Air Dispersion Modeling

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Why Model?

- Identify impacts from the construction or modification of facilities that are seeking a permit to install/operate air emission sources.
- AQD Policy and Procedure AQD-22 (March 3, 2015)

DEQ	AIR QUALITY DIVISION POLICY AND PROCEDURE		DEPARTMENT OF ENVIRONMENTAL QUALITY
Original Effective Date: March 3, 2015 Revised Date: NA Reformatted Date: NA	Subject: Dispersion Modeling Guidance for Federally Regulated Pollutants Program Name: Air Permits to Install		Category: ☐ Internal/Administrative ☒ External/Non-Interpretive ☐ External/Interpretive
	Number: AQD-22	Page 1 of 17	

A Department of Environmental Quality (DEQ) Policy and Procedure cannot establish regulatory requirements for parties outside of the DEQ. This document provides direction to the DEQ staff regarding the implementation of rules and laws administered by the DEQ. It is merely explanatory; does not affect the rights of, or procedures and practices available to, the public; and does not have the force and effect of law.

INTRODUCTION:

This policy and procedure discusses the federal and state statutory and regulation-based requirements to assure compliance with the National Ambient Air Quality Standards (NAAQS) and the Prevention of Significant Deterioration (PSD) increments during the review and evaluation of Permit to Install (PTI) applications. As part of the PTI application approval process, a determination that the project will not interfere with the NAAQS and the PSD increment must be made. This is true for both major sources and minor sources.

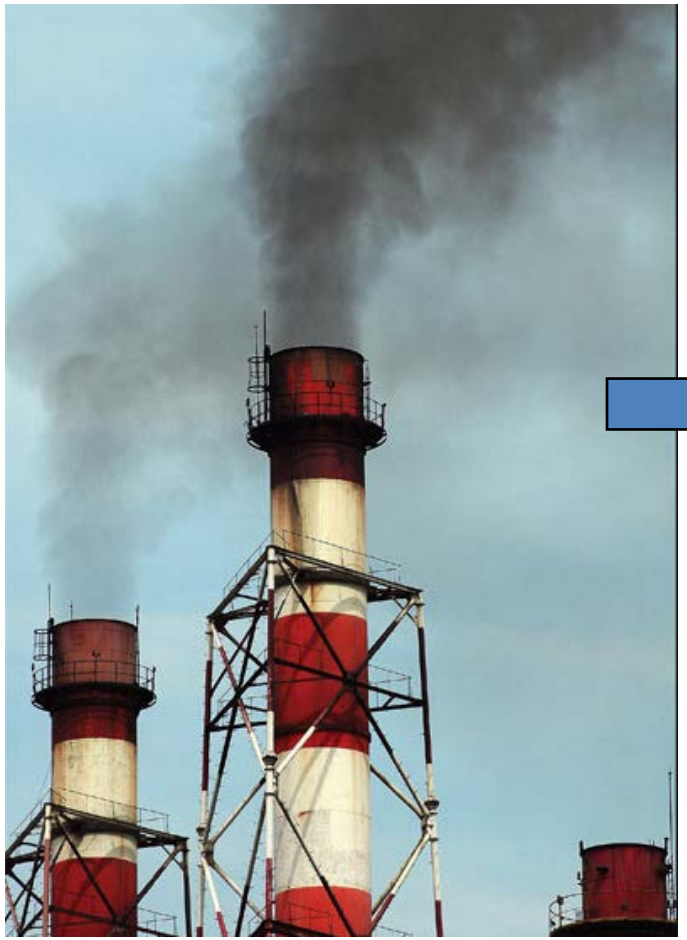
Major sources and major modifications at existing major sources in attainment areas are subject to PSD and are required to demonstrate that the project will not cause a violation of the NAAQS or PSD increment. This demonstration is done through dispersion modeling.

When to Model?

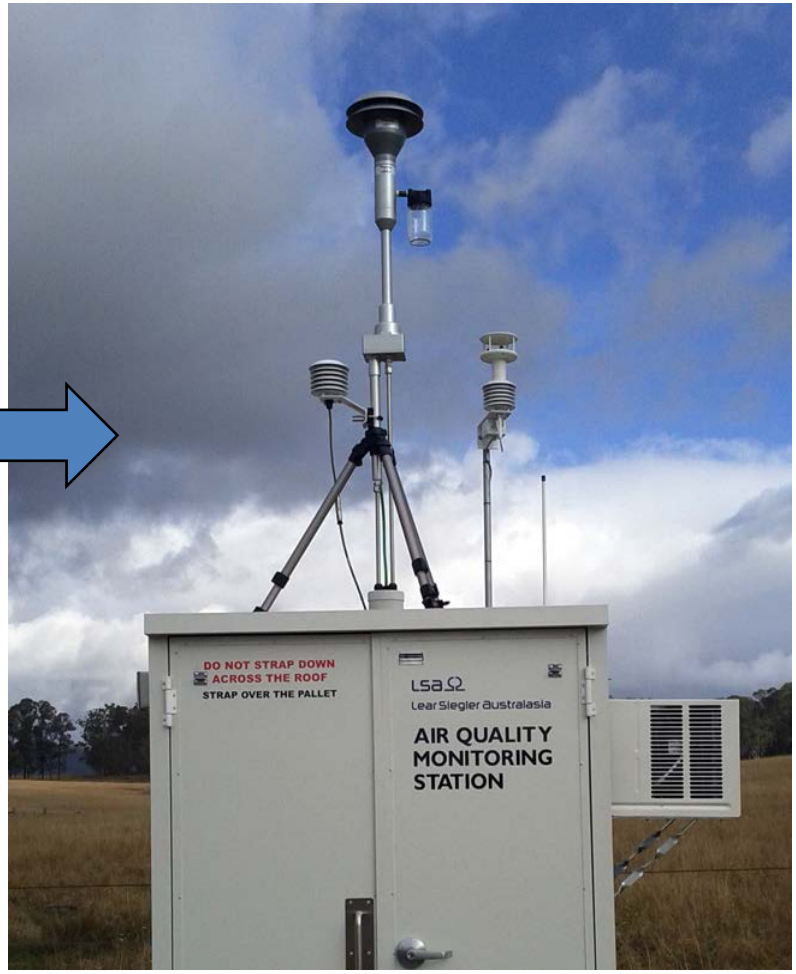
- You are a major **OR** minor source
- Emissions submitted do not demonstrate protection of Air Quality standards
- Examples:
  - Poor dispersion
  - Close proximity to sensitive groups
  - Potential existing problems in the area

What is modeling and how is it done?

