict the design value through a formal non-parametric linear regression (Theil-Sen) process along with characterization of the uncertainty of that prediction through bootstrapping.

The selection of days to request for waiver will be based on a multi-step process. If a monitoring site passes the "brute-force" screening, the Department will request a waiver for all missing days at that site. After conducting the Theil-Sen linear regression for sites that did not screen out with the "brute-force" technique, the Department will request a waiver based on two criteria.

First, for those monitoring sites which have had exceedances in the last five years, the Department will seek a waiver for missing days which meet all four of the meteorological criteria for not being conducive for ozone formation. Secondly, for the remaining missing days, the Department will select those days which had a modeled daily maximum concentration of 56 ppb or lower through the Theil-Sen regression process. This threshold is approximately 80% of the level of the Ozone NAAQS. The Department believes that this threshold presents a number sufficiently low enough to ensure that there will be little chance of an exceedance being measured on that day.

The Department is requesting concurrence from the EPA to count some of the missing days toward the minimum data completeness requirement in section 4(b). All computer programming code used to generate the analysis will be provided to the EPA Region 4 office to assist with their decision making.

Regulatory requirements for the treatment of data

The regulations in 40 CFR Appendix U to Part 50, Section 4(b) and (c) address missing data. It specifies:

> *(b) A design value greater than the level of the NAAQS is always considered to be valid. A design value less than or equal to the level of the NAAQS must meet minimum data completeness requirements in order to be considered valid. These requirements are met for a 3-year period at a site if valid daily maximum 8-hour average O_3 concentrations are available for at least 90% of the days within the O_3 monitoring season, on average, for the 3-year period, with a minimum of at least 75% of the days within the O_3 monitoring season in any one year.*
>
> *(c) When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to*

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demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the NAAQS. Missing days assumed less than the level of the NAAQS are counted for the purpose of meeting the minimum data completeness requirements, subject to the approval of the appropriate Regional Administrator.

Identification of missing days

This section will characterize the frequency of missing days by month and the number of exceedances for the years 2014 – 2016 (which coincided with the most recent design value) for all monitoring sites which did not meet the data completeness requirements found in 40 CFR Appendix U to Part 50.

Augusta-Richmond County, GA-SC MSA

Missing days for the Trenton ozone monitoring station

The Trenton ozone monitor had 78, 91, and 9 incomplete days for 2014, 2015, and 2016, respectively (Figure 1). The MDA8 (

Figure 2) for each year comprising the design value shows that there were only two exceedances of 70 ppb.

Figure 1: Trenton missing data by year and month

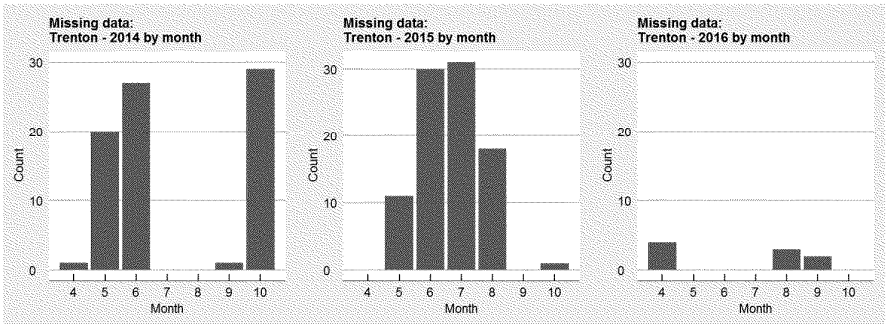

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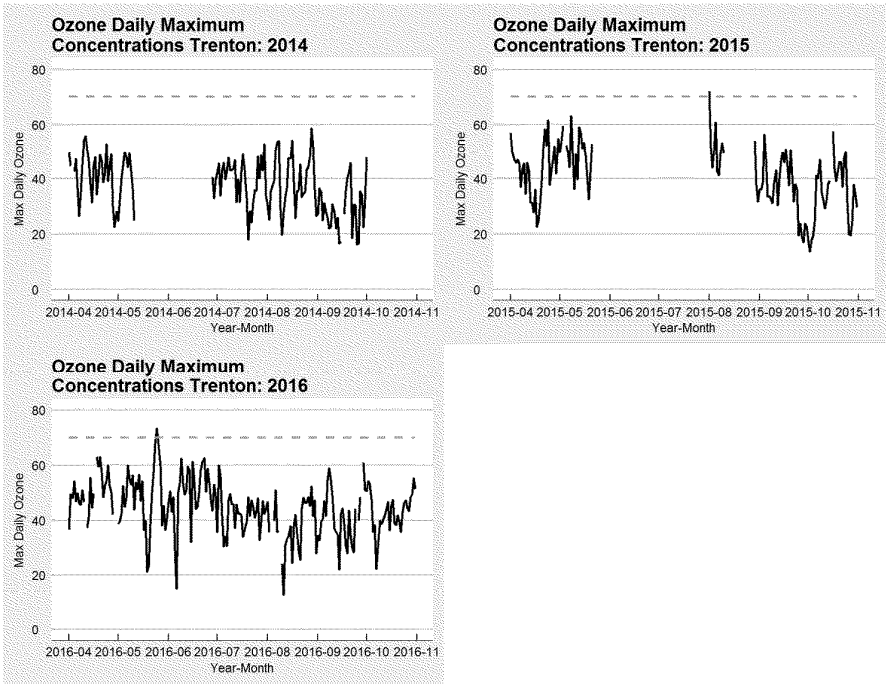
Figure 2: Trenton MDA8 by year



Charleston-North Charleston MSA

Missing days for the Bushy Park ozone monitoring station

The Bushy Park ozone monitor had 20, 28, and 33 incomplete days for 2014, 2015, and 2016, respectively (Figure 3). The MDA8 (Figure 4) for each year comprising the design value show that there no exceedances of 70 ppb.

Figure 3: Bushy Park missing data by year and month

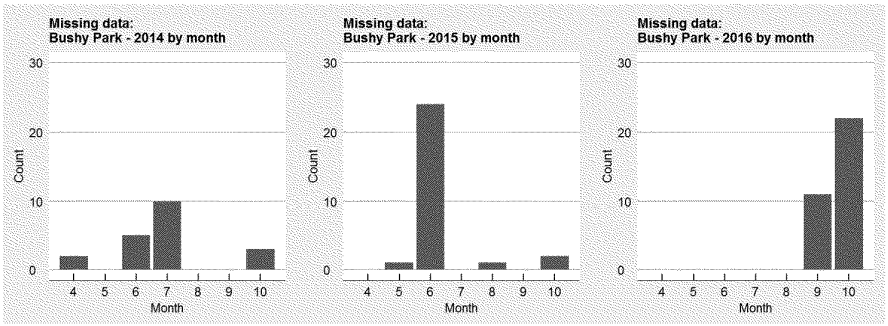
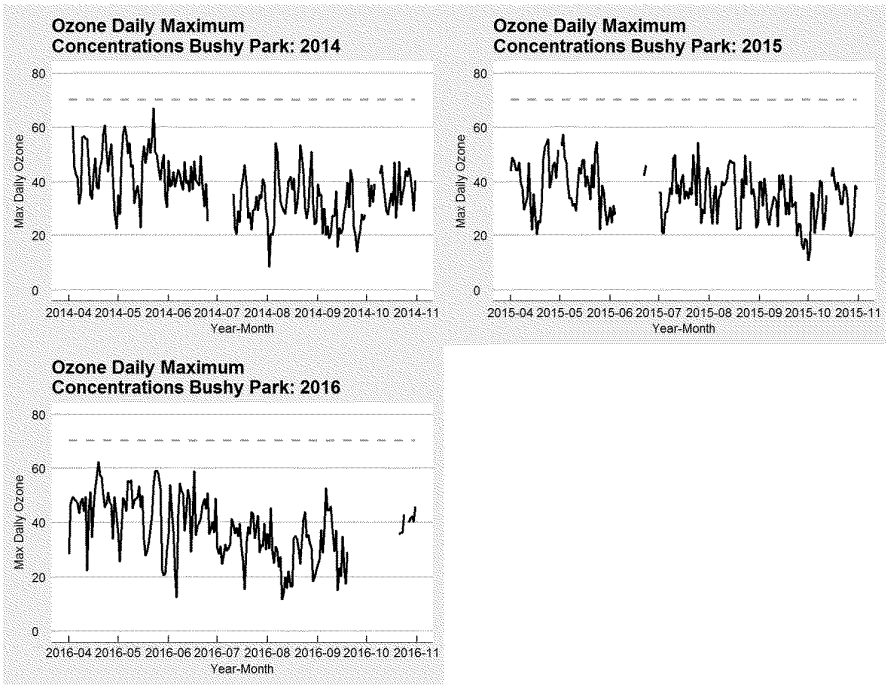


Figure 4: Bushy Park MDA8 by year



Missing days for the Cape Romain ozone monitoring station

The Cape Romain ozone monitor had 39, 35, and 71 incomplete days for 2014, 2015, and 2016, respectively (Figure 5). The MDA8 (Figure 6) for each year comprising the design value show that there were no exceedances of 70 ppb.

Figure 5: Cape Romain missing data by year and month

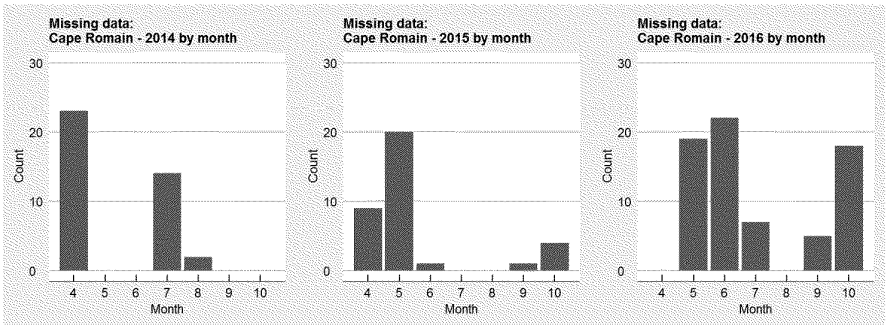
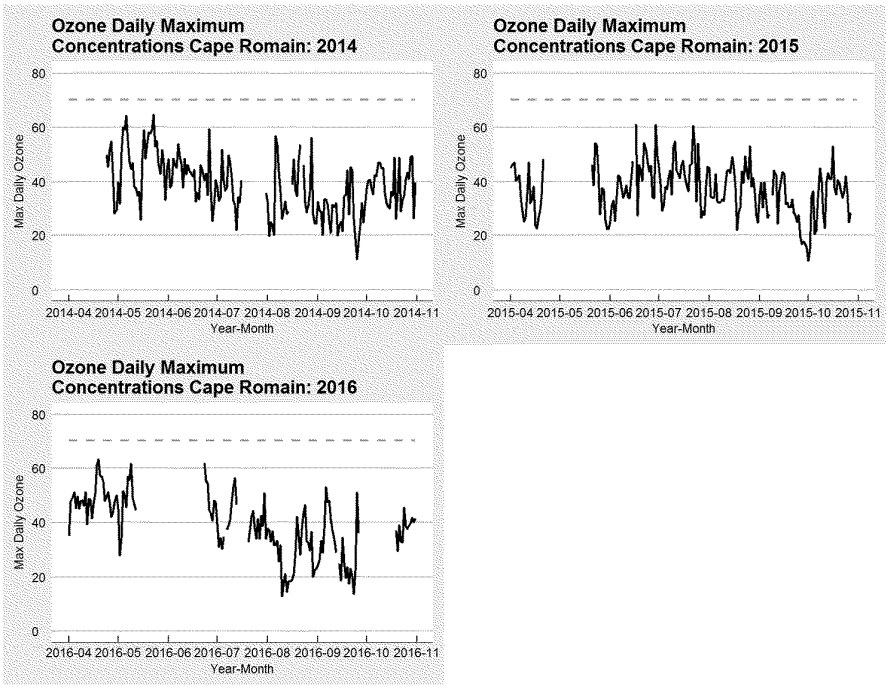


Figure 6: Cape Romain MDA8 by year



Columbia MSA

Missing days for the Parklane ozone monitoring station

The Parklane ozone monitor had 62, 32, and 53 incomplete days for 2014, 2015, and 2016, respectively (Figure 7). The MDA8 (Figure 8) for each year comprising the design value show that there were two exceedances of 70 ppb.

Figure 7: Parklane missing data by year and month

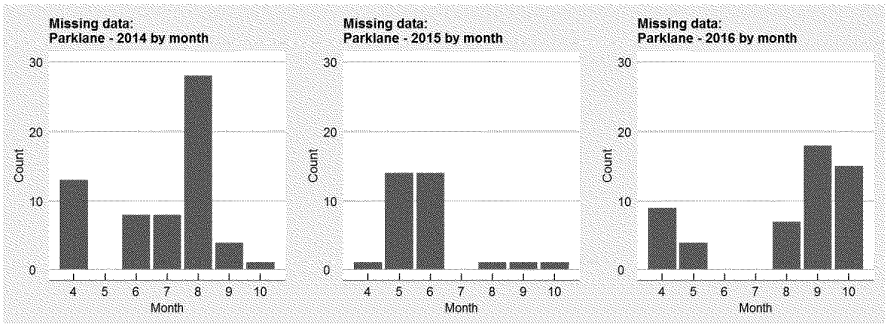
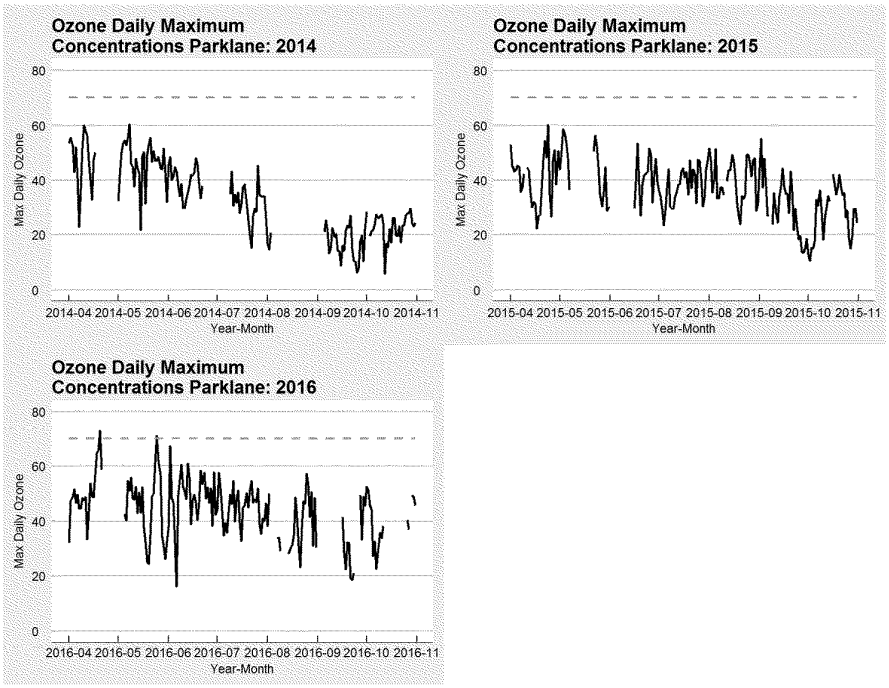


Figure 8: Parklane MDA8 by year



Missing days for the Congaree Bluff ozone monitoring station

The Congaree Bluff ozone monitor had 33, 66, and 18 incomplete days for 2014, 2015, and 2016, respectively (Figure 9). The MDA8 (Figure 10) for each year comprising the design value show that there were no exceedances of 70 ppb.

Figure 9: Congaree Bluff missing data by year and month

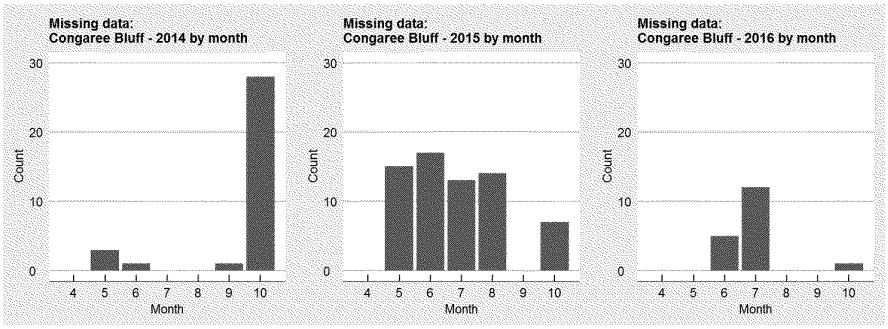
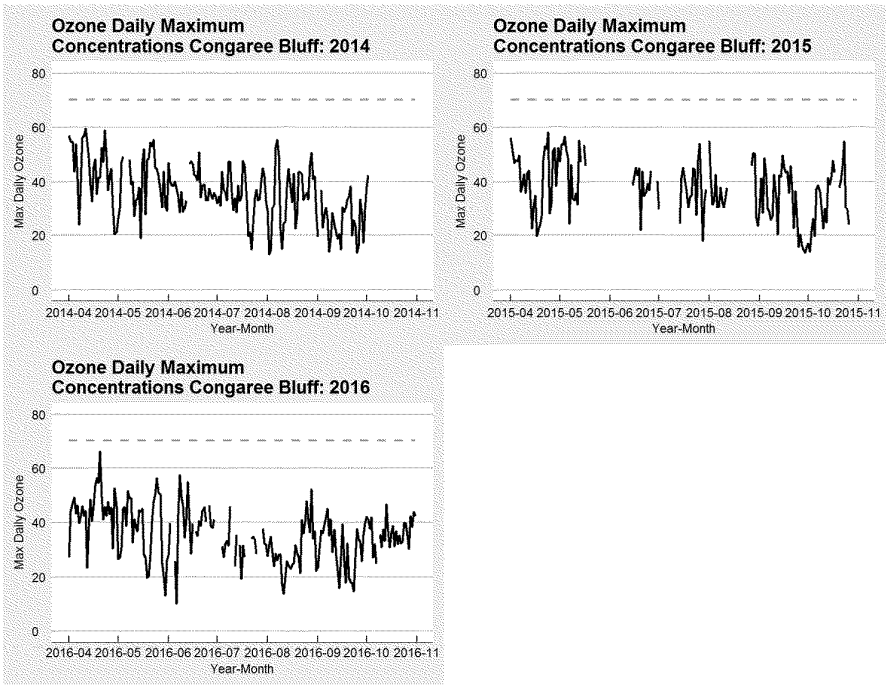


Figure 10: Congaree Bluff MDA8 by year



Missing days for the Sandhill ozone monitoring station

The Sandhill ozone monitor had 34, 36, and 3 incomplete days for 2014, 2015, and 2016, respectively (Figure 11). The MDA8 (Figure 12) for each year comprising the design value show that there were three exceedances of 70 ppb.

Figure 11: Sandhill missing data by year and month

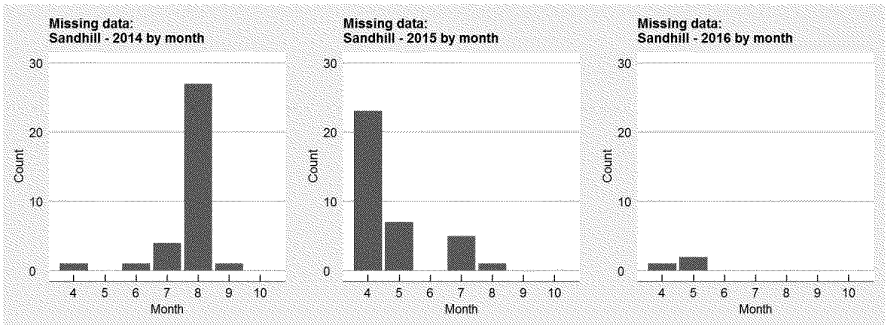
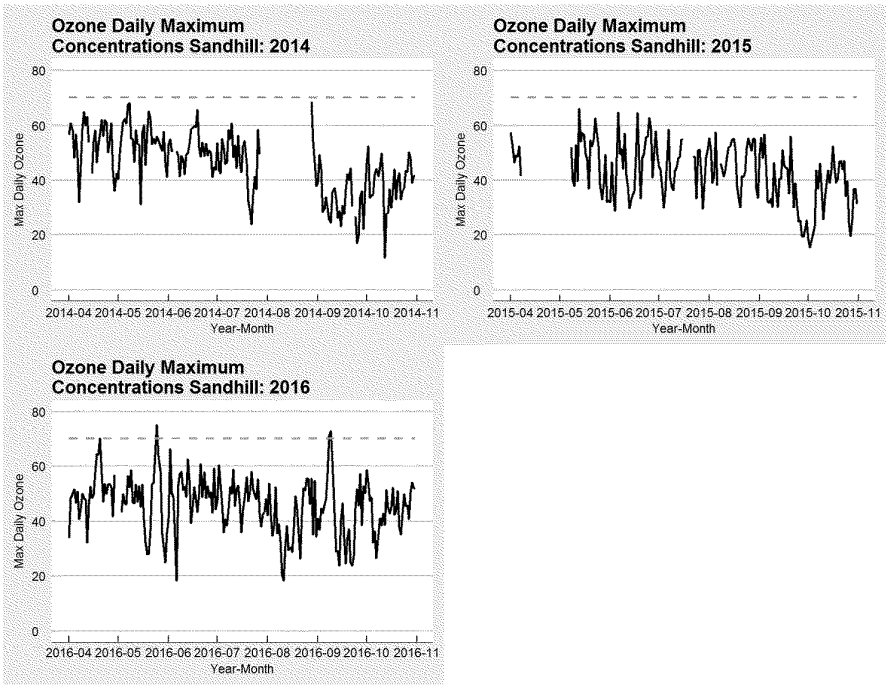


Figure 12: Sandhill MDA8 by year



Greenville-Anderson-Mauldin MSA

Missing days for the Hillcrest ozone monitoring station

The Hillcrest ozone monitor had 62, 21, and 11 incomplete days for 2014, 2015, and 2016, respectively (Figure 13). The MDA8 (Figure 14) for each year comprising the design value show that there were three exceedances of 70 ppb.

Figure 13: Hillcrest missing data by year and month

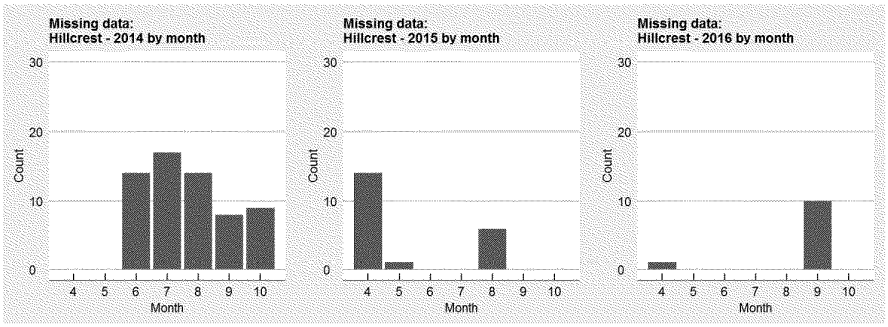
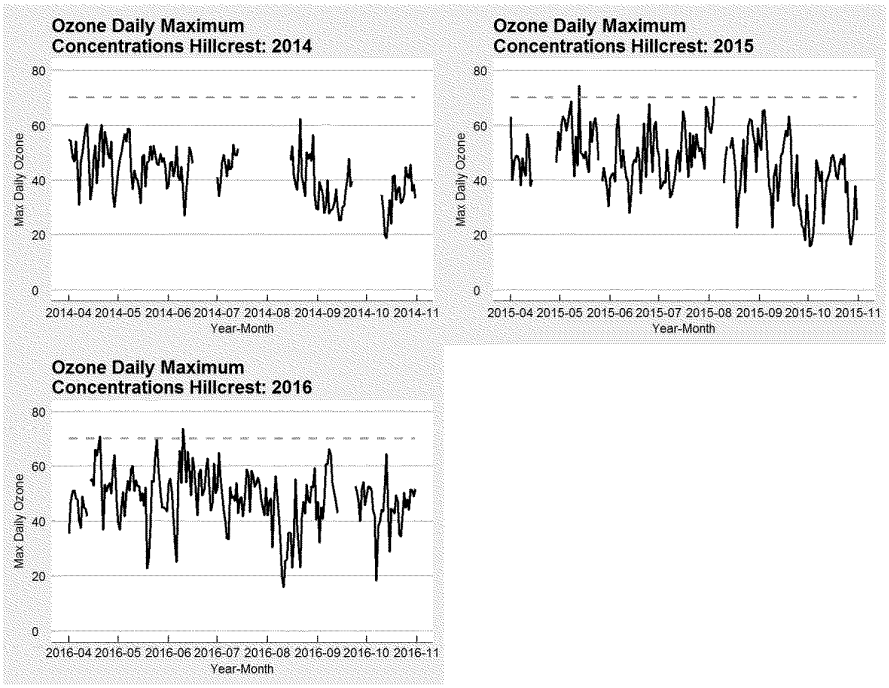


Figure 14: Hillcrest MDA8 by year



Missing days for the Clemson CMS ozone monitoring station

The Clemson CMS ozone monitor had 4, 60, and 8 incomplete days for 2014, 2015, and 2016, respectively (Figure 15). The MDA8 (Figure 16) for each year comprising the design value show that there was one exceedance of 70 ppb.

Figure 15: Clemson CMS missing data by year and month

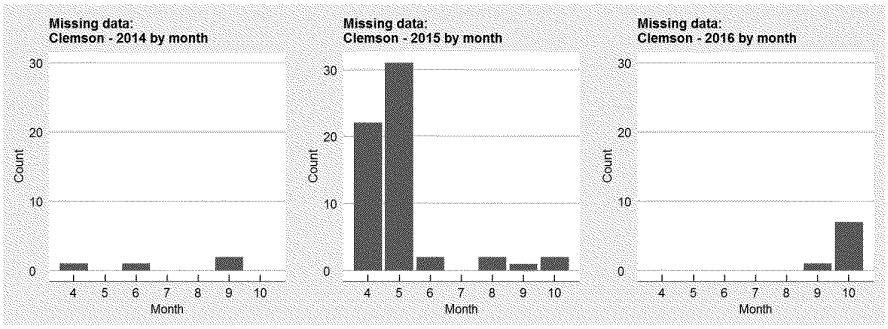
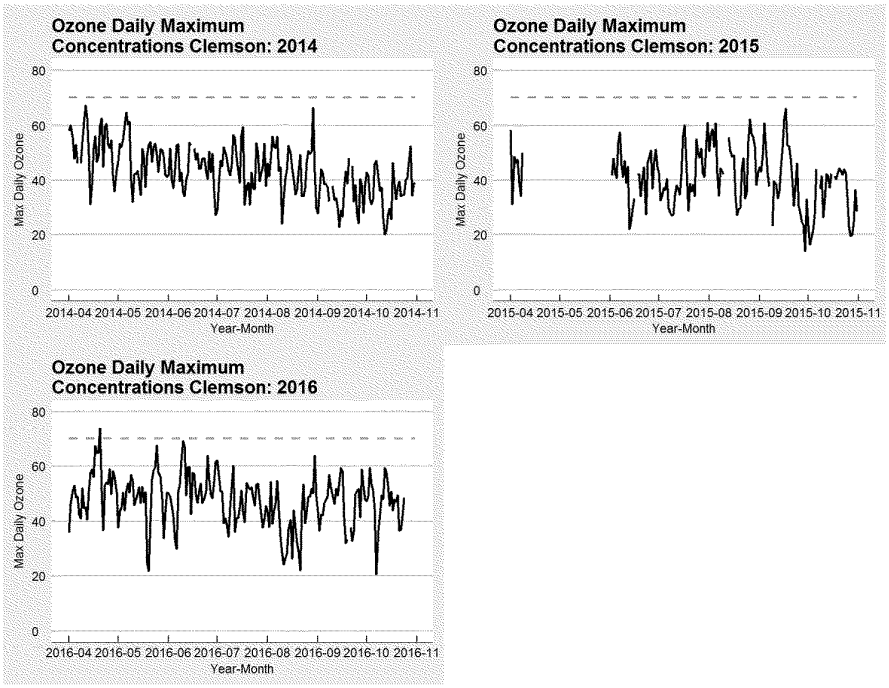


Figure 16: Clemson CMS MDA8 by year



Missing days for the Wolf Creek ozone monitoring station

The Wolf Creek ozone monitor had 9, 76, and 6 incomplete days for 2014, 2015, and 2016, respectively (Figure 17). The MDA8 (Figure 18) for each year comprising the design value show that there was one exceedance of 70 ppb.

Figure 17: Wolf Creek missing data by year and month

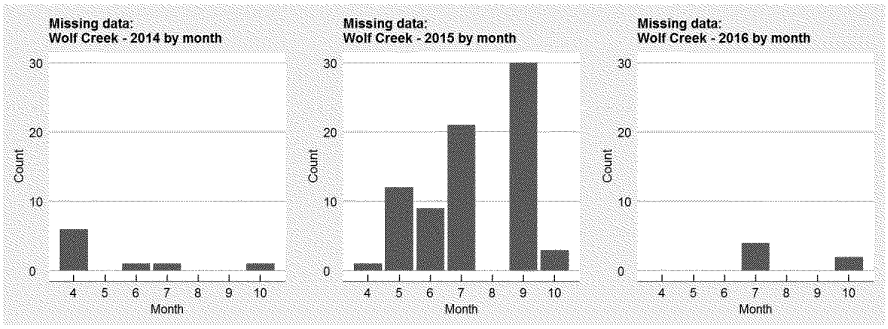
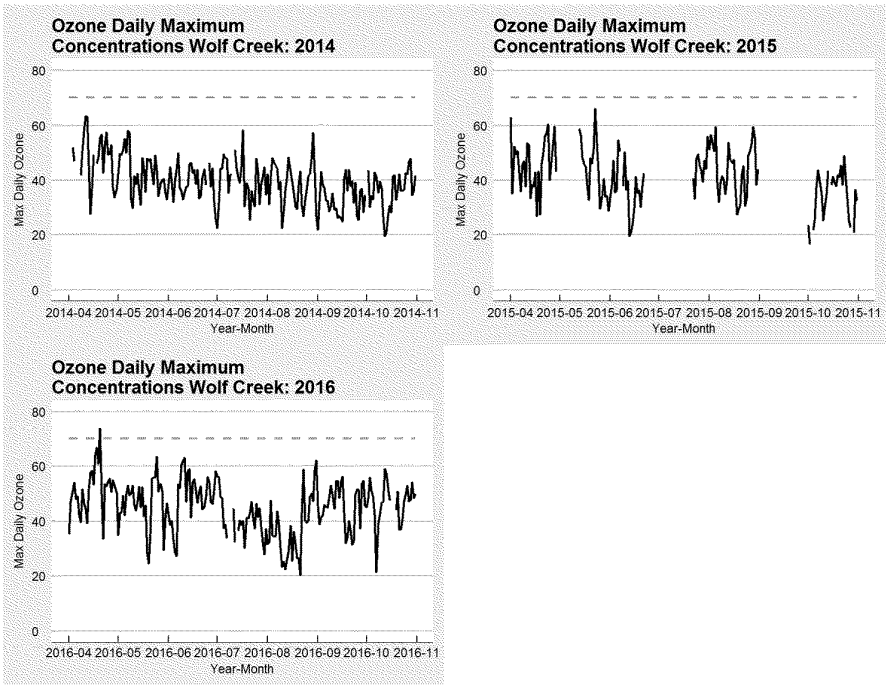


Figure 18: Wolf Creek MDA8 by year



Spartanburg MSA

Missing days for the NSFS ozone monitoring station

The North Spartanburg ozone monitor had 14, 46, and 46 incomplete days for 2014, 2015, and 2016, respectively (Figure 19). The MDA8 (Figure 20) for each year comprising the design value show that there were three exceedances of 70 ppb.

Figure 19: NSFS missing data by year and month

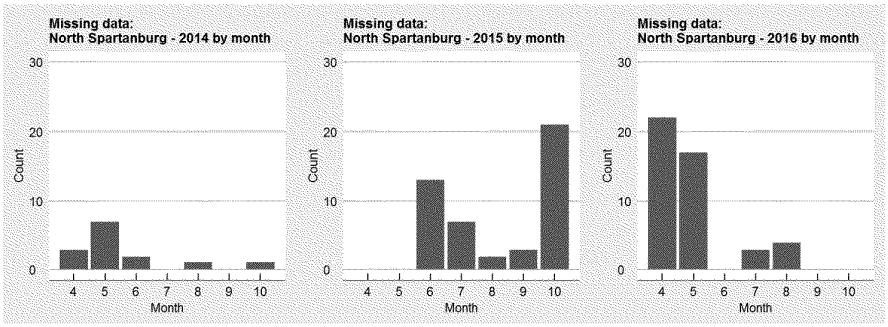
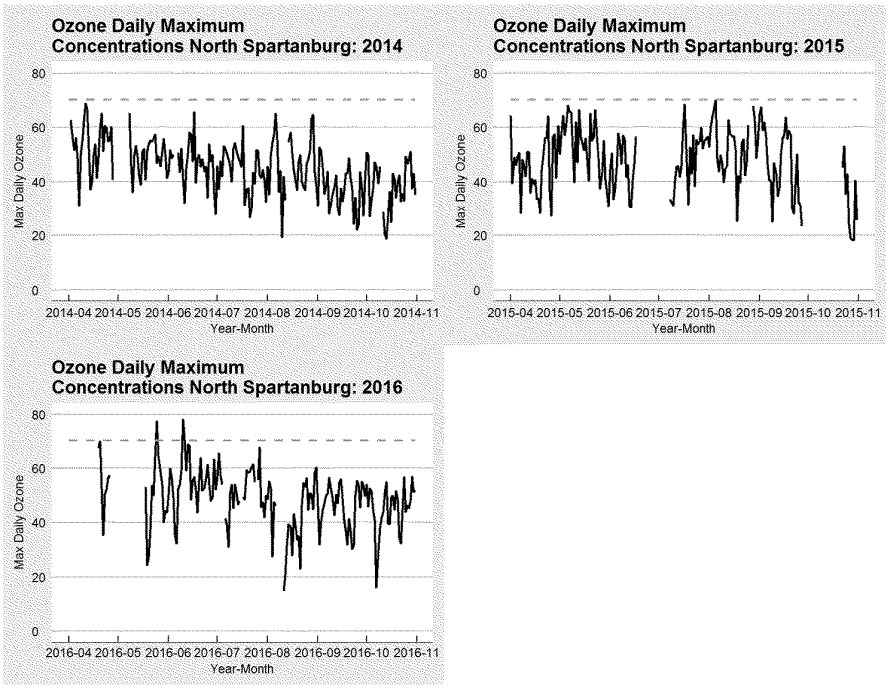


Figure 20: NSFS MDA8 by year



Remainder of the State

Missing days for the Due West ozone monitor

The Due West ozone monitor in Abbeville County, had 78, 91, and 51 incomplete days for 2014, 2015, and 2016, respectively (Figure 21). The MDA8 (Figure 22) for each year comprising the design value show that there were no exceedances of 70 ppb.

Figure 21: Due West missing data by year and month

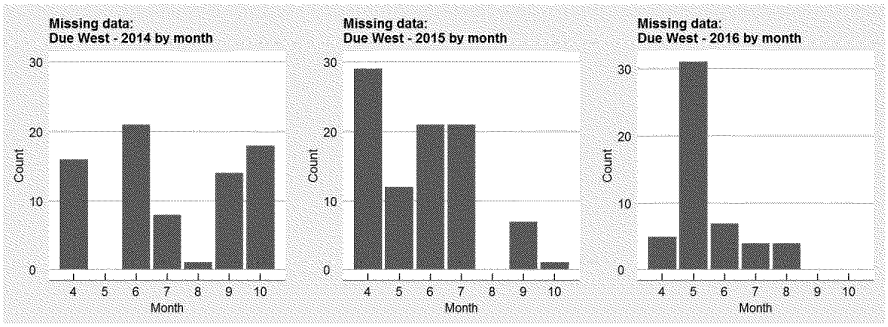
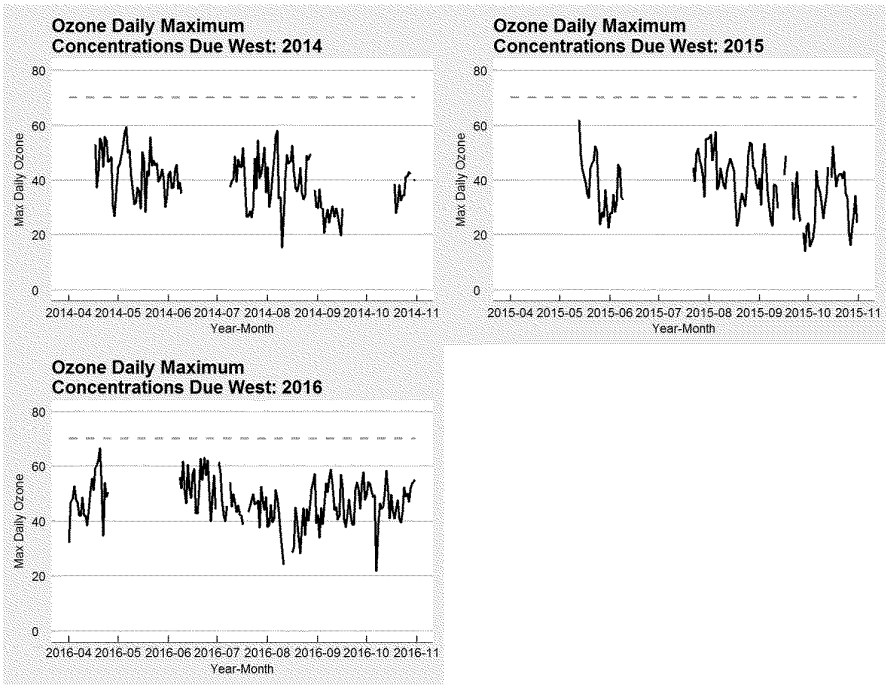


Figure 22: Due West MDA8 by year



Missing days for the Ashton ozone monitor

The Ashton ozone monitor in Colleton County, had 21, 67, and 30 incomplete days for 2014, 2015, and 2016, respectively (Figure 23). The MDA8 (Figure 24) for each year comprising the design value show that there were no exceedances of 70 ppb.

Figure 23: Ashton missing data by year and month

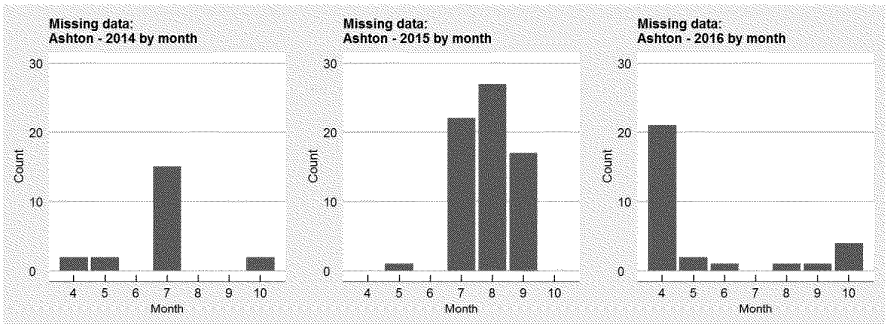
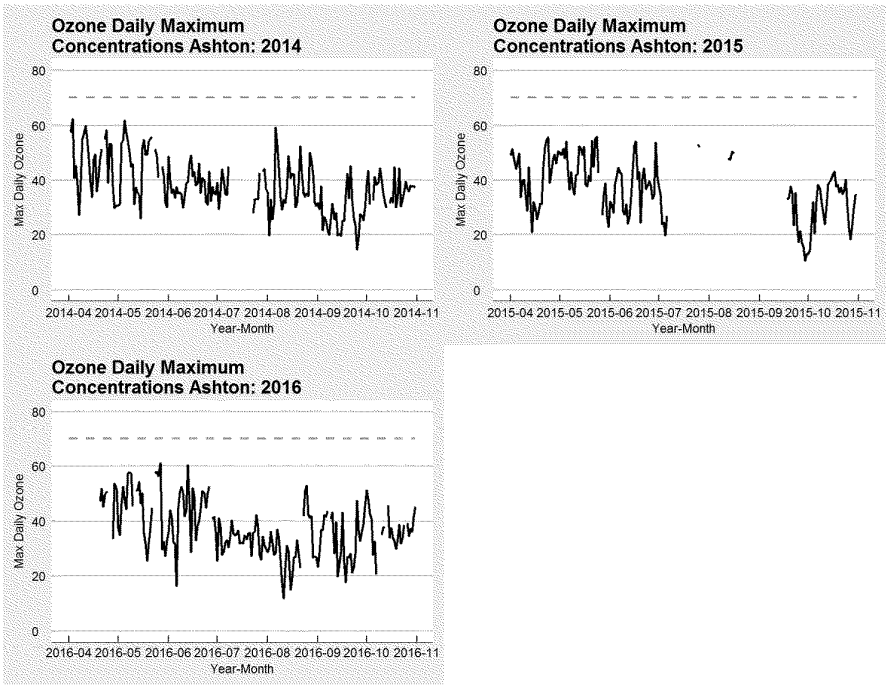


Figure 24: Ashton MDA8 by year



Selection of days to waive

The Department first looked to see which meteorological conditions are not conducive to ozone formation to demonstrate that missing days occurred on days not conducive to ozone formation. The most important meteorological conditions to ozone formation in South Carolina are maximum daily temperature, mid-day (1000 – 1600 EST) relative humidity, temperature difference (daily maximum-daily minimum), and afternoon (1300 – 1600 EST) wind speed. These parameters were selected based on a paper (Cox & Chu, 1996) used to develop the EPA's Trends in Ozone Adjusted for Weather Conditions (US EPA, n.d.)

Meteorological conditions

To understand meteorological conditions that are conducive to ozone formation for the South Carolina monitoring stations, the Department obtained the MDA8 ozone concentrations for each monitoring station with incomplete data. The Department selected meteorological data from the nearby airports for 2012 – 2016. The monitoring station, meteorological station pairings can be found in

Table 2.

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Table 2: Monitoring/Meteorological site pairings for analysis

Site Name	Site ID	Meteorological Station
Due West	450010001	KAND
Bushy Park	450150002	KCHS
Cape Romain	450190046	KCHS
Ashton	450290002	KOGB
Congaree Bluff	450790021	KCAE
Hillcrest	450450016	KGSP
North Spartanburg	450830009	KGSP
Parklane	450790007	KCAE
Trenton	450370001	KCAE
Wolf Creek	450770003	KGSP
Sandhill	450791001	KCAE
Clemson	450770002	KGSP

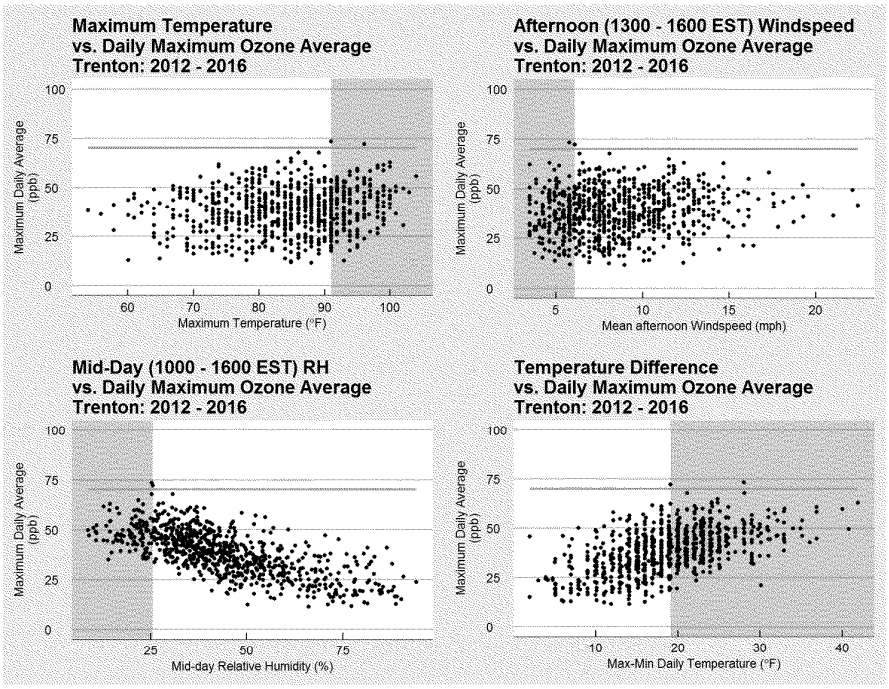
Augusta-Richmond County, GA-SC MSA

Meteorological conditions and missing data for the Trenton ozone monitor

The Department used the Trenton ozone data and meteorological data from the Columbia Metropolitan Airport (KCAE) to examine meteorological conditions that were conducive to ozone formation (Figure 25). Scatterplots between the MDA8 at the monitoring site and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 91ºF, mid-day relative humidity is less than 25.5%, afternoon wind speed is less than 6 mph, and temperature difference (between daily low and high temperatures) is greater than 19ºF. In the preceding five years, the MDA8 exceeded the level of the NAAQS under these meteorological conditions.

ED_001361_00002078

Figure 25: Trenton meteorological conditions vs. ozone



The Department applied a "brute-force" technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at the Trenton site would not have exceeded the ozone NAAQS.

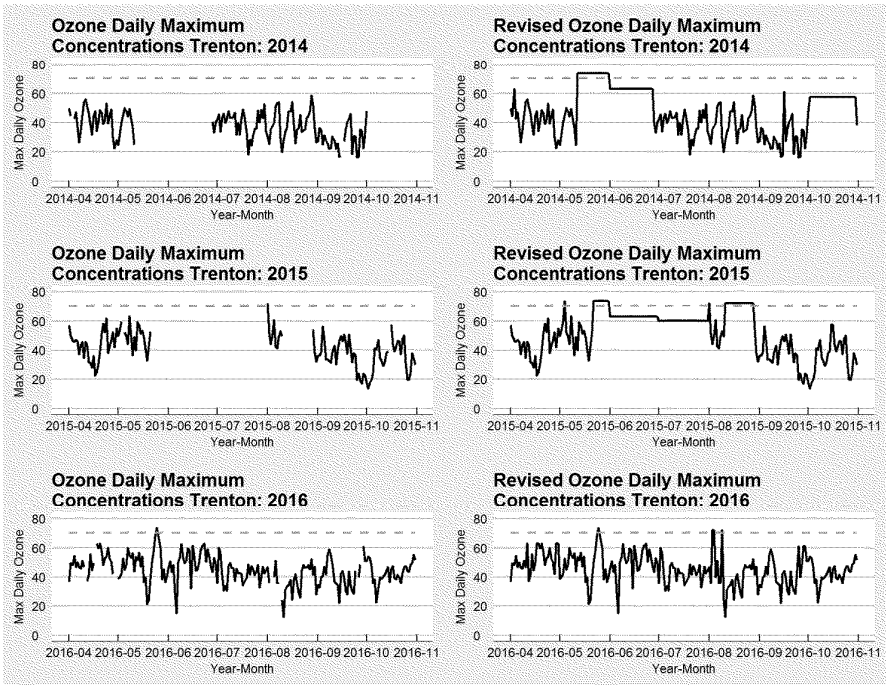
Data from 2012 – 2016 at the Trenton ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 3).

Table 3: Trenton highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	63
May	73
June	63
July	60
August	72
September	61
October	57

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 26). The time series graphic of the pre- and post-substitution show occasional exceedances of the NAAQS from 2014 - 2016.

Figure 26: Trenton MDA8 pre and post data substitution



The design values were then recalculated for Trenton for all missing days. This conservative approach shows that under the worst-case scenario, Trenton design values are expected to slightly exceed the ozone NAAQS with a recalculated design value of 72 ppb (Table 4). Since this test design value is above the level of the NAAQS, the Department will further evaluate the missing data through a regression process detailed in the next section.

Table 4: Pre- and post-data substitution design value calculation for Trenton

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	54	64	73	100
2015	60	57	73	100
2016	62	96	72	100
DV	58	72	72	100

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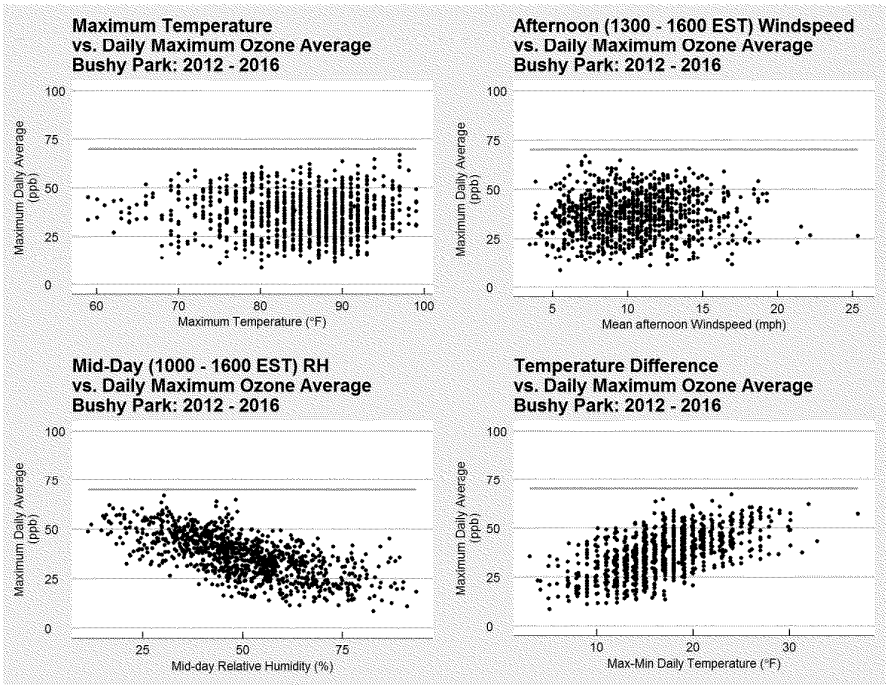
Charleston-North Charleston MSA

Meteorological conditions and missing data for the Bushy Park ozone monitor

The Department used Bushy Park ozone data and meteorological data from the Charleston International Airport (KCHS) to examine meteorological conditions that were conducive to ozone formation (Figure 27). There were no exceedances of the ozone NAAQS from 2012 – 2016. However, some ozone is formed under similar meteorological conditions found at other sites (high maximum temperatures, low afternoon wind speeds, and low mid-day relative humidity).

Figure 27: KCHS meteorological conditions vs. ozone



The Department applied a "brute-force" technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at the Bushy Park would not have exceeded the ozone NAAQS.

Data from 2012 – 2016 at the Bushy Park ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 5).

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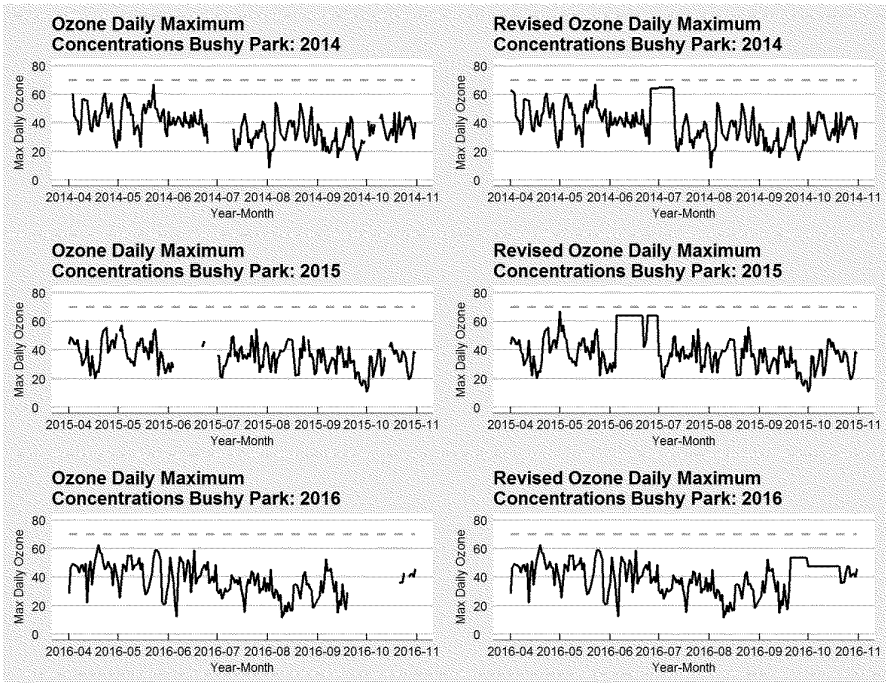
Table 5: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	62
May	67
June	64
July	65
August	56
September	53
October	47

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 28). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 28: Bushy Park MDA8 pre and post data substitution



The design values were then recalculated for Bushy Park for all missing days. This conservative approach shows that under the worst-case scenario, Bushy Park design values are expected to still meet the ozone NAAQS with a recalculated design value of 62 ppb (Table 6).

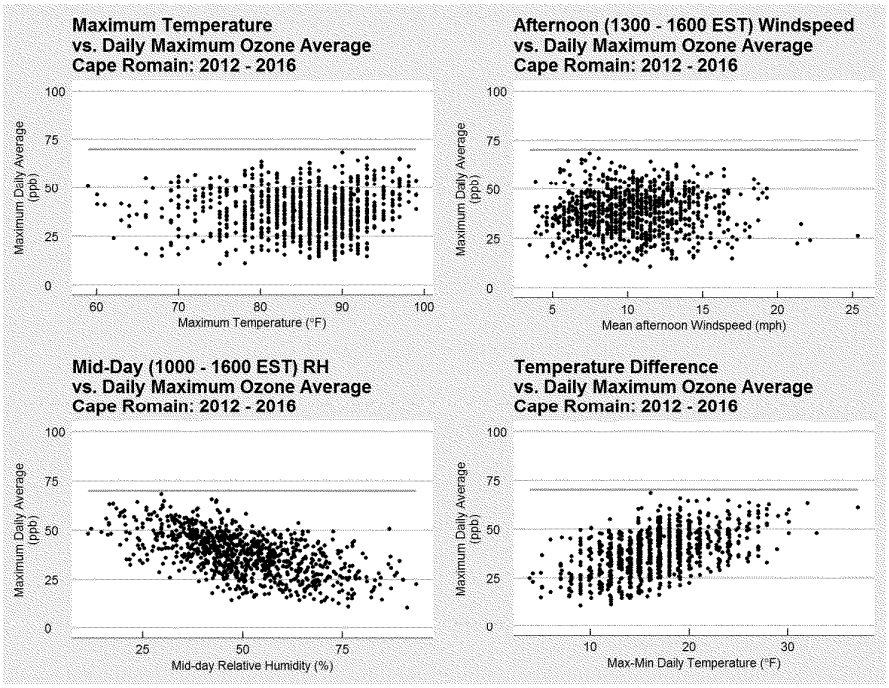
Table 6: Pre- and post-data substitution design value calculation for Bushy Park

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	60	91	65	100
2015	54	87	64	100
2016	58	85	59	100
DV	57	87	62	100

Meteorological conditions and missing data for the Cape Romain ozone monitor

The Department used Cape Romain ozone data and meteorological data from the Charleston International Airport (KCHS) to examine meteorological conditions that were conducive to ozone formation (Figure 29). There were no exceedances of the ozone NAAQS from 2012 – 2016. However, some ozone is formed under similar meteorological conditions found at other sites (high maximum temperatures, low afternoon wind speeds, and low mid-day relative humidity).

Figure 29: KCHS meteorological conditions vs. ozone



The Department applied a "brute-force" technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative

approach to demonstrate that even under a worst-case scenario, the design value at Cape Romain would not have exceeded the ozone NAAQS.

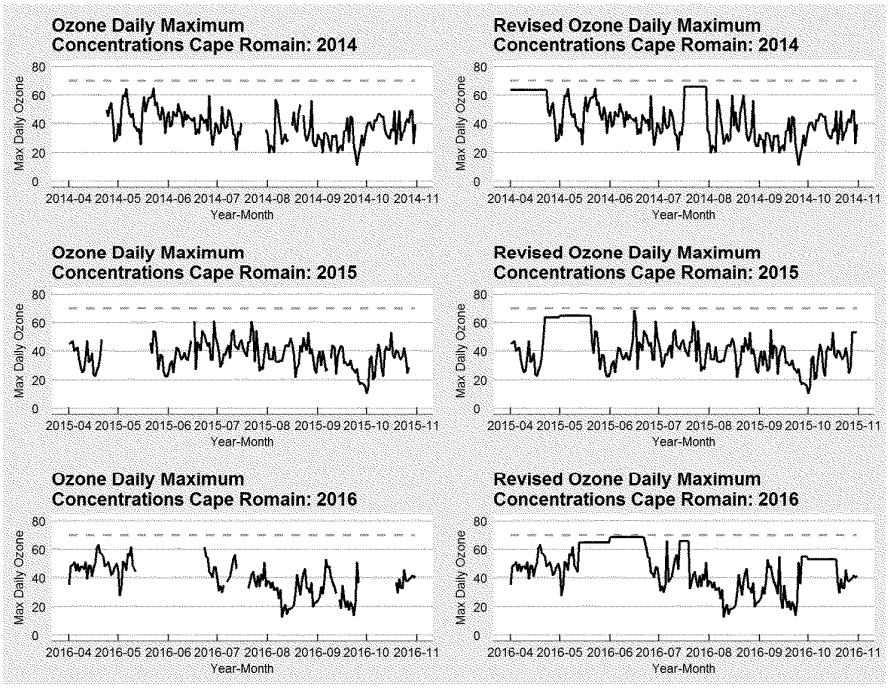
Data from 2012 – 2016 at the Cape Romain ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 7).

Table 7: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	64
May	65
June	68
July	66
August	60
September	55
October	53

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 30). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 30: Cape Romain MDA8 pre and post data substitution



The design values were then recalculated for Cape Romain for all missing days. This conservative approach shows that under the worst-case scenario, Cape Romain design values are expected to still meet the ozone NAAQS with a recalculated design value of 66 ppb (Table 8).

Table 8: Pre- and post-data substitution design value calculation for Cape Romain

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	59	82	66	100
2015	54	84	65	100
2016	60	67	68	100
DV	57	77	66	100

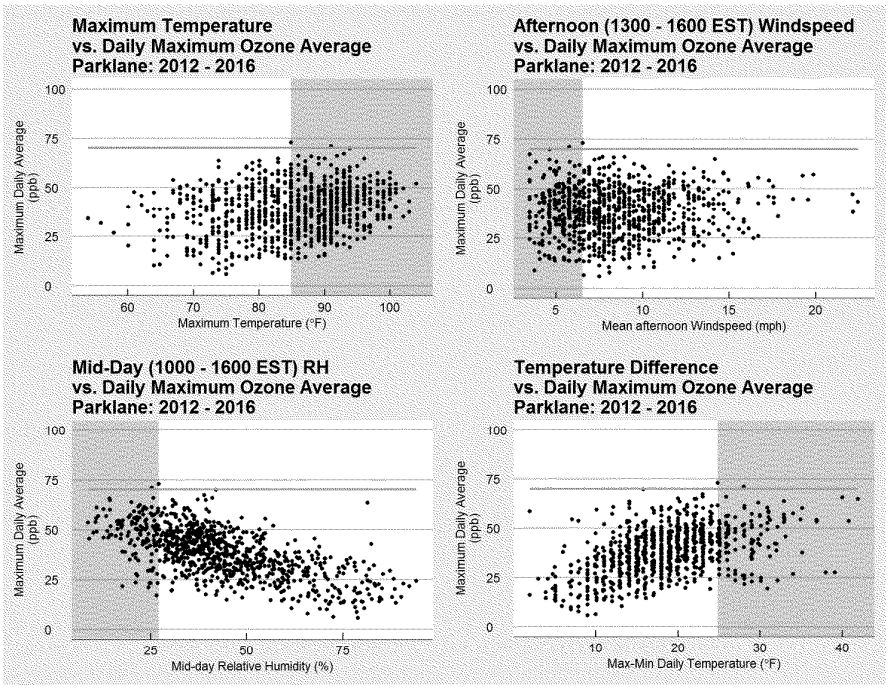
Columbia MSA

Meteorological conditions and missing data for the Parklane ozone monitor

The Department used the Parklane ozone data and meteorological data from the Columbia Metropolitan Airport (KCAE) to examine meteorological conditions that were conducive to ozone formation (Figure 31). Scatterplots between the MDA8 at the monitoring site and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 85°F, mid-day relative humidity is less than 27.1%, afternoon wind speed is less than 6 mph, and temperature difference is greater than 24°F. In the preceding five years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions.

ED_001361_00002078

Figure 31: KCAE meteorological conditions vs. ozone



The Department applied a "brute-force" technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Parklane would not have exceeded the ozone NAAQS.

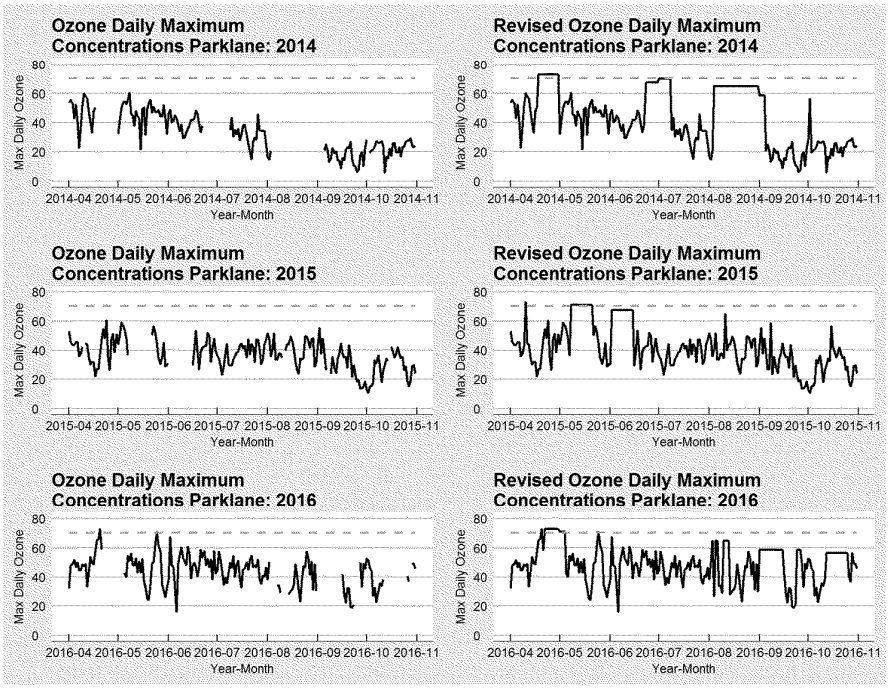
Data from 2012 – 2016 at the Parklane ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 9).

Table 9: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	73
May	71
June	67
July	70
August	65
September	58
October	56

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 32). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 32: Parklane MDA8 pre and post data substitution



The design values were then recalculated for Parklane for all missing days. This conservative approach shows that under the worst-case scenario, Parklane design values are expected to slightly exceed the ozone NAAQS with a recalculated design value of 72 ppb (Table 10). Since this test design value is above the level of the NAAQS, the Department will further evaluate the missing data through a regression process detailed in the next section.

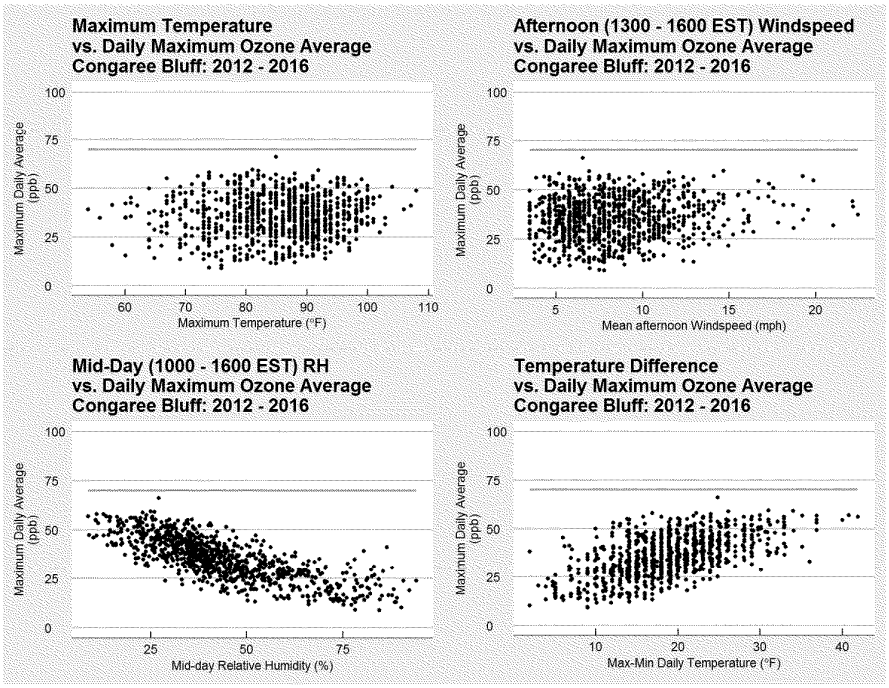
Table 10: Pre- and post-data substitution design value calculation for Parklane

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	56	71	73	100
2015	56	85	71	100
2016	65	75	73	100
DV	59	77	72	100

Meteorological conditions and missing data for the Congaree Bluff ozone monitor

The Department used Congaree Bluff ozone data and meteorological data from the Columbia Metropolitan Airport (KCAE) to examine meteorological conditions that were conducive to ozone formation (Figure 33). There were no exceedances of the ozone NAAQS from 2012 – 2016. However, some ozone is formed under similar meteorological conditions found at other sites (high maximum temperatures, low afternoon wind speeds, and low mid-day relative humidity).

Figure 33: KCAE meteorological conditions vs. ozone



The Department applied a "brute-force" technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Congaree Bluff would not have exceeded the ozone NAAQS.

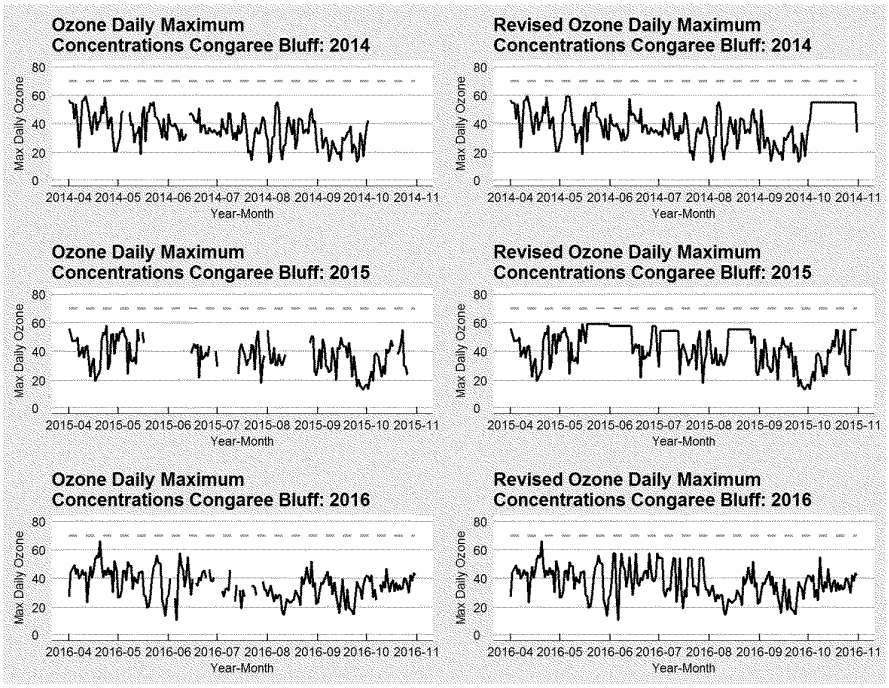
Data from 2012 – 2016 at the Congaree Bluff ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 11).

Table 11: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	66
May	59
June	57
July	54
August	55
September	50
October	55

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 34). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 34: Congaree Bluff MDA8 pre and post data substitution



The design values were then recalculated for Congaree Bluff for all missing days. This conservative approach shows that under the worst-case scenario, Congaree Bluff design values are expected to still meet the ozone NAAQS with a recalculated design value of 58 ppb (Table 12).

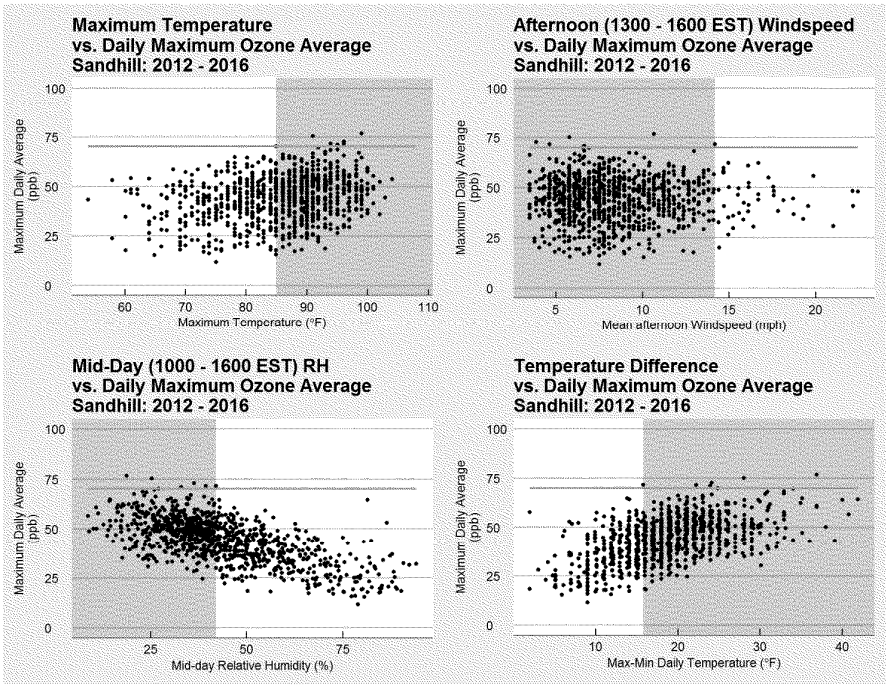
Table 12: Pre- and post-data substitution design value calculation for Congaree Bluff

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	56	85	59	100
2015	55	69	59	100
2016	56	92	57	100
DV	55	82	58	100

Meteorological conditions and missing data for the Sandhill ozone monitor

The Department used the Sandhill ozone data and meteorological data from the Columbia Metropolitan Airport (KCAE) to examine meteorological conditions that were conducive to ozone formation (Figure 35). Scatterplots between the MDA8 at the monitoring site and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 85ºF, mid-day relative humidity is less than 42.1%, afternoon wind speed is less than 14 mph, and temperature difference is greater than 16ºF. In the preceding five years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions.

Figure 35: KCAE meteorological conditions vs. ozone



The Department applied a "brute-force" technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the

number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Sandhill would not have exceeded the ozone NAAQS.

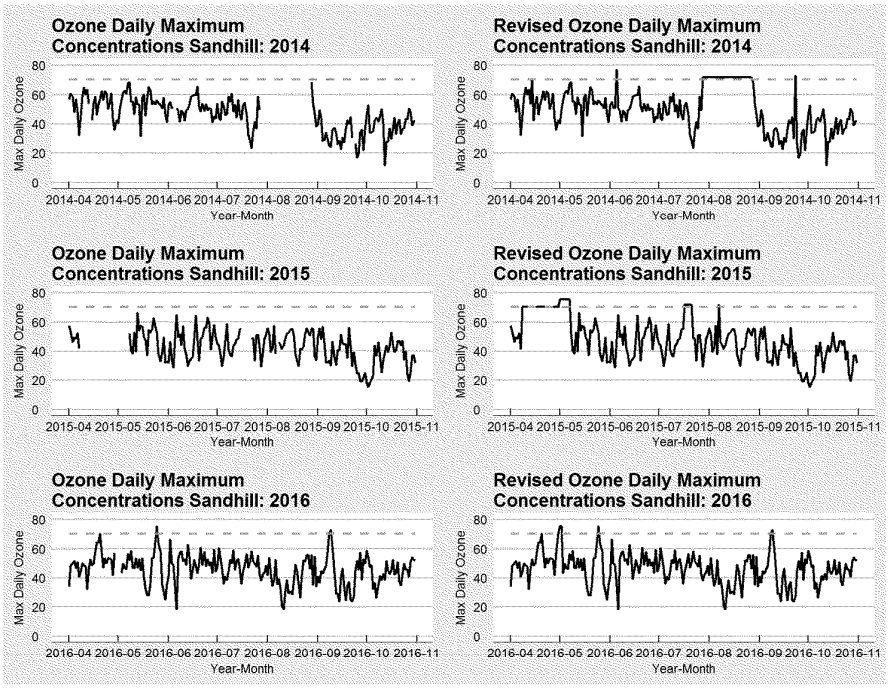
Data from 2012 – 2016 at the Sandhill ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 13).

Table 13: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	70
May	75
June	77
July	72
August	72
September	73
October	58

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 36). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 36: Sandhill MDA8 pre and post data substitution



The design values were then recalculated for Sandhill for all missing days. This conservative approach shows that under the worst-case scenario, Sandhill design values are expected to slightly exceed the ozone NAAQS with a recalculated design value of 73 ppb (Table 14). Since this test design value is above the level of the NAAQS, the Department will further evaluate the missing data through a regression process detailed in the next section.

Table 14: Pre- and post-data substitution design value calculation for Sandhill

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	65	84	72	100
2015	62	83	75	100
2016	70	99	73	100
DV	65	89	73	100

Greenville-Anderson-Mauldin MSA

Meteorological conditions and missing data for the Hillcrest ozone monitor

The Department used the Hillcrest ozone data and meteorological data from the Greenville Spartanburg International Airport (KGSP) to examine meteorological conditions that were conducive to ozone formation (Figure 37). Scatterplots between the MDA8 at the monitoring site and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 78ºF, mid-day relative humidity is less than 39.6%, afternoon wind speed is less than 8 mph, and temperature difference is greater than 16ºF. In the preceding five years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions.

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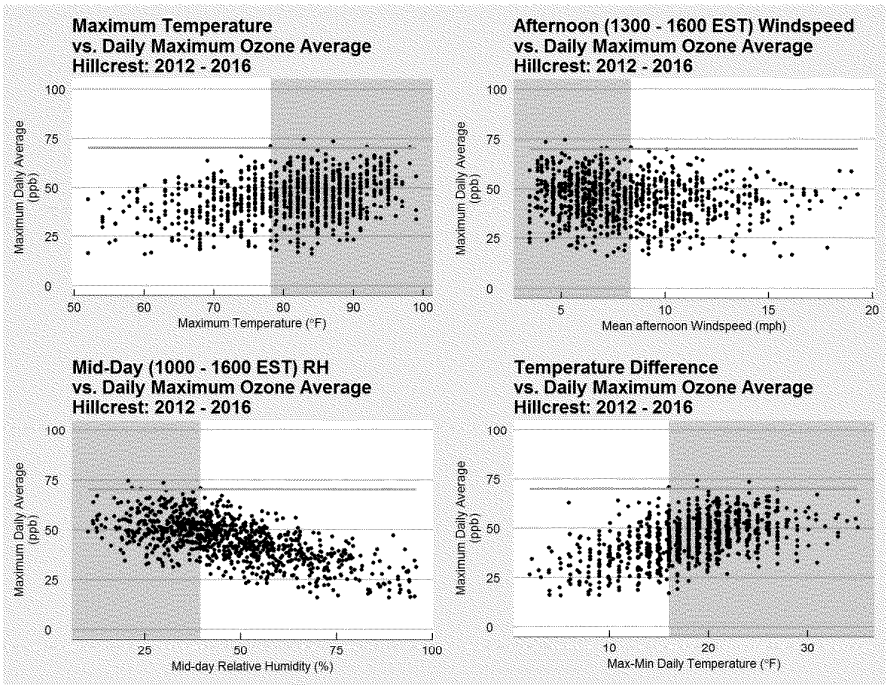
Figure 37: KGSP meteorological conditions vs. ozone



The Department applied a "brute-force" technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Sandhill would not have exceeded the ozone NAAQS.

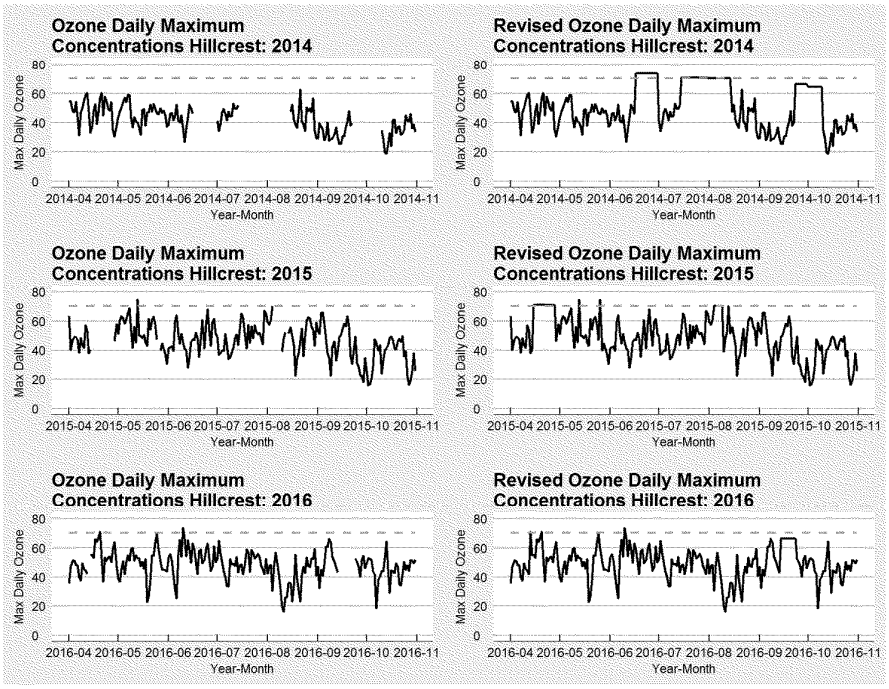
Data from 2012 – 2016 at the Hillcrest ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 15).

Table 15: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	71
May	74
June	73
July	71
August	70
September	66
October	64

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 38). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 38: Hillcrest MDA8 pre and post data substitution



The design values were then recalculated for Hillcrest for all missing days. This conservative approach shows that under the worst-case scenario, Hillcrest design values are expected to slightly exceed the ozone NAAQS with a recalculated design value of 71 ppb (Table 16). Since this test design value is above the level of the NAAQS, the Department will further evaluate the missing data through a regression process detailed in the next section.

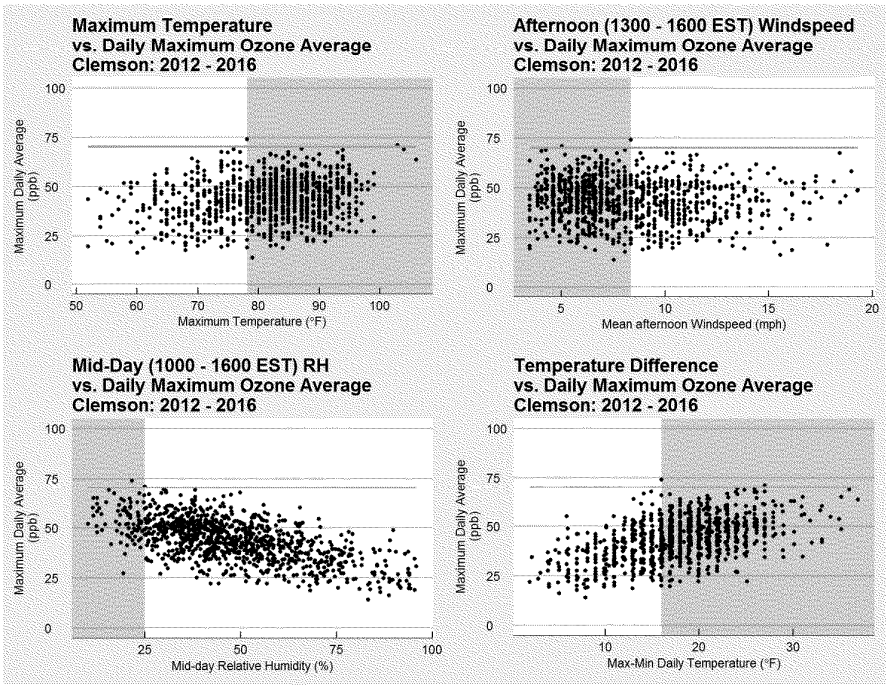
Table 16: Pre- and post-data substitution design value calculation for Hillcrest

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	58	71	73	100
2015	67	90	71	100
2016	66	95	70	100
DV	63	85	71	100

Meteorological conditions and missing data for the Clemson CMS ozone monitor

The Department used the Clemson CMS ozone data and meteorological data from the Greenville Spartanburg International Airport (KGSP) to examine meteorological conditions that were conducive to ozone formation (Figure 39). Scatterplots between the MDA8 at the monitoring site and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 78ºF, mid-day relative humidity is less than 25.0%, afternoon wind speed is less than 8 mph, and temperature difference is greater than 16ºF. In the preceding five years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions.

Figure 39: KGSP meteorological conditions vs. ozone



The Department applied a "brute-force" technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Sandhill would not have exceeded the ozone NAAQS.

Data from 2012 – 2016 at the Clemson CMS ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 17).

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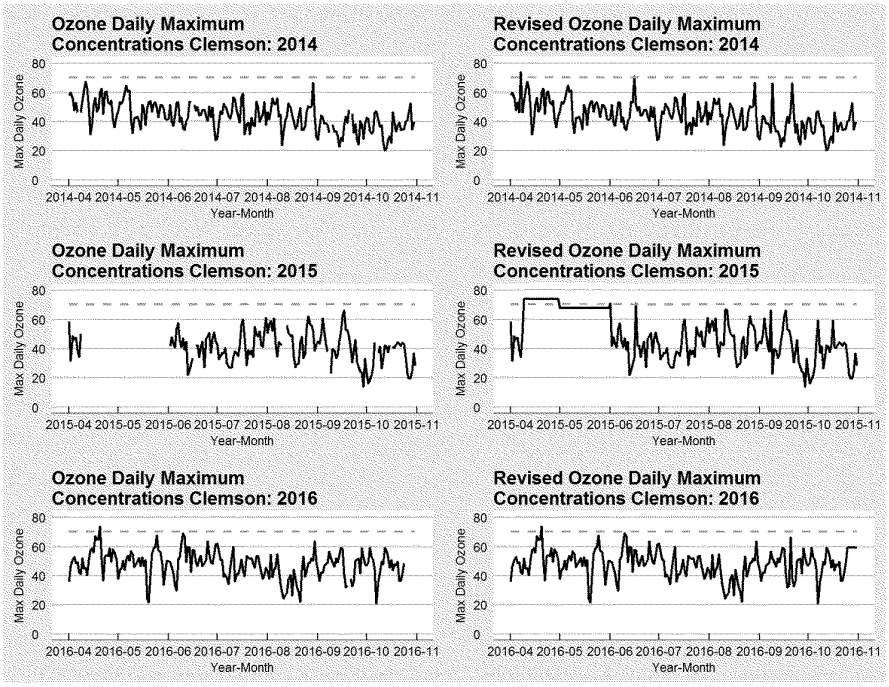
Table 17: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	74
May	67
June	71
July	68
August	66
September	66
October	59

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 40). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 40: Clemson CMS MDA8 pre and post data substitution



The design values were then recalculated for Clemson CMS for all missing days. This conservative approach shows that under the worst-case scenario, Clemson CMS design values are expected to still meet the ozone NAAQS with a recalculated design value of 69 ppb (Table 18).

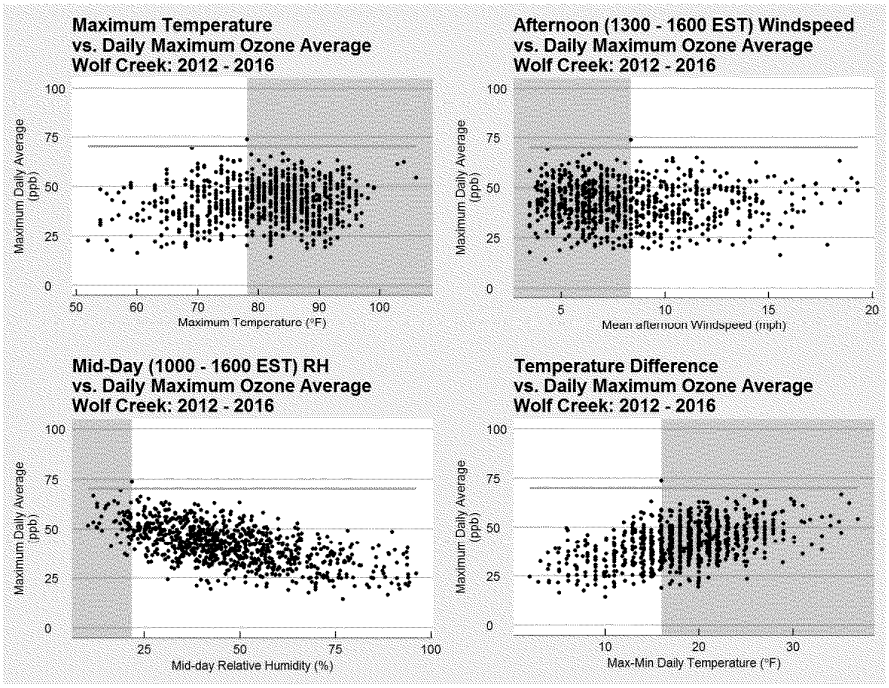
Table 18: Pre- and post-data substitution design value calculation for Clemson CMS

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	62	98	66	100
2015	60	72	74	100
2016	67	96	67	100
DV	63	89	69	100

Meteorological conditions and missing data for the Wolf Creek ozone monitor

The Department used the Wolf Creek ozone data and meteorological data from the Greenville Spartanburg International Airport (KGSP) to examine meteorological conditions that were conducive to ozone formation (Figure 41). Scatterplots between the MDA8 at the monitoring site and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 78°F, mid-day relative humidity is less than 21.7%, afternoon wind speed is less than 8 mph, and temperature difference is greater than 16°F. In the preceding five years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions.

Figure 41: KGSP meteorological conditions vs. ozone



The Department applied a "brute-force" technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the

number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Sandhill would not have exceeded the ozone NAAQS.

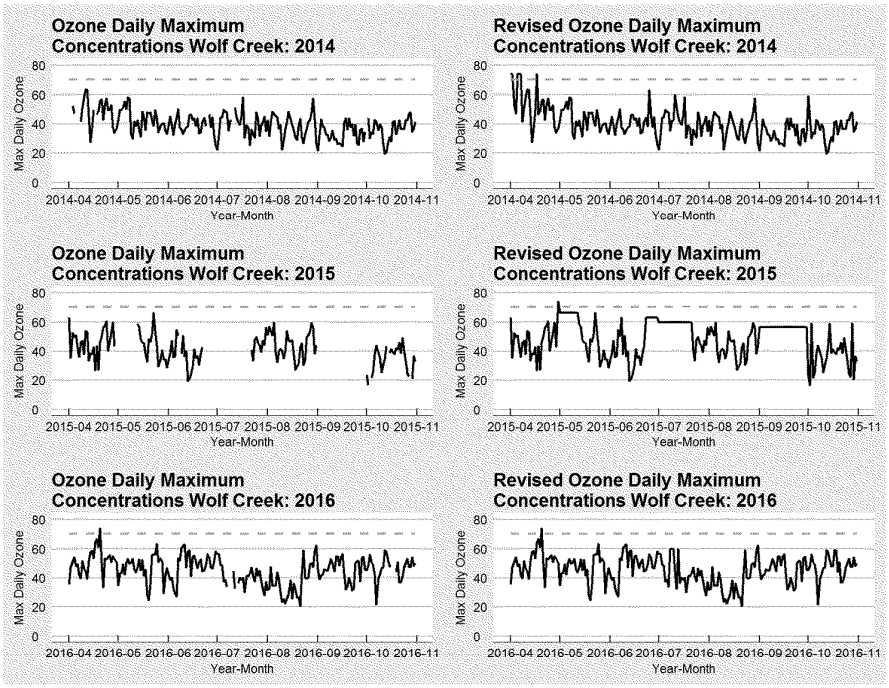
Data from 2012 – 2016 at the Wolf Creek ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 19).

Table 19: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	74
May	66
June	63
July	59
August	61
September	56
October	59

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 42). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 42: Wolf Creek MDA8 pre and post data substitution



The design values were then recalculated for Wolf Creek for all missing days. This conservative approach shows that under the worst-case scenario, Wolf Creek design values are expected to still meet the ozone NAAQS with a recalculated design value of 67 ppb (Table 20).

Table 20: Pre- and post-data substitution design value calculation for Wolf Creek

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	58	96	74	100
2015	59	64	66	100
2016	63	97	63	100
DV	60	86	67	100

Spartanburg MSA

Meteorological conditions and missing data for the North Spartanburg Fire Station #2 ozone monitor

The Department used the North Spartanburg ozone data and meteorological data from the Greenville Spartanburg International Airport (KGSP) to examine meteorological conditions that were conducive to ozone formation (Figure 43). Scatterplots between the MDA8 at the monitoring site and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 85°F, mid-day relative humidity is less than 31.6%, afternoon wind speed is less than 12 mph, and temperature difference is greater than 24°F. In the preceding five years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions.

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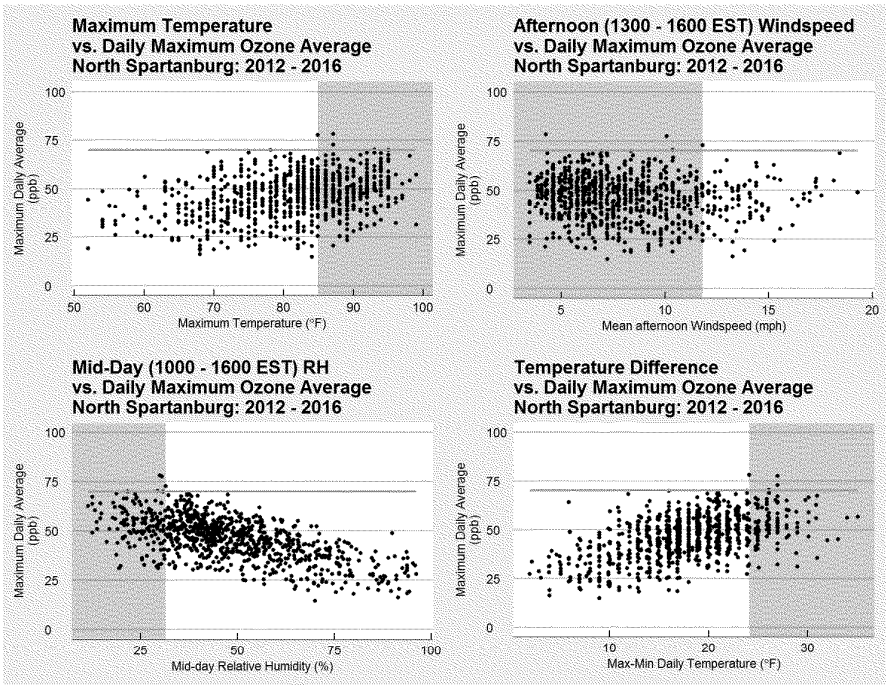
Figure 43: KGSP meteorological conditions vs. ozone



The Department applied a "brute-force" technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Sandhill would not have exceeded the ozone NAAQS.

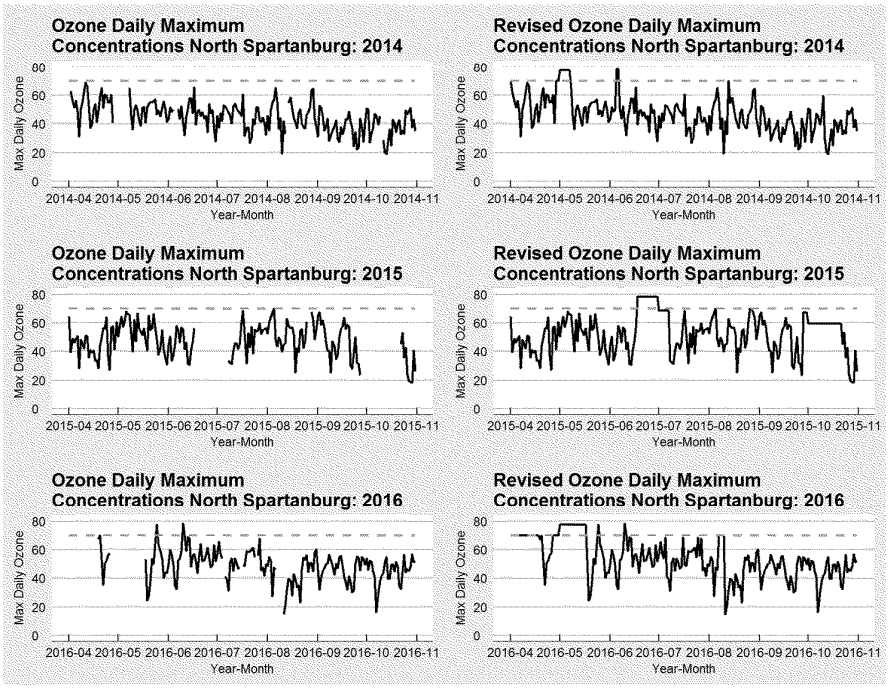
Data from 2012 – 2016 at the North Spartanburg ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 21).

Table 21: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	70
May	78
June	78
July	68
August	70
September	67
October	59

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 44). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 44: North Spartanburg MDA8 pre and post data substitution



The design values were then recalculated for North Spartanburg for all missing days. This conservative approach shows that under the worst-case scenario, North Spartanburg design values are expected to exceed the ozone NAAQS with a recalculated design value of 77 ppb (Table 22). Since this test design value is above the level of the NAAQS, the Department will further evaluate the missing data through a regression process detailed in the next section.

Table 22: Pre- and post-data substitution design value calculation for North Spartanburg

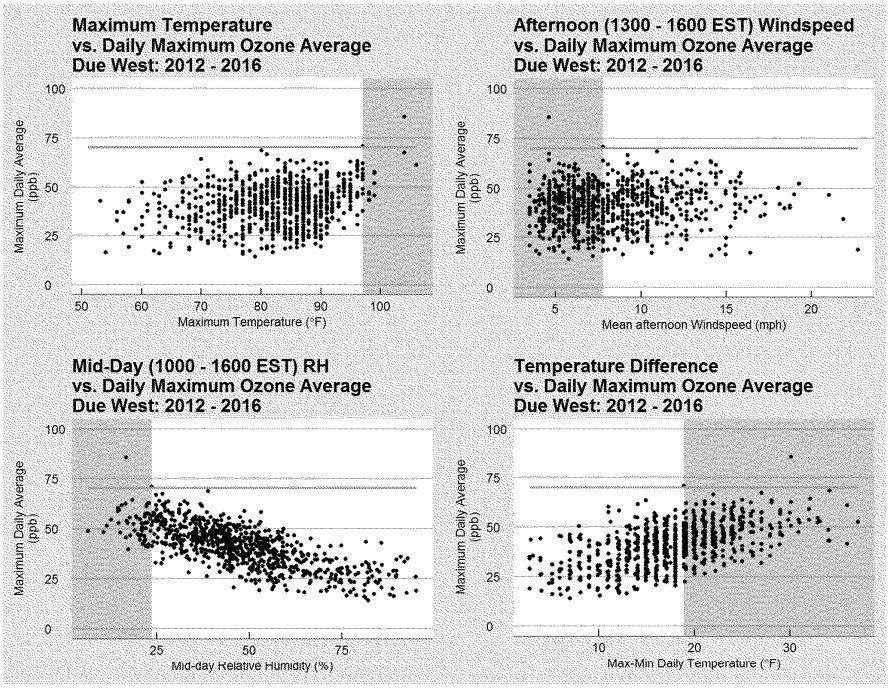
Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	65	93	77	100
2015	67	79	78	100
2016	69	79	77	100
DV	67	83	77	100

Remainder of the State

Meteorological conditions and missing data for the Due West ozone monitor

The Department used the Due West ozone data in Abbeville County, and meteorological data from the Anderson Regional Airport (KAND) to examine meteorological conditions that were conducive to ozone formation (Figure 45). Scatterplots between the MDA8 at the monitoring site and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 97°F, mid-day relative humidity is less than 23.7%, afternoon wind speed is less than 8 mph, and temperature difference is greater than 19°F. In the preceding five years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions.

Figure 45: KAND meteorological conditions vs. ozone



The Department applied a "brute-force" technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at Sandhill would not have exceeded the ozone NAAQS.

Data from 2012 – 2016 at the Due West ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 23).

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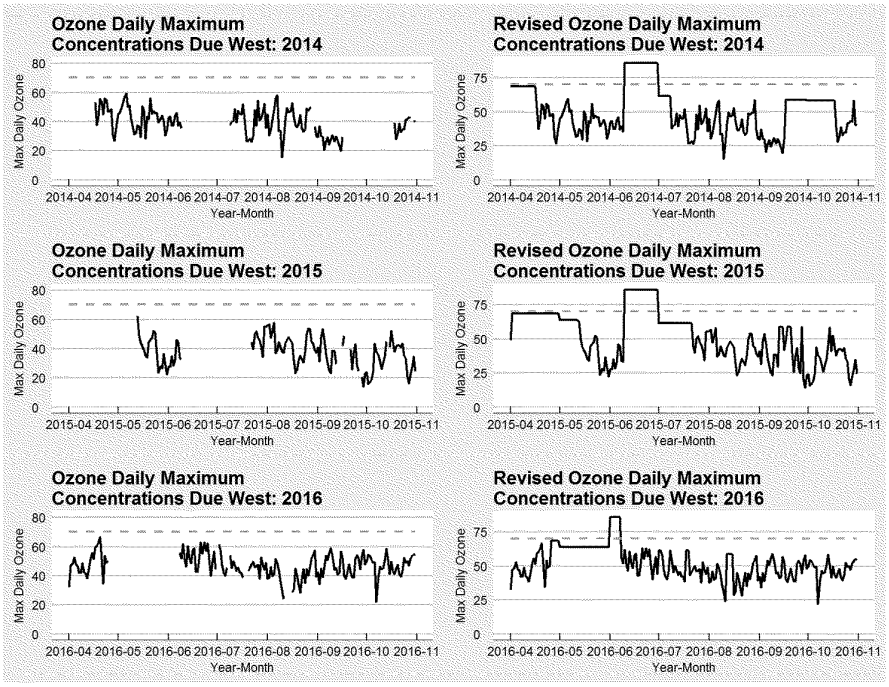
Table 23: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	68
May	64
June	85
July	61
August	58
September	59
October	58

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 46). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 46: Due West MDA8 pre and post data substitution



The design values were then recalculated for Due West for all missing days. This conservative approach shows that under the worst-case scenario, Due West design values are expected to exceed the ozone NAAQS with a recalculated design value of 85 ppb (Table 24). Since this test design value is above the level of the NAAQS, the Department will further evaluate the missing data through a regression process detailed in the next section.

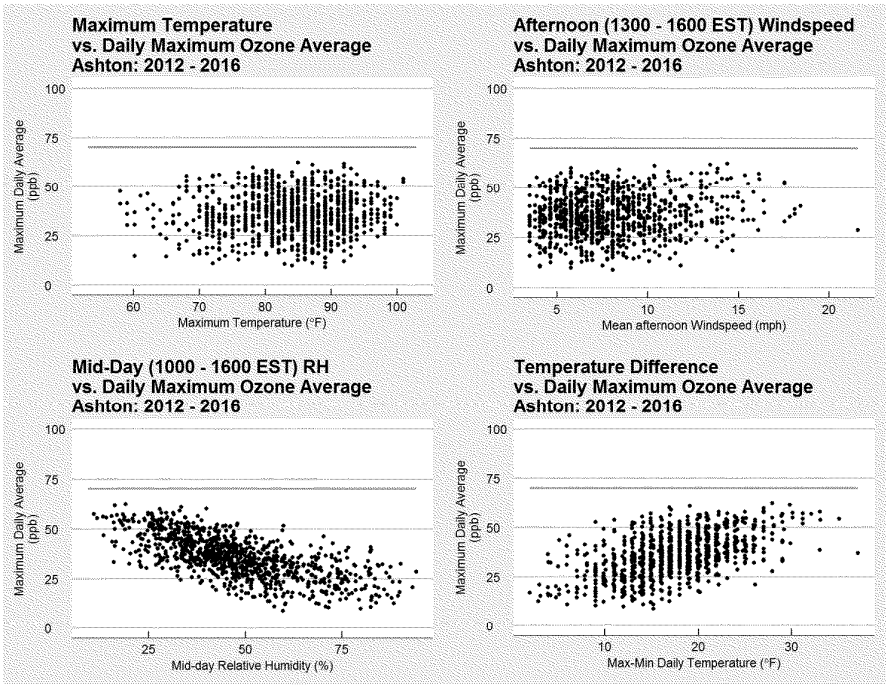
Table 24: Pre- and post-data substitution design value calculation for Due West

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	57	64	85	100
2015	55	57	85	100
2016	62	76	85	100
DV	58	66	85	100

Meteorological conditions and missing data for the Ashton ozone monitor

The Department used Ashton ozone data in Colleton County, and meteorological data from the Orangeburg Municipal Airport (KOGB) to examine meteorological conditions that were conducive to ozone formation (Figure 47). There were no exceedances of the ozone NAAQS from 2012 – 2016. However, some ozone is formed under similar meteorological conditions found at other sites (high maximum temperatures, low afternoon wind speeds, and low mid-day relative humidity).

Figure 47: KOGB meteorological conditions vs. ozone



The Department applied a "brute-force" technique by substituting the highest daily maximum ozone concentration by month for the years 2014 - 2016 to determine the number of days for which to seek a waiver. The Department believes this is a conservative

approach to demonstrate that even under a worst-case scenario, the design value at Ashton would not have exceeded the ozone NAAQS.

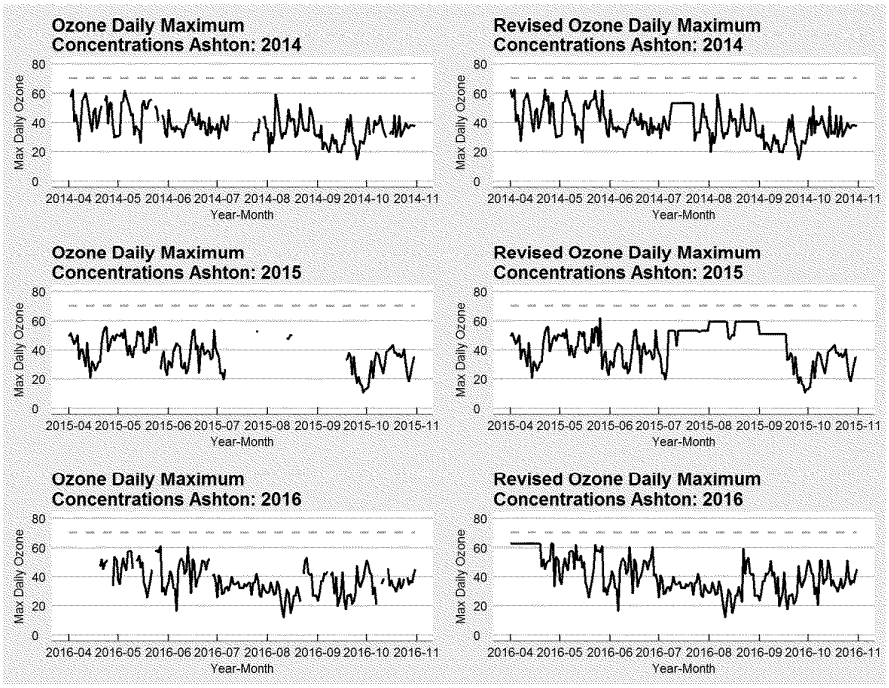
Data from 2012 – 2016 at the Ashton ozone monitor was evaluated in order to determine the highest daily maximum ozone average per month (Table 25).

Table 25: Highest monthly MDA8 2012 - 2016

Month	Highest Daily Maximum Average (ppb)
April	62
May	62
June	60
July	53
August	59
September	51
October	51

These monthly maximums were then substituted for all missing data for 2014 – 2016 (Figure 48). The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2016.

Figure 48: Ashton MDA8 pre and post data substitution



The design values were then recalculated for Ashton for all missing days. This conservative approach shows that under the worst-case scenario, Ashton design values are expected to still meet the ozone NAAQS with a recalculated design value of 61 ppb (Table 26).

Table 26: Pre- and post-data substitution design value calculation for Ashton

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2014	59	90	62	100
2015	54	69	59	100
2016	57	86	62	100
DV	56	82	61	100

Ozone regression analysis

A linear regression analysis of missing data was conducted for those sites which did not show a test design value less than or equal to the level of the ozone NAAQS in the previous section. This analysis will serve as an additional "weight of evidence" that the sites will attain the 2015 ozone NAAQS based on data collected from 2014 – 2016. This analysis estimates the missing samples at the incomplete sites by using a linear regression model and bootstrapping to estimate the design value for a "complete" data set in 2016. See page 46 for more information about bootstrapping.

Step 1: Organize data and perform linear regression between incomplete site and candidate sites

The Theil-Sen regression method was chosen to develop the statistical model (Team, R Core, 2016), (Maindonald & Braun, 2015), (Komsta, 2013) to predict missing ambient ozone concentrations at the incomplete site from monitoring that has been conducted at other nearby candidate sites over the past five years. The Theil-Sen regression is a nonparametric linear model and is typically less likely to be influenced by outliers than a least squares linear regression (Hollander & Wolfe, 1999, pp. 415-457). Linear regressions were developed for all candidate sites which had at least 803 sample pairs (which is approximately 75% data completion over the five-year period), a Spearman's Rank Correlation Coefficient of at least 0.80, and a minimum of 75% data completeness for the candidate site in 2016.

Step 2: Select the best candidate site as the predictor site

The methodology for the best candidate site was selected based on an earlier analysis (EPA Region 4, 2015). Summary statistics for the best predictor site (which meets the acceptance criteria listed in Step 1 of this section) for each of the incomplete sites are shown in Table 27. Deviations from this methodology are listed as footnotes to Table 27.

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Plots of the Theil-Sen regression models for each site which did not pass the "brute force" technique are provided in Appendix A.

Table 27: Model statistics

Incomplete Site	Predictor Site	n Sample Pairs	Minimum Pairs Met	Theil Slope	Theil Intercept	Spearman	Theil RMSE (ppb)
North Spartanburg (450830009)	Clemson CMS (450770002)	803	Yes	0.93	5.61	0.86	5.39
Due West (450010001) [a]	Clemson CMS (450770002)	750	No	0.89	2.80	0.85	5.36
Hillcrest (450450016) [b]	Big Creek (450070005)	827	Yes	1.04	1.36	0.94	3.62
Sandhill(450791001)	Congaree Bluff (450790021)	808	Yes	0.86	14.32	0.84	5.94
Trenton (450370001) [a]	Evans, GA (130730001)	772	No	0.90	2.14	0.83	6.06
Parklane (450790007)	Evans, GA (130730001)	834	Yes	0.97	-1.83	0.82	6.88

[a] Site did not meet the required 803 sample pairs over the five-year period. We chose candidate site with highest available pairs that still met the Spearman threshold. These sites had >70% data completion for the five-year period.

[b] This paring had slightly lower sample pairs, but had the highest Spearman threshold. The predictor site for this pair had 100% data completion in 2016.

Step 3: Calculate a test design value

Next, a 2014 – 2016 test design value was calculated using the combination of collected and estimated samples. The test design value for each of the incomplete sites which did not pass the "brute force" technique can be found in Table 28.

Step 4: Conduct Bootstrapping Analysis

A bootstrapping analysis was conducted to determine the variance around the predicted design value. This will provide further evidence that a design value would have been less than or equal to the 2015 ozone NAAQS if it had been based on complete data. Bootstrapping is a statistical procedure that resamples a dataset to estimate the variance of a statistic, in this case the design value. The following procedure was used:

a. Residuals were calculated from the Theil-Sen regression model.

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b. For each missing sample that was estimated in Step 2, a regression residual was randomly selected with replacement from the pool of residuals and added (or subtracted, in the case of a negative residual) to the estimated value.
c. Repeat (b) 1,000 times
d. For each of the 1,000 runs, the predicted three-year design value was calculated as in Step 3.

The resulting 1,000 predicted design values are interpreted as an approximate probability distribution of the design values at the incomplete site, had it collected complete data. In order to ensure the likelihood of that the ozone NAAQS would not have been exceeded, an "Incomplete Site" should not have an Upper 95% Confidence Interval greater than 70.00 ppb, and there should not be more than 5% of the 1,000 predictions (<50) greater than 70.00 ppb. All incomplete sites which did not pass the "brute force" analysis had predicted design values and upper bound 95% confidence intervals less than 70.00 ppb. Two sites had bootstrapped predicted design values greater than 70.00 ppb. North Spartanburg had 10 predicted bootstrap design values greater than 70.00 ppb, or 1% of all runs. The Due West site had 6 predicted bootstrap design values greater than 70.00 ppb, or 0.6% of all runs. Therefore, all sites show evidence that there is an extremely low probability that there would have been an exceedance of the ozone NAAQS if completed data had been collected. The distribution of the resulting bootstrap design values for each site are shown in Appendix B, and summarized in Table 28.

Table 28: Bootstrap results

Incomplete Site	Predictor Site	Bootstrap Runs	Predicted DV* (ppb)	95% Confidence Interval (ppb)	Max Bootstrapped DV* (ppb)
450830009	450770002	1000	67	Lower: 66.47 Upper: 68.26	70.83
450010001	450770002	1000	62	Lower: 55.81 Upper: 63.56	73.49
450450016	450070005	1000	63	Lower: 63.98 Upper: 65.62	66.24
450791001	450790021	1000	66	Lower: 67.47 Upper: 68.98	69.09
450370001	130730001	1000	61	Lower: 59.38 Upper: 61.75	65.82
450790007	130730001	1000	61	Lower: 62.92 Upper: 65.63	65.14

*Note: the design values provided in this table are based on statistical modeling and are not intended to reflect actual design values as calculated in accordance with 40 CFR Part 50, Appendix U.

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Conclusions and Recommendations

All monitors which operated in South Carolina between 2014 and 2016 and collected a complete data set attained the 2015 ozone NAAQS. The sites listed in Table 1 did not have complete data for this time period, but showed design values less than the level of the ozone NAAQS. This analysis provides evidence that there was a minimal chance that the monitors could have exceeded the 2015 ozone NAAQS. A "brute force" analysis at many sites showed that under a worst-case scenario, the design value would have remained below the level of the NAAQS. A meteorological analysis, combined with a regression analysis to predict an ozone design value, demonstrates that six sites which did not pass the "brute force" analysis also would have attained the ozone NAAQS. The Department recommends that the EPA approve our request to deem the design values for all sites listed in Table 1 as complete because they occurred on days that were not conducive to ozone concentrations above the NAAQS in accordance with 40 CFR Appendix U to Part 50. The specific dates the Department requests exclusion for each site can be found on Table 29 and the new data completeness rates found on Table 30 both of which are located in Appendix C. The Due West monitoring site (450010001) did not meet 90% data completion after selecting additional days to waive. This site was terminated after the conclusion of the 2016 ozone monitoring season. The Department does not believe that the ozone NAAQS could have been exceeded at this site due to the long history of low ambient air concentrations of ozone.

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Appendix A – Theil-Sen Regression Plots

Figure 49: North Spartanburg

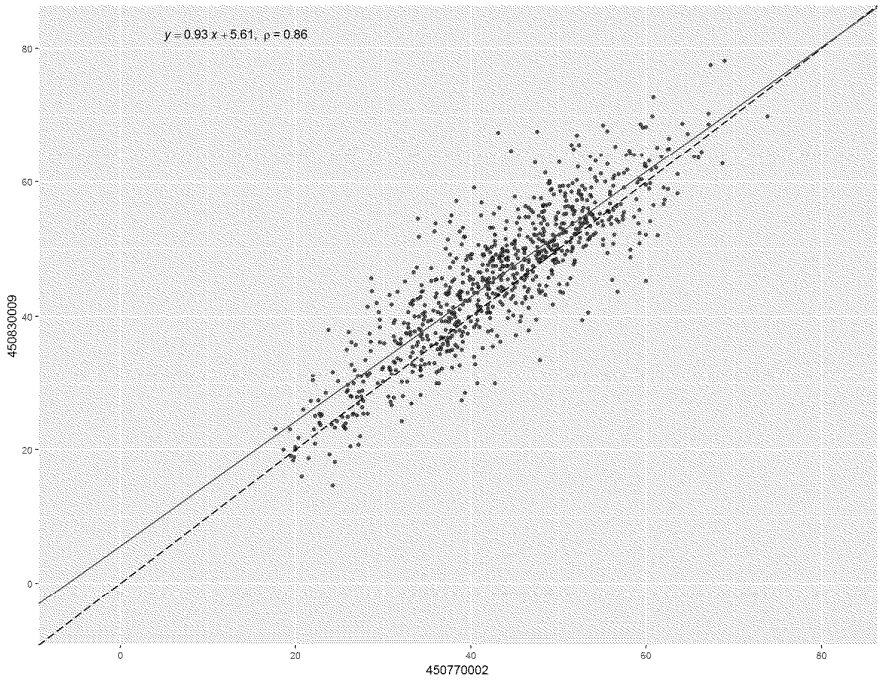


Figure 50: Due West

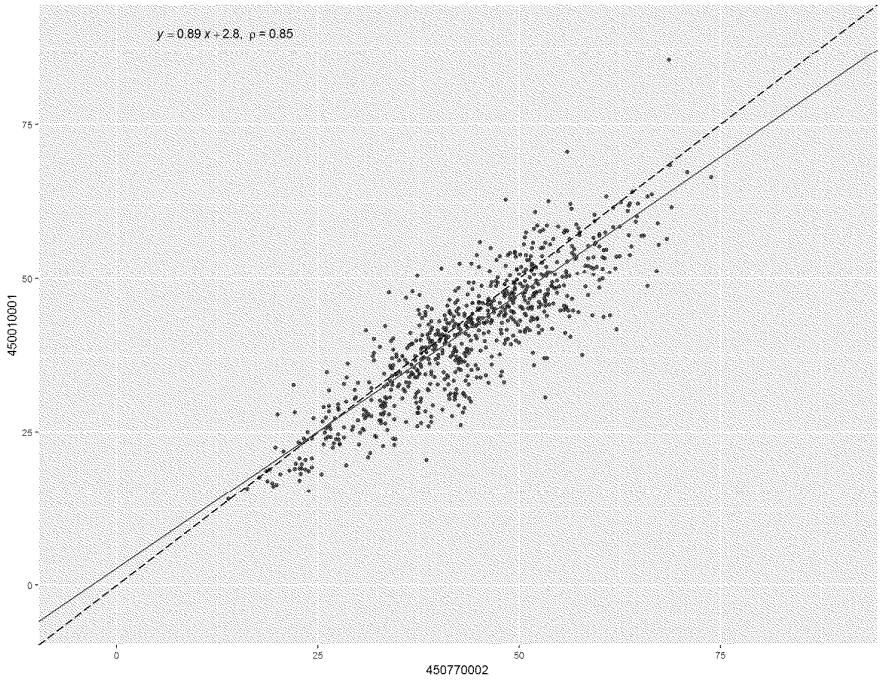


Figure 51: Hillcrest

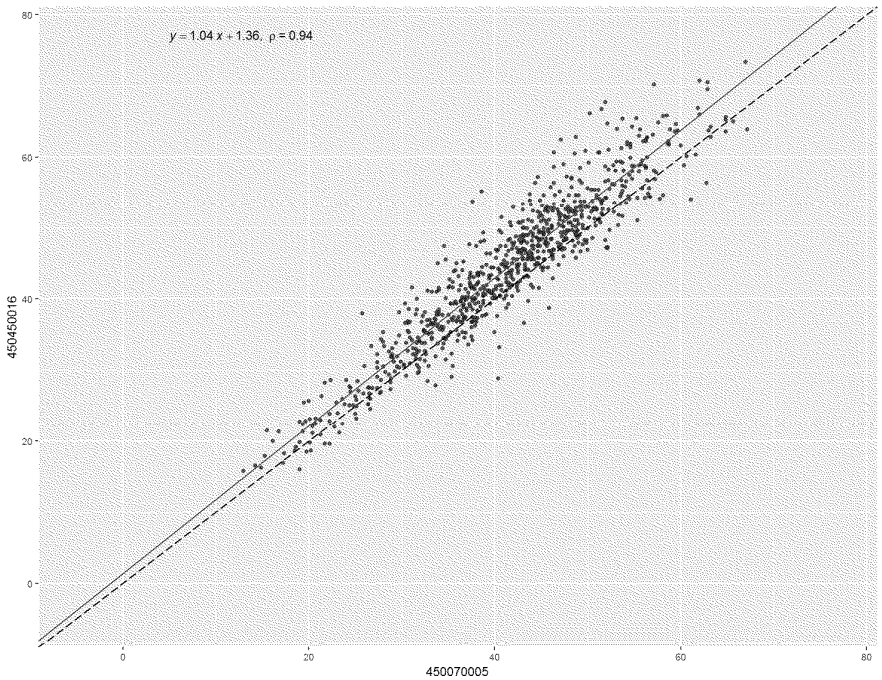


Figure 52: Sandhill

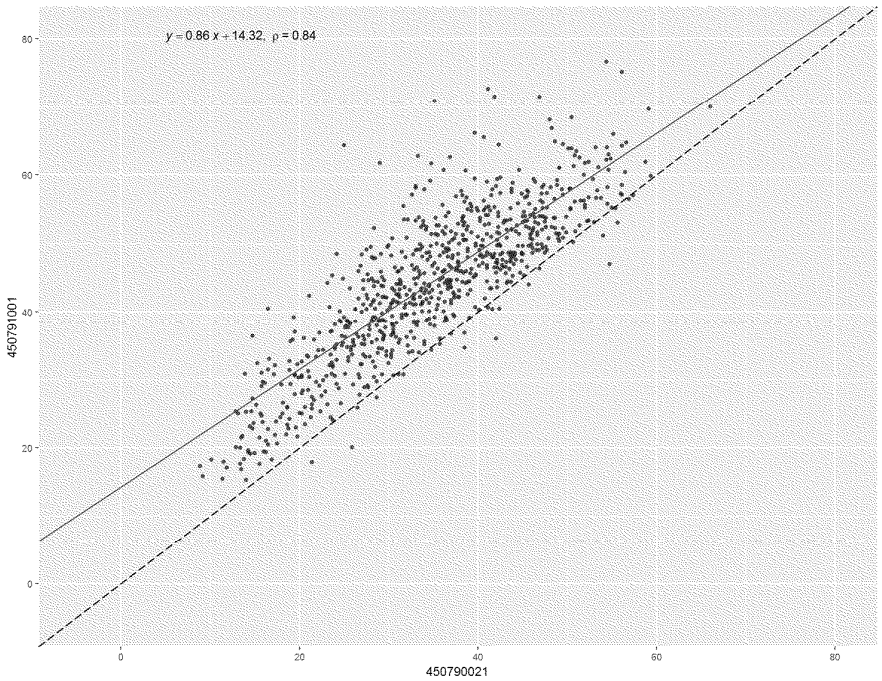


Figure 53: Trenton

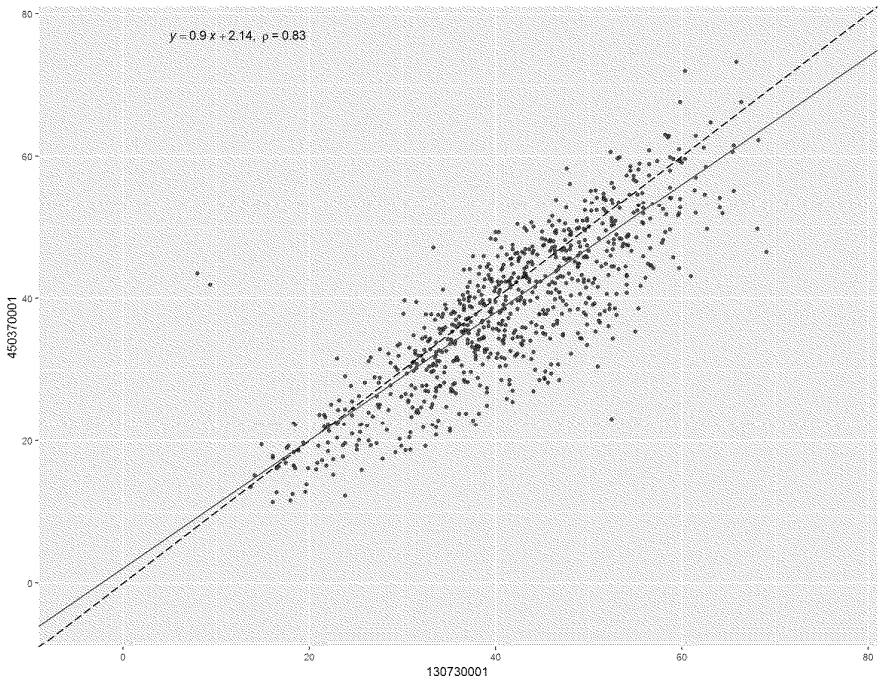
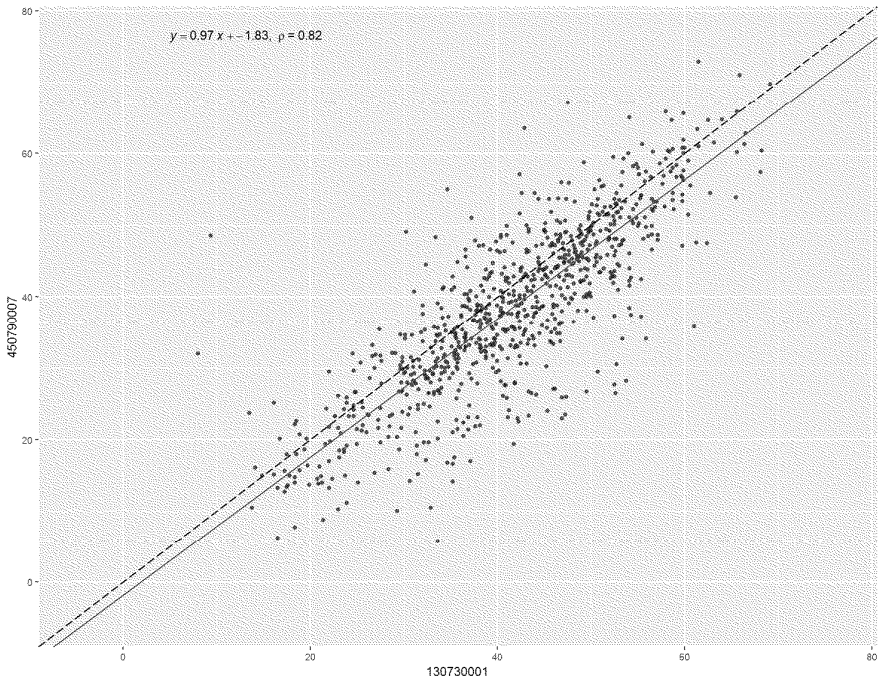
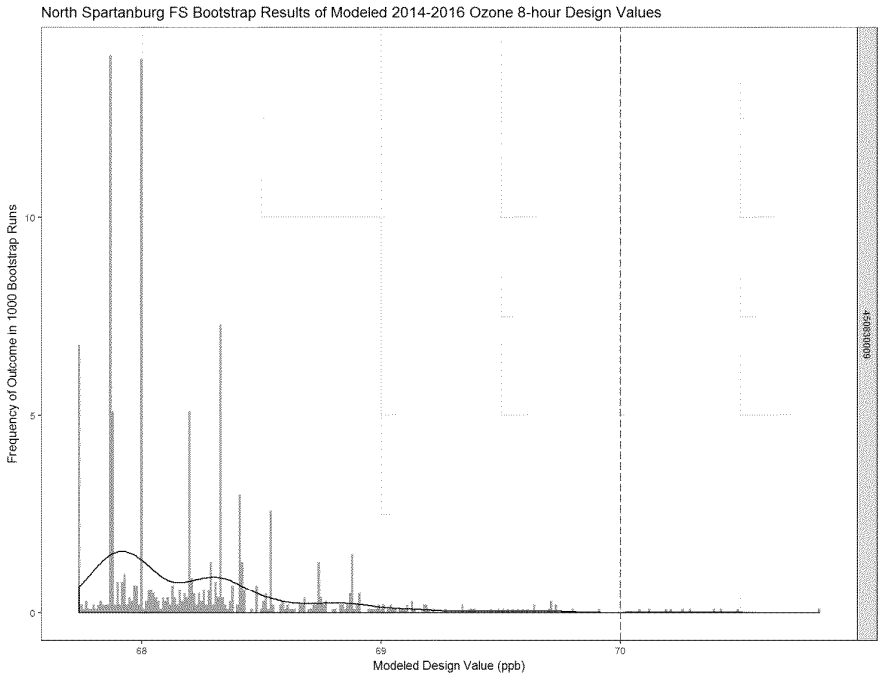
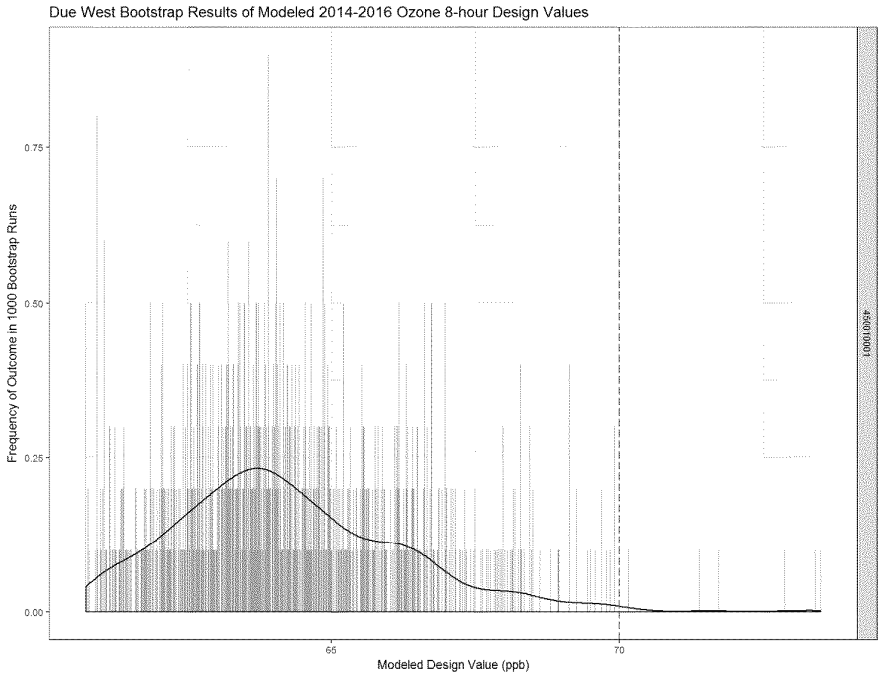


Figure 54: Parklane

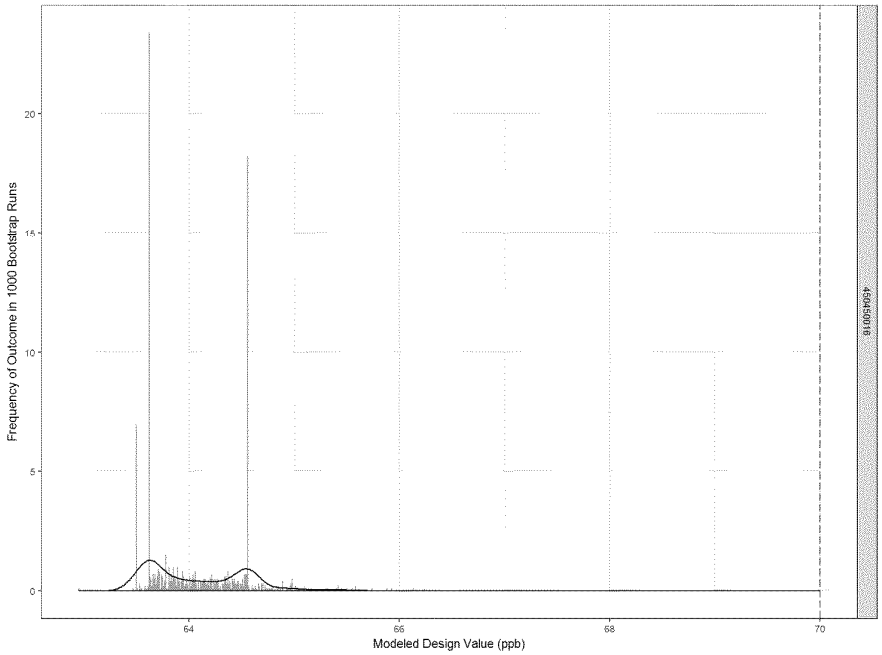


Appendix B – Bootstrap results for modeled design values

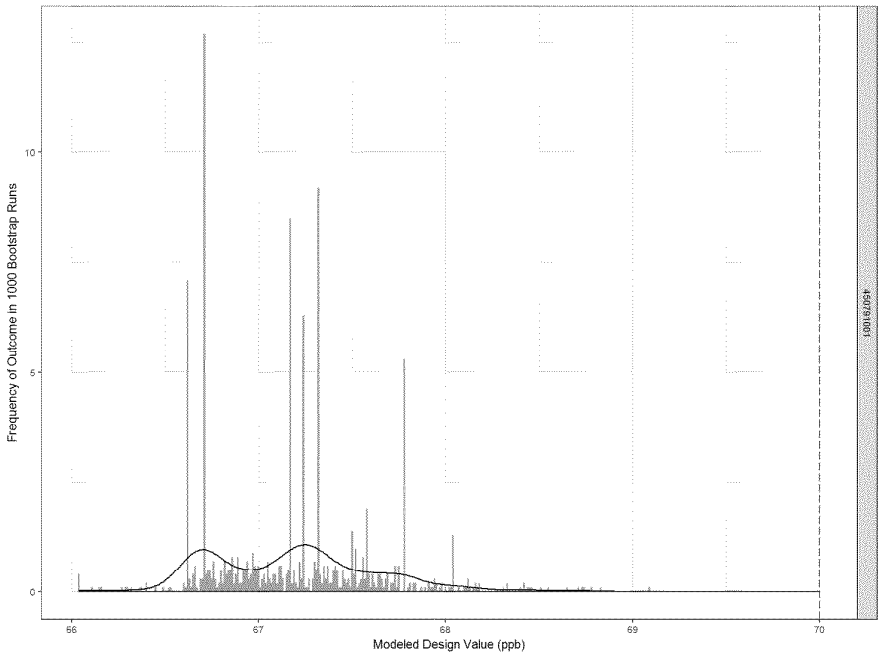


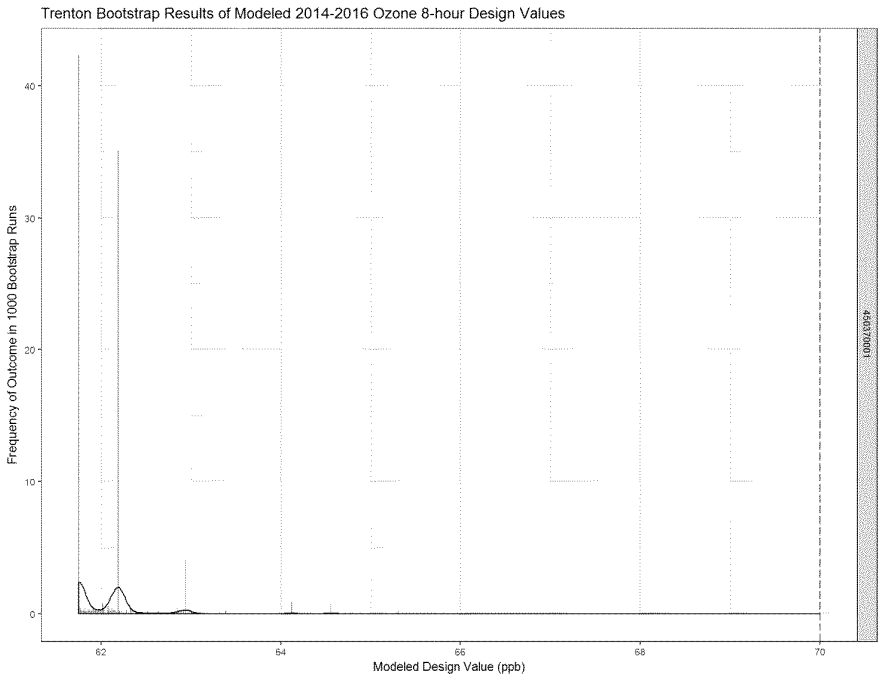


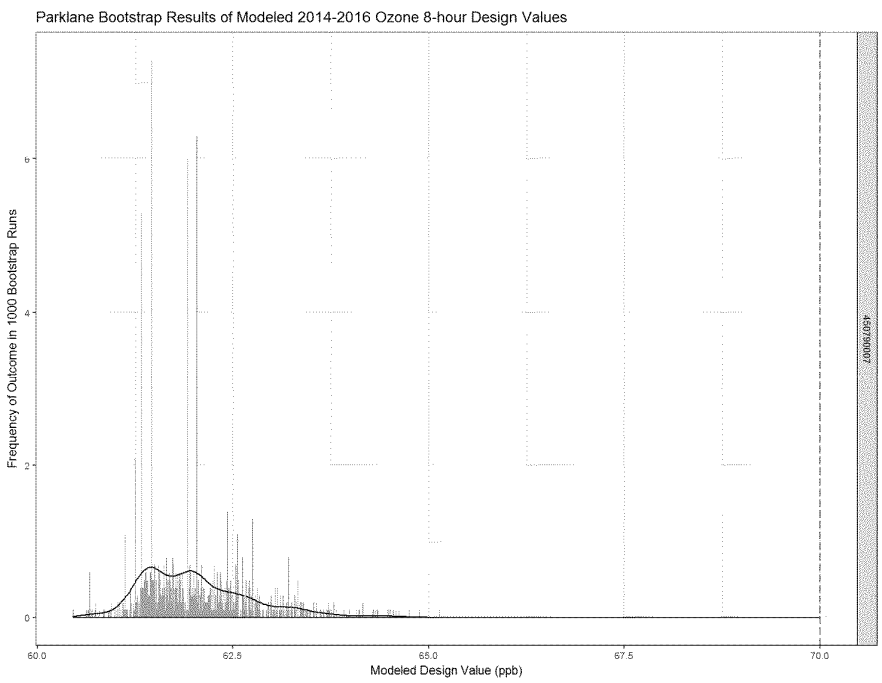
Hillcrest Bootstrap Results of Modeled 2014-2016 Ozone 8-hour Design Values



Sandhill Bootstrap Results of Modeled 2014-2016 Ozone 8-hour Design Values




Trenton Bootstrap Results of Modeled 2014-2016 Ozone 8-hour Design Values
Frequency of Outcome in 1000 Bootstrap Runs
Modeled Design Value (ppb)
34013000 1


Parklane Bootstrap Results of Modeled 2014-2016 Ozone 8-hour Design Values
Frequency of Outcome in 1000 Bootstrap Runs
Modeled Design Value (ppb)
450390007

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Appendix C – Days Requested for Exclusion from Data Completion Requirements

Table 29: Days requested for waiver

Year	Month	Due West 450010001	Bushy Park 450190002	Cape Romain 450190046	Ashton 450290002	Trenton 450370001	Hillcrest 450450016	Clemson CMS 450770002	Wolf Creek 450770003	Parklane 450790007	Congaree Bluff 450790021	Sandhill 450791001	North Spartanburg 450830009
2014	April	1,3 – 6, 8 – 9, 13 – 16 (11)	1 – 2 (2)	1 – 23 (23)	1, 22 (2)	3 (1)		7 (1)	1 – 2, 5 – 7, 17 (6)	18 – 23, 25 – 30 (12)		14 (1)	29 – 30 (2)
	May				23, 27 (2)	12 – 20, 22, 28 – 31 (14)					5 – 7 (3)		1 – 3 (3)
	June	10 – 15, 17 – 30 (20)	26 – 30 (5)			1 – 27 (27)	21 – 26, 28 – 30 (9)	16 (1)	25 (1)	23 – 30 (8)	13 (1)	5 (1)	5 – 6 (2)
	July	1 – 8 (8)	1 – 10 (10)	17 – 30 (14)	9 – 22, 28 (15)		15 – 16, 18 – 29, 31 (15)		11 (1)	1 – 8 (8)		28 – 31 (4)	
	August			15, 22 (2)			1 – 5, 8 – 14 (12)			4 – 15, 17 – 27, 30 – 31 (25)		1 – 5, 9 – 27 (24)	13 (1)
	September	17 – 20, 22 – 30 (13)				16 (1)	23 – 30 (8)	9, 21 (2)		1 – 4 (4)	2 (1)	23 (1)	
	October	1 – 17, 29 (18)	1, 7 – 8 (3)		4, 14 (2)	2 – 30 (29)	1 – 9 (9)		1 (1)	2 (1)	3 – 30 (28)		10 (1)
	Total	**50**	**20**	**39**	**21**	**72**	**53**	**4**	**9**	**58**	**33**	**31**	**9**
2015	April	2 – 8 (7)		22 – 30 (9)			15 – 19 (5)	9 – 30 (22)	30 (2)	10 (1)		8 – 21, 25 – 26, 29 (17)	
	May		1 (1)	1 – 20 (20)	26 (1)	4, 22 – 31 (11)		1 – 31 (31)	1 – 12 (12)	8 – 13, 15 – 21 (13)	15, 18 – 31 (15)	1, 7 (2)	
	June	10 – 16, 18 – 30 (20)	5 – 21, 24 – 30 (24)	16 (1)		1 – 30 (30)		1, 17 (2)	8, 23 – 30 (9)	2 – 15 (14)	1 – 14, 27 – 29 (17)		18 – 30 (13)
	July	1 – 16, 18 – 21 (20)			7 – 11, 13 – 24, 27 – 31 (22)	1 – 31 (31)			1 – 21 (21)		2 – 13, 31 (13)	17 – 21 (5)	1 – 7 (7)
	August		25 (1)		1 – 12, 17 – 31 (27)	11 – 28 (18)	6 – 9, 13 (5)	11 – 12 (2)		11 (1)	13 – 26 (14)	7 (1)	
	September	13 – 15, 18 – 20, 27 (7)		8 (1)	1 – 17 (17)			8 (1)	1 – 30 (30)	8 (1)			28 – 30 (3)
	October	14 (1)	13 – 14 (2)	28 – 31 (4)		15 (1)		7, 16 (2)	3, 14, 28 (3)	15 (1)	18 – 19, 27 – 31 (7)		1 – 6, 8 – 15, 17 – 21 (19)

Year	Month	Due West 450010001	Bushy Park 450190002	Cape Romain 450190046	Ashton 450290002	Trenton 450370001	Hillcrest 450450016	Clemson CMS 450770002	Wolf Creek 450770003	Parklane 450790007	Congaree Bluff 450790021	Sandhill 450791001	North Spartanburg 450830009
	Total	**55**	**28**	**35**	**67**	**91**	**10**	**60**	**77**	**31**	**66**	**25**	**42**
2016	April	26 – 30 (5)			1 – 19, 26 – 27 (21)	11, 17, 29 – 30 (4)	13 (1)			22 – 30 (9)		30 (1)	1 – 13, 27, 30 (15)
	May	1 – 24, 26 – 31 (30)		13 – 31 (19)	11, 23 (2)					1 – 4 (4)		1 – 2 (2)	1 – 8, 11 – 17 (15)
	June	1 – 7 (7)		1 – 22 (22)	27 (1)						3 – 4, 17, 25, 30 (5)		
	July	8, 18 – 19 (3)		6, 14 – 19 (7)					8 – 10, 13 (4)		1 – 3, 10 – 11, 14, 19 – 21, 26 – 28 (12)		5, 16, 25 (3)
	August	12 – 15 (4)			22 (1)	3 – 4, 9 (3)				3, 5 – 6, 10 – 13 (7)			8 – 10 (3)
	September		20 – 30 (11)	13, 27 – 30 (5)	8 (1)	25, 28 (2)	14, 16 – 23 (9)	20 (1)		1 – 15, 24 – 26 (18)			
	October		1 – 20, 25 – 26 (22)	1 – 18 (18)	8 – 9, 13, 25 (4)			25 – 31 (7)	17 – 18 (2)	12 – 14, 16 – 25, 28 (14)	8 (1)		
	Total	**49**	**33**	**71**	**30**	**9**	**10**	**8**	**6**	**52**	**18**	**3**	**36**

Table 30: Proposed Data Completeness with Days Waived

Site ID	Site Name	2014 Complete Days (% Complete)	2015 Complete Days (% Complete)	2016 Complete Days (% Complete)	Three year data completeness
450010001	Due West	136 (83%)	123 (77%)	163 (99%)	86%
450150002	Bushy Park	194 (100%)	186 (100%)	181 (100%)	100%
450190046	Cape Romain	175 (100%)	179 (100%)	143 (100%)	100%
450290002	Ashton	193 (100%)	147 (100%)	184 (100%)	100%
450370001	Trenton	136 (96%)	123 (100%)	205 (100%)	99%
450450016	Hillcrest	152 (94%)	193 (95%)	203 (100%)	96%

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Site ID	Site Name	2014 Complete Days (% Complete)	2015 Complete Days (% Complete)	2016 Complete Days (% Complete)	Three year data completeness
450770002	Clemson CMS	210 (100%)	154 (100%)	206 (100%)	100%
450770003	Wolf Creek	205 (100%)	138 (100%)	208 (100%)	100%
450790007	Parklane	152 (97%)	182 (99%)	161 (99%)	99%
450790021	Congaree Bluff	181 (100%)	148 (100%)	196 (100%)	100%
450791001	Sandhill	180 (98%)	178 (94%)	211 (100%)	98%
450830009	North Spartanburg	200 (98%)	168 (98%)	168 (94%)	97%

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AGENDA

U.S. EPA Region 4
Air Monitoring Workshop
March 21 - 23, 2017

Ex. 6 - Personal Privacy

Athens, Georgia

TUESDAY, March 21st

8:30 – 9:00	Registration	
9:00 - 9:30	Welcome - Introductions	- J. Gettle, L. Ackerman, T. Rinck
9:30 – 10:00	CASTNet Network Design & Data	- Tim Sharac – EPA
10:00 – 10:30	National Atmospheric Deposition Program	- David Gay- NADP
10:30 – 11:00	Break	
11:00 – 12:00	SO_2 / O_3 Designation Update	- Daniel Garver, APTMD
12:00 - 1:15	LUNCH	
1:15 - 2:00	Low Level Audit Update	- Keith Harris, Tony Bedel
2:00 - 2:30	Teledyne 640 - $PM_{2.5}$ Continuous Instrument	- Teledyne API
2:30 - 3:00	Break	
3:00 - 4:00	Tips, Tricks and Techniques	- Chattanooga, Louisville, MS, NC
4:00 - 5:00	EXHIBITION VIEWING	- EPA Available for Discussion

WEDNESDAY, March22nd

8:00 - 8:45	Quality Assurance 102 - SOPs	- Stephanie McCarthy
8:45 - 9:15	Region 4 - SOP Checklist	- Keith Harris / Group Discussion
9:15 - 10:00	Lead Lab & Data Issues	- Stacie Masters
10:00 - 10:30	Break	
10:30 – 11:00	Exceptional Events	- Darren Palmer
11:00 - 11:45	Tips, Tricks and Techniques	- Charlotte, Winston-Salem, Asheville
11:45 - 1:00	LUNCH	
1:00 - 1:45	Questions to EPA	- SESD, APTMD, OAQPS
1:45 - 2:30	Data Validation & Precision Data	- Tony Bedel / S. McCarthy
2:30 - 3:00	Break	
3:00 - 3:30	NPAP - PEP Update – New Mobile Lab Tour	- Mike Crowe, Jason Brown-Alion
3:30 - 4:00	Tips, Tricks and Techniques	- SC, TENNESSEE
4:00 - 5:00	EXHIBITION VIEWING	- EPA Available for Discussion

3/20/2017 3:20:41 PM

THURSDAY , March 23rd

8:00 – 9:00	Tips, Tricks and Techniques	- Memphis, Nashville, Knoxville, EBCI
9:00- 9:30	NO_2 CAPs Update/NO_2 Cylinder Testing	- Vicki Taylor / Joette Steger
9:30 – 10:00	PAMS Program Developments	- Kevin Cavender / OAQPS
10:00 - 10:30	Break - (Hotel Checkout)	
10:30 - 10:45	Region 4 Toxic Studies Update	- Sara Waterson
10:45 - 11:15	Probing Precision Problems	- Sid Stevens
11:15 - 11:45	National Air Toxics Trends Stations (NATTS)	- Dave Shelow
11:45 - 12:00	NATTS TSAs	- Greg Noah
12:00	ADJOURN	

- - - -

To: Flynn, Thomas[flynntj@dhec.sc.gov]
Cc: Garver, Daniel[garver.daniel@epa.gov]
From: Brown, Ryan
Sent: Tue 8/30/2016 6:04:51 PM
Subject: Ozone Incomplete Data Demonstrations
Philadelphia_example.zip
AQM -2013 Freemansburg Missing Ozone Analysis.pdf
Delaware_example.zip
Imperial FOA Missing Data Analysis_04222013_dmv.docx
Knox County Ozone Air Directors Presentation Final.pptx

Tommy,

Here are the examples of previously approved ozone incomplete data demonstrations. Daniel and I worked on the Knoxville demonstration. The others are from Region 3 and Region 9.

Ryan

Ryan Brown

U.S. Environmental Protection Agency, Region 4

Air, Pesticides & Toxics Management Division

61 Forsyth Street, SW

Atlanta, GA 30303

(404) 562-9147

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

MISSING OZONE DATA ANALYSIS FOR THE 2013 OZONE SEASON

FREEMANSBURG Ozone Sampler

(AQS SITE ID 42-095-0025)

BUREAU OF AIR QUALITY

July 2015

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Background and Summary

The Pennsylvania Department of Environmental Protection (DEP) operates and maintains several ozone monitors in the Allentown-Bethlehem-Easton ozone nonattainment area (Allentown Area) for the 2008 8-hour ozone National Ambient Air Quality Standard (NAAQS). During the 2013 ozone monitoring season, the Freemansburg ambient air monitoring station (AQS ID 42-095-0025) in Northampton County had missing ozone ambient air monitoring data for 75 days during the ozone monitoring season. The primary period for missing ozone ambient air data occurred at the Freemansburg ozone monitor from August 10, 2013, to October 1, 2013, as a result of a malfunctioning sensor. In addition, other miscellaneous issues resulted in smaller data loss on certain days in June, July, August and October 2013. The resulting total valid ozone data capture for 2013 at the Freemansburg monitoring site was 65%. With regard to calculating the 2014 design value for Freemansburg, data from 2012, 2013 and 2014 is necessary. The ozone data capture for 2012 was 99% and the data capture for 2014 was 98%, resulting in a three year (2012-2014) average of 88%.

Section 2.3(b) of Appendix P to 40 CFR Part 50 requires three consecutive years of ambient air ozone data with data availability of at least 90% of the days within the ozone monitoring season, on average, with a minimum data completeness in any one year of at least 75% within the ozone monitoring season. Section 2.3(b) of Appendix P further specifies the following:

> *"…When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard. Missing days assumed less than the level of the standard are counted for the purpose of meeting the data completeness requirement, subject to the approval of the appropriate Regional Administrator."*

In order for days with missing ozone data to be considered for the completeness calculation, a "BG" qualifier flag has to be placed for the corresponding days in EPA's Air Quality System (AQS), indicating "Missing ozone data not likely to exceed level of standard." As part of its analysis to determine which day s in 2013 would be considered for flagging, DEP's Bureau of Air Quality (BAQ) air quality monitoring staff utilized a 5-year ozone data set (2010 to 2014) from the Freemansburg ozone monitor to account for representative meteorology during ozone exceedances. In determining the link between meteorology and ozone exceedances, BAQ was able to determine which meteorological factors were not conducive to ozone concentrations above the 2008 ozone standard. In addition, BAQ performed a correlation analysis between the Freemansburg ozone monitoring site and other local regional ozone monitors to demonstrate that a suitable linear regression equation with a high coefficient of determination could be used to generate estimated daily 8-hour ozone maxima for the missing days in 2013.

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Results for the 2013 Missing Data Analysis for the Freemansburg Ozone Monitor

1.) Meteorological Analysis Approach

Ozone formation in the 2010 to 2014 period at the Freemansburg monitor can be characterized by the following meteorological factors:

a.) Afternoon temperatures at the Lehigh Valley International Airport (KABE) reached at least 86 °F during ozone exceedance days.
b.) Prevailing wind flow was from the west, southwest during ozone exceedance days.

Using the factors above, BAQ characterized the days for flagging consideration based on the following criteria:

a.) Days in which the maximum temperatures at KABE reached 85°F or lower.
b.) Days in which the prevailing wind flow was from any direction EXCEPT the west and southwest.

After performing this analysis, BAQ was able to determine which days are eligible for flagging. Table 1 below illustrates the group of days BAQ is requesting to have the "BG" flag assigned.

Table 1 – Proposed Dates for "BG" Flag

Dates	No. of Days
7/13	1
8/5	1
8/11	1
8/15	1
8/17 - 8/18	2
8/23 - 8/24	2
8/29	1
9/6	1
9/9	1
9/13 - 9/15	3
9/17	1
9/21	1
9/23 - 9/29	7
10/1	1
10/6 - 10/7	2
10/9 - 10/16	8
Total	34

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The addition of the 34 days of missing data to the 2013 Freemansburg ozone data results in a yearly data completeness of 81%.

2.) *Correlation Analysis Approach*

BAQ performed a correlation analysis to illustrate how well the daily maximum 8-hour ozone data at the Freemansburg ozone monitoring site tracks with the regional daily maxima.

The results of the correlation analysis showed a high coefficient of determination ($R^2 = 0.9155$) between the Freemansburg daily 8-hour maximum ozone concentration and the regional daily maximum ozone concentration. Due to the high level of correlation, the regression equation was deemed suitable for generating estimated daily maxima ozone values for the missing days at Freemansburg.

By using the regression equation to calculate Freemansburg's ozone concentration as a function of the regional daily maxima, all of the 75 missing days at Freemansburg were below the 2008 8-hnour ozone NAAQS of 0.075ppm.

Freemansburg's current 2013 4th high ozone concentration is 0.065 ppm. Filling in the 75 missing days at Freemansburg utilizing the result from the regression equation yields a new 2013 4th high concentration of 0.067 ppm. As a result, the projected 2014 design value would be 0.069 ppm, 0.006 ppm below the 2008 ozone NAAQS of 0.075 ppm. Therefore, based on the results of the correlation analysis, BAQ is predicting that the Freemansburg ozone monitor would be monitoring attainment of the 2008 ozone NAAQS.

Conclusions

BAQ utilized two approaches to demonstrate that the Freemansburg monitor would be in attainment of the 2008 8-hour ozone NAAQS. Based on the results of the first approach, the BAQ is requesting EPA's approval to flag 34 days with the "BG" flag in AQS. By doing so, the 2013 annual completeness percentage will increase from 65% to 81%, fulfilling the 75% complete annual data capture rate. With 2013's annual completeness percentage at 81%, the completeness percentage over the 2014 design period would be calculated to be 93%, which meets the minimum requirement of 90% as outlined in 40 CFR Part 50 Appendix P Section 2.3(b).

In addition, BAQ used a correlation analysis to demonstrate that a substitution method by regression method (i.e. calculating daily Freemansburg concentrations based on a regional daily maxima) would be adequate to demonstrate continued attainment of the 8-hour ozone NAAQS within the Allentown-Bethlehem-Easton ozone nonattainment area.

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Data Analysis for 2013

Overview

BAQ utilized two approaches to determine whether the Freemansburg ozone monitor would attain the 2008 ozone NAAQS by July 2015: a meteorological analysis approach and a correlation analysis approach. The primary approach was the meteorological analysis approach, as outlined 40 CFR Part 50 Appendix P Section 2.3(b). The correlation analysis used for the secondary approach reemphasizes that if a substitution method was a practical method to account for missing ozone data, the Freemansburg ozone monitor would continue to attain the 2008 ozone NAAQS.

Methodology for the Meteorological Analysis

By completing the meteorological analysis approach, BAQ is able to formally request the addition of the "BG" flag to ozone data in AQS so that the Freemansburg ozone data can be considered complete for 2013. BAQ was able to utilize two factors: daily high temperatures and Hysplit back trajectories, to determine which of the missing days to flag.

Historical Ozone Data at Freemansburg

BAQ used ozone data from the 2010 to 2014 period to determine the representative meteorological conditions necessary to cause ozone exceedances at the Freemansburg monitor. Daily maximum temperatures correlate very well with daily maximum 8-hour ozone concentrations. For this analysis, maximum temperatures were extracted from KABE, which is approximately 5 miles to the west, northwest of the Freemansburg monitor. The topographical map in Figure 1 illustrates the location the Freemansburg ozone monitor with respect to KABE.

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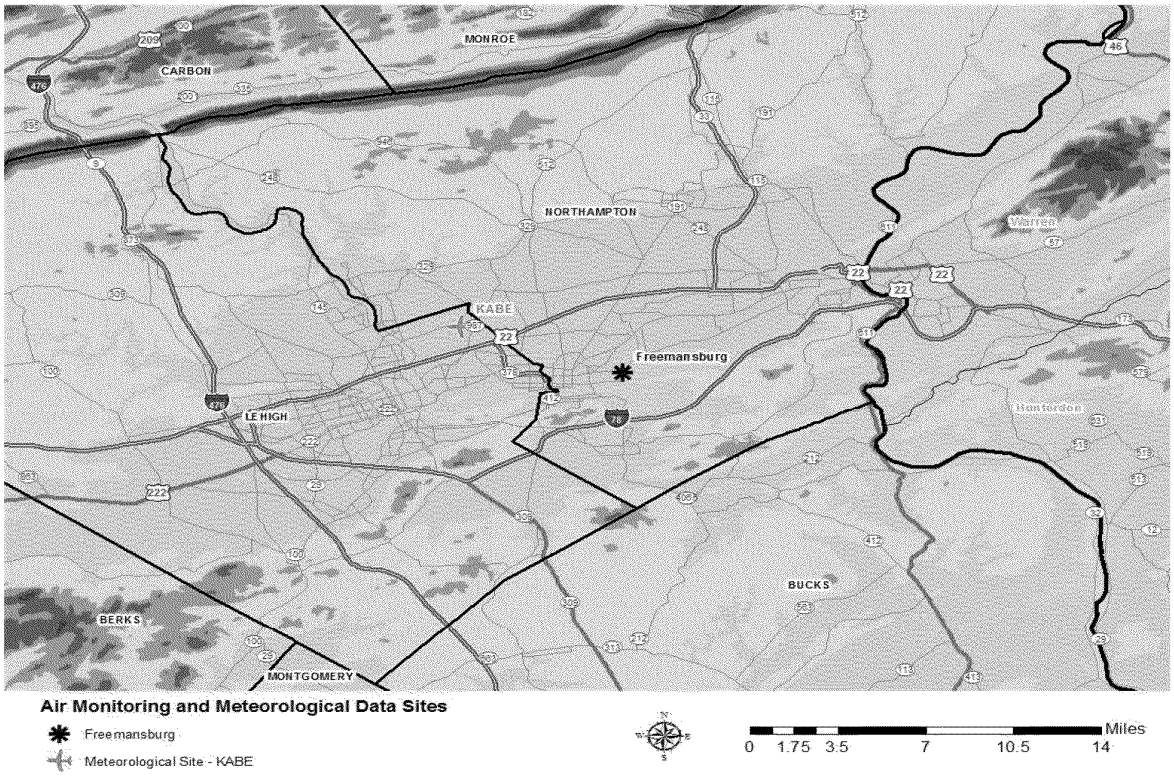
Figure 1 – Topographical Map Illustrating Location of Freemansburg Monitor and KABE



The Freemansburg ozone monitor and KABE are both situated in a valley, bounded to the north by Blue Mountain and to the south by South Mountain. Therefore, the meteorological conditions at KABE are representative of conditions at the Freemansburg site. Table 2 illustrates the days in which the Freemansburg monitor exceeded the 2008 ozone NAAQS and the recorded high temperature for those days at KABE.

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Table 2 – Days the Freemansburg Maximum Ozone Daily 8-Hour Conc. Exceeded 0.075 ppm

Date	Max 8-Hour Ozone Conc. (ppm)	KABE High Temp (°F)
6/26/2010	0.076	89
7/4/2010	0.082	96
7/6/2010	0.079	101
7/28/2010	0.076	86
8/10/2010	0.078	92
8/19/2010	0.082	87
9/1/2010	0.094	95
9/2/2010	0.092	96
9/22/2010	0.078	88
6/7/2011	0.076	87
6/9/2011	0.079	96
7/20/2011	0.076	94
7/21/2011	0.076	100
6/10/2012	0.079	90
7/17/2012	0.082	95

** The maximum high temperature is highlighted in RED, the minimum high temperature is highlighted in BLUE.

There were a total of 15 exceedance days at the Freemansburg ozone monitor from 2010 to 2014. During these exceedance days, the lowest maximum temperature was 86°F. In addition to determining a minimum temperature threshold for ozone exceedances at the Freemansburg site, BAQ determined the direction of the prevailing wind during the ozone exceedance days. To determine the prevailing wind direction on ozone exceedance days, Hysplit back trajectories (at a height of 500 meters) were generated at KABE. The 500 meter height was used because it represents the transport flow within the boundary layer.

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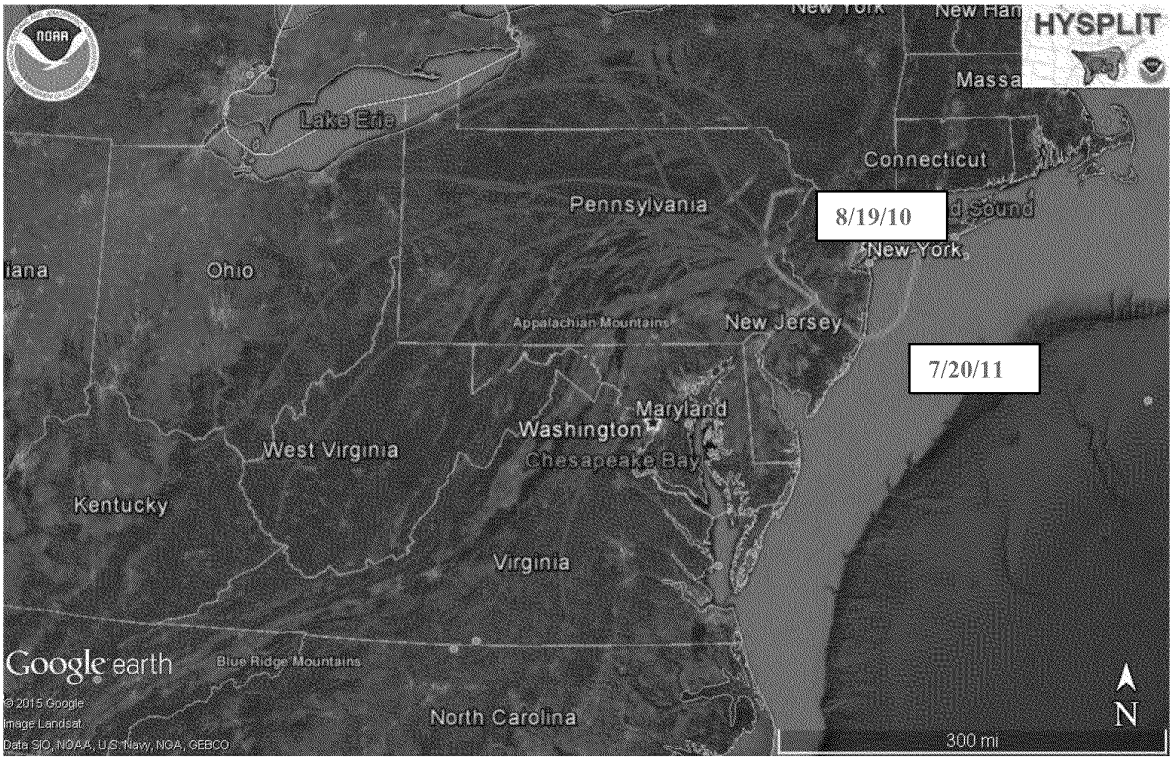
Figure 2 below illustrates the location of the prevailing wind during the ozone exceedance days at the Freemansburg site.

Figure 2 – 500-meter Back Trajectories of the 15 Ozone Exceedance Days at the Freemansburg Site Between 2010 and 2014

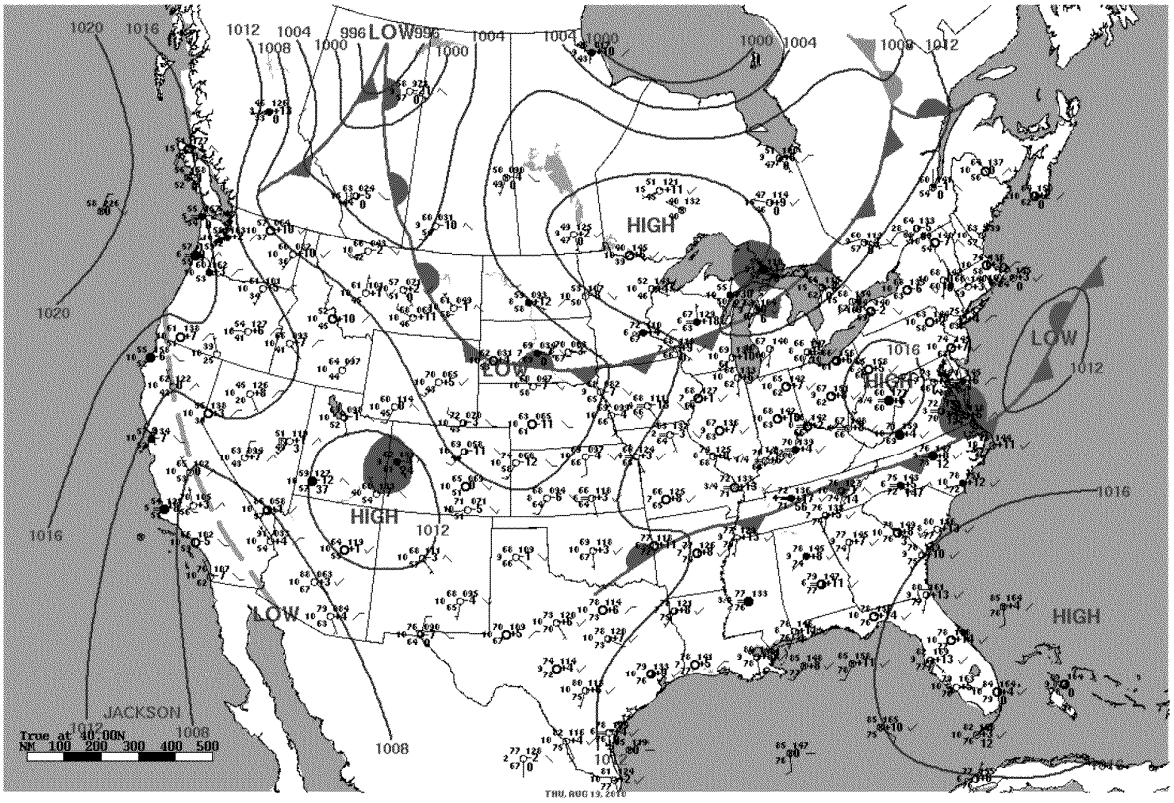
Two of the back trajectories are outliers. Figure 3 illustrates the two back trajectories, highlighted in purple, that are the outliers.

Figure 3 – The Two Outlier 500-Meter Back Trajectories



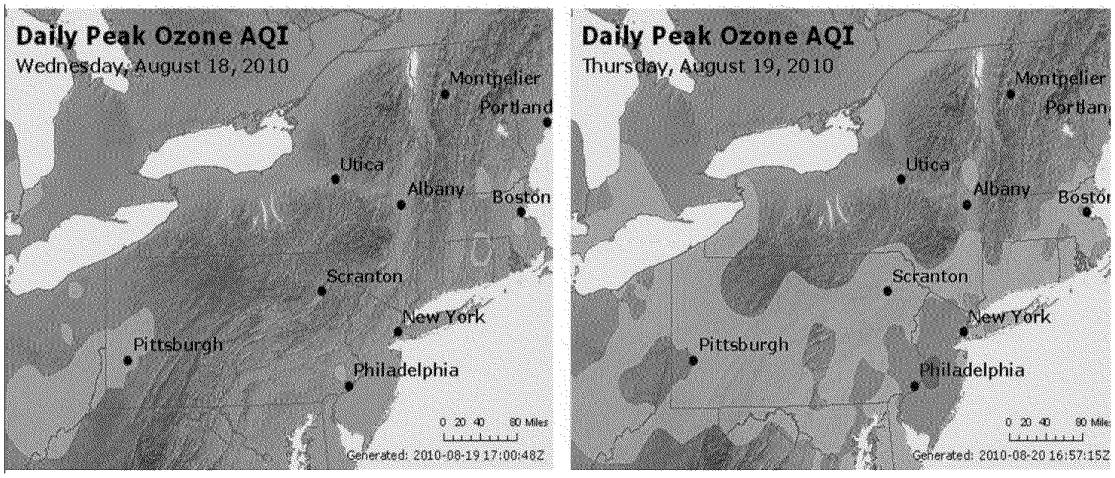
The two outlier trajectories occurred on August 19, 2010 and July 20, 2011. These two days were considered outliers based on the types of ozone exceedances that occurred on those days. Figure 4 below is a surface map developed by NOAA for August 19, 2010.

Figure 4 – NOAA Surface Map for August 19, 2010



On August 19, 2010, an area of high pressure was situated across western PA. The clockwise circulation around the high allowed Freemansburg to experience northerly winds during the day. Generally, northerly flow promotes a cleaner air mass across the Freemansburg area. The EPA Airnow maps in Figure 5 below illustrates why that was not the case.

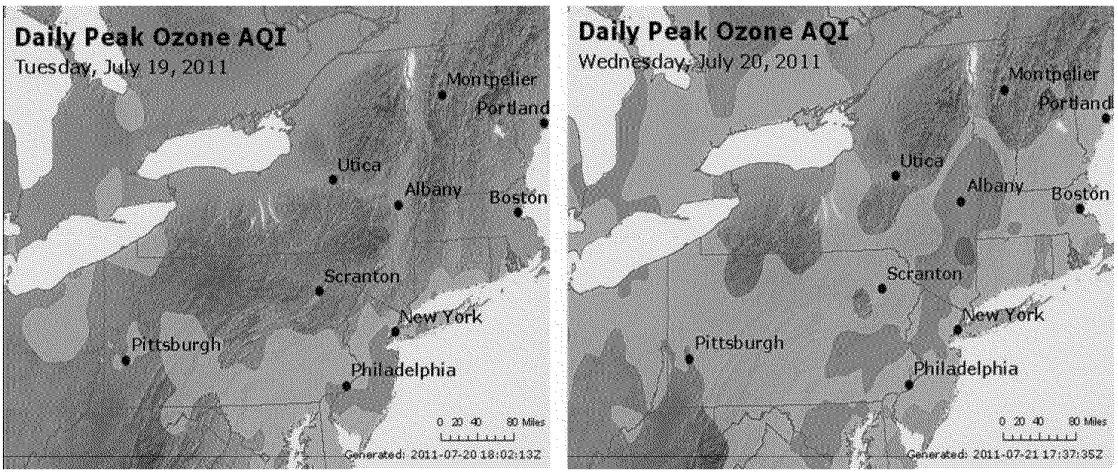
Figure 5 – EPA Airnow Maps from August 18, 2010 and August 19, 2010



Elevated ozone concentrations across New England the preceding day (August 18, 2010) along with light winds within the boundary layer (note how short the August 19, 2010, trajectory is in Figure 3 – this leads to more stagnant conditions developing over eastern PA) lead to the high ozone concentrations at the Freemansburg site on August 19, 2010.

Based on the back trajectory for July 20, 2011, winds were blowing from east to west across New Jersey and into Freemansburg. Figure 6 illustrates the maximum 8-hour ozone concentrations the preceding the day and the day of the ozone exceedance in Freemansburg.

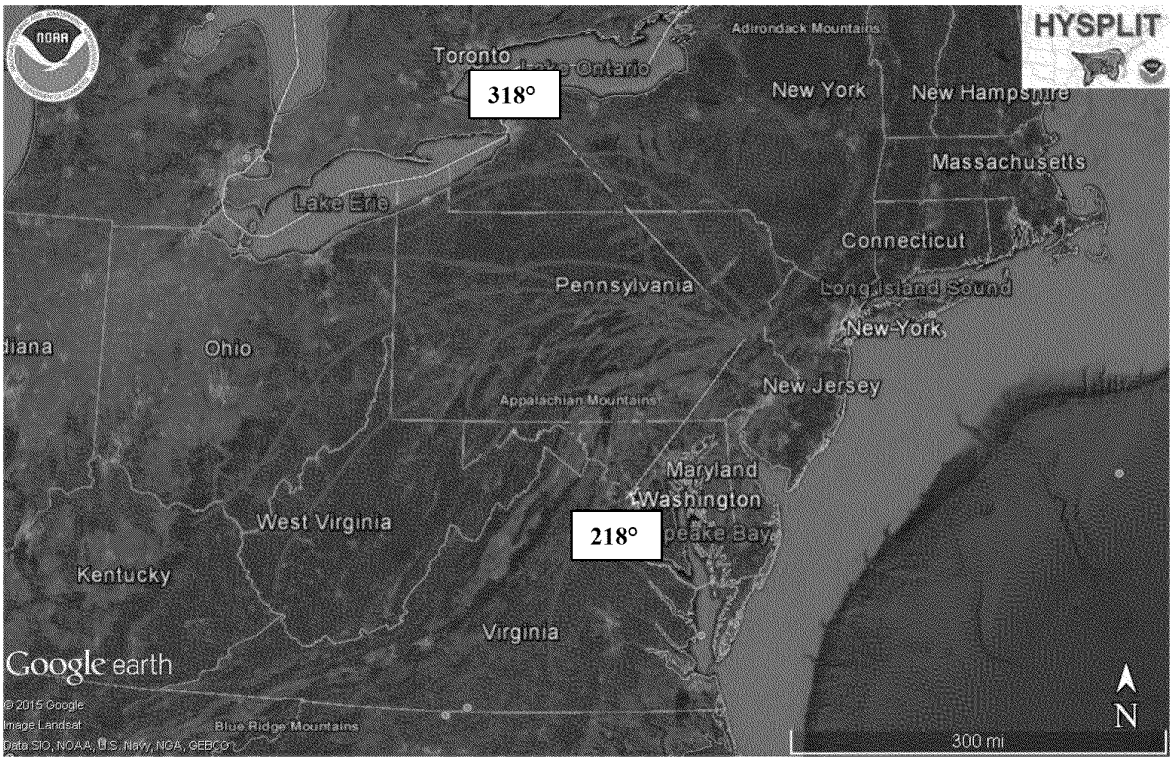
Figure 6 – EPA Airnow Maps from July 19, 2011 and July 20, 2011



Ozone concentrations were high across New Jersey on July 19, 2011. The easterly winds on July 20, 2011, allowed the air mass from New Jersey to recirculate back into eastern PA, causing the ozone exceedances in Freemansburg.

In order to determine the prevailing wind flow across the Freemansburg area, BAQ disregarded the two back trajectories from August 19, 2010, and July 19, 2011. Figure 7 analyzes the remaining the trajectories for boundaries of the prevailing wind flow.

Figure 7 – 500-Meter Back Trajectories of the Remaining 13 Ozone Exceedance Days at Freemansburg Between 2010 and 2014

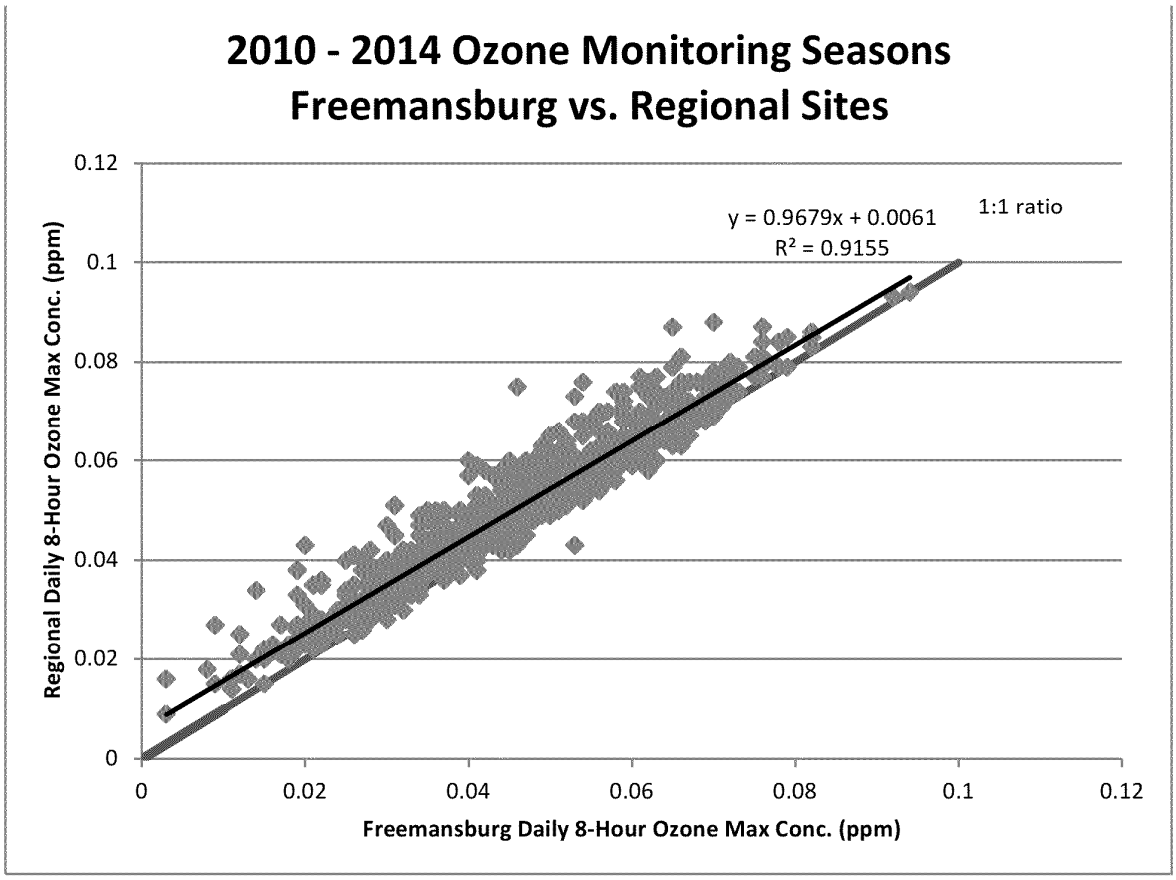


BAQ has highlighted the two trajectories (in blue) that form the bound of the wind direction profile necessary for ozone exceedances in the Freemansburg area. The two yellow lines are straight lines drawn from the origin (KABE) to the starting point of the back trajectories that form the bounds. The southern bound is at 218 degrees and the northern bound is at 318 degrees.

By using ozone data collected at seven regional monitors, BAQ was able to analyze the daily regional 8-hour ozone maximum concentration. On days when the Freemansburg data was available between 2010 and 2014, BAQ analyzed the correlation between the Freemansburg's daily 8-hour ozone maximum and the daily regional 8-hour ozone maximum concentration. The analysis demonstrated that there was a high coefficient of determination ($R^2 = 0.9155$) between the Freemansburg daily 8-hour ozone maximum concentration and the regional daily 8-hour ozone maximum concentration.

An X-Y scatter plot illustrating the high rate of correlation between the two data sets is provided below in Figure 8. This figure is further explained in the "Methodology for the Correlation Analysis" section in this document.

Figure 8 – Correlation Between the Freemansburg Daily 8-Hour Ozone Maximum Concentration and the Regional Daily 8-Hour Ozone Maximum Concentration



2013 Ozone Data at Freemansburg

In 2013, Freemansburg ozone data was missing for 75 of the 214 days in the ozone monitoring season. In order to determine which of these 75 missing days to flag, BAQ determined the days in which the maximum temperatures did not rise higher than 85°F and the back trajectories were between 0° to 218° and 318° to 360°. Table 3 displays the 75 days which were missing ozone data in 2013. Table 3 also highlights those days that met both the maximum temperature and back trajectory criteria listed above. Days in which met the back trajectory criteria were mapped. This map is displayed in Figure 9. In addition, the daily regional ozone maximum concentration during days when Freemansburg had missing data is outlined in Table 3. A more detailed table outlining the development of the daily regional ozone maxima appears in Appendix A.

Table 3 – Days in Which the Freemansburg Ozone Monitor Has Missing Ozone Data for 2013

Dates	KABE Max Temp (°F)	Hysplit Met Criteria	Regional Ozone Maxima (ppm)
6/25/2013	91		0.060
7/13/2013	83	X	0.043
7/14/2013	90		0.032
7/15/2013	95		0.050
8/5/2013	77	X	0.042
8/6/2013	79		0.059
8/10/2013	83		0.048
8/11/2013	81	X	0.048
8/12/2013	83		0.048
8/13/2013	80		0.050
8/14/2013	72		0.030
8/15/2013	76	X	0.042
8/16/2013	80		0.056
8/17/2013	82	X	**0.060**
8/18/2013	73	X	0.045
8/19/2013	76		0.045
8/20/2013	86		0.058
8/21/2013	86		0.071
8/22/2013	82		0.048
8/23/2013	80	X	0.031
8/24/2013	80	X	0.044
8/25/2013	80		0.054
8/26/2013	84		0.061
8/27/2013	88		0.058
8/28/2013	75		0.037
8/29/2013	84	X	0.053
8/30/2013	83		0.060
8/31/2013	85		0.054
9/1/2013	87		0.049
9/2/2013	83		0.048
9/3/2013	80		0.042
9/4/2013	79		0.052
9/5/2013	76		0.041
9/6/2013	71	X	0.039
9/7/2013	78		0.059
9/8/2013	80		0.044

**** The maximum regional ozone concentration is highlighted in RED.**

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Dates	KABE Max Temp (°F)	Hysplit Met Criteria	Regional Ozone Maxima (ppm)
9/9/2013	74	X	0.039
9/10/2013	88		0.065
9/11/2013	93		0.075
9/12/2013	85		0.062
9/13/2013	74	X	0.025
9/14/2013	61	X	0.023
9/15/2013	72	X	0.042
9/16/2013	71		0.038
9/17/2013	66	X	0.033
9/18/2013	71		0.047
9/19/2013	76		0.055
9/20/2013	79		0.062
9/21/2013	78	X	0.051
9/22/2013	67		0.030
9/23/2013	64	X	0.032
9/24/2013	73	X	0.040
9/25/2013	74	X	0.037
9/26/2013	74	X	0.036
9/27/2013	72	X	0.040
9/28/2013	74	X	0.040
9/29/2013	73	X	0.041
9/30/2013	73		0.044
10/1/2013	80	X	0.047
10/2/2013	83		
10/3/2013	80		0.054
10/4/2013	85		0.052
10/5/2013	85		0.052
10/6/2013	72	X	0.049
10/7/2013	76	X	0.030
10/8/2013	68		0.033
10/9/2013	61	X	0.033
10/10/2013	57	X	0.031
10/11/2013	64	X	0.033
10/12/2013	74	X	0.043
10/13/2013	68	X	0.040
10/14/2013	69	X	0.038
10/15/2013	74	X	0.043
10/16/2013	64	X	0.027
10/17/2013	74		

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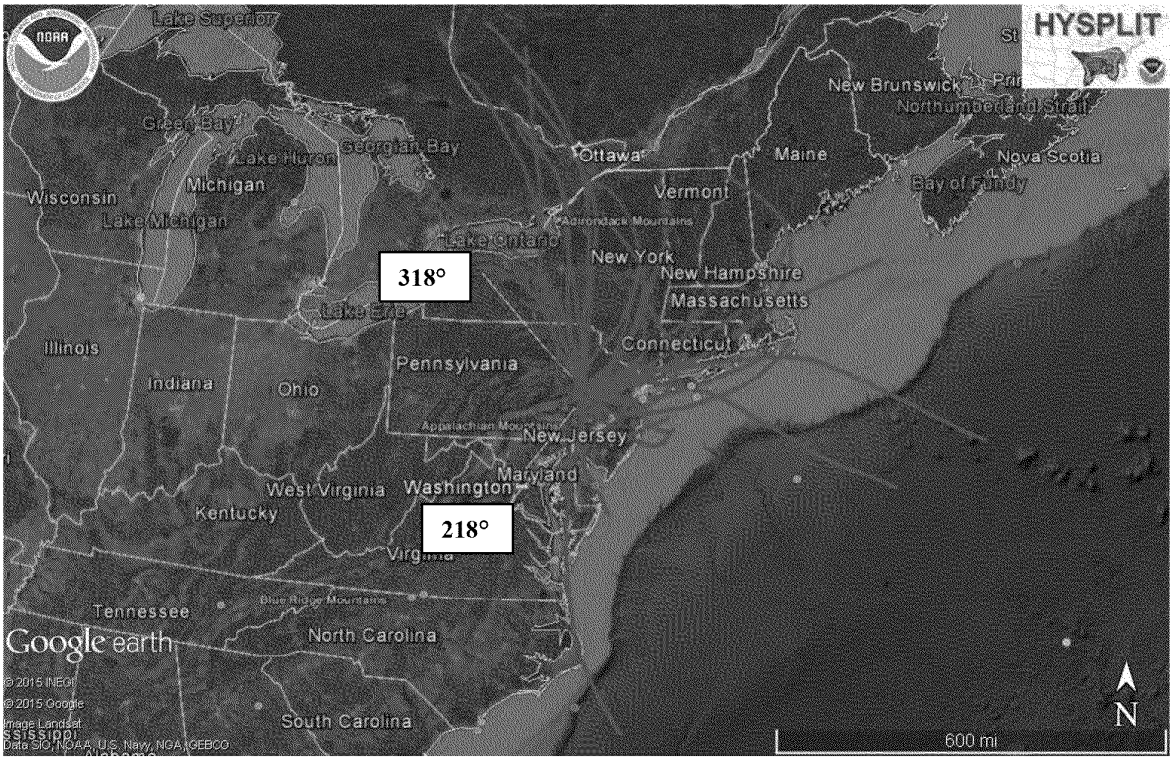
Figure 9 - 500-Meter Back Trajectories That Met the Trajectory Threshold During the Days That Had Missing Ozone Data



Conclusions

After the meteorological analysis was completed, BAQ determined there were 34 days (highlighted in grey in Table 3) which met both the maximum temperature and back trajectory criteria. During these 34 days, the highest daily regional ozone maximum concentration was 0.060 ppm on August 17, 2013. Due to the high rate of correlation between the Freemansburg daily 8-hour ozone maximum concentration and the daily regional ozone maximum concentration, BAQ determined that the Freemansburg monitor would not have experienced ozone concentrations exceeding the 2008 ozone NAAQS during the 34 missing days.

Therefore, the BAQ is requesting to flag the 34 days, which are highlighted in grey in Table 3, as "BG" within AQS. By doing so, the 2013 annual completeness percentage increase from 65% to 81%, fulfilling the 75% complete annual data capture rate outlined in 40 CFR Part 50 Appendix P Section 2.3(b).

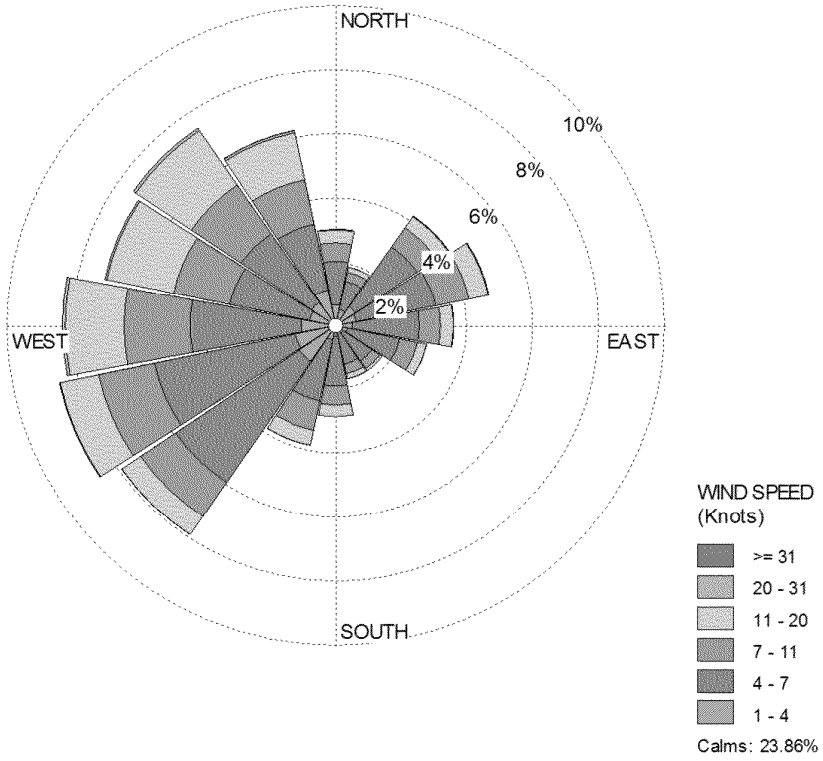
Methodology for the Correlation Analysis

As further support for DEP's request to qualify 34 missing days as not likely to exceed the level of the 2008 ozone standard, BAQ analyzed the historical data record for the Freemansburg ozone monitoring site and several surrounding sites to determine the correlation between the Freemansburg monitoring site and the maximum values measured in the greater surrounding region. BAQ then used this historical correlation to estimate values for the missing Freemansburg ozone data in 2013.

Historical Ozone Data at Freemansburg and the Surrounding Region

BAQ identified seven ozone monitoring sites around the Freemansburg area to represent the varied topographical and meteorological conditions in the broader northeastern Pennsylvania region around Freemansburg. The Lehigh Valley region is bound by elevated terrain to the north and the south. KABE was chosen as a representative meteorological data set due to its proximity to the Freemansburg site along with its location within the valley (KABE has a similar base elevation to the Freemansburg site). To illustrate prevailing wind direction from the 2010 to 2014 period, a wind rose (as seen in Figure 10) was generated to summarize the KABE wind data during the period.

Figure 10 – KABE Wind Rose (2010 – 2014)

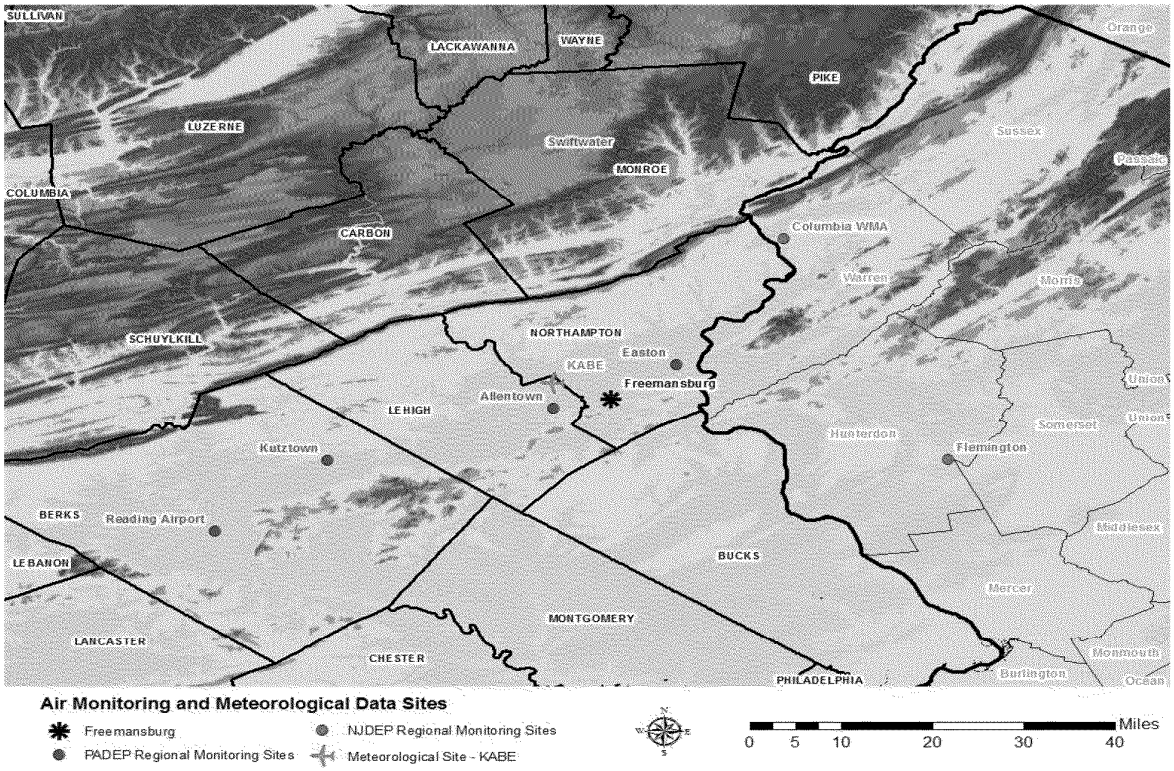


After analyzing the meteorological data at KABE, BAQ determined which monitoring sites to include in its regional analysis. The seven ozone monitoring sites that were chosen are representative of the region because they represent locations equally upwind and downwind of the Freemansburg area. The seven additional regional sites chosen for the analysis are outlined as follows:

1. Kutztown (Berks County, PA)
2. Reading Airport (Berks County, PA)
3. Allentown (Lehigh County, PA)
4. Easton (Northampton County, PA)
5. Swiftwater (Monroe County, PA)
6. Columbia WMA (Warren County, NJ)
7. Flemington (Hunterdon County, NJ)

These sites are displayed in relation to the Freemansburg ozone monitoring site and KABE in Figure 11 below.

Figure 11 – Topographical Map Illustrating Location of Freemansburg Monitor and Regional Sites



BAQ used ozone data from these sites to determine five yearly data sets for the ozone seasons from 2010 through 2014. The daily maximum 8-hour ozone concentrations for each site during the 2010-2014 period were retrieved from EPA's AQS system, using the report AMP435 "Daily Summary Report." BAQ only used 8-hour maximums from valid days in its analysis. Valid days were determined as those meeting the completeness requirements set forth in 40 CFR Part 50, Appendix P Section 2.1. BAQ relied on the AMP435 Report's "Daily Validity Indicator" to identify valid days. This same procedure was used to identify a similar 2010-2014 data set for the Freemansburg ozone monitoring site. Table A-1 in Appendix A of this document displays the daily 8-hour ozone maximum data sets used in the analysis for each site.

Evaluation of the Correlation between the Freemansburg and Regional Ozone Maximum Data Sets

From the seven regional comparison sites, BAQ identified the maximum daily 8-hour max for each date and defined this data set as the "Regional Maximum" data set. BAQ assessed the correlation using the Microsoft® Excel CORREL function to determine the correlation coefficient, otherwise known as the Pearson correlation ("R"). The correlation coefficient is a measure of the direction and strength of a linear relationship. "R" values are always between -1 and 1, with values closest to these thresholds representing the highest amount of correlation. Positive "R" values represent a positive correlation, meaning that as the first variable increases, the comparison value also increases. Negative "R" values represent a negative correlation, meaning that where the first variable increases, the comparison value decreases. All correlation coefficients calculated for this analysis were positive. Calculated "R" values greater than 0.7 represent a high degree of correlation while "R" values greater than 0.9 represent a very high degree of correlation. "R" values below 0.5 represent a low degree of correlation while values below 0.3 represent a degree of correlation which is negligible.

The 2010-2014 data sets for each regional ozone monitoring site was compared against the 2010-2014 data set for the Freemansburg site. Table 4 below displays the correlation coefficients between the Freemansburg site and each of the regional sites, as well as the Regional Maximum data set. As shown, all ozone monitoring sites achieved a correlation with the Freemansburg site above 0.8, indicating a high degree of correlation.

Table 4 – Pearson Correlations Between Freemansburg and Regional Sites

Ozone Season (Year)	Easton	Kutztown	Reading Airport	Allentown	Swiftwater	Flemington	Columbia WMA	Regional Maximum
2010	0.96622	0.96649	0.94443	0.98583	0.92226	0.95352	N/A	0.96437
2011	0.97281	0.95378	0.93824	0.98003	0.89261	0.95109	0.90436	0.96157
2012	0.98465	0.95110	0.95561	0.98456	0.92329	0.93383	0.95610	0.96472
2013	0.95218	0.90273	0.94087	0.97023	0.83025	0.82353	0.94037	0.94950
2014	0.97708	0.90644	0.93164	0.97107	0.83555	0.84087	0.85572	0.93705

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BAQ then created an X-Y scatter chart, using the 2010-2014 Freemansburg data set as the "X" axis and the 2010-2014 Regional Maximum data set as the "Y" axis (Figure 8 above). The R^2 value, or "coefficient of determination," calculated by the Excel software was displayed as 0.9155.

The coefficient of determination is indicative of how well a regression line represents the data, specifically what percentage of the variation between the data pairs fit the regression line. For example, an "R^2" value of 0.63 means that 63% of the variation between the data pairs can be explained by the regression line.[1,2] The R^2 value of 0.9155 between the Freemansburg data set and the Regional Maximum data set indicated a high level of correlation.

Calculation of the Freemansburg Substitution Values

Based on the high degree of correlation between the Freemansburg site and the Regional Maximum data set, BAQ used the linear regression equation calculated by the Excel software from the scatter graph (Figure 8 above) to calculate an estimated daily 8-hour maximum ozone concentration for the Freemansburg site, for all missing days in 2013. Table A-2 in Appendix A of this document displays the 2013 Freemansburg data set, including the substituted values. None of the estimated values exceeded the NAAQS value of 0.075 ppm. Using the substituted data set for the Freemansburg site, BAQ then calculated an estimated 3-year design value. Table 5 below details the current and estimated 2014 design value.

Table 5 – Design Value Calculations for the Freemansburg Monitoring Site Using Current Data vs. Estimated Data for 2013

	Current Data			Using 2013 Substituted Data		
	Valid Days	**% Completeness**	**4th Max**	**Valid Days**	**% Completeness**	**4th Max**
2012	211	99%	0.073	211	99%	0.073
2013	139	65%	0.065	214	100%	0.067
2014	210	98%	0.067	210	98%	0.067
3-Year Average		88%	**0.068**		99%	**0.069**

[1] http://mathbits.com/MathBits/TISection/Statistics2/correlation.htm
[2] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3576830/table/T1/

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Conclusions

Based on the high degree of correlation between the Freemansburg ozone monitoring site and the Regional Maximum data set, and subsequent analysis of estimated data for 100% of missing 2013 days, BAQ concludes that the likelihood of the Freemansburg site exceeding the 2008 8-hour NAAQS on any of the missing days is minimal. This correlation analyses provides further support for DEP's request to designate the 34 missing days identified by meteorological analysis as not likely to exceed the level of the 2008 ozone NAAQS.

In addition, the estimated values (using substation for 100% of missing 2013 days) do not significantly impact on the 3-year design value for 2014. At 0.069 ppm, this estimated value remains well below the 2008 ozone NAAQS concentration of 0.075 ppm.

For these reasons, the DEP concludes that the Freemansburg site is adequately characterized as meeting the 2008 8-hour ozone NAAQS, with the "BG" designations applied to the 34 missing days, during the 2013 ozone monitoring season, identified by meteorological analysis.

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Appendix A – Data Tables

Table A-1 – Daily Maximum 8-Hour Ozone Concentrations, 2010 – 2014 Ozone Seasons, in Parts per Million

	Missing Freemansburg Data								
Dates	Freemansburg 420950025	Easton 420958000	Kutztown 420110006	Reading Airport 420110011	Allentown 420770004	Swiftwater 420890002	Flemington 340190001	Columbia WMA 340410007	Regional Maximum
4/1/2013	0.051	0.050	0.051	0.049	0.051	0.053		0.050	0.053
4/2/2013	0.048	0.048	0.048	0.046	0.049	0.050		0.048	0.050
4/3/2013	0.049	0.051	0.050	0.050	0.051	0.052		0.050	0.052
4/4/2013	0.046	0.045	0.045	0.046	0.048	0.048		0.043	0.048
4/5/2013	0.054	0.056	0.054	0.056	0.056	0.056		0.056	0.056
4/6/2013	0.049	0.049	0.050	0.049	0.050	0.051		0.049	0.051
4/7/2013	0.054	0.056	0.057	0.055	0.057	0.059		0.056	0.059
4/8/2013	0.053	0.058	0.058	0.060	0.060	0.057		0.055	0.060
4/9/2013	0.052	0.053	0.052	0.054	0.055	0.053		0.053	0.055
4/10/2013	0.049	0.050	0.046	0.050	0.052	0.048		0.048	0.052
4/11/2013	0.037	0.036	0.041	0.041	0.038	0.036		0.040	0.041
4/12/2013	0.037	0.035	0.040	0.040	0.038	0.041		0.039	0.041
4/13/2013	0.044	0.043	0.043	0.045	0.044	0.043		0.044	0.045
4/14/2013	0.051	0.051	0.048	0.049	0.051	0.050		0.051	0.051
4/15/2013	0.042	0.045	0.041	0.039	0.043	0.043		0.041	0.045
4/16/2013	0.045	0.047	0.046	0.048	0.049	0.048		0.048	0.049
4/17/2013	0.051	0.048	0.050	0.048	0.053	0.050		0.048	0.053
4/18/2013	0.037	0.034	0.036	0.037		0.040		0.037	0.040
4/19/2013	0.034	0.034	0.034	0.034	0.035	0.038		0.035	0.038
4/20/2013	0.045	0.045	0.045	0.045	0.046	0.046		0.045	0.046
4/21/2013	0.053	0.052	0.053	0.052	0.052	0.051		0.051	0.053
4/22/2013	0.043	0.040	0.044	0.044	0.044	0.046		0.039	0.046
4/23/2013	0.033	0.033	0.032	0.034	0.034	0.042	0.025	0.032	0.042
4/24/2013	0.046	0.050	0.045		0.050	0.053	0.044	0.048	0.053
4/25/2013	0.055	0.054	0.052		0.055	0.056	0.046	0.054	0.056
4/26/2013	0.058	0.057	0.056	0.057	0.060	0.058	0.047	0.059	0.060
4/27/2013	0.061	0.062	0.057	0.062	0.062	0.062	0.052	0.059	0.062
4/28/2013	0.065	0.068	0.063	0.065	0.068	0.071	0.061	0.067	0.071
4/29/2013	0.050	0.051	0.052	0.050	0.051	0.055	0.036	0.041	0.055
4/30/2013	0.054	0.055	0.058	0.058	0.055	0.054		0.053	0.058
5/1/2013	0.050	0.052	0.053	0.054	0.051	0.061		0.044	0.061
5/2/2013	0.047	0.049	0.051	0.051	0.051	0.054		0.050	0.054
5/3/2013	0.050	0.050	0.050	0.051	0.051	0.054		0.048	0.054
5/4/2013	0.048	0.051	0.050	0.049	0.050	0.051		0.047	0.051
5/5/2013	0.056	0.059	0.060	0.060	0.060	0.061		0.052	0.061
5/6/2013	0.036	0.038	0.042	0.042	0.039	0.044		0.036	0.044
5/7/2013	0.031	0.033	0.035	0.035	0.033	0.040		0.029	0.040
5/8/2013	0.038	0.037	0.042	0.042	0.039	0.038	0.018	0.029	0.042
5/9/2013	0.042	0.044	0.044	0.044	0.046	0.039		0.043	0.046
5/10/2013	0.050	0.052	0.055	0.060	0.056	0.051		0.054	0.060
5/11/2013	0.037	0.038	0.036	0.039	0.040	0.039		0.034	0.040
5/12/2013	0.043	0.043	0.040	0.039	0.042	0.043		0.043	0.043
5/13/2013	0.045	0.044	0.043	0.044	0.045	0.044		0.044	0.045
5/14/2013	0.052	0.053	0.049	0.050	0.053	0.053		0.052	0.053
5/15/2013	0.053	0.054	0.050	0.050	0.057	0.056	0.046	0.054	0.057
5/16/2013	0.060	0.060	0.056	0.062	0.063	0.057	0.046	0.061	0.063

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	Missing Freemansburg Data								
Dates	**Freemansburg 420950025**	**Easton 420958000**	**Kutztown 420110006**	**Reading Airport 420110011**	**Allentown 420770004**	**Swiftwater 420890002**	**Flemington 340190001**	**Columbia WMA 340410007**	**Regional Maximum**
5/17/2013	0.048	0.047	0.048	0.049	0.049	0.046	0.030	0.046	0.049
5/18/2013	0.039	0.038	0.047	0.046	0.039	0.035	0.021	0.035	0.047
5/19/2013	0.029	0.030	0.033	0.033	0.028	0.031	0.018	0.028	0.033
5/20/2013	0.036	0.039	0.036	0.043	0.040	0.035	0.031	0.034	0.043
5/21/2013	0.047	0.051	0.044	0.058	0.052	0.050	0.041	0.048	0.058
5/22/2013	0.054	0.056	0.050	0.065	0.059	0.060	0.043	0.055	0.065
5/23/2013	0.033	0.033	0.030	0.038	0.033	0.036	0.023	0.029	0.038
5/24/2013	0.026	0.025	0.024	0.025	0.025	0.025	0.017	0.025	0.025
5/25/2013	0.036	0.034	0.037	0.038	0.036	0.033	0.024	0.033	0.038
5/26/2013	0.042	0.041	0.043	0.043	0.042	0.041	0.031	0.041	0.043
5/27/2013	0.056	0.051	0.050	0.053	0.054	0.046	0.038	0.053	0.054
5/28/2013	0.023	0.020	0.018	0.018	0.015	0.024	0.008	0.027	0.027
5/29/2013	0.062	0.061	0.054	0.062	0.066	0.054	0.047	0.060	0.066
5/30/2013	0.064	0.064	0.053	0.062	0.065	0.065	0.050	0.062	0.065
5/31/2013	0.063	0.064	0.065	0.077	0.064	0.065	0.048	0.074	0.077
6/1/2013	0.054	0.057	0.059	0.067	0.058	0.056	0.045	0.058	0.067
6/2/2013	0.041	0.042	0.037	0.041	0.043	0.042	0.036	0.041	0.043
6/3/2013	0.042	0.036	0.036	0.039	0.044	0.037	0.022	0.039	0.044
6/4/2013	0.052	0.050	0.047	0.049	0.051	0.048		0.051	0.051
6/5/2013	0.061	0.058	0.061	0.064	0.059	0.056		0.054	0.064
6/6/2013	0.047	0.048	0.050	0.045	0.043	0.048		0.050	0.050
6/7/2013	0.026	0.024	0.025	0.021	0.022	0.028		0.025	0.028
6/8/2013	0.033	0.033	0.030	0.032	0.033	0.027		0.032	0.033
6/9/2013	0.062	0.057	0.058	0.057	0.061	0.047		0.054	0.061
6/10/2013	0.032	0.033	0.036	0.036	0.030	0.034		0.034	0.036
6/11/2013	0.043	0.042	0.039	0.044	0.044	0.038		0.044	0.044
6/12/2013	0.043	0.042	0.043	0.045	0.043	0.043		0.044	0.045
6/13/2013	0.035	0.032	0.041	0.048	0.033	0.034		0.036	0.048
6/14/2013	0.039	0.038	0.036	0.041	0.040	0.037		0.036	0.041
6/15/2013	0.054	0.051	0.047	0.050	0.053	0.043		0.050	0.053
6/16/2013	0.055	0.055	0.049	0.055	0.055	0.050		0.056	0.056
6/17/2013	0.053	0.052	0.049	0.058	0.055	0.049		0.051	0.058
6/18/2013	0.038	0.040	0.040	0.039	0.039	0.041		0.036	0.041
6/19/2013	0.045	0.040	0.047	0.047	0.045	0.037		0.041	0.047
6/20/2013	0.057	0.057	0.059	0.059	0.056	0.052		0.063	0.063
6/21/2013	0.068	0.068	0.069	0.069	0.067	0.062		0.076	0.076
6/22/2013	0.048	0.050	0.052	0.055	0.051	0.050		0.052	0.055
6/23/2013	0.031	0.032	0.032	0.034	0.032	0.037		0.034	0.037
6/24/2013	0.057	0.059	0.055	0.066	0.061	0.058		0.061	0.066
6/25/2013		0.058	0.049	0.059	0.056	0.056		0.060	0.060
6/26/2013	0.052	0.052	0.050	0.059	0.058	0.045		0.056	0.059
6/27/2013	0.058		0.059	0.060	0.064	0.051		0.058	0.064
6/28/2013	0.046	0.050	0.046	0.053	0.051	0.040		0.052	0.053
6/29/2013	0.057	0.062	0.054	0.062	0.064	0.048		0.059	0.064
6/30/2013	0.043	0.044	0.044	0.046	0.046	0.039		0.035	0.046
7/1/2013	0.023	0.025	0.027	0.026	0.025		0.024	0.026	0.027
7/2/2013	0.029	0.030	0.025	0.033	0.030	0.023	0.033	0.036	0.036
7/3/2013	0.026	0.026	0.023	0.030	0.027		0.024	0.029	0.030
7/4/2013	0.026	0.024	0.020	0.028	0.027	0.023	0.031	0.031	0.031
7/5/2013	0.039	0.038	0.035	0.043	0.042	0.032	0.047	0.039	0.047
7/6/2013	0.047	0.044	0.036	0.047	0.049	0.032	0.048	0.046	0.049
7/7/2013	0.046	0.045	0.034	0.045	0.049	0.033	0.054	0.045	0.054
7/8/2013	0.055	0.053	0.040	0.055	0.057	0.046	0.059	0.051	0.059
7/9/2013	0.051	0.051	0.040	0.050	0.053	0.042	0.058	0.061	0.061

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	Missing Freemansburg Data								
Dates	Freemansburg 420950025	Easton 420958000	Kutztown 420110006	Reading Airport 420110011	Allentown 420770004	Swiftwater 420890002	Flemington 340190001	Columbia WMA 340410007	Regional Maximum
7/10/2013	0.053	0.050	0.042	0.055	0.057	0.043	0.061	0.055	0.061
7/11/2013	0.049	0.045	0.037	0.053	0.053	0.046	0.047	0.053	0.053
7/12/2013	0.033	0.030	0.028	0.030	0.035	0.034	0.026	0.035	0.035
7/13/2013		0.022	0.038	0.043	0.029	0.023	0.025	0.027	0.043
7/14/2013		0.026	0.020	0.028	0.031	0.025	0.032	0.024	0.032
7/15/2013		0.039	0.036	0.048	0.043	0.037	0.037	0.050	0.050
7/16/2013	0.051	0.046	0.043	0.053	0.053	0.044	0.039	0.043	0.053
7/17/2013	0.069	0.061	0.055	0.071	0.070	0.053	0.058	0.056	0.071
7/18/2013	0.060	0.050	0.048	0.059	0.062	0.048	0.057	0.065	0.065
7/19/2013	0.066	0.063	0.052	0.066	0.071	0.049	0.073	0.073	0.073
7/20/2013	0.054	0.050	0.044	0.057	0.058	0.044	0.059	0.060	0.060
7/21/2013	0.053	0.047	0.044	0.050	0.052	0.034	0.050	0.068	0.068
7/22/2013	0.048	0.044	0.047	0.049	0.050	0.054	0.059	0.051	0.059
7/23/2013	0.044	0.037	0.033	0.045	0.047	0.042	0.045	0.046	0.047
7/24/2013	0.031	0.026	0.027	0.033	0.034	0.028	0.028	0.034	0.034
7/25/2013	0.025	0.020	0.027	0.029	0.025	0.024	0.020	0.017	0.029
7/26/2013	0.046	0.043	0.043	0.047	0.047	0.039	0.049	0.049	0.049
7/27/2013	0.055	0.055	0.049	0.050	0.054	0.050	0.059	0.061	0.061
7/28/2013	0.032	0.032	0.034	0.042	0.037	0.030	0.023	0.035	0.042
7/29/2013	0.047	0.045	0.043	0.046	0.047	0.044	0.052	0.049	0.052
7/30/2013	0.047	0.043	0.042	0.044	0.049	0.035	0.043	0.048	0.049
7/31/2013	0.058	0.054	0.055	0.059	0.060	0.052	0.059	0.052	0.060
8/1/2013	0.037	0.038	0.038	0.035	0.041	0.033	0.032	0.035	0.041
8/2/2013	0.053		0.045	0.053	0.055	0.042	0.052	0.052	0.055
8/3/2013	0.037	0.036	0.030	0.036	0.039	0.035	0.041	0.035	0.041
8/4/2013	0.031	0.030	0.030	0.033	0.033	0.028	0.032	0.032	0.033
8/5/2013		0.038	0.040	0.042	0.042	0.037	0.036	0.036	0.042
8/6/2013		0.050	0.047	0.043	0.049	0.049	0.059	0.050	0.059
8/7/2013	0.038	0.035	0.035	0.034	0.037	0.020	0.033	0.040	0.040
8/8/2013	0.044	0.028	0.040	0.047	0.028	0.034	0.039	0.041	0.047
8/9/2013	0.053	0.037	0.034	0.040	0.043	0.034	0.039	0.042	0.043
8/10/2013		0.040	0.035	0.045	0.048	0.037	0.039	0.046	0.048
8/11/2013		0.039	0.044	0.048	0.045	0.025	0.038	0.035	0.048
8/12/2013		0.042	0.043	0.047	0.048	0.037	0.040	0.041	0.048
8/13/2013		0.046	0.043	0.047	0.049	0.039	0.050	0.047	0.050
8/14/2013		0.027	0.028	0.030	0.030	0.025	0.029	0.030	0.030
8/15/2013		0.035	0.039	0.038	0.042	0.033	0.035	0.038	0.042
8/16/2013		0.053	0.051	0.056	0.055	0.038	0.051	0.050	0.056
8/17/2013		0.046	0.056	0.052	0.051	0.042	0.050	0.060	0.060
8/18/2013		0.043	0.042	0.043	0.045	0.040	0.040	0.044	0.045
8/19/2013		0.042	0.036	0.038	0.042	0.044	0.045	0.044	0.045
8/20/2013		0.054	0.046	0.053	0.055	0.047	0.058	0.052	0.058
8/21/2013		0.063	0.058	0.065	0.071	0.057	0.065	0.064	0.071
8/22/2013		0.033	0.039	0.048	0.044	0.048	0.047	0.045	0.048
8/23/2013		0.025	0.022	0.026	0.031	0.029	0.019	0.025	0.031
8/24/2013		0.040	0.044	0.044	0.044	0.038	0.040	0.044	0.044
8/25/2013		0.050	0.048	0.050	0.052	0.041	0.054	0.049	0.054
8/26/2013		0.048	0.053	0.061	0.060	0.045	0.042	0.059	0.061
8/27/2013		0.051	0.053	0.055	0.058	0.046	0.049	0.050	0.058
8/28/2013		0.029	0.037	0.032	0.036	0.028	0.025	0.024	0.037
8/29/2013		0.047	0.048	0.052	0.053	0.041	0.039	0.047	0.053
8/30/2013		0.049	0.047	0.060	0.053	0.043	0.053	0.052	0.060
8/31/2013		0.042	0.041	0.054	0.047	0.034	0.051	0.052	0.054
9/1/2013		0.043	0.038	0.049	0.042	0.033	0.043	0.046	0.049

	Missing Freemansburg Data								
Dates	**Freemansburg 420950025**	**Easton 420958000**	**Kutztown 420110006**	**Reading Airport 420110011**	**Allentown 420770004**	**Swiftwater 420890002**	**Flemington 340190001**	**Columbia WMA 340410007**	**Regional Maximum**
9/2/2013		0.033	0.042	0.048	0.038	0.034	0.040	0.039	0.048
9/3/2013		0.037	0.031	0.040	0.041	0.033	0.036	0.042	0.042
9/4/2013		0.042	0.031	0.045	0.047	0.040	0.052	0.045	0.052
9/5/2013		0.035	0.036	0.041	0.039	0.039	0.032	0.039	0.041
9/6/2013		0.035	0.039	0.039	0.039	0.034	0.035	0.038	0.039
9/7/2013		0.051	0.051	0.059	0.055	0.046	0.053	0.049	0.059
9/8/2013		0.037	0.037	0.041	0.040	0.035	0.039	0.044	0.044
9/9/2013		0.035	0.034	0.034	0.037	0.033	0.039	0.037	0.039
9/10/2013		0.054	0.058	0.065	0.061	0.046	0.059	0.064	0.065
9/11/2013		0.059	0.060	0.068	0.064	0.057	0.075	0.074	0.075
9/12/2013		0.042	0.036	0.044	0.051	0.040	0.052	0.062	0.062
9/13/2013		0.020	0.020	0.025	0.024	0.019	0.021	0.024	0.025
9/14/2013		0.021	0.022	0.023	0.023	0.022	0.021	0.022	0.023
9/15/2013		0.036	0.039	0.042	0.040	0.033	0.038	0.036	0.042
9/16/2013		0.033	0.035	0.037	0.038	0.038	0.033	0.034	0.038
9/17/2013		0.030	0.033	0.033	0.033	0.030		0.033	0.033
9/18/2013		0.042	0.043	0.047	0.047	0.043		0.045	0.047
9/19/2013		0.048	0.050	0.053	0.055	0.053		0.055	0.055
9/20/2013		0.057	0.059	0.059	0.061	0.060		0.062	0.062
9/21/2013		0.050	0.046	0.045	0.051	0.051		0.047	0.051
9/22/2013		0.027	0.029	0.030	0.030	0.029		0.028	0.030
9/23/2013		0.029	0.031	0.032	0.031	0.029		0.030	0.032
9/24/2013		0.036	0.038	0.038	0.040	0.038		0.036	0.040
9/25/2013		0.030	0.035	0.034	0.037	0.034		0.032	0.037
9/26/2013		0.030	0.036	0.034	0.031	0.030		0.030	0.036
9/27/2013			0.038	0.040	0.035	0.033		0.030	0.040
9/28/2013			0.040	0.039	0.038	0.037		0.037	0.040
9/29/2013			0.041	0.040	0.040	0.039		0.032	0.041
9/30/2013			0.040	0.041	0.041	0.044		0.044	0.044
10/1/2013			0.043	0.045	0.047	0.044		0.045	0.047
10/2/2013	0.053		0.051	0.051	0.055	0.053		0.054	0.055
10/3/2013			0.050	0.052	0.054	0.047		0.046	0.054
10/4/2013			0.043	0.045	0.049	0.045		0.052	0.052
10/5/2013			0.048	0.048	0.052	0.044		0.047	0.052
10/6/2013			0.039	0.049	0.039	0.042		0.042	0.049
10/7/2013			0.027	0.030	0.030	0.029		0.026	0.030
10/8/2013			0.032	0.032	0.033	0.031		0.027	0.033
10/9/2013			0.026	0.026	0.028	0.033		0.025	0.033
10/10/2013			0.023	0.019	0.022	0.031		0.020	0.031
10/11/2013			0.025	0.018	0.025	0.033		0.024	0.033
10/12/2013			0.042	0.039	0.041	0.043		0.036	0.043
10/13/2013			0.039	0.040	0.036	0.038		0.034	0.040
10/14/2013			0.032	0.034	0.038	0.037		0.031	0.038
10/15/2013			0.043	0.041	0.042	0.041		0.032	0.043
10/16/2013			0.026	0.026	0.022	0.027		0.023	0.027
10/17/2013	0.028		0.031	0.030	0.032	0.038		0.029	0.038
10/18/2013	0.029		0.028	0.028	0.032	0.032		0.028	0.032
10/19/2013	0.035		0.037	0.036	0.039	0.038		0.032	0.039
10/20/2013	0.036		0.034	0.034	0.038	0.036		0.034	0.038
10/21/2013	0.037		0.039	0.039	0.043	0.042		0.038	0.043
10/22/2013	0.028		0.027	0.028	0.030	0.037		0.028	0.037
10/23/2013	0.028		0.029	0.030	0.030	0.031		0.026	0.031
10/24/2013	0.028		0.026	0.026	0.030	0.030		0.027	0.030
10/25/2013	0.027		0.026	0.026	0.030	0.030		0.026	0.030

	Missing Freemansburg Data								
Dates	Freemansburg 420950025	Easton 420958000	Kutztown 420110006	Reading Airport 420110011	Allentown 420770004	Swiftwater 420890002	Flemington 340190001	Columbia WMA 340410007	Regional Maximum
10/26/2013	0.036		0.035	0.035	0.038	0.037		0.037	0.038
10/27/2013	0.028		0.029	0.029	0.031	0.030		0.029	0.031
10/28/2013	0.025		0.024	0.027	0.028	0.033		0.030	0.033
10/29/2013	0.026		0.025	0.023	0.028	0.025		0.022	0.028
10/30/2013	0.009		0.023	0.022	0.015	0.027		0.018	0.027
10/31/2013	0.032		0.034	0.039	0.039	0.037		0.036	0.039

Table A-2 – Daily Maximum 8-Hour Ozone Concentrations for the Freemansburg Monitoring Site, Including Estimated Concentrations for Missing Days, 2010 – 2014 Ozone Seasons, in Parts per Million

	Substituted Freemansburg Data from Regression Equation y=0.9679x + 0.0061, where x=Regional Max and y=Freemansburg Conc.	
Dates	**Freemansburg 420950025**	**Regional Maximum**
4/1/2013	0.051	0.053
4/2/2013	0.048	0.050
4/3/2013	0.049	0.052
4/4/2013	0.046	0.048
4/5/2013	0.054	0.056
4/6/2013	0.049	0.051
4/7/2013	0.054	0.059
4/8/2013	0.053	0.060
4/9/2013	0.052	0.055
4/10/2013	0.049	0.052
4/11/2013	0.037	0.041
4/12/2013	0.037	0.041
4/13/2013	0.044	0.045
4/14/2013	0.051	0.051
4/15/2013	0.042	0.045
4/16/2013	0.045	0.049
4/17/2013	0.051	0.053
4/18/2013	0.037	0.040
4/19/2013	0.034	0.038
4/20/2013	0.045	0.046
4/21/2013	0.053	0.053
4/22/2013	0.043	0.046
4/23/2013	0.033	0.042
4/24/2013	0.046	0.053
4/25/2013	0.055	0.056
4/26/2013	0.058	0.060
4/27/2013	0.061	0.062
4/28/2013	0.065	0.071
4/29/2013	0.050	0.055
4/30/2013	0.054	0.058
5/1/2013	0.050	0.061
5/2/2013	0.047	0.054
5/3/2013	0.050	0.054
5/4/2013	0.048	0.051
5/5/2013	0.056	0.061
5/6/2013	0.036	0.044

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	Substituted Freemansburg Data from Regression Equation y=0.9679x + 0.0061, where x=Regional Max and y=Freemansburg Conc.	
Dates	**Freemansburg 420950025**	**Regional Maximum**
5/7/2013	0.031	0.040
5/8/2013	0.038	0.042
5/9/2013	0.042	0.046
5/10/2013	0.050	0.060
5/11/2013	0.037	0.040
5/12/2013	0.043	0.043
5/13/2013	0.045	0.045
5/14/2013	0.052	0.053
5/15/2013	0.053	0.057
5/16/2013	0.060	0.063
5/17/2013	0.048	0.049
5/18/2013	0.039	0.047
5/19/2013	0.029	0.033
5/20/2013	0.036	0.043
5/21/2013	0.047	0.058
5/22/2013	0.054	0.065
5/23/2013	0.033	0.038
5/24/2013	0.026	0.025
5/25/2013	0.036	0.038
5/26/2013	0.042	0.043
5/27/2013	0.056	0.054
5/28/2013	0.023	0.027
5/29/2013	0.062	0.066
5/30/2013	0.064	0.065
5/31/2013	0.063	0.077
6/1/2013	0.054	0.067
6/2/2013	0.041	0.043
6/3/2013	0.042	0.044
6/4/2013	0.052	0.051
6/5/2013	0.061	0.064
6/6/2013	0.047	0.050
6/7/2013	0.026	0.028
6/8/2013	0.033	0.033
6/9/2013	0.062	0.061
6/10/2013	0.032	0.036
6/11/2013	0.043	0.044
6/12/2013	0.043	0.045
6/13/2013	0.035	0.048
6/14/2013	0.039	0.041
6/15/2013	0.054	0.053
6/16/2013	0.055	0.056
6/17/2013	0.053	0.058
6/18/2013	0.038	0.041
6/19/2013	0.045	0.047
6/20/2013	0.057	0.063
6/21/2013	0.068	0.076
6/22/2013	0.048	0.055
6/23/2013	0.031	0.037
6/24/2013	0.057	0.066
6/25/2013	**0.055**	0.060
6/26/2013	0.052	0.059
6/27/2013	0.058	0.064
6/28/2013	0.046	0.053
6/29/2013	0.057	0.064
6/30/2013	0.043	0.046
7/1/2013	0.023	0.027
7/2/2013	0.029	0.036
7/3/2013	0.026	0.030
7/4/2013	0.026	0.031
7/5/2013	0.039	0.047

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	Substituted Freemansburg Data from Regression Equation y=0.9679x + 0.0061, where x=Regional Max and y=Freemansburg Conc.	
Dates	**Freemansburg 420950025**	**Regional Maximum**
7/6/2013	0.047	0.049
7/7/2013	0.046	0.054
7/8/2013	0.055	0.059
7/9/2013	0.051	0.061
7/10/2013	0.053	0.061
7/11/2013	0.049	0.053
7/12/2013	0.033	0.035
7/13/2013	**0.038**	0.043
7/14/2013	**0.026**	0.032
7/15/2013	**0.045**	0.050
7/16/2013	0.051	0.053
7/17/2013	0.069	0.071
7/18/2013	0.060	0.065
7/19/2013	0.066	0.073
7/20/2013	0.054	0.060
7/21/2013	0.053	0.068
7/22/2013	0.048	0.059
7/23/2013	0.044	0.047
7/24/2013	0.031	0.034
7/25/2013	0.025	0.029
7/26/2013	0.046	0.049
7/27/2013	0.055	0.061
7/28/2013	0.032	0.042
7/29/2013	0.047	0.052
7/30/2013	0.047	0.049
7/31/2013	0.058	0.060
8/1/2013	0.037	0.041
8/2/2013	0.053	0.055
8/3/2013	0.037	0.041
8/4/2013	0.031	0.033
8/5/2013	**0.037**	0.042
8/6/2013	**0.054**	0.059
8/7/2013	0.038	0.040
8/8/2013	0.044	0.047
8/9/2013	0.053	0.043
8/10/2013	**0.043**	0.048
8/11/2013	**0.043**	0.048
8/12/2013	**0.043**	0.048
8/13/2013	**0.045**	0.050
8/14/2013	**0.024**	0.030
8/15/2013	**0.037**	0.042
8/16/2013	**0.051**	0.056
8/17/2013	**0.055**	0.060
8/18/2013	**0.040**	0.045
8/19/2013	**0.040**	0.045
8/20/2013	**0.053**	0.058
8/21/2013	**0.067**	0.071
8/22/2013	**0.043**	0.048
8/23/2013	**0.025**	0.031
8/24/2013	**0.039**	0.044
8/25/2013	**0.049**	0.054
8/26/2013	**0.056**	0.061
8/27/2013	**0.053**	0.058
8/28/2013	**0.031**	0.037
8/29/2013	**0.048**	0.053
8/30/2013	**0.055**	0.060
8/31/2013	**0.049**	0.054
9/1/2013	**0.044**	0.049
9/2/2013	**0.043**	0.048
9/3/2013	**0.037**	0.042

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	Substituted Freemansburg Data from Regression Equation y=0.9679x + 0.0061, where x=Regional Max and y=Freemansburg Conc.	
Dates	**Freemansburg 420950025**	**Regional Maximum**
9/4/2013	**0.047**	0.052
9/5/2013	**0.036**	0.041
9/6/2013	**0.033**	0.039
9/7/2013	**0.054**	0.059
9/8/2013	**0.039**	0.044
9/9/2013	**0.033**	0.039
9/10/2013	**0.060**	0.065
9/11/2013	**0.071**	0.075
9/12/2013	**0.057**	0.062
9/13/2013	**0.019**	0.025
9/14/2013	**0.017**	0.023
9/15/2013	**0.037**	0.042
9/16/2013	**0.032**	0.038
9/17/2013	**0.027**	0.033
9/18/2013	**0.042**	0.047
9/19/2013	**0.050**	0.055
9/20/2013	**0.057**	0.062
9/21/2013	**0.046**	0.051
9/22/2013	**0.024**	0.030
9/23/2013	**0.026**	0.032
9/24/2013	**0.035**	0.040
9/25/2013	**0.031**	0.037
9/26/2013	**0.030**	0.036
9/27/2013	**0.035**	0.040
9/28/2013	**0.035**	0.040
9/29/2013	**0.036**	0.041
9/30/2013	**0.039**	0.044
10/1/2013	**0.042**	0.047
10/2/2013	0.053	0.055
10/3/2013	**0.049**	0.054
10/4/2013	**0.047**	0.052
10/5/2013	**0.047**	0.052
10/6/2013	**0.044**	0.049
10/7/2013	**0.024**	0.030
10/8/2013	**0.027**	0.033
10/9/2013	**0.027**	0.033
10/10/2013	**0.025**	0.031
10/11/2013	**0.027**	0.033
10/12/2013	**0.038**	0.043
10/13/2013	**0.035**	0.040
10/14/2013	**0.032**	0.038
10/15/2013	**0.038**	0.043
10/16/2013	**0.021**	0.027
10/17/2013	0.028	0.038
10/18/2013	0.029	0.032
10/19/2013	0.035	0.039
10/20/2013	0.036	0.038
10/21/2013	0.037	0.043
10/22/2013	0.028	0.037
10/23/2013	0.028	0.031
10/24/2013	0.028	0.030
10/25/2013	0.027	0.030
10/26/2013	0.036	0.038
10/27/2013	0.028	0.031
10/28/2013	0.025	0.033
10/29/2013	0.026	0.028
10/30/2013	0.009	0.027
10/31/2013	0.032	0.039

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

To: Memo to File

From: Matthew Lakin, EPA Region 9

Prepared by: Dena Vallano, EPA Region 9

Date: April 23, 2013

Re: El Centro Missing Data Analysis for October 1, 2010 to December 31, 2010

Between October 1, 2010 and December 31, 2010, ozone data was not reported for the El Centro monitoring site in Imperial County, California due to poor quality assurance results[1]. For purposes of the Imperial Ozone Finding of Attainment, EPA must evaluate whether the El Centro ozone monitor met applicable data completeness requirements in the 2009 to 2011 period. 40 CFR §50 Appendix 1 Section 2.3(b) states:

> "…When computing whether minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard. Missing days assumed less than the level of the standard are counted for purpose of meeting the minimum data completeness requirement, subject to the approval of the appropriate Regional Administrator."

Thus, EPA evaluated whether the conditions on missing days were conducive to concentrations at the El Centro monitor above the 1997 8-hour ozone standard of 0.08 ppm (i.e. above 84 ppb). This analysis informs EPA's decision whether to count days between October 1, 2010 and December 31, 2010 towards meeting the minimum data completeness requirement.

EPA examined the comparability of ozone concentrations for several surrounding Imperial County ozone monitors (Figure 1). Monitors evaluated included:

- *El Centro* (AQS Site ID: 06-025-1003-1): Missing data from October 1, 2010 to December 31, 2010; monitor in operation since 1998.
- *Calexico-Ethel* (AQS Site ID: 06-025-0005-1): Closest monitor to El Centro; monitor in operation since 1994.
- *Westmoreland* (AQS Site ID: 06-025-4003-1): 2nd closest monitor in operation since 1993.
- *Niland* (AQS Site ID: 06-025-4004-1): 3rd closest monitor in operation since 1996.

[1] See AMP 350 report from U.S. EPA's Air Quality Systems (AQS) database (April 23, 2013).

Specifically, EPA examined daily 8-hour maximum ozone concentrations for December 1, 2006 to December 31, 2011 for El Centro and Calexico-Ethel, and additionally, daily 8-hour maximum ozone concentrations from October 1, 2010 to December 31, 2010 for surrounding ozone monitors Calexico-Ethel, Westmoreland, and Niland (presented in attached Figures 2 and 3). EPA's analysis showed that daily 8-hour maximum ozone concentrations at the El Centro and Calexico-Ethel monitors track well with each other, with all of the exceedances at El Centro also observed as elevated concentrations at Calexico-Ethel. For all of the exceedances at El Centro, Calexico-Ethel ozone concentrations were at least 64 ppb, which is significant, given that Calexico-Ethel does not exceed 50 ppb for the October 1, 2010 through December 31, 2010 period. Further, we did not find any exceedances or elevated levels in daily 8-hour maximum ozone concentrations from October 1, 2010 to December 31, 2010 for surrounding ozone monitors Calexico-Ethel, Westmoreland, and Niland. Therefore, EPA concludes that conditions on missing days were not conducive to concentrations at the El Centro monitor above the 1997 8-hour ozone standard, and thus it would be appropriate to count days between October 1, 2010 and December 31, 2010 towards meeting the minimum data completeness requirement.

Figure 1. Map of Imperial County ozone monitors (from Imperial County Air Pollution Control District 2012 Annual Network Plan for Ambient Monitoring, Page 6)

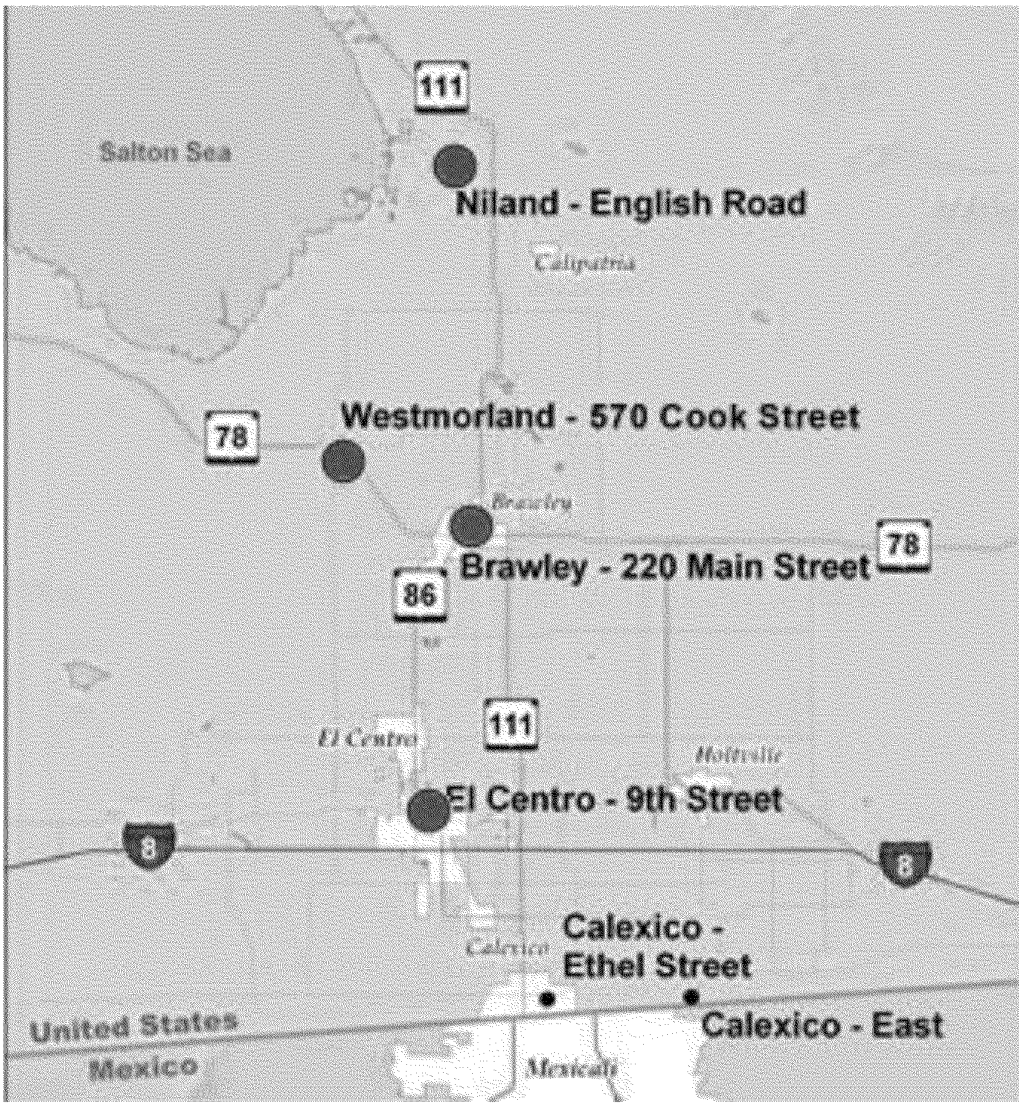
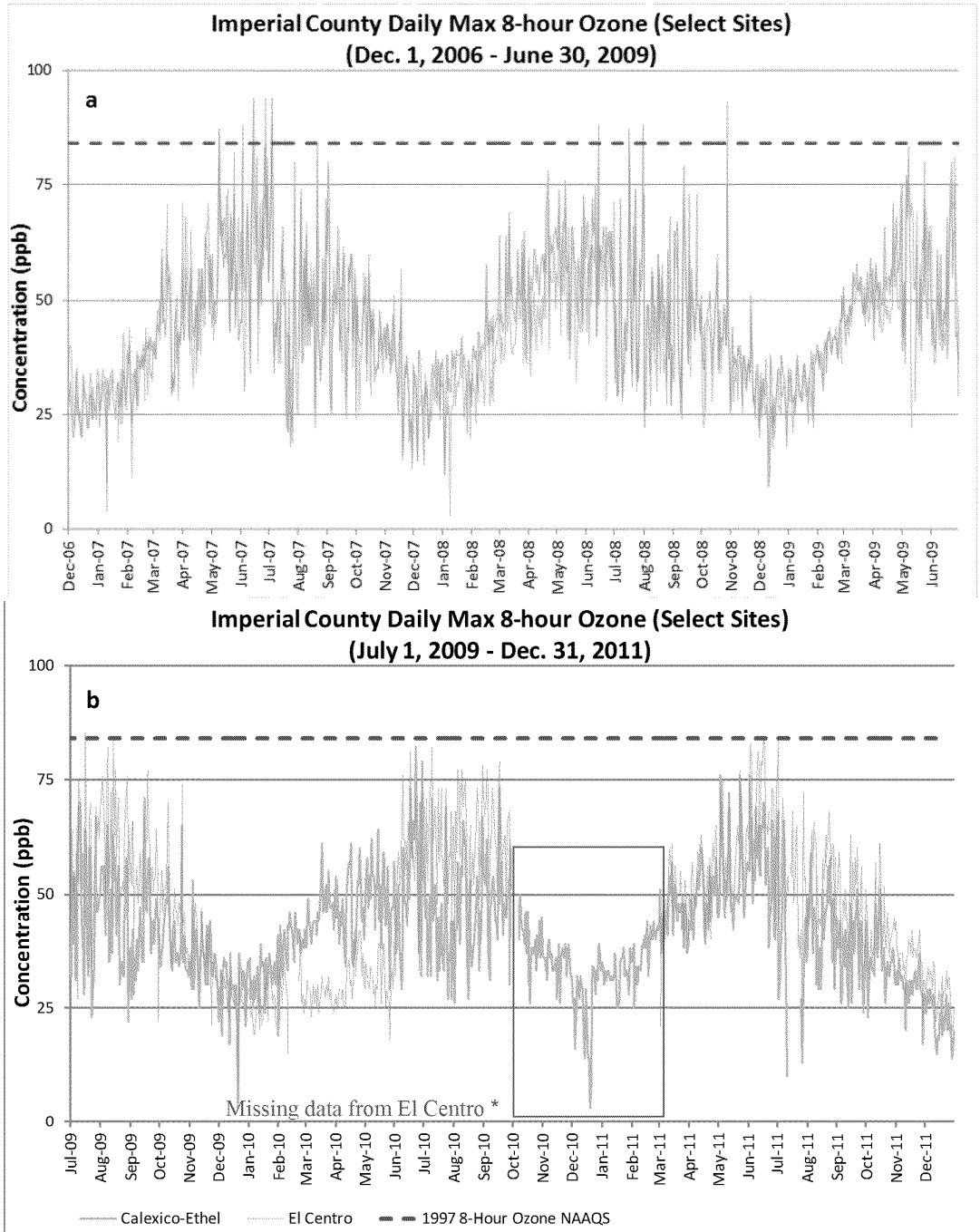
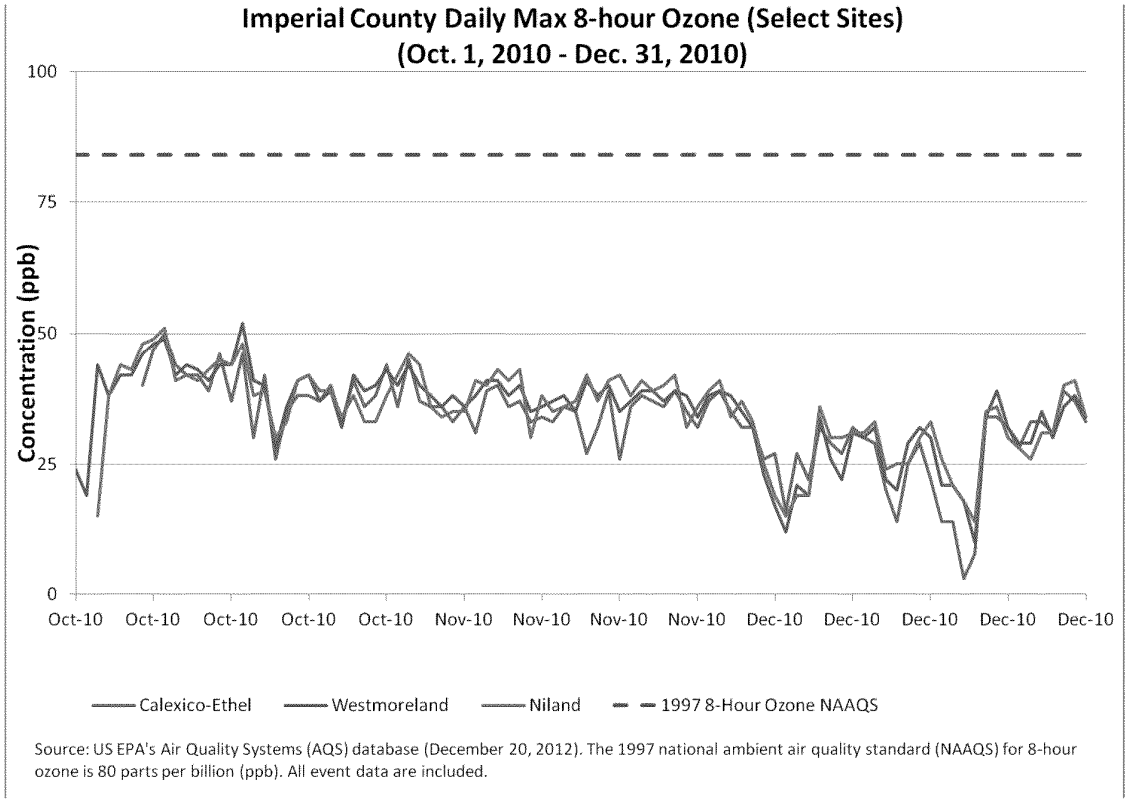


Figure 2. (a) December 1, 2006 to June 30, 2009 and (b) July 1, 2009 to December 31, 2011 Imperial County daily maximum 8-hour ozone concentration (ppb) at El Centro and Calexico-Ethel



Source: US EPA's Air Quality Systems (AQS) database (December 20, 2012). The 1997 national ambient air quality standard (NAAQS) for 8-hour ozone is 80 parts per billion (ppb). All event data are included.

Figure 3. October 1, 2010 – December 31, 2010 Imperial County daily maximum 8-hour ozone concentration (ppb) at Calexico-Ethel, Westmoreland, and Niland



Incomplete Ozone Data Handling

Case Study: Knoxville, Tennessee, 2011

Daniel Garver, Ryan Brown, and Stacy Harder
US Environmental Protection Agency, Region 4

EPA United States Environmental Protection Agency

ED_001361_00002102

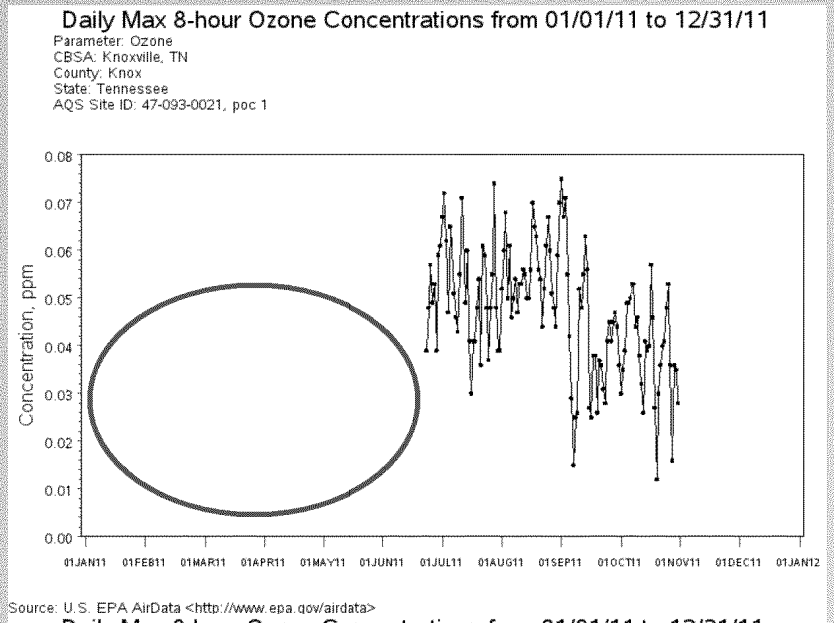
Overview

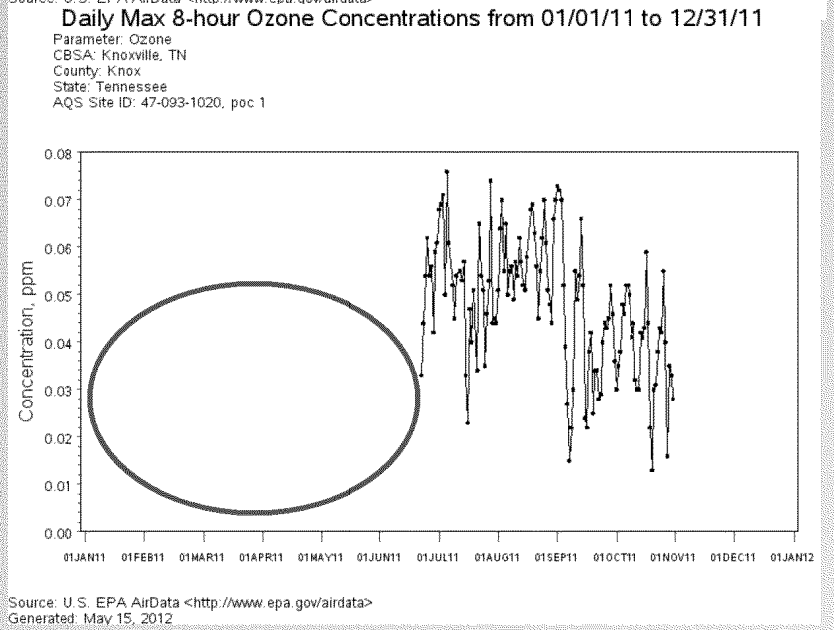
- Background
- “Appendix P” Demonstration: Days not conducive to high ozone
- Prediction of missing data using regression model with nearby monitors
- Results

ED_001361_00002102

Background

- Valid ozone data was not collected at both Knox County monitoring sites from March – mid June 2011
- Both monitors violated the NAAQS based on 2008-2010 data
- Several monitors in the Southeast were able to show attainment based on 2009-2011 data, including other monitors in the Knoxville CBSA
- The 2009-2011 design values for both Knox County monitors were incomplete and invalid





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Missing Days

- The EPA Regional Administrator can give credit for missing days:

"When computing whether the minimum data completeness requirements have been met, ***meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard.*** Missing days assumed less then the level of the standard are counted for the purpose of meeting the data completeness requirement, subject to the approval of the appropriate Regional Administrator."

40 CFR Part 50 Appendix P Section 2.3(b) (emphasis added).

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Identification of Missing Days Not Conducive to High Ozone

- Both sites needed credit for 63 missing days in order to produce complete design values
- Tennessee, Knox County, and EPA worked together to identify these days
- Focused on relationships between historical ozone levels and temp, cloud cover, and precipitation data
- Tennessee submitted a package to EPA requesting credit for missing days

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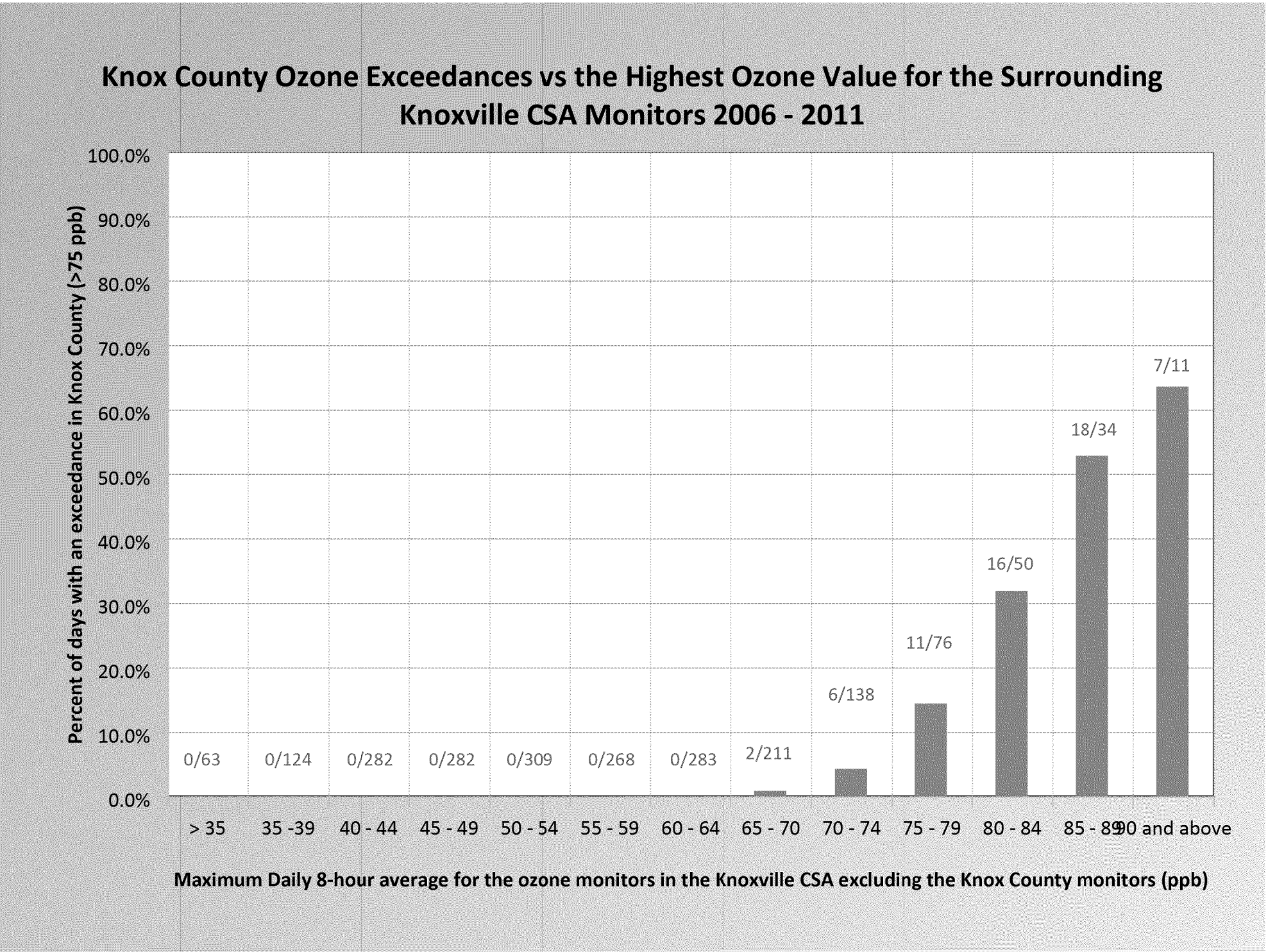

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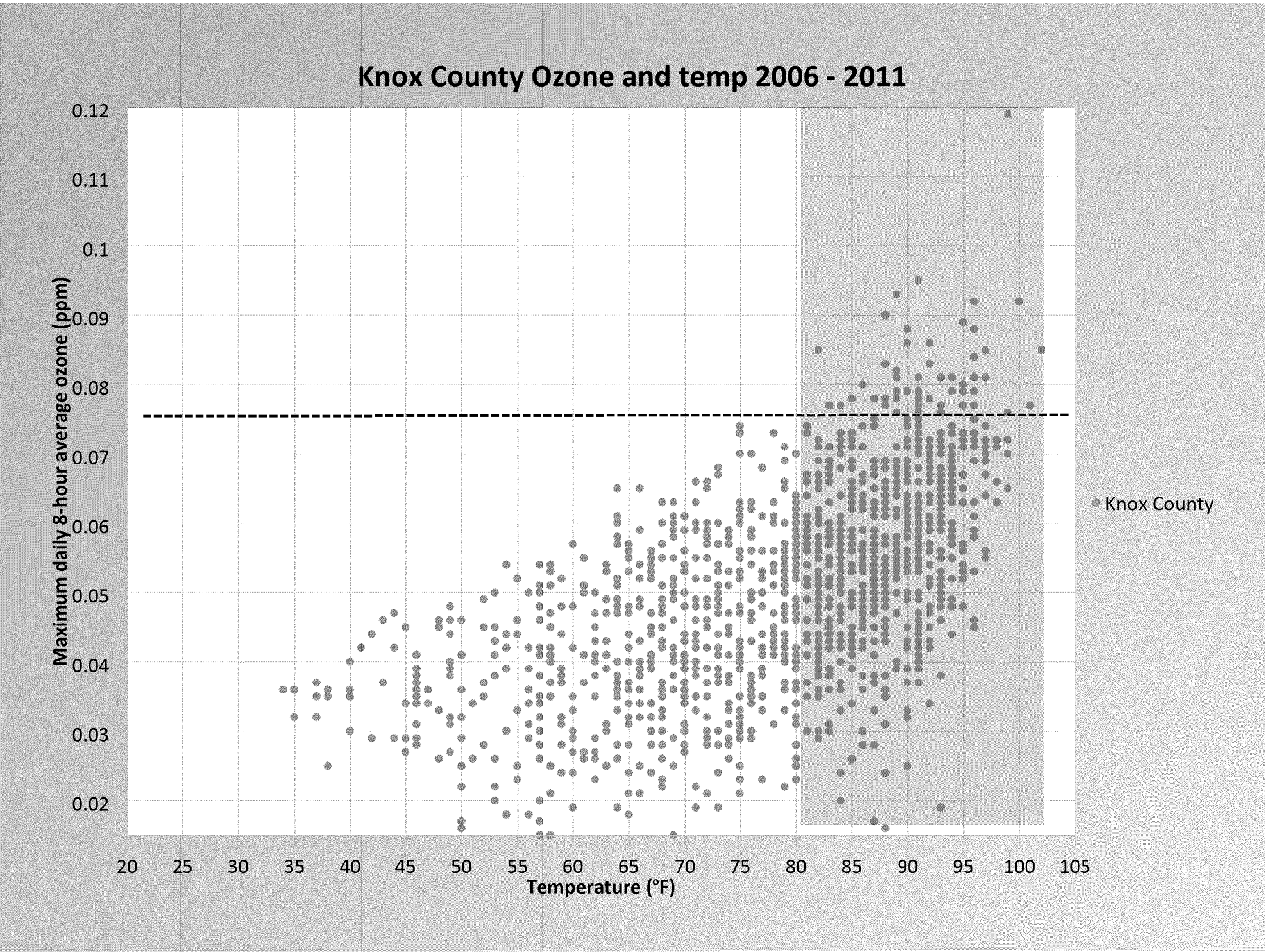

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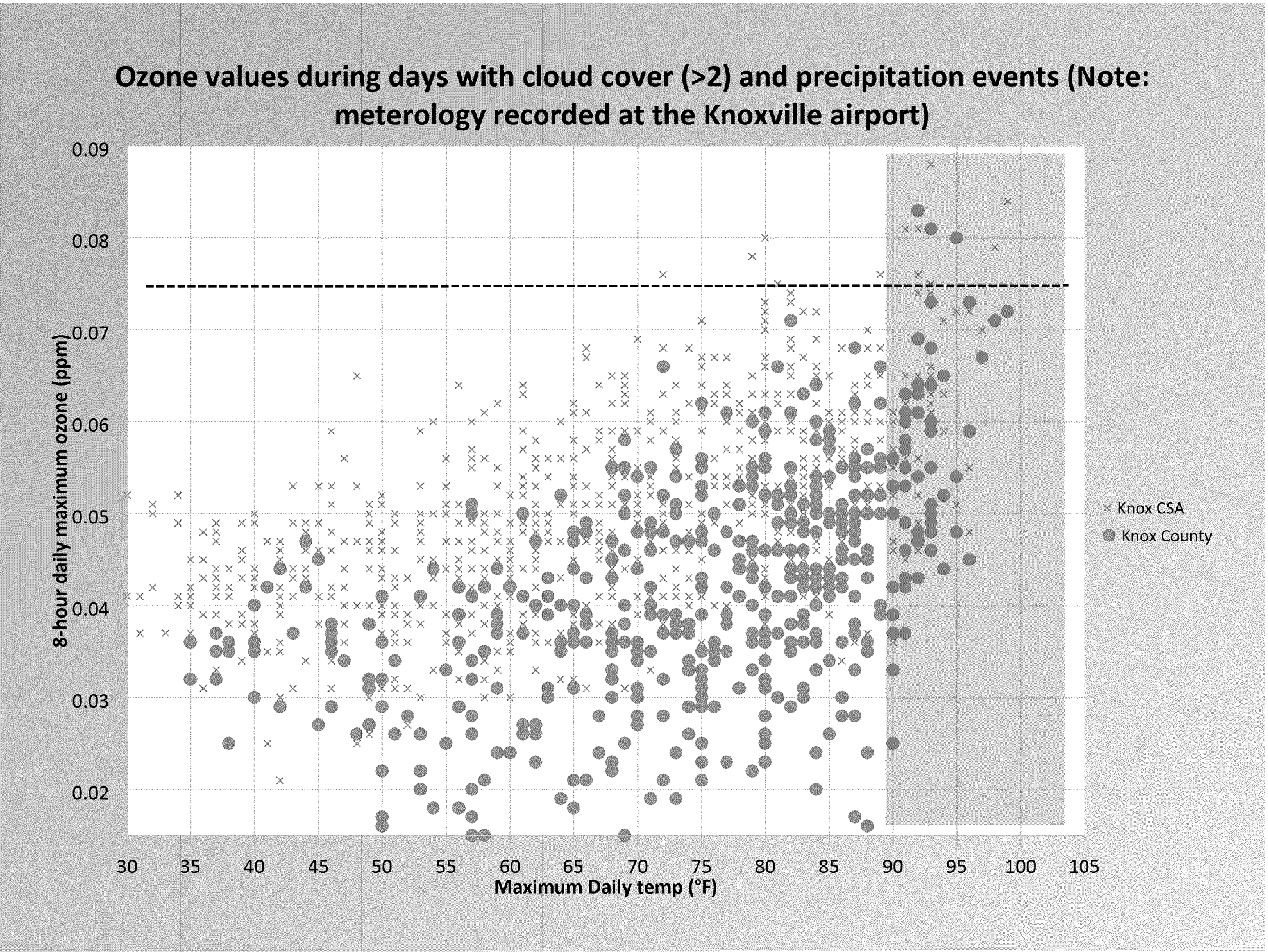

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Selection of Days

Description	Number of days	Running total
Ozone < 65 ppb and max temp < 75°F	42	42
Ozone < 65 ppb and max temp < 78°F	5	47
Ozone < 65 ppb and rain events/cloud cover	13	60
Ozone < 50 ppb and max temp >78°F	3	
Ozone > 50 ppb and < 65 ppb and max temp > 78°F	10	73
Ozone = 65 ppb and max temp > 78°F	7	80
Ozone > 65 ppb and max temp < 75°F	4	84
Ozone > 65 ppb and max temp > 75°F	28	112

Ozone data used was the maximum 8-hr average collected in the Knoxville CSA

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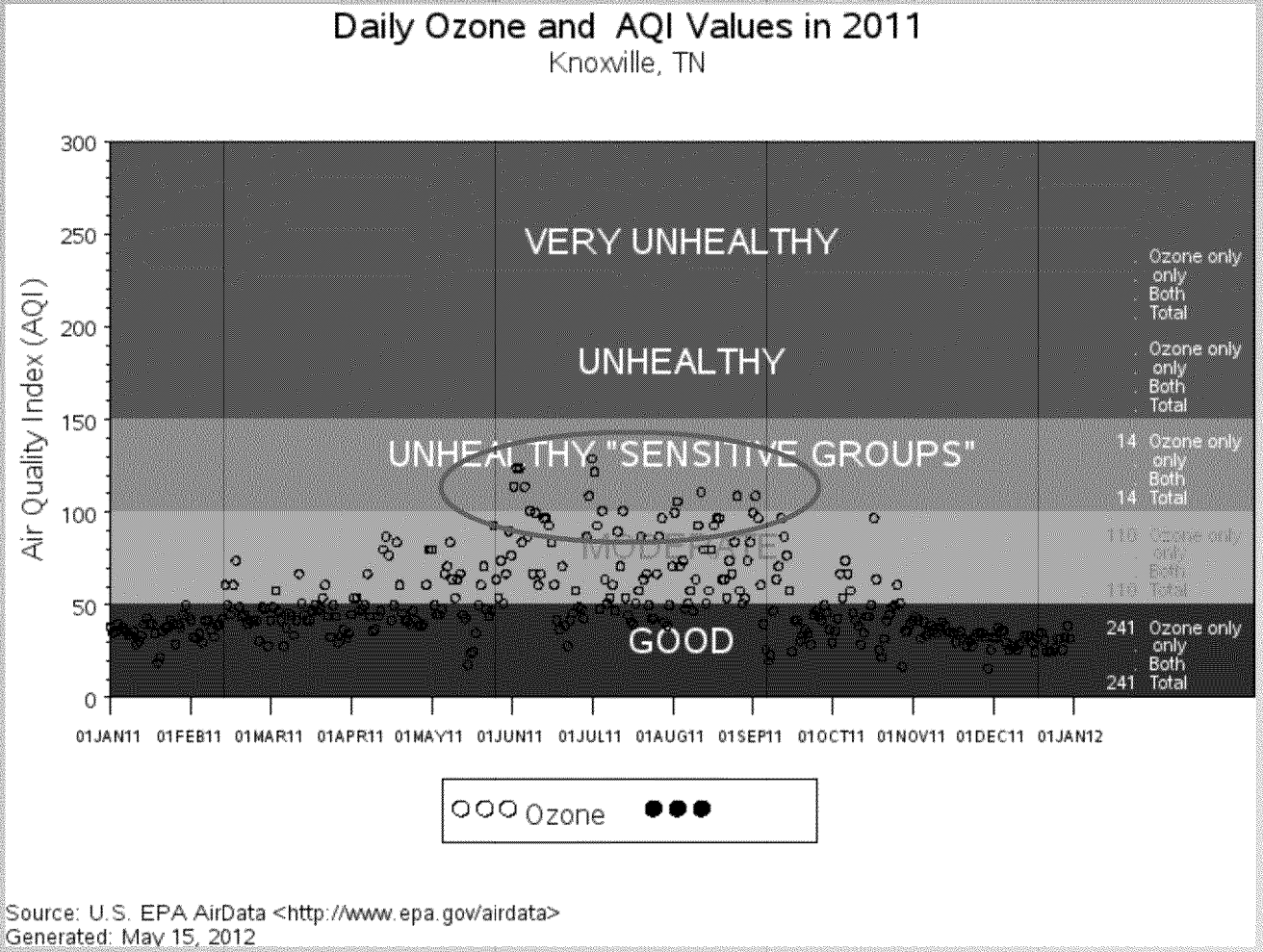
What about missing days that *were* conducive to high ozone?



