New Jersey Department of Environmental Protection
Division of Air Quality
Bureau of Technical Services

Technical Manual 1002

Guideline on Air Quality Impact Modeling Analysis

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1.0 Introduction

1.1 Purpose of Document

This document provides the NJDEP Division of Air Quality (DAQ)'s modeling guidance for predicting the ambient air quality impact of emissions from stationary sources. It addresses modeling issues for a wide range of source types and regulatory modeling requirements such as Prevention of Significant Deterioration (PSD). It is intended for use by permit applicants and their consultants who need to conduct ambient impact analysis in support of air permit applications and other activities which require air quality impact modeling.

This document is not intended to describe the implications of modeling results. Such implications are generally controlled by the permit rules and other relevant state and federal regulations, laws and guidance. It is not intended to provide an all-inclusive description of the requirements of a modeling analysis because each modeling analysis is unique. The purpose of this guidance is to provide a general framework for how the modeling analysis should be conducted, and to promote technically sound and consistent modeling techniques while encouraging the use of improved and more accurate techniques as they become available. Individuals responsible for conducting the air quality impact analysis should at a minimum be familiar with the following U.S. EPA documents:

- Appendix W to 40 CFR Part 51 – Guideline on Air Quality Models
- AERMOD Implementation Guide
- AERMOD User's Guide
- AERSURFACE User's Guide
- AERMET User's Guide
- Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations). USEPA, 1985
- Additional guidance from the EPA Support Center for Regulatory Atmospheric Modeling (SCRAM) at http://www.epa.gov/ttn/scram/. Within SCRAM is the *Model Clearinghouse Information Storage and Retrieval System* (MCHISRS) at http://cfpub.epa.gov/oarweb/MCHISRS. It is the data base of Model Clearinghouse memos addressing the interpretation of modeling guidance for specific regulatory applications.

The applicant should work closely with the modeling staff at the Bureau of Technical Services (BTS), Division of Air Quality to ensure that all modeling requirements are met. The contact phone number is (609) 633-1110. Additional information can be found at the air quality permit program's website: http://www.nj.gov/dep/aqpp/. Note that the New Jersey Technical Manual 1003 entitled "*Guidance on Risk Assessment for Air Contaminant Emissions*" is available specifically for the preparation of risk assessment.

1.2 Purpose of an Air Quality Impact Analysis

Air quality impact analysis is used to establish compliance with the National Ambient Air Quality Standards (NAAQS), the New Jersey Ambient Air Quality Standards (NJAAQS), and the Prevention of Significant Deterioration (PSD) allowable increments. An air quality impact analysis may also be required for:

- Assessing if a source is causing "air pollution," defined under N.J.A.C. 7:27-5 as the presence in the outdoor atmosphere of one or more air contaminants in such quantities and duration as are, or tend to be, injurious to human health or welfare, animal or plant life or property, or would unreasonably interfere with the enjoyment of life or property. This usually involves a risk assessment (cancerous and non-cancerous health effects) or an odor impact evaluation.

- Visibility and other Air Quality Related Value (AQRV) assessments for the Brigantine Division of the Edwin B. Forsythe National Wildlife Refuge Class I area;

1.3 Requirements Unique to NJDEP

The following policies and procedures are unique to the NJDEP:

- The New Jersey ambient air quality standards are defined in terms of running hourly (3-hour to 24-hour) or monthly (greater than 24-hour) averages.

- New Jersey has adopted as a guideline value and reference concentration the California 1-hour average NO_2 ambient air quality standard of 470 ug/m^3.

- New Jersey currently has the interim $PM_{2.5}$ modeling procedures for minor $PM_{2.5}$ sources.

2.0 Sources Requiring Air Quality Impact Analysis

2.1 New Jersey Regulations and Modeling Analysis

The New Jersey regulations that address the issue of air quality modeling are found in the New Jersey Administrative Code (N.J.A.C.) Title 7 Chapter 27 Subchapters 8 (Permits and Certificates for Minor Facilities and Major Facilities without an Operating Permit), 18 (Emission Offset Rules), and 22 (Operating Permits).

2.1.1 Title V Operating Permits

The majority of sources that will need to submit modeling analysis in support of their permit applications will be those sources requiring a Title V operating permit. N.J.A.C. 7:27-22.8 concerns modeling of Title V sources. This guidance applies to a new major source requesting an initial Title V permit, a significant modification to an existing major facility, or a minor modification to an existing major facility.

7:27-22.8 Air quality simulation modeling and risk assessment:

(a) An applicant for an initial operating permit for a new major facility, or for a minor modification or significant modification to an existing operating permit, shall conduct air quality simulation modeling in accordance with (c) below if:

1. The application is subject to PSD air quality impact analysis requirements set forth at 40 CFR 52;

2. The application is subject to the air quality impact analysis requirements set forth at N.J.A.C. 7:27-18.4;

3. The application includes relocation of a temporary facility to a site not specifically authorized in the operating permit, and air quality simulation modeling or risk assessment was required for the location(s) authorized in the operating permit; or

4. The application includes source operations which, based on screening procedures published in technical manuals by the Department, have the potential to cause any of the adverse air quality effects listed in (b)1 through 4 below.

The adverse air quality effects listed in 22.8(b) 1 through 4 are a violation of any NJAAQS or NAAQS, an exceedance of a PSD increment as defined in 40 CFR 52, an increase in the ambient air concentration that equals to or exceeds the significant air quality impact levels listed in Table 1 of N.J.A.C. 7:27-18.4(a) in a nonattainment area, or air pollution as defined in N.J.A.C. 7:27-5 (see Section 1.2).

Of the four scenarios given in 22.8(a) requiring modeling, three are of principal concern and are described in more detail below.

22.8(a)1 - The criteria for determining if an application is subject to the PSD air quality impact analysis requirements can be found in 40 CFR Part 52.21(m).

22.8(a)2 - An application is subject to the air quality impact analysis requirements set forth at N.J.A.C. 7:27-18.4 if it is proposing a net emissions increase that exceeds any of the major source thresholds listed in Table 2-1 for at least one pollutant. An air quality impact analysis must be conducted for each pollutant whose proposed net emissions increase exceeds those amounts listed in Table 2-2 below. In addition, if a permit application for an existing major source (allowable emissions above the levels in Table 2-1) is proposing a net emissions increase that exceeds those amounts listed in Table 2-2, an air quality impact analysis must be conducted for each exceeding pollutant.

Table 2-1. Major Facility Thresholds

Air Contaminant	Threshold Value (tons/yr)
SO_2	100
TSP	100
PM_{10}	100
$PM_{2.5}$	100 [a]
CO	100
NO_x	25
VOC	25
Pb	10

a. $PM_{2.5}$ is not currently addressed in N.J.A.C. 7:27-18. This value reflects 40 CFR Part 51 Appendix S guidance.

Table 2-2. Significant Net Emissions Increase Thresholds

Air Contaminant	Significant Net Emission Increase (tons/yr)
SO_2	40
PM_{10}	15
$PM_{2.5}$	10 [a]
NO_x	25
CO	100
Pb	0.6

a. $PM_{2.5}$ is not currently addressed in N.J.A.C. 7:27-18. This value reflects 40 CFR Part 51 Appendix S guidance.

Note that VOC has been taken out of Table 2-2 because single-source ozone modeling is normally not done. Total Suspended particulate (TSP) has also been removed from the table because BTS assumes that if the PM_{10} and $PM_{2.5}$ NAAQS are met, the TSP NJAAQS will also be met.

22.8(a)4 - New and modified sources at major facilities with operating permits may need to submit a risk assessment if they emit certain contaminants regarded as air toxics. These air toxics are listed in Subchapter 22, Appendix Table B, as "Hazardous Air Pollutants" (HAPs). Sources that must conduct modeling to meet this requirement are principally those that fail the Department's Level-1 risk screening procedures due to their emissions of HAPs. The Level-1 risk screening procedures are described in Chapter 3 of the New Jersey Technical Manual 1003 (*Guidance on Risk Assessment for Air Contaminant Emissions*) and can be downloaded from the Division of Air Quality's "Risk Screening Tools" webpage at www.nj.gov/dep/aqpp/risk.html. Occasionally, the Level-1 risk screening is used to obtain the worst-case prediction of the odor impact of a compound.

2.1.2 Permits and Certificates for Minor Facilities and Major Facilities without an Operating Permit

The criteria for determining who needs to submit a modeling analysis for minor facilities and major facilities without an operating permit are specified in N.J.A.C. 7:27-8.5 (Air Quality Impact Analysis). They are listed below.

7:27-8.5 Air quality impact analysis

(a) *An application shall include an air quality impact analysis, conducted in accordance with this section, if:*

1. *The application is subject to PSD air quality impact analysis requirements set forth at 40 CFR Part 52;*

2. *The proposed maximum allowable emissions of an air contaminant would result in a significant net emission increase* (listed in Table 2-2 of this document) *, as calculated in accordance with N.J.A.C. 7:27-18.7, and:*

   i. *The facility for which the application is submitted is a major facility as defined at N.J.A.C. 7:27-8.1* (listed in Table 2-1 of this document); *or*

   ii. *The emission increase, proposed in the application for any air contaminant, by itself equals to or exceeds the major facility threshold level* (listed in Table 2-1 of this document) *which determines if a facility is a major facility for that air contaminant;*

3. *A State or Federal rule requires that an air quality impact analysis be performed; or*

4. *The Department determines that an air quality impact analysis is required for an accurate assessment of the environmental impact of the activities proposed.*

(b) *An air quality impact analysis shall include ambient air monitoring and risk assessment, if the Department determines that this is required for an accurate assessment of the impact of the activities proposed.*

The criteria are similar to those of the Title V operating permits. Sections 7:27-8.5(1) and (2) are identical to Sections 7:27-22.8(a)1 and 2. As is the case with Section 7:27-22.8(a)4, most sources affected by Section 7:27-8.5(b) will be those that fail the Department's Level-1 risk screening procedure due to their emissions of HAPs. These are listed in Subchapter 8, Appendix 1, Table B. Section 7:27-8.5(a)4 is a catch all condition for permit applications that NJDEP believes may cause or contribute to a violation of an ambient air quality standard or a PSD increment, or poses a threat to public health or welfare, but are not subject to modeling for the other criteria.

2.2 Who Must Conduct a Modeling Analysis?

Based on the guidance in N.J.A.C. 7:27-8 and 7:27-22, the following sources must conduct an air quality modeling analysis in support of their air permit applications:

1. Applications subject to PSD air quality impact analysis requirements per 40 CFR Part 52.21(m) (see Appendix A for more details).

2. Applications for a new major source or an existing minor source proposing an emissions increase that exceeds the major source thresholds listed in Table 2-1 for at least one pollutant. An air quality impact analysis must be conducted for each pollutant whose proposed net emissions increase exceeds those amounts listed in Table 2-2.

3. Applications for an existing major source (allowable emissions above the levels in Table 2-1 for at least one pollutant) must conduct an air quality impact analysis for those pollutants whose proposed net emissions increase exceed those amounts listed in Table 2-2.

4. Applicants who fail the Department's Level-1 risk screening procedure due to their emissions of HAPs (historically, BTS has in many cases conducted the modeling and risk assessment for these sources)

5. Division of Air Quality may request modeling in other unique circumstances. These circumstances could involve a permit application at a new or existing major facility that NJDEP believes may cause or contribute to a violation of an ambient air quality standard or a PSD increment, or pose a threat to public health or welfare. For example, if a proposed increase in the hourly emission rate of a criteria pollutant is of sufficient magnitude that, in combination with the source's stack height, it may cause or contribute to a violation of a short-term ambient air quality standard or a PSD increment, modeling may be required even though the annual emissions increase may not be significant. Another example is a minor source with insufficient annual emissions to meet the major source threshold values in Table 2-1, but has a proposed emission increase and stack parameters

that suggest high air impacts. A new source proposing 80 tons per year of PM_{10} would likely need to be modeled.

2.3 Netting Analysis and the Requirements for Modeling

In some cases an applicant may perform a netting analysis, pursuant to N.J.A.C. 7:27-18, when obtaining a pre-construction permit for a new or modified source. By accounting for creditable emission reductions, the net emissions increase at a facility for a pollutant may be reduced below levels of Emissions Offset Rule (Table 2-2). The methodology for calculating the net emissions increase at a facility is described in N.J.A.C. 7:27-18.7 (Determination of a net emission increase or a significant net emission increase). Portions of EPA's netting procedures to determine PSD applicability at an existing facility are being contested by New Jersey. There are also proposed changes to other portions of the rules regarding PSD netting analysis. Therefore, the Division of Air Quality should be contacted for further guidance on this issue.

A netting analysis may also reduce the emissions increase at the facility below the major source threshold for which an air quality impact analysis is required. An exemption from performing a modeling analysis can be requested in such a situation. The request must be accompanied by a demonstration that the source at which the emissions increase occurs will have a higher final plume height than that from which the emissions reduction are being taken. The higher plume height must occur under all atmospheric conditions. If there is uncertainty as to the relative heights of the plumes, EPA's simple screening model SCREEN3 can provide this information under a variety of atmospheric conditions.

The exemption request may be denied by NJDEP. A denial would occur if NJDEP believes that the reduction in ambient air concentrations from the emissions decrease will not be sufficient to prevent the proposed emissions increase from causing or contributing to a violation of an ambient air quality standard or a PSD increment, or posing a threat to public health or welfare. Proposed emission increases from a source located near complex terrain, near the property boundary line of the facility, in an area where elevated background air concentrations exist, or a stack subject to building downwash would be examples of situations where a requested exemption from modeling may be denied.

When modeling a source for which a netting analysis has been conducted, an applicant may in most cases include not only the proposed emission increases, but also the creditable emission reductions at the source.

3.0 Regulatory Requirements

The permit applicant must demonstrate compliance with the federal and the New Jersey air quality regulations. Below is a brief summary of the applicable air quality modeling regulations.

3.1 New Jersey and National Ambient Air Quality Standards

3.1.1 New Jersey Ambient Air Quality Standards (NJAAQS)

New Jersey's ambient air quality standards (NJAAQS) are listed in Table 3-2. The differences between the New Jersey and the National standards are as follows:

- New Jersey maintains a 12-month and a 24-hour secondary standard for SO_2;

- New Jersey maintains 12-month and 24-hour primary and secondary standards for Total Suspended Particulates (TSP) and has no standards for $PM_{2.5}$ and PM_{10}.

New Jersey regulations specify its 3-hr, 8-hr, and 24-hr standards in terms of moving or non-overlapping running hourly averages, and its 3-month and 12-month standards in terms of moving or non-overlapping running monthly averages.

Table 3-1. New Jersey Ambient Air Quality Standards

Pollutant	Averaging Period[a]	Primary NJAAQS[b]	Secondary NJAAQS[b]
NO_2	12-Month	100 μg/m^3 (0.05 ppm)	100 μg/m^3 (0.05 ppm)
	1-hr [c]	470 μg/m^3 (0.25 ppm)	---
CO	1-hour	40 mg/m^3 (35 ppm)	40 mg/m^3 (35 ppm)
	8-hour	10 mg/m^3 (9 ppm)	10 mg/m^3 (9 ppm)
SO_2	3-hour	---	1,300 μg/m^3 (0.5 ppm)
	24-hour	365 μg/m^3 (0.14 ppm)	260 μg/m^3 (0.10 ppm)
	12-Month	80 μg/m^3 (0.03 ppm)	60 μg/m^3 (0.02 ppm)
TSP	24-hour	260 μg/m^3	150 μg/m^3
	12-Month	75 μg/m^3	60 μg/m^3
Ozone	1-hour	0.12 ppm	0.08 ppm
Lead	3-month	1.5 μg/m^3	1.5 μg/m^3

a: All short-term (1-hr, 3-hr, 8-hr, and 24-hr) standards except ozone are not to be exceeded more than once per 12 month period, 3-month and 12-month standards are never to be exceeded. All averages are calculated as running or moving averages. The 12-month TSP standards are geometric means.

b: The actual form of each standard is listed first. The values in parentheses are approximations provided for convenience.

c: Based on a California ambient air quality standard. Represents a reference concentration, not a NJAAQS.

3.1.2 National Ambient Air Quality Standards (NAAQS)

The 1970 Clean Air Act was enacted by Congress to protect the health and welfare of the public from the adverse effects of air pollution. Subsequently, the U.S. EPA established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: sulfur dioxide (SO_2), particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), and lead. The NAAQS include both "primary" and "secondary" standards and are periodically updated to reflect the latest scientific findings. The primary standards are intended to protect human health with an adequate margin of safety; whereas the secondary standards are intended to protect public welfare from any known or anticipated adverse effects associated with the presence of air pollutants, such as damage to materials or vegetation. Both the primary and the secondary standards must be addressed in the modeling evaluation.