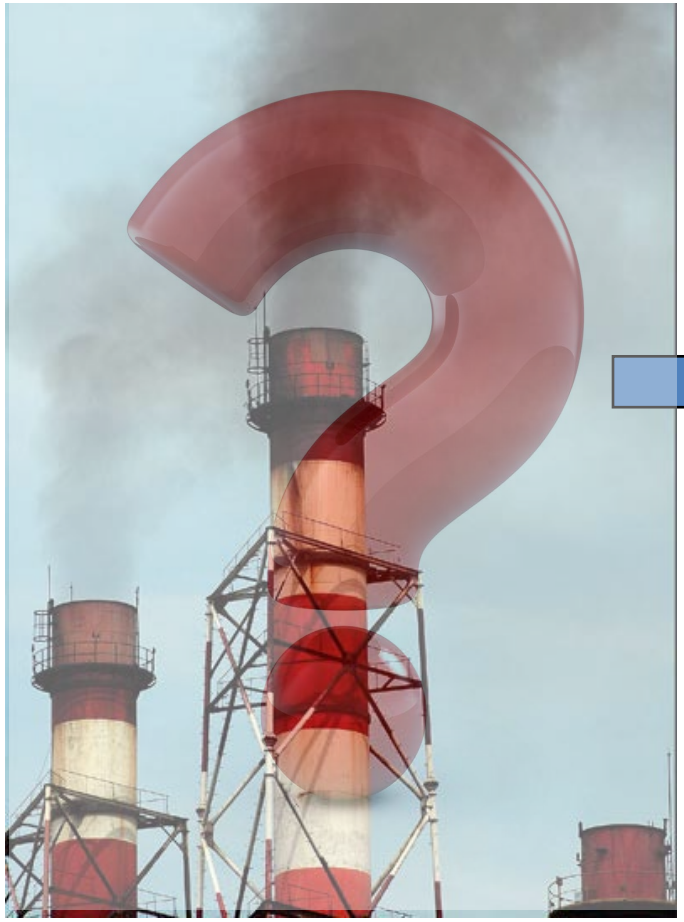
Mission: Determine Impacts from Emissions



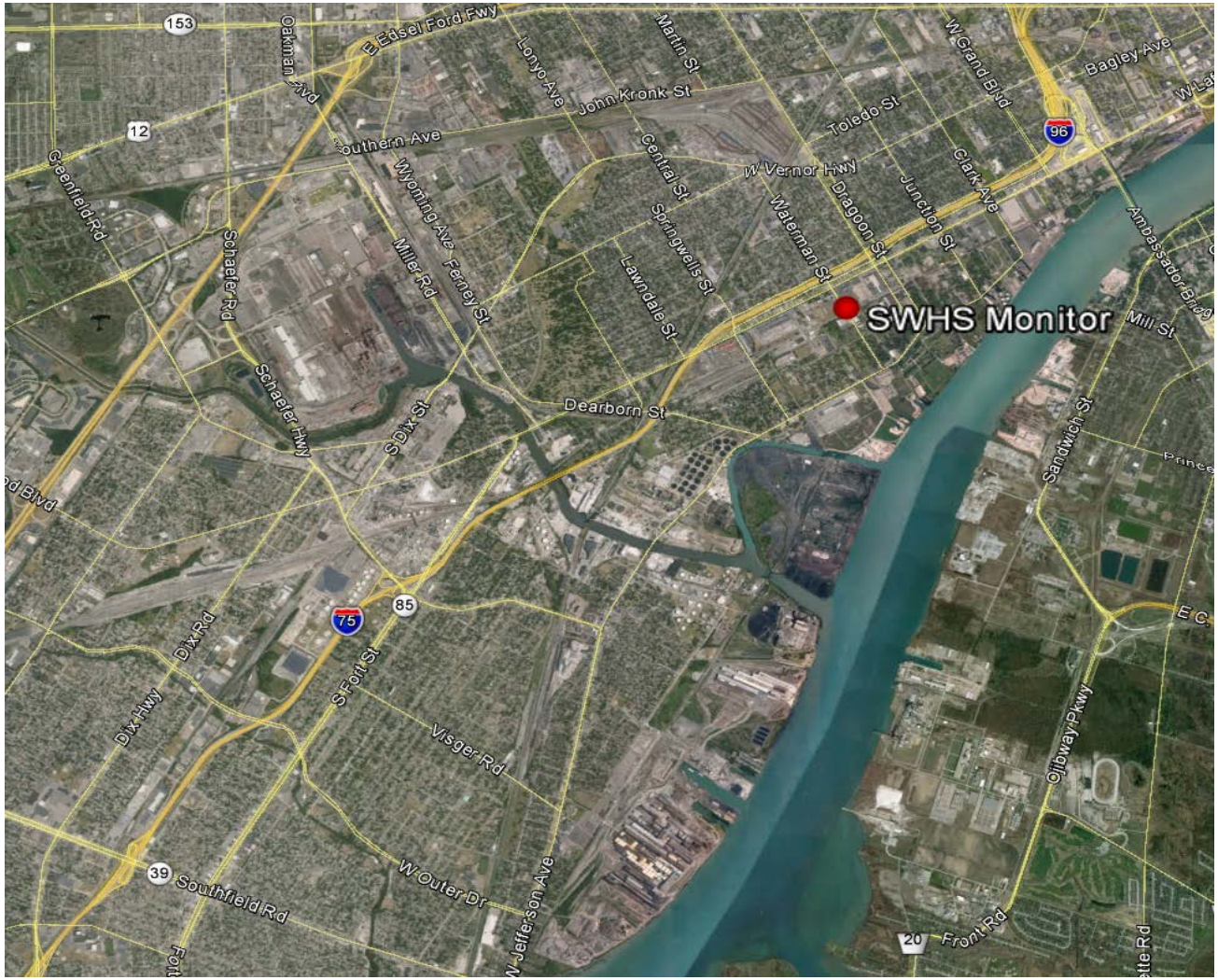
Measuring Impacts: Pre-Permit/Construction



Measuring Post-Permit Impacts: Where to Locate?



