



# **NC Air Quality Modeling & Modeling Requirements**

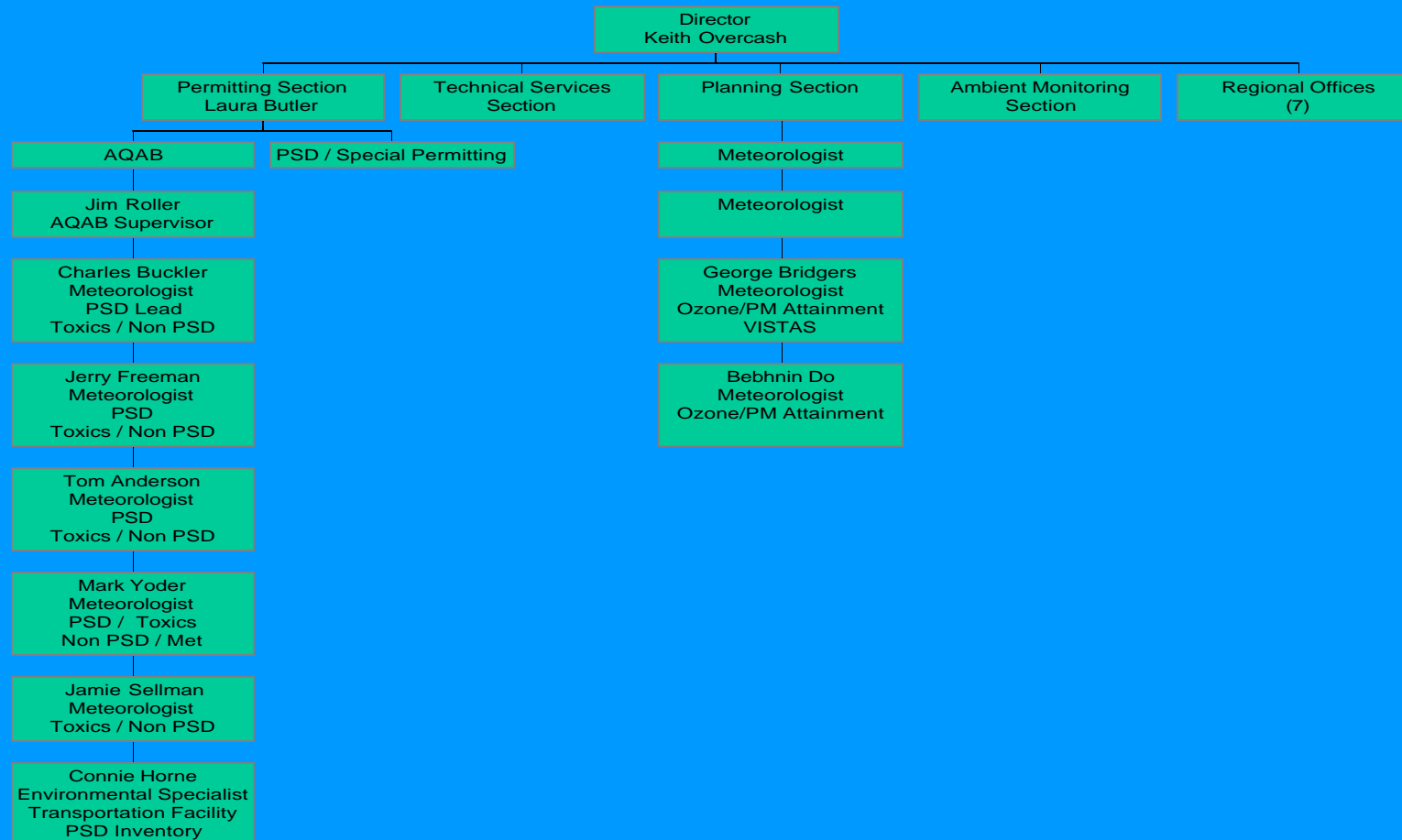
**Presented by: Jim Roller  
2004**

# Division of Air Quality



# ORGANIZATIONAL CHART

North Carolina Department of Environment and Natural Resources Division of Air Quality





## NC Modeling Presentation

### Objectives

- Generic Permitting / Non-Permitting Programs
- Program Modeling Requirements
- NC Air Toxics
- NC Air Toxics Modeling Requirements
  - Modeling Protocol
  - Modeling Protocol Checklist
  - Modeling Request D3 Form
- AQAB Dispersion Models



## Modeling Support

### Permitting Activities

- PSD: Major Source / Criteria Pollutants
- Non-PSD: Minor Source / Criteria Pollutants
- NC Air Toxics: NC Toxics Pollutants (TAPs)
- State Implementation Plan (SIP):  
Criteria Pollutants
- Transportation Facility (TF): CO



## Modeling Support

### Non-Permitting (Other) Activities

- Compliance Issues
- Public Concerns / Complaints
- Epidemiology Health / Exposure Studies
- Air Quality Monitor Siting
- "Special" Studies