Table 3-2. National Ambient Air Quality Standards

Pollutant	Averaging Period[a]	Primary NAAQS [b]	Secondary NAAQS [b]
NO_2	1-hour	80-100 ppb (150-190 $\mu g/m^3$) [c]	---
	Annual	0.053 ppm (100 $\mu g/m^3$)	0.053 ppm (100 $\mu g/m^3$)
CO	1-hour	35 ppm (40,000 $\mu g/m^3$)	---
	8-hour	9 ppm (10,000 $\mu g/m^3$)	---
SO_2	1-hour	50-100 ppb (130-260 $\mu g/m^3$) [c]	---
	3-hour	---	0.5 ppm (1,300 $\mu g/m^3$)
	24-hour	0.14 ppm (365 $\mu g/m^3$)	---
	Annual	0.03 ppm (80 $\mu g/m^3$)	---
PM_{10}	24-hour	150 $\mu g/m^3$	150 $\mu g/m^3$
$PM_{2.5}$	24-hour	35 $\mu g/m^3$	35 $\mu g/m^3$
	annual	15.0 $\mu g/m^3$	15 $\mu g/m^3$
Ozone	1-hour	0.12 ppm (applies only in limited areas)	0.12 ppm (applies only in limited areas)
	8-hour	0.075 ppm	0.075 ppm
Lead	Rolling 3-month	0.15 $\mu g/m^3$	0.15 $\mu g/m^3$

a. All short-term (1-hr, 3-hr, 8-hr, and 24-hr) standards except ozone, $PM_{2.5}$ and PM_{10} are not to be exceeded more than once per year. For 8-hr ozone, EPA uses the average of the annual 4^{th} highest 8-hour daily maximum concentrations from each of the last three years of air quality monitoring data to determine a violation of the standard. For 24-hour PM_{10}, EPA uses the 6^{th} highest 24-hour maximum concentration from the last three years of air quality monitoring data to determine a violation of the standards. For 24-hour $PM_{2.5}$, EPA uses the 98% percentile 24-hour maximum concentration from the last three years of air quality monitoring data to determine a violation of the standard. For the proposed 1-hour NO_2 and1-hour SO_2 NAAQS, compliance would be determined ed using the 3-year average of the 4^{th} daily high of hourly averages for each year. 3-month and annual standards are never to be exceeded.

b. The actual form of each standard is listed first. The values in parentheses are approximations provided for convenience.

c. Standards proposed by EPA.

3.2 Modeling Recommendations for Individual Criteria Pollutants

3.2.1 Federal Recommendations:

Guidance on how to demonstrate compliance with the NAAQS is given in 40 CFR 51 Appendix W Section 10.2.3.2 (NAAQS Analysis for New or Modified Sources):

"For new or modified sources predicted to have a significant ambient impact and to be located in areas designated attainment or unclassifiable for the SO_2, Pb, NO_2, or CO NAAQS, the demonstration as to whether the source will cause or contribute to an air quality violation should be based on: (1) The highest estimated annual average concentration determined from annual averages of individual years; or (2) the highest, second-highest estimated concentration for averaging times of 24-hours or less; and (3) the significance of the spatial and temporal contribution to any modeled violation. ~~*For Pb, the highest estimated concentration based on an individual calendar quarter averaging period should be used.*~~ [See guidance below] *Background concentrations should be added to the estimated impact of the source. The most restrictive standard should be used in all cases to assess the threat of an air quality violation."*

Additional guidance on showing NAAQS compliance for PM_{10} is in 40 CFR 51 Appendix W Section 7.2.1.1:

"For the 24-hour PM_{10} NAAQS (which is a probabilistic standard)--when multiple years are modeled, they collectively represent a single period. Thus, if 5 years of NWS data are modeled, then the highest sixth highest concentration for the whole period becomes the design value. And in general, when n years are modeled, the (n+1)th highest concentration over the n-year period is the design value, since this represents an average.

The following is additional guidance on specific pollutants.

<u>Ozone</u>
A modeling analysis showing compliance of an individual source with the ozone NAAQS is generally not required.

<u>$PM_{2.5}$</u>
As with the 24-hour PM_{10} NAAQS, the 24-hour $PM_{2.5}$ NAAQS is a probabilistic standard. A violation of the 24-hour $PM_{2.5}$ NAAQS occurs when the 98^{th} percentile 24-hour concentration, averaged over three years, exceeds 35 ug/m^3. When modeling a full year of meteorological data, this corresponds to a 3-year average of the maximum 8^{th} high 24-hour average $PM_{2.5}$ predicted at any receptor.

EPA defined major $PM_{2.5}$ sources or major modifications should follow the EPA guidance contained in *Implementation of the New Source Review Program for Particulate Matter Less Than 2.5 Micrometers, Final Rule* (May 16, 2008 Federal Register) and 40 CFR Part 51, Appendix S. EPA considers the following as a $PM_{2.5}$ major source or major modification:

a. Any **new** facility that has the potential to emit 100 TPY or more of $PM_{2.5}$, or

b. Any **existing** facility that has the potential to emit 100 TPY or more of $PM_{2.5}$ that is proposing a net emissions increase of 10 TPY or more of $PM_{2.5}$.

Per NJDEP's current permitting policy, minor $PM_{2.5}$ sources in this manual are defined as proposed projects, at a facility that is subject to N.J.A.C.7:27 Subchapter 18 (Emissions Offset Rule), with the proposed net emissions increase of $PM_{2.5}$ of 10 tons/year or more, but are less than 100 tons/yr to trigger PSD or Appendix S applicability. Guidance on modeling $PM_{2.5}$ for these sources is given in the Division of Air Quality memo *Revised Interim Permitting and Modeling Procedures for sources Emitting between 10-100 Tons per Year of* $PM_{2.5}$ (Fine Particulate) (dated March 17, 2009). This memo can be found at the following web site: http://www.state.nj.us/dep/aqpp/downloads/PM-2.5modelingpolicy_Mar2009.pdf. Updates to this memo will be drafted as needed and posted to the same web site.

Lead

On October 15, 2008, EPA revised the lead NAAQS from 1.5 ug/m^3 based on calendar quarters to 0.15 ug/m^3 based on a rolling 3-month average. Therefore, the guidance given above in 40 CFR 51 Appendix W Section 10.2.3.2 reflecting the old lead NAAQS has been lined-out.

3.2.2 New Jersey Recommendations:

Many of the NJAAQS are identical to the NAAQS. However, the New Jersey rules specify its 3-hr, 8-hr, and 24-hr standards in terms of moving or running hourly averages, and its 3-month and 12-month (annual) standards in terms of moving or running monthly averages. The NAAQS are defined in terms of blocked averages, both for short-term (24-hours or less) and annual averages. For example, when demonstrating compliance with a 24-hour NAAQS, pollutant concentrations are calculated from midnight to midnight the next day. When demonstrating compliance with a 24-hour NJAAQS, pollutant concentrations are calculated from midnight to midnight, from 1 a.m. to 1 a.m. the next day, from 2 a.m. to 2 a.m. the next day, etc.

Initially, compliance with the NJAAQS can be based on use of blocked averages (similar to the NAAQS). However, if the modeled impact based on blocked averages with representative background concentration added exceeds 90 percent of the NJAAQS, compliance must then be based on the running hourly and monthly averages for that pollutant and averaging time.

As with the ozone NAAQS, single-source ozone modeling to demonstrate compliance with the ozone NJAAQS is usually not required because of the lack of modeling tools. Modeling of a source's total suspended particulate (TSP) impact is generally not required because DAQ assumes that if the PM_{10} and $PM_{2.5}$ NAAQS are met, then the TSP NJAAQS will also be met.

New Jersey uses the State of California's 1-hour NO_2 ambient air standard of 470 ug/m^3 as a guideline (reference concentration) in assessing short-term NOx impact from a specific source. The high, second-high modeled 1-hour NO_2 prediction should be added to a representative background value to demonstrate compliance. The action taken by the Department when values above this guideline value are predicted will depend on the magnitude, frequency, and location of the exceedances.

3.3 Prevention of Significant Deterioration (PSD) Increments

The proposed emissions increases from **all new or modified sources** (both PSD applicable and non-PSD applicable) must not cause or contribute to an exceedance of a PSD allowable increment. The PSD allowable increments for Class I and Class II areas are listed in Table 3.3.

Table 3-3. PSD Allowable Increments

Pollutant	Averaging Period	Allowable Increments (ug/m^3)	
		Class I Area	Class II Area
SO_2	3-hr	25	512
	24-hr	5	91
	Annual	2	20
PM_{10}	24-hr	8	30
	Annual	4	17
NO_2	annual	2.5	25

The relevant federal guidance on how compliance with the PSD increments is determined is listed below.

<u>40 CFR 51 Appendix W Section 10.2.3.3 – PSD Air Quality Increments and Impacts</u>

a. The allowable PSD increments for criteria pollutants are established by regulation and cited in 40 CFR 51.166. These maximum allowable increases in pollutant concentrations may be exceeded once per year at each site, except for the annual increment that may not be exceeded. The highest, second-highest increase in estimated concentrations for the short term averages as determined by a model should be less than or equal to the permitted increment. The modeled annual averages should not exceed the increment.

A discussion of the additional requirements required in the air quality impact assessment for a PSD permit is presented in Appendix A**.**

3.4 Modeling Recommendations for Air Toxic Emissions and Risk Assessment

Air toxics are natural or man-made pollutants that, when emitted into the air, may cause an adverse health effect. The federal 1990 Clean Air Act Amendments created a list of air toxics, called "hazardous air pollutants" or "HAPs." Air emissions of these HAPs from specific sources are regulated under the Clean Air Act.

The list of air toxics generally excludes "criteria pollutants," that is, those for which National or New Jersey Ambient Air Quality Standards have been established. The exception to this is lead, which is a criteria pollutant and is also considered to be a HAP because of its ability to cause significant adverse health impact at very low exposures. "Lead compounds" are included in EPA's HAP list, as are many specific volatile organic compounds (VOCs) and heavy metals, which also fall under criteria pollutant regulations for VOCs and particulate matter.

Air permit applications that list the emissions of air toxics identified as HAPs in N.J.A.C. 7:27-8 & 22 must be evaluated in a risk assessment if NJDEP has identified a reference concentration or a unit risk factor for that specific air toxic. The air toxics are listed in Table B (Thresholds for Reporting Emissions of Hazardous Air Pollutants) of the appendix of Subchapter 22 and in Table B (Reporting and SOTA thresholds for HAPs) of Appendix 1 in Subchapter 8.

The risk screening procedures consider only inhalation exposure. There are two tiers of risk screening: a **1st level risk screening** and a **2nd level risk screening**. These risk screening procedures are described in detail in Section 3 of the New Jersey Technical Manual 1003 "*Guidance on Risk Assessment for Air Contaminant Emissions*". The screening process is designed to minimize the likelihood of erroneously approving sources that potentially pose a significant health risk. Therefore, the 1st level risk screening uses a set of worst-case assumptions designed to overestimate the risk for most sources. The 1st level risk screen has been placed in a simple Excel worksheet that can be easily used to estimate the cancer and noncancer risks of a permit application.

A 2nd level risk screening is required of the sources who either did not conduct a 1st level risk screening, or who fail the 1st level risk screening. A 2nd level risk screening consists of a modeling analysis that more accurately estimates ambient air concentrations by using stack- and source-specific data and representative meteorological data. The 2nd level risk screening can also be carried out by the applicant, with approval from BTS. A modeling protocol is not always required.

For certain types of facilities, a multi-pathways, comprehensive risk assessment may be required. A hazardous waste incinerator is an example of a facility that may require submittal of a comprehensive risk assessment. In a comprehensive risk assessment (described in more detail in Section 4 of Technical Manual 1003), the applicant is required to prepare a step-by-step detailed risk assessment after first obtaining approval of a protocol from the BTS. Risk assessment guidelines are described in Section 5 of Technical Manual 1003.

4.0 Basic Steps of an Air Quality Impact Analysis

There are up to three major components in an air quality impact analysis: modeling protocols; preliminary (single-source) modeling, and multisource modeling analysis. Each component is described in the following sections.

4.1 Modeling Protocol

4.1.1 Preliminary (Single-Source) Modeling Protocol

In accordance with N.J.A.C. 7:27-8.5(d), 18.4(c), and 22.8(c), a modeling protocol must be submitted and approved in advance by BTS before the air quality impact analysis and/or a risk assessment is conducted. These regulations specify that the protocol address all relevant general and site-specific factors and how the air quality impact analysis and/or risk assessment will be conducted. N.J.A.C. 7:27-8.5(d), 18.4(c), and 22.8(c) all reference this document and Technical Manual 1003 (*Guidance on Risk Assessment for Air Contaminant Emissions*) for guidance on preparing a modeling protocol.

The protocol should document in detail how the applicant proposes to conduct the modeling analysis and present the results. The protocol must receive prior approval from BTS before a detailed modeling analysis is conducted and submitted. BTS will not accept a modeling analysis without a pre-approved protocol.

In general, a modeling protocol should contain the following information:

- Project Description, including a project overview, facility plot plan, and emissions and stack parameters;

- Project Site Characteristics, including a land use analysis, attainment status, description of the local topography, a Good Engineering Practice (GEP) stack height analysis, and the meteorological data proposed for use in the modeling analysis;

- Regulatory Requirements, including a description of what federal and New Jersey regulations and guidelines apply to the proposed project;

- Proposed Air Quality Analysis, including the proposed air quality model selection and justification for use, screening analysis, and the proposed methods for refined modeling.

- Special Modeling Considerations, including the approach for addressing visibility/Class I area modeling, effects on soils and vegetation/growth analysis, cooling tower modeling, coastal fumigation, health risk assessment, fugitive emissions, deposition and odor modeling, if necessary;

- Establishing Background Air Quality, including justification of the background air quality monitoring data to be used in the analysis and the need to model existing nearby major sources; and

- Presentation of Air Quality Modeling Results, including how maximum impacts, significant impact areas, and compliance with ambient air quality standards and PSD increments will be demonstrated.

Appendix B of this document contains a summary checklist that can be used to assess the completeness of an air quality modeling protocol and analysis. NJDEP recommends that this checklist be reviewed by the applicant before the documents are submitted to the Department. It is recommended that the modeling protocol be submitted at the same time the air permit application for the source is sent to the Department. DAQ's permit engineer for the project should be informed that a modeling protocol has been submitted to BTS. As a general rule, BTS will not review protocols until an air permit application is received by DAQ. Modeling protocols and analyses should be sent to:

Chief, Bureau of Technical Services
NJDEP, Division of Air Quality
P.O. Box 027
401 East State Street, 2nd Floor
Trenton, New Jersey 08625

4.1.2 Multisource Modeling Protocol

As discussed in Section 4.3 of this chapter, a multisource modeling analysis may be necessary if preliminary single-source modeling shows that the proposed source has a significant impact. In this situation, the applicant should submit an additional protocol known as a multisource modeling protocol. A multisource modeling protocol should be submitted and approved by the Division before an applicant conducts multisource modeling of nearby sources. The multisource modeling protocol should be limited to detailing how the multisource inventory was generated, providing information on the sources included in the multisource inventory, and the modeling methodology that would be employed in the multisource analysis. The same air quality models and meteorological data used in the preliminary (single-source) modeling of the proposed source are normally used for the multisource analysis.

4.2 Preliminary (Single-Source) Modeling Analysis

The preliminary modeling analysis evaluates only the emissions from the proposed new sources, or the net emissions increase from a proposed modification.

One of the principal functions of the preliminary modeling analysis is to determine whether emissions from the proposed sources or modification will increase ambient concentrations of that pollutant by more than the significant ambient impact levels listed in Table 4-1. The **highest** modeled pollutant concentration for each pollutant's NAAQS/NJAAQS averaging time is used to determine whether a source will have a significant impact.

When modeling a facility for which a netting analysis has been performed, the source's proposed emission increases should be modeled first to determine if they will cause a significant impact. No further modeling is required for those pollutants and averaging times for which the proposed emissions increase is predicted to be insignificant. For those pollutants and averaging times that the proposed emissions increase is predicted to have significant impact, additional refined modeling may be conducted which accounts for the effect of the creditable emission reductions at the facility. In this modeling analysis, the proposed emission increases should be modeled as positive emissions and the creditable emission reductions at the facility modeled as negative emissions.