Source: U.S. EPA AirData <http://www.epa.gov/airdata>
Generated: May 15, 2012

Would the two incomplete sites have violated the NAAQS if they had collected complete data in 2011?

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Ozone Regression Analysis

- Theil-Sen regression model that predicts missing data based on data collected at nearby sites
  - Paired daily maximum 8-hr average ozone values for each site
- Calculates a confidence interval using a bootstrapping method
- Results in a predicted 4th max and design value with an associated confidence interval

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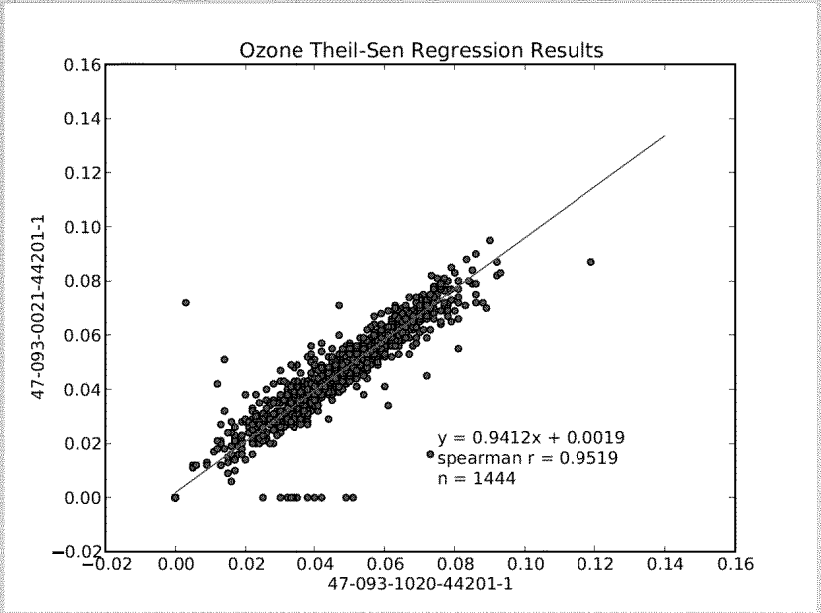
Theil-Sen Regression Model

- Nonparametric linear regression model
  - Less influenced by outliers than least squares regression
  - Does not assume normally distributed data
  - Does not assume error is only in y-direction
- Spearman's Rank Correlation Coefficient
  - Nonparametric equivalent of Pearson's r
  - Measures positive or negative correlation



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Step 1: Screen Nearby Sites and Select the Best Predictor Sites

- Selected predictor sites for each incomplete site that meet the following criteria:
  - At least 920 valid sample pairs (approx. 75% over the previous 5 years)
  - Spearman's Rank Correlation Coefficient > 0.80
  - At least 75% data completeness in the year to be predicted
- Also calculated Pearson Correlation Coefficient and Theil-Sen Regression for each site pair

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Example Site Selection Matrix: Spring Hill Site (AQS ID: 47-093-1020)

comparison_site	incomplete_site	n	spearman_r	spearman_pval	pearson_r	pearson_pval	theil_slope	theil_int
47-093-1020-44201-1	47-093-0021-44201-1	1444	0.951914952	0	0.943372755	0	0.94118	0.00185
47-063-0003-44201-1	47-093-0021-44201-1	292	0.941248585	9.46E-139	0.933572848	2.90E-131	0.91892	7.00E-05
47-105-0108-44201-1	47-093-0021-44201-1	93	0.912599594	4.10E-37	0.900784971	1.00E-34	0.75	0.01025
47-089-0002-44201-1	47-093-0021-44201-1	**1417**	**0.877047948**	0	0.733866562	6.64E-240	1	-0.001
47-105-0109-44201-1	47-093-0021-44201-1	**1327**	**0.832461933**	0	0.704831416	7.99E-200	0.88889	0.00411
47-001-0101-44201-1	47-093-0021-44201-1	**1420**	**0.825591772**	0	0.693255698	5.94E-204	0.92453	0.00421
47-009-0101-44201-1	47-093-0021-44201-1	1482	0.747143127	7.83E-265	0.641101197	2.45E-172	0.91667	-0.00271
47-155-0101-44201-1	47-093-0021-44201-1	1484	0.726548204	8.57E-244	0.619745174	3.62E-158	1.03571	-0.00966
47-155-0102-44201-1	47-093-0021-44201-1	1102	0.655271896	3.59E-136	0.474699528	5.18E-63	0.94118	-0.00524
47-009-0102-44201-1	47-093-0021-44201-1	1425	0.637935642	1.17E-163	0.535401114	1.65E-106	0.85714	0.00771

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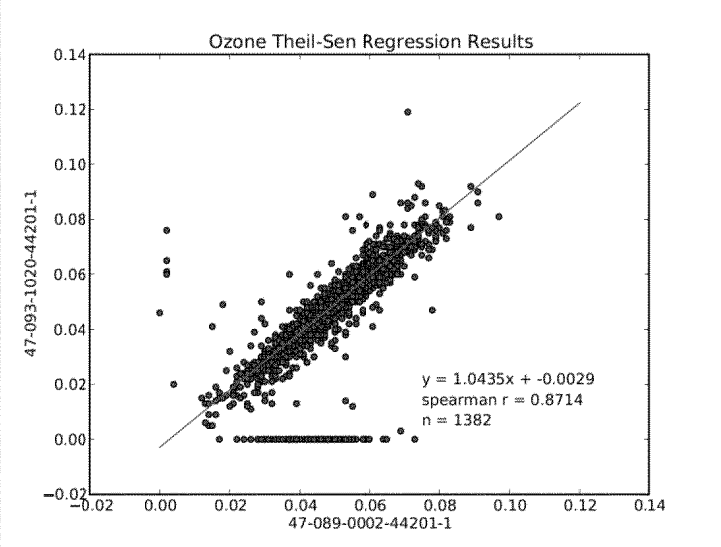
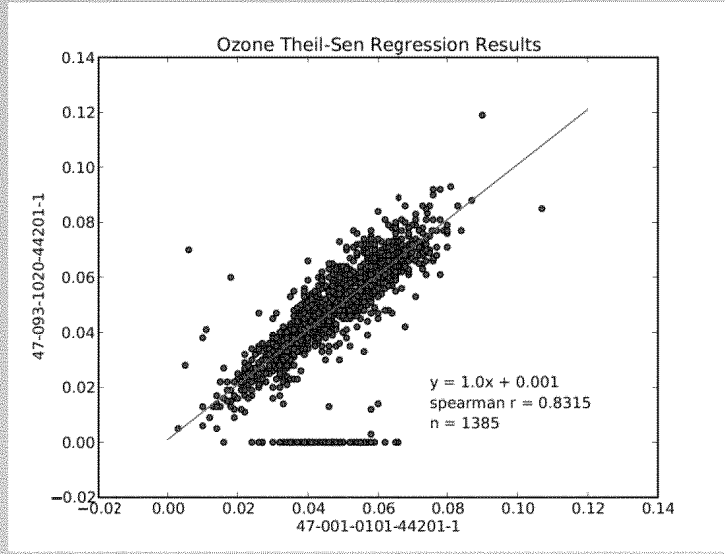
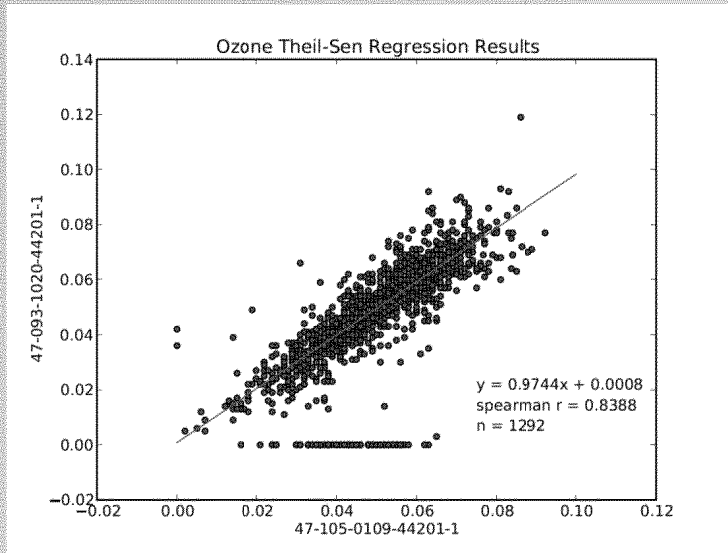
Example Regression Plots:
Spring Hill vs. Selected Predictor Sites







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Step 2: Calculate Predicted Data and Design Value

- For each selected predictor site:
  - Predicted missing daily maximum 8-hr ozone values for the incomplete site (up to 100% or as much as possible)
  - Calculated new 4th maximum for the incomplete year using new “complete” data set of collected and predicted values
  - Calculated 3-year design value using predicted 4th max and other measured 4th max values

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Step 3: Estimate Confidence Interval Using Resampling or "Bootstrapping"

- Randomly resampled *n* sample pairs from original dataset
- Performed Theil-Sen regression on resampled dataset
- Repeated 1,000 times
- Estimated confidence interval by taking 95th and 5th percentile slope and intercept values
- Re-predicted missing data using 95th and 5th percentile slope and intercept values
- Calculated confidence interval as 95th and 5th percentile 4th max and design value

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Results

AQS ID	2011: Percent Complete	2011: 4th Maximum	2011: Predicted 4th Max	2009-2011 Predicted Design Value
47-093-0021	53	0.071	0.074 [0.074 - 0.074]	0.070 [0.070 - 0.070]
47-093-1020	52	0.072	0.074 [0.074 - 0.076]	0.072 [0.072 - 0.072]
47-089-0002	100	0.073		

- This means that we can be 90% confident that the 2009-2011 design value for Knox County would have been 0.072 ppm.
- So, the Knox County monitors would have attained the ozone standard.
- Thus, EPA approved Tennessee's request for credit for missing days, and the Knox County data was certified as complete and attaining the NAAQS.

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Questions?

ED_001361_00002102

DATA SUBSTITUTION ANALYSIS
2009 OZONE
BRANDYWINE (AQS SITE ID 10-003-1010)

DELAWARE DNREC

DIVISION OF AIR QUALITY

JULY 15, 2010

Summary

In April 2009, several weather-related problems caused extensive down-time at the Brandywine air monitoring station (AQS ID 10-003-1010). An extended power outage combined with downed telephone lines resulted in no valid data being collected from the beginning of the ozone season on April 1, 2009 through May 15, 2009. Mechanical problems with the monitor resulted in additional data losses in late August, early September, and most of October 2009. The total valid data capture for 2009 at Brandywine was 53%.

Section 2.3(b) of Appendix I to 40 CFR Part 50 requires three consecutive years of data with data availability of at least 90% on average, with a minimum data completeness in any one year of at least 75%. Furthermore, this section also states:

> "… When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard. Missing days assumed less than the level of the standard are counted for the purpose of meeting the data completeness requirement, subject to the approval of the appropriate Regional Administrator."

The Delaware DNREC Division of Air Quality (DAQ) has analyzed the meteorological and ambient monitoring data for the 2009 ozone season and determined that the use of the null data code, "BG", for the following 57 days is appropriate:

Dates	Day Count
4/1/09 – 4/17/09	17
4/19/09 – 4/24/09	6
4/29/09 – 5/7/09	9
5/10/09 – 5/13/09	4
6/11/09	1
9/10/09	1
10/2/09 – 10/8/09	7
10/10/09 – 10/20/09	11
10/22/09	1
TOTAL	**57**

Adding the 57 days to the Brandywine data results in a data capture percentage of 79% for 2009, which meets the requirements of 40 CFR Part 50 Appendix I Section 2.3(b).

Methodology

Delaware DAQ used a conservative approach to determine what missing days should be counted as valid days in regards to data completeness. Because ozone levels are largely dependent on maximum daily temperature, meteorological data from the Wilmington area can be used in combination with ozone data (both historical data from the Brandywine site and 2009 data from other nearby ozone sites) to evaluate the missing days of data to determine which days could be assumed to be below the NAAQS 8-hour standard of 0.075 ppm.

Historical data: Ozone data and daily high temperature data from 1997 – 2008 were compiled for the Brandywine monitoring site to create a profile of maximum daily 8-hr ozone values at various temperatures throughout the ozone season (Figure 1 in Appendix B). Ozone data prior to the administration of the NOx SIP Call was used as part of the conservative approach.

Daily maximum temperature data was retrieved from the National Weather Service site at New Castle County Airport south of Wilmington (see Appendix C). Analysis of the historical data shows that all exceedances of the 8-hour NAAQS of 0.075 ppm occurred on days with maximum daily temperatures at or above 77 °F. To maintain a conservative approach, a maximum daily temperature of 75 °F was chosen as the cut-off level for assuming the maximum 8-hour ozone level would have been below the NAAQS.

Other ozone sites: In addition to the meteorological data, ambient monitoring data from monitors in neighboring counties provide additional evidence that levels on the missing days were well below the 8-hr ozone NAAQS at Brandywine. Table 1 in Appendix B shows the maximum daily 8-hr ozone data from the 2009 ozone season for the Brandywine monitor and monitors from neighboring counties in Delaware, Maryland, Pennsylvania, and New Jersey (Figure 2 in Appendix B).

Results

Table 1 in Appendix B identifies the days assumed to be less than the standard at Brandywine as follows. Cells highlighted in yellow represent the maximum daily 8-hr ozone value at the sites used in the analysis. Cells highlighted in orange represented days when the Brandywine monitor was down. Cells highlighted in orange with an "x" represent days that DAQ deems appropriate for use in the data completeness calculation. These days are summarized below:

Dates	Day Count
4/1/09 – 4/17/09	17
4/19/09 – 4/24/09	6
4/29/09 – 5/7/09	9
5/10/09 – 5/13/09	4
6/11/09	1
9/10/09	1
10/2/09 – 10/8/09	7
10/10/09 – 10/20/09	11
10/22/09	1
TOTAL	**57**

A total of 57 days were identified as meeting the requirement to be assumed as below the 8-hour NAAQS. The maximum daily 8-hr ozone value at neighboring sites for the missing days was 0.065 ppm, well below the NAAQS. The addition of the 57 days to the data for Brandywine results in a data capture percentage of 79% for 2009.

APPENDIX A - Procedure

Procedure

(1) Download ambient monitoring data from AQS (maximum daily 8-hr ozone values, AMP 435 Report).
   a. The daily maximum 8-hr values are identified in column "Daily Max Sample Value" when the "Duration" column equals "8-HR RUN AVG BEGIN HOUR".
   b. Data from the following sites were downloaded:

AQS SITE ID	COUNTY, STATE	SITE NAME	PERIOD
10-003-1010	New Castle County, DE	Brandywine	1997 – 2009
10-003-1013	New Castle County, DE	Bellefonte2	4/1/09 – 10/31/09
10-003-1007	New Castle County, DE	Lums Pond	4/1/09 – 10/31/09
10-001-0002	Kent County, DE	Killens Pond	4/1/09 – 10/31/09
42-029-0100	Chester County, PA	New Garden Airport	4/1/09 – 10/31/09
42-045-0002	Delaware County, PA	Chester	4/1/09 – 10/31/09
34-007-1001	Camden, NJ	Camden	4/1/09 – 10/31/09
34-015-0002	Gloucester County, NJ	Clarksboro	4/1/09 – 10/31/09
24-015-0003	Cecil County, MD	Fair Hill	4/1/09 – 10/31/09

(2) Download daily weather data from the National Weather Service at New Castle County airport (ILG).
   a. 1997 – 2004 data: http://www.erh.noaa.gov/phi/localclimate.html#Archives
   b. 2005 – 2009 data: http://www.weather.gov/climate/index.php?wfo=phi

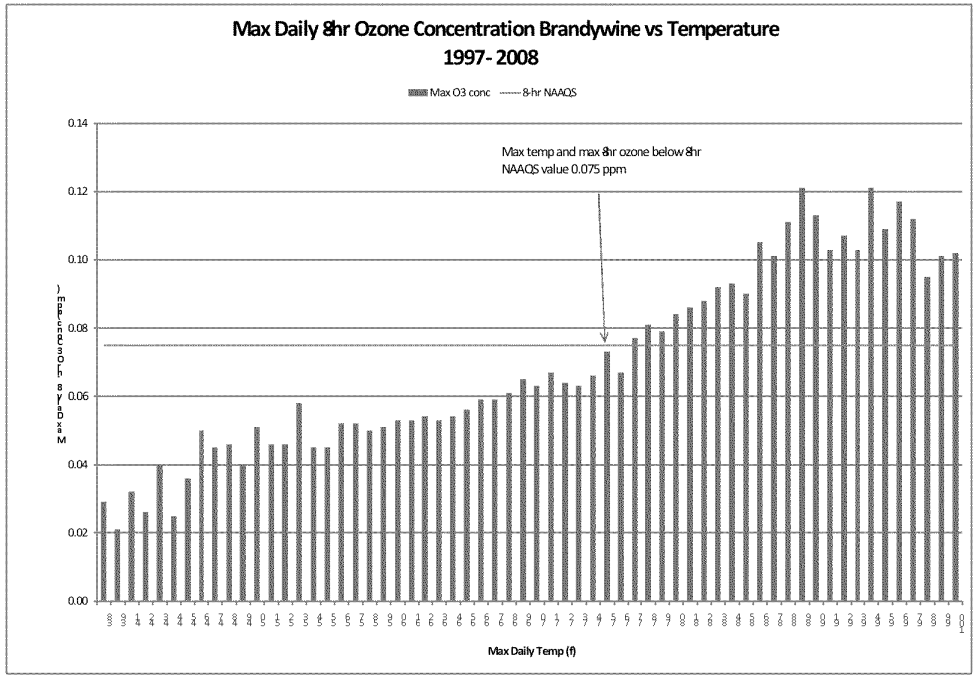
(3) During the ozone season (April 1 – October 31), create a profile of maximum daily 8-hr ozone values versus temperature
   a. Merge data from steps (1) and (2), to create a table of maximum daily 8-hr ozone value and count for each temperature.
   b. See Figure 1. Maximum Daily 8-hr Ozone Concentration versus Temperature

(4) Analyze 2009 Ozone data
   a. Create a table of ambient monitoring and weather data for 2009.
   b. Based on Figure 1, determine the maximum temperature (and maximum 8-hr value) that falls below the 8-hr ozone NAAQS of 0.075 ppm.
   c. Based on (4)(b), identify days that should be counted towards data completeness.

(5) All data is provided on CD as an attachment.

APPENDIX B – Figures and Tables

Figure 1. Maximum Daily 8-hr Ozone Concentration versus Temperature



ED_001361_00002103

Figure 2. Ozone Monitors in counties adjoining Brandywine site (10-003-1010) in New Castle County, DE

ED_001361_00002103

Table 1. 2009 Daily Maximum 8-hr Ozone Data

Monitor down at Brandywine

x Assumed below NAAQS based on meteorology and monitoring data from other sites

Maximum 8-hour daily ozone level from regional monitors

Date	Brandywine (New Castle) 10-003-1010	Bellefonte2 (New Castle) 10-003-1013	Lums Pond (New Castle) 10-003-1007	Killens Pond (Kent) 10-001-0002	Fair Hill (Cecil, MD) 24-015-0003	New Garden Airport (Chester, PA) 42-045-0002	Chester (Delaware, PA) 42-045-0002	Camden (Camden, NJ) 34-007-1001	Clarksboro (Gloucester, NJ) 34-015-0002	Max Temp °F
4/1/2009	x	0.027		0.040	0.040		0.037	0.042	0.034	52
4/2/2009	x	0.030		0.040	0.040		0.033	0.042	0.036	63
4/3/2009	x	0.046		0.051	0.049	0.047	0.044	0.052	0.048	72
4/4/2009	x	0.050		0.053	0.053	0.051	0.049	0.055	0.051	62
4/5/2009	x	0.053		0.054	0.059	0.055	0.052	0.061	0.054	67
4/6/2009	x	0.039		0.048	0.048	0.042		0.051	0.041	60
4/7/2009	x	0.043		0.045	0.046	0.045	0.045	0.047		49
4/8/2009	x	0.046		0.050	0.052	0.048		0.051	0.046	54
4/9/2009	x	0.055		0.056	0.060		0.054	0.063	0.057	63
4/10/2009	x	0.056	0.059	0.059	0.062	0.058	0.059	0.065	0.063	67
4/11/2009	x	0.042	0.043	0.046	0.047	0.043	0.043	0.052	0.041	53
4/12/2009	x	0.047	0.050	0.050	0.052	0.048	0.049	0.055	0.049	53
4/13/2009	x	0.046	0.046	0.049	0.048	0.046	0.046	0.054	0.047	56
4/14/2009	x	0.034	0.047	0.050	0.046	0.042	0.038	0.056	0.048	49
4/15/2009	x	0.032	0.044	0.048	0.045	0.036	0.034	0.055	0.047	48
4/16/2009	x	0.045	0.050	0.050	0.052	0.049	0.048	0.056	0.047	64
4/17/2009	x	0.055	0.058	0.059	0.060	0.056	0.055	0.064	0.058	69
4/18/2009		0.064	0.066	0.066		0.064	0.063	0.075	0.068	77
4/19/2009	x	0.050	0.056	0.052		0.056	0.051	0.054	0.052	67
4/20/2009	x	0.039	0.044	0.047		0.040	0.043	0.047	0.043	52
4/21/2009	x	0.045	0.049	0.045	0.054	0.049	0.045	0.048	0.047	68
4/22/2009	x	0.034	0.036		0.040	0.037	0.033	0.038	0.034	53
4/23/2009	x	0.042	0.046	0.048	0.047	0.044	0.042	0.050	0.044	60

4/24/2009	x	0.053	0.060	0.060	0.064	0.059	0.056	0.068	0.060	72
4/25/2009		0.065	0.063	0.061	0.076	0.067	0.058	0.073	0.067	88
4/26/2009		0.069	0.063	0.064	0.070	0.065	0.058	0.074	0.063	91
4/27/2009		0.067	0.064	0.061	0.072	0.068	0.061	0.067	0.064	89
4/28/2009		0.061	0.059	0.053	0.067	0.065	0.057	0.062	0.064	86
4/29/2009	x	0.032	0.034	0.040	0.032	0.028	0.040	0.044	0.034	68
4/30/2009	x	0.040	0.049	0.047	0.050	0.049	0.044	0.054	0.048	64
5/1/2009	x	0.025	0.033	0.036	0.034	0.028	0.026	0.037		73
5/2/2009	x	0.031	0.034	0.033	0.035	0.040	0.035	0.035	0.035	65
5/3/2009	x	0.031	0.041	0.043	0.036	0.034	0.041	0.043	0.039	58
5/4/2009	x	0.033	0.039	0.046	0.042	0.040	0.026	0.049	0.056	55
5/5/2009	x	0.031	0.042	0.042	0.039	0.036	0.027	0.048	0.030	60
5/6/2009	x	0.034		0.038	0.038	0.038	0.036	0.040	0.039	65
5/7/2009	x	0.026	0.033	0.032	0.031	0.038	0.026	0.033	0.032	73
5/8/2009		0.054	0.057	0.054	0.059	0.055	0.056	0.063	0.059	76
5/9/2009		0.054	0.053	0.046	0.057	0.052	0.051	0.054	0.056	83
5/10/2009	x	0.047	0.047	0.049	0.048	0.044	0.045	0.049	0.046	72
5/11/2009	x	0.031	0.036	0.036	0.032	0.030	0.029	0.037	0.032	63
5/12/2009	x	0.052	0.053	0.049	0.055	0.051	0.049	0.050	0.049	69
5/13/2009	x	0.059	0.063	0.061	0.065	0.063	0.061		0.063	71
5/14/2009			0.044	0.045	0.048	0.044	0.044	0.049	0.046	75
5/15/2009				0.035	0.055	0.053	0.043	0.029	0.045	79
5/16/2009	0.038			0.033	0.032	0.032	0.030	0.031	0.032	78
5/17/2009	0.053			0.032	0.041	0.037	0.039	0.046	0.043	68
5/18/2009	0.049			0.047	0.049	0.045	0.043	0.047	0.046	62
5/19/2009	0.054	0.051		0.054	0.061	0.055	0.050	0.054	0.053	68
5/20/2009		0.063		0.064	0.068	0.065	0.063	0.068	0.062	78
5/21/2009		0.055		0.050	0.062	0.060	0.056	0.062	0.059	79
5/22/2009	0.065	0.059		0.053	0.068	0.065	0.056	0.060	0.061	82
5/23/2009	0.050	0.045		0.040	0.052	0.049	0.046	0.049	0.050	85
5/24/2009	0.047	0.045		0.030	0.045	0.042	0.039	0.037	0.043	82
5/25/2009	0.058	0.062		0.033	0.058	0.056	0.063	0.057	0.066	84
5/26/2009	0.036	0.036	0.031	0.039	0.039	0.036	0.037	0.042		70
5/27/2009	0.025	0.025	0.028	0.029	0.025	0.026	0.026	0.027	0.031	75
5/28/2009	0.024	0.021	0.026	0.024	0.029	0.028	0.021	0.023	0.023	79
5/29/2009	0.032	0.031	0.040	0.037	0.037	0.034	0.030	0.037	0.030	77
5/30/2009	0.057	0.057	0.055	0.059	0.056	0.054	0.055	0.060	0.060	79
5/31/2009	0.058	0.057	0.060	0.060	0.056	0.055	0.057	0.060	0.062	81
6/1/2009	0.046	0.043	0.048	0.049	0.050	0.047	0.046	0.049	0.048	71
6/2/2009	0.055	0.056	0.068	0.069			0.054	0.065	0.057	86
6/3/2009	0.038	0.039	0.052	0.061		0.041	0.042	0.046	0.048	78

6/4/2009	0.030	0.030	0.037	0.045	0.030	0.029	0.034	0.039	0.030	63
6/5/2009	0.034	0.027	0.038	0.046	0.034	0.033	0.023	0.046	0.037	62
6/6/2009	0.041	0.042	0.042	0.038	0.045	0.042	0.044	0.052	0.049	76
6/7/2009	0.057	0.053	0.054	0.051	0.060	0.057	0.056	0.055	0.058	81
6/8/2009	0.056	0.055	0.047	0.046	0.053	0.054	0.054	0.049	0.054	84
6/9/2009	0.036	0.040	0.047	0.045		0.035	0.035	0.037	0.040	81
6/10/2009		0.051	0.064	0.056		0.066	0.043	0.037	0.045	82
6/11/2009	x	0.019	0.041	0.035	0.028	0.023	0.022		0.019	73
6/12/2009	0.047	0.048	0.047	0.047	0.046	0.044	0.046	0.050	0.049	85
6/13/2009	0.037	0.035	0.050	0.049	0.049	0.043	0.036	0.042	0.037	81
6/14/2009	0.043	0.043	0.045	0.047	0.044	0.041	0.041	0.044	0.047	80
6/15/2009	0.048	0.046	0.044	0.037	0.048	0.049	0.046	0.044	0.052	76
6/16/2009	0.031	0.030	0.034	0.034	0.030	0.031	0.034	0.033	0.031	70
6/17/2009	0.026	0.023	0.029	0.028	0.025	0.025	0.027	0.026	0.025	69
6/18/2009	0.031	0.030	0.034	0.035	0.031	0.029	0.035	0.039	0.036	72
6/19/2009	0.042	0.043	0.044	0.044	0.042	0.041	0.039	0.047	0.042	79
6/20/2009	0.037	0.037	0.040	0.039	0.037	0.035	0.034	0.040	0.037	78
6/21/2009	0.032	0.034	0.032	0.034	0.032	0.031	0.032	0.032	0.033	79
6/22/2009	0.037	0.034	0.039	0.037	0.038	0.037	0.030		0.026	84
6/23/2009		0.043	0.046	0.040	0.044	0.043	0.041	0.049	0.043	83
6/24/2009	0.043	0.043	0.047	0.045	0.048	0.046	0.042	0.042	0.041	83
6/25/2009	0.063	0.059	0.064	0.045	0.068	0.063	0.064	0.060	0.072	84
6/26/2009	0.075	0.076	0.078	0.059	0.083	0.078	0.072	0.064	0.076	88
6/27/2009	0.041	0.041	0.044	0.051	0.043	0.039	0.040	0.053	0.046	83
6/28/2009	0.044	0.046	0.045	0.047	0.046	0.044	0.043	0.052	0.048	85
6/29/2009	0.055	0.057	0.054	0.060	0.053	0.053	0.053	0.061	0.060	84
6/30/2009		0.052	0.054	0.055	0.057	0.056	0.052	0.057	0.057	86
7/1/2009		0.057	0.052	0.058	0.056	0.054	0.057	0.060	0.066	85
7/2/2009		0.050	0.050	0.055	0.047	0.047	0.048	0.058	0.056	83
7/3/2009		0.041	0.041	0.044	0.039	0.039	0.040	0.046	0.044	81
7/4/2009		0.048	0.049	0.049	0.047	0.045	0.045	0.050	0.048	82
7/5/2009	0.045	0.049	0.050	0.040	0.046	0.044	0.049	0.048	0.054	78
7/6/2009	0.052	0.054	0.057	0.058	0.058	0.054	0.054	0.068	0.059	85
7/7/2009	0.061	0.064	0.065	0.059	0.064	0.060	0.061	0.065	0.067	86
7/8/2009	0.037	0.039	0.038	0.042	0.036	0.035	0.038	0.043	0.040	80
7/9/2009	0.046	0.048	0.045	0.037	0.049	0.047	0.050	0.041	0.046	80
7/10/2009	0.054	0.056	0.055	0.043	0.061	0.060	0.062	0.049	0.053	79
7/11/2009	0.043	0.042	0.047	0.045	0.046	0.045	0.046	0.056	0.050	79
7/12/2009	0.045	0.047	0.050	0.053	0.049	0.046	0.047	0.054	0.048	85
7/13/2009	0.049	0.048	0.048	0.047	0.054	0.054	0.052	0.048	0.053	82
7/14/2009	0.053	0.054	0.051	0.049	0.052	0.053	0.053	0.057	0.055	83

7/15/2009	0.070	0.069	0.068	0.066	0.072	0.069	0.070	0.064	0.070	86
7/16/2009	0.058	0.058	0.077	0.069	0.077	0.057	0.061	0.059	0.066	89
7/17/2009	0.049	0.051	0.061	0.059	0.055	0.053	0.057	0.062	0.060	85
7/18/2009	0.047	0.047	0.045	0.052	0.045	0.044	0.047	0.052	0.051	82
7/19/2009	0.041	0.042	0.046	0.047	0.044	0.042	0.044	0.051	0.051	83
7/20/2009	0.056	0.053	0.058	0.051	0.058	0.064	0.060	0.052	0.058	83
7/21/2009	0.037	0.034	0.037	0.045	0.037	0.034	0.034	0.036	0.036	76
7/22/2009	0.053	0.048	0.053	0.045	0.048	0.054	0.053	0.048	0.055	84
7/23/2009		0.030	0.030	0.027	0.026	0.031	0.029	0.035	0.034	77
7/24/2009		0.050	0.051	0.047	0.050	0.048	0.050	0.058	0.058	81
7/25/2009	0.059	0.050	0.057	0.061	0.056	0.054	0.053	0.056	0.057	86
7/26/2009	0.058	0.049	0.052	0.054	0.054	0.054	0.049	0.054	0.055	88
7/27/2009	0.054	0.045	0.051	0.045	0.059	0.056	0.047	0.047	0.049	86
7/28/2009	0.055	0.045	0.055	0.056	0.048	0.053	0.048	0.050	0.051	87
7/29/2009	0.050	0.041	0.045		0.045	0.040	0.041	0.050	0.044	87
7/30/2009	0.058	0.054	0.053	0.057	0.054	0.053	0.053	0.063	0.059	87
7/31/2009	0.045	0.037	0.041		0.042	0.037	0.039	0.040	0.041	88
8/1/2009	0.058	0.050	0.052	0.045	0.045	0.050		0.052	0.052	84
8/2/2009	0.040	0.033	0.039	0.031	0.037	0.036			0.034	80
8/3/2009		0.055	0.054	0.048	0.054	0.058	0.055		0.062	85
8/4/2009		0.047	0.053	0.044	0.051	0.050	0.050		0.053	86
8/5/2009		0.059	0.059	0.065	0.056	0.054	0.057		0.067	85
8/6/2009		0.030	0.028	0.025	0.034	0.034	0.030	0.031	0.024	78
8/7/2009		0.045	0.044	0.044	0.043	0.043	0.043	0.047	0.045	81
8/8/2009		0.062	0.056	0.060	0.058	0.060	0.065	0.046	0.058	82
8/9/2009			0.048	0.057	0.044	0.040	0.045	0.053	0.050	87
8/10/2009			0.061	0.064	0.052	0.051	0.055	0.070	0.067	93
8/11/2009		0.055	0.061	0.064	0.055	0.054	0.055	0.069	0.059	88
8/12/2009		0.043	0.056	0.052	0.051	0.049	0.045	0.050	0.048	88
8/13/2009		0.025	0.049	0.045	0.046	0.041	0.029	0.036	0.036	78
8/14/2009		0.058	0.058	0.051	0.049	0.049	0.063	0.058	0.071	84
8/15/2009	0.077	0.069	0.061	0.057	0.065	0.059	0.070	0.062	0.067	87
8/16/2009	0.063	0.059	0.059	0.068	0.065	0.058	0.064	0.071	0.074	88
8/17/2009	0.068	0.062	0.058	0.047	0.061	0.060	0.063	0.063	0.069	90
8/18/2009	0.064	0.049	0.055	0.046		0.060	0.054	0.054	0.054	90
8/19/2009	0.054	0.051	0.059	0.049		0.056	0.052	0.059	0.058	88
8/20/2009	0.046	0.037	0.048	0.046	0.043	0.039	0.043	0.046	0.041	90
8/21/2009	0.048	0.034	0.043	0.045	0.039	0.033	0.033	0.040	0.035	92
8/22/2009	0.046	0.034	0.040	0.040	0.038	0.036	0.038	0.030	0.037	87
8/23/2009	0.049	0.041	0.045	0.046	0.042	0.039	0.041	0.049	0.047	86
8/24/2009		0.045	0.046	0.046	0.045	0.043	0.047	0.060	0.048	86

8/25/2009		0.046	0.048	0.046	0.048	0.043	0.049	0.058	0.055	85
8/26/2009		0.057	0.060	0.064	0.055	0.056	0.057	0.064	0.061	87
8/27/2009		0.039	0.065	0.050	0.046	0.044	0.037	0.042	0.039	84
8/28/2009		0.030	0.041	0.041	0.033	0.032	0.034	0.041	0.035	76
8/29/2009		0.024	0.037	0.024	0.032	0.029	0.027	0.032	0.031	82
8/30/2009		0.046	0.047	0.053	0.045	0.044	0.046	0.053	0.051	83
8/31/2009		0.028	0.017	0.029	0.027	0.025	0.027	0.028	0.025	75
9/1/2009		0.040	0.015	0.045	0.038	0.039	0.041	0.042	0.035	75
9/2/2009		0.056	0.021	0.048	0.064	0.061	0.058	0.052	0.054	77
9/3/2009	0.055	0.045	0.039	0.038	0.055	0.055	0.048	0.040	0.044	79
9/4/2009	0.056	0.051	0.045	0.065	0.047	0.046	0.051	0.058	0.055	82
9/5/2009	0.057	0.051	0.049	0.052	0.051	0.049	0.052	0.059	0.054	86
9/6/2009	0.047	0.033	0.037	0.054	0.044	0.042	0.034	0.029	0.032	79
9/7/2009	0.033	0.024	0.026	0.034	0.025	0.025	0.027	0.027	0.026	74
9/8/2009	0.032	0.028	0.025	0.037	0.032	0.035	0.033	0.032	0.030	74
9/9/2009	0.038	0.032	0.031	0.039	0.033	0.030	0.030	0.029	0.030	74
9/10/2009	x	0.026	0.029	0.029	0.030	0.029	0.024	0.029	0.029	71
9/11/2009	0.034	0.020	0.019	0.022	0.020	0.019	0.019	0.026	0.019	65
9/12/2009	0.023	0.014	0.012	0.015	0.014	0.013	0.013	0.019	0.016	68
9/13/2009	0.046	0.035	0.033	0.032	0.036	0.034	0.037	0.040	0.039	80
9/14/2009	0.051	0.042	0.043	0.046	0.044	0.042	0.041	0.045	0.044	80
9/15/2009	0.05	0.039	0.038	0.041	0.040	0.040	0.041	0.043	0.043	82
9/16/2009	0.028	0.015	0.019	0.029	0.018	0.020	0.012	0.024	0.020	70
9/17/2009	0.027	0.014	0.018	0.028	0.018	0.018	0.012	0.024	0.018	66
9/18/2009	0.044	0.031	0.025	0.031	0.038	0.037	0.030	0.034	0.029	75
9/19/2009	0.035	0.032	0.032	0.034	0.032	0.033	0.032	0.034	0.033	72
9/20/2009	0.053	0.048	0.046	0.045	0.051	0.053	0.049	0.049	0.052	71
9/21/2009	0.045	0.035	0.037	0.037	0.038	0.039	0.037	0.036	0.040	76
9/22/2009	0.038	0.025	0.035	0.034	0.031	0.030	0.030	0.032	0.030	76
9/23/2009	0.050	0.026	0.033	0.030	0.037	0.035	0.026	0.029	0.028	81
9/24/2009	0.057	0.044	0.047	0.049		0.041	0.041	0.045	0.043	83
9/25/2009	0.033	0.028	0.028	0.034	0.030	0.029	0.029	0.029	0.030	76
9/26/2009	0.034	0.026	0.028	0.030	0.028	0.028	0.030	0.027	0.028	68
9/27/2009	0.041	0.030	0.031	0.030	0.031	0.029	0.027	0.030	0.030	75
9/28/2009	0.054	0.041	0.041	0.047	0.042	0.040	0.041	0.046	0.043	78
9/29/2009	0.031	0.026	0.026	0.033	0.026	0.024	0.024		0.026	68
9/30/2009	0.023	0.018	0.022	0.023	0.021	0.020	0.016		0.016	66
10/1/2009	0.034	0.031	0.030	0.030	0.031	0.030	0.030	0.031	0.030	60
10/2/2009	x	0.036	0.039	0.043	0.039	0.039	0.040	0.039	0.038	68
10/3/2009	x	0.037	0.036	0.040	0.041	0.042	0.035	0.035	0.038	74
10/4/2009	x	0.041	0.038	0.040	0.039	0.039	0.041	0.047	0.043	74

10/5/2009	x	0.024	0.025	0.028	0.024	0.023	0.022	0.024	0.023	69
10/6/2009	x	0.029	0.031	0.030	0.031	0.031	0.030	0.032	0.031	67
10/7/2009	x	0.031	0.030	0.032	0.031	0.030	0.029	0.032	0.030	72
10/8/2009	x	0.029	0.030	0.031	0.030	0.029	0.028	0.029	0.029	67
10/9/2009		0.047	0.048	0.047		0.049	0.046	0.048	0.049	79
10/10/2009	x	0.024	0.021	0.024	0.024	0.024	0.024	0.023	0.024	71
10/11/2009	x	0.033	0.031	0.035	0.031	0.032	0.033	0.034	0.034	65
10/12/2009	x	0.019	0.023	0.027	0.020	0.017	0.023	0.026	0.021	55
10/13/2009	x	0.031	0.030	0.033	0.031	0.029	0.028	0.030	0.028	68
10/14/2009	x	0.020	0.020	0.023	0.023	0.022	0.018	0.024	0.020	53
10/15/2009	x	0.013	0.010	0.025		0.015	0.012	0.020	0.011	49
10/16/2009	x	0.015	0.012	0.020	0.018	0.017	0.013	0.018	0.013	45
10/17/2009	x	0.021	0.020	0.019	0.023	0.022	0.021	0.020	0.016	46
10/18/2009	x	0.026	0.027	0.024	0.030	0.029	0.026	0.024	0.024	51
10/19/2009	x	0.030	0.029	0.031	0.031	0.032	0.029	0.027	0.026	57
10/20/2009	x	0.027	0.023	0.037	0.026	0.031	0.019	0.035	0.027	67
10/21/2009		0.043	0.032	0.044		0.044	0.038	0.037	0.038	75
10/22/2009	x	0.026	0.031	0.049	0.033	0.032	0.023	0.044	0.037	73
10/23/2009	0.023	0.019	0.024	0.038	0.023	0.023	0.025	0.029	0.027	67
10/24/2009	0.026	0.025	0.026	0.030	0.027	0.027	0.026	0.030	0.029	73
10/25/2009	0.034	0.030	0.029	0.028	0.031	0.031	0.030	0.027	0.028	62
10/26/2009	0.025	0.023	0.028	0.034	0.026	0.024	0.027	0.032	0.028	62
10/27/2009	0.013	0.014	0.017	0.031	0.019	0.013	0.007	0.029	0.011	60
10/28/2009	0.021	0.020	0.021	0.030	0.022	0.021	0.017	0.030	0.022	68
10/29/2009	0.018	0.017	0.013	0.026	0.018	0.018	0.019	0.021	0.014	57
10/30/2009	0.032	0.028	0.032	0.034	0.033	0.033	0.033	0.034	0.033	58
10/31/2009	0.027	0.026	0.024	0.032	0.025	0.026	0.026	0.035	0.029	71

APPENDIX C- Data

See attached CD for:

(1) Monthly weather data

(2) AMP 435 reports (zip files)

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES
& ENVIRONMENTAL CONTROL
DIVISION OF AIR AND WASTE MANAGEMENT
655 S. Bay Road, Suite 5N
DOVER, DELAWARE 19901

AIR QUALITY MANAGEMENT
SECTION

Telephone: (302) 739 - 9402
Fax No.: (302) 739 - 3106

July 19, 2010

Mr. Shawn M. Garvin (RA000)
Regional Administrator
United States Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Dear Mr. Garvin:

In April 2009, several weather-related problems caused extensive down-time at the Brandywine air monitoring station (AQS ID 10-003-1010) during the spring and fall of 2009. The total valid data capture for the 2009 ozone season at Brandywine was 53%. Section 2.3(b) of Appendix I to 40 CFR Part 50 requires three consecutive years of data with data availability of at least 90% on average, with a minimum data completeness in any one year of at least 75%. Furthermore, this section also states:

> "… When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard. Missing days assumed less than the level of the standard are counted for the purpose of meeting the data completeness requirement, subject to the approval of the appropriate Regional Administrator."

The Delaware DNREC Division of Air Quality (DAQ) has analyzed the meteorological and ambient monitoring data for the 2009 ozone season and determined that the use of the null data code, "BG", for the following 57 days is appropriate:

Dates	Day Count
4/1/09 – 4/17/09	17
4/19/09 – 4/24/09	6
4/29/09 – 5/7/09	9
5/10/09 – 5/13/09	4
6/11/09	1
9/10/09	1
10/2/09 – 10/8/09	7
10/10/09 – 10/20/09	11
10/22/09	1
TOTAL	**57**

DAQ is submitting the attached data substitution request for 57 days listed above. The incorporation of the "BG" data code for the Brandywine data results in a data capture percentage of 79% for 2009, which meets the requirements of 40 CFR Part 50 Appendix I, Section 2.3(b). DAQ has discussed this process and data review with Andrew Hass of EPA Region III. The data substitution analysis and raw data on CD are attached. A revised 2009 Delaware Data Certification package for the updated ozone data will also be submitted to EPA Region III. Please feel free to contact Betsy Frey,(302) 323-4542, if you have any questions.

Sincerely,

Ali Mirzakhalili, P.E.
Director

Enclosure

cc: Aimee Howell, EPA, Region III
Walter Wilkie, EPA Region III
Andrew Haas, EPA Region III
Pauline Devose, EPA Region III
David Lutz, Data Certification Contact, EPA (Mail Code C304-06)
Ron Amirikian, DAQ
Betsy Frey, DAQ
Joe Martini, DAQ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

SEP 24 2010

Mr. Ali Mirzakhalili, Director
Division of Air and Waste Management
Delaware Department of Natural Resources
and Environmental Control
655 South Bay Road, Suite 5N
Dover, Delaware 19901

Dear Mr. Mirzakhalili:

By letter and enclosures dated July 19, 2010, the Delaware Department of Natural Resources and Environmental Control (DNREC) submitted to the U.S. Environmental Protection Agency, Region III (EPA) a data completeness substitution package for its Brandywine ambient air ozone monitoring site (AIRS ID# 10-003-1010) in accordance with the regulatory requirements of 40 CFR Part 50 Appendix I. 2.3(b) – National Primary and Secondary Ambient Air Quality Standards. The regulatory requirements of 40 CFR Part 50 Appendix I. 2.3 (b) prescribe the following:

> "....When computing whether the minimum data completeness requirements have been met, meteorological or ambient data maybe sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard. Missing days assumed, less than the level of the standard, are counted for the purpose of meeting the minimum data completeness requirement, subject to the approval of the appropriate Regional Administrator."

The DNREC data substitution package contained documentation and analysis showing that meteorological conditions for the concurred missing days was not conducive to forming elevated concentrations of ground-level ozone which would have exceeded the 8-hour ozone standard of 0.075 parts per million. DNREC further substantiated its analysis by providing information that showed that reported ozone concentrations at nearby monitoring sites were well below the 8-hour ozone standard for the concurred missing days. Therefore, based on our review of the analysis and supporting documentation provided by DNREC, EPA hereby approves DNREC's request to allow missing ambient air ozone concentrations for the days during calendar year 2009, as provided below, to be counted when calculating yearly data completeness requirements of 40 CFR Part 50 Appendix I:

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Customer Service Hotline: 1-800-438-2474

Dates	Day Count
4/1/09 – 4/17/09	17
4/19/09 – 4/23/09	5
4/29/09 – 5/7/09	9
5/10/09 – 5/12/09	3
6/11/09	1
9/10/09	1
10/2/09 – 10/8/09	7
10/10/09 – 10/20/09	11
10/22/09	1
TOTAL	55

If you have any questions regarding this approval action, please do not hesitate to contact Ms. Diana Esher, Director, Air Protection Division, at (215) 814-2706 or Mr. Walter K. Wilkie, Associate Director of the Office of Air Monitoring and Analysis, at (215) 814-2150.

Sincerely,

Shawn M. Garvin
Regional Administrator

cc: Mr. Ron Amirikian, DNREC
Ms. Betsy Frey, DNREC
Mr. Joseph Martini, DNREC
Mr. David Lutz, EPA-OAPQS

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Customer Service Hotline: 1-800-438-2474

CITY OF PHILADELPHIA

DEPARTMENT OF PUBLIC HEALTH
Municipal Services Building
1401 JFK Boulevard, Room 600
Philadelphia, Pennsylvania 19102
Tel: (215) 686-9009

DONALD F. SCHWARZ, MD, MPH
Deputy Mayor, Health & Opportunity
Health Commissioner

April 9, 2010

Shawn M. Garvin
Regional Administrator
United States Environmental Protection Agency
Region III
Mail Code 3RA00
1650 Arch Street
Philadelphia, PA 19103-2029

Dear Mr. Garvin:

During the 2009 Ozone Season, the failure of an exhaust fan pump resulted in significant downtime for the ozone monitor located at Northeast Airport in Philadelphia County (AQS Monitor ID 42-101-0024). The downtime lasted from 9/16/2009 – 10/26/2009 (42 days) and resulted in 71% data collection during the ozone season. Section 2.3(b) of Appendix I to 40 CFR Part 50 requires three consecutive years of data with data availability of at least 90% on average, with a minimum data completeness in any one year of at least 75%. Furthermore, this section also states:

> "… When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard. Missing days assumed less than the level of the standard are counted for the purpose of meeting the data completeness requirement, subject to the approval of the appropriate Regional Administrator."

The City of Philadelphia, Department of Public Health, Air Management Services (AMS), is therefore submitting a data substitution request to approve the null data code, "BG", for all missing days that AMS is proposing to have counted towards meeting the data completeness requirements. Based on analysis of meteorological and ambient monitoring data, AMS has determined use of the null data code, "BG", is appropriate for the following 29 days:

Dates	Day Count
9/16/09 – 9/17/09	2
9/19/09	1
9/26/09	1
9/29/09 – 10/2/09	4
10/4/09 – 10/8/09	5
10/11/09 – 10/26/09	16
TOTAL	**29**

AMS has contacted Andrew Hass of EPA Region III, who has reviewed and commented on the methodology.

The data substitution analysis and correspondence with Andrew Hass is attached.

If you have any questions, please contact Thomas Huynh at 215-685-7584 or thomas.huynh@phila.gov.

Sincerely,

Donald Schwarz, MD, MPH

Enclosure

cc: Pauline DeVose, EPA Region III
David Lutz, Data Certification Contact, US EP (D304-06)
Walter Wilkie, EPA Region III
Thomas Huynh, Director, Air Management Services
Ed Braun, Regulatory Services Manager, Air Management Services
Henry Kim, Chief, Program Services, Air Management Services
Kirit Dalal, PADEP Division of Air Quality Monitoring
Arleen Shuman, PADEP Division of Resources Management

DATA SUBSTITUTION ANALYSIS:
AQS SITE ID: 42-101-0024
POLLUTANT: OZONE (44201)
YEAR: 2009

CITY OF PHILADELPHIA
DEPARTMENT OF PUBLIC HEALTH
AIR MANAGEMENT SERVICES

3/29/10

ED_001361_00002107

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Summary

During the 2009 Ozone Season, the failure of an exhaust fan pump resulted in significant down time for the ozone monitor located at Northeast Airport in Philadelphia County (NEA) (AQS Monitor ID 42-101-0024). The down time lasted from 9/16/2009 – 10/26/2009 (42 days) and resulted in 71% data collection during the ozone season. Section 2.3(b) of Appendix I to 40 CFR Part 50 requires three consecutive years of data with data availability of at least 90% on average, with a minimum data completeness in any one year of at least 75%. Furthermore, this section also states:

> "… When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard. Missing days assumed less than the level of the standard are counted for the purpose of meeting the data completeness requirement, subject to the approval of the appropriate Regional Administrator."

The City of Philadelphia, Department of Public Health, Air Management Services (AMS), has analyzed the meteorological and ambient monitoring data for the 2009 Ozone season and determined that the use of the null data code, "BG", for the following 29 days is appropriate:

Dates	Day Count
9/16/09 – 9/17/09	2
9/19/09	1
9/26/09	1
9/29/09 – 10/2/09	4
10/4/09 – 10/8/09	5
10/11/09 – 10/26/09	16
TOTAL	**29**

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Methodology

AMS used a conservative approach to determine what missing days should be counted as valid days in regards to data completeness. Temperature plays a vital role in the formation of ozone. Ozone data and daily high temperature data from 1997 – 2008 were compiled for the NEA monitoring site to create a profile of maximum daily 8-hr ozone values at various temperatures during the ozone season (see Figure 1). Ozone data prior to the administration of the NOx SIP Call was used to demonstrate the conservative approach.

For the 2009 Ozone season, the 4th highest 8-hr ozone value at NEA was 0.072 ppm. Based on the 4th highest value for 2009 and Figure 1, historical data shows that temperatures at or below 74F would not exceed 0.072 ppm. The temperature of 74F was chosen as it represents not only the maximum temperature but the maximum daily 8-hr value that would not exceed the 4th highest value for 2009. In the initial analysis presented to Andrew Hass of EPA Region III, a temperature of 73F was chosen using weather data from the Penn State web site (http://climate.met.psu.edu/data/mesonet/datainv.php). For the final analysis, data from the National Weather Service was used (see Appendix C). It is important to note that AMS has chosen the 4th highest 8-hr ozone value as the level to count the missing days as opposed to "the level of the standard" as described in Section 2.3(b) of Appendix I to 40 CFR Part 50. The use of the 4th highest value continues the conservative approach used by AMS.

Table 1, shows the maximum daily 8-hr ozone data from the 2009 Ozone season. Monitors from neighboring counties of Philadelphia (see Figure 2) were included. Cells highlighted in "orange" represented days when the NEA monitor was down. Cells highlighted in "orange" with an "X" represent days that AMS deems appropriate for use in the data completeness calculation. These days are summarized below:

Dates	Day Count
9/16/09 – 9/17/09	2
9/19/09	1
9/26/09	1
9/29/09 – 10/2/09	4
10/4/09 – 10/8/09	5
10/11/09 – 10/26/09	16
TOTAL	**29**

Cells highlighted in "yellow" represent the maximum daily 8-hr ozone value.

In addition to the meteorological data, ambient monitoring data from neighboring counties provide additional evidence that levels on the 29 days were well below the 4th highest 8-hr ozone value at NEA. The maximum daily 8-hr ozone value for the 29 days was 0.048 ppm.

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Analysis

Steps:

(1) Download ambient monitoring data from AQS (maximum daily 8-hr ozone values, AMP 435 Report).
   a. The daily maximum 8-hr values are identified in column "Daily Max Sample Value" when the "Duration" column equals "8-HR RUN AVG BEGIN HOUR".
   b. Data from the following sites were downloaded:

AQS SITE ID	COUNTY, STATE	SITE NAME	PERIOD
42-101-0024	Philadelphia County, PA	Northeast Airport	1997 – 2009
42-101-0004	Philadelphia County, PA	AMS Lab	4/1/09 – 10/31/09
42-017-0012	Bucks County, PA	Bristol	4/1/09 – 10/31/09
42-029-0100	Chester County, PA	New Garden Airport	4/1/09 – 10/31/09
42-045-0002	Delaware County, PA	Chester	4/1/09 – 10/31/09
42-091-0013	Montgomery County, PA	Norristown	4/1/09 – 10/31/09
34-029-0006	Ocean County, NJ	Colliers Mills	4/1/09 – 10/31/09
34-015-0002	Gloucester County, NJ	Clarksboro	4/1/09 – 10/31/09
24-015-0003	Cecil County, MD	Fair Hill	4/1/09 – 10/31/09

   c. Data was downloaded on 3/5/10, 3/8/10, 3/19/10.
   d. See Figure 2. Ozone Monitors near Northeast Airport (42-101-0024).

(2) Download daily weather data from the National Weather Service at PHL airport.
   a. 1997 – 2004 data: http://www.erh.noaa.gov/phi/localclimate.html#Archives
   b. 2005 – 2009 data: http://www.weather.gov/climate/index.php?wfo=phi
   c. Data downloaded 3/26/10.

(3) During the ozone season (April 1 – October 31), create a profile of maximum daily 8-hr ozone values versus temperature
   a. Merge data from steps (1) and (2), to create a table of maximum daily 8-hr ozone value and count for each temperature.
   b. See Figure 1. Maximum Daily 8-hr Ozone Concentration versus Temperature

(4) Analyze 2009 Ozone data
   a. Create a table of ambient monitoring and weather data for 2009.
   b. Based on Figure 1, determine the maximum temperature (and maximum 8-hr value) that falls below the 4th highest 8-hr ozone value for 2009.
   c. Based on (4)(b), identify days that should be counted towards data completeness.
   d. See Table 1. 2009 Ozone Analysis.

(5) All data is provided on CD as an attachment.

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APPENDIX

APPENDIX A: Figures

Figure 1. Maximum Daily 8-hr Ozone Concentration versus Temperature

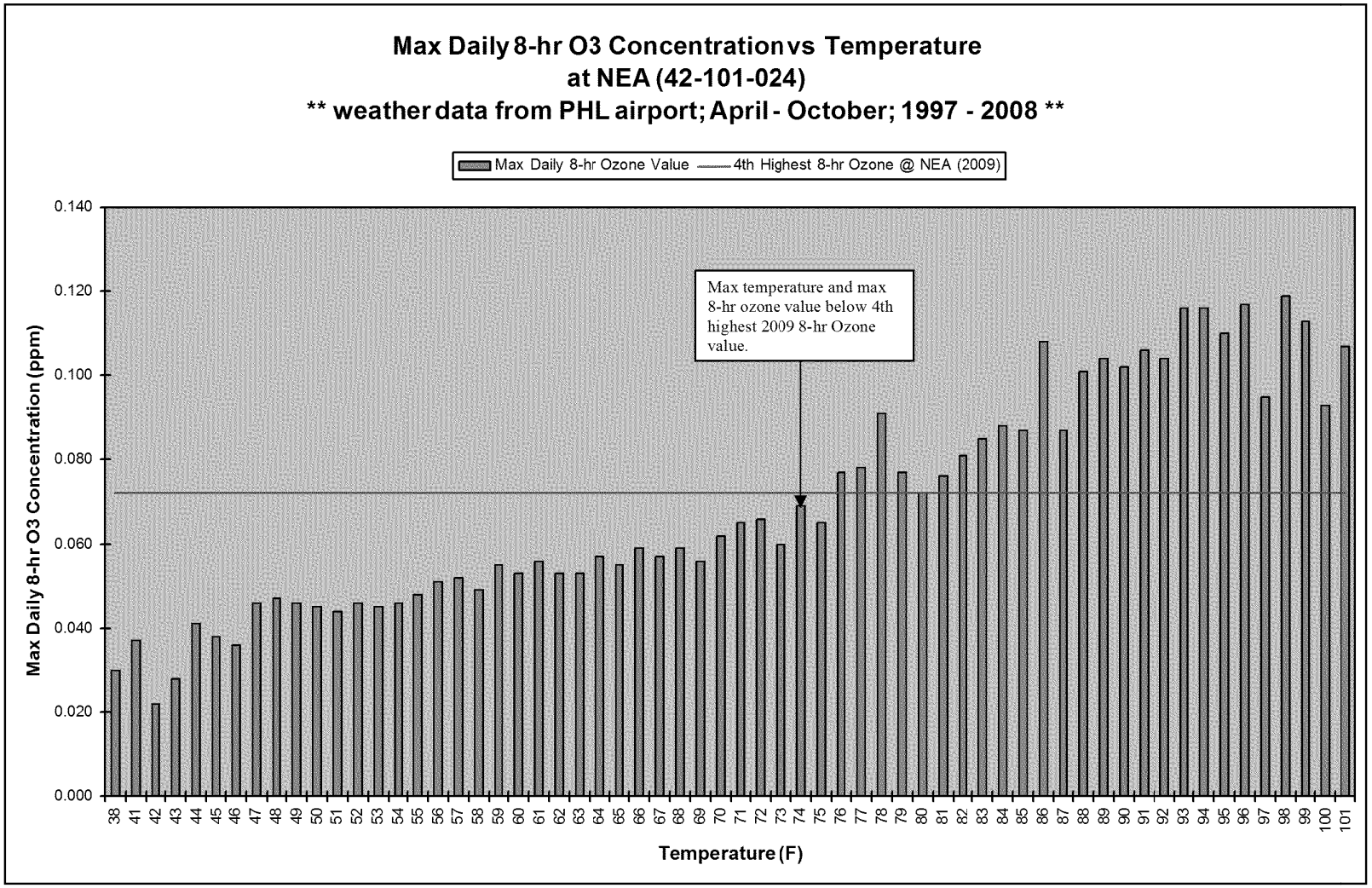

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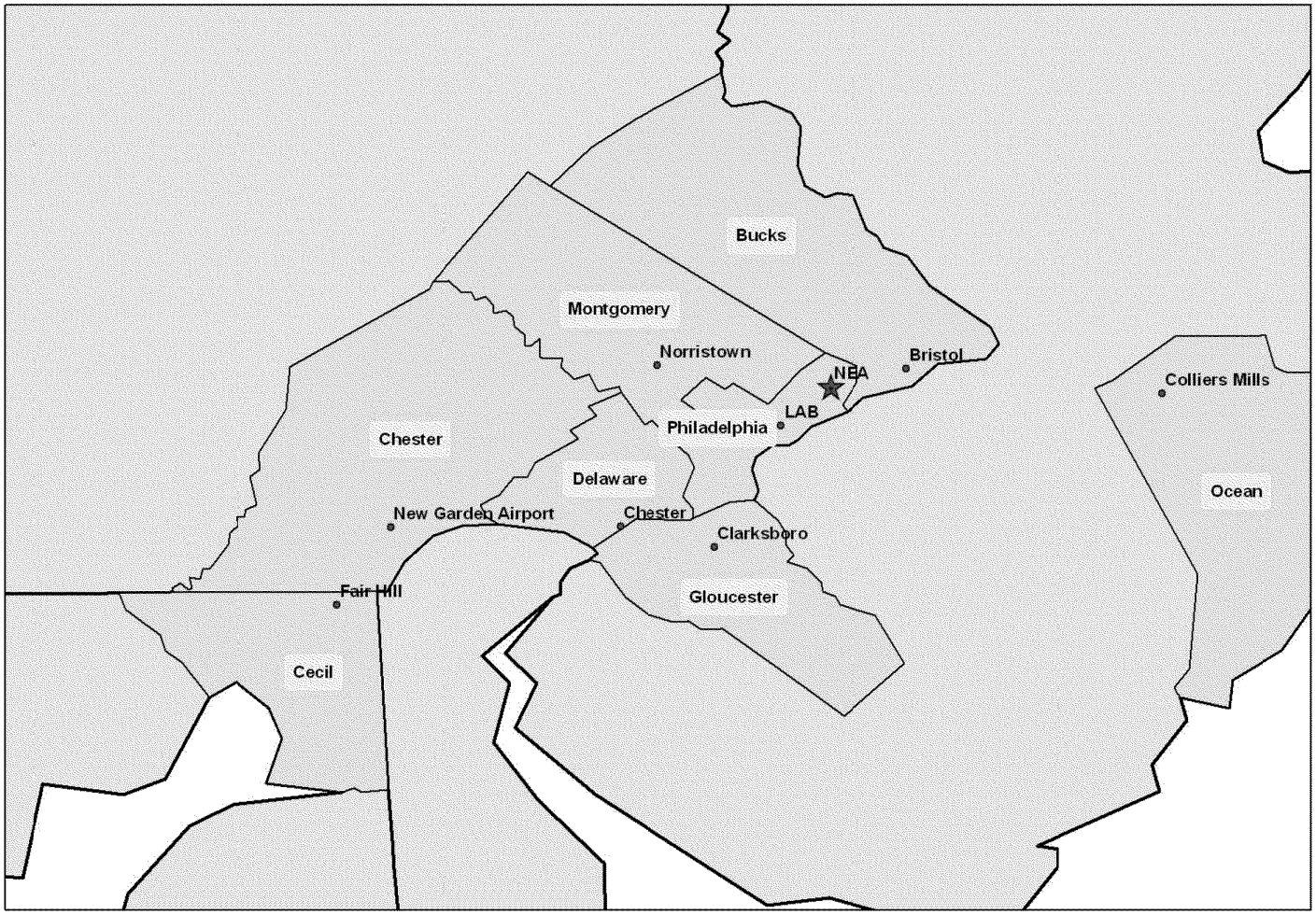
Figure 2. Ozone Monitors Near Northeast Airport (42-101-0024)



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APPENDIX B: Tables

ED_001361_00002107

Table 1. 2009 Daily Maximum 8-hr Ozone Data

Date	Max Temp @ PHL airport, F (data from NOAA)	NEA (Phila) 42-101-0024	LAB (Phila) 42-101-0004	Bristol (Bucks) 42-017-0012	New Garden Airport (Chester) 42-029-0100	Chester (Delaware) 42-045-0002	Norristown (Montgomery) 42-091-0013	Colliers Mills (Ocean County, NJ) 34-029-0006	Clarksboro (Gloucester County, NJ) 34-015-0002	Fair Hill (Cecil County, MD) 24-015-0003
20090401		0.036	0.024	0.037	0.033	0.037	0.022	0.043	0.034	0.04
20090402		0.035	0.028	0.036	0.038	0.033	0.029	0.039	0.036	0.04
20090403		0.045	0.042	0.046	0.047	0.044	0.042	0.046	0.048	0.049
20090404		0.048	0.042	0.049	0.051	0.049	0.045	0.049	0.051	0.053
20090405		0.054	0.043	0.055	0.055	0.052	0.05	0.056	0.054	0.059
20090406		0.04	0.035	0.04	0.042	0.04	0.029	0.043	0.041	0.048
20090407		0.044	0.036	0.044	0.045	0.045	0.037	0.043	0.044	0.046
20090408		0.045	0.035	0.045	0.048	0.045	0.038	0.045	0.046	0.052
20090409		0.055	0.045	0.055	0.056	0.054	0.047	0.055	0.057	0.06
20090410		0.055	0.049	0.056	0.058	0.059	0.042	0.056	0.063	0.062
20090411		0.044	0.038	0.043	0.043	0.043	0.038	0.047	0.041	0.047
20090412		0.05	0.044	0.051	0.048	0.049	0.043	0.051	0.049	0.052
20090413		0.045	0.038	0.046	0.046	0.046	0.04	0.047	0.047	0.048
20090414		0.044	0.04	0.044	0.042	0.038	0.036	0.054	0.048	0.046
20090415		0.037	0.033	0.038	0.036	0.034	0.033	0.051	0.047	0.045
20090416		0.05	0.039	0.052	0.049	0.048	0.047	0.051	0.047	0.052

Monitor down at NEA	X	Allow data based on weather and monitoring data	max 8-hr value from regional monitors

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20090417		0.052	0.044	0.057	0.056	0.055	0.055	0.058	0.058	0.06
20090418		0.067	0.057	0.069	0.064	0.063	0.066	0.071	0.068	0.046
20090419		0.051	0.045	0.052	0.056	0.051	0.052	0.051	0.052	
20090420		0.043	0.039	0.044	0.04	0.043	0.042	0.048	0.043	0.042
20090421		0.043	0.034	0.045	0.049	0.045	0.042	0.041	0.047	0.054
20090422		0.031	0.025	0.031	0.037	0.033	0.036	0.033	0.034	0.04
20090423		0.042	0.034	0.043	0.044	0.042	0.043	0.042	0.044	0.047
20090424		0.058	0.046	0.06	0.059	0.056	0.054	0.061	0.06	0.064
20090425		0.063	0.051	0.068	0.067	0.058	0.061	0.069	0.067	0.076
20090426		0.062	0.05	0.064	0.065	0.058	0.064	0.065	0.063	0.07
20090427		0.064	0.047	0.067	0.068	0.061	0.07	0.058	0.064	0.072
20090428		0.068	0.048	0.073	0.065	0.057	0.069	0.066	0.064	0.067
20090429		0.046	0.035	0.044	0.028	0.04	0.034	0.041	0.034	0.032
20090430		0.048	0.037	0.05	0.049	0.044	0.041	0.047	0.048	0.05
20090501		0.024	0.019	0.028	0.028	0.026	0.027	0.033	0.031	0.034
20090502		0.039	0.028	0.039	0.04	0.035	0.04	0.037	0.035	0.035
20090503		0.039	0.034	0.041	0.034	0.041	0.031	0.042	0.039	0.036
20090504		0.037	0.033	0.033	0.04	0.026	0.041	0.044	0.056	0.042
20090505		0.036	0.031	0.035	0.036	0.027	0.035	0.044	0.03	0.039
20090506		0.038	0.03	0.039	0.038	0.036	0.031	0.038	0.039	0.038
20090507		0.027	0.018	0.03	0.038	0.026	0.031	0.032	0.032	0.031
20090508		0.059	0.039	0.061	0.055	0.056	0.055	0.057	0.059	0.059
20090509		0.056	0.041	0.059	0.052	0.051	0.055	0.057	0.056	0.057
20090510		0.043	0.037	0.045	0.044	0.045	0.044	0.042	0.046	0.048
20090511		0.034	0.023	0.036	0.03	0.029	0.036	0.039	0.032	0.032
20090512		0.049	0.04	0.051	0.051	0.049	0.053	0.052	0.049	0.055
20090513		0.062	0.052	0.061	0.063	0.061	0.057	0.059	0.063	0.065
20090514		0.044	0.034	0.047	0.044	0.044	0.037	0.048	0.046	0.048
20090515		0.046	0.032	0.046	0.053	0.043	0.056	0.048	0.045	0.055

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20090516		0.031	0.021	0.031	0.032	0.03	0.031	0.028	0.032	0.032
20090517		0.044	0.041	0.044	0.037	0.039	0.045	0.043	0.043	0.041
20090518		0.043	0.036	0.044	0.045	0.043	0.047	0.046	0.046	0.049
20090519		0.049	0.036	0.055	0.055	0.05	0.053	0.049	0.053	0.061
20090520		0.059	0.05	0.065	0.065	0.063	0.067	0.07	0.062	0.068
20090521		0.058	0.045	0.064	0.06	0.056	0.064	0.064	0.059	0.062
20090522		0.06	0.044	0.063	0.065	0.056	0.062	0.064	0.061	0.068
20090523		0.063	0.036	0.065	0.049	0.046	0.061	0.059	0.05	0.052
20090524		0.048	0.035	0.051	0.042	0.039	0.051	0.043	0.043	0.045
20090525		0.057	0.048	0.063	0.056	0.063	0.058	0.069	0.066	0.058
20090526		0.039	0.032	0.038	0.036	0.037	0.038	0.042	0.041	0.039
20090527		0.031	0.021	0.03	0.026	0.026	0.026	0.032	0.031	0.025
20090528		0.024	0.02	0.024	0.028	0.021	0.023	0.028	0.023	0.029
20090529		0.026	0.018	0.025	0.034	0.03	0.033	0.028	0.03	0.037
20090530		0.054	0.045	0.056	0.054	0.055	0.058	0.057	0.06	0.056
20090531		0.059	0.047	0.061	0.055	0.057	0.061	0.063	0.062	0.056
20090601		0.048	0.035	0.051	0.047	0.046	0.05	0.048	0.048	0.05
20090602		0.061	0.045	0.064	0.045	0.054	0.062	0.069	0.057	0.052
20090603		0.041	0.034	0.043	0.041	0.042	0.041	0.05	0.048	0.047
20090604		0.033	0.028	0.029	0.029	0.034	0.03	0.042	0.03	0.03
20090605		0.037	0.028	0.036	0.033	0.023	0.034	0.046	0.037	0.034
20090606		0.047	0.032	0.049	0.042	0.044	0.047	0.052	0.049	0.045
20090607		0.068	0.05	0.068	0.057	0.056	0.065	0.056	0.058	0.06
20090608		0.064	0.044	0.056	0.054	0.054	0.063	0.056	0.054	0.053
20090609		0.033	0.021	0.034	0.035	0.035	0.021	0.038	0.04	0.039
20090610		0.041	0.031	0.037	0.066	0.043	0.043	0.029	0.045	0.064
20090611		0.02	0.015	0.018	0.023	0.022	0.019	0.029	0.019	0.028
20090612		0.048	0.034	0.046	0.044	0.046	0.048	0.051	0.049	0.046
20090613		0.04	0.032	0.039	0.043	0.036	0.042	0.039	0.037	0.049

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20090614		0.046	0.037	0.047	0.041	0.041	0.045	0.038	0.047	0.044
20090615		0.049	0.038	0.051	0.049	0.046	0.051	0.036	0.052	0.048
20090616		0.038	0.03	0.04	0.031	0.034	0.036	0.036	0.031	0.03
20090617		0.027	0.019	0.028	0.025	0.027	0.026	0.027	0.025	0.025
20090618		0.034	0.025	0.036	0.029	0.035	0.03	0.039	0.036	0.031
20090619		0.036	0.027	0.036	0.041	0.039	0.04	0.04	0.042	0.042
20090620		0.032	0.028	0.032	0.035	0.034	0.036	0.037	0.037	0.037
20090621		0.029	0.027	0.029	0.031	0.032	0.035	0.03	0.033	0.032
20090622		0.03	0.025	0.029	0.037	0.03	0.035	0.034	0.026	0.038
20090623		0.042	0.032	0.039	0.043	0.041	0.046	0.045	0.043	0.044
20090624		0.037	0.029	0.031	0.046	0.042	0.043	0.035	0.041	0.048
20090625		0.065	0.051	0.069	0.063	0.064	0.065	0.045	0.072	0.068
20090626		0.075	0.059	0.076	0.078	0.072	0.071	0.067	0.076	0.083
20090627		0.043	0.03	0.042	0.039	0.04	0.044	0.045	0.046	0.043
20090628		0.045	0.036	0.045	0.044	0.043	0.047	0.052	0.048	0.046
20090629		0.055	0.043	0.055	0.053	0.053	0.058	0.06	0.06	0.053
20090630		0.056	0.039	0.055	0.056	0.052	0.052	0.055	0.057	0.057
20090701	86	0.064	0.057	0.067	0.054	0.057	0.062	0.06	0.066	0.056
20090702	83	0.056	0.041	0.057	0.047	0.048	0.057	0.065	0.056	0.047
20090703	82	0.041	0.03	0.042	0.039	0.04	0.044	0.042	0.044	0.039
20090704	83	0.04	0.033	0.041	0.045	0.045	0.044	0.042	0.048	0.047
20090705	80	0.045	0.038	0.052	0.044	0.049	0.047	0.055	0.054	0.046
20090706	85	0.039	0.049	0.058	0.054	0.054	0.057	0.06	0.059	0.058
20090707	88		0.051	0.057	0.06	0.061	0.067	0.059	0.067	0.064
20090708	80		0.027	0.038	0.035	0.038	0. 04	0.04	0.04	0.036
20090709	81		0.039	0.046	0.047	0.05	0.049	0.04	0.046	0.049
20090710	83		0.046	0.06	0.06	0.062	0.06	0.054	0.053	0.061
20090711	82		0.04	0.053	0.045	0.046	0. 05	0.054	0.05	0.046
20090712	86		0.035	0.046	0.046	0.047	0.049	0.047	0.048	0.049

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20090713	84		0.044	0.058	0.054	0.052	0.061	0.044	0.053	0.054
20090714	84		0.04	0.051	0.053	0.053	0.055	0.053	0.055	0.052
20090715	87		0.059	0.077	0.069	0.07	0.075	0.071	0.07	0.072
20090716	91		0.051	0.074	0.057	0.061	0. 07	0.08	0.066	0.077
20090717	88		0.047	0.058	0.053	0.057	0.054	0.06	0.06	0.055
20090718	83		0.037	0.047	0.044	0.047	0.048	0.051	0.051	0.045
20090719	84		0.035	0.044	0.042	0.044	0.046	0.046	0.051	0.044
20090720		0.063	0.052	0.063	0.064	0.06	0.065	0.058	0.058	0.058
20090721		0.031	0.028	0.033	0.034	0.034	0.036	0.04	0.036	0.037
20090722		0.057	0.047	0.053	0.054	0.053	0.058	0.044	0.055	0.048
20090723		0.033	0.031	0.032	0.031	0.029	0.037	0.038	0.034	0.026
20090724		0.055	0.042	0.057	0.048	0.05	0.057	0.055	0.058	0.05
20090725		0.061	0.048	0.057	0.054	0.053	0.061	0.053	0.057	0.056
20090726		0.058	0.046	0.057	0.054	0.049	0.059	0.05	0.055	0.054
20090727		0.056	0.041	0.056	0.056	0.047	0.053	0.045	0.049	0.059
20090728		0.058	0.046	0.054	0.053	0.048	0.058	0.051	0.051	0.048
20090729		0.046	0.034	0.044	0.04	0.041	0.045	0.047	0.044	0.045
20090730		0.055	0.048	0.054	0.053	0.053	0.058	0.057	0.059	0.054
20090731		0.042	0.031	0.045	0.037	0.039	0.042	0.042	0.041	0.042
20090801		0.06	0.054	0.058	0.05	0.054	0.06	0.05	0.052	0.045
20090802		0.033	0.028	0.034	0.036		0.037	0.033	0.034	0.037
20090803	86		0.05	0.065	0.058	0.055	0. 06	0.069	0.062	0.054
20090804	89		0.046	0.063	0.05	0.05	0.061	0.055	0.053	0.051
20090805		0.064	0.052	0.065	0.054	0.057	0.061	0.07	0.067	0.056
20090806		0.022	0.031	0.035	0.034	0.03	0.046	0.03	0.024	0.034
20090807		0.029	0.034	0.042	0.043	0.043	0.046	0.043	0.045	0.043
20090808		0.028	0.053	0.057	0.06	0.065	0.058	0.045	0.058	0.058
20090809		0.042	0.033	0.046	0.04	0.045	0.041	0.047	0.05	0.044
20090810		0.061	0.049	0.062	0.051	0.055	0.062	0.069	0.067	0.052

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20090811		0.056	0.046	0.057	0.054	0.055	0.058	0.061	0.059	0.055
20090812		0.047	0.041	0.044	0.049	0.045	0.044	0.047	0.048	0.051
20090813		0.034	0.031	0.034	0.041	0.029	0.03	0.036	0.036	0.046
20090814		0.064	0.057	0.064	0.049	0.063	0.056	0.055	0.071	0.049
20090815		0.084	0.072	0.073	0.059	0.07	0.068	0.061	0.067	0.065
20090816		0.073	0.063	0.074	0.058	0.064	0.07	0.072	0.074	0.065
20090817		0.072	0.058	0.071	0.06	0.063	0.071	0.085	0.069	0.061
20090818		0.068	0.052	0.063	0.06	0.054	0.059	0.052	0.054	0.071
20090819		0.063	0.048	0.063	0.056	0.052	0.057	0.062	0.058	0.066
20090820		0.049	0.035	0.039	0.039	0.043	0.047	0.041	0.041	0.043
20090821		0.041	0.028	0.035	0.033	0.033	0.037	0.039	0.035	0.039
20090822		0.033	0.023	0.025	0.036	0.038	0.035	0.021	0.037	0.038
20090823		0.042	0.036	0.04	0.039	0.041	0.044	0.04	0.047	0.042
20090824		0.045	0.04	0.044	0.043	0.047	0.046	0.047	0.048	0.045
20090825		0.05	0.043	0.046	0.043	0.049	0.049	0.051	0.055	0.048
20090826		0.069	0.058	0.067	0.056	0.057	0.07	0.071	0.061	0.055
20090827		0.026	0.025	0.023	0.044	0.037	0.032	0.026	0.039	0.046
20090828		0.032	0.027	0.031	0.032	0.034	0.035	0.036	0.035	0.033
20090829		0.023	0.021	0.026	0.029	0.027	0.027	0.029	0.031	0.032
20090830		0.049	0.041	0.049	0.044	0.046	0.053	0.05	0.051	0.045
20090831		0.027	0.02	0.023	0.025	0.027	0.032	0.024	0.025	0.027
20090901	76	0.043	0.038	0.036	0.039	0.041	0.04	0.04	0.035	0.038
20090902	79	0.058	0.052	0.055	0.061	0.058	0.053	0.053	0.054	0.064
20090903	80	0.048	0.043	0.043	0.055	0.048	0.054	0.04	0.044	0.055
20090904	84	0.051	0.041	0.049	0.046	0.051	0.051	0.06	0.055	0.047
20090905	85	0.053	0.046	0.046	0.049	0.052	0.054	0.049	0.054	0.051
20090906	78	0.033	0.028	0.03	0.042	0.034	0.041	0.027	0.032	0.044
20090907	76	0.03	0.026	0.029	0.025	0.027	0.032	0.028	0.026	0.025
20090908	75	0.033	0.028	0.03	0.035	0.033	0.039	0.033	0.03	0.032

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20090909	75	0.03	0.028	0.027	0.03	0.03	0.03	0.033	0.03	0.033
20090910	70	0.029	0.024	0.027	0.029	0.024	0.032	0.03	0.029	0.03
20090911	67	0.021	0.017	0.02	0.019	0.019	0.025	0.028	0.019	0.02
20090912	70	0.016	0.01	0.014	0.013	0.013	0.018	0.018	0.016	0.014
20090913	81	0.038	0.03	0.036	0.034	0.037	0.039	0.035	0.039	0.036
20090914	81	0.039	0.032	0.038	0.042	0.041	0.044	0.04	0.044	0.044
20090915	81	0.031	0.031	0.034	0.04	0.041	0.041	0.039	0.043	0.04
20090916	71	X	0.018	0.018	0.02	0.012	**0.026**	0.024	0.02	0.018
20090917	65	X	0.014	0.014	0.018	0.012	0.02	**0.023**	0.018	0.018
20090918	77		0.028	0.033	0.037	0.03	0.042	0.034	0.029	0.038
20090919	71	X	0.028	0.029	0.033	0.032	**0.037**	0.032	0.033	0.032
20090920	76		0.048	0.054	0.053	0.049	0.058	0.047	0.052	0.051
20090921	78		0.03	0.039	0.039	0.037	0.038	0.036	0.04	0.038
20090922	78		0.021	0.029	0.03	0.03	0.027	0.031	0.03	0.031
20090923	83		0.018	0.028	0.035	0.026	0.032	0.029	0.028	0.037
20090924	83		0.029	0.039	0.041	0.041	0.044	0.045	0.043	0.034
20090925	75		0.02	0.027	0.029	0.029	0.031	0.026	0.03	0.03
20090926	69	X	0.021	0.026	0.028	**0.03**	**0.03**	0.027	0.028	0.028
20090927	75		0.021	0.026	0.029	0.027	0.032	0.03	0.03	0.031
20090928	79		0.029	0.041	0.04	0.041	0.041	0.044	0.043	0.042
20090929	70	X	0.018	0.023	0.024	0.024	**0.029**	0.025	0.026	0.026
20090930	64	X	0.013	0.012	0.02	0.016	**0.025**	0.017	0.016	0.021
20091001	59	X	0.022	0.026	0.03	0.03	**0.033**	0.028	0.03	0.031
20091002	68	X	0.029	0.034	**0.039**	0.04	0.034	0.038	0.038	**0.039**
20091003	76		0.022	0.032	0.042	0.035	0.038	0.03	0.038	0.041
20091004	74	X	0.032	0.044	0.039	0.041	0.045	**0.048**	0.043	0.039
20091005	68	X	0.016	0.023	0.023	0.022	**0.029**	0.025	0.023	0.024
20091006	68	X	0.028	0.031	0.031	0.03	**0.032**	**0.032**	0.031	0.031
20091007	72	X	0.022	0.028	0.03	0.029	**0.034**	0.031	0.03	0.031

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20091008	67	X	0.025	0.029	0.029	0.028	**0.031**	**0.031**	0.029	0.03
20091009	80		0.032	0.043	0.049	0.046	0. 04	0.046	0.049	0.053
20091010	76		0.014	0.021	0.024	0.024	0.022	0.024	0.024	0.024
20091011	66	X	0.026	0.032	0.032	0.033	0.031	**0.034**	**0.034**	0.031
20091012	55	X	0.016	0.018	0.017	0.023	0.014	**0.025**	0.021	0.02
20091013	68	X	0.023	0.026	0.029	0.028	0.027	0.03	0.028	**0.031**
20091014	53	X	0.017	0.021	0.022	0.018	0.022	0.02	0.02	**0.023**
20091015	50	X	0.013	0.014	0.015	0.012	**0.016**	0.02	0.011	0.015
20091016	46	X	0.013	0.015	0.017	0.013	0.017	**0.019**	0.013	0.018
20091017	48	X	0.018	0.02	0.022	0.021	0.021	0.021	0.016	**0.023**
20091018	49	X	0.021	0.025	0.029	0.026	0.024	0.023	0.024	**0.03**
20091019	57	X	0.021	0.027	**0.032**	0.029	0.029	0.03	0.026	0.031
20091020	68	X	0.02	0.026	**0.031**	0.019	0.028	0.027	0.027	0.026
20091021	74	X	0.031	0.033	**0.044**	0.038	0.036	0.034	0.038	0.039
20091022	73	X	0.009	0.017	0.032	0.023	0.026	**0.038**	0.037	0.033
20091023	65	X	0.021	0.024	0.023	0.025	0.02	**0.03**	0.027	0.023
20091024	71	X	0.022	0.026	0.027	0.026	0.023	**0.03**	0.029	0.027
20091025	63	X	0.023	0.029	**0.031**	0.03	0.03	0.028	0.028	**0.031**
20091026	64	X	0.022	0.025	0.024	0.027	0.016	**0.032**	0.028	0.026
20091027	59	0.009	0.009	0.01	0.013	0.007	0.008	0.027	0.011	0.019
20091028	64	0.024	0.016	0.022	0.021	0.017	0.018	0.036	0.022	0.022
20091029	57	0.014	0.013	0.013	0.018	0.019	0.014		0.014	0.018
20091030	59	0.031	0.022	0.033	0.033	0.033	0.023		0.033	0.033
20091031	72	0.026	0.02	0.027	0.026	0.026	0.024		0.029	0.025

ED_001361_00002107

APPENDIX C: Data

See attached CD for:

(1) Monthly weather data
(2) AMP 435 reports
(3) Access database

APPENDIX D:
Correspondence with
Andrew Hass of EPA, Region III

Henry Kim/Health/Phila
03/10/2010 04:21 PM

To hass.andrew@epa.gov
cc Thomas Huynh/Health/Phila@Phila
bcc
Subject AMS 2009 Ozone Data: Missing Days analysis

Drew.

As I mentioned in our 3/5/10 phone call, attached is a preliminary analysis of our 2009 Ozone data. Any comments you provide would be useful. Thanks.

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In summary, there are 28 missing days that should be considered valid.

Dates	Day Count
9/16/09 – 9/17/09	2
9/19/09 – 9/20/09	2
9/26/09	1
9/29/09 – 10/2/09	4
10/5/09 – 10/8/09	4
10/11/09 – 10/20/09	10
10/22/09 – 10/26/09	5
TOTAL	**28**

Here's a short write-up of the analysis:

Steps:
(1) download maximum daily 8-hr ozone values from 1997 - 2008 at NEA site (AQS AMP 435 report)
(2) download weather data to compute maximum daily temperature from 1997 - 2008 (http://climate.met.psu.edu/data/mesonet/datainv.php)
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(4) download the 2009 maximum daily 8-hr ozone values for all sites in Philadelphia and surrounding counties (Bucks, Chester, Delaware, & Montgomery Counties in PA) and identify down time at NEA (see excel attachment: 2009 O3 Data - HRK.xls)

Description:
AMS used a conservative approach to determine what missing days should be counted as valid days. Temperature plays a vital role in the formation of ozone. Ozone data and temperature data from 1997 - 2008 were compiled to create a profile of maximum daily 8-hr ozone values at various temperatures during the ozone season (MAX8). The 4th highest 8-hr ozone value at NEA for 2009 was 0.072 ppm. Based on the 4th high value for 2009 and the MAX8 profile, historical data shows that temperatures at or below 73F would not exceed 0.072 ppm. Additionally, monitoring data from local counties were compared on days when the temperature was 73F or less to assure monitoring data remained less than the 2009 4th high value at NEA.

Max 8-hr O3 vs Temp at NEA (1997-2008).xls

2009 O3 Data - HRK.xls

****

Henry Kim
Chief, Program Services
Air Management Services
Department of Public Health
City of Philadelphia
321 University Ave
Philadelphia, PA 19104
Phone: 215-685-9439
Fax: 215-685-7593
E-mail: henry.kim@phila.gov

Henry Kim/Health/Phila
03/22/2010 04:13 PM

To hass.andrew@epa.gov
cc
bcc
Subject Fw: AMS 2009 Ozone Data: Missing Days analysis

Drew.

Based on our conservation from 3/18/10, attached are the following:
(1) map of the NEA ozone monitor and neighboring monitors
(2) 2009 maximum 8-hr daily values: this version includes ozone data from Ocean County (NJ), Gloucester County (NJ), and Cecil County (MD) .

Thanks.

O3 Map.pdf 2009 O3 Data (2010.03.19) - HRK.xls

Henry Kim
Chief, Program Services
Air Management Services
Department of Public Health
City of Philadelphia
321 University Ave
Philadelphia, PA 19104
Phone: 215-685-9439
Fax: 215-685-7593
E-mail: henry.kim@phila.gov

----- Forwarded by Henry Kim/Health/Phila on 03/22/2010 04:10 PM -----

Henry Kim/Health/Phila
03/10/2010 04:21 PM

To hass.andrew@epa.gov
cc Thomas Huynh/Health/Phila@Phila
Subject AMS 2009 Ozone Data: Missing Days analysis

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Department of Public Health
City of Philadelphia
321 University Ave
Philadelphia, PA 19104
Phone: 215-685-9439
Fax: 215-685-7593
E-mail: henry.kim@phila.gov

Hass.Andrew@epamail.epa.gov
03/22/2010 04:20 PM

To Henry.Kim@phila.gov
cc
bcc
Subject Re: Fw: AMS 2009 Ozone Data: Missing Days analysis

History: This message has been forwarded.

Henry,

Thanks for the info. Per our discussion last week, this approach is acceptable. You have done a good job showing nearby monitors concentrations from the days missing as well as showed meteorology more then likely would not have played a part creating high concentrations of ozone. I have a call into HQ to see how AQS handles the data completeness claculations.
I will provide you updated info when available.

Hope you had a good weekend.

Drew

From: Henry.Kim@phila.gov
To: Andrew Hass/R3/USEPA/US@EPA
Date: 03/22/2010 04:13 PM
Subject: Fw: AMS 2009 Ozone Data: Missing Days analysis

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Thanks.

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Air Management Services
Department of Public Health

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Phone: 215-685-9439
Fax: 215-685-7593
E-mail: henry.kim@phila.gov

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Henry Kim/Health/Phila

03/10/2010 04:21 PM

To hass.andrew@epa.gov
cc Thomas Huynh/Health/Phila@Phila
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Phone: 215-685-9439
Fax: 215-685-7593
E-mail: henry.kim@phila.gov
[attachment "Max 8-hr O3 vs Temp at NEA (1997-2008).xls" deleted by Andrew Hass/R3/USEPA/US] [attachment "2009 O3 Data - HRK.xls" deleted by Andrew Hass/R3/USEPA/US] [attachment "O3 Map.pdf" deleted by Andrew Hass/R3/USEPA/US] [attachment "2009 O3 Data (2010.03.19) - HRK.xls" deleted by Andrew Hass/R3/USEPA/US]

Hass.Andrew@epamail.epa.gov
03/25/2010 03:19 PM

To Henry.Kim@phila.gov
cc Wilkie.Walter@epamail.epa.gov
bcc
Subject Process for data substitution

History: This message has been replied to and forwarded.

Henry,

I want to provide you what is the process to properly get the ozone data substitution final for the missing days in 2009.

1)Put the Null Data code "BG" for all the missing days in AQS that Phila AMS is proposing have counted towards meeting data completeness requirements.
2) Put together and send R3 a package documenting the justification for why this ozone data would not have exceeded the ozone NAAQS on the missing day.
- 40 CFR Pt 50 App. I Sec. 2.2(b) give a descrpition of what is suffucient to show a day would not have had an ozone concentration above theNAAQS
-what you provided me already is acceptable...just needs to be submitted in a more formal package
3) Once received R3 will review and, if RA approves the package, will put a concurrence flag in AQS

Since the Data Substitution package needs regional Administrator approval, it should come from the same person at Phila AMS who signs off on the Annual Monitoring Network Plans. The Data Substitution package needs to be sent to Shawn Garvin - the R3 Regional Administrator.

Please let me know if you have any questions or need add'l info.

Thanks.

Drew

Henry Kim/Health/Phila
03/26/2010 10:55 AM

To Hass.Andrew@epamail.epa.gov
cc Wilkie.Walter@epamail.epa.gov, Thomas Huynh/Health/Phila
bcc
Subject Re: Process for data substitution

Drew.

Thanks for all your help.

Just a few questions:
(1) In the formal submittal, should I also submit the raw data (weather data, AMP435 reports, etc) or just the summaries (similar to what I sent earlier)?
(2) Can AMS submit the ozone data substitution request in the same letter as the ozone data certification letter?

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Hass.Andrew@epamail.epa.gov

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Drew

Hass.Andrew@epamail.epa.gov
03/29/2010 12:37 PM

To Henry.Kim@phila.gov
cc Thomas.Huynh@phila.gov, Wilkie.Walter@epamail.epa.gov
bcc
Subject Re: Process for data substitution

Henry,

There is not a set format for what should/should not be submitted w/ the package. What you provided earlier is fine. However, I would recommend that you include everything that you think will make it hard for someone to question the data substitution. If you want, the raw data can be submitted as an Appendix.

As for the letters, these are two different issues, so I would send separately. However, I am not sure if that will cause a major delay in getting this finalized and thus cause a delay in the what is needed for planning. Another issue here is how will this affect the data certification? What I mean is, once any changes are made to certified data, the data certification flag for that year is removed and that S/L agency must re-submit another data certification letter for EPA to re-concur on. Would the best course of action be for Phila AMS to submit a data substitution package for R3 to concur, get those flags in AQS and then have AMS submit the data cert. package? This would make AMS only have to submit one data cert package to R3. I am not an AQS expert so my rationale may not be correct.

This may be an issue, planning or AQS folks needs to discuss and see what would be the best way to proceed.

Hope this help.

Drew

From: Henry.Kim@phila.gov
To: Andrew Hass/R3/USEPA/US@EPA
Cc: Walter Wilkie/R3/USEPA/US@EPA, Thomas.Huynh@phila.gov
Date: 03/26/2010 10:55 AM
Subject: Re: Process for data substitution

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Thanks for all your help.

Just a few questions:
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(2) Can AMS submit the ozone data substitution request in the same letter as the ozone data certification letter?

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cc Wilkie.Walter@epamail.epa.gov
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Please let me know if you have any questions or need add'l info.

Thanks.

Drew

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

COPY FOR YOUR INFORMATION

MAY 17 2010

Dr. Donald F. Schwartz, MD, MPH
Deputy Mayor, Health and Opportunity Health Commissioner
Philadelphia Department of Public Health
1401 JFK Boulevard, Room 600
Philadelphia, Pennsylvania 19102

Dear Dr. Schwartz:

By letter and enclosures dated April 9, 2010, Philadelphia Air Management Services (AMS) submitted to the U.S. Environmental Protection Agency – Region III (EPA) a data substitution package for the Northeast Airport ambient air ozone monitoring site (AIRS ID# 42-101-0024) in accordance with the regulatory requirements of 40 CFR Part 50 Appendix I. 2.3(b) – National Primary and Secondary Ambient Air Quality Standards. 40 CFR Part 50 Appendix I 2.3 (b) requires:

> "....When computing whether the minimum data completeness requirements have been met, meteorological or ambient data maybe sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard. Missing days assumed less then the level of the standard are counted for the purpose of meeting the minimum data completeness requirement, subject to the approval of the appropriate Regional Administrator."

The AMS data substitution package contained documentation and analysis showing that meteorological conditions for the missing days was not conducive to forming elevated concentrations of ground-level ozone which would have exceeded the 8-hour ozone standard of 0.075ppm. This was substantiated by AMS providing information showing reported ozone concentrations at nearby monitoring sites well below the 8-hour ozone standard for the missing days. Based on our review, EPA hereby approves AMS's request to allow missing ambient air ozone concentrations for the following days of September and October in 2009 be counted when calculating yearly data completeness requirements of the CFR:

Dates	Day Count
9/16/09 – 9/17/09	2
9/19/09	1
9/26/09	1
9/29/09 – 10/2/09	4
10/4/09 – 10/8/09	5
10/11/09 –10/26/09	16
TOTAL	**29**

If you have any questions regarding this approval action, please feel free to contact Mr. David Arnold, Acting Director, Air Protection Division, at (215) 814-2172 or Mr. Walter K. Wilkie, Associate Director of the Office of Air Monitoring and Analysis, at (215) 814- 2150.

Sincerely,

Shawn M. Garvin
Regional Administrator

cc: Ms. Joyce Epps
Director, PADEP

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Customer Service Hotline: 1-800-438-2474

ED_001361_00002108

To: cara.keslar@wyo.gov[cara.keslar@wyo.gov]
Cc: Carlson, Albion[Carlson.Albion@epa.gov]; Morales, Monica[Morales.Monica@epa.gov]
From: Fallon, Gail
Sent: Sat 1/14/2017 12:30:51 AM
Subject: EPA TSA report
WY 2016 TSA Report Final, 1-13-2017.pdf
WY TSA 2016 cover letter.pdf

Cara,

Enclosed is our final report for Wyoming's 2016 Technical Systems Audit which I understand you are anxious to receive. We finalized the document today but will need to send you the signed cover sheet and appendix document on Tuesday. The hard copy will follow by regular mail. I signed this as I am the acting Director today.

Thanks,

Gail

Gail Fallon

US EPA, Region 8

Denver, CO

(303) 312-6281

QUALITY ASSURANCE AUDIT REPORT

TECHNICAL SYSTEMS AUDIT
WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION
AMBIENT AIR MONITORING NETWORK

JUNE 20-24, 2016

Prepared by:
Albion Carlson
Environmental Scientist

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region 8

Prepared by:

_____
Albion Carlson
Environmental Scientist
Air Permitting and Monitoring Unit

Approved by:

_____
Gail Fallon
Acting Director, Air Program

ED_001361_00002616

Executive Summary

This report details the Technical Systems Audit (TSA) of the Wyoming Department of Environmental Quality (WDEQ) ambient air monitoring program conducted by the United States Environmental Protection Agency (EPA) Region 8 in June of 2016. The EPA periodically reviews the quality assurance (QA) of ambient air monitoring programs in the form of a TSA. The EPA Regional offices are required by 40 CFR part 58 appendix A section 2.5 to conduct a TSA of each ambient air monitoring organization every three years. The purpose of the audit is to ascertain how the QA program is being implemented by the Air Quality Division (AQD) of the WDEQ. One objective of this collaborative review is to help to ensure that the QA program of the AQD is equivalent to the national standards and guidelines for QA. Another objective is to suggest solutions to any QA problems that are found. While conducted in depth, systems audits emphasize on-site evaluations of QA procedures over inspection and performance audits of individual instruments. The last TSA of the AQD ambient air monitoring program was conducted in September of 2012. As a result of the current evaluation, Region 8 makes a set of recommendations that are explained in the following sections and tabulated in section 6 of this report.

The TSA was conducted June 20-24, 2016 through on-site reviews and inspections at six state operated monitoring stations located throughout the state. In addition, facility inspections and a records review were performed at the AQD offices in Cheyenne. The focus of the TSA was compliance with regulatory requirements for collection, analysis, validation, and reporting of ambient air quality data. A TSA questionnaire was provided to the AQD and a response was returned to the EPA in an email dated April 18, 2016. There were no major findings identified through the TSA.

While no major findings were identified as a result of the TSA, several minor findings were noted, including the need for updating Quality Assurance Project Plan (QAPP) documents to include the checklist instructions maintained at monitoring sites, to reflect current monitoring equipment utilized in the monitoring network, and to identify the current project personnel for each site. The Partisol-FRM Model 2000 Verification & Maintenance Forms used by the AQD Site Technicians were found to have inconsistent entries, and not all site logs were kept current as specified in the QAPPs and Standard Operating Procedures (SOPs). The ozone monitor at the Casper Gaseous Site, currently designated a Special Purpose Monitor (SPM) in the Annual Monitoring Network Plan (AMNP) fulfills the State and Local Air Monitoring Stations (SLAMS) minimum ozone monitoring requirement for the Casper metropolitan area, and so should be re-designated as a SLAMS monitor. It was also found that Contract Site Technicians would benefit from annual training to ensure they are adequately following SOPs. In follow-up to issues noted in the TSAs performed in 2009 and 2012, the state has continued to enhance Quality Assurance (QA) oversight of contractors including conducting a joint state/EPA TSA of Air Resource Specialists (ARS) performed in 2013. The state has also developed an "all-digital" Records Management Plan which requires a close and accountable coordination between the two distinct information technology groups assigned to the DEQ AQD and the broader state of Wyoming. Lastly, there were biases in collocated $PM_{2.5}$ precision data noted in both the 2012 TSA and the current TSA. Those identified in 2012 were resolved when the state ultimately changed out all the particle size separators at the affected sites. Those identified during the

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current TSA were determined by the state to likely be the result of errors in background zero settings. The state is encouraged to analyze the source of these errors to ensure that bias does not exist at other $PM_{2.5}$ monitoring sites.

ED_001361_00002616

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6.0 Conclusions and Recommendations 24

ED_001361_00002616

1.0 Background

The purpose of a TSA is to assess an agency's ambient air monitoring program's compliance with regulatory requirements for collection, analysis, validation, and reporting of ambient air quality data. The total QA system is reviewed in order to qualitatively evaluate the system's ability to ensure quality, in this case the reporting of valid data to the EPA's Air Quality System (AQS). The QA requirements of 40 CFR part 58, appendices A through E pertain to regulatory air monitors used in evaluations of National Ambient Air Quality Standards (NAAQS). A systems audit of a regulatory air monitoring program should address SLAMS monitoring and other areas such as SPMs. The systems audit consists of three steps. First, a questionnaire is sent to the agency to be audited for completion by their personnel. Second, this questionnaire is reviewed and on-site interviews are conducted. Finally, a systems audit report is issued.

Region 8 began the current systems audit of the AQD ambient air monitoring program on February 5, 2016 by sending an email message notifying the AQD of the planned audit and including the systems audit questionnaire as an attachment. Figure 1, provided in the response to the questionnaire and copied later in this report, charts the organizational structure of the Monitoring Section in the AQD Air Quality Resource Management Program.

The questionnaire was taken from the EPA's QA handbook for air pollution measurement systems (QA Handbook), revised May 2013.[1] Cara Keslar, Ambient Air Monitoring Network Manager, returned the written response to the questionnaire in electronic format by email on April 18, 2016. The response to the questionnaire is included in Appendix A of this report.

Table 1 identifies the air monitoring stations in the current Wyoming network.

Table 1. AQD Air Monitoring Stations.

AQS Number	Site Name	County	Monitor Type	Pollutant(s)
56-025-0001	Casper SLAMS	Natrona	SLAMS	PM_{10}, $PM_{2.5}$
56-021-0001	Cheyenne SLAMS	Laramie	SLAMS	PM_{10}, $PM_{2.5}$
56-029-0001	Cody SLAMS	Park	SLAMS	PM_{10}, $PM_{2.5}$
56-005-1002	Gillette SLAMS	Campbell	SLAMS	PM_{10}
56-039-1006	Jackson SLAMS	Teton	SLAMS	PM_{10}, $PM_{2.5}$
56-013-1003	Lander SLAMS	Fremont	SLAMS	PM_{10}, $PM_{2.5}$
56-001-0006	Laramie SLAMS	Albany	SLAMS	PM_{10}, $PM_{2.5}$
56-037-0007	Rock Springs SLAMS	Sweetwater	SLAMS	PM_{10}, $PM_{2.5}$

[1] EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Quality Monitoring Program, EPA-454/B-08-003, May, 2013, (QA Handbook) appendix D. http://www.epa.gov/ttn/amtic/files/ambient/pm25/qa/QA-Handbook-Vol-II.pdf

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Table 1 (cont.). AQD Air Monitoring Stations.

AQS Number	Site Name	County	Monitor Type	Pollutant(s)
56-033-1003	Sheridan Meadowlark SLAMS	Sheridan	SLAMS	PM_{10}, $PM_{2.5}$
56-033-0002	Sheridan Police Station SLAMS	Sheridan	SLAMS	PM_{10}, $PM_{2.5}$
56-035-0700	Big Piney	Sublette	SPM	NO, NO_2, NO_x, O_3
56-035-0099	Boulder	Sublette	SPM	NO, NO_2, NO_x, O_3, PM_{10}
56-005-0456	Campbell County	Campbell	SPM	NO, NO_2, NO_x, O_3, PM_{10}
56-025-0100	Casper Gaseous	Natrona	SPM	NO, NO_2, NO_x, O_3
56-009-0010	Converse County	Converse	SPM	NO, NO_2, NO_x, O_3, PM_{10}
56-035-0100	Daniel South	Sublette	SPM	NO, NO_2, NO_x, O_3, PM_{10}
56-037-0077	Hiawatha	Sweetwater	SPM	O_3
56-035-1002	Juel Spring	Sublette	SPM	NO, NO_2, NO_x, O_3
56-037-0300	Moxa Arch	Sweetwater	SPM	NO, NO_2, NO_x, O_3, PM_{10}, SO_2
56-041-0101	Murphy Ridge	Uinta	SPM	NO, NO_2, NO_x, O_3, PM_{10}
56-035-0101	Pinedale Gaseous	Sublette	SPM	NO, NO_2, NO_x, O_3, $PM_{2.5}$
56-013-0099	South Pass	Fremont	SPM	NO, NO_2, NO_x, O_3, $PM_{2.5}$
56-005-0123	Thunder Basin	Campbell	SPM	NO, NO_2, NO_x, O_3
56-037-0200	Wamsutter	Sweetwater	SPM	NO, NO_2, NO_x, O_3, PM_{10}
56-005-0099	Wright Jr-Sr High School	Campbell	SPM	PM_{10}
56-009-0009	Antelope – Site 7	Converse	SPM	NO, NO_2, NO_x, $PM_{2.5}$
56-005-0892	Belle Ayr BA-4	Campbell	SPM	NO, NO_2, NO_x, $PM_{2.5}$
56-005-0891	Black Thunder BTM-36-2	Campbell	SPM	$PM_{2.5}$
56-005-1899	Buckskin Mine	Campbell	SPM	$PM_{2.5}$
56-015-0004	Torrington Mobile (12/21/2015-press time)	Goshen	Mobile	NO, NO_2, NO_x, O_3, PM_{10}, $PM_{2.5}$, SO_2

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Table 1 (cont.). AQD Air Monitoring Stations.

AQS Number	Site Name	County	Monitor Type	Pollutant(s)
56-021-0002	Cheyenne Mobile (3/15/2016-press time)	Laramie	Mobile	NO, NO_2, NO_x, O_3, PM_{10}, $PM_{2.5}$, SO_2
56-045-0004	Newcastle Mobile (7/10/2015-press time)	Weston	Mobile	NO, NO_2, NO_x, O_3, PM_{10}, $PM_{2.5}$, SO_2
56-021-0100	Cheyenne NCore	Laramie	NCore	PM_{10}, $PM_{10\text{-}2.5}$, $PM_{2.5\text{speciated}}$, $PM_{2.5}$, O_3, NO, NO_2, NO_y, SO_2, CO

The Region 8 auditors, Albion Carlson and Ethan Brown, conducted the on-site interview part of the audit from June 20–June 24, 2016. The interviews with AQD covered a wide range of topics including but not limited to data management and validation, computer systems and database management, monitor maintenance and corrective actions.

The air monitoring station site visits were performed June 20-23. Figure 2 is a map depicting the locations of the various types of ambient air monitoring stations in the Wyoming air quality monitoring network. Figure 3 is a map showing the location of the selected sites and offices that were visited in the performance of the TSA. Those sites were: the Casper SLAMS Site, the Casper Gaseous Site, the Lander SLAMS Site, the South Pass Site, the Rock Springs SLAMS Site, and the Wamsutter Site. Cara Keslar, AQD monitoring network manager, participated in all of the site visits as did Mark Gagen, the Project Manager for all Wyoming SLAMS sites. Steve Mugg, QA Coordinator, participated in the Casper sites visits. Dan Sharon, SPM Project Manager, participated in the South Pass Site visit and Aaron Maisch, SPM Project Manager, participated in the Wamsutter Site visit.

Prior to the air monitoring station site visits, interviews were conducted at the AQD main offices in Cheyenne on June 20th which included a review of AQD's response to the questionnaire with Cara Keslar and her staff, and a visit to the QA laboratory where monitor repair and maintenance is performed. On June 24th the on-site audits were concluded with records reviews and staff interviews conducted at the AQD main offices in Cheyenne; and, an exit interview held with Cara Keslar to discuss the initial findings of the audit.

The following AQD personnel were interviewed on-site:

Cara Keslar, Monitoring Section Supervisor, AQD
Mark Gagen, SLAMS Project Manager, AQD
Steve Mugg, Quality Assurance Coordinator, AQD
Leif Paulson, Data Manager, AQD
Dan Sharon, SPM Project Manager, AQD
Aaron Maisch, SPM Project Manager, AQD
Kristina Hooper, SPM Project Manager, AQD
Paul Bailey, Site Technician, AQD
Grant Roach, Site Technician, AQD

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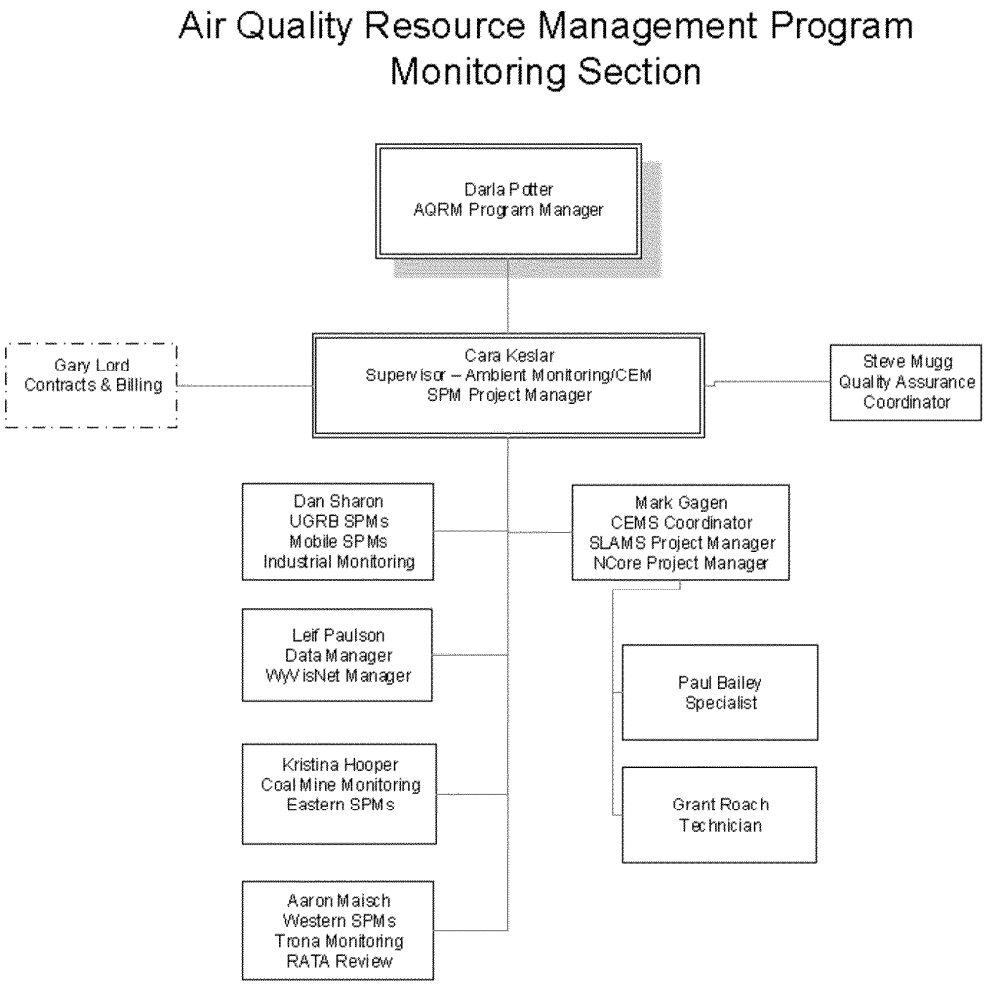
Figure 1. AQD Air Quality Resource Management Program Organizational Chart.
(Source: Wyoming TSA Questionnaire Response)



AQD maintains a well-trained and effective monitoring team comprised of individuals based in the main offices in Cheyenne. Their duties include network design and siting, project management, data management, monitor operation and maintenance, and quality assurance activities. Supporting AQD personnel are contracted monitor operators, site technicians and quality assurance personnel.

The completed questionnaire explained the AQD's use of contractors. The AQD directly operates SLAMS stations that strictly monitor particulate matter (either as PM_{10} or as $PM_{2.5}$) and they use contractors to run the SPM stations that monitor for gaseous pollutants. Where particulate monitoring is included at an SPM, the contractor responsible for operating the gaseous analyzers also runs the particulate monitors. As indicated in the completed questionnaire, the companies being employed by the AQD to operate SPMs include Air

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Resource Specialists, Inc. (ARS) of Fort Collins, Colorado; and Meteorological Solutions Inc. (MSI) of Salt Lake City, Utah.

2.0 Project Management

All criteria pollutant monitors operated by AQD are currently demonstrating attainment status with respect to the NAAQS. Figure 2 depicts the locations of the ambient monitoring sites currently operated by AQD in Wyoming. Attainment status is determined from the ambient air concentrations data gathered through AQD's ambient air monitoring network. Currently there are 32 air monitoring stations in the ambient air monitoring network managed by AQD. There are 10 SLAMS sites that are used to determine compliance with the NAAQS; 19 SPM locations employed to monitor compliance with the NAAQS, background concentrations, and for special studies of impacts from air emissions sources; three mobile monitoring trailers used for short term investigations, and one National Core (NCore) multi-pollutant site which provides lower concentration data on specific pollutants for long-term trend analyses. In addition, the AQD oversees a large amount of industrial monitoring required by air quality permits and also helps fund and evaluate visibility and acid deposition monitoring.

The SLAMS stations are directly operated by AQD and are used to monitor particulate matter. PM_{10} data is collected at all SLAMS sites, and $PM_{2.5}$ data is collected at all but one of the SLAMS sites. The AQD uses contractors to operate the SPM stations. Both gaseous and particulate monitoring are conducted at most of the SPM stations; although, a few of the SPM stations are sited for either solely gaseous or solely particulate monitoring. The pollutants monitored at the individual monitoring stations are listed in Table 1. AQD operates the NCore Site located in Cheyenne. The NCore Site is a required multi-pollutant monitoring site that provides data on several pollutants at lower detection levels. Its primary purpose is to monitor population exposure concentrations in the state's largest city. The Wyoming Ambient Air Monitoring Network Plan 2016 submitted to EPA Region 8 by AQD details the monitoring network and identifies planned or potential modifications to the network. It was made available for public comment and was reviewed by Region 8 in 2016.

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Figure 2. Wyoming Air Monitoring Sites. (Source: Wyoming TSA Questionnaire Response)

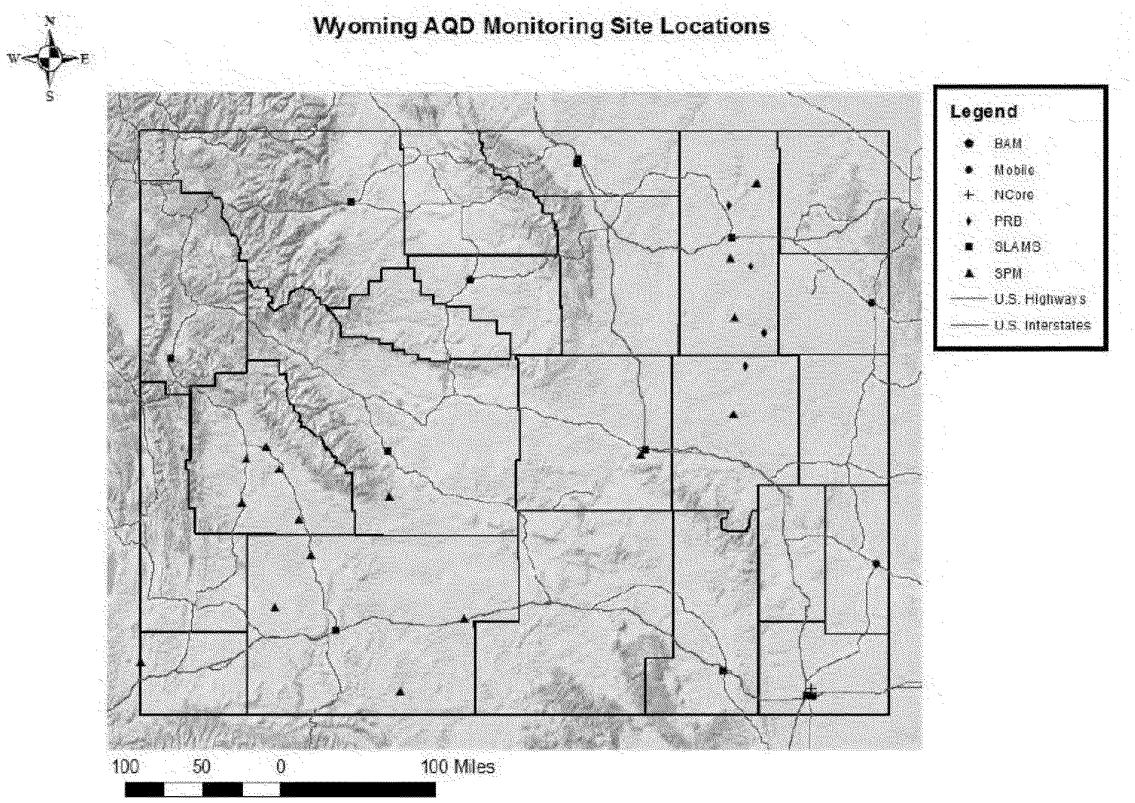
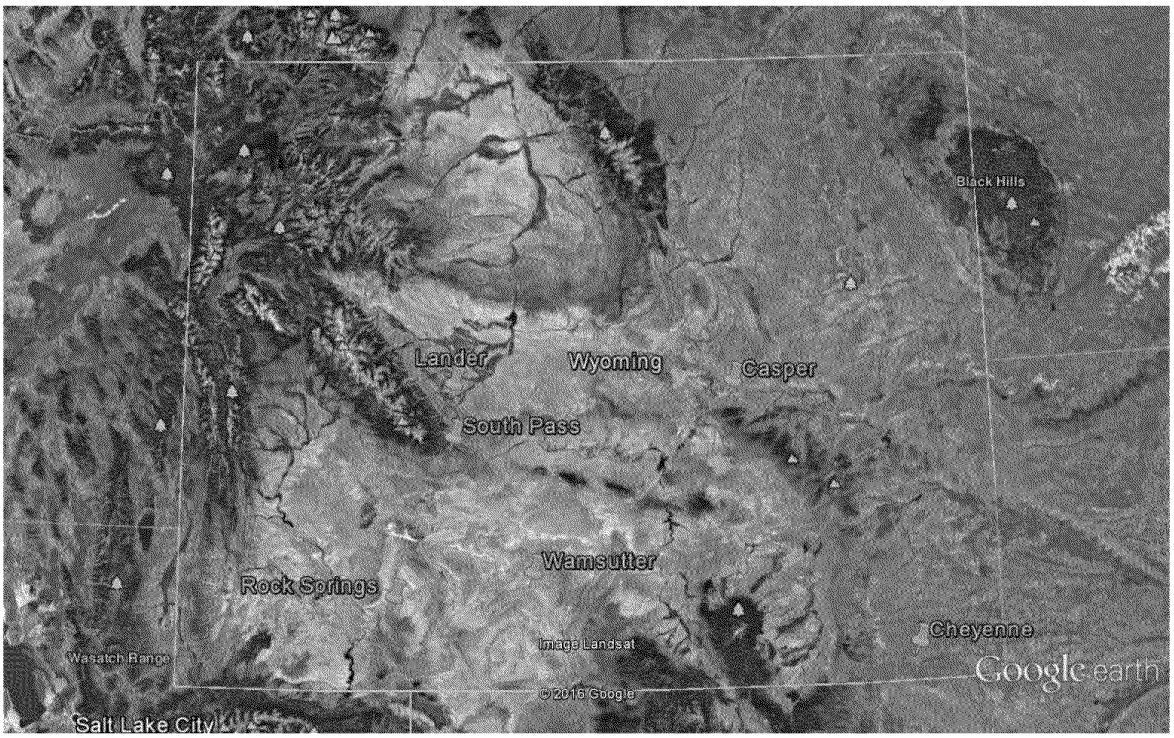


Figure 3. Wyoming Air Monitoring Sites and Offices Visited during the TSA.



The monitoring sites in Wyoming were established in part to determine ambient air concentrations in high density population areas as well as those areas impacted by significant emissions sources. Monitoring of background concentrations is another objective of network design.

During the on-site interview, major changes made to the monitoring network design since the last TSA was conducted (2012) were reviewed. The state has added, removed, and relocated several monitoring stations and monitors in the network since the last TSA. Many of these changes followed mobile monitoring station deployments and assessments of the data collected during those deployments. Most of the recent mobile gaseous monitoring trailer deployments have been to locations near major oil refineries. The mobile monitoring trailer deployed at Gillette, Wyoming at the time of the 2012 TSA was relocated to Converse County in December of 2012. Consequently, based on the assessment of the data collected during the mobile monitoring trailer deployment, the state added a new long-term SPM station to the network at Converse County in April of 2015. In July of 2015, the mobile monitoring trailer was relocated to Newcastle, Wyoming where it is currently stationed. Similarly, the Rock Springs Mobile station was relocated to Lovell, Wyoming where it operated from July of 2014 through June of 2015. The Lovell Mobile station was relocated to Torrington, Wyoming where it has been in operation since December of 2015. In January of 2016, an SO_2 monitor was added to the Torrington Mobile station. The Big Piney Mobile station operating at the time of the 2012 TSA

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was relocated to Sinclair, Wyoming in December of 2013. It was then moved again (in February of 2016) to Cheyenne, Wyoming where it has operated as the Cheyenne Mobile station since March of 2016. The Big Piney Mobile Station was replaced with a long-term SPM station added to the monitoring network. In November of 2013 the Wyoming Range station was shut down and removed from the network because the data collected was determined to be redundant to data collected at the Daniel South station. The PM_{10} TEOM particulate monitors, which had been operating at the South Pass and Wamsutter sites in 2012, were removed and replaced with $PM_{2.5}$ BAM particulate monitors in March of 2014 and June of 2016 respectively. The Antelope Site-3 station was relocated (due to construction of a road) and renamed Antelope Site-7 in February of 2015.

Planned changes to the network include relocating the Newcastle Mobile station to another location that is near a large refinery: a location in the city of Casper. The relocation is expected to take place in the early fall of 2016.

Network design is managed on an annual basis through the AMNP required by 40 CFR Section 58.10. The AQD submitted an electronic version of the 2016 AMNP to the EPA on June 16, 2016. The Monitoring Network Assessment is required on a 5-year schedule. The last Monitoring Network Assessment year was 2015. Necessary monitoring network changes which are not addressed in the AMNPs or 5-year assessments can be approved by the EPA through monitoring network modification requests at any time.

Quality control and assurance of ambient air quality data collected by the AQD is managed through the state's Quality Management Plan (QMP), QAPPs and SOPs. The EPA-approved QMP (last approval date January 6, 2016) provides for AQD to approve their QAPPs and SOPs. AQD does not employ a single comprehensive QAPP; instead, they rely on a number of QAPPs and relevant SOPs, most of which are station specific and prepared and updated by AQD's contractors. The QAPP prepared by AQD for $PM_{2.5}$ and PM_{10} monitoring at SLAMS sites applies to several stations but is specific to particulate monitoring. Implementation of QAPPs is verified through quarterly report reviews conducted by AQD Project Managers and semi-annual audits performed by the AQD QA auditor for all SPM and SLAMS sites. It was noted during the TSA that QAPP approvals are up to date. It was also noted during the TSA that some QAPPS are not current with respect to project personnel (e.g. South Pass QAPP) and that annual QAPP reviews should include making the necessary updates.

Independent quality assurance (QA) and quality control (QC) operations are maintained through having AQD SPM monitoring stations operated by independent contractors (ARS and MSI) who employ and oversee field technicians, project managers and QA personnel that manage the stations separately from the AQD QA and QC operations. The contractors report to AQD Project Managers and receive no direction from the AQD QA auditor. At the AQD SLAMS sites, the day-to-day operations are conducted by contracted site technicians who are responsible for the PM filter collection while the AQD Site Technicians perform routine and preventative maintenance on the samplers.

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Laboratory facilities used by AQD in support of monitoring activities are the AQD monitoring lab in Cheyenne (monitor maintenance and QA/QC) and the private Intermountain Labs (IML) located in Sheridan Wyoming (filter weighing).

States are required to certify all data from SLAMS and SPMs if the SPM is a Federal Reference Method (FRM), Federal Equivalent Method (FEM), or Approved Regional Method (ARM) monitor, and meets the QA requirements of 40 CFR 58 appendix A. Annual data certification confirms that the monitoring agency has loaded all of its data for the year and has completed the monitoring agency's normal validation process. It was noted during the TSA that AQD had submitted the required data certification letter and AQS reports to the EPA for annual certification of the 2015 data (due May 31, 2016).

3.0 Site Visits

The TSA monitoring site visits were conducted June 20, 2016 through June 23, 2016. On June 20th, the Casper SLAMS Site located in Natrona County was visited. On June 21st, the Casper Gaseous site in Natrona County and the Lander SLAMS Site in Fremont County were visited. On June 22nd, The South PassSsite in Fremont County and the Rock Springs SLAMS Site in Sweetwater County were visited. On June 23rd, the Wamsutter Site in Sweetwater County was visited.

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Casper SLAMS Site

The Casper SLAMS Site (Figure 4) is located on the roof of the City and County Building in downtown Casper, Wyoming. Casper is the second largest city in Wyoming. The contract site field technician is Cindy Rissler who is responsible for filter collection. Site maintenance and QA is performed by AQD. The station began operation in 1991. It is a SLAMS site where the state currently monitors $PM_{2.5}$ and PM_{10} with manual filter-based (Partisol 2000) samplers. The PM_{10} samplers are collocated with the primary and the satellite samplers operating on a once in three days sampling frequency and the collocated sampler operating on a once in twelve days sampling frequency. The $PM_{2.5}$ samplers are set up with once in six days sampling frequencies that are offset between the primary and the satellite samplers for a once in three days sampling frequency for $PM_{2.5}$. The monitoring objective for this site is population exposure. No siting issues were noted while visiting the site; however, there were some operational issues noted. The internal clock time was observed to be off by as much as 20 minutes on the samplers and all were in excess of the one minute per month time acceptance criteria found in Appendix D of the QA Handbook and specified in the SOP. The internal clock time should be documented and the internal clock should be maintained and reset by the AQD field technicians during their regularly scheduled verification and maintenance.

Figure 4. Casper SLAMS Site

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Casper Gaseous Site

The Casper Gaseous Site (Figure 5) is located at 2800 Pheasant Drive in Casper, Wyoming. The contract site field technician is Curt Rissler who is responsible for inline filter replacement. Site maintenance and QA is performed by ARS. The station began operation in 2013. It is an SPM site where the state currently monitors O_3 and NO_x with Teledyne T400 and Teledyne T200 monitors. The monitoring objective for this site is population exposure. The ozone monitor at the Casper Gaseous Site, currently designated an SPM in the AMNP fulfills the SLAMS minimum ozone monitoring requirement for the Casper metropolitan area, and so should be re-designated as a SLAMS monitor.

Figure 5. Casper Gaseous Site

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Lander SLAMS Site

The Lander SLAMS Site (Figure 6) is located on a roof of a school building at 600 Washington street in residential Lander, Wyoming. Lander has a population of approximately 7,600 people. The contract site field technician is Lanny Cole Jr. who is responsible for filter collection. Site maintenance and QA is performed by AQD. The station began operation in 1989. It is a SLAMS site where the state currently monitors $PM_{2.5}$ and PM_{10} with manual filter-based (Partisol 2000) samplers. The PM_{10} and $PM_{2.5}$ samplers are set up with once in six days sampling frequencies that are offset between the primary and the satellite samplers for a once in three days sampling frequency. The monitoring objective for this site is population exposure. There were no siting or operational issues noted while visiting the site.

Figure 6. Lander SLAMS Site

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South Pass Site

The South Pass Site (Figure 7) is located on South Pass on the southern end of the Wind River Range. The contract site field technician is Marty Hamilton who is responsible for inline filter replacement. Site maintenance and QA is performed by ARS. The station began operation in 2007. It is an SPM site where the state currently monitors O_3 and NO_x. with Thermo 49i and Thermo 42i monitors, respectively, and $PM_{2.5}$ using a Met One BAM 1020 instrument. The monitoring objective for this site is to determine general background concentrations. No siting issues were noted during the visit; however, it was noted that the United States Forest Service (USFS) had cut a number of trees in the immediate area and stacked numerous slash piles for a planned burn. The EPA was concerned that AQD should coordinate with USFS to learn the date(s) of the planned burning in order to accurately flag the high data values and possibly protect the sensitive gaseous monitors from any potential damage. AQD agreed to coordinate with USFS and update the EPA on their plans. Operationally, it was noted that inside the shelter a 3-ring notebook contained checklist instructions (CIs) for the site operators. There were various versions of CIs in the notebook but no copy of the SOP. Also, the QAPP for this site does not include CI version control.

Figure 7. South Pass Site

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Rock Springs SLAMS Site

The Rock Springs SLAMS Site (Figure 8) is located on the roof of a school building at 625 Ahsay Avenue in residential Rock Springs, Wyoming. Rock Springs has a population of approximately 23,200 people. The contract site field technician is Scott Pies who is responsible for filter collection. Site maintenance and QA is performed by AQD. The station began operation in 1989. It is a SLAMS site where the state currently monitors $PM_{2.5}$ and PM_{10} with manual filter-based (Partisol 2000) samplers. The PM_{10} and $PM_{2.5}$ samplers are set up with once in six days sampling frequencies that are offset between the primary and the satellite samplers for a once in three days sampling frequency. The monitoring objective for this site is population exposure. There were only four outlets for the four samplers which could inhibit Performance Evaluation Program (PEP) auditing due to restricted power access. There were no siting or operational issues noted while visiting the site.

Figure 8. Rock Springs SLAMS Site

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Wamsutter Site

The Wamsutter Site (Figures 9 and 10) is located two miles west of Wamsutter, Wyoming. The field site technician is Grant Roach of AQD who is responsible for inline filter replacement. Site maintenance and QA is performed by ARS. The station began operation in 2006. It is an SPM site where the state currently monitors O_3 and NO_x with Thermo 49i and Thermo 42i monitors, respectively, and $PM_{2.5}$ using a Met One BAM 1020 instrument. The monitoring objectives for this site are source oriented and general background concentrations. There were no siting or operational issues noted while visiting the site.

Figure 9. Wamsutter Site

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Figure 10. Wamsutter Site

4.0 Findings and Observations

While no major findings were identified as a result of the TSA, several minor findings were noted. These findings include specific opportunities for improvement within the current program and recognition of actions taken by the state to correct issues noted in previous TSAs.

Quality control and assurance of ambient air quality data collected by the AQD is managed through the AQD QMP, and the AQD approved QAPPs and SOPs. The reference, EPA Requirements for Quality Assurance Project Plans QA/R-5, Section 2.7, requires annual Quality Assurance Project Plan reviews and updates as necessary. The QA Handbook, Section 1.3.1, indicates that SOPs should be developed as part of the QAPP development (or revision) process. Keeping SOPs current is an important part of maintaining a quality monitoring network that collects defensible data. During the TSA it was noted that there are several needed updates to QAPP and SOP documents. These necessary updates include revisions to include the current checklist instructions (CIs) maintained at monitoring sites (e.g. at the South Pass Site), to reflect current monitoring equipment utilized at sites, and to identify the current project personnel for each site (contract and AQD Site Technicians and Project Managers). The dynamic AQD

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monitoring network might best be served by a practice of revising QAPPs and SOPs as changes occur in project personnel, CIs, and monitoring equipment, instead of waiting until the annual QAPP review is performed to make these types of revisions. It was also noted during the TSA that the SLAMS QAPP could be repaginated to ease the revision process.

As part of the TSA, the Partisol-FRM Model 2000 Verification & Maintenance Forms and AQD site logbooks were reviewed at the AQD's offices in Cheyenne. It was observed that the AQD has made revisions to the Partisol-FRM Model 2000 Verification & Maintenance Forms (used for monthly field verifications) that are consistent with recommendations from the earlier TSA performed in 2012. During the review the Partisol-FRM Model 2000 Verification & Maintenance Forms were found to have inconsistent entries, and not all site logbooks were kept current as specified in the QAPPs and SOPs. The Partisol-FRM Model 2000 Verification & Maintenance Forms, used by the AQD Site Technicians, currently have an entry for time. It was ambiguous whether the time entered on the form was understood to be the time recorded from the sampler or the time of the AQD Site Technicians arrival on the site. The QA Handbook, Appendix D, addresses time acceptance criteria and clock timer verification for the samplers. The AQD SLAMS QAPP specifies in Table 14-1, Field QC Checks, the clock/timer verification is to be performed once per month with the acceptance criteria of one-minute drift per month. The form should either be revised to allow recording both clock/timer verification and time of arrival, or revised to specify that the time recorded is the required clock/timer verification. Also, the site logbooks were not always current with practices specified in the QAPPs and SOPs. Site logbooks and forms should be reconciled with current QAPPs and SOPs.

The ozone monitor at the Casper Gaseous Site, currently designated an SPM in the AMNP, meets the SLAMS minimum ozone monitoring requirements for re-designating the monitor as a SLAMS monitor. A recent revision to the ozone NAAQS (promulgated in October of 2015) lowered the 8-hour standard to 70 parts per billion. The requirements found at 40 CFR part 58 appendix D Table D-2 specify that a metropolitan statistical area (MSA) which contains an urbanized area of 50,000 or more in population and for which the most recent 3-year design value concentration is greater than 85% of the ozone NAAQS must have an ozone SLAMS. The ozone monitor located at the Casper Gaseous Site in Casper (population 59,628 in 2013) has a 3-year (2012 -2015) design value concentration of 62 parts per billion which is 89% of the current ozone NAAQS of 70 parts per billion. The state should re-designate the ozone monitor at the Casper Gaseous Site which is currently designated as an SPM, as a SLAMS monitor. The state will need to submit a Network Modification Request Form for re-designating the ozone monitor as SLAMS to Region 8 for approval, and submit the request in time for the re-designation to be approved for inclusion in the 2017 AMNP.

During the TSA it was noted that the AQD Contract Site Technicians (responsible for PM filter collection at the AQD SLAMS sites) receive an initial training from the AQD Site Technicians. Thereafter they generally have infrequent in-person contact with state personnel because the AQD Site Technicians (who visit the remote monitoring site locations only once per month) and the AQD Contract Site Technicians (who often have to schedule their part-time monitoring work to be performed after normal working hours) are unlikely to be at the site at the same time. Given the conflict in schedules, there is little opportunity for the AQD to observe that filter collection SOPs are consistently followed. AQD should provide annual training to Contract Site

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Technicians in order to ensure SOPs are adequately followed.

The TSAs performed in 2009 and 2012 documented the need for (and the EPA's willingness to provide training for) the state to enhance their QA oversight of contractors. It was suggested in both the previous audits that the EPA could provide training to the state via a joint state/EPA systems audit of one of the contractors. The joint TSA of ARS was performed in September of 2013 by the AQD QA Coordinator and the Region 8 monitoring contact for Wyoming. The state plans to continue to enhance their QA oversight of contractors through the performance of TSAs and continued discussions with Region 8 on QA topics.

In response to the recommendation received from the TSA performed in 2009, the AQD monitoring section has developed a draft Records Management Plan to manage hard copy and electronic records. A copy of the draft plan dated April 3, 2016, was provided to the EPA during the TSA. The plan addresses the elements of a records management policy as recommended in the EPA QA Handbook. The Wyoming state legislature has required the Wyoming DEQ to implement a legislative action called the "Paperless Initiative" and the AQD has fundamentally achieved that goal relying on electronic primary records for all collected data beginning January 1, 2016. A lot of their official records are maintained in the Impact database which is an online searchable system. Other records are accessible on a AQD shared drive and in hard copy paper files at the AQD offices. Electronic files are stored in the shared drives or the IMPACT databases and those shared drives and databases are managed by the Wyoming Department of Enterprise Technology Services (ETS), a state department responsible for implementing the state-wide Paperless Initiative. During the TSA an interview was conducted with representatives from ETS and AQD IT specialists to discuss and review the data storage, retrieval and back-up procedures in place. It was evident from the discussion that the "all digital" approach to records management is very efficient and has improved data access and usability; however, data security and reliable access to data in the paperless system also requires a close and accountable coordination between ETS and AQD. The EPA recognizes the achievements made by AQD in paperless record keeping and encourages continued coordination between ETS and AQD for the secure handling of ambient monitoring data records.

There were biases in collocated $PM_{2.5}$ precision data noted in both the 2012 TSA and the current TSA. Those identified in 2012 were resolved when the state ultimately changed out all the particle size separators at two affected sites. Those identified during the current TSA were determined by the state to likely be the result of errors in background zero settings at a third site. In 2012, precision data from the collocated sites in Cheyenne and Sheridan indicated the primary $PM_{2.5}$ monitors tended to read higher concentrations than the secondary monitors at both sites during the second quarter of 2012. At the time that the bias in collocated $PM_{2.5}$ precision data was noted in the 2012 TSA, the collocated Partisol FRM Model 2000 samplers installed in Cheyenne and Sheridan were all equipped with Well Impactor Ninety Six (WINS) particle size separators. Subsequently, after the state replaced all the WINS particle size separators with Very Sharp Cut Cyclone (VSCC) fractionators at these sites, the bias was no longer observed in the data. During the current TSA, the precision data from the two sites was studied and found to not have exhibited further subsequent bias. However, during the review of three years of collocated $PM_{2.5}$ precision data from the Belle Ayr BA-4 SPM Site (in the Powder River Basin $PM_{2.5}$ Network) it was noted that the precision data from that site exhibited a bias. The collocated

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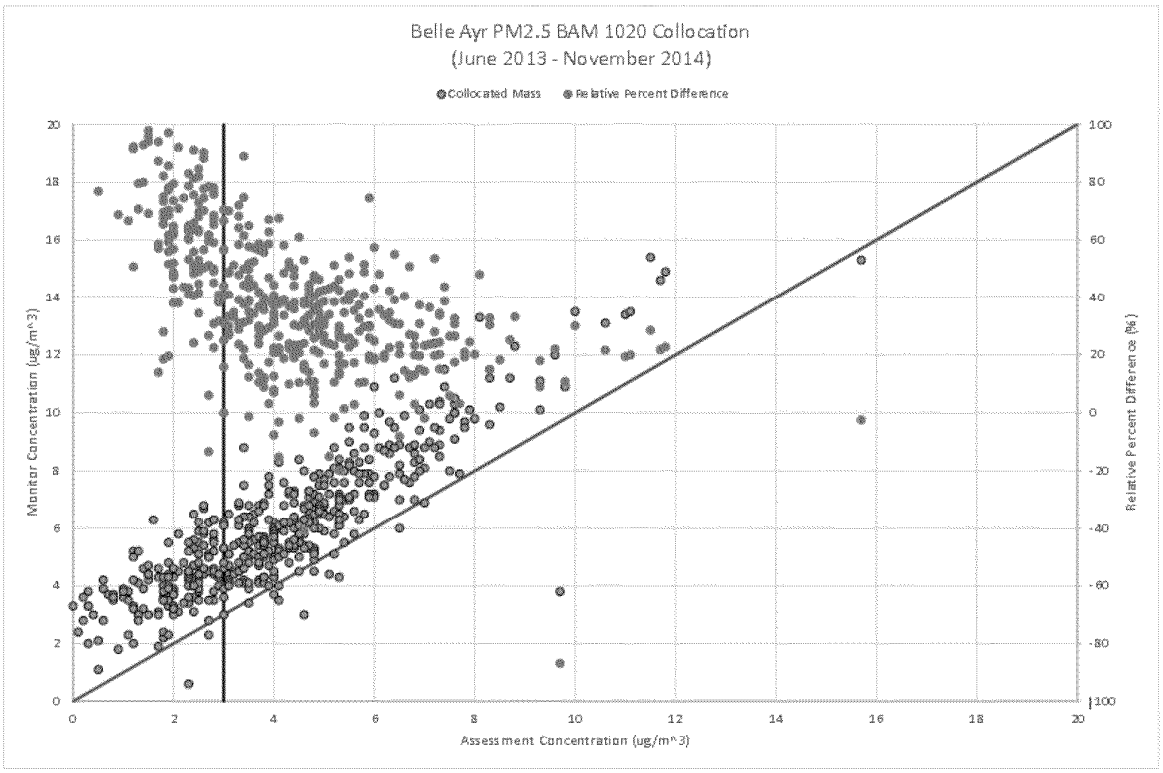
$PM_{2.5}$ monitors at the Belle Ayr BA-4 Site were installed during the second quarter of 2013 as replacement monitors for monitors that had reliability issues. The collocated $PM_{2.5}$ replacement monitors at the Belle Ayr BA-4 Site are Met One BAM 1020 monitors whereas the collocated $PM_{2.5}$ monitors at the SLAMS sites in Cheyenne and Sheridan (and all SLAMS sites) are Partisol FRM Model 2000 monitors. From June of 2013 until November of 2014 the precision data from the collocated $PM_{2.5}$ replacement monitors at the Belle Ayr BA-4 Site show a positive relative difference. In other words, the primary $PM_{2.5}$ monitor tended to read higher concentrations than the secondary monitor (see Figure 11). In November of 2014 the observed bias disappears. This indicates that for nearly one and a half years the problem went unnoticed. During the TSA, the state explained that the bias found in the collocated $PM_{2.5}$ precision data at the Belle Ayr BA-4 Site was likely due to errors in background zero settings. Given the experience with the two sites in 2012, it is concerning that the bias at the Belle Ayr BA-4 SPM site was not addressed much earlier than it was. Another concern is that similar but undiscovered biases may exist in $PM_{2.5}$ data collected at $PM_{2.5}$ monitoring sites in Wyoming that are not collocated. The state is encouraged to analyze the source of these errors in order to help ensure that bias does not exist in the $PM_{2.5}$ data collected at the other (non-collocated) $PM_{2.5}$ monitoring sites in Wyoming.

Figure 11. Belle AYR BA-4 Site – $PM_{2.5}$ Bias



5.0 Data Validation and Usability

The polling frequency for raw data from AQD monitoring sites depends on whether the data is collected from SLAMS or SPM sites. At SPM sites (run by contractors) data is polled (daily by

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MSI, hourly by ARS) and the continuous data is collected hourly via an automated process. SLAMS data is downloaded by AQD monthly. For SPMs, the raw data files are automatically collected and uploaded into the contractors' databases, the AQD WyVisNet Website raw data database and the EPA's AirNow website. Only after the contractors validate and format the data for uploading to AQS is it then uploaded into AQD's IMPACT data repository. Contractors maintain data records to flag the raw data per validation codes and to separate fields for validated values. Raw values are not changed and notes on data that was invalidated are maintained in the database with the data. AQD first stores the data from the IMPACT data repository onto an AQD internal server and then uploads the validated data from there to AQS via the Exchange Network.

Data validation is performed by the contractors and AQD pursuant to established criteria documented in QAPPs and SOPs. The data validation codes and raw data flags (for suspect values) exist in each data record and validation notes also accompany validated data within the database. Data are invalidated when established acceptance criteria limits are exceeded. Invalidated data are assigned codes which translate to AQS null data codes. Validated data that are changed or corrected subsequent to entering it into AQS are automatically logged by the databases. Daily, monthly, and annual reviews are performed to determine if values are reasonable or need to be corrected.

6.0 Conclusions and Recommendations

Table 2 is a list of the findings and recommendations from the June 2016 TSA for the AQD. Major findings are those which, if uncorrected, have the potential to lead to instances where collected data might be inaccurate or invalidated after problem detection and investigation. No major findings were identified in this audit, and few other issues, termed minor findings, were identified. Although some findings are similar to those identified in the last TSA performed in 2012, progress has been made to improve and update the monitoring network in those areas.

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Table 2. Findings and Recommendations.

FINDING - MAJOR	RECOMMENDATION(S)
1. None	
FINDING - MINOR	**RECOMMENDATION(S)**
1. The ozone monitor at the Casper Gaseous Site, currently designated an SPM in the AMNP, meets the SLAMS minimum ozone monitoring requirements found at 40CFR part 58 Appendix D, Table D-2.	1. Submit a Network Modification Request Form for re-designating the ozone monitor as SLAMS to Region 8 for approval. Submit the request in time for the re-designation to be approved for inclusion in the 2017 AMNP.
2. The QAPP for the South Pass Site did not include CIs maintained on site and current project personnel (AQD site operators and Project Managers) and monitoring equipment.	2. Revise QAPPs to include current CI version used in the Wyoming monitoring network, current project personnel and monitoring equipment. QA/R-5, Section 2.7 requires annual QAPP reviews and updates as necessary. Keeping QAPPs current is an important part of maintaining a quality monitoring network that collects defensible data.
3. The Partisol-FRM Model 2000 Verification & Maintenance Forms have inconsistent entries for "Time." Not all site logbooks were kept current as specified in the QAPPs and SOPs.	3. Update the Partisol-FRM Model 2000 Verification & Maintenance Forms to remove ambiguity and specify that sampler time is to be recorded, verified, and adjusted as necessary. The QA Handbook, appendix D, addresses time acceptance criteria and clock timer verification for the samplers. Maintain site logbooks and update SOPs to include current procedures.
4. For records management, in implementing a paperless system, data security, accessibility, and reliability may be compromised.	4. To ensure data security, accessibility, and reliability, coordination between ETS and AQD should remain close and accountable.

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5. The review of three years of collocated $PM_{2.5}$ precision data from the Belle Ayr BA-4 SPM Site showed that the precision data had exhibited bias. The state determined the error stemmed from incorrect background zero settings. The Belle Ayr BA-4 SPM Site problem existed 17 months before being corrected. Bias was previously found in Cheyenne and Sheridan $PM_{2.5}$ precision data from 2012 during the 2012 TSA.	5. The state is encouraged to analyze the source of these errors in order to help ensure that bias does not exist in the $PM_{2.5}$ data collected at the other (non-collocated) $PM_{2.5}$ monitoring sites in Wyoming. Data review should include collocated assessments per AMP 251 AQS reports. Reducing/eliminating the bias will improve data defensibility. (QA Handbook, appendix D)
6. AQD Contract Site Technicians receive initial training from the AQD Site Technicians but then generally have infrequent direct contact with state personnel thereafter.	6. AQD should provide annual training to Contract Site Technicians in order to ensure SOPs are adequately followed.

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Appendix A

Wyoming
2016 TSA
Questionnaire Response

ED_001361_00002616

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
Denver, CO 80202-1129
Phone 800-227-8917
www.epa.gov/region8

JAN 13 2017

Ref: 8P-AR

Ms. Nancy E. Vehr
Administrator, Air Quality Division
Department of Environmental Quality
Herschler Building
122 West 25th Street
Cheyenne, Wyoming 82002

Dear Ms. Vehr:

Enclosed with this letter is the final report of a Technical Systems Audit (TSA) of the ambient air monitoring program operated by the Wyoming Department of Environmental Quality Air Quality Division. The on-site interviews conducted during this audit occurred on June 20 through June 24, 2016. The report includes several minor findings and recommendations.

On September 20, 2016, EPA provided the draft TSA report to Ms. Cara Keslar, of your staff, for review and comment. In a letter dated October 20, 2016, Ms. Keslar responded with comments on the draft report and audit findings. Those comments have been addressed in the enclosed report. The continued collaboration between our staffs on the TSA represents a key part of the technical interaction between EPA and your air monitoring program.

If you have any questions on this issue, please contact me at (303) 312-6281 or Albion Carlson, of my staff, at (303) 312-6207.

Sincerely,

Gail Fallon, Acting Director
Air Program

cc: Cara Keslar WY DEQ

To: Carlson, Albion[Carlson.Albion@epa.gov]
From: Hyatt, Chuck R.
Sent: Thur 6/8/2017 9:12:33 PM
Subject: RE: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

Okay. Thanks Albion.

-Chuck

From: Carlson, Albion [mailto:Carlson.Albion@epa.gov]
Sent: Thursday, June 08, 2017 3:58 PM
To: Hyatt, Chuck R. <chyatt@nd.gov>
Subject: FW: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

CAUTION: This email originated from an outside source. Do not click links or open attachments unless you know they are safe.

Hi Chuck,

FYI I'm forwarding this message I read while checking my email this afternoon. EPA is extending the ozone designations by a year. Thanks,

Albion

From: Fallon, Gail
Sent: Wednesday, June 07, 2017 8:56 AM
To: R8 Air Program <R8AirProgram@epa.gov>
Subject: FW: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

From: Mutter, Andrew
Sent: Wednesday, June 07, 2017 8:46 AM
To: R8 RLT <R8_RLT@epa.gov>
Cc: R8 OCPI <R8_OCPI@epa.gov>
Subject: FW: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

From: U.S. EPA Media Relations [mailto:no-replysubscriptions@epa.gov]
Sent: Tuesday, June 06, 2017 4:33 PM

To: Mutter, Andrew <mutter.andrew@epa.gov>
Subject: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

CONTACT:
press@epa.gov

FOR IMMEDIATE RELEASE
June 6, 2017

EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

WASHINGTON – U.S. Environmental Protection Agency (EPA) Administrator Scott Pruitt sent a letter to governors today to inform them of EPA's efforts related to the National Ambient Air Quality Standards (NAAQS) for ozone promulgated in October 2015. EPA is extending the deadline for promulgating initial area designations, by one year, for the 2015 ozone NAAQS.

"States have made tremendous progress and significant investment cleaning up the air. We will continue to work with states to ensure they are on a path to compliance," **said Administrator Scott Pruitt.**

The National Ambient Air Quality Standard (NAAQS) for ground-level ozone is an outdoor air regulation under the Clean Air Act. As part of the process to determine what areas of the country are able to meet the current air quality standards, states are currently submitting their proposals for area designations under the 70 parts per billion (ppb) standard, which was lowed from 75 ppb in 2015. Areas designated as being in "nonattainment" of the standard face consequences, including: increased regulatory burdens, restrictions on infrastructure investment, and increased costs to businesses.

EPA is giving states more time to develop air quality plans and EPA is looking at providing greater flexibility to states as they develop their plans. And, pursuant to the language in the recently-enacted FY2017 Omnibus funding bill, Administrator Pruitt is establishing an Ozone Cooperative Compliance Task Force to develop additional flexibilities for states to comply with the ozone standard.

Additionally, the Agency is taking time to better understand some lingering, complicated issues so that air attainment decisions can be based on the latest and greatest information. This additional time will also provide the agency time to review the 2015 ozone NAAQS, prior to taking this initial implementation step.

Although the new ozone standard was set on October 1, 2015, there remains a host of complex

issues that could undermine associated compliance efforts by states and localities. The Agency is evaluating these issues, primarily focused on:

- Fully understanding the role of background ozone levels;
- Appropriately accounting for international transport,
- And, timely consideration of exceptional events demonstrations.

"We share the goal of clean air, a robust economy and stronger, healthier communities. We are committed to working with states and local officials to effectively implement the ozone standard in a manner that is supportive of air quality improvement efforts without interfering with local decisions or impeding economic growth," **said Administrator Pruitt.**

Since 1980, total emissions of the six principal air pollutants have dropped by 63 percent and ozone levels have declined by 33 percent. Despite the continued improvement of air quality, costs associated with compliance of the ozone NAAQS have significantly increased.

R107

If you would rather not receive future communications from Environmental Protection Agency, let us know by clicking here.
Environmental Protection Agency, 1200 Pennsylvania Avenue NW, Washington, DC 20460 United States

To: Carlson, Albion[Carlson.Albion@epa.gov]
Cc: O'Clair, Terry L.[toclair@nd.gov]; rmills@nd.gov[rmills@nd.gov]
From: Hyatt, Chuck R.
Sent: Thur 5/4/2017 6:32:37 PM
Subject: RE: 2016 Data Certification and Invalidation of Ozone data in AQS due to QC issues

Albion,

In consideration of your responses, below, and our discussion during the EPA/ND midyear call today, I have updated our analysis of the actions needed to be taken with regards to the Null Data Request for the ozone data to be used in designation determinations. Today you confirmed that data that were certified under our QAPP (as it existed at the time) will be considered valid by EPA. Therefore:

OAQPS has identified the following 7 monitors in North Dakota as Phase 1:

Monitor ID	Site Name	Region	State	County	CBSA	Begin Date	End Date	Phase	% Diff (Original/After)	Explanation	Action
380530002 1	TRNP-NU	8	North Dakota	McKenzie		2014-07-17	2014-08-12	1	*10/-2.2*	***Wrong actual set point Entered 80 should be 90***	***Updated***
380530002 1	TRNP-NU	8	North Dakota	McKenzie		2015-01-15	2015-02-10	1	*7.77*	***Meets QAPP***	***No Change***
380530002 1	TRNP-NU	8	North Dakota	McKenzie		2016-09-22	2016-10-18	1	*8.75/-3.3*	***Wrong Actual Set point Entered 80 should be 90***	***Updated***
381050003	Williston	8	North Dakota	Williams	Williston, ND	2014-02-25	2014-03-23	1	*8.8*	***Meets QAPP***	***No Change***
381050003	Williston	8	North Dakota	Williams	Williston, ND	2014-05-06	2014-06-01	1	*8.8*	***Meets QAPP***	***No Change***
381050003	Williston	8	North Dakota	Williams	Williston, ND	2015-04-21	2015-05-17	1	*7.7*	***Meets QAPP***	***No Change***
381050003	Williston	8	North Dakota	Williams	Williston, ND	2016-05-17	2016-06-12	1	*8.8*	***Meets QAPP***	***No Change***

We will continue to examine the Phase 2 data periods in anticipation of future action.

Regards,

-Chuck

From: Carlson, Albion [mailto:Carlson.Albion@epa.gov]
Sent: Tuesday, May 02, 2017 5:53 PM
To: Hyatt, Chuck R.
Cc: O'Clair, Terry L.; Mills, Ryan D.; Papp, Michael; Payton, Richard; Fallon, Gail
Subject: RE: 2016 Data Certification and Invalidation of Ozone data in AQS due to QC issues

CAUTION: This email originated from an outside source. Do not click links or open attachments unless you know they are safe.

Chuck,

Thank you for the analysis and questions. Region 8's responses to your questions are written below each question in red. The analysis you provided for the Phase 1 data should change in light of these responses, particularly where the analysis questioned whether data from outside the ozone season will be used in designations (it will be). The correction for data where the wrong actual set point had been entered makes sense as does retaining as valid the data that met the specified acceptance criteria of the EPA-approved QAPP (zero and span limits in this case) in place at the time.

Please send me your updated analysis as soon as you can. Let me know if you have questions or want to discuss. Thanks,

Albion

From: Hyatt, Chuck R. [mailto:chyatt@nd.gov]
Sent: Monday, May 01, 2017 11:09 AM

To: Carlson, Albion <Carlson.Albion@epa.gov>
Cc: O'Clair, Terry L. <toclair@nd.gov>; rmills@nd.gov
Subject: RE: 2016 Data Certification and Invalidation of Ozone data in AQS due to QC issues

Albion,

We have examined the 'Phase I' data items that were listed in the original data invalidation (null) request sent on 4/14/2017. Through this analysis we have identified possible actions that could be taken to bring the percent difference for the 1-point QC completeness to a level consistent with ND's understanding of regulatory intent - without jeopardizing the quality of the data used for designations. This analysis is presented below. However, the action North Dakota ultimately takes is strongly dependent on the answers to the following questions:

1. The IG's Management Alert of Feb. 6. 2017 did not include any action recommendations. What is the justification for EPA choosing data null requests as opposed to guidance changes or other actions in response to this alert? Were any alternatives examined and why were these ultimately discarded as workable options?

The IG notified EPA Air Program of concerns; EPA OAR developed the response to those concerns.

2. Phase I and Phase II null requests to ND include data periods in 2013. It was ND's understanding that ozone designations were to be based on 2014-2016 design values. Will 2013 data be evaluated as well in ozone designation determinations?

ND included 2013-2015 data in its designations recommendation of October 2016; EPA will base final designations on 2014-2016 data, but the rulemaking will refer to the ND recommendation which included 2013 data. 2013 data needs to be updated if data validation deviated from released EPA guidance highlighted by the OIG.

3. The ND developed and approved QAPP, which was in place during the 2014-2016 design value period for ozone designations, specified data validation limits per section 12 of the 8/98 QA Handbook Volume II. Does EPA guidance as referenced in the null request supersede an approved QAPP?

Region 8 interprets the null request as acknowledging that approved alternative data validation techniques in QAPPs provide other acceptable data validation pathways.

4. CY2016 data certification AMP 600 guidance distributed to states one day prior to the null request memo (on 4/13/16) stated that 1-Point QC precision alone of 8-20% would not generate a recommend N flag in AQS. Can this guidance be reconciled with the null request memo?

Data Certification report evaluates the overall data quality against long-standing CFR Data Quality Objectives (40 CFR Part 58 Appendix A 2.3.1.2). QA Handbook reflects tighter but readily achievable performance objectives for well managed monitoring networks.

5. Some of the null requests reference data outside of North Dakota's ozone season. Will data from outside the ozone season be used in designations?

All data in AQS will be used for designations; ozone exceedances outside ozone seasons always "count".

6. The changes to data as requested will result in ND having to recertify data for past years. If this cannot be completed prior to the May 1 deadline (or any nominal extension), will designations proceed based on un-certified data? What are the consequences of doing so?

Yes, designations will proceed even if modified data have not yet been recertified.

7. The use of POC2 ozone monitors as opposed to POC1 would resolve some data validation issues. Can ND specify the use of POC2 over POC1?

Yes, 40 CFR Part 50, Appendix U section 2 requires ND to designate one of the monitors as primary; POC 1 is currently primary, but ND can change POC 2 to primary for any or all of the time there have been two monitors running. Change using the monitors tab in AQS.

Can Region or OAQPS please address these questions and respond back? We will take the answers into consideration as we plan our next steps, not only with respect to Phase I, but also the Phase II listed data periods.

The analysis summary takes the form of the original Phase 1 identification table. The '% Diff' column shows the 1-point QC precision difference as it currently stands and, if applicable, as it would be if potential actions are taken. The 'Explanation' column gives a description of why a

given action may be warranted. The 'Potential Action/Question' column outlines action that could be taken, describes why no action may be needed, or prompts for the answer to one of the questions above which would help resolve which action, if any, may be preferred.

OAQPS has identified the following 7 monitors in North Dakota as Phase 1:

Monitor ID	Site Name	Region	State	County	CBSA	Begin Date	End Date	Phase	% Diff (Original/Expl)	Explanation	Potential Action/Quest
380530002 1	TRNP-NU	8	North Dakota	McKenzie		2014-07-17	2014-08-12	1	*10/-2.2*	***Wrong actual set point Entered 80 should be 90***	***Update and correct record***
											Meets QAPP.
380530002 1	TRNP-NU	8	North Dakota	McKenzie		2015-01-15	2015-02-10	1	*7.77*	***This is outside the Ozone season***	***Is this data used for the Ozone Designation?***
380530002 1	TRNP-NU	8	North Dakota	McKenzie		2016-09-22	2016-10-18	1	*8.75/-3.3*	***Wrong Actual Set point Entered 80 should be 90***	***Update and correct record***
											Meets QAPP.
381050003	Williston	8	North Dakota	Williams	Williston, ND	2014-02-25	2014-03-23	1	*8.8*	***This is outside the Ozone season***	***Is this data used for the Ozone Designation?***
381050003	Williston	8	North Dakota	Williams	Williston, ND	2014-05-06	2014-06-01	1	*8.8*		***Meets QAPP***
381050003	Williston	8	North Dakota	Williams	Williston, ND	2015-04-21	2015-05-17	1	*7.7*	***Only 17 days within the Ozone Season***	***Meets QAPP***
381050003	Williston	8	North Dakota	Williams	Williston, ND	2016-05-17	2016-06-12	1	*8.8*		***Meets QAPP***

Please contact me if you have any questions or need clarification on anything in this e-mail.
Thank you.

-Chuck

--

Chuck Hyatt - Program Manager

Air Quality Monitoring Program

Division of Air Quality

North Dakota Department of Health

918 E. Divide Ave., 2nd Floor

Bismarck, ND 58501-1947

chyatt@nd.gov

www.ndhealth.gov/AQ

701-328-5188

From: Hyatt, Chuck R.
Sent: Monday, May 01, 2017 10:01 AM
To: 'Carlson, Albion'
Cc: O'Clair, Terry L.; Mills, Ryan D.
Subject: RE: 2016 Data Certification

Albion,

In accordance with 40 CFR 58, EPA Region 8 requests that North Dakota Department of Health annually certify all ambient air monitoring data submitted to AQS. This certification is due by May 1 of each year for data collected the previous calendar year.

On April 14, 2017, the Department received an e-mail from Region 8 requesting that specific periods of ozone data collected in North Dakota be evaluated for invalidation in response to an EPA Inspector General Management Alert (see attached for the e-mail). The request was made that invalidations occur by May 1, 2017, prior to certification, to "correct" 2014-2016 design values calculated for ozone designations.

In subsequent telephone conversation between the Department and EPA, it became clear that there are a number of outstanding questions regarding the referenced data periods, answers to which would dictate how North Dakota would approach the data invalidation request. In light of the extremely short amount of time between the request and the deadline, the complex nature of the questions relating to data invalidation, and the uncertainty as to when EPA will ultimately address these questions, it has become apparent that North Dakota will not be able to adhere to the May 1, 2017 deadline for certification of the 2016 data. This e-mail serves as a notice to this fact.

North Dakota will follow-up this message with an analysis of the data periods identified in the attached e-mail as Phase I. This analysis will also describe in detail the questions referenced above. Once these issues are resolved, the Department will move ahead with data certification, the timing of which will be communicated to EPA.

If you have any questions, please contact me.

Regards,

-Chuck

--

Chuck Hyatt - Program Manager

Air Quality Monitoring Program

Division of Air Quality

North Dakota Department of Health

918 E. Divide Ave., 2nd Floor

Bismarck, ND 58501-1947

chyatt@nd.gov

www.ndhealth.gov/AQ

701-328-5188

To: Carlson, Albion[Carlson.Albion@epa.gov]
Cc: O'Clair, Terry L.[toclair@nd.gov]; rmills@nd.gov[rmills@nd.gov]
From: Hyatt, Chuck R.
Sent: Mon 5/1/2017 3:00:56 PM
Subject: RE: 2016 Data Certification
Invalidation of Ozone data in AQS due to QC issues

Albion,

In accordance with 40 CFR 58, EPA Region 8 requests that North Dakota Department of Health annually certify all ambient air monitoring data submitted to AQS. This certification is due by May 1 of each year for data collected the previous calendar year.

On April 14, 2017, the Department received an e-mail from Region 8 requesting that specific periods of ozone data collected in North Dakota be evaluated for invalidation in response to an EPA Inspector General Management Alert (see attached for the e-mail). The request was made that invalidations occur by May 1, 2017, prior to certification, to "correct" 2014-2016 design values calculated for ozone designations.

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North Dakota will follow-up this message with an analysis of the data periods identified in the attached e-mail as Phase I. This analysis will also describe in detail the questions referenced above. Once these issues are resolved, the Department will move ahead with data certification, the timing of which will be communicated to EPA.

If you have any questions, please contact me.

Regards,

-Chuck

--

Chuck Hyatt - Program Manager

Air Quality Monitoring Program

Division of Air Quality

North Dakota Department of Health

918 E. Divide Ave., 2nd Floor

Bismarck, ND 58501-1947

chyatt@nd.gov

www.ndhealth.gov/AQ

701-328-5188

To: Hyatt, Chuck R.[chyatt@nd.gov]
Cc: Payton, Richard[Payton.Richard@epa.gov]
From: Carlson, Albion
Sent: Fri 4/14/2017 9:11:34 PM
Subject: Invalidation of Ozone data in AQS due to QC issues

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Chuck,

As a response to the EPA Inspector General Management Alert of Feb. 6, 2017 (https://www.epa.gov/sites/production/files/2017-02/documents/_epaoig_20170206-17-p-0106_glance.pdf), OAQPS has searched AQS for raw ozone data associated with QC checks outside the +/-7% validation criteria of the QA Handbook. OAQPS requests that for "high priority monitors whose 2014-2016 design value would change or become incomplete due to the data invalidations" any such data be replaced in AQS by null codes **by May 1, 2017**, prior to certification, so that 2014-2016 design values calculated for designations this coming October can be "correct". These "high priority monitors" are "Phase 1".

OAQPS has identified the following 7 monitors in North Dakota as Phase 1:

Monitor ID	Site Name	Region	State	County	CBSA	Begin Date	End Date	Phase
3805300021	TRNP-NU	8	North Dakota	McKenzie		2014-07-17	2014-08-12	1
3805300021	TRNP-NU	8	North Dakota	McKenzie		2015-01-15	2015-02-10	1
3805300021	TRNP-NU	8	North Dakota	McKenzie		2016-09-22	2016-10-18	1
3810500031	Williston	8	North Dakota	Williams	Williston, ND	2014-02-25	2014-03-23	1
3810500031	Williston	8	North Dakota	Williams	Williston, ND	2014-05-06	2014-06-01	1
3810500031	Williston	8	North Dakota	Williams	Williston, ND	2015-04-21	2015-05-17	1
3810500031	Williston	8	North Dakota	Williams	Williston, ND	2016-05-17	2016-06-12	1

There are also ozone monitors designated "Phase 2" in North Dakota. These monitors have a less immediate impact on designations and so are being included in the Phase 2 action.

OAQPS requests that for these monitors any such data be replaced in AQS by null codes by August 1, 2017.

OAQPS has identified the following 8 monitors in North Dakota as Phase 2:

Monitor ID	Site Name	Region	State	County	CBSA	Begin Date	End Date	Phase
380130004	LOSTWOOD NWR	8	North Dakota	Burke		2013-06-27	2013-07-23	2
380130004	LOSTWOOD NWR	8	North Dakota	Burke		2015-07-23	2015-08-18	2
380150003	BISMARCK RESIDENTIAL	8	North Dakota	Burleigh	Bismarck, ND	2013-01-01	2013-01-23	2
380171004	FARGO NW	8	North Dakota	Cass	Fargo, ND-MN	2016-08-25	2016-09-19	2
380250003	DUNN CENTER	8	North Dakota	Dunn		2013-05-14	2013-05-29	2
380570004	BEULAH NORTH	8	North Dakota	Mercer		2016-06-21	2016-09-11	2
380650002	HANNOVER	8	North Dakota	Oliver	Bismarck, ND	2013-01-01	2013-01-28	2
381050003	Williston	8	North Dakota	Williams	Williston, ND	2013-05-07	2013-06-02	2

Thanks, and please call me if you have questions.

Albion

To: Carlson, Albion[Carlson.Albion@epa.gov]
Cc: rmills@nd.gov[rmills@nd.gov]
From: Hyatt, Chuck R.
Sent: Tue 4/25/2017 7:24:23 PM
Subject: RE: Invalidation of Ozone data in AQS due to QC issues
Qamvol1.pdf
2000QNC4.pdf

Albion,

See attached for the version 6 of the ND QAPP, dated 2006, which was the most recent version until the latest revision. From my records, this was sent to Ken Distler on May 3, 2007. Section C.4 – Reconciliation with Data Quality Objectives – specifies that zero and span limits as specified in Section 12 of the QA Handbook Vol II are used in determining validity of continuous ambient data. The version of the Handbook referenced is EPA-454/R-98-004, revised 8/98 (attached). See Appendix 3 of the handbook which contains the Measurement Quality Objectives (available online at https://www3.epa.gov/ttnamti1/archive/files/ambient/monitorstrat/app3.pdf). Also see Figure 12.2.

-Chuck

From: Carlson, Albion [mailto:Carlson.Albion@epa.gov]
Sent: Thursday, April 20, 2017 2:26 PM
To: cara.keslar@wyo.gov; Hyatt, Chuck R.
Cc: Payton, Richard
Subject: FW: Invalidation of Ozone data in AQS due to QC issues

CAUTION: This email originated from an outside source. Do not click links or open attachments unless you know they are safe.

Cara and Chuck,

For additional background information on this quality assurance issue, please refer to the attached memo provided by OAQPS entitled "Ozone 1-point QC Check Data Quality Evaluation and Next Steps". Thanks, and please call me if you have questions.

Albion

From: Carlson, Albion
Sent: Friday, April 14, 2017 3:33 PM
To: cara.keslar@wyo.gov
Cc: Payton, Richard <Payton.Richard@epa.gov>
Subject: Invalidation of Ozone data in AQS due to QC issues

Cara,

As a response to the EPA Inspector General Management Alert of Feb. 6, 2017 (https://www.epa.gov/sites/production/files/2017-02/documents/_epaoig_20170206-17-p-0106_glance.pdf), OAQPS has searched AQS for raw ozone data associated with QC checks outside the +/-7% validation criteria of the QA Handbook. OAQPS requests that for "high priority monitors whose 2014-2016 design value would change or become incomplete due to the data invalidations" any such data be replaced in AQS by null codes **by May 1, 2017**, prior to certification, so that 2014-2016 design values calculated for designations this coming October can be "correct". These "high priority monitors" are "Phase 1".

OAQPS has identified the following monitor in Wyoming as Phase 1:

Monitor ID	Site Name	Region	State	County	CBSA	Begin Date	End Date	Phase
560070100 1	Atlantic Rim Sun Dog	8	Wyoming	Carbon		2014-06-14	2014-07-16	1

There are also ozone monitors designated "Phase 2" in Wyoming. These monitors have a less immediate impact on designations and so are being included in the Phase 2 action. OAQPS requests that for these monitors any such data be replaced in AQS by null codes by August 1, 2017.

OAQPS has identified the following monitors in Wyoming as Phase 2:

Monitor ID	Site Name	Region	State	County	CBSA	Begin Date	End Date	Phase
560019991	Centennial	8	Wyoming	Albany	Laramie, WY	2013-02-20	2013-02-20	2
560019991	Centennial	8	Wyoming	Albany	Laramie, WY	2013-02-23	2013-02-23	2
560019991	Centennial	8	Wyoming	Albany	Laramie, WY	2013-03-29	2013-04-01	2
560019991	Centennial	8	Wyoming	Albany	Laramie, WY	2013-09-04	2013-09-04	2
560019991	Centennial	8	Wyoming	Albany	Laramie, WY	2013-09-13	2013-09-13	2
560019991	Centennial	8	Wyoming	Albany	Laramie, WY	2014-02-12	2014-02-18	2
560030002	Basin	8	Wyoming	Big Horn		2016-09-08	2016-09-08	2
560030002	Basin	8	Wyoming	Big Horn		2016-09-13	2016-09-13	2
560050123	Thunder Basin	8	Wyoming	Campbell	Gillette, WY	2014-03-24	2014-03-28	2
560050456	Campbell County	8	Wyoming	Campbell	Gillette, WY	2013-02-23	2013-02-25	2
560050456	Campbell County	8	Wyoming	Campbell	Gillette, WY	2013-03-03	2013-03-05	2
560050456	Campbell County	8	Wyoming	Campbell	Gillette, WY	2013-07-11	2013-07-13	2
560050456	Campbell County	8	Wyoming	Campbell	Gillette, WY	2013-10-29	2013-10-31	2
560050456	Campbell County	8	Wyoming	Campbell	Gillette, WY	2013-12-18	2013-12-20	2
560050456	Campbell County	8	Wyoming	Campbell	Gillette, WY	2013-12-22	2013-12-24	2
560130099	South Pass	8	Wyoming	Fremont	Riverton, WY	2015-09-21	2015-09-25	2
5601302321		8	Wyoming	Fremont	Riverton, WY	2015-02-16	2015-02-18	2
560210100	Cheyenne NCore	8	Wyoming	Laramie	Cheyenne, WY	2015-03-30	2015-04-03	2
560250100	Casper Gaseous	8	Wyoming	Natrona	Casper, WY	2014-02-01	2014-02-09	2
5602526011		8	Wyoming	Natrona	Casper, WY	2014-05-27	2014-05-29	2
5603300041		8	Wyoming	Sheridan	Sheridan, WY	2013-02-26	2013-03-10	2
5603300041		8	Wyoming	Sheridan	Sheridan, WY	2013-09-14	2013-09-17	2
5603300041		8	Wyoming	Sheridan	Sheridan, WY	2013-11-21	2013-11-26	2
560391011	Yellowstone National Park, Water Tank	8	Wyoming	Teton	Jackson, WY-ID	2015-05-	2015-05-	2

Thanks, and please call me if you have questions.

Albion

United States Environmental Protection Agency
Air

Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

EPA-454/R-98-004
August 1998

Quality Assurance Handbook for Air Pollution Measurement Systems

Volume II: Part 1

Ambient Air Quality Monitoring Program Quality System Development

ED_001361_00002624

Foreword

This document represents Volume II of a 5-volume quality assurance (QA) handbook series dedicated to air pollution measurement systems. Volume I provides general QA guidance that is pertinent to the remaining volumes. Volume II is dedicated to the Ambient Air Quality Surveillance Program and the data collection activities of that program.

The intent of the document is twofold. The first is to provide additional information and guidance on the material covered in the Code of Federal Regulations pertaining to the Ambient Air Quality Surveillance Program. The second is to establish a set of consistent QA practices that will improve the quality of the nation's ambient air data and ensure data comparability among sites across the nation. Therefore, the document is written for technical personnel at State and local monitoring agencies and is intended to provide enough information to develop a quality system for ambient air quality monitoring.

The information in this document was revised/developed by many of the organizations implementing the Ambient Air Quality Surveillance Program. Therefore, the guidance has been peer reviewed and accepted by these organizations and should serve to provide consistency among the organizations collecting and reporting ambient air data.

This document has been written in a style similar to a QA project plan, as specified in the document "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations" (EPA QA/R5). Earlier versions of the Handbook contained many of the sections required in EPA QA/R5 and since many State and local agencies, as well as the EPA, are familiar with these elements, it was felt that the document would be more readable in this format.

This document is available on hardcopy as well as accessible as a PDF file on the Internet under the Ambient Monitoring Technical Information Center (AMTIC) Homepage (http://www.epa.gov/ttn/amtic). The document can be read and printed using Adobe Acrobat Reader software, which is freeware that is available from many Internet sites (including the EPA web site). The Internet version is write-protected and will be updated every three years. It is recommended that the Handbook be accessed through the Internet. AMTIC will provide information on updates to the Handbook. Hardcopy versions are available by writing or calling:

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Recommendations for modifications or revisions are always welcome. Comments should be sent to the appropriate Regional Office points of contact identified on AMTIC bulletin board. The Handbook Steering Committee plans on meeting quarterly to discuss any pertinent issues or proposed changes.

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State and Local Organizations

Douglas Tubbs, Ventura County APCD, Ventura, CA
Michael Warren, California Office of Emergency Services, Sacramento, CA
Alice Westerinen, California Air Resources Board, Sacramento, CA
Charles Pieteranin, New Jersey Department of Environmental Protection, Trenton, NJ

EPA Regions

Region
1 Norman Beloin, Mary Jane Cuzzupe
2 Clinton Cusick, Marcus Kantz
3 Victor Guide, Theodore Erdman
4 Dennis Mikel, Jerry Burger, Chuck Padgett
5 Gordon Jones
6 Kuenja Chung
7 Doug Brune
8 Richard Edmonds, Ron Heavner, Gordan MacRae, Joe Delwiche
9 Manny Aquitania, Bob Pallarino
10 Laura Castrilli

National Exposure Research Laboratory

William Mitchell, Frank McElroy, David Gemmill

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Jim Flanagan, Cynthia Salmons

Office of Air Quality Planning and Standards

Joseph Elkins, David Musick , Joann Rice, Shelly Eberly

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Acronyms and Abbreviations

AIRS	Aerometric Information Retrieval System
ADBA	AIRS data base administrator
AMTIC	Ambient Monitoring Technical Information Center
APTI	Air Pollution Training Institute
AQSSD	Air Quality Strategies and Standards Division
AWMA	Air and Waste Management Association
CAA	Clean Air Act
CBI	confidential business information
CFR	Code of Federal Regulations
CMD	Contracts Management Division
CO	Contracting Officer
CSA	consolidated statistical area
DCO	Document Control Officer
DD	Division Director
DQA	data quality assessment
DQAO	Deputy QA Officers
DQOs	data quality objectives
EDO	environmental data operation
EMAD	Emissions, Monitoring, and Analysis Division
EPA	Environmental Protection Agency
EPAAR	EPA Acquisition Regulations
ESD	Emission Standards Division
ETSD	Enterprise Technology Services Division
FAR	Federal Acquisition Regulations
FEM	Federal Equivalent Method
FIPS	Federal Information Processing Standards
FRM	Federal Reference Method
GIS	geographical information systems
GLP	good laboratory practice
HAP	hazardous air pollutants
IAG	interagency agreement
IDP	Individual Development Plans
IT	information technology
ITPID	Information Transfer and Program Integration Division
LAN	local area network
MACT	Maximum Achievable Control Technology
MQAG	Monitoring and Quality Assurance Group
MQOs	measurement quality objectives
MPA	monitoring planning area
MSA	metropolitan statistical area
MSR	management system review
NAAQS	National Ambient Air Quality Standards
NAMS	national air monitoring station
NECMSA	New England county metropolitan statistical area
NESHAP	National Emission Standards for Hazardous Air Pollutants
NIST	National Institute of Standards and Technology
NPAP	National Performance Audit Program
NSPS	New Source Performance Standard
OAQPS	Office of Air Quality Planning and Standards
OARM	Office of Administration and Resources Management
OIRM	Office of Information Resources Management

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OMB	Office of Management and Budget
ORD	Office of Research and Development
PAMS	Photochemical Assessment Monitoring Stations
P&A	precision and accuracy
PC	personal computer
PE	performance evaluation
PR	procurement request
PMSA	primary metropolitan statistical area
PSD	Prevention of Significant Deterioration
PDW	primary wind direction
QA	quality assurance
QA/QC	quality assurance/quality control
QAARWP	quality assurance annual report and work plan
QAD	EPA Quality Assurance Division
QAM	quality assurance manager
QAO	quality assurance officer
QAPP	quality assurance project plan
QMP	quality management plan
RCRA	Resource Conservation and Recovery Act
SAMWG	Standing Air Monitoring Workgroup
SCG	Source Characterization Group
SIPS	State Implementation Plans
SIRMO	servicing information resources management officer
SLAMS	state and local monitoring stations
SOP	standard operating procedure
SOW	statement or scope of work
SPMS	special purpose monitoring stations
SYSOP	system operator
TSA	technical system audit
TSP	total suspended solids
VOC	volatile organic compound
WAM	Work Assignment Manager

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0. Introduction

0.1 Intent of the Handbook

This document is Volume II of a 5-volume quality assurance (QA) handbook series dedicated to air pollution measurement systems. Volume I provides general QA guidance that is pertinent to the four remaining volumes. Volume II is dedicated to the Ambient Air Quality Surveillance Program and the data collection activities of that program. This guidance is one element of a quality management system whose goal is to ensure that the Ambient Air Quality Surveillance Program provides data of a quality that meets the program objectives and is implemented consistently across the Nation.

The intent of the Handbook is twofold. First, the document is written for technical personnel at State and local monitoring agencies to assist them in developing and implementing a *quality system* for the Ambient Air Quality Surveillance Program. A quality system, as defined by *The American National Standard-Specifications and Guidelines for Environmental Data Collection and Environmental Technology Programs*[9], is "a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan for ensuring the quality in its work processes, products, and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance (QA) and quality control (QC)". An organizations quality system for the Ambient Air Quality Surveillance Program is described in their QA project plan. Second, the Handbook provides additional information and guidance on the material covered in the Code of Federal Regulations (CFR) pertaining to the Ambient Air Quality Surveillance Program.

Based on the intent, the first part of the Handbook has been written in a style similar to a QA project plan as specified in the draft *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA QA/R5)*[34]. Earlier versions of the Handbook contained many of the sections required in *QA/R5* and because many State and local agencies, as well as EPA, are familiar with these elements, it was felt that the Handbook would be more readable in this format. The information can be used as guidance in the development of detailed quality assurance project plans for State and local monitoring operations.

Earlier versions of the Handbook focused on the six criteria pollutants monitored at the State and Local Ambient Monitoring Stations (SLAMS) and National Ambient Monitoring Stations (NAMS). This edition includes quality assurance guidance for the Photochemical Assessment Monitoring Stations (PAMS), open path monitoring and the fine particulate standard ($PM_{2.5}$). The majority of the PAMS and open path information are derived from the *Photochemical Assessment Monitoring Stations Implementation Manual* and the *Network Design, Siting, and Quality Assurance Guidelines for the Ultraviolet Absorption Spectrometer (UV-DOS) Open Path Analyzer* respectively.

0.2 Handbook Structure

The document has been segregated into two parts. Part 1 includes general guidance pertaining to the development and implementation of a quality system (based upon *QA/R5*), and Part 2 includes the methods, grouped by pollutant, and written as guidance for the preparation of standard operating procedures.

0.3 Shall, Must, Should and May

This Handbook uses the accepted definitions of *shall, must*, *should* and *may,* as defined in *ANSI/ASQC E4-1994*[9]*:*

- *shall, must* When the element and deviation from specification will constitute non-conformance with 40 CFR and the Clean Air Act
- *should* when the element is recommended
- *may* when the element is optional or discretionary

0.4 Handbook Review and Distribution

The information in this Handbook was revised and/or developed by many of the organizations implementing the Ambient Air Quality Surveillance Program (see Acknowledgments). It has been peer-reviewed and accepted by these organizations and serves to provide consistency among the organizations collecting and reporting ambient air data.

This Handbook is accessible as a PDF file on the Internet under the AMTIC Homepage:

[http://www.epa.gov/ttn/amtic]

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Recommendations for modifications or revisions are always welcome. Comments should be sent to the appropriate Regional Office Ambient Air Monitoring contact or posted on AMTIC. The Handbook Steering Committee will meet quarterly to discuss any pertinent issues and proposed changes.

1. Program Organization

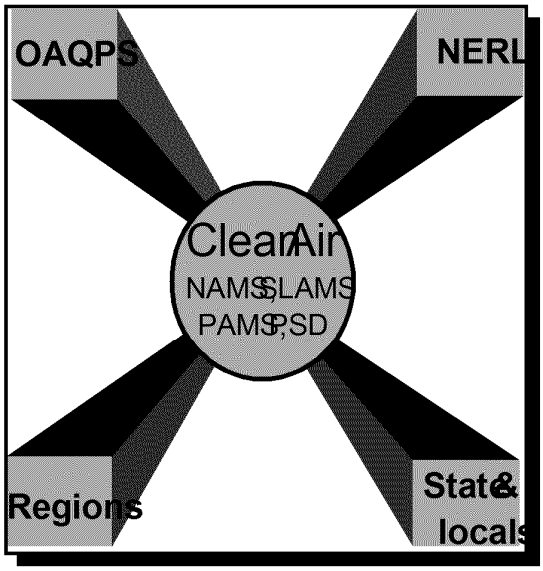

Figure 1.1 Ambient Air Program Organization

Federal, State, Tribal and local agencies all have important roles in developing and implementing satisfactory air monitoring programs. EPA's responsibility, under the Clean Air Act (CAA) as amended in 1990, includes: setting National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to the public health and environment; ensuring that these air quality standards are met or attained (in cooperation with States) through national standards and strategies to control air emissions from sources; and ensuring that sources of toxic air pollutants are well controlled. Within the area of quality assurance, the EPA is responsible for developing the necessary tools and guidance so that State and local agencies can effectively implement their monitoring and QA programs. Figure 1.1 represents the primary organizations responsible for the Ambient Air Quality Monitoring Program. The responsibilities of each organization follow.

1.1 Organization Responsibilities

1.1.1 Office of Air Quality Planning and Standards (OAQPS)

OAQPS is the organization charged under the authority of the CAA to protect and enhance the quality of the nation's air resources. OAQPS sets standards for pollutants considered harmful to public health or welfare and, in cooperation with EPA's Regional Offices and the States, enforces compliance with the standards through state implementation plans (SIPs) and regulations controlling emissions from stationary sources. OAQPS evaluates the need to regulate potential air pollutants and develops national standards; works with State and local agencies to develop plans for meeting these standards; monitors national air quality trends and maintains a database of information on air pollution and controls; provides technical guidance and training on air pollution control strategies; and monitors compliance with air pollution standards.

Within the OAQPS Emissions Monitoring and Analysis Division, the Monitoring and Quality Assurance Group (MQAG) is responsible for the oversight of the Ambient Air Quality Monitoring Network. MQAG has the responsibility to:

- ensure that the methods and procedures used in making air pollution measurements are adequate to meet the programs objectives and that the resulting data are of satisfactory quality
- operate the National Performance Audit Program (NPAP)
- evaluate the performance of organizations making air pollution measurements of importance to the regulatory process
- implement satisfactory quality assurance programs over EPA's Ambient Air Quality Monitoring Network

- ensure that guidance pertaining to the quality assurance aspects of the Ambient Air Program are written and revised as necessary
- render technical assistance to the EPA Regional Offices and air pollution monitoring community

In particular to this Handbook, OAQPS will be responsible for:

- coordinating the Steering Committee responsible for continued improvement of the Handbook
- seeking resolution on Handbook issues
- incorporating agreed upon revisions into the Handbook
- reviewing and revising (if necessary) the Handbook (Vol II) every three years

Specific MQAG leads for the various QA activities (e.g, precision and accuracy, training, etc.) can be found within the OAQPS Homepage on the Internet (http://www.epa.gov/oar/oaqps/qa/)and on the AMTIC Bulletin Board under "Points of Contact (QA/QC contacts)"

1.1.2 EPA Regional Offices

EPA Regional Offices have been developed to address environmental issues related to the states within their jurisdiction and to administer and oversee regulatory and congressionally mandated programs.

The major quality assurance responsibilities of EPA's Regional Offices in regards to the Ambient Air Quality Program are the coordination of quality assurance matters between the various EPA offices and the State and local agencies. This role requires that the Regional Offices make available to the State and local agencies the technical and quality assurance information developed by EPA Headquarters and make known to EPA Headquarters the unmet quality assurance needs of the State and local agencies. Another very important function of the Regional Office is the evaluation of the capabilities of State and local agency laboratories to measure the criteria air pollutants. These reviews are accomplished through network reviews and technical systems audits whose frequency is addressed in the Code of Federal Regulations. To be effective in these roles, the Regional Offices must maintain their technical capabilities with respect to air pollution monitoring.

Specific responsibilities as it relates to the Handbook include:

- serving as a liaison to the State and local reporting agencies for their particular Region
- serving on the Handbook Steering Committee
- fielding questions related to the Handbook
- reporting issues that would require Steering Committee attention
- serving as a reviewer of the Handbook and participating in its revision

1.1.3 State and Local Agencies

40 CFR Part 58 defines a State Agency as "the air pollution control agency primarily responsible for the development and implementation of a plan (SIP) under the Act (CAA)". Section 302 of the CAA provides a more detailed description of the air pollution control agency.

40 CFR Part 58 defines the Local Agency as "any local government agency, other than the state agency, which is charged with the responsibility for carrying out a portion of the plan (SIP).

The major responsibility of State and local agencies is the implementation of a satisfactory monitoring program, which would naturally include the implementation of an appropriate quality assurance program. It is the responsibility of State and local agencies to implement quality assurance programs in all phases of the data collection process, including the field, their own laboratories, and in any consulting and contractor laboratories which they may use to obtain data.

Specific responsibilities as it relates to the Handbook include:

- serving as a representative for the State and local agencies on the Handbook Steering Committee
- assisting in the development of QA guidance for various sections
- reporting issues and comments to Regional Contacts or on the AMTIC Bulletin Board

1.1.4 Reporting Organizations

40 CFR Part 58 Appendix A defines a reporting organization as "a State, subordinate organization within a State, or other organization that is responsible for a set of stations that monitor the same pollutant and for which precision or accuracy assessments can be pooled. States must define one or more reporting organization for each pollutant such that each monitoring station in the State SLAMS network is included in one, and only one, reporting organization." Common factors that should be considered by States in defining a reporting organization include:

1. operation by a common team of field operators,
2. common calibration facilities,
3. oversight by a common quality assurance organization, and
4. support by a common laboratory or headquarters.

Reporting organizations are used as one level of aggregation in the evaluation of quarterly and yearly data quality assessments of precision, bias and accuracy.

1.1.5 National Exposure Research Laboratory (NERL)

The mission of NERL is to develop scientific information and assessment tools to improve the Agency's exposure/risk assessments, identify sources of environmental stressors, understand the transfer and transformation of environmental stressors, and develop multi-media exposure models. The NERL provides the following activities:

- develops, improves, and validates methods and instruments for measuring gaseous, semi-volatile, and non-volatile pollutants in source emissions and in ambient air
- supports multi-media approaches to assessing human exposure to toxic contaminated media through development and evaluation of analytical methods and reference materials, and provides analytical and method support for special monitoring projects for trace elements and other inorganic and organic constituents and pollutants
- develops standards and systems needed for assuring and controlling data quality
- assesses whether emerging methods for monitoring criteria pollutants are "equivalent" to accepted Federal Reference Methods and are capable of addressing the Agency's research and regulatory objectives
- provides an independent audit and review function on data collected by NERL or other appropriate clients

Historically, NERL was responsible for the development and maintenance of all five volumes of the Handbook and will continue to assist in the following activities for Handbook Volume II:

- serving on the Steering Committee
- providing overall guidance
- participating in the Handbook review process
- developing and submitting new methods including the appropriate QA/QC

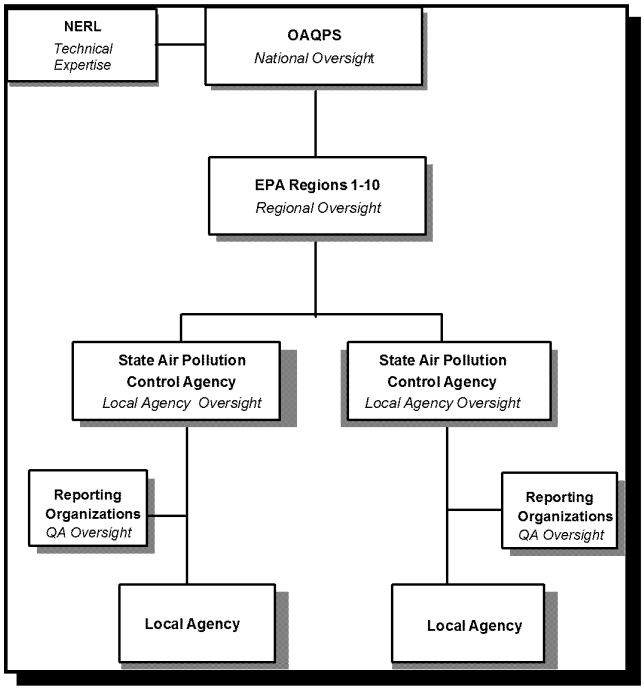

Figure 1.2 Lines of communication

1.2 Lines of Communication

In order to maintain a successful Ambient Air Quality Monitoring Program, effective communication is essential. Figure 1.2 illustrates the lines of communication between the different organizations responsible for this program. The figure represents a general model. Specific lines of communication within an EPA Region may be different as long as it is understood and maintained among all air monitoring organizations. Lines of communication will ensure that decisions can be made at the most appropriate levels in a more time-efficient manner. It also means that each organization in this structure must be aware of the regulations governing the Ambient Air Quality Monitoring Program. Any issues that require a decision, especially in relation to the quality of data, or the quality system, should follow this line. At times, it is appropriate to obtain information from a level higher than the normal lines of communication, as shown by the dashed line from a local agency to the EPA Regional Office. This is appropriate as long as decisions are not made during these information seeking communications. If important decisions are made at various locations along the line, it is important that the information is disseminated in all directions in order that improvements to the quality system can reach all organizations in the Program. Nationwide communication will be accomplished through AMTIC and the subsequent revisions to this Handbook.

1.3 The Handbook Steering Committee

The Handbook Steering Committee is made up of representatives from following four entities in order to provide representation at the Federal, State and local level:

- **OAQPS-** OAQPS is represented by the coordinator for the Handbook and other representatives of the Ambient Air Quality Monitoring QA Team.
- **Regions-** A minimum of 1 representative from each EPA Regional Office.
- **NERL -** A minimum of one representative. NERL represents historical knowledge of the Handbook series as well as the expertise in the reference and equivalent methods program and QA activities.
- **SAMWG -** A minimum of three members from SAMWG who represent State and local air monitoring organizations.

The mission of the committee is to provide a mechanism to meet the goals of the Handbook; which are to provide guidance on quality assurance techniques that can help to ensure that data meet the Ambient Air Quality Monitoring Program objectives and to ensure data comparability across the Nation.

The Steering Committee will meet quarterly to discuss emerging ambient air monitoring issues that have the potential to effect the Handbook. Issues may surface from comments made by State and local agencies to Regional liaisons, AMTIC bulletin board comments, or the development/revision of regulations. The committee will also attempt to meet on an annual basis at a relevant national air meeting. This will provide another forum to elicit comments and suggestions from agencies implementing ambient air monitoring networks.

2. Program Background

2.1 Ambient Air Quality Monitoring Network.

The purpose of this section is to describe the general concepts for establishing the Ambient Air Quality Monitoring Network. The majority of this material as well as additional details can be found in the CAA, 40 CFR Part 58[24] and their references.

Between the years 1900 and 1970, the emission of six principal pollutants increased significantly. The principal pollutants, also called criteria pollutants are: particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead. In 1970 the CAA was signed into law. The CAA and its amendments provides the framework for all pertinent organizations to protect air quality.

As illustrated in Figure 2.1, air quality samples are generally collected for one or more of the following objectives:

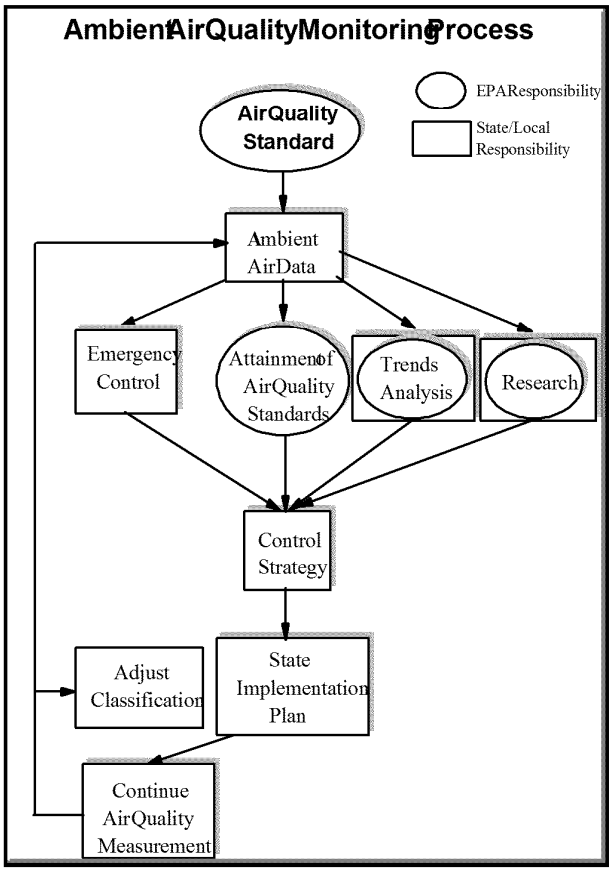

Figure 2.1 Ambient air quality monitoring process

- to judge compliance with and/or progress made towards meeting ambient air quality standards
- to activate emergency control procedures that prevent or alleviate air pollution episodes as well as develop long term control strategies
- to observe pollution trends throughout the region, including non-urban areas
- to provide a data base for research and evaluation of effects: urban, land-use, and transportation planning; development and evaluation of abatement/control strategies; and development and validation of diffusion models

With the end use of the air quality samples as a prime consideration, the network should be designed to:

1. determine the highest concentrations expected to occur in the area covered by the network;
2. determine representative concentrations in areas of high population density;
3. determine the impact on ambient pollution levels of significant sources or source categories;
4. determine the general background concentration levels;

5. determine the extent of regional pollutant transport among populated areas, and in support of secondary standards; and
6. determine the welfare-related impacts in more rural and remote areas (such as visibility impairment and effects on vegetation)

These six objectives indicate the nature of the samples that the monitoring network will collect and will be used during the development of data quality objectives (Section 3). As one reviews the objectives, it becomes apparent that it will be rare that sites can be located to meet more than two or three objectives. Therefore, each organization needs to prioritize their objectives in order to choose the sites that are most representative of that objective and will provide data of adequate quality.

Through the process of implementing the CAA, a number of ambient air quality monitoring networks have been developed. The EPA's Ambient Air Quality Monitoring Program is carried out by State and local agencies and consists of four major categories of monitoring stations or networks that measure the criteria pollutants. These stations are described below.

State and Local Air Monitoring Stations (SLAMS)

The SLAMS consist of a network of ~ 4,000 monitoring stations whose size and distribution is largely determined by the needs of State and local air pollution control agencies to meet their respective state implementation plan (SIP) requirements. The SIPs provide for the implementation, maintenance, and enforcement of the national ambient air quality standards (NAAQS) in each air quality control region within a state.

National Air Monitoring Stations (NAMS)

The NAMS (~1,000 stations) are a subset of the SLAMS network with emphasis being given to urban and multi-source areas. In effect, they are key sites under SLAMS, with emphasis on areas of expected maximum concentrations (category A) and stations which combine poor air quality with high population density (category B). Generally, category B monitors would represent larger spatial scales than category A monitors.

Special Purpose Monitoring Stations (SPMS)

Special Purpose Monitoring Stations provide for special studies needed by the State and local agencies to support SIPs and other air program activities. The SPMS are not permanently established and can be adjusted to accommodate changing needs and priorities. The SPMS are used to supplement the fixed monitoring network as circumstances require and resources permit. If the data from SPMS are used for SIP purposes, they must meet all QA and methodology requirements for SLAMS monitoring.

Photochemical Assessment Monitoring Stations (PAMS)

A PAMS network is required in each ozone non-attainment area that is designated serious, severe, or extreme. The required networks will have from two to five sites, depending on the population of the area. There is a phase-in period of one site per year which started in 1994. The ultimate PAMS network could exceed 90 sites at the end of the 5-year phase-in period.

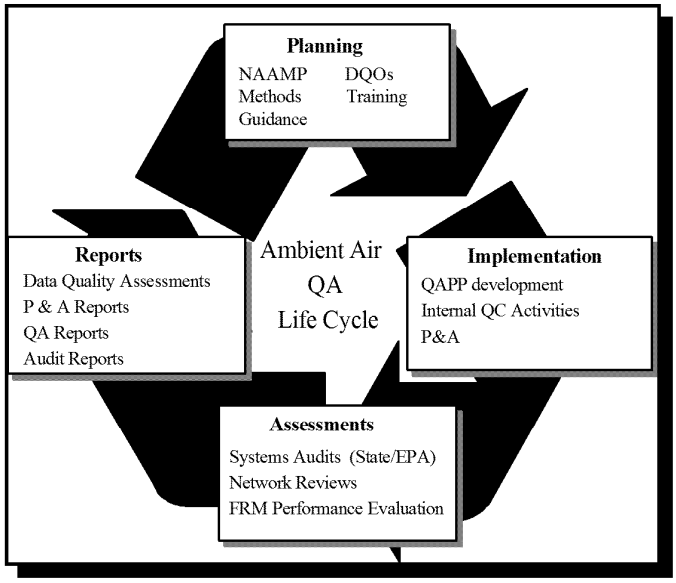

Figure 2.2 Ambient Air Quality Monitoring QA Program

2.2 Ambient Air Monitoring QA Program

Figure 2.2 represents the stages of the Ambient Air Quality Monitoring QA Program. The planning, implementation, assessment and reporting tools will be briefly discussed below.

2.2.1 Planning

Planning activities include:

The National Ambient Air Management Plan (NAAMP) - This is a document that describes how the QA activities that are the responsibility of the EPA Regions and Headquarters will be implemented.

Data Quality Objectives (DQOs) - DQOs are qualitative and quantitative statements derived from the outputs of the DQO Process that: 1) clarify the study objective; 2) define the most appropriate type of data to collect; 3) determine the most appropriate conditions from which to collect the data; and 4) specify tolerable limits on decision errors which will be used as the basis for establishing the quantity and quality of data needed to support the decision. This process is discussed in Section 3.

Methods- Reference methods and measurement principles have been written for each criteria pollutant. Since these methods can not be applied to the actual instruments acquired by each State and local organization, they should be considered as guidance for detailed standard operating procedures that would be developed as part of an acceptable QA project plan.

Training - Training is a part of any good monitoring program. Training activities are discussed in Section 4.

Guidance - This QA Handbook as well as many other guidance documents have been developed for the Ambient Air Quality Monitoring Program. A list of these documents is included in Appendix 2.

2.2.2 Implementation

Implementation activities include:

QA Project Plan (QAPP) Development - Each State and local organization must develop a QAPP. The primary purpose of the QAPP is to provide an overview of the project, describe the need for the measurements, and define QA/QC activities to be applied to the project, all within a single document. The QAPP should be detailed enough to provide a clear description of every aspect of the project and include information for every member of the project staff, including samplers, lab staff, and data reviewers. The QAPP facilitates communication among clients, data users, project staff, management, and external

reviewers. Effective implementation of the QAPP assists project managers in keeping projects on schedule and within the resource budget.

Internal QC Activities - Quality Control (QC) is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; that are used to fulfill requirements for quality[9]. In the case of the Ambient Air Quality Monitoring Network, QC activities are used to ensure that measurement uncertainty is maintained within established acceptance criteria for the attainment of the DQOs.

Federal regulation provides for the implementation of a number of qualitative and quantitative checks to ensure that the data will meet the DQOs. Each of the checks attempts to evaluate phases of measurement uncertainty. Some of these checks are discussed below and in Section 10.

Precision and Accuracy (P & A) Checks - These checks are described in the Code of Federal Regulations[14], as well as a number of sections in this document, in particular, Section 10. These checks can be used to provide an overall assessment of measurement uncertainty.

Zero/Span Checks - These checks provide an internal quality control check of proper operation of the measurement system. These checks are discussed in Section 10 and 12.

Annual Certifications - A certification is the process which ensures the traceability and viability of various QC standards. Standard traceability is the process of transferring the accuracy or authority of a primary standard to a field-usable standard. Traceability protocols are available for certifying a working standard by direct comparison to an NIST-SRM[66 91]. Certification requirements are included in Section 10 as well as the individual methods in Part 2.

Calibrations - Calibrations should be carried out at the field monitoring site by allowing the analyzer to sample test atmospheres containing known pollutant concentrations. Calibrations are discussed in Section 12.

2.2.3 Assessments

Assessment, as defined in *E4*[9], are evaluation processes used to measure the performance or effectiveness of a system and its elements. It is an all inclusive term used to denote any of the following: audit, performance evaluation, management systems review, peer review, inspection, or surveillance. Assessments for the Ambient Air Quality Monitoring Program, as discussed in Section 15, include:

Technical Systems Audits (TSA) -A TSA is an on-site review and inspection of a State or local agency's ambient air monitoring program to assess its compliance with established regulations governing the collection, analysis, validation, and reporting of ambient air quality data. Both EPA and State organizations perform TSAs. Procedures for this audit are included in Appendix 15 and discussed in general terms in Section 16

Network Reviews - The network review is used to determine how well a particular air monitoring network is achieving its required air monitoring objective(s), and how it should be modified to continue to meet its objective(s). Network reviews are discussed in Section 16.

Performance Evaluations- Performance evaluations are a type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst , laboratory, or measurement system. The following performance evaluations are included in the Ambient Air Quality Monitoring Program:

State Performance Evaluations (Audits) - These performance evaluation audits are used to provide an independent assessment on the measurement operations of each instrument by comparing performance samples or devices of "known" concentrations or values to the values measured by the instrument. This audit is discussed in Section 16.

NPAP - The goal of the NPAP is to provide audit material and devices that will enable EPA to assess the proficiency of agencies who are operating monitors in the SLAMS, NAMS, PAMS and PSD networks. NPAP samples or devices of "known" concentration or values, but unknown to the audited organization, are compared to the values measured by the audited instrument. This audit is discussed in Section 16.

$PM_{2.5}$ Federal Reference Method (FRM) Performance Evaluation -The FRM Performance Evaluation is a quality assurance activity which will be used to evaluate measurement system bias of the $PM_{2.5}$ monitoring network. The pertinent regulations for this performance evaluation are found in 40 CFR Part 58, Appendix A[14]. The strategy is to collocate a portable FRM $PM_{2.5}$ air sampling instrument with an established routine air monitoring instrument, operate both monitors in exactly the same manner and then compare the results of this instrument against the routine sampler at the site. This evaluation is discussed in Section 16.

2.2.4 Reports

All concentration data will require data assessments to evaluate the attainment of the DQOs, and reports of these assessments or reviews. The following types of reports, as discussed in Section 16, should include:

Data quality assessment (DQA) -is the scientific and statistical evaluation to determine if data are of the right type, quality and quantity to support their intended use (DQOs). QA/QC data can be statistically assessed at various levels of aggregation to determine whether the DQOs have been attained. Data quality assessments of precision, bias and accuracy can be aggregated at the following three levels.

- **Monitor-** monitor/method designation
- **Reporting Organization-** monitors in a method designation, all monitors
- **National** - monitors in a method designation, all monitors

P & A Reports - These reports are generated annually and evaluate the precision and accuracy data against the acceptance criteria discussed in Section 3.

QA Reports - A QA report provides an evaluation of QA/QC data for a given time period to determine whether the data quality objectives were met. Discussions of QA reports can be found in sections 16 and 18.

Meetings and Calls - Various national meetings and conference calls can be used as assessment tools for improving the network. It is important that information derived from the avenues of communication are appropriately documented (annual QA Reports) .

3. Data Quality Objectives

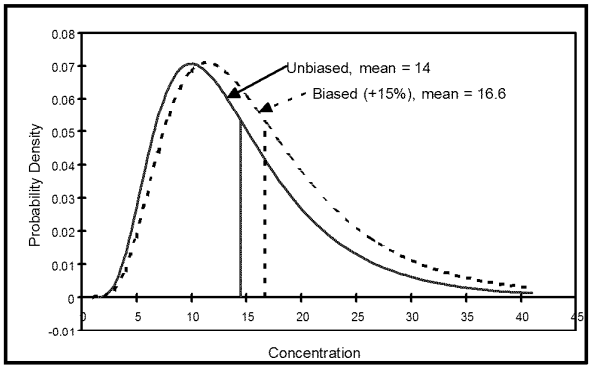

Figure 3.1. Effect of positive bias on the annual average estimate, resulting in a false positive decision error

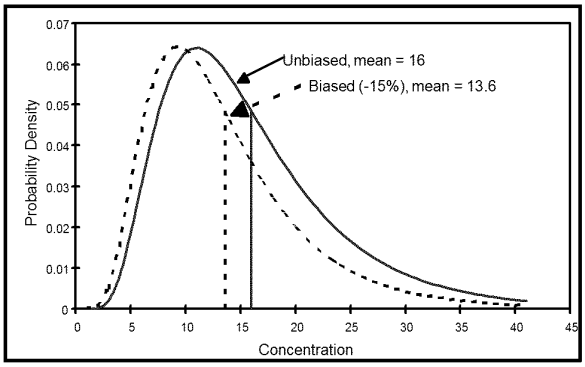

Figure 3.2. Effect of negative bias on the annual average resulting in a false negative decision error

Data collected for the Ambient Air Quality Monitoring Program are used to make very specific decisions that can have an economic impact on the area represented by the data. Data quality objectives (DQOs) are a full set of performance constraints needed to design an environmental data operation (EDO), including a specification of the level of uncertainty that a decision maker (data user) is willing to accept in the data to which the decision will apply. Throughout this document, the term *decision maker* is used. This term represents individuals that are the ultimate users of ambient air data and therefore may be responsible for: setting the NAAQS, developing a quality system, evaluating the data, or declaring an area nonattainment. The DQO will be based on the data requirements of the decision maker. Decision makers need to feel confident that the data used to make environmental decisions are of adequate quality. The data used in these decisions are never error free and always contain some level of uncertainty. Because of these uncertainties or errors, there is a possibility that decision makers may declare an area "nonattainment" when the area is actually in "attainment" (false positive error) or "attainment" when actually the area is in "nonattainment" (false negative error). Figures 3.1 and 3.2 illustrate how false positive and negative errors can affect a NAAQS attainment/nonattainment decision based on an annual mean concentration value of 15. There are serious political, economic and health consequences of making such decision errors. Therefore, decision makers need to understand and set limits on the probabilities of making incorrect decisions with these data.

In order to set probability limits on decision errors, one needs to understand and control uncertainty. Uncertainty is used as a generic term to describe the sum of all sources of error associated with an EDO. Uncertainty can be illustrated as follows:

$$S_o^2 = S_p^2 + S_m^2 \qquad \text{(equation 1)}$$

Where:

S_o= overall uncertainty
S_p= population uncertainty (spatial and temporal)
S_m= measurement uncertainty (data collection)

The estimate of overall uncertainty is an important component in the DQO process. Both population and measurement uncertainties must be understood.

Population uncertainties - The most important data quality attribute of any ambient air monitoring network is representativeness. This term refers to the degree in which data accurately and precisely represent a characteristic of a population, parameter variation at a sampling point, a process condition, or an environmental condition[9]. Population uncertainty, the spatial and temporal components of error, can effect representativeness. These uncertainties can be controlled through the selection of appropriate boundary conditions (the area and the time period) to which the decision will apply, and the development of a proper statistical sampling design (see Section 6). Appendix H of the QAD document titled *EPA Guidance for Quality Assurance Project Plans*[32] provides a very good dissertation on representativeness. It does not matter how precise or unbiased the measurement values are if a site is unrepresentative of the population it is presumed to represent. Assuring the collection of a representative air quality sample depends on the following factors:

- selecting a network size that is consistent with the monitoring objectives and locating representative sampling sites
- determining restraints on the sampling sites that are imposed by meteorology, local topography, emission sources, and the physical constraints and documenting these
- planning sampling schedules that are consistent with the monitoring objectives

Measurement uncertainties are the errors associated with the EDO, including errors associated with the field, preparation and laboratory measurement phases. At each measurement phase, errors can occur, that in most cases, are additive. The goal of a QA program is to control measurement uncertainty to an acceptable level through the use of various quality control and evaluation techniques. In a resource constrained environment, it is most important to be able to calculate/evaluate the total measurement system uncertainty (S_m) and compare this to the DQO. If resources are available, it may be possible to evaluate various phases (field, laboratory) of the measurement system.

Three data quality indicators are most important in determining total measurement uncertainty:

- **Precision** - a measure of mutual agreement among individual measurements of the same property usually under prescribed similar conditions. This is the random component of error. Precision is estimated by various statistical techniques using some derivation of the standard deviation.

- **Bias** - the systematic or persistent distortion of a measurement process which causes error in one direction. Bias will be determined by estimating the positive and negative deviation from the true value as a percentage of the true value.

- **Detectability** - The determination of the low range critical value of a characteristic that a method specific procedure can reliably discern.

Accuracy has been a term frequently used to represent closeness to "truth" and includes a combination of precision and bias error components. This term has been used throughout the CFR and in some of the sections of this document. If possible, it is recommended that an attempt be made to distinguish measurement uncertainties into precision and bias components.

3.1 The DQOs Process

The DQO process is used to facilitate the planning of EDOs. It asks the data user to focus their EDO efforts by specifying the use of the data (the decision), the decision criteria, and the probability they can accept making an incorrect decision based on the data. The DQO process:

- establishes a common language to be shared by decision makers, technical personnel, and statisticians in their discussion of program objectives and data quality
- provides a mechanism to pare down a multitude of objectives into major critical questions
- facilitates the development of clear statements of program objectives and constraints which will optimize data collection plans
- provides a logical structure within which an iterative process of guidance, design, and feedback may be accomplished efficiently

The DQO process contains the following steps:

- the problem to be resolved
- the decision
- the inputs to the decision
- the boundaries of the study
- the decision rule
- the limits on uncertainty
- study design optimization

The DQO Process is fully discussed in the document titled *Guidance for the Data Quality Objectives Process EPA QA/G4*[39], and is available on the EPA QA Division Homepage *(http://es.epa.gov/ncerqa/qa /)*. The EPA QA Division also provides a software program titled*Data Quality Objectives (DQO) Decision Error Feasibility Trials (DEFT)*. This software can help individuals develop appropriate sampling designs based upon the outputs of the DQO Process.

3.2 Ambient Air Quality DQOs

As indicated above, the first step in the DQO process is to identify the problems that need to be resolved. The objectives (problems) of the Ambient Air Quality Monitoring Program as mentioned in Section 2 are:

1. To judge compliance with and/or progress made towards meeting the NAAQS.
2. To activate emergency control procedures that prevent or alleviate air pollution episodes as well as develop long term control strategies.
3. To observe pollution trends throughout the region, including non-urban areas.
4. To provide a data base for research and evaluation of effects: urban, land-use, and transportation planning; development and evaluation of abatement/control strategies; and development and validation of diffusion models.

These different objectives could potentially require different DQOs, making the development of DQOs complex. However, if one were to establish DQOs based upon the objective requiring the most stringent data quality requirements, one could assume that the other objectives could be met. Therefore, the DQOs have been initially established based upon ensuring that decision makers can make attainment/nonattainment decisions in relation to the NAAQS within a specified degree of certainty.

Appendix 3 will eventually contain information on the DQO process for each criteria pollutant. Since the Ambient Air Quality Monitoring Network was established prior to the development of the DQO Process, a different technique was used to establish data quality acceptance levels[27]. Therefore, all criteria pollutants are being reviewed in order to establish DQOs using the current DQO process.

3.3 Measurement Quality Objectives

Once a DQO is established, the quality of the data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. Measurement quality objectives are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. MQOs can be defined in terms of the following data quality indicators:

Precision - defined above

Bias - defined above.

Representativeness - defined above

Detectability- defined above

Completeness - a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions. Data completeness requirements are included in the reference methods (40 CFR Pt. 50).

Comparability - a measure of confidence with which one data set can be compared to another.

For each of these attributes, acceptance criteria can be developed for various phases of the EDO. Various parts of 40 CFR [21-24] have identified acceptance criteria for some of these attributes. In theory, if these MQOs are met, measurement uncertainty should be controlled to the levels required by the DQO. Tables of the most critical MQOs can be developed. Table 3-1 is an example of an MQO table for carbon monoxide. MQO tables for the remaining criteria pollutants can be found in Appendix 3.

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Table 3-1 Measurement Quality Objectives - Parameter CO

Measurement Quality Objectives - Parameter CO (Nondispersive Infrared Photometry)				
Requirement	**Frequency**	**Acceptance Criteria**	**Reference**	**Information/Action**
Standard Reporting Units	All data	ppm	40 CFR, Pt 50.8	
Shelter Temperature **Temperature range** **Temperature control**	 Daily Daily	 20 to 30 C. < ± 2 C	40 CFR, Pt. 53.20 Vol II, S 7.1 [1/]	Instruments designated as reference or equivalent have been tested over this temperature range. Maintain shelter temperature above sample dewpoint. Shelter should have a 24- hour temperature recorder. Flag all data for which temperature range or fluctuations are outside acceptance criteria.
Equipment CO analyzer Flow controllers Flowmeters	 Purchase specification	 Reference or equivalent method Flow rate regulated to ± 1% Accuracy ± 2%	 40 CFR, Pt 50, App C " "	
Detection Limit Noise Lower detectable level	 Purchase specification	 0.5 ppm 1.0 ppm	 40 CFR, Pt 53.20 & 23 "	Instruments designated as reference or equivalent have been determined to meet these acceptance criteria.
Completeness 8-hour average	hourly	75 % of hourly averages for the 8-hour period	40 CFR, Pt 50.8	
Compressed Gases Dilution gas (zero air) Gaseous standards	 Purchase specification Purchase specification	 < 0.1 ppm CO NIST Traceable (e.g., EPA Protocol Gas)	 40 CFR, Pt 50, App C " EPA-600/R97/12	Return cylinder to supplier. Carbon monoxide in nitrogen or air EPA Protocol Gases have a 36-month certification period and must be recertified to extend the certification.

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Measurement Quality Objectives - Parameter CO (Nondispersive Infrared Photometry)

Requirement	Frequency	Acceptance Criteria	Reference	Information/Action
Calibration				
Multipoint calibration (at least 5 points)	Upon receipt, adjustment, or 1/ 6 months	All points within ± 2% of full scale of best-fit straight line	Vol II, S 12.6 Vol II, MS.2.6.1	Zero gas and at least four upscale calibration points. Points outside acceptance criterion are repeated. If still outside criterion, consult manufacturers manual and invalidate data to last acceptable calibration.
Zero/span check-level 1	1/ 2 weeks	Zero drift ± 2 to 3 ppm Span drift ± 20 to 25 %	Vol II, S 12.6 "	**If calibration updated at each zero/span**, invalidate data to last acceptable check, adjust analyzer, perform multipoint calibration.
		Zero drift ± 1 to 1.5 ppm Span drift ± 15%	Vol II, S 12.6 "	**If fixed calibration used to calculate data**, invalidate data to last acceptable check, adjust analyzer, perform multipoint calibration.
Flowmeters	1/3 months	Accuracy ± 2 %	Vol II, App 12	Flowmeter calibration should be traceable to NIST standards.
Performance Evaluation				
(NPAP)	1/year at selected sites	Mean absolute difference 15%	Vol II, S 16.3	Use information to inform reporting agency for corrective action and technical systems audits
State audits	1 /year	State requirements	Vol II, pp 15, S 3	
Precision				
Single analyzer	½ weeks	None		
Reporting organization	1/3 months	95% CI ± 15%	40 CFR, Pt 58, App A EPA-600/4-83-023 Vol II, App 15, S 5	Concentration = 8 to 10 ppm. Aggregation of a quarters measured precision values.
Accuracy				
Single analyzer	25 % of sites quarterly (all sites yearly)	None	40 CFR, Pt 58, App A	Four concentration ranges. If failure, recalibrate and reanalyze. Repeated failure requires corrective action.
Reporting organization		95% CI ± 20%		

1/ - reference refers to the QA Handbook for Air Pollution Measurement Systems Volume II . The use of "S" refers to sections within the handbook. The use of "MS" refers to sections of the method for the particular pollutant.

4. Personnel Qualifications, Training and Guidance

4.1 Personnel Qualifications

Personnel assigned to ambient air monitoring activities are expected to have met the educational, work experience, responsibility, personal attributes and training requirements for their positions. In some cases, certain positions may require certification and or recertification. These requirements should be outlined in the position advertisement and in personal position descriptions. Records on personnel qualifications and training should be maintained and should be accessible for review during audit activities. These records should be retained as described in Section 5.

4.2 Training

Adequate education and training are integral to any monitoring program that strives for reliable and comparable data. Training is aimed at increasing the effectiveness of employees and their organization. As part of a quality assurance program, 40 CFR Part 58 App A[14] requires the development of operational procedures for training. These procedures should include information on:

- personnel qualifications- general and position specific
- training requirements - by position
- frequency of training

Appropriate training should be available to employees supporting the Ambient Air Quality Monitoring Program, commensurate with their duties. Such training may consist of classroom lectures, workshops, teleconferences and on-the-job training.

4.2.1 Suggested Training

Over the years, a number of courses have been developed for personnel involved with ambient air monitoring and quality assurance aspects. Formal QA/QC training is offered through the following organizations:

- Air Pollution Training Institute (APTI) *http://www.epa.gov/oar/oaq.apti.html*
- Air & Waste Management Association (AWMA) *http://www2.awma.org*
- American Society for Quality Control (ASQC) *http://www.asqc.org/products/educat.html*
- EPA Institute
- EPA Quality Assurance Division (QAD) *http://es.epa.gov/ncerqa/qa /*
- EPA Regional Offices

In addition, OAQPS uses contractors and academic institutions to develop and provide training for data collection activities that support regulatory efforts throughout OAQPS, as well as the States and Regions. The OAQPS QA Program maintains a list of available courses.

Table 4-1 provides a suggested sequence of core QA-related ambient air monitoring courses for ambient air monitoring staff, and QA managers (marked by asterisk). The suggested course sequences assume little or no experience in QA/QC or air monitoring. Persons having experience in the subject matter described in the

courses would select courses according to their appropriate experience level. Courses not included in the core sequence would be selected according to individual responsibilities, preferences, and available resources.

Table 4-1. Suggested Sequence of Core QA-related Ambient Air Training Courses for Ambient Air Monitoring and QA Personnel

Sequence	Course Title (SI = self instructional)	Source
1*	Air Pollution Control Orientation Course (Revised), SI:422	APTI
2*	Principles and Practices of Air Pollution Control, 452	APTI
3*	Orientation to Quality Assurance Management	QAD
4*	Introduction to Ambient Air Monitoring (Under Revision 7/98), SI:434	APTI
5*	General Quality Assurance Considerations for Ambient Air Monitoring (Under Revision 9/98), SI:471	APTI
6*	Quality Assurance for Air Pollution Measurement Systems (Under Revision 8/98), 470	APTI
7*	Data Quality Objectives Workshop	QAD
8*	Quality Assurance Project Plan	QAD
9	Atmospheric Sampling (Under Revision 7/98), 435	APTI
10	Analytical Methods for Air Quality Standards, 464	APTI
11	Chain Of Custody Procedures for Samples and Data, SI:443	APTI
*	Data Quality Assessment	QAD
*	Management Systems Review	QAD
*	Beginning Environmental Statistical Techniques (Revised), SI:473A	APTI
*	Introduction to Environmental Statistics, SI:473B	APTI
*	Quality Audits for Improved Performance	AWMA
*	Statistics for Effective Decision Making	ASQC

* Courses recommended for QA Managers

4.3 Regulations and Guidance

Information on the proper implementation of the Ambient Air Quality Monitoring QA Program has been developed at three levels, as indicated in Figure 4.1. The top two levels (shaded) provide standards, regulations and guidance that form the basis for implementation documents for specific projects. A discussion of the information in these levels follow.

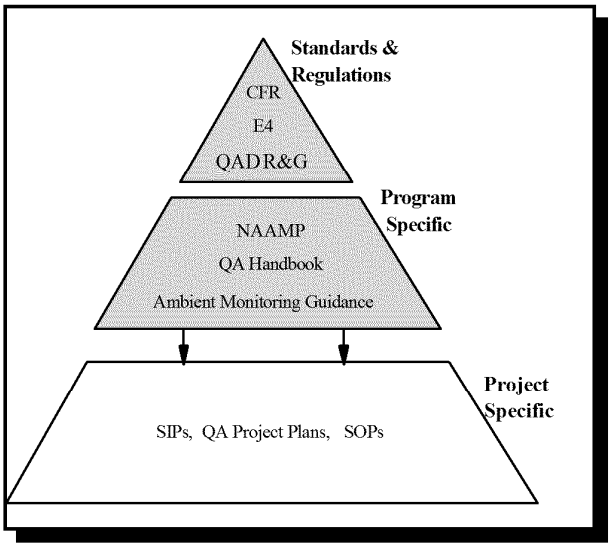

Figure 4.1 Hierarchy of regulations and guidance

4.3.1 Standards and Regulations

At the highest level, standards and regulations determine what QA is required for the monitoring program and therefore sets the stage for program and project specific guidance. The standards and regulations pertinent to the Ambient Air Quality Monitoring Program include:

CFR - The CFR series provides the mandate for monitoring and the minimum requirements for the quality system. It also requires the development of QA Project Plans for any environmental data operations.

E4 - E4 refers to the document *American National Standard-Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs (ANSI/ASQC E4-1994)*[9]. This document describes a basic set of mandatory specifications and non-mandatory guidelines by which a quality system for programs involving environmental data collection can be planned, implemented, and assessed. The EPA QA Order (5360.1 CHG 1) adheres to E4 under the authority of the Office of Management and Budget.

QAD guidance and regulations- QAD refers to the EPA QA Division, the organization within the EPA that is responsible for the "Mandatory QA Program". QAD is responsible for developing QA and QC requirements and for overseeing Agency-wide implementation of the EPA Quality System. QAD has developed a series of regulation/guidance documents that describe how to plan implement and assess environmental data operations. Figure 4.2 describes the documents and the stages in the EDO in which they apply. Many of these documents and can be downloaded from the Internet *(http://es.epa.gov/ncerqa/qa/).*

4.3.2 Program Specific Guidance

Based upon the standards and regulations, the Office of Air Quality Planning and Standards, ORD, and other organizations implementing air monitoring have developed guidance specific to the Ambient Air Quality Monitoring Program. This Handbook provides the majority of the guidance necessary for the State and local agencies to develop QA project plans specific to their data collection needs. Other guidance has been developed specific to a part of the measurement system (i.e., calibration techniques) or to specific methods. A listing of this guidance is included in Appendix 2. It is anticipated that the majority of these documents will be available through the Internet, most likely on the AMTIC bulletin board

4.3.3 Project Specific

The term "project specific" refers to the environmental data operations that occur at each State and local organization operating a monitoring network. An environmental data operation refers to the work performed to obtain, use, or report information pertaining to environmental processes and conditions[9].

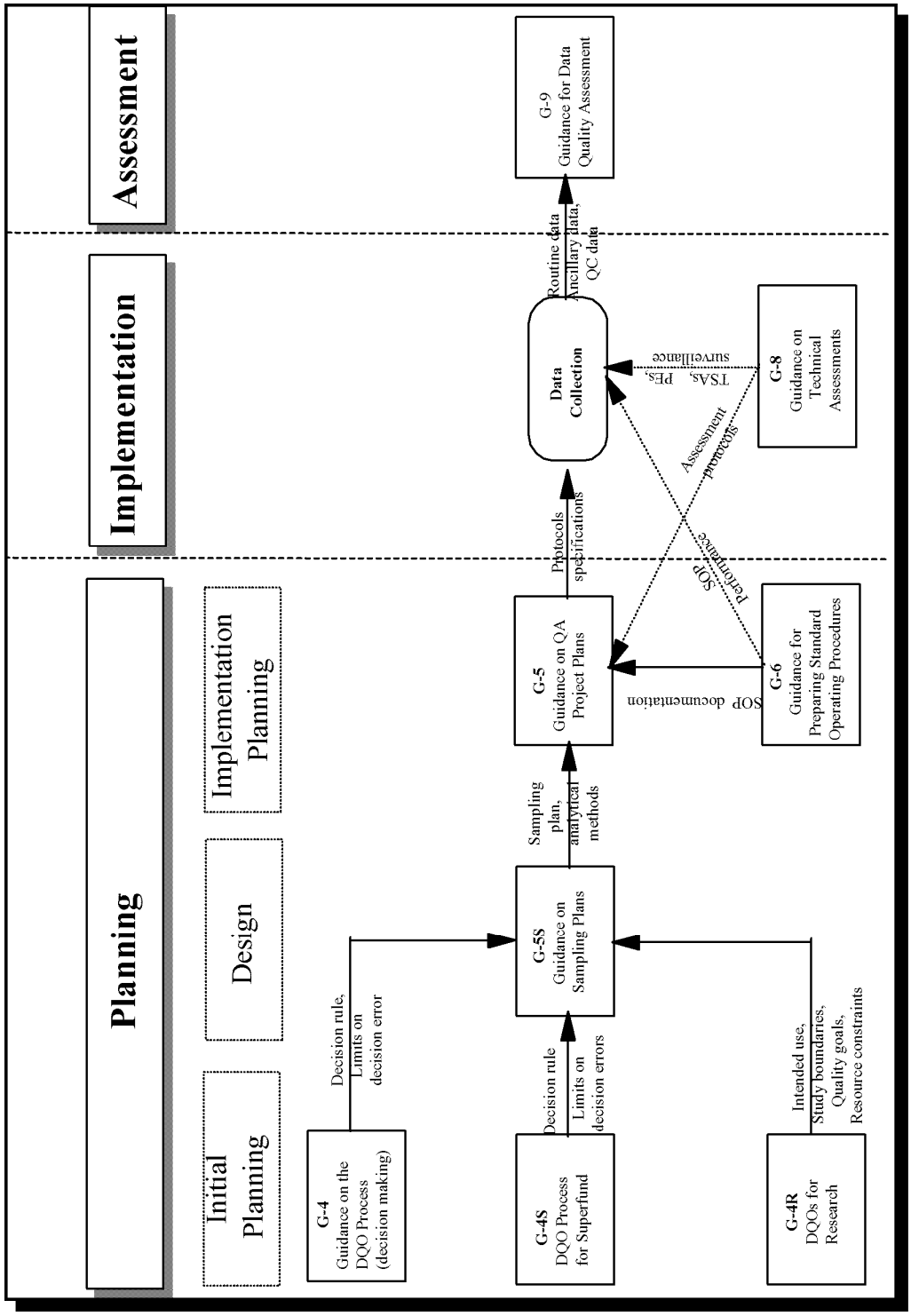

Figure 4.2 EPA QA Division Guidance Documents

5. Documentation and Records

Organizations that perform EDOs and management activities must establish and maintain procedures for the timely preparation, review, approval, issuance, use, control, revision and maintenance of documents and records. A document, from a records management perspective, is a volume that contains information which describes, defines, specifies, reports, certifies, or provides data or results pertaining to environmental programs. As defined in the Federal Records Act of 1950 and the Paperwork Reduction Act of 1995 (now 44 U.S.C. 3101-3107), records are: "...books, papers, maps, photographs, machine readable materials, or other documentary materials, regardless of physical form or characteristics, made or received by an agency of the United States Government under Federal Law or in connection with the transaction of public business and preserved or appropriate for preservation by that agency or its legitimate successor as evidence of the organization, functions, policies, decisions, procedures, operations, or other activities of the Government or because of the informational value of data in them.... " This section will provide guidance of documentation and records for the Ambient Air Quality Monitoring Program.

Table 5-1 Types of Information that Should be Retained Through Document Control

Categories	Record/Document Types
Management and Organization	State Implementation Plan Reporting agency information Organizational structure of monitoring program Personnel qualifications and training Quality management plan Document control plan Support contracts
Site Information	Network description Site characterization file Site maps/pictures
Environmental Data Operations	QA Project Plans Standard operating procedures (SOPs) Field and laboratory notebooks Sample handling/custody records Inspection/maintenance records
Raw Data	Any original data (routine and QC)
Data Reporting	Air quality index report Annual SLAMS air quality information Data/summary reports Journal articles/papers/presentations
Data Management	Data algorithms Data management plans/flowcharts
Quality Assurance	Control charts Data quality assessments QA reports System audits Network reviews

Table 5-1 represents the categories and types of records and documents which are applicable to document control. Information on key documents in each category follow. It should be noted that the list contains documents that may not be applicable to particular organizations and therefore is not meant to be a list of required documentation. This list should also not be construed as the definitive list of record and document types.

Statute of Limitations -

As stated in 40 CFR part 31.42, in general, all information considered as documentation and records should be retained for 3 years from the date the grantee submits its final expenditure report unless otherwise noted in the funding agreement. However, if any litigation, claim, negotiation, audit or other action involving the records has been started before the expiration of the 3-year period, the records must

be retained until completion of the action and resolution of all issues which arise from it, or until the end of the regular 3-year period, whichever is later.

Management and Organization

Documentation for many of the document types listed in Table 5-1 for this category can be found in a single document, a quality management plan, which is a blueprint for how an organizations quality management objectives will be attained. The EPA QA Division provides requirements for quality management plans that State and local organizations may find helpful[33].

Site Information

Site information provides vital data about each monitoring site. Historical site information can help determine and evaluate changes in measurement values at the site. The quality assurance project plan should include specific documentation of site characteristics for each monitoring station. This information will assist in providing objective inputs into the evaluation of data gathered at that site. Typically, the site identification record should include:

1. Data acquisition objective (e.g., air quality standards monitoring).
2. Station type.
3. Instrumentation checklist (manufacturer's model number, pollutant measurement technique, etc.).
4. Sampling system.
5. Spatial scale of the station (site category--i.e., urban/industrial, suburban/commercial, etc.; physical location--i.e., address, AQCR, UTM coordinates, etc.).
6. Influential pollutant sources (point and area sources, proximity, pollutant density, etc.).
7. Topography (hills, valleys, bodies of water, trees; type and size, proximity, orientation, etc. picture of a 360° view from the probe of the monitoring site).
8. Atmospheric exposure (unrestricted, interferences, etc.).
9. Site diagram (sample flowsheet, service lines, equipment configuration, etc.).
10. Site audits.

Environmental Data Operations

A quality assurance program associated with the collection of ambient air monitoring data must include an effective procedure for preserving the integrity of the data. Ambient air test results and, in certain types of tests, the sample itself may be essential elements in proving the compliance status of a facility; that is, it may be necessary to introduce the sample or the test results as evidence in an enforcement proceeding. These will not be admitted as evidence unless it can be shown that they are representative of the conditions that existed at the time that the test was conducted. Therefore, each step in the testing and analysis procedure must be carefully monitored and documented. There are basically four elements in the evidentiary phase of an overall quality assurance program:

1. Data collection - includes testing, preparation and identification of the sample, strip charts, or other data.
2. Sample handling - includes protection from contamination and tampering during transfer between individuals and from the sampling site to the evidence locker (i.e., chain of custody).
3. Analysis - includes storage of samples prior to and after analysis as well as data interpretation.
4. Preparation and filing of test report - includes evidentiary requirements and retention of records.

Failure to include any one of these elements in the collection and analysis of ambient air monitoring data may render the results of the program inadmissible as evidence, or may seriously undermine the credibility of any report based on these data.

Environmental data operations include all the operations required to successfully measure and report a value within the data quality objectives. Documentation for environmental data operations would include:

- **QA Project Plans** - Documents how environmental data operations are planned, implemented, and assessed during the life cycle of a program, project, or task[32,34]. See below.
- **Standard operating procedures (SOPs)-**Written documents that detail the method for an operation, analysis, or action with thoroughly prescribed techniques and steps[42]. See Section 9 and below.
- **Field and laboratory notebooks-** Any documentation that may provide additional information about the environmental data operation (e.g., calibration notebooks, temperature records, site notes, maintenance records etc.). See below
- **Sample handling/custody records-** Records tracing sample handling from the site through analysis, including transportation to facilities, sample storage, and handling between individuals within facilities. Section 12 provides more information on this activity.

Quality Assurance Project Plans--

As mentioned in the assistance agreement sections of 40 CFR parts 30.54 (Non-State an Local Gov.) and 31.45 (State and Local Gov.) quality assurance programs must be established. In addition to the grant requirements, 40 CFR Part 58 Appendix A[14] states that each quality assurance program must be described in detail in accordance with the *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* [34].

Standard operating procedures--

Standard operating procedures are written documents that detail the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. It is officially approved as the method for all routine activities, especially those that are involved in the environmental data operations, which generally involve repetitious operations performed in a consistent manner. SOPs should be written by individuals performing the procedures that are being standardized. Individuals with appropriate training and experience with the process need to review the SOPs, and the SOPs should be approved by the supervisor of the personnel responsible for writing the document. For documentation purposes, the approving official should sign and date the title page of the SOP. More details of SOPs are discussed in Section 9

Field and Laboratory Notebooks--

Manual recording of data are sometimes required for ambient air tests. Standardized forms should be utilized to ensure that all necessary information is obtained. These forms should be designed to clearly identify the process tested, the date and time, location of the test station, and operating personnel. This information may determine the credibility of the data and should not be erased or altered. Any errors should be crossed out with a single line, and the correct value recorded above the crossed-out number.

Do not discard original field records; copies are not normally admissible as evidence. For neatness, the field data may be transcribed or copied for incorporation in a final report, but the originals should be kept on file. Since these records may be subpoenaed, it is important that all field notes be legible.

Raw Data

Raw data includes any original factual information from a measurement activity or study recorded in laboratory work sheets, records, memoranda, notes, or exact copies thereof and that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photographs, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. For automated information systems, raw data is considered the original observations recorded by the information system that are needed to verify, calculate, or derive data that are or may be reported. Organizations should critically review the Ambient Air Quality Monitoring Program and create a list of what the organization considers raw data and provide a means to store this information in a manner that is readily accessible.

Data Reporting

In addition to samples and field records, the report of the analysis itself may serve as material evidence. Just as the procedures and data leading up to the final report are subject to the rules of evidence, so is the report. Written documents, generally speaking, are considered as hearsay, and are not admissible as evidence without a proper foundation. A proper foundation consists of introducing testimony from all persons having anything to do with the major portions of the test and analysis. Thus the field operator, all persons having custody of the samples, and the analyst would be required to lay the foundation for the introduction of the test report as evidence.

To ensure compliance with legal rules, all test reports should be filed in a safe place by a custodian having this responsibility. Although the field notes and calculations are not generally included in the summary report, these materials may be required at a future date to bolster the acceptability and credibility of the report as evidence in an enforcement proceeding. Therefore, the full report including all original notes and calculation sheets should be kept in the file. Signed receipts for all samples, strip charts, or other data, should also be filed.

The original of a document is the best evidence, and a copy is not normally admissible as evidence. Microfilm, snap-out carbon copies, and similar contemporary business methods of producing copies are acceptable in many jurisdictions if unavailability of the original is adequately explained and if the copy was made in the ordinary course of business.

In summary, although all original calculations and test data need not be included in the final report, they should be kept in the agency's files. It is a good rule to file all reports together in a secure place. Keeping these documents under lock and key will ensure that the author can testify at future court hearings that the report has not been altered.

Data Management

Much of the data collected for the Ambient Air Quality Monitoring Program will be collected through the use of automated systems. These systems must be effectively managed and documented by using a set of

guidelines and principles by which adherence will ensure data integrity. Discussions of data management activities and the requirements for documentation can be found in section 15.

Quality Assurance

Quality assurance information is necessary to document the quality of data. This information should be retained in a manner that it can be associated with the routine data that it represents. QA Information include:

- **Control charts -** Use of control charts is explained in section 12.
- **Data quality assessments (DQAs)-** These assessments are a statistical and scientific evaluation of the data set to determine the validity and performance of the data collection design and to determine the adequacy of the data set for its intended use. Further discussion on DQAs can be found in section 16.
- **QA Reports -** Reports pertaining to the quality of data, usually related to some aggregate (quarterly, yearly etc.) focusing on measurement quality attributes and data quality objectives, are discussed in Sections 3 and 18.
- **Evaluation/Audits-** Assessments of various phases of the environmental data operation are discussed in section 16.

6. Sampling Process Design

The selection of a specific monitoring site includes four major activities :

1. Developing and understanding the monitoring objective and appropriate data quality objectives.
2. Identifying the spatial scale most appropriate for the monitoring objective of the site.
3. Identifying the general locations where the monitoring site should be placed.
4. Identifying specific monitoring sites.

This section describes the general concepts for establishing the State and Local Air Monitoring Stations (SLAMS), National Air Monitoring Stations (NAMS), Photochemical Assessment Monitoring Stations (PAMS), and open path monitoring. Additional details can be found in 40 CFR Part 58 [23] and the *PAMS Implementation Manual* [77].

Air quality samples are generally collected for one or more of the following purposes:

- to judge compliance with and/or progress made towards meeting ambient air quality standards
- to activate emergency control procedures that prevent or alleviate air pollution episodes
- to observe pollution trends throughout the region, including nonurban areas
- to provide a data base for research evaluation of effects: urban, land-use, and transportation planning; development and evaluation of abatement strategies; and development and validation of diffusion models

Compliance Monitoring

The information required for selecting the number of samplers and the sampler locations include isopleth maps, population density maps, and source locations. The following are suggested guidelines:

- the priority area is the zone of highest pollution concentration within the region; one or more stations are to be located in this area
- close attention should be given to densely populated areas within the region, especially when they are in the vicinity of heavy pollution
- the quality of air entering the region is to be assessed by stations situated on the periphery of the region; meteorological factors (e.g., frequencies of wind directions) are of primary importance in locating these stations
- sampling should be undertaken in areas of projected growth to determine the effects of future development on the environment
- a major objective of surveillance is evaluation of progress made in attaining the desired air quality; for this purpose, sampling stations should be strategically situated to facilitate evaluation of the implemented control tactics
- some information of air quality should be available to represent all portions of the regions

Some stations will be capable of fulfilling more than one of the functions indicated; for example, a station located in a densely populated area can indicate population exposures and can also document the changes in pollutant concentrations resulting from mitigation strategies used in the area.

Emergency Episode Monitoring

For episode avoidance purposes, data are needed quickly--in no less than a few hours after the pollutant contacts the sensor. While it is possible to obtain data rapidly by on-site manual data reduction and telephone reporting, there is a trend towards using automated monitoring networks. The severity of the problem, the size of the receptor area, and the availability of resources all influence both the scope and sophistication of the monitoring system.

It is necessary to use continuous air samplers because of the short durations of episodes and the control actions taken must be based on real-time measurements that are correlated with the decision criteria. Based on episode alert criteria and mechanisms now in use, 1-h averaging times are adequate for surveillance of episode conditions. Shorter averaging times provide information on data collecting excursions, but they increase the need for automation because of the bulk of data obtained. Longer averaging times (>6 hours) are not desirable because of the delay in response that these impose. After an alert is announced, data are needed quickly so that requests for information on the event can be provided.

Collection and analysis must be accomplished rapidly if the data are to be useful immediately. Collection instruments must be fully operable at the onset of an episode. For the instrument to be maintained in peak operating condition, either personnel must be stationed at the sites during an episode or automated equipment must be operated that can provide automatic data transmission to a central location.

Monitoring sites should be located in areas where human health and welfare are most threatened:

- in densely populated areas
- near large stationary sources of pollution
- near hospitals
- near high density traffic areas
- near homes for the aged

A network of sites is useful in determining the range of pollutant concentrations within the area, but the most desirable monitoring sites are not necessarily the most convenient. Public buildings such as schools, firehouses, police stations, hospitals, and water or sewage plants should be considered for reasons of access, security and existing communications.

Trends Monitoring

Trends monitoring is characterized by locating a minimal number of monitoring sites across as large an area as possible while still meeting the monitoring objectives. The program objective is to determine the extent and nature of the air pollution and to determine the variations in the measured levels of the atmospheric contaminants in respect to the geographical, socio-economic, climatological and other factors. The data are useful in planning epidemiological investigations and in providing the background against which more intensive community and statewide studies of air pollution can be conducted.

Urban sampling stations are usually located in the most densely populated areas of the region. In most regions, there are several urban sites. Non-urban stations encompass various topographical categories such as farmland, desert, forest, mountain and coast. Non-urban stations are not selected specifically to be “clean air” control sites for urban areas, but they do provide a relative comparison between some urban and nearby non-urban areas.

In interpreting trends data, limitations imposed by the network design must be considered. Even though precautions are taken to ensure that each sampling site is as representative as possible of the designated area, it is impossible to be certain that measurements obtained at a specific site are not unduly influenced by local factors. Such factors can include topography, structures, sources of pollution in the immediate vicinity of the site, and other variables; the effects which cannot always be accurately anticipated, but nevertheless, should be considered in network design. Comparisons among pollution levels for various areas are valid only if the sites are representative of the conditions for which the study is designed.

Research Monitoring

Air monitoring networks related to health effects are composed of integrating samplers both for determining pollutant concentrations for $\leq$ 24 hours and for developing long term ($\geq$ 24 hour) ambient air quality standards. The research requires that monitoring points be located so that the resulting data will represent the population group under evaluation. Therefore, the monitoring stations are established in the centers of small well-defined residential areas within a community. Data correlations are made between observed health effects and observed air quality exposures.

Requirements for aerometric monitoring in support of health studies are as follows:

- the station must be located in or near the population under study
- pollutant sampling averaging times must be sufficiently short to allow for use in acute health effect studies that form the scientific basis for short-term standards
- sampling frequency, usually daily, should be sufficient to characterize air quality as a function of time
- the monitoring system should be flexible and responsive to emergency conditions with data available on short notice

6.1. Monitoring Objectives and Spatial Scales

With the end use of the air quality samples as a prime consideration, the SLAMS/NAMS networks should be designed to determine one of six basic monitoring objectives listed below:

1. Highest concentrations expected to occur in the area covered by the network.
2. Representative concentrations in areas of high population density.
3. Impact on ambient pollution levels of significant sources or source categories.
4. General background concentration levels.
5. Extent of regional pollutant transport among populated areas, and in support of secondary standards.
6. Welfare-related impacts in more rural and remote areas.

These six objectives indicate the nature of the samples that the monitoring network will collect which must be representative of the spatial area being studied. In the case of PAMS, the design criteria are site specific, and therefore, there are specific monitoring objectives associated with each location for which PAMS stations are required (see Table 6-4).

Sampling equipment requirements are generally divided into three categories, consistent with the desired averaging times:

1. **Continuous**- Pollutant concentrations determined with automated methods, and recorded or displayed continuously.
2. **Integrated**- Pollutant concentrations determined with manual or automated methods from integrated hourly or daily samples on a fixed schedule.
3. **Static**- Pollutant estimates or effects determined from long-term (weekly or monthly) exposure to qualitative measurement devices or materials.

Air monitoring sites that use automated equipment to continually sample and analyze pollutant levels may be classified as primary. Primary monitoring stations are generally located in areas where pollutant concentrations are expected to be among the highest and in areas with the highest population densities; thus, they are often used in health effects research networks. These stations are also designed as part of the air pollution episode warning system.

The goal in siting stations is to correctly match the spatial scale represented by the sample of monitored air with the spatial scale most appropriate for the monitoring objective of the station. The representative measurement scales of greatest interest are shown below:

Micro	Concentrations in air volumes associated with area dimensions ranging from several meters up to about 100 meters
Middle	Concentrations typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 kilometer
Neighborhood	Concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers range
Urban	Overall, citywide conditions with dimensions on the order of 4 to 50 kilometers. This scale would usually require more than one site for definition
Regional	Usually a rural area of reasonably homogeneous geography and extends from tens to hundreds of kilometers
National/Global	Concentrations characterizing the nation and the globe as a whole

Table 6-1 illustrates the relationships among the four basic monitoring objectives and the scales of representativeness that are generally most appropriate for that objective. Appendix 6-A provides more detailed spatial characteristics for each pollutant while Table 6-2 provides a summary for SLAMS, NAMS, PAMS and open path sites.

Table 6-1 Relationship Among Monitoring Objectives and Scales of Representativeness

Monitoring Objective	Appropriate Siting Scale
Highest Concentration	Micro, middle, neighborhood, sometimes urban
Population	Neighborhood, urban
Source impact	Micro, middle, neighborhood
General/background	Neighborhood, regional
Regional Transport	Urban./regional
Welfare-related	Urban/regional

There is the potential for using open path monitoring for microscale spatial scales. For microscale areas, however, siting of open path analyzers must reflect proper regard for the specific monitoring objectives and

for the path-averaging nature of these analyzers. Specifically, the path-averaging nature of open path analyzers could result in underestimations of high pollutant concentrations at specific points within the measurement path for other ambient air monitoring situations. In open path monitoring, monitoring path lengths must be commensurate with the intended scale of representativeness and located carefully with respect to local sources or potential obstructions. For short-term/high-concentration or source-oriented monitoring, the monitoring path may need to be further restricted in length and be oriented perpendicular to the wind direction(s) determined by air quality modeling leading to the highest concentration, if possible. Alternatively, multiple paths may be used advantageously to obtain both wider area coverage and peak concentration sensitivity.

Table 6-2 Summary of Spatial Scales for SLAMS, NAMS, PAMS and Open Path (OP) Sites

Spatial Scale	Scale Applicable for SLAMS							Scales Required for NAMS							PAMS	OP
	SO_2	CO	O_3	NO_2	Pb	PM_{10}	$PM_{2.5}$	SO_2	CO	O_3	NO_2	Pb	PM_{10}	$PM_{2.5}$		
Micro		*			*	*	*		*			*	*	*[1]		
Middle	*	*	*	*	*	*	*					*	*	*[1]		*
Neighborhood	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Urban	*		*	*	*	*	*			*	*			*[2]	*	*
Regional	*		*		*	*	*							*[2]		*

[1]- Only permitted if representative of many such microscale environments in a residential district (for middle scale, at least two)
[2] -Either urban or regional scale for regional transport sites.

