Ohio EPA
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GUIDANCE DOCUMENT

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Engineering Guide #69[1]: Air Dispersion Modeling Guidance

Background:

The Division of Air Pollution Control (DAPC) has received several questions concerning computer modeling of air pollution sources. This guide is intended to respond to those questions. Below is a list of all of the questions. The rest of the Guide contains the Division's responses. The Division welcomes comments on the application of this Guide and additional questions related to air dispersion modeling.

This document will answer the most commonly asked questions to provide a basis for consistent model application although many other questions require case-specific responses. The answers in this document do not reflect a rule or regulation, are not intended to be treated as a rule or regulation, and are subject to change on a case-by-case basis. The information within is provided so that permitting personnel, regulated entities and the public will have an understanding of the expected outcome of the situations described in this document. If you have additional questions on modeling, or comments on this guide, you should contact the Division of Air Pollution Control (614-644-2270).

[1] This Engineering Guide is not binding, does not have the force and effect of law, is not a "rule" as defined in section 119.01(C) of the Revised Code, and is not a "policy" as defined in section 3745.30(A)(1) of the Revised Code.

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Questions and Answers

Question 1: What specific modeling requirements are incorporated by Ohio EPA in the review of air contaminant sources?

Answer 1: The following is intended to identify current Ohio EPA, DAPC requirements for air pollution control modeling applications within Ohio. Where applicable, Ohio EPA is consistent with U.S. EPA guidance. In real world applications, the U.S. EPA Guideline on Air Quality Models (Appendix W of 40 CFR Part 51) and supplementary guidance does not always address detailed problems that confront modelers.

The purpose of air dispersion modeling is to predict pollutant concentrations resulting from a source or group of sources under various meteorological conditions. Modeling is necessary to demonstrate that the subject source or sources will 1) not cause or significantly contribute to a violation of the National Ambient Air Quality Standards (NAAQS); 2) not cause ambient concentrations which exceed allowable Prevention of Significant Deterioration (PSD) increments; 3) comply with Ohio EPA's policy of no new source consuming more than one half of the available PSD increment (one half the increment is the effective goal for all new source modeling of criteria pollutants, regardless of the size or location of the new source.); and/or 4) not cause ground level concentrations which exceed the Maximum Allowable Ground Level Concentration (MAGLC) for air toxics[2] identified in Ohio Administrative Code (OAC) rule 3745-114-01. For criteria pollutants which do not have identified PSD increments, maximum incremental impact of new source emissions is limited to one quarter of the NAAQS.

The combined emission increases from all of the new or modified sources (the project) must be evaluated to determine the maximum incremental impact if the total emissions exceed the amounts indicated in Table 3. For criteria pollutants, Ohio EPA expects (with the exceptions discussed in the response to Question 15) that the incremental impact for the project will not exceed one half of any PSD increment or, if no PSD increment exists, one quarter of the NAAQS. These are general guidelines. The management of air quality impacts from new or modified sources is complex and it is necessary to balance air quality impacts from one new or modified source with the air quality impacts from future sources. There is no requirement to model Volatile Organic Compound (VOC) emissions for incremental impact on ozone concentrations[3] (although specific VOC constituents may require air toxic modeling). **For exceptions to the one half PSD increment policy, see Answer 15.**

New or modified sources with emissions of air toxics that exceed the level (one ton per year) identified in Table 3 must be evaluated to determine the maximum impact of these emissions for comparison with the MAGLC as required by the procedures in division (F)(4) of section 3704.03 of the Revised Code.

Where the permit includes both emission increases and decreases (generally restricted to a contemporaneous 5- or 10-year period), the net increase should be modeled. Ohio EPA must approve the 'netting' emissions prior to modeling.

Question 2: What models are to be used?

Answer 2: The specific source/receptor situation dictates the appropriate model for determining ambient concentrations for comparison with NAAQS, PSD increments, short or long term exposure limits, etc. The size and complexity of the source, the toxicity of the emissions along with other factors will dictate whether a screening model or a refined model is appropriate.

Screening models are generally the first level tools for evaluating air quality impacts. High predicted concentrations from a screening model may indicate the need for further refined modeling. Larger more significant sources and groups of sources will require the application of a refined model.

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[2] References to "air toxic" in this document refers to regulated toxic air contaminants listed in Ohio Administrative Code rule 3745-114-01.

[3] A non-modeling VOC analysis may be necessary in certain cases, see Answer 25.

With the latest regulatory models (AERMOD and AERSCREEN), all terrain features and elevations should typically be included in the modeling for regulatory applications. Inclusion of terrain elevations is a mandatory requirement in modeling of any source whether using a screening model or refined model. This applies to both criteria pollutants and air toxics. When using other models, such as SCREEN3, sources in areas where terrain elevation is significant relative to the stack height will require evaluation using receptor elevations. Where terrain exceeds the stack height, a complex or intermediate terrain modeling analysis is necessary.

Generally, the most recent version of a model is to be used. The most recent versions of models contained in The Guideline on Air Quality Models - (Appendix W of 40 CFR Part 51) can be obtained by accessing the U.S. EPA Support Center for Regulatory Air Models (SCRAM), Technology Transfer Network at http://www.epa.gov/ttn/scram/dispersion_prefrec.htm. The SCRAM web page also provides model users manuals, ancillary programs, meteorological data and additional model application information. This Engineering Guide is available on the Ohio EPA DAPC web page located at http://epa.ohio.gov/portals/27/engineer/eguides/guide69.pdf. In addition, meteorological data for Ohio sources are available on the Ohio EPA DAPC web page located at http://epa.ohio.gov/dapc/model/modeling/metfiles.aspx.

Screening models:

The current U.S. EPA recommended model for screening point, volume or area sources in simple and elevated terrains is the most recent version of AERSCREEN, for criteria pollutants or for applications where maximum ambient concentrations of neutral buoyancy pollutants are desired. A fundamental assumption for pollutants being modeled with traditional Gaussian models is that the concentration of the pollutant in the plume will not make the plume disperse or diffuse differently than air.

AERSCREEN is the required screening model for all NAAQS or PSD projects. SCREEN3 will still be accepted by Ohio EPA for state-only permit modeling. More information on AERSCREEN can be found in U.S. EPA's April 11, 2011 guidance memo, "AERSCREEN Released as the EPA Recommended Screening Model."

Applications requiring an evaluation of emergency release scenarios or sources emitting 'light' or 'heavy' plumes may use one of the commercially available toxic release models to determine if ambient impacts exceed the applicable Maximum Acceptable Ground Level concentration (MAGLC). Most routine releases, even of heavy compounds, will have a density close to that of air due to high dilution.

Point sources with stacks less than good engineering height (discussed below) must be evaluated for downwash impacts using AERSCREEN or SCREEN3 (when selected for state-only modeling). Initial screening estimates of source impacts involving intermediate or complex terrain should utilize AERSCREEN or SCREEN3 (when selected for state-only modeling).

The output from these models identifies short term (1-hour) maximum impacts. It should be noted that the conversion factors for different averaging times are now part of the AERSCREEN screening model. For the SCREEN3 model, which is acceptable for state-only modeling requirements, the following are the conversion factors to be used to convert these short term estimates to the averaging time of concern. Separate conversion factors have been recommended by U.S. EPA for terrain below stack tip (simple terrain) and terrain above stack tip (complex terrain).

Conversion Factors

	Desired Averaging Period						
Model Output	1-hr	3-hr	8-hr	24-hr	Month	Quarter	Annual
Simple	1	0.9	0.7	0.4	0.18	0.13	0.08
Complex	1	0.7	0.5	0.15		0.06	0.03

Additional guidance on the use of AERSCREEN and SCREEN3 is provided in Appendix A and Appendix B, respectively, of this document.

Refined models:

AERMOD is the required refined model for point, area and volume sources involving simple, intermediate and complex terrain, using representative meteorological data in the regulatory default modes. ISC is no longer accepted by the Ohio EPA. Several commercial versions of these models have been granted model equivalency by U.S. EPA and are therefore also acceptable. For refined air toxic analyses, the same procedures used for criteria pollutants are used to determine ambient concentrations. There are currently no requirements for deposition calculations**.**

Question 2.1: Can Screening models be used for more than one source?

Answer 2.1: Yes, screening models can be used to determine the maximum modeled concentration from more than one source. While screen modeling is a single-source model, it can be used to develop a conservative estimate of the peak potential impact of emissions from multiple egress locations.

The modeler may either model the worst case stack parameters from each of the sources and model those at the source located closest to the fence line or the modeler may model each source individually and sum the maximum modeled concentrations before comparing the results to the applicable standard.

A conservative approach combines the peak impact from each individual run as if the peak impact from each emission point occurred at the same point in space.

In the case of multiple identical stacks, all of the emissions can be assumed to come from one stack (modeled using the combined emission rate with the stack flow parameters for a single stack).

If the stacks are not identical, all of the emissions could be assumed to be emitted from the 'worst case' emission point. Sometimes the determination of worst case is straightforward (e.g., shortest, coldest, lowest flow stack). In other situations, the choice may not be clear and the Local Air Agency, District Office or Central Office should be consulted.

The approaches described above will result in conservative estimates. If the source(s) does not pass using the above assumptions, less conservative approaches can be considered in consultation with the Local Air Agency, District Office or Central Office. A multisource refined model may also be appropriate to use to model the actual separation of emission points and estimate their combined peak impact.

Question 3: What meteorological data sets are to be used?

Answer 3:

Short Term

AERMOD Data Sets: On-site or National Weather Service two minute surface data sets are combined with local surface characteristics and upper air observations within the AERMET preprocessor program to create the modeling meteorological data sets for AERMOD.

If the modeling is for NAAQS or PSD analyses, at least one year of on-site or recent available five years of representative off-site NWS data are required. If the source of concern is located in intermediate or complex terrain, U.S. EPA believes that NWS data might not be representative for the above stack portion of the analysis. Therefore, more reasonable representative meteorological data requirements may apply for such a source. However, occasionally the most representative NWS met site may not necessarily be the closest to the source(s) to be considered for modeling. In such cases, if the source is in a complex wind environment, a site-specific meteorological tower may be needed to collect representative data. For state-only modeling requirements, five years of NWS data are considered acceptable for use in a conservative screening analysis.

Recent five-year NWS data sets are currently available from Ohio EPA for the period 2008-2012 and will be updated as necessary with more current years. These data are processed in AERMET along with two-minute wind speeds and directions (processed in AERMINUTE) and upper air data to generate surface (.sfc) and profile (.pfl) AERMOD input files. AERMET-processed data sets include a threshold wind velocity of 0.5 m/s, based on U.S. EPA recommendations. NWS data sets later than 2008 are also acceptable but not required. Off-site NWS data sets are assigned by county. Table 1 identifies the appropriate data set for each county in Ohio.