The possibility of a significant impact in a class I area must also be examined if the source needs a PSD permit and is located within 100 km of a class I area. On a case-by-case basis, PSD sources with large emissions located beyond 100 km may also need to examine their impact on the Class I area. The applicant should contact the Fish and Wildlife Office in Denver, Colorado to find out if a Class I modeling analysis is required. Contact information is listed in Appendix A.

The only Class I area in or within a 100 km of New Jersey is the Brigantine Division of the Edwin B. Forsythe National Wildlife Refuge (see Figure A-1). If refined modeling shows that the proposed PSD source has a significant impact in this Class I area, a multisource modeling analysis is necessary to determine PSD increment consumption at the Class I area and possible effects on its Air Quality Related Values (AQRVs). Further guidance on conducting a Class I visibility and other AQRVs analysis is given in Appendix A.

Significant impact levels for Class I and Class II areas currently used by DAQ are listed in Table 4-1.

Table 4-1. Class I and Class II Area Significant Impact Levels

Pollutant	Averaging Period	Significant Impact Levels (ug/m^3)	
		Class I Area	Class II Area
SO_2	3-hr	1.0	25
	24-hr	0.2	5
	Annual	0.1	1
NO_2	Annual	0.1	1
CO	1-hr	---	2,000
	8-hr	---	500
$PM_{2.5}$ [a]	24-hr	---	1.2
	Annual	---	0.3
PM_{10}	24-hr	0.3	5
	Annual	0.2	1
Pb [a]	3-month	---	0.01

a. NJDEP interim significance levels. EPA has yet to promulgate a value.

4.2.1 Prediction of Insignificant Impact

When the significant impact levels for each applicable pollutant at each applicable averaging time are not exceeded, no multisource modeling analysis is necessary. The applicant needs to demonstrate compliance with the allowable PSD increments by comparing the appropriate modeled concentrations with the PSD increments. See Section 3.3 of this document for additional information. The applicant needs to demonstrate compliance with the National and the New Jersey Ambient Air Quality Standards by adding the applicable background concentrations to the appropriate modeled concentrations.

4.2.2 Prediction of Significant Impact in Attainment Areas

If predicted impacts are above the significant impact levels in an attainment area, then a multisource modeling protocol as described in Section 4.1.2 and a multisource modeling analysis as described in Section 4.3 will likely be required, and the project's Significant Impact Area (SIA) must be calculated. The SIA is a circular area with a radius extending from the source to the most distant point where approved dispersion modeling predicts a significant ambient impact will occur. SIA should be determined for each pollutant and averaging period that has been assigned a significant impact level. For example, if modeling SO_2, its annual, 24-hour, and 3-hour significant impact areas should be determined. The largest of the SIAs determined for SO_2 should be used for SO_2 multisource analysis.

4.2.3 Prediction of Significant Impact in Nonattainment Areas

The requirements of N.J.A.C. 7:27-18 (Emission Offset Rule) for LAER and emission offsets will apply to the emissions of a criteria pollutant if the facility is located in an area which is nonattainment for that criteria pollutant **and** the permit application is Subchapter 18 applicable for that criteria pollutant (discussed in Section 2.1.1 and Tables 2-1 and 2-2 of this document). In addition, a permit application can be subject to the LAER and offset requirements of Subchapter 18 for a given criteria pollutant when the facility is located in an area which is attainment for that criteria pollutant and the following occurs:

1. The permit application is Subchapter 18 applicable for that criteria pollutant and the proposed net emission increase would result in an increase in the ambient concentration of the criteria pollutant in an area that is nonattainment for that criteria pollutant, and

2. The increase in the ambient concentration of the criteria pollutant equals to or exceeds the significant air quality impact level specified in Table 4-1.

Therefore, when applicable, the preliminary modeling analysis must include an evaluation of the permit application's proposed net emission increase on any nearby nonattainment areas. The following areas are currently designated as non-attainment areas for New Jersey:

$PM_{2.5}$
The Counties of Bergen, Burlington, Camden, Essex, Gloucester, Hudson, Mercer, Middlesex, Monmouth, Morris, Passaic, Somerset, and Union.

Ozone
The entire state is classified as moderate non-attainment for the 8-hr ozone standard.

SO_2
Warren County: the Town of Belvidere, the Township of Harmony, portion of Liberty Township (south of UTM coordinate N4522 and west of UTM coordinate E505), portion of Mansfield Township (west of coordinate E505), the Township of Oxford, the Township of White

NO_2, TSP, PM_{10}, and Lead
No areas in the State are designated as non-attainment.

4.3 Multisource Modeling Analysis

When the impact from the proposed source or modification is significant in an attainment area, a comprehensive assessment of air quality is obtained by performing a multisource modeling analysis. The multisource modeling includes not only the facility obtaining the permit, but the contribution from other nearby major sources as well as representative air monitoring data. Those major sources that are located within or near the SIA of the proposed source or modification should be included in the multisource modeling analysis. As mentioned earlier, if the proposed source's air quality impact requires a multisource modeling, the applicant must submit a multisource modeling protocol.

A major source is generally considered to be a facility with the potential to emit 100 or more tons per year of the subject pollutant (0.6 ton per year or more for lead) and is located within or near the significant impact area of the proposed source or modification. However, other sources with the potential to emit less than 100 tons per year may need to be included in the modeling if they are located within or near the SIA. For applicants requiring a PSD permit, near is considered to extend 50 km beyond the SIA. For non-PSD sources, near is usually considered to extend 10 km beyond the SIA.

The applicant is responsible for developing the multisource modeling inventory. The multisource modeling analysis usually consists of two separate evaluations, one for the National/New Jersey AAQS and one for the PSD increments. As a result, two separate modeling inventories may need to be developed. The modeling inventory needs to include the emission units, emission rates, and stack parameters for each source included in the modeling analysis. Building parameters may have to be included if DAQ believes the downwash effects are important in accurately predicting the source's contribution to the multisource impact. DAQ will normally assist the applicant in identifying potential sources for inclusion in the modeling. For those sources identified as potential candidates for inclusion in the multisource modeling, a request can be made to DAQ for a copy of their Title V Operating Permit. The necessary emission rates and stack parameters can be obtained from the Operating Permit. For proposed sources or modifications with significant impact areas that approach or extend into an adjacent state, a similar type of inventory must be obtained from that state as well. It is the responsibility of the applicant to obtain the necessary data from the other state(s).

In cases where a large number of nearby sources have been identified, the applicant may propose screening techniques to limit the number of sources that are explicitly modeled. The multisource modeling protocol should discuss the screening methodology used to eliminate sources and the results of this analysis. The applicant should obtain the Division's agreement on the methodology selected to remove sources from the inventory before submittal of the multisource inventory.

5.0 Model Selection

There are two levels of sophistication of models used in an air quality modeling analysis. The first level consists of relatively simple estimation techniques that generally use preset, worst-case meteorological conditions to provide conservative estimates of the air quality impact of a specific source, or source category. These are called screening techniques or screening models. The second level consists of those analytical techniques that provide more detailed treatment of physical and chemical atmospheric processes, require more detailed and precise input data, and provide more specialized concentration estimates. As a result, they provide a more refined and, at least theoretically, a more accurate estimate of source impact and the effectiveness of control strategies. These are referred to as refined models.

Several factors must be considered in the model selection process. These factors include source type, pollutant averaging times that are to be addressed, the potential for aerodynamic building downwash affecting the emissions, nearby terrain features and the existence of complex terrain or complex wind flows, and the local urban/rural land use characteristics. The modeling protocol should specify the models selected, their version numbers, and a justification for their use in the air quality modeling analysis. The model options used in the analysis must be consistent with those recommended by EPA and approved by the Bureau.

5.1 Screening Models

A screening modeling analysis is sometimes conducted for the following reasons: (1) to provide a preliminary indication of worst-case pollutant concentrations, (2) to identify the source's worst-case load or plant operating conditions that cause the highest ground-level concentrations, (3) to assist in delineating the appropriate receptor grid for detailed or refined modeling, (4) to determine a source's impacts during equipment startup and shutdown, and (5) to determine the impact of a source located in complex terrain for which no representative hourly meteorological data is available.

5.1.1 SCREEN3 Model

In simple and intermediate terrain situations, the commonly used screening model is SCREEN3. If changes in terrain elevations need to be considered when using the SCREEN3 model, the applicant should use the discrete receptor distance option (not the automated distance option). The 1-hour concentrations determined by SCREEN3 model runs may be factored to other short-term averaging times and an annual average using the following EPA recommended factors:

Table 5-1. SCREEN3 Conversion Factors

Averaging Time	Multiplying Factor
3-hr	0.9
8-hr	0.7
24-hr	0.4
annual	0.1

The above factors apply to a source which is continually emitting for the averaging time of concern (i.e., use of the 1-hour to 24-hour conversion factor of 0.4 assumes the source is emitting for the entire 24-hours). If an applicant believes an alternative to the 1-hour conversion factors listed in Table 5-1 should be used in a specific situation, credible evidence supporting the proposed value should be submitted and approved by BTS.

5.1.2 CTSCREEN Model

CTSCREEN can be used to obtain conservative, yet realistic, estimates for receptors located on terrain above stack height. CTSCREEN accounts for the three-dimensional nature of plume and terrain interaction and requires detailed terrain data representative of the modeling domain. The terrain data must be digitized in the same manner as for CTDMPLUS and a terrain processor is available.

CTSCREEN is designed to execute a fixed matrix of meteorological values for wind speed, standard deviation of horizontal and vertical wind speeds, vertical potential temperature gradient, Monin-Obukhov length, mixing height as a function of terrain height, and wind directions for both neutral/stable conditions and unstable convective conditions. CTSCREEN is designed to address a single source scenario. Placement of receptors requires very careful attention when modeling in complex terrain. Often the highest concentrations are predicted to occur under very stable conditions, when the plume is near, or impinges on, the terrain.

5.1.3 AERSCREEN Model

AERSCREEN is the screening model whose algorithms are based on AERMOD. The model will produce estimates of regulatory design concentrations without the need for on-site or NWS meteorological data and is designed to produce concentrations that are equal to or greater than the estimates produced by AERMOD with a fully developed set of meteorological and terrain data. It will make predictions in both simple and complex terrain for a single source.

5.2 Refined Models

Refined models are more complex than screening models and are used to address the impacts of both single and multiple sources. They require more detailed and precise input data than screening models, and use more complex calculations to provide more accurate estimates of pollutant concentrations.

AERMOD - An atmospheric dispersion model based on atmospheric boundary layer turbulence structure and scaling concepts, including treatment of multiple ground-level and elevated point, area and volume sources. It handles flat or complex terrain, rural or urban land use, and includes algorithms for building effects and plume penetration of inversions aloft. It uses Gaussian dispersion for stable atmospheric conditions (i.e., low turbulence) and non-Gaussian dispersion for unstable conditions (high turbulence). While the model can estimate wet and dry deposition, it has not been granted Appendix W status as an approved method for use in calculating deposition, and should be limited to plume transport distance of less than 50 km. This model was officially promulgated by the U.S. EPA in 2005 as the replacement guideline model for ISC3 model.

The following are implemented when AERMOD's default option is selected: the elevated terrain algorithm that requires input of terrain height data, stack-tip downwash (except for building downwash cases), the calms processing routines, the missing data processing routines, and a 4-hr half life for exponential decay of SO_2 for urban sources. The regulatory default options should generally be used in the modeling analysis. However, use the elevated terrain option that needs the input of terrain height data is not required in most New Jersey locations because of the flat terrain.

CALPUFF - A non-steady-state puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on pollution transport, chemical transformation of sulfur dioxide and nitrogen oxides to sulfate and nitrate, and both dry and wet deposition. CALPUFF can be applied for long-range transport modeling (> 50 km) and in the near-field situations with complex wind fields such as in complex terrain or the coastline (i.e., sea-breeze).

BLP - A Gaussian plume dispersion model designed to handle unique modeling problems associated with industrial sources where plume rise and downwash effects from stationary line sources are important.

CALINE3 - A steady-state Gaussian dispersion model designed to determine pollution concentrations at receptor locations downwind of highways located in relatively uncomplicated terrain.

CAL3QHC and CAL3QHCR - CAL3QHC is a CALINE3 based model with queuing calculations and a traffic model to calculate delays and queues that occur at signalized intersections. CAL3QHCR is a more refined version based on CAL3QHC that requires local meteorological data.

CTDMPLUS - A Complex Terrain Dispersion Model (CTDM) Plus algorithms for unstable situations (i.e., highly turbulent atmospheric conditions). It is a refined point source Gaussian air quality model for use in all stability conditions (i.e., all conditions of atmospheric turbulence) for complex terrain.

6.0 Project Description and Site Characteristics

It is essential that the air quality modeling protocol contain a description of the project and clearly describe the project site characteristics. This description should include a land survey, good engineering practice (GEP) stack height analysis, urban/rural land use analysis, population estimates, and a discussion of the topography in the vicinity of the project. Each of these topics is discussed in more detail in the following subsections.

6.1 Project Overview

Description of the proposed source or modification should contain the following essential information:

- Type of facility (e.g., resource recovery facility, coal-fired power plant, sewage sludge incinerator, etc.)

- Size of the Facility (e.g., waste input in pounds per hour or tons per day, megawatts, heat input in MMBTU/hr, etc.)

- Primary and secondary (if applicable) fuel type

- Description of the facility equipment

- Proposed control equipment

- Proposed hours of operation

- Pollutant emission rates (lbs/hr and tons/yr)

- Map with an appropriate scale indicating the location of the facility

- Location of property line and fence line/ambient air boundaries (if applicable)

- Attainment status of all criteria pollutants and source location relative to non-attainment areas

- Distance to the Brigantine Class I area

- Brief description of the area in the vicinity of the source in terms of land use, major geographic features, residential areas, etc.

- Topographical information: base elevation of the stack(s), closest terrain point above stack top, proximity of hilly terrain, whether the site is coastal or inland, how close the site is to the coast if within 20 km, the closest state border, and whether there are any predominant features (i.e., high-rise structures, man-made hills, lakes, river valleys, etc.) in the vicinity.

6.2 Facility Plot Plan

A plot plan (also called land survey/site plan) of the facility property must be provided with the modeling protocol. The preparation and submittal of a plot plan to a regulatory agency in New Jersey is governed by the State Board of Professional Engineers and Land Surveyors and is codified in the New Jersey Administrative Code at Title 13, Chapter 40. **In accordance with N.J.A.C. 13:40-5.1 (J) (n), all land surveys, construction plans, and maps prepared to show topographic data or planimetric data and delineate property lines submitted to the bureau must bear the signature and impression seal of the licensed land surveyor or professional engineer.** Any plot plan submitted in the modeling protocol must show the facility's property line and the location of all sources and stacks that will be included in the modeling analysis. It shall also identify fences and other barriers, if any, which would deter public access.

The plot plan must be of sufficient detail (showing all building dimensions) to enable a determination of GEP formula stack height and the potential for building downwash considerations for stack heights less than GEP formula heights. The grade elevation and height above grade for each structure shall be indicated as well as the stack base elevation. In complex cases where there are a number of existing structures or tiers which must be considered in the GEP analysis, photographs or three dimensional sketches may also be required as additional documentation.

In summary, the applicant must provide a detailed plot plan of the site with the following information:

- Depiction of the site, drawn to scale (with the scale indicated), certified by a professional engineer or land surveyor;

- An indication of true north. If plant north is shown on the plot plan, the relationship between true north and plant north must be provided.

- Location of: All proposed emission points (stacks, vents, etc.);
All buildings and structures on-site
The facility property line;
The facility fence line (if any)
- Location of buildings and structures immediately adjacent to the applicant's property, if they are located near enough to the proposed emission points to potentially cause downwash effects;

- Height, width, and length of all buildings and structures;

- For those modeling analyses evaluating the health risk due to the emissions of hazardous air pollutants, show the location of nearby residences and other sensitive receptors, such as hospitals, nursing homes, schools, and day care centers.

6.3 Good Engineering Practice (GEP) Stack Height Analysis

The use of stack height credit in excess of Good Engineering Practice stack height or credit resulting from any other dispersion technique is prohibited in the development of emission limitations (40 CFR 51). If stacks for new or existing major sources are found to be less than the height defined by EPA's refined formula for determining GEP height, the increased turbulence due to wake effects from the nearby building structures should be determined.