Monitor Impacts: Coverage



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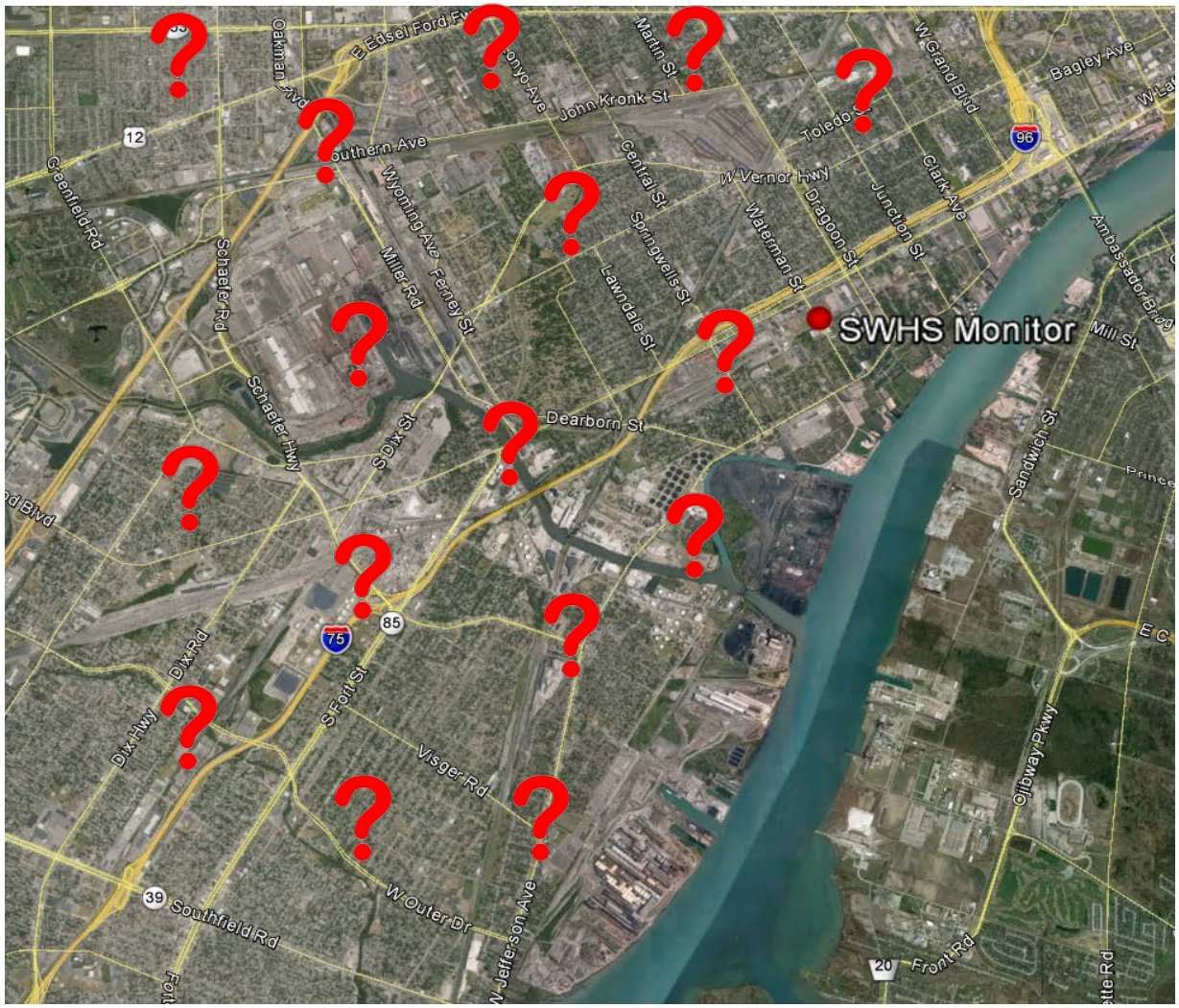
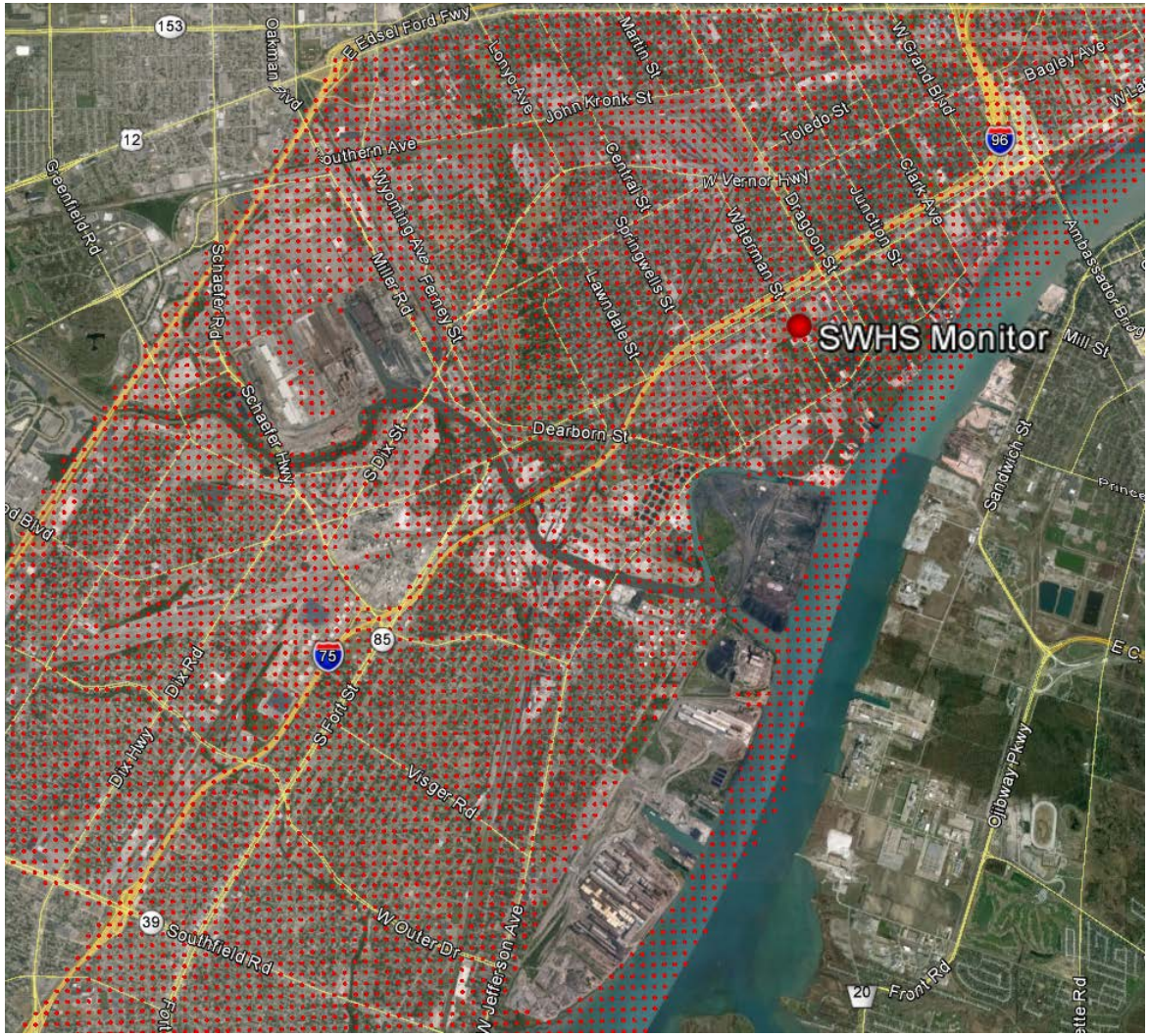


