AERSCREEN User's Guide

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Preface

This document provides a description of AERSCREEN, the screening version of AERMOD. Included in the document are descriptions of inputs, processing methodology in AERSCREEN, and outputs.

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1. Overview of AERSCREEN

AERSCREEN is a screening-level air quality model based on AERMOD (U.S. EPA, 2004a). 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, but also interfaces with AERMAP (U.S. EPA, 2004b) and BPIPPRM (Schulman et al. 2000; U.S. EPA, 2004d) to automate the processing of terrain and building information respectively, and interfaces with the AERMOD model utilizing the SCREEN option to perform the modeling runs. AERSCREEN interfaces with version 09292 and later versions of AERMOD and will not work with earlier versions of AERMOD. The AERSCREEN program also includes averaging time factors for worst-case 3-hr, 8-hr, 24-hr and annual averages.

The screening mode of the current version of AERMOD, which is controlled by the SCREEN option on the CO MODELOPT card, forces the model calculations to represent values for the plume centerline, regardless of the source-receptor-wind direction orientation. This option is included in AERMOD to facilitate the use of the model in a screening mode to estimate worst-case impacts. Since the screening option in AERMOD is designed to be used with a non-sequential meteorological data file representing a matrix of conditions, currently generated by the MAKEMET program, the SCREEN option also forces the use of the NOCHKD option even if NOCHKD is not included on the MODELOPT card. The NOCHKD option suspends the checks made within AERMOD for proper date sequences in the surface and profile meteorological input data files. The SCREEN option also restricts the averaging period options to 1-hour averages only on the CO AVERTIME card.

Given these two basic components of AERSCREEN, the AERMOD model can be run in a screening mode by either: 1) using the AERSCREEN command-prompt interface; or 2) using the stand-alone MAKEMET program to generate the matrix of meteorological conditions and running AERMOD directly with the SCREEN option. The first approach automates much of the processing for the user, including building and terrain processing, while the second approach gives the user more flexibility for defining the receptor network to be used in the screening analysis and may be more appropriate in certain situations, especially in very complex terrain settings. These two options for running AERMOD in a screening mode will not necessarily produce the same results. This is because the results for the stand-alone application of AERMOD with MAKEMET-generated meteorology will be determined by the user-specified receptor network, whereas the AERSCREEN program performs a more precise search to isolate the receptor distance with the highest impact, similar to the automated distance option in SCREEN3 (U.S. EPA, 1995). In general, the AERSCREEN program should produce slightly more conservative results than stand-alone AERMOD with MAKEMET data, depending on the receptor resolution used for the latter.

Before running AERSCREEN, users should consult and become familiar the following:
- AERMOD User's Guide and addenda (U.S. EPA, 2004a)
- AERMAP User's Guide and addenda (U.S. EPA, 2004b)
- AERMET User's Guide [for surface characteristics tables] (U.S. EPA, 2004c)
- BPIPPRM User's Guide (U.S. EPA, 2004d)
- *Guideline on Air Quality Models (Appendix W)* (U.S. EPA, 2005)
- AERSURFACE User's Guide (U.S. EPA, 2008)
- AERMOD Implementation Guide (U.S., EPA, 2009)
- Screening Procedures for Estimating the Air Quality Impact of Stationary Sources (U.S. EPA, 1992)

The above documents and other support documents can be found at the AERMOD modeling page of the Support Center for Regulatory Atmospheric Modeling (SCRAM) page at: http://www.epa.gov/scram001/dispersion_prefrec.htm#aermod and the *Guideline on Air Quality Models* (hereafter referred to as Appendix W) can be found at: http://www.epa.gov/scram001/guidance/guide/appw_05.pdf

1.1 Description of AERSCREEN

As stated above, AERSCREEN is an interactive command-prompt application that interfaces with MAKEMET for generating the meteorological matrix, but also interfaces with AERMAP and BPIPPRM to automate the processing of terrain and building information, and interfaces with the AERMOD model utilizing the SCREEN option to perform the modeling runs. The AERSCREEN program also includes averaging time factors for worst-case 3-hr, 8-hr, 24-hr and annual averages. The AERSCREEN program is currently limited to modeling a single point (vertical uncapped stack), capped stack, horizontal stack, rectangular area, circular area, flare, or volume source.

Inputs or options to AERSCREEN are:
- Source parameters for point, rectangular area, circular area, volume, capped stack, horizontal stack or flare sources
- Building downwash information for point, capped stack, horizontal stack, and flare sources
- Ability to model NOx to NO_2 conversion
  - Plume Volume Molar Ratio (PVMRM) (Hanrahan, 1999a and 1999b) or
  - Ozone Limiting Method (OLM)
  - Input of representative ozone background concentration
- Ability to use terrain heights for source and receptors via AERMAP
- Specify ambient minimum and maximum temperatures for MAKEMET
- Specify minimum wind speed and anemometer height for MAKEMET
- Specify surface characteristics for input to MAKEMET by the following methods:

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- o user-defined single values for albedo, Bowen ratio, and surface roughness (no temporal or spatial variation in surface characteristics)
    - o AERMET seasonal tables (temporal variation only)
    - o Values listed in an external file, either an AERSURFACE (U.S. EPA, 2008) output file or surface characteristics listed in an AERMET stage 3 input file
- Probe distance (maximum downwind distance) of receptors
- Use of flagpole receptors and define flagpole height
- Specify urban or rural source and urban population if urban source
- Minimum ambient distance for ambient air receptors
- Up to ten discrete receptor distances in a user supplied text file
- Performs error checks on AERSCREEN inputs, AERMOD output and/or AERMAP output
- Calculate maximum concentration by distance
- Search routine to find overall worst case scenario (maximum 1-hour concentration)

AERSCREEN automatically provides impacts for other averaging periods using scaling ratios. The averaging period ratios currently implemented in AERSCREEN are as follows *(SCREEN3 factors are shown for comparison)*:

- 3-hour   fixed ratio of 1.00   *0.90*
- 8-hour   fixed ratio of 0.90   *0.70*
- 24-hour   fixed ratio of 0.60   *0.40*
- Annual   fixed ratio of 0.10   *0.08*

For area sources (rectangular and circular), the averaging factors are based on guidance in Section 4.5.4 of the EPA screening guidance document (U.S. EPA, 1992). For area sources, the 3, 8, and 24-hour average concentrations are equal to the 1-hour average calculated by AERMOD in screening mode. No annual average concentration is calculated.

1.2 Description of MAKEMET

The MAKEMET program generates a matrix of meteorological conditions, in the form of AERMET-ready surface (AERSCREEN.sfc) and profile (AERSCREEN.pfl) files, based on user-specified surface characteristics, ambient temperatures, minimum wind speed, and anemometer height. See the AERMET User's Guide (U.S. EPA, 2004c) for file formats. The current version of MAKEMET also allows the user to specify the minimum wind speed to include in the matrix and the anemometer height as well. These options have been included to facilitate comparisons of AERSCREEN estimates to estimates from AERMOD in a refined mode to eliminate differences that may be due to either the minimum wind speed in the refined data or the anemometer height. The suggested default values for routine application of MAKEMET are 0.5 m/s for the minimum wind speed and 10 meters for the anemometer height.

MAKEMET allows the user to specify more than one set of surface characteristics and ambient temperatures, such as for seasonal or monthly variations, and will concatenate the resulting meteorological matrices into single surface and profile files. For AERSCREEN, this option is not used and separate files are created for seasonal or monthly variations in surface characteristics. No variation in minimum and maximum temperature is done in MAKEMET. MAKEMET also allows the user to specify a single wind direction or a range of wind directions for the meteorological matrix. This option may be useful for applications involving building downwash to ensure that building dimensions for all sectors are included in the screening analysis (the treatment of building downwash in the AERSCREEN program is described in Section 3.2.2). However, in AERSCREEN processing, the wind direction is set to a single direction of 270 degrees.

MAKEMET can be run from the command-prompt, with the prompts in Figure 1 for user input.

ENTER SFC MET FILE NAME

ENTER PFL MET FILE NAME

ENTER MIN. WS (M/S)

ENTER ANEM HT (M)

ENTER NUMBER OF WIND DIRECTIONS

 If the user enters one for the number of wind directions
ENTER WIND DIRECTION

Otherwise
ENTER STARTING WIND DIRECTION

ENTER CLOCKWISE WIND DIRECTION INCREMENT

ENTER MIN AND MAX AMBIENT TEMPS IN KELVIN

ENTER ALBEDO

ENTER BOWEN RATIO

ENTER SURFACE ROUGHNESS LENGTH IN METERS

DO YOU WANT TO GENERATE ANOTHER MET SET THAT WILL BE
APPENDED TO CURRENT FILE?
[TYPE EITHER "Y" OR "y" FOR YES; OR HIT "ENTER" TO EXIT

If ("Y" or "y") then the program loops through prompts 7 through 10 for each additional data set (e.g. seasonal).

Figure 1. User prompts for MAKEMET.

The MAKEMET program has a long complex history, dating back over 10 years. Suffice it to say that the version of MAKEMET supplied with AERSCREEN operates in the following

manner. As mentioned earlier, MAKEMET generates a matrix of meteorological conditions for application of AERMOD in a screening mode and output the results in the form of AERMOD-ready surface and profile meteorological data files. The matrix is generated based on looping through a range of wind speeds, cloud covers, ambient temperatures, solar elevation angles, and convective velocity scales (w* for convective conditions only) for user-specified surface characteristics (Z_o, B_o, r). For stable cases, the mechanical mixing height (Z_{im}) is calculated based on the friction velocity, u*. A loop through Z_{im} factors (multiplied times the initial value calculated form u*) is also included to account for smoothing of Z_{im} that occurs with refined AERMET data. Stable transition cases with solar angle greater than zero but less than the critical solar angle (ACRIT) are also included in the matrix.

The program calculates u*, Monin-Obukhov length (L), and Z_{im} for each combination in the matrix, and also calculates the convective mixing height (Z_{ic}) based on w* for convective cases. The program uses subroutines from AERMET (U.S. EPA, 2004c) to calculate boundary layer parameters for each combination in the matrix. The program generates a log file, called MAKEMET.LOG, which summarizes the inputs selected for that run, and the number of "hours" in the final screening matrix for each set of surface characteristics. An effort has been made to optimize the MAKEMET program for AERMOD screening applications by eliminating combinations that are unnecessary in terms of identifying worst-case impacts, based on a wide range of tests comparing screening to refined AERMOD estimates (which are briefly summarized below). The number of "hours" per set of surface characteristics will typically be around 300-400, but will vary depending on the user inputs. The number will tend to be larger for applications with lower surface roughness due to the internal checks made to eliminate unnecessary combinations.

MAKEMET uses the following scheme to assign dates for each of the "hours" in the meteorological matrix. The default starting year for the data is 10, and the year is incremented by 10 for each additional data set generated. Thus, for seasonal data files, the first season date will start with a '1', second season will start with a '2', etc. The hour is used to distinguish between stable and convective conditions, with hours 01 through 11 indicating stable hours, and hours 12 through 24 indicating convective hours. Note that for monthly data sets and/or for large numbers of wind directions (greater than 36), duplicate dates may be generated. A warning message is written to the log file in these cases. AERMOD will still run since the NOCHKD option is invoked, but determining which conditions produced the worst-case results could become problematic. In addition to the required variables for input to AERMOD, the surface file generated by MAKEMET also includes five columns of integer variables that provide the loop indices for each of the loops in the met matrix corresponding to each "hour" of screening meteorology. These indices can be used to analyze the frequency of occurrence for various combinations within the meteorological matrix resulting in the controlling (highest) concentration.

AERSCREEN provides three options for surface characteristics inputs for generating the screening meteorology. One option allows for user-specified surface characteristics – albedo, Bowen ratio, and surface roughness (no spatial or temporal variation), the second option is to use seasonally varying surface characteristics for generic land use classifications based on Tables 4-

1, 4-2, and 4-3 of the AERMET User's Guide (U.S. EPA 2004c). The third option is to input the name of an external file such as an AERSURFACE (U.S. EPA, 2008) output file or AERMET stage 3 input file that contains surface characteristics. Monthly, seasonal, and annual output for one sector or multiple sectors is allowed with the third option.   AERSCREEN will setup and run the MAKEMET program to generate the screening meteorological data for input to AERMOD. AERSCREEN will run MAKEMET for each combination of temporal period and spatial sector of the surface characteristics. If AERSURFACE output is used, AERSCREEN does not call AERSURFACE, so the user must run AERSURFACE prior to running AERSCREEN.

1.3 Differences with SCREEN3

The three areas where AERSCREEN deviates significantly from SCREEN3 and will, thus, be the most difficult for first time users are:

1) **Building wake effects** – AERSCREEN utilizes all the advantages of PRIME (Schulman et al., 2000) including stacks detached from the building. This requires three additional pieces of information from the user beyond the normal building height and dimensions. The additional information is orientation of the maximum dimension relative to north, angle relative to north of the stack and, distance between the stack and building center. AERSCREEN will use this information to setup and run the BPIPPRM program and extract the information needed for the AERMOD model. More downwash details can be found in Section 2.2.

2) **Meteorology** – AERSCREEN provides three options for generating the screening meteorology. One option allows for user-specified surface characteristics – albedo, Bowen ratio, and surface roughness (no temporal or spatial variation) – the second option is to use seasonally varying surface characteristics for generic land use classifications based on Tables 4-1, 4-2, and 4-3 of the AERMET User's Guide. The third option is to use surface characteristics listed in an external file such as an AERSURFACE output file or AERMET stage 3 input file. The user enters the name of the file. The user also specifies the overall minimum and maximum ambient temperatures. AERSCREEN will setup and run the MAKEMET program to generate the screening meteorological data for input to AERMOD. More details about meteorology can be found in Section 2.3.

3) **Terrain** – AERSCREEN provides the option for incorporating terrain impacts on the screening analysis. The user must create a file called demlist.txt. The first line of this file describes the type of terrain file being used. The file type must be DEM or NED. DEM refers to any DEM file type and NED refers to National Elevation Dataset. The third line of the file lists the location of the NAD conversion files and the fourth line begins the list of terrain files with each file on a separate line. When AERSCREEN is run, the user will be prompted to provide the source coordinates and associated NAD datum. AERSCREEN will then setup the necessary input file for AERMAP, run AERMAP, and extract the information needed for the AERMOD model. More terrain processing details can be found in Section 2.4

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Given the use of surface characteristics and terrain, it is important that the user know the exact coordinates of the source, i.e., stack or center location of volume or area source.

2. AERSCREEN features

    As noted in Section 1.1, AERSCREEN has many features and options available to the user. In this section, the features and inputs to the restart file, AERSCREEN.INP, are described. When running AERSCREEN from a restart file, the file must be named AERSCREEN.INP or AERSCREEN will automatically begin prompting the user for data. The prompts used to enter the data interactively are described in each relevant section as well. Prompts are not necessarily shown in the order in which they appear but in the order for the parameters shown in AERSCREEN.INP for each data section. The prompts described are based on metric units. When processing data from the input file, all units are assumed to be metric. Some variables listed below are not requested when using the prompts to enter data, but are automatically defaulted, such as when processing a rectangular area source, volume source, or circular area source. In the case of a rectangular area source, terrain use and downwash are automatically set to "no" and the user is not prompted for the choice of terrain processing and source coordinates. For all three source types, downwash is automatically set to "no" and downwash information is not requested. When reading data from the input file, if one of the data sections (source, building, terrain, meteorology, etc.) is missing, AERSCREEN will notify the user and stop processing. Also, if the source data is listed after the building, terrain, or miscellaneous data, AERSCREEN will alert the user and stop processing. This is done because the source type is needed to determine if parameters must be reset in the building or terrain sections, such as resetting building downwash to "no" if an area or volume source is being processed. Also, if data is missing or invalid (such as negative emission rate) when reading AERSCREEN.INP, AERSCREEN alerts the user and stops processing.

2.1 Source inputs

    AERSCREEN can be used for a single point, flare, capped stack, horizontal stack, volume, rectangular area source, or circular area source. Below are listed the source types with required input variables and example values from the first line of the AERSCREEN.INP file. Building downwash is allowed for the point, capped stack, horizontal stack, and flare sources but not for volume or area (rectangular or circular) sources. Terrain processing is allowed for all sources except rectangular area sources. For all source types, emission rates are in g/s or lb/hr. For area source types, AERSCREEN calculates the emission rate per unit area, the required input for AERMOD.

2.1.1 Point, capped stacks and horizontal stack sources

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, 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)
- and stack velocity (ft/s or m/s) or flow rate (ACFM)

Note that stack velocity can be input as ft/s or m/s, regardless of using English or metric units for other parameters. AERSCREEN.INP and prompt inputs (shown in italics) are shown in Figures 2 through 4 for point, capped stack and horizontal stacks, respectively. If a stack temperature of zero (Fahrenheit or Kelvin) or negative stack temperature is entered, the entered temperature will be used as a difference between the stack and ambient temperature. A negative number, such as -10, implies that the stack is 10 degrees warmer than the ambient temperature. For capped and horizontal stacks, AERMOD uses the BETA option on the MODELOPT keyword in the AERMOD runstream file, AERMOD.INP, to invoke the algorithms for those source types.

AERSCREEN.INP point source inputs						
** STACK DATA	Rate	Height	Temp.	Velocity	Diam.	Flow
**	0.1896E+01	5.0902	353.7056	13.2662	0.6096	8204.
Point source prompts inputs						

If the user enters "P" or "p" for point source:

Enter Emission Rate (g/s):

Enter Stack Height (meters):

Enter Stack Diameter (meters):

Enter Stack Temperature (K)
 Enter 0 for ambient temperature
 or a negative number for temperature difference ((K))
between stack temperature and ambient temperature:

Option (1) - Exit Velocity (m/s)
Option (2) - Exit Velocity (ft/s)
Option (3) - Flow Rate (ACFM)

Enter Option for Flow Rate or Exit Velocity:

If the user chooses option 1, the prompt is:

Enter Exit Velocity (m/s):

If the user chooses option 2, the prompt is:

Enter Exit Velocity (ft/s):

If the user chooses option 3, the prompt is:

Enter Flow Rate (ACFM):

Figure 2. AERSCREEN.INP and prompts inputs for point sources.

AERSCREEN.INP capped stack source inputs						
** POINTCAP DATA	Rate	Height	Temp.	Velocity	Diam.	Flow
**	0.1896E+01	5.0902	353.7056	13.2662	0.6096	8204.

Capped stack source prompts inputs
If the user enters "S" or "s" for capped stack source: *Enter Emission Rate (g/s):* *Enter Stack Height (meters):* *Enter Stack Diameter (meters):* *Enter Stack Temperature (K)* *Enter 0 for ambient temperature* *or a negative number for temperature difference ((K))* *between stack temperature and ambient temperature:* *Option (1) - Exit Velocity (m/s)* *Option (2) - Exit Velocity (ft/s)* *Option (3) - Flow Rate (ACFM)* *Enter Option for Flow Rate or Exit Velocity:* If the user chooses option 1, the prompt is: *Enter Exit Velocity (m/s):* If the user chooses option 2, the prompt is: *Enter Exit Velocity (ft/s):* If the user chooses option 3, the prompt is: *Enter Flow Rate (ACFM):*

Figure 3. AERSCREEN.INP and prompts inputs for capped stack sources.

AERSCREEN.INP horizontal stack source inputs						
** POINTHOR DATA	Rate	Height	Temp.	Velocity	Diam.	Flow
**	0.1896E+01	5.0902	353.7056	13.2662	0.6096	8204.
Horizontal stack source prompts inputs						

If the user enters "H" or "h" for horizontal stack source:

Enter Emission Rate (g/s):

Enter Stack Height (meters):

Enter Stack Diameter (meters):

Enter Stack Temperature (K)
Enter 0 for ambient temperature
or a negative number for temperature difference ((K))
between stack temperature and ambient temperature:

Option (1) - Exit Velocity (m/s)
Option (2) - Exit Velocity (ft/s)
Option (3) - Flow Rate (ACFM)

Enter Option for Flow Rate or Exit Velocity:

If the user chooses option 1, the prompt is:

Enter Exit Velocity (m/s):

If the user chooses option 2, the prompt is:

Enter Exit Velocity (ft/s):

If the user chooses option 3, the prompt is:

Enter Flow Rate (ACFM):

Figure 4. AERSCREEN.INP and prompts inputs for horizontal stack sources.

2.1.2 Flares

    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 user selected or the SCREEN3 default value of 0.55. For information about heat loss fractions, see Leahey and Davies (1984). 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 as done in SCREEN3 (U.S. EPA, 1995). The stack diameter and effective stack height used in AERMOD are calculated from the inputs as:

$$D = 9.88 \times 10^{-4} \times \sqrt{HR \times (1 - HL)} \qquad (1)$$

$$H_{eff} = H_s + 4.56 \times 10^{-3} \times HR^{0.478} \qquad (2)$$

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 entered by the user.

AERSCREEN.INP and prompt inputs (in italics) are shown in Figure 5.