A GEP stack height analysis shall be conducted in accordance with the EPA stack height regulation (40 CFR 51) and the *Guideline for Determination of Good Engineering Practice Stack Height* (USEPA, 1985). The formula for the GEP stack height, as defined by the EPA guidelines, is listed below:

$$H_{GEP} = H_b + 1.5\ L$$

where: H_{GEP} is formula GEP stack height,
H_b is the height of adjacent or nearby building,
L is the lesser of the height and the maximum projected width of adjacent or nearby building, i.e., the critical dimension.

A stack is considered close enough to a building to be affected by downwash if it is located within 5L of the downwind (trailing edge) of the building in any wind direction.

The GEP Stack height analysis must identify all buildings on and off site with the potential to cause aerodynamic downwash of emissions from the stack. This analysis need only consider buildings within 0.8 kilometer or 5 L from the stack, whichever is lesser. For each stack, a table shall be provided with the following data for each building (or tier):

a. Building height (relative to stack base elevation);
b. Maximum projected building width;
c. Distance from the stack;
d. 5L distance; and
e. Calculated formula GEP stack height.

In the table identify the building which gives the greatest formula GEP stack height. In addition to the GEP stack height table, a table with coordinates must be provided for all stacks and each corner of any structure (or structure tiers) that are within 5L of the stack.

The EPA's Building Profile Input Program with the Plume Rise Model Enhancements (BPIPPRM) is used to derive the parameters necessary to simulate directional dependent aerodynamic downwash in the model. The output from BPIPPRM can help to complete the GEP stack height table described above. Output from this program shall not be used as a substitute for the GEP stack height table. Accurate input to the GEP stack height software program is vital. The Bureau will verify the information provided in the GEP stack height table with the facility plot plan. Input/output files from the BPIPPRM program should be submitted to the Bureau in electronic format with the protocol.

The proposed or modified sources may not employ dispersion techniques (as defined in 40 CFR 51.100(hh)) or seek to increase the height of an existing stack unless the provisions in 40 CFR 51.100(kk)2 are met. If the height of the stack is above both the calculated formula GEP height and the de minimus GEP height of 65 meters, the higher of either the calculated GEP height or 65 meters (not the actual stack height) must be used in the modeling to demonstrate compliance with ambient air quality standards. Exceptions are sometimes made for modeling to be used in health risk assessments or in the sitting of ambient monitors. Before modeling a stack height above GEP, the applicant is urged to consult with the Bureau.

6.4 Urban/Rural Determination

It is important to determine whether a source is located in an urban or rural dispersion environment. Urban areas have more turbulence in the atmosphere than rural locations due to their larger surface roughness length and the nighttime convective boundary layer associated with urban heat islands. AERMOD has two keyword switches for turning on the urban mode: the URBANOPT keyword on the CO pathway and the URBANSRC keyword on the SO pathway. AERMOD enhances the turbulence for urban nighttime conditions more than what would be expected at adjacent rural locations. In addition, AERMOD uses population estimates as a surrogate to define the magnitude of the differential heating caused by the urban heat island effect.

Sources located in an area defined as urban should be modeled using the urban mode. Sources located in areas defined as rural should be modeled using the rural dispersion parameters. For analysis of whole urban complexes, the entire area should be modeled as an urban region if most of the sources are located in areas classified as urban. Buoyancy-induced dispersion (BID), as identified by Pasquill, is included in the preferred models and should be used where buoyant sources, e.g., sources involving fuel combustion, are involved.

In some situations professional judgment must also be used in classifying a site as urban or rural. For example, Auer's land use analysis may result in a rural designation when a source is located in a heavily urbanized area next to a large body of water. At such a site there are strong arguments that an urban designation is more appropriate. In these and other cases where the urban/rural determination is borderline, consult with the Bureau to determine the mode under which to model the subject source(s). The two methods for determining whether a source should be modeled as urban or rural are described in the following two sections. Of the two methods, the land use procedure is considered more definitive.

6.4.1 Land Use Analysis

Section 7.2.3 of the *Guideline on Air Quality Models* (EPA, 2005) provides the basis for determining the urban/rural status of a source. For most applications the Land Use Procedure described in Section 7.2.3(c) is sufficient for determining the urban/rural status.

To perform the land use procedure: (1) Classify the land use within the total area circumscribed by a 3km radius circle about the source using the meteorological land use typing scheme shown in Table 6-1 (Auer, 1978) (2) if land use types I1, I2, C1, R2, and R3 account for 50 percent or more of the total area, use urban dispersion coefficients; otherwise, use appropriate rural dispersion coefficients. Major roadways and clover leafs should be identified as urban land use areas. Unless the source is located in an area that is distinctly urban or rural, the land use analysis should provide the percentage of each land use type from the Auer scheme and the total percentages for urban versus rural. The latest available United States Geological Survey (USGS) topographic quadrangle maps in the vicinity of the facility should be used in this analysis. In some circumstances, such as in an area undergoing rapid development, county or local planning board maps may need to be used.

Table 6-1. Identification and Classification of Land Use

Type	Use and Structures	Vegetation
I1	Heavy Industrial: Major chemical, steel and fabrication industries; generally 3-5 story buildings, flat roofs	Grass and tree growth extremely rare; < 5% vegetation
I2	Light-moderate industrial: Rail yards, truck depots, warehouses, industrial parks, minor fabrications; generally 1-3 story buildings, flat roofs	Very limited grass, trees almost total absent; <5% vegetation
C1	Commercial: Office and apartment buildings, hotels; > 10 story heights, flat roofs	Limited grass and trees; < 15% vegetation
R1	Common residential: Single family dwelling with normal easements; generally one story, pitched roof structures; frequent driveways	Abundant grass lawns and light-moderately wooded; > 70% vegetation
R2	Compact residential: Single, some multiple, family dwelling with close spacing; generally < 2 story, pitched roof structures; garages (via alley), no driveways	Limited lawn sizes and shade trees; < 30% vegetation
R3	Compact residential: Old multi-family dwellings with close (<2 m) lateral separation; generally 2 story, flat roof structures; garages (via alley) and ash pits, no driveways	Limited lawn sizes, old established shade trees: < 35% vegetation
R4	Estate residential: Expansive family dwelling on multi-acre tracts	Abundant grass lawns and lightly wooded; > 95% vegetation
A1	Metropolitan natural: Major municipal, state, or federal parks, golf courses, cemeteries, campuses, occasional single story structures	Nearly total grass and lightly wooded; > 95% vegetation
A2	Agricultural rural	Local crops (e.g., corn, soybean); > 95% vegetation
A3	Undeveloped: Uncultivated; wasteland	Mostly wild grasses and weeds, lightly wooded; > 90% vegetation
A4	Undeveloped rural	Heavily wooded; > 95% vegetation
A5	Water surfaces: Rivers, lakes	

1978: Correlation of Land Use and Cover with Meteorological Anomalies. *Journal of Applied meteorology*, 17, 636-643.

6.4.2 Population Density Procedure

Population Density Procedure: (1) Compute the average population density, p, per square kilometer within the 3km radius area; (2) If p is greater than 750 people/km^2, use urban dispersion coefficients; otherwise use rural dispersion coefficients. The selection of either urban or rural dispersion coefficients can become difficult in adjacent urban areas and across areas of suburban sprawl. Population density should be used with caution and should not be applied to highly industrialized areas where the population density may be low and thus a rural classification would be indicated, but the area is sufficiently built-up so that the urban land use criteria would be satisfied. In this case, the classification should already be "urban" and urban dispersion parameters should be used.

The AERMOD model requires population data when sources are located in urban areas. Guidance on determining the population of the urban area can be found in EPA's *AERMOD Implementation Guide*. According to this document, if a source is located in a relatively isolated urban area, the published census data corresponding to the Metropolitan Statistical Area (MSA) for that location can be used. When the urban area is located next to other urban areas or corridors, it is necessary to identify the area of population that will contribute to the urban heat island that will affect the modeled sources' plume. EPA does not recommend the use of population based on the Consolidated MSA (CSMA) for applications within urban corridors as this may overestimate the urban heat island effect. When an MSA can not be clearly identified, it is recommended that the extent of the area where the population density exceeds 750 people per square kilometer be determined. The combined population within the defined area should be input to the AERMOD model. EPA suggests using grided population based on census block or block group data.

Regardless of how the population estimate is obtained, the applicant must include a section in the protocol describing the methodology and data used to derive the estimate. In situations where the population cannot be clearly determined, consult with BTS.

6.5 Topography

In terms of an air quality modeling analysis, the topography in the region of a source is defined as being simple terrain for land features that are below stack top, or being intermediate/complex terrain for land features that are above stack top. Terrain must be considered in the model selection process. The EPA recommended model for regulatory applications (AERMOD) has been formulated to produce valid design concentrations in both simple and intermediate/complex terrains.

When AERMOD is used in the regulatory default mode, AERMOD calculates the total concentration as the weighted sum of 2 plume states: a horizontal plume state and a terrain-responding plume state. In the horizontal plume state, the plume height is determined by the release height and plume rise. Impingement occurs if terrain rises to the elevation of the plume. In the terrain-responding plume state, the plume follows the terrain. When terrain is gently sloping down from the stack base, AERMOD may under-estimate concentrations. This situation and the recommended correction are discussed in the *AERMOD Implementation Guide* (USEPA, 2009). Whether a source should be modeled with terrain elevations or flat terrain will be determined on a case-by-case basis. Some locations in New Jersey can be modeled as flat (simple) terrain.

AERMAP requires either Digital Elevation Model (DEM) data or National Elevation Dataset (NED) in order to process the terrain. The Bureau requires the use of 10 meter or 30 meter resolution data. A detailed discussion on the use of DEM and NED data in AERMAP is contained in Section 4.3 of the *AERMOD Implementation Guide*. The size of the modeling domain should be discussed and all DEM/NED files used in the analysis should be submitted with the modeling protocol.

7.0 Emissions and Source Data

7.1 Emissions

Allowable emissions of the source must be specified on both annual (tons/year) and hourly (lbs/hour) basis. Often a source will have more than one operating scenario. Each operating scenario may have its own lbs/hour allowable emission rate and stack parameters. Therefore, each operating scenario may need to be evaluated to determine which will cause the highest impacts used to demonstrate compliance with the AAQS and PSD increments. For example, if a boiler uses natural gas as primary fuel and No. 2 diesel as backup fuel, then the fuel which produces the highest impact for each pollutant and pollutant-specific averaging period should be used to show compliance.

Other examples include the variation in operating loads (Section 7.1.1) and the variation of emission rates and stack parameters that occur with ambient temperature in simple and combined-cycle turbines. As the density of air entering the turbine increases (colder temperatures), the mass of air flowing through the turbine increases as does the turbine output power, gas flow, and mass emissions. It is reasonable to calculate annual emissions and stack parameters at a representative annual average temperature, but short-term emissions and stack parameters should be calculated using reasonable minimum and maximum temperatures that can be expected at the site.

Table 7-1 specifies how the allowable emission rates of the proposed or modified source applying for a permit should be calculated. The table is based on Table 8-2 in EPA's *Guideline on Air Quality Models*.

Table 7-1. Point Source Emission Input Data for NAAQS Compliance Demonstration

Averaging Time	Emission Limit (lb/MMBtu)	Operating Level (MMBtu/hr)[1]	Operating Factor (e.g., hr/yr, hr/day)
Annual and quarterly	Maximum allowable emission limit or federally enforceable permit limit	Design capacity or federally enforceable permit condition	Continuous operation (i.e., 8760 hrs/yr)[2]
Short Term (<= 24 hrs)	Maximum allowable emission limit or federally enforceable permit limit	Design capacity or federally enforceable permit condition.[3]	Continuous operation, i.e., all hours of each time period under consideration (for all hours of the hours of the meteorological data base.)[2]

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

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

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

When modeling a proposed modification to a source, only the net change in emissions need to be modeled when determining whether the modification will have a significant impact on air quality (see Section 2.3 of this technical manual). Emissions from emergency generators and fire pumps are generally not included in the air quality impact modeling analysis.

7.1.1 Partial Load and Startup/Shutdown Emissions

The operating scenario analysis may include an evaluation of the various operating loads of the project's emission units. Because emission rate, exit velocity, and temperature may vary as a function of operating load or condition, modeling is required to determine which load has the potential for the highest ambient impact. At a minimum, the emission unit should be modeled using the design capacity (100% load), or any higher load rates if it can be operated at those higher rates. Sources that operate for appreciable amounts of time at loads less than the design capacity require an analysis at partial loads, such as 50% and 75%, to identify the operating conditions that cause the maximum ground-level concentrations. It should be noted that while emissions and stack flow rates are relatively linear with load for boilers, emissions and stack flows for combustion turbines are not linear with load. Engineering data should be submitted by the applicant to define turbine low load emissions and flow data. In general, load analysis is required only for larger emission units operating for significant amount of time at less than 100% load. Applicants should describe their proposed partial-load approach and assumptions in the modeling protocol.

A modeling analysis of short-term air quality impact during source startup/shutdown and equipment malfunction is required when the applicant requests special emission limits during these time periods and the duration of these conditions will exceed 1-hour. Startup/shutdown and equipment malfunction modeling may also be requested if these conditions coincide with a very low stack exit velocity or temperature. Most evaluations of startup/shutdown and equipment malfunction can be accomplished with screening modeling. Unless the startup/shutdown or equipment malfunctions will occur for an extended period, the maximum predicted impact during these scenarios will not be compared to significance levels for the purposes of requiring multisource modeling.

7.1.2 Fugitive Emissions

Fugitive emissions from a facility are those emissions that are not captured and released through a stack or active vent. A proposed source must model the impact of its fugitive emissions unless the release height, emission rate, or distance to the property line is such that minimal air quality impacts would result. A few examples of fugitive emission sources are coal piles, paved and unpaved roads, and gaseous emissions from landfills. Fugitive emissions are usually modeled as area or volume sources. All fugitive emission calculations and modeling assumptions should be discussed in detail and referenced in the modeling protocol.

7.2 Types of Emission Sources

7.2.1 Point Sources

Point sources include emission units that exhaust through stacks, chimneys, exhaust fans, or vents. The required input data include emission rate, stack height, stack inside diameter, stack exit temperature, and stack exit velocity. The base elevation of the stack should be based upon local topographic data. The stack location in Universal Transverse Mercator (UTM) coordinates may also need to be provided.

7.2.2 Area Sources

Area sources are identified as sources with low level or ground level releases with minimal thermal or momentum plume rise, and include material storage piles, lagoons and other low lying sources. In AERMOD, individual area sources may be represented as rectangles with aspect ratios (length/width) of up to 10 to 1. Rectangles may be rotated in a clockwise (positive angle value) or counterclockwise (negative angle value) direction, relative to a north-south orientation. The rotation angle and the location of the source are specified relative to the location of the southwest corner of the source. Irregular shaped sources may be represented by a series of smaller rectangles, or a polygon. The modeling of area sources is discussed in detail in Section 3.3.2.3 of the AERMOD User's Guide.

The emission rate for the area source is expressed as g/sec/m^2. In addition to the emission rate, release height (h), physical dimensions and orientation of the area source, the applicant may optionally provide the initial vertical dimension of the area source plume.

Area sources are not affected by the building downwash algorithms in the models. Additionally, elevated terrain is not considered when modeling impacts from area sources. AERMOD treats area sources as if in flat terrain, even if elevated receptors are incorporated.

7.2.3 Volume Sources

Volume sources are sources that have initial dispersion prior to release, such as building roof monitors, vents and conveyor belts. Volume sources can also be used to characterize the mobile emissions associated with construction activities. The modeling of volume sources is discussed in Section 3.3.2.2 of the AERMOD User's Guide. The location of the volume source is specified relative to the location of the center of the source. Volume sources are characterized by volume emission rate (g/s), emission release height, initial lateral dimension (σy_O), and initial vertical dimension (σz_O). The release height is the height of the center of where most of the plume is emitted from (i.e., the center of the initial volume).

For buoyant sources, such as engine emissions associated with construction/yard activities, assume that the volume height equals the plume height under annual average (or period average) conditions. The initial lateral and vertical dimensions represent one standard deviation of the plume. Therefore, the initial dimensions can be smaller than the release height.

The initial lateral dimension is calculated differently depending on whether the source is a single volume source or a line source. The initial vertical dimension is calculated differently depending on the emission release height and the presence of buildings. EPA's suggested procedures for estimating σy_O and σz_O are listed in Table 7-2.