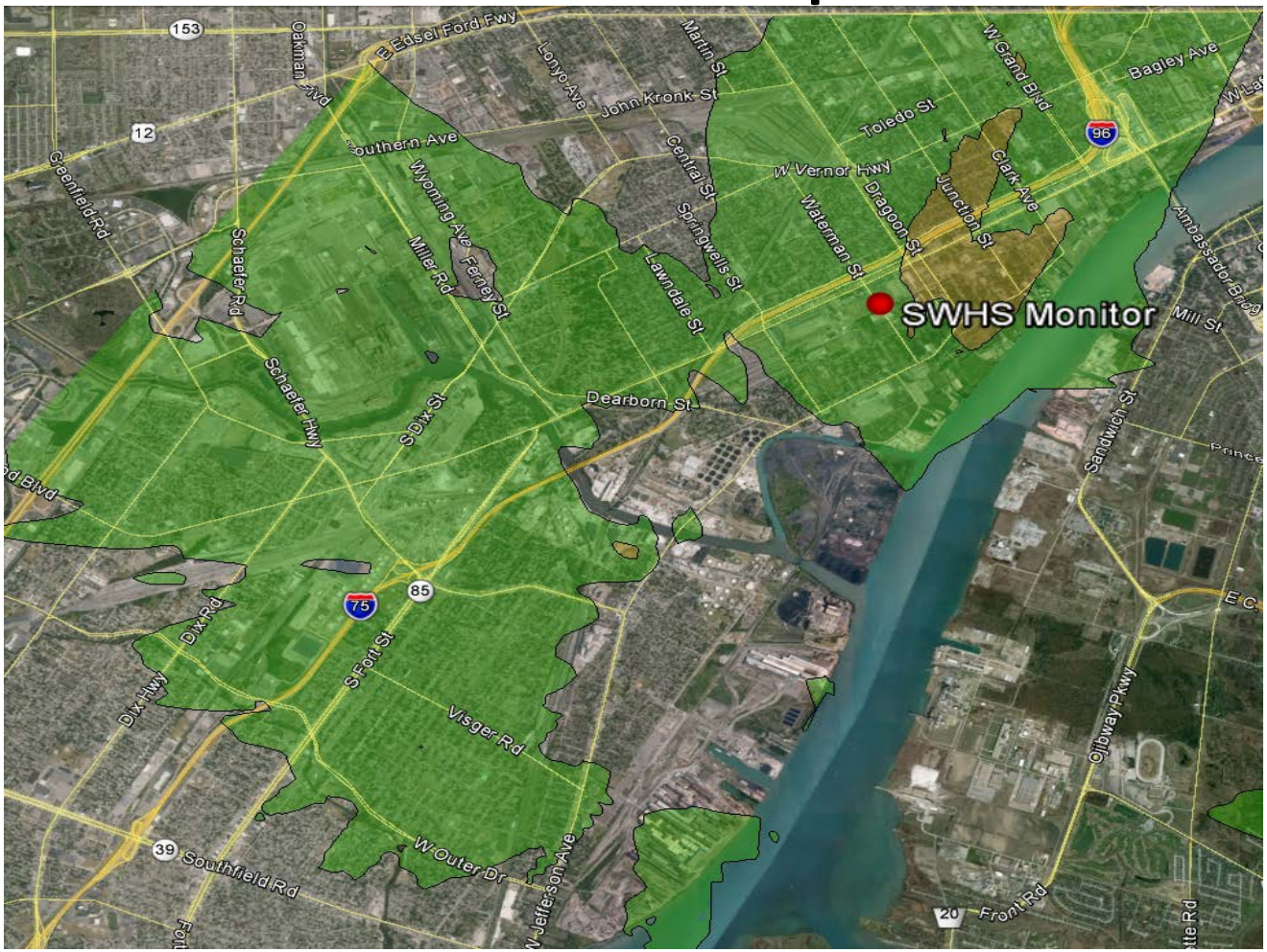
Can AQ Models Help With These Problems?

Air Quality Models are Computer Simulations of Pollutants in the Atmosphere

Virtual Monitors Over Entire Affected Area



Predicts Magnitude & Location of Maximum Impact



Basic Modeling Elements:

