Air Dispersion Modeling Guidelines

For Oklahoma Air Quality Permits

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1.   Introduction

This is a guidance document on air dispersion modeling developed by the Air Quality Division (AQD) of the Oklahoma Department of Environmental Quality. The guidance provides assistance to applicants in demonstrating compliance with modeling requirements. These requirements help to protect the public's health, general welfare, physical property, and the natural environment.

Air dispersion modeling analyses may be required with an Air Quality permit application under Oklahoma Administrative Code (OAC), Title 252, Chapter 100, Subchapters 8, 31, and 42. This guidance clarifies existing practices, aids the modeler in developing an acceptable analysis, and assists AQD personnel in expediting the review process.

This document relies on modeling guidance contained in the *Guideline On Air Quality Models* as codified in 40 CFR Part 51, Appendix W, which can be accessed on the EPA Support Center for Regulatory Atmospheric Modeling (SCRAM) web site at: https://www3.epa.gov/ttn/scram/guidance/guide/appw_17.pdf as well as guidance issued by the EPA Office of Air Quality Planning and Standards (OAQPS) and EPA Region VI.

Section 1 and Section 2 address general modeling concepts. Section 3 address specific issues related to modeling toxic air contaminates (TAC), per OAC 252:100-42, and modeling compliance with the National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) Increments consumption for Title V/Part 70 permit applications. Section 4 address specific issues related to modeling compliance with the NAAQS and PSD Increments consumption for PSD and New Source Review (NSR) permit applications. Appendix A contains a table of point source model input data (emissions) requirements for PSD and NSR compliance demonstrations. Appendix B provides a derivation for flare modeling guidance. Appendix C contains a checklist for modeling protocol submission. Appendix D contains a checklist for final modeling data submittal.

1.1   What is Air Dispersion Modeling

Air dispersion modeling is a method of predicting the ambient air impact of one or more stationary sources of air pollutants. The algorithms used in the models are based on known physics of atmospheric processes and empirical data. The results of an analysis are used by AQD staff to demonstrate that emissions from new or existing sources will comply with state and federal maximum ambient air concentration limits. The models calculate the ambient impacts of a source and are designed to be conservative, i.e., over-predict ambient impacts. Because the models may over-predict the ambient air impacts, a modeled exceedance alone does not mean that there will be a violation of the applicable state or federal ambient air concentration limit. A modeled exceedance just indicates there is a potential for an air quality violation. When a modeling analysis calculates an exceedance, additional requirements such as more complex modeling or changing physical or operational parameters of the source to reduce ambient impacts may be required. If modeling continues to predict an exceedance, the AQD may require the source to conduct ambient air monitoring.

1.2 State and Federal Regulations Requiring Modeling

Various state and federal regulations require modeling. OAC, Title 252, Chapter 100 codifies air regulations for the AQD. OAC 252:100-8 regulates major sources. The federal PSD and NSR construction permit programs and the federal Title V/Part 70 permit program are incorporated in Subchapter 8. These programs require modeling to demonstrate compliance with the NAAQS and PSD Increments.

OAC 252:100-31 regulates emissions of sulfur (S) compounds from stationary sources in Oklahoma. This subchapter limits the ambient air concentrations of hydrogen sulfide (H_2S).

OAC 252:100-42 regulates emissions and impacts of TAC in Areas of Concern (AOC). This subchapter provides the methodology for developing and promulgating Maximum Acceptable Ambient Concentrations (MAAC) for individual TAC. TAC and associated MAAC are listed in Appendix O of OAC 252:100. After an AOC has been designated, modeling may be required as part of the compliance strategy for the AOC.

1.3 Levels of Modeling

1.3.1 Screening Modeling/Techniques

Screening modeling analyses theoretically provide conservative estimates of source impacts with simplified assumptions of model inputs (i.e., worst case meteorological conditions). The current EPA approved screening model is AERSCREEN. AERSCREEN is the screening model for AERMOD and replaced SCREEN3. AERSCREEN produces worst-case estimates of 1-hour impacts for a single source using default meteorological data and actual terrain data. AERSCREEN also includes averaging time factors for calculating the worst-case 3-hour, 8-hour, 24-hour, and annual averages. The calculated AERSCREEN concentrations are expected to be equal to or greater than the estimates produced by AERMOD.

Screening techniques usually make simplified and conservative assumptions about source and chemical and physical processes compared to a refined model to determine source impacts. In general, screening techniques may involve use of a reduced form of a refined model.

1.3.2 Refined Modeling

Refined modeling requires more detailed and precise input data and utilizes more complex air dispersion models to theoretically provide more accurate estimates of ground level concentrations. Refined modeling may be required if the screening analysis (model/technique) indicates that the impacts from the sources evaluated could exceed a standard or guideline. Refined modeling may also be requested if it is determined that a screening analysis will not adequately address the modeling scenario. It is usually the applicant's responsibility to perform refined modeling analyses.

1.4 Acceptable Models

In general, AQD defers to the *Guideline on Air Quality Models* in 40 CFR Part 51, Appendix W for the issue of acceptable models. Appendix W provides guidance on appropriate model applications and is updated as EPA approves new models. However, AQD reserves the option to evaluate the use of unapproved models on a case-by-case basis. Depending on circumstance, this

evaluation may require concurrence by EPA Region VI and/or public review. The following models may be used as is appropriate.

1.4.1 AERSCREEN

AERSCREEN is the primary single-source screening model available from EPA. The model may be used for point, area, volume, and flare sources.

1.4.2 AERMOD

As of December 9, 2006, the AERMOD modeling system, a steady-state plume dispersion model for assessment of pollutant concentrations from a variety of sources, has become the primary model used for refined modeling. AERMOD incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain. There are two input data processors of the regulatory AERMOD modeling system: AERMET, a meteorological data preprocessor that incorporates planetary boundary layer turbulence structure and scaling concepts, and AERMAP, a terrain data preprocessor that incorporates complex terrain using United States Geological Survey (USGS) as National Elevation Dataset (NED) data and Digital Elevation Model (DEM) data. The model code and supporting documents are not static but evolve to accommodate the best available science. Be sure to check the EPA SCRAM website often for updates. Modeling should be conducted using the most recent version of the model as of the date of submittal. However, AQD reserves the right to require updated modeling if more recent versions are released prior to issuance of the permit if there are changes that will significantly affect the submitted modeling.

1.4.3 CALPUFF

CALPUFF is a Lagrangian multi-layer, multi-species non-steady-state puff dispersion model. As of May 22, 2017, the CALPUFF model was removed as a preferred model for long-range impact (greater than 50 km) assessments of PSD increments for Class I areas. CALPUFF is now considered a screening technique along with other Lagrangian models for long-range transport assessments of PSD increments. Acceptability of CALPUFF modeling for Air Quality Related Values (AQRV) (i.e., visibility (light extinction) and acid deposition) in Class I areas is regulated by the Federal Land Managers (See Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report Revised 2010 (FLAG 2010)).

1.5 Modeling Protocols

A modeling protocol is generally required prior to performing any refined modeling analysis for PSD and NSR permit applications. All PSD Tier III NO_2 modeling analyses and Tier II $PM_{2.5}$ secondary formation modeling analyses are required to submit a modeling protocol which will also be forwarded to EPA Region 6 for review. The AQD requests that the protocol be available for review prior to pre-application meetings. The applicant should allow one-to-two weeks for review. If the applicant proposes to use an unapproved model (including BETA options), four-to-six weeks should be allowed for examination. Upon review, the applicant will receive written notification concerning the review of the modeling protocol as well as guidance on any outstanding issues. However, the applicant should be aware that an approved modeling protocol does not necessarily limit the extent of the modeling that will be required to demonstrate compliance with the applicable standards. A general outline for a complete modeling protocol is

available in Appendix C. The outline identifies the suggested format and content of the submission.

2. Modeling Analysis

2.1 Types of Sources
Detailed guidance for modeling different types of sources using AERMOD is contained in the *User's Guide for the AMS/EPA Regulatory Model (AERMOD)* (EPA-454/B-16-011, 12/2016) and the *AERMOD Model Formulation and Evaluation* document (EPA-454/R-17-001, 5/2017) which can be accessed on the EPA SCRAM web site at:

- https://www3.epa.gov/ttn/scram/models/aermod/aermod_userguide.pdf
- https://www3.epa.gov/ttn/scram/models/aermod/aermod_mfed.pdf

2.1.1 Point Source
Point sources are the most common type of source to be modeled. Emissions from these sources are released to the atmosphere through well-defined stacks, chimneys, or vents. Point sources are usually buoyant and have an upward velocity. The following source parameters are needed to model point sources: emission rate, stack height, diameter, velocity or flow rate, and temperature. Other parameters relating to nearby structures (height, width, length, and location with respect to the stack) are also needed to include effects from building downwash.

If a value of 0 is entered for stack temperature, AERMOD will adjust the stack temperature to the ambient temperature. The stack temperature may also be set at a fixed amount above ambient by entering a negative stack temperature. To model plumes with temperatures below the ambient temperature a dense gas model should be used.

2.1.1.1 Capped and Horizontal Stacks
Select the appropriate POINTCAP or POINTHOR source type (See the *User's Guide for the AMS/EPA Regulatory Model (AERMOD)* Section 3.2.2.3) and input the normal point source parameters as if it was a non-capped or vertical point source.

2.1.2 Area Source
Area sources are used to model emissions from low level or ground level releases with no plume rise (e.g., storage piles, slag dumps, lagoons, and external floating roof storage vessels). Area sources may be used to specify a rectangular-shaped area with arbitrary orientation, an irregularly-shaped polygon of up to 20 sides, or a circular-shaped area source (modeled as an equal-area polygon of up to 20 sides). The following source parameters are needed to model area sources: area emission rate, release height above ground, length of sides, orientation angle, and initial vertical dimension. Area sources use an emission rate per unit area instead of total emissions. The total emissions are divided by the total area in square meters.

Caution: A 10:1 aspect ratio of length to width must be maintained when developing rectangular areas sources. If this ratio is to be exceeded, the area should be subdivided accordingly to achieve the target aspect ratio.