Approved meteorological files can be found at: http://epa.ohio.gov/dapc/model/modeling/metfiles.aspx

NOTE: While the State of Ohio accepts NWS data for use in modeling in both simple and complex terrain for state-only modeling requirements, U.S. EPA has a more restrictive interpretation of 'representative' meteorological data when modeling impacts at receptors with elevations above the stack tip. For this and other reasons, it is important when preparing to model major PSD or nonattainment sources, that a protocol is developed and approved to assure that acceptable model calculations will be obtained for each source/receptor relationship.

Question 4: What modeled emission rate(s) should be used?

Answer 4: Tables 8-1 and 8-2 in the Guideline on Air Quality Models (Appendix W of 40 CFR Part 51) identify the various emission rates to be used in modeling a source. In general, the short term maximum potential (allowable) emission rate is used in the evaluation of a short term standard. If the permit does not list a short-term limit for the pollutant, then the short-term state and/or federally enforceable controlled potential to emit shall be used. For an existing source, a representative long term actual emission rate can be used to evaluate a longer term (quarterly or annual) standard. An annual permit restriction can also be used to develop a long term average emission rate to be used in evaluating a long term standard for a new source.

For state permit modeling, the peak short term increase which the permit will allow is the emission rate to be modeled to determine the peak ambient impact this permit action will allow. Specifically for modeling of air toxics, the maximum hourly rate of emissions from the source shall be modeled. Modeling shall be based on information including, but not limited to, any emission control devices or methods, operational restrictions, stack parameters, and emission dispersion devices or methods that may affect ground level concentrations, either individually or in combination. This could involve the combined peak impact of several sources if there are several sources included in the same project.

For a federal netting or synthetic minor permit, the difference between baseline actual~~s~~ emissions and permit allowable emissions, as determined in the netting calculation, is modeled for comparison to the Ohio Acceptable Incremental Impacts (AII). For state-only netting modeling evaluations, the allowable to allowable difference is usually acceptable, but must be agreed upon in a modeling protocol. For PSD or federal netting, though, modeled emissions should be consistent with the netting evaluation performed for the permit.

For a modification which involves an emission increase only, the net change allowed by the permit is evaluated. For PSD and other federal analyses, the net change is the difference between the existing actual emissions and the new potential allowable emissions. For state-only review, modeling the difference in allowable emission rates is usually acceptable, but must be agreed upon in a modeling protocol.
According to U.S. EPA, it should be noted that modeling of negative emission rates is not recommended for NO_2 modeling for

any permit analyses because all of the NO to NO_2 conversion approaches in the model are considered as screening techniques. For a modification involving a change in stack parameters which could increase the ambient impact due to the source(s), the emissions affected by the modification (potential allowable) are modeled to determine if the impact of the modification is below the Ohio acceptable incremental impacts. If necessary, the present (before modification) emissions can be modeled as negatives in a refined analysis to determine the net impact of the permitted modification for comparison to the Ohio acceptable incremental impacts.

Like-kind replacements would not need modeling if all emissions parameters remain the same since there would be no increase in impact due to the permit action. If, however, the replacement involves the use of a shorter stack, lower temperatures, etc., the replacement may cause an increased peak impact which would need evaluation. As noted above, if the replacement, when viewed alone, exceeds the Ohio acceptable incremental impacts as identified in Table 3, the source being replaced can be modeled with a negative emission rate in a refined modeling analysis to determine the net peak impact for comparison to the Ohio acceptable incremental impacts. Also, see Question 12 for additional information on emission inventories.

Question 4.1: Are fugitive emissions modeled?

Answer 4.1: Major new source PSD and Nonattainment Review includes all significant sources, including fugitive sources such as storage piles and roadways. U.S. EPA's draft guidance on haul roads may be helpful for the modeling of haul road fugitive emissions. (Haul Road Workgroup Final Report, U.S. EPA, March 2, 2012)

In minor source state permit modeling, though, only the boiler or process source criteria and air toxic emissions increases (both controlled and fugitive) are to be modeled. Non-process fugitive sources such as roadways and parking lots, material storage and material transfer operations are not modeled. Grinding, crushing, mixing and screening operations are considered processes and should be modeled. An evaluation of all project emissions may be required in a state analysis if circumstances warrant.

Question 4.2: Are there any exceptions to the modeling thresholds for modeling criteria pollutants and air toxics contained in Table 3?

Answer 4.2: There are several new source emissions scenarios which Ohio EPA has historically not reviewed for state-only permits. These scenarios generally involve fugitive emissions from parking lots, roadways, material handling and storage piles. These scenarios usually represent situations where modeling results often indicate potential problems due to unreliable emission factors and/or unusual or extreme source configurations. Field experience with these sources, though, indicates that normal operating practices and compliance with required controls result in acceptable ambient impacts as demonstrated by ambient monitoring, field measurements of visible emissions or a lack of verified complaints by local citizens.

Division (F)(4)(f) of section 3704.03 of the Revised Code, effective August 3, 2006, specifically provides an exemption from air toxics modeling for "parking lots, storage piles, storage tanks, transfer operations, grain silos, grain dryers, emergency generators, gasoline dispensing operations, air contaminant sources that emit air contaminants solely from the combustion of fossil fuels, or the emission of wood dust, sand, glass dust, coal dust, silica, and grain dust."

Therefore, the following list of source/pollutant scenarios will not be required to perform an air quality analysis in support of a state-only permit **unless factors such as source size, tons of emissions, particle size, pre-existing concerns or proximity to other sources or citizen populations indicate that a modeling review is warranted**[4]:

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[4] Division (F)(4)(f)(ii) of section 3704.03 of the Revised Code, effective August 3, 2006, provides for the director to request additional information from a source for the purposes of air toxic contaminant modeling if there is reason to believe the source will potentially cause an increase in ground level concentration beyond the facility's boundary that exceeds the MAGLC.

Air Toxics or criteria pollutants from parking lots
Air Toxics or criteria pollutants from storage piles
Air Toxics or criteria pollutants from storage tanks
Air Toxics or criteria pollutants from transfer operations
Air Toxics or criteria pollutants from grain silos or grain dryers
Air Toxics or criteria pollutants from emergency generators
Air Toxics or criteria pollutants from gasoline dispensing operations
Air Toxics from sources emitting air contaminants solely from the combustion of fossil fuels

In addition, the following pollutants will be treated as PM but not as air toxic for modeling purposes:

Wood dust
Sand
Glass dust
Coal dust
Silica
Grain dust

Source/air toxics combinations subject to a MACT, residual risk standard under section 112 of the CAA, or identified in 40 CFR 51.166(b)(23) where BACT or LAER has been required, that would restrict the amount of that pollutant that could be released are not subject to air toxics modeling **unless factors such as source size, tons of emissions, particle size, pre-existing concerns or proximity to other sources or citizen populations indicate that a modeling review is warranted**.

Question 4.3: Should sources be modeled that emit air toxics listed in the ACGIH book, do not have a Time Weighted Average (TWA), but do have a Ceiling Limit Value?

Answer 4.3: Yes, pollutants without a listed TWA are addressed by multiplying the Ceiling Limit Value by 0.737 and then following the procedures in 'Option A' to develop a Maximum Acceptable Ground Level concentration (MAGLC).

Option A can be found on the Ohio EPA web page at http://www.epa.ohio.gov/dapc/atu.aspx

Question 4.4: Are minor and exempt sources included in the modeling for a project which exceeds the thresholds in Table 3?

Answer 4.4: All sources or units contained in the permits that make up a project are initially considered significant with respect to the potential impact due to the project. Many small sources, while individually insignificant, could combine to cause or contribute to an ambient problem. Smaller sources can be removed from the modeling analysis if it can be demonstrated that their emissions are insignificant relative to the rest of the project. Sources not included in the modeling must be agreed upon in a modeling protocol before they can be eliminated from the modeling.

Question 4.5: Do you model sources within a building that have no direct vent to the outside or do not have an identified control device for capture, control and release of the emissions from the unit?

Answer 4.5: Sources can be located within an enclosure or building with no obvious control and/or vent moving the emissions to the outside. It must be assumed that all emissions coming from the device are either captured and controlled or are escaping to ambient air. If they are not being captured and controlled (with the cleaned air being reintroduced to the work area), the emissions must be escaping the building and the modeler must determine how the emissions are being removed from the building or enclosure to the ambient air. The emission rate leaving the building or enclosure is assumed to be the same as the emission rate from the source(s). Any credit for some portion of the emissions being retained in the building due to "building capture" must be supportable and will be evaluated on a case-by-case basis.

Often the emissions are removed by the building ventilation system. In other situations, the only exchange between indoor and outdoor air occurs through open doors and windows. In any event, the modeler must identify the egress point(s) and characterize the releases as one of the available modeling release scenarios (i.e., point, area or volume). If best engineering judgment justifies assigning a fraction of the total emissions through specific egress points, the individual points can be modeled with their assigned emission rates. When using a single source screening model, the individual modeled peaks are then added together.

If it is unclear which potential egress point the emissions are actually venting through, the worst case egress point is assumed. If it is not clear which egress point is worst case, each scenario should be modeled and the highest results should be compared to the applicable standard.

Question 5: Is building downwash required for state modeling?

Answer 5: Any stack source file must include building dimension data if the stack is not at or above good engineering practice (GEP) stack height. GEP is determined by evaluating all nearby structures using the formula GEP = H + 1.5L where H is the height of the structure and L is the lesser of the height or projected width of the structure. The GEP height is the highest height calculated for any nearby structure (a structure is 'nearby' if it is within five times the lesser of its height or width from the stack). If direction specific building dimensions (discussed below) are not calculated, the most conservative dimensions should be used for all directions. The most conservative building dimensions are usually associated with the height and diagonal width of the tallest nearby building.

Direction specific building dimensions may be determined for 36 wind directions for AERMOD. This allows the model to include the effects of the critical structure for each wind direction. Direction specific building dimensions are calculated using facility plot plans and manually determining the dominant structure dimensions for each wind direction for each stack. Alternatively, the BPIP-PRIME program provided by the U.S. EPA, as well as several commercial software packages, are available which will calculate the dimensions for each wind direction from a single building or group of buildings for each stack.

Buildings with multiple segments can be viewed as multiple buildings. For example, a predominantly flat one story building is interrupted by a three-story tower, the flat, one story building is evaluated and the 'four story' building (1 + 3), with lateral dimensions of the tower is also evaluated.

Building dimensions are not contained in state or federal emissions data bases. These data need to be obtained from facility personnel if sources at that facility are subject to building downwash. Distant background sources might be modeled without downwash with Ohio EPA permission since this would most likely maximize those sources' impact in the study area and therefore be 'conservative'.

Question 5.1: What building height do I use if the building has a pitched roof?