AERSCREEN.INP flare source inputs				
** FLARE DATA	Rate	Height	Heat	HeatLoss
**	0.1000E+03	35.0000	0.1000E+08	0.550
Flare source prompts inputs				
If the user enters "F" or "f" for flare source: *Enter Emission Rate (g/s):* *Enter Flare Stack Height (meters):* *Enter Total Heat Release Rate (cal/sec):* *Enter Radiative Heat Loss Fraction –* *<Enter> for default value of 0.55:*				

Figure 5. AERSCREEN.INP and prompts inputs for flare sources.

2.1.3 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)

AERSCREEN.INP and prompt inputs (in italics) are shown in Figure 6.

AERSCREEN.INP volume source inputs				
** VOLUME DATA	Rate	Height	Syinit	Szinit
**	0.1000E+03	2.0000	1.5000	3.0000
Volume source prompts inputs				
If the user enters "V" or "v" for volume source: *Enter Emission Rate (g/s):* *Enter Center of Volume Height (meters):* *Enter Initial Lateral Dimension (meters):* *Enter initial Vertical Dimension (meters):*				

Figure 6. AERSCREEN.INP and prompts inputs for volume sources.

2.1.4 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)

　　As previously noted, the emission rate is in g/s or lb/hour, not emission rate per unit area as entered in AERMOD input files. AERSCREEN automatically calculates the emission rate per unit area to input into AERMOD. 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. AERSCREEN.INP and prompt inputs (in italics) are shown in Figure 7. For rectangular area sources, AERMOD uses the non-default FASTAREA keyword on the MODELOPT keyword in the CO pathway of the AERMOD.INP file.

AERSCREEN.INP rectangular area inputs						
** AREA DATA	Rate	Height	Length	Width	Angle	Szinit
**	0.1000E+03	2.0000	500.0000	200.0000	0.0	1.50
Rectangular area source prompts inputs						
If the user enters "A" or "a" for rectangular area source: *Enter Emission Rate (g/s):* *Enter Release Height Above Ground (meters):* *Enter Long Side of Area Source (meters):* *Enter Short Side of Area Source (meters):* *Enter Initial Vertical Dimension (meters):*						

Figure 7. AERSCREEN.INP and prompts inputs for rectangular area sources.

2.1.5 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 in g/s or lb/hour, not emission rate per unit area. AERSCREEN.INP and prompt inputs (in italics) are shown in Figure 8. For circular area sources, AERMOD uses the non-default FASTAREA keyword on the MODELOPT keyword in the CO pathway of the AERMOD.INP file.

AERSCREEN.INP circular area source inputs					
** AREACIRC DATA	Rate	Height	Radius	NVerts	Szinit
**	0.1000E+03	2.0000	250.0000	20	1.50
Circular area source prompts inputs					
If the user enters "C" or "c" for circular area source: *Enter Emission Rate (g/s):* *Enter Release Height Above Ground (meters):* *Enter Radius of AREACIRC Source (meters):* *Enter Initial Vertical Dimension (meters):*					

Figure 8. AERSCREEN.INP and prompts inputs for circular area sources.

2.1.6 NOx to NO$_2$ conversion

Beginning with version 11060, AERSCREEN allows the option to include NOx to NO$_2$ conversion either by using the Plume Volume Molar Ratio Method (PVMRM) or the Ozone Limiting Method (OLM). See Section 2.4 of the AERMOD User's Guide Addendum for more information about PVMRM and OLM and Hanrahan (1999a and 1999b) for background on PVMRM.

When entering data via the prompts, the user is asked to enter an option for modeling NOx to NO$_2$ conversion:

1. No chemistry or pollutant is not NO$_2$
2. Use Ozone Limiting Method (OLM)
3. Use Plume Volume Molar Ratio Method (PVMRM)

If option two or three is chosen, the user is prompted for the NO$_2$/NOx in-stack ratio (AERMOD card CO NOSTACK) and a representative ozone background concentration (AERMOD card CO OZONEVAL). The NO$_2$/NOX 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 (μg/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.

When entering data via AERSCREEN.INP, the user can specify NOx to NO$_2$ conversion by setting the appropriate keywords in the CO pathway of the AERMOD runstream file portion of AERSCREEN.INP. PVMRM or OLM must be included on the MODELOPT keyword string, POLLUTID must be NO2, NO2STACK must be specified with a ratio, and the background ozone concentration and units must be specified using OZONEVAL. Figure 9 shows the inputs using AERSCREEN.INP or interactive prompts.

AERSCREEN.INP NOx to NO₂ chemistry inputs
MODELOPT CONC SCREEN   OLM   POLLUTID NO2   NO2STACK 0.9000   OZONEVAL   0.4000 UG/M3
MODELOPT CONC SCREEN   PVMRM   POLLUTID NO2   NO2STACK 0.9000   OZONEVAL   0.4000 UG/M3
NOx to NO₂ chemistry prompts inputs
Enter an option for modeling NO2 chemistry   *1) No chemistry or pollutant is not NO2*   *2) Use Ozone Limiting Method (OLM)*   *3) Use Plume Volume Molar Ratio Method (PVMRM)*   If the user enters "2" or "3"   *Enter in-stack NO2/NOx ratio (0 to 1.0):*   *Enter concentration units for representative ozone concentration*   *1) Micrograms per cubic meter (ugm/m^3)*   *2) Parts per million (ppm)*   *3) Parts per billion (ppb)*   *Enter ozone concentration:*

Figure 9. AERSCREEN.INP and prompts inputs for NOx to NO₂ conversion.

2.1.7 Other inputs

Other inputs in the source input prompts are urban/rural classification and minimum ambient distance. These are discussed in more detail in Section 2.7.

2.2 Downwash

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 horizontal dimension (feet or meters)
- Minimum building horizontal 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)

Building parameter data are denoted by the term "** BUILDING DATA" in the input file in the line above the building dimensions. These inputs are listed in the second block of data of AERSCREEN.INP (Figure 10) and must be entered in the AERSCREEN.INP file after the emissions data or AERSCREEN will stop processing. The order of variables is as listed above. Prompts for building downwash are also shown in Figure 10. When entering data via the prompts, building prompts will only appear when processing point, capped stack, horizontal stacks, or flare sources. Building dimensions are in feet or meters. Angles are in degrees relative to North (0 to 360 degrees). An example building/stack configuration is shown in Figure 11. When entering building parameters, either through the building data line or prompts shown in Figure 10, the parameters are for a single tier rectangular or square shaped building. If the user wishes to use downwash for multiple buildings, tiers, or more complicated geometries, the user can enter a BPIPPRM input filename at the prompts ("Use pre-existing BPIPPRM input file") or in the CO pathway of the AERSCREEN input file using the TITLETWO keyword. If a BPIPPRM input filename is entered, AERSCREEN will use the parameters from the file but will not overwrite parameters from the building data block. If a pre-existing BPIPPRM input file is used, the process, line 2 of the BPIPPRM input file, must be set to 'P' or 'p' for PRIME downwash and only one stack located within the file or AERSCREEN will abort.

AERSCREEN.INP building inputs on BUILDING DATA line

```
** BUILDING DATA    BPIP    Height  Max dim.  Min dim.  Orient.   Direct.   Offset
**                   Y      34.0000 120.0000  60.0000   90.0000   26.6000   45.0000
```

AERSCREEN.INP building BPIPPRM input filename line

```
CO STARTING
   TITLEONE flare
   TITLETWO BUILDING.INP
**           REFINE STAGE 3
   MODELOPT CONC SCREEN
   AVERTIME 1
   POLLUTID OTHER
   RUNORNOT RUN
CO FINISHED
```

Building prompts inputs

Include Building Downwash? (y/n):

If user enters "y" or "Y":

Use pre-existing BPIPPRM input file? (y/n):

If user enters "y" or "Y" for pre-existing BPIPPRM input file:

Enter user created BPIPPRM input file:

If user enters "n" or "N" for pre-existing BPIPPRM input file:

Enter Building Height (meters):

Enter Maximum Horizontal Building Dimension (meters):

Enter Minimum Horizontal Building Dimension (meters):

Enter Maximum Building Dimension Angle to True North (0 - 179 degees):

Enter Direction of Stack from Building Center (0 - 360 degrees):

Enter Distance Between Stack and Building Center (meters):

If user enters "n" or "N" for building downwash use then no prompts are processed.

Figure 10. AERSCREEN.INP and prompts inputs for building inputs.
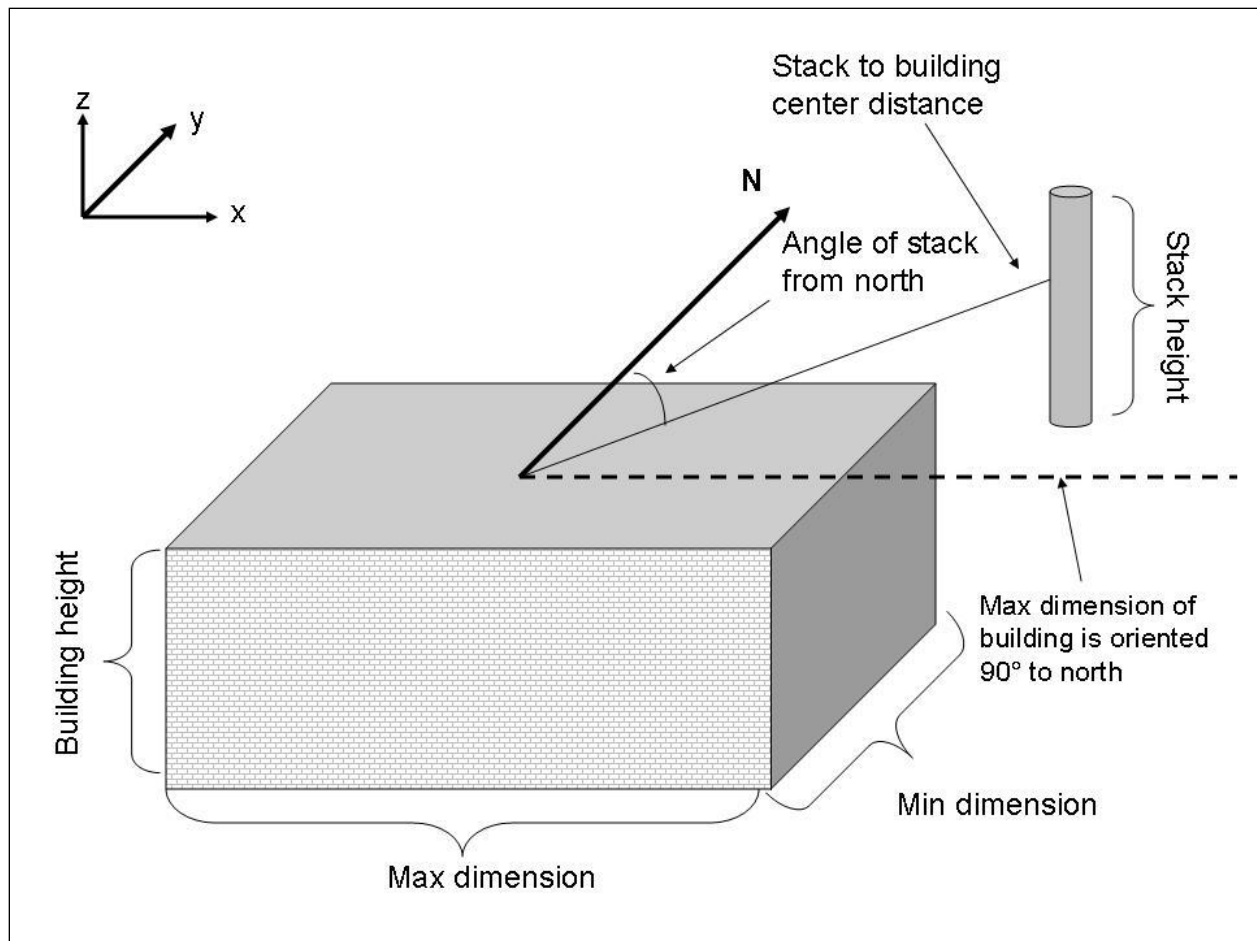
Figure 11. Stack and building orientation for a building oriented 90 degrees to north and stack oriented 45 degrees to north.

2.3 Meteorology and surface characteristics

For inputs to MAKEMET, the user enters the following:

- Minimum and maximum ambient air temperatures (Fahrenheit or Kelvin)
- Minimum wind speed (m/s)
- Anemometer height (m)
- Surface characteristics type (user-entered, AERMET tables, or surface characteristics listed in an external file)

When entering data via the prompts, the user can choose to enter default values for temperatures, wind speed, and anemometer height (see Figure 12). If using non-default values for temperatures, the record minimum and maximum temperatures for the area containing the source should be entered. If using a non-default value for the minimum wind speed, a wind speed less than 0.5 m/s is allowed. When entering surface characteristics, if the user chooses to

utilize user-entered single value surface characteristics, the user will be prompted for those values. If the user chooses to use AERMET seasonal tables, the user will be prompted for land use type and surface moisture (average, dry, or wet). If the user chooses to use an external file, i.e. AERSURFACE output or AERMET stage 3 input file, the user will be prompted to enter the name of the file. If the filename contains spaces or the pathname contains spaces, the pathname should be entered in quotations. If the surface characteristics are in a file that is not an AERSURFACE file or AERMET stage 3 input file, the format should follow that as outlined in the AERMET User's Guide, Section 4.7.7 (U.S. EPA, 2004c).   After entering the filename, AERSCREEN will check for its existence and if it does not exist, the user will be re-prompted for the filename. AERSCREEN will also check the file for format and valid values for surface characteristics and if the format is incorrect or surface characteristics are not valid, the user will be re-prompted for the surface characteristics type (user, AERMET tables, or external file) when entering data from the prompts. If the data is entered from AERSCREEN.INP and the file is missing, the format is incorrect or surface characteristics are not valid, AERSCREEN will alert the user and stop processing.

AERSCREEN will also alert the user if the ambient temperatures exceed current world record temperatures (183 K and 331 K), Bowen ratio is less than -10 or greater than 10, and if the surface roughness is less than 0.001 (but positive) or greater than two meters. If surface roughness is less than 0.001 and not negative, AERSCREEN automatically resets the value to 0.001 and notifies the user. In the case of these warnings, AERSCREEN will use the entered values but warns the user that they may exceed reasonable values.

If the user uses the AERSCREEN input file to enter the meteorological parameters, the inputs are as follows in the third block of data of the input file and the data section is denoted by "** MAKEMET DATA" in the input file. The order of the MAKEMET data line relative to the other data sections is unimportant. In the AERSCREEN.INP file, temperatures are in degrees Kelvin. For prompts based input, temperatures are in degrees Fahrenheit or Kelvin. Regardless of the units convention, wind speeds are in m/s and anemometer height is in meters. The AERSCREEN.INP and prompts inputs are shown in Figure 12.

AERSCREEN.INP meteorological inputs									
** MAKEMET DATA	MinT	MaxT Speed	AnemHt Surf Clim	Albedo	Bowen	Length	SC FILE
**	250.00	310.00 0.5	10.000 0 0	0.1600	0.8700	0.0440	"aersurface 12.out"

Prompts inputs

Enter Min & Max Ambient Temperatures (K) or
<Enter> to default to 250 310 K...

Enter Minimum Temperature (K):

If user enters a number for minimum temperature:

Enter Maximum Temperature (K):

Enter Minimum Wind Speed or <Enter> to default to 0.5 m/s...

Enter Anemometer Height or <Enter> to default to 10.0 meters...

----
1) Single user specified values
2) AERMET seasonal tables
3) External file

Enter surface characteristics option:

If the user enters 1

Enter Albedo:

Enter Bowen Ratio:

Enter Surface Roughness Length (m):

If the user enters 2
1) Water
2) Deciduous Forest
3) Coniferous Forest
4) Swamp
5) Cultivated Land
6) Grassland
7) Urban
8) Desert Shrubland

Enter Dominant Surface Profile:

1) Average Moisture
2) Wet Conditions
3) Dry Conditions

Enter Dominant Climate Profile:

If user enters 3

Enter filename containing surface characteristics.
Enclose filename with quotes if path or filename includes spaces...

Figure 12. AERSCREEN.INP and prompts inputs for meteorological and surface characteristics data.

The parameters in the input file are:
- Minimum temperature
- Maximum temperature
- Minimum wind speed
- Anemometer height
- Land use type for surface characteristics
    - 0 = user-entered surface characteristics
    - 1 = water
    - 2 = deciduous forest
    - 3 = coniferous forest
    - 4 = swamp
    - 5 = cultivated land
    - 6 = grassland
    - 7 = urban
    - 8 = desert shrub land
    - 9 = use external file of surface characteristics
- Climatology type (for land use of 1 through 8)
    - 1 = average moisture
    - 2 = wet conditions
    - 3 = dry conditions
- User defined albedo (not used/requested if land use type is 1 through 9)
- User defined Bowen ratio (not used/requested if land use type is 1 through 9)
- User defined surface roughness (not used/requested if land use type is 1 through 9)
- External surface characteristics filename (not used/requested if land use type is 0 through 8)

When determining surface characteristics, the user should consider the location of the source (stack or center of volume or area source). Often in emission inventories, the location given for a source is not the actual location of the source, but an average of sources in a facility or location of an address. The user should verify coordinates of a stack, volume, or area source. The exact location of the source is important in determining surface characteristics, especially when using a tool such as AERSURFACE. Inaccurate source locations can lead to inaccurate surface characteristics estimations, especially surface roughness. When determining surface characteristics for the source, regardless of method (user-entered, AERMET tables, or AERSURFACE), the user is highly encouraged to review Section 3.1 of the AERMOD Implementation Guide (U.S. EPA, 2009) and if using AERSURFACE, to review the AERSURFACE User's Guide (U.S. EPA, 2008).

2.4 Terrain

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 (discussed in Section 2.6) (beginning with version 11060)
- Flagpole receptors (discussed in Section 2.7)
- Source elevation or use AERMAP to determine source elevation
- Source coordinates (geographic or UTM)
- NAD datum (NAD 27 or 83)
- UTM zone (if UTM coordinates entered)

If the user is processing a rectangular area source, the only inputs the user enters via the prompts are probe distance, use of discrete receptor distances (version 11060), flagpole receptors, and source elevation. The user will not have the choice of using AERMAP for source elevation determination. If flat terrain is being processed for any source type, the user cannot use AERMAP for source elevation determination. When entering data via the prompts and processing terrain, the user has the choice of inputting geographic coordinates (latitude and longitude) or UTM coordinates, as well as the NAD datum of the coordinates , North American Datum of 1927 (NAD 27) or North American Datum of 1983 (NAD 83). If the user enters geographic or UTM coordinates with NAD 27 datum, AERSCREEN converts the coordinates to UTM coordinates with NAD 83 datum. If the user enters geographic coordinates with NAD 83, AERSCREEN converts the coordinates to UTM coordinates with NAD 83 datum and writes those to the AERSCREEN.INP file. If the terrain files read in AERMAP are NAD datum 27 and not datum 83, AERMAP will do the necessary conversions to NAD 27 for terrain processing in AERMAP. For more information about the NAD conversion process see the AERMAP User's Guide (U.S. EPA, 2004b).

If geographic to UTM conversion is performed, AERSCREEN will write the converted NAD 83 UTM coordinates to the new AERSCREEN.INP file with a message that the latitude and longitude coordinates were converted to UTM coordinates. AERSCREEN will also write a message to the input file if coordinates were switched from NAD 1927 to NAD 1983. When entering data using the AERSCREEN.INP file, coordinates must be in UTM coordinates. If the coordinates are indicated to be in NAD 1927, AERSCREEN will convert to NAD 1983 UTM coordinates and notify the user. Coordinates should only be in NAD 1927 if the user manually changed the coordinates and NAD in AERSCREEN.INP. The variables are as follows in the fourth line of the AERSCREEN input file (Figure 13). Terrain data is denoted by the term "** TERRAIN DATA" in the input file. Prompts are also shown in Figure 13.

AERSCREEN.INP inputs								
** TERRAIN DATA	Terrain	UTM East	UTM North	Zone	Nada	Probe	PROFBASE	Use AERMAP elev
**	N	406672.0	3698970.8	12	1	5.0	18.30	N

Prompts inputs

Include Terrain Heights? (y/n):

If user enters "y" or "Y":

Enter Maximum Distance (m) to probe
 <Enter> for default (10000 m):

If user enters "n" or "N":
Enter Maximum Distance (m) to probe
 <Enter> for default (5000 m):

Enter stack elevation (m) or
 <Enter> for AERMAP derived elevation:

If the user enters "n" or "N" for terrain or source is a rectangular area source:

Enter source elevation (m) or
 <Enter> for default 0 m:

If user enters "y" or "Y" for terrain:

Enter coordinate type:
 LATLON for latitutde & longitude or
 UTM for UTM coordinates

If the user enters LATLON:

Enter Source Latitude (North positive) (xx.xxxx):

Enter Source Longitude (West negaitive) (xxx.xxxx):

If the user enters UTM:

Enter Source UTM Easting   (xxxxxx.x):

Enter Source UTM Northing (xxxxxxx.x):

The following prompt is shown for UTM coordinates:

Enter Source UTM Zone (xx):

--
Option (1) - North American Datum of 1927
Option (4) - North American Datum of 1983
--

Enter Option for Applicable UTM Nada:

Figure 13. AERSCREEN.INP and prompts inputs for terrain data.