## Modeling Requirements

**PROTOCOL**

**STATION NETWORKS**



**PSD Increment**

**CHECKLISTS**

**NAAQs**

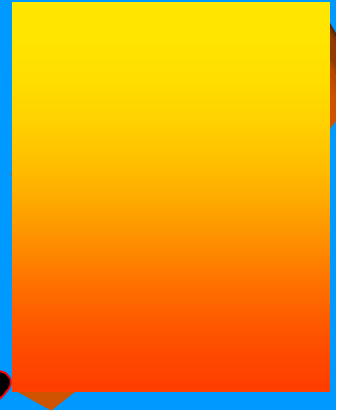


**TOXICS**



**CLASS /**

**APPROXIMATE CONCENTRATION**



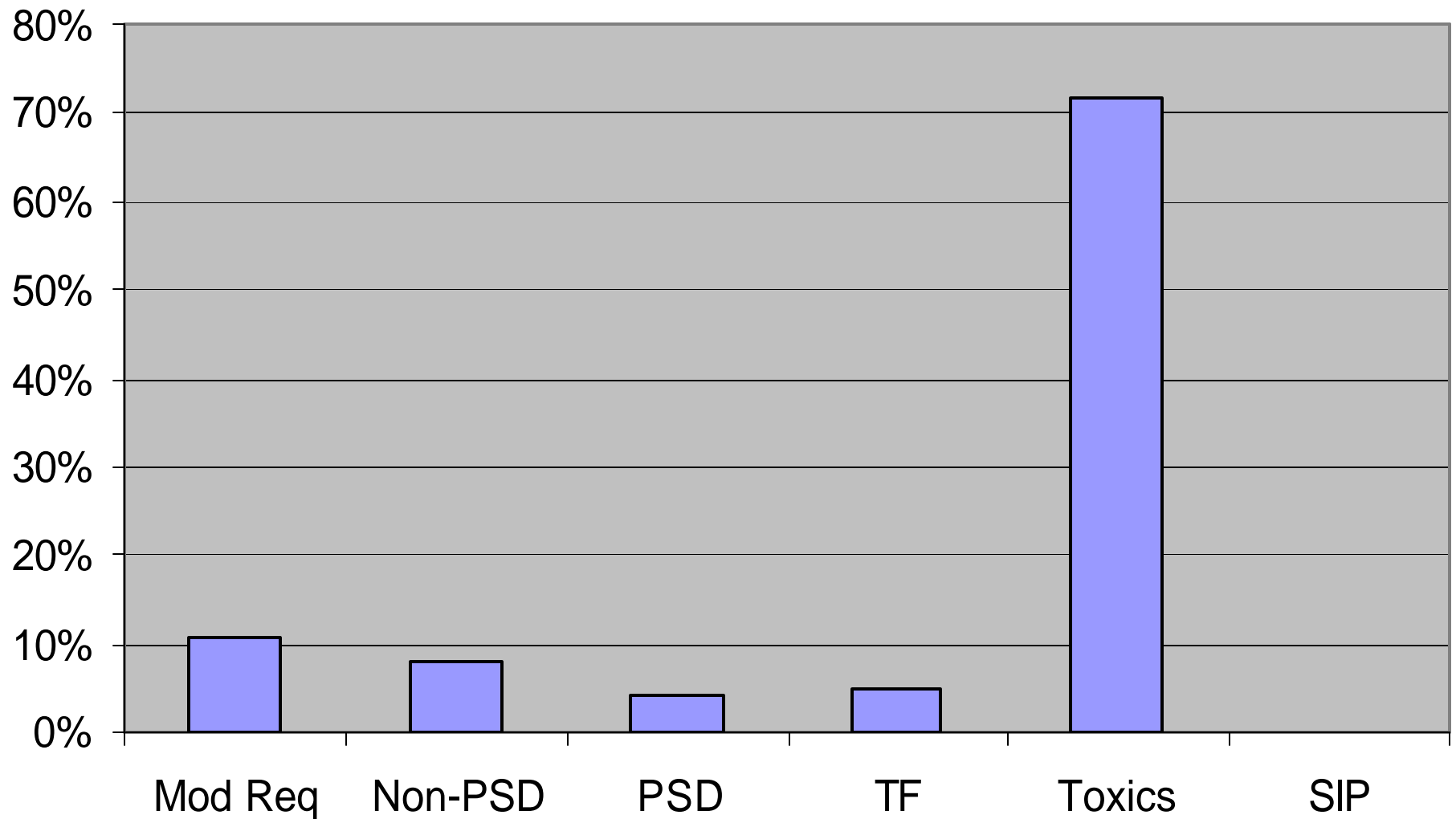


## Modeling Requirements

	PSD	Non PSD	SIP	NC Toxics	TF
Pre Application Meeting	X		X		
Modeling Protocol	X		X		X
Modeling Protocol Checklist / Modeling Worksheet		X		X	
Preliminary Impact Analysis	X	X			LOS
NAAQS Analysis	X	X	X		X
PSD Increment Analysis	X	X			
Offsite Inventory	X	X	X		
Background Concentrations	X	X	X		X
NC Toxics Analysis	X			X	
Pre / Post Construction Monitoring	X				
Additional Impact Analysis (Growth, Vis, Soils)	X				
Class I Area Analysis	X				
Modeling Report	X	X	X	X	X



## NC Modeling Summary





## NC Air Toxics Program

- Health Based Program :  
Acceptable Ambient Levels (AALs)
- Established in 1990 time frame
- 97 Toxics Air Pollutants (TAPs)



## NC Air Toxics Program

### Premise

A facility should not emit the listed toxics in such quantities that may cause or contribute beyond the contiguous property boundary to any significant ambient air concentrations that may adversely affect human health.