Answer 5.1: Pitched roofs present a nonstandard modeling scenario. The horizontal dimensions at the peak are reduced to a single line. A conservative approach is to assume that the entire horizontal dimensions are covered by a flat roof at the elevation of the peak of the pitched roof. An acceptable alternative is to assume a building height one half the height of the pitched roof and the corresponding horizontal dimensions below that 'roof' (i.e., one horizontal dimension would also be halved)**.**

Question 6: Is there any special guidance for nonstandard point source emissions?

Answer 6: Nonstandard source emissions are not specifically addressed in the above screening or refined models. For example, if emissions do not exit the stack in an upward (vertical) direction, alternative characterizations of the source should be developed to more accurately represent the release point. If a 'point source' is still assumed, even though the exit velocity is blocked or diverted sideways or downward (such as in a rain cap, discussed below), an exit velocity of 0.001 m/s should be input into the model so that a fictitious upward momentum is not credited to that source.

If the temperature of the release is near ambient, a characterization as an area or volume source might be appropriate. If temperature is significant, a virtual stack might be created to represent the emission point. Alternative characterizations should be discussed with Ohio EPA staff prior to modeling.

Question 6.1: How do I model rain caps and horizontal releases?

Answer 6.1: For stacks that are fitted with a rain cap or have a horizontal orientation, the guidance found in U.S. EPA's AERMOD Implementation Guide should be followed. The AERMOD Implementation Guide can be found at:. http://www.epa.gov/ttn/scram/7thconf/aermod/aermod_implmtn_guide_19March2009.pdf .

U.S. EPA has provided a specific solution to address hot stack plumes that are interrupted by a rain cap or which are released horizontally. U.S. EPA requires that these sources reduce their stack exit velocity to 0.001 m/s. This adjustment to stack velocity, as described below, was incorporated into AERMOD as a beta option starting with AERMOD v. 06341. Adjustments to the stack velocity can be performed manually by the user, or by selecting the beta option in the CO MODELOPT card. The methodologies are equivalent, and are described in the excerpt from U.S. EPA's AERMOD Implementation Guide, below.

> "For capped and horizontal stacks that are NOT subject to building downwash influences, a simple screening approach (Model Clearinghouse procedure for ISC) can be applied. That is, an effective stack diameter may be used to maintain the flow rate, and hence the buoyancy, of the plume, while suppressing plume momentum by setting the exit velocity to 0.001 m/s. To appropriately account for stack-tip downwash, the user should first apply the non-default option of no stack-tip downwash (i.e., NOSTD keyword). Then, for capped stacks, the stack release height should be reduced by three actual stack diameters to account for the maximum stack-tip downwash adjustment while no adjustment to release height should be made for horizontal releases. Capped and horizontal stacks that are subject to building downwash, should not use an effective stack diameter to simulate the restriction to vertical flow since the PRIME algorithms use the stack diameter to define the plume radius which, in turn, is used to solve conservation laws. The user should input the actual stack diameter and exit temperature but set the exit velocity to a nominally low value, such as 0.001 m/s. This approach will have the desired effect of restricting the vertical flow while avoiding the mass conservation problem inherent with effective diameter approach. The approach suggested here is expected to provide a conservative estimate of impacts. Also, since PRIME does not explicitly consider stack-tip downwash, no adjustments to stack height should be made."

In addition to the U.S. EPA recommended treatment of horizontal or capped stacks, Ohio EPA has developed a similar methodology that reduces the velocity, as recommended, yet maintains the effect of the buoyancy that the volume of hot gas would normally have. This alternative methodology will be considered by Ohio EPA under certain circumstances, such as a significant temperature difference between emissions at the egress point and ambient air. The Ohio EPA recommended methodology provides for retention of the buoyancy while addressing the impediment to the vertical momentum of the release. The procedure is as follows (stack parameters' units are assumed to be in metric units):

1) The stack exit velocity (V_s) is set equal to 0.001 m/s (V_s')

2) Stack diameter (d_s) is adjusted using the equation

$$d_s' = 31.6 * d_s * (V_s)^{0.5}$$

(Where V_s is the actual stack exit velocity, NOT 0.001m/s)

3) Use V_s' and d_s' in the model

The results of this approach can create an extremely large modeled stack diameter. Receptors should not be placed within the calculated diameter, d_s'.

Question 6.2: How do I model flares?

Answer 6.2: For screening purposes, the flare option in SCREEN3 (State-only) or AERSCREEN is acceptable. SCREEN3 recommends a default radiative heat loss factor of 55%. This is very conservative as most gases have values about half of that. For refined modeling, it is necessary to compute equivalent emission parameters, i.e., adjusted values of temperature and stack height and diameter. Several methods appear in the literature, none of which seems to be universally accepted. Ohio EPA/DAPC has used the following procedure, which is believed to be consistent with SCREEN3 and AERSCREEN:

1) compute the adjustment to stack height as a function of heat release Q in MMBtu/hr:

$$H_{equiv} = H_{actual} + 0.944(Q)^{0.478} \quad \text{(a)}$$

Where H has units of meters;

2) assume temperature of 1273 deg. K;

3) assume exit velocity of 20 meters/sec;

4) assume the following buoyant flux:

$$F_b = 1.162(Q)$$

5) back-calculate the stack diameter that corresponds to the above assumed parameters. Recall the definition of buoyant flux:

$$F_b = 3.12(V)(T_{stack} - T_{ambient})/T_{stack}$$

Where V is the volumetric flow rate, actual m^3/sec.

Substituting for F_b and solving for the equivalent stack diameter $d_{equiv.}$:

$$d_{equiv.} = 0.1755(Q)^{0.5}$$

(a) Beychok, M., 1979. Fundamentals of Stack Gas Dispersion, Irvine, CA.

This method pertains to the "typical" flare, and will be more or less accurate depending on various parameters of the flare in question, such as heat content and molecular weight of the fuel, velocity of the un-combusted fuel/air mixture, presence of steam for soot control, etc. Hence, this method may not be applicable to every situation, and the applicant may submit his own properly documented method in a modeling protocol.

An alternative method of flare modeling, based on U.S. EPA's AERMOD Implementation Guide, may also be used. According to U.S. EPA, flares can be modeled as a pseudo point source using the technique below to derive the modeling input parameters needed for point sources.

1) Calculate the Total Heat Released (Q_T) by multiplying the heating value of the flare gas by the gas flow rate to obtain total potential gross heat release in calories per second (cal/s).

2) Calculate the sensible or Net Heat Available (Q_H) for plume rise enhancement in cal/s by multiplying the total heat released by 0.45 which assumes that 55 percent of the total heat is lost due to radiation.

$$Q_H=0.45(Q_T)$$

3) Determine the effective flare stack diameter in meters (m) based on the net heat released as follows:

$$D_{eff} = 9.88\text{x}10^{-4}(Q_H)^{0.5}$$

4) Calculate the Effective Release Height (H_{eff}) using the formula below:

$$H_{eff} = H_S + [0.00456 \text{ x } (Q_T)^{0.478}]$$

where: H_s = physical height of the stack in meters (m)
Q_T = Total Heat Released (cal/s)

5) Use the effective release height and diameter as calculated above, and an assumed stack gas exit velocity (V_e) of 20 m/s and gas exit temperature (T_e) of 1273 K as point source modeling inputs to the model.

Question 6.3: What special modeling considerations are necessary for modeling combustion turbines?

Answer 6.3: Combustion turbines are unique in that stack temperatures and flow rates, as well as emission rates, are dependent on ambient conditions, especially ambient temperature. Determining a worst case operating scenario resulting in peak source impacts involves evaluating the source at multiple loads (50%, 75% and 100%) as well as average and extreme ambient temperatures. Three general approaches are normally followed to establish the worst case operating scenario. The approaches described below address a PSD application.

Approach 1: Each scenario is modeled using AERSCREEN. If each scenario results in insignificant impact, then the demonstration is complete. If one or more scenarios result in significant impact, the worst case scenario is carried forward into the PSD and NAAQS analyses using AERMOD. If there is no clear cut worst case scenario, multiple scenarios may need to be carried forward into the subsequent comprehensive analyses. All other things being equal, it is preferable to move forward with a 100% load scenario rather than a reduced load scenario.

Approach 2: Each scenario is modeled with AERMOD using the latest year of meteorology. The worst case scenario(s) is then run with five years of meteorology to determine if the proposed project will have a significant impact. If there is a significant impact, then the worst case scenarios are carried forward into the PSD and NAAQS analyses.

Approach 3: Worst case emission rates and stack parameters from all scenarios are used to estimate a worst case impact. This virtual worst case stack can be used through all phases of the analysis.

The same approaches can be followed for state-only (e.g., synthetic minors) modeling, with the only goal to be achieved being the Ohio Acceptable Incremental Impacts.

Question 7: What receptor grids must I use?

Answer 7: It is important that the receptor grid (i.e., specific coordinates where the model predicts downwind concentrations) is sufficiently dense to ensure that the point of maximum ambient impact is identified. Ambient air is defined as that portion of the atmosphere, external to buildings, to which the general public has access. Receptors are necessary in the vicinity of projected maximum concentrations to assure that the peak concentration(s) has been found. For most applications, the spacing should be no more than 50 meters at the fence line and other 'hotspots', determined from the preliminary modeling results (AERMOD or a screening model), out to a distance sufficient to assure that the maximum concentration has been found. For facilities without a distinct fence line or other secured boundary, it is reasonable to include a 25 meter buffer distance between receptors and structures with stacks. Receptors generally do not need to be placed within secured property. A "secured property line" means a boundary that prevents general public access to property owned by a facility. Additional receptors should also be placed in areas of special concern (e.g., areas of source interaction and areas of significant terrain). It is also important that the extent of the grid covers the entire area of significant impact from the proposed project.
Receptor elevations are necessary in the modeling demonstration since the default option of both AERMOD and AERSCREEN requires terrain elevation data. Any exceptions to this would need to be made on a case-by-case basis, similar to the sloping terrain example given in the AERMOD Implementation Guide (available from U.S. EPA's SCRAM website).

Receptor elevation information as well as source and receptor location information can be downloaded from the USGS site at http://ned.usgs.gov/

AERMOD receptor grids must be exclusively developed using the AERMAP preprocessor using NED data. Receptor information must contain calculated information concerning the relative height of the nearby terrain (receptor height scales) in addition to the location and elevation of the receptor. A maximum of one arc second data should be used to determine the elevation of the receptor.

Question 8: What are the state significant emission rates which trigger modeling?

Answer 8: A comprehensive list of emission rates which trigger state and federal modeling requirements is contained in Table 3 under the heading "Ohio Modeling Significant Emission Rates." The emissions increase which will be allowed by the permit action (potential allowable increase) are compared to these levels.

Question 8.1: Can a source modification trigger a requirement for modeling even where there is no increase in emission rate?