Table 7-2. Suggested Procedures for Estimating σy_O and σz_O

Type of Source	Procedure for Obtaining Initial Dimension
(a) Initial Lateral Dimensions (σy_O)	
Single Volume Source	σy_O = length of side divided by 4.3
Line Source Represented by Adjacent Volume Sources	σy_O = length of side divided by 2.15
Line Source Represented by Separated Volume Sources	σy_O = center to center distance divided by 2.15
(b) Initial Vertical Dimensions (σz_O)	
Surface-Based Source	σz_O = vertical dimension of source divided by 2.15
Elevated Source on or Adjacent to a Building	σz_O = building height divided by 2.15
Elevated Source not on or Adjacent to a Building	σz_O = vertical dimension of source divided by 4.3

Like area sources, volume sources are not affected by the building downwash algorithms in the models.

7.2.4 Roadways and Line Sources

Line sources are sources that may be represented as a series of volume or area sources, such as roads, runways or conveyor belts. Near ground level sources may be modeled using a series of area sources. As mentioned earlier, in AERMOD individual area sources may be represented as rectangles with aspect ratios (length/width) of up to 10 to 1. Line sources with an initial plume depth, such as a conveyor belt or rail line, may be modeled as a series of volume sources. The number of line sources required to represent the source, N, is calculated as the length of the line source divided by its width.

In the case of a long and narrow line source such as a rail line, it may not be practical to divide the source into N volume sources. It is acceptable to approximate the representation of the line source by placing a smaller number of volume sources at equal intervals along the line source. In general, the spacing between individual volume sources should not be greater than twice the width of the line source. However, a larger spacing can be used if the ratio of the minimum source-receptor separation and the spacing between individual volume sources is greater than about 3. The total line source emission rate is divided equally among the individual volumes used to represent the line source, unless there is a known spatial variation in emissions.

The impact of particulate emissions from vehicle traffic (e.g., road dust) in which an initial wake behind the vehicle is created should be characterized using multiple volume or area sources. The number of volume sources, N, should be calculated as described above. The vertical dimension of the source used in the calculation of σz_O is typically equivalent to the height of the vehicles generating the emissions, commonly 1.5 to 3.0 meters.

7.2.5 Flares

Unlike enclosed flares, open flares are a unique point sources as they do not have a defined stack exit diameter. For modeling, it is necessary to compute equivalent emission parameters, i.e. adjusted values of temperature, stack height and "stack" inside diameter. SCREEN3 has a source category for flares, and makes these adjustments internally. AERMOD does not have a source category for flares and therefore need to have the adjustments made by the modeler. The approach consistent with SCREEN3 is as follows:

1. Compute the adjustment to stack height (H in meters) as a function of total heat release Q (in MMBtu/hr): $H_{equivalent} = H_{actual} + 0.944(Q)^{0.478}$

   [Note: 1) some flares are rated in calories per second and the conversion factor is 14.3 Btu/hr for every cal/s; and 2) the adjustment is to account for flame length and assumes the flame is tilted 45-degrees from the vertical.]

2. Assume a temperature of 1,273 °K;

3. Assume an exit velocity of 20 meters/sec; and

4. Assume an effective stack diameter d_{eff} of,

   $$d_{eff} = 0.1755(Q)^{0.5}$$

Equivalent diameter is applicable for both vertical and horizontal flares since it is back calculated from a buoyancy flux assumption. Buoyancy flux is not a function of flare orientation. Therefore, the equation can be used for both horizontal and vertical flare orientations.

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

8.0 Establish Background Air Quality Concentrations

Background air quality concentrations are an essential part of the total air quality concentrations to be considered in assessing source impacts. Background air quality includes pollutant concentrations due to: (1) natural sources; (2) nearby sources that were not included in the modeling analysis; and (3) distant sources (e.g., long-range transport).

Air monitoring data used in the background determination should be representative of the area of interest (i.e., it should typify the existing concentrations expected at locations of predicted maximum impacts). If possible, select a monitor upwind of the existing sources included in the modeling to avoid double-counting the impact from these sources. In some instances, in a multisource modeling analysis a different background monitor will need to be used than that proposed in the single-source modeling analysis.

Modeling protocols must specify the monitors selected as representative of background air concentrations, justify their selections, and list the pollutant concentrations that will be used in the analysis. Unless instructed otherwise by the Bureau and regardless of the anticipated significance or insignificance of the source, the applicant must include a discussion of background data in the protocol. This data is often incorporated into the public information package when a draft permit for the proposed source is issued.

Possible sources of background air quality data are NJDEP's monitoring network, the monitoring network of another local or state agency, or source-specific monitors. Data other than that from NJDEP's air monitoring network must be shown to meet NJDEP's air monitoring quality assurance requirements for representativeness, completeness, precision, and accuracy.

In 2008, the NJDEP maintained over 40 monitoring sites in its continuous and manual monitoring networks. The continuous monitoring network consists of sites which measure CO, NO_x, O_3, SO_2, and meteorological data by automated instruments (not all pollutants are measured at all sites). Also, in the continuous monitoring network are real time $PM_{2.5}$ (TEOM) monitors. The data from the $PM_{2.5}$ real-time analyzer cannot be used for comparison to the NAAQS or as background for modeling, only $PM_{2.5}$ concentrations from the USEPA approved manual samplers can be used for those purposes.

Unless air quality data collected from a source specific network are used, the latest three years of available monitoring data are to be reviewed. The highest annual and highest, second-highest short-term concentrations from the selected representative monitor should be used as the background concentration for the site. For $PM_{2.5}$, the three-year average of the highest monitored annual average $PM_{2.5}$ concentrations and the three-year average of the monitored 8th high 24-hour average concentrations should be used as background. Further refinement of these background air quality values such as those techniques discussed in Section 8.2 of EPA's *Guideline on Air Quality Models* will be considered by NJDEP on a case-by-case basis.

Yearly summaries of air quality data collected by NJDEP are available as Air Quality Reports. These reports can be easily accessed at the following site:

http://www.nj.gov/dep/airmon/reports.htm. These reports also contain information on the address and description of each monitoring site in the NJDEP ambient air quality monitoring network. A map showing the locations of the ambient air monitoring sites is contained in Figure 8-1. Air pollutants monitored at each monitoring site are listed in Table 8-1. Further information can be obtained by calling (609) 292-0138.

Table 8-1. List of Pollutants Monitored at Each Site

Monitoring Site	NO_2	SO_2	CO	O_3	$PM_{2.5}$	PM_{10}	TSP/Pb
Ancora State Hospital		x	x	x			
Atlantic City					x	x	
Bayonne	x	x		x			
Brigantine [a]				x	x		
Burlington		x	x				
Camden Lab	x	x	x	x	x	x	
Camden-RRF						x	
Chester	x	x		x	x		
Clarksboro		x		x			
Colliers Mills				x			
East Orange	x		x				
Elizabeth		x	x				
Elizabeth Lab	x	x	x		x		
Elizabeth-Mitchell Building					x		
Flemington				x			
Fort Lee			x			x	
Fort Lee-Library					x		
Freehold			x				
Gibbstown [b]					x		
Hackensack		x	x				
Jersey City-Firehouse					x	x	
Jersey City		x	x				
Leonia	x			x			
Millville	x	x		x			
Monmouth University				x			
Morristown			x				
Morristown-Ambulance Squad					x		
Nacote Creek Research Station [c]		x		x			
New Brunswick					x		
New Brunswick-Delco Remy [d]							x
Newark Firehouse (Proposed)	x	x	x	x	x		
Newark-Willis Center					x		
Paterson					x		
Pennsauken					x		
Perth Amboy		x	x				
Phillipsburg					x		
Rahway					x		

Monitoring Site	NO_2	SO_2	CO	O_3	$PM_{2.5}$	PM_{10}	TSP/Pb
Ramapo				x			
Rider University	x			x			
Rutgers University	x			x			
Teaneck	x			x			
Toms River					x		
Trenton					x	x	
Union City					x		
Washington Crossing					x		

a. Briganite site, located at the visitor center, began $PM_{2.5}$ monitoring January 2007 and ozone monitoring April 2007.

b. Gibbstown $PM_{2.5}$ site discontinued in 2006 and restarted at a different location in Gibbstown February 2007.

c. Nacote Creek monitor permanently discontinued in December 2007.

d. New Brunswick TSP/lead monitor discontinued in June 2007.

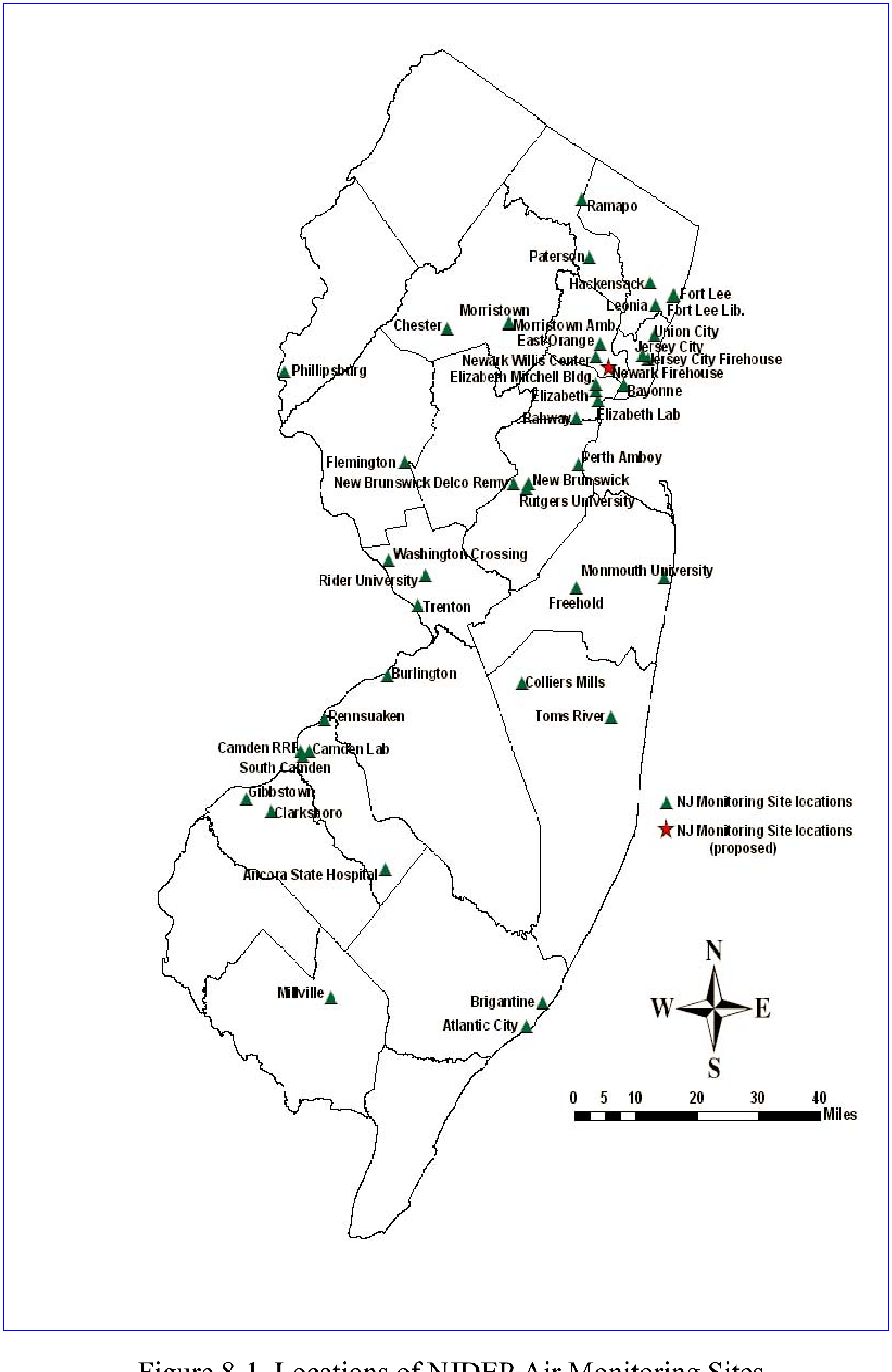

Figure 8-1. Locations of NJDEP Air Monitoring Sites

9.0 Receptor Network and Meteorological Data

9.1 Receptor Network

Receptor locations used in refined modeling should be of sufficient density to enable the identification of the highest concentrations and possible violations of an AAQS or a PSD increment. In designing a receptor network, the emphasis should be placed on receptor resolution and location, not total number of receptors. The selection of receptor locations should be a case-by-case determination taking into consideration the topography, the climatology, monitor sites, and the results of the initial screening procedures.

The NJDEP recommends that, at a minimum, receptors should include a Cartesian grid with receptors spaced as follows:

- 50 m along the facility property line or fence line (if applicable), whichever is closer to the source
- 50 m extending from the property line/fence line to 0.5 km
- 100 m extending from 0.5 km to 1.5 km
- 250 m extending from 1.5 km to 3 km
- 500 m extending from 3 km to 5 km

Concentrations should clearly be decreasing near the edge of the receptor grid. If not, additional receptors should be added. Fine grids (50 m) should be placed over the area(s) of maximum concentration to ensure that the true maximum concentration is identified. Tall buildings with balconies or other elevated open-air locations that could be occupied for extended periods must also be include in the AAQS analysis. These locations should be modeled as “flag pole” receptors.

In a multisource modeling analysis, receptors only need to be placed in the Significant Impact Area. Receptors of interest are the following:

1. location of the maximum concentration predicted from the multisource modeling analysis of other nearby major sources;
2. location of maximum impact from the proposed source; and
3. location of the maximum impact of the combined effect of the nearby sources and the proposed source.

The proper location of receptors when modeling the Brigantine Class I area impact is discussed in Appendix A.

9.2 Ambient Air

The air quality modeling analysis must be performed in all locations of “ambient air”, which has been defined by EPA as “that portion of the atmosphere, external to buildings, to which the general public has access” (40 CFR 50.1(e)). Public access to the facility’s property must be restricted by a physical barrier such as a fence or river with signage along the riverbank. If no physical barrier exists, when conducting an air quality impact analysis for compliance demonstration of a NAAQS/NJAAQS or a PSD increment, receptors shall be placed both on and off the facility's property. If a physical barrier exists, when conducting an air quality impact analysis for compliance demonstration of a NAAQS/NJAAQS or a PSD increment, receptors shall be placed along and outside of a facility's property line.

When conducting modeling for risk assessment, as a general policy, receptors are only placed along and outside of a facility's property line regardless of public access. The exception to this policy is a situation where there is the potential for short-term health impacts on the facility's property where a significant public presence may occur (e.g. park or recreation structures located on the facility's property).

In situations involving leasing arrangements where a source is located on land leased to them by another source, applicants should apply the guidance contained in the June 22, 2007 EPA memorandum entitled: *Interpretation of "Ambient Air" In Situations Involving Leased Land Under the Regulations for Prevention of Significant Deterioration (PSD).*

9.3 Meteorological Data

The protocol should describe and justify the use of all meteorological data that will be used in the modeling analysis. The representativeness of meteorological data is not only a function of proximity, but also other factors such as nearby terrain.

Five years of representative NWS meteorological data or at least one year of on-site meteorological data should be used when estimating concentrations with an air quality model. With NWS data, consecutive years from the most recent, readily available 5-year period are preferred. However, DAQ considers the NWS standard ASOS (automated surface observing stations) data to be inadequate due to their high percentage of hours with calm and missing winds. In the future DAQ hopes to generate 5-year NWS meteorological data sets with the 1-minute ASOS data. Meteorological data based on the 1-minute ASOS data will be superior to the standard ASOS data because it will represent a true 1-hour average wind speed and direction, contain fewer hours of missing data and calm conditions, and will not exclude wind speeds less than 3 kts.

The Bureau maintains five-year AERMET data sets for four NWS station locations for the pre-ASOS period of 1990 through 1994. These data are available to the general public upon request. The applicant should consult with the Bureau for the proper AERMET data to run the AERMOD model. The following briefly describes how the AERMET files were generated.

<u>Meteorological Data</u>
AERMET data were generated for the following four NWS stations: Newark, Philadelphia, Atlantic City, and Wilmington. The source of the surface air data used for these four stations was HUSWO (Hourly United States Weather Observations) for 1990-1994. Upper air data used was FSL (Forecast Systems Laboratory) for 1990-1994. Upper air stations used are Atlantic City and Dulles. However, since the Atlantic City station ceased upper air operations in late August 1994, upper air data from Brookhaven, NY was used in its place from September – December 1994.