6.1.1 Monitoring Boundaries

The standards refer to several boundaries that are defined below. These definitions are derived from the document entitled *Guidance for Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM_{10}*.

Metropolitan Statistical Area (MSA)- are designated by the U.S. Office of Management and Budget (OMB) as having a large population nucleus, together with adjacent communities having a high degree of economic and social integration with that nucleus. MSA boundaries correspond to portions of counties that often include urban and nonurban areas. MSAs are useful for identifying which parts of a state have sufficient populations to justify the installation of a compliance monitoring network. Their geographical extent may be too big for defining the boundaries of Metropolitan Planning Areas and Community Monitoring Zones.

Primary Metropolitan Statistical Area (PMSA)- are single counties or groups of counties that are the component metropolitan portions of a mega-metropolitan area. PMSAs are similar the MSAs with the additional characteristic of having a degree of integration with surrounding metropolitan areas.

Consolidated Metropolitan Statistical Area (CSA)- are a group of PMSAs having significant economic and social integration.

New England County Metropolitan Statistical Area (NECMSA)- is a county-based alternative for the city- and town-based New England MSAs and CMSAs.

Monitoring Planning Area (MPA)-are defined by SIPs as the basic planning unit for $PM_{2.5}$ monitoring. A MPA is a contiguous geographic area with established, well defined boundaries. MPAs may cross state lines and can be further subdivided into Community Monitoring Zones. A MPA does not necessarily correspond to the boundaries within which pollution control strategies will be applied. MPAs will normally contain at least 200,000 people, though portions of a state not associated with MSAs can be considered as a single MSA. Optional MPAs may be designated for other areas of a state. MPAs in MSAs are completely covered by one or more Community Monitoring Zones.

Community Monitoring Zone (CMZ)- When spatial averaging is utilized for making comparisons to the annual $PM_{2.5}$ NAAQS, CMZs must be defined in the monitoring network description. This averaging approach is specified in 40 CFR part 50 Appendix N. A CMZ should characterize an area of relatively similar annual average air quality (i.e., the average concentrations at individual sites should not exceed the spatial average by more than 20%). CMZs have dimensions of 4-50 km with boundaries defined by political demarcations with population attributes. They could be smaller in densely populated areas with large pollutant gradients. Each CMZ would ideally equal the collective zone of representation of one or more community-oriented monitors within that zone. The CMZ, applicable only to $PM_{2.5}$, is intended to represent the spatial uniformity of $PM_{2.5}$ concentrations. In practice, more than one monitor may be needed with each CMZ to evaluate the spatial uniformity of $PM_{2.5}$ concentrations and to accurately calculate the spatial average for comparison with the annual $PM_{2.5}$ NAAQS. When spatial averaging is used, each MPA would be completely covered by one or more contiguous CMZs.

6.2 Site Location

Four criteria should be considered, either singly or in combination when locating sites, depending on the sampling objective. Orient the monitoring sites to measure the following:

1. Impacts of known pollutant emission categories on air quality.
2. Population density relative to receptor-dose levels, both short and long term.
3. Impacts of known pollutant emission sources (area and point) on air quality.
4. Representative area-wide air quality.

To select locations according to these criteria, it is necessary to have detailed information on the location of sources of emissions, geographical variability of ambient pollutant concentrations, meteorological conditions and population density. Therefore, selection of the number, locations and types of sampling stations is a complex process. The variability of sources and their intensities of emissions, terrains, meteorological conditions and demographic features requires that each network be developed individually. Thus, selection of the network will be based upon the best available evidence and on the experience of the decision team. The sampling site selection process involves considerations of the following factors:

Economics - The amount of resources required for the entire data collection activity, including instrumentation, installation, maintenance, data retrieval, data analysis, quality assurance and data interpretation.

Security - Experience has shown that in some cases, a particular site may not be appropriate for the establishment of an ambient monitoring station simply due to problems with the security of the equipment in a certain area. If the problems cannot be remedied via the use of standard security measures such as lighting, fences, etc., then attempts should be made to locate the site as near to the identified sector as possible while maintaining adequate security.

Logistics - Logistics is the process of dealing with the procurement, maintenance and transportation of material and personnel for a monitoring operation. This process requires the full knowledge of all aspects of the data collection operation including:

Planning	*Staffing*
Reconnaissance	*Procurement of goods and services*
Training	*Communications*
Scheduling	*Inventory*
Safety	

Atmospheric considerations - Atmospheric considerations may include spatial and temporal variabilities of the pollutants and their transport. Effects of buildings, terrain, and heat sources or sinks on the air trajectories can produce local anomalies of excessive pollutant concentrations. Meteorology must be considered in determining not only the geographical location of a monitoring site but also such factors as height, direction, and extension of sampling probes. The following meteorological factors can greatly influence the dispersal of pollutants:

Wind speed affects the travel time from the pollutant source to the receptor and the dilution of polluted air in the downwind direction. The concentrations of air pollutants are inversely proportional to the wind speed.

Wind direction influences the general movements of pollutants in the atmosphere. Review of available data can indicate mean wind direction in the vicinity of the major sources of emissions.

Wind variability refers to the random motions in both horizontal and vertical velocity components of the wind. These random motions can be considered atmospheric turbulence, which is either mechanical (caused by structures and changes in terrain) or thermal (caused by heating and cooling of land masses or bodies of water). If the scale of turbulent motion is larger than the size of the pollutant plume, the turbulence will move the entire plume and cause looping and fanning; if smaller, it will cause the plume to diffuse and spread out.

If the meteorological phenomena impact with some regularity, data may need to be interpreted in light of these atmospheric conditions. Other meteorological condition to consider are atmospheric stability and lapse rate.

A useful way of displaying wind data is a wind rose diagram constructed to show the distribution of wind speeds and directions. The wind rose diagram shown in Figure 6.1 represents conditions as they converge on the center from each direction of the compass. More detailed guidance for meteorological considerations is available[49]. Relevant weather information such as stability-wind roses are usually available from local National Weather Service stations. For PAMS monitoring, in many areas, there are three types of high ozone days: overwhelming transport, weak transport (or mixed transport and stagnation) and stagnation. The wind rose concept to site monitors is only applicable to the transport types, but not applicable to the stagnation type. In general, transport types dominate north of 40°N, stagnation types dominate the Ohio River Valley and northern Gulf Coast, and a mixture of the two is observed in the rest of the eastern United States. In areas where stagnation dominates the high ozone days, a well-defined primary wind direction

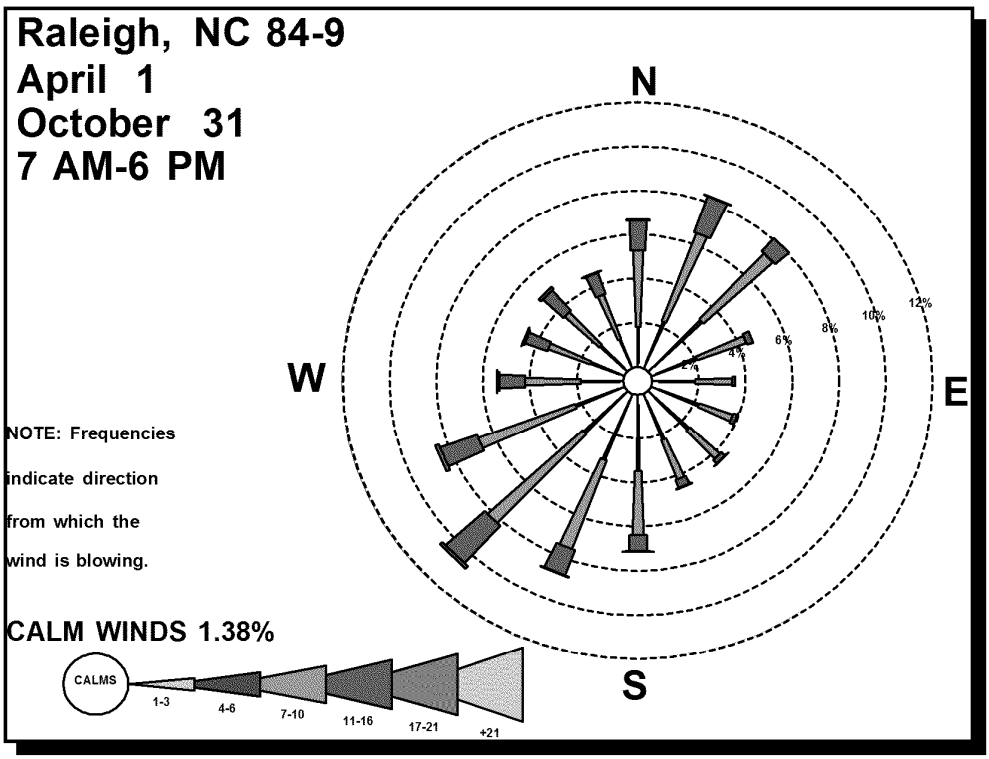

Figure 6.1 Wind rose pattern

(PWD) may not be available. If no well-defined PWD can be resolved, the major axes of the emissions sources should be used as substitutes for the PWDs and the PAMS monitors should be located along these axes.

Meteorological conditions, particularly those that can affect light transmission, should also be considered in selecting the location for open path analyzers (*e.g.*, the influence of relative humidity on the creation of fog, the percentage of heavy snow, and the possible formation of haze, etc.). The percent fog, percent snow fall, percent haze, and hourly visibility (from nearest airport) may impact data completeness. Although sites with high relative humidity may have data capture rates around 90 percent, sites with relative humidity greater than 80 percent more than 20 percent of the time should be carefully assessed for data completeness, or avoided. Similarly, severe fog, snow fall, or haze that affects visibility can affect data completeness and should be kept to less than 20 percent of the time. The time of day or season when such conditions occur should also be determined to ensure that representative data from various time periods and seasons are collected. No more than 20 percent of data in any time period should be lost as a result of the aforementioned meteorological conditions. Sometimes, high data capture at locations with frequent fog or other obscurant conditions can be enhanced by using a shorter path length of 50 to 100 meters. However, this can be done only for microscale sites. Meteorological data considerations therefore should include the following measurements: (1) hourly precipitation amounts for climatological comparisons, (2) hourly relative humidity, (3) percent haze, and (4) airport visibility.

Topography Both the transport and the diffusion of air pollutants are complicated by topographical features. Minor topographical features may exert small influences; major features, such as deep river valleys

or mountain ranges, may affect large areas. Before final site selection, review the topography of the area to ensure that the purpose of monitoring at that site will not be adversely affected. Table 6-3 summarizes important topographical features, their effects on air flow, and some examples of influences on monitoring site selection. Land use and topographical characterization of specific areas can be determined from U.S. Geological Survey (USGS) maps as well as from land use maps.

Table 6-3 Relationships of Topography, Air Flow, and Monitoring Site Selection

Topographical feature	Influence on air flow	Influence on monitoring site selection
Slope/Valley	Downward air currents at night and on cold days; up slope winds on clear days when valley heating occurs. Slope winds and valley channeled winds; tendency toward down-slope and down-valley winds; tendency toward inversions	Slopes and valleys as special sites for air monitors because pollutants generally are well dispersed; concentration levels not representative of other geographic areas; possible placement of monitor to determine concentration levels in a population or industrial center in valley
Water	Sea or lake breezes inland or parallel to shoreline during the day or in cold weather; land breezes at night.	Monitors on shorelines generally for background readings or for obtaining pollution data on water traffic
Hill	Sharp ridges causing turbulence; air flow around obstructions during stable conditions, but over obstructions during unstable conditions	Depends on source orientation; upwind source emissions generally mixed down the slope, and siting at foot of hill not generally advantageous; downwind source emissions generally down washed near the source; monitoring close to a source generally desirable if population centers adjacent or if monitoring protects workers
Natural or manmade obstruction	Eddy effects	Placement near obstructions not generally representative in readings

Pollutant Considerations A sampling site or an array of sites for one pollutant may be appropriate for another pollutant species because of the configuration of sources, the local meteorology, or the terrain. Pollutants undergo changes in their compositions between their emission and their detection; therefore, the impact of that change on the measuring system should be considered. Atmospheric chemical reactions such as the production of O_3 in the presence of NO_x and hydrocarbons (HCs) and the time delay between the emission of NO_x and HCs and the detection peak of O_3 values may require either a sampling network for the precursors of O_3 and/or a different network for the actual O_3 measurement.

The success of the PAMS monitoring program is predicated on the fact that no site is unduly influenced by any one stationary emissions source or small group of emissions sources. Any significant influences would cause the ambient levels measured by that particular site to mimic the emissions rates of this source or sources rather than following the changes in nonattainment area-wide emissions as intended by the Rule. For purposes of this screening procedure, if more than 10% of the typical "lower end" concentration measured in an urban area is due to a nearby source of precursor emissions, then the PAMS site must be relocated or a more refined analysis conducted than is presented here. Detailed procedures can be found in the *PAMS Implementation Manual*[77].

None of the factors mentioned above stand alone. Each is dependent in part on the others. However, the objective of the sampling program must be clearly defined before the selection process can be initiated, and the initial definition of priorities may have to be reevaluated after consideration of the remaining factors and before the final site selection. While the interactions of the factors are complex, the site selection problems can be resolved. Experience in the operation of air quality measurement systems; estimates of air quality,

field and theoretical studies of air diffusion; and considerations of atmospheric chemistry and air pollution effects make up the required expertise needed to select the optimum sampling site for obtaining data representative of the monitoring objectives.

6.2.1 PAMS Site descriptions

The PAMS network array for an area should be fashioned to supply measurements which will assist States in understanding and solving ozone nonattainment problems. EPA has determined that for the larger areas, the minimum network which will provide data sufficient to satisfy a number of important monitoring objectives should consist of five sites as described in Table 6-4

Table 6-4 Site Descriptions of PAMS Monitoring Sites

Site #	Meas. Scale	Description
1	Urban	**Upwind and background characterization** to identify those areas which are subjected to overwhelming incoming transport of ozone. The #1 Sites are located in the predominant morning upwind direction from the local area of maximum precursor emissions and at a distance sufficient to obtain urban scale measurements. Typically, these sites will be located near the upwind edge of the photochemical grid model domain.
2	Neighborhood	**Maximum ozone precursor emissions impacts** located immediately downwind (using the same morning wind direction as for locating Site #1) of the area of maximum precursor emissions and are typically placed near the downwind boundary of the central business district (CBD) or primary area of precursor emissions mix to obtain neighborhood scale measurements.
2a	Neighborhood	**Maximum ozone precursor emissions impacts -second-most predominant morning wind direction**
3	Urban	**Maximum ozone concentrations** occurring downwind from the area of maximum precursor emissions. Locations for #3 Sites should be chosen so that urban scale measurements are obtained. Typically, these sites are located 10 to 30 miles from the fringe of the urban area
4	Urban	**Extreme downwind monitoring** of transported ozone and its precursor concentrations exiting the area and will identify those areas which are potentially contributing to overwhelming ozone transport into other areas. The #4 Sites are located in the predominant afternoon downwind direction from the local area of maximum precursor emissions at a distance sufficient to obtain urban scale measurements. Typically, these sites will be located near the downwind edge of the photochemical grid model domain.

There are three fundamental criteria to consider when locating a final PAMS site: sector analysis, distance, and proximate sources [77]. These three criteria are considered carefully by EPA when approving or disapproving a candidate site for PAMS

6.3 Monitor Placement

SLAMS/NAMS

Final placement of the monitor at a selected site depends on physical obstructions and activities in the immediate area, accessibility/availability of utilities and other support facilities in correlation with the defined purpose of the specific monitor and its design. Because obstructions such as trees and fences can significantly alter the air flow, monitors should be placed away from obstructions. It is important for air flow around the monitor to be representative of the general air flow in the area to prevent sampling bias. Detailed information on urban physiography (e.g., buildings, street dimensions) can be determined through

visual observations, aerial photography and surveys. Such information can be important in determining the exact locations of pollutant sources in and around the prospective monitoring site areas.

Network designers should avoid sampling locations that are unduly influenced by down wash or ground dust (e.g., a rooftop air inlet near a stack or a ground- level inlet near an unpaved road); in these cases, the sample intake should either be elevated above the level of the maximum ground turbulence effect or placed at a reasonable distance from the source of ground dust.

Depending on the defined monitoring objective, the monitors are placed according to exposure to pollution. Due to the various physical and meteorological constraints discussed above, tradeoffs will be made to locate a site in order to optimize representativeness of sample collection. The consideration should include categorization of sites relative to their local placements. Suggested categories relating to sample site placement for measuring a corresponding pollution impact are identified in Table 6-5.

Table 6-5 Relationships of Topography, Air Flow, and Monitoring Site Selection

Station Category	Characterization
A (ground level)	Heavy pollutant concentrations, high potential for pollutant buildup. A site 3 to 5 m (10-16 ft) from major traffic artery and that has local terrain features restricting ventilation. A sampler probe that is 3 to 6 m (10-20 ft) above ground.
B (ground level)	Heavy pollutant concentrations, minimal potential for a pollutant buildup. A site 3 to 15 m (15-50 ft) from a major traffic artery, with good natural ventilation. A sampler probe that is 3 to 6 m (10-20 ft) above ground.
C (ground level)	Moderate pollutant concentrations. A site 15 to 60 m (5-200 ft) from a major traffic artery. A sampler probe that is 3 to 6 m (10-20 ft) above ground.
D (ground level)	Low pollutant concentrations. A site 60 $\geq$ m ($\geq$ 200 ft) for a traffic artery. A sampler probe that is 3 to 6 m (10-20 ft) above ground.
E (air mass)	Sampler probe that is between 6 and 45 m (20-150 ft) above ground. Two subclasses: (1) good exposure from all sides (e.g., on top of building) or (2) directionally biased exposure (probe extended from window).
F (source-oriented)	A sampler that is adjacent to a point source. Monitoring that yields data directly relatable to the emission source.

6.3.1 Concurrent Open Path Monitoring

In addition to requirements for establishing a new site, 40 CFR Part 58, Appendix D[17] addresses requirements for changing to an open path monitor at an existing SLAMS site. Changes must be made with careful consideration given to the impact of the change on the network/site's ability to meet the intended goals. Appendix D[17] requires that the effects of the change on the monitoring data be quantified, if possible, or at least characterized. Appendix D[17] requires concurrent, nominally collocated monitoring in all cases where an open path analyzer is intended to replace a criteria pollutant point monitor which meets either of the following: (1) data collected at the site represent the maximum concentration for a particular nonattainment area, or (2) data collected at the site are currently used to characterize the development of a nonattainment area State implementation plan (SIP). The recommended period of concurrent monitoring is one year (or one season of maximum pollutant concentration) with a maximum term indexed to the subject pollutant NAAQS compliance interval (e.g., three calendar years for O_3). These requirements are intended to provide a bridge between point and open path air monitoring data to evaluate and promote continuity in understanding of the historical representation of the database.

Sites at which open path analyzers are likely to be used to measure NO_2 and O_3 are generally going to be neighborhood scales of representativeness or larger. Since NO_2 and O_3 concentration levels at such sites are likely to be homogeneous, concurrent monitoring is not likely to be useful. However, concurrent monitoring would be required if data from the site were used for attainment designations. In the future, monitoring efforts for SO_2 are likely to concentrate on assessing potential short-term (5-minute average) SO_2 source-related impacts and be conducted at source-oriented micro- to middle-scale sites. For such situations, concurrent monitoring of SO_2 may be useful. Additional information on procedures for locating open path sites can be found in Appendix 6-B

6.4 Minimum Network Requirements

Table 6-6 lists the appropriate numbers of stations for each NAMS, as determined by population and concentrations categories, for SO_2 and PM_{10} as specified in 40 CFR part 58 Appendix D[17]. Tables 6-7 and 6-8 identify the numbers of core SLAMs and NAMS goals for the $PM_{2.5}$ Network.

Table 6-6 NAMS Station Number Criteria

		Approximate number of Stations per area			
Pollutant	**Population Category**		**High Conc.**	**Medium Conc.**	**Low Conc.**
CO	>500,000	≥2	NA	NA	NA
Pb	>500,000	≥2	NA	NA	NA
NO_2	>1,000,000	≥2	NA	NA	NA
O_3	>200,000	≥2	NA	NA	NA
PM_{10} and SO_2	> 1,000,000	--	6-10	4-8	2-4
	500,000-1,000,000	--	4-8	2-4	1-2
	650,000-500,000	--	3-4	1-2	0-1
	100,000-650,000	--	1-2	0-1	0

In addition to requiring reasonably consistent methodologies for sampling ozone precursors and meteorological parameters, 40 CFR 58[24] (and subsequently 40 CFR 58, Appendix D), specifies minimum network requirements and sampling frequencies. For clarity, Table 2 of Appendix D[17] of the codified Rule has been reformatted and follows as Table 6-9. More detailed explanations can be found in the *PAMS Implementation Manual* [77].

Table 6-7 $PM_{2.5}$ Core SLAMS Sites Related to MSA

MSA Population	Min Required No. of Core Sites[1]
>1 Million	3
>2 Million	4
>4 Million	6
>6 Million	8
>8 Million	10

[1] Core SLAMS at PAMS are in addition to this number

Table 6-8 Goals for the Number of $PM_{2.5}$ NAMS by Region

EPA Region	Number of NAMS	EPA Region	Number of NAMS
1	15 - 20	6	25 - 35
2	20 - 30	7	10 - 15
3	20 - 25	8	10 - 15
4	35 - 50	9	25 - 40
5	35 - 50	10	10 - 15

Table 6-9 PAMS Minimum Network Requirements

MINIMUM NETWORK REQUIREMENTS

POPULATION OF MSA/CMSA	FREQ TYPE	SITE LOCATION
LESS THAN 500,000	A or C	(1)
	A/D or C/F	(2)
500,000 TO 1,000,000	A or C	(1)
	B/E	(2)
	A or C	(3)
1,000,000 TO 2,000,000	A or C	(1)
	B/E	(2)
	B/E	(2)
	A or C	(3)
GREATER THAN 2,000,000	A or C	(1)
	B/E	(2)
	B/E	(2)
	A or C	(3)
	A or C	(4)

VOC SAMPLING FREQUENCY REQUIREMENTS

Type	Requirement
A	8 3-Hour Samples Every Third Day 1 24-Hour Sample Every Sixth Day
B	8 3-Hour Samples Everyday 1 24-Hour Sample Every Sixth Day (year-round)
C	8 3-Hr Samples 5 Hi-Event/Previous Days & Every 6th Day 1 24-Hour Sample Every Sixth Day

CARBONYL SAMPLING FREQUENCY REQUIREMENTS

Type	Requirement
D	8 3-Hour Samples Every Third Day
E	8 3-Hour Samples Everyday
F	8 3-Hr Samples 5 Hi-Event/Previous Days & Every 6th Day

MINIMUM PHASE-IN

YEARS AFTER PROMULGATION	NUMBER OF SITES OPERATING	OPERATING SITE LOCATION RECOMMENDATION
1	1	2
2	2	2,3
3	3	1,2,3
4	4	1,2,3,4
5	5	1,2,2,3,4

6.5 Sampling Schedules

Current Federal regulations specify the frequency of sampling for criteria pollutants to meet minimum State implementation plan (SIP) surveillance requirements. Continuous sampling is specified except for 24-hour measurements of PM_{10}, $PM_{2.5}$ (see below) Pb, and TSP and 24-hour integrated values of SO_2 and NO_2.

The 24-hour samples PM_{10}, Pb, and TSP should be taken from midnight (local standard time) to midnight and thus represent calendar days to permit the direct use of sampling data in standard daily meteorological summaries. The frequency of sampling is minimally every six days and the specific day of the week is idendtified based upon the national sampling schedule.

The following are recommended frequencies for noncontinuous hi-vol and impinger sampling to adequately define SO_2, and NO_2 levels:

1. The most polluted sites in an urban area should be sampled at frequencies greater than the minimum requirements.
2. Sites where the highest 24-hour and annual averages are expected should yield the most frequent particulate samples.
3. Areas of maximum SO_2 and NO_2 concentrations should be sampled using continuous monitors in place of SO_2/ NO_2 impingers if possible.
4. Noncritical sites (sites with other than maximum concentration) can be sampled intermittently. Intermittent sampling calls for adopting a systematic sampling schedule that considers statistical relationships for characterizing an air pollutant for a given time period and area (see items 6 and 7 below). Any schedule which provides 61 samples/yr and 5/quarter (in accordance with item 6 below) is satisfactory, but not as convenient as the systematic schedule of every 6th day, for example.
5. Downwind sites monitoring SO_2, NO_2, and particulate matter from isolated point sources should use continuous instruments for gaseous pollutants, and should sample at least once every 6 days for particulate matter.
6. The minimum numbers of samples required for appropriate summary statistics should be taken. At least 75% of the total possible observations must be present before summary statistics are calculated. The exact requirements follow:

Time Interval	Minimum number of observations/averages
3-h running average	3 consecutive hourly observations
8-h running average	6 hourly observations
64 h	18 hourly observations
Monthly	61 daily averages
Quarterly	3 consecutive monthly averages
Yearly	9 monthly averages with at least 6 monthly averages/quarter

For intermittent sampling data, there must be at least five observations/quarter; if one month has no observations, the remaining two months must have at least two.

7. If validation procedures indicate that the criteria in item 6 are not fulfilled (the minimum numbers must be valid observations), the sampling frequency should be increased during the period in which corrective measures are being pursued.

More extensive treatments of sampling frequencies, as related to data analysis, are in references 7, 50 and 55. Section 4.3 of 40 CFR 58, Appendix D[17], stipulates that the PAMS monitoring should be conducted annually throughout the months of June, July and August as a minimum. In most States, these months

incorporate the periods when peak ozone values are likely to occur. EPA, however, encourages the States to extend the PAMS monitoring period whenever feasible to include the entire ozone season or perhaps the entire calendar year. Monitoring which is conducted on an intermittent schedule should be coincident with the previously-established intermittent schedule for particulate matter sampling. The codified ozone monitoring seasons for the PAMS-affected States are displayed in Table 6-10

Table 6-10 Ozone Monitoring Seasons PAMS Affected States

State	Begin Month	End Month	State	Begin Month	End Month
California	January	December	Massachusetts	April	September
Connecticut	April	October	New Hampshire	April	September
Delaware	April	October	New Jersey	April	October
District of Columbia	April	October	New York	April	October
Georgia	April	October	Pennsylvania	April	October
Illinois	April	October	Rhode Island	April	September
Indiana	April	September	Texas AQCR 4, 5, 7, 10, 11	January	December
Louisiana	January	December	Texas AQCR 1, 2, 3, 6, 8, 9, 12	March	October
Maine	April	September	Virginia	April	October
Maryland	April	October	Wisconsin	April 15	October 15

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$PM_{2.5}$ Sampling Schedule

Table 6-11 represents the $PM_{2.5}$ sampling schedule as discussed in CFR. The 24-hour sample will be taken from midnight (local standard time) to midnight The frequency of sampling is minimally every six days and the specific day of the week is idendtified based upon the national sampling schedule.

Table 6-11 $PM_{2.5}$ Sampling Schedule

Sampling Frequency	Types of Sites Subject to Sampling Frequency (As per 40 CFR part 58 Section 58.13 and Appendix D)
Daily	At least 2 core PM2.5 sites in each MSA with population> 1M (At least 1 in 3 if collocated with continuous analyzer in priority 2 areas, which are MSAs with > 1 Million people and $PM_{2.5}$ concentrations > 80% of NAAQS)
	At least 2 core PM2.5 sites in each MSA with population between 500K and 1M (At least 1 in 3 if collocated with continuous analyzer)
	1 core PM2.5 site in each PAMS area (daily sampling year round)
	1 site in areas suspected to have conc > 24-hr PM2.5 NAAQS (daily sampling encouraged during seasons of high concentrations, otherwise 1 in 3)
1 in 3	all other SLAMS
1 in 6	SLAMS with Regional Office waiver*
Any	SPMs**

* In accordance with future EPA guidance
** Status of sites is examined during annual network review

7. Sampling Methods

Ambient air sampling is primarily concerned with the atmospheric concentrations of such pollutants as particulates, SO_2, NO_X, CO, and photochemical oxidants. To establish the basic validity of such ambient air monitoring data, it must be shown that:

- the proposed sampling method complies with the appropriate testing regulations
- the equipment is accurately sited
- the equipment was accurately calibrated using correct and established calibration methods
- the organization implementing the data collection operation are qualified and competent

For example, if the only reasonable test site has a less than ideal location, the data collection organization must decide whether a representative sample can be obtained at the site. This determination should be recorded and included in the program's protocol. Although after-the-fact site analysis may suffice in some instances, good quality assurance techniques dictate that this analysis be made prior to expending the resources required to collect the data.

The purpose of this section is to describe the attributes of the sampling system that will ensure the collection of data of a quality acceptable for the Ambient Air Quality Monitoring Program.

7.1 Environmental Control

7.1.1 Monitoring Station Design

State and local agencies should design their monitoring stations with the station operator in mind. Careful thought to safety, ease of access to instruments and optimal work space should be given every consideration. If the station operator has these issues addressed, then he/she will be able to perform their duties more efficiently and diligently. Having the instruments in an area that is difficult to work in creates frustration and prolongs downtime. The goal is to optimize data collection and quality. This must start with designing the shelter and laboratory around staff needs and requirements. The following is a description of the optimal station and laboratory design.

The EPA is aware that monitoring stations may be located in urban areas where space and land are at a premium, especially in large cities that are monitoring for NO_x and CO. In many cases, the monitoring station is located in a building or school that is gracious enough to allow an agency to locate their equipment there. Sometimes, a storage or janitorial closet is all that is available. However, this can pose serious problems. If the equipment is located in a closet, then it is difficult for the agency to control the temperature, humidity, light, vibration and chemicals that the instruments are subjected to. In addition, security can also be an issue if people other than agency staff have access to the equipment. State and local agencies should give serious thought to locating their air monitoring equipment in stand-alone shelters with limited access, or modify existing rooms to the recommended station design if funds and staff time are available.

In general, air monitoring stations should be designed for functionality and ease of access, i.e., instrumentation easily accessed for operation and repair. In addition, the shelter should be rugged enough to withstand any weather that the local area may generate. In the past, small utility trailers were the norm in monitoring shelters. However, in some areas, this will not suffice. Recently, steel and aluminum storage containers are gaining wide acceptance as monitoring shelters. It is recommended that monitoring stations be housed in

shelters that are fairly secure from intrusion or vandalism. All sites should be located in fenced or secure areas with access only through locked gates or secure pathways. The shelter's design dictates that they be insulated (R-19 minimum) to prevent temperature extremes within the shelter. All foundations should be earthquake secured. All monitoring shelters should be designed to control excessive vibrations and external light falling on the instruments, and provide 110/220 VAC voltage throughout the year. When designing a monitoring shelter, make sure that enough electrical circuits are secured for the current load of equipment plus other instruments that may be added later. Figure 7.1 represents one shelter design that has proven adequate.

The first feature of the shelter is that there are two rooms separated by a door. The reasons for this are two-fold. The entry and access should be into the computer/data review area. This allows access to the site without having to open the room that houses the equipment. It also isolates the equipment from cold/hot air that can come into the shelter when someone enters. Also, the Data Acquisition System (DAS)/data review area is isolated from the noise and vibration of the equipment. This area can be a place where the operator can print data, and prepare samples for the laboratory. This also gives the operator an area where cursory data review can take place. If something is observed during this initial review then possible problems can be corrected or investigated at that time. The DAS can be linked through cables that travel through conduit into the equipment area. The conduit is attached to the ceiling or walls and then dropped down to the instrument rack.

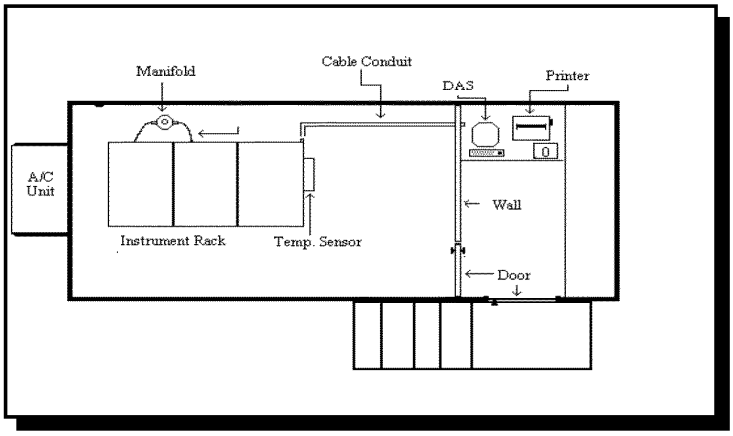

Figure 7.1 Example design for shelter

The air conditioning/heating unit should be mounted to heat and cool the equipment room. When specifying the unit, make sure it will cool the room on the warmest and heat on the coldest days of the year. Also, make sure the electrical circuits are able to carry the load. If necessary, keep the door closed between the computer and equipment room to lessen the load on the heating or cooling equipment.

All air quality instrumentation should be located in an instrument rack or equivalent. The instruments and their support equipment are placed on sliding trays or rails. By placing the racks away from the wall, the rear of the instruments are accessible. The trays or rails allows the site operators access to the instruments without removing them from the racks. Most instrument vendors offer sliding rails as an optional purchase.

7.1.2 Sampling Environment

A proper sampling environment demands control of all physical parameters external to the samples that might affect sample stability, chemical reactions within the sampler, or the function of sampler components. The important parameters to be controlled are summarized in Table 7-1.

Table 7-1 Environment Control Parameters

Parameter	Source of specification	Method of Control
Instrument vibration	Manufacturer's specifications	Design of instrument housings, benches, etc., per manufacturer's specifications.
Light	Method description or manufacturer's specifications	Shield chemicals or instruments that can be affected by natural or artificial light
Electrical voltage	Method description or manufacturer's specifications	Constant voltage transformers or regulators; separate power lines; isolated high current drain equipment such as hi-vols, heating baths, pumps from regulated circuits
Temperature	Method description or manufacturer's specifications	Regulated air conditioning system 24-hour temperature recorder; use electric heating and cooling only
Humidity	Method description or manufacturer's specifications	Regulated air conditioning system; 24-hour temperature recorder

With respect to environmental temperature for designated analyzers, most such analyzers have been tested and qualified over a temperature range of 20°C to 30°C; few are qualified over a wider range. This temperature range specifies both the range of acceptable operating temperatures and the range of temperature change which the analyzer can accommodate without excessive drift. The latter, the range of temperature change that may occur between zero and span adjustments, is the most important. When one is outfitting a shelter with monitoring equipment, it is important to recognize and accommodate the instrument with the most sensitive temperature requirement.

To accommodate energy conservation regulations or guidelines specifying lower thermostat settings, designated analyzers located in facilities subject to these restrictions may be operated at temperatures down to 18°C, provided the analyzer temperature does not fluctuate by more than 10°C between zero and span adjustments. Operators should be alert to situations where environmental temperatures might fall below 18°C, such as during night hours or weekends. Temperatures below 18°C may necessitate additional temperature control equipment or rejection of the area as a sampling site.

Shelter temperatures above 30°C also occur, due to temperature control equipment that is malfunctioning, lack of adequate power capacity, or shelters of inadequate design for the environmental conditions. Occasional fluctuations above 30°C may require additional assurances that data quality is maintained. Sites that continually have problems maintaining adequate temperatures may necessitate additional temperature control equipment or rejection of the area as a sampling site. If this is not an option, a waiver to operate beyond the required temperature range should be sought with the EPA Regional Office, if it can be shown that the site can meet established data quality requirements.

In order to detect and correct temperature fluctuations, a 24-hour temperature recorder at the analyzer site is suggested. These recorders can be connected to data loggers and should be considered official documentation that should be filed (see Section 5). Many vendors offer these type of devices. Usually they are thermocouple/thermistor devices of simple design and are generally very sturdy. Reasons for using electronic shelter temperature devices are two-fold: 1) through remote interrogation of the DAS, the agency can tell if values collected by air quality instruments are valid, and 2) that the shelter temperature is within a safe operating range if the air conditioning/heating system fails.

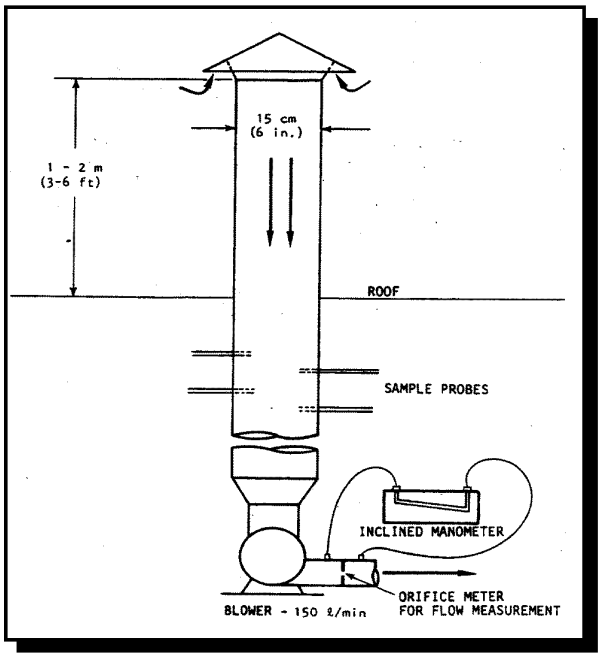

Figure 7.2 Vertical laminar flow manifold

7.2 Sampling Probes And Manifolds

7.2.1 Design of Probes and Manifolds for Automated Methods

Some important variables affecting the sampling manifold design are the diameter, length, flow rate, pressure drop, and materials of construction. Considerations for these parameters are discussed below for both a vertical laminar flow and a conventional manifold design.

Vertical laminar flow design - Figure 7.2 is an example of a vertical laminar flow manifold. By the proper selection of a large diameter vertical inlet probe and by maintaining a laminar flow throughout, the sample air is not permitted to react with the walls of the probe. Numerous materials such as glass, PVC plastic, galvanized steel, and stainless steel, can be used for constructing the probe. Removable sample lines constructed of Teflon or glass can be used to provide each device with sample air.

Inlet line diameters of 15 cm with a flow rate of 150 L/min are necessary if diffusion losses and pressure drops are to be minimized. The sampling rate should be maintained to insure laminar flow conditions. This configuration has the following advantages:

- a 15-cm pipe can be cleaned easily by pulling a cloth through it with a string
- sampling ports can be cut into the pipe at any location and, if unused, can be plugged with stoppers of similar composition
- metal poses no breakage hazard
- there is less potential for sample contamination than there is with smaller tubes

Conventional manifold design - In practice, it may be difficult to achieve vertical laminar flow because of the elbows within the intake manifold system. Therefore, a conventional horizontal manifold system should be constructed of inert materials such as Pyrex glass and/or Teflon, and in modular sections to enable frequent cleaning. The system (Figure 7.3) consists of a vertical "candy cane" protruding through the roof of the shelter with a horizontal sampling manifold connected by a tee to the vertical section. Connected to the other vertical outlet of the tee is a bottle for collecting heavy particles and moisture before they enter the horizontal section. A small blower, 1700 L/min at 0 cm of water at static pressure, is at the exhaust end of the system to provide a flow through the system of approximately 85 to 140 L/min. Particulate monitoring instruments, such as nephelometers, each have separate intake probes that are as short and as straight as possible to avoid particulate losses due to impaction on the walls of the probe.

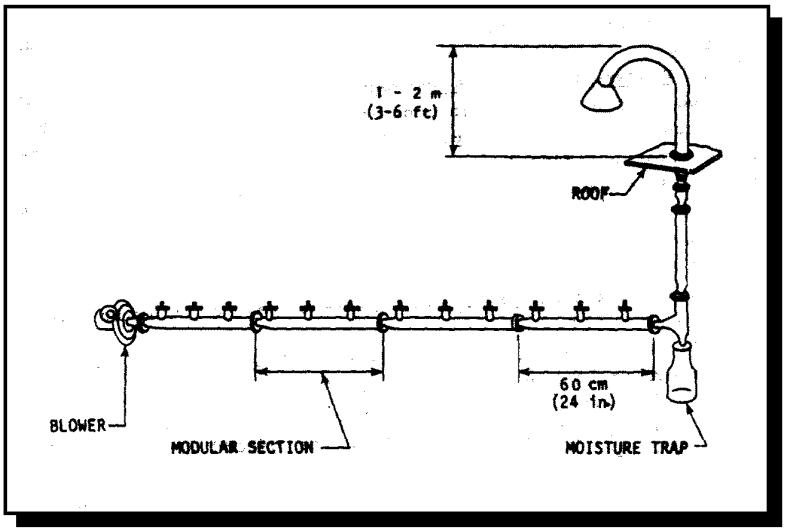

Figure 7.3 Conventional manifold system

Another type of manifold that is being widely used is known as the "ARB" style manifold illustrated in Figure 7.4. This manifold has a reduced profile, i.e., there is less volume in the cane and manifold, therefore, there is less of a need for by-pass flow.

These manifolds allow the user more options than the other conventional manifolds. If the combined flow rates are high enough with the instruments at the monitoring location, by-pass flow devices such as blower motors are not required.

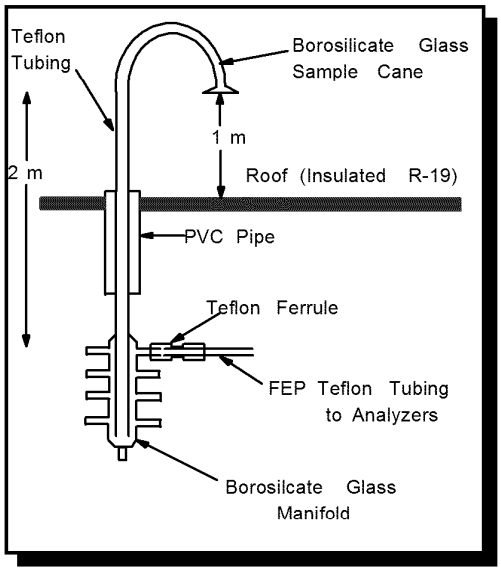

Figure 7.4 Alternate manifold design

Residence time Determination: The residence time of pollutants within the sampling manifold is critical. Residence time is defined as the amount of time that it takes for a sample of air to travel from the opening of the cane to the inlet of the instrument and is required to be less than 20 seconds for reactive gas monitors[18]. It is recommended that the residence time within the manifold and sample lines to the instruments be less than 10 seconds. If the volume of the manifold does not allow this to occur, then a blower motor or other device (vacuum pump) can be used to decrease the residence time. The residence time for a manifold system is determined in the following way. First the volume of the cane, manifold and sample lines must be determined using the following equation:

$$Total\ Volume = Cv + Mv + Lv$$

Where:
Cv = Volume of the sample cane and extensions
Mv = Volume of the sample manifold and trap
Lv = Volume of the instrument lines

Each of the components of the sampling system must be measured individually. To measure the volume of the components, use the following calculation:

$$V = pi * (d/2)^2 * L$$

Where:
V = volume of the component
pi = 3.14159
L = Length of the component
d = inside diameter

Once the total volume is determined, divide the volume by the flow rate of all instruments. This will give the residence time. If the residence time is greater than 10 seconds, attach a blower or vacuum pump to increase the flow rate and decrease the residence time.

It has been demonstrated that there are no significant losses of reactive gas (O_3) concentrations in conventional 13 mm inside diameter sampling lines of glass or Teflon if the sample residence time is 10 seconds or less. This is true even in sample lines up to 38 m in length, which collect substantial amounts of visible contamination due to ambient aerosols. However, when the sample residence time exceeds 20 seconds, loss is detectable, and at 60 seconds the loss is nearly complete.

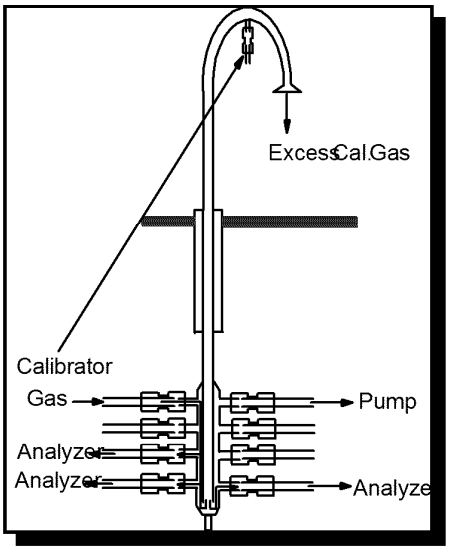

Figure 7.5 Positions of calibration line in sampling manifold

Placement of tubing on the Manifold: If the manifold that is employed at the station has multiple ports (See Figures 7.3 and 7.4) then placement of the instrument lines can be crucial. If a manifold similar to Figure 7.5 is used, it is suggested that instruments requiring lower flows be placed towards the bottom of the manifold. The general rule of thumb states that the calibration line (if used) placement should be in a location so that the calibration gases flow past the instruments before the gas is evacuated out of the manifold. Figure 7.5 illustrates two potential introduction ports for the calibration gas. The port at the elbow of the sampling cane provides more information about the cleanliness of the sampling system.

7.2.2 Placement of Probes and Manifolds

Probes and manifolds must be placed to avoid introducing bias to the sample. Important considerations are probe height above the ground, probe length (for horizontal probes), and physical influences near the probe. Some general guidelines for probe and manifold placement are:

- probes should not be placed next to air outlets such as exhaust fan openings
- horizontal probes must extend beyond building overhangs
- probes should not be near physical obstructions such as chimneys which can affect the air flow in the vicinity of the probe
- height of the probe above the ground depends on the pollutant being measured

In addition, Table 7-2 summarizes the probe and monitoring path siting criteria while Table 7-3 summarizes the spacing of probes from roadways. This information can be found in 40 CFR part 58, Appendix E[18]
For PM_{10} and $PM_{2.5}$, Figure 7.6 provides the acceptable areas for micro, middle, neighborhood and urban samplers, with the exception of microscale street canyon sites.

Table 7-2 Summary of Probe and Monitoring Path Siting Criteria

Pollutant	Scale (maximum monitoring path length, meters)	Height from ground to probe or 80% of monitoring path[A] (meters)	Horizontal and vertical distance from supporting structures[B] to probe or 90% monitoring path [A] (meters)	Distance from trees to probe of monitoring path [A] (meters)
SO_2 [C, D, E, F]	Middle (300m) Neighborhood, Urban, and Regional (1 km)	3 - 15	>1	>10
CO [D, E, G]	Micro, Middle (300m) Neighborhood(I km)	3 $\pm$ 0.5; 3 - 15	>1	>10
O_3 [C, D, E]	Middle (300m) Neighborhood, Urban, and Regional (1 km)	3 - 15	>1	>10
Ozone precursors for (PAMS) [C, D, E]	Neighborhood, and Urban (1km)	3 - 15	>1	>10
NO_2 [C, D, E]	Middle (300m) Neighborhood, and Urban (1 km)	3 - 15	>1	>10
Pb [C, D, E, F, H]	Micro, Middle Neighborhood, Urban, and Regional (1 km)	2-7 (micro); 2-15 (all other scales)	>2 (all scales, horizontal distance only)	>10 (all scales)
PM_{10} [C, D, E, F, H]	Micro, Middle Neighborhood, Urban, and Regional	2-7 (micro); 2-15 (all other scales)	>2 (all scales, horizontal distance only)	>10 (all scales)
$PM_{2.5}$ [C, D, E, F, H, I]	Micro, Middle Neighborhood, Urban, and Regional	2-7 (micro); 2-15 (all other scales)	>2 (all scales, horizontal distance only)	>10 (all scales)

N/A - Not applicable
[A]- Monitoring Path for open path analyzers is applicable only to middle or neighborhood scale CO monitoring and all applicable scales for monitoring SO_2, O_3, O_3 precursors, and NO_2
[B]- When probe is located on a rooftop, this separation distance is in reference to walls, parapets, or penthouses located on roof
[C] Should be > 20 meters from the dripline of tree(s) and must be 10 meters from the dripline when the trees (s) act as an obstruction
[D] - Distance from sampler, probe, or 90% of monitoring path to obstacle, such as a building, must be at least twice the height the obstacle protrudes above the sampler, probe or monitoring path. Sites not meeting this criterion may be classified as middle scale.
[E] Must have unrestricted air flow 270° around probe or sampler; 180° if the probe is on the side f a building
[F] - The Probe, sampler, or monitoring path should be away from minor sources, such as a furnace or incineration flues. The separation distance is dependent on the height of the minor sources's emission point (such as a flue), the type of fuel or waste bed, and the quality of fuel (sulfur, ash, or lead content). This criterion is designed to avoid undue influences from minor sources.
[G] - For microscale CO monitoring sites, he probe must be >10 meters from a street intersection and preferably at a midblock location
[H] - For collocated Pb an PM-10 samplers, a 2-4 meter separation distance between collocated samplers must be met
[I] - For collocated PM-.5 samplers, a 1-4 meter separation distance between collocated samplers must be met.

Table 7-3 Minimum Separation Distance Between Sampling Probes and Roadways

Roadway ave. daily traffic vehicles per day	Minimum separation distance in meters between roadways and probes or monitoring paths at various scales						
	O_3 Neighbor. & Urban	NO_2 Neighbor. & Urban	CO Neighbor.	Pb Micro	Pb Middle	Pb Neighbor., Urban, Reg.	PAMS
≤ 10,000	10	10	10	5-15	>15-50	>50	> 10
15,000	20	20	25				20
20,000	30	30	45	5-15	>15-75	>75	30
30,000			80				
≥ 40,000				5-15	>15-100	>100	
40,000	50	50	115				50
50,000			135				
≥ 60,000			150				
70,000	100	100					100
≥110,000	250	250					250

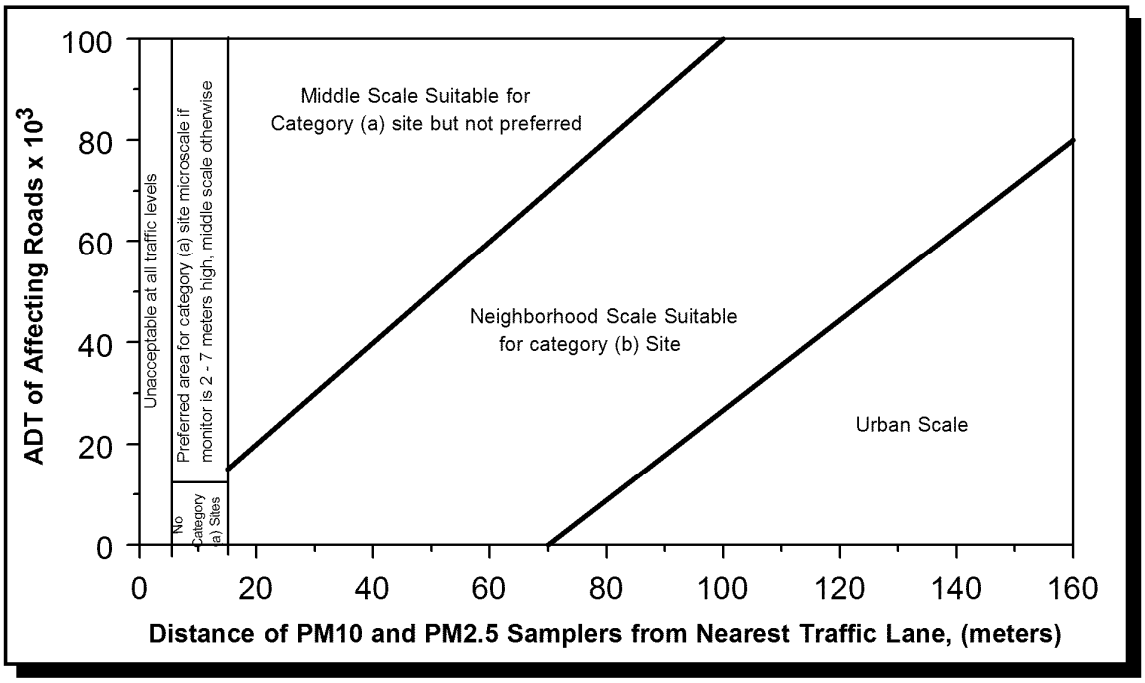

Figure 7.6 Acceptable areas for PM_{10} and $PM_{2.5}$ micro, middle, neighborhood, and urban samplers except for microscale street canyon sites

Open Path Monitoring

To ensure that open path monitoring data are representative of the intended monitoring objective(s), specific path siting criteria are needed. 40 CFR part 58, Appendix E[18], contains specific location criteria applicable to monitoring paths after the general station siting has been selected based on the monitoring objectives, spatial scales of representativeness, and other considerations presented in Appendix D[17]. The new open path siting requirements largely parallel the existing requirements for point analyzers, with the revised provisions applicable to either a "probe" (for point analyzers), a "monitoring path" (for open path analyzers), or both, as appropriate. Criteria for the monitoring path of an open path analyzer are given for horizontal and vertical placement, spacing from minor sources, spacing from obstructions, spacing from trees, and spacing from roadways. These criteria are summarized in Table 7-2.

Cumulative Interferences on a Monitoring Path: To control the sum effect on a path measurement from all the possible interferences which exist around the path, the cumulative length or portion of a monitoring path that is affected by obstructions, trees, or roadways must not exceed 10 percent of the total monitoring path length. This limit for cumulative interferences on the monitoring path controls the total amount of interference from minor sources, obstructions, roadways, and other factors that might unduly influence the open path monitoring data.

Monitoring Path Length: For NO_2, O_3, and SO_2, the monitoring path length must not exceed 1 kilometer for analyzers in neighborhood, urban, or regional scales, or 300 meters for middle scale monitoring sites. These path limitations are necessary in order to produce a path concentration representative of the measurement scale and to limit the averaging of peak concentration values. In addition, the selected path length should be long enough to encompass plume meander and expected plume width during periods when high concentrations are expected. In areas subject to frequent periods of rain, snow, fog, or dust, a shortened monitoring path length should be considered to minimize the loss of monitoring data due to these temporary optical obstructions.

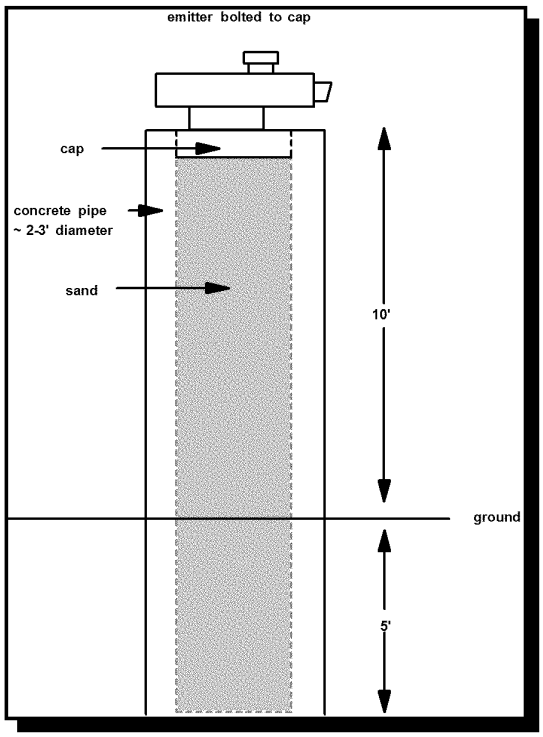

Figure 7.7 Optical mounting platform

Mounting of Components and Optical Path Alignment: Since movements or instability can misalign the optical path, causing a loss of light and less accurate measurements or poor readings, highly stable optical platforms are critical. Steel buildings and wooden platforms should be avoided as they tend to move more than brick buildings when wind and temperature conditions vary. Metal roofing will, for example, expand when heated by the sun in the summer. A concrete pillar with a wide base, placed upon a stable base material, has been found to work well in field studies. A sketch of an optical platform is included in Figure 7.7

7.2.3 Probe and Manifold Maintenance

After an adequately designed sampling probe and/or manifold has been selected and installed, the following steps will help in maintaining constant sampling conditions:

1. Conduct a leak test. For the conventional manifold, seal all ports and pump down to approximately 1.25 cm water gauge vacuum, as indicated by a vacuum gauge or manometer connected to one port. Isolate the system. The vacuum measurement should show no change at the end of a 15-min period.
2. Establish cleaning techniques and a schedule. A large diameter manifold may be cleaned by pulling a cloth on a string through it. Otherwise the manifold must be disassembled periodically and cleaned with distilled water. Soap, alcohol, or other products that may contain hydrocarbons should be avoided when cleaning the sampling train. These products may leave a residue that may affect volatile organic measurements. Visible dirt should not be allowed to accumulate.
3. Plug the ports on the manifold when sampling lines are detached.
4. Maintain a flow rate in the manifold that is either 3 to 5 times the total sampling requirements or at a rate equal the total sampling requirement plus 140 L/min . Either rate will help to reduce the sample residence time in the manifold and ensure adequate gas flow to the monitoring instruments.
5. Maintain the vacuum in the manifold <0.64 cm water gauge. Keeping the vacuum low will help to prevent the development of leaks.

7.2.4 Support Services

Most of the support services necessary for the successful operation of ambient air monitoring networks can be provided by the laboratory. The major support services are the generation of reagent water and the preparation of standard atmospheres for calibration of equipment. Table 7-4 summarizes guidelines for quality control of these two support services.

In addition to the information presented above, the following should be considered when designing a sampling manifold:

- suspending strips of paper in front of the blower's exhaust to permit a visual check of blower operation
- positioning air conditioner vents away from the manifold to reduce condensation of water vapor in the manifold
- positioning sample ports of the manifold toward the ceiling to reduce the potential for accumulation of moisture in analyzer sampling lines, and using borosilicate glass, stainless steel, or their equivalent for VOC sampling manifolds at PAMS sites is to avoid adsorption and desorption reactions of VOC's on FEP Teflon
- if moisture in the sample train poses a problem (moisture can absorb gases, namely NO_x and SO_2) :
  - wrap the manifold and instrument lines with "heat wrap", a product that has heating coils within a cloth covering that allows the manifold to be maintained at a constant temperature.
  - make sure the manifold has a moisture trap and that it is emptied often.
  - use of water resistant particulate filters in-line with the instrument

Table 7-4 Techniques for Quality Control of Support Services

Support Service	Parameters affecting quality	Control techniques
Laboratory and calibration gases	Purity specifications vary among manufacturers	Develop purchasing guides
	Variation among lots	Overlap use of old and new cylinders
	Atmospheric interferences	Adopt filtering and drying procedures
	Composition	Ensure traceability to primary standard
Reagents and water	Commercial source variation	Develop purchasing guides. Batch test for conductivity
	Purity requirements	Redistillation, heating, deionization with ion exchange columns
	Atmospheric interferences	Filtration of exchange air
	Generation and storage equipment	Maintenance schedules from manufacturers

7.3 Reference And Equivalent Methods

For monitoring in a SLAMS or NAMS network, either reference or equivalent methods are usually required. This requirement, and any exceptions, are specified in 40 CFR part 58, Appendix C[16]. In addition, reference or equivalent methods may be required for other monitoring applications, such as those associated with prevention of significant deterioration (PSD). Requiring the use of reference or equivalent methods helps to assure the reliability of air quality measurements including: ease of specification, guarantee of minimum performance, better instruction manuals, flexibility of application, comparability with other data and increased credibility of measurements. However, designation as a reference or equivalent method provides no guarantee that a particular analyzer will always operate properly. Appendices A[14] and B[15] require the monitoring organization to establish an internal QC program. Specific guidance for a minimum QC program is described in Section 10 of this Handbook.

The definitions and specifications of reference and equivalent methods are given in 40 CFR part 53[23]. For most monitoring applications, the distinction between reference and equivalent methods is unimportant and either may be used interchangeably.

Reference and equivalent methods may be either manual or automated (analyzers). For SO_2, particulates, and Pb, the reference method for each is a unique manual method that is completely specified in 40 CFR part 50[21] (appendices A, B, and G respectively); all other approved methods for SO_2 and Pb qualify as equivalent methods. As yet, there is no provision in the regulations for designating equivalent methods for particulates. For CO, NO_2, and O_3, Part 50[21] provides only a measurement principle and calibration procedure applicable to reference methods for those pollutants. Automated methods (analyzers) for these pollutants may be designated as either reference methods or equivalent methods, depending on whether the methods utilize the same measurement principle and calibration procedure specified in Part 50[21] for reference methods. Because any analyzer that meets the requirements of the specified measurement principle and calibration procedure may be designated as a reference method, there are numerous reference

methods for CO, NO_2, and O_3. Further information on this subject is in the preamble to 40 CFR part 53[23]. Part II of this Handbook provides details on many of the current reference or equivalent methods.

Except for the unique reference methods for SO_2, particulates, and Pb specified in 40 CFR Part 50[21], all reference and equivalent methods must be officially designated as such by EPA under the provisions of 40 CFR part 53[23]. Notice of each designated method is published in the *Federal Register* at the time of designation. In addition, a current list of all designated reference and equivalent methods is maintained and updated by EPA whenever a new method is designated. This list can be found on the *AMTIC Bulletin Board (http://www.epa.gov/ttn/amtic),* obtained from the Quality Assurance Coordinator at any EPA Regional Office, or from the National Environmental Research Laboratory (MD-77, RTP NC 27711). Moreover, any analyzer offered for sale as a reference or equivalent method after April 16, 1976, must bear a label or sticker indicating that the analyzer has been designated as a reference or equivalent method by EPA.

Sellers of designated automated methods must comply with the conditions summarized below:

1. A copy of the approved operation or instruction manual must accompany the analyzer when it is delivered to the ultimate purchaser.
2. The analyzer must not generate any unreasonable hazard to operators or to the environment.
3. The analyzer must function within the limits of the performance specifications in Table 7-5 for at least 1 year after delivery when maintained and operated in accordance with the operation manual.
4. Any analyzer offered or sale as a reference or equivalent method must bear a label or sticker indicating that it has been designated as a reference or equivalent method in accordance with 40 CFR Part 53[23].
5. If such an analyzer has one or more selectable ranges, the label or sticker must be placed in close proximity to the range selector and must indicate which range or ranges have been designated as reference or equivalent methods.
6. An applicant who offers analyzers for sale as reference or equivalent methods is required to maintain a list of purchasers of such analyzers and to notify them within 30 days if a reference or equivalent method designation applicable to the analyzers has been canceled or if adjustment of the analyzers is necessary under 40 CFR part 53.11(b) to avoid a cancellation.

Aside from occasional malfunctions, consistent or repeated noncompliance with any of these conditions should be reported to EPA at the address given previously. In selecting designated methods, remember that designation of a method indicates only that it meets certain minimum standards. Competitive differences still exist among designated analyzers. Some analyzers or methods may have performance, operational, economic or other advantages over others. A careful selection process based on the individual air monitoring application and circumstances is very important.

Some of the performance tests and other criteria used to qualify a method for designation as a reference or equivalent method are intended only as pass/fail tests to determine compliance with the minimum standards. Test data may not allow quantitative comparison of one method with another.

$PM_{2.5}$ Reference and Equivalent Methods

All formal sampler design and performance requirements and the operational requirements applicable to reference methods for $PM_{2.5}$ are specified in Appendix L of 40 CFR Part 50[21] (EPA 1997a). These requirements are quite specific and include explicit design specifications for the type of sampler, the type of

filter, the sample flow rate, and the construction of the sample collecting components. However, various designs for the flow-rate control system, the filter holder, the operator interface controls, and the exterior housing are possible. Hence, various reference method samplers from different manufacturers may vary considerably in appearance and operation. Also, a reference method may have a single filter capability (single sample sampler) or a multiple filter capability (sequential sample sampler), provided no deviations are necessary in the design and construction of the sample collection components specified in the reference method regulation. A $PM_{2.5}$ method is not a reference method until it has been demonstrated to meet all the reference method regulatory requirements and has been officially designated by EPA as a reference method for $PM_{2.5}$.

Equivalent methods for $PM_{2.5}$ have a much wider latitude in their design, configuration, and operating principle than reference methods. These methods are not required to be based on filter collection of $PM_{2.5}$; therefore, continuous or semi-continuous analyzers and new types of $PM_{2.5}$ measurement technologies are not precluded as possible equivalent methods. Equivalent methods are not necessarily required to meet all the requirements specified for reference methods, but they must demonstrate both **comparability** to reference method measurements and similar $PM_{2.5}$ **measurement precision**.

The requirements that some (but not all) candidate methods must meet to be designated by EPA as equivalent methods are specified in 40 CFR Part 53[23]. To minimize the difficulty of meeting equivalent method designation requirements, three classes of equivalent methods have been established in the 40 CFR Part 53[23] regulations, based on a candidate method's extent of deviation from the reference method requirements. All three classes of equivalent methods are acceptable for SLAMS or SLAMS-related $PM_{2.5}$ monitoring. But not all types of equivalent methods may be equally suited to various $PM_{2.5}$ monitoring requirements or applications.

Class I equivalent methods are very similar to reference methods, with only minor deviations, and must meet nearly all of the reference method specifications and requirements. The requirements for designation as Class I equivalent methods are only slightly more extensive than the designation requirements for reference methods. Also, because of their substantial similarity to reference methods, Class I equivalent methods operate very much the same as reference methods.

Class II equivalent methods are filter-collection-based methods that differ more substantially from the reference method requirements. The requirements for designation as Class II methods may be considerably more extensive than for reference or Class I equivalent methods, depending on the specific nature of the variance from the reference method requirements.

Class III equivalent methods cover any $PM_{2.5}$ methods that cannot qualify as reference or Class I or II equivalent methods because of more profound differences from the reference method requirements. This class encompasses $PM_{2.5}$ methods such as continuous or semi-continuous $PM_{2.5}$ analyzers and potential new $PM_{2.5}$ measurement technologies. The requirements for designation as Class III methods are the most extensive, and, because of the wide variety of $PM_{2.5}$ measurement principles that could be employed for candidate Class III equivalent methods, the designation requirements are not explicitly provided in 40 CFR Part 53.

Table 7-5. Performance Specifications for Automated Methods

Performance Parameter	Units	SO_2	O_3	CO	NO_2	Def and test procedure-Sec.
1) Range	ppm	0-0.5	0-0.5	0-50	0-0.5	53.23(a)
2) Noise	ppm	0.005	0.005	0.50	0.005	53.23(b)
3) Lower detectable limit	ppm	0.01	0.01	1.0	0.01	53.23©
4) Interference equivalent Each Interferant Total Interferant	ppm	 ±.02 0.06	 ±.02 0.06	 ±.1.0 1.5	 ±.02 0.04	53.23(d)
5) Zero drift, 14 and 24 hour	ppm	±.02	±.02	±1.0	±.02	53.23(e)
6) Span drift, 24 hour 20% of upper range limit 80% of upper range limit	percent	 ±20.0 ±5.0	 ±20 ±5.0	 ± 10 ±2.5	 ±20 ±5.0	53.23(e)
7) Lag time	minutes	20	20	10	20	53.23(e)
8) Rise Time	minutes	15	15	5	15	53.23(e)
9) Fall Time	minutes	15	15	5	15	53.23(e)
10) Precision 20% of upper range limit 80% of upper range limit	ppm	 0.01 0.015	 0.01 0.01	 0.5 0.5	 0.02 0.03	53.23(e)

8. Sample Handling and Custody

A critical activity within any data collection phase is the process of handling samples in the field, through the transit stages, through storage and through the analytical phases. Documentation ensuring that proper handling has occurred is part of the custody record.

8.1 Sample Handling

In the Ambient Air Quality Monitoring Program, only the manual methods of lead, particulates (PM_{10} and $PM_{2.5}$), and PAMS samples are handled. In particular, one must pay particular attention to the handling of filters for $PM_{2.5}$. It has been suggested that the process of filter handling may be where the largest portion of measurement error occurs. Due to the manner in which concentrations are determined, it is critical that samples are handled as specified in SOPs. The various phases of sample handling include:

- labeling,
- sample collection, and
- transportation.

8.1.1 Sample Labeling and Identification

Care must be taken to properly mark all samples and monitoring device readings to ensure positive identification throughout the test and analysis procedures. The rules of evidence used in legal proceedings require that procedures for identification of samples used in analyses form the basis for future evidence. An admission by the laboratory analyst that he/she cannot be positive whether he/she analyzed sample No. 6 or sample No. 9, for example, could destroy the validity of the entire test report.

Positive identification also must be provided for any filters used in the program. If ink is used for marking, it must be indelible and unaffected by the gases and temperatures to which it will be subjected. Other methods of identification can be used (bar coding), if they provide a positive means of identification and do not impair the capacity of the filter to function.

Each sampling transport container should have a unique identification to preclude the possibility of interchange. The number of the container should be subsequently recorded on the analysis data form. Figure 8.1 shows a standardized identification sticker which may be used. Additional information may be added as required, depending on the particular monitoring program.

Samples must be properly handled to ensure that there is no contamination and that the sample analyzed is actually the sample taken under the conditions reported. For this reason, samples should be kept in a secure place between the time they are collected and the time they are analyzed. It is highly recommended that all samples be secured until discarded. These security measures should be documented by a written record signed by the handlers of the sample.

Strip charts from automated analyzers must also be clearly and unambiguously identified. The information must be placed upon each strip chart so as not to interfere with any of the data on the chart. If the strip chart is very long, the information should be placed at periodic intervals on the chart. The markings should be indelible and permanently affixed to each strip chart.

(Name of Sampling Organization)

Sample ID No: _____

Sample Type:_____

Date Collected: _____

Site Name:_____

Site Address:_____

Sampler:_____

Figure 8.1 Example sample label

8.1.2 Sample Collection

To reduce the possibility of invalidating the results, all collected samples must be carefully removed from the monitoring device and placed in sealed, nonreactive containers. The best method of sealing depends on the container; in general, the best way is to simply use a piece of tape to preclude accidental opening of the container and to act as a sufficient safeguard where all other aspects of the chain-of-custody procedure are observed. However, when there is any possibility of temporary access to the samples by unauthorized personnel, the sample containers or envelopes should be sealed with a self-adhesive sticker which has been signed and numbered by the operating technician. This sticker must adhere firmly to ensure that it cannot be removed without destruction. The samples should then be delivered to the laboratory for analysis. It is recommended that this be done on the same day that the sample is taken from the monitor. If this is impractical, all the samples should be placed in a carrying case (preferably locked) for protection from breakage, contamination, and loss.

8.1.3 Transportation

In transporting samples and other monitoring data, it is important that precautions be taken to eliminate the possibility of tampering, accidental destruction, and/or physical and chemical action on the sample. Attributes that can effect the integrity of samples include temperature extremes, air pressure (air transportation) and the physical handling of samples (packing, jostling, etc.). These practical considerations must be dealt with on a site-by-site basis and should be documented in the organizations QAPP and site specific SOPs .

The person who has custody of the samples, strip charts, or other data must be able to testify that no tampering occurred. Security must be continuous. If the samples are put in a vehicle, lock the vehicle. After delivery to the laboratory, the samples must be kept in a secured place.

To ensure that none of the sample is lost in transport, mark all liquid levels on the side of the container with a grease pencil. Thus, any major losses which occur will be readily ascertainable.

When using passivated stainless steel canisters for PAMS, the canister pressure, upon receipt, should be recorded and compared to the final sample collection pressure to indicate canister leakage and sample loss.

8.2 Chain Of Custody

If the results of a sampling program are to be used as evidence, a written record must be available listing the location of the data at all times. This chain-of custody record is necessary to make a prima facie showing of the representativeness of the sampling data. Without it, one cannot be sure that the sampling data analyzed was the same as the data reported to have been taken at a particular time. The data should be handled only by persons associated in some way with the test program. A good general rule to follow is "the fewer hands the better," even though a properly sealed sample may pass through a number of hands without affecting its integrity.

Each person handling the samples or strip charts must be able to state from whom the item was received and to whom it was delivered. It is recommended practice to have each recipient sign a chain-of-custody form for the sampling data. Figure 8.2 is an example of a form which may be used to establish the chain of custody. This form should accompany the samples or strip charts at all times from the field to the laboratory. All persons who handle the data should sign the form.

When using the U.S. Postal Service to transport sampling data, only certified or registered mail should be used, and a return receipt should be requested. When using the United Parcel Service, or similar means of shipment, information describing the enclosed sampling data should be placed on the bill of lading. Similarly, when using next-day services, a copy of the receipt, including the air bill number, should be kept as a record. The package should be marked "Deliver to Addressee Only," and it should be addressed to the specific person authorized to receive the package.

W.O. No		Project Name		Sample Type	Number & Type of Container						Remarks
Samplers: (Signature)											
Sta. No.	Date	Time	Station Description								

Relinquished By: (signature)	Date	Time	Received By: (signature)	(Print)	Comments

Figure 8.2 Example field chain of custody form

Once the samples arrive at their destination, the samples should first be checked to ensure that their integrity is intact. Any samples whose integrity are questionable should be flagged and these flags should be "carried" along with the data until the validity of the samples can be proven. This information can be included in the remark section of Figure 8.2 or documented on another form. A chain of custody form should be used to track the handling of the samples through various stages of storage, processing and analysis at the laboratory. Figure 8.3 is an example of a laboratory chain of custody form.

Laboratory/Plant:_____					
Sample Number	Number of Container	Sample Description			
Person responsible for samples			Time:		Date:
Sample Number	Relinquished By:	Received By:	Time:	Date:	Reason for change in custody

Figure 8.3 Example laboratory chain of custody form

9. Analytical Methods

The choice of methods used for any EDO should be influenced by the DQO. From the DQO and an understanding of the potential population uncertainty, one can then determine what measurement uncertainty is tolerable and select the method most appropriate in meeting that tolerance. Methods are usually selected based upon their performance characteristics (precision, bias, limits of detection), ease of use, and their reliability in field and laboratory conditions.

Since both field and analytical procedures have been developed for the criteria pollutants in the Ambient Air Quality Monitoring Program, and can be found in Part II of this document, this section will discuss the general concepts of standard operating procedures and good laboratory practices as they relate to the reference and equivalent methods.

9.1 Standard Operating Procedures

In order to perform sampling and analysis operations consistently, standard operating procedure (SOPs) must be written as part of the QAPP. Standard operating procedures (SOPs) are written documents that detail the method for an operation, analysis, or action with thoroughly prescribed techniques and steps and is officially approved as the method for performing certain routine or repetitive tasks[9].

SOPs should ensure consistent conformance with organizational practices, serve as training aids, provide ready reference and documentation of proper procedures, reduce work effort, reduce error occurrences in data, and improve data comparability, credibility, and defensibility. They should be sufficiently clear and written in a step-by-step format to be readily understood by a person knowledgeable in the general concept of the procedure. Elements to include in SOPs are:

1. Scope and Applicability
2. Summary of Method
3. Definitions
4. Health and Safety Warnings
5. Cautions
6. Interferences
7. Personnel Qualifications
8. Apparatus and Materials
9. Instrument or Method Calibration
10. Sample Collection
11. Handling and Preservation Sample Preparation and Analysis
12. Troubleshooting
13. Data Acquisition, Calculations & Data Reduction
14. Computer Hardware & Software (used to manipulate analytical results and report data)
15. Data Management and Records Management

SOPs should follow the guidance document *Guidance for the Preparation of Standard Operating Procedures* EPA QA/G-6[42]. Copies of this document are available through the QAD office as well as the QAD Homepage *(http://es.epa.gov/ncerqa).*

Many of these operational procedures listed above are included in the EPA reference and equivalent methods, and EPA guidance documents. However, it is the organization's responsibility to develop its own unique written operational procedures applicable to air quality measurements made by the organization.

SOPs should be written by individuals performing the procedures that are being standardized. SOPs for the Ambient Air Quality Monitoring Program environmental data operations must be included in QAPPs, either by reference or by inclusion of the actual method. If a method is referenced, it must be stated that the method is followed exactly or an addendum that explains changes to the method must be included in the QAPP. If a modified method will be used for an extended period of time, the method should be revised to include the changes to appropriate sections. In general, approval of SOPs occur during the approval of the QAPP. Individuals with appropriate training and experience with the particular SOPs in the QAPP need to review the SOPs.

9.2 Good Laboratory Practices

Good laboratory practices (GLPs) refer to general practices that relate to many, if not all of the measurements made in a laboratory. They are usually independent of the SOP and cover subjects such as maintenance of facilities, records, sample management and handling, reagent control, and cleaning of laboratory glassware[99]. In many cases the activities mentioned above may not be formally documented because they are considered common knowledge. Although not every activity in a laboratory needs to be documented, the activities that could potentially cause unnecessary measurement uncertainties, or have caused significant variance or bias, should be cause to generate a method.

In 1982, the Organization for Economic Co-operation and Development (OECD) developed principles of good laboratory practice. The intent of GLP is to promote the quality and validity of test data by covering the process and conditions under which EDOs are planned, performed, monitored, recorded and reported. The principles include[97] :

- test facility organization and personnel
- quality assurance program
- facilities
- apparatus, material and reagents
- test systems
- test and reference substances
- standard operating procedures
- performance of the study
- reporting of study results
- storage and retention of records and material

9.3 Laboratory Activities

For ambient air samples to provide useful information or evidence, laboratory analyses must meet the following four basic requirements:

1. Equipment must be frequently and properly calibrated and maintained (Section 12).
2. Personnel must be qualified to make the analysis (Section 4).
3. Analytical procedures must be in accordance with accepted practice (Section 9.1 above).
4. Complete and accurate records must be kept (Section 5).

As indicated, these subjects are discussed in other sections of this document. For the Ambient Air Quality Monitoring Program, laboratory activities are mainly focused on the pollutants associated with manual measurements; basically lead, particulate matter, and PAMS (VOCs). However, many laboratories also prepare reference material, test or certify instruments, and perform other activities necessary to collect and report measurement data. Each laboratory should define these critical activities and ensure there are consistent methods for their implementation.

10. Quality Control

Quality Control (QC) is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer[9]. QC is both corrective and proactive in establishing techniques to prevent the generation of unacceptable data, and so the policy for corrective action should be outlined. In the case of the Ambient Air Quality Monitoring Program, QC activities are used to ensure that measurement uncertainty, as discussed in Section 4, is maintained within acceptance criteria for the attainment of the DQO. Figure 10.1 describes the process of accepting routine data, which includes implementing and evaluating QC activities. The QAD document titled *EPA Guidance for Quality Assurance Project Plans*[31] provides additional guidance on this subject. This document is available on the EPA QA Division Homepage *(http://es.epa.gov/ncerqa/qa /)*.

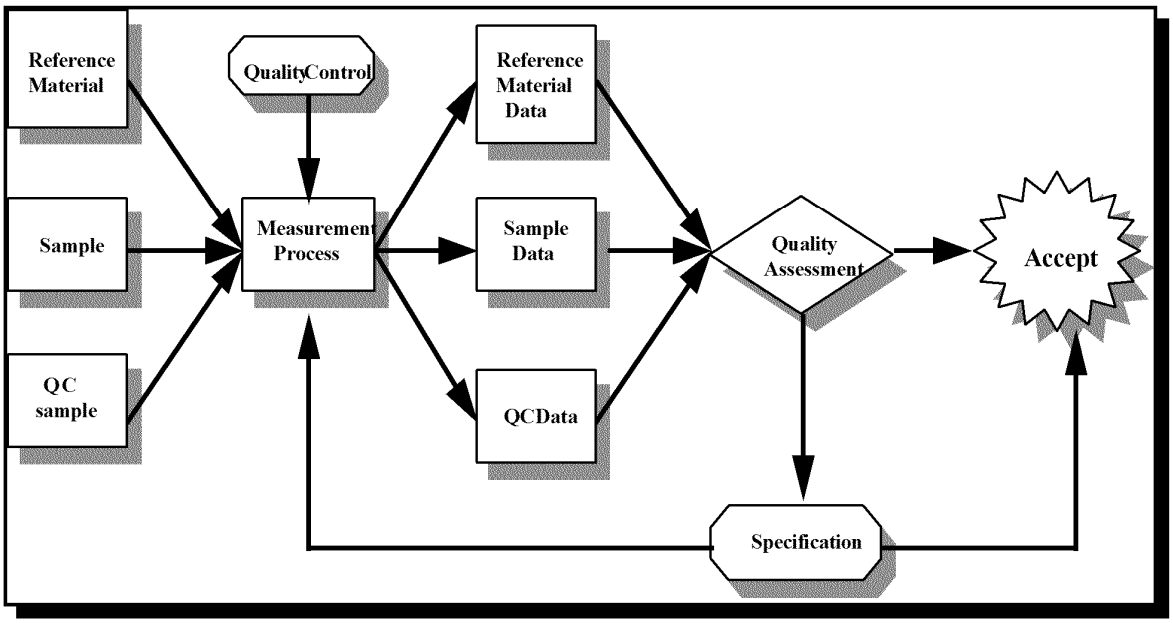

Figure 10.1 Flow diagram of the acceptance of routine data values

There is a wide variety of techniques that fall under the category of QC. Figure 10.2 lists a number of these activities. Figures 10.1 and 10.2 illustrate the types QC and quality assessment activities used to assess data quality. For the Ambient Air Quality Monitoring Program, 40 CFR Part 58 Appendix A[14], and the federal reference and equivalent methods in Part II of this document discuss a number of QC checks that are to be used. The MQO tables included in Appendix 3 also identify the most critical QC samples. However, it is the responsibility of the State and local organizations through the development of their QAPP and quality system to develop and document the:

- QC techniques
- frequency of the check and the point in the measurement process in which the check is introduced
- traceability of standards
- matrix of the check sample
- level of concentration of analyte of interest

- actions to be taken in the event that a QC check identifies a failed or changed measurement system
- formulae for estimating data quality indicators
- procedures for documenting QC results, including control charts
- description of how the data will be used to determine that measurement performance is acceptable

Tables 10-1 and 10-2 provide an example of the QC criteria established for the $PM_{2.5}$ network. Some of the elements identified above are included in this table.

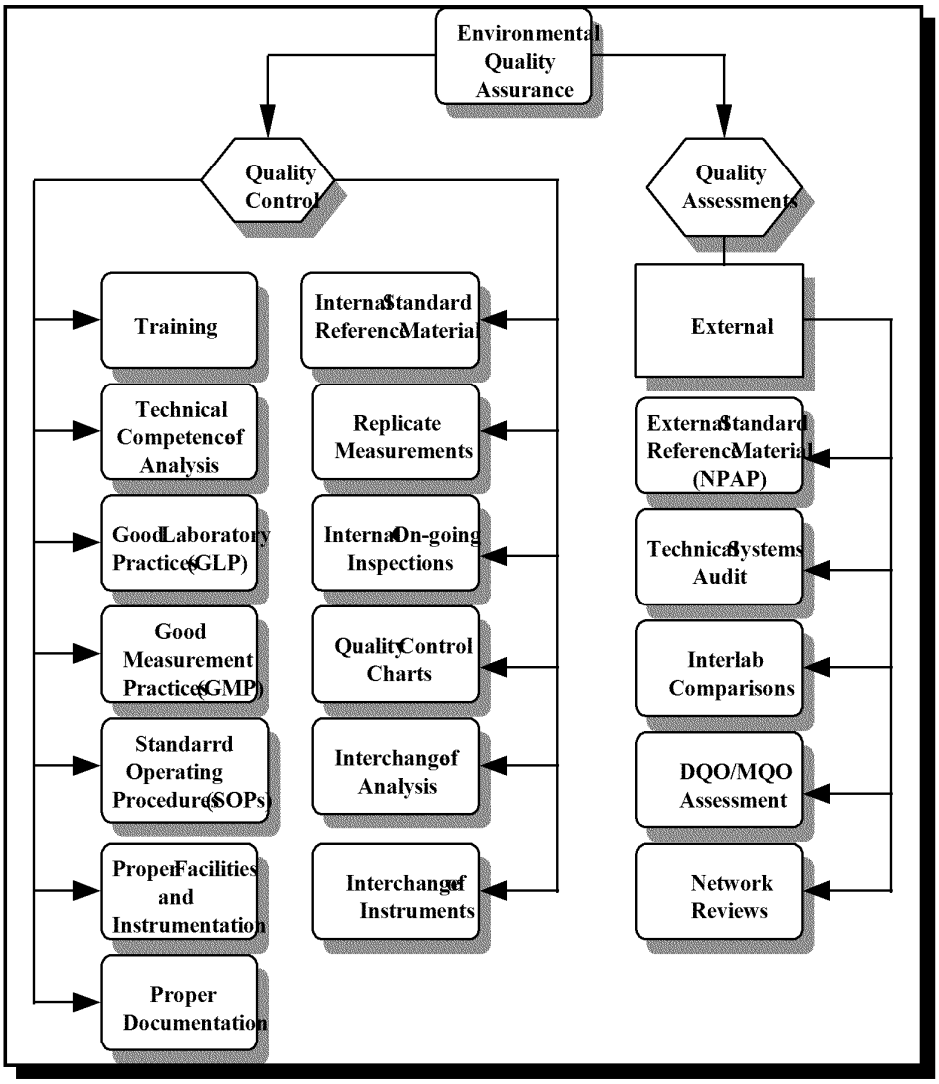

Figure 10.2 Types of quality control and quality assessment activities

Table 10-1 $PM_{2.5}$ Field QC Checks

Requirement	Frequency	Acceptance Criteria	CFR Reference	2.12 Reference	Information Provided
Calibration Standards					
Flow Rate Transfer Std.	1/yr	±2% of NIST-traceable Std.	Part 50, App.L Sec 9.1, 9.2	Sec. 6.3	Certification of Traceability
Field Thermometer	1/yr	± 0.1° C resolution	not described	Sec 4.2 and 8.3	Certification of Traceability
		± 0.5° C accuracy	not described	"	
Field Barometer	1/yr	± 1 mm Hg resolution	not described	"	Certification of Traceability
		± 5 mm Hg accuracy	not described	"	
Calibration/Verification					
Flow Rate (FR) Calibration	If multi-point failure	± 2% of transfer standard	Part 50, App.L, Sec 9.2	Sec 6.3 and 6.6	Calibration drift and memory effects
FR multi-point verification	1/yr	± 2% of transfer standard	Part 50, App.L, Sec 9.2.5	Sec 8.3	Calibration drift and memory effects
One point FR verification	1/4 weeks	± 4% of transfer standard		Sec 8.3	Calibration drift and memory effects
External Leak Check	every 5 sampling events	80 mL/min	Part 50, App.L, Sec 7.4	Sec. 8.3	Sampler function
Internal Leak Check	every 5 sampling events	80 mL/min	"	Sec. 8.3	Sampler function
Temperature Calibration	If multi-point failure	± 2% of standard	Part 50, App.L, Sec 9.3	Sec. 6.4	Calibration drift and memory effects
Temp multi-point verification	on installation, then 1/yr	± 2 C of standard	Part 50, App.L, Sec 9.3	Sec. 6.4 and 8.2	Calibration drift and memory effects
One- point temp Verification	1/4 weeks	± 4 C of standard	"	Sec. 6.4 and 8.2	Calibration drift and memory effects
Pressure Calibration	on installation, then 1/yr	±10 mm Hg	"	Sec. 6.5	Calibration drift and memory effects
Pressure Verification	1/4 weeks	±10 mm Hg	"	Sec. 8.2	Calibration drift and memory effects
Clock/timer Verification	1/ 4 weeks	1 min/mo	Part 50, App.L, Sec 7.4	not described	Verification of to assure proper function
Blanks					
Field Blanks	See 2.12 reference	±30 ug	Part 50, App.L Sec 8.2	Sec. 7.10	Measurement system contamination
Precision Checks					
Collocated samples	every 6 days	CV ≤ 10%	Part 58, App.A, Sec 3.5, 5.5	Sec. 10.3	Measurement system precision
Accuracy					
Flow rate audit	1/2wk (automated)	± 4% of transfer standard	Part 58, App A, Sec 3.5.1	Sec. 8.1	Instrument bias/accuracy
	1/3mo (manual)				
External Leak Check	4/yr	< 80 mL/min		"	Sampler function
Internal Leak Check	4/yr	< 80 mL/min	not described	"	Sampler function
Temperature Check	4/yr	± 2 C	not described	"	Calibration drift and memory effects
Pressure Check	4/yr (?)	±10 mm Hg	not described	"	Calibration drift and memory effects
Audits (*external assessments*)					
FRM Performance audit	25% of sites 4/yr	± 10%	Part 58, App A, Sec 3.5.3	Sec 10.3	Measurement system bias
Flow rate audit	1/yr	± 4% of audit standard	not described	Sec 10.2	External verification bias/accuracy
External Leak Check	1/yr	< 80 mL/min	not described		Sampler function
Internal Leak Check	1/yr	< 80 mL/min	not described		Sampler function
Temperature Audit	1/yr	± 2 C	not described		Calibration drift and memory effects
Pressure Audit	1/yr	±10 mm Hg	not described		Calibration drift and memory effects

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Table 10 $_{2.PM2.5}$ Laboratory QC Checks

Requirement	Frequency	Acceptance Criteria	QA Guidance Document 2.12 Reference	Information Provided
Blanks				
Lot Blanks	3-lot	±15 ug difference	2.12 Sec. 7	Filter stabilization/equilibrium
Lab Blanks	3 per batch	±15 ug difference	Part 50, App.L Sec 8.2 2.12 Sec. 7.10	Laboratory contamination
Calibration/Verification				
Balance Calibration	1/yr	Manufacturers spec.	2.12 sec 7.2	Verification of equipment operation
Lab Temp. Calibration	3 mo	± 2 C	QAPP Sec. 13/16	Verification of equipment operation
Lab Humidity Calibration	3 mo	±2%	QAPP Sec. 13/16	Verification of equipment operation
Accuracy				
Balance Audit	1/year	±15 g for unexposed filters	2.12 Sec 10.2	Laboratory technician operation
Balance Check	beginning, every 10th samples, end	≤ 3 ug	2.12 Sec. 7.8	Balance accuracy/stability
Calibration standards				
Working Mass Stds.	3-6 mo.	25 ug	2.12 Sec 4.3 and 7.3	Standards verification
Primary Mass Stds.	1/yr	25 ug	"	Primary standards verification
Precision				
Duplicate filter weighings	1 per weighing session	±15 ug difference	2.12 Tab 7-1 QAPP Sec. 13/16	Weighing repeatability/filter stability

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Other elements of an organization's QAPP that may contain related sampling and analytical QC requirements include:

- **Sampling Design,** which identifies the planned field QC samples as well as procedures for QC sample preparation and handling;
- **Sampling Methods Requirements**, which includes requirements for determining if the collected samples accurately represent the population of interest;
- **Sample Handling and Custody Requirements**, which discusses any QC devices employed to ensure samples are not tampered with (e.g., custody seals) or subjected to other unacceptable conditions during transport;
- **Analytical Methods Requirements**, which includes information on the subsampling methods and information on the preparation of QC samples (e.g., blanks and replicates); and
- **Instrument Calibration and Frequency**, which defines prescribed criteria for triggering recalibration (e.g., failed calibration checks).

10.1 Use of Computers for Quality Control

With the wide range of economical computers now available, consideration should be given to a computer system that can process and output the information in a timely fashion. Such a computer system should be able to:

- compute calibration equations
- compute measures of linearity of calibrations (e.g., standard error or correlation coefficient)
- plot calibration curves
- compute zero/span drift results
- plot zero/span drift data
- compute precision and accuracy results
- compute control chart limits
- plot control charts
- automatically flag out-of-control results
- maintain and retrieve calibration and performance records

11. Instrument Equipment Testing, Inspection, and Maintenance

Implementing an ambient air monitoring network, with the various types of equipment needed, is no easy task. It is important that all equipment used to produce data are tested, inspected, and maintained in sound condition. Every piece of equipment has an expected life span. Through proper testing, inspection and maintenance programs, organizations can be assured that equipment is capable of operating at acceptable performance levels.

Some procedures for equipment testing, inspection and maintenance are explained below or in other sections. Due to the enormous amount of equipment that potentially could be used in the Ambient Air Monitoring Program, this section can not provide guidance on each type of equipment. In most cases, the manufacturers of the equipment provide inspection and maintenance information in the operating manuals. What is important is that State and local organizations, in the development of the QAPP and a quality system, should address the scheduling and documentation of routine testing, inspection and maintenance. Many organizations develop detailed maintenance documents for ambient air monitoring; some for each monitoring site. Elements to include in testing, inspection and maintenance documents would include:

- equipment lists - by organization or station
- spare equipment/parts lists - by equipment, including suppliers
- inspection/maintenance frequency - by equipment
- testing frequency and source of the test concentrations or equipment
- equipment replacement schedules
- sources of repair- by equipment
- service agreements that are in place
- monthly check sheets and entry forms for documenting testing, inspection, maintenance performed

Testing, inspection and maintenance procedures should be available at each monitoring station.

11.1 Instrumentation

11.1.1 Analyzers

Except for the specific exceptions described in Appendix C of Part 58[16], monitoring methods used for SLAMS monitoring must be a reference or equivalent method, designated as such by the 40 CFR Part 53[23] (see Section 7.3). Among reference and equivalent methods, a variety of analyzer designs and features are available. For some pollutants, analyzers employing different measurement principles are available, and some analyzer models provide a higher level of performance than others that may only meet the minimum performance specifications (see Table 7-5). Accordingly, in selecting a designated method for a particular monitoring application, consideration should be given to such aspects as:

- the suitability of the measurement principle
- analyzer sensitivity
- susceptibility to interferences that may be present at the monitoring site
- requirements for support gases or other equipment
- reliability
- maintenance requirements
- initial as well as operating costs

- features such as internal or fully automatic zero and span checking or adjustment capability, etc.

References 60, 68 69, 70 and 95 may be helpful in evaluating and selecting automated analyzers. It is important that the purchase order for a new reference or equivalent analyzer specify the designation by the EPA and document the required performance specifications, terms of the warranty, time limits for delivery and for acceptance testing, and what happens in the event that the analyzer delivered falls short of the requirements[60]. Upon receiving the new analyzer, the user should carefully read the instruction or operating manual provided by the manufacturer of the analyzer. The manufacturer's manual should contain information or instructions concerning:

- unpacking and verifying that all component parts were delivered
- checking for damage during shipment
- checking for loose fittings and electrical connections
- assembling the analyzer
- installing the analyzer
- calibrating the analyzer
- operating the analyzer
- preventive maintenance schedule and procedures
- trouble shooting
- list of expendable parts

Following analyzer assembly, an initial verification that the instrument is calibrated should be performed to determine if the analyzer is operating properly. Analyzer performance characteristics such as response time, noise, short-term span and zero drift, and precision should be checked during the initial calibration or measured by using abbreviated forms of the test procedures provided in 40 CFR Part 53[23]. Acceptance of the analyzer should be based on results from these performance tests[60]. Once accepted, reference and equivalent analyzers are warranted by the manufacturer to operate within the required performance limit for one year[23].

11.1.2 Support Instrumentation

Experience of the State and local staff plays the major role in the selection of support equipment. Preventive maintenance, ease of maintenance, and general reliability play a crucial role in the selection of support equipment. The following examples show some support equipment and some typical features to look for when selecting this equipment.

- **Calibration Standards:** Calibration standards are normally two types: Mass Flow Controlled (MFC) or permeation devices. See Appendix 12 for details on these type of devices. Normally, it is recommended that they are 110 VAC, compatible with DAS systems for automated calibrations and have true transistor-transistor logic (TTL).
- **Data Acquisition Systems (DAS):** It is recommended that DAS have 16 bit logic, have modem capabilities, allow remote access and control and be able to initiate automated calibrations.
- **Analog Chart Recorders:** It is recommended that chart recorders be able to have multi-pen capablities, accept multi-voltage inputs (i.e, be able to accept 1, 5 or 10 volt inputs) and be programmable.
- **Instrument Racks:** Instrument racks should be constructed of steel and be able to accept sliding trays or rails. Open racks help to keep instrument temperature down and allow air to circulate through easily.

- **Zero Air Systems:** Zero air systems should be able to deliver 10 liters/min of air that is free of contaminants, be free of ozone, NO, NO_2, SO_2 to 0.001 ppm and CO and Hydrocarbons to 0.1 ppm. There are many commercially available systems. However, simple designs can be obtained by using a series of canisters. See Section 12 for more guidance on zero air.

11.1 3 Laboratory Support

State and local agencies should employ full laboratory facilities. These facilities should be equipped with all equipment to test, repair, troubleshoot and calibrate all analyzers and support equipment necessary to operate the Ambient Air Monitoring Networks. In some cases, a State or local agency may have a central laboratory.

The laboratory should be designed to accommodate the air quality lab/shop and PM_{10} and $PM_{2.5}$ filter rooms, and enforcement instrumentation support activities. The air quality portion consists of several benches flanked by instrument racks. One bench and rack are dedicated to ozone traceability. The other instrument racks are designated for calibration and repair. A room should be set aside to house spare parts and extra analyzers.

A manifold/sample cane should be mounted behind the bench. If possible, mount a sample cane through the roof to allow any analyzers that are being tested to sample outside air. Any excess calibration gas can be exhausted to the atmosphere. It is recommended that the pump room be external to the building to eliminate noise.

Each bench area should have an instrument rack that is attached to the bench. The instrument rack should be equipped with sliding trays or rails that allow easy installation of instruments. If instrumentation needs to be repaired and then calibrated, this can be performed on the bench top or within the rack. Analyzers then can be allowed to warm up and be calibrated by a calibration unit. Instruments that are to be tested are connected to the sample manifold and allowed to sample air in the same manner as if the analyzer is being operated within a monitoring station. The analyzer's analog voltage is connected to a DAS and chart recorder and allowed to operate. If intermittent problems occur, then they can be observed on the chart recorder. The analyzer can be allowed to operate over several days to see if the anomaly or problem reappears. If it does, there is a chart record of the problem. If the instrument rack has a DAS and calibrator, nightly auto calibrations can be performed to see how the analyzer reacts to known gas concentrations. In addition, the ozone recertification bench and rack are attached to a work bench. The rack should house the ozone primary standard, and the ozone transfer standards that are being checked for recertification. Zero air is plumbed into this rack for the calibration and testing of ozone analyzers and transfer standards.

11.2 Preventive Maintenance

Every State and local agency should develop a preventive maintenance program. Preventive maintenance is what its name implies; maintaining the equipment within a network to prevent downtime and costly repairs. Preventive maintenance is an ongoing portion of quality control. Since this is an ongoing process, it normally is enveloped into the daily routines. In addition to the daily routines, there are monthly, quarterly, semi-annually, and annually scheduled activities that must be performed.

Preventive maintenance is the responsibility of the station operators and the supervisory staff. It is important that the supervisor reviews the preventive maintenance work, and continually checks the schedule. The supervisor is responsible for making sure that the preventive maintenance is being accomplished in a

timely manner. Preventive maintenance is not a static process. Procedures must be updated for many reasons, including but not limited to new models or types of instruments and new or updated methods. Each piece of equipment (analyzers and support equipment) should have a bound notebook that contains all preventive maintenance and repair data for that particular instrument. This notebook should stay with the instrument wherever it travels.

The preventive maintenance schedule is changed whenever an activity is moved or is completed. For instance, if a multipoint calibration is performed in February instead of the March date, then the six month due date moves from August to September. The schedule is constantly in flux because repairs must be followed by calibrations or verifications. On a regular basis, the supervisor should review the preventive maintenance schedule with the station operators.

11.2.1 Instrumentation Log

Each instrument and support equipment (with the exception of the instrument racks) should have a Instrumentation Repair Log. The log can be a folder or bound notebook that contains the repair and calibration history of that particular instrument. Whenever multipoint calibrations, instrument maintenance, repair, or relocation occur, detailed notes are written in the instrumentation log. The log contains the most recent multipoint calibration report, a preventive maintenance sheet, and the acceptance testing information. If an instrument is malfunctioning and a decision is made to relocate that instrument, the log travels with that device. The log can be reviewed by staff for possible clues to the reasons behind the instrument malfunction. In addition, if the instrument is shipped to the manufacturer for repairs, the log always travels with the instrument. This helps the non-agency repair personnel with troubleshooting instrument problems.

11.2.2 Station Maintenance

Station maintenance is a portion of preventive maintenance that does not occur on a routine basis. These tasks usually occur on an "as needed" basis. The station maintenance items are checked monthly or whenever an agency knows that the maintenance needs to be performed. Examples of some station maintenance items include:

- floor cleaning
- shelter inspection
- air conditioner repair
- AC filter replacement
- weed abatement
- roof repair
- general cleaning

11.2.3 Station Log

The station log is a chronology of the events that occur at the monitoring station. The log is an important part of the equation because it contains the narrative of problems and solutions to problems. The site log notes should be written in a narrative rather than technical details. The technical details belong in the instrumentation log. The items that belong in the station log are:

- the date, time, and initials of the person(s) who have arrived at the site
- brief description of the weather (i.e., clear, breezy, sunny, raining)
- brief description of exterior of the site. Any changes that might affect the data, for instance, if someone is parking a truck or tractor near the site, this may explain high NOx values, etc.
- any unusual noises, vibrations or anything out of the ordinary
- description of the work accomplished at the site (i.e., calibrated instruments, repaired analyzer)
- detailed information about the instruments that may be needed for repairs or troubleshooting

11.2.4 Routine Operations

Routine operations are the checks that occur at specified periods of time during a monitoring station visit. The duties are the routine day-to-day operations that must be performed in order to operate a monitoring network at optimal levels. Some typical routine operations are detailed in Table 11-1.

Table 11-1 Routine Operations

Item	Each Visit	Weekly	Monthly
Print Data	X		
Mark Charts	X		
Check Exterior		X	
Change Filters.		X	
Drain Compressor		X	
Leak Test		X	
Check Desiccant			X
Inspect tubing			X
Inspect manifold and cane			X
Check electrical connections			X

In addition to these items, the exterior of the building, sample cane, meteorological instruments and tower, entry door, electrical cables and any other items deemed necessary to check should be inspected for wear, corrosion and weathering. Costly repairs can be avoided in this manner.

12. Instrument Calibration and Frequency

Prior to the implementation of a sampling and analysis program, a variety of sampling and analysis equipment must be calibrated. All data and calculations involved in these calibration activities should be recorded in a calibration log book. It is suggested that this log be arranged so that a separate section is designated for each apparatus and sampler used in the program.

In some cases, reagents are prepared prior to sampling. Some of these reagents will be used to calibrate the equipment, while others will become an integral part of the sample itself. In any case, their integrity must be carefully maintained from preparation through analysis. If there are any doubts about the method by which the reagents for a particular test were prepared or about the competence of the laboratory technician preparing these items, the credibility of the ambient air samples and the test results will be diminished. It is essential that a careful record be kept listing the dates the reagents were prepared, by whom, and their locations at all times from preparation until actual use. Prior to the test, one individual should be given the responsibility of monitoring the handling and the use of the reagents. Each use of the reagents should be recorded in a field or lab notebook.

Calibration of an analyzer establishes the quantitative relationship between actual pollutant concentration input (in ppm, ppb, ug/m^3, etc.) and the analyzer's response (chart recorder reading, output volts, digital output, etc.). This relationship is used to convert subsequent analyzer response values to corresponding pollutant concentrations. Since the response of most analyzers has a tendency to change somewhat with time (drift), the calibration must be updated (or the analyzer's response must be adjusted) periodically to maintain a high degree of accuracy. Each analyzer should be calibrated as directed by the analyzer's operation or instruction manual and in accordance with the general guidance provided here. For reference methods for CO, NO_2, and O_3, detailed calibration procedures may also be found in the appropriate appendix to 40 CFR Part 50[21]. Additional calibration information is contained in References 29, 30, 76, 77, 100 and 111 and in Part II.

Calibrations should be carried out at the field monitoring site by allowing the analyzer to sample test atmospheres containing known pollutant concentrations. The analyzer to be calibrated should be in operation for at least several hours (preferably overnight) prior to the calibration so that it is fully warmed up and its operation has stabilized. During the calibration, the analyzer should be operating in its normal sampling mode, and it should sample the test atmosphere through all filters, scrubbers, conditioners, and other components used during normal ambient sampling and through as much of the ambient air inlet system as is practicable. All operational adjustments to the analyzer should be completed prior to the calibration (see section 12.7). Analyzers that will be used on more than one range or that have auto-ranging capability should be calibrated separately on each applicable range.

Calibration documentation should be maintained with each analyzer and also in a central backup file. Documentation should be readily available for review and should include calibration data, calibration equation(s) (and curve, if prepared), analyzer identification, calibration date, analyzer location, calibration standards used and their traceabilities, identification of calibration equipment used, and the person conducting the calibration.

12.1 Calibration Standards

In general, ambient monitoring instruments should be calibrated by allowing the instrument to sample and analyze test atmospheres of known concentrations of the appropriate pollutant in air. All such (non-zero) test concentrations must be, or be derived from, local or working standards (e.g., cylinders of compressed gas or permeation devices) that are certified as traceable to a NIST primary standard. "Traceable" is defined in 40 CFR Parts 50[21] and 58[24] as meaning *" ... that a local standard has been compared and certified, either directly or via not more than one intermediate standard, to a primary standard such as a National Institute of Standards and Technology Standard Reference Material (NIST SRM) or a USEPA/NIST-approved Certified Reference Material (CRM)".* Normally, the working standard should be certified directly to the SRM or CRM, with an intermediate standard used only when necessary. Direct use of a CRM as a working standard is acceptable, but direct use of an NIST SRM as a working standard is discouraged because of the limited supply and expense of SRM's. At a minimum, the certification procedure for a working standard should:

- establish the concentration of the working standard relative to the primary standard
- certify that the primary standard (and hence the working standard) is traceable to an NIST primary standard
- include a test of the stability of the working standard over several days
- specify a recertification interval for the working standard

Certification of the working standard may be established by either the supplier or the user of the standard.

Test concentrations of ozone must be traceable to a primary standard UV photometer as described in 40 CFR Part 50 Appendix D[17]. Reference 67 describes procedures for certifying transfer standards for ozone against UV primary standards.

Test concentrations at zero concentration are considered valid standards. Although zero standards are not required to be traceable to a primary standard, care should be exercised to ensure that zero standards are indeed adequately free of all substances likely to cause a detectable response from the analyzer. Periodically, several different and independent sources of zero standards should be compared. The one that yields the lowest response can usually (but not always) be assumed to be the "best zero standard". If several independent zero standards produce exactly the same response, it is likely that all the standards are adequate.

The accuracy of flow measurements is critically important in many calibration procedures. Flow or volume measuring instruments should be calibrated and certified at appropriate intervals (usually 3 to 6 months) against NIST or other authoritative standards such as a traceable bubble flow meter or gas meter. Flow rate verifications, calibrations, acceptance criteria, methods, and frequencies are discussed in individual methods found in Part II of this Volume of the Handbook.

12.2 Multi-point Calibrations

Multi-point calibrations consist of three or more test concentrations, including zero concentration, a concentration between 80% and 90% of the full scale range of the analyzer under calibration, and one or more intermediate concentrations spaced approximately equally over the scale range. Multi-point calibrations are used to establish or verify the linearity of analyzers upon initial installation, after major repairs and at specified frequencies. Most modern analyzers have a linear or very nearly linear response with concentration. If a non-linear analyzer is being calibrated, additional calibration points should be included to adequately define the calibration relationship, which should be a smooth curve. Multi-point calibrations are likely to be more accurate than two-point calibrations because of the averaging effect of the multiple points and because an error in the generation of a test concentration (or in recording the analyzer's response) is more likely to be noticed as a point that is inconsistent with the others. For this reason, calibration points should be plotted or evaluated statistically as they are obtained so that any deviant points can be investigated or repeated immediately.

Most analyzers have zero and span adjustment controls, which should be adjusted based on the zero and highest test concentrations, respectively, to provide the desired scale range within the analyzer's specifications (see section 12.5). For analyzers in routine operation, unadjusted (''as is") analyzer zero and span response readings should be obtained prior to making any zero or span adjustments . $NO/NO_2/NO_x$ analyzers may not have individual zero and span controls for each channel; the analyzer's operation/instruction manual should be consulted for the proper zero and span adjustment procedure. Zero and span controls often interact with each other, so the adjustments may have to be repeated several times to obtain the desired final adjustments.

After the zero and span adjustments have been completed and the analyzer has been allowed to stabilize on the new zero and span settings, all calibration test concentrations should be introduced into the analyzer for the final calibration. The final, post-adjusted analyzer response readings should be obtained from the same device (chart recorder, data acquisition system, etc.) that will be used for subsequent ambient measurements. The analyzer readings are plotted against the respective test concentrations, and the best linear (or nonlinear if appropriate) curve to fit the points is determined. Ideally, least squares regression analysis (with an appropriate transformation of the data for non-linear analyzers) should be used to determine the slope and intercept for the best fit calibration line of the form, $y = mx + a$, where y represents the analyzer response, x represents the pollutant concentration, m is the slope, and a is the x-axis intercept of the best fit calibration line. When this calibration relationship is subsequently used to compute concentration measurements (x) from analyzer response readings (y), the formula is transposed to the form, $x = (y - a)/m$.

As a quality control check on calibrations, the standard error or correlation coefficient can be calculated along with the regression calculations. A control chart of the standard error or correlation coefficient could then be maintained to monitor the degree of scatter in the calibration points and, if desired, limits of acceptability can be established.

12.3 Level 1 Zero and Span Calibration

A level 1 zero and span calibration is a simplified, two-point analyzer calibration used when analyzer linearity does not need to be checked or verified. Sometimes when no adjustments are made to the analyzer, the level 1 calibration may be called a zero/span check, in which case it must not be confused with a level 2 zero/span check (see 12.4). Since most analyzers have a reliably linear or near-linear output response with concentration, they can be adequately calibrated with only two concentration standards (two-point calibration). Furthermore, one of the standards may be zero concentration, which is relatively easily obtained and need not be certified. Hence, only one certified concentration standard is needed for the two-point (level 1) zero and span calibration. Although lacking the advantages of the multi-point calibration, the two-point zero and span calibration can be (and should be) carried out much more frequently. Also, two-point calibrations are easily automated. Frequent checks or updating of the calibration relationship with a 2-point zero and span calibration improves the quality of the monitoring data by helping to keep the calibration relationship more closely matched to any changes (drift) in the analyzer response.

As with any calibration, the analyzer should be operating in its normal sampling mode, and generally the test concentrations should pass through as much of the inlet and sample conditioning system as is practicable. For NO_2, SO_2, and particularly for O_3, wet or dirty inlet lines and particulate filters can cause changes in the pollutant concentration. For PAMS, sample inlet lines to the analyzer should be kept as short as possible. Efforts should be made, at least periodically, to introduce the span calibration concentration into the sampling system as close to the outdoor sample inlet point as possible. The calibration response under these conditions can then be compared to the response when the span concentration is introduced at the analyzer, downstream of the sample inlet components, as a check of the entire sample inlet system. Some CO analyzers may be temporarily operated at reduced vent or purge flows, or the test atmosphere may enter the analyzer at a point other than the normal sample inlet provided that such a deviation from the normal sample mode is permitted by the analyzer's operation or instruction manual and the analyzer's response is not likely to be altered by the deviation. Any such operational modifications should be used with caution, and the lack of effect should be verified by comparing test calibrations made before and after the modification. The standards used for a level 1 zero and span calibration must be certified traceable as described previously under Section 12.1. The span standard should be a concentration between about 70% and 90% of the analyzer's full scale measurement range. Adjustments to the analyzer may be made during the zero and span calibration. However, it is strongly recommended that unadjusted (i.e., "as is") analyzer response readings be obtained before any adjustments are made to the analyzer. As described later, these unadjusted zero and span readings provide valuable information for: (1) confirming the validity of (or invalidating) the measurements obtained immediately preceding the calibration, (2) monitoring the analyzer's calibration drift, and (3) determining the frequency of recalibration. Accordingly, the following procedure for a zero and span calibration is recommended:

1. Disconnect the analyzer's inlet from the ambient intake and connect it to a calibration system. Leave the analyzer in its normal sampling mode, and make no other adjustments to the analyzer (except as mentioned previously for some CO analyzers).
2. Sample and measure the span test concentration and record the unadjusted, stable ("as is") span response reading (S'). NOTE: All analyzer response readings should be recorded in the analyzer's normal output units, e.g., millivolts, percent of scale, etc. (the same units used for the calibration curve). If these units are concentration units they should be identified as “indicated" or “uncorrected” to

differentiate them from the "actual" concentration units that are used for reporting actual ambient concentration measurements.

3. Sample and measure the zero test concentration standard and record the unadjusted, stable zero reading (Z').
4. Perform any needed analyzer adjustments (flow, pressure, etc.) or analyzer maintenance.
5. If adjustment of the zero is needed (see sections 12.5 and 12.6) or if any adjustments have been made to the analyzer, adjust the zero to the desired zero reading. Record the adjusted, stable zero reading (Z). Note that if no zero adjustment is made, the Z=Z'. Offsetting the zero reading (e.g., to 5% of scale) may help to observe any negative zero drift that may occur. If an offset (A) is used, record the non-offset reading, that is, record Z-A.
6. Sample and measure the span test concentration. If span adjustment is needed (see sections 12.5 and 12.6), adjust the span response to the desired value, allowing for any zero offset used in the previous step. Record the final adjusted, stable span reading (S). If no span adjustment is made and no offset is used, then S = S'.
7. If any adjustments made to the zero, span, or other parameters or if analyzer maintenance was carried out, allow the analyzer to restabilize at the new settings, then recheck the zero and span readings and record new values for Z and S, if necessary.

If the calibration is updated for each zero/span calibration (see section 12.9), the new calibration relationship should be plotted using the Z and S readings, or the intercept and slope should be determined as follows:

$$I = intercept = Z$$

$$M = slope = \frac{S - Z}{span\ concentration}$$

12.3.1 Documentation

All level 1 zero or span calibrations should be documented in a chronological format. Documentation should include analyzer identification, date, standard used and its traceability, equipment used, the individual conducting the span calibration, the unadjusted zero and drift span responses, and the adjusted zero and span responses. Again, quality control charts are an excellent form of documentation to graphically record and track calibration results. See Section 12.6 for a discussion on control chats. Level 1 zero and span documentation should be maintained both in a central file and at the monitoring site.

12.4 Level 2 Zero and Span Check

A level 2 zero and span check is an ''unofficial" check of an analyzer's response. It may include dynamic checks made with uncertified test concentrations, artificial stimulation of the analyzer's detector, electronic or other types of checks of a portion of the analyzer, etc. Level 2 zero and span checks are not to be used as a basis for analyzer zero or span adjustments, calibration updates, or adjustment of ambient data. They are intended as quick, convenient checks to be used between zero and span calibrations to check for possible analyzer malfunction or calibration drift. Whenever a level 2 zero and span check indicates a possible calibration problem, a level 1 zero and span (or multipoint) calibration should be carried out before any corrective action is taken.

If a level 2 zero and span check is to be used in the quality control program, a “reference response” for the check should be obtained immediately following a zero and span (or multipoint) calibration while the analyzer's calibration is accurately known. Subsequent level 2 check responses should then be compared to the most recent reference response to determine if a change in response has occurred. For automatic level 2 zero and span checks, the first scheduled check following the calibration should be used for the reference response. It should be kept in mind that any level 2 check that involves only part of the analyzer's system cannot provide information about the portions of the system not checked and therefore cannot be used as a verification of the overall analyzer calibration.

12.5 Physical Zero and Span Adjustments

Almost all ambient monitoring instruments have physical means by which to make zero and span adjustments. These adjustments are used to obtain the desired nominal scale range (within the instruments' specifications), to provide convenient (nominal) scale units, and to periodically adjust the instruments' response to correct for calibration drift. **Note**: $NO/NO_2/NO_X$ analyzers may not have individual zero and span controls for each channel. If that is the case, the zero and span controls must be adjusted only under the conditions specified in the calibration procedure provided in the analyzer's operation/instruction manual.

Precise adjustment of the zero and span controls may not be possible because of: (1) limited resolution of the controls, (2) interaction between the zero and span controls, and (3) possible delayed reaction to adjustment or a substantial stabilization period after adjustments are made. Precise adjustments may not be necessary because calibration of the analyzer following zero and span adjustments will define the precise response characteristic (calibration curve). Accordingly, zero and span adjustments must always be followed by a calibration. Allow sufficient time between the adjustments and the calibration for the analyzer to fully stabilize. This stabilization time may be substantial for some analyzers. Also, obtain unadjusted response readings before adjustments are made, as described in the previous section on level 1 zero and span calibration.

Zero and span adjustments do not necessarily need to be made at each calibration. In fact, where only relatively small adjustments would be made, it is probably more accurate not to make the adjustments because of the difficulty of making precise adjustments mentioned earlier. An appropriate question, then, is how much zero or span drift can be allowed before a physical zero or span adjustment should be made to an analyzer?

Ideally, all ambient measurements obtained from an analyzer should be calculated or adjusted on the basis of the most recent (zero and span or multipoint) calibration or on the basis of both the previous and subsequent calibrations (see section 12.9). In this case, considerable drift (i.e., deviation from an original or nominal response curve) can be allowed before physical adjustments must be made because the calibration curve used to calculate the ambient measurements is kept in close agreement with the actual analyzer response. The chief limitations are the amount of change in the effective scale range of the analyzer that can be tolerated and possible loss of linearity in the analyzer's response due to excessive deviation from the design range. Cumulative drifts of up to 20% or 25% of full scale from the original or nominal zero and span values may not be unreasonable, subject to the limitations mentioned above.

In situations where it is not possible to update the calibration curve used to calculate the ambient readings after each zero and span calibration, then the ambient readings must be calculated from the most recent multipoint calibration curve or from a fixed nominal or "universal" calibration curve (section 12.9). In this case the zero and span calibrations serve only to measure or monitor the deviation (drift error) between the actual analyzer response curve and the calibration curve used to calculate the ambient measurements. Since this error must be kept small, physical zero and span adjustments are much more critical and should be made before the error becomes large. More information on drift limits and determining when physical zero and span adjustments are needed is contained in the next section on frequency of calibration.

12.6 Frequency of Calibration and Analyzer Adjustment

As previously indicated, a multipoint calibration should be carried out on new analyzer(s), or after major repairs, to establish analyzer linearity. It is also appropriate to carry out a multipoint calibration on each analyzer in routine operation at least twice per year to reverify linearity, although an annual multipoint audit may serve in lieu of one of these. Nonlinear analyzers may require more frequent multipoint calibration if they cannot be calibrated adequately with 2-point calibrations. Specific requirements for calibration can be found in the guidance methods (Part II) and summarized in Appendix 3.

The calibrations referred to below would normally be 2-point zero and span (level 1) calibrations. However, a multi-point calibration can always substitute for a 2-point calibration. An analyzer should be calibrated (or recalibrated):

- upon initial installation
- following physical relocation
- after any repairs or service that might affect its calibration
- following an interruption in operation of more than a few days
- upon any indication of analyzer malfunction or change in calibration
- at some routine interval (see below)

Analyzers in routine operation should be recalibrated periodically to maintain close agreement between the calibration relationship used to convert analyzer responses to concentration measurements and the actual response of the analyzer. The frequency of this routine periodic recalibration is a matter of judgment and is a tradeoff among several considerations, including: the inherent stability of the analyzer under the prevailing conditions of temperature, pressure, line voltage, etc. at the monitoring site; the cost and inconvenience of

carrying out the calibrations; the quality of the ambient measurements needed; the number of ambient measurements lost during the calibrations; and the risk of collecting invalid data because of a malfunction or response problem with the analyzer that wouldn't be discovered until a calibration is carried out.

When a new monitoring instrument is first installed, level 1 zero and span calibrations should be very frequent, perhaps daily or 3 times per week, because little or no information is available on the drift performance of the analyzer. Information on another unit of the same model analyzer may be useful; however, individual units of the same model may perform quite differently. After enough information on the drift performance of the analyzer has been accumulated, the calibration frequency can be adjusted to provide a suitable compromise among the various considerations mentioned above. However, prudence suggests that the calibration frequency should not be less than every two weeks. If a biweekly frequency is selected and the level 1 zero/span calibration is carried out on the same day as the one-point precision check required in Subsection 3 of Appendices A and B of Part 58[24], the precision check must be done first.

To facilitate the process of determining calibration frequency, it is strongly recommended that control charts be used to monitor the zero and span drift performance of each analyzer. Control charts can be constructed in different ways, but the important points are to visually represent and statistically monitor zero and span drift, and to be alerted if the drift becomes excessive so that corrective action can be taken. Examples of simple zero and span control charts are shown in Figure 12.1. Such control charts make important use of the unadjusted zero and span response readings mentioned in Section 12.3.

In the zero drift chart of Figure 12.1, cumulative zero drift is shown by plotting the zero deviation in ppb for each zero/span calibration relative to a nominal calibration curve (intercept = 0 scale percent, slope = 200 scale percent per ppm for a nominal scale range of 0.5 ppm). This zero deviation may be calculated as follows:

$$D_Z = \frac{Z' - I_o}{m_o} \; X \; 1000 \; ppb/ppm$$

where:

D_Z = zero deviation from the reference calibration (e.g., nominal or original calibration), ppb;

Z' = unadjusted zero reading, e.g., scale percent;

I_o = intercept of reference calibration, e.g., scale percent;

m_o = slope of reference calibration, e.g., scale percent/ppm.

Similarly, cumulative span drift may be shown by plotting the percent deviation in the slope of the calibration curve relative to the reference calibration. This percent deviation in the span slope may be calculated as follows:

$$D_s = \frac{m_c - m_o}{m_o} \; X \; 100 \; percent$$

where:

D_s = span deviation from reference calibration, percent;

m_o= slope of reference calibration, e.g., scale percent/ppm;

m_c= slope of current analyzer calibration

$$slope = \frac{S' - Z'}{C}$$, e.g., scale percent/ppm;

S' = unadjusted span reading, e.g., scale percent;

Z' = unadjusted zero reading, e.g., scale percent;

C = span concentration.

Where physical zero or span adjustments have been made to the analyzer (marked by diamonds along the horizontal axes in Figure 12.1), both the unadjusted (Z', S') and the adjusted readings (Z, S) are plotted (substitute Z for Z' and S for S' in the formulas). The connecting line stops at the unadjusted reading, makes a vertical transition representative of the physical adjustment, then continues from the adjusted reading.

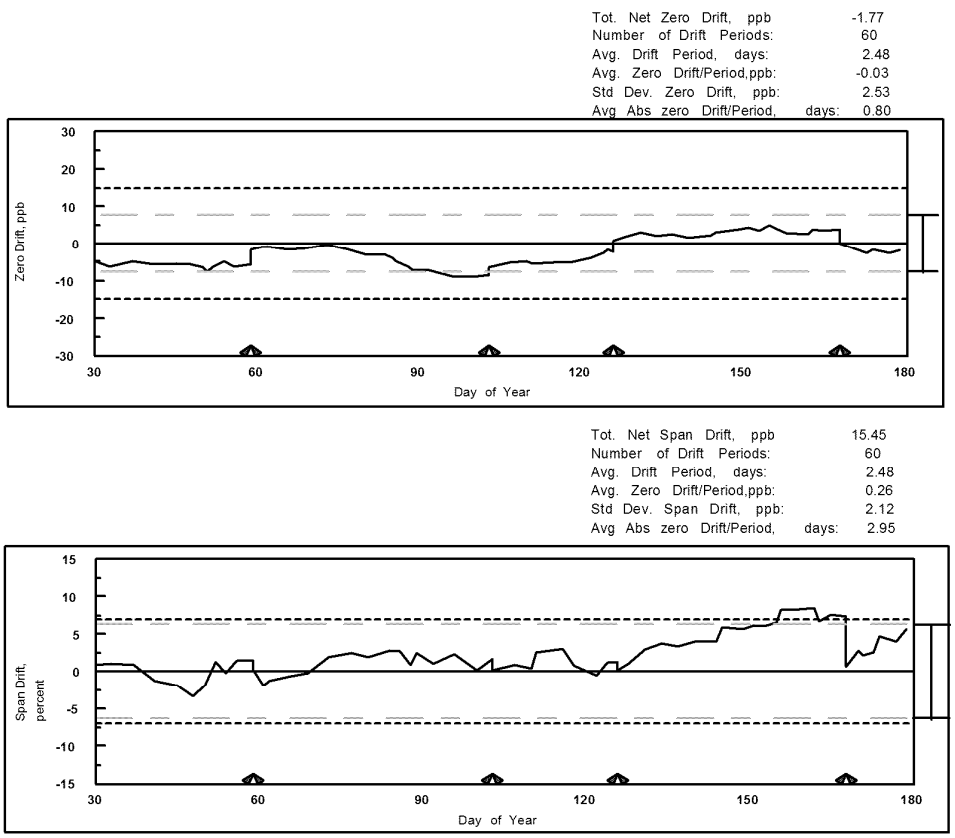

Figure 12.1 Examples of simple zero and span charts

The charts in Figure 12.1 cover a period of 180 days, with zero/span calibration every 2 or 3 days (2.5 days on the average). Practical adjustment limits were set at ±15 ppb for zero and ± 7% for span, (shown as broken lines in Figure 12.1), although most of the span adjustments and all of the zero adjustments were made before these limits were reached. These limits could have been set wider because the calibration slope and intercept used to calculate the ambient readings were updated at each zero/span calibration. Narrower limits may be needed if the calibration curve used to calculate the ambient data is not updated at each zero/span calibration.

The total net cumulative zero drift over the entire 180 day period (ignoring zero adjustments) was -1.77 ppb, indicating that the analyzer's zero stability was good. Total net cumulative span drift (ignoring span adjustments) was +15.45%, indicating that the analyzer should be watched closely for continued positive span drift. Most of the individual zero and span drifts (i.e., the net change from one zero/span calibration to the next) were small. The average of the absolute values of these individual zero drifts (ignoring zero adjustments) was 0.80 ppb, and the average of the absolute values of the individual span drifts (ignoring span adjustments) was 2.95 percent. In view of these relatively low values, the frequency of zero/span calibrations could be reduced, say to twice a week or every 4 days, particularly if level 2 zero/span checks were used between the level 1 zero/span calibrations. However, such reduced calibration frequency would tend to increase the average error between the actual analyzer response and the calibration curve used to calculate the ambient measurements. Reduced calibration frequency would also increase the risk of collecting invalid data because of potentially increased delay in discovering a malfunction or serious response change. If either of the average zero or average span drift is large, more frequent zero/span calibration should be considered.

A final pair of statistics that should be calculated is the standard deviations of the individual zero and span drifts, respectively (again, ignoring zero and span adjustments). These values (2.53 ppb and 2.12%, respectively, for the charts shown in Figure 12.1) provide a measure of the typical drift performance of the analyzer. A band equal to +3 standard deviations can be established to represent "normal" performance of the analyzer. Such a band is represented on the charts of Figure 12.1 by the I-bands at the right edge of the charts. Any excursion outside of these bands is an indication of a possible performance problem that may need corrective action or additional scrutiny.

In continuous monitoring, the total cumulative drift, average of the absolute values of the individual drifts, and the standard deviation of the individual drifts should be calculated on a running basis over the last 100 or so days. Figure 12.2 summarizes some of the ranges and control chart limits discussed previously. These limits are suggested, but they could be modified somewhat at the discretion of the monitoring agency. There are also other ways to control chart.

12.7 Automatic Self-Adjusting Analyzers

Some air monitoring analyzers are capable of periodically carrying out automatic zero and span calibrations and making their own zero and span self adjustments to predetermined readings. How should such automatic zero/span calibrations be treated? If the automatic zero/span calibration meets all the requirements discussed previously for level 1 zero and span calibrations (i.e., traceable standards that pass through the sample inlet and sample conditioning system) and both the adjusted and unadjusted zero and span response readings can be obtained from the data recording device, then the calibration may be treated

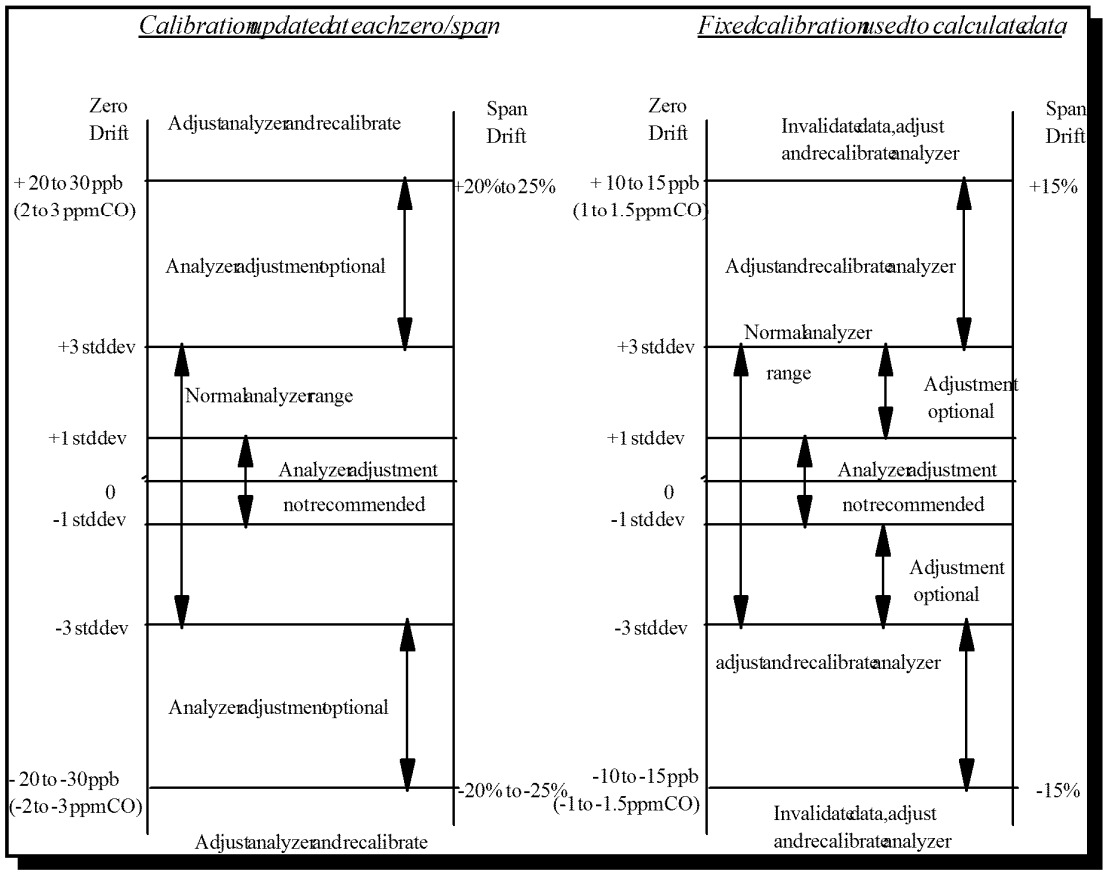

Figure 12.2 Suggested zero and span drift limits when calibration is used to calculate measurements is updated at each zero/span calibration and when fixed calibration is used to calculate measurements.

as a valid zero/span calibration as discussed in this section. If the automatic calibrations do not qualify as level 1 calibrations (because the zero and span readings cannot be read from the strip chart for example), then the analyzer must receive manual zero/span calibrations as if it had no automatic capabilities. In this case, the automatic zero and span adjustments should be ignored, except that manual calibrations should be separated in time as much as possible from the occurrence of the automatic calibrations for maximal benefit. It may sometimes happen that automatic and manual calibrations interact, producing a detrimental effect on the monitoring data. If so, the automatic calibrations should be discontinued or adjusted to avoid continuation of the conflict.

12. 8 Data Reduction Using Calibration Information

As noted previously, an analyzer's response calibration curve relates the analyzer response to actual concentration units of measure, and the response of most analyzers tends to change (drift) unpredictably with passing time. These two conditions must be addressed in the mechanism that is used to process the raw analyzer readings into final concentration measurements. Four practical methods are described below. They are listed in order of preference, with the first one being the most likely to minimize errors caused by differences between the actual analyzer response and the response curve used to calculate the measurements.

As would be expected, the order also reflects decreasing complexity and decreasing difficulty of implementation. The first 3 methods are best implemented with automatic data processing systems because of the number of calculations required. Methods 3 and 4 could be used on a manual basis and are more labor intensive because of the need for more frequent and precise physical adjustment of analyzer zero and span controls

1) Linear Interpolation--In this method, the (linear) calibration curve used to convert analyzer readings to concentration values is defined by a slope and intercept, which are updated at each calibration. Both unadjusted and adjusted response readings are required for each calibration. Each ambient concentration is calculated from individual slope and intercept values determined by linear interpolation between the adjusted slope and intercept of the most recent previous calibration and the unadjusted slope and intercept of the first subsequent calibration.

Because of the need for subsequent (level 1) calibration information, this method cannot be used for real time calculation of concentration readings. Also, some contingency arrangement (such as method 2) must be employed when a subsequent calibration is missing (e.g., following a disabling malfunction). Physical zero and span adjustments to the analyzer are needed only to maintain an appropriate scale range or to avoid scale nonlinearity due to cumulative drift in excess of design values.

Within these constraints, data invalidation limits should be based on net change from one calibration to the next, rather than on total cumulative drift, because the calibration is continually updated. A significant problem with this method is acquiring the requisite calibration data and making sure it is merged correctly with the ambient data to facilitate the required calculations. Some automated data acquisition systems support this application by making special provisions to acquire and process periodic zero and span data. One way to ensure that the zero/span data are correctly merged with the ambient readings is to code the zero and span values directly into the data set at the location corresponding to the time of calibration, replacing the normal hourly reading that is lost anyway because of the calibration. This data can be marked (such as with a negative sign) to differentiate it from ambient data and later deleted from the final report printout. When zero and span data is acquired automatically by a data acquisition system for direct computer processing, the system must be sufficiently sophisticated to:

- ensure that zero or span data is never inadvertently reported as ambient measurements
- ignore transient data during the stabilization period before the analyzer has reached a stable zero or span response (this period may vary considerably from one analyzer to another)
- average the stable zero and span readings over some appropriate time period so that the zero or span reading obtained accurately represents the analyzers true zero or span response
- ignore ambient readings for an appropriate period of time immediately following a zero or span reading until the analyzer response has restabilized to the ambient-level concentration

2) Step-Change Update--This method is similar to Method 1 above except that the adjusted slope and intercept of the most recent calibration are used to calculate all subsequent ambient readings until updated by another calibration (i.e., no interpolation). No unadjusted zero or span readings are used, and ambient measurements can be calculated in real time if desired. The same comments concerning physical zero and span adjustments and data invalidation limits given for Method 1 apply, as well as the comments concerning zero and span data acquired automatically by a data acquisition system.

3) Major Calibration Update--In this method, the calibration slope and intercept used to calculate ambient measurements are updated only for "major" calibration--i.e., monthly or quarterly multi-point calibrations. All ambient measurements are calculated from the most recent major calibration. Between major calibrations, periodic zero and span calibrations are used to measure the difference between the most recent major calibration and the current instrument response. Whenever this difference exceeds the established zero/span adjustment limits (see sections 12.5 and 12.6), physical zero and/or span adjustments are made to the analyzer to restore a match between the current analyzer response and the most recent major calibration. Neither adjusted nor unadjusted zero or span readings are used in the calculation of the ambient concentrations.

4) "Universal" Calibration--A fixed, "universal" calibration is established for the analyzer and used to calculate all ambient readings. All calibrations are used to measure the deviation of the current analyzer response from the universal calibration. Whenever this deviation exceeds the established zero and span adjustment limits, physical zero and/or span adjustments are made to the analyzer to match the current analyzer response to the universal calibration.

12.9 Validation of Ambient Data Based on Calibration Information

When zero or span drift validation limits (see section 12.6) are exceeded, ambient measurements should be invalidated back to the most recent point in time where such measurements are known to be valid. Usually this point is the previous calibration (or accuracy audit), unless some other point in time can be identified and related to the probable cause of the excessive drift (such as a power failure or malfunction). Also, data following an analyzer malfunction or period of non-operation should be regarded as invalid until the next subsequent (level 1) calibration unless unadjusted zero and span readings at that calibration can support its validity.

13. Inspection/Acceptance for Supplies and Consumables

Pollutant parameters are measured using either wet chemical techniques or physical methods. Chemical analysis always involves the use of consumable supplies that must be replaced on a schedule consistent with their stability and with the rate at which samples are taken. Currently used instruments require adequate supplies of chemicals for operation for 3 months so that the supplier can comply with the delivery schedules. In some cases, analytical reagents for specific air contaminants deteriorate rapidly and need protective storage. The following information may be helpful when considering the use of these consumable items. Much of the information presented below is derived from the document *Quality Assurance Principles for Analytical Laboratories*[36].

13.1 Supplies Management

Control of supplies and consumables is important to the success of the quality assurance program. It is important that specifications for each item are prepared and adhered to during the procurement process. When specifications are prepared, the following points should be considered: identity, purity, potency, source, tests to be conducted for quality and purity, need for further purification, storage and handling procedures, and replacement dates.

As part of supplies management, the following actions are recommended:

- establish criteria and specifications for the important supplies and consumables
- check and test the supplies and consumables against specifications, before placing them in use
- design and maintain a supplies management program to ensure the quality of reagents used in day-to-day operations, paying particular attention to primary reference standards, working standards, and standard solutions
- decide on the kinds of purified water that are necessary, and develop suitable tests and testing intervals to ensure the quality of water used in analytical work and for cleaning glassware
- purchase only Class A volumetric glassware and perform calibrations and recalibrations that are necessary to achieve reliable results
- establish procedures for cleaning and storing glassware with due consideration for the need for special treatment of glassware used in trace analysis
- discard chipped and etched glassware

13.2 Standards and Reagents

In some cases, reagents are prepared prior to sampling. Some of these reagents will be used to calibrate the equipment, while others will become an integral part of the sample itself. In any case, their integrity must be carefully maintained from preparation through analysis. If there are any doubts about the method by which the reagents for a particular test were prepared or about the competence of the laboratory technician preparing these items, the credibility of the ambient air samples and the test results will be diminished. It is essential that a careful record be kept listing the dates the reagents were prepared, by

whom, and their locations at all times from preparation until actual use. Prior to the test, one individual should be given the responsibility of monitoring the handling and the use of the reagents. Each use of the reagents should be recorded in a field/laboratory notebook.

Chemical reagents, solvents and gases are available in various grades. Reagents can be categorized into the following 6 grades[36]:

1. **Primary standard** - Each lot is analyzed, and the percentage of purity is certified.
2. **Analyzed reagents-** Can fall into 2 classes: a) each lot is analyzed and the percentages of impurities are reported; and b) conformity with specified tolerances is claimed, or the maximum percentages of impurities are listed.
3. **USP and NF Grade-** These are chemical reference standards where identity and strength analysis are ensured.
4. "**Pure," "c.p.," "chemically pure," "highest purity"** - These are qualitative statements for chemicals without numerical meaning
5. **"Pure," "purified," "practical grades"** - These are usually intended as starting substances for laboratory syntheses.
6. **Technical or commercial grades** - These are chemicals of widely varying purity.

Part II of this document, which contains the reference and equivalent methods, define the grades and purities needed for the reagents and gases required in the Ambient Air Quality Monitoring Program.

All reagent containers should be properly labeled either with the original label or at a minimum, the reagent, date prepared, expiration date, strength and preparer. Leftover reagents used during preparation or analysis should never be returned to bottles.

13.2.1 Primary Reference Standards

A primary reference standard can be defined as a homogenous material with specific properties such as identity, unity, and potency, that has been measured and certified by a qualified and recognized organization[36], such as the NIST) standard reference materials (SRMs). NIST maintains a catalog of SRMs that can be accessed through the Internet *(http://www.nist.gov*). Primary reference standards are usually quite expensive and are often used to calibrate, develop or assay working or secondary standards.

It is important that primary reference standards are maintained, stored and handled in a manner that maintains their integrity. These samples should be kept under secure conditions and records should be maintained that document chain of custody information.

13.2.2 Standard Solutions

Most laboratories maintain a stock of standard solutions. The following information on these solutions should be kept in a log book:

- identity of solution
- strength
- method of preparation (reference to SOP)
- standardization calculations
- recheck of solution for initial strength
- date made/expiration date
- initials of the analyst

As mentioned above, all standard solutions should contain appropriate labeling as to contents and expiration dates.

13.2.3 Purified Water

Water is one of the most critical but most often forgotten reagent in the laboratory. The water purification process should be documented, from the quality of the starting raw water to the systems used to purify the water including, how the water is delivered, the containers in which it is stored, and the tests and the frequency used to ensure the quality of the water.

13.3 Volumetric Glassware

Use of the appropriate glassware is important since many preparation and analysis require the development of reagents, standards, dilutions and controlled delivery systems. It is suggested that "Class A" glassware be used in all operations requiring precise volumes. SOPs requiring volumetric glassware should specify the size/type required for each specific operation.

13.4 Filters

Filters are used for the manual methods for the criteria pollutants PM_{10} , $PM_{2.5}$, and Pb. No commercially available filter is ideal in all respects. The sampling program should determine the relative importance of certain filter evaluation criteria (e.g., physical and chemical characteristics, ease of handling, cost). The reference methods for the PM_{10} , $PM_{2.5}$, and Pb present detailed acceptance criteria for filters; some of the basic criteria that must be met regardless of the filter type follows:

- Visual inspection for pinholes, tears, creases, or other flaws which may affect the collection efficiency of the filter which may be consistent through a batch. This visual inspection would also be made prior to filter installation and during laboratory pre- and post-weighings to assure the

integrity of the filter is maintained and therefore, the ambient air sample obtained with each filter adequately represents the sampled pollutant conditions.

- Collection efficiency - Greater than 99% as measured by DOP test (ASTM 2988) with 0.3 micrometer particles at the sampler's operating face velocity.

- Integrity - (pollutant specific) measured as the concentration equivalent corresponding to the difference between the initial and final weights of the filter when weighed and handled under simulated sampling conditions (equilibration, initial weighing, placement on inoperative sampler, removal from a sampler, re-equilibration, and final weighing).

- Alkalinity - Less than 0.005 milliequivalent/gram of filter following at least 2 months storage at ambient temperature and relative humidity.

Note: Some filters may not be suitable for use with all samplers. Due to filter handling characteristics or rapid increases in flow resistance due to episodic loading, some filters, although they meet the above criteria, may not be compatible with the model of sampler chosen. It would be prudent to evaluate more than one filter type before purchasing large quantities for network use. In some cases EPA Headquarters may have national contracts for acceptable filters which will be supplied to State and local organizations.

14. Data Acquisition and Information Management

14.1 General

Success of the Ambient Air Quality Program objectives rely on data and their interpretation. It is critical that data be available to users and that these data are:

- reliable
- of known quality
- easily accessible to a variety of users
- aggregated in a manner consistent with it prime use

In order to accomplish this activity, information must be collected and managed in a manner that protects and ensures its integrity.

Most of the data collected from the Ambient Air Monitoring Program will be collected through automated systems at various facilities. These systems must be effectively managed by using a set of guidelines and principles by which adherence will ensure data integrity. The EPA has a document entitled Good Automated Laboratory Practices (GALP)[38]. The GALP defines six data management principles:

1. DATA: The system must provide a method of assuring the integrity of all entered data. Communication, transfer, manipulation, and the storage/recall process all offer potential for data corruption. The demonstration of control necessitates the collection of evidence to prove that the system provides reasonable protection against data corruption.

2. FORMULAE: The formulas and decision algorithms employed by the system must be accurate and appropriate. Users cannot assume that the test or decision criteria are correct; those formulas must be inspected and verified.

3. AUDIT: An audit trail that tracks data entry and modification to the responsible individual is a critical element in the control process. The trail generally utilizes a password system or equivalent to identify the person or persons entering a data point, and generates a protected file logging all unusual events.

4. CHANGE: A consistent and appropriate change control procedure capable of tracking the system operation and application software is a critical element in the control process. All software changes should follow carefully planned procedures, including a pre-install test protocol and appropriate documentation update.

5. STANDARD OPERATING PROCEDURES (SOPs): Control of even the most carefully designed and implemented systems will be thwarted if appropriate procedures are not followed. The principles implies the development of clear directions and Standard Operating Procedures (SOPs); the training of all users; and the availability of appropriate user support documentation.

6. DISASTER: Consistent control of a system requires the development of alternative plans for system failure, disaster recovery, and unauthorized access. The control principle must extend to planning for reasonable unusual events and system stresses.

The principles listed above apply to both the local and central information management systems. In order to address these principles the following elements will be discussed:

Personnel	Quality Assurance
Facilities	Equipment
Security	Standard Operating Procedures
Software	Data Entry
Raw Data	Data transfer
Records/Archive	Reporting

14.1.1 Personnel

Each organization responsible for data on automated systems should identify a person within the organization responsible for this information management system. This person should have adequate education, training, and experience to enable him/her to perform the assigned system functions. This person should be identified in the organizational structure in the QAPP. To assist or assure user competence, users should be provided with clear standard operating procedures (SOPs) to enable them to perform the assigned functions and sufficient training to clarify these SOPs.

Once an information management system is in place, data should be made available to the system in a timely manner. Personnel responsible for local and central systems should be of sufficient number for the timely and proper implementation of the information management system.

14.1.2 Quality Assurance

As part of the quality assurance responsibility, a group/individual needs to be identified whose responsibilities would be primarily those of system and data inspection, audit and review. The objective of QA is to provide proof that the information management system operates in a correct manner consistent with its recommended functions.

14.1.3 Facilities

The facility used to house the information management system should have provisions to regulate the environmental conditions (temperature, humidity, electricity) adequately to protect the systems against data loss. The facility should also have adequate storage capability for the automated information management system and provide for retention of raw data, including archives of computer resident data.

14.1.4 Equipment

Information management system equipment should be of appropriate design and capacity to function according to the specifications. Guidelines for the minimum hardware specifications of the system should be developed. Hardware should be on a maintenance schedule. Backup and recovery procedures should be accomplished on a routine basis and should be incorporated into SOPs.

14.1.5 Security

Information management systems need to be safeguarded against accidental or deliberate:

- **Modification or destruction of data-** This relates to maintaining the integrity of the data which would include developing policy/procedures for computer use (password protection and authorization) data entry (i.e., double entry, verification checks etc.) editing, and transfer.
- **Unavailability of data or services -** Ensuring that data does not get lost (i.e. data backup policies and storage on more than one media or system) or that services are not interrupted (maintenance of hardware, surge protection, backup systems)
- **Unwanted disclosure of data-** This relates to confidentiality and ensuring that secured or confidential data can not accidentally or deliberately be disclosed.

14.1.6 Standard Operating Procedures

Standard operating procedures (SOPs) are protocols for routine activities involved in a data collection activity which generally involve repetitious operations performed in a consistent manner. SOPs should be established for:

- maintaining system security
- defining raw data (distinction between raw and processed data)
- entry of data
- verification of manually or electronically input data
- interpretation of error codes/flags and corrective action
- changing data
- data analysis, processing, transfer, storage, and retrieval
- backup and recovery
- electronic reporting (if applicable)

14.1.7 Software

Software, either developed internally or "off -the-shelf" must accurately perform its intended function. Tests of the software prior to implementation should occur and be documented. Algorithms should be checked

and source code reviewed as part of the process. Source code, including processing comments, should be archived. Procedures for reporting software problems and corrective action should be in place.

14.1.8 Data Entry/Formatting

Organizations using information management systems should ensure that data input is traceable to the person entering it. Also, instruments transmitting data to the system should be identified. It should be possible to trace each record transmitted back to the source instrument, including the date and time of generation.

Any change in data entry after initial entry should have an audit trail which indicates the new value, the old value, a reason for change, and person who entered the change. As part of a organizations QAPP, procedures should exist for validating the data entered manually or automatically.

Since data will be transferred to a central repository, the Aerometric Information Retrieval System (AIRS), any formatting accomplished at the local level that enhances the ease of transferring the data to the central data structure will be most advantageous. The procedures for transmitting data to the AIRS data base can be found in section 14.2 and 14.3.

14.1.9 Raw Data

Raw data are worksheets, records, memoranda, notes, or exact copies thereof, that are the result of original observations and activities of a study and are necessary for the reconstruction and evaluation of that study.... "Raw data" may include photographs, microfilm or microfiche copies, computer printouts, magnetic media, ... and recorded data from automated instruments" (40 CFR 792.3). Data entered into a system directly by keyboard or automatically by lab test devices are considered raw data. Organizations should define raw data above this minimum and make provisions for their storage and retrieval.

14.1.10 Data Transfer

Data transfer is discussed in more detail in Sections 14.2 and 14.3

14.1.11 Records and Archive

As mentioned in Section 5, all raw data, documentation and records should be retained for an appropriate period of time. Correspondence and other documentation relating to interpretation and evaluation of data collected, analyzed, processed or maintained on automated data collection systems should also be retained. Other records to be maintained include but are not limited to:

- software source code
- software and/or hardware acceptance tests
- records

- hardware maintenance records
- records of problems and corrective actions
- records of qa activities (inspections etc.)
- records of backups and recoveries

14.1.12 Reporting

Reporting will be discussed in Section 14.2

14.1.13 Systematic Data Management

An orderly process of data management, based on the analysis of all data handling procedures and their interrelationships, is sometimes referred to as a "systems" approach. This kind of systematic overview of the total data function is accomplished in three phases:

- surveying current and future reporting requirements
- outlining the present routine flow of data within and outside the agency
- redesigning the current system to allow maximum functional overlap of filing and retrieval routines

A survey of current reporting requirements involves summarizing and categorizing the reports currently required and their important data elements. The purpose of this analysis is to identify report elements that require similar input, to allow optimum scheduling, and to differentiate between required reports and those provided as a service. Future reporting requirements will be based on projected legal requirements, projected developments of systems for communicating with various data banks, and projected growth of the air quality surveillance network.

Outlining present data flow requires a review of the origin of each data form, the editing procedures applied, the calculations performed, the application of quality control procedures, and the reports for which each form is used. The purpose of outlining the data flow is to identify data elements that are subjected to similar checks and to similar calculating procedures and to classify them according to their points of origin. Once again, this procedure provides a means of preventing unnecessary duplication.

As a final step in systematic data management, the data system should be continually updated. The following items are suggested for review:

- what operations are duplicated in the system?
- how can the system be changed to eliminate needless duplications?
- how do the manual systems and computerized systems augment each other?
- are the data formats, identification codes, and other elements compatible throughout the system?
- can reporting schedules be changed to minimize the filing and retrieval of each data record?

- can special techniques, such as the use of multi-part forms, be applied to minimize data transposition?
- are filing and retrieval systems sufficiently flexible to allow expansion or upgrading at minimum cost?

14.2 Data Acquisition

All ambient air monitoring data will eventually be transferred and stored in AIRS. As stated in 40 CFR Part 58[24], the State shall report all criteria pollutant data and information specified by the AIRS Users Guide (Volume II, Air Quality Data Coding [3], and Volume III, Air Quality Data Storage[4]) to be coded into the AIRS-AQS Format. The following sections provides some information on these requirements.

14.2.1 Standard Forms for Reporting

Data forms are used to provide a consistent format for recording information that will eventually be entered into an electronic data base. Examples of standard forms and procedures to be followed in completing these forms can be found in the appropriate AIRS AQS manuals[3,4], but any form can be generated by the State and local organization as long as the appropriate data, is submitted to AIRS.

If computer techniques are used for recording results, the computer system must be designed to maintain compatibility between the AIRS station codes and the codes used by the computer program. Whenever station parameters change or when a station is moved, updated site identification information should be submitted to the AIRS.

Identification errors can be avoided by preprinting entry forms with the station identification. If this technique is adopted, control must be employed to be certain that unused forms are discarded and new ones printed when the station identification changes. Preprinting the pollutant I.D. and the proper decimal points (Table 14-1) for that pollutant on the reporting forms can eliminate the problem of misplaced decimals.

Table 14-1 Data Reporting Requirements

Pollutant	Decimal Places	ug/m^3	ppm	ppbC*
PM2.5	--	15		
PM10	--	50		
Lead	1	1.5		
Sulfur dioxide	2		0.03	
Nitrogen dioxide	3		0.053	
Carbon monoxide	0		9	
Ozone	2		0.12	
PAMS	2			6.23

* part per billion-carbon

Acceptability limits for start-stop times, flow rate, and other routine system checks performed by the operator should appear on the data recording form as a reminder to the operator. If a value outside these limits of acceptability is recorded, the operator should flag the value for the attention of individuals performing data validation functions.

14.2.2 Data Errors in Intermittent Sampling

The most common errors in recording data in the field are transposition of digits and incorrect placement of decimal points. These errors are almost impossible to detect. The decimal error can be avoided to some extent by providing an operator with the guidelines in Table 14-1 that are listed by the concentrations reported in the AIRS data base.

14.2.3 Data Errors in Continuous Sampling

Data errors in continuous sampling primarily include errors in recording device functioning, errors in strip chart reading for manual techniques or in data transmission for automated techniques of data recording.

Strip chart errors - Errors due to recording device malfunctions of strip charts can occur. General guidelines to avoid errors or loss of data caused by mechanical problems follow:

- perform a daily check to assure an adequate supply of strip chart paper
- check the ink level in the recorder pen to verify that the level is adequate for the next sampling period and that the pen tip is not blocked
- perform a daily check to verify that the pen on the recorder aligns with the baseline of the strip chart during the instrument zero check.
- verify the timing of the strip chart drive against a standard timepiece immediately after installation of the recorder and at intervals dictated by experience with the recorder
- replace recorder pens, and soak in cleaning solution occasionally
- examine the strip chart for apparent evidence of chart drag or malfunction, and mark suspected intervals

When reviewing a strip chart, typical signs of system malfunction are:

- a straight trace for several hours (other than minimum detectable)
- excessive noise as indicated by a wide solid trace, or erratic behavior such as spikes that are sharper than possible with the normal instrument response time (noisy outputs usually result when analyzers are exposed to vibrations)
- a long steady increase or decrease in deflection
- a cyclic pattern of the trace with a definite time period indicating a sensitivity to changes in temperature or parameters other than the pollutant concentration
- periods where the trace drops below the zero baseline (this may result from a larger-than-normal drop in the ambient room temperature or power line voltage)

Void any data for any time interval for which malfunction of the sampling system is detected. Suggestions for minimizing errors in reading strip charts are as follows:

- chart readers should be trained with a standard strip of chart, whose readings have been determined by one or more experienced readers
- when the new reader can perform adequately on the standard strip, then permit him/her to read new sample charts
- an individual should spend only a portion of a day reading strip charts since productivity reliability are expected to decrease after a few hours
- a senior technician should verify a percentage (5-10%) of the reduced strip chart values. If minimum performance criteria established for a particular network are not being met, additional training is indicated
- use a chart reader to reduce technician fatigue and to achieve accuracy and consistency in data reduction

14.2.4 Automated Data Acquisition Requirements

The use of a data logging device to automate data handling from a continuous sensor is not a strict guarantee against recording errors. Internal validity checks are necessary to avoid serious data recording errors. This section provides information on Data Acquisition Systems (DAS), a term signifying any system that collects, stores, summarizes, reports, prints, calculates or transfers data. The transfer is usually from an analog or digital format to a digital medium. In addition, this section will discuss limitations with data collected with DAS. Uncertainty of data will be discussed and how to ascertain the quality of the data.

DAS have been available to air quality professionals since the early 1980s. The first systems were single and multi-channel systems that collected data on magnetic media. This media was usually hand transferred to a central location or laboratory for downloading to a central computer. With the advent of digital data transfer from the stations to a central location, the need to hand transfer data has diminished. However, errors in data reporting can occur with strip chart as well as digital data. For DAS, there are two sources of error between the instrument (sensor) and the recording device: 1) the output signal from the sensor, and 2) the errors in recording by the data logger. This section will relate how to ascertain quality data from DAS.

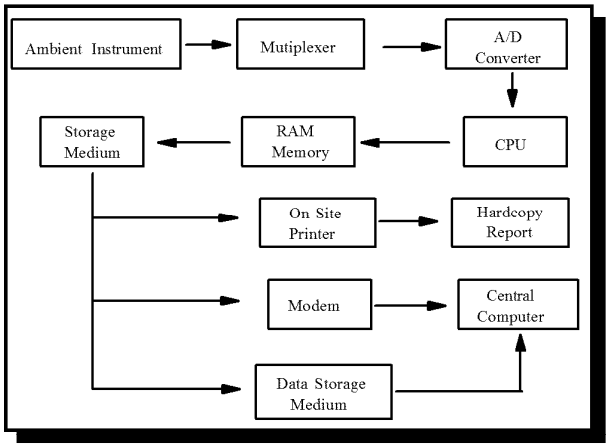

Figure 14.1 DAS flow diagram

14.2.4.1 DAS Data Acquisition Layout and Collection

Figure 14.1 shows the basic transfer of data from the instrument to the final product, a hard copy report or transfer to a central computer. The instrument has a voltage potential that generally is a DC voltage. This voltage varies directly with the concentration collected. Most instruments'

output is a DC voltage in the 0-1 or 0-5 volts range.

- the voltage is measured by the multiplexer which allows voltages from many instruments to be read at the same time.
- the multiplexer sends a signal to the a/d converter which changes the analog voltage to a low amperage digital signal.
- the a/d converter send signals to the central processing unit (cpu) that directs the digital electronic signals to a display or to the random access memory (ram) which stores the short-term data until the end of a pre-defined time period.
- the cpu then shunts the data from the ram to the storage medium which can be magnetic tape, computer hard-drive or computer diskette.
- the computer storage medium can be accessed remotely, or at the monitoring location.

The data transfer can occur via modem to a central computer storage area or printed out as hard copy. In some instances, the data can be transferred from one storage medium (i.e. hard drive to a diskette or tape) to another storage medium.

14.2.4.2 DAS Quality Assurance/Quality Control

Quality assurance aspects of the DAS deal with whether the system is being operated within some given guidance. Usually, this means that the data that is collected on the DAS is the same value that is generated from the analyzer all the way to the AIRS data base. This usually is accomplished by a data trail audit performance audits and calibrations.

Data Trail Audit- The data trail audit consists of following a value or values collected by the DAS to the central data collection site and then eventually to AIRS. A person other than the normal station operator should perform this duty. The following procedure should be followed:

- a data point should be collected from the DAS (usually an hourly value) and be checked on the DAS storage medium against the hard copy report
- the auditor goes to the central computer and checks to see if this hourly value is the same
- if the data has been submitted to airs, then the airs data base should be checked as well

Performance Audit- The performance audit consists of challenging the instrument and DAS to a known audit source gas and observing the final response. The response should correspond to the value of the audit source gas.

Calibrations-The quality control aspects of data collection are well defined in terms of chart recorders. DAS systems are much more complex but the approach to calibration of a DAS is similar to the chart recorder. The calibration of a DAS is performed by inputting known voltages into the DAS and measuring the output of the DAS. The DAS owner's manual should be followed. It is recommended that DAS be calibrated once per year. An example of a calibration technique can be found in Appendix 14.

14.2.4.3 DAS Data Transfer

Data transfer is usually accomplished in three ways: hard copy printout, downloading data from internal storage medium to external storage medium, or digital transfer via the telephone lines.

Hard copy report- Most DAS have the ability to create a hard copy report. Usually, this report is in tabular format showing 1 minute, 5 minute or hourly averages vs. hours in the day. Agencies are encouraged to keep hard copy printouts for several reasons:

- the hard copy report can be reviewed by the station operators during site visits to ascertain the quality of the data
- the hard copy reports can be compared against the strip charts at the site for validation
- notes can be made on the hard copy reports for later review by data review staff
- this creates a "back-up" to the electronically based data

External Storage- This term refers to storing and transferring the data on diskettes or tape. Many DAS have the ability to download data to diskette or cassette tape. The data can then be hand transferred to a central office for downloading and data review.

Digital Transfer- There are many commercially available DAS which allow access to the computer via the telephone and modem. These systems allow fast and effective ways to download data to a central location. The EPA recommends using these systems for the following reasons:

- In case of malfunction of an ambient instrument, the senior staff at the central location can try to diagnose any problems and decide a course of action.
- Downloading the data allows the data processing team to get a head start on reviewing the data.
- When pollution levels are high or forecasted to be high, this allows the pollution forecaster the ability to check trends.

As stated previously, the measurement instruments produce an analog voltage that is collected by a DAS and averaged for a particular time period (e.g., one hour). The data is stored by the DAS and may be retrieved via phone line and modem by a central computer. The data should be stored on a central computer until the end of the month as preliminary data. The station operators/lab technician should print out the data at the monitoring station and submit a report outlining any corrections or changes to the preliminary data that is stored. In addition to the electronic collected data, the analog output of the analyzers should be recorded on chart recorders. This serves as a back-up system in case of DAS failure.

14.2.4.4 DAS Data Review

The data review is an ongoing process that is performed by the station operators (SO) and the data processing team (DP). It would be extremely difficult for the data processing team to review the raw data without the

notations, notes and calibration information that the station operators provide for the group. The review process for the station operator could include:

- (SO) reviewing calibration information, the hourly data, and any flags that could effect data and recording any information on the daily summaries that might be vital to proper review of the data
- (SO)at regular intervals, bringing strip charts, daily summaries, monthly maintenance sheets and site log notes to the laboratory for secondary review
- (SO) at the laboratory, reviewing the data and marking any notations, or invalidations that occurred, providing strip charts, daily summaries, site notes, and monthly maintenance sheets for ready access by the data processing staff
- (DP) reviewing all hand reduced data, calibrations, precision data, station notes, and monthly maintenance sheets for the month; checking a percentage of all calibrations and strip chart data for comparison against the DAS, and if significant differences are observed, determining what corrective action steps are required

14.2.4.5 DAS Data Handling and Reporting

This section presents standard data handling and reporting techniques that should be used by reporting agencies.

Initialization Errors --

All data acquisition systems must be initialized. The initialization consists of an operator "setting up" the parameters so that the voltages produced by the instruments can be read, scaled correctly and reported in the correct units. Errors in initializations can create problems when the data is collected and reported. Read the manufacturer's literature before parameters are collected. If the manufacturer does state how these parameters are collected, request this information The following should be performed when setting up the initializations:

- check the full scale outputs of each parameter.
- calibrations should be followed after each initialization (each channel of a DAS should be calibrated independently) Appendix 14 provides an example of a DAS calibration technique.
- review the instantaneous data stream if possible to see if the DAS is collecting the data correctly
- save the initializations to a storage medium; if the DAS does not have this capability, print out the initialization and store it at the central computer location and at the monitoring location
- check to see if the flagging routines are performed correctly; data that is collected during calibrations and down time should be flagged correctly
- check the DAS for excessive noise. Noisy data that is outside of the normal background is a concern. Noisy data can be caused by improperly connected leads to the multiplexer, noisy AC power, or a bad multiplexer. Refer to the owner's manual for help on noisy data
- check to see that the average times are correct. Some DAS consider 45 minutes to be a valid hour, while others consider 48 minutes. Agency guidelines should be referred to before setting up averaging times

14.3 The Information Management System

Eventually, all required data will reside in the AIRS data base. The AIRS database is divided into 4 subsystems, two of which are important to the ambient air monitoring: 1) the air quality subsystem (AQS) including air quality data and monitoring site descriptions, and 2) the geographic/common subsystem, which contains geographic and other codes common to the other 3 subsystems and database control information. Information on the AQS is described in 5 users manual:

1. AIRS Volume AQ1. - Air Quality Data Dictionary
2. AIRS Volume AQ2 - Air Quality Data Coding Manual
3. AIRS Volume AQ3 - Air Quality Data Storage Manual
4. AIRS Volume AQ4 - Air Quality Data Retrieval Manual
5. AIRS Volume AQ5 - Ad-hoc Retrieval Manual

Recommended procedures for coding, key punching, and data editing are described in various sections of these users manuals These documents should be available to data management personnel. The AQS system contains a number of files in which data are entered and stored.

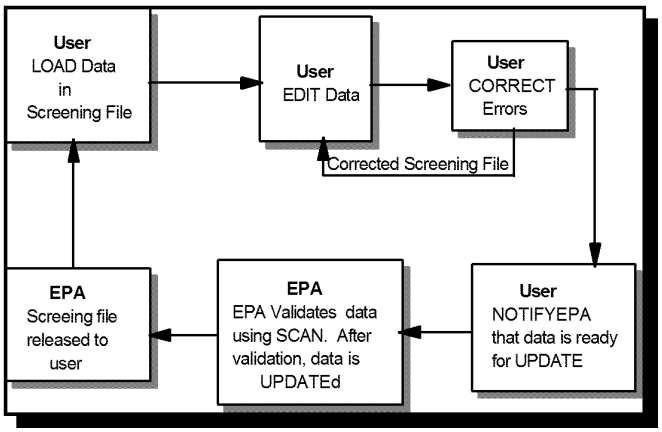

Figure 14.2 Data input flow diagram

14.3.1 Data Input

One of the functions of the AIRS is to read transactions coded by State, local and regional users of AIRS, validate these transactions, and use them to update the AIRS database as illustrated in Figure 14.2. To accomplish this, there are two primary players, AIRS users and the AIRS data base administrator (ADBA).

The AIRS users are responsible for the following steps in the update process:

LOAD	transfers transactions (either from tape or a database) into a screening file.
EDIT	checks the validity of the transactions in the screening file and produces a report to identify errors.
CORRECT	alters, removes, or creates transactions in the screening file in order to fix errors identified in the EDIT.
NOTIFY	informs the ADBA that transactions in the screening file are ready to be updated. This function can also be used to cancel a request to update a particular screening file for updating.

MESSAGE allows the user and the ADBA to track the above mentioned functions performed to a screening file when they were performed, and who performed them.

DELETE removes any transactions that exist in a screening file.

The ADBA primarily performs the following functions in the updating process:

SCAN produces a report used by the ADBA to coordinate the update processing across several screening files. This function also "locks" the screening file to prevent the user access to the screening file during the updating activity.

UPDATE changes values and files on the AIRS database identified during the SCAN process. This process also removes any transactions from the screening file that have been updated and releases the screening file back to the user.

14.3.2 Processing of Quality Assurance Information

It is of the utmost importance that all precision and accuracy assessment readings from an analyzer be processed exactly as ambient readings recorded at that time would be processed. Many automated data acquisition and processing systems do not include provision for handling such extra readings, and this capability may be difficult to incorporate into such systems unless it is done in the early planning stage. External or hand processing of such readings should be discouraged unless it is done with extreme care and assurance that processing is identical to the way ambient readings are processed by the automated system. Perhaps the best way to handle such readings is to enter them into the automatic processing system in such a way that the system thinks they are actual ambient readings and processes them accordingly. After processing, the readings can be removed from the final ambient data listing and used in the data quality assessment calculations.

14.3.3 Non-Programmed Adjustments to Ambient Data

Adjustments to ambient data, made routinely according to a documented, pre-established procedure (programmed adjustments), would be a normal part of an overall scheme to maintain high levels of data quality. In contrast, after-the-fact adjustments or "corrections" are occasionally proposed to ambient data based on unanticipated events or discoveries. This latter type of adjustment should be scrutinized completely before any changes are made to ambient data. These changes should be discussed with the appropriate EPA Regional Office prior to enacting these changes. In general, such adjustments are discouraged as there is a substantial risk that they may cause more harm than good. There is also a risk that such proposed adjustments might be used or might appear to be used for ulterior purposes.

If, after scrutiny, a special, unprogrammed adjustment is determined to be appropriate and is made to a block of ambient data, it is very important to ensure that the exact same adjustment is also made to any QA data (precision and accuracy measurements) obtained during the affected time period. Any data quality calculations affected by the change should also be recomputed. All such adjustments should be completely documented, including the rationale and justification for the adjustment.

15. Assessment and Corrective Action

An assessment is an evaluation process used to measure the performance or effectiveness of a system and its elements. It is an all-inclusive term used to denote any of the following: audit, performance evaluation, management systems review, peer review, inspection and surveillance[9]. For the Ambient Air Quality Monitoring Program, the following assessments will be discussed: network reviews, performance evaluations, technical systems audits and data quality assessments.

15.1 Network Reviews

Conformance with network requirements of the Ambient Air Monitoring Network set forth in 40 CFR Appendices D[17] and E[18] are determined through annual network reviews of the ambient air quality monitoring system. The annual review of the network is used to determine how well the network is achieving its required monitoring objectives and how it should be modified to continue to meet its objectives. Most network reviews are accomplished by the EPA Regional Office, however, the following information can be useful to State and local organizations to prepare for reviews or assess their networks.

In order to maintain consistency in implementing and collecting information from a network review, EPA has developed *SLAMS/NAMS/PAMS Network Review Guidance*. The information presented in this section provides some excerpts from this guidance document.

15.1.1 Network Selection

Due to the resource-intensive nature of network reviews, it may be necessary to prioritize agencies and/or pollutants to be reviewed. The following criteria may be used to select networks:

- date of last review
- areas where attainment/nonattainment redesignations are taking place or are likely to take place
- results of special studies, saturation sampling, point source oriented ambient monitoring, etc.
- agencies which have proposed network modifications since the last network review

In addition, pollutant-specific priorities may be considered (e.g., newly designated ozone nonattainment areas, PM_{10} "problem areas", etc.).

Once the agencies have been selected for review, significant data and information pertaining to the review should be compiled and evaluated. Such information might include the following:

- network files for the selected agency (including updated site information and site photographs)
- AIRS reports (AMP220, 225, 380, 390, 450)
- air quality summaries for the past five years for the monitors in the network
- emissions trends reports for major metropolitan areas

- emission information, such as emission density maps for the region in which the monitor is located and emission maps showing the major sources of emissions
- National Weather Service summaries for monitoring network area

Upon receiving the information, it should be checked to ensure it was the latest revision and for consistency. Discrepancies should be noted on the checklist (Appendix 15) and resolved with the agency during the review. Files and/or photographs that need to be updated should also be identified.

15.1.2 Conformance to 40 CFR Part 58 Appendix D- Network Design Requirements

With regard to 40 CFR Part 58 Appendix D[17] requirements, the network reviewer must determine the adequacy of the network in terms of number and location of monitors: specifically, (1) is the agency meeting the number of monitors required by the design criteria requirements?; and (2) are the monitors properly located, based on the monitoring objectives and spatial scales of representativeness?

15.1.2.1 Number of Monitors

For SLAMS, the number of monitors required is not specified in the regulations, with the exception of $PM_{2.5}$ stations, but rather is determined by the Regional Office and State agencies on a case-by-case basis to meet the monitoring objectives specified in Appendix D[17]. Adequacy of the network may be determined by using a variety of tools, including the following:

- maps of historical monitoring data
- maps of emission densities
- dispersion modeling
- special studies/saturation sampling
- best professional judgement
- SIP requirements
- revised monitoring strategies (e.g., lead strategy, reengineering air monitoring network)

For NAMS, areas to be monitored must be selected based on urbanized population and pollutant concentration levels. To determine whether the number of NAMS are adequate, the number of NAMS operating is compared to the number of NAMS specified in Appendix D[17] and summarized in Table 6-6 in this Handbook. The number of NAMS operating can be determined from the AMP220 report in AIRS. The number of monitors required based on concentration levels and population can be determined from the AMP450 report and the latest census population data.

For PAMS, the required number and type of monitoring sites and sampling requirements are based on the population of the affected MSA/CMSA or ozone nonattainment area (whichever is larger). PAMS minimum monitoring network requirements are summarized in Table 6-9.

15.1.2.2 Location of Monitors

For SLAMS, the location of monitors is not specified in the regulations, but is determined by the Regional Office and State agencies on a case-by-case basis to meet the monitoring objectives specified in Appendix D[17]. Adequacy of the location of monitors can only be determined on the basis of stated objectives. Maps, graphical overlays, and GIS-based information is extremely helpful in visualizing or assessing the adequacy of monitor locations. Plots of potential emissions and/or historical monitoring data versus monitor locations are especially useful.

For NAMS, locations are based on the objectives specified in Appendix D[17]. Most often, these locations are those that have high concentrations and large population exposure. Population information may be obtained from the latest census data and ambient monitoring data from the AIRS AMP450 Quick Look Report.

For PAMS, there is considerable flexibility when locating each PAMS within a nonattainment area or transport region. The three fundamental criteria which need to be considered when locating a final PAMS site are: (1) sector analysis - the site needs to be located in the appropriate downwind (or upwind) sector (approximately 45°) using appropriate wind directions; (2) distance - the sites should be located at distances appropriate to obtain a representative sample of the areas precursor emissions and represent the appropriate monitoring scale; and (3) proximate sources.

15.1.3 Conformance to 40 CFR Part 58 Appendix E[18] - Probe Siting Requirements

Applicable siting criteria for SLAMS, NAMS and PAMS are specified in Appendix E[18]. The on-site visit itself consists of the physical measurements and observations needed to determine compliance with the Appendix E[18] requirements, such as height above ground level, distance from trees, paved or vegetative ground cover, etc.

Prior to the site visit, the reviewer should obtain and review the following:

- most recent hard copy of site description (including any photographs)
- data on the seasons with the greatest potential for high concentrations for specified pollutants
- predominant wind direction by season

The checklist provided in Appendix 15 is also intended to assist the reviewer in determining conformance with Appendix E[18]. In addition to the items on the checklist, the reviewer should also do the following:

- ensure that the manifold and inlet probes are clean
- estimate probe and manifold inside diameters and lengths
- inspect the shelter for weather leaks, safety, and security
- check equipment for missing parts, frayed cords, etc.
- check that monitor exhausts are not likely to be introduced back to the inlet
- record findings in field notebook and/or checklist

- take photographs/videotape in the 8 directions
- document site conditions, with additional photographs/videotape

15.1.4 Checklists and Other Discussion Topics

Checklists are provided in Appendix 15 to assist network reviewers (SLAMS, NAMS, and PAMS) in conducting the review. In addition to the items included in the checklists, other subjects for possible discussion as part of the network review and overall adequacy of the monitoring program include:

- installation of new monitors
- relocation of existing monitors
- siting criteria problems and suggested solutions
- problems with data submittals and data completeness
- maintenance and replacement of existing monitors and related equipment
- quality assurance problems
- air quality studies and special monitoring programs
- other issues
  - -proposed regulations
  - -funding

15.1.5 Summary of Findings

Upon completion of the network review, a written network evaluation should be prepared. The evaluation should include any deficiencies identified in the review, corrective actions needed to address the deficiencies, and a schedule for implementing the corrective actions. The kinds of discrepancies/deficienciesto be identified in the evaluation include discrepancies between the agency network description and the AIRS network description; and deficiencies in the number, location, and/or type of monitors. Regions are encouraged to send copies of the SLAMS, NAMS and PAMS network reviews to OAQPS's Monitoring and Quality Assurance Group. Also, the AIRS has an area for the entry of these reviews.

15.2 Performance Evaluations

Performance evaluations (PEs) are a means of independently verifying and evaluating the quality of data from a measurement phase, or the overall measurement system. This is accomplished through the use of samples of known composition and concentration or devices that produce a known effect. These samples can be introduced into the measurement system as single blind (identity is known but concentration is not) or double blind (concentration and identity unknown). These samples can be used to control and evaluate bias, accuracy and precision and to determine whether DQOs or MQOs have been satisfied. PEs can also be used to determine inter- and intra-laboratory variability and temporal variability over long projects.

15.2.1 National Performance Audit Program

The NPAP is a cooperative effort among OAQPS, the 10 EPA Regional Offices, and the 170 state and local agencies that operate the SLAMS/NAMS/PAMS/PSD air pollution monitors. Also included in the NPAP are approximately 135 organizations (governmental and private) that operate air monitors at PSD sites. Participation in the NPAP is required for agencies operating SLAMS/NAMS/PAMS/PSD monitors as per Section 2.4 of 40 CFR Part 58, Appendix A and Section 2.4 of 40 CFR Part 58, Appendix B. Participation in the NPAP program is also mandatory for the 22 agencies which monitor for photochemical oxidants under EPA's Photochemical Assessment Monitoring (PAMS) program. These agencies monitor for carbonyl compounds, volatile organic compounds, NO_x and ozone.

The NPAP's goal is to provide audit materials and devices that will enable EPA to assess the proficiency of agencies that are operating monitors in the SLAMS/NAMS/PAMS/PSD networks. To accomplish this, the NPAP has established acceptable limits or performance criteria, based on the data quality needs of the SLAMS/NAMS/PAMS/PSD requirements, for each of the audit materials and devices used in the NPAP.

All audit devices and materials used in the NPAP are certified as to their true value, and that certification is traceable to a National Institute of Standards and Technology (NIST) standard material or device wherever possible. The audit materials used in the NPAP are as representative and comparable as possible to the calibration materials and actual air samples used and/or collected in the SLAMS/NAMS/PAMS/PSD networks. The audit material/gas cylinder ranges used in the NPAP are specified in the Federal Register.

The NPAP is managed by the Monitoring and Quality Assurance Group of OAQPS. The mailing address for the NPAP is:

NPAP Project Officer
US EPA
Office of Air Quality Planning and Standards
MD-14
Research Triangle Park, NC 27711

The NPAP audits are accomplished using a variety of mailable audit systems. The participants use these audit systems to generate pollutant concentrations and flowing air streams which are introduced into their sampling system. The pollutant concentrations and air stream flow rate are unknown to the audit participants. The outputs from the sampler that result from the use of the audit system are recorded on a data form, returned to EPA, and compared to the concentration or flow rate that should have been generated by the audit system under the environmental conditions at the site. The differences between the EPA expected (certified) values and the NPAP participants' reported values are calculated and returned to the participant. Table 15-1 lists the acceptance criteria for the audit material.

Table 15-1 NPAP Acceptance Criteria

Audit	EPA determined limits
High volume/PM-10(SSI)	% difference > ± 15% for 1 or more flows
Dichot (PM-10)	% difference > ±15% for 1 or more flows
Pb (analytical)	% difference > ± 15% for 1 or more levels
SO_2, NO_2, O_3 and CO	Mean absolute % difference > 15%
PAMS	
Volatile Organic Compounds	Compound Specific
Carbonyls	Compound and level specific

Description of NPAP Audit Materials/Devices

The following materials and devices are currently being used in NPAP:

High-Volume/PM-10 (SSI) Flow Audits

The reference flow (ReF) device used for the high volume flow audit consists of a modified orifice, a wind deflector, a manometer, and five resistance plates. The ReF for the PM-10 size selective inlet (SSI) flow audit is similar except a filter is used as the only resistance.

Sulfur Dioxide/Carbon Monoxide (GDS) Audits

The gas dilution system (GDS) consists of a dilution device, a zero air generator and a cylinder of gas containing approximately 30 ppm sulfur dioxide and 3000 ppm carbon monoxide.

Ozone (TECO 165) Audit

The audit device is self-contained with its own zero air and ozone generation system.

Lead Audit

The samples are 1.9 cm wide and 20 cm long glass fiber filter strips that have been spiked with an aqueous solution of lead nitrate and oven-dried. Two filter strips comprise a sample.

Dichotomous (PM-10) Flow Audit

The audit device consists of a laminar flow element (LFE), an inclined manometer, an altimeter, and a small dial thermometer. It measures fine flow (15.00 lpm) and total flow (16.7 lpm).

Ozone/Nitrogen Dioxide/Sulfur Dioxide/Carbon Monoxide (TECO 175) Audit

The audit device is a combination of the TECO 165 and the GDS audit systems. It uses the same zero air generation system as the GDS, the ozone generation system of the TECO 165, and a gas cylinder containing approximately 3000 ppm carbon monoxide, 30 ppm sulfur dioxide and 30 ppm nitric oxide. The ozone generation system is used with the pollutant gas to convert nitric oxide to nitrogen dioxide via a gas phase titration.

PAMS Volatile Organic Compound (VOC) Audit

This audit uses a gas transfer system (GTS), stock (concentrated) compressed gas mixtures containing PAMS compounds and 1.5L compressed gas (audit) cylinders. The stock mixtures are mixed and diluted using the GTS and the resulting mixture is placed in the 1.5L audit cylinders. These audit cylinders are pressurized to 800-1000 psi to yield recoverable gas volumes of 60 to 80 L. Three audits are scheduled for each year. Each of the 22 PAMS agencies receives one cylinder for each audit. The cylinders contain between 15 and 35 PAMS analytes at concentrations from 10 to 60 ppbv as carbon. The PAMS VOC audit was added to the NPAP in 1995. There are plans to phase out the treated aluminum cylinders for replacement with humidified SUMMA® or Silcosteel® stainless steel canisters.

PAMS Carbonyl Compound Audit

This audit uses three glass tubes containing dinitrophenylhydrazene (DNPH) coated silica gel which have been spiked with solutions containing acetone, formaldehyde and acetaldehyde. Each tube contains from 0.2 to 10 micrograms of each dirivatized carbonyl compound. A blank cartridge is typically included with each audit sample set. The audit is conducted on the same schedule as the PAMS VOC audit. Each PAMS agency recovers the carbonyl compounds from the three DNPH-tubes and reports the results to EPA. The PAMS carbonyl audit was added to the NPAP in 1995.

15.2.2 $PM_{2.5}$ FRM Performance Evaluation

The Federal Reference Method (FRM) Performance Evaluation is a quality assurance activity which will be used to evaluate measurement system bias of the $PM_{2.5}$ monitoring network. The pertinent regulations for this performance audit are found in 40 CFR Part 58, Appendix A, section 3.5.3. The strategy is to collocate a portable FRM $PM_{2.5}$ air sampling instrument with an established routine air monitoring site, operate both monitors in exactly the same manner and then compare the results of this instrument against the routine sampler at the site. For allocation of FRM evaluations, every method designation ***must:***

- allocate 25% of sites, including collocated sites (even those collocated with FRM instruments), to FRM performance evaluations (values of .5 and greater round up) each year. All sites would be audited within 4 years
- have at least 1 monitor evaluated
- be evaluated at a frequency of 4 per year

Since performance evaluations are independent assessments, Figure 15.1 was developed to define independence for the FRM performance evaluation to allow State and local organizations to implement this activity. Since the regulations define the performance evaluations as an NPAP like activity, EPA has made arrangements to implement this audit. State/locals can determine, on a yearly basis, to utilize federal implementation by directing their appropriate percentage of grant resources back to the OAQPS or implement the audit themselves.

Independent assessment - an assessment performed by a qualified individual, group, or organization that is not part of the organization directly performing and accountable for the work being assessed. This auditing organization must not be involved with the generation of the routine ambient air monitoring data. An organization can conduct the FRM Performance Audit if it can meet the above definition and has a management structure that, at a minimum, will allow for the separation of its routine sampling personnel from its auditing personnel by two levels of management, as illustrated in Figure 1. In addition, the pre and post weighing of audit filters must be performed by separate laboratory facility using separate laboratory equipment. Field and laboratory personnel would be required to meet the FRM Performance Audit field and laboratory training and certification requirements. The State and local organizations are also asked to consider participating in the centralized field and laboratory standards certification process.

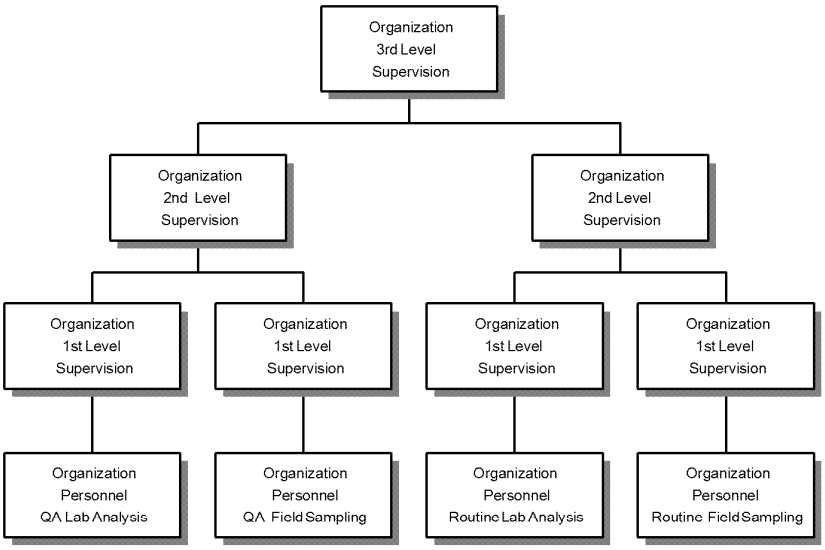

Figure 1

Organizations planning to implement the FRM Performance Audit must submit a plan demonstrating independence to the EPA Regional Office responsible for overseeing quality assurance related activities for the ambient air monitoring network.

Figure 15.1 Definition of independent assessment

The following activities will be established for federal implementation:

- field personnel assigned to each EPA Region, the hours based upon the number of required audits in the Region
- 2 National laboratories, one in Region 4 and one in Region 10 to serve as weighing labs

Information on the FRM performance evaluation can be found in the *FRM Performance Evaluation Implementation Plan* found on the AMTIC Bulletin Board.

15.2.3 State and Local Organization Performance Audits

In addition to NPAP, State and local organizations also conduct performance audits. Detailed information on the procedures for this audit can be found in Appendix 15.

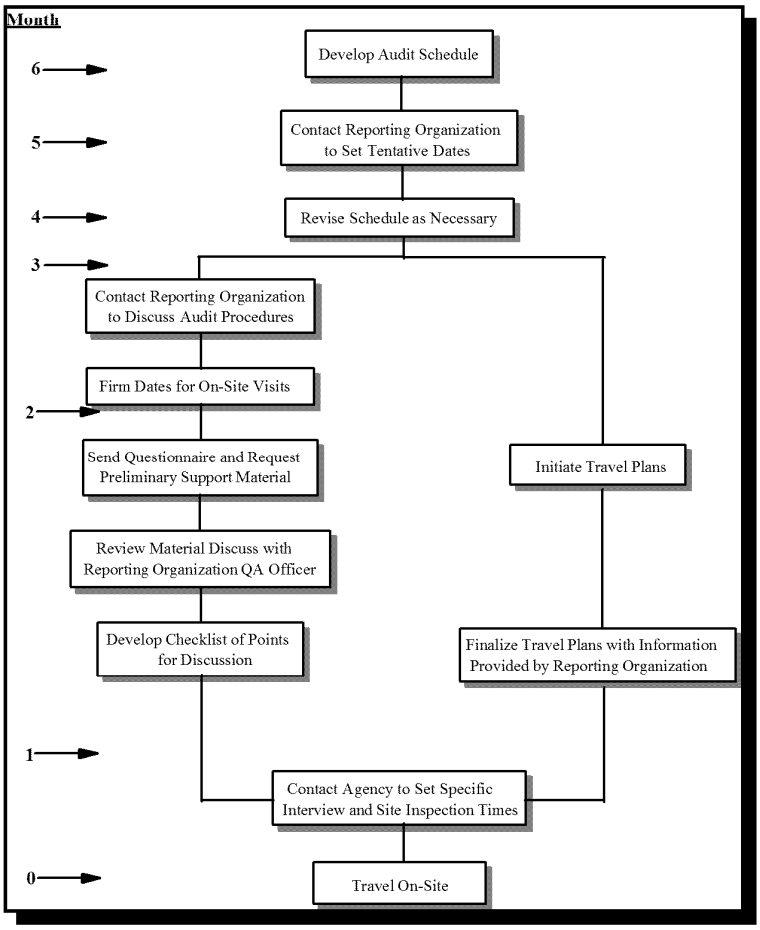

Figure 15.2 Pre-audit activities

15.3 Technical Systems Audits

A systems audit is an on-site review and inspection of a State or local agency's ambient air monitoring program to assess its compliance with established regulations governing the collection, analysis, validation, and reporting of ambient air quality data. A systems audit of each state or autonomous agency within an EPA Region is performed every three years by a member of the Regional Quality Assurance (QA) staff. Detailed discussions of the audits performed by the EPA and the State and local organizations are found in Appendix 15; the information presented in this section provides general guidance for conducting technical systems audits. A systems audit should consist of three separate phases:

- pre-audit activities
- on-site audit activities
- post-audit activities

Summary activity flow diagrams have been included as Figures 15.2, 15.3 and 15.5, respectively. The reader may find it useful to refer to these diagrams while reading this guidance.

15.3.1 Pre-Audit Activities-

At the beginning of each fiscal year, the audit lead or a designated member of the audit team, should establish a tentative schedule for on-site systems audits of the agencies within their Region. It is suggested that the audit lead develop an audit plan. This plan should address the elements listed in Table 15-2. The audit plan is not a major undertaking and in most cases will be a one page table or report. However, the document

represents thoughtful and conscious planning for an efficient and successful audit. The audit plan should be made available to the organization audited, with adequate lead time to ensure that appropriate personnel and documents are available for the audit. Three months prior to the audit, the audit lead should contact the quality assurance officer (QAO) of the organization to be audited to coordinate specific dates and schedules for the on-site audit visit. During this initial contact, the audit lead should arrange a tentative schedule for meetings with key personnel as well as for inspection of selected ambient air quality monitoring and measurement operations. At the same time, a schedule should be set for the exit interview used to debrief the agency director or his/her designee, on the systems audit outcome. As part of this scheduling, the audit lead should indicate any special requirements such as access to specific areas or activities. The audit lead should inform the agency QAO that the QAO will receive a questionnaire, which is to be reviewed and completed.

Table 15-2 Suggested Elements of an Audit Plan

Audit Title -	Official title of audit that will be used on checksheets and reports
Audit Number-	Year and number of audit can be combined; 91-1, 91-2Date of audit
Scope -	Establishes the boundary of the audit and identifies the groups and activities to be evaluated. The scope can vary from general overview, total system, to part of system, which will effect the length of the audit.
Purpose -	What the audit should achieve
Standards -	Standards are criteria against which performance is evaluated. These standards must be clear and concise and should be used consistently when auditing similar facilities or procedures. The use of audit checklists is suggested to assure that the full scope of an audit is covered. An example checklist for the Regional RSA is found in Appendix 15-A.
Audit team -	Team lead and members.
Auditees -	People that should be available for the audit from the audited organization. This should include the Program Manager, Principal Investigator, organizations QA Representative, and other management, and technicians as necessary.
Documents -	Documents that should be available in order for the audit to proceed efficiently. Too often documents are asked for during an audit, when auditors do not have the time to wait for these documents to be found. Documents could include QMPs, QAPjPs, SOPs, GLPs, control charts, raw data, QA/QC data, previous audit reports etc.
Timeline -	A timeline of when organizations(auditors/auditees)will be notified of the audit in order for efficient scheduling and full participationof all parties.

The audit lead should emphasize that the completed questionnaire is to be returned within one (1) month of receipt. The information within the questionnaire is considered a minimum, and both the Region and the agency under audit should feel free to include additional information. Once the completed questionnaire has been received, it should be reviewed and compared with the pertinent criteria and regulations. The PARS and completeness data as well as any other information on data quality can augment the documentation received from the reporting organization under audit. This preliminary evaluation will be instrumental in selecting the sites to be evaluated and in the decision on the extent of the monitoring site data audit. The audit lteam should then prepare a checklist detailing specific points for discussion with agency personnel.

The audit team should be made of several members to offer a wide variety of backgrounds and expertise. This team may then divide into groups once on-site, so that both audit coverage and time utilization can be

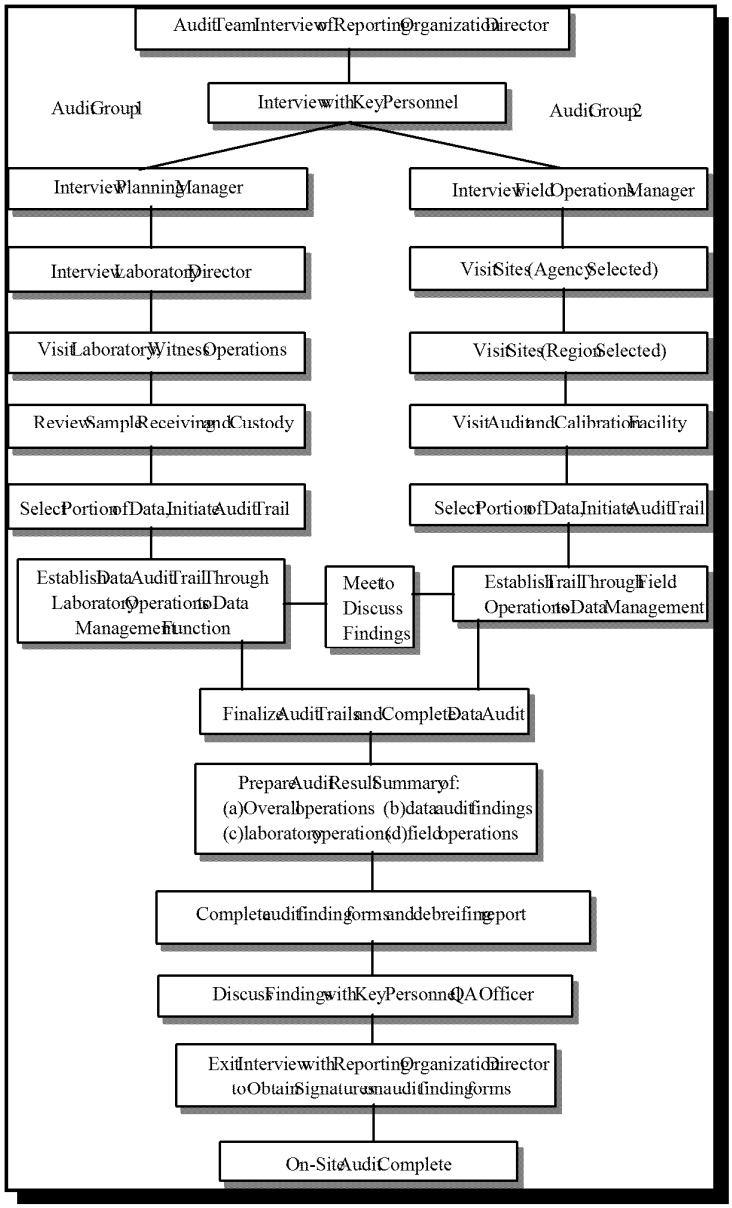

Figure 15.3 On-site activities

optimized. A possible division may be that one group assesses the support laboratory and headquarters operations while another evaluates sites, and subsequently assesses audit and calibration information. The audit lead should confirm the proposed audit schedule with the audited organization immediately prior to traveling to the site.

15.3.2. On-Site Activities

The audit team should meet initially with the audited agency's director or his/her designee to discuss the scope, duration, and activities involved with the audit. This should be followed by a meeting with key personnel identified from the completed questionnaire, or indicated by the agency QAO. Key personnel to be interviewed during the audit are those individuals with responsibilities for: planning, field operations, laboratory operations, QA/QC, data management and reporting. At the conclusion of these introductory meetings, the audit team may begin work as two or more independent groups, as illustrated in Figure 15.3. To increase uniformity of site inspections, it is suggested that a site checklist be developed and used. The format for Regional TSAs are found in Appendix 15.

The importance of the audit of data quality (ADQ) cannot be overstated. Thus, sufficient time and effort should be devoted to this activity so that the audit team has a clear understanding and complete documentation of data flow. Its importance stems from the need to have documentation on the quality of ambient air monitoring data for all the criteria pollutants for which the agency has monitoring requirements. The ADQ will serve as an effective framework for organizing the extensive amount of information gathered during the audit of laboratory, field monitoring and support functions within the agency.

The entire audit team should prepare a brief written summary of findings, organized into the following areas: planning, field operations, laboratory operations, quality assurance/quality control, data management, and reporting. Problems with specific areas should be discussed and an attempt made to rank them in order of their potential impact on data quality. For the more serious problems, audit findings should be drafted (Fig. 15.4) .

The audit finding form has been designed such that one is filled out for each major deficiency that requires formal corrective action. They inform the agency being audited about a serious finding that may compromise the quality of the data and therefore require specific corrective actions. They are initiated by the audit team, and discussed at the debriefing. During the debriefing discussion, evidence may be presented that reduces the significance of the finding; in which case the finding may be removed. If the audited agency is in agreement with the finding, the form is signed by the agency's director or his/her designee during the exit interview. If a disagreement occurs, the QA Team should record the opinions of the agency audited and set a time at some later date to address the finding at issue.

Audit Finding

Audit Title: _____ **Audit #**: ____ **Finding #**:____

_____

Finding:

_____

Discussion:

QA Lead Signature: **Date:**

Audited Agencies
Signature: **Date:**

Figure 15.4. Audit finding form

The audit is now completed by having the audit team members meet once again with key personnel, the QAO and finally with the agency's director to present their findings. This is also the opportunity for the agency to present their disagreements. The audit team should simply state the audit results, including an indication of the potential data quality impact. During these meetings, the audit team should also discuss the systems

audit reporting schedule and notify agency personnel that they will be given a chance to comment in writing, within a certain time period, on the prepared audit report in advance of any formal distribution.

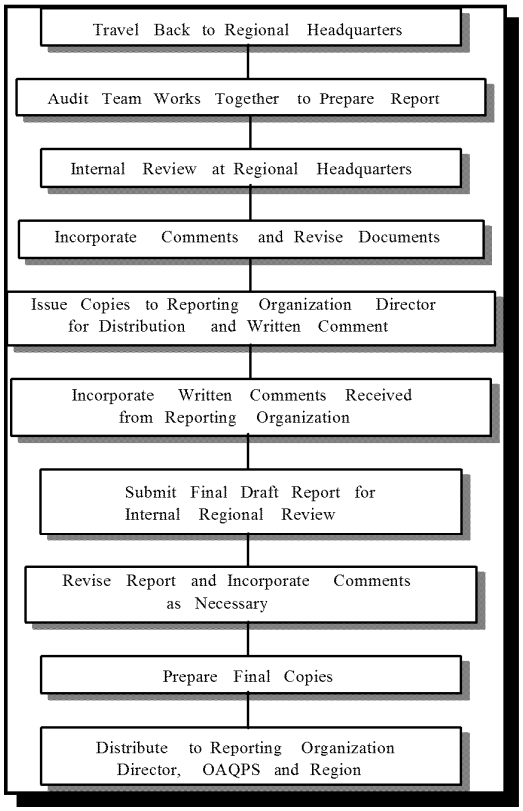

Figure 15.5. Post-audit activities

15.3.3 Post-Audit Activities-

The major post-audit activity is the preparation of the systems audit report. The report will include:

- audit title and number and any other identifying information
- audit team leaders, audit team participants and audited participants
- background information about the project, purpose of the audit, dates of the audit, particular measurement phase or parameters that were audited, and a brief description of the audit process
- summary and conclusions of the audit and corrective action requirements
- attachments or appendices that include all audit evaluations and audit finding forms

To prepare the report, the audit team should meet and compare observations with collected documents and results of interviews and discussions with key personnel. Expected QA project plan implementation is compared with observed accomplishments and deficiencies and the audit findings are reviewed in detail. Within thirty (30) calendar days of the completion of the audit, the audit report should be prepared and submitted.

The technical systems audit report is submitted to the audited agency. It is suggested that a cover letter be used to reiterate the fact that the audit report is being provided for review and written comment. The letter should also indicate that, should no written comments be received by the audit lead within thirty (30) calendar days from the report date, it will be assumed acceptable to the agency in its current form, and will be formally distributed without further changes.

If the agency has written comments or questions concerning the audit report, the audit team should review and incorporate them as appropriate, and subsequently prepare and resubmit a report in final form within thirty (30) days of receipt of the written comments. Copies of this report should be sent to the agency director or his/her designee for internal distribution. The transmittal letter for the amended report should indicate official distribution and again draw attention to the agreed-upon schedule for corrective action implementation.

15.3.4 Follow-up and Corrective Action Requirements

As part of corrective action and follow-up, an audit finding response form (Fig 15.6) is generated by the audited organization for each finding form submitted by the audit team. The audit finding response form is signed by the audited organizations director and sent to the organization responsible for oversight who reviews and accepts the corrective action. The audit response form should be completed by the audited organization within 30 days of acceptance of the audit report.

Audit Finding Response Form

Audit Title: _____ **Audit #:** ____ **Finding #:**____

Finding:

Cause of the problem:

Actions taken or planned for correction:

Responsibilities and timetable for the above actions:

Prepared by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Remarks:

Is this audit finding closed? _____ **When?** _____

File with official audit records. Send copy to auditee

Figure 15.6. Audit response form

15.4 Data Quality Assessments

A data quality assessment (DQA) is the statistical analysis of environmental data, to determine whether the quality of data is adequate to support the decision which are based on the DQOs. Data are appropriate if the level of uncertainty in a decision, based on the data, is acceptable. The DQA process is described in detail in *Guidance for the Data Quality Assessment Process*, EPA QA/G-9 [41], in Section 18 and is summarized below.

1. *Review the data quality objectives (DQOs) and sampling design of the program*: review the DQO and develop one, if it has not already been done. Define statistical hypothesis, tolerance limits, and/or confidence intervals.

2. *Conduct preliminary data review*. Review QA data and other available QA reports, calculate summary statistics, plots and graphs. Look for patterns, relationships, or anomalies.

3. *Select the statistical test*: select the best test for analysis based on the preliminary review, and identify underlying assumptions about the data for that test.

4. *Verify test assumptions*: decide whether the underlying assumptions made by the selected test hold true for the data and the consequences.

5. *Perform the statistical test:* perform test and document inferences. Evaluate the performance for future use.

The G-9[41] document provides many appropriate statistical tests. QAD is also developing statistical software to complement the document. Both can be found on the QAD Homepage *(http://es.epa.gov/ncerqa)* .

OAQPS plans on performing data quality assessments for the pollutants of the Ambient Air Quality Monitoring Network at a yearly frequency for data reports and at a 3-year frequency for more interpretative reports. Reporting organizations and State and local agencies are encouraged to implement data quality assessments at their levels. Attaining the DQOs at a local level will ensure that the DQOs will be met when data is aggregated at higher levels.

16. Reports to Management

This section provides guidance and suggestions to air monitoring organizations on how to report the quality of the aerometric data and how to convey personnel information and requests for assistance concerning quality control and quality assurance problems. The guidance offered here is primarily intended for reporting organizations that provide data to one or more of these national networks:

- SLAMS (State and Local Air Monitoring Stations)
- NAMS (National Air Monitoring Stations, a subset of SLAMS)
- PAMS (Photochemical Air Monitoring Stations)
- PSD (Prevention of Significant Deterioration stations)
- Air Toxics

This guidance may also be useful in preparing reports that summarize data quality of other pollutant measurements such as those made at Special Purpose Monitoring Stations and state-specific programs.

Several kinds of reports can be prepared; the size and frequency of the reports will depend on the information requested or to be conveyed. A brief, corrective action form or letter-style report might ask for attention to an urgent problem. On the other hand, an annual quality assurance report to management would be a much larger report containing sections such as:

- executive summary
- network background and present status
- quality objectives for measurement data
- quality assurance procedures
- results of quality assurance activities
- recommendations for further quality assurance work, with suggestions for improving performance and fixing problems with equipment, personnel training, infrastructure needs, etc.

A report to management should not solely consist of tabulations of analyzer-by-analyzer precision and accuracy check results for criteria pollutants. This information is required to be submitted with the data each quarter and is thus already available to management through AIRS. Instead, the annual quality assurance report to management should summarize and discuss the results of such checks. These summaries from individual reporting organizations can be incorporated into additional reports issued by the State and/or the EPA Regional Office.

This section provides general information for the preparation of reports to management and includes:

- the types of reports that might be prepared, the general content of each type of report, and a suggested frequency for their preparation
- sources of information that can be tapped to retrieve information for the reports
- techniques and methods for concise and effective presentation of information

Appendix 16 presents examples of two types of reports to management; the annual quality assurance report to management and a corrective action request.

16.1 Guidelines for Preparation of Reports to Management

16.1.1 Types of QA Reports to Management

Listed in Table 16-1 are examples of typical QA reports to management. An individual reporting organization may have others to add to the list or may create reports that are combinations of those listed below.

Table 16-1 Types of QA Reports to Management

Type of QA Report to Management	Contents	Suggested Reporting Frequency				
		As required	Week	Month	Quarter	Year
Corrective action request	Description of problem; recommended action required; feedback on resolution of problem	x				
Control chart with summary	Repetitive field or lab activity; control limits versus time. Prepare monthly or whenever new check or calibration samples are used.	x		x		
National Performance Audit Program results	Summary of SLAMS, NAMS, and NPAP audit results	x			x	x
State and local organization performance audits	Summary of audit results; recommendations for action, as needed.	x				x
System audits	Summary of system audit results; recommendations for action, as needed.	x				x
Quality assurance report to management	Executive summary. Precision, bias, and system and performance audit results.					x
Network reviews (by EPA Regional Office)	Review results and suggestions for actions, as needed.	x				x

16.1.2 Sources of Information

Information for inclusion in the various reports to management may come from a variety of sources, including: records of precision and accuracy checks, results of systems and performance audits, laboratory and field instrument maintenance logbooks, NPAP audits, etc. Table 16-2 lists useful sources and the type of information expected to be found.

Table 16-2 Sources of Information for Preparing Reports to Management

Information Source	Expected Information and Usefulness
State implementation plan	Types of monitors, locations, and sampling schedule
Quality assurance program and project plans	Data quality indicators and goals for precision, accuracy, completeness, timeliness
Quality objectives for measurement data document	Quality objectives for measurement data. Audit procedures and frequency.
Laboratory and field instrument maintenance logbooks	Record of maintenance activity, synopsis of failures, recommendations for equipment overhaul or replacement
Laboratory weighing room records of temperature, humidity	A record of whether or not environmental control in the weighing room is adequate to meet goals
Audit results (NPAP, local, etc.)	Results of audit tests on ambient air pollutant measurement devices

16.1.3 Methods of Presenting Information

Reports to Management are most effective when the information is given in a succinct, well-summarized fashion. Methods useful for distilling and presenting information in ways that are easy to comprehend are listed in Table 16-3. Several of these methods will be available on-line in the revised AIRS database; others are available in commercially available statistical and spreadsheet computer programs.

Table 16-3. Presentation Methods for Use in Reports to Management

Presentation Method	Typical Use	Examples
Written text	Description of results and responses to problems	Appendix 16
Control chart	Shows whether a repetitive process stays within QC limits.	Figure 12.3 of this Handbook
Black box report	Shows if project goals were met.	Executive Summary of Appendix 16
Bar charts	Shows relationships between numerical values.	Included in most graphic and spreadsheet programs
X Y (scatter) charts	Shows relationships between two variables.	Included in most graphic and spreadsheet programs
Probability limit charts	Show a numerical value with its associated precision range.	Figure 1 of Appendix 16

16.1.4 Annual Quality Assurance Report

The annual quality assurance report (an example is provided in Appendix 16) should consist of a number of sections that describe the quality objectives for measurement data and how those objectives have been met. A suggested organization might include:

Executive Summary of Report to Management - The executive summary should be a short (no more than two page) section that summarizes the annual quality assurance report to management. It should contain a checklist graphic that lets the reader know how the reporting organization has met its goals for the report period. In addition, a short discussion of future needs and plans should be included.

Introduction - This section describes the quality objectives for measurement data and serves as an overview of the reporting organization's structure and functions. It also briefly describes the procedures used by the reporting organization to assess the quality of field and laboratory measurements.

Quality information for each ambient air pollutant monitoring program - These sections are organized by ambient air pollutant category (e.g., gaseous criteria pollutants, air toxics). Each section includes the following topics:

- program overview and update
- quality objectives for measurement data
- data quality assessment

16.1.5 Corrective Active Request

A corrective action request should be made whenever anyone in the reporting organization notes a problem that demands either immediate or long-term action to correct a safety defect, a operational problem, or a failure to comply with procedures. A typical corrective action request form, with example information entered, is shown in Appendix 16. A separate form should be used for each problem identified.

The corrective action report form is designed as a closed-loop system. First it identifies the originator, that person who reports and identifies the problem, states the problem, and may suggest a solution. The form then directs the request to a specific person (or persons), i.e., the recipient, who would be best qualified to "fix" the problem. Finally, the form closes the loop by requiring that the recipient state how the problem was resolved and the effectiveness of the solution. The form is signed and a copy is returned to the originator and other copies are sent to the supervisor and the applicable files for the record.

17. Data Review, Verification and Validation

Data review, verification and validation are techniques used to accept, reject or qualify data in an objective and consistent manner. Verification can be defined as confirmation by examination and provision of objective evidence that *specified requirements* have been fulfilled. Validation can be defined as confirmation by examination and provision of objective evidence that the particular requirements for a specific *intended use* are fulfilled. It is important to describe the criteria for deciding the degree to which each data item has met its quality specifications as described in an organization's QAPP. This section will describe the techniques used to make these assessments.

In general, these assessment activities are performed by persons implementing the environmental data operations as well as by personnel "independent" of the operation, such as the organization's QA personnel and at some specified frequency. The procedures, personnel and frequency of the assessments should be included in an organization's QAPP. These activities should occur prior to submitting data to AIRS and prior to final data quality assessments that will be discussed in Section 18.

Each of the following areas of discussion should be considered during the data review/verification/validation processes. Some of the discussion applies to situations in which a sample is separated from its native environment and transported to a laboratory for analysis and data generation; others are applicable to automated instruments. The following information is an excerpt from *EPA G-5*[32]:

Sampling Design - How closely a measurement represents the actual environment at a given time and location is a complex issue that is considered during development of the sampling design. Each sample should be checked for conformity to the specifications, including type and location (spatial and temporal). By noting the deviations in sufficient detail, subsequent data users will be able to determine the data's usability under scenarios different from those included in project planning.

Sample Collection Procedures- Details of how a sample is separated from its native time/space location are important for properly interpreting the measurement results. Sampling methods and field SOPs provide these details, which include sampling and ancillary equipment and procedures (including equipment decontamination). Acceptable departures (for example, alternate equipment) from the QAPP, and the action to be taken if the requirements cannot be satisfied, should be specified for each critical aspect. Validation activities should note potentially unacceptable departures from the QAPP. Comments from field surveillance on deviations from written sampling plans also should be noted.

Sample Handling- Details of how a sample is physically treated and handled during relocation from its original site to the actual measurement site are extremely important. Correct interpretation of the subsequent measurement results requires that deviations from the sample handling section of the QAPP and the actions taken to minimize or control the changes, be detailed. Data collection activities should indicate events that occur during sample handling that may affect the integrity of the samples. At a minimum, investigators should evaluate the sample containers and the preservation methods used and ensure that they are appropriate to the nature of the sample and the type of data generated from the sample. Checks on the identity of the sample (e.g., proper labeling and chain of custody records) as well as proper physical/chemical storage

conditions (e.g., chain of custody and storage records) should be made to ensure that the sample continues to be representative of its native environment as it moves through the analytical process.

Analytical Procedures- Each sample should be verified to ensure that the procedures used to generate the data were implemented as specified. Acceptance criteria should be developed for important components of the procedures, along with suitable codes for characterizing each sample's deviation from the procedure. Data validation activities should determine how seriously a sample deviated beyond the acceptable limit so that the potential effects of the deviation can be evaluated during DQA.

Quality Control- The quality control section of the QAPP specifies the QC checks that are to be performed during sample collection, handling and analysis. These include analyses of check standards, blanks and replicates, which provide indications of the quality of data being produced by specified components of the measurement process. For each specified QC check, the procedure, acceptance criteria, and corrective action (and changes) should be specified. Data validation should document the corrective actions that were taken, which samples were affected, and the potential effect of the actions on the validity of the data.

Calibration- Calibration of instruments and equipment and the information that should be presented to ensure that the calibrations:

- were performed within an acceptable time prior to generation of measurement data
- were performed in the proper sequence
- included the proper number of calibration points
- were performed using standards that "bracketed" the range of reported measurement results otherwise, results falling outside the calibration range should be flagged as such
- had acceptable linearity checks and other checks to ensure that the measurement system was stable when the calibration was performed

When calibration problems are identified, any data produced between the suspect calibration event and any subsequent recalibration should be flagged to alert data users.

Data Reduction and Processing- Checks on data integrity evaluate the accuracy of "raw" data and include the comparison of important events and the duplicate keying of data to identify data entry errors.

Data reduction is an irreversible process that involves a loss of detail in the data and may involve averaging across time (for example, hourly or daily averages) or space (for example, compositing results from samples thought to be physically equivalent) such as the $PM_{2.5}$ spatial averaging techniques. Since this summarizing process produces few values to represent a group of many data points, its validity should be well-documented in the QAPP. Potential data anomalies can be investigated by simple statistical analyses[41].

The information generation step involves the synthesis of the results of previous operations and the construction of tables and charts suitable for use in reports. How information generation is checked, the requirements for the outcome, and how deviations from the requirements will be treated, should be addressed.

17.1 Data Review Methods

The flow of data from the field environmental data operations to the storage in the database requires several distinct and separate steps:

- initial selection of hardware and software for the acquisition, storage, retrieval and transmittal of data
- organization and the control of the data flow from the field sites and the analytical laboratory
- input and validation of the data
- manipulation, analysis and archival of the data
- submittal of the data into the EPA's AIRS database.

Both manual and computer-oriented systems require individual reviews of all data tabulations. As an individual scans tabulations, there is no way to determine that all values are valid. The purpose of manual inspection is to spot unusually high (or low) values (outliers) that might indicate a gross error in the data collection system. In order to recognize that the reported concentration of a given pollutant is extreme, the individual must have basic knowledge of the major pollutants and of air quality conditions prevalent at the reporting station. Data values considered questionable should be flagged for verification. This scanning for high/low values is sensitive to spurious extreme values but not to intermediate values that could also be grossly in error.

Manual review of data tabulations also allows detection of uncorrected drift in the zero baseline of a continuous sensor. Zero drift may be indicated when the daily minimum concentration tends to increase or decrease from the norm over a period of several days. For example, at most sampling stations, the early morning (3:00 a.m. to 4:00 a.m.) concentrations of carbon monoxide tend to reach a minimum (e.g., 2 to 4 ppm). If the minimum concentration differs significantly from this, a zero drift may be suspected. Zero drift could be confirmed by review of the original strip chart.

In an automated data processing system, procedures for data validation can easily be incorporated into the basic software. The computer can be programmed to scan data values for extreme values, outliers or ranges. These checks can be further refined to account for time of day, time of week, and other cyclic conditions. Questionable data values are then flagged on the data tabulation to indicate a possible error. Other types of data review can consist of preliminary evaluations of a set of data, calculating some basic statistical quantiles and examining the data using graphical representations.

17.2 Data Verification Methods

Data verification is defined as the confirmation by examination and provision of objective evidence that *specified requirements* have been fulfilled[32]. These requirements for each data operation is included in the organizations QAPP and in SOPs. The data verification process involves the inspection, analysis, and acceptance of the field data or samples. These inspections can take the form of technical systems audits (internal or external) or frequent inspections by field operators and lab technicians. Questions that might be asked during the verification process include:

- Were the environmental data operations performed according to the SOP's governing those operations?
- Were the environmental data operations performed on the correct time and date originally specified? Many environmental operations must be performed within a specific time frame; for example, the NAAQS samples for particulates are collected once every six days from midnight to midnight. The monitor timing mechanisms must have operated correctly for the sample to be collected within the time frame specified.
- Did the sampler or monitor perform correctly? Individual checks such as leak checks, flow checks, meteorological influences, and all other assessments, audits, and performance checks must have been acceptably performed and documented.
- Did the environmental sample pass an initial visual inspection? Many environmental samples can be flagged (qualified) during the initial visual inspection.
- Were the environmental data operations performed to meet data quality objectives designed for those specific data operations and were the operations performed as specified? The objectives for environmental data operations must be clear and understood by all those involved with the data collection.

17.3 Data Validation Methods

Data validation is a routine process designed to ensure that reported values meet the quality goals of the environmental data operations. Data validation is further defined as examination and provision of objective evidence that the particular requirements for a specific *intended use* are fulfilled. A progressive, systematic approach to data validation must be used to ensure and assess the quality of data.

The purpose of data validation is to detect and then verify any data values that may not represent actual air quality conditions at the sampling station. Effective data validation procedures usually are handled completely independently from the procedures of initial data collection.

Because the computer can perform computations and make comparisons extremely rapidly; it can also make some determination concerning the validity of data values that are not necessarily high or low. Data validation procedures should be recommended as standard operating procedures. One way to do this is to test the difference between successive data values, since one would not normally expect very rapid changes in concentrations of a pollutant during a 5-min or 1-h reporting period. When the difference between two successive values exceeds a predetermined value, the tabulation can be flagged, with an appropriate symbol.

Quality control data can support data validation procedures. If data assessment results clearly indicate a serious response problem with the analyzer, the agency should review all pertinent quality control information to determine whether any ambient data, as well as any associated assessment data, should be invalidated. When precision, bias or accuracy assessment readings are obtained during any period for which the ambient readings immediately before or immediately after these readings are determined, by suitable reason, to be invalid, then the precision, bias and accuracy readings should also be invalidated. Any data quality calculations using the invalidated readings should be redone. Also, the precision, bias or accuracy checks should be rescheduled, preferably in the same calendar quarter. The basis or justification for all data invalidations should be permanently documented.

Certain criteria, based upon CFR and field operator and laboratory technician judgement, may be used to invalidate a sample or measurement. These criteria should be explicitly identified in the organizations QAPP. Many organizations use flags or result qualifiers to identify potential problems with data or a sample. A flag is an indicator of the fact and the reason that a data value (a) did not produce a numeric result, (b) produced a numeric result but it is qualified in some respect relating to the type or validity of the result, or (c) produced a numeric result but for administrative reasons is not to be reported outside the organization. Flags can be used both in the field and in the laboratory to signify data that may be suspect due to contamination, special events or failure of QC limits. Flags can be used to determine if individuals samples (data), or samples from a particular instrument, will be invalidated. In all cases, the sample (data) should be thoroughly reviewed by the organization prior to any invalidation.

Flags may be used alone or in combination to invalidate samples. Since the possible flag combinations can be overwhelming and can not always be anticipated, an organization needs to review these flag combinations and determine if single values or values from a site for a particular time period will be invalidated. The organization should keep a record of the combination of flags that resulted in invalidating a sample or set of samples. These combinations should be reported to the EPA Region and can be used to ensure that the organization evaluates and invalidates data in a consistent manner.

Procedures for screening data for possible errors or anomalies should also be implemented. References 41 and 90 recommend several statistical screening procedures for ambient air quality data that should be applied to identify gross data anomalies. Additional information on validation of air monitoring data is contained in references 89 and 110.

17.3.1 Automated Methods

When zero or span drift validation limits (see Section 12) are exceeded, ambient measurements should be invalidated back to the most recent point in time where such measurements are known to be valid. Usually this point is the previous calibration (or accuracy audit), unless some other point in time can be identified and related to the probable cause of the excessive drift (such as a power failure or malfunction). Also, data following an analyzer malfunction or period of non-operation should be regarded as invalid until the next subsequent (level 1) calibration unless unadjusted zero and span readings at that calibration can support its validity.

17.3.2 Manual Methods

For manual methods, the first level of data validation should be to accept or reject monitoring data based upon results from operational checks selected to monitor the critical parameters in all three major and distinct phases of manual methods--sampling, analysis, and data reduction. In addition to using operational checks for data validation, the user must observe all limitations, acceptance limits, and warnings described in the reference and equivalent methods per se that may invalidate data. It is further recommended that results from performance audits/evaluations required in 40 CFR 58 Appendices A and B not be used as a sole criteria for data invalidation because these checks (performance audits) are intended to assess the quality of the data.

18.0 Reconciliation with Data Quality Objectives

Section 3 described the data quality objective (DQO) process, which is an important planning tool to determine the objectives of an environmental data operation, to understand and agree upon the allowable uncertainty in the data, and with that, optimize the sampling design. This information, along with sampling and analytical methods and appropriate QA/QC should be documented in an organization's QAPP. The QAPP is then implemented by the State or local organization under the premise that if it is followed, the DQOs should be met. Reconciliation with the DQO involves reviewing both routine and QA/QC data to determine whether the DQOs have been attained and that the data is adequate for its intended use. This process of evaluating the data against the DQOs has been termed data quality assessment (DQA).

The DQA process has been developed for cases where formal DQOs have been established. However, these procedures can also be used for data that do not formally have DQOs. Guidance on the DQA process can be found in the document titled *Guidance for Data Quality Assessment (EPA QA/G-9)*[41]. This document focuses on evaluating data for fitness in decision- making and also provides many graphical and statistical tools.

DQA is built on a fundamental premise: " *Data quality, as a concept, is meaningful only when it relates to the intended use of the data*[41]". By using the DQA Process, one can answer two fundamental questions:

1. Can the decision (or estimate) be made with the desired confidence, given the quality of the data set?
2. How well can the sampling design be expected to perform over a wide range of possible outcomes?

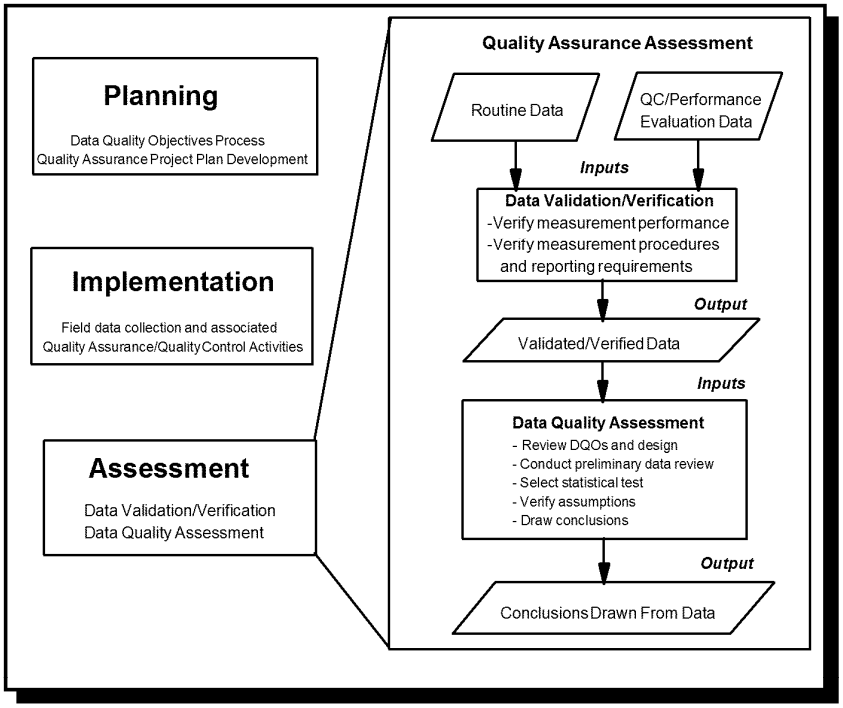

Figure 18.1 DQA in the context of the data life cycle.

DQA is a key part of the assessment phase of the data life cycle (Fig. 18.1), which is very similar to the ambient air QA life cycle described in Section 2 (Fig. 2.2) . As the part of the assessment phase that follows data validation and verification, DQA determines how well the validated data can support their intended use.

18.1 Five Steps of the DQA Process

As described in *EPA QA/G-9*[41], the DQA process is comprised of five steps. The steps are detailed below. Since DQOs are available for the $PM_{2.5}$ program, they will be used as an example for the type of information that might be considered in each step. The $PM_{2.5}$ information is italicized and comes from a Model $PM_{2.5}$ QAPP for a fictitious reporting organization called Palookaville. The Model QAPP was developed to help States and local organizations develop QAPPs based upon the new R-5[34] QAPP requirements.

Step 1. Review DQOs and Sampling Design. Review the DQO outputs to assure that they are still applicable. If DQOs have not been developed, specify DQOs before evaluating the data (e.g., for environmental decisions, define the statistical hypothesis and specify tolerable limits on decision errors; for estimation problems, define an acceptable confidence probability interval width). Review the sampling design and data collection documentation for consistency with the DQOs.

The $PM_{2.5}$ DQOs define the primary objective of the $PM_{2.5}$ ambient air monitoring network ($PM_{2.5}$ NAAQS comparison), translate the objective into a statistical hypothesis (3-year average of annual mean $PM_{2.5}$ concentrations less than or equal to 15 $\mu g/m^3$ and 3-year average of annual 98th percentiles of the $PM_{2.5}$ concentrations less than or equal to 65 $\mu g/m^3$), and identify limits on the decision errors (incorrectly conclude area in non-attainment when it truly is in attainment no more than 5% of the time, and incorrectly conclude area in attainment when it truly is in non-attainment no more than 5% of the time).

The CFR contains the details for the sampling design, including the rationale for the design, the design assumptions, and the sampling locations and frequency. If any deviations from the sampling design have occurred, these will be indicated and their potential effect carefully considered throughout the entire DQA.

Step 2. Conduct Preliminary Data Review. Review QA reports, calculate basic statistics, and generate graphs of data. Use this information to learn about the structure of the data and identify patterns, relationships, or potential anomalies.

A preliminary data review will be performed to uncover potential limitations to using the data, to reveal outliers, and generally to explore the basic structure of the data. The first step is to review the quality assurance reports. The second step is to calculate basic summary statistics, generate graphical presentations of the data, and review these summary statistics and graphs.

***Review Quality Assurance Reports**. Palookaville will review all relevant quality assurance reports that describe the data collection and reporting process. Particular attention will be directed to looking for anomalies in recorded data, missing values, and any deviations from standard operating procedures. This is a qualitative review. However, any concerns will be further investigated in the next two steps.*

Calculation of Summary Statistics and Generation of Graphical Presentations. *Palookaville will generate some summary statistics for each of its primary and QA samplers. The summary statistics will be calculated at the quarterly, annual, and three-year levels and will include only valid samples. The summary statistics are:*

> *Number of samples, mean concentration, median concentration, standard deviation, coefficient of variation, maximum concentration, minimum concentration, interquartile range, skewness and kurtosis.*

These statistics will also be calculated for the percent differences at the collocated sites. The results will be summarized in a table. Particular attention will be given to the impact on the statistics caused by the observations noted in the quality assurance review. In fact, Palookaville may evaluate the influence of a potential outlier by evaluating the change in the summary statistics resulting from exclusion of the outlier.

Palookaville will generate some graphics to present the results from the summary statistics and to show the spatial continuity over Palookaville. Maps will be created for the annual and three-year means, maxima, and interquartile ranges for a total of 6 maps. The maps will help uncover potential outliers and will help in the network design review. Additionally, basic histograms will be generated for each of the primary and QA samplers and for the percent difference at the collocated sites. The histograms will be useful in identifying anomalies and evaluating the normality assumption in the measurement errors.

Step 3. Select the Statistical Test. Select the most appropriate procedure for summarizing and analyzing the data, based upon the reviews of the DQOs, the sampling design, and the preliminary data review. Identify the key underlying assumptions that must hold for the statistical procedures to be valid.

The primary objective for the $PM_{2.5}$ mass monitoring is determining compliance with the $PM_{2.5}$ NAAQS. As a result, the null and alternative hypotheses are:

$$H_0\text{: } X \quad 15\ \mu g/m^3 \text{ and } Y \quad 65\ \mu g/m^3$$
$$H_A\text{: } X > 15\ \mu g/m^3 \text{ or } Y > 65\ \mu g/m^3$$

where X is the three-year average $PM_{2.5}$ concentration and Y is the three-year average of the annual 98th percentiles of the $PM_{2.5}$ concentrations recorded for an individual monitor. The exact calculations for X and Y are specified in 40 CFR Part 50 Appendix N. The null hypothesis is rejected, that is, it is concluded that the area is not in compliance with the $PM_{2.5}$ NAAQS when the observed three-year average of the annual arithmetic mean concentration exceeds 15.05 $\mu g/m^3$ or when the observed three-year average of the annual 98th percentiles exceeds 65.5 $\mu g/m^3$. If the bias of the sampler is greater than -10% and less than +10% and the precision is within 10%, then the error rates (Type I and Type II) associated with this statistical test are less than or equal to 5%. The definitions of bias and precision will be outlined in the following step.

Step 4. Verify Assumptions of Statistical Test. Evaluate whether the underlying assumptions hold, or whether departures are acceptable, given the actual data and other information about the study.

The assumptions behind the statistical test include those associated with the development of the DQOs in addition to the bias and precision assumptions. Their method of verification will be addressed in this step. Note that when less than three years of data are available, this verification will be based on as much data as are available.

***The DQO is based on the annual arithmetic mean NAAQS**. For each primary sampler, Palookaville will determine which, if either, of the $PM_{2.5}$ NAAQS is violated. In the DQO development, it was assumed that the annual standard is more restrictive than the 24-hour standard. If there are any samplers that violate ONLY the 24-hour NAAQS, then this assumption is not correct. The seriousness of violating this assumption is not clear. Conceptually, the DQOs can be developed based on the 24-hour NAAQS and the more restrictive bias and precision limits selected. However, Palookaville will assume the annual standard is more restrictive, until proven otherwise.*

Normal distribution for measurement error. Assuming that measurement errors are normally distributed is common in environmental monitoring. Palookaville has not investigated the sensitivity of the statistical test to violate this assumption; although, small departures from normality generally do not create serious problems. Palookaville will evaluate the reasonableness of the normality assumption by reviewing a normal probability plot, calculating the Shapiro-Wilk W test statistic (if sample size less than 50), and calculating the Kolmogorov-Smirnoff test statistic (if sampler size greater than 50). All three techniques are provided by standard statistical packages and by the statistical tools provided in EPA QA/G-9D: Data Quality Evaluation Statistical Tools (DataQUEST). If the plot or statistics indicate possible violations of normality, Palookaville may need to determine the sensitivity of the DQOs to departures in normality.

Decision error can occur when the estimated 3-year average differs from the actual, or true, 3-year average. This is not really an assumption as much as a statement that the data collected by an ambient air monitor is stochastic, meaning that there are errors in the measurement process, as mentioned in the previous assumption.

The limits on precision and bias are based on the smallest number of required sample values in a 3-year period. In the development of the DQOs, the smallest number of required samples was used. The reason for this was to ensure that the confidence was sufficient in the minimal case; if more samples are collected, then the confidence in the resulting decision will be even higher. For each of the samplers, Palookaville will determine how many samples were collected in each quarter. If this number meets or exceeds 12, then the data completeness requirements for the DQO are met.

The decision error limits were set at 5%. Again, this is more of a statement. If the other assumptions are met, then the decision error limits are less than or equal to 5%.

Measurement imprecision was established at 10% coefficient of variation (CV). For each sampler, Palookaville will review the coefficient of variation calculated in Step 2. If any exceed 10%, Palookaville may need to determine the sensitivity of the DQOs to larger levels of measurement imprecision.

Table 18-1 will be completed during each DQA. The table summarizes which, if any, assumptions have been violated. A check will be placed in each of the row/column combinations that apply. Ideally, there will be no checks. However, if there are checks in the table, the implication is that the decision error rates are unknown even if the bias and precision limits are achieved. As mentioned above, if any of the DQO assumptions are violated, then Palookaville will need to reevaluate its DQOs.

Achievement of bias and precision limits. Lastly, Palookaville will check the assumption that at the three-year level of aggregation the sampler bias is within ± 10% and precision is less than 10%. The data from the collocated samplers will be used to estimate quarterly, annual, and three-year bias and precision estimates even though it is only the three-year estimates that are critical for the statistical test.

Since all the initial samplers being deployed by Palookaville will be FRMs, the samplers at each of the collocated sites will be identical method designations. As such, it is difficult to determine which of the collocated samplers is closer to the true $PM_{2.5}$ concentration. Palookaville will calculate an estimate of precision. A bias measure will also be calculated but it can only describe the relative difference of one sampler to the other, not definitively indicate which sampler is more "true." Following are the algorithms for calculating precision and bias. This are similar, but differ slightly, from the equations in 40 CFR Part 58 Appendix A[14].

Table 18-1. Summary of Violations of DQO Assumptions

Site	Violate 24-Hour Standard ONLY?	Measurement Errors Non-Normal?	Data Complete? (12 samples per quarter)	Measurement CV > 10%?
Primary Samplers				
A1				
A2				
A3				
A4				
B1				
QA Samplers				
A1				
B1				

Before describing the algorithm, first some ground work. When less than three years of collocated data are available, then the three-year bias and precision estimates must be predicted. Palookaville's strategy for accomplishing this will be to use all available quarters of data as the basis for projecting where the bias and precision estimates will be at the end of the three-year monitoring period. Three-year point estimates will be computed by weighting the quarterly components, using the most applicable of the following assumptions:

1. *Most recent quarters precision and bias are most representative of what the future quarters will be.*
2. *All previous quarters precision and bias are equally representative of what the future quarters will be.*
3. *Something unusual happened in the most recent quarter, so the most representative quarters are all the previous ones, minus the most recent.*

Each of these scenarios results in weights that will be used in the following algorithms. The weights are shown in Table 18-2 where the variable Q represents the number of quarters for which observed bias and precision estimates are available. Note that when Q=12, that is, when there are bias and precision values for all of the quarters in the three-year period, then all of the following scenarios result in the same weighting scheme.

Table 18-2. Weights for Estimating Three-Year Bias and Precision

Scenario	Assumption	Weights
1	Latest quarter most representative	$w_q = 12-(Q-1)$ for latest quarter, $w_q = 1$ otherwise
2	All quarters equally representative	$w_q = 12/Q$ for each quarter
3	Latest quarter unrepresentative	$w_q = 1$ for latest quarter, $w_q = 11/(Q-1)$ otherwise

In addition to point estimates, Palookaville will develop confidence intervals for the bias and precision estimates. This will be accomplished using a re-sampling technique. The protocol for creating the confidence intervals are outlined in Box 18-1.

Box 18-1. Method for Estimating Confidence in Achieving Bias and Precision DQOs

Let Z be the statistic of interest (bias or precision). For a given weighting scenario, the re-sampling will be implemented as follows:

1. *Determine M, the number of collocated pairs per quarter for the remaining 12-Q quarters (default is M=15 or can use M=average number observed for the previous Q quarters.*
2. *Randomly select with replacement M collocated pairs per quarter for each of the future 12-Q quarters in a manner consistent with the given weighting scenario.*
   Scenario 1: Select pairs from latest quarter only.
   Scenario 2: Select pairs from any quarter.
   Scenario 3: Select pairs from any quarter except the latest one.
   Result from this step is "complete" collocated data for a three-year period, from which bias and precision estimates can be determined.
3. *Based on the "filled-out" three-year period from step 2, calculate three-year bias and precision estimate, using Equation 1 where $w_q = 1$ for each quarter.*
4. *Repeat steps 2 and 3 numerous times, such as 1000 times.*
5. *Determine P, the fraction of the 1000 simulations for which the three-year bias and precision criteria are met. P is interpreted as the probability that the sampler is generating observations consistent with the three-year bias and precision DQOs.*

The algorithms for determining whether the bias and precision DQOs have been achieved for each sampler follow

Bias Algorithm

1. *For each measurement pair, estimate the percent relative bias, d_i.*

$$d_i = \frac{Y_i - X_i}{(Y_i + X_i)/2} x100$$

where X_i represents the concentration recorded by the primary sampler, and Y_i represents the concentration recorded by the collocated sampler.

2. *Summarize the percent relative bias to the quarterly level, $D_{j,q}$, according to*

$$D_{j,q} = \frac{1}{n_{j,q}} \sum_{i=1}^{n_{j,q}} d_i$$

where $n_{j,q}$ is the number of collocated pairs in quarter q for site j.

3. *Summarize the quarterly bias estimates to the three-year level using*

$$\hat{D}_j = \frac{\sum_{q=1}^{n_q} w_q D_{j,q}}{\sum_{q=1}^{n_q} w_q} \qquad \textit{Equation 1}$$

where n_q is the number of quarters with actual collocated data and w_q is the weight for quarter q as specified by the scenario in Table 18-2.

4. *Examine $D_{j,q}$ to determine whether one sampler is consistently measuring above or below the other. To formally test this, an non-parametric test will be used. The test is called the Wilcoxon Signed Rank Test and is described in EPA QA/G-9[41]. If the null hypothesis is rejected, then one of the samplers is consistently measuring above or below the other. This information may be helpful in directing the investigation into the cause of the bias.*

Precision Algorithm

1. *For each measurement pair, calculate the coefficient of variation according to Equation 20 from Section 14 and repeated below:*

$$CV_i = \frac{d_i}{\sqrt{2}}$$

2. *Summarize the coefficient of variation to the quarterly level, $CV_{j,q}$, according to*

$$CV_{j,q} = \sqrt{\frac{\sum_{i=1}^{n_j} CV_i^2}{n_{j,q}}}$$

where $n_{j,q}$ is the number of collocated pairs in quarter q for site j.

3. *Summarize the quarterly precision estimates to the three-year level using*

$$\hat{CV}_j = \sqrt{\frac{\sum_{q=1}^{n_q} (w_q CV_{j,q}{}^2)}{\sum_{q=1}^{n_q} w_q}} \qquad \textit{Equation 2}$$

where n_q is the number of quarters with actual collocated data and w_q is the weight for quarter q as specified by the scenario is Table 24-2.

4. *If the null hypothesis in the Wilcoxon signed rank test was not rejected, then the coefficient of variation can be interpreted as a measure of precision. If the null hypothesis in the Wilcoxon signed rank test was rejected, the coefficient of variation has both a component representing precision and a component representing the (squared) bias.*

Confidence in Bias and Precision Estimates

1. *Follow the method described in Box 18-1 to estimate the probability that the sampler is generating observations consistent with the three-year bias and precision DQOs. The re-sampling must be done for each collocated site.*

Summary of Bias and Precision Estimation

The results from the calculations and re-sampling will be summarized in Table 18-3. There will be one line for each site operating a collocated sampler.

Table 18-3. Summary of Bias and Precision

Collocated	Three-year Bias Estimate (Equation. 1)	Three-year Precision Estimate (Equation. 2)	Null Hypothesis of Wilcoxon Test Rejected?	*P* (Box 18-1)
A1				
B1				

Step 5. Draw Conclusions from the Data.- Perform the calculations required for the statistical test and document the inferences drawn as a result of these calculations. If the design is to be used again, evaluate the performance of the sampling design.

Before determining whether the monitored data indicate compliance with the $PM_{2.5}$ NAAQS, Palookaville must first determine if any of the assumptions upon which the statistical test is based are violated. This can be easily checked in Step 5 because of all the work done in Step 4. In particular, as long as

- *in Table 18-1, there are no checks, and*
- *in Table 18-3,*
  - *the three year bias estimate is in the interval [-10%,10%], and*
  - *the three year precision estimate is less than or equal to 10%*

then the assumptions underlying the test appear to be valid. As a result, if the observed three-year average $PM_{2.5}$ concentration is less than 15 $\mu g/m^3$ and the observed three-year average 98th percentile is less than 65 $\mu g/m^3$, the conclusion is that the area seems to be in compliance with the $PM_{2.5}$ NAAQS, with an error rate of 5%.

If any of the assumptions have been violated, then the level of confidence associated with the test is suspect and will have to be further investigate.

DQA without DQOs

Even though DQOs, based upon the EPA G-4 guidance has not been developed for all criteria pollutants, a process very similar to this approach was originally used[27]. In addition, State and local organizations collect enough types of QA/QC data to estimate the quality of there data and should be able to express the confidence in that information.

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Appendix 2

QA-Related Guidance Documents for Ambient Air Monitoring Activities

The following documents provide guidance on various aspects of the Ambient Air Quality Monitoring Program. It is anticipated that many of these documents will be available on the Internet and the AMTIC Bulletin Board.

QA-RELATED AMBIENT MONITORING DOCUMENTS

DOCUMENT TITLE	STATUS
General	
Quality Assurance Handbook for Air Pollution Measurement Systems, Volume I: A Field Guide to Environmental Quality Assurance, U.S. Environmental Protection Agency, EPA-600/R-94-038a, April 1994.	Current
Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Specific Methods, U.S. Environmental Protection Agency, EPA-600/R-94-038b, April 1994.	Interim edition [replaces EPA-600/4-77-027a (revised 1990)]; final updated edition expected early 1998.
Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III: Stationary Source Specific Methods, U.S. Environmental Protection Agency, EPA-600/R-94-038c, September 1994.	Interim edition [replaces EPA-600/4-77-027b (revised 1992); final updated edition expected late 1995.
Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, U.S. Environmental Protection Agency, EPA-600/R-94/038d, Revised April 1994.	
Quality Assurance Handbook for Air Pollution Measurement Systems, Volume V: Precipitation Measurement Systems (Interim Edition), EPA-600/R-94-038e, April 1994.	Interim edition (replaces EPA-600/4-82-042a-b); final updated edition expected early 1996.
Air Monitoring Strategy for State Implementation Plans, EPA-450/2-77-010, June 1977.	Historical interest only
Guideline on the Implementation of the Ambient Air Monitoring Regulations 40 CFR Part 58, EPA-450/4-79-038, November 1979.	Historical interest only
Model Quality Assurance Project Plan for the $PM_{2.5}$ Ambient Air Monitoring Program, March 1998	Presently on AMTIC *www.epa.gov/ttn/amtic/pmqa.html*
Quality Management	
EPA Quality Systems Requirements for Environmental Programs, *EPA QA/R-1*	Available in Summer, 1998
Guidance for Developing Quality Systems for Environmental Data Operations EPA QA/G-1	Fall, 1998.
EPA Requirements for Quality Management Plans," EPA QA/R-2 U.S. Environmental Protection Agency, QAD, August 1994.	Final version of this document is expected to be available in Summer, 1998.
Guidance for Preparing Quality Management Plans EPA QA/G-2:	Unsure when available.

DOCUMENT TITLE	STATUS
Guidance for the Management Systems Review Process EPA QA/G-3: Draft January, 1994	Available in Summer, 1998.
EPA Requirements for Quality Assurance Project Plans, QA/R-5, Current Version: Draft - August 1994	Final version of this document will be available in Spring, 1997.
"Guidance on Quality Assurance Project Plans" EPA/G-5, EPA/600/R-98/018.	Final - February 1998
Policy and Program Requirements to Implement the Mandatory Quality Assurance Program, Order 5360.1, April 1984.	Current, basis for EPA QA program (updated in 1995 draft Order)
Data Quality Objectives	
Data Quality Objectives for the Toxic Air Monitoring System (Stages I and II), December 1987.	Historical interest only.
Data Quality Objectives for the Urban Air Toxic Monitoring Program (Stages I and II), June 6, 1988.	Historical interest only.
Guidance on Applying the Data Quality Objectives Process for Ambient Air Monitoring Around Superfund Sites (Stages I and II), EPA-450/4-89-015, August 1989.	Basically current guidance
Guidance on Applying the Data Quality Objectives Process for Ambient Air Monitoring Around Superfund Sites (Stage III), EPA-450/4-90-005, March 1990.	Basically current guidance
Decision Error Feasibility Trials (DEFT) Software for the Data Quality Objectives Process, *QA/G-4D*: EPA/600/R-96/056,	Final: September, 1994
The Data Quality Objectives Process: Case Studies, EPA QA/G-4CS:	Expected to be available in Fall, 1998.
Guidance for the Data Quality Objectives Process, U.S. *QA/G-4*, EPA/600/R-96/055,	Final: September, 1994
Ambient Air Monitoring Data Quality Objectives (DQOs) for the Photochemical Assessment Monitoring Stations Program preliminary draft report, July 9, 1992.	Incorporated DQOs in PAMS Implementation Manual
NPAP	
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DOCUMENT TITLE	STATUS
Quality Assurance Project Plan for the National Performance Audit Program (NPAP), U.S. Environmental Protection Agency, September 15, 1993. Includes the following Standard Operating Procedures: - SOP-QAD-004: Audit Systems Verification Center Operational Procedures - SOP-QAD-508: Calibration of ReF Devices for Surveying Performance of Hi-Vol Sampler Flow Rates - SOP-QAD-510: Conducting the Lead NPAP Audit - SOP-QAD-512: Calibration of a Pulsed Fluorescent SO2 Analyzer - SOP-QAD-520: SO2 Audit Device Calibration - SOP-QAD-521: Conducting the Sulfate-Nitrate NPAP Audit - SOP-QAD-523: Analysis of NO/NO2/NOx in Gas Cylinders - SOP-QAD-542: NO2 Audit Device Quality Assurance Operation Checks - SOP-QAD-543: Quality Assurance Checks of Dichot (PM-10) Audit Devices - SOP-QAD-544: Conducting an Ozone National Performance Audit - SOP-QAD-546: Computer Data Entry, Report Printing and Maintenance for the NPAP - SOP-QAD-547: Conducting Performance Audits for Carbon Monoxide - SOP-QAD-548: Data Validation for Data Bases of the NPAP - SOP-QAD-549: Analysis of CO in Gas Cylinders with GFC Analysis - SOP-QAD-551: Editing NPAP Data Bases - SOP-QAD-553: Performing the Routine Activities of the AREAL Coordinator of the NPAP	Revision of the NPAP QAPP
P&A	
Analysis of Protocol Gases: An Ongoing Quality Assurance Audit, U.S. Environmental Protection Agency, EPA-600/A-93-168, May 1993.	Historical interest only
Guideline on the Meaning and Use of Precision and Accuracy Data Required by 40 CFR Part 58, Appendices A and B, U.S. Environmental Protection Agency, EPA-600/4-83-023, June 1983.	Some items out of date (e.g., SAROAD versus AIRS, no PM-10, etc.)
Issues Concerning the Use of Precision and Accuracy Data, Special Report, U.S. Environmental Protection Agency, EPA-450/4-84-006, February 1984.	Historical interest only

DOCUMENT TITLE	STATUS
Guidance for the Data Quality Assessment: Practical Methods for Data Analysis EPA QA/G-9 EPA/600/R-96/084,	Final: January, 1998
System Audits	
National Air Audit System Guidance Manual for FY 1988-FY 1989, U.S. Environmental Protection Agency, EPA-450/2-88-002, February 1988.	National audit report discontinued in FY89
Network Design and Siting	
Enhanced Ozone Monitoring Network Design and Siting Criteria Guidance Document, EPA-450/4-91-033, November 1991.	
PAMS Implementation Manual, EPA-454/B-93-051, March 1994	
Guidance for Conducting Ambient Air Monitoring for Lead Around Lead Point Sources, January 1992.	Designed to supersede EPA-450/4-81-006, assuming change in lead NAAQS and revised EPA lead policy; policy has been changed but not NAAQS
Guidance for Network Design and Optimum Site Exposure for PM2.5 and PM10, December, 1997	Draft published 12/15/97. Presently on AMTIC *www.epa.gov/ttn/amtic*
Guideline for PM-10 Monitoring and Data Reporting, May 1985.	Partially out of date
Guideline for Short-Term Lead Monitoring in the Vicinity of Point Sources, OAQPS Number 1.2-122, March 26, 1979.	Superseded by *Guidance for Conducting Ambient Air Monitoring for Lead Around Point Sources*, January 1992
Network Design and Optimum Site Exposure Criteria for Particulate Matter, EPA-450/4-87-009, May 1987.	Basically current; could be revised when new PM standard is proposed
Guidance for Network Design and Optimum Exposure for $PM_{2.5}$ and PM_{10}. Draft December 1997	Currently draft on AMTIC
Network Design and Site Exposure Criteria for Selected Noncriteria Air Pollutants, EPA-450/4-84-022, September 1984.	Partially out of date
Appendix E and F to Network Design and Site Exposure Criteria for Selected Noncriteria Air Pollutants, EPA-450/4-84-022a, October 1987.	Partially out of date
Optimum Sampling Site Exposure Criteria for Lead, EPA-450/4-84-012, February 1984.	Historical interest only
Optimum Site Exposure Criteria for SO2 Monitoring, EPA-450/3-77-013, April 1977.	Should be revised when EPA promulgates final SO_2 regulation

DOCUMENT TITLE	STATUS
Selecting Sites for Carbon Monoxide Monitoring, EPA-450/3-75-077, September 1975.	Current guidance but out of date
Selecting Sites for Monitoring Total Suspended Particulates, EPA-450/3-77-018, December 1977.	Historical interest only
Site Selection for the Monitoring of Photochemical Air Pollutants, EPA-450/3-78-013, April 1978.	Need for revision partially met through *PAMS Implementation Manual* (EPA-454/8-98-051)
Ambient Air Monitoring Methods	
Photochemical Assessment Monitoring Stations Implementation Manual, EPA-454/B-93-051, October 1994	
Technical Assistance Document for Sampling and Analysis of Toxic Organic Compounds in Ambient Air, EPA-600/8-90-005, March 1990.	Currently being revised; sections being included in *PAMS Implementation Manual*
EPA QA/G-6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations Final - EPA/600/R-96/027, November, 1995	
Ambient Air Monitoring Costs	
Guidance for Estimating Ambient Air Monitoring Costs for Criteria Pollutants and Selected Air Toxic Pollutants, EPA-454/R-93-042, October 1993.	Partially out of date; need longer amortization schedule
Other	
Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD), EPA-450/4-87-007, May 1987.	Partially out of date
EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards, EPA-600/R-93-224, Revised September 1993.	Current guidance
Guidebook: Preparation and Review of Emission Test Reports, January 10, 1992.	Current guidance
Guidebook: Preparation and Review of Site Specific Test Plans, OAQPS, December 1991.	Current guidance
Guideline on the Identification and Use of Air Quality Data Affected by Exceptional Events, EPA-450/4-86-007, July 1986.	Currently being updated by MQAG

DOCUMENT TITLE	STATUS
IntraAgency Task Force Report on Air Quality Indicators, EPA-450/4-81-015, February 1981.	Not a policy or guidance document; could be updated to include more modern analysis and presentation techniques
Screening Procedures for Ambient Air Quality Data, EPA-450/2-78-037, July 1978.	Could be updated to include more modern computer programs and newer screening procedures
Third Generation Air Quality Modeling System, Vol. 4: Project Verification and Validation, EPA-600/R-94-220d, June 1994 (draft, in review).	Being updated
Validation of Air Monitoring Data, U.S. Environmental Protection Agency, EPA-600/4-80-030, June 1980.	Partially out of date;

Appendix 3

Measurement Quality Objectives

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Measurement Quality Objectives - Parameter NO_2 (Chemiluminescence)				
Requirement	**Frequency**	**Acceptance Criteria**	**Reference**	**Information/Action**
Standard Reporting Units	All data	ppm	40 CFR, Pt 50.11	
Shelter Temperature Temperature range Temperature control	 Daily Daily	 20 to 30 C ± 2 C	 40 CFR, Pt. 53.20 Vol II, S 7.1 1/ Vol II, MS 2.3.2	Instruments designated as reference or equivalent have been tested over this temperature range. Maintain shelter temperature above sample dewpoint. Shelter should have a 24- hour temperature recorder. Flag all data for which temperature range or fluctuations are outside acceptance criteria.
Equipment NO_2 analyzer Air flow controllers Flowmeters	 Purchase specification	 Reference or equivalent method Flow rate regulated to ± 2 % Accuracy ± 2 %	 40 CFR, Pt 53.9 40 CFR, Pt 50, App F, S 2.2 EPA-600/4-75-003	
Detection Noise Lower detectable level	 Purchase specification	 0.005 ppm 0.01 ppm	 40 CFR, Pt 53.20 & 23 "	Instruments designated as reference or equivalent have been determined to meet these acceptance criteria
Completeness Hourly Data	 Quarterly	 75 %	 40 CFR, Pt 50.11	
Compressed Gases Dilution gas (zero air) Gaseous standards	 Purchase specification Purchase specification	 Free of contaminants NIST Traceable (e.g., EPA Protocol Gas)	 EPA-600/4-75-003 40 CFR, Pt 50, App F, S 1.3 EPA-600/R-97/121	Return cylinder to supplier. Nitric oxide in nitrogen EPA Protocol Gases have a 24-month certification period and must be recertified to extend the certification.

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Measurement Quality Objectives - Parameter NO_2 (Chemiluminescence)

Requirement	Frequency	Acceptance Criteria	Reference	Information/Action
Calibration				
Multipoint calibration (at least 5 points)	≥ 1/6 months., after failure of QC check or after maintenance	Residence time ≤ 2 min Dynam. parameter ≥ 2.75 ppm-min All points within ± 2 % of full scale of best-fit straight line	40 CFR, Pt 50, App F, S 1 Vol II, S 12.6 Vol II, MS 2.3.2	Zero gas and at least four upscale calibration points. Points outside acceptance criterion are repeated. If still outside consult manufacturers manual and invalidate data to last acceptable multipoint calibration or zero/span check .
Convertor efficiency	During multipoint calibrations	96 %	40 CFR, Pt. 50, App F	Replace or service converter.
Zero/span check - level 1	1/ 2 weeks	Zero drift ± 20 to 30 ppb Span drift ± 20 to 25 % Zero drift ± 10 to 15 ppb Span drift ± 15 %	Vol II, MS.2.3.2 Vol II, S 12.6 Vol II, MS 2.3.2 Vol II, S 12.6 Vol II, MS 2.3.2	**If calibration factors are updated after each zero/span**, invalidate data to last acceptable zero/span check, adjust analyzer, and perform multipoint calibration. **If fixed calibration factors are used to calculate data**, invalidate data to last acceptable zero/span check, adjust analyzer, and perform multipoint calibration.
Flowmeters	1/3 months	Accuracy ± 2 %	Vol II, App 12	Flowmeter calibration should be traceable to NIST standards.
Performance Evaluation				
(NPAP)	1/year at selected sites	Mean absolute difference 15 %	NPAP QAPP	Use information to inform reporting agency for corrective action and technical systems audits.
State audits	1/year	State requirements	Vol II, App 15, S 3	
Precision				
Single analyzer Reporting organization	1/ 2 weeks 1/3 months	None 95 % Confidence Interval ± 15 %	40 CFR, Pt 58, App A EPA-600/4-83-023 Vol II, App 15, S 6	Concentration. = 0.08-0.10 ppm.
Accuracy				
Single analyzer Reporting organization	25 % of sites quarterly (all sites yearly)	None 95% Confidence Interval ± 20%	40 CFR, Pt 58, App A EPA-600/4-83-023 Vol II, App 15, S 3	Four concentration ranges. If failure, recalibrate analyzer and reanalyze samples. Repeated failure requires corrective action.

1/ - reference refers to the QA Handbook for Air Pollution Measurement Systems, Volume II . The use of "S" refers to sections within Part 1 of Volume II. The use of "MS" refers to method-specific sections in Volume II.