Input parameters in AERSCREEN.INP are:

- Terrain flag (Y=use terrain, N=do not use terrain)
- UTM X coordinate
- UTM Y coordinate
- UTM zone
- NAD datum of source location
- Probe distance in meters
- Source elevation (feet or meters)
- Override source elevation with AERMAP value (Y=yes, N=no)

When the probe distance is entered, AERSCREEN checks to see if the probe distance is a multiple of 25 meters. If the distance is not a multiple of 25, the probe distance is reset to the next distance that is greater than the entered probe distance and is a multiple of 25. AERSCREEN alerts the user of the change. For example, if the entered probe distance is 1,031 m, AERSCREEN will reset the distance to 1,050 m. This is done because the receptor spacing between zero and 5 km is 25 m and a multiple of 100 between 5 km and the probe distance. The reset makes it easier to perform the calculations.

If the user enters the source coordinates as latitude and longitude, the UTM zone will not be requested and is determined by AERSCREEN. If not processing terrain, the user can enter the actual elevation for the source or choose a default of zero. The user will not be prompted for AERMAP override of user-entered source elevation.

When entering data via the prompts, the prompt for terrain processing and overriding of source elevation with AERMAP will appear for all source types except rectangular area sources. The other prompts will appear for all sources.

The name(s) of the terrain input file(s) that AERMAP reads are input into AERSCREEN by a file called demlist.txt, which is to be located in the same directory as the AERSCREEN executable or local folder in which the user is working. The demlist.txt file is not created by AERSCREEN but the user must create the file prior to running AERSCREEN. If terrain is to be processed, AERSCREEN will check for the existence of this file and if it is not present, AERSCREEN will stop processing. The general format of the file and three examples are shown in Figure 14. The general format is that the first line contains either "NED" or "DEM" (the case can be lower or upper case) as the first three characters to denote the file type. The rest of the line is for informational purposes and not read by AERSCREEN. The second line is a delineator between the file type and the file list, usually a series of dashes. The third line is to specify the location of the grid files (conus.las, conus.los, etc.) that will be used for NAD conversion (from 27 to 83 or vice versa). The location is specified by starting the line with "NADGRIDS" followed by the pathname of the files. If the pathname contains spaces, the entire pathname should be enclosed in quotations. Beginning with AERSCREEN version 11060, a trailing "\" is no longer necessary at the end of the pathname. In Figure 14a, AERSCREEN will accept

"c:\grid files\" or "c:\grid files". If the files are in the current working directory[1], the rest of the line after "NADGRIDS" can be the full path of the current working directory, blank, or .\.. However, if the files are not in the working directory, AERSCREEN will stop processing. Regardless of the NAD datum of the coordinates, the field will be read by AERSCREEN and input into AERMAP. If the line beginning with NADGRIDS is not in the demlist.txt file, AERSCREEN will notify the user and stop processing.

Finally beginning with the fourth line, is the list of the files to be read into AERMAP, each file on a separate line. If the filename or pathname of the file contains spaces, the filename or pathname must be enclosed in quotations. For NED files only, the units of the terrain data can be included. The units are:

- FEET for units of feet
- DECI-FEET or DECIFEET for units of decifeet
- DECA-FEET or DECAFEET for units of decafeet
- METERS for meters
- DECI-METERS or DECIMETERS for units of decimeters
- DECA-METERS or DECAMETERS for units of decameters

Note that the units are not case sensitive, so lower-case text is allowed. If no units are entered, i.e. blank after the filename, the units are understood to be meters and AERMAP will give a non-fatal warning to the user when AERMAP is executed. If units are included, when AERSCREEN creates the AERMAP.INP file, the TIFFDEBUG keyword will be added to the DATAFILE line in the AERMAP.INP file.

In Figure 14a, a single National Elevation Data (NED) file called ned_file.tif is to be read into AERMAP with units of meters by default. Also, the NADGRIDS files are located in a folder with spaces in the pathname so the filename is in quotations. Figure 14b gives an example of a NED file whose pathname contains spaces, so the name is enclosed in quotations. The units of the terrain are specified to be meters. Figure 14b also shows that the location of the grid files used for NAD conversion. Figure 14c shows a list of DEM files that will be processed in AERMAP with NAD grid files located in the current working directory. Note that units cannot be included with DEM files.

Users are encouraged to use NED data as DEM data is static and no longer updated. NED data is more up to date and is regularly updated.

---

[1] Current working directory refers to the directory or folder that a DOS prompt is working in when using a DOS window or to the folder that the AERSCREEN executable is in when double clicking the AERSCREEN executable icon.

```
NED   : Must be either DEM or NED                                    a

      --------------------------------------------

NADGRIDS "c:\grid files\"
ned_file.tif
```
```
NED   : Must be either DEM or NED                                    b

      --------------------------------------------

NADGRIDS  c:\aermap\grids
"test dir\ned_file.tif"  meters
```
```
DEM   : Must be either DEM or NED                                    c

      --------------------------------------------

NADGRIDS
test01.dem
test02.dem
test03.dem
```

Figure 14. Example formats of demlist.txt.

If terrain is to be included, users should consult the AERMOD Implementation Guide, specifically sections 4.3, 4.4, and 4.5 (U.S. EPA, 2009) as well as the AERMAP User's Guide and addendum (U.S. EPA, 2004b).

2.6 Inclusion of discrete distances

Beginning with version 11060, AERSCREEN allows for the input of up to ten discrete receptor distances that are not part of the regularly spaced receptor network created by AERSCREEN (See Section 3.4) . 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. Discrete receptor use is entered in AERSCREEN.INP via the 6th data line in AERSCREEN.INP (Figure 15) or during the terrain processing prompts when entering via the prompts. If the user wishes to include discrete distances, the distances should be entered into a simple text file. The user will also be prompted for the filename of distances. The distances

listed in the file can be in several units: meters, feet, kilometers, or miles and is independent of whether other data (source inputs, meteorology, etc.) are in metric or English units. To define the units, the first line of the text file should be the line "units: "followed by the units of the distances. An example file is shown in Figure 16 with distances listed in meters. The format of the units line is not case sensitive but it must be the first line of the file. Distances can be entered as:

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

If the units line is present but no distance units are entered, i.e. the line is just "units: ", then AERSCREEN will assume distance units of meters. When entering the filename from AERSCREEN.INP, if the file does not exist, or the number of receptors exceeds ten, or no units line is listed, AERSCREEN will alert the user and stop processing. If entering the filename using prompts and one of the conditions above is met, AERSCREEN will alert the user and re-prompt for a filename.

If the discrete receptor data line is not in AERSCREEN.INP, AERSCREEN will assume no discrete receptor distances will be used in modeling. The user can then include discrete receptor use in the data validation phase of AERSCREEN.

AERSCREEN.INP inputs
<pre>** DISCRETE RECEPTORS Discflag   Receptor file
**   Y   "discrete rec.txt"</pre>
Prompts inputs
Include up to 10 discrete receptors (y/n)? If user enters "y" or "Y":   *Enter name of file with discrete receptors.* *Enclose filename with quotes if path or filename includes spaces...*

Figure 15. AERSCREEN.INP and prompts inputs for including discrete distances.

units: meters 26.0 35.1 111.5 427.35 535.0

Figure 16. Sample distances in a discrete distances text file.

2.7 Other inputs

Other inputs or options used by AERSCREEN are:

- units of inputs (metric or English),
- urban/rural classification
- urban population if urban
- minimum ambient distance (feet or meters)
- use of flagpole receptors
- flagpole receptor height (feet or meters)

These variables in the sixth line of the AERSCREEN input file are shown in Figure 15 and are denoted by the term "** UNITS/POPULATION." This line must be listed after the source input line. While entering data via prompts, the English or metrics unit prompt is before any other prompts, while the urban/rural and ambient distance prompts occur during the source input processing. The flagpole receptor prompts occur in the terrain inputs processing.

AERSCREEN.INP inputs						
** UNITS/POPULATION	Units	R/U	Population	Amb. dist.	Flagpole	Flagpole height
**	M	R	0.	50.000	N	0.00
Prompts inputs						
English or Metric Units? (E or M):						
Rural or Urban? (R or U):						
Enter Population of Urban Area:						
Enter Minimum Distance (meters) to Ambient Air –						
<Enter> for default (1 m):						
Use Flagpole receptors? (y or n):						
If user enters "y" or "Y":						
Enter Flagpole receptor height (meters)						

Figure 17. AERSCREEN.INP and prompts inputs for other inputs.

Inputs in AERSCREEN.INP are:
- Units of data (M=metric, E=English)
- Urban/rural flag (U=urban, R=Rural)
- Population for urban source
- Minimum ambient distance
- Use Flagpole receptors
- Flagpole receptor height (ignored if flagpole receptors = no)

If the units flag in AERSCREEN.INP is set to "E" AERSCREEN will stop processing and notify the user that the flag is not set to "M." for metric. The user can enter the data in English units when entering data from the prompts but AERSCREEN will change the units flag to metric and convert the variables from English to metric units during processing. When AERSCREEN creates the AERSCREEN.INP file from prompt-entered data, there will be a comment in the new input file that units were converted from English to metric.

For minimum ambient air distances for non-volume sources, when entering data with English units, the default value listed will be 3.3 feet, or 1 meter. For volume sources, the ambient distance must be greater than or equal to 2.15 times the initial lateral dimension, $2.15\sigma_y$ plus one meter. In AERMOD, receptors with source-receptor distances less than $2.15\sigma_y$ plus one meter are not included in concentration calculations. When entering data via the prompts, the default value that is listed will be $2.15\sigma_y$ plus 1 m (or equivalent in feet). If the user chooses the default value by hitting <Enter>, that will be the ambient distance. If the user enters a different value from the listed default value, it must be greater than or equal to the default value listed. Otherwise, the user will receive a message that the value reset to $2.15\sigma_y$ plus 1 m. When obtaining the ambient distance from AERSCREEN.INP, AERSCREEN will compare that value against $2.15\sigma_y$ plus 1 m and if the entered value is less than $2.15\sigma_y$ plus 1m, it is reset to $2.15\sigma_y$ plus 1 m. If the user does not wish to use the reset value, it change be changed at the validation page but must be greater than or equal to $2.15\sigma_y$ plus 1m.

When the source is a non-volume source and the ambient distance is less than 1 meter in the AERSCREEN.INP, the distance will be reset to 1 meter and AERSCREEN will alert the user. If the user enters a distance less than 1 meter using the prompts, the distance will be reset to 1 m and the user will be alerted.

2.8 Non-default name for output file

The default output files for AERSCREEN are AERSCREEN.OUT and max_conc_distance.txt. AERSCREEN.OUT lists the inputs and various outputs of the AERSCREEN run. The file max_conc_distance.txt, lists the maximum concentration by distance. Beginning with AERSCREEN version 11060, the user can choose different names other than the defaults. The filename must have an ".out" extension. The user can specify a filename within the current working folder or a complete path. If a complete pathname is entered, AERSCREEN will check to make sure that the target folder or directory exists. If the folder does not exist, the user must re-enter the filename. The filename that is used for output file is also used to construct the maximum concentration by distance file. The prefix (including folder name) of the new output file is used for the maximum concentration file. The prefix (including folder name) is also used to copy the final AERSCREEN.INP file and AERSCREEN.LOG files to new files that have the same prefix as the output file. The user can change the filename using prompts or by the seventh data line beginning with "** OUTPUT FILE" followed by the output filename. Figure 18 shows the AERSCREEN.INP inputs and prompts inputs. If the output file option is not listed in AERSCREEN.INP, AERSCREEN will

assume the default AERSCREEN.OUT for the filename and the user can change the filename during the data validation phase of AERSCREEN.

AERSCREEN.INP inputs
`** OUTPUT FILE "AERSCREEN.OUT"`
Prompts inputs
Enter name of AERSCREEN output file   *Enter <Enter> to use default name AERSCREEN.OUT*   *Filename should include .out or .OUT extension*   *If filename contains spaces, enter entire filename in quotations*

Figure 18. AERSCREEN.INP and prompts inputs for output filename.

2.9 Error checking

When entering data via the AERSCREEN.INP file or via prompts, AERSCREEN will check for invalid responses for flags (use downwash, terrain, urban/rural, etc.) and numeric values (stack height, building height, etc.). When processing input from the AERSCREEN.INP file, any flags or parameters found to be invalid or outside a realistic data range (minimum ambient temperature is greater than maximum ambient temperature), AERSCREEN lists error messages for the parameters to the AERSCREEN.LOG file and stops AERSCREEN processing to allow the user to correct the values in the AERSCREEN.INP file. Examples would be a character other than "Y", "y", "N", or "n" for the building downwash flag or a negative building height for downwash. If processing input data from the prompts, AERSCREEN will re-prompt the user for a valid response. For the two examples listed above, AERSCREEN would re-prompt the user for responses. Appendix A lists the input parameters, reasons for invalid values, and actions taken by AERSCREEN.

When entering data from AERSCREEN.INP, AERSCREEN checks to make sure that the emissions data is listed before the building, terrain, and miscellaneous data lines. If the emissions data line is listed after one of the other three lines, AERSCREEN notifies the user and stops processing.

AERSCREEN also checks for the presence of several files, if applicable:
- Demlist.txt (when processing terrain)
- BPIPPRM input file (if processing downwash and filename is entered)
- External surface characteristics file (if isurf equals 9)
- Discrete receptor file (if processing discrete receptors)

If these files are not found, AERSCREEN issues a message and stops processing. Note that if demlist.txt does not exist, AERSCREEN stops processing, regardless of whether data is being entered via prompts or AERSCREEN.INP. AERSCREEN will also check if the pathname of the output file is valid. If the folder or directory does not exist, AERSCREEN issues a message and

stops processing. AERSCREEN also checks for the presence of the AERMOD and MAKEMET executables in the current working folder. If one of those executables is not present, AERSCREEN issues a warning and prompts the user for the location of the executable. AERSCREEN will copy the executable from the entered locations to the current working folder. If processing downwash, AERSCREEN will check for the presence of the BPIPPRM executable and the AERMAP executable if processing terrain. If those are not present, AERSCREEN will issue a warning, prompt the user for the locations of the executables, and copy them to the current working folder.

3. AERSCREEN Program Execution

The AERSCREEN program can be run from the command-prompt or by double-clicking on the AERSCREEN.EXE from Windows Explorer. The user should make sure that demlist.txt, the AERMOD, MAKEMET, and if necessary the AERMAP and BPIPPRM executables are in the current working directory. General AERSCREEN processing is shown in Figure 19. If a restart file generated from a previous run (called 'AERSCREEN.INP') is present in the folder, then the user will be asked to continue with the restart file or enter data via the prompts (Figure 20a). If there is no restart file, the prompts will begin automatically (Figure 20b).
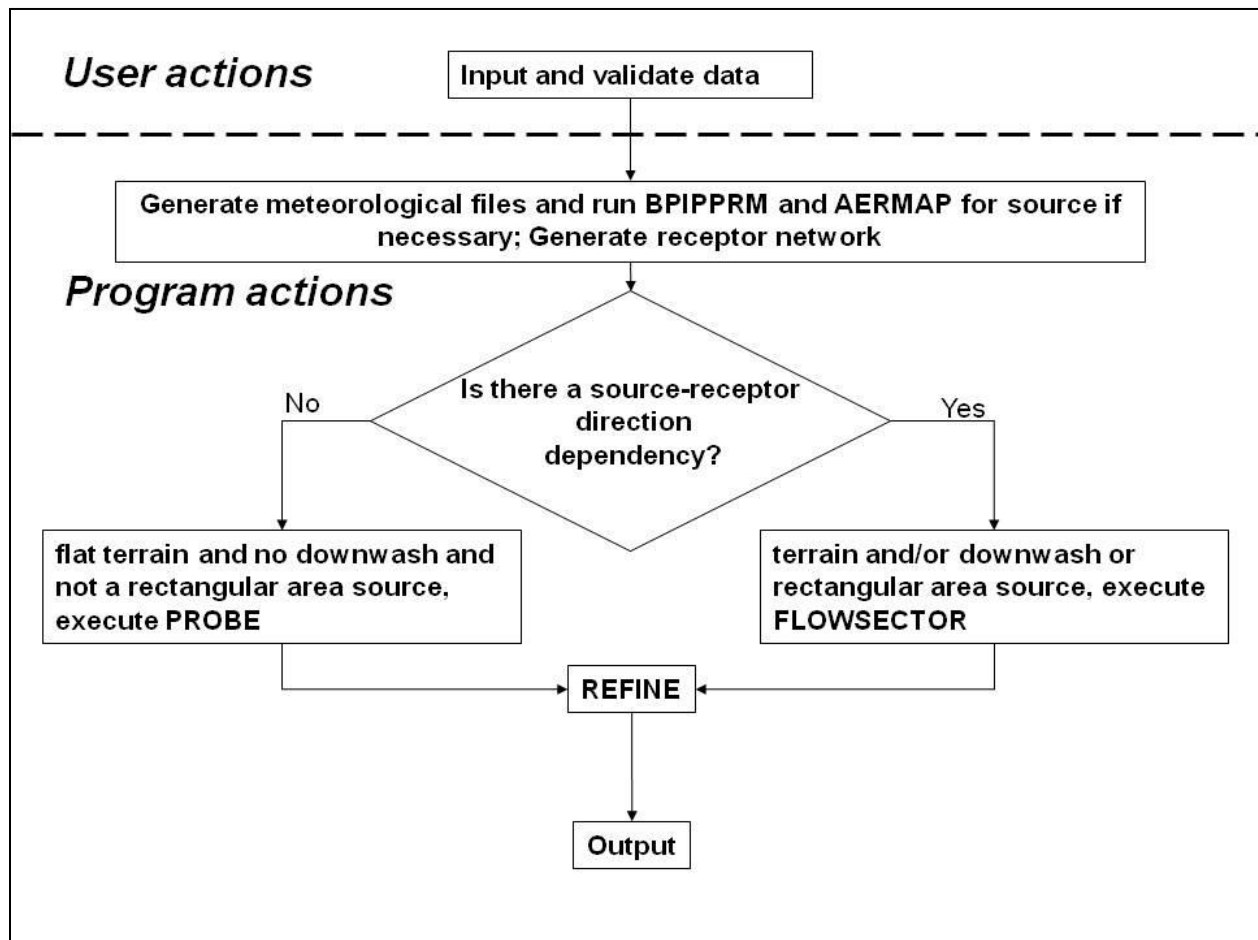
Figure 19. AERSCREEN processing and stages.

```
                         AERSCREEN 11060
     RESTART file title: POINT, FLAT, DOWNWASH                    a
     Continue with RESTART File? <press Y>:
                     OR
        Start a NEW Run? <press Enter>:
                Enter choice:




                         AERSCREEN 11060
     AERSCREEN.INP does not exist                                 b
     User must enter data
             ----------------- INITIAL INFORMATION -------------------
     Enter Title:
```
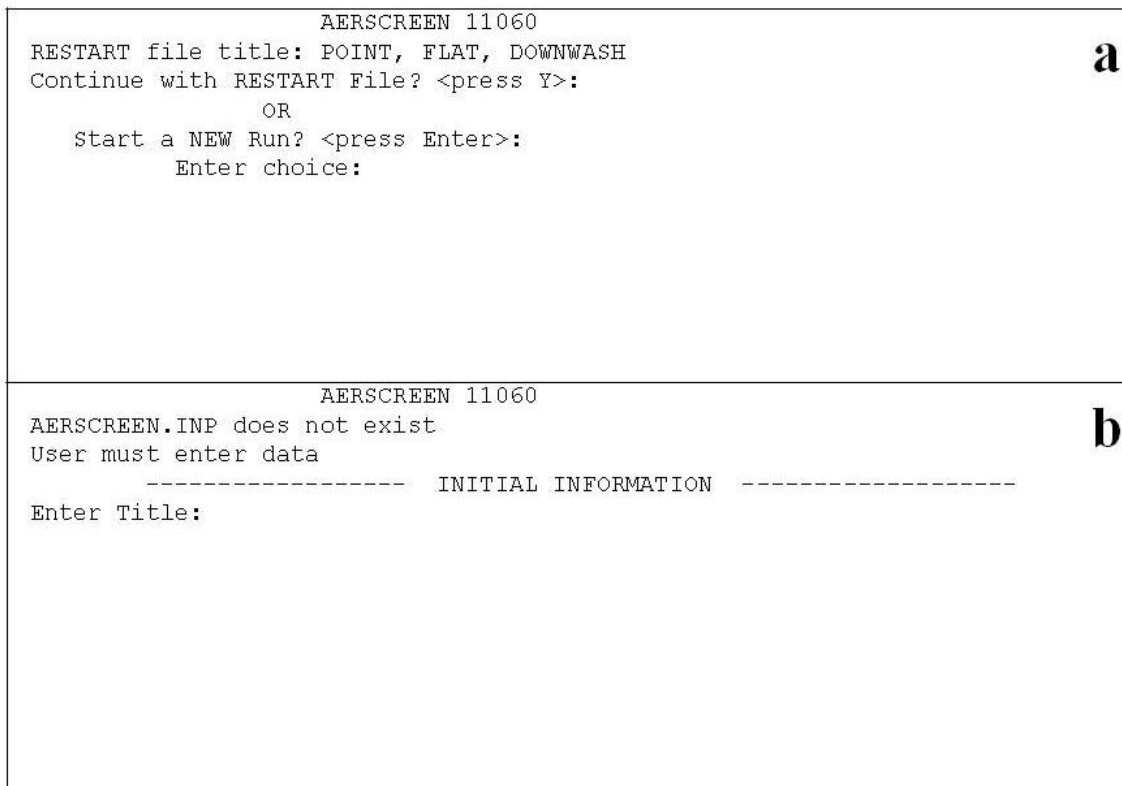
Figure 20. AERSCREEN start screen.