The Station paring is as following:

Surface Station	Upper Air Station
Newark	Atlantic City 93755(1990-Aug 1994)/Brookhaven 94703(Sept. – Dec. 1994)
Philadelphia	Atlantic City (1990-Aug 1994)/Brookhaven (Sept. – Dec. 1994)
Atlantic City	Atlantic City (1990-Aug 1994)/Brookhaven (Sept. – Dec. 1994)
Wilmington	Dulles International Airport (Sterling, Va.)

The exact coordinates and height of each airport's anemometer are listed below. Pre-ASOS meteorological data has an anemometer height above ground of 20 ft (6.1 m). ASOS meteorological data normally has an anemometer height above ground of 10 m.

NWS Station	Latitude	Longitude	UTM (km)		Base Height above Sea Level (m)
			East	North	
Newark (14734)	40.69 N	74.16 W	570.789	4504.983	7
Philadelphia (13739)	39.88 N	75.25 W	480.226	4413.170	6
Atlantic City (93730)	39.45 N	74.57 W	536.469	4367.569	23
Wilmington (13781)	39.67 N	75.60 W	448.049	4391.832	24

<u>Generate Vertical Atmospheric Profiles with Land Surface Characteristics</u>

The development of land surface characteristics was achieved by using NJDEP's GIS-based land use data, consisting of 70 land use land cover (LULC) categories accurate to 1 meter. Within the GIS application, the routine constructs a circle centered on the selected anemometer location and divides the circle into 12 evenly spaced (30-degree) sectors. For surface roughness, a distance of 1 km from the anemometer location was used. For albedo and Bowen ratio, a distance of 5 km from the anemometer location was used. The application then calculates the average albedo, Bowen ratio and surface roughness according to land use for each sector for each month.

10.0 Special Modeling Considerations

Some special modeling considerations that may need to be addressed by both PSD and non-PSD sources include, but are not limited to, atmospheric deposition, cooling tower modeling, coastal fumigation modeling, fugitive emissions, start-up/shutdown impacts, modeling of other nearby major sources, and modeling for a risk assessment. This section addresses some of these special requirements and also contains a brief discussion of running and block averages and their relation to NAAQS, NJAAQS, and PSD increments. The applicant should include in the protocol details on how each of these topics will be addressed in the modeling analysis, when applicable.

10.1 Cooling Towers

In the permitting of facilities with wet or wet/dry cooling towers, NJDEP may require modeling of the cooling tower plumes to determine their potential for causing fogging and icing of nearby highways. In addition, the cooling towers must be included in the air quality modeling when their PM_{10} emissions exceed 1 lb/hr. Details on how the particulate emission rate is calculated and what assumptions are made must be included in the modeling protocol and analysis. Cooling towers are normally modeled as a series of point sources, with each cell in the cooling tower associated with a diameter, exit temperature, and exit velocity. Often, cooling towers are subject to downwash effects from the cooling tower structure itself. The PM_{10} and $PM_{2.5}$ concentrations due to cooling tower emissions should be added to those caused by other sources at the facility.

10.2 Coastal Fumigation

Fumigation occurs when a plume that was originally emitted into a stable layer is mixed rapidly to ground-level when unstable air below the plume reaches plume level. The well-mixed, unstable air, which develops as air coming from the ocean is heated over land, is known as the thermal internal boundary layer (TIBL). Sources with tall stacks that are located in an area designated as rural and within 3 km of a large body of water must address coastal fumigation in their modeling analysis. Other sources located beyond 3 km may also need to examine their coastal fumigation impacts if NJDEP believes such an analysis is warranted. Two EPA point source models are capable of simulating coastal fumigation, Calpuff and the Shoreline Dispersion Model.

10.3 Health Risk Assessment

Health risk assessment is required for any facility required to prepare a modeling analysis that also emits a toxic substance above its reporting threshold for which NJDEP has designated an inhalation unit risk factor or a reference concentration. The atmospheric modeling techniques used in a health risk assessment should generally follow the guidance outlined in this document. A listing of those substances for which NJDEP has unit risk factors or reference concentrations and other important information concerning a risk assessment can be found on the Department's web site: www.nj.gov.dep.aqpp.risk.html**.**

As with an air quality analysis, a risk assessment protocol should be approved by BTS before an applicant submits the health risk assessment.

An air quality impact analysis which includes a health risk assessment should include at a minimum:

1. For each substance included by NJDEP on the unit risk factor (URF) list: the maximum predicted long-term average concentration and its location; the applicable unit risk factor; and the calculated incremental cancer risk (source impact times the URF);

2. For each substance included by NJDEP on the reference concentration list: the maximum predicted long-term (chronic) or short-term (acute) average concentration and its location, the reference concentration, and the calculated hazard quotient (source impact divided by the reference concentration).

The maximum short-term concentration modeled (not highest, second-high) should be used to calculate the hazard quotient for compounds with acute health effects. With the exception of the 1-hour NO_2 concentration, background values are not normally added to the modeled values. In addition to providing incremental cancer risk and hazard quotients at the point of maximum impact, health risks at the sensitive receptor with the greatest predicted impact may also need to be provided. For health risk assessments, sensitive receptors can include, but are not limited to, residents of occupied homes, hospitals, schools, and parks. Cancer risks and long-term hazard quotients need only be predicted at and beyond the applicant's property line. If the general public has access to the site, DAQ may require estimates of the short-term hazard quotient be made on the facility's property.

The predicted cancer risk and hazard quotient will be compared to the DAQ Risk Management Guidelines for Air Toxics listed below. The type of action the applicant may need to take when this guideline value is exceeded will depend on the location, frequency, and magnitude of the exceedances. For more information on NJDEP's Risk Management Guidelines for Air Toxics and the Risk Management Committee, see Section 5 of Technical Manual 1003 "*Guidance on Risk Assessment for Air Contaminant Emissions*". Hazard quotients above 1.0 but below 1.5 are rounded down to 1.

Cancer Risk Guidelines for Individual Sources

Risk $\leq$ 1 in a million ($1x10^{-6}$)	Negligible risk.
1 in a million < Risk < 100 in a million	Case-by-case review by Risk Management Committee. Permit may be issued if risk is acceptably minimized.
Risk $\geq$ 100 in a million ($1x10^{-4}$)	Unacceptable risk; permit will not be approved.

Facility-Wide Cancer Risk Guidelines

Risk $\leq$ 10 in a million ($1x10^{-5}$)	Negligible risk
10 in a million < Risk $\leq$ 100 in a million	Pursue long-term (5-year) risk minimization strategy.
100 in a million < Risk < 1000 in a million	Pursue short-term ($\leq$1 year) and long-term risk minimization strategy.
Risk $\geq$ 1000 in a million ($1x10^{-3}$)	Unacceptable risk. Pursue N.J.A.C. 7:27-5, enforcement action for existing facilities.

Noncancer Risk Guidelines for All Sources

Hazard Quotient ≤ 1	Negligible risk.
Hazard Quotient > 1	Case-by-case review by Risk Management Committee.

10.4 Proximity to Major Sources

In special cases where a proposed source will be located in very close proximity to an existing major source, the NJDEP may require a modeling analysis of emissions from the proposed source along with emissions from the existing source, even if the predicted impacts of the proposed source are insignificant. This type of analysis is usually required in response to, or in anticipation of, concerns on the part of the public and the need to show that the ambient air quality standard will be met in the area surrounding the proposed source.

10.5 Use of Running Averages and Block Averages

There are two methods of calculating pollutant concentration averages, running averages and block averages. The time when the block average begins and when it ends is specifically defined and never varies. For example, all 24-hour averages are calculated from midnight to midnight, annual averages are calculated from January 1 through December 31, and 3-hour averages are calculated from midnight (12 p.m.) to 3 a.m., 3 a.m. to 6 a.m., etc. Conversely, running averages (sometimes called moving averages) have no set time when they must begin and end. A 24-hour average can begin at 3 a.m. one day and run to 3 a.m. the next day. Running annual averages can occur over any consecutive 12 month period (e.g. April 1 through March 31, October 1 through September 30).

As mentioned in Section 3.1.2, New Jersey's 3-hour, 8-hour, and 24-hour AAQS are defined in terms of running hourly averages, and its 3-month and 12-month AAQS are defined in terms of running monthly averages. However, all NAAQS, PSD increments, and the AAQS of all States surrounding New Jersey are defined in terms of block averages. It should be noted that New Jersey has no AAQS for PM_{10} or $PM_{2.5}$.

To help avoid confusion in the execution and presentation of the modeling results, BTS recommends the following:

Initially, calculate all short-term impacts in terms of block averages. Quarterly and annual concentrations can also be determined as block averages. These values should be used to determine whether the proposed source has a significant impact. After adding background and the impact of other sources (if multisource modeling was conducted), if the total concentration is greater than 90 percent of the NJAAQS, then running averages should be calculated.

10.6 Nitrogen Oxide to Nitrogen Dioxide Conversion

Approximately 90 percent of nitrogen oxides (NOx) emissions from a combustion source are emitted in the form of nitrogen oxide (NO). The rate at which NO will convert to nitrogen dioxide (NO_2) in the atmosphere will be a function of the background levels of ozone and other oxidizing agents.

Compliance demonstrations with the NO_2 annual average NAAQS/NJAAQS, the NO_2 PSD increment, and the 1-hour NJDEP guideline (reference) concentration in near-field modeling (source-to-receptor distances less than about 50 km) can be done following the tiers described in Section 5.2.4 of EPA's *Guideline on Air Quality Models*.

Tier 1 - a 100% conversion of NO_x emissions to NO_2
(assume NO_2 emission rate = NO_x emission rate)

Tier 2 - a 75% conversion of NO_x emissions to NO_2 based on the national default Ambient Ratio Method (ARM) conversion ratio, or

Tier 3 - a detailed analysis reflecting source conditions using techniques such as the ozone limiting method (OLM) or a site specific ARM calculation.

The DAQ recommends for long-range transport modeling (e.g., source-to-receptor distances greater than about 50 km), assume a 100 % NO to NO_2 conversion.

10.7 Treatment of Horizontal Stacks and Rain Caps

For horizontal stacks or rain caps present on a point source stack, the vertical momentum component of the exit velocity is effectively removed. Consequentially, a unique approach may be needed to characterize these stacks. The approach varies by model, as discussed below.

• **AERMOD**: For capped and horizontal stacks that are NOT subject to building downwash influences, a simple screening approach (Model Clearinghouse procedure for ISC) can be applied. This approach uses an effective stack diameter to maintain the flow rate, and hence the buoyancy, of the plume, while suppressing plume momentum by setting the exit velocity to 0.01 m/s. To appropriately account for stack-tip downwash, the user should first apply the non-default option of no stack-tip downwash (i.e., NOSTD keyword). Then, for capped stacks, the stack release height should be reduced by three actual stack diameters to account for the maximum stack-tip downwash adjustment while no adjustment to release height should be made for horizontal releases.

Capped and horizontal stacks that are subject to building downwash should not be modeled using an effective stack diameter to simulate the lack of vertical momentum. The problem is that the PRIME algorithms use the stack diameter to define the initial plume radius which, in turn, is used to solve conservation laws. The user should input the actual stack diameter and exit temperature but set the exit velocity to a nominally low value, such as 0.01 m/s. This approach will have the desired effect of restricting the vertical flow while avoiding the mass conservation problem inherent with effective diameter approach. The approach suggested here will most likely result in a lower plume height and therefore will provide a conservative estimate of impacts. Also, since PRIME does not explicitly consider stack-tip downwash, no adjustments to stack height should be made.

• **SCREEN3**: Use the following procedure: Assume the exit velocity = 0.01 m/s.

For situations in which multiple point sources are modeled and not all stacks are discharged horizontally, applicants are still free to make separate runs (or modify the source code), but this would be decided on a case-by-case basis. Most applicants prefer to make a single model run to avoid the post-processing effort of combining results on a receptor-by-receptor basis.

11.0 Air Quality Modeling Results

Results of the air quality dispersion modeling analysis are discussed in this section.

11.1 Modeling Submitted in Support of a New Jersey Air Permit Application

Air quality dispersion modeling analysis must clearly show that emissions of criteria pollutants from the proposed facility will not cause or significantly contribute to a violation of any New Jersey or National Ambient Air Quality Standards. The modeling results section of the analysis must contain the following essential information:

1. the location and magnitude of maximum predicted impacts for each modeled criteria and hazardous air pollutant for each applicable averaging time;

2. a comparison of the maximum predicted impact to defined significant impact levels (Table 4-1) for each criteria pollutant modeled;

3. for any proposed source with a predicted insignificant impact, a comparison of the appropriate predicted impact with monitored background concentration added to applicable state and federal air quality standards;

4. for any proposed source with a predicted significant impact, a comparison of the total impact (the combination of the proposed source impact, the impact of other existing nearby major sources, and the monitored background concentration) to applicable state and federal air quality standards; and

5. the results of any additional analyses performed such as a risk assessment or cooling tower analysis.

In addition, BTS may request a comparison of the source's impact to the PSD increments. The highest long-term average concentrations and the highest, second-high short-term average concentrations may be used to determine compliance with NAAQS (except $PM_{2.5}$ and PM_{10}), NJAAQS, and PSD Class II increments when five years of off-site or at least one year of on-site meteorological data are used in the modeling analysis. Guidance on demonstrating compliance with the $PM_{2.5}$ and PM_{10} NAAQS is contained at the following website: http://www.nj.gov/dep/aqpp/pm25notice.html and Section 3.2.1 of this document.

11.2 PSD Permit Applications

In addition to the demonstration required in Section 11.1 above, for PSD permit applications the air quality dispersion modeling analysis must also provide the following additional information:

1. a comparison of the predicted impacts to the PSD Class II increments for each pollutant for which the proposed source is PSD applicable;

2. an analysis of the effect of the proposed source on soil and vegetation in the impacted area and a growth analysis;

3. for any PSD source within 100 km from the Brigantine Class I area, BTS will normally require a comparison of the predicted impacts to the PSD Class I increments. For a proposed source with predicted significant impacts at the Brigantine Class I area, the modeled impact of other PSD increment consuming sources must be included; and

4. for any PSD source within 300 km from the Brigantine Class I area, the FLM for the Brigantine Class I area (U.S. Fish and Wildlife Service) will, on a case-by-case basis, require an evaluation of the proposed project's impact on the Brigantine's Air Quality Related Values (AQRVs). AQRVs include visibility and atmospheric deposition of sulfur and nitrogen.

11.3 Documentation

Copies of example model input and output files should be provided with the modeling submittals. NJDEP strongly recommends that modeling protocols and analyses be presented in loose leaf format in a binder so that additions or revisions can be made easily. If this is not done, both minor and major revisions will require resubmittal of the entire document.

Applicants are reminded that all impact assessments are public information (except process information marked confidential as defined in N.J.A.C.7-27-1.11) and that major permit applications frequently undergo extra examination during public hearing/comment processes. Acronyms and abbreviations should be defined, tables and figures should be clearly labeled, and excess technical jargon should be avoided.

12.0 References

40 CFR Part 51, Appendix W. *Guideline on Air Quality Models*

USEPA, 2009. *AERMOD Implementation Guide*. USEPA, Research Triangle Park, North Carolina, March 2009

Auer, A.H., 1978. *Correlation of Land Use and Cover with Meteorological Anomalies*. JAM, Volume 17

USEPA, 2004a. *User's Guide to the Building Profile Input Program*. EPA-454/R-93-038, USEPA, Research Triangle Park, North Carolina, Revised April 21, 2004

USEPA, 200b. *User's Guide for the AMS/EPA Regulatory Model – AERMOD*. EPA-454/B-03-001, USEPA, Research Triangle Park, North Carolina, September 2004.

USEPA, 2004c. *User's Guide for the AERMOD Terrain Preprocessor (AERMAP)*. EPA-454/B-03-003, USEPA, Research Triangle Park, North Carolina, October 2004

USEPA, 2004d. *User's Guide for the AERMOD Meteorological Preprocessor (AERMET)*. EPA-454/B-03-002, USEPA, Research Triangle Park, North Carolina, November 2004

USEPA, 1985. *Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations)*. EPA-450/4-80-023R, USEPA, Research Triangle Park, North Carolina, 1985

USEPA, 1981. *A Screening Procedure for Impacts of Air Pollution Sources on Plants, Soils, and Animals*. EPA-450/2-81-078, USEPA, Research Triangle Park, North Carolina, October 1981

USEPA, 1987. *Ambient Monitoring Guidelines for PSD*. EPA-450/4-87-007, USEPA, Research Triangle Park, North Carolina, 1987

USGS, 1993. *Digital Elevation Models Data User's Guide 5*. U.S. Geological Survey, Earth Science Information Center

USEPA, 2000. *Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report*. December 2000

USEPA, 2008. *Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report – Draft Revised*. June 2008

USEPA, 1998. *Interagency Workgroup on Air Quality Modeling Phase II (IWAQM, 1998)*

APPENDIX A

Additional Issues for PSD Affected New or Modified Sources

This appendix provides a brief discussion of the additional issues a Prevention of Significant Deterioration (PSD) affected source must address. Further details concerning PSD regulations may be found in the Federal Register (45 FR 52676, August 7, 1980) and in the Code of Federal Regulations (40 CFR 52.21). A good source of EPA memos regarding PSD issues is at www.epa.gov/region07/programs/artd/air/policy/search.htm.