Answer 8.1: OAC 3745-31-01(QQQ)(1)(b)-defines "modification" to include "Any physical change in, or change in the method of operation of any significant air contaminant source that, for the specific air contaminant . . . for which the source is classified as significant, results in an increase in the ambient air quality impact . ." greater than certain values specified in the rule. Thus, if the source is "significant" (as defined in OAC 3745-31-01(LLLLL)) and the proposed incremental impact at any receptor exceeds the specified value (listed under the "3745-31-01(QQQ)(1)(b)" heading in Table 3) then the change is a modification requiring a permit-to-install, notwithstanding the fact that it may entail no increase in emissions.

It should be kept in mind that the provisions for OAC 3745-31-01(QQQ)(1)(b)–were promulgated for the sole purpose of ensuring that the ambient air quality standards are protected. If this provision is triggered, BAT is not required. Also, this provision is not required under any federal regulation and has not been submitted to U.S. EPA for approval as part of the SIP.

It should also be noted that the concentrations (QQQ) are only trigger concentrations and are not maximum allowable impacts. The ambient air quality standards and, if applicable, the PSD increments would be the limiting factor.

An example is a coal-fired boiler where a scrubber is proposed to be installed to remove sulfur dioxide. Even though the actual and allowable emissions of NO_x might not increase, the reduced stack temperature and velocity associated with the scrubber could result in an increase of ambient concentration at some receptor exceeding the 15 ug/m^3 limit under (QQQ)(1)(b), thereby triggering the requirement to obtain a PTI before beginning construction. Another example is any reduction of stack height. For either example the need for modeling is apparent, to resolve the PTI question. A screening model may be used, or if a refined model is selected, the controlling concentration will be the high-high increase of concentration anywhere on the receptor grid, for the relevant averaging period, using five years of off-site or one-year of on-site meteorological data.

Question 9: What are the state target concentrations for acceptable incremental impacts?

Answer 9: Table 3 also contains a listing of NAAQS and PSD increments as well as state target ambient concentrations for criteria pollutants and specific air toxic emissions subject to the air toxics requirements. The state target concentrations for criteria and air toxics listed under the heading “Ohio Acceptable Incremental Impact” represent the acceptable incremental impact of the new emissions which are the subject of a state permit requirement. The Ohio significant impacts under OAC 3745-31-01 (QQQ)(1)(b) identify modeled impact levels which trigger permit to install requirements for a source modification (including stack height changes).

Question 10: What special requirements exist for sources of fluoride?

Answer 10: The potential for secondary impacts due to fluorides is greater than the probability for primary human health effects. Therefore, there may be observable impacts and actual complaints of damage to plants and property when the MAGLC has not been exceeded.

The approach to follow when evaluating the secondary impacts due to fluorides is as follows. The secondary ' target’ is 0.5 ug/m^3 as a 30-day average. The screening approach is to model a 1-hour concentration using AERSCREEN and convert it to a 'monthly' average using the 0.18 conversion. Monthly averages can also be modeled directly using AERMOD. The incremental impact of the new emissions is modeled.

This 'secondary' approach would also be appropriate for any other pollutants where it is determined that there may be significant non health related impacts at levels below the MAGLC.

Question 11: How do I obtain background values when performing NAAQS analyses in Ohio?

Answer 11: PSD and NAAQS modeling analyses estimate total concentrations of a pollutant and must account for those sources which are either too small or too distant to be included in the modeling analysis. This is accomplished by adding a background value to the modeled concentrations.

A separate background value is needed for each NAAQS pollutant and for each NAAQS averaging time. Actual monitored data for the most recent year, from a representative monitoring site(s) are the basis for acceptable background values. Ideally, the monitor should not be impacted by any major sources or any local smaller sources. If an un-impacted monitor is available, the second highest value for each short-term period would represent the short term backgrounds. The annual average is the annual background. The rolling three-month average would be used for lead.

If an un-impacted monitor is not available, non-impacted values from monitors which are near a limited number of sources and which have non-impacted sectors (no upwind sources) can be used to develop background values. **Unadjusted impacted monitor values can also be used as a conservative background**.

A non-impacted value is a monitored value measured during a period when the wind was not blowing from a 90-degree sector centered on a line between the monitor and the potentially impacting source. For a 3-hour value, no winds should be from the impacting sectors. For 24-hour values, no more than two hours should have winds from the impacting sectors. For short term backgrounds, the second highest non-impacted value is chosen as a fixed background. Long term background values are the average of the non-impacted values for the specific averaging time period.

Please contact Ohio EPA for a representative background for your project. If you would like to suggest a background, it must be approved in a modeling protocol. Ohio EPA recommends following U.S. EPA's March 1, 2011 memo, "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 Ambient Air Quality Standard," which recommends tiered methods for determining background concentrations.

Question 12: What sources do I include in a major source PSD and/or NAAQS analysis?

Answer 12: Major Source NAAQS Analysis: All sources within the significant impact area (SIA) of the emissions increase with potential allowable emissions greater than the PSD significant emission rates (listed in Table 3), must be included in a new source review NAAQS analyses. SIA is defined as the region over which any exceedance of a PSD significant impact increment (listed in Table 3) occurs, based on each high-high concentration over five years of modeling (one year if on-site, representative data are available). In addition, all major sources with potential allowable emissions greater than 100 tons per year (tpy) outside of the SIA and within 50 km must also be included if they interact with the new source.

Whether to include a potentially interacting source can be determined using the '20D' approach. Under this approach, the modeler may exclude sources whose potential allowable emissions in tpy are less than 20 times the distance between the two sources in kilometers. Prior to commencement of final modeling, though, Ohio EPA must be advised as to what sources the modeler chooses to exclude using the 20D method. While the 20D method is acceptable, recently more emphasis has been placed on the methods in Section 8.2.3 of the Guideline on Air Quality Models (Appendix W of 40 CFR Part 51). This section states that based on "professional judgment," "all sources expected to cause a significant concentration gradient in the vicinity of the source or sources under consideration for emission limits should be explicitly modeled. The number of these sources is expected to be small except in unusual situations." Ohio EPA reserves the right to require any or all of these sources to be included in a final analysis if Ohio EPA believes that any or all are potentially significant.

Major Source PSD Increment Analysis: All PSD sources located within an area where PSD baseline has been triggered or within the SIA of the new source, whichever is larger, must be included in the PSD increment analysis modeling inventory. PSD sources located outside of the baseline area or SIA which interacts with the new source must also be included. These sources may be screened using the 20D approach.

Inventory data should be obtained from the state emissions inventory system or the AIRS national data base system. Basic modeling source parameters (stack height or release height, diameter, temperature, exit velocity or volume flow, emission rate, etc.) are contained in these data systems.

The DAPC emissions inventory unit has placed several data sets on the Ohio EPA web page at: http://epa.ohio.gov/dapc/aqmp/eiu/eis.aspx. While the later data sets have significant amounts of current information, it is important to check the 1990 and 1995 data bases which contain information on short term allowable emission rates. The short term allowable rates and source capacities are included in these earlier data sets. These are important for determining maximum short term allowable emission rates for the significant sources consistent with Section 9.1 of the GAQM. If source information is missing or is suspect, you will need to contact the local air pollution agency or field office to obtain current, correct information. The most recent emissions inventory should be used in the modeling analysis.

Question 13: How do I model major sources in nonattainment areas to demonstrate net air quality improvement?

Answer 13: OAC 3745-31-25 discusses the requirements for determination of net air quality benefit for major sources wishing to locate in a nonattainment area (NAA). Both the rule and U.S. EPA guidance indicate the need for demonstrating area-wide benefit and progress toward attainment.

VOC emissions are not required to be modeled for net air quality benefit (However, in some cases a non-modeling analysis may be required. See Answer #25). All major nonattainment pollutant emissions increases and corresponding offsetting emissions will need to be modeled for a net air quality benefit.

In general, all NAAs have undergone SIP modeling at some point and the State has identified key receptor areas for the SIP attainment demonstrations. In cases where the potential offsets could impact critical receptors, those receptors must show impacts less than or equal to zero. For the remaining receptors, the receptors within the significant impact area of the increasing emissions must, on average, show no net increase for each averaging period.

If greater than zero impacts at critical receptors or net area-wide increases are modeled, the applicant may present a complete NAAQS demonstration for the significant impact area of the project.

Question 14: If multiple pollutants are being emitted, does an individual model run have to be performed for each pollutant?

Answer 14: If the emission characteristics are identical for each pollutant (all of the pollutants are emitted in the same proportion from each of the egress points) one run can be performed and the results can be adjusted. Gaussian models such as AERMOD, AERSCREEN and SCREEN3 are ‘linear’ models in that the impacts will vary proportionally to the emission rate. Therefore, in this example case, if one pollutant is being emitted at twice the rate of another pollutant, the impact of the second pollutant will be twice as high.

In the case of multiple pollutants being emitted from a single emission point, an emission rate of one gram per second can be modeled and the results multiplied by each allowable emission rate (expressed in grams per second) to determine the predicted ambient concentration of each of the pollutants.

If emission characteristics vary for different pollutants, or the pollutants do not vary proportionately from each egress point, then a separate modeling analysis for each pollutant is necessary.

Question 15: For PSD and non-PSD sources, can facilities be installed if modeling shows that more than ½ the available PSD increment is consumed?

Answer 15: The purpose of PSD is to keep clean areas clean. The intent of the one half increment portion of the policy is to allow future growth by preventing any single emissions increase from consuming all of the available increment.

Non-PSD sources still consume increment and increase background concentrations. Therefore, these emissions can also threaten future growth.

As such, it is Ohio EPA's practice that any new source, whether PSD or not, will not consume more than one half the available PSD increment (In application, state-only permits do not involve modeling which would assess available increment, therefore, one half the increment is the effective goal).

In some cases, Ohio EPA will grant exceptions to this policy for new PSD or non-PSD sources where modeling predicts exceedances of one half of, but less than 83 percent of the available increment. (For example: If the available increment were 30 ug/m3, between 15 and 25 ug/m3.) Exceptions will be granted on a case-by-case basis (but only when public health will not be adversely affected or where modeling results are suspect). The following are examples of where exceptions will be granted:

1) Modeling shows that the exceedance of the one half of the available increment occurs in a very localized area near the emissions source either due to the source parameters or due to downwash and, in the Ohio EPA's judgment, it is unlikely that other new sources located near the facility will significantly impact the same exceedance locations. In other words, if it is unlikely that another source would be negatively impacted by the exceedance then the Ohio EPA may grant the exception. An example of this would be a fugitive source with low release points having close proximity maximum impact areas that in the Ohio EPA's judgment would not be areas that other facilities would impact.

2) If the source is located such that it is unlikely in the Ohio EPA's judgment that any other major source would locate in the same area (for instance, in an extremely remote, rural area).