Stack Parameters

Meteorology

Building Wake Effects

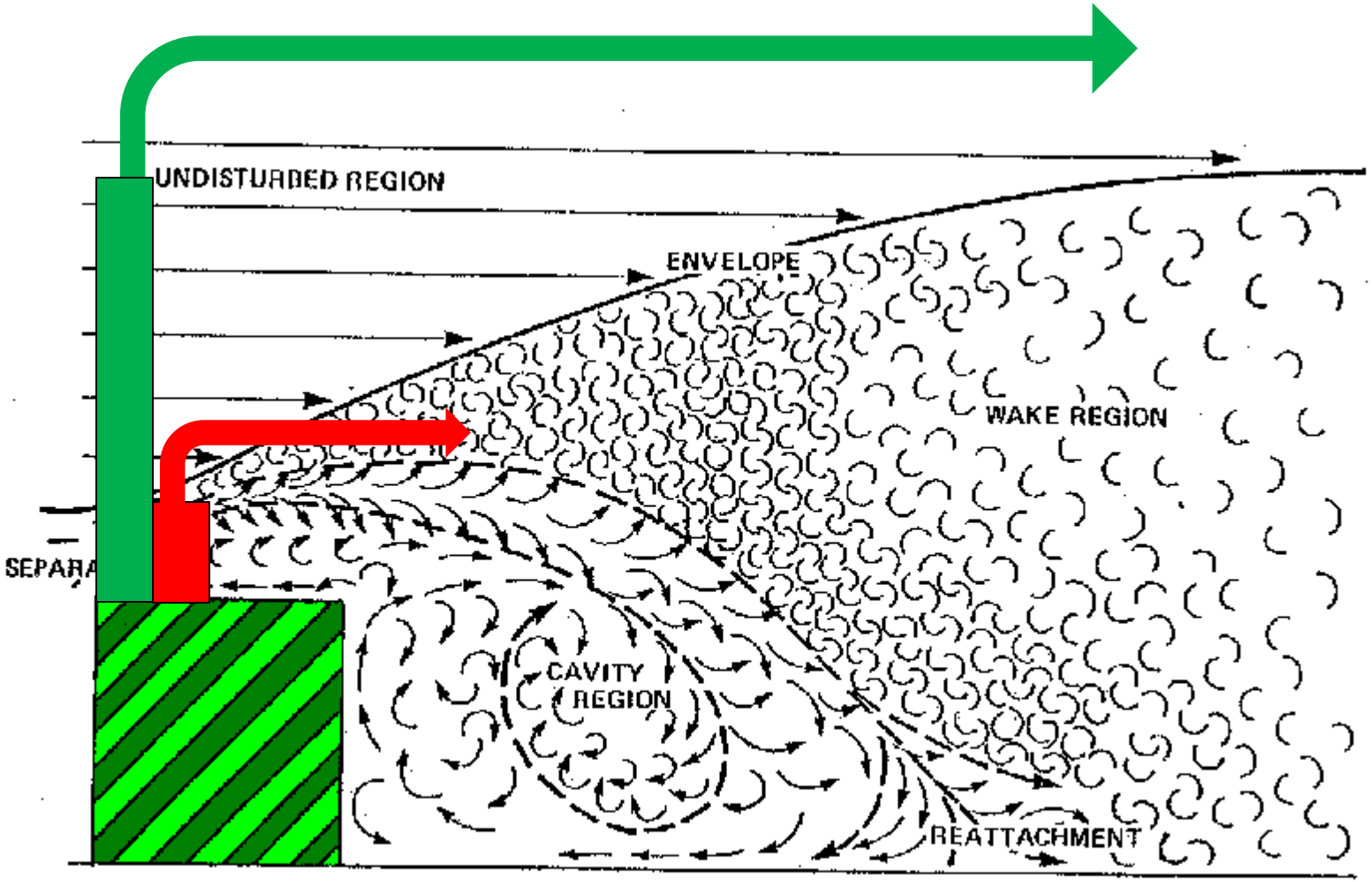
Terrain Features

Stack Parameters

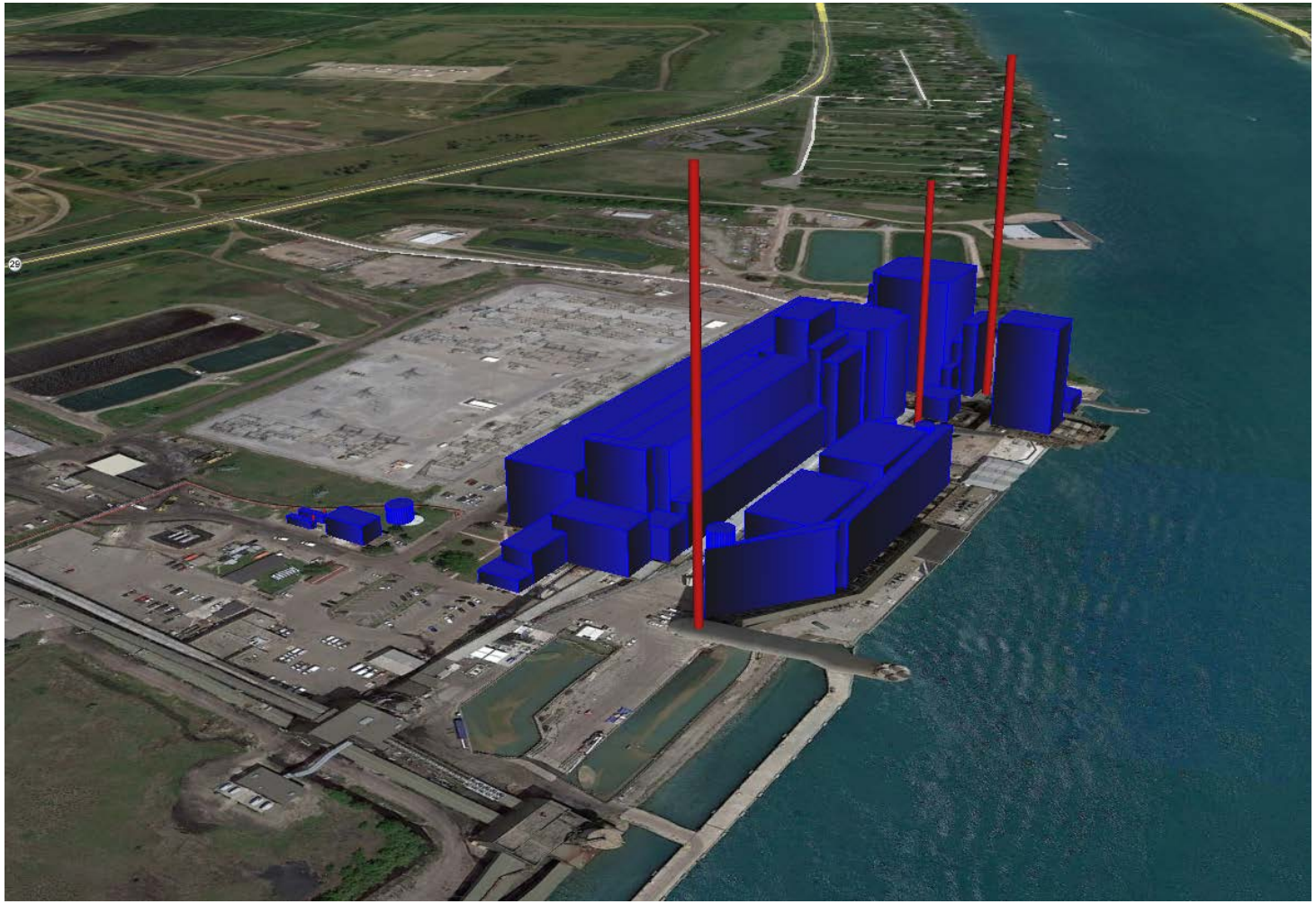
- Emission Rate
- Stack Height
- Temperature
- Flow Rate
- Stack Diameter
- Stack Orientation

Stack Orientation

Building Wake Effect



Building Wake Effect

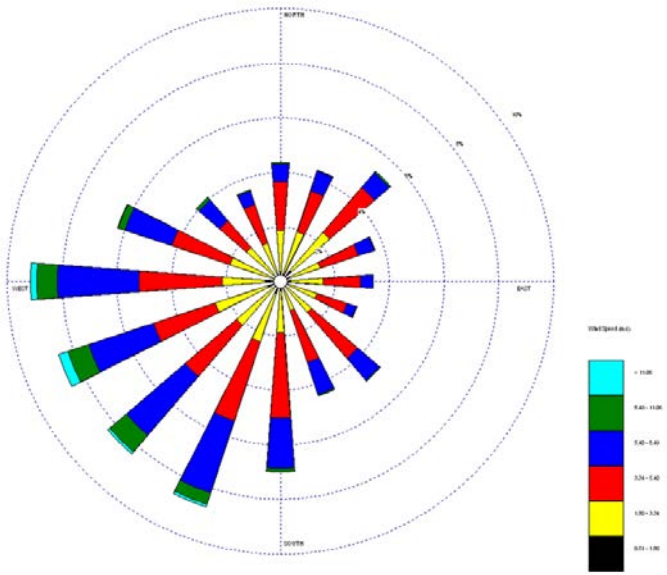


Meteorology

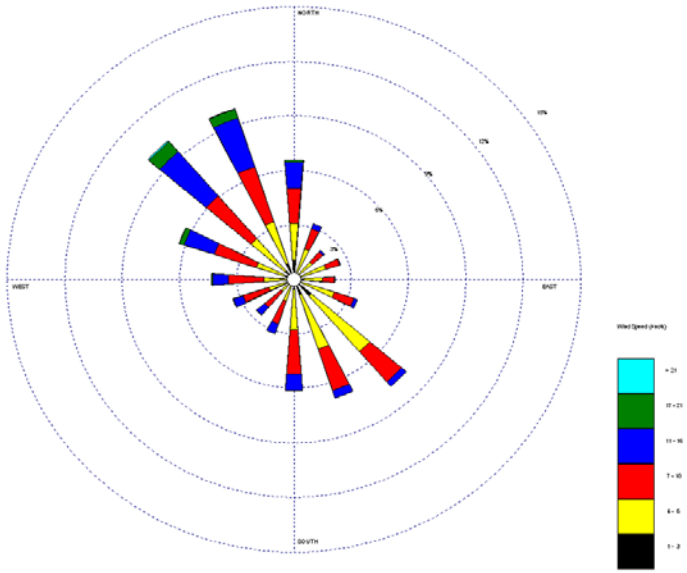
- Wind Speed
- Wind Direction
- Temperature
- Precipitation
- Upper Air Data
- Surface Features
- Representativeness