A.1 Pre-application Air Quality Monitoring

For any criteria pollutant that the applicant proposes to emit in significant amounts, continuous ambient monitoring data may be required as part of the air quality analysis. If, however, either (1) the predicted ambient impact, i.e., the highest modeled concentration for the applicable averaging time, caused by the proposed significant emissions increase (or significant net emissions increase), or (2) the existing ambient pollutant concentrations, are less than the prescribed significant monitoring values (see Table A-1), BTS has discretionary authority to exempt an applicant from this air quality monitoring requirement. BTS will also exempt a source from pre-application monitoring if it believes air quality in the area is adequately represented by existing monitors. Information on PSD monitoring can be found in *Ambient Monitoring Guidelines for PSD* (EPA-450/4-87-007), 1987.

Table A-1. Significant Monitoring Concentrations

Pollutant	Air Quality Concentration and Averaging Time (ug/m^3)
CO	575 (8-hr)
NO_2	14 (annual)
SO_2	13 (24-hr)
TSP	10 (24-hr)
PM_{10}	10 (24-hr)
Ozone	a
Lead	0.1 (3-month)
Asbestos	b
Beryllium	0.001 (24-hr)
Mercury	0.25 (24-hr)
Vinyl Chloride	15 (24 hr)
Fluorides	0.25 (24 hr)
Sulfuric acid mist	b
Total reduced sulfur (including H_2S)	b
Reduced sulfur (including H_2S)	b
Hydrogen sulfide	0.2 (1-hr)

a: No significant air quality concentration for ozone monitoring has been established. Instead, applicants with a net emissions increase of 100 tons/yr or more of VOCs subject to PSD would be required to perform an ambient impact analysis, including pre-application monitoring data.

b: Acceptable monitoring techniques may not be available at this time. Monitoring requirements for this pollutant should be discussed with the Bureau.

A.2 Post-construction Air Quality Monitoring

Post-construction monitoring may be required when there are valid reasons, such as (1) when the NAAQS are threatened, and (2) when there are uncertainties in the data bases for modeling. Any decision to require post-construction monitoring will generally be made after the PSD application has been thoroughly reviewed.

A.3 PSD Baseline Trigger Date

The PSD increments are the maximum allowable increase in ambient pollutant concentrations that can occur above the applicable baseline concentrations. The baseline concentration is the ambient concentration of a pollutant existing at the time that the first complete PSD permit application affecting the area was submitted. That date is referred to as the PSD "Minor Source Baseline Date". To demonstrate compliance with PSD increment levels, the area that will be impacted by the project must first be defined and then the amount of increment available in that area must be calculated. In order to calculate the amount of increment available, the PSD Minor Source Baseline Date of the area where the proposed project is located must be determined. The following PSD minor source baseline dates have been established in New Jersey:

1. New Jersey Portion of the New York - New Jersey - Connecticut Interstate Air Quality Control Region (Bergen, Essex, Hudson, Middlesex, Monmouth, Morris, Passaic, Somerset, and Union Counties)

Sulfur Dioxide	November 3, 1977	(Exxon)
PM_{10}	November 15, 1978	(GAF)

2. New Jersey Portion of the Metropolitan Philadelphia Interstate Air Quality Control Region (Burlington, Camden, Gloucester, Mercer, and Salem Counties)

Sulfur Dioxide	October 6, 1977	(Seaview Petroleum)
PM_{10}	July 18, 1979	(BF Goodrich)

3. New Jersey Portion of the Northeast Pennsylvania Upper Delaware Valley Interstate Air Quality Control Region (Huntington, Sussex, and Warren Counties)

Sulfur Dioxide	November 21, 1980	(Hoffmann LaRoche)
PM_{10}	September 20, 1978	(Hoffmann LaRoche)

4. New Jersey Intrastate Air Quality Control Region (Atlantic, Cape May, Cumberland, and Ocean Counties)

Sulfur Dioxide	November 17, 1988	(CNG Lakewood)
PM_{10}	November 17, 1988	(CNG Lakewood)

The PSD minor source baseline date for nitrogen dioxide is February 8, 1988 for all areas of New Jersey. It corresponds to the date on which the increments for nitrogen dioxide were first proposed in the Federal Register.

The following emission changes must be used to calculate available increment. The sources that need to be addressed are those within SIA and 50 km beyond the SIA.

1. The actual emissions increases (or decreases) at any stationary source after the Minor Source Baseline Date.

2. The actual emissions increases (or decreases) after the Major Source Baseline Date that are associated with construction at a major source. The sulfur dioxide and PM_{10} Major Source Baseline Date is August 6, 1975; the nitrogen dioxide major source baseline date is February 8, 1988.

3. Allowable emissions from PSD sources (including secondary and fugitive emissions) which have submitted a PSD application as of 30 days prior to the date of application by the proposed source. If the source is an existing PSD source and has been in operation for more than two years actual emissions may be used.

4. Actual emission increases from general area growth.

5. Changes in emissions due to State Implementation Plan (SIP) revisions.

For short-term averaging periods, the difference between the current maximum actual emissions and the maximum actual emissions as of the applicable baseline date is modeled. The maximum actual emissions are considered to be the highest occurrence or an upper percentile value for that averaging period during the previous two years of operation. For the annual averaging period the difference between the current average actual emissions and the average actual emissions as of the applicable baseline date are modeled. In both cases the average actual emissions are calculated as the average over the previous two year period.

Many facilities do not have the necessary records to support the calculation of the change in actual emissions since the applicable baseline date. Therefore, as a conservative approach, the Bureau recommends that the first level of the increment analysis be accomplished using the actual emissions from the previous two years for all emission sources included in the analysis. If this approach results in predicted concentrations above the applicable PSD increment, then the difference in actual emissions can be determined for the emission unit(s) contributing to the exceedances and the model rerun.

This approach eliminates the need to calculate the difference in actual emissions for all increment consuming sources.

If the change in actual emissions included a change in stack parameters, then the stack parameters and emission rates associated with both the baseline case and the current case are input into the same model run, with the baseline case modeled as negative emissions and the current case modeled as positive emissions, each with the appropriate stack parameters.

The Bureau will assist all PSD applicants with their increment analysis by providing air quality monitoring data on file, parameters for existing sources located in the State, and modeling analyses developed in support of SIP revisions, when available. It is the responsibility of the applicant to obtain details on specific permits from the DAQ files and to obtain necessary data from any other state(s) or agency(s).

DAQ currently has no policy which limits the amount of short-term or long-term increment one source can consume. However, to allow for future economic development, permit applicants are discouraged from proposing emission increases that will consume most or all of the available PSD increment in an area.

A.4 Additional Impact Analysis - Growth

This analysis is an estimate of the projected residential, commercial, and industrial growth that will occur as a result of the PSD project and an estimate of the air emissions associated with this growth. Air emissions associated with any new growth predicted to result from the proposed project and the air emissions from the proposed PSD project are modeled together. The applicable background values are added to the resulting modeled concentrations and the results compared with the applicable NAAQS and PSD increments.

Often the new residential, commercial, and industrial growth estimated to occur as a result of the PSD project is negligible. In this case, further modeling analyses for growth is not necessary.

A.5 Additional Impact Analysis - Soils and Vegetation

The soils and vegetation analysis is based on an inventory of the soils and vegetation types found in the area. The inventory of vegetation should include all vegetation with any commercial or recreational value. Once an inventory of soils and vegetation is completed, a literature search is conducted to determine the sensitivity of these soils and vegetation to each of the applicable pollutants that will be emitted in significant amounts. This information should be compared to the predicted concentrations determined from the modeling analysis.

Potentially sensitive vegetation species may require a more careful examination. Some species may be harmed by long-term exposure to low pollutants concentrations. The analysis should evaluate predicted concentrations for the averaging periods associated with the averaging periods addressed in the applicable vegetation impact studies. Since multiple pollutants may impact soils and vegetation synergistically, the combined impacts of NO_x and SO_2 (if applicable) should be evaluated. One reference for information on the relative sensitivities of plants to NO_2 is Table 9-6 of EPA's "*Air Quality Criteria for Oxides of Nitrogen, Summary of Vegetation Impacts*" Volume II, August 1993 (EPA 600/8-91/049bF).

A.6 Class I Area Impact Analysis

All areas of the United States are classified as Class I, II, or III PSD areas. Class I areas are generally national parks and wilderness areas; Class II areas allow for moderate growth and represent most areas of the country; and Class III are designated as areas which intend to foster extensive industrial development.

The entire New Jersey is designated as a Class II PSD area with the exception of the Brigantine Wilderness in the Brigantine Division of the Edwin B. Forsythe National Wildlife Refuge (formerly the Brigantine National Wildlife Refuge), which is a Class I PSD area.

Proposed PSD source or modification located within 50 km of the Brigantine Class I area must conduct a modeling analysis of the source's impact at the Class I area. Any proposed PSD source or modification from 50 to 300 km of this Class I area will need to evaluate its Class I area impact on a case-by-case basis. The FLM normally will make that determination. The Q/D methodology in Section C.2 of the *June 2008 draft revised Federal Land Managers Air Quality Related Values Workgroup (FLAG) Phase I Report* has been used to determine the need for a Class I area modeling analysis. This draft document has been made available at the following web site: www.nature.nps.gov/air/permits/flag/docs/FLAG_RevisedFinalDraft20080624.pdf. BTS may require a Class I increment analysis of sources closer than 100 km from the Brigantine Class I area even when not required by the FLM.

The basic procedures that should be used in a Class I area analysis can be found in the following documents: EPA's *Guideline on Air Quality Models*, *Interagency Workgroup on Air Quality Modeling Phase II (IWAQM, 1998)*, *Federal Land Managers Air Quality Related Values Workgroup Phase I Report* (FLAG, 2000), and the *June 2008 draft revised FLAG Phase I Report*. The FLM's permit review process consists of three main analyses:

- an air quality analysis to ensure that the pollutant levels do not exceed national ambient air quality standards (NAAQS) and PSD increments;

- an AQRV analysis to ensure that the Class I area air quality related values are not adversely affected by the proposed emissions; and

- a Best Available Control Technology (BACT) analysis to ensure that the emission increases from the proposed facility are minimized using appropriate pollution control equipment.

The Federal Land Manager (FLM) of the Brigantine Class I area is the United States Fish and Wildlife Service (F&WS). Ms. Jill Webster is currently the F&WS permitting lead on PSD applications affecting the Brigantine Class I area. Her contact information is listed below.

Jill Webster, Environmental Scientist
US Fish and Wildlife Service
National Wildlife Refuge System
Branch of Air Quality
7333 West Jefferson Ave., Suite 375
Lakewood, Colorado 80235-2017
(303)914-3804, Jill_Webster@fws.gov

Guidance on Class I area modeling issues may be obtained from Mr. Tim Allen of the F&WS (303-914-3802, Tim_Allen@fws.gov).

A.6.1 Class I PSD Increments

As discussed in EPA's *Guideline on Air Quality Models*, the type of modeling conducted to predict PSD increment consumption at the Brigantine Class I area will depend on the location of the source. Those sources located within 50 km will use a steady-state model such as AERMOD in their modeling analysis. If the source is beyond 50 km, the non-steady-state puff model Calpuff should be used. The Class I significant impact levels, as well as the Class I PSD increments are listed in Table A-2. For sources modeling PM_{10} with Calpuff, sulfate and nitrate formed during plume transport to the Class I area should be added to the predicted impact due to direct PM_{10} emissions. A PSD project whose proposed impact exceeds the Class I significant impact levels at the Brigantine Class I area must conduct a multisource modeling analysis to determine cumulative increment consumption.

Table A-2. PSD Class I Significant Impact Levels and PSD Increments

Pollutant	Averaging Period	Class I Significant Impact Levels (ug/m^3)	Class I PSD Increments (ug/m^3)
SO_2	3-hr	1.0	25
	24-hr	0.2	5
	Annual	0.1	2
PM_{10}	24-hr	0.3	8
	Annual	0.2	4
NO_2	annual	0.1	2.5

A.6.2 Class I Area Air Quality Related Values (AQRVs)

In addition to the PSD increments, there are requirements for the protection of various Class I area resources that might be affected by air pollution. These "air quality related values", or "AQRVs", include visibility, vegetation, lakes and streams, soils, fish, and animals. In the April 1996 Proposed New Source Review Reform Regulations, EPA proposed to define AQRV as a scenic, cultural, physical, biological, ecological, or recreational resource which may be affected by a change in air quality as defined by the Federal Land Manager. CAA gave the Federal land managers an affirmative responsibility to protect AQRVs. Among the Brigantine Class I area's AQRVs of interest to the FLM are visibility, the impact of sulfur/nitrogen deposition on soils and water quality, and ozone damage to sensitive vegetation. The FLM's recommendations on how the applicant should assess its impact on Class I areas are found in the FLAG documents. Below is a very brief summary of the AQRV issues.

A.6.2.a Visibility Impairment Analysis

Any proposed PSD source or modification, located within 300 km of the Brigantine Class I area whom the FLM has requested a Class I evaluation, must address its visibility impact at the Class I area. If the source is located within 50 km of the Brigantine Class I area, a method of assessing the source's visibility impact due to coherent plumes should be used. Applicants should first model their potential plume impacts using the EPA's screening model, VISCREEN, or, if the next level of analysis is called for, the EPA's PLUVUE II. Both of these models use steady-state, Gaussian-based plume dispersion techniques to calculate one-hour concentrations within an elevated plume. These two models calculate the change in the color difference index (ΔE) and contrast between the plume and the viewing background. Values of ΔE and plume contrast are based on the concentrations of fine primary particulates (including sulfates), nitrogen dioxide (NO_2), and the geometry of the observer, target, plume, and the position of the sun. PLUVUE II also allows consideration of the effects of secondarily formed sulfates.

If the source is located beyond 50 km from the Brigantine Class I area, regional haze is the primary concern. CALPUFF is used to evaluate whether the proposed source or modification will be below the FLM's visibility threshold for concern (i.e., 5% change in light extinction).

A.6.2.b Atmospheric Deposition Analysis

Deposition of sulfur (S) and nitrogen (N) has the potential to affect terrestrial, freshwater, and estuarine ecosystems on FLM lands. The FLM has identified, where possible, AQRVs sensitive to deposition of S and N on FLM lands and the critical loads associated with those AQRVs. A proponent of a source of new emissions with the potential to contribute to S or N deposition in a FLM area should consult with the FLM to determine what analyses are needed to assess AQRV effects. The FLM may request a deposition impact analysis as summarized below.

1. Estimate the current deposition rate to the FLM area. A list of monitoring sites providing data to characterize deposition in FLM areas is included on the respective Agencies websites.

2. Estimate the future deposition rate by adding the existing rate, the new emissions' contribution to deposition, the contribution of sources permitted but not yet operating, and then subtracting the credit for enforceable emission reductions. Modeling of new, reduced, and permitted but not yet operating emissions' contribution to deposition should be conducted following current EPA modeling guidance.

3. Compare the future deposition rate with the recommended screening criteria (*e.g.,* critical load, concern threshold, or screening level value) for the affected FLM area.

A.6.3 Class I Required Receptors

When conducting a Class I impact analysis, the impact at 44 pre-selected receptors at the Brigantine Class I area must be evaluated. A listing of the latitude, longitude, and height above sea-level of these sensitive receptors can be downloaded at the following web site: http://www.nature.nps.gov/air/Maps/Receptors/index.cfm. Figure A-1 shows the location of these receptors on a map.

