TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

June 29, 2016

Mr. Mark Hansen
Associate Director, Air Programs
U.S. Environmental Protection Agency
Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 78202-2733
Re: 2016 Annual Monitoring Network Plan

Dear Mr. Hansen:

In accordance with 40 Code of Federal Regulations §58.10, the Texas Commission on Environmental Quality (TCEQ) is submitting the *2016 Annual Monitoring Network Plan* (AMNP) for your consideration.

The AMNP provides information on the Texas network of ambient air monitors established to meet regulatory requirements of the National Ambient Air Quality Standards and other monitors that support this effort. This document presents the current Texas network as well as proposed changes to the network from July 1, 2015, through December 31, 2017.

The AMNP was made available for public inspection for 30 days prior to submission. During the comment period, the TCEQ received three sets of comments concerning the 2016 AMNP. In response to these comments, the TCEQ added Appendix K to summarize and provide a written response to each comment. All comments received during the public inspection period are enclosed.

If you need additional information, please contact me at (512) 239-0539.

Sincerely,

Richard C. Chism, Director
Monitoring Division

Enclosures

Texas Commission on Environmental Quality

2016 Annual Monitoring Network Plan

P.O. Box 13087, Austin, Texas 78711-3087

Table of Contents

List of Appendices

List of Tables

2016 Annual Monitoring Network Plan

Introduction

Title 40 Code of Federal Regulations (CFR) Part 58.10 requires states to submit an annual monitoring network plan (AMNP) to the United States (U.S.) Environmental Protection Agency (EPA) by July 1 of each year. This monitoring plan is required to provide the implementation and maintenance framework for an air quality surveillance system, known commonly as the ambient air quality monitoring network. The AMNP must be made available for public inspection and comment for at least 30 days prior to submission to the EPA. The AMNP is forwarded to the EPA for final review and approval along with any comments received during the 30-day inspection period and the associated Texas Commission on Environmental Quality (TCEQ) responses as an appendix.

This document provides information on the TCEQ ambient air monitoring network established to meet the National Ambient Air Quality Standards (NAAQS) regulatory requirements and other monitors that support this effort. This document presents the current Texas network, as well as recommended changes to the network, from July 1, 2015, through December 31, 2017. As described in 40 CFR Part 58, Appendix D, monitors are deployed to meet minimum design requirements for the State or Local Air Monitoring Stations (SLAMS), Photochemical Assessment Monitoring Stations (PAMS), and National Core Multipollutant Monitoring Stations (NCore) federally required ambient air monitoring networks. A list of all monitors and their respective networks is located in Appendix A.

Based on annual internal audits performed to date, all monitoring sites are meeting the requirements defined in 40 CFR Part 58 Appendices A, B, C, D, and E, with one exception. The Brownsville site (EPA air quality system [AQS] database number [#] 480610006) is no longer meeting the siting criteria defined 40 CFR Part 58, Appendix E due to a utility structure constructed in the monitoring path of the sampler inlets after the site was deployed. The TCEQ is investigating options for site relocation to meet siting criteria.

Because SLAMS requirements are partially based on population, a summary of core based statistical areas (CBSAs) or metropolitan statistical areas (MSAs), 2015 U.S. Census Bureau population estimates, and a summary count of required monitors is located in Appendix B. The TCEQ relied on this summary in evaluating monitors as documented in this AMNP. The U.S. Census Bureau defines CBSA as a collective term for MSAs, and the terms are used interchangeably in this plan.

Note: Monitoring data has been updated from originally posted copy to reflect final data certification. In addition, Baytown Refinery has been removed from the list of sources to be monitored by January 1, 2017, in this AMNP to reflect the current list of 13 sources initially identified in the Data Requirements Rule.

Regulatory Network Changes

Nitrogen Dioxide (NO_2)

The TCEQ NO_2 network is designed to meet area-wide, Regional Administrator 40 (RA-40), and near-road monitoring requirements. Title 40 CFR Part 58, Appendix D, Section 5 also requires hourly averaged NO_2, nitrogen oxide (NO), and total reactive nitrogen compounds (NO_y) to be collected at required NCore sites under the PAMS program. The state-wide NO_2 network consists of NO_2 monitoring at 46 sites, with NO_y measured at five sites. Appendix C of this plan summarizes the monitoring requirements and the current number of NO_2 and NO_y monitors in each MSA in Texas.

Area-Wide Monitoring Requirements

Title 40 CFR Part 58, Appendix D, Section 4.3.3 requires one area-wide ambient air quality monitoring site in each CBSA with a population of 1,000,000 or more persons in Texas. The requirements stipulate that the site must be located in the area with the expected highest NO_2 concentrations that are also representative of a neighborhood or larger (urban) spatial scale. Neighborhood scale monitoring is representative of air quality conditions in an area with dimensions between 0.5 and 4.0 kilometers, and urban scale monitoring is representative of air quality conditions in an area with dimensions between 4.0 and 50 kilometers according to 40 CFR Part 58, Appendix D, Section 4.3.5(a).

Based on 2015 U.S. Census Bureau population estimates for Texas, area-wide neighborhood or urban scale NO_2 monitoring is required in the Dallas-Fort Worth-Arlington, Houston-Woodlands-Sugar Land, San Antonio-New Braunfels, and Austin-Round Rock CBSAs. The following four NO_2 monitors meet these area-wide requirements, as approved in the TCEQ *2013 Annual Monitoring Network Plan* response letter from EPA Region 6 dated May 28, 2014. These monitors and their identification numbers are:

- Houston-The Woodlands-Sugar Land: Clinton (AQS# 482011035);
- Dallas-Fort Worth-Arlington: Dallas Hinton (AQS# 481130069);
- San Antonio-New Braunfels: San Antonio Northwest (AQS# 480290032); and
- Austin-Round Rock: Austin Northwest (AQS# 484530014).

Regional Administrator Monitoring Requirements

Title 40 CFR Part 58, Appendix D, Section 4.3.4 states that the EPA Regional Administrators will collaborate with the states to designate a minimum of 40 NO_2 monitoring stations nationwide that are sited in locations to protect susceptible and vulnerable populations. The TCEQ collaborated with the EPA to identify appropriate monitoring sites to meet this requirement. The following four NO_2 monitors meet this requirement, as approved in the TCEQ *2013 Annual Monitoring Network Plan* response letter from EPA Region 6 dated May 28, 2014:

- El Paso: Ascarate Park Southeast (SE) (AQS# 481410055);
- Houston: Clinton (AQS# 482011035);
- Arlington: Arlington Municipal Airport (AQS# 484393011); and
- Nederland: Nederland High School (AQS# 482451035).

Near-Road NO_2 Monitoring Requirements

Title 40 CFR Part 58, Appendix D, Section 4.3.2 requires one microscale near-road monitor in each CBSA with a population of 500,000 or more persons to be located near a major road with high annual average daily traffic (AADT) counts. An additional near-road monitor is required in each CBSA with a population of 2,500,000 or more persons. The current TCEQ near-road monitoring network, summarized in Table 1, is meeting this requirement with six operational near-road sites as approved in the TCEQ *2014 Annual Monitoring Network Plan* response letter from EPA Region 6 received January 14, 2015.

Table 1: Near-Road Site List

AQS Number	Site Name	Core Based Statistical Area	U.S. Census Bureau 2015 Population Estimate	Parameters Monitored (described below)
481131067	Dallas LBJ Freeway	Dallas-Fort Worth-Arlington	7,102,796	NO_2, met
484391053	Fort Worth California Parkway North	Dallas-Fort Worth-Arlington	7,102,796	NO_2, CO, $PM_{2.5}$, met
482011066	Houston Southwest Freeway	Houston-The Woodlands-Sugar Land	6,656,947	NO_2, met
482011052	Houston North Loop	Houston-The Woodlands-Sugar Land	6,656,947	NO_2, CO, $PM_{2.5}$, met
480291069	San Antonio Interstate 35*	San Antonio-New Braunfels	2,384,075	NO_2, met
484531068	Austin North Interstate 35*	Austin-Round Rock	2,000,860	NO_2, met

*Carbon monoxide (CO) and particulate matter of 2.5 micrometers or less ($PM_{2.5}$) will be added by 1/1/2017.
AQS – Air Quality System
met – meteorological equipment with sensors to monitor wind speed, wind direction, and ambient temperature
NO_2 – nitrogen dioxide
U.S. – United States

Title 40 CFR Part 58, Appendix D, Section 4.3.2 currently requires the establishment of NO_2 near-road sites in the El Paso and McAllen-Edinburg-Mission CBSAs based on each area's 2015 U.S. Census Bureau population estimates. However, on May 5, 2016, the EPA proposed to remove the rule that requires NO_2 near-road monitoring in CBSAs with populations between 500,000 and 1,000,000 persons. The EPA is initiating this action based on a review of data generated by existing near-road NO_2 sites in larger CBSAs beginning in 2012. The data from these near-road sites indicate that the current NO_2 air quality concentrations in the near-road environment are generally well below both the annual and one-hour daily maximum NAAQS levels of 53 parts per billion (ppb) and 100 ppb, respectively. The EPA's proposal does not remove or modify the existing requirements for near-road NO_2 monitoring in CBSAs with 1,000,000 or more persons. The proposal is available at the following web address.
https://www3.epa.gov/airquality/nitrogenoxides/pdfs/nr_no2_rev_050516.pdf

Due to the EPA proposal on May 5, 2016, to revise the near-road NO_2 monitoring requirements, the TCEQ has currently suspended planning activities for near-road sites in the El Paso and McAllen-Edinburg-Mission CBSAs. The TCEQ understands that EPA plans to complete the associated final rule before the January 1, 2017, deadline for operation. The TCEQ will continue to follow this issue and adjust near-road planning as further information becomes available from the EPA.

Changes to the Regulatory NO_2 Monitoring Network

The EPA recently finalized a clarification for NO_2 monitoring requirements in the Federal Register on March 28, 2016, *Revisions to the Ambient Monitoring Quality Assurance and Other Requirements; Final Rule,* stating that NO_2 was never a required NCore measurement and that the definition in 40 CFR Part 58 was erroneous. Based on this clarification, the TCEQ recommends removal of the NCore network designation from the NO_2 monitors at El Paso Chamizal (AQS# 481410044) and Houston Deer Park #2 (AQS# 482011039) from AQS effective April 27, 2016. These two monitors will continue to operate and fulfill PAMS and SLAMS NO_2 network requirements.

The TCEQ NO_2 network, as discussed above and summarized in Appendix C, meets or exceeds monitoring requirements in all areas. No further changes to the network are recommended at this time.

Sulfur Dioxide (SO_2)

Monitoring Requirements

Title 40 CFR Part 58, Appendix D, Section 4.4.2, requires states to establish an SO_2 monitoring network based on a calculated population weighted emissions index (PWEI). This index is calculated by multiplying the population of a CBSA with the emissions inventory (EI) data for counties within that CBSA. The calculated value is then divided by one million to obtain the PWEI value. The PWEI monitoring requirements are listed below:

- One monitor in CBSAs with a PWEI value equal to or greater than 5,000;
- Two monitors in CBSAs with a PWEI value equal to or greater than 100,000; and
- Three monitors in CBSAs with a PWEI value equal to or greater than 1,000,000.

As shown in Appendix D, the TCEQ used the 2015 U.S. Census Bureau population estimates and 2011 National Emissions Inventory (NEI) data with 2014 TCEQ point-source EI data to calculate the PWEI and determine the minimum monitoring requirements for each CBSA. The PWEI analysis described in Appendix D confirms that the TCEQ is currently meeting PWEI SO_2 monitoring requirements.

Data Requirements Rule

On June 2, 2010, the EPA established a primary (health based) one-hour SO_2 NAAQS at a level of 75 ppb. On August 10, 2015, EPA finalized the *Data Requirements Rule for the 1-Hour Sulfur Dioxide Primary NAAQS* (DRR). This DRR requires air agencies to provide data to characterize air quality around sources that emit 2,000 tons per year (tpy) or more of SO_2 and that are not located in an area already designated nonattainment. The DRR establishes criteria for identifying the emission sources and associated areas for SO_2 air quality characterization. The DRR also provides deadlines for source-oriented monitoring and/or modeling to characterize ambient air quality impacts from the identified SO_2 sources. Air agencies have the option to characterize air quality by modeling predicted impacts of actual source emissions or by using strategically sited ambient air quality monitors. Monitors must be located in areas surrounding the identified SO_2 sources where maximum one-hour SO_2 concentrations are expected. The agency is required to submit information on deployment of new monitoring stations to the EPA Regional Administrator by July 1, 2016, as part of the AMNP.

Changes to the Regulatory SO_2 Monitoring Network

On January 15, 2016, the TCEQ provided the EPA with a list of 25 SO_2 sources meeting the DRR emissions applicability threshold. Based on the need to characterize air quality for the purposes of making area designations, the TCEQ will deploy source-oriented SO_2 monitors near 13 sources by the January 1, 2017, rule deadline. Due to the close geographical proximity of 4 out of the 13 sources, a total of 11 monitoring stations, listed in Table 2, are proposed for deployment to characterize ambient air quality surrounding each of these sources. The EPA is expected to finalize area designations for the remaining 12 sources by July 2, 2016. The TCEQ will pursue monitoring station locations as expeditiously as practical for any of the 12 remaining sources designated as nonattainment under the EPA's final action.

Table 2: Recommended Source-Oriented Sulfur Dioxide Monitoring Stations

Facility Name(s)	County Name	New Air Monitoring Station Name	AQS Number
Big Spring Carbon Black	Howard	Big Spring Midway	482271072
Calaveras Plant	Bexar	Heritage Middle School	480290622
Oxbow Calcining	Jefferson	Port Arthur 7th Street	482451071
AEP Pirkey Power Plant	Harrison	Hallsville Red Oak	482031079
Streetman Plant	Navarro	Streetman Interstate 45*	483491081
Welsh Power Plant	Titus	Cookville FM 4855	484491078
Sandow Steam Electric Station and Sandow 5 Generating Plant	Milam	Rockdale John D. Harper Road*	483311075
Oak Grove Steam Electric Station	Robertson	Franklin Oak Grove*	483951076
Sid Richardson Borger Carbon Black and Orion Borger Carbon Black	Hutchinson	Borger FM 1559*	482331073
Harrington Generating Station	Potter	Amarillo Xcel El Rancho	483751077
Orion Echo Carbon Black Plant	Orange	Orange 1st Street*	483611083

*Site name and location pending EPA approval
AQS – Air Quality System
FM – farm-to-market

TCEQ Site Selection Process

The TCEQ focused on complying with the directly-applicable federal requirements listed in 40 CFR Part 58, Appendix E regarding siting criteria. In addition, the TCEQ evaluated monitoring station locations that would appropriately and sufficiently characterize air quality in areas around an SO_2 emissions source. The DRR requirements stipulate that ambient air monitoring stations must be deployed in areas of maximum expected one-hour SO_2 concentrations in ambient air. The TCEQ approach included utilizing multiple techniques and guidance provided in the *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistant Document* (Monitoring TAD). The Monitoring TAD suggests that modeling is one technique that may be used to assist in identifying potential ambient air monitoring sites. The TCEQ's modeling for monitor placement used the Comprehensive Air Model with Extensions (CAMx) with model options set as equivalent as possible to American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD).

The TCEQ considered the modeling analyses, but did not rely solely on them in the prioritization of potential sites. The latitude and longitude of each SO_2 source designated for ambient air monitoring was plotted on a satellite map. Surrounding properties and associated owners were identified utilizing county appraisal district information. The TCEQ then collectively considered the following parameters: predominant wind flow, modeling analyses, property owner agreement, and logistical constraints, such as space, power availability, terrain, grade, and drainage. Failure to meet criteria for any single parameter did not necessarily exclude the location from consideration.

A monitor placement evaluation was performed for each source-oriented SO_2 air monitoring station listed in Table 2. The evaluations and resultant siting proposals are located in Appendix E. Evaluations with a draft watermark are pending EPA approval.

Lead (Pb)

Monitoring Requirements

The TCEQ Pb network is designed to meet 40 CFR Part 58, Appendix D, Section 4.5 monitoring requirements. This section requires a minimum of one source-oriented ambient air Pb monitoring site to measure maximum concentrations near each facility that emits 0.50 tpy and each airport that emits 1.0 tpy or more of Pb based on either the most recent NEI data or annual EI data submitted to meet state reporting requirements. In addition, state agencies are required to conduct ambient air Pb monitoring near Pb sources that are expected to show, or have shown in the past, to contribute to a maximum Pb concentration in ambient air in excess of the NAAQS of 0.15 micrograms per cubic meter ($\mu g/m^3$). To meet these requirements, the TCEQ supports total suspended particulate (TSP) Pb monitoring at six source-oriented sites and seven population exposure sites. Three of these sites also support non-source-oriented NCore requirements. The TCEQ network meets or exceeds federal requirements with Pb monitoring at these 13 sites.

Lead Waivers

The EPA Regional Administrator may waive the requirement in 40 CFR Part 58, Appendix D, 4.5(a) for monitoring near specific Pb sources with sufficient demonstration that the Pb source will not contribute to a maximum concentration in ambient air greater than 50 percent (%) of the NAAQS of 0.15 $\mu g/m^3$ based on historical monitoring data, modeling, or other approved means. All approved waivers must be renewed once every five years as part of the network assessment required under 40 CFR Part 58.10(d).

The TCEQ has submitted five Pb waivers for source-oriented monitoring since 2010, and all were granted by the EPA Region 6. Three of these waivers are no longer required because source emissions have decreased below the 0.50 tpy threshold. Requests to renew the Pb waivers for the Lower Colorado River Authority Fayette Power Plant in Fayette County and the U.S. Department of the Army facility in Fort Hood were submitted in the 2015 TCEQ *Texas Five-Year Ambient Monitoring Network Assessment*. The two waiver renewal requests included information regarding a Pb modeling analysis indicating that the predicted maximum ground level concentration for a rolling three-month average continue to remain below 50% of the NAAQS. These waiver renewal requests were approved in the TCEQ *2015 Annual Monitoring Network Plan* response letter from EPA Region 6 dated October 26, 2015, and are considered valid until July 1, 2020. In addition to the waivers, a Pb ambient air monitor was deployed in 2011 to monitor ambient Pb concentrations downwind of the Conecsus, Limited Liability Company (LLC) facility just west of the City of Terrell, therefore, no waiver request has been submitted for this source.

The TCEQ compared 2013 and 2014 point source EI data to reevaluate sources that reported Pb emissions of 0.50 tpy or more. Table 3 provides information regarding the sources with existing Pb waivers and required Pb monitoring. Three sources reported Pb emissions greater than 0.50 tpy in 2013. All three sources reduced their reported Pb emissions in 2014, with two out of the three sources reporting emissions well below this threshold. Through existing ambient air monitors and current Pb waivers, the TCEQ is meeting or exceeding all federal Pb monitoring requirements.

Table 3: 2013-2014 Lead Point Source Emissions Inventory Data

Company	County	2013 Pb Emissions (tpy)	2014 Pb Emissions (tpy)	TCEQ Comments
United States Department of the Army, Fort Hood	Bell	0.74	0.08	Pb waiver renewal approved on October 26, 2015.
Lower Colorado River Authority	Fayette	0.59	0.51	Pb waiver renewal approved on October 26, 2015.
Conecsus LLC	Kaufman	0.69	0.33	Pb is currently monitored at the Terrell Temtex site.

LLC – limited liability company
Pb - lead
TCEQ – Texas Commission on Environmental Quality
tpy – tons per year

According to 40 CFR Part 58, Appendix D, Section 3, Pb monitoring has been a required NCore measurement at sites in CBSAs with a population of 500,000 or more persons since 2011. However, the requirement to measure airborne particulate Pb at NCore sites was eliminated in the EPA's final rule published in the Federal Register on March 28, 2016, *Revisions to the Ambient Monitoring Quality Assurance and Other Requirements; Final Rule*. The EPA removed this requirement due to the extremely low concentrations being measured at these sites. The certified NCore non-source Pb data received by the EPA has typically been low: 3-month rolling averages measure around 0.01 $\mu g/m^3$ as compared to the NAAQS level of 0.15 $\mu g/m^3$.

In addition, the EPA noted that non-source Pb data will continue to be measured as particulate matter of 10 micrometers or less in diameter (PM_{10}) Pb at National Air Toxics Trends Station (NATTS) sites. The EPA also noted that the ongoing monitoring networks will adequately support the Pb non-source monitoring objectives. The TCEQ currently measures PM_{10} Pb speciation at two NATTS sites, Houston Deer Park #2 (AQS# 482011039) and Karnack (AQS# 482030002), and $PM_{2.5}$ Pb speciation as a part of the Chemical Speciation Network (CSN) at Houston Deer Park #2, Dallas Hinton (AQS# 481130069), and El Paso Chamizal (AQS# 481410044), as noted in Appendix A. The TCEQ currently measures NCore TSP Pb at three sites: Dallas Hinton, Houston Deer Park #2, and Ascarate Park SE (AQS# 481410055) in El Paso. Table 4 details the locations of the NCore TSP Pb measurements along with NATTS PM_{10} Pb speciation and CSN $PM_{2.5}$ Pb speciation.

Table 4: Sites Measuring National Core Multipollutant Monitoring Stations Total Suspended Particulate Lead

Sites Measuring NCore TSP Pb	AQS Number	2013-2015 Design Value ($\mu g/m^3$)	Other Pb Monitoring in Area
Dallas Hinton	481130069	0.01	$PM_{2.5}$ Pb speciation at this site for CSN
Ascarate Park SE (in El Paso)	481410055	0.01	$PM_{2.5}$ Pb speciation at El Paso Chamizal for CSN
Houston Deer Park #2	482011039	0.00	PM_{10} Pb speciation at this site for NATTS

- number
$\mu g/m^3$ – micrograms per cubic meter
AQS – Air Quality System
CSN – Chemical Speciation Network
NATTS – National Air Toxics Trends Stations
NCore – National Core Multipollutant Monitoring Stations
PM_{10} – particulate matter 10 micrometers or less
$PM_{2.5}$ – particulate matter 2.5 micrometers or less
Pb - lead
SE - southeast
TSP – total suspended particulate

Collin County Pb Redesignation Request

On December 31, 2010, the EPA designated an area surrounding Exide Technologies (Exide) located in Frisco, Collin County, as nonattainment for the 2008 Pb NAAQS (75 Federal Register 71033). To demonstrate attainment, the area is required to have three-month rolling average monitoring data below the NAAQS for 36 consecutive months. The Collin County Pb monitoring network consists of four regulatory Pb ambient air quality monitors, two collocated Pb ambient air quality monitors, and a meteorological station. Data from these monitors are used to determine the area's compliance with the 2008 Pb NAAQS. Between January 1, 2013, and December 31, 2015, there was no measured three-month rolling average above the Pb NAAQS. The current design value is 0.08 $\mu g/m^3$ as of December 31, 2015. Thus, the area has demonstrated compliance with the 2008 Pb NAAQS.

Based on measured compliance with the standard, the TCEQ proposed the *Collin County Redesignation Request and Maintenance Plan State Implementation Plan Revision for the 2008 Lead National Ambient Air Quality Standard* on April 27, 2016.

With this state implementation plan revision, the TCEQ would request that the Collin County Pb nonattainment area be redesignated as attainment for the 2008 Pb standard and that the EPA approve the associated proposed maintenance plan. The tentatively scheduled adoption is scheduled to occur by October 2016. Once adopted by the Commissioners, the request will be submitted to the EPA for approval. If the EPA approves the TCEQ request to designate the Collin County area as attainment for Pb, the TCEQ will evaluate and may propose changes to the existing Pb monitors in Collin County as allowed by the maintenance plan.

Collocation Requirements

Title 40 CFR Part 58, Appendix A, Section 3.4.4 requires a primary quality assurance organization to select 15% of the Pb monitoring sites within their network, not counting non-source-oriented NCore sites, for collocated sampling with the first of these sites measuring the highest Pb concentrations in the network. Based on the current network of primary Pb monitors, excluding the three NCore sites, the TCEQ is required to have two collocated Pb monitors. The TCEQ has three collocated Pb monitors; two are in Collin County at the Frisco Eubanks site (AQS# 480850009) and the Frisco 7 site (AQS# 480850007), and the third is in El Paso at the Ojo De Agua site (AQS# 481411021). The 2015 average concentration at the Frisco Eubanks site has decreased and is no longer the highest Pb concentration in the state. According to 2015 data, the Terrell Temtex (AQS# 482570020) site now has the highest three-month rolling average concentration (0.04 $\mu g/m^3$) in the network. The TCEQ recommends relocation of the collocated monitor in order to maintain compliance, as discussed in the Changes section below.

Changes to the Regulatory Pb Monitoring Network

Pending the EPA's approval of the TCEQ's final Collin County Pb redesignation request, the TCEQ may propose future changes to existing primary Pb monitors in Collin County. However, the collocation needs of the TCEQ Pb network have changed due to the decrease in measured concentrations from the Frisco monitors. To maintain compliance with collocation requirements, the TCEQ recommends the relocation of the collocated Pb monitor from the Frisco 7 site to the Terrell Temtex site.

Due to revisions to 40 CFR Part 58, Appendix D, Section 3(b) published by the EPA on March 28, 2016, TSP Pb monitoring is no longer a required measurement at NCore sites. The TCEQ recommends to discontinue the TSP Pb monitors at the three NCore sites listed in Table 4.

Ozone (O_3)

Network design criteria for SLAMS sites, described in 40 CFR Part 58, Appendix D, Section 4.1, require O_3 monitoring in each CBSA with a population of 350,000 or more persons. Monitoring is also required in CBSAs with lower populations if measured O_3 values in that MSA are within 85% of the NAAQS of 0.070 parts per million (ppm). According to 2015 U.S. Census Bureau population estimates and 2013-2015 eight-hour O_3 design values, the TCEQ is required to operate a minimum of 25 O_3 monitors to meet SLAMS network requirements. The TCEQ is exceeding the requirement with more than 50 O_3 monitors in the SLAMS network, as listed in Appendix A.

Additional monitoring at NCore sites in a CBSA with a population of 1,000,000 or more persons is also required as a part of the PAMS program under 40 CFR Part 58, Appendix D, Section 5. The TCEQ is exceeding PAMS and NCore requirements with O_3 monitors at all three NCore sites in the Houston, Dallas, and El Paso CBSAs.

The EPA published a final rule on October 26, 2015, revising the primary and secondary NAAQS for O_3. Both the primary and secondary standards were strengthened to 0.070 ppm from the existing standard of 0.075 ppm. The measurement form remains as the annual fourth-highest daily maximum eight-hour concentration, averaged over three years. Revisions to the O_3 NAAQS also include changes to monitoring, network design, and data handling, including updates to the PAMS program requirements. According to 2013-2015 eight-hour O_3 design values, the revisions to the standard will not change the number of overall network monitors required in 2016. This information is shown in Appendix F of this document. The TCEQ is required to operate a minimum of 30 O_3 monitors for all combined network requirements and is currently exceeding the requirements with 70 monitors across the state.

Changes to the Regulatory O_3 Monitoring Network

As described above and summarized in Appendix F of this document, the TCEQ O_3 network is meeting or exceeding the current MSA requirements, and no changes to the network are recommended at this time.

Carbon Monoxide (CO)

Title 40 CFR Part 58, Appendix D, Section 3.0 requires high-sensitivity CO monitors at NCore sites. The TCEQ meets this requirement with CO monitors at all three NCore sites in the Houston-Woodlands-Sugar Land, Dallas-Fort Worth-Arlington, and El Paso CBSAs. Title 40 CFR Part 58, Appendix D, Section 4.2 also requires CO monitors at near-road sites in CBSAs of 1,000,000 or more persons. The TCEQ meets this requirement with CO monitors at near-road sites in the Houston and Dallas CBSAs. The TCEQ will deploy CO monitors to meet the January 1, 2017, deadline at near-road sites in the Austin-Round Rock and San Antonio-New Braunfels CBSAs.

The TCEQ CO monitoring network is required to operate a total of seven CO monitors. The TCEQ is currently exceeding the requirements through the operation of thirteen total CO monitors: eight CO monitors and five high-sensitivity CO monitors. A summary of the required and current CO monitors in each CBSA is included in Appendix G.

The EPA revisions to the PAMS program under the final rule published on October 26, 2015, and as listed in 40 CFR Part 58, Appendix D, Section 5, remove CO from the list of required PAMS measurements. The CO monitors at the Houston Clinton site (AQS# 482011035) and the Beaumont Nederland High School site (AQS# 482451035) are now exceeding minimum requirements. The TCEQ will reevaluate the option to decommission these monitors during the assessment of the PAMS network to be published in the 2018 AMNP.

Changes to the Regulatory CO Monitoring Network

In compliance with near-road requirements in the Austin-Round Rock and San Antonio-New Braunfels CBSAs, the TCEQ will deploy gas filter correlation CO monitors (method 093) at the Austin North Interstate 35 (AQS# 484531068) and San Antonio Interstate 35 (AQS# 480291069) sites by January 1, 2017.

Particulate Matter of 10 Micrometers or Less (PM_{10})

The TCEQ PM_{10} network is designed to meet the area requirements of 40 CFR Part 58, Appendix D, Section 4.6, which specifies the range of PM_{10} monitoring stations required in MSAs based on population and measured concentrations, if available. A sample of this information is provided in Table 5. The TCEQ network consists of PM_{10} monitoring at 27 sites. Compliance with the PM_{10} standard is based on the number of measured exceedances of the 150 µg/m^3 standard on average over a three year period. The evaluation of PM_{10} monitoring requirements was completed using the 2015 U.S. Census Bureau population estimates and 2015 measured PM_{10} concentrations. This evaluation and the associated maximum 2013-2015 concentrations for each MSA are shown in Appendix H, Table 1. From this evaluation, the TCEQ determined that each MSA listed in Appendix H within the PM_{10} network meets or exceeds minimum PM_{10} monitoring requirements.

Table 5: Particulate Matter of 10 Micrometers or Less Monitoring Requirements

Population Category	High Concentration[1]	Medium Concentration[2]	Low Concentration[3]
>1,000,000	6-10	4-8	2-4
500,000-1,000,000	4-8	2-4	1-2
250,000-500,000	3-4	1-2	0-1
100,000-250,000	1-2	0-1	0

[1]High Concentration areas are those for which ambient PM_{10} data show ambient concentrations exceeding the PM_{10} NAAQS by 20 percent or more
[2]Medium Concentration areas are those for which ambient PM_{10} data show ambient concentrations exceeding 80 percent of the PM_{10} NAAQS
[3]Low Concentration areas are those for which ambient PM_{10} data show ambient concentrations less than 80 percent of the PM_{10} NAAQS
PM_{10} – particulate matter of 10 micrometers or less in diameter
> - greater than

Collocation Requirements

Title 40 CFR Part 58, Appendix A, Section 3.3.4 requires a primary quality assurance organization to select 15% of the PM_{10} monitoring sites within the PM_{10} network for collocated sampling. At least 50% of the selected sites should have an annual mean particulate matter concentration among the highest in the network. Based on the current network of 27 PM_{10} monitors, the TCEQ is required to have four collocated monitors. The TCEQ has eight PM_{10} collocated monitors at the sites listed in Table 6.

Table 6: Particulate Matter of 10 Micrometers or Less Collocation Summary

AQS Number	Sites with PM_{10} Collocated Monitors	2013-2015 Maximum Concentration **(µg/m³)**	2013-2015 Annual Average Concentration **(µg/m³)**	Additional Information
482011035	Clinton	130	38	Ranked in the highest 25% network concentration
482150043	Socorro Hueco	145	30	Ranked in the highest 25% network concentration
482010047	Convention Center	93	27	Ranked in the highest 25% network concentration
481411021	Laredo Vidaurri	80	25	Decreasing trend, not in the highest 25% for 2014, and 2015
484530021	Dona Park	83	23	Decreasing trend, not in the highest 25% for 2014, and 2016
482010071	Ojo De Agua	91	17	Collocated to support exceptional events
484790017	Houston Deer Park #2	91	19	Collocation to meet NATTS requirements
481410029	Texas City Fire Station	92	18	Not ranked in the highest 25% network concentration

- number
% - percent
µg/m³ - micrograms per cubic meter
AQS - Air Quality System
NATTS - National Air Toxics Trends Stations
PM_{10} - particulate matter 10 micrometers or less

PM_{10} measured annual average concentration data was evaluated from 2013-2015 as shown in Table 6 and in more detail in Appendix H, Table 2. PM_{10} measurement concentrations at Clinton (AQS# 482011035), Socorro Hueco (AQS# 481410057), and Convention Center (AQS# 481130050) sites had annual mean concentrations among the highest in the network and continue to satisfy collocation requirements. The three-year average PM_{10} concentration is not in the network highest 25% at Ojo De Agua (AQS# 481411021); however the data supports area exceptional events. Additionally, the Ojo De Agua PM_{10} collocated monitor supports exceptional events analysis. The PM_{10} collocated monitor at Houston Deer Park #2 (AQS# 482011039) supports collocation requirements for the NATTS program.

Appendix H, Table 2 lists the maximum concentration measurement during the 3-year period of 2013-2015 and also includes the 2013, 2014, and 2015 annual mean concentrations for each PM_{10} site. All of these data were utilized during the PM_{10} collocation assessment. The TCEQ exceeds minimum PM_{10} collocation requirements through the PM_{10} monitor operation of the eight sites listed in Table 6. The TCEQ annually evaluates the data to determine network efficacy for the collocated PM_{10} monitors.

Changes to the Regulatory PM_{10} Monitoring Network

The TCEQ recommends the decommission of the Pasadena HL&P site PM_{10} monitor in the Houston-Woodlands-Sugar Land MSA by December 31, 2016. This MSA is required to have a range of four to eight PM_{10} monitors; the TCEQ currently operates eight. The Pasadena HL&P PM_{10} site measured the lowest 2013-2015 three-year maximum concentration (74 $\mu g/m^3$, 49% of the NAAQS) in the MSA. The area contains adequate spatial coverage with one PM_{10} monitor four miles to the west and seven total PM_{10} monitors in the area. The number of required and current PM_{10} monitors in each MSA is included in Appendix H, Table 1.

According to 2013, 2014, and 2015 monitoring data and trends, PM_{10} concentrations at Laredo Vidaurri, Dona Park, and Texas City Fire Station are not in the network's highest 25% annual concentrations. The TCEQ recommends the decommission of collocated monitors, with primary monitors remaining active, at the sites listed below:

- Laredo Vidaurri (AQS# 484790016);
- Dona Park (AQS# 483550034); and
- Texas City Fire Station (AQS# 481670004).

Particulate Matter of 2.5 Micrometers or Less ($PM_{2.5}$)

Monitoring Requirements

The TCEQ $PM_{2.5}$ network is designed to meet area, NCore, and near-road monitoring requirements. The state-wide $PM_{2.5}$ network consists of $PM_{2.5}$ federal reference method (FRM) gravimetric monitoring at 25 sites, continuous $PM_{2.5}$ monitoring at 45 sites, and $PM_{2.5}$ speciation monitoring at seven sites, for a total of 53 sites with at least one type of $PM_{2.5}$ monitoring. Title 40 CFR Part 58, Appendix D, Section 4.7 requires $PM_{2.5}$ monitoring in MSAs with populations of 500,000 or more persons and in MSAs with lower populations if measured $PM_{2.5}$ design values for an MSA are within 85% of the NAAQS. The current $PM_{2.5}$ annual arithmetic mean concentration standard is 12.0 $\mu g/m^3$ averaged over three years and the $PM_{2.5}$ 24-hour average concentration standard is 35 $\mu g/m^3$ for the 98th percentile, averaged over three years.

Title 40 CFR Part 58, Appendix D, Section 4.7.1(2) requires $PM_{2.5}$ monitoring at near-road stations and 40 CFR Part 58.13 (f) requires the $PM_{2.5}$ monitor to be located in each CBSA with a population of 2,500,000 or more persons by January 1, 2015, and also in each CBSA with a population of 1,000,000 or more persons by January 1, 2017. In addition, 40 CFR Part 58, Appendix D, Section 3 requires $PM_{2.5}$ monitoring at all NCore sites.

A detailed analysis of $PM_{2.5}$ monitoring and siting requirements using the 2015 U.S. Census Bureau population estimates and 2015 measured $PM_{2.5}$ concentrations is provided in Appendix I. A summary of the MSA populations, design values, and requirements is provided in Table 7. Through this evaluation, the TCEQ determined that minimum requirements are met or exceeded for all areas and parameters. The TCEQ's assessment of $PM_{2.5}$ monitoring requirements and current monitors is included in Appendix I, Table 1. Appendix I, Table 2 provides information regarding each $PM_{2.5}$ FRM site.

Table 7: Particulate Matter of 2.5 Micrometers or Less Monitoring Requirements

Metropolitan Statistical Area	$PM_{2.5}$					
	FRM Required Monitors[1]	FRM Existing Monitors[2]	Speciation Required Monitors[1,2]	Speciation Existing Monitors[1,2]	Continuous Required Monitors[1,2]	Continuous Existing Monitors[2]
Dallas-Fort Worth-Arlington	4	6	1	2	3	8
Houston-The Woodlands-Sugar Land	4	6	2	2	3	10
San Antonio-New Braunfels	2	2	0	0	1	5
Austin-Round Rock	2	2	0	0	1	3
El Paso	2	2	1	1	2	4
McAllen-Edinburg-Mission[4]	2	2	0	0	1	1
Corpus Christi	1	2	1	1	1	1
Killeen-Temple	0	0	0	0	0	0
Brownsville-Harlingen	1	1	0	0	1	1
Beaumont-Port Arthur	0	0	0	0	0	3
Lubbock	0	0	0	0	0	1
Laredo	0	0	0	0	0	1
Waco	0	0	0	0	0	1
Amarillo	0	0	0	0	0	1
Odessa	0	0	0	0	0	2
Texarkana	1	1	0	0	1	1
Marshall[3]	0	1	0	1	0	1
Eagle Pass[3]	0	0	0	0	0	1
Totals	19	25	5	7	14	45

[1]Required monitors include State or Local Air Monitoring Stations (SLAMS) and National Core (NCore) requirements.
[2]Individual monitors may fulfill one or more requirements.
[3]Area is classified as a micropolitan area and not subject to SLAMS requirements.
[4]Site annual values do not meet completeness criteria.
FRM - federal reference method
$PM_{2.5}$ - particulate matter of 2.5 micrometers or less in diameter

Collocation Requirements

Title 40 CFR Part 58, Appendix A, Section 3.2.3 requires a primary quality assurance organization to select 15% of the $PM_{2.5}$ monitoring sites within the network for collocated sampling. Eighty percent of the collocated audit monitors should be deployed at sites with annual average or daily concentrations estimated to be within 20% of the NAAQS listed in the previous section. Based on the current $PM_{2.5}$ network of 25 FRM monitors, the TCEQ is required to have four collocated $PM_{2.5}$ monitors and currently has three. To meet this requirement, the TCEQ recommends adding a collocated $PM_{2.5}$ FRM monitor in the El Paso MSA.

The EPA approved a collocated $PM_{2.5}$ FRM monitor at the El Paso Chamizal site (AQS# 481410044) in the TCEQ 2015 AMNP response letter. This site was chosen based on the annual and 24-hour $PM_{2.5}$ concentrations in the El Paso area. This site has an annual 2013-2015 design value of 9.9 $\mu g/m^3$, which is within 17% of the NAAQS, meeting the collocation requirements listed above.

Changes to the Regulatory $PM_{2.5}$ Monitoring Network

In compliance with near-road monitoring requirements, the TCEQ recommends deployment of $PM_{2.5}$ FRM monitors (method 145 with a 1-in-3 day sampling schedule) at existing near-road stations in the Austin-Round Rock and San Antonio-New Braunfels CBSAs. The TCEQ plans to deploy a new $PM_{2.5}$ FRM monitor to the San Antonio Interstate 35 site (AQS# 480291069) and relocate the $PM_{2.5}$ FRM monitor from the Austin Audubon Society site (AQS# 484530020) to the Austin North Interstate 35 near-road site (AQS# 484531068). The 2013-2015 annual design value of the $PM_{2.5}$ monitor at the Austin Audubon Society site is 7.8 $\mu g/m^3$, 65% of the annual $PM_{2.5}$ NAAQS of 12.0 $\mu g/m^3$. The relocation of the Austin Audubon Society $PM_{2.5}$ monitor to the Austin North Interstate 35 station will allow the monitor to support multiple monitoring requirements. $PM_{2.5}$ monitors will be operational by January 1, 2017 at the Austin North Interstate 35 site (AQS# 484531068) and the San Antonio Interstate 35 site (AQS# 480291069).

As discussed in the TCEQ 2015 AMNP, the TCEQ relocated the Texarkana station (AQS# 480370004) approximately one mile northwest to physically accommodate both an FRM monitor and a continuous monitor to comply with requirements. The new location is Texarkana New Boston (AQS# 480371031). The EPA approved this site on March 23, 2016. This site fulfills area requirements for a continuous $PM_{2.5}$ monitor and a $PM_{2.5}$ FRM monitor. The established design value for the Texarkana MSA for 2013-2015 is 9.8 $\mu g/m^3$, and exhibits a decreasing trend from the 2012-2014 design value of 10.2 $\mu g/m^3$. The TCEQ requests EPA approval for a reduction in the sampling frequency of the FRM monitor at this site from 1-in-3 days to 1-in-6 days.

Title 40 CFR Part 58, Appendix D, Section 4.7 Table D-5 lists the $PM_{2.5}$ MSA minimum monitoring requirements. Continuous $PM_{2.5}$ monitoring is required for at least one-half of these sites and requires at least one continuous analyzer in each MSA to be collocated with a required FRM monitor. Details regarding the entire TCEQ $PM_{2.5}$ network are found in Appendix I. The TCEQ recommends the decommission of four continuous $PM_{2.5}$ tapered element oscillating microbalances (TEOMs), listed below in Table 8, designated as special purpose monitors. The continuous $PM_{2.5}$ TEOMs are not necessary to meet CFR requirements. The remaining monitors in these MSAs continue to meet and exceed federal requirements.

Table 8: Continuous Particulate Matter of 2.5 Micrometers or Less Decommission Recommendation Summary

Site Name	Metropolitan Statistical Area (MSA)	2015 Annual Mean (µg/m³)	MSA Required Monitors	MSA Existing Monitors	Reason
Dallas Hinton (AQS# 481130069)	Dallas-Fort Worth-Arlington	8.8	3	8	Redundant due to one FRM and one continuous FEM at this site, excess of continuous monitors in MSA
Kingwood (AQS# 482011042)	Houston-The Woodlands-Sugar Land	8.7	3	10	No longer needed for spatial coverage, excess of continuous monitors in MSA
Italy (AQS# 481391044)	Dallas-Fort Worth-Arlington	7.9	3	8	No longer needed for spatial coverage, excess of continuous monitors in MSA
Odessa Hays Elementary School (AQS# 481350003)	Odessa	7.7	0	2	No longer needed for spatial coverage, excess of continuous monitors in MSA

- number
µg/m³ - micrograms per cubic meter
AQS - Air Quality System
FRM - federal reference method
FEM - federal equivalent method

Volatile Organic Compounds (VOCs)

Title 40 CFR Part 58, Appendix D, Section 5 requires hourly averaged speciated VOC monitoring at NCore sites located in a CBSA with a population of 1,000,000 or more persons as part of the revised PAMS program requirements. The TCEQ meets this requirement with one automated gas chromatograph (autoGC) at each NCore site. The TCEQ also monitors speciated VOC concentrations using discrete canister sampling. The TCEQ has eight autoGCs and six canister samplers in the PAMS network and an additional four canister samplers to support the NATTS and special purpose monitoring. No changes are recommended for the VOC monitoring network. However, the TCEQ will reevaluate all PAMS measurements during the assessment of the PAMS network to be published in the 2018 AMNP.

The PAMS network canister samplers and autoGC monitors are listed in Table 9, and a complete list of these monitors is in Appendix A of this document.

Table 9: Canister and Automated Gas Chromatograph Site List

AQS Number	TCEQ Region	Site Name	Sampler Type	AQS Network & Monitor Type
481130069	04-Dallas/Fort Worth	Dallas Hinton	Canister	PAMS
481130069	04-Dallas/Fort Worth	Dallas Hinton	AutoGC	PAMS/NCore
481210034	04-Dallas/Fort Worth	Denton Airport South	Canister	PAMS
481391044	04-Dallas/Fort Worth	Italy	Canister	PAMS
482511008	04-Dallas/Fort Worth	Johnson County Luisa	Canister	SPM
484391002	04-Dallas/Fort Worth	Fort Worth Northwest	Canister	PAMS
484391002	04-Dallas/Fort Worth	Fort Worth Northwest	AutoGC	PAMS
484393009	04-Dallas/Fort Worth	Grapevine Fairway	Canister	PAMS
482030002	05-Tyler	Karnack	Canister	SPM
481410044	06-El Paso	El Paso Chamizal	AutoGC	PAMS/NCore
482450009	10-Beaumont	Beaumont Downtown	AutoGC	PAMS
482451035	10-Beaumont	Nederland High School	AutoGC	PAMS
482010026	12-Houston	Channelview	AutoGC	PAMS
482011035	12-Houston	Clinton	AutoGC	PAMS
482011039	12-Houston	Houston Deer Park #2	Canister	NATTS/PAMS
482011039	12-Houston	Houston Deer Park #2	Canister	NATTS, QA Collocated
482011039	12-Houston	Houston Deer Park #2	AutoGC	PAMS/NCore
484790017	16-Laredo	Laredo Bridge	Canister	SPM

- number
AQS - Air Quality System
AutoGC - automated gas chromatograph
NATTS - National Air Toxics Trends Stations
NCore – National Core Multipollutant Monitoring Stations
PAMS - Photochemical Assessment Monitoring Stations
QA - quality assurance
SPM - special purpose monitor
TCEQ – Texas Commission on Environmental Quality

Carbonyls

The TCEQ collects carbonyl samples at three sites in accordance with PAMS requirements listed under 40 CFR Part 58, Appendix D, Section 5. In addition, the TCEQ has two special purpose carbonyl samplers in support of the NATTS program and one additional special purpose sampler. The TCEQ exceeds monitoring requirements with a total of six carbonyl samplers at the sites listed below:

- Dallas Hinton (AQS# 481130069);
- Clinton (AQS# 482011035);
- Houston Deer Park #2 (AQS# 482011039);
- Karnack (AQS# 482030002);
- Fort Worth Northwest (AQS# 484391002); and
- Ascarate Park SE (AQS# 481410055).

As summarized above and in Appendix A of this document, the TCEQ carbonyl monitoring network is meeting or exceeding all requirements, and no changes are recommended this year.

Meteorology

Title 40 CFR Part 58, Appendix D, Section 5 requires surface and upper-air meteorology measurements at all PAMS sites located at NCore stations in CBSAs with a population of 1,000,000 or more persons. The TCEQ collects surface meteorology data at all PAMS sites and most network sites. Surface meteorology includes wind speed, wind direction, and outdoor temperature. The TCEQ operates radar profilers to fulfill the PAMS upper air meteorology requirements. Surface meteorology and upper air meteorology are included in the Appendix A site list.

On March 28, 2016, the EPA published revisions to 40 CFR Part 58.16 (effective April 27, 2016) that removed the requirements for air agencies to report the average daily temperature and average daily pressure from manual $PM_{2.5}$ samplers. It also removed the requirement for Pb sites to report average temperature and average pressure recorded by the sampler or from nearby airports. The TCEQ requests approval to discontinue the submittal of this meteorological data to AQS effective May 1, 2016.

Three meteorological parameters listed in the Special Purpose network in the 2015 AMNP are required to support the PAMS network: relative humidity, ultraviolet (UV) radiation, and solar radiation. The meteorological parameters at the monitoring sites listed below were updated to be listed under the PAMS network as of January 1, 2016:

- Dallas Hinton (AQS# 481130069) relative humidity;
- El Paso University of Texas at El Paso (UTEP) (AQS# 481410037) UV radiation;
- El Paso Chamizal (AQS# 481410044) solar radiation; and
- Houston Aldine (AQS# 482010024) relative humidity.

Summary

Status of Previously Recommended Changes

The following is a summary of changes that have occurred since the 2015 AMNP.

- The EPA approved the Texarkana station (AQS# 480370004) relocation on March 23, 2016, approximately one mile northwest to physically accommodate both a $PM_{2.5}$ FRM monitor and a $PM_{2.5}$ continuous monitor to comply with area requirements. The new station, deployed February 27, 2016, is named Texarkana New Boston (AQS# 480371031). This site fulfills area requirements with a continuous $PM_{2.5}$ monitor (method 702 deployed on April 7, 2016) and a $PM_{2.5}$ FRM monitor (method 145).

- The TCEQ deployed the required McAllen-Edinburg-Mission MSA PM_{10} monitor (method 141) at the new Edinburg East Freddy Gonzalez Drive (AQS# 482151046) site to meet requirements in the area on July 16, 2015.

- The TCEQ deployed two $PM_{2.5}$ FRM gravimetric samplers (method 145 with a 1-in-3 day sampling schedule) to the existing network at Brownsville station (AQS# 480610006) in the Brownsville-Harlingen MSA and at the new Edinburg East Freddy Gonzalez Drive station (AQS# 482151046) in the McAllen-Edinburg-Mission MSA in June and July of 2015, respectively.

- The continuous $PM_{2.5}$ TEOM special purpose monitor at the City Public Service (CPS) Pecan Valley site (AQS# 480290055) located in the San Antonio area was decommissioned in November 2015. The site was removed at the property owner's request. The San Antonio-New Braunfels MSA population is greater than 1,000,000 persons and requires a minimum of two $PM_{2.5}$ FRM monitors and one $PM_{2.5}$ continuous monitor according to requirements in 40 CFR Part 58, Appendix D, Section 4.7.1. and 4.7.2. Currently, two $PM_{2.5}$ FRM monitors and five $PM_{2.5}$ continuous monitors are located in the area. The $PM_{2.5}$ annual design value for the area is 8.5 $\mu g/m^3$ and is 71% of the NAAQS. These monitors meet and exceed $PM_{2.5}$ monitoring requirements in this MSA and no further action is proposed for this monitor.

- The EPA indicated in the 2015 TCEQ AMNP approval letter that the AQS network designation on the following monitors be changed from SPM to PAMS. The following parameters were updated in AQS as of January 1, 2016:

  - Relative humidity at Dallas Hinton (AQS# 481130069);
  - UV radiation at El Paso UTEP (AQS# 481410037);
  - Solar radiation at El Paso Chamizal (AQS# 481410044); and
  - Relative humidity at Houston Aldine (AQS# 482010024).

2016 Proposed Network Changes

The following is a summary of proposed changes discussed in this year's assessment.

- The TCEQ recommends removal of the NCore network designation in AQS for the NO_2 monitors at El Paso Chamizal (AQS# 481410044) and Houston Deer Park #2 (AQS# 482011039) and maintaining the PAMS and SLAMS network designations only. The EPA clarified in the March 28, 2016, revision to 40 CFR Part 58 that NO_2 was never a required measurement under NCore and that the previous version was erroneous to include it.

- The TCEQ proposes to deploy 12 SO_2 monitoring stations to characterize the ambient air near designated sources of SO_2 emissions in accordance with the DRR.

- The TCEQ recommends deployment of $PM_{2.5}$ FRM monitors (method 145 with a 1-in-3 day sampling schedule) at existing near-road stations in the Austin-Round Rock and San Antonio-New Braunfels CBSAs. The TCEQ plans to deploy a new $PM_{2.5}$ FRM monitor to the San Antonio Interstate 35 site (AQS# 480291069) and relocate the $PM_{2.5}$ FRM monitor from the Austin Audubon Society site (AQS# 484530020) to the Austin North Interstate 35 near-road site (AQS# 484531068) before January 1, 2017.

- The TCEQ plans to deploy gas filter correlation CO monitors (method 093) to the San Antonio Interstate 35 site (AQS# 480291069) and to the Austin North Interstate 35 near-road site (AQS# 484531068) before January 1, 2017.

- The TCEQ recommends the relocation of a collocated Pb monitor from the Frisco 7 site to the Terrell Temtex site since it measures the highest 2015 Pb average concentration in the network.

- Due to revisions to 40 CFR Part 58, Appendix D, Section 3(b), TSP Pb monitoring is no longer a required measurement at NCore sites. The TCEQ recommends to discontinue the TSP Pb monitors at three NCore sites Houston Deer Park #2 (AQS# 482011039), Dallas Hinton (AQS# 481130069), and El Paso Chamizal site (AQS# 481410044).

- The TCEQ recommends the decommission of the Pasadena HL&P PM_{10} monitor in the Houston-Woodlands-Sugar Land MSA by December 31, 2016.

- The TCEQ recommends the decommission of collocated PM_{10} monitors, with primary monitors remaining active, at the Laredo Vidaurri (AQS# 484790016), Dona Park (AQS# 483550034), and Texas City Fire Station (AQS# 481670004) sites.

- The TCEQ recommends the decommission of four continuous $PM_{2.5}$ TEOMs designated as special purpose monitors located at Dallas Hinton (AQS# 481130069), Kingwood (AQS# 482011042), Italy (AQS# 481391044), and Odessa Hays Elementary School (AQS# 481350003).

- The TCEQ plans to deploy a collocated $PM_{2.5}$ FRM monitor to the El Paso Chamizal site (AQS# 481410044) to meet collocation requirements.

- The TCEQ requests to discontinue the submittal of average daily temperature and average daily pressure, effective May 1, 2016, from manual $PM_{2.5}$ samplers, and average temperature and average pressure recorded at Pb sites by the sampler or from nearby airports to AQS, according to changes to 40 CFR 58.16 requirements.

Conclusion

After consideration of the federal regulations, 2015 U.S. Census Bureau population data, and 2015 design values, the TCEQ will meet or exceed all monitoring requirements with the above mentioned recommendations for the next calendar year. This network plan focuses on the current network and changes within this network from July 1, 2015, through December 31, 2017.

Instructions for Comments

Send comments pertaining to this document to the following address.

Texas Commission on Environmental Quality
P.O. Box 13087
Attention: Holly Landuyt, MC-165
Austin, Texas 78711-3087

Or email to: monops@tceq.texas.gov

Appendix A

Ambient Air Monitoring Network Site List

Texas Commission on Environmental Quality

2016 Annual Monitoring Network Plan

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
480271045	Temple Georgia	8406 Georgia Avenue, Temple	Killeen-Temple-Fort Hood, TX	31.1224187	-97.4310523	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Urban Scale
480271045	Temple Georgia	8406 Georgia Avenue, Temple	Killeen-Temple-Fort Hood, TX	31.1224187	-97.4310523	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Neighborhood
480271045	Temple Georgia	8406 Georgia Avenue, Temple	Killeen-Temple-Fort Hood, TX	31.1224187	-97.4310523	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
480271047	Killeen Skylark Field	1605 Stone Tree Drive, Killeen	Killeen-Temple-Fort Hood, TX	31.0880022	-97.6797343	Urban and Center City	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Urban Scale
480271047	Killeen Skylark Field	1605 Stone Tree Drive, Killeen	Killeen-Temple-Fort Hood, TX	31.0880022	-97.6797343	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Urban Scale
480271047	Killeen Skylark Field	1605 Stone Tree Drive, Killeen	Killeen-Temple-Fort Hood, TX	31.0880022	-97.6797343	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Urban Scale
480290032	San Antonio Northwest	6655 Bluebird Lane, San Antonio	San Antonio, TX	29.5150900	-98.6201660	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Population Exposure	Neighborhood
480290032	San Antonio Northwest	6655 Bluebird Lane, San Antonio	San Antonio, TX	29.5150900	-98.6201660	Suburban	O3	SLAMS	UV Photometric	Continuous	Max Ozone Concentration; Population Exposure	Urban Scale
480290032	San Antonio Northwest	6655 Bluebird Lane, San Antonio	San Antonio, TX	29.5150900	-98.6201660	Suburban	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/6 Days	Population Exposure	Urban Scale
480290032	San Antonio Northwest	6655 Bluebird Lane, San Antonio	San Antonio, TX	29.5150900	-98.6201660	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Urban Scale
480290032	San Antonio Northwest	6655 Bluebird Lane, San Antonio	San Antonio, TX	29.5150900	-98.6201660	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Highest Concentration	Urban Scale
480290032	San Antonio Northwest	6655 Bluebird Lane, San Antonio	San Antonio, TX	29.5150900	-98.6201660	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Urban Scale
480290052	Camp Bullis	F Range (1000Yd marker off Wilderness Trail), Near Wilderness Rd, San Antonio	San Antonio, TX	29.6320582	-98.5649364	Rural	O3	SLAMS	UV Photometric	Continuous	Max Ozone Concentration; Population Exposure	Urban Scale
480290052	Camp Bullis	F Range (1000Yd marker off Wilderness Trail), Near Wilderness Rd, San Antonio	San Antonio, TX	29.6320582	-98.5649364	Rural	Solar Radiation	SPM	Photovoltaic	Continuous	Highest Concentration	Urban Scale
480290052	Camp Bullis	F Range (1000Yd marker off Wilderness Trail), Near Wilderness Rd, San Antonio	San Antonio, TX	29.6320582	-98.5649364	Rural	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Highest Concentration	Urban Scale
480290052	Camp Bullis	F Range (1000Yd marker off Wilderness Trail), Near Wilderness Rd, San Antonio	San Antonio, TX	29.6320582	-98.5649364	Rural	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Urban Scale
480290053	Selma	16289 North Evans Rd #2, Selma	San Antonio, TX	29.5877408	-98.3125118	Suburban	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
480290053	Selma	16289 North Evans Rd #2, Selma	San Antonio, TX	29.5877408	-98.3125118	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
480290059	Calaveras Lake	14620 Laguna Rd, San Antonio	San Antonio, TX	29.2753812	-98.3116919	Rural	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Source Oriented; Upwind Background	Urban Scale
480290059	Calaveras Lake	14620 Laguna Rd, San Antonio	San Antonio, TX	29.2753812	-98.3116919	Rural	O3	SLAMS	UV Photometric	Continuous	Source Oriented; Upwind Background	Urban Scale

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
480290059	Calaveras Lake	14620 Laguna Rd, San Antonio	San Antonio, TX	29.2753812	-98.3116919	Rural	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/6 Days	Population Exposure; Upwind Background	Urban Scale
480290059	Calaveras Lake	14620 Laguna Rd, San Antonio	San Antonio, TX	29.2753812	-98.3116919	Rural	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Regional Transport	Regional Scale
480290059	Calaveras Lake	14620 Laguna Rd, San Antonio	San Antonio, TX	29.2753812	-98.3116919	Rural	SO2	SLAMS	Pulsed Fluorescence	Continuous	Population Exposure; Source Oriented	Neighborhood
480290059	Calaveras Lake	14620 Laguna Rd, San Antonio	San Antonio, TX	29.2753812	-98.3116919	Rural	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Source Oriented	Urban Scale
480290059	Calaveras Lake	14620 Laguna Rd, San Antonio	San Antonio, TX	29.2753812	-98.3116919	Rural	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Source Oriented	Urban Scale
480290060	Frank Wing Municipal Court	401 South Frio St, San Antonio	San Antonio, TX	29.4221832	-98.5053810	Urban and Center City	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Middle Scale
480290676	Palo Alto	9011 Poteet Jourdanton Hwy, San Antonio	San Antonio, TX	29.3327898	-98.5513832	Urban and Center City	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
480290676	Palo Alto	9011 Poteet Jourdanton Hwy, San Antonio	San Antonio, TX	29.3327898	-98.5513832	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Neighborhood
480290676	Palo Alto	9011 Poteet Jourdanton Hwy, San Antonio	San Antonio, TX	29.3327898	-98.5513832	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
480290677	Old Hwy 90	911 Old Hwy 90 West, San Antonio	San Antonio, TX	29.4239439	-98.5804991	Urban and Center City	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
480290677	Old Hwy 90	911 Old Hwy 90 West, San Antonio	San Antonio, TX	29.4239439	-98.5804991	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Neighborhood
480290677	Old Hwy 90	911 Old Hwy 90 West, San Antonio	San Antonio, TX	29.4239439	-98.5804991	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
480291069	San Antonio Interstate 35	9904 IH 35 N, San Antonio	San Antonio, TX	29.5294000	-98.3913900	Urban and Center City	NO/NO2/NOx	Near Road/ SLAMS	Chemiluminescence	Continuous	Max Precursor Emissions Impact	Microscale
480291069	San Antonio Interstate 35	9904 IH 35 N, San Antonio	San Antonio, TX	29.5294000	-98.3913900	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Max Precursor Emissions Impact	Microscale
480291069	San Antonio Interstate 35	9904 IH 35 N, San Antonio	San Antonio, TX	29.5294000	-98.3913900	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Max Precursor Emissions Impact	Microscale
480370004	Texarkana	2315 W 10th Street, Texarkana	Texarkana, TX-Texarkana, AR	33.4257582	-94.0708021	Urban and Center City	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/3 Days	Population Exposure	Urban Scale
480371031	Texarkana New Boston	2700 New Boston Road	Texarkana, TX-Texarkana, AR	33.4361110	-94.0777800	Urban and Center City	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/3 Days	Population Exposure	Urban Scale
480371031	Texarkana New Boston	2701 New Boston Road	Texarkana, TX-Texarkana, AR	33.4361110	-94.0777800	Urban and Center City	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Urban Scale
480391004	Manvel Croix Park	4503 Croix Pkwy, Manvel	Houston-Sugar Land-Baytown, TX	29.5204432	-95.3925089	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Population Exposure	Neighborhood/ Urban Scale
480391004	Manvel Croix Park	4503 Croix Pkwy, Manvel	Houston-Sugar Land-Baytown, TX	29.5204432	-95.3925089	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Urban Scale

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
480391004	Manvel Croix Park	4503 Croix Pkwy, Manvel	Houston-Sugar Land-Baytown, TX	29.5204432	-95.3925089	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
480391004	Manvel Croix Park	4503 Croix Pkwy, Manvel	Houston-Sugar Land-Baytown, TX	29.5204432	-95.3925089	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
480391016	Lake Jackson	109B Brazoria Hwy 332 West, Lake Jackson	Houston-Sugar Land-Baytown, TX	29.0437592	-95.4729462	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Population Exposure; Source Oriented	Middle Scale/ Neighborhood
480391016	Lake Jackson	109B Brazoria Hwy 332 West, Lake Jackson	Houston-Sugar Land-Baytown, TX	29.0437592	-95.4729462	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure; Source Oriented	Neighborhood
480391016	Lake Jackson	109B Brazoria Hwy 332 West, Lake Jackson	Houston-Sugar Land-Baytown, TX	29.0437592	-95.4729462	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	Highest Concentration	Middle Scale
480391016	Lake Jackson	109B Brazoria Hwy 332 West, Lake Jackson	Houston-Sugar Land-Baytown, TX	29.0437592	-95.4729462	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Highest Concentration	Middle Scale
480391016	Lake Jackson	109B Brazoria Hwy 332 West, Lake Jackson	Houston-Sugar Land-Baytown, TX	29.0437592	-95.4729462	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Middle Scale
480430101	Bravo Big Bend	Big Bend National Park, Big Bend Nat Park	None	29.3025518	-103.1779076	Rural	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Regional Transport	Regional Scale
480430101	Bravo Big Bend	Big Bend National Park, Big Bend Nat Park	None	29.3025518	-103.1779076	Rural	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Regional Scale
480430101	Bravo Big Bend	Big Bend National Park, Big Bend Nat Park	None	29.3025518	-103.1779076	Rural	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Regional Scale
480610006	Brownsville	344 Porter Drive, Brownsville	Brownsville-Harlingen, TX	25.8925176	-97.4938295	Urban and Center City	Ambient Temperature TSP (Pb)	SPM	Derived from KBRO	24 Hours; 1/6 Days	General/Background	Urban Scale
480610006	Brownsville	344 Porter Drive, Brownsville	Brownsville-Harlingen, TX	25.8925176	-97.4938295	Urban and Center City	Barometric Pressure TSP (Pb)	SPM	Derived from KBRO	24 Hours; 1/6 Days	General/Background	Urban Scale
480610006	Brownsville	344 Porter Drive, Brownsville	Brownsville-Harlingen, TX	25.8925176	-97.4938295	Urban and Center City	CO	SPM	Gas Filter Correlation	Continuous	Highest Concentration	Neighborhood
480610006	Brownsville	344 Porter Drive, Brownsville	Brownsville-Harlingen, TX	25.8925176	-97.4938295	Urban and Center City	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
480610006	Brownsville	344 Porter Drive, Brownsville	Brownsville-Harlingen, TX	25.8925176	-97.4938295	Urban and Center City	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/3 Days	Population Exposure	Regional Scale
480610006	Brownsville	344 Porter Drive, Brownsville	Brownsville-Harlingen, TX	25.8925176	-97.4938295	Urban and Center City	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Urban Scale
480610006	Brownsville	344 Porter Drive, Brownsville	Brownsville-Harlingen, TX	25.8925176	-97.4938295	Urban and Center City	Solar Radiation	SPM	Photovoltaic	Continuous	Highest Concentration	Neighborhood
480610006	Brownsville	344 Porter Drive, Brownsville	Brownsville-Harlingen, TX	25.8925176	-97.4938295	Urban and Center City	SVOC	SPM	HiVol PUF XAD GC-MS	24 Hours; 1/6 Days	Population Exposure; Upwind Background	Middle Scale
480610006	Brownsville	344 Porter Drive, Brownsville	Brownsville-Harlingen, TX	25.8925176	-97.4938295	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Urban Scale
480610006	Brownsville	344 Porter Drive, Brownsville	Brownsville-Harlingen, TX	25.8925176	-97.4938295	Urban and Center City	TSP (Pb)	SLAMS	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure	Urban Scale

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
480610006	Brownsville	344 Porter Drive, Brownsville	Brownsville-Harlingen, TX	25.8925176	-97.4938295	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Neighborhood
480611023	Harlingen Teege	1602 W Teege Avenue, Harlingen	Brownsville-Harlingen, TX	26.2003347	-97.7126837	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
480611023	Harlingen Teege	1602 W Teege Avenue, Harlingen	Brownsville-Harlingen, TX	26.2003347	-97.7126837	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
480611023	Harlingen Teege	1602 W Teege Avenue, Harlingen	Brownsville-Harlingen, TX	26.2003347	-97.7126837	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
480612004	Isla Blanca Park	Lot B 69 1/2, South Padre Island	Brownsville-Harlingen, TX	26.0696153	-97.1621996	Rural	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Regional Transport	Urban Scale
480612004	Isla Blanca Park	Lot B 69 1/2, South Padre Island	Brownsville-Harlingen, TX	26.0696153	-97.1621996	Rural	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Regional Transport	Regional Scale
480612004	Isla Blanca Park	Lot B 69 1/2, South Padre Island	Brownsville-Harlingen, TX	26.0696153	-97.1621996	Rural	Wind (3m)	SPM	Potentiometer Cup Anemometer	Continuous	Regional Transport	Regional Scale
480710013	Smith Point Hawkins Camp	1850 Hawkins Camp Rd, Anahuac	Houston-Sugar Land-Baytown, TX	29.5462437	-94.7869686	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Source Oriented	Neighborhood
480710013	Smith Point Hawkins Camp	1850 Hawkins Camp Rd, Anahuac	Houston-Sugar Land-Baytown, TX	29.5462437	-94.7869686	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Source Oriented	Neighborhood
480850003	Frisco 5th St	7471 South 5th Street, Frisco	Dallas-Fort Worth-Arlington, TX	33.1423361	-96.8246832	Suburban	Ambient Temperature TSP (Pb)	SPM	Derived from 484393009	24 Hours; 1/6 Days	General/Background	Middle Scale
480850003	Frisco 5th St	7471 South 5th Street, Frisco	Dallas-Fort Worth-Arlington, TX	33.1423361	-96.8246832	Suburban	Barometric Pressure TSP (Pb)	SPM	Derived from 484393009	24 Hours; 1/6 Days	General/Background	Middle Scale
480850003	Frisco 5th St	7471 South 5th Street, Frisco	Dallas-Fort Worth-Arlington, TX	33.1423361	-96.8246832	Suburban	TSP (Pb)	SLAMS	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure; Source Oriented	Middle Scale
480850005	Frisco	6590 Hillcrest Road, Frisco	Dallas-Fort Worth-Arlington, TX	33.1324003	-96.7864188	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Urban Scale
480850005	Frisco	6590 Hillcrest Road, Frisco	Dallas-Fort Worth-Arlington, TX	33.1324003	-96.7864188	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	General/Background	Urban Scale
480850005	Frisco	6590 Hillcrest Road, Frisco	Dallas-Fort Worth-Arlington, TX	33.1324003	-96.7864188	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Urban Scale
480850005	Frisco	6590 Hillcrest Road, Frisco	Dallas-Fort Worth-Arlington, TX	33.1324003	-96.7864188	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Urban Scale
480850007	Frisco 7	6931 Ash Street, Frisco	Dallas-Fort Worth-Arlington, TX	33.1474141	-96.8257693	Suburban	Ambient Temperature TSP (Pb)	SPM	Derived from 484393009	24 Hours; 1/6 Days	General/Background	Neighborhood
480850007	Frisco 7	6931 Ash Street, Frisco	Dallas-Fort Worth-Arlington, TX	33.1474141	-96.8257693	Suburban	Barometric Pressure TSP (Pb)	SPM	Derived from 484393009	24 Hours; 1/6 Days	General/Background	Neighborhood
480850007	Frisco 7	6931 Ash Street, Frisco	Dallas-Fort Worth-Arlington, TX	33.1474141	-96.8257693	Suburban	TSP (Pb)	SLAMS	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure; Source Oriented	Neighborhood
480850007	Frisco 7	6931 Ash Street, Frisco	Dallas-Fort Worth-Arlington, TX	33.1474141	-96.8257693	Suburban	TSP (Pb)	QA Collocated/ SLAMS	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure; Source Oriented	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
480850009	Frisco Eubanks	6601 Eubanks, Frisco	Dallas-Fort Worth-Arlington, TX	33.1446618	-96.8288087	Suburban	Ambient Temperature TSP (Pb)	SPM	Derived from 484393009	24 Hours; 1/6 Days	General/Background	Neighborhood
480850009	Frisco Eubanks	6601 Eubanks, Frisco	Dallas-Fort Worth-Arlington, TX	33.1446618	-96.8288087	Suburban	Barometric Pressure TSP (Pb)	SPM	Derived from 484393009	24 Hours; 1/6 Days	General/Background	Neighborhood
480850009	Frisco Eubanks	6601 Eubanks, Frisco	Dallas-Fort Worth-Arlington, TX	33.1446618	-96.8288087	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure; Source Oriented	Neighborhood
480850009	Frisco Eubanks	6601 Eubanks, Frisco	Dallas-Fort Worth-Arlington, TX	33.1446618	-96.8288087	Suburban	TSP (Pb)	QA Collocated/ SLAMS	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure; Source Oriented	Neighborhood
480850009	Frisco Eubanks	6601 Eubanks, Frisco	Dallas-Fort Worth-Arlington, TX	33.1446618	-96.8288087	Suburban	TSP (Pb)	SLAMS	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure; Source Oriented	Neighborhood
480850009	Frisco Eubanks	6601 Eubanks, Frisco	Dallas-Fort Worth-Arlington, TX	33.1446618	-96.8288087	Suburban	Wind (3m)	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	
480850029	Frisco Stonebrook	7202 Stonebrook Parkway, Frisco	Dallas-Fort Worth-Arlington, TX	33.1360249	-96.8244725	Urban and Center City	Ambient Temperature TSP (Pb)	SPM	Derived from 484393009	24 Hours; 1/6 Days	General/Background	Neighborhood
480850029	Frisco Stonebrook	7202 Stonebrook Parkway, Frisco	Dallas-Fort Worth-Arlington, TX	33.1360249	-96.8244725	Urban and Center City	Barometric Pressure TSP (Pb)	SPM	Derived from 484393009	24 Hours; 1/6 Days	General/Background	Neighborhood
480850029	Frisco Stonebrook	7202 Stonebrook Parkway, Frisco	Dallas-Fort Worth-Arlington, TX	33.1360249	-96.8244725	Urban and Center City	TSP (Pb)	SPM	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481130018	Morrell	3049 Morrell, Dallas	Dallas-Fort Worth-Arlington, TX	32.7449810	-96.7818829	Urban and Center City	PM10 (Speciation)	SPM	ICP-AES	24 Hours; 1/6 Days	Source Oriented	Neighborhood
481130050	Convention Center	717 South Akard, Dallas	Dallas-Fort Worth-Arlington, TX	32.7742622	-96.7976859	Urban and Center City	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481130050	Convention Center	717 South Akard, Dallas	Dallas-Fort Worth-Arlington, TX	32.7742622	-96.7976859	Urban and Center City	PM10 (FRM)	QA Collocated/ SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481130050	Convention Center	717 South Akard, Dallas	Dallas-Fort Worth-Arlington, TX	32.7742622	-96.7976859	Urban and Center City	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/3 Days	Highest Concentration; Population Exposure	Neighborhood
481130050	Convention Center	717 South Akard, Dallas	Dallas-Fort Worth-Arlington, TX	32.7742622	-96.7976859	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
481130050	Convention Center	717 South Akard, Dallas	Dallas-Fort Worth-Arlington, TX	32.7742622	-96.7976859	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
481130061	Earhart	3434 Bickers (Earhart Elem School), Dallas	Dallas-Fort Worth-Arlington, TX	32.7853591	-96.8765711	Urban and Center City	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	Ambient Temperature TSP (Pb)	SPM	Derived from KDAL	24 Hours; 1/6 Days	General/Background	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	Barometric Pressure TSP (Pb)	SPM	Derived from KDAL	24 Hours; 1/6 Days	General/Background	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	Carbonyl	PAMS	DNPH Silica HPLC	3 Hours; Seasonal, 24 Hours;	Max Precursor Emissions Impact	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	CO (High Sensitivity)	NCORE/ PAMS/ SLAMS	Gas Filter Correlation	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	Dew Point	SPM	Derived at site	Continuous	Population Exposure	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	NO/NO2/NOx	PAMS/ SLAMS	Chemiluminescence	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	NOy (High Sensitivity)	NCORE/ SLAMS	Chemiluminescence	Continuous	Highest Concentration	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	O3	NCORE/ PAMS/ SLAMS	UV Photometric	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	PM10-2.5	NCORE	Beta Attentuation	Continuous	Population Exposure	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	PM2.5 (FEM)	NCORE/ SLAMS	Beta Attentuation	Continuous	Population Exposure	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	PM2.5 (FRM)	NCORE/ SLAMS	Sequential FRM Gravimetric	24 Hours; 1/1 Days	Population Exposure	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	PM2.5 (FRM)	QA Collocated/SLAMS	Sequential FRM Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	PM2.5 (Speciation)	NCore	Carbons | Elements | Ions | Sequential Non-	24 Hours; 1/3 Days	Population Exposure	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Highest Concentration	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	Relative Humidity	NCORE/ PAMS	Humidity Sensor	Continuous	Max Precursor Emissions Impact	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	SO2 (High Sensitivity)	NCORE/ SLAMS	Pulsed Fluorescence	Continuous	Population Exposure	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	Solar Radiation	PAMS/ SLAMS	Photovoltaic	Continuous	Max Precursor Emissions Impact	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	Speciated VOC (AutoGC)	PAMS	GC	Continuous	Highest Concentration; Max Precursor Emissions	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	Speciated VOC (Canister)	PAMS	Canister GC-MS	24 Hours; 1/6 Days	Max Precursor Emissions Impact	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Max Precursor Emissions Impact	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	TSP (Pb)	NCORE/ SLAMS	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	Visibility	SPM	Visibility Sensor	Continuous	Population Exposure	Neighborhood
481130069	Dallas Hinton	1415 Hinton Street, Dallas	Dallas-Fort Worth-Arlington, TX	32.8200608	-96.8601165	Urban and Center City	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Max Precursor Emissions Impact	Neighborhood
481130075	Dallas North #2	12532 1/2 Nuestra Drive, Dallas	Dallas-Fort Worth-Arlington, TX	32.9192056	-96.8084975	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Population Exposure	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
481130075	Dallas North #2	12532 1/2 Nuestra Drive, Dallas	Dallas-Fort Worth-Arlington, TX	32.9192056	-96.8084975	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Urban Scale
481130075	Dallas North #2	12532 1/2 Nuestra Drive, Dallas	Dallas-Fort Worth-Arlington, TX	32.9192056	-96.8084975	Suburban	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Urban Scale
481130075	Dallas North #2	12532 1/2 Nuestra Drive, Dallas	Dallas-Fort Worth-Arlington, TX	32.9192056	-96.8084975	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	General/Background	Neighborhood
481130075	Dallas North #2	12532 1/2 Nuestra Drive, Dallas	Dallas-Fort Worth-Arlington, TX	32.9192056	-96.8084975	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Neighborhood
481130075	Dallas North #2	12532 1/2 Nuestra Drive, Dallas	Dallas-Fort Worth-Arlington, TX	32.9192056	-96.8084975	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
481130087	Dallas Redbird Airport Executive	3277 W Redbird Lane, Dallas	Dallas-Fort Worth-Arlington, TX	32.6764506	-96.8720596	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Population Exposure	Neighborhood
481130087	Dallas Redbird Airport Executive	3277 W Redbird Lane, Dallas	Dallas-Fort Worth-Arlington, TX	32.6764506	-96.8720596	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Urban Scale
481130087	Dallas Redbird Airport Executive	3277 W Redbird Lane, Dallas	Dallas-Fort Worth-Arlington, TX	32.6764506	-96.8720596	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Neighborhood
481130087	Dallas Redbird Airport Executive	3277 W Redbird Lane, Dallas	Dallas-Fort Worth-Arlington, TX	32.6764506	-96.8720596	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
481131067	Dallas LBJ Freeway	8652 LBJ Freeway, Dallas	Dallas-Fort Worth-Arlington, TX	32.9211800	-96.7535500	Urban and Center City	NO/NO2/NOx	Near Road/ SLAMS	Chemiluminescence	Continuous	Max Precursor Emissions Impact	Microscale
481131067	Dallas LBJ Freeway	8652 LBJ Freeway, Dallas	Dallas-Fort Worth-Arlington, TX	32.9211800	-96.7535500	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Max Precursor Emissions Impact	Microscale
481131067	Dallas LBJ Freeway	8652 LBJ Freeway, Dallas	Dallas-Fort Worth-Arlington, TX	32.9211800	-96.7535500	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Max Precursor Emissions Impact	Microscale
481210034	Denton Airport South	Denton Airport South, Denton	Dallas-Fort Worth-Arlington, TX	33.2190690	-97.1962836	Rural	Dew Point	SPM	Derived at site	Continuous	Population Exposure	Urban Scale
481210034	Denton Airport South	Denton Airport South, Denton	Dallas-Fort Worth-Arlington, TX	33.2190690	-97.1962836	Rural	NO/NO2/NOx	PAMS	Chemiluminescence	Continuous	Max Ozone Concentration; Population Exposure	Urban Scale
481210034	Denton Airport South	Denton Airport South, Denton	Dallas-Fort Worth-Arlington, TX	33.2190690	-97.1962836	Rural	NOy (High Sensitivity)	PAMS	Chemiluminescence	Continuous	Max Ozone Concentration; Population Exposure	Urban Scale
481210034	Denton Airport South	Denton Airport South, Denton	Dallas-Fort Worth-Arlington, TX	33.2190690	-97.1962836	Rural	O3	PAMS	UV Photometric	Continuous	Max Ozone Concentration; Population Exposure	Urban Scale
481210034	Denton Airport South	Denton Airport South, Denton	Dallas-Fort Worth-Arlington, TX	33.2190690	-97.1962836	Rural	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Urban Scale
481210034	Denton Airport South	Denton Airport South, Denton	Dallas-Fort Worth-Arlington, TX	33.2190690	-97.1962836	Rural	Precipitation	PAMS	Rain Gauge	Continuous	Max Ozone Concentration	Urban Scale
481210034	Denton Airport South	Denton Airport South, Denton	Dallas-Fort Worth-Arlington, TX	33.2190690	-97.1962836	Rural	Relative Humidity	PAMS	Humidity Sensor	Continuous	Max Ozone Concentration	Urban Scale
481210034	Denton Airport South	Denton Airport South, Denton	Dallas-Fort Worth-Arlington, TX	33.2190690	-97.1962836	Rural	Solar Radiation	PAMS	Photovoltaic	Continuous	Max Ozone Concentration	Urban Scale

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
481210034	Denton Airport South	Denton Airport South, Denton	Dallas-Fort Worth-Arlington, TX	33.2190690	-97.1962836	Rural	Speciated VOC (Canister)	PAMS	Canister GC-MS	24 Hours; 1/6 Days	Max Ozone Concentration; Population Exposure	Urban Scale
481210034	Denton Airport South	Denton Airport South, Denton	Dallas-Fort Worth-Arlington, TX	33.2190690	-97.1962836	Rural	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Max Ozone Concentration	Urban Scale
481210034	Denton Airport South	Denton Airport South, Denton	Dallas-Fort Worth-Arlington, TX	33.2190690	-97.1962836	Rural	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Max Ozone Concentration	Urban Scale
481211032	Pilot Point	792 E Northside Dr, Pilot Point	Dallas-Fort Worth-Arlington, TX	33.4106476	-96.9445903	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Regional Scale
481211032	Pilot Point	792 E Northside Dr, Pilot Point	Dallas-Fort Worth-Arlington, TX	33.4106476	-96.9445903	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	Upwind Background	Regional Scale
481211032	Pilot Point	792 E Northside Dr, Pilot Point	Dallas-Fort Worth-Arlington, TX	33.4106476	-96.9445903	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Upwind Background	Regional Scale
481211032	Pilot Point	792 E Northside Dr, Pilot Point	Dallas-Fort Worth-Arlington, TX	33.4106476	-96.9445903	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Upwind Background	Regional Scale
481350003	Odessa-Hays Elementary School	Barrett & Monahans Streets, Odessa	Odessa, TX	31.8365747	-102.3420368	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Urban Scale
481350003	Odessa-Hays Elementary School	Barrett & Monahans Streets, Odessa	Odessa, TX	31.8365747	-102.3420368	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Highest Concentration	Neighborhood
481350003	Odessa-Hays Elementary School	Barrett & Monahans Streets, Odessa	Odessa, TX	31.8365747	-102.3420368	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Neighborhood
481351014	Odessa Gonzales	2700 Disney, Odessa	Odessa, TX	31.8702534	-102.3347563	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Highest Concentration	Neighborhood
481351014	Odessa Gonzales	2700 Disney, Odessa	Odessa, TX	31.8702534	-102.3347563	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
481351014	Odessa Gonzales	2700 Disney, Odessa	Odessa, TX	31.8702534	-102.3347563	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
481390016	Midlothian OFW	2725 Old Fort Worth Road, Midlothian	Dallas-Fort Worth-Arlington, TX	32.4820829	-97.0268987	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Source Oriented	Neighborhood
481390016	Midlothian OFW	2725 Old Fort Worth Road, Midlothian	Dallas-Fort Worth-Arlington, TX	32.4820829	-97.0268987	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Urban Scale
481390016	Midlothian OFW	2725 Old Fort Worth Road, Midlothian	Dallas-Fort Worth-Arlington, TX	32.4820829	-97.0268987	Suburban	PM2.5 (FRM)	SPM	Sequential FRM Gravimetric	24 Hours; 1/6 Days	Population Exposure; Source Oriented	Microscale
481390016	Midlothian OFW	2725 Old Fort Worth Road, Midlothian	Dallas-Fort Worth-Arlington, TX	32.4820829	-97.0268987	Suburban	PM2.5 (Speciation)	SPM	Carbons | Elements | Ions | Sequential FRM	24 Hours; 1/6 Days	Population Exposure; Source Oriented	Neighborhood
481390016	Midlothian OFW	2725 Old Fort Worth Road, Midlothian	Dallas-Fort Worth-Arlington, TX	32.4820829	-97.0268987	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Regional Transport	Regional Scale
481390016	Midlothian OFW	2725 Old Fort Worth Road, Midlothian	Dallas-Fort Worth-Arlington, TX	32.4820829	-97.0268987	Suburban	SO2	SLAMS	Pulsed Fluorescence	Continuous	Source Oriented	Neighborhood
481390016	Midlothian OFW	2725 Old Fort Worth Road, Midlothian	Dallas-Fort Worth-Arlington, TX	32.4820829	-97.0268987	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	General/Background	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
481390016	Midlothian OFW	2725 Old Fort Worth Road, Midlothian	Dallas-Fort Worth-Arlington, TX	32.4820829	-97.0268987	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Neighborhood
481390016	Midlothian OFW	2725 Old Fort Worth Road, Midlothian	Dallas-Fort Worth-Arlington, TX	32.4820829	-97.0268987	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
481391044	Italy	900 FM 667 Ellis County, Italy	Dallas-Fort Worth-Arlington, TX	32.1754166	-96.8701892	Rural	Dew Point	SPM	Derived at site	Continuous	Upwind Background	Urban Scale
481391044	Italy	900 FM 667 Ellis County, Italy	Dallas-Fort Worth-Arlington, TX	32.1754166	-96.8701892	Rural	NO/NO2/NOx	PAMS/ SLAMS	Chemiluminescence	Continuous	Upwind Background	Urban Scale
481391044	Italy	900 FM 667 Ellis County, Italy	Dallas-Fort Worth-Arlington, TX	32.1754166	-96.8701892	Rural	O3	PAMS/ SLAMS	UV Photometric	Continuous	Upwind Background	Urban Scale
481391044	Italy	900 FM 667 Ellis County, Italy	Dallas-Fort Worth-Arlington, TX	32.1754166	-96.8701892	Rural	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Upwind Background	Regional Scale
481391044	Italy	900 FM 667 Ellis County, Italy	Dallas-Fort Worth-Arlington, TX	32.1754166	-96.8701892	Rural	Relative Humidity	PAMS	Humidity Sensor	Continuous	Upwind Background	Urban Scale
481391044	Italy	900 FM 667 Ellis County, Italy	Dallas-Fort Worth-Arlington, TX	32.1754166	-96.8701892	Rural	SO2	SPM	Pulsed Fluorescence	Continuous	Upwind Background	Urban Scale
481391044	Italy	900 FM 667 Ellis County, Italy	Dallas-Fort Worth-Arlington, TX	32.1754166	-96.8701892	Rural	Solar Radiation	PAMS	Photovoltaic	Continuous	Upwind Background	Urban Scale
481391044	Italy	900 FM 667 Ellis County, Italy	Dallas-Fort Worth-Arlington, TX	32.1754166	-96.8701892	Rural	Speciated VOC (Canister)	PAMS	Canister GC-MS	24 Hours; 1/6 Days	Upwind Background	Urban Scale
481391044	Italy	900 FM 667 Ellis County, Italy	Dallas-Fort Worth-Arlington, TX	32.1754166	-96.8701892	Rural	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Upwind Background	Urban Scale
481391044	Italy	900 FM 667 Ellis County, Italy	Dallas-Fort Worth-Arlington, TX	32.1754166	-96.8701892	Rural	UV Radiation	PAMS	Photovoltaic	Continuous	Upwind Background	Urban Scale
481391044	Italy	900 FM 667 Ellis County, Italy	Dallas-Fort Worth-Arlington, TX	32.1754166	-96.8701892	Rural	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Upwind Background	Urban Scale
481410029	Ivanhoe	10834 Ivanhoe (Ivanhoe Fire Station), El Paso	El Paso, TX	31.7857687	-106.3235781	Suburban	O3	SPM	UV Photometric	Continuous	Population Exposure	Neighborhood
481410029	Ivanhoe	10834 Ivanhoe (Ivanhoe Fire Station), El Paso	El Paso, TX	31.7857687	-106.3235781	Suburban	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481410029	Ivanhoe	10834 Ivanhoe (Ivanhoe Fire Station), El Paso	El Paso, TX	31.7857687	-106.3235781	Suburban	Relative Humidity	Border Grant/SPM	Humidity Sensor	Continuous	General/Background	Neighborhood
481410029	Ivanhoe	10834 Ivanhoe (Ivanhoe Fire Station), El Paso	El Paso, TX	31.7857687	-106.3235781	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Neighborhood
481410029	Ivanhoe	10834 Ivanhoe (Ivanhoe Fire Station), El Paso	El Paso, TX	31.7857687	-106.3235781	Suburban	Wind	Border Grant/SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	Ambient Temperature TSP (Pb)	SPM	Sequential FRM Gravimetric		General/Background	Neighborhood
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	Barometric Pressure TSP (Pb)	SPM	Sequential FRM Gravimetric		General/Background	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	Dew Point	SPM	Derived at site	Continuous	Max Ozone Concentration; Population Exposure	Neighborhood
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	NO/NO2/NOx	PAMS/ SLAMS	Chemiluminescence	Continuous	Max Ozone Concentration; Population Exposure	Neighborhood
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	O3	PAMS/ SLAMS	UV Photometric	Continuous	Max Ozone Concentration; Population Exposure	Neighborhood
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/6 Days	General/Background; Population Exposure	Neighborhood
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Highest Concentration	Neighborhood
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	Precipitation	PAMS	Rain Gauge	Continuous	Max Ozone Concentration	Neighborhood
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	Relative Humidity	PAMS	Humidity Sensor	Continuous	Max Ozone Concentration	Neighborhood
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	SO2	SLAMS	Pulsed Fluorescence	Continuous	Population Exposure	Neighborhood
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	Solar Radiation	SPM	Photovoltaic	Continuous	Max Ozone Concentration	Neighborhood
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Max Ozone Concentration	Neighborhood
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	TSP (Pb)	SLAMS	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	UV Radiation	PAMS	Photovoltaic	Continuous	Max Ozone Concentration	Neighborhood
481410037	El Paso UTEP	250 Rim Rd, El Paso	El Paso, TX	31.7682914	-106.5012595	Urban and Center City	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Max Ozone Concentration	Neighborhood
481410038	Riverside	301 Midway Dr (Riverside High School), El Paso	El Paso, TX	31.7338000	-106.3721000	Suburban	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	CO (High Sensitivity)	NCORE/ SLAMS	Gas Filter Correlation	Continuous	Highest Concentration	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	Dew Point	SPM	Derived at site	Continuous	Highest Concentration; Max Precursor Emissions	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	NO/NO2/NOx	NCORE/ PAMS/ SLAMS	Chemiluminescence	Continuous	Highest Concentration; Max Precursor Emissions	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	NOy (High Sensitivity)	NCORE	Chemiluminescence	Continuous	Highest Concentration	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	O3	NCORE/ PAMS/ SLAMS	UV Photometric	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	PM10-2.5	NCORE	Beta Attentuation	Continuous	Highest Concentration; Population Exposure	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	PM2.5 (FEM)	NCORE/ SLAMS	Beta Attentuation	Continuous	Highest Concentration; Population Exposure	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	PM2.5 (FRM)	NCORE/ SLAMS	Sequential FRM Gravimetric	24 Hours; 1/3 Days	Highest Concentration; Population Exposure	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	PM2.5 (FRM)	QA Collocated/ SLAMS	Sequential FRM Gravimetric	24 Hours; 1/6 Days	Highest Concentration; Population Exposure	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	PM2.5 (Speciation)	NCORE	Carbons | Elements | Ions | Sequential Non-	24 Hours; 1/3 Days	Highest Concentration	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	Relative Humidity	PAMS	Humidity Sensor	Continuous	Max Precursor Emissions Impact	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	SO2 (High Sensitivity)	NCORE	Pulsed Fluorescence	Continuous	Highest Concentration	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	Solar Radiation	PAMS	Photovoltaic	Continuous	Max Precursor Emissions Impact	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	Speciated VOC (AutoGC)	PAMS	GC	Continuous	Highest Concentration; Max Precursor Emissions	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Max Precursor Emissions Impact	Neighborhood
481410044	El Paso Chamizal	800 S San Marcial Street, El Paso	El Paso, TX	31.7656854	-106.4552272	Urban and Center City	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Max Precursor Emissions Impact	Neighborhood
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	Ambient Temperature TSP (Pb)	NCORE		24 Hours; 1/6 Days	General/Background	Neighborhood
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	Barometric Pressure	PAMS	Barometer	Continuous	Max Ozone Concentration; Upwind Background	Neighborhood
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	Barometric Pressure TSP (Pb)	NCORE		24 Hours; 1/6 Days	General/Background	Neighborhood
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	Carbonyl	SPM	DNPH Silica HPLC	24 Hours; 1/6 Days	Max Ozone Concentration; Upwind Background	Neighborhood
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	CO	SLAMS	Gas Filter Correlation	Continuous	Highest Concentration	Urban Scale
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	Dew Point	SPM	Derived at site	Continuous	Highest Concentration; Upwind Background	Urban Scale
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	NO/NO2/NOx	PAMS	Chemiluminescence	Continuous	Highest Concentration; Upwind Background	Neighborhood / Urban Scale
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	O3	PAMS	UV Photometric	Continuous	Max Ozone Concentration; Upwind Background	Neighborhood
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	Relative Humidity	PAMS	Humidity Sensor	Continuous	Max Ozone Concentration; Upwind Background	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	Solar Radiation	PAMS	Photovoltaic	Continuous	Max Ozone Concentration; Upwind Background	Neighborhood
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Max Ozone Concentration; Upwind Background	Neighborhood
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	TSP (Pb)	NCORE	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	Visibility	SPM	Visibility Sensor	Continuous	Highest Concentration; Population Exposure	Urban Scale
481410055	Ascarate Park SE	650 R E Thomason Loop, El Paso	El Paso, TX	31.7467753	-106.4028059	Suburban	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Max Ozone Concentration; Upwind Background	Neighborhood
481410057	Socorro Hueco	320 Old Hueco Tanks Road, El Paso	El Paso, TX	31.6675000	-106.2880000	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
481410057	Socorro Hueco	320 Old Hueco Tanks Road, El Paso	El Paso, TX	31.6675000	-106.2880000	Suburban	PM10 (FRM)	Border Grant/QA Collocated/	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481410057	Socorro Hueco	320 Old Hueco Tanks Road, El Paso	El Paso, TX	31.6675000	-106.2880000	Suburban	PM10 (FRM)	Border Grant/ SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	General/Background ; Population Exposure	Neighborhood
481410057	Socorro Hueco	320 Old Hueco Tanks Road, El Paso	El Paso, TX	31.6675000	-106.2880000	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
481410057	Socorro Hueco	320 Old Hueco Tanks Road, El Paso	El Paso, TX	31.6675000	-106.2880000	Suburban	SVOC	SPM	HiVol PUF XAD GC-MS	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481410057	Socorro Hueco	320 Old Hueco Tanks Road, El Paso	El Paso, TX	31.6675000	-106.2880000	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
481410057	Socorro Hueco	320 Old Hueco Tanks Road, El Paso	El Paso, TX	31.6675000	-106.2880000	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
481410058	Skyline Park	5050A Yvette Drive, El Paso	El Paso, TX	31.8939133	-106.4258270	Suburban	O3	Border Grant/ SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
481410058	Skyline Park	5050A Yvette Drive, El Paso	El Paso, TX	31.8939133	-106.4258270	Suburban	SO2	Border Grant/ SLAMS	Pulsed Fluorescence	Continuous	Population Exposure	Neighborhood
481410058	Skyline Park	5050A Yvette Drive, El Paso	El Paso, TX	31.8939133	-106.4258270	Suburban	Temperature (Outdoor)	Border Grant/SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
481410058	Skyline Park	5050A Yvette Drive, El Paso	El Paso, TX	31.8939133	-106.4258270	Suburban	Wind	Border Grant/SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
481410693	Van Buren	2700 Harrison Avenue, El Paso	El Paso, TX	31.8133700	-106.4645200	Urban and Center City	PM10 (FRM)	SPM	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481410693	Van Buren	2700 Harrison Avenue, El Paso	El Paso, TX	31.8133700	-106.4645200	Urban and Center City	Relative Humidity	SPM	Humidity Sensor	Continuous	Population Exposure	
481410693	Van Buren	2700 Harrison Avenue, El Paso	El Paso, TX	31.8133700	-106.4645200	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	
481410693	Van Buren	2700 Harrison Avenue, El Paso	El Paso, TX	31.8133700	-106.4645200	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
481411021	Ojo De Agua	6767 Ojo De Agua, El Paso	El Paso, TX	31.8624700	-106.5473000	Suburban	Ambient Temperature TSP (Pb)	SPM	Derived from KELP	24 Hours; 1/6 Days	General/Background	Neighborhood
481411021	Ojo De Agua	6767 Ojo De Agua, El Paso	El Paso, TX	31.8624700	-106.5473000	Suburban	Barometric Pressure TSP (Pb)	SPM	Derived from KELP	24 Hours; 1/6 Days	General/Background	Neighborhood
481411021	Ojo De Agua	6767 Ojo De Agua, El Paso	El Paso, TX	31.8624700	-106.5473000	Suburban	CO	SLAMS	Gas Filter Correlation	Continuous	Population Exposure	Neighborhood
481411021	Ojo De Agua	6767 Ojo De Agua, El Paso	El Paso, TX	31.8624700	-106.5473000	Suburban	PM10 (FRM)	QA Collocated/ SLAMS	HiVol Gravimetric	24 Hours; 1/12 Days	Population Exposure	Neighborhood
481411021	Ojo De Agua	6767 Ojo De Agua, El Paso	El Paso, TX	31.8624700	-106.5473000	Suburban	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481411021	Ojo De Agua	6767 Ojo De Agua, El Paso	El Paso, TX	31.8624700	-106.5473000	Suburban	TSP (Pb)	QA Collocated/ SLAMS	HiVol ICP-MS	24 Hours; 1/12 Days	Population Exposure	Neighborhood
481411021	Ojo De Agua	6767 Ojo De Agua, El Paso	El Paso, TX	31.8624700	-106.5473000	Suburban	TSP (Pb)	SLAMS	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure	Neighborhood
481411021	Ojo De Agua	6767 Ojo De Agua, El Paso	El Paso, TX	31.8624700	-106.5473000	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
481490001	Fayette County	636 Roznov Rd, Round Top	None	29.9624745	-96.7458748	Rural	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Regional Transport; Source Oriented	Regional Scale
481670004	Texas City Fire Station	2516 Texas Avenue, Texas City	Houston-Sugar Land-Baytown, TX	29.3844440	-94.9308330	Urban and Center City	PM10 (FRM)	QA Collocated/ SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Highest Concentration	Neighborhood
481670004	Texas City Fire Station	2516 Texas Avenue, Texas City	Houston-Sugar Land-Baytown, TX	29.3844440	-94.9308330	Urban and Center City	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Highest Concentration	Neighborhood
481671034	Galveston 99th Street	9511 Avenue V 1/2, Galveston	Houston-Sugar Land-Baytown, TX	29.2544736	-94.8612886	Suburban	Dew Point	SPM	Derived at site	Continuous	General/Background; Upwind Background	Middle Scale
481671034	Galveston 99th Street	9511 Avenue V 1/2, Galveston	Houston-Sugar Land-Baytown, TX	29.2544736	-94.8612886	Suburban	NO/NO2/NOx	PAMS	Chemiluminescence	Continuous	General/Background; Upwind Background	Middle Scale / Urban Scale
481671034	Galveston 99th Street	9511 Avenue V 1/2, Galveston	Houston-Sugar Land-Baytown, TX	29.2544736	-94.8612886	Suburban	O3	PAMS/ SLAMS	UV Photometric	Continuous	Max Ozone Concentration; Upwind Background	Urban Scale
481671034	Galveston 99th Street	9511 Avenue V 1/2, Galveston	Houston-Sugar Land-Baytown, TX	29.2544736	-94.8612886	Suburban	PM2.5 (FRM)	SPM	Sequential FRM Gravimetric	24 Hours; 1/6 Days; 24 Hours; Daily	Regional Transport	Regional Scale
481671034	Galveston 99th Street	9511 Avenue V 1/2, Galveston	Houston-Sugar Land-Baytown, TX	29.2544736	-94.8612886	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Regional Transport	Regional Scale
481671034	Galveston 99th Street	9511 Avenue V 1/2, Galveston	Houston-Sugar Land-Baytown, TX	29.2544736	-94.8612886	Suburban	Relative Humidity	PAMS	Humidity Sensor	Continuous	Max Ozone Concentration; Upwind Background	Urban Scale
481671034	Galveston 99th Street	9511 Avenue V 1/2, Galveston	Houston-Sugar Land-Baytown, TX	29.2544736	-94.8612886	Suburban	Solar Radiation	PAMS	Photovoltaic	Continuous	Max Ozone Concentration; Upwind Background	Urban Scale
481671034	Galveston 99th Street	9511 Avenue V 1/2, Galveston	Houston-Sugar Land-Baytown, TX	29.2544736	-94.8612886	Suburban	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Max Ozone Concentration; Upwind Background	Urban Scale
481671034	Galveston 99th Street	9511 Avenue V 1/2, Galveston	Houston-Sugar Land-Baytown, TX	29.2544736	-94.8612886	Suburban	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Max Ozone Concentration; Upwind Background	Urban Scale

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
481830001	Longview	Gregg Co Airport near Longview, Longview	Longview, TX	32.3786823	-94.7118107	Rural	NO/NO2/NOx	SPM	Chemiluminescence	Continuous	Population Exposure	Neighborhood
481830001	Longview	Gregg Co Airport near Longview, Longview	Longview, TX	32.3786823	-94.7118107	Rural	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
481830001	Longview	Gregg Co Airport near Longview, Longview	Longview, TX	32.3786823	-94.7118107	Rural	Precipitation	SPM	Rain Gauge	Continuous	General/Background	Neighborhood
481830001	Longview	Gregg Co Airport near Longview, Longview	Longview, TX	32.3786823	-94.7118107	Rural	SO2	SLAMS	Pulsed Fluorescence	Continuous	General/Background ; Population Exposure	Neighborhood
481830001	Longview	Gregg Co Airport near Longview, Longview	Longview, TX	32.3786823	-94.7118107	Rural	Solar Radiation	SPM	Photovoltaic	Continuous	General/Background	Neighborhood
481830001	Longview	Gregg Co Airport near Longview, Longview	Longview, TX	32.3786823	-94.7118107	Rural	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Neighborhood
481830001	Longview	Gregg Co Airport near Longview, Longview	Longview, TX	32.3786823	-94.7118107	Rural	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
482010024	Houston Aldine	4510 1/2 Aldine Mail Rd, Houston	Houston-Sugar Land-Baytown, TX	29.9010364	-95.3261373	Suburban	Barometric Pressure	PAMS	Barometer	Continuous	Max Ozone Concentration	Neighborhood
482010024	Houston Aldine	4510 1/2 Aldine Mail Rd, Houston	Houston-Sugar Land-Baytown, TX	29.9010364	-95.3261373	Suburban	Dew Point	SPM	Derived at site	Continuous	Population Exposure	Urban Scale
482010024	Houston Aldine	4510 1/2 Aldine Mail Rd, Houston	Houston-Sugar Land-Baytown, TX	29.9010364	-95.3261373	Suburban	NO/NO2/NOx	PAMS	Chemiluminescence	Continuous	Max Ozone Concentration; Population Exposure	Neighborhood
482010024	Houston Aldine	4510 1/2 Aldine Mail Rd, Houston	Houston-Sugar Land-Baytown, TX	29.9010364	-95.3261373	Suburban	NOy (High Sensitivity)	PAMS	Chemiluminescence	Continuous	Max Ozone Concentration; Population Exposure	Neighborhood
482010024	Houston Aldine	4510 1/2 Aldine Mail Rd, Houston	Houston-Sugar Land-Baytown, TX	29.9010364	-95.3261373	Suburban	O3	PAMS	UV Photometric	Continuous	Max Ozone Concentration; Population Exposure	Neighborhood
482010024	Houston Aldine	4510 1/2 Aldine Mail Rd, Houston	Houston-Sugar Land-Baytown, TX	29.9010364	-95.3261373	Suburban	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Middle Scale
482010024	Houston Aldine	4510 1/2 Aldine Mail Rd, Houston	Houston-Sugar Land-Baytown, TX	29.9010364	-95.3261373	Suburban	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
482010024	Houston Aldine	4510 1/2 Aldine Mail Rd, Houston	Houston-Sugar Land-Baytown, TX	29.9010364	-95.3261373	Suburban	PM2.5 (Speciation)	SPM	Carbons	Elements	Ions	Sequential FRM	24 Hours; 1/6 Days	Population Exposure	Neighborhood
482010024	Houston Aldine	4510 1/2 Aldine Mail Rd, Houston	Houston-Sugar Land-Baytown, TX	29.9010364	-95.3261373	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
482010024	Houston Aldine	4510 1/2 Aldine Mail Rd, Houston	Houston-Sugar Land-Baytown, TX	29.9010364	-95.3261373	Suburban	Relative Humidity	PAMS	Humidity Sensor	Continuous	Max Ozone Concentration	Neighborhood
482010024	Houston Aldine	4510 1/2 Aldine Mail Rd, Houston	Houston-Sugar Land-Baytown, TX	29.9010364	-95.3261373	Suburban	Solar Radiation	PAMS	Photovoltaic	Continuous	Max Ozone Concentration	Neighborhood
482010024	Houston Aldine	4510 1/2 Aldine Mail Rd, Houston	Houston-Sugar Land-Baytown, TX	29.9010364	-95.3261373	Suburban	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Max Ozone Concentration	Neighborhood
482010024	Houston Aldine	4510 1/2 Aldine Mail Rd, Houston	Houston-Sugar Land-Baytown, TX	29.9010364	-95.3261373	Suburban	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Max Ozone Concentration	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
482010026	Channelview	1405 Sheldon Road, Channelview	Houston-Sugar Land-Baytown, TX	29.8027073	-95.1254948	Suburban	Dew Point	SPM	Derived at site	Continuous	Highest Concentration	Neighborhood
482010026	Channelview	1405 Sheldon Road, Channelview	Houston-Sugar Land-Baytown, TX	29.8027073	-95.1254948	Suburban	NO/NO2/NOx	PAMS	Chemiluminescence	Continuous	Population Exposure	Middle Scale / Neighborhood
482010026	Channelview	1405 Sheldon Road, Channelview	Houston-Sugar Land-Baytown, TX	29.8027073	-95.1254948	Suburban	O3	PAMS	UV Photometric	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482010026	Channelview	1405 Sheldon Road, Channelview	Houston-Sugar Land-Baytown, TX	29.8027073	-95.1254948	Suburban	Relative Humidity	PAMS	Humidity Sensor	Continuous	Max Precursor Emissions Impact	Neighborhood
482010026	Channelview	1405 Sheldon Road, Channelview	Houston-Sugar Land-Baytown, TX	29.8027073	-95.1254948	Suburban	Solar Radiation	PAMS	Photovoltaic	Continuous	Max Precursor Emissions Impact	Neighborhood
482010026	Channelview	1405 Sheldon Road, Channelview	Houston-Sugar Land-Baytown, TX	29.8027073	-95.1254948	Suburban	Speciated VOC (AutoGC)	PAMS	GC	Continuous	Population Exposure	Neighborhood
482010026	Channelview	1405 Sheldon Road, Channelview	Houston-Sugar Land-Baytown, TX	29.8027073	-95.1254948	Suburban	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Max Precursor Emissions Impact	Neighborhood
482010026	Channelview	1405 Sheldon Road, Channelview	Houston-Sugar Land-Baytown, TX	29.8027073	-95.1254948	Suburban	TNMOC (AutoGC)	PAMS	GC	Continuous	Population Exposure	Neighborhood
482010026	Channelview	1405 Sheldon Road, Channelview	Houston-Sugar Land-Baytown, TX	29.8027073	-95.1254948	Suburban	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Max Precursor Emissions Impact	Neighborhood
482010029	Northwest Harris County	16822 Kitzman, Tomball	Houston-Sugar Land-Baytown, TX	30.0395240	-95.6739508	Rural	Dew Point	SPM	Derived at site	Continuous	Source Oriented	Microscale
482010029	Northwest Harris County	16822 Kitzman, Tomball	Houston-Sugar Land-Baytown, TX	30.0395240	-95.6739508	Rural	NO/NO2/NOx	PAMS	Chemiluminescence	Continuous	Extreme Downwind; Population Exposure; Upwind	Urban Scale
482010029	Northwest Harris County	16822 Kitzman, Tomball	Houston-Sugar Land-Baytown, TX	30.0395240	-95.6739508	Rural	O3	PAMS	UV Photometric	Continuous	Extreme Downwind; Population Exposure; Upwind	Urban Scale
482010029	Northwest Harris County	16822 Kitzman, Tomball	Houston-Sugar Land-Baytown, TX	30.0395240	-95.6739508	Rural	Relative Humidity	PAMS	Humidity Sensor	Continuous	Extreme Downwind; Upwind Background	Urban Scale
482010029	Northwest Harris County	16822 Kitzman, Tomball	Houston-Sugar Land-Baytown, TX	30.0395240	-95.6739508	Rural	Solar Radiation	PAMS	Photovoltaic	Continuous	Extreme Downwind; Upwind Background	Urban Scale
482010029	Northwest Harris County	16822 Kitzman, Tomball	Houston-Sugar Land-Baytown, TX	30.0395240	-95.6739508	Rural	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Extreme Downwind; Upwind Background	Urban Scale
482010029	Northwest Harris County	16822 Kitzman, Tomball	Houston-Sugar Land-Baytown, TX	30.0395240	-95.6739508	Rural	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Extreme Downwind; Upwind Background	Urban Scale
482010046	Houston North Wayside	7330 1/2 North Wayside, Houston	Houston-Sugar Land-Baytown, TX	29.8280859	-95.2840958	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
482010046	Houston North Wayside	7330 1/2 North Wayside, Houston	Houston-Sugar Land-Baytown, TX	29.8280859	-95.2840958	Suburban	SO2	SPM	Pulsed Fluorescence	Continuous	Population Exposure	Neighborhood
482010047	Lang	4401 1/2 Lang Rd, Houston	Houston-Sugar Land-Baytown, TX	29.8341670	-95.4891670	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Population Exposure	Middle Scale / Urban Scale
482010047	Lang	4401 1/2 Lang Rd, Houston	Houston-Sugar Land-Baytown, TX	29.8341670	-95.4891670	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Urban Scale