Meteorology Representativeness

Meteorology Representativeness



LANSING



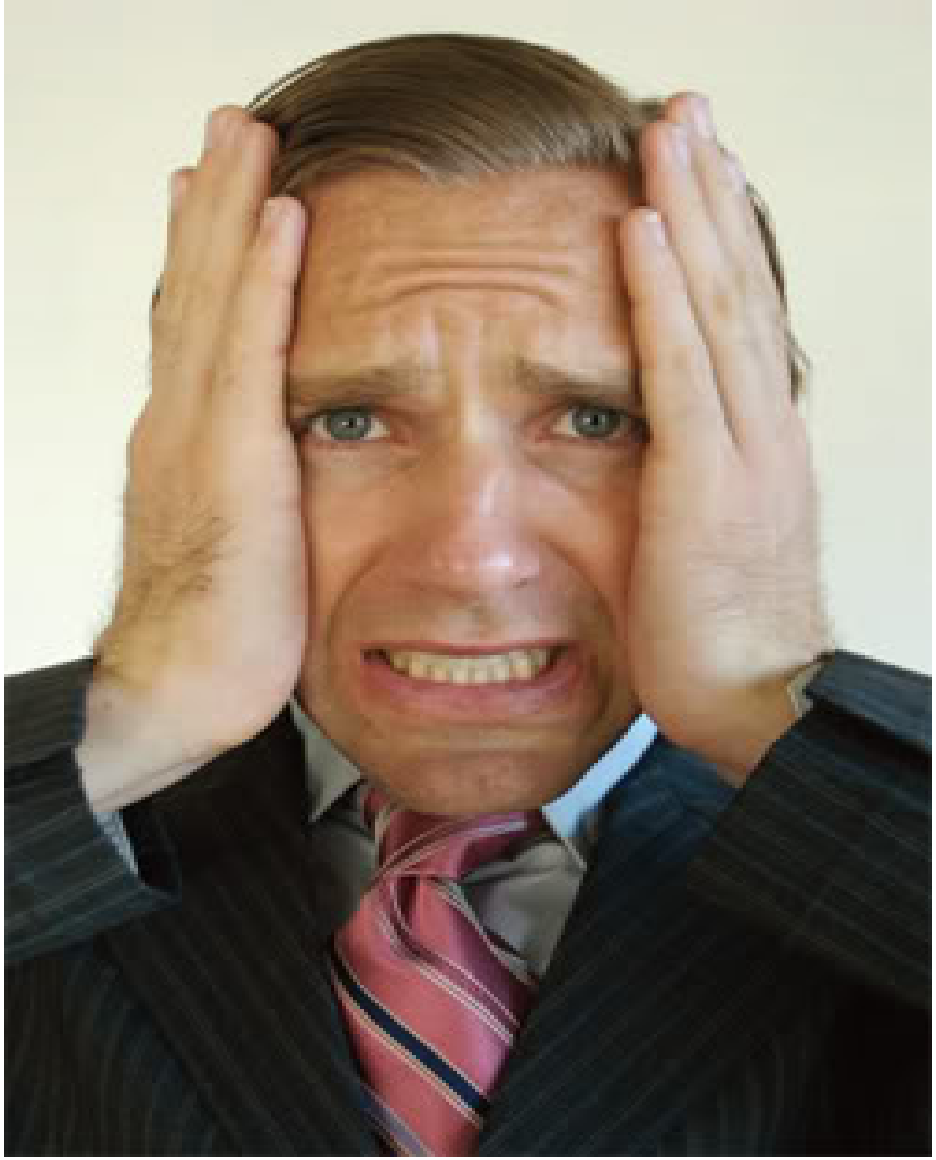
IRON MOUNTAIN

Wind Direction

Terrain Features

Terrain Features

There’s the Devil in the Details…



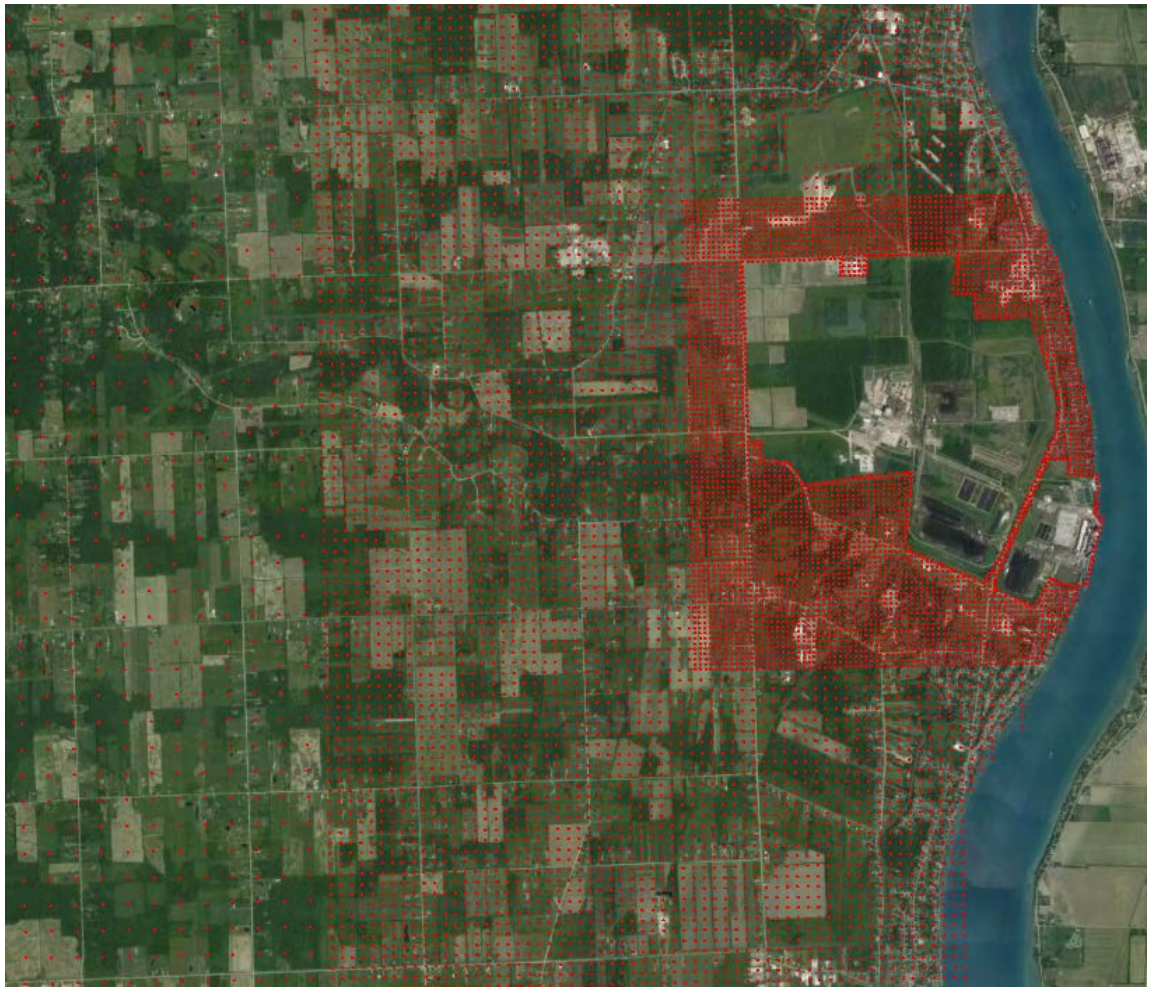
Other Considerations…

- Ambient Air
- Receptor spacing
- Fugitive Dust
- Secondary Pollutants
- Background Concentration
- Other Nearby Sources
- Additional Impacts