3.1 Data input and validation

       If the user chooses the restart file, AERSCREEN goes directly into the user validation page.
The user should carefully review the data to ensure accurate inputs. If processing terrain,
particular attention should be paid to the coordinates to ensure that any NAD conversions were
successful. Also on the validation page, the user will have the option of rerunning the same
inputs or selectively modifying specific components, such as building or terrain information
(Figure 21).   For example, if changes are to be made to building parameters, the user chooses
option 2 and a list of further options will appear (Figure 23). The user can change individual
parameters without having to re-enter all the parameters. The option to re-enter all parameters is
a choice as well. Changes to individual parameters are available for source, meteorological, and
terrain parameters as well. Some options cannot be changed without changing another parameter
first. These include changing urban population for a rural source or surface characteristics (i.e.
user defined values when AERMET tables are chosen).   Figure 22 shows the list of choices for
various source types, Figure 23 shows the choices for building parameters, Figure 24 lists the
choices for terrain processing, and Figure 25 lists the choices for meteorological processing. For
each submenu, once the desired changes are made, the user can hit <Enter> to return to the
validation page. Some changes will automatically return the user to the validation page, such as
choosing option 1 in Figure 23a for building downwash.

Note, that if the user chooses to change source data, the source type cannot be changed; only parameters for the source type from the AERSCREEN.INP file or from the prompts. For example, the user cannot change the source from point to rectangular area. For building data, if the user is running AERSCREEN for an area source, rectangular or circular, or a volume source (which do not use building downwash) and chooses option 2 from the validation page, AERSCREEN will give the message that building parameters cannot be changed due to source type and return to the validation page. The same is true for changing terrain data when running a rectangular area source.   The user may also change parameters in the AERSCREEN.INP file before running AERSCREEN, instead of modifying the data using the prompts.

```
                                AERSCREEN 11060

              ----------------  DATA ENTRY VALIDATION  ----------------
                             METRIC              ENGLISH
   ** STACKDATA **  --------------      ----------------

  Emission Rate:        1.0000 g/s              7.937 lb/hr
  Stack Height:          61.00 meters          200.13 feet
  Stack Diameter:        5.000 meters          196.85 inches
  Stack Temperature:    415.0 K                287.3 Deg F
  Exit Velocity:        11.000 m/s              36.09 ft/s
  Stack Flow Rate:      457646 ACFM
  Model Mode:           RURAL
  Dist to Ambient Air:        50.0 meters            164. feet


   ** BUILDING DATA **

   User defined BPIPPRM input file:
  BUILDING.INP



   ** TERRAIN DATA **

   No Terrain Elevations
   Source Base Elevation:  25.0 meters        82.0  feet

   Probe distance:  10000. meters       32808. feet

   No flagpole receptors

   Using discrete receptors in
   discrete_rec.txt

   Only receptors between the ambient and probe distances will be included
   Input distance units are: METERS


   ** METEOROLOGY DATA **

   Min/Max Temperature:  270.0 / 310.0 K    26.3 /    98.3 Deg F

   Minimum Wind Speed:     0.5 m/s

   Anemometer Height:   10.000 meters

   Using surface characteristics in file: season_3.out


   AERSCREEN output file:
  POINT_FLAT_DW.OUT


   *** AERSCREEN Run is Ready to Begin - Choose Option to Proceed ***

                    1 - Change Source Data;
                    2 - Change Building Data;
                    3 - Change Terrain Data;
                    4 - Change Meteorology Data;
                    5 - Change Title;
                    6 - Change Output Filename;
                    7 - Stop AERSCREEN;
                              - or -
                     Hit <Enter> to Start Run
```

Figure 21. AERSCREEN validation page.

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```
-----------------------------------------------
Enter number of parameter to change or      a
<Enter> to return to validation page

Point Source
1)  Emission rate
2)  Stack height
3)  Stack diameter
4)  Stack temperature
5)  Exit velocity
6)  Urban/Rural
7)  Urban population
8)  Distance to ambient air
9)  NO2 chemistry
10)  NO2/NOx in stack ratio
11)  Ozone concentration
12)  Update all parameters
-----------------------------------------------
```

```
-----------------------------------------------
Enter number of parameter to change or      b
<Enter> to return to validation page

Volume Source
1)  Emission rate
2)  Center of volume height
3)  Initial lateral dimension
4)  Initial vertical dimension
5)  Urban/Rural
6)  Urban population
7)  Distance to ambient air
8)  NO2 chemistry
9)  NO2/NOx in stack ratio
10)  Ozone concentration
11) Update all parameters
-----------------------------------------------
```

```
-----------------------------------------------
Enter number of parameter to change or      c
<Enter> to return to validation page

Rectangular area source
1)  Emission rate
2)  Release height
3)  Long side dimension
4)  Short side dimension
5)  Initial vertical dispersion parameter
6)  Urban/Rural
7)  Urban population
8)  Distance to ambient air
9)  NO2 chemistry
10)  NO2/NOx in stack ratio
11)  Ozone concentration
12)  Update all parameters
-----------------------------------------------
```

```
-----------------------------------------------
Enter number of parameter to change or      d
<Enter> to return to validation page

Circular area source
1)  Emission rate
2)  Release height
3)  Radius
4)  Initial vertical dispersion parameter
5)  Urban/Rural
6)  Urban population
7)  Distance to ambient air
8)  NO2 chemistry
8)  NO2/Nox in stack ratio
10)  Ozone concentration
11)  Update all parameters
-----------------------------------------------
```

```
-----------------------------------------------
Enter number of parameter to change or      e
<Enter> to return to validation page

Flare Source
1)  Emission rate
2)  Stack height
3)  Total heat release rate
4)  Heat loss fraction
5)  Urban/Rural
6)  Urban population
7)  Distance to ambient air
8)  NO2 chemistry
9)  NO2/Nox in stack ratio
10)  Ozone concentration
11)  Update all parameters
-----------------------------------------------
```

Figure 22. Submenus for changing source parameters for a) point, capped or horizontal stack, b) volume, c) rectangular area, d) circular area, and e) flare sources.

38

```
--------------------------------------------------------
Enter number of parameter to change or
<Enter> to return to validation page

Pre-existing BPIPPRM input filename must be
re-entered if it is to be used (Option 2)
1)  Do not include building downwash
2)  BPIPPRM input filename
3)  Building height
4)  Maximum horizontal dimension
5)  Minimum horizontal dimension
6)  Maximum building dimension angle to North
7)  Angle of stack from building center
8)  Distance between stack and building center
9)  Update all parameters
--------------------------------------------------------
```
a

```
--------------------------------------------------------
Enter number of parameter to change or
<Enter> to return to validation page

Pre-existing BPIPPRM input filename must be
re-entered if it is to be used (Option 2)
1)  Include building downwash
2)  BPIPPRM input filename
3)  Building height
4)  Maximum horizontal dimension
5)  Minimum horizontal dimension
6)  Maximum building dimension angle to North
7)  Angle of stack from building center
8)  Distance between stack and building center
9)  Include building downwash and update all parameters
--------------------------------------------------------
```
b

Figure 23. Building downwash submenus for a) building downwash included and b) building downwash not included.

```
-------------------------------------------------
Enter number of parameter to change or                          a
<Enter> to return to validation page

1) Do not include terrain heights
2) Probe distance
3) Use flagpole receptors
4) Flagpole receptor height
5) Source elevation input (user entered or AERMAP)
6) Input coordinate type and coordinates (LATLON or
   UTM), UTM zone, and NAD
7) Include discrete receptors
8) Filename of discrete receptor list
9) Update all parameters
-------------------------------------------------
```
```
-------------------------------------------------
Enter number of parameter to change or                          b
<Enter> to return to validation page

1) Include terrain heights
2) Probe distance
3) Use flagpole receptors
4) Flagpole receptor height
5) Source elevation input (user entered or AERMAP)
6) Input coordinate type and coordinates (LATLON or
   UTM), UTM zone, and NAD
7) Include discrete receptors
8) Filename of discrete receptor list
9) Include terrain heights and update all parameters
-------------------------------------------------
```
```
-------------------------------------------------
Enter number of parameter to change or                          c
<Enter> to return to validation page
1) Probe distance
2) Use flagpole receptors
3) Flagpole receptor height
4) Source elevation input
5) Include discrete receptors
6) Filename of discrete receptor list
7) Update all parameters
-------------------------------------------------
```

Figure 24.   Terrain submenus for a) terrain heights included, b) terrain heights not included and c) rectangular area sources.


```
-------------------------------------------------------
Enter number of parameter to change or
<Enter> to return to validation page

1) Use default min and max temperatures
2) Minimum temperature
3) Maximum temperature
4) Minimum wind speed
5) Anemometer height
6) Input surface characteristics
7) User albedo
8) User Bowen ratio
9) User surface roughness length
10) landuse
11) Moisture
12) AERSURFACE output file
13) Update all parameters
-------------------------------------------------------
```
Figure 25. Meteorological data submenu.

If the user chooses to run from the restart file, while reading the file, AERSCREEN may automatically change some of the options in the file, depending on other options. If the source being modeled is a rectangular area source and the terrain flag is set to "y" or "Y" then the terrain flag is reset to "N." For rectangular area sources, circular area sources, or volume sources, if the BPIP flag is set to "Y" or "y" in the input file then the BPIP flag is set to "N" and no downwash is calculated. If the user enters data using prompts instead of the AERSCREEN.INP file, the validation page will appear after all prompts have been processed for the source, building, terrain, and meteorological data.

3.2 Meteorological data files

After reading the input file or prompt inputs, and prompting the user for any changes, AERSCREEN processes the surface characteristics and runs MAKEMET to create the AERMOD meteorological input files (.sfc, and .pfl files). MAKEMET is run for each temporal period /spatial sector combination of surface characteristics. Depending on the temporal resolution and number of spatial sectors of the surface characteristics, one surface and one profile file (annual, 1 sector) to a maximum of 144 (monthly, 12 sector) surface files and 144 profile files are created, one for each temporal period/spatial sector combination (Figure 26). In the meteorological files naming convention, the first set of 2-digit numbers refers to the temporal period of the surface characteristics, which ranges from 1 to 12. If processing annual surface characteristics, the number would be "01" and if processing seasonal or monthly surface characteristics, the number would be range from "01" to "04" for seasonal output and "01" to "12" for monthly output. The second set of numbers in the filenames is the number of spatial sectors for surface roughness. This can range from "01" to "12" for one sector to 12 sectors. In Figure 26, aerscreen_01_01.sfc and aerscreen_01_01.pfl use surface characteristics for January, sector 1; aerscreen_01_02.sfc and aerscreen_01_02.pfl use surface characteristics for January, sector 2 and so on with aerscreen_12_12.sfc and aerscreen_12_12.pfl using surface characteristics for December, and sector 12.

```
Creating met files aerscreen_01_01.sfc & aerscreen_01_01.pfl

Creating met files aerscreen_01_02.sfc & aerscreen_01_02.pfl

Creating met files aerscreen_01_03.sfc & aerscreen_01_03.pfl

Creating met files aerscreen_01_04.sfc & aerscreen_01_04.pfl

Creating met files aerscreen_01_05.sfc & aerscreen_01_05.pfl
.
.
.
Creating met files aerscreen_12_12.sfc & aerscreen_12_12.pfl
```
Figure 26. Meteorological file creation for monthly 12 sector AERSURFACE output.

The input parameters to MAKEMET, which are normally entered using prompts, are written to a text file called prompts.inp by AERSCREEN and then "piped" to the MAKEMET call by AERSCREEN with the call system command, "makemet < prompts.inp."   Using the MAKEMET prompts shown in Figure 1 as a guide, AERSCREEN assigns the names for the surface and upper air meteorological files requested in the first two prompts shown in Figure 1 based on the file naming convention described above. The minimum wind speed and anemometer height are assigned the values entered by the user. The number of wind directions is automatically set to 1 by AERSCREEN and the wind direction is set to 270 degrees. The minimum and maximum temperatures are assigned the values entered by the user. The albedo, Bowen ratio and surface roughness length are assigned the values for the particular temporal/spatial combination being processed. The final prompt, "DO YOU WANT TO GENERATE ANOTHER MET SET THAT WILL BE APPENDED TO CURRENT FILE? [TYPE EITHER "Y" OR "y" FOR YES; OR HIT "ENTER" TO EXIT]" is set not to generate another file. An example for monthly, 12 sector AERSURFACE output is shown in Table 1.

Table 1. MAKEMET prompts and example values for the first month and surface roughness sector and last month and surface roughness sector for monthly 12 sector AERSURFACE output.

MAKEMET prompt	Value (month 1, sector 1)	Value (month 12, sector 12)
ENTER SFC MET FILE NAME	aerscreen_01_01.sfc	aerscreen_12_12.sfc
ENTER PFL MET FILE NAME	aerscreen_01_01.pfl	aerscreen_12_12.pfl
ENTER MIN. WS (M/S)	User input minimum wind speed	User input minimum wind speed
ENTER ANEM HT (M)	User input anemometer height	User input anemometer height
ENTER NUMBER OF WIND DIRECTIONS	1	1
ENTER WIND DIRECTION	270	270
ENTER MIN AND MAX AMBIENT TEMPS IN KELVIN	User entered temperatures	User entered temperatures
ENTER ALBEDO	Albedo for month 1, sector 1	Albedo for month 12, sector 12
ENTER BOWEN RATIO	Bowen ratio for month 1, sector 1	Bowen ratio for month 12, sector 12
ENTER SURFACE ROUGHNESS LENGTH IN METERS	Surface roughness for month 1, sector 1	Surface roughness for month 12, sector 12
DO YOU WANT TO GENERATE ANOTHER MET SET THAT WILL BE APPENDED TO CURRENT FILE? [TYPE EITHER "Y" OR "y" FOR YES; OR HIT "ENTER" EXIT]	N	N

3.3 BPIPPRM execution

     If downwash is to be considered, BPIPPRM inputs are calculated and written to a BPIPPRM input file or the user entered input file is used. For either method, BPIPPRM is executed to create the projected building dimensions for input into AERMOD. If a user-entered file is used and the processing flag (line 2) of the BPIPPRM input file is not a "P" or "p" then BPIPPRM will abort and AERSCREEN will notify the user and stop processing. Beginning with AERSCREEN version 11060, AERSCREEN also checks to make sure only one stack is listed in the BPIPPRM input file. If more than one stack is listed, AERSCREEN will stop processing and notify the user.

3.4 Source elevation calculation

     If terrain is being used, AERSCREEN calls AERMAP to get the source location's elevation. The source elevation, user-entered or AERMAP calculated, can be used as the source elevation in the SO pathway of the AERMOD runstream file, AERMOD.INP, and as the station elevation, keyword PROFBASE in the ME pathway of the AERMOD input file. If the user has chosen to replace the input source elevation, either from the restart file or via prompts, AERSCREEN will use the AERMAP elevation as the source location's elevation. If the user chose to keep the input elevation, AERSCREEN will calculate a percent difference between the user-entered elevation and the AERMAP calculated elevation and write the difference to the AERSCREEN log file.

3.4 Receptor network

An array of receptor distances is also created including the minimum ambient distance, automatically calculated distances (as described in steps 1 and 2 below), and any discrete receptor distances. The probe distance is set to the user-specified probe distance, or reset probe distance (as described in Section 2.4). Depending on the probe distance, there may be two receptor spacing values:
1. 25 meters from zero to 5 km
2. From 5 km to the final probe distance, the spacing is the greater of 25 m or a spacing calculated by: (probe distance – 5,000 m)/100 where 100 represents 100 receptors

     For example, if the user enters a probe distance of 12, 500 m, the receptor spacing from zero to 5,000 m is 25 m and the spacing from 5,000 to 12,500 is 75 m (7,500 m/100).

     Receptors located at distances less than the minimum ambient distance, either discrete or automatically calculated, are not included in the set of receptors. Also, any discrete receptor distances that exceed the probe distance are not included. Discrete receptors that are also equal to any distance in the automatic array are not included to avoid duplicate receptors. Receptor distances are relative to x=0 and y=0. For point, capped stacks, horizontal stacks, and flare

sources, x=0 and y=0 represent the stack or flare location. For volume and circular area sources, x=0 and y=0 represent the center of the source.

There are three main routines in AERSCREEN: PROBE, FLOWSECTOR and REFINE as shown in Figure 19. PROBE is executed when there is no source-receptor direction dependency (no terrain, no building downwash, and the source is not a rectangular area source). FLOWSECTOR is executed when there is a source-receptor direction dependency (terrain and/or building downwash, or source is a rectangular area source). REFINE is executed after PROBE or FLOWSECTOR. Details about each section and the final output of AERSCREEN are described in each of the following sections.

3.5 PROBE

PROBE executes AERMOD for each combination of temporal periods and spatial sectors. For example, if user defined surface characteristics are used (annual, 1 spatial sector), AERMOD is executed once (Figure 27a). If monthly, 12 spatial sector AERSURFACE output is used, then AERMOD is executed 144 times, 12 months x 12 sectors (Figure 27b).

Figure 27. Sequence of AERMOD runs in PROBE for different surface characteristics combinations.

AERSCREEN reads the output from AERMOD for each run and the highest concentration and its distance from the source are stored in arrays that will be used to find the highest overall

concentration in REFINE. AERSCREEN also retains the high first high (H1H) 1-hour concentration for each receptor. These concentrations are later used in determining the maximum concentration by downwind distance.

3.6 FLOWSECTOR

FLOWSECTOR is executed when there is a source-receptor direction dependency (terrain and/or building downwash, or rectangular area source).

If terrain is to be used, AERSCREEN checks for the presence of output from a previous AERMAP run. If there is output available, AERSCREEN checks the following against the same parameters in the current AERSCREEN run:
- source location
- probe distance
- minimum ambient distance
- receptor spacing
- number of receptors
- NAD datum
- UTM zone
- Type (DEM or NED files), number and names of terrain input files
- If all of the above parameters match between the existing AERMAP output and the current AERSCREEN run, AERSCREEN then checks the receptor coordinates in the previous AERMAP run to ensure the distances and directions match the receptor spacing of the current run and that all 36 radial directions are included. This step is done in case the file was changed or corrupted without the user's knowledge or if different discrete receptors are used, but the number of receptors has not changed.

If any of the above parameters differ, AERMAP will be executed to create new receptor elevations. If all parameters match, the user is prompted to decide to use the elevations from the previous output, or to run AERMAP to create new elevations. If the older AERMAP output is for a source type different than the one being processed in the current run, the user may want to consider re-running AERMAP. AERSCREEN sets the ANCHORXY, x=0 and y=0 to the source location and receptor locations are relative to this location. For volume and circular area sources, this represents the center of the source. For point and flare sources, this is the stack location.

If AERMAP is run in FLOWSECTOR, AERSCREEN will calculate a domain for the receptor grid to include with the DOMAINXY keyword in the AERMAP.INP file that AERSCREEN generates to run AERMAP. This will speed up processing, especially if large terrain files are used. For FLOWSECTOR, the domain is 1.1 times the probe distance.

After running AERMAP for the receptor elevations, AERSCREEN checks the AERMAP.OUT file for any warnings or errors. If any are found, they are written to the AERSCREEN log file and AERSCREEN stops processing.

3.6.1 Rectangular area sources

For rectangular area sources, the angle of the diagonal is calculated from the center to the corner of the rectangle. Next, radials are calculated every five degrees, beginning with 0 degrees up to the nearest 5 degrees past the diagonal. For example, if the diagonal of the source was found to be 26 degrees, radials are calculated for 0, 5, 10, 15, 20, 25, and 30 degrees, as shown in Figure 28.
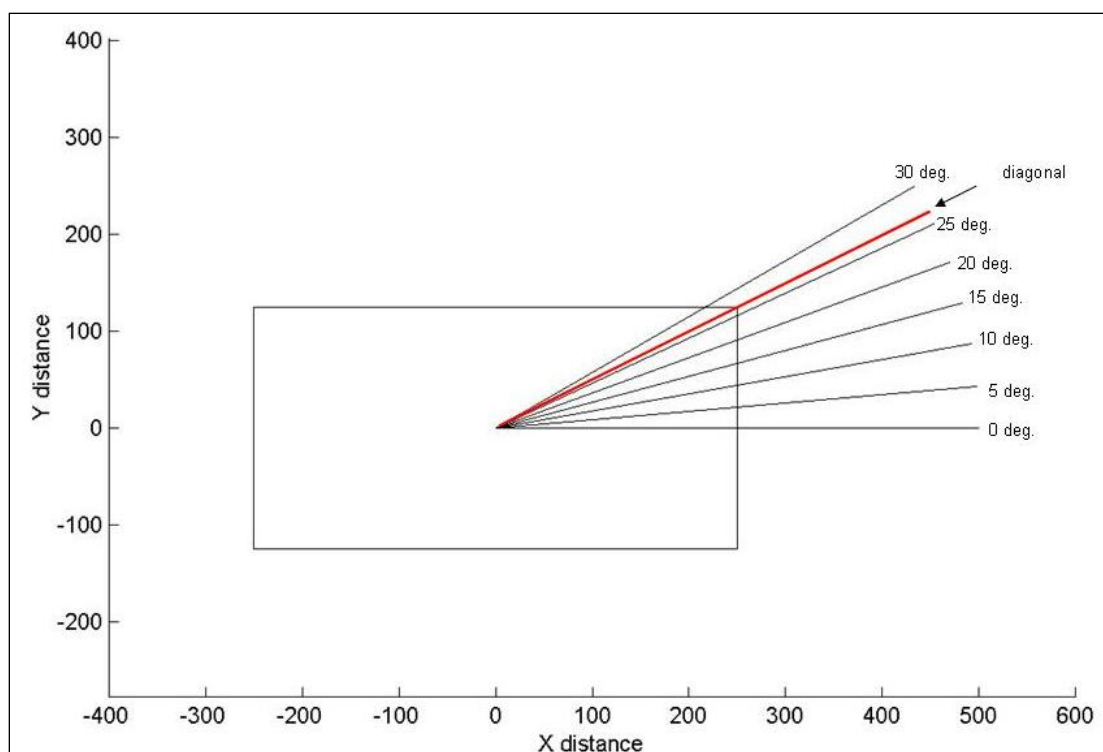
Figure 28. Receptor radials for rectangular area sources.

For each one of these radials, receptors are placed out to the probe distance at the calculated spacing(s). For each radial, the WDROTATE keyword is used in the ME pathway of the AERMOD runstream input file with the value set to the angle of the radial (0, 5, 10, etc.). See Figure 29 for examples.