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
482010047	Lang	4401 1/2 Lang Rd, Houston	Houston-Sugar Land-Baytown, TX	29.8341670	-95.4891670	Suburban	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
482010051	Houston Croquet	13826 1/2 Croquet, Houston	Houston-Sugar Land-Baytown, TX	29.6238890	-95.4741670	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
482010051	Houston Croquet	13826 1/2 Croquet, Houston	Houston-Sugar Land-Baytown, TX	29.6238890	-95.4741670	Suburban	SO2	SPM	Pulsed Fluorescence	Continuous	Population Exposure	Neighborhood
482010051	Houston Croquet	13826 1/2 Croquet, Houston	Houston-Sugar Land-Baytown, TX	29.6238890	-95.4741670	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
482010051	Houston Croquet	13826 1/2 Croquet, Houston	Houston-Sugar Land-Baytown, TX	29.6238890	-95.4741670	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
482010055	Houston Bayland Park	6400 Bissonnet Street, Houston	Houston-Sugar Land-Baytown, TX	29.6957294	-95.4992190	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Population Exposure	Middle Scale / Neighborhood
482010055	Houston Bayland Park	6400 Bissonnet Street, Houston	Houston-Sugar Land-Baytown, TX	29.6957294	-95.4992190	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Middle Scale
482010055	Houston Bayland Park	6400 Bissonnet Street, Houston	Houston-Sugar Land-Baytown, TX	29.6957294	-95.4992190	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	General/Background; Max Precursor Emissions Impact	Middle Scale
482010055	Houston Bayland Park	6400 Bissonnet Street, Houston	Houston-Sugar Land-Baytown, TX	29.6957294	-95.4992190	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background; Max Precursor Emissions Impact	Middle Scale
482010055	Houston Bayland Park	6400 Bissonnet Street, Houston	Houston-Sugar Land-Baytown, TX	29.6957294	-95.4992190	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background; Max Precursor Emissions Impact	Middle Scale
482010058	Baytown	7210 1/2 Bayway Drive, Baytown	Houston-Sugar Land-Baytown, TX	29.7706975	-95.0312316	Suburban	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/6 Days	Population Exposure	Middle Scale / Neighborhood
482010058	Baytown	7210 1/2 Bayway Drive, Baytown	Houston-Sugar Land-Baytown, TX	29.7706975	-95.0312316	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Regional Transport	Neighborhood
482010058	Baytown	7210 1/2 Bayway Drive, Baytown	Houston-Sugar Land-Baytown, TX	29.7706975	-95.0312316	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Highest Concentration	Neighborhood
482010058	Baytown	7210 1/2 Bayway Drive, Baytown	Houston-Sugar Land-Baytown, TX	29.7706975	-95.0312316	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Neighborhood
482010060	Houston Kirkpatrick	5565 Kirkpatrick, Houston	Houston-Sugar Land-Baytown, TX	29.8074146	-95.2936223	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
482010060	Houston Kirkpatrick	5565 Kirkpatrick, Houston	Houston-Sugar Land-Baytown, TX	29.8074146	-95.2936223	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
482010062	Houston Monroe	9726 1/2 Monroe, Houston	Houston-Sugar Land-Baytown, TX	29.6255560	-95.2672220	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
482010062	Houston Monroe	9726 1/2 Monroe, Houston	Houston-Sugar Land-Baytown, TX	29.6255560	-95.2672220	Suburban	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
482010062	Houston Monroe	9726 1/2 Monroe, Houston	Houston-Sugar Land-Baytown, TX	29.6255560	-95.2672220	Suburban	Precipitation	SPM	Rain Gauge	Continuous	General/Background	Neighborhood
482010062	Houston Monroe	9726 1/2 Monroe, Houston	Houston-Sugar Land-Baytown, TX	29.6255560	-95.2672220	Suburban	SO2	SPM	Pulsed Fluorescence	Continuous	Population Exposure	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
482010066	Houston Westhollow	3333 1/2 Hwy 6 South, Houston	Houston-Sugar Land-Baytown, TX	29.7233330	-95.6358330	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
482010066	Houston Westhollow	3333 1/2 Hwy 6 South, Houston	Houston-Sugar Land-Baytown, TX	29.7233330	-95.6358330	Suburban	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
482010066	Houston Westhollow	3333 1/2 Hwy 6 South, Houston	Houston-Sugar Land-Baytown, TX	29.7233330	-95.6358330	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
482010066	Houston Westhollow	3333 1/2 Hwy 6 South, Houston	Houston-Sugar Land-Baytown, TX	29.7233330	-95.6358330	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
482010071	Pasadena HL&P	1001 1/2 Red Bluff, Pasadena	Houston-Sugar Land-Baytown, TX	29.7164829	-95.2013298	Urban and Center City	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
482010416	Park Place	7421 Park Place Blvd, Houston	Houston-Sugar Land-Baytown, TX	29.6863890	-95.2947220	Urban and Center City	Barometric Pressure	SPM	Barometer	Continuous	General/Background	Neighborhood
482010416	Park Place	7421 Park Place Blvd, Houston	Houston-Sugar Land-Baytown, TX	29.6863890	-95.2947220	Urban and Center City	Dew Point	SPM	Derived at site	Continuous	General/Background	Neighborhood
482010416	Park Place	7421 Park Place Blvd, Houston	Houston-Sugar Land-Baytown, TX	29.6863890	-95.2947220	Urban and Center City	NO/NO2/NOx	SPM	Chemiluminescence	Continuous	Population Exposure	Neighborhood
482010416	Park Place	7421 Park Place Blvd, Houston	Houston-Sugar Land-Baytown, TX	29.6863890	-95.2947220	Urban and Center City	O3	SPM	UV Photometric	Continuous	Population Exposure	Neighborhood
482010416	Park Place	7421 Park Place Blvd, Houston	Houston-Sugar Land-Baytown, TX	29.6863890	-95.2947220	Urban and Center City	Precipitation	SPM	Rain Gauge	Continuous	General/Background	Neighborhood
482010416	Park Place	7421 Park Place Blvd, Houston	Houston-Sugar Land-Baytown, TX	29.6863890	-95.2947220	Urban and Center City	Relative Humidity	SPM	Humidity Sensor	Continuous	General/Background	Neighborhood
482010416	Park Place	7421 Park Place Blvd, Houston	Houston-Sugar Land-Baytown, TX	29.6863890	-95.2947220	Urban and Center City	SO2	SPM	Pulsed Fluorescence	Continuous	Population Exposure	Neighborhood
482010416	Park Place	7421 Park Place Blvd, Houston	Houston-Sugar Land-Baytown, TX	29.6863890	-95.2947220	Urban and Center City	Solar Radiation	SPM	Photovoltaic	Continuous	General/Background	Neighborhood
482010416	Park Place	7421 Park Place Blvd, Houston	Houston-Sugar Land-Baytown, TX	29.6863890	-95.2947220	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Neighborhood
482010416	Park Place	7421 Park Place Blvd, Houston	Houston-Sugar Land-Baytown, TX	29.6863890	-95.2947220	Urban and Center City	UV Radiation	SPM	Photovoltaic	Continuous	General/Background	Neighborhood
482010416	Park Place	7421 Park Place Blvd, Houston	Houston-Sugar Land-Baytown, TX	29.6863890	-95.2947220	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
482011015	Lynchburg Ferry	4407 Independence Parkway South, Baytown	Houston-Sugar Land-Baytown, TX	29.7616528	-95.0813861	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Source Oriented	Middle Scale / Neighborhood
482011015	Lynchburg Ferry	4407 Independence Parkway South, Baytown	Houston-Sugar Land-Baytown, TX	29.7616528	-95.0813861	Suburban	O3	SLAMS	UV Photometric	Continuous	Source Oriented	Middle Scale
482011015	Lynchburg Ferry	4407 Independence Parkway South, Baytown	Houston-Sugar Land-Baytown, TX	29.7616528	-95.0813861	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	Highest Concentration	Neighborhood
482011015	Lynchburg Ferry	4407 Independence Parkway South, Baytown	Houston-Sugar Land-Baytown, TX	29.7616528	-95.0813861	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Highest Concentration	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
482011015	Lynchburg Ferry	4407 Independence Parkway South, Baytown	Houston-Sugar Land-Baytown, TX	29.7616528	-95.0813861	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Neighborhood
482011017	Baytown Garth	8622 Garth Road Unit A, Baytown	Houston-Sugar Land-Baytown, TX	29.8233190	-94.9837860	Suburban	O3	SLAMS	UV Photometric	Continuous	Max Ozone Concentration	Neighborhood
482011017	Baytown Garth	8622 Garth Road Unit A, Baytown	Houston-Sugar Land-Baytown, TX	29.8233190	-94.9837860	Suburban	SO2	SLAMS	Pulsed Fluorescence	Continuous	Population Exposure	Neighborhood
482011017	Baytown Garth	8622 Garth Road Unit A, Baytown	Houston-Sugar Land-Baytown, TX	29.8233190	-94.9837860	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	Population Exposure	Neighborhood
482011017	Baytown Garth	8622 Garth Road Unit A, Baytown	Houston-Sugar Land-Baytown, TX	29.8233190	-94.9837860	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
482011017	Baytown Garth	8622 Garth Road Unit A, Baytown	Houston-Sugar Land-Baytown, TX	29.8233190	-94.9837860	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
482011034	Houston East	1262 1/2 Mae Drive, Houston	Houston-Sugar Land-Baytown, TX	29.7679965	-95.2205822	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Highest Concentration; Population Exposure	Middle Scale / Neighborhood
482011034	Houston East	1262 1/2 Mae Drive, Houston	Houston-Sugar Land-Baytown, TX	29.7679965	-95.2205822	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
482011034	Houston East	1262 1/2 Mae Drive, Houston	Houston-Sugar Land-Baytown, TX	29.7679965	-95.2205822	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
482011034	Houston East	1262 1/2 Mae Drive, Houston	Houston-Sugar Land-Baytown, TX	29.7679965	-95.2205822	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Urban Scale
482011034	Houston East	1262 1/2 Mae Drive, Houston	Houston-Sugar Land-Baytown, TX	29.7679965	-95.2205822	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	Barometric Pressure	PAMS	Barometer	Continuous	Max Precursor Emissions Impact	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	Carbonyl	PAMS	DNPH Silica HPLC	24 Hours; Seasonal, 3 Hours;	Max Precursor Emissions Impact	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	CO (High Sensitivity)	PAMS	Gas Filter Correlation	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	Dew Point	SPM	Derived at site	Continuous	Population Exposure	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	NO/NO2/NOx	PAMS	Chemiluminescence	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	O3	PAMS	UV Photometric	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/3 Days	Highest Concentration; Source Oriented	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	PM10 (FRM)	QA Collocated/ SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Highest Concentration; Population Exposure	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	PM10 (Speciation)	SPM	ICP-MS	24 Hours; 1/3 Days	Population Exposure; Source Oriented	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/1 Days	Highest Concentration; Population	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	PM2.5 (FRM)	QA Collocated/ SLAMS	Sequential FRM Gravimetric	24 Hours; 1/6 Days	Highest Concentration; Population Exposure	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	Precipitation	SPM	Rain Gauge	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	Relative Humidity	PAMS	Humidity Sensor	Continuous	Max Precursor Emissions Impact	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	SO2	SLAMS	Pulsed Fluorescence	Continuous	Population Exposure	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	Solar Radiation	PAMS	Photovoltaic	Continuous	Max Precursor Emissions Impact	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	Speciated VOC (AutoGC)	PAMS	GC	Continuous	Highest Concentration; Population	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Max Precursor Emissions Impact	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	UV Radiation	PAMS	Photovoltaic	Continuous	Max Precursor Emissions Impact	Neighborhood
482011035	Clinton	9525 1/2 Clinton Dr, Houston	Houston-Sugar Land-Baytown, TX	29.7337263	-95.2575931	Urban and Center City	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Max Precursor Emissions Impact	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	Ambient Temperature TSP (Pb)	SPM	Derived from KHOU	24 Hours; 1/6 Days	General/Background	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	Barometric Pressure TSP (Pb)	SPM	Derived from KHOU	24 Hours; 1/6 Days	General/Background	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	Carbonyl	PAMS	DNPH Silica HPLC	24 Hours; 1/6 Days	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	CO (High Sensitivity)	NCORE	Gas Filter Correlation	Continuous	Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	Dew Point	SPM	Derived at site	Continuous	Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	NO/NO2/NOx	NCORE/ PAMS/ SLAMS	Chemiluminescence	Continuous	Population Exposure; Source Oriented	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	NOy (High Sensitivity)	NCORE	Chemiluminescence	Continuous	Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	O3	NCORE/ PAMS/ SLAMS	UV Photometric	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	PM10 (FRM)	QA Collocated/ SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Max Precursor Emissions Impact; Population	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	PM10 (Speciation)	QA Collocated/ NATTS	ICP-MS	24 Hours; 1/6 Days	Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	PM10 (Speciation)	NATTS	ICP-MS	24 Hours; 1/6 Days	Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	PM10-2.5	NCORE	Beta Attentuation	Continuous	Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	PM2.5 (Carbon)	SPM	Aethalometer	Continuous	Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	PM2.5 (FEM)	NCORE/ SLAMS	Beta Attentuation	Continuous	Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	PM2.5 (FRM)	NCORE/ SLAMS	Sequential FRM Gravimetric	24 Hours; 1/3 Days	Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	PM2.5 (Speciation)	NCORE	Carbons | Elements | Ions | Sequential Non-	24 Hours; 1/3 Days	Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	PM2.5 (Speciation)	QA Collocated/ NCORE	Carbons | Elements | Ions | Sequential Non-	24 Hours; 1/6 Days, 24 Hours; 1/3	Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	Relative Humidity	NCORE/ PAMS	Humidity Sensor	Continuous	Max Precursor Emissions Impact	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	SO2 (High Sensitivity)	NCORE	Pulsed Fluorescence	Continuous	Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	Solar Radiation	PAMS	Photovoltaic	Continuous	Max Precursor Emissions Impact	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	Speciated VOC (AutoGC)	PAMS	GC	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	Speciated VOC (Canister)	NATTS/ PAMS	Canister GC-MS	24 Hours; 1/6 Days	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	Speciated VOC (Canister)	NATTS/QA Collocated/ SLAMS	Canister GC-MS	24 Hours; 1/6 Days	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	SVOC	QA Collocated	HiVol PUF XAD GC-MS	24 Hours; 1/6 Days	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	SVOC	NATTS	HiVol PUF XAD GC-MS	24 Hours; 1/6 Days	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Max Precursor Emissions Impact	Neighborhood
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	TSP (Pb)	NCORE	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
482011039	Houston Deer Park #2	4514 1/2 Durant St, Deer Park	Houston-Sugar Land-Baytown, TX	29.6700250	-95.1285077	Urban and Center City	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Max Precursor Emissions Impact	Neighborhood
482011042	Kingwood	3603 1/2 West Lake Houston Pkwy, Houston	Houston-Sugar Land-Baytown, TX	30.0584604	-95.1897514	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
482011042	Kingwood	3603 1/2 West Lake Houston Pkwy, Houston	Houston-Sugar Land-Baytown, TX	30.0584604	-95.1897514	Suburban	Precipitation	SPM	Rain Gauge	Continuous	General/Background	Neighborhood
482011043	La Porte Airport C243	La Porte Airport, 2434 Buchanan Street, La Porte	Houston-Sugar Land-Baytown, TX	29.6720000	-95.0647000	Suburban	Precipitation	PAMS	Rain Gauge	Continuous	General/Background	Neighborhood
482011043	La Porte Airport C243	La Porte Airport, 2434 Buchanan Street, La Porte	Houston-Sugar Land-Baytown, TX	29.6720000	-95.0647000	Suburban	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	General/Background	Neighborhood
482011043	La Porte Airport C243	La Porte Airport, 2434 Buchanan Street, La Porte	Houston-Sugar Land-Baytown, TX	29.6720000	-95.0647000	Suburban	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
482011050	Seabrook Friendship Park	4522 Park Rd, Seabrook	Houston-Sugar Land-Baytown, TX	29.5830473	-95.0155437	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Population Exposure	Middle Scale / Neighborhood
482011050	Seabrook Friendship Park	4522 Park Rd, Seabrook	Houston-Sugar Land-Baytown, TX	29.5830473	-95.0155437	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
482011050	Seabrook Friendship Park	4522 Park Rd, Seabrook	Houston-Sugar Land-Baytown, TX	29.5830473	-95.0155437	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Highest Concentration	Middle Scale
482011050	Seabrook Friendship Park	4522 Park Rd, Seabrook	Houston-Sugar Land-Baytown, TX	29.5830473	-95.0155437	Suburban	SO2	SPM	Pulsed Fluorescence	Continuous	Population Exposure; Source Oriented	Neighborhood
482011050	Seabrook Friendship Park	4522 Park Rd, Seabrook	Houston-Sugar Land-Baytown, TX	29.5830473	-95.0155437	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	Highest Concentration	Middle Scale
482011050	Seabrook Friendship Park	4522 Park Rd, Seabrook	Houston-Sugar Land-Baytown, TX	29.5830473	-95.0155437	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Highest Concentration	Middle Scale
482011050	Seabrook Friendship Park	4522 Park Rd, Seabrook	Houston-Sugar Land-Baytown, TX	29.5830473	-95.0155437	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Middle Scale
482011052	Houston North Loop	822 North Loop, Houston	Houston-Sugar Land-Baytown, TX	29.8145300	-95.3876900	Urban and Center City	CO	Near Road/ SLAMS	Gas Filter Correlation	Continuous	Max Precursor Emissions Impact	Microscale
482011052	Houston North Loop	822 North Loop, Houston	Houston-Sugar Land-Baytown, TX	29.8145300	-95.3876900	Urban and Center City	NO/NO2/NOx	Near Road/ SLAMS	Chemiluminescence	Continuous	Max Precursor Emissions Impact	Microscale
482011052	Houston North Loop	822 North Loop, Houston	Houston-Sugar Land-Baytown, TX	29.8145300	-95.3876900	Urban and Center City	PM2.5 (FRM)	Near Road/ SLAMS	Sequential FRM Gravimetric	24 Hours; 1/3 Days	Max Precursor Emissions Impact	Microscale
482011052	Houston North Loop	822 North Loop, Houston	Houston-Sugar Land-Baytown, TX	29.8145300	-95.3876900	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Max Precursor Emissions Impact	Microscale
482011052	Houston North Loop	822 North Loop, Houston	Houston-Sugar Land-Baytown, TX	29.8145300	-95.3876900	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer | [020]SPOT	Continuous	Max Precursor Emissions Impact	Microscale
482011066	Houston Southwest Freeway	5617 Westward Avenue, Houston	Houston-Sugar Land-Baytown, TX	29.7216000	-95.4926500	Urban and Center City	NO/NO2/NOx	Near Road/ SLAMS	Chemiluminescence	Continuous	Max Precursor Emissions Impact	Microscale
482011066	Houston Southwest Freeway	5617 Westward Avenue, Houston	Houston-Sugar Land-Baytown, TX	29.7216000	-95.4926500	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Max Precursor Emissions Impact	Microscale

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
482011066	Houston Southwest Freeway	5617 Westward Avenue, Houston	Houston-Sugar Land-Baytown, TX	29.7216000	-95.4926500	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Max Precursor Emissions Impact	Microscale
482030002	Karnack	Hwy 134 & Spur 449, Not In A City	None	32.6689873	-94.1674569	Rural	Carbonyl	SPM	DNPH Silica HPLC	24 Hours; 1/6 Days	General/Background	Regional Scale
482030002	Karnack	Hwy 134 & Spur 449, Not In A City	None	32.6689873	-94.1674569	Rural	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	General/Background	Regional Scale / Urban Scale
482030002	Karnack	Hwy 134 & Spur 449, Not In A City	None	32.6689873	-94.1674569	Rural	O3	SLAMS	UV Photometric	Continuous	General/Background	Regional Scale
482030002	Karnack	Hwy 134 & Spur 449, Not In A City	None	32.6689873	-94.1674569	Rural	PM10 (FRM)	SPM	HiVol Gravimetric	24 Hours; 1/6 Days	General/Background	Neighborhood
482030002	Karnack	Hwy 134 & Spur 449, Not In A City	None	32.6689873	-94.1674569	Rural	PM10 (Speciation)	NATTS	ICP-MS	24 Hours; 1/6 Days	General/Background	Regional Scale
482030002	Karnack	Hwy 134 & Spur 449, Not In A City	None	32.6689873	-94.1674569	Rural	PM2.5 (FRM)	SPM	Sequential FRM Gravimetric	24 Hours; 1/6 Days	General/Background	Regional Scale / Urban Scale
482030002	Karnack	Hwy 134 & Spur 449, Not In A City	None	32.6689873	-94.1674569	Rural	PM2.5 (Speciation)	CSN Supplemental	Carbons | Elements | Ions | Sequential Non-	24 Hours; 1/3 Days	General/Background ; Regional Transport	Regional Scale
482030002	Karnack	Hwy 134 & Spur 449, Not In A City	None	32.6689873	-94.1674569	Rural	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	General/Background	Regional Scale
482030002	Karnack	Hwy 134 & Spur 449, Not In A City	None	32.6689873	-94.1674569	Rural	Solar Radiation	SPM	Photovoltaic	Continuous	General/Background	Urban Scale
482030002	Karnack	Hwy 134 & Spur 449, Not In A City	None	32.6689873	-94.1674569	Rural	Speciated VOC (Canister)	SPM	Canister GC-MS	24 Hours; 1/6 Days	General/Background	Regional Scale
482030002	Karnack	Hwy 134 & Spur 449, Not In A City	None	32.6689873	-94.1674569	Rural	SVOC	SPM	HiVol PUF XAD GC-MS	24 Hours; 1/6 Days	General/Background	Regional Scale
482030002	Karnack	Hwy 134 & Spur 449, Not In A City	None	32.6689873	-94.1674569	Rural	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Urban Scale
482030002	Karnack	Hwy 134 & Spur 449, Not In A City	None	32.6689873	-94.1674569	Rural	Visibility	SPM	Visibility Sensor	Continuous	General/Background	Urban Scale
482030002	Karnack	Hwy 134 & Spur 449, Not In A City	None	32.6689873	-94.1674569	Rural	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Urban Scale
482150043	Mission	2300 North Glasscock, Mission	McAllen-Edinburg-Mission, TX	26.2262097	-98.2910690	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
482150043	Mission	2300 North Glasscock, Mission	McAllen-Edinburg-Mission, TX	26.2262097	-98.2910690	Suburban	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Urban Scale
482150043	Mission	2300 North Glasscock, Mission	McAllen-Edinburg-Mission, TX	26.2262097	-98.2910690	Suburban	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/6 Days	Population Exposure	Urban Scale
482150043	Mission	2300 North Glasscock, Mission	McAllen-Edinburg-Mission, TX	26.2262097	-98.2910690	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Urban Scale
482150043	Mission	2300 North Glasscock, Mission	McAllen-Edinburg-Mission, TX	26.2262097	-98.2910690	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	Population Exposure	Microscale

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
482150043	Mission	2300 North Glasscock, Mission	McAllen-Edinburg-Mission, TX	26.2262097	-98.2910690	Suburban	SVOC	SPM	HiVol PUF XAD GC-MS	24 Hours; 1/6 Days	Population Exposure	Microscale
482150043	Mission	2300 North Glasscock, Mission	McAllen-Edinburg-Mission, TX	26.2262097	-98.2910690	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Microscale
482150043	Mission	2300 North Glasscock, Mission	McAllen-Edinburg-Mission, TX	26.2262097	-98.2910690	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Microscale
482151046	Edinburg East Freddy Gonzalez Drive	1491 East Freddy Gonzalez Drive, Edinburg	McAllen-Edinburg-Mission, TX	26.2886220	-98.1520660	Urban and Center City	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Regional Scale
482151046	Edinburg East Freddy Gonzalez Drive	1491 East Freddy Gonzalez Drive, Edinburg	McAllen-Edinburg-Mission, TX	26.2886220	-98.1520660	Urban and Center City	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/3 Days	Population Exposure	Regional Scale
482151046	Edinburg East Freddy Gonzalez Drive	1491 East Freddy Gonzalez Drive, Edinburg	McAllen-Edinburg-Mission, TX	26.2886220	-98.1520660	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Regional Scale
482151046	Edinburg East Freddy Gonzalez Drive	1491 East Freddy Gonzalez Drive, Edinburg	McAllen-Edinburg-Mission, TX	26.2886220	-98.1520660	Urban and Center City	Wind (3m)	SLAMS	Potentiometer Cup Anemometer	Continuous	Population Exposure	Regional Scale
482210001	Granbury	200 N Gordon Street, Granbury	Granbury, TX	32.4423044	-97.8035291	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
482210001	Granbury	200 N Gordon Street, Granbury	Granbury, TX	32.4423044	-97.8035291	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	General/Background	Middle Scale
482210001	Granbury	200 N Gordon Street, Granbury	Granbury, TX	32.4423044	-97.8035291	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Middle Scale
482210001	Granbury	200 N Gordon Street, Granbury	Granbury, TX	32.4423044	-97.8035291	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Middle Scale
482311006	Greenville	824 Sayle Street, Greenville	Dallas-Fort Worth-Arlington, TX	33.1530882	-96.1155717	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Population Exposure; Upwind Background	Neighborhood
482311006	Greenville	824 Sayle Street, Greenville	Dallas-Fort Worth-Arlington, TX	33.1530882	-96.1155717	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure; Upwind Background	Neighborhood
482311006	Greenville	824 Sayle Street, Greenville	Dallas-Fort Worth-Arlington, TX	33.1530882	-96.1155717	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	General/Background	Neighborhood
482311006	Greenville	824 Sayle Street, Greenville	Dallas-Fort Worth-Arlington, TX	33.1530882	-96.1155717	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Neighborhood
482311006	Greenville	824 Sayle Street, Greenville	Dallas-Fort Worth-Arlington, TX	33.1530882	-96.1155717	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
482450009	Beaumont Downtown	1086 Vermont Avenue, Beaumont	Beaumont-Port Arthur, TX	30.0364221	-94.0710606	Suburban	NO/NO2/NOx	PAMS	Chemiluminescence	Continuous	Population Exposure	Neighborhood
482450009	Beaumont Downtown	1086 Vermont Avenue, Beaumont	Beaumont-Port Arthur, TX	30.0364221	-94.0710606	Suburban	O3	PAMS/ SLAMS	UV Photometric	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482450009	Beaumont Downtown	1086 Vermont Avenue, Beaumont	Beaumont-Port Arthur, TX	30.0364221	-94.0710606	Suburban	SO2	SLAMS	Pulsed Fluorescence	Continuous	Population Exposure	Neighborhood
482450009	Beaumont Downtown	1086 Vermont Avenue, Beaumont	Beaumont-Port Arthur, TX	30.0364221	-94.0710606	Suburban	Solar Radiation	PAMS	Photovoltaic	Continuous	Max Precursor Emissions Impact	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
482450009	Beaumont Downtown	1086 Vermont Avenue, Beaumont	Beaumont-Port Arthur, TX	30.0364221	-94.0710606	Suburban	Speciated VOC (AutoGC)	PAMS	GC	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482450009	Beaumont Downtown	1086 Vermont Avenue, Beaumont	Beaumont-Port Arthur, TX	30.0364221	-94.0710606	Suburban	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Max Precursor Emissions Impact	Neighborhood
482450009	Beaumont Downtown	1086 Vermont Avenue, Beaumont	Beaumont-Port Arthur, TX	30.0364221	-94.0710606	Suburban	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Max Precursor Emissions Impact	Neighborhood
482450011	Port Arthur West	623 Ellias Street, Port Arthur	Beaumont-Port Arthur, TX	29.8975163	-93.9910842	Urban and Center City	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
482450011	Port Arthur West	623 Ellias Street, Port Arthur	Beaumont-Port Arthur, TX	29.8975163	-93.9910842	Urban and Center City	SO2	SLAMS	Pulsed Fluorescence	Continuous	Source Oriented	Neighborhood
482450011	Port Arthur West	623 Ellias Street, Port Arthur	Beaumont-Port Arthur, TX	29.8975163	-93.9910842	Urban and Center City	Solar Radiation	SPM	Photovoltaic	Continuous	Population Exposure; Source Oriented	Neighborhood
482450011	Port Arthur West	623 Ellias Street, Port Arthur	Beaumont-Port Arthur, TX	29.8975163	-93.9910842	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Source Oriented	Neighborhood
482450011	Port Arthur West	623 Ellias Street, Port Arthur	Beaumont-Port Arthur, TX	29.8975163	-93.9910842	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure; Source Oriented	Neighborhood
482450018	Jefferson County Airport	End of 90th Street @ Jefferson County Airport, Port Arthur	Beaumont-Port Arthur, TX	29.9427981	-94.0007700	Suburban	Precipitation	PAMS	Rain Gauge	Continuous	General/Background	Neighborhood
482450018	Jefferson County Airport	End of 90th Street @ Jefferson County Airport, Port Arthur	Beaumont-Port Arthur, TX	29.9427981	-94.0007700	Suburban	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	General/Background	Neighborhood
482450018	Jefferson County Airport	End of 90th Street @ Jefferson County Airport, Port Arthur	Beaumont-Port Arthur, TX	29.9427981	-94.0007700	Suburban	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
482450021	Port Arthur Memorial School	2200 Jefferson Drive, Port Arthur	Beaumont-Port Arthur, TX	29.9228943	-93.9090184	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
482450022	Hamshire	12552 Second St, Not In A City	Beaumont-Port Arthur, TX	29.8639574	-94.3178017	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	General/Background; Regional Transport	Neighborhood / Urban Scale
482450022	Hamshire	12552 Second St, Not In A City	Beaumont-Port Arthur, TX	29.8639574	-94.3178017	Suburban	O3	SLAMS	UV Photometric	Continuous	General/Background; Regional Transport	Urban Scale
482450022	Hamshire	12552 Second St, Not In A City	Beaumont-Port Arthur, TX	29.8639574	-94.3178017	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
482450022	Hamshire	12552 Second St, Not In A City	Beaumont-Port Arthur, TX	29.8639574	-94.3178017	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	General/Background	Neighborhood
482450022	Hamshire	12552 Second St, Not In A City	Beaumont-Port Arthur, TX	29.8639574	-94.3178017	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Neighborhood
482450022	Hamshire	12552 Second St, Not In A City	Beaumont-Port Arthur, TX	29.8639574	-94.3178017	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
482450101	SETRPC 40 Sabine Pass	5200 Mechanic, Not In A City	Beaumont-Port Arthur, TX	29.7279314	-93.8940805	Rural	O3	PAMS	UV Photometric	Continuous	Max Ozone Concentration	Neighborhood
482450102	SETRPC 43 Jefferson Co Airport	Jefferson County Airport, Port Arthur	Beaumont-Port Arthur, TX	29.9427514	-94.0006841	Suburban	O3	SPM	UV Photometric	Continuous	Max Precursor Emissions Impact	Middle Scale

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
482451035	Nederland High School	1800 N. 18th Street, Nederland	Beaumont-Port Arthur, TX	29.9789255	-94.0108717	Suburban	Barometric Pressure	PAMS	Barometer	Continuous	Max Precursor Emissions Impact	Neighborhood
482451035	Nederland High School	1800 N. 18th Street, Nederland	Beaumont-Port Arthur, TX	29.9789255	-94.0108717	Suburban	CO (High Sensitivity)	PAMS	Gas Filter Correlation	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482451035	Nederland High School	1800 N. 18th Street, Nederland	Beaumont-Port Arthur, TX	29.9789255	-94.0108717	Suburban	Dew Point	SPM	Derived at site	Continuous	Population Exposure	Neighborhood
482451035	Nederland High School	1800 N. 18th Street, Nederland	Beaumont-Port Arthur, TX	29.9789255	-94.0108717	Suburban	NO/NO2/NOx	PAMS	Chemiluminescence	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482451035	Nederland High School	1800 N. 18th Street, Nederland	Beaumont-Port Arthur, TX	29.9789255	-94.0108717	Suburban	O3	PAMS	UV Photometric	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482451035	Nederland High School	1800 N. 18th Street, Nederland	Beaumont-Port Arthur, TX	29.9789255	-94.0108717	Suburban	Relative Humidity	PAMS	Humidity Sensor	Continuous	Max Precursor Emissions Impact	Neighborhood
482451035	Nederland High School	1800 N. 18th Street, Nederland	Beaumont-Port Arthur, TX	29.9789255	-94.0108717	Suburban	Solar Radiation	PAMS	Photovoltaic	Continuous	Max Precursor Emissions Impact	Neighborhood
482451035	Nederland High School	1800 N. 18th Street, Nederland	Beaumont-Port Arthur, TX	29.9789255	-94.0108717	Suburban	Speciated VOC (AutoGC)	PAMS	GC	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
482451035	Nederland High School	1800 N. 18th Street, Nederland	Beaumont-Port Arthur, TX	29.9789255	-94.0108717	Suburban	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Max Precursor Emissions Impact	Neighborhood
482451035	Nederland High School	1800 N. 18th Street, Nederland	Beaumont-Port Arthur, TX	29.9789255	-94.0108717	Suburban	UV Radiation	PAMS	Photovoltaic	Continuous	Max Precursor Emissions Impact	Neighborhood
482451035	Nederland High School	1800 N. 18th Street, Nederland	Beaumont-Port Arthur, TX	29.9789255	-94.0108717	Suburban	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Max Precursor Emissions Impact	Neighborhood
482510003	Cleburne Airport	1650 Airport Drive, Cleburne	Dallas-Fort Worth-Arlington, TX	32.3535945	-97.4367419	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Urban Scale
482510003	Cleburne Airport	1650 Airport Drive, Cleburne	Dallas-Fort Worth-Arlington, TX	32.3535945	-97.4367419	Suburban	Solar Radiation	PAMS	Photovoltaic	Continuous	Highest Concentration	Neighborhood
482510003	Cleburne Airport	1650 Airport Drive, Cleburne	Dallas-Fort Worth-Arlington, TX	32.3535945	-97.4367419	Suburban	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Highest Concentration	Neighborhood
482510003	Cleburne Airport	1650 Airport Drive, Cleburne	Dallas-Fort Worth-Arlington, TX	32.3535945	-97.4367419	Suburban	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Neighborhood
482511008	Johnson County Luisa	2420 Luisa Ln, Alvarado	Dallas-Fort Worth-Arlington, TX	32.4697010	-97.1692710	Suburban	Speciated VOC (Canister)	SPM	Canister GC-MS	24 Hours; 1/6 Days	Population Exposure	Neighborhood
482511008	Johnson County Luisa	2420 Luisa Ln, Alvarado	Dallas-Fort Worth-Arlington, TX	32.4697010	-97.1692710	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
482511008	Johnson County Luisa	2420 Luisa Ln, Alvarado	Dallas-Fort Worth-Arlington, TX	32.4697010	-97.1692710	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
482570005	Kaufman	3790 S Houston St, Kaufman	Dallas-Fort Worth-Arlington, TX	32.5649684	-96.3176873	Suburban	Dew Point	SPM	Derived at site	Continuous	Highest Concentration	Neighborhood
482570005	Kaufman	3790 S Houston St, Kaufman	Dallas-Fort Worth-Arlington, TX	32.5649684	-96.3176873	Suburban	NO/NO2/NOx	PAMS	Chemiluminescence	Continuous	Population Exposure; Upwind Background	Neighborhood / Urban Scale

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
482570005	Kaufman	3790 S Houston St, Kaufman	Dallas-Fort Worth-Arlington, TX	32.5649684	-96.3176873	Suburban	O3	PAMS	UV Photometric	Continuous	Population Exposure; Upwind Background	Urban Scale
482570005	Kaufman	3790 S Houston St, Kaufman	Dallas-Fort Worth-Arlington, TX	32.5649684	-96.3176873	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Upwind Background	Regional Scale
482570005	Kaufman	3790 S Houston St, Kaufman	Dallas-Fort Worth-Arlington, TX	32.5649684	-96.3176873	Suburban	Relative Humidity	PAMS	Humidity Sensor	Continuous	Upwind Background	Urban Scale
482570005	Kaufman	3790 S Houston St, Kaufman	Dallas-Fort Worth-Arlington, TX	32.5649684	-96.3176873	Suburban	SO2	SLAMS	Pulsed Fluorescence	Continuous	Population Exposure; Upwind Background	Urban Scale
482570005	Kaufman	3790 S Houston St, Kaufman	Dallas-Fort Worth-Arlington, TX	32.5649684	-96.3176873	Suburban	Solar Radiation	PAMS	Photovoltaic	Continuous	Upwind Background	Urban Scale
482570005	Kaufman	3790 S Houston St, Kaufman	Dallas-Fort Worth-Arlington, TX	32.5649684	-96.3176873	Suburban	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Upwind Background	Urban Scale
482570005	Kaufman	3790 S Houston St, Kaufman	Dallas-Fort Worth-Arlington, TX	32.5649684	-96.3176873	Suburban	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Upwind Background	Urban Scale
482570020	Terrell Temtex	2988 Temtex Blvd, Terrell	Dallas-Fort Worth-Arlington, TX	32.7319190	-96.3179110	Rural	Ambient Temperature TSP (Pb)	SPM	Derived from KTRL	24 Hours; 1/6 Days	General/Background	Neighborhood
482570020	Terrell Temtex	2988 Temtex Blvd, Terrell	Dallas-Fort Worth-Arlington, TX	32.7319190	-96.3179110	Rural	Barometric Pressure TSP (Pb)	SPM	Derived from KTRL	24 Hours; 1/6 Days	General/Background	Neighborhood
482570020	Terrell Temtex	2988 Temtex Blvd, Terrell	Dallas-Fort Worth-Arlington, TX	32.7319190	-96.3179110	Rural	TSP (Pb)	SLAMS	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure; Source Oriented	Neighborhood
482730314	National Seashore	20420 Park Road, Corpus Christi	Kingsville, TX	27.4269813	-97.2986922	Rural	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Regional Transport	Regional Scale
482730314	National Seashore	20420 Park Road, Corpus Christi	Kingsville, TX	27.4269813	-97.2986922	Rural	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Regional Transport	Regional Scale
482730314	National Seashore	20420 Park Road, Corpus Christi	Kingsville, TX	27.4269813	-97.2986922	Rural	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Regional Transport	Regional Scale
483091037	Waco Mazanec	4472 Mazanec Rd, Waco	Waco, TX	31.6530743	-97.0706982	Rural	CO	SLAMS	Gas Filter Correlation	Continuous	Upwind Background	Urban Scale
483091037	Waco Mazanec	4472 Mazanec Rd, Waco	Waco, TX	31.6530743	-97.0706982	Rural	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Upwind Background	Urban Scale
483091037	Waco Mazanec	4472 Mazanec Rd, Waco	Waco, TX	31.6530743	-97.0706982	Rural	O3	SLAMS	UV Photometric	Continuous	Upwind Background	Regional Scale
483091037	Waco Mazanec	4472 Mazanec Rd, Waco	Waco, TX	31.6530743	-97.0706982	Rural	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Regional Transport	Regional Scale
483091037	Waco Mazanec	4472 Mazanec Rd, Waco	Waco, TX	31.6530743	-97.0706982	Rural	SO2	SLAMS	Pulsed Fluorescence	Continuous	Upwind Background	Urban Scale
483091037	Waco Mazanec	4472 Mazanec Rd, Waco	Waco, TX	31.6530743	-97.0706982	Rural	Solar Radiation	SPM	Photovoltaic	Continuous	Regional Transport	Urban Scale
483091037	Waco Mazanec	4472 Mazanec Rd, Waco	Waco, TX	31.6530743	-97.0706982	Rural	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Regional Transport	Urban Scale

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
483091037	Waco Mazanec	4472 Mazanec Rd, Waco	Waco, TX	31.6530743	-97.0706982	Rural	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Regional Transport	Urban Scale
483230004	Eagle Pass	265 Foster Maldonado, Eagle Pass	Eagle Pass, TX	28.7046070	-100.4511555	Urban and Center City	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Regional Transport	Regional Scale
483230004	Eagle Pass	265 Foster Maldonado, Eagle Pass	Eagle Pass, TX	28.7046070	-100.4511555	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Regional Transport	Regional Scale
483230004	Eagle Pass	265 Foster Maldonado, Eagle Pass	Eagle Pass, TX	28.7046070	-100.4511555	Urban and Center City	Visibility	SPM	Visibility Sensor	Continuous	Regional Transport	Regional Scale
483230004	Eagle Pass	265 Foster Maldonado, Eagle Pass	Eagle Pass, TX	28.7046070	-100.4511555	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Regional Transport	Regional Scale
483390078	Conroe Relocated	9472A Hwy 1484, Conroe	Houston-Sugar Land-Baytown, TX	30.3503017	-95.4251278	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	General/Background; Population Exposure	Urban Scale
483390078	Conroe Relocated	9472A Hwy 1484, Conroe	Houston-Sugar Land-Baytown, TX	30.3503017	-95.4251278	Suburban	O3	PAMS/ SLAMS	UV Photometric	Continuous	General/Background; Population Exposure	Urban Scale
483390078	Conroe Relocated	9472A Hwy 1484, Conroe	Houston-Sugar Land-Baytown, TX	30.3503017	-95.4251278	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	General/Background	Neighborhood
483390078	Conroe Relocated	9472A Hwy 1484, Conroe	Houston-Sugar Land-Baytown, TX	30.3503017	-95.4251278	Suburban	Solar Radiation	PAMS/ SLAMS	Photovoltaic	Continuous	Highest Concentration	Neighborhood
483390078	Conroe Relocated	9472A Hwy 1484, Conroe	Houston-Sugar Land-Baytown, TX	30.3503017	-95.4251278	Suburban	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Highest Concentration	Neighborhood
483390078	Conroe Relocated	9472A Hwy 1484, Conroe	Houston-Sugar Land-Baytown, TX	30.3503017	-95.4251278	Suburban	Wind	PAMS/ SLAMS	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Neighborhood
483491051	Corsicana Airport	Corsicana Airport, Corsicana	Corsicana, TX	32.0319335	-96.3991408	Rural	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Source Oriented	Neighborhood
483550025	Corpus Christi West	Corpus Christi State School (Airport Rd), 902 AIRPORT BLVD, Corpus Christi	Corpus Christi, TX	27.7653399	-97.4342619	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
483550025	Corpus Christi West	Corpus Christi State School (Airport Rd), 902 AIRPORT BLVD, Corpus Christi	Corpus Christi, TX	27.7653399	-97.4342619	Suburban	SO2	SLAMS	Pulsed Fluorescence	Continuous	Population Exposure	Neighborhood
483550025	Corpus Christi West	Corpus Christi State School (Airport Rd), 902 AIRPORT BLVD, Corpus Christi	Corpus Christi, TX	27.7653399	-97.4342619	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	Population Exposure	Neighborhood
483550025	Corpus Christi West	Corpus Christi State School (Airport Rd), 902 AIRPORT BLVD, Corpus Christi	Corpus Christi, TX	27.7653399	-97.4342619	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
483550025	Corpus Christi West	Corpus Christi State School (Airport Rd), 902 AIRPORT BLVD, Corpus Christi	Corpus Christi, TX	27.7653399	-97.4342619	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
483550026	Corpus Christi Tuloso	9860 La Branch, Corpus Christi	Corpus Christi, TX	27.8324089	-97.5553798	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
483550026	Corpus Christi Tuloso	9860 La Branch, Corpus Christi	Corpus Christi, TX	27.8324089	-97.5553798	Suburban	SO2	SLAMS	Pulsed Fluorescence	Continuous	Population Exposure	Neighborhood
483550026	Corpus Christi Tuloso	9860 La Branch, Corpus Christi	Corpus Christi, TX	27.8324089	-97.5553798	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Highest Concentration	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
483550026	Corpus Christi Tuloso	9860 La Branch, Corpus Christi	Corpus Christi, TX	27.8324089	-97.5553798	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Neighborhood
483550032	Corpus Christi Huisache	3810 Huisache Street, Corpus Christi	Corpus Christi, TX	27.8045054	-97.4315816	Urban and Center City	PM2.5 (FRM)	QA Collocated/ SLAMS	Sequential FRM Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
483550032	Corpus Christi Huisache	3810 Huisache Street, Corpus Christi	Corpus Christi, TX	27.8045054	-97.4315816	Urban and Center City	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/3 Days	Population Exposure	Neighborhood
483550032	Corpus Christi Huisache	3810 Huisache Street, Corpus Christi	Corpus Christi, TX	27.8045054	-97.4315816	Urban and Center City	SO2	SLAMS	Pulsed Fluorescence	Continuous	Highest Concentration; Population Exposure	Neighborhood
483550032	Corpus Christi Huisache	3810 Huisache Street, Corpus Christi	Corpus Christi, TX	27.8045054	-97.4315816	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Middle Scale
483550032	Corpus Christi Huisache	3810 Huisache Street, Corpus Christi	Corpus Christi, TX	27.8045054	-97.4315816	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Middle Scale
483550034	Dona Park	5707 Up River Rd, Corpus Christi	Corpus Christi, TX	27.8118166	-97.4657031	Urban and Center City	PM10 (FRM)	QA Collocated/ SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
483550034	Dona Park	5707 Up River Rd, Corpus Christi	Corpus Christi, TX	27.8118166	-97.4657031	Urban and Center City	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
483550034	Dona Park	5707 Up River Rd, Corpus Christi	Corpus Christi, TX	27.8118166	-97.4657031	Urban and Center City	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
483550034	Dona Park	5707 Up River Rd, Corpus Christi	Corpus Christi, TX	27.8118166	-97.4657031	Urban and Center City	PM2.5 (Speciation)	CSN Supplemental	Carbons | Elements | Ions | Sequential FRM	24 Hours; 1/6 Days	Population Exposure	Neighborhood
483550034	Dona Park	5707 Up River Rd, Corpus Christi	Corpus Christi, TX	27.8118166	-97.4657031	Urban and Center City	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Regional Transport	Urban Scale
483550034	Dona Park	5707 Up River Rd, Corpus Christi	Corpus Christi, TX	27.8118166	-97.4657031	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Highest Concentration	Regional Scale
483550034	Dona Park	5707 Up River Rd, Corpus Christi	Corpus Christi, TX	27.8118166	-97.4657031	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Regional Scale
483611001	West Orange	2700 Austin Ave, West Orange	Beaumont-Port Arthur, TX	30.0852629	-93.7613411	Urban and Center City	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Population Exposure	Neighborhood
483611001	West Orange	2700 Austin Ave, West Orange	Beaumont-Port Arthur, TX	30.0852629	-93.7613411	Urban and Center City	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
483611001	West Orange	2700 Austin Ave, West Orange	Beaumont-Port Arthur, TX	30.0852629	-93.7613411	Urban and Center City	Solar Radiation	SPM	Photovoltaic	Continuous	Source Oriented	Neighborhood
483611001	West Orange	2700 Austin Ave, West Orange	Beaumont-Port Arthur, TX	30.0852629	-93.7613411	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Source Oriented	Neighborhood
483611001	West Orange	2700 Austin Ave, West Orange	Beaumont-Port Arthur, TX	30.0852629	-93.7613411	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Source Oriented	Neighborhood
483611100	SETRPC 42 Mauriceville	Intersection of TX Hwys 62 & 12, Port Arthur	Beaumont-Port Arthur, TX	30.1945576	-93.8672365	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Upwind Background	Regional Scale
483670081	Parker County	3033 New Authon Rd, Weatherford	Dallas-Fort Worth-Arlington, TX	32.8687727	-97.9059308	Rural	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Urban Scale

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
483670081	Parker County	3033 New Authon Rd, Weatherford	Dallas-Fort Worth-Arlington, TX	32.8687727	-97.9059308	Rural	Solar Radiation	SPM	Photovoltaic	Continuous	Source Oriented	Neighborhood
483670081	Parker County	3033 New Authon Rd, Weatherford	Dallas-Fort Worth-Arlington, TX	32.8687727	-97.9059308	Rural	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Source Oriented	Neighborhood
483670081	Parker County	3033 New Authon Rd, Weatherford	Dallas-Fort Worth-Arlington, TX	32.8687727	-97.9059308	Rural	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Source Oriented	Neighborhood
483750024	Amarillo SH 136	7100 State Highway 136, Amarillo	Amarillo, TX	35.2802728	-101.7156402	Rural	Ambient Temperature TSP (Pb)	SPM	Derived from KAMA	24 Hours; 1/6 Days	General/Background	Middle Scale
483750024	Amarillo SH 136	7100 State Highway 136, Amarillo	Amarillo, TX	35.2802728	-101.7156402	Rural	Barometric Pressure TSP (Pb)	SPM	Derived from KAMA	24 Hours; 1/6 Days	General/Background	Middle Scale
483750024	Amarillo SH 136	7100 State Highway 136, Amarillo	Amarillo, TX	35.2802728	-101.7156402	Rural	TSP (Pb)	SLAMS	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure; Source Oriented	Middle Scale
483750320	Amarillo A&M	6500 Amarillo Blvd West, Amarillo	Amarillo, TX	35.2015922	-101.9092746	Urban and Center City	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Urban Scale
483751025	Amarillo 24th Avenue	4205 NE 24th Avenue, Amarillo	Amarillo, TX	35.2367360	-101.7874050	Suburban	SO2	SLAMS	Pulsed Fluorescence	Continuous	Population Exposure	Neighborhood
483751025	Amarillo 24th Avenue	4205 NE 24th Avenue, Amarillo	Amarillo, TX	35.2367360	-101.7874050	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Neighborhood
483751025	Amarillo 24th Avenue	4205 NE 24th Avenue, Amarillo	Amarillo, TX	35.2367360	-101.7874050	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
483970001	Rockwall Heath	100 E Heath St, Rockwall	Dallas-Fort Worth-Arlington, TX	32.9365230	-96.4592108	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
483970001	Rockwall Heath	100 E Heath St, Rockwall	Dallas-Fort Worth-Arlington, TX	32.9365230	-96.4592108	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	Population Exposure	Neighborhood
483970001	Rockwall Heath	100 E Heath St, Rockwall	Dallas-Fort Worth-Arlington, TX	32.9365230	-96.4592108	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
483970001	Rockwall Heath	100 E Heath St, Rockwall	Dallas-Fort Worth-Arlington, TX	32.9365230	-96.4592108	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
484230007	Tyler Airport Relocated	14790 County Road 1145, Tyler	Tyler, TX	32.3440079	-95.4157515	Rural	NO/NO2/NOx	SPM	Chemiluminescence	Continuous	General/Background	Urban Scale
484230007	Tyler Airport Relocated	14790 County Road 1145, Tyler	Tyler, TX	32.3440079	-95.4157515	Rural	O3	SLAMS	UV Photometric	Continuous	General/Background	Urban Scale
484230007	Tyler Airport Relocated	14790 County Road 1145, Tyler	Tyler, TX	32.3440079	-95.4157515	Rural	Precipitation	SPM	Rain Gauge	Continuous	General/Background	Neighborhood
484230007	Tyler Airport Relocated	14790 County Road 1145, Tyler	Tyler, TX	32.3440079	-95.4157515	Rural	Solar Radiation	SPM	Photovoltaic	Continuous	General/Background	Neighborhood
484230007	Tyler Airport Relocated	14790 County Road 1145, Tyler	Tyler, TX	32.3440079	-95.4157515	Rural	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Neighborhood
484230007	Tyler Airport Relocated	14790 County Road 1145, Tyler	Tyler, TX	32.3440079	-95.4157515	Rural	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
484390075	Eagle Mountain Lake	14290 Morris Dido Newark Rd, Eagle Mountain	Dallas-Fort Worth-Arlington, TX	32.9878908	-97.4771754	Rural	O3	SLAMS	UV Photometric	Continuous	Max Ozone Concentration	Neighborhood
484390075	Eagle Mountain Lake	14290 Morris Dido Newark Rd, Eagle Mountain	Dallas-Fort Worth-Arlington, TX	32.9878908	-97.4771754	Rural	Solar Radiation	SPM	Photovoltaic	Continuous	Highest Concentration	Middle Scale
484390075	Eagle Mountain Lake	14290 Morris Dido Newark Rd, Eagle Mountain	Dallas-Fort Worth-Arlington, TX	32.9878908	-97.4771754	Rural	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Highest Concentration	Middle Scale
484390075	Eagle Mountain Lake	14290 Morris Dido Newark Rd, Eagle Mountain	Dallas-Fort Worth-Arlington, TX	32.9878908	-97.4771754	Rural	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Middle Scale
484391002	Fort Worth Northwest	3317 Ross Ave, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.8058183	-97.3565675	Urban and Center City	Carbonyl	SPM	DNPH Silica HPLC	24 Hours; 1/6 Days	Max Precursor Emissions Impact	Neighborhood
484391002	Fort Worth Northwest	3317 Ross Ave, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.8058183	-97.3565675	Urban and Center City	Dew Point	SPM	Derived at site	Continuous	Population Exposure	Middle Scale
484391002	Fort Worth Northwest	3317 Ross Ave, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.8058183	-97.3565675	Urban and Center City	NO/NO2/NOx	PAMS/ SLAMS	Chemiluminescence	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
484391002	Fort Worth Northwest	3317 Ross Ave, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.8058183	-97.3565675	Urban and Center City	O3	PAMS/ SLAMS	UV Photometric	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
484391002	Fort Worth Northwest	3317 Ross Ave, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.8058183	-97.3565675	Urban and Center City	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/3 Days	Population Exposure	Neighborhood
484391002	Fort Worth Northwest	3317 Ross Ave, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.8058183	-97.3565675	Urban and Center City	Relative Humidity	PAMS	Humidity Sensor	Continuous	Max Precursor Emissions Impact	Neighborhood
484391002	Fort Worth Northwest	3317 Ross Ave, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.8058183	-97.3565675	Urban and Center City	Solar Radiation	PAMS	Photovoltaic	Continuous	Max Precursor Emissions Impact	Neighborhood
484391002	Fort Worth Northwest	3317 Ross Ave, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.8058183	-97.3565675	Urban and Center City	Speciated VOC (AutoGC)	PAMS	GC	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
484391002	Fort Worth Northwest	3317 Ross Ave, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.8058183	-97.3565675	Urban and Center City	Speciated VOC (Canister)	PAMS	Canister GC-MS	24 Hours; 1/6 Days	Max Precursor Emissions Impact; Population Exposure	Neighborhood
484391002	Fort Worth Northwest	3317 Ross Ave, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.8058183	-97.3565675	Urban and Center City	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Max Precursor Emissions Impact	Neighborhood
484391002	Fort Worth Northwest	3317 Ross Ave, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.8058183	-97.3565675	Urban and Center City	TNMOC (AutoGC)	PAMS	GC	Continuous	Max Precursor Emissions Impact; Population Exposure	Neighborhood
484391002	Fort Worth Northwest	3317 Ross Ave, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.8058183	-97.3565675	Urban and Center City	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Max Precursor Emissions Impact	Neighborhood
484391006	Haws Athletic Center	600 1/2 Congress St, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.7591432	-97.3423337	Urban and Center City	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/3 Days	Highest Concentration; Population Exposure	Neighborhood
484391006	Haws Athletic Center	600 1/2 Congress St, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.7591432	-97.3423337	Urban and Center City	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Highest Concentration	Neighborhood
484391053	Fort Worth California Parkway North	1198 California Parkway North,	Dallas-Fort Worth-Arlington, TX	32.6647220	-97.3380560	Urban and Center City	CO	Near Road/ SLAMS	Gas Filter Correlation	Continuous	Max Precursor Emissions Impact	Microscale
484391053	Fort Worth California Parkway North	1198 California Parkway North,	Dallas-Fort Worth-Arlington, TX	32.6647220	-97.3380560	Urban and Center City	NO/NO2/NOx	Near Road/ SLAMS	Chemiluminescence	Continuous	Max Precursor Emissions Impact	Microscale

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
484391053	Fort Worth California Parkway North	1198 California Parkway North,	Dallas-Fort Worth-Arlington, TX	32.6647220	-97.3380560	Urban and Center City	PM2.5 (FRM)	Near Road/ SLAMS	Sequential FRM Gravimetric	24 Hours; 1/3 Days	Max Precursor Emissions Impact	Microscale
484391053	Fort Worth California Parkway North	1198 California Parkway North,	Dallas-Fort Worth-Arlington, TX	32.6647220	-97.3380560	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Max Precursor Emissions Impact	Microscale
484391053	Fort Worth California Parkway North	1198 California Parkway North,	Dallas-Fort Worth-Arlington, TX	32.6647220	-97.3380560	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Max Precursor Emissions Impact	Microscale
484392003	Keller	FAA Site off Alta Vista Road, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.9224736	-97.2820880	Suburban	O3	SLAMS	UV Photometric	Continuous	Max Ozone Concentration; Population Exposure	Neighborhood
484392003	Keller	FAA Site off Alta Vista Road, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.9224736	-97.2820880	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	General/Background	Urban Scale
484392003	Keller	FAA Site off Alta Vista Road, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.9224736	-97.2820880	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Urban Scale
484392003	Keller	FAA Site off Alta Vista Road, Fort Worth	Dallas-Fort Worth-Arlington, TX	32.9224736	-97.2820880	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Urban Scale
484393009	Grapevine Fairway	4100 Fairway Dr, Grapevine	Dallas-Fort Worth-Arlington, TX	32.9842596	-97.0637211	Suburban	Barometric Pressure	PAMS	Barometer	Continuous	Max Ozone Concentration	Neighborhood
484393009	Grapevine Fairway	4100 Fairway Dr, Grapevine	Dallas-Fort Worth-Arlington, TX	32.9842596	-97.0637211	Suburban	Dew Point	SPM	Derived at site	Continuous	Highest Concentration; Max Ozone	Neighborhood
484393009	Grapevine Fairway	4100 Fairway Dr, Grapevine	Dallas-Fort Worth-Arlington, TX	32.9842596	-97.0637211	Suburban	NO/NO2/NOx	PAMS/ SLAMS	Chemiluminescence	Continuous	Max Ozone Concentration; Population Exposure	Neighborhood
484393009	Grapevine Fairway	4100 Fairway Dr, Grapevine	Dallas-Fort Worth-Arlington, TX	32.9842596	-97.0637211	Suburban	O3	PAMS/ SLAMS	UV Photometric	Continuous	Max Ozone Concentration; Population Exposure	Neighborhood
484393009	Grapevine Fairway	4100 Fairway Dr, Grapevine	Dallas-Fort Worth-Arlington, TX	32.9842596	-97.0637211	Suburban	Relative Humidity	PAMS	Humidity Sensor	Continuous	Max Ozone Concentration	Neighborhood
484393009	Grapevine Fairway	4100 Fairway Dr, Grapevine	Dallas-Fort Worth-Arlington, TX	32.9842596	-97.0637211	Suburban	Solar Radiation	PAMS	Photovoltaic	Continuous	Max Ozone Concentration	Neighborhood
484393009	Grapevine Fairway	4100 Fairway Dr, Grapevine	Dallas-Fort Worth-Arlington, TX	32.9842596	-97.0637211	Suburban	Speciated VOC (Canister)	PAMS	Canister GC-MS	24 Hours; 1/6 Days	Max Ozone Concentration; Population Exposure	Neighborhood
484393009	Grapevine Fairway	4100 Fairway Dr, Grapevine	Dallas-Fort Worth-Arlington, TX	32.9842596	-97.0637211	Suburban	Temperature (Outdoor)	PAMS	Aspirated Thermister	Continuous	Max Ozone Concentration	Neighborhood
484393009	Grapevine Fairway	4100 Fairway Dr, Grapevine	Dallas-Fort Worth-Arlington, TX	32.9842596	-97.0637211	Suburban	Wind	PAMS	Potentiometer Cup Anemometer	Continuous	Max Ozone Concentration	Neighborhood
484393010	Stage Coach	8900 West Freeway, White Settlement	Dallas-Fort Worth-Arlington, TX	32.7392000	-97.4703300	Suburban	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
484393011	Arlington Municipal Airport	5504 South Collins Street, Arlington	Dallas-Fort Worth-Arlington, TX	32.6563574	-97.0885849	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Population Exposure	Neighborhood
484393011	Arlington Municipal Airport	5504 South Collins Street, Arlington	Dallas-Fort Worth-Arlington, TX	32.6563574	-97.0885849	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
484393011	Arlington Municipal Airport	5504 South Collins Street, Arlington	Dallas-Fort Worth-Arlington, TX	32.6563574	-97.0885849	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Highest Concentration	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
484393011	Arlington Municipal Airport	5504 South Collins Street, Arlington	Dallas-Fort Worth-Arlington, TX	32.6563574	-97.0885849	Suburban	Solar Radiation	SPM	Photovoltaic	Continuous	Highest Concentration	Neighborhood
484393011	Arlington Municipal Airport	5504 South Collins Street, Arlington	Dallas-Fort Worth-Arlington, TX	32.6563574	-97.0885849	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Highest Concentration	Neighborhood
484393011	Arlington Municipal Airport	5504 South Collins Street, Arlington	Dallas-Fort Worth-Arlington, TX	32.6563574	-97.0885849	Suburban	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Neighborhood
484530014	Austin Northwest	3724 North Hills Dr, Austin	Austin-Round Rock, TX	30.3544356	-97.7602554	Suburban	NO/NO2/NOx	SLAMS	Chemiluminescence	Continuous	Population Exposure	Urban Scale
484530014	Austin Northwest	3724 North Hills Dr, Austin	Austin-Round Rock, TX	30.3544356	-97.7602554	Suburban	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
484530014	Austin Northwest	3724 North Hills Dr, Austin	Austin-Round Rock, TX	30.3544356	-97.7602554	Suburban	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
484530014	Austin Northwest	3724 North Hills Dr, Austin	Austin-Round Rock, TX	30.3544356	-97.7602554	Suburban	SO2	SLAMS	Pulsed Fluorescence	Continuous	Population Exposure	Urban Scale
484530014	Austin Northwest	3724 North Hills Dr, Austin	Austin-Round Rock, TX	30.3544356	-97.7602554	Suburban	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	General/Background	Neighborhood
484530014	Austin Northwest	3724 North Hills Dr, Austin	Austin-Round Rock, TX	30.3544356	-97.7602554	Suburban	Wind (3m)	SPM	Potentiometer Cup Anemometer	Continuous	General/Background	Neighborhood
484530020	Austin Audubon Society	12200 Lime Creek Rd, Leander	Austin-Round Rock, TX	30.4831681	-97.8723005	Rural	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
484530020	Austin Audubon Society	12200 Lime Creek Rd, Leander	Austin-Round Rock, TX	30.4831681	-97.8723005	Rural	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
484530020	Austin Audubon Society	12200 Lime Creek Rd, Leander	Austin-Round Rock, TX	30.4831681	-97.8723005	Rural	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
484530020	Austin Audubon Society	12200 Lime Creek Rd, Leander	Austin-Round Rock, TX	30.4831681	-97.8723005	Rural	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
484530020	Austin Audubon Society	12200 Lime Creek Rd, Leander	Austin-Round Rock, TX	30.4831681	-97.8723005	Rural	Solar Radiation	SPM	Photovoltaic	Continuous	Population Exposure	Urban Scale
484530020	Austin Audubon Society	12200 Lime Creek Rd, Leander	Austin-Round Rock, TX	30.4831681	-97.8723005	Rural	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Urban Scale
484530020	Austin Audubon Society	12200 Lime Creek Rd, Leander	Austin-Round Rock, TX	30.4831681	-97.8723005	Rural	Wind (3m)	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Urban Scale
484530021	Austin Webberville Rd	2600B Webberville Rd, Austin	Austin-Round Rock, TX	30.2632079	-97.7128831	Urban and Center City	PM10 (FRM)	SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
484530021	Austin Webberville Rd	2600B Webberville Rd, Austin	Austin-Round Rock, TX	30.2632079	-97.7128831	Urban and Center City	PM2.5 (FRM)	SLAMS	Sequential FRM Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
484530021	Austin Webberville Rd	2600B Webberville Rd, Austin	Austin-Round Rock, TX	30.2632079	-97.7128831	Urban and Center City	PM2.5 (TEOM)	SPM	TEOM Gravimetric	Continuous	Population Exposure	Neighborhood
484530021	Austin Webberville Rd	2600B Webberville Rd, Austin	Austin-Round Rock, TX	30.2632079	-97.7128831	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
484530021	Austin Webberville Rd	2600B Webberville Rd, Austin	Austin-Round Rock, TX	30.2632079	-97.7128831	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
484531068	Austin North Interstate 35	8912 N IH 35 SVRD SB, Austin	Austin-Round Rock, TX	30.3538600	-97.6916600	Urban and Center City	NO/NO2/NOx	Near Road/ SLAMS	Chemiluminescence	Continuous	Max Precursor Emissions Impact	Microscale
484531068	Austin North Interstate 35	8912 N IH 35 SVRD SB, Austin	Austin-Round Rock, TX	30.3538600	-97.6916600	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Max Precursor Emissions Impact	Microscale
484531068	Austin North Interstate 35	8912 N IH 35 SVRD SB, Austin	Austin-Round Rock, TX	30.3538600	-97.6916600	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Max Precursor Emissions Impact	Microscale
484690003	Victoria	106 Mockingbird Lane, Victoria	Victoria, TX	28.8361697	-97.0055298	Urban and Center City	O3	SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
484690003	Victoria	106 Mockingbird Lane, Victoria	Victoria, TX	28.8361697	-97.0055298	Urban and Center City	Solar Radiation	SPM	Photovoltaic	Continuous	Highest Concentration	Neighborhood
484690003	Victoria	106 Mockingbird Lane, Victoria	Victoria, TX	28.8361697	-97.0055298	Urban and Center City	Temperature (Outdoor)	SPM	Aspirated Thermister	Continuous	Highest Concentration	Neighborhood
484690003	Victoria	106 Mockingbird Lane, Victoria	Victoria, TX	28.8361697	-97.0055298	Urban and Center City	Wind	SPM	Potentiometer Cup Anemometer	Continuous	Highest Concentration	Neighborhood
484790016	Laredo Vidaurri	2020 Vidaurri Ave, Laredo	Laredo, TX	27.5174485	-99.5152185	Suburban	Ambient Temperature TSP (Pb)	SPM	Derived from KLRD	24 Hours; 1/6 Days	General/Background	Neighborhood
484790016	Laredo Vidaurri	2020 Vidaurri Ave, Laredo	Laredo, TX	27.5174485	-99.5152185	Suburban	Barometric Pressure TSP (Pb)	SPM	Derived from KLRD	24 Hours; 1/6 Days	General/Background	Neighborhood
484790016	Laredo Vidaurri	2020 Vidaurri Ave, Laredo	Laredo, TX	27.5174485	-99.5152185	Suburban	CO	Border Grant/SPM	Gas Filter Correlation	Continuous	Population Exposure	Neighborhood
484790016	Laredo Vidaurri	2020 Vidaurri Ave, Laredo	Laredo, TX	27.5174485	-99.5152185	Suburban	O3	Border Grant/ SLAMS	UV Photometric	Continuous	Population Exposure	Neighborhood
484790016	Laredo Vidaurri	2020 Vidaurri Ave, Laredo	Laredo, TX	27.5174485	-99.5152185	Suburban	PM10 (FRM)	Border Grant/QA Collocated/	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
484790016	Laredo Vidaurri	2020 Vidaurri Ave, Laredo	Laredo, TX	27.5174485	-99.5152185	Suburban	PM10 (FRM)	Border Grant/ SLAMS	HiVol Gravimetric	24 Hours; 1/6 Days	Population Exposure	Neighborhood
484790016	Laredo Vidaurri	2020 Vidaurri Ave, Laredo	Laredo, TX	27.5174485	-99.5152185	Suburban	Temperature (Outdoor)	Border Grant/SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
484790016	Laredo Vidaurri	2020 Vidaurri Ave, Laredo	Laredo, TX	27.5174485	-99.5152185	Suburban	TSP (Pb)	Border Grant/SPM	HiVol ICP-MS	24 Hours; 1/6 Days	Population Exposure	Neighborhood
484790016	Laredo Vidaurri	2020 Vidaurri Ave, Laredo	Laredo, TX	27.5174485	-99.5152185	Suburban	Wind	Border Grant/SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
484790017	Laredo Bridge	700 Zaragosa St, Laredo	Laredo, TX	27.5018255	-99.5029843	Urban and Center City	CO	Border Grant/SPM	Gas Filter Correlation	Continuous	Population Exposure; Source Oriented	Microscale
484790017	Laredo Bridge	700 Zaragosa St, Laredo	Laredo, TX	27.5018255	-99.5029843	Urban and Center City	PM10 (FRM)	Border Grant/SPM	HiVol Gravimetric	24 Hours; 1/6 Days	Highest Concentration	Microscale
484790017	Laredo Bridge	700 Zaragosa St, Laredo	Laredo, TX	27.5018255	-99.5029843	Urban and Center City	Speciated VOC (Canister)	Border Grant/SPM	Canister GC-MS	24 Hours; 1/6 Days	Highest Concentration	Neighborhood

Appendix A: Ambient Air Monitoring Network Site List

AQS Site ID	Site Name	Address/Location	MSA / CBSA	Latitude	Longitude	Location Setting	Sampler Type	AQS Network	Sampling/ Analysis Methods	Operating Schedule	Monitoring Objective	Spatial Scale
484790017	Laredo Bridge	700 Zaragosa St, Laredo	Laredo, TX	27.5018255	-99.5029843	Urban and Center City	Temperature (Outdoor)	Border Grant/SPM	Aspirated Thermister	Continuous	Population Exposure	Neighborhood
484790017	Laredo Bridge	700 Zaragosa St, Laredo	Laredo, TX	27.5018255	-99.5029843	Urban and Center City	Wind	Border Grant/SPM	Potentiometer Cup Anemometer	Continuous	Population Exposure	Neighborhood
484790313	World Trade Bridge	Mines Road 11601 FM 1472, Laredo	Laredo, TX	27.5994440	-99.5333330	Suburban	PM2.5 (TEOM)	Border Grant/SPM	TEOM Gravimetric	Continuous	Source Oriented	Microscale

Appendix A: Ambient Air Monitoring Network Site List

LEGEND

@	at
1 24-Hour Avg, 1/6 Days	1 24-Hour Average, Once every Sixth Day
1 24-Hour; 1/3 Days	1 24-Hour Sample, Once every Third Day
1 24-Hours, Daily	1 24-Hour Sample, Daily
24 1-Hour Avg; Daily	24 1-Hour Average, Daily
8 3-Hours; 1/3 Days (Jul. - Sept.)	8 3-Hour Samples, Once every Third Day from July through September
8 3-Hours; 1/3 Days (Jun. - Aug.)	8 3-Hour Samples, Once every Third Day from June through August
AMNP	Annual Monitoring Network Plan
AQS	Air Quality System
AutoGC	automated gas chromatograph
Ave	Avenue
Blvd	Boulevard
Border	The Border network designation is part of the SLAMS network for monitors within 100 kilometers of the United States/Mexico border.
CO	carbon monoxide
Co	County
Dr	Drive
E	East
Elem	Elementary
FM	Farm-to-Market
FRM	federal reference method
Hwy	Highway
IH	Interstate Highway
Max	Maximum
N	North
NATTS	National Air Toxics Trends Stations
NCore	National Core Multipollutant Monitoring Stations
NE	Northeast
$NO/NO_2/NO_x$	nitrogen oxides
NO_y	total reactive nitrogen
O_3	ozone
PAMS	Photochemical Assessment Monitoring Stations
PM_{10}	particulate matter of 10 micrometers or less in diameter
$PM_{10-2.5}$	coarse particulate matter

$PM_{2.5}$	particulate matter of 2.5 micrometers or less in diameter
QA Collocated	quality assurance collocated monitor
Rd	Road
S	South
SB	South Bound
SETRPC	Southeast Texas Regional Planning Commission
SLAMS	State or Local Air Monitoring Stations
SO_2	sulfur dioxide
SPM	special purpose monitor
St	Street
SVOC	semi-volatile organic compound
TCEQ	Texas Commission on Environmental Quality
TEOM	tapered element oscillating microbalance
TSP	total suspended particulate
TSP (Pb)	total suspended particulate (lead)
UV	ultraviolet
VOC	volatile organic compound
W	West
Yd	Yard

Appendix B

Population and Monitoring Requirements by Metropolitan Statistical Area

Texas Commission on Environmental Quality

2016 Annual Monitoring Network Plan

Appendix B: Population and Monitoring Requirements by Metropolitan Statistical Area

Texas Metropolitan Statistical Areas	Population*	$NO / NO_2 / NO_x / NO_y$		SO_2		Pb		O_3		CO		PM_{10}		$PM_{2.5}$		VOC	
		Required	Current†	Required	Current†	Required	Current†	Required	Current†	Required	Current†	Required	Current†	Required	Current†	Required	Current†
Dallas-Fort Worth-Arlington	7,102,796	7	15	3	4	3	6	5	19	2	2	4 - 8	4	8	15	2	8
Houston-The Woodlands-Sugar Land	6,656,947	7	19	3	8	1	1	5	20	2	3	4 - 8	8	9	18	4	5
San Antonio-New Braunfels	2,384,075	2	3	1	1	0	0	2	3	1	0	2 - 4	2	3	7	0	0
Austin-Round Rock	2,000,860	2	2	1	1	0	0	2	2	1	0	2 - 4	2	3	5	0	0
El Paso	838,972	3	4	1	3	1	3	3	6	1	3	2 - 4	5	5	7	1	1
McAllen-Edinburg-Mission	842,304	0	0	0	0	0	0	1	1	0	0	2 - 4	2	3	3	0	0
Corpus Christi	452,422	0	0	0	3	0	0	2	2	0	0	0 - 1	1	3	4	0	0
Killeen-Temple	431,032	0	0	0	0	0	0	2	2	0	0	0 - 1	0	0	0	0	0
Brownsville-Harlingen	422,156	0	0	0	0	0	1	1	2	0	1	0 - 1	0	2	3	0	0
Beaumont-Port Arthur	408,419	1	4	1	2	0	0	2	7	0	1	0 - 1	0	0	3	2	2
Lubbock	311,154	0	0	0	0	0	0	0	0	0	0	0 - 1	0	0	1	0	0
Laredo	269,721	0	0	0	0	0	1	1	1	0	2	0 - 1	2	0	1	0	1
Waco	262,813	0	1	0	1	0	0	1	1	0	1	0 - 1	0	0	1	0	0
Amarillo	262,056	0	0	0	1	1	1	0	0	0	0	0 - 1	0	0	1	0	0
College Station-Bryan	249,156	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tyler	222,936	0	1	0	0	0	0	1	1	0	0	0	1	0	0	0	0
Longview	217,781	0	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0
Abilene	169,578	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Midland	166,718	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Odessa	159,436	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Wichita Falls	150,780	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Texarkana	149,769	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0
Sherman-Denison	125,467	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
San Angelo	119,659	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Victoria	99,913	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Marshall[1]	66,746	0	1	0	0	0	0	0	1	0	0	0	2	0	4	0	1
Total		22	51	11	25	6	13	30	70	7	13	16-40	29	38	77	9	18

†Monitors may fulfill multiple monitoring requirements, but are only counted once.

*United States Census Bureau population estimates as of July 1, 2015

[1]Area is classified as a micropolitan statistical area and not subject to SLAMS requirements

$NO/NO_2/NO_x/NO_y$ - oxides of nitrogen and total reactive nitrogen compounds

CO - carbon monoxide

SO_2 - sulfur dioxide

Pb - lead

O_3 - ozone

PM_{10} - particulate matter of 10 micrometers or less

$PM_{2.5}$ - particulate matter of 2.5 micrometers or less

VOC - volatile organic compound

Only monitors included in Appendix A are included in this table.

Required and current monitor counts include NOy, high sensitivity SO_2, and high sensitivity CO.

Current monitor counts for Pb and PM_{10} include speciation and collocated QA monitors.

Current monitor counts for $PM_{2.5}$ include collocated QA, federal reference method, speciation, and continuous monitors.

Current monitor counts for VOC include automated gas chromatograph, canister, and collocated QA monitors.

$PM_{10\text{-}2.5}$ NCore requirements are not included in particulate matter counts

Planned deployment of required monitors is discussed in the applicable section of the AMNP document.

Appendix C

Nitrogen Dioxide and Total Reactive Nitrogen Monitoring Requirements

Texas Commission on Environmental Quality

2016 Annual Monitoring Network Plan

Appendix C: Nitrogen Dioxide and Total Reactive Nitrogen Monitoring Requirements

Core Based Statistical Areas	2015 Population Estimates[1]	Required NO_2 Area-Wide Monitors	Required NO_2 RA-40 Monitors	Required NO_2 Near-Road Monitors	Required NO_2 PAMS Monitors	Required High Sensitivity NO_y NCore Monitors	Required High Sensitivity NO_y PAMS Monitors	Total Required Monitors[3]	Total Current Monitors[2]
Dallas-Fort Worth-Arlington	7,102,796	Dallas Hinton	Arlington Municipal Airport	Dallas LBJ Freeway and Fort Worth California Parkway	Dallas Hinton	Dallas Hinton	Denton Airport South	7	15
Houston-The Woodlands-Sugar Land	6,656,947	Clinton	Clinton	Houston Southwest Freeway and Houston North Loop	Houston Deer Park #2	Houston Deer Park #2	Houston Aldine	7	19
San Antonio-New Braunfels	2,384,075	San Antonio Northwest	None	San Antonio Interstate 35	None	None	None	2	3
Austin-Round Rock	2,000,860	Austin Northwest	None	Austin North Interstate 35	None	None	None	2	2
El Paso	838,972	None	Ascarate Park SE	None	El Paso Chamizal	El Paso Chamizal	None	3	4
McAllen-Edinburg-Mission	842,304	None	None	None	None	None	None	0	0
Corpus Christi	452,422	None	None	None	None	None	None	0	0
Killeen-Temple	431,032	None	None	None	None	None	None	0	0
Brownsville-Harlingen	422,156	None	None	None	None	None	None	0	0
Beaumont-Port Arthur	408,419	None	Nederland High School	None	None	None	None	1	4
Lubbock	311,154	None	None	None	None	None	None	0	0
Laredo	269,721	None	None	None	None	None	None	0	0
Waco	262,813	None	None	None	None	None	None	0	1
Amarillo	262,056	None	None	None	None	None	None	0	0
College Station-Bryan	249,156	None	None	None	None	None	None	0	0
Tyler	222,936	None	None	None	None	None	None	0	1
Longview	217,781	None	None	None	None	None	None	0	1
Abilene	169,578	None	None	None	None	None	None	0	0
Midland	166,718	None	None	None	None	None	None	0	0
Odessa	159,436	None	None	None	None	None	None	0	0
Wichita Falls	150,780	None	None	None	None	None	None	0	0
Texarkana	149,769	None	None	None	None	None	None	0	0
Sherman-Denison	125,467	None	None	None	None	None	None	0	0
San Angelo	119,659	None	None	None	None	None	None	0	0
Victoria	99,913	None	None	None	None	None	None	0	0
Marshall*	66,746	None	None	None	None	None	None	0	1
Total		4	4	6	3	3	2	22	51

[1]United States Census Bureau population estimates as of July 1, 2015

[2]Monitors may fulfill multiple monitoring requirements but are only counted once

[3]Total required monitors is a count of individual requirements for area-wide, RA-40, near-road, PAMS, and high sensitivity monitors. Deployed monitors can fulfill multiple monitoring requirements.

*Area is classified as a micropolitan statistical area and not subject to SLAMS requirements

PAMS - Photochemical Assessment Monitoring Stations

NCore - National Core Multipollutant Monitoring Stations

RA-40 - Regional Administrator 40

NO_2 - nitrogen dioxide

NO_Y - total reactive nitrogen compounds

Appendix D

Sulfur Dioxide Monitoring Requirements

Texas Commission on Environmental Quality
2016 Annual Monitoring Network Plan

TCEQ

Appendix D: Sulfur Dioxide Monitoring Requirements

Core Based Statistical Area	County	2015 Population Estimates*	2011 Point Source (tpy)	2011 NEI Data (tpy)	2014 Point Source (tpy)	2011 NEI Non-Point Source Data with 2014 Point Source Data (tpy)	PWEI	Required SLAMS Monitors	Required SO_2 DRR Monitors***	Required High Sensitivity SO_2 NCore Monitors	Total Required SO_2 Monitors	Existing Monitors**
Amarillo		262,056				14,644.26	3,838	0	1	0	1	1
	Armstrong		0.05	22.26	0.32	22.53						
	Carson		0.23	18.19	0.17	18.13						
	Potter		15,139.02	15,265.36	14317.79	14,444.14						
	Randall		120.57	157.28	118.52	155.23						
	Oldham		0.00	4.24	0.00	4.24						
Austin-Round Rock		2,000,860				3,875.83	7,755	1	0	0	1	1
	Bastrop		283.53	1,138.44	288.17	1,143.09						
	Caldwell		330.80	490.37	350.29	509.86						
	Hays		1,166.09	1,276.29	1330.51	1,440.71						
	Travis		274.49	837.06	62.94	625.51						
	Williamson		0.78	157.04	0.40	156.66						
Beaumont-Port Arthur		408,419				24,701.99	10,089	1	2	0	3	2
	Hardin		0.95	252.35	2205.09	2,456.50						
	Jefferson		11,682.11	14,025.26	13305.69	15,648.84						
	Orange		6,891.09	7,221.80	6188.20	6,518.91						
	Newton		11.61	77.89	11.46	77.74						
Dallas-Fort Worth-Arlington		7,102,796				12,930.93	91,846	1	0	1	2	4
	Collin		663.08	964.23	23.58	324.74						
	Dallas		422.39	2,162.75	315.88	2,056.24						
	Denton		252.62	453.59	453.44	654.41						
	Ellis		6,806.10	6,945.07	4008.64	4,147.61						
	Hunt		1.10	131.54	0.16	130.59						
	Kaufman		170.69	257.37	73.86	160.54						
	Rockwall		0.02	21.89	0.01	21.89						
	Johnson		61.75	154.40	88.32	180.98						
	Parker		78.25	130.08	154.39	206.23						
	Tarrant		17.34	1,581.13	23.00	1,586.80						
	Wise		11.50	55.95	16.06	60.50						
	Hood		8.21	3,394.07	11.96	3,397.82						
	Somervell		0.00	2.59	0.00	2.59						
Houston-The Woodlands-Sugar Land		6,656,947				60,432.75	402,298	2	1	1	4	8
	Austin		71.74	156.04	83.76	168.06						
	Brazoria		1,323.83	1,943.39	557.59	1,177.15						
	Chambers		71.84	566.00	218.21	712.37						
	Fort Bend		49,557.00	49,676.34	43988.84	44,108.19						
	Galveston		1,079.40	1,963.27	1178.00	2,061.87						
	Harris		12,123.67	15,906.38	7773.61	11,556.32						
	Liberty		22.14	168.18	12.72	158.76						
	Montgomery		18.25	258.34	10.97	251.06						
	Waller		1.95	239.46	1.46	238.97						
Longview		217,781				54,430.07	11,854	1	0	0	1	1
	Gregg		39.87	261.15	25.48	246.77						
	Rusk		69,068.26	69,218.44	53903.48	54,053.66						
	Upshur		60.64	160.09	30.19	129.64						

Appendix D: Sulfur Dioxide Monitoring Requirements

Core Based Statistical Area	County	2015 Population Estimates*	2011 Point Source (tpy)	2011 NEI Data (tpy)	2014 Point Source (tpy)	2011 NEI Non-Point Source Data with 2014 Point Source Data (tpy)	PWEI	Required SLAMS Monitors	Required SO_2 DRR Monitors***	Required High Sensitivity SO_2 NCore Monitors	Total Required SO_2 Monitors	Existing Monitors**
San Antonio-New Braunfels		2,384,075				28,226.14	67,293	1	1	0	2	1
	Atascosa		10,194.70	10,227.81	6944.87	6,977.98						
	Bandera		0.08	23.83	0.12	23.87						
	Bexar		22,820.01	24,637.28	17826.49	19,643.76						
	Comal		343.91	438.51	377.02	471.62						
	Guadalupe		120.36	265.20	112.34	257.19						
	Kendall		0.24	36.36	0.04	36.16						
	Medina		0.00	120.31	0.00	120.31						
	Wilson		79.59	111.02	663.82	695.25						
Abilene		169,578				1,738.90	295	0	0	0	0	0
	Callahan		0.17	1,651.81		1,651.63						
	Jones		0.00	19.16	0.00	19.16						
	Taylor		0.01	68.10	0.02	68.11						
Brownsville-Harlingen		422,156				268.82	113	0	0	0	0	0
	Cameron		0.48	269.04	0.25	268.82						
College Station-Bryan		249,156				266.09	66	0	0	0	0	0
	Brazos		10.02	119.68	12.62	122.28						
	Burleson		0.00	63.61	0.00	63.61						
	Robertson		11,050.35	11,130.55	0.00	80.20						
Corpus Christi		452,422				1,804.50	816	0	0	0	0	3
	Aransas		0.00	300.17	0.00	300.17						
	Nueces		975.53	1,516.30	790.35	1,331.12						
	San Patricio		23.10	167.13	29.18	173.20						
El Paso		838,972				577.60	485	0	0	1	1	3
	El Paso		283.18	572.15	262.73	551.70						
	Hudspeth		4.58	23.20	7.28	25.90						
Killeen-Temple		431,032				467.30	201	0	0	0	0	0
	Bell		70.34	230.87	61.67	222.19						
	Coryell		0.00	188.86	0.00	188.86						
	Lampasas		0.00	56.25	0.00	56.25						
Laredo		269,721				350.22	94	0	0	0	0	0
	Webb		1.62	61.34	290.50	350.22						
Lubbock		311,154				217.19	68	0	0	0	0	0
	Crosby		0.00	40.70	0.00	40.70						
	Lubbock		11.25	156.26	5.34	150.35						
	Lynn		0.00	26.15	0.00	26.15						
McAllen-Edinburg-Mission		842,304				252.10	212	0	0	0	0	0
	Hidalgo		52.55	254.35	50.30	252.10						
Midland		166,718				1,229.17	205	0	0	0	0	0
	Midland		222.07	957.86	415.03	1,150.82						
	Martin		68.13	103.25	43.23	78.35						

<u>Appendix D: Sulfur Dioxide Monitoring Requirements</u>

Core Based Statistical Area	County	2015 Population Estimates*	2011 Point Source (tpy)	2011 NEI Data (tpy)	2014 Point Source (tpy)	2011 NEI Non-Point Source Data with 2014 Point Source Data (tpy)	PWEI	Required SLAMS Monitors	Required SO_2 DRR Monitors***	Required High Sensitivity SO_2 NCore Monitors	Total Required SO_2 Monitors	Existing Monitors**
Odessa		159,436				1,920.14	306	0	0	0	0	0
	Ector		1,083.35	1,532.11	1471.38	1,920.14						
San Angelo		119,659				89.48	11	0	0	0	0	0
	Irion		0.26	40.72	0.24	40.70						
	Tom Green		0.75	48.99	0.55	48.79						
Sherman-Denison		125,467				170.10	21	0	0	0	0	0
	Grayson		1.03	167.12	4.01	170.10						
Texarkana		149,769				259.17	39	0	0	0	0	0
	Bowie		161.29	299.93	120.52	259.17						
Tyler		222,936				234.16	52	0	0	0	0	0
	Smith		403.33	621.97	15.52	234.16						
Victoria		99,913				318.78	32	0	0	0	0	0
	Goliad		13,829.53	13,884.78	135.73	190.98						
	Victoria		14.56	103.78	38.58	127.80						
Waco		262,813				3,837.83	1,009	0	0	0	0	1
	McLennan		1,019.06	1,297.37	3529.81	3,808.11						
	Falls		0.00	29.72	0.00	29.72						
Wichita Falls		150,780				628.00	95	0	0	0	0	0
	Archer		0.00	36.94	0.00	36.94						
	Clay		0.03	67.35	0.04	67.36						
	Wichita		472.40	615.12	380.98	523.70						

*United States Census Bureau population estimates as of July 1, 2015

** Individual monitors may fulfill more than one monitoring requirement.

***Monitor required to be operational by January 1, 2017.

DRR - Data Requirements Rule

NCore - National Core Multipollutant Monitoring Stations

NEI - National Emissions Inventory

PWEI - population weighted emission index (Population *[2011 NEI non-point source data plus 2014 point source data]/1,000,000)

SO_2 - sulfur dioxide

tpy - tons per year

SLAMS - State or Local Air Monitoring Stations

Appendix E

Sulfur Dioxide Data Requirements Rule Monitoring Placement Evaluations

Texas Commission on Environmental Quality
2016 Annual Monitoring Network Plan

TCEQ

Appendix E: Sulfur Dioxide Monitoring Placement Evaluations

Introduction

On August 21, 2015, the United States (U.S.) Environmental Protection Agency (EPA) finalized the sulfur dioxide (SO_2) Data Requirements Rule (DRR) for the 2010 one-hour SO_2 primary National Air Ambient Quality Standard (NAAQS). The DRR requires air agencies to characterize current air quality in areas around sources that emit 2,000 tons per year (tpy) or more of SO_2 and that are not located in an area already designated nonattainment. The DRR gives air agencies the option to characterize air quality using either modeling of actual source emissions or using appropriately sited ambient air quality monitors. Air agencies are required to locate the source-oriented SO_2 monitors in locations of expected maximum one-hour concentrations.

Per the DRR requirements, on January 15, 2016, the Texas Commission on Environmental Quality (TCEQ) provided the EPA with a list identifying 25 SO_2 sources meeting the rule's applicability threshold. Of the 25 DRR sources, the TCEQ will deploy source-oriented SO_2 monitors near 13 sources by the January 1, 2017, rule deadline. Due to the close geographical proximity of four out of the 13 sources, a total of 11 monitoring stations are proposed for deployment to characterize ambient air quality surrounding each of the 13 sources. The EPA is expected to finalize area designations for the remaining 12 sources by July 2, 2016. The TCEQ will pursue monitoring station locations as expeditiously as practical for any of the 12 remaining sources designated as nonattainment under the EPA's final action.

The TCEQ focused on complying with the directly-applicable federal requirements listed in 40 Code of Federal Regulations (CFR) Part 58, Appendix E regarding siting criteria. In addition, the TCEQ evaluated monitoring station locations that would appropriately and sufficiently characterize ambient air quality in areas around an SO_2 emissions source. The DRR requirements stipulate that air monitoring stations must be deployed in areas of maximum expected one-hour concentrations in ambient air. This approach included utilizing multiple techniques and guidance provided in the *SO_2 NAAQS* (National Ambinet Air Quality Standards) *Designations Source-Oriented Monitoring Technical Assistant Document* (Monitoring TAD). The Monitoring TAD suggests that modeling is one technique that may be used to assist in identifying potential monitoring sites. The TCEQ's modeling for monitor placement used the Comprehensive Air Model with Extensions (CAMx) with model options set as equivalent as possible to American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD).

The TCEQ considered the modeling analysis, but did not rely solely on it in the prioritization of potential sites. The latitude and longitude of each SO_2 source designated for ambient air monitoring was plotted on a satellite map. Surrounding properties and associated owners were identified using county appraisal district information. The TCEQ then collectively considered the following parameters: predominant wind flow, modeling analyses, property owner agreement, and logistical constraints, such as space, power availability, terrain, grade, and drainage. Failure to meet criteria for any single parameter did not necessarily exclude the location from consideration.

This appendix includes information specific to each source used in locating new source-oriented SO_2 monitors for the purpose of compliance with the DRR.

Appendix E: Sulfur Dioxide Monitoring Placement Evaluations

Appendix E Table of Contents

Monitoring Placement Evaluations Approved by the EPA

Note: The original posting of this document incorrectly identified CAPCOG Hutto and Lake Georgetown monitoring stations as having SO_2 monitors, when in fact they do not. In addition, Baytown Refinery has since been removed from this Appendix. Because Baytown Refinery's recent SO_2 emissions fell below the threshold set in the SO_2 DRR, the TCEQ removed Baytown Refinery from the list of sources initially identified for monitoring per the DRR. All draft monitoring placement evaluations have been approved by the EPA since original posting except the Streetman Plant Evaluation.

Big Spring Carbon Black Monitor Placement Evaluation

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Source Information

- Name: Big Spring Carbon Black (Figure 2)
- Owner: Sid Richardson Carbon Company
- Facility function: chemical manufacturing
- Location: 32.267390, -101.418244, Texas Commission on Environmental Quality (TCEQ) Region 7, Howard County, Texas
- Sulfur Dioxide (SO_2) emissions data: 8,307 tons (2013), 5,947 tons (2014)
- Long-term emissions trend: decreasing, 40 percent (%) decrease from 2004 to 2014
- Emission profile: operational year-round
- Stack height: 51 meters
- SO_2 emission controls: none
- Permit related data: Federal Operating Permit

Existing Air Monitoring Sites

The nearest ambient air quality monitoring sites are detailed in Table 1. No TCEQ ambient air quality monitors are located within 98 kilometers (km) of Big Spring Carbon Black. The existing sites listed in Table 1 are not located to characterize maximum SO_2 source concentrations and are not downwind.

Table 1: Air Monitoring Sites Near Big Spring Carbon Black

Site	Location	Current Sulfur Dioxide (SO_2) Monitoring	SO_2 Design Value (2012–2014)
Odessa Gonzales	98.5 kilometers southwest	No	Not applicable
Odessa-Hays Elementary School	101 kilometers southwest	No	Not applicable

Settings and Surroundings

The rural and suburban area surrounding Big Spring Carbon Black consists of the southwestern tablelands with elevation ranging from 690 to 850 meters as shown in Figure 1. (Griffith et al. 2004) No significant changes to the landscape were noted during the reconnaissance as compared to the Google Earth view shown in Figure 8. Mountain and valley wind channeling or other terrain related meteorological impacts are not expected in this area as detailed in Table 2.

Alon USA LP Big Spring Refinery (Alon), located approximately 1.5 km southwest of Big Spring Carbon Black, has the potential to influence SO_2 concentrations in the Big Spring Carbon Black area under certain meteorological conditions. Alon's SO_2 emissions were reported as 819 tons in 2014. Due to the site's location and the area's predominant southeasterly wind flow, it is anticipated that Alon would only minimally impact SO_2 concentrations around the Big Spring Carbon Black area when winds are from the southwest (approximately 4% of the time according to the Big Spring Airport wind rose data; Figures 3 and 4).

Figure 1: Big Spring Carbon Black Area Elevation Map

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

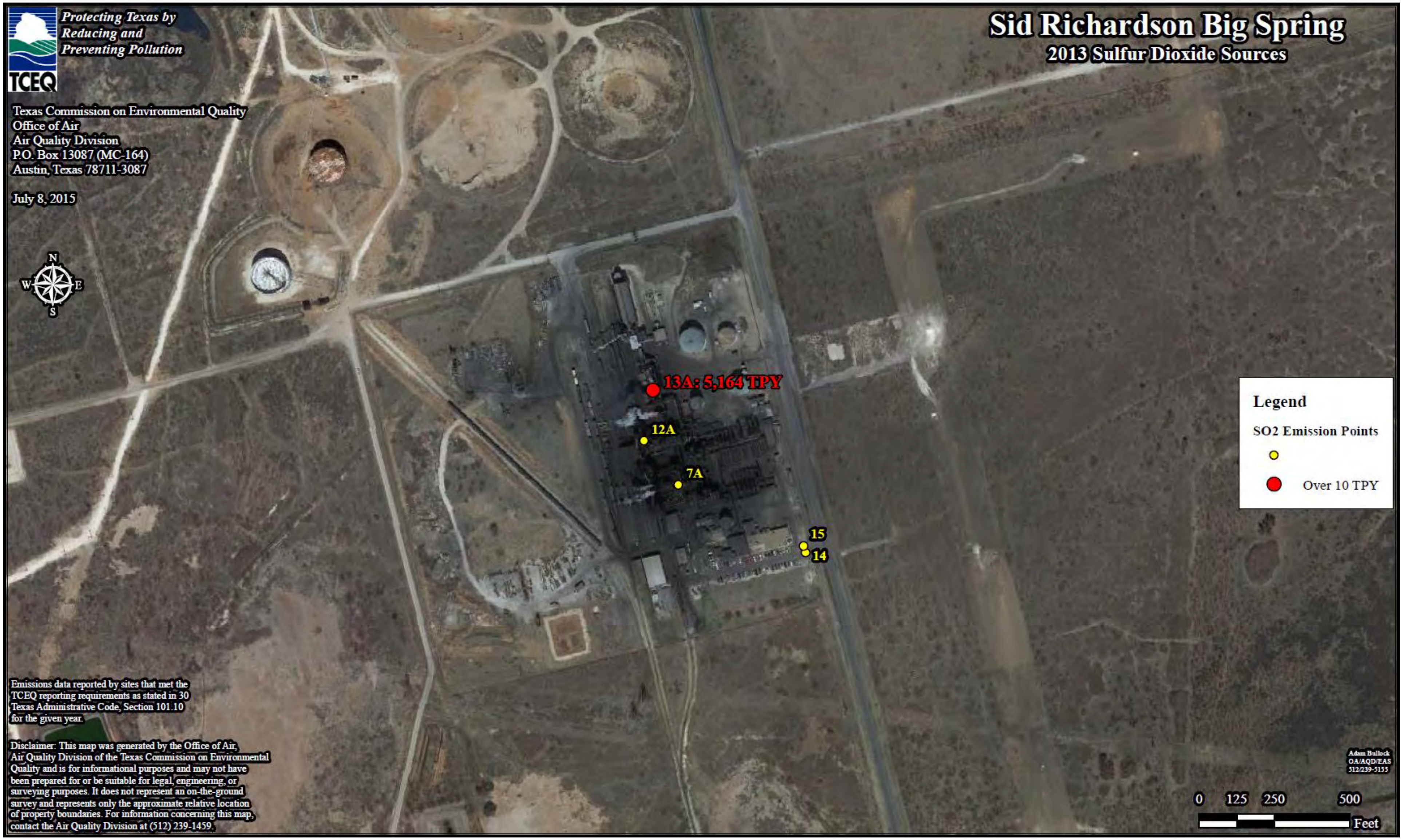


Figure 2: Big Spring Carbon Black Sulfur Dioxide Stacks and Emissions, 2013

Meteorological Data

Figure 3 provides illustrations of area annual average wind speed and direction for 2012, 2013, and 2014 from meteorological sensors at the Big Spring Airport, located 12 miles southwest of Big Spring Carbon Black. Figure 4 illustrates the 2012-2014 annual average wind speed. The length of each wind rose bar corresponds to the frequency of the wind coming from the indicated direction by percentage. Based on analysis of the 2012-2014 wind data, the dominant wind flow direction is from the south to southeast, approximately 36% of the average area wind flows. Over this three year period, calm winds (0-2 miles per hour) occurred on average 9% of the time and wind speeds averaged 10.3 miles per hour.

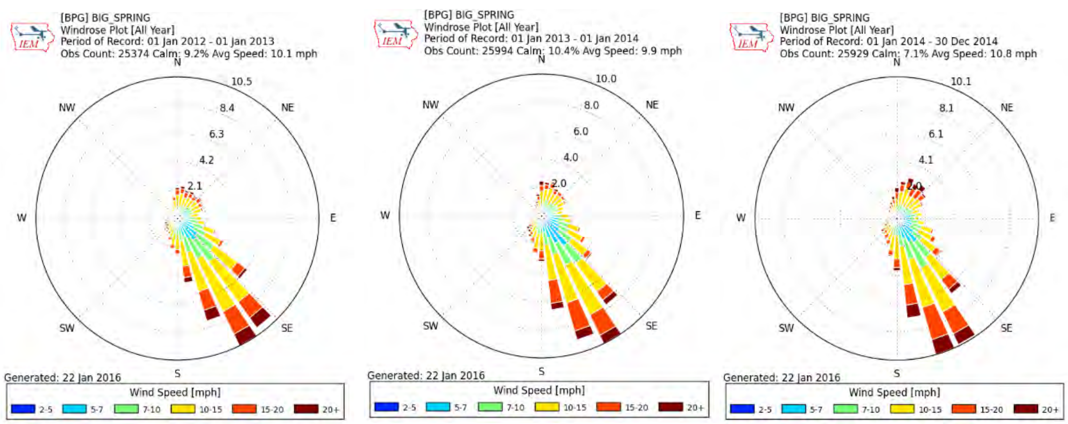


Figure 3: (From left to right) 2012, 2013, and 2014 Individual Wind Rose Plots

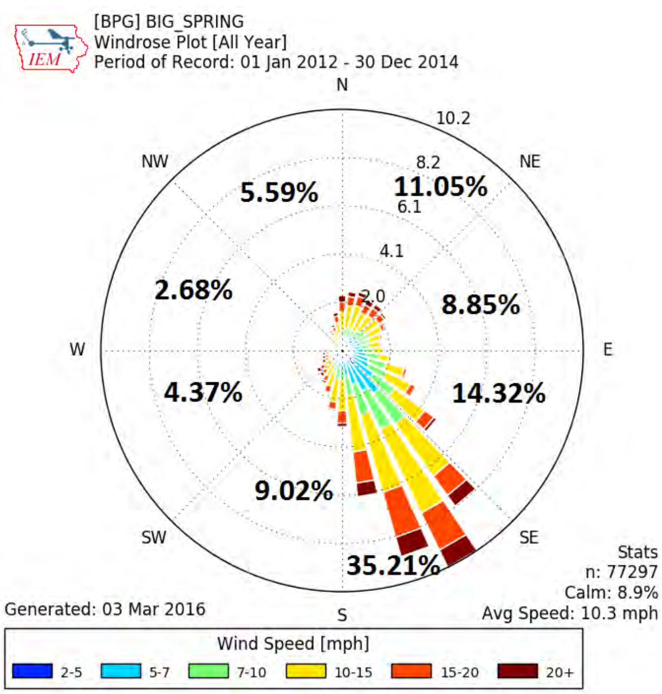


Figure 4: 2012-2014 Combined Average Wind Rose Plot

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Modeling Analysis for Monitoring Site Placement

The *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistant Document* (Monitoring TAD) suggests that modeling is one technique that may be used to assist in identifying potential monitoring sites. The TCEQ's modeling for monitor placement used the Comprehensive Air Model with Extensions (CAMx) with model options set as equivalent as possible to American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The setup included the following parameterizations:

- CAMx 6.20 with speed ups and Plume-in-Grid (PiG) fix, without chemistry and without half-life decay;
- 500-meter PiG sampling grid centered on the source spatially covering 72 km by 72 km;
- the one kiln stack was modeled and tracked as individual PiG puffs;
- full year of 2012 12 km gridded Weather Research and Forecasting Model (WRF) meteorology interpolated to 4 km;
- 2014 hourly point source electric generating unit (EGU) emissions; and
- 2014 annual point source non-EGU emissions from State of Texas Air Reporting System (STARS) processed down to hourly emissions.