Note: AERMOD has not implemented plume meander for area sources. As a result, concentration predictions for area sources may be overestimated under very light wind conditions (i.e., u << 1.0 m/s). Please refer to the *AERMOD Implementation Guide* (August 3, 2015) for guidance concerning this issue which can be accessed on the EPA SCRAM web site at: https://www3.epa.gov/ttn/scram/models/aermod/aermod_implementation_guide.pdf

FASTAREA option is used to optimize model runtime. FASTAREA incorporates a non-default three tiered approach depending on the location of the receptor relative to the source.

2.1.2.1   Circular Area Sources

AREACIRC is used to represent a circular area source by generating a regular polygon of up to 20 sides. Select the AREACIRC source type and enter the normal area source parameters. The following additional source parameters are needed to model circular area sources: radius, and number of vertices (20 sides is used if omitted).

2.1.2.2   Polygonal Area Sources

AREAPOLY is used to represent an arbitrarily shaped polygon between 3 and 20 sides. Select the AREAPOLY source type and enter the normal area source parameters. AERMOD will not calculate impacts for portions of the area that are closer than 1meter upwind of the receptor. The following additional source parameter is needed to model polygonal area sources: number of vertices. The locations of the vertices of the polygon are entered using the AREAVERT keyword.

2.1.2.3   Open Pits

OPENPIT is used to model particulate emissions from below-grade open pits, such as surface coal mines and rock quarries. The open pit source option uses an effective area source for modeling pit emissions based on meteorological conditions. The AERMOD model accepts rectangular pits with an optional rotation angle specified relative to a north-south orientation. The rotation angle is specified relative to the vertex used to define the source location (e.g., the southwest corner). Open pit sources have no plume rise. The following additional source parameters are needed to model open pit sources: the average release height above base of pit, the volume of the open pit, and the orientation angle in degrees from the north. The escaping fraction of pit emissions are calculated based on area source size relative to wind direction and wind speed and account for variations in emissions due to distribution of particle sizes. Please note the following:

- The release height parameter cannot exceed the effective depth of the pit, which is calculated by the model based on the length, width, and volume of the pit.
- A release height of 0.0 indicates emissions that are released from the base of the pit.
- Unlike the area source, the open pit cannot be subdivided. Characterize irregularly shaped pit areas by a rectangular shape of equal area.

2.1.2.4   Line Sources

LINE and BOUYLINE are a simplified representation of an area source. However, the LINE source type does not utilize a rotation angle. For both the LINE and BOUYLINE type sources a start-point and end-point of the line and the width of the line must be specified. For the

BUOYLINE source, the start and end point definitions are similar to the LINE source. However, since AERMOD can only model a single BOUYLINE source, when modeling multiple lines the LOCATION keyword and parameters should be repeated for each line that comprises the buoyant line source.

The BUOYLINE source also requires the user to enter average values representative of the source as a whole and not for the individual lines that comprise the buoyant line source: average building length, width, height, average line source width, average building separation, and average buoyancy parameter.

2.1.3 Volume Source

The volume source algorithms are used to model releases from a variety of industrial sources, such as building roof monitors, multiple vents, conveyor belts, and roadways. The following parameters are needed to characterize volume sources: emission rate, release height (h_e), and initial horizontal (σ_{Yo}) and vertical dimensions (σ_{Zo}). Volume source algorithms are most applicable to line sources with some initial plume depth, such as roadways, conveyor belts, and rail lines.

The release height is the center of the volume above ground. Determination of the initial horizontal and vertical dimensions (initial sigmas) are based on the geometry and location of the source. The actual height, width, and depth of the release are used to calculate the initial horizontal and vertical dispersion parameters. Guidance for developing the initial sigmas is contained in Table 3-1 of the *User's Guide for the AMS/EPA Regulatory Model (AERMOD)* (EPA-454/B-16-011, 12/2016) and is reproduced below.

The base of the volume source must be square. If the source is not square, model the source as a series of adjacent volume sources. For relatively uniform sources, determine the "Equivalent Square" by taking the square root of the area of the length and width of the volume base.

Table 2.1.3 Summary of Suggested Procedures for Estimating Initial Lateral Dimensions σ_{Yo} and Initial Vertical Dimensions σ_{Zo} for Volume and Line Sources

Type of Source	Procedure for Obtaining Initial Dimension
Initial Lateral Dimension (σ_{Yo})	
Single Volume Source	σ_{Yo} = length of side divided by 4.3
Line Source Represented by Adjacent Volume Sources	σ_{Yo} = length of side divided by 2.15
Line Source Represented by Separated Volume Sources	σ_{Yo} = center to center distance divided by 2.15
Initial Vertical Dimension (σ_{Zo})	
Surface-based Source ($h_e \sim 0$)	σ_{Zo} = vertical dimension of source divided by 2.15
Elevated Source ($h_e > 0$) on or adjacent to a Building	σ_{Zo} = building height divided by 2.15
Elevated Source ($h_e > 0$) not on or adjacent to a building	σ_{Zo} = vertical dimension of source divided by 4.3

2.1.4   Road Emissions

Fugitive dust from road emissions should follow the recommendations of the *Haul Road Workgroup Final Report* which can be accessed on the EPA SCRAM web site at: https://www3.epa.gov/ttn/scram/reports/Haul_Road_Workgroup-Final_Report_Package-20120302.pdf.

2.1.4.1   Road Characterization

The following steps, which are paraphrased from the *Haul Road Workgroup Final Report,* describe characterization of volume sources for modeling road emissions:

Step 1:   Determine the width of the plume. The width of the plume for single lane roadways should be the width of the vehicle plus 6 meters. The width of the plume for heavy two way traffic is the width of the road plus 6 meters. The additional width represents turbulence caused by the vehicles as they move along the road. This width will represent a side of the base of the volume.

Step 2:   Determine the number of volume sources, N. Divide the length of the road by the width of the plume. The result is the maximum number of volume sources that can be used to represent the road.

  • Roadways can be represented by alternating volume sources by dividing the roadway by twice the adjusted width. This representation is often used for long roads.

Step 3:   Determine the height of the plume. The height will be equal to 1.7 times the height of the vehicle generating the emissions; rounded to the nearest tenth of a meter.

Step 4:   Determine the initial horizontal (σ_{Yo}) and vertical (σ_{Zo}) sigmas for each volume source using Table 2.1.3-1.

Step 5:   Determine the release height. Divide the height of the plume by two. This point is in the center of the volume source.

Step 6:   Determine the emission rate for each volume source. Divide the total emission rate equally among the individual volumes used to represent the road, unless there is a known spatial variation in emissions.

Step 7:   Determine the Universal Transverse Mercator (UTM) coordinate for the release points. The release point location is the center of the base of the volume source. This location must be at least 2.15 x the horizontal sigma (σ_{Yo}) plus 1 meter from the nearest receptor. This is known as the exclusion zone.

2.1.7   Flares

Flares are handled similarly to point sources; however, the heat release is used to calculate plume rise and effective stack diameter. For screening purposes, the flare option in AERSCREEN is acceptable. A flare option is not available in AERMOD. Therefore, in refined modeling, it is necessary to compute equivalent emission parameters to account for the buoyancy of the plume. There are several assumptions made in the AERSCREEN flare option, which form the basis of the equivalent parameter approach. The following parameters are assumed in AERSCREEN:

  • An ambient temperature of 293 K;
  • 55% of the heat lost due to radiation;
  • a plume rise calculated from the top of the flame, assuming that the flame is bent 45 degrees from the vertical;

- an effective stack exit velocity of 20 meters per second; and
- an effective stack exit temperature of 1,273 K.

The stack height and inside diameter are adjusted to account for the flame height and the buoyancy of the plume by the following equations:

$$H_{equiv} = H_{actual} + 0.00128 Q_c^{0.478}$$ (Eq. 1)

$$D_{equiv} = 1.752 x 10^{-4} \sqrt{Q_c}$$ (Eq. 2)

Where:

H_{equiv}	= equivalent height of the flare, m
H_{actual}	= actual height of the stack from the ground, m
Q_c	= flared gas heat release, Btu/hr
D_{equiv}	= equivalent diameter of the flare, m

The derivation for the equations is available in Appendix B. The selection of effective stack parameters could influence the building downwash estimates. Therefore, if building downwash is of concern then more realistic stack parameters should be evaluated. For this circumstance, please seek individual guidance from AQD.

2.1.8 Open Doors
Open doors may be modeled as horizontal point sources with a stack height of two thirds (⅔) the total height of the opening. The stack height may be adjusted based on the release height within the building. Please seek specific guidance from the AQD.

2.1.9 Storage Vessels
Storage vessels with external floating roofs may be modeled as circular area sources. Fixed roof storage vessels with or without internal floating roofs are usually equipped with an external vent which should be modeled as a point source or pseudo-point source with an exit velocity equal to 0.001 m/s.

2.2 General Modeling Information
Modeling design values for comparison to the NAAQS should be based on the form of the standard indicated below.

Table 2.2 Modeling Design Values for Comparison to the NAAQS

Pollutant	Averaging Period	Basis Of Design Value
NO_2	1-hour	5 Year Average of 98th Percentile[1] 1-Hour Daily Maximum
NO_2	Annual	Annual Average
$PM_{2.5}$	24-hour	5 Year Average of 98th Percentile[1] 24-Hour Average
$PM_{2.5}$	Annual	5 Year Average of the Weighted Annual Averages
SO_2	1-hour	5 Year Average of 99th Percentile[2] 1-Hour Daily Maximum
SO_2	3-hour	Highest Second Highest (H2H)
CO	1-hour	Highest Second Highest (H2H)

Table 2.2 Modeling Design Values for Comparison to the NAAQS

Pollutant	Averaging Period	Basis Of Design Value
CO	8-hour	Highest Second Highest (H2H)
PM$_{10}$	24-hour	5 Year Average Highest Sixth Highest Value (H6H)

[1] - Based on the modeled highest eighth high (H8H).

[2] - Based on the modeled highest fourth high (H4H).