```
ME STARTING                                a      ME STARTING                                b
   SURFFILE  AERSCREEN.SFC  FREE                 SURFFILE  AERSCREEN.SFC  FREE
   PROFFILE  AERSCREEN.PFL  FREE                 PROFFILE  AERSCREEN.PFL  FREE
   SURFDATA  11111  2010  SCREEN                 SURFDATA  11111  2010  SCREEN
   UAIRDATA  22222  2010  SCREEN                 UAIRDATA  22222  2010  SCREEN
   PROFBASE  18.3 METERS                         PROFBASE  18.3 METERS
ME WDROTATE   0.0                               ME WDROTATE   5.0
ME FINISHED                                     ME FINISHED


ME STARTING                                c      ME STARTING                                d
   SURFFILE  AERSCREEN.SFC  FREE                 SURFFILE  AERSCREEN.SFC  FREE
   PROFFILE  AERSCREEN.PFL  FREE                 PROFFILE  AERSCREEN.PFL  FREE
   SURFDATA  11111  2010  SCREEN                 SURFDATA  11111  2010  SCREEN
   UAIRDATA  22222  2010  SCREEN                 UAIRDATA  22222  2010  SCREEN
   PROFBASE  18.3 METERS                         PROFBASE  18.3 METERS
ME WDROTATE   10.0                              ME WDROTATE   15.0
ME FINISHED                                     ME FINISHED
```

Figure 29. ME pathway in the AERMOD runstream with WRDOTATE keyword and values for various angles.

The WDROTATE keyword rotates the wind to be along the radial being processed in AERMOD because the wind direction in the meteorological files is 270 degrees. Receptor x and y coordinates are also calculated based on the angle of the radial, i.e. for the 10 degree radial at 50 m x=49.24 m, y=8.68 m. AERMOD is run for each of the radials for each surface characteristic temporal/spatial sector combination.   In the example in Figure 28, for annual surface characteristics for the whole 360 degree sector, AERMOD is executed seven times, once for each radial. For seasonal surface characteristics for 2 spatial sectors, AERMOD is executed 56 times, once for each radial for each season and sector. For monthly surface characteristics with the maximum 12 sectors for surface roughness, AERMOD is executed 1,008 times, once for each radial, month, and surface roughness sector. Figure 30 shows sample AERMOD run sequences for seasonal, 12 sector surface characteristics for a rectangular area source with six radials. First, winter surface characteristics for sector 1 are used for each of the six radials. Next, winter surface characteristics for sector 2 are used for each of the six radials. This process is followed for each season and surface characteristic sector finishing with autumn sector 12 surface characteristics. For each temporal/sector combination, AERSCREEN then determines the worst case concentration, associated radial, and meteorology to be used later in the REFINE stage.

```
Processing Winter

Processing surface roughness sector  1
Processing wind flow sector   1
Processing wind flow sector   2
Processing wind flow sector   3
Processing wind flow sector   4
Processing wind flow sector   5
Processing wind flow sector   6
Processing surface roughness sector  2
Processing wind flow sector   1
Processing wind flow sector   2
Processing wind flow sector   3
Processing wind flow sector   4
Processing wind flow sector   5
Processing wind flow sector   6
.
.
Processing surface roughness sector 12
Processing wind flow sector   1
Processing wind flow sector   2
Processing wind flow sector   3
Processing wind flow sector   4
Processing wind flow sector   5
Processing wind flow sector   6
.
.
Processing Autumn
Processing surface roughness sector  12
Processing wind flow sector   1
Processing wind flow sector   2
Processing wind flow sector   3
Processing wind flow sector   4
Processing wind flow sector   5
Processing wind flow sector   6
```

Figure 30. AERMOD run sequences for rectangular area source for seasonal 12 sector surface characteristics.

3.6.2 Non-rectangular area sources

For non-rectangular area sources, FLOWSECTOR arranges receptors along 36 radials from the source, every 10 degrees, shown below in Figure 31. AERMOD is executed for each temporal period (annual, seasonal, or monthly) of the surface characteristics (Figure 32). However, it is not executed for each surface roughness sector. Instead, for each radial, AERSCREEN determines the upwind surface roughness sector of the radial being processed. That is, AERSCREEN determines the sector that contains the direction 180 degrees from the radial being processed. That is done because the radial is considered in the direction of the flow while surface characteristics are for the sector from which the wind is blowing, i.e. upwind. Figure 33 shows which sector is used for the 10 degree flow vector (solid black arrow) for three sectors from AERSURFACE output. In this case, the upwind direction of 10 degrees, 190 degrees (dashed black arrow), is contained in the 90 to 225 surface roughness sector.

Figure 31. Receptor placement for point (including capped and horizontal stacks), flare, volume, or circular area sources in FLOWSECTOR.

```
Processing Winter

Processing wind flow sector  10
Processing wind flow sector  20
Processing wind flow sector  30
Processing wind flow sector  40
.
.
Processing wind flow sector 360
.
.
Processing Spring
Processing wind flow sector  10
.
.
Processing Autumn
Processing wind flow sector  10
Processing wind flow sector  20
Processing wind flow sector  30
Processing wind flow sector  40
.
.
Processing wind flow sector 360
```
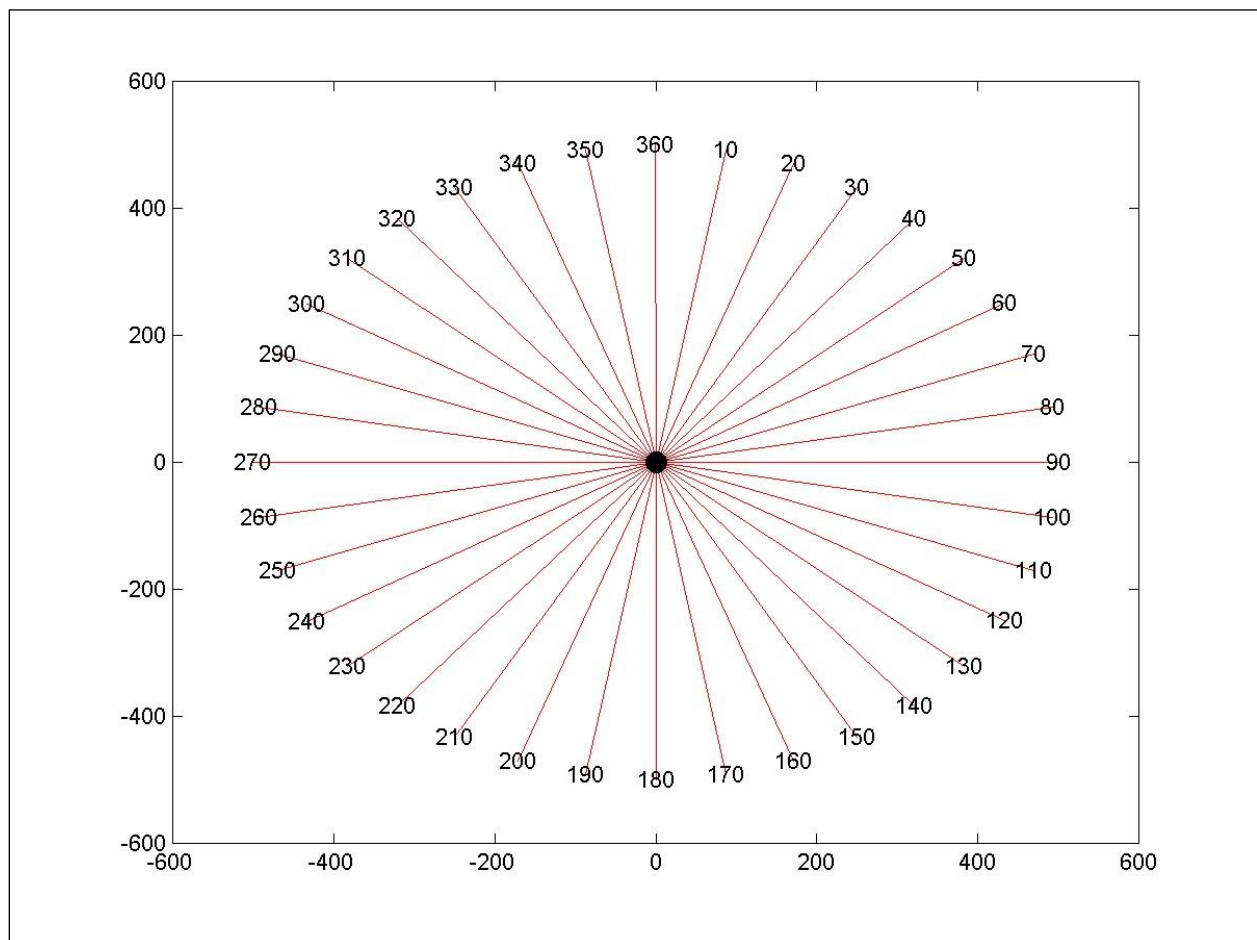
Figure 32. AERMOD sequence for seasonal 12 sector surface characteristics when processing terrain and/or building downwash.
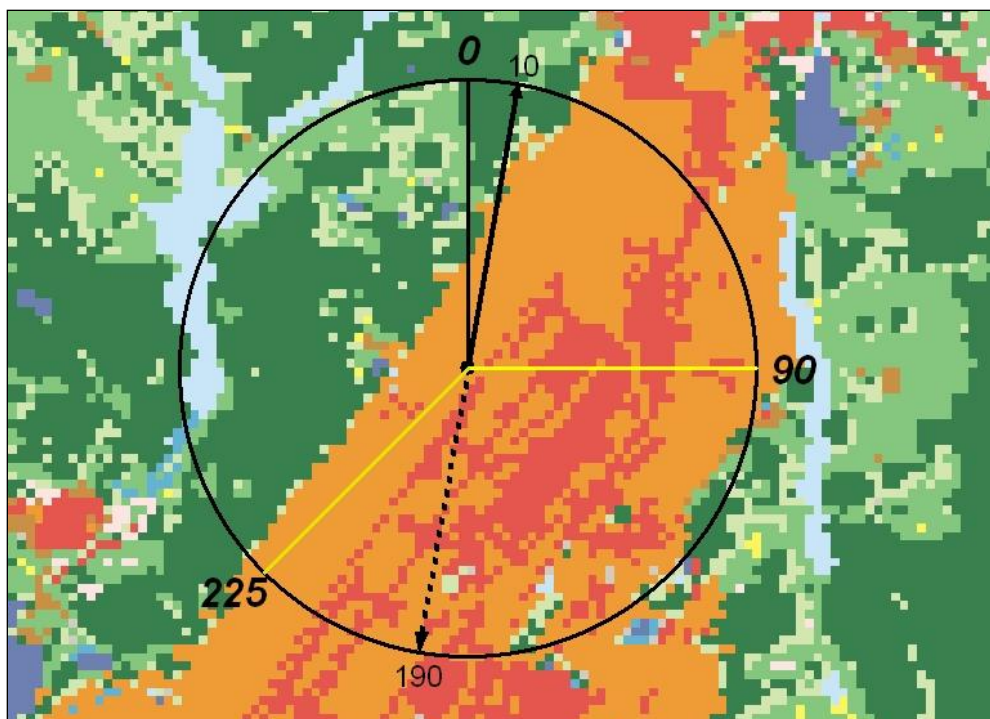
Figure 33. Flow vector (solid arrow) of 10 degrees and associated upwind surface roughness sector for three surface roughness sectors (0 to 90, 90 to 225, 225 to 0).

    If building downwash is considered, projected building dimensions calculated by BPIPPRM for the flow direction being modeled are included in the AERMOD run. If terrain is processed, AERSCREEN will find the appropriate receptors (based on distance and direction) from the AERMAP output and include the appropriate terrain data in the AERMOD input file. AERSCREEN also checks to ensure the receptor coordinates match the specified distance and direction. If they do not, AERSCREEN will issue an error and stop processing. Since AERSCREEN generates the receptor elevations via AERMAP, this should not happen, unless the AERMAP output file became corrupted during processing. When extracting the appropriate receptors, if any receptors have a missing elevation, i.e. -9999.0, AERSCREEN will skip those receptors and they will not be included in the AERMOD run for that particular direction. AERSCREEN will notify the user of how many receptors were skipped for the particular AERMOD run (Figure 34a). If any receptors did have missing elevations, the warning messages for those receptors will appear in the AERSCREEN.LOG file for the AERMAP quality assurance check (Figure 34b). AERSCREEN will notify the user of the total number of receptors skipped for FLOWSECTOR at the end of the AERSCREEN run (Figure 34c). If the user finds that receptors have been skipped due to missing elevations, the user may want to check the input terrain files for gaps or other irregularities or reconsider the probe distance, as this can affect the final maximum 1-hour concentration from AERSCREEN.

51

```
Running AERMOD
 Processing Winter
****************************************************                          a
Processing wind flow sector  10
 AERMOD Finishes Successfully for FLOWSECTOR stage 2 Winter sector  10
      0 receptors skipped due to missing elevations
    .

    .
Processing wind flow sector 150
 AERMOD Finishes Successfully for FLOWSECTOR stage 2 Winter sector 150
      8 receptors skipped due to missing elevations
    .

    .
Processing wind flow sector 160
 AERMOD Finishes Successfully for FLOWSECTOR stage 2 Winter sector 160
      7 receptors skipped due to missing elevations

Running AERMAP for FLOWSECTOR
   *** AERMAP Finishes Successfully ***  for stage 2                          b
   ********   WARNING MESSAGES   ********
OU W400  7265  FIND4:Receptor Location Outside Range of Profiles, IREC=   2997
OU W410  7265  MAIN:Receptor Elevation is Missing (-9999.0),    IREC=   2997
OU W400  7265  FIND4:Receptor Location Outside Range of Profiles, IREC=   2998
OU W410  7265  MAIN:Receptor Elevation is Missing (-9999.0),    IREC=   2998
    .

    .
 OU W410  7265  MAIN:Receptor Elevation is Missing (-9999.0),    IREC=   4210
      51 receptors have missing elevations
and will be skipped in AERMOD processing