All model outputs were normalized relative to the predicted off-property maximum concentration, and therefore do not represent absolute predicted results comparable to the NAAQS. The results were then analyzed using three metrics: normalized 99th percentile concentration, normalized frequency, and a composite using both the 99th percentile and frequency metrics. The primary areas targeted for monitor placement included consideration of all three model output metrics, along with the meteorological data presented in Figures 3 and 4.

From the model outputs, normalized 99th percentile concentrations were calculated by dividing the 99th percentile daily maximum concentration for each grid cell within the modeling domain by the predicted off-property maximum concentration for the domain. The calculated results thus represent a percentage of the predicted concentrations for each grid cell to the off-property maximum. Figure 5 presents the results for the normalized 99th percentile concentration metric analysis with the location of the predicted off-property maximum indicated by a + symbol. Big Spring Carbon Black's permitted property is outlined in black. Based on this analysis, the highest normalized concentrations, greater than 85% of the predicted off-property maximum, are expected within or north, northeast and east of Big Spring Carbon Black's property. The proposed monitor locations identified within Figure 5 (sites 14, 15, and 18) are within areas with predicted normalized concentrations within 50% to 80% of the off-property maximum.

To evaluate the frequency at which high concentrations may be expected, a normalized frequency metric was developed to represent the number of days the modeled concentration for each grid cell was predicted to be greater than 75% of the off-property maximum concentration. This metric was calculated by dividing the number of days the 99th percentile concentration for each grid cell was greater than 75% of the predicted off-

property maximum concentration by the number of days the off-property maximum was predicted to occur. Figure 6 presents the geographic distribution of normalized frequency around the Big Spring Carbon Black facility. Again, the location of the predicted off-property maximum is indicated by a + symbol and Big Spring Carbon Black's permitted property is outlined in black. Using this analysis metric, areas directly to the north, northeast, and east of the Big Spring Carbon Black facility scored greater than 60% and would be expected to see the highest frequency of elevated SO_2 concentrations. The areas directly to the north and northeast are not viable for monitor placement based on site reconnaissance and discussion with property owners.

Finally, a composite metric was developed to aid in identifying areas where the predicted highest concentration and predicted highest frequency overlap. The composite metric was calculated at each grid cell by averaging the normalized 99th percentile concentration and normalized frequency metrics. Figure 7 illustrates the geographic distribution of the composite metric analysis results with the location of the predicted off-property maximum with a λ symbol and Big Spring Carbon Black's permitted property is outlined in black. As with the normalized 99th percentile and normalized frequency metrics, areas directly north and directly east of the Big Spring Carbon Black facility scored greater than 90% using the composite metric. Based on the TCEQ's site reconnaissance and outreach to property owners, areas with the highest composite metric score did not yield a viable location for monitor placement.

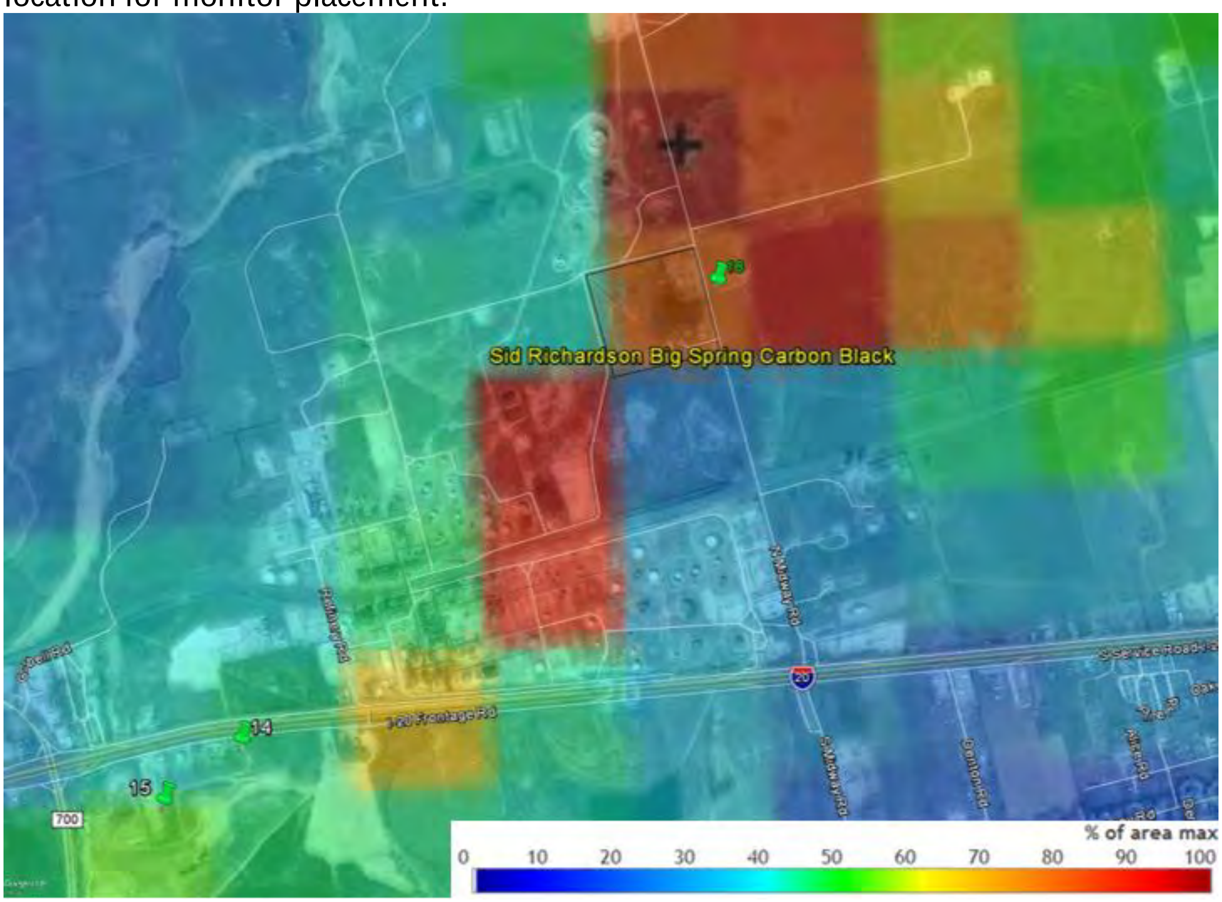


Figure 5: Big Spring Area CAMx Model Predictions, Normalized Concentrations, and Viable Site Locations (14, 15, 18)

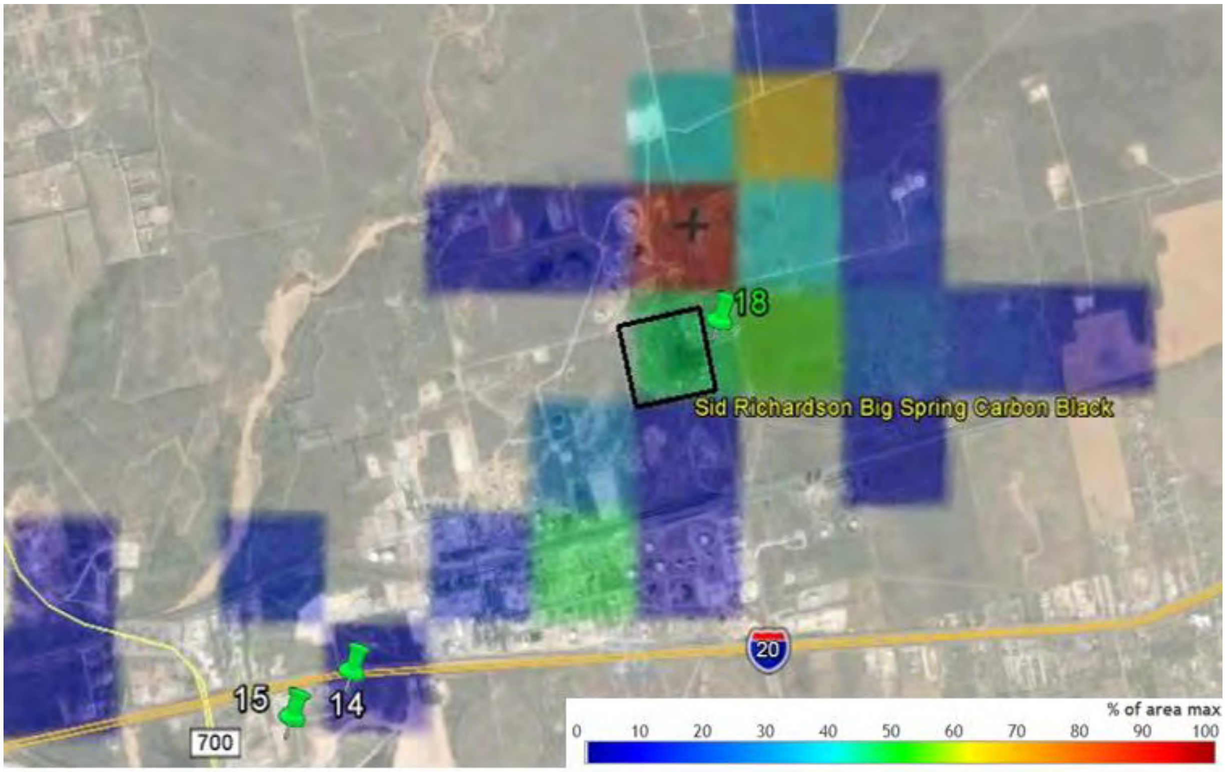


Figure 6: Big Spring Area CAMx Model Predictions, Normalized Frequency, (Number of Days) and Viable Site Locations

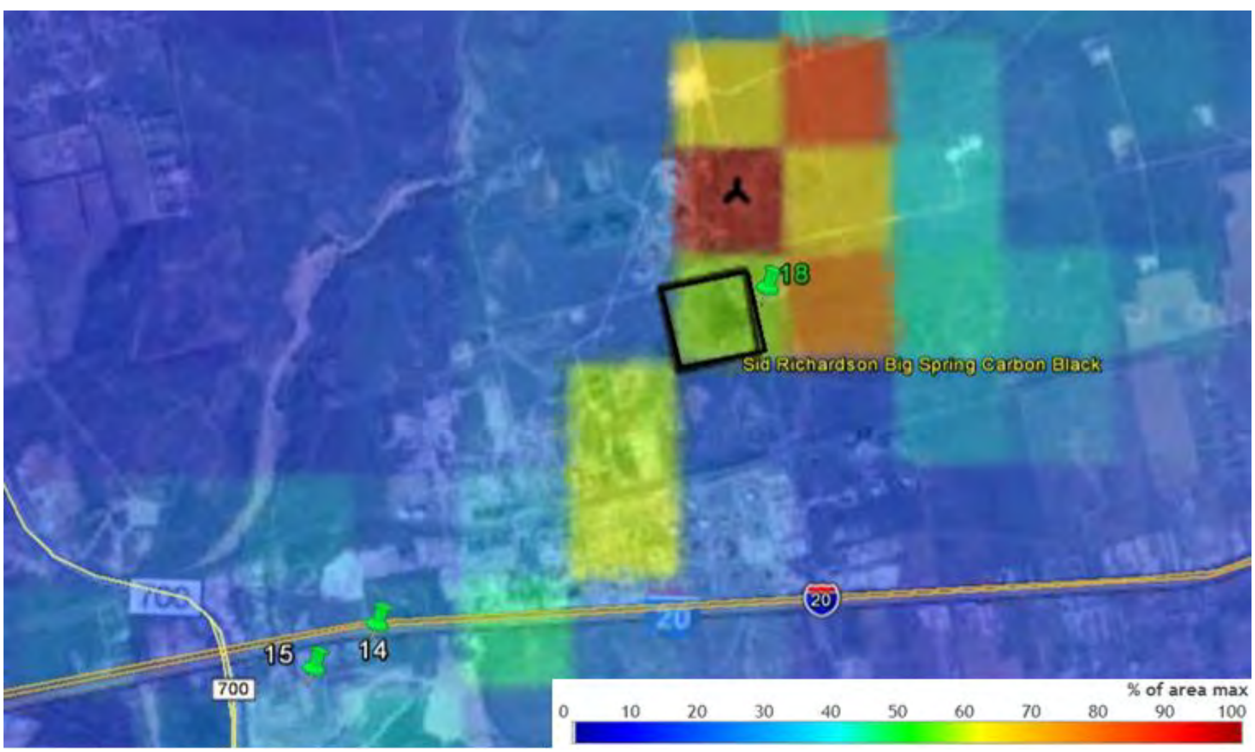


Figure 7: Big Spring Area CAMx Model Predictions Composite Metric and Viable Site Locations

Siting Options and Criteria

The TCEQ does not currently have SO_2 monitors located in the area surrounding Big Spring Carbon Black that would characterize the highest SO_2 concentrations from this facility; therefore a new site is required. The TCEQ focused on complying with the federal requirements listed in Section 40 of the Code of Federal Regulations (CFR) Part 58, Appendix E regarding siting criteria. In addition, the TCEQ evaluated monitoring site locations that would appropriately and sufficiently characterize air quality in areas around an SO_2 emissions source. This approach includes utilizing multiple techniques and guidance provided in the Monitoring TAD.

The modeling analysis provided in Figures 5, 6, and 7 suggest that maximum SO_2 concentrations are expected to occur north and east of the Big Spring Carbon Black facility. In addition, the highest frequency of SO_2 concentrations predicted to be greater than 75% of the off-property maximum is expected within or directly north of Big Spring Carbon Black.

Twenty-three potential sites were identified as shown in Figure 8. Twenty of the identified potential sites (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 17, 19, 20, 21, 22, and 23) are not considered viable and are indicated by red pins in Figure 8. Sites 1, 2, 3, 4, 5, 7, 8, 10, and 11 were in areas with restricted access, such as a locked gate to a private road. Property owners at sites 6, 9, 12, 16, 19, and 20 were unwilling or unresponsive. The property owner of site 16 was actively pursued due to the proximity to maximum off property concentrations, frequency, and composite metrics. After numerous conversations and written communication it was determined that the property owner was not willing to locate a monitoring site anywhere on the property. The outline of each non-viable property is indicated in yellow in Figure 8. While downwind of the source, predicted SO_2 concentrations around site 13 were considerably lower than other potential site locations. Sites 17, 21, 22, and 23 were also in areas with low predicted SO_2 concentrations and were not in preferable downwind locations. As a result these sites are no longer under consideration.

The three sites with satisfactory logistical and siting characteristics and locations anticipated to have peak concentrations include sites 14, 15, and 18, which are indicated by green pins in Figures 5, 6, 7, and 8. These site locations are also identified on the model and satellite image overlay shown in Figures 5, 6, and 7.

- Site 14 is positioned approximately 2.25 km southwest of the Big Spring Carbon Black facility. Although this site is not directly downwind of the source, the site does provide level ground, adequate space, and available power. The normalized 99^{th} percentile concentration metric analysis predicted concentrations in this area to be 45-50% of the maximum concentrations, so the site would be expected to measure elevated concentrations (likely during periods of calm or northerly winds). The property owner is amenable to a site agreement.
- Site 15 is positioned approximately 2.5 km southwest of the Big Spring Carbon Black facility. Although this site is not directly downwind of the source, the site does provide level ground, adequate space, and available power. The normalized 99^{th} percentile concentration metric analysis predicted concentrations in this area

to be 45-50% of the maximum concentrations, so the site would be expected to measure elevated concentrations (likely during periods of calm or northerly winds). The property owner is amenable to a site agreement.

- Site 18 is positioned directly east of the Big Spring Carbon Black facility and less than 0.5 km south of the off-property maximum concentration (see Figure 7). Although this site is not downwind of the source, the area approximately 150 meters south of the northeast corner property line, offers level ground, adequate space, and available power. This site area is the closest to the source within a radius of 2,500 meters. The northeast edge of this property is not viable due to numerous electrical, buried cable, and road easements restricting site location. The normalized 99th percentile concentration metric analysis predicted area concentrations to be 80-90% of the maximum, therefore the site would be expected to measure peak SO_2 concentrations near the source. A site agreement has been negotiated with the property owner.

Recommendation

Based on current facility operations, available emission data, wind patterns, modeling analysis, and evaluation of surrounding areas during site reconnaissance, site 18 (see Figures 9 and 10) is the only viable site recommended for placement of a new source-oriented ambient SO_2 monitoring station. No other areas withing a 2,500 meter radius were available for consideration. Although this site is not downwind, it is expected to measure peak concentrations during periods of calm wind speeds. While the modeling analysis predicts the highest maximum normalized concentration and composite metric score to be located 0.5 km to the north, a site agreement with the property owner of site 16 is unattainable. Site 18 is the closest location to the source and predicted maximum normalized SO_2 concentrations with available power, adequate space, level ground, and meets all federal siting criteria.

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

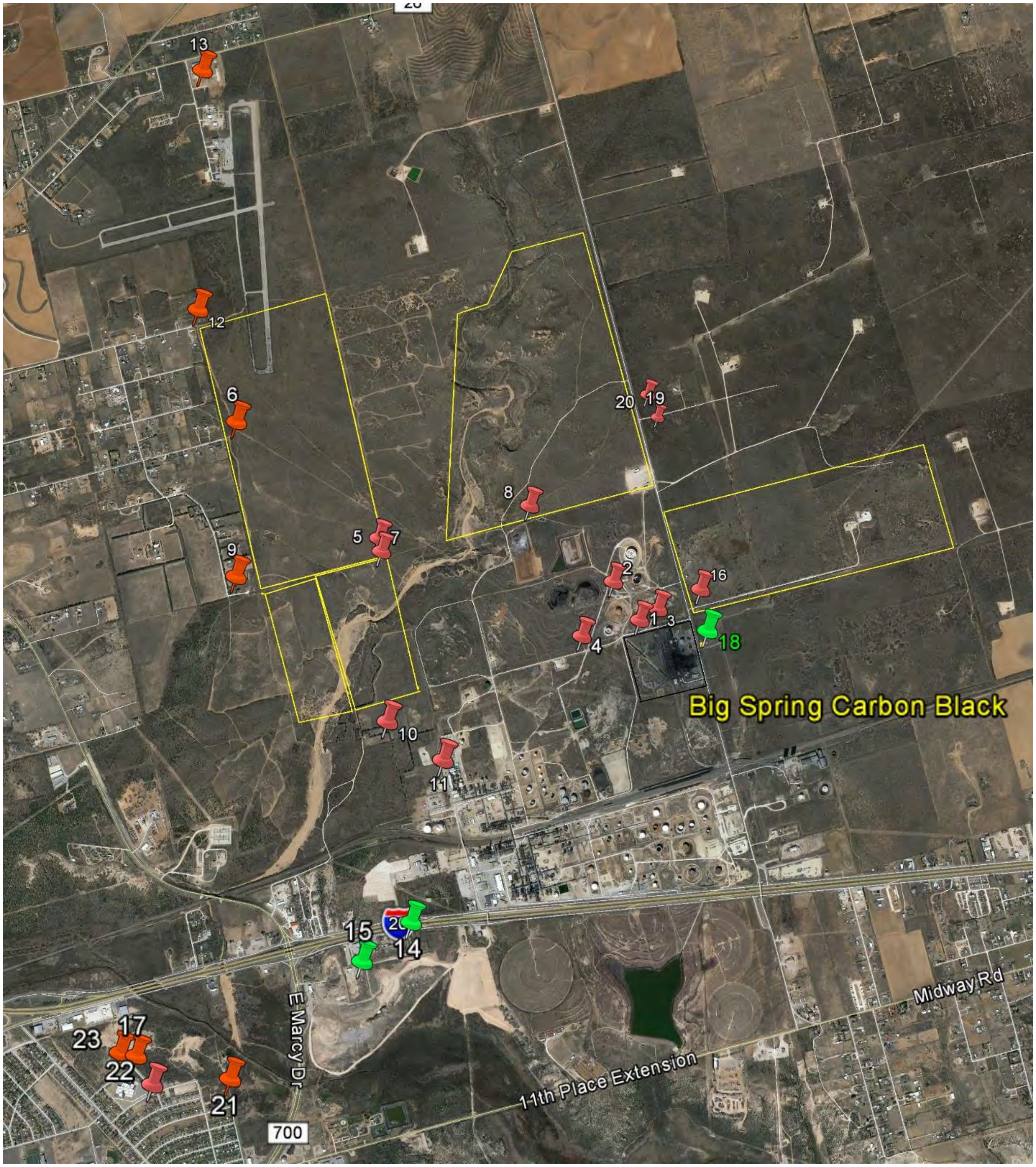


Figure 8: Potential Monitoring Sites for Big Spring Carbon Black

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Table 2: Potential Sites Assessment[1]

Site Number	Big Spring #1	Big Spring #2	Big Spring #3
Location	32.28067, -101.41135	32.28271, -101.41299	32.28125, -101.41021
Distance from SO_2 Source[2]	292 m	560 m	252 m
Wind Direction	S, SE	S, SE	S, SE
Grade	Not applicable	Not applicable	>2%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (N)	Yes (NW)	Yes (N)
Obstructions and Height	Not measured, no site access	Not measured, no site access	Not measured, no site access
Distance from Site to Obstructions	Not applicable	Not applicable	Not applicable
Road/Site Access	No	No	No
Electricity Available <18 m	Not evaluated, no site access	Not evaluated, no site access	Not evaluated, no site access
Pros	Not applicable	Not applicable	Not applicable
Cons	• No site access • Requires special permission and use of private industry road to access site	• No site access • Requires special permission and use of private industry road to access site	• No site access • Requires special permission and use of private industry road to access site • >2% grade
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Big Spring #4	Big Spring #5	Big Spring #6
Location	32.27989, -101.41493[2]	32.28484, -101.42758[2]	32.29113, -101.43735
Distance from SO_2 Source[2]	608 m	1,883 m	3,020 m
Wind Direction	S, SE	S, SE	S, SE
Grade	Not applicable	Not applicable	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	Yes (NW)
Obstructions and Height	Not measured, no site access	Not measured, no site access	Trees (4-5 m) Ridge (5 m)
Distance from Site to Obstructions	Not applicable	Not applicable	Trees (18 m, 32 m SW, W from dripline) Ridge (132 m SE, E)
Road/Site Access	No	No	No
Electricity Available <18 m	Not evaluated, no site access	Not evaluated, no site access	Yes
Pros	Not applicable	Not applicable	• Level ground • Downwind • Space available • Power available • Easy operator access
Cons	• No site access • Requires special permission and use of private industry road to access site	• No site access • Requires special permission and use of private industry road to access site	• Slight grade in surrounding areas • Declined by property owner
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Big Spring #7	Big Spring #8	Big Spring #9
Location	32.27989, -101.41493	32.28484, -101.42758	32.28390, -101.43652
Distance from SO_2 Source[2]	2,060 m	1,218 m	2,650 m
Wind Direction	S, SE	S, SE	S, SE
Grade	Not applicable	Not applicable	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	Yes (NW)
Obstructions and Height	Not measured, no site access	Not measured, no site access	Trees (4-8 m) Ridge (5 m)
Distance from Site to Obstructions	Not applicable	Not applicable	Trees (9 m, 38 m, 39 m NW) Ridge (30 m N)
Road/Site Access	No	No	Yes
Electricity Available <18 m	Not evaluated, no site access	Not evaluated, no site access	Yes
Pros	• Not applicable	• Not applicable	• Level ground • Downwind • Space available • Power available • Easy operator access
Cons	• No site access • Requires special permission and use of private road to access site.	• No site access • Requires special permission and use of private road to access site.	• Slight grade in surrounding areas • On unpaved, dirt road; site may not be accessible during heavy rain events • Declined by property owner
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Big Spring #10	Big Spring #11	Big Spring #12
Location	32.27528, -101.42696	32.27328, -101.42349	32.29732, -101.43947
Distance from SO_2 Source[2]	1,786 m	1,570 m	3,496 m
Wind Direction	S, SE	S, SE	S, SE
Grade	Not applicable	Not applicable	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	No	No	No
Wind Channeling	None	None	None
Downwind[2]	No (W)	No (W)	Yes (NW)
Obstructions and Height	Not measured, no site access	Not measured, no site access	Trees (3-7 m) Buildings (4-5 m)
Distance from Site to Obstructions	Not applicable	Not applicable	Trees (45 m NW, E, SE, S from dripline) Buildings (33, 36 m NE)
Road/Site Access	No	No	Yes
Electricity Available <18 m	Not evaluated, no site access	Not evaluated, no site access	Yes
Pros	Not applicable	Not applicable	• Level ground • Downwind • Space available • Power available • Easy operator access • Strong cellular service
Cons	• No site access • Requires special permission and use of private road to access site	• No site access • Requires special permission and use of private road to access site	• Declined by property owner • Planned future development
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Big Spring #13	Big Spring #14	Big Spring #15
Location	32.31065, -101.43968	32.26497, -101.42531	32.26308, -101.42832
Distance from SO_2 Source[2]	4,500 m	2,251 m	2,599 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	No (SW)	No (SW)
Obstructions and Height	Trees (7 m)	Tree (10 m) Buildings (5 m, 7 m) Tree (8 m)	None
Distance from Site to Obstructions	Trees (30 m SE)	Tree (10 m SW) Building (22 m W, 21 m N) Tree (13 m SE)	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Level terrain • Property owner willing • Road base and two sides of fence existing	• Level ground • Site agreement possible • Space available • Power available • Easy operator access	• Level ground • Power available • Site agreement Possible • Space available
Cons	• Low concentration of SO_2 according to modeling analysis	• Low concentration of SO_2 according to modeling analysis • Not downwind	• Low concentration of SO_2 according to modeling analysis • Not downwind
Viable Site (Yes, No, or Preferred)	No	Yes	Yes

Site Number	Big Spring #16	Big Spring #17	Big Spring #18
Location	32.28495, -101.40840	32.25825, -101.44174	32.28004, -101.40716
Distance from SO_2 Source[2]	592 m	3,908 m	160 m
Wind Direction	S, SE	S, SE	S, SE
Grade	Varies	>2%	<1%
Flood Plains	Varies	Possible	No
Mountain/ Valley Winds	None	None	None
Water Body Nearby[2]	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (N)	No (SW)	No (E)
Obstructions and Height	None	Hill (3 m)	None
Distance from Site to Obstructions	None	Building (71 m) Steep grade (18 m)	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Power available • Maximum off-property concentration of SO_2 emissions according to modeling analysis	• Power available • Site agreement possible • Space available	• High concentration and frequency according to modeling analysis • Power Available • Level ground • Signed site agreement
Cons	• Rough terrain • Numerous "No Trespassing" signs • Unresponsive owner	• Low concentration of SO_2 according to modeling analysis • >2% grade	• Not downwind • Will require minor work to level ground and clear brush
Viable Site (Yes, No, or Preferred)	No	No	Preferred

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Big Spring #19	Big Spring #20	Big Spring #21
Location	32.29177, -101.41015	32.29290, -101.41080	32.25711, -101.43613
Distance from SO_2 Source[2]	1,324 m	1,481 m	3,591 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (N)	Yes (N)	No (SW)
Obstructions and Height	None	None	Trees (6 m, 12 m) Building (6 m)
Distance from Site to Obstructions	None	None	Trees (8 m N, 15 m NE, 44 m SW) Building (S 25 m)
Road/Site Access	No	No	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Level ground • Power available	• Level ground • Power available	• Level ground • Power available • Site agreement possible • Space available
Cons	• Unresponsive property owner • No driveway access • Low concentration of SO_2 according to modeling analysis	• Unresponsive property owner • No driveway access • Low concentration of SO_2 according to modeling analysis	• Low concentration of SO_2 according to modeling analysis • Not downwind
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Big Spring #22	Big Spring #23
Location	32.25684, -101.44078	32.25833, -101.44281
Distance from SO_2 Source[2]	3,901 m	3,984 m
Wind Direction	S, SE	S, SE
Grade	<1%	<1%
Flood Plains	No	No
Mountain/Valley Winds	None	None
Water Body Nearby[2]	No	No
Wind Channeling	None	None
Downwind[2]	No (SW)	No (SW)
Obstructions and Height	Tree (12 m)	Tree (3 m) Building (20 m)
Distance from Site to Obstructions	Tree (44 m NE)	Tree (8 m S) Building (58 m S)
Road/Site Access	Yes	Yes
Electricity Available <18 m	Yes	Yes
Pros	• Level ground • Power available • Space available • Accessible	• Level ground • Power available • Space Available • Accessible
Cons	• Low concentration of SO_2 according to modeling analysis • Not downwind	• Low concentration of SO_2 according to modeling analysis • Not downwind
Viable Site (Yes, No, or Preferred)	No	No

[1]Based on 40 Code of Federal Regulations Part 58 and *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document*

[2]Based on Google Earth

% – percent
N – north
S – south
E – east
W – west
NE – northeast
NW – northwest
SE – southeast
SW – southwest
m – meter
– number
< – less than
> – greater than

Figure 9: Big Spring Carbon Black #18 Potential Site Cardinal Direction Photos

Figure 10: Big Spring Carbon Black #18 Potential Site

References

Griffith, G. E., S. A. Bryce, J. M. Omernik, J. A. Comstock, A. C. Rogers, B. Harrison, S. L. Hatch, and D. Bezanson. Ecoregions of Texas. (2 sided color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia: U.S. Geological Survey, 2004. Scale 1:2,500,000.

"IEM : Site Locator." Iowa Environmental Mesonet. 2016. Accessed April 06, 2016. https://mesonet.agron.iastate.edu/sites/locate.php?network=TX_ASOS.

Calaveras Plant Monitor Placement Evaluation

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Source Information

- Name: Calaveras Plant (Calaveras) (Figure 2)
- Owner: City Public Service (CPS)
- Facility function: electric generation
- Location: 29.308300, -98.321000, TCEQ Region 13, Bexar County, Texas
- SO_2 emissions data: 12,718 tons (2013), 17,133 tons (2014)
- Long-term emissions trend: decreasing, 33% decrease from 2009 to 2014
- Emission profile: operational year-round
- Stack height(s): 2 stacks 102 meters high, which are currently active (shown in Figure 2).
- SO_2 emission controls: 1 limestone scrubber and 1 catalytic reduction each reduce SO_2 emissions by 90%. 1 absorption tower also reduces SO_2 emissions by 80% on a separate stack.
- Permit related data: Prevention of Significant Deterioration(PSD) permit

Existing Air Monitoring Sites

The nearest ambient air quality monitoring sites are detailed in Table 1. All existing SO_2 monitors have design values below the current SO_2 standard of 75 parts per billion (ppb). With the exception of Heritage Middle School, these existing monitoring sites are not located to characterize maximum SO_2 source concentrations and are not downwind. Heritage Middle School site is currently owned and operated by CPS and is in an optimal location.

Table 1: Air Monitoring Sites Near Calaveras Power Plant

Site	Location	Current Sulfur Dioxide (SO_2) Monitoring	SO_2 Design Value (2012–2014)
Gate 58 CPS	1.57 kilometers northwest	No	Not applicable
Gate 9A CPS	2.3 kilometers southwest	No	Not applicable
Gardner Rd. Gas Sub-Station	2.8 kilometers north	No, private monitor on Calaveras property	Not applicable
Calaveras Lake	3.6 kilometers south	Yes, TCEQ	0.64 parts per billion*
Heritage Middle School	4.7 kilometers north	Yes, non-TCEQ private monitor	Not comparable

*design value data does not meet completeness requirements for 2012

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Settings and Surroundings

The rural area surrounding Calaveras consists of interior plains with a low elevation as shown in Figure 1. The terrain is characterized by flat to gently rolling hills, and grasses, forbs, and croplands are the dominant vegetation (Griffith et al. 2004). No significant changes to the landscape were noted during the reconnaissance as compared to the Google Earth view shown in Figure 8. Mountain and valley wind channeling or other terrain related meteorological impacts are not characteristic of this area as detailed in Table 2.

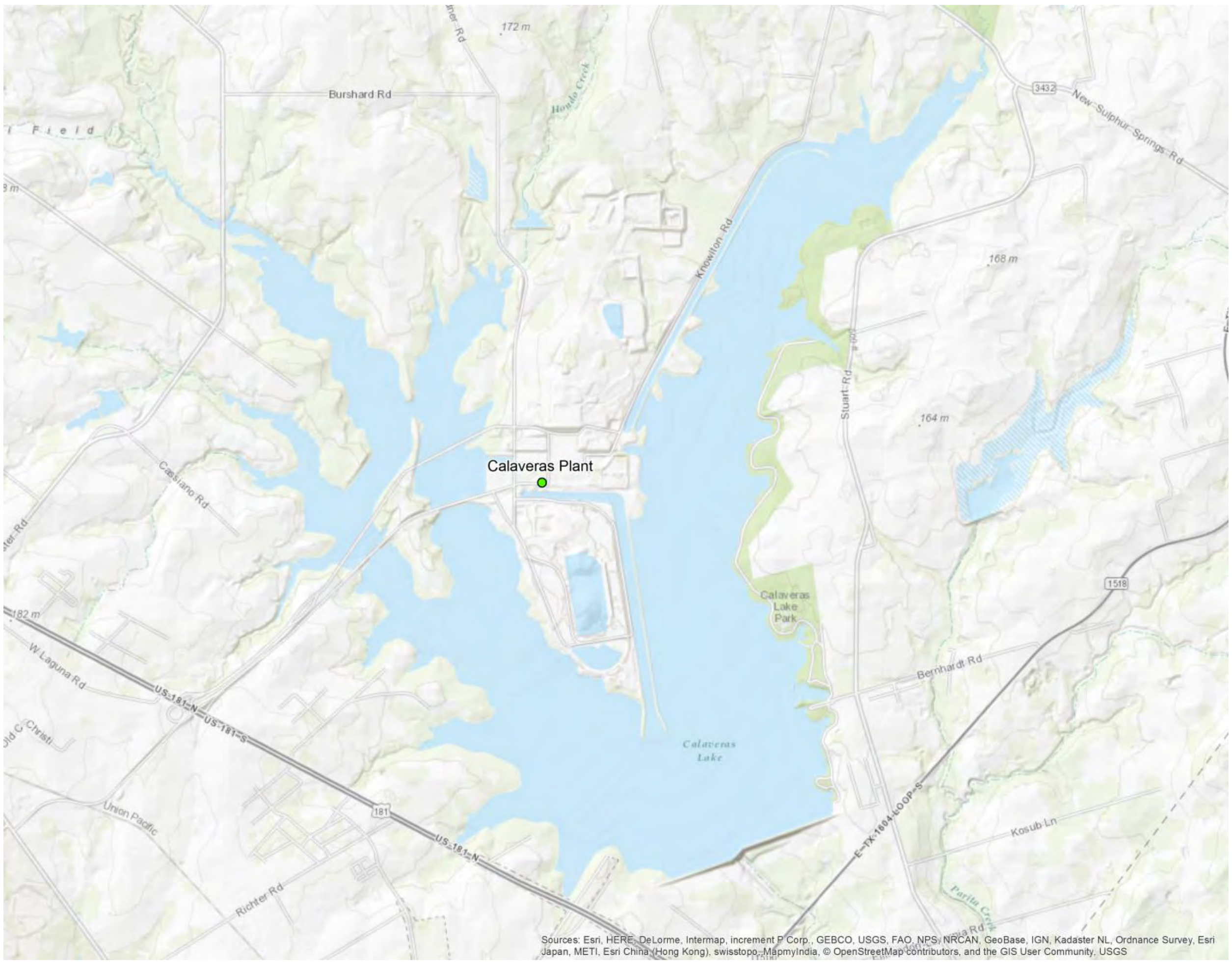


Figure 1: Calaveras Power Plant Area Elevation Map

Figure 2: Calaveras Power Plant SO_2 Stacks and Emissions, 2013

Meteorological Data

Figure 3 provides illustrations of area annual average wind speed and direction for 2012, 2013, and 2014 from meteorological sensors at the San Antonio International Airport, located 29 kilometers northwest of Calaveras. Figure 4 illustrates the 2012-2014 annual average wind speed. The length of each wind rose bar corresponds to the frequency of the wind coming from the indicated direction by percentage. Based on analysis of the 2012–2014 wind data, the dominant wind flow direction for the area is south to southeast, with wind flows from the north, northeast, and northwest accounting for only 19% of the average annual wind flows. Over this three year period, calm winds (0-2 miles per hour) occurred on average 13% of the time and wind speeds averaged 8.2 miles per hour (Iowa Environmental Mesonet 2016).

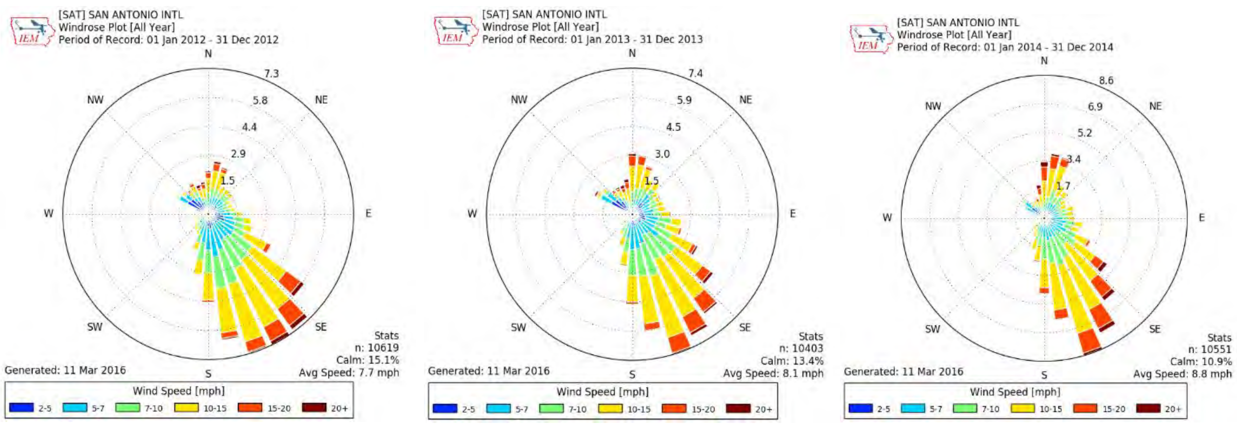


Figure 3: (From left to right) 2012, 2013, and 2014 individual Wind Rose Plots

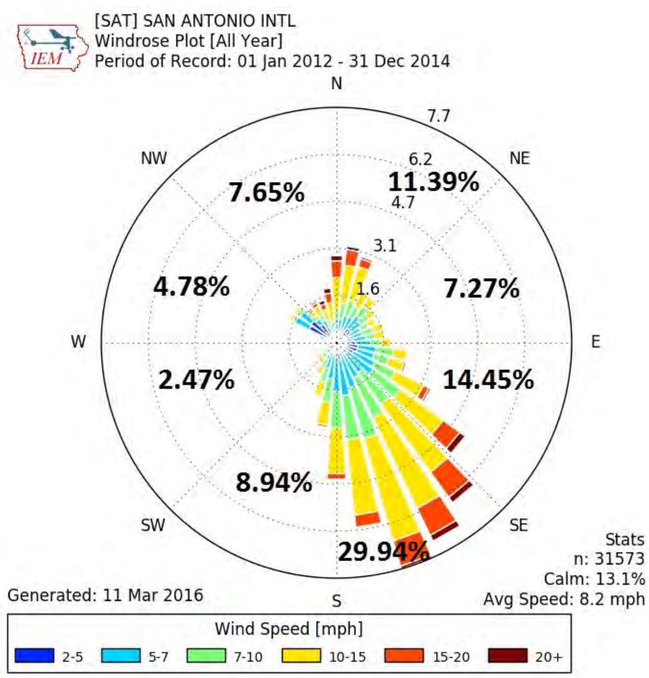


Figure 4: 2012-2014 Combined Average Wind Rose Plot

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Modeling Analysis for Monitoring Site Placement

The *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistant Document* (Monitoring TAD) suggests that modeling is one technique for identifying potential monitoring sites. The TCEQ's modeling for monitor placement used the Comprehensive Air Model with Extensions (CAMx) with model options set as equivalent as possible to American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The setup included the following parameterizations:

- CAMx 6.20 with speed ups and Plume-in-Grid (PiG) fix, without chemistry and without half-life decay;
- 500-meter PiG sampling grid centered on the source spatially covering 72-km by 72-km;
- the two kiln stacks were modeled and tracked as individual PiG puffs;
- full year of 2012 12-km gridded Weather Research and Forecasting Model (WRF) meteorology interpolated to 4-km;
- 2014 hourly point source electric generating unit (EGU) emissions; and
- 2014 annual point source non-EGU emissions from State of Texas Air Reporting System (STARS) processed down to hourly emissions.

All model outputs were normalized relative to the predicted off-property maximum concentration, and therefore do not represent absolute predicted results comparable to the NAAQS. The results were then analyzed using three metrics: normalized 99th percentile concentration, normalized frequency, and a composite using both the 99th percentile and frequency metrics. The primary areas targeted for monitor placement included consideration of all three model output metrics, along with the meteorological data presented in Figures 3 and 4.

From the model outputs, normalized 99th percentile concentrations were calculated by dividing the 99th percentile daily maximum concentration for each grid cell within the modeling domain by the predicted off-property maximum concentration for the domain. The calculated results thus represent a percentage of the predicted concentrations for each grid cell to the off-property maximum. Figure 5 graphically presents the results for the normalized 99th percentile concentration metric analysis with the location of the predicted off-property maximum indicated by a black square. Calaveras' permitted property is outlined in blue. Based on this analysis, the highest normalized concentrations, greater than 80% of the predicted off-property maximum, are expected within or immediately surrounding and to the north of Calaveras' property. The proposed monitor locations identified within Figure 5 are within areas with predicted normalized concentrations within 80% to 99% of the off-property maximum.

To evaluate the frequency at which high concentrations may be expected, a normalized frequency metric was developed to represent the number of days the modeled concentration for each grid cell was predicted to be greater than 75% of the off-property maximum concentration. This metric was calculated by dividing the number of days the 99th percentile concentration for each grid cell was greater than 75% of the predicted off-property maximum concentration by the number of days the off-property maximum was predicted to occur. Figure 6 presents the geographic distribution of normalized frequency around the Calaveras facility. Again, the location of the predicted off-property maximum is indicated by a black square and Calaveras' permitted property is outlined in blue. Using this analysis metric, areas directly to the north and areas directly west of the Calaveras facility scored greater than 80% and would be expected to see the highest frequency of elevated SO_2 concentrations.

Finally, a composite metric was developed to aid in identifying areas where the predicted highest concentration and predicted highest frequency overlap. The composite metric was calculated at each grid cell by averaging the normalized 99th percentile concentration and normalized frequency metrics. Figure 7 illustrates the geographic distribution of the composite metric analysis results with the location of the predicted off-property maximum indicated by a black square, the off-property maximum composite metric indicated with λ, and Calaveras' permitted property is outlined in blue. As with the normalized 99th percentile and normalized frequency metrics, areas north and west of the Calaveras facility scored greater than 80% using the composite metric. Based on the TCEQ's site reconnaissance and outreach to property owners, areas with the highest composite metric score did yield a viable location for monitor placement.

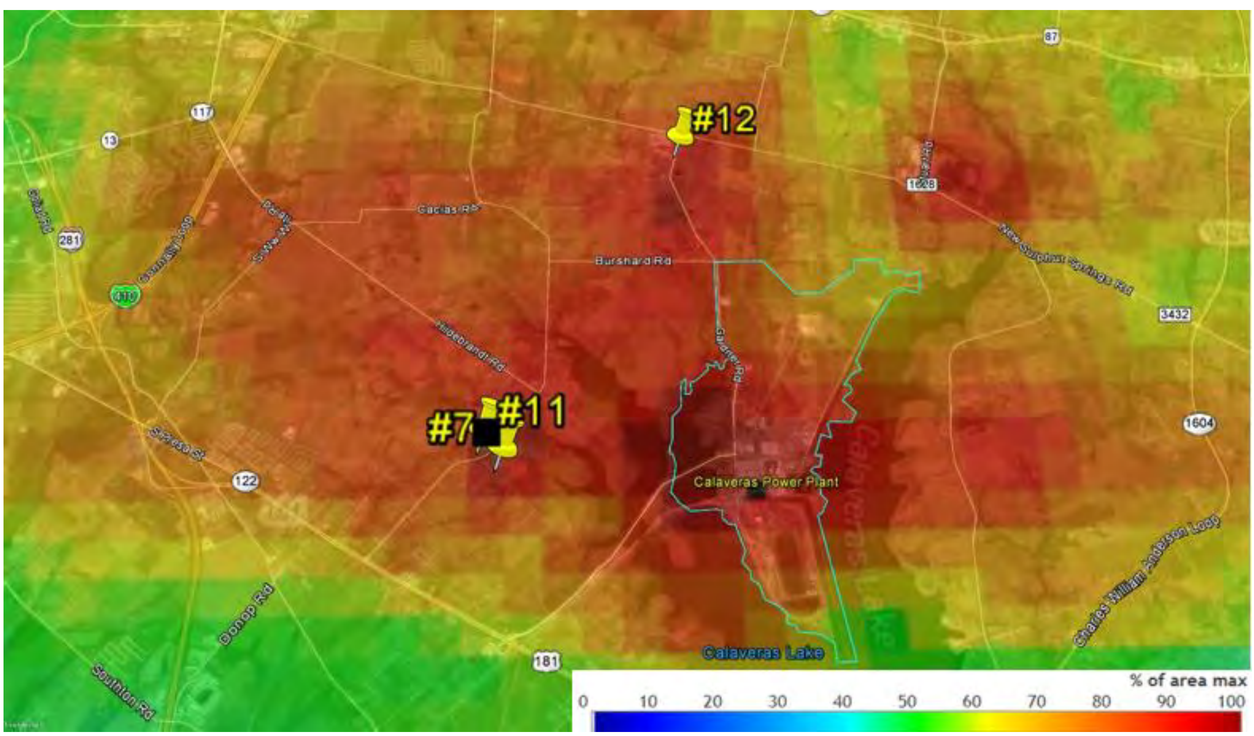


Figure 5: Calaveras Area CAMx Model Predictions Normalized Concentrations and Viable Site Locations

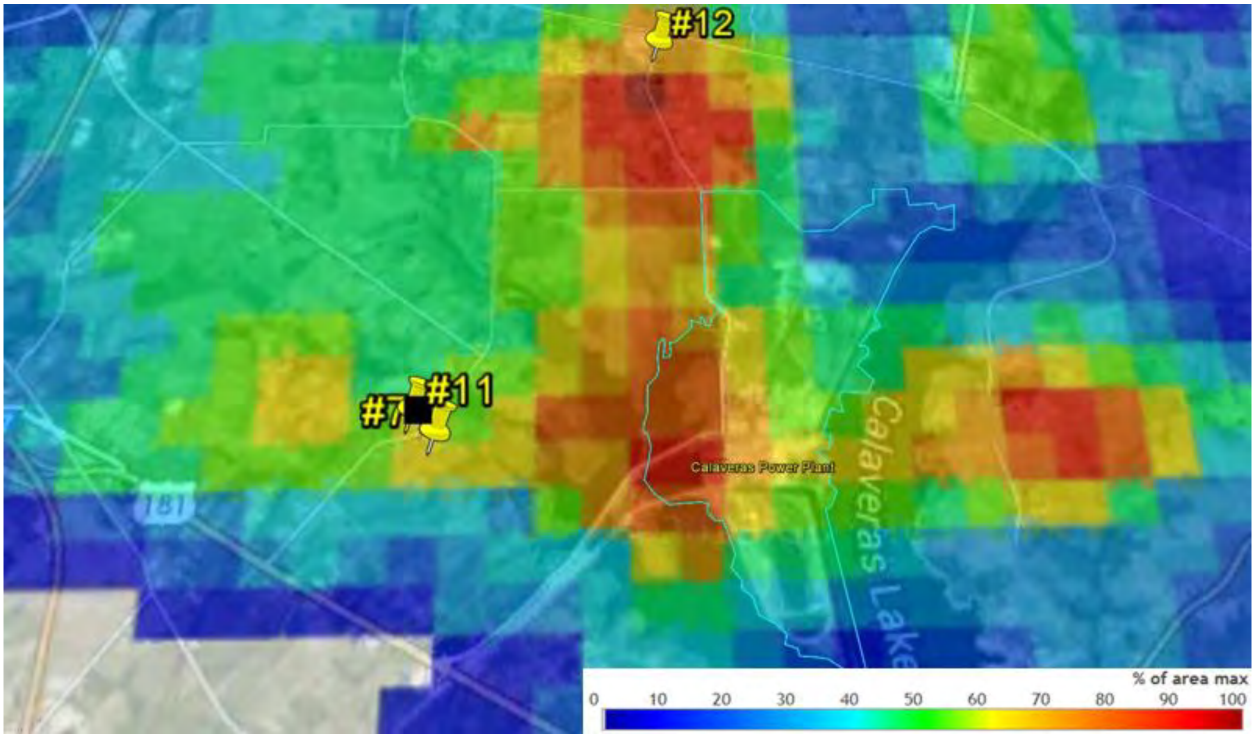


Figure 6: Calaveras Area CAMx Model Predictions Normalized Frequency (number of days) and Viable Site Locations

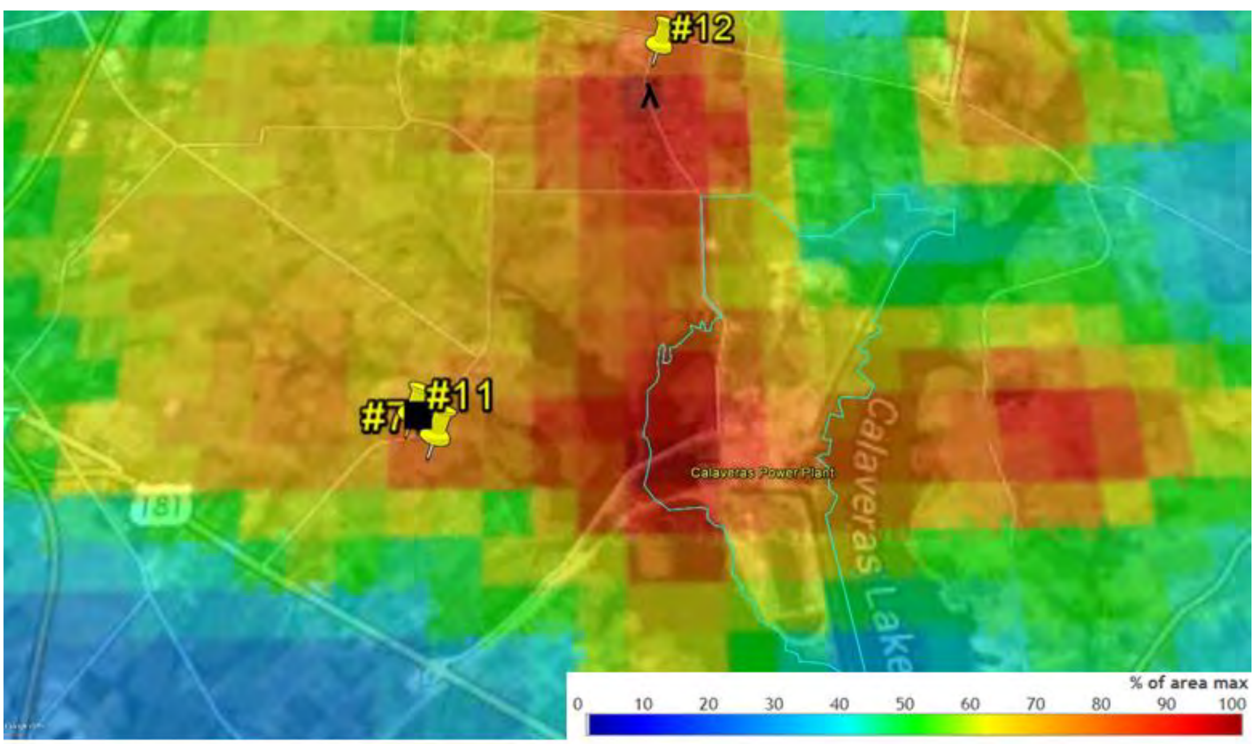


Figure 7: Calaveras Area CAMx Model Predictions Composite Metric and Viable Site Locations

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Selection Criteria and Options

The TCEQ currently does not monitor SO_2 downwind of the Calaveras Power Plant; therefore an additional site is required to characterize maximum concentrations. The TCEQ focused on complying with the federal requirements listed in 40 CFR Part 58, Appendix E regarding siting criteria. In addition, the TCEQ evaluated monitoring site locations that would appropriately and sufficiently characterize air quality in areas around an SO_2 emissions source. This approach includes utilizing multiple techniques and guidance provided in the Monitoring TAD.

The modeling analysis provided in Figures 5, 6, and 7 suggest that maximum ground level concentrations are expected to occur north and west of Calaveras.

Fifteen potential sites were identified as shown in Figure 8. Twelve of the identified potential sites (1, 2, 3, 4a, 4b, 4c, 4d, 5, 6, 8, 9, and 10) are not considered viable. Sites 2, 4a, and 4b were declined by the property owner. There was no response from the property owners at Sites 1, 3, and 6. Site 4c does not provide adequate space to locate an air monitor. Sites 4d and 5 have steep terrains that present significant grade issues diminishing their viability as a suitable monitoring site. Site 8 is on City Public Service property and within the restricted, fenced area permitted for the Calaveras Plant. Site 9 is logistically challenging due the presence of a gas pipeline that would hinder site construction activities, such as digging. Site 10 is limited by large trees that would present challenges in meeting federal requirements for minimum distance from an obstruction. Areas north of Site 8 and south of Site 12 along Gardner Road consist of private property homes and agricultural land retained by unresponsive property owners. As a result, these sites are no longer under consideration.

The three sites with satisfactory logistical and siting characteristics and locations anticipated to have peak off-property concentrations include sites 7, 11, and 12. These site locations are also identified on the model and satellite image overlay shown in Figures 5, 6, and 7.

- Site 7 is located approximately 3.5 km west from the Calaveras Plant in a rural community. This site is on level ground, has space and power available, but would involve logistical improvements, such as a new driveway and gate. The site is not directly downwind, but based on TCEQ's monitor placement modeling is located within an area of predicted maximum off-property SO_2 concentrations.
- Site 11 is located 3.7 km west of the Calaveras Plant in a rural community. This site is on level ground, has space and power available, but would involve logistical improvements, such as a new driveway and gate. The site is not directly downwind, but based on TCEQ's monitor placement modeling is located within an area of predicted maximum off-property SO_2 concentrations.
- Site 12 is approximately 4.7 km north of the Calaveras Plant and is approximately 0.4 km directly north from the off-property maximum composite metric indicated with λ noted in Figure 7at an existing monitoring station owned and operated by City Public Service adjacent to Heritage Middle School. Given this location is currently being used as a monitoring site, it satisfies all infrastructure and siting requirements for placement of an SO_2 monitor. A site agreement has been negotiated with the property owner and City Public Service is willing to

convey access to the TCEQ. This potential site is downwind and within an area of predicted a maximum off-property SO_2 concentrations based and a predicted off-property maximum composite metric on TCEQ's modeling.

Recommendation

Based on current plant operations, available emission data, wind patterns, and CAMx model predictions, Site 12 is the recommended location for placement of a new source-oriented ambient SO_2 monitoring station. While the modeling analysis results for sites 7, 11, and 12 show similar SO_2 concentrations, Site 12 is also well positioned between the source and an area frequented by the public, providing an advantage over the other viable sites. Site 12 is also the location of the off-property maximum composite metric, an average of the normalized 99th percentile concentration and normalized frequency metrics. Site 12 has an existing monitoring station in place and meets all federal siting criteria. Site 12 is shown in Figures 5, 6, 7, 8, 9, and 10.

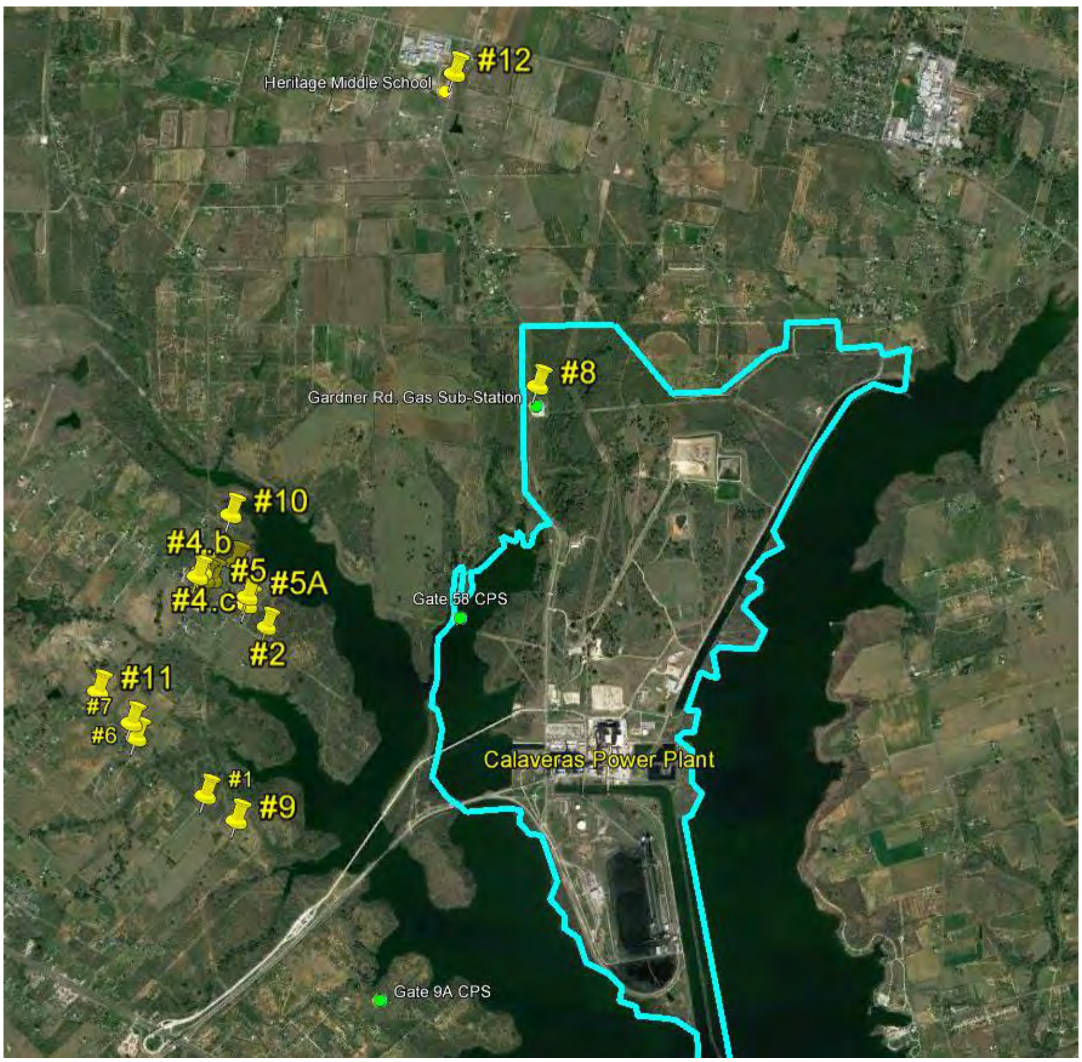


Figure 8: Potential Sites for Calaveras Power Plant

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Table 2: Potential Sites Assessment[1]

Site Number	Calaveras #1	Calaveras #2	Calaveras #3
Location[2]	29.30476°, -98.35152°	29.31612°, -98.34669°	29.320369°, -98.35104°
Distance from SO_2 Source (meters)[2]	3,075	2,685	3,250
Wind Direction	S, SE (dominant)	S, SE (dominant)	S, SE (dominant)
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	Yes; reservoir (E); 3.07 kilometers	Yes; reservoir (E); 0.87 kilometers	Yes; reservoir (E); 1.45 kilometers
Wind Channeling	None	None	None
Downwind[2]	No (W)	Yes (NW)	Yes (NW)
Obstructions and Height	Trees (10 m)	Trees (5 m)	Trees (15 m)
Distance from Site to Obstructions	Power substation (20-60 m E/SE) Trees (20-30 m E/SE from dripline)	Power substation (32 m E/SE) Trees (5 m E/SE from dripline)	Power substation (20 m SE)[2] Trees (20 m SE from dripline)[2]
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 meters	Yes	Yes	Yes
Pros	• Level ground • Gate in place	• Level ground • Downwind • Power available • Easy access • Few Obstructions	• Level ground • Downwind • Space available • Power available
Cons	• Not directly downwind (W of plant) • Requires a transformer • No response from property owner	• Property owner not agreeable	• No response from property owner
Viable Site (yes, no, or preferred)	No	No	No

Site Number	Calaveras #4a	Calaveras #4b	Calaveras #4c
Location[2]	29.31914°, -98.35145°	29.31364°, -98.35651°	29.319243°, -98.35148°
Distance from SO_2 Source (meters)[2]	3,200	3,535	3,220
Wind Direction	S, SE (dominant);	S, SE (dominant);	S, SE (dominant)
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	Yes; reservoir (E); 0.72 kilometers	Yes; reservoir (E); 1.96 kilometers	Yes; reservoir (E); 0.70 kilometers
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	Yes (NW)
Obstructions and Height	N/A	N/A	Shrubs height (5 m)
Distance from Site to Obstructions	N/A	N/A	Power substation (10 m S) Shrubs (5 m S from dripline)[2]
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 meters	Yes	Yes	Yes
Pros	• Level ground • Space available • Optimal site of all 4a, 4b, 4c, and 4d locations • Downwind	• Level ground • Downwind • Power available • Safe access • Open field not used	• Level ground • Power available • Downwind
Cons	• Property owner is not agreeable	• Property owner is not agreeable	• Residential backyard used for recreation • Not enough space • Cable line SE of site
Viable Site (yes, no, or preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Calaveras #4d	Calaveras #5	Calaveras #6
Location[2]	29.31926°, -98.35142°	29.31786°, -98.34853°	29.308712, -98.35646
Distance from SO_2 Source (meters)[2]	3,220	2,890	3,560
Wind Direction	S, SE (dominant)	S, SE (dominant)	S, SE (dominant)
Grade	>1%	>1%	<1%
Flood Plains	No	Yes	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	Yes; reservoir (E); 0.72 kilometers	Yes; reservoir (E); 0.87 kilometers	Yes; reservoir (E); 0.83 kilometers
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	No (W)
Obstructions and Height	Trees (10 m and 15 m)	Trees (10 m)	Brush (10 m) Tree line (10 m)
Distance from Site to Obstructions	Trees (27m NE, 37m SE from dripline)[2]	Trees (12 m) Trees (10 m in all directions from dripline)[2]	Brush (20 m E, 20m E from dripline)[2] Trees (42m SE, 42m SE from dripline)[2]
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 meters	Yes	No	Yes
Pros	• Power available • Downwind	• Downwind	• Good access • Power available
Cons	• Significant slope • Two additional electric poles needed • Ditch at entryway	• Uneven Terrain • Significant slope • Natural Gas Pipeline present on site • No Power available • Flood plains	• Needs Transformer • Not Downwind • No response from property owner
Viable Site (yes, no, or preferred)	No	No	No

Site Number	Calaveras #7	Calaveras #8	Calaveras #9
Location[2]	29.30959°, -98.35745°	29.33215°, -98.32643°	291811, -982058
Distance from SO_2 Source (meters)[2]	3,500	2,555	2,800
Wind Direction	S, SE (dominant)	S, SE (dominant)	S, SE (dominant);
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	No
Water Body Nearby[2]	Yes; reservoir (E); 1.38 kilometers	Yes; reservoir (E); 1.22 kilometers	No
Wind Channeling	None	None	None
Downwind[2]	No (W)	Yes (NW)	No (W)
Obstructions and Height	Trees (20 m)	None	Tree (10 m)
Distance from Site to Obstructions	Trees (20 m N from dripline)[2]	NA	Tree (15 m to S)
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 meters	Yes	Yes	Yes
Pros	• Close proximity to modeled maxima • Space available • Power available • Safe access • Agreeable property owner	• Level ground • Downwind • Power available • Safe access • Site agreement possible	• Level grade • Close to the source
Cons	• Gate installation required • Not downwind	• On Calaveras property • Natural gas pipeline may hinder installation • Access issues	• Gas pipeline hinders construction of site • A transformer would need to be installed • Property owner not agreeable
Viable Site (yes, no, or preferred)	Yes	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Calaveras #10	Calaveras #11	#12 Heritage Middle School
Location[2]	29.19.21N, -98.211	29.311591°, -98.359697°	29.354663°, -98.334565°
Distance from SO_2 Source (meters)[2]	3,240	3,700	4,700
Wind Direction	S, SE (dominant);	S, SE (dominant);	S, SE (dominant);
Grade	<1%	<1%	<1%
Flood Plains	None	None	No
Mountain/Valley Winds	None	None	No
Water Body Nearby[2]	No	Yes; pond (N) 177 m	No
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	No (W)	Yes (N)
Obstructions and Height	Trees (10 m, 6 m, and 10 m)	Barn (5 m)	NA
Distance from Site to Obstructions	Trees (35 m to SE); tree (20 m to SE); tree (21 m to E)	Barn (48 m to N)	NA
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 meters	Yes	Yes	Yes
Pros	• Downwind • Agreeable property owner	• Flat area • Agreeable property owner • Close proximity to modeled maxima	• Nearest to maximum frequency and maximum composite metric • Current air monitoring site available • Agreeable property owner • Proximity to maximum concentrations • Captures concentrations adjacent to a school • Minimal installation
Cons	• Surrounded by large obstructions	• A gate and driveway would have to be constructed • Not downwind	• None
Viable Site (yes, no, or preferred)	No	Yes	**Recommended**

[1]Based on guidance from March 1, 2011, memorandum from Tyler Fox, EPA Office of Air Quality Planning and Standards, "Additional Clarification Regarding the Application of Appendix W Modeling Guidance for the 1-hr NAAQS." Research Triangle Park, North Carolina 27711.
[2]Based on Google Earth

SO_2 – sulfur dioxide
m - meters
% – percent
< - less than
E – east
N – north
NE – northeast

NW – northwest
SE – southeast
SW – southwest
– number
° – degree
NA – Not applicable

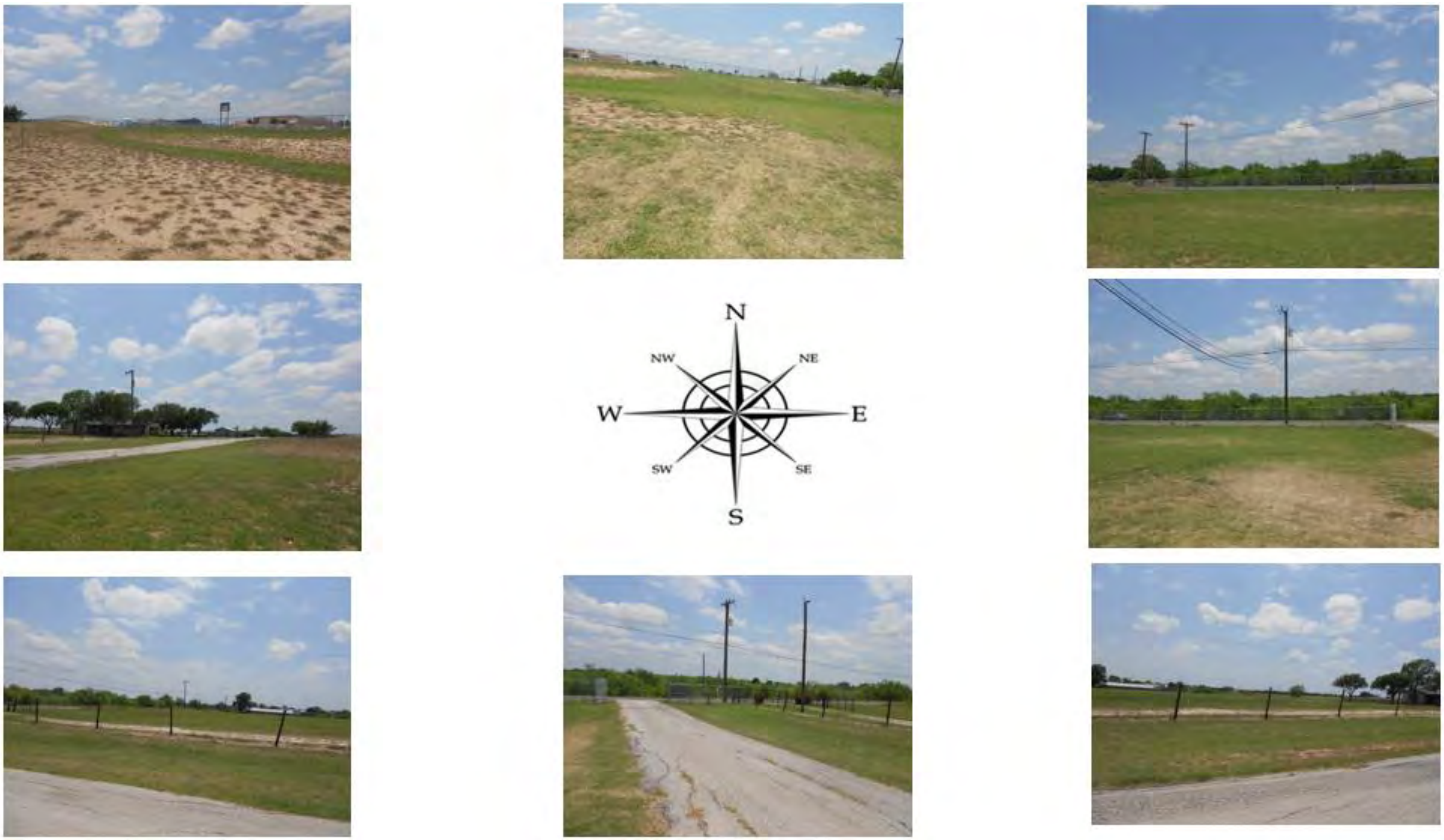


Figure 9: Calaveras #12 Potential Site Cardinal Direction Photos

Figure 10: Calaveras #12 Potential Site References

References

Griffith, G. E., S. A. Bryce, J. M. Omernik, J. A. Comstock, A. C. Rogers, B. Harrison, S. L. Hatch, and D. Bezanson. *Ecoregions of Texas*. (2 sided color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia: U.S. Geological Survey, 2004. Scale 1:2,500,000.

"IEM : Site Locator." Iowa Environmental Mesonet. 2016. Accessed April 06, 2016. https://mesonet.agron.iastate.edu/sites/locate.php?network=TX_ASOS.

Oxbow Calcining Monitor Placement Evaluation

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Source Information

- Name: Oxbow Calcining LLC (Oxbow)
- Owner: Oxbow Carbon LLC
- Facility function: petroleum and coal products
- Location: 29.83560°, -93.96300°, Texas Commission on Environmental Quality (TCEQ) Region 10, Jefferson County, Texas
- Sulfur dioxide (SO_2) emissions data: 7,964 tons (2013), 11,319 tons (2014, preliminary data)
- Long-term emissions trend: decreasing, 25 percent (%) decrease from 2003 through 2013
- Emission profile: operational year-round
- Stack height(s): 4 stacks total; one is 38 meters and the other three are 56 meters each (shown in Figure 2)
- SO_2 emission controls: none
- Permit related data: Federal Operating Permit 1493

Existing Air Monitoring Sites

The nearest ambient air quality monitoring sites are detailed in Table 1. All existing SO_2 monitors have design values below the current SO_2 standard of 75 parts per billion (ppb). The existing sites are not located to characterize maximum SO_2 source concentrations and are not downwind.

Table 1: Air Monitoring Sites Located Near Oxbow

Site	Location	Current Sulfur Dioxide (SO_2) Monitoring	SO_2 Design Value (2012-2014)
SETRPC Port Arthur	3.7 kilometers north	Yes (non-TCEQ private monitor)	not comparable
City Service Center Port Arthur	6.9 kilometers north	No	not applicable
Port Arthur West	7.3 kilometers northwest	Yes	51 parts per billion*
Port Arthur Memorial School	11.1 kilometers northeast	No	not applicable
Jefferson County Airport	12.6 kilometers northwest	No	not applicable

*design value data does not meet completeness requirements for 2012

Settings and Surroundings

The rural area surrounding Oxbow consists of flat gulf coastal plains with a sea level elevation as shown in Figure 1. The gulf coast plains are primarily coastal prairies marked by forested vegetation and river channels. (Griffith et al. 2004) River channels run east, west, and south of Oxbow. No significant changes to the landscape were noted during the reconnaissance as compared to the Google Earth view shown in Figure 8. Mountain and valley wind channeling or other terrain related meteorological impacts are not characteristic of this area as detailed in Table 2.

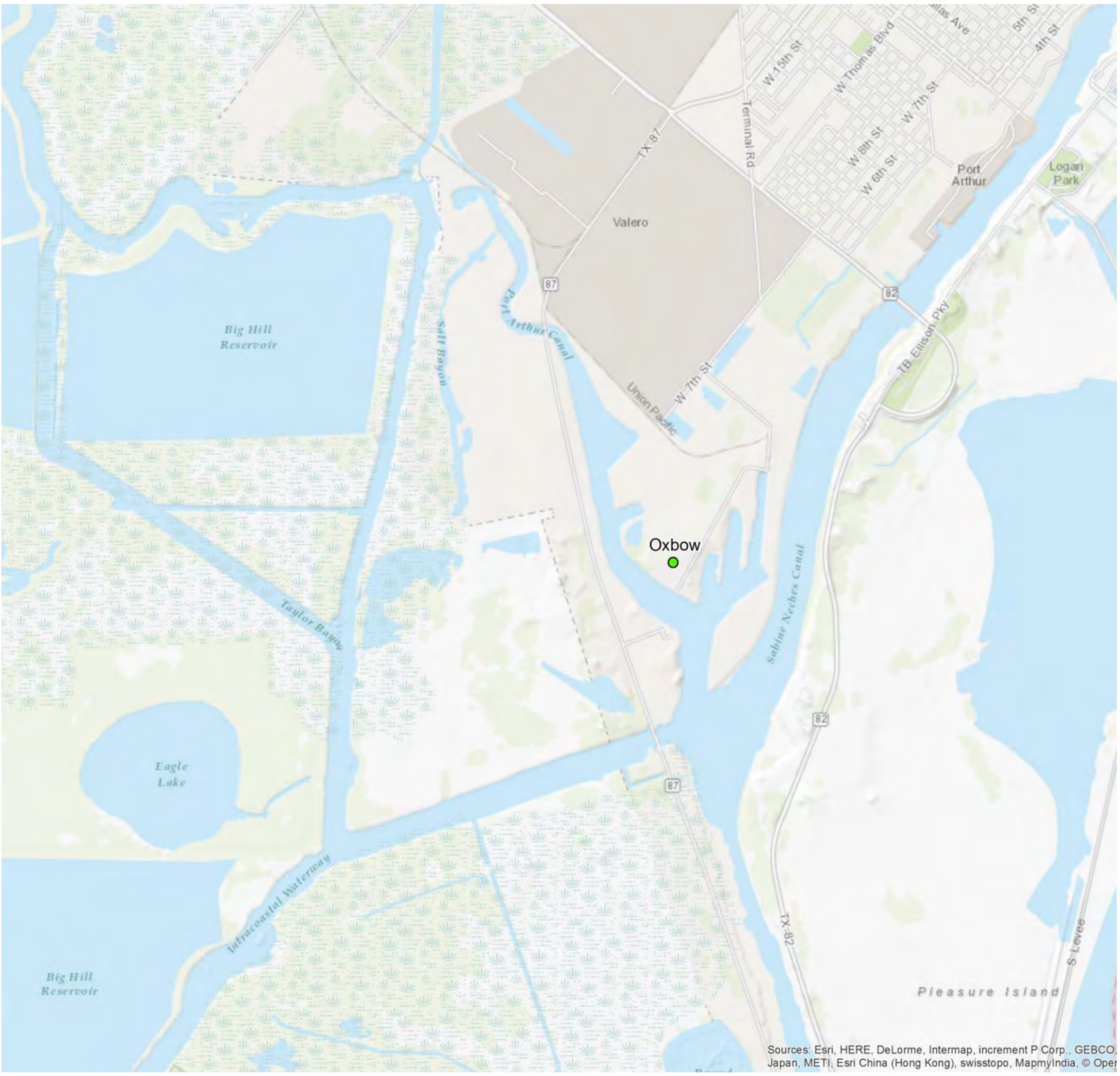


Figure 1: Oxbow Area Elevation Map

Figure 2: Oxbow Calcining Sulfur Dioxide Stacks and Emissions, 2013

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Meteorological Data

Figure 3 provides illustrations of area annual average wind speed and direction for 2012, 2013, and 2014 from meteorological sensors at the Jefferson County Airport, located 13 kilometers north-northwest of Oxbow. Figure 4 illustrates the 2012-2014 annual average wind speed. The length of each wind rose bar corresponds to the frequency of the wind coming from the indicated direction by percentage. Based on analysis of the 2012 – 21014 wind data, the dominant wind flow direction for the area is south to southeast, with wind flows from the north, northeast, and northwest accounting for only 23% of the average annual wind flows. Over this three year period, calm winds (0-2 miles per hour) occurred on average 17% of the time and wind speeds averaged 7.9 miles per hour (Iowa Environmental Mesonet 2016).

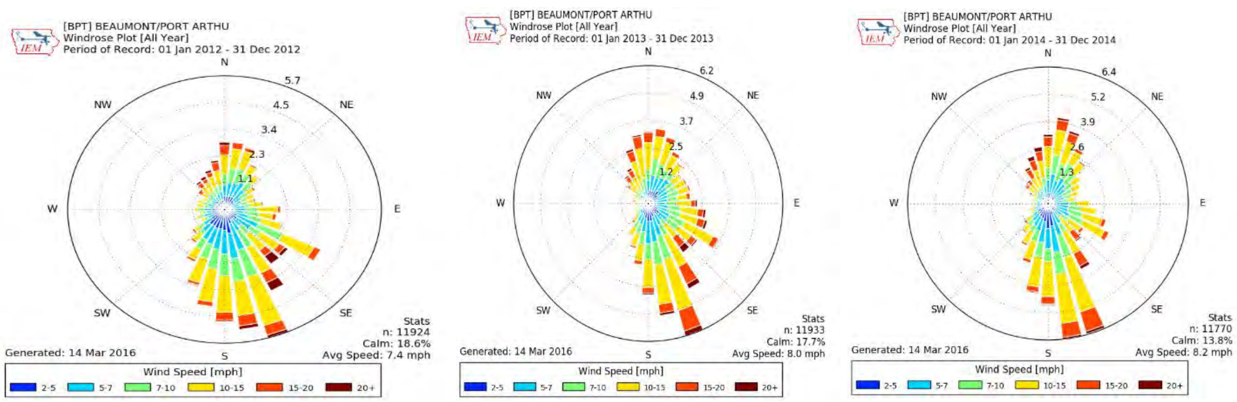


Figure 3: (From left to right) 2012, 2013, and 2014 individual Wind Rose Plots

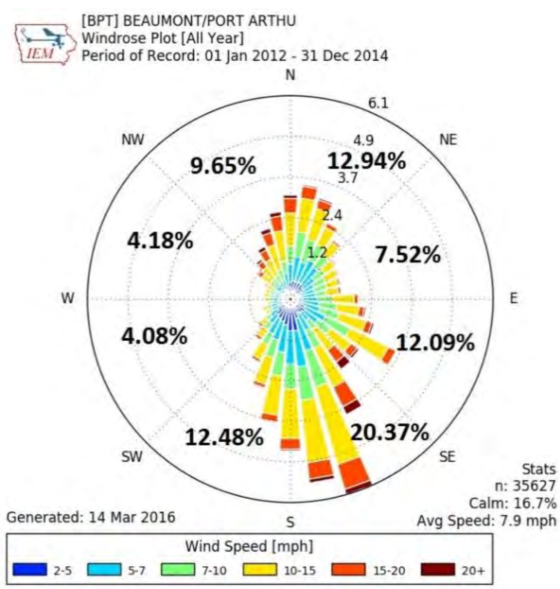


Figure 4: 2012-2014 Combined Average Wind Rose Plot

Modeling Analysis for Monitoring Site Placement

The *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistant Document* (Monitoring TAD) suggests that modeling is one technique for identifying potential monitoring sites. The TCEQ's modeling for monitor placement used the Comprehensive Air Model with Extensions (CAMx) with model options set as equivalent as possible to American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The setup included the following parameterizations:

- CAMx 6.20 with speed ups and Plume-in-Grid (PiG) fix, without chemistry and without half-life decay;
- 500-meter PiG sampling grid centered on the source spatially covering 72-km by 72-km;
- the four kiln stacks were modeled and tracked as individual PiG puffs;
- full year of 2012 12-km gridded Weather Research and Forecasting Model (WRF) meteorology interpolated to 4-km;
- 2014 hourly point source electric generating unit (EGU) emissions; and
- 2014 annual point source non-EGU emissions from State of Texas Air Reporting System (STARS) processed down to hourly emissions.

All model outputs were normalized relative to the predicted off-property maximum concentration, and therefore do not represent absolute predicted results comparable to the NAAQS. The results were then analyzed using three metrics: normalized 99th percentile concentration, normalized frequency, and a composite using both the 99th percentile and frequency metrics. The primary areas targeted for monitor placement included consideration of all three model output metrics, along with the meteorological data presented in Figures 3 and 4.

From the model outputs, normalized 99th percentile concentrations were calculated by dividing the 99th percentile daily maximum concentration for each grid cell within the modeling domain by the predicted off-property maximum concentration for the domain. The calculated results thus represent a percentage of the predicted concentrations for each grid cell to the off-property maximum. Figure 5 graphically presents the results for the normalized 99th percentile concentration metric analysis with the location of the predicted off-property maximum indicated by a black cross. Oxbow's permitted property is outlined in blue. Based on this analysis, the highest normalized concentrations, greater than 70% of the predicted off-property maximum, are expected within or immediately surrounding Oxbow's property. The area immediately surrounding the predicted off-property maximum is a water retention and overflow area not viable for monitor placement based on site reconnaissance and discussions with property owners. However, both of the proposed monitor locations identified within Figure 5 are within areas with predicted normalized concentrations within 70% to 80% of the off-property maximum.

To evaluate the frequency at which high concentrations may be expected, a normalized frequency metric was developed to represent the number of days the modeled concentration for each grid cell was predicted to be greater than 75% of the off-property maximum concentration. This metric was calculated by dividing the number of days the 99th percentile concentration for each grid cell was greater than 75% of the predicted off-

property maximum concentration by the number of days the off-property maximum was predicted to occur. Figure 6 presents the geographic distribution of normalized frequency around the Oxbow facility. Again, the location of the predicted off-property maximum is indicated by a black cross and Oxbow's permitted property is outlined in blue. Using this analysis metric, areas within or directly to the north of the Oxbow facility scored greater than 70% and would be expected to see the highest frequency of elevated SO_2 concentrations. These areas are not viable for monitor placement based on site reconnaissance and discussions with property owners.

Finally, a composite metric was developed to aid in identifying areas where the predicted highest concentration and predicted highest frequency overlap. The composite metric was calculated at each grid cell by averaging the normalized 99th percentile concentration and normalized frequency metrics. Figure 7 illustrates the geographic distribution of the composite metric analysis results with the location of the predicted off-property maximum indicated by a black cross and Oxbow's permitted property is outlined in blue. As with the normalized 99th percentile and normalized frequency metrics, areas within and directly north of the Oxbow facility scored greater than 70% using the composite metric. Based on the TCEQ's site reconnaissance and outreach to property owners, areas with the highest composite metric score did not yield a viable location for monitor placement.

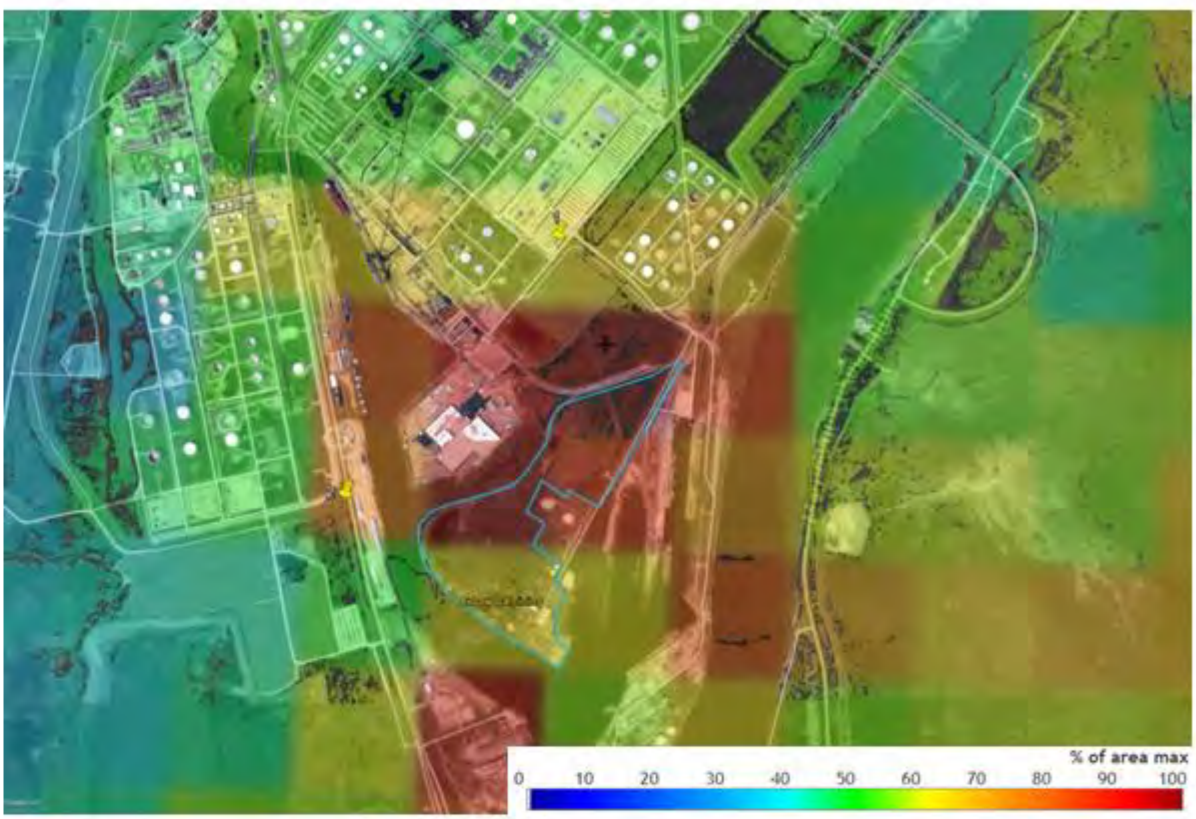


Figure 5: Oxbow Area CAMx Predicted Normalized 99th Percentile Concentrations and Viable Site Locations

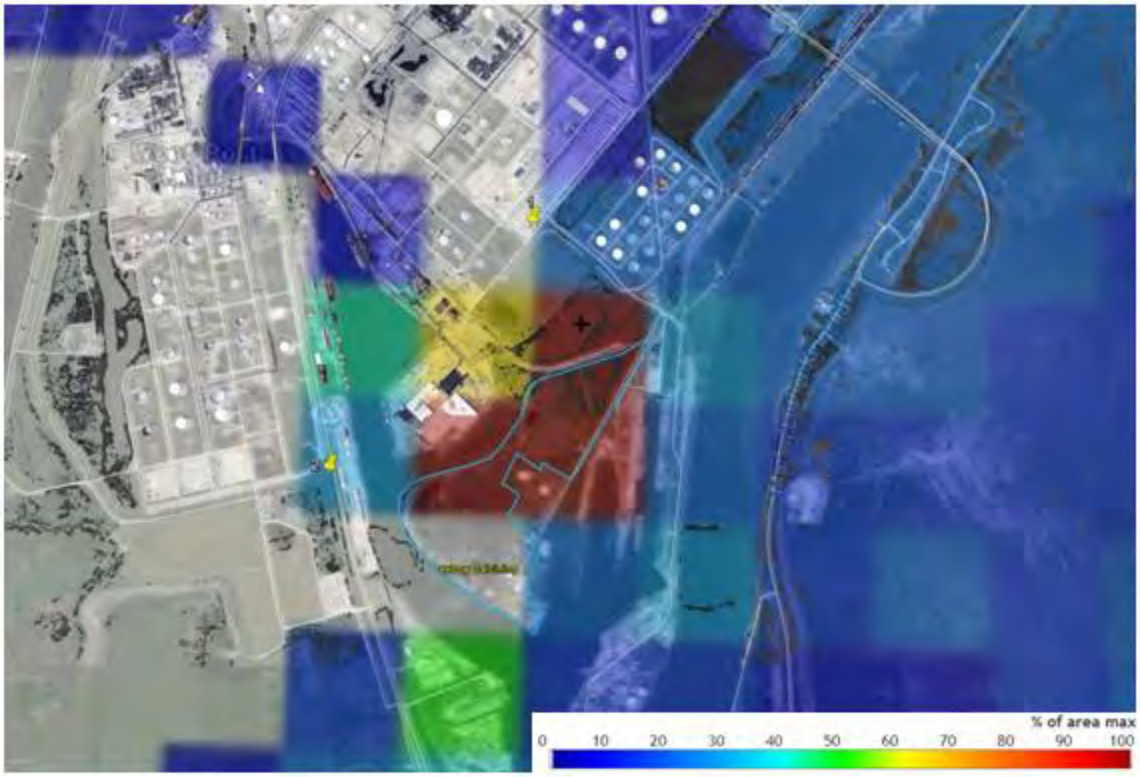


Figure 6: Oxbow Area CAMx Predicted Normalized Frequency (number of days) and Viable Site Locations

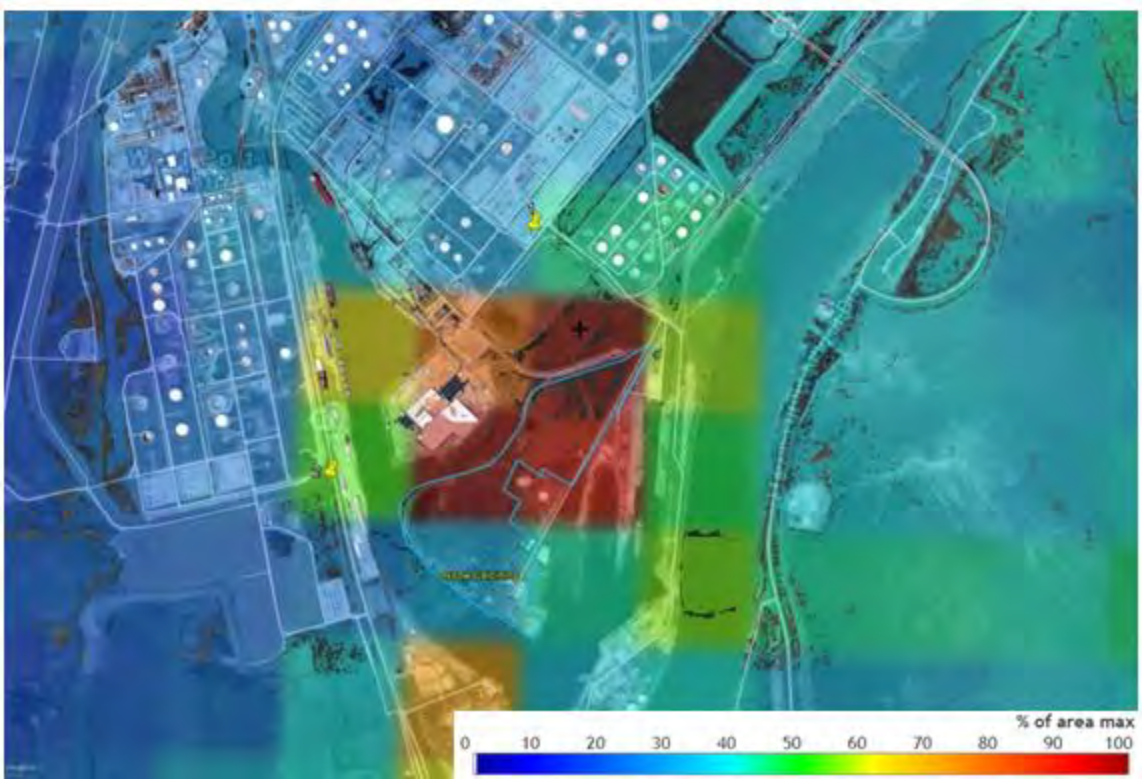


Figure 7: Oxbow Area CAMx Predicted Composite Metric and Viable Site Locations

Site Selection Criteria and Options

The TCEQ does not currently have SO_2 monitors located in the area surrounding Oxbow that would characterize the highest SO_2 concentrations from this facility; therefore a new site is required. The TCEQ focused on complying with the federal requirements listed in 40 CFR Part 58, Appendix E regarding siting criteria. In addition, the TCEQ evaluated monitoring site locations that would appropriately and sufficiently characterize air quality in areas around an SO_2 emissions source. This approach includes utilizing multiple techniques and guidance provided in the Monitoring TAD.

The modeling analysis provided in Figures 5, 6, and 7 suggest that maximum SO_2 concentrations are expected to occur north-northeast of Oxbow and slightly south on days with northerly and/or calm winds. In addition, the highest frequency of SO_2 concentrations predicted to be greater than 75% of the off-property maximum is expected within or directly north of the Oxbow facility.

Ten potential sites were identified as shown in Figure 8. A logistical summary of all the potential sites is provided in Table 2. Eight of the identified potential sites (sites 3, 4, 5, 6, 7, 8, 9, and 10) are not considered viable. Sites 3 and 6 were excluded due to a lack of electrical availability and logistical issues. Sites 5 and 7 are on land that is currently for sale by the property owner. Sites 3, 4, 8, 9, and 10 are located well outside of the model maxima predicted area. Figure 8 also includes the identification of two parking lots labeled P 1 and P 2. Parking lot number 1 (P 1) is utilized for private facility parking beyond secured access gates. Parking lot number 2 (P 2) is utilized for heavy duty on-road vehicle parking and frequently contains idling vehicles. As a result, these sites are no longer under consideration.

The two sites with satisfactory logistical and siting characteristics and locations anticipated to have peak concentrations include sites 1 and 2. These site locations are also identified on the model and satellite image overlays shown in Figures 5, 6, and 7.

- Site 1 is positioned slightly north of Oxbow and southwest of a neighborhood that includes Abraham Lincoln Middle School and Booker T. Washington Elementary School approximately 3.5 to 4 kilometers from Oxbow. Electricity is available, and obstructions are a sufficient distance from the location to meet siting criteria. A site agreement has been negotiated with the property owner. This potential site is approximately 1.5 km north of Oxbow.
- Site 2 is located northwest of Oxbow in an industrial area, east of a large bayou and west of a marine vessel shipping channel. Electricity is available, and obstructions are a sufficient distance from the location to meet siting criteria. A site agreement has been negotiated with the property owner. This potential site is approximately 1.0 km west of Oxbow.

Recommendation

Based on current plant operations, available emission data, wind patterns, and CAMx model predictions, Site 1 is the recommended location for placement of a new source-oriented ambient SO_2 monitoring station. While the modeling analysis results for Sites 1 and 2 are very comparable, Site 1 would be directly downwind of the Oxbow facility and has the benefit of being well positioned between the source and a populated neighborhood with two schools. Site 1 offers open areas, has available electricity, and meets all federal siting criteria. Site 1 is shown in Figures 5, 6, 7, 8, 9, and 10.

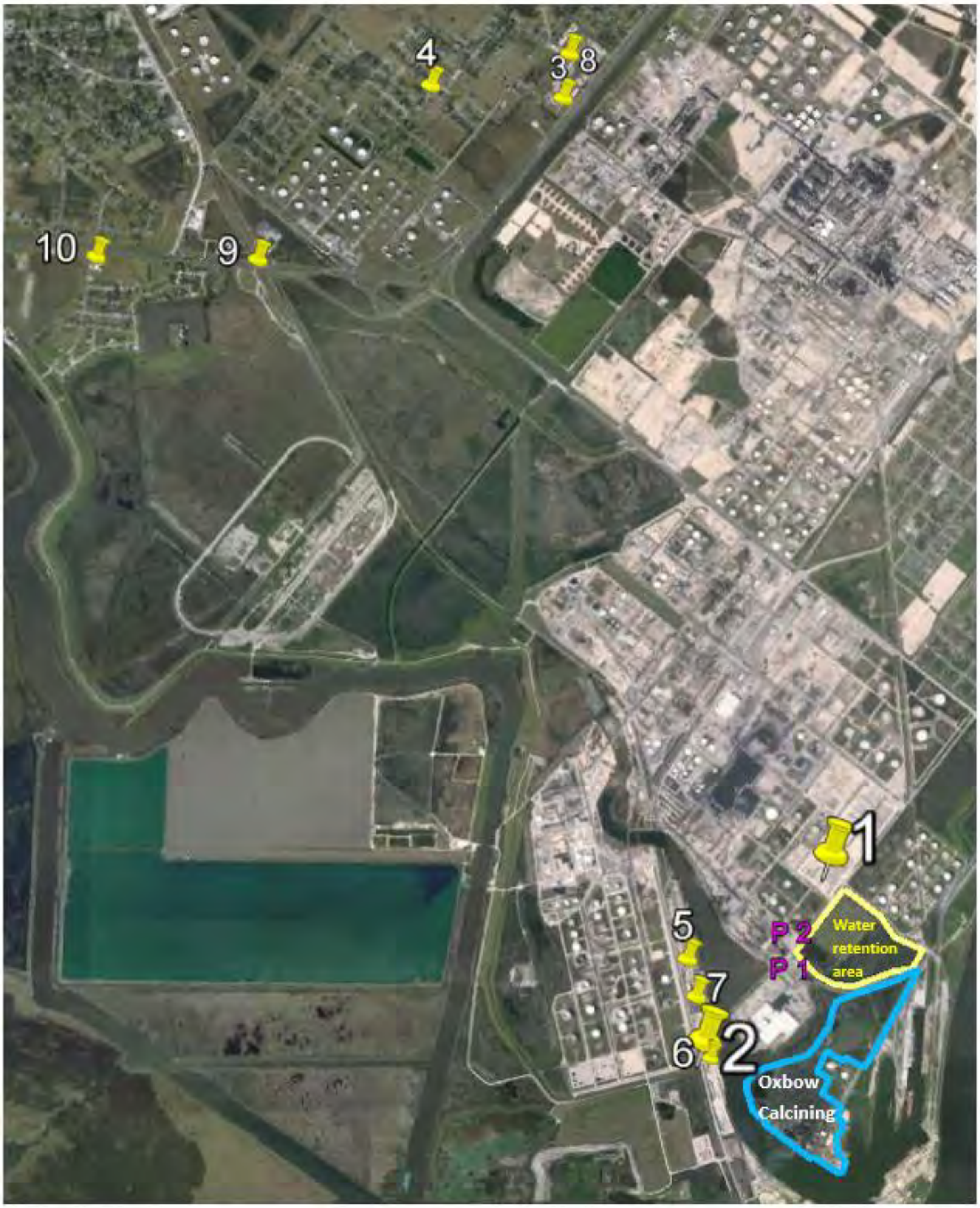


Figure 8: Potential Sulfur Dioxide Monitoring Sites for Oxbow Calcining

Figure 9: Oxbow #1 Potential Site Cardinal Direction Photos

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Figure 10: Oxbow #1 Potential Site

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Table 2: Potential Sites Assessment

Site Number	Oxbow #1	Oxbow #2	Oxbow #3
Location[2]	29.84575° -93.96348°	29.83887°, -93.97028°	29.89393°, -93.97913°
Distance From SO_2 Source[2]	1,500 meters	800 meters	7,000 meters
Wind Direction	N, NW	N, NW	N, NW
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	Yes; river (E)	Yes; river (E)	Yes; river (E)
Wind Channeling	None	None	None
Downwind[2]	Yes (N)	Yes (NW)	Yes (NW)
Obstructions and Height	None	None	Trees (10 meters)
Distance from Site to Obstructions	Not applicable	Not applicable	Trees (18 meters SE from dripline)[2]
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 meters	Yes	Yes	No
Pros	• Downwind • Power available • Space available • Close proximity to source and modeled maxima • Located between the source and a neighborhood with schools • Predicted to receive the most frequent daily maximum concentrations	• Level ground • Power available • Space available • Close proximity to source and modeled maxima	• Level ground • Downwind • Space available • Intergovernmental agreement possible
Cons	• Located east of large truck parking	• Adjacent to area with marine vessel transport • Not downwind	• Far from source • No power available
Viable Site (yes, no, or recommended)	**Recommended**	Yes	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Oxbow #4	Oxbow #5	Oxbow #6
Location[2]	29.89436°, -93.98871°	29.84382°, -93.97142°	29.83891°, -93.97016°
Distance From SO_2 Source[2]	7,030 m	1,240 m	775 m
Wind Direction	N, NW	N, NW	N, NW
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	Yes; river (E)	Yes; river (E)	Yes; river (E)
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	Yes (NW)
Obstructions and Height	Building (10 m)	Building (8 m)	None
Distance from Site to Obstructions	Building (23 m NE)[2]	Building (60 m E)[2]	Not applicable
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 meters	Yes	Yes	No
Pros	• Downwind • Space available • Level ground	• Downwind • Power available • Close proximity to source • Level ground	• Downwind • Close proximity to source • Level ground
Cons	• Outside modeled maxima	• Property is for sale	• Power may be difficult to acquire
Viable Site (yes, no, or recommended)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Oxbow #7	Oxbow #8	Oxbow #9
Location[2]	29.84188°, -93.97092°	29.89652°, -93.97865°	29.88459°, -93.99966°
Distance From SO_2 Source[2]	1,000 meters	7,050 meters	6,520 meters
Wind Direction	N, NW	N, NW	N, NW
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	Yes; river (E)	Yes; river (E)	Yes; river (E)
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	Yes (NW)
Obstructions and Height	Building (8 meters)	Not applicable	Not applicable
Distance from Site to Obstructions	Building (60 meters E)[2]	None	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 meters	No	Yes	Yes
Pros	• Close proximity to source • Downwind	• Downwind	• Downwind
Cons	• Property is for sale • No power available	• Outside modeled maxima	• Outside modeled maxima
Viable Site (yes, no, or recommended)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Oxbow #10
Location[2]	29.88479°, -94.01070°
Distance From SO_2 Source[2]	7,220 meters
Wind Direction	N, NW
Grade	<1%
Flood Plains	No
Mountain/Valley Winds	None
Water Body Nearby[2]	Yes; river (SW)
Downwind[2]	Yes (NW)
Obstructions and Height	Building (7 meters)
Distance from Site to Obstructions	Building (50 meters E)[2]
Road/Site Access	Yes
Electricity Available <18 meters	No
Pros	• Downwind
Cons	• Outside modeled maxima
Viable Site (yes, no, or recommended)	No

[1]Based on guidance from March 1, 2011, memorandum from Tyler Fox, EPA Office of Air Quality Planning and Standards, "Additional Clarification Regarding the Application of Appendix W Modeling Guidance for the 1-hr NAAQS." Research Triangle Park, North Carolina 27711.
[2]Based on Google Earth
SO_2 – sulfur dioxide
% – percent
< - less than
E – east
N – north
NE – northeast
NW – northwest
SE – southeast
SW – southwest
– number
° – degree

References

Griffith, G. E., S. A. Bryce, J. M. Omernik, J. A. Comstock, A. C. Rogers, B. Harrison, S. L. Hatch, and D. Bezanson. *Ecoregions of Texas*. (2 sided color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia: U.S. Geological Survey, 2004. Scale 1:2,500,000.

"IEM : Site Locator." Iowa Environmental Mesonet. 2016. Accessed April 06, 2016. https://mesonet.agron.iastate.edu/sites/locate.php?network=TX_ASOS.

AEP Pirkey Power Plant Monitor Placement Evaluation

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Source Information

- Name: AEP Pirkey Power Plant (Pirkey) (Figure 2)
- Owner: Southwestern Electric Power Company
- Facility function: electric generation
- Location: 32.46106, -94.48502, Texas Commission on Environmental Quality (TCEQ) Region 5, Harrison County, Texas
- Sulfur dioxide (SO_2) emissions data: 7,339 tons (2013), 2,916 tons (2014)
- Long-term emissions trend: decreasing, 84 percent (%) decrease from 2004 to 2014
- Emission profile: operational year-round
- Stack height: 160 meters
- SO_2 emission controls: limestone wet-scrubbing, 97% reduction efficiency
- Permit related data: Federal Operating Permit

Existing Air Monitoring Sites

The nearest ambient air quality monitoring sites are detailed in Table 1. No TCEQ ambient air quality monitors are located within 23 kilometers (km) of Pirkey. The existing SO_2 monitor at Longview has a design values below the current SO_2 standard of 75 parts per billion (ppb). The SO_2 monitor at Tyler Airport Relocated is a seasonal non-regulatory monitor. The Tyler Airport Relocated 2015 maximum 1-hour SO_2 concentration was 12.9 ppb. The existing sites listed in Table 1 are not located to characterize maximum SO_2 source concentrations and are not downwind.

Table 1: Air Monitoring Sites Near Pirkey

Site	Location	Current Sulfur Dioxide (SO_2) Monitoring	SO_2 Design Value (2013-2015)
Longview	23 kilometers southwest	Yes	46 parts per billion (ppb)
Karnack	38 kilometers northeast	No	Not applicable
Tyler Airport Relocated*	88 kilometers west	Yes	Not applicable

*Tyler Airport Relocated operates a non-regulatory, seasonal SO_2 monitor.