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Measurement Quality Objectives - Parameter O_3 (Ultraviolet Photometric)				
Requirement	**Frequency**	**Acceptance Criteria**	**Reference**	**Information/Action**
Standard Reporting Units	All data	ppm	40 CFR, Pt 50.9	
Shelter Temperature Temperature range Temperature control	 Daily Daily	 20 to 30 C. ± 2 C	 40 CFR, Pt. 53.20 Vol II, S 7.1 [1/] *Determination of Ozone by Ultraviolet Analysis (draft)*	Instruments designated as reference or equivalent have been tested over this temperature range. Maintain shelter temperature above sample dewpoint. Shelter should have a 24- hour temperature recorder. Flag all data for which temperature range or fluctuations are outside acceptance criteria.
Equipment O_3 analyzer	Purchase specification	Reference or equivalent method	40 CFR, Pt 53.9 EPA-600/4-79-057	Air flow controllers must be capable of regulating air flows as necessary to meet the output stability and photometer precision requirements. The photometric measurement of absorption is not directly related to flow rate, but may be indirectly related due to thermal or other effects.
Detection Noise Lower detectable level	Purchase specification	0.005 ppm 0.01 ppm	40 CFR, Pt. 53.20 & 23 "	Instruments designated as reference or equivalent have been determined to meet these acceptance criteria.
Completeness (seasonal) Maximum 1-hour concentration	Daily	75% values from 9:01 AM to 9:00 PM (LST)	40 CFR, Pt 50, App H, S 3	A missing daily maximum ozone value may be assumed to be less than the standard if valid daily maxima on the preceding and following days do not exceed 75 percent of the standard.
Transfer standard Qualification and certification Recertification to local primary standard	 Upon receipt of transfer standard 1/3 months (if at a fixed site)	 ±4% or ±4 ppb (whichever greater) RSD of six slopes 3.7% Std. dev. of six intercepts 1.5% New slope = ±0.05 of previous	 EPA-600/4-79-056 EPA-600/4-79-057 " "	6 comparison runs that include, at minimum, 6 concentrations per comparison run including 0 and 90 ± 5% of upper range. A single six-point comparison run.

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Measurement Quality Objectives - Parameter O_3 (Ultraviolet Photometric)				
Requirement	**Frequency**	**Acceptance Criteria**	**Reference**	**Information/Action**
Local primary standard				
Certification/recertification to Standard Photometer	1/year	Difference ±5 % (preferably ± 3%)	*Determination of Ozone by Ultraviolet Analysis (draft)*	The local primary standard is a standard in its own right, but it must be repaired and recertified if the acceptance criterion is exceeded.
(if recertified via a transfer standard)	"	Regression slopes = 1.00 ± 0.03 and two intercepts are 0 ± 3 ppb	"	
EPA Standard Reference Photometer recertification	1/year	Regression slope = 1.00 ± 0.01 and intercept < 3 ppb	Protocol for Recertification of Standard Reference Photometers... (TRC Environmental Document)	9 replicate analysis over 12 conc. ranges. Disagreement must be resolved. EPA Standard Reference Photometer rechecked with NIST. If OK Network STANDARD REFERENCE PHOTOMETER must be repaired.
Zero air	Purchase specification	Free of O_3 or any substance that might react with O_3 (e.g., NO, NO_2, hydrocarbons, and particulates)	EPA-600/4-79-057	Return cylinder to supplier
Ozone analyzer calibration				
Zero/span check -level 1	1/ 2 weeks	Zero drift ± 20 to 30 ppb Span drift ± 20 to 25 %	Vol II, S 12.6 "	**If calibration updated at each zero/span**, Invalidate data to last acceptable check, adjust analyzer, perform multipoint calibration. **If fixed calibration used to calculate data**, Invalidate data to last acceptable check, adjust analyzer, perform multipoint calibration. Zero gas and at least four upscale calibration points. Check verify accuracy of flow dilution. Redo analysis. If failure persists corrective action required.
		Zero drift ± 10 to 15 ppb Span drift ± 15%	Vol II, S 12.6 "	
Multipoint calibration (at least 5 points)	Upon receipt, adjustment, or 1/ 6 months	Linearity error <5%	40 CFR, Pt 50, App D, S 5.2.3 EPA-600/4-79-057 S.5 Vol II, S 12.2	
Performance Evaluation				
(NPAP)	1/year at selected sites	Mean absolute difference 15%	Vol II, S 16.3	Use information to inform reporting agency for corrective action and technical systems audits.
State audits	1/year	State requirements	Vol II, App 15, S 3	

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Measurement Quality Objectives - Parameter O_3 (Ultraviolet Photometric)				
Requirement	**Frequency**	**Acceptance Criteria**	**Reference**	**Information/Action**
Precision Single analyzer Reporting organization	1/ 2 weeks 1/3 months	None 95% CI < ± 15%	40 CFR, Pt 58, App A EPA-600/4-83-023 Vol II, App 15, S 6	Concentration = 0.08-0.10 ppm.
Accuracy Single analyzer Annual accuracy	25 % of sites quarterly (all sites yearly)	None 95% CI ± 20%	40 CFR, Pt 58, App A EPA-600/4-83-023 Vol II, App 15, S 6	Four concentration ranges. If failure, recalibrate and reanalyze. Repeated failure requires corrective action.

1/ - reference refers to the QA Handbook for Air Pollution Measurement Systems, Volume II . The use of "S" refers to sections within Part 1 of Volume II. The use of "MS" refers to method-specific sections in Volume II.

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Measurement Quality Objectives - Parameter Lead (Atomic Absorption Spectroscopy)				
Requirement	**Frequency**	**Acceptance Criteria**	**Reference**	**Information/Action**
Reporting Units	All data	µg/m^3	40 CFR, Pt 50.12	
Filter Checks				
Visual defect check	All filters	See reference	Vol II, MS 2.2.4	Discard any defective filters
Filter Integrity				
Collection efficiency	Purchase specification	99%	40 CFR, Pt 50, App B, S 7.1	Measure using DOP test (ASTM-2988). Reject shipment
Integrity		2.4 mg max weight loss	"	
pH		6 to 10	"	
Equipment				
Sampler	Purchase specification	Reference or equivalent method	40 CFR, Pt 53.9 40 CFR, Pt 50, App B, S 7	
Flow rate transfer standard	Purchase specification	0.02 std. m^3/min	"	
Detection Limit				
LDL	Not applicable	0.07 g/m^3	40 CFR, Pt 50, App G, S 2	This value is based on a collaborative test of the method. Assumed air volume of 2,400 m^3.
Completeness	Quarterly	75%		
Sampler calibration				
Orifice calibration unit (flow rate transfer standard)	On receipt and yearly	Indicated flow rate within ± 2 % of actual flow rate	Vol II, MS 2.8.1 Vol II, MS 2.2.2	Adopt a new calibration curve. A rotary-type, gas displacement meter is the recommended NIST-traceable reference standard. Adjust or replace meter
Elapsed time meter	On receipt and 1/6 months	± 2 min/24 hours	"	
On/Off Timer	On receipt and 1/3 months	± 30 min/24 hour	Vol II, MS 2.2.2	Checked against elapsed time meter. Adjust or repair.
Sampler flow rate	On receipt, if audit deviation > 7 %, after maintenance	All points within ± 5 % of full scale of best-fit straight line	"	Rerun points outside limits until acceptable.

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Measurement Quality Objectives - Parameter Lead (Atomic Absorption Spectroscopy)				
Requirement	**Frequency**	**Acceptance Criteria**	**Reference**	**Information/Action**
Analytical calibration				
Reproducibilitytest	On receipt	5%	Vol II, MS 2.8.1	Reproducibility= 100 ([high response-lowresponse]/average response). Responses should be corrected for the blank level. If acceptance criterion is exceeded, instrument should be checked by a service rep or qualified operator.
Calibrationstability	Before first sample, after every tenth sample, after last sample	± 5 % deviation from calibration curve.	Vol II, MS 2.8.5	Alternate between two control standards with concentrations 1 µg/mL or 1 to 10 µg/mL. Take corrective action and repeat the previous ten analyses.
Performance Evaluation				
(NPAP)	1/year at selected sites	Mean absolute difference 15%	Vol II, S 16.3 40 CFR, Pt 58, App A	Use information to inform reporting agency for corrective action and technical systems audits
Sampler performance Audit (flow rate)	1/3 months	Percentage difference ±7%	Vol II, MS 2.2.8	Recalibrate before any additional sampling
Precision				
Single analyzer	1/6 days	None	40 CFR, Pt 58, App A, S 5.3	Both lead values must be > 0.15 µg/m^3
Reporting organization	1/ 3 months	95% CI < ± 15%	40 CFR, Pt 58, App A, S 5.3	
Accuracy				
Single analyzer Reporting organization	25 % of sites quarterly	Percentage difference ± 16% 95% CI ± 20%	Vol II, MS 2.8.8 40 CFR, Pt 58, App A, S 3.4 EPA-600/4-83-023	Analyze three audit samples in each of the two concentrationranges. The audit samples shall be distributedas much as possible over the entire calendar quarter.

[1] - reference refers to the QA Handbook for Air Pollution Measurement Systems, Volume II . The use of "S" refers to sections within Part 1 of Volume II. The use of "MS" refers to method-specific sections in Volume II.

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Measurement Quality Objectives - Parameter PM10 (Dichotomous Sampler)				
Requirement	**Frequency**	**Acceptance Criteria**	**Reference**	**Information/Action**
Reporting Units	All data	µg/m^3	40 CFR, Pt 50.7	
Filter Checks				
Visual defect check	All filters	See reference	Vol II, MS 2.10.4	Discard any defective filters
Filter Integrity				
Collection efficiency	Purchase specification	99 %	40 CFR, Pt 50, App M, S 7.2	As measure by DOP test (ASTM-2988). Reject shipment.
Integrity		± 5 µg/m^3	"	
Alkalinity		< 25.0 microequivalents/gram	"	Following 2 months storage at ambient temp and relative humidity. Reject filters
Filter Conditioning				
Equilibration time	All Filters	at least 24 hours	40 CFR, Pt 50, App M, S 9.3	Repeat equilibration
Temperature range	"	15 to 30 C	40 CFR, Pt 50, App M, S 7.4	Keep thermometer in balance room and record temperature daily.
Temperature control	"	± 3 C	"	
Humidity range	"	20 to 45 % relative humidity	"	Keep hygrometer in the balance room and record humidity daily.
Humidity control	"	± 5 % relative humidity	"	
Equipment				
Sampler	Purchase specification	Reference or equivalent method	40 CFR, Pt 53.9	
Flow rate transfer standard	Purchase specification	± 2 % accuracy (NIST traceable)	40 CFR, Pt 50, App M, S7.3	
Analytical balance	Purchase specification	Sensitivity = 0.1 mg	40 CFR, Pt 50, App M, S 7.5 Vol II, MS 2.10.4	This acceptance criterion is inconsistent with other acceptance criteria for balance that are in the quality assurance handbook.
Mass reference standards	Purchase specification	NIST traceable (e.g., ANSI/ASTM Class 2)	Vol II, MS 2.10.4	
Detection Limit				
LDL	Not applicable	Not applicable	40 CFR, Pt 50, App M, S 3.1	The lower limit of the mass concentration is determined by the repeatability of filter tare weights, assuming the nominal air sample volume for the sampler.
Completeness	quarterly	75%	40 CFR, Pt 50, App K, S 2.3	

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Measurement Quality Objectives - Parameter PM10 (Dichotomous Sampler)				
Requirement	**Frequency**	**Acceptance Criteria**	**Reference**	**Information/Action**
Sampler Calibration				
Flow control device	On installation, after repairs, after out-of-limits flow check	<4% difference from manufacturers spec and actual	40 CFR, Pt 50, App M, S 7.1 Vol II, MS 2.10.2	Adopt new calibration curve if no evidence of damage, otherwise replace.
Elapsed time meter	On receipt and 1/6 months	± 15 min	40 CFR, Pt 50, App M, S 7.1 Vol II, MS 2.10.1	Adjust or replace.
Flow-rate transfer Standard	Periodically	±2% over the expected range of ambient conditions	40 CFR, Pt 50, App M, S 8.2 Vol II, MS 2.10.1	Checked against NIST-traceable primary standard.
Balance Calibration	1/year		Vol II, MS 2.10.4	Calibrate and maintain according to the manufacturer's recommendations.
Performance Evaluation (NPAP)	1/year at selected sites	Mean absolute difference 15%	Vol II, S 16.3	Use information to inform reporting agency for corrective action and technical systems audits
Precision				
Single analyzer	1/6 days	5 g/m^3 for conc. 80 µg/m^3	40 CFR, Pt 50, App M, S 4.1	Both PM10 values must be > 20 µg/m^3.
Reporting organization	1/ 3 months	7% for conc. >80 µg/m^3 95% CI < ± 15%	40 CFR, Pt 58, App A, S 5.3 EPA-600/4-83-023	
Accuracy				
Single analyzer Annual accuracy	25 % of sites quarterly (all sites yearly)	None 95% CI ± 20%	40 CFR, Pt 58, App A EPA-600/4-83-023 Vol II, App 15, S 6	Transfer standards different then those used in calibration. Recalibrate before any additional sampling. Invalidate data to last acceptable flow check if difference $\geq$ 10%.

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Measurement Quality Objectives - Parameter PM10 (Dichotomous Sampler)				
Requirement	**Frequency**	**Acceptance Criteria**	**Reference**	**Information/Action**
QC Checks				
Field calibration flow check	1/month	Percentage difference ±7 % from sampler's indicated flow rate or ± 10 % from design condition flow rate	40 CFR, Pt 50, App M, S 8.2 Vol II, MS 2.10.3	Trouble shoot and recalibrate sampler.
"Standard" filter weighing	at beginning of weighing day	± 20 g of original weight	Vol II, S 2.10.4	Trouble shoot and reweigh.
Reweighing filters	5 exposed and 5 unexposed/day	± 20 g of original weight	Vol II, S 2.10.4	Trouble shoot and reweigh.
Balance zero and calibration check	every fifth filter	± 4 g at zero ± 2 g at 10 mg	Vol II, S 2.10.4	Trouble shoot and reweigh.

1/ - reference refers to the QA Handbook for Air Pollution Measurement Systems, Volume II . The use of "S" refers to sections within Part 1 of Volume II. The use of "MS" refers to method-specific sections in Volume II.

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Measurement Quality Objectives - Parameter SO_2 (Ultraviolet Fluorescence)				
Requirement	**Frequency**	**Acceptance Criteria**	**Reference**	**Information/Action**
Standard Reporting Units	All data	ppm	40 CFR, Pt 50.4	
Shelter Temperature Temperature range Temperature control	 Daily Daily	 20 to 30 C ± 2 C	 40 CFR Pt. 53.20 Vol II, S 7.1 1/ Vol II, MS 2.9	Instruments designated as reference or equivalent have been tested over this temperature range. Maintain temperature above sample dewpoint. Shelter should have a 24- hour temperature recorder. Flag all data for which temperature range or fluctuations are outside acceptance criteria.
Equipment SO_2 analyzer Air flow controllers Flowmeters	 Purchase specification	 Reference or equivalent method Flow rate regulated to ± 2 % Accuracy ± 2 %	 Vol II, MS 2.9 " "	
Detection Noise Lower detectable level	 Purchase specification	 .005 ppm .01 ppm	 40 CFR, Pt 53.20 & 23 "	Instruments designated as reference or equivalent have been determined to meet these acceptance criteria.
Completeness Annual standard 24-hour standard 3-hour standard	 Quarterly 24 hours 3 hours	 75% 75% 75%	 40 CFR, Pt 50.43 " "	
Compressed Gases Dilution gas (zero air) Gaseous standards	 Purchase specification Purchase specification	 SO_2 free, 21 % O_2/78 % N_2, 300 to 400 ppm CO_2, 0.1 ppm aromatics NIST Traceable (e.g., permeation tube or EPA Protocol Gas	 Vol II, MS 2.9.2 EPA-600/R97/121	Return cylinder to supplier. It is recommended that a clean air system be used instead of compressed air cylinders. Sulfur dioxide in nitrogen EPA Protocol Gases have a 24-month certification period for concentrations between 40 and 499 ppm and a 36-month certification period for higher concentrations.

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Measurement Quality Objectives - Parameter SO_2 (Ultraviolet Fluorescence)

Requirement	Frequency	Acceptance Criteria	Reference	Information/Action
Calibration				
Multipoint calibration (at least 4 points)	Upon receipt, adjustment, or 1/ 6 months	All points within + 2% of full scale of best-fit straight line	Vol II, S 12.6 Vol II, MS 2.9.2	Zero gas and at least three upscale points. Note: two pages from Section 2.4 (Calibration Procedures) of Vol II, MS 2.9.2 are missing from the 1994 reprinting of the QA Handbook.
Zero/span check -level 1	1/ 2 weeks	Zero drift ± 20 to 30 ppb Span drift ± 20 to 25 %	Vol II, S 12.6 "	**If calibration updated at each zero/span-** Invalidate data to last acceptable check, adjust analyzer, perform multipoint calibration **If fixed calibration used to calculate data**. Invalidate data to last acceptable check, adjust analyzer, perform multipoint calibration
		Zero drift ± 10 to 15 ppb Span drift ± 15%	Vol II, S 12.6 "	Flowmeter calibration should be traceable to NIST standards
Flowmeters	1/3 months	Accuracy ± 2 %	Vol II, App 12	
Performance Evaluation				
(NPAP)	1/year at selected sites	Mean absolute difference 15%	Vol II, S 16.3	Use information to inform reporting agency for corrective action and technical systems audits.
State audits	1/year	State requirements	Vol II, App 15, S 3	
Precision				
Single analyzer	1/2 weeks	None	40 CFR, Pt 58, App	Concentration = 0.08-0.10 ppm.
Reporting organization	1/3 months	95% CI < ± 15%	EPA-600/4-83-023 Vol II, S 16, S2	
Accuracy				
Annual accuracy check-Reporting organization	25 % of sites quarterly (all sites yearly)	None 95% CI ± 20%	40 CFR, Pt 58, App A EPA-600/4-83-023 Vol II, S 16	Four concentration ranges. If failure, recalibrate and reanalyze. Repeated failure requires corrective action.

[1/] - reference refers to the QA Handbook for Air Pollution Measurement Systems, Volume II . The use of "S" refers to sections within Part 1 of Volume II. The use of "MS" refers to method-specific sections in Volume II.

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Measurement Quality Objectives - Parameter CO (Nondispersive Infrared Photometry)				
Requirement	**Frequency**	**Acceptance Criteria**	**Reference**	**Information/Action**
Standard Reporting Units	All data	ppm	40 CFR, Pt 50.8	
Shelter Temperature **Temperature range** **Temperature control**	 Daily Daily	 20 to 30 C. < ± 2 C	40 CFR, Pt. 53.20 Vol II, S 7.1 [1/]	Instruments designated as reference or equivalent have been tested over this temperature range. Maintain shelter temperature above sample dewpoint. Shelter should have a 24-hour temperature recorder Flag all data for which temperature range or fluctuations are outside acceptance criteria.
Equipment CO analyzer Flow controllers Flowmeters	Purchase specification	Reference or equivalent method Flow rate regulated to ± 1% Accuracy ± 2%	40 CFR, Pt 50, App C " "	
Detection Limit Noise Lower detectable level	Purchase specification	0.5 ppm 1.0 ppm	40 CFR, Pt 53.20 & 23 "	Instruments designated as reference or equivalent have been determined to meet these acceptance criteria.
Completeness 8-hour average	hourly	75 % of hourly averages for the 8-hour period	40 CFR, Pt 50.8	
Compressed Gases Dilution gas (zero air) Gaseous standards	 Purchase specification Purchase specification	 < 0.1 ppm CO NIST Traceable (e.g., EPA Protocol Gas)	 40 CFR, Pt 50, App C " EPA-600/R97/12	 Return cylinder to supplier. Carbon monoxide in nitrogen or air EPA Protocol Gases have a 36-month certification period and must be recertified to extend the certification.

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Measurement Quality Objectives - Parameter CO (Nondispersive Infrared Photometry)

Requirement	Frequency	Acceptance Criteria	Reference	Information/Action
Calibration				
Multipoint calibration (at least 5 points)	Upon receipt, adjustment, or 1/ 6 months	All points within ± 2% of full scale of best-fit straight line	Vol II, S 12.6 Vol II, MS.2.6.1	Zero gas and at least four upscale calibration points. Points outside acceptance criterion are repeated. If still outside criterion, consult manufacturers manual and invalidate data to last acceptable calibration.
Zero/span check-level 1	1/ 2 weeks	Zero drift ± 2 to 3 ppm Span drift ± 20 to 25 %	Vol II, S 12.6 "	**If calibration updated at each zero/span**, invalidate data to last acceptable check, adjust analyzer, perform multipoint calibration.
		Zero drift ± 1 to 1.5 ppm Span drift ± 15%	Vol II, S 12.6 "	**If fixed calibration used to calculate data**, invalidate data to last acceptable check, adjust analyzer, perform multipoint calibration.
Flowmeters	1/3 months	Accuracy ± 2 %	Vol II, App 12	Flowmeter calibration should be traceable to NIST standards.
Performance Evaluation				
(NPAP)	1/year at selected sites	Mean absolute difference 15%	Vol II, S 16.3	Use information to inform reporting agency for corrective action and technical systems audits
State audits	1 /year	State requirements	Vol II, pp 15, S 3	
Precision				
Single analyzer	1/2 weeks	None		
Reporting organization	1/3 months	95% CI ± 15%	40 CFR, Pt 58, App A EPA-600/4-83-023 Vol II, App 15, S 5	Concentration = 8 to 10 ppm. Aggregation of a quarters measured precision values.
Accuracy				
Single analyzer **Reporting organization**	25 % of sites quarterly (all sites yearly)	None 95% CI ± 20%	40 CFR, Pt 58, App A	Four concentration ranges. If failure, recalibrate and reanalyze. Repeated failure requires corrective action.

[1/] - reference refers to the QA Handbook for Air Pollution Measurement Systems, Volume II . The use of "S" refers to sections within Part 1 of Volume II. The use of "MS" refers to method-specific sections in Volume II.

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Measurement Quality Objectives- Parameter $PM_{2.5}$				
Requirement	**Frequency**	**Acceptance Criteria**	**40 CFR Reference**	**QA Guidance Document 2.12 Reference**
Filter Holding Times				
Pre-sampling	all filters	< 30 days before sampling	Part 50, App.L Sec 8.3	Sec. 7.9
Post-sampling Weighing	"	< 10 days at 25° C from sample end date < 30 days at 4°C from sample end date	" "	Sec. 7.11 "
Sampling Period	All data	1380-1500 minutes or value if < 1380 and exceedance of NAAQS	Part 50, App.L Sec 3.3	
Reporting Units	All data	g/m^3	Part 50.3	Sec. 11.1
Detection Limit				
Lower DL	All data	2 g/m^3	Part 50, App.L Sec 3.1	
Upper Conc. Limit	All data	200 g/m^3	Part 50, App.L Sec 3.2	
Sampling Instrument				
Flow Rate	every 24 hours of op " "	$\leq$ 5% of 16.67 $\leq$ 2% CV measured $\leq$ 5% average for < 5 min.	Part 50, App.L Sec 7.4 " "	
Filter Temp Sensor	"	$\leq$ 5° C of ambient for <30min		
Data Completeness	quarterly	75%	Part 50, App. N, Sec. 2.1	

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Measurement Quality Objectives- Parameter $PM_{2.5}$				
Requirement	**Frequency**	**Acceptance Criteria**	**40 CFR Reference**	**QA Guidance Document 2.12 Reference**
Filter				
Visual Defect Check	All Filters	See reference	Part 50, App.L Sec 6.0	Sec 7.5
Filter Conditioning Environment				
Equilibration	All filters	24 hours minimum	Part 50, App.L Sec 8.2	Sec. 7.6
Temp. Range	"	20-23° C	"	"
Temp. Control	"	±2° C SD over 24 hr	"	"
Humidity Range	"	30% - 40% RH or	"	"
		± 5% sampling RH but >20%RH	"	"
Humidity Control	"	± 5% SD over 24 hr.		
Pre/post sampling RH	"	± 5% RH	Part 50, App.L Sec 8.3.3	
Balance	"	located in filter conditioning environment	"8.3.2	
Filter Checks				
Lot Blanks	3 filters per lot	less than 15 g change between weighings	not described	Sec. 7.7
Exposure Lot Blanks	3 filters per lot	less than 15 g change between weighings	not described	Sec. 7.7
Lab QC Checks				
Field Filter Blank	10% or 1 per weighing session	±30 g change between weighings	Part 50, App.L Sec 8.3	Sec. 7.7
Lab Filter Blank	10% or 1 per weighing session	±15 g change between weighings	Part 50, App.L Sec 8.3	"
Balance Check	beginning, every 10th sample, end	≤3 g	not described	Sec. 7.9
Duplicate Filter Weighing	1 per weighing session	±15 g change between weighings	not described	Sec 7.11

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Measurement Quality Objectives- Parameter $PM_{2.5}$				
Requirement	**Frequency**	**Acceptance Criteria**	**40 CFR Reference**	**QA Guidance Document 2.12 Reference**
Calibration/Verification				
Flow Rate (FR) Calibration	If multi-point failure	± 2% of transfer standard	Part 50, App.L, Sec 9.2	Sec 6.3
FR multi-point verification	1/yr	± 2% of transfer standard	Part 50, App.L, Sec 9.2.5	Sec 6.3 & 8.4
One point FR verification	1/4 weeks	± 4% of transfer standard	Part 50, App.L, Sec 9.2	Sec 8.4
External Leak Check	every 5 sampling events	80 mL/min	Part 50, App.L, Sec 7.4	Sec. 6.6 & 8.4
Internal Leak Check	every 5 sampling events	80 mL/min	"	Sec. 6.6 & 8.4
Temperature Calibration	If multi-point failure	± 2% of standard	Part 50, App.L, Sec 9.3	Sec. 6.4
Temp M-point Verification	on installation, then 1/yr	± 2 C of standard	Part 50, App.L, Sec 9.3	Sec. 6.4 and 8.4
One-point temp Verification	1/4 weeks	± 4 C of standard	"	Sec. 6.4 and 8.4
Pressure Calibration	on installation, then 1/yr	±10 mm Hg	"	Sec. 6.5
Pressure Verification	1/4 weeks	±10 mm Hg	"	Sec. 8.2
Clock/timer Verification	1/ 4 weeks	1 min/mo	Part 50, App.L, Sec 7.4	not described
Accuracy				
FRM Performance Evaluation	25% of sites 4/yr	± 10%	Part 58, App A, Sec 3.5	Sec 10.2
External Leak Check	4/yr	< 80 mL/min	not described	Sec. 10.2
Internal Leak Check	4/yr	< 80 mL/min	not described	"
Temperature Audit	4/yr	± 2 C	not described	"
Pressure Audit	4/yr (?)	±10 mm Hg	not described	"
Balance Audit	1/yr	Manufacturers specs	not described	"
Accuracy				
Flow Rate Audit	1/2wk (automated) 4/yr (manual)	± 4% of audit standard	Part 58, App A, Sec 3.5	Sec. 10.2

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Measurement Quality Objectives- Parameter $PM_{2.5}$				
Requirement	**Frequency**	**Acceptance Criteria**	**40 CFR Reference**	**QA Guidance Document 2.12 Reference**
Precision				
Collocatedsamples	every 6 days for 25% of sites	CV $\leq$ 10%	Part 58, App.A, Sec 3.5 and 5.5	Sec. 10.2
			not described	
Single analyzer	1/3 mo.	CV $\leq$ 10%	not described	not described
Single Analyzer	1/ yr	CV $\leq$ 10%	not described	not described
Reporting Org.	1/ 3 mo.	CV $\leq$ 10%		not described
Calibration & Check Standards				
Flow Rate Transfer Std.	1/yr	$\pm$2% of NIST-traceableStd.	Part 50, App.L Sec 9.1 & 9.2	Sec. 6.3
Field Thermometer	1/yr	$\pm$ 0.1° C resolution	not described	Sec 4.2 & 6.4
		$\pm$ 0.5° C accuracy		"
Field Barometer	1/yr	$\pm$ 1 mm Hg resolution	not described	"
		$\pm$ 5 mm Hg accuracy		"
Working Mass Stds.	3-6 mo.	0.025 mg	not described	Sec 4.3 and 7.3
Primary Mass Stds.	1/yr	0.025 mg	not described	"

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Measurement Quality Objectives - Parameter PAMS Volatile Organic Compounds (VOC)				
Requirement	**Frequency**	**Acceptance Criteria**	**Reference**	**Information/Action**
Standard Reporting Units	All data	ppbC	TAD, July 1997	
Shelter Temperature **Temperature range**	Daily	20 to 30 C.	Vol II, S 7.1 [1/]	Instruments designated as reference or equivalent have been tested over this temperature range. Maintain shelter temperature above sample dewpoint. Shelter should have a 24-hour temperature recorder Flag all data for which temperature range or fluctuations are outside acceptance criteria.
Detection Limit System detection limit		1 ppbC	TAD Sect 2.8 2.3	Calculation based on multiple manual or automated analysis and 40 CFR recommendations
Completeness (sesonal)	annually	85 %	TAD 2.8.1	
Calibration Multipoint retention time calibration standard	Start of analytical season	correlation coefficient $\geq$ 0.995	TAD 2.8.2.3	Triplicate analysis of multiple level propane standards over the expected sample concentration range (a minimum of three levels)
Performance Evaluation NPAP	prior to start of sampling season and twice during monitoring season	In absence of specified objectives within 25%	TAD 2.8.2.3	Useful for informing reporting agency for corrective actions and technical systems audits.
Precision Duplicate samples	once/2weeks automated 10% -manual	± 25% RSD or RPD	TAD 2.8.2.1.1	Comparison of duplicate field samples, or replicate sample analysis using manual or automated field devices.
QC Checks Retention time (RT) calibration check Canister cleaning	Weekly	Response Factor within 10% RPD of calibration curve < 10 ppbC total	TAD 2.8.2.3	Retention time checked versus annual PAMS retention time cylinder provided to each site in the program. Canister cleaning per approved methodology
Background/carryover	weekly and after calibration& RT	< 20 ppbC for both columns or <10 ppbC per column	TAD 2.8.2.3	Background testing according to TAD

Appendix 6-A

Characteristics of Spatial Scales Related to Each Pollutant

The following tables provides information in order to match the spatial scale represented by the monitor with the monitoring objectives. This information can also be found in 40 CFR Part 58, Appendix D.

Pollutant	Spatial Scale	Characteristics
PM_{10}	Micro	Areas such as downtown street canyons and traffic corridors; generally not extending more than 15 meters from the roadway but could continue the length of the roadway. Sites should be located near inhabited buildings or locations where the general public can be expected to be exposed to the concentration measured.
	Middle	Measurements of this type would be appropriate for the evaluation of possible short-term public health effects of particulate matter pollution. This scale also includes the characteristic concentrations for other areas with dimensions of a few hundred meters such as the parking lot and feeder streets associated with shopping centers, stadia, and office buildings. In the case of PM10, unpaved or seldom swept parking lots associated with these sources could be an important source in addition to the vehicular emissions themselves.
	Neighborhood	Measurements in this category would represent conditions throughout some reasonably homogeneous urban subregion with dimensions of a few kilometers. This category also includes industrial and commercial neighborhoods, as well as residential.
	Urban	This class of measurement would be made to characterize the particulate matter concentration over an entire metropolitan or rural area. Such measurements would be useful for assessing trends in area-wide air quality, and hence, the effectiveness of large scale air pollution control strategies.
	Regional	These measurements would characterize conditions over areas with dimensions of as much as hundreds of kilometers. Using representative conditions for an area implies some degree of homogeneity in that area. For this reason, regional scale measurements would be most applicable to sparsely populated areas with reasonably uniform ground cover. Data characteristics of this scale would provide information about larger scale processes of particulate matter emissions, losses and transport.
$PM_{2.5}$	Micro	Areas such as downtown street canyons and traffic corridors where the general public can be expected to be exposed to maximum concentrations from mobile sources. In some circumstances, the microscale is appropriate for particulate stations; core SLAMS on the microscale should however, be limited to urban sites that are representative of long term human exposure and of many such microenvironments in the area.
	Middle	Measurements of this type would be appropriate for the evaluation of possible short-term exposure public health effects of particulate matter pollution. This scale also includes the characteristic concentrations for other areas with dimensions of a few hundred meters such as the parking lot and feeder streets associated with shopping centers, stadia, and office buildings.
	Neighborhood	Measurements in this category would represent conditions throughout some reasonably homogeneous urban subregion with dimensions of a few kilometers and of generally more regular shape than middle scale. Much of the PM2.5 exposures are expected to be associated with this scale of measurement. This category also include industrial and commercial neighborhoods, as well as residential.
	Urban	This class of measurement would be made to characterize the particulate matter concentration over an entire metropolitan or rural area. Such measurements would be useful for assessing trends in area-wide air quality, and hence, the effectiveness of large scale air pollution control strategies.
	Regional	These measurements would characterize conditions over areas with dimensions of as much as hundreds of kilometers. Using representative conditions for an area implies some degree of homogeneity in that area. For this reason, regional scale measurements would be most applicable to sparsely populated areas with reasonably uniform ground cover. Data characteristics of this scale would provide information about larger scale processes of particulate matter emissions, losses and transport.

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Pollutant	Spatial Scale	Characteristics
SO_2	Middle	Assessing the effects of control strategies to reduce urban concentrations(especially for the 3-hour and 24-hour averaging times) and monitoring air pollution episodes.
	Neighborhood	This scale applies in areas where the SO_2 concentration gradient is relatively flat (mainly suburban areas surrounding the urban center) or in large sections of small cities and towns. May be associated with baseline concentrations in areas of projected growth.
	Urban	Data from this scale could be used for the assessment of air quality trends and the effect of control strategies on urban scale air quality.
	Regional	Provide information on background air quality and interregional pollutant transport.
CO	Micro	Measurements on this scale would represent distributions within street canyons, over sidewalks, and near major roadways.
	Middle	This category covers dimensions from 100 meters to 0.5 kilometer. In certain cases, it may apply to regions that have a total length of several kilometers. If an attempt is made to characterize street-side conditions throughout the downtown area or along an extended stretch of freeway, the dimensions may be tens of meters by kilometers. Also include the parking lots and feeder streets associated with indirect sources (shopping centers, stadia, and office buildings) which attract significant numbers of pollutant emitters.
	Neighborhood	Homogeneous urban subregions, with dimensions of a few kilometers
O_3	Middle	Represents conditions close to sources of NOx such as roads where it would be expected that suppression of O_3 concentrations would occur.
	Neighborhood	Represents conditions throughout some reasonably homogeneous urban subregion, with dimensions of a few kilometers. Useful for developing, testing, and revising concepts and models that describe urban/regional concentration patterns.
	Urban	Used to estimate concentrations over large portions of an urban area with dimensions of several kilometers to 50 or more kilometers. Such measurements will be used for determining trends, and designing area-wide control strategies. The urban scale stations would also be used to measure high concentrations downwind of the area having the highest precursor emissions.
	Regional	Used to typify concentrations over large portions of a metropolitan area and even larger areas with dimensions of as much as hundreds of kilometers. Such measurements will be useful for assessing the ozone that is transported into an urban area.
NO_2	Middle	Dimensions from about 100 meters to 0.5 kilometer. These measurements would characterize the public exposure to NO_2 in populated areas.
	Neighborhood	Same as for O_3
	Urban	Same as for O_3

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Pollutant	Spatial Scale	Characteristics
Pb	Micro	Would typify areas such as downtown street canyons and traffic corridors where the general public would be exposed to maximum concentrations from mobile sources. Because of the very steep ambient Pb gradients resulting from Pb emissions from mobile sources, the dimensions of the Micro scale for Pb generally would not extend beyond 15 meters from the roadway.
	Middle	Represents Pb air quality levels in areas up to several city blocks in size with dimensions on the order of approximately 100 meters to 500 meters. However, the dimensions for middle scale roadway type stations would probably be on the order of 50-150 meters because of the exponential decrease in lead concentration with increasing distances from roadways. The middle scale may for example, include schools and playgrounds in center city areas which are close to major roadways.
	Neighborhood	Would characterize air quality conditions throughout some relatively uniform land use areas with dimensions in the 0.5 to 4.0 kilometer range. Stations of this scale would provide monitoring data in areas representing conditions where children live and play.
	Urban	Would be used to present ambient Pb concentrations over an entire metropolitan area with dimensions in the 4 to 50 kilometer range.
PAMs	Neighborhood	Would define conditions within some extended areas of the city that have a relatively uniform land use and range from 0.5 to 4 km. Measurements on a neighborhood scale represent conditions throughout a homogeneous urban subregion. Precursor concentrations, on this scale of a few kilometers, will become well mixed and can be used to assess exposure impacts and track emissions. Neighborhood data will provide information on pollutants relative to residential and local business districts. VOC sampling at Site #2 is characteristic of a neighborhood scale. Measurements of these reactants are ideally located just downwind of the edge of the urban core emission areas. Further definition of neighborhood and urban scales is provided in Appendix D of 40 CFR 58 and Reference 9.
	Urban	Would represent concentration distributions over a metropolitan area. Monitoring on this scale relates to precursor emission distributions and control strategy plans for an MSA/CMSA. PAMS Sites #1, #3, and #4 are characteristic of the urban scale.

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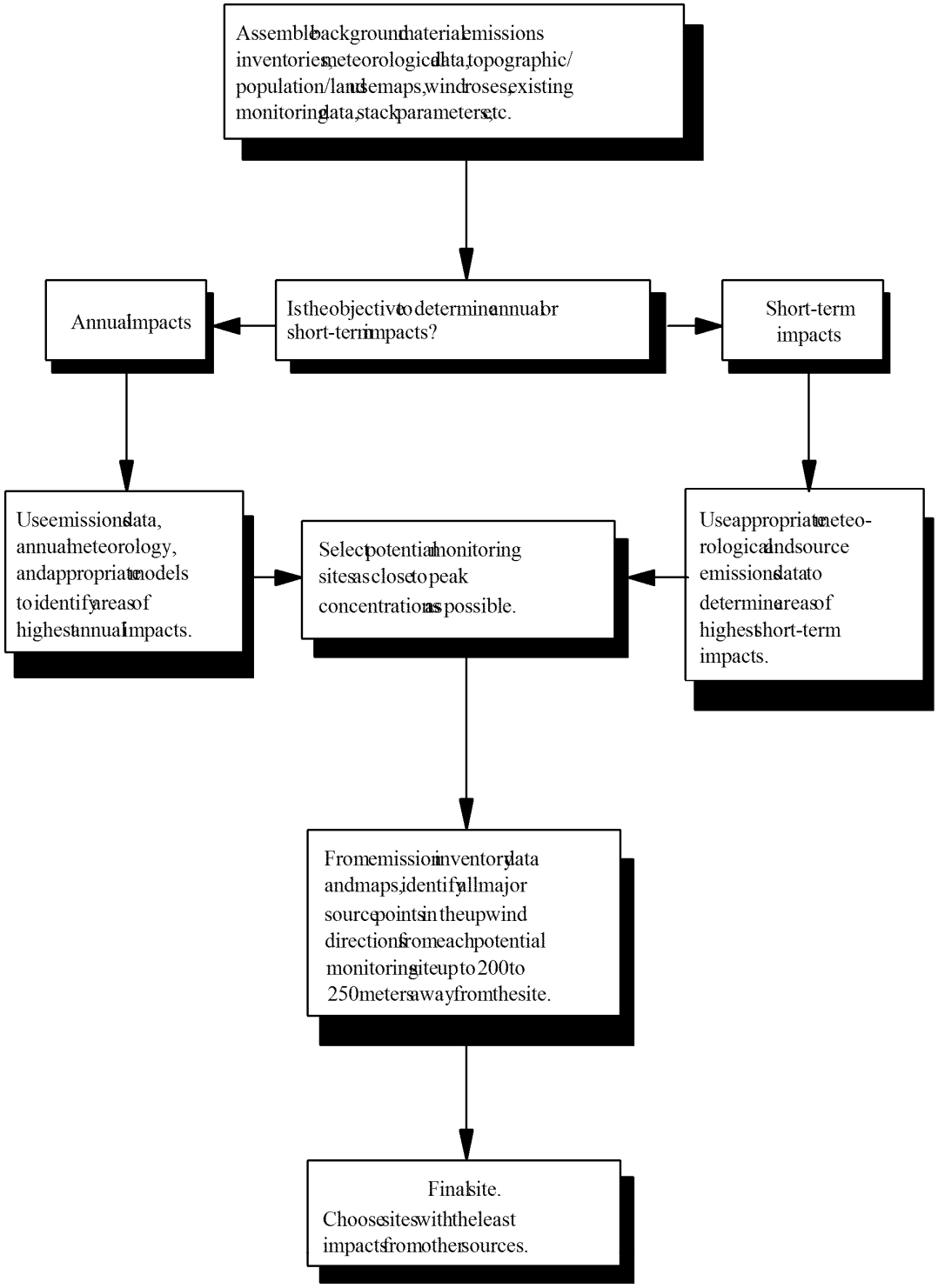
Appendix 6-B

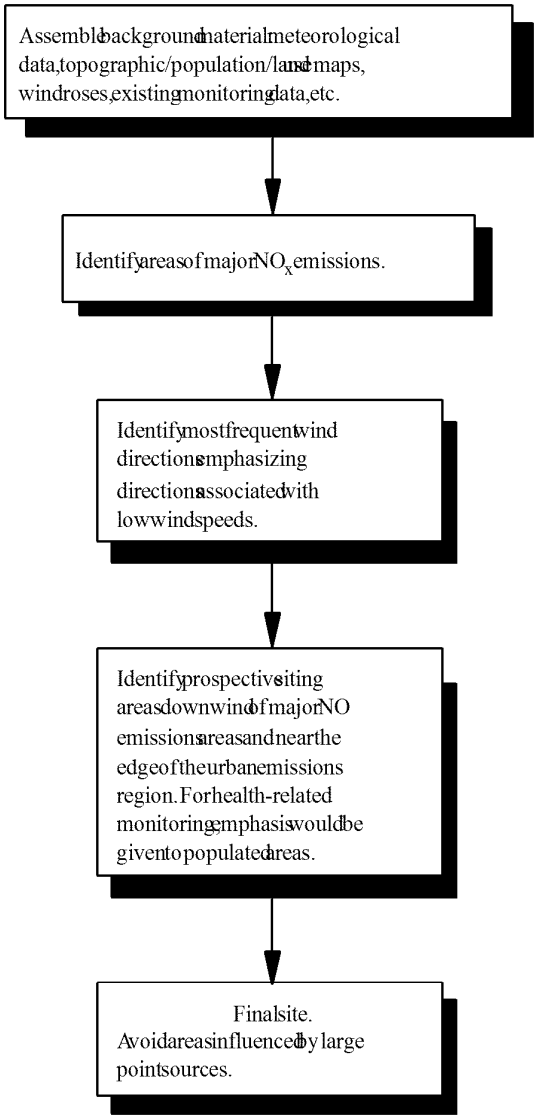
Procedures for locating Open Path Instruments

The following figures represent procedures for locating open path instruments for various pollutants based upon different sampling scales.

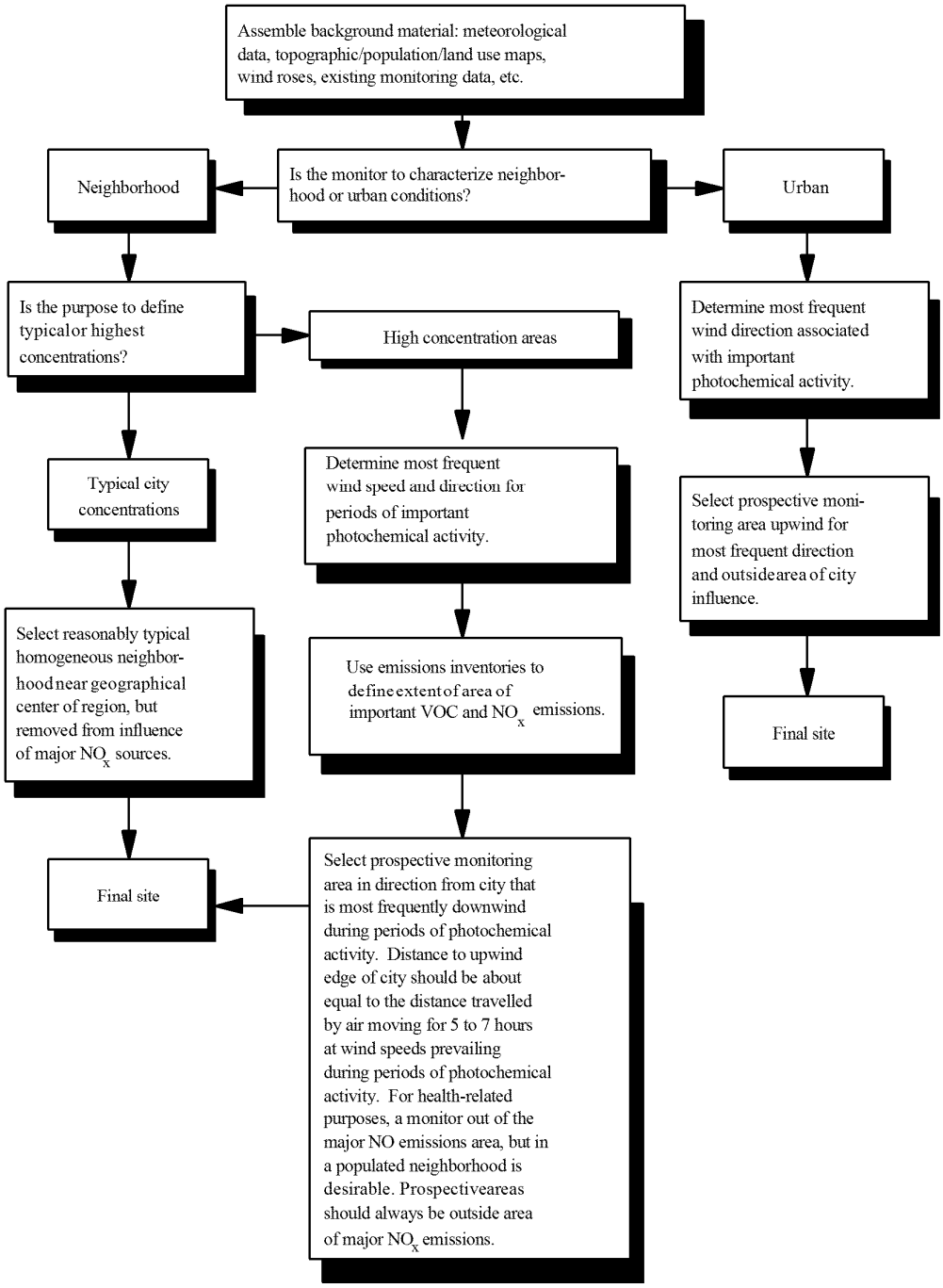
Procedure for Locating NO_2 Source-Impact Stations.



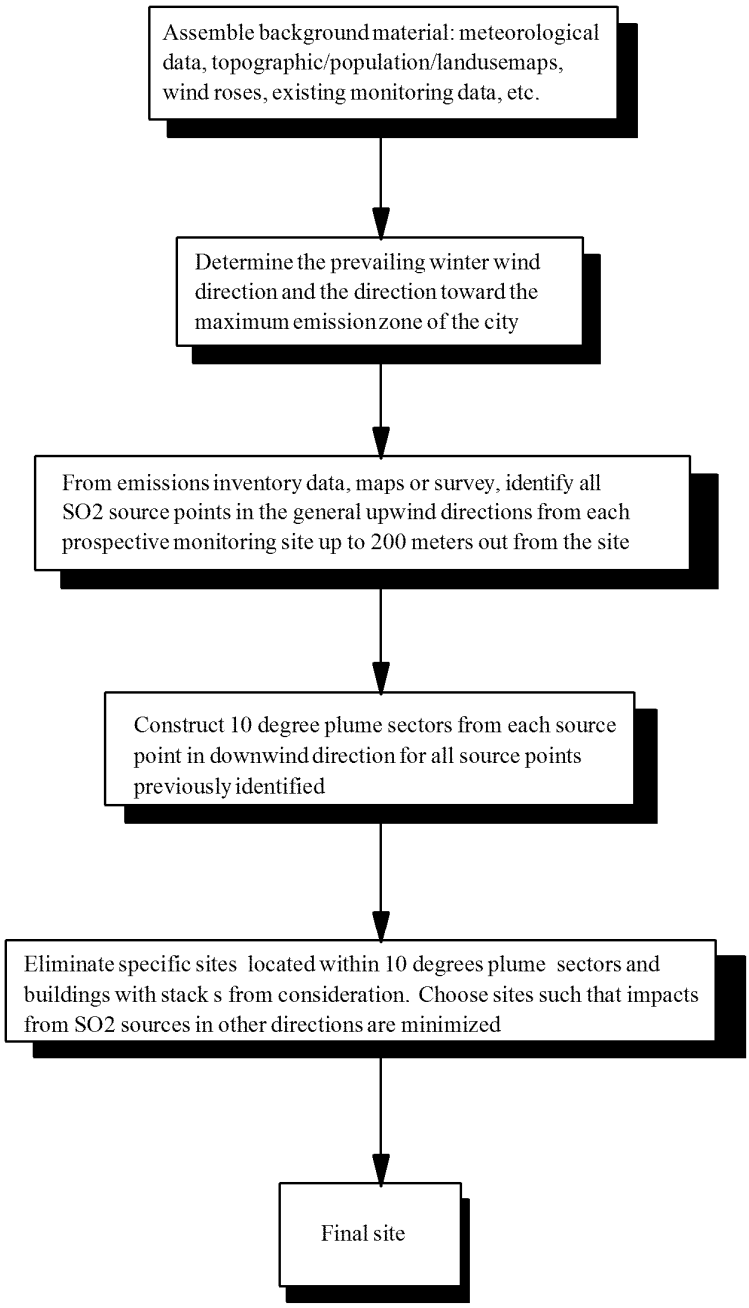
Procedures for Locating NO and NO_2 Neighborhood Scale Stations



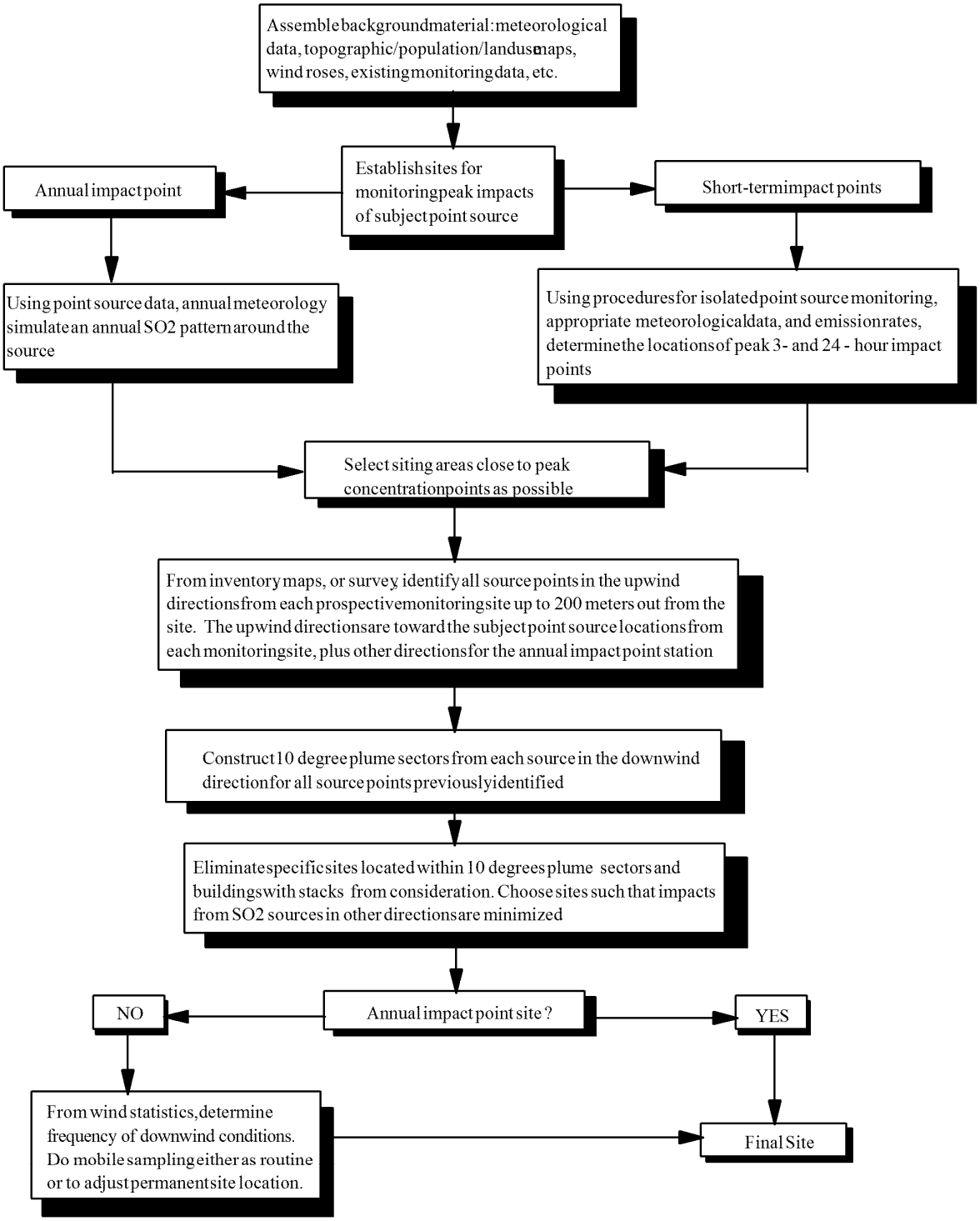
Procedures for Locating O_3 Neighborhood and Urban Scale Stations.



Procedures for Locating SO_2 Population Exposure Middle-Scale Stations



Procedures for Locating SO_2 Point Source-Impact Middle-Scale Stations



Appendix 12

Calibration of Primary and Secondary Standards for Flow Measurements

Calibration of Primary and Secondary Standards for Flow Measurements

1. Introduction

Air pollution monitoring quality control procedures call for flow calibrations to be performed on field calibration devices. These "field standard" calibration units require a mass flow or volumetric flow calibration to ascertain the final concentration of the gas. This appendix will examine the how to obtain a flow device that is traceable to the National Institute of Standards and Technology (NIST). This discussion will also discuss secondary and primary standards and the establishment of their traceability.

2. Definitions

Traceability: This term is defined in 40 CFR Parts 50 and 58 as meaning, "that a local standard has been compared and certified, either directly or via not more than one intermediate standard, to a primary standard such as a National Institute of Standards and Technology Standard Reference Material (NIST-SRM).[1]

Primary Standard: This is a flow device that is certified to be directly traceable to the NIST-SRM. These devices usually provide paperwork that proves that the device is traceable. Bubblemeters, volumetric burettes and some piston devices can be considered to be primary standards. Check with the vendor for certification of a primary standard. The primary standard should remain in the central laboratory and not be moved.

Transfer Standard: A transfer standard is a device that is certified against a primary standard. These standards usually travel to monitoring stations. Transfer standards can be volumetric, electronic flow meters, wet test meters, pressure gauges or pressure/flow transducers. These devices usually have a certain amount of error involved in their operation and can drift with time. Therefore they must be verified against a primary standard on a known set schedule.

Calibration Standards: Calibration standards are devices that are specifically designed to be placed in a monitoring location and can be used to calibrate air monitoring instruments. See Section 12 for definitions and cautions concerning calibrations of air quality instruments. These devices are commercially available from a number of vendors. These units usually are permeation devices or mass flow calibrators (MFC). The flow rates of these devices are verified by the transfer standard on a set schedule.

Permeation devices: Permeation devices are calibration units that pass a known volume of air over a permeation tube. The permeation tube is a small cylinder (usually steel) that has a permeable membrane at one end. Usually the tube is filled with a liquid that permeate out through the membrane at a given rate at a very narrow temperature range. By knowing the permeation rate and the air flow rate, a NIST traceable concentration in parts per million can be calculated[2].

Mass Flow Controller: MFC are a device that works on the principle of heat loss. The mass flow meter within the MFC has a small thermister that is sensitive to heat loss. A potential voltage is applied to the thermister. As the air flow increases across the thermister, the resistance of the thermister changes. This change in resistance can be measured very accurately by electronic circuitry. The mass flow circuitry can then be integrated with controlling loop circuit that can control/monitor the flow instantaneously. Usually, MFC have two channels, gas and diluant or air flow. The gas portion of the unit allows for gases from compressed cylinders to be allowed in and metered. The air flow side of the unit blends down the high concentration from the compressed cylinders to the desired working concentration. The flow rate of both portions of the unit must be measured accurately. It is important when purchasing a MFC calibrator that it meet the 40 CFR 50 requirements of have +/- 2% accuracy[3].

Verification: A verification is the process of checking one primary authority against another primary authority. This can be done by inter-comparing two primary standards against each other or an agency primary standard against another agencies primary standard or NIST standard.

Certification: A certification is the process of checking a transfer standard against a primary standard and establishing a mathematical relationship that is used to adjust the transfer standard values back to the primary standard.

Calibration: A calibration is the process of checking and adjusting the flow rate of a field calibration standard against a transfer standard.

3. Hierarchy of Standards

NIST Standards: The highest authority lies with the NIST. The NIST keeps a set of standards that is referenced by all manufacturers of glassware, standard equipment and electronic primary standards.

Primary Standards: The next level is a primary standard. Every state or local agency, contractor or laboratory should have, at a minimum, one primary standard. Normally, once you have received a primary standard from the manufacturer, it will not need to be re-verified by NIST. However, if a shift is observed, contact the manufacturer to reverify your primary standard against the manufacturer's standards. If two primary standards exist for flow devices, then one should be considered the alpha unit, etc. It is good laboratory practice that the alpha unit always remain in the laboratory and should not be used outside, unless you suspect the unit is not operating correctly, then it should be sent to the manufacturer for repair and re-certification to NIST standards. If the agency has two primary standards, the beta unit can be a traveling instrument but should be crossed referenced once per year to verify that neither unit has shifted its standards. Primary standards should agree with one another within 2%.

Transfer Standards: The next level of traceability is the transfer standard. Transfer standards can be many different devices. It is recommended that if one type of device be used as a transfer standard for an agency. This will eliminate any error that may occur from different types of standards. It is recommended that transfer standards be calibrated at least every six months. Electronic type of transfer standards sometimes have problems with baseline drift. If this appears to be a problem, then verification of the transfer standard should occur more often. If an agency is small, one transfer standard may be sufficient. However, most agencies will have many transfer standards and will probably need to reverify on a staggered schedule.

Calibration Standards: As discussed earlier, calibration standards can be MFC or permeation devices. These units are calibrated by the transfer standards. These should be calibrated quarterly, or if a shift in response occurs with the instruments. It is also recommended that the flow rates of calibration standards be calibrated when a cylinder is changed or a permeation tube is replaced.

4. Cautions

The following precautions should be taken before verifying or calibrating standards:

- When checking calibration standards, always ventilate the monitoring shelter properly. Gas concentrations may be generated that can be health hazards.
- Always transport the transfer standards in its protective carrying case. The internal hardware can be damaged by sudden jolts.
- Do not leave the transfer standards in the sun or a closed car. Extreme heat can damage the internal computer.
- Zero air systems and gas cylinders are operated under high pressure. Always bleed of pressure to the connecting lines before and after operation of the standard. This will assure that the unit will not be damaged.
- Use caution whenever using electronic equipment. Read the directions carefully to avoid electrical shock.

5. Primary Standard Verification

Generally, primary standards do not need to be re-verified to NIST standards. However, if the primary standard is a bubble, piston or electronic type of instrument, it is recommended that it be re-verified against another primary standard. If the agency suspects that the primary standard is not operating correctly, it is recommended that it be sent to the manufacturer for repair and re-calibration. The following procedure should be used when verifying a primary standard:

- Allow the primary standards to warm up sufficiently.
- Attach the alpha primary standard to an air flow generating device. Note: it is useful if MFC calibrator is available for this test. The MFC can meter air/gas flows and allow the user to change the flow rate in the ranges normally used by the primary standard. Attach tubing to the primary standard from the output of the air supply. With most primary standards, the gas flow range is 0 - 200 cc/min, while the air flow is 0 - 10 liters/min. Since this is a large difference, the primary standard usually are purchased with two or three sets of volumes. Attach the air flow measuring device to the primary standard. Making sure that the ports are open, allow air to pass through the primary standard. Record the barometric pressure and the shelter temperature.
- If using a MFC, set the flow rate Thumb Wheel Settings (TWS) to the desired setting. Allow the calibrator to stabilize, usually 2-3 minutes. Read the value of the alpha primary standard. Record 5-10 readings and average. Without changing the TWS, attach the beta primary standard. Record the response of this unit and average. Record these on to a sheet.
- Adjust the Thumb Wheel Settings to the next level that you wish to measure and repeat step 3. It is recommended that a minimum of 5 levels be measured.
- Repeat this procedure for the gas device using flows in the range of the primary standard flow device. Repeat steps 3-4.
- After the values have been averaged and tabulated, adjust the values to Standard Temperature and Pressure (STP). For air monitoring, standard temperature is 298° Kelvin, 29.92 inches of Mercury. Calculate the percent difference for each point (using the alpha primary standard as the known). Also, calculate the least squares regression of the air and gas flows, using the alpha as the abscissa.

Calculations

Since primary standards are volumetric measuring devices, the flows must be corrected to standard temperature and pressure, i.e., 298° Kelvin and 29.92 in Hg (inches of mercury). The following equation illustrates how to calculate the standard temperature and pressure correction factor:

$$Fc = Fr * (Pm/29.92 \text{ in Hg}) * (298^{\circ} K/Tm) \quad \text{(equation 1)}$$

Where:

Fc = Corrected flow rate to standard conditions

Fr = Uncorrected flow rate readings

Pm = Atmospheric barometric pressure at the site; in Hg

Tm = Shelter temperature in degrees. Kelvin (i.e., 273° Kelvin + temperature in degrees C)

6. Transfer Standard Certification

After the Primary Standard has been certified to NIST standards or verified against another primary standard, the traceability of the primary standard can be "transferred" to the field transfer standard.

Generally, transfer standards should be re-verified on a regular basis or if the agency suspects that the transfer standard baseline has drifted or malfunctioned. The transfer standard must always be verified against a primary standard. The following procedure should be used when verifying a transfer standard:

- Allow the primary standard and transfer standard to warm up sufficiently.
- Attach the primary standard to an air flow generating device. Note: it is useful if MFC calibrator is available for this test. The MFC can meter air/gas flows and allow the user to change the flow rate in the ranges normally used by the primary and transfer standard. With most primary and transfer standards, the gas flow range is 0 - 200 cc/min, while the air flow is 0 - 10 liters/min. Since this is a large difference, the primary and transfer standard usually are purchased with two or three sets of volumes. Making sure that the ports are open, allow air to pass through the primary standard. Attach the output of the primary standard to the input of the transfer standard. Record the barometric pressure and the shelter temperature. Note: if the primary or transfer standard are piston type of instrument, this can cause the non-piston type of standard flow rates to fluctuate over a wide range. If this is the case, then the procedure as outlined in section .5 should be used, substituting the transfer standard for the beta primary standard.
- If using a MFC, set the flow rate Thumb Wheel Settings to the desired setting. Allow the calibrator to stabilize, usually 2-3 minutes. Read the value of the primary standard and the transfer standard. Record 5-10 readings and average the values from the primary standard and the transfer standard.
- Adjust the Thumb Wheel Settings to the next level that you wish to measure and repeat step 3. It is recommended that a minimum of 5 levels be measured.
- Repeat this procedure for the gas device using flows in the range of the primary and transfer standard flow devices. Repeat steps 3-4.
- After the values have been averaged and tabulated, adjust the values to STP. See equation 1. Calculate the percent difference for each point (using the primary standard as the known). Also, calculate the least squares regression of the air and gas flows, using the primary standard as the abscissa. Note: at this time, the relationship of the transfer standard and the primary standard must be examined. In some cases, the response of the transfer standard may not be 1:1 with the primary standard. If this is the case, then the correlation coefficient must the factor examined in accepting or rejecting the transfer standard as a useable standard. It is recommended that the correlation coefficient be no less than 0.9990. Also, if the agency deems it necessary, the slope, intercept and correlation coefficient may be averaged over a period of time to ascertain the relative drift of the transfer standard in relationship to the primary. It is recommended that a new transfer standard be tested at least twice to ascertain the drift of the instrument. If the slope and intercept or the transfer standard relative to a primary is not exactly 1:1, then a slope and intercept factor must be applied to the output of the transfer standard whenever it is used in a field situation. By using the equation $y = mx+b$, where y = raw reading from transfer standard, m = slope factor of the linear regression, x = adjusted reading of the transfer standard and b = the intercept of the linear regression, then the adjusted value for every reading on the transfer standard is; $x = (y-b)/m$. Every value read on the transfer standard should be adjusted using this equation. By performing this derivation, all transfer standard values are adjusted back to the primary standard.

7. Calibration of Field Standard

After the transfer standard has been certified to a primary standard, the traceability of the transfer standard can be "transferred" to the field calibration standard. Generally, calibration standards should be re-calibrated on a regular basis or if the agency suspects that the calibration standard baseline has drifted or malfunctioned. The calibration standard must always be verified against a transfer or primary standard. The following procedure should be used when verifying a transfer standard:

7.1 Mass Flow Calibration Standards

- Allow the calibration standard and transfer standard to warm up sufficiently.
- Note: if the calibration standard is a MFC calibrator, then the calibration standard response will be a TWS or a digital display. Attach tubing to the transfer standard from the output of the calibration standard. With most MFC calibrators, the gas flow range is 0 - 200 cc/min, while the air flow is 0 - 10 liters/min. Since this is a large difference, the transfer standard usually are purchased with two or three sets of volumes. Making sure that the ports are open, allow air to pass through the transfer standard. Record the barometric pressure and the shelter temperature.
- Set the flow rate TWS to the desired setting. Actuate the calibration standard (calibrator) manually or remotely using the data acquisition system if applicable. Allow the calibrator to stabilize, usually 2-3 minutes. Read the value of the transfer standard and record the digital display or TWS on the calibrator. Record 5-10 readings and average the values from the transfer standard.
- Adjust the Thumb Wheel Settings to the next level that you wish to measure and repeat steps 3. It is recommended that a minimum of 5 levels be measured.
- Repeat this procedure for the gas device using flows in the range of field calibration devices. Repeat steps 3-4. Note: with MFC calibrators, the gas and diluant air are brought together in an internal mixing chamber. The combined mixture is then shunted to the output of the calibrator. It is important to disconnect the air flow source from the unit and cap the air input port before measuring the gas flow.
- After the values have been averaged and tabulated, adjust the values to STP. See equation 1. Calculate the percent difference for each point (using the transfer standard as the known). Note: make sure to apply the correction factor for the transfer standard to the raw outputs if necessary before calculating the regression. Calculate the least squares regression of the air and gas flows, using the primary standard as the abscissa.
- Once the gas and air flows mass flow meters have been calibrated using the transfer standard, the next step is to calculate the concentration that will be blended down from the high concentration gas cylinder.

The equation for this calculation follows:

$$C = (G * Fg)/(Fg + Fa) \quad \text{(equation 2)}$$

where:

C = Final concentration of gas from the output of calibrator in ppm

G = Gas concentration from NIST traceable cylinder in ppm

Fg = Flow rate of the cylinder gas through the MFC, cc/min

Fa = Flow rate of air through the MFC, cc/min

7.2 Permeation Calibration Standards

Permeation devices work on a different principle from the MFC type of calibration standard. The permeation device allows a calibrated volume of air to pass over a permeation tube of a known permeation rate. It is the measurement of the flow rate to STP that is critical to the success of calibration of instruments.

- Allow the calibration standard permeation device and transfer standard to warm up sufficiently. Note: Most permeation devices must be operated at a specific temperature range for the operator to know the

permeation rate. Allow sufficient time for the permeation device to warm up to this temperature. See the manufacturer's manual for guidance.

- Attach the output of the permeation device to the input of the transfer standard. Set the flow rate TWS or rotometer to the desired setting. Actuate the calibration standard (calibrator) manually or remotely using the data acquisition system if applicable. Allow the calibrator to stabilize. Read the value of the transfer standard and record the TWS or rotometers on the calibrator. Record 5-10 readings and average the values from the transfer standard.
- Adjust the Thumb Wheel Settings or rotometer to the next level that you wish to measure and repeat steps 2. It is recommended that a minimum of 5 levels be measured.

Once the flow rates have been measured the calculation for permeation devices concentrations is as follows:

$$C = (Pr * Mv)/(Ft*Mw) \quad \text{(equation 3)}$$

where:

C = Concentration in ppm

Pr = permeation rate of permeation tube at a known temperature, usually as ug/min

Mv= Molar gas constant at standard pressure, 24.45 liters/mole

Mw = Molecular weight of the permeation gas, grams/mole

Ft = STP flow rate of diluant air across the permeation tube, liters/min

REFERENCES

1. Code of Federal Regulations, Title40, Part 50, "definitions"
2. Code of Federal Regulations, Title40, Part 50, Appendix A, section 10.
3. Code of Federal Regulations, Title40, Part 50, Appendix C, section 2.2

Appendix 14
Example Procedure for Calibrating a Data Aquisition System

The following is an example of a DAS calibration. The DAS owner's manual should be followed. The calibration of a DAS is performed by inputting known voltages into the DAS and measuring the output of the DAS.

1. The calibration begins by obtaining a voltage source and an ohm/voltmeter.

2. Place a wire lead across the input of the DAS multiplexer. With this "shorted" out, the DAS should read zero.

3. If the output does not read zero, adjust the output according to the owners manual.

4. After the background zero has been determined, it is time to adjust the full scale of the system. Most DAS system work on a 1, 5 or 10 volt range, i.e., the full scale equals an output of voltage. In the case of a 0 - 1000 ppb range instrument, 1.00 volts equals 1000 ppb. Accordingly, 500 ppb equals 0.5 volts (500 milivolts). To get the DAS to be linear throughout the range of the instrument being measured, the DAS must be tested for linearity.

5. Attach the voltage source to a voltmeter. Adjust the voltage source to 1.000 volts (this is critical that the output be **1.000 volts**). Attach the output of the voltage source the DAS multiplexer. The DAS should read 1000 ppb. Adjust the DAS voltage A/D card accordingly. Adjust the output of the voltage source to 0.250 volts. The DAS output should read 250 ppb. Adjust the A/D card in the DAS accordingly. Once you have adjusted in the lower range of the DAS, check the full scale point. With the voltage source at 1.000 volts, the output should be 1000 ppb. If it isn't, then adjust the DAS to allow the high and low points to be as close to the source voltage as possible. In some cases, the linearity of the DAS may be in question. If this occurs, the data collected may need to be adjusted using a linear regression equation. See Section 2.0.9 for details on data adjustment. The critical range for many instruments is in the lower 10 % of the scale. It is critical that this be linear.

6. Every channel on a DAS should be calibrated. In some newer DAS systems, there is only one A/D card voltage adjustment which is carried throughout the multiplexer. This usually will adjust all channels. It is recommended that DAS be calibrated once per year.

Appendix 15

Audit Information

The following sections are included in the Appendix:

Section	Description
1	Network Audit Checklist
2	EPA Regional Technical System Audit Information and Questionnaire
3	State and Local Audit Procedures
4	California Air Resources Board Thru-The-Probe Criteria Audits

Section 1
Network Review Checklist

The following checklist is intended to assist reviewers in conducting a network review. The checklist will help the reviewer to determine if the network conforms with the network design and siting requirements specified in Appendices D and E. Section I of the checklist includes general information on the network. Section II addresses conformance with Appendix D requirements. Section III includes pollutant-specific evaluation forms to address conformance with Appendix E requirements. In addition to completing the checklist during the network review, the following list of action items is provided as a guide during an onsite visit of a monitoring station.

- ensure that the manifold and inlet probe are clean
- estimate probe and manifold inside diameter and length
- inspect the shelter for weather leads, safety, and security
- check equipment for missing parts, frayed cords, etc.
- check that monitor exhausts are not likely to be reentrained by the sampling inlet
- record findings in field notebook
- take photographs/videotape in eight directions

NETWORK REVIEW CHECKLIST

SECTION I - GENERAL INFORMATION

Reviewer:	Review Date:

1. State or Local Agency:

   Address

   Contact

   Telephone Number

2. Type of network review (check all that apply)
   ☐SLAMS ☐NAMS ☐PAMS ☐SPM/Other

3. Network Summary Description
   Number of sites currently operating or temporarily inoperative (30 days), not including collocated or index sites.

	SLAMS (excluding NAMS/PAMS)	NAMS	PAMS	SPM/Other
CO			---	
SO_2			---	
NO_2				
O_3				
PM10			---	
Pb			---	
$PM_{2.5}$				
VOC	---	---		
Carbonyls	---	---		
Met	---	---		

4. Network Description
   Date of most current official network description? _____
   Copy available for review? Yes ☐ No ☐

   For each site, are the following items included:

	Yes	No
AIRS Site ID	☐	☐
Sampling and Analysis Method	☐	☐
Operative Schedule	☐	☐
Monitoring Objective	☐	☐
Scale of Representativeness	☐	☐
Zip Code	☐	☐
Any Proposed Changes	☐	☐

5. Date of last network review? _____

Modifications made since last network review

	Number of Monitors		
	Added	Deleted	Relocated
Carbon Monoxide			
Lead			
Nitrogen Dioxide			
Ozone			
PM-10			
$PM_{2.5}$			
Sulfur Dioxide			
Total Suspended Particulate			
For PAMS:			
Carbonyls			
Meteorological Measurements			
VOCs			

7. Network Design and Siting
   Summarize any nonconformance with the requirements of 40 CFR 58, Appendices D and E found in Sections II and III

	AIRS Site ID	Site Type	Reason for Nonconformance
CO			
SO_2			
NO_2			
O_3			
PM10			
$PM_{2.5}$			
Pb			
VOC			
Carbonyls			
Met			

8. List problems found, actions to be taken, corrective measures, etc. called for in the last network review that still have not been addressed.

SECTION II - EVALUATION OF CONFORMANCE WITH APPENDIX D REQUIREMENTS

	Yes	No
1. Is the Agency meeting the number of monitors required based on 40 CFR Part 58 requirements?		
SLAMS	☐	☐
NAMS	☐	☐
PAMS	☐	☐

If no, explain:

	Yes	No
2. Is the Agency operating existing monitors according to 40 CFR Part 58 requirements?		
SLAMS	☐	☐
NAMS	☐	☐
PAMS	☐	☐

If no, explain:

	Yes	No
3. Are monitors properly located based on monitoring objectives and spatial scales of representativeness specified in Appendix D?		
SLAMS	☐	☐
NAMS	☐	☐
PAMS	☐	☐

If no, explain:

	Yes	No
4. For PAMS, when C or F sampling frequency is used, has an ozone event forecasting scheme been submitted and reviewed?	☐	☐

If no, explain:

Network Design/Review Determined by (check all that apply)

☐ Dispersion modeling ☐ Special studies (including saturation sampling)
☐ Best professional judgement ☐ Other (specify _____)

Comment (for example, SO_2 dispersion modeling for urbanized area A; PM-10 saturation study for urbanized area B, etc.)

Evaluation was based on the following information (check all that apply):

☐ emission inventory data ☐ traffic data ☐ AIRS site reports
☐ meteorological data ☐ topographic data ☐ site photographs, videotape, etc.
☐ climatological data ☐ historical data ☐ other (specify _____)

SECTION III - EVALUATION OF CONFORMANCE WITH APPENDIX E REQUIREMENTS

IIIA - CARBON MONOXIDE NAMS/SLAMS SITE EVALUATION

Agency Site Name : _____

Site Address : _____

City & State : _____

AIRS Site ID : _____

Date : _____

Observed by : _____

CRITERIA	REQUIREMENTS	OBSERVED	CRITERIA MET?	
			Yes	No
Horizontal and Vertical Probe Placement (Par. 4.1)	3 ±½ m for microscale			
	3-15 m for middle and neighborhood scale			
Spacing from Obstructions (Par. 4.2)	270 or 180 if on side of building			
Spacing from Roads (Par. 4.3)	2-10 m from edge of nearest traffic lane for microscale; 10 m from intersection, preferably at midblock			
	See Table 1 for middle and neighborhood scale			
Spacing from Trees (Par 4.4)	Should be 10 m from dripline of trees		N/A	

Comments

*Citations from 40 CFR 58, Appendix E.

IIIB - LEAD NAMS/SLAMS SITE EVALUATION

Agency Site Name : _____

Site Address : _____

City & State : _____

AIRS Site ID : _____

Date : _____

Observed by : _____

CRITERIA	REQUIREMENTS	OBSERVED	CRITERIA MET?	
			Yes	No
Vertical Probe Placement (Par. 7.1)	2-7 m above ground for microscale			
	2-15 m above ground for other scales			
Obstructions on Roof (Par. 7.2)	2 m from walls, parapets, penthouses, etc.			
Obstacle Distance (Par. 7.2)	2 x height differential			
Unrestricted Airflow (Par. 7.2)	At least 270 (except for street canyon sites)			
Furnace or Incinerator Flues (Par. 7.2)	**Recommended** that none are in the vicinity		N/A	
Spacing from Station to Road (Par. 7.3)	5-15 m for microscale			
	See Table 4 for other scales			
Spacing from Trees (Par. 7.4)	Should be 20 m from trees		N/A	
	10 m if trees are an obstruction			
Comments				

*Citations from 40 CFR 58, Appendix E.

IIIC - NITROGEN DIOXIDE NAMS/SLAMS SITE EVALUATION

Agency Site Name : _____

Site Address : _____

City & State : _____

AIRS Site ID : _____

Date : _____

Observed by : _____

CRITERIA	REQUIREMENTS	OBSERVED	CRITERIA MET?	
			Yes	No
Vertical Probe Placement (Par. 6.1)	3-15 m above ground			
Spacing from Supporting Structure (Par. 6.1)	Greater than 1 m			
Obstacle Distance (Par. 6.2)	Twice the height the obstacle protrudes above probe			
Unrestricted Airflow (Par. 6.2)	Must be 270 or 180 if on side of building			
Spacing between Station and Roadway (Par. 6.3)	See Table 3			
Spacing from Trees (Par. 6.4)	Should be 20 m		N/A	
	10 m if trees are an obstruction			
Probe Material (Par. 9)	Teflon or pyrex glass			
Residence Time (Par. 9)	Less than 20 seconds			

Comments

*Citations from 40 CFR 58, Appendix E.

IIID - OZONE NAMS/SLAMS SITE EVALUATION

Agency Site Name : _____

Site Address : _____

City & State : _____

AIRS Site ID : _____

Date : _____

Observed by : _____

CRITERIA	REQUIREMENTS	OBSERVED	CRITERIA MET?	
			Yes	No
Vertical Probe Placement (Par. 5.1)	3-15 m above ground			
Spacing from Supporting Structure (Par. 5.1)	Greater than 1 m			
Obstacle Distance (Par. 5.2)	Twice the height the obstacle protrudes above probe			
Unrestricted Airflow (Par. 5.2)	Must include predominant wind. 180 if on side of building. Otherwise 270			
Spacing between Station and Roadway (Par. 5.3)	See Table 2			
Spacing from Trees (Par. 5.4)	Should be 20 m		N/A	
	10 m if blocking daytime wind			
Probe Material (Par. 9)	Teflon or pyrex glass			
Residence Time (Par. 9)	Less than 20 seconds			

Comments

*Citations from 40 CFR 58, Appendix E.

IIIE - $PM_{2.5}$ NAMS/SLAMS SITE EVALUATION

Agency Site Name : _____

Make and Model # of Instrument : _____

Site Address : _____

City & State : _____

AIRS Site ID : _____

Date : _____

Observed by : _____

CRITERIA*	REQUIREMENTS*	OBSERVED	CRITERIA MET?	
			Yes	No
Vertical Probe Placement (Par. 8.1)	2-7 m above ground for microscale			
	2-15 m above ground for other scales			
Obstructions on Roof	2 m from walls, parapets, penthouses, etc.			
Spacing from Trees (Par. 8.2)	Should be 20 m from dripline of trees		N/A	
	Must be 10 m from dripline if trees are an obstruction**			
Obstacle Distance (Par. 8.2)	2 x height differential (street canyon sites exempt)			
Unrestricted Airflow (Par. 8.2)	At least 270 including the predominant wind direction			
Furnace or Incinerator Flues (Par. 8.2)	**Recommended** that none are in the vicinity		N/A	
Distance between Co-located Monitors (Appendix A, Par. 3.5.2)	1 to 4 m			
Spacing from Station to Road (Par. 8.3)	See Par. 8.3 and/or Figure 2 of Appendix E			
Paving (Par. 8.4)	Area **should** be paved or have vegetative ground cover		N/A	
Comments				

*Citations from 40 CFR 58, Appendix E.
**A tree is considered an obstruction if the distance between the tree(s) and the sampler is less than the height that the tree protrudes above the sampler.

IIIF - PM_{10} NAMS/SLAMS SITE EVALUATION

Agency Site Name : _____

Site Address : _____

City & State : _____

AIRS Site ID : _____

Date : _____

Observed by : _____

CRITERIA	REQUIREMENTS	OBSERVED	CRITERIA MET?	
			Yes	No
Vertical Probe Placement (Par. 8.1)	2-7 m above ground for microscale			
	2-15 m above ground for other scales			
Obstructions on Roof	2 m from walls, parapets, penthouses, etc.			
Spacing from Trees (Par. 8.2)	Should be 20 m from trees		N/A	
	10 m if trees are an obstruction			
Obstacle Distance (Par. 8.2)	2 x height differential (street canyon sites exempt)			
Unrestricted Airflow (Par. 8.2)	At least 270 including the predominant wind direction			
Furnace or Incinerator Flues (Par. 8.2)	**Recommended** that none are in the vicinity		N/A	
Distance between Co-located Monitors (Appendix A, Par. 3.3)	2 to 4 m			
Spacing from Station to Road (Par. 8.3)	See Par. 8.3 and/or Figure 2 of Appendix E			
Paving (Par. 8.4)	Area **should** be paved or have vegetative ground cover		N/A	

Comments

*Citations from 40 CFR 58, Appendix E.

IIIG - SULFUR DIOXIDE NAMS/SLAMS SITE EVALUATION

Agency Site Name : _____

Site Address : _____

City & State : _____

AIRS Site ID : _____

Date : _____

Observed by : _____

CRITERIA	REQUIREMENTS	OBSERVED	CRITERIA MET?	
			Yes	No
Horizontal and Vertical Probe Placement (Par. 3.1)	3-15 m above ground			
	> 1 m from supporting structure			
	Away from dirty, dusty areas			
	If on side of building, should be on side of prevailing winter wind		N/A	
Spacing from Obstructions (Par. 3.2)	1 m from walls, parapets, penthouses, etc.			
	If neighborhood scale, probe must be at a distance twice the height the obstacle protrudes above probe			
	270 arc of unrestricted airflow around vertical probes and wind during peak season must be included in arc			
	180 if on side of building			
	No furnace or incineration flues or other minor sources of SO_2 should be nearby		N/A	
Spacing from Trees (Par. 3.3)	Should be 20 m from dripline of trees		N/A	
	10 m when trees act as an obstruction			

*Citations from 40 CFR 58, Appendix E.

Section 2
EPA Regional Technical Systems Audits Information and Questionnaire

1.0 Scope

The purpose of the guidance included here is to provide the background and appropriate technical criteria which form the basis for the air program evaluation by the Regional audit team. To promote national uniformity in the evaluation of state and local agency monitoring programs and agencies' performance, all EPA Regional Offices are required to use the questionnaire that follows, the audit finding and response forms (Figures 15.4 and 15.5 in Section 15), and the systems audit reporting format that follows in Section 6 of this appendix, upon implementing an audit.

The scope of a systems audit is of major concern to both EPA Regions and the agency to be evaluated. A systems audit, as defined in the context of this document, is seen to include an appraisal of the following program areas: network management, field operations, laboratory operations, data management, quality assurance and reporting. The guidance provided concerning topics for discussion during an on-site interview have been organized around these key program areas. Besides the on-site interviews, the evaluation should include the review of some representative ambient air monitoring sites and the monitoring data processing procedure from field acquisition through reporting into the AIRS computer system. The systems audit results should present a clear, complete and accurate picture of the agency's acquisition of ambient air monitoring data.

The following topics are covered in the subsections below:

- a discussion of:
  1. the requirements on the agency operating the SLAMS network;
  2. program facets to be evaluated by the audit; and
  3. additional criteria to assist in determining the required extent of the forthcoming audit;
- a recommended audit protocol for use by the Regional audit team, followed by a detailed discussion of audit results reporting,
- criteria for the evaluation of State and local agency performance including suggested topics for discussion during the on-site interviews,
- a questionnaire, organized around the six key program areas to be evaluated, and
- a bibliography of APA guideline documents, which provides additional technical background for the different program areas under audit.

Section 15 of this Handbook provides a general description of the audit process which includes planning, implementation, and reporting and complements the material in this appendix. It is suggested that Section 15 should be read and understood. The guidance provided in this section is addressed primarily to EPA Regional audit leads and members of the Regional audit teams to guide them in developing and implementing an effective and nationally uniform audit program. However, the criteria presented can also prove useful to agencies under audit to provide them with descriptions of the program areas to be evaluated. Clarification of certain sections, special agency circumstances, and regulation or guideline changes may require additional discussion or information. For these reasons, a list of contact names and telephone numbers are provided on the AMTIC Bulletin Board *(http://www.epa.gov/ttn/amtic)*.

The authority to perform systems audits is derived from the Code of Federal Regulation (Title 40); specifically: 40 CFR Part 35, which discusses agency grants and grant conditions, and 40 CFR Part 58, which addresses installation, operation and quality assurance of the SLAMS/NAMS networks. The regulations contained in 40 CFR Part 35 mandate the performance of audits of agency air monitoring programs by the Regional Administrators or their designees.

The specific regulatory requirements of an EPA-acceptable quality assurance program are to be found in to 40 CFR Part 58 Appendix A and in the document titled *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*[32] The elements described in the document provide the framework for organizing the required operational procedures, integrating quality assurance activities and documenting overall program operations.

2.0 Guidelines for Preliminary Assessment and Audit Systems Planning

In performing a systems audit of a given agency, the Regional audit lead is seeking a complete and accurate picture of that agency's current ambient air monitoring operations. Past experience has shown that four (4) person-days should be allowed for an agency operating 10-20 sites within close geographical proximity. The exact number of people and the time allotted to conduct the audit are dependent on the magnitude and complexity of the agency and on the EPA Regional Office resources. During the allotted time frame, the Regional QA audit team should perform those inspections and interviews recommended in the questionnaire. This includes on-site interviews with key program personnel, evaluations of some ambient air monitoring sites operated by the agency, and scrutiny of data processing procedures.

3.0 Frequency of Audits

The EPA Regional Office retains the regulatory responsibility to evaluate agency performance every three years. Regional Offices are urged to use the questionnaire that follows, the audit finding and response forms (Figs. 15.4 and 15.5), and the audit reporting format in Section 6.0 of this appendix. Utilizing the forms mentioned above will establish a uniform basis for audit reporting throughout the country.

The primary screening tools to aid the EPA Regional QA audit team are:

A. National Performance Audit Program (NPAP) Data--which provide detailed information on the ability of participants to certify transfer standards and/or calibrate monitoring instrumentation. Audit data summaries provide a relative performance ranking for each participating agency when compared to the other participants for a particular pollutant. These data could be used as a preliminary assessment of laboratory operations at the different local agencies.

B. Precision and Accuracy Reporting System (PARS) Data--which provide detailed information on precision and accuracy checks for each local agency and each pollutant, on a quarterly basis. These data summaries could be used to identify out-of-control conditions at different local agencies, for certain pollutants.

C. AIRS AP430 Data Summaries-- which provide a numerical count of monitors meeting and those not meeting specifications on monitoring data completeness on a quarterly basis, together with an associated summary of precision and accuracy probability limits. In addition the program will provide data summaries indicating the percent of data by site and/or by state for each pollutant.

4.0 Selection of Monitoring Sites for Evaluation

It is suggested that approximately five percent (5%) of the sites of each local agency included in the reporting organization be inspected during a systems audit. Many reporting organizations contain a large number of monitoring agencies, while in other cases, a monitoring agency is its own reporting organization. For smaller local agencies, no fewer than two (2) sites should be inspected. To insure that the selected sites represent a fair cross-section of agency operations, one half of the sites to be evaluated should be selected by the agency itself, while the other half should be selected by the Regional QA audit team.

The audit team should use both the Precision and Accuracy Reporting System (PARS) and the AIRS computer databases in deciding on specific sites to be evaluated. High flexibility exists in the outputs obtainable from the AIRS AP430 computer program; data completeness can be assessed by pollutant, site, agency, time period and season. These data summaries will assist the audit team in spotting potentially persistent operational problems in need of more complete on-site evaluation. At least one site showing poor data completeness, as defined by AIRS must be included in those selected to be evaluated.

If the reporting organization under audit operates many sites and/or its structure is complicated and perhaps inhomogeneous, then an additional number of sites above the initial 5% level should be inspected so that a fair and accurate picture of the state and local agency's ability to conduct field monitoring activities can be obtained. At the completion of the site evaluations, the audit team is expected to have established the adequacy of the operating procedures, the flow of data from the sites, and be able to provide conclusions about the adequacy of the environmental data operations of the reporting organization.

5.0 Data and Information Management Audits

With the implementation of automated data acquisition systems, the data management function has become increasingly complex. Therefore, a complete systems audit must include a review of the data processing and reporting procedures starting at the acquisition stage and terminating at the point of data entry into the AIRS computer system. The process of auditing the data processing trail will be dependent on size and organizational characteristics of the reporting organization, the volume of data processed, and the data acquisition system's characteristics. The details of performing a data processing audit are left, therefore, to Regional and reporting organization personnel working together to establish a data processing audit trail appropriate for a given agency.

Besides establishing and documenting processing trails, the data processing audits procedure must involve a certain amount of manual recomputation of raw data. The preliminary guidance provided here, for the number of data to be manually recalculated, should be considered a minimum, enabling only the detection of gross data mishandling:

(a) For continuous monitoring of criteria pollutants, the Regional audit lead should choose two 24-hour periods from the high and low seasons for that particular pollutant per local agency per year. In most cases the seasons of choice will be winter and summer. The pollutant and time interval choices are left to the discretion of the Regional audit lead.

(b) For manual monitoring, four 24-hour periods per local agency per year should be recomputed. The Regionalauditlead should choose the periods for the data processing audit while planning the systems audit and inspecting the completeness records provided by the AIRS AP430 data. The recommended acceptancelimits for the differences between the data input into AIRS and that recalculated during the

on-site phase of the systems audit, are given in Table 1. Systems audits conducted on large reporting organizations (e.g. four local agencies) require recomputation of eight 24-hour periods for each of the criteria pollutants monitored continuously. This results from two 24-hour periods being recomputed for each local agency, for each pollutant monitored, during a given year. For manual methods, sixteen 24-hour periods are recomputed, consisting of four periods per local agency, per year.

Table 1. Acceptance Criteria for Data Audits

Data Acquisition Mode	Pollutants	Measurement Range (ppm)[a]	Tolerance Limits
Automatic Data Retrieval	SO_2, O_3, NO_2 CO	0-0.5, or 0-1.0 0-20, or 0-50	± 3ppb ± 0.3ppm
Strip chart Records	SO_2, O_3, NO_2 CO	0-0.5, or 0-1.0 0-20, or 0-50	± 20 ppb ± 1ppm
Manual Reduction	TSP Pb	_____ _____	± 2 ug/m^3 [b] ± 0.1 ug/m^3

(a) Appropriate scaling should be used for higher measurement ranges.
(b) Specified at 760 mm Hg and 25° C.

6.0 Audit Reporting

The Systems Audit Report format discussed in this section has been prepared to be consistent with guidance offered by the STAPPA/ALAPCO Ad Hoc Air Monitoring Audit Committee. The format is considered as acceptable for annual systems audit reports submitted to the OAQPS. audit team members shall use this framework as a starting point and include additional material, comments, and information provided by the agency during the audit to present an accurate and complete picture of its operations and performance evaluation.

At a minimum, the systems audit report should include the following six sections:

1) Executive Summary--summarizes the overall performance of the agency's monitoring program. It should highlight problem areas needing additional attention and should describe any significant conclusions and/or broad recommendations.

2) Introduction--describes the purpose and scope of the audit and identifies the audit team members, key agency personnel, and other section or area leaders who were interviewed. It should also indicate the agency's facilities and monitoring sites which were visited and inspected, together with the dates and times of the on-site audit visit. Acknowledgment of the cooperation and assistance of the Director and the QAO should also be considered for inclusion.

3) Audit Results--presents sufficient technical detail to allow a complete understanding of the agency operations. The information obtained during the audit should be organized using the recommended subjects and the specific instructions given below.

A. Network Design and Siting

1. **Network Size**--Provide an overview of the network size and the number of local agencies responsible to the state for network operation.

2. **Network Design and Siting**--Describe any deficiencies in network design or probe siting discovered during the audit. Indicate what corrective actions are planned to correct deficiencies.
3. **Network Audit**--briefly discuss the conclusions of the last network annual audit and outline any planned network revision resulting from that audit.
4. **Non-criteria Pollutants**--Briefly discuss the agency's monitoring and quality assurance activities related to non-criteria pollutants.

B. Resources and Facilities

1. **Instruments and Methods**--Describe any instrument nonconformance with the requirements of 40 CFR 50, 51, 53, and 58. Briefly summarize agency needs for instrument replacement over and above nonconforming instruments.
2. **Staff and Facilities**--Comment on staff training, adequacy of facilities and availability of NIST-traceable standard materials and equipment necessary for the agency to properly conduct the bi-weekly precision checks and quarterly accuracy audits required under 40 CFR Part 58, Appendix A.
3. **Laboratory Facilities**--Discuss any deficiencies of laboratory procedures, staffing and facilities to conduct the tests and analyses needed to implement the SLAMS/NAMS monitoring and the quality assurance plans.

C. Data and Data Management

1. **Data Processing and Submittal**-- Comment on the adequacy of the agency's staff and facilities to process and submit air quality data as specified in 40 CFR 58.35 and the reporting requirements of 40 CFR 58, Appendices A and F. Include an indication of the timeliness of data submission by indicating the fraction of data which are submitted more than forty-five (45) days late.
2. **Data Review**--A brief discussion of the agency's performance in meeting the 75% criteria for data completeness. Additionally, discuss any remedial actions necessary to improve data reporting.
3. **Data Correction**--Discuss the adequacy and documentation of corrections and/or deletions made to preliminary ambient air data, and their consistency with both the agency's QA Manual and Standard Operating Procedures, and any revised protocols.
4. **Annual Report**--Comment on the completeness, adequacy and timeliness of submission of the SLAMS Annual Report which is required under 40 CFR 58.26.

D. Quality Assurance/Quality Control

1. **Status of Quality Assurance Plan**--Discuss the status of the Agency's Quality Assurance Plan. Include an indication of its approval status, the approval status of recent changes and a general discussion of the consistency, determined during the systems audit, between the Agency Standard Operating Procedures and the Quality Assurance Plan.
2. **Audit Participation**--Indicate frequency of participation in an audit program. Include as necessary, the agency's participation in the National Performance Audit Program (NPAP) as required by 40 CFR Part 58. Comment on audit results and any corrective actions taken.
3. **Accuracy and Precision**--As a goal, the 95% probability limits for precision (all pollutants) and TSP accuracy should be less than $\pm$ 15%. At 95% probability limits, the accuracy for all other pollutants should be less than $\pm$20%. Using a short narrative and a summary table, compare the reporting organization's performance against these goals over the last two years. Explain any deviations.

4) Discussion--includes a narrative of the way in which the audit results above are being interpreted. It should clearly identify the derivation of audit results which affect both data quality and overall agency operations, and should outline the basis in regulations and guideline documents for the specific, mutually agreed upon, corrective action recommendations.

5) Conclusions and Recommendations--should center around the overall performance of the agency's monitoring program. Major problem areas should be highlighted. The salient facts of mutually agreed upon corrective action agreements should be included in this section. An equally important aspect to be considered in the conclusion is a determination of the homogeneity of the agency's reporting organizations and the appropriateness of pooling the Precision and Accuracy data within the reporting organizations.

6) Appendix of Supporting Documentation--contains a clean and legible copy of the completed questionnaire and any audit finding forms. Additional documentation may be included if it contributes significantly to a clearer understanding of audit results

7.0 Criteria For The Evaluation of State and Local Agency Performance

Table 2 is designed to assist the audit team in interpretation of the completed questionnaire received back from the agency prior to the on-site interviews. It also provides the necessary guidance for topics to be further developed during the on-site interviews.

The table is organized such that the specific topics to be covered and the appropriate technical guidance are keyed to the major subject areas of the questionnaire. The left-hand side of the page itemizes the discussion topics and the right-hand side provides citations to specific regulations and guideline documents which establish the technical background necessary for the evaluation of agency performance.

Table 2 Criteria For The Evaluation of State and Local Agency Performance

Topic	Background Documents
Planning ‣ General information on reporting organization and status of Air Program, QA Plan and availability of SOPs ‣ Conformance of network design with regulation, and completeness of network documentation ‣ Organization staffing and adequacy of educational background and training of key personnel ‣ Adequacy of current facilities and proposed modifications	‣ State Implementation Plan ‣ U.S. EPA QAMS 005/80 ‣ Previous Systems Audit report ‣ QA Handbook for Air Pollution Measurement Systems, Vol. ll--Ambient Air Specific Methods, Section 2.0.1. ‣ 40 CFR 58 Appendices D and E ‣ OAQPS Siting Documents (available by pollutant) ‣ QA Handbook for Air Pollution Measurement Systems, Vol. l--Principles, Section 1.4 Vol. ll--Ambient Air Specific Methods, Section 2.0.5

Topic	Background Documents
Field Operations	
‣ Routine operational practices for SLAMS network, and conformance with regulations	‣ QA Handbook for Air Pollution Measurement Systems, Vol. ll, Section 2.0.9 ‣ QA Handbook for Air Pollution Measurement Systems, Vol. ll ‣ 40 CFR 50 plus Appendices A through G (potentially K for PM 1 O) ‣ 40 CFR 58 Appendix C--Requirements for SLAMS analyzers
‣ Types of analyzers and samplers used for SLAMS network	‣ QA Handbook for Air Pollution Measurement Systems, Vol. ll
‣ Adequacy of field procedures, standards used and field documentation employed for SLAMS network	‣ Instruction Manuals for Designated Analyzers ‣ QA Handbook for Air Pollution Measurement Systems, Vol. ll--Ambient Air Specific Methods Section 2.0.9
‣ Frequency of zero/span checks, calibrations and credibility of calibration equipment used	‣ QA Handbook for Air Pollution Measurement Systems, Vol. ll--Ambient Air Specific Methods Section 2.0.7
‣ Traceability of monitoring and calibration standards	‣ 40 CFR 58 Appendix A Section 2.3
‣ Preventive maintenance system including spare parts, tools and service contracts for major equipment	‣ QA Handbook for Air Pollution Measurement Systems, Vol. Il, Section 2.0.6
‣ Record keeping to include inspection of some site log books and chain-of-custody procedures ‣ Data acquisition and handling system establishing a data audit trail from the site to the central data processing facility	‣ QA Handbook for Air Pollution Measurement Systems, Vol. Il--Ambient Air Specific Methods Sections 2.0.3 and 2.0.9
Laboratory Operations	
‣ Routine operational practices for manual methods used in SLAMS network to include quality of chemical and storage times	‣ 40 CFR 50 Appendices A and B, and QA Handbook, Vol. ll
‣ List of analytical methods used for criteria pollutants and adherence to reference method protocols	‣ 40 CFR 58 Appendix C; "List of Designated Reference and Equivalent Methods"
‣ Additional analyses performed to satisfy regional, state or local requirements	‣ Refer to locally available protocols for analysis of aldehydes, sulfate, nitrate, pollens, hydrocarbons, or other toxic air contaminants.
‣ Laboratory quality control including the regular usage of duplicates, blanks, spikes and multi-point calibrations	‣ U.S. EPA APTD-1132 "Quality Control Practices in Processing Air Pollution Samples" ‣ 40 CFR 58 Appendix C; "'List of Designated Reference and Equivalent Methods"
‣ Participation in EPA NPAP and method for inclusion of audit materials in analytical run	‣ 40 CFR 58 Appendix A Section 2.4 ‣ QA Handbook for Air Pollution Measurement Systems, Vol. ll, Section 2.0.10
‣ Documentation and traceability of laboratory measurements such as weighing, humidity and temperature determinations	‣ 40 CFR 58 Appendix C; "List of Designated Reference and Equivalent Methods"
‣ Preventive maintenance in the laboratory to include service contracts on major pieces of instrumentation	‣ 40 CFR 58 Appendix C; "List of Designated Reference and Equivalent Methods"
‣ Laboratory record keeping and chain-of-custody procedures to include inspection of logbooks used	‣ QA Handbook for Air Pollution Measurement Systems, Vol. ll, Section 2.0.6
‣ Adequacy of Laboratory facilities, Health and Safety practices and disposal of wastes	‣ Handbook for Analytical Quality Control in Water and Wastewater Laboratories
‣ Data acquisition, handling and manipulations system establishing data flow in the laboratory, data back-up system and data reduction steps	‣ QA Handbook for Air Pollution Measurement Systems. Vol. ll. Sections 2.0.3 and 2.0.9
‣ Data validation procedures, establishing an audit trail for the laboratory to the central data processing facility	‣ Annual Book of ASTM Standards, Part 41, 1 978. Standard Recommended Practice for Dealing with Outlying Observations (E 178-75)

Topic	Background Documents
Data Management	
‣ Data flow from field and laboratory activities to a central data processing facility	‣ QA Handbook for Air Pollution Measurement Systems, Vol. II, Section 2.0.3
‣ Extent of computerization of data management system and verification of media changes, transcriptions and manual data entry	‣ QA Handbook for Air Pollution Measurement Systems, Vol. ll, Section 2.0.9
‣ Software used for processing and its documentation; to include functional description of software, test cases and configuration control for subsequent revisions	‣ QA Handbook for Air Pollution Measurement Systems, Vol. II, Sections 2.0.3 and 2.0.9
‣ System back-up and recovery capabilities	
‣ Data screening, flagging and validation	‣ Validation of Air Monitoring Data, EPA-600/4-80-030 ‣ Screening Procedures for Ambient Air Quality Data, EPA450/2-78-037
‣ Data correction procedures and key personnel allowed to correct ambient air data	‣ QA Handbook for Air Pollution Measurement Systems, Vol. ll, Section 2.0.9
‣ Reports generated for in-house distribution and for submittal to EPA	
‣ Responsibility for preparing data for entry into the SAROAD and PARS systems and for responsibility for its final validation prior to submission	‣ AQS Manual Series, Vol. ll, AIRS User's Manual, EPA
QA/QC Program	
‣ Status of QA Program and its implementation	‣ 40 CFR 58 Appendix A and QAMS 005/80
‣ Documentation of audit procedures, integrity of audit devices and acceptance criteria for audit results	‣ QA Handbook for Air Pollution Measurement Systems, Vol. ll, Sections 2.0.16 and 2.0.12 ‣ 40 CFR 58 Appendix A
‣ Participation in the National Performance Audit Program for what pollutants and ranking of results	‣ QA Handbook for Air Pollution Measurement Systems, Vol. ll, Section 2.0.10
‣ Additional internal audits such as document reviews or data processing audits	
‣ Procedure and implementation of corrective action ‣ Frequency of performance and concentration levels for precision checks for each criteria pollutant	‣ 40 CFR 58 Appendix A
Reporting	
‣ Preparation of precision and accuracy summaries for the PARS system	‣ PARS User's Manual (in preparation) ‣ 40 CFR 58 Appendix A
‣ Other internal reports used to track performance and corrective action implementation	
‣ Summary air data reports required by regulations	‣ 40 CFR 58 Appendices F and G
‣ Completeness, legibility and validity of P & A data on Form 1	‣ 40 CFR 58 Appendix A

Systems Audit Long Form Questionnaire

A. Network Management
1. General
2. Network Design and Siting
3. Organization, Staffing and Training
4. Facilities

B. Field Operations
1. Routine Operations
2. Quality Control
3. Preventative Maintenance
4 Record Keeping
5. Data Acquisition and Handling

C. Laboratory Operations
1. Routine Operations
2. Quality Control
3. Preventative Maintenance
4 Record Keeping
5. Data Acquisition and Handling
6. Specific Pollutants
PM-10 and PM 2.5
Lead

D. Data and Data Management
1. Data handling
2. Software Documentation
3. Data Validation and Correction
4. Data Processing
5. Internal Reporting
6. External reporting

E. Quality Assurance/Quality Control
1. Status of Quality Assurance Program
2. Audits and Audits System Traceability
3. National Performance Audit Program (NPAP) and Additional Audits
4. Documentation and data Processing Review
5. Corrective Action System
7. Audit Result Acceptance Criteria

A. NETWORK MANAGEMENT

1. General

Questions	Yes	No	Comments
a) Is there an organization chart showing the agency's structure and its reporting organization (attach charts)?			
b) Basis for the current structure of the agency's reporting organization?			
Field operations for all local agencies, conducted by a common team of field operators?			
Common calibration facilities are used for all local agencies?			
Precision checks performed by common staff for all local agencies?			
Accuracy checks performed by common staff for all local agencies?			
Data handling follows uniform procedure for all local agencies?			
Traceability of all standards by one central support laboratory?			
One central analytical laboratory handles all analyses for manual methods?			
c) Does the agency feel that the data for the reporting organizations it contains can be pooled?			

d) Describe any changes which will be made within the agency's monitoring program the next calendar year

e) Complete the table below for each of the pollutants monitored as part of your air monitoring network

	SO_2	NO_2	CO	O_3	PM-10	PM-2.5	Pb
NAMS							
SLAMS							
SPM PAMS							
Total							

Question	Yes	No	Comment
f) What is the most current official SLAMS Network Description?			
I. Is it available for public inspection			
II Does it include the following for each site			
Monitor ID Code (AIRS Site ID#)			
Sampling and Analysis Method			
Operative Schedule			
Monitoring Objective and Scale of Representativeness			
Any Proposed Changes			

g) Modification since last audit Date of last audit: _____

	Number of Monitors		
Pollutant	**Added**	**Deleted**	**Relocated**
SO_2			
NO_2			
CO			
O_3			
PM-10			
PM-2.5			
Pb			

H) What changes to the Air Monitoring Network are planned for the next period (discuss equipment needs in section B.3.g)

Question	Yes	No	Comment
I) Does an overall SLAM/NAMS Monitoring Plan exist?			
j) Has the agency prepared and implemented standard operating procedures (SOPs) for all facets of agency operation?			
k) Do the SOPs adequately address ANSI/ASQC E-4.quality system required by 40 CFR App A			

l) Clearly identify by section number and /or document title, major changes made to documents since the last on-site review	
Title/Section #	**Pollutant(s) Affected**

Question	**Yes**	**No**	**Comment**
m) Does the agency have an implemented plan for operations during emergency episodes? Indicate latest revision, approval date and current location of this plan			Document Title Revision Date: Approved:
n) During episodes, are communications sufficient so that regulatory actions are based on real time data?			
o) Identify the section of the emergency episode plan where quality control procedures can be found.			

2. Network Design and Siting

a) Indicate by Site ID # any non-conformance with the requirements of 40 CFR 58, Appendices D and E		
Monitor	**Site ID**	**Reason for Non-Conformance**
SO_2		
O_3		
CO		
NO_2		
PM-10		
PM-2.5		
Pb		

b) Please provide the following information on your previous Network Review required by 40 CFR 58.20d.
Review performed on: Date
Performed by:
Location and title of review document:

Briefly discuss all problems uncovered by this review

Question	Yes	No	Comment
c) Have NAMS hard copy information reports been prepared and submitted for all monitoring sites within the network?			
d) Does each site have the required information including:			
AIRS Site ID Number?			
Photographs/slides to the four cardinal compass points?			
Startup and shutdown dates?			
Documentation of instrumentation?			
Reasons for periods of missing data?			
e) Who has custody of the current network documents			Name: Title:
f) Does the current level of monitoring effort, site placement, instrumentation, etc., meet requirements imposed by current grant conditions?			
g) How often is the network design and siting reviewed?			Frequency: Date of last review:

h) Provide a summary of the monitoring activities conducted as the SLAMS/NAMS network by the agency			
I. Monitoring is *seasonal* for (indicate pollutant and month of high and low concentrations).			
Pollutant	**High Concentrations**	**Low Concentrations**	**Collocated (Y/N)**

II Monitoring is *year-round* for (indicate pollutant)	
Pollutant	**Collocated (Y/N)**

Question	Yes	No	Comment
I) Does the number of collocated monitoring sites meet the requirements of 40 CFR 58 Appendix A?			
j) Does the agency monitor and/or analyze for non-criteria air and /or toxic air pollutants?			

If j is yes complete forms below

Pollutant	Monitoring Method/Instrument	SOP Available (Y/N)

3. Organization, Staffing and Training

a) Key Individuals

Agency Director:
Slams Network Manager:
Quality Assurance Officer:
Field Operations Supervisor:
Laboratory Supervisor:
Data Management Supervisor:
SLAMS Reporting Supervisor:

b) Number of personnel available to each of the following program areas		
Program Area	Number	Comment on need for additional personnel
Network Design and Siting		
Resources and Facilities		
Data and Data Management		
QA/QC		

Question	Yes	No	Comment
c) Does the agency have an established training program?			
I Where is it documented			
II Does it make use seminars, courses, EPA sponsored college level courses?			

III Indicate below the 3 most recent training events and identify the personnel participating in them.

Event	Dates	Participant(s)

4. Facilities

a) Identify the principal facilities where the work is performed which is related to the SLAMS/NAMS network. Do not include monitoring sites but do include any work which is performed by contract or other arrangements

Facility	Location	Main SLAMS/NAMS Function

b) Indicate any areas of facilities that should be upgraded. Identify by location

c) Are there any significant changes which are likely to be implemented to agency facilities before the next systems audit? Comment on your agency's needs for additional physical space (laboratory, office, storage, etc.)

Facility	Function	Proposed Change - Date

B: FIELD OPERATIONS

1. Routine Operations

Complete the table

Pollutant Monitored	Date of Last SOP Revision
SO_2	
NO_2	
CO	
O3	
PM-10	
PM-2.5	
Pb	

Question	Yes	No	Comment
a) Is the documentation of monitoring SOPs complete			
b) Are such procedures available to all field operations personnel			
c) Are SOPs prepared and available to field personnel which detail operations during episode monitoring?			

d) For what does each reporting organization within the agency monitor		
Reporting Organization	**# of Sites**	**Pollutants**

Question	Yes	No	Comment
e) On average, how often are most of your sites visited by a field operator?			_____ per _____
f)Is this visit frequency consistent for all reporting organizations within your agency.			If no, why:
g) On average, how many sites does a single site operator have responsibilityfor?			
h) How many of the sites of your SLAMS/NAMS network are equipped with manifolds(s)			
I Briefly describe most common manifold type			
II Are Manifolds cleaned periodically			How often?
III If the manifold is cleaned, what is used			
IV Are manifold(s) equipped with a blower			
V Is there sufficient air flow through the manifold at all times?			Approximate air flow:
VI Is there a conditioning period for the manifold after cleaning?			Length of time:
I)What material is used for instrument lines? 2) How often are lines changed?			
j) Has the agency obtained necessary waiver provisions to operate equipment which does not meet the effective reference and equivalency requirements?			

k) Please complete the table below to indicate which analyzers do not conform with the requirements of 40 CFR 53 for NAMS, SLAMS, or SIP related SPM's

Pollutant	Number	Make/Model	Site ID	Comments on Variances
SO_2				
NO_2				
CO				
O_3				
PM-10				
PM-2.5				
Pb				

l) Please comment briefly and prioritize your currently identified instrument needs

2 Quality Control

a) Please indicate the frequency of multi point calibrations		
Reporting Organization	**Pollutant**	**Frequency**

Question	**Yes**	**No**	**Comment**
b) Are field calibration procedures included in the document SOPs			Location (site, lab etc.):
c) Are calibrations performed in keeping with the guidance in section Vol II of the QA Handbook for Air Pollution Measurement Systems?			If no, why?
d) Are calibration procedures consistent with the operational; requirements of Appendices to 40 CFR 50 or to analyzer operation/instruction manuals.			If no, why?
e) Have changes been made to calibration methods based on manufacturer's suggestions for a particular instrument			
f) Do standard materials used for calibrations meet the requirements of appendices to 40 CFR 50 (EPA reference methods) and Appendix A tp 40 CFR (traceability of materials to NIST-SRMs or CRMs)?			Comment on deviations
g) Are all flow-measurement devices checked and certified?			

h) Please list the authoritative standards used for each type of flow measurement, indicate the frequency of calibration standards to maintain field material/device credibility		
Flow Device	**Primary Standard**	**Frequency of Calibration**

Question	Yes	No	Comment
I) Where do filed operations personnel obtain gaseous standards?			
Are those standards certified by:			
The agency laboratory			
EPA/NERL standards laboratory			
A laboratory separate from this agency's but part of the same reporting organization?			
The vendor?			
NIST			
j) Does the documentation include expiration data of certification?			
Reference to primary standard used			
What traceability is used?			
Please attach an example of recent documentation of traceability			
k) Is calibration equipment maintained at each site?			For what pollutants
l) How is the functional integrity of this equipment documented			

m) Please complete the table below for your agency's site standards (up to 7% of the sites, not to exceed 20 sites)

Parameter	Primary Standard	Secondary Standard	Recertification Date
CO			
NO_2			
SO_2			
O_3			

Please complete the table below for Continuous Analyzers		
Pollutant	Span Conc.	Frequency

PM 10 Analyzers	
Flow Rate	Frequency
$PM_{2.5}$ Analyzers	

Question	**Yes**	**No**	**Comment**
n) Are level 1 zero and span (z/s) calibrations(or calibration checks made for all continuous monitoring equipment and flow checks made for PM 10 and PM2.5 samplers			
o) Does the agency have acceptance criteria for zero/span checks			
I. Are these criteria known to the field operations personnel?			
II. Are they documented in standard operating procedures?			If not indicate document and section where they can be found?
III. Do the documents discussed in (II) above indicate when zero/span adjustments should and should not be made?			Indicate an example
IV. Are zero and span check control charts maintained?			

Question	Yes	No	Comment
p) In keeping with 40 CFR 58 regulations, are any necessary zero and span adjustments made after precision checks?			If no, why not?
(q) Are precision check control charts maintained?			
(r) Who has the responsibility for performing zero/span checks?			
(s) Are precision checks routinely performed within concentration ranges and with a frequency which meets or exceeds the requirements of 40 CFR 58, Appendix A?			Please comment on any discrepancies

(t) Please identify person(s) with the responsibility for performance of precision checks on continuous analyzers.

Person(s)_____

Title_____

3. Preventive Maintenance

a) Has the field operator been given any special training in performing preventive maintenance? Briefly comment on background and/or courses

b) Is this training routinely reinforced? Yes ___ No___
If no, why not?

c) If preventive maintenance is MINOR, it is performed at (check one or more): field site ___, Headquarters facilities___, equipment is sent to manufacturer_____

d) If preventive maintenance is MAJOR, it is performed at (check one or more): field site___, Headquarters facilities___, equipment is sent to manufacturer____

e) Does the agency have service contracts or agreements in place with instrument manufacturers? Indicate below or attach additional pages to show which instrumentation is covered.

f) Comment briefly on the adequacy and availability of the supply of spare parts, tools and manuals available to the field operator to perform any necessary maintenance activities. Do you feel that this is adequate to prevent any significant data loss?

g) Is the agency currently experiencing any recurring problem with equipment or manufacturer(s)? If so, please identify the equipment and/or manufacturer, and comment on steps taken to remedy the problem.

4. Record Keeping

Question	Yes	No	Comment
a) Is a log book(s) maintained at each site to document site visits, preventive maintenance and resolution of site operational problems and corrective actions taken?			Other uses?
b) Is the logbook maintained currently and reviewed periodically?			Frequency of Review
(c) Once entries are made and all pages filled, is the logbook sent to the laboratory for archiving?			If no, is it stored at other location(s)(specify)
(d) What other records are used?			
Zero/span record?			
Gas usage log?			
Maintenance log?			
Log of precision checks?			
Control charts?			
A record of audits?			
Please describe the use and storage of these documents.			
(e) Are calibration records or at least calibration constants available to field operators?			
Please attach an example field calibration record sheet to this questionnaire			

5. Data Acquisition and Handling

(a) With the exception of PM 10, are instrument outputs (that is data) recorded to (a) stripcharts, (b) magnetic tape acquisition system, (c) digitized and telemetered directly to agency headquarters? Please complete the table below for each of the reporting organizations, or agencies within the overall R.O.

Reporting Organization	Pollutants	Data Acquisition Media (a, b, c or combination)

Question	Yes	No	Comment
b) Is there stripchart backup for all continuous analyzers?			
(c) Where is the flow of high-volume samplers recorded at the site?			
For samplers with flow controllers?			Log sheet___ , Dixon chart___ , Other__ (specify)
On High-volume samplers without flow controllers?			Log sheet____, Dixon chart___ , Other _____ (specify)

d) What kind of recovery capabilities for data acquisition equipment are available to the field operator after power outages, storms, etc? Briefly describe below.

(e) Using a summary flow diagram, indicate below all data handling steps performed at the air monitoring site. Identify the format, frequency and contents of data submittals to the data processing section. Clearly indicate points at which flow path differs for different criteria pollutants. Be sure to include all calibration, zero/span and precision check data flow paths. How is the integrity of the data handling system verified?

C. LABORATORY OPERATIONS

1. Routine Operations

(a) What analytical methods are employed in support of your air monitoring network?

Analysis	Methods
PM-10	
Pb	
PM 2.5	
SO_4	
NO_3	
Others (list by pollutant)	

Question	Yes	No	Comment
b) Are bubblers used for any criteria pollutants in any agencies?			If yes, attach a table which indicates the number of sites where bubblers are used, the agency and pollutant(s).
(c) Do any laboratory procedures deviate from the reference, equivalent, or approved methods?			If yes, are the deviations for lead analysis _____, PM-10 filter conditioning____ or other _____ (specify below)?
(d) Have the procedures and/or any changes been approved by EPA?			Date of Approval
(e) Is the documentation of Laboratory SOP complete?			

Complete the table below.

Analysis	Method
PM-10	
Pb	
SO_4	
NO_3	
PM 2.5	
Others (list by pollutant)	

(f) Is sufficient instrumentation available to conduct your laboratory analyses? Yes___ No___ If no, please indicate instrumentation needs

Instrument Needed	Analysis	New or Replacement	Year of Acquisition

2. Quality Control

a) Please complete the table for your agency's laboratory standards.

Parameter	Primary Standard	Secondary Standard	Recertification Date
CO			
NO2			
SO2			
O3			
Weights			
Temperature			
Moisture			
Barometric Pressure			
Flow			
Lead			
Sulfate			
Nitrate			

Question	Yes	No	Comment
b) Are all chemicals and solutions clearly marked with an indication of shelf life?			
c) Are chemicals removed and properly disposed of when shelf life expires?			
d) Are only ACS chemicals used by the laboratory?			

e) Comment on the traceability of chemicals used in the preparation of calibration standards.

Question	Yes	No	Comment
f) Does the laboratory Purchase standard solutions such as those for use with lead or other AA analysis?			
__ Make the solutions themselves?			
If the laboratory staff routinely make their own standard solutions, are procedures for such available?			Attach an example.
g) Are all calibration procedures documented?			Where?_____ _____ (title) (revision)
Unless fully documented, attach a brief description of a calibration procedure.			
(h) Are at least one duplicate, one blank, and one standard or spike included with a given analytical batch?			Identify analyses for which this is routine operation

Ii) Briefly describe the laboratory's use of data derived from blank analyses.

Question	Yes	No	Comment
Do criteria exist which determine acceptable/non-acceptable blank data?			

Please complete the table below.

Pollutant	Blank Acceptance Criteria
SO2	
NO2	
SO4	
NO3	
Pb	
$PM_{2.5}$	

j) How frequently and at what concentrationranges does the lab perform duplicate analysis? What constitutes acceptable agreement? Please complete the table below

Pollutant	Frequency	Acceptance Criteria
SO2		
NO2		
SO4		
NO3		
Pb		
PM-10		

(k) How does the lab use data from spiked samples? Please indicate what may be considered acceptable percentage recovery by analysis? Please complete the table below

Pollutant	% Recovery Acceptance Criteria

Question	Yes	No	Comment
(I) Does the laboratory routinely include samples of reference material obtained from EPA within an analytical batch			If yes, indicate frequency, level, and material used.
(m) Are mid-range standards included in analytical batches?			
If yes, are such standards included as a QC check (span check) on analytical stability?			
Please indicate the frequency, level and compound used in the space provided below			
(n) Do criteria exist for "real time quality control based on the results obtained for the mid-range standards discussed above?			

Question	Yes	No	Comment
If yes, briefly discuss them below or indicate the document in which they can be found.			
(o) Are appropriate acceptance criteria documented for each type of analysis conducted?			
Are they known to at least the analysts working with respective instruments?			

3. Preventive Maintenance

Question	Yes	No	Comment
(a) For laboratory equipment, who has responsibility for major and/or minor preventive maintenance? Person_____ Title_____			
(b) Is most maintenance performed: in the lab?			
in the instrument repair facility?			
at the manufacturer's facility?			
(c) Is a maintenance log maintained for each major laboratory instrument?			Comment
(d) Are service contracts in place for the following analytical instruments			
Analytical Balance			
Atomic Absorption Spectrometer			
Ion Chromatograph			
Automated Colorimeter			

4. Record Keeping

Question	Yes	No	Comment
(a) Are all samples that are received by the laboratory logged in?			
assigned a unique laboratory sample number?			
routed to the appropriate analytical section?			
Discuss sample routing and special needs for analysis (or attach a copy of the latest SOP which covers this). Attach a flow chart if possible			
(b) Are logbooks kept for all analytical laboratory instruments?			

Question	Yes	No	Comment
(c) Do these logbooks indicate:			
analytical batches processed?			
quality control data?			
calibration data?			
results of blanks, spikes and duplicates?			
initials of analyst?			
(d) Is there a logbook which indicates the checks made on: weights			
humidity indicators?			
balances?			
thermometer(s)?			
(e) Are logbooks maintained to track the preparation of filters for the field?			
Are they current?			
Do they indicate proper use of conditioning?			
Weighings?			
Stamping and numbering?			
(f) Are logbooks kept which track filters returning from the field for analysis?			
(g) How are data records from the laboratory archived? Where? Who has the responsibility?Person Title How long are records kept? Years			
(h) Does a chain-of-custody procedure exist for laboratory samples?			If yes, indicate date, title and revision number where it can be found.

5. Data Acquisition and Handling

Question	Yes	No	Comment
(a) Identify those laboratory instruments which make use of computer interfaces directly to record data. Which ones use stripcharts? integrators?			
(b) Are QC data readily available to the analyst during a given analytical run?			
(c) For those instruments which are computer interfaced, indicate which are backed up by stripcharts?			
(d) What is the laboratory's capability with regard to data recovery? In case of problems, can they recapture data or are they dependent on computer operations? Discuss briefly.			
(e) Has a users manual been prepared for the automated data acquisition instrumentation?			Comment
Is it in the analyst's or user's possession?			
Is it current?			
(f) Please provide below a data flow diagram which establishes, by a short summary flow chart: transcriptions, validations, and reporting format changes the data goes through before being released to the data management group. Attach additional pages as necessary.			

6. Specific Pollutants: PM-10 and PM 2.5 and Lead

Question	Yes	No	Comment
PM10 and PM 2.5			
(a) Are filters supplied by EPA used at SLAMS sites?			
(b) Do filters meet the specifications in the Federal Register 40 CFR 50?			
(c) Are filters visually inspected via strong light from a view box for pinholes and other imperfections?			If no, comment on way imperfections are determined?
(d) Are filters permanently marked with a serial number?			Indicate when and how this is accomplished
(e) Are unexposed filters equilibrated in controlled conditioning environment which meets or exceeds the requirements of 40 CFR 50?			If no, why not?
(f) Is the conditioning environment monitored?			Indicate frequency
Are the monitors properly calibrated			Indicate frequency
(g) Is the balance checked with Class "S" weights each day it is used?			If no, indicate frequency of such checks
(h) Is the balance check information placed in QC logbook?			If no, where is it recorded?
(i) Is the filter weighed to the nearest milligram?			If not, what mass increment
(j) Are filter serial numbers and tare weights permanently recorded in a bound notebook?			If no, indicate where
(k) Are filters packaged for protection while transporting to and from the monitoring sites?			
(l) How often are filter samples collected? (Indicate average lapse time (hrs.) between end of sampling and laboratory receipt.)			
(m) Are field measurements recorded in logbook or on filter folder?			
(n) Are exposed filters reconditioned for at least 24 hrs in the same conditioning environment as for unexposed filters?			If no, why not?
(o) Are exposed filters removed from folders, etc., before conditioning?			
(p) Is the exposed filter weighed to the nearest milligram?			
(q) Are exposed filters archived			When? Where? Indicate retention period

Question	Yes	No	Comment
(r) Are blank filters reweighed?			If no, explain why not. If yes, how frequently?
(s) Are analyses performed on filters?			Indicate analyses other than Pb and mass which are routinely performed.
(t) Are sample weights and collection data recorded in a bound laboratory logbook?			
On data forms?			
(u) Are measured air volumes corrected to reference conditions as given in CFR regulations (Q_{std} of 760 mm Hg and 25 C) prior to calculating the Pb concentration?			If not, indicate conditions routinely employed for both internal and external reporting
LEAD			
(a) Is analysis for lead being conducted using atomic absorption spectrometry with air acetylene flame?			If not, has the agency received an equivalency designation of their procedure?
(b) Is either the hot acid or ultrasonic extraction procedure being followed precisely?			Which?
(c) Is Class A borosilicate glassware used throughout the analysis?			
(d) Is all glassware scrupulously cleaned with detergent, soaked and rinsed three times with distilled-deionized water?			If not, briefly describe or attach procedure.
(e) If extracted samples are stored, are linear polyethylene bottles used?			
(f) Are all batches of glass fiber filters tested for background lead content?			
At a rate of 20 to 30 random filters per batch of 500 or greater?			Indicate rate
(g) Are ACS reagent grade HNO_3 and HCI used in the analysis			If not, indicate grade used
(h) Is a calibration curve available having concentrations that cover the linear absorption range of the atomic absorption instrumentation?			
(I) Is the stability of the calibration curve checked by alternately remeasuring every 10th sample a concentration 1 g Pb/ml; 10 g Pb/ml?			If not, indicate frequency.
(j) Are measured air volumes corrected to reference conditions as given in CFR regulations (Q_{std} of 760 mm Hg and 25 C) prior to calculating the Pb concentration?			If not, indicate conditions routinely employed for both internal and external reporting.
(k) In either the hot or ultrasonic extraction procedure, is there always a 30-min H_2O soaking period to allow HNO_3 trapped in the filter to diffuse into the rinse water?			

Question	Yes	No	Comment
(l) Is a quality control program in effect that includes periodic quantification of (1) lead in 3/4" x 8" glass fiber filter strips containing 100-300 g Pb/strip, and/or (2) a similar strip with 600-1000 g strip, and (3) blank filter strips with zero Pb content to determine if the method, as being used, has any bias?			Comment on lead QC program or attach applicable SOP
(m) Are blank Pb values subtracted from Pb samples assayed?			If not, explain why

D: DATA AND DATA MANAGEMENT

1. Data Handling

Question	Yes	No	Comment
(a) Is there a procedure, description, or a chart which shows a complete data sequence from point of acquisition to point of submission of data to EPA?			
Please provide below a data flow diagram indicating both the data flow within the reporting organization and the data received from the various local agencies.			
(b) Are data handling and data reduction procedures documented?			
For data from continuous analyzers?			
For data from non-continuous methods?			

(c) In what format and medium are data submitted to data processing section? Please provide separate entry for each reporting organization.

Reporting Organization	Data Medium	Format

Question	Yes	No	Comment
(d) How often are data received at the processing center from the field sites and laboratory? at least once a week?____ every 1- 2 weeks?_____ once a month?____			
(e) Is there documentation accompanying the data regarding any media changes, transcriptions, and/or flags which have been placed into the data before data are released to agency internal data processing? Describe.			
(f) How are the data actually entered to the computer system? Digitization of stripcharts? Manual or computerized transcriptions? Other?			
(g) Is a double-key entry system used for data at the processing center?			
duplicate card decks prepared			If no, why not?
(h) Have special data handling procedures been adopted for air pollution episodes?			If yes, provide brief description

2. Software Documentation

Question	Yes	No	Comment
(a) Does the agency have available a copy of the AIRS Manual?			
(b) Does the agency have the PARS user's guide available?			
c) Does the Data Management Section have complete software documentation?			If yes, indicate the implementation date and latest revision dates for such documentation.
(d) Do the documentation standards follow the guidance offered by the EPA Software Documentation Protocols?			If no, what protocols are they based on?
e) What is the origin of the software used to process air monitoring data prior to its release into the SAROAD/NADB database?			
I. Purchased?			Supplier Date of latest version
II. Written in-house?			Latest version Date
III. Purchased with modifications in-house?			Latest version Date
(f) Is a user s manual available to data management personnel for all software currently in use at the agency for processing SLAMS/NAMS data?			

Question	Yes	No	Comment
(g) Is there a functional description either: included in the user's manual?			
separate from it and available to the users?			
(h) Are the computer system contents, including ambient air monitoring data backed up regularly?			Briefly describe, indicating at least the media, frequency, and backup-media storage location
(I) What is the recovery capability (how much time and data would be lost) in the event of a significant computer problem?			
(j) Are test data available to evaluate the integrity of the software?			
Is it properly documented?			

3. Data Validation and Correction

Question	Yes	No	Comment
(a) Have validation criteria, applicable to all pollutant data processed by the reporting organization been established and documented?			If yes, indicate document where such criteria can be found (title, revision date).
(b) Does documentation exist on the identification and applicability of flags (i.e., identification of suspect values) within the data as recorded with the data in the computer files?			
(c) Do documented data validation criteria employ address limits on and for the following:			
I. Operational parameters, such as flow rate measurements or flow rate changes			
II. Calibration raw data, calibration validation and calibration equipment tests.			
III. All special checks unique to a measurement system			
IV. Tests for outliers in routine data as part of screening process			
V. Manual checks such as hand calculation of concentrations and their comparison with computer-calculated data			
(d) Are changes to data submitted to NADB documented in a permanent file?			If no, why not?

Question	Yes	No	Comment
(e) Are changes performed according to a documented Standard Operating Procedure or your Agency Quality Assurance Project Plan?			If not according to the QA Project Plan, please attach a copy of your current Standard Operating Procedure
(f) Who has signature authority for approving corrections? (Name) (Program Function)			
(g) Are data validation summaries prepared at each critical point in the measurement process or information flow and forwarded with the applicable block of data to the next level of validation?			Please indicate the points where such summaries are performed.
(h) What criteria are applied for data to be deleted? Discuss briefly.			
(I) What criteria are applied to cause data to be reprocessed? Discuss.			
(j) Is the group supplying data provided an opportunity to review data and correct erroneous entries?			If yes, how?
(k) Are corrected data resubmitted to the issuing group for cross-checking prior to release?			

4. Data Processing

Question	Yes	No	Comment
(a) Does the agency generate data summary reports?			
Are the data used for in-house distribution and use?			
Publication?			Other (specify)

(b) Please list at least three (3) reports routinely generated, providing the information requested below

Report Title	Distribution	Period Covered

Question	Yes	No	Comment
(c) Have special procedures been instituted for pollution index reporting?			If yes, provide brief description.
(d) Who at the agency has the responsibility for submitting data to AIRS? Name Title			
Is the data reviewed and approved by an officer of the agency prior to submittal?			
(e) Are those persons different from the individuals who submit data to PARS?			
If yes, provide name and title of individual responsible for PARS data submittal. Name Title PARS data review and approval (name)			
(f) How often are data submitted to: - AIRS ? PARS?			
(g) How and/or in what form are data submitted? TO AIRS? TO PARS?			
(h) Are the recommendations and requirements for data coding and submittal, in the AIRS User's Manual?			Comment on any routine deviations in coding procedures.
(f) Are the recommendations and requirements for data coding and submittal, in the PARS User's Guide, followed closely?			Comment on any routine deviations in coding and/or computational procedures.
(j) Does the agency routinely request a hard copy printout on submitted data:			
from AIRS?			
from PARS?			
(k) Are records kept for at least 3 years by the agency in an orderly, accessible form?			If yes, does this include raw data__ , calculation__ , QC data__, and reports__? If no, please comment.
(l) In what format are data received at the data processing center? (Specify appropriate pollutant.) (a) concentration units ____ (b) % chart____ (c) voltages____ (d) other_____			

Question	Yes	No	Comment
(m) Do field data include the following documentation?			
Site ID?			
Pollutant type?			
Date received at the center?			
Collection data (flow, time date)?			
Date of Laboratory Analysis/if applicable)			
Operator/Analyst?			
(n) Are the appropriate calibration equations submitted with the data to the processing center?			If not, explain.
(o) Provide a brief description of the procedures and appropriate formulae used to convert field data to concentrations prior to input into the data bank.			
SO_2			
NO_2			
CO			
O_3			
PM 2.5			
CH_4THC			
Pb			
PM 10			
(p) Are all concentrations corrected to EPA standard (298 K, 760 mm Hg) temperature and pressure condition before input to the AIRS?			If no, specify conditions used
(q) Are data reduction audits performed on a routine basis?			If yes, at what frequency?
are they done by an independent group?			
(r) Are there special procedures available for handling and processing precision, accuracy, calibrations and span checks?			If no, comment
If yes, provide a brief description: Span checks Calibration data Precision data Accuracy data			

Question	Yes	No	Comment
(s) Are precision and accuracy data checked each time they are recorded, calculated or transcribed to ensure that incorrect values are not submitted to EPA?			Please comment and/or provide a brief description of checks performed
(t) Is a final data processing check performed prior to submission of any data?			If yes, document procedure briefly If no, explain

5. Internal Reporting

(a) What reports are prepared and submitted as a result of the audits required under 40 CFR Appendix A?	
Report Title	Frequency
(Please include an example audit report and, by attaching a coversheet, identify the distribution such reports are given within the agency.)	

b) What internal reports are prepared and submitted as a result of precision checks also required under 40 CFR 58 Appendix A?	
Report Title	Frequency
(Please include an example of a precision check report and, identify the distribution such reports receive within the agency.)	

Question	Yes	No	Comment
(c) Do either the audit or precision reports indicated include a discussion of corrective actions initiated based on audit or precision results?			If yes, identify report(s) and section numbers
(d) Does the agency prepare Precision and Accuracy summaries other than Form 1?			If no, please attach examples of recent summaries including a recent Form 1.

(e) Who has the responsibility for the calculation and preparation of data summaries? To whom are such P and A summaries delivered?			
Name	**Title**	**Type of Report**	**Recipient**

(f) Identify the individual within the agency who receives the results of the agency's participation in the NPAP and the internal distribution of the results once received.	
Principal Contact for NPAP is (name, title)	
Distribution	

6. External Reporting

(a) For the current calendar year or portion thereof which ended at least 90 calendar days prior to the receipt of this questionnaire, please provide the following percentages for required data submitted

%Submitted on Time*							
Monitoring Qtr.	**SO_2**	**CO**	**O_3**	**NO_2**	**PM2.5**	**PM-10**	**Pb**
1 (Jan 1-March 31)							
2 (Apr 1- June 30)							
3 (July 1-Sept. 30)							
4 (Oct.1-Dec. 31)							

*"On-Time" = within 90 calendar days after the end of the quarter in which the data were collected.

(b) Identify the individual within the agency with the responsibility for preparing the required 40 CFR 58 Appendix F and G reporting inputs.

Name Title

(c) Identify the individual within the agency with the responsibility for reviewing and releasing the data.

Name Title

(d) Does the agency regularly report the Pollutant Standard Index (PSI)? Briefly describe the media, coverage, and frequency of such reporting.

(e) What fraction of the SLAMS sites (by pollutant) reported less than 75% of the data (adjusted for seasonal monitoring and site start-ups and terminations)?

Percent of Sites <75% Data Recovery FY____

Pollutant	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Ozone				
Nitrogen Dioxide				
Sulfur Dioxide				
Carbon Monoxide				

PM-10				
PM2.5				
Lead				

Question	Yes	No	Comment
(f) Does the agency's annual report (as required in 40 CFR 58.26) include the following?			
Data summary required in Appendix F			
Annual precision and accuracy information described in Section 5.2 of Appendix A.			
Location, date, pollution source and duration of all episodes reaching the significant harm levels.			
Certification by a senior officer in the State or his designee.			
(g) Please provide the dates at which the annual reports have been submitted for the last 2 years.			

E. QUALITY ASSURANCE/QUALITY CONTROL

1. Status of Quality Assurance Program

Question	Yes	No	Comment
(a) Does the agency have an EPA-approved quality assurance program plan?			
If yes, have changes to the plan been approved by the EPA?			
Please provide: Date of Original Approval Date of Last Revision Date of Latest Approval			
b) Do you have any revisions to your QA Program Plan still pending?			
(c) Is the QA Plan fully implemented?			
(d) Are copies of QA Plan or pertinent sections available to agency personnel?			If no, why not?
(e) Which individuals routinely receive updates to QA Plan?			

2. Audits and Audit System Traceability

Question	Yes	No	Comment
(a) Does the agency maintain a separate audit/calibration support facility laboratory?			
(b) Has the agency documented and implemented specific audit procedures?			
(c) Have audit procedures been prepared in keeping with the requirements of Appendix A to 40 CFR 58?			
(d) Do the procedures meet the specific requirements for independent standards and the suggestions regarding personnel and equipment?			
(e) Are SRM or CRM materials used to routinely certify audit materials?			
(f) Does the agency routinely use NIST-SRM or CPM materials?			For audits only?__ For calibrations only?__ For both?__ For neither, secondary standards are employed__
(g) Does the agency audit the Meteorological sites?			

(g) Please list below areas routinely covered by this review, the date of the last review, and changes made as a direct result of the review.		
Pollutants	**Audit Method**	**Audit Standard**
CO		
O_3		
NO_2		
$S0_2$		
PM-10		
PM 2.5		

Question	**Yes**	**No**	**Comment**
(h) Are SRM or CRM materials used to establish traceability of calibration and zero/span check materials provided to field operations personnel?			
(I) Specifically for gaseous standards, how is the traceability of audit system standard materials established?			
Are they: purchased certified by the vendor?			
certified by the QA support laboratory which is part of this agency?			
(j) Are all agency traceability and standardization methods used documented?			Indicate document where such methods can be found.
(k) Do the traceability and standardization methods conform with the guidance of VOL. Il of the Handbook for Air Pollution Measurement Systems?			
For permeation devices?			
For cylinder gases?			
(l) Does the agency have identifiable auditing equipment (specifically intended for sole use) for audits?			If yes, provide specific identification
(m) How often is auditing equipment certified for accuracy against standards and equipment of higher authority?			

(n) As a result of the audit equipment checks performed, have pass/fail (acceptance criteria) been decided for this equipment? Indicate what these criteria are with respect to each pollutant. Where are such criteria documented?	
Pollutant	**Criteria**

3. National Performance Audit Program (NPAP) And Additional Audits

(a) Identify the individual with primary responsibility for the required participation in the National Performance Audit Program.

For gaseous materials? (name, title)

For laboratory materials? (name, title)

Question	Yes	No	Comment
(b) Does the agency currently have in place any contracts or similar agreements either with another agency or outside contractor to perform any of the audits required by 40 CFR 58?			
If yes, has the agency included QA requirements with this agreement?			
Is the agency adequately familiar with their QA program?			
(c) Date last systems audit was conducted	**Date:**	**By Whom:**	

(d) Please complete the table below	
Parameter Audited	**Date of Last NPAP**
SO_2	
CO	
Pb	
PM-10	
O_3	
NO_2	

Question	Yes	No	Comment
(e) Does the agency participate in the National Performance Audit Program (NPAP) as required under 40 CFR 58 Appendix A?			If no, why not? Summarize below.

4. Documentation and Data Processing Review

Question	Yes	No	Comment
(a) Does the agency periodically review its record-keeping activities?			

Please list below areas routinely covered by this review, the date of the last review, and changes made as a direct result of the review.			
Area/Function	**Date of Review**	**Changes? (Y/N)**	**Discuss Changes**

Question	Yes	No	Comment
(b) Are data audits (specific re-reductions of strip charts or similar activities routinely performed for criteria pollutants data reported by the agency?			If no, please explain.
(c) Are procedures for such data audits documented?			
(d) Are they consistent with the recommendations of Sections 16.4.2.3 of Vol. II of the QA Handbook for Air Pollution Measurement Systems?			If no, why not?

(e) What is the frequency and level (as a percentage of data processed of these audits?			
Pollutant	**Audit Frequency**	**Period of Data Audited**	**% of Data Rechecked**

(f) Identify the criteria for acceptable/non-acceptable result from a data processing audit for each pollutant, as appropriate		
Pollutant	**Acceptance Criteria**	**Data Concentration Level**

Question	Yes	No	Comment
(g) Are procedures documented and implemented for corrective actions based on results of data audits which fall outside the establishedlimits?			If yes, where are such corrective action procedures documented?

5. Corrective Action System

Question	Yes	No	Comment
(a) Does the agency have a comprehensive Corrective Action program in place and operational?			
b) Have the procedures been documented?			
As a part of the agency QA Plan?			
As a separate Standard Operating Procedure?			Briefly describe it or attach a copy
(c) How is responsibility for implementing corrective actions on the basis of audits, calibration problems, zero/span checks, etc assigned? Briefly discuss.			
(d) How does the agency follow up on implemented corrective actions?			
(e) Briefly describe two (2) recent examples of the ways ;n which the above corrective action system was employed to remove a problem area with I. Audit Results: Il. Data Management:			

6. Audit Result Acceptance Criteria

Question	Yes	No	Comment
(a) Has the agency established and has it documented criteria to define agency-acceptable audit results?			

Please complete the table below with the pollutant, monitor and acceptance criteria.	
Pollutant	**Audit Result Acceptance Criteria**
CO	
O_3	
NO_2	
SO_2	
PM-10.	
PM2.5	

Question	Yes	No	Comment
(b) Were these audit criteria based on, or derived from, the guidance found in Vol./. Il of the QA Handbook for Air Pollution Measurement System, Section 2.0.12?			If no, please explain. If yes, please explain any changes or assumptions made in the derivation.
(c) What corrective action may be taken if criteria are exceeded? If possible, indicate two examples of corrective actions taken within the period since the previous systems audit which are based directly on the criteria discussed above. Corrective Action # 1 Corrective Action #2			

(d) As a goal, the 95 percent probability limits for precision (all pollutants) and PM-10 accuracy should be less than + 15 percent. At 95 percent probability limits, the accuracy for all other pollutants should be less than +20 percent. Using a short narrative and a summary table, compare the reporting organizations performance against these goals over the last year. Explain any deviations.

NOTE: Precision and accuracy are based on reporting organizations; therefore this question concerns the reporting organizations that are the responsibility of the agency. Complete the tables below indicating the number of reporting organizations meeting the goal stated above for each pollutant by quarter

I. Precision Goals (Report level 2 checks unless otherwise directed by Regional Office.)					
Pollutant	**# of Reporting Organization**	**Qtr/Yr**	**Qtr/Yr**	**Qtr/Yr**	**Qtr/Yr**
CO					
O_3					
NO_2					
SO_2					
PM-10.					
PM2.5					
Pb					

I. Accuracy Goals (Report level 2 checks unless otherwise directed by Regional Office.)					
Pollutant	**# of Reporting Organization**	**Qtr/Yr**	**Qtr/Yr**	**Qtr/Yr**	**Qtr/Yr**
CO					
O_3					
NO_2					
SO_2					
PM-10.					
PM2.5					
Pb					

(e) To the extent possible, describe problems preventing the meeting of precision and accuracy goals.

Section 3
State and Local Audit Procedures

40 CFR 58, Appendix A[1] outlines the minimum quality assurance requirements for state and local air monitoring stations (SLAMS). All subsequent revisions to Appendix A have been included in the preparation of this document[2]. Quality assurance guidelines for PSD monitoring are found in 40 CFR 58, Appendix B[3].

This section describes performance audit procedures for each automated and manual monitoring method referenced in Appendix A[1]. In addition, quality assurance and quality control are defined, standard traceability procedures are discussed, and data interpretation procedures are specified relative to the requirements of Appendix A[1].

Quality Assurance and Control

Emphasis on quality assurance is increasing in the environmental community. Since its introduction in the manufacturing industry 30 years ago, quality assurance has expanded in scope to include all phases of environmental monitoring.

Quality assurance consists of two distinct and equally important functions. One function is the assessment of the quality of the monitoring data by estimating their precision and accuracy. The other function is the control and improvement of data quality by implementing quality control policies and procedures and by taking corrective actions. These two functions form a control loop where the assessment indicates when data quality is inadequate and where the control effort must be increased until the data quality is acceptable. Each agency should develop and implement a quality control program consisting of policies, procedures, specifications, standards, corrective measures, and documentation necessary to : 1) provide data of adequate quality to meet monitoring objectives and, 2) minimize loss of air quality data because of malfunctions and out- of-control conditions.

The selection and degree of specific control measures and corrective actions depend on a number of factors such as the monitoring methods and equipment, field and laboratory conditions, monitoring objectives, level of data quality required, expertise of assigned personnel, cost of control procedures, and pollutant concentration levels.

Standard Traceability

Traceability is the process of transferring the accuracy or authority of a primary standard to a field-usable standard. Gaseous standards (permeation tubes and devices and cylinders of compressed gas) used to obtain audit concentrations of CO, SO_2, and NO_2 must be working standards certified by comparison to NIST--SRM's. Traceability protocols are available for certifying a working standard by direct comparison to an NIST-SRM[4,5]. Direct use of an NIST-SRM is discouraged because of the limited supply and expense. NIST-SRM availability and ordering procedures are given in Reference 6.

Test concentrations for O_3 must be obtained by means of a UV photometric calibration procedure (Subsection A.10.4) or by a certified transfer standard[7]. Flow measurements must be made by an instrument that is traceable to an authoritative volume or other standard[8,9].

General Discussion of Audit Procedures

The benefits of a performance audit are twofold. From a participant standpoint, agencies are furnished a means of rapid self-evaluation of a specific monitoring operation. The EPA is furnished a continuing index of the validity of the data reported to the air quality data bank. The performance audit is used to validate and document the accuracy of the data generated by a measurement system. A list of the specific audit procedures which are outlined in this section is contained in Table A-1. Procedures which use the principles of dynamic dilution, gas phase titration, UV photometry, and flow rate measurement are presented. The general guidelines for performance audits are the same for all procedures.

Table A-1 Audit Procedures

Pollutant	Audit procedure
Sulfur dioxide	Dynamic dilution--permeation tube Dynamic dilution--compressed gas cylinder
Nitrogen dioxide	Gas phase titration
Carbon monoxide	Dynamic dilution--compressed gas cylinder Multiple compressed gas cylinders
Ozone	Ultraviolet photometry
Total suspended particulate	Flow rate measurement

1. A performance audit should be conducted only if calibration data are available for the analyzers or samplers being audited.
2. A performance audit should be conducted only if the site operator or representative is present, unless written permission is given to the auditor before the audit.
3. Before the audit, a general procedures protocol, including the audit policy and special instructions from the auditor, should be provided to the agency being audited.
4. A signed acknowledgment that the audit has been completed should be obtained from the station operator.
5. The auditor should discuss the audit results with the site operator or representative at the conclusion of the audit. A form showing the audit concentrations, station responses, and other pertinent data recorded by the auditor should be given to the site operator or representative; the form must indicate that the results are not official until the final report is issued. If the site operator or representative is not on-site at the conclusion of the audit, the auditor should contact the agency before leaving the area or promptly when returning to the base of operations.
6. The auditor should document the verification of his equipment before and after the audit; this verification includes calibration and traceability data. This information and a written record of the audit should be kept in a bound notebook in a secure location.
7. The auditor should use specific procedures that are consistent with the performance audit procedures manual. Any deviation from these must be approved by the agency performing the audit.
8. All audit equipment and standards including standard gases, permeation tubes, flow measuring apparatus, and temperature and pressure monitors should be referenced to primary standards.
9. Verification of the total audit system output by performing an audit on calibrated instrumentation should be conducted before the audit. The verification instrumentation should be calibrated using an independent set of equipment and standards.

10. Upon arrival at the audit site, all equipment should be inspected for transit damage. Each auditor should have a quality control checklist or a specified procedure that can be used to verify system integrity.

Performance Audit by

PEDCo Environmental, Inc.
11499 Chester Road
Cincinnati, Ohio 45246-0100

Date _____ *Auditor* _____

Start _____ *Parameter*

Figure A.1 Audit identification stamp

Before starting the audit, the auditor should record the following data: the site address, operating agency, type of analyzer being audited, zero and span settings, type of in-station calibration used, and general operating procedures. These data may be used later to determine the cause of discrepancies between the audit concentrations and station responses. The auditor should also mark the data record with a stamp similar to the one shown in Figure A.1 to verify that the audit was performed and to prevent the audit data from being transcribed and mistaken for ambient monitoring data. Before disconnecting a monitor or sampler from its ambient sampling mode, have the station operator make a note on the data acquisition system to indicate that an audit is being performed.

All station responses should be converted by the station operator to engineering units (e.g., ppm or ug/m^3) by using the same procedures used to convert the actual ambient data. This procedure allows evaluation of the total monitoring system--the station operator, equipment, and procedures.

Upon completion of the audit, all monitoring equipment must be reconnected and returned to the configuration recorded before initiating the audit. Before the auditor leaves the station, audit calculations should be performed to ensure that no extraneous or inconsistent differences exist in the data. Sometimes a recording mistake is found after leaving the station, and the error cannot be rectified without returning to the test site.

1. Sulfur Dioxide Audit Procedure Using Dynamic Permeation Dilution

1.1 Principle-Audit concentrations are generated by a dynamic system which dilutes an SO_2 permeation source with clean, dry air. This method can be used to audit all commercially available SO_2/total sulfur analyzers. Several variations in clean, dry air must be made to accommodate operating characteristics of certain analyzers. The procedure, its applicability, precision and accuracy, and apparatus requirements are discussed in the following subsections.

1.2 Applicability-The dynamic dilution method can be used to supply SO_2 audit concentrations in the range of 0 to 0.5 ppm. Concentrations for challenging other operating ranges such as 0 to 50 ppb, 0 to 0.2 ppm, 0 to 1.0 ppm, and 0 to 5 ppm can also be generated by using this procedure.

1.3 Accuracy-The accuracy of the audit procedure should be within $\pm$2.5% if the SO_2 permeation source is referenced and if gas flow rates are determined using EPA recommended procedures.

1.4 Apparatus-An audit system which uses a dynamic permeation dilution device to generate concentrations is illustrated in Figure A.2. The eight components of the system are discussed below.

1. Permeation Chamber--A constant-temperature chamber capable of maintaining the temperature around the permeation tube to an accuracy of ±0.10 C is required. The permeation oven should be equipped with a readout that is sensitive enough to verify the temperature of the permeation device during normal operation.

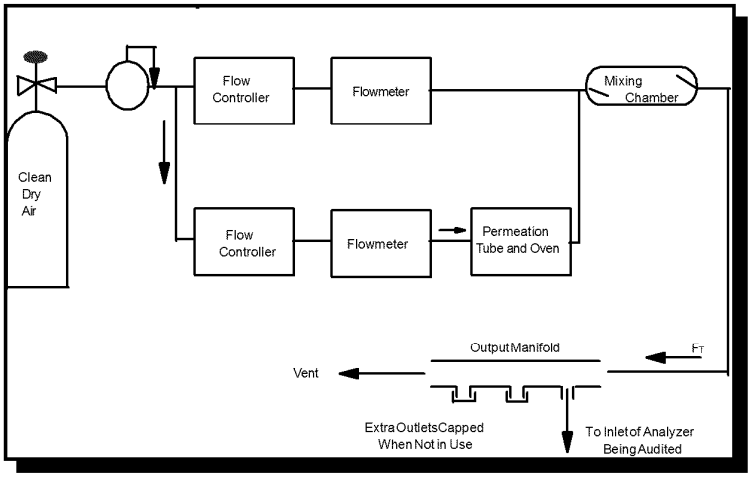


Figure A.2 Schematic diagram of a permeation audit system

2. Flow Controllers--Devices capable of maintaining constant flow rates to within ± 2% are required. Suitable flow controllers include stainless steel micro metering valves in tandem with a precision regulator and with mass flow controllers, capillary restrictors, and porous plug restrictors.

3. Flowmeters--Flowmeters capable of measuring pollutant and diluent gas flow rates to within ±2% are required. NIST-traceable soap bubble flowmeters, calibrated mass flow controllers or mass flowmeters, and calibrated orifice, capillary, and porous plug restrictors are suitable.

4. Mixing Chamber--A glass chamber is used to mix SO_2 with dilution air. The inlet and outlet should be of sufficient diameter so that the chamber is at atmospheric pressure under normal operation, and sufficient turbulence must be created in the chamber to facilitate thorough mixing. Chamber volumes in the range of 100 to 500 cm^3 are sufficient. Glass Kjeldahl connecting flasks are suitable mixing chambers.

5. Output Manifold and Sample Line--An output manifold used to supply the analyzer with an audit atmosphere at ambient pressure should be of sufficient diameter to ensure a minimum pressure drop at the analyzer connection, and the manifold must be vented so that ambient air will not mix with the audit atmosphere during system operations. Recommended manifold materials are glass or Teflon. The sample line must be nonreactive and flexible; therefore, Teflon tubing is preferred.

6. Dilution Air Source--The diluent source must be free of sulfur contaminants and water vapor; clean dry air from a compressed gas cylinder (Grade 0.1) may be used. When auditing a flame photometric analyzer, a diluent source which contains approximately 350 ppm CO_2 is required. A clean air system may be used; however, the system must not remove the CO_2 from the ambient airstream.

In all cases, the O_2 content of the diluent air must be 20.9 ±0.2%. Gas manufacturers that blend clean dry air do not always adhere to the exact ambient proportions of O_2 and N_2; in these cases, the O_2 content should be verified by paramagnetic response.

7. Sulfur Dioxide Permeation Tube--An SO_2 permeation tube with NIST traceability is used as the pollutant source. Permeation rates between 0.5 to 1.5 ug/min fulfill the auditing requirements. Traceability is established by referencing the permeation device to an NIST-SRM (number 1625. 1626. or 1627)

8. Permeation Tube Storage--A storage device capable of keeping the permeation tube encased in dry air is required; small cases containing Drierite or silica gel will serve this purpose. The useful life of a permeation tube will vary among vendor types (a 9-mo life can be used for estimating purposes); low temperature (2 to 5 C) will prolong the tube life. Do not freeze the permeation tube.

1.5 Procedure

Equipment Setup --Remove the permeation tube from the storage case, insert it into the permeation chamber, and start the carrier flow (approximately 50 cm^3/min) across the tube. Set the permeation temperature at the desired setting and allow the permeation source to equilibrate. For changes of 1 or 2 C, an equilibrium period of 3 h should suffice. For changes of 10 C or when the source is removed from low temperature storage, an equilibrium period of 24 h is advisable. Several commercially available permeation calibrators use a carrier flow to maintain a constant temperature around the tube during transport. In this instance, equilibration is not necessary because the oven temperature is continuously maintained within 0.10 C of the desired permeation temperature.

Audit sequence--After all the equipment has been assembled and set up, have the station operator mark the strip chart recorder to indicate that an audit is beginning. The auditor's name, start time, date, and auditing agency should be entered; if it is not possible to record written comments on the chart, record the start and stop times to preclude the use of audit data as monitoring data. After recording these data, disconnect the analyzer sample line from the station manifold and connect it to the audit manifold, as shown in Figure A.3. Cap the sample port on the station manifold. The audit atmosphere must be introduced through any associated filters or sample pretreatment apparatus to duplicate the path taken by an ambient sample. Record the analyzer type and other identification data on the data form (Table A-2). Conduct the audit as shown in steps 1-5 below.

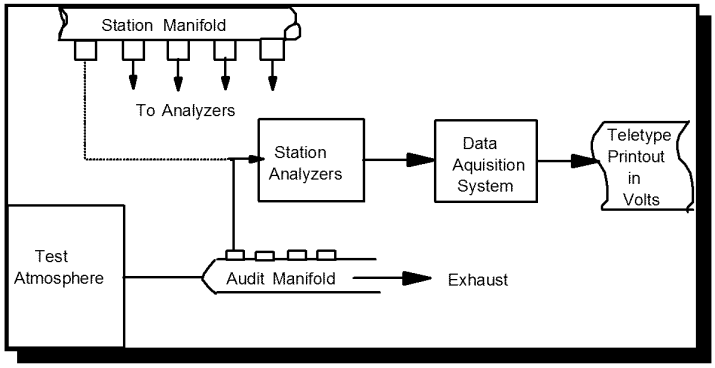


Figure A.3 Schematic configuration utilized in auditing the gas analyzers

1. Introduce into the audit manifold a clean dry air gas at a flow rate in excess of 10% to 50% of the analyzer sample demand. Allow the analyzer to sample the clean dry air until a stable response is obtained; that is, until the response does not vary more than 12% of the measurement range over a 5-min period. Obtain the station response and concentration from the station operator, and record the data in the appropriate blanks on the data form.

Audit Point	Concentration Range (ppm)
1	0.03 - 0.08
2	0.15 - 0.20
3	0.35 - 0.45
4	0.80 - 0.90

2. Generate SLAMS audit concentrations (which are compatible with the analyzer range) as audit atmospheres consistent with the requirements in Appendix A[1].

Generate the concentrations by adjusting the dilution air flow rate (F_D) and the permeation device air flow rate (F_C) to provide the necessary dilution factor. Calculate the concentrations as follows.

$$[SO_2] = \frac{P_R \ x \ 10^3}{F_C + F_D} \ x \ 3.82 \ x \ 10^{-4} \qquad \text{Equation 1-1}$$

where:
$[SO_2]$ = SO_2 audit concentration, ppm,
P_R = permeation flow rate at the specified temperature, ug SO_2/min,
F_C = carrier flow rate over the permeation tube, standard liters/min, and
F_D = diluent air flow rate, standard liters/min.

10^3 converts liters to m^3, and the 3.82 x 10^{-4} converts ug SO_2/cm^3 to ppm SO_2 at 25 C and 760 mm Hg

3. Generate the highest audit concentration first, and consecutively generate audit points of decreasing concentration. Allow the analyzer to sample the audit atmosphere until a stable response is obtained. Obtain the station response and concentration from the station operator, and record the data in the appropriate spaces in Table A-2.

4. If desired, additional points at upscale concentrations different from those specified in step 2 may be generated. Generation of these audit concentrations plus a post audit clean dry air response will enhance the statistical significance of the audit data regression analysis.

5. After supplying all audit concentrations and recording all data, reconnect the analyzer sample line to the station manifold. Make a notation of the audit stop time and have the station operator make a note on the data recorder to indicate the stop time. Have the station operator check all equipment to ensure that it is in order to resume normal monitoring activities.

1.6 Calculations-Tabulate the data in Table A-2 in the appropriate blank spaces.

% difference--The % difference is calculated as follows.

$$\%\ Difference = \frac{C_M - C_A}{C_A} \ x \ 100 \qquad \text{Equation 1-2}$$

where:
C_M = the station measured concentration, ppm
C_A = the calculated audit concentration, ppm.

Regression analysis-- Calculate by the method of least squares the slope, intercept, and correlation coefficient of the station analyzer response data (y) versus the audit concentration data (x). These data can be used to interpret the analyzer performance.

1.7 Reference- References 4 through 6 and 10 and 11 provide additional information on this SO_2 audit procedure.

Table A-2 Sulfur Dioxide Data Report

Station _____ Date: _____

Address _____ Start Time:_____

T_A _____ °C; P_A _____ mm Hg; P_{H2O} _____ mm Hg Auditor:_____

Analyzer _____ Serial Number _____

Calibration standard _____ Span source _____

Last calibration date _____ Frequency _____ Range _____

Calibration Comments _____

Zero setting_____ Data acquisition system _____

Span setting _____ Recorder _____

Audit system _____ Bubble flowmeter serial number _____

Audit standard _____; P _____ psig; [ ] = _____ ppm

Clean, dry air _____ Catalytic oxidizer Yes No

Flow correction $\left(\frac{P_A - P_{H_2O}}{760\ mm}\right) x \left(\frac{298\ K}{T_A + 273}\right)$ = _____ = (C_F)

Dilution air response _____ % Chart; _____ V_{DC}; _____ ppm

Other response _____

Audit Point I

Dilution flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

Audit Point II

Dilution flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

Table A-2 continued

Audit Point III

Dilution flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

Audit Point IV

Dilution flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

Audit Point V

Dilution flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

Method

_____

_____

_____

Permeation temperature _____ ^{o}C Permeation rate _____ ug/min

Table A-2 continued

Point Number	Gas flow rates std cm^3/min		Audit Concentration, ppm	Analyzerresponse		Difference	
	QC	QD		ppm	% MV/chart	Analyzer-audit ppm	%

Regression analysis [audit concentration (x) vs. Analyzer response (y)]

$y = mx + b$

Slope (m) _____

Intercept (b) _____

Correlation (r) _____

Comments:

2. Sulfur Dioxide Audit Procedure Using Dynamic Dilution of a Gas Cylinder

2.1 Principle- A dynamic dilution system is used to generate SO_2 concentrations in air for auditing continuous ambient analyzers. The audit procedure consists of diluting a gas cylinder of low SO_2 concentration with clean dry dilution air. Traceability is established by referencing the gas cylinder to an NIST-SRM. This procedure can be used to audit all commercially available SO_2/total sulfur analyzers. Variations in clean dry air must be made to accommodate operating characteristics of certain analyzers. The procedure, its applicability, accuracy, and apparatus requirements are discussed in the following subsections.

2.2 Applicability-Dynamic dilution can be used to supply SO_2 audit concentrations in the range of 0 to 0.5 ppm. Concentrations for challenging other operating ranges such as 0 to 50 ppb, 0 to 0.2 ppm, 0 to 1.0 ppm, and 0 to 5 ppm can also be readily generated by using this procedure.

2.3 Accuracy-The accuracy of the audit procedure should be within $\pm$2.5% if the SO_2 gas cylinder concentration is referenced and if gas flow rates are determined using EPA recommended procedures.

2.4 Apparatus-An audit system which uses a dynamic dilution device to generate audit concentrations is illustrated in Figure A.4. The seven components of the device are discussed below.

1. Gas Cylinder Regulator--A stainless steel gas regulator is acceptable. A low dead space, two stage regulator should be used to achieve rapid equilibration. A purge assembly is helpful.

2. Flow Controllers--Devices capable of maintaining constant flow rates to within +2% are required. Suitable flow controllers include stainless steel micro metering valves in tandem with a precision regulator, mass flow controllers, capillary restrictors, and porous plug restrictors.

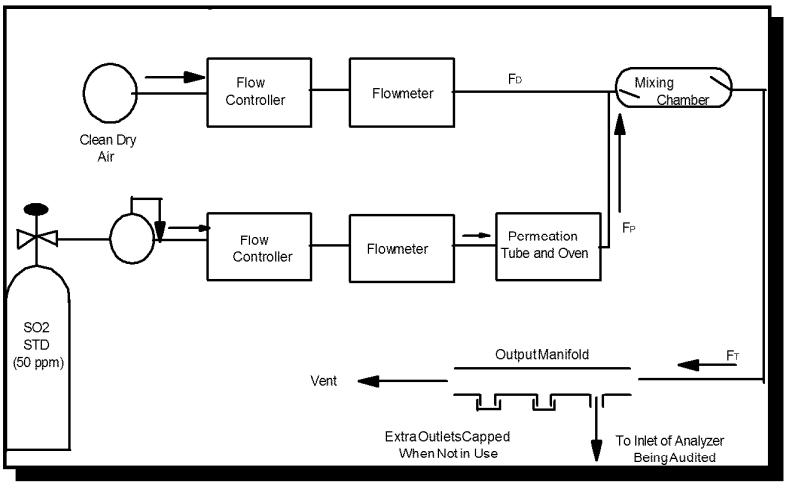


Figure A.4 Schematic diagram of a dilution audit system

3. Flowmeters--Flowmeters capable of measuring pollutant and diluent gas flow rates to within $\pm$2% are required. NIST-traceable soap bubble flowmeters, calibrated mass flow controllers or mass flowmeters, and calibrated orifice, capillary, and porous plug restrictors are suitable for flow determination.

4. Mixing Chamber--A glass or Teflon chamber is used to mix the SO_2 with dilution air. The inlet and outlet should be of sufficient diameter so that the chamber is at atmospheric pressure under normal operation, and sufficient turbulence must be created in the chamber to facilitate thorough mixing. Chamber volumes in the range of 100 to 500 cm^3 are sufficient. Glass Kjeldahl connecting flasks are suitable mixing chambers.

5. Output Manifold and Sample Line--An output manifold used to supply the analyzer with an audit atmosphere at ambient pressure should be of sufficient diameter to ensure a minimum pressure drop at the analyzer connection, and the manifold must be vented so that ambient air will not mix with the audit atmosphere during system operations. Recommended manifold materials are glass or Teflon. The sample line must be nonreactive and flexible; therefore, Teflon tubing is preferred.

6. Dilution Air Source--The diluent source must be free of sulfur contaminants and water vapor; clean dry air from a compressed gas cylinder (Grade 0.1) may be used. When auditing a flame photometric analyzer, a diluent source which contains approximately 350 ppm CO_2 is required. A clean air system may be used; however, the system must not remove the CO_2 from the ambient airstream.

In all cases, the O_2 content of the diluent air must be 20.9 $\pm$0.2%. Gas manufacturers that blend clean dry air do not always adhere to the exact ambient proportions of O_2 and N_2; in these cases, the O_2 content should be verified by paramagnetic response.

7. Sulfur Dioxide Gas Cylinder--A compressed gas cylinder containing 50 to 100 ppm SO_2 in air is used as the dilution source. This cylinder must be traceable to an NIST-SRM (number 1661, 1662, 1663, or 1664).

2.5 Procedure--Equipment setup--Assemble the audit equipment as required, and verify that all equipment is operational. If a dilution air system equipped with a catalytic oxidizer is used, allow the oxidizer to warm up for 30 min. Connect the gas regulator to the SO_2 cylinder, and evacuate the regulator as follows:

1. With the cylinder valve closed, connect a vacuum pump to the evacuation outlet on the regulator and start the pump.
2. Open and close the evacuation port.
3. Open and close the cylinder valve.
4. Open and close the evacuation port.
5. Repeat steps 2 through 4 five more times to be sure all O_2 impurities are removed from the regulator.

If the regulator does not have an evacuation port but has a supported diaphragm, the procedure can be conducted at the gas exit port. For regulators that do not have an evacuation port but have an unsupported diaphragm, use the following procedure:

1. Connect the regulator to the cylinder, and close the gas exit port.
2. Open and close the cylinder valve to pressurize the regulator.
3. Open the gas exit port, and allow the gas to purge the regulator. Repeat steps 2 and 3 five more times; then close the gas exit port, and open the cylinder valve. The regulator should remain under pressure. Connect the gas cylinder to the audit device. Repeat the procedure for each cylinder.

Audit sequence--Before disconnecting the analyzer from the station manifold, mark the data recorder to indicate that an audit is beginning. The auditor's name, start time, date, and auditing organization should be recorded. If it is not possible to record written comments, the start and stop times should be recorded to preclude the use of audit data as monitoring data. After recording these data, disconnect the analyzer sample line from the station manifold, and connect it to the audit manifold, as shown in Figure A.5. Cap the sample port on the station manifold. The audit atmosphere must be introduced through any associated filters or sample pretreatment apparatus to duplicate the path taken by an ambient sample. Record the analyzer type and other identification data on the data form (Table A-3). Conduct the audit by following steps 1 through 5 below.

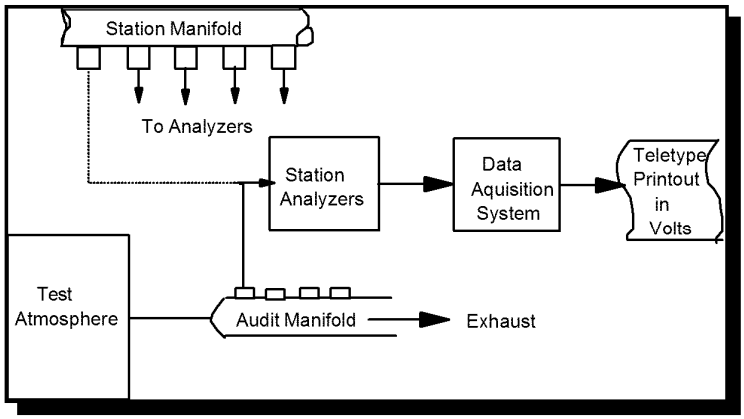


Figure A.5 Schematic configuration utilized in auditing the gas analyzers

1. Introduce into the audit manifold a clean dry air-gas at a flow rate in excess of 10% to 50% of the analyzer sample demand. Allow the analyzer to sample the clean dry air until a stable response is obtained; that is, until the response does not vary more than +2% of the measurement range over a 5-min period. Obtain the station response and concentration from the station operator and record the data in the appropriate blanks on the data form.

Audit point	Concentration range (ppm)
1	0.03-0.08
2	0.15-0.20
3	0.35-0.45
4	0.80-0.90

2. Generate the SLAMS audit concentrations (which are compatible with the analyzer range) as audit atmospheres consistent with the requirements in Appendix A[1].

Generate the audit concentrations by adjusting the pollutant flow rate (Fp) and the total flow rate (Ft) to provide the necessary dilution factor.

Calculate the audit concentration as follows:

$$[SO_2] = \frac{F_P}{F_T} \; x \; [SO_2]_{STD} \qquad \text{Equation 1-3}$$

where:
$[SO_2]$ = audit concentration of SO_2, ppm,
F_P = pollutant flow rate, cm^3/min
F_T =total flow rate, cm^3/ min [equal to the sum of the pollutant flow rate (F_P) and the dilution flow rate (F_D)
$[SO_2]_{STD}$=concentration of the standard cylinder, ppm.

3. Generate the highest audit concentration first, and consecutively generate audit points of decreasing concentration. Allow the analyzer to sample the audit atmosphere until a stable response is obtained. Obtain the station response and concentration from the station operator, and record the data in the appropriate spaces in Table A-3.

4. If desired, additional points at upscale concentrations different from those specified in step 2 may be generated. Generation of these audit concentrations plus a post audit lean dry air response will enhance the statistical significance of the audit data regression analysis.

5. After supplying all audit sample concentrations and recording all data, reconnect the analyzer sample line to the station manifold. Make a notation of the audit stop time. Have the station operator make a note on the data recorder to indicate the stop time, and check all equipment to ensure that it is in order to resume normal monitoring activities.

2.6 Calculations- Record the data in Table A-3 in the appropriate spaces.

% difference--The % difference is calculated as follows.

$$\%\ Difference = \frac{C_M - C_A}{C_A}\ x\ 100 \qquad \text{Equation 1-4}$$

where:
C_M = the station measured concentration, ppm
C_A = the calculated audit concentration, ppm.

Regression analysis--Calculate by the method of least squares the slope, intercept, and correlation coefficient of the station analyzer response data (y) versus the audit concentration data (x). These data can be used to interpret the analyzer performance.

2.7 References

References 4 through 6 and 10 and 11 provide additional information on this SO_2 audit procedure.

Table A-3 SO_2 Audit Data Report

Station _____ Date: _____

Address _____ Start Time:_____

T_A _____ °C; P_A _____ mm Hg; P_{H2O} _____ mm Hg Auditor:_____

Analyzer _____ Serial Number _____

Calibration standard _____ Span source _____

Last calibration date _____ Frequency _____ Range _____

Calibration Comments _____

Zero setting_____ Data acquisition system _____

Span setting _____ Recorder _____

Audit system _____ Bubble flowmeter serial number _____

Audit standard _____; P _____ psig; [ ] = _____ ppm

Clean, dry air _____ Catalytic oxidizer Yes No

Flow correction $\left(\frac{P_A - P_{H_2O}}{760\ mm}\right) x \left(\frac{298\ K}{T_A + 273}\right)$ = _____ = (C_F)

Dilution air flow

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Dilution air response _____ % Chart; _____ V_{DC}; _____ ppm

Other response _____

Audit Point I

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

Audit Point II

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

Audit Point III

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

Audit Point IV

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

Audit Point V

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

Table A-3 continued

Point Number	flow rates		Audit Concentration, ppm	Analyzerresponse		Difference	
	Pollutant cm^3/min	Total cm^3/min		ppm	% MV/chart	Analyzer-audit ppm	%

Regression analysis [audit concentration (x) vs. Analyzer response (y)]

$y = mx + b$

Slope (m) _____

Intercept (b) _____

Correlation (r) _____

Comments:

Auditor_____

Audit Method _____

Zero Setting _____ Span setting _____ Equivalency reference no. _____

Station Calibration source_____

_____

3. Nitrogen Dioxide Audit Procedure Using Gas Phase Titration

3.1 Principle-The auditing procedure is based on the gas phase reaction between NO and O_3

$NO + O_3 \rightarrow NO_2 + O_2$ - Equation 1-5

The generated NO_2 concentration is equal to the NO concentration consumed by the reaction of 0_3 with excess NO. The NO and NO_X channels of the chemiluminescence$_{NOX}$ analyzer are audited with known NO concentrations produced by a dynamic dilution system which uses clean dry air to dilute a gas cylinder containing NO in nitrogen. After completion of the NO-NO_X audits, stoichiometric mixtures of NO_2 in combination with NO are generated by adding 0_3 to known NO concentrations. These audit data are used to evaluate the calibration of the NO-NO_X-NO_2 analyzer channels and to calculate analyzer converter efficiency.

3.2 Applicability-The procedure can be used to supply audit concentrations of NO-NO_2-NO_X in the range of 0.010 to 2.0 ppm.

3.3 Accuracy-The accuracy of the audit procedure should be within $\pm$2.5% if the NO gas cylinder concentration is referenced and if the gas flow rates are determined by using EPA-recommended procedures.

3.4 Apparatus--Audit system

A typical gas phase titration system is illustrated in Figure A.6. All connections and components downstream from the 0_3 generator and the pollutant source must be constructed of nonreactive (glass or Teflon) material. The seven components of the system are discussed below.

1. Flow Controllers--Devices capable of maintaining constant flow rates to within $\pm$2% are required. Suitable flow controllers include brass (for air) or stainless steel (for NO_X) micro metering valves in tandem with a precision regulator, mass flow controllers, capillary restrictors, and porous plug restrictors.

2. Flowmeters--Flowmeters capable of measuring pollutant and diluent gas flow rates to within $\pm$2% are required. NIST-traceable soap bubble flowmeters, calibrated mass flow controllers or mass flowmeters, and calibrated orifice, capillary, and porous plug restrictors are all suitable for flow determination.

3. Gas Cylinder Regulator--A noncorrosive two-stage stainless steel regulator with an evacuation port is suggested.

4. Ozone Generator--An 0_3 generator that produces a stable concentration is required during the gas phase titration sequence of the audit. An ultraviolet lamp generator is recommended.

5. Reaction Chamber--A glass chamber used for the quantitative reaction of 0_3 with NO should have sufficient volume, 100 to 500 cm^3, for the residence time to be $\leq$ 2 min. Elongated glass bulbs such as Kjeldahl connecting flasks are suitable.

6. Mixing Chamber--A glass or Teflon chamber is used to mix the NO, NO_2, or 0_3 with dilution air. The inlet and outlet should be of sufficient diameter so that the chamber is at atmospheric pressure under normal operation, and sufficient turbulence must be created in the chamber to facilitate thorough mixing. Chamber

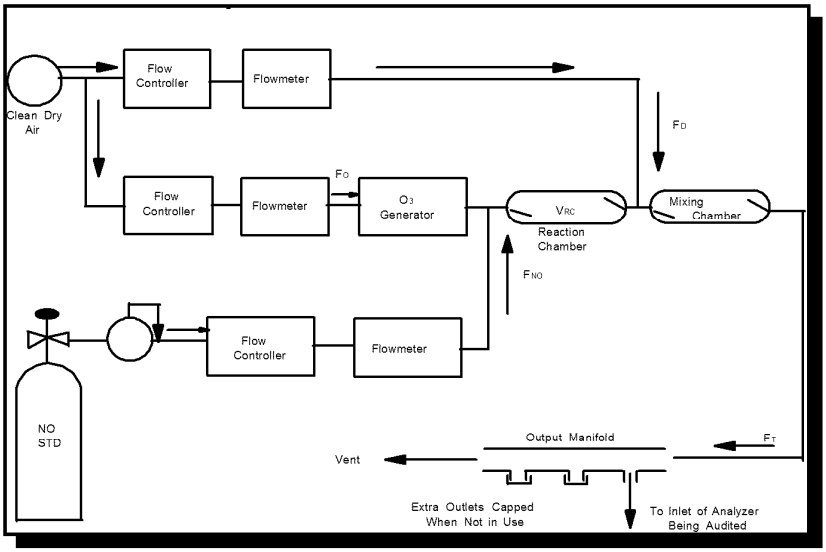


Figure A.6 Schematic diagram of a gas phase titration audit system

volumes in the range of 150 to 250 cm^3 are sufficient. Glass Kjeldahl connecting flasks are suitable mixing chambers.

7. Output Manifold and Sample Line--An output manifold used to supply the analyzer with an audit atmosphere at ambient pressure should be of sufficient diameter to ensure a minimum pressure drop at the analyzer connection, and the manifold must be vented so that ambient air will not mix with the audit atmosphere during system operations. Recommended manifold materials are glass or Teflon. The sample line must be nonreactive and flexible; therefore, Teflon is preferred.

Dilution air system--Clean dry air from a compressed gas cylinder (Grade 0.1) is a suitable source for dilution air; however, if large volumes of clean dry air ($\geq$5 liters/min) are required, purified compressed air is preferred. The clean dry air must be free of contaminants such as NO, $N0_2$, 0_3 or reactive hydrocarbons that would cause detectable responses on the NO_X analyzer or that might react with NO or NO_2 in the audit system. The air can be purified to meet these specifications by passing it through silica gel for drying, by treating it with 0_3 to convert any NO to NO_2, and by passing it through activated charcoal (6-14 mesh) and a molecular sieve (6-16 mesh, type 4A) to remove NO_2, O_3, or hydrocarbons.

Silica gel maintains its drying efficiency until it has absorbed 20% of its weight; it can be regenerated indefinitely at 120 C. Addition of cobalt chloride to the surface of the gel provides a water absorption indicator. A transparent drying column is recommended. The activated charcoal and molecular sieve have a finite absorption capability; because it is difficult to determine when the capability has been exceeded, both should be replaced either before each audit or after 8 hrs of use.

Nitric oxide gas cylinder--A compressed gas cylinder containing 50 to 100 ppm NO in N_2 is used as the NO dilution source. This cylinder must be traceable to an NIST-SRM (number 1683, 1684, 1685, 1686, or 1687).

3.5 Procedure

Equipment setup--Assemble the audit equipment as required, and verify that all equipment is operational. If a clean, dry air system equipped with a catalytic oxidizer and/or O_3 lamp is used, allow the oxidizer and/or O_3 lamp to warm up for 30 minutes. Connect the gas regulator to the NO cylinder, and evacuate the regulator as follows:

1. With the cylinder valve closed, connect a vacuum pump to the evacuation outlet on the regulator, and start the pump.
2. Open and close the evacuation port.

3. Open and close the cylinder
4. Open and close the evacuation port.
5. Repeat steps 2 through 4 five more times to be sure all O_2 impurities are removed from the regulator. If the regulator does not have an evacuation port but has a supported diaphragm, the procedure can be conducted at the gas exit port.

For regulators that do not have an evacuation port but have an unsupported diaphragm, use the following procedure:
1. Connect the regulator to the cylinder, and close the gas exit port.
2. Open and close the cylinder valve to pressurize the regulator.
3. Open the gas exit port, and allow the gas to purge the regulator.
4. Repeat steps 2 and 3 five more times, close the gas exit port, and open the cylinder valve. Connect the dilution air source and NO cylinder to the audit device as shown in Figure A.6. Use 1/8-in. o.d. tubing of minimum length for the connection between the NO cylinder and the audit device.

Dynamic parameter specifications--The flow conditions used in the GPT audit system are selected to assure a complete NO-O_3 reaction. The gas flow rates must be adjusted according to the following relationships:

$$P_R = [NO]_{RC} \; x \; t_R \quad 2.75 \; ppm\text{-min} \qquad \text{Equation 1-6}$$

$$[NO]_{RC} = [NO]_{STD} \; x \; \frac{F_{NO}}{F_O + F_{NO}} \qquad \text{Equation 1-7}$$

$$t_R = \frac{V_{RC}}{F_O + F_{NO}} \quad 2 \text{ min} \qquad \text{Equation 1-8}$$

where:
P_R =dynamic parameter specification, determined empirically, to ensure complete reaction of the available 0_3, ppm-min,
$[NO]_{RC}$ = NO concentration in the reaction chamber, ppm,
t_R = residence time of the reactant gases in the reaction chamber, min,
$[NO]_{STD}$ = concentration of the NO gas cylinder, ppm.
F_{NO} = NO flow rate, standard cm^3/min,
F_O = O_3 generator air flow rate, standard cm^3/min, and
V_{RC} =volume of the reaction chamber, cm^3.

The flow conditions to be used in the GPT audit system are selected according to the following sequence:

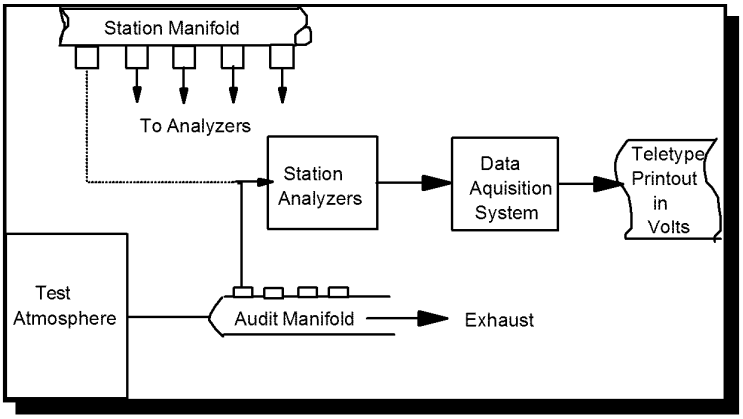


Figure A.7 Schematic of configuration utilized in auditing the gas analyzers

1. Determine F_T, the total flow rate required at the output manifold (F_T = analyzer(s) demand plus 10% to 50% excess).

2. Determine F_{NO}. the flow rate of NO required to generate the lowest NO concentration required at the output manifold during the GPT (approximately 0.15 ppm).

$$F_{NO} = \frac{0.15 \ x \ F_T}{[NO]_{STD}} \qquad \text{Equation 1-9}$$

3. Measure the system's reaction chamber volume; must be in the range of approximately 100 to 500 cm^3.

4. Compute FO.

$$F_O = \sqrt{\frac{[NO]_{STD} \ x \ F_{NO} \ x \ V_{RC}}{2.75}} - F_{NO} \qquad \text{Equation 1-10}$$

5. Compute t_R, using Equation 1-8; verify that $t_R \leq 2$ min.

6. Compute F_D

$$F_D = F_T - F_O - F_{NO} \qquad \text{Equation 1-11}$$

where:
F_D = diluent air flow, standard cm^3/min.

Adjust F_O to the value determined above. F_O should not be further adjusted during the NO-NO_X or NO_2 audit procedures; only F_{NO} (or F_D) and the O_3 generator settings are adjusted during the course of the audit.

Audit sequence--After all the equipment has been assembled and set up, have the station operator mark the strip chart recorder to indicate that the audit is beginning. Information such as the auditors' name, start time, date, and auditing organization should be entered. If it is not possible to enter written comments, the start and stop times should be recorded to preclude the use of audit data as monitoring data. After recording the data, disconnect the analyzer sample line from the station manifold, and connect it to the audit manifold, as shown in Figure A.7. Cap the sample port on the station manifold. The audit atmosphere must be introduced

through any associated filters or sample pretreatment apparatus to duplicate the path taken by an ambient sample. Record the analyzer type and other identification data on the data form (Table A-4).

Conduct the NO-NO_X and NO_2 audits as follows:

NO-NO_X Audit--The NO-NO_X audit involves generating concentrations to challenge the calibration of the NO and NO_X channels of the analyzer. Data collected during this audit are used to construct a calibration curve that will be used later for calculating the NO_2 audit concentrations.

NO-NO_X Audit Procedure--

1. Introduce clean dry air into the audit manifold at a flow rate in excess of 10% to 50% of the analyzer sample demand. Allow the analyzer to sample the clean dry air until a stable response is obtained; that is, until the response does not vary more than $\pm$ 2% of the measurement range over a 5-min period. Record the readings for the NO, NO_X, and NO_2 channels, and have the station operator report the audit responses in concentration units. Record these data and the responses of all three channels in Table A-4.

2. Generate upscale NO audit concentrations corresponding to 10%, 20%, 40%, 60%, and 90% of the full-scale range of the analyzer by adjusting the flow rate of the NO standard. For each audit concentration level generated, calculate the NO concentration

$$[NO] = \frac{F_P}{F_T} \; x \; [NO]_{STD} \qquad \text{Equation 1-12}$$

where
[NO] = NO-NO_X audit concentration, ppm (the NO_2 impurity in the stock standard should be negligible),
F_P = pollutant flow rate, cm^3/min,
F_T = total flow rate, cm^3/min, and
$[NO]_{STD}$ = concentration of the standard cylinder, ppm.

NOTE: Alternatively, the upscale NO audit concentrations may be generated by maintaining a constant pollutant flow rate (F_P) and varying the dilution air flow rate (F_D). In this case, the entries for dilution air flow and pollutant flow in Table A-4 should be reversed and clearly indicated.

3. Generate the lowest audit concentration level first and consecutively generate audit points of increasing concentration. Allow the analyzer to sample the audit atmosphere until a stable response is obtained. Record the audit concentration. Obtain the station response and concentration from the station operator for the NO, NO_X, and NO_2 channels, and record the data in the appropriate spaces in Table A-4.

4. Prepare audit calibration curves for the NO and NO_X channels by using least squares. Include the zero air points. (The audit concentration is the x variable; the analyzer response in % chart is the y variable.) The NO audit calibration curve will be used to determine the actual audit concentrations during the generation of the NO_2 atmospheres.

The NO_X audit calibration curve will be used to determine NO_2 converter efficiency.

NO_2 Audit--The NO_2 audit involves generating NO_2 concentrations in combination with approximately 0.10 ppm of NO to challenge the calibration of the NO_2 channel of the analyzer. The NO_2 audit concentrations are calculated from the responses of the NO channel of the analyzer using the NO audit calibration equation obtained during the NO/NO_X audit.

NO_2 Audit Procedure--

1. Verify that the O_3 generator air flow rate (F_O) is adjusted to the value determined earlier (Dynamic parameter specifications).

2.Generate the SLAMS audit concentrations (which are compatible with the analyzer range) consistent with the Appendix A' requirements.

Audit point	Concentration range (ppm)
1	0.03-0.08
2	0.15-0.45
3	0.35-0.45
4	0.80-0.90

3. Generate an NO concentration which is approximately 0.08 to 0.12 ppm higher than the NO_2 audit concentration level required. Allow the analyzer to sample this concentration until a stable response is obtained; that is, until the response does not vary more than ± 2 % of the measurement range over a 5-minute period. Record the NO and NO_X responses on the data form. Calculate and record $[NO]_{ORIG}$ and $[NO_X]_{ORIG}$ using the NO and NO_X audit calibration equations derived during the $NO\text{-}NO_X$ audit.

4. Adjust the 0_3 generator to generate sufficient 0_3 to produce a decrease in the NO concentration equivalent to the NO_2 audit concentration level required. After the analyzer response stabilizes, record the NO and NO_X responses on the data form. Calculate and record $[NO]_{REM}$ and $[NO_X]_{REM}$ using the NO and NO_X audit calibration equations derived during the $NO\text{-}NO_X$ audit. (Note: $[NO]_{REM}$ should be approximately 0.08 to 0.12 ppm for each audit point).

5. Calculate and record the NO_2 audit concentration $[NO_2]_A$.

$$[NO_2]_A = [NO]_{ORIG} - [NO]_{REM} \qquad \text{Equation 1-13}$$

6. Obtain the NO_2 station response and concentration from the station operator and record on the data form.

7. Generate the highest audit concentration level first, and consecutively generate audit points of decreasing NO_2 concentration. Allow the analyzer to sample the audit atmospheres until stable responses are obtained. Obtain the necessary data and record in the appropriate spaces in Table A-4.

8. If desired, additional points at upscale concentrations different from those specified in step 2, may be generated. These additional audit points plus the zero air point (obtained at the start of the audit) will enhance the statistical significance of the audit data regression analysis.

9. After supplying all audit sample concentrations and recording all data, reconnect the analyzer sample line to the station manifold. Make a notation of the audit stop time. Have the station operator make a note on the data recorder to indicate the stop time, and check all equipment to ensure that it is in order to resume normal monitoring activities.

Converter efficiency--$[NO_2]_{CONV}$ is calculated for each audit point using Equation 1-14 and is used to determine the NO_X analyzer converter efficiency using Equation 1-15. $[NO_X]_{ORIG}$ and $[NO_X]_{REM}$ are calculated from the NO_X audit calibration equation.

$$[NO_2]_{CONV} = [NO_2]_A - [NO_X]_{ORIG} - [NO_X]_{REM} \qquad \text{Equation 1-14}$$

$$\text{\% converter efficiency} = \frac{[NO_2]_{CONV}}{[NO_2]_A} \; x \; 100 \qquad \text{Equation 1-15}$$

3.6 Calculations-Record the audit data in the appropriate spaces of Table A-4.

Percent difference--The % difference is calculated as follows:

$$\%\ difference = \frac{C_M - C_A}{C_A} \; x \; 100 \qquad \text{Equation 1-16}$$

where:
C_M = station-measured concentration, ppm, and
C_A = calculated audit concentration, ppm

Regression analysis--Calculate by least squares the slope, intercept and correlation coefficient of the station analyzer response data (y) versus the audit concentration data These data can be used to interpret analyzer performance.

3.7 Reference- References 4 through 6, 8, 10, and 12 provide additional information on the NO_2 audit procedure.

Table A-4 Gas Phase Audit Data Report

Station _____ Date: _____

Address _____ Start Time:_____

T_A _____ °C; P_A _____ mm Hg; P_{H2O} _____ mm Hg Auditor:_____

Analyzer _____ Serial Number _____

Calibration standard _____ Span source _____

Last calibration date _____ Frequency _____ Range _____

Calibration Comments _____

Flow settings _____

Zero setting NO_____ NO_X_____ NO_2_____

Span setting NO_____ NO_X_____ NO_2_____

Other settings _____

Audit system _____ Bubble flowmeter serial number _____

Audit standard _____; P _____ psig; [ ] = _____ ppm

Clean, dry air _____

Flow correction $\left(\frac{P_A - P_{H_2O}}{760\ mm}\right) x \left(\frac{298\ K}{T_A + 273}\right)$ = _____ = $\overline{F}^{(C)}$

Dilution air flow

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Ozone generator flow

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Analyzer response clean dry air

	% Chart	Vdc	( )	ppm
NO	_____	_____	_____	_____
NO_X	_____	_____	_____	_____
NO_2	_____	_____	_____	_____

Table A-4 continued

Part 1 NO-NO_X AUDIT

NO-NO_X Audit point I (10%)

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

NO, NO_X audit concentration _____ ppm

Analyzer response

	% Chart	Vdc	( )	ppm
NO	_____	_____	_____	_____
NO_X	_____	_____	_____	_____
NO_2	_____	_____	_____	_____

NO-NO_X Audit point II (20%)

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

NO, NO_X audit concentration _____ ppm

Analyzer response

	% Chart	Vdc	( )	ppm
NO	_____	_____	_____	_____
NO_X	_____	_____	_____	_____
NO_2	_____	_____	_____	_____

NO-NO_X Audit point I (40%)

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

NO, NO_X audit concentration _____ ppm

Analyzer response

	% Chart	Vdc	( )	ppm
NO	_____	_____	_____	_____
NO_X	_____	_____	_____	_____
NO_2	_____	_____	_____	_____

Table A-4 continued
$NO\text{-}NO_X$ Audit point II (60%)

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

NO, NO_X audit concentration _____ ppm

Analyzer response

	% Chart	Vdc	( )	ppm
NO	_____	_____	_____	_____
NO_X	_____	_____	_____	_____
NO_2	_____	_____	_____	_____

$NO\text{-}NO_X$ Audit point II (90%)

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

NO, NO_X audit concentration _____ ppm

Analyzer response

	% Chart	Vdc	( )	ppm
NO	_____	_____	_____	_____
NO_X	_____	_____	_____	_____
NO_2	_____	_____	_____	_____

$NO\text{-}NO_X$ audit calibration equation ($y = mx + b$)

NO audit concentration (x)
vs. Analyzer response in
% chart (y)

Slope (m) = _____

Intercept (b) = _____

Correlation (r) =_____

NO audit concentration (x)
vs. Analyzer response in
% chart (y)

Slope (m) = _____

Intercept (b) = _____

Correlation (r) =_____

Table A-4 continued
Part II NO_2 Audit

NO_2 Audit Point I

Analyzer response

	% Chart	V_{DC}	( )	[ ]*	ORIG
NO	_____	_____	_____	_____	ppm
NO_X	_____	_____	_____	_____	ppm

O_3 generator setting = _____

	% Chart	V_{DC}	( )	[ ]*	ORIG
NO	_____	_____	_____	_____	ppm
NO_X	_____	_____	_____	_____	ppm

$[NO_2]_A = [NO]^*_{ORIG} - [NO]^*_{REM} =$ _____ *ppm*

	% Chart	V_{DC}	( )	ppm	
NO_2	_____	_____	_____	_____	ppm

NO_2 Audit Point II

Analyzer response

	% Chart	V_{DC}	( )	[ ]*	ORIG
NO	_____	_____	_____	_____	ppm
NO_X	_____	_____	_____	_____	ppm

O_3 generator setting = _____

	% Chart	V_{DC}	( )	[ ]*	ORIG
NO	_____	_____	_____	_____	ppm
NO_X	_____	_____	_____	_____	ppm

$[NO_2]_A = [NO]^*_{ORIG} - [NO]^*_{REM} =$ _____ *ppm*

	% Chart	V_{DC}	( )	ppm	
NO_2	_____	_____	_____	_____	ppm

NO_2 Audit Point III

Analyzer response

	% Chart	V_{DC}	( )	[ ]*	ORIG
NO	_____	_____	_____	_____	ppm
NO_X	_____	_____	_____	_____	ppm

O_3 generator setting = _____

	% Chart	V_{DC}	( )	[ ]*	ORIG
NO	_____	_____	_____	_____	ppm
NO_X	_____	_____	_____	_____	ppm

$[NO_2]_A = [NO]^*_{ORIG} - [NO]^*_{REM} =$ _____ *ppm*

	% Chart	V_{DC}	( )	ppm	
NO_2	_____	_____	_____	_____	ppm

Table A-4 continued

NO_2 Audit Point IV

		% Chart	V_{DC}	( )	[ ]*	ORIG
Analyzer response	NO	_____	_____	_____	_____	ppm
	NO_X	_____	_____	_____	_____	ppm

O_3 generator setting = _____

	% Chart	V_{DC}	( )	[ ]*	ORIG
NO	_____	_____	_____	_____	ppm
NO_X	_____	_____	_____	_____	ppm

$[NO_2]_A = [NO]^*_{ORIG} - [NO]^*_{REM} =$ _____ *ppm*

	% Chart	V_{DC}	( )	ppm	
NO_2	_____	_____	_____	_____	ppm

NO_2 Audit Point V

		% Chart	V_{DC}	( )	[ ]*	ORIG
Analyzer response	NO	_____	_____	_____	_____	ppm
	NO_X	_____	_____	_____	_____	ppm

O_3 generator setting = _____

	% Chart	V_{DC}	( )	[ ]*	ORIG
NO	_____	_____	_____	_____	ppm
NO_X	_____	_____	_____	_____	ppm

$[NO_2]_A = [NO]^*_{ORIG} - [NO]^*_{REM} =$ _____ *ppm*

	% Chart	V_{DC}	( )	ppm	
NO_2	_____	_____	_____	_____	ppm

* Calculated concentration from NO or NO_X audit calibration equation *(y = mx + b)*

Part III Data Tabulation

NO Channel

Point	Audit Conc. ppm	Analyzer-NO		Difference	
		Concentration ppm	Response	Analyzer-audit ppm	%
Zero					
10%					
20%					
40%					
60%					
90%					

Analyzer response (ppm) = m (audit) + b
Slope (m)= _____; Intercept (b) = _____; Correlation (r) = _____

Table A-4 continued
NO_X Channel

Point	Audit Conc. ppm NO NO_2 NO_XTotal	Analyzer-NO_X		Difference	
		Concentration ppm	Response	Analyzer-audit ppm	%
Zero					
10%					
20%					
40%					
60%					
90%					

Analyzer response (ppm) = m (audit) + b

Slope (m)= _____; Intercept (b) = _____; Correlation (r) = _____

NO_2 Channel

Point	Audit Conc. ppm	Analyzer-NO_2		Difference	
		Concentration ppm	Response	Analyzer-audit ppm	%
Zero					
1					
2					
3					
4					
5					

Analyzer response (ppm) = m (audit) + b

Slope (m)= _____; Intercept (b) = _____; Correlation (r) = _____

Converter efficiency

Point Number	$[NO_2]_A$, ppm	$[NO_2]_{CONV}$, ppm	Percent converter efficiency
1			
2			
3			
4			
5			

4. Carbon Monoxide Audit Procedure Using Dynamic Dilution of a Gas Cylinder

4.1 Principle--A dynamic calibration system used to generate CO concentrations for auditing continuous ambient analyzers, consists of diluting a CO gas cylinder with clean dry air.

4.2 Applicability-Dynamic dilution can be used to audit all types of CO analyzers; CO concentrations in the range of 0 to 100 ppm can be generated.

4.3 Accuracy-The accuracy of the audit procedure should be within ±2.5% if the CO gas cylinder concentration is referenced and if gas flow rates are determined using recommended procedures.

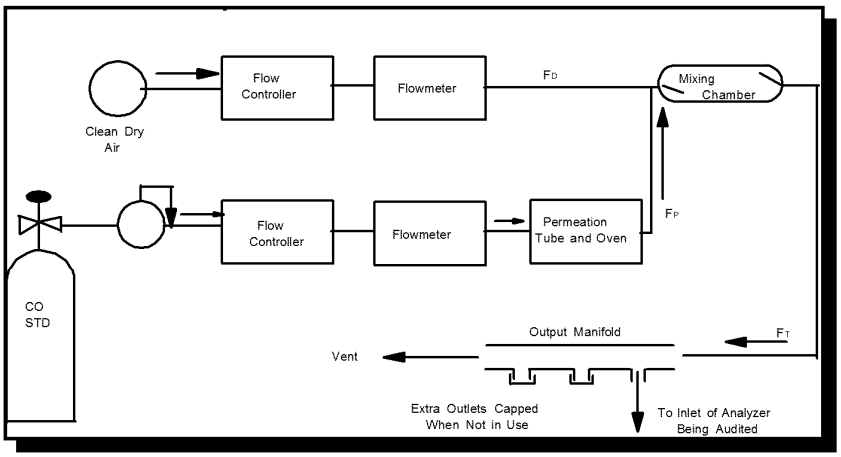


Figure A.8 Schematic diagram of a dilution audit system

4.4 Apparatus-An audit system which uses a dynamic dilution device to generate audit concentrations is illustrated in Figure A.8. The seven components of the system are discussed below.

1. Gas cylinder regulator. A brass regulator is acceptable. A low dead space, two-stage regulator should be used to achieve rapid equilibration.

2. Flow controllers. Devices capable of maintaining constant flow rates to within ±2% are required. Suitable flow controllers include brass micro metering valves in tandem with a precision regulator, mass flow controllers, capillary restrictors, and porous plug restrictors.

3. Flowmeters. Flowmeters capable of measuring pollutant and diluent gas flow rates to within ±2% are required. NIST-traceable soap bubble flowmeters, calibrated mass flow controllers mass flowmeters, and calibrated orifice, capillary, and porous plug restrictors are suitable.

4. Mixing chamber. A glass or Teflon chamber is used to mix the CO with dilution air. The inlet and outlet should be of sufficient diameter so that the chamber is at atmospheric pressure under normal operation, and sufficient turbulence must be created in the chamber to facilitate thorough mixing. Chamber volumes in the range of 100 to 250 cm^3 are sufficient. Glass Kjeldahl connecting flasks are suitable mixing chambers.

5. Output manifold and sample line. An output manifold used to supply the analyzer with an audit atmosphere at ambient pressure should be of sufficient diameter to ensure a minimum pressure drop at the analyzer connection, and the manifold must be vented so that ambient air will not mix with the audit atmosphere during system operations. Recommended manifold materials are glass or Teflon. The sample line must be nonreactive and flexible; therefore, Teflon tubing is preferred .

6. Dilution air source. The diluent source must be free of CO and water vapor. Clean dry air from a compressed gas cylinder is suitable choices for dilution air. A catalytic oxidizer connected in line is one method of scrubbing CO from the dilution air.

7. CO gas cylinder. A compressed gas cylinder containing 100 to 200 ppm CO in an air or N_2 matrix is used as the CO dilution source. If the CO standard is contained in a N_2 matrix the zero air dilution ratio cannot be less than 100:1. This cylinder must be traceable to an NIST-SRM (number 1677, 1678 1679, 1680, or 1681).

4.5 Procedure

Equipment setup- Assemble the audit equipment as required, and verify that all the equipment is operational. If a clean dry air system equipped with a catalytic oxidizer is used, allow the oxidizer to warm up for 30 min. Connect the gas regulator to the CO cylinder, and evacuate the regulator as follows:

1. With the cylinder valve closed connect a vacuum pump to the evacuation outlet on the regulator, and start the pump.
2. Open and close the evacuation port.
3. Open and close the cylinder valve.
4. Open and close the evacuation port.
5. Repeat steps 2 through 4 five more times to be sure all 2 impurities are removed from the regulator. If the regulator does not have an evacuation port but has a supported diaphragm, the procedure can be conducted at the gas exit port..

For regulators that do not have an evacuation port but have an unsupported diaphragm, use the following procedure:

1. Connect the regulator to the cylinder, and close the gas exit port.
2. Open and close the cylinder valve to pressurize the regulator.
3. Open the gas exit port, and allow the gas to purge the regulator.
4. Repeat steps 2 and 3 five more times; then close the gas exit port, and open the cylinder valve. The regulator should remain under pressure. Connect the gas cylinder to the audit device. Repeat the procedure for each cylinder.

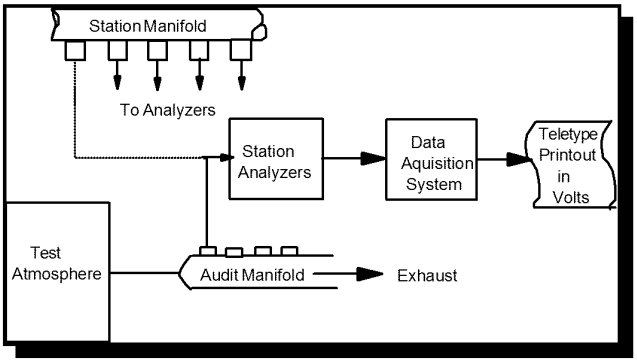


Figure A.9 Schematic of configuration utilized in auditing the gas analyzers

Audit sequence-After all the equipment has been assembled and set up, have the station operator mark the strip chart recorder to indicate that an audit is beginning. Information such as the auditor's name start time, date, and auditing organization should be entered. If it is not possible to enter written comments, the start and stop times should be recorded to preclude the use of audit data as monitoring data. After recording the data, disconnect the analyzer sample line from the station manifold, and connect it to the audit manifold, as shown in Figure A.9. Cap the sample port on the station manifold. The

audit atmosphere must be introduced through any associated filters or sample pretreatment apparatus to duplicate the path taken by an ambient sample. Record the analyzer type and other identification data on the data form (Table A-5). Conduct the audit as follows:

1. Introduce into the audit manifold a clean dry air at a flow rate in excess of 10% to 50% of the analyzer sample demand. Allow the analyzer to sample the clean dry air until a stable response is obtained; that is, until the response does not vary more than ± 2% of the measurement range over a 5-min period. Obtain the station response and concentration from the station operator, and record the data in the appropriate spaces on the data form.

Audit point	Concentration Range (ppm)
1	3-8
2	15-20
3	35-45
4	80-90

2. Generate the SLAMS audit concentrations (which are compatible with the analyzer range) as audit atmospheres consistent with the Appendix A[1] requirements.

Generate the audit concentrations by adjusting the pollutant flow rate (F_P) and the total flow rate (F_T) to provide the necessary dilution factor. Calculate the audit concentration as follows:

$$[CO] = \frac{F_P}{F_T} \; x \; [CO]_{STD} \qquad \text{Equation 1-17}$$

where:
[CO] = audit concentration of CO, ppm
F_P = pollutant flow rate, cm^3/ min
F_T = total flow rate, cm^3/min [equal to the sum of the pollutant flow rate (F_P) and the dilution flow rate (F_D)], and
$[CO]_{STD}$ = concentration of the standard cylinder, ppm.

3. Generate the highest audit concentration level first. and consecutively generate audit points of decreasing concentrations. Allow the analyzer to sample the audit atmosphere until a stable response is obtained. Obtain the station response and concentration from the station operator, and record the data in appropriate spaces in Table A-5.

4. If desired, additional points at upscale concentrations different from those specified in step 2 may be generated. Generation of these audit concentrations plus a post audit clean dry air response will enhance the statistical significance of the audit data regression analysis

5. After supplying all audit sample concentrations and recording all data, reconnect the analyzer sample line to the station manifold. Make a notation of the audit stop time. Have the station operator make a note on the data recorder to indicate the stop time, and check all equipment to ensure that it is in order to resume normal monitoring activities.

4.6 Calculations-Record the audit data in the appropriate spaces of Table A-4.

Percent difference--The % difference is calculated as follows

$$\%\ difference = \frac{C_M - C_A}{C_A}\ x\ 100 \qquad \text{Equation 1-18}$$

where
C_M = station-measured concentration, ppm, and
C_A = calculated audit concentration, ppm

Regression analysis--Calculate by least squares the slope, intercept and correlation coefficient of the station analyzer response data (y) versus the audit concentration data These data can be used to interpret analyzer performance.

4.7 Reference- References 4 through , 10, and 13 provide additional information on the CO audit procedure.

Table A-5 Carbon Monoxide Audit Data Report

Station _____ Date: _____

Address _____ Start Time:_____

T_A _____ °C; P_A _____ mm Hg; P_{H2O} _____ mm Hg Auditor:_____

Analyzer _____ Serial Number _____

Calibration standard _____ Span source _____

Last calibration date _____ Frequency _____ Range _____

Calibration Comments _____

Zero setting_____ Data acquisition system _____

Span setting _____ Recorder _____

Audit system _____ Bubble flowmeter serial number _____

Audit standard _____; P _____ psig; [ ] = _____ ppm

Clean, dry air _____ Catalytic oxidizer Yes No

Flow correction $\left(\frac{P_A - P_{H_2O}}{760\ mm}\right) x \left(\frac{298\ K}{T_A + 273}\right)$ = _____ = (C_F)

Dilution air flow

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Clean dry air response _____ % Chart; _____ V_{DC}; _____ ppm

Other response _____

Audit Point I

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

Table A-5 continued

Audit Point II

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

Audit Point III

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

Audit Point VI

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

Audit Point V

Pollutant flow measurement

Volume _____ cm^3 Flowmeter _____

T1_____

T2_____ $\overline{T}$ _____ min $(C_F)\left(\frac{Volume}{\overline{T}}\right)$ = _____cm3/min

T3_____

Audit concentration _____ ppm

Analyzer response _____ % Chart; _____ V_{DC}; _____ ppm

Other response_____

TableA-5 continued

Part 1

Location _____ Date _____

Analyzer/model number _____

Serial number _____ Pollutant cylinder no. _____

Auditor _____ Pollutant cylinder concentration _____

Start time _____ Stop time _____

Zero setting _____ Span setting _____ Time constant _____

Part II

Point Number	F_p, cm^3/min	F_r, cm^3/min	Audit Concentration ppm	Analyzer response	Analyzer concentration, ppm	% difference
Zero		Zero				
1						
2						
3						
4						
5						

Part III REGRESSION ANALYSIS

Analyzer response (ppm) = m (audit) + b

Slope (m) =_____ ; Intercept (b) _____; Correlation (r) = _____

Comments:

_____

5. Carbon Monoxide Audit Procedure Using Multiple Concentration Gas Cylinders

5.1 Principle-Separate compressed gas cylinders which contain various CO concentrations are supplied in excess to a vented manifold; the analyzer which is being audited samples each concentration until a stable response results.

5.2 Applicability- The procedure can be used to audit all types of CO analyzers. Concentrations of CO in the range of 0 to 100 ppm can be generated.

5.3 Accuracy-The accuracy of the audit procedure should be within ±2.5% if the CO gas cylinder concentration is referenced and if gas flow rates are determined using recommended procedures.

5.4 Apparatus-A system used to generate audit concentrations is illustrated in Figure A.10. The ***six*** components of the system are discussed below.

1. Gas cylinder regulator. A brass regulator is acceptable. A low dead space, two-stage regulator should be used to achieve rapid equilibration.

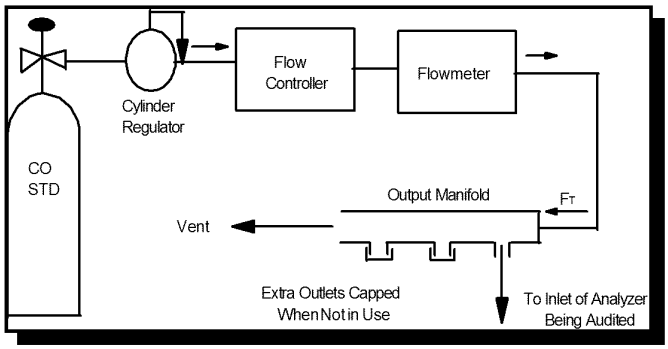


Figure A.10 Schematic diagram of a dynamic audit system

2. Flow controllers. Devices capable of maintaining constant flow rates to within ±2% are required. Suitable flow controllers include brass micro metering valves in tandem with a precision regulator, mass flow controllers, capillary restrictors, and porous plug restrictors.

3. Flowmeters. Flowmeters capable of measuring pollutant and diluent gas flow rates to within ±2% are required. NIST-traceable soap bubble flowmeters, calibrated mass flow controllers mass flowmeters, and calibrated orifice, capillary, and porous plug restrictors are suitable.

4. Output manifold and sample line. An output manifold used to supply the analyzer with an audit atmosphere at ambient pressure should be of sufficient diameter to ensure a minimum pressure drop at the analyzer connection, and the manifold must be vented so that ambient air will not mix with the audit atmosphere during system operations. Recommended manifold materials are glass or Teflon. The sample line must be nonreactive and flexible; therefore, Teflon tubing is preferred .

5. CO gas cylinder. A compressed gas cylinder containing CO in an air matrix is used as the audit gas. These cylinders must be traceable to an NIST-SRM (number 1677, 1678 1679, 1680, or 1681), and must be within the following concentration ranges: 3 to 8 ppm, 15 to 20 ppm, 35 to 45 ppm, and 80 to 90 ppm.

6. Dilution air source. The diluent source must be free of CO and water vapor. Clean dry air from a compressed gas cylinder is suitable choices for dilution air. A catalytic oxidizer connected in line is one method of scrubbing CO from the dilution air.

5.5 Procedure

Equipment setup- Assemble the audit equipment as required and verify that all the equipment is operational. If a clean dry air system equipped with a catalytic oxidizer is used for a zero air source, allow the oxidizer to warm up for 30 min. Connect the gas regulator to a CO cylinder, and evacuate the regulator as follows:

1. With the cylinder valve closed, connect a vacuum pump to the evacuation outlet on the regulator and start the pump.
2. Open and close the evacuation port.
3. Open and close the cylinder valve.
4. Open and close the evacuation port.
5. Repeat steps 2 through 4 five more times to be sure all O_2 impurities are removed from the regulator. If the regulator does not have an evacuation port but has a supported diaphragm, the procedure can be conducted at the gas exit port.

For regulators that do not have an evacuation port but have an unsupported diaphragm, use the following procedure:

1. Connect the regulator to the cylinder, and close the gas exit port.
2. Open and close the cylinder valve to pressurize the regulator.
3. Open the gas exit port, and -allow the gas to purge the regulator.
4. Repeat steps 2 and 3 five more times; then close the gas exit port, and open the cylinder valve. (The regulator should remain under pressure.) Connect the gas cylinder to the audit device.

Repeat the procedure for each cylinder.

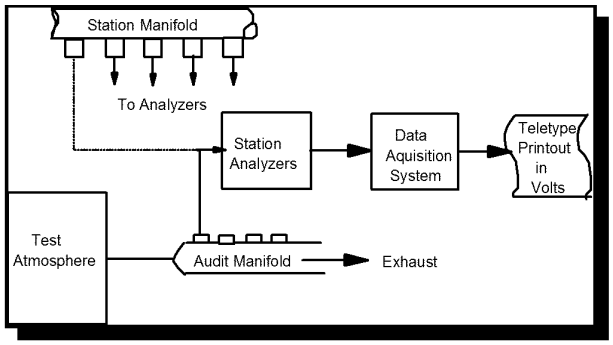


Figure A.11 Schematic of configuration in auditing the gas analyzers

Audit sequence--After all the equipment has been assembled and set up, have the station operator mark the strip chart recorder to indicate that an audit is beginning. Information such as the auditor's name, start time, date, and auditing organization should be entered. If it is not possible to enter written comments, the Start and stop times should be recorded to preclude the use of audit data as monitoring data. After recording the data, disconnect the analyzer sample line from the station manifold, and connect it to the audit manifold, as shown in Figure A.11. Cap the sample port on the station manifold. The audit atmosphere must be introduced through any associated filters or sample pretreatment apparatus to duplicate the path taken by an ambient sample. Record the analyzer type and other identification data on the data form (Table A-6).

Conduct the audit as follows:

1. Introduce into the audit manifold a zero air gas at a flow rate in excess of 10% to 50% of the analyzer sample demand. Allow the analyzer to sample the zero air until a stable response is obtained; that is, until

the response does not vary more than +2% of the measurement range over a 5-min period. Obtain the station response and concentration from the station operator, and record the data in the appropriate spaces on the data form.

2. Generate the SLAMS audit concentrations (which are compatible with the analyzer range) as audit atmospheres consistent with the Appendix A[1] requirements.

Audit point	Concentration range, (ppm)
1	3-8
2	15-20
3	35-45
4	80-90

3. Generate the highest audit concentration level first, and consecutively generate decreasing concentrations. The audit concentration equals the CO gas cylinder concentration.

4. If desired, additional points at upscale concentrations different from those specified in step 2 may be generated. Generation of these audit concentrations plus a post audit clean dry air response will enhance the statistical significance of the audit data regression analysis.

5. After supplying all audit concentrations and recording all data, reconnect the analyzer sample line to the station manifold. Make a notation of the audit stop time. Have the station operator make a note on the data recorder to indicate the stop time, and check all equipment to ensure that it is in order to resume normal monitoring activities.

5.6 Calculations-Record the audit data in the appropriate spaces of Table A-4.

Percent difference--The % difference is calculated as follows:

$$\%\ difference = \frac{C_M - C_A}{C_A}\ x\ 100 \qquad \text{Equation 1-19}$$

where:
C_M = station-measured concentration, ppm, and
C_A = calculated audit concentration, ppm

Regression analysis--Calculate by least squares the slope, intercept and correlation coefficient of the station analyzer response data (y) versus the audit concentration data These data can be used to interpret analyzer performance.

5.7 References-References 4 through 6, 10, and 13 provide additional information on the CO audit procedure.

Table A-6 Carbon Monoxide Audit Data Report

Part 1

Location _____ Date _____

Analyzer/model number _____

Serial number _____ Pollutant cylinder no. _____

Auditor _____ Pollutant cylinder concentration _____

Start time _____ Stop time _____

Zero setting _____ Span setting _____ Time constant _____

Part II

Point Number	Audit cylinder number	NIST reference conc. ppm	Analyzer response	Analyzer concentration , ppm	% difference
Zero	Zero				
1					
2					
3					
4					
5					

Part III REGRESSION ANALYSIS

Analyzer response (ppm) = m (audit) + b

Slope (m) =_____ ; Intercept (b) _____; Correlation (r) = _____

Comments:

_____

6. Ozone Audit Procedure Using Ultraviolet Photometry

6.1 Principle- O_3 concentrations are generated by using a UV generator (transfer standard), and each atmosphere is verified by using UV photometry. The UV photometry procedure for O_3 audits is based on the Lambert-Beer absorption law:

$$Transmittance = \frac{I}{I_O} = e^{-acl} \qquad \text{Equation 1-20}$$

where:
a= the absorption coefficient of O_3 at 254 nm = 308 $\pm$ 4atm^{-1} cm^{-1} at 0° C and 760 torr,
c= the O_3 concentration, atm and
l= the optical path length, cm.

6.2 Applicability- The procedure can be used to audit all types of commercially available O_3 analyzers which operate in a range of 0 to 1ppm

6.3 Accuracy- The accuracy of the audit procedure should be within $\pm$ 2.5% if the O_3 source is a photometer or transfer standard, and flow rates are determined to using EPA-recommended procedures.

6.4 Apparatus- An UV photometric system which is used for auditing O_3 analyzers is illustrated in Figure A.12. The system consists of an O_3 source and a standard UV photometer. Components of the system are discussed below.

1. Ozone generator. An O_3 generator that produces a stable O_3 concentration is required. An UV lamp generator is recommended.

2. Flow controllers. Devices capable of maintaining constant flow rates to within $\pm$2% are required. Suitable flow controllers include brass micro metering valves in tandem with a precision regulator, mass flow controllers, capillary restrictors, and porous plug restrictors.

3. Flowmeters. Flowmeters capable of measuring pollutant and diluent gas flow rates to within $\pm$2% are required. NIST-traceable soap bubble flowmeters, calibrated mass flow controllers mass flowmeters, and calibrated orifice, capillary, and porous plug restrictors are suitable

4. Mixing chamber. A glass or Teflon chamber is used to mix the O_3 with dilution air. The inlet and outlet should be of sufficient diameter so that the chamber is at atmospheric pressure under normal operation, and sufficient turbulence must be created in the chamber to facilitate thorough mixing. Chamber volumes in the range of 100 to 500 cm^3 are sufficient. Glass Kjeldahl connecting flasks are suitable mixing chambers.

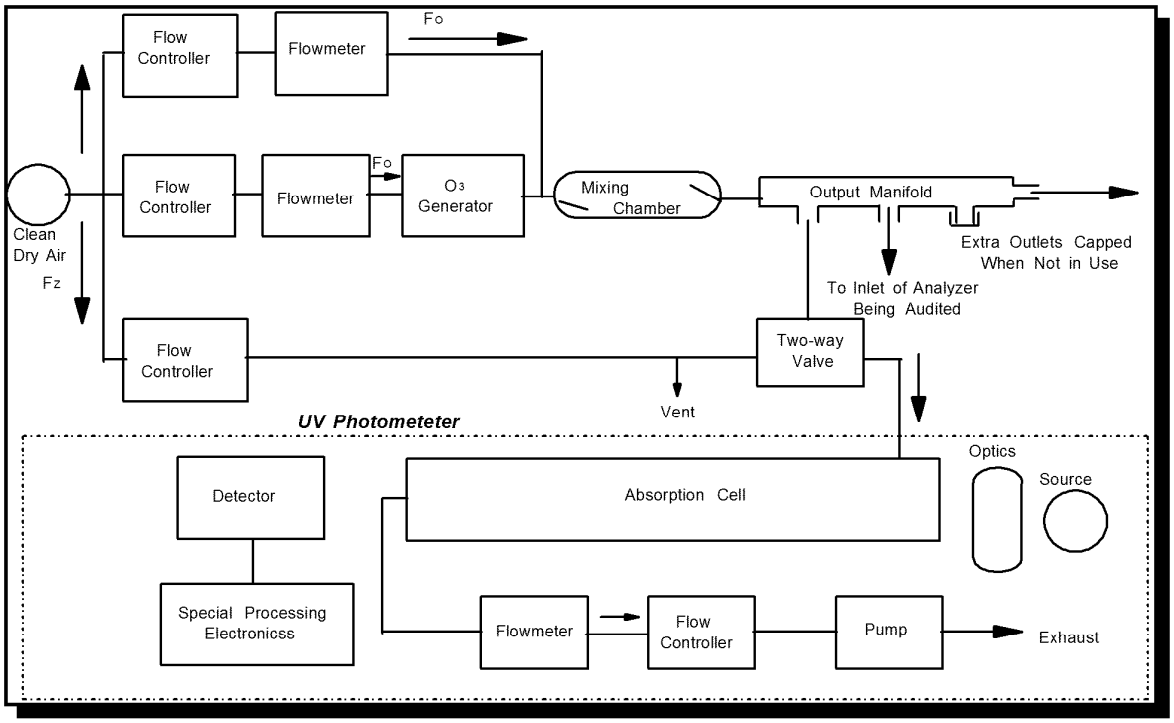


Figure A.12 Schematic diagram of an ultraviolet photometric audit system

5. Output manifold. An output manifold used to supply the analyzer with an audit atmosphere at ambient pressure. The manifold should be of sufficient diameter to ensure minimum pressure drop at the output ports, and the manifold must be vented so that ambient air will not mix with the audit atmosphere during system operations. Recommended manifold materials are glass or Teflon.

6. Sample line and connecting lines. The sample lines and connecting lines downstream of the O_3 generator must be made of non-reactive material such as Teflon.

7. Dilution air system. Clean dry air from a compressed gas cylinder (Grade 0.1) is a suitable source of dilution air; however, if large volumes of air (5 liters/min or greater) are required, purified compressed air is preferred. The clean dry air must be free of contaminants, such as such as NO, $N0_2$, 0_3 or reactive hydrocarbons that would cause detectable responses on the NO_X analyzer or that might react with NO or NO_2 in the audit system. The air can be purified to meet these specifications by passing it through silica gel for drying, by treating it with 0_3 to convert any NO to NO_2, and by passing it through activated charcoal (6-14 mesh) and a molecular sieve (6-16 mesh, type 4A) to remove NO_2, O_3, or hydrocarbons.

Silica gel maintains its drying efficiency until it has absorbed 20% of its weight; it can be regenerated in-definitely at 120 C. Addition of cobalt chloride to the surface of the gel provides a water absorption indicator. A transparent drying column is recommended. The activated charcoal and molecular sieve have a finite absorption capability; because it is difficult to determine when the capability has been exceeded, both should be replaced either before each audit or after 8 hrs of use.

8. Ultraviolet photometer- The UV photometer consists of a low-pressure mercury discharge lamp, collimator optics, an absorption cell, a detector, and signal-processing electronics. as illustrated in Figure A.12. The photometer must be capable of measuring the transmittance, I/I_O, at a wavelength of 254 NM with sufficient precision for the standard deviation of concentration measurements not to exceed the greater of 0.005ppm or 3% of the concentration. Because the low pressure mercury lamp radiates at several wavelengths, the photometer must incorporate suitable means to be sure that no O_3 is generated in the cell by the lamp and at least 99.5% of the radiation sensed by the detector is 254-nm radiation. This goal can be achieved by prudent selection of the optical filter and detector response characteristics. The length of the light path through the absorption cell must be known with an accuracy of at least 99.5% In addition, the cell and associated plumbing O_3 from contact with cell walls and gas handling components.

9. Barometer. A barometer with an accuracy of $\pm$ torr is required to determine the absolute cell pressure.

10. Temperature indicator. A temperature indicator accurate to $\pm$ 1° C is required to determine cell temperature.

6.5 Procedure

Equipment setup- Assemble the audit equipment according to figure A.12. Allow the photometer and O_3 generator to warm up for approximately 1 h or until the normal operating cell temperature, 6° to 8° C above ambient, is attained.

Photometer adjustment (Dasibi)- Several checks are made after the photometer has reached normal operating temperature.

1. Switch the photometer to sampling frequency. Using Table A-7, record and calculate the mean of five consecutive readouts. The mean sample frequency should be between 45.0 and 49.0.
2. Switch the photometer to control frequency. Using table A-7, record and calculate the mean of five consecutive readouts. the mean control frequency should be between 23.0 and 28.0
3. Switch the photometer to span. Record this span number and calculate the new span number as follows.

$$Span\ number = 45.684\ x \left(\frac{760}{P_b}\right) x \left(\frac{T_c + 273.16}{273.16}\right) \qquad \text{Equation 1-21}$$

where:
P_b = barometric pressure, mm Hg, and
T_c= cell temperature ,° C.

Dial in the new span number on the photometer, and display the correct entry.

4. Switch the selector to the operate position, and adjust the flowmeter to 2 l/min. Using the offset adjust control on the front panel of the photometer, set the instrument to read between 0.005 and 0,010 while sampling clean dry air.

5. Determine the true zero display reading by recording 10 consecutive display updates from the panel meter. Calculate the mean of these 10 readings.

Audit sequence-Adjust the clean dry airflow rate through the O_3 generator to meet the range specifications. of the station analyzer and the O_3 output capability of the generator. Adjust the dilution clean dry air flow rate pf 10 to 50% of the station analyzer and photometer sample demand is generated. Mark the data acquisition system to indicate that an audit is beginning, and disconnect the sample line from the station manifold. Plug the disconnected sample port to the station manifold.

2. Connect the audit analyzer and photometer to the output manifold as shown in Figure A.12. Allow the station analyzer and photometer to sample the clean dry air until the station response is obtained; That is, until the response does not vary by more then $\pm$ 2% of the measurement range over a 5-min period. Obtain the analyzer response from the station operator, and record the data and the photometer response in the appropriate spaces in table A-7.

3. Generate the following SLAMS audit concentrations (which are compatible with the analyzer range) as audit atmospheres consistent with the Appendix A[1] requirements.

Audit point	Concentration range, (ppm)
1	0.03 - 0.08
2	0.15 - 0.20
3	0.35 - 0.45
4	0.80 - 0.90

Record ten consecutive display updates of the photometer for each audit point. Calculate and record the mean of these ten updates. Record the station analyzer response. Both the photometer and station analyzer readings should be taken only after a stable response is exhibited by both instruments. Calculate the audit concentrations:

$$[O_3] = R_D - R_Z. \quad \text{Equation 1-22}$$

where:
$[O_3]$ = the audit concentration of O_3, ppm,
R_D = the mean of the 10 photometer display updates, and
R_Z = the average photometer clean dry air offset

4. Generate the highest audit concentration level first by adjusting the O_3 output of the generator, the amount of dilution air, or the amount of clean dry air flowing through the generator. Then consecutively generate the decreasing concentrations.

5. If desired, additional points at upscale concentrations different from those specified in step 3 may be generated. Generation of these audit concentrations plus a post audit clean dry air response will enhance the statistical significance of the audit data regression analysis.

6. After supplying all audit concentrations and recording all data, reconnect the analyzer sample line to the station manifold. Make a notation of the audit stop time. Have the station operator make a note on the data recorder to indicate the stop time, and check all equipment to ensure that it is in order to resume normal monitoring activities.

6.6 Calculations-Record the audit data in the appropriate spaces of Table A-4.

Percent difference--The % difference is calculated as follows:

$$\%\ difference = \frac{C_M - C_A}{C_A}\ x\ 100 \qquad \text{Equation 1-23}$$

where:
C_M = station-measured concentration, ppm, and
C_A = calculated audit concentration, ppm

Regression analysis--Calculate by least squares the slope, intercept and correlation coefficient of the station analyzer response data (y) versus the audit concentration data These data can be used to interpret analyzer performance.

Table A-7 Ozone Audit Data Report

Station _____ Date: _____

Address _____ Start Time:_____

T_A _____ °C; P_A _____ mm Hg; P_{H2O} _____ mm Hg Auditor:_____

Analyzer _____ Serial Number _____

Calibration standard _____ Span source _____

Last calibration date _____ Frequency _____ Range _____

Calibration Comments _____

Zero setting_____ Data acquisition system _____

Span setting _____ Recorder _____

Audit system _____ Serial number _____

Clean, dry air _____

Sample frequency _____ Cell temperature (T_C) _____ °C

Control frequency _____

Span number calculation: $45.684 \; x \left(\frac{760 \; mm}{P_A} \right) x \left(\frac{T_C + 273}{273} \right)$ = _____

Observed span number _____

Dilution air

Photometer display _____ _____ _____ _____

_____ _____ _____ _____ _____ _____

Average _____

Analyzer response _____ Chart; _____V_{DC}; _____ppm

Other Response _____

Audit Point I

Photometer display _____ _____ _____ _____

_____ _____ _____ _____ _____ _____

Average _____

Analyzer response _____ Chart; _____V_{DC}; _____ppm

Other Response _____

Audit Point II

Photometer display _____ _____ _____ _____

_____ _____ _____ _____ _____ _____

Average _____

Analyzer response _____ Chart; _____ V_{DC}; _____ ppm

Other Response _____

Audit Point III

Photometer display _____ _____ _____ _____

_____ _____ _____ _____ _____ _____

Average _____

Analyzer response _____ Chart; _____ V_{DC}; _____ ppm

Other Response _____

Audit Point IV

Photometer display _____ _____ _____ _____

_____ _____ _____ _____ _____ _____

Average _____

Analyzer response _____ Chart; _____ V_{DC}; _____ ppm

Other Response _____

Audit Point V

Photometer display _____ _____ _____ _____

_____ _____ _____ _____ _____ _____

Average _____

Analyzer response _____ Chart; _____ V_{DC}; _____ ppm

Other Response _____

Point Number	Audit concentration, ppm	Analyzer		
		Response	Concentration ppm	% difference
1				
2				
3				
4				
5				
6				

Regression (y = mx + b)
Analyzer response (ppm) = m(audit) + b Slope(m) = _____ Intercept (b) = _____ Correlation (r)=_____

7. Total Suspended Particulate Sampler Audit Procedure Using a Reference Flow Device (ReF)

7.1 Principle-An ReF device is one type of orifice transfer standard and is used to audit a TSP hi-vol sampler. The ReF device uses orifice plates to audit the sampler flow rate by measuring the pressure drop caused by the flow of air through a restricting orifice. A calibration equation is used to translate this pressure drop into a flow rate at either standard or actual conditions.

7.2 Applicability- The procedure can be used to audit hi-vol samplers with or without flow controllers operating in the flow range of 0.5 to 2.4 std m^3/min. Other types of orifice transfer standards may be used following the same procedures.

7.3 Accuracy-The accuracy of the audit procedure is approximately 2% when traceability is established by calibrating the ReF device to a Rootsmeter or other primary volume measurement device.

7.4 Apparatus-

1.ReF device- An ReF device is an interfacing unit that attaches to the filter holder of a TSP hi-vol sampler. The device typically exhibits a sensitivity of 0.01 m^3/ min per 0.1-in. pressure change. The ReF device is equipped with five air-restricting orifice plates which are used one at a time to vary the flow rate of the hi-vol sampler. A slack tube water manometer accompanies the ReF device and measures the pressure drop caused by the flow restriction of the plates. A cylindrical plexiglass windflow deflector should be attached to the top of the ReF device to protect it from ambient air flow.

2. Differential manometer--A tube manometer capable of measuring at least 16 in. of water is required.

3. Barometer--A barometer capable of measuring atmospheric pressure with an accuracy of $\pm$2 torr is required.

4. Temperature indicator--An indicator accurate to $\pm$1 C is required to determine ambient temperature.

5 Glass fiber filter--Glass fiber filters with at least 99% efficiency for collection of 0.3-um diameter particles are suitable.

7.5 Procedure-

Samplers equipped with flow controllers--A hi-vol sampler equipped with a flow controller is typically calibrated in terms of standard flow rate. Audit calculations are performed as shown in Section 12.11.6.
Note: It is imperative to know whether the hi-vol was calibrated in terms of actual conditions at the time of calibration, seasonal average conditions, or the flow rates have been corrected to standard temperature and pressure. The comparison between audit and station flow rates MUST be made with the same units and corrections.
Conduct the audit as follows:
1. Remove the filter holder clamp from the sampler. If a filter is in place for an upcoming sampling period, have the station operator remove the filter and store it until the audit is completed. Attempt to schedule audits so they do not interfere with normal sampling runs.
2. Place a clean glass fiber filter on the filter screen, and place the ReF device on top of the filter. Securely fasten the ReF device to the holder using the four wingnuts at each corner of the sampler filter holder.

3. With no resistance plate in the ReF device, close the lid and fasten it using the two wingnuts. Place the wind deflector in position, and then connect and zero the water manometer.
4. Start the sampler motor and allow it to stabilize. A warm-up time of 25 min should be allowed. Record the pressure drop shown on the manometer (in. H2O), ambient temperature l C), barometric pressure (mm Hg), and station flow rate (obtained from the station operator) on the data form in Table A-8. If the barometric pressure cannot be determined by an audit barometer (because of high elevations that exceed the limits of the barometer), determine the barometric pressure (PA) as follows:

PA = 760 - (elevation in meters x 0.076). Equation 1-24

5. At the conclusion of the audit, have the station operator replace the filter and reset the sampler timer as it was before the audit.

Samplers without flow controllers --A hi-vol sampler not equipped with a constant flow controller is typically calibrated in terms of actual flow rates. Audit calculations are performed as shown in Subsection 7.6.

Note: It is imperative to know whether the hi-vol was calibrated in terms of actual conditions at the time of calibration, seasonal average conditions, or the flow rates have been corrected to standard temperature and pressure. The comparison between audit and station flow rates MUST be made with the same units and corrections.

Conduct the audit as follows.:
1. Remove the filter holder clamp from the sampler. If a filter is in place for an upcoming sampling period, have the station operator remove the filter and store it until the audit is completed. Attempt to schedule audits so they do not interfere with normal sampling runs.
2. Place the ReF device on the filter holder, and secure the device to the holder by tightening the four wingnuts at each corner of the sample filter holder.
3. Place the 18-hole resistance plate in the ReF device, close the lid, and fasten the lid using the two wingnuts. Place the wind deflector in position, and then connect and zero the water manometer.
4. Start the sampler motor and allow it to stabilize. A warm-up time of ~5 min should be allowed. Record the pressure drop shown on the manometer (in. H2O), ambient temperature (C), barometric pressure (mm Hg), and station flow rate (obtained from the station operator) on the data form in Table A-8. If the barometric pressure cannot be determined by an audit barometer (because of high elevations that exceed the limits of the barometer), determine the barometric pressure by using Equation A-24.
5. Repeat steps 3 and 4 using the remaining resistance plates.
6. At the conclusion of the audit, have the station operator replace the filter and reset the sampler timer as it was before the audit.

7.6 Calculations

Calculate the audit flow rate at standard conditions for those hi-vols with flow rates corrected to standard temperature and pressure.

$$Q_{STD} = \frac{1}{m}\left[\sqrt{\Delta H\left(\frac{P_b}{760}\right)\left(\frac{298}{T_a}\right)} - b\right] \qquad \text{Equation 1-25}$$

where:
Q_{STD} =standard flow rate, m3/min
m and b =calibration coefficients determined during calibration of the ReF device, using flow rates corrected to standard conditions
ΔH = pressure drop shown on the manometer, in. H_2O
Pb = barometric pressure, mm Hg, and
T_a = ambient temperature in degrees Kelvin (273.16 + C)

Perform this calculation for each flow rate comparison and calculate the % difference for each audit point as follows:

$$\%\ difference = \frac{F_S - F_A}{F_A}\ x\ 100 \qquad \text{Equation 1-26}$$

where:
F_S = the station-measured flow rate, std m^3/min, and
F_A = the audit flow rate, std m^3/min.

For samplers calibrated in terms of actual or seasonal average conditions, calculate the audit flow rate in terms of actual conditions:

$$Q_{ACT} = Q_{STD}\left(\frac{760}{P_b}\right)\left(\frac{T_a}{298.16}\right) \qquad \text{Equation 1-29}$$

where:
Q_{ACT} = the actual flow rate, m^3/min
Q_{STD} = the standard flow rate, m^3/min
P_b = the barometric pressure, mm Hg, and
T_a = the ambient temperature in degrees Kelvin (273.16 + C).

Note: If seasonal temperature and barometric pressure were used in the calibration of the hi-vol sampler, then:

P_b = seasonal barometric pressure, mm Hg, and
T_a = seasonal ambient temperature in degrees Kelvin (273.16 + C)

convert from m^3/min to ft^3/min by multiplying by 35.31.

7.7 References- References 8 and 9 provide additional information on the TSP audit procedure.

Table A-8 Hi-vol Sampler Audit Data Report

Station location _____

Date _____ Barometric pressure _____

Time _____ Temperature _____

Sampler serial number _____ Serial number _____

Flow controller number _____

Plate Number	Audit manometer reading in. H_2O	Audit Flow	Analyzer		Difference	
			Response	Flow	m^3/min	%
No plate						
18						
13						
10						
7						
5						

Audit device ID number _____ Regression coefficient

Q_{std}; Slope (m) = _____ Intercept (b) = _____

$Q_{ac}t$; Slope (m) = _____ Intercept (b) = _____

Other information:

Audited by:_____ Authorized by :_____

_____

8 Data Interpretation

Interpretation of quality assurance audit results is not well defined, and audit data must be assembled and presented so that interpretation is possible. Subsection 8.1 discusses the data reporting requirements specified in Appendix A1. In addition to these requirements, optional data interpretation methods, including case examples, are in Subsection 8.2.

8.1 SLAMS Reporting Requirements- Reference 1 specifies the minimum data reporting procedures for automated and manual methods. Compare the station responses obtained for each audit point.

$$\%\ difference = \frac{C_M - C_A}{C_A}\ x\ 100 \qquad \text{Equation 1-29}$$

where:
C_M = station-measured concentration, ppm, and
C_A = calculated audit concentration,

This comparison indicates the % difference for each audit concentration generated and each analyzer response recorded.

Table A-9 contains example audit data for an SO_2 analyzer operating on a 0- to 0.5-ppm range. As indicated by the data set, the station analyzer shows a negative deviation of approximately 4% when compared to the audit concentrations.

Table A-9. Example Audit Data for an SO_2 Analyzer

SLAMS concentration range ppm	Audit concentration ppm	Station analyzer response, ppm	% difference
0.03 to 0.08	0.044	0.042	-4.6
0.15 to 0.20	0.165	0.159	-3.6
0.35 to 0.45	0.412	0.394	-4.4

A % difference calculation is used to evaluate manual method audit data. For example, a hi-vol sampler with a flow controller is audited using an ReF device. A one-point audit is performed at the normal operating flow rate with a glass fiber filter on the device. The audit and station flow rates are compared on the basis of % difference using Equation 1-29 and are designated as C_A and C_M, respectively.

Table A-10 Least Squares Calculations

$$\bar{x} = average\ x\ value = \frac{x}{N}$$

$$\bar{y} = average\ y\ value = \frac{y}{N}$$

$$slope = m = \frac{xy - \frac{x\ \ y}{N}}{x^2 - \frac{(\ \ x)^2}{N}}$$

$$intercept = b = \bar{y} - m\bar{x}$$

$$correlation\ coefficient = r = \frac{ms_x}{S_y}$$

$$S^2{}_y = variance\ of\ the\ y\ values = \frac{\left[\frac{y^2}{N} - \bar{y}^2\right]}{(N-1)}$$

$$S^2{}_x = variance\ of\ the\ x\ values = \frac{\left[\frac{x^2}{N} - \bar{x}^2\right]}{(N-1)}$$

8.2 Least Squares

The data analysis described in Appendix A[1] calculates the % accuracy of the audit data at specific operating levels within an analyzer's range. Because this method compares the operating differences at a maximum of four points, its use in determining overall analyzer performance is limited.

With an increase in the number and range of audit points generated, linear regression analysis can be used to aid in evaluating analyzer performance data. This method involves supplying a zero concentration and five upscale concentrations corresponding to approximately 10%, 20%, 40%, 60%. and 90% of the analytical range. The regression coefficients are calculated by designating the audit concentration (ppm) as the abscissa (x variable) and the station analyzer response (ppm) as the ordinate (y variable). The resultant straight line (y = mx + b) minimizes the sum of the squares of the deviations of the data points from the line.

Table A.11 Linear Regression Criteria

Slope		
Excellent	$\leq \pm 5\%$	between analyzer response and audit conc.
Satisfactory	$\pm 6\%$- $\pm 15\%$	between analyzer response and audit conc.
Unsatisfactory	$> \pm 15\%$	between analyzer response and audit conc.
Intercept		
Satisfactory	$\leq \pm 3\%$	of analyzer range
Unsatisfactory	$> \pm 3\%$	of analyzer range
Correlation coefficient		
Satisfactory	0.9950 to (1.0000)	linear analyzer response to audit conc.
Unsatisfactory	<0.9950	nonlinear analyzer response to audit conc.

Table A-10 summarizes the calculations by the method of least squares, and Table A-11 lists criteria which may be used to evaluate the regression data in terms of analyzer performance. The slope and intercept describe the data set when fitted to a line; the correlation coefficient describes how well the straight line fits the data points. Presently

Point No	Audit Conc. (ppm)	Station Conc. (ppm)	% Difference
1	.000	.000	-
2	.044	.042	-4.6
3	.103	.098	-4.9
4	.165	.159	-3.6
5	.294	.283	-3.7
6	.412	.394	-4.4

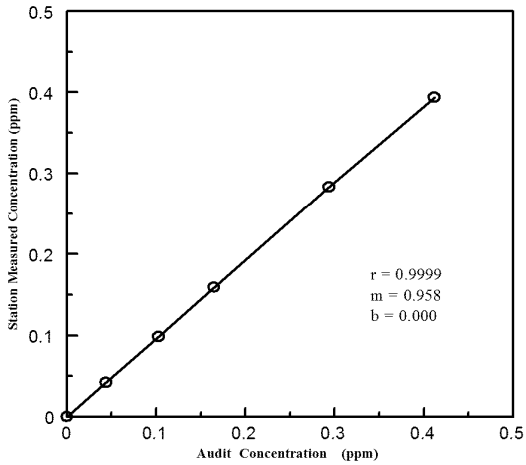


Figure A.13 Example of audit data regression analysis

there are no published criteria for judging analyzer performance. Criteria are normally specified by the operating agency. Figure A.13 shows an example audit data set that is analyzed both by the % difference and least squares technique.

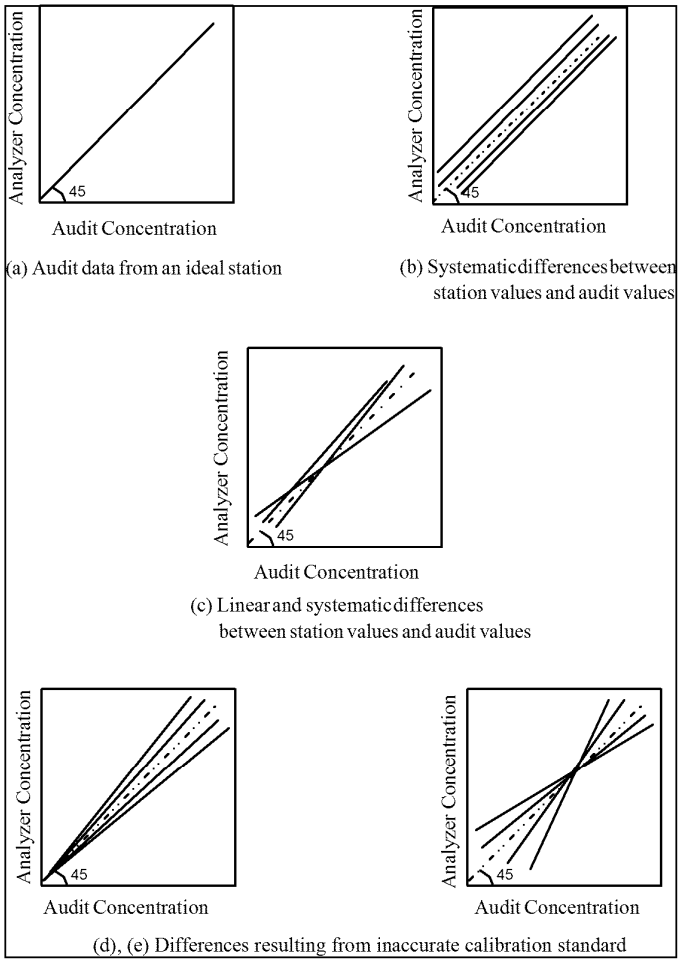


Figure A.15 Multiple audit data variations

The slope shows an average difference of -4.2% which agrees with the % difference data. The zero intercept of 0.000 agrees with the analyzer response during the audit; this indicates a nonbias response. The correlation coefficient of 0.9999 indicates a linear response to the audit points. It can be deduced that the % difference of the slope index is caused by the calibration source (i.e., the standard pollutant source, flow measurement apparatus, and the dilution air source). Figure A.14 illustrates data variations which may be encountered when auditing a monitored network.

Figure A.14(a) represents audit results in which the analyzer response agrees perfectly with the generated audit concentrations. Figure A.14(b) represents data from a group of stations showing constant systematic differences, (i.e., differences independent of concentration levels between stations and between stations and the audit system).

A network of stations showing linear systematic differences that may or may not be independent of concentration is shown in Figure A.14 (c). This example is more representative of audit data resulting from a network of stations. Figure A.14(d) and

A.14(e) illustrates two special cases of the general case shown in Figure A.14(c). Analysis of the data for a grouping of stations, such as for a given State, not only yields precision and accuracy estimates but may also provide clues as to the proper corrective action to take if larger than acceptable differences are observed. For example, Figure A.14(d) shows constant relative differences within stations that vary among stations. Such data patterns can result, for example, from errors in the calibration standards if high concentration cylinders and dilution are used for calibration. Constant systematic (absolute) differences (within stations), such as Figure A.14(b), may indicate contaminated zero and dilution air, in which case all results would tend to be on one side of the 45° line. Figure A.14(e) illustrates a case in which stations were calibrated using a high concentration span level, but not multipoint concentrations or zero point.

The use of regression analysis is not as straightforward when the intercept is significantly different from zero and/or the correlation is low (<0.995). In these instances, the auditor must rely on his experience to draw conclusions about the cause of a high or low intercept, a low correlation, and the subsequent meaning of the results. The five most commonly encountered audit cases are discussed in the following subsections.

Case 1--The data set and data plot in Figure A.15 illustrates a case in which the % difference and the linear regression analysis of audit data must be used jointly to characterize analyzer performance. Inspection of the % difference for each audit point shows large negative differences at the low concentrations and small differences at the upper concentrations. The slope of the regression line indicates an overall slope of +2.2% and a significant intercept of -0.014. The following statements apply to the regression data: 1. Analyzer zero drift may have occurred. 2. The dilution air source used to calibrate the analyzer has a bias (not of sufficient purity). 3. The calibration procedure used by the operator is not correct.

Data for figure A.15

Point No.	Audit Concentration (ppm)	Station Concentration (ppm)	% Difference
1	.000	-.013	-
2	.053	.043	-18.9
3	.119	.103	-13.5
4	.222	.208	- 6.3
5	.269	.263	- 2.2
6	.396	.392	- 1.0

A similar data set is frequently encountered when auditing analyzers that use a calibration system supplying scrubbed ambient air as the diluent source. High ambient concentrations of impurities are often difficult to remove from ambient air without the addition of auxiliary scrubbers. Spent sorbent materials may also generate impure dilution air which causes a detectable absolute analyzer response bias during the audit.

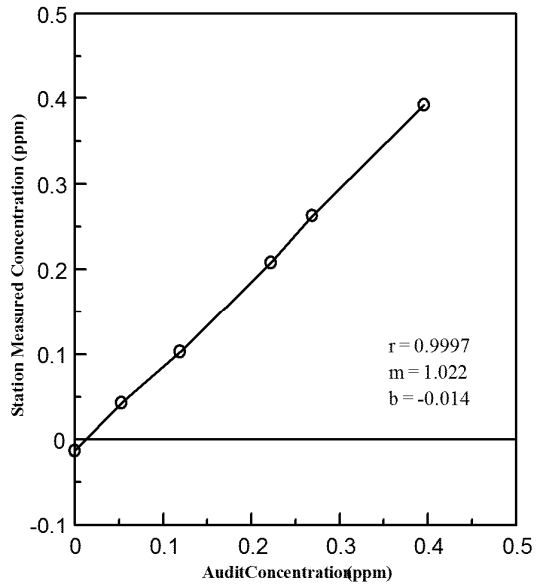


Figure A.15. Audit data interpretation- Case 1.

Case 2--Figure A.16 shows that Case 2 is similar to Case 1, but the zero response is accurate. The percent data range from large negative differences at low concentration levels to negligible differences at high concentration levels. However, the regression slope indicates a difference of 0.2% between the audit concentrations and analyzer responses and a zero intercept of -0.009. Inspection of the individual differences

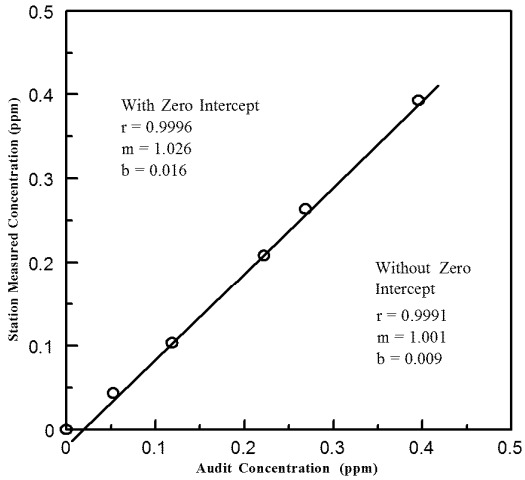


Figure A.16 Audit data interpretation- Case 2

Data for Figure A.16

Point No.	Audit Concentration (ppm)	Station Concentration (ppm)	% Difference
1	.000	.000	-
2	.053	.043	-18.9
3	.119	.103	-13.5
4	.222	.208	- 6.3
5	.269	.263	- 2.2
6	.396	.392	- 1.0

indicates either a nonlinear response or a true negative zero response. Recalculation of the regression coefficients, excluding the zero audit data, indicates the true zero lies at approximately -0.016 ppm.

This situation is most commonly encountered when auditing analyzers that use log amplifiers, logic counter circuitry, or data loggers that are incapable of recording a negative response. Flame photometric and UV photometric analyzers may exhibit audit data of this kind.

Case 3--Figure A.17 illustrates a data set which indicates a positive response to the audit zero air concentration. An inspection of the % difference data shows a large positive difference at the lower audit concentrations and negligible differences at the higher audit

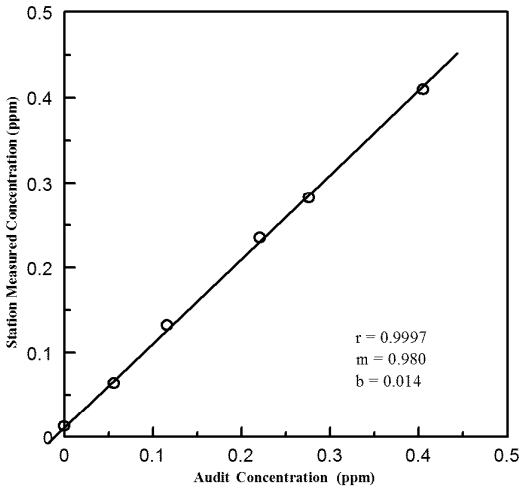


Figure A.17 Audit data interpretation- Case 3

Data for Figure A.17

Point No.	Audit Concentration (ppm)	Station Concentration (ppm)	% Difference
1	.000	.013	-
2	.053	.064	14.3
3	.119	.132	13.8
4	.222	.235	6.3
5	.269	.282	2.2
6	.396	.409	1.0

concentrations. The slope of the regression line indicates a difference between the audit concentrations and analyzer responses of -2.0% with an intercept that is not significantly different from the zero-air response. The data indicate that the audit zero-air source has a positive bias or the problem may be caused by analyzer positive zero drift.

Case 4--The data in Figure A.18 illustrate a nonlinear analyzer response. An operating organization may not detect a nonlinear response if an analyzer is calibrated using only a zero and one upscale span concentration. When an analyzer responds in a nonlinear fashion, the audit data will show varying percent differences and the regression data will normally show a low correlation coefficient and possibly a significant zero intercept. A graphic plot will verify suspected analyzer nonlinearity.