3) If the source is temporary and the increment consumed will become available in the near future for future growth (for instance, at a clean-up site where the source will be operated for only a couple of years.)

4) If the source is locating in a 'brownfield' area and otherwise would locate in a greenfield site.

Question 16: What determines whether a locale is rural or urban?

Answer 16: Section 7.2.3 in The Guideline on Air Quality Models (Appendix W of 40 CFR Part 51) outlines two methods by which an area can be categorized as either 'urban' or 'rural'. These methods rely on evaluating either the land use or population density within a three-kilometer radius circle around the subject source. Either of these methods is acceptable for the determination of the proper classification for that source, although the land use approach is preferred. Population density should be used with caution. It should not be applied to highly industrialized areas where the population density may be low and thus a rural classification would be indicated, but the area is sufficiently built-up so that the urban land use criteria would be satisfied. More information on the urban/rural classification can be found in Appendix C of this document.

Also, there may be sources located within an urban area, but located close enough to a body of water or to other non-urban land use categories to result in a predominately rural land use classification within three kilometers of the source following the land use procedure. Therefore, users are cautioned against applying the land use procedure on a source-by-source basis and should consider the potential for urban heat island influences across the full modeling domain. Furthermore, Section 7.2.3(f) of Appendix W of 40 CFR Part 51 recommends modeling all sources within an urban complex using the urban option even if some sources may be defined as rural based on the land use procedure. Such an approach is consistent with the fact that the urban heat island is not a localized effect, but is more regional in character.

In Ohio, many counties have had significant SIP development modeling performed which included sources from across the county. Therefore, if multiple facilities over a wider area are being modeled as part of a PSD or NAAQS analysis, the Central Office should be consulted as to the historic classification so that a consistent approach will be maintained.

Question 17: How do you model PM2.5 secondary formation for PSD?

Answer 17: AERMOD does not account for chemistry involved in PM2.5 secondary formation. In order to account for the secondary formation Ohio EPA follow's U.S. EPA's four assessment cases to determine which level of analysis must be submitted. The cases are as follows:

Case 1: If direct PM2.5 emissions are less than 10 tpy, and *both* NOx and SO2 emissions are *individually* less than 40 tpy, then no PM2.5 secondary formation compliance demonstration is required.

Case 2: If direct PM2.5 emissions are greater than or equal to 10 tpy and *both* NOx and SO2 emissions are *individually* less than 40 tpy, then a PM2.5 compliance demonstration is required for direct PM2.5 emission only, based on dispersion modeling. No accounting of the impacts for secondary formation is required.

Case 3: If direct PM2.5 emissions are greater than or equal to 10 tpy and *either* NOx or SO2 emissions are *individually* greater than 40 tpy, then a compliance demonstration is required for direct PM2.5 emissions based on dispersion modeling, AND the applicant must account for the impact of precursor emissions from the project source.

- Case 3 could involve a strictly qualitative analysis, a hybrid qualitative/quantitative analysis, or photochemical modeling. Please contact Ohio EPA if Case 3 is required.

Case 4: If direct PM2.5 emissions are less than 10 tpy and *either* NOx or SO2 emissions are *individually* greater than 40 tpy, then a PM2.5 compliance demonstration for direct PM2.5 emissions is not required. However, an analysis of precursor emission impacts on secondary PM2.5 formation is required, as in Case 3, above.

- Case 4 could involve a strictly qualitative analysis, a hybrid qualitative/quantitative analysis, or photochemical modeling. Please contact Ohio EPA if Case 4 is required.

These four assessment cases are discussed in greater detail in U.S. EPA's May 20, 2014 Guidance for PM2.5 Permit Modeling which can be found on the web at:http://www.epa.gov/ttn/scram/guidance/guide/Guidance_for_PM25_Permit_Modeling.pdf.

Question18: Which averaging times should I use?

Answer18: Modeled averaging times should be consistent with the standard. AERMOD and AERSCREEN have built-in algorithms to simulate the concentration across various averaging periods. Please see Table 3 for averaging times and standards.

Question 19: Are modeling protocols required?

Answer 19: Modeling protocols are not required for state-only modeling if all default options are used, except for reasons stated elsewhere in this engineering guide. Modeling protocols are required for all Nonattainment Review and PSD projects and projects where non-default options are used. It is also recommended that complex modeling or modeling that is highly unusual in nature includes obtaining an approved modeling protocol before final modeling is conducted and submitted. Modeling protocols should be submitted for approval by Ohio EPA in advance of the final modeling submittal.

Question 20: Does start up and shutdown emissions need to be modeled?

Answer 20: Startup and shutdown emissions might need to be modeled if the emissions from startup/shutdown operations are greater than non-startup/shutdown maximum emission rates. Discuss this issue with the field office if the startup/shutdown emissions are higher. Ohio EPA will make a case-by-case decision concerning the need for these emissions to be modeled.

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Question 21: When is a Class I Modeling Analysis required?

Answer 21: A Class I Modeling Analysis is required for any PSD facility that is greater than 50 km but within 300 km of a Class I Area, and when the ratio below is greater than 10:

$$\frac{Q\ (SO2\ +\ NOX\ +\ PM10\ +\ H2SO4)}{d}$$

Where **Q** is the combined emissions increase from a source of sulfur dioxide (SO_2), oxides of nitrogen (NO_x), particulate matter less than 10 microns (PM_{10}), and sulfuric acid mist (H_2SO_4) in ton per year (tpy) based on 24-hour maximum allowable emissions (which are annualized) and **d** is the nearest distance to a Class I area in kilometers (km) from the source. This approach is limited to sources that operate year round. Emissions from sources that operate intermittently or seasonally must be adjusted to account for year round operation if the applicant uses the Q/d Initial Screening approach.

Distances From Ohio Cities to Nearby Class I Areas (km)

Area	Mammoth Cave	Dolly Sods/ Otter Creek	Great Smokey Mountains	Seney
Akron	563.5	257.6	547.4	644
Canton	563.5	241.5	547.4	768.4
Cincinnati	241.5	434.7	370.3	772.8
Cleveland	611.8	322	595.7	627.6
Columbus	386.4	322	434.7	740.6
Dayton	322	402.5	434.7	708.4
Portsmouth	305.9	322	305.9	853.3
Steubenville	579.6	161	512.2	772.8
Toledo	531.3	434.7	627.9	536.1
Youngstown	627.9	241.5	579.6	724.5

Appendix W of 40 CFR Part 51 states the appropriate Federal Land Manager(s)(FLM) should be consulted with regarding modeling associated with PSD permit applications that involve a Class I area. The Federal Land Managers AQRV Workgroup (FLAG) Phase I Report – Revised (FLAG, 2010) provides guidance on FLM review of Class I PSD modeling and has made specific technical revisions while retaining the background material and general information provided in the Phase I document issued in 2000 (FLAG, 2000).

If a Class I Modeling Analysis is required, please contact Ohio EPA for more information.

Question 22: Will Ohio EPA do air dispersion modeling for my facility?

Answer 22: No, Ohio EPA only reviews the dispersion modeling submitted in support of a permit. Each facility is responsible for conducting and submitting its own modeling analysis. Please contact your local district office for information.

Question 23: What files need to be submitted to Ohio EPA for a modeling review?

Answer 23: The following files need to be submitted to Ohio EPA for a modeling review submittal to be deemed complete:

- Approved modeling protocol (when applicable)
- All AERMOD input files

- All AERMET input files (if using meteorological data not supplied by Ohio EPA)
- All AERSURFACE input files (if using meteorological data not supplied by Ohio EPA)
- All downwash files
- All AERMOD output files
- All AERMET output files (if using meteorological data not supplied by Ohio EPA)
- All AERSURFACE output files (If using meteorological data not supplied by Ohio EPA)
- All AERMAP output files
- Modeling report

Question 24: Do I need to model Greenhouse Gases?

Answer 24: No, Ohio EPA does not require you to model Greenhouse Gases.

Question 25: How do I evaluate Ozone?

Answer 25: Ohio EPA does not require modeling for ozone. If NOx or VOC emissions exceed 40 tpy, a qualitative analysis is required. The qualitative analysis must show that increases in NOx and/or VOC emissions will not cause or contribute to an ozone exceedance. Please contact Ohio EPA for more information should you need to submit an ozone analysis.

Question 26: Are there special modeling requirements for 1-hour NO_2?

Answer 26: To assist sources and permitting authorities in carrying out the required air quality analysis for 1-hour NO_2 compliance demonstrations, U.S. EPA has issued two guidance memorandums:

1) Applicability of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard (U.S. EPA, 2010a); and

2) Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard (U.S. EPA, 2011d).

Three-Tiered Approach for 1-hour NO_2 Modeling
Based on the U.S. EPA's guidance memorandums, the following three-tiered approach is recommended for 1-hour NO_2 modeling:

1) Tier 1 - Total Conversion - assuming full conversion of NO to NO_2 without any additional justification.

2) Tier 2 - Ambient Ratio Method (ARM) - multiply Tier 1 result by empirically-derived NO_2/NOx ratio, with 0.8 as default ambient ratio for the 1-hour NO_2 standard without additional justification. Note that the national annual default for NO_2/NOx ratio is 0.75.

3) Tier 3 - Plume Volume Molar Ratio Method (PVMRM)/Ozone Limiting Method (OLM) - the two approaches are available as non-regulatory-default options within the AERMOD model. Both of these options account for ambient conversion of NO to NO_2 in the presence of ozone, namely the ozone titration mechanism. The main distinction between PVMRM and OLM is the approach taken to estimate the ambient concentration of NO and O_3 for which the ozone titration mechanism should be applied. For Tier 3 modeling analysis, U.S. EPA approval is required.

The NO_2/NOx in-stack ratio is critical since it defines the portion of the model predicted NOx concentration that will be automatically converted to NO_2. The in-stack ratio data can be found on U.S.EPA's NO_2/NOx In-Stack Ratio (ISR) Database website at http://www.epa.gov/scram001/no2_isr_database.htm.