Settings and Surroundings

The rural area surrounding Pirkey consists of interior coastal plains with elevations ranging from approximately 100 to 130 m (as shown in Figure 1). The terrain is considered part of the Piney Woods ecological area and includes some of the most densely forested regions of Texas (Griffith et al. 2004). No significant changes to the landscape were noted during the reconnaissance as compared to the Google Earth view shown in Figures 8 and 9. Mountain and valley wind channeling or other terrain related meteorological impacts are not expected in this area as detailed in Table 2.

Martin Lake Electrical Station (Martin Lake), located approximately 24 km southwest of Pirkey, has the potential to influence SO_2 concentrations in the Pirkey area under certain meteorological conditions. Martin Lake's SO_2 emissions were reported as 53,660 tons in 2014. Due to Pirkey's location, and the area's predominant southeasterly wind flow, it is anticipated that Martin Lake would only minimally impact SO_2 concentrations around the Pirkey area when winds are from the south-southwest (approximately 8% of the time according to the Marshall Airport wind rose data; Figures 3 and 4).

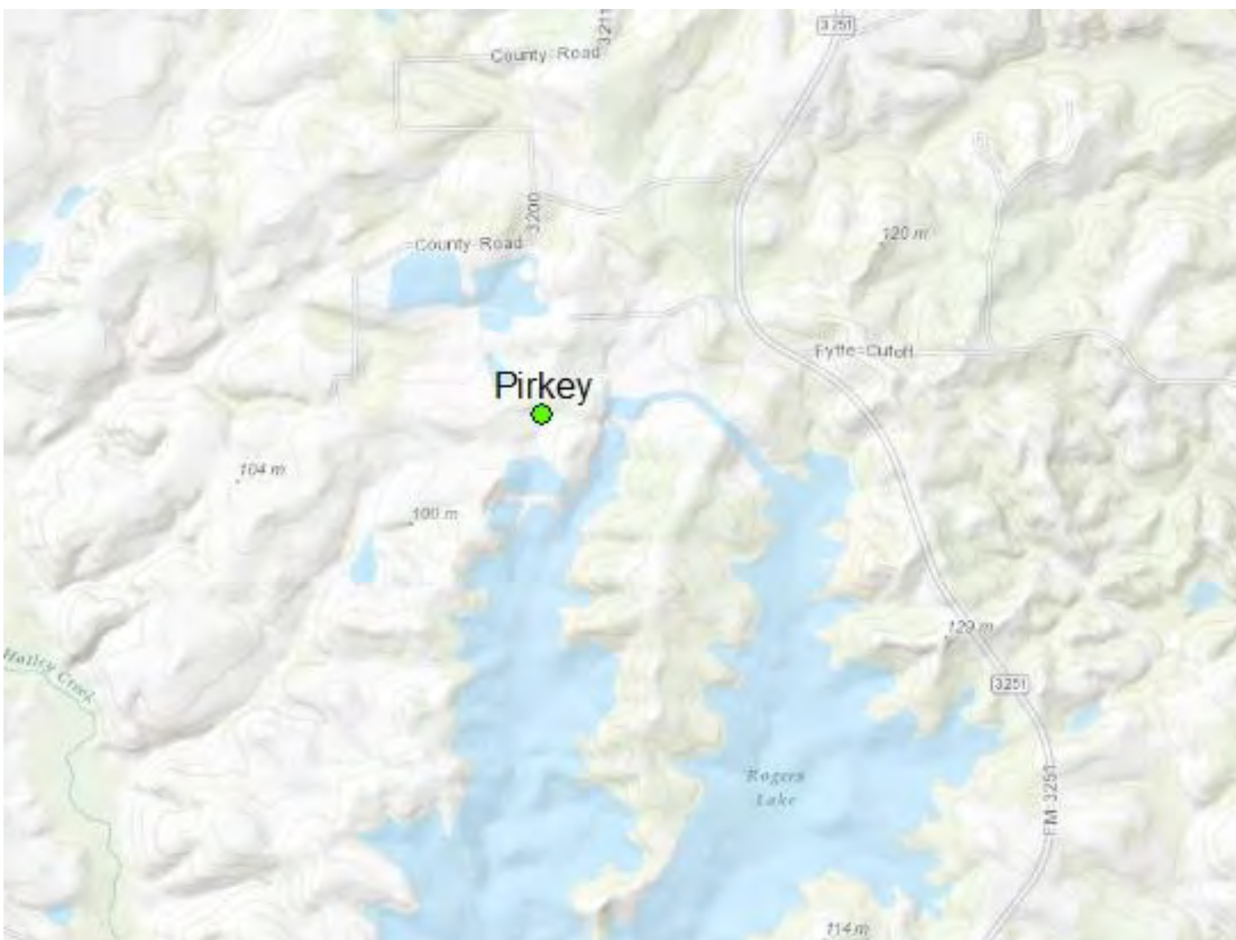


Figure 1: Pirkey Area Elevation Map

Figure 2: Pirkey Sulfur Dioxide Stacks and Emissions, 2013

Meteorological Data

Figure 3 provides illustrations of area annual average wind speed and direction for 2012, 2013, and 2014 from meteorological sensors at the Harrison County Airport in Marshall, Texas, located 18 km northeast of Pirkey. Figure 4 illustrates the 2012-2014 annual average speed. The length of each wind rose bar corresponds to the frequency of the wind coming from the indicated direction by percentage. Based on analysis of the 2012-2014 wind data, the dominant wind flow direction is 135 degrees southeast to 215 degrees south-southwest, approximately 29% of the average area wind flows. Over this three year period, calm winds (0-2 miles per hour) occurred on average 40% of the time and wind speeds averaged 4.3 miles per hour (Iowa Environmental Mesonet 2016).

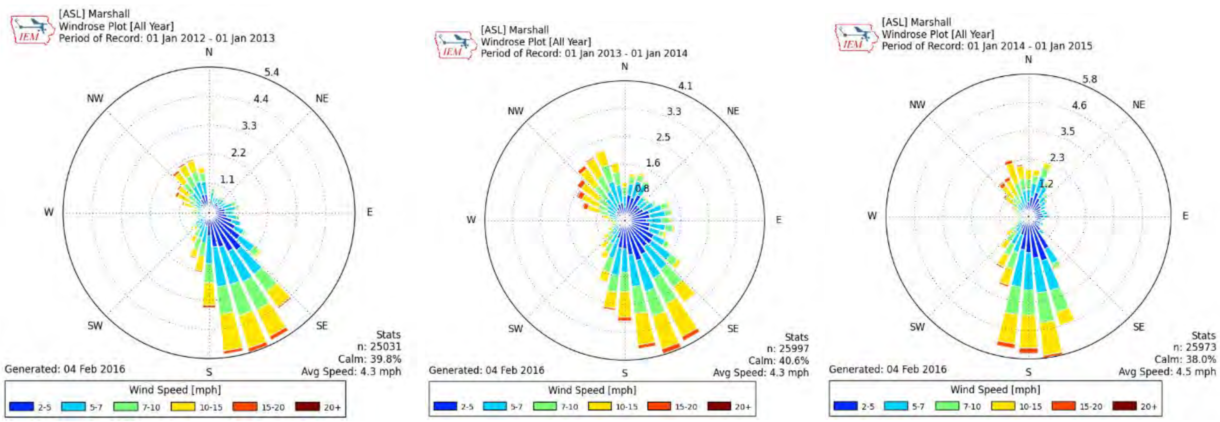


Figure 3: (From left to right) 2012, 2013, and 2014 Individual Wind Rose Plots

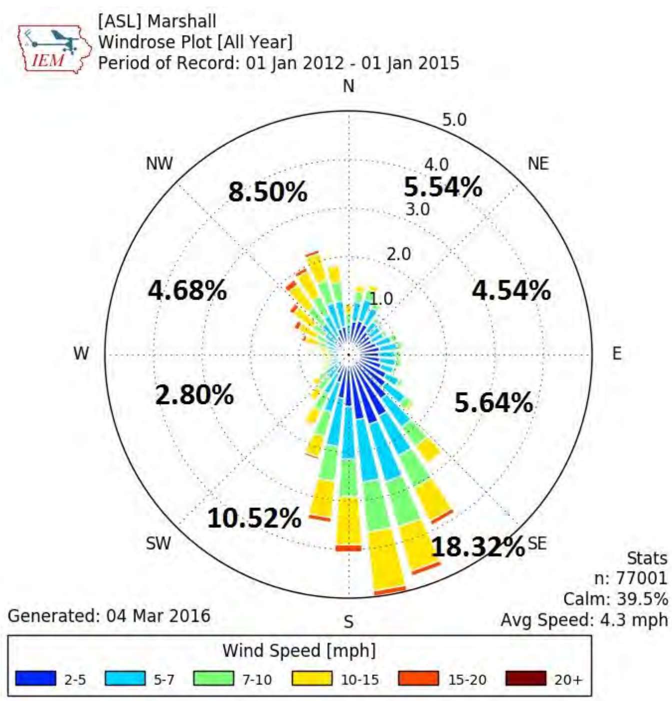


Figure 4: 2012-2014 Combined Average Wind Rose Plot

Modeling Analysis for Monitoring Site Placement

The *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistant Document* (Monitoring TAD) suggests that modeling is one technique that may be used to assist in identifying potential monitoring sites. The TCEQ's modeling for monitor placement used the Comprehensive Air Model with Extensions (CAMx) with model options set as equivalent as possible to American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The setup includes the following parameterizations:

- CAMx 6.20 with speed ups and Plume-in-Grid (PiG) fix, without chemistry and without half-life decay;
- 500-meter PiG sampling grid centered on the source spatially covering 72 km by 72 km;
- the kiln stack was modeled and tracked as an individual PiG puff;
- full year of 2012 12 km gridded Weather Research and Forecasting Model (WRF) meteorology interpolated to 4 km;
- 2014 hourly point source electric generating unit (EGU) emissions; and
- 2014 annual point source non-EGU emissions from State of Texas Air Reporting System (STARS) processed down to hourly emissions.

All model outputs were normalized relative to the predicted off-property maximum concentration, and therefore do not represent absolute predicted results comparable to the NAAQS. The results were then analyzed using three metrics: normalized 99^{th} percentile concentration, normalized frequency, and a composite using both the 99^{th} percentile and frequency metrics. The primary areas targeted for monitor placement included consideration of all three model output metrics, along with the meteorological data presented in Figures 3 and 4.

From the model outputs, normalized 99^{th} percentile concentrations were calculated by dividing the 99^{th} percentile daily maximum concentration for each grid cell within the modeling domain by the predicted off-property maximum concentration for the domain. The calculated results thus represent a percentage of the predicted concentrations for each grid cell to the off-property maximum. Figure 5 graphically presents the results for the normalized 99^{th} percentile concentration metric analysis with the location of the predicted off-property maximum indicated by a + symbol. Pirkey's permitted property is outlined in black. Based on this analysis, the highest normalized concentrations, greater than 85% of the predicted off-property maximum, are expected approximately 18 km to the far north and northwest of Pirkey. The proposed monitor location identified in Figure 5 (site 15) is in an area of 75-80% predicted normalized off-property maximum concentrations.

To evaluate the frequency at which high concentrations may be expected, a normalized frequency metric was developed to represent the number of days the modeled concentration for each grid cell was predicted to be greater than 75% of the off-property maximum concentration. This metric was calculated by dividing the number of days the 99^{th} percentile concentration for each grid cell was greater than 75% of the predicted off-property maximum concentration by the number of days the off-property maximum was predicted to occur. Figure 6 presents the geographic distribution of normalized frequency around the Pirkey facility. Again, the location of the predicted off-property maximum is indicated by a + symbol and Pirkey's permitted property is outlined in black. Using this analysis metric, areas directly to the north and northwest of Pirkey scored greater than 50% and would be expected to see the highest frequency of elevated SO_2 concentrations.

Finally, a composite metric was developed to aid in identifying areas where the predicted highest concentration and predicted highest frequency overlap. The composite metric was calculated at each grid cell by averaging the normalized 99th percentile concentration and normalized frequency metrics. Figure 7 illustrates the geographic distribution of the composite metric analysis results with the location of the predicted off-property maximum with λ symbol and Pirkey's permitted property is outlined in black. The area approximately 6 km to the north of Pirkey scored greater than 70% using the composite metric. Based on the TCEQ's site reconnaissance and outreach to property owners, areas with the highest composite metric score, did not yield a viable location for monitor placement.

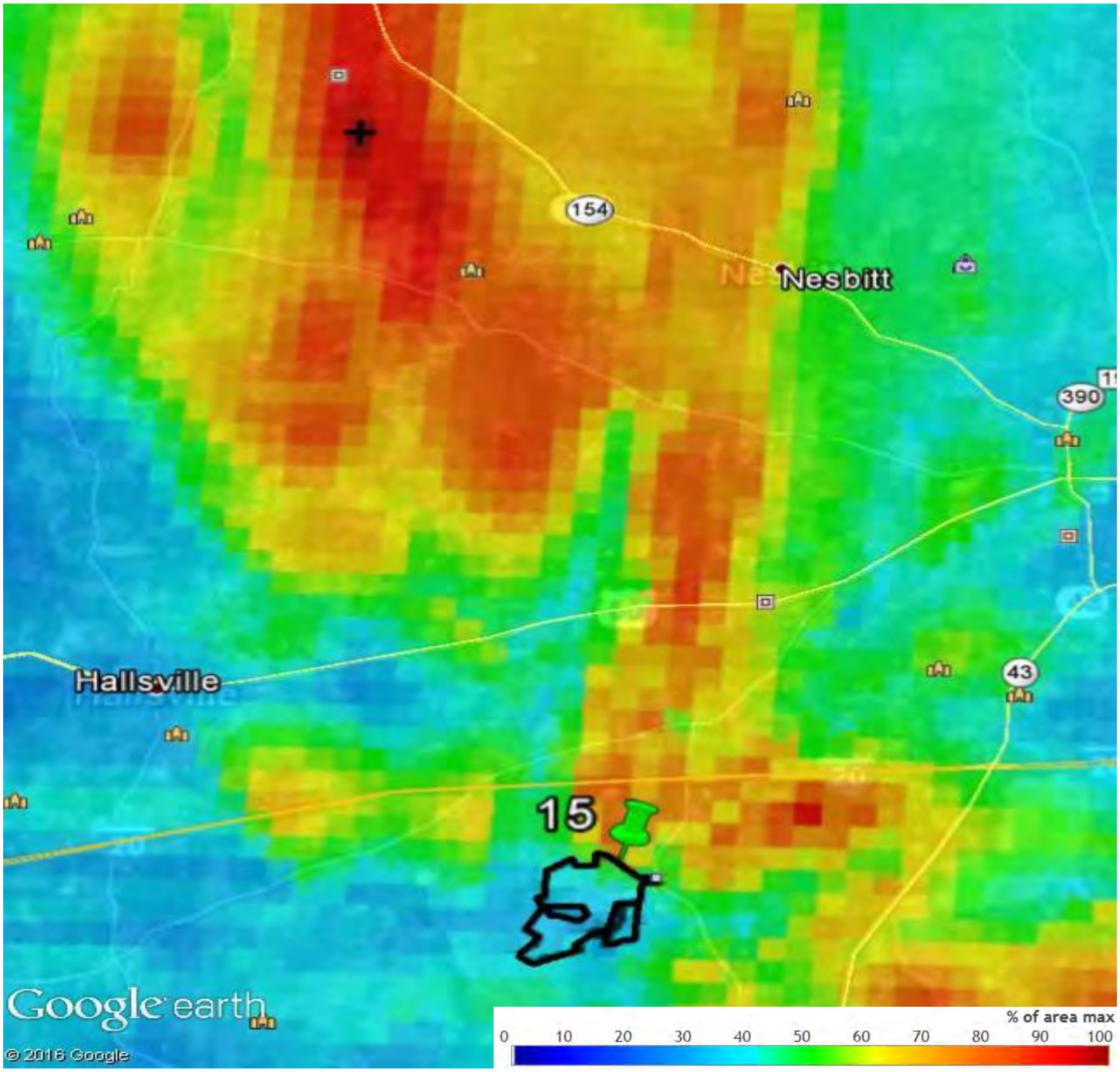


Figure 5: Pirkey Area CAMx Model Predictions Normalized Concentrations, and Viable Site Locations

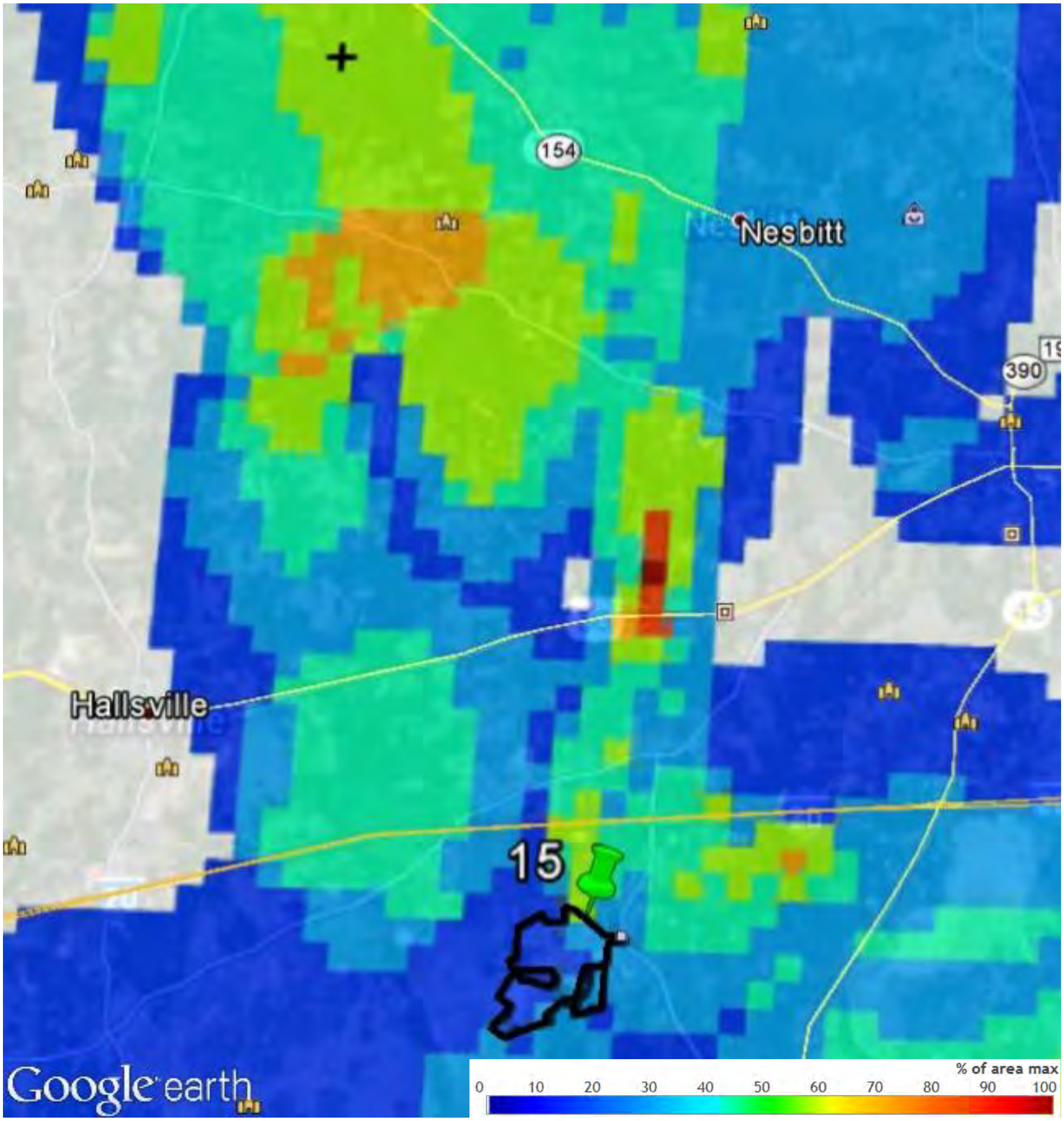


Figure 6: Pirkey Area CAMx Model Predictions, Normalized Frequency (number of days), and Viable Site Locations

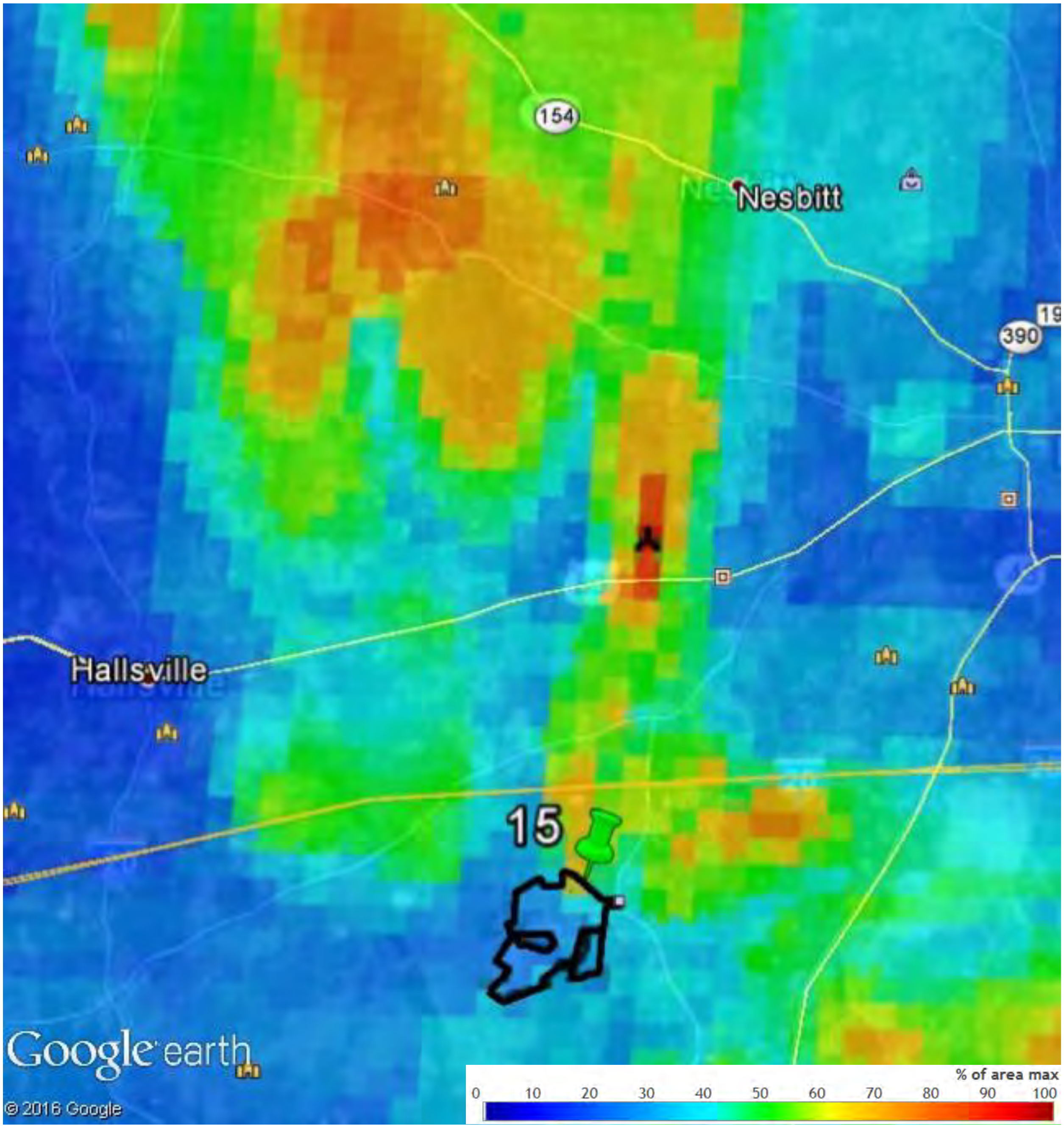


Figure 7: Pirkey Area CAMx Model Predictions Composite Metric and Viable Site Locations

Siting Options and Criteria

The TCEQ does not currently have SO_2 monitors located in the area surrounding Pirkey that would characterize the highest SO_2 concentrations from this facility; therefore a new site is required. The TCEQ focused on complying with the federal requirements listed in Section 40 of the Code of Federal Regulations (CFR) Part 58, Appendix E regarding siting criteria. In addition, the TCEQ evaluated monitoring site locations that would appropriately and sufficiently characterize air qualities in areas around an SO_2 emissions source. This approach includes utilizing multiple techniques and guidance provided in the Monitoring TAD.

The modeling analysis provided in Figures 5, 6, and 7 suggest that maximum SO_2 concentrations are expected to occur north and northwest of Pirkey. In addition, the highest frequency of SO_2 concentrations predicted to be greater than 75% of the off-property maximum is expected north of Pirkey.

Twenty potential sites were identified as shown in Figures 8 and 9. A summary of all potential sites is shown in Table 2. Nineteen of the identified potential sites (sites 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, and 20) are not considered viable and are indicated by red pins in Figures 8 and 9. Property owners at sites 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 16, 17, 18, 19, and 20 either declined or were unresponsive. Site 6, located 2 km from the source, was in an area where obstructions are not a sufficient distance from the location to meet siting criteria. Site 9, located 3.7 km from the source, contained uneven terrain and is prone to flooding. Site 10, located 4 km from the source was in an area with low predicted SO_2 concentrations according to modeling analysis. As a result, these sites are no longer under consideration.

Site 15 is positioned approximately 1.0 km directly north of Pirkey. This site provides level ground, adequate space, and available power. The normalized 99^{th} percentile concentration metric analysis predicted concentrations in this area to be 75-80% of maximum concentrations, therefore the site would be expected to measure peak SO_2 concentrations near the source. A site agreement has been negotiated with the property owner.

Recommendation

Based on current facility operations, available emission data, wind patterns, logistics, and modeling analysis, site 15 (Figures 8, 9, 10, and 11) is the recommended location for placement of a new source-oriented ambient SO_2 monitoring station and is indicated by a green pin in Figures 5, 6, 7, 8, 9, and 11. While the modeling analysis predicts the highest maximum normalized concentrations and the highest composite metric scores to the north and northwest of the source, access to the property in these areas is unattainable. Site 15 is located in an area with predicted maximum normalized SO_2 concentrations of 75–80%, meets all federal siting criteria, and has available power, space, and level ground.

Figure 8: Potential Air Monitoring Sites within 4 km of Pirkey

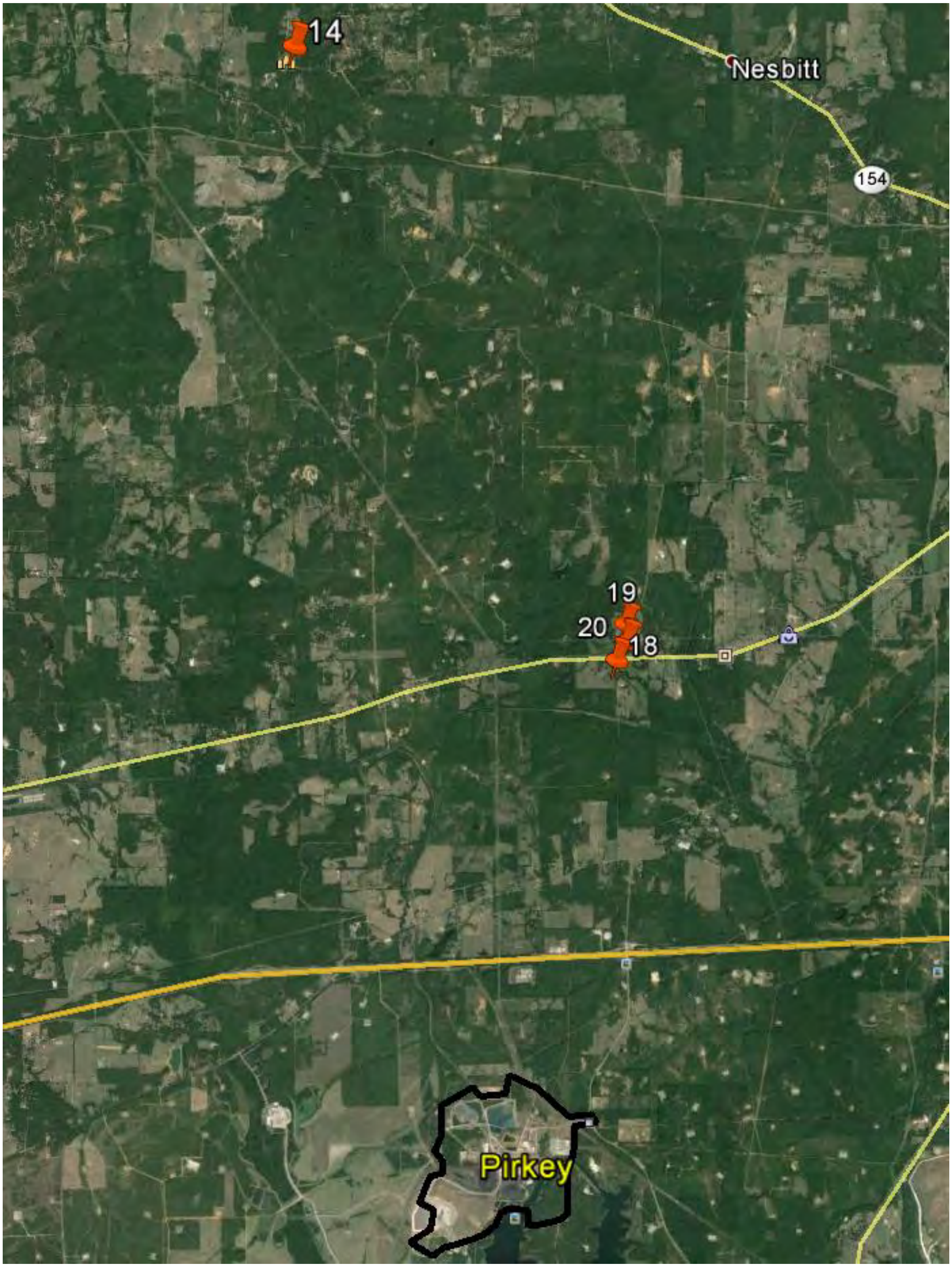


Figure 9: Potential Air Monitoring Sites More Than 4 km from Pirkey

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Table 2: Potential Air Monitoring Site Assessment[1]

Site Number	Pirkey #1	Pirkey #2	Pirkey #3
Location[2]	32.47321, -94.48573	32.47239, -94.48566	32.47129, -94.48298
Distance from SO_2 Source[2]	1298 m	1265 m	1142 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	Yes	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (N)	Yes (N)	Yes (N)
Obstructions and Height	Trees (15 m)	None	None
Distance from Site to Obstructions	Trees (20 m N from dripline)	None	None
Road/Site Access	No	Yes	Yes
Electricity Available <18 m	No	No	Yes
Property Owner	Jerry Michael and Annette McMullen	James Earl Byers	James Earl Byers
Pros	• Level ground • Space available • Downwind	• Level ground • Space available • Downwind	• Level ground • Space available • Power available • Downwind
Cons	• Difficult access • Extra power pole needed • No response from the property owner	• Challenging electrical connection • Property owner declined • Existing flood plain	• Property owner declined
Viable Site (yes, no, or preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Pirkey #4	Pirkey #5	Pirkey #6
Location[2]	32.471914, -94.48293	32.47057, -94.48181	32.48070, -94.48164
Distance from SO_2 Source[2]	1100 m	750 m	2183 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	>2%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (N)	Yes (N)	Yes (N)
Obstructions and Height	Church (18 m)	None	Trees (20 m and 25 m)
Distance from Site to Obstructions	Church (15 m N)	None	Trees (30 m N from dripline) Trees (30 m W from dripline)
Road/Site Access	Yes	No	No
Electricity Available <18 m	Yes	No	No
Pros	• Level ground • Close to the source • Power available • Downwind	• Close to the source • Downwind • Level ground	• Downwind • Space available
Cons	• Unresponsive property owner	• Property owner declined • No power	• No power • Difficult access • Slight grade in surrounding areas • Numerous obstructions
Viable Site (yes, no, or preferred)	No	No	No

Site Number	Pirkey #7	Pirkey #8	Pirkey #9
Location[2]	32.48517, -94.48203	32.48433, -94.50815	32.49364, -94.48735
Distance from SO_2 Source[2]	2557 m	3383 m	3700 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	>1%
Flood Plains	No	No	Yes
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (N)	Yes (NW)	Yes (NW)
Obstructions and Height	Trees (25 m) Building (20 m)	Trees (25 m)	Trees (15 m)
Distance from Site to Obstructions	Trees (20 m N from dripline) Building (35 m S)	Trees (30 m N from dripline Trees (30 m S from dripline)	Trees (20 m E from dripline) Trees (20 m W from dripline)
Road/Site Access	Yes	Yes	No
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Space available • Level ground • Close to source • Downwind	• Level ground • Space available • Power available • Downwind	• Space available • Power available • Downwind
Cons	• Property owner declined	• Unresponsive property owner • Low SO_2 concentrations according to modeling analysis	• Slight grade in surrounding areas • Existing flood plains • Difficult to access
Viable Site (yes, no, or preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	**Pirkey #10**	**Pirkey #11**	**Pirkey #12**
Location[2]	32.49396, -94.50600	32.48805, -94.50419	32.47840, -94.48701
Distance from SO_2 Source[2]	4200 m	3537 m	1934 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	Yes (N)
Obstructions and Height	Trees (20 m)	Trees (20-30 m)	None
Distance from Site to Obstructions	Trees (40 m N from dripline)	Trees (30 m E from dripline) Trees (30 m S from dripline)	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	No	Yes
Pros	• Level ground • Space available • Power available • Downwind	• Level ground • Downwind	• Level ground • Space available • Power available • Downwind
Cons	• Low concentration of SO_2 according to modeling analysis	• No power • Property owner declined	• Close proximity to power lines and other utility markers
Viable Site (yes, no, or preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Pirkey #13	Pirkey #14	Pirkey #15
Location[2]	32.48689, -94.47846	32.61527, -94.54527	32.47045, -94.48152
Distance from SO_2 Source[2]	2850 m	15150 m	1000 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (NE)	Yes (NW)	Yes (N)
Obstructions and Height	None	None	None
Distance from Site to Obstructions	None	None	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	No	Yes
Pros	• Level ground • Space available • Power available • Easy access to site • Downwind	• Maximum off-property concentration of SO_2 emissions according to CAMx modeling Downwind • Level ground	• Level ground • Agreeable property owner • Easy access to site • High concentration and frequency according to modeling analysis • Power available • Downwind
Cons	• Property owner declined	• Unresponsive property owner • No power	• None
Viable Site (yes, no, or preferred)	No	No	Preferred

Site Number	Pirkey #16	Pirkey #17	Pirkey #18
Location[2]	32.46728, -94.48268	32.48793, -94.48365	32.51969, -94.47123
Distance from SO_2 Source[2]	650 m	2940 m	6770 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (N)	Yes (N)	Yes (NE)
Obstructions and Height	Trees (20 m)	None	None
Distance from Site to Obstructions	Trees (55 m N from dripline)	None	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	No	No
Pros	• Level ground • Space available • Power available • Easy access to site • Downwind	• High SO_2 concentrations and frequency according to modeling analysis • Downwind • Level ground	• High SO_2 concentrations and frequency according to modeling analysis • Level ground • Downwind
Cons	• Property owner declined	• Unresponsive property owner • No power	• Unresponsive property owner • No power
Viable Site (yes, no, or preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Pirkey #19	Pirkey #20
Location[2]	32.52403, -94.47001	32.52193, -94.46981
Distance from SO_2 Source[2]	7220 m	7050 m
Wind Direction	S, SE	S, SE
Grade	>1%	>1%
Flood Plains	No	No
Mountain/Valley Winds	None	None
Water Body Nearby[2]	No	No
Wind Channeling	None	None
Downwind[2]	Yes (NE)	Yes (NE)
Obstructions and Height	None	None
Distance from Site to Obstructions	None	None
Road/Site Access	Yes	Yes
Electricity Available <18 m	No	No
Pros	• High SO_2 concentrations and frequency according to modeling analysis • Level ground • Downwind	• High SO_2 concentrations and frequency according to modeling analysis • Level ground • Downwind
Cons	• Unresponsive property owner • No power	• Unresponsive property owner • No power
Viable Site (yes, no, or preferred)	No	No

[1]Based on 40 Code of Federal Regulations Part 58 and *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document*
[2]Based on Google Earth
% – percent
N – north
E – east
W – west
S - south
NE – northeast
NW – northwest
SE – southeast
SW – southwest
m – meter
– number
< – less than
> - greater than
SO_2 – sulfur dioxide

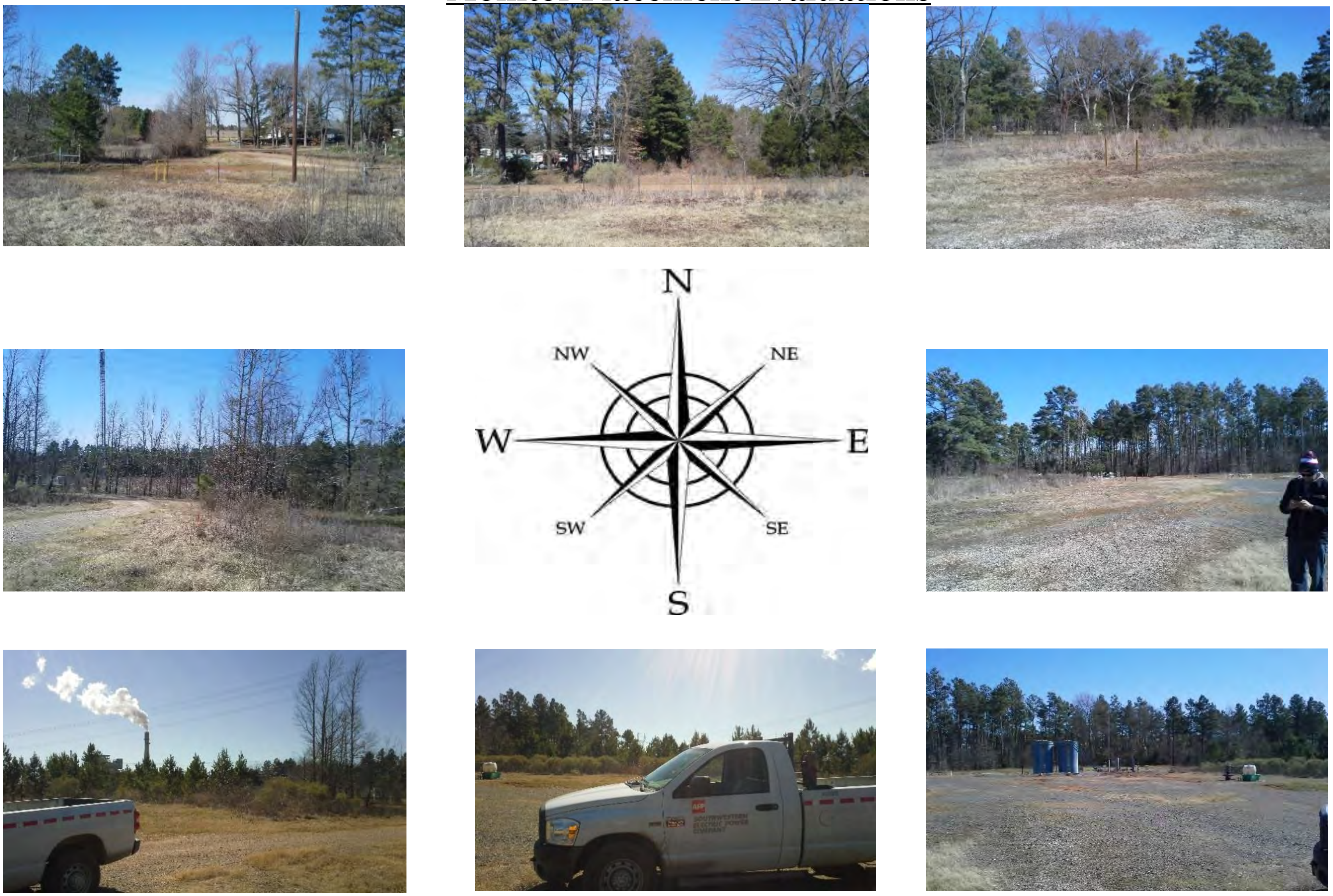


Figure 10: Pirkey #15 Preferred Site Cardinal Direction Photos

Figure 11: Pirkey #15 Preferred Air Monitoring Site

References

Griffith, G. E., S. A. Bryce, J. M. Omernik, J. A. Comstock, A. C. Rogers, B. Harrison, S. L. Hatch, and D. Bezanson. *Ecoregions of Texas*. (2 sided color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia: U.S. Geological Survey, 2004. Scale 1:2,500,000.

"IEM : Site Locator." Iowa Environmental Mesonet. 2016. Accessed April 06, 2016. https://mesonet.agron.iastate.edu/sites/locate.php?network=TX_ASOS.

Welsh Power Plant Monitor Placement Evaluation

Source Information

- Name: Welsh Power Plant (Welsh) (Figure 2)
- Owner: Southwestern Electric Power Company
- Facility function: electric generation
- Location: 33.05500, -94.83944, Texas Commission on Environmental Quality (TCEQ) Region 5, Titus County, Texas
- Sulfur dioxide (SO_2) emissions data: 19,720 tons (2013), 18,225 tons (2014)
- Long-term emissions trend: decreasing, 47 percent (%) decrease from 2004 to 2014
- Emission profile: operational year-round
- Stack heights: stacks 1, 2, and 3, each 92 meters (m), were decommissioned in late 2015; new 159 m stack was installed in 2015
- SO_2 emission controls: none
- Permit related data: Prevention of Significant Deterioration permit

Existing Air Monitoring Sites

The TCEQ operates four ambient air monitoring sites within a 100 kilometer (km) radius of Welsh. Table 1 details the four closest monitoring sites to Welsh in order of proximity. Maximum SO_2 ground level concentrations can be expected within close proximity to the source. Although two of these locations (Longview and Tyler Airport Relocated) are currently monitoring SO_2, none of the existing sites are positioned downwind or within reasonable proximity to the source to characterize maximum SO_2 concentrations.

Table 1: Air Monitoring Sites near Welsh

Site	Location	Current Sulfur Dioxide (SO_2) Monitoring	SO_2 Design Value (2013–2015)
Texarkana	71 kilometers northeast	No	Not applicable
Longview	76 kilometers south	Yes	46 parts per billion
Karnack	77 kilometers southeast	No	Not applicable
Tyler Airport Relocated*	95 kilometers southwest	Yes	Not applicable

*Tyler Airport Relocated operates a non-regulatory, seasonal SO_2 monitor.

Settings and Surroundings

The rural area surrounding Welsh consists of interior coastal plains with elevations ranging from approximately 100 to 130 m as shown in Figure 1. (Griffith et al. 2004) The terrain is considered part of the Piney Woods ecological area and includes some of the most densely forested regions of Texas. The area contains the Welsh Reservoir water body, surrounded by dense vegetation, and limited power sources. No significant changes to the landscape were noted during the reconnaissance as compared to the Google Earth view in Figure 8. Mountain and valley wind channeling or other terrain related meteorological impacts are not expected in this area.

Monticello Steam Electric Station (Monticello), located approximately 19 km northwest of Welsh, has the potential to influence SO_2 concentrations in the Welsh area under certain meteorological conditions. Monticello's SO_2 emissions were reported as 20,515 tons in 2014. Due to the site's location and the area's predominant southeasterly wind flow, it is anticipated that Monticello could impact SO_2 concentrations around the Welsh area when winds are from the northwest (approximately 8% of the time according to Mount Pleasant Airport wind rose data; Figures 3 and 4).

Figure 1: Welsh Area Elevation Map

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

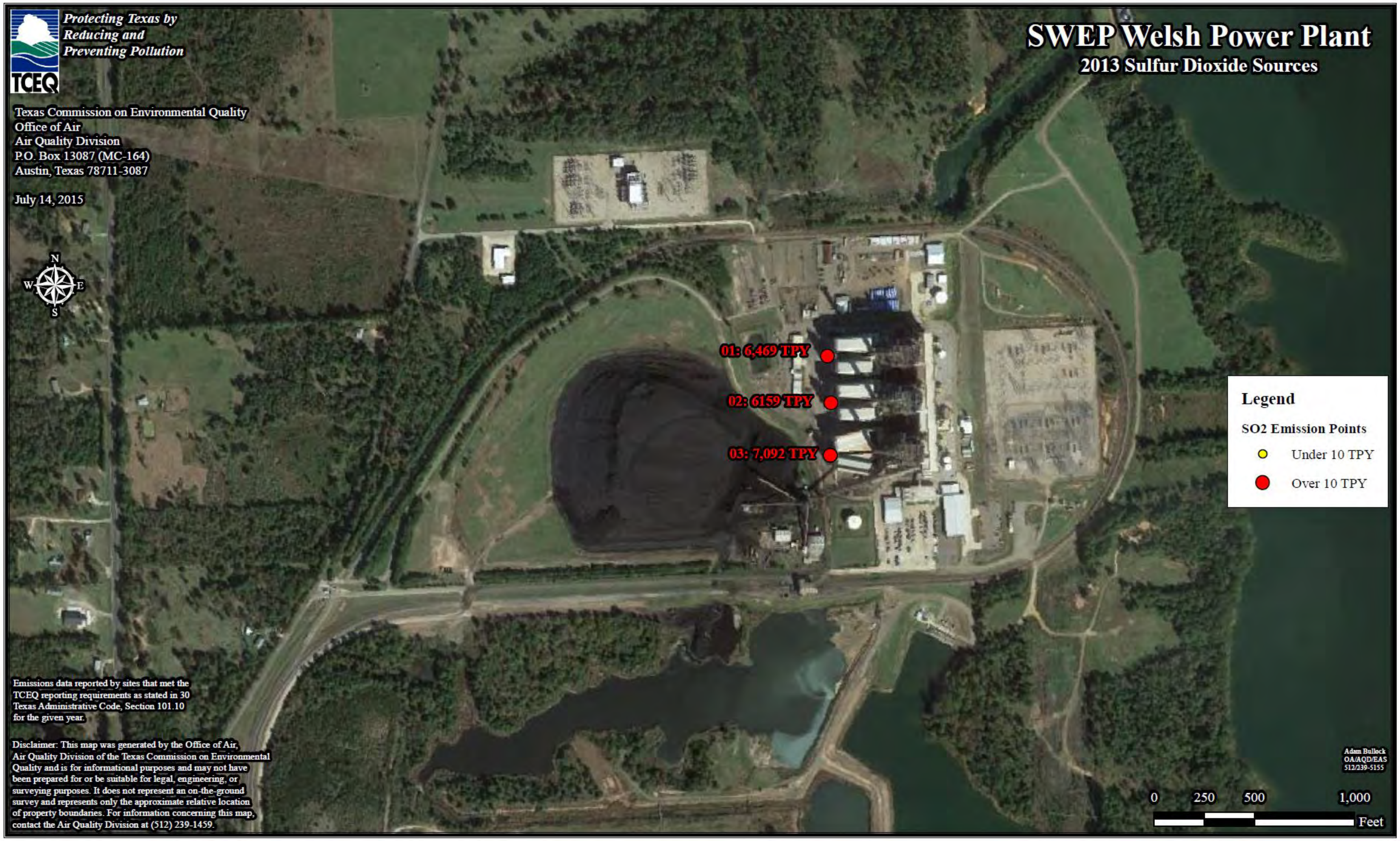


Figure 2: Welsh Power Plant Sulfur Dioxide Stacks and Emissions, 2013

Meteorological Data

Figure 3 provides illustrations of area annual average wind speed and direction for 2012, 2013, and 2014 from meteorological sensors at Mount Pleasant Airport, located 13 km northwest of Welsh. Figure 4 illustrates the 2012-2014 annual average speed. The length of each wind rose bar corresponds to the frequency of the wind coming from the indicated direction by percentage. Based on analysis of the 2012-2014 wind data, the dominant wind flow direction is 110 degrees southeast to 180 degrees south. Approximately 30% of average annual wind flows are from the dominant wind flow direction. Over this three year period, calm winds (0-2 miles per hour) occurred 27% of the time and wind speeds averaged 5.8 miles per hour. (Iowa Environmental Mesonet 2016).

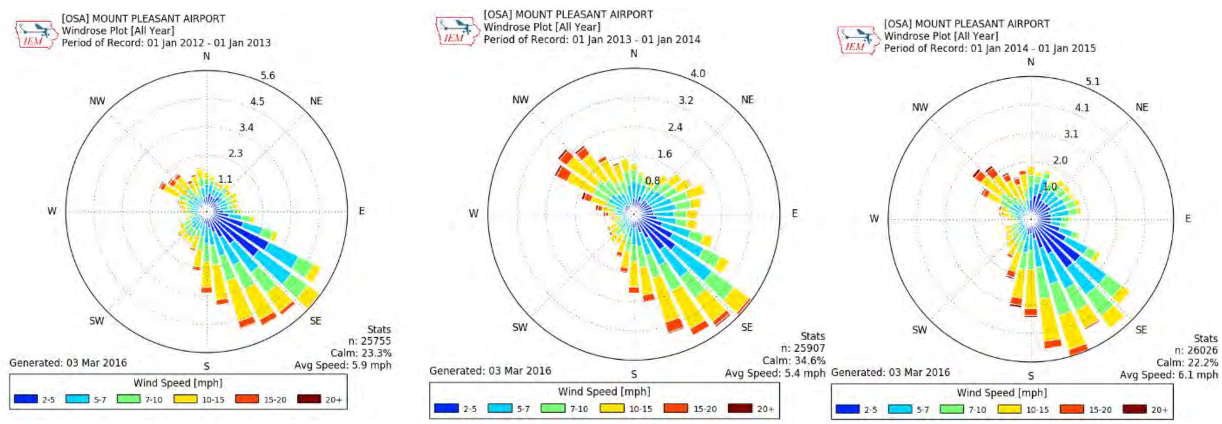


Figure 3: (From left to right) 2012, 2013, and 2014 Individual Wind Rose Plots

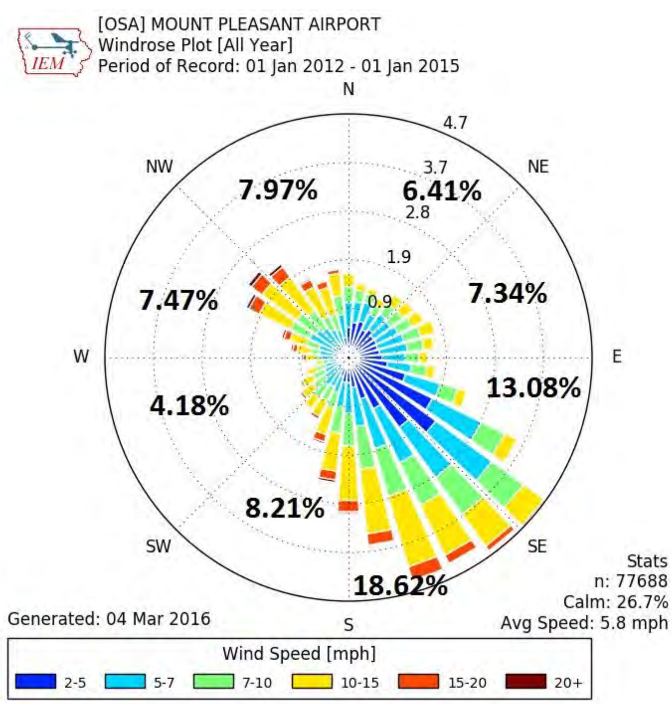


Figure 4: 2012-2014 Combined Average Wind Rose Plot

Modeling Analysis for Monitoring Site Placement

The *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistant Document* (Monitoring TAD) suggests that modeling is one technique that may be used to assist in identifying potential monitoring sites. The TCEQ's modeling for monitor placement used the Comprehensive Air Model with Extensions (CAMx) with model options set as equivalent as possible to American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The setup includes the following parameterizations:

- CAMx 6.20 with speed ups and Plume-in-Grid (PiG) fix, without chemistry and without half-life decay;
- 500-m PiG sampling grid centered on the source spatially covering 72 km by 72 km;
- the four kiln stacks were modeled and tracked as individual PiG puffs;
- full year of 2012 12 km gridded Weather Research and Forecasting Model (WRF) meteorology interpolated to 4 km;
- 2014 hourly point source electric generating unit (EGU) emissions; and
- 2014 annual point source non-EGU emissions from State of Texas Air Reporting System (STARS) processed down to hourly emissions.

All model outputs were normalized relative to the predicted off-property maximum concentration, and therefore do not represent absolute predicted results comparable to the NAAQS. The results were then analyzed using three metrics: normalized 99th percentile concentration, normalized frequency, and a composite using both the 99th percentile and frequency metrics. The primary areas targeted for monitor placement included consideration of all three model output metrics, along with the meteorological data presented in Figures 3 and 4.

From the model outputs, normalized 99th percentile concentrations were calculated by dividing the 99th percentile daily maximum concentration for each grid cell within the modeling domain by the predicted off-property maximum concentration for the domain. The calculated results thus represent a percentage of the predicted concentrations for each grid cell to the off-property maximum. Figure 5 graphically presents the results for the normalized 99th percentile concentration metric analysis with the location of the predicted off-property maximum indicated by a + symbol. Welsh permitted property is outlined in black. Based on this analysis, the highest normalized concentrations, greater than 85% of the predicted off-property maximum, are expected to occur in the area approximately 2 km to the north of Welsh over the Welsh Reservoir water body. The proposed monitor locations identified in Figure 5 (sites 14 and 15) are in areas of 75%-85% predicted normalized off-property maximum concentrations. Site 14 is located 0.75 km northwest of the predicted off-property maximum, while site 15 is located 1.16 km northeast of the predicted off-property maximum.

To evaluate the frequency at which high concentrations may be expected, a normalized frequency metric was developed to represent the number of days the modeled concentration for each grid cell was predicted to be greater than 75% of the off-property maximum concentration. This metric was calculated by dividing the number of days the 99th percentile concentration for each grid cell was greater than 75% of the predicted off-property maximum concentration by the number of days the off-property maximum was predicted to occur. Figure 6 presents the geographic distribution of normalized frequency around Welsh. Again, the location of the predicted off-property maximum is indicated by a + symbol and Welsh's permitted property is outlined in black. Using this analysis metric, areas directly to the north and areas directly northwest of Welsh scored greater than 80% and would be expected to see the highest frequency of elevated SO_2 concentrations. Based on the TCEQ's site reconnaissance and outreach to property owners, areas with the highest normalized frequency score did not yield a viable location for monitor placement.

Finally, a composite metric was developed to aid in identifying areas where the predicted highest concentration and predicted highest frequency overlap. The composite metric was calculated at each grid cell by averaging the normalized 99th percentile concentration and normalized frequency metrics. Figure 7 illustrates the geographic distribution of the composite metric analysis results with the off-property maximum composite metric indicated with λ, and Welsh's permitted property is outlined in black. As with the normalized 99th percentile and normalized frequency metrics, areas approximately 2 km north of Welsh scored greater than 80% using the composite metric. Based on the TCEQ's site reconnaissance and outreach to property owners, areas with the highest composite metric score did not yield a viable location for monitor placement.

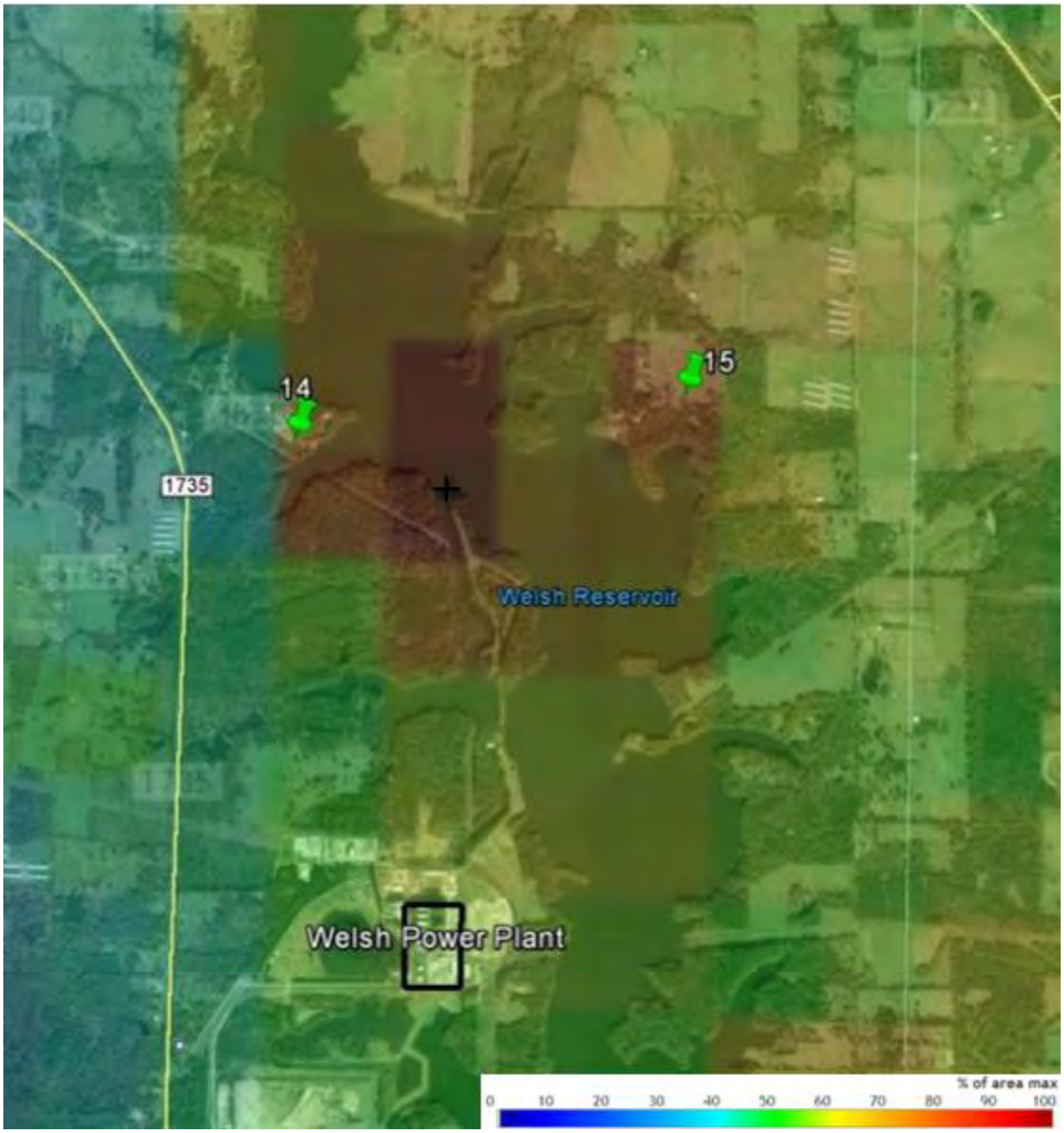


Figure 5: Welsh Area CAMx Model Predictions, Normalized Concentrations, and Viable Site Locations

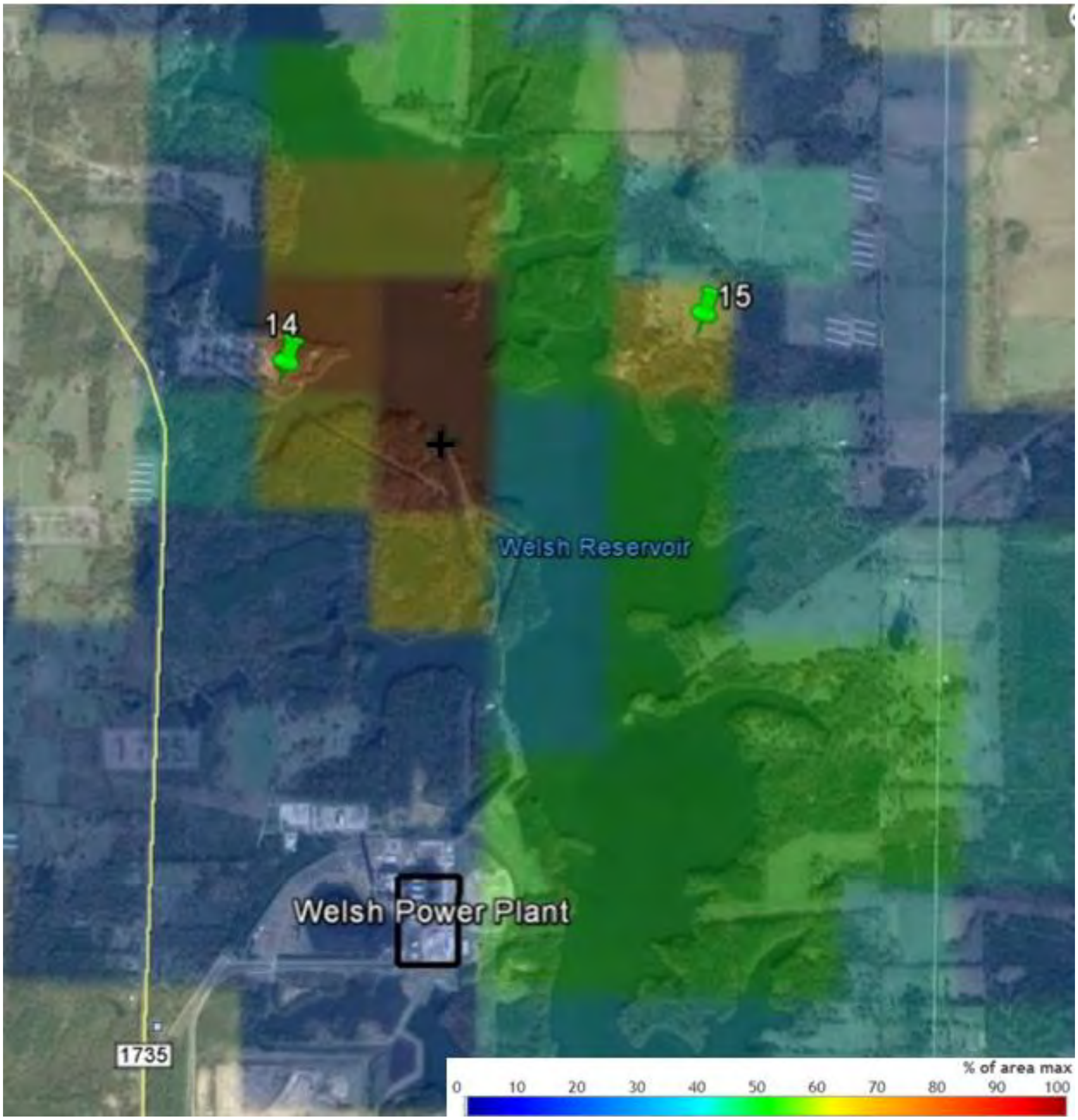


Figure 6: Welsh CAMx Model Predictions, Normalized Frequency, (Number of Days), and Viable Site Locations

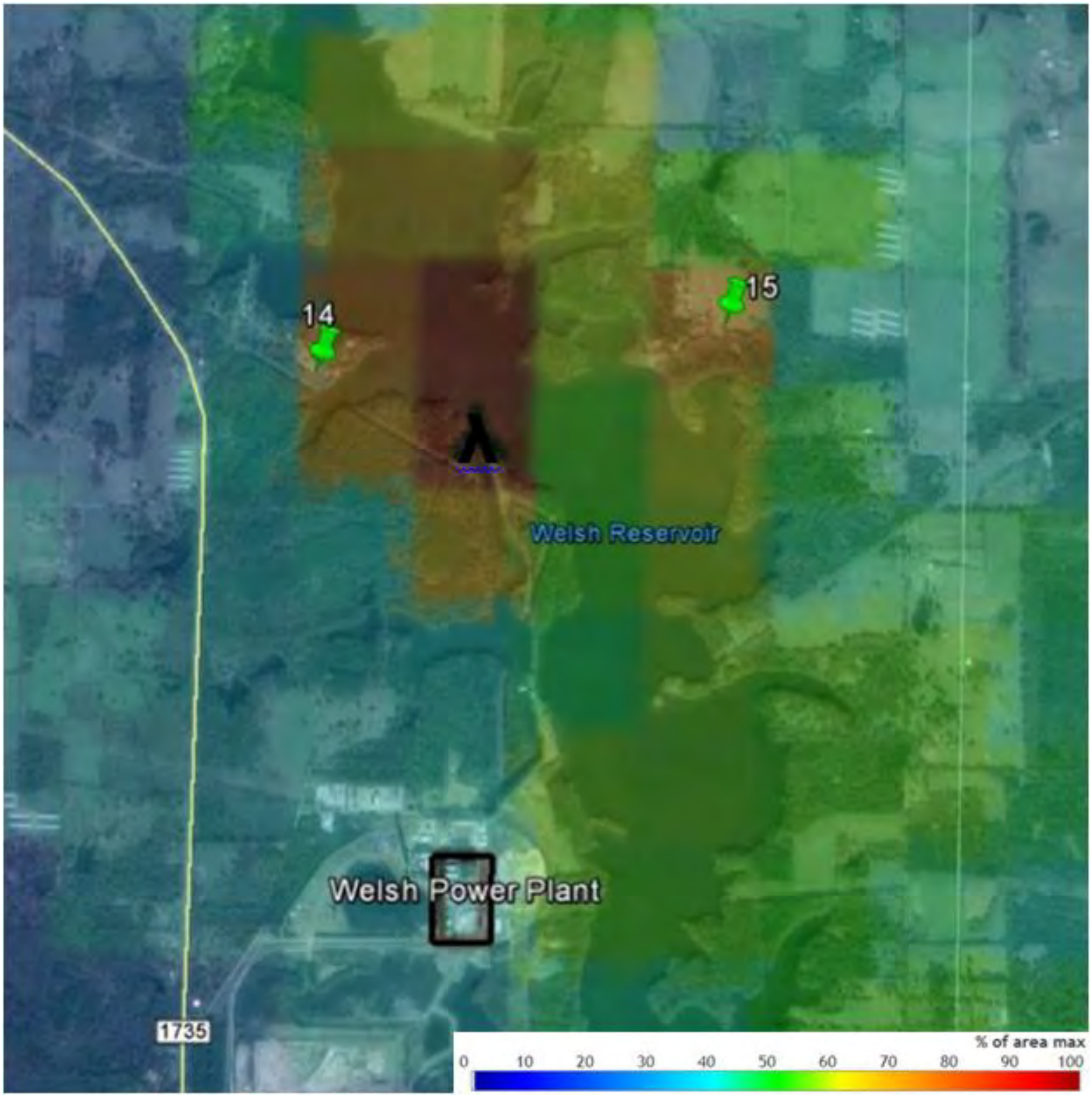


Figure 7: Welsh Area CAMx Model Predictions Composite Metric and Viable Site Locations

Siting Options and Criteria

The TCEQ does not currently have SO_2 monitors located in the area surrounding Welsh that would be expected to characterize the highest SO_2 concentrations from this facility; therefore a new site is proposed. The TCEQ focused on complying with the federal requirements listed in Section 40 of the Code of Federal Regulations (CFR) Part 58, Appendix E regarding siting criteria. In addition, the TCEQ evaluated monitoring site locations that would appropriately and sufficiently characterize air quality in areas around an SO_2 emissions source. This approach includes utilizing multiple techniques and guidance provided in the Monitoring TAD.

The modeling analyses provided in Figures 5, 6, and 7 suggest that maximum SO_2 concentrations are expected to occur north of Welsh. In addition, the highest frequency of SO_2 concentrations predicted to be greater than 75% of the off-property maximum is expected north of Welsh.

Nineteen potential sites were identified as shown in Figure 8. Seventeen of the identified potential sites (1, 2, 3, 3A, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 17, and 18) are not considered viable and are indicated by red pins in Figure 8. Property owners at sites 2, 7, 10, 11, and 12 either declined or were unresponsive. Sites 3A, 13, and 16 had a large number of obstructions or were prone to flooding. Sites 1, 3, 4, 5, 6, 8, 9, 17, and 18 were in areas with low predicted SO_2 concentrations according to modeling analysis. The property north of site 2 and south of site 14 exhibited logistical hindrances including heavy vegetation common in the Piney Woods, a large water body, and a lack of access, and power sources. As a result, these sites and area are not suitable for placement of a monitor.

The two sites with satisfactory logistical and siting characteristics, located in areas anticipated to have peak concentrations, are sites 14 and 15. These site locations are identified on the model and satellite image overlays shown in Figures 5, 6, 7, and 8 indicated with a green pin.

- Site 14 is positioned approximately 2.2 km northwest of Welsh on the west side of the water body. This site is directly downwind of the source, provides level ground, adequate space, and available power, as shown in Figure 9. The normalized 99th percentile concentration metric analysis predicted concentrations in this area to be 75%-80% of the maximum concentrations. An air monitoring site at this location would be expected to monitor peak SO_2 concentrations based on the dominant wind patterns and model analysis predictions. A site agreement has been negotiated with the property owner.
- Site 15 is positioned approximately 2.7 km northeast of Welsh on the east side of the water body. Although it is not directly downwind, this site is on level ground, has space, and power available. The normalized 99th percentile concentration metric analysis predicted concentrations in this area to be 75-80% of the maximum concentrations; therefore, an air monitoring site at this location would be expected to monitor peak SO_2 concentrations. The property owner is amenable to a site agreement.

Recommendation

Based on current facility operations, available emissions data, wind patterns, and modeling analysis, site 14 (see Figures 9 and 10) is the recommended location for placement of a new source oriented ambient SO_2 monitoring station and is shown in Figures 5, 6, 7, 8, and 10. Site 14 is positioned directly downwind, on the same side of the Welsh Reservoir, and is expected to monitor a greater frequency of maximum concentrations than site 15. While the modeling analysis predicts the highest maximum normalized concentration and composite metric scores to the north of the source, a site agreement in this area is not viable due to the terrain and water body. Site 14 is located in an area with predicted maximum normalized SO_2 concentrations of 75%–80%, meets all federal siting criteria, and has available power and level ground.

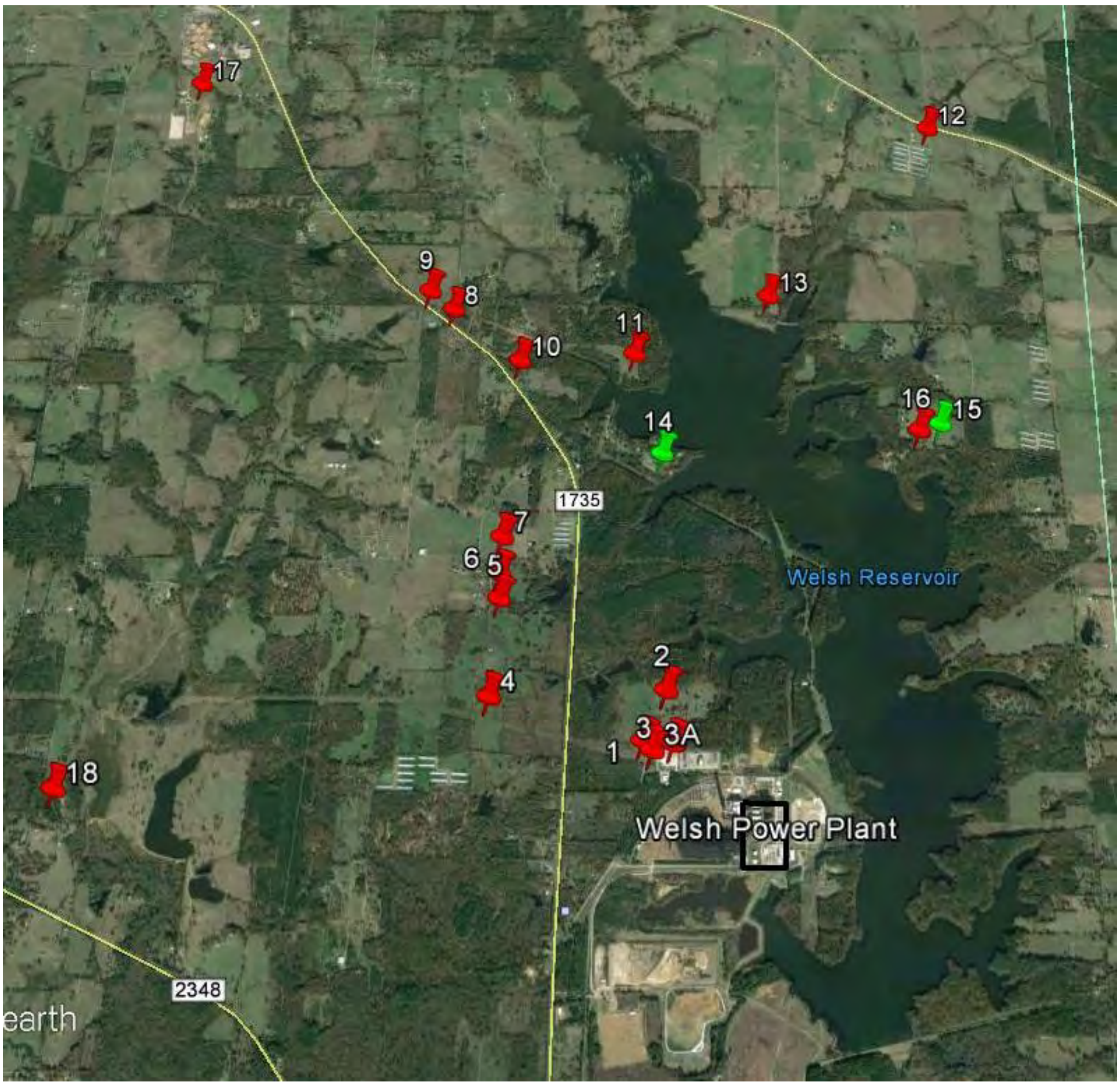


Figure 8: Potential Monitoring Sites for Welsh Power Plant

Table 2: Potential Sites Assessment[1]

Site Number	Welsh #1	Welsh #2	Welsh #3
Location[2]	33.05855, -94.84753	33.06118, -94.84673	33.05818, -94.84609
Distance from SO_2 Source[2]	582 m	909 m	428 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	Yes; reservoir (E)	Yes; reservoir (E)	Yes; reservoir (E)
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	Yes (NW)
Obstructions and Height	Trees (15 m)	Trees (25 m)	Power substation (10 m), trees (20 m)
Distance from Site to Obstructions	Trees (20 m NE)	Trees (52 m E to dripline) Trees (56 m SE to dripline)	Power substation (20 m SE) Trees (10 m N to dripline)
Road/Site Access	Yes	Yes	No
Electricity Available <18 m	No	Yes	Yes
Pros	• Level ground • Space available • Downwind	• Level ground • Downwind • Power available • Space available	• Level ground • Downwind • Close to source • Power available • Space available
Cons	• No power • Too close to facility	• Property owner declined	• Low SO_2 concentrations according to modeling analysis
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Welsh #3A	Welsh #4	Welsh #5
Location[2]	33.05783, -94.84740	33.06071, -94.85780	33.06614, -94.85742
Distance from SO_2 Source[2]	522 m	1,776 m	2,041 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	Yes	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	Yes; reservoir (E)	Yes; reservoir (E)	Yes; reservoir (E)
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	Yes (NW)
Obstructions and Height	Trees (30 m)	None	Trees (10-20 m)
Distance from Site to Obstructions	Trees (20 m N to dripline) Trees (9 m E to dripline) Trees (9 m S to dripline)	None	Trees (55 m NW to dripline) Trees (30 m NE to dripline) Trees (70 m S to dripline)
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	No	Yes
Pros	• Close to source • Downwind • Level ground	• Level ground • Space available • Downwind	• Level ground • Downwind • Space available • Power available
Cons	• Numerous obstructions • Flood prone	• No power • Low SO_2 concentrations according to modeling analysis	• Site access would require extensive engineering due to a high berm • Low SO_2 concentrations according to modeling analysis
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Welsh #6	Welsh #7	Welsh #8
Location[2]	33.06758, -94.85738	33.06974, -94.85744	33.08403, -94.86159
Distance from SO_2 Source[2]	2,150 m	2,300 m	3,806 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	Yes; reservoir (E)	Yes; reservoir (E)	Yes; reservoir (E)
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	Yes (NW)
Obstructions and Height	None	None	Trees (30 m)
Distance from Site to Obstructions	None	None	Trees (20-50 m all directions to dripline)
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	No	Yes	Yes
Pros	• Level ground • Space available • Downwind	• Level ground • Downwind • Space available • Power available	• Level ground • Downwind • Power available
Cons	• No power • Low SO_2 concentrations according to modeling analysis.	• Unresponsive property owner • Low SO_2 concentrations according to modeling analysis	• Numerous obstructions • Low SO_2 concentrations according to modeling analysis
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Welsh #9	Welsh #10	Welsh #11
Location[2]	33.08527, -94.86334	33.08067, -94.85698	33.08142, -94.84899
Distance from SO_2 Source[2]	4,015 m	3,180 m	3,022 m
Wind Direction	S, SE	S, SE	S, SE
Grade	>5%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	Yes; reservoir (E)	Yes; reservoir (E)	Yes; reservoir (E)
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	Yes (NW)
Obstructions and Height	None	Trees (15 m)	Trees (25 m) House (15 m)
Distance from Site to Obstructions	None	Trees (15 m N to dripline) Trees (15 m E to dripline) Trees (15 m W to dripline)	Trees (51 m NW to dripline) House (25 m SW)
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Downwind • Power available	• Level ground • Downwind • Space available • Power available	• Level ground • Downwind • Space available • Power available
Cons	• Unlevel terrain • Low SO_2 concentrations according to modeling analysis	• Numerous obstructions • Unresponsive Property owner	• Unresponsive property owner
Viable Site (Yes, No, or Preferred)	No	No	No

Site Number	Welsh #12	Welsh #13	Welsh #14
Location[2]	33.09678, -94.82739	33.08495, -94.83948	33.07481, -94.84691
Distance from SO_2 Source[2]	4,884 m	3,300 m	2,290 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	>1%	<1%
Flood Plains	No	Yes	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	No	Yes; reservoir (S)	Yes; reservoir (E)
Wind Channeling	None	None	None
Downwind[2]	No (NE)	Yes (N)	Yes (NW)
Obstructions and Height	None	None	Trees (12-14 m)
Distance from Site to Obstructions	None	None	Trees (17 m NW to dripline) Trees (18 m NE to dripline)
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	No	Yes
Pros	• Level ground • Space available • Easy access • Power available	• Easy access • Downwind	• Level ground • Downwind • Power available • Space Available • Agreeable property owner • Located on the same reservoir side as facility
Cons	• Not downwind • Property owner declined	• No Power • Difficult access • Flood prone • Slight grade in surrounding area	• None
Viable Site (Yes, No, or Preferred)	No	No	Preferred

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Welsh #15	Welsh #16	Welsh #17
Location[2]	33.07664, -94.82795	33.07626, -94.82940	33.10694, -94.89578
Distance from SO_2 Source[2]	2,600 m	2,450 m	6,380 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Nearby[2]	Yes; reservoir (W)	Yes; reservoir (W)	No
Wind Channeling	None	None	None
Downwind[2]	No (NE)	No (NE)	Yes (NW)
Obstructions and Height	None	Trees (14 m)	None
Distance from Site to Obstructions	None	Trees (23 m NE to dripline) Trees (24 m NW to dripline) Trees (26 m S to dripline)	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	No	Yes
Pros	• Space available • Power available • High concentration and frequency according to modeling analysis • Level ground	• Power available • Level ground	• Agreeable property owner • Space available • Downwind • Level ground • Power available
Cons	• Not downwind • Located on the west reservoir side	• Numerous obstructions • Not downwind	• Low SO_2 concentrations according to modeling analysis
Viable Site (Yes, No, or Preferred)	Yes	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	**Welsh #18**
Location[2]	33.05584, -94.88454
Distance from SO_2 Source[2]	4,130 m
Wind Direction	S, SE
Grade	<1%
Flood Plains	No
Mountain/Valley Winds	None
Water Body Nearby[2]	No
Wind Channeling	None
Downwind[2]	No (W)
Obstructions and Height	Trees (15 m)
Distance from Site to Obstructions	Trees (25 m SW to dripline) Trees (30 m NE to dripline) Trees (25 m S to dripline)
Road/Site Access	Yes
Electricity Available <18 m	Yes
Pros	• Level ground
Cons	• Not downwind • No power
Viable Site (Yes, No, or Preferred)	No

[1]Based on guidance from March 1, 2011, memorandum from Tyler Fox, EPA Office of Air Quality Planning and Standards, "Additional Clarification Regarding the Application of Appendix W Modeling Guidance for the 1-hr NAAQS." Research Triangle Park, North Carolina 27711.
[2]Based on Google Earth
E – east
m – meter
N – north
NE – northeast
NW – northwest
S – south
SE – southeast
SO_2 – sulfer dioxide
SW – southwest
W – west
> – greater than
< – less than
– number
% – percent

Figure 9: Welsh #14 Potential Site Cardinal Direction Photos

Figure 10: Welsh #14 Preferred Air Monitoring Site

References

Griffith, G. E., S. A. Bryce, J. M. Omernik, J. A. Comstock, A. C. Rogers, B. Harrison, S. L. Hatch, and D. Bezanson. *Ecoregions of Texas*. (2 sided color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia: U.S. Geological Survey, 2004. Scale 1:2,500,000.

"IEM : Site Locator." Iowa Environmental Mesonet. 2016. Accessed April 06, 2016. https://mesonet.agron.iastate.edu/sites/locate.php?network=TX_ASOS.

Sandow Monitor Placement Evaluation

Source Information

Two separately permitted facilities with sulfur dioxide (SO_2) emissions greater than 2,000 tons per year are located on contiguous property in Milam County, Texas. The facilities are officially referred to as the Sandow 5 Generating Plant and the Sandow Steam Electric Station and are approximately 250 meters (m) apart from each other (Figure 1). All subsequent discussions reference the two sources collectively as "Sandow."

Source 1

- Name: Sandow 5 Generating Plant (Figure 2)
- Owner: Luminant Generation Company, LLC
- Facility function: electric generation
- Location: 30.56725, -97.06101, Texas Commission on Environmental Quality (TCEQ) Region 9, Milam County, Texas
- SO_2 emissions data: 2,406 tons (2013), 2,260 tons (2014)
- Long-term emissions trend: increasing, 51 percent (%) increase from 2010 to 2014
- Emission profile: operational year-round
- Stack height(s): two stacks 102 m high, currently active
- SO_2 emission controls: miscellaneous methods of control reduce SO_2 emissions by 95% on two limestone injection boilers, polishing scrubbers also reduce SO_2 emissions by 3% on a circulating fluidized bed boiler
- Permit related data: Federal Operating Permit

Source 2

- Name: Sandow Steam Electric Station (Figure 3)
- Owner: Luminant Generation Company, LLC
- Facility function: electric generation
- Location: 30.56603, -97.06331, TCEQ Region 9, Milam County, Texas
- SO_2 emissions data: 19,761 tons (2013), 21,943 tons (2014)
- Long-term emissions trend: increasing, 34% increase from 2010 to 2014
- Emission profile: operational year-round
- Stack height: one stack 121 m high, currently active
- SO_2 emission controls: limestone wet-scrubbing, reduces SO_2 emissions by 76.6% on main boiler stack
- Permit related data: Federal Operating Permit

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Existing Air Monitoring Sites

There are four existing air monitoring stations within a 75 kilometer (km) radius of Sandow. Two ambient air monitoring sites are operated by TCEQ (Austin Northwest and Austin Webberville Road) and two are operated by Capital Area Council of Governments (CAPCOG). Table 1 details the four closest monitoring sites in order of proximity. Maximum SO_2 ground level concentrations can be expected within close proximity to the source. Although one of these locations is currently monitoring SO_2, none of the existing sites are positioned downwind or within reasonable proximity to the source to characterize maximum SO_2 concentrations.

Table 1: Air Monitoring Sites Near Sandow

Site	Distance from Sandow	Current Sulfur Dioxide (SO_2) Monitoring	SO_2 Design Value (2013-2015)
CAPCOG Hutto College Street	46 km west	No	Not applicable
CAPCOG Lake Georgetown	65 km northwest	No	Not applicable
Austin Northwest	70 km southwest	Yes	5 parts per billion
Austin Webberville Road	71 km southwest	No	Not applicable

CAPCOG – Capital Area Council of Governments
km – kilometers

Settings and Surroundings

The primarily rural area surrounding Sandow consists of the blackland prairie, which is characterized by flat to gently rolling hills, grasses, forbs, and croplands (Griffith et al. 2004). The elevation ranges from 150 to 171 meters as shown in Figure 1. No significant changes to the landscape were noted during the reconnaissance as compared to the satellite view shown in Figure 9. Due to a general lack of geographical obstructions and thick elevated vegetation, wind patterns are highly consistent across the Central Texas area. Mountain and valley wind channeling or other terrain related meteorological impacts are not expected in this area.

Figure 1: Sandow Area Elevation Map

Figure 2: Sandow 5 Sulfur Dioxide (SO_2) Stacks and Emissions, 2013

Figure 3: Sandow Steam Electric Station Sulfur Dioxide (SO_2) Stacks and Emissions, 2013

Meteorological Data

Figure 4 provides illustrations of area annual average wind speed and direction for 2012, 2013, and 2014 from meteorological sensors at the Cameron Airport, located 35 km northeast of Sandow. Figure 5 illustrates the 2012-2014 annual average wind speed. The length of each wind rose bar corresponds to the frequency of the wind coming from the indicated direction by percentage. Based on the analysis of the 2012-2014 wind data, the dominant wind flow direction is 150 degrees south-southeast to 215 degrees south-southwest. Approximately 48% of the average area wind flows move from these directions. Over this three year period, calm winds (0-2 miles per hour) occurred on average 16.5% of the time, and wind speeds averaged 7.2 miles per hour (Iowa Environmental Mesonet 2016).

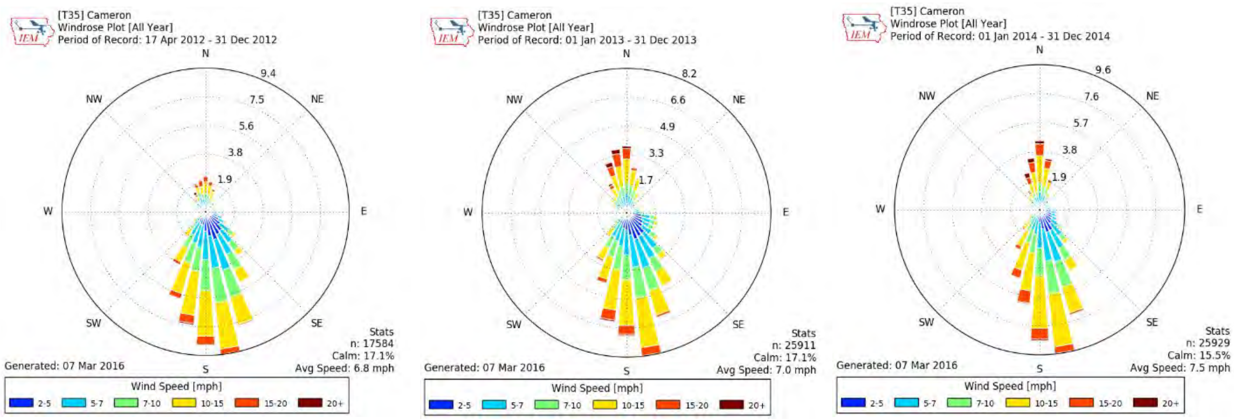


Figure 4: (From left to right) 2012, 2013, and 2014 Individual Wind Rose Plots

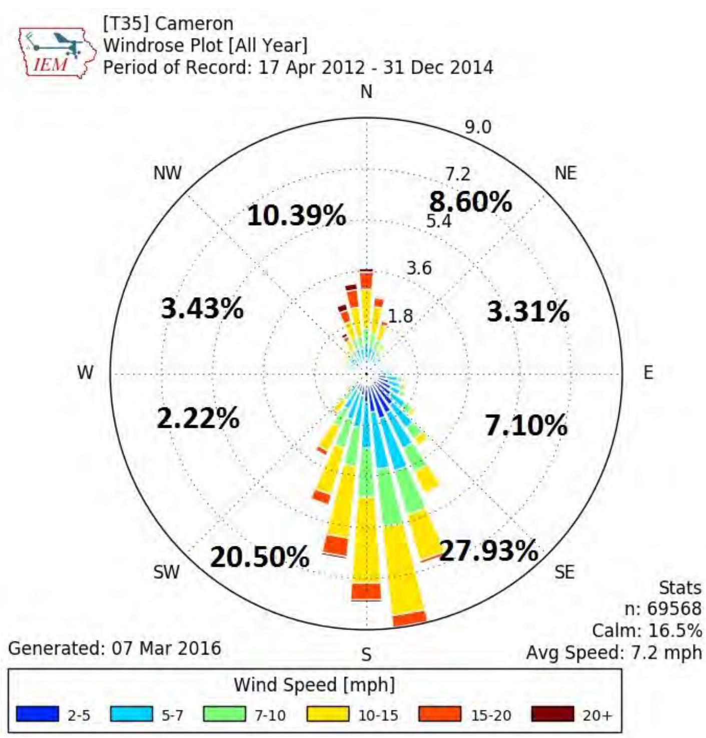


Figure 5: 2012-2014 Combined Average Wind Rose Plot

Modeling Analysis for Monitoring Site Placement

The *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistant Document* (Monitoring TAD) suggests that modeling is one technique that may be used to assist in identifying potential monitoring sites. The TCEQ's modeling for monitor placement used the Comprehensive Air Model with Extensions (CAMx) with model options set as equivalent as possible to American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The setup included the following parameterizations:

- CAMx 6.20 with speed ups and Plume-in-Grid (PiG) fix, without chemistry and without half-life decay;
- 500-meter PiG sampling grid centered on the source spatially covering 72 km by 72 km;
- the three kiln stacks were modeled and tracked as individual PiG puffs;
- full year of 2012 12 km gridded Weather Research and Forecasting Model (WRF) meteorology interpolated to 4 km;
- 2014 hourly point source electric generating unit (EGU) emissions; and
- 2014 annual point source non-EGU emissions from State of Texas Air Reporting System (STARS) processed down to hourly emissions.

All model outputs were normalized relative to the predicted off-property maximum concentration, and therefore do not represent absolute predicted results comparable to the NAAQS. The results were then analyzed using three metrics: normalized 99th percentile concentration, normalized frequency, and a composite using both the 99th percentile and frequency metrics. The primary areas targeted for monitor placement included consideration of all three model output metrics, along with the meteorological data presented in Figures 4 and 5.

From the model outputs, normalized 99th percentile concentrations were calculated by dividing the 99th percentile daily maximum concentration for each grid cell within the modeling domain by the predicted off-property maximum concentration for the domain. The calculated results thus represent a percentage of the predicted concentrations for each grid cell to the off-property maximum. Figure 6 presents the results for the normalized 99th percentile concentration metric analysis with the location of the predicted off-property maximum indicated by a "+" symbol. Sandow's permitted properties are outlined in black. Based on this analysis, the highest normalized concentrations, greater than 95% of the predicted off-property maximum, are expected to occur 2.1 km directly north of the Sandow facilities. This area, however, is not viable for monitor placement. After thorough consideration was given to the area north of Alcoa Lake (outlined in purple in Figure 9), the TCEQ determined that no viable site locations exist in this area due to lack of power and vehicle access (see section "Siting Options and Criteria"). Approximately 2.3 km southwest of the predicted off-property maximum is the proposed monitor location identified in Figure 6 as site 7. This site is in an area of predicted normalized concentrations within 40% to 50% of the off-property maximum.

To evaluate the frequency at which high concentrations may be expected, a normalized frequency metric was developed to represent the number of days the modeled concentration for each grid cell was predicted to be greater than 75% of the off-property maximum concentration. This metric was calculated by dividing the number of days the 99th percentile concentration for each grid cell was greater than 75% of the predicted off-property maximum concentration by the number of days the off-property maximum was predicted to occur. Figure 7 presents the geographic distribution of normalized frequency around the Sandow facilities. Again, the location of the predicted off-property maximum is indicated by a "+" symbol, and Sandow's permitted properties are outlined in black. Using this analysis metric, areas directly to the north of the Sandow facilities scored greater than 95% and would be expected to see the highest frequency of elevated SO_2 concentrations.

Finally, a composite metric was developed to aid in identifying areas where the predicted highest concentration and predicted highest frequency overlap. The composite metric was calculated at each grid cell by averaging the normalized 99th percentile concentration and normalized frequency metrics. Figure 8 illustrates the geographic distribution of the composite metric analysis results with the location of the predicted off-property maximum with a "λ" symbol, and Sandow's permitted properties are outlined in black. Similar to the normalized 99th percentile and normalized frequency metrics, areas directly north of the Sandow facilities scored greater than 95% using the composite metric. Based on the TCEQ's site reconnaissance and outreach to property owners, areas with the highest composite metric score did not yield a viable location for monitor placement.

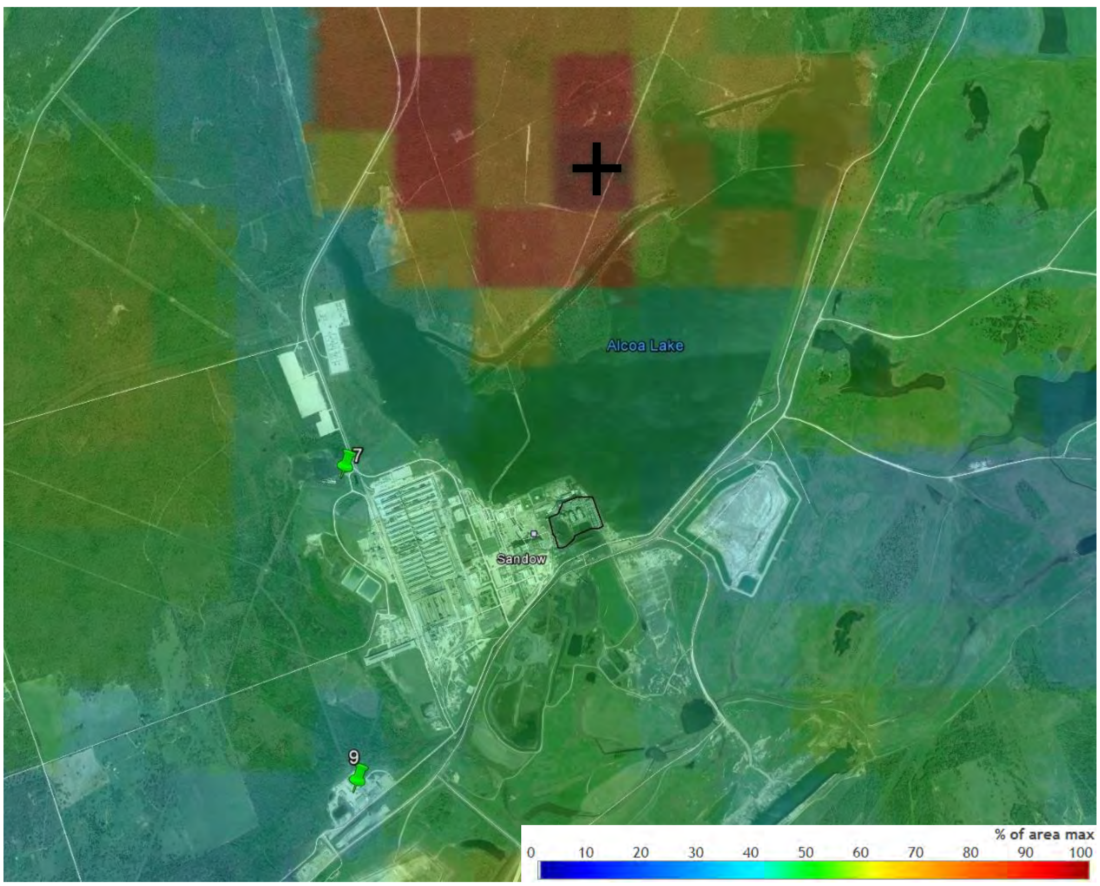


Figure 6: Sandow Area CAMx Model Predictions, Normalized Concentrations, and Viable Site Locations (7, 9)

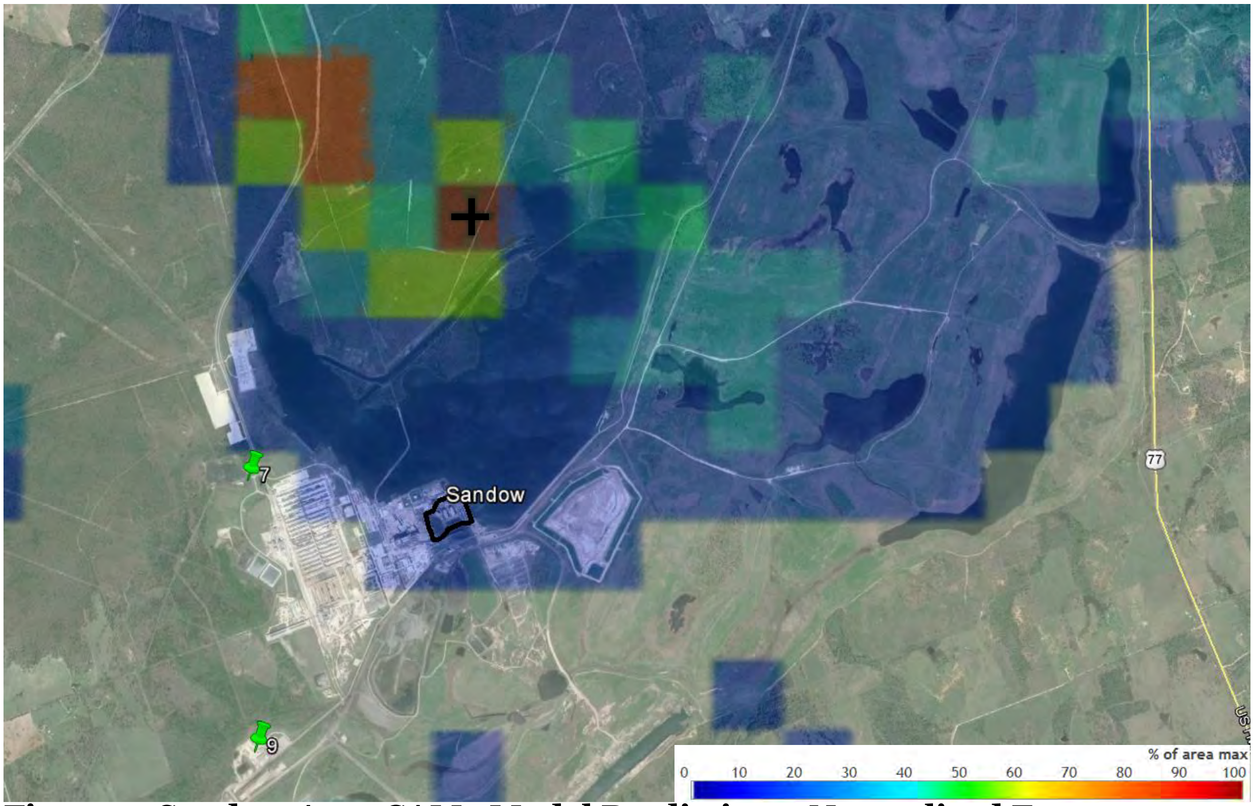


Figure 7: Sandow Area CAMx Model Predictions, Normalized Frequency, (Number of Days), and Viable Site Locations (7, 9)

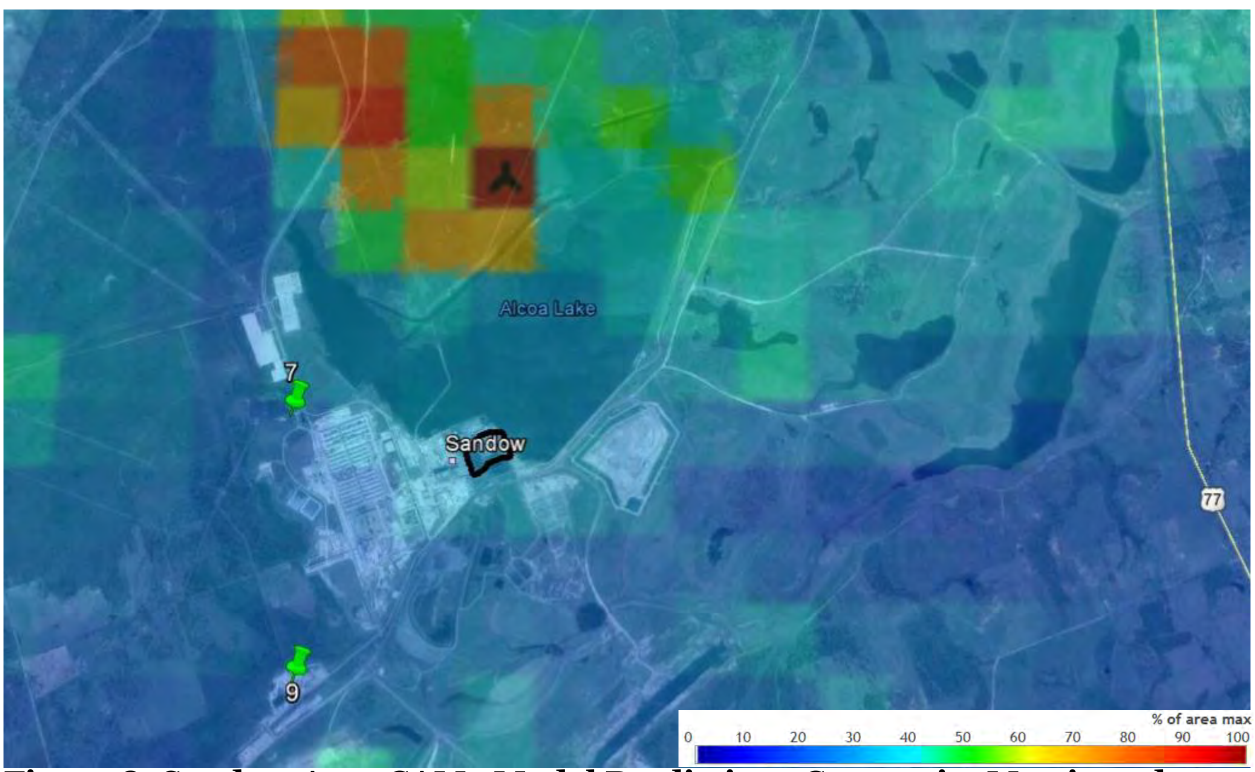


Figure 8: Sandow Area CAMx Model Predictions Composite Metric and Viable Site Locations (7, 9)

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Siting Options and Criteria

The TCEQ does not currently have SO_2 monitors located in the area surrounding Sandow that would be expected to characterize the highest SO_2 concentrations from these facilities; therefore a new site is proposed. The TCEQ focused on complying with the federal requirements listed in 40 Code of Federal Regulations (CFR) Part 58, Appendix E regarding siting criteria. In addition, the TCEQ evaluated monitoring site locations that would appropriately and sufficiently characterize air quality in areas around an SO_2 emissions source. This approach included utilizing multiple techniques and guidance provided in the Monitoring TAD.

The modeling analyses provided in Figures 6, 7, and 8 suggest that maximum SO_2 concentrations are expected to occur north of the Sandow facilities. In addition, the highest frequency of SO_2 concentrations predicted to be greater than 75% of the off-property maximum is expected within or directly north of Sandow. Figure 9 depicts all potential site locations (red and green pins), their corresponding property lines (green), Sandow's permitted property (black), and Alcoa Lake (orange). The area in the figure outlined in blue belongs to a single property owner with the exception of areas outlined in green. The aforementioned wind rose and modeling data resulted in extensive consideration for potential site locations between Alcoa Lake and the northern borders of the blue property outline (outlined in purple). It was determined, however, that necessary electricity and vehicle access infrastructure to support a monitoring site was nonexistent, and the entire area had been pledged for the development of a solar farm. Thus, no further site agreements for land use could be granted. Consequently, ten potential sites were identified northwest, west, and southwest of the facility as shown in Figure 9. Eight of the identified potential sites (1, 2, 3, 4, 5, 6, 8, and 10) are not considered viable and are indicated by red pins. Sites 1 and 4 had many siting obstructions. Site 2 is in an area with restricted access, such as a locked gate to a private road. Property owners at sites 3, 5, and 6 were unwilling to negotiate site agreements or were unresponsive.

The owner of the area outlined in blue provided options for four monitoring sites northwest and southwest of the Sandow facilities; sites 7, 8, 9, and 10. Site 10 has no access to electricity and is prone to flooding. The area surrounding site 8 (outlined in yellow) is under a solar farm lease agreement and is therefore unsuitable for monitor placement. As a result, these potential sites are no longer under consideration.

Sites 7 and 9, indicated with green pins in Figure 9, have satisfactory logistical and siting characteristics. These site locations are also identified on the model and satellite image overlays in Figures 6, 7, and 8.

- Site 7 is positioned 1.4 km west of the Sandow facilities and approximately 2.4 km southwest of the off-property maximum concentration (see Figure 8). The site offers level ground, adequate space, available power, and is close to the source (see Table 2 and section "Recommendation"). The normalized 99th percentile concentration metric analysis predicted area concentrations to be 45% of the maximum concentrations. A site agreement has been negotiated with the property owner.
- Site 9 is positioned 1.9 km southwest of the Sandow facilities and approximately 4 km southwest of the off-property maximum concentration (see Figure 8). The site

provides level ground, adequate space, and available power. The normalized 99th percentile concentration metric analysis predicted concentrations in this area to be 40% of the maximum concentrations. The property owner is amenable to a site agreement.

Recommendation

Based on current facility operations, available emissions data, wind patterns, logistics, and modeling analyses, site 7 (see Figures 10 and 11) is the recommended location for placement of a new source-oriented ambient SO_2 monitoring station. The most influential factors constraining potential site placement for Sandow were logistics (e.g., electricity and property access) and averse property owners. While the modeling analyses predict the highest maximum normalized concentration and composite metric score to be located 2.4 km to the northeast of site 7, a site placement in that area is not logistically feasible (electricity and access). This area was also not offered by the owner due to a preexisting lease agreement with a solar farm.