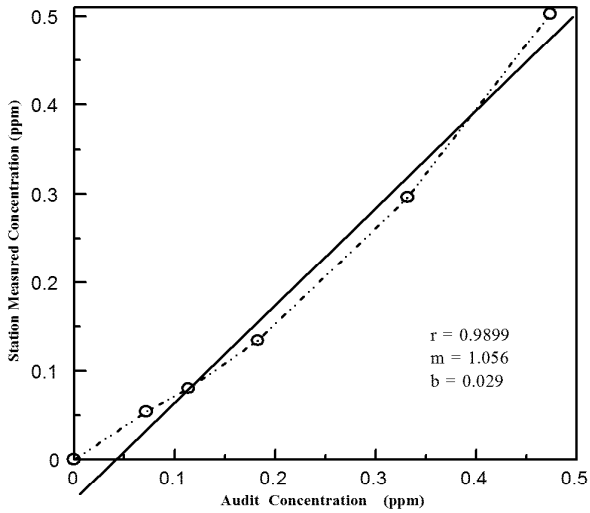


Figure A.18 Audit data interpretation- Case 4

Data for Figure A.18

Point No.	Audit Concentration (ppm)	Station Concentration (ppm)	% Difference
1	.000	.000	-
2	.072	.064	-25.0
3	.114	.080	-29.8
4	.183	.134	-26.8
5	.332	.296	-10.8
6	.474	.503	6.2

Case 5--The data illustrated in Figure A.19 show the results of an audit performed on a NO_X analyzer. The regression coefficients show an overall difference between the audit concentrations and analyzer responses of -20.0% and an intercept of 0.011 ppm. The analyzer response for the zero concentration and first four audit concentrations shows a constant bias which would be expected for the entire range. Percent differences for the three remaining audit levels become increasingly large. A graphic plot of the audit data indicates the analyzer converter efficiency is decreasing with increasing audit concentration.

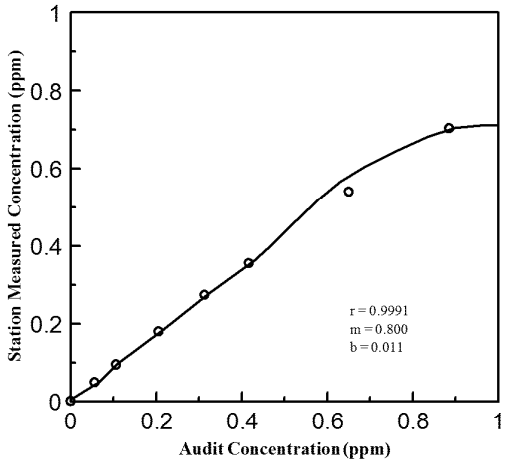


Figure A.19 Audit data interpretation-Case 5

Data for Figure A.19

Point No.	Audit Concentration (ppm)	Station Concentration (ppm)	% Difference
1	.000	.000	-
2	.056	.049	-12.5
3	.106	.094	-11.3
4	.206	.180	-12.6
5	.313	.273	-12.8
6	.417	.355	-14.9
7	.651	.540	-17.1
8	.885	.703	-19.7

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STATE OF CALIFORNIA AIR RESOURCES BOARD

MONITORING AND LABORATORY DIVISION

QUALITY ASSURANCE SECTION

VOLUME V

AUDIT PROCEDURES MANUAL

FOR

AIR QUALITY MONITORING

APPENDIX E

PERFORMANCE AUDIT PROCEDURES

FOR

THRU-THE-PROBE CRITERIA AUDITS

NOVEMBER 1995

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MONITORING AND LABORATORY DIVISION

QUALITY ASSURANCE SECTION

VOLUME V

AUDIT PROCEDURES MANUAL

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AIR QUALITY MONITORING

APPENDIX E.1

PERFORMANCE AUDIT PROCEDURES

FOR

THRU-THE-PROBE CRITERIA AUDITS

NOVEMBER 1995

E.1.0 INTRODUCTION

E.1.0.1 GENERAL INFORMATION

The California Air Resources Board, Air Monitoring Quality Assurance Procedures address the requirements for the set-up and operation of the audit equipment used while conducting performance audits as specified by 40 CFR Part 58, Appendix A. Read the entire procedures before beginning the audit.

The Quality Assurance Section (QAS) conducts thru-the-probe audit by diluting known quantities of National Institute of Standards and Technology (NIST) traceable gases with 25 liters of pure air to achieve ambient levels, then challenging the analyzers through the site's inlet probe. This audit method tests the integrity of the ambient monitoring site's entire ambient air sampling system, from the probe inlet to the air monitoring equipment.

In this method, a gas calibrator is used to control the dilution of high concentration gases from compressed gas cylinders containing CO, NO, S02, CH4; CO, H2S; CO, CH4, and C6H14. The gas calibrator is also used as an ozone source. The API 400 ozone analyzer is used as a transfer standard for auditing the site's ozone analyzer. A TECO 48 CO analyzer is calibrated at two known ambient level concentrations, plus zero, and is used to trace the amount of CO present in the diluted sample. The amount of CO present in the diluted sample is then used to calculate the true concentrations of the other gases in the compressed gas cylinder at each audit level.

The gases and transfer standards used in the audits are certified on a quarterly basis by the Standards Laboratory of the Program Evaluation and Standards Section.

E.1.0.2 EQUIPMENT

The current thru-the-probe audit system utilizes the following equipment:

1. Mobile audit van with auxiliary 12.5 KW AC generator.

2. Elgar 1001SL - II Voltage stabilized line conditioner.

3. Elgar 401SD-001 Selectable frequency oscillator.

4. Compressed gas cylinder traceable to the National Institute of Standards and Technology (NIST).

   a. Carbon Monoxide, 40-45 ppm (High CO).

   b. Carbon Monoxide, 6 - 8 ppm (Low CO).

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c. Ultrapure Zero Air.

d. Superblend 1: Carbon Monoxide (CO), Methane (CH4), Sulfur Dioxide (SO2), and Nitric Oxide (NO).

e. Superblend 2: Carbon Monoxide (CO) and Hydrogen Sulfide (H2S).

f. Superblend 3: Carbon Monoxide (CO), Methane (CH4), and Hexane (C6H14).

g. Meta-Xylene.

5. Aadco 737R pure air system with CH4 burner and compressor capable of delivering a constant 20 lpm air supply measured at the output of the audit gas presentation line.

6. Dasibi 1009 CP Gas Calibrator with ozone generator and ozone analyzer or Dasibi 1009 CP Gas Calibrator with ozone generator and an API 400 ozone analyzer.

7. TECO 48 Carbon Monoxide (CO) analyzer.

8. 150 foot 1/2" teflon line with stainless steel braiding.

9. 10 lpm by-pass rotameter and glass mixing tee.

10. PX961 Electronic Barometer.

11. 30 lpm Vol-o-Flo.

12. Portable or rack-mounted computer, printer, and related audit software.

E.1.1 START-UP PROCEDURES

E.1.1.1 GENERATOR

1. Open the generator compartment cover.

2. Check to ensure that the generator oil level is in the safe operating zone.

E.1.1.2 VAN INTERIOR

1. Ensure that the power source selector switch is in the neutral (unloaded) position.

2. Ensure that all circuit breakers are on.

3. Start the generator. After the generator speed is stable (3 - 5 minutes), place the power source selector switch in the generator position.

4. Remove the end cap from the 150 foot audit gas presentation line ("LINE").

5. Turn on the power to the compressor.

6. Turn on the power to the Aadco.

7. Turn on the power to the line conditioner.

8. Turn on the power to the barometric pressure transducer.

9. Turn on the power to the gas calibrator, API 400 ozone analyzer and the CO analyzer. Press the air switch on the Dasibi 1009 CP to the "ON" position.

10. Turn on the power to chart recorder and press "START/STOP". The chart recorder will log in with the current time and the channels that are in use. Ensure that the yellow "POWER" light is lit to indicate the logging mode; if not, press "START/STOP" again.

11. Drain all water from the two (2) compressed air water traps located on the back of the Aadco.

12. Allow a one hour warm-up time for the Dasibi 1009 CP.

13. Allow a 2 1/2 hour warm-up time for the TECO 48.

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E.1.1.3 SITE SET-UP

1. Attach approximately 2 to 5 feet of 1/4" teflon tubing to the open end of the 150 foot audit gas presentation line if necessary. This will depend on the site's inlet probe configuration.

2. Check the Aadco compressor and all cooling fans for normal operation. Recheck and purge any residual water from the water traps.

3. Ensure that the air switch on the Dasibi 1009 CP is in the "ON" position and the air flow thumbwheel is set to obtain a flow of 25.0 liters per minute (lpm).

4. Record the site name, site number, date, air monitoring personnel present, and the auditors' names on the van and site charts.

5. Before taking the line up to the site's inlet probe, measure the van's output flow using a Vol-o-Flo or other suitable flow measurement device. The site's inlet flow is determined by totaling the flow of all the instruments in use. Record the flows on the QA Audit Van Data Worksheet (Figure E.1.1.2).

   NOTE: The audit van's line output flow must be a minimum of 1 lpm greater than the station's probe inlet flow.

6. If the audit van's line output flow exceeds the station's inlet flow by more than 10 liters, a by-pass must be used at the end of the line to vent excess flow.

   NOTE: A glass tee of equal interior diameter may be used as a by- pass by inserting the teflon tubing attached to the line into the side port, securing one end of the tee to the station's inlet probe and allowing the excess flow to be vented out the third port. Some stations may contain only a single ozone analyzer, in which case a 10 lpm by-pass rotameter is attached to the end of the line with a 2 foot teflon tubing attached to the rotameter, and the glass tee connected in the same fashion as above.

7. Check for an internal by-pass flow between 0.3 and 0.4 lpm on the by-pass rotameter.

8. Record the station information on the QA Audit Station Data Worksheet (Figure E.1.1.1).

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QA AUDIT STATION DATA WORKSHEET

SITE NAME:_____ DATE:_____

SITE NUMBER: _____ CONTACT PERSON/PHONE: _____

SITE ADDRESS: _____

CORRECTION FOR ZEROES: YES[ ] NO [ ] DATA READ BY: AUDITOR [ ] OPERATOR [ ]

DATA READ FROM: CHART [ ] DAS [ ] OTHER [ ] TYPE: _____

INSTRUMENT RANGE AND RESPONSE:

							OZONE OFF		OZONE ON	
INSTRUMENT	O3	CO	THC	CH4	SO2	H2S	NO	NOX	NO	NOX
RANGE: (PPM)									XXXX XXXX	XXXXX XXXXX
RESPONSE: PRE-ZERO									XXXX XXXX	XXXXX XXXXX
HIGH - 1ST PT									XXXX XXXX	XXXXX XXXXX
NOX - 1ST PT MED. - 2ND PT								XXXX XXXX	XXXX XXXX	XXXXX XXXXX
NOX - 2ND PT	XXXXX XXXXX	XXXX XXXX								
LOW - 3RD PT										
M-XYLENE NOX - OPT PT	XXXXX XXXXX	XXXX XXXX							XXXX XXXX	XXXXX XXXXX
POST-ZERO									XXXX XXXX	XXXXX XXXXX

STATION INSTRUMENT INFORMATION:

INSTRUMENTS	OZONE	CO	THC/CH4	SO2	H2S	NO/NOX
MANUFACTURER						
MODEL NUMBER						
PROPERTY NUMBER						
EPA EQUIV. NUM.						
NAMS/SLAMS/SPM						
ZERO SETTING						
SPAN SETTING						
PRESS/VAC (+/-)						
INDICATED FLOW						
CALIBRATION DATE						
MLD-98 REVSED 02/94				CONVERTER TEMP.		

Figure E.1.1.1 QA Audit Station Data Worksheet

E.1.1.4 VAN O3 INSTRUMENT OPERATIONAL CHECK

NOTE: The following section applies only to the Dasibi 1009 CP. If the API 400 ozone analyzer is being used to measure the ozone output, the following section does not apply.

1. Turn the selector switch on the Dasibi 1009 CP to "SAMP. FREQ.". Record the sample frequency response on the QA Audit Van Data Worksheet (Figure E.1.1.2).

2. Turn the selector switch to "CONT. FREQ.". Record the control frequency on the QA Audit Van Data Worksheet (Figure E.1.1.2).

   NOTE: Make certain that both the sample frequency and the control frequency are within correct tolerance limits. The sample frequency should be between 40.000 and 48.000 megahertz, while the control frequency should be between 21.000 and 28.000 megahertz. If the sample and control frequency are not within these ranges, adjustment is not needed before the audit, but needs to be corrected prior to the next audit. (See Volume II Air Monitoring Quality Assurance Manual, Appendix A, Section. A.1.2.3.)

3. Locate the TP/GAS switch on the Dasibi 1009 CP, if so equipped, and switch it to the "TP" (temperature) position. The display for the "TP" is the gas mass flow controller. Record the temperature on the QA Audit Van Data Worksheet (Figure E.1.1.2). The display should read 60 $\pm$ 5. If the calibrator is not equipped with a TP/GAS selector switch, the temperature is read from the digital volt meter in the upper right hand corner. Record the temperature on the QA Audit Van Data Worksheet (Figure E.1.1.2). The temperature should be 35 $\pm$ 3. If either temperature is not within the acceptable range, the audit may not be performed.

4. Turn the selector switch to the "SPAN" position and adjust the span to 5200, 5210, 5220, 5230, and 5240, respectively. There are a total of four selector switches. The span selector switch is the third switch from the left on the front of the Dasibi 1009 CP under "SPAN SET". Allow sufficient time at each span position for the chart recorder to mark the chart (5 minutes). These points should be within 0.2% of full scale at 0, 10, 20, 30, and 40% on the chart. Adjust the analog zero or span pots as necessary.

5. Set the span setting to 5250 and confirm the correct setting when the display is updated. The span setting is to remain at 5250 throughout the performance audit. Ensure that the span setting has marked correctly on the chart.

6. Turn the selector switch back to the "OPERATE" position.

7. Adjust the sample flow rate for 2.8 lpm and record the flow rate on the QA Audit Van Data Worksheet (Figure E.1.1.2).

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SITE NAME: _____ AUDIT DATE: _____

SITE NUM. _____ TECO 48 ID#: _____ API 400 ID#: _____

VAN: A [ ] B [ ] VAN FLOW: _____ STAION FLOW: _____

AUDITORS: _____ / _____

QUARTER 1 [ ] 2 [ ] 3 [ ] 4 [ ] STANDARDS VERSION: _____ YEAR: _____

AUDIT POINT	OZONE SETTING	DISPLAY AIR	OZONE DISPLAY										OZONE AVE.

VAN CO ANALYZER RESPONSES

CYLINDER CONTENT	PRE-AUDIT AAADCO	HI CO	LOW CO	ULTRAPURE		POST-AUDIT AADCO	HI CO	ULTRAPURE

AUDIT POINT	MODE	THUMBWHEEL OZONE	GAS	DISPLAY AIR	GAS	DISPLAY AVERAGE	DISPLAY READINGS									
	ZERO	XXXXX XXXXX	XXXX XXXX													
	HIGH	XXXXX XXXXX														
	MIDDLE	XXXXX XXXXX														
	NO2					XXXXXXX XXXXXXX										
	OPTION	XXXXX XXXXX														
	NO2					XXXXXXX XXXXXXX										
	LOW	XXXXX XXXXX														
	NO2					XXXXXXX XXXXXXX										
	M-XYLENE OPT NO	XXXXX XXXXX														
	ZERO	XXXXX XXXXX	XXXX													

Figure E.1.1.2 QA Audit Van Data Worksheet

E.1.2 THRU-THE-PROBE AUDIT

E.1.2.1 STATION DATA RETRIEVAL

The data responses for each pollutant at each level of testing are taken from the data aquisition system used for record. The data aquisition system varies from strip chart recorders to data logger systems to telemetry systems. The data are read or interpreted by the station operator (in most locations) and reported to the auditor who records this data on a station data worksheet for later transfer to the computer in the audit van for computing the final results.

The strip chart data retrieval is done by taking pre and post zero response in parts per million along with a response at each of the three levels of the audit. The zero is not used in calculating the percent deviation if the technician does not normally use zero correction in reducing the strip chart data.

Many of the districts are using electronic data loggers which store data at the site until collected on a weekly or monthly basis. The data are handled like the chart recorder data, except they are read off a display at each level of test, then recorded by the auditor on the worksheet for later transfer to the computer.

Several of the districts have strip charts and telemetry systems which send data to the home office. The telemetry data are considered the primary data reduction method and the strip charts are the back-up. The telemetry is updated every few minutes on dedicated telephone lines and the data are averaged and stored in the home office computer. The station results are obtained by the station operator calling the office at each level of audit for analyzer results or dialing the office computer through telephone modem and directly receiving the data going into the office computer. These results are recorded on the station data worksheet for later entry into the audit van computer.

When data are taken from data loggers or telemetry systems, zero responses are usually not part of the computation for percent difference. This is because any offset is normally programmed into the calculation the office computer performs before its data output.

E.1.2.2 AUDIT PROGRAM INITIATION

1. Turn on the computer.

2. Select Option 2 "FOX VAN AUDIT PROGRAM" from the Quality Assurance Menu.

3. Press the "ENTER" key to start the program.

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4. Select Option 1, "SELECT SITE", from the ARB Van Audit Program's Main Menu and enter the information requested by the computer prompt. This information can be obtained from the Quality Assurance Site List.

5. Press Escape ("ESC") to return to the ARB Van Audit Program's Main Menu.

6. Select Option 2, "DATA ENTRY MENU", from the ARB Van Audit Program's Main Menu. Select Option 1, "VAN OZONE", from the Data Entry Menu to enter the audit van's responses for barometric pressure, pre-zero, audit points, and post-zero. Select Option 3 to enter the station's responses for the audit levels and instrument information.

7. Press Escape ("ESC") to return to the Data Entry Menu.

NOTE: You may continue to access either the Van Ozone or the Station O3 by using the Escape ("ESC") key. This will allow you to update the files as the actual data are entered.

E.1.2.3 OZONE AUDIT

True ozone (ozone concentration at the site's inlet probe) is determined by applying an ozone correction factor to the net display reading from the Dasibi 1009 CP, then applying the altitude correction factor (if applicable), and multiplying by the line loss correction factor (one minus the line loss percentage) as indicated by the following formula.

True Ozone (ppm) = (O3 Display Response [ppm] - O3 Zero Response [ppm] x (Ozone Calibration Correction Factor) x (Altitude Correction Factor) x (Line Loss Correction Factor).

NOTE: If the audit van uses the API 400 ozone analyzer to measure the ozone generated by the Dasibi 1009-CP, true ozone is determined by applying an ozone correction factor to the net display reading from the API 400 ozone analyzer, then multiplying by the line loss correction factor.

True Ozone (ppm) = (O3 Display Response - O3 Zero Response [ppm] x (Ozone Calibration Correction Factor) x (Line Loss Correction Factor).

1. If not in Option 1, "VAN OZONE", of the Data Entry Menu, return there and enter the current barometric pressure. The barometric pressure is taken from the reading of the barometric pressure display. Enter the display reading on the QA Audit Van Data Worksheet (Figure E.1.1.2) and into the computer.

NOTE: If the API 400 Ozone Analyzer is being used to measure the true ozone

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concentration,enter "A" when prompted to do so. The API 400 ozone analyzer is corrected internally fortemperature and pressure, so the computer does not correct it further.

2. O3 Audit Point 1 - Make certain that switches on the Dasibi 1009 CP are in the correct audit positions before continuing. These positions are as follows:

   a. The Air Switch is "ON".

   b. The Ozone switch is "OFF".

   c. The Auto/Man switch is in the "MAN" position.

   d. The Latch/Load switch is in the "LOAD" position.

   When the zero has stabilized, take 10 consecutive readings from the Dasibi 1009 CP or the API 400 display and record them on the QA Audit Van Data Worksheet (Figure E.1.1.2). Record the average of the ten readings on the worksheet and enter this average into the computer for the Audit Van "PRE-ZERO" response. Record the site's zero response on the QA Audit Station Data Worksheet (Figure E.1.1.1) and enter it into the computer under the Station O3 "PRE-ZERO" response.

   NOTE: The 10 consecutive readings taken from the van ozone analyzer displays are to be taken at 30 second intervals (5 minute averages).

   NOTE: Normal zero response for the Dasibi 1009 CP or the API 400 is between ±.002 ppm, while the station response is usually between ±.01 ppm.

3. O3 Audit Point 2 - Set the thumbwheel on the Dasibi 1009 CP for a number sufficient to reach the Level 1 ozone response of 0.35 to 0.45 ppm. Press the "OZONE" switch to the "ON" position. When the readings have stabilized, take ten consecutive readings from the appropriate display (Step 2 above). Record these readings on the QA Audit Van Data Worksheet and enter the average of the ten readings into the computer. Record the site's Level 1 ozone response on the QA Audit Station Data Worksheet (Figure E.1.1.1) and into the computer under the Station O3 "HIGH" response.

   NOTE: Stabilization time will vary from site to site, depending on the instrument response, but verify a stable trace/reading for at least 10 minutes. Normal Level 1 ozone is a setting between 35 and 60 on the "MAN O3" thumbwheel on the Dasibi 1009-CP.

4. O3 Audit Point 3 - Set the thumbwheel on the Dasibi 1009 CP for a number sufficient to reach the Level 2 ozone response of 0.15 to 0.20 ppm. When the readings have stabilized, take ten consecutive readings from the appropriate display (Step 2 above). Record these readings on the QA Audit Van Data Worksheet and enter the average of the ten readings into the computer.

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Record the site's Level 2 ozone response on the QA Audit Station Data Worksheet (Figure E.1.1.1) and into the computer under the Station O3 "MEDIUM" response.

NOTE: Normal Level 2 ozone is a setting between 20 and 40 on the "MAN O3" thumbwheel on the Dasibi 1009-CP.

5. O3 Audit Point 4 - Set the thumbwheel on the Dasibi 1009 CP for a number sufficient to reach the Level 3 ozone response of 0.03 to 0.08 ppm. When the readings have stabilized, take ten consecutive readings from the appropriate display (Step 2 above). Record these readings on the QA Audit Van Data Worksheet and enter the average of the ten readings into the computer. Record the site's Level 2 ozone response on the QA Audit Station Data Worksheet (Figure E.1.1.1) and into the computer under the Station O3 "MEDIUM" response.

NOTE: Normal Level 3 ozone is a setting between 10 and 20 on the "MAN O3" thumbwheel on the Dasibi 1009-CP.

6. O3 Audit Point 5 - Press the ozone switch to the "OFF" position. When the zero has stabilized, take 10 consecutive readings from the the appropriate display (Step 2 above) and record them on the QA Audit Van Data Worksheet (Figure E.1.1.2). Record the average of the ten readings on the worksheet and enter this average into the computer for the Audit Van "POST-ZERO" response. Record the site's zero response on the QA Audit Station Data Worksheet (Figure E.1.1.1) and enter it into the computer under the Station O3 "POST-ZERO" response.

7. If the site contains only an ozone analyzer, the preliminary ozone audit report may be printed out at this time. Refer to Section E.1.3.1.

E.1.2.4 CARBON MONOXIDE ANALYZER CALIBRATION

The concentrations of CO, NO, CH4, and SO2 present in the diluted gas is determined by certifying the TECO 48 CO analyzer using Ultrapure air, Aadco zero air, and NIST traceable span gases in the 45ppm and 7ppm CO ranges, then tracing the amount of CO present in the diluted sample as indicated by the following formula:

CO Analyzer Slope and Intercept:
Readings From CO Analyzer Display (Y) Vs. Zero and Span Cylinders of Known CO Concentration (X) in ppm

The final pollutant concentrations are based on pre- and post- certification results of the audit van's CO calibration gases.

NOTE: All responses are to be entered into the computer and on the QA Audit Van Data Worksheet under the Van CO Analyzer response.

The three-way valve, located next to the sample manifold, has two positions that are used during the CO Analyzer Calibration Procedure. These will be referred to as POSITION "1" and POSITION "2".

POSITION "1" - 1/4" teflon line from the Instrument Port of the rear manifold through the needle valve to the Calibration Port of the front manifold.

POSITION "2" - 1/8" teflon line from the CO span cylinders/Ultrapure Air to the pressure regulator. 1/4" teflon line from the pressure regulator to the Calibration Port of the front manifold.

1. Ensure that the CO analyzer has swarmed up for a minimum of 2 1/2 hours (can be warming up during ozone audit or while driving to the site).

2. Check the sample flow to the TECO 48 CO Analyzer. It should be set for approximately 1 lpm.

3. Readjust the needle valve on the by-pass rotameter (if necessary) in POSITION "1" to obtain a by-pass flow between 0.3 and 0.4 lpm.

4. Set the zero thumbwheels on the TECO 48 CO Analyzer so the display reads zero (0.0), $\pm$ 0.1.

5. When the zero display has stabilized, mark it on the chart and record the reading on the QA Audit Van Data Worksheet under pre-audit Aadco Zero (Figure E.1.1.2).

6. Turn off the valve/pump on the Dasibi 1009 CP.

7. Switch from POSITION "1" to POSITION "2" on the three-way valve. Connect the 45* ppm CO compressed gas cylinder standard and adjust the cylinder's pressure regulator for a by-pass flow between 0.3 and 0.4 lpm.

8. Adjust the span thumbwheels on the TECO 48 CO analyzer until the display matches the actual span value. When the chart recorder indicates a stable trace for CO, record the cylinder number on the chart next to the trace. Record the CO analyzer's response on the QA Audit Van Data Worksheet under pre-audit High CO (Figure E.1.1.2).

9. Disconnect the 45 ppm CO standard and connect the 7** ppm CO standard. Adjust the cylinder's pressure regulator to obtain a by-pass flow between 0.3 and 0.4 lpm. When the chart recorder indicates a stable trace for CO, record the cylinder number on the chart next to the trace. Record the CO analyzer's response on the QA Audit Van Data Worksheet (Figure E.1.1.2).

10. Disconnect the 7 ppm standard and connect the Ultrapure Zero Air Cylinder. Adjust the cylinder's pressure regulator to obtain a by-pass flow between 0.3 and 0.4 lpm. When the chart recorder indicates a stable trace for CO, record the cylinder number on the chart next to the trace. Record the CO analyzer's response on the QA Audit Van Data Worksheet (Figure E.1.1.2).

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NOTE: The CO analyzer response should be within ± 0.2 chart divisions of the expected value. If adjustments are made to either the zero or span thumbwheels, the calibration points must be rerun.

11. Disconnect the Ultrapure Zero Air cylinder. Switch from POSITION "2" to POSITION "1" on the three-way valve. Turn the compressed gas cylinders off. Switch the Valve/Pump on the Dasibi 1009 CP "ON". If necessary, readjust the by-pass flow between 0.3 and 0.4 lpm.

12. Select option 2, "DATA ENTRY MENU" from the ARB Van Audit Program's Main Menu. Select Option 2, "VAN CO (Superblend cylinder #1)". Enter the CO analyzer responses for Ultrapure, High CO, Low CO, and AADCO.

NOTE: After entering the chart responses, it is possible to enter estimated chart responses until the best response for each audit level of the performance audit is obtained. It will then be possible to adjust the "GAS" thumbwheel on the Dasibi 1009 CP to obtain these levels during the audit.

E.1.2.5 CO, THC, CH4, NO2, AND SO2 AUDIT

The ambient level concentrations for each pollutant are determined by multiplying a dilution ratio times the concentration value for each pollutant at each audit level. The dilution ratio and ambient level concentrations are determined using the following formulae:

$$\text{Dilution Ratio} = \frac{\dfrac{\text{CO Response (ppm)} - \text{Aadco Zero Response (ppm)}}{\text{CO Analyzer Slope}}}{\text{High CO Standard (ppm)}}$$

Values for CO, THC, CH4, NO, NOX, SO2 (in ppm) =

Dilution Ratio x High Concentration Value*** (in ppm) for that pollutant

IMPORTANT: The status of the methane burner should be monitored throughout the audit. This can be done by checking the heater lights on the monitor to insure that they are cycling on and off.

1. Check the station instruments operating ranges before starting Point 1. If the NO/NOX operating range is 0 - 0.5 ppm or the THC/CH4 operating range is 0 - 10 ppm, disconnect the sample line to the instrument at the manifold and cap the manifold.

NOTE: In the event that an Ozone audit was performed prior to the NO/NOX audit, it is possible to use the thumbwheel settings obtained from the ozone audit to determine the correct levels of ozone necessary to perform the Gas Phase Titration portion of

the NO/NOX audit.

2. Open the valve on the Superblend compressed gas cylinder and adjust the regulator to 15 psi.

3. Superblend Audit Point 1: Record all zero instrument responses on the QA Audit Station Data Worksheet (Figure E.1.1.1) and the QA Audit Van Data Worksheet (Figure E.1.1.2). These responses will also be entered into the computer.

4. Superblend Audit Point 2: Press the Dasibi 1009 CP "GAS" switch "ON", "OZONE" switch is "OFF". Set the "GAS" thumbwheels on the Dasibi 1009 CP to 650 to obtain Level 1 concentrations of CO, SO2, THC/CH4 and NO, provided the NO/NOX instrument operating range is 0-1 ppm and the THC/CH4 operating range is 0-20 ppm. After the audit van's chart recorder trace for CO has stabilized, take ten consecutive readings from the display and record the average of the ten readings on the QA Audit Van Worksheet. Enter the analyzer's response into the computer to obtain the actual values. Record the station's responses when the readings have stabilized, and enter them into the computer.

NOTE: All thumbwheel settings are approximate. Thumbwheel adjustment will be necessary to obtain values in the correct audit ranges.

5. Superblend Audit Point 3: Reset the "GAS" thumbwheel on the Dasibi 1009 CP to 300. At this point, Level 1 concentrations of NO/NOX, and Level 2 concentrations of CO, SO2 and THC/CH4 (if the operating range is 0-20 ppm) are obtained. After the audit van's chart recorder trace for CO has stabilized, take ten consecutive readings from the display and record the average of the readings on the QA Audit Van Worksheet. Enter the analyzer's response into the computer to obtain actual values. Record the station's responses when the readings have stabilized, and enter them into the computer.

6. Superblend Audit Point 4: Press the Dasibi 1009 CP "OZONE" switch "ON", and readjust the "OZONE" thumbwheels to obtain the Level 1 NO2 concentration. The nominal NO2 concentration = [Site NO Response (point 3) - Site NO Response (point 4)] x [1 + True NO (point 3) - Site Net NO Response (point 3)]. Do not make any adjustments to other Dasibi 1009 CP settings. Record the station's NO/NOX responses when stable.

NOTE: If an ozone audit was performed prior to the NO2 audit, it is possible to use the thumbwheel settings obtained during that audit to determine the correct levels of ozone necessary to perform the Gas Phase Titration portion of the NO2 audit. The amount of NO titrated should not exceed 90% of the original NO concentration if possible.

7. Superblend Audit Point 5: Press the "OZONE" switch "OFF". Set the "GAS" thumbwheels to 230 to obtain Level 2 concentrations of NO/NOX only. After the audit van's chart recorder trace for CO has stabilized, take ten consecutive readings from the display and record the average of the readings on the QA Audit Van Worksheet. Enter the analyzer's response into the computer to obtain the actual values. Record the station's response when the readings have stabilized, and enter them into the computer.

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8. Superblend Audit Point 6: Press the Dasibi 1009 CP "OZONE" switch "ON" and readjust the "OZONE" thumbwheels to obtain the Level 2 NO2 concentration. The nominal NO2 concentration = [Site No Response (Point 5) - Site NO Response (point 6)] x [1 + True NO Response (point 5) - Site NO Response (point 5). Do not make any adjustments to other 1009 CP settings. Record the station's NO/NOX responses when stable.

9. Superblend Audit Point 7: Press the Dasibi 1009 CP "OZONE" switch "OFF". Set the "GAS" thumbwheels to 130 to obtain Level 3 concentrations of CO, NO/NOX, SO2, and CH4/THC (Level 1 concentration if the instrument operating range is 0-10 ppm). After the van's chart recorder trace for CO has stabilized, take ten consecutive readings from the display and record the average of the ten readings on the QA Audit Van Worksheet. Enter the analyzer's response into the computer to obtain actual values. Record the station's response on the QA Audit Station Worksheet when the readings have stabilized, and enter them into the computer.

10. Superblend Audit Point 8: Press the Dasibi 1009 CP "OZONE" switch "ON" and readjust the "OZONE" thumbwheels to obtain the Level 3 NO2 concentration. The nominal NO2 concentration = [Site NO Response (point 7) - Site NO response (point 8)] x [1 + True NO Response (point 7) - Site NO Response (point 7). Do not make any adjustments to other 1009 CP settings. Record the station's NO/NOX responses when stable.

11. Superblend Audit Point 9: Press the Dasibi 1009 CP "OZONE" switch "OFF". Set the "GAS" thumbwheels to 50 to obtain an additional NO and THC/CH4 level if the NO/NOX operating range is 0-.5 ppm or the THC/CH4 operating range is 0-10 ppm. After the audit van's chart recorder trace for CO has stabilized, take ten consecutive readings from the display and record the average of the ten readings on the QA Audit Van Worksheet. Enter the analyzer's response into the computer to obtain actual values. Record the station's response on the QA Audit Station Worksheet when the readings have stabilized, and enter them into the computer.

NOTE: If Superblend Audit Point 9 is not needed for a lower NO and/or THC/CH4 level, proceed to Step 12. This point may be used for Meta-Xylene (Meta-Xylene Procedure, Section E.1.2.7).

12. Superblend Audit Point 10: Press the Dasibi 1009 CP "GAS" switch to "OFF". After the audit van's chart recorder trace for CO has stabilized, take ten consecutive readings from the display and record the average of the ten readings on the QA Audit Van Worksheet. Enter the analyzer's response into the computer to obtain actual values. Record the station's response on the QA Audit Station Worksheet when the readings have stabilized, and enter them into the computer.

    a. Converter Efficiency: The converted NO2 concentration is used at each point to determine the NO/NOX analyzer converter efficiency. The converter efficiency is calculated as follows:

$$\% \ CE = \frac{NO - NOX}{NO} \ x \ 100$$

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Where:
CE = Converter Efficiency
NO = ([NO]orig - [NO]rem) / NO Slope
NOX = ([NOX]orig - [NOX]rem) / NOX Slope

b. In the event that the converter efficiency falls below 96%, an Air Quality Data Action (AQDA) request will need to be issued. All data will be deleted for the period of time that the converter efficiency is out of the correct control limits.

c. In the event that an analyzer fails the performance audit, a diagram of the audit setup should be drawn. This will facilitate the issuing of an AQDA request and make possible troubleshooting easier in the future. The diagram should include the setup of the site's inlet probe, manifold and delivery system. The diagram should also include the analyzers being audited and the method of hook-up to the site's inlet probe. Any other pertinent information should be included that could have affected the audit results. In addition to the diagram, a list of troubleshooting procedures that were used to correct or determine possible problems should be included.

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E.1.2.6 H2S AUDIT

NOTE: Turn the three-way valve in the back of the audit van from Superblend cylinder 1 (Super1) to Superblend cylinder 2 (Super 2). Open the valve on Super 2 and adjust the regulator for 15 psi. Close the valve on Super 1.

The ambient level concentrations for each pollutant are determined by multiplying a dilution ratio times the concentration value for each pollutant at each audit level. The dilution ratio and ambient level concentrations are determined using the following formulae:

$$\text{Dilution Ratio} = \frac{\dfrac{\text{CO Chart Value (ppm)} - \text{Aadco Zero Response (ppm)}}{\text{(CO Analyzer Slope)}}}{\text{H2S CO Concentration (ppm)}}$$

Values for H2S (in ppm) = Dilution Ratio x High Concentration Value*

1. Calibrate the CO instrument as described in Section E.1.2.4.

2. H2S Audit Point 1: Select option 2, "DATA ENTRY MENU", from the ARB Van Audit Program's Main Menu. Select option F, "H2S MENU", from the Data Entry Menu. Select Option 1, "VAN CO (Superblend cyl #2)", and enter the CO analyzer responses for Ultrapure Zero Air, High CO, Low CO, and Aadco from the QA Audit Van Data Worksheet (Figure E.1.1.2).

3. H2S Audit Point 2: Press the Dasibi 1009 CP "GAS" switch "ON". Set the "GAS" thumbwheels to 460 to obtain Audit Point 1 concentration for H2S. After the audit van's chart recorder trace for CO has stabilized, take ten consecutive readings from the display and record the average of the ten readings on the QA Audit Van Data Worksheet. Enter the analyzer's response into the computer to obtain actual values. Record the station's response on the QA Audit Station Data Worksheet, and enter them into the computer.

4. H2S Audit Point 3: Set the "GAS" thumbwheels on the Dasibi 1009 CP to 230, to obtain Audit Point 2 concentration for H2S. After the audit van's chart recorder trace for CO has stabilized, take ten consecutive readings from the display and record the average of the ten readings on the QA Audit Van Data Worksheet. Enter the analyzer's response into the computer to obtain actual values. Record the station's response on the QA Audit Station Data Worksheet when the readings have stabilized, and enter them into the computer.

5. H2S Audit Point 4: Set the "GAS" thumbwheels on the Dasibi 1009 CP to 130, to obtain Audit Level 3 concentration for H2S. After the audit van's chart recorder trace for CO has stabilized, take ten consecutive readings from the display and record the average of the ten readings on the QA Audit Van Data Worksheet. Enter the analyzer's response into the computer to obtain actual values. Record the station's response on the QA Audit Station Data Worksheet when the readings have stabilized, and enter them into the computer.

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6. H2S Audit Point 5: Press the 1009 CP "GAS" switch to "OFF". After the audit van's chart recorder trace for CO has stabilized, take ten consecutive readings from the display and record the average of the ten readings on the QA Audit Van Data Worksheet. Enter the analyzer's response into the computer to obtain actual values. Record the station's response on the QA Audit Station Data Worksheet when the readings have stabilized, then enter them into the computer.

E.1.2.7 META-XYLENE CHECK

After completing the last audit point of the Superblend dilution, but prior to the final zero, perform the following steps for meta- xylene if the station being audited has an operating THC/CH4 analyzer. If the station has an SO2 analyzer, interference for SO2 can also be checked at the same time.

1. Press the "GAS" thumbwheel on the Dasibi 1009 CP to "OFF".

2. Switch the Dasibi 1009 CP internal pump to the "OFF" position.

3. If the Station being audited has a Ozone Analyzer, disconnect the line from the sample distribution manifold and cap off the open port.

4. Turn the "AADCO/CYLINDER" Valve, on the front of the audit van's instrument rack, to the "CYLINDER" position.

5. Turn the pressure valve on the Meta-xylene compressed gas cylinder to the "OPEN" position. Increase the regulator pressure until the pressure gauge on the front of the van's instrument rack reads between 15 and 20 psi.

6. Record the station's response on the QA Audit Station Data Worksheet when the readings have stabilized, and enter them into the computer.

7. Turn the pressure valve on the Meta-Xylene cylinder to the "OFF" position.

8. Turn the "AADCO/CYLINDER" valve back to the "AADCO" position.

9. Switch the Dasibi 1009 CP internal pump back to the "ON" position.

10. Reconnect the station Ozone analyzer.

11. When the station's zero response has stabilized, take ten consecutive readings and record the average of the ten readings on the QA Audit Station Data Worksheet. Enter the response into the computer.

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E.1.2.8 NON-METHANE HYDROCARBON AUDIT

NOTE: Disconnect the Superblend 1 cylinder in the back of the audit van. Connect Superblend 3 cylinder to the Superblend 1 cylinder line using the connector on the Superblend 3 cylinder.

The ambient level concentrations for each pollutant are determined by multiplying a dilution ratio times the concentration value for each pollutant at each audit level. The dilution ratio and ambient level concentrations are determined using the following formula:

$$Diution\ Ratio = \frac{True\ CO\ Response}{Superblend\ Bottle\ Co\ Concentration}$$

WHERE:

$$True\ CO\ Response = \frac{CO\ Display\ Value - (Aadco\ Ultrapure) - CO\ Intercept}{CO\ Slope}$$

1. Calibrate the CO instrument as described in Section E.1.2.4.

2. NMHC Audit Point 1: Select Option 2, "DATA ENTRY MENU", from the ARB Van Audit Program's Main Menu. Select Option M, "NMHC MENU" from the Data Entry Menu. Select Option 1, "VAN CO (Superblend cyl #2)", and enter the CO analyzer responses for Ultrapure Zero Air, High CO, Low CO, and Aadco Zero from the QA Audit Van Data Worksheet (Figure E.1.1.2).

3. NMHC Audit Point 2: Press the Dasibi 1009 CP "GAS" switch "ON". Set the "GAS" thumbwheels to 460 to obtain Audit Point 1 concentration for NMHC. After the audit van's chart recorder trace for CO has stabilized, take ten consecutive readings from the display and record the average of the ten readings on the QA Audit Van Data Worksheet. Enter the analyzer's response into the computer to obtain actual values. Record the station's response on the QA Audit Station Data Worksheet when the readings have stabilized, then enter them into the computer.

4. NMHC Audit Point 3: Reset the "GAS" thumbwheels on the Dasibi 1009 CP to 230 to obtain Audit Point 2 concentrations for NMHC. After the audit van's chart recorder indicates a stable trace for CO, take ten consecutive readings from the display and record the average of the ten readings on the QA Audit Van Data Worksheet. Enter the analyzer's response into the computer to obtain actual values. Record the station's response on the QA Audit Station Data Worksheet when the readings have stabilized, then enter them into the computer.

5. NMHC Audit Point 4: Reset the "GAS" thumbwheels on the Dasibi 1009 CP to 130 to obtain Audit Point 3 concentrations for NMHC. After the audit van's chart recorder indicates a stable trace for CO, take ten consecutive readings from the display and record the average of the ten readings on the QA Audit Van Data Worksheet. Enter the analyzer's response into the computer

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to obtain actual values. Record the station's response on the QA Audit Station Data Worksheet when the readings have stabilized, then enter them into the computer.

6. NMHC Audit Point 5: Press the Dasibi 1009 CP "GAS" switch to "OFF". After the audit van's chart recorder indicates a stable trace for CO, take ten consecutive readings from the analyzer display and record the average of the ten readings on the QA Audit Van Data Worksheet. Enter the analyzer's response into the computer to obtain actual values. Record the station's response on the QA Audit Station Data Worksheet when the readings have stabilized, then enter them into the computer.

AUDIT STANDARDS DATA SHEET

HIGH CONCENTRATION BLEND	HIGH CONCENTRATION BLEND	AMBIENT LEVEL GASES
CO = 14,500 ppm	CO = 14,800 ppm	7 ppm and 45 ppm CO
NO = 330 ppm	H2S = 320 ppm	Ultra-Pure Air
CH4 = 6,600 ppm		Nist Traceable
SO2 = 150 ppm		Calibration Standard

HIGH CONCENTRATION BLEND

CO = 15,350 ppm
C6H14 = 557 ppm
CH4 = 6,680 ppm

ALL CYLINDER CONCENTRATIONS ARE APPROXIMATE

DASIBI 1009 CP Calibrator with Ozone Source and Ozone Photometer	API 400 Ozone Analyzer	TECO 48 CO Analyzer (0-50 ppm Range)

AIR FLOW = 25 LITERS PER MINUTE

DILUTED CONCENTRATION

CO, NO, CH4, SO2, H2S, C6H14

AUDIT VAN DELIVERY SYSTEM

$$DILUTION\ RATIO = \frac{True\ CO\ response\ (ppm)}{Superblend\ Cylinder\ CO\ Concentration\ (ppm)}$$

AUDIT MONITORING STATION INLET

TRUE CONCENTRATION = Superblend Concentrations x Dilution Ratio

Figure E.1.2.1 Audit Gas Flow Chart

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Table E.1.2.1 - LEVELS OF POLLUTANT CONCENTRATIONS (PPM)

STEP #	O3 (PPM)
1	ZERO
2	0.35 - 0.45
3	0.15 - 0.20
4	0.03 - 0.08
5	ZERO

Point #	O3 OFF		O3 ON		NO2	CO	THC/CH4	SO2	H2S	HEXANE	METHANE
	NO	NOX	NO	NOX							
1	ZERO	ZERO	XXX	XXX	XXX	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
2	* .900					35-45	15-20	.35-.45	.35-.45	0-10	15-20
3	** .440	.440				15-20		.15-.20	.15-.20	0-10	0-10
4			.O65	.440	.375				.03-.08		
5	.275	.275							ZERO	0-10	0-10
6			.100	.275	.175						
7	.170	.170				03-08	03-08	.03-.08		0-10	0-10
8			.100	.170	.O70						
9	.070		OPTIONAL M-XYLENE				03-08			0-10	0-10
10	ZERO	ZERO	XXX	XXX	XXX	ZERO	ZERO	ZERO		ZERO	ZERO

* Indicates Point 1 for NO/NOX analyzers operating on a 0-1.0 ppm range.
** Indicates Point 1 for NO/NOX analyzers operating on a 0-0.5 ppm range.

LEVEL #	NO/NOX	O3	SO2	THC/CH4	CO	H2S	HEXANE	METHANE
1	0.35-0.45	0.35-0.45	0.35-0.45	* 15-20	35-45	.35-.45	0-10	15-20
2	0.15-0.20	0.15-0.20	0.15-0.20	** 03-08	15-20	.15-.20	0-10	0-10
3	0.03-0.08	0.03-0.08	0.03-0.08	03-08	03-08	.03-.08	0-10	0-10

* Indicates Level 1 for THC/CH4 analyzers operating on a 0-20 ppm range.
** Indicates Level 1 for THC/CH4 analyzers operating on a 0-10 ppm range.

E.1.2.9 POST-AUDIT CARBON MONOXIDE ANALYZER CALIBRATION

1. After taking the final Aadco Zero reading (Section E.1.2.5, step 12), record this reading on the QA Audit Van Data Worksheet (Figure E.1.1.2) under both the Van CO Analyzer Response and the Post-Audit Aadco Response.

2. Switch the sample pump on the Dasibi 1009 CP to the "OFF" position.

3. Turn the three-way valve on the van's sample manifold from POSITION "1" (Section E.1.2.4) to POSITION "2". Connect the 45 ppm CO compressed gas cylinder standard and adjust the by-pass flow for a reading between 0.3 and 0.4 lpm. After the van's chart recorder trace for CO has stabilized, take ten consecutive readings from the display and record them on the QA Audit Van Data Worksheet (Figure E.1.1.2) under the Post-Audit Hi-CO Analyzer Response. Enter the response into the computer.

4. Disconnect the 45 ppm CO standard and connect the Ultrapure Zero Air Compressed Gas Cylinder. After the audit van's chart recorder trace for CO has stabilized, take ten consecutive readings from the display and record the average on the QA Audit Van Data Worksheet (Figure E.1.1.2) under the Post-Audit Ultrapure Analyzer Response. Enter the response into the computer.

5. Disconnect the Ultrapure cylinder. Switch the three-way valve on the van's sample manifold from POSITION "2" to POSITION "1". Switch the sample pump on the Dasibi 1009 CP to the "ON" position and readjust the needle valve to obtain a by-pass flow reading between 0.3 and 0.4 lpm.

6. After the audit van's chart recorder trace for CO has stabilized, the van's instruments are now ready for the van shut-down procedure (Section E.1.4).

E.1.2.10 PERFORMANCE AUDIT FAILURES

1. If the results of an audit indicate a failed condition, the entire system should be checked for possible failure causes. The System includes everything from the van operation to the station instrument operation.

   NOTE: If the possible cause for the failed condition is determined during any point in the investigation, the problem should be resolved, if possible, and the audit resumed. However, an AQDA will need to be issued to the site operator to indicate an "AS IS" failure, unless the cause of the failure is determined to be the audit van set-up. In this case, the problem should be corrected and the audit restarted with no AQDA issued.

2. Beginning with the audit van, all instruments need to be checked to ensure proper operation. This will include all the following unless the cause for failure is discovered and resolved.

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a. Check the van calibrator. Is the air flow set correctly? What values do the mass flow controllers indicate? If doing an ozone audit, are the switches set correctly? Are the thumbwheels set to the correct values? Does the display on the API ozone analyzer indicate the correct ozone level?

b. If doing a gaseous audit, is the TECO 48 CO analyzer indicating the correct CO range? Is the methane reactor cycling on and off?

c. Is the compressor running? Is the Aadco cycling? Are the input and output pressures set correctly? Is the by-pass set between 0.3 and 0.4 lpm?

d. Are all the lines connected to the manifolds? Are the lines to the instruments connected? Are any leaks detected?

3. When all of these have been checked for proper operation, the next step is to ensure that the station being audited is receiving enough flow to the inlet probe. The flow can be checked with a Vol-O-Flo to determine whether the station is receiving too much flow (pressurizing the instruments), or not enough flow (starving the instruments).

4. Following this (if necessary), check the path of the audit gas from the probe inlet to the back of the instruments. This can be accomplished by visually examining the probe inlet, probe line, manifold, all related teflon lines, and any in-line filters.

5. If no possible cause can be determined during this examination, the next step is to remove the audit presentation line from the station's inlet probe and connect it to the back of the instrument manifold, then rechecking the instruments for proper response.

6. If the instruments still indicate a failed condition, the last step is to remove the audit presentation line from the instrument manifold and checking for the proper response at the back of the instruments.

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E.1.3 POST-AUDIT PROCEDURES

E.1.3.1 PRINTING AUDIT RESULTS

1. After final CO calibration, verify that all the audit van's and station's responses have been correctly entered.

2. Select Option 3, "PRINT MENU", from the ARB Van Audit Program's Main Menu.

3. Select Option 1, "AUDIT RESULTS", from the Print Menu.

4. Verify that the correct site information is being displayed. If not, type in the correct site number. Enter "P" for Preliminary results and then 3 for number of copies to be printed. Enter "Y" if the information is correct, and the computer will recalculate the data and print out the number of copies requested. If the information is not correct, enter "N", and enter the correct information.

5. Give the station operator one copy of the audit report, and retain the other two copies for ARB use.

E.1.3.2 AIR QUALITY DATA ACTION (AQDA)

NOTE: AQDA'S are issued when the audit reveals that the station's instruments are not operating within the prescribed limits. These limits are defined in EPA's Volume II.

If the station being audited has failed the audit or a portion of the audit, it will be necessary to issue an Air Quality Data Action (AQDA).

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E.1.4 SHUT DOWN PROCEDURES -- VAN

E.1.4.1 INTERIOR

1. After printing the preliminary audit report, exit the audit program by pressing escape (ESC) until the display on the computer screen reads "ARE YOU SURE YOU WANT TO EXIT?(Y/N) [ ]. Enter "Y" to exit the program, and type "PARK" at the prompt. This parks the heads on the computer and avoids damage to the hard disk. Shut the computer off.

2. Turn off the power to the printer.

3. Turn off the power to the Dasibi 1009 CP.

4. Turn off the power to the TECO 48.

5. Turn off the power to the Elgar.

6. Close all compressed gas cylinders' valves.

7. Turn off the power to the Aadco compressor.

8. Turn off the power to the Methane Reactor.

9. Turn off the air conditioning units, if they were used.

10. After placing the generator power switch in the "UNLOADED" position, shut off the generator.

11. Secure all loose articles or equipment in preparation for transportation to another location.

E.1.4.2 EXTERIOR

1. Remove the audit presentation "LINE" from the site's inlet probe.

2. Reel in the audit presentation "LINE" and cap the end. Tighten the securing bolt on the "LINE" reel to prevent the "LINE" from unrolling while in transit.

3. Secure the ladder and safety cones, if used, in the the audit van.

4. Verify that the van steps are up. If the steps are electric, turn the power off.

E.1.5 CALIBRATIONS CHECKS AND PROCEDURES

E.1.5.1 QUARTERLY "LINE LOSS" START-UP PROCEDURE

The purpose of the line loss test is to determine the actual ozone concentration that is being delivered to the end of the audit presentation line. The line is 150 feet long and there is an expected ozone loss due to the length of the line. By analyzing the ozone concentration before and after the line, it is possible to determine the amount of ozone loss due to the line. This percentage loss is then used to correct for true ozone.

1. Plug in the audit van land line.
2. Place the Generator/Land Line switch in the "LAND LINE" position.
3. Turn on the Aadco.
4. Turn on the compressor.
5. Turn on the Elgar line conditioner power.
6. Turn on the power to the Dasibi 1009 CP and press the air switch to the "ON" position.
7. Turn on the Omega chart recorder power.
8. Press "START" to begin the recorder logging. It will log in with the correct time and the channels in use. Record the date, vehicle, type of test performed, and the name of the person performing the test.
9. Drain the moisture from the compressed air water traps located on the back of the Aadco.

E.1.5.2 QUARTERLY AUDIT PRESENTATION "LINE LOSS" TEST

Two (2) lines are used during the quarterly "LINE LOSS" test, referred to as the "INSIDE" line and the "OUTSIDE" line.

INSIDE - 1/4 Inch teflon line from the Instrument Port of the rear manifold through the needle valve to the Calibration Port of the front manifold.

OUTSIDE- 1/2 Inch by 150 foot stainless steel braided line with 10 lpm by-pass rotameter, glass tee, and two feet of teflon line to connect to the front manifold.

NOTE: Two manifolds are used in the audit vans.

The "FRONT" manifold is used to deliver the diluted sample or the zero and span gases to the van ozone and CO instruments, and utilizes a 0.3 to 0.4 lpm by-pass to keep a slight (one inch of water) positive pressure in the manifold to prevent any dilution with outside air.

The "REAR" manifold is used to deliver the diluted pollutant concentrations of audit gases to the inlet probe of the station being audited. This manifold works under a positive pressure of 30 psi and delivers a flow rate between 15 and 30 lpm.

1. Warm up the Dasibi 1009 CP for a least one hour prior to performing the "LINE LOSS" check.

2. Uncap the OUTSIDE line and connect a 10 lpm by-pass rotameter and a glass tee to it by use of a 1/4 inch teflon line (5 feet is sufficient).

3. Press the air switch on the Dasibi 1009 CP to the "ON" position and adjust the air thumbwheel setting to achieve an output flow of 15 lpm or greater.

4. Connect the INSIDE line to the front manifold on the instrument rack and adjust the by-pass flow for 0.3 to 0.4 lpm using the in-line needle valve(s).

5. Disconnect the INSIDE line from the front manifold and connect the OUTSIDE line. Adjust the by-pass flow rate to 0.3 to 0.4 lpm by partially blocking the open end of the glass tee using masking tape or other suitable material.

6. Disconnect the OUTSIDE line and reconnect the INSIDE line. Readjust the by-pass flow between 0.3 and 0.4 lpm, if needed.

7. Allow the ozone response to establish a stable trace on the chart recorder for at least 10 minutes. When the trace has stabilized, take 10 consecutive readings from the Dasibi 1009 CP display and record them on Quarterly Line Loss Test Form, (Figure E.1.5.1).

8. Disconnect the INSIDE from the front manifold and reconnect the OUTSIDE LINE. Readjust the by-pass flow between 0.3 and 0.4 lpm, if needed.

9. Allow the ozone response to establish a stable trace on the chart recorder for at least 10 minutes. When the trace has stabilized, take ten (10) consecutive readings from the Dasibi 1009 CP display and record them on the Quarterly Line Loss Test Form (Figure E.1.5.1).

10. Repeat steps 6 through 9 for a total of three readings.

11. Adjust the ozone thumbwheel on the Dasibi 1009 CP to achieve Level 1 (Table E.1.2.1) concentrations of ozone. This setting is usually between 30 and 60 on the "MAN" thumbwheel. Press the ozone switch "ON".

12. Repeat steps 6 through 9 for a total of three readings.

13. Adjust the ozone thumbwheel on the Dasibi 1009 CP to achieve Level 2 (Table E.1.2.1) concentrations of ozone. This setting is usually between 20 and 40 on the "MAN" thumbwheel.

14. Repeat steps 6 through 9 for a total of three readings.

15. Adjust the ozone thumbwheel on the Dasibi 1009 CP to achieve Level 3 (Table E.1.2.1) concentrations of ozone. This setting is usually between 10 and 20 on the "MAN" thumbwheel.

16. Repeat steps 6 through 9 for a total of three readings.

17. To figure the quarterly line loss, total the readings for the INSIDE line for each level, and divide this total by the number of readings. Record the results under the average for that level. Repeat this process for the OUTSIDE line. Add the zero correction to each level to arrive at the corrected response. Compare the INSIDE line response to the OUTSIDE line response to arrive at a percent difference for each level. Total all three levels and divide the total by three to arrive at the average percent difference. Add this average percent difference to the previous line loss percent difference (has to be within ± 1%). Divide this by two to arrive at the current quarter line loss.

    NOTE: "QUARTERLY LINE LOSS TEST FORM" ozone response should be within ± 2.5% of the manifold ozone response.

18. Press the ozone on the Dasibi 1009 CP "OFF".

19. Repeat steps 6 through 9 for a total of three readings.

20. Drain the moisture from the Aadco water traps.

21. Turn the compressor off.

22. Turn the Aadco off.

23. Turn the Dasibi 1009 CP off.

24. Turn the Elgar 1001-SL off.

25. Turn the chart recorder off.

26. Disconnect the OUTSIDE line from the front manifold and reconnect the INSIDE line.

27. Remove the 10 lpm by-pass rotameter and glass tee from the OUTSIDE line and recap the line.

28. Rewind the OUTSIDE line back onto the reel.

E.1.5.3 QUARTERLY INSTRUMENT AND GAS RECERTIFICATION

1. Dasibi 1009 CP - The Standards Laboratory recertifies the UV Photometer against a Primary Photometer and checks the mass flow controllers. The slope and intercept derived from the ozone certification are entered into the van standards file and used to calculate true van ozone concentrations.

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2. Dasibi 1008 PC - The Standards Laboratory recertifies the UV Photometer against a Primary Photometer. The slope and intercept derived from this certification are used to calculate true ozone concentrations. The Dasibi 1008 PC is used in areas inaccessible to the audit van.

3. Gases - The High and Low Carbon Monoxide Standards, H2S, and Superblend Gas Standards (NO, CH4, SO2, CO and C6H14, CH4, CO) are recertified by the Standards Laboratory. The concentrations obtained from certification are entered into the van standard's file and are used to determine the true values during a performance audit.

E.1.5.4 QUARTERLY AUDIT GAS COMPARISON WITH STANDARDS LABORATORY

At the beginning of each quarter, an in-house audit will be performed with the Program Evaluation and Standards Section. The purpose of this audit is to verify the actual concentration of the gases at the end of the audit presentation line. This audit is to be performed following the standard Performance Audit format outlined in Sections E.1.2.3, E.1.2.4, E.1.3, and E.1.4 of this procedure. The results obtained from this audit can be used to correct the computer generated audit gas concentrations to actual audit gas concentrations in the event that there is a greater than $\pm$ 3.6 percent difference between the calculated and actual values.

E.1.5.5 ANNUAL RECERTIFICATION PROCEDURES

1. Annual certifications are performed on the TECO 48 Carbon Monoxide Analyzer, Barometric Pressure Transducer, Thermometers, and Ultrapure Air.

2. TECO 48 CO Analyzer - Certified by the Standards Laboratory against NIST traceable primary CO standards for the 0-50 ppm range only. A linearity check is also performed at the same time to verify that the instrument is linear throughout the entire operating range.

3. Barometric Pressure Transducer - Certified by the Standards Laboratory against a mercury manometer and a Wallace & Tiernan pressure gauge. A slope and intercept are derived from this certification, and entered into the van standards file to be used in the correction of ozone and PM10 data to the standard barometric pressure of 760 mm Hg.

4. Hi-Vol Orifice - Certified by the Standards Laboratory against a Primary Roots Meter. The slope and intercept derived from the certification are entered into the van standards file, and are used to calculate Hi-Vol sampler flow rates.

INSTRUMENT: _____ ID#: _____ DATE: _____

QUARTER 1[ ] 2[ ] 3 [ ] 4 [ ] VEHICLE: VAN "A" [ ] VAN "B" [ ]

TRUE OZONE = _____ PREVIOUS QUARTER LINE LOSS = _____

INSIDE												OUTSIDE											
ZERO AIR SET																							ZERO
AVERAGE												% DIFFERENCE											
HIGH O3 SET																							HIGH O3 SET
AVERAGE												% DIFFERENCE											
MED O3 SET																							MED O3 SET
AVERAGE												% DIFFERENCE											
LOW O3 SET																							LOW O3 SET
AVERAGE												% DIFFERENCE											
ZERO AIR SET																							ZERO AIR SET
AVERAGE												% DIFFERENCE											

Quarterly line loss = $\frac{\text{Current Quarter Line Loss/Previous Quarter Line Loss}}{2}$

QA FORM LL1_____

QUARTERLY LINE LOSS % [ ]

Figure E.1.5.1 Quarterly Line Loss Test Form

Appendix 16

Examples of Reports to Management

The following example of an annual quality assurance report consist of a number of sections that describe the quality objectives for selected sets of measurement data and how those objectives have been met. Sections include:

- Executive Summary,
- Introduction, and
- Quality information for each ambient air pollutant monitoring program..

The report is titled "Acme Reporting Organization, Annual Quality Assurance Report for 2000".

ACME REPORTING ORGANIZATION
ANNUAL QUALITY ASSURANCE REPORT FOR 2000

Prepared by

Quality Assurance Department
Acme Reporting Organization
110 Generic Office Building
Townone XX, 00001

April 2001

ACME REPORTING ORGANIZATION
ANNUAL QUALITY ASSURANCE REPORT FOR 2000
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ACME REPORTING ORGANIZATION
ANNUAL QUALITY ASSURANCE REPORT FOR 2000

EXECUTIVE SUMMARY

This summary describes the Acme Reporting Organization's (ARO's) success in meeting its quality objectives for ambient air pollution monitoring data. ARO's attainment of quantitative objectives, such as promptness, completeness, precision, and bias, are shown in Table 1, below. ARO met these objectives for all pollutants, with the exception of nitrogen dioxide. The failure to meet completeness and timeliness goals for nitrogen dioxide was due to the breakdown of several older analyzers. Replacement parts were installed and the analyzers are now providing data that meet ARO's quality objectives.

Table 1. Attainment of Quantitative Quality Objectives for Ambient Air Monitoring Data

Measurement	Program met objectives for			
	Promptness	Completeness	Precision	Bias
Air Toxics	Yes	Yes	Yes	Yes
Carbon Monoxide	Yes	Yes	Yes	Yes
Lead	Yes	Yes	Yes	Yes
Nitrogen Dioxide	No	No	Yes	Yes
Ozone	Yes	Yes	Yes	Yes
Sulfur Dioxide	Yes	Yes	Yes	Yes
PM_{10}	Yes	Yes	Yes	Yes
$PM_{2.5}$	Yes	Yes	Yes	Yes
Volatile Organic Compounds (VOCs)	Yes	Yes	Yes	Yes

Other quality objectives (for example those concerning siting, recordkeeping, etc.) were assessed via laboratory and field system audits. The results of these audits indicate compliance with ARO's standard operating procedures except for the following:

- The Towntwo site was shadowed by a 20 story office building which was recently completed. This site was closed in July 2000.
- The Townfour site had problems with vandalism. A new, more secure, fence was installed in April and the sheriff's department increased patrols in the area to prevent reoccurrences.
- Newly acquired laboratory analytical instruments did not have maintenance logs. New logs were obtained and personnel were instructed on their use. A spot check, approximately one month later, indicated the new logs were in use.

A review of equipment inventories identified three older sulfur dioxide ambient air monitors that, based on our past experience, are likely to experience problems. Cost information and a schedule for replacement has been prepared and submitted to management for funding. Based on this schedule, the new monitors will be installed before the end of 2001.

INTRODUCTION

The Acme Reporting Organization (ARO) conducts ambient air monitoring programs for the State Bureau of Environmental Quality and local air quality management districts. These programs involve:

- monitoring of criteria pollutants to determine the National Ambient Air Quality Standards (NAAQS) attainment status of state and local air quality. This monitoring is conducted as part of the State and Local Air Monitoring Stations (SLAMS) and National Air Monitoring Stations (NAMS) networks.
- monitoring compounds (volatile organic compounds and nitrogen oxides), referred to as ozone precursors, that can produce the criteria pollutant ozone. This monitoring is conducted as part of the Photochemical Assessment Monitoring Stations (PAMS) network.
- monitoring toxic air pollutants.

The purpose of this report is to summarize the results of quality assurance activities performed by ARO to ensure that the data meets its quality objectives. This report is organized by ambient air pollutant category (e.g., gaseous criteria pollutants, air toxics). The following are discussed for each pollutant category:

- program overview and update
- quality objectives for measurement data
- data quality assessment

DATA QUALITY

Data quality is related to the need of users for data of sufficient quality for decision making. Each user specifies their needed data quality in the form of their data quality objectives (DQOs). Quality objectives for measurement data are designed to ensure that the end user's DQOs are met. Measurement quality objectives are concerned with both with quantitative objectives (such as representativeness, completeness, promptness, accuracy, precision and detection level) and qualitative objectives (such as site placement, operator training, and sample handling techniques).

QUALITY ASSURANCE PROCEDURES

Quality assurance is a general term for the procedures used to ensure that a particular measurement meets the quality requirements for its intended use. In addition to performing tests to determine bias and precision, additional quality indicators (such as sensitivity, representativeness, completeness, timeliness, documentation quality, and sample custody control) are also evaluated. Quality assurance procedures fall under two categories:

- **quality control** - procedures built into the daily sampling and analysis methodologies to ensure data quality, and
- **quality assessment** - which refers to periodic outside evaluations of data quality.

Some ambient air monitoring is performed by automated equipment located at field sites, while other measurements are made by taking samples in the field which are transported to the laboratory for analysis. For this reason, it is useful to divide quality assurance procedures into two parts – field quality assurance and laboratory quality assurance.

Field Quality Assurance

Quality control of automated analyzers and samplers consists of calibration and precision checks. The overall precision of sampling methods is measured using collocated samplers. Quality assurance is evaluated by periodic performance and system audits.

Calibration - Automated analyzers (except ozone) are calibrated by comparing the instrument's response when sampling a cylinder gas standard mixture to the cylinder's known concentration level. The analyzer is then adjusted to produce the correct response. Ozone analyzers are calibrated by on-site generation of ozone whose concentration is determined by a separate analyzer which has its calibration traceable to the U.S. Environmental Protection Agency. The site's analyzer is then adjusted to produce the same measured concentration as the traceable analyzer. Manual samplers are calibrated by comparing their volumetric flow rate at one or more flow rates to the flow measured by a flow rate transfer standard. Calibrations are performed when an instrument is first installed and at semi-annual intervals thereafter. Calibrations are also performed after instrument repairs or when quality control charts indicate a drift in response to quality control check standards.

Precision - Precision is a measure of the variability of an instrument. The precision of automated analyzers is evaluated by comparing the sample's known concentration against the instrument's response. The precision of manual samplers is determined by collocated sampling – the simultaneous operation of two identical samplers placed side by side. The difference in the results of the two samplers is used to estimate the precision of the entire measurement process (i.e., both field and laboratory precision).

Performance Audits - The bias of automated methods is assessed through field performance audits. Performance audits are conducted by sampling a blind sample (i.e., a sample whose concentration is known, but not to the operator). Bias is evaluated by comparing the measured response to the known value. Typically, performance audits are performed annually using blind samples of several different concentrations.

System Audits - System audits indicate how well a sampling site conforms to the standard operating procedures as well as how well the site is located with respect to its mission (e.g., urban or rural sampling, special purpose sampling site, etc.). System audits involve sending a trained observer (QA Auditor) to the site to review the site compliance with standard operating procedures. Some areas reviewed include: site location (possible obstruction, presence of nearby pollutant sources), site security, site characteristics (urban versus suburban or rural), site maintenance, physical facilities (maintenance, type and operational quality of equipment, buildings, etc.), recordkeeping, sample handling, storage and transport.

Laboratory Quality Assurance

Laboratory quality control includes calibration of analytical instrumentation, analysis of blank samples to check for contamination, and analysis of duplicate samples to evaluate precision. Quality assurance is accomplished through laboratory performance and system audits.

Calibration - Laboratory analytical instruments are calibrated by comparing the instrument's response when sampling standards of known concentration level. The difference between the measured and known concentrations is then used to adjust the instrument to produce the correct response.

Blank Analysis - A blank sample is one that has intentionally not been exposed to the pollutant of interest. Analysis of blank samples reveals possible contamination in the laboratory or during field handling or transportation.

Duplicate Analysis - Duplicate analyses of the same sample are performed to monitor the precision of the analytical method.

Performance Audits - Regular performance audits are conducted by having the laboratory analyze samples whose physical or chemical properties have been certified by an external laboratory or standards organization. The difference between the laboratory's reported value and the certified values is used to evaluate the analytical method's accuracy.

System Audits - System audits indicate how well the laboratory conforms to its standard operating procedures. System audits involve sending a trained observer (QA Auditor) to the laboratory to review compliance with standard operating conditions. Areas examined include: record keeping, sample custody, equipment maintenance, personnel training and qualifications, and a general review of facilities and equipment.

GASEOUS CRITERIA POLLUTANTS

The Acme Reporting Organization monitors the ambient concentrations of the gaseous criteria pollutants carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and sulfur dioxide (SO_2) to determine attainment of Federal (NAAQS) and State ambient air quality standards. Monitoring of these pollutants is conducted continuously by a network of automated stations.

PROGRAM UPDATE

At the beginning of 2000, the Acme Reporting Organization operated 38 ambient air monitoring stations that measured gaseous criteria pollutants. On March 1, 2000, a station was opened at Townone to monitor CO, NO_2, O_3, and SO_2 . The station at Towntwo, which monitored NO_2, O_3, and SO_2, was closed in April 2000.

QUALITY OBJECTIVES FOR MEASUREMENT DATA

The Quality Objectives for the Acme Reporting Organization's ambient air monitoring of gaseous criteria pollutants are shown in Table 2, below.

Table 2. Quality Objectives for Gaseous Criteria Pollutants

Data Quality Indicator	Objective
Precision	±10%
Bias	±15%
Completeness	75%
Promptness	100%

DATA QUALITY ASSESSMENT

Summary

Assessment of the data quality for ARO gaseous criteria pollutants showed that all instruments met goals for accuracy, precision, completeness, and promptness. System audits showed siting problems at three sites, two of these were corrected promptly, while the third site had to be closed due to the construction of a nearby large office building.

Promptness and Completeness

At least 75 percent of scheduled monitoring data must be reported for purposes of determining attainment of NAAQS. All data must be submitted within 90 days after the end of the reporting quarter. Table 3 summarizes promptness and completeness for gaseous criteria pollutant data.

Table 3. Data Quality Assessment for Promptness and Completeness

Pollutant	Promptness	Completeness
Carbon monoxide	100%	95%
Nitrogen dioxide	100%	97%
Ozone	100%	94%
Sulfur dioxide	100%	96%

Precision

At least once every two weeks, precision is determined by sampling a gas of known concentration. Table 4 summarizes the precision checks for gaseous criteria pollutants.

Table 4. Data Quality Assessment for Precision

Pollutant	Precision checks completed	Percentage within limits
Carbon monoxide (CO)	98%	98%
Nitrogen dioxide (NO_2)	100%	97%
Ozone (O_3)	97%	98%
Sulfur dioxide (SO_2)	100%	98%

Bias

The results of annual performance audits conducted by ARO personnel are shown in Figure 1, below. The center line for each pollutant represents the average bias across all analyzers (i.e., with all analyzers weighted equally). The lower and upper probability limits represent the boundaries within which 95 percent of the individual bias values are expected to be distributed.

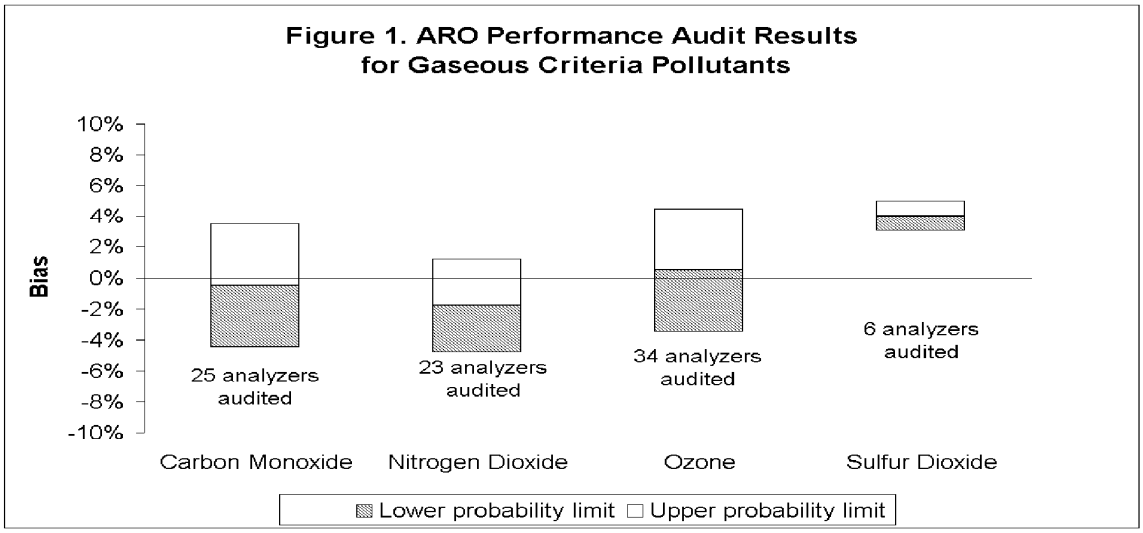
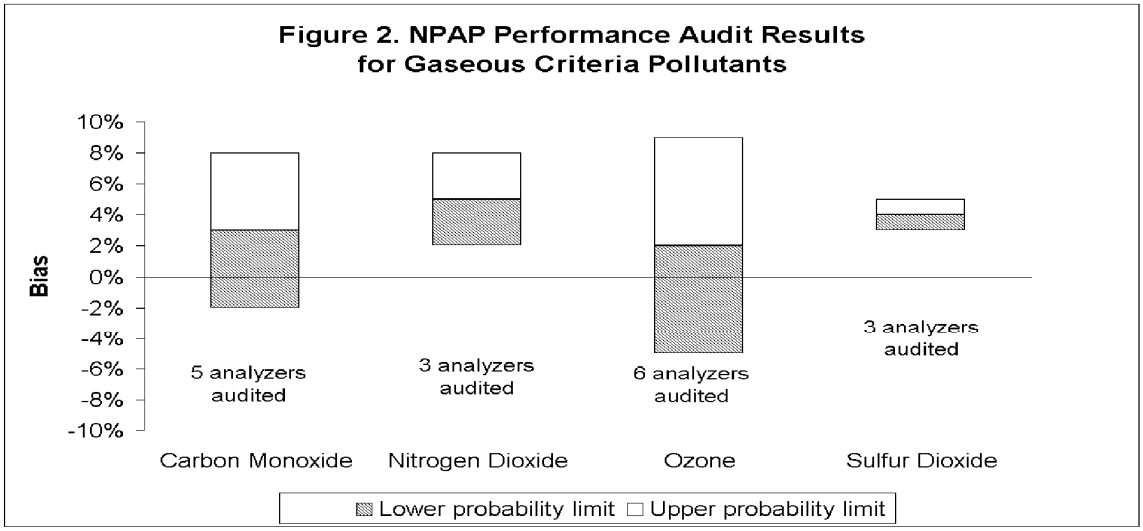


Figure 2 shows the results of external performance audits performed with the National Performance Audit Program (NPAP), administered by the U.S. EPA.



System Audits

Systems audits were performed at approximately 25 percent of the sites during the calendar year 2000. These audits evaluated areas such as siting criteria, analyzer operation and maintenance, operator training, recordkeeping, and serve as a general review of site operations. No significant problems were observed, except for the following:

- The Towntwo site was shadowed by a 20 story office building which was recently completed. This site was closed in July 2000.
- The Townfour site had problems with repeated vandalism. A new, more secure, fence was installed in April and the sheriff's department increased patrols in the area to prevent reoccurrences.
- The Townsix site had vegetation which had grown too close to the analyzer inlet probes. The vegetation was removed within one week after the problem was reported. Personnel from the County Parks and Recreation Department provided assistance removing the vegitation.

PARTICULATE CRITERIA POLLUTANTS

The Acme Reporting Organization monitors the ambient concentrations of three particulate criteria pollutants:

- lead,
- PM_{10} (particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers, and
- $PM_{2.5}$ (particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers)

This monitoring is used to determine attainment of Federal (NAAQS) and State ambient air quality standards. Monitoring of these pollutants is conducted by sampling for 24 hours every six days by a network of manually operated samplers.

PROGRAM UPDATE

At the beginning of 2000, the Acme Reporting Organization operated 22 ambient air monitoring stations that measured particulate criteria pollutants. On March 1, 2000, a station was opened at Townone to monitor PM_{10}, $PM_{2.5}$, and lead. The station at Towntwo, which monitored PM_{10}, $PM_{2.5}$, and lead, was closed in April 2000.

QUALITY OBJECTIVES FOR MEASUREMENT DATA

The Quality Objectives for the Acme Reporting Organization's ambient air monitoring of particulate criteria pollutants are shown in Table 5, below.

Table 5. Quality Objectives for Particulate Criteria Pollutants

Data Quality Indicator	Objective
Precision	±7%
Bias	±10%
Completeness	75%
Promptness	100%

DATA QUALITY ASSESSMENT

Summary

Assessment of the data quality for ARO particulate criteria pollutants showed that all samplers met goals for accuracy, precision, completeness, and promptness. System audits showed siting problems at three sites. Two of these were corrected promptly, while the third site had to be closed due to the construction of a large office building, nearby.

Promptness and Completeness

At least 75 percent of scheduled monitoring data must be reported for purposes of determining attainment of NAAQS. All data must be submitted within 90 days after the end of the reporting quarter. Table 6 summarizes promptness and completeness data for particulate criteria pollutants.

Table 6. Data Quality Assessment for Promptness and Completeness

Pollutant	Promptness	Completeness
Lead	100%	93%
PM_{10}	100%	95%
$PM_{2.5}$	100%	92%

Precision

Precision is determined by operating collocated samplers (i.e., two identical samplers operated in the identical manner). Due to the anticipated poor precision for very low levels of pollutants, only collocated measurements above a minimum level (0.15 g/m^3 for lead, 20 g/m^3 for PM_{10}, and 6 g/m^3 for $PM_{2.5}$) are used to evaluate precision. Table 7 summarizes the results of collocated measurements made during the calendar year 2000.

Table 7. Data Quality Assessment for Precision

Pollutant	Collocated precision measurements completed	Collocated measurements within limits
Lead	98%	98%
PM_{10}	100%	97%
$PM_{2.5}$	97%	98%

Flow rate precision

A flow rate precision check is conducted at least every two weeks for PM_{10} and $PM_{2.5}$ samplers. The flow should be within ±10% of the specified value. Results are shown in Table 8.

Table 8. Flow Rate Precision Checks for Particulate Criteria Pollutants

Pollutant	Precision Checks completed	Precision Checks within limits
Lead	98%	98%
PM_{10}	100%	97%
$PM_{2.5}$	97%	98%

Flow rate bias

Results of the annual flow rate audits conducted by ARO personnel are shown in Figure 3, below. The center line for each pollutant represents the average bias across all sampler (i.e., with all sampler weighted equally). The lower and upper probability limits represent the boundaries within which 95 percent of the individual bias values are expected to be distributed.

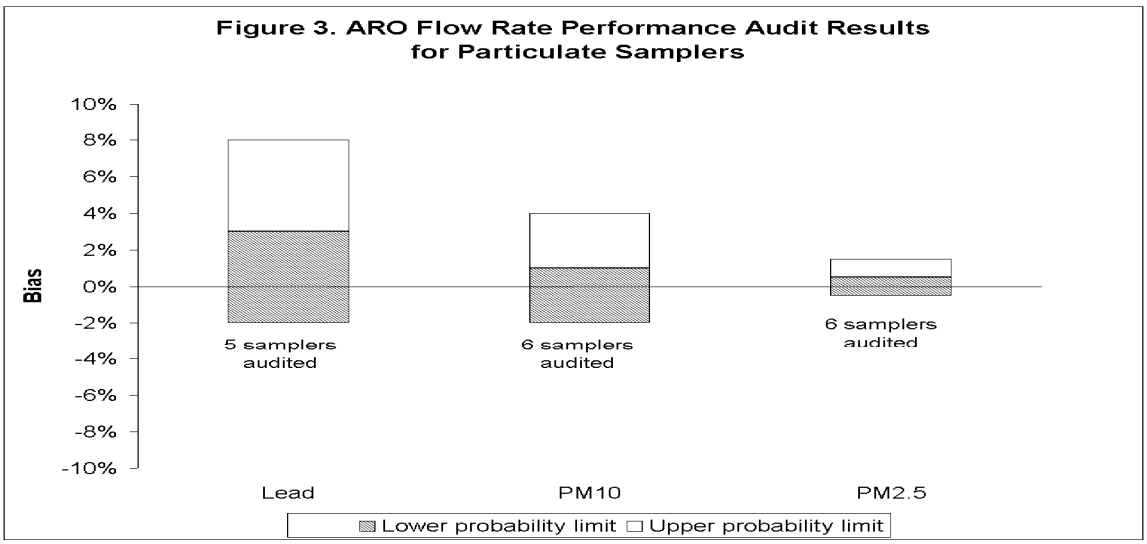
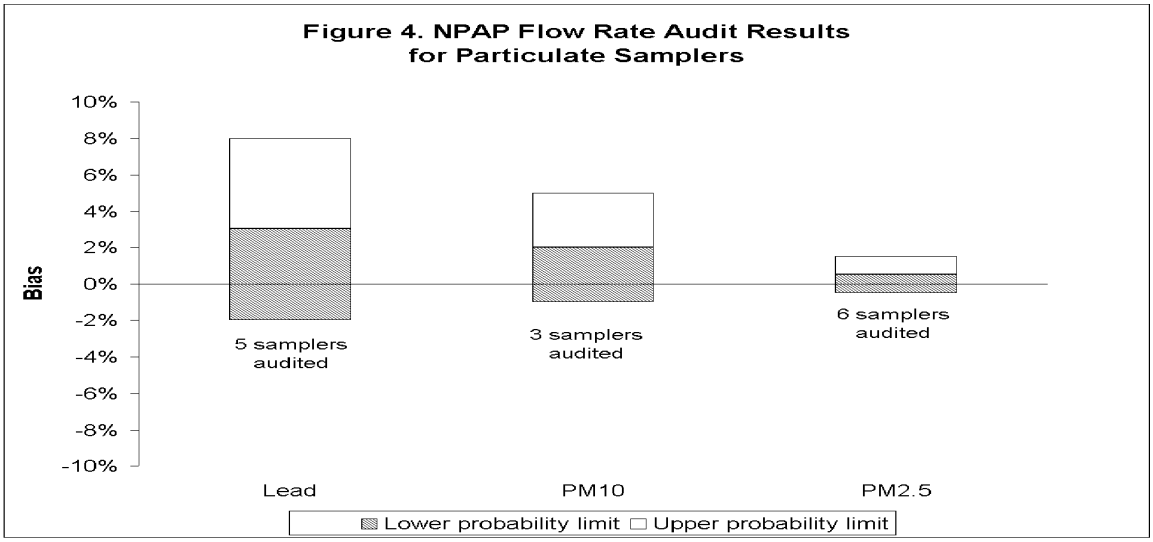


Figure 4 shows the results of external flow rate audits for PM_{10} and lead samplers performed with the National Performance Audit Program (NPAP) which is administered by the U.S. EPA. Currently NPAP audits of $PM_{2.5}$ samplers involve sampler collocation rather than flow rate checks.



Measurement Bias

Measurement bias is evaluated for $PM_{2.5}$ analyzers by collocated sampling using a audit sampler. For internal audits, the collocated measurements provide an estimate of bias resulting from sampler operations. For external NPAP audits, the collocated measurements provide an estimate of bias resulting from both sampler and laboratory operations. Measurement bias for lead is evaluated by use of standard lead test samples. This provides an estimate of the bias resulting from laboratory operations. The results of the annual performance audits of $PM_{2.5}$ and lead conducted by ARO personnel are shown in Figure 5, below.

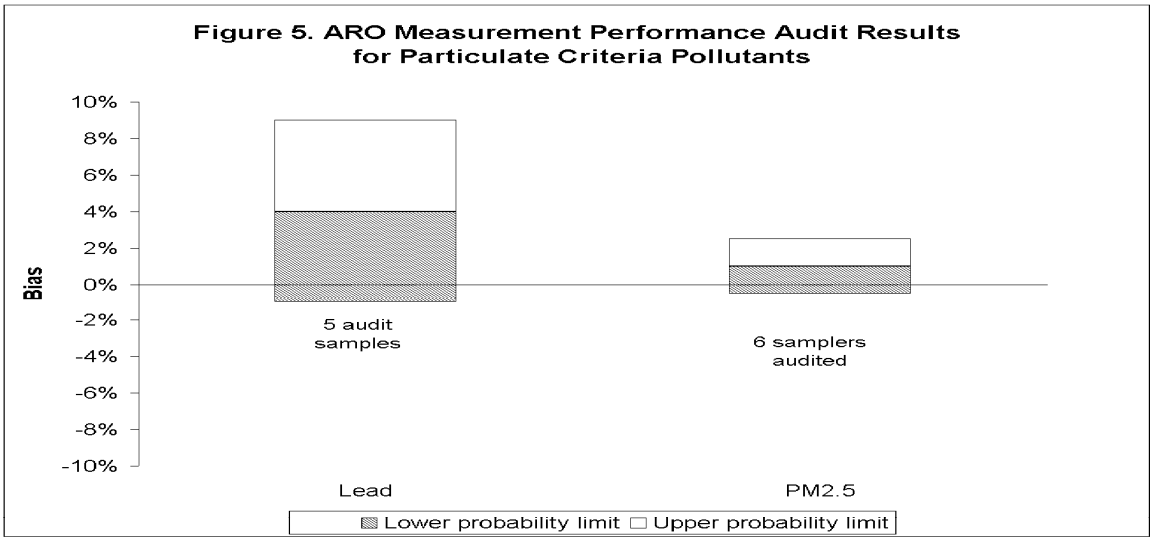
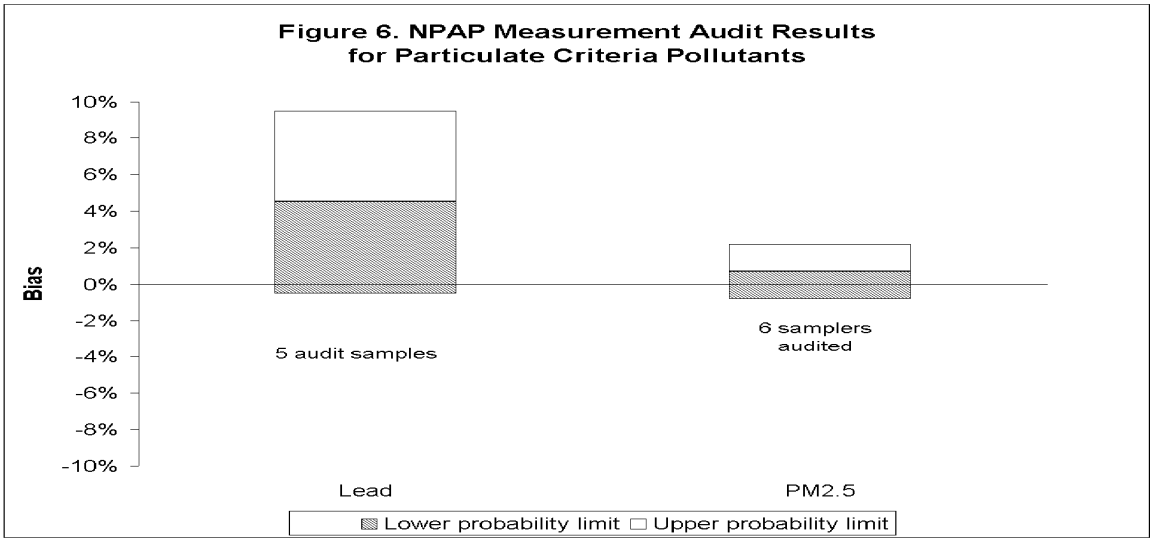


Figure 6 shows the results of external performance audits for PM_{10} and lead performed with the National Performance Audit Program (NPAP) which is administered by the U.S. EPA.



System Audits

Systems audits were performed at approximately one fourth of the sites and at the central analytical laboratory during calendar year 2000. These audits evaluated areas such as siting criteria, equipment operation and maintenance, operator training, recordkeeping, and served as a general review of site operations. No significant problems were observed, except for the following:

- The Towntwo site was shadowed by a 20 story office building which was recently completed. This site was closed in July 2000.
- The Townfour site had problems with repeated vandalism. A new, more secure, fence was installed in April and the sheriff's department increased patrols in the area to prevent reoccurrences.

No significant problems were found in the laboratory audits, except for failure to keep maintenance logs on several newly acquired analytical instruments. New logs were obtained and personnel instructed on their use. A spot check, approximately one month later, indicated the logs were in use.

TOTAL AND SPECIATED VOLATILE ORGANIC COMPOUNDS (PAMS)

The Acme Reporting Organization monitors the ambient concentrations of ozone precursors (volatile organic compounds [VOCs], carbonyls, and nitrogen oxides that can produce the criteria pollutant ozone). This monitoring is conducted as part of the Photochemical Assessment Monitoring Stations (PAMS) network. Nitrogen dioxide (one of the nitrogen oxides measured in PAMS) is also a criteria pollutant and its measurement is described under the gaseous criteria pollutant section, above. Total nitrogen oxides (NO_x) measurements are obtained continuously by a network of automated stations. Volatile organic compounds (VOCs), excluding carbonyls, are measured by continuous analyzers (on-line gas chromatographs) at selected sites. The remaining sites use automated samplers to collect VOC canister samplers which are then transported to the laboratory for analysis. Carbonyls are collected in adsorbent sampling tubes, which are transported to the laboratory for analysis.

PROGRAM UPDATE

At the beginning of 2000, the Acme Reporting Organization operated 5 ambient air monitoring stations that measured ozone precursors. On March 1, 2000, a station was opened at Townone to monitor VOCs, carbonyls, and NO_x.

QUALITY OBJECTIVES FOR MEASUREMENT DATA

The Quality Objectives for the Acme Reporting Organization's ambient air monitoring of ozone precursors are shown in Table 9, below.

Table 9. Quality Objectives for Ozone Precursors

Data Quality Indicator	Objective
Precision (NO_x)	±10%
Precision (VOC, Carbonyls)	±25%
Bias (NO_x)	±15%
Bias (VOC, Carbonyls)	±20%
Completeness	75%
Promptness	100%

DATA QUALITY ASSESSMENT

Summary

Assessment of the data quality for ozone precursors showed that all instruments met goals for accuracy, precision, completeness, and promptness. System audits showed siting problems at two sites, both of these were corrected promptly.

Promptness and Completeness

At least 75 percent of scheduled monitoring data must be reported. All data must be submitted within six months after the end of the reporting quarter. Table 10 summarizes promptness and completeness data for ozone precursors.

Table 10. Data Quality Assessment for Promptness and Completeness

Ozone precursor	Promptness	Completeness
Carbonyls	100%	80%
Nitrogen Oxides (NO_x)	100%	96%
Total VOCs (Total non-methane hydrocarbons)	100%	87%
Speciated VOCs	100%	83%

Precision

At least once every two weeks, precision for nitrogen oxides (NO_x) and automated VOC analysis were determined by sampling a gas of known concentration. Precision for manual VOC sampling and carbonyl sampling is obtained by analysis of duplicate samples. Duplicates are taken at a frequency of one duplicate for every 10 samples. Table 11 summarizes the precision check results for 2000.

Table 11. Data Quality Assessment for Precision

Ozone precursor	Precision checks completed	Precision checks within limits
Carbonyls	91%	90%
Nitrogen Oxides (NO_x)	98%	97%
Total VOCs (Total non-methane hydrocarbons)	90%	91%
Speciated VOCs	95%	80%

Bias

The results of the annual performance audits conducted by ARO personnel are shown in Figure 7, below. For NO_x and the automated VOC analyzers, the center line represents the average bias across all sites (i.e., with all sites weighted equally). For the carbonyl and manual VOC analyses, the center line represents the average of all audit samples for the central analytical laboratory. The lower and upper probability limits represent the boundaries within which 95 percent of the individual bias values are expected to be distributed. Carbonyl and Total VOC measurements represent the average of all audit species.

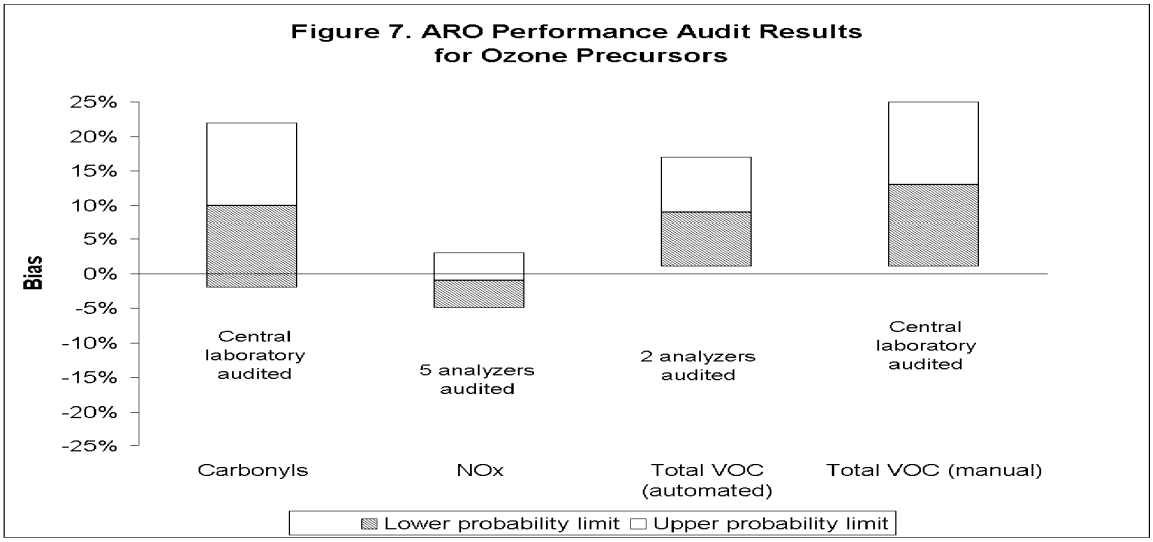
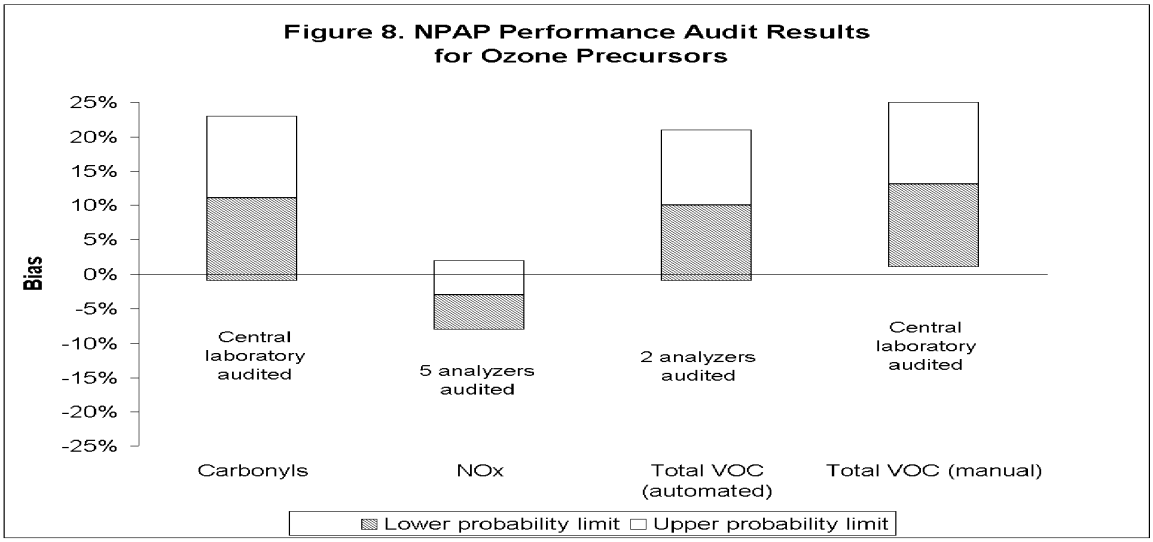


Figure 8 shows the results of the external performance audits performed with the National Performance Audit Program (NPAP) which is administered by the U.S. EPA.



System Audits

Systems audits were performed at two sites during calendar year 2000. These audits evaluated areas such as siting criteria, analyzer and sampler operation and maintenance, operator training, recordkeeping, and serve as a general review of site operations. In general both sites were performing well except for the following:

- The Townsix site had vegetation which had grown too close to the analyzer inlet probes. The vegetation was removed within one week, with assistance from the County Parks and Recreation Department.

A systems audit was also performed at the central analytical laboratory. Results were good with only minor items noted for improvements.

AIR TOXICS

The Acme Reporting Organization monitors the ambient concentrations of air toxic compounds. Three different methods are used, depending on the class of air toxic compound. Volatile organic compounds (VOCs), excluding carbonyls, are measured by continuous analyzers (on-line gas chromatographs) at selected sites. The remaining sites use automated samplers to collect VOC cannister samplers which are then transported to the laboratory for analysis. Carbonyls are collected with adsorbent sampling tubes, which are transported to the laboratory for analysis. Inorganic compounds are collected on $PM_{2.5}$ filters (as part of particulate criteria pollutant monitoring) and analyzed (after weighing for $PM_{2.5}$ mass) by inductively coupled plasma mass spectrometry (ICP MS). This monitoring is conducted as part of the Air Toxics monitoring network.

PROGRAM UPDATE

At the beginning of 2000, the Acme Reporting Organization operated five ambient air monitoring stations that measured ambient air toxics. On March 1, 2000, a station was opened at Townone to monitor air toxics.

QUALITY OBJECTIVES FOR MEASUREMENT DATA

The Quality Objectives for the Acme Reporting Organization's ambient air monitoring of ambient air toxics are shown in Table 12, below.

Table 12. Quality Objectives for Air Toxics

Data Quality Indicator	Objective
Precision	±25%
Bias	±25%
Completeness	75%
Promptness	100%

DATA QUALITY ASSESSMENT

Summary

Assessment of the data quality for ambient air toxics showed that all instruments met goals for accuracy, precision, completeness, and promptness. System audits showed siting problems at two sites, both of these were corrected promptly.

Promptness and Completeness

At least 75 percent of scheduled monitoring data must be reported. All data must be submitted within six months after the end of the reporting quarter. Table 13 summarizes promptness and completeness for ambient air toxics monitoring data.

Table 13. Data Quality Assessment for Promptness and Completeness

Pollutant	Promptness	Completeness
Carbonyls	100%	78%
Volatile organic compounds	100%	84%
Inorganic compounds	100%	87%

Precision

At least once every two weeks, precision for automated VOC analysis is determined by sampling a gas of known concentration. Precision for manual VOC sampling, carbonyl sampling, and inorganic sampling is obtained by analysis of duplicate samples. Duplicates are taken at a frequency of one duplicate for every 10 samples. Table 14 summarizes the precision check results for 2000.

Table 14. Data Quality Assessment for Precision

Pollutant	Precision checks completed	Precision checks within limits
Carbonyls	91%	90%
Volatile organic compounds	98%	97%
Inorganic compounds	90%	91%

Bias

The results of the annual performance audits conducted by ARO personnel are shown in Figure 9, below. For the automated VOC analyzers, the center line represents the average bias across all sites (i.e., with all sites weighted equally). For the carbonyl, manual VOC, and inorganic analyses, the center line represents the average of all audit samples for the central analytical laboratory. The lower and upper probability limits represent the boundaries within which 95 percent of the individual bias values are expected to be distributed. All measurements represent the average of all audit species.

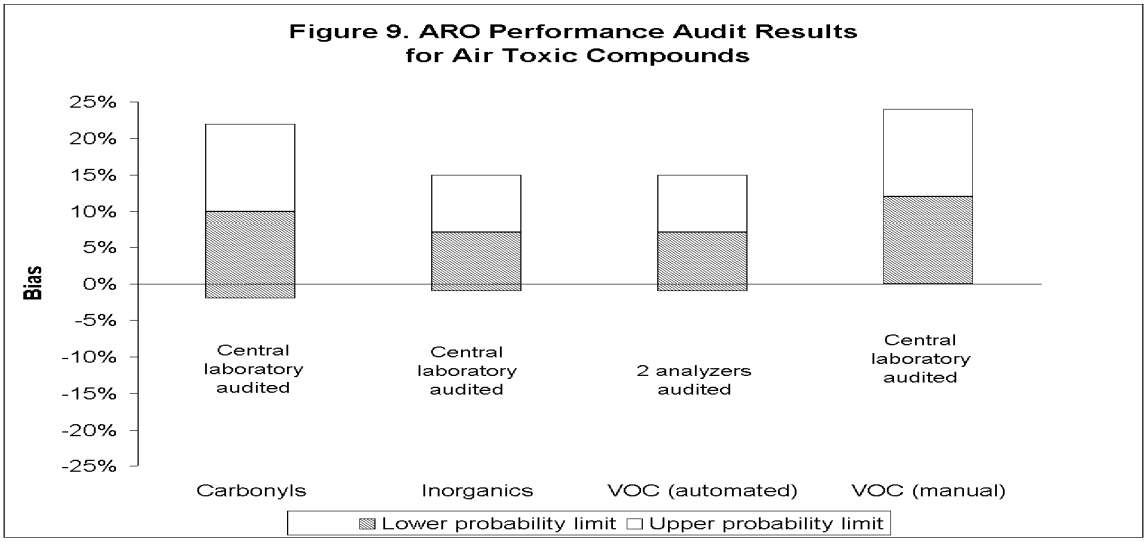
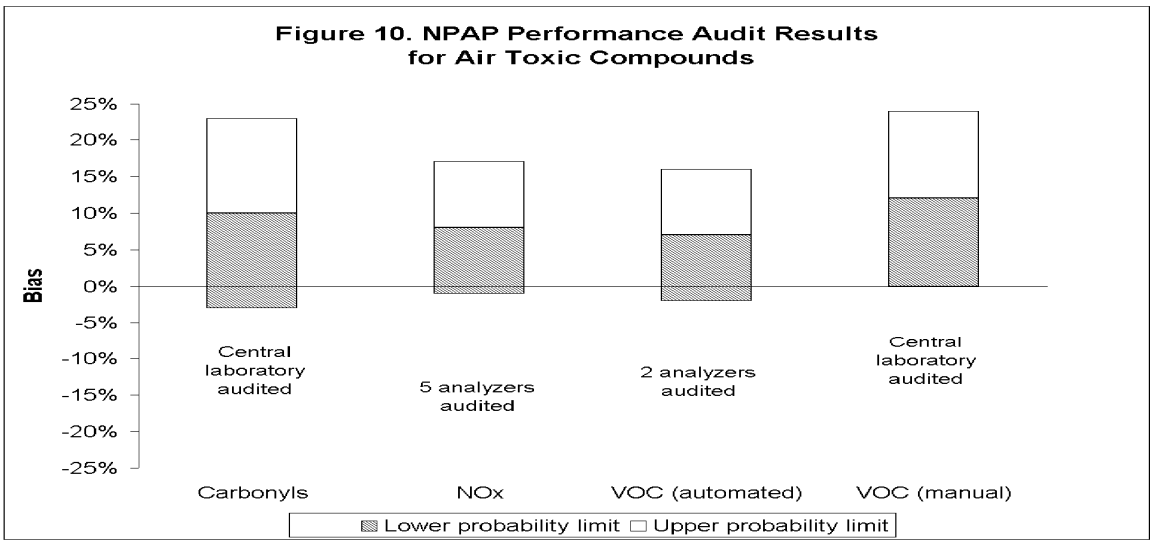


Figure 10 shows the results of the external performance audits performed with the National Performance Audit Program (NPAP) which is administered by the U.S. EPA.



System Audits

Systems audits were performed at two sites during the calendar year 2000. These audits evaluated areas such as siting criteria, analyzer and sampler operation and maintenance, operator training, recordkeeping, and serve as a general review of site operations. No significant problems were found, except for the following:

- The Townsix site had vegetation which had grown too close to the analyzer inlet probes. The vegetation was removed within one week, with assistance from the County Parks and Recreation Department.

A systems audit was also performed at the central analytical laboratory. No significant problems were found.

Example of Corrective Action Form

A corrective action request should be made whenever anyone in the reporting organization notes a problem that demands either immediate or long-term action to correct a safety defect, a operational problem, or a failure to comply with procedures. A typical corrective action request form, with example information entered, is shown below. A separate form should be used for each problem identified.

The corrective action report form is designed as a closed-loop system. First it identifies the originator, that person who reports and identifies the problem, states the problem, and may suggest a solution. The form then directs the request to a specific person (or persons), i.e., the recipient, who would be best qualified to "fix" the problem. Finally, the form closes the loop by requiring that the recipient state how the problem was resolved and the effectiveness of the solution. The form is signed and a copy is returned to the originator and other copies are sent to the supervisor and the applicable files for the record.

ARO - Corrective Action Request

Part A - To be completed by requestor

To: *John S. Visor*

Organization Responsible for Action *ARO Ambient Air Monitoring Section*

Urgency:

☐ Emergency (failure to take action immediately may result in injury or property damage)

☐ Immediate (4 hours) ☒ Urgent (24 hours) ☐ Routine (7 days)

☐ As resources allow ☐ For Information only

From: *William Operator* phone: *(000) 555 - 1000*

fax: *(000) 555 - 1001* e-mail: *billo@localhost*

Copies to:

(Always send a copy to the ARO Site Coordinator at 115 Generic Office Building, Townone XX, 00001)

Problem Identification

Site(Location): *Townsix site*

System: *sample inlet*

Date problem identified: *Aug. 1, 2000*

Nature of problem: *Glass sample inlet and dropout trap broken during removal of weeds from site*

Recommended Action: *Replace broken parts*

Signature: *William Operator* Date: *Aug. 1, 2000*

Part B - to be completed by responsible organization

Problem Resolution

Date corrective action taken: *August 4, 2000*

Summary of Corrective Action: *Replacement parts were ordered and received. The new parts were installed within three days of the request. Data from the days with a cracked sample inlet will be flagged as questionable.*

Effectiveness of corrective action: *Sample inlet restored to new condition.*

Signature: *John Visor* Date: *Aug. 4, 2000*

Phone: *(000) 555 - 2000* Fax: *(000) 555 - 2001*

e-mail: *jsv@localhost*

Send copies of the completed form to the requestor and the ARO Site Coordinator at 115 Generic Office Building, Townone XX, 00001)

ARO form CAR-1 , May 1, 1999

NORTH DAKOTA
DEPARTMENT of HEALTH

Quality Assurance/Quality Control Documentation

Title: Quality Assurance Project Plan for State of North Dakota Ambient Air Monitoring Program

Prepared By: Division of Air Quality, Air Quality Monitoring Branch

Date: July 1, 2006

Authorizations

Title	Name	Signature
Program Manager	Dan Harman	
QA Coordinator	Dana Mount	
DAQ Director	Terry O'Clair	
EHS Chief	L. David Glatt	

Revision History

Revision	Change Description	Date	Authorization
5	New title page, SOP updates, and updates to reflect new analyzers	8/1/2005	

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Distribution List

This quality assurance project plan has been organized according to guidance provided in the EPA document entitled "EPA Requirements for Quality Assurance Project Plans" to ensure that environmental and related data collected, compiled, and/or generated for this program are complete, accurate, and of the type, quality and quantity required for the intended use. The work conducted by the North Dakota Department of Health will be in conformance with the Quality Management Plan for the Department's Environmental Health Section (NDHD 2000) and with the procedures described in this QAPP. The Manager, Air Quality Monitoring (AQM) Branch, is responsible for coordinating the development of new sections of the plan and revisions to existing sections.

An official list of personnel receiving the plan is included below:

1. Manager, AQM Branch (Quality Assurance Representative), Division of Air Quality, NDHD.

2. Electronics Equipment Technicians, AQM Branch, Division of Air Quality, NDHD.

3. Quality Assurance Coordinator, EHS, NDHD (Volume I only)

A.3 Problem Definition/Background

A.3.1 Background

The North Dakota Department of Health, Division of Air Quality, has the primary responsibility of protecting the health and welfare of North Dakotans from the detrimental effects of air pollution. To that end, the Division of Air Quality ensures that the ambient air quality in North Dakota is maintained in accordance with the levels established by the State and National Ambient Air Quality Standards (AAQS) and the Prevention of Significant Deterioration of Air Quality (PSD) Rules. For the current State ambient air quality standards see the "North Dakota Air Pollution Control Rules," Section 33-25-02 (Ambient Air Quality Standards). The Federal standards are in 40 CFR 50. To carry out this responsibility, the Division of Air Quality operates and maintains a network of ambient air quality monitors.

A.3.2 Monitoring Objectives

The monitoring objectives of the Department are to track those pollutants that have the potential to cause identified adverse effects to human health and the environment.

A.3.4 Site Selection Criteria

All ambient air quality monitoring sites shall be located so that the data can be readily used to evaluate compliance with Ambient Air Quality Standards (AAQS) and Prevention of Significant Deterioration (PSD) air quality increments. Other considerations are long range transport/visibility impacts, background pollutant levels, source impact, and population exposure.

All monitoring sites shall be located to meet the monitoring and quality assurance requirements established in Reference 1 and the provisions contained in this QA Plan.

A.4 Project/Task Description

A.4.1 Organization

The North Dakota Department of Health (Department) air quality monitoring program is administered by the Division of Air Quality, Air Quality Monitoring Branch. The network is operated by Air Quality Monitoring Branch personnel with assistance from local site operators who take care of routine operations that must be performed on a frequent basis. Analysis of pollutants which require laboratory facilities are performed by IML Air Science, Sheridan, WY.

The organization of the Department is shown in Figure 1. The basic organization of the personnel involved in the ambient air quality monitoring program is shown in Figure 2.

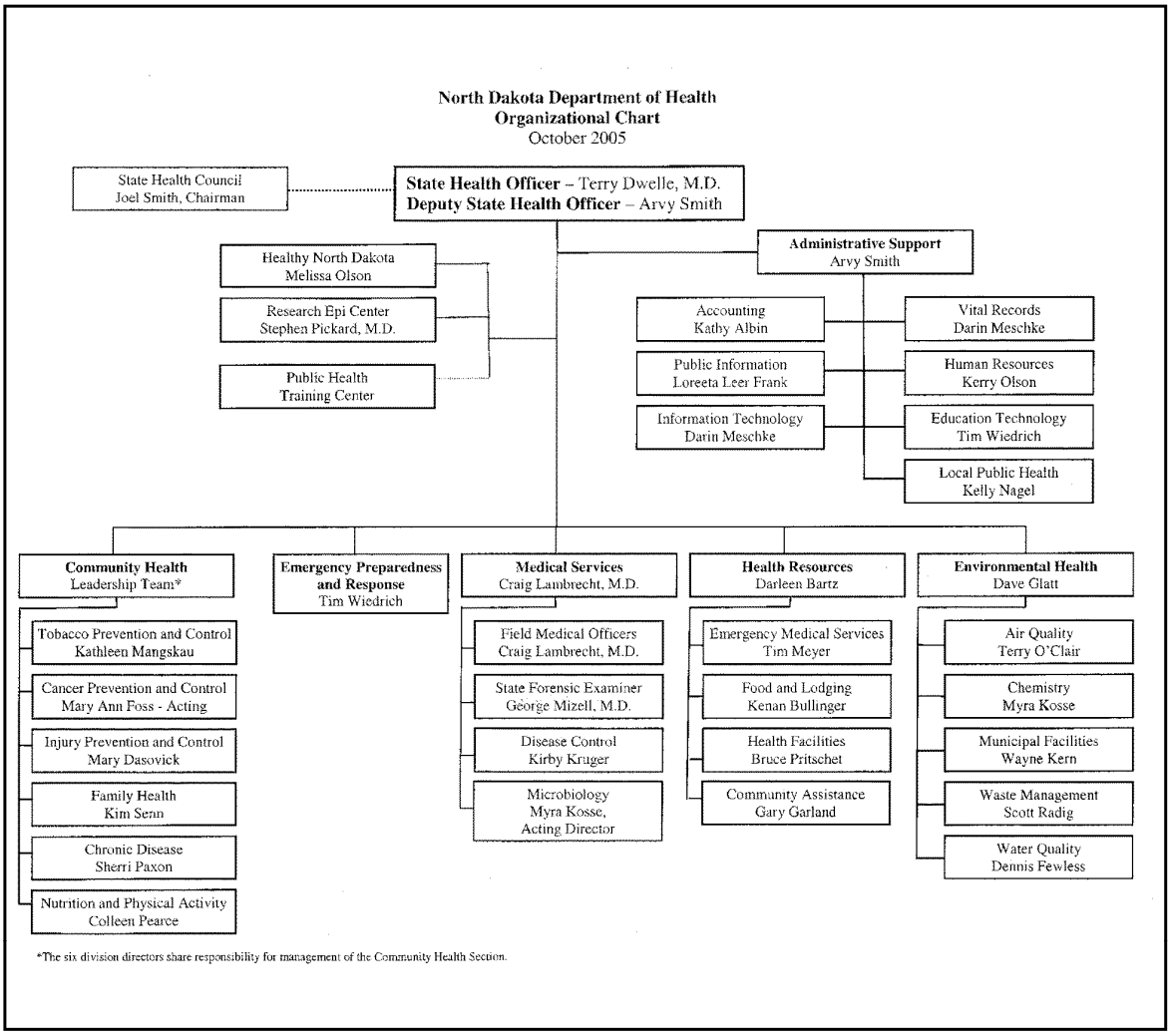

Figure 1 Department Organizational Chart

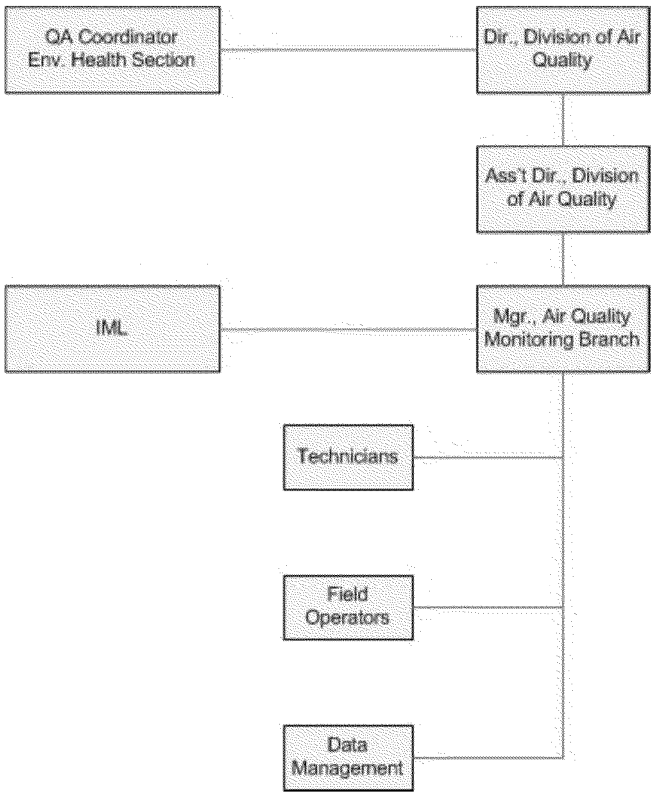

Figure 2 Relationship among Personnel with Respect to the Qaulity Assurance Project Plan

A.4.2 Responsibilities

A.4.2.1 QA Coordinator, Environmental Health Section

Enhance and maintain overall QA throughout the Environmental Health Section. Act as the communication focal point on QA matters between the Environmental Health Section and the EPA Region VIII office in Denver.

A.4.2.2 Manager, Air Quality Monitoring (AQM) Branch

The responsibilities include: 1) The development and implementation of air quality monitoring plans and procedures; 2) Operation of the branch; 3) Quality Assurance Representative for the Division of Air Quality and in that capacity is responsible to the Environmental Health Section Quality Assurance Coordinator; 4) Responsible to the Division's Director to ensure that the AQM Branch staff and the laboratory provide ambient air quality data and reports that meet the

goals specified in Section A.5; and, 5) Identify equipment, personnel, and training needs.

A.4.2.3 Electronic Equipment Technician

Responsibilities include: 1) Report to the AQM Branch Manager for the routine operation, maintenance and repair of manual and continuous ambient air monitoring equipment; 2) Perform and document quality assurance activities associated with assigned monitoring sites; and, 3) Edit and review continuous monitoring data and the acceptance or rejection of data based on the results of level one zero/span checks.

A.4.2.4 On-Site Field Operator

Performs routine non-technical tasks pertaining to the operation of the PM_{10} samplers. The primary tasks are sample set up, take down, and mailing filter samples.

A.4.2.5 Data Management

Responsibilities include: 1) Report to the AQM Branch Manager for the processing of the ambient air quality data; 2) Receives continuous method data from the Electronic Equipment Technicians and manual method data from the laboratories and processes the data using the Division's and EPA's computer facilities; and 3) Prepares various data reports and listings for distribution to requesting agencies, industries, public and other staff members.

A.4.2.6 Laboratory Activities

A laboratory is responsible for the analysis of those samples that require manual analysis. The laboratory techniques and quality assurance activities for PM_{10} and $PM_{2.5}$ filters are coordinated with the AQM Branch Manager to assure agreement and compliance with EPA requirements. The EPA has oversight of the speciation contract laboratory techniques and quality assurance for speciation filters.

A.4.2.7 Contract Laboratories

The PM_{10} and $PM_{2.5}$ filters are sent to IML

A.4.2.8 Monitoring Sites

All sites in the network are designated as State and Local Monitoring sites (SLAMS) unless the site is specifically designated a Special Purpose Monitor (SPM). An SPM site is established for a specified time period not to exceed three years and collects data used for compliance investigation or source emissions investigation. A list of monitoring sites and the parameters monitored at active and terminated sites is available on EPA's AIRS-AQS data management system.

A.4.3 Project Description

The Division of Air Quality (DAQ) has the primary objective of protecting the health and welfare of North Dakotans from the detrimental effects of air pollution. As such, the Division has a responsibility to ensure that the ambient air quality in North Dakota is maintained in accordance with the levels established by State Ambient Air Quality Standards (AAQS), and the Prevention of Significant Deterioration of Air Quality (PSD) Regulations.

The Division of Air Quality, Air Quality Monitoring (AQM) Branch has the overall responsibility for administering the ambient air quality monitoring program for the state. As a part of this program, the AQM Branch is responsible for, and applies, quality assurance practices to all phases of monitoring. The objective of this quality assurance program is to provide data that meet user requirements for completeness, precision, accuracy, representativeness, comparability, and dependability such that the data can be used to make decisions related to North Dakota's air environment.

The purpose of this quality assurance project plan is to document the quality assurance organization, responsibilities, procedures, documentation, audits, control limits, and other criteria which have been established by the North Dakota Department of Health to meet the monitoring objective noted above. The Environmental Health Section's Quality Management Plan provides the minimum required format and minimum information to be included in the Plan.

The AQM Branch's QA Manual for the Ambient Air Quality Monitoring Network, Volume II, provides specific Standard Operating Procedures (SOP's) associated with the operation and maintenance of the State's AQM program.

The Division of Air Quality operates and maintains several ambient air quality

monitoring sites. These sites vary in pollutants monitored from a single FEM $PM_{2.5}$ sampler to a multi-analyzer site equipped with continuous analyzers to measure any combination of pollutants such as FEM and continuous $PM_{2.5}$, sulfur dioxide (SO_2), oxides of nitrogen (NO, NO_2, NO_x), ozone (O_3), hydrogen sulfide (H_2S), carbon monoxide (CO), meteorological (MET) parameters, and speciation samplers (59 parameters).

For the location of the monitoring sites and the parameters monitored, see the latest Annual Network Review. Table 1 provides the activity level, records maintained, and reports in which each parameter appears.

The Department has adopted the speciation and air toxics QAPPs by reference.

Table 1 Monitoring Parameters

Parameters	Activity	Records	Reports
Sulfur Dioxide	Hourly	Tabular Listing, Electronic Strip Chart	Quarterly, Annual, Network Review
Oxides of Nitrogen	Hourly	Tabular Listing, Electronic Strip Chart	Quarterly, Annual, Network Review
Ozone	Hourly	Tabular Listing, Electronic Strip Chart	Quarterly, Annual, Network Review
MET (WS, WD, SR, BP, RH, Delta Temp, Temp)	Hourly	Tabular Listing, Electronic Strip Chart	Quarterly, Annual, Network Review
Cont. PM_{10}	Hourly	Tabular Listing, Electronic Strip Chart	Quarterly, Annual, Network Review
Manual PM_{1O}, FEM $PM_{2.5}$	24-hours every 3rd/6th day	Tabular Listing, Electronic Bench Sheets	Quarterly, Annual, Network Review
$PM_{2.5}$ Category III	Hourly	Tabular Listing Electronic Strip Chart	Quarterly, Annual, Network Review

A.5 Data Quality Objectives

Statistical limits for evaluating continuous analyzer operation and accepting data are taken from Reference 2, Section 12, Figure 12.2. Table 2 defines the criteria for interpreting audit results. If any one of the three criteria in Table 2 is unsatisfactory, the audit is unsatisfactory. Table 3 describes the quality assurance checks performed for each measurement method and the applicable correct reactions.

Continuous analyzers shall be installed in an environmentally controlled shelter with sufficient area for work space, instruments, records, QA/QC gases, etc. The shelters will be operated in conformance with the provisions in References 1 and 2 and the appropriate sections contained in this QA Project Plan, Volume II (Operations and Maintenance Manual for North Dakota State Department of Health Ambient Air Quality Monitoring Network). EPA is developing a QAPP to address both manual and continuous $PM_{2.5}$ operation.

Table 2 Criteria for Interpreting Audit Results

Slope (m)	
Excellent	≤ ±5% Difference from unity
Satisfactory	> ±5% - ±15% Difference from unity
Unsatisfactory	> ±15% Difference from unity
Intercept (b)	
Satisfactory	≤ ±3% of the analyzer range
Unsatisfactory	> ±3% of the analyzer range
Correlation Coefficient (r)	
Satisfactory	≥ 0.9950
Unsatisfactory	< 0.9950

Table 3 Measurement Method Quality Assurance Checks

Measurement	Operational Check	Control Limits		Corrective Action
		SPAN	ZERO	
Continuous SO_2, NO_2, H_2S, CO, O_3, NH_3	Bi-weekly level 1 span and zero drift check	1. <±2σ	1. ---	No adjustment recommended
		2. ±2-±3σ	2. ±0.003 PPM ±0.5 PPM*	Opt. analyzer adjust. Adjust & calibrate analyzer
		3. >±3σ	3. ±0.005 PPM ±1.0 PPM*	Calibrate, invalidate data
	Bi-weekly precision check	±1-±3σ		Adjust analyzer
	Quarterly accuracy check	≥±15%		Adjust analyzer
	Bi-weekly QA values compared to DAS values	--		Correct or invalidate data
	Bi-weekly, independent reading and comparison of DAS QA checks and strip chart values	--		Enter correct QA missing data codes
Continuous $PM_{2.5}$	Bi-weekly flow check	≤±7%		Void data and recalibrate
Meteorological	Biweekly	Observe WS & WD for proper output and alignment Compare RH to a sling psychrometer when temps are above 0EC At sites with TEOMs, compare the amb. temp. to the DeltaCal/TriCal temps.		Determine cause for error and initiate corrective action
	Annually, audit the wind system	WS: >±5%		Determine cause for error and initiate corrective action
		WD: >±3%		Initiate corrective action
	Biannually	Send solar radiation sensors in for calibration		
	Semi- annually	BP: <±10 mm Hg Temperature: <±2E C Rel. Hum: <±2%		Recalibrate Recalibrate Recalibrate

A.6 General Training Requirements

All new personnel in the Air Quality Monitoring Branch are trained in the specific functions of their job. The primary method of training is on-the-job training (OJT). Depending on prior work experience, the new employee will receive instruction from EPA sponsored formal training courses (see http://www.epa.gov/oar/oaqps/eog/).

Each new employee will be assigned to a primary trainer. The trainer familiarizes the new employee (trainee) with all aspects of the job, including data collection, reduction, checking and quality assurance procedures. The OJT portion of the training consists of the following:

1. The trainee:

    a. Becomes familiar with the quality assurance procedures as contained in the Quality Assurance Handbook.

    b. Reads and follows the specific guidance and procedures contained in the Branch's Quality Assurance Project Plan and SOP's .

    c. Accompanies and observes the trainer perform the required QA checks and operational procedures at the monitoring sites.

    d. Performs the required QA checks and operational procedures at the monitoring sites under the supervision of the trainer.

    e. Performs the required QA checks and operational procedures independently. (It is the responsibility of the trainer to ensure the checks and procedures meet the QA requirements as specified in the appropriate SOP.)

2. At such time as the trainer feels the new employee is capable of performing the required QA checks and operational procedures independently with only "normal" checking, the trainer will certify, in writing, such capability to the Manager.

Workshops, meetings, and training courses are methods of keeping current on monitoring and technological information and methodologies. Continued training and education is encouraged, and every effort should be made to take advantage of available offerings.

State Position Information Questionnaires (PIQ) are used to define the minimum basic knowledge, skills, and abilities required for each position. A copy of each PIQ is maintained by the Air Quality Monitoring Branch manager.

To ensure site operators maintain their independent contractor status, training is restricted to basic sampler operation and they are provided with a handout, outlining the service required.

B Measurement/Data Acquisition

B.1 Documentation and Records

The Department maintains a records management plan which specifies the location and retention period for network reviews, quarterly, annual, and trend reports. Other data location and retention periods are presented in Table 4. For the purpose of this table, "year" is defined as calendar year.

Table 4 Ambient Air Quality Records Management Plan

Data Type	Location	Retention Time
Raw and Edited Data	AIRNow File Server	Minimum of current year plus four previous years. Data retained is limited by disk space.
Strip Charts (Electronic)	PI Database Server	At least seven years. Duration is limited by storage limitation on the PI server.
Electronic Calibration Forms, Zero/Span/Precision Check Forms, Audit Forms	Technician laptops and mapped networked Y Drive	At least seven years. Duration is limited by storage limitation on the Y Drive.

The AIRNow, PI Database, and AQ Lab computers are backed up every Friday evening using a scheduled task to a removable disk. The AQ Lab computer is incrementally backed up Monday - Thursday evening. There are five disks in the backup set - one for each Friday in any given month.

B.2 Sampling Process Design

A combination of site types will be used that will meet the changing monitoring needs. The primary site types will be background and population exposure (see Reference 1, Appendix D, Section 1, for complete definitions). The other site type that may be employed is the special purpose monitor. Annually, a network review is performed to identify any changes required. Those changes are outlined and scheduled in a network modification plan prepared in January/February each year.

B.3 Sampling Methods Requirements

Volume II of this Quality Assurance Project Plan (Operations and Maintenance Manual for North Dakota Department of Health Ambient Air Quality Monitoring Network) contains the Standard Operation Procedures (SOP) for the sampling methods used. The SOPs included in Volume II are as follows:

Ammonia (Sec. 1.0)
- TECO 17C

Sulfur Dioxide (Sec 2.0)
- TECO 43C (Sec 2.1)
- TECO 43C-TLE (Sec 2.2)

Nitrogen Oxides (Sec 3.0)
- TECO 42C (3.1)

Ozone (Sec. 4.0)
- TECO 49C (Sec 4.1)

Wind Speed (Sec 6.0)
- METOne (6.1)

Wind Direction (Sec 7.0)
- METOne (7.1)

Inhalable Particulate (8.0, Manual)
- R&P FEM PM_{10} (Models 2000 & 2025) (Sec 8.1)
- R&P FEM $PM_{2.5}$ (Models 2000 & 2025) (Sec 8.2)

Inhalable Particulate (Continuous)
- R&P TEOM 1400A ($PM_{2.5}$) (Sec 9.1)
- R&P TEOM 1400A (PM_{10}) (Sec 9.2)

Speciation (Sec 10)
- METOne (10.1)

B.4 Sample Handling and Custody Requirements

Samples for inhalable particulate (PM_{10}, $PM_{2.5}$, speciation) and continuous data shall be subject to consistent handling procedures to protect the integrity of both the samples and the data.

$PM_{2.5}$ filters, upon receipt from EPA, are sent to the contract laboratory for weighing. PM_{10} filters are provided by the contract laboratory as a part of the billed cost. Procedures for PM_{10} and $PM_{2.5}$ filter preparation, shipping, sample analysis, and filter storage are contained in the contract laboratory's respective QA Plans. The results of the filter analysis are sent to the AQM Branch on a quarterly basis. The results are then uploaded to AQS for processing and storage.

Sample handling and chain of custody for FRM $PM_{2.5}$ and speciation samples is specified in the applicable EPA QAPP.

B.5 Analytical Methods Requirements

The analytical methods used for each of the parameters monitored are displayed in the following table.

Table 5 Analytical Methods

Parameter	**Method**
Criteria Pollutants	
Sulfur Dioxide (SO_2)	Pulse Fluorescent
Oxides of Nitrogen(NO_X),	Chemiluminescence
Ozone (O_3)	U.V. Photometric
Particulate Matter (PM_{10}, $PM_{2.5}$)	Gravimetric
Non-criteria Pollutants	
Hydrogen Sulfide (H_2S)	Pulse Fluorescent
Particulate Matter (continuous)	Gravimetric
Ammonia (NH_3)	Chemiluminescence
Wind Speed (Scalar & Vector)	Electronic Averaging
Wind Direction (Scalar & Vector)	Electronic Averaging
Solar Radiation	Electronic Averaging
Relative Humidity	Electronic Averaging
Barometric Pressure	Electronic Averaging
Temperature (inc. Delta T)	Electronic Averaging

B.5.1 Instrument Maintenance Requirements

All air quality samplers and analyzers used within the monitoring network for criteria pollutants are selected from the list of EPA designated reference or equivalent methods. All monitoring equipment (criteria, non-criteria, and meteorological) is selected for compatibility with existing equipment to facilitate familiarity with the operation and maintenance of the equipment and consistency in spare parts and supplies.

The operation of all monitoring equipment meets the requirements of this document, the guidelines provided in References 1 and 2, and the manufacturers recommendations.

Analytical methods for continuous analyzers currently used within the network are as follows:

Sulfur Dioxide: TECO 43C, (0.5 ppm) - Pulsed Fluorescence
Equivalent Method (EQSA-0486-060)
TECO 43C-TLE, (100ppb) - Pulsed Fluorescence
Equivalent Method (EQSA-????-560)

Nitrogen Oxides: TECO 42C (0.5 ppm) - Chemiluminescence
Reference Method (RFNA-1289-074)

Ozone: TECO 49C (0.5 ppm) - U.V. Photometric
Reference Method (EQOA-0880-047)

Ammonia: TECO 17C (.2 ppm) - Chemiluminescence
(Non-reference)

Meteorological Instrumentation: MetOne

Data Acquisition System: ESC
Data Acquistion Software

Analytical methods for Particulate Matter are the following:

Inhalable Particulate (PM_{10}): R&P 2000
Reference Method (RFPS-0694-098)
R&P 2025
Reference Method (RFPS-1298-127)
R&P TEOM 1400ab
Equivalent Method (EQPM-1090-079)

Inhalable Particulate ($PM_{2.5}$): MET One SASS Speciation Sampler
(Non-reference)
R&P 2000
Equivalent Method (EQPM-0202-143)
R&P 2025
Equivalent Method (EQPM-0202-145)
R&P TEOM 1400ab
(Category III non-reference)

Gravimetric Analysis

B.6 Instrument Calibration & Frequency

B.6.1 Continuous Analyzers

All continuous analyzers will be calibrated in accordance with the manufacturer's recommended procedures, the specific procedures contained in the appropriate portion of Volume II of this QA Plan and the recommendations in Reference 2, Section 12. A calibration is performed at initial installation at a site and a recalibration is performed as follows:

1. No later than six (6) months after the most recent calibration or performance audit that indicated an acceptable analyzer response.

2. Analyzer operation is interrupted for more than a few days.

3. Following any repairs that may affect the calibration.

4. Following any indication, including excessive zero or span drift, of possible significant inaccuracy of the analyzer.

As a minimum, the calibration will establish a calibration equation utilizing a zero concentration and three upscale concentrations spaced over the current analyzer operating range. A calibration establishes the relationship between an actual pollutant concentration and the analyzer response. This relationship is used to correct subsequent analyzer response values to corresponding pollutant concentrations until the next calibration is performed.

In addition to multi-point calibrations, a Level 1 zero and span check shall be performed manually on all continuous analyzers at least once every two weeks in accordance with the procedures contained in the appropriate section of Volume II of this QA Plan and requirements in 40 CFR 58, Appendix A, except under extenuating conditions. Zero and span checks shall be performed for the following reasons:

1. To provide data to facilitate analyzer adjustment for zero and span drift,

2. To provide data from which a decision can be made on when to calibrate an analyzer, and

3. To provide a decision point for data validation.

The limits established for these checks are found in Reference 2, Section 12, Figure 12.2.

Calibration and span gases used for continuous analyzers for SO_2, CO, and $NO/NO_2/NO_x$ shall be traceable to National Institute of Standards and Technology

(NIST), Standard Reference Materials (SRM) as specified in Reference 2, Section 12, and the appropriate section of Volume II of this QA Plan. Calibration and span gases shall be 110 $\pm$ 10 ppm. Gases for trace level analyzers (SO_2, NO_y, and CO) will be selected to fit the specific full scale range for each analyzer. Calibration and span gases for hydrogen sulfide (H_2S) shall be purchased and returned to the supplier for certification as necessary.

Calibration/span gases for ozone shall be traceable to an authoritative UV photometric device via transfer standards certified according to requirements and procedures specified in References 1, 2, 4, 5, 6 and Volume II of this QA Plan.

B.6.2 Manual/Continuous Particulate Methods

Inhalable particulate samplers and analyzers shall be calibrated in accordance with the manufacturer's recommended procedures, the specific procedures contained in the appropriate section of Volume II of this QA Plan, the procedures outlined in Reference 3, and the recommendations set forth in Reference 2. All flows shall be traceable to an NIST reference flow standard.

C Assessment/Oversight

C.1 Quality Control Requirements

The quality control requirements are detailed in Table 3.

C.2 Assessments and Response Actions

Performance Audits are conducted by the Environmental Protection Agency, Region VIII, in accordance with the Performance Partnership Agreement(PPA) and by the Air Quality Monitoring Branch on a quarterly basis in accordance with Section 8 of this document and the requirements of Reference 1.

As a minimum, systems audits of the type and frequency outlined in Reference 1, Appendix A and the PPA are conducted. The objective is to address documentation of methodology and assess the State's current QA program with the primary focus placed on the SLAMS pollutant monitoring program.

In addition, the Department participates in the Environmental Protection Agency's National Performance Audit Program as required in Reference 1, Appendix A.

All audit results are reviewed by the Air Quality Monitoring Branch Manager. For performance audits, either internal or National Performance Audit Program, if any part of the audit does not meet at least the satisfactory conditions (see Table 6-3), corrective action is initiated by the technician operating the site. If any part of a system audit requires corrective action, the Air Quality Monitoring Branch Manager initiates what ever action is necessary to correct the deficiency.

C.3 Data Review, Validation and Verification Requirements

For each parameter measured, internal quality control checks are conducted during routine sampling and analysis. These checks include, at a minimum, applicable control checks as specified in Reference 2, Part 1, Section 12 and those checks detailed in Volume II of this QA Plan.

A list of internal quality control checks, control limits, frequency, and required corrective actions is shown in Table 3.

C.3.1 Data Validation and Verifications Methods

C.3.1.1 Validation

The purpose of a data validation program is to screen for possible errors and to void invalid data. The digital strip charts recorders, in addition to providing back-up to the automated data acquisition system, are used as the legal record for all collected, non-calculated, data. The QA check dates and times are verified and the data voided using the appropriate missing data codes. After this procedure is completed, the data are uploaded monthly to the EPA AQS database by the Environmental Scientist.

The final level of data validation is to accept or reject monitoring data, as the data are reduced, based upon the results of level one zero/span checks discussed in Section 4. Up to two weeks of monitoring data (all data since the last zero/span check) may be invalidated if zero/span drift limits are exceeded. The decision to invalidate data ultimately will be made by the AQM Branch Manager

All validated data are entered into the EPA AQS Database. If any data are determined to be incorrect after the data have been entered into the data base, the required changes and/or voids are to be entered into the data base with the next update and the required entries are made in the "Record Book of AIRS Data Changes and Deletions." These entries shall contain the following information:

AQS Site ID, Parameter Code, Year(s), Month(s), Day(s), Hour(s)
Reason for making the change to the affected value/block of values.

C.3.1.2 Verification

Data from the continuous analyzers are stored at the sites using a data acquisition system with digital strip chart recorders as a backup. Except for sites with a phone line, a copy of data since the last site visit is made at the site approximately every two weeks and is returned to the office for processing. Should the data acquisition system fail, hourly averages are generated using the digital chart recorder data stored in the secure database. The data are reviewed on screen and checked for obvious anomalies, such as exceeding an expected range. Data are printed only as necessary. Any data anomalies are investigated on a case-by-case review of the data. Data on the technician's office computer are edited by the site operator. After the data are edited, an entry is made in a notebook signifying the data are ready for review by a second technician.

Manual sampler PM_{10} and $PM_{2.5}$ sample analysis for inhalable particulates is performed by a contract lab. The contract lab maintains its own QA Plan and

SOPs. The filter preparation and filter analysis are required to meet or exceed the QA required by EPA.

C.3.2 Reporting

All data from the North Dakota Air Quality Monitoring program will be compiled by the Air Quality Monitoring Branch. Quarterly and annual data reports in the form of data summaries and exceedance listings, and in some instances raw data, will be distributed to appropriate Division personnel. Air quality monitoring data are also available to other State agencies, industry, and the general public upon request. In addition, all related QA information can also be provided.

SLAMS data reporting requirements to EPA and precision and accuracy calculation/reporting procedures are outlined in Reference 1. These reporting requirements consist primarily of quarterly reports of SLAMS data along with the respective QA results. Any changes/deletions to the AQS Database are submitted along with new data in the next scheduled report to EPA. Industry data are reported quarterly to AQS and included in all reports.

C.3.4 High Values

All exceedances measured by the State monitoring system are examined to determine if they occurred as the result of some natural event, as defined in EPA Guideline Publication 450/4-86-007. Documentation and reporting will be in accordance with the guidelines in that document. All documentation pertaining to the event will be retained by the AQM Branch Manager and will be available for review by the public. Copies of the documentation will be forwarded to EPA, Region VIII for their concurrence/nonconcurrence as to the appropriateness of the special event designation.

C.4 Reconciliation with Data Quality Objectives

Preliminary comparisons of ambient raw data to the Data Quality Objectives (DQO) are made biweekly for continuous data and upon receipt of the laboratory results for PM data. Quarterly and annual reports are produced for interim and final comparison to the DQO. Zero and span control charts with the limits specified Reference 2, Section 12, and audit limits (Table 2) are used to determine the validity of the continuous ambient data. Precision and audit results (see Table 3) are used to determine the validity of the PM data. The AQM Branch Manager makes the final data validity determination.

D References

1. U.S. Environmental Protection Agency, Ambient Air Quality Surveillance Regulations, Code of Federal Regulations 40, Part 58, Thursday, May 10, 1979, as amended.

2. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Part 1, Ambient Air Quality Program Quality System Development, EPA-454/R-98-004, August 1998.

3. Reference Method for the Determination of Suspended Particulates in the Atmosphere (High Volume Method), Code of Federal Regulations 40, Part 50, Appendix B, as amended December 6, 1982 (47 CFR 54912).

4. 40 CFR, Part 50, Appendix D.

5. Technical Assistance Document for calibration of ambient ozone monitors. EPA publication available from EPA. Dept. E (MD-77), Research Triangle Park, NC 27711. EPA-600/4-79-057, September 1979.

6. Transfer Standards for Calibration of Ambient Air Monitoring Analyzers for Ozone, EPA Publication Available from EPA, Dept. E (MD-77), Research Triangle Park, NC 27711. EPA-600/4-79-056.

To: Carlson, Albion[Carlson.Albion@epa.gov]
Cc: cara.keslar@wyo.gov[cara.keslar@wyo.gov]; Tanner Shatto[tanner.shatto@wyo.gov]; Chris Hanify[chris.hanify@wyo.gov]
From: Kristina Hooper
Sent: Tue 10/4/2016 10:25:20 PM
Subject: 2015 Powder River Basin Network Review
2015 PRBNR1.pdf

Albion,
I have attached the 2015 Powder River Network Review for your convenience. I sent the hard copy to the Region 8 Denver office via FedEx on September 28th, 2016. If you have any questions please feel free to contact either Cara Keslar or myself.

Sincerely,

Kristina Hooper

Coal Mine Project Manager

Wyoming DEQ, Air Quality Division

200 W. 17th St., 3rd Floor

Cheyenne, WY 82002

Office: (307) 777-5108

Email: kristina.hooper@wyo.gov

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WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

Ambient Air Quality Monitoring Network Review

For Wyoming's Powder River Basin

Year 2015

9/16/2016

WYOMING DEPARTMENT OF
ENVIRONMENTAL
QUALITY

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Introduction

The Powder River Basin's (PRB's) industrial monitoring network is a network of industry-operated PM_{10} samplers situated to monitor ambient PM_{10} concentrations outside the Lands Necessary to Conduct Mining (LNCM) boundaries of the surface coal mines of Wyoming's Powder River Basin. Ambient air in Wyoming's PRB is defined in Wyoming Air Quality Standards and Regulations Chapter 2, Section 2 (c) as, *"that portion of the atmosphere, external to buildings, to which the general public has access.* ***For surface mining operations, the application of this definition will be limited to only those lands that are necessary to conduct mining operations*** *as determined by the Administrator of the Wyoming Air Quality Division."* [emphasis added]

This report is intended to cover changes in this network and notable occurrences at the monitors in this network for the year 2015. The report is organized by mine (starting with the northernmost and finishing with the southernmost) and contains information about measured ambient PM_{10} concentrations as well as data quality. All data is as reported by the facilities. Also included is information about air quality permits issued in 2015 by the State of Wyoming Air Quality Division (AQD).

PRB Mines covered by this report are listed in Table 1. All maps in this document show approximate permit boundaries and monitor locations as of December 31, 2015, and include monitors shut down in 2015. These maps are designed to serve as an overview; mine boundaries and monitor locations on maps in this document are intended to be approximate, not definitive.

Table 1: Coal Mines in the PRB

Northern Group	Middle Group	Southern Group
Buckskin	Caballo	Black Thunder
Rawhide	Belle Ayr	School Creek
Eagle Butte	Cordero Rojo	North Antelope Rochelle (NARM)
Dry Fork	Coal Creek	Antelope
Wyodak		

In the last several years, the AQD has made a significant effort to strengthen permitting requirements and implement other control strategies. On average this has resulted in fewer exceedances in the PRB, though 2015 had high wind events which increased the number of exceedances.

The AQD's strategy for meeting the PM_{10} NAAQS begins with the permitting process. Applications require a justification that proposed dust control measures comply with the Best Available Control Technology (BACT) requirements per Chapter 6, Section 2 of Wyoming Air Quality Standards and Regulations. The AQD also requires a periodic review of dust control measures as part of BACT evaluations in mine permits. For instance, one particular modification that has been successful at reducing particulate emissions is a requirement to scarify the surface of exposed acreage during mining. With the finalization of the revisions to Subpart Y the Division has been updating in modification permits, where the truck dump is an affected source, how the relative control effectiveness for the truck dump control system(s) is determinedfor an existing truck dump(s). Any truck dumps constructed or modified after April 28, 2008 are subject to the monitoring requirements under Subpart Y.

Even with the strengthening of control measures through permitting, there are cases when more control is warranted. AQD also negotiates specific controls and/or mitigation at specific mines/industries or regions. Inrecent cases, mines with real-time monitoring in place have been required to develop dust action plans intended to establish action levels

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corresponding to high levels of fugitive dust based on real time monitor data. These dust action plans are then incorporated in the mine's air quality permits as enforceable permit conditions to create clear action levels for the mine personnel.

Additionally, since coal removal is continually changing location at the mines, all AQD permits issued since 2007 require annual demonstrations that a mine's monitors are properly sited. Required in this Network Demonstration (also known as Network Justification) is a map with a five-year projection of mining activities, the mine's current LNCM boundary, current monitor locations, and an annual wind rose. Based on review of this information, the AQD has required mines in the State to alter their monitoring network in order to more accurately characterize the facility's impact on ambient air.

The Monitoring Section is in the process of ensuring that all monitors, even upwind monitors that were sited before the concept of the LNCM was added to the Wyoming Air Quality Standards and Regulations (WAQSR), are sited outside a facility's LNCM boundary. In cases where a facility has a monitor inside their LNCM the Monitoring Section will require that these monitors be relocated at new sites, which meet current siting criteria for ambient monitoring as opportunities arise.

Quarterly, all mines are required to submit both EPA Air Quality System (AQS) text files and written reports to the Division for individual review. The reviewer looks for appropriate Quality Assurance (QA) checks, ensures the audit schedule was followed, looks at agreement between collocated monitors, calculates collection efficiency and performs an overall review of the data collected and submitted by each mine. Summary data is collected and shared with other sections within the AQD as appropriate.

Currently there are several pairs of samplers in the PRB that are collecting data on an offset 1 in 6schedule. These samplers are referred to as main and satellite samplers and the data from the two samplers ateach site is aggregated and reported to the AQD as 1 in 3 data. Historically, this was done to allow fewer trips to remote sampling sites where, especially during bad weather, travel might be unsafe or impossible. Starting in first quarter 2015, the AQD has required all facilities using this configuration to report each sampler separately under a unique parameter occurrence code (POC) in the EPA's database, AQS. This applies to eight (8) sites in the Powder River Basin.

The Natural Events Action Plan (NEAP) for coal mines in Campbell and Converse County was created to establish criteria under which a PM_{10} reading greater than 150 $\mu g/m^3$ could be flagged as due to a high wind event. The NEAP, which was approved by EPA in 2007, describes the BACT, Best Available Control Measures (BACM), and reactionary measures that are intended to control PM_{10} emissions during wind events in excess of 20 mph. Additionally, coal mines may also have exceedances that potentially qualify under 40 CFR Part 50.14 as exceptional events. Facilities may submit a request and demonstration to the AQD to flag exceedances as exceptional events. Recently, during an internal review of the NEAP document and process, AQD staff noted that the NEAP and Exceptional Event rule were very similar. Ultimately, on March 3, 2014 the AQD review team decided to retire the NEAP and rely on the Exceptional Event Rule, though certain elements of the NEAP, such as the high wind threshold developed for the PRB and the high wind/ blowing dust notifications issued in cooperation with the National Weather Service, would be preserved.

For the year 2015, all mines in the PRB are meeting the National Ambient Air Quality Standards for Particulate Matter (PM_{10} NAAQS). Three exceedances of the PM_{10} NAAQS occurred in the PRB in March 2015 and four exceedances occurred in November 2015 due to high wind events in the area. Exceptional Event packets were submitted by the facilities to the AQD for these exceedances. The AQD agreed with the demonstrations through the AQD review process and have submitted the Exceptional Event packets to the Region 8 EPA. All exceedances that have occurred in the Powder River Basin for the past three years are listed in Table 2.

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Table 2: Powder River Basin Exceedances in the Last Three Years (2013-2015)

Facility	Site Name	AQS Site ID	24 Hour Average	Date	Collection Efficiency (Quarter)
Black Thunder Mine	36	56-005-0891	166*	03/04/2013	95.6
School Creek Mine	SC-3	56-005-0086	171+	10/23/2014	97.8
Antelope Mine	6 Site TEOM	56-009-0851	175*	03/28/2015	86.7
North Antelope Rochelle Mine	NA-8	56-009-0088	276*	03/28/2015	100
North Antelope Rochelle Mine	RO-1	56-005-0869	191*	03/28/2015	100
North Antelope Rochelle Mine	NA-8	56-009-0088	267*	11/18/2015	89.1
Rawhide Mine	Hilltop	56-005-0826	253*	11/18/2015	96.7
Wyodak Mine	5 Site	56-005-5555	187*	11/18/2015	87
Wyodak Mine	6 Site	56-005-6666	351*	11/18/2015	90.2

* AQD accepted exceptional event flag under 50.14. Currently pending EPA approval.

+ No Exceptional Event demonstration was submitted for this exceedance.

In 2015, no monitors were shut down.

In 2015, one (1) new monitor was added to the network; Antelope added a monitor named 7PM10 on February 5th.

Table 3: PRB Monitors Started Up in 2015

Antelope	7PM10	02/05/2015

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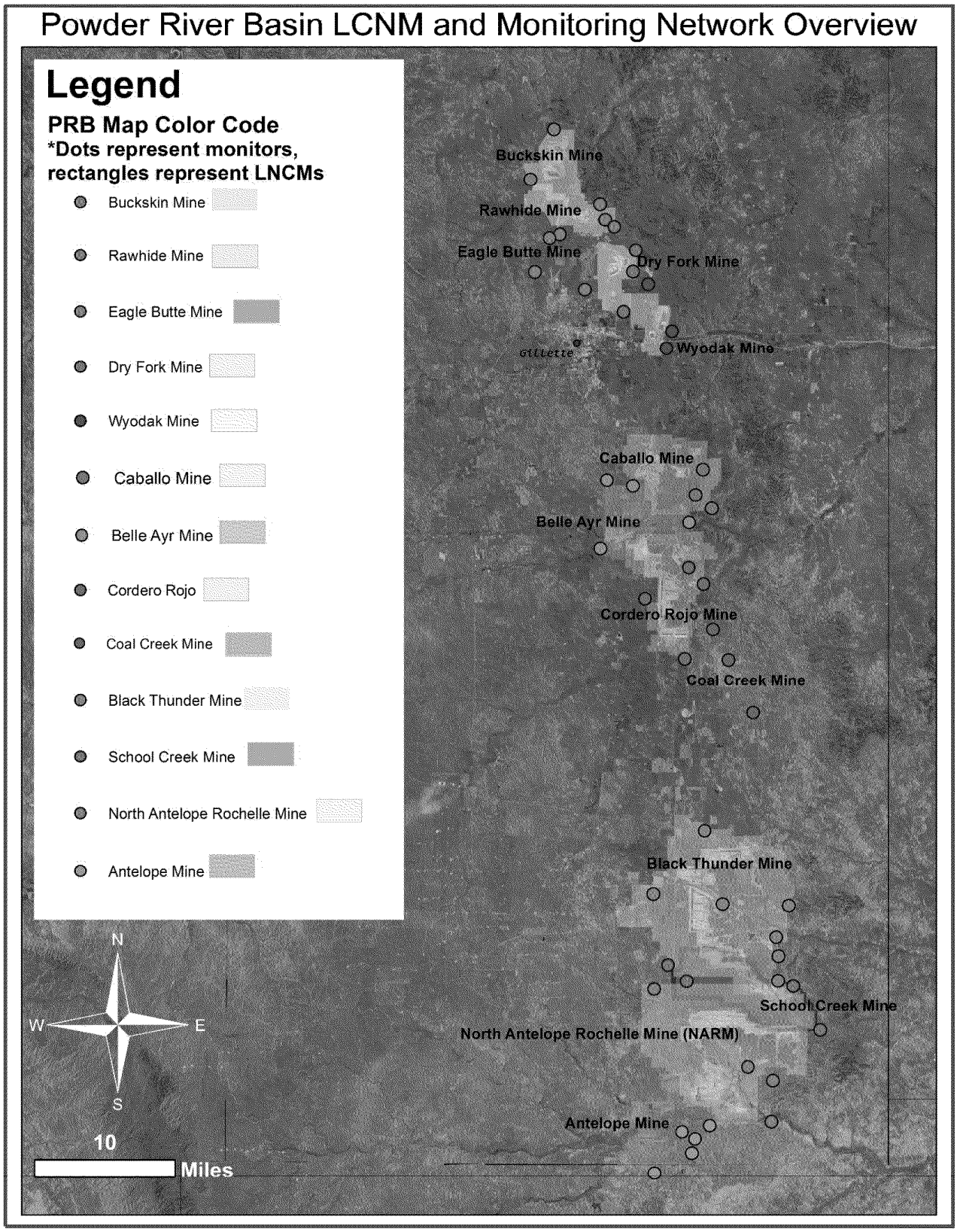
Powder River Basin Overview Map with LNCM Permit Boundaries



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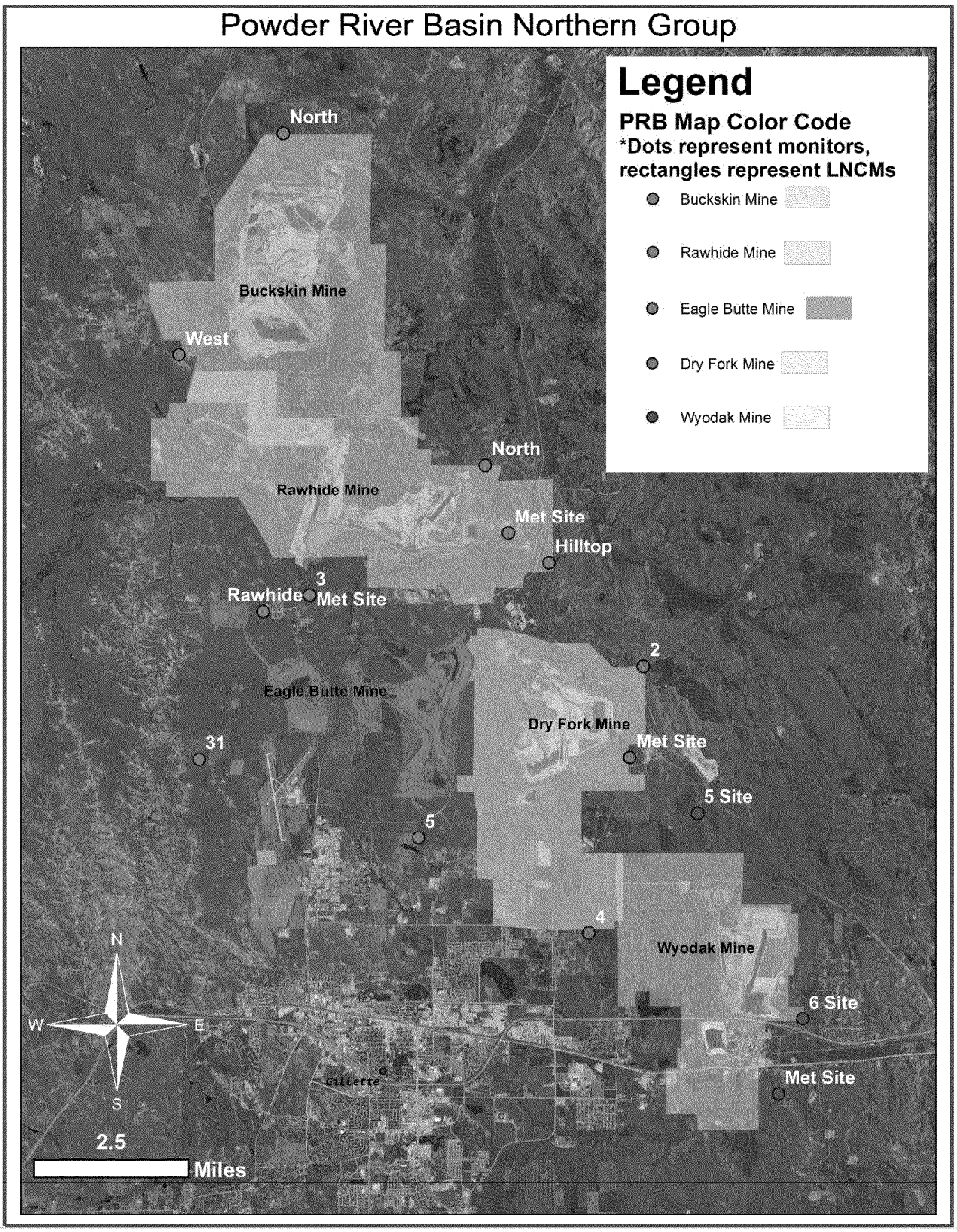
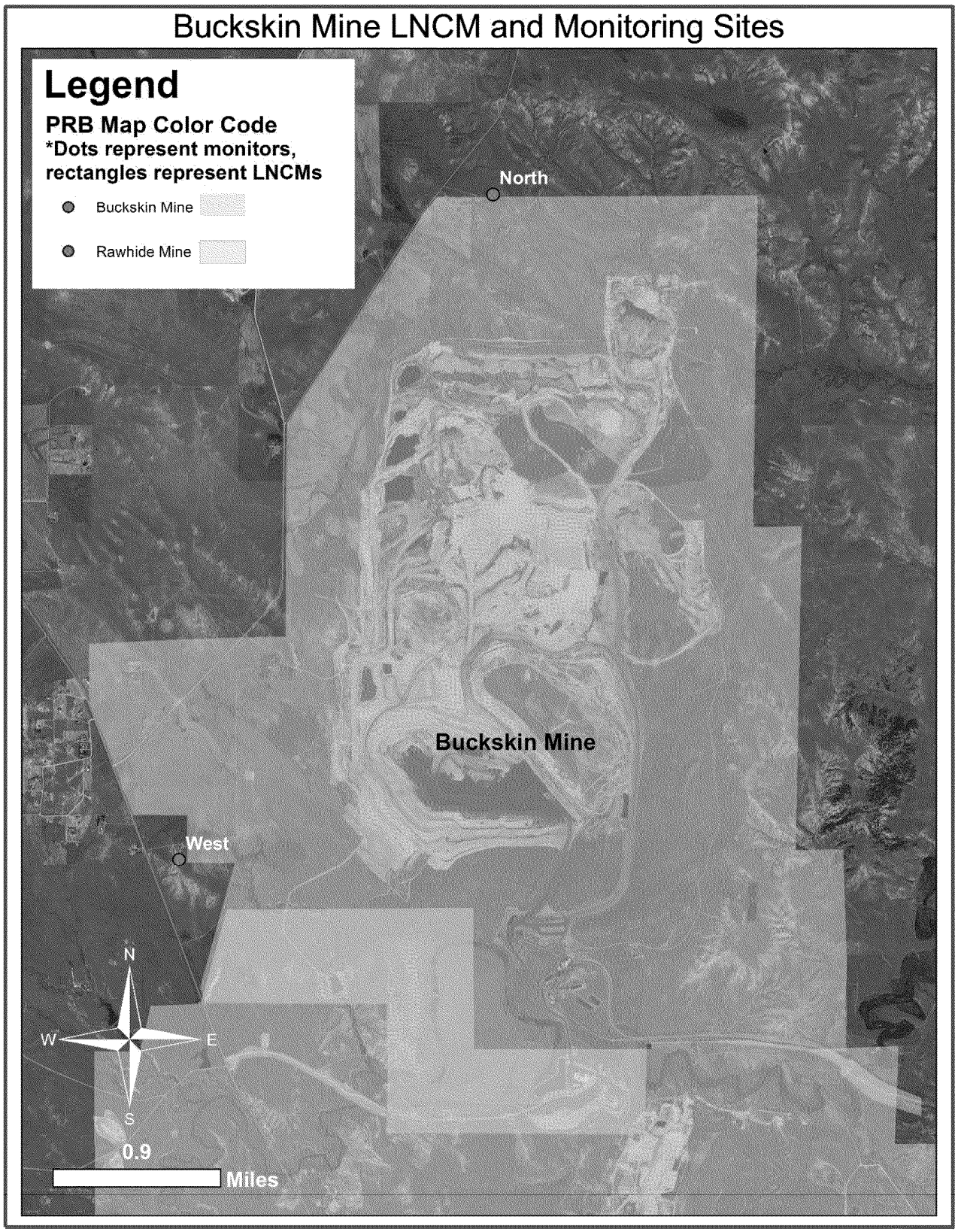
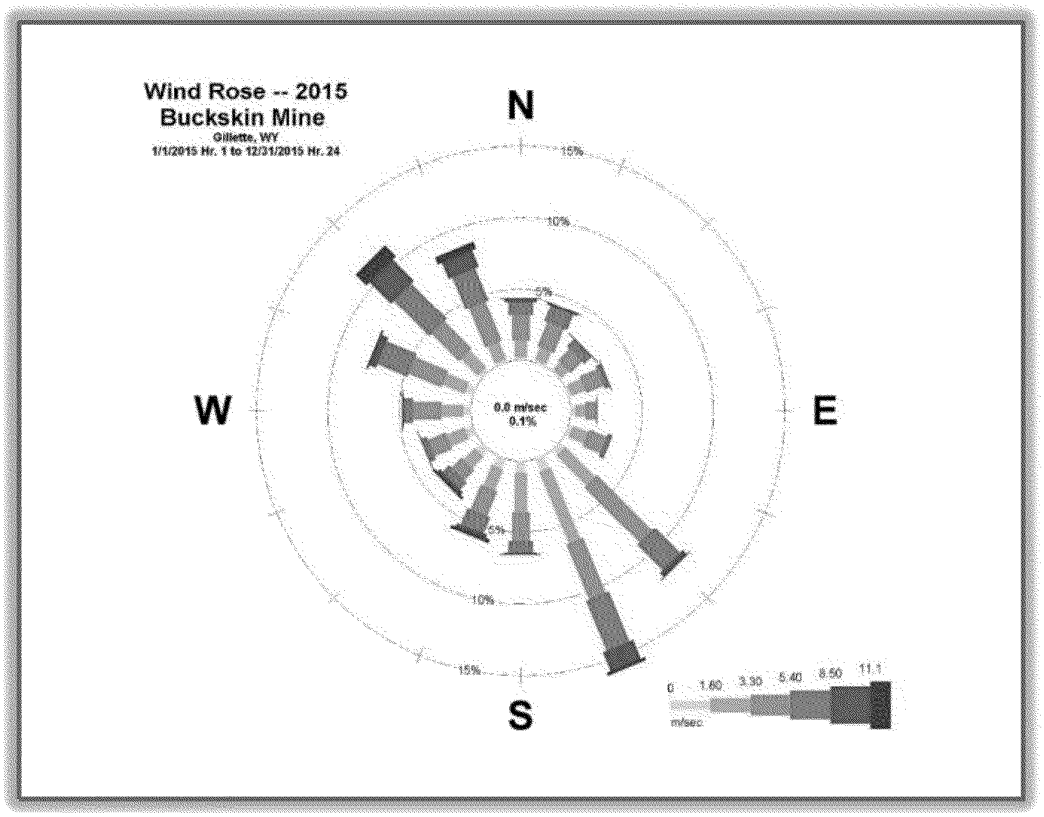
Northern Group



Buckskin Mine





Mine Monitor Information

Monitor Name	AQS SITE ID	Status	Collection Frequency	Purpose	Instrument Description	Notes
North	56-005-1899	Active	Daily	Downwind	TEOM	Meteorological monitoring in addition to PM10.
West	56-005-0884	Active	Daily	Upwind	TEOM	

Monitor Availability

Monitor	AQS ID	2015		Notes
North	56-005-1899	Q1	100.0%	
		Q2	96.7%	
		Q3	100.0%	
		Q4	100.0%	
West	56-005-0884	Q1	100.0%	
		Q2	100.0%	
		Q3	100.0%	
		Q4	93.5%	

Data Completeness for 2015

The data completeness report retrieved from AQS indicated no monitors with annual data completeness of 75% or less.

Audits and Flow Verifications in 2015

Flow verifications were performed as required. Flow audits were conducted on the North and West samplers during the first and third quarters.

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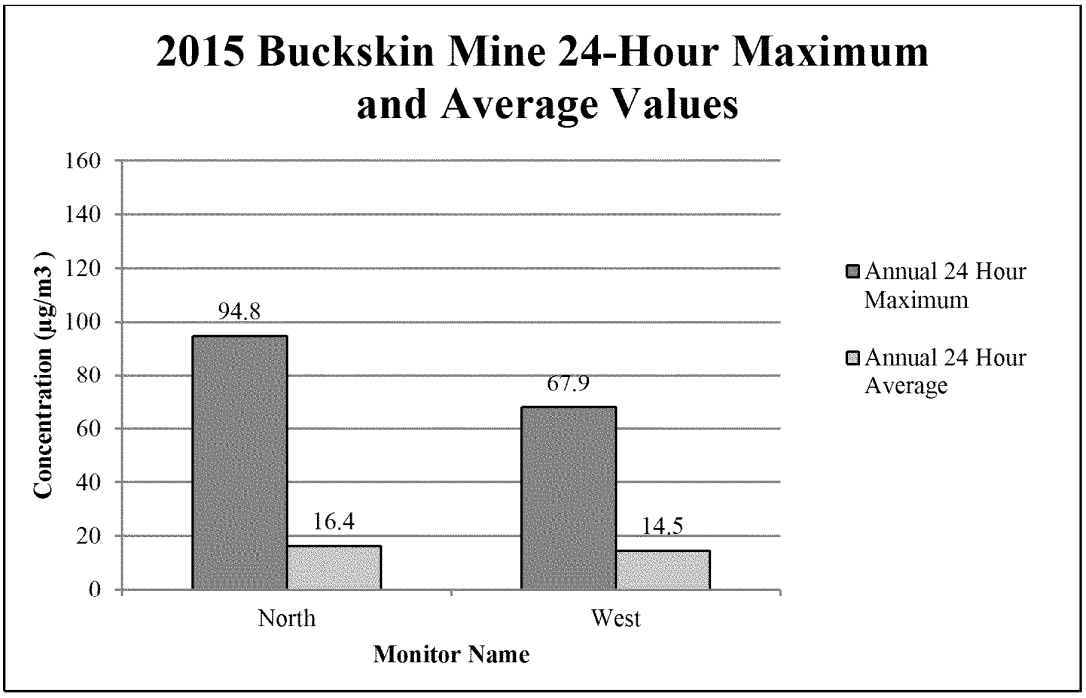
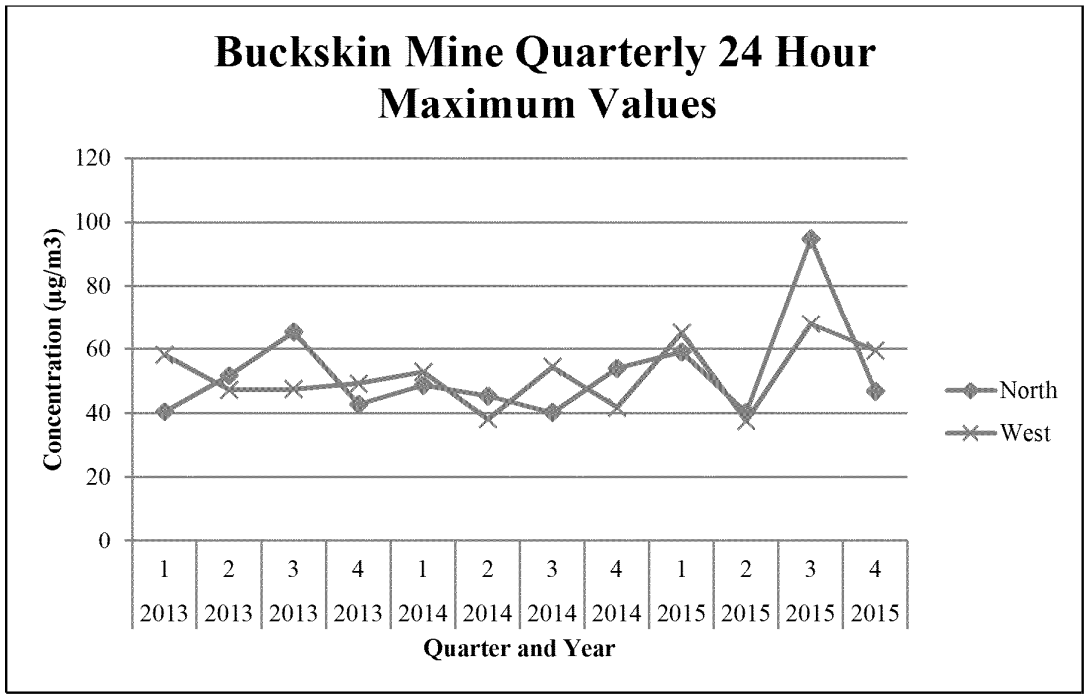
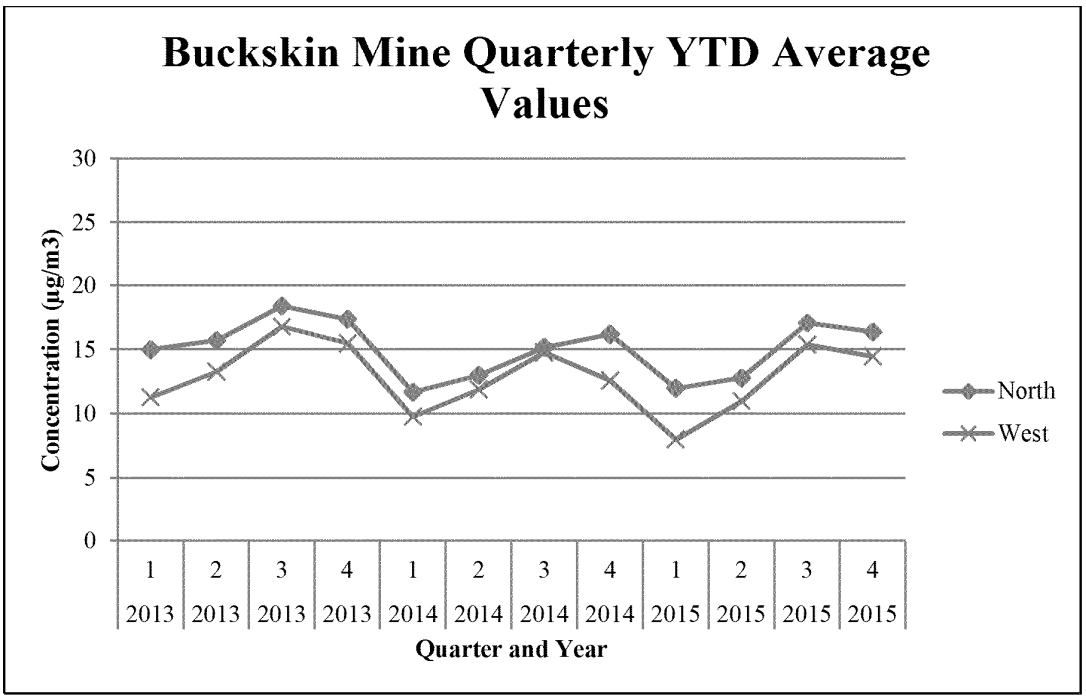
Monitor Precision as Reported

Monitor	AQS ID	2015		Notes
North	56-005-1899	Q1	1.26%	Percent Difference.
		Q2	1.30%	Percent Difference.
		Q3	0.14%	Percent Difference.
		Q4	0.56%	Percent Difference.
West	56-005-0884	Q1	1.95%	Percent Difference.
		Q2	1.62%	Percent Difference.
		Q3	1.42%	Percent Difference.
		Q4	1.77%	Percent Difference.







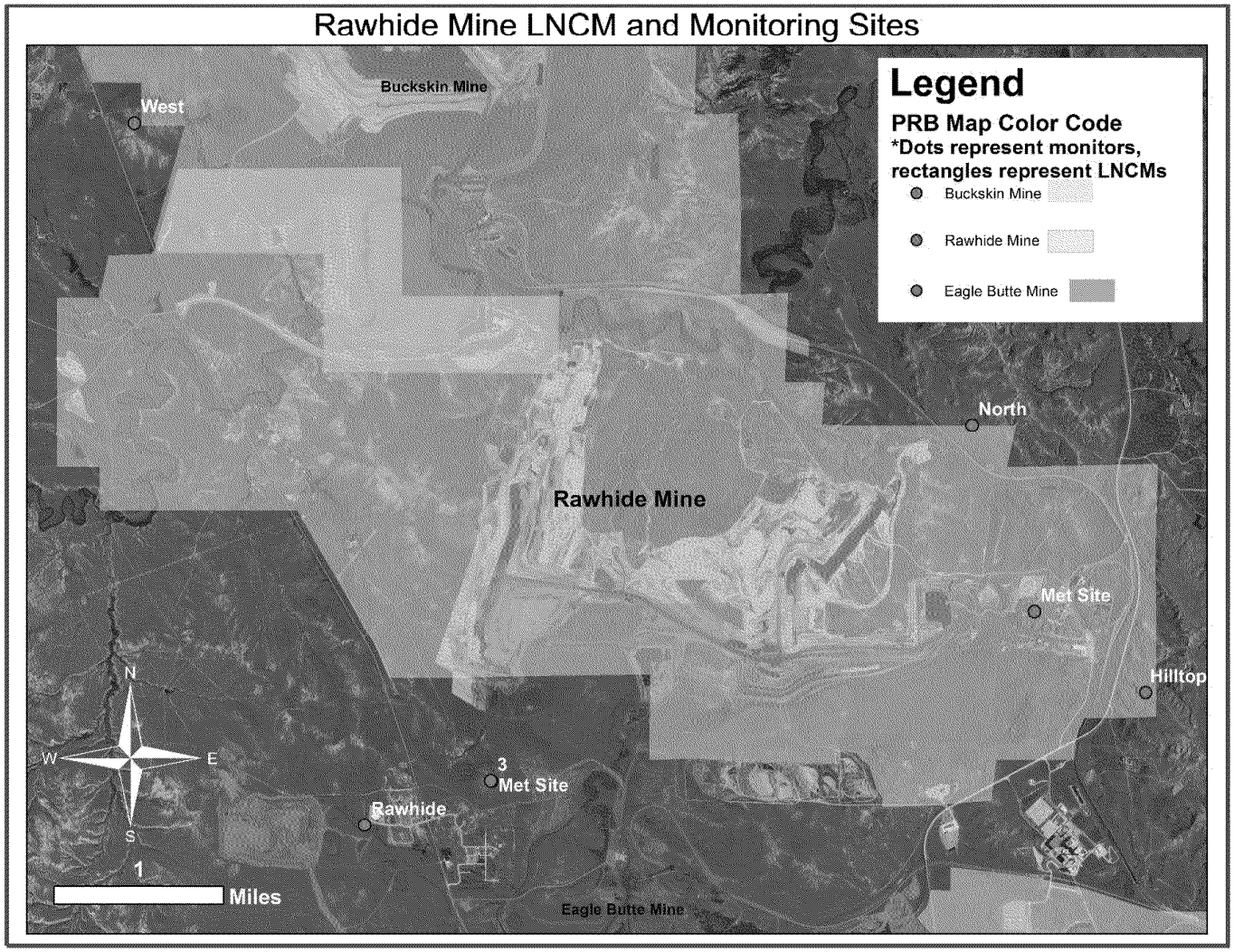
Permitting Action (2015)

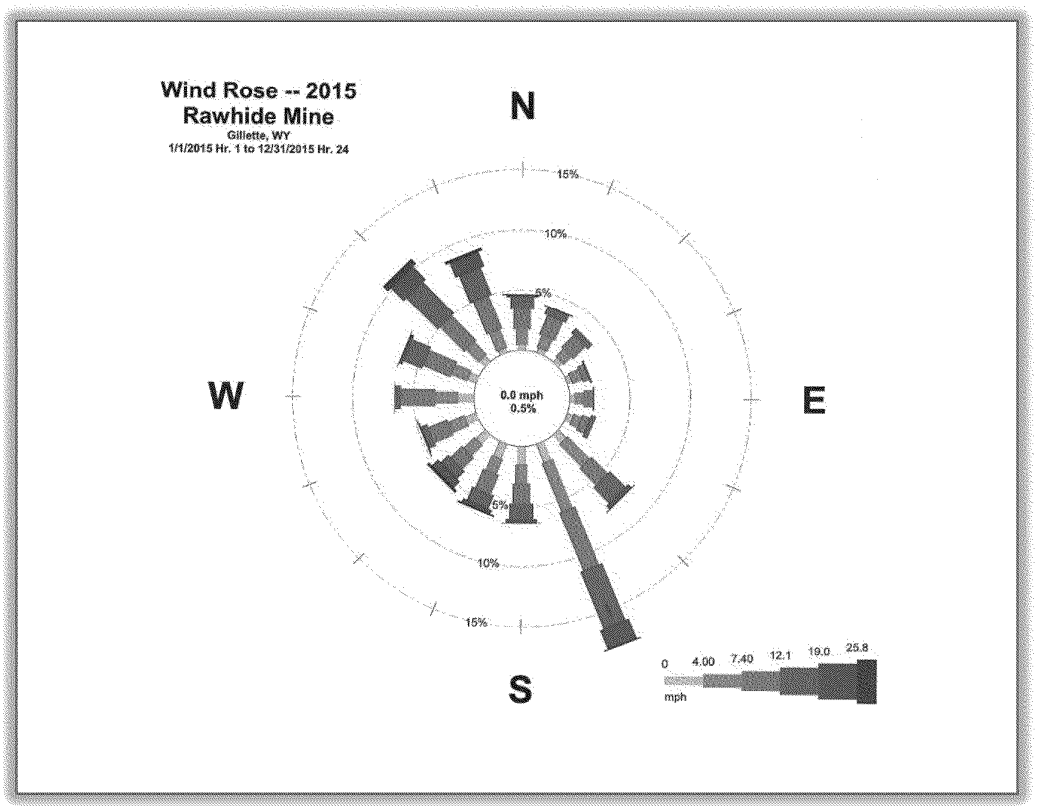
No permits were issued to this facility in 2015.

Facility Summary

Overall, data collection and data quality at this facility are good with no exœedances in the report period.

Rawhide Mine





Mine Monitor Information

Monitor Name	AQS SITE ID	Status	Collection Frequency	Purpose	Instrument Description:	Notes
RA-23	56-005-0826	Active	Daily	Downwind	TEOM	Also known as Hilltop.
RA-24	56-005-0895	Active	Daily	Upwind	TEOM	Also known as North.

Monitor Availability

Monitor	AQS ID	2015		Notes
RA-23	56-005-0826	Q1	100.0%	
		Q2	97.8%	
		Q3	100.0%	
		Q4	96.7%	
RA-24	56-005-0895	Q1	100.0%	
		Q2	97.8%	
		Q3	98.9%	
		Q4	98.9%	

Data Completeness for 2015

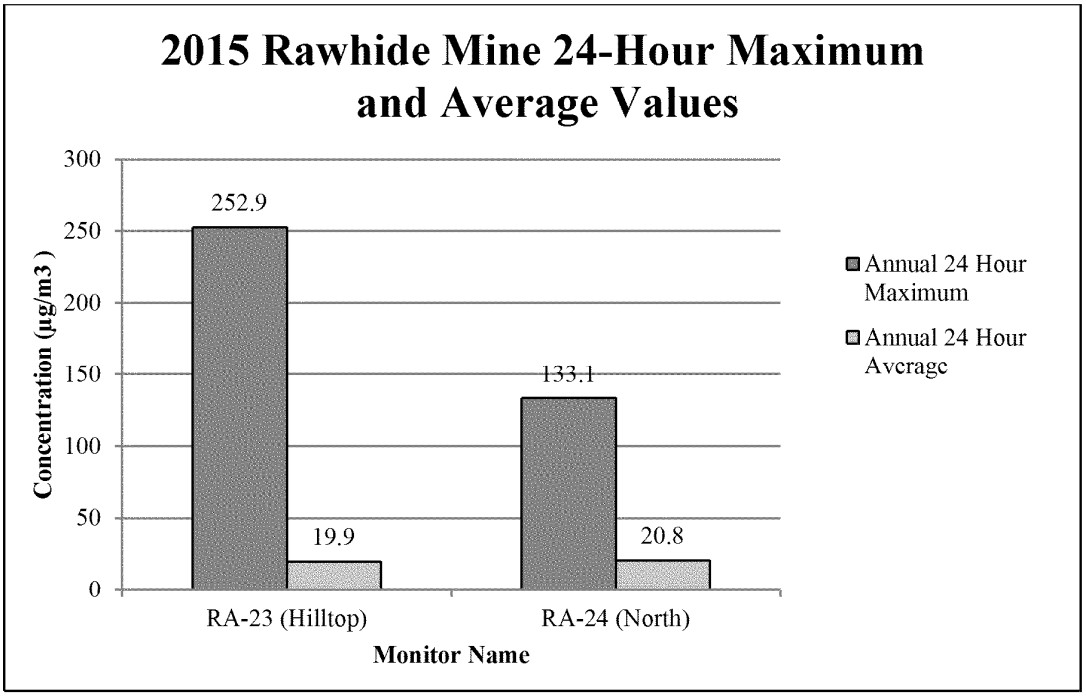
The data completeness report retrieved from AQS indicated no monitors with annual data completeness of 75% or less.

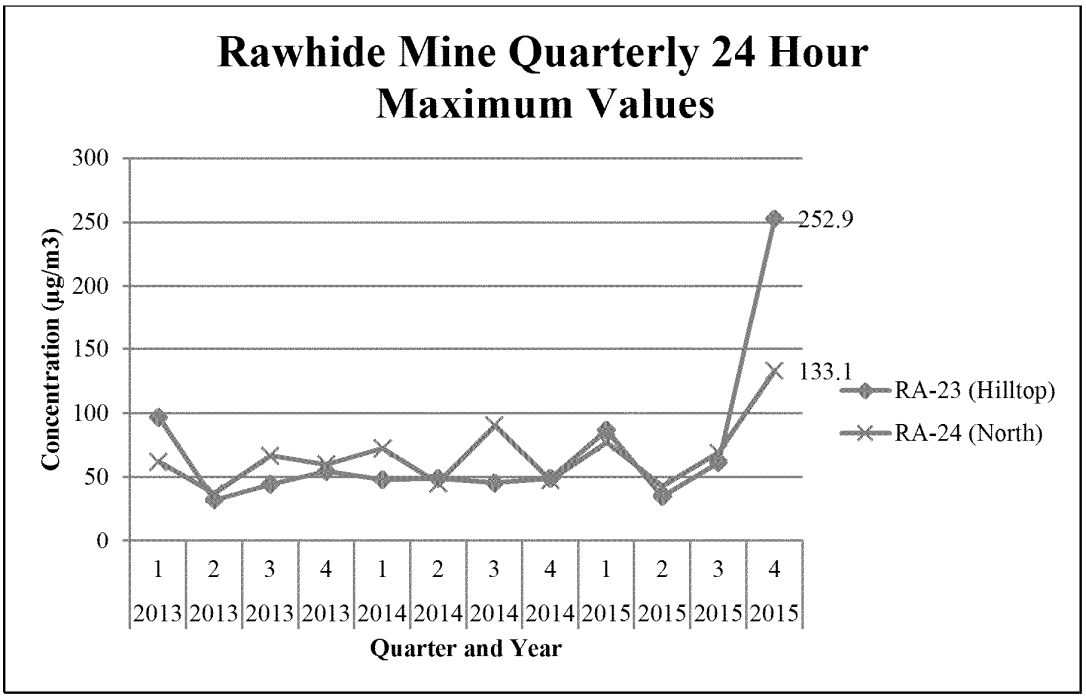
Audits and Flow Verifications in 2015

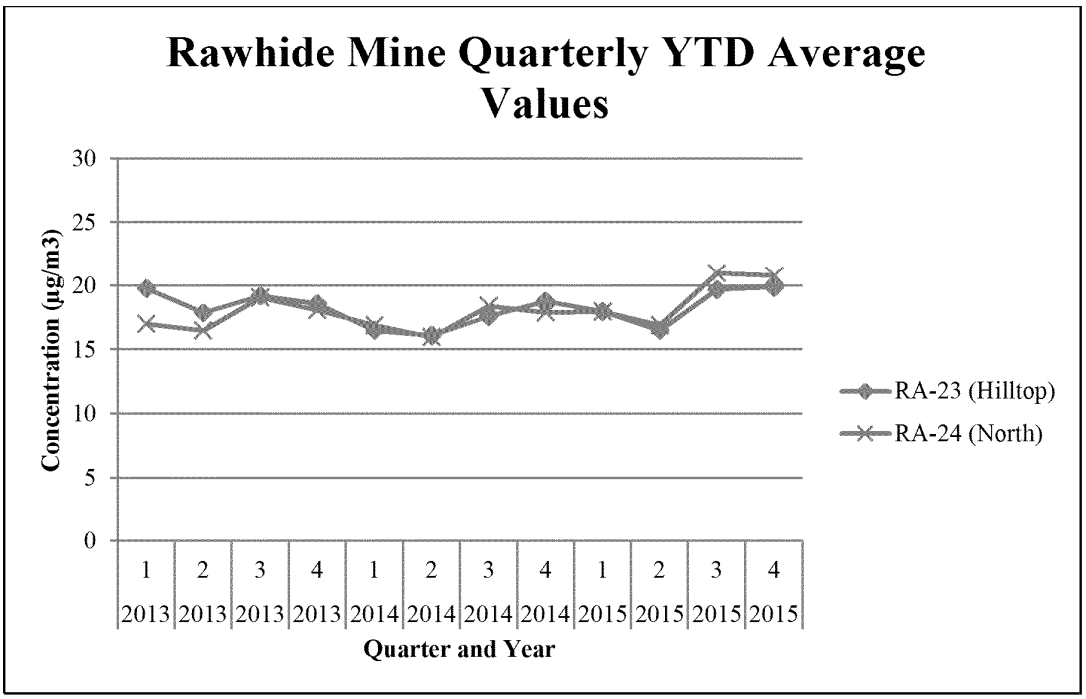
Flow verifications were performed as required. Flow audits were conducted on the RA-23 sampler in the first, second, third and fourth quarters. Flow audits were conducted on the RA-24 sampler in the first, second, and fourth quarters.

Monitor Precision as Reported

Monitor	AQS ID	2015		Notes
RA-23	56-005-0826	Q1	0.48%	Percent Difference.
		Q2	0.16%	Percent Difference.
		Q3	0.18%	Percent Difference.
		Q4	0.45%	Percent Difference.
RA-24	56-005-0895	Q1	1.30%	Percent Difference.
		Q2	0.93%	Percent Difference.
		Q3	0.28%	Percent Difference.
		Q4	0.79%	Percent Difference.







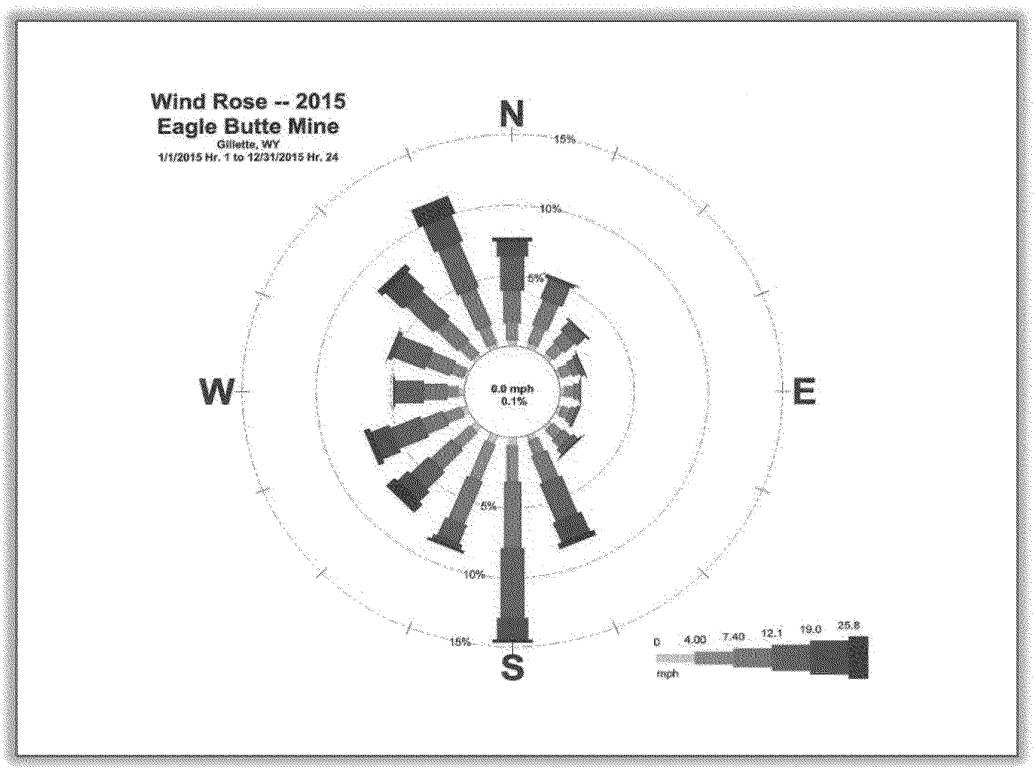
Permitting Action (2015)

No permits were issued to this facility in 2015.

Facility Summary

Overall, data collection and data quality at this facility are good. One exceedance was recorded on November 18, 2015 due to a high wind exceptional event. An exceptional event package was submitted to AQD and forwarded to the EPA. The Rawhide Hilltop monitor appears to be within the LNCM. This will be investigated and addressed in 2017. (Note: Rawhide does not have a Network Demonstration requirement.)

Eagle Butte Mine



Mine Monitor Information

Monitor Name	AQS SITE ID	Status	Collection Frequency	Purpose	Instrument Description	Notes
EB-3N	56-005-0808	Active	1 in 3	Downwind	GMW 1200	
EB-3S	56-005-0808	Active	1 in 6	Precision	GMW 1200	Collocated with EB-3N.
EB-5	56-005-2900	Active	1 in 3	Downwind	Graseby	
EB-31	56-005-1906	Active	Continuous	Upwind	TEOM	
Rawhide	56-005-2901	Active	Continuous	Downwind	TEOM	

Monitor Availability

Monitor	AQS ID	2015		Notes
EB-3N	56-005-0808	Q1	93.3%	
		Q2	100.0%	
		Q3	96.8%	
		Q4	100.0%	
EB-3S	56-005-0808	Q1	80.0%	
		Q2	100.0%	
		Q3	100.0%	
		Q4	100.0%	
EB-5	56-005-2900	Q1	100.0%	
		Q2	96.7%	
		Q3	100.0%	
		Q4	100.0%	
EB-31	56-005-1906	Q1	100.0%	
		Q2	98.9%	
		Q3	100.0%	
		Q4	95.7%	Four (4) days invalid due to missing records.
Rawhide	56-005-2901	Q1	61.1%	Thirteen (13) days invalid due to failure of instrument's compact flash card. Twenty-two (22) days invalid while troubleshooting and waiting for replacement parts.
		Q2	87.9%	Six (6) days invalid due to missing records. Three (3) days invalid due to machine malfunction. Two (2) days invalid due to flow faults.
		Q3	84.8%	Nine (9) days invalid due to flow faults. Two (2) days invalid due to the unit not having auxiliary flow. Three (3) days invalid due to missing records.
		Q4	95.7%	Three (3) days invalid due to missing records. One (1) day missing due to machine malfunction.

Data Completeness for 2015

The data completeness report retrieved from AQS indicated no monitors with annual data completeness of 75% or less.

Audits and Flow Verifications in 2015

Flow verifications were performed as required. Flow audits were conducted on samplers EB-31 and EB-3S in the first and third quarters. Flow audits were conducted on the Rawhide sampler in the first, second and fourth quarters.

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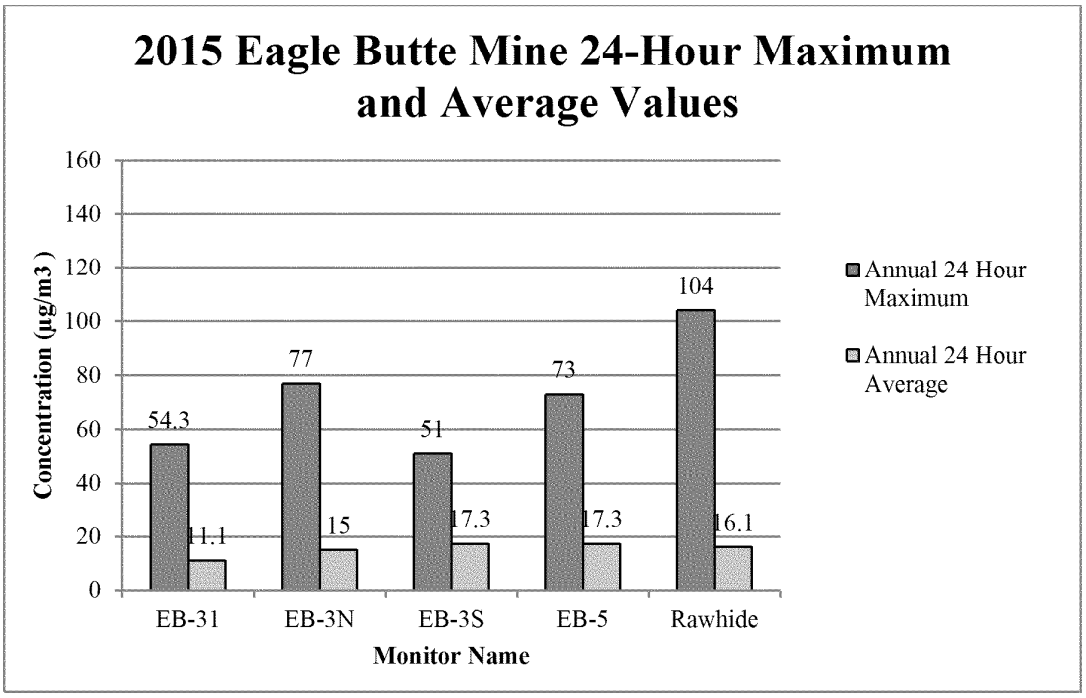
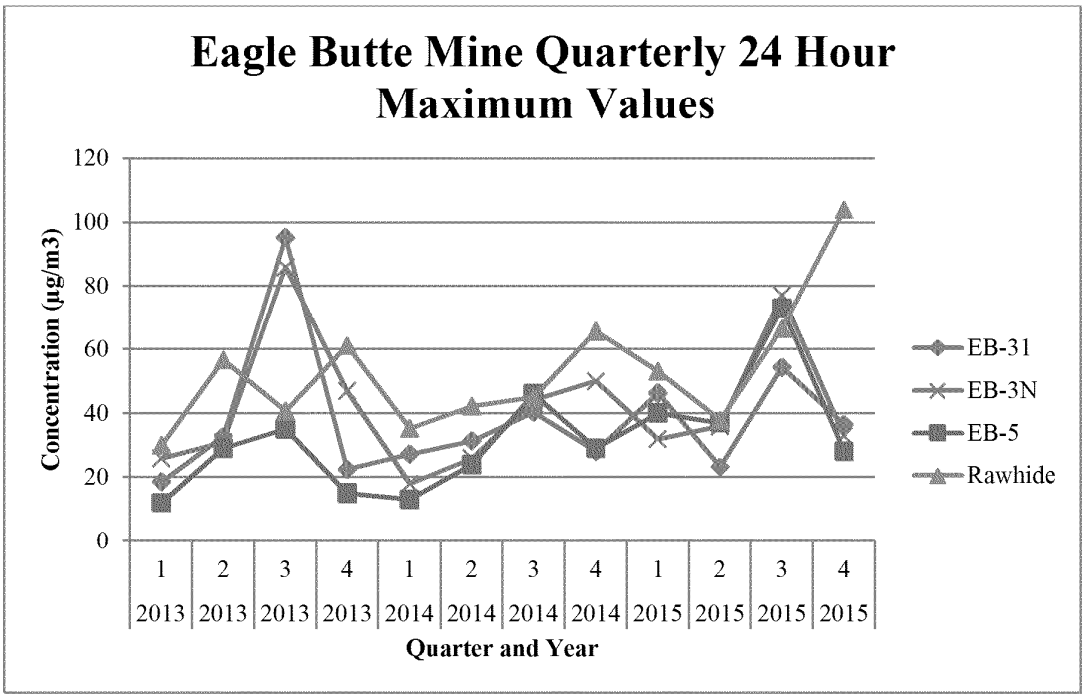
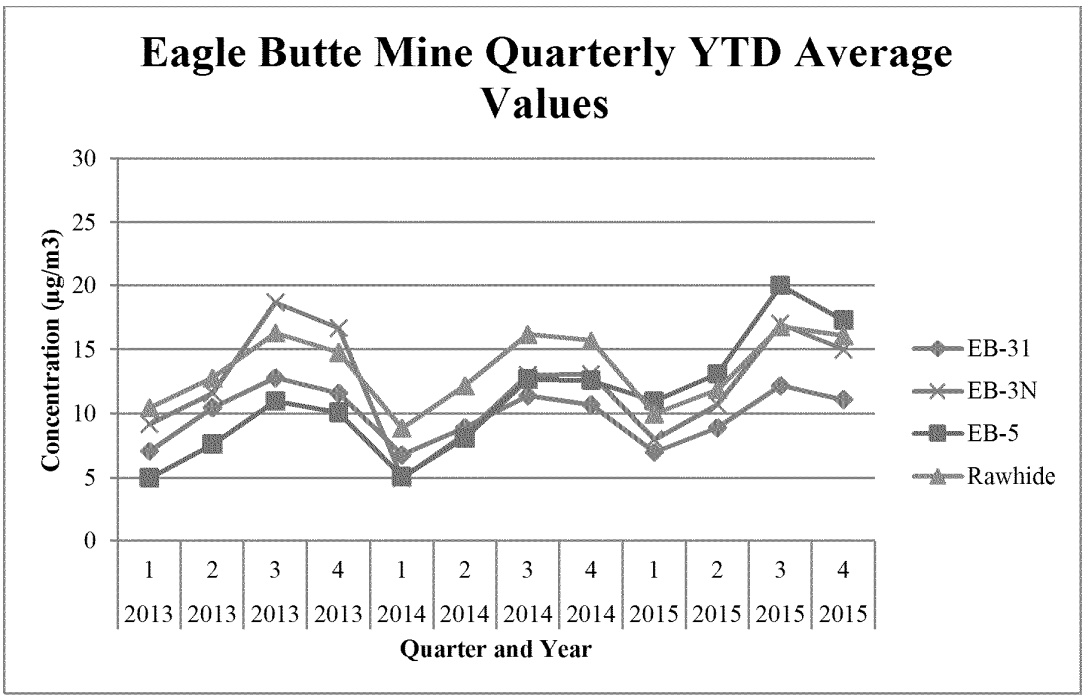
Monitor Precision as Reported

Site/Monitor	AQS ID	2015		Notes
EB-3S	56-005-0808	Q1	22.60%	Based on two (2) sample pairs greater than 15 µg/m^3: 17 & 21 and 24 &28. No explanation given.
		Q2	21.90%	Poor precision in 5 out of 6 valid sample pairs. No explanation provided.
		Q3	42.00%	Poor precision in 6 out of 13 valid samples Report notes that select filter pairs were reweighed and examined, with no evident reason for the differences.
		Q4	83.80%	Based on two sample pairs greater than 15 µg/m3: 20 & 18 and 18 & 20. No explanation provided.
EB-31	56-005-1906	Q1	2.82%	Percent Difference.
		Q2	0.48%	Percent Difference.
		Q3	0.30%	Percent Difference.
		Q4	0.56%	Percent Difference.
Rawhide	56-005-2901	Q1	0.22%	Percent Difference.
		Q2	6.25%	Percent Difference. June flow verification out of limits. No explanation given.
		Q3	1.05%	Percent Difference. Audit could not be performed due to the unit having no auxiliary flow.
		Q4	1.04%	Percent Difference.







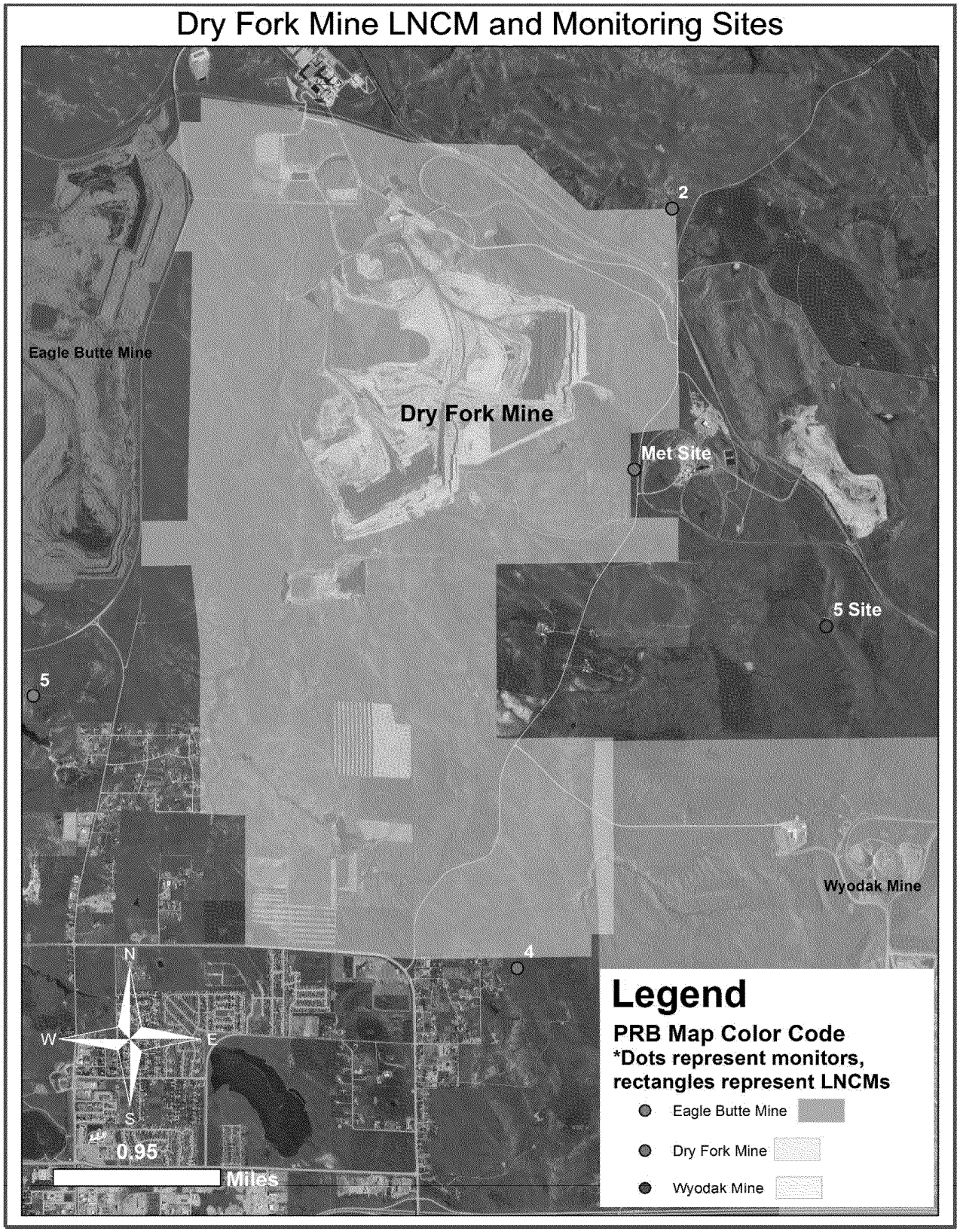
Permitting Action (2015)

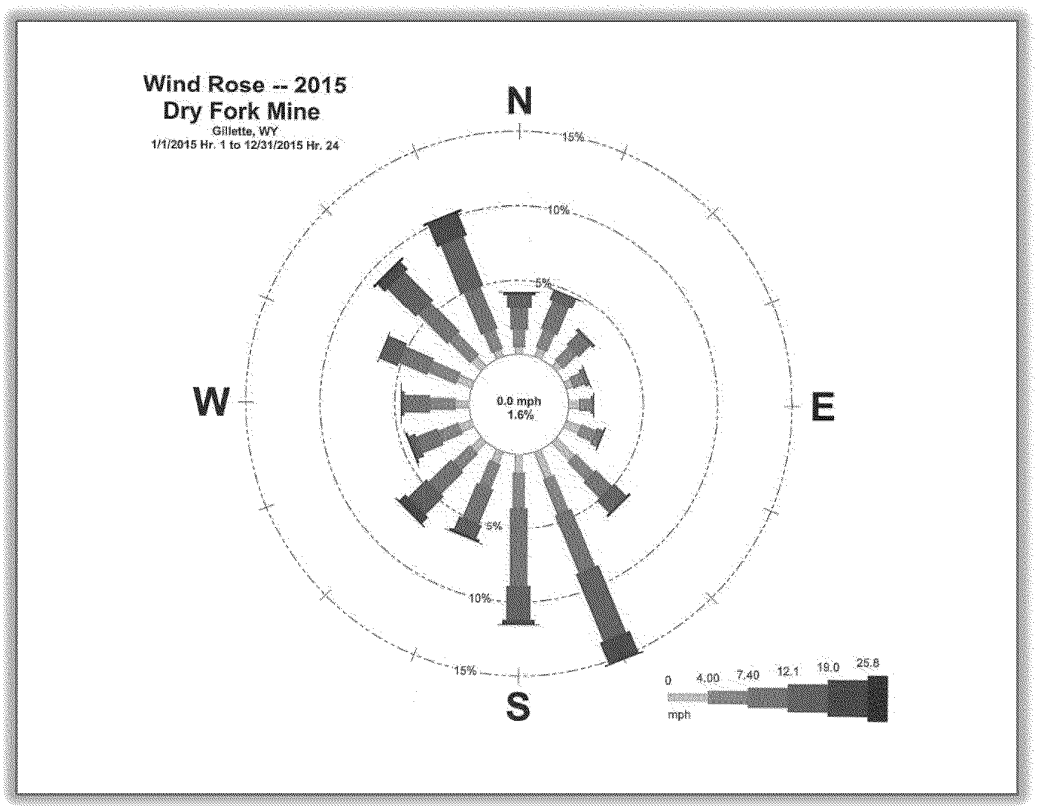
No permits were issued to this facility in 2015.

Facility Summary

Overall, data collection and data quality at this facility are good with no exceedances in the report period. There was poor precision for the EB-3S site. Filter pairs were reweighed and reexamined during the third quarter, but no apparent reason was discovered. Eagle Butte monitors that appear to be within the LNCM will be investigated in 2017 during the next Network Demonstration.

Dry Fork Mine





Mine Monitor Information

Monitor Name	AQS SITE ID	Status	Collection Frequency	Purpose	Instrument Description	Notes
DF-2	56-005-1879	Active	1 in 6	Upwind	Wedding	
DF-4M/N	56-005-0897	Active	1 in 3	Downwind	Wedding	Operates with satellite on alternate 6 day cycle
DF-4S	56-005-0897	Active	1 in 6	Precision	Wedding	Collocated with DF-4M/N

Monitor Availability

Monitor	AQS ID	2015		Notes
DF-2	56-005-1879	Q1	100.0%	
		Q2	100.0%	
		Q3	100.0%	
		Q4	93.3%	
DF-4N/4M	56-005-0897	Q1	100.0%	
		Q2	96.7%	
		Q3	100.0%	
		Q4	83.3%	
DF-4S	56-005-0897	Q1	93.3%	
		Q2	93.3%	
		Q3	100.0%	
		Q4	100.0%	

Data Completeness for 2015

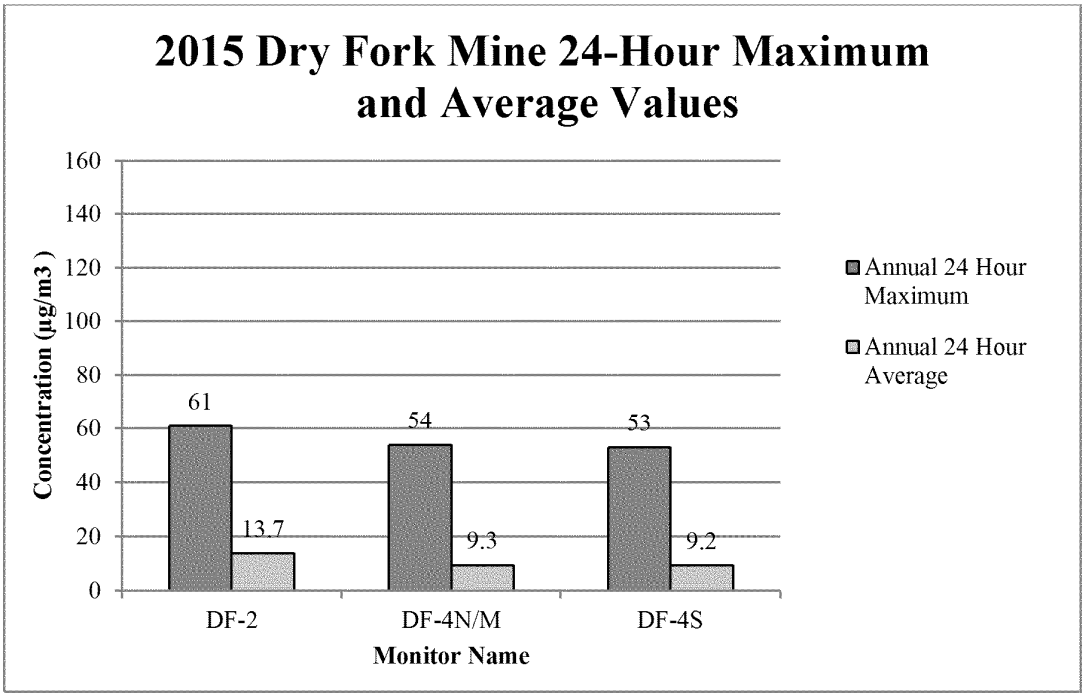
The data completeness report retrieved from AQS indicated no monitors with annual data completeness of 75% or less.

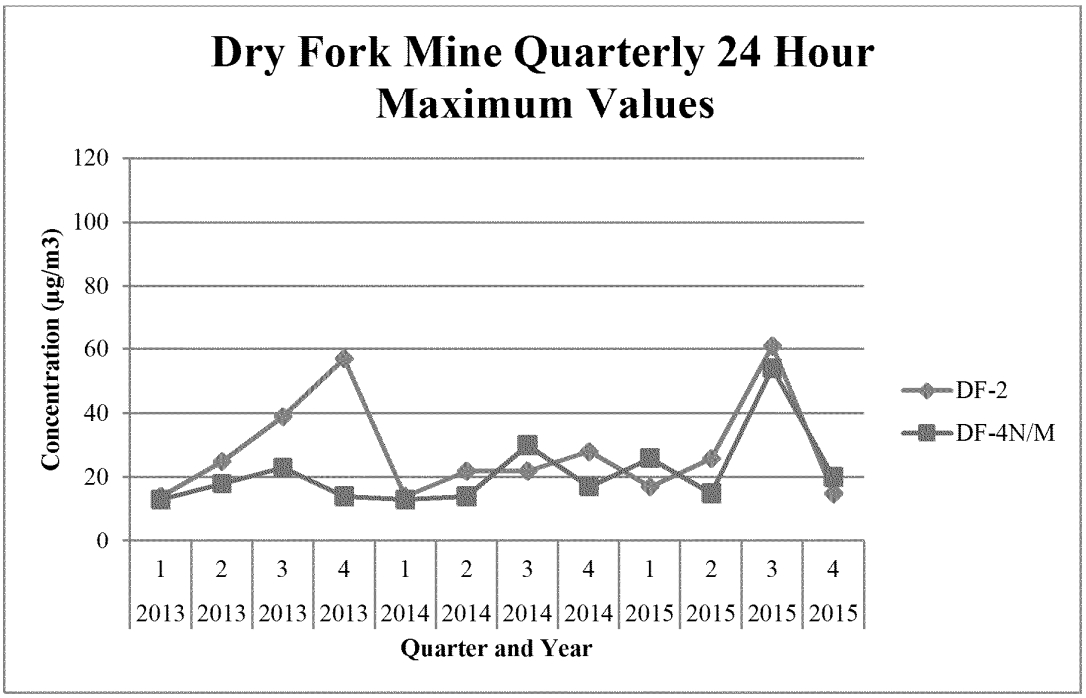
Audits and Flow Verifications in 2015

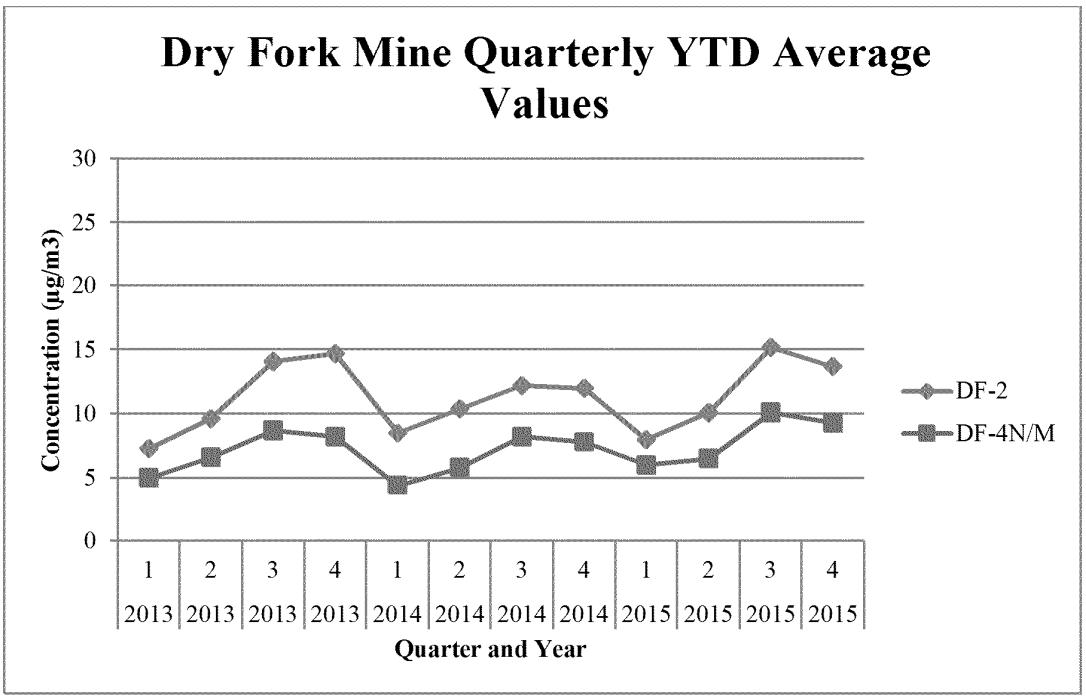
Flow verifications were performed as required. Flow audits were conducted on all samplers in the second and fourth quarters.

Monitor Precision as Reported

Site	AQS ID	2015		Notes
DF-4S	56-005-0897	Q1	N/A	No sample pairs greater than 15 µg/m^3 were collected during this quarter.
		Q2	N/A	No sample pairs greater than 15 µg/m^3 collected this quarter.
		Q3	3.20%	Coefficient of Variation.
		Q4	N/A	No sample pairs greater than 15 µg/m^3 were collected this quarter.







Permitting Action (2015)

No permits were issued to this facility in 2015.

Facility Summary

Overall, data collection and data quality at this facility are good with no exœedances in the report period.

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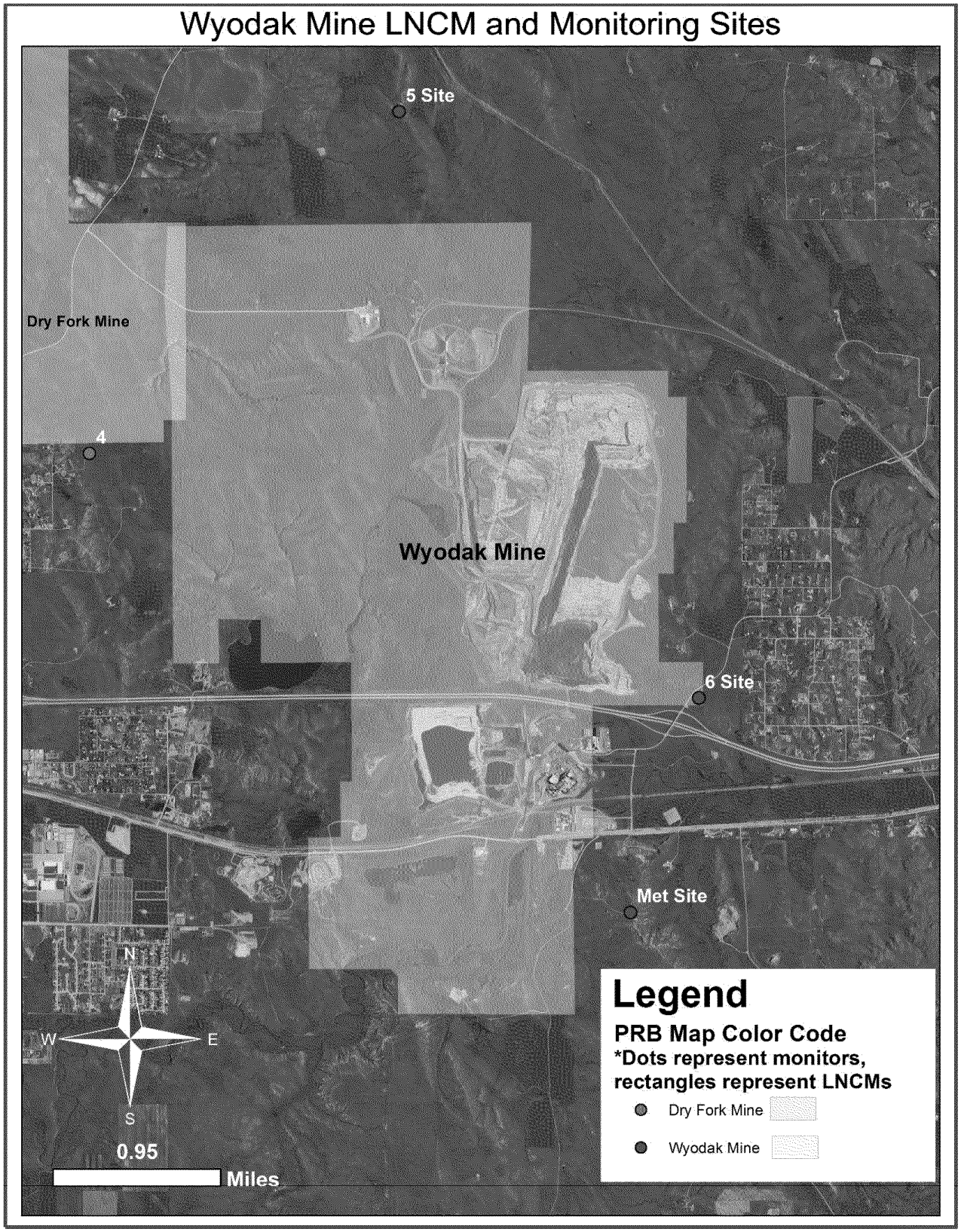
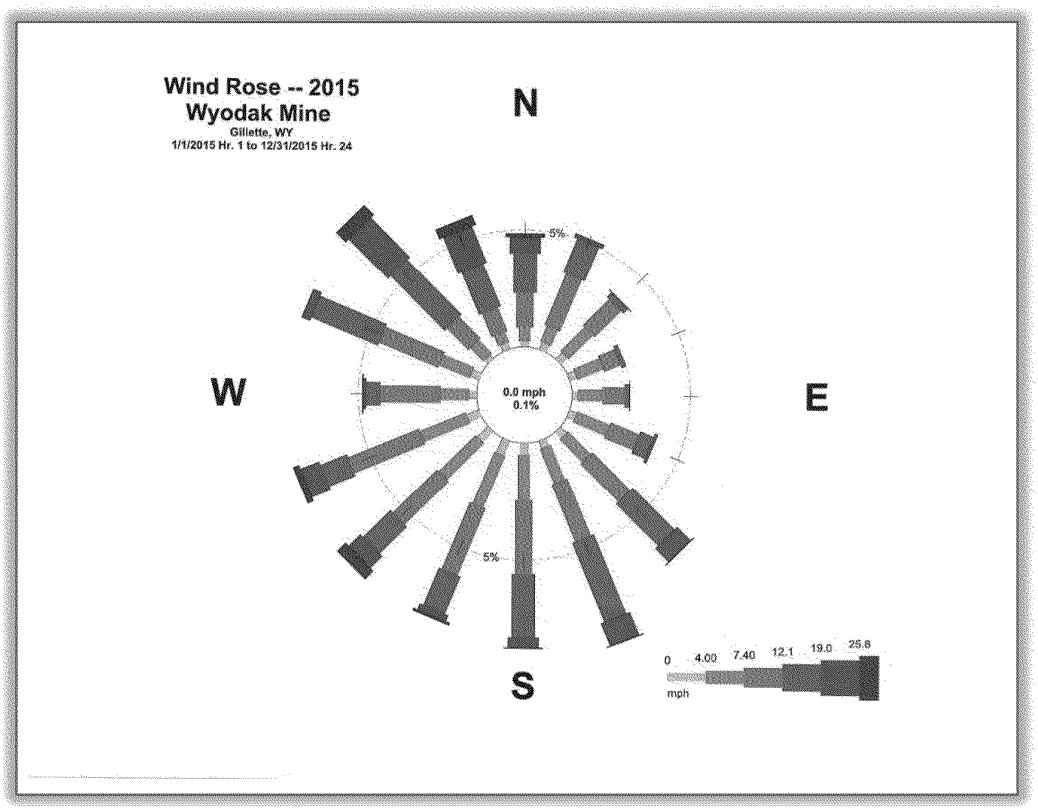
Wyodak Mine


Wyodak Mine LNCM and Monitoring Sites
5 Site
Dry Fork Mine
4
Wyodak Mine
6 Site
Met Site
N
W
E
S
0.95
Miles
Legend
PRB Map Color Code
*Dots represent monitors, rectangles represent LNCMs
Dry Fork Mine
Wyodak Mine



Mine Monitor Information

Monitor Name	AQS SITE ID	Status	Collection Frequency	Purpose	Instrument Description	Notes
5	56-005-5555	Active	Daily	Upwind	TEOM	Unit was replaced by a spare from 1/5/15 to 1/21/15.
6	56-005-6666	Active	Daily	Downwind	TEOM	

Monitor Availability

Monitor	AQS ID	2015		Notes
5	56-005-5555	Q1	88.9%	Nine (9) days invalid due to monitoring being offline. One (1) day invalid due to flow faults.
		Q2	98.9%	
		Q3	77.2%	Twenty-one (21) days invalid due to power failure.
		Q4	87.0%	Seven (7) days invalid due to power failure. Five (5) days invalid due to missing records, cause unknown.
6	56-005-6666	Q1	100.0%	
		Q2	95.6%	
		Q3	92.4%	
		Q4	90.2%	

Data Completeness for 2015

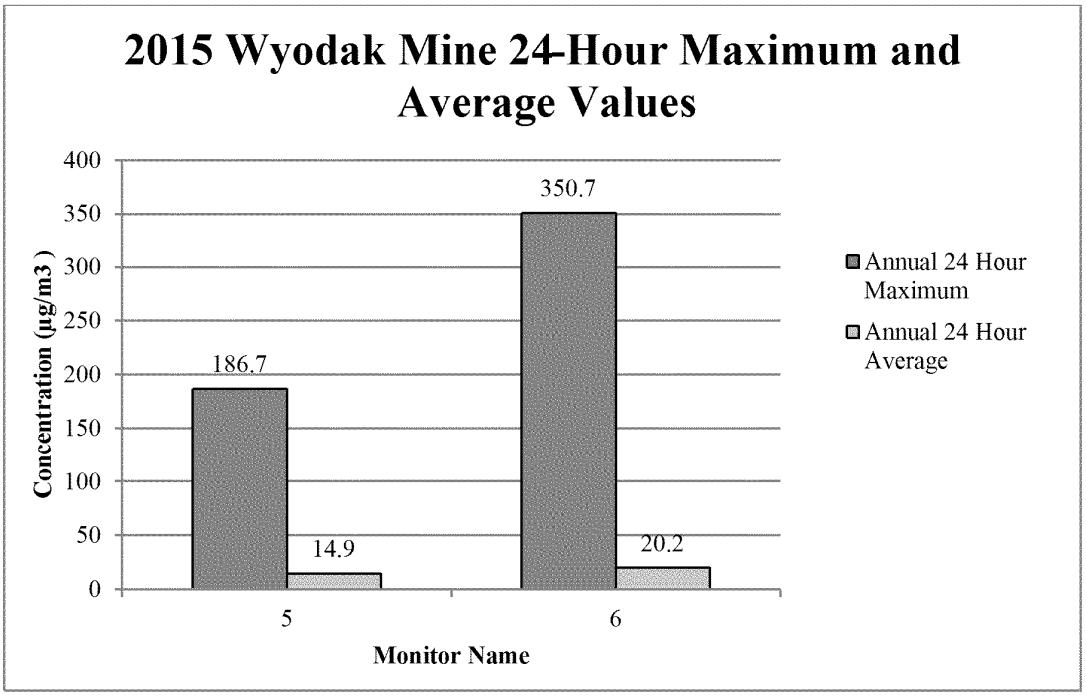
The data completeness report retrieved from AQS indicated no monitors with annual data completeness of 75% or less.

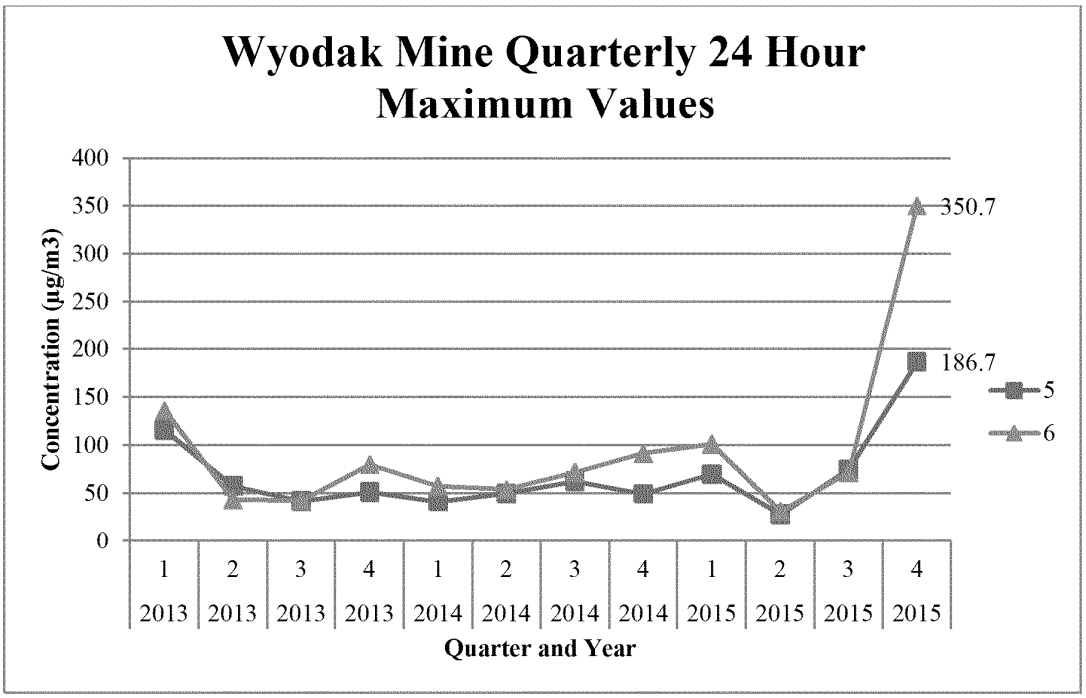
Audits and Flow Verifications in 2015

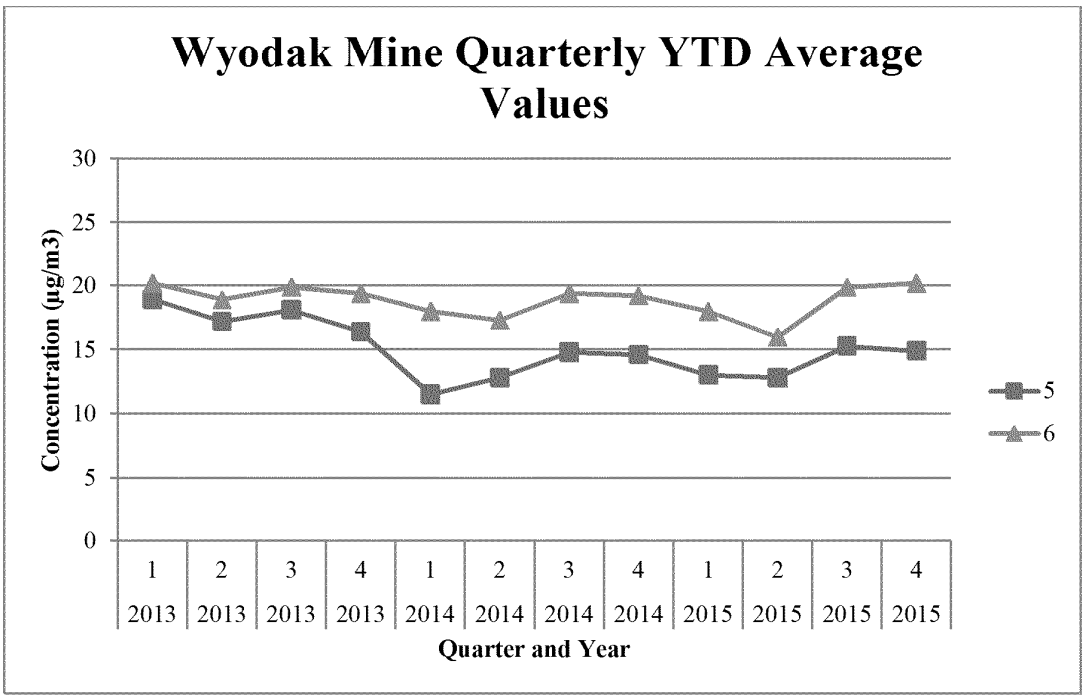
Flow verifications were performed as required. Flow audits were conducted on all samplers inthe first and third quarters.

Monitor Precision as Reported

Monitor	AQS ID	2015		Notes
5	56-005-5555	Q1	0.53%	Percent Difference.
		Q2	0.10%	Percent Difference.
		Q3	0.60%	Percent Difference.
		Q4	1.22%	Percent Difference.
6	56-005-6666	Q1	1.42%	Percent Difference.
		Q2	0.89%	Percent Difference.
		Q3	0.73%	Percent Difference.
		Q4	0.75%	Percent Difference.




Wyodak Mine Quarterly 24 Hour Maximum Values
Concentration (µg/m3)
400
350
300
250
200
150
100
50
0
350.7
186.7
5
6
1 2013
2 2013
3 2013
4 2013
1 2014
2 2014
3 2014
4 2014
1 2015
2 2015
3 2015
4 2015
Quarter and Year


Wyodak Mine Quarterly YTD Average Values
Concentration (µg/m3)
30
25
20
15
10
5
0
5
6
1 2013
2 2013
3 2013
4 2013
1 2014
2 2014
3 2014
4 2014
1 2015
2 2015
3 2015
4 2015
Quarter and Year

Permitting Action (2015)

Permit Number	Date Issued	Description
P0020084	10/14/2015	Revise how the remaining 125,000 tons of coal will be transported and processed with the flexibility of two (2) different options at the Wyodak Mine.

Facility Summary

Overall, data collection and data quality at this facility are good. Wyodak reported an exceedance at both 5 & 6 Sites on 11/18/2015. A high wind exceptional event package was submitted for AQD review. The AQD agreed to pursue the flag of the data as a high wind exceptional event and the package has been sent to EPA. Wyodak 6 Site appears to be within the LNCM, but note that these maps are approximate. This monitor is actually a few feet outside of Wyodak's LNCM.

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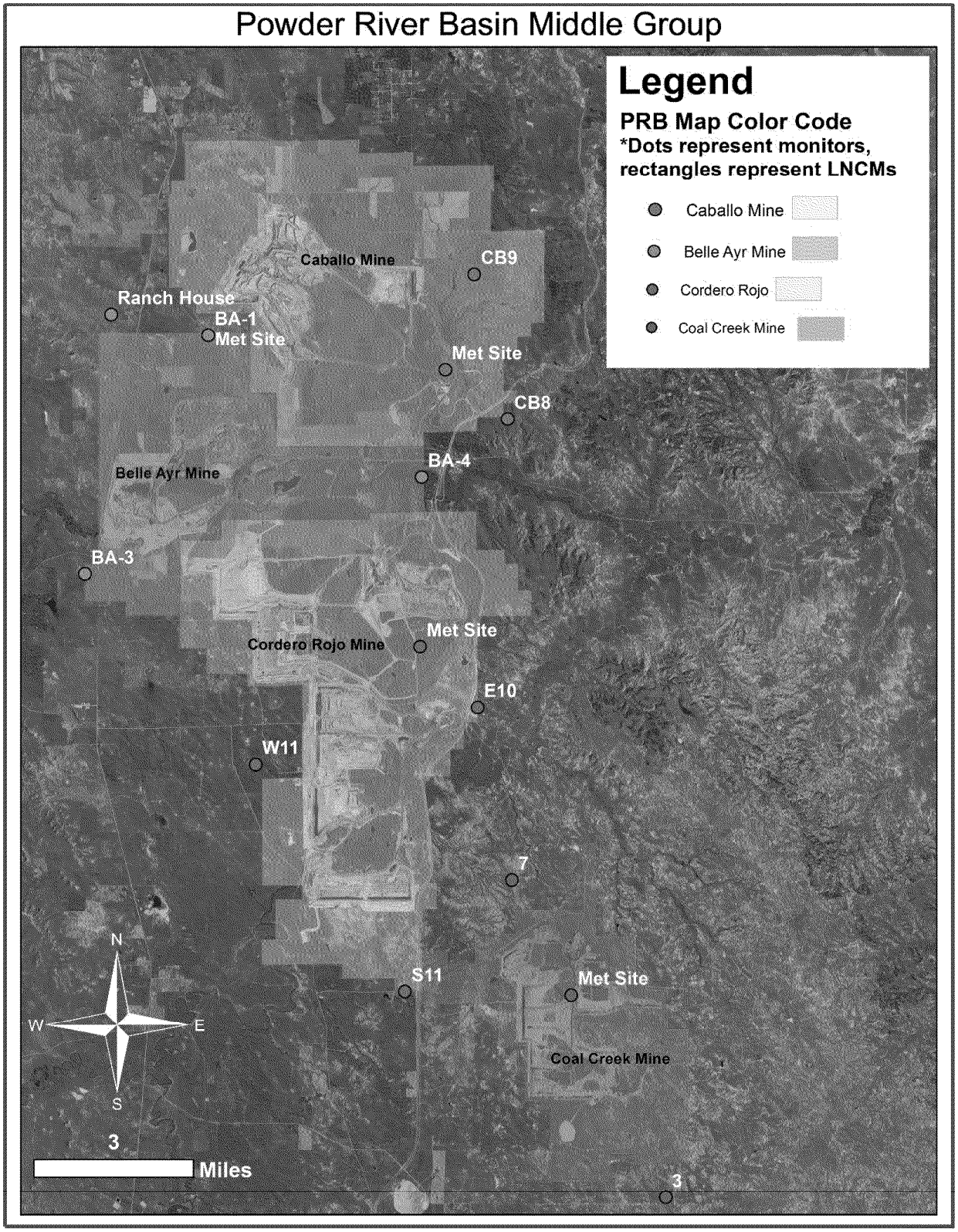
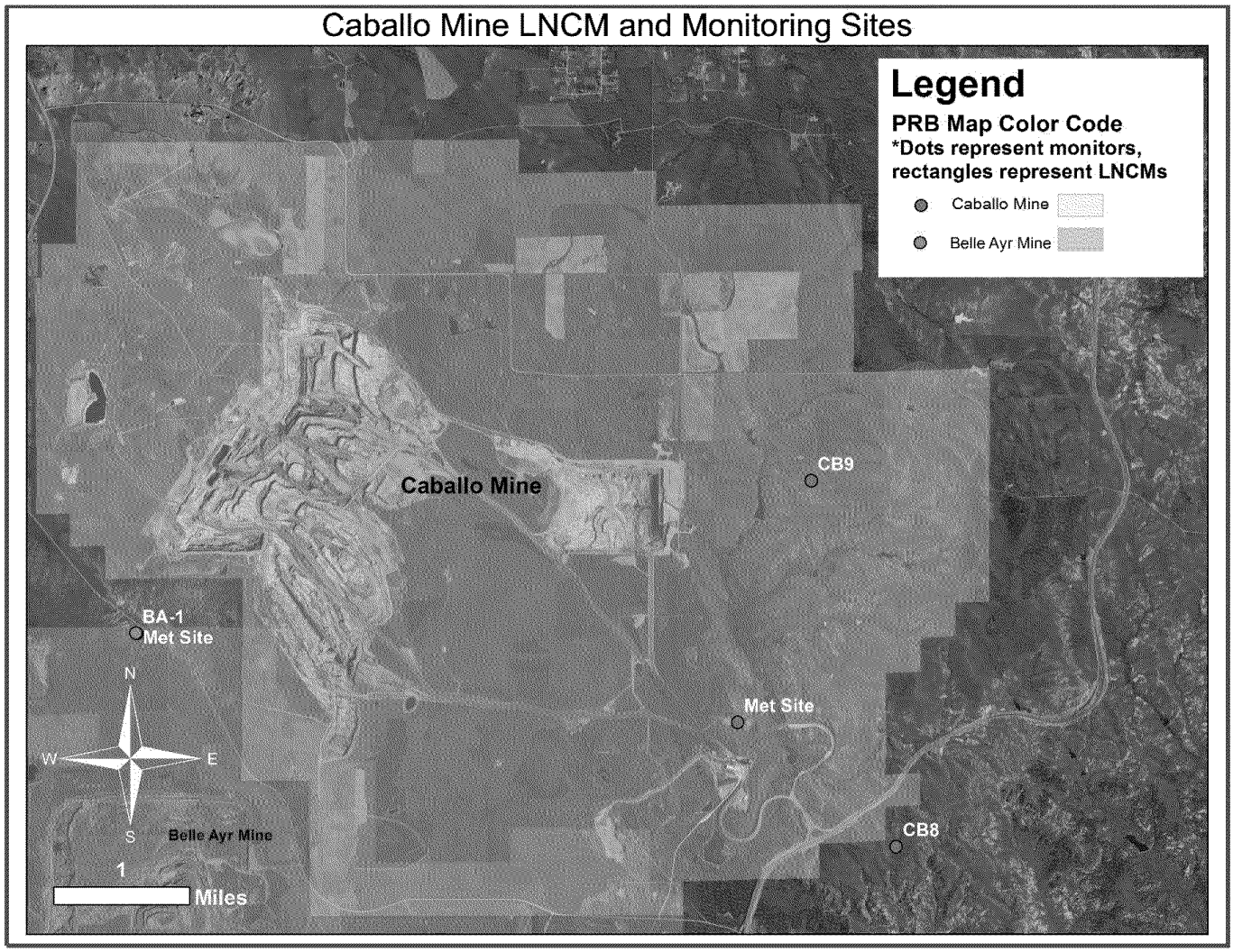
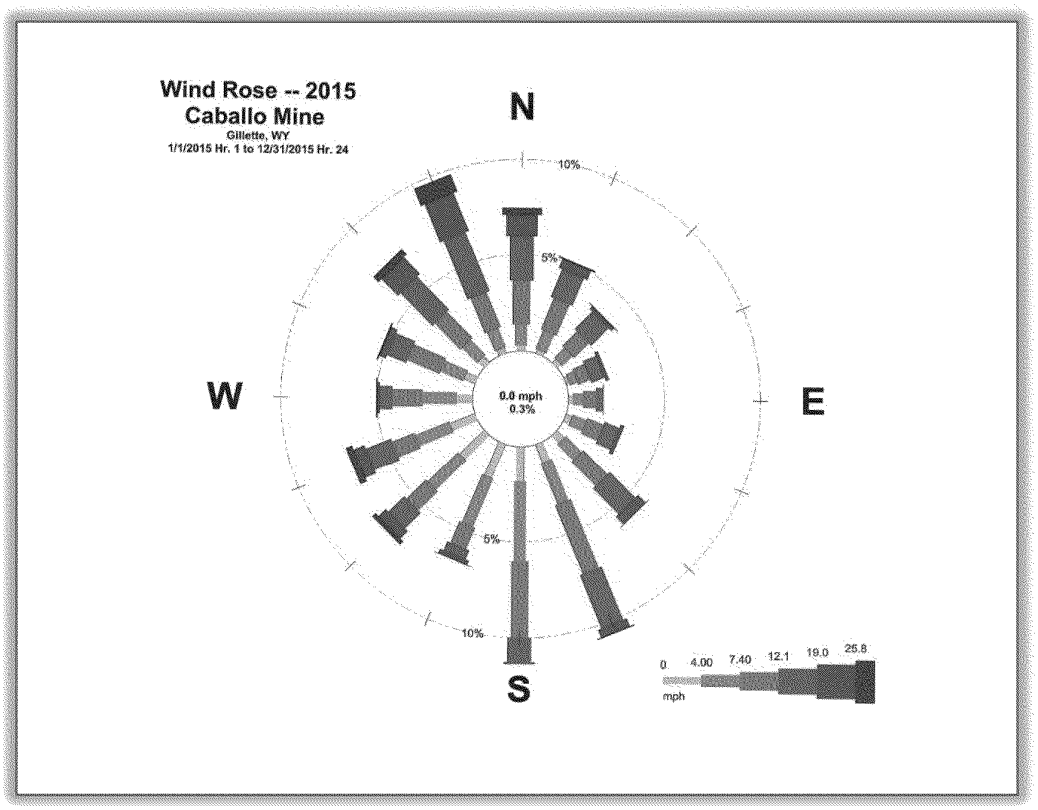
Middle Group



Caballo Mine





Mine Monitor Information

Monitor Name	AQS SITE ID	Status	Collection Frequency	Purpose	Instrument Description	Notes
CB-8	56-005-0886	Active	Daily	Downwind	TEOM	
CB-9	56-005-0908	Active	Daily	Upwind	TEOM	

Monitor Availability

Monitor	AQS ID	2015		Notes
CB-8	56-005-0886	Q1	100.0%	
		Q2	100.0%	
		Q3	98.9%	
		Q4	98.9%	
CB-9	56-005-0908	Q1	100.0%	
		Q2	100.0%	
		Q3	100.0%	
		Q4	98.9%	

Data Completeness for 2015

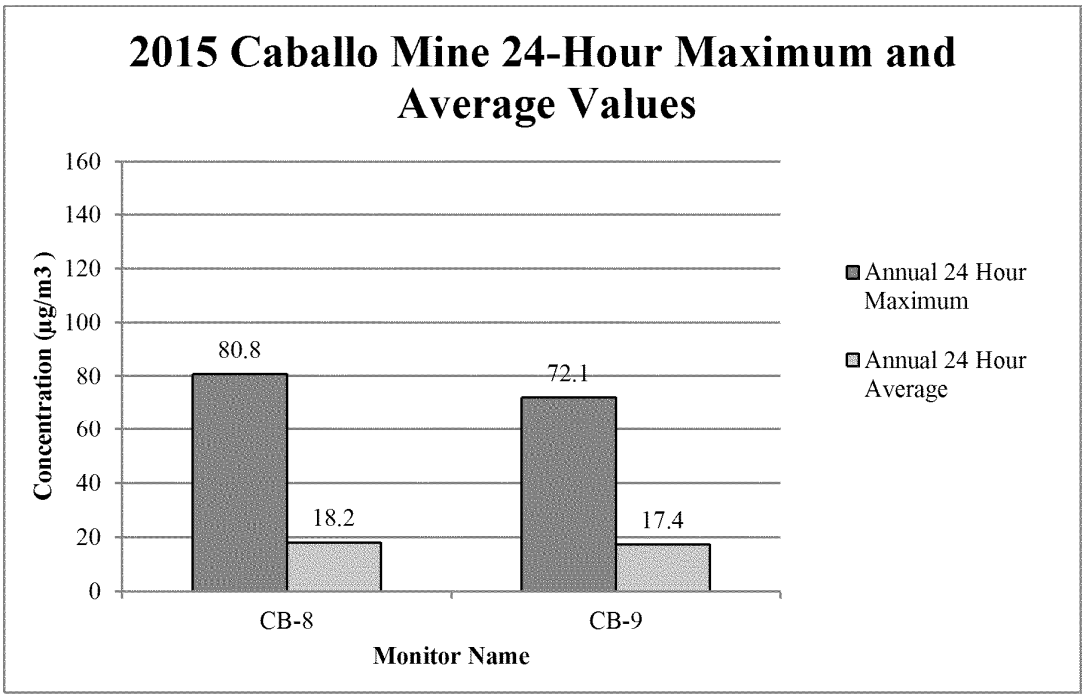
The data completeness report retrieved from AQS indicated no monitors with annual data completeness of 75% or less.

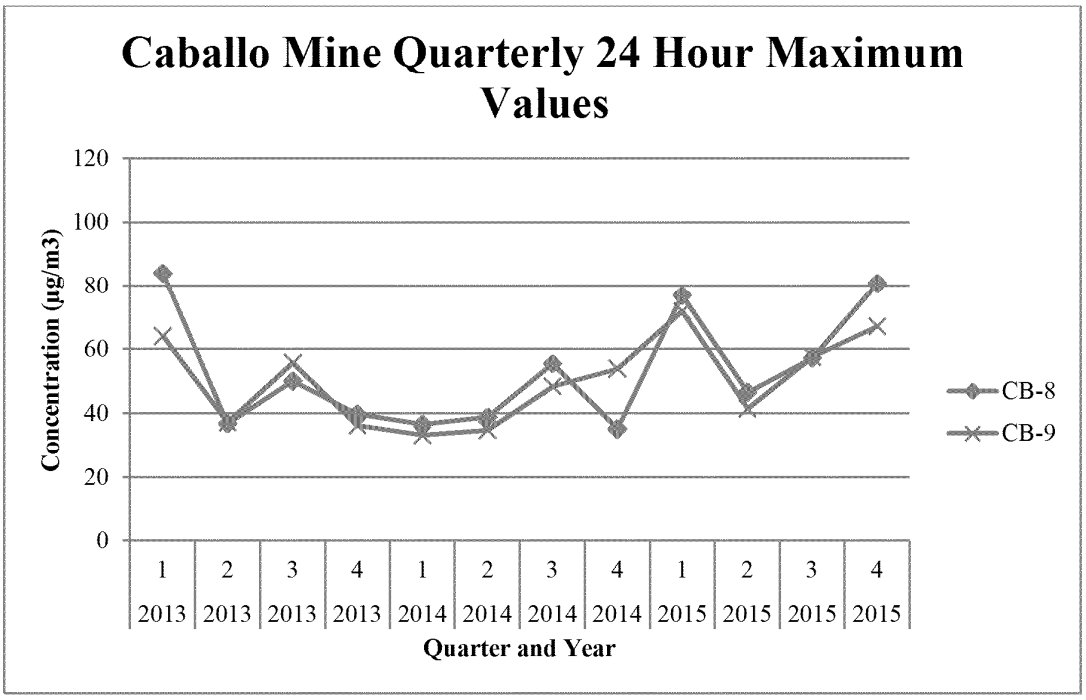
Audits and Flow Verifications in 2015

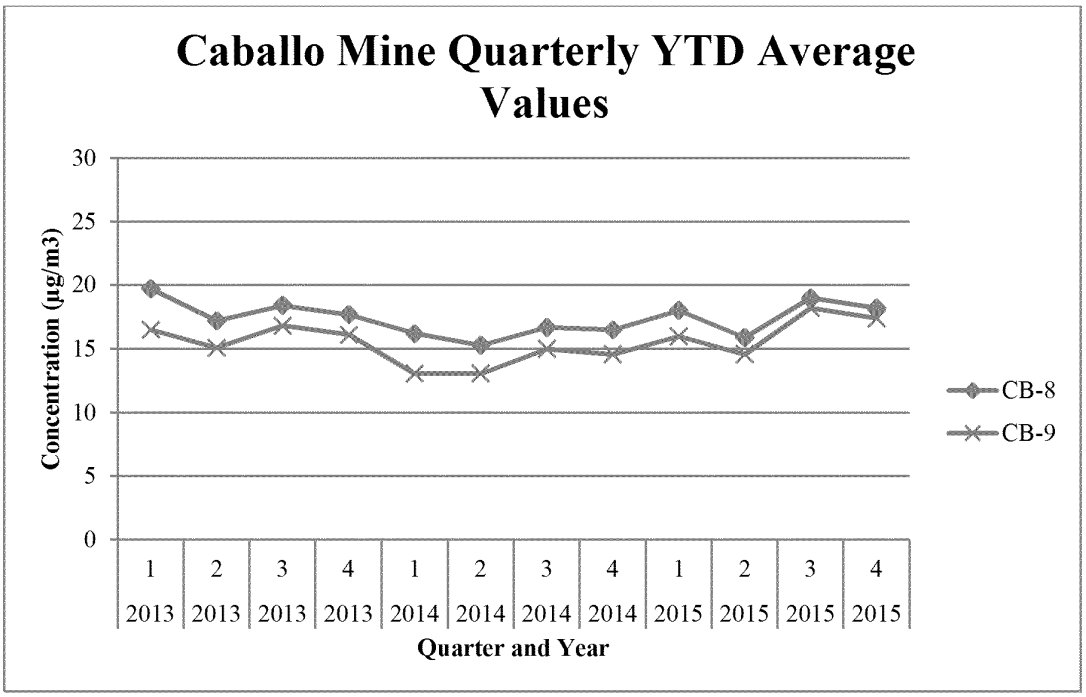
Flow verifications were performed as required. Flow audits were conducted on all samplers in the second and fourth quarters.

Monitor Precision as Reported

Monitor	AQS ID	2015		Notes
CB-8	56-005-0886	Q1	3.48%	Percent Difference.
		Q2	1.63%	Percent Difference.
		Q3	1.09%	Percent Difference.
		Q4	3.20%	Percent Difference.
CB-9	56-005-0908	Q1	1.14%	Percent Difference.
		Q2	0.76%	Percent Difference.
		Q3	1.40%	Percent Difference.
		Q4	0.82%	Percent Difference.







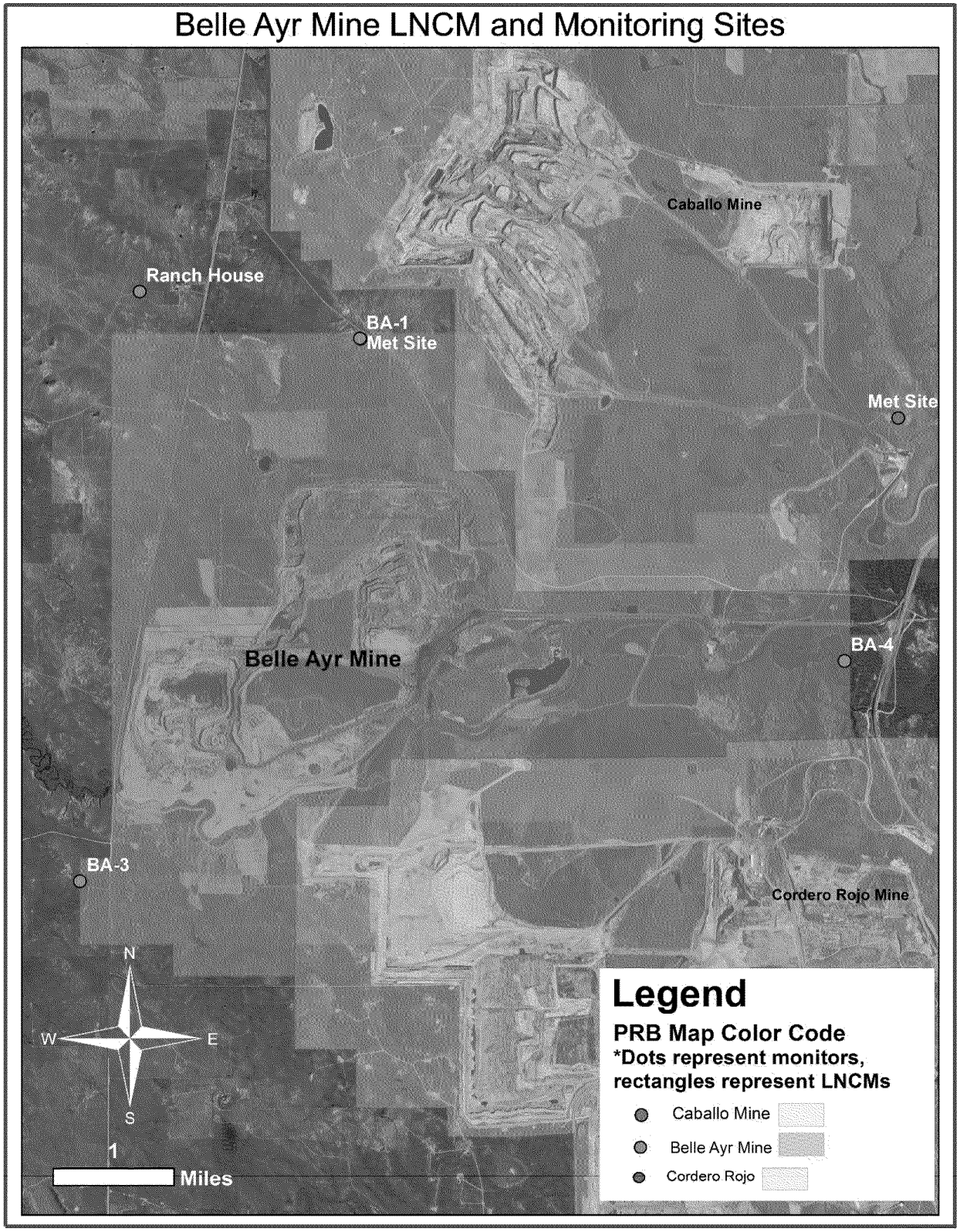
Permitting Action (2015)

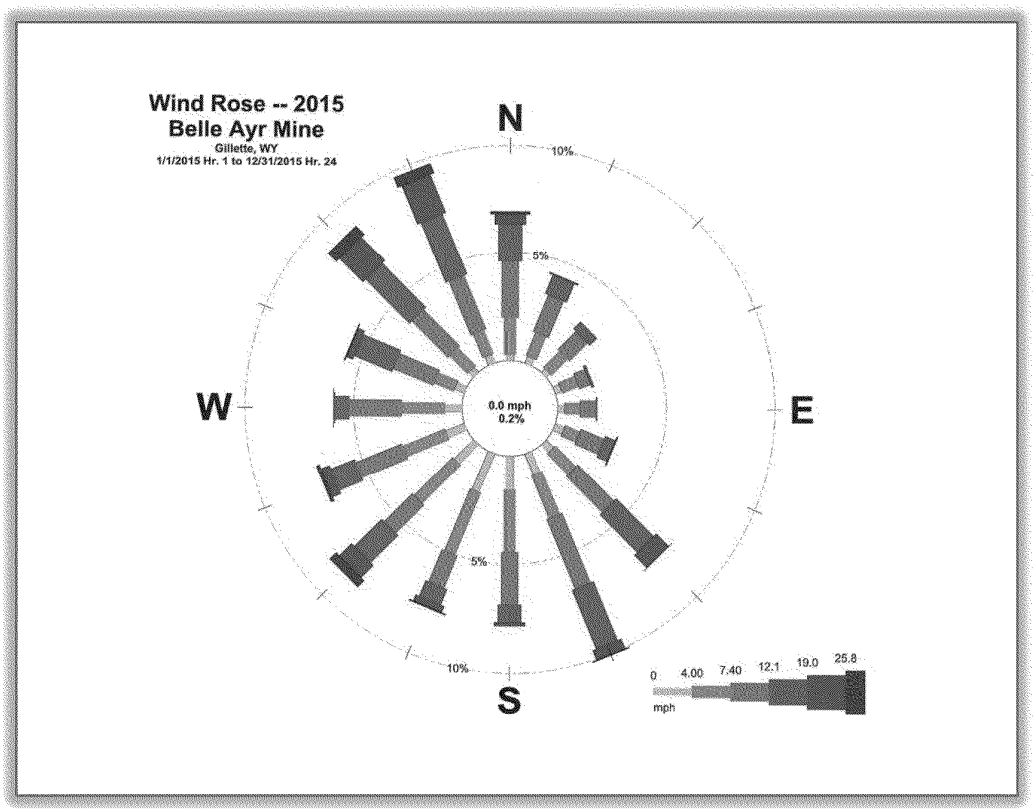
No permit actions happened in 2015.