Table 1
Meteorological Assignments and Map

COUNTY	SURFACE	MIXING HEIGHT
ADAMS	Huntington	Wilmington
ALLEN	Dayton	Wilmington
ASHLAND	Akron	Pittsburgh
ASHTABULA	Erie	Buffalo
ATHENS	Parkersburg	Pittsburgh
AUGLAIZE	Dayton	Wilmington
BELMONT	Pittsburgh	Pittsburgh
BROWN	Cincinnati	Wilmington
BUTLER	Cincinnati	Wilmington
CARROLL	Pittsburgh	Pittsburgh
CHAMPAIGN	Dayton	Wilmington
CLARK	Dayton	Wilmington
CLERMONT	Cincinnati	Wilmington
CLINTON	Cincinnati	Wilmington
COLUMBIANA	Pittsburgh	Pittsburgh
COSHOCTON	Columbus	Pittsburgh
CRAWFORD	Columbus	Wilmington
CUYAHOGA	Cleveland	Buffalo
DARKE	Dayton	Wilmington

Table 1
Meteorological Assignments and Map

COUNTY	SURFACE	MIXING HEIGHT
DEFIANCE	Fort Wayne	Detroit KDTX
DELAWARE	Columbus	Wilmington
ERIE	Cleveland	Buffalo
FAIRFIELD	Columbus	Wilmington
FAYETTE	Columbus	Wilmington
FRANKLIN	Columbus	Wilmington
FULTON	Toledo	Detroit KDTX
GALLIA	Huntington	Pittsburgh
GEAUGA	Cleveland	Buffalo
GREENE	Dayton	Wilmington
GUERNSEY	Pittsburgh	Pittsburgh
HAMILTON	Cincinnati	Wilmington
HANCOCK	Toledo	Wilmington
HARDIN	Dayton	Wilmington
HARRISON	Pittsburgh	Pittsburgh
HENRY	Toledo	Detroit KDTX
HIGHLAND	Cincinnati	Wilmington
HOCKING	Columbus	Pittsburgh
HOLMES	Akron	Pittsburgh
HURON	Cleveland	Buffalo
JACKSON	Huntington	Pittsburgh

Table 1
Meteorological Assignments and Map

COUNTY	SURFACE	MIXING HEIGHT
JEFFERSON	Pittsburgh	Pittsburgh
KNOX	Columbus	Wilmington
LAKE	Cleveland	Buffalo
LAWRENCE	Huntington	Pittsburgh
LICKING	Columbus	Wilmington
LOGAN	Dayton	Wilmington
LORAIN	Cleveland	Buffalo
LUCAS	Toledo	Detroit KDTX
MADISON	Columbus	Wilmington
MAHONING	Youngstown	Pittsburgh
MARION	Columbus	Wilmington
MEDINA	Akron	Pittsburgh
MEIGS	Parkersburg	Pittsburgh
MERCER	Fort Wayne	Wilmington
MIAMI	Dayton	Wilmington
MONROE	Parkersburg	Pittsburgh
MONTGOMERY	Dayton	Wilmington
MORGAN	Parkersburg	Pittsburgh
MORROW	Columbus	Wilmington
MUSKINGUM	Columbus	Pittsburgh

Table 1
Meteorological Assignments and Map

COUNTY	SURFACE	MIXING HEIGHT
NOBLE	Parkersburg	Pittsburgh
OTTAWA	Toledo	Detroit KDTX
PAULDING	Fort Wayne	Wilmington
PERRY	Columbus	Pittsburgh
PICKAWAY	Columbus	Wilmington
PIKE	Huntington	Wilmington
PORTAGE	Akron	Pittsburgh
PREBLE	Dayton	Wilmington
PUTNAM	Fort Wayne	Wilmington
RICHLAND	Columbus	Wilmington
ROSS	Columbus	Wilmington
SANDUSKY	Toledo	Detroit KDTX
SCIOTO	Huntington	Wilmington
SENECA	Toledo	Wilmington
SHELBY	Dayton	Wilmington
STARK	Akron	Pittsburgh
SUMMIT	Akron	Pittsburgh
TRUMBULL	Youngstown	Pittsburgh
TUSCARAWAS	Akron	Pittsburgh
UNION	Columbus	Wilmington

Table 1
Meteorological Assignments and Map

COUNTY	SURFACE	MIXING HEIGHT
VAN WERT	Fort Wayne	Wilmington
VINTON	Huntington	Pittsburgh
WARREN	Cincinnati	Wilmington
WASHINGTON	Parkersburg	Pittsburgh
WAYNE	Akron	Pittsburgh
WILLIAMS	Toledo	Detroit KDTX
WOOD	Toledo	Detroit KDTX
WYANDOT	Columbus	Wilmington

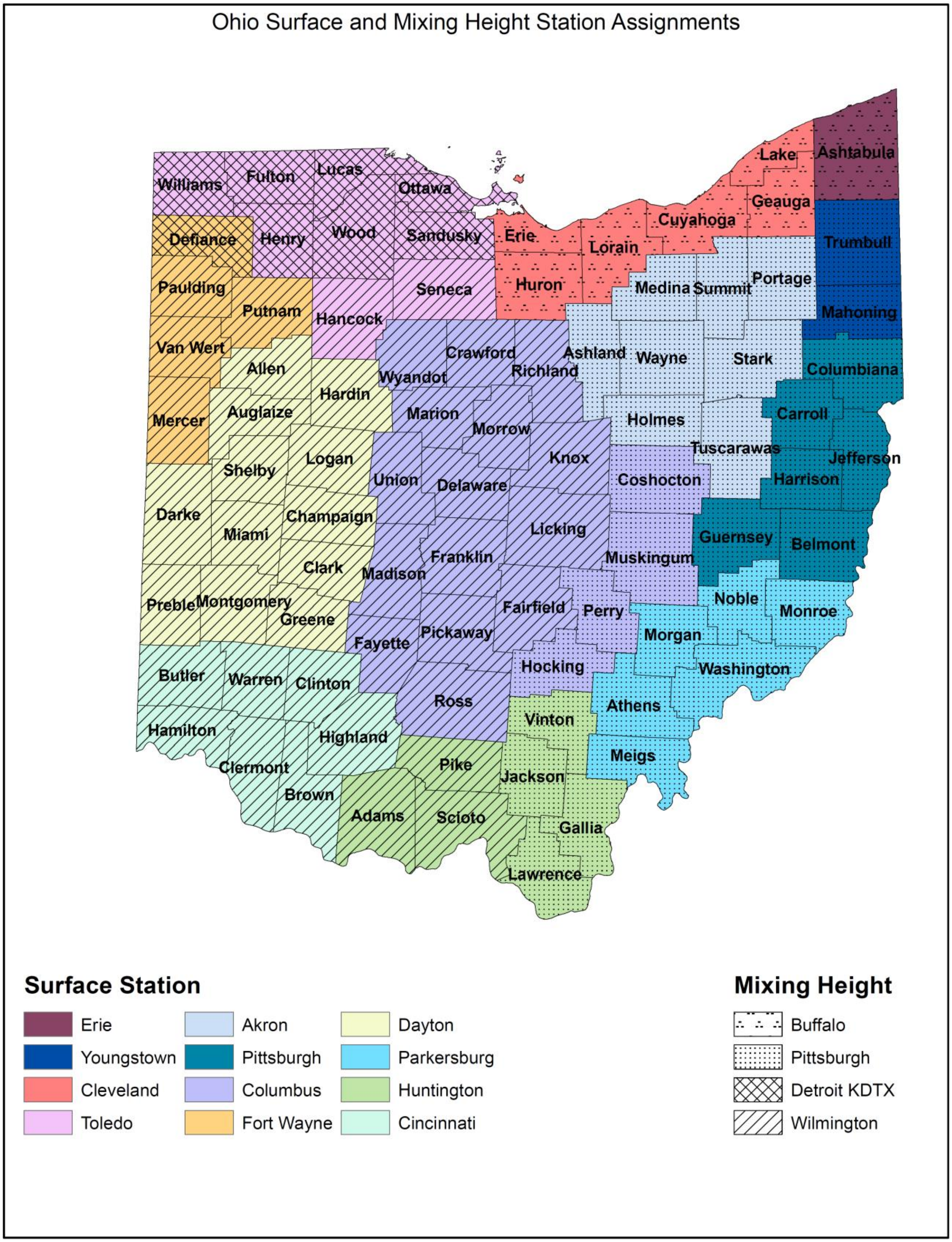
Ohio Surface and Mixing Height Station Assignments
Ashtabula
Lake
Geauga
Cuyahoga
Trumbull
Lorain
Erie
Huron
Medina
Summit
Portage
Mahoning
Ashland
Wayne
Stark
Columbiana
Richland
Crawford
Holmes
Carroll
Tuscarawas
Jefferson
Harrison
Coshocton
Knox
Guernsey
Belmont
Muskingum
Noble
Monroe
Perry
Morgan
Washington
Athens
Meigs
Hocking
Vinton
Jackson
Gallia
Lawrence
Williams
Fulton
Lucas
Ottawa
Wood
Sandusky
Defiance
Henry
Seneca
Hancock
Paulding
Putnam
Van Wert
Allen
Wyandot
Hardin
Marion
Morrow
Mercer
Auglaize
Shelby
Logan
Union
Delaware
Darke
Miami
Champaign
Licking
Clark
Franklin
Madison
Fairfield
Preble
Montgomery
Greene
Fayette
Pickaway
Butler
Warren
Clinton
Ross
Hamilton
Clermont
Highland
Brown
Pike
Adams
Scioto
Surface Station
Erie
Youngstown
Cleveland
Toledo
Akron
Pittsburgh
Columbus
Fort Wayne
Dayton
Parkersburg
Huntington
Cincinnati
Mixing Height
Buffalo
Pittsburgh
Detroit KDTX
Wilmington

Table 2
National Weather Service Anemometer Heights and Station Numbers

Site	Anemometer Height	Station Number
Akron/Canton	20 feet	14895
Cincinnati/Covington	20 feet	93814
Cincinnati/Abbe Obs	51 feet	93890
Cleveland	10 meters	14820
Columbus	20 feet	14821
Dayton	22 feet	93815(surface)
Dayton (Wright Pat)	NA	13840(upper air)
Mansfield	20 feet	14891
Toledo	30 feet	94830
Youngstown	20 feet	14852
Buffalo, NY	10 meters	14733
Erie, Pa.	20 feet	14860
Flint, Mi.	21 feet	14826
Fort Wayne, In.	20 feet	14827
Huntington, WV	20 feet	03860
Charleston WV	117 feet	13866
Elkins WV	20 feet	13729
Pittsburgh, Pa	20 feet	94823
Parkersburg, WV	100 feet	13867