From the source, sites 7 and 9 are 1.4 km and 1.9 km respectively. In addition, the Sandow area experienced calm winds an average of 16.5% of the time from 2012-2014 (Figure 5). During calm wind conditions the proximity of site 7 would be expected to yield higher SO_2 concentrations than site 9. Site 7 is also the closest viable site to prevailing wind patterns coming from approximately 150 degrees south-southeast of the source. The recommended site has available power, adequate space, level ground, and meets all federal siting criteria. A site agreement has been negotiated with the property owner.

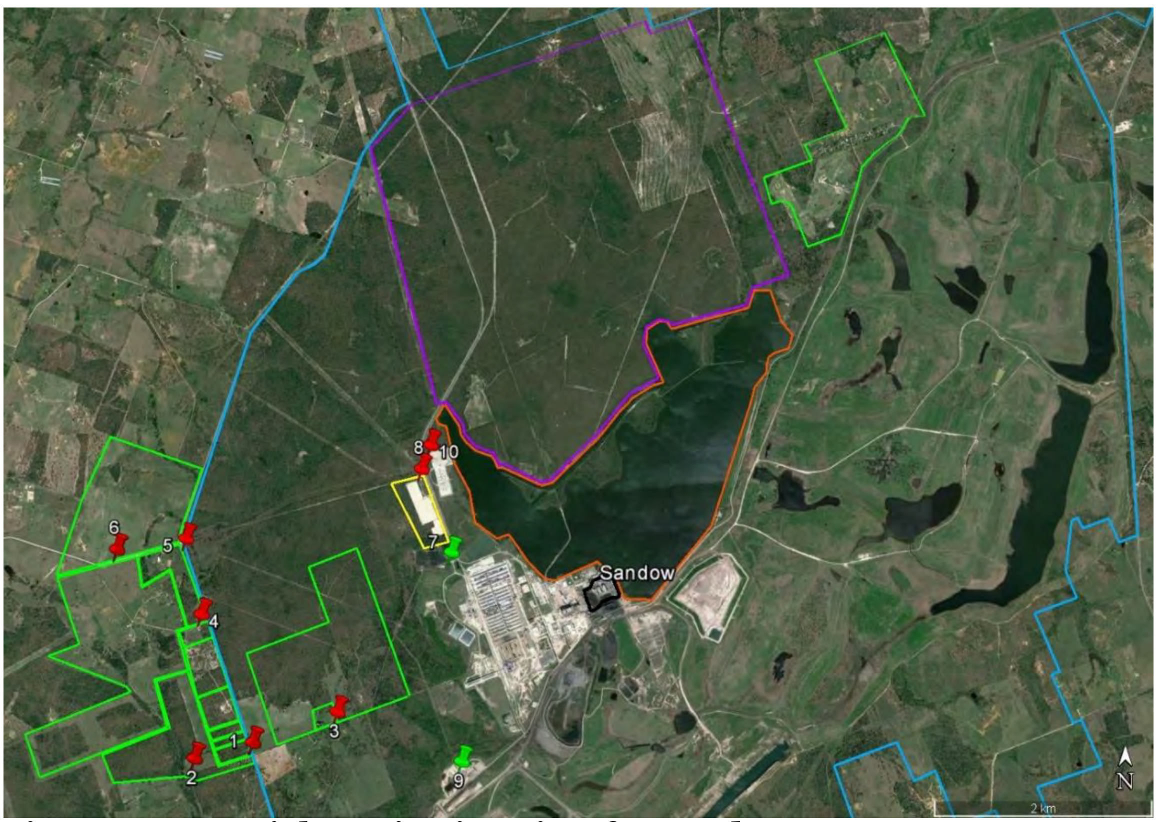


Figure 9: Potential Monitoring Sites for Sandow

Table 2: Potential Sites Assessment[1]

Site Number	Sandow #1	Sandow #2	Sandow #3
Location	30.55379, -97.09541	30.55251, -97.10099	30.55628, -97.08730
Distance from SO_2 Source[2]	3,670 m	4,190 m	2,810 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	None	None	None
Wind Channeling	None	None	None
Downwind[2]	No (SW)	No (SW)	No (SW)
Obstructions and Height	Trees (10 m)	Trees (20 m) Barn 5 m (E)	Barn (5 m)
Distance from Site to Obstructions	Trees (0-5 m N, S, E, W)	Trees (30 m SE) Trees (35 m S) Barn (15 m E)	Barn (55 m NW)
Road/Site Access	Yes	No	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Level ground • Space available	• Level ground • Space available	• Level ground • Space available
Cons	• Numerous obstructions • Not downwind	• No site access • Not downwind	• Property owner declined • Not downwind
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Sandow #4	Sandow #5	Sandow #6
Location	30.56429, -97.10073	30.57064, -97.10248	30.56974, -97.10925
Distance from SO_2 Source[2]	3,790 m	4,000 m	4,610 m
Wind Direction	S, SE	S, SE	S, SE
Elevation/Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	None	None	None
Wind Channeling	None	None	None
Downwind[2]	No (W)	No (W)	No (W)
Obstructions and Height	Trees (12 m)	Trees (6 m)	None
Distance from Site to Obstructions	Trees (15-20 m, NW, W, E)	Trees (10 m NW)	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Level ground • Space available	• Level ground • Space available	• Level ground • Space available
Cons	• Numerous obstructions • Not downwind	• No driveway access • Not downwind	• Unresponsive property owner • Unlevel ground • Not downwind
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Sandow #7	Sandow #8
Location	30.56946, -97.07621	30.57660, -97.07919
Distance from SO_2 Source[2]	1,470 m	1,970 m
Wind Direction	S, SE	S, SE
Elevation/Grade	<1%	<1%
Flood Plains	No	No
Mountain/Valley Winds	None	None
Water Body Within 1,000 m	Yes; Lake (E)	Yes; Lake (E)
Wind Channeling	None	None
Downwind[2]	No (W)	No (NW)
Obstructions and Height	None	None
Distance from Site to Obstructions	None	None
Road/Site Access	Yes	Yes
Electricity Available <18 m	Yes	Yes
Pros	• Level ground • Space available • Close to the source • Easy operator access	• Level ground • Space available • Easy operator access
Cons	• Not downwind	• Leased to solar farm • Not downwind
Viable Site (Yes, No, or Preferred)	Preferred	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Sandow #9	Sandow #10
Location	30.55227, -97.07529	30.57869, -97.07828
Distance from SO_2 Source[2]	1,915 m	2,019 m
Wind Direction	S, SE	S, SE
Elevation/Grade	<1%	<1%
Flood Plains	No	Yes
Mountain/Valley Winds	None	None
Water Body Within 1,000 m	None	Yes; Lake (E)
Wind Channeling	None	None
Downwind[2]	No (SW)	No (NW)
Obstructions and Height	None	None
Distance from Site to Obstructions	None	None
Road/Site Access	Yes	Yes
Electricity Available <18 m	Yes	No
Pros	• Level ground • Space available • Easy operator access	• Space available • Easy operator access
Cons	• Not downwind	• No power • Prone to flooding • Rough terrain • Not downwind
Viable Site (Yes, No, or Preferred)	Yes	No

[1]Based on 40 Code of Federal Regulations Part 58 and *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document*
[2]Based on Google Earth
E – east
m – meter
N – north
NE – northeast
NW – northwest
S – south
SE – southeast
SO_2 – sulfur dioxide
SW – southwest
W – west
> – greater than
< – less than
– number
% – percent

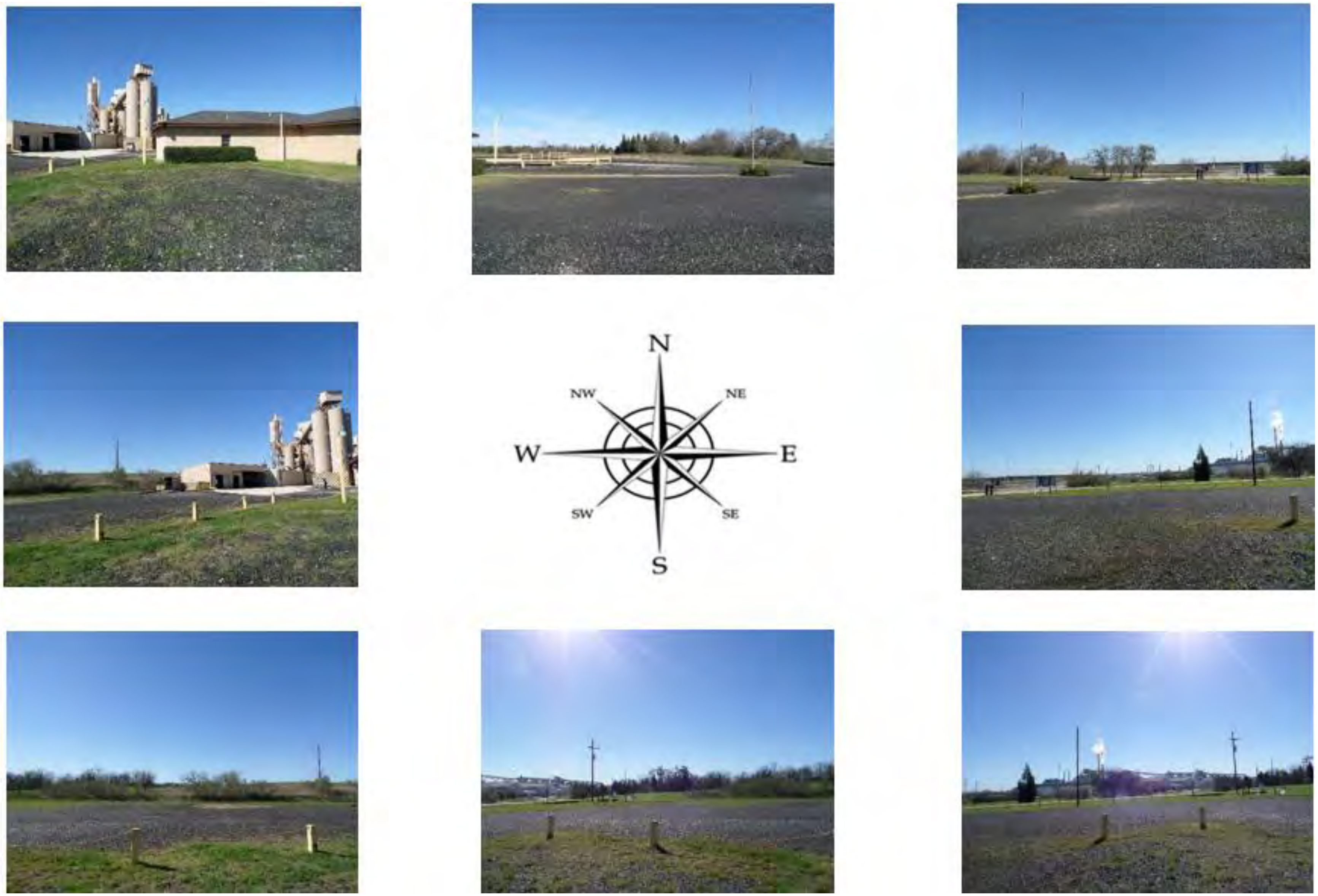


Figure 10: Sandow #7 Potential Site Cardinal Direction Photos

Figure 11: Sandow #7 Potential Site

References

Griffith, G. E., S. A. Bryce, J. M. Omernik, J. A. Comstock, A. C. Rogers, B. Harrison, S. L. Hatch, and D. Bezanson. *Ecoregions of Texas*. (2 sided color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia: U.S. Geological Survey, 2004. Scale 1:2,500,000.

"IEM : Site Locator." Iowa Environmental Mesonet. 2016. Accessed April 06, 2016. https://mesonet.agron.iastate.edu/sites/locate.php?network=TX_ASOS.

Borger Monitor Placement Evaluation

Source Information

Two separately permitted facilities with sulfur dioxide (SO_2) emissions greater than 2,000 tons per year are located in Borger, Texas. The facilities are officially referred to as the Sid Richardson Carbon Company Borger Carbon Black Plant and the Orion Engineered Carbons LLC Borger Carbon Black Plant. The two plants are approximately 195 meters (m) apart from each other. All subsequent modeling and recommendations consider the two sources separately; however, for practical reasons the facilities are collectively referred to as "Borger".

Source 1

- Name: Borger Carbon Black (Figure 2)
- Owner: Sid Richardson Carbon, LTD
- Facility function: electric generation
- Location: 35.66390, -101.43500, Texas Commission on Environmental Quality (TCEQ) Region 1, Hutchinson County, Texas
- SO_2 emissions data: 4,923 tons (2013), 4,862 tons (2014)
- Long-term emissions trend: decreasing, 46 percent (%) decrease from 2004 to 2014
- Emission profile: operational year-round
- Stack height: two stacks at 547 (m) and one stack at 132 m
- SO_2 emission controls: none
- Permit related data: Federal Operating Permit #1867A and Prevention of Significant Deterioration (PSD) permit #PSDTX1032

Source 2

- Name: Borger Carbon Black (Figure 3)
- Owner: Orion Engineered Carbons, LLC
- Facility function: chemical manufacturing
- Location: 35.66636, -101.43300, TCEQ Region 1, Hutchinson County, Texas
- SO_2 emissions data: 3,172 tons (2013), 3,027 (2014)
- Long-term emissions trend: increasing, 10% increase from 2010 to 2014
- Emission profile: operational year-round
- Stack height: one stack at 37 m, one stack at 30 m, and two stacks at 25 m
- SO_2 emission controls: none
- Permit related data: Federal Operating Permit #8780 and PSD # PSDTX416M1
-

Existing Air Monitoring Sites

The TCEQ operates six ambient air monitoring sites within a 70 kilometer (km) radius of Borger. Table 1 details the six closest monitoring sites in order of proximity. Maximum SO_2 ground level concentrations can be expected within close proximity to the sources. Although one of these locations is currently monitoring SO_2, none of the existing sites are positioned downwind or within reasonable proximity to the source to characterize maximum SO_2 concentrations

Table 1: TCEQ Air Monitoring Sites Near Borger

Site	Distance From Borger	Current Sulfur Dioxide (SO_2) Monitoring	SO_2 Design Value (2013–2015)
Pantex 7	33 kilometers	No	Not applicable
Pantex 5	37 kilometers	No	Not applicable
Pantex 4	39 kilometers	No	Not applicable
Amarillo SH 136	50 kilometers	No	Not applicable
Amarillo 24th Avenue	54 kilometers	Yes	22 parts per billion*
Amarillo A&M	67 kilometers	No	Not applicable

* – incomplete data
TCEQ – Texas Commission on Environmental Quality

Settings and Surroundings

The rural area surrounding Borger consists of the southwestern tablelands with elevations ranging from 933 to 1009 m as shown in Figure 1 (Griffith et al. 2004). This area is characterized by rugged terrain and is undeveloped, with no power accessibility. No significant changes to the landscape were noted during the reconnaissance as compared to the satellite view shown in Figure 9. Mountain and valley wind channeling, or other terrain related meteorological impacts are not expected in this area.

Harrington Station Power Plant (Harrington Station), located approximately 55 km southwest of Borger, has the potential to influence SO_2 concentrations in the Borger area under certain meteorological conditions. Harrington Station's SO_2 emissions were reported as 15,465 tons in 2014. Due to the site's location and the area's predominant southwesterly wind flow, it is anticipated that Harrington Station could impact SO_2 concentrations around the Borger area when winds are from the southwest (approximately 21% of the time according to the Hutchinson County Airport wind rose data; Figures 4 and 5).

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Figure 1: Borger Area Elevation Map

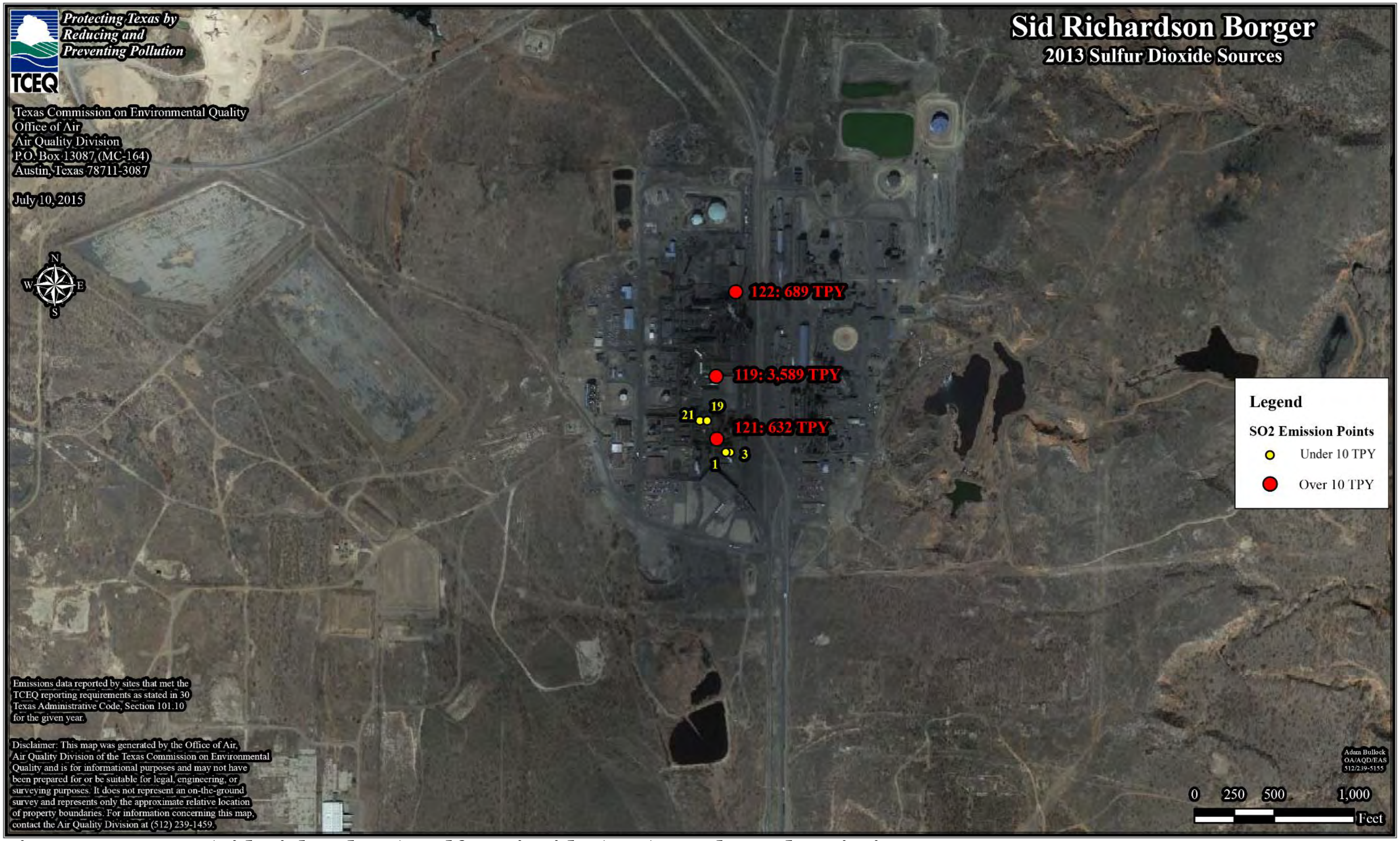


Figure 2: Borger (Sid Richardson) Sulfur Dioxide (SO_2) Stacks and Emissions, 2013

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

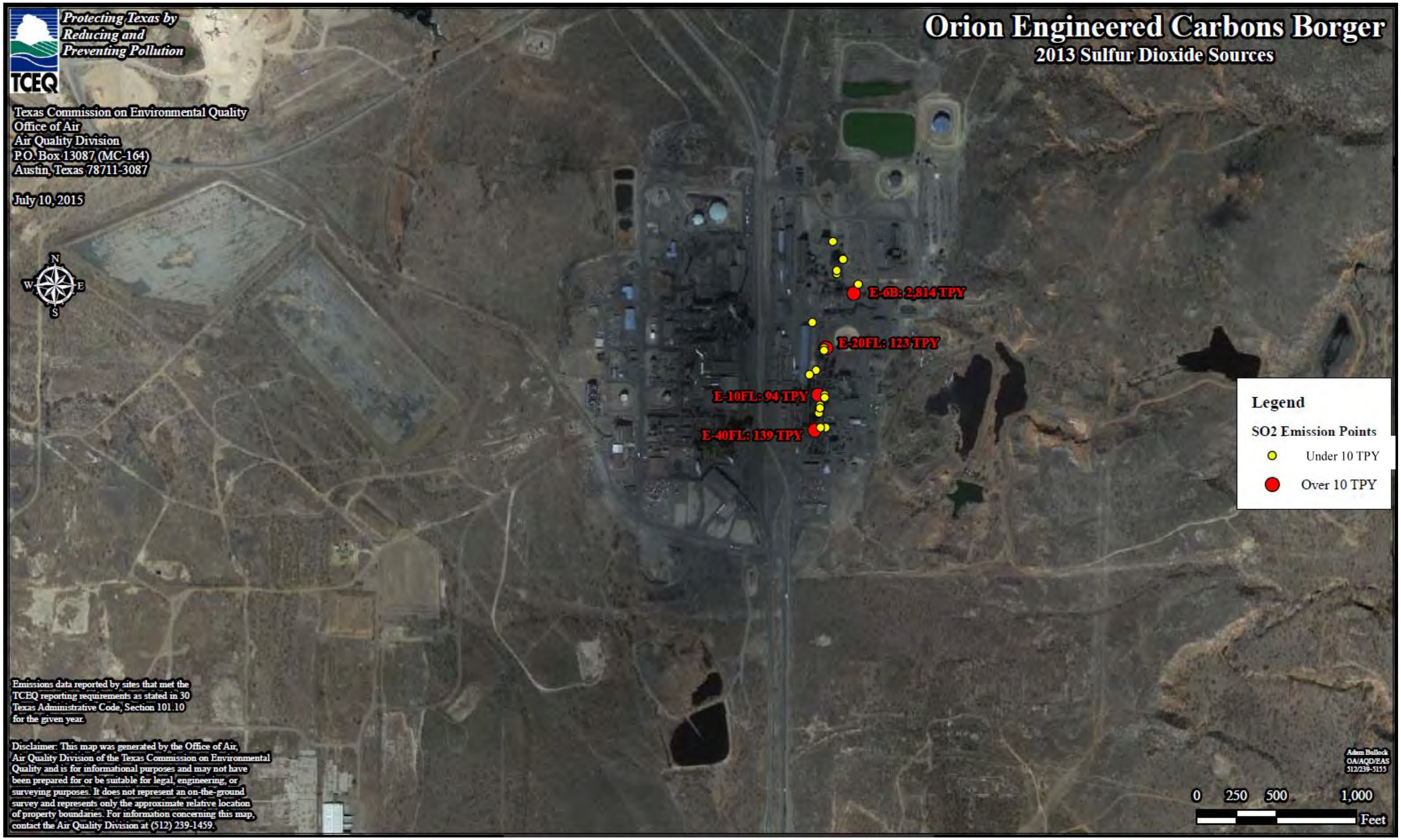


Figure 3: Borger (Orion) Sulfur Dioxide (SO_2) Stacks and Emissions, 2013

Meteorological Data

Figure 4 provides illustrations of area annual average wind speed and direction for 2012, 2013, and 2014 from meteorological sensors at Hutchinson County Airport, located 5 km northeast of Borger. Figure 5 illustrates the 2012-2014 annual average speed. The length of each wind rose bar corresponds to the frequency of the wind coming from indicated direction by percentage. Based on analysis of the 2012–2014 wind data, the dominant wind flow direction is 150 degrees southeast to 240 degrees west-southwest. Approximately 45% of the average area wind flows are from the dominant wind flow direction. Over this three year period, calm winds (0-2 miles per hour) occurred 9.7% of the time and wind speeds averaged 10.3 miles per hour (Iowa Environmental Mesonet 2016).

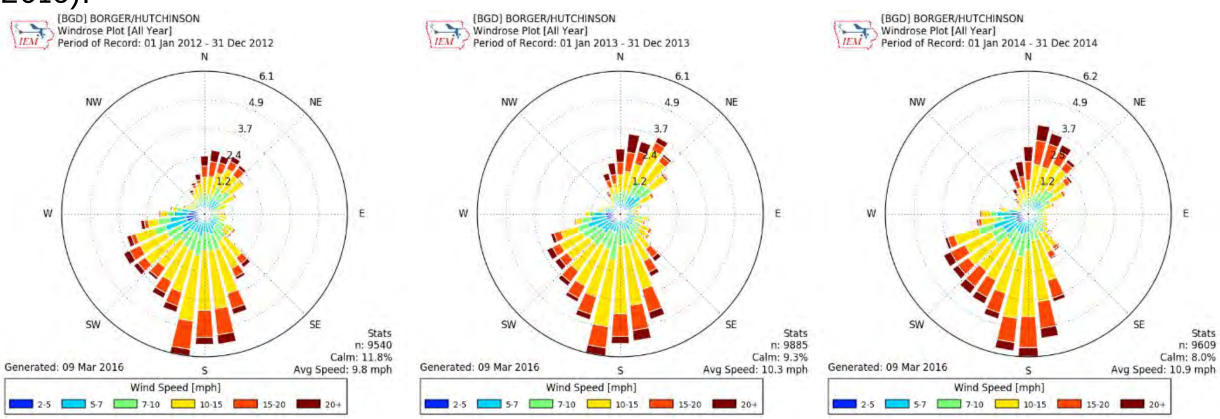


Figure 4: (From left to right) 2012, 2013, and 2014 Individual Wind Rose Plots

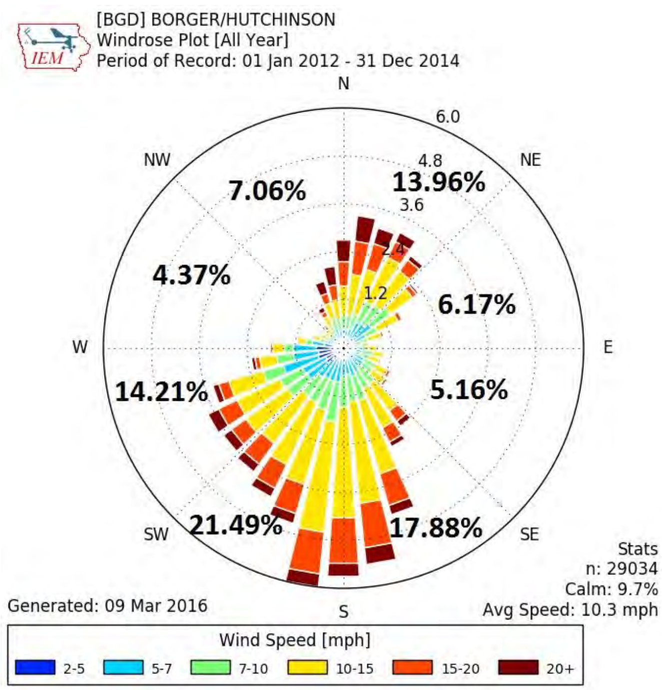


Figure 5: 2012-2014 Combined Average Wind Rose Plot

Modeling Analysis for Monitoring Site Placement

The *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistant Document* (Monitoring TAD) suggests that modeling is one technique that may be used to assist in identifying potential monitoring sites. The TCEQ's modeling for monitor placement used the Comprehensive Air Model with Extensions (CAMx), with model options set as equivalent as possible to American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The setup included the following parameterizations:

- CAMx 6.20 with speed ups and Plume-in-Grid (PiG) fix, without chemistry and without half-life decay;
- 500-meter PiG sampling grid centered on the source spatially covering 72 km by 72 km;
- the one kiln stack was modeled and tracked as individual PiG puffs;
- full year of 2012 12 km gridded Weather Research and Forecasting Model (WRF) meteorology interpolated to 4 km;
- 2014 hourly point source electric generating unit (EGU) emissions; and
- 2014 annual point source non-EGU emissions from State of Texas Air Reporting System (STARS) processed down to hourly emissions.

All model outputs were normalized relative to the predicted off-property maximum concentration, and therefore do not represent absolute predicted results comparable to the NAAQS. The results were then analyzed using three metrics: normalized 99th percentile concentration, normalized frequency, and a composite using both the 99th percentile and frequency metrics. The primary areas targeted for monitor placement included consideration of all three model output metrics, along with the meteorological data presented in Figures 4 and 5.

From the model outputs, normalized 99th percentile concentrations were calculated by dividing the 99th percentile daily maximum concentration for each grid cell within the modeling domain by the predicted off-property maximum concentration for the domain. The calculated results thus represent a percentage of the predicted concentrations for each grid cell to the off-property maximum. Figure 6 graphically presents the results for the normalized 99th percentile concentration metric analysis with the location of the predicted off-property maximum indicated by a "+" symbol. Borger permitted properties are outlined in black. Based on this analysis, the highest normalized concentrations, greater than 85% of the predicted off-property maximum, are expected to occur 1 km north of Borger. The viable monitor locations identified in Figure 6 as sites 9, 13, and 23 are within areas with predicted normalized concentrations between 65% and 80% of the off-property maximum.

To evaluate the frequency at which high concentrations may be expected, a normalized frequency metric was developed to represent the number of days the modeled concentration for each grid cell was predicted to be greater than 75% of the off-property maximum concentration. This metric was calculated by dividing the number of days the 99th percentile concentration for each grid cell was greater than 75% of the predicted off-

property maximum concentration by the number of days the off-property maximum was predicted to occur. Figure 7 presents the geographic distribution of normalized frequency around Borger. Again, the location of the predicted off-property maximum is indicated by a “+” symbol, and the Borger permitted properties are outlined in black. Using this analysis metric, areas directly to the north of Borger scored greater than 70% and would be expected to see the highest frequency of elevated SO_2 concentrations. The areas directly to the north are not viable for monitor placement due to the undeveloped area, a lack of power sources, and no road access.

Finally, a composite metric was developed to aid in identifying areas where the predicted highest concentration and predicted highest frequency overlap. The composite metric was calculated at each grid cell by averaging the normalized 99th percentile concentration and normalized frequency metrics. Figure 8 illustrates the geographic distribution of the composite metric analysis results with the location of the predicted off-property maximum with a “λ” symbol, and Borger permitted properties are outlined in black. As with the normalized 99th percentile and normalized frequency metrics, areas directly north of Borger scored greater than 90% using the composite metric. The TCEQ’s site reconnaissance showed that this area is not a viable location for an air monitoring station due to undeveloped areas, a lack of power sources, and no road access.

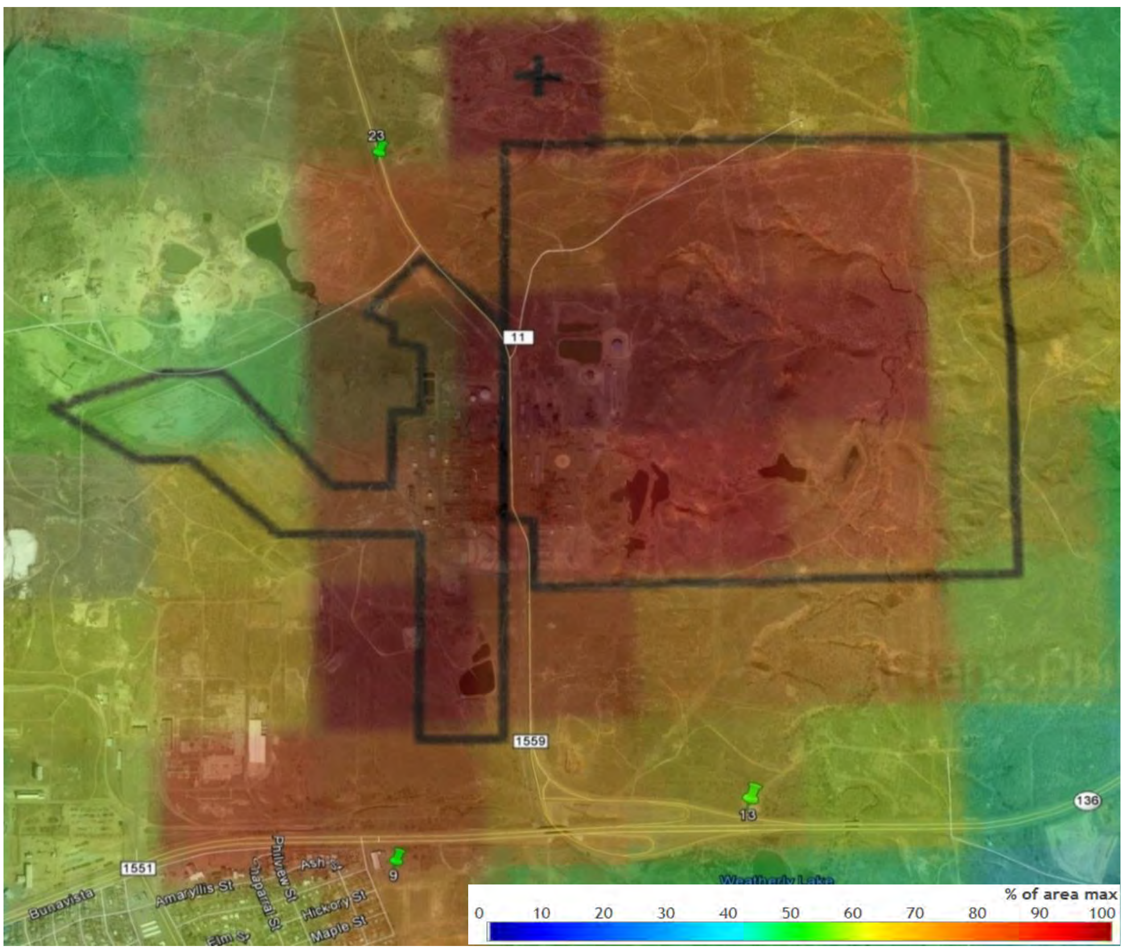


Figure 6: Borger Area CAMx Model Predictions, Normalized Concentrations, and Viable Site Locations

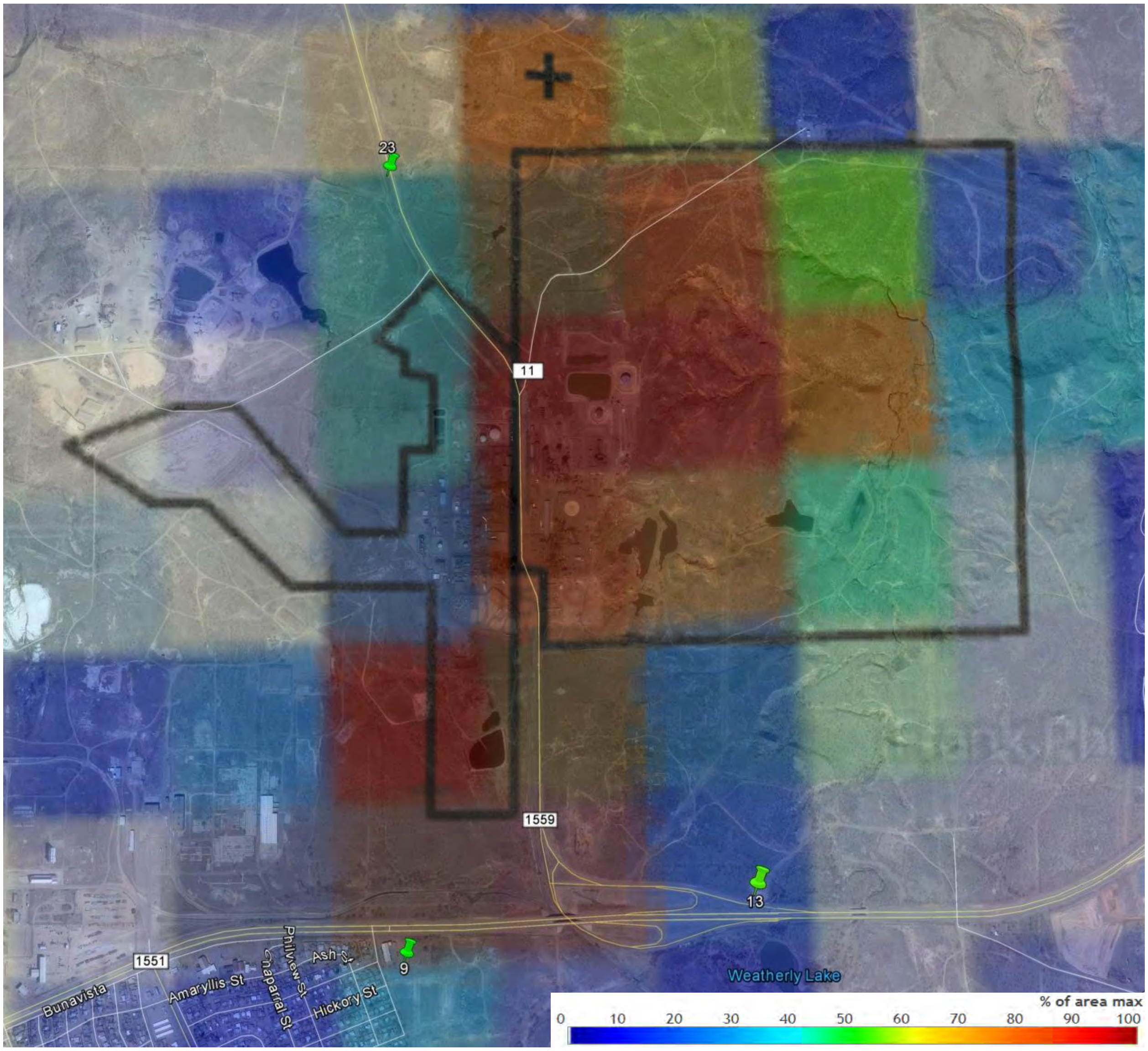


Figure 7: Borger Area CAMx Model Predictions, Normalized Frequency (Number of Days), and Viable Site Locations

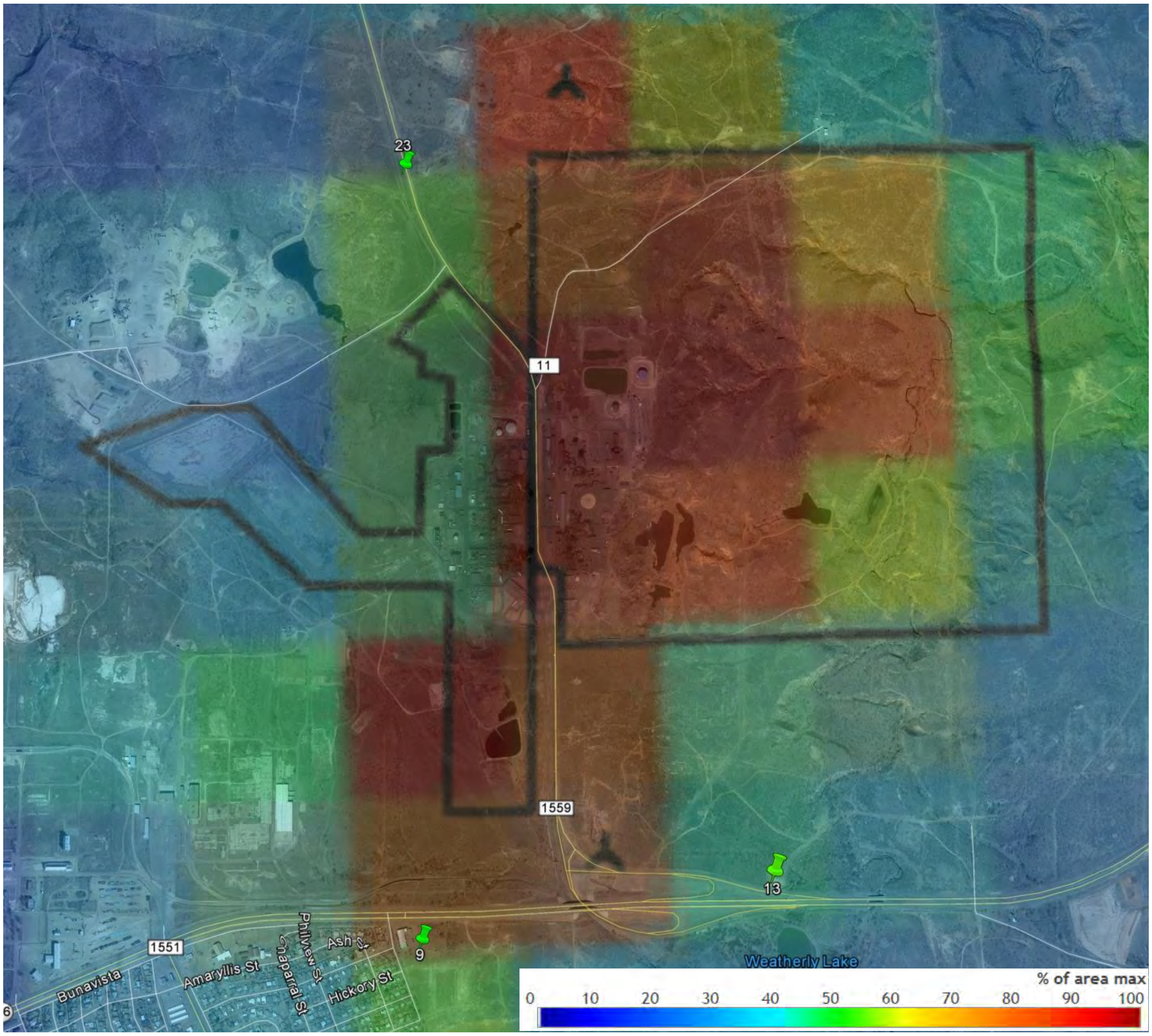


Figure 8: Borger Area CAMx Model Predictions Composite Metric and Viable Site Locations

Siting Options and Criteria

The TCEQ does not currently have SO_2 monitors located in the area surrounding Borger that would be expected to characterize the highest SO_2 concentrations from these facilities; therefore, a new site is proposed. The TCEQ focused on complying with the federal requirements listed in 40 Code of Federal Regulations (CFR) Part 58, Appendix E regarding siting criteria. In addition, the TCEQ evaluated monitoring site locations that would appropriately and sufficiently characterize air quality in areas around an SO_2 emissions source. This approach includes utilizing multiple techniques and guidance provided in the Monitoring TAD.

The modeling analyses provided in Figures 6, 7, and 8 suggest that maximum SO_2 concentrations are expected to occur north of Borger. In addition, the highest frequency of SO_2 concentrations predicted to be greater than 75% of the off-property maximum is expected north of Borger. Upon completing field assessments north of Borger, the TCEQ determined that necessary power and vehicle access infrastructure to support a monitoring site was nonexistent in this area.

Twenty-three potential sites were identified as shown in Figure 9. Although the highest modeled concentrations are to the north of Borger, this area is undeveloped and lacks power sources. The TCEQ visited more developed areas to the east, for a broader availability of power sources and property owners. A summary of all potential sites is shown in Table 2. Twenty of the identified potential sites (1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, and 22) are not considered viable and are indicated by red pins in Figure 9. Property owners at sites 1, 11, 16, 18, and 22 declined to negotiate site agreements. Sites 2, 3, 4, 12, 15, and 17 were not downwind of Borger and had low SO_2 concentrations according to the modeling analyses. Sites 5, 6, 7, 10, 20, and 21 were not viable due to potential interference from other local SO_2 sources, such as a barbecue restaurant, a gas plant, and gas wells. Site 8, located approximately 1.6 km southwest from the source was prone to flooding. Site 14, located approximately 4.0 km northeast from the source had no available power. Site 19, located approximately 0.5 km northwest from the source, contained an uneven terrain and was prone to flooding. As a result, these potential sites are no longer under consideration.

The three sites with satisfactory logistical and siting characteristics, located in areas anticipated to have peak concentrations, are sites 9, 13, and 23. These site locations are identified with a green pin on the model and satellite image overlays shown in Figures 6, 7, 8, and 9.

- Site 9 is positioned approximately 1.5 km south-southwest of Borger. This site is downwind of Borger when winds flow from the north-northeast (approximately 19% of the time). It is on level ground and has available space and power. This site has trees in the area that would influence final monitor placement. The normalized 99th percentile concentration metric analysis predicted concentrations in this area to be 75%-80% of maximum concentrations. The property owner is amenable to a site agreement.

- Site 13 is positioned approximately 1.4 km south of Borger. This site is downwind of Borger when winds flow from the north-northwest (approximately 11% of the time). It is on level ground and has available space, power, a site pad, and an existing fence. The normalized 99th percentile concentration metric analysis predicted concentrations in this area to be 55%-60% of maximum concentrations. A city owned utility building in the area would influence final monitor placement. The property owner is amenable to a site agreement
- Site 23 is positioned approximately 1.6 km northwest of Borger. This site is downwind of Borger when winds flow from the south-southeast (approximately 23% of the time). It is on level ground and has available space and power, as shown in Figure 10. Other areas within a 0.3 km radius were not considered viable due to the uneven terrain and a lack of available power sources. The normalized 99th percentile concentration metric analysis predicted concentrations in this area to be 65%-70% of maximum concentrations. A site agreement has been negotiated with the property owner.

Recommendation

Due to the close proximity of Sid Richard Carbon, LTD and Orion Engineered Carbons, LLC, the TCEQ proposes one monitoring station for deployment to characterize ambient air quality surrounding these two sources. Based on property owner cooperation, proximity to the source, current facility operations, available emissions data, wind patterns, and modeling analyses, site 23 (see Figures 10 and 11) is the recommended location for placement of a new source-oriented ambient SO_2 monitoring station. This site is indicated by a green pin in Figures 6, 7, 8, 9 and 11. Of the viable sites, site 23 is the only site located downwind of Borger. Therefore, the TCEQ expects that site 23 will receive higher levels of SO_2 concentrations than sites 9 and 13. Site 23 is located in an area with predicted maximum normalized SO_2 concentrations between 65% and 80%. The recommended site has available power, level ground, and meets all federal siting criteria. A site agreement has been negotiated with the property owner.

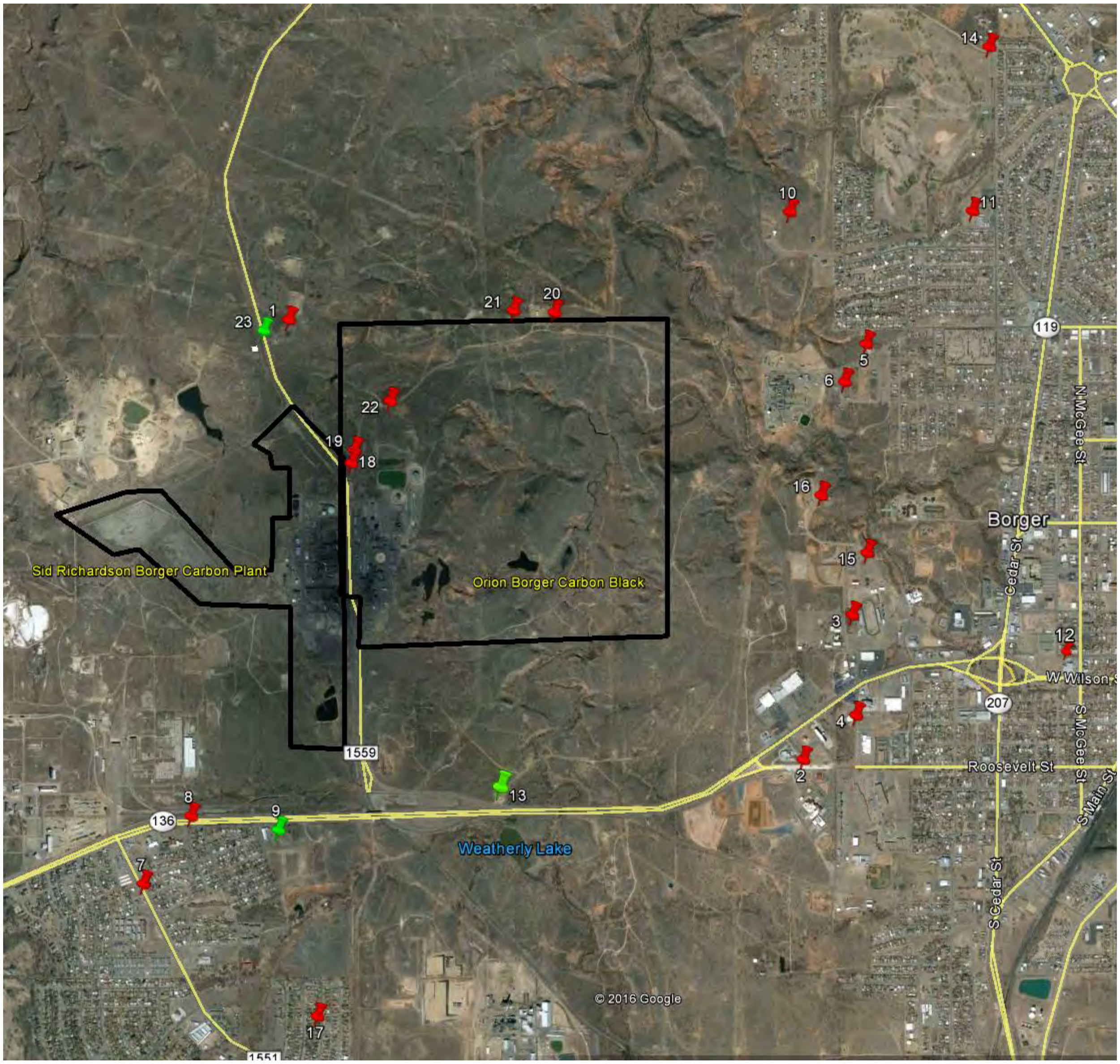


Figure 9: Potential Monitoring Sites for Borger

Table 2: Potential Sites Assessment[1]

Site Number	Borger #1	Borger #2	Borger #3
Location[2]	35.67678, -101.43972	35.65684, -101.40979	35.66333, -101.40705
Distance from SO_2 Source[2]	1,370 m	2,313 m	2,358 m
Wind Direction	S, SW	S, SW	S, SW
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	No (SE)	No (SE)
Obstructions and Height	None	None	Trees (3 m) Trees (7 m)
Distance from Site to Obstructions	None	None	Trees (10 m NW to dripline) Trees (7m SW to dripline)
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	No	Yes	No
Pros	• Level ground • Downwind • High SO_2 modeling	• Level ground • Power available	• Level ground • Power available • Agreeable property owner
Cons	• No power • Difficult access • Property owner declined	• Not downwind • Low SO_2 modeling	• Not downwind • No power • Low SO_2 modeling
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Borger #4	Borger #5	Borger #6
Location[2]	35.65881, -101.40684	35.67554, -101.40624	35.67384, -101.40745
Distance from SO_2 Source[2]	2,468 m	2,661 m	2,625 m
Wind Direction	S, SW	S, SW	S, SW
Grade	<1%	>2%	>1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	No	No	No
Wind Channeling	None	None	None
Downwind[2]	No (SE)	Yes (NNE)	Yes (NNE)
Obstructions and Height	Trees (12 m) Building (4 m)	None	Trees (3 m) Trees (5 m)
Distance from Site to Obstructions	Trees (22 m NW to dripline) Building (31 m N)	None	Trees (18 m SW to dripline) Trees (27 m NW to dripline)
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	No	No	No
Pros	• Level ground	• Downwind	• Level ground • Downwind
Cons	• Not downwind • No power • Low SO_2 modeling	• No power • Possible interferences from local gas plant • Slight grade in surrounding area • Low SO_2 modeling	• No power • Possible interferences from local gas plant • Low SO_2 modeling
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Borger #7	Borger #8	Borger #9
Location	35.65126, -101.44626	35.65430, -101.44365	35.65367, -101.43883
Distance from SO_2 Source[2]	2,010 m	1,587 m	1,449 m
Wind Direction	S, SW	S, SW	S, SW
Grade	<1%	<1%	<1%
Flood Plains	No	Yes	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	No	No	No
Wind Channeling	None	None	None
Downwind[2]	No (SW)	No (SW)	No (SW)
Obstructions and Height	Trees (4 m) Trees (6 m)	Trees (9 m)	Trees (10 m)
Distance from Site to Obstructions	Trees (13 m NW to dripline) Trees (18 m W to dripline)	Trees (17 m NE to dripline)	Trees (16 m E to dripline) Trees (6 m S to dripline)
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Level ground • Power available	• Level ground • Power available	• Level ground • Power available • Agreeable property owner • High SO_2 modeling
Cons	• Not downwind • Smoke from local restaurant may create interference • Low SO_2 modeling	• Not downwind • Smoke from local restaurant may create interference • Flood prone • Numerous pipelines underground • Low SO_2 modeling	• Not downwind • Local obstructions
Viable Site (Yes, No, or Preferred)	No	No	Yes

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Borger #10	Borger #11	Borger #12
Location	35.68153, -101.41049	35.68155, -101.40035	35.66179, -101.39518
Distance from SO_2 Source[2]	2,740 m	3,799 m	3,805 m
Wind Direction	S, SW	S, SW	S, SW
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (NNE)	Yes (NNE)	No (E)
Obstructions and Height	None	None	None
Distance from Site to Obstructions	None	None	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Level ground • Downwind • Power available	• Level ground • Downwind • Power available	• Level ground • Power available
Cons	• Possible interference from local gas plant • Low SO_2 modeling	• Property owner declined • Low SO_2 modeling	• Not downwind • Low SO_2 modeling
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Borger #13	Borger #14	Borger #15
Location	35.65547, -101.42660	35.68896, -101.39941	35.66613, -101.40620
Distance from SO_2 Source[2]	1,390 m	3,967 m	2,440 m
Wind Direction	S, SW	S, SW	S, SW
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	No	No	No
Wind Channeling	None	None	None
Downwind[2]	No (S)	Yes (NNE)	No (E)
Obstructions and Height	Building (3 m)	None	None
Distance from Site to Obstructions	Building (8 m E)	None	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	No	Yes
Pros	• Level ground • No pad or fence needed • Power available • Agreeable property owner • High SO_2 modeling	• Level ground • Downwind • Agreeable property owner	• Level ground • Power available • Agreeable property owner
Cons	• Not downwind • Local obstructions	• No power • Low SO_2 modeling	• Not downwind • Low SO_2 modeling
Viable Site (Yes, No, or Preferred)	Yes	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Borger #16	Borger #17	Borger #18
Location	35.66872, -101.40876	35.64530, -101.43667	35.67016, -101.43480
Distance from SO_2 Source[2]	1,170 m	2,194 m	752 m
Wind Direction	S, SW	S, SW	S, SW
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	No	No	No
Wind Channeling	None	None	None
Downwind[2]	No (E)	No (S)	Yes (N)
Obstructions and Height	Trees (3 m)	None	None
Distance from Site to Obstructions	Trees (10 m to dripline)	None	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Level ground • Power available	• Level ground • Power available	• Level ground • Downwind • Power available • Close proximity to source • High SO_2 modeling
Cons	• Not downwind • Property owner declined • Low SO_2 modeling	• Not downwind • Low SO_2 modeling	• Property owner declined • Numerous pipelines • Obstructed by large boulders
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Borger #19	Borger #20	Borger #21
Location	35.67075, -101.43464	35.67697, -101.42357	35.67703, -101.42583
Distance from SO_2 Source[2]	458 m	1,620 m	1,549 m
Wind Direction	S, SW	S, SW	S, SW
Grade	<2%	<1%	<1%
Flood Plains	Yes	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (N)	Yes (NE)	Yes (NE)
Obstructions and Height	None	None	None
Distance from Site to Obstructions	None	None	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	No	Yes	No
Pros	• Downwind • Close proximity to source • High SO_2 modeling • Agreeable property owner	• Level ground • Downwind • Power available • Agreeable property owner	• Level ground • Downwind • Agreeable property owner • High SO_2 modeling
Cons	• Property owner declined • No power • Flood prone • High grade in surrounding area	• Possible interference from local gas well • Low SO_2 modeling	• Possible interference from local gas well • No power
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Borger #22	Borger #23
Location	35.67296, -101.43266	35.67613, -101.43967
Distance from SO_2 Source[2]	1,035 m	1,060 m
Wind Direction	S, SW	S, SW
Grade	<1%	<1%
Flood Plains	No	No
Mountain/Valley Winds	None	None
Water Body Within 1,000 m	No	No
Wind Channeling	None	None
Downwind[2]	Yes (N)	Yes (NE)
Obstructions and Height	None	None
Distance from Site to Obstructions	None	None
Road/Site Access	Yes	Yes
Electricity Available <18 m	Yes	Yes
Pros	• Level ground • Downwind • Power available • Close proximity to source • High SO_2 modeling	• Level ground • Downwind • Power available • Agreeable property owner • High SO_2 modeling
Cons	• Property owner declined	• None
Viable Site (Yes, No, or Preferred)	No	Preferred

[1]Based on 40 Code of Federal Regulations Part 58 and *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document*
[2]Based on Google Earth
% – percent
N – north
S – south
E – east
W – west
NE – northeast
NNE – north-northeast
NW – northwest
SE – southeast
SW – southwest
m – meter
– number
< – less than
> – greater than
SO_2 – sulfur dioxide

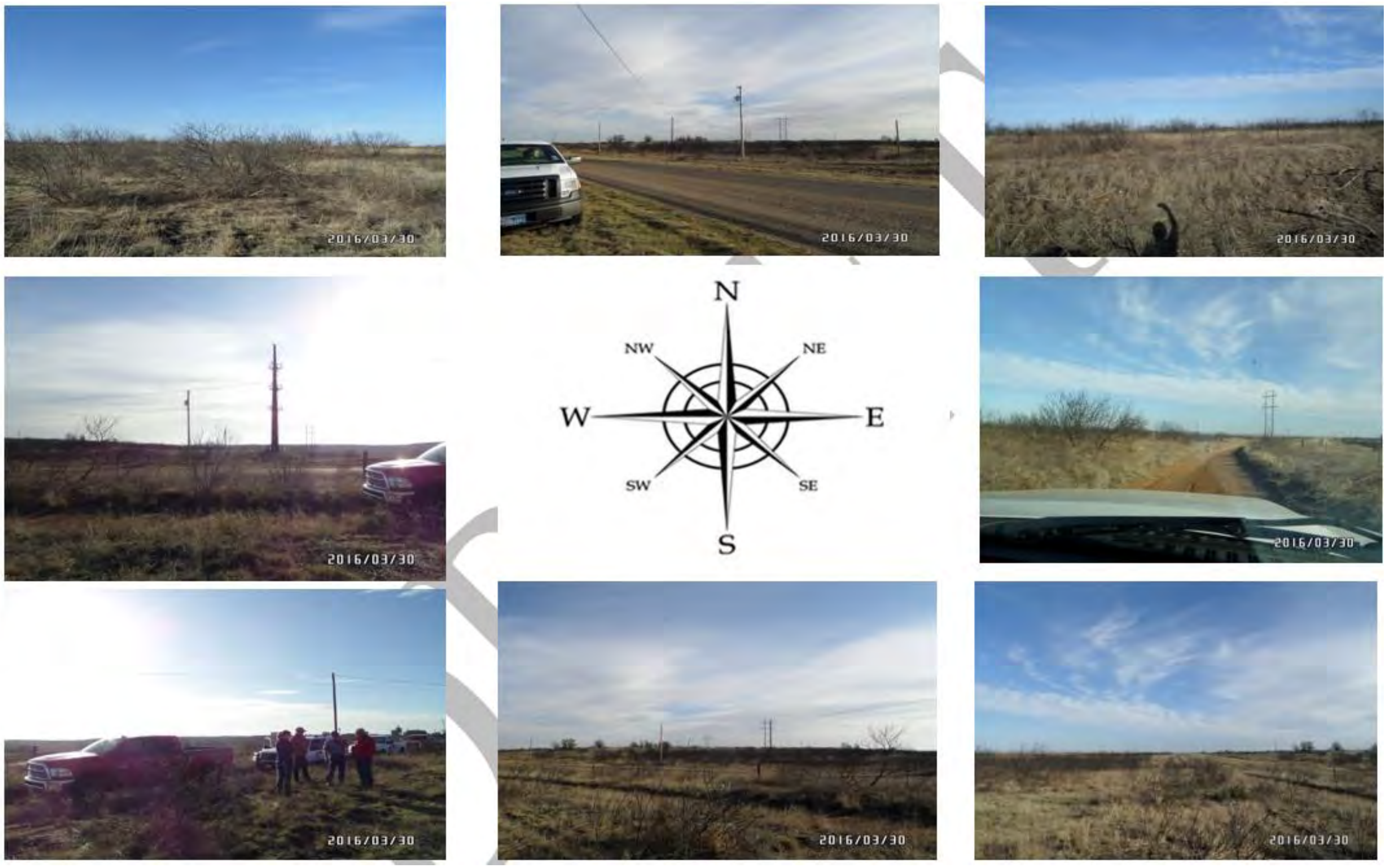


Figure 10: Borger #23 Preferred Site Cardinal Direction Photos

Figure 11: Borger Potential Site #23 Satellite Image

References

Griffith, G. E., S. A. Bryce, J. M. Omernik, J. A. Comstock, A. C. Rogers, B. Harrison, S. L. Hatch, and D. Bezanson. Ecoregions of Texas. (2 sided color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia: U.S. Geological Survey, 2004. Scale 1:2,500,000.

"IEM : Site Locator." Iowa Environmental Mesonet. 2016. Accessed April 06, 2016. https://mesonet.agron.iastate.edu/sites/locate.php?network=TX_ASOS.

Oak Grove Monitor Placement Evaluation

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Source Information

- Name: Oak Grove Steam Electric Station (Oak Grove) (Figure 2)
- Owner: Oak Grove Management Company, LLC
- Facility function: electric generation
- Location: 31.18208, -96.48806, Texas Commission on Environmental Quality (TCEQ) Region 9, Robertson County, Texas
- Sulfur dioxide (SO_2) emissions data: 6,950 tons (2013), 7,404 tons (2014)
- Long-term emissions trend: increasing, 205 percent (%) increase from 2010 to 2014
- Emission profile: operational year-round
- Stack height(s): two stacks 137 meters (m) high, currently active
- SO_2 emission controls: none
- Permit related data: New Source Review permit, Permit By Rule permit

Existing Air Monitoring Sites

The TCEQ operates three ambient air monitoring sites within a 100 kilometer (km) radius of Oak Grove. Table 1 details the three closest monitoring sites in order of proximity. Maximum SO_2 ground level concentrations can be expected close to the source. Although three of these locations are currently monitoring SO_2, none of the existing sites are within reasonable proximity to the source to characterize maximum SO_2 concentrations.

Table 1: Air Monitoring Sites Near Oak Grove

Site	Distance from Oak Grove	Current Sulfur Dioxide (SO_2) Monitoring	SO_2 Design Value (2013–2015)
Waco Mazanec	76 km northwest	Yes	7 parts per billion (ppb)
Temple Georgia	90 km west	No	Not applicable
Corsicana Airport	94 km north	Yes	39 ppb

km – kilometer

Settings and Surroundings

The primarily rural area surrounding Oak Grove is located in the northern portion of the Southern Post Oak Savanna ecoregion of the East Central Texas Plains. This area is characterized by a mix of post oak woods, improved pasture, and rangeland (Griffith et al. 2004). The elevation ranges from 156 to 159 m as shown in Figure 1. The area is speckled with inactive oil and gas drilling pad sites with no access to power (Figure 8). No significant changes to the landscape were noted during the reconnaissance as compared to the satellite image shown in Figure 8. Due to the general lack of geographical obstructions and thick elevated vegetation, wind patterns are highly consistent across the Central Texas area. Mountain and valley wind channeling, or other terrain related meteorological impacts, are not expected in this area.

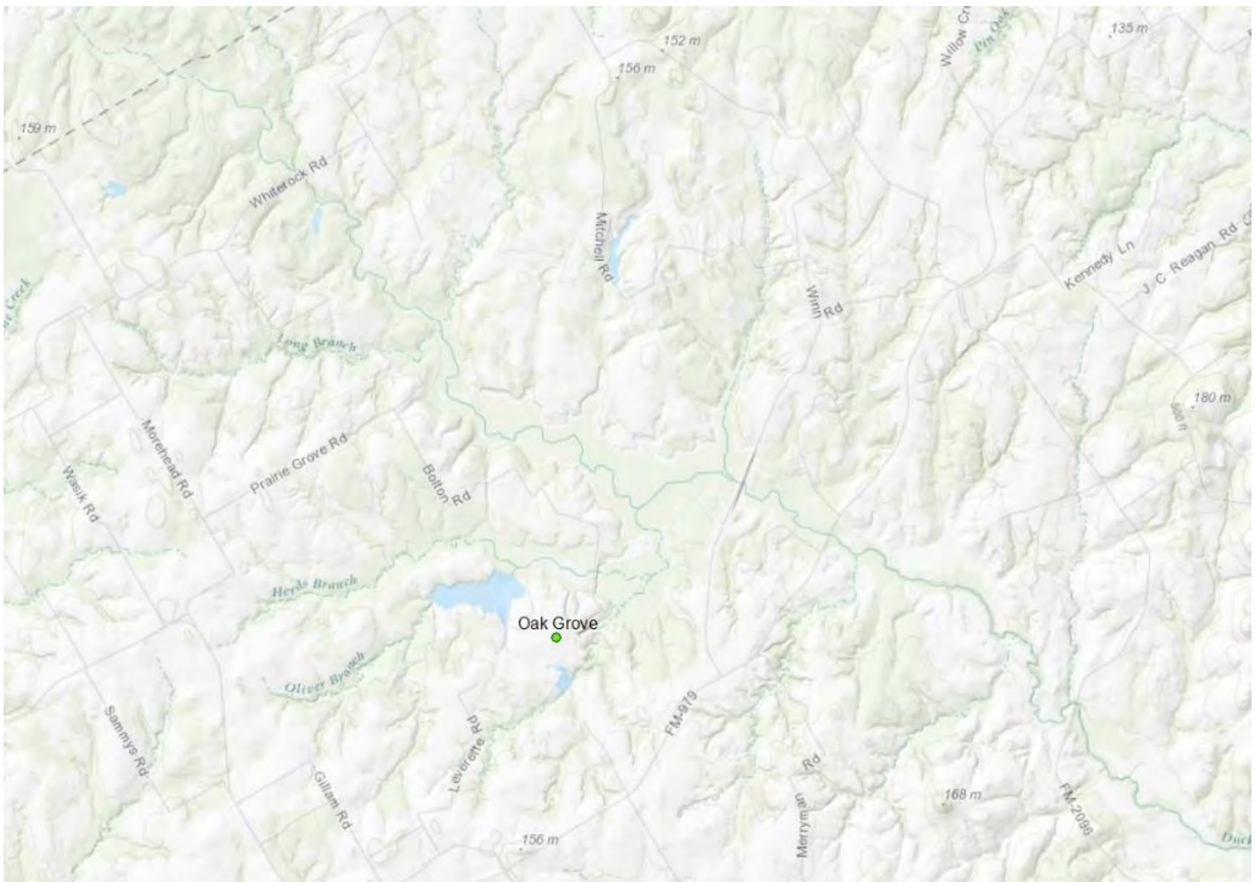


Figure 1: Oak Grove Area Elevation Map

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Figure 2: Oak Grove Sulfur Dioxide (SO_2) Stacks and Emissions, 2013

Meteorological Data

Figure 3 provides illustrations of area annual average wind speed and direction for 2012, 2013, and 2014 from meteorological sensors at Hearne Airport, located 35 km southwest of Oak Grove. Figure 4 illustrates the 2012-2014 annual average wind speed. The length of each wind rose bar corresponds to the frequency of the wind coming from the indicated direction by percentage. Based on the analysis of the 2012-2014 wind data, the dominant wind flow direction for the area is 115 degrees southeast to 175 degrees south. Approximately 42% of the average area wind flows move from these directions. Over this three year period, calm winds (0-2 miles per hour) occurred on average 28.5% of the time, and wind speeds averaged 7.2 miles per hour (Iowa Environmental Mesonet 2016).

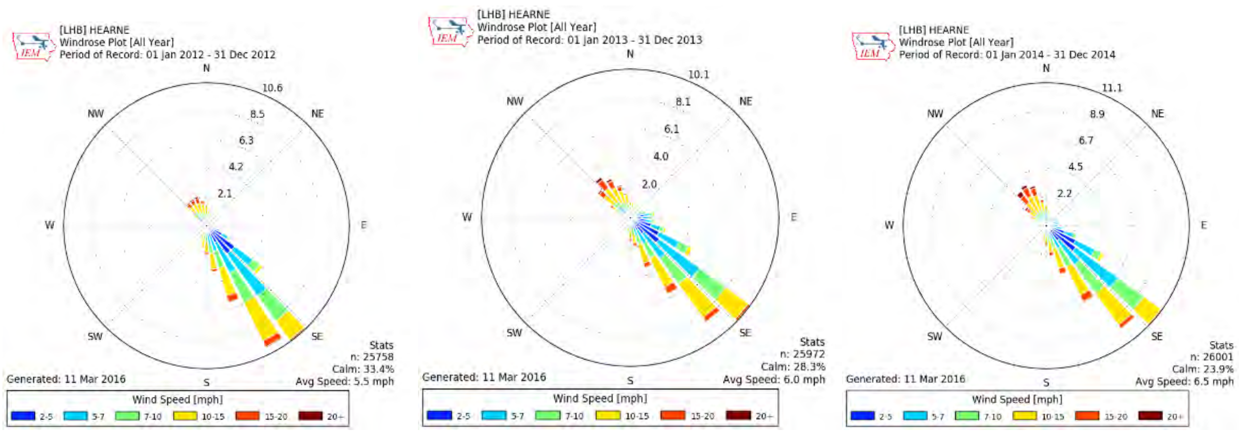


Figure 3: (From left to right) 2012, 2013, and 2014 Individual Wind Rose Plots

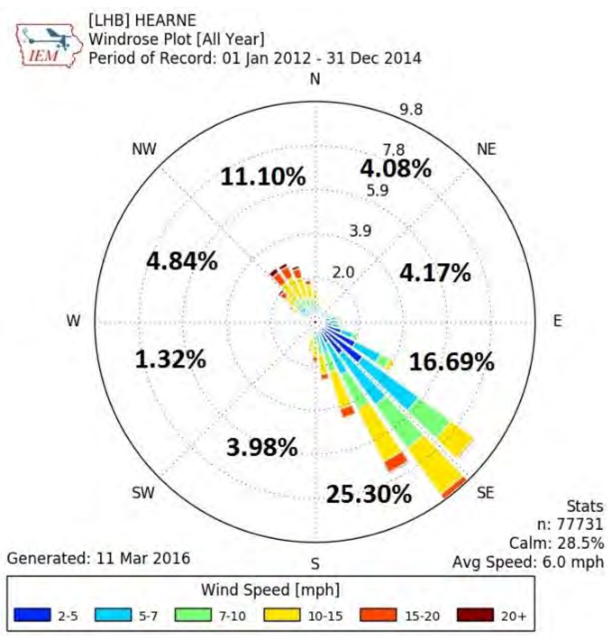


Figure 4: 2012-2014 Combined Average Wind Rose Plot

Modeling Analysis for Monitoring Site Placement

The *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistant Document* (Monitoring TAD) suggests that modeling is one technique that may be used to assist in identifying potential monitoring sites. The TCEQ's modeling for monitor placement used the Comprehensive Air Model with Extensions (CAMx) with model options set as equivalent as possible to American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The setup included the following parameterizations:

- CAMx 6.20 with speed ups and Plume-in-Grid (PiG) fix, without chemistry and without half-life decay;
- 500-meter PiG sampling grid centered on the source spatially covering 72 km by 72 km;
- the two kiln stacks were modeled and tracked as individual PiG puffs;
- full year of 2012 12 km gridded Weather Research and Forecasting Model (WRF) meteorology interpolated to 4 km;
- 2014 hourly point source electric generating unit (EGU) emissions; and
- 2014 annual point source non-EGU emissions from State of Texas Air Reporting System (STARS) processed down to hourly emissions.

All model outputs were normalized relative to the predicted off-property maximum concentration, and therefore do not represent absolute predicted results comparable to the NAAQS. The results were then analyzed using three metrics: normalized 99th percentile concentration, normalized frequency, and a composite using both the 99th percentile and frequency metrics. The primary areas targeted for monitor placement included consideration of all three model output metrics, along with the meteorological data presented in Figures 3 and 4.

From the model outputs, normalized 99th percentile concentrations were calculated by dividing the 99th percentile daily maximum concentration for each grid cell within the modeling domain by the predicted off-property maximum concentration for the domain. The calculated results thus represent a percentage of the predicted concentrations for each grid cell to the off-property maximum. Figure 5 presents the results for the normalized 99th percentile concentration metric analysis with the location of the predicted off-property maximum indicated by a "+" symbol. Oak Grove's permitted property is outlined in black. Based on this analysis, the highest normalized concentrations, greater than 95% of the predicted off-property maximum, are expected to occur 2.6 km south of the Oak Grove facility; 0.3 km from the southern property line. Approximately 1.7 km northeast of the predicted off-property maximum is the proposed monitor location identified in Figure 5 as site 6. This site is in an area of predicted normalized concentrations within 50% to 55% of the off-property maximum.

To evaluate the frequency at which high concentrations may be expected, a normalized frequency metric was developed to represent the number of days the modeled concentration for each grid cell was predicted to be greater than 75% of the off-property maximum concentration. This metric was calculated by dividing the number of days the

99th percentile concentration for each grid cell was greater than 75% of the predicted off-property maximum concentration by the number of days the off-property maximum was predicted to occur. Figure 6 presents the geographic distribution of normalized frequency around Oak Grove. Again, the location of the predicted off-property maximum is indicated by a "+" symbol, and Oak Grove's permitted property is outlined in black. Using this analysis metric, the same area 2.6 km south of the facility scored greater than 95% and would be expected to see the highest frequency of elevated SO_2 concentrations.

Finally, a composite metric was developed to aid in identifying areas where the predicted highest concentration and predicted highest frequency overlap. The composite metric was calculated at each grid cell by averaging the normalized 99th percentile concentration and normalized frequency metrics. Figure 7 illustrates the geographic distribution of the composite metric analysis results with the location of the predicted off-property maximum with a "λ" symbol, and Oak Grove's permitted property is outlined in black. As with the normalized 99th percentile and normalized frequency metrics, the same area south of the Oak Grove facility scored greater than 95% using the composite metric. Based on the TCEQ's site reconnaissance and outreach to property owners, areas with the highest composite metric score did not yield a viable location for monitor placement as amenable property owners were not located in these areas.

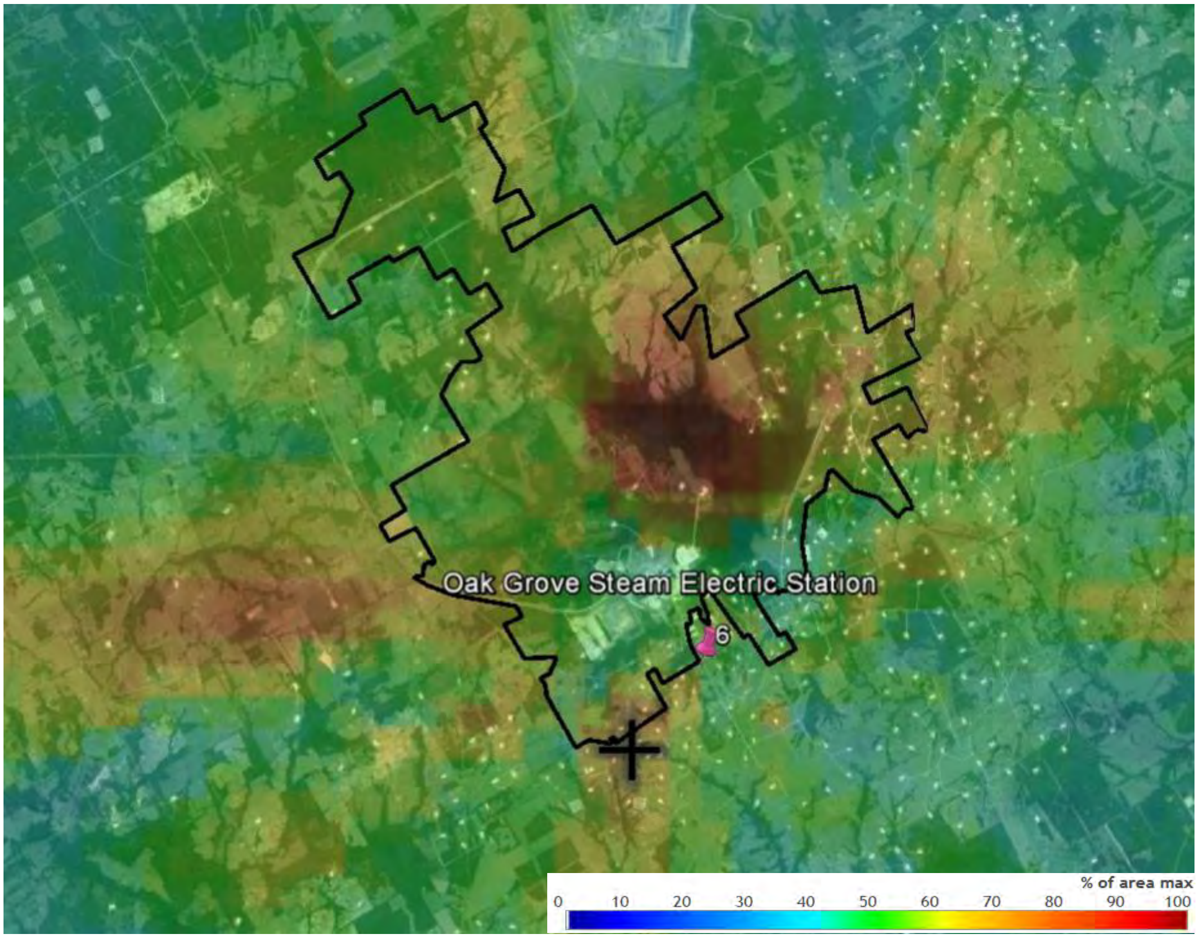


Figure 5: Oak Grove Area CAMx Model Predictions, Normalized Concentrations, and Viable Site Location 6

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

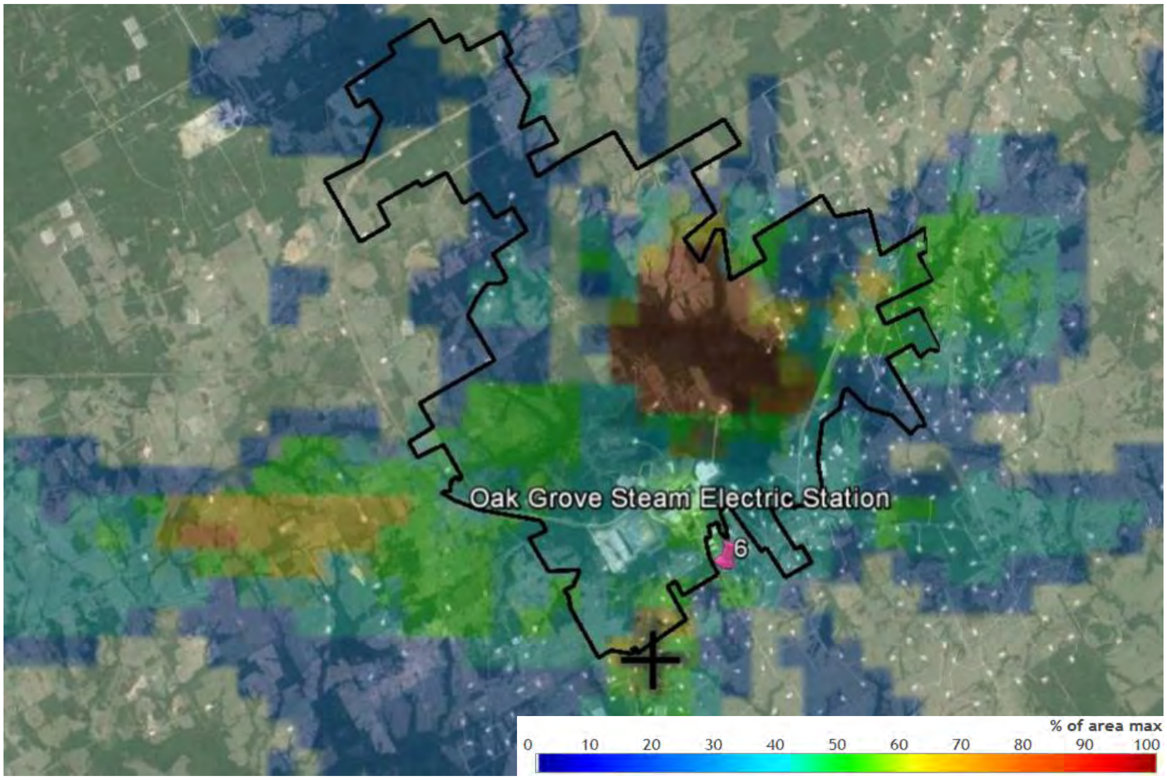


Figure 6: Oak Grove Area CAMx Model Predictions, Normalized Frequency (Number of Days), and Viable Site Location

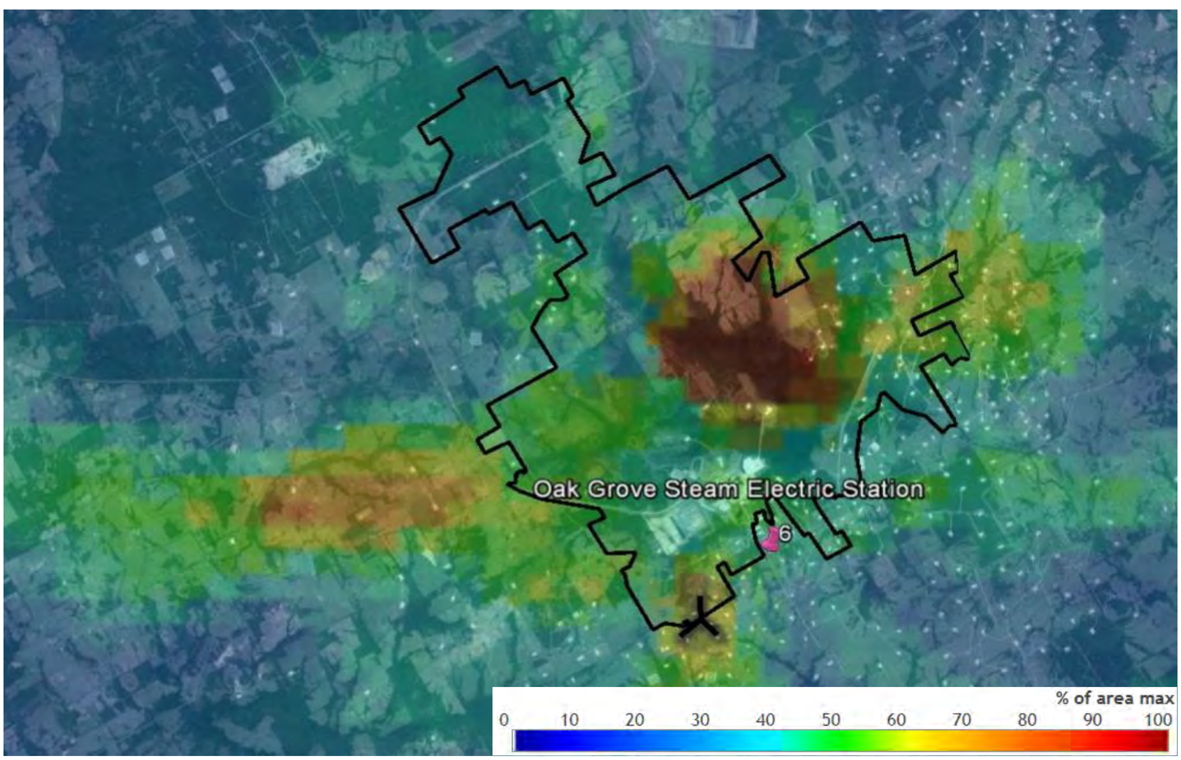


Figure 7: Oak Grove Area CAMx Model Predictions Composite Metric and Viable Site Location

Siting Options and Criteria

The TCEQ does not currently have SO_2 monitors located in the area surrounding Oak Grove that would be expected to characterize the highest SO_2 concentrations from this facility, therefore, a new site is proposed. The TCEQ focused on complying with the federal requirements listed in 40 Code of Federal Regulations (CFR) Part 58, Appendix E regarding siting criteria. In addition, the TCEQ evaluated monitoring site locations that would appropriately and sufficiently characterize air quality in areas around an SO_2 emissions source. This approach included utilizing multiple techniques and guidance provided in the Monitoring TAD.

The modeling analyses provided in Figures 5, 6, and 7 suggest that off-property maximum SO_2 concentrations are expected to occur south of the Oak Grove facility. In addition, the highest frequency of SO_2 concentrations predicted to be greater than 75% of the off-property maximum is expected south of Oak Grove. Figure 8 depicts all potential site locations (yellow, red, and pink pins), their corresponding private property lines (yellow), and the facility property line (black). A total of 25 potential sites were identified as shown in the figure. Upon first contact, property owners at sites 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, and 25 (yellow pins) all refused any monitor placements, or their property was unsuitable. Therefore, no reconnaissance was performed in these locations, and they do not appear in Table 2. More detailed reconnaissance was performed at all other potential sites (red and pink pins). Six of the identified potential sites (1, 2, 3, 4, 5, and 8) are not considered viable; they are indicated by red pins. Site 1 is in an area with restricted access and the property owner was unresponsive. Property owners at sites 2, 3, and 4 were unwilling due to the obstruction a site would create. Site 5 is not considered viable due to lack of power on the property. After consideration, the property owner of Site 8 declined an air monitoring station on the property. As a result, these potential sites are no longer under consideration.

The one site with satisfactory logistical and siting characteristics is site 6. Site 6 is located in an area anticipated to experience elevated SO_2 concentrations and is indicated by a pink pin in Figures 5, 6, 7, and 8. Site 6 is positioned approximately 1.48 km south-southeast of the Oak Grove facility. This site is downwind of the source when winds are from the northwest, 15.9% of the year on average (see Figure 4). The site offers level ground, adequate space, available power, and is close to the source (see section "Recommendation" and Table 2), which is a benefit during calm conditions. The normalized 99th percentile concentration metric analysis predicted area concentrations in this area to be 45-50% of the maximum concentrations. A site agreement has been negotiated with the property owner.

Recommendation

Based on current facility operations, available emission data, wind patterns, logistics, and modeling analyses, site 6 (Figures 9 and 10) is the recommended location for placement of a new source-oriented ambient SO_2 monitoring station. The most influential factors constraining site placement for Oak Grove were averse property owners and logistics (e.g., property access and electricity). Property owners in areas where modeling predicted the highest concentrations (sites 7, 8, 9, 10, 11, and 16) all declined to negotiate site agreements. Additional locations were considered based on wind rose data but were either logistically unsuitable or property owners declined (sites 1, 2, 3, 4 and 5).

Historical meteorological data from 2012-2014 (Figure 4) show the area around site 6 experiences calm conditions an average of 28.5% of the year and is downwind of Oak Grove during northwesterly winds 15.9% of the year. Combined, calm or northwesterly wind conditions occurred an average of 44.4% annually, a greater percentage of time than prevailing wind patterns (42%). Site 6 is the closest viable location to the source (1.4 km) and the predicted off-property maximum normalized SO_2 concentrations with available power, adequate space, level ground, and meets all federal siting criteria. A site agreement has been negotiated with the property owner.

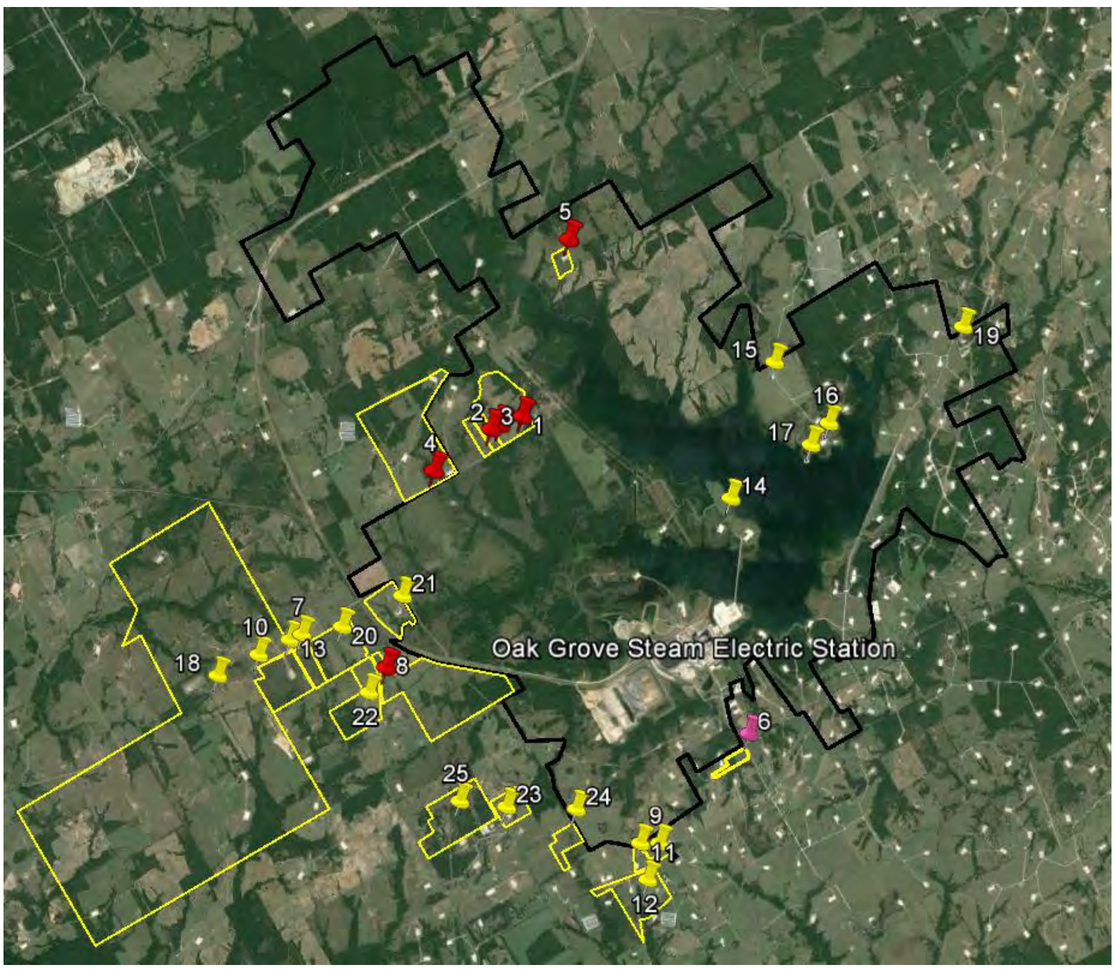


Figure 8: Potential Monitoring Sites for Oak Grove

Table 2: Potential Sites Assessment[1]

Site Number	Oak Grove #1	Oak Grove #2	Oak Grove #3
Location[2]	31.20789, -96.51338	31.20619, -96.51809	31.20628, -96.51869
Distance from SO_2 Source[2]	3,728 m	3,842 m	3,885 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	Yes; reservoir (E)	None	None
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	Yes (NW)
Obstructions and Height	Trees (20 m)	Trees (4 m, 30 m)	Trees (4 m, 30 m)
Distance from Site to Obstructions	Trees (30 m E, SW)	Trees (23 m E, 64 m SE, 28-50 m S, 8 m SW)	Trees (23 m E, 64 m SE, 28-50 m S, 8 m SW)
Road/Site Access	No	Yes	Yes
Electricity Available <18 m	Yes	No	Yes
Pros	• Level ground • Power available • Downwind	• Level ground • Downwind	• Level ground • Power available • Space available • Downwind
Cons	• Unresponsive property owner • No site access • Requires new road construction	• Property owner declined • Requires work to access electricity • Local obstructions	• Property owner declined • Local obstructions
Viable Site (Yes, No, or Preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Oak Grove #4	Oak Grove #5	Oak Grove #6
Location[2]	31.20115, -96.52689	31.22970, -96.50714	31.16895, -96.48191
Distance from SO_2 Source[2]	4,165 m	5,570 m	1,483 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	None	Yes; lake (S)	Yes; lake (N)
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	No (SSE)
Obstructions and Height	Trees (10 m, 15 m)	Trees (6 m, 7 m, 10 m)	Trees (5 m, 12 m)
Distance from Site to Obstructions	Trees (36 m S, 46 m SE, 70 m E)	Trees (30 m W, E, NNE) Tanks (38 m SE)	Trees (12 m W, 40 m N)
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	No	Yes
Pros	• Level ground • Power available • Downwind • Space available	• Level ground • Downwind	• Level ground • Power available • Space available • Strong cell phone signal • Agreeable property owner
Cons	• Property owner declined	• Power unavailable • Existing oil and gas site	• Not downwind
Viable Site (Yes, No, or Preferred)	No	No	Preferred

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Oak Grove #8
Location[2]	31.17705, -96.53370
Distance from SO_2 Source[2]	4,383 m
Wind Direction	S, SE
Grade	<1%
Flood Plains	No
Mountain/Valley Winds	None
Water Body Within 1,000 m	None
Wind Channeling	None
Downwind[2]	No (W)
Obstructions and Height	Trees (12 m)
Distance from Site to Obstructions	Trees (34 m SE)
Road/Site Access	Yes
Electricity Available <18 m	No
Pros	• Level ground • Power available • Space Available
Cons	• Property owner declined • Not downwind
Viable Site (Yes, No, or Preferred)	No

[1]Based on 40 Code of Federal Regulations Part 58 and *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document*
[2]Based on Google Earth
E – east
m – meter
N – north
NE – northeast
NW – northwest
S – south
SE – southeast
SO_2 – sulfur dioxide
SW – southwest
W – west
> – greater than
< – less than
– number
% – percent

Figure 9: Oak Grove Potential Site #6 Cardinal Direction Photos

Figure 10: Oak Grove Potential Site #6 Satellite Image

References

Griffith, G. E., S. A. Bryce, J. M. Omernik, J. A. Comstock, A. C. Rogers, B. Harrison, S. L. Hatch, and D. Bezanson. *Ecoregions of Texas*. (2 sided color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia: U.S. Geological Survey, 2004. Scale 1:2,500,000.

"IEM : Site Locator." Iowa Environmental Mesonet. 2016. Accessed April 06, 2016. https://mesonet.agron.iastate.edu/sites/locate.php?network=TX_ASOS

Orion Echo Carbon Black Plant Monitor Placement Evaluation

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Source Information

- Name: Orion Echo Carbon Black Plant (Orion Echo) (Figure 2)
- Owner: Orion Engineered Carbons, Limited Liability Company (LLC)
- Facility function: chemical manufacturing
- Location: 30.15245, -93.72090, Texas Commission on Environmental Quality (TCEQ) Region 10, Orange County, Texas
- Sulfur dioxide (SO_2) emission data: 4,132 tons (2013), 4,255 tons (2014)
- Long-term emissions trend: decreasing, 23 percent (%) decrease from 2004 through 2014
- Emission profile: operational year-round
- Stack height(s): 10 stacks over 10 tons per year, 31-50 meters (m) high, with 11 currently active sources
- SO_2 emission controls in place: none
- Permit related data: Federal Operating Permit, Prevention of Significant Deterioration (PSD) permit #PSDTX627M2

Existing Air Monitoring Sites

The TCEQ operates four ambient air monitoring sites within a 30 kilometer (km) radius of Orion Echo. Table 1 details the four closest monitoring sites in order of proximity. Maximum SO_2 ground level concentrations can be expected within close proximity to the source. None of the existing sites monitor for SO_2, and none are positioned downwind or within reasonable proximity to the source to characterize maximum SO_2 concentrations.

Table 1: Air Monitoring Sites Near Orion Echo

Site	Distance From Orion Echo	Current Sulfur Dioxide (SO_2) Monitoring	SO_2 Design Value (2012-2015)
West Orange	8.3 km southwest	No	Not applicable
SETRPC 42 Mauriceville	14.3 km northwest	No	Not applicable
Groves	27 km southwest	No	Not applicable
Port Neches Avenue L	29 km southwest	No	Not applicable

km – kilometer
SETRPC – South East Texas Regional Planning Commission

Settings and Surroundings

The Texas Gulf Coast includes the relatively flat Gulf Coastal Plains as shown in Figure 1. The prairies transition to the Interior Coastal Plains just west of Corpus Christi, Houston, and Beaumont-Port Arthur. These plains reach a maximum elevation of 800 feet and are marked by more forested vegetation and river valleys (Wermund 1996). The area surrounding Orion Echo contains dense forests and swampland. No significant changes to the landscape were noted during the reconnaissance as compared to the satellite view in Figure 8. Mountain and valley wind channeling or other terrain related meteorological impacts are not expected in this area.

The Temple-Inland Paper Mill (Temple-Inland) located approximately 7 km north-northwest of Orion Echo, has the potential to influence SO_2 concentrations in the Orion Echo area under certain meteorological conditions. Temple-Inland's SO_2 emissions were reported as 1,756 tons in 2014. Due to the site's location and the area's southeasterly wind flow, it is anticipated that Temple-Inland could impact SO_2 concentrations in the Orion Echo area when winds are from the northwest (approximately 7% of the time according to the Orange County Airport wind rose data; Figures 3 and 4).

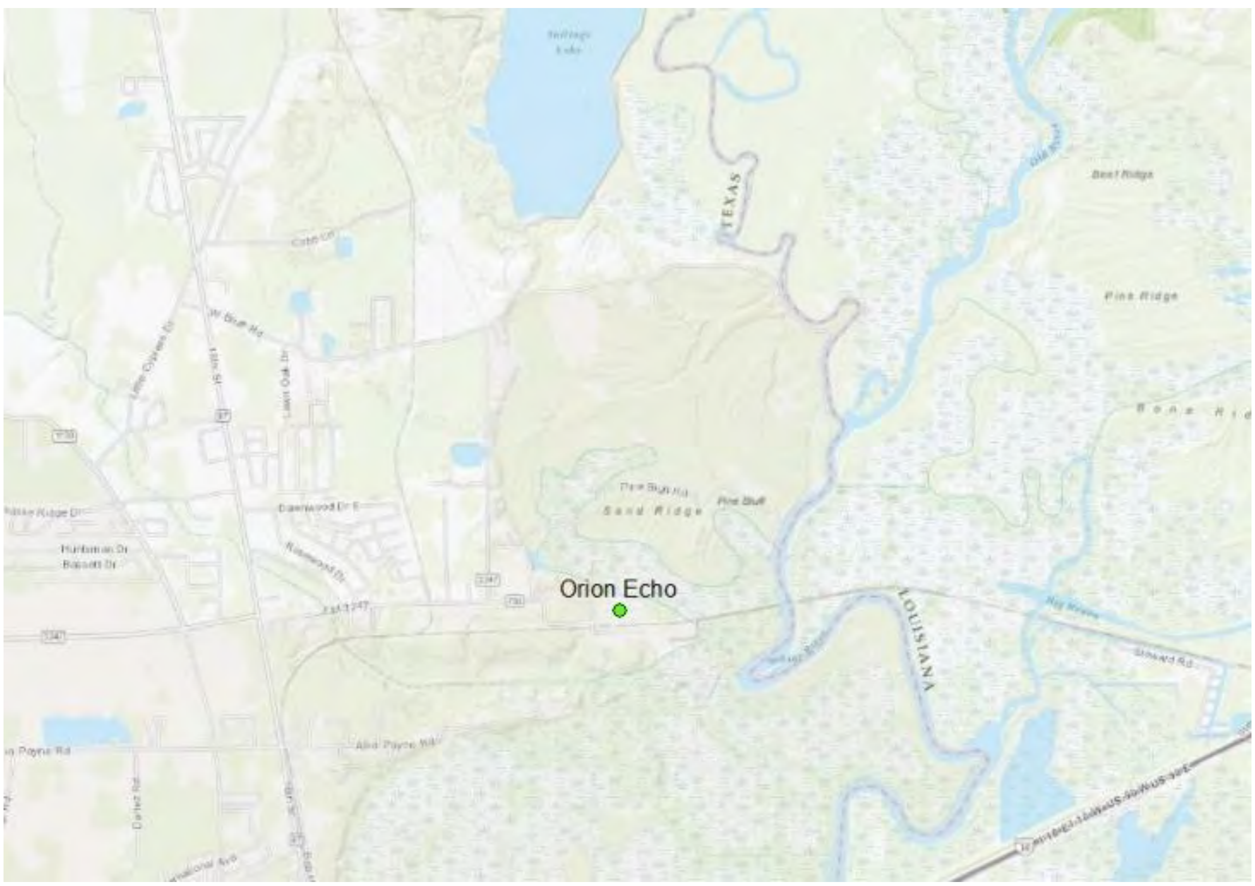


Figure 1: Orion Echo Area Elevation Map

Figure 2: Orion Sulfur Dioxide (SO_2) Stacks and Emissions, 2013

Meteorological Data

Figure 3 provides illustrations of area annual average wind speed and direction for 2012, 2013, and 2014 from meteorological sensors at the Orange County Airport, located 12 km southwest of Orion Echo. Figure 4 illustrates the 2012-2014 annual average wind speed and direction. The length of each wind rose bar corresponds to the frequency of the wind coming from the indicated direction by percentage. Based on analysis of the 2012-2014 wind data, the dominant wind flow direction is 135 degrees southeast to 205 degrees south-southeast. Approximately 26% of average annual wind flows are from the dominant wind flow direction. Over this three year period, calm winds (0-2 miles per hour) occurred 27% of the time, and wind speeds averaged 5.4 miles per hour (Iowa Environmental Mesonet 2016).

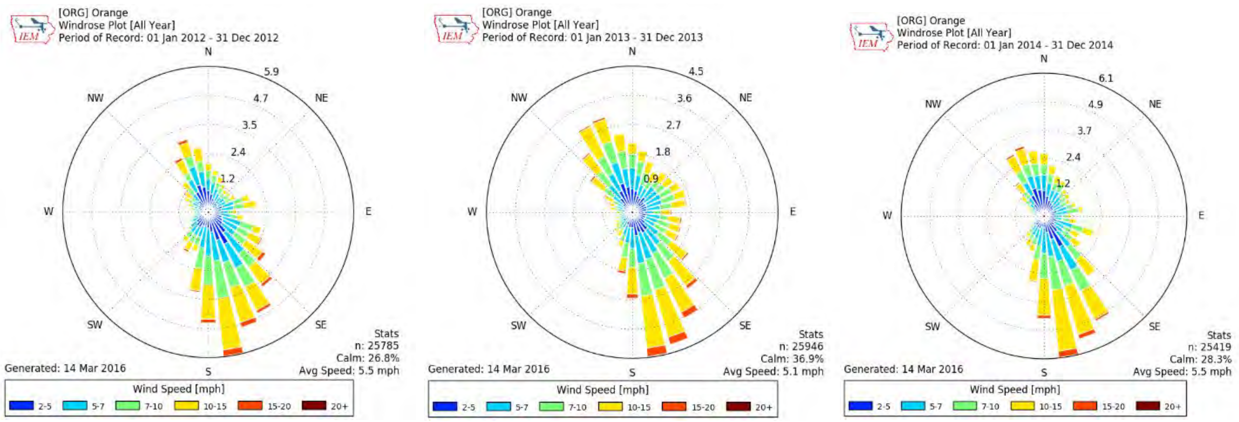


Figure 3: (From left to right) 2012, 2013, and 2014 Individual Wind Rose Plots

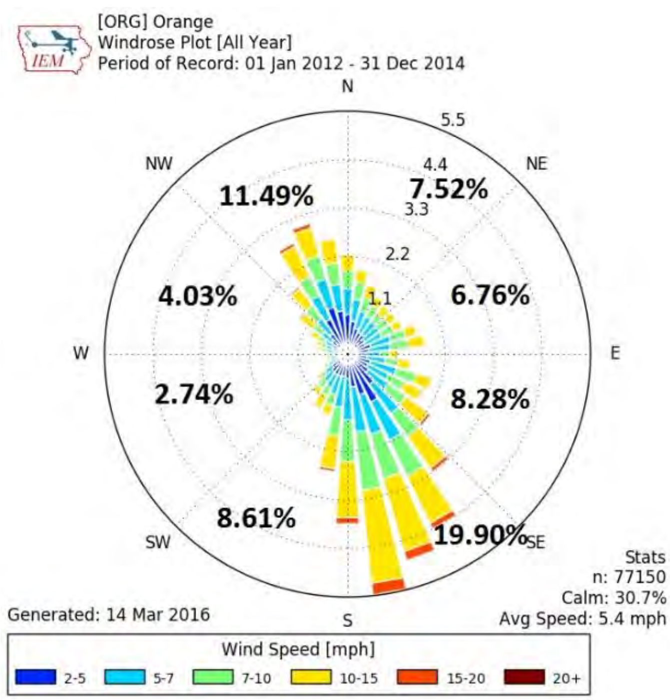


Figure 4: 2012-2014 Combined Average Wind Rose Plot

Modeling Analysis for Monitoring Site Placement

The *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistant Document* (Monitoring TAD) suggests that modeling is one technique that may be used to assist in identifying potential monitoring sites. The TCEQ's modeling for monitor placement used the Comprehensive Air Model with Extensions (CAMx) with model options set as equivalent as possible to American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The setup included the following parameterizations:

- CAMx 6.20 with speed ups and Plume-in-Grid (PiG) fix, without chemistry and without half-life decay;
- 500-m PiG sampling grid centered on the source spatially covering 72 km by 72 km;
- the kiln stacks were modeled and tracked as individual PiG puffs;
- full year of 2012 12 km gridded Weather Research and Forecasting Model (WRF) meteorology interpolated to 4 km;
- 2014 hourly point source electric generating unit (EGU) emissions; and
- 2014 annual point source non-EGU emissions from State of Texas Air Reporting System (STARS) processed down to hourly emissions.