Facility Summary

Overall, data collection and data quality at this facility are good with no exceedances in the report period. CB9 is located within the LNCM. Relocation of this monitor will be discussed with Caballo in 2016.

Belle Ayr Mine





Mine Monitor Information

Monitor Name	AQS SITE ID	Status	Collection Frequency	Purpose	Instrument Description	Notes
BA-1/1B	56-005-0802	Active	1 in 3	Downwind	Wedding	Operates with satellite on alternate 6 day cycle.
BA-3/3B	56-005-0893	Active	1 in 3	Upwind	Wedding	Operates with satellite on alternate 6 day cycle.
BA-4/4B	56-005-0892	Active	1 in 3	Downwind	Wedding	Operates with satellite on alternate 6 day cycle.
BA4-S	56-005-0892	Active	1 in 6	Precision	Wedding	Collocated with BA-4.
Ranch/B	56-005-0898	Active	1 in 3	Downwind	Wedding	Operates with satellite on alternate 6 day cycle.

Monitor Availability

Monitor	AQS ID	2015		Notes
BA-1/1B	56-005-0802	Q1	100.0%	
		Q2	93.3%	
		Q3	96.8%	
		Q4	100.0%	
BA-3/3B	56-005-0893	Q1	100.0%	
		Q2	96.7%	
		Q3	96.8%	
		Q4	100.0%	
BA-4/4B	56-005-0892	Q1	100.0%	
		Q2	96.7%	
		Q3	93.8%	
		Q4	100.0%	
BA4-S	56-005-0892	Q1	86.7%	Two days invalid due to machine malfunction.
		Q2	100.0%	
		Q3	100.0%	
		Q4	100.0	
Ranch/B	56-005-0898	Q1	100.0%	
		Q2	96.7%	
		Q3	100.0%	
		Q4	90.0%	Ranch House had one day invalid due to sample time being out of limits. Ranch House B had two days invalid due to power failure.

Data Completeness for 2015

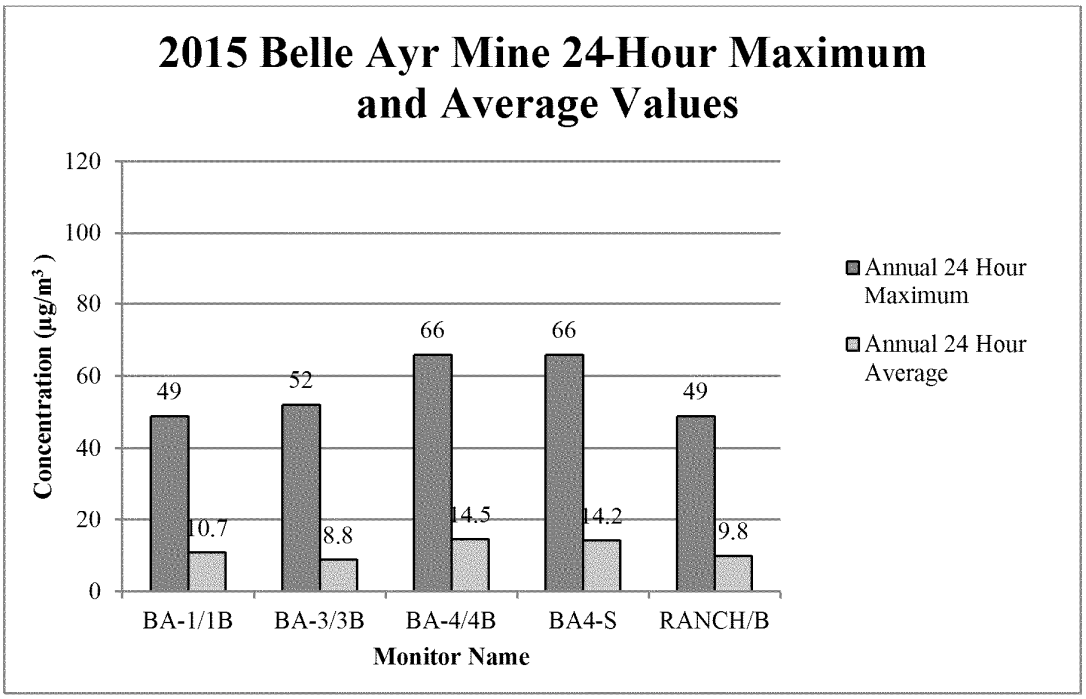
The data completeness report retrieved from AQS indicated no monitors with annual data completeness of 75% or less.

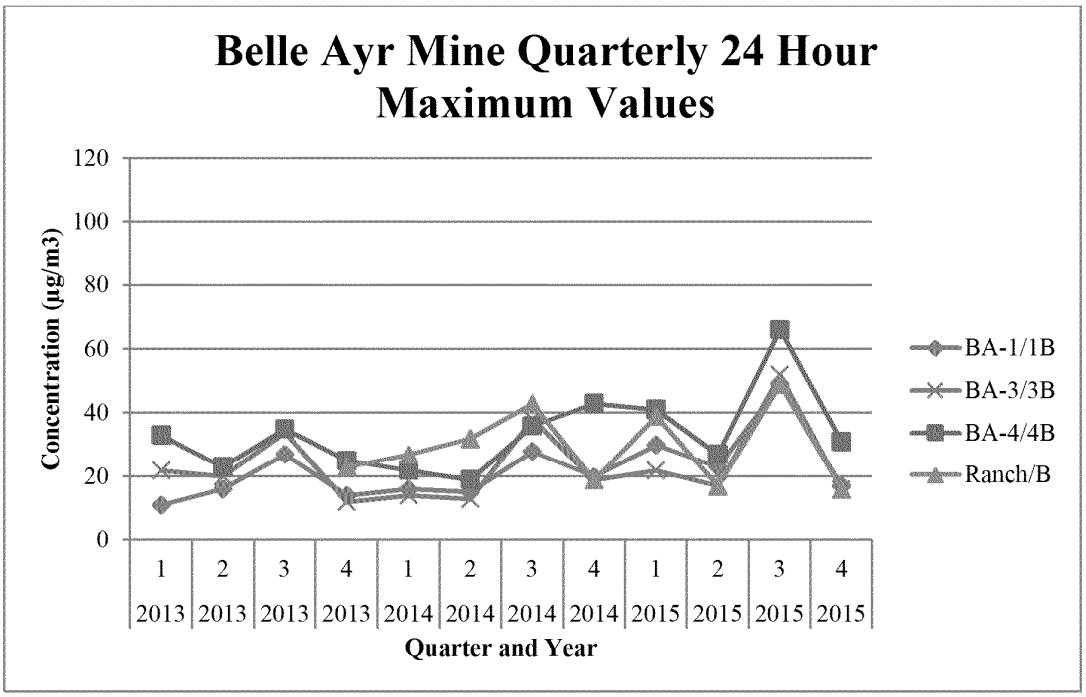
Audits and Flow Verifications in 2015

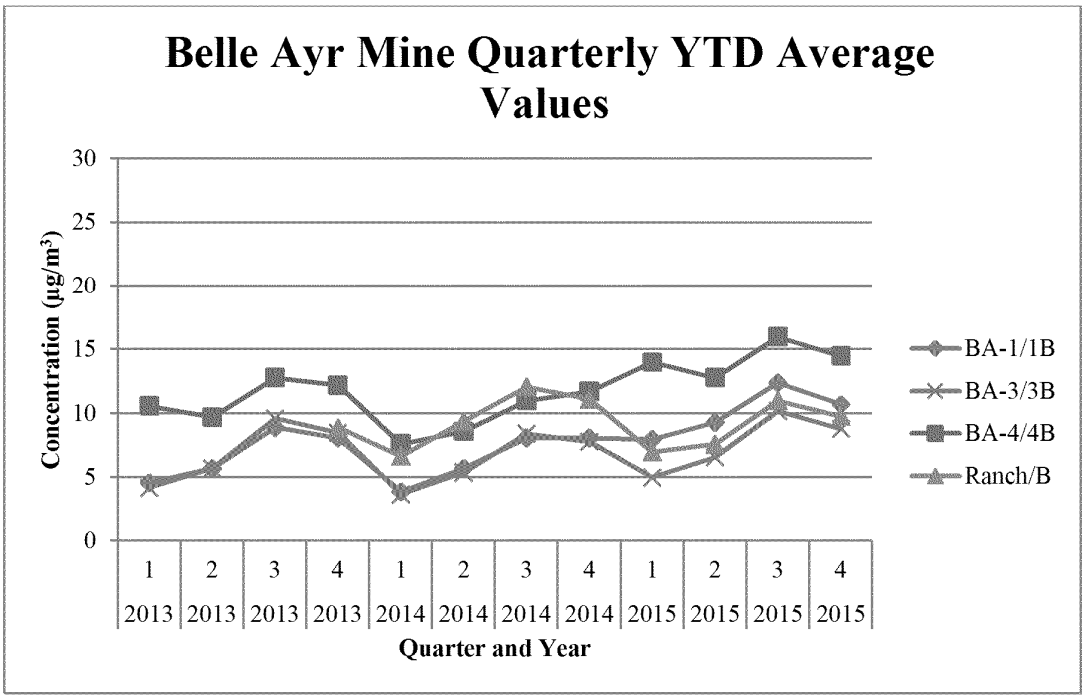
Flow verifications were performed as required. Flow audits were conducted on all samplers in the first and third quarters.

Monitor Precision as Reported

Site	AQS ID	2015		Notes
BA4-S	56-005-0892	Q1	24.10%	Based on only two sample pairs greater than 15 µg/m^3.
		Q2	36.80%	Poor precision in 1 out of 3 valid sample pairs. No explanation given.
		Q3	13.20%	
		Q4	N/A	No sample pairs greater than 15 µg/m3 were collected this quarter.


2015 Belle Ayr Mine 24-Hour Maximum and Average Values
Concentration (µg/m³)
120
100
80
60
40
20
0
49
10.7
52
8.8
66
14.5
66
14.2
49
9.8
BA-1/1B
BA-3/3B
BA-4/4B
BA4-S
RANCH/B
Monitor Name
Annual 24 Hour Maximum
Annual 24 Hour Average


Belle Ayr Mine Quarterly 24 Hour Maximum Values
Concentration (µg/m3)
120
100
80
60
40
20
0
1 2013
2 2013
3 2013
4 2013
1 2014
2 2014
3 2014
4 2014
1 2015
2 2015
3 2015
4 2015
Quarter and Year
BA-1/1B
BA-3/3B
BA-4/4B
Ranch/B



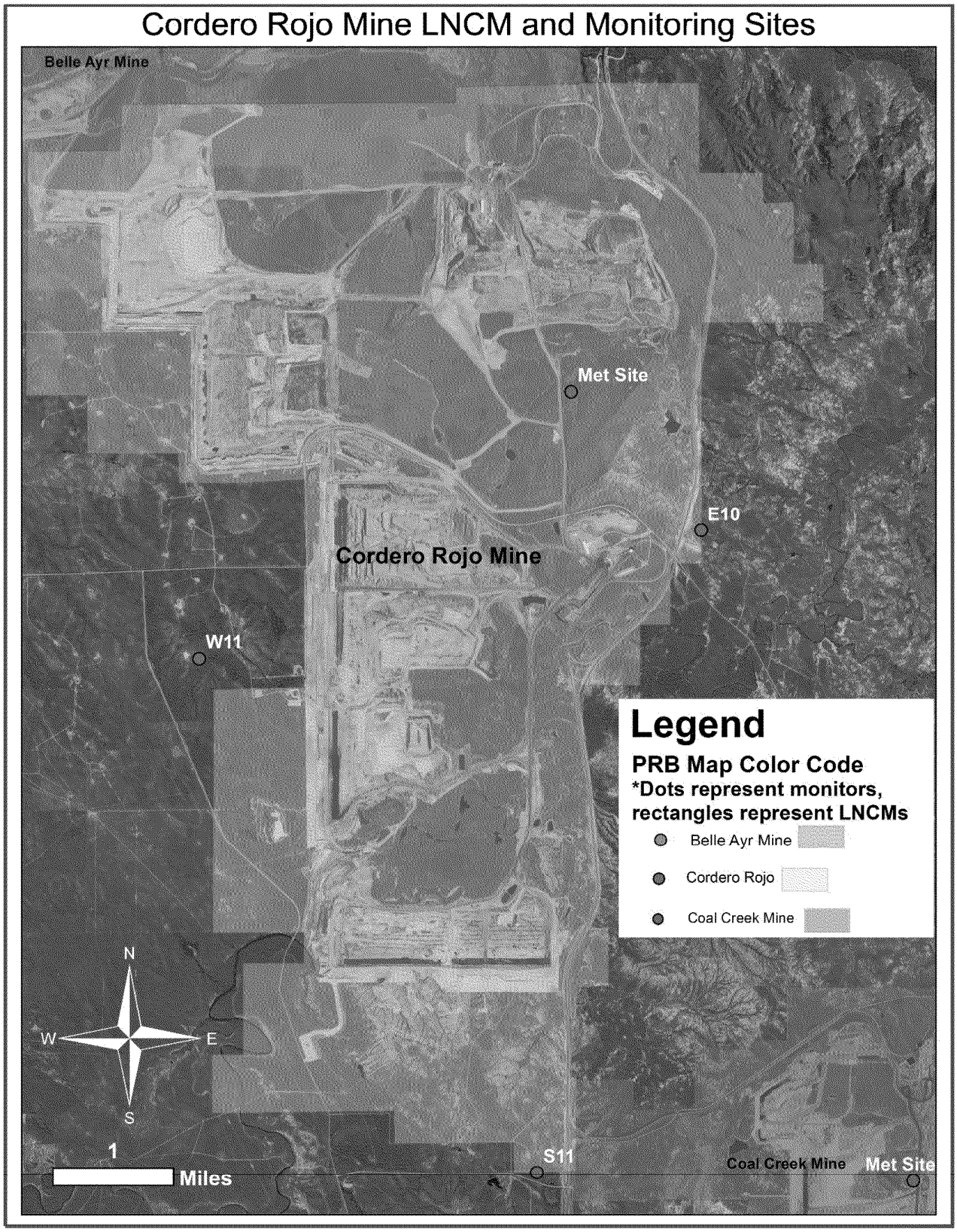
Permitting Action (2015)

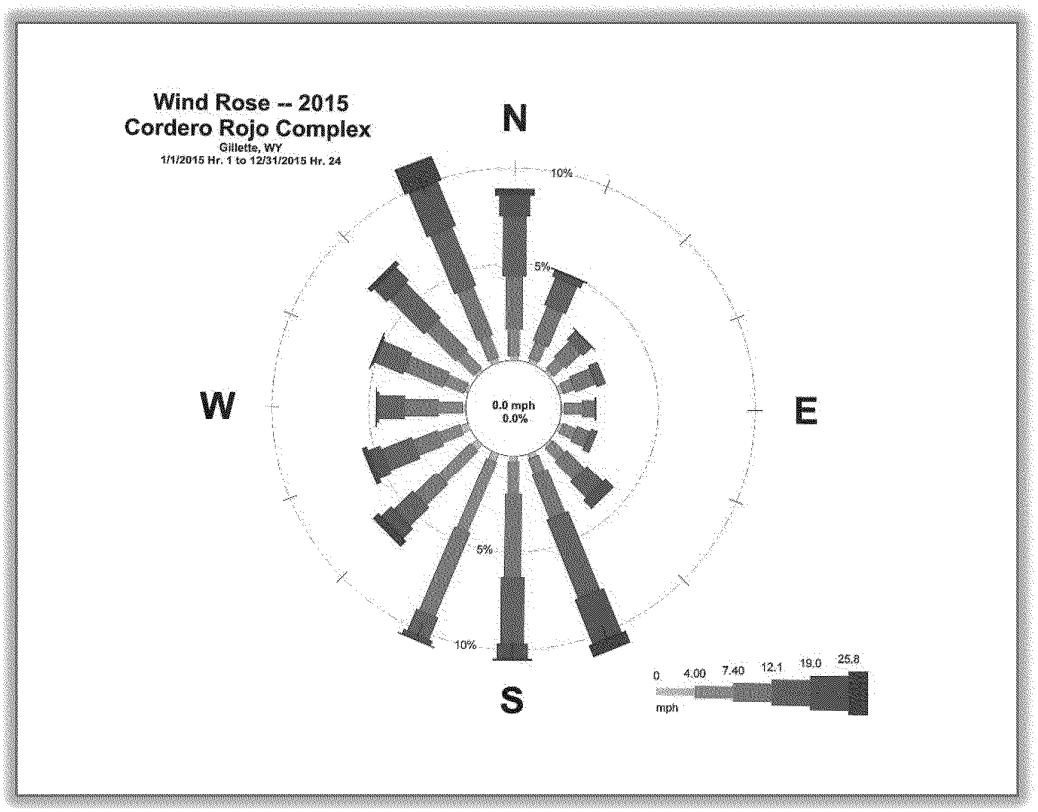
Permit Number	Date Issued	Description
P0014896	06/03/2015	Modify operations at the Belle Ayr Mine, to modify the coal progression sequence, and to modify the lands necessary to conduct mining (LNCM) boundary. This application also proposes to reduce the maximum annual coal production rate from 45 million tons per year (MMtpy) to 35 MMtpy.

Facility Summary

Overall, data collection and data quality at this facility are good with no exceedances in the report period.As of early 2016, Belle Ayr modified their LNCM so that the BA-1 site is now in ambient air.

Cordero Rojo Mine





Mine Monitor Information

Monitor Name	AQS SITE ID	Status	Collection Frequency	Purpose	Instrument Description	Notes
CRC-E10	56-005-0885	Active	1 in 3	Downwind	R-P 2000	Operates with second inlet on alternate 6 day cycle.
CRC-E10A	56-005-0885	Active	1 in 6	Precision	R-P 2000	Collocated with CRC-E10.
CRC-S11	56-005-1009	Active	1 in 3	Downwind	R-P 2000	Operates with second inlet on alternate 6 day cycle.
CRC-W11	56-005-1003	Active	1 in 3	Downwind	R-P 2000	Operates with second inlet on alternate 6 day cycle.

Monitor Availability

Monitor	AQS ID	2015		Notes
CRC-E10	56-005-0885	Q1	100.0%	
		Q2	100.0%	
		Q3	100.0%	
		Q4	100.0%	
CRC-E10A	56-005-0885	Q1	100.0%	
		Q2	80.0%	Two days invalid due to machine malfunction. One day invalid due to power failure.
		Q3	80.0%	Three days invalid due to insufficient data.
		Q4	100.0%	
CRC-S11	56-005-1009	Q1	100.0%	
		Q2	100.0%	
		Q3	96.8%	
		Q4	100.0%	
CRC-W11	56-005-1003	Q1	100.0%	
		Q2	100.0%	
		Q3	96.8%	
		Q4	100.0%	

Data Completeness for 2015

The data completeness report retrieved from AQS indicated no monitors with annual data completeness of 75% or less.

Audits and Flow Verifications in 2015

Flow verifications were performed as required. Flow audits were conducted on all samplers inthe first and third quarters.

Monitor Precision as Reported

Site	AQS ID	2015		Notes
CRC-E10A	56-005-0885	Q1	24.30%	Report notes that there was poor precision, sample pair on 2/17 was audited, but no reason could be determined for the poor agreement (22.3 vs. 8.5 µg/m^3).
		Q2	7.90%	
		Q3	8.50%	
		Q4	21.90%	

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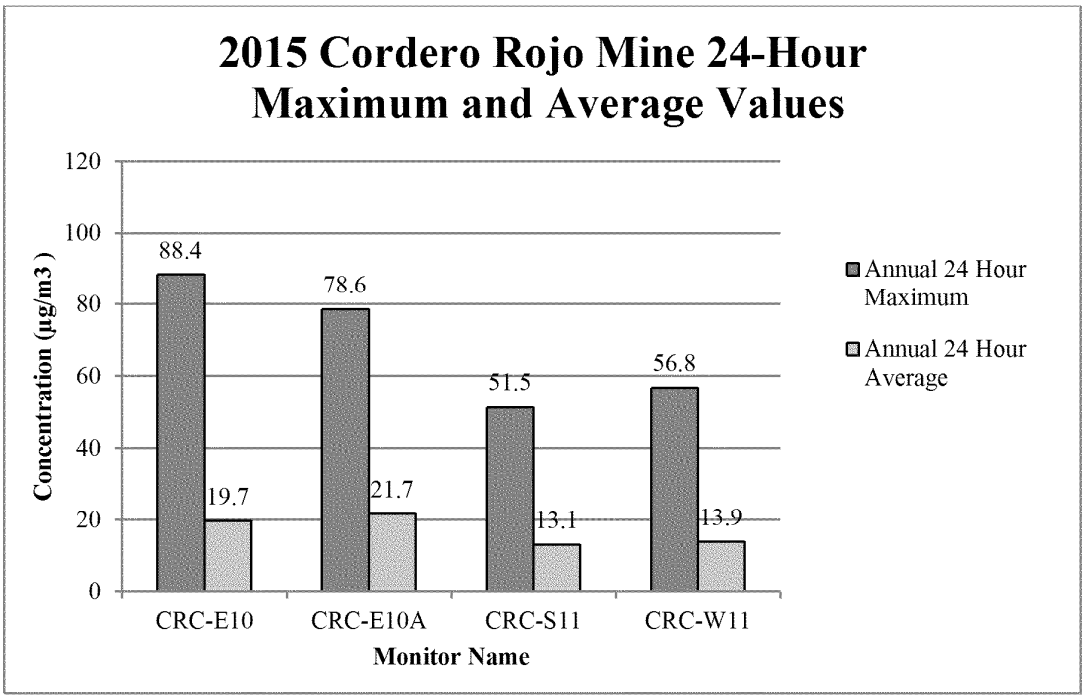
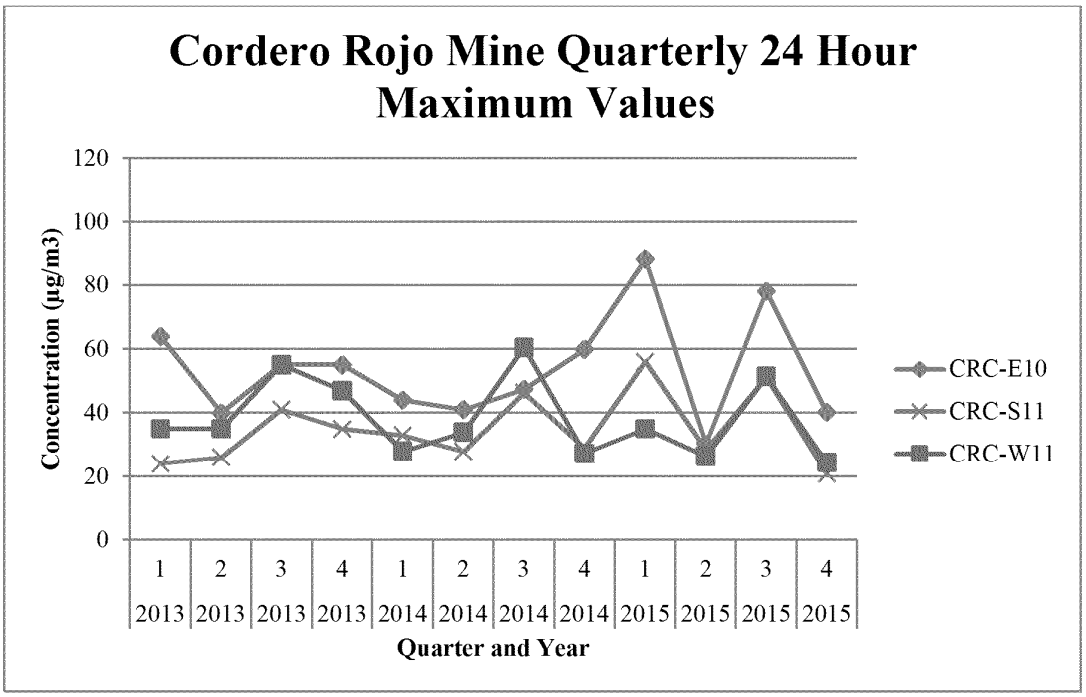
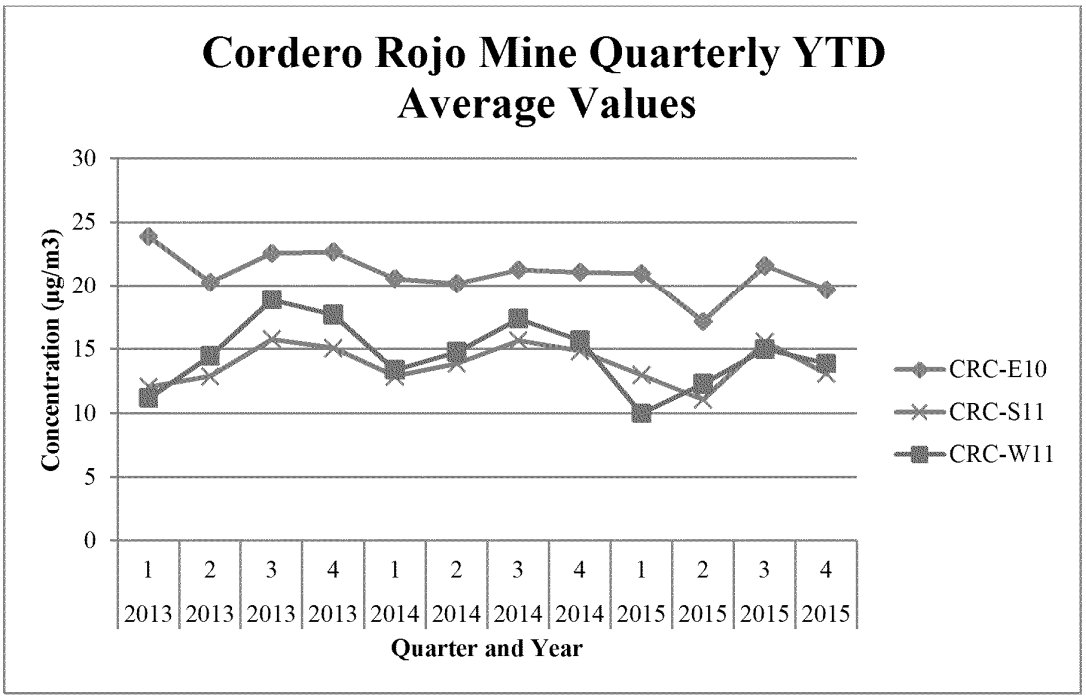

2015 Cordero Rojo Mine 24-Hour Maximum and Average Values
Concentration (µg/m3)
120
100
80
60
40
20
0
88.4
19.7
78.6
21.7
51.5
13.1
56.8
13.9
CRC-E10
CRC-E10A
CRC-S11
CRC-W11
Monitor Name
Annual 24 Hour Maximum
Annual 24 Hour Average


Cordero Rojo Mine Quarterly 24 Hour Maximum Values
Concentration (µg/m3)
120
100
80
60
40
20
0
1 2013
2 2013
3 2013
4 2013
1 2014
2 2014
3 2014
4 2014
1 2015
2 2015
3 2015
4 2015
Quarter and Year
CRC-E10
CRC-S11
CRC-W11



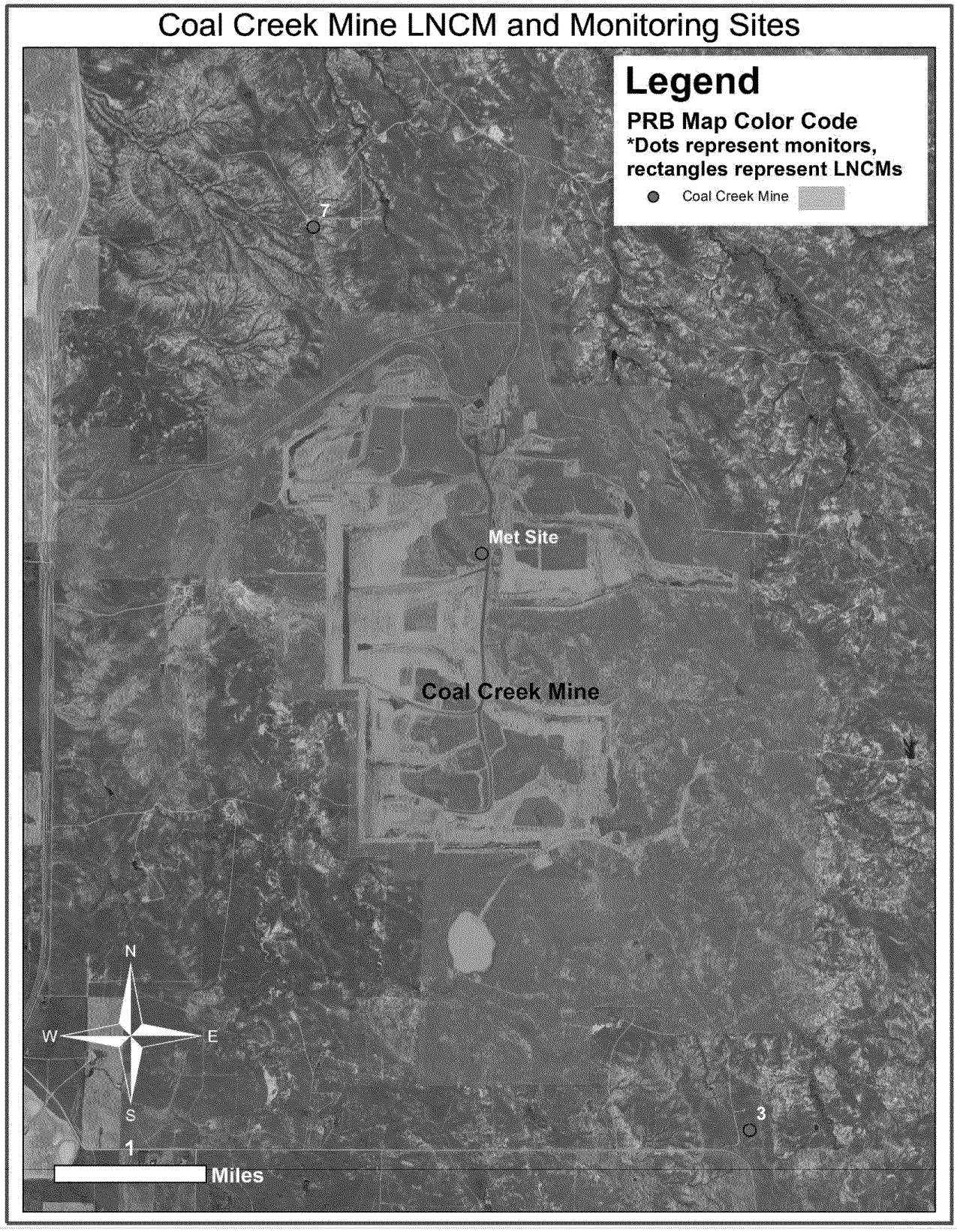
Permitting Action (2015)

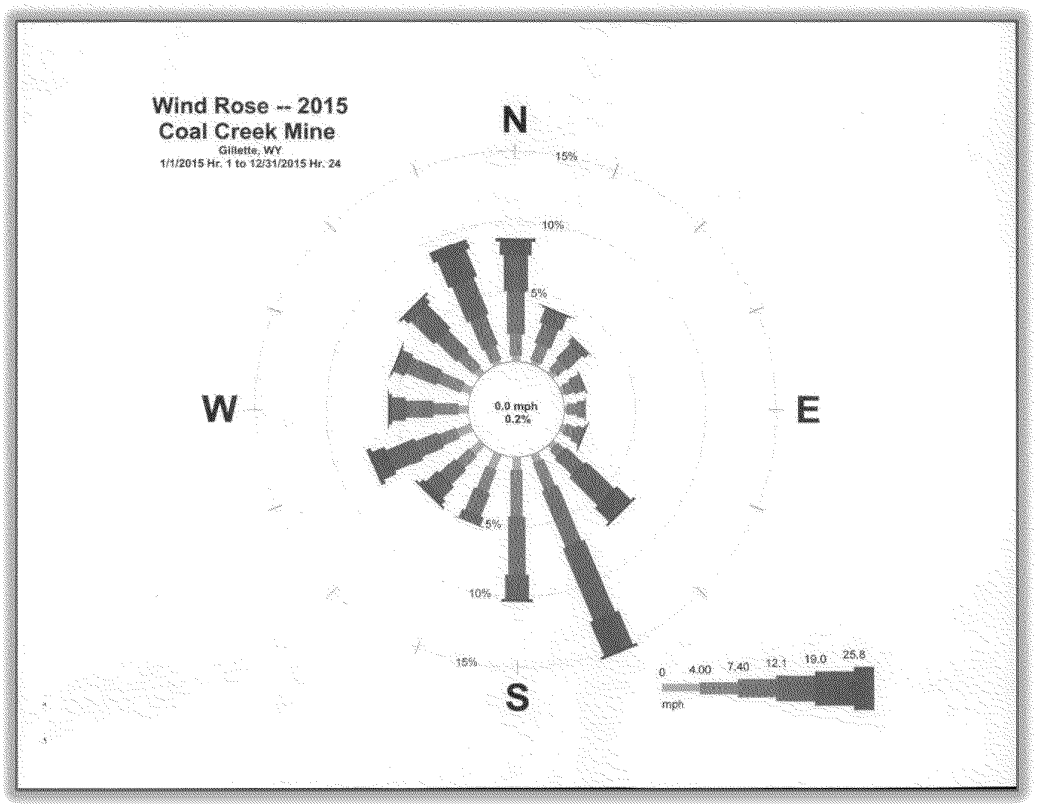
No permitting actions occurred for Cordero Rojo Mine in 2015.

Facility Summary

Overall, data collection and data quality at this facility are good with no exceedances in the report period.

Coal Creek Mine





Mine Monitor Information

Monitor Name	AQS SITE ID	Status	Collection Frequency	Purpose	Instrument Description	Notes
7-1A	56-005-0841	Active	1 in 6	Upwind	Wedding	
3-1A/2	56-005-0303	Active	1 in 3	Downwind	BGI 200PQ	Operates with satellite on alternate 6 day cycle.
3-1B	56-005-0303	Active	1 in 6	Precision	BGI 200PQ	Collocated with 3-A.

Monitor Availability

Monitor	AQS ID	2015		Notes
7-1A	56-005-0841	Q1	100.0%	
		Q2	100.0%	
		Q3	100.0%	
		Q4	100.0%	
3-1A/2	56-005-0303	Q1	100.0%	
		Q2	100.0%	
		Q3	96.8%	
		Q4	96.7%	
3-1B	56-005-0303	Q1	100.0%	
		Q2	100.0%	
		Q3	100.0%	
		Q4	100.0%	

Data Completeness for 2015

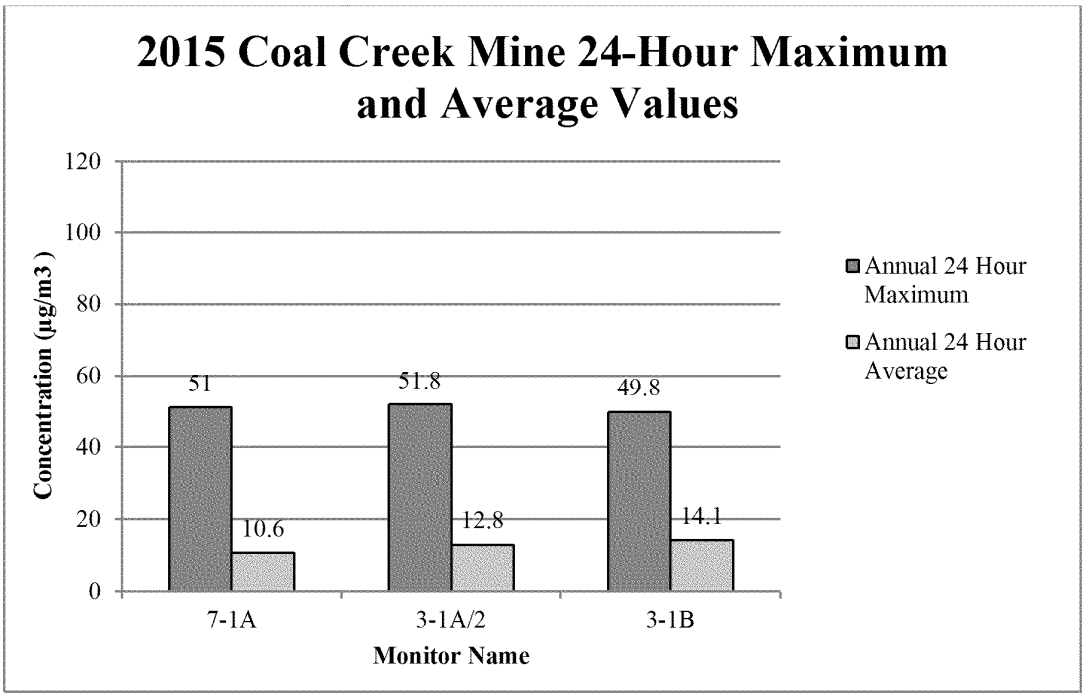
The data completeness report retrieved from AQS indicated no monitors with annual data completeness of 75% or less.

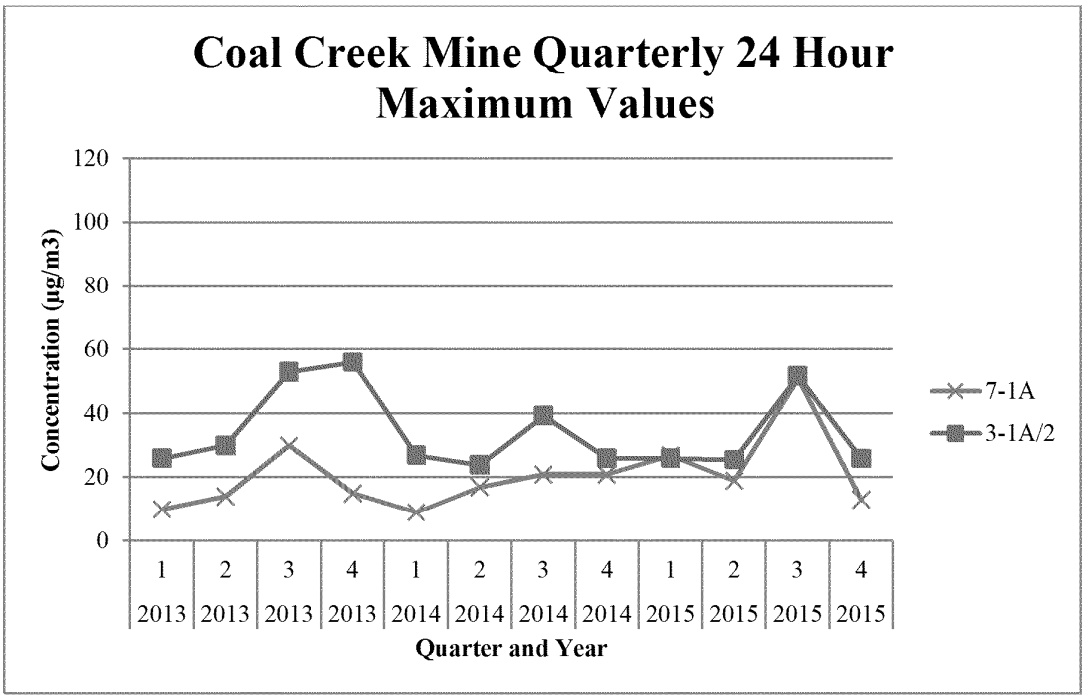
Audits and Flow Verifications in 2015

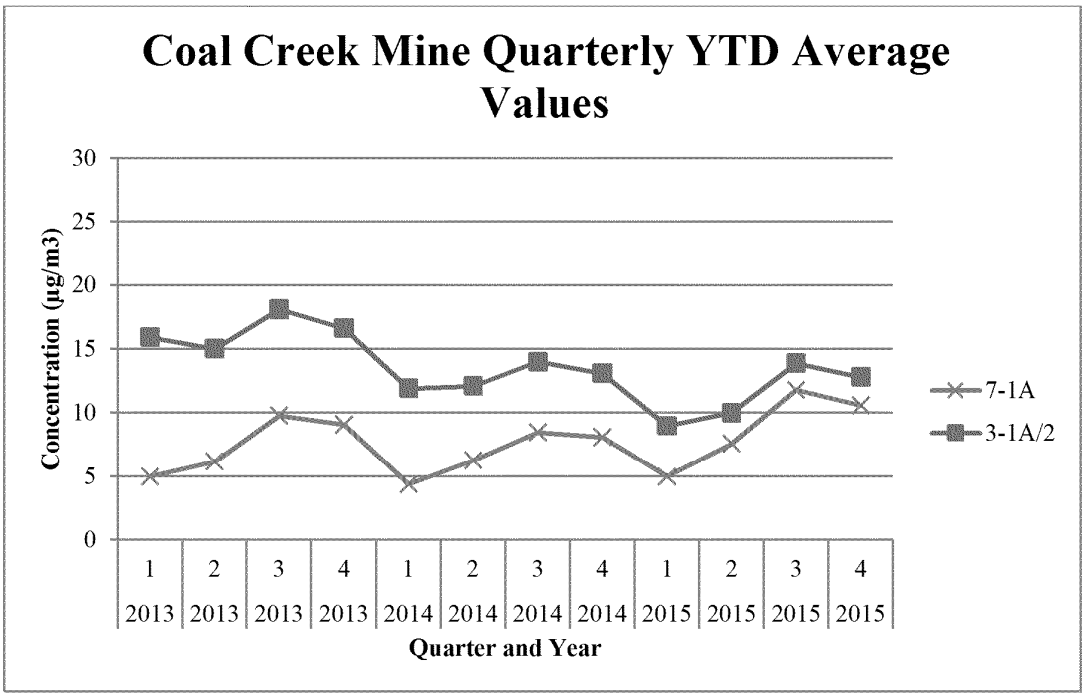
Flow verifications were performed as required. Flow audits were conducted on all samplers in the second and fourth quarters.

Monitor Precision as Reported

Site	AQS ID	2015		Notes
3-1B	56-005-0303	Q1	33.70%	Poor precision in 7 out of 14 valid sample pairs. No explanation provided.
		Q2	17.30%	
		Q3	8.10%	
		Q4	17.10%	







Permitting Action (2015)

No permits were issued to this facility in 2015.

Facility Summary

Overall, data collection and data quality at this facility are good with no exceedances in the report period.

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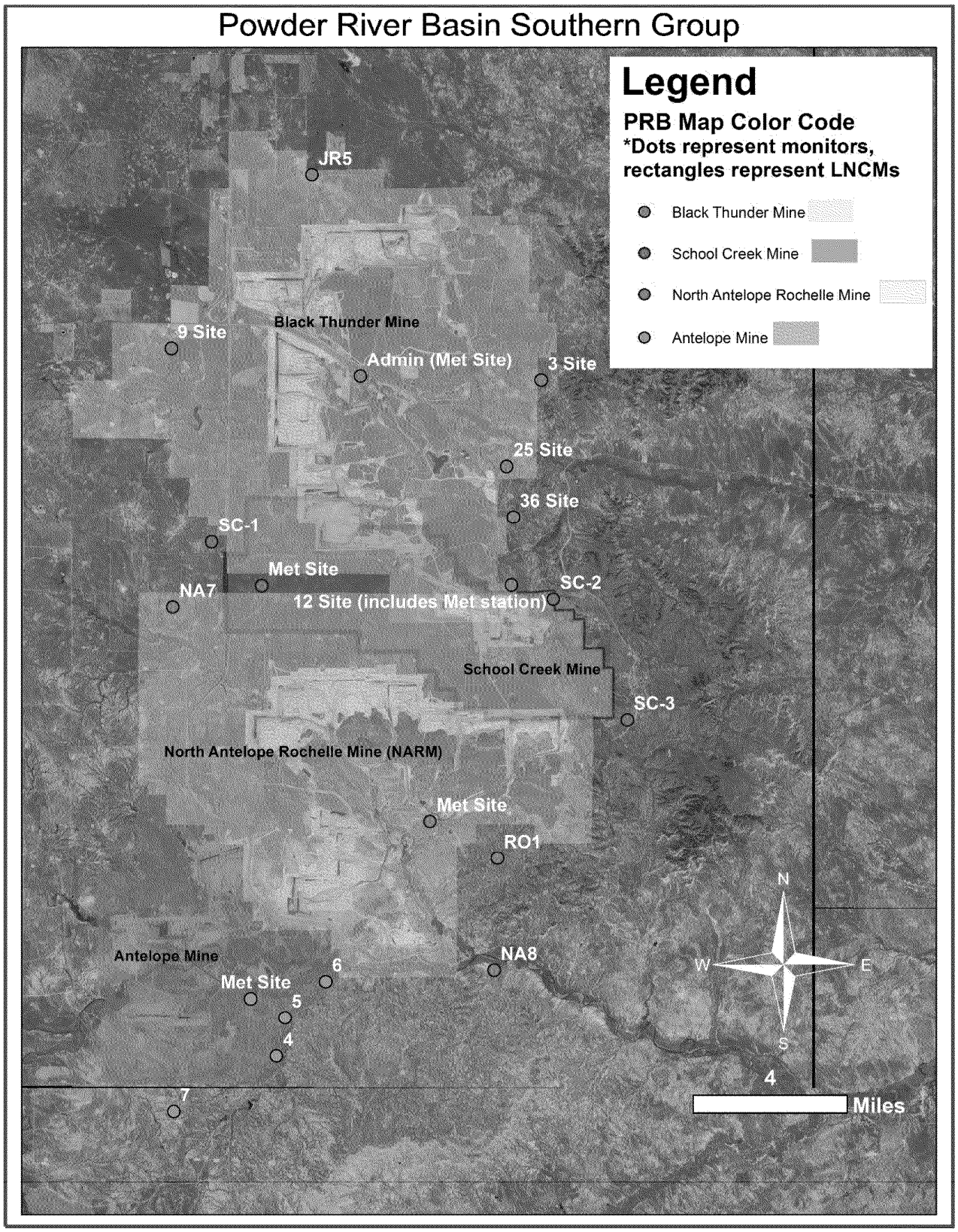
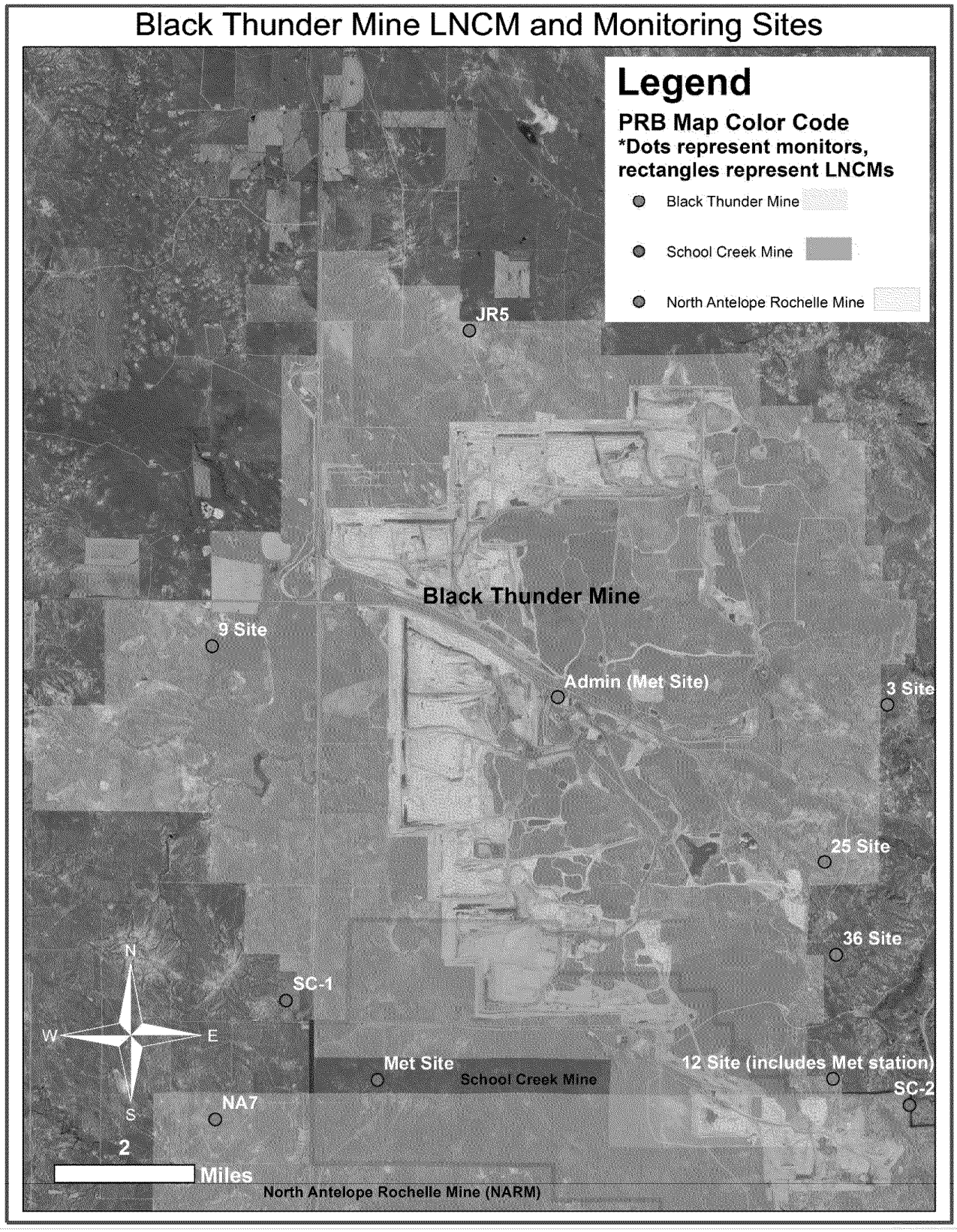
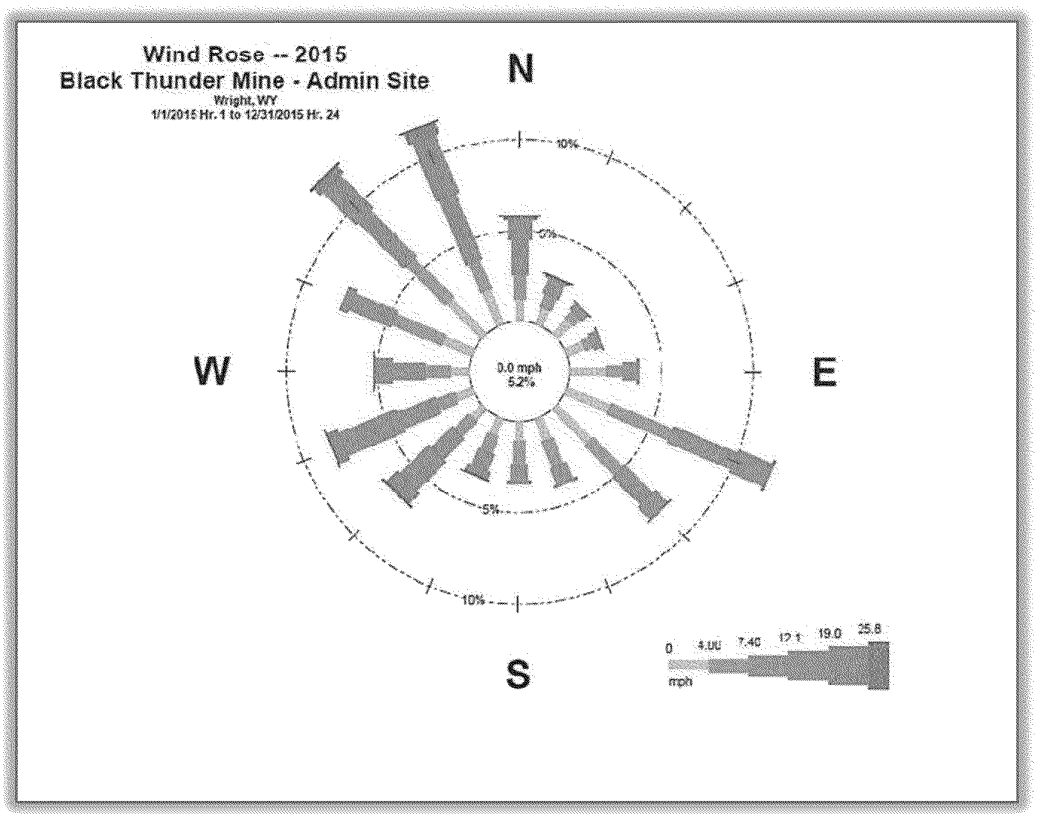
Southern Group



Black Thunder Mine





Mine Monitor Information

Monitor Name	AQS SITE ID	Status	Collection Frequency	Purpose	Instrument Description	Notes
25-3/4	56-005-1877	Active	1 in 3	Downwind	Wedding	Operates with satellite on alternate 6 day cycle.
25-5	56-005-1877	Active	1 in 6	Precision	Wedding	Collocated with 25-3/4.
36	56-005-0891	Active	Daily	Downwind	TEOM	
9-1/2	56-005-1915	Active	1 in 6	Upwind	R-P 2000	Operates with satellite on alternate 6 day cycle.
3APM10	56-005-0875	Active	1 in 3	Downwind	R-P 2000	
JR-5	56-005-1917	Active	Daily	Downwind	TEOM	

Monitor Availability

Monitor	AQS ID	2015		Notes
25-3/4	56-005-1877	Q1	96.7%	
		Q2	96.7%	
		Q3	93.8%	
		Q4	96.7%	
25-5	56-005-1877	Q1	100.0%	
		Q2	93.8%	
		Q3	100.0%	
		Q4	100.0%	
36	56-005-0891	Q1	100.0%	
		Q2	97.8%	
		Q3	59.8%	Twenty-eight (28) days invalid due to poor quality assurance results. Five (5) days invalid due to power failure. Three days invalid due to missing records. One (1) day invalid due to machine malfunction.
		Q4	94.6%	
9-1/2	56-005-1915	Q1	100.0%	
		Q2	96.7%	
		Q3	93.5%	
		Q4	93.3%	
3APM10	56-005-0875	Q1	100.0%	
		Q2	100.0%	
		Q3	100.0%	
		Q4	93.3%	
JR-5	56-005-1917	Q1	100.0%	
		Q2	95.6%	
		Q3	97.8%	
		Q4	100.0%	

Data Completeness for 2015

The data completeness report retrieved from AQS indicated no monitors with annual data completeness of 75% or less.

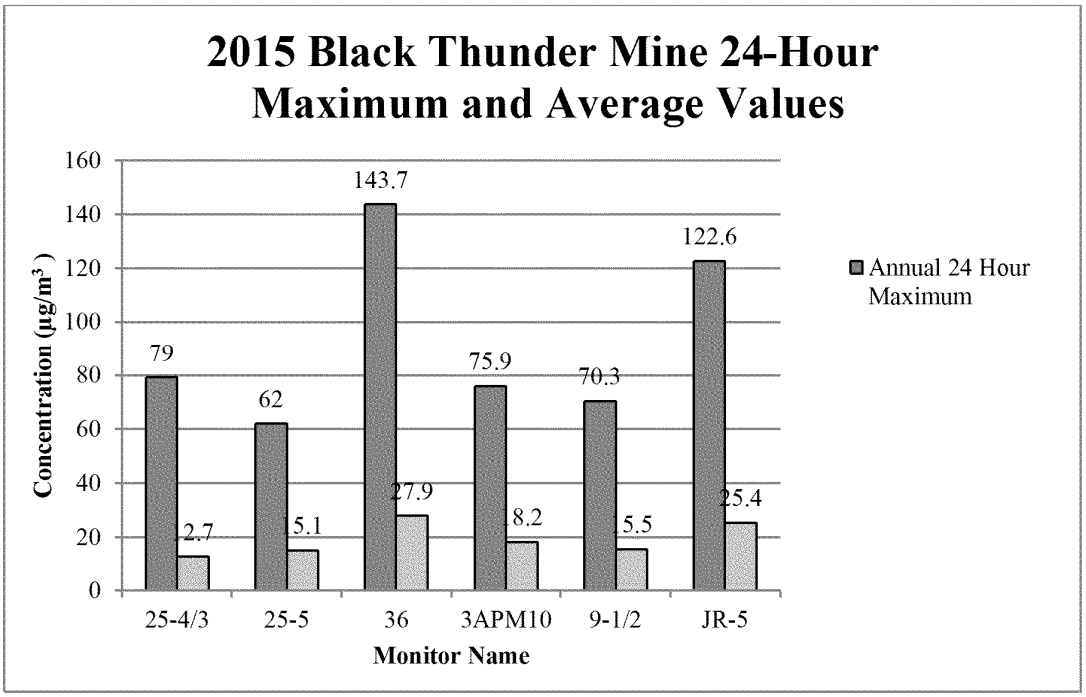
Audits and Flow Verifications in 2015

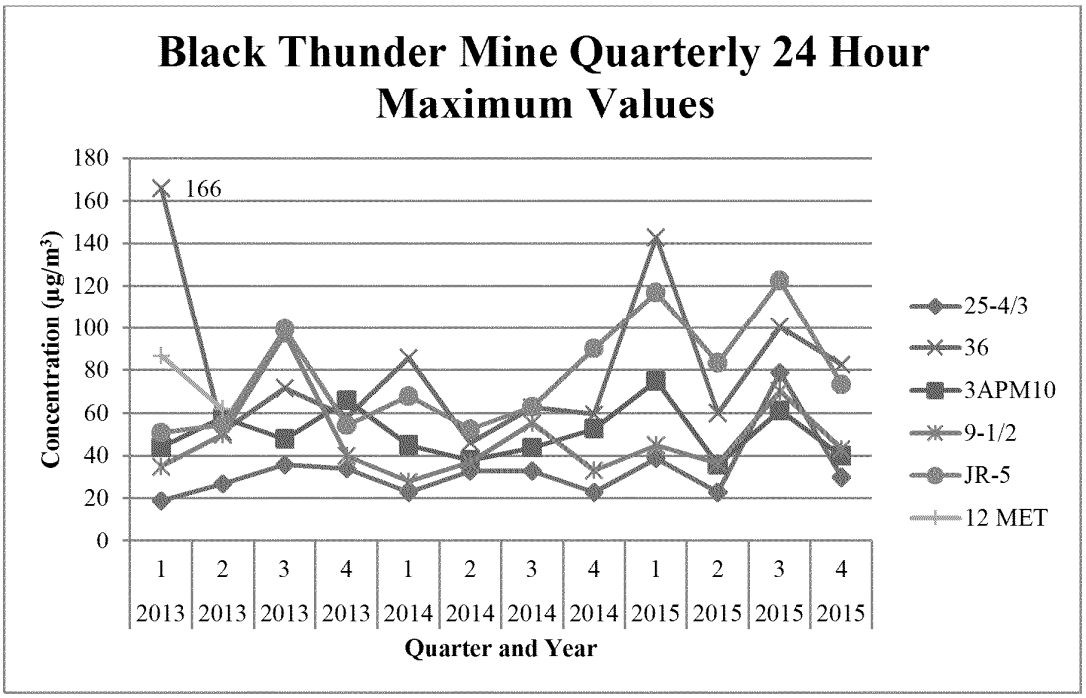
Flow verifications were performed as required. Flow audits were conducted on all samplers in the first and third quarters. The April 2015 flow verifications at the Site 36 TEOM were out of limits and calibration was performed on the same day, two (2) days were invalidated. The July 2015 flow verification for Site 36 TEOM was also out of limits resulting in 28 days of data invalidated.

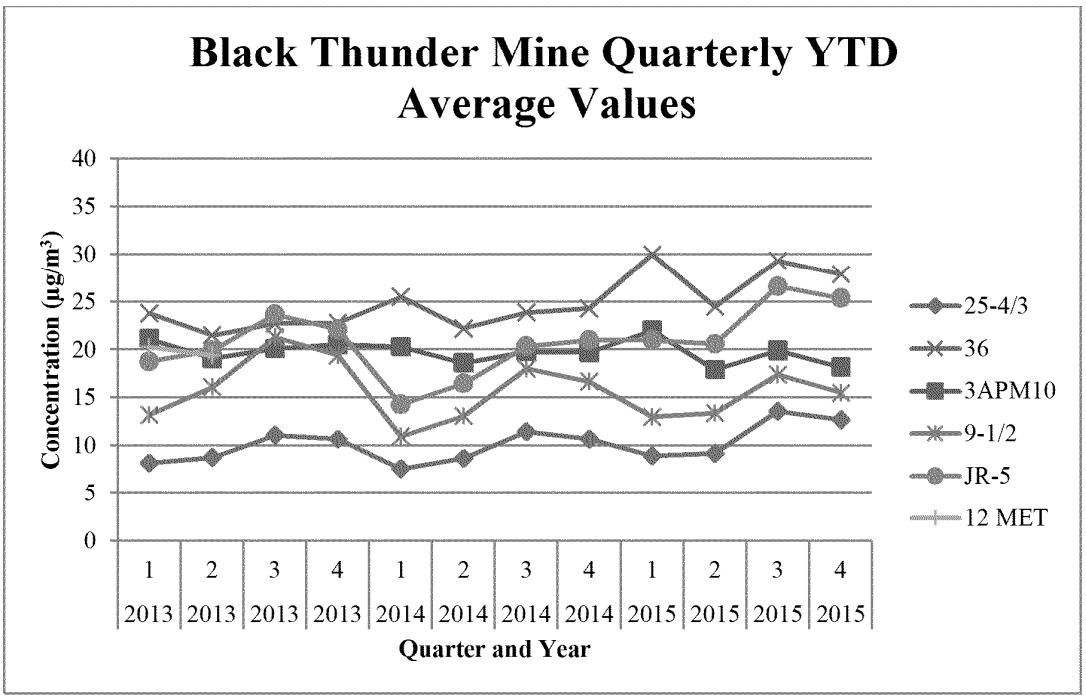
ED_001361_00002636

Monitor Precision as Reported

Monitor/Site	AQS ID	2015		Notes
25	56-005-1877	Q1	53.80%	Coefficient of Variation. Based on two sample pairs greater than 15 µg/m3. No explanation given.
		Q2	105.10%	Coefficient of Variation. Based on two sample pairs greater than 15 µg/m3. No explanation given.
		Q3	18.40%	
		Q4	N/A	Sample concentrations not high enough for calculations.
36	56-005-0891	Q1	1.94%	Percent Difference.
		Q2	2.03%	Percent Difference. April flow verification out of limits. Calibrated same day. Audit performed on April 30th prior to removing spare spensor unit.
		Q3	5.54%	Percent Difference. July flow verification out of limits.
		Q4	0.50%	Percent Difference.
JR-5	56-005-1917	Q1	2.15%	Percent Difference.
		Q2	1.16%	Percent Difference.
		Q3	0.68%	Percent Difference.
		Q4	0.36%	Percent Difference.




Black Thunder Mine Quarterly 24 Hour Maximum Values
Concentration (µg/m³)
180
160
140
120
100
80
60
40
20
0
166
1 2013
2 2013
3 2013
4 2013
1 2014
2 2014
3 2014
4 2014
1 2015
2 2015
3 2015
4 2015
Quarter and Year
25-4/3
36
3APM10
9-1/2
JR-5
12 MET


Black Thunder Mine Quarterly YTD Average Values
Concentration (µg/m³)
40
35
30
25
20
15
10
5
0
1 2013
2 2013
3 2013
4 2013
1 2014
2 2014
3 2014
4 2014
1 2015
2 2015
3 2015
4 2015
Quarter and Year
25-4/3
36
3APM10
9-1/2
JR-5
12 MET

Permitting Action (2015)

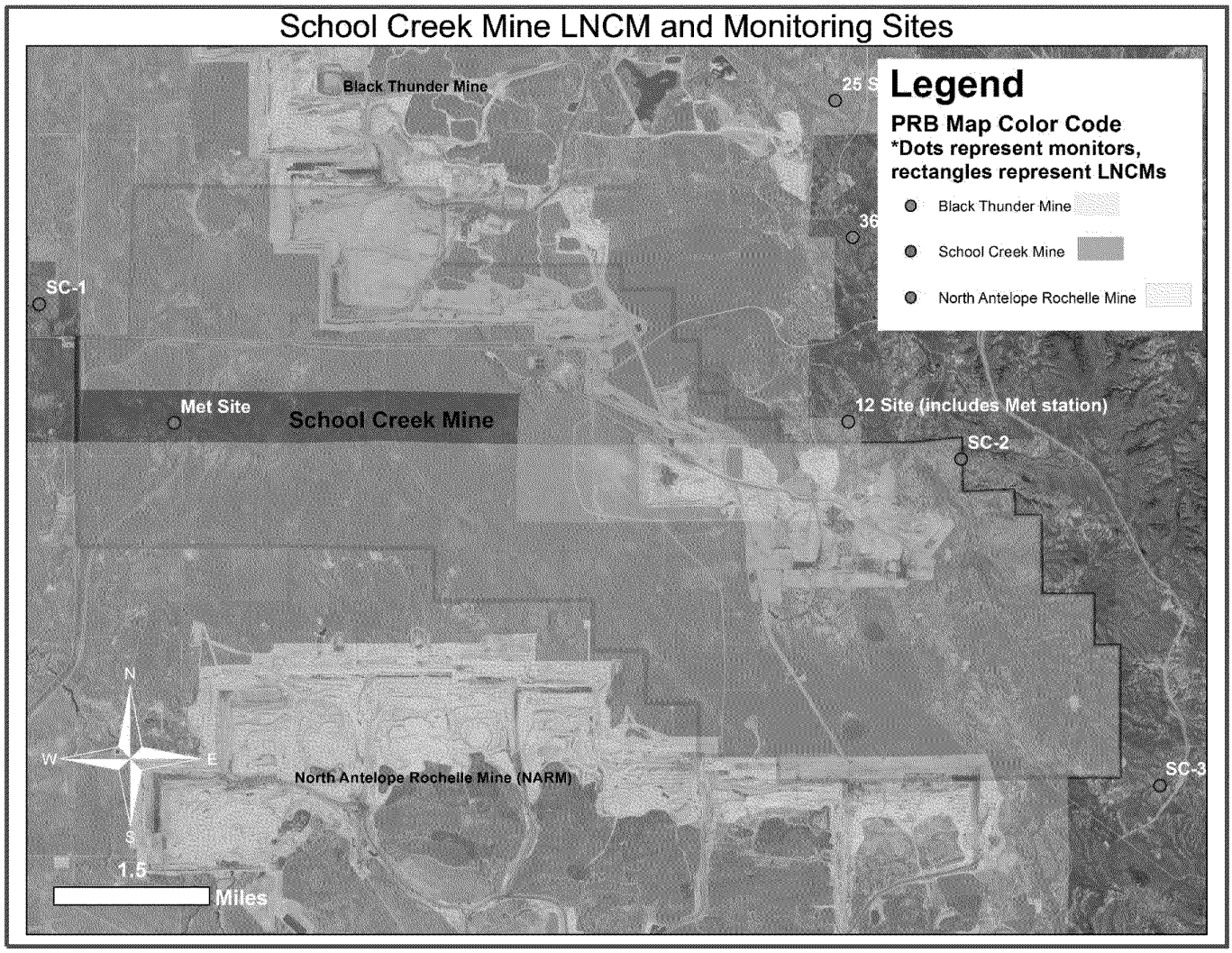
Permit Number	Date Issued	Description
P0015010	10/27/2015	Modify the coal removal progression with a maximum annual coal production rate of 190 million tons per year, and to modify the LNCM boundary for the Black Thunder Mine. A new truck dump and associated coal preparation facilities (West Hilight) will be constructed on the west side of the mine which will connect into the existing west loadout facilities at the mine.

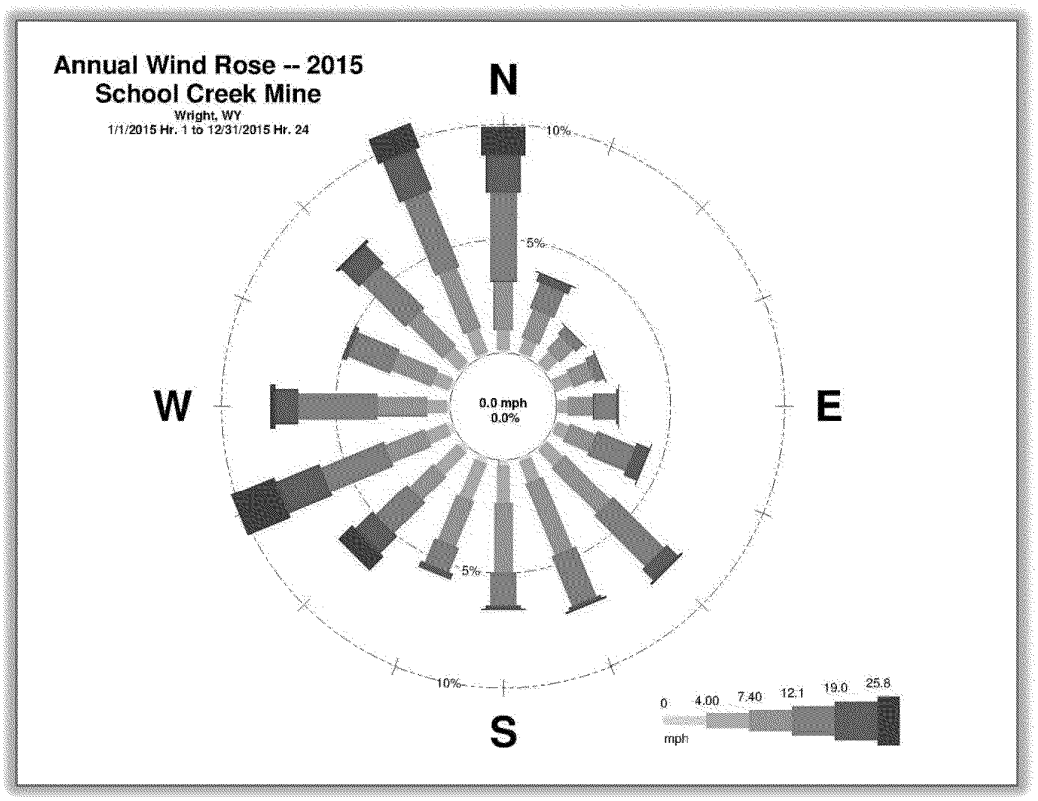
Facility Summary

Overall, data collection and data quality at this facility are good with no exœedances in the report period. Black Thunder modified their monitoring network in early 2016 to move their monitors back into ambient air, outside of their LNCM. These changes will be included in the 2016 Powder River Basin Network Review.

ED_001361_00002636

School Creek Mine





Mine Monitor Information

Monitor Name	AQS SITE ID	Status	Collection Frequency	Purpose	Instrument Description	Notes
SC-1	56-005-0084	Active	Daily	Upwind	TEOM	
SC-2	56-005-0087	Active	Daily	Downwind	TEOM	
SC-3	56-005-0086	Active	Daily	Downwind	TEOM	

Monitor Availability

Monitor	AQS ID	2015		Notes
SC-1	56-005-0084	Q1	98.9%	
		Q2	100.0%	
		Q3	97.8%	
		Q4	95.7%	
SC-2	56-005-0087	Q1	100.0%	
		Q2	29.7%	Forty-nine (49) days invalid due to poor quality assurance results. Monitor failed April and June flow verifications.
		Q3	83.7%	Fifteen (15) days invalid due to poor quality assurance results. Monitor failed July flow verification.
		Q4	100.0%	
SC-3	56-005-0086	Q1	100.0%	
		Q2	100.0%	
		Q3	100.0%	
		Q4	100.0%	

Data Completeness for 2015

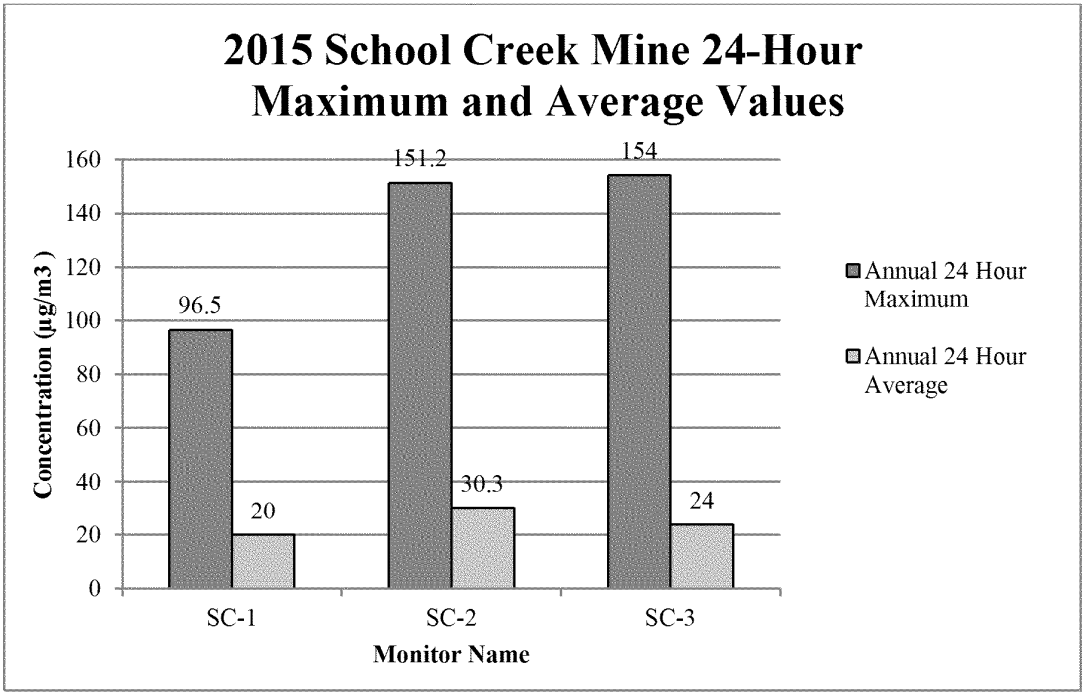
The data completeness report retrieved from AQS indicated no monitors with annual data completeness of 75% or less.

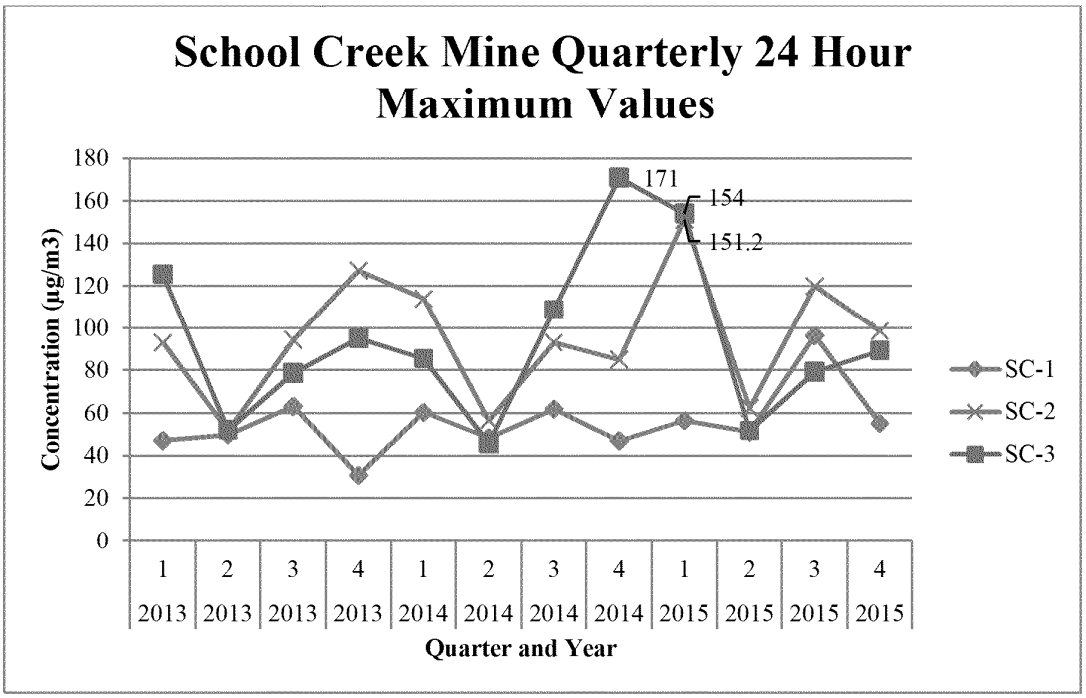
Audits and Flow Verifications in 2015

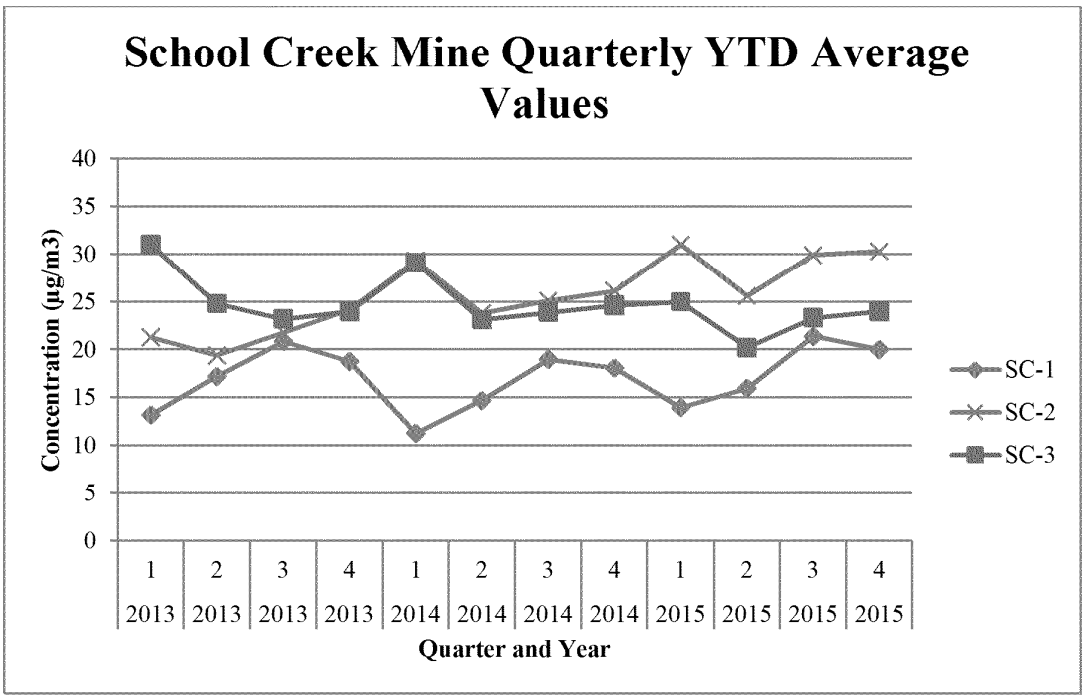
Flow verifications were performed as required. April, June, and July flow verifications were out of limits at the SC-2 monitor site resulting in 64 days of invalidated data. Instrument calibrations were performed after each failure. Flow audits were conducted on all samplers in the second and fourth quarters.

Monitor Precision as Reported

Monitor	AQS ID	2015		Notes
SC-1	56-005-0084	Q1	0.30%	Percent Difference.
		Q2	0.52%	Percent Difference.
		Q3	0.16%	Percent Difference.
		Q4	0.40%	Percent Difference.
SC-2	56-005-0087	Q1	1.53%	Percent Difference.
		Q2	2.44%	Percent Difference. April and June flow verifications out of limits. Instrument calibrated following each failure.
		Q3	1.62%	Percent Difference. July flow verification out of limits. Instrument was replaced by a spare on 7/15.
		Q4	0.76%	Percent Difference.
SC-3	56-005-0086	Q1	2.56%	Percent Difference.
		Q2	2.21%	Percent Difference.
		Q3	2.00%	Percent Difference.
		Q4	1.19%	Percent Difference.




School Creek Mine Quarterly 24 Hour Maximum Values
Concentration (µg/m3)
180
160
140
120
100
80
60
40
20
0
171
154
151.2
1 2013
2 2013
3 2013
4 2013
1 2014
2 2014
3 2014
4 2014
1 2015
2 2015
3 2015
4 2015
Quarter and Year
SC-1
SC-2
SC-3


School Creek Mine Quarterly YTD Average Values
Concentration (µg/m3)
40
35
30
25
20
15
10
5
0
1 2013
2 2013
3 2013
4 2013
1 2014
2 2014
3 2014
4 2014
1 2015
2 2015
3 2015
4 2015
Quarter and Year
SC-1
SC-2
SC-3

Permitting Action (2015)

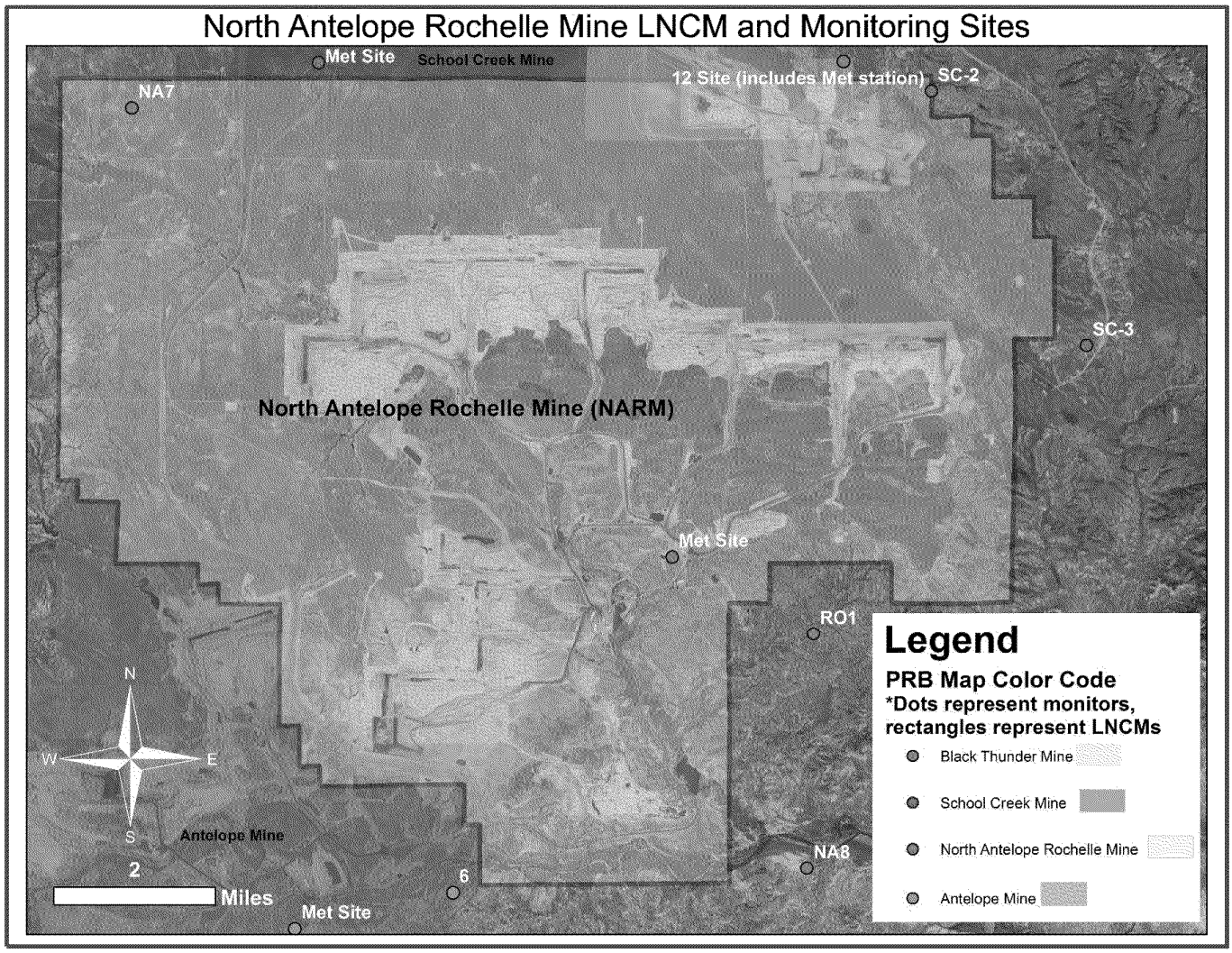
Permit Number	Date Issued	Description
P0020047	09/28/2015	Waiver to construct a new coal haul road to facilitate coal transport from NARM to crushing and load-out facilities at School Creek.

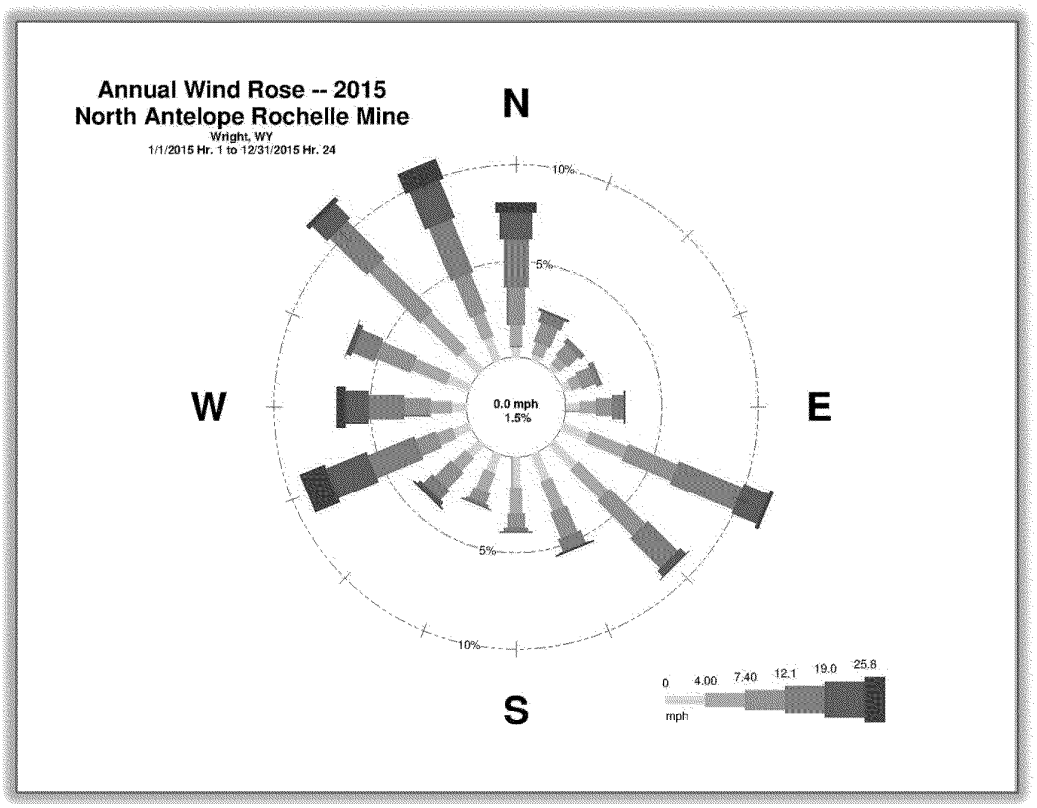
Facility Summary

Data collection and data quality at this facility were moderate during 2015 due to more than three (3) months data invalidated due to failed verifications at the SC-2 site. The SC-2 monitor was removed for repair in July and a spare was installed. Precision improved after this corrective action was taken. No exceptional events were recorded.

ED_001361_00002636

North Antelope Rochelle Mine





Mine Monitor Information

Monitor Name	AQS SITE ID	Status	Collection Frequency	Purpose	Instrument Description	Notes
NA-7	56-005-1900	Active	Daily	Upwind	TEOM	
RO-1	56-005-0869	Active	Daily	Downwind	TEOM	
NA-8	56-009-0088	Active	Daily	Downwind	TEOM	

Monitor Availability

Monitor	AQS ID	2015		Notes
NA-7	56-005-1900	Q1	100.0%	
		Q2	98.9%	
		Q3	100.0%	
		Q4	100.0%	
NA-8	56-009-0088	Q1	100.0%	
		Q2	100.0%	
		Q3	98.9%	
		Q4	89.1%	Seven (7) days invalid due to flow faults. Three (3) days invalid due to missing records due to communications being down.
RO-1	56-005-0869	Q1	100.0%	
		Q2	100.0%	
		Q3	100.0%	
		Q4	96.7%	

Data Completeness for 2015

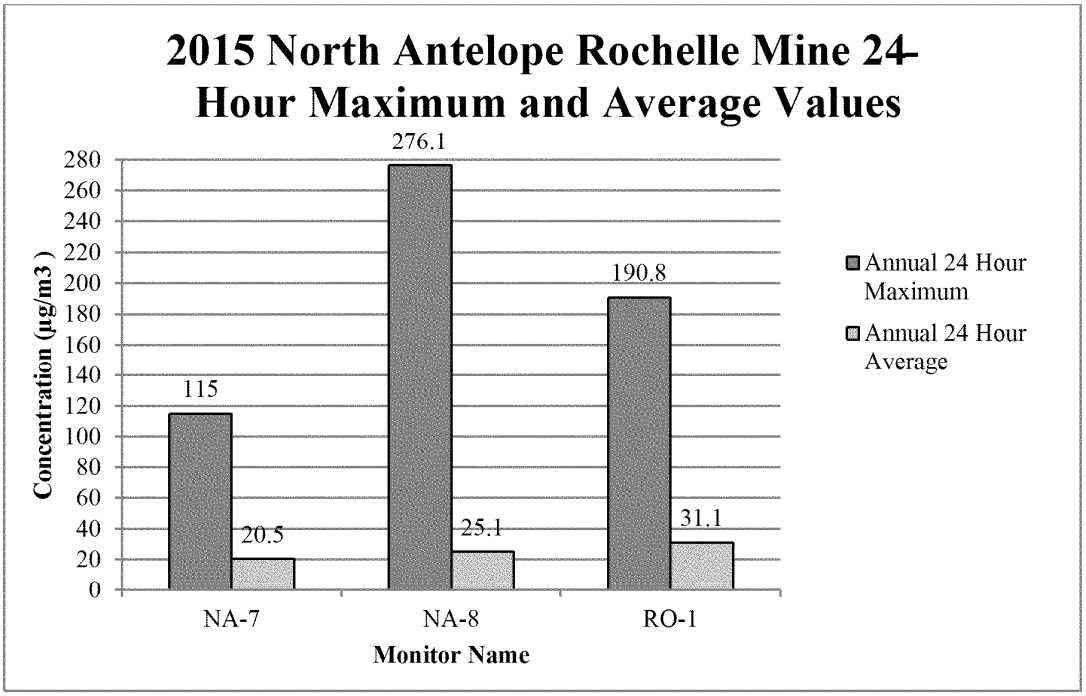
The data completeness report retrieved from AQS indicated no monitors with annual data completeness of 75% or less.

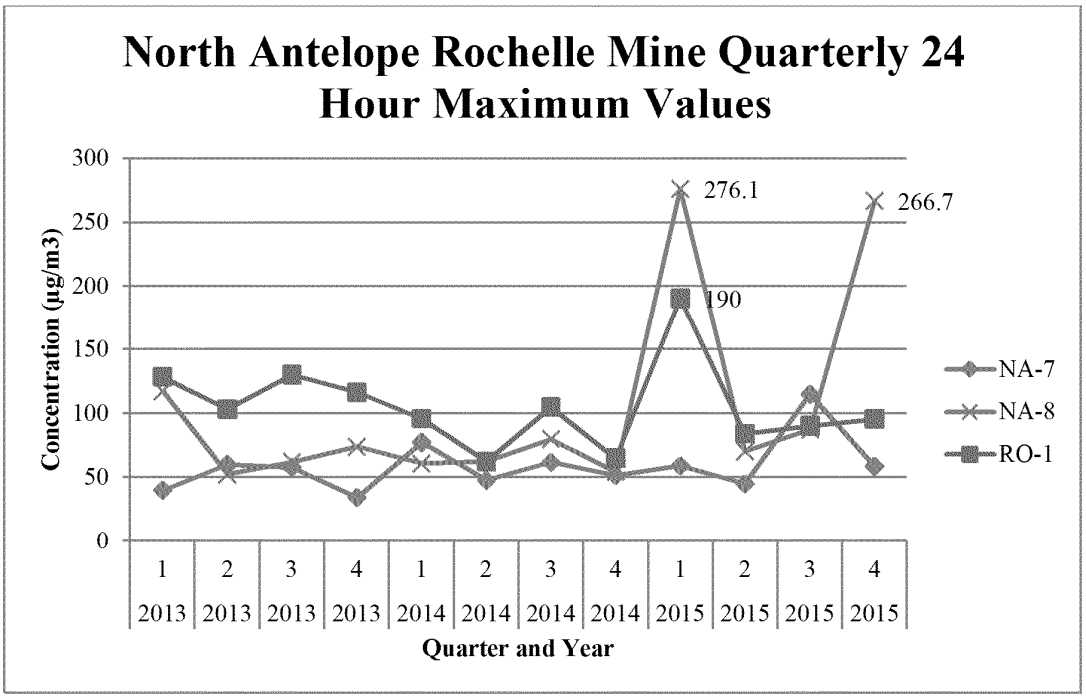
Audits and Flow Verifications in 2015

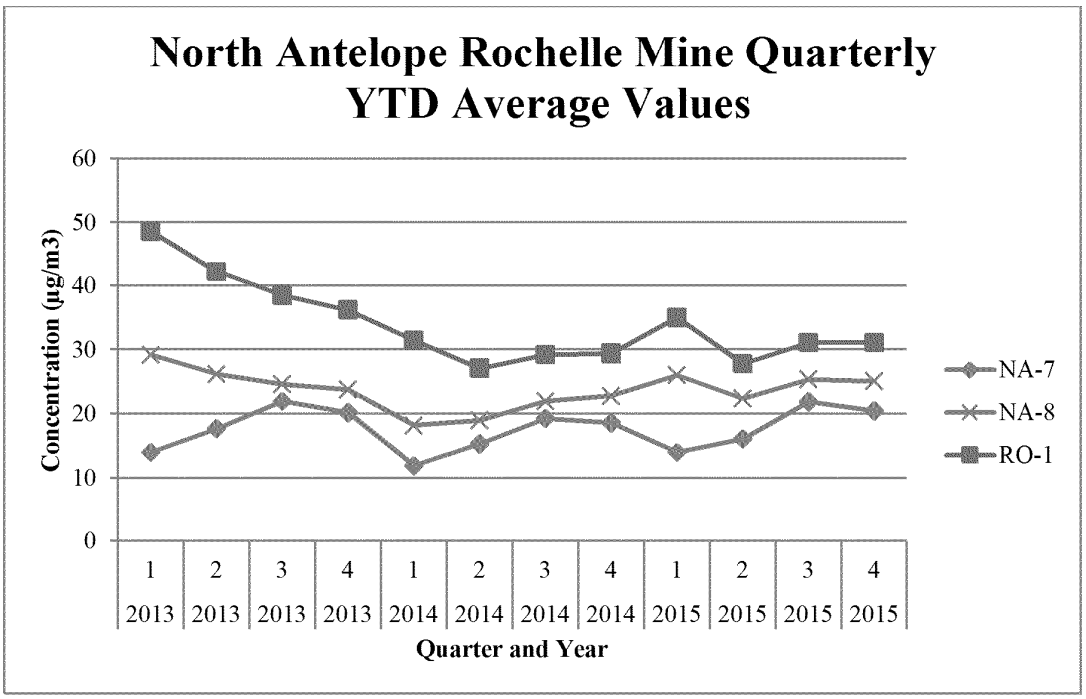
Flow verifications were performed every quarter except for the third quarter. Flow audits were conducted on all samplers in the second and fourth quarters.

Monitor Precision as Reported

Monitor	AQS ID	2015		Notes
NA-7	56-005-1900	Q1	0.97%	Percent Difference.
		Q2	0.28%	Percent Difference.
		Q3	0.32%	Percent Difference.
		Q4	0.79%	Percent Difference.
NA-8	56-009-0088	Q1	0.30%	Percent Difference.
		Q2	0.60%	Percent Difference.
		Q3	0.73%	Percent Difference.
		Q4	1.14%	Percent Difference.
RO-1	56-005-0869	Q1	0.24%	Percent Difference.
		Q2	0.97%	Percent Difference.
		Q3	0.83%	Percent Difference.
		Q4	0.34%	Percent Difference.




North Antelope Rochelle Mine Quarterly 24 Hour Maximum Values
Concentration (µg/m3)
300
250
200
150
100
50
0
276.1
266.7
190
NA-7
NA-8
RO-1
1 2013
2 2013
3 2013
4 2013
1 2014
2 2014
3 2014
4 2014
1 2015
2 2015
3 2015
4 2015
Quarter and Year


North Antelope Rochelle Mine Quarterly YTD Average Values
Concentration (µg/m3)
60
50
40
30
20
10
0
NA-7
NA-8
RO-1
1 2013
2 2013
3 2013
4 2013
1 2014
2 2014
3 2014
4 2014
1 2015
2 2015
3 2015
4 2015
Quarter and Year

Permitting Action (2015)

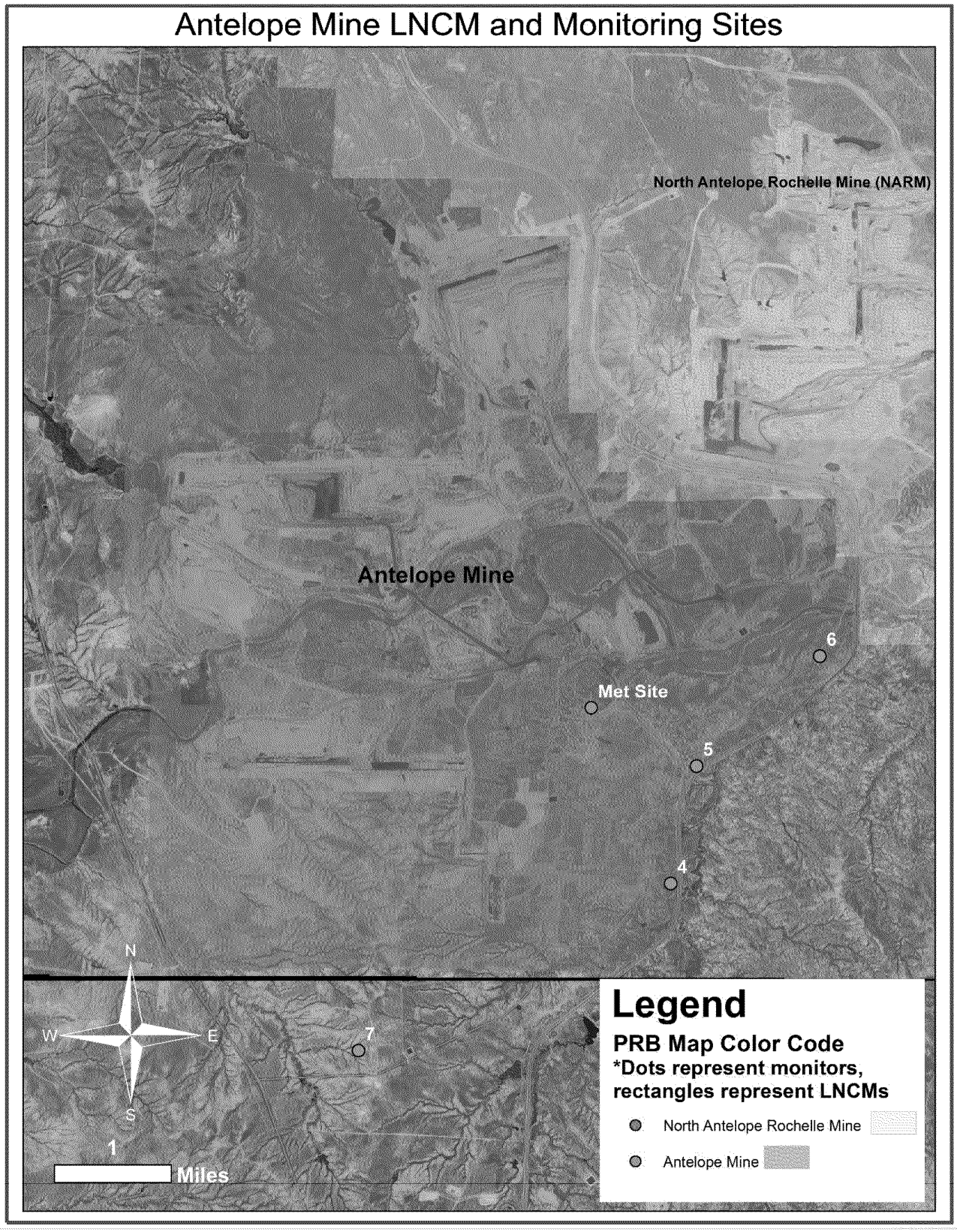
Permit Number	Date Issued	Description
P0020046	09/28/2016	Waiver to construct a new coal haul road to facilitate coal transport from NARM to crushing and load-out facilities at School Creek.

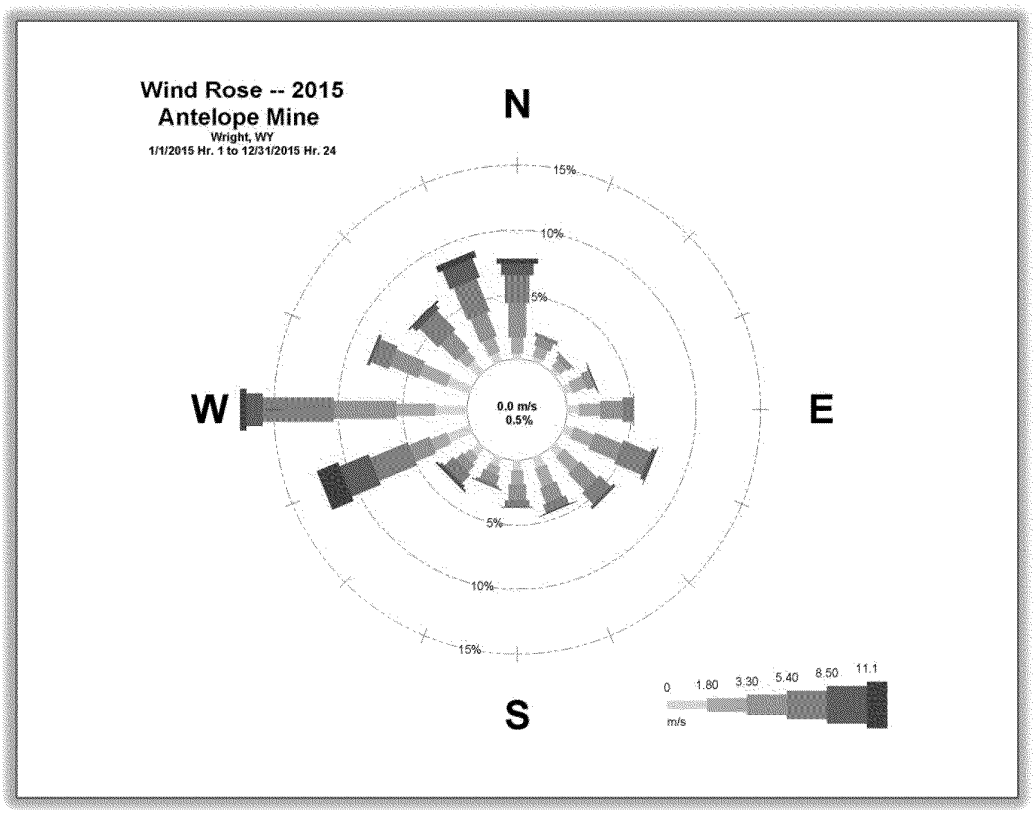
Facility Summary

Overall, data collection and data quality at this facility are good with three exceedances in the report period. The exceedances were due to high wind exceptional events and NARM submitted exceptional event packages for AQD review. The requests to flag the data were approved by AQD and packages have been submitted to the EPA. The NA-7 site was located within the LNCM during 2015, the location was moved in early 2016 so that it is now monitoring ambient air.

ED_001361_00002636

Antelope Mine





Mine Monitor Information

Monitor Name	AQS SITE ID	Status	Collection Frequency	Purpose	Instrument Description	Notes
4PM10	56-009-0881	Active	1 in 3	Downwind	R-P 2000	Operates with second inlet on alternate 6 day cycle.
5PM10	56-009-0850	Active	1 in 3	Downwind	R-P 2000	Operates with second inlet on alternate 6 day cycle.
5PM10B	56-009-0850	Active	1 in 6	Precision	R-P 2000	Collocated with 5PM10/S.
6 Site	56-009-0851	Active	Daily	Downwind	TEOM	
7PM10	56-009-0009	Active	1 in 6	Upwind	R-P 2000	Start date 2/5/2015.

Monitor Availability

Monitor	AQS ID	2015		Notes
4PM10	56-009-0881	Q1	93.3%	
		Q2	100.0%	
		Q3	96.8%	
		Q4	100.0%	
5PM10	56-009-0850	Q1	100.0%	
		Q2	96.7%	
		Q3	93.8%	
		Q4	100.0%	
5PM10B	56-009-0850	Q1	100.0%	
		Q2	100.0%	
		Q3	100.0%	
		Q4	100.0%	
6 Site	56-009-0851	Q1	86.7%	Nine (9) days invalid due to flow faults caused by the pump failing. Two (2) days invalid due to loss of power.
		Q2	100.0%	
		Q3	100.0%	
		Q4	100.0%	
7PM10	56-009-0851	Q1	60.0%	Site started up 2/5/2015. Four (4) days invalid due to machine malfunction.
		Q2	100.0%	
		Q3	100.0%	
		Q4	100.0%	

Data Completeness for 2015

The data completeness report retrieved from AQS indicated no monitors with annual data completeness of 75% or less.

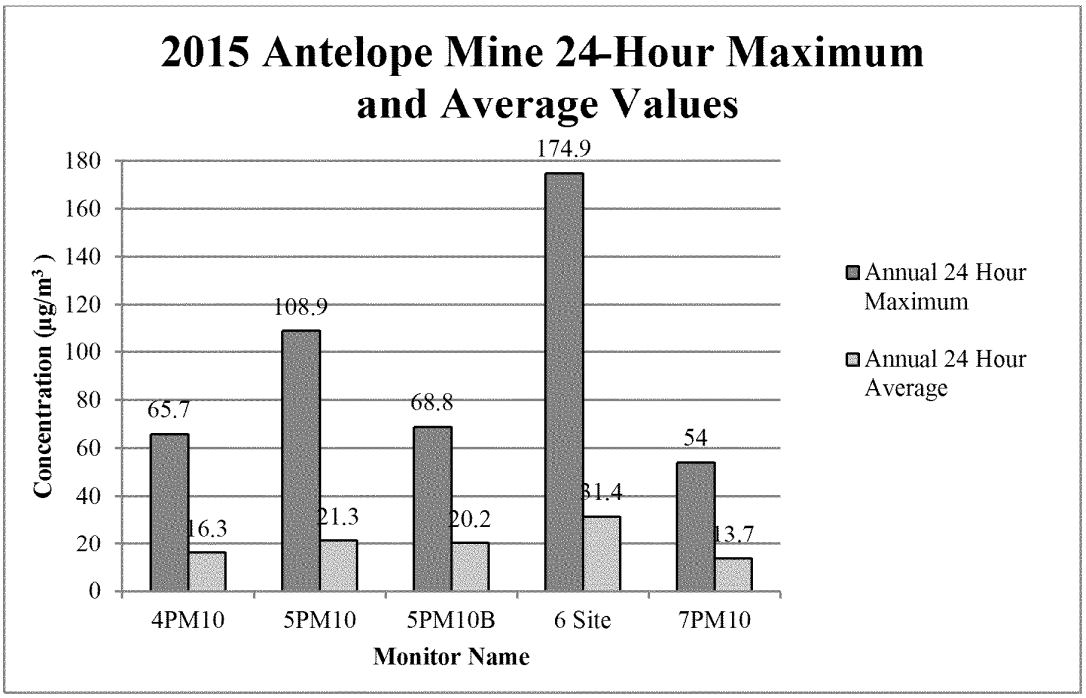
Audits and Flow Verifications in 2015

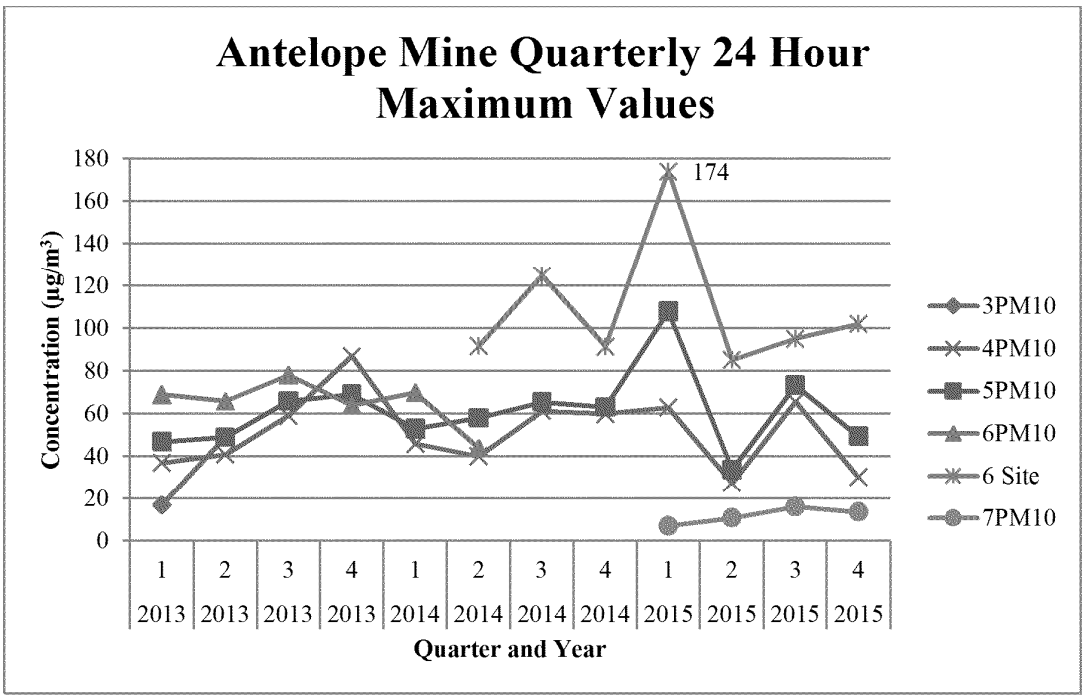
Flow verifications were performed as required. Flow audits were conducted on all samplers inthe first and third quarters.

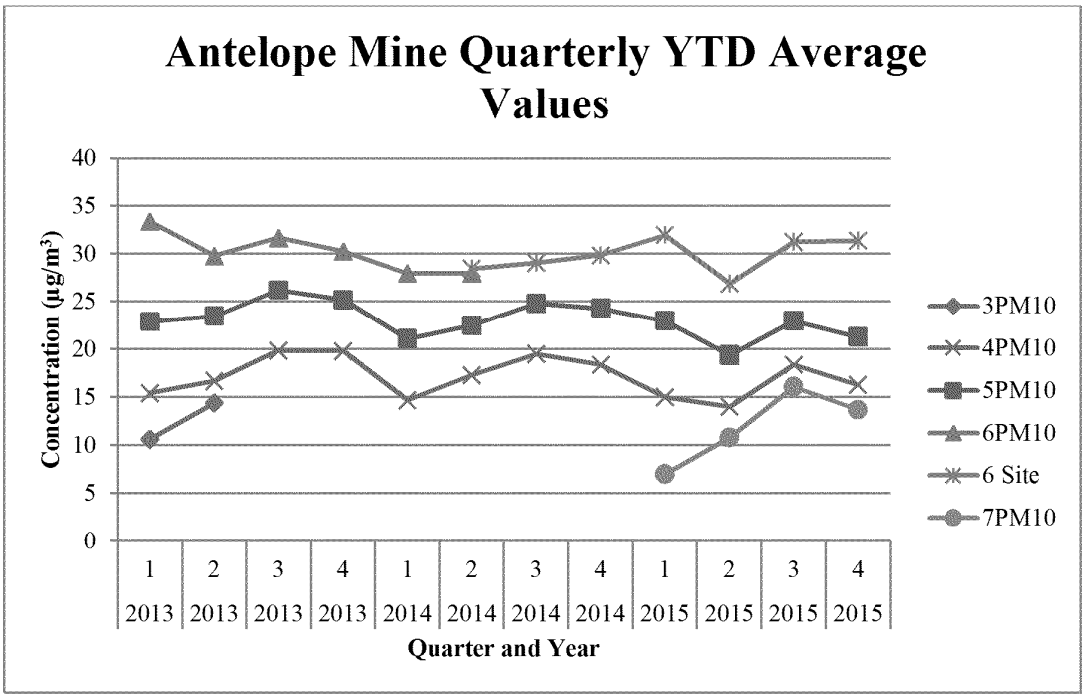
Monitor Precision as Reported

Site	AQS ID	2015		Notes
5PM10B	56-009-0850	Q1	12.30%	Coefficient of Variation.
		Q2	9.00%	Coefficient of Variation.
		Q3	20.80%	Coefficient of Variation. Poor precision in 6 out of 14 valid sample pairs. No explanation provided.
		Q4	18.50%	Coefficient of Variation. Poor precision in 6 out of 15 valid pair samples. No explanation provided.
6 Site	56-009-0851	Q1	1.45%	Percent difference.
		Q2	1.73%	Percent difference.
		Q3	1.43%	Percent Difference.
		Q4	1.69%	Percent Difference.

ED_001361_00002636


2015 Antelope Mine 24-Hour Maximum and Average Values
Concentration (µg/m³)
180
160
140
120
100
80
60
40
20
0
65.7
16.3
108.9
21.3
68.8
20.2
174.9
31.4
54
13.7
4PM10
5PM10
5PM10B
6 Site
7PM10
Monitor Name
Annual 24 Hour Maximum
Annual 24 Hour Average


Antelope Mine Quarterly 24 Hour Maximum Values
Concentration (µg/m³)
180
160
140
120
100
80
60
40
20
0
174
1 2013
2 2013
3 2013
4 2013
1 2014
2 2014
3 2014
4 2014
1 2015
2 2015
3 2015
4 2015
Quarter and Year
3PM10
4PM10
5PM10
6PM10
6 Site
7PM10



Permitting Action (2015)
No permits were issued to this facility in 2015.

Facility Summary
Overall, data collection and data quality at this facility are good. One exceedance occurred at 6 Site in the report period in March 2015.

Site 3, the upwind site for this network, was shut down on 7/1/2013 due to the construction of an oilfield service road less than 100 feet from the site. Antelope began monitoring at a new upwind site, called the 7 Site, in February 2015. Antelope Mine's monitoring sites within the LNCM will be addressed during the 2017 Network Demonstration.

Appendix A

AMP 430 – 2015 Powder River Basin Data Completeness Reports By County

(All monitors in Campbell and Converse counties)

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

User ID: XKMHOOPER

DATA COMPLETENESS REPORT

Report Request ID: 1439143 Report Code: AMP430 Apr. 25, 2016

GEOGRAPHIC SELECTIONS

Tribal Code	State	County	Site	Parameter	POC	City	AQCR	UAR	CBSA	CSA	EPA Region
	56	009		81102							
	56	005		81102							

PROTOCOL SELECTIONS

Parameter Classification	Parameter	Method	Duration
CRITERIA			

SELECTED OPTIONS

Option Type	Option Value
OZONE EVALUATION	SEASONAL-HOURLY
MERGE PDF FILES	YES
AGENCY ROLE	REPORTING

SORT ORDER

Order	Column
1	EPA_REGION
2	STATE_CODE
3	MONITOR_TYPE
4	COUNTY_CODE
5	SITE_ID
6	PARAMETER_CODE
7	POC

DATE CRITERIA

Start Date	End Date
2015 01	2015 12

APPLICABLE STANDARDS

Standard Description
CO 1-hour 1971
Lead 3-Month 2009
Lead 3-Month PM10 Surrogate 2009
NO2 Annual 1971
Ozone 1-hour Daily 2005
PM10 24-hour 2006
PM25 Annual 2013
SO2 1-hour 2010

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REGION: (08) DENVER
STATE: Wyoming

REP ORG: Amax Coal Company
MONITOR TYPE: INDUSTRIAL

SITE ID / CITY / ADDRESS	PARAMETER	POC	DURATION / METHOD	OBSERVATIONS NUMBER / PERCENT JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
56-005-0808	81102 PM10 Total 0-10um STP	1	7	8	9	11	10	10	10	9	11	10	10	10	10	118
			063	80%	100%	100%	100%	100%	100%	90%	100%	100%	100%	100%	100%	98%
EAGLE BUTTE EB-3																
56-005-0808	81102 PM10 Total 0-10um STP	2	7	2	4	6	5	5	5	5	5	5	5	5	5	57
			063	40%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	95%
EAGLE BUTTE EB-3																
56-005-2900	81102 PM10 Total 0-10um STP	1	7	10	9	11	10	10	9	10	11	10	10	10	10	120
			063	100%	100%	100%	100%	100%	90%	100%	100%	100%	100%	100%	100%	99%
Amax Eagle Butte Mine Eb-5 Rural																

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STATE: Wyoming

REP ORG: Antelope Coal Company
MONITOR TYPE: INDUSTRIAL

SITE ID / CITY / ADDRESS	PARAMETER	POC	DURATION / METHOD	OBSERVATIONS NUMBER / PERCENT JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
56-009-0850	81102 PM10 Total 0-10um STP	1	7	10	9	11	10	9	10	10	9	10	10	10	10	118
			126	100%	100%	100%	100%	90%	100%	100%	82%	100%	100%	100%	100%	98%
ANTELOPE SITE 5																
56-009-0881	81102 PM10 Total 0-10um STP	1	7	5	4	6	5	5	5	5	5	5	5	5	5	60
			126	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ANTELOPE SITE 4																

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REGION: (08) DENVER
STATE: Wyoming

REP ORG: Carter Mining Company
MONITOR TYPE: INDUSTRIAL

SITE ID / CITY / ADDRESS	PARAMETER	POC	DURATION / METHOD	OBSERVATIONS NUMBER / PERCENT JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
56-005-0826	81102 PM10 Total 0-10um STP	1	7	10	9	11	10	10	10	10	11	10	10	10	10	121
			079	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
RAWHIDE HILLTOP SITE																
56-005-0895	81102 PM10 Total 0-10um STP	1	7	10	9	11	10	10	10	10	11	10	10	10	10	121
			079	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
RAWHIDE NORTH SITE																

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REGION: (08) DENVER
STATE: Wyoming

REP ORG: Cordero Mining Company
MONITOR TYPE: INDUSTRIAL

SITE ID / CITY / ADDRESS	PARAMETER	POC	DURATION / METHOD	OBSERVATIONS NUMBER / PERCENT JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
56-005-0885	81102 PM10 Total 0-10um STP	1	7	5	4	6	5	5	5	5	5	5	5	5	5	60
			126	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Cordero CRC-E10A

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REGION: (08) DENVER
STATE: Wyoming

REP ORG: Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE: INDUSTRIAL

SITE ID / CITY / ADDRESS	PARAMETER	POC	DURATION / METHOD	OBSERVATIONS NUMBER / PERCENT JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
56-005-0084	81102 PM10 Total 0-10um STP	1	7	31	27	31	30	31	30	30	30	30	31	27	30	358
			079	100%	96%	100%	100%	100%	100%	97%	97%	100%	100%	90%	97%	98%
SC-1. 39,000 distance from mining activity, 6670" from LNCM																
56-005-0086	81102 PM10 Total 0-10um STP	1	7	31	28	31	30	31	30	31	31	30	31	30	31	365
			079	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SC-3 Southeast of mine																
56-005-0087	81102 PM10 Total 0-10um STP	1	7	31	28	31	15	12	0	16	31	30	31	30	31	286
			079	100%	100%	100%	50%	39%	0%	52%	100%	100%	100%	100%	100%	78%
SC-2 East of School Creek Mine																
56-005-0885	81102 PM10 Total 0-10um STP	2	7	5	4	6	5	2	5	4	3	5	5	5	5	54
			126	100%	100%	100%	100%	40%	100%	80%	60%	100%	100%	100%	100%	90%
Cordero CRC-E10A																
56-005-1879	81102 PM10 Total 0-10um STP	1	7	5	4	6	5	5	5	5	5	5	5	5	4	59
			062	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	80%	98%
Dry Fork Site DF-2																
56-005-1899	81102 PM10 Total 0-10um STP	1	7	31	28	31	30	31	27	31	31	30	31	30	31	362
			079	100%	100%	100%	100%	100%	90%	100%	100%	100%	100%	100%	100%	99%
Buckskin Mine North Site																

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REGION: (08) DENVER
STATE: Wyoming

REP ORG: Powder River Coal Company
MONITOR TYPE: INDUSTRIAL

SITE ID / CITY / ADDRESS	PARAMETER	POC	DURATION / METHOD	OBSERVATIONS NUMBER / PERCENT JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
56-005-0869	81102 PM10 Total 0-10um STP	2	7	31	28	31	30	31	30	31	31	30	31	27	31	362
			079	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	90%	100%	99%
ROCHELLE R0-1																
56-005-0886	81102 PM10 Total 0-10um STP	1	7	31	28	31	30	31	30	31	30	30	30	30	31	363
			079	100%	100%	100%	100%	100%	100%	100%	97%	100%	97%	100%	100%	99%
CABALLO C-8A/B																
56-005-0908	81102 PM10 Total 0-10um STP	2	7	31	28	31	30	31	30	31	31	30	30	30	31	364
			079	100%	100%	100%	100%	100%	100%	100%	100%	100%	97%	100%	100%	100%
CABALLO C-9																
56-005-1003	81102 PM10 Total 0-10um STP	1	7	10	9	11	10	10	10	10	11	9	10	10	10	120
			126	100%	100%	100%	100%	100%	100%	100%	100%	90%	100%	100%	100%	99%
Cordero Rojo CRM-W11 Hilight Road																
56-005-1900	81102 PM10 Total 0-10um STP	1	7	31	28	31	30	31	29	31	31	30	31	30	31	364
			079	100%	100%	100%	100%	100%	97%	100%	100%	100%	100%	100%	100%	100%
NARM NA-7																
56-009-0088	81102 PM10 Total 0-10um STP	1	7	31	28	31	30	31	30	30	31	30	24	27	31	354
			079	100%	100%	100%	100%	100%	100%	97%	100%	100%	77%	90%	100%	97%
NA-8 North Antelope Rochelle (Near Irwin Ranch Road)																

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REP ORG: Thunder Basin Coal Company
MONITOR TYPE: INDUSTRIAL

SITE ID / CITY / ADDRESS	PARAMETER	POC	DURATION / METHOD	OBSERVATIONS NUMBER / PERCENT JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
56-005-0841	81102 PM10 Total 0-10um STP	1	7	5	4	6	5	5	5	5	5	5	5	5	5	60
			062	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
COAL CREEK CCM 7-1																
56-005-0891	81102 PM10 Total 0-10um STP	2	7	31	28	31	30	31	28	3	26	26	31	28	28	321
			079	100%	100%	100%	100%	100%	93%	10%	84%	87%	100%	93%	90%	88%
BTM-36-2 (BLACK THUNDER MINE)																

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REP ORG: Triton Coal
MONITOR TYPE: INDUSTRIAL

SITE ID / CITY / ADDRESS	PARAMETER	POC	DURATION / METHOD	OBSERVATIONS NUMBER / PERCENT JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
56-005-0884	81102 PM10 Total 0-10um STP	4	7	5	4	6	5	5	5	5	5	5	5	5	5	60
			079	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

TRITON COAL BUCKSKIN MINE GILLETTE, WY

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STATE: Wyoming

REP ORG: Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SLAMS

SITE ID / CITY / ADDRESS	PARAMETER	POC	DURATION / METHOD	OBSERVATIONS NUMBER / PERCENT JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
56-005-1002	81102 PM10 Total 0-10um STP	5	7	4	4	6	5	5	5	5	4	5	5	5	5	58
Gillette			126	80%	100%	100%	100%	100%	100%	100%	80%	100%	100%	100%	100%	97%
Gillette - 1000 West 8th																

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STATE: Wyoming

REP ORG: Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: INDUSTRIAL

SITE ID / CITY / ADDRESS	PARAMETER	POC	DURATION / METHOD	OBSERVATIONS NUMBER / PERCENT JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
56-005-0303	81102 PM10 Total 0-10um STP	1	7	5	4	6	5	5	5	5	5	4	5	4	5	58
			125	100%	100%	100%	100%	100%	100%	100%	100%	80%	100%	80%	100%	97%
SW SE S3 T45N R70W																
56-005-0303	81102 PM10 Total 0-10um STP	11	7	5	5	5	5	5	5	5	6	5	5	5	5	61
			125	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SW SE S3 T45N R70W																
56-005-0303	81102 PM10 Total 0-10um STP	2	7	5	4	6	5	5	5	5	5	5	5	5	5	60
			125	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SW SE S3 T45N R70W																
56-005-0802	81102 PM10 Total 0-10um STP	1	7	5	4	5	5	4	4	5	5	5	5	5	5	57
			062	100%	100%	83%	100%	80%	80%	100%	100%	100%	100%	100%	100%	95%
BELLE AYR BA-1																
56-005-0802	81102 PM10 Total 0-10um STP	11	7	5	5	5	5	5	4	5	5	4	5	5	4	57
			062	100%	100%	100%	100%	100%	80%	100%	83%	80%	100%	100%	80%	93%
BELLE AYR BA-1																
56-005-0875	81102 PM10 Total 0-10um STP	1	7	5	4	6	5	5	5	5	5	5	5	5	4	59
			126	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	80%	98%
JACOBS RANCH SITE 3																
56-005-0892	81102 PM10 Total 0-10um STP	1	7	5	4	5	5	5	4	5	5	5	5	5	5	58
			062	100%	100%	83%	100%	100%	80%	100%	100%	100%	100%	100%	100%	97%
BELLE AYR BA-4,5N,5S																
56-005-0892	81102 PM10 Total 0-10um STP	11	7	5	5	5	4	5	5	5	5	3	5	5	4	56
			062	100%	100%	100%	80%	100%	100%	100%	83%	60%	100%	100%	80%	92%
BELLE AYR BA-4,5N,5S																
56-005-0892	81102 PM10 Total 0-10um STP	2	7	5	3	5	5	5	5	5	5	5	5	5	5	58
			062	100%	75%	83%	100%	100%	100%	100%	100%	100%	100%	100%	100%	97%
BELLE AYR BA-4,5N,5S																
56-005-0893	81102 PM10 Total 0-10um STP	1	7	5	4	5	5	4	4	4	5	5	5	5	5	56
			062	100%	100%	83%	100%	80%	80%	80%	100%	100%	100%	100%	100%	93%
BELLE AYR BA-3																

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MONITOR TYPE: INDUSTRIAL

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56-005-0893	81102 PM10 Total 0-10um STP	11	7	5	5	5	5	4	5	5	6	4	5	5	4	58
			062	100%	100%	100%	100%	80%	100%	100%	100%	80%	100%	100%	80%	95%
BELLE AYR BA-3																
56-005-0897	81102 PM10 Total 0-10um STP	1	7	5	4	6	5	5	5	5	5	5	4	5	3	57
			062	100%	100%	100%	100%	100%	100%	100%	100%	100%	80%	100%	60%	95%
Dry Fork Mine Site 4																
56-005-0897	81102 PM10 Total 0-10um STP	11	7	5	5	5	5	5	4	5	6	5	5	3	5	58
			062	100%	100%	100%	100%	100%	80%	100%	100%	100%	100%	60%	100%	95%
Dry Fork Mine Site 4																
56-005-0897	81102 PM10 Total 0-10um STP	2	7	4	4	6	4	5	5	5	5	5	5	5	5	58
			062	80%	100%	100%	80%	100%	100%	100%	100%	100%	100%	100%	100%	97%
Dry Fork Mine Site 4																
56-005-0898	81102 PM10 Total 0-10um STP	1	7	5	4	5	5	5	4	5	5	5	5	4	5	57
			062	100%	100%	83%	100%	100%	80%	100%	100%	100%	100%	80%	100%	95%
Belle Ayr Ranch House 805' E HWY 59																
56-005-0898	81102 PM10 Total 0-10um STP	11	7	5	5	5	5	4	5	5	6	4	5	3	4	56
			062	100%	100%	100%	100%	80%	100%	100%	100%	80%	100%	60%	80%	92%
Belle Ayr Ranch House 805' E HWY 59																
56-005-1009	81102 PM10 Total 0-10um STP	1	7	10	9	11	10	10	10	10	11	9	10	10	10	120
			126	100%	100%	100%	100%	100%	100%	100%	100%	90%	100%	100%	100%	99%
Cordero Rojo CRM-S11																
56-005-1877	81102 PM10 Total 0-10um STP	1	7	5	4	5	5	5	4	3	5	5	4	5	5	55
			062	100%	100%	83%	100%	100%	80%	60%	100%	100%	80%	100%	100%	92%
Black Thunder Mine BTM-25																
56-005-1877	81102 PM10 Total 0-10um STP	11	7	4	5	5	5	5	5	5	6	5	5	5	5	60
			062	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	98%
Black Thunder Mine BTM-25																
56-005-1877	81102 PM10 Total 0-10um STP	2	7	5	4	6	5	5	5	5	5	5	5	5	5	60
			062	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Black Thunder Mine BTM-25																

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STATE: Wyoming

REP ORG: Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: INDUSTRIAL

SITE ID / CITY / ADDRESS	PARAMETER	POC	DURATION / METHOD	OBSERVATIONS NUMBER / PERCENT JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
56-005-1906	81102 PM10 Total 0-10um STP	1	7	10	9	11	10	10	10	10	11	10	10	10	10	121
			079	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
EAGLE BUTTE EB-31																
56-005-1915	81102 PM10 Total 0-10um STP	1	7	5	4	6	5	5	4	5	5	5	5	5	5	59
			126	100%	100%	100%	100%	100%	80%	100%	100%	100%	100%	100%	100%	98%
Black Thunder Mine Site BTM-9, Gillette, WY																
56-005-1915	81102 PM10 Total 0-10um STP	11	7	5	5	5	5	5	5	3	6	5	4	5	4	57
			126	100%	100%	100%	100%	100%	100%	60%	100%	100%	80%	100%	80%	93%
Black Thunder Mine Site BTM-9, Gillette, WY																
56-005-1917	81102 PM10 Total 0-10um STP	1	7	31	28	31	30	31	26	29	31	30	31	30	31	359
			079	100%	100%	100%	100%	100%	87%	94%	100%	100%	100%	100%	100%	98%
Jacob Ranch Mine Site 5, Gillette, WY																
56-005-2901	81102 PM10 Total 0-10um STP	1	7	31	18	6	26	31	23	22	29	27	31	30	27	301
			079	100%	64%	19%	87%	100%	77%	71%	94%	90%	100%	100%	87%	82%
EB-RSCH, 200 Prospector Parkway, Gillette																
56-005-5555	81102 PM10 Total 0-10um STP	1	7	25	28	27	30	31	29	24	24	23	26	24	30	321
			079	81%	100%	87%	100%	100%	97%	77%	77%	77%	84%	80%	97%	88%
WYDK-M 3,044 meters NE of intersection of Wyodak Mine Access Rc																
56-005-6666	81102 PM10 Total 0-10um STP	1	7	31	28	31	26	31	30	31	30	24	27	26	30	345
			079	100%	100%	100%	87%	100%	100%	100%	97%	80%	87%	87%	97%	95%
1,008 meters North of I-90 & 361 West of American Ranch Rd																
56-009-0009	81102 PM10 Total 0-10um STP	1	7		4	2	5	5	5	5	5	5	5	5	5	51
			126		100%	33%	100%	100%	100%	100%	100%	100%	100%	100%	100%	93%
Antelope Site 7 PM10 Monitor																
56-009-0850	81102 PM10 Total 0-10um STP	2	7	5	4	6	5	5	5	5	5	5	5	5	5	60
			126	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ANTELOPE SITE 5																
56-009-0851	81102 PM10 Total 0-10um STP	1	7	8	9	11	10	10	10	10	11	10	10	10	10	119
			079	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	98%
ANTELOPE SITE 6																

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
DATA COMPLETENESS REPORT

Apr. 25, 2016

MONITORS REPORTING

DATE RANGE: JAN. 01, 2015 THRU DEC. 31, 2015
REGION: (08) DENVER
STATE: Wyoming

REP ORG: Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM

SITE ID / CITY / ADDRESS	PARAMETER	POC	DURATION / METHOD	OBSERVATIONS NUMBER / PERCENT JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
56-005-0099	81102 PM10 Total 0-10um STP	3	7	5	4	6	5	5	4	5	5	5	5	5	5	59
Wright			126	100%	100%	100%	100%	100%	80%	100%	100%	100%	100%	100%	100%	98%
WRIGHT JR-SENIOR HIGH SCHOOL-220 Wright Blvd																
56-005-0456	81102 PM10 Total 0-10um STP	1	1	688	640	707	680	695	714	707	742	659	742	715	742	8431
			079	92%	95%	95%	94%	93%	99%	95%	100%	92%	100%	99%	100%	96%
SOUTH CAMPBELL COUNTYAPPROX 15 MILES SSW OF GILLETTE WY (SEE AI																
56-009-0010	81102 PM10 Total 0-10um STP	1	1				372	705	716	736	733	692	692	714	743	6103
			122				91%	95%	99%	99%	99%	96%	93%	99%	100%	97%
Converse County Long-Term 16 Miles West of Wyoming Highway 59 or																
56-009-0801	81102 PM10 Total 0-10um STP	1	1	734	648	729	712	727	711	166						4427
			122	99%	96%	98%	99%	98%	99%	77%						97%
369 E. Antelope, Douglas																

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
DATA COMPLETENESS REPORT

Apr. 25, 2016

REPORT SUMMARY

DATE RANGE: JAN. 01, 2015 THRU DEC. 31, 2015
REGION: (08) DENVER
STATE: Wyoming
REP ORG: Amax Coal Company
MONITOR TYPE: INDUSTRIAL

PARAMETER	ACTIVE MONITORS	# NOT REPORTING	# MONITORS > 75%	MONITORS AVG COMPLETENESS
81102 PM10 Total 0-10um STP	3	0	3	97.3%
MT SUMMARY: INDUSTRIAL	3	0	3	97.3%
RO SUMMARY: Amax Coal Company	3	0	3	97.3%

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
DATA COMPLETENESS REPORT

Apr. 25, 2016

REPORT SUMMARY

DATE RANGE: JAN. 01, 2015 THRU DEC. 31, 2015
REGION: (08) DENVER
STATE: Wyoming
REP ORG: Antelope Coal Company
MONITOR TYPE: INDUSTRIAL

PARAMETER	ACTIVE MONITORS	# NOT REPORTING	# MONITORS > 75%	MONITORS AVG COMPLETENESS
81102 PM10 Total 0-10um STP	2	0	2	99.0%
MT SUMMARY: INDUSTRIAL	2	0	2	99.0%
RO SUMMARY: Antelope Coal Company	2	0	2	99.0%

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
DATA COMPLETENESS REPORT

Apr. 25, 2016

REPORT SUMMARY

DATE RANGE: JAN. 01, 2015 THRU DEC. 31, 2015
REGION: (08) DENVER
STATE: Wyoming
REP ORG: Carter Mining Company
MONITOR TYPE: INDUSTRIAL

PARAMETER	ACTIVE MONITORS	# NOT REPORTING	# MONITORS > 75%	MONITORS AVG COMPLETENESS
81102 PM10 Total 0-10um STP	2	0	2	100.0%
MT SUMMARY: INDUSTRIAL	2	0	2	100.0%
RO SUMMARY: Carter Mining Company	2	0	2	100.0%

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
DATA COMPLETENESS REPORT

Apr. 25, 2016

REPORT SUMMARY

DATE RANGE: JAN. 01, 2015 THRU DEC. 31, 2015
REGION: (08) DENVER
STATE: Wyoming
REP ORG: Cordero Mining Company
MONITOR TYPE: INDUSTRIAL

PARAMETER	ACTIVE MONITORS	# NOT REPORTING	# MONITORS > 75%	MONITORS AVG COMPLETENESS
81102 PM10 Total 0-10um STP	1	0	1	100.0%
MT SUMMARY: INDUSTRIAL	1	0	1	100.0%
RO SUMMARY: Cordero Mining Company	1	0	1	100.0%

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
DATA COMPLETENESS REPORT

Apr. 25, 2016

REPORT SUMMARY

DATE RANGE: JAN. 01, 2015 THRU DEC. 31, 2015
REGION: (08) DENVER
STATE: Wyoming
REP ORG: Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE: INDUSTRIAL

PARAMETER	ACTIVE MONITORS	# NOT REPORTING	# MONITORS > 75%	MONITORS AVG COMPLETENESS
81102 PM10 Total 0-10um STP	6	0	6	93.8%
MT SUMMARY: INDUSTRIAL	6	0	6	93.8%
RO SUMMARY: Inter-Mountain Laboratory Sheridan, WY	6	0	6	93.8%

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
DATA COMPLETENESS REPORT

Apr. 25, 2016

REPORT SUMMARY

DATE RANGE: JAN. 01, 2015 THRU DEC. 31, 2015
REGION: (08) DENVER
STATE: Wyoming
REP ORG: Powder River Coal Company
MONITOR TYPE: INDUSTRIAL

PARAMETER	ACTIVE MONITORS	# NOT REPORTING	# MONITORS > 75%	MONITORS AVG COMPLETENESS
81102 PM10 Total 0-10um STP	6	0	6	99.0%
MT SUMMARY: INDUSTRIAL	6	0	6	99.0%
RO SUMMARY: Powder River Coal Company	6	0	6	99.0%

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
DATA COMPLETENESS REPORT

Apr. 25, 2016

REPORT SUMMARY

DATE RANGE: JAN. 01, 2015 THRU DEC. 31, 2015
REGION: (08) DENVER
STATE: Wyoming
REP ORG: Thunder Basin Coal Company
MONITOR TYPE: INDUSTRIAL

PARAMETER	ACTIVE MONITORS	# NOT REPORTING	# MONITORS > 75%	MONITORS AVG COMPLETENESS
81102 PM10 Total 0-10um STP	2	0	2	94.0%
MT SUMMARY: INDUSTRIAL	2	0	2	94.0%
RO SUMMARY: Thunder Basin Coal Company	2	0	2	94.0%

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
DATA COMPLETENESS REPORT

Apr. 25, 2016

REPORT SUMMARY

DATE RANGE: JAN. 01, 2015 THRU DEC. 31, 2015
REGION: (08) DENVER
STATE: Wyoming
REP ORG: Triton Coal
MONITOR TYPE: INDUSTRIAL

PARAMETER	ACTIVE MONITORS	# NOT REPORTING	# MONITORS > 75%	MONITORS AVG COMPLETENESS
81102 PM10 Total 0-10um STP	1	0	1	100.0%
MT SUMMARY: INDUSTRIAL	1	0	1	100.0%
RO SUMMARY: Triton Coal	1	0	1	100.0%

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
DATA COMPLETENESS REPORT

Apr. 25, 2016

REPORT SUMMARY

DATE RANGE: JAN. 01, 2015 THRU DEC. 31, 2015
REGION: (08) DENVER
STATE: Wyoming
REP ORG: Wyoming Air Quality Division, Dept Of Environmental Quality

MONITOR TYPE: SLAMS

PARAMETER	ACTIVE MONITORS	# NOT REPORTING	# MONITORS > 75%	MONITORS AVG COMPLETENESS
81102 PM10 Total 0-10um STP	1	0	1	97.0%
MT SUMMARY: SLAMS	1	0	1	97.0%

MONITOR TYPE: INDUSTRIAL

PARAMETER	ACTIVE MONITORS	# NOT REPORTING	# MONITORS > 75%	MONITORS AVG COMPLETENESS
81102 PM10 Total 0-10um STP	30	0	30	95.5%
MT SUMMARY: INDUSTRIAL	30	0	30	95.5%

MONITOR TYPE: SPM

PARAMETER	ACTIVE MONITORS	# NOT REPORTING	# MONITORS > 75%	MONITORS AVG COMPLETENESS
81102 PM10 Total 0-10um STP	4	0	4	97.0%
MT SUMMARY: SPM	4	0	4	97.0%

RO SUMMARY: Wyoming Air Quality Division, Dept Of Environm	35	0	35	95.7%
STATE SUMMARY: Wyoming	58	0	58	96.3%
REGION SUMMARY: (08) DENVER	58	0	58	96.3%
REPORT SUMMARY:	58	0	58	96.3%

ED_001361_00002636

Appendix B

AMP 350 – 2015 Powder River Basin Raw Data Report

(All monitors in Campbell and Converse counties)

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

User ID: XKMHOOPER

RAW DATA REPORT

Report Request ID: 1462297 Report Code: AMP350 Jul. 11, 2016

GEOGRAPHIC SELECTIONS

Tribal Code	State	County	Site	Parameter	POC	City	AQCR	UAR	CBSA	CSA	EPA Region
	56	009									
	56	005									

PROTOCOL SELECTIONS

Parameter Classification	Parameter	Method	Duration
CRITERIA	81102		

SELECTED OPTIONS

Option Type	Option Value
DAILY STATISTICS	MAXIMUM
UNITS	STANDARD
MERGE PDF FILES	YES
RAW DATA EVENTS	INCLUDE EVENTS
INCLUDE NULLS	YES
AGENCY ROLE	PQAO

SORT ORDER

Order	Column
1	STATE_CODE
2	COUNTY_CODE
3	SITE_ID
4	PARAMETER_CODE
5	POC

DATE CRITERIA

Start Date	End Date
2015 01 01	2015 12 31

APPLICABLE STANDARDS

Standard Description
PM10 24-hour 2006

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0084 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SC-1. 39,000 distance from mining activity, 6670" from LNCM
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.6389272767
LONGITUDE: -105.36982968
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1491.9
PROBE HEIGHT:

SUPPORT AGENCY: (0527) Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0527) Inter-Mountain Laboratory Sheridan, WY

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	14	18	14	16	32	19	26	53	22	43	24	4
2	19	17	26	10	21	15	35	36	12	20	14	5
3	13	9	14	20	32	16	35	50	25	10	22	8
4	19	9	8	23	23	9	42	22	23	9	8	6
5	17	7	10	25	18	11	38	AI	15	13	3	9
6	14	7	13	32	7	12	AN	18	17	25	9	22
7	17	14	10	27	19	11	52	21	37	16	6	8
8	8	8	9	9	17	14	33	43	35	22	5	11
9	30	17	10	21	3	20	29	12	38	28	8	8
10	14	6	13	20	5	25	15	36	35	5	7	AI
11	9	12	9	24	13	14	12	33	39	28	7	12
12	9	10	11	11	18	28	13	30	37	20	25	11
13	7	9	36	25	13	19	20	29	57	35	16	14
14	5	26	24	51	18	19	29	59	37	35	4	18
15	7	5	9	13	4	11	17	19	25	24	8	16
16	9	3	14	10	7	14	13	57	22	40	15	11
17	6	4	12	16	4	27	17	22	15	55	7	12
18	8	7	18	8	15	21	15	12	21	35	26	14
19	5	17	15	7	5	34	23	14	29	18	14	5
20	5	5	36	7	8	20	25	69	27	11	5	7
21	5	6	27	18	12	41	31	63	19	22	7	7
22	5	8	22	26	8	17	24	29	37	15	4	12
23	6	AH	32	27	8	28	14	24	28	7	31	16
24	4	3	9	16	5	32	26	54	30	18	13	6
25	3	8	15	16	7	18	26	63	33	18	10	38
26	5	12	8	4	9	15	31	45	28	19	AI	19
27	5	21	9	4	12	26	46	27	30	7	AI	35
28	6	7	56	19	7	39	10	91	17	3	AI	22
29	21		24	27	10	44	21	96	13	21	15	10
30	19		33	15	16	21	46	51	25	6	21	9
31	28		55		14		58	35		6		8
NO.:	31	27	31	30	31	30	30	30	30	31	27	30
MAX:	30.	26.	56.	51.	32.	44.	58.	96.	57.	55.	31.	38.
MEAN:	11.0	10.2	19.4	18.2	12.6	21.3	27.4	40.4	27.6	20.5	12.4	12.8

ANNUAL OBSERVATIONS: 358 ANNUAL MEAN: 19.6 ANNUAL MAX: 96.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0086 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SC-3 Southeast of mine
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.5718277580
LONGITUDE: -105.15399680
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1523
PROBE HEIGHT:

SUPPORT AGENCY: (0527) Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0527) Inter-Mountain Laboratory Sheridan, WY

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	29	22	25	37	16	10	33	33	35	27	33	36
2	12	27	12	21	23	18	21	29	37	13	15	26
3	30	12	24	43	26	12	21	29	53	8	21	17
4	14	10	53	50	11	9	19	17	34	4	7	25
5	21	17	48	32	8	9	34	17	29	9	12	25
6	7	50	46	30	7	16	42	19	28	15	22	60
7	7	107	32	13	8	15	43	35	28	16	18	39
8	22	18	18	6	7	21	18	33	19	17	35	24
9	21	19	40	3	2	17	14	17	26	29	27	59
10	18	15	21	35	11	14	38	12	12	59	14	18
11	16	9	43	51	10	9	42	14	15	89	20	14
12	5	17	32	16	10	8	44	30	30	34	18	5
13	11	24	21	9	19	14	43	21	27	33	41	5
14	21	11	61	18	16	9	23	23	72	20	38	5
15	21	8	68	17	2	7	16	44	38	6	21	40
16	31	13	38	8	21	11	19	49	35	19	47	18
17	28	17	5	12	6	13	18	20	17	38	34	41
18	33	19	18	6	6	11	19	10	16	45	73	41
19	23	18	18	8	5	20	20	10	11	42	14	21
20	18	17	24	19	3	15	31	37	37	17	14	9
21	12	6	37	18	5	17	16	64	27	12	68	18
22	25	10	19	11	4	12	14	52	24	6	58	23
23	38	29	23	18	4	21	23	27	16	7	16	24
24	39	37	22	12	4	26	25	24	13	11	52	40
25	30	21	10	11	6	8	28	37	12	10	24	42
26	25	8	23	3	8	15	28	41	33	7	7	37
27	39	8	39	4	7	15	42	57	47	7	8	44
28	22	14	154	4	10	15	18	79	18	12	8	31
29	12		35	9	7	17	33	37	9	7	11	25
30	10		26	17	8	45	22	54	13	47	13	27
31	15		19		15		23	41		34		28
NO.:	31	28	31	30	31	30	31	31	30	31	30	31
MAX:	39.	107.	154.	51.	26.	45.	44.	79.	72.	89.	73.	60.
MEAN:	21.1	20.8	34.0	18.0	9.5	15.0	26.8	32.6	27.0	22.6	26.3	28.0

ANNUAL OBSERVATIONS: 365 ANNUAL MEAN: 23.5 ANNUAL MAX: 154.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0087 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SC-2 East of School Creek Mine
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.6175198096
LONGITUDE: -105.19231016
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1459
PROBE HEIGHT:

SUPPORT AGENCY: (0527) Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0527) Inter-Mountain Laboratory Sheridan, WY

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	38	21	28	52	24	AS	AS	30	48	31	29	20
2	29	29	18	25	30	AS	AS	36	82	13	20	43
3	29	13	20	62	32	AS	AS	30	84	9	34	33
4	39	11	43	58	11	AS	AA	28	48	4	8	49
5	21	35	53	39	9	AS	AS	29	76	9	13	25
6	10	80	32	36	7	AS	AS	18	30	21	37	58
7	13	151	35	16	8	AS	AS	37	26	22	58	71
8	28	23	37	6	8	AS	AS	41	42	19	72	22
9	38	39	47	AS	2	AS	AS	15	76	26	57	88
10	22	21	48	AS	3	AS	AS	16	12	48	21	12
11	19	11	50	AS	12	AS	AS	15	15	97	16	10
12	6	23	47	AS	12	AS	AS	37	28	30	18	6
13	16	32	22	AS	AS	AS	AS	20	34	37	64	17
14	21	18	84	AS	AS	AS	AS	24	120	24	50	6
15	38	12	97	AS	AS	AS	AS	49	115	28	82	22
16	55	11	44	AS	AS	AS	16	46	69	17	58	18
17	26	5	5	AS	AS	AS	18	14	18	32	17	28
18	40	18	23	AS	AS	AS	18	9	13	98	78	28
19	28	14	20	AS	AS	AS	25	11	23	77	33	34
20	18	20	24	AS	AS	AS	32	54	62	26	17	11
21	22	5	41	AS	AS	AS	18	74	35	12	44	37
22	42	10	24	AS	AS	AS	25	51	25	7	40	36
23	37	44	27	AS	AS	AS	61	42	17	11	52	27
24	35	25	16	15	AS	AS	38	24	19	10	78	61
25	11	10	11	12	AS	AS	31	40	10	11	23	19
26	21	7	25	4	AS	AS	27	50	68	8	14	27
27	44	8	40	5	AS	AS	70	45	50	11	11	31
28	22	17	139	10	AS	AS	17	76	24	16	8	26
29	14		39	10	AS	AS	54	39	9	12	18	31
30	17		35	20	AS	AS	39	80	16	33	12	34
31	25		53		AS		29	49		25		24
NO.:	31	28	31	15	12	0	16	31	30	31	30	31
MAX:	55.	151.	139.	62.	32.		70.	80.	120.	98.	82.	88.
MEAN:	26.6	25.5	39.6	24.7	13.2		32.4	36.4	43.1	26.6	36.1	30.8

ANNUAL OBSERVATIONS: 286 ANNUAL MEAN: 31.8 ANNUAL MAX: 151.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0099 POC: 3
COUNTY: (005) Campbell
CITY: (85015) Wright
SITE ADDRESS: WRIGHT JR-SENIOR HIGH SCHOOL-220 Wright Blvd
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: RESIDENTIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.7577636219
LONGITUDE: -105.49139737
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 8
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE:SPM
COLLECTION AND ANALYSIS METHOD: (126) R - P Co Partisol Model 2000 Gravi
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			13									
2											11	4
3									17	11		
4								26				
5		7				AG	37					
6	7			31	16							
7			9									
8											6	AF
9									22	10		13
10						12		28				
11		13				AF	21					
12	9			5	14							
13			15									
14											4	AF
15									29	15		16
16								52				
17		9				19	9					
18	4			5	8							
19			10									
20											9	4
21									12	15		
22								26				
23		8				32	17					
24	3			16	AF							
25			10		6							
26											4	9
27									24	5		
28								66				
29						22	23					
30	13			13	14							
31			21									
NO.:	5	4	6	5	5	4	5	5	5	5	5	5
MAX:	13.	13.	21.	31.	16.	32.	37.	66.	29.	15.	11.	16.
MEAN:	7.2	9.3	13.0	14.0	11.6	21.3	21.4	39.6	20.8	11.2	6.8	9.2

ANNUAL OBSERVATIONS: 59 ANNUAL MEAN: 15.4 ANNUAL MAX: 66.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0303 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SW SE S3 T45N R70W
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.9009574904
LONGITUDE: -105.25051250
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1476.7
PROBE HEIGHT: 2.5

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (125) BGI Inc. Model PQ200 PM10 Gravimet
PQAO: (1039) Thunder Basin Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			10									
2											6	3
3									25	6		
4								22				
5		5				9	45					
6	6			22	7							
7			6									
8											AN	5
9									24	12		
10								14				
11		5				9	19					
12	6			4	9							
13			9									
14											6	5
15									34	11		
16								44				
17		5				14	12					
18	3			6	5							
19			10									
20											11	6
21									AG	8		
22								36				
23		15				17	16					
24	2			8	2							
25			10									
26											9	10
27									33	6		
28								51				
29						22	12					
30	6			15	7							
31			15									
NO.:	5	4	6	5	5	5	5	5	4	5	4	5
MAX:	6.	15.	15.	22.	9.	22.	45.	51.	34.	12.	11.	10.
MEAN:	4.6	7.5	10.0	11.0	6.0	14.2	20.8	33.4	29.0	8.6	8.0	5.8

ANNUAL OBSERVATIONS: 58 ANNUAL MEAN: 13.1 ANNUAL MAX: 51.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0303 POC: 11
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SW SE S3 T45N R70W
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.9009574904
LONGITUDE: -105.25051250
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1476.7
PROBE HEIGHT: 2.5

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (125) BGI Inc. Model PQ200 PM10 Gravimet
PQAO: (1039) Thunder Basin Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1								14				
2		11				25	21					
3	20			12	18							
4			9									
5											4	4
6									13	14		
7								15				
8		4				17	19					
9	14			4	1							
10			26									
11											8	3
12									14	21		
13								16				
14		8				7	17					
15	6			11	3							
16			13									
17											9	7
18									8	25		
19								5				
20		3				12	14					
21	9			12	2							
22			15									
23											16	4
24									9	13		
25								26				
26		4				10	15					
27	7			3	7							
28			11									
29											4	8
30									8	8		
31								35				
NO.:	5	5	5	5	5	5	5	6	5	5	5	5
MAX:	20.	11.	26.	12.	18.	25.	21.	35.	14.	25.	16.	8.
MEAN:	11.2	6.0	14.8	8.4	6.2	14.2	17.2	18.5	10.4	16.2	8.2	5.2

ANNUAL OBSERVATIONS: 61 ANNUAL MEAN: 11.5 ANNUAL MAX: 35.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0303 POC: 2
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SW SE S3 T45N R70W
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.9009574904
LONGITUDE: -105.25051250
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1476.7
PROBE HEIGHT: 2.5

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (125) BGI Inc. Model PQ200 PM10 Gravimet
PQAO: (1039) Thunder Basin Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			9									
2											7	4
3									29	7		
4								21				
5		4				9	44					
6	5			23	6							
7			8									
8											4	5
9									23	12		
10								13				
11		6				9	20					
12	17			8	9							
13			9									
14											4	5
15									31	12		
16								46				
17		6				14	11					
18	4			7	6							
19			9									
20											8	5
21									17	7		
22								39				
23		34				16	16					
24	4			8	2							
25			10									
26											7	8
27									33	6		
28								49				
29						17	9					
30	9			16	7							
31			26									
NO.:	5	4	6	5	5	5	5	5	5	5	5	5
MAX:	17.	34.	26.	23.	9.	17.	44.	49.	33.	12.	8.	8.
MEAN:	7.8	12.5	11.8	12.4	6.0	13.0	20.0	33.6	26.6	8.8	6.0	5.4

ANNUAL OBSERVATIONS: 60 ANNUAL MEAN: 13.7 ANNUAL MAX: 49.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0456 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SOUTH CAMPBELL COUNTYAPPROX 15 MILES SSW OF GILLETTE WY (SEE APPLE BUTTE QUAD MAP
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: DESERT
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.146964
LONGITUDE: -105.529994
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1408
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: JANUARY 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	5	1	2	0	3	3	0	4	4	9	6	1	2	4	6	4	2	4	2	4	8	11	5	5	24	11.
2	8	3	5	30	42	22	0	14	26	17	7	6	12	4	17	6	4	5	12	9	6	5	6	7	24	42.
3	11	7	9	4	2	17	18	12	10	8	3	5	7	-1	6	5	1	3	4	5	3	1	4	9	24	18.
4	11	2	3	6	5	4	8	3	7	9	9	5	7	5	7	5	3	4	5	4	10	4	5	3	24	11.
5	19	10	21	20	19	23	45	43	37	13	13	5	6	4	10	7	-2	6	1	4	4	2	7	5	24	45.
6	3	0	2	1	2	17	12	6	16	19	15	9	13	7	21	17	0	12	6	9	2	4	2	4	24	21.
7	5	1	11	-2	7	-2	3	4	5	6	8	13	10	11	13	11	11	12	20	40	50	49	34	25	24	50.
8	15	0	10	4	4	4	4	6	6	6	6	29	31	31	17	13	8	8	6	11	5	1	1	4	24	31.
9	2	4	4	3	1	6	3	5	7	12	17	32	41	81	85	96	77	69	28	50	37	62	54	55	24	96.
10	37	20	18	11	3	5	7	4	14	14	15	12	7	6	11	21	24	23	29	28	27	31	21	14	24	37.
11	22	25	14	6	13	9	11	10	7	6	12	14	11	18	6	6	7	9	8	7	9	10	12	9	24	25.
12	AN	AN	AN	AN	4	5	5	4	8	9	7	3	6	5	4	7	5	6	4	4	5	6	5	6	20	9.
13	4	8	10	6	3	3	13	8	BA	12	10	4	5	3	4	4	11	5	9	6	5	3	2	7	23	13.
14	3	5	3	2	2	2	4	3	15	12	9	7	0	4	3	3	5	7	4	8	2	4	6	4	24	15.
15	3	6	2	6	2	6	3	7	5	8	12	6	7	7	-3	5	4	7	6	3	3	6	4	4	24	12.
16	3	4	4	2	0	5	5	10	6	10	7	7	5	6	7	5	7	7	9	5	9	6	3	3	24	10.
17	8	6	5	1	0	6	3	6	9	10	8	5	7	2	3	6	2	4	4	4	3	2	3	4	24	10.
18	10	6	4	1	7	6	6	3	AN	AN	AN	AN	AN	0	5	7	5	6	6	AN	AN	AN	AN	AN	14	10.
19	AN	0	3	1	4	5	2	6	10	9	6	3	6	1	6	4	1	7	8	7	4	6	5	3	23	10.
20	4	5	3	2	5	2	8	7	13	8	10	2	2	2	7	4	4	4	2	5	2	5	5	2	24	13.
21	4	1	2	2	2	5	3	5	6	5	5	5	4	3	1	2	4	18	17	9	8	8	9	5	24	18.
22	4	3	7	8	6	5	4	4	9	34	22	11	8	12	12	17	16	10	7	6	4	4	6	4	24	34.
23	3	6	5	5	5	5	8	14	17	9	17	18	7	7	7	7	5	15	8	4	3	3	2	2	24	18.
24	0	2	3	3	4	2	7	12	2	9	4	7	6	2	13	3	4	7	2	3	4	1	2	1	24	13.
25	3	2	2	3	5	6	5	3	6	4	7	2	4	3	4	4	0	2	4	4	4	5	4	4	24	7.
26	6	3	2	2	3	2	7	5	9	8	7	3	4	6	7	6	3	6	3	7	4	1	3	4	24	9.
27	3	3	2	5	0	5	2	7	14	6	8	15	8	8	BA	BA	BA	AN	AN	AN	AN	AN	AN	AN	14	15.
28	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	BA	AN	AN	AN	AN	AN	AN	AN	AN	0	
29	AN	AN	AN	AN	AN	AN	2	2	5	2	2	-2	5	2	7	5	5	7	3	9	26	40	36	31	18	40.
30	28	11	8	5	4	3	6	1	7	12	2	2	2	5	3	7	5	14	16	14	17	9	8	7	24	28.
31	6	4	3	19	7	7	11	15	25	16	6	12	11	5	6	7	12	5	5	3	1	3	4	6	24	25.
NO.:	27	28	28	28	29	29	30	30	28	29	29	29	29	30	29	29	29	29	29	28	28	28	28	28		
MAX:	37.	25.	21.	30.	42.	23.	45.	43.	37.	34.	22.	32.	41.	81.	85.	96.	77.	69.	29.	50.	50.	62.	54.	55.		
AVG:	8.5	5.3	6.0	5.6	5.7	6.5	7.2	7.8	10.9	10.4	9.0	8.3	8.4	8.4	10.2	10.1	8.0	10.1	8.2	9.7	9.5	10.4	9.2	8.5		

MONTHLY OBSERVATIONS: 688 MONTHLY MEAN: 8.4 MONTHLY MAX: 96.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0456 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SOUTH CAMPBELL COUNTYAPPROX 15 MILES SSW OF GILLETTE WY (SEE APPLE BUTTE QUAD MAP
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: DESERT
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.146964
LONGITUDE: -105.529994
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1408
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: FEBRUARY 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	6	0	4	6	4	6	5	2	10	5	4	6	3	3	5	5	2	1	6	9	48	29	18	21	24	48.
2	31	34	35	31	15	7	7	8	11	9	11	3	1	2	2	0	7	7	13	16	12	8	14	13	24	35.
3	11	2	2	0	23	12	9	7	17	13	6	5	3	4	5	5	6	6	11	1	6	8	6	6	24	23.
4	9	4	6	6	6	5	6	5	9	9	8	6	5	8	7	9	5	6	12	14	15	15	22	24	24	24.
5	38	23	20	19	17	11	11	4	6	11	7	4	6	8	5	8	4	7	9	7	4	4	5	-1	24	38.
6	11	3	1	9	6	1	-1	7	12	11	13	9	11	16	9	10	6	6	1	9	2	2	4	13	24	16.
7	7	5	6	-1	5	9	12	13	18	29	25	53	57	70	49	AN	AN	AN	AN	AN	AN	AN	AN	AN	15	70.
8	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	2	0	-1	10	8	15	10	11	12	9	15.
9	7	9	7	8	23	10	27	AN	AN	AN	12	12	10	14	20	21	7	0	10	0	18	-2	2	3	21	27.
10	5	4	4	5	6	3	11	6	9	2	11	4	1	2	3	5	4	2	4	7	2	6	6	6	24	11.
11	6	4	5	3	4	5	4	6	7	6	7	5	7	1	1	4	9	12	8	9	10	9	10	14	24	14.
12	13	12	6	8	4	8	9	13	13	16	20	5	7	6	5	6	1	0	11	17	15	10	6	5	24	20.
13	7	4	6	4	5	4	7	6	9	9	7	16	8	8	5	8	3	7	19	17	9	8	4	4	24	19.
14	3	2	5	2	4	4	7	15	22	46	27	17	26	7	8	11	15	19	13	13	17	22	7	5	24	46.
15	8	5	7	7	6	5	4	5	7	6	5	3	2	3	3	1	1	4	5	5	6	6	0	4	24	8.
16	4	3	2	4	4	7	1	6	5	4	8	6	5	3	11	1	-3	1	4	4	3	3	4	-3	24	11.
17	6	-8	1	10	0	0	3	1	4	10	4	6	4	3	5	2	5	0	3	5	1	4	AN	AN	22	10.
18	4	3	3	10	14	4	10	8	8	9	6	5	5	4	AN	3	3	3	3	3	2	6	3	3	23	14.
19	4	8	17	11	15	17	15	25	27	17	5	0	6	7	-6	9	10	6	16	14	7	9	5	5	24	27.
20	4	2	6	7	5	4	4	6	5	4	3	5	3	4	5	3	2	4	6	1	5	2	0	5	24	7.
21	11	2	0	1	3	2	4	5	1	4	5	5	3	10	6	7	8	5	5	3	3	5	8	3	24	11.
22	10	0	4	5	5	5	4	8	12	2	8	5	3	3	4	4	4	3	2	6	3	4	3	5	24	12.
23	7	3	4	6	4	4	32	28	14	7	7	6	6	5	7	4	4	5	4	4	7	5	8	6	24	32.
24	5	1	3	4	0	3	7	9	12	5	5	6	4	3	2	3	-2	2	4	4	3	7	5	5	24	12.
25	7	4	5	3	6	5	3	1	7	6	BA	BA	10	15	5	7	3	4	4	-1	1	0	2	0	22	15.
26	3	-1	1	2	2	1	1	4	1	5	2	2	2	4	6	5	3	1	5	4	5	8	7	22	24	22.
27	3	1	0	3	4	0	1	8	12	16	28	28	40	42	42	37	19	24	16	20	14	13	7	7	24	42.
28	5	2	3	9	4	6	3	11	8	5	5	6	3	5	6	2	3	5	3	7	8	7	10	10	24	11.
29																									0	
30																									0	
31																									0	
NO.:	27	27	27	27	27	27	27	26	26	26	26	26	27	27	26	27	27	27	27	27	27	27	26	26		
MAX:	38.	34.	35.	31.	23.	17.	32.	28.	27.	46.	28.	53.	57.	70.	49.	37.	19.	24.	19.	20.	48.	29.	22.	24.		
AVG:	8.7	4.9	6.0	6.7	7.2	5.5	7.6	8.3	10.2	10.2	9.6	8.8	8.9	9.6	8.5	6.7	4.8	5.1	7.7	7.6	8.9	7.7	6.8	7.6		

MONTHLY OBSERVATIONS: 640 MONTHLY MEAN: 7.6 MONTHLY MAX: 70.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0456 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SOUTH CAMPBELL COUNTYAPPROX 15 MILES SSW OF GILLETTE WY (SEE APPLE BUTTE QUAD MAP
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: DESERT
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.146964
LONGITUDE: -105.529994
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1408
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: MARCH 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

HOUR / DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	10	5	6	3	8	4	6	8	8	7	7	8	6	4	7	5	6	3	6	5	7	9	7	10	24	10.
2	9	4	3	7	6	13	22	21	25	19	17	15	8	-2	6	14	6	14	12	12	6	18	35	17	24	35.
3	13	14	9	13	8	1	1	8	11	6	8	5	2	5	5	4	2	4	4	11	5	8	7	5	24	14.
4	5	2	6	6	4	6	13	12	20	9	9	12	8	10	8	7	6	5	6	7	7	10	9	7	24	20.
5	8	8	7	4	9	6	9	14	21	16	18	15	11	8	7	10	7	2	13	11	6	9	6	6	24	21.
6	14	4	7	8	12	8	11	17	20	19	12	15	10	10	11	12	6	5	12	10	8	8	8	8	24	20.
7	15	3	5	6	6	6	7	13	13	15	7	9	6	5	3	4	11	7	23	6	9	14	10	8	24	23.
8	10	0	5	6	5	8	7	9	22	14	7	12	4	5	8	9	8	8	6	11	10	10	8	8	24	22.
9	12	5	6	11	8	9	12	15	16	14	4	7	8	5	5	6	10	10	14	10	13	17	13	5	24	17.
10	11	2	7	11	7	8	27	51	32	8	12	9	9	6	20	11	9	5	23	28	10	7	10	7	24	51.
11	13	7	15	19	15	10	10	16	26	37	40	13	13	13	10	5	3	21	13	8	11	6	7	7	24	40.
12	16	12	10	8	3	12	15	35	4	16	14	9	10	10	9	11	5	7	9	15	8	13	12	9	24	35.
13	10	9	2	3	7	9	8	15	8	9	9	7	5	7	9	6	11	2	5	6	13	29	33	31	24	33.
14	27	25	16	13	7	9	6	12	18	14	14	21	25	20	17	12	13	10	9	7	10	7	7	5	24	27.
15	11	8	8	10	13	8	8	12	12	14	8	16	19	14	12	6	8	6	9	5	9	3	7	6	24	19.
16	9	11	14	3	15	6	11	26	28	18	17	38	17	11	14	12	9	11	3	4	7	3	5	1	24	38.
17	0	2	8	-3	7	10	8	5	AV	AV	AV	AV	AV	AV	AV	AV	AV	AV	AV	AV	AV	AV	AV	AV	8	10.
18	AV	AV	AV	AV	AV	AV	AV	AG	AG	AG	AG	AV	AV	BA	4	5	6	6	4	1	4	6	3	2	10	6.
19	7	0	3	7	-2	7	5	8	9	6	4	AV	AV	AV	AV	BA	4	5	2	2	6	5	5	5	19	9.
20	9	7	3	5	4	7	10	16	10	8	7	7	6	6	5	7	7	7	9	19	21	27	23	16	24	27.
21	32	33	11	7	8	14	14	22	37	27	15	11	10	9	10	8	8	9	16	12	12	13	12	12	24	37.
22	11	10	9	13	11	9	9	9	7	10	9	8	6	6	5	5	6	9	5	10	8	8	19	22	24	22.
23	19	16	15	23	13	10	11	17	13	18	35	24	14	5	31	27	20	11	9	16	20	14	18	4	24	35.
24	2	1	2	5	3	2	6	6	3	5	0	2	4	3	3	9	-1	3	5	7	12	4	4	6	24	12.
25	9	5	7	7	6	8	8	9	8	8	8	7	5	6	3	6	6	1	1	3	1	2	8	11	24	11.
26	10	6	8	5	9	4	5	6	6	5	3	5	5	3	4	5	4	5	5	5	5	3	5	5	24	10.
27	7	7	5	4	3	4	7	8	11	12	5	5	6	9	8	8	9	8	10	12	8	9	10	6	24	12.
28	7	8	6	8	6	7	8	16	9	10	9	6	7	8	18	10	165	231	204	256	138	74	48	29	24	281.
29	66	15	7	3	3	2	9	7	6	6	3	2	5	2	6	2	8	8	10	2	6	9	14	20	24	66.
30	12	9	9	6	14	7	10	14	11	9	2	6	7	BA	BA	16	16	4	4	14	8	12	10	13	22	16.
31	10	10	14	13	18	17	32	46	48	16	7	7	10	9	8	6	5	6	12	15	16	2	13	18	24	48.
NO.:	30	30	30	30	30	30	30	30	29	29	29	28	28	27	28	29	30	30	30	30	30	30	30	30		
MAX:	66.	33.	16.	23.	18.	17.	32.	51.	48.	37.	40.	38.	25.	20.	31.	27.	165.	281.	204.	256.	138.	74.	48.	31.		
AVG:	13.1	8.3	7.8	7.8	7.9	7.7	10.5	15.8	15.9	12.9	10.7	10.8	8.8	7.3	9.1	8.6	12.8	16.1	15.4	17.7	13.5	12.0	12.5	10.3		

MONTHLY OBSERVATIONS: 707 MONTHLY MEAN: 11.4 MONTHLY MAX: 281.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

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MONITOR COMMENTS:

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UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1408
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: APRIL 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

HOUR / DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	20	12	20	15	10	7	11	10	9	12	16	12	11	13	10	10	9	5	9	12	12	22	8	8	24	22.
2	7	6	5	2	3	4	9	10	7	7	6	5	5	5	5	7	5	4	7	5	6	3	8	7	24	10.
3	5	5	6	4	6	5	10	15	7	6	8	6	6	8	6	1	7	3	16	9	13	14	27	48	24	48.
4	55	37	26	25	22	18	17	17	20	14	8	7	9	9	10	11	10	13	14	17	15	15	15	15	24	55.
5	11	13	15	19	12	10	16	21	20	20	14	20	25	32	19	33	24	22	15	23	27	22	20	16	24	33.
6	13	13	17	15	15	11	18	21	21	32	45	37	27	BA	BA	BA	BA	29	19	20	35	12	7	5	20	45.
7	10	14	13	12	10	11	12	14	8	8	11	5	7	5	7	8	5	5	2	10	16	23	9	7	24	23.
8	11	4	10	10	9	5	7	7	AV	AV	AV	AN	AN	BA	BA	0	2	-1	0	1	0	2	0	0	17	11.
9	0	1	1	2	2	3	4	4	6	6	6	5	2	2	4	3	4	3	1	1	4	4	4	4	24	6.
10	3	1	6	4	6	13	13	7	19	18	6	8	3	9	11	11	15	14	19	11	12	11	8	10	24	19.
11	7	10	9	6	12	22	25	28	13	18	17	17	18	20	15	16	14	11	14	15	11	AN	AN	AN	21	28.
12	AN	7	10	12	9	6	2	4	4	3	6	8	4	4	7	2	1	AN	AN	AN	7	5	5	3	20	12.
13	5	5	5	5	5	5	13	AN	AN	17	6	7	9	8	9	11	9	11	6	26	63	15	11	8	22	63.
14	10	9	6	20	22	18	26	32	21	15	19	12	11	11	10	10	15	34	30	38	34	66	64	57	24	66.
15	62	47	23	24	20	9	10	7	7	7	5	6	0	AN	AN	AN	AN	6	9	1	3	1	3	AN	19	62.
16	AN	2	AN	AN	AN	AN	8	6	20	2	9	12	9	13	14	15	13	8	10	8	16	15	12	16	19	20.
17	10	9	11	10	8	9	17	19	21	19	16	16	8	18	14	23	16	17	13	10	10	7	7	18	24	23.
18	2	-4	1	3	0	6	9	10	AN	AN	AN	-3	12	13	10	AN	AN	11	15	11	10	6	5	8	19	15.
19	0	3	5	5	6	5	9	9	7	6	AN	AN	AN	0	6	7	5	4	2	1	11	1	4	3	21	11.
20	3	4	3	4	3	8	9	6	10	8	8	8	8	5	7	8	7	6	6	7	12	15	14	9	24	15.
21	15	10	4	12	4	11	18	1	15	17	11	15	14	BA	BA	21	28	6	8	-4	15	11	12	20	22	28.
22	15	6	12	11	10	15	20	21	26	18	13	17	14	14	14	13	13	12	16	40	10	7	8	8	24	40.
23	5	15	13	11	11	16	15	19	28	10	14	12	13	15	13	15	21	17	13	14	13	11	2	4	24	28.
24	7	3	3	4	2	6	10	14	9	9	8	14	11	15	19	13	6	10	8	10	14	21	6	8	24	21.
25	14	21	32	19	11	10	17	14	14	7	10	8	5	5	3	1	3	1	4	4	4	7	5	3	24	32.
26	8	-2	4	6	5	3	7	5	6	7	4	6	4	3	4	2	1	5	1	2	1	0	1	3	24	8.
27	2	0	1	2	3	3	3	3	5	5	3	7	7	6	6	6	2	5	4	2	5	0	2	3	24	7.
28	2	0	2	3	1	6	8	12	5	2	2	2	4	5	-1	5	9	13	31	44	16	5	10	9	24	44.
29	20	15	12	10	10	16	16	15	16	7	11	25	19	18	14	10	9	17	17	21	29	59	37	25	24	59.
30	3	9	13	19	13	14	17	16	8	9	11	22	11	12	7	6	19	3	8	6	20	11	6	10	24	22.
31																									0	
NO.:	28	30	29	29	29	29	30	29	27	28	27	28	28	26	26	27	27	29	29	29	30	29	29	28		
MAX:	62.	47.	32.	25.	22.	22.	26.	32.	28.	32.	45.	37.	27.	32.	19.	33.	28.	34.	31.	44.	63.	66.	64.	57.		
AVG:	11.6	9.2	9.9	10.1	8.6	9.5	12.5	12.7	13.0	11.0	10.9	11.3	9.9	10.3	9.3	9.9	10.1	10.1	10.9	12.6	14.8	13.5	11.0	12.0		

MONTHLY OBSERVATIONS: 680 MONTHLY MEAN: 11.0 MONTHLY MAX: 66.

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UTM NORTHING:
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ELEVATION-MSL: 1408
PROBE HEIGHT:

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MONITOR TYPE: SPM
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PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: MAY 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

HOUR / DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	14	AN	AN	AN	3	13	19	18	12	6	11	10	9	14	13	13	14	14	12	22	30	24	23	26	21	30.
2	30	20	19	10	14	18	25	28	11	27	12	9	15	11	13	18	16	16	18	28	18	21	20	25	24	30.
3	24	16	30	30	25	40	28	27	25	7	16	14	AN	AN	AN	18	22	20	AN	AN	14	9	10	9	19	40.
4	10	9	11	0	6	14	8	19	15	17	16	15	15	16	18	17	24	17	24	28	11	11	8	13	24	28.
5	10	7	9	10	9	15	12	15	13	11	14	6	14	13	0	10	11	14	18	18	13	5	AN	AN	22	18.
6	AN	AN	AN	AN	AN	AN	AN	AN	8	12	9	-2	1	1	1	3	5	6	8	9	13	13	14	14	16	14.
7	11	9	5	8	9	9	12	11	12	10	9	9	6	10	2	9	13	9	9	5	7	2	6	4	24	13.
8	7	1	2	7	7	11	11	13	8	8	11	9	11	9	10	8	9	8	11	10	7	9	0	4	24	13.
9	6	3	8	1	1	2	13	-7	0	-1	-1	5	2	5	0	4	4	4	2	5	0	3	0	2	24	13.
10	5	1	6	4	6	4	9	10	6	9	10	9	7	4	7	3	7	7	6	6	8	5	4	4	24	10.
11	12	4	9	6	6	10	10	8	14	3	14	5	9	8	7	7	10	9	8	AN	AN	5	16	18	22	18.
12	12	6	12	9	12	11	13	14	18	25	13	10	11	9	9	13	27	15	11	12	11	12	15	11	24	27.
13	14	6	12	10	9	13	12	15	17	11	11	9	10	11	17	14	19	13	13	24	18	10	4	4	24	24.
14	6	5	5	4	6	15	15	23	12	12	19	12	18	16	18	16	14	13	16	15	12	15	5	7	24	23.
15	9	4	5	6	6	1	5	5	7	6	3	3	5	6	3	4	6	-4	2	3	5	1	2	2	24	9.
16	6	3	5	5	4	8	12	14	15	6	3	5	5	10	6	8	9	5	4	7	11	9	3	6	24	15.
17	5	3	6	7	4	5	3	3	8	4	11	5	6	4	4	5	3	5	3	1	6	6	1	5	24	11.
18	2	1	3	3	3	5	7	8	12	10	13	11	9	10	9	8	8	8	12	6	6	15	9	8	24	15.
19	8	8	12	13	11	8	6	7	8	6	7	6	4	4	0	2	2	2	3	3	3	3	4	4	24	13.
20	4	1	3	3	4	4	8	4	4	4	6	4	6	4	5	3	3	5	2	0	5	3	4	4	24	8.
21	8	7	4	1	5	13	8	11	6	6	13	9	6	6	5	9	9	12	9	12	6	8	13	8	24	13.
22	8	5	9	9	8	AN	AN	AN	AN	5	11	2	12	11	8	10	4	AN	AN	AN	5	3	5	AN	16	12.
23	AN	AN	AN	AN	AN	4	4	4	3	6	14	21	13	35	11	8	8	8	11	7	7	6	4	5	19	35.
24	AN	AN	AN	0	5	4	5	2	4	4	5	2	1	0	3	4	4	5	4	3	6	6	5	5	21	6.
25	11	6	8	11	7	7	6	10	7	10	8	11	14	6	9	12	8	5	5	8	6	1	0	1	24	14.
26	6	3	-2	3	3	10	13	14	8	AN	AN	AN	AN	7	4	9	9	15	11	13	7	5	8	9	20	15.
27	7	2	5	3	3	18	16	0	0	7	4	5	5	8	7	10	16	AZ	AZ	AN	AN	AN	AN	AN	17	18.
28	AN	AN	2	2	1	3	4	5	0	6	1	0	2	8	4	2	7	5	0	-2	4	5	1	1	22	8.
29	4	10	5	0	3	0	0	3	3	12	10	15	5	6	1	9	6	7	3	7	5	5	7	12	24	15.
30	9	11	3	3	4	5	3	10	7	12	12	15	11	15	13	13	5	11	12	14	11	11	13	11	24	15.
31	3	12	7	8	5	9	17	2	4	9	2	7	4	7	4	8	9	6	8	8	20	36	27	8	24	36.
NO.:	27	26	27	28	29	29	29	29	30	30	30	30	29	30	30	31	31	29	28	27	29	30	29	28		
MAX:	30.	20.	30.	30.	25.	40.	28.	28.	25.	27.	19.	21.	18.	35.	18.	18.	27.	23.	24.	28.	30.	36.	27.	26.		
AVG:	9.3	6.3	7.5	6.3	6.5	9.6	10.5	10.2	8.9	9.0	9.6	8.0	8.1	9.1	7.0	8.9	10.0	9.0	8.8	10.1	9.5	8.9	8.0	8.2		

MONTHLY OBSERVATIONS: 695 MONTHLY MEAN: 8.7 MONTHLY MAX: 40.

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2	10	6	7	6	6	10	9	7	9	6	8	8	7	11	13	13	10	11	AN	AN	5	5	6	9	22	13.
3	11	6	8	7	8	11	11	6	9	21	20	18	20	20	16	13	12	15	AN	AN	18	5	4	9	22	21.
4	3	-7	0	1	4	9	10	7	4	8	9	13	12	11	9	14	9	9	12	18	14	13	14	3	24	18.
5	16	-1	9	8	8	4	11	10	8	12	13	16	23	14	17	36	40	12	14	9	7	14	10	7	24	40.
6	11	-1	6	8	14	0	12	12	10	11	11	8	14	11	7	8	14	11	10	8	6	10	2	9	24	14.
7	9	5	9	7	7	11	13	11	10	7	7	11	9	12	10	12	9	17	14	6	16	6	10	6	24	17.
8	7	2	6	5	15	29	27	18	14	10	9	7	10	11	10	12	9	12	12	5	14	17	13	8	24	29.
9	7	9	19	-3	10	13	13	15	18	14	16	16	12	14	13	8	13	13	11	19	22	13	23	26	24	26.
10	22	-1	2	17	21	17	18	19	34	47	29	24	26	17	54	13	8	12	8	13	10	15	9	9	24	54.
11	13	7	8	9	17	20	16	15	18	12	16	1	12	19	8	16	-11	15	10	19	17	8	6	13	24	20.
12	13	5	6	12	11	8	13	19	14	22	17	17	11	10	12	14	22	32	18	77	22	9	11	16	24	77.
13	17	16	8	11	13	12	10	15	14	19	24	21	23	18	18	15	14	24	17	14	18	19	15	15	24	24.
14	2	6	8	6	13	10	12	11	11	8	11	10	8	9	13	14	0	9	11	9	13	7	9	6	24	14.
15	13	4	10	9	5	7	7	8	4	12	3	8	11	9	7	11	18	21	16	31	30	10	10	10	24	31.
16	12	0	19	6	10	9	5	8	6	8	5	10	8	6	12	17	-2	24	-9	6	13	16	1	6	24	24.
17	7	4	4	8	8	20	15	16	12	15	11	-7	8	35	2	9	26	12	16	14	48	5	0	4	24	48.
18	10	4	5	8	9	12	14	4	5	29	27	17	19	28	30	27	19	20	27	27	17	18	15	6	24	30.
19	13	6	6	5	8	8	8	19	30	20	24	27	27	27	28	49	39	21	31	48	26	9	6	5	24	49.
20	6	5	6	8	13	10	15	8	10	8	9	8	9	9	15	9	16	17	13	17	13	9	12	11	24	17.
21	13	15	19	13	10	9	22	12	13	27	13	28	14	15	12	14	24	38	18	31	20	29	34	2	24	38.
22	18	-5	1	2	10	15	16	7	15	17	9	6	8	8	16	21	19	14	9	13	13	16	19	22	24	22.
23	24	17	15	14	14	13	13	23	26	26	21	23	BA	BA	38	29	28	28	23	23	23	29	21	17	22	38.
24	8	5	10	13	11	20	27	32	34	17	30	29	26	26	29	27	25	20	15	5	11	5	12	1	24	34.
25	10	11	20	13	9	10	7	10	12	2	7	11	12	9	7	6	7	11	9	4	10	5	1	6	24	20.
26	4	6	6	3	6	11	12	14	10	8	9	8	9	8	15	1	8	13	15	8	12	13	17	18	24	18.
27	10	13	12	15	18	26	25	24	16	14	12	10	8	12	12	12	14	16	15	12	12	16	33	29	24	33.
28	27	28	19	29	28	27	21	28	23	23	22	19	17	19	12	14	11	13	35	30	42	36	26	20	24	42.
29	30	11	13	48	22	22	31	25	24	35	24	21	15	15	29	12	13	11	16	21	35	49	38	27	24	49.
30	31	28	17	15	18	25	24	34	30	19	27	25	19	9	14	4	15	20	17	12	18	21	43	11	24	43.
31																									0	
NO.:	30	30	30	30	30	30	30	30	30	30	30	30	29	29	30	30	30	30	28	28	30	30	30	30		
MAX:	31.	28.	20.	48.	28.	29.	31.	34.	34.	47.	30.	29.	27.	35.	54.	49.	40.	38.	35.	77.	48.	49.	43.	29.		
AVG:	12.7	7.1	9.6	10.2	11.8	13.7	14.9	15.1	15.4	16.5	15.2	14.0	14.1	14.5	16.3	15.4	14.9	16.9	14.9	18.5	17.9	14.9	14.4	11.4		

MONTHLY OBSERVATIONS: 714 MONTHLY MEAN: 14.2 MONTHLY MAX: 77.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0456 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SOUTH CAMPBELL COUNTYAPPROX 15 MILES SSW OF GILLETTE WY (SEE APPLE BUTTE QUAD MAP
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: DESERT
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.146964
LONGITUDE: -105.529994
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1408
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: JULY 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	19	11	12	19	23	37	34	25	17	22	32	26	20	21	25	25	34	36	36	35	69	29	22	17	24	69.
2	22	18	18	18	14	24	20	22	23	24	26	28	28	28	25	24	24	23	11	18	25	25	24	25	24	28.
3	26	21	22	20	20	19	45	43	28	21	18	23	13	17	12	15	7	29	25	21	53	AN	AN	AN	21	53.
4	27	26	25	30	26	27	31	32	38	14	13	17	23	17	19	18	18	15	21	16	42	31	20	28	24	42.
5	43	39	39	31	33	34	30	45	52	35	28	27	19	21	23	54	48	49	34	22	23	32	53	45	24	54.
6	45	37	46	37	35	38	30	28	30	31	34	33	27	27	25	38	29	31	30	25	24	27	22	30	24	46.
7	40	35	49	59	56	63	63	60	59	55	37	29	26	28	31	22	26	22	14	26	29	28	34	25	24	63.
8	25	27	27	28	25	27	23	22	23	14	22	19	20	10	16	14	22	18	24	24	16	15	16	14	24	28.
9	24	24	27	29	28	33	30	20	28	30	26	21	24	39	43	37	35	42	30	48	55	28	27	22	24	55.
10	16	18	19	13	15	27	17	36	36	47	31	24	18	17	15	14	9	24	8	4	12	11	13	10	24	47.
11	7	8	8	10	12	20	18	14	13	17	16	19	22	22	12	14	11	12	16	15	13	13	17	13	24	22.
12	15	6	9	12	AN	20	29	25	20	16	26	42	28	24	14	26	21	10	23	40	AN	AN	AN	AN	19	42.
13	AN	AN	39	11	30	49	37	18	43	57	33	-9	-1	-12	15	17	40	18	21	61	10	20	15	31	22	61.
14	22	34	23	9	7	33	16	16	20	18	24	18	23	14	3	11	24	24	36	43	21	2	25	0	24	43.
15	0	6	6	AN	AN	AN	AN	AN	AN	AN	AN	AN	21	28	23	6	17	38	AN	AN	AN	8	13	16	12	38.
16	6	5	8	6	9	20	26	25	10	15	-4	0	-11	8	-1	10	25	-3	50	73	AN	16	29	37	23	73.
17	10	5	8	7	5	10	4	0	19	23	7	18	10	11	6	10	35	22	44	13	11	5	7	8	24	44.
18	-7	10	AN	16	15	7	10	13	9	9	8	7	37	8	16	11	12	9	8	25	27	12	19	AN	22	37.
19	8	14	12	16	16	32	29	7	8	3	2	36	7	14	6	7	17	14	9	2	AN	AN	AN	AN	20	36.
20	AN	9	9	9	12	28	27	14	22	12	27	29	20	9	12	8	22	34	42	42	83	27	50	37	23	83.
21	25	12	11	5	10	12	20	18	11	18	26	16	28	54	9	23	19	14	11	13	17	19	9	8	24	54.
22	3	8	11	12	12	30	25	32	11	19	BA	BA	BA	BA	BA	24	4	-1	15	-9	11	6	6	17	19	32.
23	10	7	6	2	14	23	20	20	20	16	0	11	7	10	4	2	8	2	3	3	3	7	12	12	24	23.
24	17	3	6	10	2	10	23	11	9	9	11	8	10	6	9	8	20	11	13	13	15	12	5	12	24	23.
25	34	10	-6	4	1	12	18	13	18	14	3	7	5	7	2	9	4	8	5	5	16	18	14	17	24	34.
26	19	11	6	35	11	23	24	29	32	25	24	12	7	9	-9	46	27	16	0	33	126	13	50	74	24	126.
27	62	22	16	14	18	19	28	34	40	26	42	17	55	15	11	19	25	16	79	47	10	-2	3	2	24	79.
28	2	-2	1	-4	1	13	17	5	9	7	3	4	BA	BA	7	3	5	0	0	0	0	5	10	-2	22	17.
29	15	-4	2	0	6	5	13	11	12	1	6	7	7	5	15	4	6	5	3	6	13	32	20	16	24	32.
30	21	0	4	81	290	17	26	15	12	6	7	7	7	6	10	7	7	6	2	5	13	10	7	100	24	290.
31	27	6	15	16	23	31	27	34	36	101	749	23	53	171	98	8	11	21	23	32	26	25	20	28	24	749.
NO.:	29	30	30	30	29	30	30	30	30	30	29	29	29	29	30	31	31	31	30	30	27	28	28	27		
MAX:	62.	39.	49.	81.	290.	63.	63.	60.	59.	101.	749.	42.	55.	171.	98.	54.	48.	49.	79.	73.	126.	32.	53.	100.		
AVG:	20.1	14.2	15.9	18.5	26.5	24.8	25.3	22.9	23.6	23.5	44.0	17.9	19.1	21.9	16.5	17.2	19.7	18.2	21.2	23.4	28.3	16.9	20.1	23.8		

MONTHLY OBSERVATIONS: 707 MONTHLY MEAN: 21.8 MONTHLY MAX: 749.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0456 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SOUTH CAMPBELL COUNTYAPPROX 15 MILES SSW OF GILLETTE WY (SEE APPLE BUTTE QUAD MAP
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: DESERT
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.146964
LONGITUDE: -105.529994
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1408
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: AUGUST 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	24	2	10	10	13	16	27	21	19	16	19	8	5	4	4	0	8	6	2	11	14	20	15	16	24	27.
2	27	26	28	25	26	23	33	67	26	21	14	23	29	29	27	37	20	27	16	22	19	24	24	41	24	67.
3	46	31	43	27	28	24	27	31	39	37	36	37	28	34	28	22	29	25	22	14	4	2	8	46	24	46.
4	43	28	34	35	37	46	53	34	12	13	9	7	14	40	23	17	19	17	9	17	21	16	20	568	24	568.
5	26	1	12	12	13	24	28	29	19	14	18	16	13	15	14	35	15	10	26	103	23	52	34	9	24	103.
6	16	-4	5	4	6	11	25	16	15	17	17	10	17	12	11	11	11	10	6	17	28	104	40	16	24	104.
7	39	0	38	6	19	14	24	22	47	33	20	20	21	19	56	28	31	16	14	30	6	7	5	8	24	56.
8	20	-3	13	28	119	56	61	41	22	19	484	12	8	209	11	80	729	423	486	409	7	10	8	10	24	729.
9	21	-3	6	8	8	9	10	12	14	11	10	12	14	7	8	24	34	31	172	136	37	30	34	25	24	172.
10	118	84	7	18	26	20	381	90	67	51	13	12	9	12	18	10	19	19	40	219	224	130	350	94	24	381.
11	27	3	19	13	15	21	34	35	26	24	39	29	71	146	60	608	42	120	531	44	69	73	30	13	24	608.
12	40	20	40	26	28	28	38	21	21	18	22	9	8	5	10	6	14	25	27	14	11	6	7	8	24	40.
13	20	-3	9	8	6	12	26	13	11	15	8	9	6	3	6	6	16	35	30	20	28	20	22	23	24	35.
14	40	14	29	32	33	32	41	49	33	92	171	48	54	76	64	131	29	34	48	49	56	20	29	19	24	171.
15	31	12	33	44	31	21	17	45	254	1339	302	4	3	7	13	14	31	30	28	23	32	25	27	26	24	1339.
16	63	50	66	73	61	57	66	56	53	55	51	51	62	44	36	30	30	18	16	14	14	12	13	11	24	73.
17	16	7	21	11	11	14	10	10	9	13	21	25	26	16	28	27	15	31	21	13	5	7	8	12	24	31.
18	14	3	9	11	10	17	12	15	17	17	11	15	11	16	8	7	12	6	3	3	9	7	7	4	24	17.
19	3	2	9	4	0	8	15	8	9	6	5	4	2	BA	BA	5	-2	0	-5	0	0	3	15	14	22	15.
20	22	10	23	18	13	13	16	15	21	23	34	38	67	68	61	50	52	44	67	63	58	61	64	56	24	68.
21	61	48	58	57	55	58	52	54	63	67	47	49	27	24	26	21	16	21	30	39	28	31	33	40	24	67.
22	71	82	60	45	113	86	28	18	9	9	5	10	11	4	12	7	7	15	-3	-3	0	1	2	0	24	113.
23	18	-14	2	0	1	3	10	11	14	10	11	32	10	21	26	20	21	13	12	60	27	71	6	6	24	71.
24	17	-10	11	12	87	81	21	29	28	33	28	72	30	33	44	48	50	30	46	32	46	24	19	23	24	87.
25	28	0	14	14	13	18	27	38	41	35	29	11	16	18	23	16	29	18	27	30	21	26	22	20	24	41.
26	41	9	28	32	30	24	27	32	39	34	33	26	28	12	33	14	16	21	18	22	18	14	16	14	24	41.
27	25	3	13	12	8	11	7	6	4	15	23	10	15	15	6	12	10	6	8	17	24	27	38	52	24	52.
28	55	24	40	37	36	37	45	52	50	46	37	41	41	45	46	41	43	41	39	41	42	43	50	53	24	55.
29	77	42	52	44	54	56	52	65	67	39	13	8	2	15	6	7	6	3	3	4	24	35	46	51	24	77.
30	51	2	16	14	10	20	37	36	17	6	16	13	10	9	6	76	15	11	7	15	7	22	18	7	24	76.
31	25	-12	6	32	14	21	30	34	35	31	35	36	29	31	14	11	11	14	44	44	29	24	24	25	24	44.
NO.:	31	31	31	31	31	31	31	31	31	31	31	31	31	30	30	31	31	31	31	31	31	31	31	31		
MAX:	118.	84.	66.	73.	119.	86.	381.	90.	254.	1339.	484.	72.	71.	209.	64.	608.	729.	423.	531.	409.	224.	130.	350.	568.		
AVG:	36.3	14.6	24.3	23.0	29.8	28.4	41.3	32.4	35.5	69.6	51.0	22.5	22.2	33.0	24.3	45.8	44.5	36.1	57.7	49.1	30.0	30.5	33.4	42.3		

MONTHLY OBSERVATIONS: 742 MONTHLY MEAN: 35.8 MONTHLY MAX: 1339.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0456 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SOUTH CAMPBELL COUNTYAPPROX 15 MILES SSW OF GILLETTE WY (SEE APPLE BUTTE QUAD MAP
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: DESERT
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.146964
LONGITUDE: -105.529994
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1408
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: SEPTEMBER 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	24	8	24	20	24	27	18	21	15	17	11	15	9	7	8	0	12	14	8	17	36	39	34	13	24	39.
2	26	0	6	5	3	11	12	18	21	15	9	6	5	6	3	15	9	7	-4	9	7	10	7	5	24	26.
3	22	-4	10	8	11	12	23	27	19	19	19	22	10	2	11	9	3	12	19	27	42	5	0	6	24	42.
4	25	-4	13	14	16	18	33	34	35	32	28	26	16	22	11	0	23	30	1	9	16	3	10	11	24	35.
5	23	-11	6	9	7	6	13	20	20	19	10	12	9	7	4	9	4	0	-1	5	35	14	2	8	24	35.
6	11	-13	3	2	3	6	6	5	9	13	14	13	10	-1	8	5	1	0	29	5	9	8	6	7	24	29.
7	25	-5	8	10	8	5	14	19	13	4	3	6	6	8	6	9	7	7	8	8	9	7	5	14	24	25.
8	13	-4	6	6	9	6	13	14	12	17	10	11	8	8	9	8	8	8	15	19	17	12	18	19	24	19.
9	28	0	12	10	6	13	14	20	26	17	14	14	26	7	4	7	8	7	5	18	9	5	10	6	24	28.
10	26	5	17	17	15	18	23	27	19	15	31	26	21	14	14	17	7	11	2	4	8	10	5	10	24	31.
11	26	8	20	12	9	16	17	28	31	23	31	14	16	10	12	14	9	5	32	12	8	10	12	12	24	32.
12	27	9	19	22	20	20	22	31	20	12	9	10	11	5	8	8	6	6	7	10	7	17	17	22	24	31.
13	34	7	20	16	14	15	23	21	17	18	16	16	16	24	16	11	14	26	22	47	52	100	100	52	24	100.
14	44	25	31	23	30	30	37	31	43	31	31	25	21	14	7	15	30	96	28	26	13	12	25	18	24	96.
15	15	-1	0	0	33	9	8	11	19	23	22	60	21	32	15	33	23	10	12	16	12	9	9	7	24	60.
16	18	-9	4	6	9	16	33	40	23	23	23	20	25	37	18	8	6	12	16	12	4	0	1	1	24	40.
17	1	4	0	2	3	4	2	9	10	6	5	5	1	4	5	3	7	10	18	17	6	4	8	5	24	18.
18	2	2	4	5	5	2	4	4	6	7	4	3	0	4	3	5	4	0	0	8	8	15	25	23	24	25.
19	9	17	13	4	6	2	6	17	20	9	5	5	4	1	3	5	5	2	2	3	6	6	6	7	24	20.
20	5	10	3	4	5	8	11	19	16	9	8	3	6	7	4	-1	8	4	-5	1	1	3	9	4	24	19.
21	6	3	5	5	3	6	13	25	15	9	6	3	5	0	9	10	7	12	10	12	11	11	10	8	24	25.
22	8	7	7	12	13	9	22	37	21	20	19	17	18	17	17	17	13	11	12	7	6	8	6	6	24	37.
23	6	6	7	8	7	6	7	6	12	19	28	31	BA	BA	38	10	18	0	15	12	11	13	14	8	22	38.
24	3	3	3	2	4	2	7	14	35	17	11	8	16	21	6	10	15	22	85	65	53	8	4	2	24	85.
25	5	2	1	2	4	4	6	7	16	20	26	22	18	20	9	20	28	18	32	12	8	9	6	7	24	32.
26	7	7	6	5	5	3	12	23	30	23	21	17	5	5	21	12	-1	4	10	8	13	7	7	15	24	30.
27	8	15	12	12	12	13	15	22	20	20	16	18	19	19	23	13	29	30	0	8	4	7	AN	AN	22	30.
28	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	0	
29	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	0	
30	AN	AN	AN	AN	AN	AN	AN	AN	AN	26	23	15	12	15	24	3	16	-8	19	10	10	7	7	11	15	26.
31																									0	
NO.:	27	27	27	27	27	27	27	27	27	28	28	28	27	27	28	28	28	28	28	28	28	28	27	27		
MAX:	44.	25.	31.	23.	33.	30.	37.	40.	43.	32.	31.	60.	26.	37.	38.	33.	30.	96.	85.	65.	53.	100.	100.	52.		
AVG:	16.6	3.2	9.6	8.9	10.5	10.6	15.3	20.4	20.1	17.3	16.2	15.8	12.4	11.7	11.3	9.8	11.4	12.7	14.2	14.5	15.0	12.8	13.4	11.4		

MONTHLY OBSERVATIONS: 659 MONTHLY MEAN: 13.1 MONTHLY MAX: 100.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0456 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SOUTH CAMPBELL COUNTYAPPROX 15 MILES SSW OF GILLETTE WY (SEE APPLE BUTTE QUAD MAP
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: DESERT
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.146964
LONGITUDE: -105.529994
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1408
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: OCTOBER 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	7	9	7	9	9	13	14	21	16	23	15	20	14	27	13	12	14	14	13	22	30	17	12	11	24	30.
2	12	11	12	14	18	3	8	6	8	6	9	6	12	18	18	20	18	9	10	3	0	2	2	5	24	20.
3	5	4	2	4	6	6	6	7	5	5	6	8	9	8	8	10	9	4	0	1	0	3	2	0	24	10.
4	2	2	0	3	1	0	3	4	0	5	1	2	1	2	4	7	4	3	5	4	2	3	3	3	24	7.
5	3	3	2	6	7	4	6	6	7	9	8	10	11	11	13	11	11	6	6	5	5	4	4	7	24	13.
6	2	2	2	4	5	6	7	7	6	9	16	15	14	17	18	15	11	7	5	7	5	6	5	5	24	18.
7	5	5	4	4	4	4	2	7	16	21	13	11	11	9	10	9	6	8	9	10	7	12	12	13	24	21.
8	16	14	14	13	9	8	8	9	10	10	10	8	6	6	7	7	7	7	7	8	6	6	6	4	24	16.
9	7	7	6	16	16	7	14	11	12	13	16	10	8	4	4	4	2	0	4	3	7	3	4	3	24	16.
10	2	3	2	5	0	7	1	13	22	10	9	5	4	8	-1	4	11	15	14	10	6	4	4	4	24	22.
11	0	1	3	3	8	3	3	3	3	2	3	4	3	6	5	16	17	10	9	4	6	6	0	5	24	17.
12	4	1	7	4	5	11	15	8	6	7	5	3	7	10	17	14	21	27	82	51	74	113	46	35	24	113.
13	40	28	27	24	12	9	6	3	7	8	2	5	3	15	4	13	9	6	8	7	7	6	6	6	24	40.
14	5	6	14	16	9	8	8	6	6	7	15	2	3	8	13	14	12	10	10	8	7	4	9	6	24	16.
15	6	7	8	9	6	8	11	12	14	10	9	11	14	9	11	21	10	10	11	8	7	8	8	7	24	21.
16	6	7	15	9	8	4	11	6	8	10	9	7	28	35	41	27	21	16	24	21	16	14	17	17	24	41.
17	15	14	13	13	15	15	24	31	46	50	59	51	46	57	55	50	43	32	36	33	22	20	20	17	24	59.
18	26	31	29	26	18	12	24	22	19	39	57	15	11	8	9	11	9	11	14	16	11	16	13	7	24	57.
19	15	6	12	10	7	7	6	18	18	13	21	13	10	8	8	5	1	5	9	0	5	2	7	-1	24	21.
20	7	2	4	6	3	6	2	18	8	7	5	6	5	3	BA	BA	10	7	4	5	2	5	5	5	22	18.
21	7	4	0	5	0	2	-4	9	5	8	9	6	3	12	15	15	39	29	23	29	28	18	16	24	24	39.
22	24	18	8	6	7	5	6	8	8	13	12	11	14	16	10	10	12	6	7	4	5	4	5	5	24	24.
23	3	2	4	4	6	5	6	9	9	10	7	6	5	3	4	4	2	2	0	6	1	1	4	1	24	10.
24	2	1	7	5	6	5	6	10	13	12	6	3	6	4	5	3	7	4	3	7	11	14	8	9	24	14.
25	7	10	14	10	8	7	5	20	15	14	12	6	6	6	5	5	6	10	8	11	10	17	10	11	24	20.
26	10	9	8	11	9	3	4	12	8	10	8	13	18	16	0	0	1	1	2	3	1	5	1	1	24	18.
27	1	8	4	2	5	3	4	13	5	8	8	1	5	2	5	0	5	3	2	1	3	1	3	0	24	13.
28	2	1	1	3	4	4	-1	8	2	9	3	5	5	3	4	3	1	6	9	4	3	2	3	3	24	9.
29	2	3	3	5	3	5	9	14	11	7	10	9	5	5	3	3	6	11	6	5	6	10	8	4	24	14.
30	5	3	3	8	1	0	7	9	6	4	4	1	4	3	4	1	0	2	2	8	3	5	1	4	24	9.
31	7	7	4	5	4	3	0	8	5	6	6	8	4	6	7	4	2	2	2	3	4	5	6	6	24	8.
NO.:	31	31	31	31	31	31	31	31	31	31	31	31	31	31	30	30	31	31	31	31	31	31	31	31		
MAX:	40.	31.	29.	26.	18.	15.	24.	31.	46.	50.	59.	51.	46.	57.	55.	50.	43.	32.	82.	51.	74.	113.	46.	35.		
AVG:	8.2	7.4	7.7	8.5	7.1	5.9	7.1	10.9	10.5	11.8	12.0	9.1	9.5	11.1	10.6	10.6	10.5	9.1	11.1	9.9	9.7	10.8	8.1	7.3		

MONTHLY OBSERVATIONS: 742 MONTHLY MEAN: 9.4 MONTHLY MAX: 113.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0456 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SOUTH CAMPBELL COUNTYAPPROX 15 MILES SSW OF GILLETTE WY (SEE APPLE BUTTE QUAD MAP
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: DESERT
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.146964
LONGITUDE: -105.529994
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1408
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: NOVEMBER 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

HOUR / DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	7	6	6	6	6	8	5	7	11	9	10	6	7	10	6	5	6	6	8	11	6	5	7	10	24	11.
2	5	12	7	7	4	3	4	7	9	8	5	5	6	9	4	11	BA	BA	BA	5	9	2	4	1	21	12.
3	-1	-3	-2	0	5	1	1	10	4	4	5	4	20	22	22	9	10	12	10	2	0	2	7	1	24	22.
4	4	2	4	5	8	5	6	6	5	3	0	0	3	0	5	2	0	0	0	0	0	0	0	0	24	8.
5	1	1	1	0	0	0	2	5	4	5	0	0	3	2	12	6	3	7	7	7	7	6	6	5	24	12.
6	6	4	4	4	7	5	7	7	8	10	9	5	3	5	6	7	18	3	3	4	5	7	5	3	24	18.
7	5	7	9	10	8	9	4	7	11	7	1	3	3	5	5	4	6	3	7	3	4	3	5	6	24	11.
8	13	-1	6	2	6	1	5	9	2	6	1	5	4	5	5	5	2	5	5	2	13	5	-2	2	24	13.
9	7	4	2	4	4	3	5	15	2	8	9	9	1	10	6	6	10	4	7	7	5	16	3	-2	24	16.
10	3	14	-3	8	8	1	1	10	10	5	5	5	6	5	7	3	2	2	0	6	3	3	0	3	24	14.
11	5	2	2	3	4	5	3	4	8	8	4	4	6	6	5	4	3	11	11	8	9	4	4	5	24	11.
12	7	7	11	5	6	4	6	7	11	7	4	5	3	-2	4	3	0	11	7	5	8	9	11	7	24	11.
13	6	9	17	11	15	11	7	9	13	3	10	2	6	7	7	7	7	7	3	12	0	0	11	7	24	17.
14	4	-2	7	3	3	4	8	3	7	3	7	6	6	5	4	3	2	7	5	3	3	3	2	2	24	8.
15	8	1	0	0	13	2	-4	6	11	15	5	11	9	4	7	7	4	7	11	11	5	9	7	7	24	15.
16	3	0	12	6	6	5	3	8	10	11	10	9	13	13	17	18	10	11	18	32	13	4	4	2	24	32.
17	2	2	1	2	4	2	3	8	16	9	5	3	7	6	-1	8	0	13	7	8	5	5	1	6	24	16.
18	5	-2	4	8	8	4	7	52	45	AZ	AZ	67	2	6	5	0	0	0	-1	2	5	0	2	0	22	67.
19	-1	4	-2	0	0	-1	4	4	8	2	2	-3	0	1	1	0	-2	19	17	9	8	8	11	12	24	19.
20	9	6	2	5	0	3	3	1	6	6	2	7	4	6	0	9	18	3	0	3	-2	1	0	4	24	18.
21	3	-1	6	5	-5	6	1	0	12	9	3	5	4	2	3	1	-1	5	2	2	0	1	6	3	24	12.
22	5	2	4	3	3	4	4	6	11	10	-6	5	-3	2	5	5	1	0	11	2	1	2	3	9	24	11.
23	-2	2	1	4	2	6	8	5	8	16	13	1	9	6	4	1	3	1	14	8	11	15	19	14	24	19.
24	6	7	1	12	5	0	3	4	4	7	0	5	6	3	5	11	15	6	6	8	18	14	8	5	24	18.
25	5	7	5	7	7	7	5	4	6	5	17	19	14	19	29	16	6	6	14	10	0	8	2	9	24	29.
26	8	5	16	5	16	15	8	7	11	16	15	9	3	5	3	6	-1	4	2	9	5	3	3	0	24	16.
27	2	4	4	5	-2	3	5	1	10	12	11	10	5	4	3	2	3	4	1	6	5	5	2	3	24	12.
28	6	3	1	-4	5	9	7	9	7	7	7	13	7	5	8	1	1	2	1	5	-3	4	0	7	24	13.
29	0	2	1	12	2	10	2	4	9	8	3	4	4	4	1	3	4	2	4	1	-1	0	1	-2	24	12.
30	3	3	-3	2	7	6	1	7	9	7	8	1	0	4	2	3	2	-1	5	1	3	4	0	8	24	9.
31																									0	
NO.:	30	30	30	30	30	30	30	30	30	29	29	30	30	30	30	30	29	29	29	30	30	30	30	30		
MAX:	13.	14.	17.	12.	16.	15.	8.	52.	45.	16.	17.	67.	20.	22.	29.	18.	18.	19.	18.	32.	18.	16.	19.	14.		
AVG:	4.5	3.6	4.1	4.7	5.2	4.7	4.1	7.7	9.6	7.8	5.7	7.5	5.4	6.0	6.3	5.5	4.6	5.5	6.4	6.4	4.8	4.9	4.4	4.6		

MONTHLY OBSERVATIONS: 715 MONTHLY MEAN: 5.6 MONTHLY MAX: 67.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0456 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: SOUTH CAMPBELL COUNTYAPPROX 15 MILES SSW OF GILLETTE WY (SEE APPLE BUTTE QUAD MAP
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: DESERT
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.146964
LONGITUDE: -105.529994
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1408
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: DECEMBER 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	2	5	1	3	10	1	7	4	6	9	5	8	5	4	6	5	3	7	9	2	4	3	5	7	24	10.
2	0	2	4	2	7	2	6	4	7	8	5	-1	1	4	3	1	7	3	3	3	8	1	4	3	24	8.
3	6	5	5	3	2	3	3	3	7	10	24	11	7	3	4	1	3	5	3	2	2	2	2	3	24	24.
4	2	1	5	2	4	5	43	5	7	7	5	0	1	6	5	5	4	3	12	5	2	5	5	0	24	43.
5	3	4	5	6	4	6	4	6	8	13	-1	5	7	5	4	2	0	1	12	3	3	1	2	2	24	13.
6	2	1	3	2	3	5	3	9	6	9	9	-1	19	10	-2	6	3	8	3	2	3	6	4	4	24	19.
7	2	5	5	2	2	5	4	4	6	6	2	4	0	7	4	5	7	12	-2	3	5	12	-3	15	24	15.
8	-8	10	2	4	6	8	9	4	0	6	7	-1	1	4	2	3	6	0	9	8	5	-5	2	12	24	12.
9	3	-5	5	2	2	8	13	0	14	12	14	11	7	-1	7	12	8	6	5	12	13	8	42	4	24	42.
10	2	2	0	2	3	2	3	3	6	4	5	-3	5	18	0	9	19	7	9	8	8	10	7	7	24	19.
11	8	3	7	10	3	1	2	7	6	8	-3	3	4	3	1	2	6	12	7	8	6	5	6	6	24	12.
12	7	5	9	11	19	20	15	14	15	15	10	7	4	2	4	2	1	2	5	2	4	2	5	4	24	20.
13	0	3	3	1	3	5	1	9	2	9	12	1	-2	5	9	17	10	11	3	3	5	12	10	9	24	17.
14	11	13	14	10	9	8	7	5	7	8	7	14	2	3	3	10	6	6	5	5	5	6	6	1	24	14.
15	3	6	1	3	6	5	6	3	1	8	1	4	5	8	9	11	0	1	-1	3	6	0	3	0	24	11.
16	5	2	-1	1	12	2	7	12	8	10	17	10	8	9	9	8	3	0	10	-1	9	5	-1	6	24	17.
17	8	8	-2	3	9	-1	0	9	10	10	7	24	6	25	23	0	1	3	3	3	4	0	7	1	24	25.
18	4	10	0	1	14	-3	4	13	8	20	16	16	0	8	17	13	4	2	5	3	3	3	4	8	24	20.
19	5	3	4	2	11	5	3	3	5	6	4	8	-2	5	10	5	4	3	3	4	2	4	0	2	24	11.
20	3	4	3	4	4	5	3	4	5	4	7	0	5	-3	8	6	2	2	2	4	2	3	4	6	24	8.
21	4	3	8	3	4	7	2	7	5	9	-4	2	3	2	4	5	4	3	3	2	4	2	3	4	24	9.
22	4	1	3	2	2	5	7	3	5	6	4	-2	2	6	4	9	5	4	0	3	-1	3	4	5	24	9.
23	5	3	2	-1	2	1	8	1	5	8	3	4	1	3	1	2	2	5	5	3	6	2	3	6	24	8.
24	1	4	3	1	4	1	6	1	7	9	5	4	3	4	4	2	3	7	4	6	4	2	2	3	24	9.
25	0	6	7	5	3	16	1	7	19	9	12	4	9	6	0	13	6	9	2	-3	11	11	2	1	24	19.
26	1	13	11	2	3	4	16	2	8	22	4	9	18	11	14	5	4	2	-1	13	0	8	2	-4	24	22.
27	5	4	12	8	2	10	3	6	16	21	53	13	2	4	8	15	19	12	19	11	11	9	6	13	24	53.
28	0	5	9	2	3	9	10	8	18	32	17	15	10	9	6	8	4	3	4	7	5	7	7	4	24	32.
29	2	7	10	13	0	4	2	8	9	6	13	4	5	16	6	10	5	2	6	6	3	7	1	4	24	16.
30	11	1	4	4	0	14	-1	5	12	3	15	7	BA	BA	9	5	1	1	5	-1	5	-1	-3	1	22	15.
31	8	-2	0	1	5	-1	4	2	-4	8	10	19	9	3	4	-2	1	-2	-2	5	-2	1	-1	5	24	19.
NO.:	31	31	31	31	31	31	31	31	31	31	31	31	30	30	31	31	31	31	31	31	31	31	31	31		
MAX:	11.	13.	14.	13.	19.	20.	43.	14.	19.	32.	53.	24.	19.	25.	23.	17.	19.	12.	19.	13.	13.	12.	42.	15.		
AVG:	3.5	4.3	4.6	3.7	5.2	5.2	6.5	5.5	7.5	10.2	9.2	6.4	4.8	6.3	6.0	6.3	4.9	4.5	4.8	4.3	4.7	4.3	4.5	4.6		

MONTHLY OBSERVATIONS: 742 MONTHLY MEAN: 5.5 MONTHLY MAX: 53.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0802 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: BELLE AYR BA-1
SITE COMMENTS: AMAX COAL CO/BELLE AYR MINE. NORTH SITE KNOWN AS BA-1S & BA-1N. CATEGORY B SITE -
MONITOR COMMENTS: PM10 SAMPLER SITED JANUARY 2001. TSP WAS REL'D TO EAST SITE.

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.1354941084
LONGITUDE: -105.42463614
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 0
PROBE HEIGHT: 4

SUPPORT AGENCY: (0027) Amax Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (0027) Amax Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1								11				
2		10					23					
3	7			18	23							
4			19									
5											3	3
6									9	13		
7								15				
8		5				17	22					
9	22			5	2							
10			11									
11											2	4
12									28	8		
13								15				
14		15				9	13					
15	7			16	7							
16			6									
17											2	2
18									6	17		
19								10				
20		4				10	12					
21	2			12	6							
22			9									
23											11	0
24									25	12		
25								26				
26		4				9	11					
27	3			5	9							
28			30									
29											5	8
30									12	4		
31								25				
NO.:	5	5	5	5	5	4	5	6	5	5	5	5
MAX:	22.	15.	30.	18.	23.	17.	23.	26.	28.	17.	11.	8.
MEAN:	8.2	7.6	15.0	11.2	9.4	11.3	16.2	17.0	16.0	10.8	4.6	3.4

ANNUAL OBSERVATIONS: 60 ANNUAL MEAN: 11.0 ANNUAL MAX: 30.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0802 POC: 11
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: BELLE AYR BA-1
SITE COMMENTS: AMAX COAL CO/BELLE AYR MINE. NORTH SITE KNOWN AS BA-1S & BA-1N. CATEGORY B SITE -
MONITOR COMMENTS: PM10 SAMPLER SITED JANUARY 2001. TSP WAS REL'D TO EAST SITE.

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.1354941084
LONGITUDE: -105.42463614
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 0
PROBE HEIGHT: 4

SUPPORT AGENCY: (0027) Amax Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (0027) Amax Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			7									
2						AV					5	5
3									AG	7		
4								19				
5		8				AV	28					
6	8			15	4							
7			6									
8											6	1
9									16	11		
10								16				
11		4				11	11					
12	6			5	10							
13			8									
14											3	3
15									15	10		
16								40				
17		1				13	10					
18	0			8	5							
19			8									
20											4	2
21									17	8		
22								26				
23		8				13	15					
24	2			8	4							
25			6									
26											7	5
27									18	4		
28								49				
29						21	11					
30	8			12	9							
31			19									
NO.:	5	4	6	5	5	4	5	5	4	5	5	5
MAX:	8.	8.	19.	15.	10.	21.	28.	49.	18.	11.	7.	5.
MEAN:	4.8	5.3	9.0	9.6	6.4	14.5	15.0	30.0	16.5	8.0	5.0	3.2

ANNUAL OBSERVATIONS: 58 ANNUAL MEAN: 10.5 ANNUAL MAX: 49.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0808 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: EAGLE BUTTE EB-3
SITE COMMENTS: AMAX COAL COMPANY EAGLE BUTTE MINE. WEST SITE KNOWN AS EB3S & 3N CATEGORY B SITE -
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.3943923976
LONGITUDE: -105.53035642
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1354
PROBE HEIGHT:

SUPPORT AGENCY: (0027) Amax Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (063) HI-VOL SA/GMW-1200 GRAVIMETRIC
PQAO: (0027) Amax Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			9					21				
2		10				11	27				11	11
3	AH			15	19				25	7		
4			10					29				
5		9				13	44				2	4
6	11			21	6				17	18		
7			5					19				
8		10				21	30				4	5
9	AH			3	1				35	10		
10			10					34				
11		6				15	15				2	11
12	9			4	14				42	9		
13			9					21				
14		20				14	37				7	6
15	2			7	4				26	20		
16			9					35				
17		4				23	21				4	2
18	0			8	8				10	33		
19			4					11				
20		1				16	50				7	3
21	5			15	7				18	18		
22			8					27				
23		8				24	AG				26	0
24	1			18	3				34	14		
25			0					37				
26		5				15	26				13	8
27	4			2	11				23	7		
28			32					77				
29						36	12				7	6
30	17			13	14				29	4		
31			24					37				
NO.:	8	9	11	10	10	10	9	11	10	10	10	10
MAX:	17.	20.	32.	21.	19.	36.	50.	77.	42.	33.	26.	11.
MEAN:	6.1	8.1	10.9	10.6	8.7	18.8	29.1	31.6	25.9	14.0	8.3	5.6

ANNUAL OBSERVATIONS: 118 ANNUAL MEAN: 15.0 ANNUAL MAX: 77.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0808 POC: 2
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: EAGLE BUTTE EB-3
SITE COMMENTS: AMAX COAL COMPANY EAGLE BUTTE MINE. WEST SITE KNOWN AS EB3S & 3N CATEGORY B SITE -
MONITOR COMMENTS: 3S IS THE COLLOCATED

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.3943923976
LONGITUDE: -105.53035642
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1354
PROBE HEIGHT:

SUPPORT AGENCY: (0027) Amax Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (063) HI-VOL SA/GMW-1200 GRAVIMETRIC
PQAO: (0027) Amax Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			10									
2											11	12
3									28	6		
4								37				
5		9				16	48					
6	AH			26	7							
7			6									
8											5	6
9									34	12		
10								51				
11		7				16	17					
12	AH			6	16							
13			12									
14											10	9
15									32	18		
16								37				
17		9				19	32					
18	3			8	10							
19			5									
20											8	4
21									21	20		
22								27				
23		8				29	39					
24	AH			22	4							
25			7									
26											21	9
27									28	7		
28								16				
29						32	16					
30	21			13	17							
31			28									
NO.:	2	4	6	5	5	5	5	5	5	5	5	5
MAX:	21.	9.	28.	26.	17.	32.	48.	51.	34.	20.	21.	12.
MEAN:	12.0	8.3	11.3	15.0	10.8	22.4	30.4	33.6	28.6	12.6	11.0	8.0

ANNUAL OBSERVATIONS: 57 ANNUAL MEAN: 17.3 ANNUAL MAX: 51.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0826 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: RAWHIDE HILLTOP SITE
SITE COMMENTS: POWDER RIVER COAL COMPAMY ASSUMED OWNERSHIP OF THIS MINE/SITE DURING THE LAST HALF
MONITOR COMMENTS: SITE SHUT DOWN AUGUST '99 REACTIVATED 10/01

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.4232180009
LONGITUDE: -105.472501
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1354
PROBE HEIGHT: 4

SUPPORT AGENCY: (0153) Carter Mining Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0153) Carter Mining Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	12	17	14	35	17	27	36	22	28	29	15	34
2	16	19	18	23	23	24	27	27	29	16	11	17
3	23	9	20	18	18	10	26	35	40	8	15	18
4	14	13	24	23	13	9	23	23	39	3	7	16
5	15	18	18	25	12	12	39	23	31	10	15	13
6	7	39	21	23	9	13	28	18	15	12	28	35
7	25	37	21	16	8	22	41	19	29	16	11	14
8	21	16	15	6	7	23	21	16	27	25	12	25
9	22	21	19	10	2	20	23	10	23	14	16	53
10	16	10	16	18	9	17	26	13	20	16	10	10
11	12	9	20	34	15	13	27	19	21	69	22	14
12	7	29	28	13	13	16	34	23	21	28	28	9
13	24	23	16	13	13	14	23	18	33	19	24	7
14	22	19	44	29	10	8	22	35	47	22	12	10
15	14	19	34	18	3	9	14	26	61	19	21	AH
16	17	17	19	10	7	9	11	33	35	27	30	12
17	19	1	5	22	5	13	14	15	12	38	13	14
18	18	11	18	11	6	14	12	10	7	38	P 252 rj	11
19	28	10	16	12	5	17	23	13	11	27	16	15
20	19	10	10	11	5	14	23	48	13	16	4	6
21	16	11	17	14	5	18	22	52	14	13	14	13
22	19	11	13	15	5	10	22	45	21	14	18	8
23	23	19	32	20	5	16	23	12	23	14	14	16
24	17	13	13	16	4	14	23	32	22	10	12	13
25	17	14	8	12	7	9	10	34	26	11	23	AH
26	20	7	8	4	7	12	17	39	29	10	14	AH
27	18	12	13	6	7	16	33	25	32	15	12	13
28	21	16	87	10	8	24	23	60	13	10	12	20
29	16		30	AN	6	25	13	52	16	14	9	17
30	17		24	AN	10	30	15	40	15	12	22	27
31	14		24		11		20	38		11		19
NO.:	31	28	31	28	31	30	31	31	30	31	30	28
MAX:	28.	39.	87.	35.	23.	30.	41.	60.	61.	69.	252.	53.
MEAN:	17.7	16.1	21.5	16.7	8.9	15.9	23.0	28.2	25.1	18.9	23.7	17.1

ANNUAL OBSERVATIONS: 360 ANNUAL MEAN: 19.5 ANNUAL MAX: 252.

1 Values marked with 'P' exceed the PRIMARY STANDARD of: 155
1 Values marked with 'S' exceed the SECONDARY STANDARD of: 155

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0841 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: COAL CREEK CCM 7-1
SITE COMMENTS: THUNDER BASIN COAL/COAL CREEK MINE. NORTH SITE KNOWN AS #7-1. CATEGORY A SITE - N
MONITOR COMMENTS: SITE SHUT DOWN JAN -01

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.9871734737
LONGITUDE: -105.30367857
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 0
PROBE HEIGHT: 4

SUPPORT AGENCY: (1039) Thunder Basin Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (1039) Thunder Basin Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			6									
2											10	5
3									18	9		
4								18				
5		1				10	29					
6	2			16	5							
7			6									
8											6	5
9									19	13		
10								15				
11		2				8	11					
12	2			5	11							
13			9									
14											7	4
15									14	13		
16								36				
17		1				13	10					
18	0			5	6							
19			8									
20											4	4
21									12	11		
22								30				
23		8				13	11					
24	2			7	3							
25			5									
26											3	7
27									19	6		
28								51				
29						19	9					
30	6			11	10							
31			27									
NO.:	5	4	6	5	5	5	5	5	5	5	5	5
MAX:	6.	8.	27.	16.	11.	19.	29.	51.	19.	13.	10.	7.
MEAN:	2.4	3.0	10.2	8.8	7.0	12.6	14.0	30.0	16.4	10.4	6.0	5.0

ANNUAL OBSERVATIONS: 60 ANNUAL MEAN: 10.6 ANNUAL MAX: 51.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0869 POC: 2
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: ROCHELLE RO-1
SITE COMMENTS: POWDER RIVER-NORTH ANTELOPE/ROCHELLE. KNOWN AS ROCHELLE RO - 1. CATEGORY A SITE -
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.5310653518
LONGITUDE: -105.22089313
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1478
PROBE HEIGHT: 4

SUPPORT AGENCY: (0882) Powder River Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0882) Powder River Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	54	47	28	64	18	12	40	45	50	36	41	16
2	14	28	13	36	35	28	22	70	34	13	24	24
3	51	19	48	44	42	13	24	41	56	10	19	13
4	35	20	40	83	12	9	23	18	50	6	12	19
5	21	25	57	60	10	9	48	18	27	10	23	27
6	20	73	47	36	11	23	46	42	45	16	19	61
7	17	130	43	18	29	23	43	58	34	57	18	77
8	40	33	32	8	8	22	24	32	65	29	42	21
9	48	33	55	8	3	32	14	22	82	22	28	73
10	23	21	37	30	7	18	43	12	16	45	20	10
11	26	11	43	42	10	12	45	15	20	95	22	21
12	6	29	58	28	13	10	90	27	52	41	28	5
13	16	41	25	19	18	17	86	45	48	42	64	7
14	22	21	57	22	18	15	36	23	74	37	48	7
15	40	13	68	26	3	8	24	36	47	40	21	63
16	76	13	43	16	21	12	18	56	41	18	AH	24
17	34	16	7	23	21	17	23	15	20	37	AH	30
18	58	22	34	7	9	14	21	16	16	71	AH	29
19	21	27	20	19	5	32	39	11	20	58	12	26
20	16	21	30	36	3	20	44	41	82	34	29	11
21	26	13	42	26	5	25	15	71	36	18	38	24
22	47	26	40	8	5	22	18	72	25	7	42	31
23	33	37	23	25	5	22	32	28	17	19	17	37
24	31	31	34	18	4	28	44	28	22	16	69	28
25	11	46	18	20	10	11	37	30	11	12	61	58
26	24	13	28	5	9	18	30	44	26	6	57	31
27	57	7	51	6	7	17	56	48	44	9	26	17
28	26	48	P 190 rj	6	14	15	31	70	26	20	8	33
29	13		50	10	9	26	48	36	10	9	16	50
30	37		49	33	8	51	39	60	15	26	19	93
31	35		31		21		52	46		40		29
NO.:	31	28	31	30	31	30	31	31	30	31	27	31
MAX:	76.	130.	190.	83.	42.	51.	90.	72.	82.	95.	69.	93.
MEAN:	31.5	30.9	43.3	26.1	12.7	19.4	37.3	37.9	37.0	29.0	30.5	32.1

ANNUAL OBSERVATIONS: 362 ANNUAL MEAN: 30.7 ANNUAL MAX: 190.

1 Values marked with 'P' exceed the PRIMARY STANDARD of: 155
1 Values marked with 'S' exceed the SECONDARY STANDARD of: 155

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0875 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: JACOBS RANCH SITE 3
SITE COMMENTS: KERR-MCGEE COAL CO/JACCBS RANCH MINE. SITE #3. CATEGORY A SITE - MAXIMUM CONCENTI
MONITOR COMMENTS: PM10 SAMPLER INSTALLED AT FORMER TSP SITE.

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.7021755098
LONGITUDE: -105.19922717
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 0
PROBE HEIGHT: 4

SUPPORT AGENCY: (0576) Kerr - McGee
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (126) R - P Co Partisol Model 2000 Gravi
PQAO: (0576) Kerr - McGee

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			25					19				
2		17				16	22				8	9
3	57			34	22				34	9		
4			15					25				
5		17				9	41				7	8
6	10			28	6				17	18		
7			33					22				
8		28				35	17				15	13
9	23			4	1				27	17		
10			31					12				
11		8				9	18				9	3
12	4			7	7				22	13		
13			14					21				
14		17				8	17				14	3
15	24			14	2				28	8		
16			22					46				
17		12				16	11				12	22
18	28			6	5				8	40		
19			10					7				
20		12				18	29				5	4
21	29			23	2				17	11		
22			7					27				
23		45				19	23				8	27
24	22			9	1				14	13		
25			5					27				
26		4				14	16				9	AN
27	45			3	6				31	8		
28			75					61				
29						18	23				17	AV
30	18			17	6				10	11		
31			26					35				
NO.:	10	9	11	10	10	10	10	11	10	10	10	8
MAX:	57.	45.	75.	34.	22.	35.	41.	61.	34.	40.	17.	27.
MEAN:	26.0	17.8	23.9	14.5	5.8	16.2	21.7	27.5	20.8	14.8	10.4	11.1

ANNUAL OBSERVATIONS: 119 ANNUAL MEAN: 17.8 ANNUAL MAX: 75.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0884 POC: 4
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: TRITON COAL BUCKSKIN MINE GILLETTE, WY
SITE COMMENTS: TRITON COAL COMPANY/BUCKSKIN MINE. WEST SITE KNOWN AS SITE C, E&F. CATEGORY B SITE
MONITOR COMMENTS: R&P TEOM SAMPLER

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.4506020009
LONGITUDE: -105.573331
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1329
PROBE HEIGHT: 4

SUPPORT AGENCY: (1056) Triton Coal
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (1056) Triton Coal

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	2	10	10	12	16	13	36	15	32	39	11	8
2	4	23	16	8	17	12	24	52	13	20	17	6
3	10	7	11	8	22	14	30	52	20	8	13	6
4	5	8	9	12	13	10	32	25	35	4	6	9
5	5	8	6	17	13	13	38	15	18	11	AH	6
6	4	6	9	24	7	10	33	13	13	15	AH	6
7	5	14	7	19	8	15	38	14	11	9	7	6
8	7	8	7	6	17	11	21	18	12	11	7	5
9	10	14	8	5	2	17	34	10	19	7	10	17
10	5	5	9	13	6	19	20	26	29	6	6	11
11	5	7	11	17	11	15	13	34	19	46	AH	7
12	4	10	9	7	15	16	22	26	20	8	8	11
13	4	7	9	15	13	18	15	17	26	12	9	13
14	3	18	10	32	12	10	25	35	34	13	7	12
15	3	7	8	8	5	11	14	26	23	16	17	9
16	3	11	10	10	7	8	14	36	21	42	AH	10
17	3	5	12	13	4	13	13	18	12	59	AH	3
18	4	4	11	8	8	19	9	12	6	20	AH	12
19	3	6	5	6	8	22	12	7	10	12	9	4
20	3	4	9	8	5	12	20	46	9	7	7	4
21	3	8	13	20	8	28	19	58	21	15	4	5
22	3	5	8	37	8	11	19	29	28	16	6	4
23	2	6	24	18	8	25	16	9	29	6	20	3
24	3	4	5	14	4	16	23	38	25	12	13	4
25	3	7	6	8	7	12	15	45	33	27	17	11
26	3	8	6	4	10	11	28	40	21	13	8	8
27	5	18	8	5	8	17	35	18	25	5	7	17
28	6	7	65	10	5	24	6	67	15	4	9	18
29	10		7	12	8	22	8	49	19	10	4	7
30	9		9	11	15	27	12	27	12	4	5	9
31	11		13		11		30	43		5		12
NO.:	31	28	31	30	31	30	31	31	30	31	24	31
MAX:	11.	23.	65.	37.	22.	28.	38.	67.	35.	59.	20.	18.
MEAN:	4.8	8.8	11.3	12.9	9.7	15.7	21.7	29.7	20.3	15.5	9.5	8.5

ANNUAL OBSERVATIONS: 359 ANNUAL MEAN: 14.2 ANNUAL MAX: 67.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0885 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Cordero CRC-E10A
SITE COMMENTS: CORDERO MINING/CORDERO MINE. EAST SITE KNOWN AS BFM-2 & 2A. CATEGORY A SITE - MA
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.0322060009
LONGITUDE: -105.321225
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 0
PROBE HEIGHT: 4

SUPPORT AGENCY: (0261) Cordero Mining Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (126) R - P Co Partisol Model 2000 Gravi
PQAO: (0261) Cordero Mining Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			15					35				
2		19				12	25				7	12
3	26			20	17				46	7		
4			15					28				
5		11				8	42				4	8
6	10			26	6				14	15		
7			17					19				
8		19				21	26				11	11
9	31			7	0				47	25		
10			20					30				
11		10				8	50				8	12
12	7			21	11				31	24		
13			13					26				
14		18				7	18				15	8
15	25			10	3				55	26		
16			25					44				
17		22				19	12				12	13
18	18			10	6				4	40		
19			18					6				
20		6				17	15				16	8
21	20			16	2				47	9		
22			14					35				
23		24				17	26				13	10
24	16			14	2				22	14		
25			11					29				
26		4				14	14				10	19
27	23			4	7				27	6		
28			88					78				
29						30	27				10	21
30	35			26	8				9	12		
31			59					31				
NO.:	10	9	11	10	10	10	10	11	10	10	10	10
MAX:	35.	24.	88.	26.	17.	30.	50.	78.	55.	40.	16.	21.
MEAN:	21.1	14.8	26.8	15.4	6.2	15.3	25.5	32.8	30.2	17.8	10.6	12.2

ANNUAL OBSERVATIONS: 121 ANNUAL MEAN: 19.3 ANNUAL MAX: 88.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0885 POC: 2
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Cordero CRC-E10A
SITE COMMENTS: CORDERO MINING/CORDERO MINE. EAST SITE KNOWN AS BFM-2 & 2A. CATEGORY A SITE - MA
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.0322060009
LONGITUDE: -105.321225
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 0
PROBE HEIGHT:

SUPPORT AGENCY: (0261) Cordero Mining Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (126) R - P Co Partisol Model 2000 Gravi
PQAO: (0261) Cordero Mining Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			13									
2											8	15
3									47	7		
4								AI				
5		11				8	42					
6	12			26	6							
7			17									
8											12	11
9									49	24		
10								AI				
11		11				9	42					
12	5			25	AN							
13			17									
14											11	7
15									54	24		
16								43				
17		8				20	13					
18	18			9	AN							
19			16									
20											9	9
21									44	10		
22								37				
23		21				18	21					
24	16			14	4							
25			10									
26											17	20
27									25	6		
28								78				
29						26	AI					
30	33			27	AV							
31			61									
NO.:	5	4	6	5	2	5	4	3	5	5	5	5
MAX:	33.	21.	61.	27.	6.	26.	42.	78.	54.	24.	17.	20.
MEAN:	16.8	12.8	22.3	20.2	5.0	16.2	29.5	52.7	43.8	14.2	11.4	12.4

ANNUAL OBSERVATIONS: 54 ANNUAL MEAN: 21.2 ANNUAL MAX: 78.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0886 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: CABALLO C-8A/B
SITE COMMENTS: POWDER RIVER COAL COMPANY ASSUMED OWNERSHIP OF THIS MINE/SITE DURING THE LAST HALF
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.1129490009
LONGITUDE: -105.310915
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1418
PROBE HEIGHT:

SUPPORT AGENCY: (0153) Carter Mining Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0882) Powder River Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	17	12	18	26	16	18	32	27	27	22	10	15
2	13	17	16	16	22	12	25	37	23	15	9	14
3	16	8	25	15	20	9	30	20	39	7	14	11
4	22	11	21	46	11	7	21	22	46	4	7	10
5	14	16	30	29	9	9	36	19	24	9	7	15
6	10	20	27	21	8	17	30	18	14	AN	15	19
7	15	54	17	13	9	31	38	19	22	17	12	10
8	22	17	20	6	6	19	20	17	18	13	11	11
9	31	18	26	10	3	19	16	14	36	14	12	29
10	31	13	26	23	7	17	21	22	17	11	10	7
11	15	7	29	25	10	10	24	14	23	60	11	11
12	6	14	23	13	13	15	32	19	31	23	16	7
13	17	15	12	16	18	15	25	25	39	26	17	7
14	16	13	24	20	12	9	19	33	55	19	13	7
15	12	12	17	14	3	8	15	22	43	15	19	19
16	9	19	26	9	9	11	13	42	26	17	28	13
17	19	21	6	13	6	18	10	13	10	37	18	16
18	15	11	15	10	7	13	12	10	9	36	80	10
19	19	14	13	10	5	19	23	8	14	29	10	10
20	14	10	17	11	3	13	18	41	25	15	8	7
21	13	13	16	18	4	18	15	47	32	9	12	10
22	21	9	12	11	5	12	21	42	21	9	23	8
23	18	21	18	18	5	18	23	18	18	12	14	14
24	16	12	6	11	4	18	22	33	21	11	14	10
25	9	14	9	10	7	9	18	34	12	10	27	18
26	18	7	12	4	8	13	19	36	27	8	21	17
27	14	7	18	6	8	15	34	26	31	7	9	9
28	24	9	77	9	8	17	14	57	16	7	14	21
29	10		23	10	8	25	17	53	9	12	7	14
30	20		25	18	9	38	21	41	9	11	11	16
31	16		45		10		24	AI		11		18
NO.:	31	28	31	30	31	30	31	30	30	30	30	31
MAX:	31.	54.	77.	46.	22.	38.	38.	57.	55.	60.	80.	29.
MEAN:	16.5	14.8	21.6	15.4	8.8	15.7	22.2	27.6	24.6	16.5	16.0	13.0

ANNUAL OBSERVATIONS: 363 ANNUAL MEAN: 17.7 ANNUAL MAX: 80.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0891 POC: 2
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: BTM-36-2 (BLACK THUNDER MINE)
SITE COMMENTS: THUNDER BASIN COAL CO/BLACK THUNDER MINE. SITE KNOWN AS #36-1. CATEGORY SITE
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.6483000009
LONGITUDE: -105.2133
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 0
PROBE HEIGHT:

SUPPORT AGENCY: (1039) Thunder Basin Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (1039) Thunder Basin Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	37	23	44	46	29	18	AS	34	AI	36	20	27
2	22	56	23	25	39	17	AS	53	AI	16	22	14
3	46	13	48	49	33	11	AS	26	49	9	33	23
4	47	18	48	59	11	9	AS	29	58	4	10	27
5	17	16	18	49	7	9	AS	30	45	10	11	17
6	12	53	33	48	8	15	AS	19	44	24	28	26
7	16	64	29	60	9	19	AS	44	34	20	29	17
8	38	51	37	7	19	36	AS	34	62	20	27	18
9	46	35	38	14	3	34	AS	18	100	19	38	37
10	25	21	45	34	8	18	AS	18	15	24	19	9
11	26	11	33	47	11	11	AS	15	20	63	20	9
12	8	34	35	20	11	12	AS	29	34	55	26	6
13	27	35	31	32	25	15	AS	25	66	47	20	11
14	34	27	52	31	19	10	AS	35	AN	42	21	6
15	45	13	22	20	3	8	AS	AV	43	33	39	AH
16	17	21	37	8	10	16	AS	AV	33	19	37	22
17	20	27	7	22	7	19	AS	AV	19	38	16	12
18	13	16	23	8	7	15	AS	AV	17	68	82	12
19	29	18	35	9	5	23	AS	8	19	61	13	16
20	24	17	22	18	3	19	AS	42	78	18	9	8
21	26	9	49	25	5	24	AS	67	28	15	28	16
22	16	14	22	12	5	12	AS	48	22	7	18	15
23	38	62	24	20	5	19	AS	35	18	20	40	30
24	20	18	18	13	4	32	AS	30	29	15	32	14
25	7	47	18	10	7	9	AS	38	13	11	AH	AH
26	18	11	23	4	10	14	AS	51	50	7	AH	AH
27	21	8	44	5	8	20	AS	36	52	13	19	14
28	25	23	143	11	13	16	AS	78	19	21	13	24
29	19		67	10	8	AS	46	68	AV	18	16	35
30	26		50	27	8	AS	70	67	18	25	13	45
31	29		70		13		26	AI		22		20
NO.:	31	28	31	30	31	28	3	26	26	31	28	28
MAX:	47.	64.	143.	60.	39.	36.	70.	73.	100.	68.	82.	45.
MEAN:	25.6	27.2	38.3	24.8	11.4	17.1	47.3	37.6	37.9	25.8	25.0	18.9

ANNUAL OBSERVATIONS: 321 ANNUAL MEAN: 26.3 ANNUAL MAX: 143.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0892 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: BELLE AYR BA-4,5N,5S
SITE COMMENTS: AMAX BELLE AYR MINE. SOUTH WEST SITE KNOWN AS BA-4. CATEGORY A SITE - MAXIMUM CONC
MONITOR COMMENTS: WEDDING COLL'D PM10'S WERE DIS'S 1-1-01, REPLACED WITH COLL'D TSP SAMPLERS EFFECTIVE 1-7-01.

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.0970740009
LONGITUDE: -105.343164
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1366
PROBE HEIGHT:

SUPPORT AGENCY: () Not Found
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (0027) Amax Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1								20				
2		22				18	26					
3	14			19	19							
4			17									
5											4	9
6									12	11		
7								19				
8		21				10	22					
9	24			6	3							
10			27									
11											6	9
12									40	20		
13								24				
14		25				9	15					
15	22			10	5							
16			22									
17											14	9
18									15	31		
19								8				
20		7				12	21					
21	6			13	4							
22			11									
23											23	7
24									20	10		
25								27				
26		4				14	19					
27	7			5	6							
28			41									
29											9	9
30									18	6		
31								29				
NO.:	5	5	5	5	5	5	5	6	5	5	5	5
MAX:	24.	25.	41.	19.	19.	18.	26.	29.	40.	31.	23.	9.
MEAN:	14.6	15.8	23.6	10.6	7.4	12.6	20.6	21.2	21.0	15.6	11.2	8.6

ANNUAL OBSERVATIONS: 61 ANNUAL MEAN: 15.3 ANNUAL MAX: 41.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
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Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0892 POC: 11
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: BELLE AYR BA-4,5N,5S
SITE COMMENTS: AMAX BELLE AYR MINE. SOUTH WEST SITE KNOWN AS BA-4. CATEGORY A SITE - MAXIMUM CONC
MONITOR COMMENTS: WEDDING COLL'D PM10'S WERE DIS'S 1-1-01, REPLACED WITH COLL'D TSP SAMPLERS EFFECTIVE 1-7-01.