Ambient Air: Where do you model?

"the portion of the atmosphere, external to buildings, to which the public has general access"

Receptor (Virtual Monitors) Spacing



Area Coverage and Spacing Sufficient to Identify the Location and Magnitude of the Highest Ambient Impact

Receptor (Virtual Monitors) Spacing

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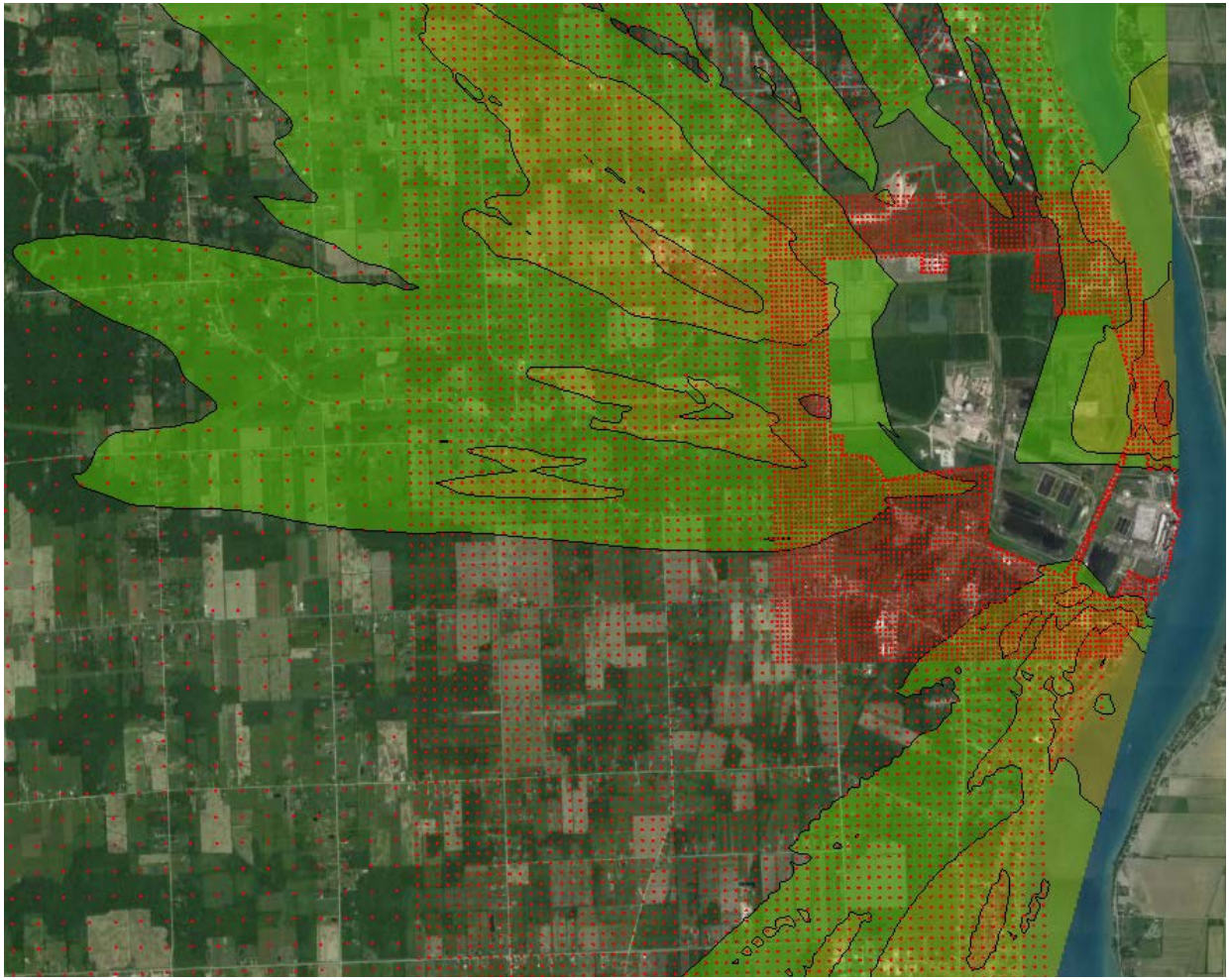
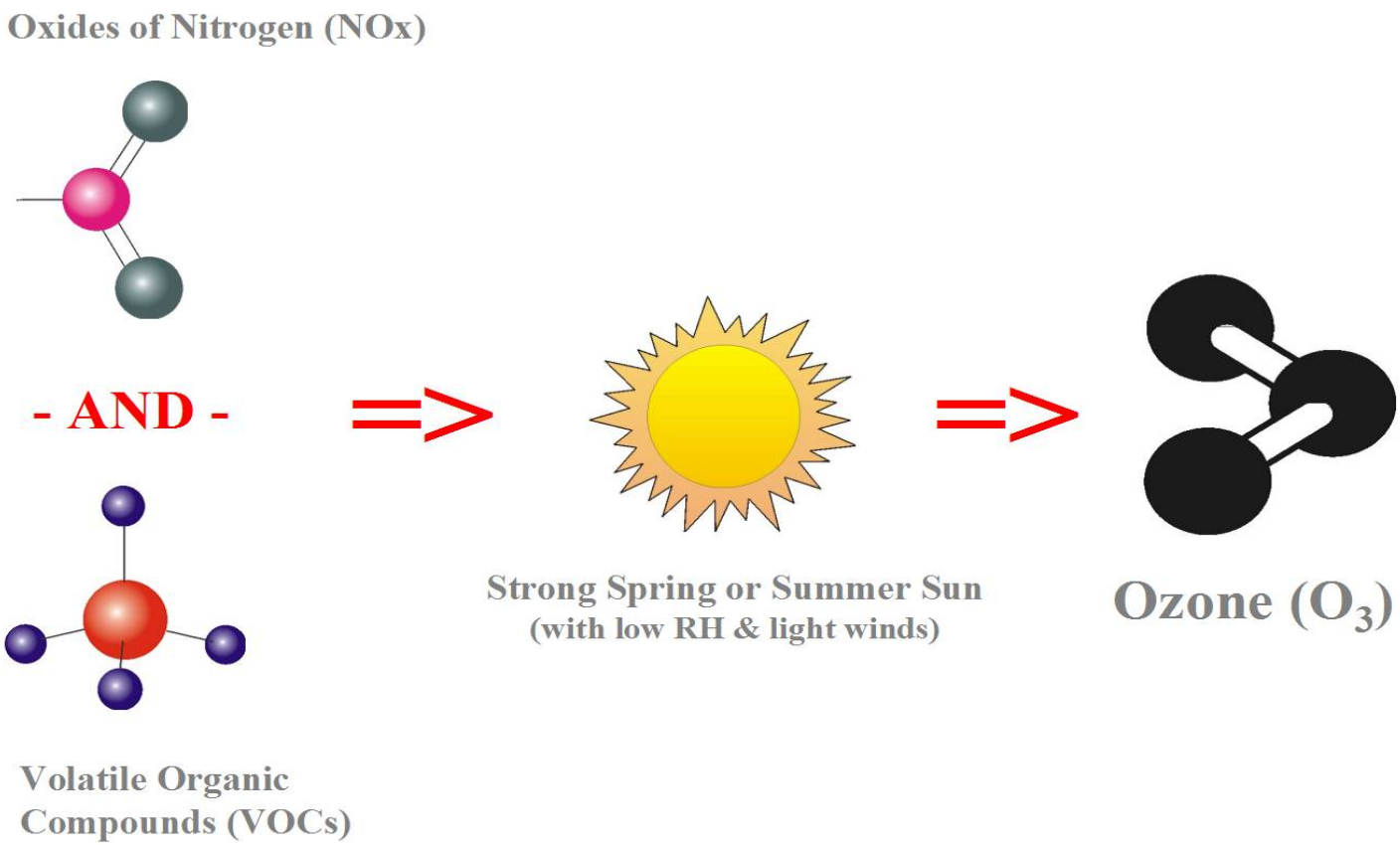