## Toxics Modeling Requirements

### When to Model

Facility wide emissions of affected toxics exceed the TPER (toxics permitting emission rate)

- a.k.a.

MEER (modeling exemption emission rate) or *deminimus* levels.



## Toxics Modeling Requirements

### When To Model

- **Last MACT:** modeling submitted with permit application; compliance by MACT deadline.
- **SIC Call:** modeling submitted with permit application within 180 days from written notification; compliance within 3 years of permit date.



# **NC Air Quality Rules – 15A NCAC 2D & 2Q**

## **NC Air Toxics**

***15A NCAC 2Q .0700 :***

**Toxic Air Pollutant Procedures**

***15A NCAC 2D .1100 :***

**Control of Toxic Air Pollutants**



## NC Air Quality Rules

### NC Air Toxics

***15A NCAC 2Q .0711 :***

**Toxics Permit Emission Rates (TPERs)**

***15A NCAC 2D .1104 :***

**Acceptable Ambient Levels (AALs)**



## Toxics Modeling Requirements

### TPER (2Q .0711)

<u>Pollutant</u>	<u>lb/yr</u>	<u>lb/day</u>	<u>lb/hr</u>
Arsenic	.016		
Styrene			2.7
MEK		78	22.4



## Toxics Modeling Requirements

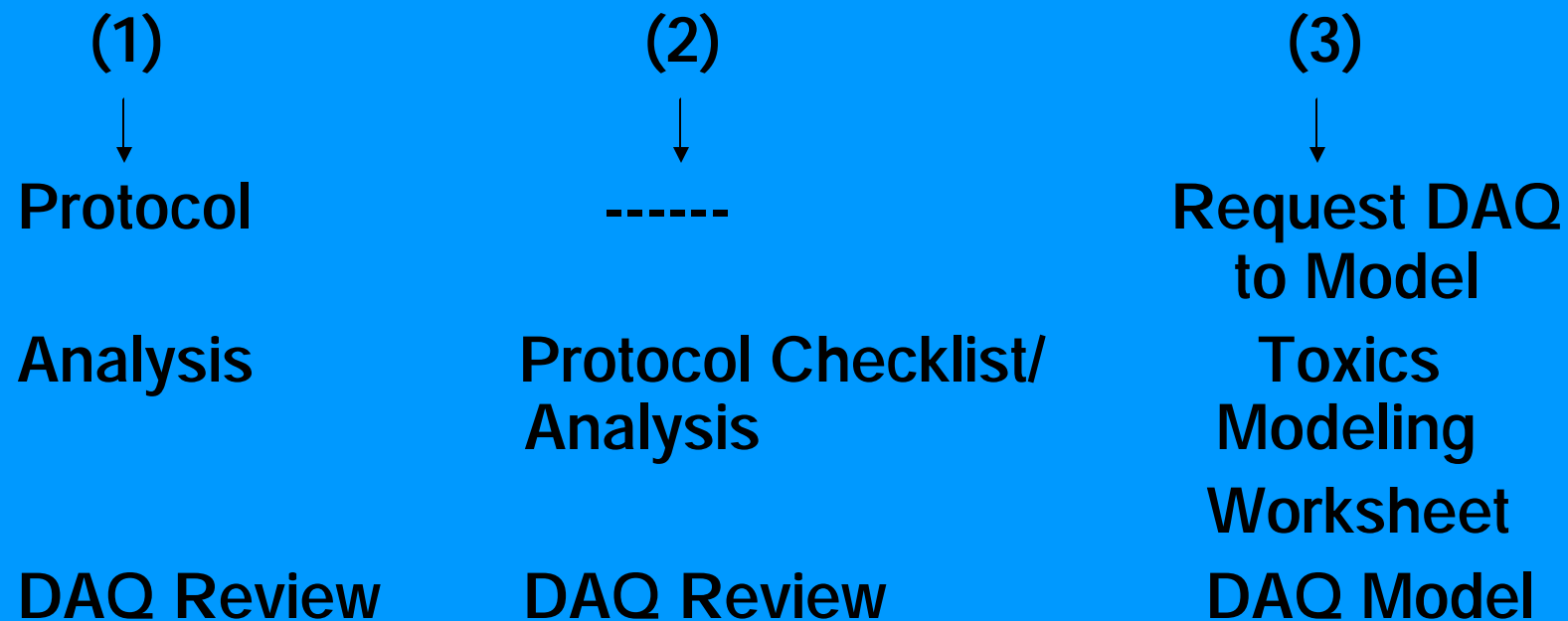
AAL (2D .1104)

<u>Pollutant</u>	<u>Annual</u>	<u>24-Hr</u>	<u>1-Hr</u>	<u>1-Hr</u> (mg/m <sup>3</sup> )
Arsenic	2.3E-7			
Styrene			10.6	
MEK		3.7		88.5



## Toxics Modeling Requirements

### Modeling Approach





## Toxics Modeling Requirements

### Modeling Protocol

Air quality analysis plan which provides an introduction defining project specifics and discusses the modeling methodology, data, and assumptions to be used in the modeling analysis.