When converting from ppb to µg/m^3 utilize the following:

$$\frac{\mu g}{m^3} = ppb \times MW \div 24.466$$

Where:

      MW is the molecular weight of the pollutant; and

      24.466 is the volume of an ideal gas at EPA Reference conditions (25 °C & 760 mmHg).

      Note: To convert ppm to ppb multiply by 1,000.

2.2.1   Emission Rates

The maximum short-term emission rate should be used to demonstrate compliance with all short term averaging rates. Model emission input data for point sources to demonstrate compliance with the NAAQS and PSD Increments has been defined by EPA in 40 CFR Part 51, Appendix W, Table 8-2 and is reproduced in Appendix A of this document.

Note: For equipment that may run under a variety of conditions that affect emission rates and dispersion modeling estimates, a series of screening analyses should be run to determine the worst-case impact. For example, turbines should be evaluated at varying loads (e.g., 50%, 75%, & 100%) and temperatures to determine the worst-case scenarios.

2.2.2   Terrain

Terrain data should be included in all modeling analyses. Terrain data is available from the United States Geological Survey (USGS) as National Elevation Dataset (NED) data. The 1/3-Arc Sec NED data is the preferred source for elevation data. NED data can be obtained from the USGS TNM Download web page at http://viewer.nationalmap.gov/basic/. Be sure to modify the file format of the NED to GeoTIFF format for use in AERMAP. This terrain data can also be obtained from the DEQ but the average file size is approximately 6 MB and generally cannot be e-mailed. Use of Digital Elevation Model (DEM) data is allowed for screening modeling.

Interpolation of receptor and source heights from the elevation data should be based on the current guidance contained in Section 4.4 of the *User's Guide for the AERMOD Terrain Preprocessor (AERMAP)* (EPA-454/B-16-012, 12/2016) which can be accessed on the EPA SCRAM web site at: https://www3.epa.gov/ttn/scram/models/aermod/aermap/aermap_userguide_v11105.pdf.

Oklahoma has three UTM zones (zones 13 (OK Panhandle), 14 (Western, OK), and 15 (Eastern, OK)). If the modeling domain crosses a UTM zone, source and receptor coordinates have to be translated to a common zone. The datum (e.g., North American Datum (NAD) 1927 (NAD27), NAD83, World Geodetic System (WGS) 1984 (WGS84)) on which source coordinates and

elevation data are based on must be reported in the application. Corpscon, developed by the Army Corps of Engineers, is a conversion program which can translate data to a common zone and can also convert from one datum to another. The program may be obtained from the Army Corp of Engineers web site at: http://www.agc.army.mil/Missions/Corpscon/.

2.2.3   Met Data

AQD is now requiring use of 2011-2015 Oklahoma Mesonet data as on-site data with National Centers for Environmental Information (NCEI) formerly the National Climatic Data Center (NCDC) Integrated Surface Hourly (ISH) data, and ESRL UA data, with all refined air dispersion modeling. AQD is incorporating use of the Oklahoma Mesonet data to help prevent adverse environmental impacts and to promote the use of good science by use of more recent, accurate, and representative data. Oklahoma Mesonet data was provided to the AQD courtesy of the Oklahoma Mesonet, a cooperative venture between Oklahoma State University (OSU) and the University of Oklahoma (OU) and supported by the taxpayers of Oklahoma. The Oklahoma Mesonet is a world-class network of meteorological monitoring stations.   The Oklahoma Mesonet is unique in its capability to measure a large variety of meteorological conditions at so many sites across an area as large as Oklahoma. At each site, these variables are continuously measured and packaged into 5-minute observations.   These 5-minute observations were processed by the AQD into a format that could be processed by AERMET. No missing data interpolation was performed for the 5-minute datasets.

The National Weather Service (NWS) operates 53 automated weather stations (16 ASOS and 38 AWOS) in Oklahoma and 30 automated weather stations (14 ASOS and 16 AWOS) in states contiguous to Oklahoma which are close enough to be potentially useful in air dispersion modeling in Oklahoma. The NWS ISH data only provides a single atmospheric measurement for each hour. The Oklahoma Mesonet consists of 120 stations with at least one station in each of Oklahoma's 77 counties and measures the variables every minute and then generates a data record of the five minute average which provides more frequent and representative local data. Data from the Oklahoma Mesonet will help make more accurate forecasts of ambient impacts from stationary sources located in Oklahoma.

In 2005, 1-minute and 5-minute data became available for all ASOS stations. The ability to incorporate these datasets in AERMET was finalized in 2014. Since the ability to incorporate more accurate wind speed data has become widely available, use of ASOS data including 1-minute and 5-minute data without Mesonet data is acceptable if the ASOS station is closer to the applicable facility than the closest Mesonet station. An Excel workbook (*Distance to Mesonet Sites.xlsx*) developed by the AQD is available upon request to determine the closest meteorological station to a particular facility.

The AQD provides preprocessed meteorological data to applicants. If meteorological data was provided and the AQD moves to a more recent dataset, an applicant can utilize the dataset previously provided as long as the modeling is submitted within three months of the AQD moving to the newer dataset. The AQD moves to a newer dataset every five years (i.e., 2011, 2016, 2021, etc.). However, the AQD reserves the right to require an applicant to utilize a revised dataset if errors are found in the dataset provided or if a revised version of AERMET is released that will significantly affect the modeling.

2.2.3.1 Mesoscale Model Interface Program (MMIF) Meteorological Data

Use of MMIF to process prognostic mesoscale meteorological model data such as Weather Research and Forecasting (WRF) meteorological data is significantly limited to case-by-case determinations. If meteorological data that was generated by the Office of Air Quality Planning and Standards (OAQPS) using MMIF is not used, a protocol for generating AERMOD ready meteorological data using MMIF must be submitted and approved by AQD prior to use in any modeling analysis. Meteorological data generated by OAQPS using MMIF and 2013 through 2015 WRF data can only be used if deemed adequately representative. A justification for use of the preprocessed OAQPS MMIF 2013-2015 WRF meteorological data must be submitted for review prior to use in any modeling analysis. The justification should include a statistical comparison of observations from local meteorological datasets.

Initial review of the OAQPS MMIF 2013-2015 WRF meteorological data indicates the following:

- Impacts based on long averaging periods (Annual, 5-year Average of 98th percentile) were within 10% of the design concentration of other meteorological data.
- Impacts for shorter averaging periods (24-hour, 8-hour, 1-hour) were significantly different from the design concentrations of other meteorological data.
- The location of maximum impacts predicted using the MIFF data did not correspond with the location of the maximum impacts predicted with other meteorological data.
- AERMINUTE and the use of sub-hourly ASOS data was to increase the accuracy of the available ISH datasets. However, the wind speeds of the OAQPS MMIF dataset are statistically more similar to the ISH data without AERMINUTE sub-hourly data.
- The OAQPS MMIF data represents synoptic scale meteorology and not local scale variations in wind flow patterns and dispersion dependent meteorology (cloud cover or CCVR).
  - CCVR is an important meteorological data for AERMOD and is used in determining the stability of the atmosphere and the related dispersion coefficients and the OAQPS MMIF data CCVR values were not statistically representative of local conditions.
- Surface characteristics (surface roughness length, albedo, and Bowen ratio) are not adequately defined for the OAQPS MMIF meteorological dataset.
  - Surface roughness length was based on seasonal data.
  - Albedo based on annual average numbers.
  - For the Bowen ratio moisture was based on average conditions for a specific season.

Overall, the OAQPS MIFF data does not seem to adequately characterize the localized transport and dispersion characteristics.

2.2.4 GEP Stack Height

Good Engineering Practice (GEP) stack height is the minimum stack height needed to prevent the stack exhaust plume from being entrained in the cavity or wake of nearby buildings or structures. If a proposed stack is below the GEP height, then the plume entrainment must be taken into account by modifying certain dispersion parameters used in air dispersion models. However, if the stack height equals or exceeds the calculated GEP stack height, then the stack

height shall be modeled at the GEP stack height. The GEP stack height limitation set forth in OAC 252:100-8-1.5 applies in all cases, except for SIP modeling.

GEP stack height defines excessive concentrations as the maximum ground-level pollutant concentration from a stack due in whole or part to downwash, wakes, and eddy effects produced by nearby structures or terrain features which is at least 40% in excess of the maximum concentration experienced in the absence of downwash, wakes, and eddy effects, the potential air quality impacts associated with downwash, wakes, and eddy effects should also be considered for stacks that equal or exceed the GEP stack height.

2.2.5 Building Downwash

When one or more structures interrupt the wind flow, an area of turbulence called building downwash is created. Pollutants emitted from a fairly low level (e.g., a roof, vent, or short stack) can be caught in this turbulence, affecting the dispersion. Modeling that includes calculations for building downwash gives a more accurate representation of pollutant impact than does modeling that omits consideration of downwash affects.

A building is any physical obstruction to airflow at the modeled facility. A structure is a building or group of buildings determined to be important in downwash considerations. The dominant downwash structure is the structure that renders the highest GEP recommended stack height. GEP stack height is calculated according to the following equation.

$$Hg = h + 1.5L$$

where: Hg = good engineering practice stack height, measured from the ground-level elevation at the base of the stack,

    h = height of nearby structure(s) measured from the ground-level elevation at the base of the stack

    L = lesser dimension (height or projected width) of nearby structure(s).

A structure or terrain feature shall be considered nearby if it is located within a distance of up to five times the lesser of the height or the width of a structure, but not more than 0.5 miles (0.8 km)

2.2.6 Rural/Urban Classification

Dispersing plumes encounter more turbulence in urban areas than in rural areas, due to building wakes as well as the somewhat warmer temperatures in urban areas. For any given set of meteorological conditions, the urban plume dispersion coefficients should be larger than the rural plume dispersion coefficients. The higher coefficients cause an urban plume to spread more rapidly than a rural plume, and hence the maximum ground-level concentration of an urban plume occurs closer to the emission source than it does for a rural plume. (Beychok 1994)

All models allow for the selection of urban or rural dispersion coefficients. Determination of the applicability of urban or rural dispersion is based on land use or population density. The land use method is preferred.