All model outputs were normalized relative to the predicted off-property maximum concentration and therefore do not represent absolute predicted results comparable to the NAAQS. The results were then analyzed using three metrics: normalized 99th percentile concentration, normalized frequency, and a composite using both the 99th percentile and frequency metrics. The primary areas targeted for monitor placement included consideration of all three model output metrics, along with the meteorological data presented in Figures 3 and 4.

From the model outputs, normalized 99th percentile concentrations were calculated by dividing the 99th percentile daily maximum concentration for each grid cell within the modeling domain by the predicted off-property maximum concentration for the domain. The calculated results thus represent a percentage of the predicted concentrations for each grid cell to the off-property maximum. Figure 5 presents the results for the normalized 99th percentile concentration metric analysis with the location of the predicted off-property maximum indicated by a "+" symbol. Orion Echo's permitted property is outlined in black. Based on this analysis, the highest normalized concentrations, greater than 80% of the predicted off-property maximum, are expected to occur in the area approximately 0.8 km to the north of Orion Echo in a densely forested region. Swamps and dense vegetation make the area directly to the north of Orion Echo an unsuitable location to deploy an air monitoring station. The proposed monitor location identified within Figure 5 as site 21 is in an area of 75%-85% of predicted normalized off-property maximum concentrations. Site 21 is located 0.9 km southwest of the predicted off-property maximum.

To evaluate the frequency at which high concentrations may be expected, a normalized frequency metric was developed to represent the number of days the modeled concentration for each grid cell was predicted to be greater than 75% of the off-property maximum concentration. This metric was calculated by dividing the number of days the

99th percentile concentration for each grid cell was greater than 75% of the predicted off-property maximum concentration by the number of days the off-property maximum was predicted to occur. Figure 6 presents the geographic distribution of normalized frequency around Orion Echo. Again, the location of the predicted off-property maximum is indicated by a "+" symbol, and Orion Echo permitted property is outlined in black. Using this analysis metric, areas directly to the north of Orion Echo scored greater than 80% and would be expected to see the highest frequency of elevated SO_2 concentrations. This area, within Orion Echo property along with areas directly to the north, is not viable due to dense vegetation and swamps.

Finally, a composite metric was developed to aid in identifying areas where the predicted highest concentration and predicted highest frequency overlap. The composite metric was calculated at each grid cell by averaging the normalized 99th percentile concentration and normalized frequency metrics. Figure 7 illustrates the geographic distribution of the composite metric analysis results with the location of the predicted off-property maximum with a "λ" symbol, and Orion Echo permitted property is outlined in black. As with the normalized 99th percentile and normalized frequency metrics, areas within Orion Echo permitted property and areas directly to the north scored greater than 80% using the composite metric. Areas with a high composite metric were not viable due to dense vegetation and swamps.

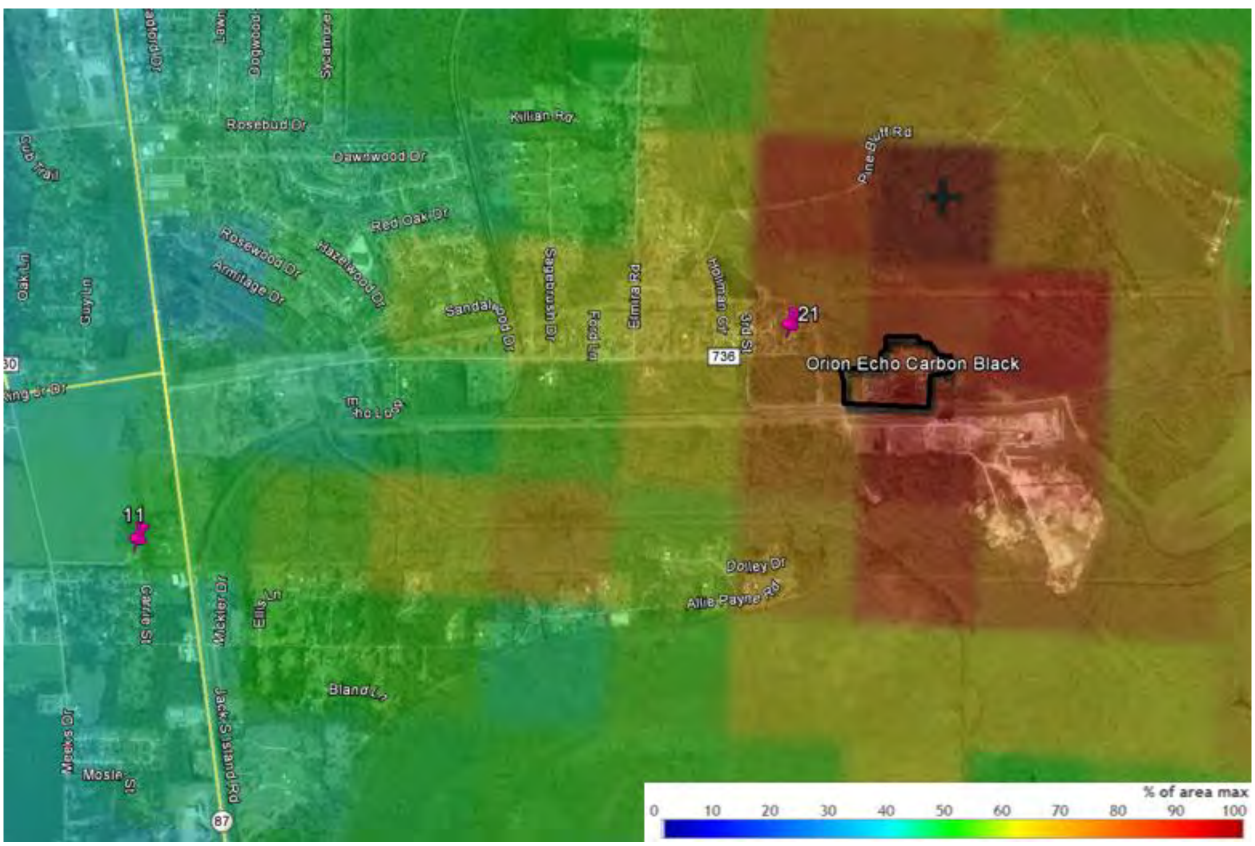


Figure 5: Orion Echo Area CAMx Model Predictions, Normalized Concentrations, and Viable Site Locations

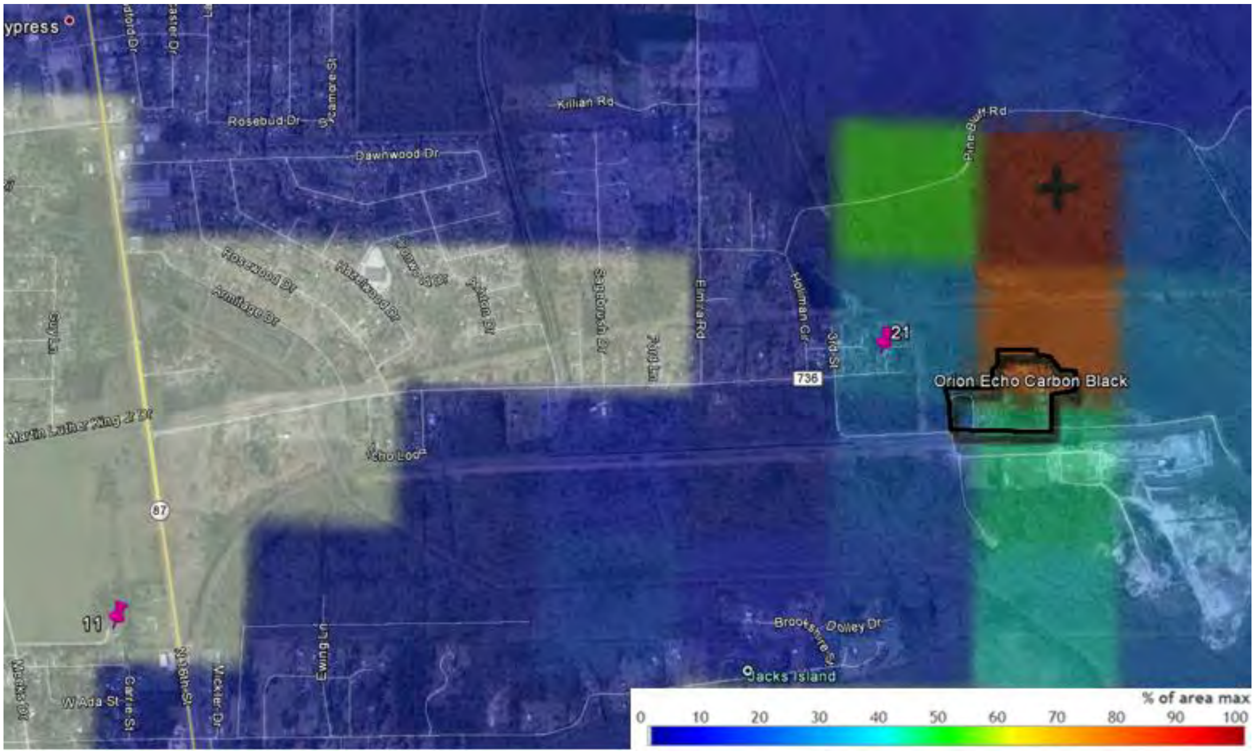


Figure 6: Orion Echo Area CAMx Model Predictions, Normalized Frequency (number of days), and Viable Site Locations

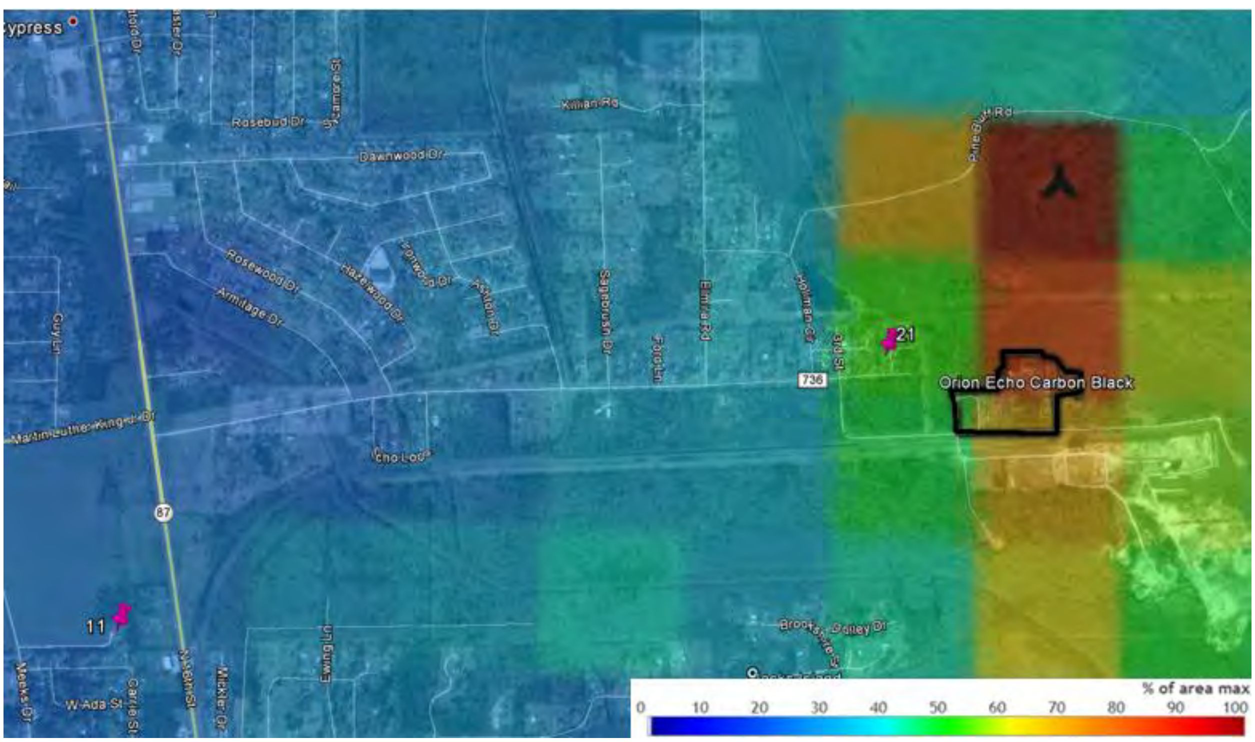


Figure 7: Orion Echo Area CAMx Model Predictions Composite Metric and Viable Site Locations

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Siting Options and Criteria

The TCEQ does not currently have SO_2 monitors located in the area surrounding Orion Echo that would be expected to characterize SO_2 concentrations from this facility; therefore a new site is proposed. The TCEQ focused on complying with the federal requirements listed in 40 Code of Federal Regulations (CFR) Part 58, Appendix E regarding siting criteria. In addition, the TCEQ evaluated monitoring site locations that would appropriately and sufficiently characterize air quality in areas around an SO_2 emissions source. This approach included utilizing multiple techniques and guidance provided in the Monitoring TAD.

The modeling analyses provided in Figures 5, 6, and 7 suggests that maximum SO_2 concentrations are expected to occur within the Orion Echo permitted area and the area directly north and northeast of Orion Echo. In addition, the highest frequency of SO_2 concentrations predicted to be greater than 75% of the off-property maximum is expected directly north of Orion Echo over a densely forested region. The TCEQ determined that the necessary space and stable ground to support a monitoring site in this area was nonexistent.

Twenty-one potential sites were identified as shown in Figure 8. A summary of all potential sites is shown in Table 2. The TCEQ was unable to explore regions to the north and east of Orion Echo due to an expansive forest and swamp terrain that encompasses the entire area. Nineteen of the potential sites (sites 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, and 20) are not considered viable and are indicated by red pins in Figure 8. Flood plains or obstructions made sites 1, 2, 3, 5, 12, 13, 17, and 20 unsuitable for monitor placement. Property owners at sites 4, 7, 8, 9, 10, 14, 16, 18, and 19 either were unwilling to negotiate a site agreement or were unresponsive. Site 6, located approximately 2.8 km from the source, contained numerous underground pipelines and associated easements. Site 15, located approximately 3.2 km from the source, is currently for sale by the owner. As a result, these sites are no longer under consideration.

The two sites with amenable property owners and satisfactory logistical and siting characteristics are sites 11 and 21. These site locations are identified with a pink pin on the model and satellite image overlays in Figures 5, 6, 7, and 8.

- Site 11 is positioned approximately 3.2 km southwest of Orion Echo. This site is downwind of Orion Echo approximately 7% of the time when wind flows from the northeast. The area is level and has available space and power. The normalized 99th percentile concentration metric analysis predicted concentrations in this area to be 45%-55% of maximum concentrations. The property owner is amenable to a site agreement
- Site 21 is positioned approximately 0.5 km northwest of Orion Echo. This site is downwind of Orion Echo approximately 20% of the time when winds flow from the south-southeast. The area is level and has available space and power. The normalized 99th percentile concentration metric analysis predicted concentrations in this area to be 70%-80% of maximum concentrations. A site agreement has been negotiated with the property owner.

Recommendation

Based on current facility operations, available emissions data, wind patterns, and modeling analysis, site 21 (see Figures 9 and 10) is the recommended location for placement of a new source-oriented ambient SO_2 monitoring station. Site 21 is indicated by a pink pin in Figures 5, 6, 7, and 8. Site 21 is positioned downwind of Orion Echo and is expected to monitor a greater frequency of maximum concentrations than site 11. Located in an area with predicted maximum normalized SO_2 concentrations between 70% and 80%, site 21 has available power, level ground, and meets all federal siting criteria. A site agreement has been negotiated with the property owner.

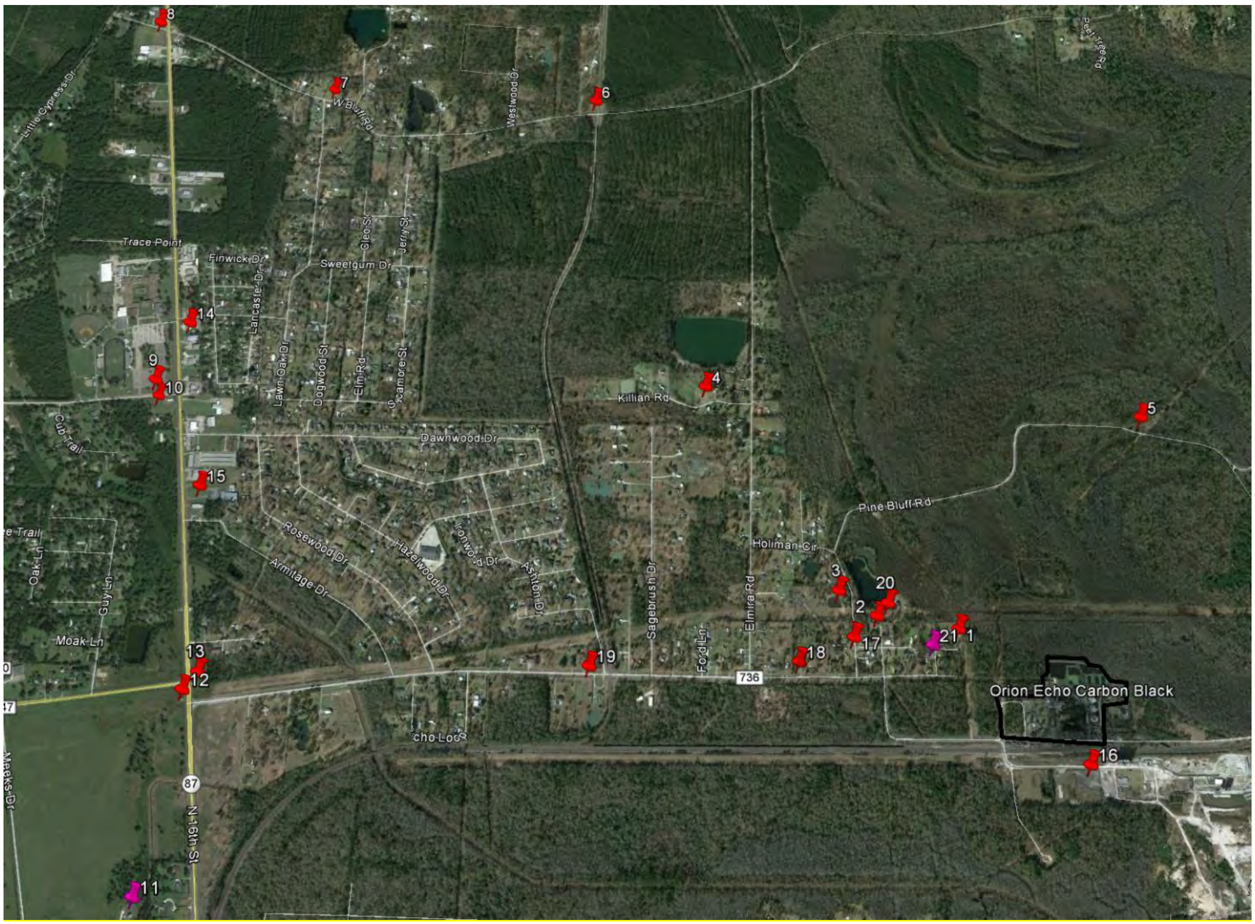


Figure 8: Potential Air Monitoring Sites for Orion Echo

Table 2: Potential Sites Assessment[1]

Site Number	Orion Echo #1	Orion Echo #2	Orion Echo #3
Location[2]	30.15395, -93.72501	30.15459, -93.72767	30.15491, -93.72866
Distance from SO_2 Source[2]	438 m	709 m	870 m
Wind Direction	S, SE (dominant)	S, SE (dominant)	S, SE (dominant)
Grade	>2%	<1%	>2%
Flood Plains	Yes	No	Yes
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	Yes; pond (NW)	Yes; pond (N)	Yes; ponds (NE, NW)
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	Yes (NW)
Obstructions and Height	Tree (17-20 m)	Trees (20 m)	Trees (20 m)
Distance from Site to Obstructions	Tree (30 m S to dripline)	Trees (7 m N to dripline), Trees (7 m W to dripline), Trees 7 m S to dripline)	Trees (30 m to dripline in all directions)
Road/Site Access	Yes	Yes	No
Electricity Available <18 m	No	No	No
Pros	• Downwind • Space available • Close proximity to source • High SO_2 modeling	• Downwind • Space available • Level ground • High SO_2 modeling	• Downwind • High SO_2 modeling
Cons	• Uneven terrain • No power available • Flood prone	• Numerous obstructions • No power available	• Flood prone • Numerous obstructions • No power available • Uneven terrain • No access
Viable Site (yes, no, or preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Orion Echo #4	Orion Echo #5	Orion Echo #6
Location[2]	30.16163, -93.73438	30.16137, -93.71763	30.17233, -93.73891
Distance from SO_2 Source[2]	1,670 m	1,050 m	2,830 m
Wind Direction	S, SE (dominant)	S, SE (dominant)	S, SE (dominant)
Grade	<1%	<1%	>2%
Flood Plains	No	Yes	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	Yes; ponds (N, SW, SE)	No	Yes; ponds (W, NW)
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	No (NNE)	Yes (NW)
Obstructions and Height	Trees (10-13 m)	Trees (25 m)	Trees (20 m)
Distance from Site to Obstructions	Tree (20 m SE from dripline), Trees (15 m SW from dripline)	Trees (30 m W to dripline), Trees (30 m W to dripline), Trees (30 m E to dripline)	Trees (28 m NW, 47 m SE)
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Downwind • Level ground • Power available	• Level ground • Power available • High SO_2 modeling	• Downwind • Space available • Level ground • Power available
Cons	• Unresponsive property owner • Low SO_2 modeling • Numerous obstructions	• Flood prone • Not downwind • Numerous obstructions	• Existing underground pipelines • Low SO_2 modeling
Viable Site (yes, no, or preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Orion Echo #7	Orion Echo #8	Orion Echo #9
Location[2]	30.17244, -93.74998	30.17496, -93.75784	30.16119, -93.75614
Distance from SO_2 Source[2]	3,570 m	4,320 m	3,470 m
Wind Direction	S, SE (dominant)	S, SE (dominant)	S, SE (dominant)
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	Yes; ponds (NE, E)	Yes; pond (E)	Yes; pond (S)
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (NW)	Yes (NW)
Obstructions and Height	Trees (13 m)	None	None
Distance from Site to Obstructions	Trees (23 m W to dripline), Trees (23 m E to dripline)	NA	NA
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Downwind • Level ground • Power available	• Downwind • Level ground • Power available	• Downwind • Level ground • Power available
Cons	• Property owner declined • Numerous obstructions • Low SO_2 modeling	• Property owner declined • Low SO_2 modeling	• Property owner declined • No space available • Low SO_2 modeling
Viable Site (yes, no, or preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Orion Echo #10	Orion Echo #11	Orion Echo #12
Location[2]	30.16076, -93.75513	30.14519, -93.75350	30.15128, -93.75278
Distance from SO_2 Source[2]	3,435 m	3,244 m	3,076 m
Wind Direction	S, SE (dominant)	S, SE (dominant)	S, SE (dominant)
Grade	<1%	<1%	>1%
Flood Plains	No	No	Yes
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	Yes; pond (S)	Yes; pond (N)	Yes; pond (NW)
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	No (SW)	No (W)
Obstructions and Height	None	Building (5 m), Building (5 m)	None
Distance from Site to Obstructions	NA	Building (15 m E), Building (15 m E)	NA
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Downwind • Space available • Level ground • Power available	• Space available • Level ground • Power available • Agreeable property owner	• Power available
Cons	• Property owner declined • Low SO_2 modeling	• Not downwind • Low SO_2 modeling • Numerous obstructions	• Slight grade in surrounding area • Not downwind • Existing underground pipelines • Flood prone • Low SO_2 modeling
Viable Site (yes, no, or preferred)	No	Yes	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Orion Echo #13	Orion Echo #14	Orion Echo #15
Location[2]	30.15178, -93.75232	30.16333, -93.75449	30.15774 -93.75321
Distance from SO_2 Source[2]	3,028 m	3,452 m	3,168 m
Wind Direction	S, SE (dominant)	S, SE (dominant)	S, SE (dominant)
Grade	>1%	<1%	<1%
Flood Plains	Yes	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	Yes; pond (NW)	Yes; pond (SW)	Yes; ponds (W, SW)
Wind Channeling	None	None	None
Downwind[2]	No (W)	Yes (NW)	Yes (NW)
Obstructions and Height	None	None	None
Distance from Site to Obstructions	NA	NA	NA
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Power available	• Downwind • Level ground • Power available	• Downwind • Level ground • Power available • Space available
Cons	• Slight grade in surrounding area • Not downwind • Existing underground pipelines • Flood prone • Low SO_2 modeling	• Property owner declined • Low SO_2 modeling	• Property is for sale • Low SO_2 modeling
Viable Site (yes, no, or preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	Orion Echo #16	Orion Echo #17	Orion Echo #18
Location[2]	30.15029, -93.72044	30.15383, -93.72877	30.15298, -93.73077
Distance from SO_2 Source[2]	242 m	775 m	953 m
Wind Direction	S, SE (dominant)	S, SE (dominant)	S, SE (dominant)
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	Yes; pond (NW), river (E)	Yes; ponds (N)	Yes; ponds (NE)
Wind Channeling	None	None	None
Downwind[2]	No (S)	Yes (NW)	No (W)
Obstructions and Height	None	Trees (20 m)	Tree (15 m)
Distance from Site to Obstructions	N/A	Tree (27 m NW to dripline), Tree (45 m W to dripline)	Tree 19 m (NE to dripline)
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	No	Yes	No
Pros	• Space available • Level ground • Close proximity to source • High SO_2 modeling	• Downwind • Space available • Level ground • Close proximity to source • Power available	• Level ground • Close to source • Easy site access
Cons	• No power available • Not downwind • Potential interference from railroad • Property owner declined	• Numerous obstructions • Low SO_2 modeling	• Property owner declined • Not downwind • No space available • No power available • Numerous obstructions • Low SO_2 modeling
Viable Site (yes, no, or preferred)	No	No	No

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Site Number	**Orion Echo #19**	**Orion Echo #20**	**Orion Echo #21**
Location[2]	30.15255, -93.73833	30.15495, -93.72751	30.15369, -93.72592
Distance from SO_2 Source[2]	1,680 m	698 m	503 m
Wind Direction	S, SE (dominant)	S, SE (dominant)	S, SE (dominant)
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	Yes; ponds (N, S)	Yes; lake (N)	Yes; ponds (NW, E)
Wind Channeling	None	None	None
Downwind[2]	No (W)	Yes (NW)	Yes (NW)
Obstructions and Height	None	Trees (10 m)	Trees (10 m)
Distance from Site to Obstructions	NA	Trees (10 m N to dripline), Trees (10 m W to dripline)	Trees (15 m N to dripline), Tree (18 m S to dripline), Trees (23 m W to dripline)
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Level ground • Power available	• Downwind • Level ground • Power available • High SO_2 modeling	• Downwind • Level ground • Power available • Close to source • High SO_2 modeling
Cons	• Unresponsive property owner • Low SO_2 modeling • Not downwind	• Existing underground pipelines • Numerous obstructions	• Numerous obstructions
Viable Site (yes, no, or preferred)	No	No	Preferred

[1]Based on 40 Code of Federal Regulations Part 58 and *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document*
[2]Based on Google Earth
% – percent
N – north
S – south
E – east
W – west
NA – not applicable
NNE – north-northeast
NW – northwest
SE – southeast
SW – southwest
m – meter
– number
< – less than
> – greater than
SO_2 – sulfur dioxide

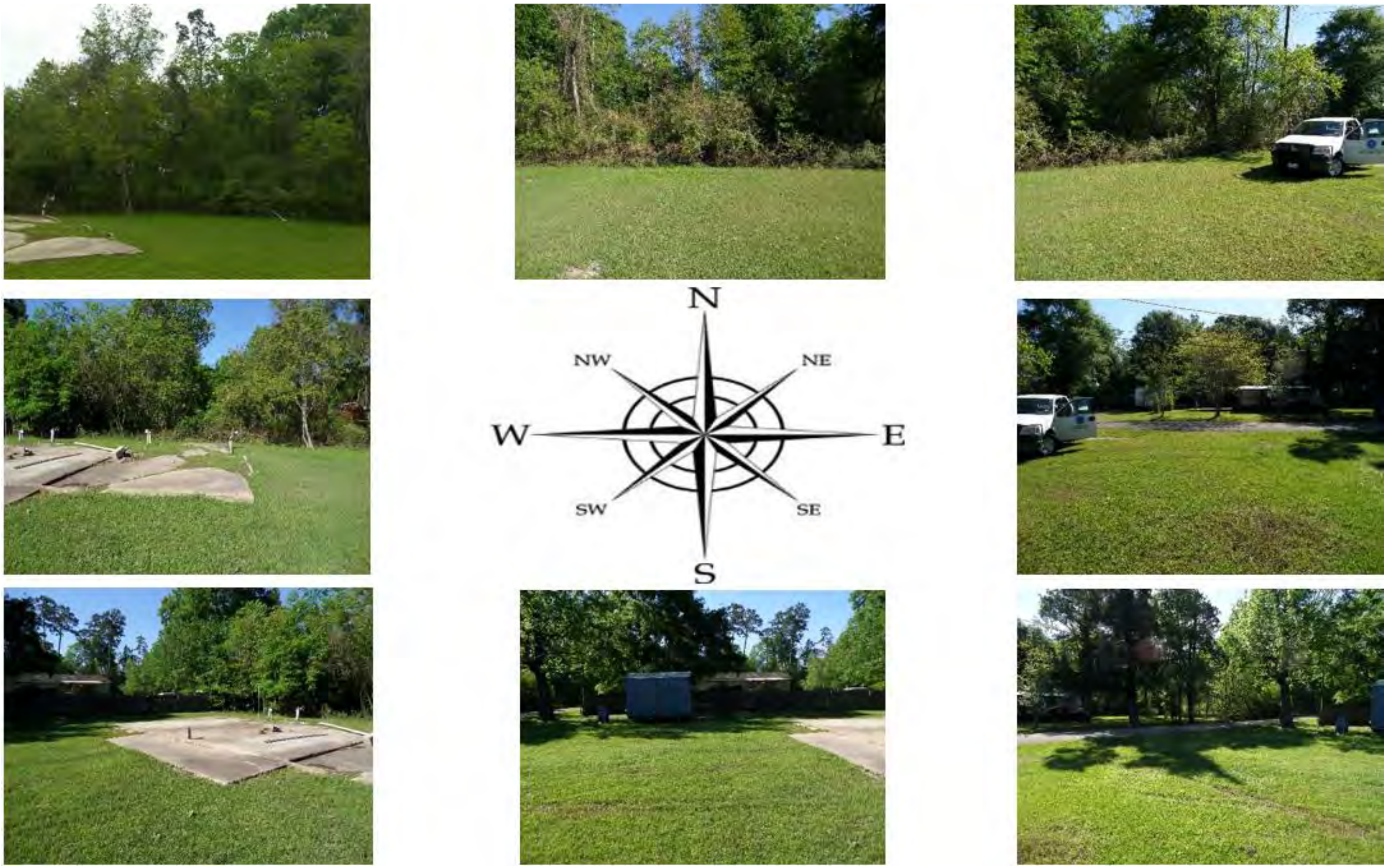


Figure 9: Orion Echo #21 Potential Site Cardinal Direction Photos

Figure 10: Orion Echo #21 Potential Site Location

References

Wermund, E.G., *Physiographic Map of Texas*, The University of Texas at Austin Bureau of Economic Geology, 1996.

"IEM : Site Locator." Iowa Environmental Mesonet. 2016. Accessed April 06, 2016. https://mesonet.agron.iastate.edu/sites/locate.php?network=TX_ASOS.

Harrington Station Power Plant Monitor Placement Evaluation

Source Information

- Name: Harrington Station Power Plant (Harrington Station) (Figure 2)
- Owner: Southwestern Public Service Company
- Facility function: electric generation
- Location: 35.29920, -101.74700, Texas Commission on Environmental Quality (TCEQ) Region 1, Potter County, Texas
- Sulfur dioxide (SO_2) emissions data: 15,349 tons (2012), 14,309 tons (2013), 15,465 tons (2014)
- Long-term emissions trend: decreasing, 44 percent (%) decrease from 2004 through 2014
- Emission profile: operational year-round
- Stack height(s): three stacks; stack 1-1, 76 meters (m), stacks 2-1 and 3-1, 91 m
- SO_2 emission controls: none
- Permit related data: Federal Operating Permit, Prevention of Significant Deterioration (PSD) permit #PSDTX017M2 and #PSDTX631M1

Existing Air Monitoring Sites

The TCEQ operates six ambient air monitoring sites within a 25 kilometer (km) radius of Harrington Station. Table 1 details the sites in order of proximity. Maximum SO_2 ground level concentrations can be expected within close proximity to the source. One of these locations is currently monitoring SO_2 (Amarillo 24th Avenue) and has a design value below the current SO_2 standard of 75 parts per billion (ppb). None of the six sites around Harrington Station are positioned downwind or within reasonable proximity to the source to characterize maximum SO_2 concentrations.

Table 1: Air Monitoring Sites near Harrington Station

Site	Distance from Harrington Station	Current Sulfur Dioxide (SO_2) Monitoring	SO_2 Design Value (2013–2015)
Amarillo SH 136	3.5 km southwest	No	Not applicable
Amarillo 24th Avenue	7.8 km southwest	Yes	22 parts per billion
Pantex 4	15 km northeast	No	Not applicable
Pantex 5	16 km northeast	No	Not applicable
Amarillo A & M	18 km southwest	No	Not applicable
Pantex 7	19 km north	No	Not applicable

km – kilometer
& – and
SH – state highway

Settings and Surroundings

The rural and suburban areas surrounding Harrington Station consist of the Llano Estacado ecoregion of the high prairies of north Texas. This area is characterized by level, treeless expanses and arid conditions (Griffith et al. 2004). The elevation ranges from 1066 to 1095 meters as shown in Figure 1. Several small bodies of water surround Harrington Station, with river channels running to the west. No significant changes to the landscape were noted during the reconnaissance as compared to the satellite image shown in Figure 8. Mountain and valley wind channeling or other terrain related meteorological impacts are not expected in this area.

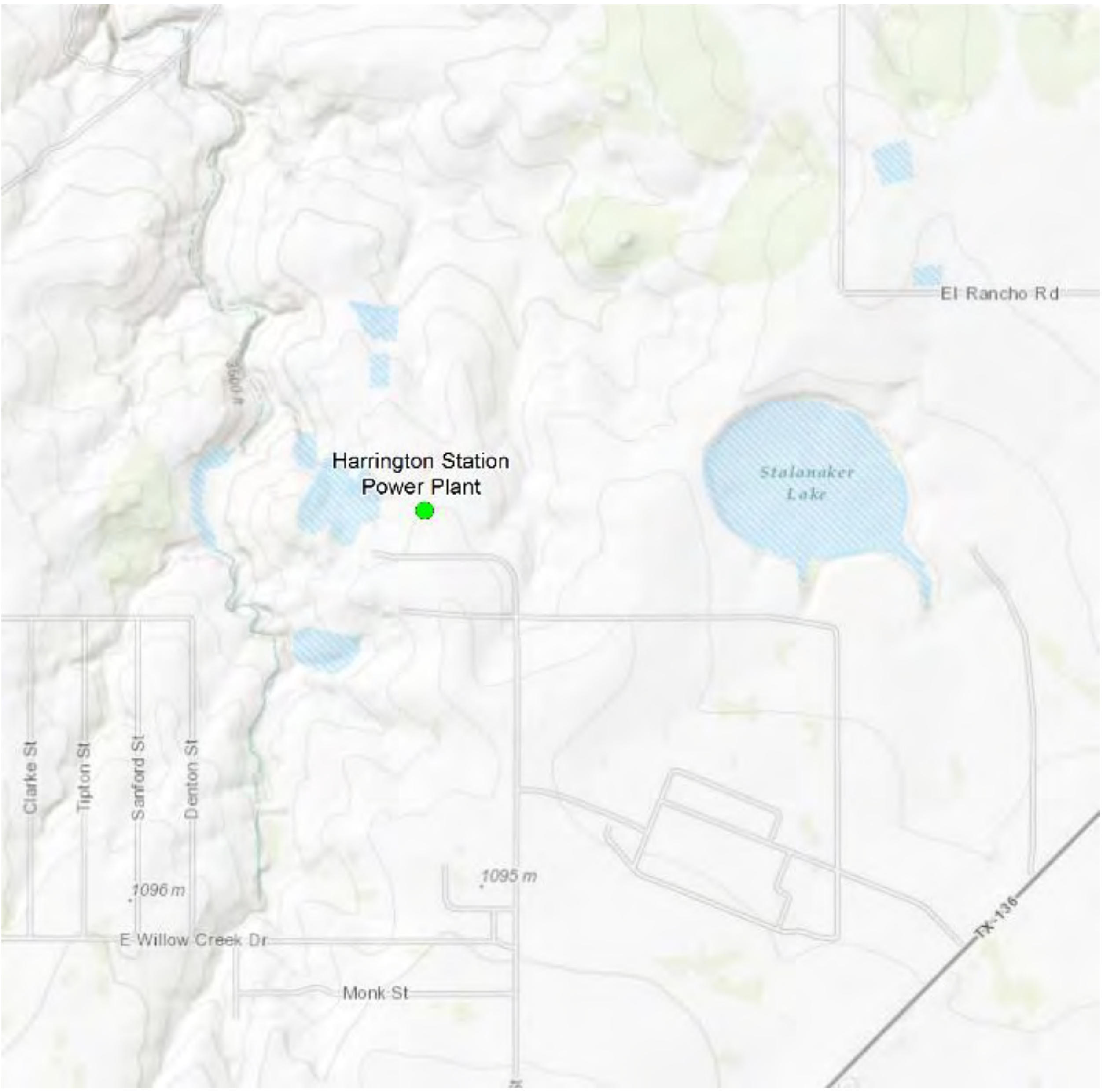


Figure 1: Harrington Station Area Elevation Map

Appendix E: Sulfur Dioxide Data Requirements Rule Monitor Placement Evaluations

Figure 2: Harrington Station Sulfur Dioxide (SO_2) Stacks and Emissions, 2013

Meteorological Data

Figure 3 provides illustrations of area annual average wind speed and direction for 2012, 2013, and 2014 from meteorological sensors at the Amarillo Airport located 8 km southeast of Harrington Station. Figure 4 illustrates the 2012-2014 annual average wind speed and direction. The length of each wind rose bar corresponds to the frequency of the wind coming from the indicated direction by percentage. Based on analysis of the 2012-21014 wind data, the dominant wind flow direction is 135 degrees southeast to 235 degrees southwest. Approximately 45% of average annual wind flows are from the dominant wind flow direction. Calm winds (0-2 miles per hour) occurred on average 3.9% of the time, and wind speeds averaged 13.3 miles per hour (Iowa Environmental Mesonet 2016).

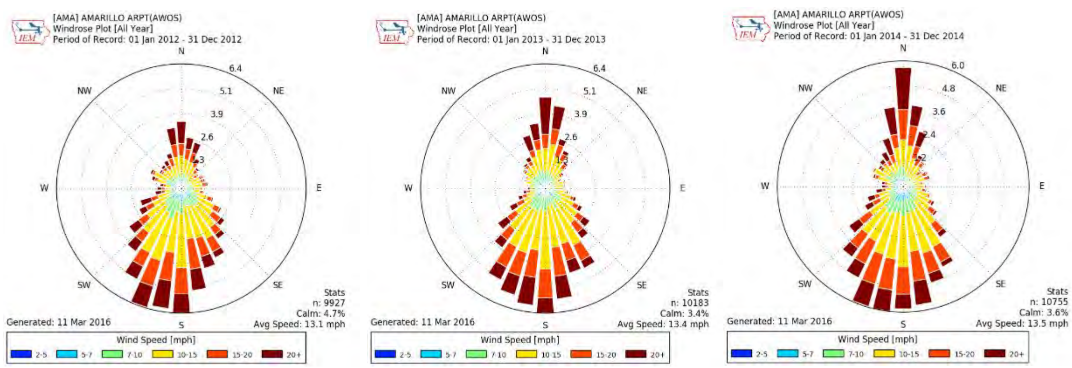


Figure 3: (From left to right) 2012, 2013, and 2014 Individual Wind Rose Plots

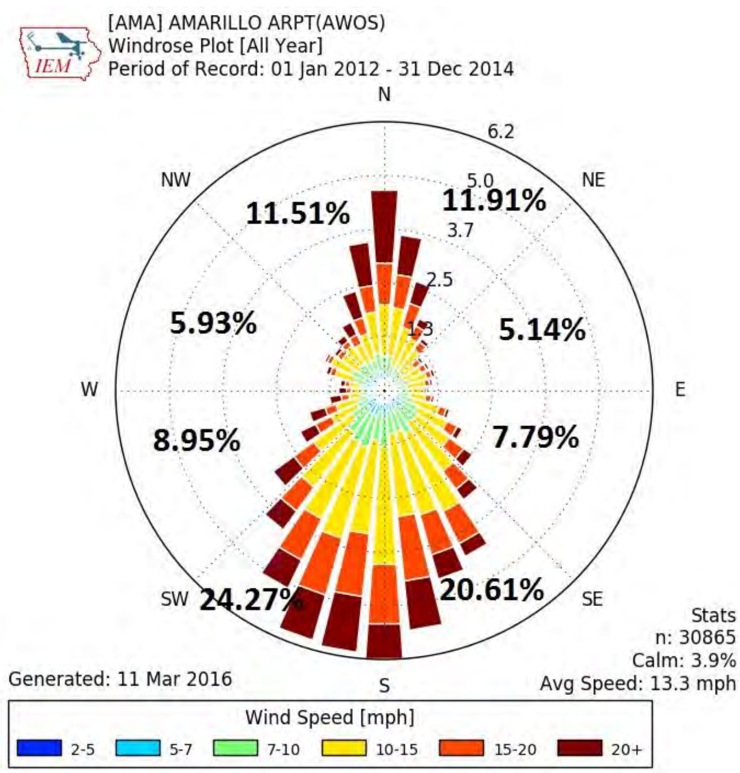


Figure 4: 2012-2014 Combined Average Wind Rose Plot

Modeling Analysis for Monitoring Site Placement

The *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistant Document* (Monitoring TAD) suggests that modeling is one technique that may be used to assist in identifying potential monitoring sites. The TCEQ's modeling for monitor placement used the Comprehensive Air Model with Extensions (CAMx) with model options set as equivalent as possible to American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The setup included the following parameterizations:

- CAMx 6.20 with speed ups and Plume-in-Grid (PiG) fix, without chemistry and without half-life decay;
- 500-meter PiG sampling grid centered on the source spatially covering 72 km by 72 km;
- the three kiln stacks were modeled and tracked as individual PiG puffs;
- full year of 2012 12 km gridded Weather Research and Forecasting Model (WRF) meteorology interpolated to 4 km;
- 2014 hourly point source electric generating unit (EGU) emissions; and
- 2014 annual point source non-EGU emissions from State of Texas Air Reporting System (STARS) processed down to hourly emissions.

All model outputs were normalized relative to the predicted off-property maximum concentration and therefore do not represent absolute predicted results comparable to the NAAQS. The results were then analyzed using three metrics: normalized 99th percentile concentration, normalized frequency, and a composite using both the 99th percentile and frequency metrics. The primary areas targeted for monitor placement included consideration of all three model output metrics, along with the meteorological data presented in Figures 3 and 4.

From the model outputs, normalized 99th percentile concentrations were calculated by dividing the 99th percentile daily maximum concentration for each grid cell within the modeling domain by the predicted off-property maximum concentration for the domain. The calculated results thus represent a percentage of the predicted concentrations for each grid cell to the off-property maximum. Figure 5 presents the results for the normalized 99th percentile concentration metric analysis with the location of the predicted off-property maximum indicated by a "+" symbol. Harrington Station's permitted property is outlined in black. Based on this analysis, the highest normalized concentrations, greater than 95% of the predicted off-property maximum, are expected 2.5 km north-northeast of Harrington Station's permitted property. This area is located on a water retention and overflow area that is not viable for monitor placement based on site reconnaissance and property owner discussions. However, the proposed monitor location identified in Figure 5 as site 1 is in an area of predicted normalized concentrations within 85% to 90% of the off-property maximum.

To evaluate the frequency at which high concentrations may be expected, a normalized frequency metric was developed to represent the number of days the modeled concentration for each grid cell was predicted to be greater than 75% of the off-property maximum concentration. This metric was calculated by dividing the number of days the 99th percentile concentration for each grid cell was greater than 75% of the predicted off-

property maximum concentration by the number of days the off-property maximum was predicted to occur. Figure 6 presents the geographic distribution of normalized frequency around the Harrington Station facility. Again, the location of the predicted off-property maximum is indicated by a "+" symbol, and Harrington Station's permitted property is outlined in black. Using this analysis metric, the area 2.3 km to the north of the Harrington Station facility scored greater than 90% and would be expected to see the highest frequency of elevated SO_2 concentrations. This area is not viable for monitor placement due to lack of power and public access.

Finally, a composite metric was developed to aid in identifying areas where the predicted highest concentration and predicted highest frequency overlap. The composite metric was calculated at each grid cell by averaging the normalized 99th percentile concentration and normalized frequency metrics. Figure 7 illustrates the geographic distribution of the composite metric analysis results with the location of the predicted off-property maximum with a "λ" symbol, and Harrington Station's permitted property is outlined in black. Similar to the normalized frequency metric, the area 2.3 km north of Harrington Station scored greater than 90% using the composite metric. However, based on the TCEQ's site reconnaissance, areas with the highest composite metric score did not yield a viable location for monitor placement.

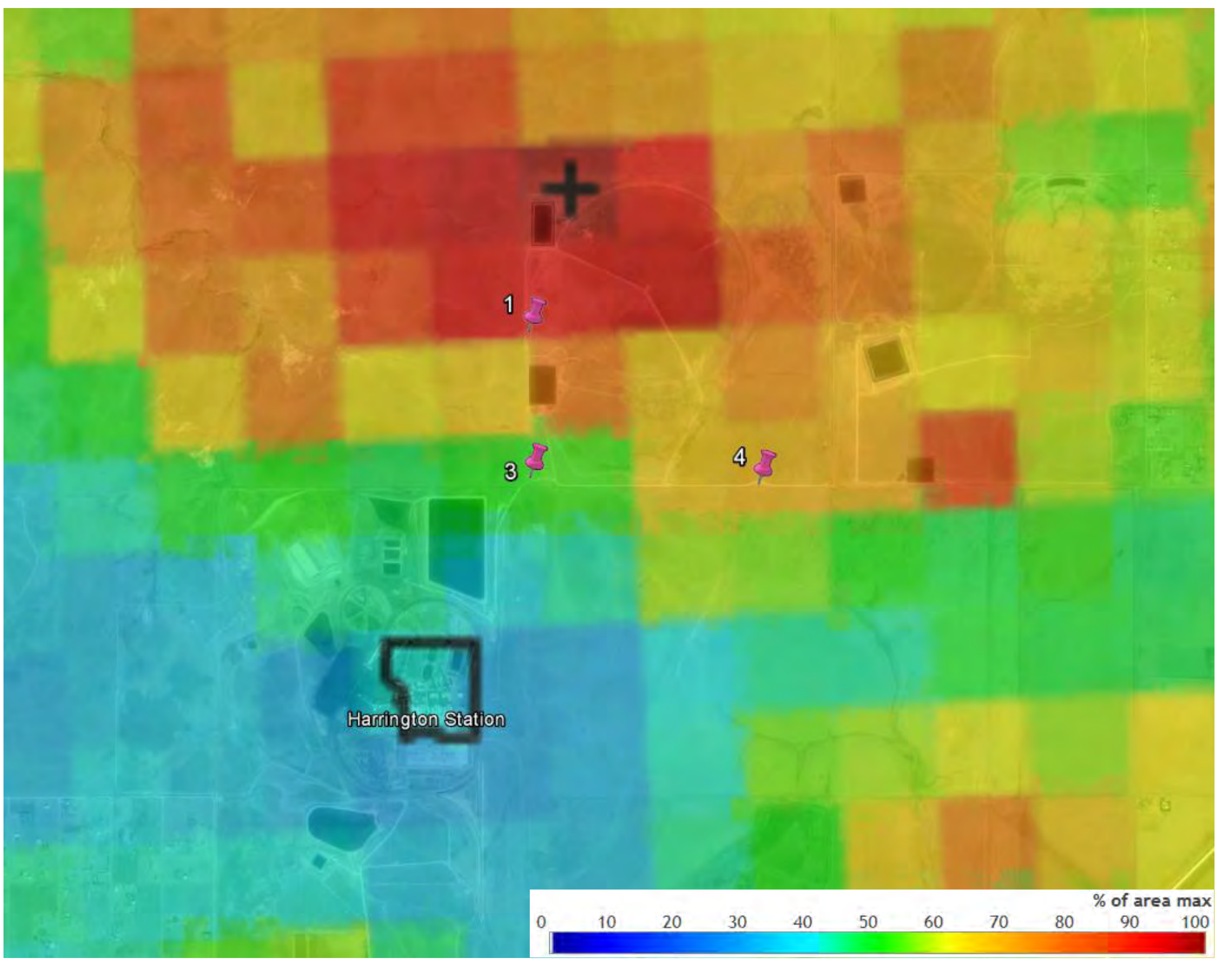


Figure 5: Harrington Station Area CAMx Model Predictions, Normalized 99th Percentile Concentrations, and Viable Site Locations (1, 3, 4)

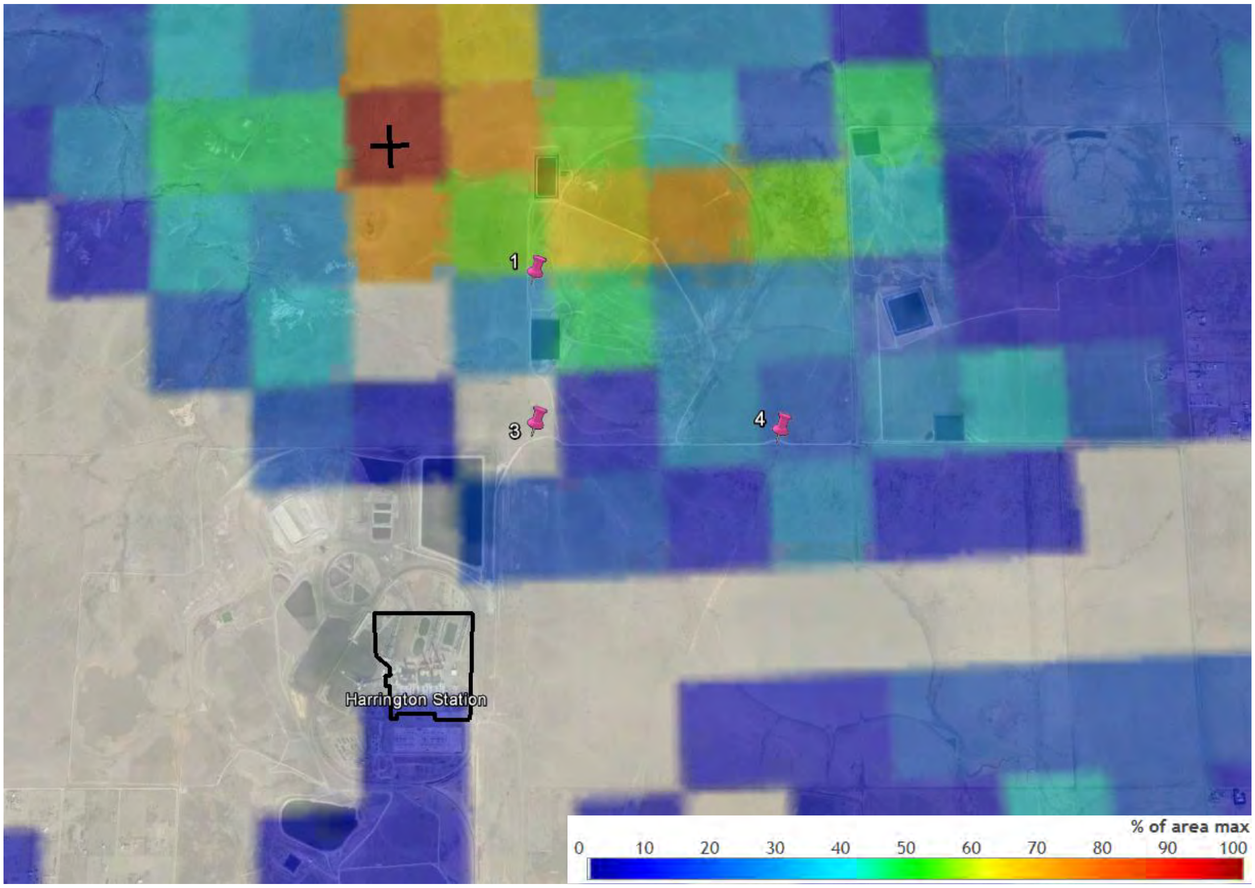


Figure 6: Harrington Station Area CAMx Model Predictions, Normalized Frequency (Number of Days), and Viable Site Locations (1, 3, 4)

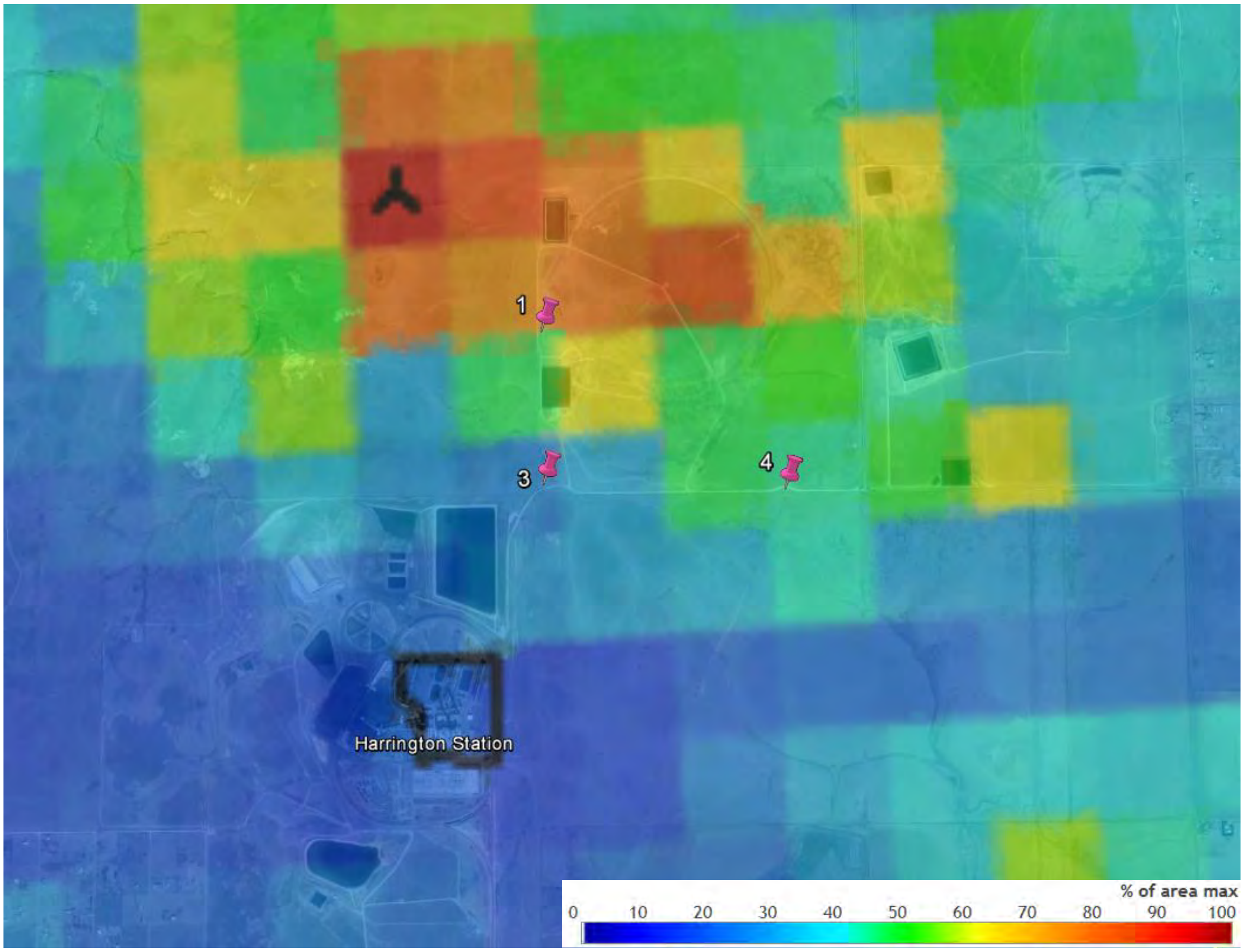


Figure 7: Harrington Station Area CAMx Model Predictions Composite Metric and Viable Site Locations (1, 3, 4)

Siting Options and Criteria

The TCEQ does not currently have SO_2 monitors located in the area surrounding Harrington Station that would be expected to characterize the highest SO_2 concentrations from this facility; therefore a new site is proposed. The TCEQ focused on complying with the federal requirements listed in 40 Code of Federal Regulations (CFR) Part 58, Appendix E regarding siting criteria. In addition, the TCEQ evaluated monitoring site locations that would appropriately and sufficiently characterize air quality in areas around an SO_2 emissions source. This approach included utilizing multiple techniques and guidance provided in the Monitoring TAD.

The modeling analyses provided in Figures 5, 6, and 7 suggest that maximum SO_2 concentrations are expected to occur north-northeast of Harrington Station. In addition, the highest frequency of SO_2 concentrations predicted to be greater than 95% of the off-property maximum is expected directly north of the Harrington Station facility. Figure 8 depicts all potential site locations (red and pink pins), their corresponding property lines (blue), Harrington Station's permitted property line (black), and Stalanaker Lake (purple). The area in the figure outlined in yellow is prone to flooding, the area outlined in white has no public access, and the area outlined in orange has no power. The property surrounding Stalanaker Lake has been leased for agricultural use. These areas are nonviable for monitor placement. Areas to the west and north of the blue property line containing sites 1, 2, and 3 have no power and no public access; these areas are nonviable monitor site locations.

Six potential sites were identified north-northeast and northeast of Harrington Station as shown in Figure 8. Three of the identified potential sites (2, 5, and 6) are not considered viable and are indicated by red pins. Site 2 has uneven terrain. Site 5 has uneven terrain and is prone to flooding. After consideration, the property owner of site 6 declined an air monitoring station on the property. As a result, these potential sites are no longer under consideration.

The three sites with satisfactory logistical and siting characteristics, located in areas anticipated to have peak concentrations, are sites 1, 3, and 4. These sites are located with a pink pin on the model and satellite image overlays shown in figures 5, 6, 7, and 8.

- Site 1 is positioned north-northeast and approximately 1.9 km from Harrington Station. This potential site is downwind and provides level ground, adequate space, and available power. This location also rests on top of a hill where up-slope air flow is maximized. The normalized 99^{th} percentile concentration metric analysis predicted concentrations in this area to be 85%-90% of the maximum concentrations. A site agreement has been negotiated with the property owner.
- Site 3 is located north-northeast of Harrington Station. This site is approximately 1.2 km from the source and is downwind. The site has adequate space and available power. However, this site is prone to flooding and is located in a low-lying area. Normalized 99^{th} percentile concentration metric analysis predicted this area to be 45%-50% of the maximum concentrations.
- Site 4 is located northeast and approximately 2.0 km from Harrington Station. The site offers level ground, available space, and power. The normalized 99^{th}

percentile concentration metric analysis predicted concentrations in this area are 60% of the maximum concentrations.

Recommendation

Based on property owner cooperation, current facility operations, available emission data, wind patterns, logistics, and modeling analyses, site 1 (Figures 9 and 10) is the recommended location for placement of a new source-oriented ambient SO_2 monitoring station. Although site 1 and 4 have comparable siting logistics, historical meteorological data from 2012-14 (Figure 4) indicates site 4 averaged winds from the source approximately 9% of the year, compared to 24% for site 1.

Site 1 is the closest viable site to the off-property maximums for all three modeling analyses performed. Despite the proximity of site 3 to the source and similar winds to site 1, geographic influences (elevation) contributed to site 3 receiving the lowest scores on each modeling analysis. Site 3 is also prone to flooding. Based on historical meteorological data and modeling, site 1 is expected to characterize maximum off-property SO_2 concentrations and meets all logistical and federal siting criteria. A site agreement has been negotiated with the property owner.

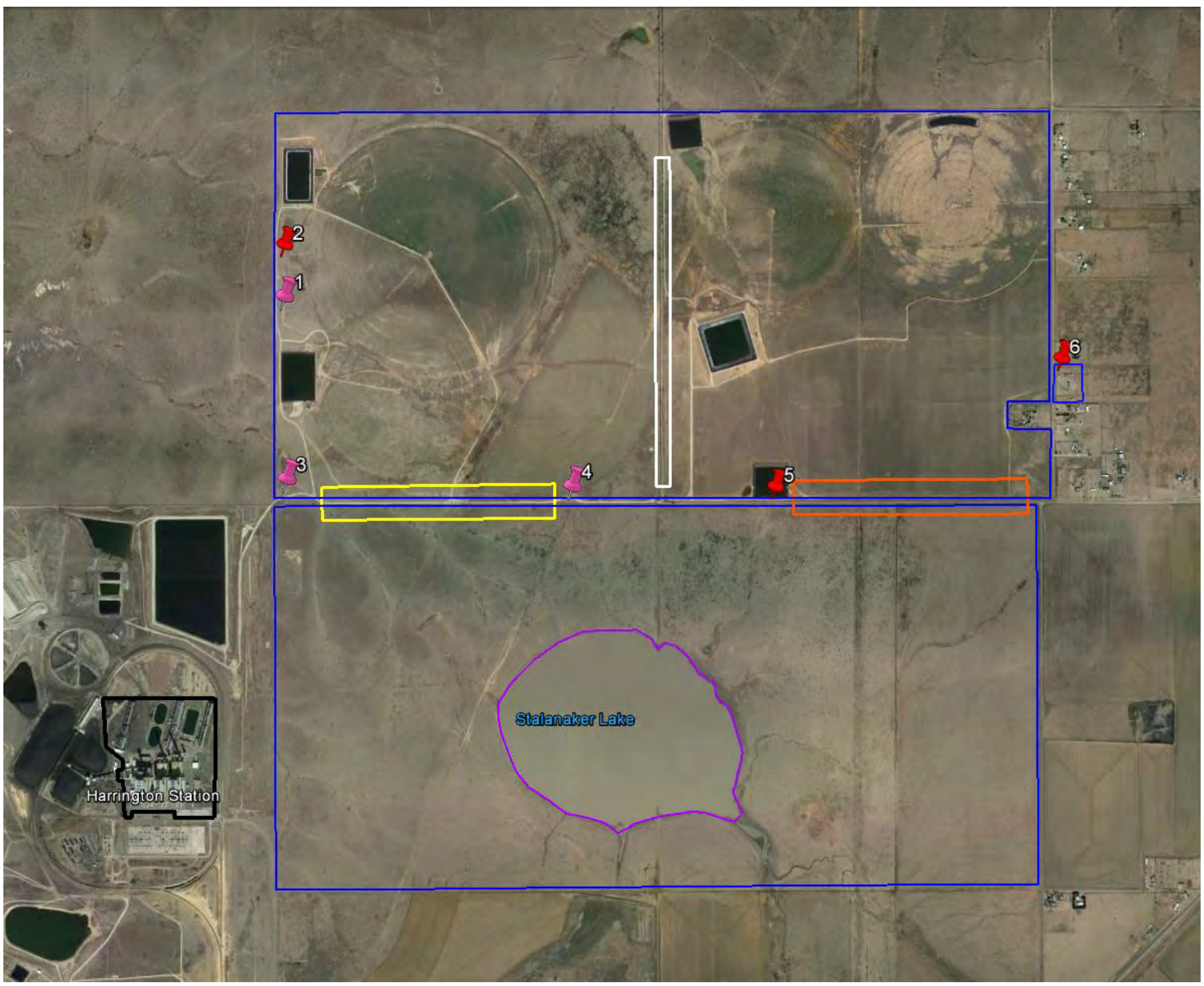


Figure 8: Potential Monitoring Sites for Harrington Station

Table 2: Potential Sites Assessment[1]

Site Number	Harrington #1	Harrington #2	Harrington #3
Location[2]	35.31629, -101.74176	35.31833, -101.74171	35.30942, -101.74168
Distance from SO_2 Source[2]	1,959 m	2,181 m	1,235 m
Wind Direction	SW, S, SE	SW, S, SE	SW, S, SE
Grade	<1%	>1%	<1%
Flood Plains	No	No	Yes
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	No	No	No
Wind Channeling	None	None	None
Downwind[2]	Yes (NNE)	Yes (NNE)	Yes (NNE)
Obstructions and Height	None	None	None
Distance from Site to Obstructions	NA	NA	NA
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Downwind • Power available • Space available • Level ground • Agreeable property owner • Accessible • High SO_2 modeling	• Downwind • Power available • Space available • Accessible • High SO_2 modeling	• Downwind • Power available • Space available • Level ground • Close to source • Accessible
Cons	• None	• Uneven terrain	• Flood prone • Low SO_2 modeling
Viable Site (Yes, No, or Preferred)	Preferred	No	Yes

Site Number	Harrington #4	Harrington #5	Harrington #6
Location[2]	35.30891, -101.72851	35.30916, -101.71912	35.31394, -101.70598
Distance from SO_2 Source[2]	1,995 m	2,762 m	4,067 m
Wind Direction	SW, S, SE	SW, S, SE	SW, S, SE
Grade	<1%	>1%	<1%
Flood Plains	No	Yes	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	Yes; lake (S)	Yes; lake (S)	No
Wind Channeling	None	None	None
Downwind[2]	Yes (NE)	Yes (NE)	Yes (NE)
Obstructions and Height	None	None	None
Distance from Site to Obstructions	NA	NA	NA
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Downwind • Power available • Space available • Level ground • Accessible • Agreeable property owner	• Downwind • Power available • Space available • Accessible • Agreeable property owner • High SO_2 modeling	• Downwind • Power available • Space available • Level ground • Accessible
Cons	• Low SO_2 modeling	• Flood prone • Uneven terrain • Will require major work to level ground	• Property owner declined • Low SO_2 modeling
Viable Site (Yes, No, or Preferred)	Yes	No	No

[1]Based on 40 Code of Federal Regulations Part 58 and *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document*
[2]Based on Google Earth
m – meter
NA – not applicable
NE – northeast
NNE – north-northeast
S – south
SE – southeast
SO_2 – sulfur dioxide
SW – southwest
> – greater than
< – less than
– number
% – percent

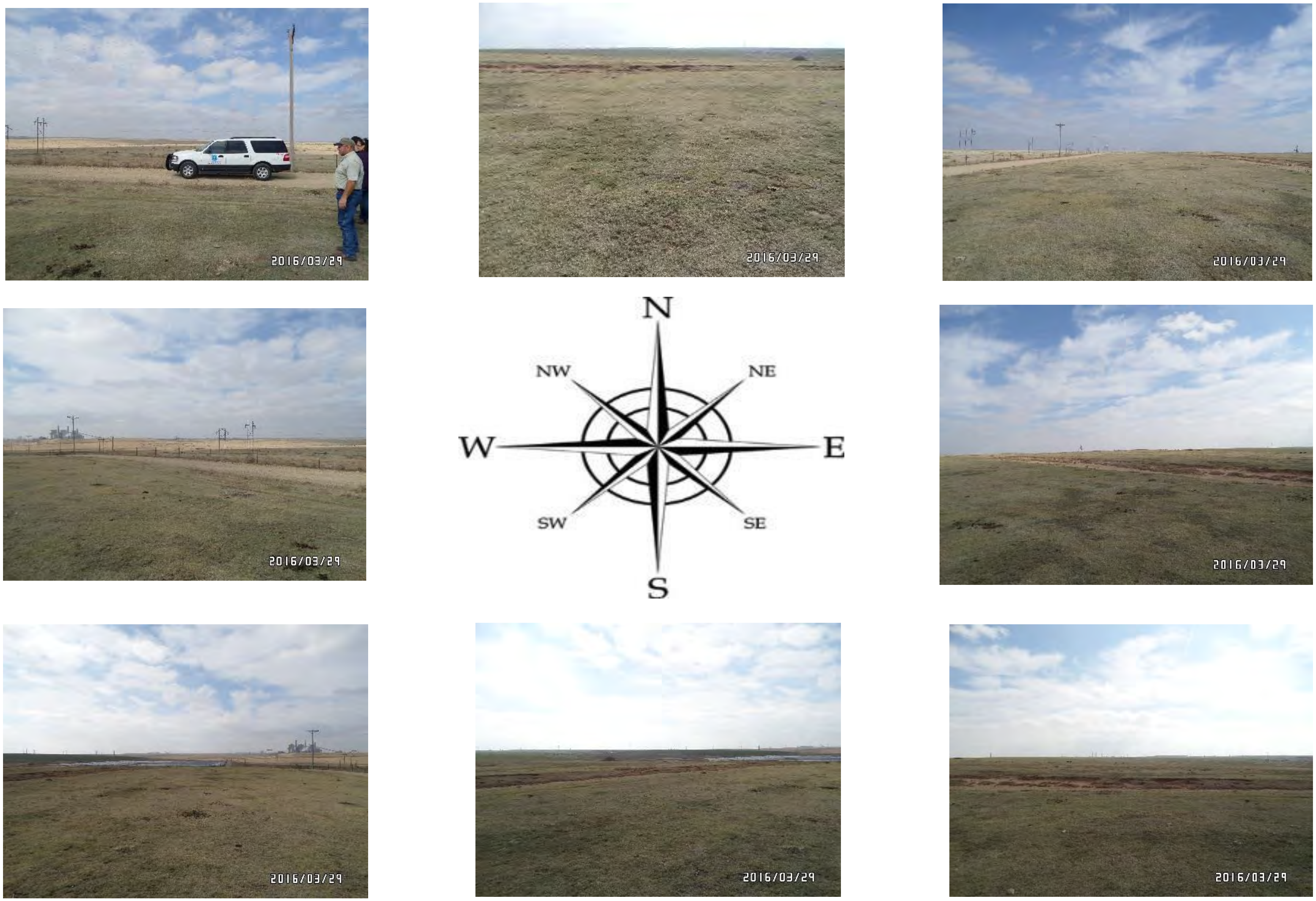


Figure 9: Harrington Station Potential Site #1 Cardinal Direction Photos

Figure 10: Harrington Station Potential Site #1 Satellite Image

References

Griffith, G. E., S. A. Bryce, J. M. Omernik, J. A. Comstock, A. C. Rogers, B. Harrison, S. L. Hatch, and D. Bezanson. Ecoregions of Texas. (2 sided color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia: U.S. Geological Survey, 2004. Scale 1:2,500,000.

"IEM : Site Locator." Iowa Environmental Mesonet. 2016. Accessed April 06, 2016. https://mesonet.agron.iastate.edu/sites/locate.php?network=TX_ASOS.

Streetman Plant Monitor Placement Evaluation

Source Information

- Name: Streetman Plant (Streetman) (Figure 2)
- Owner: TRNLWS Limited Liability Company (LLC)
- Facility function: lightweight aggregate manufacturing
- Location: 31.91385, -96.34903, Texas Commission on Environmental Quality (TCEQ) Region 4, Navarro County, Texas
- Sulfur dioxide (SO_2) emissions: 3,391 tons (2013), 3,350 tons (2014)
- Long-term emissions trend: Decreasing, 4.6 percent (%) decrease from 2004 through 2014
- Emission profile: operational year-round
- Stack height: 35 meters (m)
- SO_2 emission controls in place: none
- Permit related data: Federal Operating Permit #1117

Existing Air Monitoring Sites

The TCEQ operates four ambient air monitoring sites within a 75 kilometer (km) radius of Streetman. Table 1 details the four closest monitoring sites to Streetman in order of proximity. Maximum SO_2 ground level concentrations can be expected within close proximity to the source. Although all of these locations are currently monitoring SO_2, none of the existing sites are positioned downwind or within reasonable proximity to the source to characterize maximum SO_2 concentrations.

Table 1: Air Monitoring Sites Near Streetman

Site	Distance From Streetman	Current Sulfur Dioxide (SO_2) Monitoring	SO_2 Design Value (2013-2015)
Corsicana Airport	14 kilometers north	Yes	39 parts per billion (ppb)
Italy	57 kilometers northwest	Yes	8 ppb
Kaufman	72 kilometers north	Yes	13 ppb
Waco Mazanec	74 kilometers southwest	Yes	7 ppb

Settings and Surroundings

The rural and suburban area surrounding Streetman consists of the Balcones Canyonlands region, with elevations ranging from approximately 111 m to 132 m as shown in Figure 1. Streetman property is bordered by the Richland Chambers Reservoir to the northwest, north, and northeast. No significant changes to the landscape were noted during the reconnaissance as compared to the Google Earth view shown in Figure 8. Mountain and valley wind channeling or other terrain related meteorological impacts are not expected in this area.

Big Brown Electric Station (Big Brown), located approximately 30 km southeast of Streetman, has the potential to influence SO_2 concentrations in the Streetman area under certain meteorological conditions. Big Brown's SO_2 emissions were reported as 57,460 tons in 2014. Due to Streetman's location and area wind flows, it is anticipated that Big Brown could impact SO_2 concentrations around the Streetman area when winds are from 100 degrees to 120 degrees southeast (approximately 6% of the time according to the Corsicana Municipal Airport wind rose data).

Figure 1: Streetman Area Elevation Map

Figure 2: Streetman Plant Sulfur Dioxide (SO_2) Stack and Emissions, 2013

Meteorological Data

Figure 3 provides illustrations of area annual average wind speed and direction for 2012, 2013, and 2014 from meteorological sensors at the Corsicana Municipal Airport, located 14 km north of Streetman. Figure 4 illustrates the 2012-2014 annual average speed. The length of each wind rose bar corresponds to the frequency of the wind coming from the indicated direction by percentage. Based on the analysis of the 2012-2014 wind data, the dominant wind flow direction is 145 degrees southeast to 205 degrees south-southwest. Approximately 38% of average area wind flows are from the dominant wind flow direction. Over this three year period, calm winds (0-2 miles per hour) occurred 8% of the time, and wind speeds averaged 8.9 miles per hour (Iowa Environmental Mesonet 2016).

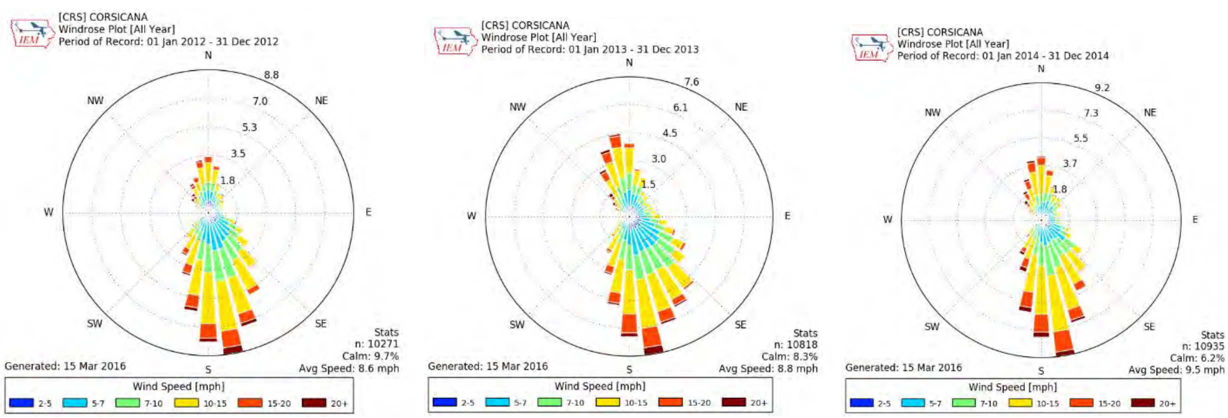


Figure 3: (From left to right) 2012, 2013, and 2014 Individual Wind Rose Plots

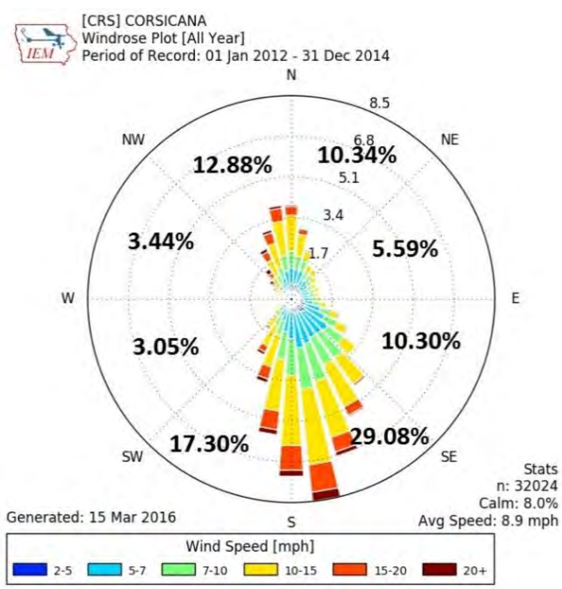


Figure 4: 2012-2014 Combined Average Wind Rose Plot

Modeling Analysis for Monitoring Site Placement

The *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistant Document* (Monitoring TAD) suggests that modeling is one technique that may be used to assist in identifying potential monitoring sites. The TCEQ's modeling for monitor placement used the Comprehensive Air Model with Extensions (CAMx) with model options set as equivalent as possible to American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The setup included the following parameterizations:

- CAMx 6.20 with speed ups and Plume-in-Grid (PiG) fix, without chemistry and without half-life decay;
- 500-meter PiG sampling grid centered on the source spatially covering 72 km by 72 km;
- the one kiln stack was modeled and tracked as an individual PiG puff;
- full year of 2012 12 km gridded Weather Research and Forecasting Model (WRF) meteorology interpolated to 4 km;
- 2014 hourly point source electric generating unit (EGU) emissions; and
- 2014 annual point source non-EGU emissions from State of Texas Air Reporting System (STARS) processed down to hourly emissions.

All model outputs were normalized relative to the predicted off-property maximum concentration, and therefore do not represent absolute predicted results comparable to the NAAQS. The results were then analyzed using three metrics: normalized 99th percentile concentration, normalized frequency, and a composite using both the 99th percentile and frequency metrics. The primary areas targeted for monitor placement included consideration of all three model output metrics, along with the meteorological data presented in Figures 3 and 4.

From the model outputs, normalized 99th percentile concentrations were calculated by dividing the 99th percentile daily maximum concentration for each grid cell within the modeling domain by the predicted off-property maximum concentration for the domain. The calculated results thus represent a percentage of the predicted concentrations for each grid cell to the off-property maximum. Figure 5 presents the results for the normalized 99th percentile concentration metric analysis with the location of the predicted off-property maximum indicated by a "+" symbol. Streetman permitted property is outlined in black. Based on this analysis, the highest normalized concentrations greater than 85% of the predicted off-property maximum are expected to occur in the area within Streetman permitted property and the area 0.3 km north-northeast over the Richland Chambers Reservoir. The proposed monitor location identified in Figure 5 (site 18) is outside the predicted normalized off-property maximum concentrations and 1.0 km south of the predicted off-property maximum.

To evaluate the frequency at which high concentrations may be expected, a normalized frequency metric was developed to represent the number of days the modeled concentration for each grid cell was predicted to be greater than 75% of the off-property maximum concentration. This metric was calculated by dividing the number of days the 99th percentile concentration for each grid cell was greater than 75% of the predicted off-property maximum concentration by the number of days the off-property maximum was predicted to occur. Figure 6 presents the geographic distribution of normalized frequency around Streetman. The location of the predicted off-property maximum is indicated by a “+” symbol, and Streetman permitted property is outlined in black. Using this analysis metric, areas within Streetman and areas directly to the north, northeast, and east of Streetman scored greater than 60% and would be expected to see the highest frequency of elevated SO_2 concentrations. The area within Streetman property along with areas directly to the north, northeast, and east of Streetman are not viable for monitor placement. The areas immediately to the north and northeast are not viable due to the Richland Chambers Reservoir. The area directly east of the plant is not viable, because the property owner declined access to the property.

Finally, a composite metric was developed to aid in identifying areas where the predicted highest concentration and predicted highest frequency overlap. The composite metric was calculated at each grid cell by averaging the normalized 99th percentile concentration and normalized frequency metrics. Figure 7 illustrates the geographic distribution of the composite metric analysis results with the location of the predicted off-property maximum with a “λ” symbol, and Streetman permitted property is outlined in black. As with the normalized 99th percentile and normalized frequency metrics, areas within Streetman property along with areas directly north and northeast of Streetman scored greater than 80% using the composite metric. Similar to areas with a high frequency metric, areas with a high composite metric were not viable due to the Richland Chambers Reservoir and property access.

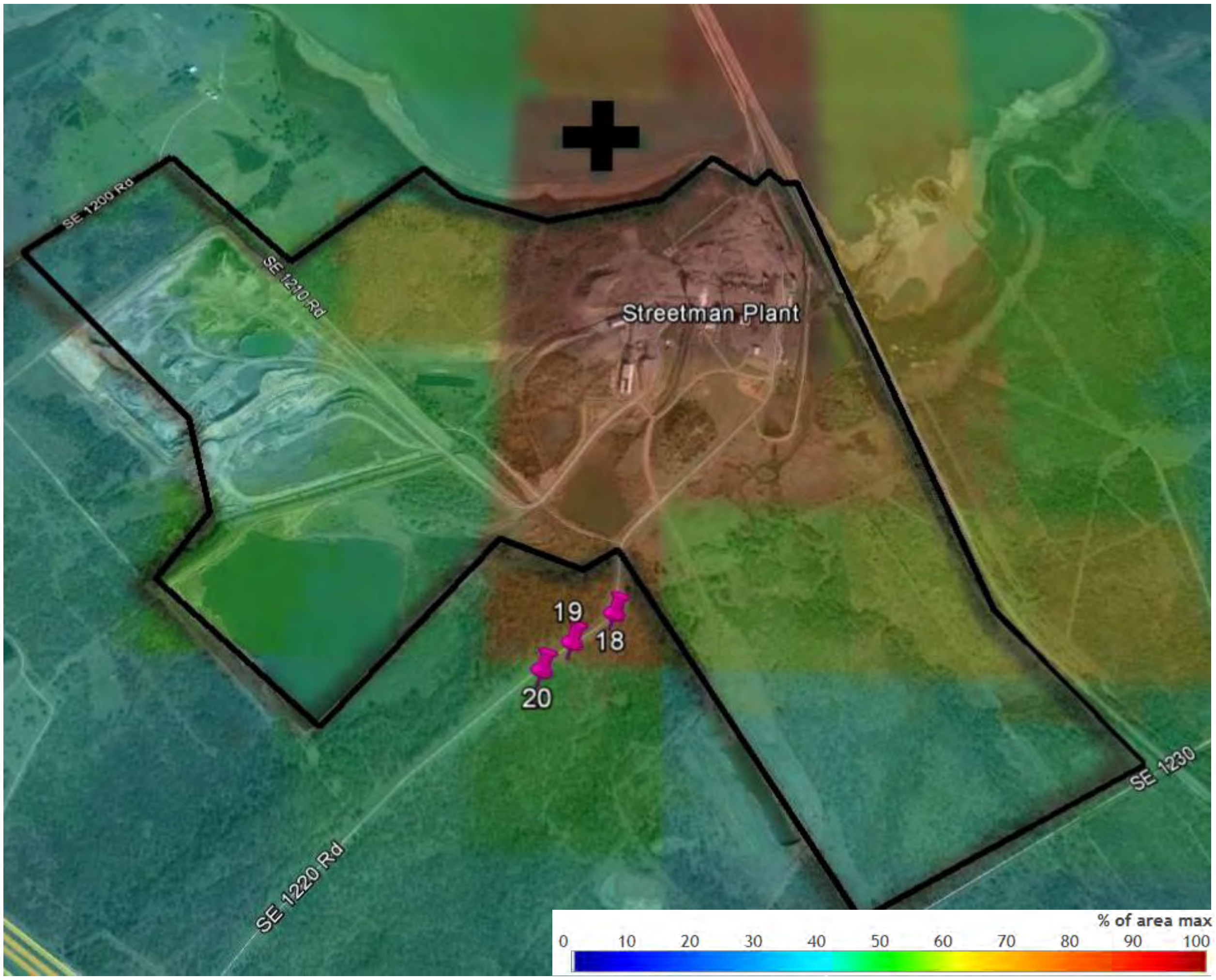


Figure 5: Streetman Area CAMx Model Predictions, Normalized Concentrations, and Viable Site Locations

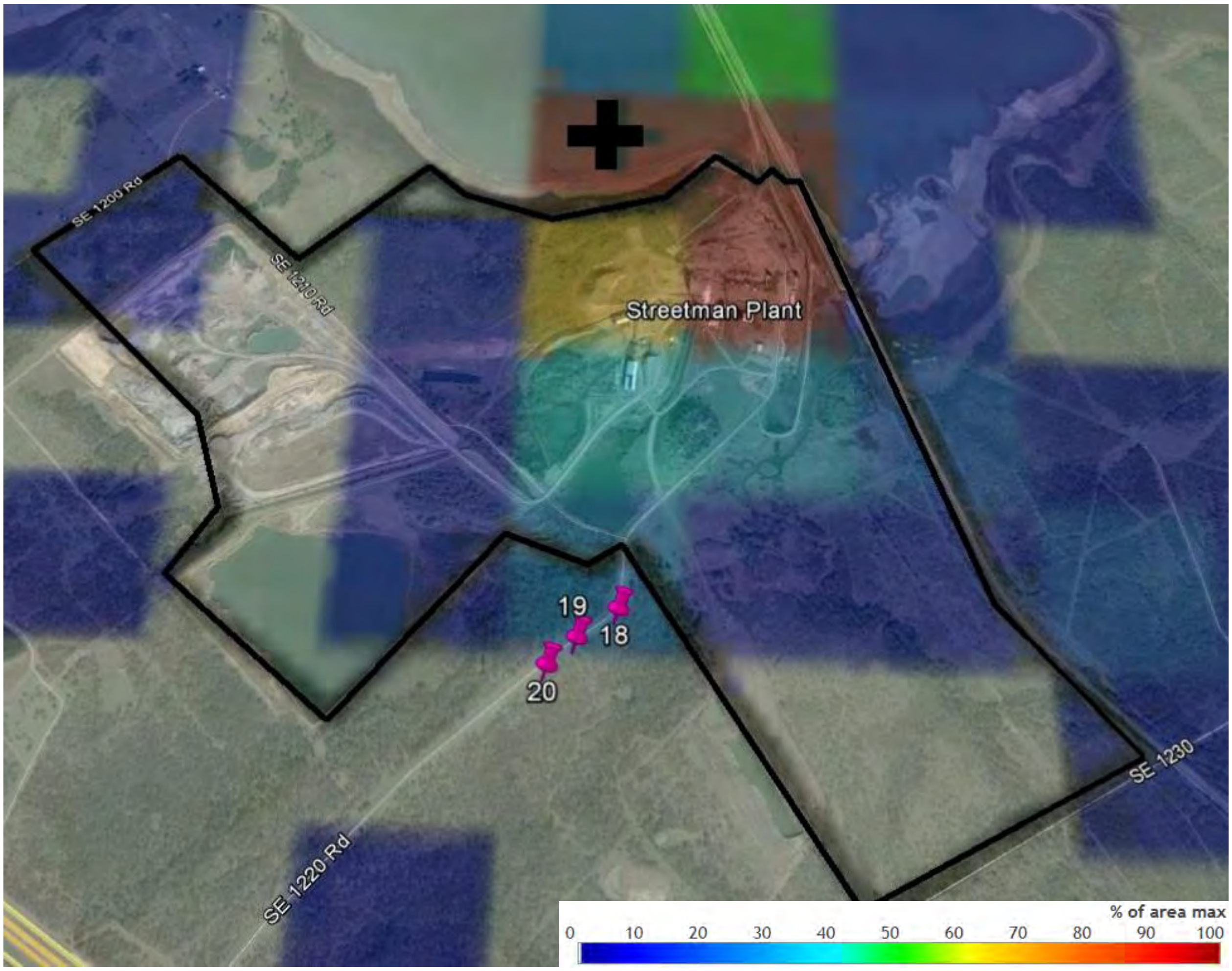


Figure 6: Streetman Area CAMx Model Predictions, Normalized Frequency (Number of Days), and Viable Site Locations

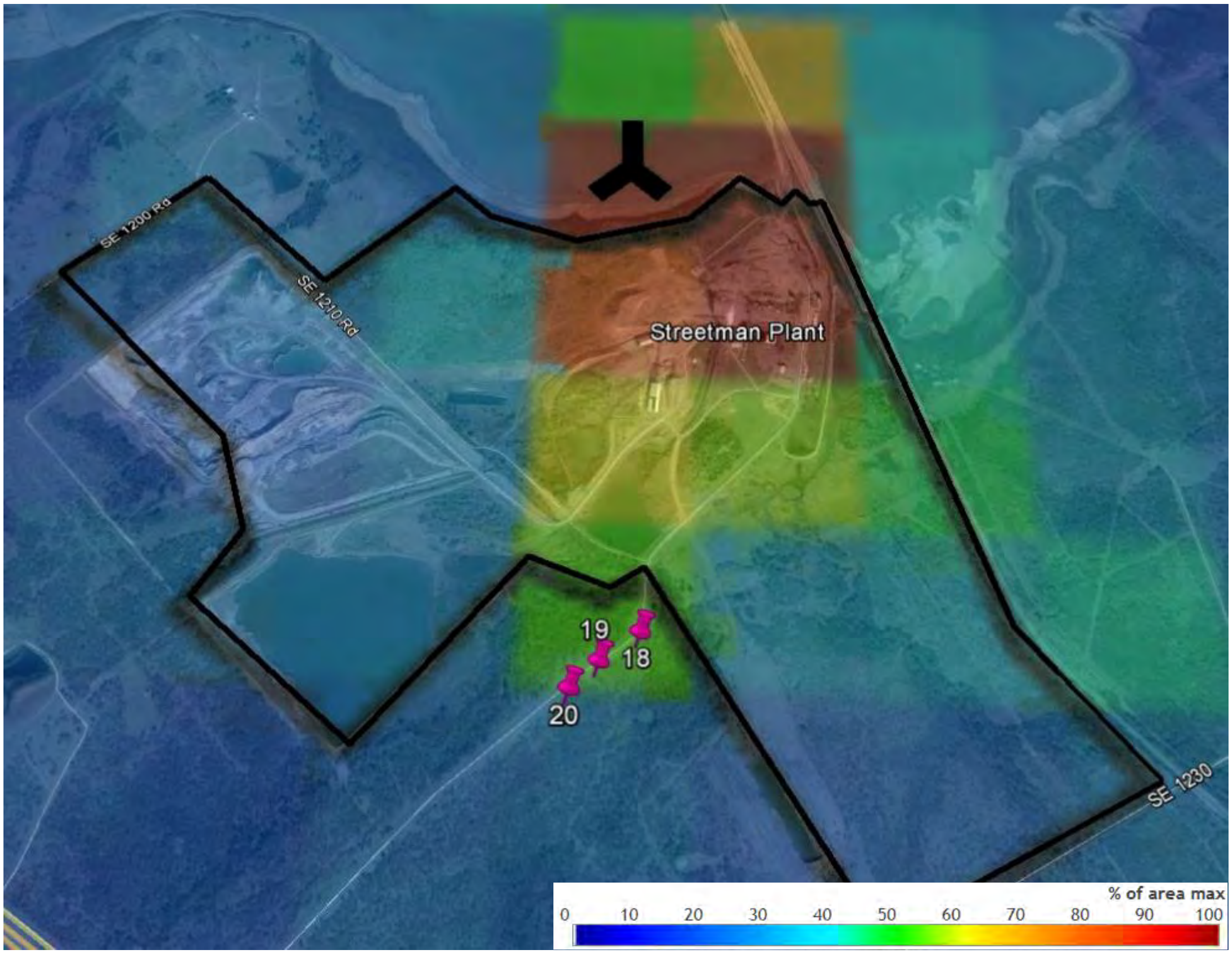


Figure 7: Streetman Area CAMx Model Predictions Composite Metric and Viable Site Locations

Siting Options and Criteria

The TCEQ does not currently have SO_2 monitors located in the area surrounding Streetman that would be expected to characterize the highest SO_2 concentrations from this facility; therefore a new site is proposed. The TCEQ focused on complying with the federal requirements listed in 40 Code of Federal Regulations (CFR) Part 58, Appendix E regarding siting criteria. In addition, the TCEQ evaluated monitoring site locations that would appropriately and sufficiently characterize air quality in areas around an SO_2 emissions source. This approach included utilizing multiple techniques and guidance provided in the Monitoring TAD.

The modeling analyses provided in Figures 5, 6, and 7 suggest that maximum SO_2 concentrations are expected to occur within the Streetman permitted area and north, northeast, and east of Streetman. In addition, the highest frequency of SO_2 concentrations predicted to be greater than 75% of the off-property maximum is expected directly north of Streetman over the Richland Chambers Reservoir. Access to the area directly to the east of the facility was declined by the property owner.

Twenty-one potential sites were identified as shown in Figures 8 and 9. A summary of all potential sites is shown in Table 2. Eighteen of the identified potential sites (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, and 21) are not considered viable and are indicated by red pins in Figures 8 and 9. Property owners at sites 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 13 either declined or were unresponsive after multiple communication attempts. Non-viable site property lines are outlined with green boundaries. Sites 12, 14, 15 and 21 were in areas with low predicted SO_2 concentrations according the modeling analysis. Sites 16 and 17 were in flood prone areas.

- Site 18 is located approximately 1.0 km south-southwest of Streetman. This site is downwind of Streetman when winds flow from the north-northeast. Access to areas with higher expected wind flows was either declined by their respective property owners or was impossible due to the Richland Chambers Reservoir. Site 18 provides level ground and adequate space. The property owner is also amenable to deploying an air monitoring station in this area. The normalized 99^{th} percentile concentration metric analysis predicted concentrations in this area to be 50%-60% of the maximum concentrations. Site 18 is indicated with a pink pin in Figures 5, 6, 7, and 8.
- Site 19 is located approximately 1.2 km southwest of Streetman. This site is downwind of Streetman when winds flow from the north-northeast. Access to areas with higher expected wind flows was either declined by their respective property owners or was impossible due to the Richland Chambers Reservoir. This site provides level ground, and adequate space. The property owner is also amenable to deploying an air monitoring station in this area. The normalized 99th percentile concentration metric analysis predicted concentrations in this area to be 50%-60% of the maximum concentrations. Site 19 is indicated with a pink pin in Figures 5, 6, 7, and 8.
- Site 20 is located approximately 1.3 km southwest of Streetman. This site is downwind of Streetman when winds flow from the north-northeast. Access to areas with higher expected wind flows was either declined by their respective property owners or was impossible due to the Richland Chambers Reservoir. This site

provides level ground, and adequate space. The property owner is also amenable to deploying an air monitoring station in this area. The normalized 99th percentile concentration metric analysis predicted concentrations in this area to be 25%-35% of the maximum concentrations. Site 20 is indicated with a pink pin in Figures 5, 6, 7, and 8.

Recommendation

The modeling analyses predicts the highest maximum normalized concentration and composite metric score to be located over the Richland Chambers Reservoir water body. Therefore, based on property owner cooperation, proximity to the source, current facility operations, available emissions data, wind patterns, and modeling analyses, site 18 (Figures 8, 10, and 11) is the recommended location for placement of a new source-oriented ambient SO_2 monitoring station. Areas directly to the east and west of the source are not viable locations due to property owners who are unwilling or unresponsive to the TCEQ. Site 18 is preferred over sites 19 and 20 due to its closer proximity to the source.

Historical meteorological data from 2012-2014 (Figure 4) shows the area around site 18 experiences calm conditions an average of 8% of the year and is downwind of Streetman during northeasterly winds 10% of the year. Combined, calm or northeasterly wind conditions occurred an average of 18% annually. Site 18 is the closest viable location to the source (1.0 km) with 75%-85% predicted off-property maximum normalized SO_2 concentrations. Site 18 also has available space, level ground, and meets all federal siting criteria. A site agreement has been negotiated with the property owner.

Figure 8: Potential Monitoring Sites South of Richland Chambers Reservoir

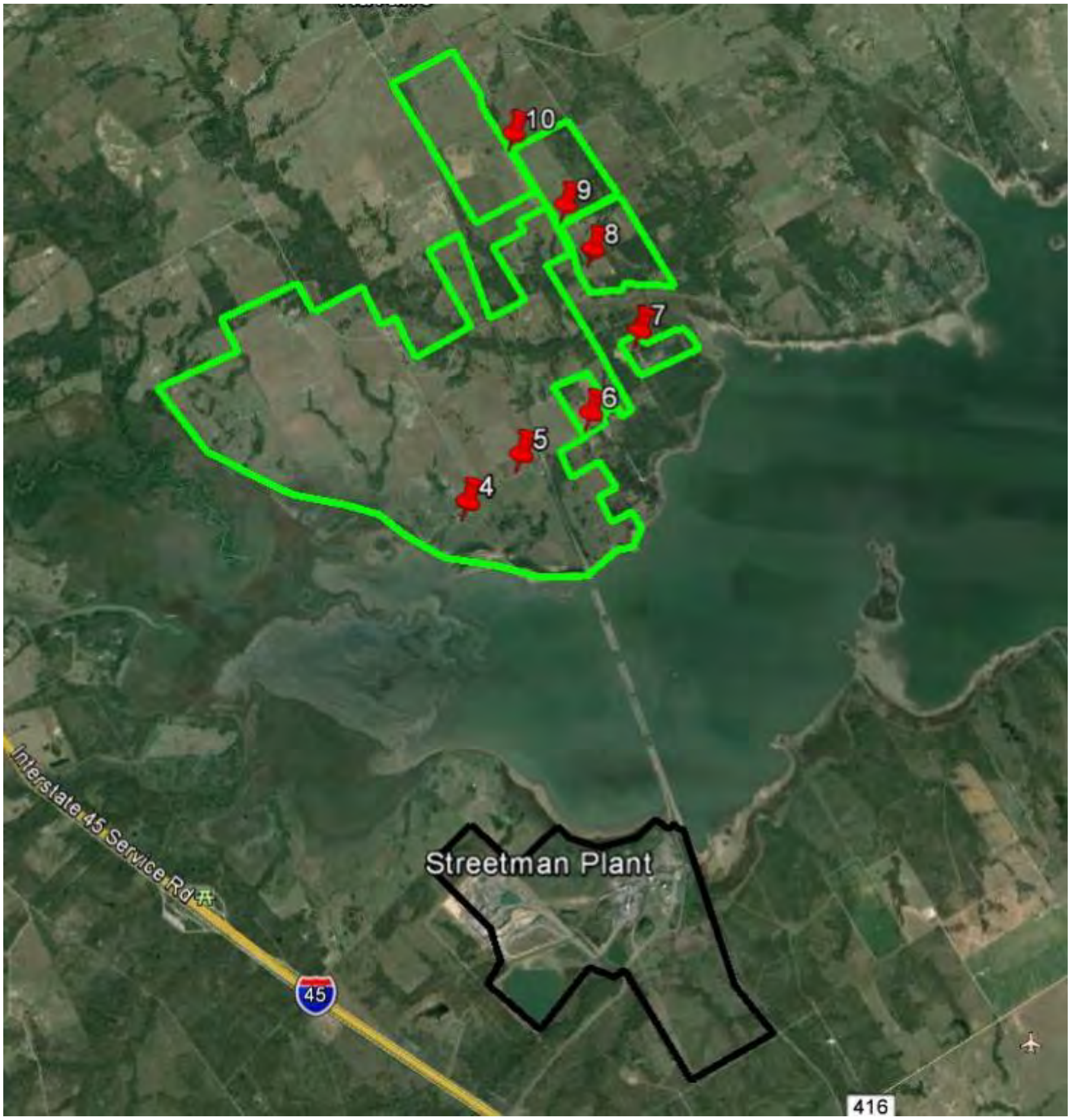


Figure 9: Potential Monitoring Sites North of Richland Chambers Reservoir

Table 2: Potential Sites Assessment[1]

Site Number	Streetman #1	Streetman #2	Streetman #3
Location	31.91678, -96.34929	31.91849, -96.36757	31.91844, -96.36790
Distance from SO_2 Source[2]	330 m	1,709 m	1,858 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	Yes; reservoir (N)	Yes; reservoir (NE)	Yes; reservoir (NE)
Wind Channeling	None	None	None
Downwind[2]	Yes (N)	Yes (NW)	Yes (NW)
Obstructions and Height	None	None	Trees (10 m)
Distance from Site to Obstructions	None	None	Trees (45 m W to dripline) Trees (30 m S to dripline)
Road/Site Access	No	Yes	Yes
Electricity Available <18 m	Yes	Yes	Yes
Pros	• Level ground • Downwind • High SO_2 modeling • Power available	• Level ground • Downwind • Site access • Power available	• Level ground • Power available • Space available • Downwind • Site access
Cons	• Property owner declined • No access	• Unresponsive property owner • Low SO_2 modeling	• Property owner declined • Low SO_2 modeling
Viable Site (Yes, No, or Preferred)	No	No	No

Site Number	Streetman #4	Streetman #5	Streetman #6
Location	31.94847, -96.36894	31.95045, -96.36329	31.95446, -96.35584
Distance from SO_2 Source[2]	4,020 m	4,388 m	4,604 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	Yes; reservoir (S)	Yes; reservoir (S)	Yes; reservoir (S)
Wind Channeling	None	None	None
Downwind[2]	Yes (NW)	Yes (N)	Yes (N)
Obstructions and Height	None	None	Trees (10 m)
Distance from Site to Obstructions	None	None	Trees (20 m W to dripline) Trees (20 m NW to dripline)
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	No
Pros	• Level ground • Downwind • Site access • Power available	• Level ground • Downwind • Power available • Site access	• Level ground • Space available • Downwind • Site access
Cons	• Property owner declined • Low SO_2 modeling	• Property owner declined • Low SO_2 modeling	• No power • Property owner declined • Low SO_2 modeling
Viable Site (Yes, No, or Preferred)	No	No	No

Site Number	**Streetman #7**	**Streetman #8**	**Streetman #9**
Location	31.96239, -96.35170	31.96966, -96.35631	31.97580, -96.35952
Distance from SO_2 Source[2]	5,590 m	6,526 m	7,025 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	>1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	Yes; reservoir (SE)	None	None
Wind Channeling	None	None	None
Downwind[2]	Yes (NE)	Yes (N)	Yes (N)
Obstructions and Height	Trees (15-20 m)	Trees (12 m)	None
Distance from Site to Obstructions	Trees (40 m SE to dripline) Trees (40 m W to dripline)	Trees (20 m SW to dripline)	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	No	No	Yes
Pros	• Level ground • Downwind • Site access	• Level ground • Space available • Downwind • Site access	• Space available • Downwind • Site access • Power available
Cons	• No power • Unresponsive property owner • Low SO_2 modeling	• Unresponsive property owner • No power • Low SO_2 modeling	• Slight grade in surrounding area • Unresponsive property owner • Low SO_2 modeling
Viable Site (Yes, No, or Preferred)	No	No	No

Site Number	Streetman #10	Streetman #11	Streetman #12
Location	31.98266, -96.36470	31.91122, -96.39605	31.54752, -96.22548
Distance from SO_2 Source[2]	7,779 m	4,440 m	2,250 m
Wind Direction	S, SE	S, SE	S, SE
Elevation/Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	None	None	Yes; reservoir (E)
Wind Channeling	None	None	None
Downwind[2]	Yes (NNE)	No (W)	No (SW)
Obstructions and Height	Trees (10 m)	None	None
Distance from Site to Obstructions	Trees (20 m SE to dripline)	None	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	No	No	Yes
Pros	• Level ground • Space available • Downwind • Site access	• Level ground • Space available • Site access	• Level ground • Space available • Power available • Close proximity to facility • Agreeable property owner • Site access
Cons	• No power • Unresponsive property owner • Low SO_2 modeling	• Not downwind • No power • Declined by property owner • Low SO_2 modeling	• Not downwind • Low SO_2 modeling
Viable Site (yes, no, or preferred)	No	No	No

Site Number	Streetman #13	Streetman #14	Streetman #15
Location	31.54346, -96.20553	31.90510, -96.38168	31.90169, -96.35473
Distance from SO_2 Source[2]	1,399 m	3,172 m	1,376 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	None	None	Yes; pond (W)
Wind Channeling	None	None	None
Downwind[2]	No (E)	No (SW)	No (S)
Obstructions and Height	None	None	None
Distance from Site to Obstructions	None	None	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	Yes	Yes	No
Pros	• Level ground • Power available • Site access	• Level ground • Power available • Site access	• Level ground • Close proximity to facility • Agreeable property owner • Site access
Cons	• Not downwind • Declined by property owner • Low SO_2 modeling	• Not downwind • Low SO_2 modeling	• Not downwind • Low SO_2 modeling • No power
Viable Site (Yes, No, or Recommended)	No	No	No

Site Number	Streetman #16	Streetman #17	Streetman #18
Location	31.90501, -96.35144	31.90594, -96.35181	31.90412, -96.35185
Distance from SO_2 Source[2]	905 m	853 m	1,037 m
Wind Direction	S, SE	S, SE	S, SE
Grade	>1%	>1%	<1%
Flood Plains	Yes	Yes	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	Yes; pond (W)	Yes; pond (W)	Yes; pond (W)
Wind Channeling	None	None	None
Downwind[2]	No (S)	No (S)	No (S)
Obstructions and Height	None	None	Trees (10 m)
Distance from Site to Obstructions	None	None	Trees (9 m SE to dripline), Trees (9 m S to dripline)
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	No	No	No
Pros	• Close proximity to facility • Agreeable property owner • Site access • High SO_2 modeling	• Close proximity to facility • Agreeable property owner • Site access • High SO_2 modeling	• Level ground • Close proximity to facility • Agreeable property owner • Site access • High SO_2 modeling • Property owner will remove obstructions
Cons	• Slight grade in surrounding area • Not downwind • No power • Flood prone	• Slight grade in surrounding area • Not downwind • No power • Flood prone	• Not downwind • No power • Removal of trees in area to meet siting criteria
Viable Site (Yes, No, or Recommended)	No	No	Preferred

Site Number	Streetman #19	Streetman #20	Streetman #21
Location	31.90332, -96.35305	31.90259, -96.35389	31.90275, -96.34872
Distance from SO_2 Source[2]	1,210 m	1,281 m	1,274 m
Wind Direction	S, SE	S, SE	S, SE
Grade	<1%	<1%	<1%
Flood Plains	No	No	No
Mountain/Valley Winds	None	None	None
Water Body Within 1,000 m	Yes; pond (W)	Yes; pond (W)	None
Wind Channeling	None	None	None
Downwind[2]	No (S)	No (S)	No (S)
Obstructions and Height	None	None	None
Distance from Site to Obstructions	None	None	None
Road/Site Access	Yes	Yes	Yes
Electricity Available <18 m	No	No	No
Pros	• Level ground • Close proximity to facility • Agreeable property owner • High SO_2 modeling • Site access	• Level ground • Close proximity to facility • Agreeable property owner • Site access	• Level ground • Close proximity to facility • Agreeable property owner • High SO_2 modeling • Site access
Cons	• Not downwind • No power	• Not downwind • No power • Low SO_2 modeling	• Not downwind • No power • Low SO_2 modeling
Viable Site (Yes, No, or Recommended)	Yes	Yes	No

[1]Based on 40 Code of Federal Regulations Part 58 and *SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document*
[2]Based on Google Earth

m – meter
% – percent
N – north
S – south
E – east
W – west
NNE – north-northeast
NE – northeast
NW – northwest
SE – southeast
SW – southwest
– number
< – less than
> – greater than
SO_2 – sulfur dioxide

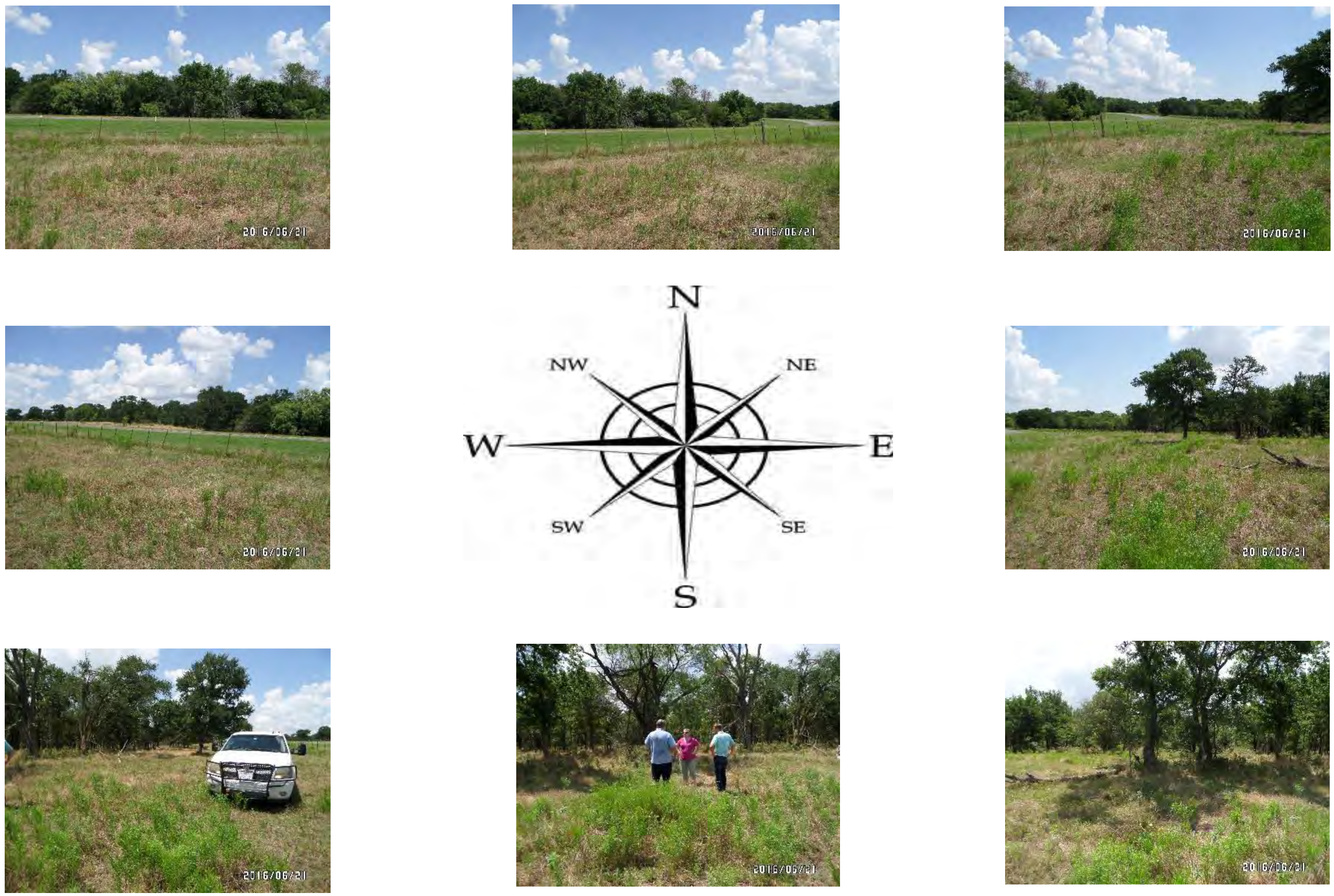


Figure 10: Streetman #18 Potential Site Cardinal Direction Photos

Figure 11: Streetman #18 Preferred Air Monitoring Site

References

"IEM : Site Locator." Iowa Environmental Mesonet. 2016. Accessed April 06, 2016. https://mesonet.agron.iastate.edu/sites/locate.php?network=TX_ASOS.