# **Toxics Modeling Requirements**

## **Modeling Protocol**

**Introduction**

**Site diagram**

**Topography**

**Model Selection**

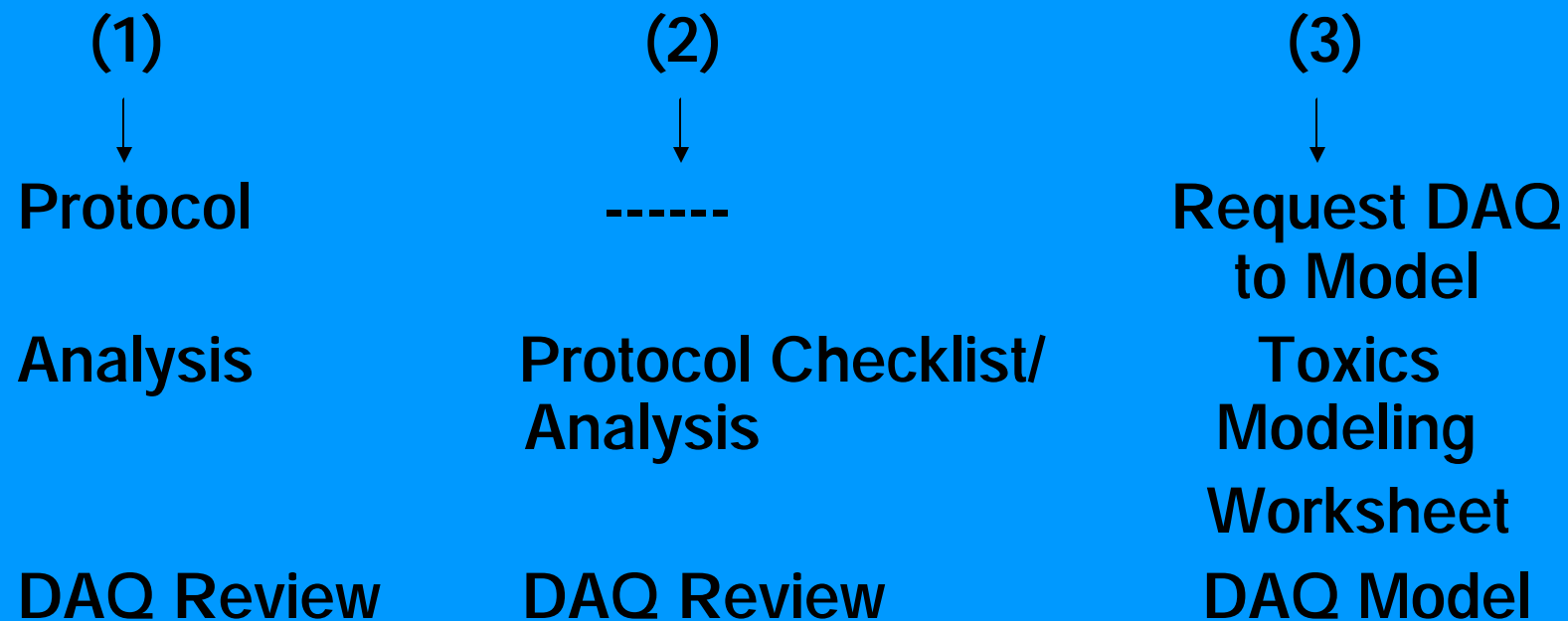
**Meteorology**

**Modeling methodology**



## Toxics Modeling Requirements

### Modeling Approach





## Toxics Modeling Requirements

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### Modeling Protocol Checklist

The modeling protocol checklist is used in lieu of developing the traditional written modeling plan and is designed to provide the same level of information as requested in a modeling plan.



## Toxics Modeling Requirements

### Modeling Protocol Checklist

#### Facility Information

#### General Modeling

#### Screen Level Modeling

#### Refined Level Modeling

# Modeling Protocol Checklist

## North Carolina Modeling Protocol Checklist

The North Carolina Modeling Protocol Checklist may be used in lieu of developing the traditional written modeling plan for North Carolina toxics and criteria pollutant modeling. The protocol checklist is designed to provide the same level of information as requested in a modeling protocol as discussed in chapter 3 of the *Guideline for Evaluating the Air Quality Impacts of Toxic Pollutants in North Carolina*. The modeling protocol checklist is submitted with the modeling analysis.

Although most of the information requested in the modeling protocol checklist is self explanatory, additional comments are provided, where applicable, and are discussed in greater detail in the toxics modeling guidelines referenced above. References to sections, tables, figures, appendices, etc., in the protocol checklist are found in the toxics modeling guidelines.