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.0970740009
LONGITUDE: -105.343164
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1366
PROBE HEIGHT:

SUPPORT AGENCY: () Not Found
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (0027) Amax Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			14									
2											6	9
3									AG	7		
4								24				
5		13				9	29					
6	6			15	4							
7			12									
8											8	7
9									AG	12		
10								21				
11		5				9	13					
12	6			9	12							
13			14									
14											13	3
15									15	17		
16								37				
17		3				17	10					
18	4			8	5							
19			9									
20											4	3
21									19	14		
22								29				
23		16				24	18					
24	5			AG	4							
25			7									
26											4	7
27									27	5		
28								66				
29						27	14					
30	19			13	6							
31			35									
NO.:	5	4	6	4	5	5	5	5	3	5	5	5
MAX:	19.	16.	35.	15.	12.	27.	29.	66.	27.	17.	13.	9.
MEAN:	8.0	9.3	15.2	11.3	6.2	17.2	16.8	35.4	20.3	11.0	7.0	5.8

ANNUAL OBSERVATIONS: 57 ANNUAL MEAN: 13.5 ANNUAL MAX: 66.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0892 POC: 2
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: BELLE AYR BA-4,5N,5S
SITE COMMENTS: AMAX BELLE AYR MINE. SCUTH WEST SITE KNOWN AS BA-4. CATEGORY A SITE - MAXIMUM CONC
MONITOR COMMENTS: DESIGNATED COLLOCATED PM10 SAMPLER - WEDDING

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.0970740009
LONGITUDE: -105.343164
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1366
PROBE HEIGHT:

SUPPORT AGENCY: () Not Found
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (0027) Amax Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			14									
2											6	9
3									47	6		
4								24				
5		13				8	31					
6	7			14	5							
7			12									
8											8	7
9									35	12		
10								22				
11		AN				10	13					
12	6			9	11							
13			14									
14											13	3
15									15	16		
16								37				
17		3				16	11					
18	5			8	5							
19			10									
20											4	3
21									27	15		
22								28				
23		17				17	18					
24	4			8	3							
25			6									
26											4	7
27									25	5		
28								66				
29						26	16					
30	19			12	7							
31			AN									
NO.:	5	3	5	5	5	5	5	5	5	5	5	5
MAX:	19.	17.	14.	14.	11.	26.	31.	66.	47.	16.	13.	9.
MEAN:	8.2	11.0	11.2	10.2	6.2	15.4	17.8	35.4	29.8	10.8	7.0	5.8

ANNUAL OBSERVATIONS: 58 ANNUAL MEAN: 14.2 ANNUAL MAX: 66.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0893 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: BELLE AYR BA-3
SITE COMMENTS: AMAX BELLE AYR SITE BA-3. WEST SITE. CATEGORY B SITE - BACKGROUND/AMBIENT AIR ORIE
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.0701530009
LONGITUDE: -105.469895
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1425
PROBE HEIGHT:

SUPPORT AGENCY: (0027) Amax Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (0027) Amax Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1								12				
2		8					25					
3	3			4	15							
4			3									
5											1	0
6									11	11		
7								11				
8		2				8	AG					
9	9			3	2							
10			7									
11											2	2
12									15	5		
13								16				
14		7				14	15					
15	4			6	3							
16			6									
17											2	0
18									7	12		
19								8				
20		1				17	10					
21	1			9	4							
22			6									
23											4	0
24									13	9		
25								26				
26		4				9	15					
27	1			3	6							
28			22									
29											3	3
30									9	4		
31								24				
NO.:	5	5	5	5	5	4	4	6	5	5	5	5
MAX:	9.	8.	22.	9.	15.	17.	25.	26.	15.	12.	4.	3.
MEAN:	3.6	4.4	8.8	5.0	6.0	12.0	16.3	16.2	11.0	8.2	2.4	1.0

ANNUAL OBSERVATIONS: 59 ANNUAL MEAN: 7.8 ANNUAL MAX: 26.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0893 POC: 11
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: BELLE AYR BA-3
SITE COMMENTS: AMAX BELLE AYR SITE BA-3. WEST SITE. CATEGORY B SITE - BACKGROUND/AMBIENT AIR ORIE
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.0701530009
LONGITUDE: -105.469895
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1425
PROBE HEIGHT:

SUPPORT AGENCY: (0027) Amax Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (0027) Amax Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

MONTH

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			5									
2						8					9	1
3									12	7		
4								14				
5		8				8	31					
6	7			12	4							
7			5									
8											3	0
9									21	7		
10								14				
11		5				10	9					
12	4			4	9							
13			6									
14											3	2
15									14	12		
16								48				
17		1				10	12					
18	1			6	7							
19			4									
20											2	1
21									14	13		
22								25				
23		3				15	10					
24	1			8	3							
25			3									
26											2	4
27									17	16		
28								52				
29						17	13					
30	7			9	AJ							
31			10									
NO.:	5	4	6	5	4	6	5	5	5	5	5	5
MAX:	7.	8.	10.	12.	9.	17.	31.	52.	21.	16.	9.	4.
MEAN:	4.0	4.3	5.5	7.8	5.8	11.3	15.0	30.6	15.6	11.0	3.8	1.6

ANNUAL OBSERVATIONS: 60 ANNUAL MEAN: 9.8 ANNUAL MAX: 52.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
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Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0895 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: RAWHIDE NORTH SITE
SITE COMMENTS: POWDER RIVER COAL COMPANY ASSUMED OPERATION OF THIS MINE DURING THE LAST HALF OF 1
MONITOR COMMENTS: SITE SHUT DOWN AUGUST '99

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.4000940009
LONGITUDE: -105.451218
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 0
PROBE HEIGHT:

SUPPORT AGENCY: (0153) Carter Mining Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0153) Carter Mining Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	18	14	15	18	20	26	35	28	30	33	17	9
2	15	13	20	13	37	12	25	33	AN	21	11	21
3	24	14	17	22	22	11	31	47	41	13	17	28
4	12	13	20	26	15	10	27	30	39	6	8	20
5	18	20	21	22	16	12	39	29	39	14	8	13
6	8	44	22	23	9	12	31	16	11	19	17	34
7	25	43	18	17	7	19	45	20	14	18	14	19
8	13	20	23	6	8	24	23	17	31	21	18	22
9	20	24	19	12	3	28	28	10	28	32	25	70
10	23	10	17	18	7	19	33	23	28	27	8	9
11	12	9	31	43	11	13	39	22	27	55	12	14
12	9	11	21	11	14	17	58	29	30	23	22	14
13	21	12	18	15	13	15	28	21	39	22	26	15
14	14	21	72	37	12	8	26	38	52	32	20	8
15	15	11	34	14	4	9	16	27	69	23	23	AN
16	26	8	20	9	8	9	13	34	53	31	26	9
17	21	4	8	25	4	13	14	17	12	50	16	9
18	17	13	14	15	7	15	11	11	8	45	133	16
19	19	9	10	7	6	16	22	8	15	39	12	12
20	8	10	10	AV	7	12	33	53	19	21	6	7
21	11	13	20	AV	6	20	24	56	17	18	15	14
22	21	10	11	17	6	9	26	29	27	17	27	7
23	18	21	27	20	6	29	34	17	28	17	22	6
24	18	13	7	15	4	20	24	39	32	13	13	14
25	22	12	8	10	7	15	12	36	33	14	16	11
26	18	5	8	4	9	17	19	38	35	13	12	14
27	22	16	10	5	10	22	25	26	27	11	19	19
28	13	10	77	12	8	28	20	66	12	7	17	18
29	20		14	14	8	26	15	61	25	19	8	12
30	30		20	19	12	32	19	44	20	15	12	14
31	19		29		12		26	42		13		13
NO.:	31	28	31	28	31	30	31	31	29	31	30	30
MAX:	30.	44.	77.	43.	37.	32.	58.	66.	69.	55.	133.	70.
MEAN:	17.7	15.1	21.3	16.8	10.3	17.3	26.5	31.2	29.0	22.6	20.0	16.4

ANNUAL OBSERVATIONS: 361 ANNUAL MEAN: 20.4 ANNUAL MAX: 133.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0897 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Dry Fork Mine Site 4
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.3155000009
LONGITUDE: -105.4386
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1394
PROBE HEIGHT:

SUPPORT AGENCY: (0315) Dry Fork Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (0315) Dry Fork Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

MONTH

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			7									
2											5	6
3									16	8		
4								14				
5		6				8	31					
6	3			12	4							
7			7									
8											5	AV
9									12	AV		
10								13				
11		4				11	12					
12	4			4	8							
13			7									
14											7	2
15									20	10		
16								30				
17		1				12	11					
18	2			4	5							
19			4									
20											4	AV
21									10	9		
22								26				
23		2				13	14					
24	1			6	2							
25			4									
26											6	6
27									17	5		
28								54				
29						15	7					
30	7			7	7							
31			12									
NO.:	5	4	6	5	5	5	5	5	5	4	5	3
MAX:	7.	6.	12.	12.	8.	15.	31.	54.	20.	10.	7.	6.
MEAN:	3.4	3.3	6.8	6.6	5.2	11.8	15.0	27.4	15.0	8.0	5.4	4.7

ANNUAL OBSERVATIONS: 57 ANNUAL MEAN: 9.6 ANNUAL MAX: 54.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0897 POC: 11
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Dry Fork Mine Site 4
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.3155000009
LONGITUDE: -105.4386
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1394
PROBE HEIGHT:

SUPPORT AGENCY: (0315) Dry Fork Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (0315) Dry Fork Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1								19				
2		6				9	23					
3	4			5	12							
4			9									
5											5	3
6									9	10		
7								13				
8		6				9	19					
9	14			3	1							
10			8									
11											6	4
12									17	12		
13								17				
14		7				AN	13					
15	4			3	3							
16			7									
17											3	2
18									7	20		
19								7				
20		2				10	12					
21	5			6	3							
22			7									
23											AV	3
24									16	9		
25								23				
26		0				11	11					
27	4			3	5							
28			26									
29											AG	7
30									10	6		
31								27				
NO.:	5	5	5	5	5	4	5	6	5	5	3	5
MAX:	14.	7.	26.	6.	12.	11.	23.	27.	17.	20.	6.	7.
MEAN:	6.2	4.2	11.4	4.0	4.8	9.8	15.6	17.7	11.8	11.4	4.7	3.8

ANNUAL OBSERVATIONS: 58 ANNUAL MEAN: 9.1 ANNUAL MAX: 27.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0897 POC: 2
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Dry Fork Mine Site 4
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.3155000009
LONGITUDE: -105.4386
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1394
PROBE HEIGHT:

SUPPORT AGENCY: (0315) Dry Fork Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (0315) Dry Fork Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			6									
2											5	5
3									15	7		
4								14				
5		6				7	29					
6	AV			13	4							
7			4									
8											6	2
9									12	11		
10								12				
11		4				11	11					
12	7			AG	7							
13			7									
14											6	0
15									14	10		
16								29				
17		1				10	11					
18	2			4	4							
19			4									
20											4	2
21									11	9		
22								25				
23		5				12	13					
24	1			6	2							
25			5									
26											7	6
27									17	5		
28								53				
29						15	6					
30	6			8	6							
31			12									
NO.:	4	4	6	4	5	5	5	5	5	5	5	5
MAX:	7.	6.	12.	13.	7.	15.	29.	53.	17.	11.	7.	6.
MEAN:	4.0	4.0	6.3	7.8	4.6	11.0	14.0	26.6	13.8	8.4	5.6	3.0

ANNUAL OBSERVATIONS: 58 ANNUAL MEAN: 9.2 ANNUAL MAX: 53.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0898 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Belle Ayr Ranch House 805' E HWY 59
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.1412130009
LONGITUDE: -105.459803
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1400
PROBE HEIGHT: 2.33

SUPPORT AGENCY: (0027) Amax Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (0027) Amax Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1								14				
2		7				9	20					
3	6			12	14							
4			5									
5											2	2
6									9	12		
7								12				
8		3				8	21					
9	21			4	4							
10			7									
11											2	4
12									18	6		
13								16				
14		10				8	11					
15	6			5	4							
16			5									
17											3	0
18									8	16		
19								10				
20		8				10	20					
21	3			9	5							
22			7									
23											14	0
24									23	10		
25								28				
26		3				11	15					
27	3			3	8							
28			39									
29											AG	12
30									10	4		
31								25				
NO.:	5	5	5	5	5	5	5	6	5	5	4	5
MAX:	21.	10.	39.	12.	14.	11.	21.	28.	23.	16.	14.	12.
MEAN:	7.8	6.2	12.6	6.6	7.0	9.2	17.4	17.5	13.6	9.6	5.3	3.6

ANNUAL OBSERVATIONS: 60 ANNUAL MEAN: 9.9 ANNUAL MAX: 39.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0898 POC: 11
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Belle Ayr Ranch House 805' E HWY 59
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.1412130009
LONGITUDE: -105.459803
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1400
PROBE HEIGHT: 2.33

SUPPORT AGENCY: (0027) Amax Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (0027) Amax Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			7									
2											4	5
3									12	7		
4								18				
5		8				9	28					
6	6			13	4							
7			5									
8											AV	0
9									12	10		
10								12				
11		4				10	10					
12	6			5	AV							
13			6									
14											4	3
15									13	8		
16								34				
17		1				12	10					
18	1			6	5							
19			4									
20											AV	2
21									12	11		
22								24				
23		6				13	14					
24	1			8	4							
25			5									
26											4	5
27									15	4		
28								49				
29						17	14					
30	6			10	9							
31			12									
NO.:	5	4	6	5	4	5	5	5	5	5	3	5
MAX:	6.	8.	12.	13.	9.	17.	28.	49.	15.	11.	4.	5.
MEAN:	4.0	4.8	6.5	8.4	5.5	12.2	15.2	27.4	12.8	8.0	4.0	3.0

ANNUAL OBSERVATIONS: 57 ANNUAL MEAN: 9.6 ANNUAL MAX: 49.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-0908 POC: 2
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: CABALLO C-9
SITE COMMENTS: REPLACEMENT SITE FOR 56-005-0878.
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.1523750009
LONGITUDE: -105.323752
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 0
PROBE HEIGHT:

SUPPORT AGENCY: (0882) Powder River Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0882) Powder River Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	21	17	14	21	18	17	30	27	25	21	17	9
2	15	18	13	13	22	10	27	35	27	14	8	14
3	10	8	20	14	21	9	29	22	41	7	15	11
4	13	10	19	35	10	8	21	29	43	4	6	11
5	11	16	32	28	9	9	35	21	28	9	6	13
6	9	17	20	22	8	19	30	18	12	AV	9	20
7	15	57	16	13	8	16	38	22	20	15	11	14
8	12	16	16	6	7	22	19	16	16	14	12	11
9	17	17	21	8	2	22	16	13	33	17	13	36
10	30	10	21	21	7	17	35	19	19	13	10	7
11	12	7	27	34	10	10	43	14	22	56	11	9
12	6	12	19	10	13	15	31	18	33	26	14	7
13	15	20	10	12	15	15	26	21	38	23	19	7
14	13	12	31	19	12	9	19	30	55	21	15	8
15	18	10	29	12	4	8	14	20	41	14	20	10
16	13	13	18	9	9	10	15	39	27	16	30	8
17	16	13	5	12	5	16	11	13	10	31	11	8
18	16	8	13	10	7	11	11	9	8	35	67	10
19	11	14	8	7	5	20	26	8	12	27	11	11
20	5	9	16	12	4	13	19	44	24	13	5	7
21	11	10	15	18	4	16	16	44	24	8	17	9
22	24	8	10	12	5	10	22	32	19	9	27	9
23	13	20	15	15	5	17	27	15	19	11	12	12
24	8	12	4	11	4	17	18	36	20	11	19	18
25	13	10	8	9	7	9	17	31	14	11	21	16
26	12	7	10	4	8	12	22	35	29	7	19	14
27	19	7	14	6	9	16	34	24	29	6	10	10
28	14	9	72	9	8	17	13	57	15	7	13	13
29	11		16	11	8	23	16	51	10	13	8	10
30	16		20	17	10	41	16	45	9	21	8	17
31	19		38		11		22	35		15		12
NO.:	31	28	31	30	31	30	31	31	30	30	30	31
MAX:	30.	57.	72.	35.	22.	41.	43.	57.	55.	56.	67.	36.
MEAN:	14.1	13.8	19.0	14.3	8.9	15.1	23.2	27.2	24.1	16.5	15.5	12.0

ANNUAL OBSERVATIONS: 364 ANNUAL MEAN: 17.0 ANNUAL MAX: 72.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-1002 POC: 5
COUNTY: (005) Campbell
CITY: (31855) Gillette
SITE ADDRESS: Gillette - 1000 West 8th
SITE COMMENTS: SUBURBAN MOBILE ACTIVE 8/78 BUBBLER DISCONTINUED 1/84 SPM STATION AT SCHOOL DIS
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: MOBILE
LOCATION SETTING: SUBURBAN

CAS NUMBER:
LATITUDE: 44.2880049190
LONGITUDE: -105.51702183
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1382
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE:SLAMS
COLLECTION AND ANALYSIS METHOD: (126) R - P Co Partisol Model 2000 Gravi
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			13 X									
2											8 X	7 X
3									14 X	4		
4								24 X				
5		7 X				16	39					
6	4 X			29 X	7							
7			13									
8											3	5
9									9 X	4		
10								18 X				
11		12				13	15					
12	AG			7	18							
13			23 X									
14											4	6
15									11	7 X		
16								1				
17		3				18 X	18 X					
18	3			11 X	9 X							
19			8									
20											0	3
21									6 X	12 X		
22								AH				
23		10 X				24 X	20					
24	3			15 X	2							
25			8									
26											2 X	7
27									10	3 X		
28								33				
29						24 X	9 X					
30	0			17	15							
31			14									
NO.:	4	4	6	5	5	5	5	4	5	5	5	5
MAX:	4.	12.	23.	29.	18.	24.	39.	33.	14.	12.	8.	7.
MEAN:	2.5	8.0	13.2	15.8	10.2	19.0	20.2	19.0	10.0	6.0	3.4	5.6

ANNUAL OBSERVATIONS: 58 ANNUAL MEAN: 11.2 ANNUAL MAX: 39.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-1003 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Cordero Rojo CRM-W11 Hilight Road
SITE COMMENTS: Site change - This site was originally CR-W10 and was relocated on 20110610
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.0184220009
LONGITUDE: -105.404804
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1471.208
PROBE HEIGHT:

SUPPORT AGENCY: (0261) Cordero Mining Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (126) R - P Co Partisol Model 2000 Gravi
PQAO: (0882) Powder River Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			10					21				
2		16				10	30				11	2
3	17			5	21				12	8		
4			7					18				
5		4				12	48				3	4
6	10			26	6				15	15		
7			8					15				
8		5				9	24				3	3
9	22			3	0				17	11		
10			7					23				
11		8				11	18				4	8
12	5			4	12				25	5		
13			13					18				
14		12				9	21				3	8
15	4			11	4				18	13		
16			13					44				
17		7				15	15				3	3
18	11			9	8				AF	17		
19			8					7				
20		2				13	18				6	3
21	3			17	7				14	20		
22			12					26				
23		3				25	19				9	2
24	4			15	2				20	8		
25			8					26				
26		19				12	20				4	10
27	5			2	10				26	4		
28			35					51				
29						28	11				4	6
30	14			13	12				15	3		
31			16					35				
NO.:	10	9	11	10	10	10	10	11	9	10	10	10
MAX:	22.	19.	35.	26.	21.	28.	48.	51.	26.	20.	11.	10.
MEAN:	9.5	8.4	12.5	10.5	8.2	14.4	22.4	25.8	18.0	10.4	5.0	4.9

ANNUAL OBSERVATIONS: 120 ANNUAL MEAN: 12.6 ANNUAL MAX: 51.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-1009 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Cordero Rojo CRM-S11
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.9570550009
LONGITUDE: -105.348153
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1436
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (126) R - P Co Partisol Model 2000 Gravi
PQAO: (0261) Cordero Mining Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			9					19				
2		14				11	25				10	3
3	36			7	21				17	7		
4			8					16				
5		5				9	44				3	4
6	18			24	8				14	14		
7			14					17				
8		9				9	21				3	7
9	13			3	0				22	16		
10			7					16				
11		8				10	13				5	6
12	6			10	18				25	7		
13			16					18				
14		12				8	19				3	8
15	4			11	3				22	15		
16			17					42				
17		12				18	16				4	6
18	3			10	8				AF	24		
19			9					7				
20		2				11	9				7	5
21	5			15	2				19	14		
22			18					39				
23		9				18	12				12	4
24	6			10	2				17	10		
25			11					28				
26		7				11	15				10	17
27	3			4	7				24	6		
28			56					51				
29						26	16				4	6
30	24			22	8				15	6		
31			30					31				
NO.:	10	9	11	10	10	10	10	11	9	10	10	10
MAX:	36.	14.	56.	24.	21.	26.	44.	51.	25.	24.	12.	17.
MEAN:	11.8	8.7	17.7	11.6	7.7	13.1	19.0	25.8	19.4	11.9	6.1	6.6

ANNUAL OBSERVATIONS: 120 ANNUAL MEAN: 13.4 ANNUAL MAX: 56.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-1877 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Black Thunder Mine BTM-25
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.6696400009
LONGITUDE: -105.21671
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 4596
PROBE HEIGHT:

SUPPORT AGENCY: (0527) Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (1039) Thunder Basin Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1												
2		7									10	12
3	8								16	10		
4			11					15				
5						6	19					
6				23	4							
7												
8		15									7	5
9	3								79	12		
10			18					12				
11						AN	19					
12				5	6							
13												
14		10									7	1
15	7								15	18		
16			11				15	38				
17						15	AN					
18				4	4							
19												
20		9									3	3
21	10								14	AG		
22			10					31				
23						11	AV					
24				8	3							
25												
26		2									0	11
27	5								21	11		
28			39					58				
29						12	23					
30				12	7							
31												
NO.:	5	5	5	5	5	4	4	5	5	4	5	5
MAX:	10.	15.	39.	23.	7.	15.	23.	58.	79.	18.	10.	12.
MEAN:	6.6	8.6	17.8	10.4	4.8	11.0	19.0	30.8	29.0	12.8	5.4	6.4

ANNUAL OBSERVATIONS: 57 ANNUAL MEAN: 13.5 ANNUAL MAX: 79.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-1877 POC: 11
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Black Thunder Mine BTM-25
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.6696400009
LONGITUDE: -105.21671
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 4596
PROBE HEIGHT:

SUPPORT AGENCY: (0527) Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (1039) Thunder Basin Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			8					22				
2						11	20					
3				21	19							
4												
5		5									2	9
6	1								27	24		
7			10					18				
8						20	13					
9				5	1							
10												
11		3									1	3
12	2								21	22		
13			10					20				
14						7	11					
15				7	2							
16												
17		4									8	5
18	5								9	30		
19			9					8				
20						13	25					
21				11	3							
22												
23		18									12	11
24	9								19	14		
25			5					23				
26						11	14					
27				3	6							
28												
29											16	15
30	AV								13	9		
31			19					27				
NO.:	4	4	6	5	5	5	5	6	5	5	5	5
MAX:	9.	18.	19.	21.	19.	20.	25.	27.	27.	30.	16.	15.
MEAN:	4.3	7.5	10.2	9.4	6.2	12.4	16.6	19.7	17.8	19.8	7.8	8.6

ANNUAL OBSERVATIONS: 60 ANNUAL MEAN: 12.0 ANNUAL MAX: 30.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-1877 POC: 2
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Black Thunder Mine BTM-25
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.6696400009
LONGITUDE: -105.21671
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 4596
PROBE HEIGHT:

SUPPORT AGENCY: (0527) Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (1039) Thunder Basin Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			11									
2											12	12
3									20	10		
4								19				
5		7				8	31					
6	3			30	5							
7			12									
8											9	8
9									62	13		
10								14				
11		4				10	20					
12	13			7	AV							
13			14		12							
14											9	1
15									19	22		
16								43				
17		7				15	13					
18	8			4	2							
19			10									
20											7	4
21									19	11		
22								35				
23		25				14	17					
24	8			9	3							
25			6									
26											9	11
27									28	12		
28								62				
29						19	30					
30	16			14	7							
31			23									
NO.:	5	4	6	5	5	5	5	5	5	5	5	5
MAX:	16.	25.	23.	30.	12.	19.	31.	62.	62.	22.	12.	12.
MEAN:	9.6	10.8	12.7	12.8	5.8	13.2	22.2	34.6	29.6	13.6	9.2	7.2

ANNUAL OBSERVATIONS: 60 ANNUAL MEAN: 15.1 ANNUAL MAX: 62.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-1879 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Dry Fork Site DF-2
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.3780610009
LONGITUDE: -105.421386
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1354
PROBE HEIGHT:

SUPPORT AGENCY: (0527) Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (062) HI-VOL-WEDDING-INLET GRAVIMETRIC
PQAO: (0527) Inter-Mountain Laboratory Sheridan, WY

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			12									
2											7	AV
3									27	9		
4								24				
5		12				13	33					
6	4			15	5							
7			11									
8											15	10
9									13	14		
10								19				
11		9				13	19					
12	5			6	10							
13			12									
14											9	3
15									41	11		
16								34				
17		3				16	14					
18	11			8	5							
19			7									
20											7	5
21									15	12		
22								26				
23		7				26	18					
24	5			10	2							
25			4									
26											5	7
27									22	8		
28								61				
29						26	15					
30	8			12	9							
31			17									
NO.:	5	4	6	5	5	5	5	5	5	5	5	4
MAX:	11.	12.	17.	15.	10.	26.	33.	61.	41.	14.	15.	10.
MEAN:	6.6	7.8	10.5	10.2	6.2	18.8	19.8	32.8	23.6	10.8	8.6	6.3

ANNUAL OBSERVATIONS: 59 ANNUAL MEAN: 13.7 ANNUAL MAX: 61.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-1899 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Buckskin Mine North Site
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.5026750009
LONGITUDE: -105.539763
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 4315
PROBE HEIGHT:

SUPPORT AGENCY: (0527) Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0527) Inter-Mountain Laboratory Sheridan, WY

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	11	18	9	12	19	18	32	27	28	24	10	7
2	9	13	25	7	20	9	25	35	22	16	6	15
3	6	10	12	24	18	11	33	40	24	9	13	18
4	4	12	32	22	16	10	28	29	35	3	6	11
5	8	11	11	16	16	13	41	22	19	10	6	9
6	5	9	9	21	8	11	28	14	14	18	13	16
7	13	14	9	15	7	13	43	14	10	11	14	11
8	5	16	16	6	10	20	19	20	24	14	10	12
9	14	20	14	9	2	AH	32	9	28	12	14	14
10	14	7	16	23	7	AH	23	15	28	12	7	13
11	7	7	19	24	11	AH	14	23	26	32	7	10
12	8	10	15	9	15	20	24	20	45	16	16	14
13	13	8	16	16	12	14	20	17	33	16	16	14
14	6	28	15	40	11	9	19	38	37	15	18	9
15	9	5	11	14	4	8	16	29	24	14	24	-4
16	8	6	10	9	8	8	8	32	20	27	18	6
17	3	0	6	18	4	14	11	15	10	46	10	7
18	6	9	12	10	7	15	10	11	10	29	45	16
19	3	10	9	5	5	18	23	8	14	27	7	5
20	3	7	12	9	8	11	19	58	23	13	15	5
21	5	9	17	17	7	19	22	66	24	14	12	10
22	11	6	12	19	6	9	29	24	24	15	10	3
23	2	14	25	21	6	19	19	13	24	13	23	4
24	4	4	4	13	4	15	22	41	28	14	15	10
25	4	10	7	12	7	10	11	39	31	14	26	8
26	5	6	5	4	10	16	20	39	23	12	10	9
27	9	18	10	5	8	18	30	18	24	10	19	21
28	8	7	59	13	7	32	9	67	11	5	14	29
29	19		17	15	7	27	8	94	21	14	7	11
30	21		17	18	13	28	19	37	16	8	8	22
31	20		31		11		34	38		7		6
NO.:	31	28	31	30	31	27	31	31	30	31	30	31
MAX:	21.	28.	59.	40.	20.	32.	43.	94.	45.	46.	45.	29.
MEAN:	8.5	10.5	15.5	14.9	9.5	15.4	22.3	30.7	23.3	15.8	14.0	11.0

ANNUAL OBSERVATIONS: 362 ANNUAL MEAN: 16.0 ANNUAL MAX: 94.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-1900 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: NARM NA-7
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.6141909710
LONGITUDE: -105.38678014
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1462
PROBE HEIGHT:

SUPPORT AGENCY: (0882) Powder River Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0882) Powder River Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

MONTH

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	26	18	17	15	28	16	24	52	26	44	21	5
2	13	17	27	9	21	15	27	41	13	24	18	5
3	15	12	14	17	35	15	34	49	19	11	21	10
4	16	9	9	19	36	9	37	22	24	6	6	17
5	17	9	10	22	17	15	41	20	15	14	4	7
6	15	6	12	32	8	12	47	16	15	22	8	7
7	15	13	11	24	20	11	50	18	35	17	6	7
8	9	9	10	10	19	13	31	34	35	17	5	7
9	35	18	15	17	3	16	34	12	45	25	7	12
10	12	7	11	22	6	27	19	47	40	6	7	18
11	11	12	9	27	11	13	13	38	37	32	8	15
12	8	11	11	10	17	23	14	38	48	18	23	11
13	8	12	25	28	11	AN	17	33	65	36	12	9
14	7	41	29	45	19	19	31	55	32	37	5	14
15	9	5	8	13	4	13	16	20	25	24	7	26
16	10	3	12	10	8	14	18	58	23	39	15	23
17	7	5	12	14	5	20	19	25	21	58	9	18
18	9	6	19	7	13	26	18	11	18	39	36	13
19	9	23	9	7	8	29	25	15	27	21	13	6
20	5	5	25	8	7	19	34	57	32	10	10	6
21	7	6	27	17	12	39	32	60	22	17	5	6
22	6	7	24	31	8	25	23	31	30	12	6	29
23	7	10	34	24	9	37	15	30	32	8	36	42
24	5	5	8	16	4	31	21	61	28	23	12	5
25	3	6	13	16	7	16	26	66	40	27	19	42
26	5	10	8	4	8	12	31	44	29	14	12	23
27	5	27	11	4	11	23	48	30	30	1	21	32
28	6	7	59	13	6	37	9	82	16	4	14	23
29	18		22	29	9	43	25	115	14	20	5	11
30	17		27	14	15	22	44	50	34	6	5	11
31	38		59		16		73	31		10		6
NO.:	31	28	31	30	31	29	31	31	30	31	30	31
MAX:	38.	41.	59.	45.	36.	43.	73.	115.	65.	58.	36.	42.
MEAN:	12.0	11.4	18.9	17.5	12.9	21.0	28.9	40.7	29.0	20.7	12.5	15.0

ANNUAL OBSERVATIONS: 364 ANNUAL MEAN: 20.1 ANNUAL MAX: 115.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-1906 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: EAGLE BUTTE EB-31
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.4076861400
LONGITUDE: -105.56583394
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1351.422
PROBE HEIGHT:

SUPPORT AGENCY: (0027) Amax Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0027) Amax Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	4	6	7	9	10	9	27	12	21	25	8	6
2	6	7	13	5	15	8	22	31	10	15	10	5
3	7	6	8	6	17	10	23	22	19	8	11	5
4	6	6	7	11	12	7	22	18	27	4	6	8
5	8	3	7	16	9	10	35	12	15	10	5	6
6	7	5	6	23	6	8	31	10	10	13	7	6
7	6	12	6	15	8	10	36	12	10	8	5	5
8	10	5	5	5	7	9	21	13	10	10	6	4
9	19	8	7	4	2	11	29	9	13	6	7	9
10	8	5	8	10	6	AN	17	15	19	5	6	8
11	11	7	8	15	8	12	13	21	12	36	5	5
12	7	6	8	7	12	14	15	13	13	6	4	6
13	5	5	8	10	11	16	17	15	17	8	6	5
14	4	11	10	22	11	9	23	22	28	11	5	8
15	4	4	7	10	4	9	14	19	21	12	6	2
16	4	3	8	9	6	7	9	37	16	AI	10	5
17	4	3	7	13	4	11	21	16	7	AI	4	4
18	4	3	9	8	9	15	9	12	6	AI	22	7
19	3	4	4	5	5	18	11	6	8	AI	8	4
20	4	3	7	7	4	11	13	44	8	8	7	4
21	3	6	11	12	5	16	13	45	10	12	4	4
22	6	5	7	18	5	10	15	23	23	12	5	4
23	4	3	16	14	6	19	17	9	22	6	8	1
24	4	3	4	14	4	16	19	27	19	8	12	2
25	3	6	5	8	6	11	11	31	19	11	11	6
26	4	5	4	4	6	8	18	29	14	9	6	7
27	4	15	6	4	6	13	23	16	20	5	5	8
28	6	6	46	7	4	17	6	54	15	4	7	8
29	6		9	13	6	16	8	30	14	8	4	6
30	7		4	8	11	20	12	19	13	4	4	6
31	7		8		7		19	32		5		4
NO.:	31	28	31	30	31	29	31	31	30	27	30	31
MAX:	19.	15.	46.	23.	17.	20.	36.	54.	28.	36.	22.	9.
MEAN:	6.0	5.8	8.7	10.4	7.5	12.1	18.4	21.7	15.3	10.0	7.1	5.4

ANNUAL OBSERVATIONS: 360 ANNUAL MEAN: 10.7 ANNUAL MAX: 54.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-1915 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Black Thunder Mine Site BTM-9, Gillette, WY
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.7140100009
LONGITUDE: -105.39127
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 4755
PROBE HEIGHT:

SUPPORT AGENCY: (0527) Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (126) R - P Co Partisol Model 2000 Gravi
PQAO: (1039) Thunder Basin Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			20									
2											11	3
3									19	12		
4								21				
5		17				13	44					
6	9			36	6							
7			8									
8											5	3
9									18	13		
10								38				
11		6				11	11					
12	13			5	17							
13			10									
14											3	11
15									18	43		
16								51				
17		11				20	3					
18	3			7	10							
19			9									
20											8	4
21									22	16		
22								28				
23		5				32	15					
24	2			15	3							
25			11									
26											5	9
27									5	3		
28								70				
29						AN	24					
30	27			14	22							
31			26									
NO.:	5	4	6	5	5	4	5	5	5	5	5	5
MAX:	27.	17.	26.	36.	22.	32.	44.	70.	22.	43.	11.	11.
MEAN:	10.8	9.8	14.0	15.4	11.6	19.0	19.4	41.6	16.4	17.4	6.4	6.0

ANNUAL OBSERVATIONS: 59 ANNUAL MEAN: 15.7 ANNUAL MAX: 70.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-1915 POC: 11
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Black Thunder Mine Site BTM-9, Gillette, WY
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.7140100009
LONGITUDE: -105.39127
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 4755
PROBE HEIGHT:

SUPPORT AGENCY: (0527) Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (126) R - P Co Partisol Model 2000 Gravi
PQAO: (1039) Thunder Basin Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1								25				
2		26				15	AN					
3	17			8	29							
4			8									
5											3	3
6									11	23		
7								13				
8		16				13	5					
9	18			7	1							
10			7									
11											7	10
12									36	8		
13								24				
14		21				12	AN					
15	5			7	4							
16			12									
17											6	4
18									22	AV		
19								13				
20		3				16	24					
21	4			18	15							
22			13									
23											13	4
24									22	19		
25								54				
26		10				11	30					
27	4			2	11							
28			45									
29											3	AV
30									23	3		
31								34				
NO.:	5	5	5	5	5	5	3	6	5	4	5	4
MAX:	18.	26.	45.	18.	29.	16.	30.	54.	36.	23.	13.	10.
MEAN:	9.6	15.2	17.0	8.4	12.0	13.4	19.7	27.2	22.8	13.3	6.4	5.3

ANNUAL OBSERVATIONS: 57 ANNUAL MEAN: 14.4 ANNUAL MAX: 54.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-1917 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Jacob Ranch Mine Site 5, Gillette, WY
SITE COMMENTS: Old site #56-005-0917 relocated
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.7555600009
LONGITUDE: -105.27056
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1502
PROBE HEIGHT:

SUPPORT AGENCY: (0527) Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0527) Inter-Mountain Laboratory Sheridan, WY

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	22	33	13	19	34	31	28	41	26	25	14	9
2	51	49	32	10	37	17	AV	34	35	19	16	10
3	9	6	38	60	31	17	52	28	54	9	32	22
4	15	17	18	45	29	11	29	30	35	4	6	18
5	17	22	21	22	16	16	48	36	24	16	5	8
6	18	13	12	30	8	14	53	14	13	24	11	19
7	46	20	13	14	9	14	49	34	16	17	27	12
8	8	17	20	6	9	32	20	58	20	27	12	6
9	66	49	21	23	2	32	32	19	17	39	12	21
10	40	12	20	34	7	34	25	50	26	22	12	12
11	8	10	44	45	13	11	27	38	38	40	6	13
12	7	12	12	14	16	39	19	46	47	42	40	18
13	7	3	26	30	15	AV	28	19	103	19	25	24
14	20	32	32	83	13	AV	24	81	87	37	18	24
15	11	7	24	17	4	AV	AV	27	33	16	25	12
16	7	18	15	8	10	13	17	53	31	47	29	17
17	5	14	16	14	5	33	13	19	22	73	5	26
18	6	5	17	7	10	16	13	10	14	67	31	10
19	5	12	29	9	8	33	38	17	24	43	16	8
20	5	6	25	9	5	13	28	55	87	10	11	7
21	18	12	23	18	15	29	39	80	35	35	6	14
22	23	16	18	19	8	15	46	32	34	21	10	10
23	7	31	34	21	7	25	19	31	30	18	73	13
24	8	5	7	13	4	27	23	79	61	24	26	9
25	4	23	23	14	7	AV	20	46	48	23	35	35
26	8	10	8	4	13	13	37	51	61	15	14	33
27	13	31	10	5	15	31	92	27	40	8	30	64
28	8	9	65	19	8	39	9	83	22	4	29	36
29	23		29	20	14	48	43	122	19	35	17	10
30	24		26	16	20	50	27	75	30	13	11	15
31	37		117		21		25	42		7		20
NO.:	31	28	31	30	31	26	29	31	30	31	30	31
MAX:	66.	49.	117.	83.	37.	50.	92.	122.	103.	73.	73.	64.
MEAN:	17.6	17.6	26.1	21.6	13.3	25.1	31.8	44.4	37.7	25.8	20.1	17.9

ANNUAL OBSERVATIONS: 359 ANNUAL MEAN: 24.9 ANNUAL MAX: 122.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-2900 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: Amax Eagle Butte Mine Eb-5 Rural
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.3376300009
LONGITUDE: -105.494
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1360
PROBE HEIGHT:

SUPPORT AGENCY: (0027) Amax Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (063) HI-VOL SA/GMW-1200 GRAVIMETRIC
PQAO: (0027) Amax Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

MONTH

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			7					38				
2		8				18	31				10	8
3	10			12	28				36	6		
4			9					32				
5		4				AF	38				3	3
6	13			24	6				24	12		
7			23					32				
8		19				2	32				3	8
9	23			5	2				31	11		
10			11					33				
11		8				15	16				5	18
12	7			7	15				39	12		
13			20					37				
14		17				16	44				4	4
15	4			9	4				33	27		
16			26					63				
17		5				24	20				10	2
18	2			14	9				15	28		
19			6					10				
20		2				32	29				7	3
21	5			22	5				20	18		
22			12					39				
23		5				30	25				16	2
24	1			14	3				31	9		
25			8					45				
26		4				37	46				11	11
27	5			5	11				26	5		
28			40					73				
29						33	25				6	9
30	25			14	11				24	5		
31			16					39				
NO.:	10	9	11	10	10	9	10	11	10	10	10	10
MAX:	25.	19.	40.	24.	28.	37.	46.	73.	39.	28.	16.	18.
MEAN:	9.5	8.0	16.2	12.6	9.4	23.0	30.6	40.1	27.9	13.3	7.5	6.8

ANNUAL OBSERVATIONS: 120 ANNUAL MEAN: 17.3 ANNUAL MAX: 73.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-2901 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: EB-RSCH, 200 Prospector Parkway, Gillette
SITE COMMENTS: Eagle Butte - Rawhide School Monitor
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: COMMERCIAL
LOCATION SETTING: SUBURBAN

CAS NUMBER:
LATITUDE: 44.3904000009
LONGITUDE: -105.5453
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1315.62
PROBE HEIGHT: 1.53

SUPPORT AGENCY: (0027) Amax Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0027) Amax Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	6	11	AI	11	14	12	31	19	32	33	9	5
2	13	13	AI	6	23	8	22	41	12	23	12	9
3	11	9	AI	8	22	AI	33	42	23	9	14	10
4	8	10	AI	20	16	AI	30	25	36	4	7	17
5	14	10	AI	16	16	10	39	18	18	12	5	7
6	10	6	AI	27	7	6	33	17	15	17	8	9
7	16	15	AI	18	12	7	43	17	11	12	7	5
8	11	11	AI	9	10	7	26	20	22	12	6	5
9	30	18	AI	6	2	11	40	12	18	8	11	10
10	15	5	AI	16	7	AN	20	26	AN	6	6	12
11	13	8	AI	16	11	AN	12	41	AN	39	4	8
12	15	9	AI	8	16	AN	19	19	23	9	6	16
13	13	6	AI	13	14	19	21	17	34	13	8	12
14	4	20	AI	37	14	11	27	42	31	14	6	13
15	5	4	AI	10	5	10	15	29	21	22	11	9
16	6	3	AI	10	8	9	10	38	26	50	14	8
17	4	5	AI	16	5	16	15	23	11	104	5	5
18	5	5	AI	9	11	AH	11	12	7	50	50	10
19	4	AI	AI	6	7	AH	18	7	14	37	13	5
20	5	AI	AI	AI	5	13	27	AI	12	10	7	4
21	5	AI	AI	AI	9	30	AH	AI	AH	21	5	5
22	8	AI	AI	AI	11	11	AH	31	36	23	5	4
23	4	AI	AI	15	9	25	AH	14	29	9	22	2
24	5	AI	AI	AI	5	21	AH	45	43	12	18	4
25	3	AI	AI	9	7	14	AH	50	47	29	20	16
26	4	AI	3	3	10	11	AH	46	27	16	13	10
27	5	AI	8	4	12	16	AH	19	23	7	10	19
28	6	AI	53	10	7	27	AH	66	15	5	10	AI
29	13		9	17	9	23	AI	51	34	13	4	AN
30	24		8	17	20	22	16	28	19	4	7	AI
31	12		17		9		32	41		5		AI
NO.:	31	18	6	26	31	23	22	29	27	31	30	27
MAX:	30.	20.	53.	37.	23.	30.	43.	66.	47.	104.	50.	19.
MEAN:	9.6	9.3	16.3	13.0	10.7	14.7	24.5	29.5	23.7	20.3	10.8	8.9

ANNUAL OBSERVATIONS: 301 ANNUAL MEAN: 15.9 ANNUAL MAX: 104.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-5555 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: WYDK-M 3,044 meters NE of intersection of Wyodak Mine Access Rd & Garner Lake Rd
SITE COMMENTS: Wyodak Site 5
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.3437499692
LONGITUDE: -105.40333329
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1375
PROBE HEIGHT: 2.5

SUPPORT AGENCY: (0027) Amax Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (1187) Wyodale Resources

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	AI	19	10	25	13	18	AV	16	AV	16	AV	13
2	AI	11	20	18	21	9	AV	25	18	13	AV	AI
3	AI	10	16	8	20	9	AV	24	24	7	10	10
4	AI	9	17	17	12	7	AV	19	45	3	AI	14
5	AI	7	14	19	12	10	AV	12	20	9	AI	8
6	10	11	19	20	8	11	AV	13	9	12	10	7
7	22	23	11	10	7	13	AV	12	14	AI	8	7
8	24	13	8	3	7	14	18	11	14	13	7	10
9	20	12	11	5	2	18	21	9	16	11	11	18
10	20	11	12	18	6	16	16	16	14	6	7	7
11	13	7	15	17	10	11	15	20	AV	57	12	8
12	5	14	18	9	14	19	25	18	21	14	14	8
13	14	19	12	9	17	12	16	15	32	18	10	8
14	9	15	21	27	12	8	14	36	53	15	7	8
15	8	9	10	16	4	10	13	21	31	14	10	8
16	14	17	AI	8	8	9	11	26	17	AI	21	9
17	11	6	AI	17	5	13	10	13	9	35	9	7
18	7	4	AI	9	6	13	11	9	5	26	P 186 rj	6
19	AH	7	AI	8	6	18	17	8	10	15	8	4
20	11	4	6	9	4	11	15	48	9	17	3	4
21	5	10	15	13	5	19	18	AV	13	10	7	4
22	13	6	11	16	6	11	16	AV	18	11	12	5
23	11	11	26	18	5	18	18	AV	19	8	15	5
24	9	8	4	12	4	15	14	AV	20	8	11	6
25	5	13	7	10	7	8	10	47	AV	10	10	8
26	7	12	6	3	7	11	17	74	AV	11	9	9
27	7	11	8	5	9	14	28	38	AV	6	10	15
28	20	18	69	8	8	21	13	66	AV	7	11	14
29	14		21	13	6	19	10	AV	AV	AV	AV	9
30	9		15	16	12	AI	13	AV	9	AV	AV	10
31	17		20		8		20	AV		AV		12
NO.:	25	28	27	30	31	29	24	24	23	26	24	30
MAX:	24.	23.	69.	27.	21.	21.	28.	74.	53.	57.	186.	18.
MEAN:	12.2	11.3	15.6	12.9	8.7	13.3	15.8	24.8	19.1	14.3	17.4	8.7

ANNUAL OBSERVATIONS: 321 ANNUAL MEAN: 14.2 ANNUAL MAX: 186.

1 Values marked with 'P' exceed the PRIMARY STANDARD of: 155
1 Values marked with 'S' exceed the SECONDARY STANDARD of: 155

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-005-6666 POC: 1
COUNTY: (005) Campbell
CITY: (00000) Not in a city
SITE ADDRESS: 1,008 meters North of I-90 & 361 West of American Ranch Rd
SITE COMMENTS: Wyodak Site 6
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (243) WYOMING
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 44.2955833295
LONGITUDE: -105.33541665
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1374
PROBE HEIGHT: 2.5

SUPPORT AGENCY: (1187) Wyodale Resources
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (1187) Wyodale Resources

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	15	14	12	26	15	19	37	24	34	29	16	17
2	15	16	15	18	28	13	29	32	24	AV	13	AI
3	13	14	15	26	21	11	28	26	37	AV	17	13
4	12	10	20	23	11	9	25	30	44	AV	AI	16
5	14	17	22	21	9	11	39	15	25	AV	AH	17
6	9	20	30	24	10	13	31	24	13	10	20	16
7	22	94	13	16	9	20	38	22	19	15	11	15
8	17	15	13	5	8	19	19	16	18	17	9	23
9	21	19	18	8	3	28	18	14	22	13	17	41
10	21	11	21	17	7	19	21	20	22	8	AH	11
11	11	9	20	AI	10	12	30	15	AV	92	AH	24
12	6	12	23	AI	13	18	31	19	29	16	30	9
13	15	21	19	AI	18	16	30	24	39	34	12	7
14	11	14	34	AI	13	10	25	33	53	20	10	12
15	8	8	14	17	4	10	17	25	63	23	15	6
16	11	10	40	10	9	11	14	38	42	33	32	10
17	22	1	6	18	5	15	13	AV	13	35	14	13
18	8	8	17	12	7	12	16	9	AH	32	P 350 rj	15
19	22	10	13	10	6	17	23	10	AV	23	20	11
20	16	4	13	14	4	16	20	52	20	17	4	8
21	10	11	20	18	5	18	21	52	AV	17	14	7
22	17	10	15	15	6	12	19	50	21	13	25	9
23	19	18	39	17	6	22	28	16	27	10	19	10
24	27	16	10	15	4	16	19	34	AV	13	20	11
25	7	11	9	13	7	11	16	39	24	14	13	13
26	19	8	11	4	8	15	18	35	19	9	13	14
27	12	9	13	7	11	22	39	22	32	9	13	12
28	14	16	101	9	9	26	19	71	15	9	13	16
29	16		44	14	8	27	14	48	11	14	7	14
30	19		18	16	11	31	22	55	AV	13	9	18
31	17		30		13		23	35		14		21
NO.:	31	28	31	26	31	30	31	30	24	27	26	30
MAX:	27.	94.	101.	26.	28.	31.	39.	71.	63.	92.	350.	41.
MEAN:	15.0	15.2	22.2	15.1	9.6	16.6	23.9	30.2	27.8	20.4	28.3	14.3

ANNUAL OBSERVATIONS: 345 ANNUAL MEAN: 19.7 ANNUAL MAX: 350.

1 Values marked with 'P' exceed the PRIMARY STANDARD of: 155
1 Values marked with 'S' exceed the SECONDARY STANDARD of: 155

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0009 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: Antelope Site 7 PM10 Monitor
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.4254196467
LONGITUDE: -105.38856588
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1492
PROBE HEIGHT: 2

SUPPORT AGENCY: (0527) Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (126) R - P Co Partisol Model 2000 Gravi
PQAO: (0041) Antelope Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			8									
2											7	4
3									9	12		
4								11				
5		4				9	32					
6				30	10							
7			AN									
8											5	2
9									24	7		
10								14				
11		6				11	15					
12				16	12							
13			10									
14											3	5
15									13	26		
16								54				
17		8				12	20					
18				4	8							
19			AN									
20											5	3
21									9	11		
22								34				
23		3				18	18					
24				13	2							
25			AN									
26											5	15
27									23	4		
28								49				
29						13	20					
30				15	6							
31			AN									
NO.:	0	4	2	5	5	5	5	5	5	5	5	5
MAX:		8.	10.	30.	12.	18.	32.	54.	24.	26.	7.	15.
MEAN:		5.3	9.0	15.6	7.6	12.6	21.0	32.4	15.6	12.0	5.0	5.8

ANNUAL OBSERVATIONS: 51 ANNUAL MEAN: 13.3 ANNUAL MAX: 54.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0010 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: Converse County Long-Term 16 Miles West of Wyoming Highway 59 on Highland Loop Roa
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.1012810009
LONGITUDE: -105.498931
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1650
PROBE HEIGHT: 4

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: APRIL 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1																									0	
2																									0	
3																									0	
4																									0	
5																									0	
6																									0	
7																									0	
8																									0	
9																									0	
10																									0	
11																									0	
12																									0	
13																									0	
14	7	15	4	7	8	7	5	15	1	7	7	2	1	3	6	4	11	8	14	12	15	31	32	29	24	32.
15	57	114	40	22	15	14	15	9	8	6	1	0	0	0	0	0	1	0	-1	0	-2	-2	0	2	24	114.
16	0	4	3	3	2	0	2	2	3	2	5	4	5	6	7	14	12	15	14	22	7	10	12	7	24	22.
17	1	5	7	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	3	7.
18	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	BR	-3	-2	-1	0	3	8	5	5	6	9	8.
19	3	2	2	3	4	4	3	1	1	3	2	0	4	4	1	2	5	4	3	4	1	0	0	1	24	5.
20	0	0	6	4	0	0	0	4	3	6	3	0	2	3	2	0	-2	2	4	2	5	5	6	5	24	6.
21	5	23	5	19	3	5	5	6	2	1	3	6	6	5	5	4	13	7	27	15	12	29	7	9	24	29.
22	7	9	8	8	6	9	5	2	12	8	25	7	5	7	24	20	4	4	7	14	14	19	10	8	24	25.
23	7	14	14	9	7	19	8	44	11	20	21	22	10	15	10	11	9	5	2	15	6	7	6	7	24	44.
24	5	3	7	4	6	4	6	8	6	6	4	1	4	5	5	4	5	4	1	15	9	6	3	2	24	15.
25	9	6	9	6	2	5	4	12	6	8	4	0	0	12	5	3	2	3	13	11	7	5	5	2	24	13.
26	1	1	0	0	-1	-3	0	0	-2	-2	-3	-2	0	2	2	1	0	-2	-3	0	0	0	0	-2	24	2.
27	-2	-2	-1	-1	-2	0	-1	0	0	0	0	0	0	-1	-1	0	1	0	0	2	1	0	0	0	24	2.
28	0	0	0	0	2	1	0	1	2	0	0	0	0	3	2	3	5	4	1	3	9	7	6	11	24	11.
29	7	8	5	7	5	2	0	1	3	5	4	2	0	1	0	2	3	1	5	4	14	6	11	9	24	14.
30	8	8	6	6	5	7	6	6	6	5	4	5	8	11	14	12	7	6	5	5	6	6	3	12	24	14.
31																									0	
NO.:	16	16	16	15	15	15	15	15	15	15	15	15	15	15	15	16	16	16	16	16	16	16	16	16		
MAX:	57.	114.	40.	22.	15.	19.	15.	44.	12.	20.	25.	22.	10.	15.	24.	20.	13.	15.	27.	22.	15.	31.	32.	29.		
AVG:	7.2	13.1	7.2	6.5	4.1	4.9	3.9	7.4	4.1	5.0	5.3	3.1	3.0	5.1	5.5	4.8	4.6	3.8	5.8	7.9	7.0	8.4	6.6	6.8		

MONTHLY OBSERVATIONS: 372 MONTHLY MEAN: 5.9 MONTHLY MAX: 114.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0010 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: Converse County Long-Term 16 Miles West of Wyoming Highway 59 on Highland Loop Roa
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.1012810009
LONGITUDE: -105.498931
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1650
PROBE HEIGHT: 4

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: MAY 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	7	15	7	8	9	14	8	10	8	18	2	6	8	7	20	15	6	12	14	14	11	12	10	11	24	20.
2	7	6	6	10	12	31	56	11	11	8	11	8	14	4	6	4	6	16	22	7	5	11	8	9	24	56.
3	6	11	12	14	18	18	20	22	21	19	17	13	13	16	17	13	19	16	13	16	12	6	2	5	24	22.
4	3	0	0	5	7	13	14	17	18	19	17	18	14	15	12	10	14	9	10	17	16	16	12	13	24	19.
5	13	13	17	3	5	4	7	5	7	7	4	3	4	4	4	3	0	6	5	1	2	2	2	1	24	17.
6	0	0	-3	0	2	0	4	5	4	5	4	2	-1	-1	0	-2	-3	3	2	3	5	7	10	11	24	11.
7	8	6	7	5	4	2	2	5	3	2	6	5	7	7	7	7	10	26	18	30	12	6	3	3	24	30.
8	2	1	13	7	3	1	5	7	5	4	8	7	8	10	7	10	7	6	6	4	2	0	0	-1	24	13.
9	1	2	1	-3	-4	-3	-3	-2	-1	0	0	-1	2	3	0	-1	-2	-2	-1	3	1	-2	0	0	24	3.
10	0	0	0	1	1	3	9	5	6	4	1	4	2	0	0	1	3	1	3	2	2	3	3	4	24	9.
11	3	2	5	3	4	8	4	0	2	5	3	1	4	3	1	0	2	4	5	5	5	7	8	6	24	8.
12	4	4	6	5	5	3	2	1	1	2	2	3	10	7	8	9	6	14	1	7	5	3	9	7	24	14.
13	7	4	2	5	5	7	4	4	3	1	3	6	4	3	4	2	5	3	1	2	2	3	1	2	24	7.
14	3	3	5	3	4	3	0	0	0	4	3	2	4	6	5	7	15	4	4	13	6	6	4	0	24	15.
15	0	0	0	0	-1	-3	-2	-1	0	0	-2	0	0	0	-2	4	4	1	0	0	2	4	4	2	24	4.
16	0	-1	-1	3	2	0	2	1	0	3	2	1	0	0	0	1	2	2	0	22	22	12	14	-3	24	22.
17	0	0	0	0	1	2	0	0	-2	-1	0	-2	0	0	0	-3	0	1	0	0	0	1	0	2	24	2.
18	4	2	0	0	0	0	0	2	1	0	2	4	8	4	-1	-1	0	0	0	2	4	3	8	10	24	10.
19	7	3	1	5	4	2	1	0	-1	0	0	0	0	0	0	0	0	0	-1	BR	BR	0	1	0	22	7.
20	0	1	0	0	0	-1	0	0	BA	BA	-3	-1	2	1	0	-3	-3	-1	-2	0	1	1	-1	-4	22	2.
21	-3	-1	1	0	-1	5	4	1	-1	-2	-1	4	5	3	2	2	2	2	2	3	4	2	1	2	24	5.
22	2	3	2	-1	0	3	3	3	2	4	3	2	-1	-2	-1	-3	-4	-1	0	-3	-1	1	-1	-1	24	4.
23	0	-1	-5	-3	1	-1	-1	-1	-3	-1	1	2	0	-3	1	2	2	1	-3	-1	1	2	2	0	24	2.
24	-1	-2	-5	-4	-4	-4	-2	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	7	-1.
25	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	4	4	3	0	4	2	0	7	4.
26	5	5	4	1	-2	-3	-1	1	0	2	1	0	0	-1	-2	2	3	4	53	20	30	7	5	2	24	53.
27	0	-1	2	1	1	3	1	-1	-2	-2	0	1	1	4	4	1	2	10	6	2	4	6	5	3	24	10.
28	4	3	2	4	4	3	6	6	2	-1	0	0	-2	3	5	2	-2	-3	1	4	6	4	1	3	24	6.
29	1	-2	0	2	1	0	1	1	1	-2	-1	1	7	13	13	8	15	11	8	5	10	8	10	9	24	15.
30	9	AQ	10	11	10	7	0	-4	1	1	-2	0	2	2	2	1	2	4	4	3	9	8	5	4	23	11.
31	3	1	1	3	2	1	1	1	1	2	2	0	1	1	-2	-1	1	1	61	10	8	4	4	4	24	61.
NO.:	30	29	30	30	30	30	30	29	28	28	29	29	29	29	29	29	29	30	30	29	29	30	30	30		
MAX:	13.	15.	17.	14.	18.	31.	56.	22.	21.	19.	17.	18.	14.	16.	20.	15.	19.	26.	61.	30.	30.	16.	14.	13.		
AVG:	3.2	2.7	3.0	2.9	3.1	3.9	4.8	3.4	3.1	3.6	2.9	3.1	4.0	3.8	3.8	3.1	3.9	5.1	7.9	6.7	6.4	4.9	4.4	3.5		

MONTHLY OBSERVATIONS: 705 MONTHLY MEAN: 4.0 MONTHLY MAX: 61.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0010 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: Converse County Long-Term 16 Miles West of Wyoming Highway 59 on Highland Loop Roa
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.1012810009
LONGITUDE: -105.498931
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1650
PROBE HEIGHT: 4

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: JUNE 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	2	4	2	5	4	4	7	6	3	7	8	17	6	17	14	11	21	11	9	6	31	4	15	-2	24	31.
2	1	7	6	3	7	10	8	26	4	4	5	8	8	10	7	12	8	8	6	6	6	8	10	8	24	26.
3	8	4	1	1	3	3	1	1	4	10	30	16	37	26	46	6	20	15	10	6	4	3	6	4	24	46.
4	4	4	3	2	-1	-2	0	1	7	12	9	6	6	7	7	8	9	8	7	5	3	0	-3	0	24	12.
5	0	-2	-2	-4	-4	-2	2	3	5	5	8	9	17	12	7	7	6	6	8	7	6	5	4	7	24	17.
6	8	5	4	6	3	1	3	3	4	9	6	4	4	4	2	-1	-1	4	8	5	3	3	6	6	24	9.
7	3	5	4	2	2	1	1	3	2	2	1	1	4	3	2	8	7	4	4	6	7	4	4	7	24	8.
8	15	8	8	3	4	5	5	6	5	6	3	5	4	2	2	2	0	2	4	6	7	6	4	3	24	15.
9	6	8	6	5	8	8	7	6	3	1	1	1	3	4	4	4	3	10	6	3	3	3	4	19	24	19.
10	6	5	0	-2	3	3	3	4	2	5	5	0	1	11	17	13	8	6	7	12	10	11	8	8	24	17.
11	4	1	2	-1	0	2	3	3	5	8	8	7	5	6	5	6	10	10	6	4	6	4	1	-1	24	10.
12	0	-2	-3	-3	-3	0	2	6	6	9	14	12	8	5	4	2	5	23	9	10	7	13	9	14	24	23.
13	8	6	3	4	9	11	8	13	13	10	8	9	9	15	18	23	14	10	7	7	11	11	11	9	24	23.
14	7	7	8	5	2	5	5	11	12	18	14	11	7	8	20	11	6	5	6	10	7	7	6	2	24	20.
15	-2	-3	-2	-2	-2	-1	2	3	1	1	3	6	3	1	4	6	10	7	3	4	3	1	2	8	24	10.
16	6	3	0	-2	-1	1	1	-3	-1	3	1	2	-2	AQ	4	21	19	11	8	4	AQ	0	3	4	22	21.
17	1	-1	2	5	6	5	3	6	12	7	18	1	BA	7	6	8	25	13	9	11	11	6	44	4	23	44.
18	4	3	1	1	2	3	3	2	2	5	12	21	50	37	10	17	24	12	18	12	15	16	15	17	24	50.
19	12	13	11	14	34	11	7	7	14	28	34	14	21	26	30	10	27	50	6	32	16	17	12	7	24	50.
20	32	6	4	3	23	1	1	3	13	14	46	8	9	18	AQ	6	7	6	7	7	13	8	6	6	23	46.
21	4	10	8	6	7	3	3	8	7	9	11	16	30	51	6	24	18	9	15	29	16	12	10	90	24	90.
22	12	11	6	5	3	54	2	4	3	1	3	1	2	36	12	17	16	12	15	13	14	10	11	8	24	54.
23	8	6	10	9	8	7	6	8	8	8	16	10	12	13	22	27	20	18	27	32	28	25	34	38	24	38.
24	29	18	7	3	0	5	22	30	33	29	26	26	27	31	21	25	35	25	32	29	16	5	5	8	24	35.
25	4	3	6	5	4	6	12	9	5	4	12	15	14	17	5	4	4	4	4	5	5	4	5	2	24	17.
26	4	5	7	7	5	1	4	2	3	6	8	7	3	3	0	4	5	9	23	17	24	6	11	9	24	24.
27	7	16	6	10	9	5	20	23	14	7	4	3	2	3	5	7	6	14	29	20	13	9	10	11	24	29.
28	17	9	9	6	5	9	6	9	9	15	9	16	12	7	9	10	6	9	31	6	14	9	7	8	24	31.
29	7	4	6	5	4	10	17	11	35	13	7	9	9	8	10	8	7	13	10	10	17	5	5	5	24	35.
30	5	7	8	6	8	98	60	94	59	18	25	12	14	12	17	7	9	10	12	17	14	11	9	8	24	98.
31																									0	
NO.:	30	30	30	30	30	30	30	30	30	30	30	30	29	29	29	30	30	30	30	30	29	30	30	30		
MAX:	32.	18.	11.	14.	34.	98.	60.	94.	59.	29.	46.	26.	50.	51.	46.	27.	35.	50.	32.	32.	31.	25.	44.	90.		
AVG:	7.4	5.7	4.4	3.6	5.1	8.9	7.5	10.3	9.7	9.1	11.8	9.1	11.2	13.8	10.9	10.4	11.8	11.5	11.5	11.4	11.4	7.5	9.1	10.6		

MONTHLY OBSERVATIONS: 716 MONTHLY MEAN: 9.3 MONTHLY MAX: 98.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0010 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: Converse County Long-Term 16 Miles West of Wyoming Highway 59 on Highland Loop Roa
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.1012810009
LONGITUDE: -105.498931
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1650
PROBE HEIGHT: 4

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: JULY 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	7	5	6	7	6	9	8	18	13	17	20	16	15	23	18	22	26	23	17	19	28	16	26	6	24	28.
2	6	6	8	6	10	15	3	5	10	9	6	8	15	19	20	22	27	20	21	17	13	12	15	10	24	27.
3	12	8	13	10	12	8	6	11	22	11	15	10	23	20	14	17	14	11	17	24	11	11	12	8	24	24.
4	6	12	19	6	6	9	5	6	5	6	6	7	8	6	7	9	10	10	15	10	10	16	9	20	24	20.
5	13	12	9	9	11	13	8	39	38	50	52	30	26	16	14	17	16	20	35	33	37	26	17	17	24	52.
6	17	38	61	61	54	44	45	47	38	47	52	54	52	41	42	37	31	32	21	20	30	36	41	59	24	61.
7	59	62	62	59	56	50	50	45	42	29	31	38	33	32	31	39	28	16	20	6	11	11	10	11	24	62.
8	13	8	6	12	12	13	9	15	28	32	24	17	18	24	20	21	17	19	16	8	15	14	13	12	24	32.
9	16	8	10	16	9	12	14	15	14	10	6	9	10	9	7	4	17	10	11	10	12	8	5	5	24	17.
10	6	9	8	5	3	6	9	12	13	12	16	13	20	5	11	10	11	8	20	8	9	6	3	2	24	20.
11	6	6	4	5	5	3	5	9	14	12	18	14	8	7	6	7	6	5	6	8	6	6	5	2	24	18.
12	3	10	8	4	2	2	3	5	5	15	11	9	12	17	7	8	7	5	11	6	9	11	7	7	24	17.
13	5	6	6	7	9	16	7	17	14	23	13	8	3	2	2	2	2	3	10	7	10	6	6	8	24	23.
14	6	7	28	17	12	15	15	12	9	9	7	10	8	9	9	10	11	29	9	14	9	6	9	12	24	29.
15	14	12	7	8	7	10	18	19	24	BA	11	6	7	2	2	25	-2	AV	AV	5	4	2	3	2	21	25.
16	-1	1	5	6	4	1	8	6	7	6	2	1	3	2	0	0	5	6	4	3	2	10	11	7	24	11.
17	48	16	5	4	2	7	5	4	2	1	1	4	5	4	21	18	-2	24	3	2	0	1	18	8	24	48.
18	5	1	2	8	10	11	7	4	5	8	5	2	2	3	2	4	6	5	4	4	4	2	0	-1	24	11.
19	-1	3	3	-1	0	4	3	2	11	9	23	18	3	6	2	1	-1	1	22	9	6	4	3	2	24	23.
20	4	4	9	6	8	18	10	17	7	6	6	5	5	2	1	8	10	14	13	10	10	13	15	9	24	18.
21	6	1	0	1	0	1	1	7	6	5	5	7	9	6	6	7	6	10	9	5	2	1	4	1	24	10.
22	6	7	11	9	5	1	4	5	8	6	10	7	4	2	17	2	5	8	3	8	7	4	-1	-3	24	17.
23	4	4	4	1	2	6	6	4	3	6	5	18	15	6	13	8	7	6	3	2	14	9	5	10	24	18.
24	8	11	14	8	8	10	9	6	4	4	8	8	9	10	12	7	12	7	4	16	17	18	10	8	24	18.
25	6	11	18	18	16	AN	AN	AN	AN	AN	4	4	4	3	7	6	3	1	2	-1	0	18	7	9	19	18.
26	7	12	11	11	12	12	8	12	12	12	8	7	2	1	2	2	5	7	6	16	58	38	16	22	24	58.
27	13	13	7	6	12	9	7	9	10	9	10	9	29	29	9	6	54	21	38	30	18	37	24	15	24	54.
28	17	5	6	8	8	12	9	6	4	4	5	4	1	-1	0	2	2	1	2	1	1	27	50	37	24	50.
29	39	10	7	7	6	3	16	5	5	5	10	8	5	3	8	11	7	4	3	5	24	11	14	14	24	39.
30	12	11	8	12	9	9	14	17	14	17	19	12	7	5	5	6	6	9	8	10	20	12	13	21	24	21.
31	11	12	18	13	15	17	11	13	17	18	7	10	6	5	6	5	10	9	31	57	14	18	9	8	24	57.
NO.:	31	31	31	31	31	30	30	30	30	29	31	31	31	31	31	31	31	30	30	31	31	31	31	31		
MAX:	59.	62.	62.	61.	56.	50.	50.	47.	42.	50.	52.	54.	52.	41.	42.	39.	54.	32.	38.	57.	58.	38.	50.	59.		
AVG:	12.0	10.7	12.4	11.3	10.7	11.5	10.8	13.1	13.5	13.7	13.4	12.0	11.8	10.3	10.4	11.1	11.5	11.5	12.8	12.0	13.3	13.2	12.2	11.2		

MONTHLY OBSERVATIONS: 736 MONTHLY MEAN: 11.9 MONTHLY MAX: 62.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0010 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: Converse County Long-Term 16 Miles West of Wyoming Highway 59 on Highland Loop Roa
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.1012810009
LONGITUDE: -105.498931
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1650
PROBE HEIGHT: 4

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: AUGUST 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	12	6	11	11	11	9	9	14	9	14	12	10	8	8	4	5	4	17	4	13	12	10	21	16	24	21.
2	19	27	29	24	22	18	16	21	16	3	8	9	7	4	4	6	9	10	9	18	16	17	15	12	24	29.
3	12	13	12	10	16	16	19	13	12	13	17	13	16	18	16	52	11	7	6	3	0	3	4	3	24	52.
4	8	5	6	10	6	2	0	1	5	6	7	5	0	-1	2	1	0	2	4	6	5	5	5	7	24	10.
5	6	7	4	7	7	8	9	13	13	8	9	11	8	10	9	18	5	4	4	4	2	4	0	-2	24	18.
6	4	8	7	7	6	5	4	3	1	-2	-2	-1	2	5	4	2	2	5	6	5	8	9	9	7	24	9.
7	11	11	10	15	9	8	6	2	4	6	10	7	9	12	16	2	4	5	5	9	6	6	4	2	24	16.
8	5	3	2	3	4	8	14	9	7	5	2	0	-1	0	4	9	7	4	17	12	8	6	5	4	24	17.
9	4	2	5	5	2	4	5	5	5	4	4	6	5	2	1	1	0	-1	9	25	13	7	4	5	24	25.
10	6	6	5	6	6	4	8	15	8	3	3	5	2	12	8	6	15	8	11	9	24	11	12	12	24	24.
11	7	10	6	3	8	7	7	6	10	21	27	10	18	6	16	27	12	7	21	11	9	16	7	8	24	27.
12	9	9	7	7	15	18	30	15	15	10	32	53	10	8	23	26	7	19	1	8	6	3	6	4	24	53.
13	0	1	-1	5	6	7	4	5	7	5	4	2	1	2	1	4	3	3	4	10	10	12	35	24	24	35.
14	19	7	8	22	12	19	9	23	24	8	12	10	5	20	27	19	11	19	37	11	31	13	19	16	24	37.
15	2	12	7	4	8	6	8	20	6	6	7	2	2	4	7	27	14	7	6	15	8	2	5	13	24	27.
16	18	12	22	48	51	54	58	53	55	52	68	53	36	46	56	36	47	54	50	51	40	21	15	16	24	68.
17	19	12	9	6	5	5	11	13	15	31	30	31	24	32	20	33	18	27	25	33	4	2	0	1	24	33.
18	2	5	6	4	4	5	7	9	6	5	6	6	6	5	2	3	8	7	7	6	3	3	2	3	24	9.
19	4	2	2	3	2	2	3	3	2	3	1	-1	0	0	1	2	1	3	2	1	5	5	5	5	24	5.
20	3	2	2	2	1	6	9	7	9	17	19	25	25	28	33	37	44	46	38	38	47	41	26	18	24	47.
21	17	18	21	19	23	45	40	45	44	43	BA	41	29	23	32	23	20	23	23	31	31	25	29	33	23	45.
22	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	12	12	27	38	34	36	10	7	4	7	7	9	6	3	14	38.
23	3	3	1	0	10	11	16	13	7	2	3	4	6	17	13	13	17	13	23	20	37	16	24	21	24	37.
24	26	24	15	16	23	27	23	21	18	21	16	22	24	20	24	27	49	25	26	37	36	28	35	37	24	49.
25	26	32	28	27	24	22	25	32	17	14	12	13	10	8	8	8	10	9	29	64	20	17	18	19	24	64.
26	21	26	27	28	27	57	49	30	24	23	21	11	31	22	11	12	36	17	8	6	11	10	12	11	24	57.
27	9	9	7	8	5	10	14	9	20	5	18	13	8	6	10	7	5	4	3	5	39	19	26	29	24	39.
28	28	31	32	45	25	20	29	26	33	21	28	28	29	32	34	34	37	48	46	37	47	40	35	41	24	48.
29	37	34	40	35	40	28	26	34	35	20	14	15	6	15	39	12	11	14	14	16	20	5	13	11	24	40.
30	15	21	21	23	18	19	30	43	39	27	19	14	10	15	7	34	9	29	18	17	8	4	2	2	24	43.
31	-3	2	6	6	4	3	27	32	19	18	19	12	11	35	36	14	23	12	7	5	11	7	4	2	24	36.
NO.:	30	30	30	30	30	30	30	30	30	30	30	31	31	31	31	31	31	31	31	31	31	31	31	31		
MAX:	37.	34.	40.	48.	51.	57.	58.	53.	55.	52.	68.	53.	36.	46.	56.	52.	49.	54.	50.	64.	47.	41.	35.	41.		
AVG:	11.6	12.0	11.9	13.6	13.3	15.1	17.2	17.8	16.2	13.7	14.6	14.2	12.1	14.6	16.2	17.3	14.5	14.6	15.1	17.2	16.9	12.1	13.0	12.4		

MONTHLY OBSERVATIONS: 733 MONTHLY MEAN: 14.5 MONTHLY MAX: 68.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0010 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: Converse County Long-Term 16 Miles West of Wyoming Highway 59 on Highland Loop Roa
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.1012810009
LONGITUDE: -105.498931
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1650
PROBE HEIGHT: 4

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: SEPTEMBER 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	1	6	6	6	2	16	36	15	21	10	10	13	8	6	6	6	6	11	7	41	32	19	-2	5	24	41.
2	4	2	1	1	2	30	1	32	21	12	28	17	14	53	1	6	6	6	7	5	3	3	4	2	24	53.
3	2	5	2	19	11	24	17	8	15	11	34	53	36	14	22	17	137	6	4	2	-1	1	1	0	24	137.
4	1	2	2	3	3	6	6	6	6	7	4	4	7	6	2	2	4	10	7	4	3	2	0	-2	24	10.
5	-1	2	3	0	-1	1	2	3	3	4	4	3	4	4	4	3	4	3	6	8	5	4	7	8	24	8.
6	6	11	7	8	7	5	13	9	9	10	12	20	15	11	9	9	6	11	13	10	13	10	9	14	24	20.
7	10	11	13	20	11	42	20	8	5	5	7	7	6	7	7	7	5	8	14	14	8	8	10	41	24	42.
8	41	27	15	11	8	6	5	14	24	BA	BA	12	12	6	1	3	4	4	7	6	3	2	1	1	22	41.
9	0	-2	9	25	17	17	15	2	6	6	5	5	7	AZ	10	AT	-5	1	4	8	11	14	12	14	22	25.
10	15	13	9	5	4	7	5	5	7	6	9	22	12	9	9	9	17	16	12	10	15	11	10	11	24	22.
11	9	7	10	11	10	13	17	17	25	9	9	5	5	4	3	10	7	8	23	28	13	17	47	15	24	47.
12	24	15	12	13	14	10	35	17	9	8	6	4	3	2	2	1	-2	-2	4	8	14	9	19	22	24	35.
13	17	15	10	8	13	21	25	26	13	8	9	8	5	9	9	10	14	13	19	19	11	14	16	16	24	26.
14	20	23	17	16	17	23	42	28	33	45	28	21	25	26	39	35	23	38	9	9	27	22	7	24	24	45.
15	4	12	6	0	2	47	15	23	32	14	18	14	23	15	10	29	15	11	8	7	6	3	0	17	24	47.
16	3	2	1	-1	-1	3	10	5	8	13	44	19	52	19	19	12	40	27	6	8	5	1	2	3	24	52.
17	1	6	4	-1	-1	2	1	-2	1	6	6	3	4	4	5	17	1	1	-1	1	6	6	5	3	24	17.
18	3	3	1	-2	-1	0	1	1	0	-1	-3	-1	0	-2	-1	0	1	2	1	4	27	9	7	10	24	27.
19	6	2	4	2	-1	3	25	2	2	3	2	0	-1	0	1	2	2	1	3	4	2	5	14	7	24	25.
20	78	1	0	1	3	4	4	2	1	1	2	-1	-2	3	3	2	28	-4	35	50	26	15	12	12	24	78.
21	17	4	6	6	3	16	30	15	10	11	6	3	1	-1	0	-1	21	4	1	-1	5	5	6	121	24	121.
22	7	207	12	10	12	10	14	21	43	18	26	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	11	207.
23	AN	AN	AN	AN	AN	AN	AN	AN	AN	18	33	18	20	24	17	17	17	18	15	7	9	9	7	22	15	33.
24	7	26	8	13	17	16	24	9	12	11	8	7	11	11	9	8	16	10	10	11	12	12	25	16	24	26.
25	17	10	14	13	11	12	14	11	8	29	25	BA	BA	8	36	14	12	61	36	8	11	14	17	34	22	61.
26	48	27	13	10	9	11	23	9	12	10	16	14	11	6	3	16	12	48	43	29	12	24	20	20	24	48.
27	6	7	7	4	9	11	11	13	18	14	20	9	14	16	10	11	15	40	27	36	32	17	11	7	24	40.
28	3	7	11	10	11	14	10	15	22	23	11	8	6	4	2	2	2	2	6	6	3	3	7	5	24	23.
29	5	3	1	0	-2	-4	-4	4	3	8	6	6	8	7	8	10	11	9	8	11	10	8	16	11	24	16.
30	11	10	8	9	6	9	12	10	8	8	6	4	3	5	3	2	5	25	10	12	8	6	9	7	24	25.
31																									0	
NO.:	29	29	29	29	29	29	29	29	29	29	29	28	28	28	29	28	29	29	29	29	29	29	29	29		
MAX:	78.	207.	17.	25.	17.	47.	42.	32.	43.	45.	44.	53.	52.	53.	39.	35.	137.	61.	43.	50.	32.	24.	47.	121.		
AVG:	12.6	16.0	7.3	7.6	6.7	12.9	14.8	11.3	13.0	11.3	13.5	10.6	11.0	9.9	8.6	9.3	14.6	13.4	11.9	12.6	11.4	9.4	10.3	16.1		

MONTHLY OBSERVATIONS: 692 MONTHLY MEAN: 11.5 MONTHLY MAX: 207.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0010 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: Converse County Long-Term 16 Miles West of Wyoming Highway 59 on Highland Loop Roa
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.1012810009
LONGITUDE: -105.498931
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1650
PROBE HEIGHT: 4

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: OCTOBER 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	11	7	4	5	6	15	5	4	6	14	13	14	13	19	29	21	15	27	5	17	12	11	6	6	24	29.
2	14	19	20	17	16	13	13	18	13	8	10	7	12	8	7	10	12	11	10	10	9	6	3	2	24	20.
3	3	3	6	6	7	6	4	4	7	8	5	5	6	11	9	9	17	20	18	20	19	15	12	7	24	20.
4	2	1	0	-1	-2	-4	-4	-1	1	0	-2	0	-1	2	3	4	2	-1	1	3	8	13	9	6	24	13.
5	8	10	6	6	9	7	8	6	7	5	5	8	8	10	8	6	8	12	12	16	10	17	18	11	24	18.
6	7	4	7	7	10	11	11	6	5	5	8	9	9	8	10	9	8	12	9	6	5	4	7	6	24	12.
7	3	5	5	3	5	4	1	0	6	4	1	3	2	2	0	-2	-1	-1	8	18	13	8	9	6	24	18.
8	5	6	6	13	18	13	15	10	6	6	6	4	1	4	4	4	4	3	1	1	28	4	7	8	24	28.
9	6	7	6	3	0	-1	3	3	2	3	4	4	14	7	6	4	1	2	2	1	1	1	6	5	24	14.
10	5	2	-2	-2	2	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	5	5.
11	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	AQ	14	13	2	14.
12	10	10	7	4	1	2	4	5	3	6	10	6	3	5	4	1	-1	0	1	-1	-1	4	4	6	24	10.
13	4	1	3	2	4	6	4	6	4	3	2	2	4	4	6	6	3	8	6	3	17	8	4	1	24	17.
14	3	6	4	3	5	5	6	7	4	4	BA	2	2	3	3	6	6	8	139	26	5	6	8	8	23	139.
15	15	9	13	13	20	12	16	8	5	2	1	2	4	5	6	8	11	13	15	9	9	7	7	9	24	20.
16	11	10	11	10	10	9	11	14	13	16	14	18	6	15	12	13	16	39	67	21	22	21	22	21	24	67.
17	23	23	21	18	26	25	27	25	26	27	24	29	11	13	16	20	21	19	31	29	36	16	14	16	24	36.
18	17	20	16	10	8	6	12	16	9	11	10	13	11	7	8	5	3	2	2	5	4	3	3	4	24	20.
19	4	2	12	6	2	2	10	6	4	4	3	1	-1	1	4	5	5	4	7	5	2	4	6	4	24	12.
20	7	6	3	0	-1	-2	1	4	10	13	11	4	2	2	0	5	4	1	4	4	2	3	2	0	24	13.
21	-1	2	6	6	8	11	10	9	9	7	3	2	6	8	5	12	8	6	6	6	6	8	7	7	24	12.
22	4	3	4	3	6	7	7	4	4	7	5	2	5	5	4	3	6	3	-1	-2	-2	0	-2	1	24	7.
23	4	1	-1	3	4	1	0	6	5	4	2	0	1	2	1	0	AQ	AQ	AQ	AQ	AQ	2	1	3	19	6.
24	3	6	4	3	2	4	2	5	2	-2	0	0	0	-3	-2	0	-3	5	3	2	1	1	1	5	24	6.
25	4	2	4	2	2	1	3	2	4	4	2	0	-1	3	2	-2	1	1	2	4	4	4	4	4	24	4.
26	3	1	4	6	5	5	5	4	3	6	2	2	3	3	8	5	3	4	4	5	6	5	4	4	24	8.
27	4	5	7	4	2	2	6	6	6	2	-2	0	-1	-1	-1	-2	1	0	-2	-2	-2	-3	-1	1	24	7.
28	-3	-5	-5	-5	-3	-3	-3	-3	-3	0	0	0	-2	-3	3	3	1	4	3	0	-1	0	-1	0	24	4.
29	3	-2	-2	2	1	2	0	AQ	AQ	AQ	-2	0	1	-2	-3	0	4	5	10	7	5	3	1	2	21	10.
30	3	5	3	-1	-4	AQ	AQ	-4	1	-1	-2	5	10	6	34	17	0	6	4	0	1	6	11	6	22	34.
31	2	1	2	2	3	4	3	2	5	5	18	8	13	26	27	15	-3	2	4	6	5	4	5	20	24	27.
NO.:	30	30	30	30	30	28	28	28	28	28	28	29	29	29	29	29	28	28	28	28	28	29	30	30		
MAX:	23.	23.	21.	18.	26.	25.	27.	25.	26.	27.	24.	29.	14.	26.	34.	21.	21.	39.	139.	29.	36.	21.	22.	21.		
AVG:	6.1	5.7	5.8	4.9	5.7	5.8	6.4	6.1	6.0	6.1	5.4	5.2	4.9	5.9	7.3	6.4	5.4	7.7	13.3	7.8	8.0	6.2	6.4	6.4		

MONTHLY OBSERVATIONS: 692 MONTHLY MEAN: 6.4 MONTHLY MAX: 139.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0010 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: Converse County Long-Term 16 Miles West of Wyoming Highway 59 on Highland Loop Roa
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.1012810009
LONGITUDE: -105.498931
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1650
PROBE HEIGHT: 4

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: NOVEMBER 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	6	6	8	7	7	8	4	1	2	26	20	20	43	18	49	-2	3	33	3	AQ	-1	1	1	2	23	49.
2	3	4	AQ	-3	-1	1	-1	1	10	5	19	15	9	62	6	25	31	28	54	13	8	23	12	13	23	62.
3	17	4	31	8	5	4	10	32	28	27	9	18	9	12	7	8	9	7	8	8	6	9	6	3	24	32.
4	2	5	2	-2	-1	0	0	2	4	6	3	1	2	0	1	2	2	4	3	0	0	-1	-2	-2	24	6.
5	-3	-2	AQ	-3	1	1	-1	0	-2	-3	1	-1	-2	0	1	-1	-2	1	2	1	2	4	5	6	23	6.
6	6	3	0	2	3	3	2	3	4	3	4	2	2	2	1	2	2	-1	1	1	AQ	5	1	4	23	6.
7	4	2	2	1	-1	-1	1	2	1	2	3	5	3	2	2	-1	1	2	-1	-1	-1	1	4	3	24	5.
8	2	3	4	5	6	3	1	5	3	2	2	6	8	6	12	6	3	5	3	0	3	3	3	2	24	12.
9	-1	0	2	-1	-2	1	3	4	3	3	BA	BA	-2	4	3	7	10	9	9	4	3	3	5	1	22	10.
10	1	-1	-4	5	4	4	3	0	2	4	1	5	5	4	8	5	3	5	6	3	2	1	0	4	24	8.
11	1	0	-2	-4	-1	2	3	3	1	0	1	-3	-2	1	1	4	3	4	5	3	4	4	3	3	24	5.
12	3	1	0	1	3	3	4	3	1	3	2	1	4	3	1	4	4	5	6	3	0	2	2	2	24	6.
13	0	1	1	2	5	11	6	2	7	4	15	12	9	7	6	6	6	5	1	8	5	0	1	1	24	15.
14	-3	-2	0	0	0	-1	-1	3	3	-1	-1	2	1	-2	-1	-1	0	3	3	2	2	2	2	3	24	3.
15	0	-2	4	3	-1	-2	2	3	1	1	3	6	6	6	2	1	5	4	2	3	3	3	3	3	24	6.
16	2	1	2	4	6	4	1	3	6	6	6	3	2	4	7	19	17	14	10	5	4	5	4	3	24	19.
17	2	0	3	4	5	3	2	1	0	2	2	2	1	0	1	2	5	6	2	3	5	2	7	6	24	7.
18	9	27	18	10	8	11	10	15	13	20	27	11	13	8	5	13	8	6	4	2	1	-1	0	3	24	27.
19	3	1	2	-1	-2	1	1	3	2	0	1	3	2	1	0	4	4	1	5	8	11	6	7	5	24	11.
20	4	5	6	5	3	2	-1	-2	-1	-1	2	2	0	4	3	6	3	2	6	6	4	2	3	3	24	6.
21	6	2	0	2	1	8	11	22	49	88	90	62	19	5	4	4	3	1	0	1	2	4	1	-1	24	90.
22	-2	2	2	2	3	4	0	-2	0	1	0	-2	-4	-3	0	1	-1	1	3	2	1	1	0	0	24	4.
23	0	-1	2	2	-2	-4	-1	4	3	10	7	3	6	14	10	5	0	-1	3	5	2	0	0	4	24	14.
24	2	11	7	4	3	1	1	4	3	5	6	23	5	2	0	1	8	6	5	7	2	-2	1	4	24	23.
25	8	5	2	6	6	6	6	3	6	4	0	1	3	7	6	6	4	5	10	13	9	6	5	3	24	13.
26	4	5	4	2	4	2	2	2	0	2	4	3	2	1	2	1	0	1	5	1	-1	1	3	4	24	5.
27	3	2	1	-1	0	0	-1	4	5	3	0	-1	2	2	1	4	8	6	3	5	5	2	0	2	24	8.
28	2	1	1	-2	-1	1	1	3	3	4	7	6	3	3	2	2	6	6	6	5	3	3	3	1	24	7.
29	1	1	-1	-1	2	0	-3	0	-1	-2	3	4	3	0	3	4	0	1	2	0	1	0	-1	4	24	4.
30	6	2	1	1	0	0	2	3	1	0	1	-1	3	3	4	2	3	4	5	4	3	2	2	2	24	6.
31																									0	
NO.:	30	30	28	30	30	30	30	30	30	30	29	29	30	30	30	30	30	30	30	29	29	30	30	30		
MAX:	17.	27.	31.	10.	8.	11.	11.	32.	49.	88.	90.	62.	43.	62.	49.	25.	31.	33.	54.	13.	11.	23.	12.	13.		
AVG:	2.9	2.9	3.5	1.9	2.1	2.5	2.2	4.2	5.2	7.5	8.2	7.2	5.2	5.9	4.9	4.6	4.9	5.8	5.8	4.0	3.0	3.0	2.7	3.0		

MONTHLY OBSERVATIONS: 714 MONTHLY MEAN: 4.3 MONTHLY MAX: 90.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0010 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: Converse County Long-Term 16 Miles West of Wyoming Highway 59 on Highland Loop Roa
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.1012810009
LONGITUDE: -105.498931
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1650
PROBE HEIGHT: 4

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: DECEMBER 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	3	9	7	6	5	3	2	1	1	5	3	1	0	1	2	3	3	0	1	6	5	3	5	4	24	9.
2	2	2	4	1	0	0	1	3	4	3	-1	-2	4	4	1	0	4	9	7	3	2	1	-1	-1	24	9.
3	0	2	3	2	5	3	0	1	3	3	7	9	5	2	4	3	4	6	3	2	-1	-2	-2	0	24	9.
4	1	1	-1	-1	0	-1	0	5	5	12	7	8	7	10	6	1	4	4	4	3	0	-1	3	2	24	12.
5	2	8	6	17	2	20	5	5	11	5	2	3	6	5	20	3	23	15	3	4	3	1	-1	5	24	23.
6	5	2	9	6	5	4	3	6	6	4	5	11	6	9	13	8	2	3	4	8	58	35	7	7	24	58.
7	5	5	4	4	4	1	2	1	4	13	32	44	87	36	85	21	19	30	13	9	85	38	20	14	24	87.
8	9	6	4	2	1	3	3	1	2	6	5	1	2	2	2	4	7	4	15	6	1	0	3	4	24	15.
9	3	5	4	6	6	20	11	7	23	10	22	12	26	83	40	22	51	44	27	0	1	4	19	2	24	83.
10	2	4	3	2	3	1	1	0	-3	-3	-3	4	4	2	1	29	12	10	7	5	4	3	3	2	24	29.
11	2	6	5	2	0	-1	0	1	4	5	2	-2	-3	-3	-2	0	23	5	18	7	113	2	3	3	24	113.
12	0	0	0	-1	-2	0	0	-2	-3	-1	0	-2	-2	-2	-2	5	5	2	3	2	0	2	2	1	24	5.
13	0	2	0	-1	0	2	4	3	2	3	-1	-3	2	3	0	-2	-1	-1	-1	0	-1	-1	0	-1	24	4.
14	0	1	1	0	-1	-2	-3	-2	0	0	-1	-2	-1	-2	-3	0	2	1	3	4	3	0	0	4	24	4.
15	3	-3	-4	0	0	-2	0	3	1	2	AT	6	6	6	6	6	3	13	9	7	6	4	2	1	23	13.
16	1	-1	-1	0	1	4	1	0	1	0	0	0	1	2	-1	0	4	4	5	3	1	2	2	0	24	5.
17	0	4	3	1	3	7	4	-1	-1	2	1	0	0	4	8	5	4	6	3	3	6	4	8	9	24	9.
18	19	29	17	24	22	18	17	18	14	19	13	11	10	10	8	6	8	7	3	1	1	1	0	2	24	29.
19	2	3	2	0	3	3	1	-1	-1	2	3	-1	-2	1	0	6	6	5	3	3	1	0	0	2	24	6.
20	2	0	1	1	1	3	3	1	2	1	0	16	-3	1	2	2	1	12	5	5	4	2	2	1	24	16.
21	0	0	4	3	0	-2	3	2	1	2	2	1	3	4	2	1	-1	0	5	5	3	1	1	2	24	5.
22	1	3	3	2	1	3	2	3	3	0	-1	-1	1	1	1	1	3	2	1	1	1	2	1	1	24	3.
23	1	3	-1	-3	-2	-1	-1	0	0	-2	0	0	2	2	1	1	0	1	2	2	1	2	2	0	24	3.
24	1	1	2	4	1	0	5	4	2	2	0	-1	1	2	2	2	3	3	3	2	1	0	1	1	24	5.
25	1	4	4	1	0	-1	0	0	-1	1	0	-2	-1	-3	3	5	6	10	11	12	7	6	6	3	24	12.
26	3	6	4	5	6	7	5	6	6	5	5	3	2	5	4	2	2	2	1	1	2	5	4	1	24	7.
27	1	1	1	0	-1	2	3	1	0	0	-3	-2	3	3	3	2	2	5	6	4	4	7	5	2	24	7.
28	2	0	3	5	5	5	3	3	8	5	4	1	1	6	5	4	3	5	2	1	1	2	0	0	24	8.
29	1	0	0	0	2	4	5	2	-2	3	1	2	3	4	4	4	3	2	6	5	3	2	2	2	24	6.
30	2	3	2	5	3	3	6	7	6	4	2	1	2	1	2	3	5	5	3	3	5	4	0	5	24	7.
31	5	2	1	1	1	3	4	5	3	1	2	2	2	1	2	5	3	2	3	4	3	6	6	9	24	9.
NO.:	31	31	31	31	31	31	31	31	31	31	30	31	31	31	31	31	31	31	31	31	31	31	31	31		
MAX:	19.	29.	17.	24.	22.	20.	17.	18.	23.	19.	32.	44.	87.	83.	85.	29.	51.	80.	27.	12.	113.	38.	20.	14.		
AVG:	2.5	3.5	2.9	3.0	2.4	3.5	2.9	2.7	3.3	3.6	3.6	3.8	5.6	6.5	7.1	4.9	6.9	3.6	5.7	3.9	10.4	4.4	3.3	2.8		

MONTHLY OBSERVATIONS: 743 MONTHLY MEAN: 4.5 MONTHLY MAX: 113.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0088 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: NA-8 North Antelope Rochelle (Near Irwin Ranch Road)
SITE COMMENTS: NA-5 moved to this site
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.4794730009
LONGITUDE: -105.22324
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1356.6
PROBE HEIGHT:

SUPPORT AGENCY: (0527) Inter-Mountain Laboratory Sheridan, WY
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0882) Powder River Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	24	22	24	70	16	11	44	35	34	36	15	32
2	20	25	9	42	28	23	23	49	18	15	17	19
3	33	8	24	35	30	15	21	30	34	11	15	18
4	34	8	25	46	12	9	23	18	44	AH	12	9
5	17	23	37	52	8	10	51	17	17	10	14	18
6	17	9	22	35	12	20	45	19	41	18	13	20
7	12	35	19	17	16	22	40	35	29	25	20	17
8	35	28	20	8	7	17	26	24	48	AH	14	15
9	29	26	31	9	3	26	15	20	65	AH	14	42
10	19	20	36	30	8	18	16	21	19	AH	22	12
11	18	9	18	29	10	12	15	16	18	AH	21	13
12	7	23	40	22	12	11	49	19	39	AH	24	5
13	15	34	33	24	19	17	33	32	45	AH	20	6
14	18	23	35	25	13	13	34	44	56	40	13	6
15	12	13	15	28	3	8	AV	26	31	44	10	60
16	10	9	34	15	7	12	16	52	29	18	57	17
17	17	13	7	27	14	20	23	28	15	49	21	12
18	8	21	34	7	10	16	23	14	17	46	P 266 rj	18
19	24	19	22	16	5	33	28	9	24	29	AI	7
20	15	17	27	25	3	16	24	31	48	20	AI	7
21	15	12	54	22	5	36	15	63	28	14	AI	9
22	22	17	31	10	5	21	12	76	23	7	25	18
23	27	29	16	18	5	20	22	24	19	14	16	26
24	18	19	23	13	4	25	29	36	19	15	18	11
25	14	51	17	13	10	10	25	31	11	13	34	49
26	19	10	33	5	7	18	21	41	17	6	38	35
27	18	8	46	5	7	15	44	47	53	10	25	18
28	25	35	P 276 rj	6	22	15	28	87	24	16	23	19
29	12		94	9	9	23	33	63	10	12	15	30
30	32		44	35	6	43	46	37	13	15	19	31
31	34		46		17		31	38		17		31
NO.:	31	28	31	30	31	30	30	31	30	24	27	31
MAX:	35.	51.	276.	70.	30.	43.	51.	87.	65.	49.	266.	60.
MEAN:	20.0	20.2	38.5	23.3	10.7	18.5	28.5	34.9	29.6	20.8	29.7	20.3

ANNUAL OBSERVATIONS: 354 ANNUAL MEAN: 24.6 ANNUAL MAX: 276.

2 Values marked with 'P' exceed the PRIMARY STANDARD of: 155
2 Values marked with 'S' exceed the SECONDARY STANDARD of: 155

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0801 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: 369 E. Antelope, Douglas
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: AGRICULTURAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 42.766972
LONGITUDE: -105.303528
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 5091
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: JANUARY 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	2	6	6	4	4	0	-3	-1	3	6	4	4	7	6	7	8	7	2	0	2	3	3	1	2	24	8.
2	5	2	4	0	-1	8	7	6	8	1	BA	BA	17	11	10	6	4	4	3	3	0	-2	1	1	22	17.
3	1	-2	-1	2	0	-3	-1	74	22	15	14	17	16	9	5	5	2	AN	-5	3	1	0	2	1	23	74.
4	-1	2	3	3	7	3	3	4	2	5	3	2	3	4	3	1	-1	0	3	4	4	4	7	4	24	7.
5	-1	3	4	1	3	6	16	21	13	10	7	6	4	2	2	1	-1	1	0	-3	0	3	-1	AN	23	21.
6	0	3	-1	0	3	4	0	1	8	8	3	2	3	2	2	2	5	8	6	1	6	7	1	-1	24	8.
7	-1	3	5	6	4	-2	0	1	2	-1	-1	2	-2	0	5	5	-3	-3	-3	0	2	0	3	4	24	6.
8	5	6	5	1	-2	1	3	3	1	2	3	3	0	3	9	6	5	9	9	5	2	1	3	6	24	9.
9	0	1	3	-1	-2	-2	1	3	1	3	11	9	2	1	1	3	4	0	2	0	-2	4	5	5	24	11.
10	3	2	1	0	7	10	4	6	6	6	5	0	0	2	5	5	-1	-2	5	3	-2	1	2	4	24	10.
11	4	-2	-3	1	2	5	4	2	7	5	4	6	6	4	4	2	4	4	1	3	3	2	3	2	24	7.
12	1	0	-1	3	3	3	1	0	7	10	9	10	9	15	9	8	10	10	17	10	6	7	9	9	24	17.
13	10	9	11	11	11	11	7	5	5	7	8	4	4	4	0	0	1	-1	-1	-2	0	0	-1	2	24	11.
14	3	2	-2	-1	1	-4	1	4	1	3	AN	2	1	0	-2	-2	0	5	3	2	5	2	-1	1	23	5.
15	0	0	6	6	4	1	-3	5	8	4	5	3	7	6	0	-2	0	3	3	2	-1	-1	4	6	24	8.
16	1	-2	1	1	4	6	2	3	7	5	0	4	9	8	4	5	4	-2	-1	2	2	1	2	8	24	9.
17	3	-1	5	0	-4	1	2	1	3	-1	-2	6	AN	3	-2	0	2	1	0	-1	2	4	-1	-3	23	6.
18	-1	2	-1	-1	2	2	4	8	8	4	5	7	2	-2	4	6	3	5	6	3	1	2	0	-3	24	8.
19	-2	2	2	-2	AN	-1	7	2	5	3	BA	-1	1	1	0	-2	2	2	4	5	2	2	3	1	22	7.
20	3	6	1	0	2	3	-1	-3	3	4	2	5	6	1	2	2	-1	1	2	-1	-1	0	-1	3	24	6.
21	2	0	-2	-1	3	3	4	1	2	1	-1	0	-1	1	5	5	5	5	4	4	0	-4	-1	0	24	5.
22	4	3	-4	-4	-2	-1	0	-2	0	5	2	-1	2	4	1	-3	-3	0	DA	7	6	6	-2	-2	23	7.
23	4	3	-1	-2	1	3	-2	0	4	0	-1	1	-1	1	2	0	-1	1	3	3	4	0	-1	4	24	4.
24	2	-2	2	1	-2	1	3	-1	3	2	0	4	6	6	7	8	7	4	0	0	2	2	0	0	24	8.
25	-2	0	0	1	2	0	2	4	3	4	1	4	7	4	-3	0	1	0	3	1	-5	-4	2	0	24	7.
26	-1	-2	-1	-2	-3	-1	-4	-2	2	3	4	5	4	0	-2	2	5	6	6	5	2	-2	-1	2	24	6.
27	7	6	3	2	0	3	2	1	4	4	0	4	5	1	7	6	3	0	-4	1	-1	-1	1	0	24	7.
28	4	3	3	5	4	1	-3	0	4	4	1	-1	AN	4	2	0	3	0	5	5	3	4	1	-1	23	5.
29	-2	-1	1	2	5	6	6	6	6	8	10	6	2	2	3	4	6	0	-4	-3	1	4	1	-1	24	10.
30	0	4	5	-3	-2	9	7	7	4	0	3	2	7	6	3	11	15	69	57	24	12	10	7	2	24	69.
31	-1	7	9	4	5	3	5	5	2	5	3	6	7	6	8	5	3	4	4	9	6	1	2	0	24	9.
NO.:	31	31	31	31	30	31	31	31	31	31	28	30	29	31	31	31	31	30	30	31	31	31	31	30		
MAX:	10.	9.	11.	11.	11.	11.	16.	74.	22.	15.	14.	17.	17.	15.	10.	11.	15.	69.	57.	24.	12.	10.	9.	9.		
AVG:	1.7	2.0	2.0	1.2	2.0	2.5	2.4	5.3	5.0	4.4	3.6	4.0	4.6	3.7	3.3	3.1	2.9	4.5	4.3	3.1	2.0	1.8	1.6	1.9		

MONTHLY OBSERVATIONS: 734 MONTHLY MEAN: 3.0 MONTHLY MAX: 74.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0801 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: 369 E. Antelope, Douglas
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: AGRICULTURAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 42.766972
LONGITUDE: -105.303528
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 5091
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: FEBRUARY 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	-2	-1	6	5	1	-2	1	2	1	6	4	4	6	7	5	1	1	1	-1	-3	2	5	5	5	24	7.
2	2	0	2	3	1	-4	0	5	2	2	BA	BA	7	9	5	2	0	17	1	0	-2	-1	3	4	22	17.
3	7	4	2	2	-4	-1	4	2	1	0	3	4	0	-3	-3	0	6	4	-2	2	1	-1	1	2	24	7.
4	8	11	10	5	3	10	8	1	1	6	2	-4	0	3	1	-1	1	2	4	3	5	5	3	5	24	11.
5	6	6	6	7	6	1	3	4	1	1	0	2	6	10	6	2	1	-3	1	0	AN	1	5	5	23	10.
6	2	1	5	1	1	6	4	-1	0	6	3	1	1	-1	-2	-1	2	-1	-2	1	5	2	-3	0	24	6.
7	5	6	4	1	1	4	8	7	3	5	5	63	54	22	5	6	9	11	7	3	1	1	4	4	24	63.
8	2	AN	AN	5	7	3	-1	3	4	1	1	2	4	-1	-1	4	3	0	-1	2	1	-2	4	3	22	7.
9	-2	-1	-1	5	5	-3	-4	4	2	4	6	-3	-4	6	AN	AV	AV	AV	AV	AV	AV	AV	AV	42	15	42.
10	22	11	7	6	7	7	4	2	2	6	8	6	4	AN	2	4	5	8	7	3	0	-5	0	5	23	22.
11	1	4	4	2	2	0	0	2	1	3	6	3	2	1	0	3	3	1	5	6	-1	1	0	-4	24	6.
12	0	1	4	6	5	6	6	6	9	10	9	3	5	9	6	5	6	7	7	17	5	3	5	8	24	17.
13	3	2	4	2	3	5	4	3	5	5	5	BA	4	2	2	4	4	6	6	4	5	3	3	1	23	6.
14	-2	4	5	AN	1	0	0	3	3	6	8	3	1	4	3	1	5	6	5	3	6	5	-2	3	23	8.
15	7	3	7	4	17	8	17	AN	6	5	2	1	5	3	-2	-1	AN	-4	2	3	4	0	-1	1	22	17.
16	0	-2	-4	-1	0	-4	AN	-1	8	4	4	5	5	6	3	1	2	2	-2	-4	-4	3	8	5	23	8.
17	4	2	-3	1	5	10	6	1	2	0	1	0	-1	1	4	1	2	6	4	0	-2	2	2	-3	24	10.
18	-4	-2	1	7	8	1	-1	5	5	-1	1	5	6	4	-1	2	8	7	0	1	1	-4	-5	-4	24	8.
19	-1	4	3	5	4	0	5	4	-1	4	2	-4	-1	5	7	2	2	4	8	11	10	6	2	4	24	11.
20	8	5	4	3	0	-4	0	8	1	4	10	7	9	9	8	3	AN	0	4	3	1	0	-1	-1	23	10.
21	-1	-4	-3	2	0	-3	-1	2	5	6	6	6	7	0	-2	6	6	4	2	3	4	3	5	8	24	8.
22	7	4	2	4	1	0	4	1	3	6	3	0	3	-2	-5	3	5	5	6	8	8	3	2	7	24	8.
23	6	3	AN	-1	0	1	1	3	8	9	8	7	7	7	4	2	4	6	3	-2	0	1	-3	-5	23	9.
24	-3	3	6	3	-1	1	-1	-4	-1	4	8	-1	-5	2	4	4	9	9	4	3	4	4	4	3	24	9.
25	4	4	3	-1	2	3	2	-2	-2	-3	-4	0	1	-1	1	6	5	6	9	7	4	3	5	4	24	9.
26	0	1	2	-1	1	2	2	5	4	2	2	2	0	0	3	1	-4	-1	-3	-3	2	-2	-1	2	24	5.
27	1	0	-2	AN	3	8	0	-3	0	5	5	6	16	7	5	5	7	8	7	5	7	7	5	7	23	16.
28	8	8	4	7	12	5	2	4	4	3	6	4	4	10	7	2	AN	6	8	6	16	6	6	5	23	16.
29																									0	
30																									0	
31																									0	
NO.:	28	27	26	26	28	28	27	27	28	28	27	26	28	27	27	27	24	27	27	27	26	27	27	28		
MAX:	22.	11.	10.	7.	17.	10.	17.	8.	9.	10.	10.	63.	54.	22.	8.	6.	9.	17.	9.	17.	16.	7.	8.	42.		
AVG:	3.1	2.9	3.0	3.2	3.3	2.1	2.7	2.4	2.8	3.9	4.2	4.7	5.2	4.4	2.4	2.5	3.8	4.3	3.3	3.0	3.2	1.8	2.1	4.1		

MONTHLY OBSERVATIONS: 648 MONTHLY MEAN: 3.3 MONTHLY MAX: 63.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0801 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: 369 E. Antelope, Douglas
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: AGRICULTURAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 42.766972
LONGITUDE: -105.303528
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 5091
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: MARCH 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

DAY / HOUR	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	0	-3	0	5	6	5	4	4	5	7	4	3	1	5	5	AN	AN	-3	5	3	AN	-3	4	6	21	7.
2	5	5	15	10	10	6	8	13	12	13	21	12	BA	BA	17	10	8	8	7	5	9	10	4	-1	22	21.
3	4	7	3	4	8	8	8	7	AN	4	40	7	6	0	0	5	6	5	3	6	7	6	7	4	23	40.
4	3	7	6	5	6	2	4	8	7	4	2	4	4	4	3	1	4	7	6	0	1	10	4	-1	24	10.
5	4	2	2	6	10	10	7	7	8	17	13	13	BA	9	6	9	12	12	11	19	7	5	6	10	23	19.
6	7	7	5	4	6	9	9	7	17	7	15	23	7	9	9	6	6	5	6	15	6	9	12	5	24	23.
7	1	AN	5	5	6	9	10	6	8	10	11	11	16	2	4	6	10	8	4	10	7	7	13	17	23	17.
8	22	8	4	5	6	3	6	17	8	2	2	5	3	4	7	5	8	10	7	3	4	7	5	6	24	22.
9	5	5	6	5	6	10	10	10	9	4	4	19	AN	9	7	AN	5	8	18	3	0	3	5	6	22	19.
10	6	4	17	2	5	9	5	2	7	8	6	2	1	7	8	2	4	3	4	13	9	5	4	5	24	17.
11	1	0	0	17	5	6	7	16	6	4	6	7	5	6	7	6	8	AN	11	12	8	3	3	3	23	17.
12	2	3	3	2	4	9	7	6	10	20	BA	12	11	10	8	8	8	19	27	20	13	16	14	11	23	27.
13	10	9	8	11	6	2	2	8	7	-1	4	7	7	7	4	1	2	5	8	9	8	5	0	0	24	11.
14	1	4	7	6	2	1	2	4	4	7	8	7	6	7	5	4	5	6	7	6	9	6	5	10	24	10.
15	9	AN	3	1	-1	6	11	7	17	8	8	6	4	4	5	5	4	7	6	4	4	5	8	5	23	17.
16	3	1	5	5	2	5	5	15	8	19	10	16	18	17	37	21	16	9	10	11	22	10	8	8	24	37.
17	10	8	7	5	5	4	4	7	3	-1	0	3	7	10	7	20	12	11	9	11	12	12	13	12	24	20.
18	11	13	12	9	5	16	34	19	18	21	10	9	11	10	6	7	10	12	19	5	4	3	2	1	24	34.
19	4	3	4	4	0	1	8	9	4	4	4	5	7	7	5	3	5	3	3	16	14	9	3	AN	23	16.
20	1	-2	-1	3	4	1	-1	-1	6	13	10	5	7	8	-1	-1	5	4	21	14	14	11	6	6	24	21.
21	6	7	6	6	7	10	13	11	10	18	17	2	1	2	1	-3	2	16	36	14	23	28	12	20	24	36.
22	16	9	9	8	4	5	9	8	3	0	2	5	5	3	2	0	7	12	11	10	9	9	6	8	24	16.
23	11	15	9	10	11	9	6	7	19	20	13	23	22	21	28	4	8	5	7	8	0	1	1	-4	24	28.
24	-4	-2	-3	-1	0	7	12	7	2	1	AN	4	6	8	12	14	8	7	9	6	3	4	1	-1	23	14.
25	1	7	11	3	2	4	5	16	2	6	8	6	5	-4	-1	6	3	5	3	4	2	1	5	5	24	16.
26	0	-1	-1	-3	1	1	3	5	5	7	8	7	4	4	8	8	9	9	37	6	10	7	5	10	24	37.
27	8	3	3	3	2	0	-2	3	9	11	13	10	7	8	9	6	5	10	11	7	11	10	4	4	24	13.
28	6	7	7	6	4	3	3	4	7	8	10	11	17	38	26	44	60	41	26	86	220	212	120	79	24	220.
29	69	39	31	17	9	4	2	7	9	5	1	3	3	6	5	-1	-1	1	4	8	7	4	3	7	24	69.
30	11	8	6	5	6	7	20	6	9	11	9	7	7	10	7	3	3	4	9	36	17	16	11	10	24	36.
31	6	4	5	3	5	10	25	21	23	13	13	13	10	6	3	3	7	23	51	26	18	10	10	8	24	51.
NO.:	31	29	31	31	31	31	31	31	30	31	29	31	28	30	31	29	30	30	31	31	30	31	31	30		
MAX:	69.	39.	31.	17.	11.	16.	34.	21.	23.	21.	40.	23.	22.	38.	37.	44.	60.	41.	51.	86.	220.	212.	120.	79.		
AVG:	7.7	6.1	6.3	5.5	4.9	5.9	7.9	8.6	8.7	8.7	9.4	8.6	7.4	7.9	8.0	7.0	8.3	9.1	12.8	12.8	15.9	14.2	9.8	8.6		

MONTHLY OBSERVATIONS: 729 MONTHLY MEAN: 8.8 MONTHLY MAX: 220.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0801 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: 369 E. Antelope, Douglas
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: AGRICULTURAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 42.766972
LONGITUDE: -105.303528
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 5091
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: APRIL 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

HOUR / DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	9	10	9	12	12	17	28	20	19	12	17	18	BA	33	16	13	13	10	9	13	11	10	13	13	23	33.
2	13	17	15	29	19	27	27	27	9	9	10	12	10	9	7	8	11	10	6	24	9	7	8	11	24	29.
3	9	7	11	8	AN	3	7	7	7	12	11	17	8	10	8	9	6	4	21	31	8	5	1	4	23	31.
4	5	5	4	2	5	7	17	17	11	11	25	7	7	6	6	7	5	6	6	5	8	16	10	18	24	25.
5	13	12	10	10	9	9	17	15	12	16	11	9	8	10	10	12	12	19	51	24	18	31	20	13	24	51.
6	18	AN	16	21	17	19	20	19	19	20	28	22	19	18	16	20	19	20	20	22	21	17	19	13	23	28.
7	16	13	13	17	12	16	23	33	25	AN	27	16	27	25	28	18	19	20	23	14	11	9	12	11	23	33.
8	11	11	10	12	20	20	8	8	8	19	10	12	15	22	19	14	7	-1	-2	1	0	0	3	2	24	22.
9	0	-2	-3	-2	0	4	3	0	1	4	5	2	2	2	2	4	6	3	5	9	6	4	2	4	24	9.
10	7	5	2	3	3	2	5	8	7	5	8	7	6	6	5	7	10	9	9	10	6	9	15	13	24	15.
11	17	16	19	28	25	24	17	27	20	24	23	20	24	14	13	11	11	12	21	22	17	20	13	11	24	28.
12	10	11	17	12	16	9	31	19	AN	9	6	-1	-4	-1	2	3	3	1	2	1	0	3	4	3	23	31.
13	2	2	3	4	6	5	3	4	6	8	8	5	5	8	6	6	4	1	1	5	6	3	3	8	24	8.
14	10	9	15	11	11	12	12	11	16	13	12	9	6	7	9	6	20	16	17	17	21	31	35	48	24	48.
15	46	56	79	36	27	23	18	19	13	11	6	4	2	0	2	1	1	0	-4	-2	1	3	2	1	24	79.
16	2	-1	-3	-2	3	4	2	0	-1	BA	BA	5	11	7	7	11	10	4	4	AN	11	9	9	4	21	11.
17	0	5	7	8	8	3	4	9	7	10	12	8	6	6	4	2	2	-1	-5	1	6	9	9	6	24	12.
18	5	5	7	2	-1	2	3	7	9	4	-1	1	3	4	2	-1	0	0	-2	3	3	6	16	2	24	16.
19	1	2	7	6	2	2	6	11	6	4	7	6	2	2	4	2	0	5	3	2	6	4	1	4	24	11.
20	2	-1	3	5	6	2	1	4	7	9	6	6	2	-3	-2	0	2	2	3	0	17	24	9	9	24	24.
21	3	0	6	5	3	7	6	6	9	22	4	8	6	1	5	8	8	11	11	32	17	16	5	6	24	32.
22	7	7	8	3	4	21	10	12	14	10	9	13	13	17	15	3	8	11	9	7	7	6	7	11	24	21.
23	5	6	4	2	9	10	19	16	7	16	13	12	16	16	16	13	26	8	8	15	-1	5	11	10	24	26.
24	11	11	8	7	6	6	5	2	8	24	10	10	7	22	7	9	8	7	17	-4	2	15	6	5	24	24.
25	2	5	6	1	6	7	7	11	11	10	8	3	0	-2	2	8	7	7	18	8	3	6	7	2	24	18.
26	6	10	9	7	8	4	-3	-3	-1	3	5	3	6	7	3	2	4	4	0	4	7	5	4	3	24	10.
27	0	0	0	-1	4	9	5	-1	-2	3	2	-2	-2	-2	-1	1	0	-1	3	3	4	8	7	4	24	9.
28	4	6	4	2	2	4	6	4	3	3	6	7	7	4	3	10	9	5	9	16	7	10	8	9	24	16.
29	11	12	9	16	2	15	13	12	8	7	18	4	4	3	-2	0	4	3	15	15	17	12	12	11	24	18.
30	11	10	9	10	12	9	6	16	18	15	11	11	8	7	24	20	32	29	13	10	16	16	16	2	24	32.
31																									0	
NO.:	30	29	30	30	29	30	30	30	29	28	29	30	29	30	30	30	30	30	30	29	30	30	30	30		
MAX:	46.	56.	79.	36.	27.	27.	31.	33.	25.	24.	28.	22.	27.	33.	28.	20.	32.	29.	51.	32.	21.	31.	35.	48.		
AVG:	8.5	8.6	10.1	9.1	8.8	10.1	10.9	11.3	9.5	11.2	10.9	8.5	7.7	8.6	7.9	7.6	8.9	7.5	9.7	10.6	8.8	10.6	9.6	8.7		

MONTHLY OBSERVATIONS: 712 MONTHLY MEAN: 9.3 MONTHLY MAX: 79.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0801 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: 369 E. Antelope, Douglas
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: AGRICULTURAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 42.766972
LONGITUDE: -105.303528
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 5091
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: MAY 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	6	10	9	AN	17	11	15	9	8	11	13	11	8	6	8	6	6	10	11	16	7	6	AN	9	22	17.
2	10	7	6	11	12	17	4	9	15	20	18	18	13	12	11	11	12	AN	20	10	17	5	9	12	23	20.
3	9	7	5	7	12	13	BA	BA	28	25	24	20	23	14	19	16	14	17	17	27	2	3	1	-1	22	28.
4	3	6	17	11	13	18	27	23	23	22	14	18	14	17	16	21	9	11	17	13	21	27	14	12	24	27.
5	20	13	22	12	19	11	9	19	15	14	12	9	3	1	2	5	9	10	4	2	1	-4	1	2	24	22.
6	-2	1	6	6	8	10	6	2	6	7	8	5	3	9	3	-4	-1	3	-1	-3	2	6	6	20	24	20.
7	12	11	9	7	7	8	10	9	6	7	7	4	4	9	19	17	16	13	8	16	4	4	5	3	24	19.
8	2	8	12	9	4	3	2	2	6	5	7	18	8	7	17	10	10	11	8	8	3	3	9	3	24	18.
9	2	4	0	2	4	1	2	2	0	-3	-4	0	0	-4	AN	-1	3	1	-5	AV	1	1	1	1	22	4.
10	1	1	2	4	3	BA	2	4	7	7	5	5	7	7	3	3	4	4	3	2	2	1	-1	1	23	7.
11	5	5	6	6	4	7	8	8	9	10	9	7	AN	9	10	4	3	6	6	7	7	4	1	1	23	10.
12	4	9	5	4	8	16	4	BA	4	7	8	9	17	6	8	10	5	6	9	4	4	6	3	1	23	17.
13	4	15	4	6	7	4	6	5	6	13	16	8	6	15	8	9	10	11	7	1	1	1	5	8	24	16.
14	7	7	9	16	6	7	7	18	12	11	AN	9	6	4	4	10	14	13	13	21	31	15	5	6	23	31.
15	6	7	7	7	5	5	8	10	4	0	1	1	4	7	7	20	1	3	5	4	1	AN	0	0	23	20.
16	0	5	4	0	0	0	3	6	AN	6	2	0	3	1	3	5	5	6	1	0	1	0	2	2	23	6.
17	2	1	2	3	1	-2	0	2	2	2	2	-3	2	9	4	-3	0	0	AN	0	2	2	5	7	23	9.
18	4	2	1	-1	0	-1	-1	-2	0	5	6	6	5	AN	8	4	2	5	5	3	3	5	5	0	23	8.
19	1	5	3	2	2	0	6	8	5	5	3	2	4	0	-4	-1	-1	-1	-1	-1	0	0	-1	-1	24	8.
20	1	1	0	1	1	0	-2	0	0	1	3	2	7	6	1	5	7	3	-1	-1	1	0	-1	0	24	7.
21	1	3	5	5	2	4	7	2	0	0	1	5	7	4	1	2	7	6	3	4	7	6	7	7	24	7.
22	3	0	2	6	5	6	10	7	5	8	4	3	6	2	0	6	3	1	5	0	0	2	4	5	24	10.
23	0	-1	4	1	0	1	3	7	8	9	9	7	5	5	7	7	8	4	1	3	-2	-2	1	0	24	9.
24	1	4	5	2	5	6	2	-3	0	6	6	4	5	7	5	2	3	2	0	1	0	-1	-1	2	24	7.
25	3	1	-1	-2	-3	-2	3	AN	1	-1	2	6	7	5	1	-2	0	1	5	7	7	11	10	9	23	11.
26	3	0	1	5	7	4	7	8	3	-1	1	3	3	7	4	2	6	6	5	18	259	AN	17	200	23	259.
27	31	122	78	36	42	13	11	10	13	11	5	33	6	6	2	1	5	5	1	2	6	17	10	9	24	122.
28	6	5	7	6	5	6	1	0	4	7	9	8	9	6	8	10	9	7	7	7	8	8	3	3	24	10.
29	0	1	2	1	2	7	10	5	0	1	4	3	2	20	16	16	13	13	14	14	20	12	13	13	24	20.
30	18	9	10	9	7	6	2	1	5	9	9	10	10	8	7	5	4	6	6	8	13	13	12	10	24	18.
31	12	12	6	2	3	5	8	6	2	6	6	4	4	4	3	3	6	6	19	12	17	9	8	8	24	19.
NO.:	31	31	31	30	31	30	30	28	30	31	30	31	30	30	30	31	31	30	30	30	31	29	30	31		
MAX:	31.	122.	78.	36.	42.	18.	27.	23.	28.	25.	24.	33.	23.	20.	19.	21.	16.	17.	20.	27.	259.	27.	17.	200.		
AVG:	5.6	9.1	8.0	6.1	6.7	6.1	6.0	6.3	6.6	7.4	7.0	7.6	6.7	7.0	6.7	6.4	6.2	6.3	6.4	6.8	14.4	5.5	5.1	11.4		

MONTHLY OBSERVATIONS: 727 MONTHLY MEAN: 7.2 MONTHLY MAX: 259.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0801 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: 369 E. Antelope, Douglas
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: AGRICULTURAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 42.766972
LONGITUDE: -105.303528
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 5091
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: JUNE 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

HOUR DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	10	8	5	5	5	5	6	9	9	9	4	5	6	5	10	12	12	12	10	9	6	4	7	6	24	12.
2	4	6	8	5	6	8	16	17	12	13	11	10	14	10	7	11	11	10	9	11	13	19	13	9	24	19.
3	6	11	14	7	6	12	BA	BA	27	0	2	16	8	18	11	16	16	21	19	24	19	4	5	7	22	27.
4	5	1	4	6	4	7	9	9	17	16	16	24	12	19	18	23	12	11	18	13	11	11	14	10	24	24.
5	6	7	10	13	11	5	6	10	13	17	17	21	16	5	7	9	6	9	8	7	11	12	12	19	24	21.
6	16	9	17	9	10	10	8	15	18	3	1	0	6	10	7	6	8	6	9	17	16	12	10	7	24	18.
7	5	5	AN	AN	AV	17	11	11	8	AN	9	10	9	10	12	10	10	10	6	9	11	11	13	7	20	17.
8	5	6	8	7	1	4	8	8	11	13	12	13	15	23	8	10	11	8	6	9	16	14	12	9	24	23.
9	10	11	6	9	13	13	76	38	227	353	277	14	44	24	-3	333	21	41	28	31	73	20	28	22	24	353.
10	2	5	8	9	7	19	10	23	29	39	15	11	10	11	14	10	24	12	405	4	28	22	10	8	24	405.
11	5	7	8	8	7	5	6	7	6	6	6	18	18	36	20	13	12	11	6	0	4	10	6	16	24	36.
12	9	8	8	6	7	8	16	18	15	15	13	10	10	11	11	8	8	10	11	15	14	12	17	13	24	18.
13	10	9	11	12	12	13	15	30	12	18	20	8	10	16	18	19	12	17	9	18	18	15	14	14	24	30.
14	14	14	15	17	11	13	21	10	8	7	17	6	18	14	14	7	19	16	18	9	11	21	10	AN	23	21.
15	6	7	7	4	3	2	3	6	6	6	18	11	11	11	7	15	6	8	11	11	10	11	15	10	24	18.
16	12	11	6	15	16	4	6	5	5	5	17	9	7	4	8	18	19	16	11	9	9	8	4	4	24	19.
17	7	10	8	7	10	8	6	9	10	12	11	10	17	167	7	16	9	16	17	21	15	15	20	27	24	167.
18	15	11	23	6	5	6	8	10	22	26	13	10	20	13	12	13	14	17	22	15	25	15	16	18	24	26.
19	14	18	16	11	16	13	13	15	22	27	22	23	19	18	19	19	50	22	20	21	29	47	23	19	24	50.
20	4	7	11	10	12	20	22	17	7	16	12	9	8	12	13	11	11	11	10	16	22	10	18	19	24	22.
21	15	7	8	7	7	9	11	9	17	21	19	21	23	16	102	38	20	23	27	27	35	26	31	80	24	102.
22	99	13	11	9	6	8	8	16	13	12	4	1	6	10	8	7	7	8	14	18	9	20	25	29	24	99.
23	25	17	18	15	24	27	16	29	21	16	22	49	23	23	27	23	28	27	25	36	32	45	45	37	24	49.
24	31	26	20	25	22	22	26	32	36	33	40	36	38	35	67	24	26	38	26	31	25	14	19	17	24	67.
25	16	14	14	18	11	11	21	18	22	32	21	18	33	19	49	23	19	18	11	11	17	4	5	6	24	49.
26	10	36	7	6	5	7	11	16	17	14	30	6	10	12	11	13	11	10	10	24	29	16	14	13	24	36.
27	11	10	10	15	11	13	21	11	16	17	6	8	9	8	10	13	11	8	17	19	20	18	16	10	24	21.
28	8	8	11	12	10	10	17	21	15	14	11	7	8	17	14	11	16	12	42	18	25	33	20	25	24	42.
29	19	16	13	9	27	26	16	20	21	19	16	BA	BA	14	11	8	22	7	17	16	23	19	14	14	22	27.
30	14	13	9	8	33	23	24	22	33	27	20	26	33	21	30	27	38	34	41	20	24	20	22	15	24	41.
31																									0	
NO.:	30	30	29	29	29	30	29	29	30	29	30	29	29	30	30	30	30	30	30	30	30	30	30	29		
MAX:	99.	36.	23.	25.	33.	27.	76.	38.	227.	353.	277.	49.	44.	167.	102.	333.	50.	41.	405.	36.	73.	47.	45.	80.		
AVG:	13.8	11.0	10.8	10.0	11.0	11.6	15.1	15.9	23.2	27.8	23.4	14.1	15.9	20.4	18.3	25.5	16.3	15.6	29.4	16.3	20.0	16.9	15.9	16.9		

MONTHLY OBSERVATIONS: 711 MONTHLY MEAN: 17.3 MONTHLY MAX: 405.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0801 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: 369 E. Antelope, Douglas
SITE COMMENTS:
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: AGRICULTURAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 42.766972
LONGITUDE: -105.303528
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 5091
PROBE HEIGHT:

SUPPORT AGENCY: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality
MONITOR TYPE: SPM
COLLECTION AND ANALYSIS METHOD: (122) INSTRUMENT MET ONE 4 MODELS BETA A
PQAO: (1188) Wyoming Air Quality Division, Dept Of Environmental Quality

REPORT FOR: JULY 2015

DURATION: 1 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	19	17	14	16	12	15	18	19	28	35	31	32	26	36	28	34	29	36	27	19	28	23	21	27	24	36.
2	17	12	16	14	7	4	18	16	16	13	17	16	17	15	15	12	28	21	32	24	20	25	15	18	24	32.
3	13	21	19	24	15	12	16	14	27	16	20	19	21	15	17	15	15	18	17	37	19	14	11	21	24	37.
4	1	4	8	11	9	AN	7	7	10	18	12	11	16	17	17	23	16	12	12	13	19	18	17	20	23	23.
5	16	11	17	14	12	15	14	13	27	48	97	77	37	39	31	37	25	29	39	37	45	42	26	34	24	97.
6	30	22	34	62	69	77	63	67	69	70	68	65	50	38	41	36	30	40	43	59	54	64	72	73	24	77.
7	73	76	72	71	68	70	80	92	95	82	67	63	60	59	53	88	59	56	41	27	19	30	27	AM	23	95.
8																									0	
9																									0	
10																									0	
11																									0	
12																									0	
13																									0	
14																									0	
15																									0	
16																									0	
17																									0	
18																									0	
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25																									0	
26																									0	
27																									0	
28																									0	
29																									0	
30																									0	
31																									0	
NO.:	7	7	7	7	7	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	6		
MAX:	73.	76.	72.	71.	69.	77.	80.	92.	95.	82.	97.	77.	60.	59.	53.	88.	59.	56.	43.	59.	54.	64.	72.	73.		
AVG:	24.1	23.3	25.7	30.3	27.4	32.2	30.9	32.6	38.9	40.3	44.6	40.4	32.4	31.3	28.9	35.0	28.9	33.3	30.1	30.9	29.1	30.9	27.0	32.2		

MONTHLY OBSERVATIONS: 166 MONTHLY MEAN: 31.6 MONTHLY MAX: 97.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0850 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: ANTELOPE SITE 5
SITE COMMENTS: KNOWN AS ANTELOPE COAL CO. #5 SITE.
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.4609600009
LONGITUDE: -105.331263
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 0
PROBE HEIGHT:

SUPPORT AGENCY: (0041) Antelope Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (126) R - P Co Partisol Model 2000 Gravi
PQAO: (0041) Antelope Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			17					43				
2		22				18	25				7	6
3	58			23	27				23	13		
4			11					25				
5		11				11	46				10	7
6	14			33	9				20	28		
7			17					AN				
8		13				14	31				20	9
9	17			6	1				27	19		
10			13					AN				
11		11				14	20				11	11
12	9			30	10				27	43		
13			24					40				
14		33				22	45				6	11
15	7			19	3				17	41		
16			34					67				
17		23				17	28				11	10
18	7			6	11				13	49		
19			22					8				
20		15				15	22				10	5
21	9			18	3				12	10		
22			27					50				
23		12				18	35				14	14
24	10			14	AN				16	16		
25			23					30				
26		26				17	22				14	17
27	8			4	6				35	10		
28			108					73				
29						21	22				26	26
30	54			22	7				15	8		
31			41					28				
NO.:	10	9	11	10	9	10	10	9	10	10	10	10
MAX:	58.	33.	108.	33.	27.	22.	46.	73.	35.	49.	26.	26.
MEAN:	19.3	18.4	30.6	17.5	8.6	16.7	29.6	40.4	20.5	23.7	12.9	11.6

ANNUAL OBSERVATIONS: 118 ANNUAL MEAN: 20.9 ANNUAL MAX: 108.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0850 POC: 2
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: ANTELOPE SITE 5
SITE COMMENTS: KNOWN AS ANTELOPE COAL CO. #5 SITE.
MONITOR COMMENTS:

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.4609600009
LONGITUDE: -105.331263
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 0
PROBE HEIGHT: 3

SUPPORT AGENCY: (0041) Antelope Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (126) R - P Co Partisol Model 2000 Gravi
PQAO: (0041) Antelope Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			12									
2											11	6
3									21	12		
4								25				
5		11				8	50					
6	14			31	8							
7			19									
8											19	6
9									34	20		
10								32				
11		10				13	21					
12	9			30	10							
13			22									
14											7	11
15									31	35		
16								65				
17		20				16	24					
18	7			7	9							
19			21									
20											13	5
21									15	10		
22								38				
23		13				17	28					
24	9			12	2							
25			23									
26											11	14
27									32	11		
28								68				
29						21	21					
30	42			23	7							
31			44									
NO.:	5	4	6	5	5	5	5	5	5	5	5	5
MAX:	42.	20.	44.	31.	10.	21.	50.	68.	34.	35.	19.	14.
MEAN:	16.2	13.5	23.5	20.6	7.2	15.0	28.8	45.6	26.6	17.6	12.2	8.4

ANNUAL OBSERVATIONS: 60 ANNUAL MEAN: 19.8 ANNUAL MAX: 68.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0851 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: ANTELOPE SITE 6
SITE COMMENTS: ANTELOPE COAL SITE SIX.
MONITOR COMMENTS: NEW PM-10 R&P PARTISOL INSTALLED 4-1-97.

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.4746880009
LONGITUDE: -105.310319
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 0
PROBE HEIGHT: 3

SUPPORT AGENCY: (0041) Antelope Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (079) INSTRUMENTAL-R&P SA246B-INLET TEOM
PQAO: (0041) Antelope Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: -50

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1	26	19	21	85	15	12	55	69	41	51	37	44
2	25	32	11	62	39	24	27	60	31	16	24	34
3	40	20	30	39	37	17	22	29	40	12	40	32
4	39	14	30	49	13	10	31	23	40	9	17	23
5	17	30	53	54	9	10	63	18	19	11	17	30
6	31	13	31	31	24	19	52	22	36	32	15	46
7	15	48	26	19	33	29	43	38	43	28	26	35
8	40	31	22	9	9	18	27	33	48	36	25	22
9	35	37	32	12	3	33	16	21	72	39	21	43
10	25	25	34	28	9	19	23	24	34	40	32	15
11	22	13	24	35	10	15	22	16	32	97	24	23
12	11	28	58	37	13	11	68	23	42	64	28	12
13	17	40	AI	23	15	23	39	87	81	45	39	13
14	24	35	AI	32	14	23	48	51	62	59	22	13
15	15	15	23	38	3	8	21	45	36	48	20	48
16	13	25	58	22	8	15	20	63	50	22	102	27
17	16	29	8	24	24	22	44	23	19	46	27	22
18	8	22	42	7	13	14	28	17	23	83	88	34
19	AH	42	33	33	5	38	45	8	53	35	22	7
20	AH	23	33	23	3	15	25	44	48	29	25	11
21	AH	19	55	31	5	64	18	95	37	16	32	12
22	AH	27	35	12	5	27	15	86	22	9	29	22
23	AH	45	22	30	4	20	46	24	21	33	19	35
24	AH	32	37	16	8	33	30	42	19	16	36	17
25	AH	54	23	18	11	15	53	36	16	17	52	76
26	AH	19	40	8	9	23	25	89	34	8	31	45
27	AH	10	40	7	8	21	45	53	84	12	35	29
28	AH	34	P 174 rj	7	13	20	61	72	21	17	48	25
29	17		53	12	10	30	33	66	11	15	26	32
30	55		56	36	8	54	52	51	16	19	28	37
31	47		56		16		31	55		27		33
NO.:	21	28	29	30	31	30	31	31	30	31	30	31
MAX:	55.	54.	174.	85.	39.	64.	68.	95.	84.	97.	102.	76.
MEAN:	25.6	27.9	40.0	28.0	12.8	22.7	36.4	44.6	37.7	32.0	32.9	28.9

ANNUAL OBSERVATIONS: 353 ANNUAL MEAN: 30.9 ANNUAL MAX: 174.

1 Values marked with 'P' exceed the PRIMARY STANDARD of: 155
1 Values marked with 'S' exceed the SECONDARY STANDARD of: 155

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
RAW DATA REPORT

Jul. 11, 2016

(81102) PM10 Total 0-10um STP

SITE ID: 56-009-0881 POC: 1
COUNTY: (009) Converse
CITY: (00000) Not in a city
SITE ADDRESS: ANTELOPE SITE 4
SITE COMMENTS: ANTELOPE COAL-ANTELOPE MINE. PIT SITE KNOWN AS SITE 4. CATEGORY A SITE - MAXIMUM
MONITOR COMMENTS: R&P PARTISOL SAMPLER INSTALLED ON 4-10-97. SAMPLES FOR PM10

STATE: (56) Wyoming
AQCR: (241) CASPER
URBANIZED AREA: (0000) NOT IN AN URBAN AREA
LAND USE: INDUSTRIAL
LOCATION SETTING: RURAL

CAS NUMBER:
LATITUDE: 43.4463152237
LONGITUDE: -105.33568167
UTM ZONE:
UTM NORTHING:
UTM EASTING:
ELEVATION-MSL: 1452
PROBE HEIGHT: 3

SUPPORT AGENCY: (0041) Antelope Coal Company
MONITOR TYPE:INDUSTRIAL
COLLECTION AND ANALYSIS METHOD: (126) R - P Co Partisol Model 2000 Gravi
PQAO: (0041) Antelope Coal Company

REPORT FOR: 2015

DURATION: 24 HOUR
UNITS: Micrograms/cubic meter (25 C)
MIN DETECTABLE: 4

Day	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1			12					50				
2		13				16	41				5	3
3	45			13	27				18	12		
4			AN					18				
5		3				9	26				6	4
6	11			22	7				16	23		
7			AN					17				
8		14				12	31				4	2
9	9			5	1				41	10		
10			10					15				
11		6				12	14				7	5
12	8			26	11				26	30		
13			13					37				
14		18				23	42				5	9
15	4			11	3				AN	24		
16			26					65				
17		12				16	22				4	6
18	2			6	14				7	17		
19			11					6				
20		10				11	16				13	5
21	5			15	3				12	9		
22			18					39				
23		5				19	31				9	10
24	3			10	2				14	11		
25			16					30				
26		29				18	18				9	9
27	2			3	6				33	6		
28			63					54				
29						18	22				12	21
30	32			18	7				11	5		
31			20					24				
NO.:	10	9	9	10	10	10	10	11	9	10	10	10
MAX:	45.	29.	63.	26.	27.	23.	42.	65.	41.	30.	13.	21.
MEAN:	12.1	12.2	21.0	12.9	8.1	15.4	26.3	32.3	19.8	14.7	7.4	7.4

ANNUAL OBSERVATIONS: 118 ANNUAL MEAN: 15.9 ANNUAL MAX: 65.

Note: Qualifier codes with regional concurrence are shown in upper case, and those without regional review are shown in lower case. An asterisk ("*") indicates that the region has reviewed the value and does not concur with the qualifier.

ED_001361_00002636

QUALIFIER CODES:

Qualifier Code	Qualifier Description	Qualifier Type
AA	Sample Pressure out of Limits	NULL
AF	Scheduled but not Collected	NULL
AG	Sample Time out of Limits	NULL
AH	Sample Flow Rate out of Limits	NULL
AI	Insufficient Data (cannot calculate)	NULL
AJ	Filter Damage	NULL
AM	Miscellaneous Void	NULL
AN	Machine Malfunction	NULL
AQ	Collection Error	NULL
AS	Poor Quality Assurance Results	NULL
AT	Calibration	NULL
AV	Power Failure	NULL
AZ	Q C Audit	NULL
BA	Maintenance/Routine Repairs	NULL
BR	Sample Value Below Acceptable Range	NULL
DA	Aberrant Data (Corrupt Files, Aberrant Chromatography, Spikes, Sh	NULL
X	Filter Temperature Difference out of Spec.	QA
rj	High Winds	REQEXC

Note: Qualifier codes with regional concurrence are shown in upper case,
and those without regional concurrence are shown in lower case.

ED_001361_00002636

To: Hyatt, Chuck R.[chyatt@nd.gov]
From: Carlson, Albion
Sent: Thur 6/8/2017 8:57:37 PM
Subject: FW: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations
AZ Ducey 6-6-17.pdf

Hi Chuck,

FYI I'm forwarding this message I read while checking my email this afternoon. EPA is extending the ozone designations by a year. Thanks,

Albion

From: Fallon, Gail
Sent: Wednesday, June 07, 2017 8:56 AM
To: R8 Air Program <R8AirProgram@epa.gov>
Subject: FW: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

From: Mutter, Andrew
Sent: Wednesday, June 07, 2017 8:46 AM
To: R8 RLT <R8_RLT@epa.gov>
Cc: R8 OCPI <R8_OCPI@epa.gov>
Subject: FW: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

From: U.S. EPA Media Relations [mailto:no-replysubscriptions@epa.gov]
Sent: Tuesday, June 06, 2017 4:33 PM
To: Mutter, Andrew <mutter.andrew@epa.gov>
Subject: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

CONTACT:
press@epa.gov

FOR IMMEDIATE RELEASE
June 6, 2017

EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

WASHINGTON – U.S. Environmental Protection Agency (EPA) Administrator Scott Pruitt sent a letter to governors today to inform them of EPA's efforts related to the National Ambient Air Quality Standards (NAAQS) for ozone promulgated in October 2015. EPA is extending the deadline for promulgating initial area designations, by one year, for the 2015 ozone NAAQS.

"States have made tremendous progress and significant investment cleaning up the air. We will continue to work with states to ensure they are on a path to compliance," **said Administrator Scott Pruitt.**

The National Ambient Air Quality Standard (NAAQS) for ground-level ozone is an outdoor air regulation under the Clean Air Act. As part of the process to determine what areas of the country are able to meet the current air quality standards, states are currently submitting their proposals for area designations under the 70 parts per billion (ppb) standard, which was lowed from 75 ppb in 2015. Areas designated as being in "nonattainment" of the standard face consequences, including: increased regulatory burdens, restrictions on infrastructure investment, and increased costs to businesses.

EPA is giving states more time to develop air quality plans and EPA is looking at providing greater flexibility to states as they develop their plans. And, pursuant to the language in the recently-enacted FY2017 Omnibus funding bill, Administrator Pruitt is establishing an Ozone Cooperative Compliance Task Force to develop additional flexibilities for states to comply with the ozone standard.

Additionally, the Agency is taking time to better understand some lingering, complicated issues so that air attainment decisions can be based on the latest and greatest information. This additional time will also provide the agency time to review the 2015 ozone NAAQS, prior to taking this initial implementation step.

Although the new ozone standard was set on October 1, 2015, there remains a host of complex issues that could undermine associated compliance efforts by states and localities. The Agency is evaluating these issues, primarily focused on:

- Fully understanding the role of background ozone levels;
- Appropriately accounting for international transport,
- And, timely consideration of exceptional events demonstrations.

"We share the goal of clean air, a robust economy and stronger, healthier communities. We are committed to working with states and local officials to effectively implement the ozone standard in a manner that is supportive of air quality improvement efforts without interfering with local decisions or impeding economic growth," **said Administrator Pruitt.**

Since 1980, total emissions of the six principal air pollutants have dropped by 63 percent and ozone levels have declined by 33 percent. Despite the continued improvement of air quality, costs associated with compliance of the ozone NAAQS have significantly increased.

R107

If you would rather not receive future communications from Environmental Protection Agency, let us know by clicking here.
Environmental Protection Agency, 1200 Pennsylvania Avenue NW, Washington, DC 20460 United States

To: Hyatt, Chuck R.[chyatt@nd.gov]
Cc: O'Clair, Terry L.[toclair@nd.gov]; rmills@nd.gov[rmills@nd.gov]; Papp, Michael[Papp.Michael@epa.gov]; Payton, Richard[Payton.Richard@epa.gov]; Fallon, Gail[fallon.gail@epa.gov]
From: Carlson, Albion
Sent: Thur 5/4/2017 7:42:32 PM
Subject: RE: 2016 Data Certification and Invalidation of Ozone data in AQS due to QC issues

Chuck,

Thank you for updating the analysis of Phase 1 data to be consistent with EPA expectations. North Dakota's prompt and thorough response on this issue is appreciated. I look forward to reviewing your Phase 2 data analysis when it's available. Thanks,

Albion

From: Hyatt, Chuck R. [mailto:chyatt@nd.gov]
Sent: Thursday, May 04, 2017 12:33 PM
To: Carlson, Albion <Carlson.Albion@epa.gov>
Cc: O'Clair, Terry L. <toclair@nd.gov>; rmills@nd.gov
Subject: RE: 2016 Data Certification and Invalidation of Ozone data in AQS due to QC issues

Albion,

In consideration of your responses, below, and our discussion during the EPA/ND midyear call today, I have updated our analysis of the actions needed to be taken with regards to the Null Data Request for the ozone data to be used in designation determinations. Today you confirmed that data that were certified under our QAPP (as it existed at the time) will be considered valid by EPA. Therefore:

OAQPS has identified the following 7 monitors in North Dakota as Phase 1:

Monitor ID	Site Name	Region	State	County	CBSA	Begin Date	End Date	Phase	% Diff (Original/After)	Explanation	Action
380530002	1TRNP-	8	North	McKenzie	2014-07-	2014-		1	*10/-*	*Wrong actual*	*Updated*

	NU	Dakota	17		08-12			*2.2*	*set point Entered 80 should be 90*	
3805300021	TRNP-NU	8	North Dakota	McKenzie	2015-01-15	2015-02-10	1	*7.77*	*Meets QAPP*	*No Change*
3805300021	TRNP-NU	8	North Dakota	McKenzie	2016-09-22	2016-10-18	1	*8.75/-3.3*	*Wrong Actual Set point Entered 80 should be 90*	*Updated*
381050003	Williston	8	North Dakota	Williams	Williston, ND	2014-02-25	2014-03-23	1	*8.8*	*Meets QAPP*	*No Change*
381050003	Williston	8	North Dakota	Williams	Williston, ND	2014-05-06	2014-06-01	1	*8.8*	*Meets QAPP*	*No Change*
381050003	Williston	8	North Dakota	Williams	Williston, ND	2015-04-21	2015-05-17	1	*7.7*	*Meets QAPP*	*No Change*
381050003	Williston	8	North Dakota	Williams	Williston, ND	2016-05-17	2016-06-12	1	*8.8*	*Meets QAPP*	*No Change*

We will continue to examine the Phase 2 data periods in anticipation of future action.

Regards,

-Chuck

From: Carlson, Albion [mailto:Carlson.Albion@epa.gov]
Sent: Tuesday, May 02, 2017 5:53 PM
To: Hyatt, Chuck R.
Cc: O'Clair, Terry L.; Mills, Ryan D.; Papp, Michael; Payton, Richard; Fallon, Gail
Subject: RE: 2016 Data Certification and Invalidation of Ozone data in AQS due to QC issues

CAUTION: This email originated from an outside source. Do not click links or open attachments unless you know they are safe.

Chuck,

Thank you for the analysis and questions. Region 8's responses to your questions are written below each question in red. The analysis you provided for the Phase 1 data should change in light of these responses, particularly where the analysis questioned whether data from outside the ozone season will be used in designations (it will be). The correction for data where the wrong actual set point had been entered makes sense as does retaining as valid the data that met the specified acceptance criteria of the EPA-approved QAPP (zero and span limits in this case) in place at the time.

Please send me your updated analysis as soon as you can. Let me know if you have questions or want to discuss. Thanks,

Albion

From: Hyatt, Chuck R. [mailto:chyatt@nd.gov]
Sent: Monday, May 01, 2017 11:09 AM
To: Carlson, Albion <Carlson.Albion@epa.gov>
Cc: O'Clair, Terry L. <toclair@nd.gov>; rmills@nd.gov
Subject: RE: 2016 Data Certification and Invalidation of Ozone data in AQS due to QC issues

Albion,

We have examined the 'Phase I' data items that were listed in the original data invalidation (null) request sent on 4/14/2017. Through this analysis we have identified possible actions that could be taken to bring the percent difference for the 1-point QC completeness to a level consistent with ND's understanding of regulatory intent - without jeopardizing the quality of the data used for designations. This analysis is presented below. However, the action North Dakota ultimately takes is strongly dependent on the answers to the following questions:

1. The IG's Management Alert of Feb. 6. 2017 did not include any action recommendations. What is the justification for EPA choosing data null requests as opposed to guidance changes or other actions in response to this alert? Were any alternatives examined and why were these

ultimately discarded as workable options?

The IG notified EPA Air Program of concerns; EPA OAR developed the response to those concerns.

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ND included 2013-2015 data in its designations recommendation of October 2016; EPA will base final designations on 2014-2016 data, but the rulemaking will refer to the ND recommendation which included 2013 data. 2013 data needs to be updated if data validation deviated from released EPA guidance highlighted by the OIG.

3. The ND developed and approved QAPP, which was in place during the 2014-2016 design value period for ozone designations, specified data validation limits per section 12 of the 8/98 QA Handbook Volume II. Does EPA guidance as referenced in the null request supersede an approved QAPP?

Region 8 interprets the null request as acknowledging that approved alternative data validation techniques in QAPPs provide other acceptable data validation pathways.

4. CY2016 data certification AMP 600 guidance distributed to states one day prior to the null request memo (on 4/13/16) stated that 1-Point QC precision alone of 8-20% would not generate a recommend N flag in AQS. Can this guidance be reconciled with the null request memo?

Data Certification report evaluates the overall data quality against long-standing CFR Data Quality Objectives (40 CFR Part 58 Appendix A 2.3.1.2). QA Handbook reflects tighter but readily achievable performance objectives for well managed monitoring networks.

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6. The changes to data as requested will result in ND having to recertify data for past years. If this cannot be completed prior to the May 1 deadline (or any nominal extension), will designations proceed based on un-certified data? What are the consequences of doing so?

Yes, designations will proceed even if modified data have not yet been recertified.

7. The use of POC2 ozone monitors as opposed to POC1 would resolve some data validation issues. Can ND specify the use of POC2 over POC1?

Yes, 40 CFR Part 50, Appendix U section 2 requires ND to designate one of the monitors as primary; POC 1 is currently primary, but ND can change POC 2 to primary for any or all of the time there have been two monitors running. Change using the monitors tab in AQS.

Can Region or OAQPS please address these questions and respond back? We will take the answers into consideration as we plan our next steps, not only with respect to Phase I, but also the Phase II listed data periods.

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OAQPS has identified the following 7 monitors in North Dakota as Phase 1:

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Please contact me if you have any questions or need clarification on anything in this e-mail.
Thank you.

-Chuck

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Chuck Hyatt - Program Manager

Air Quality Monitoring Program

Division of Air Quality

North Dakota Department of Health

918 E. Divide Ave., 2nd Floor

Bismarck, ND 58501-1947

chyatt@nd.gov

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701-328-5188

From: Hyatt, Chuck R.
Sent: Monday, May 01, 2017 10:01 AM
To: 'Carlson, Albion'
Cc: O'Clair, Terry L.; Mills, Ryan D.
Subject: RE: 2016 Data Certification

Albion,

In accordance with 40 CFR 58, EPA Region 8 requests that North Dakota Department of Health annually certify all ambient air monitoring data submitted to AQS. This certification is due by May 1 of each year for data collected the previous calendar year.

On April 14, 2017, the Department received an e-mail from Region 8 requesting that specific periods of ozone data collected in North Dakota be evaluated for invalidation in response to an EPA Inspector General Management Alert (see attached for the e-mail). The request was made that invalidations occur by May 1, 2017, prior to certification, to "correct" 2014-2016 design values calculated for ozone designations.

In subsequent telephone conversation between the Department and EPA, it became clear that there are a number of outstanding questions regarding the referenced data periods, answers to which would dictate how North Dakota would approach the data invalidation request. In light of the extremely short amount of time between the request and the deadline, the complex nature of the questions relating to data invalidation, and the uncertainty as to when EPA will ultimately address these questions, it has become apparent that North Dakota will not be able to adhere to the May 1, 2017 deadline for certification of the 2016 data. This e-mail serves as a notice to this fact.

North Dakota will follow-up this message with an analysis of the data periods identified in the attached e-mail as Phase I. This analysis will also describe in detail the questions referenced above. Once these issues are resolved, the Department will move ahead with data certification, the timing of which will be communicated to EPA.

If you have any questions, please contact me.

Regards,

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Chuck Hyatt - Program Manager

Air Quality Monitoring Program

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701-328-5188

To: Hyatt, Chuck R.[chyatt@nd.gov]
Cc: O'Clair, Terry L.[toclair@nd.gov]; rmills@nd.gov[rmills@nd.gov]; Papp, Michael[Papp.Michael@epa.gov]; Payton, Richard[Payton.Richard@epa.gov]; Fallon, Gail[fallon.gail@epa.gov]
From: Carlson, Albion
Sent: Tue 5/2/2017 10:53:07 PM
Subject: RE: 2016 Data Certification and Invalidation of Ozone data in AQS due to QC issues

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chyatt@nd.gov

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701-328-5188

To: cara.keslar@wyo.gov[cara.keslar@wyo.gov]; Hyatt, Chuck R.[chyatt@nd.gov]
Cc: Payton, Richard[Payton.Richard@epa.gov]
From: Carlson, Albion
Sent: Thur 4/20/2017 7:25:37 PM
Subject: FW: Invalidation of Ozone data in AQS due to QC issues
Ozone 1-point data quality evaluation_V9_4_12_17.docx

Cara and Chuck,

For additional background information on this quality assurance issue, please refer to the attached memo provided by OAQPS entitled "Ozone 1-point QC Check Data Quality Evaluation and Next Steps". Thanks, and please call me if you have questions.

Albion

From: Carlson, Albion
Sent: Friday, April 14, 2017 3:33 PM
To: cara.keslar@wyo.gov
Cc: Payton, Richard <Payton.Richard@epa.gov>
Subject: Invalidation of Ozone data in AQS due to QC issues

Cara,

As a response to the EPA Inspector General Management Alert of Feb. 6, 2017 (https://www.epa.gov/sites/production/files/2017-02/documents/_epaoig_20170206-17-p-0106_glance.pdf), OAQPS has searched AQS for raw ozone data associated with QC checks outside the +/-7% validation criteria of the QA Handbook. OAQPS requests that for "high priority monitors whose 2014-2016 design value would change or become incomplete due to the data invalidations" any such data be replaced in AQS by null codes **by May 1, 2017**, prior to certification, so that 2014-2016 design values calculated for designations this coming October can be "correct". These "high priority monitors" are "Phase 1".

OAQPS has identified the following monitor in Wyoming as Phase 1:

Monitor ID	Site Name	Region	State	County	CBSA	Begin Date	End Date	Phase

560070100 1	Atlantic Rim Sun Dog	8	Wyoming	Carbon	2014-06-14	2014-07-16	1

There are also ozone monitors designated "Phase 2" in Wyoming. These monitors have a less immediate impact on designations and so are being included in the Phase 2 action. OAQPS requests that for these monitors any such data be replaced in AQS by null codes by August 1, 2017.

OAQPS has identified the following monitors in Wyoming as Phase 2:

Monitor ID	Site Name	Region	State	County	CBSA	Begin Date	End Date	Phase
560019991	Centennial	8	Wyoming	Albany	Laramie, WY	2013-02-20	2013-02-20	2
560019991	Centennial	8	Wyoming	Albany	Laramie, WY	2013-02-23	2013-02-23	2
560019991	Centennial	8	Wyoming	Albany	Laramie, WY	2013-03-29	2013-04-01	2
560019991	Centennial	8	Wyoming	Albany	Laramie, WY	2013-09-04	2013-09-04	2
560019991	Centennial	8	Wyoming	Albany	Laramie, WY	2013-09-13	2013-09-13	2
560019991	Centennial	8	Wyoming	Albany	Laramie, WY	2014-02-12	2014-02-18	2
560030002 1	Basin	8	Wyoming	Big Horn		2016-09-08	2016-09-08	2
560030002 1	Basin	8	Wyoming	Big Horn		2016-09-13	2016-09-13	2
560050123	Thunder Basin	8	Wyoming	Campbell	Gillette, WY	2014-03-24	2014-03-28	2
560050456	Campbell County	8	Wyoming	Campbell	Gillette, WY	2013-02-23	2013-02-25	2
560050456	Campbell County	8	Wyoming	Campbell	Gillette, WY	2013-03-03	2013-03-05	2
560050456	Campbell County	8	Wyoming	Campbell	Gillette, WY	2013-07-11	2013-07-13	2
560050456	Campbell County	8	Wyoming	Campbell	Gillette, WY	2013-10-29	2013-10-31	2
560050456	Campbell County	8	Wyoming	Campbell	Gillette, WY	2013-12-18	2013-12-20	2

560050456	Campbell County	8	Wyoming	Campbell	Gillette, WY	2013-12-22	2013-12-24	2
560130099	South Pass	8	Wyoming	Fremont	Riverton, WY	2015-09-21	2015-09-25	2
5601302321	8	Wyoming	Fremont	Riverton, WY	2015-02-16	2015-02-18	2	
560210100	Cheyenne NCore	8	Wyoming	Laramie	Cheyenne, WY	2015-03-30	2015-04-03	2
560250100	Casper Gaseous	8	Wyoming	Natrona	Casper, WY	2014-02-01	2014-02-09	2
5602526011	8	Wyoming	Natrona	Casper, WY	2014-05-27	2014-05-29	2	
5603300041	8	Wyoming	Sheridan	Sheridan, WY	2013-02-26	2013-03-10	2	
5603300041	8	Wyoming	Sheridan	Sheridan, WY	2013-09-14	2013-09-17	2	
5603300041	8	Wyoming	Sheridan	Sheridan, WY	2013-11-21	2013-11-26	2	
560391011	Yellowstone National Park, Water Tank	8	Wyoming	Teton	Jackson, WY-ID	2015-05-27	2015-05-27	2

Thanks, and please call me if you have questions.

Albion

Ozone 1-point QC Check Data Quality Evaluation and Next Steps
April 12, 2017

Introduction/Statement of the Issue

The Management Alert issued February 6, 2017, by the Office of the Inspector General (OIG) identified a number of issues that OAQPS has responded to and will be addressing through corrective action. Although the OIG identified monitoring organizations in two states that were not implementing critical criteria as recommended in Appendix D of the QA Handbook (i.e., the Validation Template), we have identified additional organizations that have not followed the critical criteria in this table.

As you are aware, EPA and monitoring organizations "use a 'weight of evidence' approach when determining the suitability of data for regulatory decisions" and "[c]onsensus built validation templates or validation criteria already approved in QAPPs should be used as the basis for the weight of evidence approach." 40 CFR Part 58 Appendix A (Section 1.2.3). Nonetheless, "EPA reserves the authority to use or not use monitoring data submitted by a monitoring organization when making regulatory decisions based on [our] assessment of the quality of the data." 40 CFR Part 58 Appendix A (Section 1.2.3).

Due to the upcoming 2014-2016 design values and designations for the 2015 ozone NAAQS, we are currently assessing the suitability of ozone data for regulatory decisions. In doing so, we are reviewing each monitoring organization's implementation of data quality indicators for precision (upper 90% confidence limit of <7.1%) and bias (upper 95% confidence limit of ±7.1%) per Appendix A (Section 2.3.1.2). We will also evaluate whether each routine (at least every 14 days) 1-point quality control (QC) check meets the acceptance criteria for ozone (< ±7.1% or < ±1.5 ppb difference, whichever is greater) identified in the Validation Template as critical criteria.[1]

The following information provides some steps for both OAQPS and the Regions to ensure a consistent approach is followed that will also be useful in addressing corrective actions to the OIG alert.

Next Steps for OAQPS

OAQPS is evaluating the ozone data in AQS to determine the extent of the problem. We have developed a procedure to:

1. Determine whether each 1-point QC ozone check that does not meet the acceptance criteria has routine data reported since the prior acceptable check. This will determine whether the monitoring organization followed the Validation Template and invalidated the routine data but reported the 1-point QC check. If this is the case, we will work with the Regions to identify and alert the monitoring organization to remove those 1-point QC checks.
2. Identify which monitoring organizations continued to report routine data after failing to meet the Validation Template acceptance criteria (as implemented in their EPA-approved QAPPs) without a compelling reason and evidence to support keeping this information. This will identify the routine ozone data that should be invalidated and allow us to determine the effect on

[1] We believe that the vast majority of EPA-approved QAPPs implement the Validation Templates as recommended in Appendix D of the QA Handbook. As described in the QA Handbook: "Observations that do not meet each and every criterion on the critical table should be invalidated unless there are compelling reasons and justifications for not doing so." QA Handbook Vol II, Section 3.0, page 5; *see also* Section 17, page 8 and Appendix D, page 2. A compelling reason is proof that upon failure of a 1-point QC check the analyzer was in fact operating within precision and bias acceptance criteria, based on some additional checking and reverification, and that the measurement error was attributed to some flaw in the QC standard delivery system. The QA Handbook suggests that a compelling reason for not invalidating the routine data be documented.

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design values (and possible implications for designations) if those data are not used. In some limited cases, these data may be reported as valid by monitoring organizations that have alternative acceptance criteria in their EPA-approved QAPP (see next steps for Regions below).

OAQPS completed a preliminary analysis of the 2014-2016 data (the AQAG analysis) which shows that about 72% of the ozone monitors nationwide had all 1-point QC checks meeting the 7.1% criteria over the 3-year period. Another 19% of the monitors had one to three 1-point QC checks not meeting the 7.1% criteria over the 3-year period, leaving 9% of the monitors with four or more 1-point QC checks not meeting the 7.1% criteria over the 3-year period. To assess the potential impact on data completeness and design values, data not meeting the 1-point QC check requirement were removed from the analysis. The removal of these data did not affect the 3-year average data completeness statistic for approximately 77% of the sites nationwide. An additional 14% of sites nationwide had a reduction of 5% or less in their 3-year average data completeness. The remaining 9% of the sites had the 3-year average data completeness statistic decrease by more than 5%.

The reductions to the 3-year average data completeness resulted in 50 (out of 1333, or about 4%) having their 2014-2016 design value status change to incomplete (meaning that the 3-year average data completeness no longer met the 90% required by Appendix U to Part 50) after the invalidations. Forty-seven of these sites were previously attaining and three were previously violating. In addition, the design value statistic itself (i.e. the 3-year average of the 4th highest daily maximum 8-hour concentration) was affected at 52 sites. Accounting for overlap between the two categories, a total of 80 sites either had a change in the design value statistic or its validity. Therefore, due to the potential impact of these sites on ozone designations, we are requesting that these sites be given first priority when performing any necessary data invalidations (see accompanying email on Phases 1 and 2 of this effort).

Next steps for EPA Regions

We believe that most monitoring organizations adhere to the language in the QA Handbook and Validation Templates since EPA has cooperatively developed the QA Handbook with monitoring organization involvement. Monitoring organizations use the regulation and the QA Handbook to develop their EPA-approved QAPPs that, in the majority of cases, conform to the QA Handbook. We believe that the EPA-approved QAPP commits the monitoring organization to the requirements they have specified in their QAPP. We ask the Regions to do the following:

- Determine which monitoring organizations have acceptance criteria in their EPA-approved QAPP that is greater than the 7.1% precision and ± 7.1% bias requirement for ozone or diverge from invalidating routine data based on this 1-point QC check.
    - Please send to OAQPS any QAPPs that diverge from the 7.1% precision and ± 7.1% bias 1-point QC critical criteria for ozone for verification/archive.
    - If a QAPP provides for acceptance criteria that deviates from the Validation Template, please work with your respective monitoring organizations to revise their QAPP to reflect the critical criteria in the QA Handbook. We recommend QAPPs be revised before the end of 2017.

With the dissemination of the AQAG analysis (see accompanying email), we ask the Regions to do the following:

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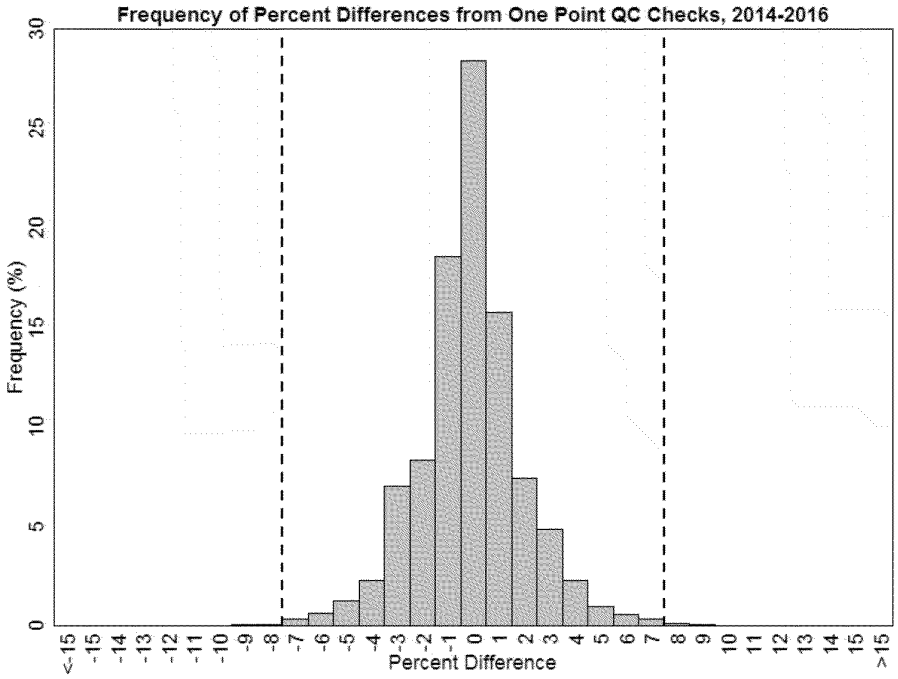
- Work with affected monitoring organizations to remove any routine data (and its associated 1-point QC check) that does not meet the acceptance criteria in their EPA-approved QAPP and for which no compelling reason or evidence exists to consider the data valid. If the monitoring organization's EPA-approved QAPP does not specify any acceptance criteria, assess the suitability of the data for use in 2014-2016 ozone design values and area designations for the 2015 ozone NAAQS in accordance with the acceptance criteria in the QA Handbook.

We should also clarify that a default decision to invalidate data when critical criteria fail is not the expectation. Regions should minimally review the compelling reasons/evidence to ensure that the decisions are appropriate. In the future, OAQPS and the Regions will work to determine a process to flag these data in AQS.

Final Thoughts

From a QA perspective, the 1-point QC check is not a difficult requirement to meet. It was developed and agreed to by a Workgroup made up of EPA Regions and monitoring organizations prior to completion of the QA Handbook in 2008. The figure below demonstrates that for 2014-2016 (same data set used in assessments described above), over 99% of the checks meet the 7% criteria and about 97% are within 5%. Since the ozone NAAQS are based on daily maximum 8-hour values, the precision and bias for the daily maximum is reflected by the precision and bias values of the 1-point QC checks before and after each daily maximum value. Therefore, meeting the acceptance criteria during each check is critical to ensuring the quality of data for a particular time period.



To: cara.keslar@wyo.gov[cara.keslar@wyo.gov]
Cc: Morales, Monica[Morales.Monica@epa.gov]
From: Carlson, Albion
Sent: Tue 9/20/2016 4:28:12 PM
Subject: Draft 2016 Wyoming TSA Report
WY 2016 TSA Report Draft_20160920 .docx

Hi Cara,

Please find attached for your review the draft 2016 Wyoming TSA Report from the TSA we conducted in June. Please review and provide me your comments as soon as you can. As we discussed, I'm hoping to have the report final for formal distribution to the State by September 30th. Thanks,

Albion

QUALITY ASSURANCE AUDIT REPORT

TECHNICAL SYSTEMS AUDIT
WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION
AMBIENT AIR MONITORING NETWORK

JUNE 20-24, 2016

Prepared by:
Albion Carlson
Environmental Scientist

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region 8

Executive Summary

This report details the Technical Systems Audit (TSA) of the Wyoming Department of Environmental Quality (WDEQ) ambient air monitoring program conducted by the United States Environmental Protection Agency (EPA) Region 8 in June of 2016. EPA periodically reviews the quality assurance (QA) of ambient air monitoring programs in the form of a TSA. EPA Regional offices are required by 40 CFR part 58 Appendix A section 2.5 to conduct a TSA of each ambient air monitoring organization every three years. The purpose of the audit is to ascertain how the QA program is being implemented by the Air Quality Division (AQD) of the WDEQ. One objective of this collaborative review is to help to ensure that the QA program of the AQD is equivalent to the national standards and guidelines for QA. Another objective is to suggest solutions to any QA problems that are found. While conducted in depth, systems audits emphasize on-site evaluations of QA procedures over inspection and performance audits of individual instruments. The last TSA of the AQD ambient air monitoring program was conducted in September of 2012. As a result of the current evaluation, Region 8 makes a set of recommendations that are explained in the following sections and tabulated in section 6 of this report.

The TSA was conducted June 20-24, 2016 through on-site reviews and inspections at six state operated monitoring stations located throughout the state. In addition, facility inspections and a records review were performed at the AQD offices in Cheyenne. The focus of the TSA was compliance with regulatory requirements for collection, analysis, validation, and reporting of ambient air quality data. A TSA questionnaire was provided to the AQD and a response was returned to the EPA in an email dated April 18, 2016. There were no major findings identified through the TSA.

While no major findings were identified as a result of the TSA, several minor findings were noted, including the need for updating Quality Assurance Project Plan (QAPP) documents to include the checklist instructions maintained at monitoring sites, reflect current monitoring equipment utilized in the monitoring network, and to identify the current project personnel for each site. The Partisol-FRM Model 2000 Verification & Maintenance Forms used by the AQD Site Technicians were found to have inconsistent entries, and not all site logs were kept current as specified in the QAPPs and Standard Operating Procedures (SOPs). The ozone monitor at the Casper Gaseous site, currently designated a Special Purpose Monitor (SPM) in the Annual Monitoring Network Plan (AMNP) meets the State and Local Air Monitoring Stations (SLAMS) minimum ozone monitoring requirements for re-designating the monitor as SLAMS. It was also found that Contract Site Technicians would benefit from annual training to ensure they are adequately following SOPs. In follow up to issues noted in the TSAs performed in 2009 and 2012, the state has continued to enhance Quality Assurance (QA) oversight of contractors including conducting a joint State / EPA TSA of ARS performed in 2013. The state has also developed an "all-digital "Records Management Plan which requires a close and accountable coordination between the two distinct information technology groups assigned to the DEQ AQD and the broader State of Wyoming. Lastly, the bias in collocated $PM_{2.5}$ precision data noted in the 2012 TSA and the current TSA, was determined by the state to be the result of errors in background zero settings at these sites. The state is encouraged to analyze the source of these errors to ensure that bias does not exist at other $PM_{2.5}$ monitoring sites.

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1.0 Background

The purpose of a TSA is to assess an agency's ambient air monitoring program's compliance with regulatory requirements for collection, analysis, validation, and reporting of ambient air quality data. The total QA system is reviewed in order to qualitatively evaluate the system's ability to ensure quality, in this case the reporting of valid data to the EPA's Air Quality System (AQS). The QA requirements of 40 CFR Part 58, Appendices A through E pertain to regulatory air monitors used in evaluations of National Ambient Air Quality Standards (NAAQS). A systems audit of a regulatory air monitoring program should address State and Local Air Monitoring Stations (SLAMS) monitoring and other areas such as special purpose monitors (SPM). The systems audit consists of three steps. First, a questionnaire is sent to the agency to be audited for completion by their personnel. Second, this questionnaire is reviewed and on-site interviews are conducted. Finally, a systems audit report is issued.

Region 8 began the current systems audit of the AQD ambient air monitoring program on February 5, 2016 by sending an email message notifying the AQD of the planned audit and including the systems audit questionnaire as an attachment. Figure 1, provided in the response to the questionnaire, charts the organizational structure of the Monitoring Section in the AQD Air Quality Resource Management Program.

The questionnaire was taken from EPA's QA handbook for air pollution measurement systems (QA handbook), revised May 2013.[1] Cara Keslar, Ambient Air Monitoring Network Manager, returned the written response to the questionnaire in electronic format by email on April 18, 2016. The response to the questionnaire is included in Appendix A of this report.

Table 1 identifies the air monitoring stations in the current Wyoming network.

Table 1. AQD Air Monitoring Stations.

AQS Number	Site Name	County	Monitor Type	Pollutant(s)
56-025-0001	Casper SLAMS	Natrona	SLAMS	PM_{10}, $PM_{2.5}$
56-021-0001	Cheyenne SLAMS	Laramie	SLAMS	PM_{10}, $PM_{2.5}$
56-029-0001	Cody SLAMS	Park	SLAMS	PM_{10}, $PM_{2.5}$
56-005-1002	Gillette SLAMS	Campbell	SLAMS	PM_{10}
56-039-1006	Jackson SLAMS	Teton	SLAMS	PM_{10}, $PM_{2.5}$
56-013-1003	Lander SLAMS	Fremont	SLAMS	PM_{10}, $PM_{2.5}$
56-001-0006	Laramie SLAMS	Albany	SLAMS	PM_{10}, $PM_{2.5}$
56-037-0007	Rock Springs SLAMS	Sweetwater	SLAMS	PM_{10}, $PM_{2.5}$

[1] Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Quality Monitoring Program, EPA-454/B-08-003, May, 2013, (QA handbook) appendix D. http://www.epa.gov/ttn/amtic/files/ambient/pm25/qa/QA-Handbook-Vol-II.pdf

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AQS Number	Site Name	County	Monitor Type	Pollutant(s)
56-033-1003	Sheridan Meadowlark SLAMS	Sheridan	SLAMS	PM_{10}, $PM_{2.5}$
56-033-0002	Sheridan Police Station SLAMS	Sheridan	SLAMS	PM_{10}, $PM_{2.5}$
56-035-0700	Big Piney	Sublette	SPM	NO, NO_2, NO_x, O_3
56-035-0099	Boulder	Sublette	SPM	NO, NO_2, NO_x, O_3, PM_{10}
56-005-0456	Campbell County	Campbell	SPM	NO, NO_2, NO_x, O_3, PM_{10}
56-025-0100	Casper Gaseous	Natrona	SPM	NO, NO_2, NO_x, O_3
56-009-0010	Converse County	Converse	SPM	NO, NO_2, NO_x, O_3, PM_{10}
56-035-0100	Daniel South	Sublette	SPM	NO, NO_2, NO_x, O_3, PM_{10}
56-037-0077	Hiawatha	Sweetwater	SPM	O_3
56-035-1002	Juel Spring	Sublette	SPM	NO, NO_2, NO_x, O_3
56-037-0300	Moxa Arch	Sweetwater	SPM	NO, NO_2, NO_x, O_3, PM_{10}, SO_2
56-041-0101	Murphy Ridge	Uinta	SPM	NO, NO_2, NO_x, O_3, PM_{10}
56-035-0101	Pinedale Gaseous	Sublette	SPM	NO, NO_2, NO_x, O_3, $PM_{2.5}$
56-013-0099	South Pass	Fremont	SPM	NO, NO_2, NO_x, O_3, $PM_{2.5}$
56-005-0123	Thunder Basin	Campbell	SPM	NO, NO_2, NO_x, O_3
56-037-0200	Wamsutter	Sweetwater	SPM	NO, NO_2, NO_x, O_3, PM_{10}
56-005-0099	Wright Jr-Sr High School	Campbell	SPM	PM_{10}
56-009-0009	Antelope – Site 7	Converse	SPM	NO, NO_2, NO_x, $PM_{2.5}$
56-005-0892	Belle Ayr BA-4	Campbell	SPM	NO, NO_2, NO_x, $PM_{2.5}$
56-005-0891	Black Thunder BTM-36-2	Campbell	SPM	$PM_{2.5}$
56-005-1899	Buckskin Mine	Campbell	SPM	$PM_{2.5}$
56-015-0004	Torrington Mobile (12/21/2015-press time)	Goshen	Mobile	NO, NO_2, NO_x, O_3, PM_{10}, $PM_{2.5}$, SO_2
56-021-0002	Cheyenne Mobile (3/15/2016-press time)	Laramie	Mobile	NO, NO_2, NO_x, O_3, PM_{10}, $PM_{2.5}$, SO_2
56-045-0004	Newcastle Mobile (7/10/2015-press time)	Weston	Mobile	NO, NO_2, NO_x, O_3, PM_{10}, $PM_{2.5}$, SO_2
56-021-0100	Cheyenne NCore	Laramie	NCore	PM_{10}, $PM_{10\text{-}2.5}$, $PM_{2.5\text{speciated}}$, $PM_{2.5}$, O_3, NO, NO_2, NO_y, SO_2, CO

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The Region 8 auditors, Albion Carlson and Ethan Brown, conducted the on-site interview part of the audit from June 20–June 24, 2016. The interviews with AQD covered a wide range of topics including but not limited to data management and validation, computer systems and database management, monitor maintenance and corrective actions.

The air monitoring station site visits were performed June 20-23. Figure 2 is a map depicting the locations of the various types of ambient air monitoring stations in the Wyoming air quality monitoring network. Figure 3 is a map showing the location of the selected sites and offices that were visited in the performance of the TSA. Those sites were: the Casper SLAMS site, the Casper Gaseous site, the Lander SLAMS site, the South Pass site, the Rock Springs SLAMS site, and the Wamsutter site. Cara Keslar, AQD monitoring network manager, participated in all of the site visits as did Mark Gagen, the Project Manager for all Wyoming SLAMS sites. Steve Mugg, QA Coordinator, participated in the Casper sites visits. Dan Sharon, SPM Project Manager, participated in the South Pass site visit and Aaron Maisch, SPM Project Manager, participated in the Wamsutter site visit.

Prior to the air monitoring station site visits, interviews were conducted at the AQD main offices in Cheyenne on June 20th which included a review of AQD's response to the questionnaire with Cara Keslar and her staff, and a visit to the QA laboratory where monitor repair and maintenance is performed. On June 24th the on-site audits were concluded with records reviews and staff interviews conducted at the AQD main offices in Cheyenne; and, an exit interview held with Cara Keslar to discuss the initial findings of the audit.

The following AQD personnel were interviewed on-site:

Cara Keslar, Monitoring Section Supervisor, AQD
Mark Gagen, SLAMS Project Manager, AQD
Steve Mugg, Quality Assurance Coordinator, AQD
Leif Paulson, Data Manager, AQD
Dan Sharon, SPM Project Manager, AQD
Aaron Maisch, SPM Project Manager, AQD
Kristina Hooper, SPM Project Manager, AQD
Paul Bailey, Site Technician, AQD
Grant Roach, Site Technician, AQD

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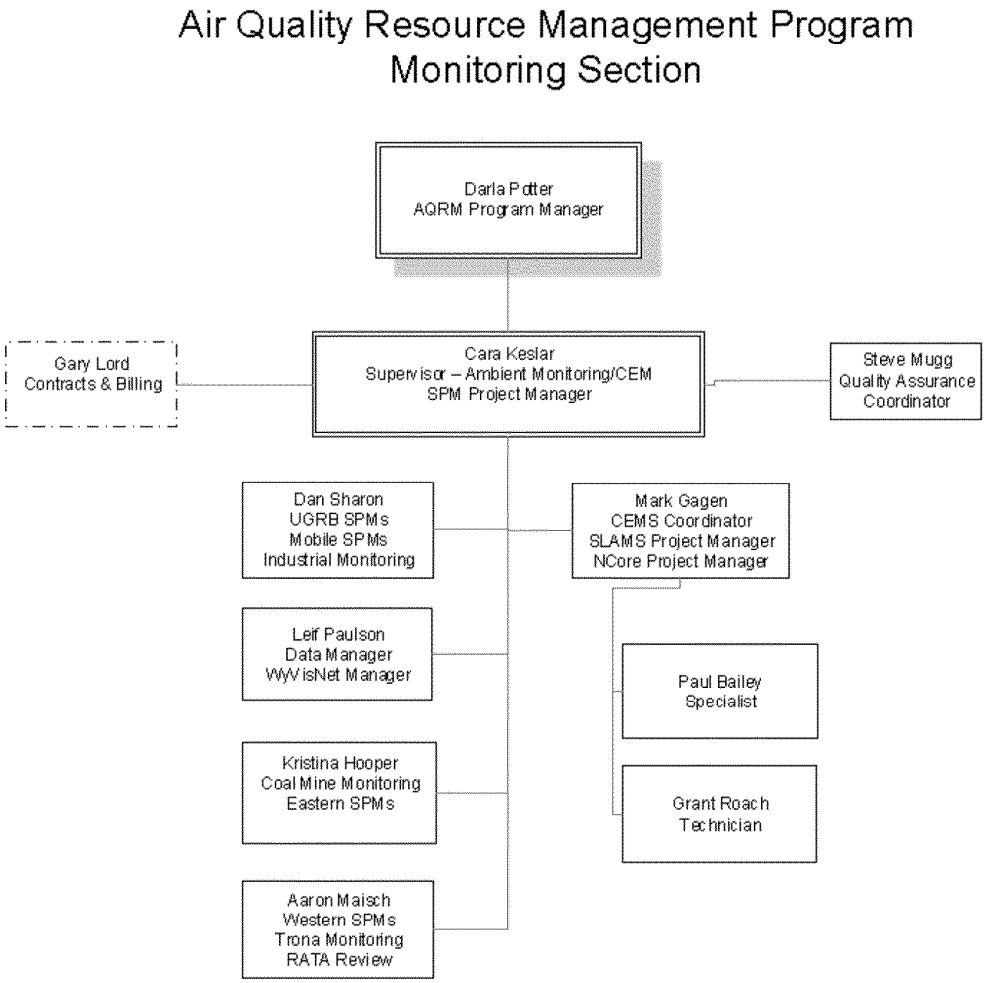
Figure 1. AQD Air Quality Resource Management Program Organizational Chart.
(Wyoming TSA Questionnaire Response)



AQD maintains a well-trained and effective monitoring team comprised of individuals based in the main offices in Cheyenne. Their duties include network design and siting, project management, data management, monitor operation and maintenance, and quality assurance activities. Supporting AQD personnel are contracted monitor operators, site technicians and quality assurance personnel.

The completed questionnaire explained the AQD's use of contractors. The AQD directly operates SLAMS stations that strictly monitor particulate matter (either as PM10 or as PM2.5) and they use contractors to run the SPM stations that monitor for gaseous pollutants. Where

particulate monitoring is included at an SPM, the contractor responsible for operating the gaseous analyzers also runs the particulate monitors. As indicated in the completed questionnaire, the companies being employed by the AQD to operate SPMs include Air Resource Specialists, Inc. (ARS) of Fort Collins, Colorado; and Meteorological Solutions Inc. (MSI) of Salt Lake City, Utah.

2.0 Project Management

All criteria pollutant monitors operated by AQD are currently demonstrating attainment status with respect to the National Ambient Air Quality Standards (NAAQS). Figure 2 depicts the locations of the ambient monitoring sites currently operated by AQD in Wyoming. Attainment status is determined from the ambient air concentrations data gathered through AQD's ambient air monitoring network. Currently there are 32 air monitoring stations in the ambient air monitoring network managed by AQD. There are 10 SLAMS sites that are used to determine compliance with the NAAQS; 19 SPM locations employed to monitor compliance with the NAAQS, background concentrations, and for special studies of impacts from air emissions sources; three mobile monitoring trailers used for short term investigations, and one National Core (NCore) multi-pollutant site which provides lower concentration data on specific pollutants for long term trend analyses. In addition, the AQD oversees a large amount of industrial monitoring required by air quality permits and also helps fund and evaluate visibility and acid deposition monitoring.

The SLAMS stations are directly operated by AQD and are used to monitor particulate matter. PM_{10} data is collected at all SLAMS sites and $PM_{2.5}$ data is collected at all but one of the SLAMS sites. The AQD uses contractors to operate the SPM stations. Both gaseous and particulate monitoring are conducted at most of the SPM stations; although, a few of the SPM stations are sited for either solely gaseous or solely particulate monitoring. The pollutants monitored at the individual monitoring stations are listed in Table 1. AQD operates the NCore site located in Cheyenne. The NCore site is a required multi-pollutant monitoring site that provides data on several pollutants at lower detection levels. Its primary purpose is to monitor population exposure concentrations in the state's largest city. The Wyoming Ambient Air Monitoring Network Plan 2016 submitted to EPA Region 8 by AQD details the monitoring network and identifies planned or potential modifications to the network. It was made available for public comment and is currently under review by Region 8.

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Figure 2. Wyoming Air Monitoring Sites. (Wyoming TSA Questionnaire Response)

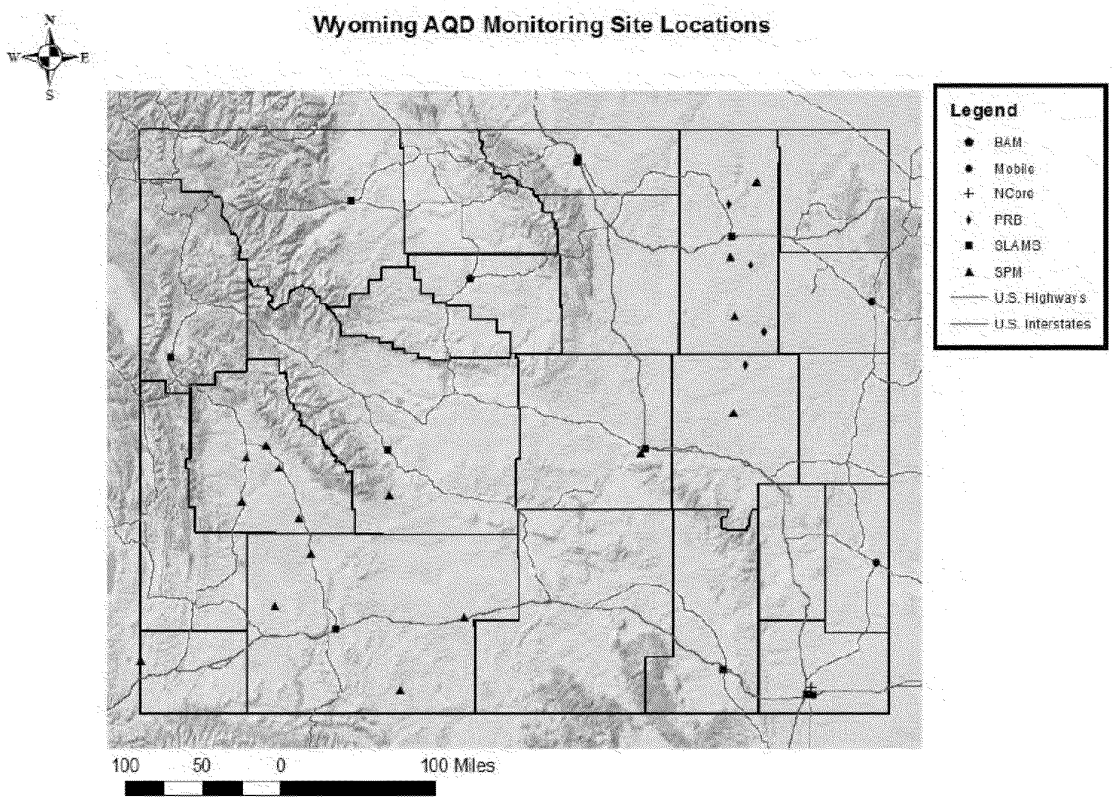
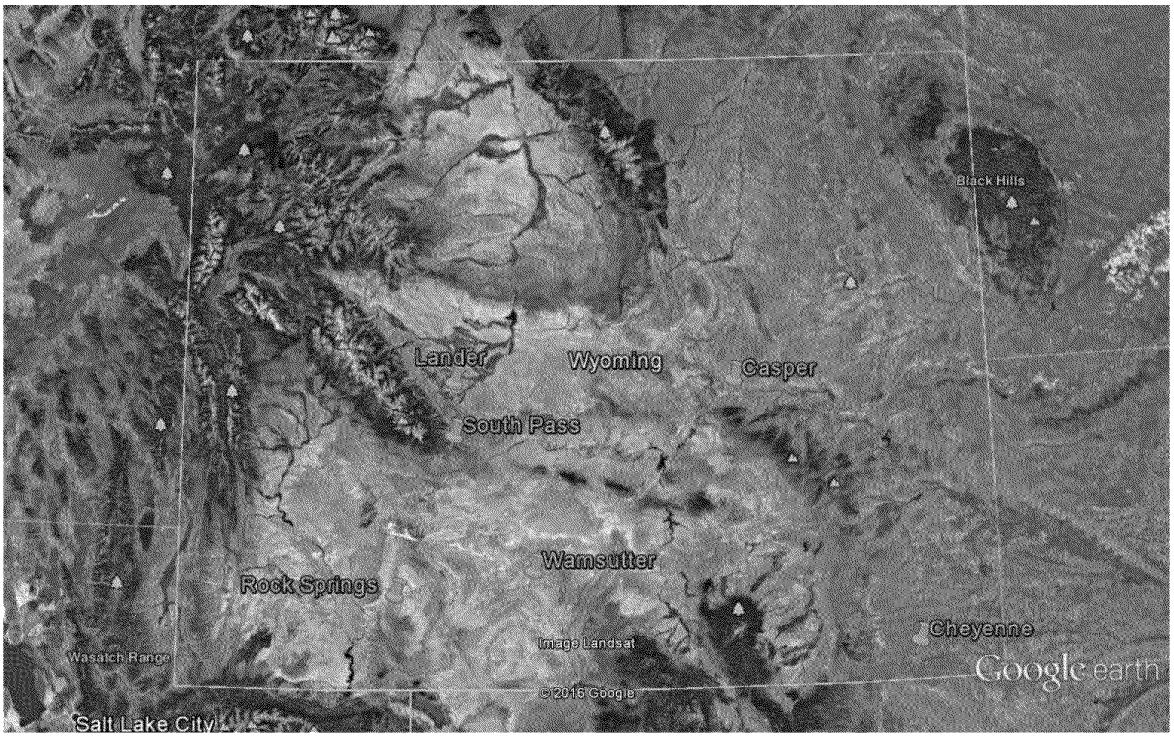


Figure 3. Wyoming Air Monitoring Sites and Offices Visited during the TSA.



The monitoring sites in Wyoming were established in part to determine ambient air concentrations in high density population areas as well as those areas impacted by significant emissions sources. Monitoring of background concentrations is another objective of network design.

During the on-site interview, major changes made to the monitoring network design since the last TSA was conducted (2012) were reviewed. The state has added, removed, and relocated several monitoring stations and monitors in the network since the last TSA. Many of these changes followed mobile monitoring station deployments and assessments of the data collected during those deployments. Most of the recent mobile gaseous monitoring trailer deployments have been to locations near major oil refineries. The mobile monitoring trailer deployed at Gillette, Wyoming at the time of the 2012 TSA was relocated to Converse County in December of 2012. Consequently (based on the assessment of the data collected during the mobile monitoring trailer deployment) the state added a new long-term SPM station to the network at Converse County in April of 2015. In July of 2015 the mobile monitoring trailer was relocated to Newcastle, Wyoming where it is currently stationed. Similarly, the Rock Springs Mobile station was relocated to Lovell, Wyoming where it operated from July of 2014 through June of 2015. The Lovell Mobile station was relocated to Torrington, Wyoming where it has been in operation since December of 2015 and then in January of 2016 an SO_2 monitor was added to the Torrington Mobile station. The Big Piney Mobile station operating at the time of the 2012 TSA

was relocated to Sinclair, Wyoming in December of 2013. It was then moved again (in February of 2016) to Cheyenne, Wyoming where it has operated as the Cheyenne Mobile station since March of 2016. The Big Piney Mobile Station was replaced with a long term SPM station added to the monitoring network. In November of 2013 the Wyoming Range station was shut down and removed from the network because the data collected was determined to be redundant to data collected at the Daniel South station. The Jackson SLAMS was relocated from its location at the Fire Department in Jackson, Wyoming in June of 2016 due to renovations at the building. The Jackson SLAMS is now located at the Teton County Transfer Station in Jackson. The PM_{10} TEOM particulate monitors which had been operating at the South Pass and Wamsutter sites in 2012 were removed and replaced with $PM_{2.5}$ BAM particulate monitors in March of 2014 and June of 2016 respectively. The Antelope Site-3 station was relocated (due to construction of a road) and renamed Antelope Site-7 in February of 2015.

Planned changes to the network include relocating the Newcastle Mobile station to another location that is near a large refinery: a location in the city of Casper. The relocation is expected to take place in the early fall of 2016.

Network design is managed on an annual basis through the AMNP required by 40 CFR Section 58.10. It was noted during the TSA that the 2016 AMNP was submitted to EPA (June 24, 2016). The Monitoring Network Assessment is required on an every 5 year schedule. The last Monitoring Network Assessment year was 2015. Necessary monitoring network changes which are not addressed in the AMNPs or 5-year assessments can be approved by the EPA through monitoring network modification requests at any time.

Quality control and assurance of ambient air quality data collected by the AQD is managed through the state's Quality Management Plan (QMP), QAPPs and SOPs. The EPA approved QMP (last approval date January 6, 2016) provides for AQD to approve their QAPPs and SOPs. AQD does not employ a single comprehensive QAPP; instead, they rely on a number of QAPPs and relevant SOPs, most of which are station specific and prepared and updated by AQD's contractors. The QAPP prepared by AQD for $PM_{2.5}$ and PM_{10} monitoring at SLAMS sites applies to several stations but is specific to particulate monitoring. Implementation of QAPPs is verified through quarterly report reviews conducted by AQD Project Managers and semi-annual audits performed by the AQD QA auditor for all SPM and SLAMS sites. It was noted during the TSA that QAPP approvals are up to date. It was also noted during the TSA that some QAPPS are not current with respect to project personnel (e.g. South Pass QAPP) and that annual QAPP reviews should include making the necessary updates.

Independent quality assurance (QA) and quality control (QC) operations are maintained through having AQD SPM monitoring stations operated by independent contractors (ARS and MSI) who employ and oversee field technicians, project managers and QA personnel that manage the stations separately from the AQD QA and QC operations. The contractors report to AQD Project Managers and receive no direction from the AQD QA auditor. At the AQD SLAMS sites, the day to day operations are conducted by contracted site technicians who are responsible for the PM filter collection while the AQD site technicians perform routine and preventative maintenance on the samplers.

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Laboratory facilities used by AQD in support of monitoring activities are the AQD monitoring lab in Cheyenne (monitor maintenance and QA/QC), and the private Intermountain Labs (IML) located in Sheridan Wyoming (filter weighing).

States are required to certify all data from SLAMS and SPMs if the SPM is a Federal Reference Method (FRM), Federal Equivalent Method (FEM), or Approved Regional Method (ARM) monitor, and meets the QA requirements of 40 CFR 58 appendix A. Annual data certification confirms that the monitoring agency has loaded all of its data for the year and has completed the monitoring agency's normal validation process. It was noted during the TSA that AQD had submitted the required data certification letter and AQS reports to the EPA for annual certification of the 2015 data (due May 31, 2016).

3.0 Site Visits

The TSA monitoring site visits were conducted from June 20, 2016 - June 23, 2016. On June 20th the Casper SLAMS site located in Natrona County was visited. On June 21st the Casper Gaseous site in Natrona County and the Lander SLAMS site in Fremont County were visited. On June 22nd, The South Pass site in Fremont County and the Rock Springs SLAMS site in Sweetwater County were visited. On June 23rd the Wamsutter site in Sweetwater County was visited.

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Casper SLAMS Site

The Casper SLAMS site (in the photo below) is located on the roof of the City and County Building in downtown Casper, Wyoming. Casper is the second largest city in Wyoming. The contract site field technician is Cindy Rissler who is responsible for filter collection. Site maintenance and QA is performed by AQD. The station began operation in 1991. It is a SLAMS site where the state currently monitors $PM_{2.5}$ and PM_{10} with manual filter-based (Partisol 2000) samplers. The PM_{10} samplers are collocated with the primary and the satellite samplers operating on a once in three days sampling frequency and the collocated sampler operating on a once in twelve days sampling frequency. The $PM_{2.5}$ samplers are set up with once in six days sampling frequencies that are offset between the primary and the satellite samplers for a once in three days sampling frequency for PM_{10}. The monitoring objective for this site is population exposure. No siting issues were noted while visiting the site; however, there were some operational issues noted. The internal clock time was observed to be off by as much as 20 minutes on the samplers and all were in excess of the one minute per month time acceptance criteria found in Appendix D of the QA Handbook and specified in the SOP. The internal clock time should be documented and the internal clock should be maintained and reset by the AQD field technicians during their regularly scheduled verification and maintenance. There was no log of site operation on site..

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Casper Gaseous Site

The Casper Gaseous Site (in the photo below) is located at 2800 Pheasant Drive in Casper, Wyoming. The contract site field technician is Curt Rissler who is responsible for inline filter replacement. Site maintenance and QA is performed by ARS. The station began operation in 2013. It is an SPM site where the state currently monitors O_3 and NO_x. with Teledyne T400 and Teledyne T200 monitors. The monitoring objective for this site is population exposure. No siting or operational issues were noted during the visit.

Lander SLAMS Site

The Lander SLAMS site (in the photo below) is located on a roof of a school building at 600 Washington street in residential Lander, Wyoming. Lander has a population of approximately 7,600 people. The contract site field technician is James Etherington who is responsible for filter collection. Site maintenance and QA is performed by AQD. The station began operation in 1989. It is a SLAMS site where the state currently monitors $PM_{2.5}$ and PM_{10} with manual filter-based (Partisol 2000) samplers. The PM_{10} and $PM_{2.5}$ samplers are set up with once in six days sampling frequencies that are offset between the primary and the satellite samplers for a once in three days sampling frequency. The monitoring objective for this site is population exposure. The siting and operational issues that were noted while visiting the site concerned the platform for the samplers. The platform for the samplers is unsafe because the materials from which it is constructed (plywood and 2x4s) have become dilapidated with time and exposure to the elements and because it is positioned at the edge of the roof. The weakened floor and railings pose safety hazards to field personnel accessing the samplers. AQD stated they plan to replace the platform with one of newer construction this summer and to place it nearer the center of the roof. There was no log of site operation on site.

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South Pass Site

The South Pass Site (in the photo below) is located on South Pass on the southern end of the Wind River Range. The contract site field technician is Marty Hamilton who is responsible for inline filter replacement. Site maintenance and QA is performed by ARS. The station began operation in 2007. It is an SPM site where the state currently monitors O_3 and NO_x with Thermo 49i and Thermo 42i monitors respectively, and $PM_{2.5}$ using a Met One BAM 1020 instrument. The monitoring objective for this site is to determine general background concentrations. No siting issues were noted during the visit; however, it was noted that the United States Forest Service (USFS) had cut a number of trees in the immediate area and stacked numerous slash piles for a planned burn. EPA was concerned that AQD should coordinate with USFS to learn the date(s) of the planned burning in order to accurately flag the high data values and possibly protect the sensitive gaseous monitors from any potential damage. AQD agreed to coordinate with USFS and update EPA on their plans. Operationally, it was noted that inside the shelter a 3 ring notebook contained checklist instructions (CIs) for the site operators. There were various versions of CIs in the notebook but no copy of the SOP. Also, the QAPP for this site does not include a CI version control.

Rock Springs SLAMS Site

The Rock Springs SLAMS site (in the photo below) is located on the roof of a school building at 625 Ahsay Avenue in residential Rock Springs, Wyoming. Rock Springs has a population of approximately 23,200 people. The contract site field technician is James Etherington who is responsible for filter collection. Site maintenance and QA is performed by AQD. The station began operation in 1989. It is a SLAMS site where the state currently monitors $PM_{2.5}$ and PM_{10} with manual filter-based (Partisol 2000) samplers. The PM_{10} and $PM_{2.5}$ samplers are set up with once in six days sampling frequencies that are offset between the primary and the satellite samplers for a once in three days sampling frequency. The monitoring objective for this site is population exposure. There were only 4 outlets for the 4 samplers which could inhibit Performance Evaluation Program (PEP) auditing due to restricted power access. There was no log of site operation on site. Safety concerns noted included the ladder access and the membrane roof material which AQD admitted was extremely slippery when covered with snow or frost. There were no other siting or operational issues noted while visiting the site.

Wamsutter Site

The Wamsutter Site (in the 1st photo below) is located two miles west of Wamsutter, Wyoming. The field site technician is Grant Roach of AQD who is responsible for inline filter replacement. Site maintenance and QA is performed by ARS. The station began operation in 2006. It is an SPM site where the state currently monitors O_3 and NO_x with Thermo 49i and Thermo 42i monitors respectively, and $PM_{2.5}$ using a Met One BAM 1020 instrument. The monitoring objectives for this site are source oriented and general background concentrations. A trip hazard was noted as being posed by the placement of visibility camera instrumentation near the point of access to the roof of the shelter (see 2nd photo below). There were no other siting or operational issues noted while visiting the site.

4.0 Findings and Observations

While no major findings were identified as a result of the TSA, several minor findings were noted. These findings include specific opportunities for improvement within the current program and recognition of actions taken by the state to correct issues noted in previous TSAs.

Quality control and assurance of ambient air quality data collected by the AQD is managed through the AQD QMP, and the AQD approved QAPPs and SOPs. EPA Requirements for Quality Assurance Project Plans QA/R-5, Section 2.7 requires annual Quality Assurance Project Plan reviews and updates as necessary. The QA Handbook for Air Pollution Monitoring Systems, Vol. 2, Section 1.3.2, indicates that SOPs should be developed as part of the QAPP development (or revision) process. Keeping SOPs current is an important part of maintaining a quality monitoring network that collects defensible data. During the TSA it was noted that there are several needed updates to QAPP and SOP documents. These necessary updates include revisions to include the current checklist instructions (CIs) maintained at monitoring sites (e.g. at the South Pass site), to reflect current monitoring equipment utilized at sites, and to identify the current project personnel for each site (contract and AQD site technicians and project managers). The dynamic AQD monitoring network might best be served by a practice of revising QAPPs and SOPs as changes occur in project personnel, CIs, and monitoring equipment, instead of

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waiting until the annual QAPP review is performed to make these types of revisions. It was also noted during the TSA that the SLAMS QAPP could be repaginated to ease the revision process.

As part of the TSA the Partisol-FRM Model 2000 Verification & Maintenance Forms and AQD site logbooks were reviewed at the AQD's offices in Cheyenne. It was observed that the AQD has made revisions to the Partisol-FRM Model 2000 Verification & Maintenance Forms (used for monthly field verifications) that are consistent with recommendations from the earlier TSA performed in 2012. During the review the Partisol-FRM Model 2000 Verification & Maintenance Forms were found to have inconsistent entries, and not all site logbooks were kept current as specified in the QAPPs and SOPs. The Partisol-FRM Model 2000 Verification & Maintenance Forms, used by the AQD Site Technicians, currently have an entry for time. It was ambiguous whether the time entered on the form was understood to be the time recorded from the sampler or the time of the AQD Site Technicians arrival on the site. The QA Handbook for Air Pollution Monitoring Systems, Vol. 2, Appendix D, addresses time acceptance criteria and clock timer verification for the samplers. The AQD SLAMS QAPP specifies in Table 14-1, Field QC Checks, the clock/timer verification is to be performed once per month and the acceptance criteria one minute drift per month. The form should either be revised to allow recording both clock/timer verification and time of arrival, or revised to specify that the time recorded is the required clock/timer verification. Also, the site logbooks were not always current with practices specified in the QAPPs and SOPs. Site logbooks and forms should be reconciled with current QAPPs and SOPs.

The ozone monitor at the Casper Gaseous site, currently designated an SPM in the AMNP, meets the SLAMS minimum ozone monitoring requirements for re-designating the monitor as a SLAMS monitor. A recent revision to the ozone NAAQS (promulgated in October of 2015) lowered the 8-hour standard to 70 parts per billion. The requirements found at 40 CFR Part 58 Appendix D Table D-2 specify that a metropolitan statistical area (MSA) which contains an urbanized area of 50,000 or more population and for which the most recent 3-year design value concentration is greater than 85% of the ozone NAAQS must have an ozone SLAMS. The ozone monitor located at the Casper Gaseous site in Casper (population 59.628 in 2013) has a 3-year (2012 -2015) design value concentration of 62 parts per billion which is 89% of the current ozone NAAQS of 70 parts per billion. The state should re-designate the ozone monitor which is currently designated an SPM at the Casper Gaseous site, as a SLAMS monitor. The state will need to submit a Network Modification Request Form for re-designating the ozone monitor as SLAMS to Region 8 for approval, and submit the request in time for the re-designation to be approved for inclusion in the 2017 AMNP.

During the TSA it was noted that the AQD Contract Site Technicians (responsible for PM filter collection at the AQD SLAMS sites) receive an initial training from the AQD Site Technicians. Thereafter they generally have infrequent contact with state personnel because the AQD Site Technicians (who visit the remote monitoring site locations only once per month) and the AQD Contract Site Technicians (who often have to schedule their part-time monitoring work to be performed after normal working hours) are unlikely to be at the site at the same time. Given the conflict in schedules, there is little opportunity for the AQD to observe that filter collection SOPs are consistently followed. AQD should provide annual training to Contract Site Technicians in order to ensure SOPs are adequately followed.

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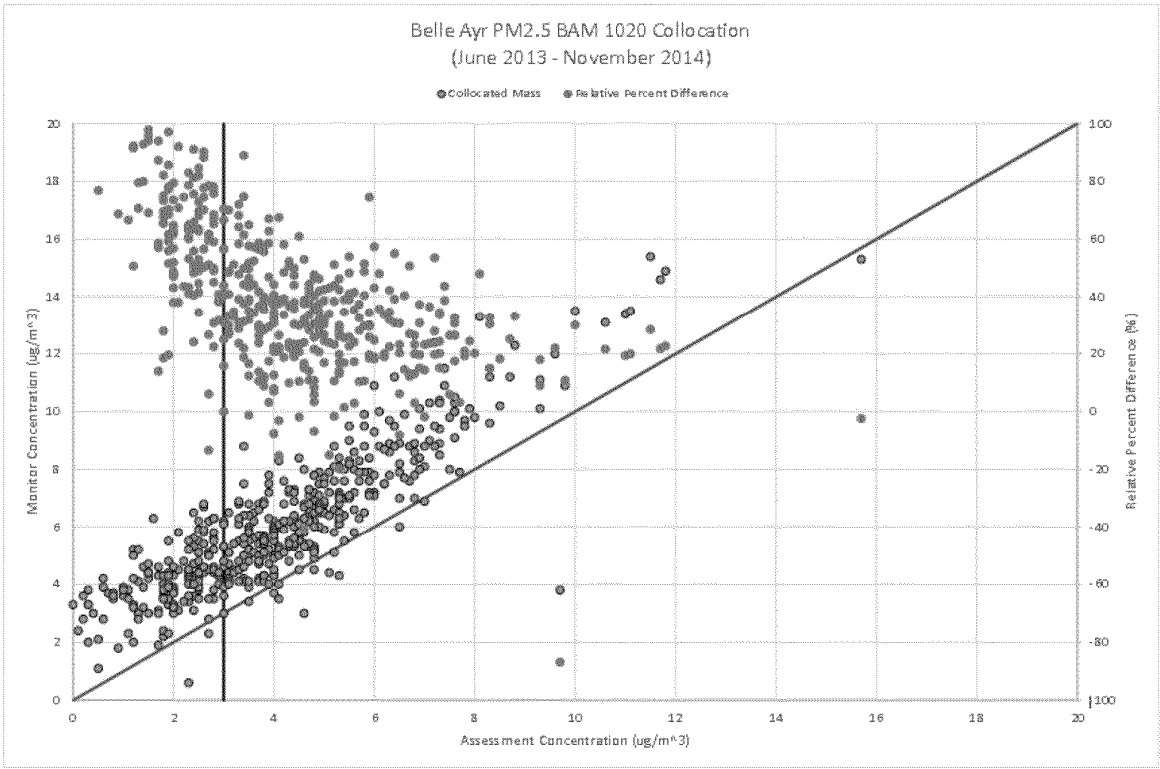
The TSAs performed in 2009 and 2012 documented the need for (and EPA's willingness to provide training for) the state to enhance their QA oversight of contractors. It was suggested in both the previous audits that EPA could provide training to the state via a joint State/EPA systems audit of one of the contractors. The joint TSA of ARS was performed in September of 2013 by the AQD QA Coordinator and the Region 8 monitoring contact for Wyoming. The state plans to continue to enhance their QA oversight of contractors through the performance of TSAs and continued discussions with Region 8 on QA topics.

In response to the recommendation received from the TSA performed in 2009, the AQD monitoring section has developed a draft Records Management Plan to manage hard copy and electronic records. A copy of the draft plan dated April 3, 2016, was provided to EPA during the TSA. The plan addresses the elements of a records management policy as recommended in the EPA QA handbook. The Wyoming State legislature has required the Wyoming DEQ to implement a legislative action called the "Paperless Initiative" and the AQD has fundamentally achieved that goal relying on electronic primary records for all collected data beginning January 1, 2016. A lot of their official records are maintained in the Impact database which is an online searchable system. Other records are accessible on a AQD shared drive and in hard copy paper files at the AQD offices. Electronic files are stored in the shared drives or the IMPACT databases and those shared drives and databases are managed by the Wyoming Department of Enterprise Technology Services (ETS) a state department responsible for implementing the state-wide Paperless Initiative. During the TSA an interview was conducted with representatives from ETS and AQD IT specialists to discuss and review the data storage, retrieval and back-up procedures in place. It was evident from the discussion that the "all digital" approach to records management is very efficient and has improved data access and usability; however, data security and reliable access to data in the paperless system also requires a close and accountable coordination between ETS and AQD. EPA recognizes the achievements made by AQD in paperless record keeping and encourages continued coordination between ETS and AQD for the secure handling of ambient monitoring data records.

The bias in collocated $PM_{2.5}$ precision data noted in the 2012 TSA has been determined by the state to be the result of errors in background zero settings at these sites. In 2012, precision data from the collocated sites in Cheyenne and Sheridan indicated the primary $PM_{2.5}$ monitors tended to read higher concentrations than the secondary monitors at both sites during the second quarter of 2012. During the current TSA, the precision data from the two sites was studied and found to not have exhibited further subsequent bias. However, during the review of three years of collocated $PM_{2.5}$ precision data from the Belle Ayr BA-4 SPM site (in the Powder River Basin $PM_{2.5}$ Network) it was noted that the precision data had exhibited a similar bias as was found in the Cheyenne and Sheridan data from 2012. The collocated $PM_{2.5}$ monitors at the Belle Ayr BA-4 site were installed during the second quarter of 2013 as replacement monitors for monitors that had reliability issues. The collocated $PM_{2.5}$ replacement monitors at the Belle Ayr BA-4 site are Met One BAM 1020 monitors whereas the collocated $PM_{2.5}$ monitors at the SLAMS sites in Cheyenne and Sheridan (and all SLAMS sites) are Partisol FRM Model 2000s. From June of 2013 until November of 2014 the precision data from the collocated $PM_{2.5}$ replacement monitors at the Belle Ayr BA-4 site shows a positive relative difference. In other words, the primary $PM_{2.5}$ monitor tended to read higher concentrations than the secondary monitor (See Figure 4). In

November of 2014 the observed bias disappears. This indicates that for nearly one and a half years the problem went unnoticed. During the TSA, the state explained that all three instances of bias found in collocated $PM_{2.5}$ precision data were due to errors in background zero settings at these sites. Given the experience with the two sites in 2012, it is concerning that the bias at the Belle Ayr BA-4 SPM site was not addressed much earlier than it was. Another concern is that similar but undiscovered bias may exist in $PM_{2.5}$ data collected at $PM_{2.5}$ monitoring sites in Wyoming that are not collocated. The state is encouraged to analyze the source of these errors in order to help ensure that bias does not exist in the $PM_{2.5}$ data collected at the other (non-collocated) $PM_{2.5}$ monitoring sites in Wyoming.

Figure 4. Belle AYR BA-4 Site – $PM_{2.5}$ Bias



5.0 Data Validation and Usability

The collection frequency for raw data from AQD monitoring sites depends on whether the data is collected from SLAMS or SPM sites. At SPM sites (run by contractors) data is polled (daily by MSI, hourly by ARS) and the continuous data is collected hourly via an automated process. SLAMS data is downloaded by AQD monthly. For SPMs, the raw data files are automatically downloaded into the contractors' databases and then uploaded into AQD's IMPACT data repository and EPA's AirNow website. Contractors maintain data records to flag the raw data per validation codes and to separate fields for validated values. Raw values are not changed and notes on data that was invalidated are maintained in the database with the data. AQD first stores

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the data from the IMPACT data repository onto an AQD internal server and then uploads the validated data from there to AQS via the Exchange Network.

Data validation is performed by the contractors and AQD pursuant to established criteria documented in QAPPs and SOPs. The data validation codes and raw data flags (for suspect values) exist in each data record and validation notes also accompany validated data within the database. Data are invalidated when established acceptance criteria limits are exceeded. Invalidated data is assigned codes which translate to AQS null data codes. Validated data that is changed or corrected subsequent to entering it into AQS is automatically logged by the databases. Daily, monthly, and annual reviews are performed to determine if values are reasonable or need to be corrected.

6.0 Conclusions and Recommendations

Table 2 is a list of the findings and recommendations from the June 2016 TSA for the AQD. Major findings are those which, if uncorrected, have the potential to lead to instances where collected data might be inaccurate or invalidated after problem detection and investigation. No major findings were identified in this audit, and few other issues, termed minor findings, were identified. Although some findings are similar to those identified in the last TSA performed in 2012, progress has been made to improve and update the monitoring network in those areas.

Table 2. Findings and Recommendations.

FINDING - MAJOR	**RECOMMENDATION(S)**
1. None	
FINDING - MINOR	**RECOMMENDATION(S)**
1. The ozone monitor at the Casper Gaseous site, currently designated an SPM in the AMNP, meets the SLAMS minimum ozone monitoring requirements found at 40CFR part 58 Appendix D, Table D-2.	1. Submit a Network Modification Request Form for re-designating the ozone monitor as SLAMS to Region 8 for approval. Submit the request in time for the re-designation to be approved for inclusion in the 2017 AMNP.
2. The QAPP for the South Pass site did not include CIs maintained on site and current project personnel (AQD site operators and Project managers).	2. Revise QAPPs to include current CI version used in the Wyoming monitoring network, current project personnel and monitoring equipment. QA/R-5, Section 2.7 requires annual QAPP reviews and updates as necessary. Keeping QAPPs current is an important part of maintaining a quality monitoring network that collects defensible data.

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3. The Partisol-FRM Model 2000 Verification & Maintenance Forms have inconsistent entries for "Time". Not all site logbooks were kept current as specified in the QAPPs and SOPs.	3. Update the Partisol-FRM Model 2000Verification & Maintenance Forms to remove ambiguity and specify that sampler time is to be recorded, verified, and adjusted as necessary. The QA Handbook for Air Pollution Monitoring Systems, Vol. 2, Appendix D, addresses time acceptance criteria and clock timer verification for the samplers. Maintain site logbooks and update SOPs to include current procedures.
4. Records Management – EPA recognizes AQD's work in drafting a Records Management Plan and implementing an "all-digital" records management system for increased efficiency and improved data access and usability. Data security and reliable access to data in the paperless system requires a close and accountable coordination between ETS and AQD.	Coordination between ETS and AQD should remain close and accountable.
5. Bias in collocated $PM_{2.5}$ precision data. The review of three years of collocated $PM_{2.5}$ precision data from the Belle Ayr BA-4 SPM site showed that the precision data had exhibited a similar bias as was found in the Cheyenne and Sheridan data from 2012. State determined the error stemmed from incorrect background zero settings at all 3 sites. Belle Ayr BA-4 SPM site problem existed 17 months before corrected.	The state is encouraged to analyze the source of these errors in order to help ensure that bias does not exist in the $PM_{2.5}$ data collected at the other (non-collocated) $PM_{2.5}$ monitoring sites in Wyoming. Data review should include collocated assessments per AMP 251 AQS reports. Reducing/eliminating the bias will improve data defensibility. (QA Handbook, Volume II, Appendix D)
6. AQD Contract Site Technicians receive an initial training from the AQD Site Technicians but then generally have infrequent contact with state personnel thereafter.	AQD should provide annual training to Contract Site Technicians in order to ensure SOPs are adequately followed

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Appendix A

Wyoming
2016 TSA
Questionnaire Response

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Wyoming Ambient Air Monitoring Annual Network Plan 2017

Taken by the automated digital camera at Thunder Basin on 8/17/2016

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Acronyms

AQD	Wyoming Department of Environmental Quality – Air Quality Division
AQRM	Air Quality Resource Management Program
AQRV	Air Quality Related Value
AQS	EPA's Air Quality System database
BAM	Beta Attenuation Monitor
CFR	United States Code of Federal Regulations
CH_4	Methane
CO	Carbon Monoxide
DRR	SO_2 Data Requirements Rule
EPA	United States Environmental Protection Agency
FEM	Federal Equivalent Method
FRM	Federal Reference Method
IMPACT	The AQD's Inventory, Monitoring, Permitting, And Compliance Tracking data system
IMPROVE	Interagency Monitoring of Protected Visual Environments
IWDW	Intermountain West Data Warehouse
MSA	Metropolitan Statistical Area
$\mu g/m^3$	Micrograms per cubic meter
µSA	Micropolitan Statistical Area
NAAQS	National Ambient Air Quality Standard
NADP	National Atmospheric Deposition Program
NCore	National Core Multi-Pollutant Monitoring Station
NMHC	Non-Methane Hydrocarbons
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
NO_y	Reactive Oxides of Nitrogen

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NOAA	National Oceanic and Atmospheric Administration
NPAP	National Performance Audit Program
NPS	United States National Park Service
NSR	AQD's New Source Review Program
O_3	Ozone
OAQPS	EPA's Office of Air Quality Planning and Standards
ppb	Parts per billion
ppm	Parts per million
PM_{10}	Particulate Matter less than 10 micrometers in aerodynamic diameter
$PM_{2.5}$	Particulate Matter less than 2.5 micrometers in aerodynamic diameter
POC	Parameter Occurrence Code
PQAO	Primary Quality Assurance Organization
PRB	Powder River Basin
PSD	Prevention of Significant Deterioration
QAPP	Quality Assurance Project Plan
QMP	Quality Management Plan
SLAMS	State and Local Air Monitoring Stations
SO_2	Sulfur Dioxide
SPM	Special Purpose Monitor
TEOM	Tapered element oscillating microbalance
THC	Total Hydrocarbons
TSA	Technical System Audit
UGRB	Upper Green River Basin (Portions of Lincoln and Sweetwater Counties and all of Sublette County)
UGWOS	Upper Green Winter Ozone Study
VOC	Volatile Organic Compounds
VSCC	Very Sharp Cut Cyclone
WAAQS	Wyoming Ambient Air Quality Standards

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WDEQ	The Wyoming Department of Environmental Quality
WyVisNet	The AQD's monitoring website, **http://www.wyvisnet.com**

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Executive Summary

The Wyoming Department of Environmental Quality – Air Quality Division (AQD) presents its 2017 Annual Network Plan for ambient air and meteorological monitoring as required by Title 40 Part 58.10 of the Code of Federal Regulations (CFR). The 2017 Annual Network Plan summarizes the AQD's monitoring efforts in Wyoming to ensure full compliance with the National Ambient Air Quality Standards (NAAQS). Throughout this document, information is presented on the AQD's State and Local Air Monitoring Stations (SLAMS), Special Purpose Monitors (SPMs), and other special monitoring studies that occurred in Wyoming throughout 2016 and future monitoring plans of the AQD. Complete data from ambient monitoring is provided from 2014-2016 for any monitoring station that operated during this 3-year period. Additionally, the AQD has updated information on industrial monitoring networks established to comply with the SO_2 Data Requirements Rule (DRR).

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1.0 Introduction

The AQD presents its Annual Network Plan for 2017 to the United States Environmental Protection Agency (EPA) as required by Title 40, Part 58.10(a)(1) of the CFR. The 2017 Annual Network Plan provides a comprehensive review of the ambient monitoring stations maintained by the AQD. These stations are the SLAMS, SPMs, mobile stations that monitor for particulates and or gaseous pollutants, and the National Core Multi-Pollutant Monitoring Station (NCore). The 2017 Annual Network Plan illustrates how the AQD's ambient monitoring network satisfies the requirements of Title 40, Part 58 Appendices A, C, D, and E of the CFR.

1.1 The AQD's Ambient Monitoring History

Since the early 1970s, the AQD Monitoring Section has been committed to monitoring the air quality of Wyoming with the goal of protecting, conserving, and enhancing the quality of Wyoming's environment for the benefit of current and future generations. The Monitoring Section comprises one third of the Air Quality Resource Management (AQRM) Program, which provides the AQD with valuable information in order to determine future policy considerations. The other two components of the AQRM Program are the Emission Inventory Section and the Planning Section.

As mentioned in the Introduction, the AQD owns and operates different types of ambient monitoring stations: SLAMS, SPMs, mobile stations, and an NCore station. The SLAMS are sited in populated areas to monitor public health and demonstrate compliance with the NAAQS, but may serve other purposes such as:

- provide air pollution data to the general public in a timely manner
- support compliance with air quality standards and emissions strategy development
- support air pollution research studies

The SPM stations collectively have multiple objectives. These objectives include:

- monitoring public health
- investigating pollutant concentrations downwind of sources
- determining background pollutant concentrations

Since 2011, the AQD has operated a fleet of mobile monitoring stations to investigate questions or concerns about air quality on a short-term basis (typically one year). Additionally, the AQD operates an NCore station as part of the national network to evaluate long-term trends in air quality. The AQD also helps fund and evaluate data from Air Quality Related Value (AQRV) monitoring within Wyoming, such as visibility and acid deposition, as well as overseeing industrial monitoring required by air quality permits. Figure 1 shows the number of monitors the AQD runs or oversees from 1999 to May of 2017.

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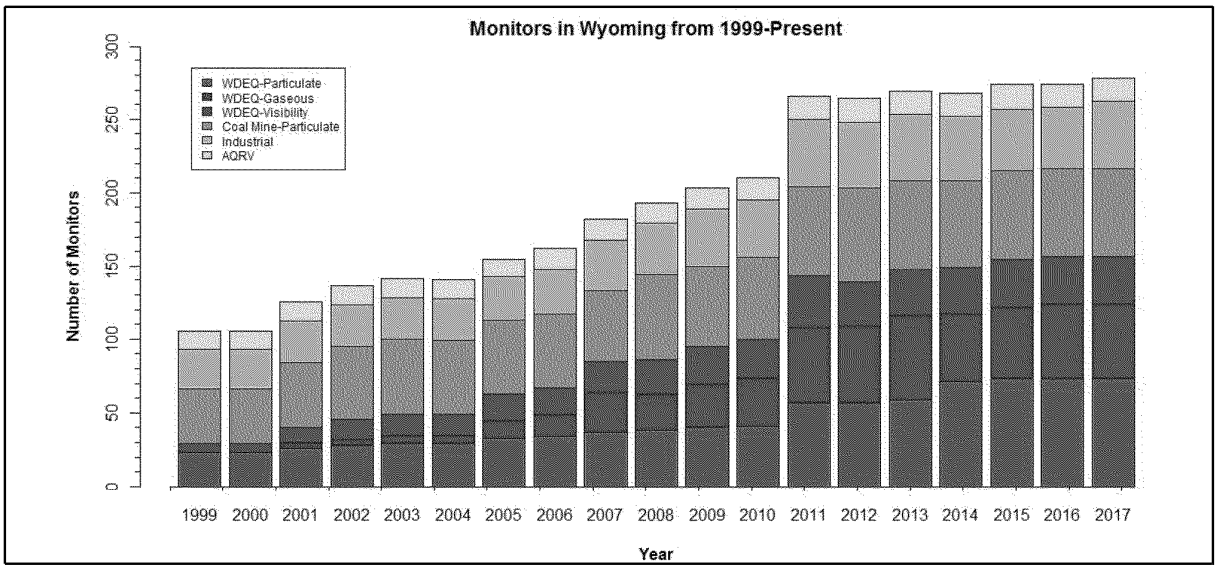

Figure 1. Number of Monitors in Wyoming from 1999-May 2017

There was a slight increase in the number of industrial monitors from 2016 to 2017. This is attributed to the application of the SO_2 DRR of Title 40, Part 51, Subpart BB of the CFR. More information about the SO_2 DRR is found in Section 4.6 of the 2017 Annual Network Plan.

1.2 General Monitoring Goals and Objectives

The AQD and Wyoming Department of Environmental Quality are committed to protect, conserve, and enhance the quality of Wyoming's environment for the benefit of current and future generations. In order to maintain the ambient air quality in accordance with the NAAQS for the seven criteria pollutants, the AQD operates and maintains a network of ambient air quality monitors.

The Wyoming monitoring network, collectively, is designed to meet the following seven basic ambient air monitoring objectives:

1. Determine the representative concentrations in areas of high population density
2. Determine the impact on ambient air quality from significant sources
3. Determine the general background concentration levels
4. Determine the extent of regional pollutant transport among populated areas and in rural and remote areas
5. Determine welfare-related impacts in support of secondary standards
6. Determine the highest concentration expected to occur in the area covered by the network
7. Research pollutant and meteorological behaviors in areas of concern

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It is important to acknowledge that not every individual monitor or monitoring station will meet all seven objectives, but the AQD's entire monitoring network will encompass and fulfill all of the objectives. Figure 2, below, is a map that shows the AQD's SLAMs, SPMs, and mobile monitoring locations at the time of this publication.

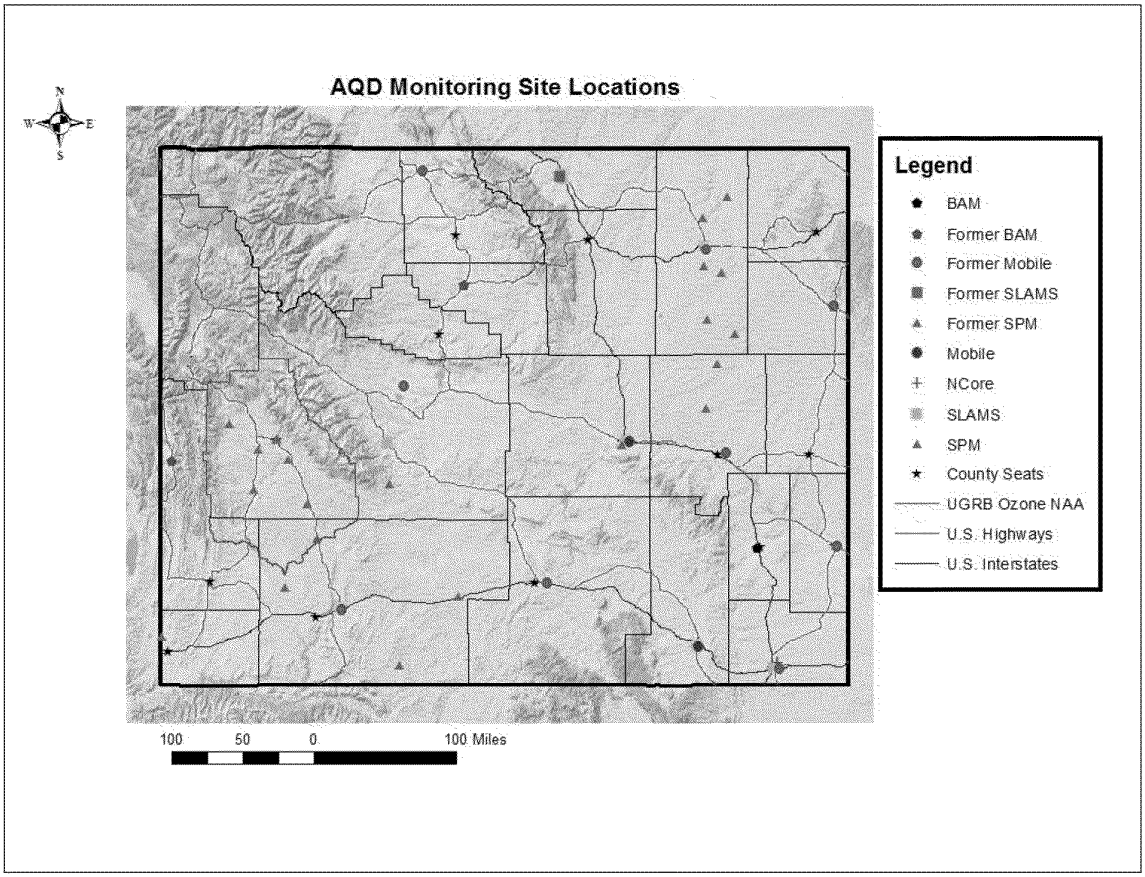

Figure 2. AQD Monitoring Site Locations (Past and Present)

NAME	COUNTY	PARAMETER										
		PM_{10} (manual)	PM_{10} (continuous)	$PM_{2.5}$ (manual)	$PM_{2.5}$ (continuous)	NO_x	O_3	SO_2	CO	Camera	Met	Other
Laramie SLAMS	Albany	X		X								
Laramie Mobile	Albany		X		X	X	X	X		X	X	CH_4/NMHC
Belle Ayr BA-4	Campbell				X	X						
Black Thunder BTM-36-2	Campbell				X							
Buckskin Mine	Campbell				X							
Campbell County	Campbell		X			X	X			X	X	
Gillette SLAMS	Campbell	X										
Thunder Basin	Campbell					X	X			X	X	Visibility
Wright Jr-Sr High School	Campbell	X										
Antelope Site 7	Converse				X	X						
Converse County	Converse		X			X	X			X	X	CH_4/NMHC
Lander SLAMS	Fremont	X		X								
South Pass	Fremont				X	X	X			X	X	
Cheyenne SLAMS	Laramie	X		X								
Cheyenne NCore	Laramie		X	X	X	X	X	Trace	Trace	X	X	NO/NO_y, $PM_{10-2.5}$, Speciated $PM_{2.5}$
Casper SLAMS	Natrona	X		X								
Casper Gaseous	Natrona					X	X			X	X	
Casper Mobile	Natrona		X		X	X	X	X		X	X	CH_4/NMHC
Cody SLAMS	Park	X		X								
Wheatland BAM Station	Platte		X		X						X	
Sheridan Meadowlark SLAMS	Sheridan	X		X								
Sheridan Police Station SLAMS	Sheridan		X	X							X	
Big Piney	Sublette					X	X			X	X	
Boulder	Sublette		X			X	X			X	X	NO_y CH_4/NMHC, Photolytic NO_2
Daniel South	Sublette		X			X	X			X	X	
Juel Spring	Sublette					X	X			X	X	
Pinedale Gaseous	Sublette				X	X	X			X	X	
Hiawatha	Sweetwater						X			X	X	

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NAME	COUNTY	PARAMETER										
		PM_{10} (manual)	PM_{10} (continuous)	$PM_{2.5}$ (manual)	$PM_{2.5}$ (continuous)	NO_x	O_3	SO_2	CO	Camera	Met	Other
Moxa Arch	Sweetwater		X			X	X	X		X	X	
Rock Springs SLAMS	Sweetwater	X		X								
Wamsutter	Sweetwater		X			X	X			X	X	CH_4/NMHC
Jackson SLAMS	Teton	X		X								
Murphy Ridge	Uinta	X				X	X			X	X	

Table 1. Overview of Currently Operating Wyoming Monitors

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2.0 Air Monitoring Plan in 2017

2.1 SLAMS

The SLAMS are used for supplying general monitoring data for criteria pollutants and determining compliance with the NAAQS. These are long-term stations that must meet and follow specific quality assurance, monitoring methodology, sampling objectives and siting requirements. The AQD SLAMS are located in Wyoming's most populous towns with the purpose of determining compliance with the NAAQS for the protection of public health. The ten stations specified as Wyoming SLAMS locations are described below. Each description includes a satellite view of the SLAMS in the town or city, a table with site and monitor information, and a graph of annual means of PM_{10} and, if measured at the site, $PM_{2.5}$. Below is a map of SLAMS.

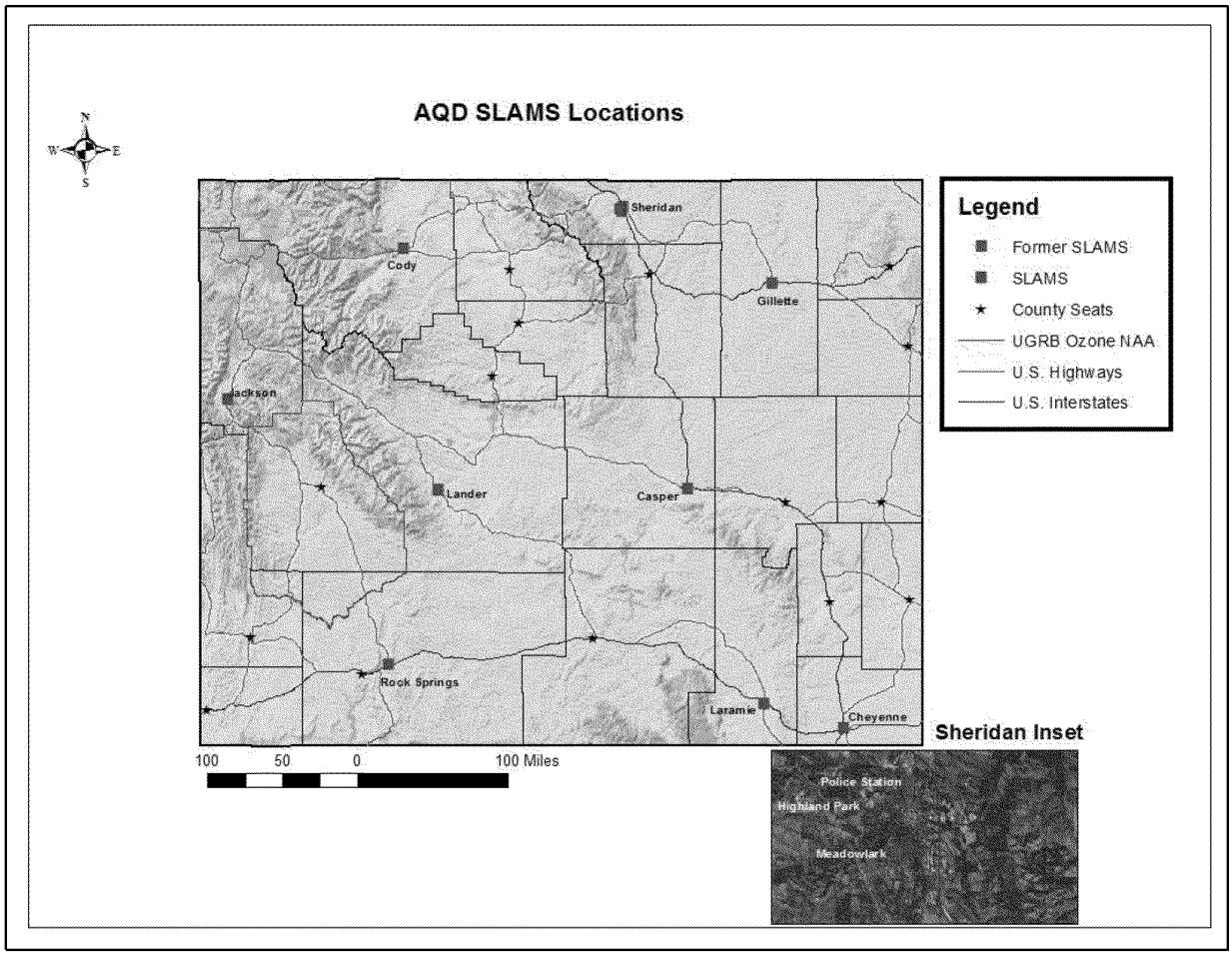

Figure 3. Map of SLAMS Locations

2.1.1 Casper SLAMS

Figure 4. Casper SLAMS satellite view and monitor photo (inset)

Casper – SLAMS Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Casper SLAMS	City, County Bldg.; Center & C Streets (Casper MSA)	56-025-0001	PM_{10}	R&P Co. Partisol Model 2000 (Manual filter-based)	Neighborhood	1 in 3 days (primary); 1 in 12 days (collocate)	No planned changes
			$PM_{2.5}$	R&P Co. Partisol Model 2000 $PM_{2.5}$ Air Sampler w/ VSCC (Manual filter-based)	Neighborhood	1 in 3 days (offset between the primary & satellite samplers)	No planned changes

Table 2. Casper SLAMS Monitor Information

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This station is located in downtown Casper, a city and metropolitan statistical area (MSA) of over 59,000 people. Casper is the second largest city in Wyoming, located in Natrona County near the center of Wyoming. Data collection for PM_{10} began at this station in 1991. A collocated PM_{10} sampler was added in 2001 and the hi-volume PM_{10} samplers were replaced with low-volume partisols in 2010. The AQD enhanced the station by adding $PM_{2.5}$ sampling on May 22, 2009 as the population of Casper increased.

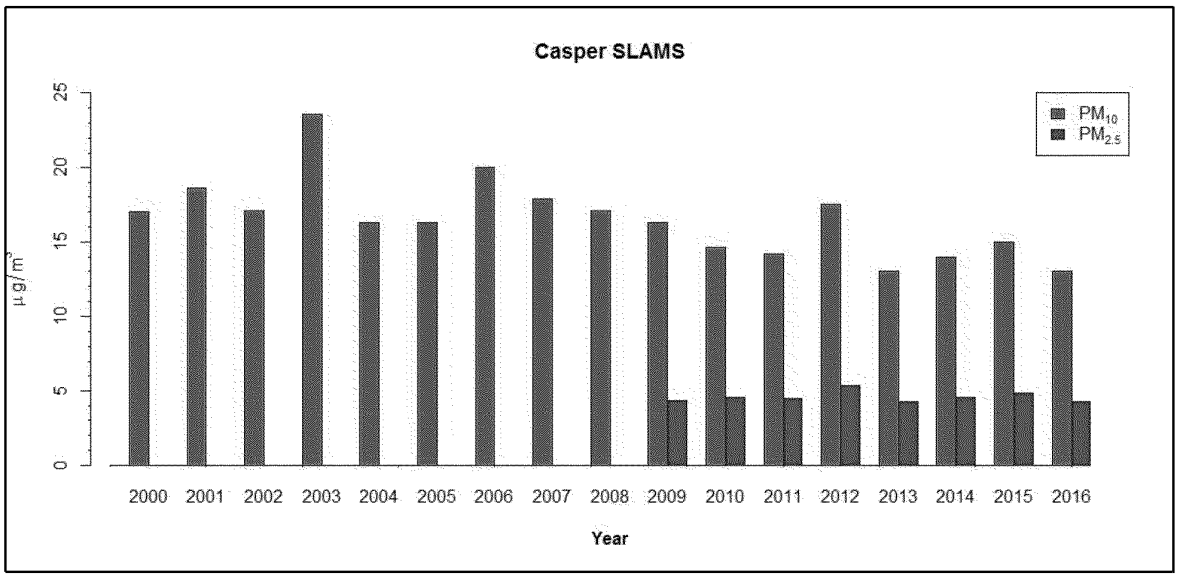

Figure 5. Casper SLAMS Annual Means

2.1.2 Cheyenne SLAMS

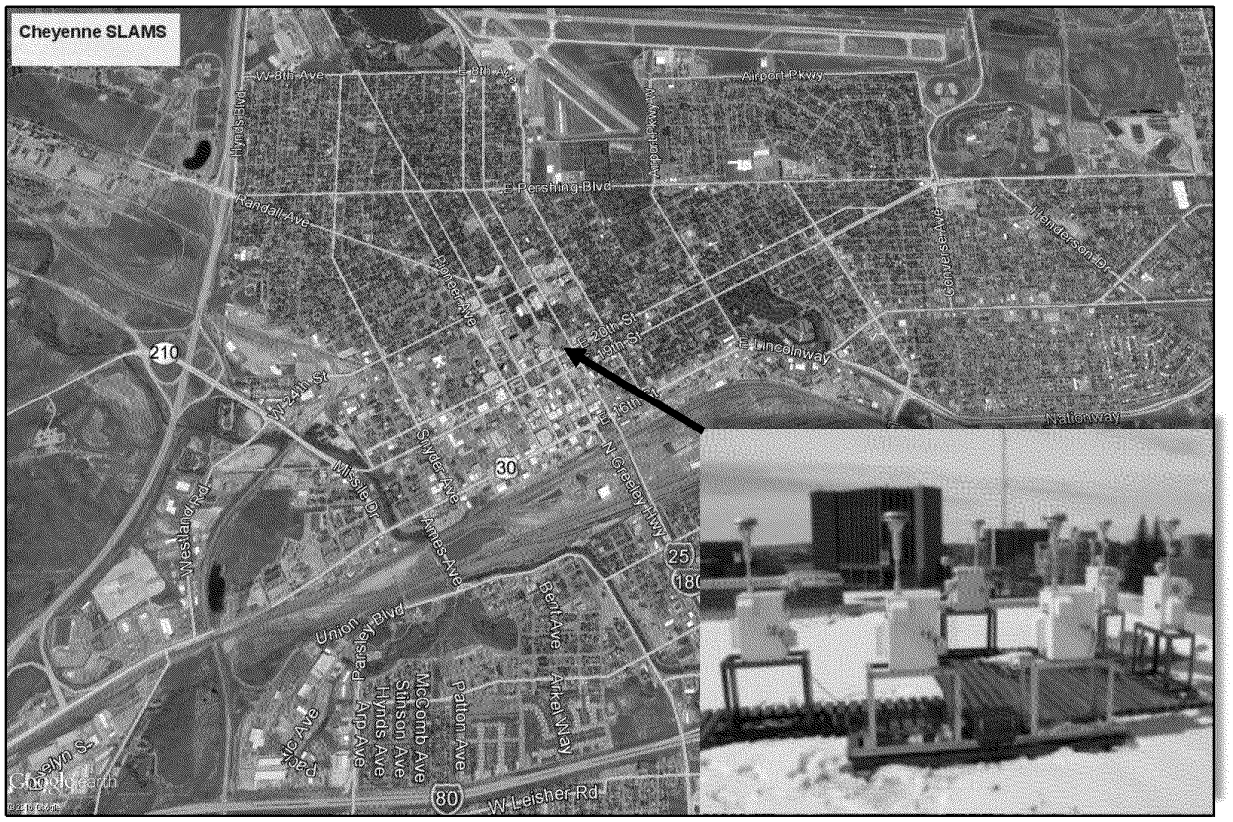

Figure 6. Cheyenne SLAMS satellite view and monitor photo (inset)

Cheyenne – SLAMS Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Cheyenne SLAMS	Emerson Bldg.; 23rd & Central Ave. (Cheyenne MSA)	56-021-0001	PM_{10}	R&P Co. Partisol Model 2000i (Manual filter-based)	Neighborhood	1 in 3 days (primary); 1 in 12 days (collocate)	No planned changes
			$PM_{2.5}$	R&P Co. Partisol Model 2000i $PM_{2.5}$ Air Sampler w/ VSCC (Manual filter-based)	Neighborhood	1 in 3 days (primary); 1 in 12 days (collocate)	No planned changes

Table 3. Cheyenne SLAMS Monitor Information

The Cheyenne monitoring station is located in downtown Cheyenne on the roof of the Emerson Building; a State of Wyoming owned building. Cheyenne is the capital and largest city of Wyoming with an approximate population over 62,000. This population size leads to the classification of Cheyenne, WY as a MSA. The PM_{10} sampling started in 1991. A collocated PM_{10} sampler was added in 2002. The $PM_{2.5}$ monitors were added in 1998. A collocated $PM_{2.5}$ sampler was added in March 2009 to comply with Title 40 Part 58 requirements from the CFR for collocation of samplers. The 2015 Network Assessment revealed a strong correlation of the PM_{10} and $PM_{2.5}$ data between the Cheyenne SLAMS and Cheyenne NCore station. The AQD plans to evaluate these data in late 2017 to determine if the SLAMS and NCore particulate data are redundant and consider options to optimize the network. In 2017, the AQD replaced the older Partisol 2000 sampler with Partisol 2000i samplers.

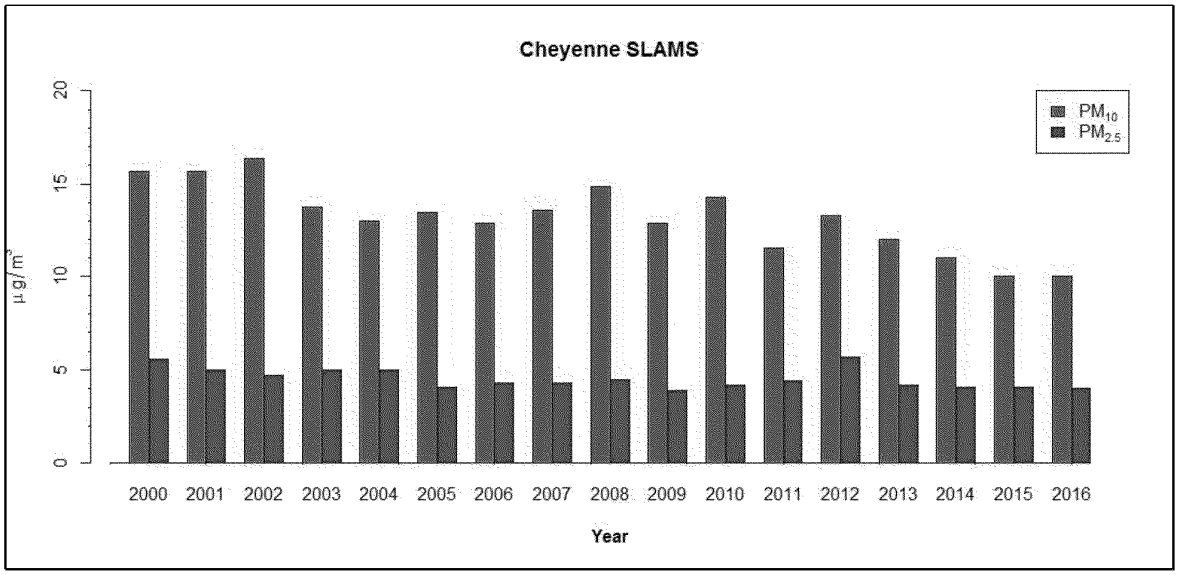

Figure 7. Cheyenne SLAMS Annual Means

2.1.3 Cody SLAMS

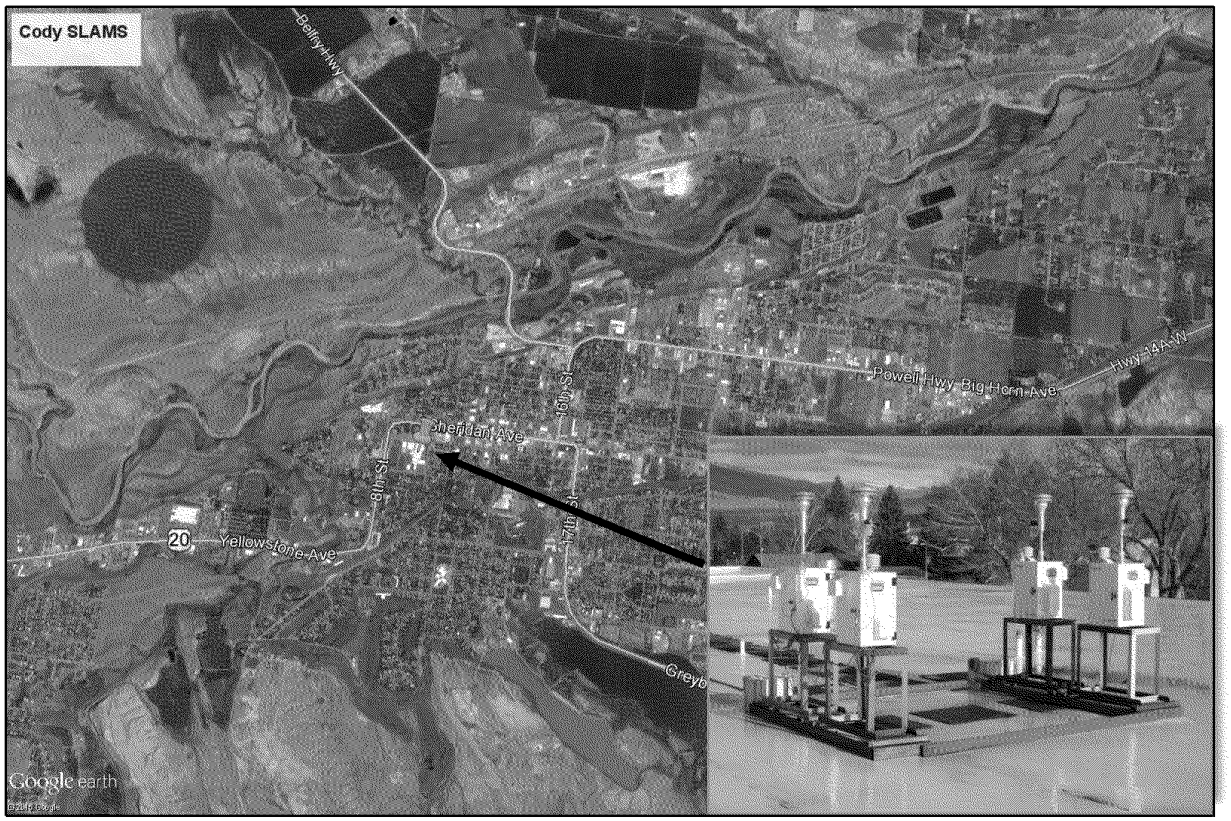

Figure 8. Cody SLAMS satellite view and monitor photo (inset)

Cody – SLAMS Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Cody SLAMS	1225 10th Street	56-029-0001	PM_{10}	R&P Co. Partisol Model 2000 (Manual filter-based)	Neighborhood	1 in 3 days (offset between the primary & satellite samplers)	No planned changes
			$PM_{2.5}$	R&P Co. Partisol Model 2000 $PM_{2.5}$ Air Sampler w/ VSCC (Manual filter-based)	Neighborhood	1 in 3 days (offset between the primary & satellite samplers)	No planned changes

Table 4. Cody SLAMS Monitor Information

Cody is located in the northwest portion of Wyoming in Park County. Its population is around 9,800. The AQD initiated PM_{10} sampling at this station in 1988. The PM_{10} samplers were upgraded to the current instrument seen in the table above during 2010. In June 2008, $PM_{2.5}$ monitoring began at the Cody SLAMS. The AQD started monitoring ambient $PM_{2.5}$ concentrations in Cody due to impacts from wintertime sanding, wood smoke, summertime wildfires, and the nearby lakebed that can be exposed at low water levels.

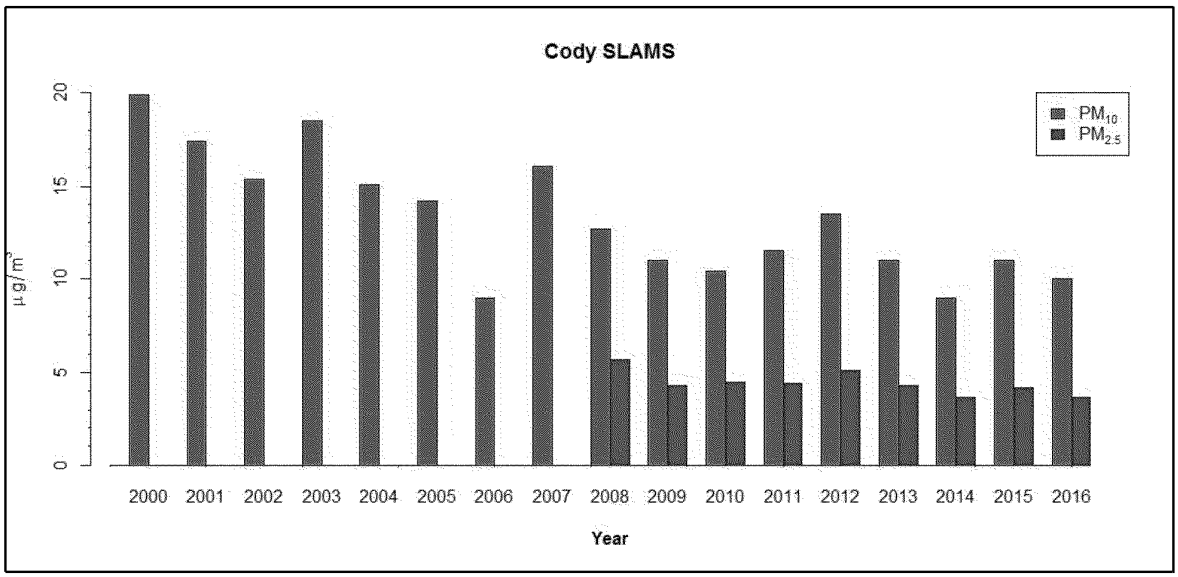

Figure 9. Cody SLAMS Annual Means

2.1.4 Gillette SLAMS

Figure 10. Gillette SLAMS satellite view and monitor photo (inset)

Gillette – SLAMS Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Gillette SLAMS	1000 W. 8th St.	56-005-1002	PM_{10}	R&P Co. Partisol Model 2000 (Manual filter-based)	Neighborhood	1 in 6 days	No planned changes

Table 5. Gillette SLAMS Monitor Information

Gillette is located in Campbell County, the northeastern part of Wyoming. Its population is approximately 31,800. The population size results in Gillette meeting the classification of micropolitan statistical area (µSA). The AQD has monitored PM_{10} at this location since 1991.

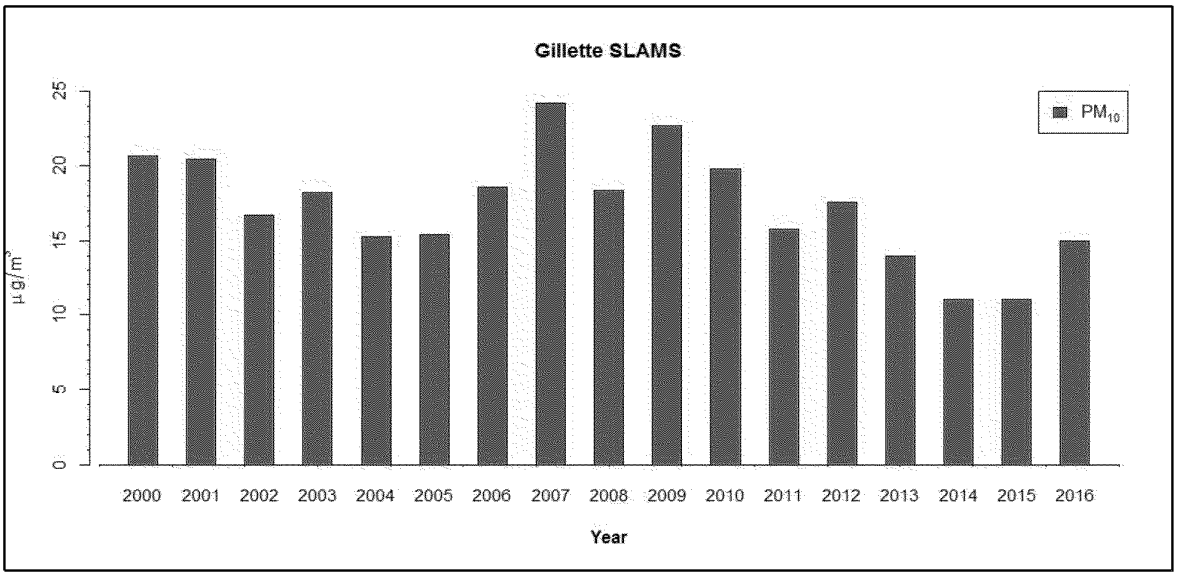

Figure 11. Gillette SLAMS Annual Means

2.1.5 Jackson SLAMS

Figure 12. Jackson SLAMS satellite view and monitor photo (inset)

Jackson – SLAMS Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Jackson SLAMS	40 E. Pearl Ave.	56-039-1006	PM_{10}	R&P Co. Partisol Model 2000 (Manual filter-based)	Neighborhood	1 in 3 days (offset between the primary & satellite samplers)	No planned changes
			$PM_{2.5}$	R&P Co. Partisol Model 2000 $PM_{2.5}$ Air Sampler w/ VSCC (Manual filter-based)	Neighborhood	1 in 3 days (offset between the primary & satellite samplers)	No planned changes

Table 6. Jackson SLAMS Monitor Information

Jackson is located in Teton County in northwest Wyoming. Its population is just over 10,100 as of 2013. Due to its size, Jackson is considered a µSA. PM_{10} and $PM_{2.5}$ sampling began in Jackson in 2001 at the Teton County Building site. The samplers were moved to the Jackson Fire Station site in 2007. On December 11, 2015, the AQD began correspondence with the EPA concerning the relocation of the Jackson SLAMS due to planned renovations of the fire station in 2016. Region VIII of the EPA approved the AQD's request for relocation on January 6, 2016. The initial request and approval of the relocation is in Appendix D of the 2016 Annual Network Plan (**http://deq.wyoming.gov/media/attachments/Air%20Quality/Monitoring/Annual%20Network%20Plans/Annual-Network-Plan_2016-Final.pdf**). The AQD moved the samplers on December 21, 2016 to the current location near Jackson High School at the southwestern region of the town.

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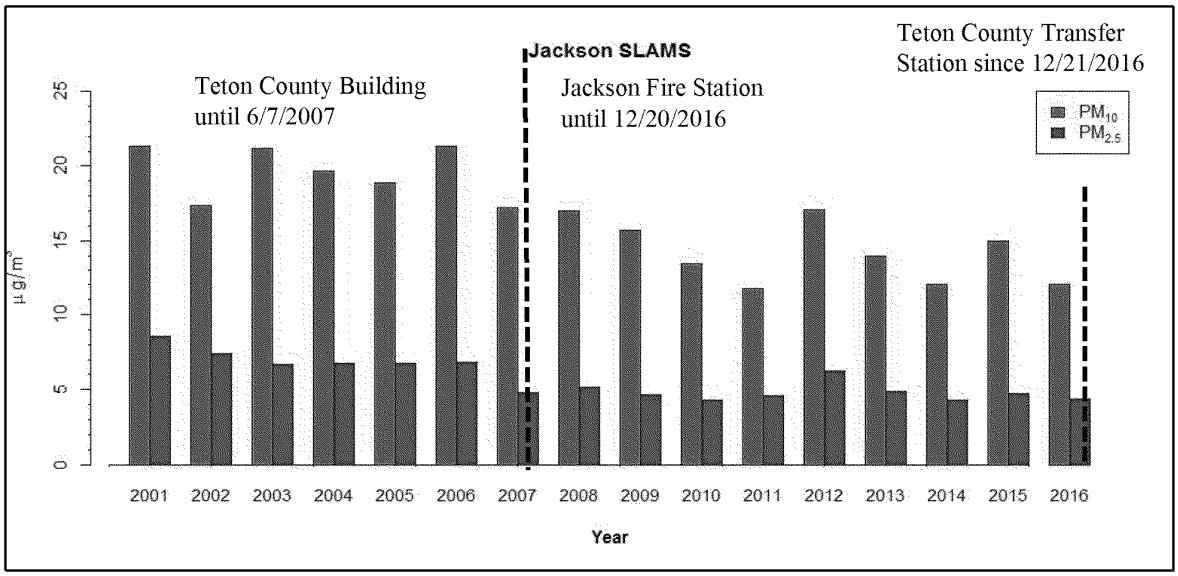

Figure 13. Jackson SLAMS Annual Means

2.1.6 Lander SLAMS

Figure 14. Lander SLAMS satellite view and monitor photo (inset)

Lander – SLAMS Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Lander SLAMS	600 Washington	56-013-1003	PM_{10}	R&P Co. Partisol Model 2000 (Manual filter-based)	Neighborhood	1 in 3 days (offset between the primary & satellite samplers)	No planned changes
			$PM_{2.5}$	R&P Co. Partisol Model 2000 $PM_{2.5}$ Air Sampler w/ VSCC (Manual filter-based)	Neighborhood	1 in 3 days (offset between the primary & satellite samplers)	No planned changes

Table 7. Lander SLAMS Monitor Information

The Lander SLAMS is located in Fremont County in the central part of the State. There is a population of just over 7,700 in Lander as of 2013. The AQD began PM_{10} sampling at this station in 1989. $PM_{2.5}$ monitors were installed at this location in 2001.

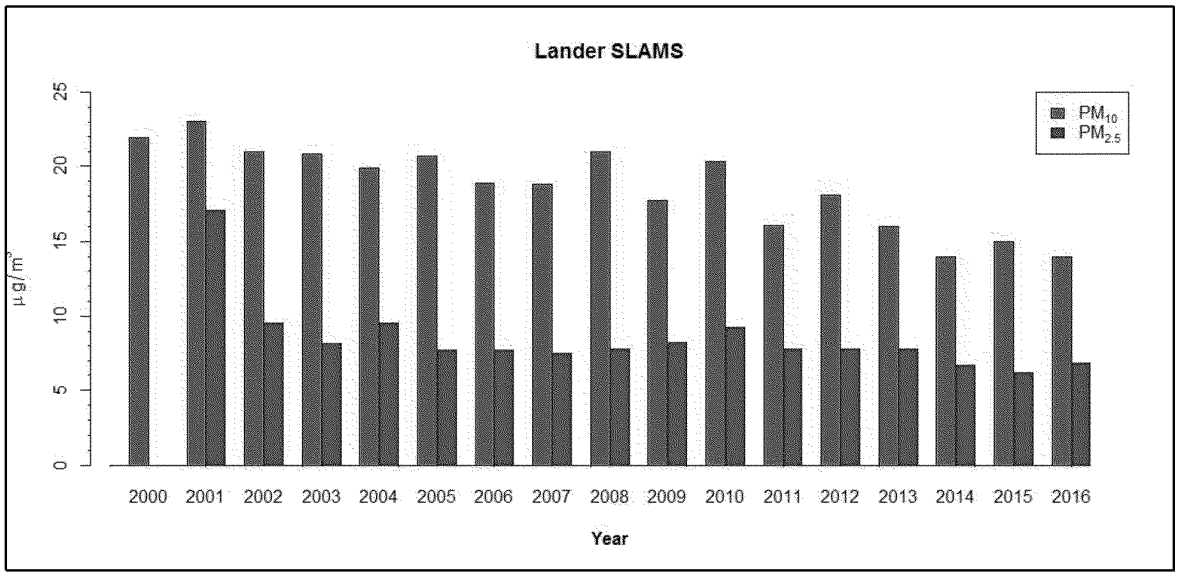

Figure 15. Lander SLAMS Annual Means

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2.1.7 Laramie SLAMS

Figure 16. Laramie SLAMS satellite view and monitor photo (inset)

Laramie – SLAMS Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Laramie SLAMS	406 Ivinson	56-001-0006	PM_{10}	R&P Co. Partisol Model 2000 (Manual filter-based)	Neighborhood	1 in 3 days (offset between the primary & satellite samplers)	No planned changes
			$PM_{2.5}$	R&P Co. Partisol Model 2000 $PM_{2.5}$ Air Sampler w/ VSCC (Manual filter-based)	Neighborhood	1 in 3 days (offset between the primary & satellite samplers)	No planned changes

Table 8. Laramie SLAMS Monitor Information

Laramie is located in Albany County in the southeastern region of Wyoming. Laramie, one of Wyoming's larger populated areas at around 31,800 as of 2013, is classified as a µSA. In 1989, the AQD began PM_{10} sampling in Laramie. The AQD added $PM_{2.5}$ samplers to the Laramie SLAMS in July 2009 to monitor impacts from wintertime sanding, wood smoke, and forest fires in the summer.