2.2.6.1   Land Use

Circumscribe a 3 km radius circle about the source. If Auer land use types I1, I2, C1, R2, and R3 account for 50 percent or more of the area, select the urban option. Otherwise, use the rural option.

<p align="center">Table 2.2.6.1 Auer Land Use Categories I1, I2, C1, & R2 (Auer 1978)</p>

Type	Use and Structure	Vegetation
I1	**Heavy Industrial**	Grass and tree growth extremely rare; <5% vegetation
	Major chemical, steel and fabrication industries; generally 3-5 story buildings, flat roofs	
I2	**Light-moderate industrial**	Very limited grass, trees almost totally absent; <5% vegetation
	Rail yards, truck depots, warehouses, industrial parks, minor fabrications; generally 1-3 story buildings, flat roofs	
C1	**Commercial**	Limited grass and trees; <15% vegetation
	Office and apartment buildings, hotels;>10 story heights, flat roofs	
R2	**Compact Residential**	Limited lawn sizes and shade trees; <30% vegetation
	Single, some multiple, family dwelling with close spacing; generally <2 story, pitched roof structures; garages (via alley), no driveways	

2.2.6.2   Population Density

Compute the average population density per square km within the area as defined above. If the density is greater than 750 people/km use the urban option. Otherwise, use the rural option.

2.2.6.3   Tall Stacks Near Small Urban Areas

For relatively tall stacks located within or adjacent to small or moderate sized urban areas, the stack height or effective plume height may extend above the urban boundary layer and, therefore, may be more appropriately modeled using rural coefficients. The urban boundary layer (Z_{iuc}) can be calculated using the formula:

$$Z_{iuc} \text{ (m)} = 400*(P/2E6)^{1/4}$$

Where:

       P is the population of the urban area (million people);
       400 is the reference height (m); and
       2E6 is the reference population (million people).

2.2.7   Background Monitoring

Background concentrations must be added to NAAQS analyses. If the modeled impacts from the facility are less than the monitoring de minims levels, ambient monitoring data from the appropriate monitoring sites should be obtained and used by the applicant. Monitoring data should be obtained from the EPA air data web site: https://www3.epa.gov/airdata/index.html. Concurrence of the AQD should be obtained on the appropriate monitor location and concentrations. If a monitoring de minimis level is exceeded, the applicant should provide justification for use of existing monitoring based on the guidance provided in the *Ambient*

Monitoring Guidelines for Prevention of Significant Deterioration (PSD) (EPA-450/4-87-007, 5/1987) which is available on the EPA web site at: https://www.epa.gov/nsr/new-source-review-policy-and-guidance-document-index. If the facility is unable to meet the guidelines provided, pre-construction ambient monitoring to determine the background concentrations may be required depending on the size and location of the area where the de minimis level is exceeded. Post construction ambient monitoring may also be required or used to demonstrate compliance with the NAAQS.

Background concentrations should be based on the most recent complete year(s) of available monitoring data and based on the form of the standard as indicated below. Only data meeting the minimum data collection requirements or the minimum percent observations should be used when determining the design value.

Table 2.2.7 Monitoring Data Design Values

Pollutant	Averaging Period	Basis of Design Value
NO_2	1-hour	3 Year Average of 98th Percentile[1] 1-Hour Daily Maximum
NO_2	Annual	Annual Average
$PM_{2.5}$	24-hour	3 Year Average of 98th Percentile[1] 24-Hour Average
$PM_{2.5}$	Annual	3 Year Average of the Weighted Annual Averages
SO_2	1-hour	3 Year Average of 99th Percentile[1] 1-Hour Daily Maximum
SO_2	3-hour	Highest Second Highest (H2H)
CO	1-hour	Highest Second Highest (H2H)
CO	8-hour	Highest Second Highest (H2H)
PM_{10}	24-hour	Highest Fourth Highest Value In 3 Years (H4H)

[1] - Determined in accordance with Appendix N, S, or T of 40 CFR Part 50, as applicable.

2.3   Screening Analyses
There are two types of screening analyses: screening modeling and screening techniques. Screening models use default meteorology or other generalized data. Screening techniques use simplified and theoretically conservative assumptions with a refined model to provide less conservative results. Screening analyses are used to reduce the time and effort needed to model impacts from a source or facility. Screening analyses using refined models can be used to demonstrate that a facility or modification has impacts below the significant impact levels or levels and does not require a comprehensive refined analysis.

2.3.1   Terrain
DEM data can be used for screening analyses using AERSCREEN. Terrain data should be included in all screening analyses.

2.3.2   Met Data
When conducting screening modeling using AERMOD, the most recent (i.e., 2011-2015) ISH data from the NCDC and UA data from the ESRL may be used without incorporating data from the Oklahoma Mesonet. However, incorporation of Oklahoma Mesonet data or ASOS 1-min/5-min data will be required for all refined modeling. For screening modeling which utilizes meteorological data not provided by the AQD, electronic copies of the meteorological data should be provided with the modeling submittal. A screening analysis may be approved using a

single year of met data on a case-by-case basis. The AQD reserves the right to require updated meteorological data to be used if errors are found with the meteorological data used or if revisions to AERMET significantly affect the modeling results.

2.3.3   Building Downwash
For a single rectangular building AERSCREEN calculates the maximum projected width as the greatest crosswind distance between two points in a building or structure. For a site with either complex structures or multiple downwash structures, the Building Parameter Input Program Plume Rise Model Enhancements (BPIP-PRIME) program should be run and used in conjunction with AERSCREEN. Individual sources and structures such as tanks should be input as buildings.

2.3.4   Surface Characteristics
When using AERSCREEN, the surface characteristics (albedo, Bowen ratio, and surface roughness length) for the site being modeled should be determined using the AERSURFACE tool version 13016. The guidelines in the *AERSURFACE User's Guide* (EPA-454/B-08-001, 1/2008, Revised 1/2013) which can be accessed on the EPA SCRAM web site at: https://www3.epa.gov/ttn/scram/7thconf/aermod/aersurface_userguide.pdf should be followed when using the AERSURFACE tool. Average surface moisture conditions can be utilized when generating surface characteristics for AERSCREEN.

2.3.5   Receptors/Grids
The receptor grid shall extend from the closest distance from the source to the fence line out at least two km for all screening analyses.

2.4   Refined Analyses

2.4.1   Terrain
All refined modeling analyses should utilize NED elevation data. When extracting NED data, the area extracted should extend 5-10 km beyond the domain to accurately determine the hill height values. All modeling submittals should contain electronic copies of all applicable AERMAP associated files. The files submitted should contain the input and output files for each AERMAP run. If AERMAP was run separately for receptors, nearby sources, or buildings, electronic copies of each of the input/output files associated with these runs should be provided with the modeling analysis.

2.4.2   Met Data
The AQD provides AERMOD ready preprocessed meteorological data. The meteorological set should generally be associated with the closest Mesonet or ASOS site with 1-min/5-min data to the facility being modeled. The AQD reserves the right to require updated meteorological data for refined modeling if material mistakes are found within the meteorological data provided or if revisions of AERMET are issued that significantly affect the meteorological data processed.

2.4.3   Building Downwash
BPIP-PRIME should be used with AERMOD in all refined modeling analyses. Electronic copies of the input and output files should be included with the modeling submittal.

2.4.4 Nearby Sources

Upon request the AQD provides preprocessed nearby source data for sources within 20 km of a specified point. For a specific modeling analysis, the nearby source data review should include data for sources located 20 km from the center of the facility. All sources and emissions provided to the applicant, as a result of a nearby source review by the AQD, should be included in the cumulative modeling analyses. Existing nearby sources are required to be included in PSD and NSR NAAQS and PSD Increments analyses. The AQD screens all nearby sources and eliminates those sources which do not have a significant concentration gradient within the expected modeling domain.

The nearby source data provided by the AQD includes stack parameters as reported annually in emission inventories and potential emissions. If required, actual emissions for use in a more refined PSD Increments consumption modeling can also be provided. For large inventories, the AQD may request that the applicant provide some assistance in obtaining potential and actual emissions for some of the sources to be modeled. This may require the applicant to review permits and permit applications of the sources. Permits usually are available from the AQD in electronic format. The applicant should submit with the application a final list of sources included in the modeling analyses.

All refined cumulative modeling analyses should establish source groups for each company/facility represented in the nearby source list provided by the AQD. Modeling should also establish a source group which contains all of the nearby sources. For those modeling domains where the nearby source list provided by the AQD contains more than 10 facilities, the AQD should be consulted to determine which facilities are required to have a specific source group established which may be pollutant specific.

2.4.5 GEP Stack Height

The GEP stack height limitation of OAC 252:100-8-1.5 applies in all cases, except for SIP modeling. BPIP-PRIME should be used with AERMOD.

2.4.6 Receptor Grids

100 meter spacing is usually sufficient for most purposes except preliminary coarse-grid modeling. While Cartesian Grids are preferred, polar grids will be acceptable so long as the receptor distances do not exceed grid spacing requirements. Before a final receptor grid formation may be established, concentrations modeled on an initial coarse grid should be evaluated. Areas of maximum concentration should be established and a fine grid (100 meter spacing) should be used uniformly throughout those areas and extending to 500 meters beyond the area(s) of maximum concentration. It is the applicant's responsibility to demonstrate that the grid is sufficiently compact to identify the maximum concentration for each averaging period.

The receptor grid used should extend far enough to determine the maximum impact from all of the sources at the facility. The receptor grid for each modeling analysis is different due to the local terrain, meteorology, and source makeup. The draft *New Source Review Workshop Manual Prevention of Significant Deterioration and Nonattainment Area Permitting* (EPA, 10/1990) indicates that in general a grid extending out to 10 km will be "adequate to identify areas of

maximum concentration. However, the total number of receptors will vary based on the specific air quality analysis performed." AQD has developed a generalized acceptable grid spacing:

- ➢ 100 m out to 1 km,
- ➢ 250 m out to 2.5 km,
- ➢ 500 m out to 5 km,
- ➢ 750 m out to 7.5 km, and
- ➢ 1 km out to 10 km from the facility.