**INSTRUCTIONS:** The modeling report supporting the compliance demonstration should include most of the information listed below. As appropriate, answer the following questions or indicate by check mark the information provided or action taken is reflected in your report.

FACILITY INFORMATION	
<b>Name / Address:</b>	<b>Consultant (if applicable):</b>
<b>Contact Name:</b>	<b>Contact Name:</b>
<b>Phone Number:</b>	<b>Phone Number:</b>

# Modeling Protocol Checklist

## GENERAL

<p><b>Description of New Source or Source / Process Modification:</b> provide a short description of the new or modified source(s) and a brief discussion of how this change affects facility production or process operation.</p>	
<p><b>Source / Pollutant Identification:</b> provide a table of the affected pollutants, by source, which identifies the source type (point, area, or volume), maximum pollutant emission rates over the applicable averaging period(s), and, for point sources, indicate if the stack is capped or non-vertical (C/N).</p>	
<p><b>Pollutant Emission Rate Calculations:</b> indicate how the pollutant emission rates were derived (e.g., AP-42, mass balance, etc.) and where applicable, provide the calculations.</p>	
<p><b>Site / Facility Diagram:</b> provide a diagram or drawing showing the location of all existing and proposed emission sources, buildings or structures, public right-of-ways, and the facility property (toxics) / fence line (criteria pollutants) boundaries. The diagram should also include a scale, true north indicator, and the UTM or latitude/longitude of at least one point.</p>	
<p><b>Certified Plat or Signed Survey:</b> a certified plat (map) from the County Register of Deeds or a signed survey must be submitted to validate property boundaries modeled.</p>	
<p><b>Topographic Map:</b> if any terrain within 5 kilometers of the facility is greater than the stack base of any source modeled, a topographic map must be submitted.</p>	
<p><b>Cavity Impact Analysis:</b> a cavity impact analysis must be conducted for all buildings or structures with a region of influence extending to one or more sources modeled to determine if cavity regions extend off property (toxics) or beyond the fence line (criteria pollutants). <i>See section 5.1</i></p>	

# Modeling Protocol Checklist

## GENERAL (continued)

**Background Concentrations** (criteria pollutant analyses only): background concentrations must be determined for each pollutant for each averaging period evaluated. The averaged background value used (e.g., high, high-second-high, high-third-high, etc.) is based on the pollutant and averaging period evaluated. The background concentrations are added to the modeled concentrations, which are then compared to the applicable air quality standard to determine compliance.

**Offsite Source Inventories** (criteria pollutant analyses only): offsite source inventories must be developed and modeled for all pollutants for which onsite sources emissions are modeled in excess of the specific pollutant significant impact levels (SILs). The DAQ AQAB must approve the inventories. **NOTE:** offsite source inventories are not required for pollutants whose onsite source emissions are modeled below the significant impact levels (SILs). The SILs are defined in the PSD New Source Review Workshop Manual.

## SCREEN LEVEL MODELING

**Model:** the latest version of the SCREEN3 model or ISCST3 (screening mode) model must be used. *See DAQ/AQAB web page.* The use of other screening models should be approved by NCDAQ prior to submitting the modeling report.

**Source / Source emission parameters:** provide a table listing the sources modeled and the applicable source emission parameters. *See NC Form 3 – appendix B.*

**Merged Sources:** identify merged sources and show all appropriate calculations. *See section 4.4*

# Modeling Protocol Checklist

<p><b>GEP Analysis:</b> SCREEN3 – for each source modeled, show all calculations identifying the critical structure used in the model run. <i>See section 4.3 and NC Form 1 - appendix B.</i> ISCST3 – use the EPA BPIP program to determine point source direction specific building dimensions.</p>	
<p><b>Cavity Impact Analysis:</b> for each source or group of sources modeled, a cavity impact analysis must be conducted to evaluate critical structure cavity impacts. <i>See section 5.1</i></p>	
<p><b>Terrain:</b> indicate the terrain modeled: simple (<i>section 5.2</i>), intermediate (<i>section 5.3</i>), complex (<i>section 5.3 and NC Form 5 – appendix B</i>). If complex terrain is within 5 kilometers of the facility, intermediate and complex terrain must be evaluated. Simple terrain must include terrain elevations if any terrain is greater than the stack base of any source modeled.</p> <p style="text-align: center;">Simple: _____                      Intermediate: _____                      Complex: _____</p>	
<p><b>Meteorology:</b> SCREEN3 – select full meteorology; ISCST3 - use SCREEN3 meteorology (<i>See Table 5-2</i>).</p>	
<p><b>Receptors:</b> SCREEN3 – use shortest distance to property boundary for each source modeled and use sufficient range to find maximum (<i>See section 5.2.1. (i) and (j)</i>); ISCST3 - use property boundary and Cartesian (rectangular) receptors with sufficient number and resolution (100 meters or less) to find maximum (<i>See section 5.2.2.3</i>). Terrain must be evaluated.</p>	
<p><b>Modeling Results:</b> for each affected pollutant, modeling results should be summarized, converted to the applicable averaging period (<i>see Table 5-1</i>), and presented in tabular format indicating compliance status with the applicable AAL, SIL or NAAQS. <i>See NC Form S6/R6 – appendix B.</i></p>	
<p><b>Modeling Files:</b> the following modeling files should be submitted on diskette: SCREEN3 – output; ISCST3 - input, output, BPIP (if applicable).</p>	