***********************************************
AERSCREEN Finished Successfully                                              c
But with Warnings
      51 receptors skipped for FLOWSECTOR
       0 receptors skipped for REFINE
Check log file for details
***********************************************
```

Figure 34. Receptor skipping notification during FLOWSECTOR run, with notification of missing elevations in AERMAP, and total number of receptors skipped for FLOWSECTOR and REFINE.

For each AERMOD run in FLOWSECTOR, the maximum concentration, downwind distance, and terrain (if applicable) are stored for later use in REFINE. The stored concentrations are concentrations for each radial and temporal period of the surface characteristics.

3.7 REFINE

REFINE finds the maximum concentration and associated distance and date output from PROBE or FLOWSECTOR. If output is from PROBE or a rectangular area source from

52

FLOWSECTOR, REFINE uses the meteorological files for the temporal period and surface roughness sector of the maximum concentration. If output is from FLOWSECTOR for non-rectangular area sources, REFINE finds the upwind surface characteristic sector of the flow direction of maximum concentration as in Figure 33. REFINE then uses the meteorological files for the appropriate temporal and surface characteristics sector. Receptor spacing becomes one, two, or five meters, depending on maximum concentration distance, to refine the output. For rectangular area sources, the receptors are placed along the radial associated with the maximum concentration. Any discrete receptors supplied by the user are not included in the REFINE AERMOD run. If building downwash is used, building dimensions based on the flow direction of maximum concentration are used. If terrain is used, REFINE will rerun AERMAP with the new receptors in the flow direction of the maximum concentration output from FLOWSECTOR. As in FLOWSECTOR, REFINE will create a domain to be used with the DOMAINXY keyword in AERMAP. After running AERMAP, REFINE then runs AERMOD using the new receptors and appropriate meteorological, building and terrain data. As with FLOWSECTOR, if any receptors have a missing elevation, they will be skipped, and the user will be notified of how many were skipped (Figure 34c).

3.8 Output

    AERSCREEN creates the file AERSCREEN.OUT or user-supplied output filename which contains source information, output from either PROBE or FLOWSECTOR, meteorology associated with the maximum concentration output from PROBE or FLOWSECTOR, maximum concentrations by distance, and REFINE output: final maximum concentration and maximum concentration at the minimum ambient distance. See Section 4 for example output. AERSCREEN also outputs a file called max_conc_distance.txt, or name based on the user-supplied output filename, that contains the highest concentration by distance, independent of worst case meteorology and flow direction, with associated meteorology for the concentrations. These concentrations were calculated in PROBE or FLOWSECTOR. Also included in the file is the overall maximum concentration output from REFINE. This concentration is denoted by an asterisk in the file. The format of this file is shown in Table 1. AERSCREEN also copies the AERMOD.INP file from the REFINE AERMOD run to the file AERSCREEN.INP, containing the inputs to AERSCREEN entered via prompts or a previous AERSCREEN.INP file with any changes that were made during AERSCREEN processing[2]. AERSCREEN also copies the AERSCREEN.INP and AERSCREEN.LOG files to new files with names based on the user-supplied filename.

---

[2] If at any time, AERSCREEN aborts during PROBE, FLOWSECTOR, or REFINE, the user may be able to copy the current AERMOD.INP file to AERSCREEN.INP to avoid re-entering data.

Table 2. Variables listed in max_conc_distance.txt.

Variable	Description
Concentration	Maximum 1-hour screening concentration ($\mu g/m^3$). A concentration with a preceding asterisk is the overall maximum concentration.
Distance	Distance (m) from source of maximum 1-hour concentration
Elevation	Elevation (m) of maximum 1-hour concentration
Flow	Flow vector (degrees) associated with maximum 1-hour concentration
Season/Month	Season/Month of maximum 1-hour concentration (can be annual, season, or month)
Zo sector	Surface roughness sector number of maximum 1-hour concentration
Date	Date of maximum 1-hour concentration
H0	Heat flux (W/m^2)of hour of maximum 1-hour concentration
U*	Friction velocity (m/s) of hour of maximum 1-hour concentration
W*	Convective velocity (m/s) of hour of maximum 1-hour concentration
DT/DZ	Lapse rate (K/m) of hour of maximum 1-hour concentration
ZICNV	Convective mixing height (m) of hour of maximum 1-hour concentration
ZIMCH	Mechanical mixing height (m) of hour of maximum 1-hour concentration
M-O LEN	Monin-Obukhov length (m) of hour of maximum 1-hour concentration
Z0	Surface roughness length (m) of hour of maximum 1-hour concentration
Bowen	Bowen ratio of hour of maximum 1-hour concentration
Albedo	Albedo of hour of maximum 1-hour concentration
REF WS	Wind speed (m/s) of hour of maximum 1-hour concentration
HT	Anemometer height (m) of hour of maximum 1-hour concentration
REF TA	Temperature (K) of hour of maximum 1-hour concentration
HT	Height of Temperature (m) of hour of maximum 1-hour concentration

4. Example run

This section will show an example AERSCREEN run for a point source with building downwash and terrain. Table 3 gives a summary of the AERSCREEN inputs and Figure 35 shows the building/stack orientation. Table 4 lists the seasonal surface characteristics and Figure 36 shows the land use and terrain for the example. Figure 37 lists the inputs for demlist.txt and Figure 38 lists the discrete receptor file contents.

Table 3. Inputs for example AERSCREEN run.

Parameters	Inputs	Input values
Source	Source type	POINT
	Stack height	10 m
	Emission rate	1 g/s
	Stack diameter	0.5 m
	Stack exit temperature	300 K
	Stack exit velocity	15 m/s
Building	Include building downwash	Yes
	Building height	34 m
	Maximum horizontal dimension	120 m
	Orientation of maximum building dimension to North	90°
	Minimum horizontal dimension	60 m
	Direction of stack from North	26.6°
	Distance from stack to building center	67 m
Meteorology	Minimum temperature	261.4
	Maximum temperature	313.1
	Minimum wind speed	1.5 m/s
	Anemometer height	10 m
	Source of surface characteristics	AERSURFACE (aersurface_12.out)
Terrain	Include terrain	Yes
	Coordinate type	Latitude and longitude (LATLON)
	Source latitude	35.891400° N
	Source longitude	78.781940° W
	NAD	83
	Probe distance	1 km
	Source elevation	126.8
	Override input elevation with AERMAP derived value	No
Discrete receptors	Use five discrete receptors, units in meters	discrete_receptors.txt
Other inputs	Input units	Metric
	Rural/urban	Urban
	Input population	2400000
	Minimum ambient distance	30 m
	Use flagpole receptors	No
Output file	Use non-default name	aerscreen_example.out
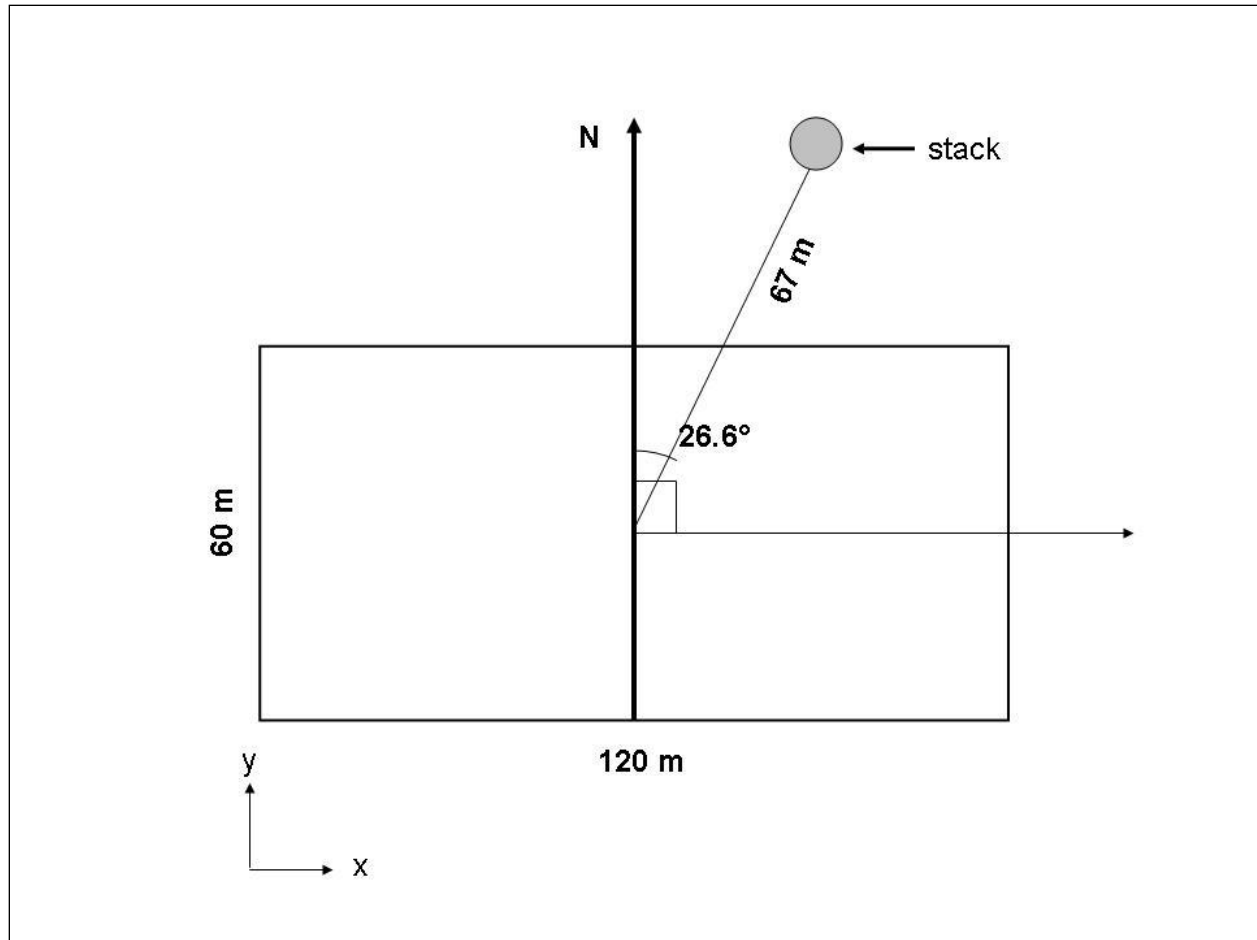
Figure 35. Plane view of building and stack orientation for example AERSCREEN run.

Table 4. Seasonal surface characteristics by sector.

Variable	Season	Sector											
		1	2	3	4	5	6	7	8	9	10	11	12
Albedo	Winter	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
	Spring	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
	Summer	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
	Autumn	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Bowen ratio	Winter	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
	Spring	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
	Summer	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
	Autumn	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Surface roughness	Winter	0.089	0.011	0.025	0.029	0.032	0.034	0.031	0.013	0.115	0.244	0.391	0.305
	Spring	0.118	0.016	0.032	0.036	0.04	0.042	0.038	0.019	0.141	0.289	0.458	0.379
	Summer	0.143	0.022	0.038	0.043	0.048	0.049	0.045	0.025	0.163	0.335	0.509	0.435
	Autumn	0.123	0.016	0.032	0.036	0.041	0.042	0.038	0.019	0.142	0.311	0.478	0.405
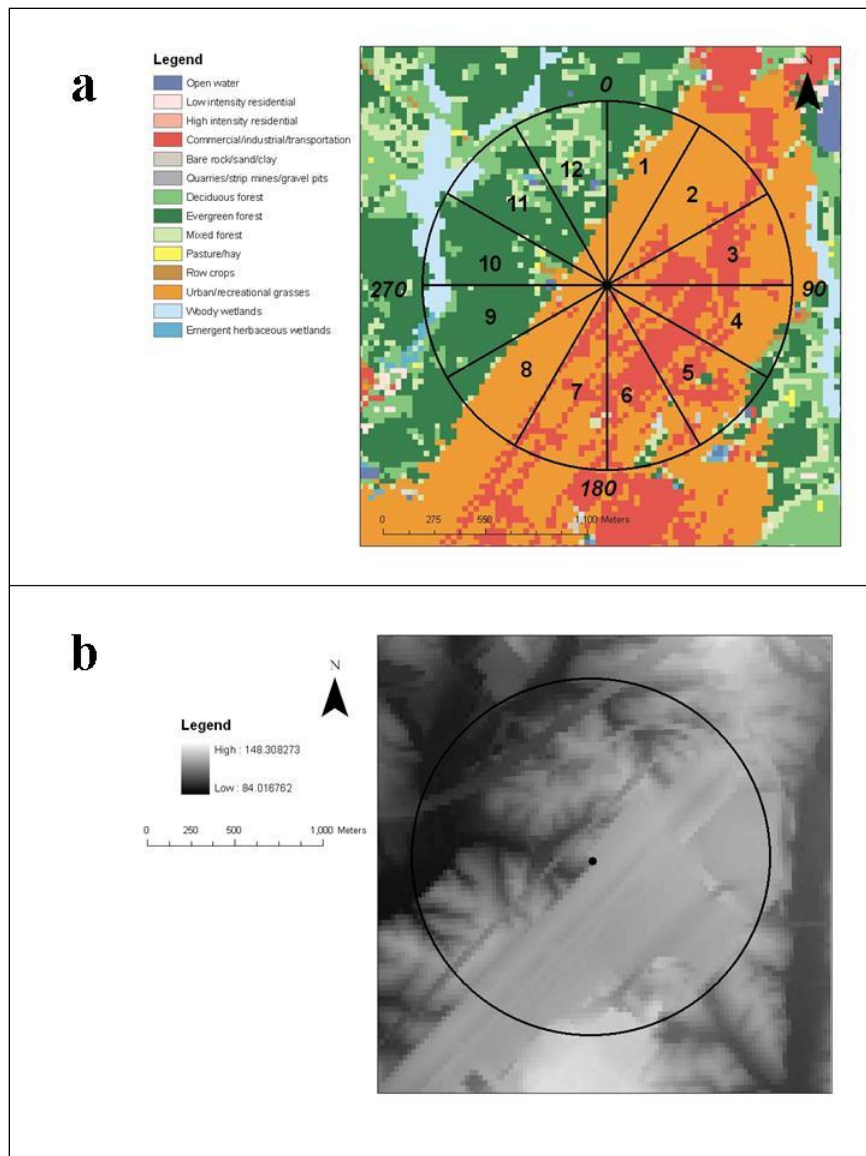
Figure 36. a) landuse pattern and sectors used for surface characteristics and b) terrain. The circle represents the 1 km radius from the source.

```
NED  :
    ------------------------------------------------------
NADGRIDS   .\
NED_22944813\NED_22944813.tif
```
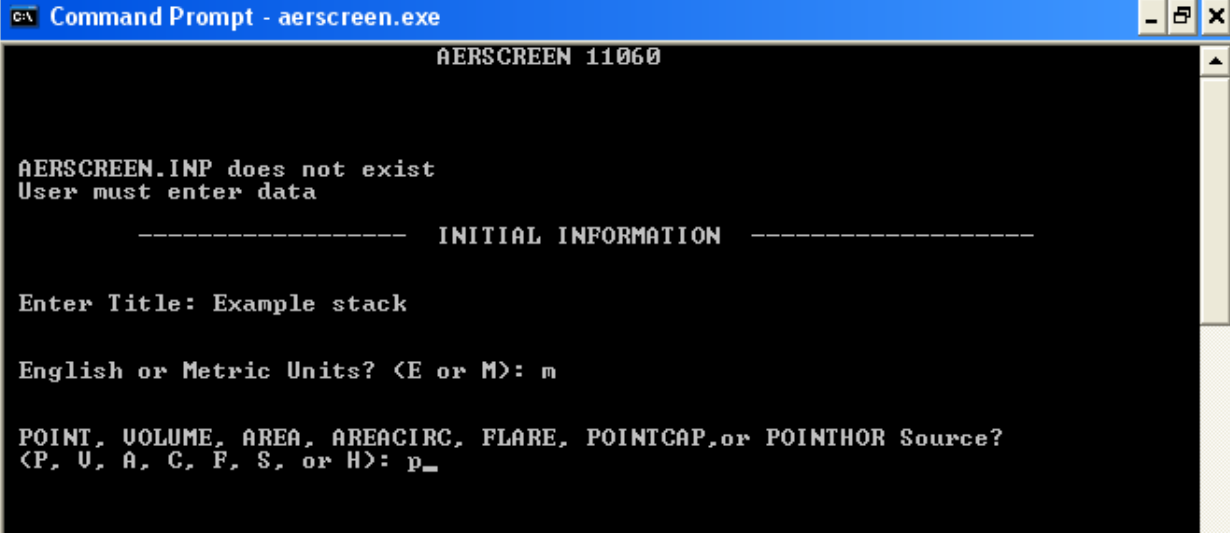
Figure 37. Contents of demlist.txt for terrain processing.

```
units: METERS
53
105
201
503
702
```

Figure 38. Contents of discrete_receptors.txt.

4.1 Processing and log file

Below in Figures 39 through 34 are the prompts and inputs for the source, building information, terrain data and meteorological data. In Figure 39, the initial prompts are shown. Since there is no existing AERSCREEN.INP file, AERSCREEN alerts the user that AERSCREEN.INP does not exist and the user must enter the data. The user enters a title, whether the inputs are in English or metric units, and the source type (point, volume, etc.).

Figure 39. Initial AERSCREEN title, units, and source type prompts.

After the initial prompts, the user then enters source parameters (Figure 40). The stack parameters, stack height, inner stack diameter, stack exit temperature, stack velocity units, and stack velocity. The user also enters if the source is urban or rural, and the urban population if an urban source. The user then enters the minimum distance to ambient air, i.e. ambient boundary. Values entered are as described in Table 3.

Figure 40. Source parameter inputs.

After source parameters have been entered, the user enters the building parameters for building downwash effects (Figures 41 and 42). In Figure 41, the initial prompts are shown. The user is prompted to include downwash if desired and if so, the user is prompted if an existing BPIPPRM input file is to be used. If the answer is yes to downwash but no to an existing BPIPPRM file, the user is then prompted for the building dimensions, building orientation, and stack orientation relative to the building (Figure 42). The inputs are building height, maximum horizontal dimension, minimum horizontal dimension, angle of maximum horizontal dimension to North, angle of stack from North, and distance between stack and building center. Building dimensions are shown in Table 3 and Figure 35.
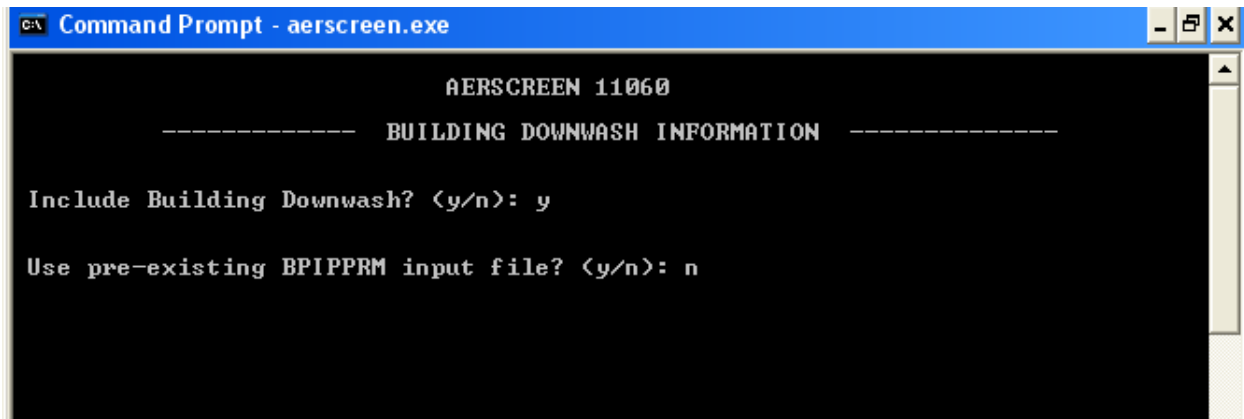
Figure 41. Initial building downwash prompts.
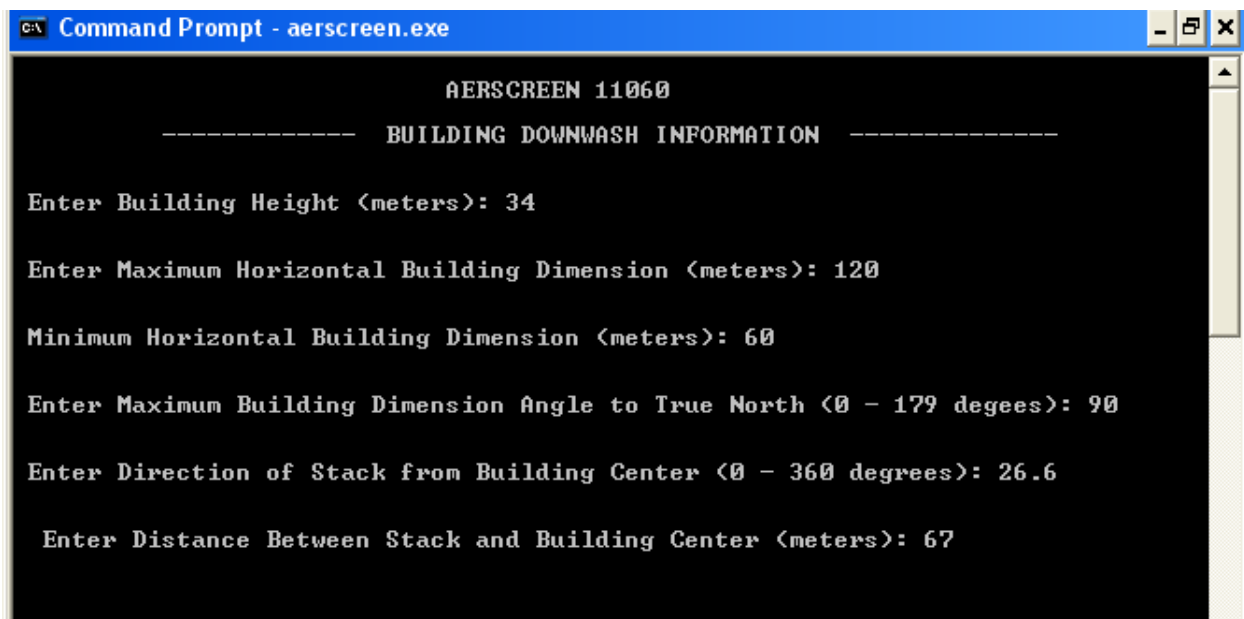
Figure 42. Building parameter inputs.

The next set of inputs is for terrain (Figure 43). The user is prompted if terrain is to be used. The user is then prompted for the probe distance with a default of 10 km available. Note, that the terrain input file or files (NED or DEM), must encompass the probe distance. Following the probe distance, the user is prompted for the use of discrete receptors and then the user is prompted for the use of flagpole receptors and if so, the flagpole height. After the flagpole information, the source elevation is input by the user. This can be an elevation or the user can hit <Enter> to use AERMAP to calculate elevation. In this case, the user has entered 126.8 m. Note if terrain is not used, this is the last prompt in the terrain section of inputs. If terrain is to be used, the user enters the coordinate type and coordinates. The NAD datum is also entered by the user. If coordinates are UTM coordinates, the user will be prompted for the UTM zone. Since geographic coordinates are used in this example, the UTM zone is determined by AERMAP.

Figure 43. Terrain parameter prompts.

The meteorological parameters are the next inputs by the user (Figure 44). The user enters the minimum and maximum air temperatures for the AERSCREEN run or accepts defaults of 250 and 310 K. The user then enters the minimum wind speed and anemometer height. For this example, a minimum of 1.5 m/s was selected for the wind speed and the default 10 m anemometer height was entered. After the anemometer height, the surface characteristics type, user-entered single values (option 1), AERMET seasonal tables (option 2), or use of an external file (option 3) is chosen. Option 3, an external file, is chosen by the user and the user then enters the filename. The file is in the same folder as the current working directory so no pathnames are necessary.

Figure 44. Meteorological parameter prompts and inputs.

After processing the meteorological data, the user is prompted for the name of the output file (Figure 45).

Figure 45. Output filename prompt and response.

Finally after the meteorological inputs, the validation page is displayed to the user listing all input parameters for the source, building downwash, terrain, and meteorological data (Figure 46). The source and building parameters are listed in both metric and English units as well as the minimum and maximum temperatures, source elevation and probe distance. AERSCREEN also displays the UTM and geographic coordinates for the source with the message that coordinates were converted from geographic to UTM coordinates. Coordinates are displayed in NAD datum of 1983. If coordinates were initially entered in NAD 1927 datum, those coordinates would be listed as well with the message that coordinates were switched from NAD 27 to NAD 83 with the NAD 27 geographic and UTM coordinates listed as well. The options listed below the meteorological data can be used to change parameters for the source, building, terrain, or meteorological data. If options 1 through 4 are chosen, the user then sees a sub-menu of parameters to choose (See Section 3). If the user is ready to proceed, option 6 is chosen and AERSCREEN begins processing the data. After choosing option 6, the same data as seen on the validation page is written to the AERSCREEN.LOG file (Figure 47).

Figure 46. Data validation page.