Appendix W to 40 CFR Part 51 indicates that maximum impacts occur on calm days as the plumes encounter hills at or near the same height as the stacks. Terrain surrounding a facility should be evaluated to determine if there are hills in the area and if the receptor grid should be extended to include them. The domain for the receptor grid should follow the guidance in Section 2.2.1 of *User's Guide for the AERMOD Terrain Preprocessor (AERMAP)* (EPA-454/B-16-012, 12/2016).

As indicated in the March 1, 2011, clarification memo *Additional Clarification Regarding Applicability of Appendix W Guidance for the 1-hour NO₂ NAAQS*,

> "While not common practice in the past, given the more complex analysis procedures associated with the form of the 1-hour NO_2 NAAQS, we deem it appropriate and acceptable in most cases to limit the cumulative impact analysis to only those receptors that have been shown to have significant impacts from a proposed new source based on the initial SIL analysis, assuming that the design of the original receptor grid was adequate to determine all areas of ambient air where the source could contribute significantly to modeled violations."

For cause and contribute analyses, AQD will allow removal of receptors outside the radius of impact when modeling compliance with the new 1-hour NO_2 and SO_2 NAAQS. However, AQD still requires NAAQS and PSD Increments modeling to include receptors outside the radius of impact (ROI) for all pollutants and averaging times. Since NAAQS and PSD Increments analyses include sources which were not included in the SIL analyses, modeling using a receptor grid which only includes those receptors at which a significant impact occurs may not ensure that the maximum impact from the "facility" and from other nearby sources is determined. If the NAAQS or PSD Increments are exceeded, then the facility can conduct cause or contribute analyses to demonstrate that the modification does not have a significant impact at those receptors and a permit may be issued. If there is a "potential" exceedance of a standard in a particular area, whether it is due to the facility or not, AQD can use the modeling to determine the potential causes of the "potential" exceedance and can take measures to mitigate or alleviate those issues.

2.4.7 Additional Modeling Guidance

For compliance with the recently promulgated 1-hour standards for NO_2 and SO_2 and the 24-hour $PM_{2.5}$ standard, the applicant should follow the current EPA guidance indicated in the following documents which are available on the EPA SCRAM web site:

- *Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and PM$_{2.5}$ under the PSD Permitting Program* (December 2, 2016);
  - https://www3.epa.gov/ttn/scram/guidance/guide/EPA-454_R-16-006.pdf
- *Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program* (August 1, 2016);
  - https://www.epa.gov/sites/production/files/2016-12/documents/draft-ozone-pm25-sils-guidance.pdf
- *Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO2 National Ambient Air Quality Standard* (September 30, 2014);
  - https://www3.epa.gov/ttn/scram/guidance/clarification/NO2_Clarification_Memo-20140930.pdf
- *Guidance for PM$_{2.5}$ Permit Modeling* (EPA-454/B-14-001, May 2014);
  - https://www3.epa.gov/ttn/scram/guidance/guide/Guidance_for_PM25_Permit_Modeling.pdf
- *Additional Clarification Regarding Applicability of Appendix W Modeling Guidance for the 1-hour NO$_2$ NAAQS* (March 1, 2011);
  - https://www3.epa.gov/ttn/scram/guidance/clarification/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf
- *Guidance Concerning the Implementation of the 1-hour SO$_2$ NAAQS for the Prevention of Significant Deterioration Program* (August 23, 2010);
  - https://www.epa.gov/sites/production/files/2015-07/documents/appwso2.pdf
- *Applicability of Appendix W Modeling Guidance for the 1-hour SO$_2$ NAAQS* (August 23, 2010);
  - https://www3.epa.gov/ttn/scram/guidance/clarification/ClarificationMemo_AppendixW_Hourly-SO2-NAAQS_FINAL_08-23-2010.pdf
- *Guidance Concerning the Implementation of the 1-hour NO$_2$ NAAQS for the Prevention of Significant Deterioration Program* (June 29, 2010); and
  - https://www.epa.gov/sites/production/files/2015-07/documents/appwno2_2.pdf
- *Applicability of Appendix W Modeling Guidance for the 1-hour NO$_2$ NAAQS* (June 28, 2010).
  - https://www3.epa.gov/ttn/scram/guidance/clarification/ClarificationMemo_AppendixW_Hourly-NO2-NAAQS_FINAL_06-28-2010.pdf

2.4.7.1   NO$_2$ Modeling Guidance

Section 4.2.3.4 of Appendix W, 40 CFR Part 51, implements a tiered screening approach to obtain estimates of NO$_2$ impacts from point sources for PSD and NSR analyses. Use of Tier I (conversion of all NO$_X$ to NO$_2$) and Tier II (Use of the Ambient Ratio Method 2 (ARM2)) of this multi-tiered approach are approved by AQD for all NO$_2$ modeling. For the Tier II analysis, the minimum ambient ratio (conversion factor) of 0.5 and the maximum ambient ratio of 0.9 should be used. Alternative in-stack minimum ambient ratios may be used upon approval of the AQD. Use of a Tier III analysis by an applicant should be approved by AQD prior to modeling submittal and requires submittal of an official protocol to EPA for approval. When Tier III modeling is used to comply with the 1-hour NAAQS, the following in-stack ratios for nearby sources can be used. Sources that are not specifically listed should use the default value of 0.2.

Table 2.4.7.1 Nearby Source In-Stack NO_2/NO_X Ratios

Source Type	Ratio
2SLB Engines	0.20
4SLB Engines With Oxidation Catalyst	0.35
4SLB Engines Without Oxidation Catalyst	0.10
4SRB Engines	0.05
Turbines With Selective Catalytic Reduction	0.20
Turbines Without Selective Catalytic Reduction	0.10
Turbines With Water Injection	0.35
Heaters/Boilers	0.10

2SLB - 2 Stroke Lean Burn; 4SLB - 4 Stroke Lean Burn; 4SRB - 4 Stroke
Rich Burn

The EPA default value for project related sources is 0.5. However, AQD will approve other in-stack ratios for project related sources on a case-by-case basis. Testing to demonstrate compliance with the in-stack ratio used will be incorporated into the permit. For Tier III analyses, the ambient equilibrium conversion ratio default value of 0.9 should be used.

2.4.7.2 $PM_{2.5}/PM_{10}$ Modeling Guidance

The determination of PM_{10} design values is briefly discussed in Appendix W, 40 CFR Part 51 and is explained in the *PM_{10} SIP Development Guideline* (EPA-450/2-86-001, 1986). Impacts for the 24-hour PM_{10} NAAQS are based on the highest sixth high (H6H) 24-hour average concentration over a 5-year period at any receptor. The MULTYEAR keyword in the Control pathway in the AERMOD model can be used to obtain the H6H concentration in 5 years. Modeling for the PM_{10} annual NAAQS is no longer required since it has been vacated. However, modeling for compliance with the PM_{10} 24-hr and Annual PSD Increments are required.

Secondary formation of $PM_{2.5}$ must be addressed for those PSD applications where emissions of SO_2 and/or NO_2 exceed the Significant Emission Rate (SER). The MERP guidance in Section 2.4.7 concerning secondary formation of $PM_{2.5}$ should be followed. The MERP guidance provides a Tier I single source screening tool to determine the impacts of $PM_{2.5}$ precursors on secondary formation of $PM_{2.5}$. These impacts along with the impacts from direct emissions of $PM_{2.5}$ modeled using AERMOD can be used to determine compliance with the NAAQS.

2.4.7.3 SO_2 Modeling Guidance

Modeling for the 24-hour standard and annual NAAQS is not required since they were vacated. However, modeling for compliance with the SO_2 3-hr NAAQS, and 3-hr, 24-hr, and Annual PSD Increments are required in addition to the 2010 SO_2 1-hr NAAQS.

2.4.7.4   Ozone (O_3) Modeling Guidance

The MERP guidance in Section 2.4.7 concerning ozone formation should be followed. The MERP guidance provides a Tier I single source screening tool to determine the impacts of O_3 precursors on formation of O_3.

2.4.7.5 Deposition

The *User's Guide For The AMS/EPA Regulatory Model (AERMOD)* (EPA-454/B-16-011, 12/2016) which can be accessed on the EPA SCRAM web site at: https://www3.epa.gov/ttn/scram/models/aermod/aermod_userguide.pdf explains the deposition algorithms and specifies the source parameters for use of deposition. Additional guidance concerning deposition can be found in the following documents:

- *AERMOD Deposition Science Document* (August 21, 2014);
  - https://www3.epa.gov/ttn/scram/7thconf/aermod/aer_scid.pdf
- *AERMOD Deposition Parameterizations Document*;
  - https://www3.epa.gov/ttn/scram/7thconf/aermod/driscdep.zip

All additional data used for an air dispersion analysis that incorporates deposition should be provided to and approved by AQD. The wet deposition option should not be used for regulatory modeling analysis. Wet deposition is not a guideline feature of AERMOD. Per EPA guidance, dry gas deposition is not usually required for PM_{10} evaluations because of negligible settling velocities. However, AQD reserves the right to request a dry deposition evaluation for any PM emissions, but more specifically for TAC.

3. State Required Modeling

3.1 TAC Modeling

The AQD as part of the compliance strategy for an AOC may require owners or operators of applicable stationary sources within an AOC to perform ambient air modeling for the TAC of concern to demonstrate compliance with the applicable MAAC established per OAC 252:100-42. All applications of air quality modeling shall be based on the applicable models, databases, and other requirements specified in Appendix W of 40 CFR Part 51. Modification or substitution of approved models will be considered on a case-by-case basis. Owners or operators of facilities located in an AOC shall not be required to demonstrate compliance with the TAC MAAC within the boundaries of their facilities.

3.2 H$_2$S Modeling

OAC 252:100 Subchapter 31 controls emissions of sulfur compounds from stationary sources. Emissions of H_2S from any facility per OAC 252:100-31-7(b) shall not result in a 24-hour average ambient air concentration of greater than 0.2 ppmv.