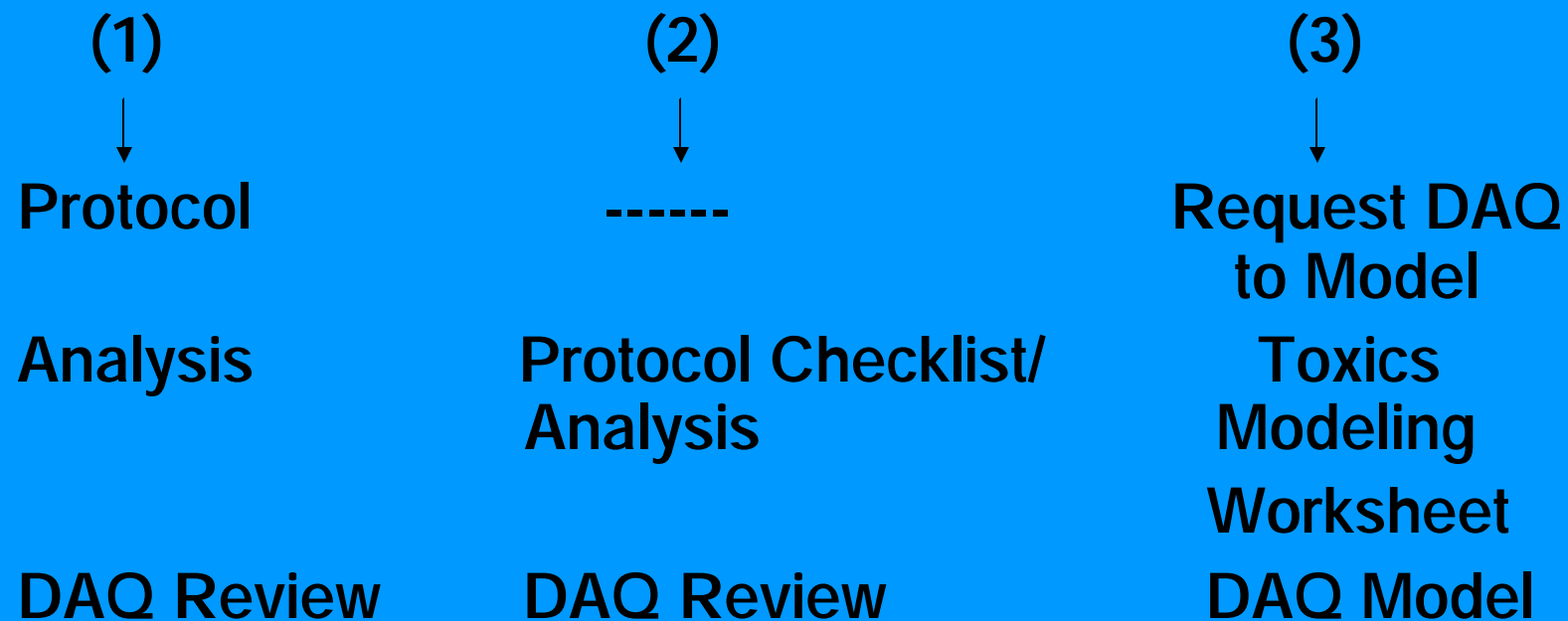
## REFINED LEVEL MODELING

<p><b>Model:</b> the latest version of the ISCST3 model should be used. <i>See DAQ/AQAB web page.</i> The use of other refined models should be approved by NCDQA prior to submitting the modeling report.</p>	
<p><b>Source / Source emission parameters:</b> provide a table listing the sources modeled and the applicable source emission parameters. <i>See NC Form 3 - appendix B.</i></p>	
<p><b>GEP Analysis:</b> ISCST3 - use the EPA BPIP program to determine point source direction specific building dimensions.</p>	
<p><b>Cavity Impact Analysis:</b> for each source or group of sources modeled, a cavity impact analysis must be conducted to evaluate critical structure cavity impacts. <i>See section 5.1 and section 6.1.</i></p>	
<p><b>Terrain:</b> if any terrain within 5 kilometers of the facility is greater than the stack base of any source modeled, the ISCST3 model should be run in the all terrain mode.</p>	
<p><b>Receptors:</b> The receptor grid should be of sufficient size and resolution to identify the maximum pollutant impact. <i>See section 6.4.</i> If any terrain within 3 miles of the facility is greater than 50% of the shortest non-fugitive stack height, receptor elevation must be used.</p>	
<p><b>Meteorology:</b> indicate the 5 year data set used in the modeling demonstration:  <i>(See section 6.5 and Table 4-2)</i>          For NC toxics, the modeling demonstration requires only the last year of the standard 5 year data set (e.g., 1991) provided the maximum impacts are less than 50% of the applicable AAL(s).  <i>Note: if maximum impacts are in complex terrain, onsite meteorological data may be required – contact DAQ/AQAB for details.</i></p>	
<p><b>Modeling Results:</b> for each affected pollutant and averaging period, modeling results should be summarized and presented in tabular format indicating compliance status with the applicable AAL, SIL or NAAQS. <i>See NC Form S6/R6 - appendix B.</i></p>	
<p><b>Modeling Files:</b> the following modeling files should be submitted on diskette: ISCST3 - input, output, &amp; DDID</p>	



## Toxics Modeling Requirements

### Modeling Approach





## Toxics Modeling Requirements

### Toxics Modeling Worksheet (D3)

The modeling worksheet is used to provide the AQAB modelers with the necessary information to conduct an initial modeling evaluation of facility toxics emissions.