Appendix F

Ozone Monitoring Requirements

Texas Commission on Environmental Quality
2016 Annual Monitoring Network Plan

Appendix F: Ozone Monitoring Requirements

Metropolitan Statistical Area	2015 Population Estimates[1]	2013-2015 8-Hour Design Value (parts per billion)	Design Value as Percent of NAAQS[2]	Total Required SLAMS Monitors	Total Required PAMS Monitors	Total Required NCore Monitors	Total Required Monitors[3]	Total Existing Monitors[4]
Dallas-Fort Worth-Arlington	7,102,796	83	119%	3	1	1	5	19
Houston-The Woodlands-Sugar La	6,656,947	80	114%	3	1	1	5	20
San Antonio-New Braunfels	2,384,075	78	111%	2	0	0	2	3
Austin-Round Rock	2,000,860	68	97%	2	0	0	2	2
McAllen-Edinburg-Mission	842,304	56	80%	1	0	0	1	1
El Paso	838,972	71	101%	2	0	1	3	6
Corpus Christi	452,422	65	93%	2	0	0	2	2
Killeen-Temple	431,032	69	99%	2	0	0	2	2
Brownsville-Harlingen	422,156	59	84%	1	0	0	1	2
Beaumont-Port Arthur	408,419	68	97%	2	0	0	2	7
Lubbock	311,154	N/A	N/A	0	0	0	0	0
Laredo	269,721	59	84%	1	0	0	1	1
Waco	262,813	67	96%	1	0	0	1	1
Amarillo	262,056	N/A	N/A	0	0	0	0	0
College Station-Bryan	249,156	N/A	N/A	0	0	0	0	0
Tyler	222,936	67	96%	1	0	0	1	1
Longview	217,781	68	97%	1	0	0	1	1
Abilene	169,578	N/A	N/A	0	0	0	0	0
Midland	166,718	N/A	N/A	0	0	0	0	0
Odessa	159,436	N/A	N/A	0	0	0	0	0
Wichita Falls	150,780	N/A	N/A	0	0	0	0	0
Texarkana	149,769	N/A	N/A	0	0	0	0	0
Sherman-Denison	125,467	N/A	N/A	0	0	0	0	0
San Angelo	119,659	N/A	N/A	0	0	0	0	0
Victoria	99,913	64	91%	1	0	0	1	1
Marshall*	66,746	N/A	N/A	0	0	0	0	1
Totals	N/A	N/A	N/A	25	2	3	30	70

[1]United States Census Bureau population estimates as of July 1, 2015

[2]2015 8-Hour Ozone National Ambient Air Quality Standard (NAAQS) is 70 parts per billion

[3]Total Required Monitors is a count of individual requirements for SLAMS, PAMS, and NCore.

[4]Individual monitors may fulfill more than one monitoring requirement.

*Classified as Micropolitan Statistical Area and does not apply to SLAMS requirements

O_3 - ozone

N/A - not applicable

PAMS - Photochemical Assessment Monitoring Stations

SLAMS - State or Local Air Monitoring Stations

NCore - National Core Multipollutant Monitoring Stations

Appendix G

Carbon Monoxide Monitoring Requirements

Texas Commission on Environmental Quality
2016 Annual Monitoring Network Plan

TCEQ

Appendix G: Carbon Monoxide Monitoring Requirements

Core Based Statistical Areas	2015 Population Estimates[1]	Required CO Near-Road Monitors	Required High Sensitivity CO NCore Monitors	Total Required Monitors	Total Current Monitors[2]
Dallas-Fort Worth-Arlington	7,102,796	Fort Worth California Parkway	Dallas Hinton	2	2
San Antonio-New Braunfels	2,384,075	San Antonio Interstate 35[3]	N/A	1[3]	0
Austin-Round Rock	2,000,860	Austin Interstate 35[3]	N/A	1[3]	0
El Paso	838,972	N/A	El Paso Chamizal	1	3
Houston-The Woodlands-Sugar Land	6,656,947	Houston North Loop	Houston Deer Park #2	2	3
Laredo	269,721	N/A	N/A	0	2
Brownsville-Harlingen	422,156	N/A	N/A	0	1
Beaumont-Port Arthur	408,419	N/A	N/A	0	1
Waco	262,813	N/A	N/A	0	1
McAllen-Edinburg-Mission	842,304	N/A	N/A	0	0
Corpus Christi	452,422	N/A	N/A	0	0
Killeen-Temple	431,032	N/A	N/A	0	0
Lubbock	311,154	N/A	N/A	0	0
Amarillo	262,056	N/A	N/A	0	0
College Station-Bryan	249,156	N/A	N/A	0	0
Tyler	222,936	N/A	N/A	0	0
Longview	217,781	N/A	N/A	0	0
Abilene	169,578	N/A	N/A	0	0
Midland	166,718	N/A	N/A	0	0
Odessa	159,436	N/A	N/A	0	0
Wichita Falls	150,780	N/A	N/A	0	0
Texarkana	149,769	N/A	N/A	0	0
Sherman-Denison	125,467	N/A	N/A	0	0
San Angelo	119,659	N/A	N/A	0	0
Victoria	99,913	N/A	N/A	0	0
Total		4	3	7	13

[1]United States Census Bureau population estimates as of July 1, 2015

[2]Monitors may fulfill multiple monitoring requirements, but are only counted once in the total monitor counts.

[3]Monitor required to be operational by January 1, 2017

CO - carbon monoxide

NCore - National Core Multipollutant Monitoring Stations

N/A - not applicable

Appendix H

Particulate Matter of 10 Micrometers or Less Monitoring Requirements, Monitor Locations, and Method Codes

Texas Commission on Environmental Quality

2016 Annual Monitoring Network Plan

Appendix H: Particulate Matter of 10 Micrometers or Less Monitoring Requirements, Monitor Locations, and Method Codes

Table 1: Particulate Matter of 10 Micrometers or Less Monitoring Requirements and Monitor Locations

Metropolitan Statistical Area	2015 Population Estimates*	Site Name	2013-2015 Maximum **Concentration (µg/m³)**	Percent of NAAQs**	Required Monitors***	Existing Monitors
Dallas-Fort Worth-Arlington	7,102,796				4-8	4
		Earhart	132	88		
		Convention Center (collocated pair)	93	62		
		Dallas North #2	82	55		
		Stage Coach	70	47		
Marshall (Micropolitan Statistical Area)	218,842				0	1
		Karnack	73	49		
Houston-The Woodlands-Sugar Land	6,656,947				4-8	8
		Clinton (collocated pair)	130	87		
		Houston Monroe	99	66		
		Houston Westhollow	95	63		
		Lang	94	63		
		Texas City Fire Station (collocated pair)	92	61		
		Houston Deer Park #2 (collocated pair)	91	61		
		Houston Aldine	90	60		
		Pasadena HL&P	74	49		
San Antonio-New Braunfels	2,384,075				2-4	2
		Selma	78	52		
		Frank Wing Municipal Court	73	49		
Austin-Round Rock	2,000,860				2-4	2
		Austin Webberville Rd	99	66		
		Austin Audubon Society	76	51		
El Paso	838,972				2-4	5
		Socorro Hueco (collocated pair)	145	97		
		Riverside	143	95		
		Ojo De Agua (collocated pair)	91	61		
		Van Buren	81	54		
		Ivanhoe	76	51		
McAllen-Edinburg-Mission	842,304				2-4	2
		Mission	138	92		
		Edinburg East Freddy Gonzalez Drive (new in 2015)	70	N/A		
Corpus Christi	452,422				0-1	1
		Dona Park (collocated pair)	83	55		
Laredo	269,721				0-1	2
		Laredo Vidaurri (collocated pair)	80	53		
		Laredo Bridge	54	36		
Totals	N/A		N/A	N/A	N/A	27

This list does not include Metropolitan Statistical Areas with zero requirements and zero monitors.

*United States Census Bureau population estimates as of July 1, 2015

**Current PM_{10} NAAQS is 150 µg/m³

***Required monitor count is based on population, percent of NAAQS, and maximum concentration

NAAQS - National Ambient Air Quality Standards

µg/m³ - micrograms per cubic meter

PM_{10} - particulate matter of 10 micrometers or less

N/A - not applicable

Appendix H: Particulate Matter of 10 Micrometers or Less Monitoring Requirements, Monitor Locations, and Method Codes

Table 2: Particulate Matter of 10 Micrometers or Less Monitor and Method Codes

AQS Number	Site Name	Method Code	2013-2015 Maximum Concentration (μg/m³)	2015 Annual Mean Concentration (μg/m³)	2014 Annual Mean Concentration (μg/m³)	2013 Annual Mean Concentration (μg/m³)
484530020	Austin Audubon Society	141	76	17	19	14
484530021	Austin Webberville Rd	141	99	23	26*	20
482011035	Clinton (collocated pair)	64	130	41*	42*	31*
481130050	Convention Center (collocated pair)	141	93	24*	27*	30*
481130075	Dallas North #2	141	82	19	20	18
483550034	Dona Park (collocated pair)	141	83	23	24	23
481130061	Earhart	141	132	24*	25*	28*
482151046	Edinburg East Freddy Gonzalez Drive	141	70	22	N/A	N/A
480290060	Frank Wing Municipal Court	141	73	22	25*	23
482010024	Houston Aldine	141	90	23	24	21
482011039	Houston Deer Park #2 (collocated pair)	141	91	19	19	18
482010062	Houston Monroe	64	99	25*	24	22
482010066	Houston Westhollow	64	95	20	20	20
481410029	Ivanhoe	62	76	19	20	20
482030002	Karnack	141	73	15	15	16
482010047	Lang	64	94	25*	24	21
484790017	Laredo Bridge	62	54	19	19	15
484790016	Laredo Vidaurri (collocated pair)	62	80	24	23	29*
482150043	Mission	141	138	27*	27*	33*
481411021	Ojo De Agua (collocated pair)	62	91	16	17	19
482010071	Pasadena HL&P	62	74	21	20	21
481410038	Riverside	62	143	25*	26*	28*
480290053	Selma	141	78	19	22	18
481410057	Socorro Hueco (collocated pair)	62	145	25*	32*	34*
484393010	Stage Coach	64	70	17	19	19
481670004	Texas City Fire Station (collocated pair)	63	92	16	20	19
481410693	Van Buren	62	81	15	20	18

*sites having annual mean particulate matter concentration among the highest 25 percent
AQS - Air Quality System
PM_{10} - particulate matter of 10 micrometers or less
μg/m³ - micrograms per cubic meter
N/A - not applicable

Appendix I

Particulate Matter of 2.5 Micrometers or Less Monitoring Requirements, Federal Reference Method Monitor Locations, and Method Codes

Texas Commission on Environmental Quality

2016 Annual Monitoring Network Plan

Appendix I: Particulate Matter of 2.5 Micrometers or Less Monitoring Requirements, Federal Reference Method Monitor Locations, and Method Codes

Table 1: Particulate Matter of 2.5 Micrometers or Less Monitoring Requirements

		2013-2015 DV (µg/m³)		Percent of NAAQS		FRM Samplers		Speciation		Continuous	
Metropolitan Statistical Area	2015 Population Estimates[1]	Annual	24-Hour	Annual[2]	24-Hour[3]	Required Monitors[4]	Existing Monitors[5]	Required Monitors[6]	Existing Monitors[6]	Required Monitors[6]	Existing Monitors[5]
Dallas-Fort Worth-Arlington	7,102,796	10.2	22	85	63	4	6	1	2	3	8
Houston-The Woodlands-Sugar Land	6,656,947	11.6	24	97	69	4	6	2	2	3	10
San Antonio-New Braunfels	2,384,075	8.5	22	71	63	2	2	0	0	1	5
Austin-Round Rock	2,000,860	9.2	22	77	63	2	2	0	0	1	3
El Paso	838,972	9.9	29	83	83	2	2	1	1	2	4
McAllen-Edinburg-Mission[8]	842,304	10.1	25	84	71	2	2	0	0	1	1
Corpus Christi	452,422	10.1	26	84	74	1	2	1	1	1	1
Killeen-Temple	431,032	N/A	N/A	N/A	N/A	0	0	0	0	0	0
Brownsville-Harlingen[8]	422,156	N/A	N/A	N/A	N/A	1	1	0	0	1	1
Beaumont-Port Arthur	408,419	N/A	N/A	N/A	N/A	0	0	0	0	0	3
Lubbock	311,154	N/A	N/A	N/A	N/A	0	0	0	0	0	1
Laredo	269,721	N/A	N/A	N/A	N/A	0	0	0	0	0	1
Waco	262,813	N/A	N/A	N/A	N/A	0	0	0	0	0	1
Amarillo	262,056	N/A	N/A	N/A	N/A	0	0	0	0	0	1
Odessa	159,436	N/A	N/A	N/A	N/A	0	0	0	0	0	2
Texarkana	150,780	9.8	22	82	63	1	1	0	0	1	1
Marshall[7]	66,746	9.0	20	75	57	0	1	0	1	0	1
Eagle Pass[7]	57,706	N/A	N/A	N/A	N/A	0	0	0	0	0	1
Totals	N/A	N/A	N/A	N/A	N/A	19	25	5	7	14	45

[1]United States Census Bureau population estimates as of July 1, 2015

[2]Current $PM_{2.5}$ Annual NAAQS is 12 micrograms per cubic meter (µg/m³)

[3]Current $PM_{2.5}$ 24-hour NAAQS is 35 µg/m³

[4]Required monitors include State or Local Air Monitoring Stations (SLAMS) and National Core (NCore) requirements.

[5]Individual monitors may fulfill one or more requirements.

[6]Required monitors include SLAMS and NCore requirements. Individual monitors may fulfill one or more requirements.

[7]Area is classified as a micropolitan area and not subject to SLAMS requirements.

[8]Site annual values do not meet completeness criteria.

DV - Design Value

SPM - special purpose monitor

FRM - federal reference method

N/A - not applicable

NAAQS - National Ambient Air Quality Standards

This list does not include Metropolitan Statistical Areas with no requirement and no monitors.

Appendix I: Particulate Matter of 2.5 Micrometers or Less Monitoring Requirements, Federal Reference Method Monitor Locations, and Method Codes

Table 2: Particulate Matter of 2.5 Micrometers or Less Federal Reference Method Locations and Method Codes

AQS Number	$PM_{2.5}$ FRM Site Name	Method Code
480290032	San Antonio Northwest	145
480290059	Calaveras Lake	145
480291069	San Antonio Interstate 35 (future deployment in 2016)	145
480370004	Texarkana	145
480610006	Brownsville	145
481130050	Convention Center	145
481130069	Dallas Hinton (collocated pair)	145
481390016	Midlothian OFW	145
481410037	El Paso UTEP	145
481410044	El Paso Chamizal (future collocated pair in 2016)	145
481671034	Galveston 99th Street	145
482010024	Houston Aldine	145
482010058	Baytown	145
482011035	Clinton (collocated pair)	145
482011039	Houston Deer Park #2	145
482011052	Houston North Loop	145
482030002	Karnack	145
482150043	Mission	145
482151046	Edinburg East Freddy Gonzalez Drive	145
483550032	Corpus Christi Huisache (collocated pair)	145
483550034	Dona Park	145
484391002	Fort Worth Northwest	145
484391006	Haws Athletic Center	145
484391053	Fort Worth California Parkway North	145
484530020	Austin Audubon Society	145
484530021	Austin Webberville Road	145
484531068	Austin North Interstate 35 (future deployment in 2016)	145

AQS - Air Quality System
FRM - federal reference method
$PM_{2.5}$ - particulate matter of 2.5 micrometers or less

Appendix J

Acronym and Abbreviation List

Texas Commission on Environmental Quality
2016 Annual Monitoring Network Plan

Appendix J: Acronym and Abbreviation List

– number
% – percent
> - greater than
$\mu g/m^3$ – micrograms per cubic meter
AADT – annual average daily traffic
AERMOD – American Meteorological Society/Environmental Protection Agency
AMNP – annual monitoring network plan
AQS – Air Quality System
autoGC – automated gas chromatograph
CAMx – Comprehensive Air Model with Extensions
CBSA – core based statistical area
CFR – Code of Federal Regulations
CO – carbon monoxide
CPS – City Public Service
CSN – Chemical Speciation Network
DRR – Data Requirements Rule
EI – emissions inventory
Exide – Exide Technologies
EPA – Environmental Protection Agency
FRM – federal reference method
HL&P – Houston Light and Power
LLC – limited liability company
MSA – metropolitan statistical area
NAAQS – National Ambient Air Quality Standards
NATTS – National Air Toxics Trends Stations
NCore – National Core Multipollutant Monitoring Stations
NEI – National Emissions Inventory
NO_2 – nitrogen dioxide
NO – nitrogen monoxide
NO_y – total reactive nitrogen compounds
O_3 – ozone
PAMS – Photochemical Assessment Monitoring Stations
Pb – lead
ppb – parts per billion
ppm – parts per million
PM_{10} – particulate matter of 10 micrometers or less in diameter
$PM_{2.5}$ – particulate matter of 2.5 micrometers or less in diameter
PWEI – population weighted emissions index
QA – quality assurance

Appendix J: Acronym and Abbreviation List

RA-40 – Regional Administrator 40
Rd – Road
SE – southeast
SETRPC – South East Texas Regional Planning Committee
SLAMS – State or Local Air Monitoring Stations
SO_2 – sulfur dioxide
SPM – special purpose monitor
STN – Speciation Trends Network
TCEQ – Texas Commission on Environmental Quality
TEOM – tapered element oscillating microbalance
tpy – tons per year
TSP – total suspended particulate
U.S. – United States
UTEP – University of Texas at El Paso
UV – ultra violet
VOC – volatile organic compound

Appendix K

TCEQ Response to Comments Received on the 2016 Annual Monitoring Network Plan

Texas Commission on Environmental Quality
2016 Annual Monitoring Network Plan

TCEQ

Appendix K: TCEQ Responses to Comments Received on the 2016 Annual Monitoring Network Plan

Introduction

As required by 40 Code of Federal Regulations (CFR) Part 58.10, the Texas Commission on Environmental Quality (TCEQ) posted the 2016 Annual Monitoring Network Plan (AMNP) for public inspection for 30 days prior to submittal to the United States (U.S.) Environmental Protection Agency (EPA). During the public comment period from May 16, 2016, to June 16, 2016, the TCEQ received three sets of comments regarding the posted document. The comments included a recommendation for an additional ozone (O_3) monitor in the Austin area, discussion of the El Paso County monitoring network, and the adequacy of the TCEQ plan for monitoring source-oriented emissions of sulfur dioxide (SO_2) and particulate matter of 2.5 micrometers or less ($PM_{2.5}$).

Summary and Response

Comment: The Capital Area Council of Governments (CAPCOG) Central Texas Clean Air Coalition (CAC) recommended that the TCEQ deploy an additional ozone monitor at Continuous Ambient Monitoring Station (CAMS) 171 in east Austin in order to provide real-time O_3 data for East Austin residents. In support for this additional monitor, CAPCOG noted that:

- *Adding an ozone monitor to CAMS 171 would enable co-pollutant analysis, due to the existing particulate matter (PM) and volatile organic compounds (VOC) sampling at the site;*
- *The marginal cost of adding an ozone monitor to this station should be much lower than the marginal cost of establishing a brand-new monitoring station elsewhere;*
- *TCEQ's 2015 Five-Year Ambient Air Monitoring Network Assessment indicated that TCEQ's two ozone monitors at CAMS 3 and 38 are "highly correlated," and that the only reason that they would not be considered "fully redundant" is that they are more than 5 kilometers (km) apart;*
- *CAMS 171 is more than 10 km away from the nearest TCEQ ozone monitor, and is located to the east of the core urban area, whereas CAMS 3 and 38 are both northwest of the urban core;*
- *Deployment of an additional regulatory ozone monitor in East Austin should not have adverse consequences for the region's attainment status, since the location is upwind of the urban core on virtually all days when the region traditionally sees high ozone measurements, and would provide an additional perspective on ozone levels in Travis County if a future ozone NAAQS used a statistical form that relied on averaging ozone levels across multiple monitoring stations; and*
- *TCEQ's decision to only report regulatory monitoring data to EPA for Air Quality Index (AQI) purposes means that residents of East Austin lack real-time data AQI data for ozone in their immediate vicinity, which would likely provide a more realistic picture of the frequency of high ozone days in that area than the data collected at CAMS 3 and 38 would provide.*

Response: The TCEQ appreciates and acknowledges CAPCOG's request, however, TCEQ evaluates all requests for additional monitor siting by assessing the current federal requirements for monitoring in addition to case specific indicators of a need for monitoring to assess public health impacts and available resources. The TCEQ is meeting all current regulatory O_3 requirements in accordance with 40 CFR Part 58, Appendix D, 4.1.

The TCEQ evaluated likely sources of precursor emissions and area topographical and meteorological information in order to select both an upwind location (to evaluate transport into the urban core) and a downwind location that was the most likely to observe the highest O_3 concentrations in the Austin-Round Rock metropolitan statistical area (MSA). The TCEQ agrees with CAPCOG's assertion that East Austin is upwind of the urban core on virtually all days when the region traditionally sees high O_3 measurements, and therefore does not agree that there is regulatory benefit for monitor placement in East Austin at this time. The placement of these regulatory monitors, in addition to the supplemental information provided by non-regulatory monitors, provides a high degree of certainty that the monitored O_3 concentrations are representative of the entire Austin-Round Rock MSA. At this time, TCEQ has no information indicating that additional monitoring is needed in East Austin.

Compliance with the NAAQS is determined using data from the monitor with the highest concentrations in an area. The O_3 NAAQS was revised on October 26, 2015, and the TCEQ does not expect any changes to the method of determining compliance for at least five years. In addition, the EPA added new requirements for states to develop and implement an Enhanced Monitoring Plan (EMP) detailing enhanced O_3 and O_3 precursor monitoring activities. The TCEQ will reevaluate its O_3 network as part of the EMP, including the consideration of the need for additional O_3 monitoring in the Austin area. The EMP and all related network changes will be included in the 2018 AMNP.

Comment: CAPCOG commented that the TCEQ listed two SO_2 monitors in Appendix E of the 2016 AMNP, at the Hutto and Lake Georgetown monitoring stations, that are no longer operational. CAPCOG requested that the TCEQ remove the two monitors from the AMNP accordingly.

Response: The TCEQ appreciates this comment, and the referenced SO_2 monitors have been removed from the document.

Comment: Western Refining, Inc. commented that it acknowledges and approves of the TCEQ's proposals for the air monitoring network in El Paso County.

Response: The TCEQ appreciates the support expressed by the commenter.

Comment: Western Refining, Inc. also suggested that the TCEQ consider the need for additional O_3 monitoring in El Paso County as part of the 2017 AMNP review, as the region may be designated nonattainment status by the EPA in the future.

Response: Comments relating to future AMNP reviews are beyond the scope of this AMNP review. However, the TCEQ appreciates the comments and looks forward to continued participation by all commenters on future AMNP reviews.

Appendix K: TCEQ Responses to Comments Received on the 2016 Annual Monitoring Network Plan

Comment: The Sierra Club (SC) commented that the TCEQ must comply with the *Data Requirements Rule for the 1-Hour Sulfur Dioxide Primary NAAQS* (DRR) to characterize peak one-hour SO_2 concetrations for all sources that emit more than 2,000 tons per year of SO_2. SC states, "TCEQ incorrectly suggests that it need not include in its monitoring plan any of the facilities subject to EPA's designation consent decree." SC recommends that the TCEQ should not wait for EPA designations before announcing a plan to comply with the rule. SC further states that the TCEQ "cannot simply wait for EPA to make a designation decision before the state decides how to comply with the rule."

Response: The TCEQ does not agree with these comments. The TCEQ is meeting all current regulatory SO_2 requirements set forth in the DRR and in 40 CFR Part 58, Appendix D, Section 4.4.2. The 2016 AMNP includes proposed SO_2 monitoring locations for the characterization of air quality relevant to those DRR sources for which monitors must be operational by January 1, 2017.

EPA plans to release designations on July, 2, 2016, for some sites, and on August 31, 2016, for the remaining sites. When the designation status of these sites is released by EPA, the TCEQ will comply with any related federal monitoring requirements. However, the TCEQ does not have the obligation to develop an attainment plan before a nonattainment designation has been made by the EPA. The TCEQ will provide notification regarding its approach to characterizing air quality to EPA by the DRR deadline of July 1, 2016. There is no requirement in the DRR that the TCEQ provide this notification as part of the AMNP.

Comment: SC commented that "monitors alone cannot accurately evaluate compliance with the SO_2 NAAQS" and that TCEQ's plan to deploy a more extensive network suffers from being "too slow, too impractical, and too ineffective for monitoring to replace modeling as the primary means of implementing the one-hour SO_2 NAAQS."

SC indicated that a single monitor may not be sufficient to characterize SO_2 and that the TCEQ may not be able to locate a monitor where the modeling indicates highest impacts. Additionally SC believes that full implementation of the NAAQS could take up to a decade and that it is more expeditious and cost-effective to perform air dispersion modeling.

Response: The TCEQ does not agree with these comments. Comments related to modeling for the determination of NAAQS compliance are beyond the scope of this AMNP, and the time required by the EPA to make attainment designations is beyond the control of the TCEQ. Air agencies are given the option to model or monitor emissions impacts from sources listed in the DRR, and the TCEQ's SO_2 monitoring plan is in compliance with the options and requirements set forth in the DRR. The TCEQ continues to support the use of ambient air monitoring data as the appropriate information for use in making designation decisions.

Comment: SC commented that the TCEQ focused only on a subset of sources applicable to the DRR, and the network is inadequate to determine if sources are emitting unhealthy levels of SO_2. SC suggests that TCEQ is undermining the core purpose of EPA's monitoring regulations by omitting monitoring plans for the largest emitters in the state. SC states that the monitoring plan will not accurately represent peak SO_2 concentrations in Texas, and recommends that the TCEQ reevaluate its proposed monitoring plan to ensure proper site placement.

Response: The TCEQ does not agree with these comments. The TCEQ is meeting or exceeding all regulatory monitoring requirements set forth in the DRR and in 40 CFR Part 58, Appendix D. The 2016 AMNP includes proposed SO_2 monitoring locations for the characterization of air quality relevant to those DRR sources for which monitors must be operational by January 1, 2017.

Comment: SC commented that the TCEQ monitoring network is not adequate to assess the air impacts of the largest polluters located in rural areas of the state.

Response: The TCEQ does not agree with these comments. As shown in the 2016 AMNP, the TCEQ air monitoring network is meeting or exceeding all federal requirements as defined in 40 CFR, Part 58, Appendix D. While these federal network design requirements emphasize monitoring in areas of high population density, the TCEQ currently operates 20 air monitoring stations with 52 monitors in rural areas throughout Texas. Of the 52 monitors, 19 are special purpose monitors that exceed federal network design requirements.

Comment: SC commented that the monitoring network is currently inadequate to assess fracking pollution across the state.

Response: The TCEQ does not agree with these comments. The TCEQ reviewed and evaluated the federal monitoring requirements for all criteria and air-toxic pollutants. The 2016 AMNP details Texas' current and future compliance with existing monitoring regulations in all areas of Texas. The TCEQ will continue to use the AMNP to annually assess compliance with federal monitoring requirements, including requirements for monitoring pollutants emitted during oil and gas activities, such as VOCs. Although outside the scope of the AMNP, a network of 18 automated gas chromatographs (autoGCs) and 14 canister samplers, most of which are state-funded and exceed federal requirements, monitor VOCs throughout the Barnett and Eagle Ford Shale areas. More information on the TCEQ's efforts related to oil and gas activities is available online at http://www.tceq.texas.gov/assistance/industry/oil-and-gas/oilgas.html.

Capital Area Council of Governments
6800 Burleson Road, Building 310, Suite 165 Austin, Texas 78744-2306
(p) 512.916.6000 (f) 512.916.6001
www.capcog.org

BASTROP BLANCO BURNET CALDWELL FAYETTE HAYS LEE LLANO TRAVIS WILLIAMSON

June 8, 2016

Ms. Holly Landuyt
P.O. Box 13087, MC-165
Texas Commission on Environmental Quality
Austin, TX 78711-3087

RE: 2016 Annual Monitoring Network Plan

Dear Ms. Landuyt:

The Capital Area Council of Governments (CAPCOG) Central Texas Clean Air Coalition (CAC) appreciates this opportunity to comment on the Texas Commission on Environmental Quality (TCEQ) *2016 Annual Monitoring Network Plan*. In light of the region's population and ozone levels, the CAC believes that it would be appropriate for TCEQ to deploy at least one additional regulatory ozone monitor in the Austin area using its own resources, and that Continuous Air Monitoring Station (CAMS) 171 in East Austin would be an appropriate location to put it.

- Adding an ozone monitor to CAMS 171 would enable co-pollutant analysis, due to the existing particulate matter (PM) and volatile organic compounds (VOC) sampling at the site;
- The marginal cost of adding an ozone monitor to this station should be much lower than the marginal cost of establishing a brand-new monitoring station elsewhere;
- TCEQ's 2015 *Five-Year Ambient Air Monitoring Network Assessment* indicated that TCEQ's two ozone monitors at CAMS 3 and 38 are "highly correlated," and that the only reason that they would not be considered "fully redundant" is that they are more than 5 kilometers (km) apart;
- CAMS 171 is more than 10 km away from the nearest TCEQ ozone monitor, and is located to the east of the core urban area, whereas CAMS 3 and 38 are both northwest of the urban core;
- Deployment of an additional regulatory ozone monitor in East Austin should not have adverse consequences for the region's attainment status, since the location is upwind of the urban core on virtually all days when the region traditionally sees high ozone measurements, and would provide an additional perspective on ozone levels in Travis County if a future ozone NAAQS used a statistical form that relied on averaging ozone levels across multiple monitoring stations; and
- TCEQ's decision to only report regulatory monitoring data to EPA for Air Quality Index (AQI) purposes means that residents of East Austin lack real-time data AQI data for ozone in their immediate vicinity, which would likely provide a more realistic picture of the frequency of high ozone days in that area than the data collected at CAMS 3 and 38 would provide.

Sincerely,

Travis County Judge Sarah Eckhardt
Chair, Central Texas Clean Air Coalition

From: MONOPS
Sent: Tuesday, May 17, 2016 8:57 AM
To: Holly Landuyt <Holly.Landuyt@tceq.texas.gov>
Cc: James Janysek <james.janysek@tceq.texas.gov>
Subject: FW: Comment on 2016 Annual Monitoring Network Plan
Importance: High

Holly,

AMNP comment received from CAPCOG, please see below.

~Heather

From: Hoekzema, Andrew [mailto:ahoekzema@capcog.org]
Sent: Monday, May 16, 2016 3:49 PM
To: MONOPS <MONOPS@tceq.texas.gov>
Cc: May, Ken <kmay@capcog.org>
Subject: Comment on 2016 Annual Monitoring Network Plan

Holly:

Page E-122 in "Appendix E: Sulfur Dioxide Data requirements Rule Monitor Placement Evaluations" (https://www.tceq.texas.gov/assets/public/compliance/monops/air/annual_review/2016-AMNP-Appendix-E.pdf), states that there are two SO_2 monitors operated by CAPCOG – one at Lake Georgetown and one at Hutto – while these stations have previously measured SO_2, they haven't for several years and we have no plans to restart SO_2 monitoring at these locations. As such, please remove reference to CAPCOG monitoring SO2 or explain that we used to operate SO2 monitors at these locations.

Thanks,

Andrew Hoekzema
Air Quality Program Manager
Capital Area Council of Governments
6800 Burleson Road, Bldg 310, Suite 165
Austin, TX 78744
Phone: (512) 916-6043 * Fax (512) 916-6001
ahoekzema@capcog.org ~ www.capcog.org

www.AirCentralTexas.org

SIERRA CLUB

June 16, 2016

Holly Landuyt, MC-165
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

monops@tceq.texas.gov

Via Electronic Mail

Re: Sierra Club Comments on Texas's Proposed 2016 Annual Monitoring Network Plan

Dear Ms. Landuyt,

On behalf of thousands of members and supporters who live, work, and recreate in Texas, Sierra Club respectfully submits these comments regarding the Texas Commission on Environmental Quality's ("TCEQ") Proposed 2016 Annual Monitoring Network Plan.

Monitoring network plans must achieve three objectives: (1) provide the public with data on air pollution; (2) provide supporting data for air pollution research; and (3) "support compliance with ambient air quality standards and emissions strategy development."[1] Additionally, a network must also incorporate "a variety of types of monitoring sites."[2]

---

[1] 40 C.F.R. § 58 App. D, § 1.1 (2011).

[2] *Id*. §1.1.1. The regulations specify "six general site types":

> (a) Sites located to determine the highest concentrations expected to occur in the area covered by the network. (b) Sites located to measure typical concentrations in areas of high population density. (c) Sites located to determine the impact of significant sources or source categories on air quality. (d) Sites located to determine general background concentration levels. (e) Sites located to determine the extent of regional pollutant transport among populated areas; and in support of secondary standards. (f) Sites located to measure air pollution impacts on visibility, vegetation damage, or other welfare-based impacts.

Monitoring sites must be capable of informing air quality managers about many things including the peak air pollution levels, typical levels in populated areas, air pollution transported into and outside of a city or region, and air pollution levels near specific sources.[3]

To further those objectives, and to ensure that Texas adopts and implements a robust air quality monitoring network that ensures clean, healthy air for all Texans, Sierra Club respectfully provides these comments, which addressing three significant concerns in TCEQ's 2016 Annual Air Monitoring Network Plan: (1) the adequacy of TCEQ's proposed SO_2 monitoring network under the Data Requirements Rule for the 2010 National Ambient Air Quality Standard ("NAAQS"); (2) the dearth of monitoring in rural areas despite many large stationary sources located there; and (3) new monitoring needs resulting from the boom in shale gas production, known as fracking.

I. TCEQ'S SO2 MONITORING NETWORK IS INSUFFICIENT TO SUPPORT COMPLIANCE WITH THE 1-HOUR SO2 NAAQS.

A. The Public Health Impacts of SO_2 Emissions are Significant.

Sulfur dioxide pollution causes numerous harmful human health and environmental effects. EPA has determined that exposure to SO_2 on time scales as short as five minutes can cause decrements in lung function, asthma attacks, and respiratory and cardiovascular morbidity.[4] Children and adults with asthma are particularly at risk for adverse health effects from short-term SO2 exposure.[5] Exposure to SO_2 can also aggravate existing heart disease, leading to increased hospitalizations and premature death.[6] According to EPA, fossil fuel combustion at electric utilities contributes the majority of anthropogenic SO_2 emissions.[7]

In addition to the direct adverse health effects of SO_2 emissions, SO_2 pollution contributes to the formation of secondary particles of fine particulate matter (PM2.5). Secondary particles of PM2.5 are formed from atmospheric reactions of chemicals, including SO2, and most of the fine particle pollution in the United States is formed in this way.[8] PM2.5 pollution contributes to a number of adverse health effects, including heart attacks, aggravated asthma, decreased lung function, coughing, and difficulty breathing.[9] Most disturbingly, PM2.5 is also associated with premature death in people with existing heart or lung disease.[10] According to the EPA, "the evidence is sufficient to conclude that the relationship between long-term PM2.5

---

[3] *Id.*
[4] *See* Primary National Ambient Air Quality Standard for Sulfur Dioxide Final Rule, 75 Fed. Reg. 35,520, 35,525 (June 22, 2010).
[5] *See id.* at 35,525-26.
[6] Sulfur Dioxide, Envtl. Prot. Agency, http://www.epa.gov/oaqps001/sulfurdioxide/health.html.
[7] Envtl. Prot. Agency, Our Nation's Air: Status and Trends Through 2008, 6, Fig. 2 (2010).
[8] EPA, Basic Information on Particulate Matter, available at http://www.epa.gov/pm/basic.html .
[9] EPA, Health Information on Particulate Matter, available at http://www.epa.gov/pm/health.html (last visited June 23, 2014).
[10] *Id*.

exposures and mortality is causal."[11]

B. EPA's 2010 SO_2 NAAQS

Recognizing that the prior 24-hour and annual SO_2 standards did not adequately protect the public against adverse respiratory effects associated with short term (5 minutes to 24 hours) SO_2 exposure, EPA revised the primary SO_2 NAAQS in 2010.[12] To reflect the most current science on SO_2 impacts, EPA set the new ambient standard at 75 ppb (196 µg/m3) as an hourly average.[13] Due both to its shorter averaging time (1-hour versus 24-hour) and significantly lower allowable concentration (75 ppb versus 140 ppb), the new standard is considerably more stringent than the prior SO_2 NAAQS and promises significant public health benefits. EPA estimated that the new 1-hour SO_2 standard would, if properly implemented, prevent 2,300-5,900 premature deaths and 54,000 asthma attacks a year.[14]

Timely implementation of the new NAAQS is therefore critical. Each year of delay in implementing the SO_2 NAAQS means, on a national level, as many as 5,900 people will die prematurely and 54,000 asthma attacks will occur unnecessarily. Each year of delay will likewise drive up the medical costs that individuals will have to pay, and will be another year in which people must abstain from everyday activities such as exercise, school, and work. EPA estimated that the net benefit of implementing the 75 ppb SO_2 NAAQS was up to $36 billion dollars nationally.[15]

In adopting the 1-hour SO2 NAAQS, EPA recognized the "strong source-oriented nature of SO_2 ambient impacts." 75 Fed. Reg. at 35,370. Unlike regional pollution problems, short term SO_2 air pollution problems are caused by single sources and occur in the near vicinity of that source. Thus, EPA concluded that the appropriate methodology for purposes of determining compliance, attainment, and nonattainment with the new NAAQS is modeling, since it would be virtually impossible to site sufficient monitors around each individual source of SO_2 pollution. *See* 75 Fed. Reg. at 35,551 (describing dispersion modeling as "the most technically appropriate, efficient, and readily available method for assessing short-term ambient SO_2 concentrations in areas with large point sources."). EPA also determined in the final SO_2 NAAQS rule that it did "not expect monitoring to become the primary method by which ambient concentrations are compared to the new 1-hour SO2 NAAQS."[16]

---

[11] EPA, Integrated Science Assessment for Particulate Matter, EPA/600/R-08/139F (Dec. 2009), at 7-96, available at http://www.epa.gov/ncea/pdfs/partmatt/Dec2009/PM_ISA_full.pdf .
[12] Minn. R. 7007.0100(7)(K-L); *see also* 40 C.F.R. § 50.17(a); Primary National Ambient Air Quality Standard for Sulfur Dioxide, 75 FR 35520, 35520-21 (June 22, 2010).
[13] 40 C.F.R. § 50.17(a).
[14] Envtl. Prot. Agency, Final Regulatory Impact Analysis (RIA) for the SO2 National Ambient Air Quality Standards (NAAQS), 5-35, tbl. 5.14 (2010).
[15] 75 Fed. Reg. 35,520, 35,588 (June 22, 2010).
[16] 75 Fed. Reg. at 35551.

C. EPA's Data Requirements Rule

On August 10, 2015, EPA finalized the Data Requirements Rule ("DRR") for the 2010 one-hour SO2 primary standard, which requires TCEQ to provide data to characterize air quality around many major sources of SO_2.[17] In particular, the rule requires the state to characterize the air quality around sources that emit 2,000 tons per year (tpy) or more of SO_2 and that are not located in an area already designated nonattainment. In Texas, there are 25 major sources of SO_2 meeting the DRR emissions applicability threshold.[18]

The DRR sets explicit deadlines for states to submit source-oriented monitoring or modeling to characterize ambient air quality impacts from major sources of SO_2 that meet the 2,000 tpy threshold. The state has three options. For each source identified under the DRR criteria, the state will be required to notify EPA by July 1, 2016, whether it intends to (1) characterize air quality through ambient monitoring, (2) characterize air quality through air quality modeling, or (3) whether it will be subjecting the pertinent source or sources to enforceable emission limits that will keep the source below this rule's 2,000 tpy threshold. If the air agency intends to rely on monitoring for a source, the air agency must include information about the planned new monitors in the annual monitoring plan that the air agency must submit to the EPA by July 1, 2016; and the air agency must also ensure that the new monitors are operational by January 1, 2017. The state's monitoring plans, however, are subject to EPA approval, and if the state's new monitors are not approved and operational by January 1, 2017, the state must demonstrate attainment with air dispersion modeling.[19]

To use monitoring to characterize air quality, states must take appropriate steps to identify, relocate and/or install new ambient SO_2 monitors that would characterize peak 1-hour SO_2 concentrations in areas around or impacted by identified SO_2 sources.[20] In determining where to locate monitors, the Data Requirements Rule's Technical Assistance Document indicates that states should take into account all existing data in determining where to site monitors, including

[17] 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) (to be codified at 40 C.F.R. § 51, Subpart BB).
[18] 2016 Air Monitoring Network Plan at 7; *see also* https://www3.epa.gov/airquality/sulfurdioxide/drr/drr-source-list-epa.pdf.
[19] See 80 Fed. Reg. at 51074, 51087-88.
[20] *See generally*, 80 Fed. Reg. 51085-88. In the Data Requirements Rule's companion Technical Assistance Document ("TAD"), EPA offers the following guidance on how air agencies might satisfy the SO2 data requirements in order to determine compliance with the NAAQS:

The EPA expects monitoring conducted in response to [an anticipated] future data requirements rule to be targeted, source-oriented monitoring, for which the primary objective would be to identify peak SO2 concentrations in the ambient air that are attributable to an identified emission source or group of sources.

See SO2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document, U.S. EPA Office of Air and Radiation, Office of Air Quality Planning and Standards, Air Quality Assessment Division (December 2013 Draft), http://www.epa.gov/airquality/sulfurdioxide/pdfs/SO2MonitoringTAD.pdf.

"existing modeling results."[21] Air agencies that choose to use monitoring as a means of satisfying the Data Requirements Rule are thus required to develop a network proposal, in which it demonstrates (based on all available modeling) that the area characterized around an identified SO_2 source (or sources) includes the locations where peak 1-hour SO_2 concentrations are expected to occur.[22]

TCEQ's 2016 Annual Monitoring Network Plan indicates that the agency intends to deploy source-oriented SO_2 monitors near 14 of the 25 identified sources by the January 1, 2017 rule deadline.[23] TCEQ further indicates that due to the close geographical proximity of 4 out of the 14 sources, a total of 12 monitoring stations are proposed for deployment to characterize ambient air quality surrounding each of these sources. Because EPA is subject to a consent decree to complete area SO2 designations for the remaining 12 sources on Texas's DRR list by July 2, 2016, [24] TCEQ has indicated that it does not intend to characterize SO2 emissions near any of those locations.[25] Sources located in Texas for which EPA will issue area designations by July 2, 2016, include Big Brown, Sandy Creek Energy Station, Sandow, Monticello, San Miguel, Coleto Creek, Martin Lake, Tolk Station, Optim Energy Twin Oaks, Harrington Station, Limestone, and WA Parish. In 2012, which is when EPA's designations were required under the 2010 standard, those 12 sources accounted for nearly 287,000 tons per year of SO_2 –nearly 85% of Texas's total emissions.[26]

D. <u>Texas Must Comply with the Data Requirements Rule for All Sources that Emit More the 2,000 TPY Threshold</u>

As an initial matter, TCEQ incorrectly suggests that it need not include in its monitoring plan any of the facilities subject to EPA's designation consent decree. The final DRR provides that for:

each source area subject to requirements for air quality characterization, the air agency shall notify the EPA by July 1, 2016, whether it has chosen to characterize peak 1- hour SO2 concentrations in such area through ambient air quality monitoring; characterize peak 1-hour SO2 concentrations in such area through air quality modeling techniques; or provide federally enforceable emission limitations by January 13, 2017 that limit emissions of applicable sources to less than 2,000 tpy, in accordance with paragraph (e) of this section, or provide documentation that the applicable source has permanently shut down.

---

[21] TAD at 2.

[22] TAD at 16 ("The primary objective is to place monitoring sites at the location or locations of expected peak concentrations.").

[23] 2016 Annual Monitoring Network Plan at 6-7.

[24] EPA, *Air Designations for the 2010 SO2 National Ambient Air Quality Standard to be Completed by July 2, 2016*, available at http://www.epa.gov/airquality/sulfurdioxide/designations/pdfs/sourceareas.pdf.

[25] See TCEQ 2016 Monitoring Netork Plan at 6-7.

[26] https://ampd.epa.gov/ampd/.

40 C.F.R. § 51.1203. If the state fails to meet those deadlines for demonstrating attainment through monitoring, the state must demonstrate attainment through modeling. Accordingly, if TCEQ wishes to demonstrate attainment through monitoring for any of the 11 sources subject to EPA's consent decree, it must still meet the deadlines set out in the DRR. TCEQ should not, and cannot, simply wait for EPA to make a designation decision before the state decides how to comply with the rule.

This is critically important because, as noted, if TCEQ fails to provide information establishing an adequate monitoring plan for a source subject to the rule, the state must demonstrate attainment through modeling. Air dispersion modeling recently conducted by Wingra Engineering, S.C. on behalf of the Sierra Club demonstrates that sulfur dioxide ("SO_2") emissions from the Big Brown Steam Electric Station, Limestone Electric Generating Station, Martin Lake Generating Station, Monticello Steam Electric Station, and the W.A. Parish Electric Generating Station in Texas have each caused downwind SO_2 ambient air concentrations to exceed the 75 parts per billion NAAQS, which translates to 196.2 micrograms per cubic meter ("$\mu g/m^3$"). Using the most recent emissions data for each facility, the modeling shows:

- Big Brown causes concentrations as high as 454 $\mu g/m^3$
- Limestone causes concentrations as high as 249 $\mu g/m^3$
- Martin Lake causes concentrations as high as 347 $\mu g/m^3$
- Monticello causes concentrations as high as 329 $\mu g/m^3$
- W.A. Parish causes concentrations as high as 394 $\mu g/m^3$

The modeling also demonstrates that the exceedances in the areas surrounding these facilities are even greater when nearby sources of SO_2 are taken into account. . The modeling analyses submitted by Sierra Club also demonstrated that even adjusting certain emissions and stack parameter assumptions, as suggested by TCEQ, these facilities still cause significant exceedances of the 1-hour standard in the surrounding areas.

Consistent with Sierra Club's recommendation, and as supported by the Wingra Engineering modeling, EPA proposed to designate the areas around Big Brown, Monticello, and Martin Lake as nonattainment. *See* 81 Fed. Reg. 10563. While TCEQ may dispute that designation, the agency's failure to develop a monitoring plan for those sources effectively precludes it from attempting to demonstrate attainment through monitoring. Moreover, even if EPA were to reverse course and designate those sources as unclassifiable, Big Brown, Monticello, and Martin Lake would still be subject to potential designation using modeling in 2017. Similarly, although EPA proposed to designate the areas surrounding Limestone and W.A. Parish as unclassifiable, TCEQ's failure to develop a monitoring plan for those facilities means that those sources may still be designated as nonattainment in 2017, using modeling. By failing to develop an attainment demonstration plan for any of the 11 largest sources of SO_2 in Texas, TCEQ is unnecessarily risking both public health and regulatory certainty.

E. Monitors Alone Cannot Accurately Evaluate Compliance with the SO_2 NAAQS

As EPA explained in the final 2010 SO_2 NAAQS Rule, "even if monitoring does not show a violation," that absence of data is not determinative of attainment status absent modeling, and that monitoring in general is "less appropriate, more expensive, and slower to establish."[27] TCEQ's plan to deploy a more extensive monitoring network as part of the NAAQS implementation process suffers from a number of drawbacks that render this approach too slow, too impractical, and too ineffective for monitoring to replace modeling as the primary means of implementing the 1-hr SO_2 NAAQS.

First, a single monitor may not be sufficient to characterize SO_2 air quality or to determine compliance with the 1-hr SO_2 standard.[28] For any area with fewer than three SO2 monitors positioned to capture peak concentrations from a large SO_2 source, monitoring will be inadequate to establish 1-hr SO_2 compliance. If only one monitor is located near a large source, that source has a clear invitation to game the system by, for example, slightly adjusting its stack or operating parameters to ensure that high impacts will not occur at the one monitor.

Second, even if TCEQ were to have the resources to deploy a sufficient number of monitors, the state may not be able to locate a monitor where the modeling indicates the highest impacts are likely to occur for technical reasons, such as an inability to gain physical or legal access to the site, or lack of access to power supply.[29]

Third, even if a sufficiently extensive monitoring network were established, full implementation of the NAAQS through monitoring would likely take up to a decade, which Sierra Club submits is an unacceptable amount of time given that the implementation of the 2010 SO_2 NAAQS has already been delayed for more than five year, and given the grave health risks associated with SO_2 exposure. Not only would this delay be a disservice to the public, it would also be a disservice to the regulated entities, especially owners of coal-fired power plants, which must make critical decisions now about future operations. Many of these sources are already in distress due to a number of factors, including low natural gas prices, declining demand for energy, an increasing availability of zero- or low- SO_2 generating sources, and the age of the existing coal-fired power plant fleet. Evaluating and achieving compliance through more expeditious and cost-effective air dispersion modeling can thus provide the regulatory clarity needed to make prudent decisions about those plants now that reliance on increased monitoring alone cannot.

Finally, EPA itself has acknowledged that, for medium to large sources, monitoring is "less appropriate, more expensive, and slower to establish."[30] This has been EPA's position for decades. For example, in 1994, EPA explained:

---

[27] 75 Fed. Reg. at 35551.
[28] *See, e.g.,* Andrew Gray, Gray Sky Solutions, "Review of Missouri's 2014 SO_2 Ambient Air Monitoring Network," June 24, 2014, at 1, attached as Ex. 1.
[29] An inability to place monitors at appropriate locations is another argument in favor of a modeling approach, as EPA has long recognized: "Although siting criteria may preclude the placement of ambient monitors at certain locations, this does not preclude the placement of model receptors at these sites." U.S. EPA 1994 SO2 Guideline Document at 2-6, available at http://www.epa.gov/ttn/naaqs/aqmguide/collection/cp2/19940201_oaqps_epa-452_r-94-008_so2_guideline.pdf [hereinafter, "1994 SO2 Guideline Document"].
[30] 75 Fed. Reg. at 35570.

> *A small number of ambient SO_2 monitors usually is not representative of the air quality for an area.* Typically, modeling estimates of maximum ambient concentration are based on a fairly infrequent combination of meteorological and source operating conditions. To capture such results on a monitor would normally require a prohibitively large and expensive network. Therefore, *dispersion modeling will generally be necessary to evaluate comprehensively a source's impacts* and to determine the areas expected high concentrations.[] Air quality modeling results would be especially important if sources were not emitting at their maximum level during the monitoring period or if the monitoring period did not coincide with potentially worst-case meteorological conditions.[31]

EPA has also explained:

> *Monitoring is not more accurate than computer modeling*, except for determining ambient concentrations under real-time conditions at a discrete location. Monitoring is limited in time as well as space. Monitoring can only measure pollutant concentrations as they occur; it cannot predict future concentrations when emission levels and meteorological conditions may differ from present conditions. Computer modeling, on the other hand, can analyze all possible conditions to predict concentrations that may not have occurred yet but could occur in the future.[32]

The cost of modeling compliance with the SO2 NAAQS is modest, particularly in comparison to the costs of installing and operating an adequate SO_2 monitoring network. This is particularly true where, as here, the vast majority of SO_2 pollution comes from a relatively small group of very large sources. If TCEQ does not have sufficient in-house modeling resources, the agency would incur some costs charged by third-party modelers, but even these costs are comparatively nominal. Independent third-party modelers could conduct AERMOD time series modeling for SO2 for less than $5,000 per source, and in most instances less than $3,000. In stark contrast, simply purchasing and installing a single monitor can cost upwards of $100,000 per site. By focusing on modeling the sources subject to the DRR, TCEQ could ensure that the protections promised by the NAAQS are met in a cost-effective and expeditious manner.

F. TCEQ's Proposed SO_2 Monitoring Network is Inadequate to Determine Whether Some of the Largest Pollution Sources are Causing Unhealthy Levels of SO_2

In 2012 the 17 Texas coal-fired power plants subject to the DRR emitted nearly 330,000 tons of sulfur dioxide—more than all of the sources in Oklahoma, Arkansas, Louisiana, New Mexico, and Mississippi combined.[33] This is due primarily to the fact that Texas's aging coal plants lack the type of cost-effective, modern pollution controls installed at many other plants

---

[31] 1994 SO2 Guideline Document at 2-5 to 2-6 (emphasis added).
[32] 67 Fed. Reg. 22,168, 22,185 (May 2, 2002) (emphasis added).
[33] *See* https://ampd.epa.gov/ampd/.

around the country.[34] In fact, the 12 power plants subject to EPA's consent decree, and which must be designated by July 2016, accounted for approximately 85% of the state's total SO_2 pollution.

Despite the massive amount of SO_2 emitted by the 25 Texas sources subject to the DRR, TCEQ proposes to operate only twelve SO_2 ambient air monitors in the state. Remarkably, even though the EPA consent decree facilities are without a doubt the largest emitters of SO_2 in the state, TCEQ proposes to install a monitor near only one of those facilities (Sandow 4). And that appears to be because Sandow 5 is also located at the same facility. Instead, TCEQ proposes to install monitors near the only the Pirkey, Welsh, Sandow 4 & 5, Oak Grove, and Harrington Plants—which collectively account for approximately 35,000 tpy SO_2. Or, approximately 12% of the total emissions from the 12 sources subject to EPA's consent decree. Instead of providing the public with helpful data about SO2 pollution in Texas, as required by EPA's regulations, the TCEQ monitoring plan serves only to distort and minimize the true extent of SO2 pollution in Texas. By focusing on a subset of sources that is responsible for only a fraction of Texas's staggering SO2 emissions, TCEQ undermines the core purposes of EPA's monitoring regulations: provide the public with accurate data on air pollution[35]

Even if TCEQ's monitoring plan accurately represented Texas SO_2 emissions (which it does not), the agency's monitoring plan fails to demonstrate that the proposed SO_2 monitors are placed in a location and manner that captures the peak predicted emissions concentrations from the few plants TCEQ does intend to monitor. By way of example, air dispersion modeling conducted by Wingra Engineering on behalf of Sierra Club demonstrates that TCEQ's proposed monitoring placements for the Harrington and Sandow power plants do not capture peak predicted impacts from the major sources subject to the DRR. Instead, the modeling demonstrates that the best location for a single monitor to identify the highest SO_2 concentrations caused by emissions from each of those major sources should be in significantly different locations. *Compare* Ex. 2 at 1-2 *with* 2016 Air Monitoring Plan App'x E at E-205 to E-207. Indeed, air dispersion modeling conducted by Wingra Engineering indicates that location of peak impacts from the Harrington coal plant is more than a half mile from TCEQ's proposed location.

Similarly, air dispersion modeling conducted by Wingra Engineering demonstrates that the location of peak impacts for the Sandow power plant is 1.75 northwest of TCEQ's proposed monitor location. *Compare* Ex. 2 at 3-4 *with* 2016 Air Monitoring Plan App'x E at E-130 to E-133. This is significant because while TCEQ proposes to monitor SO2 concentrations right outside the Sandow fence line, air dispersion modeling demonstrates that the high impacts are actually nearly two miles away on private property.

As explained in the reports attached as Exhibit 2, this modeling was conducted according to EPA protocol, using recent actual emissions. The recommended monitor sites attached in Exhibit 3, and the modeling reports attached in Exhibit 2, represent the beginning of what Sierra

---

[34] *See* NRDC, *Benchmarking Air Emissions of the 100 Largest Electric Power Producers in the U.S., 2014*, *available at* http://www.nrdc.org/air/pollution/benchmarking/.
[35] 40 C.F.R. § 58 App. D, § 1.1 (2011).

Club hopes will eventually be a robust monitoring network—informed and supplemented by air quality modeling—that will ensure that Texas is able to identify, address, and prevent SO_2 NAAQS exceedances.

Sierra Club urges TCEQ to reevaluate its proposed monitoring placement to ensure that the agency's proposed monitoring network captures peak SO_2 impacts, as required by the DRR. Sierra Club also urges TCEQ to reevaluate its decision to forego characterization of ambient air quality near the 12 coal plants subject to EPA's consent decree deadline. If TCEQ fails to submit an approvable plan for evaluating SO2 emissions near those facilities, EPA may designate those facilities based on modeling information.

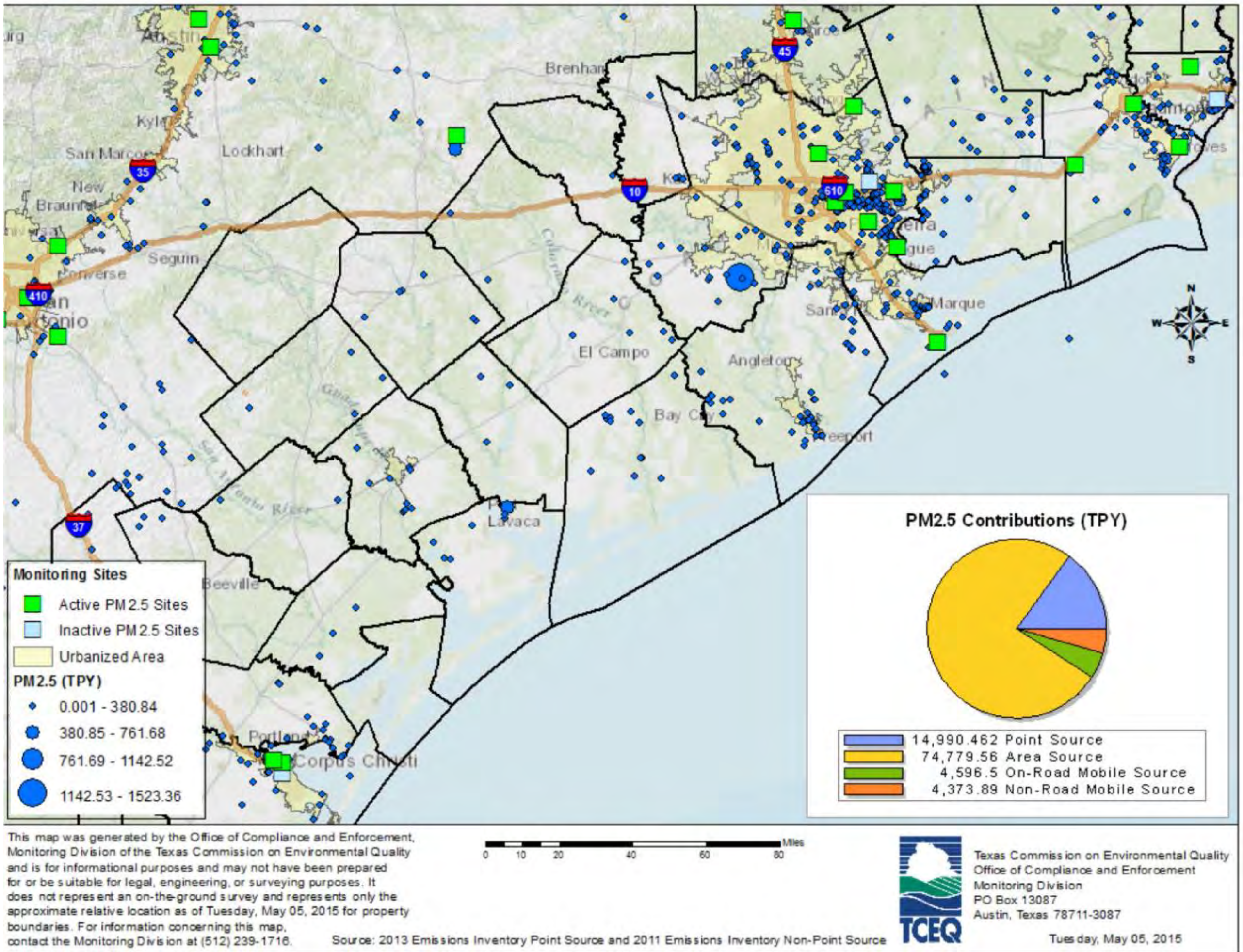
II. THE MONITORING NETWORK IS NOT ADEQUATE TO ASSESS THEAIR IMPACTS OF THE STATE'S LARGEST POLLUTERS, MANY OF WHICH ARE LOCATED OUTSIDE URBAN AREAS.

As noted, monitoring network plans must achieve three objectives: (1) provide the public with data on air pollution; (2) provide supporting data for air pollution research; and (3) "support compliance with ambient air quality standards and emissions strategy development."[36] Additionally, a network must also incorporate "a variety of types of monitoring sites."[37] Monitoring sites must be capable of informing managers about many things including the peak air pollution levels, typical levels in populated areas, air pollution transported into and outside of a city or region*, and air pollution levels near specific sources.*[38]

Texas' existing monitoring network fails to ensure health protections for citizens of non-urban areas near highly polluting sources. This is true not only for SO_2, as discussed above, but also $PM_{2.5}$, NOx, and other pollutants. Indeed, the 2016 Annual Monitoring Network Plan makes clear that many of the largest sources of SO_2, NOx, and $PM_{2.5}$ are in areas with no representative monitor. TCEQ fails to explain why there is no need to monitor air quality near these sources. In particular, there are insufficient $PM_{2.5}$ monitors to capture the local or area impacts of any of the following large sources: W.A. Parish, Big Brown, Martin Lake, or Fayette, each by far largest point sources of $PM_{2.5}$ in their respective regions. *See e.g.*, 2016 Annual Monitoring Network Plan at App'x I (no listed monitors near those sources; see also Five Year Assessment, at 58 and pasted below (large blue circle representing PM2.5 emissions in the location of W.A. Parish plant); 111 (large blue circles representing PM2.5 emissions in location of Martin Lake and Big Brown plants); 153 (large blue circles representing PM2.5 emissions in location of Fayette and Big Brown plants).

---

[36] 40 C.F.R. § 58 App. D, § 1.1.
[37] *Id.* §1.1.1. The regulations specify "six general site types:
(a) Sites located to determine the highest concentrations expected to occur in the area covered by the network. (b) Sites located to measure typical concentrations in areas of high population density. (c) Sites located to determine the impact of significant sources or source categories on air quality. (d) Sites located to determine general background concentration levels. (e) Sites located to determine the extent of regional pollutant transport among populated areas; and in support of secondary standards. (f) Sites located to measure air pollution impacts on visibility, vegetation damage, or other welfare-based impacts."
Id.
[38] *Id*.



Although population levels are one metric by which states must consider where to place monitor, EPA has also indicated that "[s]tates may also propose, and EPA would be inclined to approve, the placement of PM2.5 monitors in populated areas too small to be subject to the requirements regarding minimum numbers of monitors, *if there is reason to believe PM2.5 concentrations are of concern*."[39]

Beyond the sheer volume of $PM_{2.5}$ being emitted by some sources outside urban areas, there is also "reason to believe $PM_{2.5}$ concentrations are of concern" because some sources, such as Luminant's Sandow 4, Martin Lake, Big Brown, and Monticello coal-fired power plants, routinely exceed the 30% opacity limit in the Texas SIP, as demonstrated in exceedance reports submitted to TCEQ. Opacity (a measure of how much light is blocked by a plume of smoke) is a proxy for particulate matter pollution and is often the only metric used to establish compliance with PM2.5 emissions limits in the plants' permits. At times, these plants will measure opacity at 70, 80, 90, or even 100% for hours on end. TCEQ has exempted such exceedances for enforcement purposes because they regularly occur during plant startups and shutdowns, periods during which the plants do not run their particulate matter controls.

[39] *Revisions to Ambient Air Monitoring Regulations*, 71 Fed. Reg. 61236, 61264 (Oct. 17, 2006).

Setting aside EPA's Startup, Shutdown, and Maintenance SIP Call—in which EPA concluded that TCEQ's approach to SSM events is inconsistent with the Clean Air Act[40]—TCEQ's refusal to monitor and account for these events results in the emission of enormous amounts of particulate matter each time one of these plants starts up and does not run its PM controls. For example, Big Brown reported to TCEQ in 2011 that 19% of its total annual PM2.5 pollution from Unit 1 is released during non-routine operations.[41] Given that these startup/shutdown or exceptional event periods occur during only a small percentage (about 2%) of the plant's operating time, the particulate matter released during those periods must be many orders of magnitude higher than during routine operations. It is no wonder that opacity readings are often upwards of 75% during these times. If TCEQ will not require the plants experiencing these regular exceedances, the agency should at a minimum provide for some air monitoring to evaluate the impact of these events on the surrounding communities' air. Although they are located outside urban areas, people do live within the vicinity of these plants, and their health should be protected. On behalf of its members living outside urban centers, Sierra Club urges TCEQ to more thoroughly evaluate the need for monitors near large, highly polluting sources in less populated areas.

III. THE MONITORING NETWORK IS CURRENTLY INADEQUATE TO ASSESS FRACKING POLLUTION ACROSS THE STATE.

The Texas fracking boom presents significant challenges for maintaining healthy air quality in Texas. A growing body of studies have documented emissions of airborne pollutants from fracking sites that are known to cause cancer and harm the nervous, respiratory, and immune systems.[42] Documented pollutants from fracking include toxics, Diesel PM, PM2.5, NOx, and others.[43] Unhealthy spikes in ozone levels also have been found to occur in areas of increased drilling activity.[44]

---

[40] State Implementation Plans: Response to Petition for Rulemaking; Restatement and Update of EPA's SSM Policy Applicable to SIPs; Findings of Substantial Inadequacy; and SIP Calls To Amend Provisions Applying to Excess Emissions During Periods of Startup, Shutdown and Malfunction; Final Rule, 80 Fed. Reg. 33840 (June 12, 2015).

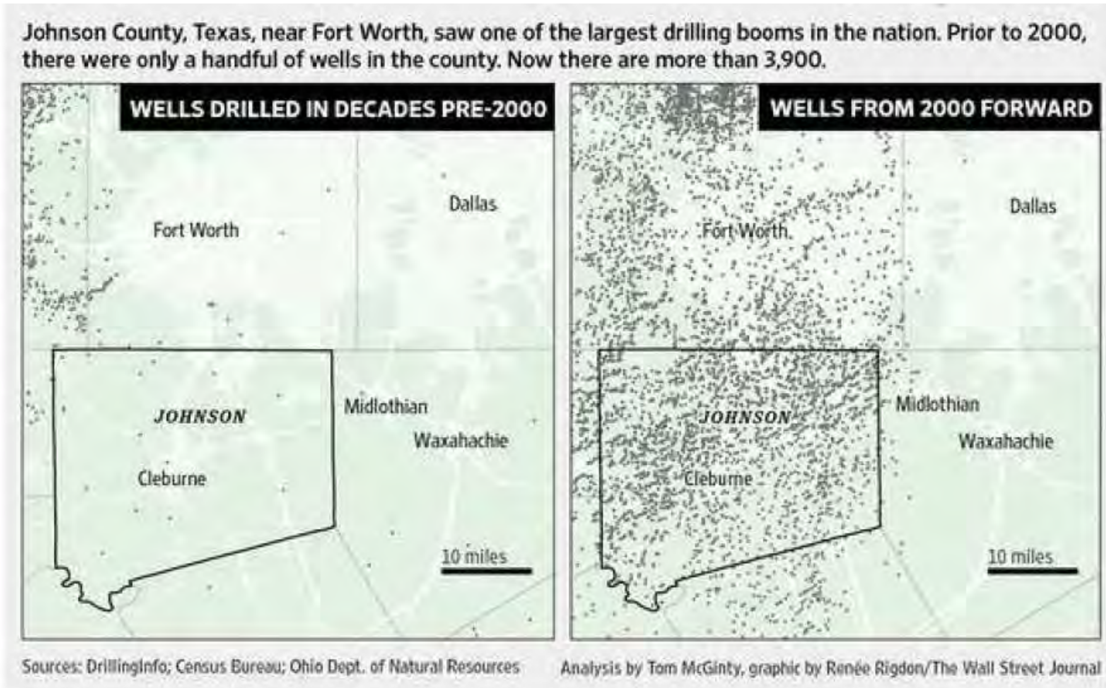
[41] *See, e.g.*, Exhibits 4 (PM, PM10, and PM2.5 emissions from top 100 sources in Texas); & 4 (Comparison of routine and non-routine PM, PM10, and PM2.5 emissions from the Big Brown Plant). Through its state permitting program for "planned" maintenance, startup, and shutdown events, TCEQ has allowed Luminant to stop reporting its plants' opacity exceedances during these periods. However, Luminant has made no changes in its operations, so we have every reason to believe that they continue.

[42] Natural Resources Defense Council, *Fracking Fumes: Air Pollution from Hydraulic Fracturing Threatens Public Health and Communities* (attached as Exhibit 5).

[43] *Id.* at 9-10.

[44] *Id.* at 2.

Both the extraction and processing of shale gas produces harmful pollutants in areas not adequately covered by the existing monitoring network. In fact, the 2016 plan fails to even mention of this issue, let alone identify how to ensure that air quality in shale gas processing areas meets federal standards. The following image gives a sense of the massive increase in new pollution sources in Texas since 2000 (but is not intended to represent the only areas affected).



While Sierra Club recognizes that there are air monitors near relatively large population centers, such as the north/west Dallas area, the monitoring plan does not adequately account for hotspots of drilling activity across the state.[45] Given the documented air pollution impacts of fracking (discussed in more detail in Exhibit 5), TCEQ must explain whether it plans to similarly expand air monitoring to protect communities living in and around other Texas shale plays, such as the Eagle Ford shale, and the Haynesville-Bossier shale, and the eastern or southern portions of the Barnett shale.

IV. CONCLUSION

For the reasons discussed above, TCEQ's monitoring plan is inadequate because the monitoring network will not properly characterize peak concentrations from . . . . . TCEQ must also consider adding source-oriented monitors in other locations, as described in the attached air dispersion modeling, to ensure that peak concentrations from other medium and large SO_2 sources are caught throughout the state. Further, TCEQ must conduct further dispersion modeling to comply with the 1-hour SO_2 standard. Finally, in order to protect the health of

[45] *See* TCEQ, Texas Active Oil and Gas Wells, *at http://www.tceq.state.tx.us/assets/public/implementation/barnett_shale/bs_images/txOilGasWells.png*

Texas citizens, TCEQ must assess the impacts of air pollution on rural areas and account for the boom in Texas fracking.

Thank you for the opportunity to comment.

Respectfully submitted,

____

Joshua Smith
Staff Attorney
Sierra Club
2101 Webster Street, Suite 1300
Oakland, CA 94612

2011 PM ALL

RN	ACCOUNT	COMPANY	SITE	SIC	SIC DESCRIPTION	FIN	FIN NAME	EPN	EPN NAME	YEAR	PM		
											ROUTINE	SMSS	EE
RN102147881	MM0023J	LUMINANT GENERATION CO LLC	SANDOW STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	S4MB	UNIT 4 MAIN BOILER	S03	MAIN BOILER STACK	2011	1415.923	180.96	2.6
RN102285921	TF0013B	LUMINANT GENERATION CO LLC	MONTICELLO STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B3	BOILER #3	S3	STACK	2011	1208.379	136.82	4.6
RN101198059	FI0020W	LUMINANT GENERATION CO LLC	BIG BROWN STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B2	UNIT #2 BOILER STACK	51	BOILER #2 STACK	2011	1115.22	193.06	1.83
RN101198059	FI0020W	LUMINANT GENERATION CO LLC	BIG BROWN STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B1	UNIT #1 BOILER	50	BOILER #1 STACK	2011	990.1873	213.3	22.94
RN100224849	PG0041R	SOUTHWESTERN PUBLIC SERVICE CO	HARRINGTON STATION POWER PLANT	4911	ELECTRIC SERVICES	UNIT 3	BOILER-GENERATOR #3	3-1	UNIT 3 STACK	2011	899.5699	1.4259	1.8169
RN102583093	RL0020K	LUMINANT GENERATION CO LLC	MARTIN LAKE ELECTRICAL STATION	4911	ELECTRIC SERVICES	U1-B1	UNIT NO. 1 BOILER	S-1	UNIT 1 BOILER STACK	2011	838.0873	66.67	5.71
RN102583093	RL0020K	LUMINANT GENERATION CO LLC	MARTIN LAKE ELECTRICAL STATION	4911	ELECTRIC SERVICES	U2-B2	UNIT NO. 2 BOILER	S-2	UNIT 2 BOILER STACK	2011	835.0537	80.88	2.72
RN100224534	LB0047N	SOUTHWESTERN PUBLIC SERVICE CO	TOLK STATION	4911	ELECTRIC SERVICES	UNIT 2	BOILER--GENERATOR #2	2-1	UNIT 2 STACK	2011	756.8518	1.0953	0.9235
RN102583093	RL0020K	LUMINANT GENERATION CO LLC	MARTIN LAKE ELECTRICAL STATION	4911	ELECTRIC SERVICES	U3-B3	UNIT NO. 3 BOILER	S-3	UNIT 3 BOILER STACK	2011	742.0374	96.01	2.92
RN100213370	TF0012D	SOUTHWESTERN ELECTRIC POWER CO	WELSH POWER PLANT	4911	ELECTRIC SERVICES	W-01	BOILER NO. 1	01	BOILER NO. 1	2011	682.46	0	0
RN100542927	LI0027L	NRG TEXAS POWER LLC	LIMESTONE ELECTRIC GENERATION STATION	4911	ELECTRIC SERVICES	2	LIMESTONE UNIT 2 STACK	LMS2	UNIT 2 BOILER STK-LMS-2	2011	634.27	60.6515	15.396
RN100542927	LI0027L	NRG TEXAS POWER LLC	LIMESTONE ELECTRIC GENERATION STATION	4911	ELECTRIC SERVICES	1	UNIT 1 STACK	LMS1	UNIT I BOILER STK (LMS-1)	2011	596.57	81.6402	20.045
RN102285921	TF0013B	LUMINANT GENERATION CO LLC	MONTICELLO STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B1	UNIT #1 BOILER	S1	STACK UNIT #1	2011	525.6647	305.69	0.16
RN100213370	TF0012D	SOUTHWESTERN ELECTRIC POWER CO	WELSH POWER PLANT	4911	ELECTRIC SERVICES	W-03	BOILER NO. 3	03	BOILER NO. 3	2011	484.06	0	0
RN101062255	WI0025C	PUBLIC SERVICE CO OF OKLAHOMA	OKLAUNION POWER STATION	4911	ELECTRIC SERVICES	OPS1	OKLAUNION POWER STATION BOILER #1	1	OKLAUNION STACK #1	2011	450.16	0	0
RN102285921	TF0013B	LUMINANT GENERATION CO LLC	MONTICELLO STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B2	BOILER #2	S2	STACK UNIT #2	2011	446.6892	116.92	2.05
RN100214550	GK0012K	TEXAS MUNICIPAL POWER AGENCY	GIBBONS CREEK	4911	ELECTRIC SERVICES	01006	SUB-BITUMINOUS COAL FIRED BOILER	BOILER1STK	SUBBITUMINOUS COAL FIRED	2011	422.2025	0	0
RN100214386	NE0112G	VALERO REFINING TEXAS LP	CORPUS CHRISTI WEST PLANT	2911	PETROLEUM REFINING	24-ST-01	F.C.C.U.	121	CAUSTIC SCRUBBER VENT	2011	399.2082	0	0
RN100216191	RI0017E	OAK GROVE MANAGEMENT COMPANY LLC	OAK GROVE STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	F-OGU1	UNIT 1 BOILER	E-OGU1	UNIT 1 BOILER STACK	2011	362.9431	0	1.174
RN102181526	CB0028T	UNION CARBIDE CORP	SEADRIFT PLANT	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	MAINTCSP5	MAIN_MNT_FIELD PAINTING & BLASTING	648	MAIN_EPT_FIELD PAINTING EMISSIONS	2011	338.0237	0	0
RN100226919	GF0002R	COLETO CREEK POWER LP	COLETO CREEK POWER STATION	4911	ELECTRIC SERVICES	B-1	UNIT 1 BOILER	1	UNIT 1 STACK	2011	334.077	2.5191	0.0001
RN100214287	HH0037F	SOUTHWESTERN ELECTRIC POWER CO	AEP PIRKEY POWER PLANT	4911	ELECTRIC SERVICES	P-16	BOILER #1	16	BOILER STACK	2011	330.2	0	0
RN100209287	JE0040F	OXBOW CALCINING LLC	OXBOW CALCINING LLC	2999	PETROLEUM AND COAL PRODUCTS, NEC	KS4/WHBS4	COKE CALCINING--KILN 4	KS4/WHBS4	WASTE HEAT BOILER STACK #4	2011	308.8087	0	0
RN100258060	MH0009H	CELANESE LTD	BAY CITY PLANT	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	301M150	VINYL ACETATE	301M150	UTIL VA COOLING TOWER	2011	308.2644	0	0
RN100210517	MR0008T	DIAMOND SHAMROCK REFINING CO LP	VALERO MCKEE REFINERY	2911	PETROLEUM REFINING	F-50	F.C.C.U. (FLUIDIZED CATALYTIC CRACKING UNIT)	V-20	VENT	2011	304.1527	0	0
RN100213370	TF0012D	SOUTHWESTERN ELECTRIC POWER CO	WELSH POWER PLANT	4911	ELECTRIC SERVICES	W-02	BOILER NO. 2	02	BOILER NO. 2	2011	288.26	0	0
RN100543115	CG0010G	INTERNATIONAL PAPER CO	TEXARKANA MILL	2621	PAPER MILLS	PB02	POWER BOILER NO. 2	PB02	POWER BOILER NO. 2 STACK	2011	286.3334	0	0
RN100226844	FC0018G	LOWER COLORADO RIVER AUTHORITY	FAYETTE POWER PROJECT	4911	ELECTRIC SERVICES	FPP-2	UNIT 2--600 M.W. STEAM ELECTRIC GENERATOR	FPP-2N	FPP 2 - NEW STACK	2011	283.8338	0	0
RN10536980S	MMA003C	LUMINANT GENERATION CO LLC	SANDOW 5 GENERATING PLANT	4911	ELECTRIC SERVICES	SA-B5A	CFB BOILER 5A	SA-S5A	SA5 BOILER A STACK	2011	279.7962	0	0
RN10536980S	MMA003C	LUMINANT GENERATION CO LLC	SANDOW 5 GENERATING PLANT	4911	ELECTRIC SERVICES	SA-B5B	CFB BOILER 5B	SA-S5B	SA5 BOILER B STACK	2011	277.8978	0	0.9766
RN102522950	WH0040R	PPG INDUSTRIES INC	WORKS NO 4	3211	FLAT GLASS	STA-22	GLASS MELTING FURNACE LINE 1	22	FURNACE LINE 1 EXHAUST	2011	268.6534	0	0
RN102522950	WH0040R	PPG INDUSTRIES INC	WORKS NO 4	3211	FLAT GLASS	STA-23	GLASS MELTING FURNACE LINE 2	23	FURNACE LINE 2 EXHAUST	2011	251.025	0	0
RN100217975	BG0057U	CITY PUBLIC SERVICE	CALAVERAS PLANT	4911	ELECTRIC SERVICES	P-6	J.K. SPRUCE, COAL-FIRED BOILER UNIT 2	U-6	J.K. SPRUCE, COAL-FIRED BOILER UNIT 2	2011	249.0939	0	0
RN100224849	PG0041R	SOUTHWESTERN PUBLIC SERVICE CO	HARRINGTON STATION POWER PLANT	4911	ELECTRIC SERVICES	UNIT 1	BOILER-GENERATOR #1	1-1	UNIT 1 STACK	2011	245.8826	3.0348	0.41S1
RN100216191	RI0017E	OAK GROVE MANAGEMENT COMPANY LLC	OAK GROVE STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	F-OGU2	UNIT 2 BOILER	E-OGU2	UNIT 2 BOILER STACK	2011	224.8836	0	1.2622
RN100226570	RI003SC	TWIN OAKS POWER III LP	TWIN OAKS POWER	4911	ELECTRIC SERVICES	FADA	FLY ASH DISPOSAL AREA-MAINTENANCE ACTIVITY	FADA	FLY ASH DISPOSAL AREA FU	2011	221	0	0
RN100209618	ND0028H	UNITED STATES GYPSUM CO	US GYPSUM SWEETWATER	327S	GYPSUM PRODUCTS	30	HAUL ROAD	30	HAUL ROAD FUGITIVES	2011	220.868	0	0
RN100226539	AG0007G	SAN MIGUEL ELECTRIC COOPERATIVE INC	LIGNITE FIRED POWER PLANT	4911	ELECTRIC SERVICES	#6	BOILER	#6	BOILER STACK EXHAUST	2011	215.898	2.4938	7.0552
RN102605375	CS0022K	CEMEX CONSTRUCTION MATERIALS SOUTH LLC	BALCONES PLANT	3241	CEMENT, HYDRAULIC	ROAD-QF-3	QUARRY TRUCK ROAD FUGITIVES	QF-3	QUARRY TRK ROAD FUGITIVES	2011	212.7961	0	0
RN100226570	RI0035C	TWIN OAKS POWER III LP	TWIN OAKS POWER	4911	ELECTRIC SERVICES	2-1	171 MW FLUID BED COMBUSTOR	2-1	FBC STACK	2011	206.038	0	0
RN100888312	FG0020V	NRG TEXAS POWER LLC	WA PARISH ELECTRIC GENERATING STATION	4911	ELECTRIC SERVICES	8	UNIT 8 BOILER	WAP8	UNIT 8 BOILER STACK	2011	204.06	0	0.0275
RN100219856	BJ0001T	CHEMICAL LIME LTD	CHEMICAL LIME CLIFTON PLANT	3274	LIME	FU-1	TRUCK TRAFFIC	FU-1	ROAD FUG.	2011	200	0	0
RN102488517	KJ0003N	EXXONMOBIL CORP	KING RANCH PLANT	1321	NATURAL GAS LIQUIDS	COOLNGTWR3	RADU COOLING TOWER	COOLNGTWR3	RADU COOLING TOWER	2011	187.5596	0	0
RN100542281	HG0033B	EQUISTAR CHEMICALS LP	CHANNELVIEW COMPLEX	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	48CT4811	C.T. 4811 (O.P. 2)	48E11	COOLING TOWER	2011	182.3485	0	0
RN100226570	RI003SC	TWIN OAKS POWER III LP	TWIN OAKS POWER	4911	ELECTRIC SERVICES	1-1	171 MW FLUID BED COMBUSTOR	1-1	FBC STACK	2011	182.157	0	0
RN100716661	HG0175D	PASADENA REFINING SYSTEM INC	PASADENA REFINING SYSTEM	2911	PETROLEUM REFINING	CTWFUCPX	COMPLEX COOLING TOWER	FUCTWCPX	COMPLEX COOLING TOWER	2011	180.085	0	0
RN100888312	FG0020V	NRG TEXAS POWER LLC	WA PARISH ELECTRIC GENERATING STATION	4911	ELECTRIC SERVICES	6	UNIT 6 BOILER	WAP6	UNIT 6 BOILER STACK	2011	172.05	0	0
RN101286227	PF0003N	GEORGIA PACIFIC WOOD PRODUCTS SOUTH LLC	CAMDEN PLYWOOD & LUMBER COMPLEX	2436	SOFTWOOD VENEER AND PLYWOOD	BOILER3	BOILER #3	S-03	BOILER #3	2011	169.8211	0	0
RN1024S07S6	JE0067I	EXXONMOBIL OIL CORP	BEAUMONT REFINERY	2911	PETROLEUM REFINING	06BLR#001	FCC CO BOILER	06STK_003	FCC SCRUBBER	2011	164	0	0
RN100214428	OC0019C	INTERNATIONAL PAPER CO	ORANGE MILL	2621	PAPER MILLS	P-BARKB	BARK BOILER	2	BARK BOILER SCRUBBER STK.	2011	163.9632	0	0
RN102157609	JC0003K	MEADWESTVACO TEXAS LP	EVADALE MILL	2631	PAPERBOARD MILLS	21-2069	NO. 6 POWER BOILER STEAM GENERATION	50	NO. 6 POWER BOILER STACK	2011	159.3144	0	0
RN100542281	HG0033B	EQUISTAR CHEMICALS LP	CHANNELVIEW COMPLEX	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	38CT3811	O.P. 1 COOLING TOWER	38E11	COOLING TOWER "OP1"	2011	158.8234	0	0
RN100226844	FC0018G	LOWER COLORADO RIVER AUTHORITY	FAYETTE POWER PROJECT	4911	ELECTRIC SERVICES	FPP-1	UNIT 1--600 M.W. STEAM ELECTRIC GENERATOR	FPP-1N	FPP 1 - NEW STACK	2011	156.9029	16.5	0.1
RN100209287	JE0040F	OXBOW CALCINING LLC	OXBOW CALCINING LLC	2999	PETROLEUM AND COAL PRODUCTS, NEC	KS3/WHBS3	COKE CALCINING--KILN 3	KS3/WHBS3	WASTE HEAT BOILER STACK #3	2011	155.6219	0	0
RN1010622S5	WI0025C	PUBLIC SERVICE CO OF OKLAHOMA	OKLAUNION POWER STATION	4911	ELECTRIC SERVICES	FS11	OKLAUNION POWER STATION	COOLINGTWR	COOLING TOWER	2011	1S3.66	0	0
RN100226844	FC0018G	LOWER COLORADO RIVER AUTHORITY	FAYETTE POWER PROJECT	4911	ELECTRIC SERVICES	3-1B	UNIT 3--470 - M.W. POWER PLANT (STEAM GENERATOR)	3-1B	"UNIT-3" STACK	2011	153.152	14.3	0
RN100214428	OC0019C	INTERNATIONAL PAPER CO	ORANGE MILL	2621	PAPER MILLS	P-REVB1	#1 RECOVERY FURNACE	1A	RECOVERY STACK	2011	150.0861	0	0
RN100224534	LB0047N	SOUTHWESTERN PUBLIC SERVICE CO	TOLK STATION	4911	ELECTRIC SERVICES	UNIT 1	BOILER--GENERATOR #1	1-1	UNIT 1 STACK	2011	147.4193	0	0.1366
RN100888312	FG0020V	NRG TEXAS POWER LLC	WA PARISH ELECTRIC GENERATING STATION	4911	ELECTRIC SERVICES	5	UNIT S BOILER	WAP5	UNIT 5 BOILER STACK	2011	144.12	0	0.0004
RN100209287	JE0040F	OXBOW CALCINING LLC	OXBOW CALCINING LLC	2999	PETROLEUM AND COAL PRODUCTS, NEC	KS5/WHBS5	COKE CALCINING--KILN 5	KS5/WHBS5	WASTE HEAT BOILER STACK #5	2011	141.047	0	0
RN100217199	ED0066B	TXI OPERATIONS LP	MIDLOTHIAN PLANT	3241	CEMENT, HYDRAULIC	E2-22	#5 CEMENT KILN STACK	E2-22	#5 KILN CEMENT KILN STACK	2011	140.9222	0	0.0633
RN10162S721	NE0022I	TICONA POLYMERS INC	BISHOP FACILITY	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	TOXCOOLTWR	TOXCOOLTWR	TOXCOOLTWR	TO COOLING TOWER	2011	134.8164	0	0
RN100542257	DF0223E	WASTE MANAGEMENT OF TEXAS INC NORTH TEXAS	DFW RECYCLING AND DISPOSAL FACILITY	49S3	REFUSE SYSTEMS	ROADS	HAUL ROADS TO ACTIVE LANDFILL FACE	FUGITIVERD	FUG. EMISS.- HAUL ROADS	2011	133.17	0	0
RN102488517	KJ0003N	EXXONMOBIL CORP	KING RANCH PLANT	1321	NATURAL GAS LIQUIDS	COOLNGTWR4	PROCESS COOLING TOWER	COOLNGTWR4	PROCESS COOLING TOWER	2011	126.7574	0	0
RN102157609	JC0003K	MEADWESTVACO TEXAS LP	EVADALE MILL	2631	PAPERBOARD MILLS	21-210S	(NO. 2 POWER BOILER) STEAM GENERATION	1	NO. 1 STACK	2011	126.1376	0	0
RN100888312	FG0020V	NRG TEXAS POWER LLC	WA PARISH ELECTRIC GENERATING STATION	4911	ELECTRIC SERVICES	7	UNIT 7 BOILER	WAP7	UNIT 7 BOILER STACK	2011	123.73	0	0.0006

RN102555166	NE0027V	CITGO REFINING AND CHEMICALS CO LP	EAST PLANT REFINERY	2911	PETROLEUM REFINING	31-PR-1	NO. 2 FCCU REGENERATOR / ESP	31-PR-1	NO. 2 F.C.C.U. ESP. STACK	2011	123.6835	0	0
RN100214337	TH0010I	AUSTIN WHITE LIME CO	MCNEIL PLANT & QUARRY	3274	LIME	54500	CRUSHING & SCREENING "C" SECTION	C&S001C	CRUSH & SCREEN "C" SCTN.	2011	122.9951	0	0
RN100238385	GB0073P	VALERO REFINING TEXAS LP	TEXAS CITY REFINERY	2911	PETROLEUM REFINING	G-001	CATALYTIC CRACKING REGENERATOR VENT	EG-001	F.C.C.U. ESP. STACK	2011	122.7775	0	0.01
RN100250869	HT0011Q	ALON USA LP	BIG SPRING REFINERY	2911	PETROLEUM REFINING	06REGENPCV	FCCU CATALYST REGENERATOR	06ESPPCV	ESP STACK	2011	122.6007	0	0
RN100633650	HG1575W	LYONDELL CHEMICAL CO	CHANNELVIEW PLANT	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	COOL1	POSM 1 COOLING TOWER	ECOOL1	POSM 1 COOLING TOWER	2011	119.0724	0	0
RN100210434	WO0009I	EXXONMOBIL CORP	HAWKINS GAS PLANT	1321	NATURAL GAS LIQUIDS	COOLTWRM	MARLEY COOLING TOWER	COOLTWRM	MARLEY COOLING TOWER	2011	118.2728	0	0
RN100235266	NE0122D	FLINT HILLS RESOURCES CORPUS CHRISTI LLC	WEST REFINERY	2911	PETROLEUM REFINING	01BF102	F.C.C.U. C.O. BOILER / CAUSTIC SCRUBBER	AA-4	SCRUBBER STACK	2011	118.1862	0	0
RN102495884	HW0018P	PHILLIPS 66 COMPANY	BORGER REFINERY	2911	PETROLEUM REFINING	40P1	UNIT 40 FCCU REGENERATOR	40P1	CAT. CRACKER REGENERATOR	2011	117.864	129.475	239.78
RN100218338	BG1066M	WASTE MANAGEMENT OF TEXAS INC	COVEL GARDENS RPD FACILITY	4953	REFUSE SYSTEMS	ROADS	COVEL GARDENS RPD FACILITY	RDFUGITIVE	ROADS	2011	117.24	0	0
RN102579307	HG0232Q	EXXONMOBIL REFINING & SUPPLY CO	BAYTOWN REFINERY	2911	PETROLEUM REFINING	FCCU2F1A	FCCU 2 FURNACE F1A FLUE GAS TO ATMOSPHER	FCCU2WGS	FLUID CAT CRACKING UNIT 2	2011	116.4776	0	0
RN100211283	NB0037F	TRNLWS LLC	STREETMAN PLANT	3295	MINERALS, GROUND OR TREATED	COOLER5TAK	CLINKER COOLER STACK	E3-2	CLINKER COOLER VENT STACK	2011	113.316	0	0
RN100217975	BG0057U	CITY PUBLIC SERVICE	CALAVERAS PLANT	4911	ELECTRIC SERVICES	BOILER 1	DEELY, COAL-FIRED, STEAM BLR. 1	E-3	DEELY BOILER STACK	2011	112.5994	0	0
RN102597846	HK0014M	TEXAS LEHIGH CEMENT CO LP	TEXAS LEHIGH CEMENT CO	3241	CEMENT, HYDRAULIC	KILN	KILN & PRECALCINER	DC-2	DUST COLLECTOR "DC-2"	2011	110.3403	0	0
RN100217975	BG0057U	CITY PUBLIC SERVICE	CALAVERAS PLANT	4911	ELECTRIC SERVICES	P-5	J.K. SPRUCE, COAL-FIRED BOILER	U-5	SPRUCE STACK	2011	109.4118	0	0
RN100543115	CG0010G	INTERNATIONAL PAPER CO	TEXARKANA MILL	2621	PAPER MILLS	RB02	NO. 2 RECOVERY BOILER	RB02B	BOILER EAST STACK ("B")	2011	108.7834	0	0.011
RN103934493	GBA004D	SOUTH HOUSTON GREEN POWER LP	SOUTH HOUSTON GREEN POWER SITE	4931	ELECTRIC AND OTHER SERVICES COMBINED	802-CTHRSG	GP-2 UNIT 802 (UNIT #2)	802-STACK	UNIT 802 STACK (UNIT 2)	2011	107.509	0.144	0
RN100825405	HN0083G	RIO GRANDE VALLEY SUGAR GROWERS INC	W R COWLEY SUGAR HOUSE	2061	RAW CANE SUGAR EXCEPT REFINING	BLR2	HEAT, STEAM, & POWER	E-02	BAGASSE FIRED BOILER	2011	105.48	0	0
RN100211283	NB0037F	TRNLWS LLC	STREETMAN PLANT	3295	MINERALS, GROUND OR TREATED	UP-6-9A	FUGITIVES TRUCK TRAFFIC	E6-9A	FUG. TR. TRAFFIC--PRODUCT	2011	105.3207	0	0
RN101625721	NE0022I	TICONA POLYMERS INC	BISHOP FACILITY	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	117CT104	MO IV COOLING TOWER	117CT104	COOLING TOWER 104 EMISS	2011	104.8572	0	0
RN102679867	SK0041T	TYLER PIPE CO	MCWANE INC	3321	GRAY & DUCTILE IRON FOUNDRIES	NPNONPROC	NON-PROCESS SPECIFIC ACTIVITIES	E2-5-3	FITTINGS CASTING/COOLING, SHELL CORE, CHARGE HANDL	2011	103.8074	0	0
RN100224849	PG0041R	SOUTHWESTERN PUBLIC SERVICE CO	HARRINGTON STATION POWER PLANT	4911	ELECTRIC SERVICES	UNIT 2	BOILER-GENERATOR #2	2-1	UNIT 2 STACK	2011	103.769	0.7279	0.0838
RN102579307	HG0232Q	EXXONMOBIL REFINING & SUPPLY CO	BAYTOWN REFINERY	2911	PETROLEUM REFINING	FCCU3S501C	FCCU3 STEAM GENERATOR 501C TO FCCU3WGS	FCCU3WGS	FCCU 3, WET GAS SCRUBBER	2011	103.4883	0	0
RN100211093	LG0006S	NUCOR CORP	NUCOR STEEL	3312	BLAST FURNACES AND STEEL MILLS	FINISHVENT	ROLLING MILL BUILDING-VENTS	FINISHVENT	ROLLING MILL BUILDING-VENTS	2011	103.3518	0	0
RN100543073	PF0002P	GEORGIA-PACIFIC WOOD PRODUCTS SOUTH LLC	CORRIGAN PLYWOOD MILL	2436	SOFTWOOD VENEER AND PLYWOOD	BOILER1	BOILER	S-06	BOILER STACK	2011	102.7317	0	0
RN100217975	BG0057U	CITY PUBLIC SERVICE	CALAVERAS PLANT	4911	ELECTRIC SERVICES	BOILER 2	DEELY, COAL-FIRED, STEAM BLR. 2	E-3	DEELY BOILER STACK	2011	102.5032	0	0
RN100218254	MB0123F	LEHIGH CEMENT COMPANY	LEHIGH PORTLAND CEMENT	3241	CEMENT, HYDRAULIC	KILN	WHITE CLINKER BURNING	39	KILN GLASS BAGHOUSE DUST COLLECTOR STACK KDC-1	2011	99.9775	0	0.2153
RN100716661	HG0175D	PASADENA REFINING SYSTEM INC	PASADENA REFINING SYSTEM	2911	PETROLEUM REFINING	BLRHT010	BOILER #10	HTBLR010	STEAM BOILER # 10	2011	99.446	0	0
RN100211283	NB0037F	TRNLWS LLC	STREETMAN PLANT	3295	MINERALS, GROUND OR TREATED	KILNSTACK	KILN	E3-1	KILN STACK	2011	98.8172	0	0
RN100213602	HG0807I	MCCARTY ROAD LANDFILL TX LP	MCCARTY RD LANDFILL	4953	REFUSE SYSTEMS	ROADS	UNPAVED ROADS	FUGITIVE	FUGITIVE EMISSIONS	2011	98.62	0	0
RN103934493	GBA004D	SOUTH HOUSTON GREEN POWER LP	SOUTH HOUSTON GREEN POWER SITE	4931	ELECTRIC AND OTHER SERVICES COMBINED	801-CTHRSG	GP-2 UNIT 801 (UNIT #3)	801-STACK	UNIT 801 STACK (UNIT 3)	2011	96.217	0.477	0
RN102495884	HW0018P	PHILLIPS 66 COMPANY	BORGER REFINERY	2911	PETROLEUM REFINING	29P1	UNIT 29 FCCU REGENERATOR	29P1	FCCU STACK	2011	95.9848	0	0
RN102534138	NE0120H	FLINT HILLS RESOURCES CORPUS CHRISTI LLC	CORPUS CHRISTI EAST PLANT	2911	PETROLEUM REFINING	FG SCRUB	F.C.C. #2 WITH FLUE GAS SCRUBBER	111	F.C.C. #2 FLUE GAS SCRUBBER STACK	2011	95.6416	0.106	0.0419
RN100716661	HG0175D	PASADENA REFINING SYSTEM INC	PASADENA REFINING SYSTEM	2911	PETROLEUM REFINING	CTWFUALK	ALKY COOLING TOWER	FUCTWALK	ALKY COOLING TOWER	2011	95.2693	0	0
RN100216142	HX1553Q	WASTE MANAGEMENT OF TEXAS INC	ATASCOCITA RECYCLING & DISPOSAL FACILITY	4953	REFUSE SYSTEMS	TRAFFIC-1	UNPAVED ROAD	TRAFFIC-1	UNPAVED ROAD	2011	94.33	0	0
RN100223585	ED0051O	OWENS CORNING INSULATING SYSTEMS LLC	WAXAHACHIE PLANT	3296	MINERAL WOOL	01FORM	"V-1" FIBERIZING & FORMING	10	MIXING CHAMBER STACK	2011	93.6721	0	0

NOTES:

1. Point source emissions inventory data obtained from the State of Texas Air Reporting System (STARS). Emissions data reported by sites that met the TCEQ reporting requirements as stated in 30 Texas Administrative Code, Section 101.10 for the given year. Data are subject to revision or update.

2. Information in this data request is provided in a sort order per requestor specifications. Ranking is neither implied nor warranted.