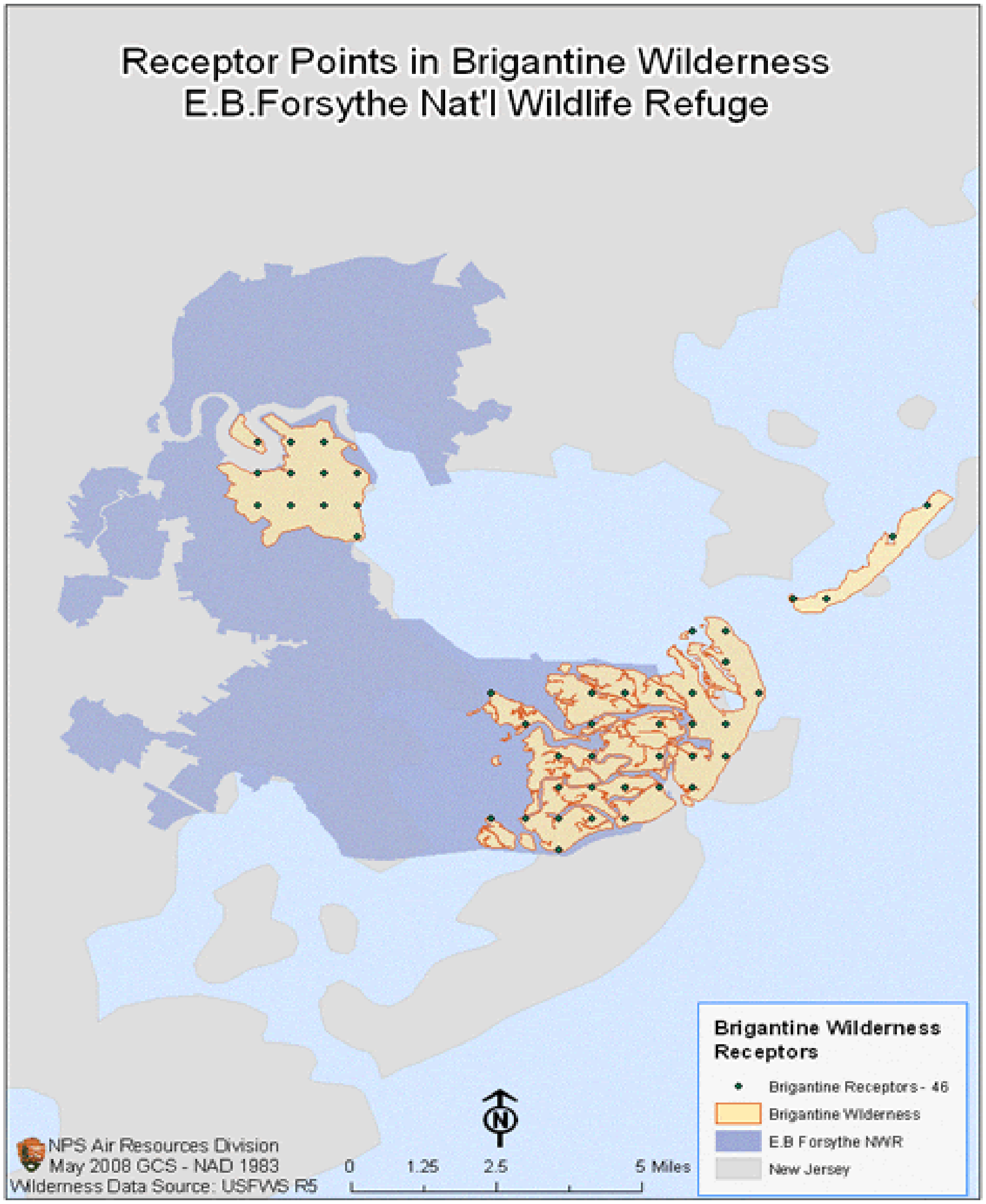

Figure A-1. Required Receptor Locations in Brigantine Division of the E.B. Forsythe National Wildlife Refuge

APPENDIX B

Example Air Quality Analysis Checklist

This checklist recommends a standardized set of data and a standard basic level of analysis needed for modeling submittals. The checklist implies a level of detail required to assess compliance with the PSD increments, the NAAQS, and the NJAAQS. Individual cases may require more or less information and the reviewing authority should be consulted at an early stage in the development of a data base for a modeling analysis.

At pre-application meetings between the applicant and the reviewing authority, this checklist should prove useful in developing a consensus on the data base, modeling techniques and overall technical approach prior to the actual analyses. Such agreement will help avoid misunderstandings concerning the final results and may reduce the later need for additional analyses.

1. Source location map(s) showing location with respect to:

    - Urban areas
    - PSD Class I areas
    - Nonattainment areas
    - Topographic map covering a 1 km radius from the source
    - Other major existing sources
    - State/local/on-site air quality monitoring locations

2. Information on urban/rural characteristics:

    - Land use within 3 km of source classified according to Auer (1978): Correlation of land use and cover with meteorological anomalies. *J. Appl. Meteor.*, **17**: 636-643.
    - Population (total and density)
    - Based on current guidance determination of whether the area should be addressed using urban or rural modeling methodology

3. Criteria and hazardous air pollutant emissions and operating/design parameters for proposed major sources

    - Allowable annual emission rates (tons/yr) and operating rates
    - Maximum design load short-term emission rate (lbs/hr)
    - Associated emissions/stack characteristics as a function of load for maximum, average, and minimum operating conditions. Screening analyses may be employed to determine the constraining load condition (e.g., 50%, 75%, or 100% load) to be relied upon in the short-term modeling analysis.
      - location (UTM's)
      - height of stack (ft/m) and grade level above MSL
      - stack exit diameter (ft/m)
      - exit velocity (m/s)

- exit temperature (°K/°F)
- Area source emissions (rates, size of area, height of area source)
- Location and dimensions of buildings (plant layout drawing)
  - to determine GEP stack height
  - to determine potential building downwash considerations for stack heights less than GEP
- Associated parameters
  - boiler size (megawatts, pounds/hr. steam, fuel consumption, etc.)
  - boiler parameters (% excess air, boiler type, type of fuel, etc.)
  - operating conditions (pollutant content in fuel, hours of operation, capacity factor, % load for winter, summer, etc.)
  - pollutant control equipment parameters (design efficiency, operation record, e.g., can it be bypassed? etc.)

4. Air quality monitoring data:

- Proposed monitors that will be used to represent background air quality.
- Justification for their selection, and the latest three years of measurements from the selected monitors

5. Meteorological data:

- Five consecutive years of representative sequential hourly National Weather Service (NWS) data, or one or more years of hourly sequential on-site data

6. Air quality modeling analyses:

- Model each individual year for which data are available with a recommended model or model demonstrated to be acceptable on a case-by-case basis
  - urban dispersion coefficients for urban areas
  - rural dispersion coefficients for rural areas
- Evaluate downwash if stack height is less than GEP
- Define worst case meteorology for screening analyses
- Determine background and document method
  - long-term
  - short-term
- Provide topographic map(s) of receptor network with respect to location of all sources
- Follow current guidance on selection of receptor sites for refined analysis
- Include receptor terrain heights (if applicable) used in analysis
- Determine extent of significant impact; provide maps
- Define areas of maximum and highest, second-highest impacts due to applicant source
  - long-term
  - short-term

7. Comparison with acceptable air quality thresholds:

- NAAQS/NJAAQS
- PSD increments
- Emission offset impacts if nonattainment
- NJDEP health risk criteria

APPENDIX C

Odor Modeling Procedures

C.1 Odor Modeling Procedures

The mechanisms of odorant dispersion in the atmosphere are the same as the dispersion of other pollutants. However, there are some special problems that must be considered when attempting to quantify a source's odor impact with dispersion modeling. Among them are determining the emission rates of the odor-producing pollutants (odorants), the high degree of subjectivity in the perception and intensity of odors, the short time period over which odors are observed, and the enhancing or masking of odors by the combinations of odorants. In addition, there are no dispersion models or modeling techniques recommended by the EPA for odor modeling.

N.J.A.C. 7:27-5 (Prohibition of Air Pollutants) states that a source shall not emit air contaminants in such quantities and duration as to unreasonably interfere with the enjoyment of life or property. In addition, odor modeling may be required of a new, reconstructed, or modified municipal wastewater/sludge handling or treatment facility as described in the Division of Air Quality's document *Guidance Document for Odor Nuisance at Municipal Wastewater/Sludge Handling & Treatment Facilities*. Therefore, in spite of the problems, NJDEP does on occasion need to evaluate or review modeling of new or modified sources capable of causing odor problems. Although there is no EPA guidance on the issue, there have been several scientific studies and technical papers written on the subject of odor modeling. The Bureau has reviewed the available literature and has developed guidance for assessing a source's odor impact with dispersion modeling. Predictions made in an odor modeling analysis following this guidance would only be considered an indication of the future odor impact of the source, not the definitive answer. It should be considered a tool in setting either a dilution-to-threshold (D/T) odor emission limit or pound per hour pollutant specific emission rate for the source.

C.2 Odor Modeling Techniques

The Bureau currently recommends two methods to model odor impact. The method selected will be a function of the number of odor-producing pollutants emitted from the source. Regardless of the type of method used, the analysis must provide predictions of maximum odor impact at sensitive receptors in the vicinity of the source. Sensitive receptors include, but are not limited to, residents of occupied homes and residential areas, employees and customers at industrial, commercial, or government establishments, schools, hospitals, and visitors at a recreational public place such as park or playground. Submittal of predicted odor frequency tables also provides useful information in the review of a source's odor impacts. As with other air quality impact analyses, The Bureau requires that a protocol be submitted and approved before the odor modeling analysis is conducted.

C.3 Sources that Emit One Primary Odor Producing Pollutant

In this situation the interaction of pollutants masking or enhancing a perceived odor should be minimal. Therefore, the odor producing pollutant can be modeled by entering the pollutant's emission rate in grams per second into the selected model. The model's predicted concentration (in mass per volume, ug/m^3) can then be compared to the pollutant's specific odor threshold.

C.4 Sources that Emit Several Odor Producing Pollutants

When there are numerous pollutants being emitted from a source, there is a much higher potential for interactions where various odorants may mask or enhance a perceived odor. Therefore, a dilution to threshold (D/T) approach to quantifying odors should be used in the analysis. D/T is dimensionless and is a measure of how many volumes of odor-free air must be added to a sample of contaminated air in order to reduce its odor level below the detection level. The odor emission rate of the source is expressed as the product of the D/T in air directly emitted by the source and the volume flow rate. In order to obtain the correct magnitude of D/T, the model selected should be set to predict g/m^3, not ug/m^3.

In the measurement of a source's D/T emission rate, the odorous air sample from the source is diluted with equal volumes of odor-free air until an odor is no longer perceptible. For example, an odorous air sample that was diluted with 100 volumes of odor-free air to reach the 50 percent odor perceptibility would have an odor level of 100 D/T.

C.5 Conversion of 1-Hour Modeled Concentrations to Short-term Averages

An odor modeling analysis can be conducted with either a puff (fluctuating plume) model or one of the standard Gaussian models recommended by the EPA such as the AERMOD model or the SCREEN3 model. If a puff type model such as TRC's Odor Model or EPA's INPUFF model is used, no conversion is necessary because short-term D/T values or pollutant concentrations will be predicted by the model. However, if a model such as AERMOD or SCREEN3 is used, predicted one-hour D/T or pollutant concentration need to be converted to short-term peak value of 5 minutes or less.

Review of the available literature indicates the relationship between a 1-hour concentration and a short-term peak concentration such as a five minute average is a function of meteorology (principally atmospheric stability), the release height of emissions, the distance from the source to receptor, building downwash, and surface roughness. In the paper *A Conversion Scheme for ISC Model In Odor Modeling* (Samuel S. Cha, Zhenjia Li, and Karen E. Brown, 1992. AQMA 85^{th} Meeting, 92-153.02), a technique was developed for converting 1-hour concentrations to 5-second concentrations for point sources. Conclusions reached in the paper indicate that the peak/mean ratios depend on the meteorological condition, the type of source and the receptor location. A summary of their results for point sources with a 20 meter plume height and a 40 meter plume height are given in Table G-1. The paper *Odor Modeling - Why and How* (Duffee, R.A., M. A. O'Brien, and M. Ostojic, 1989. AWMA Specialty Conference) compares 1-hour ISCST predictions to the instantaneous predictions of the INPUFF model. When modeling an area source during stable conditions, a relatively constant conversion ratio of approximately 7 was found at receptor distances of 0.8 km, 1.6 km, and 2.4 km.

Though often too simplistic, another method of converting values to shorter averaging times is the power law relationship. The following is an example of using the power law to convert a 1-hour concentration or D/T value to a five minute average:

$$C_p = C_m (t_m/t_p)^{0.2}$$

where: C_p = 5-minute average concentration or D/T

C_m = 1-hour average concentration or D/T

t_p = 5 minutes

t_m = 60 minutes

An applicant planning to conduct odor modeling with a model similar to ISCST3 or AERMOD can suggest the use of a conversion ratio based on the above discussion or propose their own. The Bureau will review the proposed conversion ratios in the modeling protocol before they are approved for use in the analysis.

C.6 Odor Modeling Results

Once short-term pollutant concentrations are calculated, they must be compared to odor detection and complaint levels. Odor detectability, or the odor threshold, is usually defined as the point at which 50 percent of a given population will perceive an odor. Table 10-1 lists some of the published odor detection levels of pollutants that often cause odor problems. Odor complaint levels are usually 2 to 3 times higher than the odor threshold levels. The Connecticut Department of Environmental Protection odor limits given in Table 10-2 are considered nuisance levels. Applicable odor detection and complaint levels for odor producing emissions from a proposed source should be discussed in the modeling protocol.

Based on the results of the modeling, a D/T emission limit at the source is set which ensures offsite D/T values will be at an acceptable level. The only odor limit specified by NJDEP is contained in the document *Guidance Document for Odor Nuisance at Municipal Wastewater/Sludge Handling & Treatment Facilities*. The document is part of the NJDEP State-of-the-Art (SOTA) Manual for Municipal Wastewater/Sludge Handling and Treatment Facilities. It states that emissions of odor-causing compound(s) from a new, reconstructed, or modified source should have an odor intensity of less than 5 D/T at the sensitive receptor with the highest impact. Once the D/T emission limit is set for a facility, it can later be verified by source testing when the facility is built.

Table C-1. Conversion Factors for Peak-To-Mean Ratio

Distance (m)	B Stability: Wind Speed: 2 m/s (4.5 mi/hr)	D Stability: Wind Speed: 6 m/s (13.4 mi/hr)	E Stability: Wind Speed: 2 m/s (4.5 mi/hr)
Case I: Point Source Plume Height = 40 Meters			
100	45.0	6.0	8.3
200	38.5	7.3	8.3
300	23.2	8.5	10.1
400	16.1	10.2	10.9
600	12.8	12.4	12.7
800	12.6	13.3	13.1
1,000 (0.62 mi)	12.4	10.2	15.6
Case II: Point Source Plume Height = 20 Meters			
100	36.0	6.0	5.6
200	14.7	9.7	7.8
300	11.6	12.6	10.9
400	11.0	10.3	12.6
600	10.8	7.4	10.9
800	10.6	6.7	8.4
1,000 (0.62 mi)	10.4	6.6	7.3

Table C-2. Published Odor Thresholds

Odorant	Odor Threshold[a] (ug/m^3)	Odor Limit[b] (ug/m^3)	Odor Threshold[c] (ug/m^3)	Odor Detection[d] (ug/m^3)
Acetaldehyde	120	---	90	90
Ammonia	---	---	3,615	3,700
Carbon Disulfide	---	---	342	3,900
Dimethyl Disulfide	---	---	---	66
Dimethyl Sulfide	---	---	---	51
Hydrogen Sulfide	---	6.3	11.3	5.5
Methyl Mercaptan	---	2.2	3.4	2.4
Phenol	230	461	153	500
Styrene	640	638	1,360	1,300
Trimethyl Amine	---	---	1.1	6

a Geometric mean of all odor threshold detection levels in literature reviewed by authors, values from *Reference Guide to Odor Thresholds for HAPS Listed in the Clean Air Act Amendments of 1990* (Draft), 1991, TRC Environmental Consultants

b Connecticut DEP - 15 minute average of concentration considered a nuisance

c Geometric mean of all odor threshold detection levels in literature reviewed by authors: "Odor as an Aid to Chemical Safety: Odor Thresholds Compared with TLV and Volatibilities for 214 Industrial Chemicals in Air and Water Dilution" from *Journal of Applied Toxicology* Vol. 3 No. 6, 1983

d Represents the 50 percent detection level: "The Odor Impact Model" from *Journal of Air and Waste Management* Vol. 41 No. 10, October 1991.