# **Toxics Modeling Requirements**

## **Toxics Modeling Worksheet (D3)**

**Introduction**

**Emissions Data**

**Source Data**

**Site Data**

**Building Data**

**Misc Data**

# Modeling Request

## FORM D3 MODELING REQUEST FORMS (3 pages)

REVISED: 02/20/03

NCDENR/Division of Air Quality - Application for Air Permit to Construct/Operate

D3

If the applicant desires, the NCDAQ/AQAB will perform the initial modeling compliance demonstration using EPA approved screening and, if applicable and where possible, refined models. If the model results indicate the facility will be unable to demonstrate compliance with applicable Acceptable Ambient Level(s) the applicant will be notified and will be required to perform the compliance demonstration using established modeling protocol and modeling analysis requirements as defined in the North Carolina Administrative Code 15A NCAC 2D .1100 and 2Q .0700 and in the Guidelines for Evaluating the Impacts of Toxic Pollutants in North Carolina.

To perform the dispersion modeling compliance demonstration, the AQAB will require the following data:

### 1. INTRODUCTION

Provide a brief description of the modification and/or addition necessitating the toxic modeling request:



# Modeling Request

3. SOURCE DATA		Source data requirements are based on the appropriate source classification. Each emission source is classified as a point, area, or volume source. Note: For fugitive area or volume source data, contact DAQ/AQAB.					
<b>POINT SOURCE</b>		<b>STACK DATA</b>					
Emission Point ID							
Stack Description							
Stack Height (ft or m) - AGL							
Stack Temperature (°F or °K)							
Stack Exit Velocity (ft/s or m/s)							
Stack Diameter (ft or m)							
Stack Base Elevation (ft) - MSL							
Stack UTM Coordinates (m)		E					
NAD version 27 / 83 (circle one)		N					
Zone							
OR							
Latitude		°N					
Longitude		°W					
Rain Cap? (Y/N)							
Vertical Stack? (Y/N)							
<b>AREA SOURCE</b> (contact DAQ for clarification of input data requirements)		<b>AREA SOURCE DATA</b> (for each area source, submit a separate detailed description of the area source, to include dimensions of the area and elevations. Also include source on site map.)					
Emission Point ID							
Source Description							
Area Source Height (ft or m) - AGL							
Area Source Length (ft or m)							
Area Source Width (ft or m)							
Source Base Elevation (ft) - MSL							
Area Source UTM Coordinates (m)		E					

# Modeling Request

VOLUME SOURCE (contact DAQ for clarification of input data requirements)		VOLUME SOURCE DATA (for each volume source, submit a separate detailed description of the volume source, to include dimensions of the volume source where emissions begin to disperse.)				
Emission Point ID						
Source Description						
Volume Source Height (ft or m) - AGL						
Volume Source Length (ft or m)						
Volume Source Bldg Height (ft or m)						
Source base Elevation (ft) - MSL						
Volume Source UTM Coordinates (m)	E					
NAD version 27 / 83 (circle one)	N					
	Zone					
<input type="checkbox"/> OR <input type="checkbox"/>						
Latitude	°N					
Longitude	°W					
ft- feet	AGL- Above Ground level	m/s- meters per second	Kelvin (degrees)=273+((°F-32) x 5/9)			
m- meters	UTM- Universal Transverse Mercator	MSL- Mean Sea Level				

# Modeling Request

## 4. SITE DATA

A detailed site diagram must be submitted and should include all of the information listed below:

- Property boundaries
- Scale and true north indicator
- All existing and proposed buildings or structures on site
- Locations of all emission sources (existing and proposed) listed in Section 2, Page 1 of Form D3
- All public rights-of-way traversing the property ( e.g. roads, railroad tracks, rivers, etc.)
- UTM coordinates or latitude/longitude of at least one point (e.g. source or building corner)

A USGS Contour Map must also be submitted with the location of your facility clearly designated.

A certified plat map from County Register of Deeds or a signed survey map.

## 5. BUILDING DATA

List each building. List tiers of different heights on a single building as separate buildings.

Building ID						
Building Description						
Building Height (ft or m)						
Building Length (ft or m)						
Building Width (ft or m)						

# Modeling Request

## 6. MISCELLANEOUS DATA

Facility Operating Limits  
(Operating hours, fuel limits,  
or other enforceable limits)

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If an operating schedule is not given, continuous operations will be assumed (i.e. 24 hours/day, 8760 hours/year).

Note: if compliance is demonstrated using the above facility operating limits, these limits will be imposed as a permit restriction.