Table 3

Federal (a) and State Modeling Standards and Significant Emission Rates

	National Ambient Air Quality Standards (NAAQS)				PSD Class I		PSD Class II			Ohio EPA	
Pollutant	**Averaging Period**	**Primary Standard**	**Secondary Standard**	**PSD Significant Emission Rate (tpy)**	**PSD Increment (ug/m^3)**	**Significant Impact Levels (ug/m^3)**	**PSD Increments (ug/m^3)**	**Significant Impact Levels (ug/m^3)**	**PSD Monitoring De Minimis Concentration (ug/m^3)**	**Ohio Modeling Significant Emission Rates (tpy)**	**Generally Acceptable Incremental Impact (ug/m^3)(b)**
Reference(s)	A			B	C	D, E	C	D, F, G, H	I		
PM2.5 (c)	Annual (2012)	12 ug/m^3 (d)	15 ug/m^3 (d)	PM2.5 – 10 SO2 – 40 NOx - 40	1 (e)	0.06 (e)	4 (e)	0.3 (e)	-----	10	2(e)
	Annual (1997)	15 ug/m^3 (d)	15 ug/m^3 (d)		1 (e)	0.06 (e)	4 (e)	0.3 (e)	-----		(2)(e)
	24-hr	35 ug/m^3 (f)	35 ug/m^3 (f)		2 (g)	0.07 (e)	9 (g)	1.2 (e)	0 (e)		4.5(g)
PM10 (c)	Annual	----	----	15	4 (e)	0.2 (e)	17 (e)	1 (e)	-----	15	8.5 (e)
	24-hr	150 ug/m^3 (h)	150 ug/m^3 (h)		8 (g)	0.3 (e)	30 (g)	5 (e)	10 (e)		15 (g)
Sulfur Dioxide	Annual	0.030 ppm (80 ug/m^3) (i)		40	2 (e)	0.1 (e)	20 (e)	1 (e)	-----	40	10 (e)
	24-hr	0.14 ppm (365 ug/m^3) (j)			5 (g)	0.2 (e)	91 (g)	5 (e)	13 (e)		45.5 (g)
	3-hr	----	0.5 ppm (1300 ug/m^3) (g)		25 (g)	1.0 (e)	512 (g)	25 (e)	-----		256 (g)
	1-hr	75 ppb (196 ug/m^3) (k)	----		-----	-----	----	7.9 (e)	-----		196(e)
Nitrogen Dioxide	Annual	53 ppb (100 ug/m^3) (e)	53 ppb (100 ug/m^3) (e)	40	2.5 (e)	0.1 (e)	25 (e)	1 (e)	14 (e)	40	12.5 (e)
	1-hr	100 ppb (188 ug/m^3) (l)	----		-----	-----	----	7.5 (e)	-----		188(e)
Ozone	8-hr (2008)	0.075 ppm (m)	0.075 ppm (m)	VOC - 40 NOx - 40(n)	-----	-----	-----	-----	-----	-----	-----
	8-hr (1997)	0.08 ppm (m)	0.08 ppm (m)		----	----	----	----	----		
Carbon Monoxide	8-hr	9 ppm 10,000 ug/m^3) (g)	----	100	-----	-----	-----	500 (e)	575 (e)	100	2500 (g)
	1-hr	35 ppm 40,000 ug/m^3) (g)	----		-----	-----	-----	2000 (e)	-----		10000 (g)
Lead	Rolling 3-Month	0.15 ug/m^3 (e)	0.15 ug/m^3 (e)	0.6	-----	-----	-----	-----	0.1(p)-	0.6	0.0375(e)
Air Toxics (1-hr)	Not Applicable									1	MAGLC (e),(q) & (r)

---- Represents a SIL, increment, monitoring requirement, or NAAQS was not effective at the time this guide was finalized or is not currently applicable to this pollutant. When there is a discrepancy (e.g., a revision to a standard made by U.S. EPA that has not yet been incorporated into this guide), U.S. EPA's standards should be utilized until such time as Table 3 is updated.

(a) With respect to criteria pollutants, it is Ohio EPA's intention to follow U.S. EPA modeling thresholds. When there is a discrepancy (e.g., an update made by U.S. EPA that has not yet been incorporated into this guide), U.S. EPA's modeling thresholds should be utilized in the evaluations until such time as Table 3 is updated.

(b) Please note that the Director always reserves the right to request modeling for projects that fall below these thresholds if it is believed that they may cause or contribute to an exceedance.(c) Filterable + Condensable.

(d) The 3-year average of the weighted annual mean PM2.5 concentrations must not exceed the NAAQS.

(e) Concentration not to be exceeded.

(f) The 3-year average of the 98th percentile of 24-hr concentrations must not exceed the NAAQS.

(g) Not to be exceeded more than once per year.

(h) Not to be exceeded more than once per year on average over three years.

(i) Concentration not to be exceeded. This standard is revoked one year after the effective date of U.S. EPA designations under the 1-hr standard for an area. For Ohio's nonattainment areas, that date is October 4, 2014. U.S. EPA has not made any designations (attainment or unclassifiable) for other areas of Ohio.

(j) Not to be exceeded more than once per year. This standard is revoked one year after the effective date of U.S. EPA designations under the 1-hr standard for an area. For Ohio's nonattainment areas, that date is October 4, 2014. U.S. EPA has not made any designations (attainment or unclassifiable) for other areas of Ohio.

(k) The 3-year average of the 99th percentile of the daily maximum 1-hr average at each monitor within an area must not exceed the NAAQS.

(l) The 3-year average of the 98th percentile of the daily maximum 1-hr average at each monitor must not exceed the NAAQS.

(m) The 3-year average of the fourth-highest daily maximum 8-hr average ozone concentrations must not exceed the NAAQS.

(n) Emissions of VOC or NOx.

(o) Not to be exceeded on more than one day per year, three year average.

(p) Not to be exceeded on a 3-month rolling average basis.

(q) Value calculated by procedures outlined in current version of the Ohio EPA Division of Air Pollution Control document entitled "Review of New Sources of Air Toxic Emissions – Option A."

(r) Note that modeling may be required by Ohio EPA when the emission rate is less than 1.0 ton/yr in the case of "highly toxic" compounds. If the permittee believes that a compound that will be emitted might be considered "highly toxic" please contact the Ohio EPA permit writer to discuss the need for modeling.

References

A NAAQS are found in 40 CFR Part 50.

B PSD Significant Emission Rates are found in 40 CFR 52.21(b)(23)(i).

C PSD Class I and Class II Ambient Air Increments are found in 40 CFR 52.21(c).

D The PM2.5 Class I and Class II Significant Impact Levels are based on U.S. EPA's "Guidance for PM2.5 Permit Modeling, May 20, 2014."

E The PM10, SO2 and NO2 Class I Significant Impact Levels are based on the July 23, 1996 NSR Reform Proposed Rulemaking (61 FR 38249).

F The 1-hr SO2 Class II Significant Impact Level is based on U.S. EPA's "Guidance Concerning the Implementation of the 1-hour SO2 NAAQS for the Prevention of Significant Deterioration Program, August 23, 2010."

G The 1-hr NO2 Class II Significant Impact Level is based on U.S. EPA's "General Guidance for Implementation of the 1-hour NO2 NAAQS in Prevention of Significant Deterioration Permits, Including an Interim 1-hour NO2 Significant Impact Level, June 28, 2010."

H The Class II Significant Impact Levels for PM10, NO2 (annual), and SO2 (annual, 24-hr and 3-hr) are found in 40 CFR 51.165(b)(2).

I The PSD Monitoring De Minimis Concentrations are found in 40 CFR 52.21(i)(5)(i).

Appendix A

AERSCREEN

Model Application Guidance

AERSCREEN is the recommended screening model and is based on AERMOD. The model will produce estimates of "worst-case" 1-hour concentrations for a single source, without the need for hourly meteorological data, and also includes conversion factors to estimate "worst-case" 3-hour, 8-hour, 24-hour, and annual concentrations. AERSCREEN is intended to produce concentration estimates that are equal to or greater than the estimates produced by AERMOD with a fully developed set of meteorological and terrain data, but the degree of conservatism will vary depending on the application. AERMOD guidance, where applicable, will also apply to AERSCREEN modeling. When submitting AERCREEN modeling results, applicants should submit all input files including elevation and external building data files where relevant, as well as all output files.

The AERSCREEN model consists of two main components: 1) the MAKEMET program, which generates a site-specific matrix of meteorological conditions for input to the AERMOD model; and 2) the AERSCREEN command-prompt interface program. AERSCREEN interfaces with MAKEMET for generating the meteorological matrix, and also interfaces with AERMAP and BPIPPRM to automate the processing of terrain and building information, respectively. It interfaces with the AERMOD model utilizing the SCREEN option to perform the modeling runs.

AERSCREEN Input

The type of AERSCREEN source to be chosen is dependent on how the emissions leave the source (if the source is not enclosed) or how they leave the building or enclosure if emitted within a building or enclosure. Once the egress points are identified and characterized, one of the following source types is applied to the emissions at the point of egress (stack, window, vent, etc.). The AERSCREEN program is currently limited to modeling a single point, capped stack, horizontal stack, rectangular area, circular area, flare, or volume source.

The following information identifies the AERSCREEN model choices to be used when modeling for Ohio new source review. Since the AERSCREEN model does not directly identify which release scenarios lead to the use of the AERSCREEN model, “AERSCREEN pathways” are identified to assist AERSCREEN users in making scenario choices and the determination of the desired source type.

The input data summary shows the inputs as they appear in the AERSCREEN input file. The summary is updated after each change to the inputs, as well as when a file is opened. Inputs required by AERSCREEN are as following:

- Source parameters – the source type appears first, followed by input parameters for the source type
- Building parameters – whether building downwash is used in the model and the inputs for a single building
- Met data – inputs to the MAKEMET program that creates meteorological data files
- Discrete receptors – whether to use discrete receptors and the file containing discrete receptor distances
- Terrain data – whether terrain is applied and the source location and elevation
- Urban area – whether the source is located in a rural or urban area and the distance from the source to the fence line.
- Output file – location of the AERSCREEN output file
- Run title – title for the AERSCREEN model run
- NO_2 Chemistry – shows NO2 chemistry options if NO_2 is being modeled with OLM or PVMRM

Source parameters

The parameters differ by source type, but an emission rate must be entered for any source type selected for modeling. The source types are:

- Point – releases from stacks and isolated vents

- Flare – releases from flares
- Volume – releases from a variety of industrial sources, such as building roof monitors, multiple vents, and conveyor belts
- Rectangular area – low level or ground level releases with no plume rise (e.g., storage piles, slag dumps, and lagoons)
- Circular area – low level or ground level releases from a source having a circular shape

Point source

Stack parameters for point (vertical stacks with no caps), capped stacks, and horizontal stacks are the same. Point sources are denoted by the term "** STACK DATA" in the input file in the line above the source parameters. Capped stacks are denoted by the term "** POINTCAP DATA" in the input file and horizontal stacks are denoted by the term "** POINTHOR DATA" in the input file. Source inputs for these three source types are shown with English and metric units in parentheses:

- Emission rate (lb/hr or g/s)
- Stack height (feet or meters)
- Stack diameter (inches or meters)
- Stack temperature (degrees Fahrenheit or Kelvin)
- Stack velocity (ft/s or m/s) or flow rate (ACFM)

The rest of the parameters are similar to the parameters in the AERMOD model. Entering 0 Kelvin for temperature will make AERSCREEN use ambient temperature from the meteorological data files.