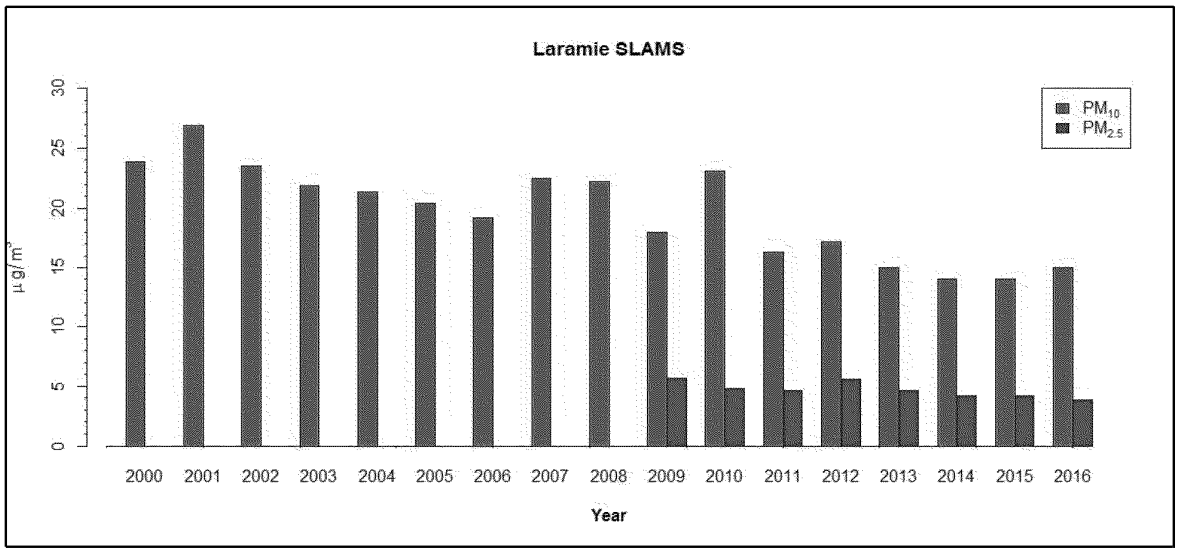

Figure 17. Laramie SLAMS Annual Means

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2.1.8 Rock Springs SLAMS

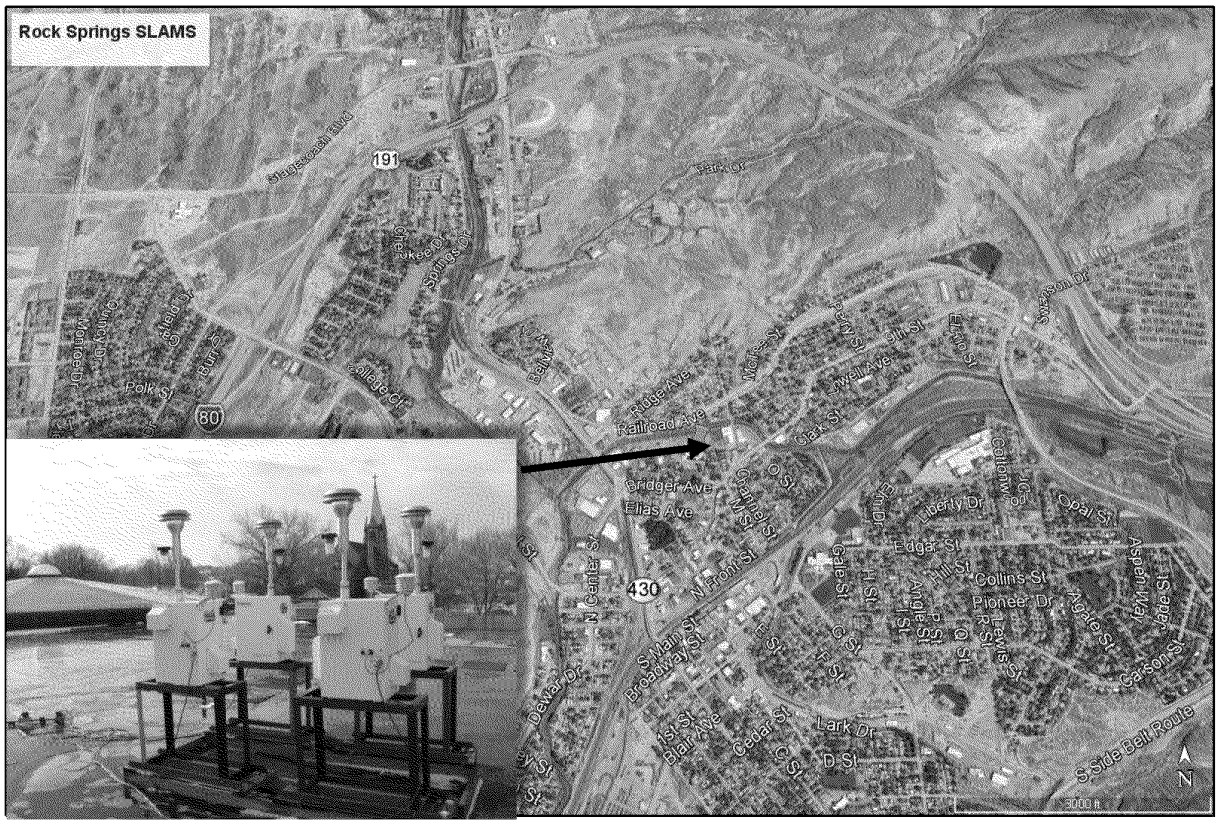

Figure 18. Rock Springs SLAMS satellite view and monitor photo (inset)

Rock Springs – SLAMS Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Rock Springs SLAMS	625 Ahsay Ave.	56-037-0007	PM_{10}	R&P Co. Partisol Model 2000 (Manual filter-based)	Neighborhood	1 in 3 days (offset between the primary & satellite samplers)	No planned changes
			$PM_{2.5}$	R&P Co. Partisol Model 2000 $PM_{2.5}$ Air Sampler w/ VSCC (Manual filter-based)	Neighborhood	1 in 3 days (offset between the primary & satellite samplers)	No planned changes

Table 9. Rock Springs SLAMS Monitor Information

Rock Springs is located in the southwestern portion of the State in Sweetwater County. Rock Springs is a µSA with a population of just over 24,100 from the 2013 census estimate. The AQD started sampling for PM_{10} at this SLAMS location in 1989. $PM_{2.5}$ monitors were added here in March 2008 due to a growth in population and energy development in the area.

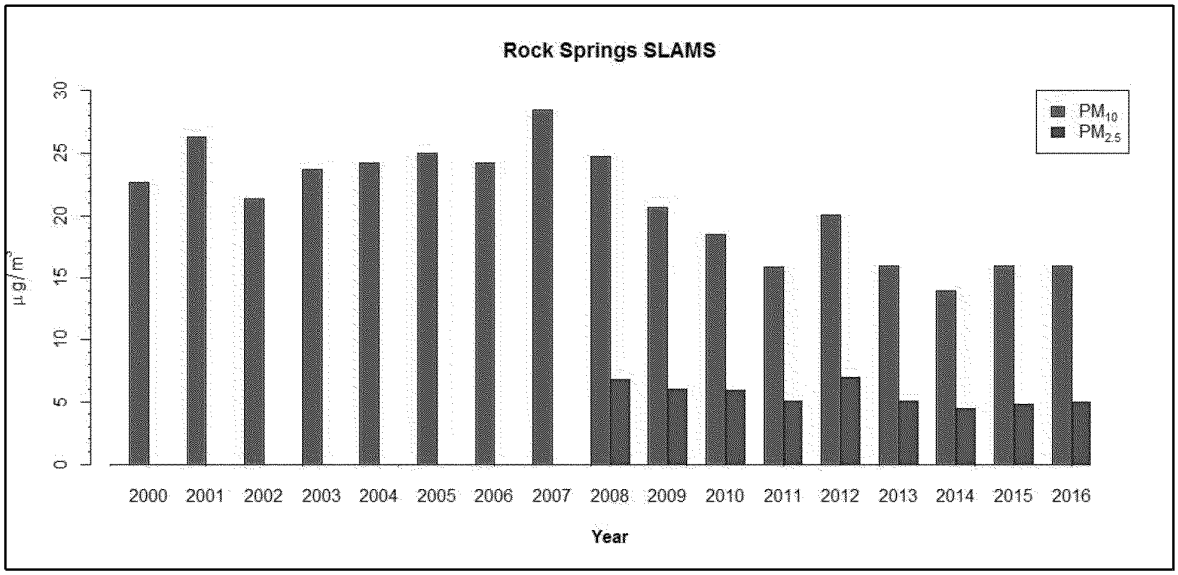

Figure 19. Rock Springs SLAMS Annual Means

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2.1.9 Sheridan Meadowlark SLAMS

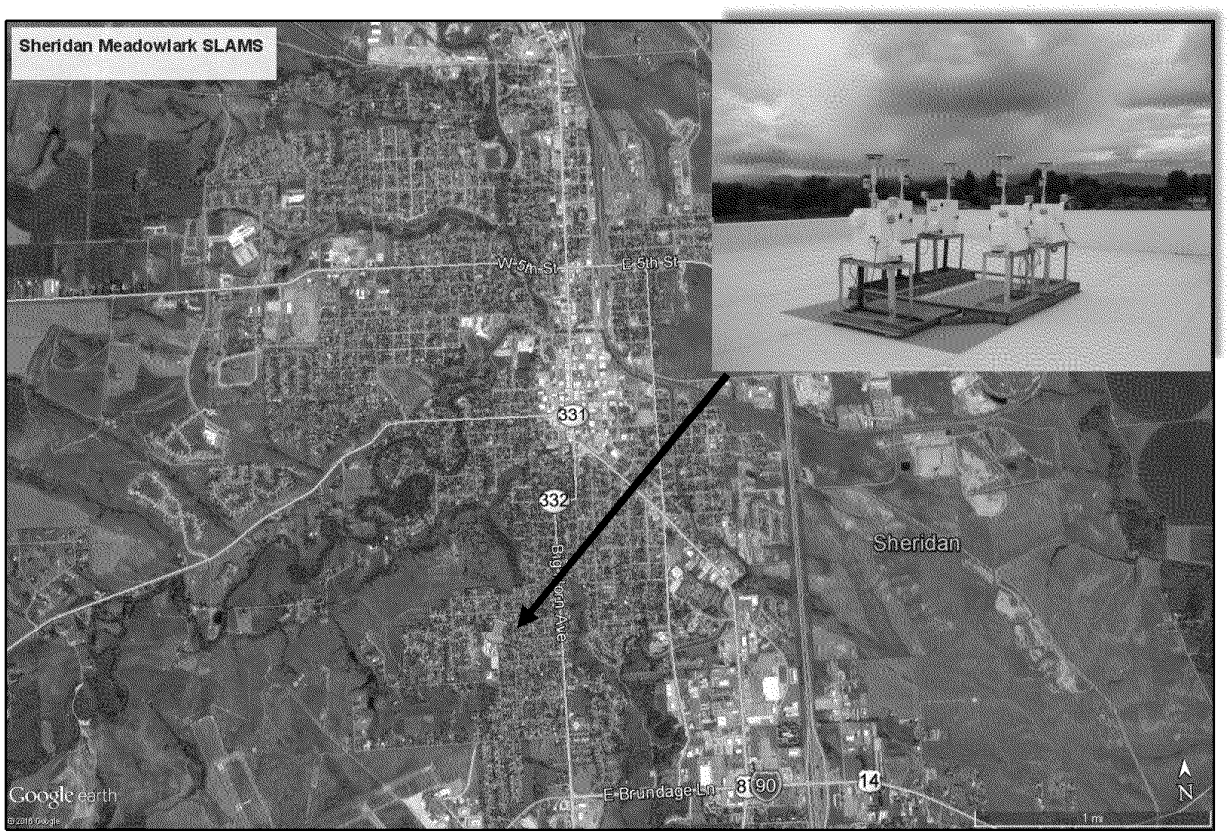

Figure 20. Sheridan Meadowlark SLAMS satellite view with monitor photo (inset)

Sheridan Meadowlark – SLAMS Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Sheridan Meadowlark SLAMS	1410 DeSmet Ave.	56-033-1003	PM_{10}	R&P Co. Partisol Model 2000 (Manual filter-based)	Neighborhood	1 in 3 days (primary); 1 in 12 days (collocate)	No planned changes
			$PM_{2.5}$	R&P Co. Partisol Model 2000 $PM_{2.5}$ Air Sampler w/ VSCC (Manual filter-based)	Neighborhood	1 in 3 days (offset between the primary & satellite samplers)	No planned changes

Table 10. Sheridan Meadowlark SLAMS Monitor Information

This monitoring location is one of two SLAMS in Sheridan, a µSA. Sheridan is located in north central Wyoming with a population of about 17,800. Wyoming's only nonattainment area for PM_{10} is located within the city limits. The AQD is pursuing the redesignation of this area as "attainment" for PM_{10}.

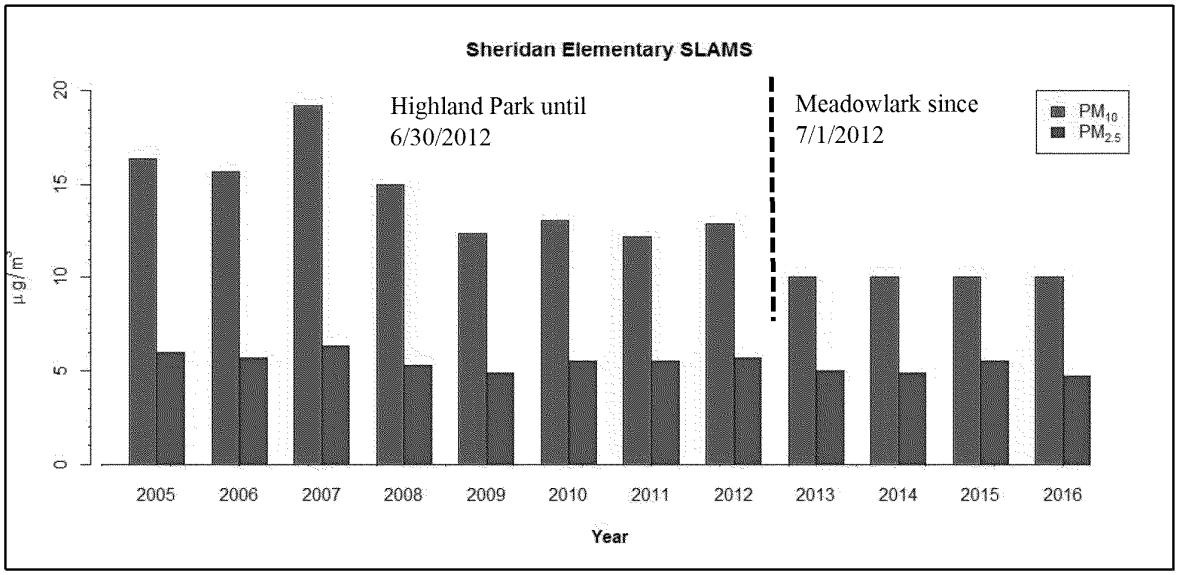

Figure 21. Sheridan Elementary SLAMS Annual Means

2.1.10 Sheridan Police Station SLAMS

Figure 22. Sheridan Police Station SLAMS satellite view and monitor photo (inset)

Sheridan Police Station – SLAMS Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Sheridan Police Station SLAMS	45 W. 12th St.	56-033-0002	PM_{10}	Continuous TEOM	Neighborhood	Hourly	No planned changes
			$PM_{2.5}$	R&P Co. Partisol Model 2000 $PM_{2.5}$ Air Sampler w/ VSCC (Manual filter-based)	Neighborhood	1 in 3 days (primary); 1 in 12 days (collocate)	No planned changes

Table 11. Sheridan Police Station SLAMS Monitor Information

The Sheridan Police Station SLAMS is one of the oldest monitoring stations in Wyoming. The monitoring objective for this station is to characterize the highest expected concentration of PM_{10} in the nonattainment area. Filter-based PM_{10} sampling began at this station in 1985 but was replaced by a continuous tapered element oscillating microbalance (TEOM) sampler on October 1, 2007. $PM_{2.5}$ sampling at this station began in 1998. Meteorological instrumentation was added in 2008 to monitor local weather conditions that provided the AQD with better information for collaborating with the community to prevent PM_{10} exceedances.

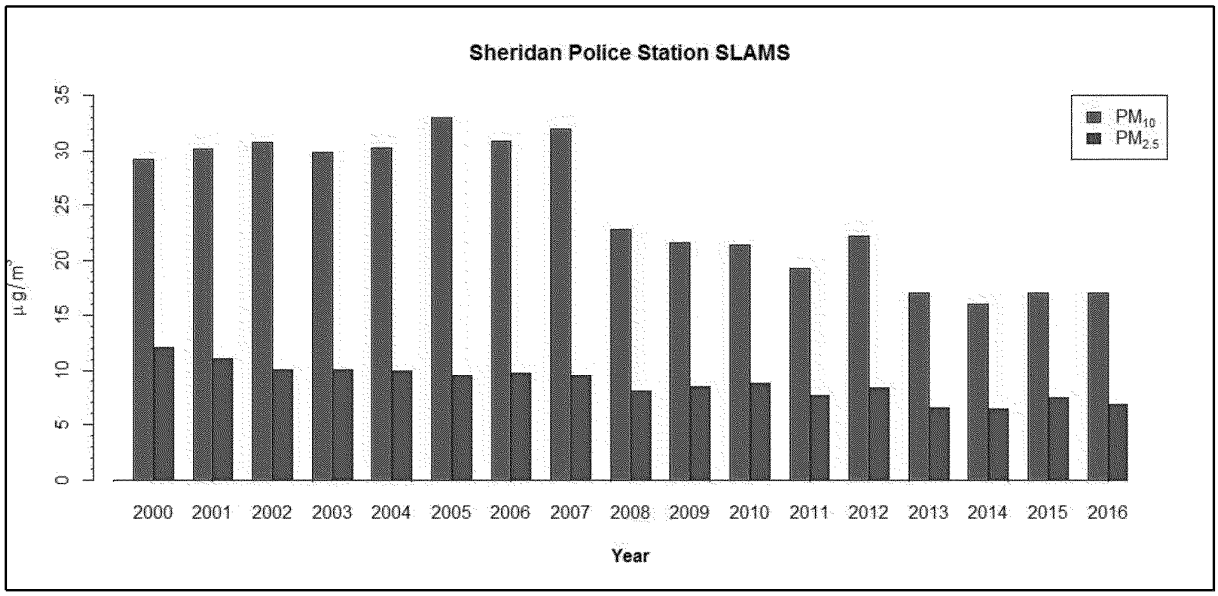

Figure 23. Sheridan Police Station SLAMS Annual Means

2.2 SPM Stations

The SPM stations, as mentioned in Section 1.1, have multiple objectives. The measurement of background and downwind pollutant concentrations, particularly with respect to public health, remain the main objectives for these stations. A description of each SPM station and its objective is provided along with a photo of the site and a table describing site and monitor information. A map of current SPM locations in Wyoming is provided below.

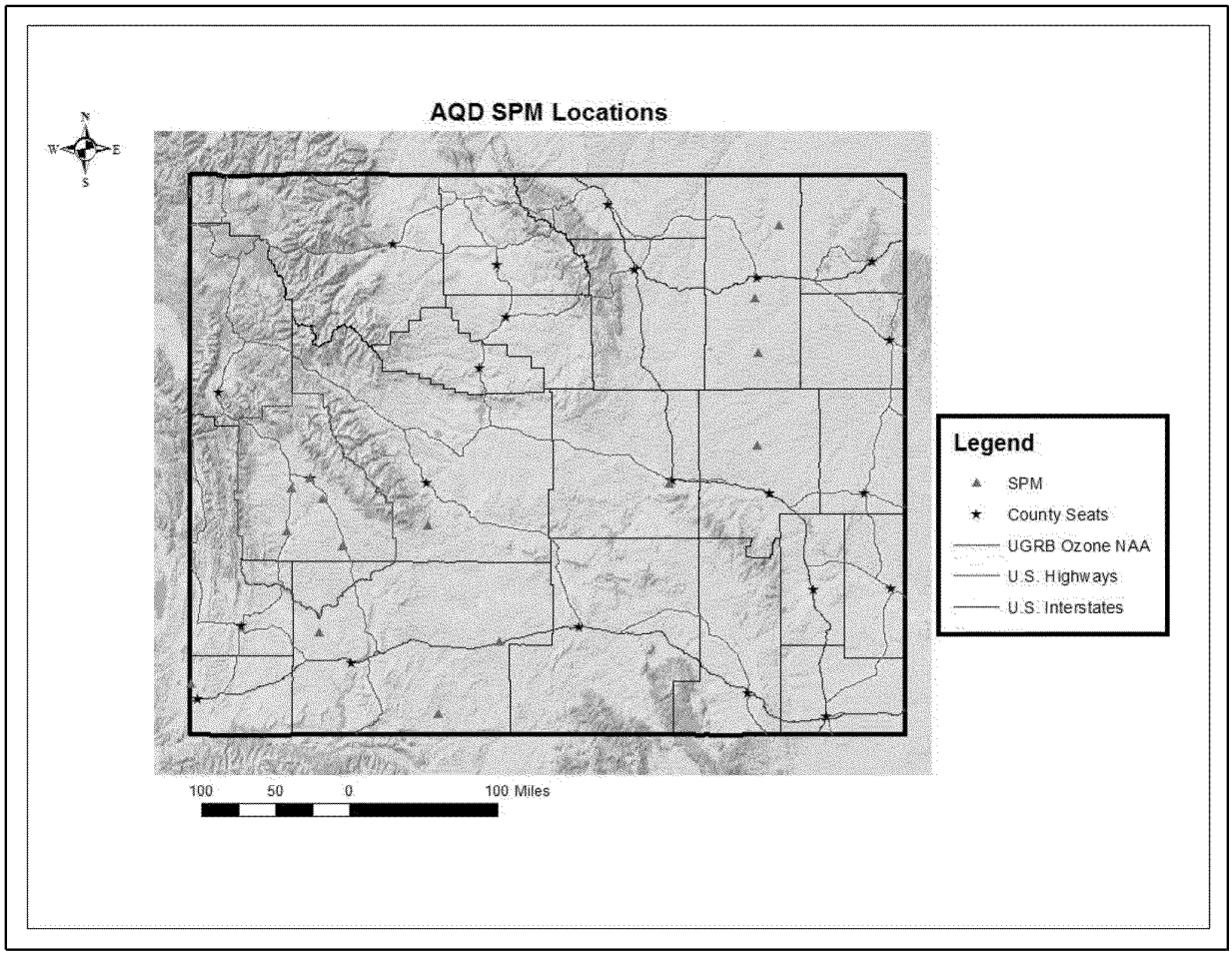

Figure 24. Map of current SPM locations

2.2.1 Big Piney

The Big Piney station is located four miles south of the Town of Big Piney. In March 2011, the AQD placed a mobile monitoring station at this location to monitor near the Big Piney and LaBarge Gas Fields. The mobile monitoring station equipment included a digital camera, ozone analyzer, oxides of nitrogen analyzer, methane/non-methane hydrocarbon (NMHC)/total hydrocarbon (THC) analyzer, continuous PM_{10} Beta Attenuation Monitor (BAM), $PM_{2.5}$ BAM monitor, and meteorological monitor. After two full years of operation, the AQD performed an assessment of the data from the Big Piney station and determined that it would be beneficial to continue monitoring some parameters at this location. On December 10, 2013, the long-term Big Piney station became operational. The station currently monitors ozone, oxides of nitrogen, meteorological parameters, and has a camera for visibility purposes. Since the station was kept in the same location, data from this station continues to be reported under AQS ID 56-035-0700.

Big Piney Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Big Piney	4 miles south of Big Piney, WY	56-035-0700	O_3	Thermo 49i	Regional	Hourly	No planned changes
			$NO/NO_2/NO_x$	Thermo Fisher Scientific Model 42i-TL	Regional	Hourly	No planned changes

Table 12. Big Piney Monitor Information

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2.2.2 Boulder

The Boulder station is located approximately five miles southwest of Boulder, Wyoming and is used to track air quality in an area of natural gas development. The Boulder station's ozone monitor is also considered the "design value monitor" for the Upper Green River Basin (UGRB) Ozone Nonattainment Area because Boulder had the highest ozone values in the UGRB and is used as the monitor to determine if the UGRB is attaining the ozone NAAQS.

The Boulder Station began monitoring in February 2005, and includes gaseous (NO_x and ozone), continuous particulate (PM_{10} BAM), camera system and meteorological monitoring. The Boulder Station was also a hub for the AQD's 2007 - 2016 Upper Green Winter Ozone Studies. Additionally, long-term monitoring has been added to the Boulder Station to better understand ozone formation in the Upper Green River Basin Ozone Nonattainment Area. In 2017, this long-term monitoring included photolytic NO_2, methane/non-methane hydrocarbons, speciated VOC monitoring, NO_y monitoring, UV radiometers, and upper air monitoring.

Boulder Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Boulder	5 miles southwest of Boulder, WY	56-035-0099	O_3	Teledyne-API Model 400 E	Neighborhood	Hourly	No planned changes
			$NO/NO_2/NO_x$	Teledyne-API Model 200E	Neighborhood	Hourly	No planned changes
			PM_{10}	Met One BAM 1020	Neighborhood	Hourly	No planned changes

Table 13. Boulder Monitor Information

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2.2.3 Campbell County

The Campbell County station began operation in June 2003 and is located approximately 15 miles southwest of Gillette. This station is used to track air quality in an area of heavy coal-bed methane development. This station includes gaseous (NO_x and ozone), continuous particulate (PM_{10} TEOM), camera system and meteorological monitoring. Campbell County's continuous particulate and NO_x analyzer were both upgraded in 2016. The continuous PM_{10} TEOM was upgraded to a BAM monitor and the Teledyne API 200E NO_x analyzer was upgraded to a Thermo 42i NO_x analyzer. The data analysis from the 2015 Network Assessment led to the determination that the Campbell County station has data from multiple pollutants which correlate well with sites owned by the AQD and by industry. Further analyses conducted in 2016 showed that this site may be decommissioned. These analyses may be viewed in Appendix C. The station will be removed and relocated to eastern Johnson County in 2017.

Campbell County Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Campbell County	15 miles SSW of Gillette, WY	56-005-0456	O_3	Thermo 49i	Regional	Hourly	Site to be decommissioned
			$NO/NO_2/NO_x$	Thermo Fisher Scientific Model 42i-TL	Regional	Hourly	Site to be decommissioned
			PM_{10}	Met One BAM 1020	Regional	Hourly	Site to be decommissioned

Table 14. Campbell County Monitor Information

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2.2.4 Casper Gaseous

The Casper Gaseous station began operations in March 2013. This station was sited to monitor population-based ozone concentrations in Wyoming's second largest city, a MSA. This siting fulfilled a finding in the 2010 Network Assessment regarding the need for population-based ozone monitoring in Casper, WY. The Casper Gaseous station monitors O_3, NO_x, meteorology, and visibility (via a camera system).

During the AQD's 2016 Technical System Audit (TSA), EPA Region VIII issued a draft finding that the ozone monitor at Casper should be reclassified from a SPM to SLAMS monitor type, based on the 3-year ozone (2014, 2015, and 2016) design value of 0.060 ppm. The AQD submitted a request of approval to reclassify the Casper ozone monitor type from SPM to SLAMS on December 14, 2016 and are waiting on approval from the EPA.

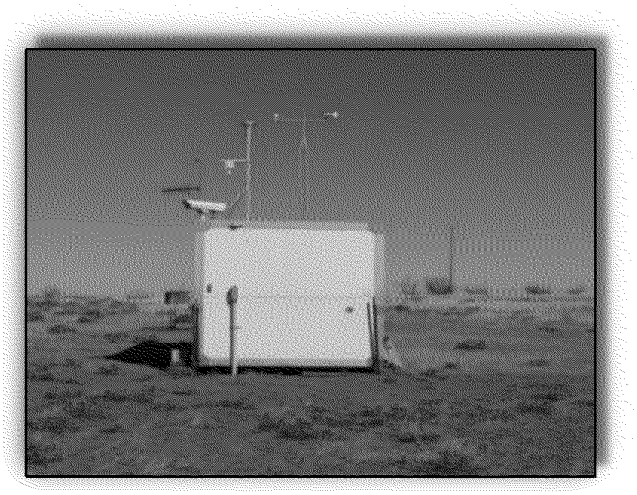
Casper Gaseous Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Casper Gaseous	2800 Pheasant Dr.	56-025-0100	O_3	Teledyne-API Model T400E	Neighborhood/Urban	Hourly	No planned changes
			$NO/NO_2/NO_x$	Teledyne-API Model T200E	Neighborhood	Hourly	No planned changes

Table 15. Casper Gaseous Monitor Information

ED_001361_00002696

2.2.5 Converse County

The Converse County station is located approximately 38 miles northwest of Douglas and is used to evaluate ambient air quality in an area of regional oil and gas development. Air quality measurements at the Converse County station include gaseous parameters (NO_x, ozone, and methane/non-methane hydrocarbons), continuous particulate (PM_{10} BAM), a camera system, and meteorological monitoring. The Converse County station began operation in April 2015. The data analysis from the 2015 Network Assessment identified additional monitoring needs in central Converse County.



Converse County Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Converse County	16 miles west of WY Highway 59 on Highland Loop Rd.	56-009-0010	O_3	Teledyne-API Model T400	Regional	Hourly	No planned changes
			$NO/NO_2/NO_x$	Teledyne-API Model 200E	Regional	Hourly	No planned changes
			PM_{10}	Met One BAM 1020	Regional	Hourly	No planned changes

Table 16. Converse County Monitor Information

ED_001361_00002696

2.2.6 Daniel South

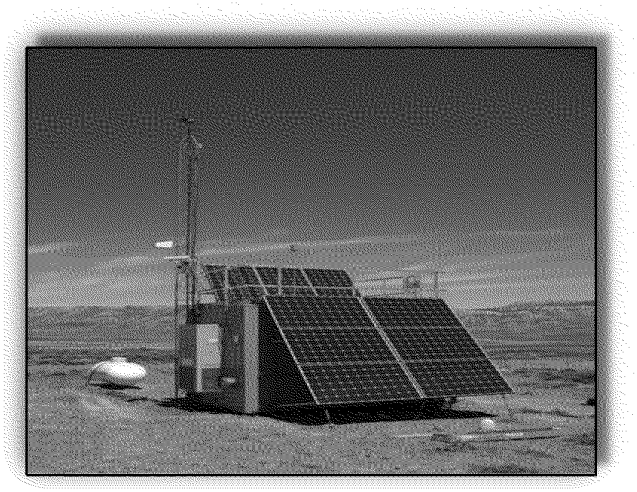
The Daniel South station is located approximately five miles south of the town of Daniel in Sublette County and is used to track air quality upwind of an area of extensive natural gas development. The Daniel South Station includes gaseous (NO_x and ozone), continuous particulate (PM_{10} BAM), camera system and meteorological monitoring. The Daniel South Station began operation in July 2005. Due to the progressive failure of the PM_{10} TEOM, the AQD replaced the instrument with a BAM 1020 in 2016.

Daniel South Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Daniel South	5 miles south of Daniel, WY	56-035-0100	O_3	Teledyne-API Model T400	Regional	Hourly	No planned changes
			$NO/NO_2/NO_x$	Teledyne-API Model 200E	Regional	Hourly	No planned changes
			PM_{10}	Met One BAM 1020	Regional	Hourly	No planned changes

Table 17. Daniel South Monitor Information

ED_001361_00002696

2.2.7 Hiawatha



The Hiawatha station commenced operation on March 30, 2011. This station originated as a result of the 2010 Network Assessment where a need for background monitoring in an area of oil and gas development was discovered. The Hiawatha station is located about 45 miles southeast of Rock Springs, WY. Due to the remote location, the Hiawatha station is the AQD's first ambient monitoring station that uses solar and wind energy as its primary power source. Ozone is the only pollutant that is monitored at Hiawatha. Meteorological conditions and the visibility scene are also observed at this station. The Hiawatha station is a part of the Intermountain West Data Warehouse (IWDW) Project.

Hiawatha Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Hiawatha	Bitter Creek Rd. 43 miles SE of Rock Springs, WY	56-037-0077	O_3	Teledyne-API Model 400E	Regional	Hourly	No planned changes

Table 18. Hiawatha Monitor Information

ED_001361_00002696

2.2.8 Juel Spring

The Juel Spring station began operation in December 2009 and is located approximately 15 miles downwind (southeast) of the Jonah Gas Field. The Juel Spring Station includes gaseous (NO_x and ozone), a camera system and meteorological monitoring. This station is located in conjunction with the Union Cellular Juel Spring Tower station.

Juel Spring Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Juel Spring	20 miles northwest of Farson, WY	56-035-1002	O_3	Teledyne-API 400A	Urban	Hourly	No planned changes
			$NO/NO_2/NO_x$	Teledyne-API 200A	Urban	Hourly	No planned changes

Table 19. Juel Spring Monitor Information

ED_001361_00002696

2.2.9 Moxa Arch

The Moxa Arch station was installed in May 2010. This station is located about 25 miles northwest of Green River. The purpose of this monitoring station is to characterize and monitor meteorology and air quality in an area of heavy energy development. This station includes NO_x, SO_2, O_3, PM_{10} (a BAM instrument), a camera system, and meteorological equipment.

Moxa Arch Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Moxa Arch	25 miles northwest of Green River, WY	56-037-0300	O_3	Teledyne-API Model 400E	Urban	Hourly	No planned changes
			$NO/NO_2/NO_x$	Teledyne-API Model 200E	Urban	Hourly	No planned changes
			PM_{10}	Met One BAM 1020	Urban	Hourly	No planned changes
			SO_2	Thermo 43i	Urban	Hourly & 5-minute	No planned changes

Table 20. Moxa Arch Monitor Information

ED_001361_00002696

2.2.10 Murphy Ridge

Operations at Murphy Ridge were initiated in 2007. The station is located in the town of Bear River, about 10 miles north of Evanston on the Utah/Wyoming border. This site monitors pollutants transported from Utah including NO_x, O_3, PM_{10} via a continuous TEOM instrument, and meteorological parameters. A camera system is mounted on the shelter to provide visibility. The data analysis from the 2015 Network Assessment showed no significant trends in air quality concentrations since 2007 and background data needs for modeling have changed. Given that the station has served its purpose to characterize pollutant transport and with possible budget reductions, the Murphy Ridge station could be decommissioned to satisfy required reductions.

Murphy Ridge Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Murphy Ridge	Bear River, WY	56-041-0101	O_3	Teledyne-API Model 400E	Regional	Hourly	No planned changes
			$NO/NO_2/NO_x$	Teledyne-API Model 200E	Regional	Hourly	No planned changes
			PM_{10}	Thermo Fisher TEOM 1400ab	Regional	Hourly	No planned changes

Table 21. Murphy Ridge Monitor Information

ED_001361_00002696

2.2.11 Pinedale Gaseous

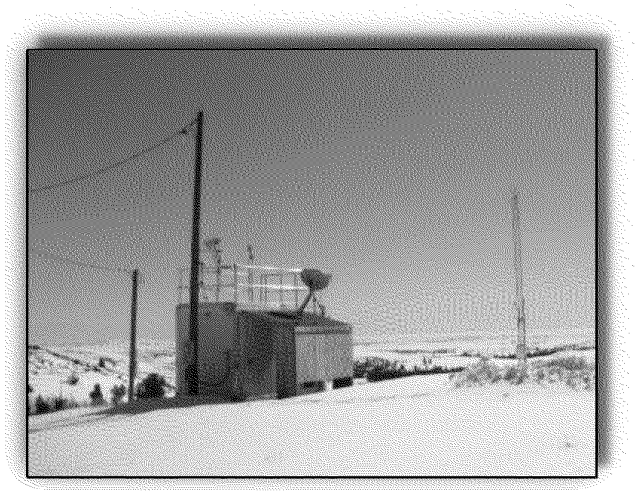
The Pinedale Gaseous station began operations in January 2009 because of the need for population-based monitoring in this location, which was noted in the 2008 Southwest Wyoming Network Assessment. This station includes ozone, NO_x, a continuous $PM_{2.5}$ BAM and meteorology within the town of Pinedale. This station monitors pollutant concentrations in the most populated area in the UGRB Ozone Nonattainment Area. A camera system is also associated with this station on WyVisNet. However, the camera is housed in a different location with the objective of providing an overlook of the town of Pinedale.

Pinedale Gaseous Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Pinedale Gaseous	West side of City Park & Pine Creek	56-035-0101	O_3	Teledyne-API Model 400E	Urban	Hourly	No planned changes
			$NO/NO_2/NO_x$	Teledyne-API Model 200E	Urban	Hourly	No planned changes
			$PM_{2.5}$	Met One BAM 1020	Urban	Hourly	No planned changes

Table 22. Pinedale Gaseous Monitor Information

ED_001361_00002696

2.2.12 South Pass



The South Pass station began operation in 2007. The station is located on South Pass at the southern end of the Wind River Range. The purpose of this station is to monitor air quality on the southern end of the range which sees air masses from both the Upper Green River Basin to the northwest, and from the southwestern corner of the State. The station includes gaseous (NO_x and ozone), continuous particulate ($PM_{2.5}$ BAM), camera system and meteorological monitoring. The PM_{10} TEOM was shut down in 2014 and was replaced with a $PM_{2.5}$ BAM. The switch to $PM_{2.5}$ was made to assist the AQD in studying the impact of wildfires in the area.

South Pass Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
South Pass	South Pass, WY	56-013-0099	O_3	Thermo 49i	Urban	Hourly	No planned changes
			$NO/NO_2/NO_x$	Thermo 42i	Urban	Hourly	No planned changes
			$PM_{2.5}$	Met One BAM 1020	Urban	Hourly	No planned changes

Table 23. South Pass Monitor Information

ED_001361_00002696

2.2.13 Thunder Basin

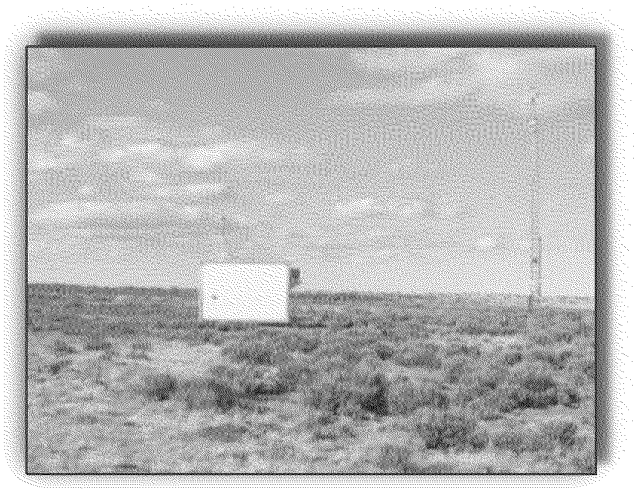
The Thunder Basin station is located approximately 30 miles northeast of Gillette, Wyoming and is used to track visibility, meteorology, and air quality in the area. The Thunder Basin Station began operating in October 1999 and includes gaseous (NO_x and ozone), camera system and meteorological monitoring. A new Thermo 42i $NO/NO_2/NO_x$ analyzer was installed in 2016 to replace the older Thermo 42C $NO/NO_2/NO_x$ analyzer.

Thunder Basin Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Thunder Basin	30 miles NNE of Gillette, WY	56-005-0123	O_3	Thermo 49i	Regional	Hourly	No planned changes
			$NO/NO_2/NO_x$	Thermo 42i	Regional	Hourly	No planned changes

Table 24. Thunder Basin Monitor Information

ED_001361_00002696

2.2.14 Wamsutter



The Wamsutter site is approximately two 2 miles west of the town of Wamsutter. The objective of this station is to track air quality and meteorology in an area of extensive natural gas development. The Wamsutter station includes gaseous (NO_x and O_3), PM_{10} BAM, CH_4, NMHC, THC, and meteorological monitoring. A camera system provides coverage of visibility. This station started operations on March 13, 2006. Due to reliability issues, the existing PM_{10} TEOM was replaced with a BAM 1020 and the original model 42c NO_x analyzer was replaced with a new 42i analyzer in 2016.

Wamsutter Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Wamsutter	2 miles west of Wamsutter, WY	56-037-0200	O_3	Thermo 49i	Urban	Hourly	No planned changes
			$NO/NO_2/NO_x$	Thermo 42i	Urban	Hourly	No planned changes
			PM_{10}	Met One BAM 1020	Urban	Hourly	No planned changes

Table 25. Wamsutter Monitor Information

ED_001361_00002696

2.2.15 Wright Jr-Sr High School

The Wright monitoring station is located in Campbell County in northern Wyoming. Wright is a community located west of the southern group of the Powder River Basin (PRB) coal mines. The purpose of this monitor is to track population exposure to PM_{10} in a community that is downwind of the coal mines. The data analysis from the 2015 Network Assessment revealed that PM_{10} data at Wright correlated significantly with six nearby industrial monitors in the PRB. Further evaluation is necessary with respect to redundancy to other available monitoring data to determine if this station may be decommissioned.

Wright Jr-Sr High School Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Wright Jr-Sr High School	Adjacent to Wright Jr-Sr High School	56-005-0099	PM_{10}	R&P Co. Partisol Model 2000 (Manual filter-based)	Neighborhood	1 in 6 days	No planned changes

Table 26. Wright Jr-Sr High School Monitor Information

ED_001361_00002696

2.2.16 Powder River Basin-NO_x

The Powder River Basin (PRB) NO_x network began operation in January 2001 through a cooperative agreement between the AQD and the Wyoming Mining Association. The network monitors regional NO_2 concentrations in the PRB. The Belle Ayr - BA-4 Station is located near the railroad and represents a "maximum concentration" in and around the coal mines. The Antelope Station is located upwind from mining activities is considered to be background. The AQD also receives data from the Thunder Basin Coal Company's station at Tracy Ranch; this monitoring station is considered downwind of mining activity. The AQD did not list the Tracy Ranch station below because it is funded and operated solely by the Thunder Basin Coal Company. Due to the construction of an oilfield service road less than 100 feet from Antelope Site 3, this site was shut down on July 1, 2013. The Antelope station was moved to a new location, renamed Antelope Site 7, and became operational in February 2015.

PRB NO_x Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Antelope – Site 7	Antelope Site 7	56-009-0009	$NO/NO_2/NO_x$	Teledyne-API 200A	Regional	Hourly	No planned changes
Belle Ayr – BA-4	Belle Ayr BA-4	56-005-0892	$NO/NO_2/NO_x$	Teledyne-API 200A	Micro Scale	Hourly	No planned changes

Table 27. Powder River Basin NO_x Monitor Information

ED_001361_00002696

2.2.17 Powder River Basin-$PM_{2.5}$

The Powder River Basin (PRB) $PM_{2.5}$ Network began operation in 1999. The purpose of the network is to characterize ambient fine particulate at and around the PRB coal mines. One monitor is located at each "group" of mines (north, middle and south) and one monitor is located away from mining activities to represent background levels. Due to the age of the instrumentation in the network, the AQD upgraded the instruments to continuous Thermo 1405DF TEOM monitors in 2010. During the second quarter of 2013, the AQD replaced the 1405DF instruments with Met One BAMs because of reliability issues with the 1405DF instruments. As a result of the construction of an oilfield service road less than 100 feet from Antelope Site 3, it was shut down on July 1, 2013 moved to a new location in February 2015, and renamed Antelope Site 7.

PRB $PM_{2.5}$ Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Antelope – Site 7	Antelope Site 7	56-009-0009	$PM_{2.5}$	Met One BAM 1020	Regional	Hourly	No planned changes
Belle Ayr – BA-4	Belle Ayr BA-4	56-005-0892	$PM_{2.5}$	Met One BAM 1020	Neighborhood	Hourly	No planned changes
Black Thunder BTM-36-2	BTM-36-2 (Black Thunder Mine)	56-005-0891	$PM_{2.5}$	Met One BAM 1020	Neighborhood	Hourly	No planned changes
Buckskin Mine	Triton Coal Gillette, WY	56-005-1899	$PM_{2.5}$	Met One BAM 1020	Neighborhood	Hourly	No planned changes

Table 28. Powder River Basin $PM_{2.5}$ Monitor Information

ED_001361_00002696

2.3 Mobile Monitoring Stations

The AQD has three mobile gaseous monitoring stations that are sited at various locations throughout Wyoming to characterize air quality. As the name of this section implies, these stations are self-contained monitoring shelters that may be moved to different locations in a relatively short period. The stations have gaseous monitors (NO_x, SO_2, O_3, CH_4, and NMHC), continuous PM_{10}, continuous $PM_{2.5}$, a camera system, and meteorological instrumentation. The mobile stations may be used to monitor and characterize events, trends in air quality, or areas downwind of industrial development. The AQD sites and operates the stations at a specific location for approximate durations of one year. The current locations as of mid-May 2017 for the mobile monitoring stations are Laramie (Mobile #1) and Casper (Mobile #3). The Cheyenne station (Mobile #2) was decommissioned on April 4, 2017 and will be relocated to Sheridan in late spring 2017. The complete history of the mobile monitoring stations is found in the table below and is also presented in the accompanying map.

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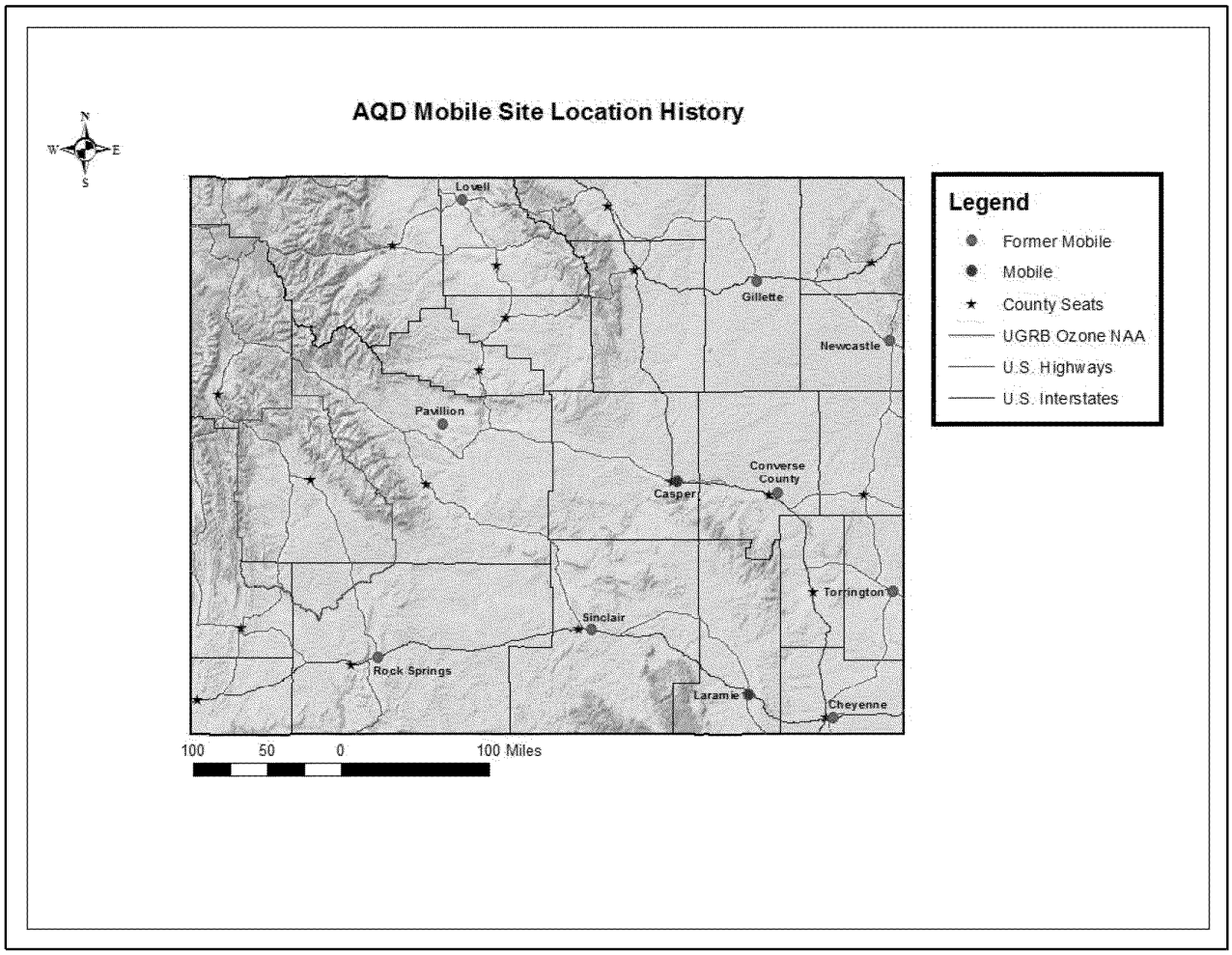

Figure 25. Map of the AQD's Mobile Gaseous Monitoring Stations

Year	Mobile Station #1	Mobile Station #2	Mobile Station #3
2011	Big Piney	Pavillion	Gillette
2012	Big Piney	Pavillion	Converse County
2013	Rock Springs	Sinclair	Converse County
2014	Lovell	Sinclair	Converse County
2015	Lovell / Torrington	Sinclair	Converse County / Newcastle
2016	Torrington	Sinclair / Cheyenne	Newcastle / Casper
2017 YTD	Laramie	Cheyenne / Sheridan	Casper

Table 29. Mobile Gaseous Monitoring Station Location History

2.3.1.1 Mobile Station #1: Torrington

The Torrington air quality mobile monitoring station operated from December 21, 2015 to December 19, 2016. The mobile station was located within the city limits of Torrington, near a residential neighborhood and school. The station's objective was to characterize the population exposure to multiple air quality parameters in the Town of Torrington, located in the vicinity and downwind of a number of Title V and minor emissions sources. A digital camera, ozone analyzer, oxides of nitrogen analyzer, methane/non-methane hydrocarbons, continuous PM_{10} and $PM_{2.5}$ BAMs and meteorological equipment were located at this station. A sulfur dioxide analyzer was added to this station in January 2016. This station was moved to Laramie which commenced operations on April 5, 2017.

Mobile Station #1: Torrington Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Torrington Mobile (12/21/2015-12/19/2016)	1446 E. N St. Torrington, WY	56-015-0004	O_3	Teledyne-API Model 400E	Neighborhood	Hourly	Moved from Torrington to Laramie
			$NO/NO_2/NO_x$	Teledyne-API Model 200E	Neighborhood	Hourly	Moved from Torrington to Laramie
			PM_{10}	Met One BAM 1020	Neighborhood	Hourly	Moved from Torrington to Laramie
			$PM_{2.5}$	Met One BAM 1020	Neighborhood	Hourly	Moved from Torrington to Laramie
			SO_2	Thermo 43i	Neighborhood	Hourly & 5 minute	Moved from Torrington to Laramie

Table 30. Mobile Station #1 Monitor Information (Torrington)

ED_001361_00002696

2.3.1.2 Mobile Station #1: Laramie

The Laramie air quality mobile monitoring station began operations on April 5, 2017, and is slated to operate at this location for one year. The mobile station is located within the city limits of Laramie on the southwest side of town, in a residential neighborhood. The station's objective is to characterize the population exposure to multiple air quality parameters in the City of Laramie, located in the vicinity of a large Title V emissions source. This city was identified in the AQD's 2015 Network Assessment as being home to a number of sensitive populations. A digital camera, ozone analyzer, oxides of nitrogen analyzer, sulfur dioxide, methane/non-methane hydrocarbons, continuous PM_{10} and $PM_{2.5}$ BAMs and meteorology equipment are located at this station.

Mobile Station #1: Laramie Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Laramie Mobile (4/5/2017-present)	998 Russell St., Laramie, WY	56-001-0010	O_3	Teledyne-API Model 400E	Urban	Hourly	Moved from Torrington to Laramie
			$NO/NO_2/NO_x$	Teledyne-API Model 200E	Urban	Hourly	Moved from Torrington to Laramie
			PM_{10}	Met One BAM 1020	Urban	Hourly	Moved from Torrington to Laramie
			$PM_{2.5}$	Met One BAM 1020	Urban	Hourly	Moved from Torrington to Laramie
			SO_2	Thermo 43C	Urban	Hourly & 5 minute	Moved from Torrington to Laramie

Table 31. Mobile Station #1 Monitor Information (Laramie)

ED_001361_00002696

2.3.2.1 Mobile Station #2: Cheyenne

The Cheyenne air quality mobile monitoring station operated from March 29, 2016 to April 4, 2017. The mobile station was located within the city limits of Cheyenne on the southeast side of town, in a residential neighborhood. The station's objective was to characterize the population exposure to sulfur dioxide and other air quality parameters in the City of Cheyenne, located near a large refinery. A digital camera, ozone analyzer, oxides of nitrogen analyzer, sulfur dioxide, methane/non-methane hydrocarbons, continuous PM_{10} and $PM_{2.5}$ BAMs and meteorology equipment were located at this station. This station will be moved to Sheridan likely in late spring 2017.

Mobile Station #2: Cheyenne Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Cheyenne Mobile (3/15/2016-4/4/2017)	Phoenix Dr. Cheyenne, WY	56-021-0002	O_3	Teledyne-API Model 400E	Urban	Hourly	Moved from Cheyenne to Sheridan
			$NO/NO_2/NO_x$	Teledyne-API Model 200E	Urban	Hourly	Moved from Cheyenne to Sheridan
			PM_{10}	Met One BAM 1020	Urban	Hourly	Moved from Cheyenne to Sheridan
			$PM_{2.5}$	Met One BAM 1020	Urban	Hourly	Moved from Cheyenne to Sheridan
			SO_2	Thermo 43C	Urban	Hourly & 5 minute	Moved from Cheyenne to Sheridan

Table 32. Mobile Station #2 Monitor Information (Cheyenne)

ED_001361_00002696

2.3.2.2 Mobile Station #2: Sheridan

The Sheridan air quality mobile monitoring station will begin operations later in 2017 and be in place for one year. The station will be placed in Sheridan in response to a 201 5 Network Assessment finding that there is a need for more population based monitoring beyond what already exists. The AQD performed analyses to better characterize the possible influence of emissions from Montana prior to siting this station. These analyses can be found in Appendix D. The mobile station will be located within the city limits of Sheridan. The station's objective is to characterize the population exposure to multiple air quality parameters in the City of Sheridan, located downwind of a number of large emissions sources in Montana in addition to multiple local sources. A digital camera, ozone analyzer, oxides of nitrogen analyzer, sulfur dioxide, methane/non-methane hydrocarbons, continuous PM_{10} and $PM_{2.5}$ BAMs and meteorology equipment will be located at this station.

Mobile Station #2: Sheridan Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Sheridan Mobile (Unknown Start Time)	Unknown Location Sheridan, WY	56-033-0006	O_3	Teledyne-API Model 400E	Urban	Hourly	Moved from Cheyenne to Sheridan
			$NO/NO_2/NO_x$	Teledyne-API Model 200E	Urban	Hourly	Moved from Cheyenne to Sheridan
			PM_{10}	Met One BAM 1020	Urban	Hourly	Moved from Cheyenne to Sheridan
			$PM_{2.5}$	Met One BAM 1020	Urban	Hourly	Moved from Cheyenne to Sheridan
			SO_2	Thermo 43C	Urban	Hourly & 5 minute	Moved from Cheyenne to Sheridan

Table 33. Mobile Station #2 Monitor Information (Sheridan)

ED_001361_00002696

2.3.3.1 Mobile Station #3: Newcastle

The Newcastle air quality mobile monitoring station operated from July 10, 2015 to October 26, 2016. The mobile station was located within the city limits of the Town of Newcastle in the center of town. The station's objective was to characterize the population's exposure to sulfur dioxide and other air quality parameters in the Town of Newcastle, located near a large refinery. A digital camera, ozone analyzer, oxides of nitrogen analyzer, sulfur dioxide, methane/non-methane hydrocarbons, continuous PM_{10} and $PM_{2.5}$ BAMs and meteorology equipment were located at this station. This station was moved to Casper on December 1, 2016.

Mobile Station #3: Newcastle Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Newcastle Mobile (7/10/2015-10/26/2016)	116 Casper Ave. Newcastle, WY	56-045-0004	O_3	Teledyne-API Model 400E	Neighborhood	Hourly	Moved from Newcastle to Casper
			$NO/NO_2/NO_x$	Teledyne-API Model 200E	Neighborhood	Hourly	Moved from Newcastle to Casper
			PM_{10}	Met One BAM 1020	Neighborhood	Hourly	Moved from Newcastle to Casper
			$PM_{2.5}$	Met One BAM 1020	Neighborhood	Hourly	Moved from Newcastle to Casper
			SO_2	Teledyne-API M100EU	Neighborhood	Hourly & 5 minute	Moved from Newcastle to Casper

Table 34. Mobile Station #3 Monitor Information (Newcastle)

ED_001361_00002696

2.3.3.2 Mobile Station #3: Casper

The Casper air quality mobile monitoring station began operations on December 1, 2016, and is slated to operate at this location for one year. The mobile station is located within the city limits of the city of Casper in the center of town. The station's objective is to characterize the population's exposure to sulfur dioxide and other air quality parameters in the city of Casper, located near a large refinery. A digital camera, ozone analyzer, oxides of nitrogen analyzer, sulfur dioxide, methane/non-methane hydrocarbons, continuous PM_{10} and $PM_{2.5}$ BAMs and meteorology equipment are located at this station.

Mobile Station #3: Casper Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Casper Mobile (12/1/2016-present)	500 South Walsh Dr., Casper, WY	56-025-0005	O_3	Teledyne-API Model 400E	Neighborhood	Hourly	No planned changes
			$NO/NO_2/NO_x$	Teledyne-API Model 200E	Neighborhood	Hourly	No planned changes
			PM_{10}	Met One BAM 1020	Neighborhood	Hourly	No planned changes
			$PM_{2.5}$	Met One BAM 1020	Neighborhood	Hourly	No planned changes
			SO_2	Teledyne-API M100EU	Neighborhood	Hourly & 5 minute	No planned changes

Table 35. Mobile Station #3 Monitor Information (Casper)

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2.4 Cheyenne NCore

The Wyoming NCore monitoring station is located in Cheyenne near the North Soccer Complex Park. The NCore station was established during the summer of 2010 and became fully operational on January 1, 2011. This station was incorporated as part of the National Core Monitoring Network. The NCore stations will be the basis for developing a representative report card on air quality across the nation, capable of delineating differences among geographic and climatological regions. The monitored data will be used to characterize and monitor trends in air quality, compliance with the NAAQS, and may be used for national health assessments, model evaluations, and comparison with other ambient air monitoring data.

As specified in Title 40 Part 58.13(a) of the CFR, the Cheyenne NCore station hosts a large suite of air quality and meteorological parameters. Gaseous parameters include: ozone, $NO/NO_2/NO_x$, trace CO, trace SO_2, and NO_y, total reactive oxides of nitrogen. In 2016, the AQD replaced the chemiluminescent $NO/NO_2/NO_x$ analyzer (a Teledyne-API T200U) with a Teledyne-API 200 EU/501 analyzer.

Particulate monitoring is a substantial part of routine operations at the NCore station. Currently, this station has a MetOne BAM Coarse system (includes PM_{10} and $PM_{2.5}$ instruments). This setup provides continuous data and an economical way to monitor PM_{10}, $PM_{10\text{-}2.5}$, and $PM_{2.5}$. The primary monitor for $PM_{2.5}$ is a filter-based Very Sharp Cut Cyclone (VSCC) gravimetric monitor. Two Thermo Partisol 2000i Federal Reference Method (FRM) monitors were installed and began sampling on a one in three day schedule on January 1, 2014. This new setup helps fulfill the Wyoming $PM_{2.5}$ monitor network FRM and Federal Equivalent Method (FEM) collocation requirements.

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Figure 26. Cheyenne NCore station image

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Cheyenne NCore Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Cheyenne NCore	6909 Chief Washakie Ave. Cheyenne, WY	56-021-0100	O_3	Teledyne-API Model 400E	Neighborhood	Hourly	New analyzer planned for 2017
			$NO/NO_2/NO_x$	Teledyne-API 200 EU/501	Neighborhood	Hourly	No planned changes
			NO_y	Teledyne-API M200EU NOY	Regional	Hourly	No planned changes
			Trace SO_2	Teledyne-API T100U	Neighborhood	Hourly	No planned changes
			Trace CO	Thermo Electron 48i-TLE	Neighborhood	Hourly	No planned changes
			PM_{10}	Met One BAM 1020	Neighborhood	Hourly	No planned changes
			Speciated $PM_{10-2.5}$	Met One BAM 1020	Neighborhood	Hourly	No planned changes
			$PM_{2.5}$	Met One BAM 1020	Neighborhood	Hourly	No planned changes
			$PM_{2.5}$ (Primary)	R&P Model 2000 $PM_{2.5}$ Air Sampler w/ VSCC (filter-based)	Neighborhood	1 in 3 days (primary); 1 in 12 days (collocate)	No planned changes
			Speciated $PM_{2.5}$	URG 3000N (filter-based)	Neighborhood	1 in 3 days	No planned changes

Table 36. Cheyenne NCore Monitor Information

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2.5 Industrial Monitoring Sites

Historically, the AQD has required several industrial sources in Wyoming to conduct ambient monitoring for criteria pollutants at and near specific facilities. The AQD's largest industrial monitoring network is at the Powder River Basin coal mines and has 59 PM_{10} monitors. In southwest Wyoming, there is an extensive network of PM_{10} monitors associated with Trona facilities and coal mines. As facilities obtain construction or modification permits from the AQD's New Source Review (NSR) program, the facilities are often required to monitor for compliance with the NAAQS downwind of their facilities. These facilities submit quarterly data to the AQD. The data is checked for compliance with the NAAQS and adherence to proper quality assurance protocols.

2.6 IMPROVE Network

The purpose of the Interagency Monitoring of Protected Visual Environments (IMPROVE) network is to establish current visibility and aerosol conditions along with the characterizing broad regional trends and visibility conditions using monitoring data collected at or near Class I areas across the United States. There are four IMPROVE locations in Wyoming: Yellowstone National Park, Est. 1988; Bridger Wilderness Areas, Est. 1988; North Absaroka Wilderness Area, Est. 2000; Thunder Basin National Grasslands, Est. 2002.

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3.0 Compliance with NAAQS

The primary purpose of the AQD's SLAMS and SPM networks is to evaluate compliance with the NAAQS. These monitoring networks utilize FRM and FEM technologies and operate according to the SLAMS or Prevention of Significant Deterioration (PSD) quality assurance specifications in order to be used for NAAQS comparison. The AQD's SLAMS and SPM networks also operate under project-specific quality assurance project plans (QAPPs) which are available in the Cheyenne office for inspection. The following tables in Section 3 also contain data from the mobile gaseous stations. These stations do operate according to the EPA's specifications for NAAQS comparison, but they are typically deployed for no more than 12 months and usually do not possess a complete calendar year of data. The mobile gaseous stations, therefore, are generally not comparable to the design value, the true test of compliance with the NAAQS.

The following tables in Section 3 show 2014-2016 data and design values for each SLAMS and SPM monitoring station. All stations that operated in 2016 are included in the tables. All stations operated by the AQD comply with the NAAQS from 2014-2016.

3.1 Particulate Matter (PM_{10})

There were 24 stations that monitored for PM_{10} at any time in 2016. The SLAMS network has nine stations that use manual samplers and one that uses a continuous sampler. There is 30% collocation among the SLAMS that use the manual samplers. This fulfills the collocation requirements of Title 40, Part 58 Appendix A of the CFR. The remainder of the AQD monitoring network (NCore and SPMs) use continuous monitoring.

To comply with the 24-hour PM_{10} NAAQS, a monitor may only have one exceedance (a 24-hour average concentration greater than 150 $\mu g/m^3$) per year on average over a three-year period. The design value is the average number of exceedances per year from 2014-2016. A design value of zero means the station has not recorded any values over 150 $\mu g/m^3$ during the three-year period. Wyoming also has an ambient air quality standard for PM_{10} in its state regulations. Compliance with the annual Wyoming Ambient Air Quality Standards (WAAQS) is determined by the three-year average of the annual mean. The three-year average of the mean must be below 50 $\mu g/m^3$. The two tables in Section 3.1 show PM_{10} values with respect to the NAAQS and the WAAQS. The tables throughout Section 3 may contain special notations in place of values. These notations are explained below in the footer.

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PM_{10} Compliance with NAAQS of 150 µg/m³					
Highest 24-Hour Average (µg/m³)					
Site Name	2014	2015	2016	Design Value (2014-2016)	In Compliance
SLAMS					
Casper	30	59	46	0	Yes
Cheyenne	33	44	28	0	Yes
Cody	29	44	53	0	Yes
Gillette	25	39	40	0	Yes
Jackson	36	53	48	0	Yes
Lander	62	53	30	0	Yes
Laramie	42	41	33	0	Yes
Rock Springs	39	54	41	0	Yes
Sheridan-Meadowlark	20	68	54	0	Yes
Sheridan-Police Station	47	94	72	0	Yes
SPM					
Boulder	31	40	40	0	Yes
Campbell County	52	135	63	0	Yes
Converse County	N/A	42	62	N/A	N/A
Daniel South	26	36	27	0	Yes
Moxa Arch	67	52	41	0	Yes
Murphy Ridge	39	59	42	0	Yes
South Pass	15*	N/A	N/A	N/A	N/A
Wamsutter	41	47	32	0	Yes
Wright Jr-Sr High School	56	66	29	0	Yes
NCore					
Cheyenne NCore	34	78	34	0	Yes
Mobile Stations**					
Casper	N/A	N/A	N/A	N/A	N/A
Cheyenne	N/A	N/A	40*	N/A	N/A
Converse County	36	71*	N/A	N/A	N/A
Lovell	45*	86*	N/A	N/A	N/A
Newcastle	N/A	42*	39*	N/A	N/A
Rock Springs	40*	N/A	N/A	N/A	N/A
Sinclair	106	82	27*	N/A	N/A
Torrington	N/A	N/A	110	N/A	N/A

Table 37. PM_{10} 24-hr NAAQS Comparison

- N/A – Site was not in operation at all for the year of study.
- * - The value did not meet data completeness requirements per Title 40 Part 50 of the CFR.
- ** - Mobile Stations are in one location for approximately one year.
- *** - Site changed from a Mobile Station to a permanent location in 2013.
- ^ - For the three-year average, incomplete data years were used per WAQSR Chapter 2 Appendix 1.

PM_{10} Compliance with WAAQS of 50 µg/m³					
Annual Arithmetic Mean (µg/m³)					
Site Name	2014	2015	2016	Average (2014-2016)^	In Compliance
SLAMS					
Casper	14	15	13	14	Yes
Cheyenne	11	10	10	10	Yes
Cody	9*	11	10	10*	Yes
Gillette	11*	11	13	11*	Yes
Jackson	12	15	12	13	Yes
Lander	14	15	14	14	Yes
Laramie	14	14	15	14	Yes
Rock Springs	14	16	16	15	Yes
Sheridan-Meadowlark	10	10	10	10	Yes
Sheridan-Police Station	16	17	17	16	Yes
SPM					
Boulder	7	6	6	6*	Yes
Campbell County	11	12	10	11	Yes
Converse County	N/A	7*	6	N/A	Yes
Daniel South	5	6	5*	5*	Yes
Moxa Arch	7	6	7	6	Yes
Murphy Ridge	9	9	8	8	Yes
South Pass	5*	N/A	N/A	N/A	N/A
Wamsutter	10	10	8*	9*	Yes
Wright Jr-Sr High School	14	15	11*	13*	Yes
NCore					
Cheyenne NCore	10	9	10*	10*	Yes
Mobile Stations**					
Casper	N/A	N/A	N/A	N/A	N/A
Cheyenne	N/A	N/A	15*	N/A	N/A
Converse County	8	8*	N/A	N/A	N/A
Lovell	20*	15*	N/A	N/A	N/A
Newcastle	N/A	14*	11*	N/A	N/A
Rock Springs	6*	N/A	N/A	N/A	N/A
Sinclair	11	10	5*	N/A	N/A
Torrington	N/A	N/A	25	N/A	N/A

Table 38. PM_{10} Annual WAAQS Comparison

3.2 Particulate Matter ($PM_{2.5}$)

Twenty-one AQD-owned monitoring stations collected $PM_{2.5}$ data at some point during 2016. Within the $PM_{2.5}$ SLAMS network, the AQD has 22.2% of the monitors collocated to meet the 15% collocation requirement of Title 40, Part 58 Appendix A of the CFR. The AQD uses manual samplers to collect the data at the SLAMS locations. The SPMs, NCore, and mobile locations use continuous samplers to monitor $PM_{2.5}$. The annual standard is attained when the three-year average does not exceed 12.0 µg/m³. The 24-hour $PM_{2.5}$ NAAQS is 35 µg/m³. Compliance with

- N/A – Site was not in operation at all for the year of study.
- * - The value did not meet data completeness requirements per Title 40 Part 50 of the CFR.
- ** - Mobile Stations are in one location for approximately one year.
- *** - Site changed from a Mobile Station to a permanent location in 2013.
- ^ - For the three-year average, incomplete data years were used per WAQSR Chapter 2 Appendix 1.

this standard is determined from the 3-year average of the 98th percentile concentration. Below are two tables that compare $PM_{2.5}$ data under the different standards.

$PM_{2.5}$ Compliance with NAAQS of 35 µg/m³					
98% 24-Hour Average					
Site Name	2014	2015	2016	Average (2014-2016)	In Compliance
SLAMS					
Casper	14.1	14.7	11.0*	13*	Yes
Cheyenne	12.7	25.0	12.8	17	Yes
Cody	9.8*	19.4	21.9	17*	Yes
Jackson	13.2	14.9	11.6	13	Yes
Lander	26.3	20.1	22.0	23	Yes
Laramie	13.2	15.2	10.9	13	Yes
Rock Springs	9.6	18.6	16.6	15	Yes
Sheridan-Meadowlark	16.5	24.0	17.7	19	Yes
Sheridan-Police Station	20.0*	35.8	23.5	26*	Yes
SPM					
Antelope Site 7 (PRB-$PM_{2.5}$ Network)	N/A	18.5	9.6	N/A	N/A
Belle Ayr BA-4 (PRB-$PM_{2.5}$ Network)	10.5	18.5	13.7	14	Yes
Black Thunder BTM-36-2 (PRB-$PM_{2.5}$ Network)	9.9	21.6*	11.0*	14*	Yes
Buckskin (PRB-$PM_{2.5}$ Network)	12.2	21.0	9.4	14	Yes
Pinedale Gaseous	12.1	14.3	13.0	13	Yes
South Pass	9.2*	11.6	7.8	10*	Yes
NCore					
Cheyenne NCore	11.7	20.9	10.3	14	Yes
Mobile Stations**					
Casper	N/A	N/A	N/A	N/A	N/A
Cheyenne	N/A	N/A	11.5*	N/A	N/A
Converse County	8.0	9.9*	N/A	N/A	N/A
Lovell	18.2*	14.5*	N/A	N/A	N/A
Newcastle	N/A	22.8*	9.9*	N/A	N/A
Rock Springs	3.2*	N/A	N/A	N/A	N/A
Sinclair	7.3	11.2	17.2*	N/A	N/A
Torrington	N/A	N/A	11.2	N/A	N/A

Table 39. $PM_{2.5}$ 24-hr NAAQS Comparison 98th Percentile

- N/A – Site was not in operation at all for the year of study.
- * - The value did not meet data completeness requirements per Title 40 Part 50 of the CFR.
- ** - Mobile Stations are in one location for approximately one year.
- *** - Site changed from a Mobile Station to a permanent location in 2013.
- ^ - For the three-year average, incomplete data years were used per WAQSR Chapter 2 Appendix 1.

$PM_{2.5}$ Compliance with NAAQS of 12.0 µg/m³					
Annual Arithmetic Mean (µg/m³)					
Site Name	2014	2015	2016	Average (2014-2016)	In Compliance
SLAMS					
Casper	4.6	4.9	4.3*	4.6*	Yes
Cheyenne	4.1*	4.1	4.0	4.1*	Yes
Cody	3.7*	4.2	3.7	3.9*	Yes
Jackson	4.3	4.7	4.4	4.5	Yes
Lander	6.7	6.2	6.8	6.6	Yes
Laramie	4.2	4.2	3.9	4.1	Yes
Rock Springs	4.5	4.8	5.0	4.8	Yes
Sheridan-Meadowlark	4.9	5.5	4.7	5.0	Yes
Sheridan-Police Station	6.4	7.4	6.8	6.9	Yes
SPM					
Antelope Site 7 (PRB-$PM_{2.5}$ Network)	N/A	4.2	2.8	N/A	N/A
Belle Ayr BA-4 (PRB-$PM_{2.5}$ Network)	5.3	5.1	4.3	4.9	Yes
Black Thunder BTM-36-2 (PRB-$PM_{2.5}$ Network)	3.9	5.0*	3.5*	4.1*	Yes
Buckskin (PRB-$PM_{2.5}$ Network)	5.5	2.2	2.7	3.5	Yes
Pinedale Gaseous	5.5	5.0	4.7	5.1	Yes
South Pass	2.7*	2.5	2.4	2.5*	Yes
NCore					
Cheyenne NCore	3.9	4.4	4.5	4.3	Yes
Mobile Stations**					
Casper	N/A	N/A	N/A	N/A	N/A
Cheyenne	N/A	N/A	5.1*	N/A	N/A
Converse County	2.3	6.9*	N/A	N/A	N/A
Lovell	7.2*	8.6*	N/A	N/A	N/A
Newcastle	N/A	6.8*	2.8*	N/A	N/A
Rock Springs	0.4*	N/A	N/A	N/A	N/A
Sinclair	1.7	2.2	2.6*	N/A	N/A
Torrington	N/A	N/A	3.7	N/A	N/A

Table 40. $PM_{2.5}$ Annual NAAQS Comparison

3.3 Nitrogen Dioxide (NO_2)

In 2016, 21 AQD-owned stations monitored NO_2. Compliance with the annual primary NO_2 NAAQS is achieved when the annual average concentration in the calendar year is less than or equal to 53 ppb. The primary standard one-hour average concentration is 100 ppb. The maximum one-hour concentration per year is listed in the second NO_2 table below. The NO_2 calculated design value is the three-year average of the 98th Percentile of the daily maximum one-hour concentrations. The design value is met when it does not exceed 100 ppb. The calculated three-year design value is located in the second NO_2 table below.

- N/A – Site was not in operation at all for the year of study.
- * - The value did not meet data completeness requirements per Title 40 Part 50 of the CFR.
- ** - Mobile Stations are in one location for approximately one year.
- *** - Site changed from a Mobile Station to a permanent location in 2013.
- ^ - For the three-year average, incomplete data years were used per WAQSR Chapter 2 Appendix 1.

NO_2 Compliance with NAAQS of 53 ppb				
Annual Arithmetic Mean (ppb)				
Site Name	2014	2015	2016	In Compliance
Antelope Site 7 (PRB-NO_x Network)	N/A	3	2	Yes
Belle Ayr BA-4 (PRB-NO_x Network)	7	6	4	Yes
Big Piney***	1	1	1	Yes
Boulder	2	1	1	Yes
Campbell County	3	3	2	Yes
Casper Gaseous	4	5	4	Yes
Converse County	N/A	0*	0	Yes
Daniel South	1	0	1	Yes
Juel Spring	1	1	1	Yes
Moxa Arch	2	2	1	Yes
Murphy Ridge	2	2	2	Yes
Pinedale Gaseous	1	2	3	Yes
South Pass	1	1	0	Yes
Thunder Basin	1	1	1	Yes
Wamsutter	3	3	4	Yes
NCore				
Cheyenne NCore	4	4	4	Yes
Mobile Stations**				
Casper	N/A	N/A	N/A	N/A
Cheyenne	N/A	N/A	8*	N/A
Converse County	3	3*	N/A	N/A
Lovell	5*	3*	N/A	N/A
Newcastle	N/A	5*	3*	N/A
Rock Springs	2*	N/A	N/A	N/A
Sinclair	6	6	8*	N/A
Torrington	N/A	N/A	4	N/A

Table 41. NO_2 Comparison with the Annual NAAQS

- N/A – Site was not in operation at all for the year of study.
- * - The value did not meet data completeness requirements per Title 40 Part 50 of the CFR.
- ** - Mobile Stations are in one location for approximately one year.
- *** - Site changed from a Mobile Station to a permanent location in 2013.
- ^ - For the three-year average, incomplete data years were used per WAQSR Chapter 2 Appendix 1.

NO_2 Compliance with NAAQS of 100 ppb					
Annual 98% of Daily Maximum 1-hour average (ppb)				3-year 98% 1-hour Design Value (ppb)	
Site Name	2014	2015	2016	Design Value (2014-2016)	In Compliance
Antelope Site 7 (PRB-NO_x Network)	N/A	34.9*	29.9	N/A	N/A
Belle Ayr BA-4 (PRB-NO_x Network)	34.8	31.7	27.5	31	Yes
Big Piney***	8.6	7.9	7.7	8	Yes
Boulder	14.2	11.6	9.6	12	Yes
Campbell County	32.4*	31.5*	28.8	31	Yes
Casper Gaseous	38.0	42.3	39.1	40	Yes
Converse County	N/A	7.7*	8.2	N/A	N/A
Daniel South	3.2	2.8	3.2	3	Yes
Juel Spring	12.6	9.7	8.0	10	Yes
Moxa Arch	17.6	18.6	22.5	20	Yes
Murphy Ridge	11.7	11.6	11.7	12	Yes
Pinedale Gaseous	21.2	19.6	19.1	20	Yes
South Pass	4.2	5.1	5.0	5	Yes
Thunder Basin	9.8	7.9	6.4	8	Yes
Wamsutter	31.9	34.7	29.8	32	Yes
NCore					
Cheyenne NCore	33.6	37.5	33.2	35	Yes
Mobile Stations**					
Casper	N/A	N/A	N/A	N/A	N/A
Cheyenne	N/A	N/A	43.7*	N/A	N/A
Converse County	23.6	23.6*	N/A	N/A	N/A
Lovell	31.7*	24.1*	N/A	N/A	N/A
Newcastle	N/A	28.1*	23.2*	N/A	N/A
Rock Springs	24.0*	N/A	N/A	N/A	N/A
Sinclair	36.7	35.9	57.0*	N/A	N/A
Torrington	N/A	N/A	24.8*	N/A	N/A

Table 42. NO_2 Comparison with the Hourly NAAQS

- N/A – Site was not in operation at all for the year of study.
- * - The value did not meet data completeness requirements per Title 40 Part 50 of the CFR.
- ** - Mobile Stations are in one location for approximately one year.
- *** - Site changed from a Mobile Station to a permanent location in 2013.
- ^ - For the three-year average, incomplete data years were used per WAQSR Chapter 2 Appendix 1.

3.4 Sulfur Dioxide (SO_2)

During 2016, six AQD-owned monitoring stations monitored for SO_2 at some point. The NAAQS one-hour primary standard is met when the three-year average of the annual 99th percentile of the daily maximum one-hour average concentration does not exceed 75 ppb.

SO_2 Compliance with NAAQS of 75 ppb					
Annual 99% 1-hour average (ppb)				3-year 99% 1-hour average (ppb)	
Site Name	2014	2015	2016	Design Value (2014-2016)	In Compliance
Moxa Arch	16	18	29	21	Yes
NCore					
Cheyenne NCore	4	19	3	9	Yes
Mobile Stations**					
Casper	N/A	N/A	N/A	N/A	N/A
Cheyenne	N/A	N/A	30*	N/A	N/A
Newcastle	N/A	6*	2*	N/A	N/A
Sinclair	8*	6*	5*	N/A	N/A
Torrington	N/A	N/A	2	N/A	N/A

Table 43. SO_2 1-hr NAAQS Comparison

3.5 Carbon Monoxide (CO)

The AQD operated one trace CO monitor at the Cheyenne NCore station in 2016. The AQD monitored for CO at an additional station, Murphy Ridge, from 2007-2008. The CO levels were minimal and the benefit of monitoring at SPM locations was not justified for a long-term period. The level for the eight-hour NAAQS for CO is 9 ppm. The level for the one-hour NAAQS for CO is 35 ppm.

CO Compliance with NAAQS							
35 ppm Maximum 1-hour average concentration (ppm)				9 ppm Maximum 8-hour average concentration (ppm)			In Compliance
Site Name	2014	2015	2016	2014	2015	2016	
NCore							
Cheyenne NCore	0.53	0.49	0.40	0.3	0.5	0.3	Yes

Table 44. CO NAAQS Comparison

- N/A – Site was not in operation at all for the year of study.
- * - The value did not meet data completeness requirements per Title 40 Part 50 of the CFR.
- ** - Mobile Stations are in one location for approximately one year.
- *** - Site changed from a Mobile Station to a permanent location in 2013.
- ^ - For the three-year average, incomplete data years were used per WAQSR Chapter 2 Appendix 1.

3.6 Ozone (O_3)

The AQD monitored for ozone at 20 stations in Wyoming at some point in 2016. Hourly ozone readings from a monitor are used to compute the daily maximum eight-hour ozone average at the station. These daily maximum eight-hour ozone averages are ranked throughout the calendar year. The 4th highest annual value in a calendar year is then averaged with 4th highest annual values from two more years to compute a three-year average referred to as the design value. The design value must not exceed 0.070 ppm. On December 28, 2015, the EPA promulgated the new ozone NAAQS in Title 40, Part 50.19(a) of the CFR. In addition to the new NAAQS, the EPA updated the calculation methodology to compute the design value. The exact methodology can be found in Title 40, Part 50 Appendix U of the CFR.

On July 20, 2012, the EPA designated all of Sublette County and parts of Lincoln and Sweetwater Counties as a marginal nonattainment area for ozone and on July 20, 2015 the EPA issued a finding of attainment for this area, with respect to the 2008 Ozone NAAQS of 0.075 ppm. The remainder of Wyoming is designated as unclassifiable/attainment.

- N/A – Site was not in operation at all for the year of study.
- * - The value did not meet data completeness requirements per Title 40 Part 50 of the CFR.
- ** - Mobile Stations are in one location for approximately one year.
- *** - Site changed from a Mobile Station to a permanent location in 2013.
- ^ - For the three-year average, incomplete data years were used per WAQSR Chapter 2 Appendix 1.

O_3 Compliance with NAAQS of 0.070 ppm 4th Highest 8-Hour Average (ppm)					
Site Name	**2014**	**2015**	**2016**	**Design Value (2014-2016)**	**In Compliance**
Big Piney***	0.060	0.059	0.065	0.061	Yes
Boulder	0.060	0.055	0.060	0.058	Yes
Campbell County	0.059	0.062	0.060	0.060	Yes
Casper Gaseous	0.061	0.060	0.061	0.060	Yes
Converse County	N/A	0.060	0.059	N/A	N/A
Daniel South	0.062	0.062	0.063	0.062	Yes
Hiawatha	0.062	0.062	0.061	0.061	Yes
Juel Spring	0.062	0.061	0.059	0.060	Yes
Moxa Arch	0.063	0.071	0.064	0.066	Yes
Murphy Ridge	0.059	0.066	0.060	0.061	Yes
Pinedale Gaseous	0.057	0.059	0.059	0.058	Yes
South Pass	0.065	0.062	0.062	0.063	Yes
Thunder Basin	0.058	0.059	0.057	0.058	Yes
Wamsutter	0.060	0.060	0.045	0.055	Yes
NCore					
Cheyenne NCore	0.065	0.063	0.061	0.063	Yes
Mobile Stations**					
Casper	N/A	N/A	N/A	N/A	N/A
Cheyenne	N/A	N/A	0.060*	N/A	N/A
Converse County	0.059	0.060*	N/A	N/A	N/A
Lovell	0.049*	0.056*	N/A	N/A	N/A
Newcastle	N/A	0.059*	0.060*	N/A	N/A
Rock Springs	0.050*	N/A	N/A	N/A	N/A
Sinclair	0.060	0.061	0.047*	N/A	N/A
Torrington	N/A	N/A	0.059	N/A	N/A

Table 45. O_3 8-hr NAAQS Comparison

- N/A – Site was not in operation at all for the year of study.
- * - The value did not meet data completeness requirements per Title 40 Part 50 of the CFR.
- ** - Mobile Stations are in one location for approximately one year.
- *** - Site changed from a Mobile Station to a permanent location in 2013.
- ^ - For the three-year average, incomplete data years were used per WAQSR Chapter 2 Appendix 1.

4.0 Special Studies

4.1 UGWOS

In the winters of 2005 and 2006, specifically February, the AQD measured 8-hour ozone concentrations greater than 80 ppb at the Daniel South, Jonah, and Boulder monitoring stations. This precipitated a study to research the winter ozone phenomenon. The purposes of the study were, originally, to better understand the reaction mechanisms and collect sufficient data to form a conceptual model of the winter ozone formation. Since 2007, the objectives of the study have been modified to minimize gaps in the data and to conceptually understand the formation of winter ozone with the ultimate intent of developing a working photochemical grid model for the UGRB.

During the summer of 2014, the AQD critically evaluated the Upper Green Winter Ozone Study (UGWOS) with respect to the current ozone reduction objective. The AQD reduced short-term winter monitoring for 2015 to Volatile Organic Compounds (VOC) and aldehydes only, based on this evaluation. The goal of the 2016 winter monitoring study was ongoing regulatory monitoring supplemented with six locations for canister and cartridge collection with speciated VOC and aldehyde analyses to track changes in species with emission reductions. After 2016, funding was no longer budgeted for this study.

Quality Assurance Plans, data, and final reports from the UGWOS campaigns are available for download from this AQD website (**http://deq.wyoming.gov/aqd/winter-ozone/resources/winter-ozone-study/**). Additionally, the AQD presented findings based on the UGWOS results at the Air and Waste Management Association's conference on *Atmospheric Optics: Aerosols, Visibility, and the Radiative Balance* in September 2016. This hyperlink (**http://visibility.awma.org/wp-content/uploads/2016/10/40post.pdf**) has these findings.

Due to early winter 2017 monitored ozone values, the AQD performed a series of speciated VOC measurements at Juel Spring, Boulder, Big Piney and Moxa. While not officially part of the UGWOS program, the study objectives were similar to evaluate VOC speciation inside and outside of the nonattainment area.

4.2 VOC Monitoring

The AQD continues to perform continuous methane/non-methane hydrocarbon measurements at the Boulder location in addition to pulling periodic speciated VOC canisters. The AQD also operates methane/non-methane hydrocarbon analyzers at its mobile gaseous stations and the Wamsutter and Converse County SPM locations.

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4.3 Mobile BAM Station

The AQD has equipped a mobile monitoring station with continuous BAM PM_{10} and $PM_{2.5}$ monitors for deployment in communities possibly affected by windblown dust or smoke from agricultural burning or wildfire activity. This station allows the AQD to monitor near-real time PM_{10} and $PM_{2.5}$ concentrations, in addition to meteorological conditions, so the AQD can properly inform the public when particulate levels may cause adverse health effects.

4.3.1 Worland

The AQD deployed the mobile BAM monitoring station to monitor particulate matter concentrations and meteorological conditions in a residential area of Worland, WY, specifically at Newell Sargent Park, that may be affected by agricultural activities. Data collection began on July 1, 2015 and ended on August 31, 2016.

4.3.2 Wheatland

The AQD mobile BAM monitoring station was deployed to Wheatland on March 1, 2017 to monitor particulate matter concentrations and meteorological conditions. The objective of this station is to monitor particulate matter concentrations in a populated area that has registered complaints regarding windblown dust and smoke.

4.4 Grand Teton

The AQD and National Park Service (NPS) work cooperatively to fund a portion of the Grand Teton Monitoring Station located near the Teton Science School in the Grand Teton National Park. This monitoring station includes ozone, the National Atmospheric Deposition Program (NADP) wet deposition, a Nephelometer, camera system, and meteorological instrumentation.

4.5 Intermountain West Data Warehouse Project

Since 2010, the AQD has participated in the Intermountain West Data Warehouse (IWDW); previously known as the Three-State Study. The IWDW provides high quality tools for understanding and assessing the effects of current and future energy development and associated emissions. The IWDW is a cooperative venture between the Wyoming AQD, state agencies from Colorado, Utah, and New Mexico, Federal Land Managers, and the EPA. As part of this

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project, the Federal Government partially funded the Hiawatha station and contributed funding to install a methane/non-methane hydrocarbon analyzer along with special canisters at the Wamsutter monitoring station. The AQD is continuing to fund the Hiawatha Monitoring Station and the methane/non-methane hydrocarbon analyzer at Wamsutter in 2017. These and other data from the IWDW project can be viewed at the IWDW website: http://views.cira.colostate.edu/TSDW/.

4.6 SO_2 Data Requirements Rule

On September 21, 2015 the EPA's "Data Requirements Rule for the 2010 1-hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS)" (SO_2 DRR) became effective. This rule directs state agencies to "provide data to characterize current air quality in areas with large sources of sulfur dioxide (SO_2) emissions to identify maximum 1-hr SO_2 concentrations in ambient air (80FR51052 August 21, 2015). Characterization can be done through three different pathways: modeling, ambient monitoring, or emissions limitation. The AQD has delegated to the sources subject to the rule the responsibility to select and implement their selected characterization pathway. Table 46 lists the sources subject to this rule and their selected pathway.

Emissions Sources Subject to the Data Requirements Rule		Pathway Chosen to Satisfy Rule	
Company	Facility	Model	Monitor
Basin Electric	Laramie River Station	X	
Multiple	Campbell County Electric Generating Units	X	
Burlington Resources	Lost Cabin Gas Plant		X
PacifiCorp	Dave Johnston	X	X
PacifiCorp	Naughton	X	
PacifiCorp	Jim Bridger		X
Sinclair Wyoming Refining Company	Sinclair Refinery		X
Multiple	Trona Group		X

Table 46. DRR Pathway for all Affected Facilities and Emissions Groups in Wyoming

After discussions in mid-2016, PacifiCorp and the AQD submitted and certified SO_2 data from the Jim Bridger Power Plant collected between 2013 and 2015 to satisfy the characterization and compliance with the 2010 SO_2 NAAQS. More information can be found in Section 4.6.3.

To comply with the rule, Wyoming's 2016 Annual Network Plan that was approved by EPA Region VIII on November 10, 2016 provided a detailed plan and justification of monitoring locations for those facilities that selected the monitoring pathway. The EPA's approval included the State's implementation of a SLAMS equivalent network under this rule. In a March 8, 2017 letter, the EPA Region VIII Air Program Acting Director notified the AQD that Section 4.6.1.2 of Wyoming's 2016 Annual Network Plan must be revised when the 2017 Annual Network Plan is submitted to the EPA for review and approval to reflect that "industrial monitoring entities in Region 8 which are subject to 40 CFR Part 58, Appendix A, Section 2.1.1 must submit their

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QMPs and QAPPs to EPA Region 8 for review and approval." An attached copy of this letter is available in Appendix E of the 2017 Annual Network Plan While the AQD maintains that the 2016 Annual Network Plan is consistent with Title 40 Part 58, Appendix A, Section 2.1.1 of the CFR, this 2017 Annual Network Plan includes the language directed by EPA Region VIII for review and approval, the updated 2016 Section 4.6.1 can be found in Appendix G.

4.6.1 Lost Cabin Gas Plant

The Lost Cabin Gas Plant air quality monitoring station began operations on January 1, 2017, and is being operated to satisfy the requirements of the SO_2 DRR. The station is located on an existing well pad approximately 0.4 miles south of the Lost Cabin Gas Plant facility in Fremont County. The station's objective is to characterize maximum 1-hr SO_2 impacts from the Lost Cabin Gas Plant, a facility subject to the DRR, and a SO_2 analyzer is located at this station.

Lost Cabin Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Lost Cabin	43.272, -107.59891	56-013-0003	SO_2	Thermo 43i	Neighborhood	Continuous	No planned changes

Table 47. Lost Cabin Monitor Information

4.6.2 Dave Johnston Power Plant

The Dave Johnston Power Plant air quality monitoring station began operations on January 1, 2017, and is being operated to satisfy the requirements of the DRR. The station is located on state land approximately 4.3 miles south of the Dave Johnston Power Plant near Glenrock. The station's objective is to characterize maximum 1-hr SO_2 impacts from the Dave Johnston Power Plant, a facility subject to the DRR, and a SO_2 analyzer is located at this station.

Dave Johnston Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Dave Johnston	42.776122, -105.798214	56-009-0011	SO_2	API T100	Urban	Continuous	No planned changes

Table 48. Dave Johnston Power Plant Monitor Information

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4.6.3 Jim Bridger Power Plant

The Jim Bridger Power Plant has an existing SO_2 monitoring station which has been used to satisfy the DRR. The station is located approximately 30 miles east of Rock Springs on County Route 15 in Sweetwater County, Wyoming. This station began operations on January 5, 2012. The station's objective is to characterize maximum 1-hr SO_2 impacts from the Jim Bridger Power Plant, a facility subject to the DRR, and a SO_2 analyzer is located at this station. On January 13, 2017, Governor Mead recommended to EPA Region VIII to designate the Jim Bridger Power Plan in attainment based on 2013-2015 data. Appendix F of the 2017 Annual Network Plan has the signed letter from Governor Mead on this matter. The average 99th percentile of 1-hr SO_2 concentrations from 2013-2015 was 31 ppb as seen in the table below.

Jim Bridger Monitoring Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Jim Bridger	41.74649, -108.80374	56-037-0020	SO_2	Teledyne-API 100E	Neighborhood	Continuous	No planned changes

Table 49. Jim Bridger Power Plant Monitor Information

	99th percentile of 1-hr daily maximum concentrations (ppb)			2015 DV
Year	**2013**	**2014**	**2015**	**Average**
Concentration (ppb)	31	32	29	31

Table 50. Jim Bridger SO_2 Monitor 2015 Design Value

4.6.4 Sinclair Oil Refinery

The Sinclair Oil Refinery has an existing SO_2 monitoring network, which will be used to help satisfy the DRR. The Sinclair In-Town station is located about 0.2 miles west of the Sinclair Oil Refinery facility with the objective of characterizing population exposure to SO_2 impacts within the Town of Sinclair. This station began operations on December 10, 2015. A SO_2 analyzer is located at this station. The Sinclair North East station is located directly north of the facility's fenceline with the objective of characterizing SO_2 impacts downwind of the facility. This station was relocated and began operations at the present site on December 18, 2015. There are SO_2 and NO_x analyzers located at this station. In addition to these existing sites, Sinclair installed another SO_2 monitor southwest of the facility, which began operations onJanuary 1, 2017 and will be operated to satisfy the requirements of the DRR. The station is located at the Sinclair employee parking lot approximately 164 feet southwest of the facility. This station's objective is to characterize maximum 1-hr SO_2 impacts from the Sinclair Oil Refinery, a facility subject to the DRR, and a SO_2 analyzer is located at this station.

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Sinclair Refinery Monitoring Network Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Sinclair In-Town	41.78270, -107.12088	56-007-0008	SO_2	Thermo 43i	Middle	Continuous	No planned changes
Sinclair North East	41.79358, -107.08339	56-007-0009	SO_2	API M-100E	Neighborhood	Continuous	No planned changes
Sinclair South Site	41.77876, -107.10899	56-007-0010	SO_2	Thermo 43C	Middle	Continuous	No planned changes

Table 51. Sinclair Oil Refinery Monitor Information

4.6.5 Trona Environmental Subcommittee

The Trona Environmental Subcommittee consisting of; Tronox Alkali Wyoming Corporation (including the Westvaco and Granger Soda Ash Plants); Solvay Soda Ash Joint Venture and TATA Chemicals (Soda Ash) Partners began SO_2 network operations on January 1, 2017, and is being operated to satisfy the requirements of the DRR. Two monitoring stations are included within the network, one located on the ridge east of TATA and Westvaco, the other located between TATA and Westvaco. The network's objective is to characterize maximum 1-hr SO_2 impacts from the Green River Basin trona producing area. A SO_2 analyzer is located at each station.

Trona Environmental Subcommittee Monitoring Network Site Specifications							
Site Name	**Location**	**AQS ID**	**Parameter**	**Instrument**	**Scale**	**Sample Frequency**	**Operational Status**
Site 2	41.63001, -109.70159	56-037-0021	SO_2	Thermo 43i	Neighborhood	Continuous	No planned changes
Site 11	41.58532, -109.76861	56-037-0014	SO_2	Thermo 43i	Neighborhood	Continuous	No planned changes

Table 52. Trona Environmental Subcommittee Monitor Information

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5.0 Future Ambient Monitoring Modifications

5.1 Sheridan Mobile

The AQD will soon deploy a mobile gaseous station to Sheridan, WY. The 2015 Network Assessment identified Sheridan as a possible future site location. Specifically, the finding stated that there is a need for population-based monitoring in Sheridan beyond the existing particulate monitoring conducted by the SLAMS.

Previously, this mobile station was located in Cheyenne, WY and was sited downwind of a large refinery. The siting of the Cheyenne Mobile station was chosen as part of an ongoing study of ambient air and meteorological conditions near local refineries.

5.2 Eastern Johnson County

The AQD is decommissioning the Campbell County station due to results from the 2015 Network Assessment. Components of the Campbell County station will be used to establish an ambient monitoring station in Eastern Johnson County between Buffalo and Gillette. An initial siting trip to Johnson County to determine ideal locations has been conducted. It is expected that the new site will be operable later in 2017.

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6.0 Conclusion

As required by Title 40, Part 58.10(a) of the CFR, the AQD has completed its 2017 Annual Network Plan. The 2017 Annual Network Plan demonstrates sufficient coverage throughout Wyoming. As population and industrial concerns change, the AQD strives to verify that the monitoring needs of Wyoming are satisfied.

Data collected at the AQD's monitoring stations through 2016 shows that all monitors are attaining the NAAQS for PM_{10}, $PM_{2.5}$, NO_2, SO_2, O_3, and CO. Further, the operation of each monitoring site has met the requirements of Title 40, Part 58 Appendices A-E.

The AQD continually evaluates data collected at the AQD, industrial, and AQRV monitors to determine if changes in policy are needed to continue managing the air resource in Wyoming.

Any comments pertaining to the Wyoming Ambient Air Monitoring 2017 Annual Network Plan should be sent to the following contact:

Ms. Cara Keslar
Monitoring Section Supervisor
Wyoming Air Quality Division
200 West 17th Street
Cheyenne, WY 82002

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Appendix A: AQD Monitoring Site Metadata

AQS ID	Site Name	Address	Land Use Type	Location Type	Monitor Type	Meets 40 CFR § 58 Appendix A, C, D & E Requirements*	Monitor Objective	Longitude	Latitude	Site Start Date
56-025-0001	Casper	City County Bldg. – Center & C Streets	Commercial	Urban & Center City	SLAMS	X	Population Exposure	-106.32509	42.85106	10/15/1998
56-021-0001	Cheyenne	Emerson Bldg. 23rd & Central Ave.	Residential	Urban & Center City	SLAMS	X	Population Exposure	-104.81766	41.13687	1/1/1979
56-029-0001	Cody	1225 10th St.	Residential	Suburban	SLAMS	X	Population Exposure	-109.06851	44.52464	1/1/1975
56-005-1002	Gillette	1000 W. 8th St.	Commercial	Urban & Center City	SLAMS	X	Population Exposure	-105.51702	44.28801	1/1/1978
56-039-1006	Jackson	40 E. Pearl Ave.	Commercial	Urban & Center City	SLAMS	X	Population Exposure	-110.79799	43.45776	6/8/2007
56-013-1003	Lander	600 Washington	Residential	Suburban	SLAMS	X	Population Exposure	-108.73556	42.84223	1/1/1987
56-001-0006	Laramie	406 Ivinson	Commercial	Urban & Center City	SLAMS	X	Population Exposure	-105.59173	41.31159	1/1/1968
56-037-0007	Rock Springs	625 Ahsay Ave.	Residential	Urban & Center City	SLAMS	X	Population Exposure	-109.22013	41.59259	1/1/1983
56-033-0002	Sheridan – Police Station	45 West 12th St.	Commercial	Urban & Center City	SLAMS	X	Highest Concentration, Population Exposure	-106.95593	44.81514	10/5/1983
56-033-1003	Sheridan Meadowlark	1410 DeSmet Ave.	Commercial	Urban & Center City	SLAMS	X	Population Exposure	-106.96432	44.78275	7/1/2012
56-009-0009	Antelope Site 7 (PRB Network)	Antelope Site 7	Industrial	Rural	SPM	X	General/Background	-105.38857	43.42542	2/18/2015
56-005-0892	Belle Ayr BA-4 (PRB Network)	Belle Ayr BA-4	Industrial	Rural	SPM	X	Highest Concentration, Source Oriented	-105.34316	44.09707	7/9/1991
56-035-0700	Big Piney	4 miles south of Big Piney, WY	Residential	Rural	SPM	X	Source Oriented, General/Background	-110.09890	42.48640	3/30/2011

AQS ID	Site Name	Address	Land Use Type	Location Type	Monitor Type	Meets 40 CFR § 58 Appendix A, C, D & E Requirements*	Monitor Objective	Longitude	Latitude	Site Start Date
56-005-0891	Black Thunder BTM-36-2 (PRB Network)	BTM-36-2 (Black Thunder Mine)	Industrial	Rural	SPM	X	Source Oriented	-105.21330	43.64830	1/1/1985
56-035-0099	Boulder	5 miles SW of Boulder, WY	Desert	Rural	SPM	X	Source Oriented, Highest Concentration	-109.75300	42.71900	2/1/2005
56-005-1899	Buckskin Mine (PRB Network)	Triton Coal Gillette, WY	Industrial	Rural	SPM	X	Source Oriented	-105.53976	44.50268	9/4/2008
56-005-0456	Campbell County	15 miles SSW of Gillette, WY	Industrial	Rural	SPM	X	Source Oriented, General/Background	-105.52999	44.14696	7/15/2003
56-025-0100	Casper Gaseous	2800 Pheasant Dr. Casper, WY	Commercial	Urban & Center City	SPM	X	Population Exposure	-106.36501	42.82231	3/1/2013
56-025-0005	Casper Mobile	500 S. Walsh Dr.	Residential	Suburban	SPM	X	Population Exposure	-106.27767	42.84630	12/1/2016
56-021-0100	Cheyenne NCore	6909 Washakie Ave.	Residential	Suburban	NCore	X	National Core Monitoring Site	-104.77842	41.18235	1/1/2011
56-009-0010	Converse County	16 miles west of WY Highway 59 on Highland Loop Rd.	Industrial	Rural	SPM	X	General/Background	-105.49896	43.10108	4/10/2015
56-035-0100	Daniel South	5 miles south of Daniel, WY	Desert	Rural	SPM	X	General/Background	-110.05510	42.79070	7/1/2015
56-037-0077	Hiawatha	Bitter Creek Rd. 43 miles SE of Rock Springs, WY	Desert	Rural	SPM	X	General/Background	-108.61900	41.15800	3/30/2011
56-035-1002	Juel Spring	20 miles NW of Farson, WY	Desert	Rural	SPM	X	Source Oriented, General/Background	-109.56050	42.37350	12/11/2009
56-001-0010	Laramie Mobile	998 Russell St., Laramie, WY	Residential	Suburban	SPM	X	Population Exposure	-105.586	41.30283056	4/5/2017

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AQS ID	Site Name	Address	Land Use Type	Location Type	Monitor Type	Meets 40 CFR § 58 Appendix A, C, D & E Requirements*	Monitor Objective	Longitude	Latitude	Site Start Date
56-037-0300	Moxa Arch	25 miles NW of Green River, WY	Desert	Rural	SPM	X	Source Oriented	-109.78833	41.75056	5/27/2010
56-041-0101	Murphy Ridge	Bear River, WY	Agricultural	Rural	SPM	X	General/Background	-111.04238	41.37300	1/1/2007
56-035-0101	Pinedale Gaseous	West side of City Park & Pine Creek	Residential	Suburban	SPM	X	Population Exposure	-109.87076	42.86982	1/1/2009
56-013-0099	South Pass	South Pass, WY	Forest	Rural	SPM	X	General/Background	-108.72000	42.53000	3/12/2007
56-005-0123	Thunder Basin	30 miles NNE of Gillette, WY	Desert	Rural	SPM	X	General/Background	-105.29030	44.65220	5/1/2001
56-037-0200	Wamsutter	2 miles west of Wamsutter, WY	Desert	Rural	SPM	X	Source Oriented, General/Background	-108.02458	41.67745	3/1/2006
NOT IN AQS	Wheatland BAM Station	West Mariposa Parkway & 27th St.	Residential	Rural	SPM	X	Population Exposure	-104.9786	42.0481	2/7/2017
56-005-0099	Wright Jr-Sr High School	Adjacent to Wright Jr-Sr High School	Residential	Rural	SPM	X	General/Background, Population Exposure	-105.49149	43.75615	11/1/2002

Table 53. Metadata for Current AQD Sites

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Appendix B: 2016 SLAMS Precision and Accuracy

$PM_{2.5}$

AQS ID	POC	Site Name	Precision Checks (Number-Type)	Accuracy Audit				Flow Verification			
				Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
56-021-0100	POC-1	Cheyenne NCore	0	1	0	1	0	3	3	3	3
	POC-11		0	1	0	1	0	3	3	3	3
	POC-2		0	1	0	1	0	3	3	3	3
	POC-3		57 – Analytical 12 – Flow Rate	1	0	1	0	3	4	4	3
56-021-0001	POC-1	Cheyenne SLAMS	30 - Analytical	0	1	0	1	4	3	3	3
	POC-11		0	0	1	0	1	3	3	3	3
	POC-2		0	0	1	0	1	3	4	3	3
56-025-0001	POC-1	Casper SLAMS	0	0	1	1	0	3	4	3	3
	POC-11		0	0	1	1	0	3	3	3	3
56-039-1006	POC-1	Jackson SLAMS	0	0	1	0	1	4	3	3	3
	POC-11		0	0	1	0	1	3	3	3	3
56-029-0001	POC-1	Cody SLAMS	0	0	1	0	1	3	3	3	3
	POC-11		0	0	1	0	1	3	4	3	3
56-013-1003	POC-1	Lander SLAMS	0	0	1	0	1	4	3	3	3
	POC-11		0	0	1	0	1	3	3	3	3
56-001-0006	POC-1	Laramie SLAMS	0	0	1	0	1	3	3	3	3
	POC-11		0	0	1	0	1	3	3	3	3
56-037-0007	POC-1	Rock Springs SLAMS	0	0	1	1	0	3	3	3	3
	POC-11		0	0	1	1	0	3	3	3	3
56-033-0002	POC-1	Sheridan Police Station SLAMS	22 - Analytical	1	0	1	0	3	4	3	3
	POC-11		0	1	0	1	0	3	4	3	3
	POC-2		0	1	0	1	0	3	4	3	3
56-033-1003	POC-1	Sheridan Meadowlark School SLAMS	0	1	0	1	0	3	4	3	3
	POC-11		0	1	0	1	0	3	4	3	3

Table 54. $PM_{2.5}$ SLAMS Precision and Accuracy

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PM_{10}

AQS ID	POC	Site Name	Precision Checks (Number-Type)	Accuracy Audit				Flow Verification			
				Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
56-025-0001	POC-4	Casper SLAMS	29 – Analytical	0	1	1	0	3	3	3	3
	POC-5		0	0	1	1	0	3	3	3	3
	POC-44		0	0	1	1	0	3	3	3	3
56-021-0001	POC-1	Cheyenne SLAMS	30 – Analytical	0	1	0	1	3	3	3	3
	POC-11		0	0	1	0	1	3	4	3	3
	POC-2		0	0	1	0	1	3	3	3	3
56-021-0100	POC-3	Cheyenne NCore	0	1	0	1	0	3	3	3	3
56-029-0001	POC-3	Cody SLAMS	0	0	1	0	1	4	4	3	3
	POC-33		0	0	1	0	1	3	4	3	3
56-005-1002	POC-5	Gillette SLAMS	0	0	1	0	1	3	3	3	3
56-039-1006	POC-1	Jackson SLAMS	0	0	1	0	1	3	3	3	3
	POC-11		0	0	1	0	1	3	3	3	3
56-013-1003	POC-3	Lander SLAMS	0	0	1	0	1	3	3	3	3
	POC-33		0	0	1	0	1	3	3	3	3
56-001-0006	POC-5	Laramie SLAMS	0	0	1	0	1	3	3	3	3
	POC-55		0	0	1	0	1	3	3	3	3
56-037-0007	POC-2	Rock Springs SLAMS	0	0	1	0	1	3	3	3	3
	POC-22		0	0	1	0	1	3	3	3	3
56-033-0002	POC-1	Sheridan Police Station SLAMS	0	1	0	1	0	3	4	3	4
56-033-1003	POC-1	Sheridan Meadowlark School SLAMS	28 – Analytical	1	0	1	0	3	4	3	3
	POC-11		0	1	0	1	0	3	4	3	3
	POC-2		0	1	0	1	0	3	4	4	3

Table 55. PM_{10} SLAMS Precision and Accuracy

Appendix C: Campbell County SPM Data Analysis Memorandum

Wyoming Department of Environmental Quality
Air Quality Division
Memorandum

To: Nancy Vehr, AQD Administrator 1/31/17

Through: Darla Potter, AQRM Program Manager 1/31/17
Cara Keslar, Monitoring Program Supervisor 1/31/17

From: Kristina Hooper, Natural Resource Analyst-Ambient Air Monitoring Project Manager

CC: Tanner Shatto, District 3 Engineer

Date: January 30, 2017

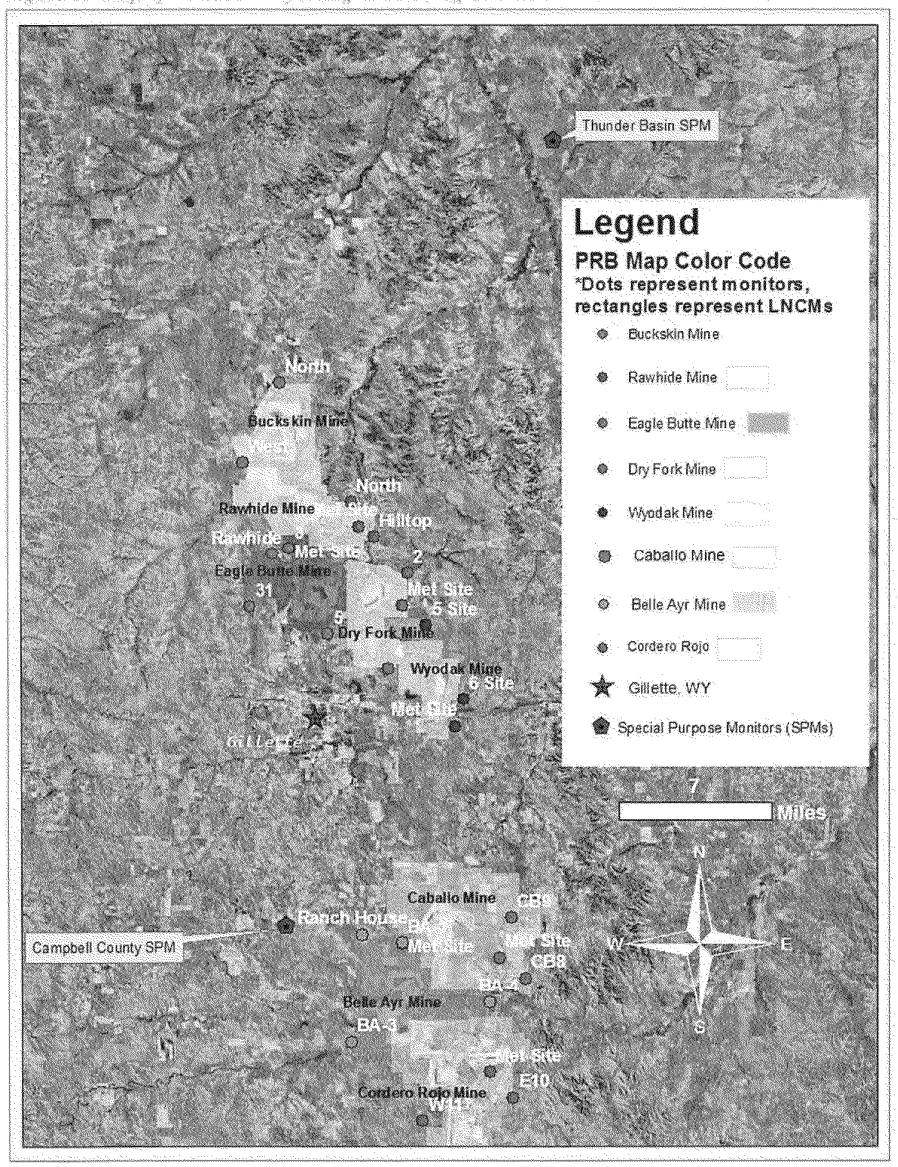
Subject: Campbell County Data Analysis

Background

The Campbell County Station is a special purpose monitor (SPM) located approximately 10 miles southwest of Gillette, WY. Since beginning its operation in June 2003, the Campbell County Station has been used to track air quality in an area of heavy industrial activity. Equipment currently at this station monitors ozone (O_3), nitrogen dioxide (NO_2), continuous particulate matter (PM_{10}), visibility via a camera, and meteorological parameters. In 2008, the high-volume particulate matter (PM_{10}) sampler was replaced with a continuous PM_{10} tapered element oscillating microbalance (TEOM) monitor. In 2009, a high resolution camera was added to the station. In 2016, a new continuous PM_{10} beta attenuation monitor (BAM) replaced the PM_{10} TEOM and a new model Thermo 42i oxides of nitrogen (NO_x) analyzer was also installed.

An analysis of the data collected at the Campbell County Station for the 2015 Network Assessment (for the years 2009-2013) revealed a high amount of correlation between Campbell County's monitors and other monitors in the area (see Figure 1). The purpose of the following analysis is to examine trends in the data, correlation between the Campbell County Station and nearby sites, and to inform decisions about monitoring in northeast Wyoming.

Figure 1. Map of Northeast Wyoming Monitoring Locations



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Station Summary

The Campbell County Station's objective is to collect air quality and meteorological data to monitor background conditions and possible impacts from coal-bed methane development in the area. A review of the data from June 2003 to June 2016 show that there were no exceedances of the National Ambient Air Quality Standards (NAAQS) for nitrogen dioxide (NO_2), particulate matter (PM_{10}), or ozone. The NAAQS for NO_2 include a 1-hour average standard of 100 parts per billion (ppb) and an annual mean of 53 ppb. Before 2010, there was no 1-hour average standard for NO_2, only an annual standard of 53 ppb. The highest 1-hour NO_2 average collected at the Campbell County Station was 48 ppb collected on January 24, 2008 and the highest annual average was 4.88 ppb during 2003. From 1987 until 2006, the NAAQS for PM_{10} were set at 150 micrograms per meter cubed ($\mu g/m^3$) for 24-hour averaging time and 50 $\mu g/m^3$ for the annual averaging time. In 2006, the NAAQS annual standard of 50 $\mu g/m^3$ was revoked while the 24-hour standard of 150 $\mu g/m^3$ was retained. However, Wyoming preserved the annual standard of 50 $\mu g/m^3$ in the Wyoming Ambient Air Quality Standards (WAAQS). The highest PM_{10} 24-hour average was 136 $\mu g/m^3$ which occurred on July 10, 2006. The NAAQS level for 8-hour average ozone have evolved over the years: from 1997 until 2008 the level was 0.08 parts per million (ppm), in 2008 the level was changed to 0.075 ppm, and in 2015 the level of the NAAQS became 0.07 ppm. The highest 8-hour ozone value for Campbell County was 83 ppb which was collected on August 16, 2003.

Data Collection

A summary of parameters monitored at this station, along with the data collection efficiency for those parameters, can be found in Tables 1 and 2 in Appendix A. The Campbell County Station data collection objective is 90% data completeness per quarter for all parameters. For NO_2 and PM_{10} parameters associated with an Ambient Air Quality Standard the data collection must meet 75% data completeness per quarter to be valid. Ozone must meet 90% data completeness for a three year period, with a minimum of 75% within the ozone monitoring season. Wyoming's ozone monitoring season was April through October up until the 2015 NAAQS rule changed Wyoming's monitoring season to January through September. Campbell County Station has collected year round ozone data since the station's establishment in 2003.

Data Summary

Data analysis focused on data collected between June 2003 and June 2016. To better visualize the data box-and-whisker plots, histograms, and time series graphs have been included for each pollutant. Figure 2 shows how to interpret a box-and-whisker plot.

To analyze the data for the Campbell County Station, it is important to compare data sets for each gaseous parameter with other AQD monitors in the area. PM_{10} data were compared to Powder River Basin industrial monitors; Caballo Mine monitor CB9 (a downwind monitor) and Eagle Butte Mine monitor EB 31 (an upwind monitor). These industrial monitors are the nearest PM_{10} monitors of the same type and collection frequency and are part of the Powder River Basin PM_{10} monitoring network. Campbell County ozone and NO_2 data have been compared to the Thunder Basin Station's monitors. The Thunder Basin

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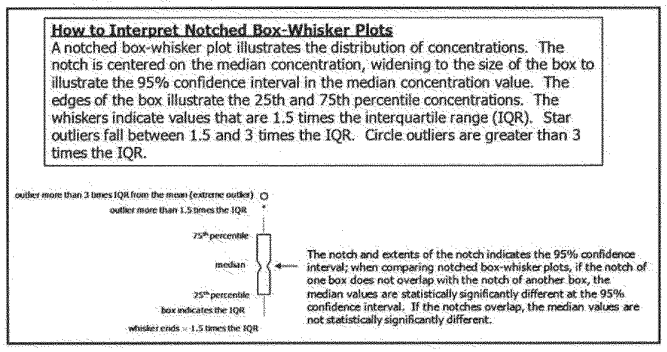
Station has the nearest ozone and NO_2 monitors for comparison. The Campbell County Station is located about 53 miles SW from the Thunder Basin Station, about 10 miles from Caballo Mine monitor CB-9, and approximately 14 miles from Eagle Butte Mine monitor EB-31.

Figure 2. Box-and-whisker plot explanation



Ozone: The NAAQS for ozone is met when the annual 4th highest daily maximum 8-hour rolling average over 3 years is equal to or less than the NAAQS value. From 1997 to 2008 the ozone 8-hour average NAAQS level was 0.08 ppm, then from 2008 to 2015 the NAAQS level was 0.075 ppm. In 2015, the ozone NAAQS level was revised to the current level of 0.070 ppm. Over the entire duration of data collection at the Campbell County Station only twenty (20) out of 4,590 values for ozone 8-hour averages have surpassed 70 ppb (Figure 3) and no values have exceeded 70 ppb since 2012. The highest 8-hour daily maximum concentration was 83 ppb on August 16, 2003. The fourth highest 8-hour daily maximums for 2003 through 2016 are shown in Figure 6. Campbell County Station's 2013-2015 design value is 62 ppb. There were no exceedances of the NAAQS levels.

Figure 3. The highest 8-hour average values of ozone for Campbell County

Date	Ozone (ppb)
7/22/2003	77
7/23/2003	77
7/27/2003	77
8/12/2003	71
8/13/2003	72
8/14/2003	76
8/15/2003	76
8/16/2003	83
9/5/2003	74
8/18/2004	70
7/20/2007	72
7/21/2007	75
7/24/2007	71
7/29/2007	70
7/30/2007	73
7/31/2007	71
8/13/2007	71
8/15/2007	76
6/6/2012	75
6/18/2012	74

Figure 4. Campbell County Station daily maximum 8-hour average ozone box-and-whisker plot (2003-2016)

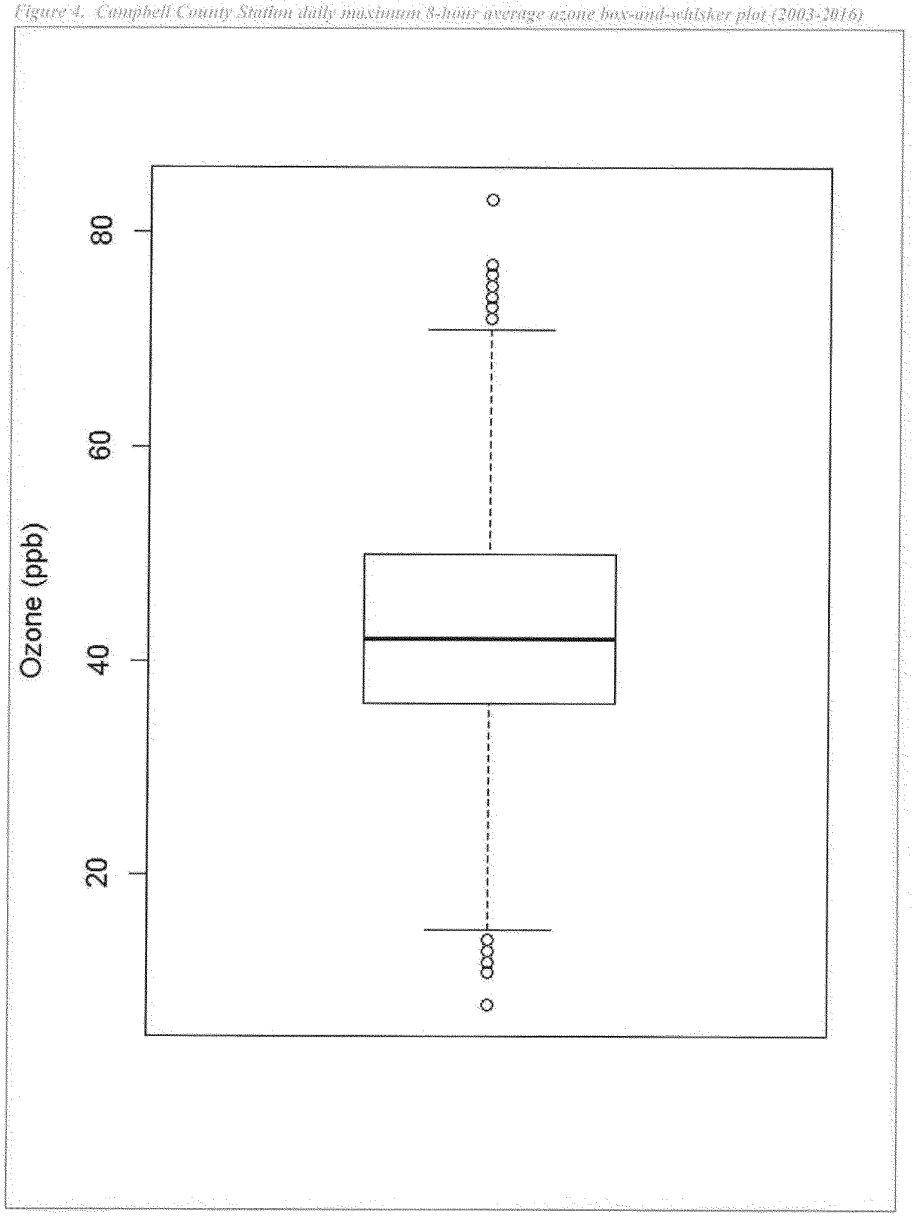


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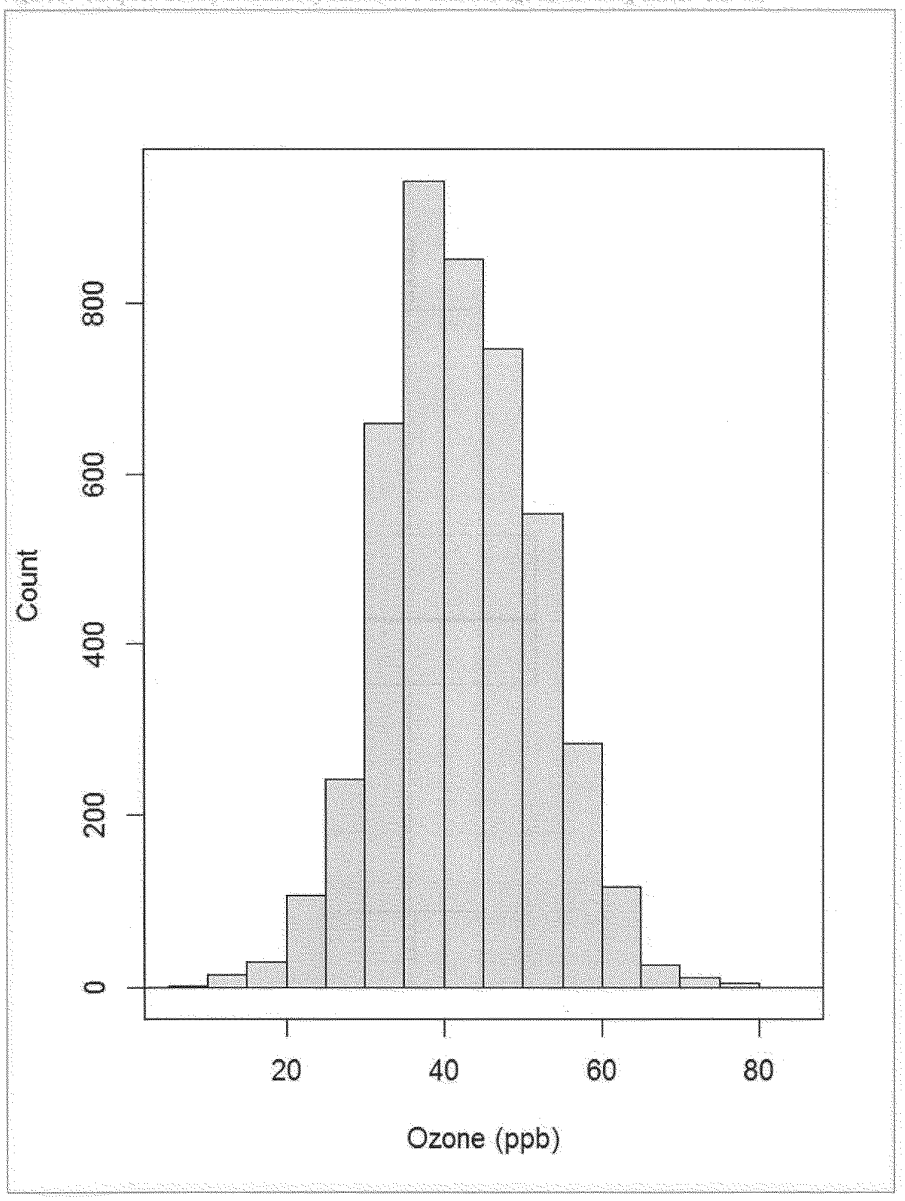
Figure 5. Campbell County Station daily maximum 8-hour average ozone histogram (2003-2016)



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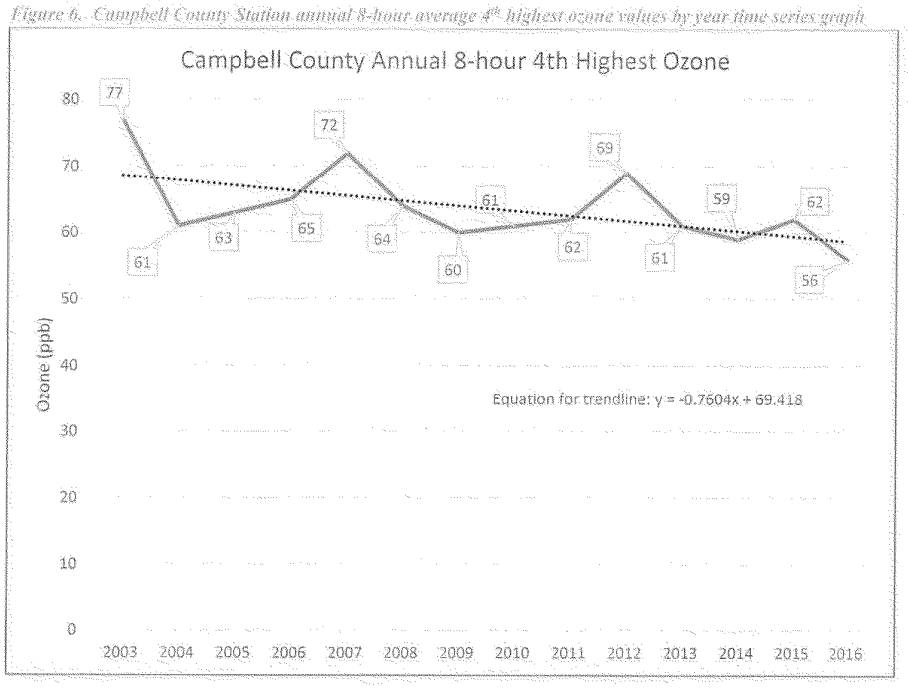
The 8-hour average ozone data set for this station show that a majority of the measured values fell between 25 ppb and 65 ppb (Figures 4 and 5). These data are consistent with general background values expected for the Western United States. There were minimal occurrences of values near 0 ppb and values near or exceeding the current NAAQS of 70 ppb. Figure 6 shows the 4th highest 8-hour ozone value by year from 2003 to 2016. The values for the 4th highest 8-hour ozone have been generally declining since 2003 and all of the values have been between 50 and 80 ppb. No values have exceeded 70 ppb since 2012.

Figure 6. Campbell County Station annual 8-hour average 4th highest ozone values by year time series graph



Regression statistics show that the 8-hour 4th highest ozone data (Figure 6) has a p-value of 1.19×10^{-15} which indicates that the trend in this graph is statistically significant. The R^2 value of 0.99 shows a strong correlation between the data points and their occurrence over time. The trend indicates that the 4th highest daily maximum ozone value is declining at this site.

Figure 7. Comparison between the Campbell County and Thunder Basin Stations for 8-hour average ozone box-and-whisker plots (2003-2016)

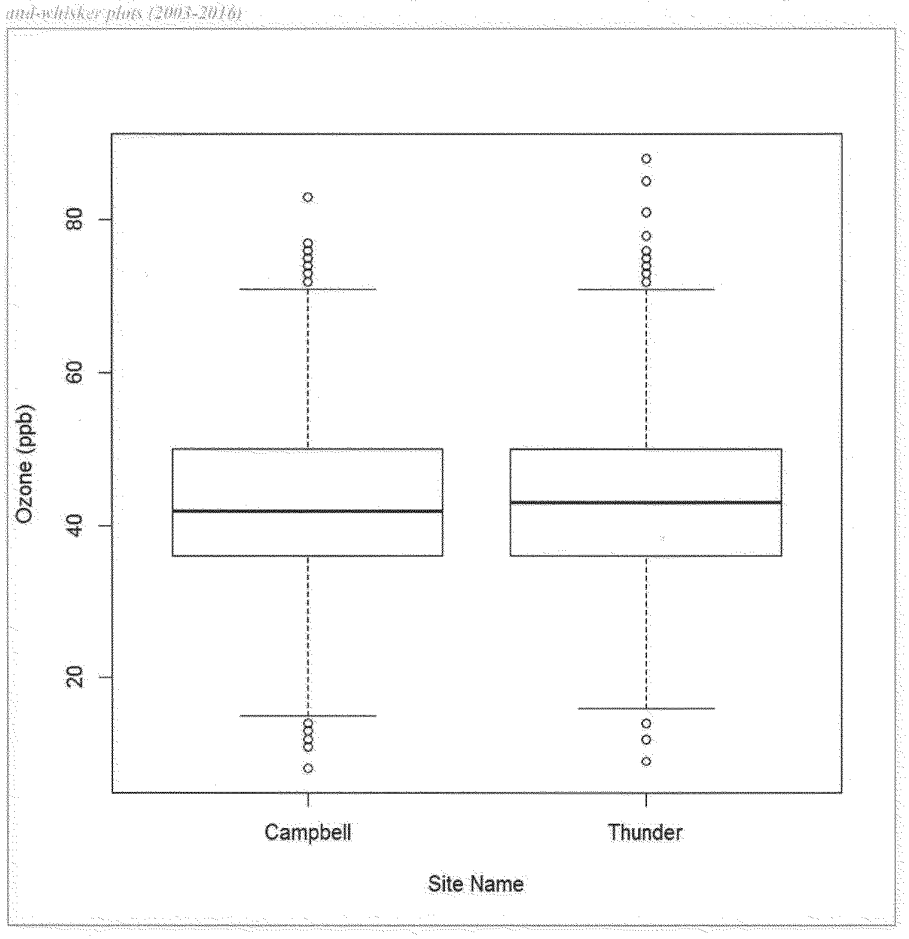


Figure 7 shows the 8-hour ozone average values from the Campbell County and Thunder Basin monitoring stations fell between 35 and 50 ppb. The data from each site is from the dates July 17, 2003 to June 30, 2016. The quartiles of both sites are nearly identical and the means of Campbell County and Thunder Basin stations are not significantly differing. The Pearson Correlation value of the Campbell County and Thunder Basin ozone 8-hour maximum data comes to 0.54, indicating a moderately strong positive correlation between the two stations. The Pearson Correlation value of the Campbell County and Thunder Basin ozone hourly data is 0.80, indicating a strong positive correlation (the strongest Pearson correlation values are +1 for total positive correlation, 0 for no correlation, and -1 for a total negative correlation).

Nitrogen Dioxide: As of 2010 the attainment of the NAAQS for nitrogen dioxide is met when the 98th percentile of the 1-hour daily maximum concentration, averaged over 3 years is at or below 100 ppb and when the annual average is less than 53 ppb. Before 2010, there was no 1-hour standard for NO_2, only an annual standard of 53 ppb. From 2003 to 2016, the station showed no concentrations above the 1-hour (100 ppb) or the annual standards (53 ppb), respectively. The highest overall 1-hour average was 48 ppb collected on January 24, 2008. The annual averages by year are shown in Figure 10. Campbell County Station's NO_2 1-hour, three year (2013-2015) design value is 32 ppb. The 2015 design value for 1-hour NO_2 is 31.5 ppb and the 2015 NO_2 annual average is 2.73 ppb.

Figure 8. Campbell County Station 1-hour average NO_2 box-and-whisker plot (2003-2016)

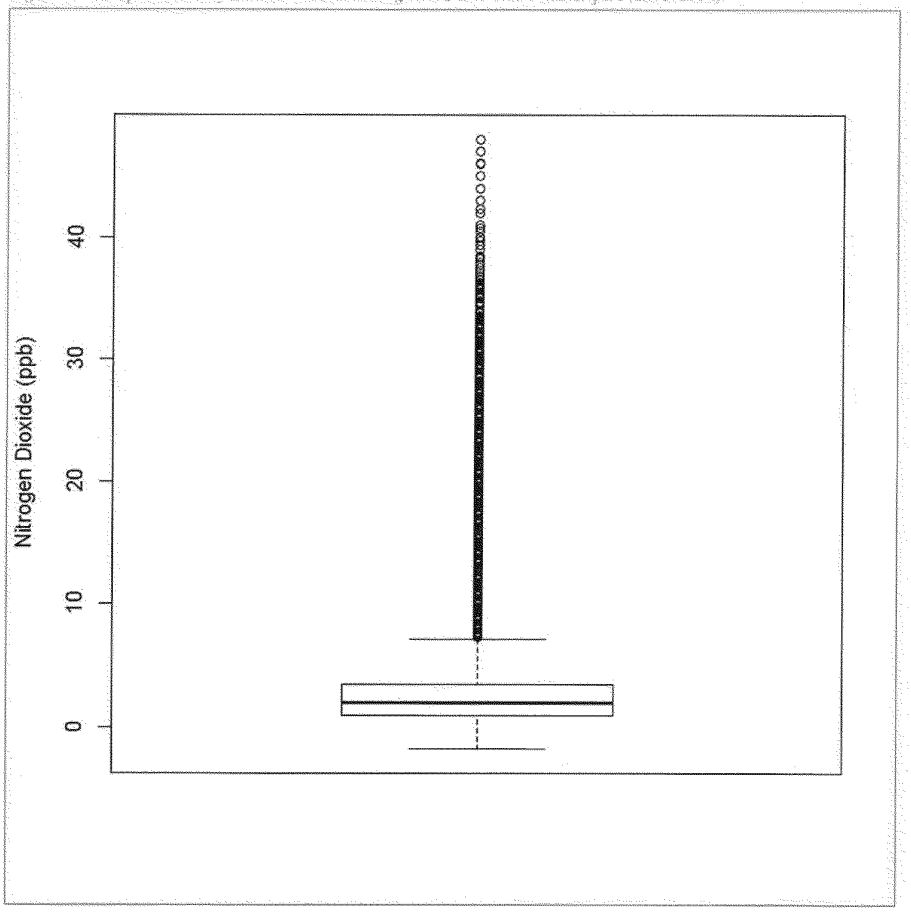


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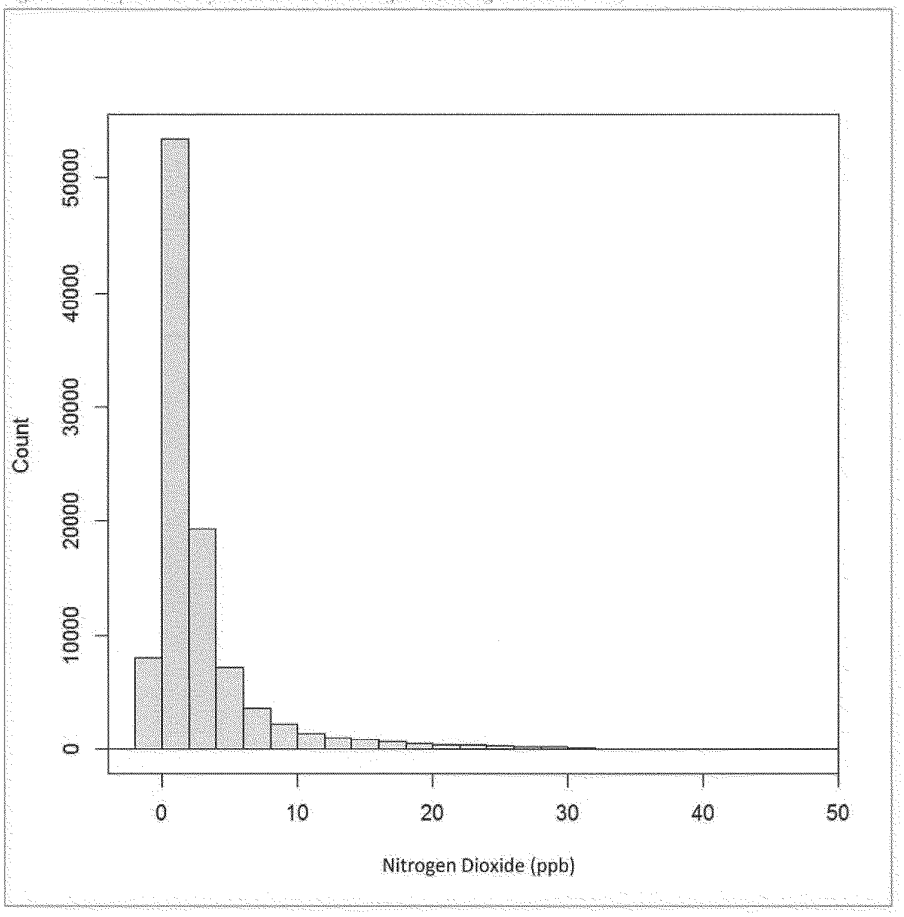
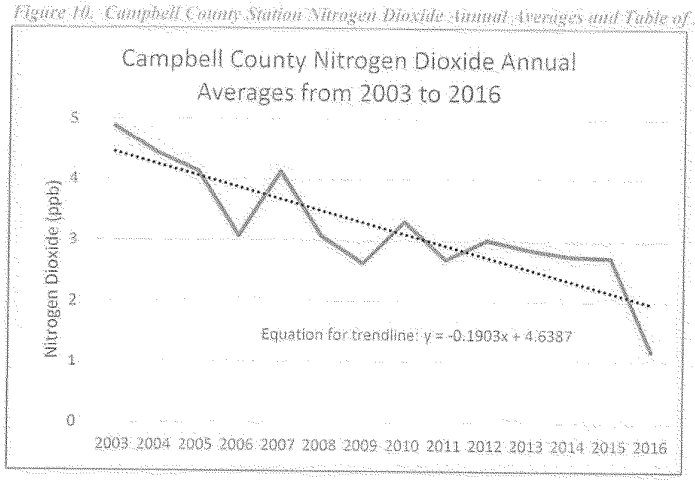
Figure 9. Campbell County Station 1-hour average NO_2 histogram (2003-2016)



The 2003 though 2016 1-hour average NO_2 data set for this station show that the majority of the measured values fell below 10 ppb (Figures 8 and 9). These data are consistent with values expected from a rural, sparsely populated area for background measurements. There were a small amount of occurrences above 20 ppb, which is well below the 1-hour NAAQS 100 ppb level.

Figure 10. Campbell County Station Nitrogen Dioxide Annual Averages and Table of Annual Average values



Year	Annual Average
2003	4.88
2004	4.44
2005	4.14
2006	3.08
2007	4.13
2008	3.07
2009	2.63
2010	3.32
2011	2.70
2012	3.01
2013	2.86
2014	2.76
2015	2.73
2016	1.21

Figure 10 shows the annual averages of nitrogen dioxide were all below 5 ppb, which is well below the NAAQS level of 53 ppb for the annual average. The associated table provides the values of the annual averages. Regression statistics show that the data has a p-value of 1.52×10^{-8} indicating that the trend in this graph is statistically significant. The R^2 value of 0.94 indicates a strong correlation between the data points and their occurrence over time. The annual averages for nitrogen dioxide are generally decreasing at the Campbell County site.

Figure 11. Campbell County Station daily maximum 1-hour average Nitrogen Dioxide histogram

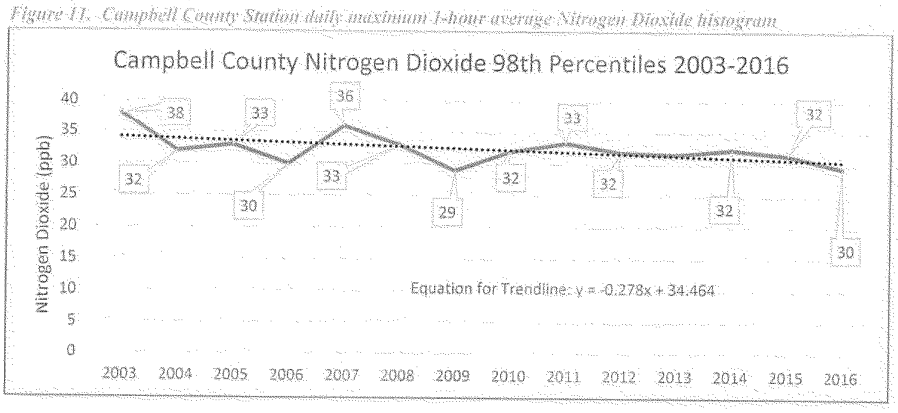


Figure 11 depicts the NO_2 1-hour average 98th percentile values from 2003 to 2016. After analyzing the regression statistics for Figure 11 data, the resulting p-value of 0.299 suggests that the trend results are not statistically significant. The R^2 value of 0.079 indicates a weak relationship between the data points and their occurrence over time. However, while there is not a strong decreasing trend of 1-hour average NO_2 values, all values are well below the level of the NAAQS.

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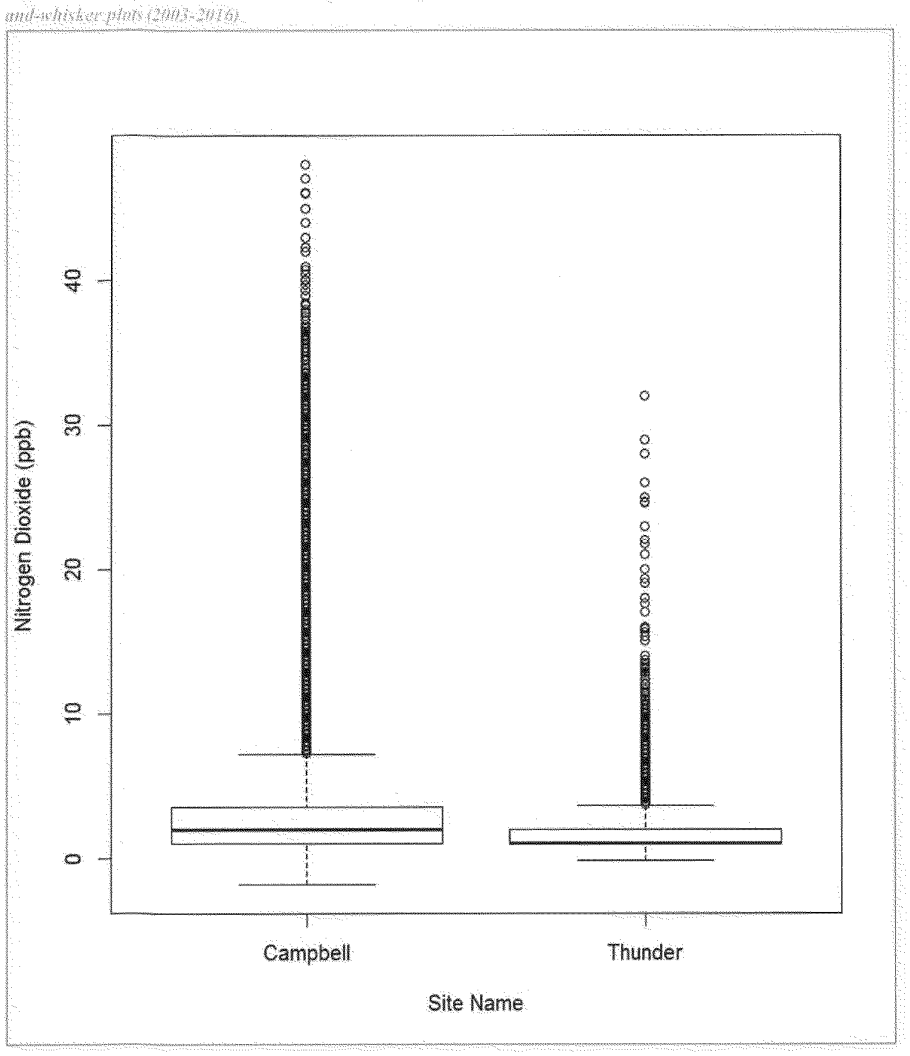
Figure 12. Comparison between the Campbell County and Thunder Basin Stations for 1-hour average NO_2 box-and-whisker plots (2003-2016).



A comparison of the 1-hour average NO_2 data at the Campbell County and Thunder Basin Stations (Figure 12) shows that most values are less than 10 ppb for both stations. The means of both stations are very close to one another while the quartiles of Campbell County spans a wider range than the quartiles of Thunder Basin. The Pearson Correlation value of the Campbell County and Thunder Basin NO_2 hourly data is 0.19, indicating a weak positive correlation (the strongest Pearson correlation values are +1 or -1).

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PM_{10}: The NAAQS for PM_{10} is met when the 24-hour average is less than 150 μg/m³, not to be exceeded more than once per year on average over a 3 year period. The NAAQS for PM_{10} were set at 150 μg/m³ for 24 hour averaging time and 50 μg/m³ for the annual averaging time standards from 1987 until 2006. In 2006, the NAAQS annual standard of 50 μg/m³ was revoked while the 24-hour standard of 150 μg/m³ was retained. However, Wyoming preserved the annual standard of 50 μg/m³ in the Wyoming Ambient Air Quality Standards (WAAQS). The highest 24-hour average was 136 μg/m³, which occurred on July 10, 2006. The highest annual average was 16 μg/m³ and occurred for the year 2012. Campbell County Station's 2013-2015 design value report from EPA's Air Quality System (AQS) database shows that there were zero exceedances, all quarters were complete, and all data were certified during the 3 year period. The 2015 annual average was 9 μg/m³.

Figure 13. Campbell County Station 24-hour average PM_{10} box-and-whisker plot (2003-2016)

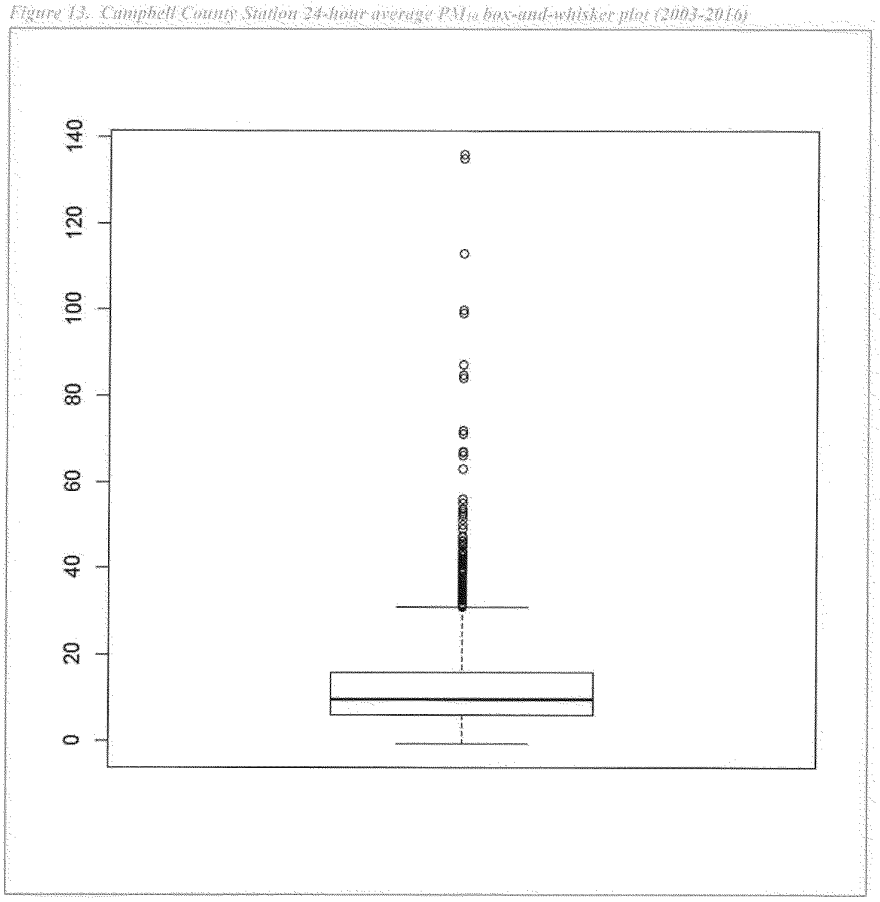

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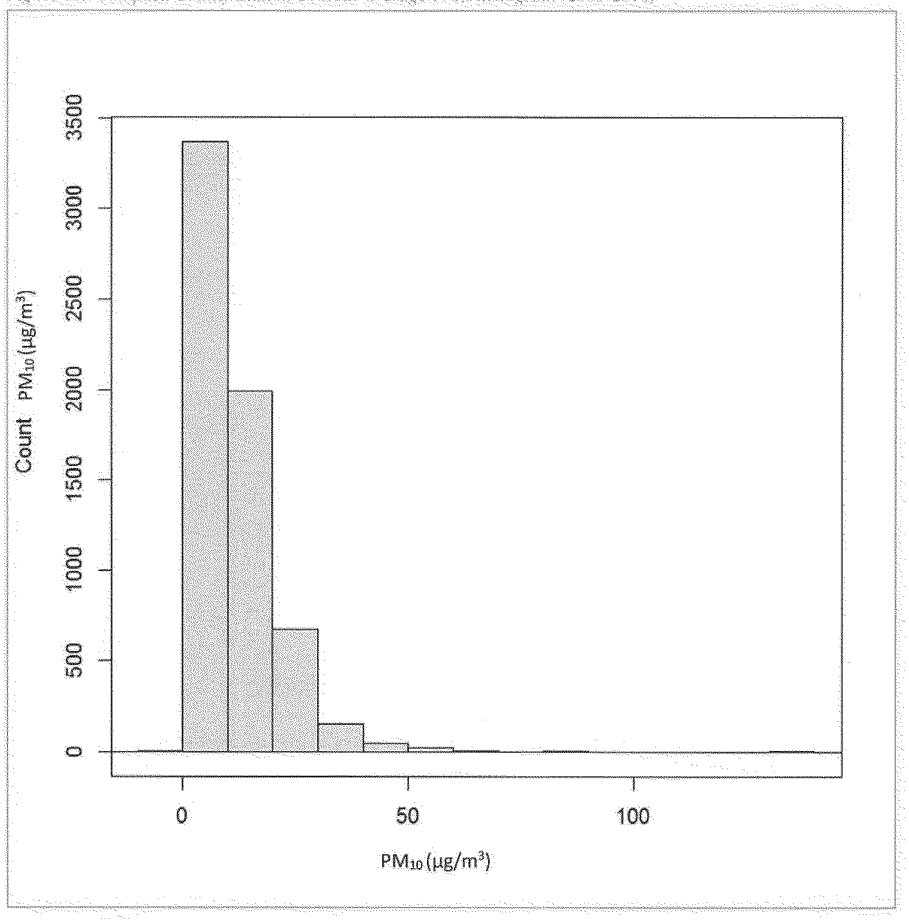
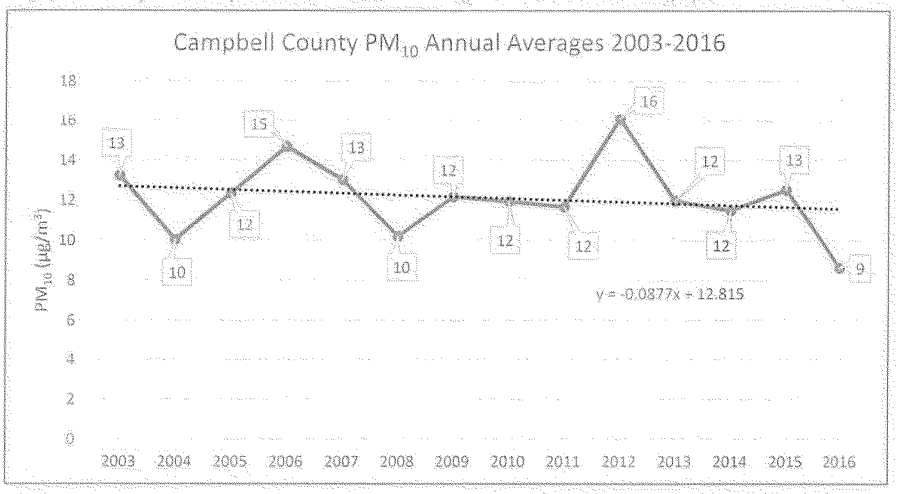
Figure 14. Campbell County Station 24-hour average PM_{10} histogram (2003-2016)



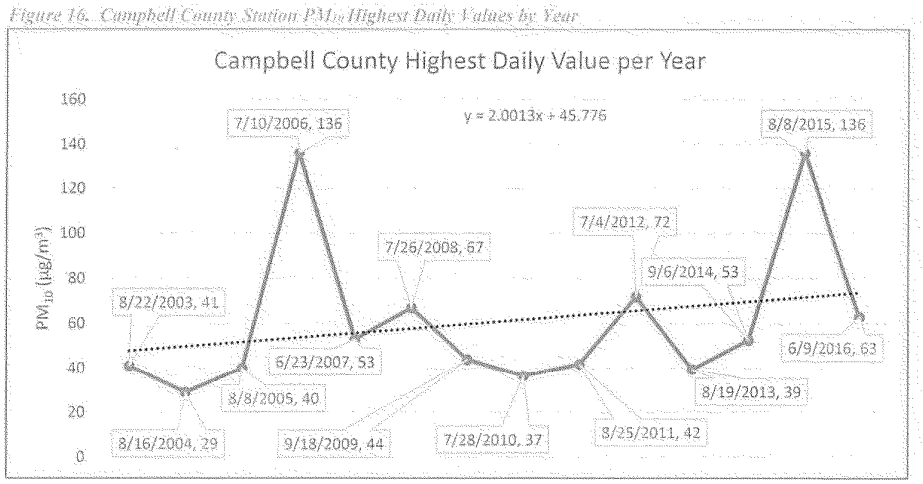
The majority of the PM_{10} 24 hour average data points occur below 30 µg/m^3 (Figures 13 and 14). These data are consistent with values expected from a rural, sparsely populated area for background measurements. There were a small amount of occurrences above 50 µg/m^3, which is well below the PM_{10} 24-hour NAAQS 150 µg/m^3 level.

Figure 15. Campbell County Station PM_{10} Annual Averages 2003-2016 time series graph



Regression statistics show that the PM_{10} annual average data (Figure 15) has a p-value of 0.00053 indicating that the trend in this graph is statistically significant. The R^2 value of 0.96 indicates a strong correlation between the data points and their occurrence over time. The PM_{10} annual averages at the Campbell County site are generally decreasing.

Figure 16. Campbell County Station PM_{10} Highest Daily Values by Year



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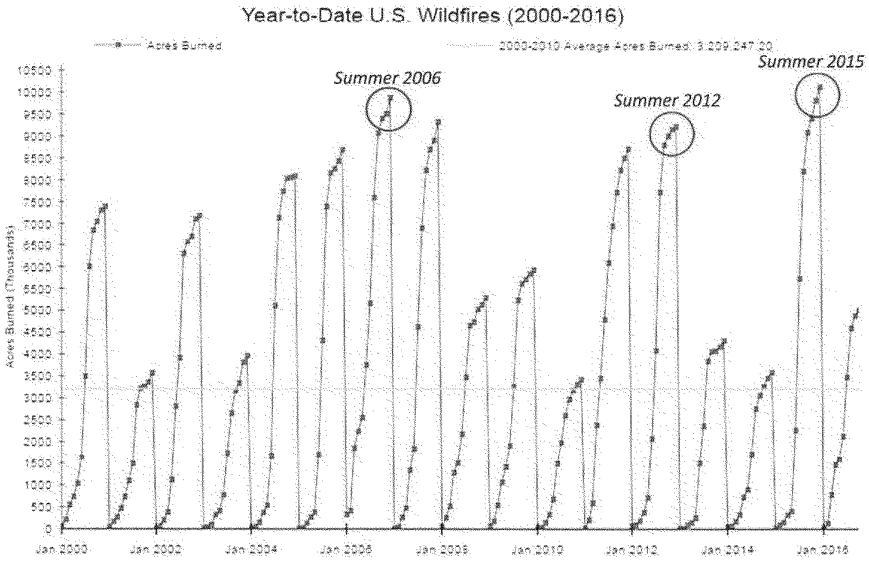
Regression statistics show that the PM_{10} highest daily value data (Figure 16) has a p-value of 0.0000293 indicating that the trend in this graph is statistically significant. The R^2 value of 0.78 shows a strong correlation between the data points and their occurrence over time. The trend shows that the highest daily value of PM_{10} values are increasing at the Campbell County site. The higher PM_{10} values of 2006, 2012, and 2015 can be explained by wildfire reports of the western United States during the late summer months of the years in question. Figure 17 shows acres burned in the United States during wildfires from National Oceanic and Atmospheric Administration (NOAA). The wildfire information presented corresponds with the higher values observed in Figure 16. Figures 18, 19, and 20 provide additional information about wildfire occurrences during 2006, 2012, and 2015 when elevated PM_{10} levels were detected at the Campbell County Station.

Figure 17. Acres Burned during wildfires in United States (2000-2016)



*Information obtained from https://www.ncdc.noaa.gov/societal-impacts/wildfires/ytd/0?params[]=acres

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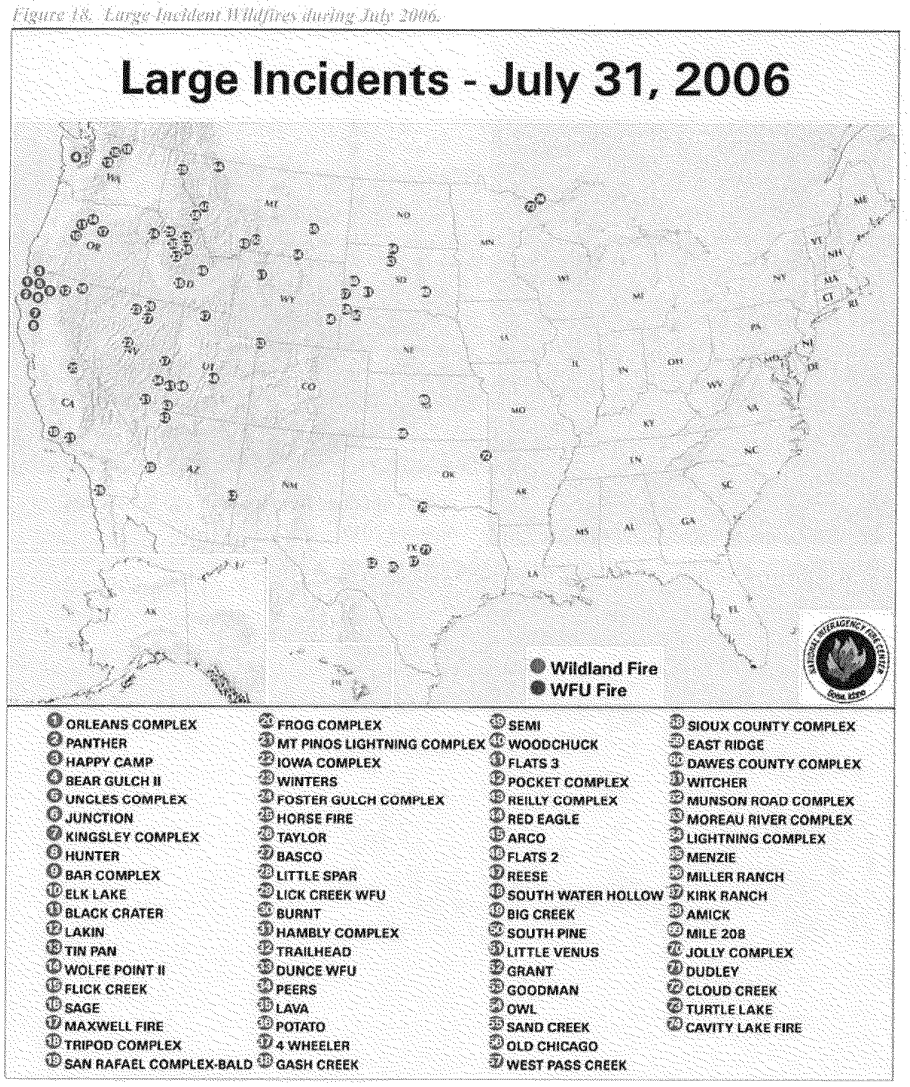
Figure 18. Large Incident Wildfires during July 2006.



*Information obtained from www.ncdc.noaa.gov

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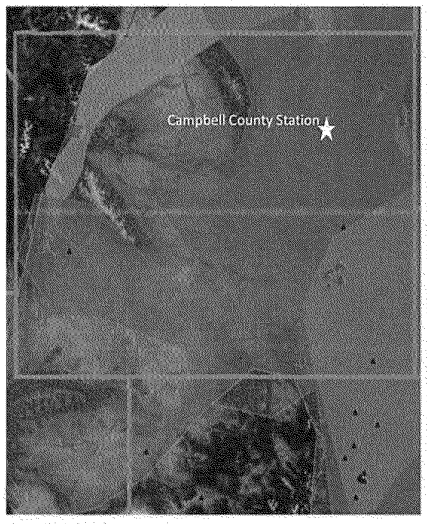
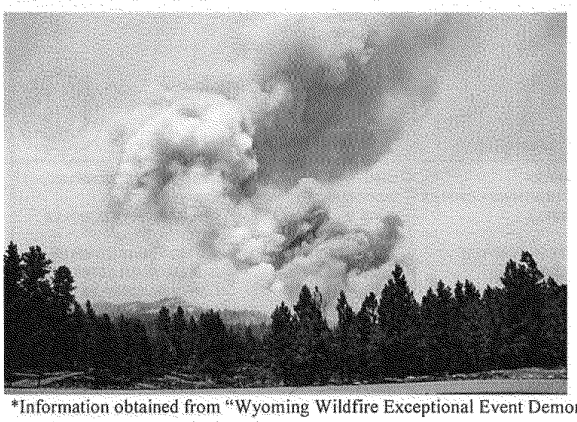
Figure 19. July 4, 2012 HMS, Smoky Sky Over Gillette, and Ash Creek Fire Image

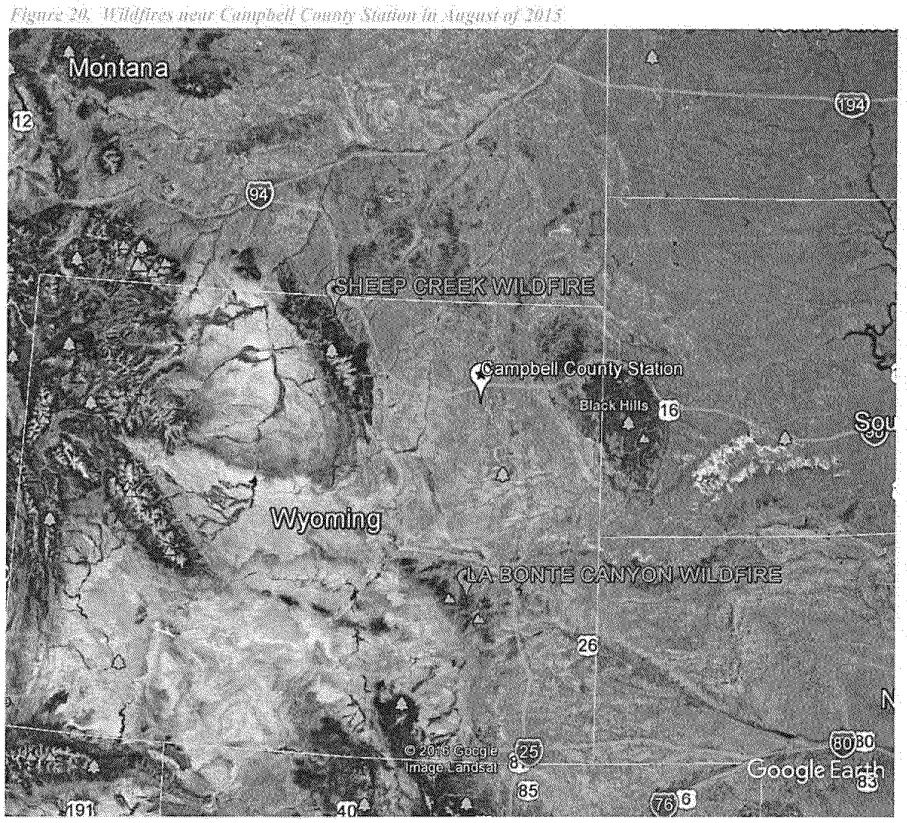


Images obtained from Inciweb and Rob Across America 2012



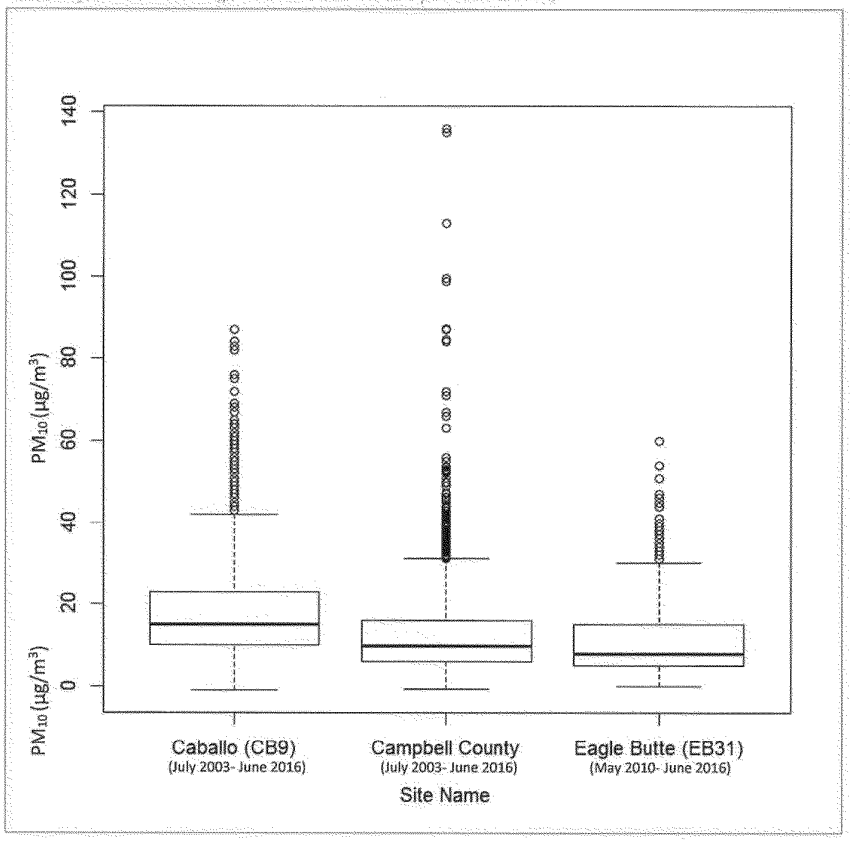
*Information obtained from "Wyoming Wildfire Exceptional Event Demonstration, June 26, 2012- July 5, 2012". Submitted to EPA on July 3, 2015.

Figure 20. Wildfires near Campbell County Station in August of 2015



*Information obtained from www.nifc.gov

Figure 21. Comparison between the Campbell County Station, Eagle Butte EB31, and Caballo Mine CB9 Monitors for 24-hour average PM_{10} box-and-whisker plots (2003-2016)



A comparison of the 24-hour averages of PM_{10} data at the Campbell County, Caballo, and Eagle Butte monitoring stations (Figure 21) shows that most values are less than 45 $\mu g/m^3$ for all stations. The medians for all three stations are very similar, spanning between approximately 6 and 15 $\mu g/m^3$. Caballo's CB9 monitor captures higher values of the area due to CB9 being downwind of mining activities at Caballo Mine. Eagle Butte and Campbell County have the strongest relationship with medians which almost overlap and quartiles ranges that are nearly identical. This observation is logical since both sites are located upwind of the Powder River Basin Coal Mine Network. The Eagle Butte and Caballo monitoring stations both reflect similar data collection values as Campbell County, excluding a few outliers. The Pearson Correlation value of the Campbell County and Caballo 24-hour average PM_{10} data is 0.54 (the strongest Pearson Correlation values are +1 for perfect positive correlation and -1 for a perfect negative correlation). The Pearson Correlation value of the Campbell County and Eagle Butte is 0.74. Both Caballo and Eagle Butte monitors have slight positive correlation with Campbell County.

Conclusion

During the monitoring period, from July 2003 through June 2016, the Campbell County Station operated and collected monitoring data for the following parameters: ozone, oxides of nitrogen, PM_{10}, wind speed, wind direction, precipitation, solar radiation, and relative humidity. There was also a camera on site for scene monitoring. Data collected and analyzed from Campbell County indicate that there have been no exceedances of the NAAQS levels at this site for ozone, nitrogen dioxide, and PM_{10}.

The Campbell County Station is a long-term monitoring station in northeast Wyoming. During the 2015 Network Assessment it was determined that this station could justifiably be moved due to high correlation with other stations in the area. This correlation indicated that the data collected at this site may be redundant and that the monitoring equipment might be more useful in eastern Johnson County. This correlation was confirmed for the Thunder Basin and Campbell County stations for ozone and NO_2 and also for Campbell County PM_{10} and industrial PM_{10} monitors from Eagle Butte Mine and Caballo Mine.

This data analysis was conducted to inform decisions on monitoring in northeast Wyoming. Taking into account anticipated development, findings of the 2015 Network Assessment, and redundancy between nearby monitors, there may be a greater need for the equipment at the Campbell County monitoring station to be relocated to a more high priority and less monitored area.

Appendix A: Data Completeness Report Summary

*Data completeness reported as percentages.

Table 1. Campbell County Station data completion report 2003-2009

Year	2003		2004				2005				2006				2007				2008				2009			
Quarter	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*
Ozone	73.0	91.0	91.3	94.0	90.3	93.3	94.7	91.6	94.7	93.7	93.0	94.3	91.3	59.0	90.7	96.3	94.0	95.0	90.3	91.3	82.3	59.3	91.0	91.0	81.3	91.0
NO2	58.3	91.0	91.3	94.3	93.3	83.3	94.7	91.6	67.7	93.7	93.0	87.0	91.3	52.0	75.7	70.3	79.7	95.3	91.0	91.7	64.3	94.3	91.0	91.0	81.0	91.3
PM10	73.7	90.0	89.0	86.7	87.0	96.7	97.0	83.3	63.3	0.0	70.0	73.3	28.3	63.7	69.0	70.0	51.7	53.3	74.7	53.3	10.0	60.0	98.0	98.3	98.3	98.7

Table 2. Campbell County Station data completion report 2010-2016

Year	2010				2011				2012				2013				2014				2015				2016	
Quarter	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*
Ozone	92.0	94.0	93.7	95.3	97.0	96.3	92.3	95.3	93.3	97.0	92.3	98.3	98.7	98.3	94.7	98.3	97.3	98.3	93.3	83.7	91.7	98.7	81.3	98.7	97.3	97.7
NO2	92.0	94.0	93.3	87.0	97.0	96.3	95.0	95.3	89.3	99.0	93.7	98.3	98.7	96.0	83.0	96.7	96.0	98.7	75.0	82.0	98.6	98.7	68.7	71.7	82.7	97.7
PM10	98.7	93.7	98.3	97.3	98.3	98.0	97.3	87.0	79.7	99.0	98.7	98.7	99.0	98.0	96.0	98.0	89.3	96.3	92.0	99.3	94.0	95.3	95.7	99.7	99.7	99.3

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Appendix D: Sheridan Analyses

Wyoming Department of Environmental Quality
Air Quality Division
Memorandum

To: Nancy E. Vehr, Air Quality Administrator 3-20-17

Through: Darla Potter, Air Quality Resource Management Program Manager 3-15-17
Cara Keslar, Monitoring Section Supervisor 3/13/17

From: Daniel Sharon, Monitoring Project Manager D.S. 3/9/17

Cc: Tanner Shatto, District 3 Engineer

Date: March 13, 2017

Subject: Wyoming Department of Environmental Quality, Air Quality Division
Sheridan Analysis to Support 2015 Network Assessment

I. Background

The Air Quality Division's (AQD) 2015 Network Assessment included a finding that the city of Sheridan, WY was a potential location for future gaseous monitoring, but that further analysis was necessary to describe the effects of emissions from Montana on the city. The language from the Network Assessment is as follows:

"***Section 4.2.5 Sheridan***

The city of Sheridan is a micropolitan statistical area without any historical gaseous monitoring. The city is downwind of many small, local, point and oil and gas sources, in addition to out-of-state emissions that are currently unquantified. A Veteran's Affairs hospital is located in town that is likely to serve a population statistically more sensitive to pollution levels.

Further analyses are necessary to better characterize the impacts of emissions from Montana on this area."

The following analysis fulfills this data need by analyzing Montana's Emissions Inventory to identify large sources of gaseous and particulate pollutants proximate to or upwind of Sheridan and presenting HYSPLIT forward-trajectory modeling runs from these sources to determine if pollutants from these sources are expected to impact the city.

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II. Meteorological Information

Wind Speed and Wind Direction information were collected from the Sheridan Police Department State and Local Air Monitoring Station (SLAMS) and the Young's Creek Mine meteorological station. The location of these two monitors is displayed in Figure 1, below.

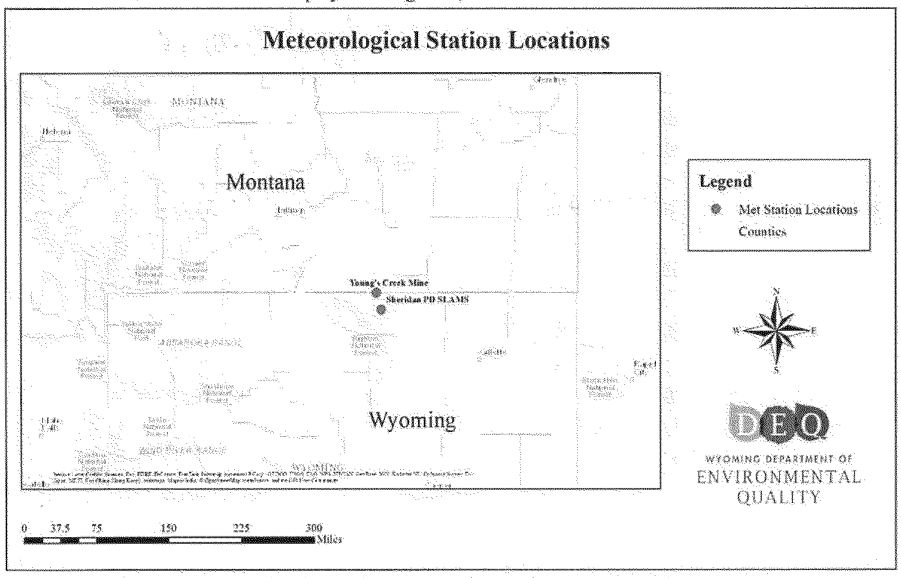

Figure 1. Sheridan PD SLAMS and Young's Creek Meteorological Station Locations

Wind roses were generated for both stations for the monitoring period of 2013-2015 (the most recent three-year period of available data for both sites). These wind roses are displayed in Figures 2 and 3, below.

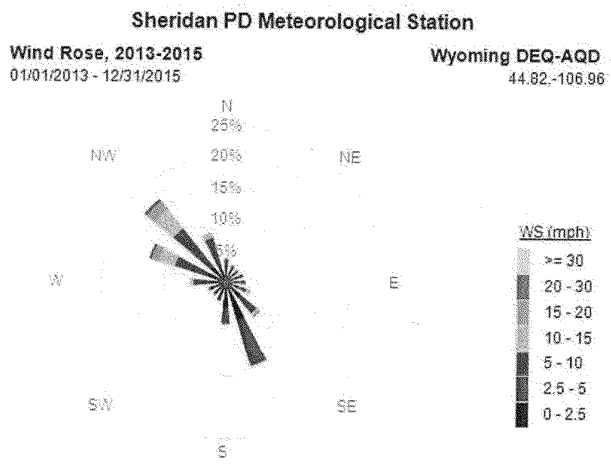

Figure 2. Sheridan PD SLAMS 2013-2015 Wind Rose

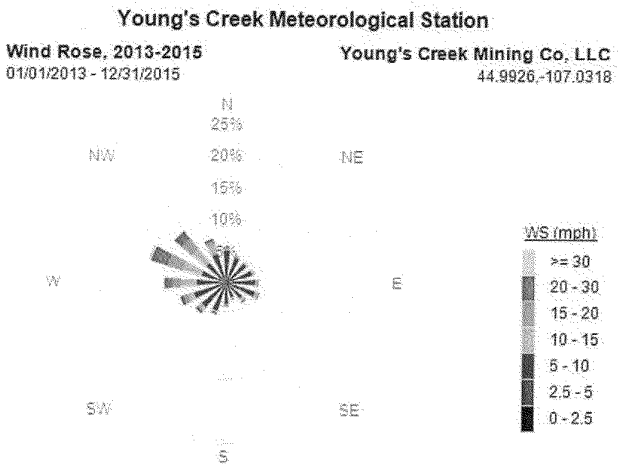

Figure 3. Young's Creek 2013-2015 Wind Rose

Based on these figures, the strongest winds in Sheridan and north central Wyoming are expected out of the NW and WNW, while winds are most likely to occur out of the NW in Sheridan and most likely to occur out of the WNW in the area around Young's Creek. This indicates that the Montana counties most likely to have an impact on Sheridan air quality are Big Horn, Yellowstone, and Carbon, which are directly upwind of the city.

III. Montana Emissions Inventory Analysis

Data for this analysis were sourced from the Environmental Protection Agency's (EPA) triennial 2014 National Emissions Inventory (NEI) data page (https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data). Only point sources were evaluated because this is the only category where accurate latitude/longitude information is provided by pollutant. The data were placed into 10 kilometer (km) by 10 km grids according to the source locations provided. The pollutants assessed were PM_{10}, $PM_{2.5}$, VOCs, NO_x, and SO_2. The resulting gridded emission inventory maps are displayed in Figures 4 through 8, below.

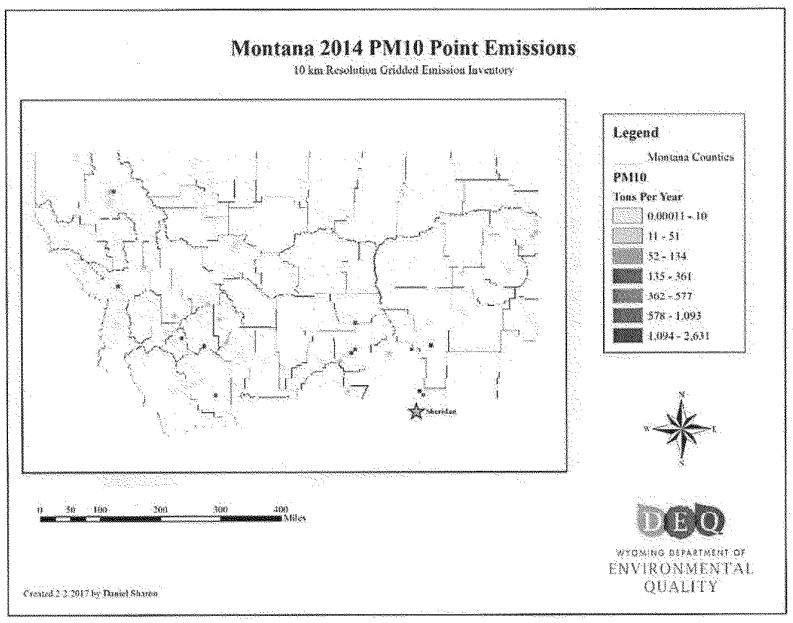

Figure 4. PM_{10} Emissions from Point Sources

The top ten point sources with the highest PM_{10} emissions in the counties directly upwind of Sheridan are listed in Table 1, below.

Facility	County	Latitude	Longitude	PM_{10} Emissions (TPY)
Spring Creek Mine	Big Horn	45.112	-106.904	1,095.1
Absaloka Mine	Big Horn	45.804	-107.079	564.7
Decker Mine	Big Horn	45.054	-106.822	426
J.E. Corette Power Plant	Yellowstone	45.775	-108.481	133.5
Exxon Mobil Billings Refinery	Yellowstone	45.814	-108.433	124.3
Phillips 66 Billings Refinery	Yellowstone	45.781	-108.489	98.7
RMP Hardin Generating Station	Big Horn	45.764	-107.6	86.1
CHS Laurel Refinery	Yellowstone	45.659	-108.768	63.8
MT Limestone Co. Quarry	Carbon	45.118	-108.596	52.2
Western Sugar Coop Billings Sugar Mill	Yellowstone	45.769	-108.498	47.2

Table 1. Montana PM_{10} Point Sources Upwind of Sheridan

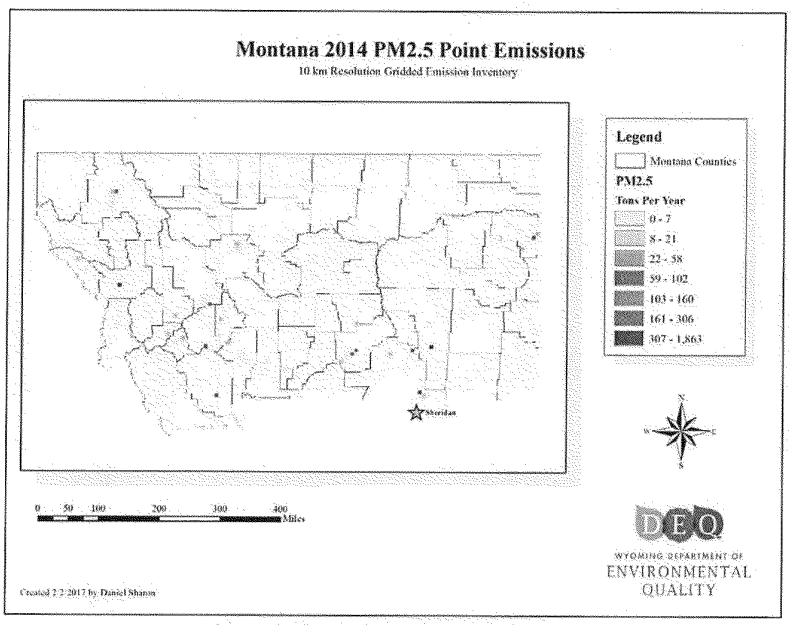

Figure 5. $PM_{2.5}$ Emissions from Point Sources

The top ten point sources with the highest $PM_{2.5}$ emissions in the counties directly upwind of Sheridan are listed in Table 2, below.

Facility	County	Latitude	Longitude	$PM_{2.5}$ Emissions (TPY)
Spring Creek Mine	Big Horn	45.112	-106.904	248.6
Exxon Mobil Billings Refinery	Yellowstone	45.814	-108.433	120.4
Phillips 66 Billings Refinery	Yellowstone	45.781	-108.489	78.77
Absaloka Mine	Big Horn	45.804	-107.079	74.3
J.E. Corette Power Plant	Yellowstone	45.775	-108.481	57.5
CHS Laurel Refinery	Yellowstone	45.659	-108.768	49.2
Decker Mine	Big Horn	45.054	-106.822	44.6
RMP Hardin Generating Station	Big Horn	45.764	-107.6	39.4
Western Sugar Coop Billings Sugar Mill	Yellowstone	45.769	-108.498	22
Billings Logan International Airport	Yellowstone	45.809	-108.56	7

Table 2. Montana $PM_{2.5}$ Point Sources Upwind of Sheridan

Because O_3 is a secondary pollutant formed through chemical interactions with precursor pollutants including NO_x and VOC emissions, the AQD examined gridded emission inventory data maps for these pollutant groups as approximate temporal indications of O_3 formation.

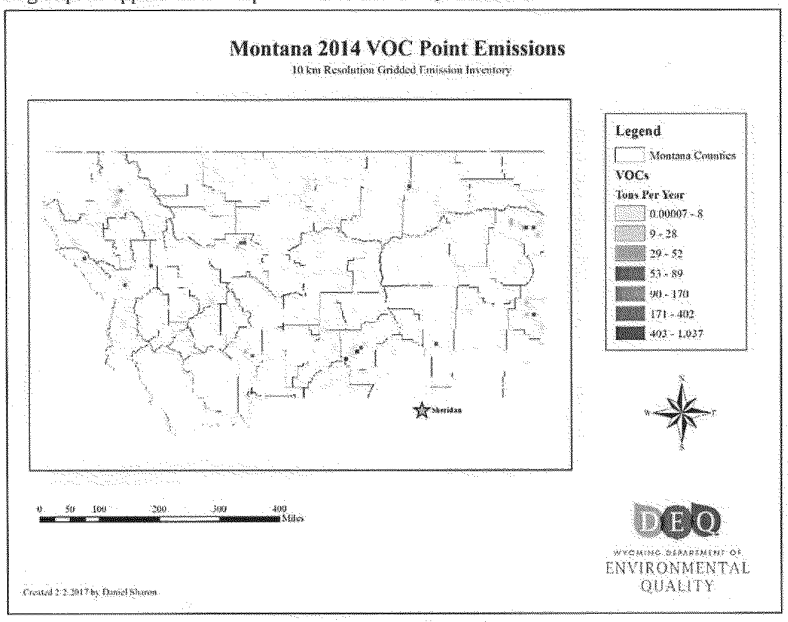

Figure 6. VOC Emissions from Point Sources

The top ten point sources with the highest VOC emissions in the counties directly upwind of Sheridan are listed in Table 3, below.

Facility	County	Latitude	Longitude	VOC Emissions (TPY)
CHS Laurel Refinery	Yellowstone	45.659	-108.768	981.9
Exxon Mobil Billings Refinery	Yellowstone	45.814	-108.433	384.6
Phillips 66 Billings Refinery	Yellowstone	45.781	-108.489	336.9
Fiberglass Structures, Inc. Tank	Yellowstone	45.668	-108.755	38.8
Billings Bakery	Yellowstone	45.749	-108.545	32.5
Billings Logan International Airport	Yellowstone	45.809	-108.56	27.6
Billings Landfill Gas Production Facility	Yellowstone	45.715	-108.549	18.7
Fiberglass Structures, Inc.	Yellowstone	45.668	-108.762	16.1
Billings Transportation Operations	Yellowstone	45.783	-108.494	13.7
J.E. Corette Power Plant	Yellowstone	45.775	-108.481	13.6

Table 3. Montana VOC Point Sources Upwind of Sheridan

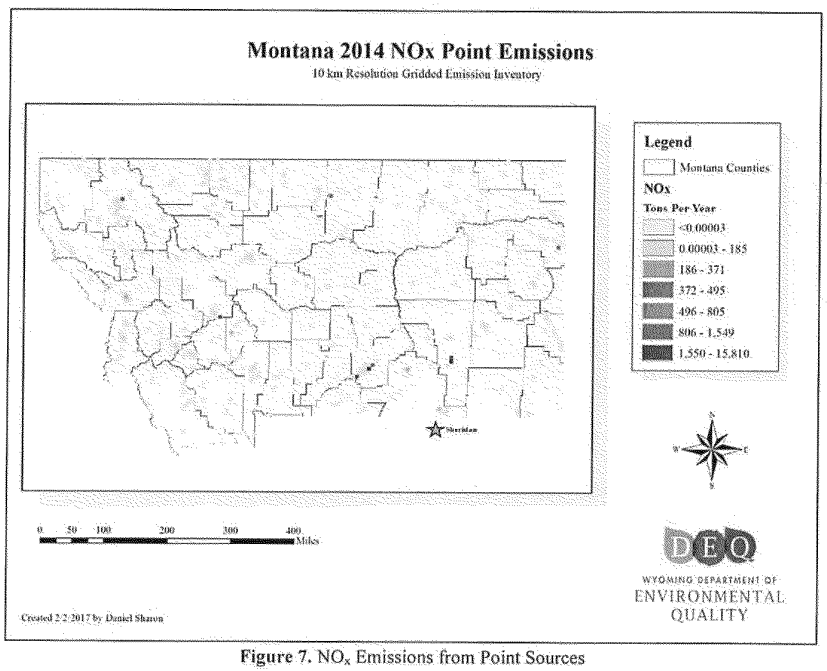

Figure 7. NO_x Emissions from Point Sources

The top ten point sources with the highest NO_x emissions in the counties directly upwind of Sheridan are listed in Table 4, below.

Facility	County	Latitude	Longitude	NO_x Emissions (TPY)
J.E. Corette Power Plant	Yellowstone	45.775	-108.481	786.4
Phillips 66 Billings Refinery	Yellowstone	45.781	-108.489	560.8
Yellowstone Power Plant	Yellowstone	45.811	-108.429	445.7
CHS Laurel Refinery	Yellowstone	45.659	-108.768	401.2
RMP Hardin Generating Station	Big Horn	45.764	-107.6	350.8
Exxon Mobil Billings Refinery	Yellowstone	45.814	-108.433	304.1
Western Sugar Coop Billings Sugar Mill	Yellowstone	45.769	-108.498	235.2
Spring Creek Mine	Big Horn	45.112	-106.904	194.5
Huntley Rail Yard	Yellowstone	45.9	-108.298	138.2
Billings Logan International Airport	Yellowstone	45.809	-108.56	75.3

Table 4. Montana NO_x Point Sources Upwind of Sheridan

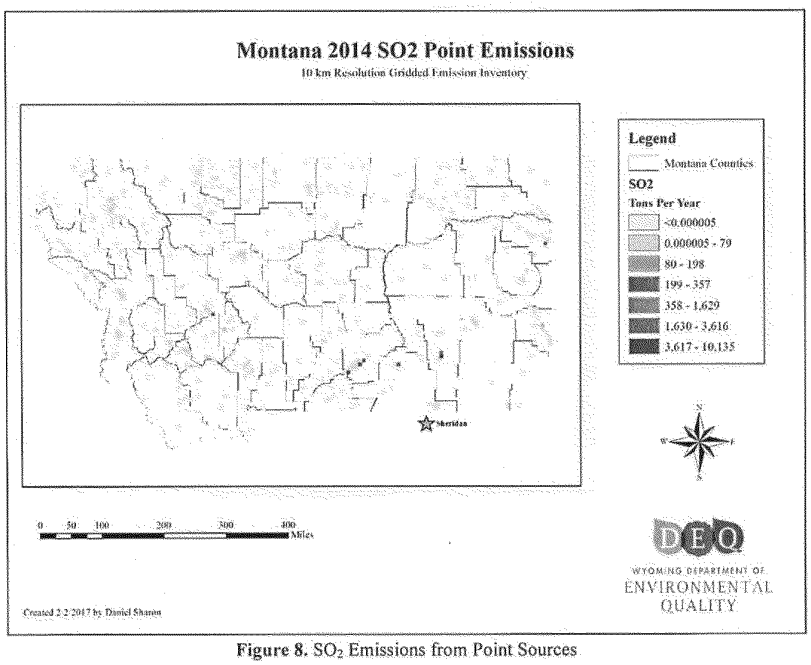

Figure 8. SO_2 Emissions from Point Sources

The top ten point sources with the highest SO_2 emissions in the counties directly upwind of Sheridan are listed in Table 5, below.

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Facility	County	Latitude	Longitude	SO_2 Emissions (TPY)
Yellowstone Power Plant	Yellowstone	45.811	-108.429	1,525.4
Montana Sulphur and Chemical Co. Plant	Yellowstone	45.814	-108.428	1,436.4
J.E. Corette Power Plant	Yellowstone	45.775	-108.481	1,433.1
Exxon Mobil Billings Refinery	Yellowstone	45.814	-108.433	652.2
RMP Hardin Generating Station	Big Horn	45.764	-107.6	381.8
CHS Laurel Refinery	Yellowstone	45.659	-108.768	236
Western Sugar Coop Billings Sugar Mill	Yellowstone	45.769	-108.498	122.9
Phillips 66 Billings Refinery	Yellowstone	45.781	-108.489	87.8
Spring Creek Mine	Big Horn	45.112	-106.904	22.9
Billings Wastewater Treatment Plant	Yellowstone	45.803	-108.47	21.5

Table 5. Montana SO_2 Point Sources Upwind of Sheridan

IV. HYSPLIT Trajectory Analyses

HYSPLIT (Hybrid Single Particle Lagrangian Integrated Trajectory) Model Analyses generate wind trajectories up to forty-eight (48) hours prior to (backwards trajectory) or after (forwards trajectory) a chosen start date of interest. A backwards trajectory is a valuable indicator of what could affect a stationary location such as a city or monitoring station. A forwards trajectory is beneficial to view possible dispersion from an emission source. Both types of trajectories were performed for this analysis, with two (2) starting heights: 250 and 500 meters.

For the purposes of this analysis, the top 20 emissions sources described in Section III above were grouped by relative location. These HYSPLIT source groups are shown in Figure 9, below.

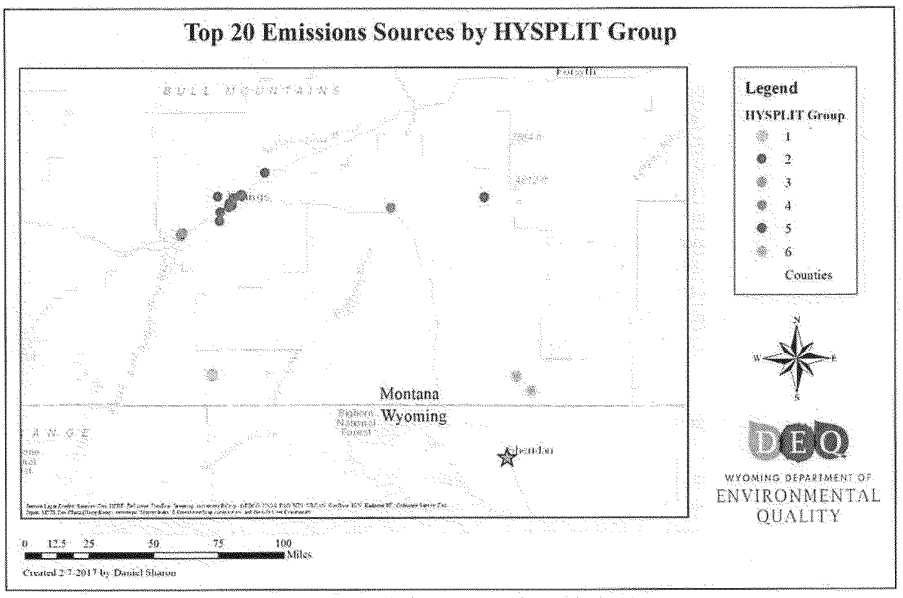

Figure 9. Emissions Point Sources Grouped by Location

The locations, starting dates, and trajectory information is found below in Table 6. Starting dates for HYSPLIT runs were chosen based on meteorological conditions conducive to pollutant transport. The locations of each HYSPLIT run is shown in Figure 10, below.

Site Location	County	Latitude	Longitude	Start Date	HYSPLIT Run	Trajectory Type
Bridger, MT	Carbon	45.118	-108.596	3/11/2013	1	Forwards
Billings, MT	Yellowstone	45.783	-108.494	1/20/2013	2	Forwards
Laurel, MT	Yellowstone	45.6643	-108.7616	4/14/2013	3	Forwards
Hardin, MT	Big Horn	45.764	-107.6	2/1/2014	4	Forwards
Hysham, MT	Big Horn	45.804	-107.079	4/8/2013	5	Forwards
Decker, MT	Big Horn	45.086	-106.8611	4/9/2013	6	Forwards
Sheridan, WY	Sheridan	44.7975	-106.9545	8/24/2014	7	Backwards

Table 6. HYSPLIT Run Information

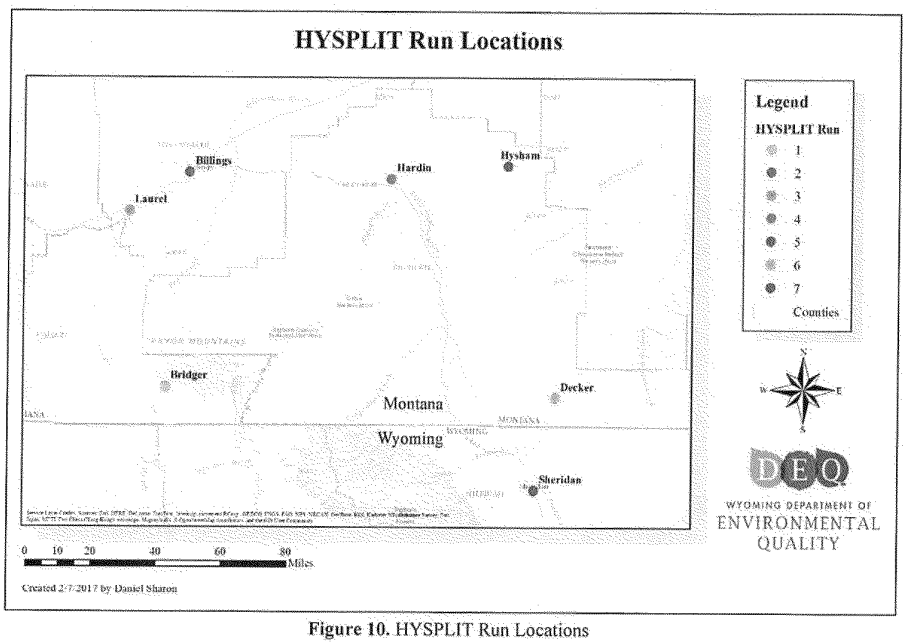

Figure 10. HYSPLIT Run Locations

Trajectory data were obtained from NOAA's Air Resource Laboratory HYSPLIT Model, available here: http://www.arl.noaa.gov/HYSPLIT_info.php[1]. The trajectory results of these model runs are shown in Figures 11 through 17, below.

[1] Stein, A.F., Draxler, R.R, Rolph, G.D., Stunder, B.J.B., Cohen, M.D., and Ngan, F., (2015). NOAA's HYSPLIT atmospheric transport and dispersion modeling system, Bull. Amer. Meteor. Soc., **96**, 2059-2077, http://dx.doi.org/10.1175/BAMS-D-14-00110.1

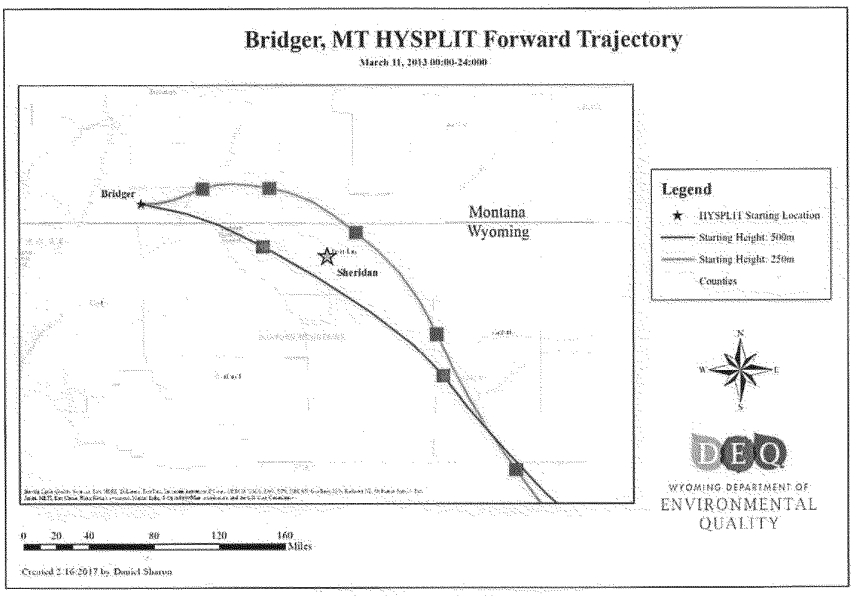

Figure 11. HYSPLIT Run 1 (Bridger)

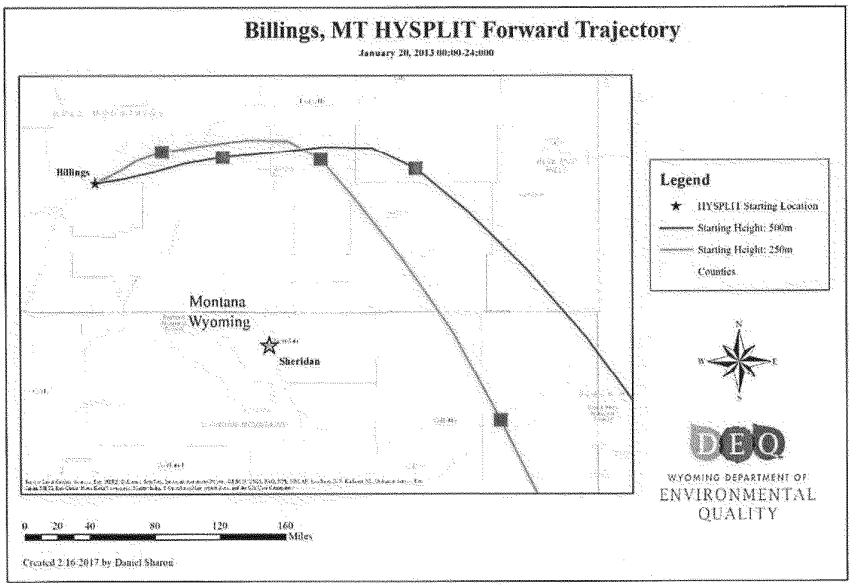

Figure 12. HYSPLIT Run 2 (Billings)

12.

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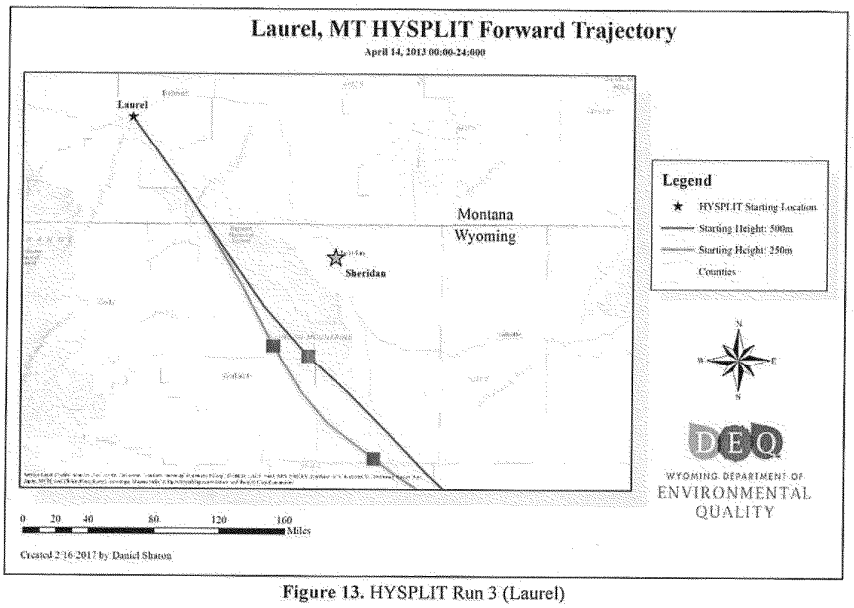

Figure 13. HYSPLIT Run 3 (Laurel)

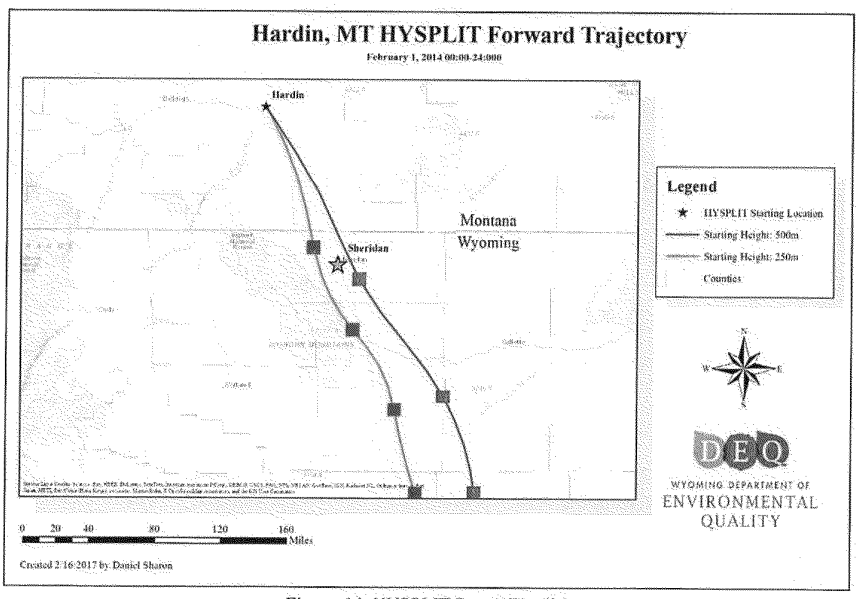

Figure 14. HYSPLIT Run 4 (Hardin)

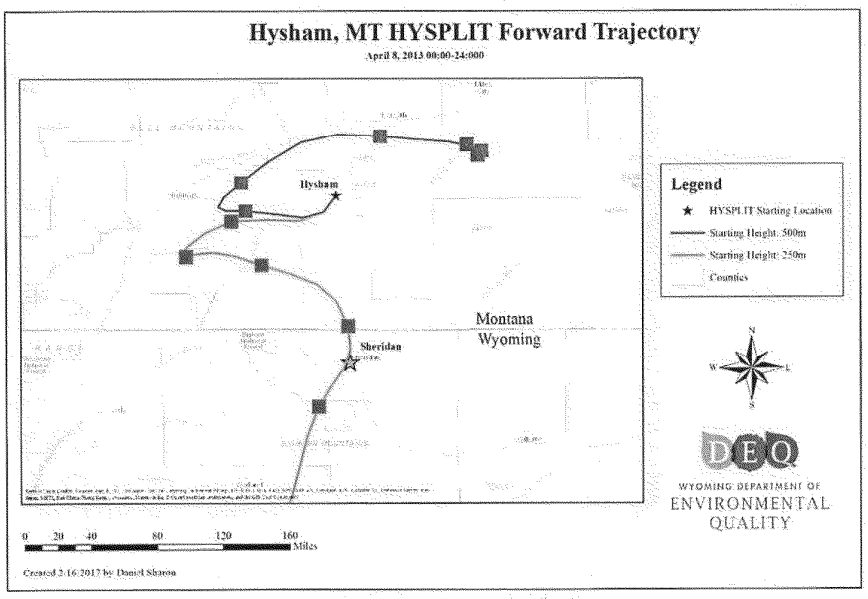

Figure 15. HYSPLIT Run 5 (Hysham)

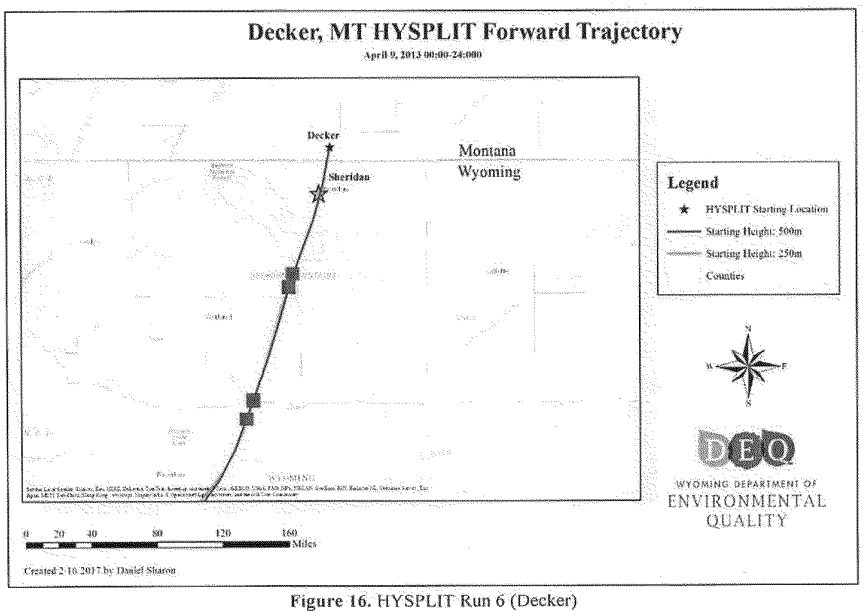

Figure 16. HYSPLIT Run 6 (Decker)

14.

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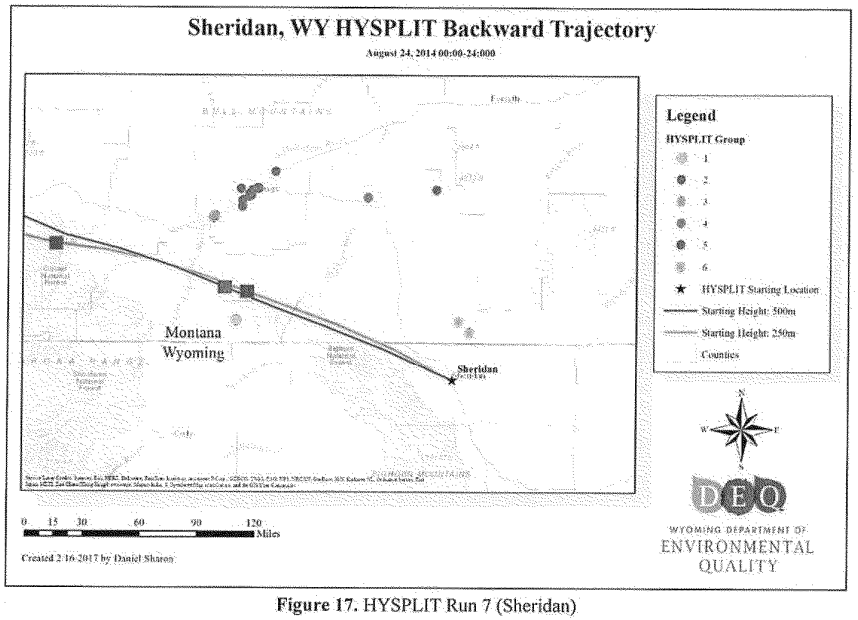

Figure 17. HYSPLIT Run 7 (Sheridan)

Based on these modeled trajectories, emissions from Montana's Carbon, Yellowstone, and Big Horn Counties can reasonably be expected to impact air quality in Sheridan under prevailing meteorological conditions. According to the Figures 12 and 13, it appears that the Big Horn mountain range, running northwest to the west of Sheridan, influences the movement of air masses between Bridger and Laurel, MT, and Sheridan, WY.

V. Summary and Conclusion

Winds in Sheridan and along the Wyoming-Montana border are predominantly out of the NW and WNW, with the strongest components from these same directions. Some of the largest emissions sources in Montana for PM_{10}, $PM_{2.5}$, VOCs, NO_x, and SO_2 are located directly upwind of Sheridan, Wyoming in Carbon, Yellowstone, and Big Horn Counties. Modeling analyses from these emissions sources demonstrate that under typical meteorological conditions air masses are reasonably expected to travel to, and influence air quality in Sheridan, Wyoming.

This conclusion validates and enhances the finding in the AQD's Network Assessment that future gaseous monitoring is needed to characterize air quality in the city of Sheridan, WY. The AQD plans to site a mobile monitoring station in or around the city of Sheridan in early 2017.

Appendix E: EPA Region VIII Letter to the AQD on the 2016 Annual Network Plan

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
Denver, CO 80202-1129
Phone 800-227-8917
www.epa.gov/region8

Ref: 8P-AR

MAR 06 2017

Received
MAR - 9 2017
Air Quality Division

Nancy E. Vehr Administrator
Air Quality Division
Wyoming Department of Environmental Quality
200 West 17th Street, Third Floor
Cheyenne, Wyoming 82002

Re: Clarification on 2016 Wyoming Annual Monitoring Network Plan

Dear Ms. Vehr:

In our letter to you dated November 3, 2016, EPA approved the 2016 Wyoming Annual Monitoring Network Plan (AMNP) with a couple of clarifications. Those clarifications pertained to Section 4.6 of the AMNP which details how the state plans to meet the requirements of the Sulfur Dioxide (SO_2) Data Requirements Rule (DRR) for characterizing SO_2 air quality through the monitoring option. Recent discussions with the EPA Office of Air Quality Planning and Standards (OAQPS) have informed us that a further clarification to Section 4.6 of the 2016 AMNP is required pertaining to approval authority for a combined Quality Management Plan/Quality Assurance Project Plan (QMP/QAPP).

At section 4.6.1.2 of the 2016 AMNP, in a paragraph titled, "Quality System Independence," the following language is found: "The industrial monitoring entity must submit a combined QMP/QAPP to the AQD for approval by October 31, 2016. Approved QMP/QAPPs will be supplied to EPA Region VIII per Title 40 Part 58 Appendix A2 of the CFR." This language is contradictory to 40 CFR part 58, appendix A, section 2.1.1 which states in part: "The QMP must be suitably documented in accordance with EPA requirements (reference 2 of this appendix), and approved by the appropriate Regional Administrator" and also "Smaller organizations, organizations that do infrequent work with the EPA or have monitoring programs of limited size or scope may combine the QMP with the QAPP if approved by, and subject to any conditions of the EPA." We are clarifying with this letter and with OAQPS concurrence that industrial monitoring entities in Region 8 which are subject to 40 CFR part 58, appendix A, section 2.1.1 must submit their QMPs and QAPPs to EPA Region 8 for review and approval.

Albion Carlson, of my monitoring staff, informed Ms. Cara Keslar, of your staff, about this clarification in a telephone conversation and a follow-up email on January 12, 2017. In a February 7, 2017 email, Ms. Keslar indicated the WDEQ would continue to follow its AMNP until additional official communications between the EPA and the WDEQ were conducted. We anticipate this letter is sufficient communication for the WDEQ to begin submitting the QMPs and QAPPs received from industrial monitoring entities to Region 8 for review and approval. We encourage you to conduct and document your own review of these plans prior to submitting them to Region 8. You should plan to revise Section

4.6 when the 2017 AMNP is routinely updated and submitted to the EPA for review and approval. Maintaining a copy of this letter as an addendum to the 2016 AMNP is sufficient to document this required deviation from the AMNP in the interim.

We appreciate your continued efforts as we work together on implementing the DRR and addressing Wyoming's unique circumstances. If you have any questions on this issue, please contact me at (303) 312-6936 or Albion Carlson, of my staff, at (303) 312-6207.

Sincerely,

Monica Morales, Acting Director
Air Program

cc: Cara Keslar, Wyoming DEQ

Appendix F: SO_2 NAAQS Designation Recommendation Letter

MATTHEW H. MEAD
GOVERNOR

THE STATE OF WYOMING

2323 Carey Avenue
CHEYENNE, WY 82002

Office of the Governor

January 13, 2017

Shaun McGrath
Region 8 Administrator
U.S. Environmental Protection Agency
1595 Wynkoop Street
Denver, CO 80202-1129

Re: Wyoming's Designation Recommendations for the 2010 one-hour Sulfur Dioxide Primary National Ambient Air Quality Standard - Areas Subject to the Data Requirements Rule (EPA Round 3 Designations)

Dear Administrator McGrath,

Pursuant to the Clean Air Act, the State of Wyoming provides the following designation recommendations for the 2010 one-hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS) for areas subject to the Data Requirements Rule (DRR). 42 U.S.C. § 7407(d)(3); 40 C.F.R. §§ 51.1200 - 51.1205. The Environmental Protection Agency (EPA) commonly refers to these as "Round 3" designations. Wyoming's recommendations are based on modeling analyses performed pursuant to 40 CFR 51 Subpart BB, otherwise known as the Data Requirements Rule, and other EPA guidance. Additionally, the State of Wyoming recommends the area surrounding the Jim Bridger Power Plant be designated based on existing monitored SO_2 data. These updated recommendations supplement my initial recommendations made on May 24, 2011.

I. Background

On June 22, 2010, the EPA replaced the 24-hour and annual SO_2 national standard with a new one-hour standard of 75 parts per billion (ppb). Primary National Ambient Air Quality Standard for Sulfur Dioxide; Final Rule, 75 Fed. Reg. 35520 (June 22, 2010); (codified at 40 C.F.R. § 50.17pt. 50). The EPA's adoption of this new national standard also triggered the requirement for each state governor to submit designation recommendations to EPA. 42 U.S.C. § 74107(d). Therefore, on May 24, 2011, I recommended that EPA designate all counties within Wyoming as "unclassifiable," excepting those portions under Tribal jurisdiction. *See* Letter from Governor Matt Mead to James B. Martin, Regional Administrator, EPA Region 8 (May 24, 2011).

PHONE: (307) 777-7434

FAX: (307) 632-3909

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On August 3, 2012, the EPA announced that it had extended its deadline to complete the designations. Extensions of Deadline for Promulgating Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standard, 77 Fed. Reg. 46295 (Aug. 3, 2012). Six months after extending the deadline, EPA Region 8 responded to my recommendations submitted back in May 2011. *See* Letter from James B. Martin, EPA Region 8 Administrator, to Governor Matt Mead (Feb. 6, 2013). EPA determined that its "review of the most recent monitored air quality data from 2009-2011 shows no violations of the 2010 SO_2 standard in any areas in Wyoming. . . and is, therefore, currently deferring action to designate areas in Wyoming." *Id.* at 1. Wyoming concurred with EPA's "no violations" determination. *See* Letter from Todd Parfitt, Wyoming DEQ Director, submitted to Docket ID No. EPA-HQ-OAR-2012-0233 (March 29, 2013). However, Wyoming disagreed with EPA's deferral decision and renewed its request that EPA act on my 2011 recommendations and designate all areas within Wyoming as "unclassifiable." *Id.* The EPA has not yet acted on my 2011 recommendations. However, the EPA noted that it would address these areas in "separate future actions." Air Quality Designations for the 2010 Sulfur Dioxide (SO2) Primary National Ambient Air Quality Standard, 78 Fed. Reg. 47191 (Aug. 5, 2013).

The deadlines by which the EPA must complete its designations for the one-hour SO_2 standard were established via Consent Decree. *See* Order Granting Joint Motion to Approve and Enter Consent Decree and Denying Other Motions as Moot, *Sierra Club v. McCarthy,* No. 3:13-cv-03953 (N.D. Cal. Mar. 2, 2015). The Court Order directed the EPA to complete designations in three additional rounds: July 2, 2016 (Round 2), December 31, 2017 (Round 3), and December 31, 2020 (Round 4). With respect to Round 2, I recommended that Carbon County remain unclassified and be included in the EPA's final round of designations. *See* Letter from Governor Matt Mead to Shaun McGrath, EPA Administrator Region 8 (Oct. 27, 2015). The EPA concurred and did not designate any areas in Wyoming as part of Round 2. Air Quality Designations for the 2010 Sulfur Dioxide (SO2) Primary National Ambient Air Quality Standard – Round 2, 81 Fed. Reg. 45039 (July 12, 2016).

The EPA has also promulgated several rules and issued guidance and technical documents that address factors and information that the EPA intends to use in its "separate future actions" for those additional designation rounds. Specifically, the EPA promulgated a rule that directed states to provide additional modeling or monitoring information on a schedule consistent with the deadlines in the Consent Decree. Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO2) Primary National Ambient Air Quality Standard (NAAQS), 80 Fed. Reg. 51052 (Aug. 21, 2015); (codified at 40 C.F.R. pt. 51, subpt. BB). In accordance with the DRR, the Wyoming Department of Environmental Quality, Air Quality Division (DEQ-AQD or Division) submitted a list of applicable SO_2 sources within Wyoming and the methods for air quality characterization. *See* Letters from Wyoming Air Quality Division to EPA Region 8, dated Jan. 13, 2016 and July 1, 2016; *see also* Wyoming Ambient Air Monitoring Annual Network Plan 2016, submitted June 15, 2016,

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supplemented August 8, 2016. The DEQ-AQD also tasked facilities subject to the DRR with providing data to characterize their ambient air quality, either through modeling or monitoring. Those facilities that have pursued the modeling pathway or have existing monitored data to characterize peak one-hour SO_2 concentrations are discussed below, along with the State of Wyoming's designation recommendations based on that data.

II. Designation Recommendations

Basin Electric – Laramie River Station

Basin Electric Power Cooperative (Basin Electric) has chosen to characterize the peak SO_2 concentrations at the Laramie River Station through modeling. The modeling protocol for the Laramie River Station was determined by the EPA Region 8 to align with EPA's DRR modeling guidance on October 18, 2016. The EPA model used to predict ambient impacts of SO2 (AERMOD) produces output in terms of microgram per cubic meter (μg/m3). Therefore, the modeled results are compared to the μg/m3 equivalent of the 1-hour NAAQS for SO2 (75 part per billion), which is 196 μg/m3.

Basin Electric provided the final modeling analysis to DEQ-AQD on November 4, 2016. The Division reviewed the modeling analysis for accuracy and determined that it followed the associated DRR modeling protocol and other EPA guidance. This analysis shows that the 1-hour modeled concentration for comparison to the NAAQS, a concentration of 84.9 $\mu g/m^3$, is well below the 1-hour SO_2 NAAQS of 196.0 $\mu g/m^3$. Details on the modeling analysis can be found in Enclosure 1 on the attached compact disc.

Based on the modeling analysis, the State of Wyoming recommends that the area surrounding the Laramie River Station be classified as Attainment.

Campbell County Electric Generating Unit

The Campbell County Electric Generating Unit (EGU) Group, which includes PacifiCorp's Wyodak plant, Basin Electric's Dry Fork Station, and Black Hills' Neil Simpson II, WyGen I, WyGen II, and WyGen III plants, has chosen to characterize their peak SO_2 concentrations through modeling. The modeling protocol for the group was found by EPA Region 8 to align with EPA's DRR modeling guidance on November 28, 2016.

Campbell County EGU Group provided a final modeling analysis to DEQ-AQD on December 14, 2016. The Division reviewed the modeling analysis for accuracy and determined that it followed the associated DRR modeling protocol and other EPA guidance. This analysis shows that the 1-hour modeled concentration for comparison to the NAAQS, a concentration of 93.7 $\mu g/m^3$, is well

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below the 1-hour SO_2 NAAQS of 196.0 $\mu g/m^3$. Details on the modeling analysis can be found in Enclosure 2 on the attached compact disc.

Based on the modeling analysis, the State of Wyoming recommends that the area surrounding the Campbell County EGU Group be classified as Attainment.

PacifiCorp – Naughton

PacifiCorp has chosen to characterize the peak SO_2 concentrations at the Naughton Power Plant through modeling. PacifiCorp provided DEQ-AQD with a modeling protocol which DEQ-AQD reviewed and approved and then submitted to EPA Region 8 for further review. The protocol was acceptable to EPA Region 8 with the exception of PacifiCorp's proposed exclusion of modeling receptors over the nearby Kemmerer Mine. DEQ-AQD had advised PacifiCorp to exclude these receptors because the DEQ-AQD does not consider the area over the nearby mine as ambient air for purposes of the DRR. *See* Enclosure 3 on the attached compact disc (Email from James Thurman, Ph.D., U.S. EPA/OAQPS/AQAD – Air Quality Modeling Group; to Bob Paine, Associate Vice President, AECOM (January 26, 2016, 8:56AM) stating that EPA's policy for purposes of the area designation process was that "receptors should not be sited where a monitor could not be placed. Accordingly, receptors are not to be placed . . . on the secured property of another industrial source").

PacifiCorp proceeded with a modeling analysis that excluded receptors over the Kemmerer Mine, and this analysis is supported by the DEQ-AQD. A final modeling report was provided to DEQ-AQD on December 22, 2016. The Division reviewed the modeling analysis for accuracy and determined that it followed the associated DRR modeling protocol and other EPA guidance. This analysis shows that the 1-hour modeled concentration for comparison to the NAAQS, a concentration of 147.5 $\mu g/m^3$, is well below the 1-hour SO_2 NAAQS of 196.0 $\mu g/m^3$. Details on the modeling analysis can be found in Enclosure 4 on the attached compact disc.

PacifiCorp also provided DEQ-AQD with a modeling analysis that accounts for the proposed conversion of Naughton Unit 3 to a natural gas-fired unit. PacifiCorp will be required to cease coal-firing on Unit 3 in January of 2019 and complete the conversion to natural gas firing by June of 2019. This additional modeling analysis included actual emissions from the current operation of Units 1 and 2 and the potential emissions from Unit 3 after the natural gas conversion. This analysis shows that the 1-hour modeled concentration for comparison to the NAAQS, a concentration of 60.6 $\mu g/m^3$, is well below the 1-hour SO_2 NAAQS of 196.0 $\mu g/m^3$.

Based on the modeling analyses performed, the State of Wyoming recommends that the area surrounding the Naughton Power Plant be classified as Attainment.

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PacifiCorp – Dave Johnston

PacifiCorp has chosen to characterize the peak SO_2 concentrations at the Dave Johnston Power Plant through modeling. Several versions of a DRR modeling protocol for Dave Johnston were provided to EPA Region 8 for review, with a final modeling protocol for the plant submitted in early December 2016. The EPA has not provided a formal determination on the acceptability of the protocol, but the final protocol included changes that accounted for all EPA comments on previous protocols.

PacifiCorp provided a final modeling analysis to DEQ-AQD on December 27, 2016. The Division reviewed the modeling analysis for accuracy and determined that it followed the associated DRR modeling protocol and other EPA guidance. This analysis shows that the 1-hour modeled concentration for comparison to the NAAQS, a concentration of 193.7 $\mu g/m^3$, is below the 1-hour SO_2 NAAQS of 196.0 $\mu g/m^3$. Details on the modeling analysis can be found in Enclosure 5 on the attached compact disc.

Based on the modeling analysis performed, the State of Wyoming recommends that the area surrounding the Dave Johnston Power Plant be classified as Attainment.

PacifiCorp – Jim Bridger Power Plant

On September 15, 2016, the DEQ-AQD's Monitoring Section had a call with EPA Region 8 to discuss facilities pursuing the monitoring pathway under the DRR. On this call, Region 8 indicated that it could be possible to make a designation determination under the DRR based on existing 2013-2015 SO_2 data for the Jim Bridger Power Plant in lieu of continuing monitoring at this facility from 2017-2019 as proposed in Wyoming's 2016 Ambient Monitoring Network Plan. In subsequent communications with Region 8, further guidance on pursuing this option was provided. 2013-2015 SO_2 data were submitted by the facility, reviewed by the DEQ-AQD's Monitoring Section, uploaded to the EPA's Air Quality System (AQS) database, and certified. The certification letter was provided by the facility on December 20, 2016 and will be forwarded to Region 8 under separate cover.

After reviewing these data, the DEQ-AQD's Monitoring Section is confident that the quality of the data is sufficient to satisfy the quality assurance requirements of 40 C.F.R. pt. 58, Appendix A and that a designation determination can be made based on the 2013-2015 SO_2 data for the Jim Bridger Power Plant in Air Quality System (AQS). The DEQ-AQD hereby requests that the EPA make a designation determination for the area surrounding the Jim Bridger Power Plant based on the 2013-2015 SO_2 data. The AQS ID number for this site is 56-037-0020, POC-1. The 2015 design value for this monitor is 31 ppb, well below the NAAQS for 1-hour SO_2 of 75 ppb (see Table 1, below).

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Table 1: Jim Bridger SO_2 Monitor 2015 Design Value

	99th percentile of 1-hr daily maximum concentrations (ppb)			2015 DV
Year	**2013**	**2014**	**2015**	**Average**
Concentration (ppb)	31	32	29	31

Based on a review of the quality of these data, as well as the 2015 design value for this monitor, the State of Wyoming recommends that the area surrounding the Jim Bridger Power Plant be classified as Attainment.

The remaining SO_2 sources in Wyoming to which the DRR applies will be characterizing their peak SO_2 concentrations through monitoring established on January 1, 2017. The EPA has indicated that this monitoring data will be considered in making Round Four designations by December 31, 2020.

Please accept Wyoming's updated recommendations. I look forward to working with the EPA to finalize attainment designations for these areas of Wyoming.

Sincerely,

Matthew H. Mead
Governor

MHM:dp

Encl.

1. Laramie River Modeling Analysis
2. Campbell County EGU Group Modeling Analysis
3. E-mail from EPA-OAQPS on DRR receptor placement
4. Naughton Modeling Analysis
5. Dave Johnston Modeling Analysis

cc: Todd Parfitt, Director, Wyoming Department of Environmental Quality

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Appendix G: Updated Section 4.6.1 from the 2016 Network Plan

4.6.1 SO_2 DRR Networks and Delegation of Operations to Industrial Sources

The following plan details how the AQD will delegate and oversee operations of the SO_2 DRR Networks in a manner equivalent to a SLAMS network per Title 40 Part 51.1203(c) of the CFR:

> "…the required monitors shall be sited and operated as a SLAMS or in a manner equivalent to a SLAMS. In either case, monitors shall meet applicable criteria in 40 CFR Part 58, appendices A, C, and E and their data shall be subject to data certification and reporting requirements as prescribed in 40 CFR Part 58.15 and 58.16."

4.6.1.1 History

The AQD's Ambient and Emission Monitoring Section has long worked with EPA Region VIII and facilities to oversee ambient monitoring and requires operations of ambient monitors at facilities to collect data directly comparable to the NAAQS. The AQD's industrial monitoring program has existed since the 1980's and has been developed with EPA Region VIII through several mechanisms including the "Memorandum of Agreement on Procedures for Protecting PM_{10} NAAQS in the Powder River Basin" and the WDEQ – EPA Performance Partnership Agreement. The AQD has a standardized approach to cooperative monitor siting, approving quality assurance plans, oversight of quarterly reporting, reporting and uploading data to AQS, and responding to EPA inquiries for permit-required industrial monitoring stations. The AQD proposes to build upon this approach to implement the SO_2 DRR Network.

4.6.1.2 Title 40 Part 58 Implementation

For implementation of the SO_2 DRR network, the AQD has delegated the responsibility of procurement, siting, and operation of monitoring to facilities that are required to characterize SO_2 concentrations under Title 40 Part 51.1203 of the CFR and have chosen the ambient monitoring pathway in Section (c). The EPA's Office of Air Quality Planning and Standards (OAQPS) has issued a memo discussing the options for implementing a network operated by industry. This proposal outlines the AQD's choices for implementation.

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Primary Quality Assurance Organization

The Primary Quality Assurance Organization (PQAO) is defined as

> "a monitoring organization, a group of organizations or other organization that is responsible for a set of stations that monitor the same pollutant and for which data quality assessments can be pooled. Each criteria pollutant sampler/monitor at a monitoring station must be associated with one PQAO."

Furthermore, Title 40 Part 58 Appendix A 1.2.1 of the CFR outlines the common factors that should be considered when defining a PQAO:

> "a) Operation by a common team of field operators according to a common set of procedures;
>
> b) Use of a common quality assurance project plan (QAPP) or standard operating procedures;
>
> c) Common calibration facilities and standards;
>
> d) Oversight by a common quality assurance organization; and
>
> e) Support by a common management organization (i.e. state agency) or laboratory."

Based on the definition and common factors, it is most appropriate to name the industrial facility, company or group of companies (known as "industrial monitoring entity" from here forward) as the PQAO for Wyoming's SO_2 DRR networks. Each industrial monitoring entity is choosing its own contractors to operate the station and perform quality control and quality assurance activities. Each of these entities will therefore have common laboratory facilities, standards, QAPPs, data validation practices and management to some degree. Therefore, the AQD will manage these networks consistent with existing industrial monitoring networks in Wyoming, with the industrial monitoring entity being the PQAO.

Coverage in Network Plans and Network Assessments

The AQD, through oversight of and cooperation with the industrial monitoring entity, will include the SO_2 DRR networks in the AQD's Annual Network Plan beginning in 2016 with the initial siting justification for EPA approval. The AQD will include these sites as a section in subsequent Network Plans and will ensure monitors are meeting the requirements stated under Title 40 Part 58.10 of the CFR. The AQD will also include these networks in the 5-year Network Assessment due in 2020 and subsequent years, if necessary.

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Annual Data Certification, Data Submittal, and Archiving Requirements

The industrial monitoring entity will be responsible for appropriate quarterly reporting of validated data to the AQD including:

1) AQS formatted "Raw Data" file including hourly and 5-min SO_2 (or 5-min hourly max) data;
2) AQS formatted "QA/QC file" including all precision checks and any performance audits conducted during the quarter;
3) Written quarterly data summary.

These quarterly reporting items, which include a certification by the Responsible Official, will be submitted to AQD through the AQD's Inventory, Monitoring, Permitting, And Compliance Tracking (IMPACT) system portal no later than 60 days after the end of the quarter. The AQD will review the data and upload the raw and QA/QC data to AQS per Title 40 Part 58.16 of the CFR.

The industrial monitoring entity will be responsible for the Annual Data Certification, by letter to EPA Region VIII, per Title 40 Part 58.15 of the CFR. The AQD will provide necessary annual reports from AQS through the IMPACT system. The AQD will provide training for industrial monitoring entities prior to 2018 on how to properly perform a data certification.

Quality System Documentation

The WDEQ has an approved Quality Management Plan (QMP) in place that allows the AQD to review and approve environmental data collection activities described and covered under QMPs and QAPPs. The AQD has a checklist and review system in place for QAPP approval from industrial monitoring entities. The industrial monitoring entity must submit a draft combined QMP/QAPP to the AQD for approval by October 31, 2016. Final AQD approved QMP/QAPPs will be supplied to EPA Region VIII per Title 40 Part 58 Appendix A2 of the CFR for the Region's review and approval.

Quality System Independence

The AQD plans for industrial monitoring entities to achieve quality independence through a combination of oversight by the AQD Quality Assurance Program and independent contracted performance evaluations. This combination will allow for consistent, qualified oversight with the appropriate levels of management separation. Details are in sections to follow.

Technical Systems Audit Program

EPA Region VIII will perform Technical Systems Audits on the industrial monitoring entities on the three-year schedule as specified in Title 40 Part 58 Appendix A of the CFR.

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Measurement Quality Checks

One–point quality control checks will be implemented by the industrial monitoring entity as will an independent contracted annual performance audit. These items will be specified in the approved QAPP and reported to the AQD for upload into AQS.

The implementation of the National Performance Audit Program (NPAP) will be the responsibility of the industrial monitoring entity. Each entity will contract with EPA Region VIII's NPAP auditor or another certified auditor to audit their monitoring networks.

Meeting Probe and Path Siting Requirements

The AQD has worked with industrial monitoring entities and EPA Region VIII during the siting process to ensure that probe and monitoring path siting requirements stated in Title 40 Part 58 Appendix E of the CFR are met and locations represented in the 2016 AQD Annual Network Plan are appropriate for meeting the needs of the SO_2 DRR. Probe and path criteria will be reevaluated during AQD Technical Systems Audits.

4.6.1.3 Conclusion

The AQD has documented a straightforward plan, based on over thirty years of industrial monitoring oversight, that will ensure operations of the SO_2 DRR Networks in a manner equivalent to SLAMS. This proposal addresses all of the major requirements in the Revised Title 40 Part 58 of the CFR as well as considerations addressed in the OAQPS memo including data submittal and certification, quality system documentation, probe and path siting requirements, and measurement quality checks.

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Proof of Publication

THE STATE OF WYOMING)ss.
County of Laramie)

AFFIDAVIT

Faith Vroman of said County of Laramie, being first duly sworn, deposes and says that he is Administrative Assistant; or Gina Larsen, of said County of Laramie, being first duly sworn, deposes and says that she is the Business Office Clerk of the

Wyoming Tribune-Eagle

a newspaper printed and published in said County and State, and in the Capitol of said State; that the notice of which the annexed is a true copy, has been published in the said newspaper.

for 1 Times, to wit:
05/16/2017

and that the first publication of said notice was made in said paper bearing date
May 16th, A.D. 2017

and that the last publication of said notice was made in said paper bearing date
May 16th, A.D. 2017

Gina Larsen

Subscribed in my presence and sworn to before me by the aforesaid Faith Vroman, Administrative Assistant or Gina Larsen, Business Office Clerk.

this 19th

Day of May, 2017

My commission expires
August 31, 2017

Notary Public

PUBLIC NOTICE
STATE OF WYOMING
Department of Environmental Quality/Air Quality Division
Annual Monitoring Network Plan

The Wyoming Air Quality Division (AQD) will submit the Wyoming Ambient Air Monitoring Annual Network Plan 2017 to EPA Region 8 in accordance with 40 CFR 58.10. The AQD is soliciting comments from the interested public on this network plan. The plan is available for public comment, and the public will be allowed a period of thirty (30) days to submit written comments. Public comments must be received no later than June 16, 2017. All comments received by the close of business on June 16, 2017 will be submitted to EPAs Region 8 along with the plan and will be retained on file in the Cheyenne office.

Notice is hereby given the State of Wyoming, Department of Environmental Quality, Air Quality Division, proposes to submit the Wyoming Ambient Monitoring Annual Network Plan 2017 to the EPA.

Comments can be submitted to the AQD's Monitoring Supervisor, Ms. Cara Keslar, Ambient and Emission Monitoring Supervisor, Air Quality Division, Department of Environmental Quality, 200 West 17th Street, 3rd Floor, Cheyenne, Wyoming 82002. Comments may also be submitted electronically through the following website: (http://deq.wyoming.gov/aqd/resources/public-comments-online/). Comments submitted by email will not be accepted. Interested parties may examine the documentation packet and relevant supporting materials on AQDs website http://deq.wyoming.gov/aqd/monitoring/resources/annual-network-plans/ as well as the AQD's Cheyenne office. Arrangements can be made with the AQD to copy relevant materials, if necessary (a fee will be assessed for reproductions). In accordance with the Americans with Disabilities Act, special assistance or alternate formats will be made available upon request for individuals with disabilities.

May 16, 2017

Received
JUN 19 2017
Air Quality Division

Jackson Hole News&Guide

PROOF OF PUBLICATION

COUNTY OF TETON
THE STATE OF WYOMING

Kevin Olson

Being duly sworn, deposes and says that he is the Publisher of the JACKSON HOLE NEWS&GUIDE, weekly newspaper published in Jackson in said county and state, and that the annexed Notice was published in 1 consecutive issues of said newspaper and not in a supplement, the first publication thereof being on May 24, 2017

Kevin Olson

Subscribed in my presence and sworn to before me this 24 Day of May, 2017.

Kathleen M. Godines

KATHLEEN M. GODINES
COUNTY OF TETON
STATE OF WYOMING
NOTARY PUBLIC
MY COMMISSION EXPIRES Jan. 12, 2021

Fee for publication $ 93.30 Charge to the following:

Account No: 39200 Name: WY DEQ - Air Quality Division

Address: 200 W 17th St. Ste. 300 Cheyenne WY 82002

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STATE OF WYOMING
Department of Environmental Quality/ Air Quality Division
Annual Monitoring Network Plan

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Publish: 05/24/17

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Department of Environmental Quality

To protect, conserve and enhance the quality of Wyoming's environment for the benefit of current and future generations.

DEQ

Matthew H. Mead, Governor

Todd Parfitt, Director

June 23, 2017

Ms. Monica Morales
Air & Radiation Program Director
EPA Region 8
1595 Wynkoop St.
Denver, CO 80202

Re: Wyoming Ambient Air Monitoring Annual Network Plan 2017

Dear Ms. Morales,

Enclosed you will find the Wyoming Ambient Air Monitoring Annual Network Plan 2017. This plan was based upon calendar year 2016 ambient air monitoring in accordance with 40 CFR §58.10.

The Air Quality Division (AQD) advertised this plan for 30 days and received no comments. The notarized proof of publications are attached. Section 4.6 and Appendix G has been updated to reflect Region 8's March 8, 2017 letter requesting revisions to the Wyoming Ambient Air Monitoring Annual Network Plan 2016 in the Wyoming Ambient Air Monitoring Annual Network Plan 2017

Questions concerning the Annual Network Plan should be directed to Cara Keslar at (307) 777-8684.

Sincerely,

Nancy E. Vehr
Air Quality Division Administrator

Enclosures
Ec: Cara Keslar – AQD, Cheyenne

200 West 17th Street · Cheyenne, WY 82002 · http://deq.wyoming.gov · Fax (307)635-1784

ADMIN/OUTREACH (307) 777-7937 | ABANDONED MINES (307) 777-6145 | AIR QUALITY (307) 777-7391 | INDUSTRIAL SITING (307) 777-7369 | LAND QUALITY (307) 777-7756 | SOLID & HAZ. WASTE (307) 777-7752 | WATER QUALITY (307) 777-7781

To: Dresser, Chris[Dresser.Chris@epa.gov]
From: Minnie Grant
Sent: Tue 2/21/2017 11:29:17 PM
Subject: RE: air now widget for Ute Tribe website

Chris,

Thank-you, we have a very good call this morning. I liked it. minnie

From: Dresser, Chris [mailto:Dresser.Chris@epa.gov]
Sent: Tuesday, February 21, 2017 4:19 PM
To: Minnie Grant <minnieg@utetribe.com>
Subject: RE: air now widget for Ute Tribe website

- DAQ Permit by Rule update: UDAQ

Utah received comments on their draft permit by rule from WEA and NRDC. WEA was concerned that the rule as written would penalize operators who obtained a permit prior to the rulemaking. WEA's suggestion would be to exempt any permit holder from the requirements of the permit by rule. Sheila expected the rule to be finalized in 4-6 wks.

- Uinta Basin FIP update: EPA

The new administration has required OMB to send all in-progress rules back to their respective agencies. The U&O oil and gas FIP was returned to EPA in late January. EPA has not made any decisions on the next steps for the FIP. But, we are aware of the need to allow for a permitting mechanism for new sources if/when the area becomes non-attainment (and the national FIP no longer applies). EPA will inform the Tribe of our intent once we determine a path forward.

- Ozone designations/implementation update: EPA

EPA is in progress with ozone designation TSDs. We will likely meet with the Tribe and State individually to communicate our thoughts prior to sending the June 120-day letters. There will be a public comment period following the 120-day letters. CY2017 air data will not be considered for initial designations.

- Ozone Advance update: UDAQ and Tribe

Chris will check with HQ for any direction on proceeding with ozone advance strategies ahead of a likely non-attainment status.

- Uinta Basin emissions inventory

Letters were sent to operators in early February with clarifying questions on the individual inventory submittals. Currently, half of operators have responded, and we are optimistic that the remainder will by March 15th.

Chris Dresser

U.S. EPA – Region 8

1595 Wynkoop Street

Denver, Colorado 80202-1129

Phone: (303) 312-6385

From: Minnie Grant [mailto:minnieg@utetribe.com]
Sent: Tuesday, February 21, 2017 4:07 PM
To: Dresser, Chris <Dresser.Chris@epa.gov>
Subject: RE: air now widget for Ute Tribe website

Chris,

Thank-you for the link, could you send me a quick little blurb on our 10 am discussion EPA/UDAQ/Tribe, the discussion items and the outcome. Thanks, minnie

From: Dresser, Chris [mailto:Dresser.Chris@epa.gov]
Sent: Tuesday, February 21, 2017 1:49 PM
To: Minnie Grant <minnieg@utetribe.com>
Subject: air now widget for Ute Tribe website

Hi Minnie,

Here is the link to instructions for setting up the widget on the Ute Tribe website:
https://airnow.gov/index.cfm?action=airnow.widget

Please tell your IT person to contact me with any questions. It will probably be best to use the Vernal zip code **84078** as the basis for the current and forecast air quality.

Thanks!

-Chris

Chris Dresser

U.S. EPA – Region 8

1595 Wynkoop Street

Denver, Colorado 80202-1129

Phone: (303) 312-6385

From: Google Calendar
Importance: Normal
Subject: Accepted: EPA/Tribe/Utah coordination meeting @ Tue Mar 21, 2017 10am - 11am (MDT) (Dresser, Chris)
Start Date/Time: Tue 3/21/2017 4:00:00 PM
End Date/Time: Tue 3/21/2017 5:00:00 PM
invite.ics

……..
,,,,,,,,

gmortensen@utah.gov has accepted this invitation.

EPA/Tribe/Utah coordination meeting

Tentative agenda:

- DAQ Permit by Rule update: UDAQ

- Uinta Basin FIP update: EPA

- Ozone designations/implementation update: EPA

- Ozone Advance update

- Uinta Basin emissions inventory

- Other?

Call-in: 866-299-9141
50577803
When Tue Mar 21, 2017 10am – 11am Mountain Time

Calendar Dresser, Chris

Who •Dresser, Chris - organizer

•gmortensen@utah.gov - creator

•minnieg@utetribe.com

•Sheila Vance

•Dave Mcneill

•Brock LeBaron

•mberger@utah.gov

Invitation from Google Calendar

You are receiving this courtesy email at the account dresser.chris@epa.gov because you are an attendee of this event.

To stop receiving future updates for this event, decline this event. Alternatively you can sign up for a Google account at https://www.google.com/calendar/ and control your notification settings for your entire calendar.

Forwarding this invitation could allow any recipient to modify your RSVP response. Learn More.

To: Minnie Grant[minnieg@utetribe.com]
From: Dresser, Chris
Sent: Tue 2/21/2017 11:19:22 PM
Subject: RE: air now widget for Ute Tribe website

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Utah received comments on their draft permit by rule from WEA and NRDC. WEA was concerned that the rule as written would penalize operators who obtained a permit prior to the rulemaking. WEA's suggestion would be to exempt any permit holder from the requirements of the permit by rule. Sheila expected the rule to be finalized in 4-6 wks.

- Uinta Basin FIP update: EPA

The new administration has required OMB to send all in-progress rules back to their respective agencies. The U&O oil and gas FIP was returned to EPA in late January. EPA has not made any decisions on the next steps for the FIP. But, we are aware of the need to allow for a permitting mechanism for new sources if/when the area becomes non-attainment (and the national FIP no longer applies). EPA will inform the Tribe of our intent once we determine a path forward.

- Ozone designations/implementation update: EPA

EPA is in progress with ozone designation TSDs. We will likely meet with the Tribe and State individually to communicate our thoughts prior to sending the June 120-day letters. There will be a public comment period following the 120-day letters. CY2017 air data will not be considered for initial designations.

- Ozone Advance update: UDAQ and Tribe

Chris will check with HQ for any direction on proceeding with ozone advance strategies ahead of a likely non-attainment status.

- Uinta Basin emissions inventory

Letters were sent to operators in early February with clarifying questions on the individual inventory submittals. Currently, half of operators have responded, and we are optimistic that the remainder will by March 15th.

Chris Dresser

U.S. EPA – Region 8

1595 Wynkoop Street

Denver, Colorado 80202-1129

Phone: (303) 312-6385

From: Minnie Grant [mailto:minnieg@utetribe.com]
Sent: Tuesday, February 21, 2017 4:07 PM
To: Dresser, Chris <Dresser.Chris@epa.gov>
Subject: RE: air now widget for Ute Tribe website

Chris,

Thank-you for the link, could you send me a quick little blurb on our 10 am discussion EPA/UDAQ/Tribe, the discussion items and the outcome. Thanks, minnie

From: Dresser, Chris [mailto:Dresser.Chris@epa.gov]
Sent: Tuesday, February 21, 2017 1:49 PM
To: Minnie Grant <minnieg@utetribe.com>
Subject: air now widget for Ute Tribe website

Hi Minnie,

Here is the link to instructions for setting up the widget on the Ute Tribe website:
https://airnow.gov/index.cfm?action=airnow.widget

Please tell your IT person to contact me with any questions. It will probably be best to use the Vernal zip code **84078** as the basis for the current and forecast air quality.

Thanks!

-Chris

Chris Dresser

U.S. EPA – Region 8

1595 Wynkoop Street

Denver, Colorado 80202-1129

Phone: (303) 312-6385

To: AIR_Update[baqupdate@dhec.sc.gov]; Coolidge, Leslie[coolidln@dhec.sc.gov]; Porter, Jack[porterje@dhec.sc.gov]; robertln@dhec.sc.gov[robertln@dhec.sc.gov]; Barnes, Brian[barnesbk@dhec.sc.gov]; Clark, Lisa B.[clarkmb@dhec.sc.gov]; Brown, Marie F.[brownmf@dhec.sc.gov]; Hollis, Andrew[HOLLISAO@dhec.sc.gov]; Jerry, Roger[jerryre@dhec.sc.gov]; maddengr@dhec.sc.gov[maddengr@dhec.sc.gov]; Mason, Maeve[masonmr@dhec.sc.gov]; Monroe, Michael[monroemc@dhec.sc.gov]; Brown, Robbie[brownrj@dhec.sc.gov]; flynntj@dhec.sc.gov[flynntj@dhec.sc.gov]; Baecker, Renee[baeckerr@dhec.sc.gov]; Lofton, Anthony[loftonat@dhec.sc.gov]; Bell, Caitlan L.[bellcl@dhec.sc.gov]; Hodges, Joel[hodgesje@dhec.sc.gov]; Griffith, Ragan[Griffire@dhec.sc.gov]; Graham, Buck W.[GRAHAMBW@dhec.sc.gov]; Sanford-Coker, Christine[SANFORCC@dhec.sc.gov]; Hughes, Jennifer R.[HUGHESJR@dhec.sc.gov]; Cook, Randolph[COOKRG@dhec.sc.gov]; Stillwell, Hollon R.[STILLWHR@dhec.sc.gov]; Boswell, Wendy[BOSWELWM@dhec.sc.gov]; Cox, Jay[coxmj@dhec.sc.gov]; Ambrose, Ted[AMBROSTS@dhec.sc.gov]; Mimms, Jr., Thomas E.[MIMMSTE@dhec.sc.gov]; Watts, Regie[WATTSRJ@dhec.sc.gov]; Baxley, Bryan[BAXLEYBC@dhec.sc.gov]; Pearson, Timothy[PEARSOTW@dhec.sc.gov]; Bates, Michael W.[BATESMW@dhec.sc.gov]; Buchanan, Benjamin R.[BUCHANBR@dhec.sc.gov]; Mathis, Harry L.[MATHISHL@dhec.sc.gov]; Carroll, Clinton[CARROLCJ@dhec.sc.gov]; Hall, Johnny[HALLJC@dhec.sc.gov]; Kirkpatrick, Natalie[KIRKPANL@dhec.sc.gov]; Madden, Samuel[MADDENSI@dhec.sc.gov]; Harvley, Mark[HARVLEMA@dhec.sc.gov]; Ball, Bryan[ballbs@dhec.sc.gov]; McCluskey, Christopher[MCCLUSCD@dhec.sc.gov]; Berry, Russell[BERRYRE@dhec.sc.gov]; Mann, Katherine A.[MANNKA@dhec.sc.gov]; Shirley, Jason C.[SHIRLEJC@dhec.sc.gov]; Watson, Christopher[watsonce@dhec.sc.gov]; Prince, Sabrina A.[princesa@dhec.sc.gov]; Washington, Melinda[WASHINMK@dhec.sc.gov]; Wright, Neshia M.[WrightNM@dhec.sc.gov]; Latta, Alexander M.[LATTAAM@dhec.sc.gov]; Stewart, Tobbi S.[STEWARTS@dhec.sc.gov]; Duffy, Robin S.[DUFFYRS@dhec.sc.gov]; Sanford-Coker, Christine[SANFORCC@dhec.sc.gov]; McCluskey, Christopher[MCCLUSCD@dhec.sc.gov]; Mathis, Harry L.[MATHISHL@dhec.sc.gov]; Hughes, Jennifer R.[HUGHESJR@dhec.sc.gov]; Graham, Buck W.[GRAHAMBW@dhec.sc.gov]; Berry, Russell[BERRYRE@dhec.sc.gov]; Ambrose, Ted[AMBROSTS@dhec.sc.gov]; Kirkpatrick, Natalie[KIRKPANL@dhec.sc.gov]
From: Baecker, Renee
Sent: Wed 9/7/2016 4:01:09 PM
Subject: September 7, 2016 BAQ Update
Advance Opportunities for BAQ update 20160831.docx

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In this installment of the BAQ Update, you will find information on the following along with an attachment of other opportunities:

1. **Funding, Training, and Other Opportunities** -The EPA Advance Program has shared the attached document containing funding, training and other opportunities. The Bureau of Air Quality is a participant in the EPA's "Advance Program" which is a collaborative effort between DHEC, EPA, and local governments. These opportunities may be of interest to you as you work to improve the air quality in your area.

To find out more about our participation in EPA's Advance Program and learn how you can help to improve air quality in South Carolina, visit www.scdhec.gov/Advance.

2. **EPA's "Climate Change" webpage -** This site, https://www3.epa.gov/climatechange/, provides considerable information on this subject, including links to climate issues, recent GHG regulations, research reports, emissions

data and more. Recently updated state-by-state fact sheets, *including one for South Carolina,* can be found at https://www3.epa.gov/climatechange/impacts/state-impact-factsheets.html.

3. **Breathe Better for Business! -** It's now easier than ever to sign up for the Breathe Better (B^2) Anti-Idling Program! B^2 has a new online enrollment form and has expanded to include businesses and organizations. With just a few clicks, schools and community stewards can commit to protecting students' and patrons' health and South Carolina's air quality. While supplies last, community stewards can request up to three free "Turn Off Your Engine" signs to post at their place of business and help protect the air we all breathe. For more information or to join B^2, visit www.scdhec.gov/b2.

Renee Baecker
Administrative Coordinator
S.C. Dept. of Health & Environmental Control

Office of Environmental Affairs
Office: (803) 898-4132

Mobile: (803) 917-4960
Fax: (803) 898-1246
Connect: www.scdhec.gov Facebook Twitter