**Facility Point of Contact  
(required)**

Name: \_\_\_\_\_

Title: \_\_\_\_\_

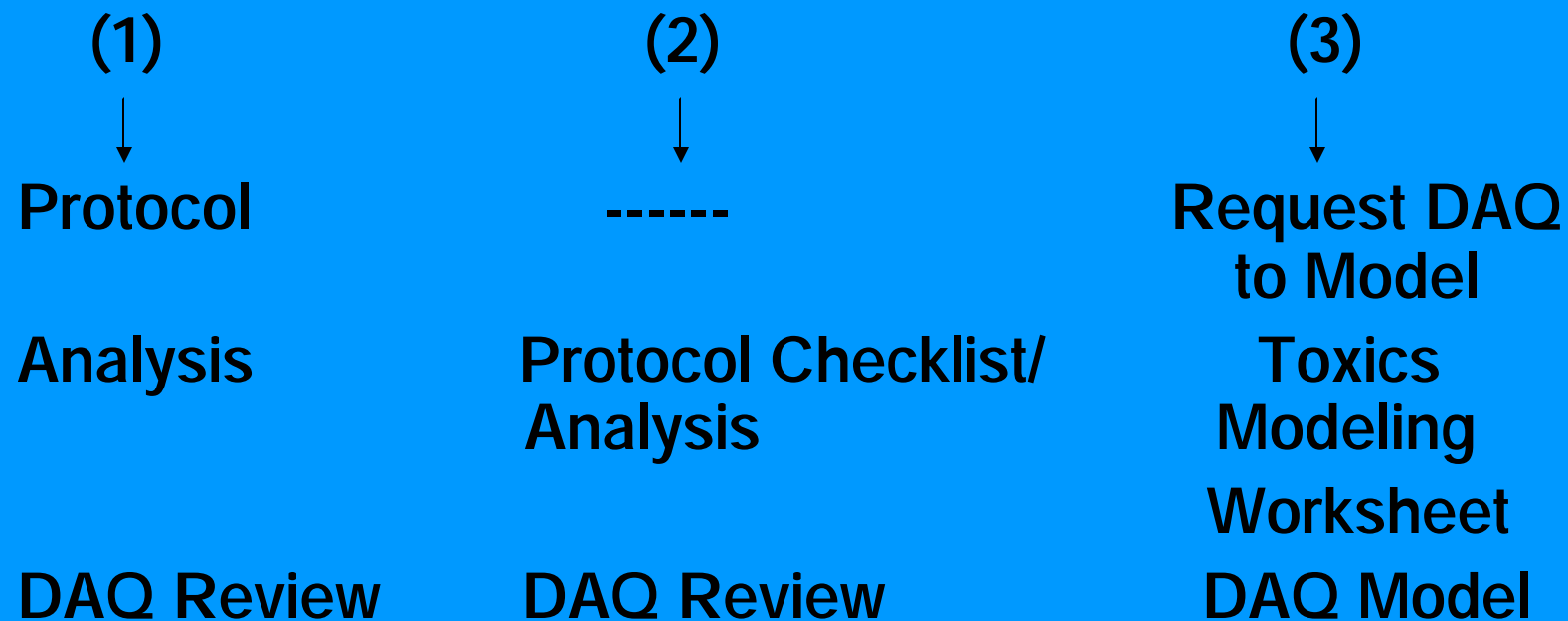
Phone: \_\_\_\_\_

Email Address: \_\_\_\_\_



## Toxics Modeling Requirements

### Modeling Approach





## Dispersion Models

### Which One to Use?

- Pollutants
- Emission Sources
- Meteorology / Geography (Topography)
- Long Range or Near Field
- Scope: Simple (Screen) or Complex (Refined)



## Dispersion Models

### EPA Preferred Models

- **Guideline on Air Quality Models: Appendix A to Appendix W of Part 51, 49 CFR Part 51**
- **Scientific Peer / Public Review**
  - scientific merit
  - model accuracy
  - practicality
  - resource constraints



## Dispersion Models

### EPA Alternative Models

- Case-By-Case Basis: e.g., no preferred model available or statistical evaluation given to demonstrate alternative model superiority
- Some but not all : Scientific peer / public review process



## DISPERSION MODELS

### AQAB models

- SCREEN3 : recommended (screen)
- ISCST3 : preferred (refined)
- AERMOD: proposed (refined)
- CALPUFF: preferred (refined)



## MODELING LEVELS

- Screen Level Modeling
- Refined Level Modeling



## Dispersion Models – Screen Level

### SCREEN3

- Preliminary or conservative estimate
- Single source / “small” facility applicability
- Simplified Use
  - minimal data input requirements
  - minimal computer resources
  - minimal user model familiarity
- Screening (Worst case) meteorology
- Conservative modeling methodology



## Dispersion Models – Refined Level

### ISCST3 / AERMOD / CALPUFF

- More accurate / less conservative estimate
- Multiple source / “large” facility applicability
- Complex
  - greater data input requirements
  - greater computer resources
  - greater user model familiarity
- Actual hourly meteorology
- More Representative modeling methodology



***THE END***