```
Start date and time  03/08/11 15:11:23
                   AERSCREEN 11060

Example stack

         Example stack


          ----------------  DATA ENTRY VALIDATION  ----------------
                     METRIC            ENGLISH
 ** STACKDATA **  --------------     ----------------

 Emission Rate:       1.0000 g/s          7.937 lb/hr
 Stack Height:         10.00 meters       32.81 feet
 Stack Diameter:       0.500 meters       19.69 inches
 Stack Temperature:   300.0 K             80.3 Deg F
 Exit Velocity:       15.000 m/s          49.21 ft/s
 Stack Flow Rate:      6240 ACFM
 Model Mode:           URBAN
 Population:         2400000
 Dist to Ambient Air:        30.0 meters          98. feet


 ** BUILDING DATA **

 Building Height:            34.0 meters        111.5 feet
 Max Building Dimension:    120.0 meters        393.7 feet
 Min Building Dimension:     60.0 meters        196.9 feet
 Building Orientation:  90.0 degrees
 Stack Direction:       26.6 degrees
 Stack Distance:        67.0 meters         219.8 feet


 ** TERRAIN DATA **

 Input coordinates switched from geographic to UTM

 Source Longitude:  -78.78194 deg        700198. Easting
 Source Latitude:    35.89140 deg       3974176. Northing
 UTM Zone:         17          Reference Datum: 4 (NAD 83)
 Source Base Elevation: 126.8 meters      416.0  feet

 Probe distance:   1000. meters        3281. feet

 No flagpole receptors

 Using discrete receptors in
 discrete_receptors.txt

 Only receptors between the ambient and probe distances will be included
 Input distance units are: METERS


 ** METEOROLOGY DATA **

 Min/Max Temperature:  261.4 / 313.1 K   10.9 / 103.9 Deg F

 Minimum Wind Speed:     1.5 m/s

 Anemometer Height:   10.000 meters

 Using surface characteristics in file:
 aersurface_12.out


 *** AERSCREEN Run is Ready to Begin


 Terrain to be used,AERMAP will be run
 ****************************************************
```

Figure 47. Input data in AERSCREEN.LOG.

After data validation, AERSCREEN reads the AERSURFACE output file and lists the surface characteristics (Figure 48).

```
SURFACE CHARACTERISTICS & MAKEMET
Obtaining surface characteristics...

Using seasonal surface characteristics for 12 spatial sector(s)
Sector    Start  End
   1         0    30
   2        30    60
   3        60    90
   4        90   120
   5       120   150
   6       150   180
   7       180   210
   8       210   240
   9       240   270
  10       270   300
  11       300   330
  12       330     0
Season       Sector  Albedo      Bo        zo
Winter           1    0.15      0.85      0.089
Winter           2    0.15      0.85      0.011
Winter           3    0.15      0.85      0.025
Winter           4    0.15      0.85      0.029
Winter           5    0.15      0.85      0.032
Winter           6    0.15      0.85      0.034
Winter           7    0.15      0.85      0.031
Winter           8    0.15      0.85      0.013
Winter           9    0.15      0.85      0.115
Winter          10    0.15      0.85      0.244
Winter          11    0.15      0.85      0.391
Winter          12    0.15      0.85      0.305
Spring           1    0.14      0.63      0.118
Spring           2    0.14      0.63      0.016
.
.

.
Autumn          11    0.15      0.84      0.478
Autumn          12    0.15      0.84      0.405

Creating met files aerscreen_01_01.sfc & aerscreen_01_01.pfl

Creating met files aerscreen_01_02.sfc & aerscreen_01_02.pfl
.
.
.
Creating met files aerscreen_04_11.sfc & aerscreen_04_11.pfl

Creating met files aerscreen_04_12.sfc & aerscreen_04_12.pfl
 **************************************************
```

Figure 48. Surface characteristics processing and meteorological files creation.

AERSCREEN then runs AERMAP for the source and determines the percent difference between the user-entered source elevation and the AERMAP derived elevation (Figure 49). The AERMAP elevation will not be used by AERSCREEN. AERSCREEN also lists any fatal error or warning messages from AERMAP. In this case warning messages about the use of default elevation units of meters for the NED file are displayed. For the example case, the difference between the AERMAP elevation, 120.98 m, and the user-entered elevation, 126.8 m, differ by 4.59%.

```
Running AERMAP for stage 0
    *** AERMAP Finishes Successfully ***   for source
    ********   WARNING MESSAGES   ********
 OU W473    26 NEDCHK:Default elevation units of METERS used; NED file:      1

AERMAP elevation,   120.98 differs from user entered elevation,   126.80 by    4.59%
```
Figure 49. AERMAP processing and elevation of source.

Once AERMAP has been run for the source, AERSCREEN then begins the FLOWSECTOR stage and executes AERMAP for the receptors (Figure 50). While processing the receptors, AERMAP writes the processing status to the screen (Figure 51). Once AERMAP is completed for all receptors for all thirty-six directions, AERSCREEN checks the AERMAP.OUT file for any warnings or errors (Figure 52).

```
Buildings and/or terrain present or rectangular area source, skipping probe

FLOWSECTOR    started 03/08/11 15:15:30
 **************************************************

Running AERMAP for FLOWSECTOR
```
Figure 50. AERSCREEN.LOG records for AERMAP processing for FLOWSECTOR.

```
+Now Processing Receptor      628 of    1621
+Now Processing Receptor      629 of    1621
+Now Processing Receptor      630 of    1621
+Now Processing Receptor      631 of    1621
+Now Processing Receptor      632 of    1621
+Now Processing Receptor      633 of    1621
+Now Processing Receptor      634 of    1621
+Now Processing Receptor      635 of    1621
+Now Processing Receptor      636 of    1621
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+Now Processing Receptor      681 of    1621
+Now Processing Receptor      682 of    1621
+Now Processing Receptor      683 of    1621
+Now Processing Receptor      684 of    1621
+Now Processing Receptor      685 of    1621
```

Figure 51. Status of AERMAP processing for FLOWSECTOR.

```
     *** AERMAP Finishes Successfully ***   for FLOWSECTOR
    ********    WARNING MESSAGES    ********
 OU W473  1461 NEDCHK:Default elevation units of METERS used; NED file:
1
   *********************************************
```

Figure 52. AERSCREEN.LOG summary of AERMAP.OUT warning and error messages.

Figure 53 shows partial AERMAP output for FLOWSECTOR. It is from this output that AERSCREEN will extract the receptor elevations for AERMOD processing in FLOWSECTOR. Receptor spacing for this example was 25 m since the probe distance was less than 5 km. Summing across all 36 radials, excluding receptors less than the minimum ambient distance, including the ambient distance, discrete receptors, and the source location, results in 1,621 total receptors. Also listed in the output is information that will be used for later AERSCREEN runs to determine if AERMAP needs to be rerun for FLOWSECTOR. This includes the UTM coordinates, probe distance (meters), receptor spacing, UTM zone, NAD datum, number of NED files and number of receptors. Coordinates, probe distance, receptor spacing, UTM zone, and NAD datum are listed in the line after "** Example stack."

```
** AERMAP – VERSION 09040                                            03/08/11
**                                                                   15:15:31
** Example stack
**    700198.4 3974175.8    1000.0       25.0        25.0          17         4
** A total of        1  NED files were used
** A total of    1621   receptors were processed
** DOMAINXY     699098.4   3973075.8  17    701298.4   3975275.8  17
** ANCHORXY          0.0        0.0         700198.4   3974175.8  17   4
** Terrain heights were extracted by default

RE ELEVUNIT METERS
   DISCCART          0.00          0.00      120.98      120.98
   DISCCART          5.21         29.54      119.75      119.75
   DISCCART          8.68         49.24      119.60      119.60
   DISCCART          9.20         52.19      119.84      119.84
   DISCCART         13.02         73.86      120.82      120.82
   DISCCART         17.36         98.48      120.82      120.82
   DISCCART         18.23        103.40      120.81      120.81
   DISCCART         21.71        123.10      120.73      120.73
   DISCCART         26.05        147.72      120.36      120.36
   DISCCART         30.39        172.34      119.77      120.36
   DISCCART         34.73        196.96      117.76      120.49
   DISCCART         34.90        197.95      117.69      120.49
   DISCCART         39.07        221.58      117.96      117.96
```
Figure 53.   Partial AERMAP output for FLOWSECTOR.

Once AERMAP has been run for all receptors, AERSCREEN processes each flow vector every 10 degrees from 10 degrees to 360 degrees. The appropriate building dimensions and meteorological files are used for each flow vector. During processing, AERSCREEN notifies the user what season or month and flow vector is being processed (Figure 54). A sample AERMOD.INP file is shown in Figure 55 with projected building dimensions and receptors for a particular flow vector. Note that the y-coordinate for each receptor is reset to 0. After AERMOD is executed for each flow vector, AERSCREEN checks the AERMOD.OUT file and notifies the user of any warning or error messages for that flow vector (Figure 56).

Figure 54. AERSCREEN processing during FLOWSECTOR.

```
SO STARTING
  LOCATION SOURCE POINT     0.0    0.0   126.80
  SRCPARAM SOURCE  0.1000E+01  10.000  300.000  15.000   0.500

  BUILDHGT SOURCE  36*34.00
  BUILDWID SOURCE  36*133.28
  BUILDLEN SOURCE  36*97.42
  XBADJ   SOURCE  36*-115.27
  YBADJ   SOURCE  36*7.70

  URBANSRC  SOURCE

  SRCGROUP  ALL

SO FINISHED


RE  STARTING
** Fence line receptor
    DISCCART      30.0        0.0    120.90     120.90
** Automatic receptors
    DISCCART      50.0        0.0    120.84     120.84
    DISCCART      53.0        0.0    120.88     120.88
    DISCCART      75.0        0.0    121.31     121.31
.
.
.
 RE FINISHED
```

Figure 55. Partial AERMOD.INP file used in FLOWSECTOR for 20 degree flow vector.

```
 Running AERMOD
Processing Winter

********************************************************
Processing wind flow sector  10

 AERMOD Finishes Successfully for FLOWSECTOR stage 2 Winter sector  10

        0 receptors skipped due to missing elevations
    ********   WARNING MESSAGES   ********
            ***  NONE  ***

********************************************************
.
.
.
********************************************************
Processing wind flow sector 360

 AERMOD Finishes Successfully for FLOWSECTOR stage 2 Autumn sector 360

        0 receptors skipped due to missing elevations
    ********   WARNING MESSAGES   ********
            ***  NONE  ***

FLOWSECTOR   ended 03/08/11 15:18:02
```

Figure 56. AERSCREEN.LOG partial output of AERMOD.OUT checks for FLOWSECTOR.

After FLOWSECTOR, AERSCREEN enters the REFINE subroutine and calculates the overall maximum concentration and its associated distance, flow vector, projected building dimensions, terrain and meteorology. AERSCREEN then reruns AERMAP (Figure 57) and AERMOD with refined receptor spacing using the terrain, projected building dimensions, and meteorology of the maximum concentration's flow vector. The receptors include the minimum ambient receptor and receptors near the maximum concentration with 1 to 5 m spacing. See Figure 58 for the partial AERMOD.INP file used in REFINE. Messages from AERSCREEN.LOG for REFINE and final processing are shown in Figure 59. The maximum concentration is along the 270 degree flow vector. AERSCREEN ends and notifies the user that AERSCREEN ended successfully with warnings and gives the end time. AERSCREEN also outputs the overall maximum 1-hour concentration and maximum 1-hour ambient boundary concentration, with scaled 3, 8, 24-hour, and annual average concentrations (Figure 60). Also listed are the distances, flow vectors direction, and receptor elevations relative to the source elevation. For the example case, the overall maximum 1-hour concentration was 378 μg/m^3 at 117 m toward 270° and the receptor's elevation was 21.07 m below the source or 105.73 m. The maximum ambient boundary concentration was 301.3 μg/m^3 north of the source at an elevation of about 118.93 m or 7.87 m below the source elevation.

Figure 57. Status of AERMAP processing for REFINE.

```
SO STARTING
   LOCATION SOURCE POINT        0.0     0.0    126.80
   SRCPARAM SOURCE   0.1000E+01  10.000  300.000   15.000    0.500

   BUILDHGT SOURCE  36*.00
   BUILDWID SOURCE  36*.00
   BUILDLEN SOURCE  36*.00
   XBADJ    SOURCE  36*.00
   YBADJ    SOURCE  36*.00

   URBANSRC   SOURCE

   SRCGROUP   ALL

SO FINISHED

RE STARTING
** Fence line receptor
   DISCCART         30.00       0.00     117.88      121.12
** Refined receptors
   DISCCART         75.00       0.00     108.82      122.03
   DISCCART         76.00       0.00     108.69      122.03
   DISCCART         77.00       0.00     108.57      122.03
   DISCCART         78.00       0.00     108.45      122.03
.
.
.
RE FINISHED
```

Figure 58. Partial AERMOD.INP file for REFINE processing.

```
REFINE       started 03/08/11 15:18:02
 **************************************************

Running AERMAP for REFINE
     *** AERMAP Finishes Successfully ***   for stage 3
     ********   WARNING MESSAGES   ********
 OU W473   123 NEDCHK:Default elevation units of METERS used; NED file:       1

 AERMOD Finishes Successfully for REFINE stage 3 Winter sector 290

       0 receptors skipped due to missing elevations
     ********   WARNING MESSAGES   ********
                  ***  NONE  ***

REFINE        ended 03/08/11 15:18:04

 ***********************************************
 AERSCREEN Finished Successfully
 But with Warnings
 Source coordinates switched from lat/lon to UTM
       0 receptors skipped for FLOWSECTOR
       0 receptors skipped for REFINE
 Check log file for details
 ***********************************************

Ending date and time  03/08/11 15:18:05
```

Figure 59. REFINE and final AERSCREEN.LOG messages.

Figure 60.   Overall maximum and maximum ambient boundary concentration statistics.

4.2 AERSCREEN output

Output from AERSCREEN is written to AERSCREEN_EXAMPLE.OUT. Following are
sections with explanations.

The first section shown lists information also shown in the log file, emissions inputs, terrain information (input terrain file and probe distance), and building inputs in both metric and English units (Figure 61).

```
AERSCREEN 11060 / AERMOD 09292                                 03/08/11
                                                               15:18:04

 TITLE: Example stack


 -------------------------------------------------------------------------------
 ****************************  STACK PARAMETERS  ****************************
 -------------------------------------------------------------------------------

 SOURCE EMISSION RATE:              1.0000 g/s                 7.937 lb/hr
 STACK HEIGHT:                       10.00 meters             32.81 feet
 STACK INNER DIAMETER:               0.500 meters             19.69 inches
 PLUME EXIT TEMPERATURE:             300.0 K                   80.3 Deg F
 PLUME EXIT VELOCITY:               15.000 m/s                49.21 ft/s
 STACK AIR FLOW RATE:                 6241 ACFM
 STACK BASE LONGITUDE:            -78.7819 deg               700198. Easting
 STACK BASE LATITUDE:              35.8914 deg              3974176. Northing
 STACK BASE UTM ZONE:                                           17
 REFERENCE DATUM (NADA):                                         4
 STACK BASE ELEVATION:              126.80 meters            416.01 feet
 RURAL OR URBAN:                     URBAN
 POPULATION:                       2400000

 DIGITAL ELEVATION MAP(S)          NED_22944813\NED_22944813.tif

 INITIAL PROBE DISTANCE =           1000. meters             3281. feet




 -------------------------------------------------------------------------------
 *********************  BUILDING DOWNWASH PARAMETERS  *********************
 -------------------------------------------------------------------------------

 BUILDING HEIGHT:                    34.0 meters             111.5 feet
 MAX BUILDING DIMENSION:            120.0 meters             393.7 feet
 MIN BUILDING DIMENSION:             60.0 meters             196.9 feet
 BUILDING ORIENTATION TO NORTH:       90. degrees
 STACK DIRECTION FROM CENTER:         27. degrees
 STACK DISTANCE FROM CENTER:         67.0 meters             219.8 feet
```

Figure 61. AERSCREEN_EXAMPLE.OUT section with source and building information.

The next section gives information about the results of FLOWSECTOR (Figure 62). The header for the section gives the receptor spacing, 25 m. Next, follows the flow sectors from 10 to 360 degrees. Included for each sector are the projected building width and length output from BPIPPRM, the x and y building adjustments from BPIPPRM, the maximum 1-hour

concentration (µg/m^3), the downwind distance from the source, and the elevation of the receptor relative to the source (receptor – source). Concentrations are written in with the "G" FORTRAN descriptor with 4 significant digits. The sector followed by an "*" indicates that this is the highest concentration sector or "worst case sector." In this case it is flow sector 270 degrees with a concentration of approximately 376.2 µg/m^3 at 125 m from the source. The relative receptor elevation is -21.38 m, meaning the receptor is at an elevation of approximately 105 m. The temporal period associated with the maximum concentration is winter.

```
--------------------------------------------------------------------------------
 ************************** FLOW SECTOR ANALYSIS  **************************
              25 meter receptor spacing: 30. meters - 1000. meters
--------------------------------------------------------------------------------


                                             MAXIMUM  IMPACT RECEPTOR
    FLOW      BUILD     BUILD                 1-HR CONC  DIST   HEIGHT  TEMPORAL
   SECTOR     WIDTH     LENGTH   XBADJ   YBADJ  (ug/m3)  (m)     (m)    PERIOD
   -----------------------------------------------------------------------------
     10      128.60     79.93  -104.17   19.14   269.7    53.0   -6.96    SPR
     20      133.28     97.42  -115.27    7.70   219.6    30.0   -6.26    SPR
     30      133.92    111.96  -122.86   -3.97   164.6    30.0   -5.90    WIN
     40      130.49    123.10  -126.73  -15.53   89.78   475.0   -3.69    SUM
     50      123.10    130.49  -126.74  -26.61   79.97   100.0   -4.85    SPR
     60      111.96    133.92  -122.90  -36.88   116.5    75.0   -4.81    WIN
     70       97.42    133.28  -115.32  -46.04   132.7    75.0   -4.63    WIN
     80       79.93    128.60  -104.25  -53.79   256.9    75.0   -4.51    WIN
     90        0.00      0.00     0.00    0.00   308.2   100.0   -4.41    WIN
    100        0.00      0.00     0.00    0.00   307.2   100.0   -4.58    WIN
    110        0.00      0.00     0.00    0.00   305.4   100.0   -4.90    WIN
    120      111.96    133.92   -62.99  -66.88   256.8    53.0   -4.72    WIN
    130      123.10    130.49   -49.72  -65.18   217.6   100.0   -5.31    WIN
    140      130.49    123.10   -34.94  -61.49   216.2   125.0   -6.09    WIN
    150      133.92    111.96   -19.10  -55.94   230.7   150.0   -6.31    WIN
    160      133.28     97.42    -2.68  -48.68   232.8   175.0   -5.95    WIN
    170      128.60     79.93    13.83  -39.95   246.5   175.0   -6.76    WIN
    180      120.00     60.00    29.91  -30.00   233.4   100.0   -5.13    WIN
    190      128.60     79.93    24.25  -19.14   246.2   105.0   -5.17    WIN
    200      133.28     97.42    17.85   -7.70   243.4   125.0   -5.34    WIN
    210      133.92    111.96    10.90    3.97   259.0   125.0   -5.69    WIN
    220      130.49    123.10     3.63   15.53   250.1   150.0   -6.42    WIN
    230      123.10    130.49    -3.76   26.61   220.0   125.0   -7.83    WIN
    240      111.96    133.92   -11.03   36.88   182.9   200.0  -13.09    WIN
    250       97.42    133.28   -17.96   46.04   208.2   150.0  -19.38    WIN
    260       79.93    128.60   -24.35   53.79   258.3    53.0  -11.47    WIN
    270*       0.00      0.00     0.00    0.00   376.2   125.0  -21.38    WIN
    280        0.00      0.00     0.00    0.00   376.2   125.0  -19.18    WIN
    290        0.00      0.00     0.00    0.00   376.2   125.0  -16.65    WIN
    300      111.96    133.92   -70.94   66.88   231.0    53.0  -14.84    WIN
    310      123.10    130.49   -80.77   65.18   167.6   100.0  -12.94    WIN
    320      130.49    123.10   -88.16   61.49   186.4   105.0  -11.18    AUT
    330      133.92    111.96   -92.86   55.94   159.2   100.0  -11.05    SPR
    340      133.28     97.42   -94.75   48.68   100.5    75.0  -10.81    WIN
    350      128.60     79.93   -93.75   39.95   213.4    30.0   -8.59    SUM
    360      120.00     60.00   -89.91   30.00   301.3    30.0   -7.87    WIN
 * = worst case flow sector
```

Figure 62. FLOWSECTOR results in AERSCREEN_EXAMPLE.OUT.

Next, follows meteorological inputs and meteorology used to calculate the overall worst case scenario (Figure 63). Listed first are the inputs: minimum and maximum temperatures (K), minimum wind speed and anemometer height. Also listed is the dominant season and surface roughness sector associated with the worst case concentration. For this case it is winter and roughness sector 4 with beginning direction 90 degrees and ending with 120 degrees. Note that this is the sector of the upwind direction of the worst case scenario.   Shown below the season and sector are the surface characteristics for that season and sector.

Next, follows the meteorological parameters used to predict the worst case concentration at the ambient boundary (Figure 63): year, month, day, Julian date, hour, heat flux, u*, w*, lapse rate, convective mixing height, mechanical mixing height, Monin-Obukhov length, surface roughness, Bowen ratio, albedo reference wind speed, anemometer height, temperature, and temperature measurement height (2 meters). The surface characteristics listed should match those listed in association with the dominant season and sector in the AERSURFACE output file or AERSCREEN.LOG file.   After the meteorological parameters, the final plume rise is also shown. After that are listed the meteorological parameters and plume height of the maximum concentration at the ambient boundary. Plume heights do not include downwash effects.