Facilities with emissions of H_2S are required to demonstrate compliance with the ambient standards using EPA approved atmospheric dispersion models. Facilities must demonstrate compliance with the ambient air standard taking into account emissions from all the sources at the facility. Per OAC 252:100-31-7(c), the ambient standards do not apply to ambient air concentrations or impacts occurring on the property from which such emission occurs, providing such property, from the emission point to the point of any such concentration, is controlled by the person responsible for such emission.

Modeling conduced for the General Permit for Oil and Natural Gas Facilities (GP-OGF) can be used to demonstrate compliance with the H_2S ambient standard.

3.3   TV (Major Source/Modification) Modeling
Criteria pollutant modeling to demonstrate compliance with the NAAQS and PSD Increments is required of any new major source or modification to an existing major source with a net increase of 100 TPY of a single criteria pollutant. NAAQS modeling (including Tier I analyses for secondary formation of $PM_{2.5}$ and Ozone; Section 2.4.7) should be conducted by evaluating the total source impact with an appropriate monitored background concentration added. Concurrence from the AQD should be obtained on which monitor will provide adequate background concentrations. PSD Increments modeling should be conducted by evaluating the total source impact of PSD Increment consuming sources at the facility. Temporary sources of emissions are not required to be included in the modeling analyses as long as they do not impact a Class I area or an area where an applicable PSD Increment is known to be violated.

Note: If modeling demonstrates that the source will exceed the PSD monitoring thresholds, post-construction monitoring though not specifically required under the Title V/Part 70 regulations may be required under the general authorizations of the DEQ. This decision will be made on a case-by-case basis and will depend on the extent of the impact area as well as the extent to which the NAAQS or PSD Increments are threatened by the source.

4.   PSD Modeling
A checklist for PSD modeling submittals is available in Appendix D.

4.1   Significant Impact Level (SIL) Analysis
A SIL analysis is the first level of modeling performed in a PSD evaluation. For each applicable pollutant, the analysis must include all stack emissions and quantifiable fugitive emissions resulting from the proposed source or modification.   For a proposed modification, the determination includes contemporaneous emission increases and decreases, with emission decreases input as negative emissions in the model. When modeling negative emissions for NO_2, the guidance from EPA concerning overestimation of the impacts of emission decreases and use of the PSDCREDIT option in AERMOD should be followed. The EPA allows for the exclusion of temporary emissions such as those associated with construction. The applicant is required to compare results to the SIL as defined in 40 CFR Part 51.165(b)(2) or interim SIL. If the highest modeled concentration over five years of meteorological data or the Highest First High (H1H) is less than or equal to the SIL, then the demonstration is complete. Per EPA guidance, the source is not considered to cause or contribute to an exceedance of the NAAQS or consume PSD Increment if the modeled impact is at or below the SIL. If the highest modeled concentration is greater than the SIL, the applicant is required to perform additional refined modeling or reduce the impact to below the SIL. If the modeled impacts remain above the SIL, a ROI is defined. The ROI extends from the center of the proposed facility to the farthest receptor that shows an impact at or above the significance levels.

Recently, the $PM_{2.5}$ SIL was vacated and remanded to EPA for review. This brought into question use of the SIL in general. Use of the SIL, in determining if a comprehensive NAAQS analysis is required, is allowed only if the difference between the current monitoring data design value and the NAAQS is greater than the SIL.

4.2   PSD Increments Analysis

For compliance with the PSD Increments, the design concentration for the short term standards (3-hour and 24-hour) is based on the H2H and the highest annual average for the annual standards. The AQD maintains a record of county/area baseline dates; however, a database of PSD Increment consuming sources is not available. Upon request, the AQD will provide the applicant with a list of sources within the ROI plus 20 kilometers. The list will include stack parameters as reported annually in emission inventories and potential emissions. PSD Increment consuming sources will be indicated in the list. When there are a large number of PSD Increment consuming sources, the AQD may request assistance from the applicant in determining actual emissions. The applicant should always submit a list of sources included in the modeling analyses with the application.

A tiered approach is taken towards modeling PSD Increment consuming sources. For Tier 1, the PSD Increment consuming sources should be modeled using their potential emissions. If the applicant is unable to show compliance with the PSD Increments using potential emissions, the next tier would be used. For Tier II, actual emissions may be used to show compliance with the PSD Increments. The applicant should make a separate request for actual emissions from sources due to the significant amount of review needed. Actual emissions are generally based on actual operating hours, production rates, and types of materials stored, processed, or combusted and will be determined based on a two year average. For short term PSD Increments, if no hourly data exists for a particular source then actual emissions should be based on potential emissions.

If the proposed site is within 50 kilometers of another state, the applicant must obtain a list of sources to be evaluated from that state. If the ROI extends into another state, the applicant must confirm whether a baseline has been set in that region or not. If a baseline date has been set, the applicant must follow the guidance provided by that state for the evaluation of PSD Increments consumption within that state.

The following excerpt related to PSD Increments analysis is taken directly from the draft *New Source Review Workshop Manual Prevention of Significant Deterioration and Nonattainment Area Permitting* (EPA, 10/1990).

> "For a PSD increment analysis, an estimate of the amount of increment consumed by existing point sources generally is based on increases in actual emissions occurring since the minor source baseline date. The exception, of course, is for major stationary sources whose actual emissions have increased (as a result of construction) before the minor source baseline date but on or after the major source baseline date. For any increment-consuming (or increment-expanding) emissions unit, the actual *emissions limit*, *operating level*, and *operating factor* may all be determined from source records and other information (e.g., state emission files), when available, reflecting actual source operation. For the annual averaging period, the change in the actual *emissions rate* should be calculated as the difference between:
>
> - *the current average actual emissions rate*, and

- *the average actual **emissions rate** as of the minor source baseline date (or major source baseline date for major stationary sources).*

In each case, the average rate is calculated as the average over the previous 2-year period (unless the permitting agency determines that a different time period is more representative of normal source operation). For each short-term averaging period (24 hours and less), the change in the actual **emissions rate** for the particular averaging period is calculated as the difference between:

- *the current maximum actual **emissions rate**, and*
- *the maximum actual **emissions rate** as of the minor source baseline date (or major source baseline date for applicable major stationary sources undergoing construction before the minor source baseline date).*

In each case, the maximum rate is the highest occurrence for that averaging period during the previous 2 years of operation."

If an exceedance of a PSD Increment is identified, as long as the project does not cause or contribute (does not have a significant impact at that receptor at that specific time) to that exceedance the AQD can issue a permit for the modification.

4.2.1 PSD Increments Analysis for Class I Areas

EPA Region 6 requires an analysis of the PSD Increments for Class I areas if a facility is within 300 km of a Class I area. This analysis is a tiered analysis to reduce the burden on the applicant. For the first tier, facilities can model the potential emissions increases from the modification using AERMOD out to 50 km. If the impact is below the proposed EPA Class I SIL at 50 km, then the facility is not required to do any additional modeling. Receptors only need to be placed along the direction of the Class I area. The arc used to establish the receptors used to determine the impact should be based on the receptors for the Class I area and include a radius at every 5 degree interval and extending 5 degrees beyond both sides of the Class I area receptors. Receptors shall be placed at every 10 km along the 50 km radius. For the second tier, if applicants exceed the SIL at 50 km using AERMOD, the applicant can model the potential emission increases from the modification using CALPUFF and a single year of MM5 meteorological data. The facility only needs to model the receptors of the affected Class I area. If the impact is below 50% of the proposed EPA Class I SIL, then the facility is not required to do any additional modeling. However, if the facility exceeds 50% of the SIL, then CALPUFF modeling must be conducted using the current three year MM5 meteorological dataset or most recent mesoscale meteorological data. If the SIL is exceeded using the three year dataset, then a cumulative analysis of the Class I area must be conducted.

4.3 NAAQS Analysis

Upon request, the AQD will provide the applicant with a list of sources within 20 km. The list will include stack parameters as reported annually in emission inventories and potential emissions. All sources and emissions provided to the applicant by AQD should be included in the modeling analyses. For large inventories, the AQD may request that the applicant provide assistance in obtaining potential emissions for some of the sources to be modeled. This may

require the applicant to review permits and permit applications for the sources. Permits may be available from the AQD electronically. The applicant should submit with the application a list of sources included in the modeling analysis.

If the proposed site is within 50 km of another state, the applicant must obtain a list of sources to be evaluated from that state. If the radius of impact extends into another state, the applicant must follow the guidance provided by that state for the evaluation of the NAAQS within that state.

4.4   Visibility Analyses

Visibility impact analyses are required for the area around the affected source and may be required for any Class I areas near the affected source. The current EPA guidance document *Workbook for Plume Visual Impact Screening and Analysis (Revised)* (EPA 454/R-92-023, 10/1992), which can be accessed on the EPA SCRAM web site at: https://www.epa.gov/ttn/scram/userg/screen/viscrdu.pdf, describes how to evaluate plume visual impacts including use of the visual impact screening model (VISCREEN) Version 13190. VISCREEN can be applied in two successive screening modes without the need for extensive input. If screening calculations using VISCREEN demonstrate that during the worst case meteorological conditions a plume is imperceptible then it will not cause an adverse impact on visibility. To determine if a plume is perceptible, the impacts are compared to the screening criteria. If impacts exceed the screening criteria, further analysis may be required. The screening criteria are a change in relative sensitivity (ΔE) value of 2.0 and a green absolute contrast value of 0.05.

4.4.1   Class II Area Impact Analysis - AQRV

VISCREEN should be used to address the visibility impacts of a source or modification within a Class II area. There are three levels of visibility analyses. The first level uses the emissions and the default parameters defined by the program. The second level is where the user selects certain variables to get a more realistic view of the predicted impacts. The third level is a comprehensive analysis using PLUVUE.