Flare source

Flare sources are denoted by the term "** FLARE DATA" in the input file in the line above the source parameters. Flare source inputs are, with English and metric units:

- Emission rate (lb/hr or g/s)
- Stack height (feet or meters)
- Total heat release rate (cal/sec)
- Radiative heat loss fraction

The heat loss fraction can be entered if known, or the default value of 0.55 can be used. AERSCREEN will process the flare in AERMOD as a POINT source type. For the exit velocity and exit temperature, AERSCREEN defaults these values to 20 m/s and 1,273 K, respectively. The stack diameter and effective stack height used in AERMOD are calculated from the inputs as:

$$D = 9.8 \times 10^{-4} \times \sqrt{HR \times (1 - HL)}$$
$$H_{eff} = H_s + 4.56 \times 10^{-3} \times HR^{0.478}$$

where D is effective stack diameter, HR is the heat release rate, HL is the heat loss fraction, H_{eff} is effective stack height , and H_s is the stack height.

Volume sources

Volume sources are denoted by the term "** VOLUME DATA" in the input file in the line above the source parameters. Volume source inputs are, with English and metric units:

- Emission rate (lb/hr or g/s)
- Release height, i.e. center of volume (feet or meters)
- Initial lateral dimension of the volume (feet or meters)
- Initial vertical dimension of the volume (feet or meters)

Rectangular area sources

Rectangular area sources are denoted by the term "** AREA DATA" in the input file in the line above the source parameters. Rectangular area source inputs are, with English and metric units:

- Emission rate (lb/hr or g/s)
- Release height above ground (feet or meters)
- Long and short dimensions of area (feet or meters)
- Initial vertical dimension of plume (feet or meters)

It is very important to note that the emission rate for a rectangular area source in AERSCREEN is specified in g/s or lb/hour, not an emission rate per unit area, as is used in AERMOD modeling applications. AERSCREEN automatically calculates the emission rate per unit area. . The angle of the source relative to north is automatically set to 0 degrees. Note that the long dimension of the area source is in the x-direction and short dimension in the y-direction.

Circular area sources

Circular area sources are denoted by the term "** AREACIRC DATA" in the input file in the line above the source parameters. Circular area source inputs are, with English and metric units:

- Emission rate (lb/hr or g/s)
- Release height above ground (feet or meters)
- Radius of circle (feet or meters)
- Initial vertical dimension of plume (feet or meters)

As with rectangular area sources, the emission rate is specified by the user in g/s or lb/hour, not as an emission rate per unit area.

NO_2 Chemistry

Starting with AERSCREEN version 11060, AERSCREEN has the option of modeling NO_X to NO_2 conversion using the OLM and PVMRM methods of the AERMOD model. This option is not selected by default. When entering data via the prompts, the user is asked to enter an option for modeling NO_X to NO_2 conversion:

- No chemistry or pollutant is not NO_2
- Use Ozone Limiting Method (OLM)
- Use Plume Volume Molar Ratio Method (PVMRM)

If option two or three is chosen, the user is prompted for the NO_2/NO_X in-stack ratio (AERMOD card CO NOSTACK) and a representative ozone background concentration (AERMOD card CO OZONEVAL). The NO_2/NO_X in-stack ratio can range from zero to one and units of the background concentration can be parts per million (ppm), parts per billion (ppb) or micrograms per cubic meter (ug/m^3). For PVMRM the NO2EQUIL ratio is set at the default value of 0.9. For OLM use, since only one source is being modeled, the OLMGROUP keyword is not needed.

Building parameters: Downwash

Building downwash only applies to point, capped stack, horizontal stack, and flare sources. Building parameter data are denoted by the term "** BUILDING DATA" in the input file in the line above the building dimensions. Several parameters are needed by AERSCREEN for input into BPIPPRM. These are:

- Include downwash (Y=use building downwash, N=no downwash)

- Option to use an existing BPIPPRM input file or,
- Building height (feet or meters)
- Maximum building dimension (feet or meters)
- Minimum building dimension (feet or meters)
- Degrees from North of maximum building horizontal dimension (0-179 degrees)
- Degrees from North of stack location relative to building center (0-360 degrees)
- Distance between stack and building center (feet or meters)

Meteorology and Surface characteristics

AERSCREEN uses the meteorological data pre-processor MAKEMET to create surface and profile meteorological data files for an AERSCREEN model run. For inputs to MAKEMET, the user enters the following:

- Minimum and maximum ambient air temperatures (Fahrenheit or Kelvin), regulatory default values of 250.00 K and 310.00 as minimum and maximum, respectively
- Minimum wind speed (m/s), regulatory default value of 0.5 m/s
- Anemometer height (m), regulatory default value of 10 m

Surface characteristics (user-entered, AERMET tables, or surface characteristics listed in an external file)

Urban area

The urban area input parameter is used to indicate whether the source is located in an urban area or a rural area. The rural area option is selected by default. If the urban area option is selected, the population for the area must be entered.

Receptors

AERSCREEN generates a receptor grid based on the values specified by the user in the Receptors form. The probe distance is the distance from the source to the farthest receptor to be included in the grid. The larger this distance, the more receptors there will be in the grid. AERSCREEN places receptors 25 meters apart up to 5 kilometers from the source, and farther apart for distances greater than 5 kilometers from the source. The ambient distance is the distance from the source to the fence line of the facility being modeled. No receptors will be generated that are closer to the source than the ambient distance. The flagpole height is the height of all receptors above ground level.

Discrete receptors: Starting with AERSCREEN version 11060, the mode has the option of entering up to ten discrete receptor distances. These distances will be used to generate receptors in addition to the receptor grid automatically created by AERSCREEN. The distances are from the source being modeled to the receptor. These could include distances to specific locations near a source such as a monitor, school, residential area, etc. AERSCREEN will read all of the locations input by the user but will only process receptors that are between the ambient distance and probe distance. Distances can be entered as:

- FEET or FT for feet
- METERS for meters
- KILOMETERS, KILO-METERS, or KM for kilometers
- MILES for miles

Terrain

AERSCREEN provides the option for incorporating terrain impacts on the screening analysis. For terrain processing in AERMAP, the user enters the following:

- Include terrain processing (yes=include terrain, no=do not include terrain effects)
- Probe distance (meters)
- Include discrete receptor distances (beginning with version 11060)

- Source coordinates (geographic or UTM)
- Flagpole receptors
- Source elevation or use AERMAP to determine source elevation
- NAD datum (NAD 27 or 83)
- UTM zone (if UTM coordinates entered)

SUMMARY OF SUGGESTED PROCEDURES FOR ESTIMATING
INITIAL LATERAL DIMENSIONS (σ_{yo}) AND
INITIAL VERTICAL DIMENSIONS (σ_{zo}) FOR VOLUME SOURCES

Description of Source	Initial Dimension	
(a) Initial Lateral Dimensions (σ_{yo})		
Single Volume Source	σ_{yo} =	length of side divided by 4.3
(b) Initial Vertical Dimensions (σ_{zo})		
Surface-Based Source (h_e ~ 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

Appendix B

SCREEN/TSCREEN

Model Application Guidance

The type of SCREEN source to be chosen is dependent on how the emissions leave the source (if the source is not enclosed) or how they leave the building or enclosure if emitted within a building or enclosure. Once the egress points are identified and characterized, one of the following source types is applied to the emissions at the point of egress (stack, window, vent, etc.)

The following information identifies the SCREEN/TSCREEN model choices to be used when modeling for Ohio new source review. Since the TSCREEN model does not directly identify which release scenarios lead to the use of the SCREEN model, "TSCREEN pathways" are identified to assist TSCREEN users in making scenario choices that will lead to the SCREEN model and the desired source type.

Point Source

TSCREEN pathways; There are several TSCREEN release scenarios which utilize the SCREEN3 point source option including Gaseous Release Type, Stacks, Vents, Conventional Point Sources or Particulate Matter Release Type, Stacks, Vents.

- Emission rate (g/s)
- Stack Height (above ground, not roof (m))
- Stack inside diameter (m, diameter of equivalent area circle if stack is not round)
- Stack exit velocity (m/s) or flow rate (ACFM or m^3/s)
- Stack gas temperature (K)
- Ambient temperature (use default of 293 K)
- Receptor height above ground (use 0, ground level)
- Urban/Rural (based on land use within 3 km of the source)
- Building downwash (Building information is necessary if stack is within the influence of a building: i.e., within five times the lesser building dimension)
- Do not consider building cavity calculations. **Note:** AERMOD has replaced ISC as the only acceptable refined model. This model does incorporate building wake and cavity effects. After 2002, users of SCREEN will also need to consider the building cavity calculations when determining peak impacts.
- Complex terrain (yes if terrain above stack height is present in the potential impact area of the source)
- Simple or flat (yes for simple: if terrain above stack base is present in the potential impact area of the source. When in doubt, say yes and perform the analysis)
- Choice of meteorology (option 1, full meteorology)
- Automated distance array (yes, minimum distance (m) begins at "ambient air" (usually the fence line) and should extend to a point which ensures that the maximum concentration has been found, up to a maximum of 50,000 m)
- Discrete distance option (used for informational purposes only)
- Fumigation Option (fumigation calculations are not used for state permit modeling)

Area Source

TSCREEN pathway; There are several TSCREEN pathways which utilize the SCREEN3 area source option including Particulate Matter Release Type, Fugitive/Windblown Dust Emissions or Storage Piles or Gaseous Release Type, Multiple Fugitive Sources. The TSCREEN pathways **do not** allow the characterization of non-square area sources which is now an option with SCREEN3.

General option choices are the same as for point source except for the following;

- Emission rate ($g/s/m^2$)
- Source height (mean height of source, m)
- Length of longer side of rectangular area, (m)
- Length of shorter side of rectangular area, (m)

- Wind direction search (yes)

Volume Source

TSCREEN pathway: (the SCREEN volume source option is not available through TSCREEN)

General options choices are the same as for point source except for the following;

- Initial lateral dimension (modified per table below (m))
- Initial vertical dimension (modified per table below (m))
- Height of release (the midpoint of the opening (m))

SUMMARY OF SUGGESTED PROCEDURES FOR ESTIMATING
INITIAL LATERAL DIMENSIONS (σ_{yo}) AND
INITIAL VERTICAL DIMENSIONS (σ_{zo}) FOR VOLUME SOURCES

Description of Source		Initial Dimension
(a) Initial Lateral Dimensions (σ_{yo})		
Single Volume Source	σ_{yo} =	length of side divided by 4.3
(b) Initial Vertical Dimensions (σ_{zo})		
Surface-Based Source (h_e ~ 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

Appendix C
Urban/Rural Classification (a)

Land Use Method: 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.

Auer Land Use Categories I1, I2, C1, & R2 (Auer 1978)

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	

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

(a) Based upon Section 7.2.3 (c and d) of Appendix W, 40 CFR Part 51.