TCEQ/OA/AQD/EAS/ADB, 2010 AND 2011 PM DATA_012014.XLSX

2011 PM10ALL

RN	ACCOUNT	COMPANY	SITE	SIC	SIC DESCRIPTION	FIN	FIN NAME	EPN	EPN NAME	YEAR	PM_{10} ROUTINE	SMSS	EE
RN102147881	MM0023J	LUMINANT GENERATION CO LLC	SANDOW STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	S4MB	UNIT 4 MAIN BOILER	S03	MAIN BOILER STACK	2011	1343.886	170.65	2.45
RN102285921	TF0013B	LUMINANT GENERATION CO LLC	MONTICELLO STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B3	BOILER #3	S3	STACK	2011	951.2832	107.4	3.61
RN101198059	FI0020W	LUMINANT GENERATION CO LLC	BIG BROWN STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B2	UNIT #2 BOILER STACK	51	BOILER #2 STACK	2011	936.785	162.38	1.54
RN100224849	PG0041R	SOUTHWESTERN PUBLIC SERVICE CO	HARRINGTON STATION POWER PLANT	4911	ELECTRIC SERVICES	UNIT 3	BOILER-GENERATOR #3	3-1	UNIT 3 STACK	2011	899.4574	1.4307	1.8167
RN101198059	FI0020W	LUMINANT GENERATION CO LLC	BIG BROWN STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B1	UNIT #1 BOILER	50	BOILER #1 STACK	2011	831.7573	179.39	19.29
RN100224534	LB0047N	SOUTHWESTERN PUBLIC SERVICE CO	TOLK STATION	4911	ELECTRIC SERVICES	UNIT 2	BOILER--GENERATOR #2	2-1	UNIT 2 STACK	2011	756.8518	1.0953	0.9235
RN102583093	RL0020K	LUMINANT GENERATION CO LLC	MARTIN LAKE ELECTRICAL STATION	4911	ELECTRIC SERVICES	U1-B1	UNIT NO. 1 BOILER	S-1	UNIT 1 BOILER STACK	2011	741.3849	58.977	5.0512
RN102583093	RL0020K	LUMINANT GENERATION CO LLC	MARTIN LAKE ELECTRICAL STATION	4911	ELECTRIC SERVICES	U2-B2	UNIT NO. 2 BOILER	S-2	UNIT 2 BOILER STACK	2011	738.6925	71.548	2.4062
RN102583093	RL0020K	LUMINANT GENERATION CO LLC	MARTIN LAKE ELECTRICAL STATION	4911	ELECTRIC SERVICES	U3-B3	UNIT NO. 3 BOILER	S-3	UNIT 3 BOILER STACK	2011	599.3379	77.547	2.3585
RN100213370	TF0012D	SOUTHWESTERN ELECTRIC POWER CO	WELSH POWER PLANT	4911	ELECTRIC SERVICES	W-01	BOILER NO. 1	01	BOILER NO. 1	2011	476.3	0	0
RN102285921	TF0013B	LUMINANT GENERATION CO LLC	MONTICELLO STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B1	UNIT #1 BOILER	S1	STACK UNIT #1	2011	452.5688	266.56	0.14
RN100542927	LI0027L	NRG TEXAS POWER LLC	LIMESTONE ELECTRIC GENERATION STATION	4911	ELECTRIC SERVICES	2	LIMESTONE UNIT 2 STACK	LMS2	UNIT 2 BOILER STK-LMS-2	2011	433.0432	40.637	10.316
RN100542927	LI0027L	NRG TEXAS POWER LLC	LIMESTONE ELECTRIC GENERATION STATION	4911	ELECTRIC SERVICES	1	UNIT 1 STACK	LMS1	UNIT I BOILER STK (LMS-1)	2011	407.2734	54.699	13.43
RN102285921	TF0013B	LUMINANT GENERATION CO LLC	MONTICELLO STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B2	BOILER #2	S2	STACK UNIT #2	2011	402.8458	103.12	1.81
RN100214386	NE0112G	VALERO REFINING TEXAS LP	CORPUS CHRISTI WEST PLANT	2911	PETROLEUM REFINING	24-5T-01	F.C.C.U.	121	CAUSTIC SCRUBBER VENT	2011	367.5654	0	0
RN100216191	RI0017E	OAK GROVE MANAGEMENT COMPANY LLC	OAK GROVE STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	F-OGU1	UNIT 1 BOILER	E-OGU1	UNIT 1 BOILER STACK	2011	362.9431	0	1.174
RN100213370	TF0012D	SOUTHWESTERN ELECTRIC POWER CO	WELSH POWER PLANT	4911	ELECTRIC SERVICES	W-03	BOILER NO. 3	03	BOILER NO. 3	2011	337.72	0	0
RN100226919	GF0002R	COLETO CREEK POWER LP	COLETO CREEK POWER STATION	4911	ELECTRIC SERVICES	B-1	UNIT 1 BOILER	1	UNIT 1 STACK	2011	334.077	2.5196	0.0001
RN100258060	MH0009H	CELANESE LTD	BAY CITY PLANT	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	301M150	VINYL ACETATE	301M150	UTIL VA COOLING TOWER	2011	308.2644	0	0
RN101062255	WI0025C	PUBLIC SERVICE CO OF OKLAHOMA	OKLAUNION POWER STATION	4911	ELECTRIC SERVICES	OPS1	OKLAUNION POWER STATION BOILER #1	1	OKLAUNION STACK #1	2011	302.05	0	0
RN100214550	GK0012K	TEXAS MUNICIPAL POWER AGENCY	GIBBONS CREEK	4911	ELECTRIC SERVICES	01006	SUB-BITUMINOUS COAL FIRED BOILER	BOILER1STK	SUBBITUMINOUS COAL FIRED	2011	284.9516	0	0
RN100543115	CG0010G	INTERNATIONAL PAPER CO	TEXARKANA MILL	2621	PAPER MILLS	PB02	POWER BOILER NO. 2	PB02	POWER BOILER NO. 2 STACK	2011	284.2938	0	0
RN100226844	FC0018G	LOWER COLORADO RIVER AUTHORITY	FAYETTE POWER PROJECT	4911	ELECTRIC SERVICES	FPP-2	UNIT 2--600 M.W. STEAM ELECTRIC GENERATOR	FPP-2N	FPP 2 - NEW STACK	2011	283.8338	0	0
RN105369805	MMA003C	LUMINANT GENERATION CO LLC	SANDOW 5 GENERATING PLANT	4911	ELECTRIC SERVICES	SA-B5A	CFB BOILER 5A	SA-S5A	SA5 BOILER A STACK	2011	279.7962	0	0
RN105369805	MMA003C	LUMINANT GENERATION CO LLC	SANDOW 5 GENERATING PLANT	4911	ELECTRIC SERVICES	SA-B5B	CFB BOILER 5B	SA-S5B	SA5 BOILER B STACK	2011	277.8978	0	0.9766
RN100210517	MR0008T	DIAMOND SHAMROCK REFINING CO LP	VALERO MCKEE REFINERY	2911	PETROLEUM REFINING	F-50	F.C.C.U. (FLUIDIZED CATALYTIC CRACKING UNIT)	V-20	VENT	2011	264.53	0	0
RN102522950	WH0040R	PPG INDUSTRIES INC	WORKS NO 4	3211	FLAT GLASS	STA-23	GLASS MELTING FURNACE LINE 2	23	FURNACE LINE 2 EXHAUST	2011	251.0239	0	0
RN100224849	PG0041R	SOUTHWESTERN PUBLIC SERVICE CO	HARRINGTON STATION POWER PLANT	4911	ELECTRIC SERVICES	UNIT 1	BOILER-GENERATOR #1	1-1	UNIT 1 STACK	2011	245.8142	3.0341	0.4151
RN100217975	BG0057U	CITY PUBLIC SERVICE	CALAVERAS PLANT	4911	ELECTRIC SERVICES	P-6	J.K. SPRUCE, COAL-FIRED BOILER UNIT 2	U-6	J.K. SPRUCE, COAL-FIRED BOILER UNIT 2	2011	225.75	0	0
RN100216191	RI0017E	OAK GROVE MANAGEMENT COMPANY LLC	OAK GROVE STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	F-OGU2	UNIT 2 BOILER	E-OGU2	UNIT 2 BOILER STACK	2011	224.8836	0	1.2622
RN100214287	HH0037F	SOUTHWESTERN ELECTRIC POWER CO	AEP PIRKEY POWER PLANT	4911	ELECTRIC SERVICES	P-16	BOILER #1	16	BOILER STACK	2011	221.2	0	0
RN102522950	WH0040R	PPG INDUSTRIES INC	WORKS NO 4	3211	FLAT GLASS	STA-22	GLASS MELTING FURNACE LINE 1	22	FURNACE LINE 1 EXHAUST	2011	219.0027	0	0
RN100226570	RI0035C	TWIN OAKS POWER III LP	TWIN OAKS POWER	4911	ELECTRIC SERVICES	2-1	171 MW FLUID BED COMBUSTOR	2-1	FBC STACK	2011	206.038	0	0
RN100213370	TF0012D	SOUTHWESTERN ELECTRIC POWER CO	WELSH POWER PLANT	4911	ELECTRIC SERVICES	W-02	BOILER NO. 2	02	BOILER NO. 2	2011	201.2	0	0
RN100888312	FG0020V	NRG TEXAS POWER LLC	WA PARISH ELECTRIC GENERATING STATION	4911	ELECTRIC SERVICES	8	UNIT 8 BOILER	WAP8	UNIT 8 BOILER STACK	2011	187.7352	0	0.0253
RN102488517	KJ0003N	EXXONMOBIL CORP	KING RANCH PLANT	1321	NATURAL GAS LIQUIDS	COOLNGTWR3	RADU COOLING TOWER	COOLNGTWR3	RADU COOLING TOWER	2011	187.5596	0	0
RN100542281	HG0033B	EQUISTAR CHEMICALS LP	CHANNELVIEW COMPLEX	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	48CT4811	C.T. 4811 (O.P. 2)	48E11	COOLING TOWER	2011	182.3486	0	0
RN100226570	RI0035C	TWIN OAKS POWER III LP	TWIN OAKS POWER	4911	ELECTRIC SERVICES	1-1	171 MW FLUID BED COMBUSTOR	1-1	FBC STACK	2011	182.157	0	0
RN100716661	HG0175D	PASADENA REFINING SYSTEM INC	PASADENA REFINING SYSTEM	2911	PETROLEUM REFINING	CTWFUCPX	COMPLEX COOLING TOWER	FUCTWCPX	COMPLEX COOLING TOWER	2011	180.088	0	0
RN100209287	JE0040F	OXBOW CALCINING LLC	OXBOW CALCINING LLC	2999	PETROLEUM AND COAL PRODUCTS, NEC	KS4/WHBS4	COKE CALCINING--KILN 4	KS4/WHBS4	WASTE HEAT BOILER STACK #4	2011	178.7627	0	0
RN102450756	JE0067I	EXXONMOBIL OIL CORP	BEAUMONT REFINERY	2911	PETROLEUM REFINING	06BLR#001	FCC CO BOILER	06STK_003	FCC SCRUBBER	2011	164	0	0
RN100214428	OC0019C	INTERNATIONAL PAPER CO	ORANGE MILL	2621	PAPER MILLS	P-BARKB	BARK BOILER	2	BARK BOILER SCRUBBER STK.	2011	163.9615	0	0
RN102157609	JC0003K	MEADWESTVACO TEXAS LP	EVADALE MILL	2631	PAPERBOARD MILLS	21-2069	NO. 6 POWER BOILER STEAM GENERATION	50	NO. 6 POWER BOILER STACK	2011	159.3144	0	0
RN100542281	HG0033B	EQUISTAR CHEMICALS LP	CHANNELVIEW COMPLEX	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	38CT3811	O.P. 1 COOLING TOWER	38E11	COOLING TOWER "OP1"	2011	158.3234	0	0
RN100888312	FG0020V	NRG TEXAS POWER LLC	WA PARISH ELECTRIC GENERATING STATION	4911	ELECTRIC SERVICES	6	UNIT 6 BOILER	WAP6	UNIT 6 BOILER STACK	2011	158.2952	0	0
RN100226844	FC0018G	LOWER COLORADO RIVER AUTHORITY	FAYETTE POWER PROJECT	4911	ELECTRIC SERVICES	FPP-1	UNIT 1--600 M.W. STEAM ELECTRIC GENERATOR	FPP-1N	FPP 1 - NEW STACK	2011	156.9029	16.S	0.1
RN100226844	FC0018G	LOWER COLORADO RIVER AUTHORITY	FAYETTE POWER PROJECT	4911	ELECTRIC SERVICES	3-1B	UNIT 3--470 - M.W. POWER PLANT (STEAM GENERATOR)	3-1B	"UNIT-3" STACK	2011	153.152	14.3	0
RN100224534	LB0047N	SOUTHWESTERN PUBLIC SERVICE CO	TOLK STATION	4911	ELECTRIC SERVICES	UNIT 1	BOILER--GENERATOR #1	1-1	UNIT 1 STACK	2011	147.4193	0	0.1366
RN101625721	NE0022I	TICONA POLYMERS INC	BISHOP FACILITY	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	TOXCOOLTWR	TOXCOOLTWR	TOXCOOLTWR	TO COOLING TOWER	2011	134.8164	0	0
RN100888312	FG0020V	NRG TEXAS POWER LLC	WA PARISH ELECTRIC GENERATING STATION	4911	ELECTRIC SERVICES	S	UNIT 5 BOILER	WAP5	UNIT 5 BOILER STACK	2011	132.5904	0	0.0004
RN100226539	AG0007G	SAN MIGUEL ELECTRIC COOPERATIVE INC	LIGNITE FIRED POWER PLANT	4911	ELECTRIC SERVICES	#6	BOILER	#6	BOILER STACK EXHAUST	2011	129.4988	0.823	1.6459
RN102488517	KJ0003N	EXXONMOBIL CORP	KING RANCH PLANT	1321	NATURAL GAS LIQUIDS	COOLNGTWR4	PROCESS COOLING TOWER	COOLNGTWR4	PROCESS COOLING TOWER	2011	126.7574	0	0
RN102157609	JC0003K	MEADWESTVACO TEXAS LP	EVADALE MILL	2631	PAPERBOARD MILLS	21-210S	(NO. 2 POWER BOILER) STEAM GENERATION	1	NO. 1 STACK	2011	126.1376	0	0
RN100250869	HT0011Q	ALON USA LP	BIG SPRING REFINERY	2911	PETROLEUM REFINING	06REGENPCV	FCCU CATALYST REGENERATOR	06ESPPCV	ESP STACK	2011	122.6007	0	4.4325
RN100633650	HG1575W	LYONDELL CHEMICAL CO	CHANNELVIEW PLANT	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	COOL1	POSM 1 COOLING TOWER	ECOOL1	POSM 1 COOLING TOWER	2011	119.0724	0	0
RN100217199	ED0066B	TXI OPERATIONS LP	MIDLOTHIAN PLANT	3241	CEMENT, HYDRAULIC	E2-22	#S CEMENT KILN STACK	E2-22	#5 KILN CEMENT KILN STACK	2011	118.3746	0	0.0531
RN100210434	WO0009I	EXXONMOBIL CORP	HAWKINS GAS PLANT	1321	NATURAL GAS LIQUIDS	COOLTWRM	MARLEY COOLING TOWER	COOLTWRM	MARLEY COOLING TOWER	2011	118.2728	0	0
RN100235266	NE0122D	FLINT HILLS RESOURCES CORPUS CHRISTI LLC	WEST REFINERY	2911	PETROLEUM REFINING	01BF102	F.C.C.U. C.O. BOILER / CAUSTIC SCRUBBER	AA-4	SCRUBBER STACK	2011	118.1862	0	0
RN100214428	OC0019C	INTERNATIONAL PAPER CO	ORANGE MILL	2621	PAPER MILLS	P-REVB1	#1 RECOVERY FURNACE	1A	RECOVERY STACK	2011	115.3575	0	0
RN100888312	FG0020V	NRG TEXAS POWER LLC	WA PARISH ELECTRIC GENERATING STATION	4911	ELECTRIC SERVICES	7	UNIT 7 BOILER	WAP7	UNIT 7 BOILER STACK	2011	113.8316	0	0.000S
RN102597846	HK0014M	TEXAS LEHIGH CEMENT CO LP	TEXAS LEHIGH CEMENT CO	3241	CEMENT, HYDRAULIC	KILN	KILN & PRECALCINER	DC-2	DUST COLLECTOR "DC-2"	2011	110.3403	0	0
RN103934493	GBA004D	SOUTH HOUSTON GREEN POWER LP	SOUTH HOUSTON GREEN POWER SITE	4931	ELECTRIC AND OTHER SERVICES COMBINED	802-CTHRSG	GP-2 UNIT 802 (UNIT #2)	802-STACK	UNIT 802 STACK (UNIT 2)	2011	107.509	0.144	0
RN100825405	HN0083G	RIO GRANDE VALLEY SUGAR GROWERS INC	W R COWLEY SUGAR HOUSE	2061	RAW CANE SUGAR EXCEPT REFINING	BLR2	HEAT, STEAM, & POWER	E-02	BAGASSE FIRED BOILER	2011	105.48	0	0
RN101625721	NE0022I	TICONA POLYMERS INC	BISHOP FACILITY	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	117CT104	MO IV COOLING TOWER	117CT104	COOLING TOWER 104 EMISS	2011	104.8572	0	0
RN102679867	SK0041T	TYLER PIPE CO	MCWANE INC	3321	GRAY & DUCTILE IRON FOUNDRIES	NPNONPROC	NON-PROCESS SPECIFIC ACTIVITIES	E2-5-3	FITTINGS CASTING/COOLING, SHELL CORE, CHARGE HANDL	2011	103.8074	0	0
RN100224849	PG0041R	SOUTHWESTERN PUBLIC SERVICE CO	HARRINGTON STATION POWER PLANT	4911	ELECTRIC SERVICES	UNIT 2	BOILER-GENERATOR #2	2-1	UNIT 2 STACK	2011	103.769	0.7273	0.0837

RN100543115	CG0010G	INTERNATIONAL PAPER CO	TEXARKANA MILL	2621	PAPER MILLS	RB02	NO. 2 RECOVERY BOILER	RB02B	BOILER EAST STACK ("B")	2011	103.5745	0	0.011
RN100211093	LG0006S	NUCOR CORP	NUCOR STEEL	3312	BLAST FURNACES AND STEEL MILLS	FINISHVENT	ROLLING MILL BUILDING-VENTS	FINISHVENT	ROLLING MILL BUILDING-VENTS	2011	103.2	0	0
RN100217975	BG0057U	CITY PUBLIC SERVICE	CALAVERAS PLANT	4911	ELECTRIC SERVICES	BOILER 1	DEELY, COAL-FIRED, STEAM BLR. 1	E-3	DEELY BOILER STACK	2011	99.9445	0	0
RN100716661	HG0175D	PASADENA REFINING SYSTEM INC	PASADENA REFINING SYSTEM	2911	PETROLEUM REFINING	BLRHT010	BOILER #10	HTBLR010	STEAM BOILER # 10	2011	99.4459	0	0
RN100217975	BG0057U	CITY PUBLIC SERVICE	CALAVERAS PLANT	4911	ELECTRIC SERVICES	P-5	J.K. SPRUCE, COAL-FIRED BOILER	U-5	SPRUCE STACK	2011	99.38	0	0
RN100211283	NB0037F	TRNLWS LLC	STREETMAN PLANT	3295	MINERALS, GROUND OR TREATED	KILNSTACK	KILN	E3-1	KILN STACK	2011	98.8172	0	0
RN103934493	GBA004D	SOUTH HOUSTON GREEN POWER LP	SOUTH HOUSTON GREEN POWER SITE	4931	ELECTRIC AND OTHER SERVICES COMBINED	801-CTHRSG	GP-2 UNIT 801 (UNIT #3)	801-STACK	UNIT 801 STACK (UNIT 3)	2011	96.217	0.477	0
RN102534138	NE0120H	FLINT HILLS RESOURCES CORPUS CHRISTI LLC	CORPUS CHRISTI EAST PLANT	2911	PETROLEUM REFINING	FG SCRUB	F.C.C. #2 WITH FLUE GAS SCRUBBER	111	F.C.C. #2 FLUE GAS SCRUBBER STACK	2011	95.6416	0.212	0.0838
RN102495884	HW0018P	PHILLIPS 66 COMPANY	BORGER REFINERY	2911	PETROLEUM REFINING	40P1	UNIT 40 FCCU REGENERATOR	40P1	CAT. CRACKER REGENERATOR	2011	95.3057	0	0
RN100716661	HG0175D	PASADENA REFINING SYSTEM INC	PASADENA REFINING SYSTEM	2911	PETROLEUM REFINING	CTWFUALK	ALKY COOLING TOWER	FUCTWALK	ALKY COOLING TOWER	2011	95.2693	0	0
RN100223585	ED0051O	OWENS CORNING INSULATING SYSTEMS LLC	WAXAHACHIE PLANT	3296	MINERAL WOOL	01FORM	"V-1" FIBERIZING & FORMING	10	MIXING CHAMBER STACK	2011	93.6721	0	0
RN100217975	BG0057U	CITY PUBLIC SERVICE	CALAVERAS PLANT	4911	ELECTRIC SERVICES	BOILER 2	DEELY, COAL-FIRED, STEAM BLR. 2	E-3	DEELY BOILER STACK	2011	90.9491	0	0
RN103934493	GBA004D	SOUTH HOUSTON GREEN POWER LP	SOUTH HOUSTON GREEN POWER SITE	4931	ELECTRIC AND OTHER SERVICES COMBINED	803-CTHRSG	GP-2 UNIT 803 (UNIT #1)	803-STACK	UNIT 803 STACK (UNIT 1)	2011	88.628	0.181	0
RN100223585	ED0051O	OWENS CORNING INSULATING SYSTEMS LLC	WAXAHACHIE PLANT	3296	MINERAL WOOL	03FORM	"V3" FIBERIZING & FORMING	40	MIXING CHAMBER STACK	2011	88.2881	0	0
RN103919817	HG0310V	CHEVRON PHILLIPS CHEMICAL CO LP	CEDAR BAYOU PLANT	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	EF-751	COOLING TOWER	1592-41	EU COOLING TOWER	2011	87.36	0	0
RN100221811	NB0014R	GUARDIAN INDUSTRIES CORP	GUARDIAN INDUSTRIES CORSICANA	3211	FLAT GLASS	01002	GLASS MELTING FURNACE	10	STACK	2011	86.7067	0	0
RN100218254	MB0123F	LEHIGH CEMENT COMPANY	LEHIGH PORTLAND CEMENT	3241	CEMENT, HYDRAULIC	KILN	WHITE CLINKER BURNING	39	KILN GLASS BAGHOUSE DUST COLLECTOR STACK KDC-1	2011	86.1808	0	0.1076
RN100238385	GB0073P	VALERO REFINING TEXAS LP	TEXAS CITY REFINERY	2911	PETROLEUM REFINING	G-001	CATALYTIC CRACKING REGENERATOR VENT	EG-001	F.C.C.U. ESP. STACK	2011	85.6628	0	0
RN100225945	BL0082R	DOW CHEMICAL CO	TEXAS DIVISION PLANT B	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	B56P9GT96	PWR9_GTB_B56P9GT96_GT-96 GAS TURBINE	B56CR96	PWR9_EPT_B56CR96_GT-96 CATALYTIC REDUCT	2011	84.462	0	0
RN100209287	JE0040F	OXBOW CALCINING LLC	OXBOW CALCINING LLC	2999	PETROLEUM AND COAL PRODUCTS, NEC	KS5/WHBS5	COKE CALCINING--KILN 5	KS5/WHBS5	WASTE HEAT BOILER STACK #5	2011	84.2064	0	0
RN100633650	HG1575W	LYONDELL CHEMICAL CO	CHANNELVIEW PLANT	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	COOL2	POSM 2 COOLING TOWER	ECOOL2	POSM 2 COOLING TOWER	2011	83.8073	0	0
RN102157609	JC0003K	MEADWESTVACO TEXAS LP	EVADALE MILL	2631	PAPERBOARD MILLS	19-2021	(NO. 4 RECOVERY UNIT) CHEMICAL RECOVERY	26	NO. 4 RECOVERY BOILER UNIT STACK	2011	83.2935	0	0
RN102212925	HG0228H	EXXONMOBIL CHEMICAL COMPANY	BAYTOWN OLEFINS PLANT	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	BOPCT	COOLING TOWER	BOPCT	COOLING TOWER	2011	83.2549	0	0
RN102513041	OC0013O	ENTERGY TEXAS INC	SABINE PLANT	4911	ELECTRIC SERVICES	B4	STEAM GENERATOR #4	4	BOILER STACK NO. 4	2011	82.09	0	0
RN103758470	GA0085T	HESS CORP	SEMINOLE GAS PROCESSING PLANT	1321	NATURAL GAS LIQUIDS	CLNGTWR	PROCESS COOLING TOWER	CLNGTWR	PROCESS COOLING TOWER	2011	82	0	0
RN102495884	HW0018P	PHILLIPS 66 COMPANY	BORGER REFINERY	2911	PETROLEUM REFINING	29P1	UNIT 29 FCCU REGENERATOR	29P1	FCCU STACK	2011	80.5644	3.89	0.009
RN100222702	ND0009L	GEORGIA PACIFIC GYPSUM LLC	SWEETWATER GYPSUM PLANT	3275	GYPSUM PRODUCTS	DRY-1	DRYER NO. 1	EP10-13,16	BOARD DRYER STACK NO. 1	2011	80.24	0	0
RN102574803	HG0229F	EXXONMOBIL CHEMICAL COMPANY	BAYTOWN CHEMICAL PLANT	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	CT17	COOLING TOWER 17	CT17	COOLING TOWER "CT17"	2011	79.0303	0	0
RN100542281	HG0033B	EQUISTAR CHEMICALS LP	CHANNELVIEW COMPLEX	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	06CT604	EAST PLANT COOLING TOWER "1X/2X"	6E04	EPLANT COOLING TOWER "1X/2X"	2011	78.6306	0	0
RN100543073	PF0002P	GEORGIA-PACIFIC WOOD PRODUCTS SOUTH LLC	CORRIGAN PLYWOOD MILL	2436	SOFTWOOD VENEER AND PLYWOOD	BOILER1	BOILER	S-06	BOILER STACK	2011	77.8636	0	0
RN102535077	GB0004L	BLANCHARD REFINING COMPANY LLC	GALVESTON BAY REFINERY	2911	PETROLEUM REFINING	FCU1-FUGIT	FCCU NO. 1 UNIT FUGITIVES	94	REGENERATOR STACK	2011	76.733	0	0
RN100218973	CB0038Q	FORMOSA PLASTICS CORP TEXAS	FORMOSA POINT COMFORT PLANT	2821	PLASTICS MATERIALS AND SYNTHETIC RESINS	CFB-S2	CIRCULATING FLUIDIZED BOILER	CFB-S2	CIRCULATING FLUIDIZED BED BOIL	2011	75.4597	0	0
RN100223585	ED0051O	OWENS CORNING INSULATING SYSTEMS LLC	WAXAHACHIE PLANT	3296	MINERAL WOOL	02FORM	"V-2" FIBERIZING & FORMING	22	FORMING & OVEN VENT	2011	75.4046	0	0
RN100242577	CB0003M	ALCOA WORLD ALUMINA LLC	POINT COMFORT PLANT	2819	INDUSTRIAL INORGANIC CHEMICALS	R55-1/FC	R 55-1 FLASH CALCINER	R55-1/FC11	R 55-1 FLASH CALCINER	2011	74.5961	0.0745	0.0047
RN100216969	MB0095I	OWENS BROCKWAY GLASS CONTAINER INC	GLASS CENTER	3221	GLASS CONTAINERS	P-03D	CONTAINER GLASS MELTING FURNACE "D"	4	GLASS MELTING FURNACE "D"	2011	72.67	0	0.03

NOTES:

1. Point source emissions inventory data obtained from the State of Texas Air Reporting System (STARS). Emissions data reported by sites that met the TCEQ reporting requirements as stated in 30 Texas Administrative Code, Section 101.10 for the given year. Data are subject to revision or update.

2. Information in this data request is provided in a sort order per requestor specifications. Ranking is neither implied nor warranted.

TCEQ/OA/AQD/EAS/ADB, 2010 AND 2011 PM DATA_012014.XLSX

2011 PM2.5 ALL

RN	ACCOUNT	COMPANY	SITE	SIC	SIC DESCRIPTION	FIN	FIN NAME	EPN	EPN NAME	YEAR	PM2.5 ROUTINE	PM2.5 SMSS	PM2.5 EE
RN102147881	MM0023J	LUMINANT GENERATION CO LLC	SANDOW STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	S4MB	UNIT 4 MAIN BOILER	S03	MAIN BOILER STACK	2011	1248.495	160.15	2.3
RN101198059	FI0020W	LUMINANT GENERATION CO LLC	BIG BROWN STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B2	UNIT #2 BOILER STACK	51	BOILER #2 STACK	2011	579.9145	98.65	0.94
RN101198059	FI0020W	LUMINANT GENERATION CO LLC	BIG BROWN STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B1	UNIT #1 BOILER	50	BOILER #1 STACK	2011	514.8974	108.99	11.72
RN102583093	RL0020K	LUMINANT GENERATION CO LLC	MARTIN LAKE ELECTRICAL STATION	4911	ELECTRIC SERVICES	U2-B2	UNIT NO. 2 BOILER	S-2	UNIT 2 BOILER STACK	2011	417.5651	40.44	1.36
RN102285921	TF0013B	LUMINANT GENERATION CO LLC	MONTICELLO STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B3	BOILER #3	S3	STACK	2011	411.3531	46.38	1.56
RN102583093	RL0020K	LUMINANT GENERATION CO LLC	MARTIN LAKE ELECTRICAL STATION	4911	ELECTRIC SERVICES	U3-B3	UNIT NO. 3 BOILER	S-3	UNIT 3 BOILER STACK	2011	399.5585	51.698	1.572
RN102583093	RL0020K	LUMINANT GENERATION CO LLC	MARTIN LAKE ELECTRICAL STATION	4911	ELECTRIC SERVICES	U1-B1	UNIT NO. 1 BOILER	S-1	UNIT 1 BOILER STACK	2011	386.8096	30.771	2.635
RN100214386	NE0112G	VALERO REFINING TEXAS LP	CORPUS CHRISTI WEST PLANT	2911	PETROLEUM REFINING	24-ST-01	F.C.C.U.	121	CAUSTIC SCRUBBER VENT	2011	367.5654	0	0
RN100216191	RI0017E	OAK GROVE MANAGEMENT COMPANY LLC	OAK GROVE STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	F-OGU1	UNIT 1 BOILER	E-OGU1	UNIT 1 BOILER STACK	2011	362.8205	0	1.174
RN100542927	LI0027L	NRG TEXAS POWER LLC	LIMESTONE ELECTRIC GENERATION STATION	4911	ELECTRIC SERVICES	2	LIMESTONE UNIT 2 STACK	LMS2	UNIT 2 BOILER STK-LMS-2	2011	336.1631	32.145	8.16
RN100542927	LI0027L	NRG TEXAS POWER LLC	LIMESTONE ELECTRIC GENERATION STATION	4911	ELECTRIC SERVICES	1	UNIT 1 STACK	LMS1	UNIT I BOILER STK (LMS-1)	2011	316.1821	43.269	10.62
RN105369805	MMA003C	LUMINANT GENERATION CO LLC	SANDOW 5 GENERATING PLANT	4911	ELECTRIC SERVICES	SA-B5A	CFB BOILER 5A	SA-S5A	SA5 BOILER A STACK	2011	256.1357	0	0
RN102522950	WH0040R	PPG INDUSTRIES INC	WORKS NO 4	3211	FLAT GLASS	STA-23	GLASS MELTING FURNACE LINE 2	23	FURNACE LINE 2 EXHAUST	2011	228.4318	0	0
RN100216191	RI0017E	OAK GROVE MANAGEMENT COMPANY LLC	OAK GROVE STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	F-OGU2	UNIT 2 BOILER	E-OGU2	UNIT 2 BOILER STACK	2011	224.8836	0	1.262
RN100226844	FC0018G	LOWER COLORADO RIVER AUTHORITY	FAYETTE POWER PROJECT	4911	ELECTRIC SERVICES	FPP-2	UNIT 2--600 M.W. STEAM ELECTRIC GENERATOR	FPP-2N	FPP 2 - NEW STACK	2011	224.3	0	0
RN102285921	TF0013B	LUMINANT GENERATION CO LLC	MONTICELLO STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B1	UNIT #1 BOILER	S1	STACK UNIT #1	2011	214.9881	125.94	0.066
RN100213370	TF0012D	SOUTHWESTERN ELECTRIC POWER CO	WELSH POWER PLANT	4911	ELECTRIC SERVICES	W-01	BOILER NO. 1	01	BOILER NO. 1	2011	206.15	0	0
RN102488517	KJ0003N	EXXONMOBIL CORP	KING RANCH PLANT	1321	NATURAL GAS LIQUIDS	COOLNGTWR3	RADU COOLING TOWER	COOLNGTWR3	RADU COOLING TOWER	2011	187.5596	0	0
RN100542281	HG0033B	EQUISTAR CHEMICALS LP	CHANNELVIEW COMPLEX	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	48CT4811	C.T. 4811 (O.P. 2)	48E11	COOLING TOWER	2011	182.3486	0	0
RN100226919	GF0002R	COLETO CREEK POWER LP	COLETO CREEK POWER STATION	4911	ELECTRIC SERVICES	B-1	UNIT 1 BOILER	1	UNIT 1 STACK	2011	176.9831	1.3307	0
RN102285921	TF0013B	LUMINANT GENERATION CO LLC	MONTICELLO STEAM ELECTRIC STATION	4911	ELECTRIC SERVICES	B2	BOILER #2	S2	STACK UNIT #2	2011	164.4128	41.51	0.728
RN102450756	JE0067I	EXXONMOBIL OIL CORP	BEAUMONT REFINERY	2911	PETROLEUM REFINING	06BLR#001	FCC CO BOILER	06STK_003	FCC SCRUBBER	2011	164	0	0
RN100542281	HG0033B	EQUISTAR CHEMICALS LP	CHANNELVIEW COMPLEX	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	38CT3811	O.P. 1 COOLING TOWER	38E11	COOLING TOWER "OP1"	2011	158.8234	0	0
RN100226570	RI0035C	TWIN OAKS POWER III LP	TWIN OAKS POWER	4911	ELECTRIC SERVICES	1-1	171 MW FLUID BED COMBUSTOR	1-1	FBC STACK	2011	152.57	0	0
RN100213370	TF0012D	SOUTHWESTERN ELECTRIC POWER CO	WELSH POWER PLANT	4911	ELECTRIC SERVICES	W-03	BOILER NO. 3	03	BOILER NO. 3	2011	146.34	0	0
RN100217975	BG0057U	CITY PUBLIC SERVICE	CALAVERAS PLANT	4911	ELECTRIC SERVICES	P-6	J.K. SPRUCE, COAL-FIRED BOILER UNIT 2	U-6	J.K. SPRUCE, COAL-FIRED BOILER UNIT 2	2011	143.6	0	0
RN101062255	WI0025C	PUBLIC SERVICE CO OF OKLAHOMA	OKLAUNION POWER STATION	4911	ELECTRIC SERVICES	OPS1	OKLAUNION POWER STATION BOILER #1	1	OKLAUNION STACK #1	2011	130.58	0	0
RN100226844	FC0018G	LOWER COLORADO RIVER AUTHORITY	FAYETTE POWER PROJECT	4911	ELECTRIC SERVICES	FPP-1	UNIT 1--600 M.W. STEAM ELECTRIC GENERATOR	FPP-1N	FPP 1 - NEW STACK	2011	127.9	16.5	0.1
RN102488517	KJ0003N	EXXONMOBIL CORP	KING RANCH PLANT	1321	NATURAL GAS LIQUIDS	COOLNGTWR4	PROCESS COOLING TOWER	COOLNGTWR4	PROCESS COOLING TOWER	2011	126.7574	0	0
RN100214550	GK0012K	TEXAS MUNICIPAL POWER AGENCY	GIBBONS CREEK	4911	ELECTRIC SERVICES	01006	SUB-BITUMINOUS COAL FIRED BOILER	BOILER1STK	SUBBITUMINOUS COAL FIRED	2011	126.6	0	0
RN105369805	MMA003C	LUMINANT GENERATION CO LLC	SANDOW 5 GENERATING PLANT	4911	ELECTRIC SERVICES	SA-B5B	CFB BOILER 5B	SA-S5B	SA5 BOILER B STACK	2011	119.5033	0	0.42
RN100633650	HG1575W	LYONDELL CHEMICAL CO	CHANNELVIEW PLANT	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	COOL1	POSM 1 COOLING TOWER	ECOOL1	POSM 1 COOLING TOWER	2011	119.0724	0	0
RN100210434	WO0009I	EXXONMOBIL CORP	HAWKINS GAS PLANT	1321	NATURAL GAS LIQUIDS	COOLTWRM	MARLEY COOLING TOWER	COOLTWRM	MARLEY COOLING TOWER	2011	118.2728	0	0
RN100235266	NE0122D	FLINT HILLS RESOURCES CORPUS CHRISTI LLC	WEST REFINERY	2911	PETROLEUM REFINING	01BF102	F.C.C.U. C.O. BOILER / CAUSTIC SCRUBBER	AA-4	SCRUBBER STACK	2011	118.1862	0	0
RN100888312	FG0020V	NRG TEXAS POWER LLC	WA PARISH ELECTRIC GENERATING STATION	4911	ELECTRIC SERVICES	8	UNIT 8 BOILER	WAP8	UNIT 8 BOILER STACK	2011	108.1518	0	0.015
RN103934493	GBA004D	SOUTH HOUSTON GREEN POWER LP	SOUTH HOUSTON GREEN POWER SITE	4931	ELECTRIC AND OTHER SERVICES COMBINED	802-CTHRSG	GP-2 UNIT 802 (UNIT #2)	802-STACK	UNIT 802 STACK (UNIT 2)	2011	107.909	0.144	0
RN102522950	WH0040R	PPG INDUSTRIES INC	WORKS NO 4	3211	FLAT GLASS	STA-22	GLASS MELTING FURNACE LINE 1	22	FURNACE LINE 1 EXHAUST	2011	106.3326	0	0
RN100825405	HN0083G	RIO GRANDE VALLEY SUGAR GROWERS INC	W R COWLEY SUGAR HOUSE	2061	RAW CANE SUGAR EXCEPT REFINING	BLR2	HEAT, STEAM, & POWER	E-02	BAGASSE FIRED BOILER	2011	105.48	0	0
RN100209287	JE0040F	OXBOW CALCINING LLC	OXBOW CALCINING LLC	2999	PETROLEUM AND COAL PRODUCTS, NEC	KS4/WHBS4	COKE CALCINING--KILN 4	KS4/WHBS4	WASTE HEAT BOILER STACK #4	2011	105.4645	0	0
RN103934493	GBA004D	SOUTH HOUSTON GREEN POWER LP	SOUTH HOUSTON GREEN POWER SITE	4931	ELECTRIC AND OTHER SERVICES COMBINED	801-CTHRSG	GP-2 UNIT 801 (UNIT #3)	801-STACK	UNIT 801 STACK (UNIT 3)	2011	96.217	0.477	0
RN100214287	HH0037F	SOUTHWESTERN ELECTRIC POWER CO	AEP PIRKEY POWER PLANT	4911	ELECTRIC SERVICES	P-16	BOILER #1	16	BOILER STACK	2011	95.8	0	0
RN102534138	NE0120H	FLINT HILLS RESOURCES CORPUS CHRISTI LLC	CORPUS CHRISTI EAST PLANT	2911	PETROLEUM REFINING	FG SCRUB	F.C.C. #2 WITH FLUE GAS SCRUBBER	111	F.C.C. #2 FLUE GAS SCRUBBER STACK	2011	93.6416	0	0
RN100226844	FC0018G	LOWER COLORADO RIVER AUTHORITY	FAYETTE POWER PROJECT	4911	ELECTRIC SERVICES	3-1B	UNIT 3--470 - M.W. POWER PLANT (STEAM GENERATOR)	3-1B	"UNIT-3" STACK	2011	89.54	1.43	0
RN103934493	GBA004D	SOUTH HOUSTON GREEN POWER LP	SOUTH HOUSTON GREEN POWER SITE	4931	ELECTRIC AND OTHER SERVICES COMBINED	803-CTHRSG	GP-2 UNIT 803 (UNIT #1)	803-STACK	UNIT 803 STACK (UNIT 1)	2011	88.628	0.181	0
RN100213370	TF0012D	SOUTHWESTERN ELECTRIC POWER CO	WELSH POWER PLANT	4911	ELECTRIC SERVICES	W-02	BOILER NO. 2	02	BOILER NO. 2	2011	87.05	0	0
RN100238385	GB0073P	VALERO REFINING TEXAS LP	TEXAS CITY REFINERY	2911	PETROLEUM REFINING	G-001	CATALYTIC CRACKING REGENERATOR VENT	EG-001	F.C.C.U. ESP. STACK	2011	85.6628	0	0
RN100225945	BL0082R	DOW CHEMICAL CO	TEXAS DIVISION PLANT B	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	B56P9GT96	PWR9_GTB_B56P9GT96_GT-96 GAS TURBINE	B56CR96	PWR9_EPT_B56CR96_GT-96 CATALYTIC REDUCT	2011	84.462	0	0
RN100223585	ED0051O	OWENS CORNING INSULATING SYSTEMS LLC	WAXAHACHIE PLANT	3296	MINERAL WOOL	01FORM	"V-1" FIBERIZING & FORMING	10	MIXING CHAMBER STACK	2011	84.2878	0	0
RN100633650	HG1575W	LYONDELL CHEMICAL CO	CHANNELVIEW PLANT	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	COOL2	POSM 2 COOLING TOWER	ECOOL2	POSM 2 COOLING TOWER	2011	83.8073	0	0
RN102513041	OC0013O	ENTERGY TEXAS INC	SABINE PLANT	4911	ELECTRIC SERVICES	B4	STEAM GENERATOR #4	4	BOILER STACK NO. 4	2011	82.09	0	0
RN100214428	OC0019C	INTERNATIONAL PAPER CO	ORANGE MILL	2621	PAPER MILLS	P-REVB1	#1 RECOVERY FURNACE	1A	RECOVERY STACK	2011	80.3294	0	0
RN100223585	ED0051O	OWENS CORNING INSULATING SYSTEMS LLC	WAXAHACHIE PLANT	3296	MINERAL WOOL	03FORM	"V3" FIBERIZING & FORMING	40	MIXING CHAMBER STACK	2011	79.4467	0	0
RN102574803	HG0229F	EXXONMOBIL CHEMICAL COMPANY	BAYTOWN CHEMICAL PLANT	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	CT17	COOLING TOWER 17	CT17	COOLING TOWER "CT17"	2011	79.0303	0	0
RN100221811	NB0014R	GUARDIAN INDUSTRIES CORP	GUARDIAN INDUSTRIES CORSICANA	3211	FLAT GLASS	01002	GLASS MELTING FURNACE	10	STACK	2011	78.88	0	0
RN100542281	HG0033B	EQUISTAR CHEMICALS LP	CHANNELVIEW COMPLEX	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	06CT604	EAST PLANT COOLING TOWER "1X/2X"	6E04	EPLANT COOLING TOWER "1X/2X"	2011	78.6306	0	0
RN102535077	GB0004L	BLANCHARD REFINING COMPANY LLC	GALVESTON BAY REFINERY	2911	PETROLEUM REFINING	FCU1-FUGIT	FCCU NO. 1 UNIT FUGITIVES	94	REGENERATOR STACK	2011	76.733	0	0
RN100888312	FG0020V	NRG TEXAS POWER LLC	WA PARISH ELECTRIC GENERATING STATION	4911	ELECTRIC SERVICES	5	UNIT 5 BOILER	WAP5	UNIT 5 BOILER STACK	2011	76.3836	0	2E-04
RN100888312	FG0020V	NRG TEXAS POWER LLC	WA PARISH ELECTRIC GENERATING STATION	4911	ELECTRIC SERVICES	6	UNIT 6 BOILER	WAP6	UNIT 6 BOILER STACK	2011	76.3836	0	0
RN100211283	NB0037F	TRNLWS LLC	STREETMAN PLANT	3295	MINERALS, GROUND OR TREATED	KILNSTACK	KILN	E3-1	KILN STACK	2011	74.2569	0	0
RN100222702	ND0009L	GEORGIA PACIFIC GYPSUM LLC	SWEETWATER GYPSUM PLANT	3275	GYPSUM PRODUCTS	DRY-1	DRYER NO. 1	EP10-13,16	BOARD DRYER STACK NO. 1	2011	74.24	0	0
RN101619179	BL0042G	PHILLIPS 66 COMPANY	SWEENY REFINERY PETROCHEM	2911	PETROLEUM REFINING	27.1-36-RE	UNIT 27.1 - CATALYST REGENERATOR	27.1-36-RE	REGENERATOR STACK	2011	71.6568	3.781	0
RN100218130	HG0048L	HOUSTON REFINING LP	HOUSTON REFINING	2911	PETROLEUM REFINING	732B0002	FCCU CO BOILER WET GAS SCRUBBER	732B0002	FCCU CO BOILER WET GAS SCRUBBER	2011	71.3927	0	0
RN100217975	BG0057U	CITY PUBLIC SERVICE	CALAVERAS PLANT	4911	ELECTRIC SERVICES	P-5	J.K. SPRUCE, COAL-FIRED BOILER	U-5	SPRUCE STACK	2011	71.1502	0	0
RN100214428	OC0019C	INTERNATIONAL PAPER CO	ORANGE MILL	2621	PAPER MILLS	P-BARKB	BARK BOILER	2	BARK BOILER SCRUBBER STK.	2011	70.6418	0	0
RN100209287	JE0040F	OXBOW CALCINING LLC	OXBOW CALCINING LLC	2999	PETROLEUM AND COAL PRODUCTS, NEC	KS5/WHBS5	COKE CALCINING--KILN 5	KS5/WHBS5	WASTE HEAT BOILER STACK #5	2011	70.1213	0	0
RN100224849	PG0041R	SOUTHWESTERN PUBLIC SERVICE CO	HARRINGTON STATION POWER PLANT	4911	ELECTRIC SERVICES	UNIT 1	BOILER-GENERATOR #1	1-1	UNIT 1 STACK	2011	70.0889	0.6537	0.013

RN100216969	MB0095I	OWENS BROCKWAY GLASS CONTAINER INC	GLASS CENTER	3221	GLASS CONTAINERS	P-03D	CONTAINER GLASS MELTING FURNACE "D"	4	GLASS MELTING FURNACE "D"	2011	69.61	0	0.03
RN100543073	PF0002P	GEORGIA-PACIFIC WOOD PRODUCTS SOUTH LLC	CORRIGAN PLYWOOD MILL	2436	SOFTWOOD VENEER AND PLYWOOD	BOILER1	BOILER	S-06	BOILER STACK	2011	69.2554	0	0
RN100226109	NC0056N	COTTONWOOD ENERGY CO LP	COTTONWOOD ENERGY CO LP	4911	ELECTRIC SERVICES	CT3	COMBUSTION TURBINE 3	STACK 3	COMBUSTION TURBINE 3 STACK	2011	68.1052	0.0576	0
RN102457520	JE0005H	TOTAL PETROCHEMICALS & REFINING USA INC	PORT ARTHUR REFINERY	2911	PETROLEUM REFINING	55RGNFLUGS	FCCU REGEN FLUE GAS SCRUBBER	55RGNFLUGS	FCCU REGEN FLUE GAS SCRUBBER	2011	66.6635	0	0.14
RN100888312	FG0020V	NRG TEXAS POWER LLC	WA PARISH ELECTRIC GENERATING STATION	4911	ELECTRIC SERVICES	7	UNIT 7 BOILER	WAP7	UNIT 7 BOILER STACK	2011	65.5769	0	3E-04
RN100223585	ED0051O	OWENS CORNING INSULATING SYSTEMS LLC	WAXAHACHIE PLANT	3296	MINERAL WOOL	02FORM	"V-2" FIBERIZING & FORMING	22	FORMING & OVEN VENT	2011	65.4758	0	0
RN102547957	SD0161L	GREGORY POWER PARTNERS LP	GREGORY POWER FACILITY	4931	ELECTRIC AND OTHER SERVICES COMBINED	101	ELECTRIC CO-GEN TURBINE	101	ELECT. CO-GEN TURBINE	2011	65.4599	0	0
RN102495884	HW0018P	PHILLIPS 66 COMPANY	BORGER REFINERY	2911	PETROLEUM REFINING	40P1	UNIT 40 FCCU REGENERATOR	40P1	CAT. CRACKER REGENERATOR	2011	63.8635	0	0
RN100217199	ED0066B	TXI OPERATIONS LP	MIDLOTHIAN PLANT	3241	CEMENT, HYDRAULIC	E2-22	#5 CEMENT KILN STACK	E2-22	#5 KILN CEMENT KILN STACK	2011	63.5764	0	0.028
RN100219286	ED0099J	HOLCIM TEXAS LP	MIDLOTHIAN PLANT	3241	CEMENT, HYDRAULIC	62*	KILN NO. 2 MAIN BAGHOUSE, BYPASS BAGHOUSE, COAL MI	62*	KILN NO. 2 MAIN BAGHOUSE, BYPASS BAGHOUSE COAL MIL	2011	62.8149	0	0
RN100217975	BG0057U	CITY PUBLIC SERVICE	CALAVERAS PLANT	4911	ELECTRIC SERVICES	BOILER 1	DEELY, COAL-FIRED, STEAM BLR. 1	E-3	DEELY BOILER STACK	2011	61.7967	0	0
RN100211879	HG0659W	SHELL CHEMICAL LP	DEER PARK PLANT	2911	PETROLEUM REFINING	H600	H600:CAT CRACKER HEATER STACK	H600	STACK - H600: CAT CRACKER HEATER STACK	2011	61.322	0	0
RN101286227	PF0003N	GEORGIA PACIFIC WOOD PRODUCTS SOUTH LLC	CAMDEN PLYWOOD & LUMBER COMPLEX	2436	SOFTWOOD VENEER AND PLYWOOD	BOILER3	BOILER #3	S-03	BOILER #3	2011	60.9199	0	0
RN100224534	LB0047N	SOUTHWESTERN PUBLIC SERVICE CO	TOLK STATION	4911	ELECTRIC SERVICES	UNIT 1	BOILER--GENERATOR #1	1-1	UNIT 1 STACK	2011	60.8967	0	0.057
RN100218254	MB0123F	LEHIGH CEMENT COMPANY	LEHIGH PORTLAND CEMENT	3241	CEMENT, HYDRAULIC	KILN	WHITE CLINKER BURNING	39	KILN GLASS BAGHOUSE DUST COLLECTOR STACK KDC-1	2011	58.7531	0	0.108
RN100226539	AG0007G	SAN MIGUEL ELECTRIC COOPERATIVE INC	LIGNITE FIRED POWER PLANT	4911	ELECTRIC SERVICES	#6	BOILER	#6	BOILER STACK EXHAUST	2011	58.218	0	0
RN100217975	BG0057U	CITY PUBLIC SERVICE	CALAVERAS PLANT	4911	ELECTRIC SERVICES	BOILER 2	DEELY, COAL-FIRED, STEAM BLR. 2	E-3	DEELY BOILER STACK	2011	56.258	0	0
RN100210608	GB0055R	MARATHON PETROLEUM COMPANY LLC	TEXAS CITY REFINERY	2911	PETROLEUM REFINING	P-93	FLUID CATALYTIC CRACKING UNIT	ES12	F.C.C.U. REGENERATOR ST.	2011	54.8747	0	0.049
RN102413689	GL0028H	STRUCTURAL METALS INC	FURNACE & STEEL MILL	3312	BLAST FURNACES AND STEEL MILLS	FURN-E	ELECTRIC ARC FURNACE "E"	RABAGHOUSE	REVERSE AIR BAGHOUSE MONITOR VENT	2011	54.0444	0	0
RN102495884	HW0018P	PHILLIPS 66 COMPANY	BORGER REFINERY	2911	PETROLEUM REFINING	29P1	UNIT 29 FCCU REGENERATOR	29P1	FCCU STACK	2011	53.9855	0	0
RN102547957	SD0161L	GREGORY POWER PARTNERS LP	GREGORY POWER FACILITY	4931	ELECTRIC AND OTHER SERVICES COMBINED	102	ELECTRIC CO-GEN TURBINE	102	ELECT. CO-GEN TURBINE	2011	53.8758	0	0
RN100214337	TH0010I	AUSTIN WHITE LIME CO	MCNEIL PLANT & QUARRY	3274	LIME	54S00	CRUSHING & SCREENING "C" SECTION	C&S001C	CRUSH & SCREEN "C" SCTN.	2011	53.8211	0	0
RN100209287	JE0040F	OXBOW CALCINING LLC	OXBOW CALCINING LLC	2999	PETROLEUM AND COAL PRODUCTS, NEC	KS3/WHBS3	COKE CALCINING--KILN 3	KS3/WHBS3	WASTE HEAT BOILER STACK #3	2011	52.403	0	0
RN100212430	ED0347N	ENNIS POWER COMPANY LLC	ENNIS ELECTRIC GENERATION PLANT	4911	ELECTRIC SERVICES	STACK 1	COMBUSTION TURBINE	STACK 1	STACK 1	2011	51.9996	0	0
RN100235266	NE0122D	FLINT HILLS RESOURCES CORPUS CHRISTI LLC	WEST REFINERY	2911	PETROLEUM REFINING	29TA2903	38.4 MWE. (ISO.) TURBINE	Z-4	TURB. STACK	2011	51.9645	0	0
RN102584026	JE0042B	PREMCOR REFINING GROUP INC	VALERO PORT ARTHUR REFINERY	2911	PETROLEUM REFINING	FCC-1241	FLUID CATALYTIC CRACKING UNIT 1241 AND DEPENTANI	E-01-WGS	WET GAS SCRUBBER	2011	49.9097	0	0
RN102597846	HK0014M	TEXAS LEHIGH CEMENT CO LP	TEXAS LEHIGH CEMENT CO	3241	CEMENT, HYDRAULIC	KILN	KILN & PRECALCINER	DC-2	DUST COLLECTOR "DC-2"	2011	49.6532	0	0
RN101941284	JE0824J	AIR PRODUCTS LLC	AIR PRODUCTS PORT ARTHUR FACILITY	2813	INDUSTRIAL GASES	SMR	STEAM METHANE REFORMER FURNACE	SMR STK	REFORMER STACK	2011	49.5767	0	0
RN102147055	CB0042C	SEADRIFT COKE LP	SEADRIFT COKE LP	2999	PETROLEUM AND COAL PRODUCTS, NEC	BC-1401	INCINERATOR	12	STACK	2011	49.02	0.0053	0
RN100825405	HN0083G	RIO GRANDE VALLEY SUGAR GROWERS INC	W R COWLEY SUGAR HOUSE	2061	RAW CANE SUGAR EXCEPT REFINING	BLR4	HEAT, STEAM, & POWER	E-04	BAGASSE FIRED BOILER	2011	48.42	0	0
RN101514214	RL0171L	TENASKA GATEWAY PARTNERS LTD	ELECTRIC POWER GENERATION	4911	ELECTRIC SERVICES	CTG1	COMBUSTION TURBINE 1 (INCLUDES HRSG DUCTBURNER)	GTDB1	GAS TURBINE	2011	47.4132	0	0
RN102574803	HG0229F	EXXONMOBIL CHEMICAL COMPANY	BAYTOWN CHEMICAL PLANT	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	CT18	COOLING TOWER 18	CT18	COOLING TOWER 18	2011	47.2148	0	0
RN100542844	JE0062S	EXXONMOBIL OIL CORP	BEAUMONT CHEMICAL PLANT	2869	INDUSTRIAL ORGANIC CHEMICALS, NEC	EM1	COOLING TOWER NO. 1	EM1	COOLING TOWER NO.1	2011	47.0921	0	0
RN100224534	LB0047N	SOUTHWESTERN PUBLIC SERVICE CO	TOLK STATION	4911	ELECTRIC SERVICES	UNIT 2	BOILER--GENERATOR #2	2-1	UNIT 2 STACK	2011	46.3935	0.0538	0.057
RN100888312	FG0020V	NRG TEXAS POWER LLC	WA PARISH ELECTRIC GENERATING STATION	4911	ELECTRIC SERVICES	MCT7	MAIN COOLING TOWER 7	WAPMCT7	MAIN COOLING TOWER 7	2011	46.0366	0	0

NOTES:

1. Point source emissions inventory data obtained from the State of Texas Air Reporting System (STARS). Emissions data reported by sites that met the TCEQ reporting requirements as stated in 30 Texas Administrative Code, Section 101.10 for the given year. Data are subject to revision or update.

2. Information in this data request is provided in a sort order per requestor specifications. Ranking is neither implied nor warranted.

TCEQ/OA/AQD/EAS/ADB, 2010 AND 2011 PM DATA_012014.XLSX

Exhibit 5

NRDC ISSUE BRIEF

DECEMBER 2014
IP:14-10-A

Fracking Fumes: Air Pollution from Hydraulic Fracturing Threatens Public Health and Communities

Just off Interstate Highway 25, Drill Rig in front of homes in the town of Frederick in Weld County, Colorado. Pipes, vehicles and storage tanks also stand in front of homes as hazy, snow capped Rocky Mountains stand in the background.

Tanja Srebotnjak
Miriam Rotkin-Ellman
Natural Resources Defense Council

INTRODUCTION

Hydraulic fracturing ('fracking') and other well stimulation methods have led to a rapid expansion of oil and gas development in the United States.[1] This expansion has brought oil and gas development closer to backyards and communities and increased the potential for human exposure to new contaminants and threats. At the same time, a growing body of new research points to health threats from unconventional oil and gas development and fracking in particular. Although health discussions, particularly in eastern states, have focused on drinking water contamination, there is mounting evidence for a range of health threats from air pollution as well. For example, research has linked pollution from fracking to unhealthy levels of smog and of toxic air contaminants. Exposure to this pollution can cause eye, nose, and throat irritation, respiratory illnesses, central nervous system damage, birth defects, cancer, or premature death.[2] At the same time, the oil and gas industry has been exempted from many regulations that limit air pollution from industrial activity.[3] At the federal level, the Environmental Protection Agency (EPA) recently issued new standards to limit harmful air pollution from the oil and gas industry—but these still contain major gaps.[4] Health protective regulations are also hampered by lack of scientific data on the potential cumulative risks posed by the combined emissions from a dense network of wells and associated infrastructure such as pipelines, compressor stations, and roads. State regulations are patchy and enforcement often cannot keep up with the industry's rapid expansion, resulting in insufficient protection from air pollutants.

HEALTH STUDIES FIND IMPACTS FROM FRACKING-RELATED AIR POLLUTION

Conventional oil and gas production has been known for some time to create harmful air emissions.[5] With the increase in fracking activity, more and more studies now document emissions of airborne pollutants at and near fracking sites that are known to cause cancer and harm the nervous, respiratory, and immune systems (see Figure 1). At the same time, people and communities in areas with many hydraulically fractured wells report health problems consistent with these types of exposures.[6,7,8,9,10] While it is difficult to measure actual exposures to pollutants from nearby fracking operations and establish clear links to adverse health outcomes, some studies found associations between air pollutants that are present at oil and gas production sites and health impacts observed in nearby communities.[11,12] In Colorado, for example, an evaluation of birth defects in areas with high concentrations of oil and gas activity found that mothers who lived near many oil and gas wells were 30 percent more likely to have babies with heart defects.[13] Similarly, preliminary results from a study in Pennsylvania show impacts among newborns that could be linked to air pollution such as increases in low birth weight.[14]

In many rural areas, the boom in oil and gas activity has been linked to unhealthy spikes in ozone concentrations.[15] In 2008 and 2011, increased ozone concentrations in Wyoming's Sublette County were associated with subsequent increases in outpatient clinic visits for respiratory problems.[16] Researchers who looked at air pollution levels near fracking sites in Colorado also found an increased risk of chronic and sub-chronic effects mainly stemming from oil and gas related pollutants, which can harm the respiratory and neurological systems and lead to symptoms like shortness of breath, nosebleeds, headaches, dizziness, and chest tightness.[17]

Thus, while research into the health effects of air pollution from unconventional oil and gas development is ongoing, there is mounting evidence that it causes pollution, which can affect the health of workers and communities.

Figure 1: Summary of major health effects associated with the release of airborne pollutants from fracking

HEALTH THREATS FROM FRACKING-RELATED AIR POLLUTION

GLOBAL EFFECTS

Emissions of carbon dioxide and methane contribute to climate change. Methane warms the climate at least 80 times more than an equal amount of carbon dioxide over a 20-year period.

REGIONAL EFFECTS

Nitrogen oxides and volatile organic compounds form ground-level ozone in the presence of sunlight, which can cause:

Respiratory problems, including coughs, shortness of breath, airway and lung inflammation, decreased lung function, worsening of asthma and other respiratory diseases, increased hospital admissions, and premature mortality

Cardiovascular effects, including cardiac arrhythmia, increased risk of heart disease, heart attacks, and stroke

LOCAL EFFECTS

Exposure to diesel particulate matter, hydrogen sulfide, toxics, including benzene, toluene, ethylbenzene, and xylene, and other volatile hydrocarbons can lead to:

Eye, nose, and throat irritation

Respiratory problems, including cough, difficulty breathing, and worsening of asthma and other respiratory diseases

Cardiovascular problems, including high blood pressure, heart attacks, and worsening of cardiac diseases

Brain and nervous system problems, including headaches, lightheadedness, and disorientation

Damage to the blood and bone marrow leading to anemia and immunological problems

Reproductive system effects

Effects on fetal and child development

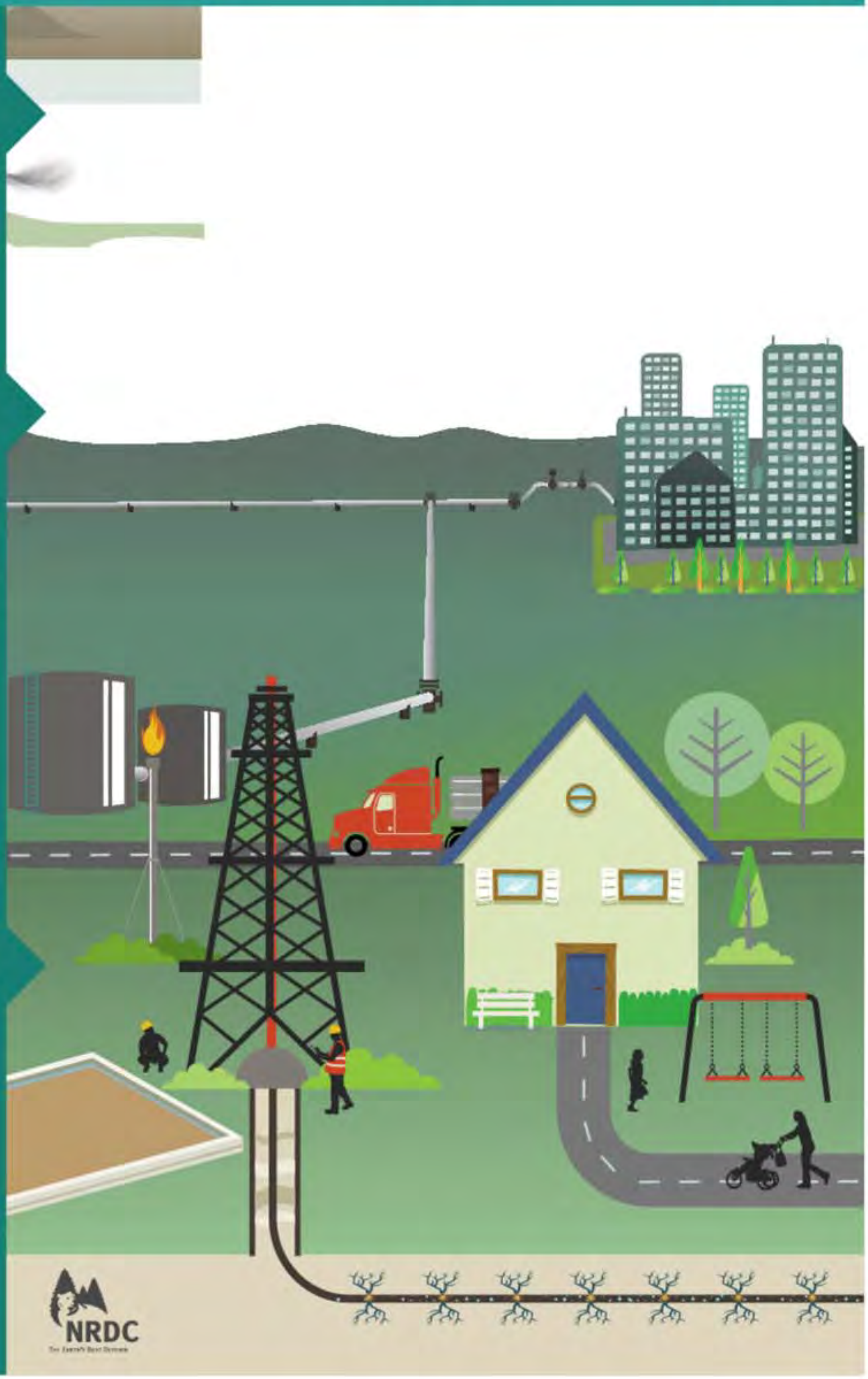
Cancer and premature mortality

Sources: ATSDR factsheets on nitrogen oxides, benzene, toluene, ethylbenzene, and xylene. [illegible]

OEHHA factsheet on health effects of diesel particulate matter. [illegible]

NIOSH pocket guide to chemical hazards: hydrogen sulfide [illegible]

US EPA on volatile organic compounds and ozone [illegible]



AIR POLLUTION FROM FRACKING

A comprehensive literature review identified 15 different oil and gas development processes and sources—including the drilling process, wastewater, and condensate tanks—that can release air contaminants (see Figure 2 in the Appendix).[18] The authors conclude that "there is legitimate concern that local air pollution may produce adverse effects in individuals who live near the high emitting site or processes." The rapid expansion of fracking, both in areas with existing oil and gas operations and previously undrilled areas, can lead to an increase in the type of pollution generally found at conventional oil and gas development and to other pollutants specific to fracking, such as silica sand, fracking chemicals, and flowback wastewater.

Local Impacts

Diesel Emissions

Diesel emissions originate from the combustion engines of heavy trucks and machinery used during well site preparation, drilling, and production. Exhaust from diesel engines contains hundreds of toxic chemicals. Of greatest concern is the fine diesel soot particles, which can lodge deep within the lungs, increasing health risks including: emergency room visits, hospital admissions, asthma attacks, cardiopulmonary disease (including heart attack and stroke), respiratory disease, adverse birth outcomes, and premature death (from pneumonia, heart attack, stroke and lung cancer).[19,20] Researchers are concerned about local residents' increased risk of exposure to diesel exhaust.[21] A study of regional air quality impacts from natural gas extraction in Pennsylvania's Marcellus Shale included diesel emissions from truck traffic, well drilling and hydraulic fracturing, gas production, on-site combustion, and compressor stations in the monetary damage calculations.[22] The National Institute for Occupational Safety and Health (NIOSH) expressed concern about the levels of diesel particulate matter measured at 11 oil and gas sites in Colorado, Arkansas, Pennsylvania, Texas, and North Dakota.[23]

Toxics

Toxic air pollutants originate from direct and fugitive emissions of hydrocarbons at the well and from associated infrastructure such as condensate tanks, dehydrators, wastewater impoundment pits, and pipelines. The fracking process involves dozens of chemicals and the process returns oil, gas, fracking chemicals, formation brines, and mobilized compounds, including heavy metals and naturally occurring radioactive materials (NORM) to the surface.

Hydrogen sulfide (H_2S) is a toxic and explosive gas that may be present in oil and gas formations and is produced along with the hydrocarbons. It is damaging to the central nervous system and can be lethal at higher concentrations (~1000 ppm).[24] While oil and gas workers may be required to wear protective respirators,[25] no such protections are considered for surrounding communities.

Benzene, toluene, ethylbenzene, and xylene (BTEX) and other toxic hydrocarbons, such as formaldehyde, released from oil and gas operations and equipment can lead to health impacts ranging from irritation of eyes, nose, mouth, and throat to aggravated asthma and other respiratory conditions, blood disorders, harm to the developing fetus, immune system-related diseases, and cancer (e.g., leukemia, non-Hodgkins lymphoma).

A study commissioned by the West Virginia Department of Environmental Protection found that, at many sites, a 625-feet distance from oil and gas activity—above the distances set by many states—still resulted in benzene concentrations above levels the Center for Disease Control and Prevention (CDC) considers "the minimum risk level for no health effects."[26] At least one of the BTEX compounds was found at all of the seven drilling sites examined. A health risk assessment in Colorado's heavily drilled Garfield County identified many hydrocarbon pollutants (including trimethylbenzenes, aliphatic hydrocarbons, and xylenes) associated with adverse respiratory and neurological effects.[27] It further found that concentrations of benzene, toluene, ethylbenzene, and xylene increased with proximity to the well site and were up to nine times higher during well completion than during well production. In tight gas fields in rural northeastern Utah, researchers estimated the total annual mass flux of volatile organic compounds (VOCs) from the surveyed gas fields to be equivalent to the emissions from 100 million cars.[28] The benzene levels measured in this study also exceeded health standards set by the Agency for Toxic Substances Disease Registry (ATSDR) and the California Environmental Protection Agency (CalEPA) to protect against harm to the developing fetus, immune system and blood.

Silica

Silica—the main component of 'frac sand'—is used widely and in large quantities to hold open the fractures created during the fracking process.[29] Inhalation of respirable silica can cause silicosis, an irreversible lung disease,[30] as well as lung cancer in miners, sandblasters, and foundry workers.[31] Silica inhalation is now also recognized as an occupational health hazard among oil and gas workers. NIOSH researchers collected 111 personal breathing zone (PBZ) samples at 11 sites in 5 states. At each one, they found that full-shift samples exceeded occupational health criteria,[32] in some cases by 10 times or more. This means that even if workers are properly using half-mask air-purifying respirators, they would not be sufficiently protected, because the measured concentrations exceed the masks' maximum use concentration.[33]

Regional Pollution

Ozone smog

Fracking-related processes and other stages of the oil and gas production process release nitrogen oxides and VOCs, which react in the presence of sunlight to form ozone ('smog'). Exposure to ozone is associated with a variety of respiratory and cardiovascular effects, including shortness of breath, reduced lung function, aggravated asthma and chronic respiratory disease symptoms, inflammatory processes, and premature death.[34] A growing number of studies have attributed emissions of ozone precursors from rapidly growing oil and gas development[35] to significantly elevated ozone concentrations in Wyoming,[36] Colorado,[37] Utah,[38,39,40] Pennsylvania,[41,42] Texas,[43,44] and Oklahoma.[45] In the study on Wyoming's Sublette County, tight gas production activities caused winter ozone levels[46] to spike above the EPA's 8-hour ozone standard of 75 parts per billion 13 times between February 14 and March 15, 2011.[47] In Utah's Uintah Basin ambient 1-hour ozone levels exceeded 150 ppb—twice the federal standard.[48]

Workers Not Protected

In addition to the community health concerns from fracking, worker safety at oil and gas production sites is also coming under increased scrutiny, in part because the oil and gas industry is one of the most dangerous occupational sectors in the country. According to statistics released by the Bureau of Labor Statistics there were 545 fatalities at U.S. oil fields between 2008 and 2012, of which 216 occurred in Texas.[49] At this level, the industry's fatality rate is 2.5 times higher than the accident-prone construction sector and more than 8 times higher than the industrial sector as a whole.[50] A major contributing factor to the industry's high fatality rate are traffic accidents, which also impact neighboring communities.

On-site toxic exposures present another health hazard to oil and gas workers. In 2010, at least four worker deaths may be linked to chemical and petroleum vapor exposure at or near flowback tanks at oil well sites in North Dakota and Montana.[51] Air samples collected by NIOSH in the personal breathing zone of workers at six flowback sites in Colorado and Wyoming identified benzene as the primary VOC of concern, especially near the hatches of the flowback tanks. Of the 17 samples, 15 met or exceeded the NIOSH Recommended Exposure Limit (REL) of 0.1 ppm.[52]

The unprotected inhalation of silica dust and diesel fumes also threatens worker health and may lead to cancers and other illnesses many years after exposure.[53] Workers may even bring contaminated clothes and boots home, putting their families at risk.

CURRENT POLICIES AND REGULATIONS PROVIDE INADEQUATE HEALTH PROTECTIONS

The oil and gas industry enjoys numerous exemptions from parts of key environmental and health protection laws, including the Clean Air Act, the Clean Water Act, and Hazardous Waste Laws.[54] These exemptions lead to weak regulations and inadequate monitoring for air pollutants and toxins from oil and gas facilities. As fracking and other extreme stimulation techniques move closer to towns and cities, this creates an information, legal, and regulatory vacuum that hampers communities' knowledge of and ability to protect themselves from harmful oil- and gas-related emissions and associated health impacts.

Faulty Inventories Underestimate Air Pollution

State and federal inventories provide important information for tracking and regulating air emissions of greenhouse gases, VOCs, and other hazardous air pollutants. Recent research indicates that these inventories may significantly underestimate air pollution from the oil and gas sector for a variety of reasons, including data gaps, uncertainty in the efficiency of emissions control equipment, use of obsolete or unrealistic emissions factors, incomplete reporting by operators, and changes in industry practices. One investigation led by the National Oceanic and Atmospheric Administration (NOAA) in Colorado's heavily drilled Denver-Julesburg Basin concludes that the state inventory for total VOCs emitted by oil and gas activities—which contribute to ozone formation and cause local toxicity—may be too low by a factor of at least two and that benzene emissions are seven-fold higher than reported in the state inventory.[55] An earlier systematic review of eleven "top-down" (starting with levels of pollutants in the atmosphere and attributing those emissions to sources) and a number of "bottom-up" (starting with measurement of a set of sources' emissions and extrapolating to aggregate emissions) studies looking at methane emissions from the sector estimates that total U.S. methane emissions from all sources were 25 percent to 75 percent higher than the U.S. Greenhouse Gas Inventory estimates for 2011, and finds that oil and gas are important contributors to these unreported emissions.[56] This review also concludes that a small number of "superemitters" could be responsible for a large fraction of the industry's methane leakage that had not been accounted for in the Inventory. In sum, the studies strongly suggest that oil and gas development is making a larger contribution to climate change than previously thought and that inventories may underestimate other pollutants.

Gaps in Federal Air Quality Regulations

In 2012, EPA issued two urgently needed standards aimed at limiting dangerous air pollution from oil and gas operations, including gas wells that are hydraulically fractured.[57] Although the rules are an improvement over the status quo, they fall short of the full level of health protection needed. The new rules, which are scheduled to take effect in 2015, will reduce well-site VOC emissions by 95 percent, but EPA monitoring will rely heavily on self-reported emissions data and the rules only apply to new gas wells and existing well sites will not be required to reduce pollution. In addition, the EPA still allows up to one ton of BTEX emissions from single glycol dehydrators per year.[58] And EPA relied relied on an analysis of health risks that was based on inadequate, inaccurate and incomplete emission inventories, ommitted pollutants with adverse health effects, excluded several sources of pollution, and failed to protect the most vulnerable populations.[59] The rules also fail to consider existing best practices that are already being deployed by many facilities to control pollution and prevent health impacts to surrounding communities. These technologies—such as improved efficiency, leak prevention systems, and emission controls—are readily available, feasible, and can even save the industry money.[60]

Lacking Enforcement

Federal and state agencies in charge of monitoring and enforcing oil and gas regulations have been overwhelmed by the industry's rapid growth. The Bureau of Land Management (BLM), charged with inspecting wells on federal lands and designating 'high priority wells' in need of greater environmental and groundwater protection, inspected only 40 percent of the 3,486 high priority wells between 2009 and 2012.[61] State oil and gas regulators, environmental protection departments, and public health agencies are left to fill in the gaps created by inadequate and constrained federal regulatory oversight. The result is a patchwork of state regulations and a distribution of responsibilities that leaves many loopholes and is plagued by a lack of resources for adequate inspections and enforcement. The Pennsylvania Department of Environmental Protection (DEP), for example, inspected fewer than 14 percent of active wells[62] and only 20 percent of producing wells in 2011.[63] A report for Texas found that enforcement actions were brought on only 2 percent of 55,000 logged violations.[64] There are no comprehensive national figures on enforcement in the oil and gas sector and state records are inconsistent in detail and accessibility.[65]

Companies are not mandated by federal regulations to disclose the identities or quantities of chemicals used during hydraulic fracturing operations on private or public lands. These chemicals can volatilize into the air from tanks and wastewater impoundments and contribute to air pollution. Some states have begun to set their own rules for chemical disclosure. Unfortunately, these laws often have shortcomings, including the non-disclosure of the composition of proprietary or "trade secret" fracking fluid products, insufficient penalties for reporting inaccurate or incomplete information, and allowances for after-the-fact reporting.[66] The industry-funded fracking fluid disclosure website FracFocus.org has been criticized in a review by researchers at Harvard Law School for inadequate transparency, accuracy, and user-friendliness.[67] The researchers concluded that "FracFocus is not an acceptable regulatory compliance method for chemical disclosures," but it is the official reporting site used by at least 11 states.[68]

These limitations leave lawmakers, regulators, public safety officers, and the public uninformed and ill-prepared to anticipate and respond to possible environmental and health hazards and emergencies associated with hydraulic fracturing fluids.

CONCLUSIONS

There is mounting evidence that air pollution from oil and gas operations threaten the health of nearby communities and immediate protections are needed. They should have the right to protect themselves by restricting or prohibiting these techniques within their jurisdictions. Where possible, ongoing unconventional oil and gas development should be put on hold to conduct comprehensive health assessments before determining whether or how these technologies should be allowed to proceed. In areas already bearing the brunt of fracking-related pollution and with no moratoria, strong safeguards are needed to control emissions and limit pollution.

RECOMMENDATIONS

The following is needed to ensure comprehensive health protections from air pollution:

- Protective standards at the federal and state level for communities and workers that ensure pollution controls including but not limited to:
  - Reduced Emission Completions (REC), also known as "green completion," to reduce methane and other VOC leaks for all wells, not only gas wells[69]
  - Leak detection and repair (LDAR) programs
  - Advanced technologies to control fugitive emissions
  - Reduction of diesel particulate matter through the use of cleaner combustion engines and alternative fuel types
  - Limitations on venting and flaring gas associated with oil production and ensuring that all gas is captured and sold or used on-site

- Comprehensive characterization of all pollution sources in unconventional oil and gas development and quantitative assessment of pollutants and emission rates through research and updated federal and state inventories
- Improved air quality monitoring before, during, and after well development and around all sources
- Expansion of the federal and state ozone monitoring network to better characterize air quality in rural areas highly impacted by pollution from oil and gas development
- Identification and implementation of adequate and protective setback requirements to reduce the exposure of residents to intermittent and chronic levels of air pollutants and toxins[70]
- Closure of regulatory loopholes in federal environmental programs to fill data gaps, increase transparency and oversight of the oil and gas industry and ensure public health protections
- Rigorous scientific studies in regions with intensive oil and gas development examining the effects of air pollution on the health of the local population, including comprehensive health impact assessments prior to new site development and followed by ongoing evaluations.[71]

WHAT RESIDENTS CAN DO

Residents can take the following actions to reduce their potential exposure to dangerous air pollutants:

Get informed

- Learn about possible pollution in your area:
  - Visit the U.S. EPA website for information on ozone and particulate levels
  - Contact your state environmental agency or health department for information on local monitoring for other air pollutants
  - Visit NRDC's Don't Get Fracked! Information Center to learn how to protect yourself and your family from pollution linked to hydraulic fracturing
  - For more information on specific oil and gas-related pollutants visit:
    - Benzene
    - Hydrogen sulfide (H_2S)
    - Diesel
    - Other toxics
- If you are worried about health symptoms or impacts, make sure to see your doctor and consult healthcare providers knowledgeable about the health impacts of air pollution. More resources are available through the following organizations:
  - The Pediatric Environmental Health Speciality Units (PEHSU)
  - Association of Environmental Medicine Clinics

Protect the most vulnerable

- Young children, the elderly, and individuals with respiratory conditions (e.g., asthma) can be sensitive to lower levels of pollution and should avoid exercise or extended outdoor activity when odors are present or agency websites (EPA or state) indicate poor air quality.

Take Action

- Improve air quality monitoring in your community
- Report spills and other environmental problems in your community
- Connect with your neighbors and set up a Citizen Science group
- Speak up and organize your community's defense
- Demand stronger protections

APPENDIX

Figure 2: Major air pollutants and air toxics released during the different fracking process stages and sources of equipment

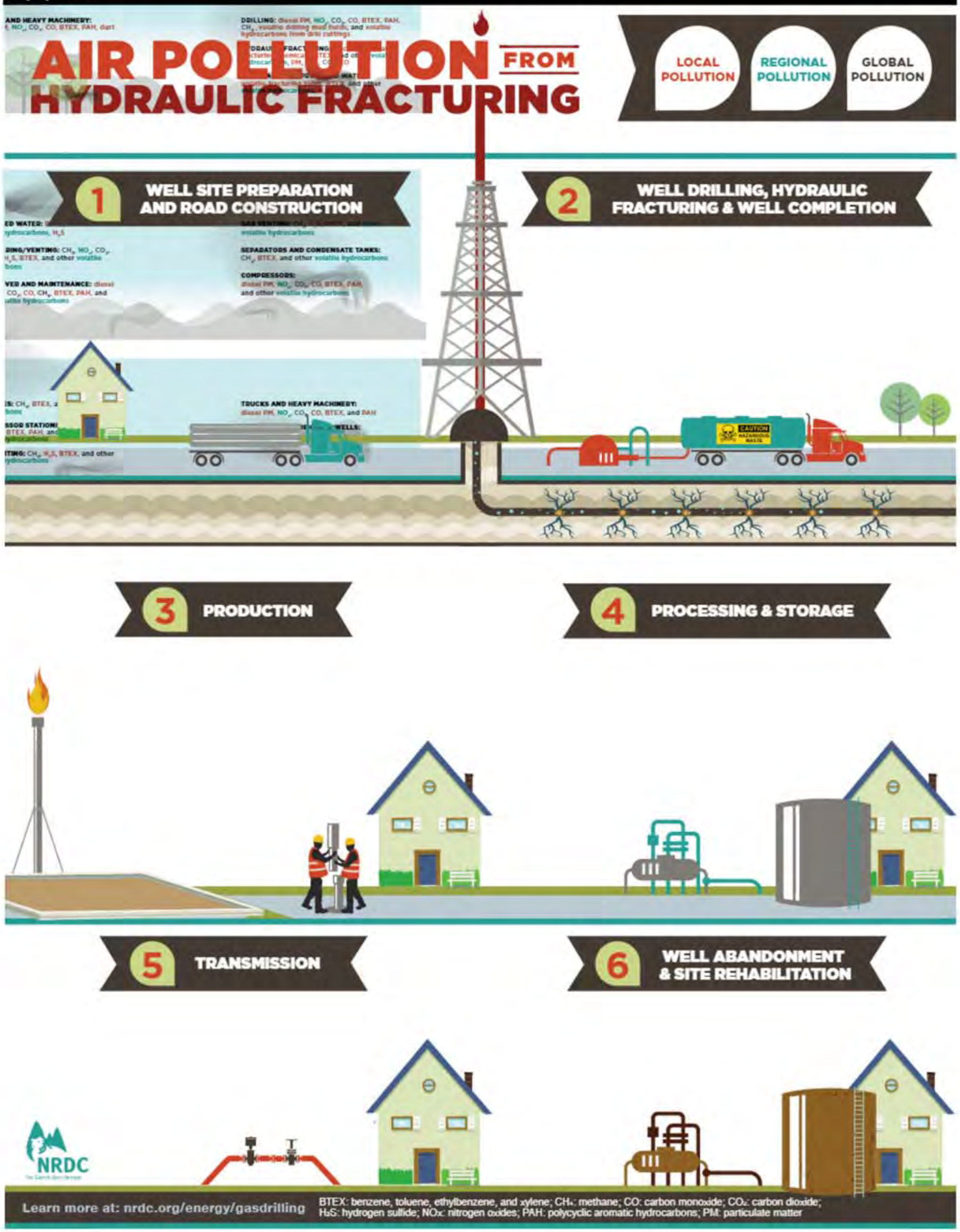


Table 1: Characterization of the main sources of air pollution from oil and gas development according to well process stage

	Local							Regional		Global	
	Particulate Matter (PM)		Volatile Organic Compounds (VOCs)							Greenhouse Gases	
Emissions Source	Diesel PM	PM_{10}	BTEX	PAH (incl. Naphthalene, Chlorobenzene, Phenol)	Other (incl. Formaldehyde, Ethylene glycol, Methanol)	H_2S	Respirable silica	VOCs	NO_x	CH_4	CO_2
Well site preparation (landscape clearing, soil movement, pipelines and other infrastructure)	●	●	●	●					●		●
Well drilling, hydraulic fracturing and well completion (drill rig, drilling muds and cuttings, fracturing fluid mixing, water trucks, pumps, generators, flowback	●	●	●	●	●	●	●	●	●	●	●
Well production (produced water, gas flaring/ venting, well maintenance work)	●	●	●	●	●	●		●	●	●	●
Processing and storage (gas venting, glycol dehydrators, separators, condensate tanks, compressors)	●	●	●	●	●	●		●	●	●	●
Transmission (compressors, gas venting, pipelines, tanker trucks	●	●	●	●	●			●	●	●	●
Well abandonment & site rehabilitation	●	●	●	●					●	●	●

Sources: Adgate, J., Goldstein, B., and McKenzie, L. 2014. "Potential Public Health Hazards, Exposures and Health Effects from Unconventional Natural Gas Development." *Environmental Science & Technology*, doi: 10.1021/es404621d. Moore, Christopher W. et al. 2014. "Air Impacts of Increased Natural Gas Acquisition, Processing, and Use: A Critical Review." *Environmental Science & Technology*, 11. doi:dx.doi.org/10.1021/es4053472.

Key: BTEX: benzene, toluene, ethylbenzene, xylene; CH_4: methane; CO_2: carbon dioxide; diesel PM: diesel particulate matter; H_2S: hydrogen sulfide; NO_x: nitrogen oxides; O_3: ozone; PAH: polycyclic aromatic hydrocarbons; PM_{10}: particulate matter of 10 micrometers or smaller in diameter.

Table 2: Health impacts of the main air pollutants by target organ and system		
Pollutant	**Target organ/system**	**Carcinogen**
Particulate Matter (PM)		
Diesel PM	Respiratory system; Cardiovascular system	●
PM_{10} and smaller	Respiratory system; Cardiovascular system	
Volatile Organic Compounds (VOCs)		
Benzene	Immune system; Blood; Fetal development, Nervous System	●
Toluene	Brain and nervous system; Respiratory system; Fetal and child development; Reproductive system	
Ethylbenzene	Fetal and child development; Liver; Kidney; Endocrine system; Auditory system	●
Xylene	Brain and nervous system; Fetal and child development	
Other VOCs (incl. Formaldehyde, Methanol)	Immune system; Respiratory system; Brain and nervous system; Fetal and child development; Liver; Kidney; Endocrine system	●
Other		
Hydrogen sulfide (H_2S)	Respiratory system; Brain and nervous system; Gastrointestinal system	
NO_x	Respiratory system	
Ozone (O_3)	Respiratory system; Cardiovascular system	
Respirable Silica	Respiratory system; Kidneys; Immune system	●
PAHs (incl. Naphthalene)	Immune system*, Reproductive system*; Brain and nervous system*; Developmental effects*	●**

* in animal studies

** probable carcinogens are among the PAHs emitted at unconventional oil & gas sites

Sources: Factsheet on the Health Effects of Diesel Exhaust. Available at http://oehha.ca.gov/public_info/facts/dieselfacts.html. U.S. EPA (1997). Health Effects of Particulate Matter. OAQPS Fact Sheet, July 17, 1997. Available at www.epa.gov/region7/air/quality/pmhealth.htm. OSHA (2014). Crystalline Silica, www.osha.gov/dsg/topics/silicacrystalline/health_effects_silica.html. ATSDR (2004). Interaction Profile For: Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX). ATSDR (2007). Public Health Statement for Benzene. Available at www.atsdr.cdc.gov/phs/phs.asp?id=37&tid=14. ATSDR (2000). Public Health Statement for Toluene. Available at http://www.atsdr.cdc.gov/phs/phs.asp?id=159&tid=29. ATSDR (2010). Public Health Statement for Ethylbenzene. Available at www.atsdr.cdc.gov/phs/phs.asp?id=381&tid=66. ATSDR (2007). Public Health Statement for Xylene. Available at www.atsdr.cdc.gov/phs/phs.asp?id=293&tid=53. Department of Health and Human Services, Centers for Disease Control, National Institute for Occupational Safety and Health. 2005. NIOSH Pocket Guide to Chemical Hazards: Benzene. 2005-149. National Institute for Occupational Safety and Health (NIOSH). www.cdc.gov/niosh/npg/npgd0049.html. Department of Health and Human Services, Centers for Disease Control, National Institute for Occupational Safety and Health. 2005. U.S. EPA. An Introduction to Indoor Air Quality. Volatile Organic Compounds. Available at www.epa.gov/iaq/voc.html. ATSDR (1995). Public Health Statement for Polycyclic Aromatic Hydrocarbons (PAHs). Available at www.atsdr.cdc.gov/phs/phs.asp?id=120&tid=25. U.S. EPA. NIOSH Pocket Guide to Chemical Hazards: Hydrogen Sulfide. 2005-149. National Institute for Occupational Safety and Health (NIOSH). www.cdc.gov/niosh/npg/npgd0337.html. ATSDR (2002). Factsheet on Nitrogen Oxides. California EPA, Office of Environmental Health Hazard Assessment (OEHHA). Health Effects of Ozone in the General Population. Available at www.epa.gov/apti/ozonehealth/population.html.

Key: BTEX: benzene, toluene, ethylbenzene, xylene; CH_4: methane; diesel PM: diesel particulate matter; H_2S: hydrogen sulfide; NO_x: nitrogen oxides; O_3: ozone; PAH: polycyclic aromatic hydrocarbons; PM_{10}: particulate matter of 10 micrometers or smaller in diameter.

Endnotes

1 U.S. Energy Information Administration, "Today in Energy. North America leads the World in Shale Gas Production," www.eia.gov/todayinenergy/detail.cfm?id=13491 (accessed June 6, 2014).

2 John L. Adgate et al. "Potential Public Health Hazards, Exposures and Health Effects from Unconventional Natural Gas Development," Environmental Science and Technology", 2014 doi:10.1021/es404621d).

3 U.S. Government Accountability Office (GAO), "*Unconventional Oil and Gas Development. Key Environmental and Public Health Requirements*," GAO-12-874.

4 The new rules still allow existing facilities to release up to 1 ton per year of the carcinogen benzene from large glycol dehydrators despite analysis showing that this could increase the cancer risk for neighboring communities. Existing facilities are also not required to upgrade their equipment to reduce emissions and protect public health.

5 U.S. Environmental Protection Agency, "Improving Air Quality in Your Community," www.epa.gov/oaqps001/community/details/oil-gas_addl_info.html (accessed September 3, 2014).

6 Elizabeth Ridlington, John Rumpler, "*Fracking by the Numbers: Key Impacts of Dirty Drilling at the State and National Level*", Environment America Research & Policy Center and the Frontier Group, 2013.

7 Charles W. Schmidt, "Estimating Wastewater Impacts from Fracking," *Environmental Health Perspectives* 121 (4) (2013): A117. doi:10.1289/ehp.121-a117.

8 Roxana Z. Witter et al., *Potential Exposure-Related Human Health Effects of Oil and Gas Development: A Literature Review (2003-2008)*, White Paper, Denver, CO, 2008, docs.nrdc.org/health/files/hea_08091702b.pdf (accessed August 21, 2014).

9 Roxana Z.Witter et al., *Health Impact Assessment for Battlement Mesa, Garfield County Colorado*, Aurora, CO, 2010, www.garfield-county.com/public-health/documents/1%20%20%20Complete%20HIA%20without%20Appendix%20D.pdf (accessed August 21, 2014).

10 Peter M. Rabinowitz et al. "Proximity to Natural Gas Wells and Reported Health Status: Results of a Household Survey in Washington County, Pennsylvania," *Environmental Health Perspectives*, 2014, doi:http://dx.doi.org/10.1289/ehp.1307732.

11 Lisa M. McKenzie et al., "Human Health Risk Assessment of Air Emissions from Development of Unconventional Natural Gas Resources," *Science of the Total Environment* 424 (2012): 79–87, doi:10.1016/j.scitotenv.2012.02.018.

12 Lisa M. McKenzie et al., "Birth Outcomes and Maternal Residential Proximity to Natural Gas Development in Rural Colorado," *Environmental Health Perspectives*, (2014), doi:http://dx.doi.org/10.1289/ehp.1306722.

13 Ibid. [12].

14 John L. Adgate et al., "Potential Public Health Hazards, Exposures and Health Effects from Unconventional Natural Gas Development," *Environmental Science & Technology*, (2014), doi:10.1021/es404621d.

15 Detlev Helmig et al., "Highly Elevated Atmospheric Levels of Volatile Organic Compounds in the Uintah Basin, Utah." *Environmental Science & Technology*, March 27, 2014. doi:10.1021/es405046r.

16 State of Wyoming Department of Health, "*Associations of Short-Term Exposure to Ozone and Respiratory Outpatient Clinic Visits — Sublette County, Wyoming, 2008–2011*," 2013; Cheyenne, WY.

17 Ibid. [11].

18 Ibid. [14].

19 Seth B. Shonkoff et al. Environmental Public Health Dimensions of Shale and Tight Gas Development. Environmental Health Perspectives. (2014).

20 John L. Adgate et al. "Potential Public Health Hazards, Exposures and Health Effects from Unconventional Natural Gas Development," Environmental Science and Technology", 2014 doi:10.1021/es404621d.

21 Allen Robinson, "*Air Pollutant Emissions from Shale Gas Development and Production*," Workshop presentation on the Health Impact Assessment of New Energy Sources: Shale, Institute of Medicine, April 30-May 1, 2012.

22 Aviva Litovitz et al., "Estimation of Regional Air-Quality Damages from Marcellus Shale Natural Gas Extraction in Pennsylvania," *Environmental Research Letters*, 8 (2013), doi:10.1088/1748-9326/8/1/014017.

23 Eric J. Esswein, Michael Breitenstein, John Snawder, "*NIOSH Field Effort to Assess Chemical Exposures in Oil and Gas Workers: Health Hazards in Hydraulic Fracturing*," Workshop presentation on the Health Impact Assessment of New Energy Sources: Shale, Institute of Medicine, April 30-May 1, 2012.

24 Ibid. [14].

25 Occupational Safety and Health Administration (OSHA), "*Standards for Hydrogen Sulfide*", www.osha.gov/SLTC/hydrogensulfide/standards.html (accessed June 6, 2014).

26 West Virginia Department of Environmental Protection, Division of Air Quality, "*Air, Noise, and Light Monitoring Results For Assessing Environmental Impacts of Horizontal Gas Well Drilling Operations (ETD-10 Project)*," Charleston, WV.

27 Ibid. [11].

28 Ibid. [15].

29 According to industry representatives, hydraulic fracturing companies use up to 10,000 tons of silica sand to hydraulically fracture a single well. See Kanika Sikka, Sneha Banerjee, "*U.S. Silica Sees Sand Demand Piling up as Fracking Goes Super-Sized*," Reuters, September 19, 2014. www.reuters.com/article/2014/09/19/us-ussilica-demand-idUSKBN0HE12P20140919.

30 Long-term exposure can lead to chronic silicosis, while short-term exposure to very large amounts of silica can cause acute silicosis.

31 OSHA, "*Silica, Crystalline*," www.osha.gov/dsg/topics/silicacrystalline/ (accessed September 4, 2014).

32 The criteria used in the study are the Occupational Safety and Health Administration calculated permissible exposure limit (PEL), the NIOSH recommended exposure limit (REL), or the threshold limit value (TLV) set by the American Conference of Industrial Hygienists (ACGIH).

33 Eric J. Esswein et al., "Occupational Exposures to Respirable Crystalline Silica during Hydraulic Fracturing." *Journal of Occupational and Environmental Hygiene* 10 (7) (2013): 347–56, doi:10.1080/15459624.2013.788352.

34 US EPA, "*Health Effects of Ozone in the General Population*," www.epa.gov/apti/ozonehealth/population.html (accessed June 13, 2014).

35 Christopher W. Moore et al., "Air Impacts of Increased Natural Gas Acquisition, Processing, and Use: A Critical Review," *Environmental Science & Technology*, 11 (2014), doi:dx.doi.org/10.1021/es4053472.

36 Wyoming Department of Environmental Quality. "*WDEQ Winter Ozone Update*," Public Meeting, Pinedale, WY, March 22, 2011.

37 Gabrielle Pétron et al., "A New Look at Methane and Non-Methane Hydrocarbon Emissions from Oil and Natural Gas Operations in the Colorado Denver-Julesburg Basin," *Journal of Geophysical Research: Atmospheres* (2014), doi: 10.1002/2013JD021272.

38 Ibid. [15].

39 Seth Lyman, Howard Shorthill, "*Final Report: 2013 Uintah Basin Winter Ozone & Air Quality Study*," CRD/9.273A, Vernal, UT: Utah State University, 2013.

40 P.M. Edwards et al., "Ozone Photochemistry in an Oil and Natural Gas Extraction Region during Winter: Simulations of a Snow-Free Season in the Uintah Basin, Utah," *Amospheric Chemistry and Physics* 13 (2013): 8955–71, doi:10.5194/acp-13-8955-2013.

41 Charles W. Schmidt "Blind Rush? Shale Gas Boom Proceeds amid Human Health Questions," *Environmental Health Perspectives, Spheres of Influence*, 119 (8) (2011): A348–53.

42 Anirban A. Roy et al., "Air Pollutant Emissions from the Development, Production, and Processing of Marcellus Shale Natural Gas," *Journal of the Air & Waste Management Association* 64 (1) (2014): 19–37, doi:10.1080/10962247.2013.826151.

43 Susan Kemball-Cook et al., "Ozone Impacts of Natural Gas Development in the Haynesville Shale," *Environmental Science & Technology* 44 (24) (2010): 9357–63, doi:10.1021/es1021137.

44 Eduardo Olaguer "The Potential near-Source Ozone Impacts of Upstream Oil and Gas Industry Emissions," *Journal of the Air & Waste Management Association* 62 (8) (2012): 966–77, doi:http://dx.doi.org/10.1080/10962247.2012.688923.

45 A.S. Katzenstein et al., "Extensive Regional Atmospheric Hydrocarbon Pollution in the Southwestern United States." *Proceedings of the National Academy of Sciences* 100 (21) (2003): 11975–79.

46 Winter time conditions such as snow cover and temperature inversions enhance the photochemical reaction of NO_x and VOCs to ozone.

47 State of Wyoming Department of Health (2013), Associations of Short-Term Exposure to Ozone and Respiratory Outpatient Clinic Visits — Sublette County, Wyoming, 2008–2011.

48 Ibid. [15].

49 Bureau of Labor Statistics, *"Census of Fatal Occupational Injuries"*, www.bls.gov/iif/oshcfoi1.htm (accessed June 6, 2014).

50 Ibid. [14].

51 NIOSH, *"Reports of Worker Fatalities during Flowback Operations,"* blogpost, blogs.cdc.gov/niosh-science-blog/2014/05/19/flowback/ (accessed August 21, 2014).

52 Calculated as a full-shift Time Weighted Average (TWA).

53 Ibid. [33].

54 Ibid. [3].

55 Ibid. [37]

56 A.R. Brandt et al., "Methane Leaks from North American Natural Gas Systems," *Science* 343 (6172) (2014): 733–35, doi:10.1126/science.1247045.

57 EPA, Regulatory Actions, *"EPA Issues Final Air Rules for the Oil and Natural Gas Industry,"* www.epa.gov/airquality/oilandgas/actions.html (accessed September 12, 2014).

58 Christopher Moore et al. "Air Impacts of Increased Natural Gas Acquisition, Processing, and Use: A Critical Review," *Environmental Science & Technology*, 11 (2014), doi:dx.doi.org/10.1021/es4053472.

59 Earthjustice, *"Petition for Reconsideration of Oil and Natural Gas Sector: National Emission Standards for Hazardous Air Pollutants Reviews,"* Final Rule, 77 Fed. Reg. 49,490 (Aug. 16, 2012), 40 C.F.R. Part 63, Subparts HH and HHH, Dkt. ID No. EPA-HQ-OAR-2010-0505, www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2010-0505-4591 (accessed August 8, 2014).

60 Susan Harvey, Vignesh Gowrishankar, Thomas Singer, *"Leaking Profits: The U.S. Oil and Gas Industry Can Reduce Pollution, Conserve Resources, and Make Money by Preventing Methane Waste,"* Natural Resources Defense Council, 2012, www.nrdc.org/energy/files/Leaking-Profits-Report.pdf. ICF International, "Economic Analysis of Methane Emission Reduction Opportunities in the U.S. Onshore Oil and Natural Gas Industries," report prepared for Environmental Defense Fund, March 2014, www.edf.org/icf-methane-cost-curve-report (accessed September 4, 2014). US Government Accountability Office (GAO), "Opportunities Exist to Capture Vented and Flared Natural Gas, Which Would Increase Royalty Payments and Reduce Greenhouse Gases," Washington D.C., 2010.

61 Associated Press, *"4 in 10 higher risk wells aren't inspected by feds,"* 2014, bigstory.ap.org/article/4-10-higher-risk-wells-arent-inspected-feds-0 (accessed September 4, 2014).

62 An active well may not be producing continuously.

63 Earthworks, *"Oil and Gas Enforcement: Inspections,"* www.earthworksaction.org/issues/detail/pennsylvania_oil_gas_enforcement_inspections#.U5IlKChW6_Y (accessed June 6, 2014).

64 Ibid. [59].

65 EnergyWire, *"Overflow: Blowouts, Leaks and Spills from the Drilling Boom,"* www.eenews.net/special_reports/overflow (accessed August 21, 2014).

66 Alexis L. Maule et al., "Disclosure of Hydraulic Fracturing Fluid Chemical Additives: Analysis of Regulations," *New Solutions: A Journal of Environmental and Occupational Health Policy*: 23 (1) (2013): 167–87, doi:10.2190/NS.23.1.j.

67 Kate Konschnik, Margaret Holden, Alexa Shasteen, *"Legal Fractures in Chemical Disclosure Laws: Why the Voluntary Chemical Disclosure Registry FracFocus Fails as a Regulatory Compliance Tool,"* Harvard University, Harvard Law School, Environmental Law Program, blogs.law.harvard.edu/environmentallawprogram/files/2013/04/4-23-2013-LEGAL-FRACTURES.pdf (accessed August 21, 2014).

68 Ibid. [63].

69 RECs and green completions refer to technologies that capture methane and other gases at the well head during and after well completion and avoid their release into the atmosphere. The NSPS of April 2014 state that owners and/or operators may use RECs or completion combustion devices, such as flaring, until January 1, 2015; as of January 1, 2015, owners and/or operators must use RECs and a completion combustion device. For more information on RECs, see EPA, *"Reduced Emissions Completions for Hydraulically Fractured Natural Gas Wells,"* a Lessons Learned from Natural Gas STAR Partners factsheet, 2011.

70 Such research could draw on findings from analyzing the dispersion of air pollution as a function of the distance from road traffic and consider data from the effects of new or existing setback rules in states with unconventional oil and gas development.

71 See, for example, the study being conducted by the Geisinger Health System in Pennsylvania: Geisinger Research, "Geisinger Leads Marcellus Shale Initiative Coalition Explores the Potential Health Effects of Natural Gas Mining in the Region," Geisinger Research Connections Winter: 1–3, 2013.

Western Refining

WNR LISTED NYSE

June 16, 2016

Texas Commission on Environmental Quality
P.O. Box 13087
Attention: Holly Landuyt, MC-165
Austin, Texas 78711-3087

Submitted by email to: monops@tceq.texas.gov

Re: **2016 Annual Air Monitoring Network Plan**

Western Refining, Inc. ("Western") respectfully submits these comments regarding the Texas Commission on Environmental Quality (TCEQ) 2016 Annual Air Monitoring Network Plan. We appreciate the opportunity to provide comment on this important tool for assuring air quality and attainment with National Ambient Air Quality Standards.

Western is an independent crude oil refiner and marketer of refined products, headquartered in El Paso, Texas. Western owns and operates two refineries, one in El Paso, Texas, and one near Gallup, New Mexico, with a combined capacity of 156,000 barrels per day. The wholesale segment includes a fleet of crude oil and finished product truck transports, and wholesale petroleum products operations in Arizona, California, Colorado, Georgia, Maryland, Nevada, New Mexico, Texas, and Virginia. The retail segment includes retail service stations and convenience stores in Arizona, New Mexico, and Texas. Western Refining, Inc. also owns the general partner and approximately 65% of the limited partnership interest of Western Refining Logistics, LP and the general partner and approximately 39% of the limited partnership interest in Northern Tier Energy, LP, including its refinery in Saint Paul Park, Minnesota.

In El Paso County, Western's business and operations provide a substantial positive impact. Western has approximately 500 employees in the El Paso area, in the refinery and company offices. Our average wage for these employees is one of the highest average wages in El Paso. We employ a number of contractors in addition to company employees. And we operate more than 25 retail gasoline stations with convenience stores in El Paso, providing additional employment. We are the largest property tax payer in the county. Western donates approximately $1,000,000 annually to local non-profit, charitable organizations; our charitable donations include scholarships and donations to nearby schools, among other things, and we are the largest contributor to the United Way of El Paso.

We applaud TCEQ's thoughtful approach to optimizing the air monitoring network and assuring cost effectiveness of the monitors operated as well as meeting or exceeding all EPA requirements. Specifically, for El Paso County, we support the following proposals included by TCEQ in the monitoring plan:

- Deploying a collocated $PM_{2.5}$ FRM monitor at the El Paso Chamizal site to meet collation requirements

- Removal of the NCore network designation for the NO_2 monitors at the El Paso Chamizal and maintaining the PAMS and SLAMS network designations only
- Adding no source-oriented sulfur dioxide monitoring stations in El Paso County
- Discontinuing the TSP Pb monitor at El Paso Chamizal

Given the annual measurements of $PM_{2.5}$ at the Chamizal site that fall within 17% of the NAAQS, the collocated $PM_{2.5}$ FRM monitor at this site may prove to be especially valuable.

We have no additional recommendations for the monitoring plan for 2016. Nonetheless, given that EPA requires an annual review of the monitoring plan, we recommend additional considerations for the monitoring plan review cycle in 2017. Very possibly, EPA will designate El Paso County nonattainment under the 2015 ozone standard. Additional monitoring information may gain importance as TCEQ strives to bring El Paso County back into attainment. The conceptual model that has been developed for El Paso County recommends additional monitoring to support further understanding of ozone transport into the area and ozone mixing from upper layers. We urge TCEQ to consider the recommendations from the conceptual model in devising future monitoring plans for El Paso County, in 2017.

If you have any questions on the information contained in this email, please contact Marise Textor at 915-474-7897 or marise.textor@wnr.com.

Sincerely,

Marise Textor
Director, Regulatory Affairs

cc: David Brymer – david.brymer@tceq.texas.gov
Donna Huff – donna.huff@tceq.texas.gov
Erik Gribbin -- erik.gribbin@tceq.texas.gov
Fernando Mercado -- fernando.mercado@tceq.texas.gov