Since VISCREEN was developed to over predict impacts and EPA's guidance was developed mainly for Class I areas, AQD was concerned that the low screening levels would cause applicants to be required to perform Level 3 analyses for Class II areas. In an effort to prevent potentially time consuming efforts which would not lead to a real improvement in air quality, AQD has determined that the Class II levels should be approximately three times the Class I screening levels. Therefore, when comparing visibility impacts in a Class II area the following levels should be used: a ΔE value of 6.0 and a green absolute contrast value of 0.15. If a Level 1 and Level 2 analysis exceeds these levels, a comprehensive analysis should be performed.

There are some sensitive areas located in Class II areas. If your facility is located within 30 km of one of these sensitive areas, the boundaries of the sensitive area should be used in the visibility analysis. The sensitive areas include but are not limited to the following areas:

Sensitive Area	Nearest Town
Tall Grass Prairie Preserve	Pearson, OK
Great Salt Plains State Park	Jet, OK
Lake Optima Wildlife Refuge	Hardesty, OK
Rita Blanca National Grassland	Felt, OK
Black Kettle National Grassland	Strong City, OK
Arbuckle's Lake Recreational Area	Sulfur, OK
Tishomingo Wildlife Refuge	Tishomingo, OK
Deep Fork Wildlife Refuge	Okmulgee, OK
Ouachita National Forest	Big Cedar, OK
McCurtain County Wildlife Refuge	Hochatown, OK
Little River Wildlife Refuge	Idabel, OK

Notes: When using VISCREEN and there are no sensitive receptors located within 30 km of the facility, the distance from the source to the observer and the distance from the source to the closest Class I area boundary should be set equal to each other and can arbitrarily be set to 1 km, and the distance from the source to farthest Class I area boundary may be arbitrarily established as 10 km. NO_2 emissions can be estimated using the ambient ratio method factor of 80%.

4.4.2 Class I Area Impact Analysis

Sources seeking PSD permits in the state of Oklahoma may be required to perform an impact analysis for a Class I area. Contact information for the federal land managers (FLM) for a Class I area may be obtained from the AQD. There is one Class I area in the state of Oklahoma: The Wichita Mountain Wildlife Preserve managed by the U.S. Fish and Wildlife Service (FWS). Two Class I areas are located in the state of Arkansas (these areas may require evaluations from sources locating in eastern Oklahoma): The Caney Creek Wilderness Preserve and The Upper Buffalo Wilderness Preserve managed by the Forest Service (FS). Another Class I area is located in the state of Missouri (this area may require evaluations from sources locating in northeastern Oklahoma): The Hercules-Glade Wilderness Preserve managed by the FS. Visibility analyses required for Class I areas located more than 50 km from a facility must be performed using the model approved by the FLM.

The National Parks Service (NPS) - Air Resources Division, FWS - Air Quality Branch and FS - Air Quality Program have produced a guidance document *Federal Land Managers' Air Quality Related Values Workgroup (Flag) Phase I Report – Revised* (2010), which can be accessed on the NPS web site at: http://www.nature.nps.gov/air/pubs/pdf/flag/FLAG_2010.pdf. The guidance set forth in this document is followed in PSD review of AQRV for Class I areas.

5. Modeling/Permit Revisions

In situations where changes in facility construction or operating plans differ from what has been indicated in a permit or permit application where modeling was required, modeling may need to be revised to accurately reflect any proposed or implemented changes. If revisions of the air dispersion modeling analyses are required, the facility may use some the modeling methodologies in this section to potentially reduce the burden of revising the initial modeling analyses.

Occasionally, sources are constructed with emission units that have different stack parameters (e.g., stack location, stack height, stack diameter, etc.), different emission units, or emissions that are different than what was relied on in the modeling analyses conducted for the permit. These types of changes at a facility can affect the ambient air impacts of a source. For example, a shorter stack, a lower exit velocity, or relocation of a stack closer to the facility boundary could increase ambient impacts.

These types of changes or revisions require a review of modeling previously conducted to determine whether or not the analyses need to be revised. Modeling analyses which may need to be reviewed can include SIL, NAAQS, PSD Increments, and Class I area ambient impact analyses. The modeling analyses must be examined to see not only if any of the previous modeling analyses should be revised, but also to determine if any new or more refined modeling analyses should be performed. Additional modeling analyses may be required if the previous modeling analyses resulted in only a screening analysis and not a comprehensive refined analysis. For example, if a PSD permit authorized a source to increase SO_2 emissions by 60 TPY and the source was not required to do a NAAQS or PSD Increments analysis because the ambient impacts of the project were below the SIL, the source may now have to conduct the NAAQS and PSD Increments analyses if the ambient impacts from the revised modification exceed the SIL.

5.1   Meteorological Data
When air dispersion modeling has to be revised, the facility should contact AQD to obtain meteorological data processed using the most recent version of AERMET. If the previous modeling had been processed with a different dataset (e.g., 2006-2010) than the current meteorological dataset (i.e., 2011-2015), the facility may utilize the previous meteorological dataset as long as the revision occurs within 18 months of the date which AQD begins using the newest meteorological dataset. However, the meteorological data should still be processed using the most recent version of AERMET. The AQD moves to a new dataset every five years and begins utilizing the new dataset at the end of the first quarter of the following year (i.e., May 2016).

5.2   Nearby Source Data
If air dispersion modeling was conducted to demonstrate compliance with the NAAQS or PSD Increments and included nearby source data, the facility should contact AQD to determine if any of the nearby source data used in the modeling analyses should be updated prior to revising the modeling analyses. When air dispersion modeling has to be revised, the nearby source inventory should be revised to reflect any new construction or source modifications that may have taken place since the submittal of the previous modeling.

5.3   Source Emission/Impact Ratio Method
Emission increases and decreases without changes to other source parameters are directly related to impacts. For example, if an emission unit's emissions double, then the emission unit's ambient impacts will double. For such cases, changes in the ambient impacts can be determined on a source by source basis using the following ratio:

$$I_{PC} = I_O \left(\frac{E_{PC}}{E_O} \right)$$

where:

        I_{PC} = post-change ambient impact, micrograms per cubic meter
        I_O = original, (pre-change) ambient impact, micrograms per cubic meter
        E_{PC} = post change emissions rate
        E_O = original, (pre-change) emissions rate
        Note: I_{PC} and I_O, must be the same averaging period.

This method cannot be used for sources which relied on a temporal emission profile (e.g., hour of day, day of week, or season hour of day) or an hourly emission file.

5.4　　　Source Screening Evaluation Method

Another potential option to review proposed changes is to use a screening analysis to determine the difference in the ambient impacts prior to the proposed revisions and after the proposed revisions which can then be added to the impacts determined in the original modeling analysis. Screening analyses are not appropriate for use when previous modeling indicated a potential violation of the ambient standard and a cause or contribute analysis was performed to show that the proposed source or facility would not cause or contribute to the potential violation of the ambient standard.

Appendix A

Point Source Model Input Data For NAAQS Compliance in PSD Demonstrations

40 CFR Part 51, Appendix W, Table 8-2

Averaging Time	Emission Limit (#/MMBTU)[1]　　　　　　X	Operating Level (MMBTU/hr)[2]　　　　　　X	Operating factor (e.g., hr/yr, hr/day)
Proposed Major New or Modified Source			
Annual & Quarterly	Maximum allowable emission limit or federally enforceable permit limit.	Design capacity or federally enforceable permit condition.	Continuous operation (i.e., 8,760 hours).[2]
Short term (≤ 24 hours)	Maximum allowable emission limit or federally enforceable permit limit.	Design capacity or federally enforceable permit condition.[3]	Continuous operation (i.e., all hours of each time period under consideration) (for all hours of the meteorological data base).[2]
Nearby Source(s)[4,5]			
Annual & Quarterly	Maximum allowable emission limit or federally enforceable permit limit.[5]	Annual level when actually operating, averaged over the most recent 2 years.[6]	Actual operating factor averaged over the most recent 2 years.[6,8]
Short term (≤ 24 hours)	Maximum allowable emission limit or federally enforceable permit limit.[5]	Temporally representative level when actually operating, reflective of the most recent 2 years.[6,7]	Continuous operation (i.e., all hours of each time period under consideration) (for all hours of the meteorological data base).[2]
Other Source(s)[5,9]			
The ambient impacts from Non-nearby or Other Sources (e.g., natural sources, minor sources and distant major sources, and unidentified sources) can be represented by air quality monitoring data unless adequate data do not exist.			

[1] Terminology applicable to fuel burning sources; analogous terminology (e.g., lb/throughput) may be used for other types of sources.

[2] If operation does not occur for all hours of the time period of consideration (e.g., 3 or 24 hours) and the source operation is constrained by a federally enforceable permit condition, an appropriate adjustment to the modeled emission rate may be made (e.g., if operation is only 8 a.m. to 4 p.m. each day, only these hours will be modeled with emissions from the source.) Modeled emissions should not be averaged across non-operating time periods.

[3] Operating levels such as 50 percent and 75 percent of capacity should also be modeled to determine the load causing the highest concentration.

Appendix A

[4] Includes existing facility to which modification is proposed if the emissions from the existing facility will not be affected by the modification. Otherwise use the same parameters as for major modification.

[5] See Section 8.3.3 of 40 CFR Part 51, Appendix W.

[6] Unless it is determined that this period is not representative.

[7] Temporally representative operating level could be based on the Continuous Emission Monitoring (CEM) data or other information and should be determined through consultation with the appropriate reviewing authority (Paragraph 3.0(b) of 40 CFR Part 51, Appendix W.).

[8] For those permitted sources not yet in operation or that have not established an appropriate factor, continuous operation (i.e., 8,760 hours) should be used.

[9] See Section 8.3.2 of 40 CFR Part 51, Appendix W.