```
--------------------------------------------------------------------------------
 ********************  MAKEMET METEOROLOGY PARAMETERS  ********************
 --------------------------------------------------------------------------------

 MIN/MAX TEMPERATURE:     261.4 / 313.1 (K)

 MINIMUM WIND SPEED:        1.5 m/s

 ANEMOMETER HEIGHT:      10.000 meters

 SURFACE CHARACTERISTICS INPUT: aersurface_12.out

 DOMINANT SECTOR:            4 ( 90 120)
 DOMINANT SEASON:          Winter

 ALBEDO:                   0.15
 BOWEN RATIO:              0.85
 ROUGHNESS LENGTH:         0.029 (meters)


        METEOROLOGY CONDITIONS USED TO PREDICT OVERALL MAXIMUM IMPACT
        -----------------------------------------------------------

  YR MO DY JDY HR
  -- -- -- --- --
  10 01 09   9 01

     H0     U*     W*   DT/DZ ZICNV ZIMCH  M-O LEN    Z0  BOWEN ALBEDO  REF WS
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 -2.90  0.051 -9.000  0.020 -999.   27.     4.5 0.029   0.85   0.15    1.50

     HT   REF TA     HT
 - - - - - - - - - - -
   10.0   313.1    2.0

 ESTIMATED FINAL PLUME HEIGHT (non-downwash):     22.7 meters


         METEOROLOGY CONDITIONS USED TO PREDICT AMBIENT BOUNDARY IMPACT
         -----------------------------------------------------------

  YR MO DY JDY HR
  -- -- -- --- --
  10 01 09   9 01

     H0     U*     W*   DT/DZ ZICNV ZIMCH  M-O LEN    Z0  BOWEN ALBEDO  REF WS
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 -2.95  0.052 -9.000  0.020 -999.   27.     4.6 0.031   0.85   0.15    1.50

     HT   REF TA     HT
 - - - - - - - - - - -
   10.0   313.1    2.0

 ESTIMATED FINAL PLUME HEIGHT (non-downwash):     22.6 meters
```

**Figure 63. Meteorological data associated with maximum FLOWSECTOR concentration
and ambient boundary concentration.**

After the meteorological parameters, follows a summary of maximum concentrations by distance (Figure 64). The concentrations shown are not necessarily in the same direction as the overall maximum concentration shown in the flow sector analysis, i.e., the maximum 30 m concentration may not be directed toward 180. Details about the concentrations' meteorology can be found in the file aerscreen_example_max_conc_distance.txt, whose format is listed in Table 1. The maximum concentration and its distance, 125 m (shown in red in Figure 64) found from FLOWSECTOR should be listed in the table and in aerscreen_example_max_conc_distances.txt.

```
--------------------------------------------------------------------------------
*********************** AERSCREEN AUTOMATED DISTANCES *********************
                OVERALL MAXIMUM CONCENTRATIONS BY DISTANCE
--------------------------------------------------------------------------------


            MAXIMUM    RECEPTOR                    MAXIMUM    RECEPTOR
     DIST   1-HR CONC  HEIGHT          DIST        1-HR CONC  HEIGHT
     (m)    (ug/m3)    (m)             (m)         (ug/m3)    (m)
     ----------------------------      ----------------------------
     30.00   301.3      -7.87          503.00      214.7      -6.90
     50.00   292.9      -9.01          525.00      210.9      -7.24
     53.00   294.5      -8.78          550.00      205.4      -7.95
     75.00   282.3      -4.49          575.00      200.0      -8.66
    100.00   367.7     -20.23          600.00      196.4      -8.92
    105.00   373.3     -20.49          625.00      187.4     -10.78
    125.00   376.2     -21.38          650.00      186.2     -10.38
    150.00   356.3     -22.38          675.00      188.7      -8.86
    175.00   328.0     -23.26          700.00      190.4      -7.54
    200.00   299.2     -16.13          702.00      190.2      -7.54
    201.00   298.1     -15.96          725.00      187.4      -7.64
    225.00   272.2     -16.55          750.00      182.0      -8.44
    250.00   247.8     -18.24          775.00      176.4      -9.29
    275.00   226.2     -17.91          800.00      171.5      -9.91
    300.00   213.5     -14.10          825.00      167.1     -10.43
    325.00   209.0     -15.04          850.00      162.4     -11.04
    350.00   208.5     -13.90          875.00      157.8     -11.65
    375.00   202.8     -15.03          900.00      150.6     -13.42
    400.00   201.4     -14.07          925.00      142.3     -16.06
    425.00   204.4     -11.77          950.00      136.9     -17.60
    450.00   210.0      -9.52          975.00      134.6     -17.23
    475.00   216.2      -7.32         1000.00      132.2     -16.96
    500.00   215.0      -6.93
```

Figure 64. Summary of maximum concentrations by distance in AERSCREEN_EXAMPLE.OUT.

The final section of the output file lists the results of REFINE (Figure 65). This is the overall maximum concentration in the direction of the worst case scenario found in FLOWSECTOR, using the same surface characteristics (winter, 90 to 120 degrees sector). In addition to the 1-hour concentration calculated by AERMOD, the scaled 3-hr, 8-hr, 24-hr, and annual concentrations are calculated by AERSCREEN and output. Also output is the distance of the maximum concentration and its direction. Similar output is listed for the maximum concentration at the minimum ambient distance.

```
--------------------------------------------------------------------------------
 *********************  AERSCREEN MAXIMUM IMPACT SUMMARY  *********************
 --------------------------------------------------------------------------------

                     MAXIMUM      SCALED      SCALED      SCALED      SCALED
                     1-HOUR       3-HOUR      8-HOUR      24-HOUR     ANNUAL
   CALCULATION        CONC         CONC        CONC        CONC        CONC
    PROCEDURE        (ug/m3)      (ug/m3)     (ug/m3)     (ug/m3)     (ug/m3)
 ---------------    ----------   ----------  ----------  ----------  ----------
 ELEVATED TERRAIN    378.0        378.0       340.2       226.8       37.80

 DISTANCE FROM SOURCE    117.0 meters directed toward 270 degrees
 RECEPTOR HEIGHT    -21.07 meters



 IMPACT AT THE
 AMBIENT BOUNDARY    301.3        301.3       271.2       180.8       31.13

 DISTANCE FROM SOURCE     30.0 meters directed toward 360 degrees
 RECEPTOR HEIGHT     -7.87 meters
```

Figure 65. Maximum concentration impact and ambient boundary summaries in AERSCREEN_EXAMPLE.OUT.

Figure 66 shows partial output for aerscreen_example_max_conc_distances.txt. Note that the overall maximum concentration 378.0 μg/m^3 is denoted by the asterisk. See Table 2 for format.

Concentration	Distance	Elevation	Flow	Season/Month	Zo sector	Date	H0	U*	W*	DT/DZ	ZICNV	ZIMCH	M-O LEN	Z0	BOWEN	ALBEDO	REF WS	HT	REF TA	HT
0.30135E+03	30.00	-7.87	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.29286E+03	50.00	-9.01	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.29450E+03	53.00	-8.78	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.28229E+03	75.00	-4.49	90	Winter	270-300	10010601	-5.73	0.081	-9.000	0.020	-999.	53.	8.9	0.244	0.85	0.15	1.50	10.0	313.1	2.0
0.36774E+03	100.00	-20.23	270	Winter	90-120	10010901	-2.90	0.051	-9.000	0.020	-999.	27.	4.5	0.029	0.85	0.15	1.50	10.0	313.1	2.0
0.37332E+03	105.00	-20.49	270	Winter	90-120	10010901	-2.90	0.051	-9.000	0.020	-999.	27.	4.5	0.029	0.85	0.15	1.50	10.0	313.1	2.0
* 0.37804E+03	117.00	-21.07	270	Winter	90-120	10010901	-2.90	0.051	-9.000	0.020	-999.	27.	4.5	0.029	0.85	0.15	1.50	10.0	313.1	2.0
0.37619E+03	125.00	-21.38	270	Winter	90-120	10010901	-2.90	0.051	-9.000	0.020	-999.	27.	4.5	0.029	0.85	0.15	1.50	10.0	313.1	2.0
0.35634E+03	150.00	-22.38	270	Winter	90-120	10010901	-2.90	0.051	-9.000	0.020	-999.	27.	4.5	0.029	0.85	0.15	1.50	10.0	313.1	2.0
0.32799E+03	175.00	-23.26	270	Winter	90-120	10012501	-2.06	0.051	-9.000	0.020	-999.	27.	6.3	0.029	0.85	0.15	1.50	10.0	313.1	2.0
0.29923E+03	200.00	-16.13	290	Winter	90-120	10012501	-2.06	0.051	-9.000	0.020	-999.	27.	6.3	0.029	0.85	0.15	1.50	10.0	313.1	2.0
0.29811E+03	201.00	-15.96	290	Winter	90-120	10012501	-2.06	0.051	-9.000	0.020	-999.	27.	6.3	0.029	0.85	0.15	1.50	10.0	313.1	2.0
0.27219E+03	225.00	-16.55	280	Winter	90-120	10012501	-2.06	0.051	-9.000	0.020	-999.	27.	6.3	0.029	0.85	0.15	1.50	10.0	313.1	2.0
0.24776E+03	250.00	-18.24	270	Winter	90-120	10012501	-2.06	0.051	-9.000	0.020	-999.	27.	6.3	0.029	0.85	0.15	1.50	10.0	313.1	2.0
0.22623E+03	275.00	-17.91	270	Winter	90-120	10012501	-2.06	0.051	-9.000	0.020	-999.	27.	6.3	0.029	0.85	0.15	1.50	10.0	313.1	2.0
0.21350E+03	300.00	-14.10	360	Winter	180-210	10011501	-0.99	0.094	-9.000	0.020	-999.	66.	80.4	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.20904E+03	325.00	-15.04	360	Winter	180-210	10011501	-0.99	0.094	-9.000	0.020	-999.	66.	80.4	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.20853E+03	350.00	-13.90	360	Winter	180-210	10011501	-0.99	0.094	-9.000	0.020	-999.	66.	80.4	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.20283E+03	375.00	-15.03	360	Winter	180-210	10011501	-0.99	0.094	-9.000	0.020	-999.	66.	80.4	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.20142E+03	400.00	-14.07	360	Winter	180-210	10011501	-0.99	0.094	-9.000	0.020	-999.	66.	80.4	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.20437E+03	425.00	-11.77	360	Winter	180-210	10011501	-0.99	0.094	-9.000	0.020	-999.	66.	80.4	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.20999E+03	450.00	-9.52	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.21620E+03	475.00	-7.32	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.21496E+03	500.00	-6.93	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.21475E+03	503.00	-6.90	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.21093E+03	525.00	-7.24	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.20542E+03	550.00	-7.95	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.20003E+03	575.00	-8.66	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.19640E+03	600.00	-8.92	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.18740E+03	625.00	-10.78	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.18620E+03	650.00	-10.38	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.18871E+03	675.00	-8.86	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.19044E+03	700.00	-7.54	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.19022E+03	702.00	-7.54	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.18737E+03	725.00	-7.64	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.18205E+03	750.00	-8.44	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.17640E+03	775.00	-9.29	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.17155E+03	800.00	-9.91	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.16706E+03	825.00	-10.43	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.16240E+03	850.00	-11.04	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.15782E+03	875.00	-11.65	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.15059E+03	900.00	-13.42	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.14228E+03	925.00	-16.06	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.13686E+03	950.00	-17.60	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.13463E+03	975.00	-17.23	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0
0.13223E+03	1000.00	-16.96	360	Winter	180-210	10010901	-2.95	0.052	-9.000	0.020	-999.	27.	4.6	0.031	0.85	0.15	1.50	10.0	313.1	2.0

Figure 66. Output of aerscreen_example_max_conc_distance.txt.

After processing, AERSCREEN creates a new AERSCREEN.INP file, with any user input changes added (Figure 67). Note that any options are that are alphabetic have been set to uppercase. AERSCREEN sets all flags to uppercase internally for program efficiency. AERSCREEN will also output the surface characteristics for the maximum concentration as the user-entered values in the MAKEMET DATA section and lists the time, flow vector, and surface roughness sector of the overall maximum concentration. AERSCREEN also copies the new AERSCREEN.INP file to AERSCREEN_EXAMPLE.INP and AERSCREEN.LOG to AERSCREEN_EXAMPLE.LOG.

```
** Coordinates switched from geographic to UTM

** STACK DATA           Rate      Height      Temp.   Velocity     Diam.      Flow
**              0.1000E+01   10.0000  300.0000   15.0000    0.5000      6241.

** BUILDING DATA    BPIP     Height  Max dim.  Min dim.   Orient.    Direct.    Offset
**                   Y      34.0000  120.0000   60.0000   90.0000    26.6000   67.0000

** MAKEMET DATA     MinT    MaxT Speed    AnemHt Surf Clim  Albedo   Bowen  Length  SC FILE
**              261.40  313.10   1.5    10.000    9    0   0.1500   0.8500   0.0290  "aersurface_12.out"

** TERRAIN DATA    Terrain    UTM East    UTM North  Zone  Nada      Probe     PROFBASE  Use AERMAP elev
**                  Y       700198.4   3974175.8    17    4      1000.0         126.80          N

** DISCRETE RECEPTORS  Discflag    Receptor file
**                  Y          "discrete_receptors.txt"

** UNITS/POPULATION    Units   R/U  Population     Amb. dist.    Flagpole    Flagpole height
**                  M     U    2400000.        30.000       N           0.00

** OUTPUT FILE "aerscreen_example.out"

** Temporal sector: Winter, flow vector: 270 degrees, spatial sector:  4
```
Figure 67. Header portion of new AERSCREEN.INP file.

5. References

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Appendix A. Input parameters and invalid responses

Below, AERSCREEN input parameters are listed with invalid responses and actions taken by AERSCREEN when reading the data from the AERSCREEN.INP file or prompts. Some variables are only checked if the appropriate flags are set. Building dimensions are not checked if downwash is not included in AERSCREEN processing. Other variables such as urban population or flagpole heights are not checked if the source is not urban or flagpole receptors are not used.

As previously noted, when reading data from AERSCREEN.INP, if any of the data sections, emissions, building information, terrain information, meteorological information, and other parameters, is missing, AERSCREEN will alert the user and stop processing. If the emissions data is listed after the building, terrain, or other parameter data sections, AERSCREEN will alert the user and stop processing.

Source parameters and invalid values.

Parameter	Source type	Invalid response	AERSCREEN.INP	Prompts
Units flag	All	If prompts, response is not upper or lower case E or M. If input file, response is not upper or lowercase M.	Issue message and stop	Re-prompt
Source type	All	Response is not upper or lower-case: P, F, H, A, C, S, or V	Issue message and stop	Re-prompt
Emission rate	All	Negative or non-numeric	Issue message and stop	Re-prompt
Stack height	Point, capped stack, horizontal stack	Negative or non-numeric	Issue message and stop	Re-prompt
Stack diameter	Point, capped stack, horizontal stack	Negative or non-numeric	Issue message and stop	Re-prompt
Negative exit velocity	Point, capped stack, horizontal stack	Non-numeric	Issue message and reset to $1x10^{-5}$ m/s if negative	Issue message and reset to $1x10^{-5}$ m/s if negative
Flare height	Flare	Negative or non-numeric	Issue message and stop	Re-prompt
Heat release rate	Flare	Negative or non-numeric	Issue message and stop	Re-prompt
Heat loss fraction	Flare	Non-numeric	Issue message and reset to 0 if negative	Issue message and reset to 0 if negative
Release height	Area, volume, circular area	Negative or non-numeric	Issue message and stop	Re-prompt
Initial vertical dimension	Area, volume, circular area	Negative or non-numeric	Issue message and stop	Re-prompt
Initial lateral dimension	Volume	Negative or non-numeric	Issue message and stop	Re-prompt
Circular radius	Circular area	Negative or non-numeric	Issue message and stop	Re-prompt
Rectangular area source horizontal dimensions	Area	Negative or non-numeric	Issue message and stop	Re-prompt
Orientation angle	Area	Non-numeric or non-zero	Issue message and stop	N/A
Number of vertices	Circular area	Non-numeric or not equal to 20	Issue message and stop	N/A
Urban/rural flag	All	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt
Urban population	All	Non-numeric, negative or less than 100 people	Issue message and stop (if source is urban)	Re-prompt
Minimum ambient distance	All	Non-numeric, negative or if volume source, inside the volume.	Issue message and reset to minimum distance based on source type if negative. If non-numeric issue message and stop	Re-prompt if non-numeric
NO$_2$ conversion method	All	"PVMRM" and "OLM" are both on MODELOPT card or POLLUTID is NO2 and neither PVMRM or OLM is on MODELOPT card	Issue message and stop	N/A
NO$_2$/NOX in-stack ratio	All	Non-numeric, negative, or exceeds 1.0	Issue message and stop	Re-prompt
Ozone background concentration	All	Non-numeric, negative, or exceeds 1.0	Issue message and stop	Re-prompt
Ozone background concentration units	All	Not upper or lower-case "PPB", "PPM", or "UG/M3"	Issue message and stop	Re-prompt
Pollutant ID	All	Not set to NO2 but MODELOPT includes PVMRM or OLM	Issue message and stop	N/A

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Invalid building parameter inputs.

Parameter	Invalid response	AERSCREEN.INP	Prompts
Downwash flag	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt
Building height	Negative or non-numeric	Issue message and stop	Re-prompt
Maximum building horizontal dimension	Negative or non-numeric	Issue message and stop	Re-prompt
Minimum building horizontal dimension	Non-numeric, negative or exceeds maximum horizontal dimension	Issue message and stop	Re-prompt
Angle of maximum horizontal dimension relative to North	Non-numeric, less than zero or exceeds 179 degrees	Issue message and stop	Re-prompt
Angle of stack location relative to North	Non-numeric, less than zero or exceeds 360 degrees	Issue message and stop	Re-prompt
Distance from stack to building center	Negative or non-numeric	Issue message and stop	Re-prompt
Use pre-existing BPIPPRM input file	File does not exist	Issue message and stop	Re-prompt
	Processing flag in file incorrectly set for AERMOD or more than one stack listed in file.	Issue message and stop	Issue message and stop

Invalid meteorological data inputs.

Parameter	Invalid response	AERSCREEN.INP	Prompts
Minimum Temperature Maximum Temperature	Non-numeric, negative (if Kelvin), or minimum temperature is equal to or exceeds maximum temperature	Issue message and stop	Re-prompt for temperatures
Minimum wind speed	Negative or non-numeric	Issue message and stop	Re-prompt
Anemometer height	Negative or non-numeric	Issue message and stop	Re-prompt
Surface code	Non-numeric, negative or greater than 9	Issue message and stop	Re-prompt
Climatology code	Non-numeric, less than 1or exceeds 4 if surface code between 1 and 8 inclusive	Issue message and stop	Re-prompt
User albedo	Non-numeric, negative, or exceeds 1.0	Issue message and stop if non-numeric. Issue message and stop if negative or exceeds 1.0 and surface code is 0	Re-prompt
User Bowen Ratio	Non-numeric	Issue message and stop if non-numeric.	Re-prompt
User surface roughness	Negative or non-numeric	Issue message and stop if non-numeric. Issue message and stop if negative and surface code is 0	Re-prompt
AERSURFACE output file	Does not exist (if surface code = 9)	Issue message and stop	Re-prompt for surface characteristics type
	Surface characteristics non-numeric, albedo is negative or exceeds 1.0 or surface roughness is negative	Issue message and stop if surface code is 9	Issue message and re-prompt for surface characteristics type

Invalid terrain data inputs.

Parameter	Invalid response	AERSCREEN.INP	Prompts
Terrain flag	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt
Latitude	Absolute value exceeds 90 degrees	N/A	Re-prompt
Longitude	Absolute value exceeds 180 degrees	N/A	Re-prompt
UTM Easting	N/A	N/A	N/A
UTM Northing	N/A	N/A	N/A
UTM zone	Negative	Issue message and stop	Re-prompt
NAD code	Not equal to 1 or 4	Issue message and stop	Re-prompt
Probe distance	Negative or less than minimum ambient distance	Issue message and stop	Re-prompt for probe distance and minimum ambient distance
Discrete receptor flag	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt
Discrete receptor file	File does not exist	Issue message and stop	Re-prompt
	The number of distances exceeds ten or negative distances found	Issue message and stop	Re-prompt
	Units line not included in file	Issue message and stop	Re-prompt
Flagpole receptor use flag	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt
Flagpole height	Negative or non-numeric	Issue message and stop (if flagpole receptors used)	Re-prompt
Source elevation	N/A	N/A	N/A
AERMAP use flag	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt
Demlist.txt	File is not in current folder	Issue message and stop	Issue message and stop
NADGRIDS directory or folder	No grid files are in directory or folder or NADGRIDS keyword not listed in demlist.txt	Issue message and stop	Issue message and stop