Appendix B

Flare Calculation Derivation

An American Petroleum Institute (API) publication (API 1969) provides a correlation for flame length as a function of the flared gas heat release. This equation was republished and modified for a flame tilted at a 45° angle from the vertical in Fundamentals of Stack Gas Dispersion (Beychok 1994). The resulting equation provides the vertical height of a flare stack flame.

$$H_{fv} = 0.00128 Q_c^{0.478}$$ (Eq. 1)

Where: H_{fv} = flare stack flame vertical height vector, m
         Q_c = flared gas heat release, Btu/hr

The equivalent height is then found by summing the height of the flare with the vertical height vector of the flame.

$$H_{equiv} = H_{actual} + 0.00128 Q_c^{0.478}$$ (Eq. 2)

Where: H_{equiv} = The equivalent height of the flare, m
         H_{actual} = The actual height of the stack from the ground, m

The total plume rise is derived from the initial vertical velocity momentum and the initial buoyancy momentum. The buoyancy momentum is essentially a measure of the sensible heat emissions from the stack. However, the AERMOD program does not allow the user to directly input the heat release. The flux parameter is instead calculated from the temperature differential between the stack and ambient air. This is a problem for a flare analysis because the heat release is diminished due to radiant heat losses. Therefore, an equivalent diameter is chosen, which when combined with the temperature assumption will force the program to calculate a buoyancy flux that accounts for the radiant heat loss. This equivalent diameter is back calculated from the Briggs' buoyancy flux parameter, which is derived from the sensible heat emissions.

The Briggs' buoyancy flux parameter may be expressed by the following equivalent expressions, with the reasonable assumption that combusted stack gas has essentially the same molecular weight and specific heat as ambient air.

$$F = \frac{g v_s d^2 (T_s - T_a)}{4 T_s}$$ (Eq. 3)

and

$$F = \frac{g Q s}{(\pi c_{pa} T_a \rho_a)}$$ (Eq. 4)

Where: g = 9.807 m/sec^2
         v_s = stack exit velocity, m/sec
         d = stack exit diameter, m

Appendix B

Qs = stack sensible heat emission, cal/sec
c_{pa} = specific heat of ambient air, cal/(g-°C)
ρ_a = ambient air density, g/m^3
T_a = ambient air temperature, K
T_s = stack gas temperature, K
F = buoyancy flux parameter, m^4/sec^3

Since g and π are constants and since c_{pa}, T_a, and ρ_a are essentially constants, it may be inferred that the buoyancy flux parameter is a measure of the sensible heat emissions from the stack. So, assuming an average annual temperature of 68°F or 20°C, the equation 4 may be restated as follows:

$$F = (3.677 x 10^{-5}) Qs(\text{cal/sec}) \qquad \text{(Eq. 5)}$$
and
$$F = (2.574 x 10^{-6}) Qs(\text{BTU/hr}) \qquad \text{(Eq. 6)}$$

where: F = buoyancy flux parameter, m^4/sec^3

Because 55% of the heat is assumed to be lost due to radiation, equation 6 is adjusted specifically for flares.

$$F = (1.158 x 10^{-6}) Qc(\text{BTU/hr}) \qquad \text{(Eq. 7)}$$

The equivalent diameter may now be found as a function of Q by setting equal equations 7 and 3 and solving for the radius (r).

$$D_{equiv} = 1.752 x 10^{-4} \sqrt{Qc(\text{BTU/hr})} \qquad \text{(Eq. 8)}$$

where: D_{equiv} = the equivalent diameter of the flare, m

The above guidance is consistent with guidance issued by the Ohio EPA. It differs from EPA Region V and Louisiana DEQ guidance with the inclusion of the stack height adjustment; however, this adjustment is made within the AERSCREEN flare option and is appropriate for the AERMOD point source option. It differs from Texas guidance with the inclusion of the stack height adjustment and an ambient temperature assumption. Texas guidance is based on an ambient temperature of 35°C. Because the ambient temperature is important in both the heat release calculation and the equivalent diameter calculation, care should be exercised in modeling specific events. Rather than using the standard guidance above, specific events should be modeled with equivalent parameters based on the actual ambient conditions.

Appendix C

Modeling Protocol Submission Outline

1. **Project Overview**
   1.1. Discussion of Facility or Modification Related to Modeling Submittal
   1.2. References to Regulatory Applicability of Modeling
2. **Emission Sources**
   2.1. Description of Sources to be Modeled
   2.2. Location of Emission Points
   2.3. Pollutants to be Modeled and Related Emission Calculations
3. **Impact Assessment Tools and Techniques**
   3.1. Description of Model(s) to be Used (AERSCREEN, AERMOD, CALPUFF, etc.)
      3.1.1. Version of Model(s)
      3.1.2. Circumstance of use, i.e., AERSCREEN for initial screening
   3.2. Discussion of Related Modeling Issues
      3.2.1. Use of Ambient Ratio, Ozone Limiting, or other Methods
      3.2.2. Discussion Concerning Secondary Formation
      3.2.3. Discussion on Merging Stacks
   3.3. For PSD Analysis
      3.3.1. Discussion of Method for Ozone Impact Assessment (if Applicable)
      3.3.2. Discussion of Class I Area Impact Assessment
4. **Area Maps and Facility Plot Plans (if available)**
   4.1. Clearly Marked Scale
   4.2. Property Lines
   4.3. Fence Lines
   4.4. Downwash Structures
   4.5. True-north Arrow
   4.6. UTM Coordinates for Vertical and Horizontal Borders
   4.7. Locations of All Emission Points
   4.8. Identification of Sensitive Receptors (e.g., Nearest Residences (Area Map Only))
   4.9. For NAAQS Analysis, Identification of Any Ambient Air Monitoring Sites Used for Background Concentrations
   4.10. For PSD Applications, identification of PSD Class I areas within 300 km (186.4 miles).
   4.11. Accompanying List of Structures with UTM Locations of Corners, Heights, and Model Labels or ID Numbers
5. **Modeling Emission Inventory**
   5.1. On-Site Sources
      5.1.1. Assumptions
      5.1.2. Table of Source Input Data (if available)
   5.2. Off-Site Sources (Nearby Sources)
      5.2.1. List of Nearby Source Data Provided by AQD
6. **Air Quality Monitoring Data For NAAQS Compliance**
   6.1. Discussion of Pre-construction Monitoring Issues
   6.2. Proposed Representative Monitoring Site(s)
7. **Land Use**
   7.1. Discussion of Rural/Urban Determination

Appendix C

8. Receptor Grid
    8.1. Discussion of Grid Type/Size
    8.2. Discussion of Special Receptor(s) Placement
9. Meteorological Data
    9.1. Mesonet Station
    9.2. Surface Station
    9.3. Upper-air Station
    9.4. Period of Record
10. Discussion on Method of Evaluation Additional Impacts Analysis (PSD)
    10.1. Class I Area Impacts Analyses (PSD)
        10.1.1. Discussion of Method of Analysis
        10.1.2. AQRV of concern

Appendix D

Final Submission Outline

1. **Project Overview**
   1.1. Discussion of Facility or Modification Related to Modeling Submittal
   1.2. References to Regulatory Applicability of Modeling
2. **Emission Sources**
   2.1. Description of Sources to be Modeled
   2.2. Location of Emission Points
   2.3. Table of Emissions by Source and Pollutants
3. **Impact Assessment Tools and Techniques**
   3.1. Description of Model(s) to be Used (AERSCREEN, AERMOD, CALPUFF, etc.)
     3.1.1. Version of Model(s)
     3.1.2. Circumstance of use, i.e., AERSCREEN for initial screening
   3.2. Discussion of Related Modeling Issues
     3.2.1. Use of Ambient Ratio, Ozone Limiting, or other Methods
     3.2.2. Discussion Concerning Secondary Formation
     3.2.3. Discussion on Collocating Sources
     3.2.4. Discussion on Merging Stacks
   3.3. For PSD Analysis
     3.3.1. Discussion of Method for Ozone Impact Assessment (if Applicable)
     3.3.2. Discussion of Class I Area Impact Assessment
4. **Area Maps and Facility Plot Plans (if available)**
   4.1. Clearly Marked Scale
   4.2. Property Lines
   4.3. Fence Lines
   4.4. Downwash Structures
   4.5. True-north Arrow
   4.6. UTM Coordinates for Vertical and Horizontal Borders
   4.7. Locations of All Emission Points
   4.8. Identification of Sensitive Receptors (e.g., Nearest Residences (Area Map Only))
   4.9. For NAAQS Analysis, Identification of Any Ambient Air Monitoring Sites Used for Background Concentrations
   4.10. For PSD Applications, identification of PSD Class I areas within 300 km (186.4 miles).
   4.11. Accompanying List of Structures with UTM Locations of Corners, Heights, and Model Labels or ID Numbers
5. **Modeling Emission Inventory**
   5.1. On-Site Sources
     5.1.1. Assumptions
     5.1.2. Table of Source Input Data
   5.2. Off-Site Sources (Nearby Sources)
     5.2.1. List of Nearby Source Data Provided by AQD
6. **Air Quality Monitoring Data For NAAQS Compliance**
   6.1. Discussion of Pre-construction Monitoring Issues
   6.2. Summary Information for Monitoring Site(s)
     6.2.1. Location

Appendix D

References

Auer, A. H. 1978. Correlation of Land Use and Cover with Meteorological Anomalies, Journal of Applied Meteorology, 17:636-643.

Beychok, Milton R. 1994. Fundamentals of Stack Gas Dispersion. 3rd ed. Irvine, California: Milton Beychok

Davies, M. J. E., and D. M. Leahey. 1984. Observation of Plume Rise from Sour Gas Flares. Atmospheric Environment Volume 18, No. 5: 917-922.

Koerber, Michael, Regional Meteorologist, EPA Region V. Letter to Regions I-IV, VI-X, 28 July 1986.

Louisiana Department of Environmental Quality (LDEQ). 1999. Air Quality Modeling Procedures. Baton Rouge, Louisiana: LDEQ

Ohio Environmental Protection Agency (Ohio EPA). Air Dispersion Modeling Guidance, Engineering Guide No. 69. Columbus, Ohio: Ohio EPA.

Texas Natural Resource Conservation Commission (TNRCC). 1999. Air Quality Modeling Guidelines. Austin, Texas: TNRCC.

United States Environmental Protection Agency (EPA). 1990. Draft New Source Review Workshop Manual. Research Triangle Park, North Carolina: EPA.

EPA Office of Air Quality Planning and Standards. July 5, 1985, Memorandum *Revised Draft Policy on Permit Modifications and Extensions*: EPA.

References