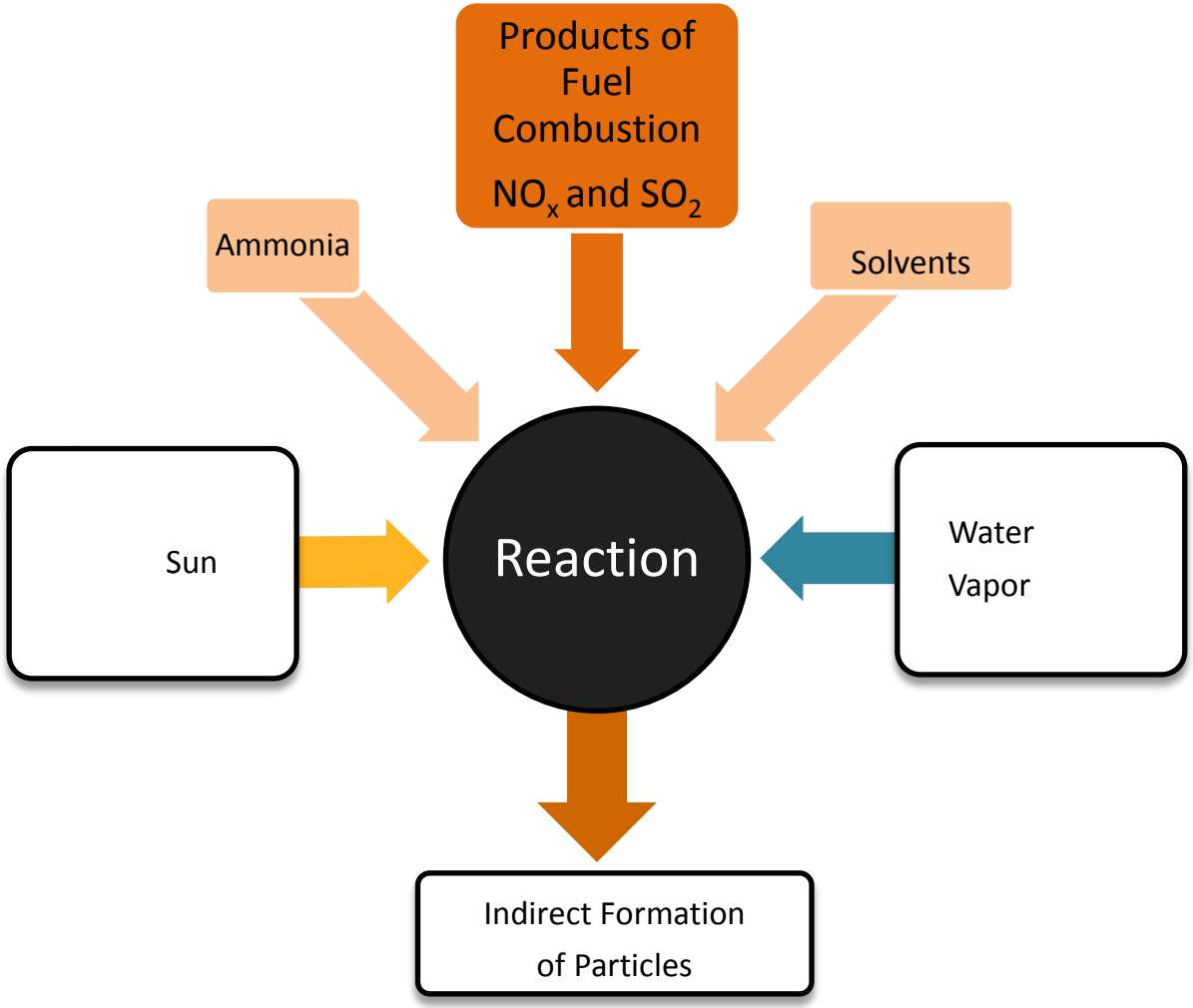
Fugitive Dust Modeling

Secondary Pollutants: O_3

Formation of Ground-level Ozone



Secondary Pollutants: $PM_{2.5}$



Total Ambient Impact

Total Impact is *Your* Proposed Process

Nearby Sources + Background

Additional Impacts

Soil Deposition

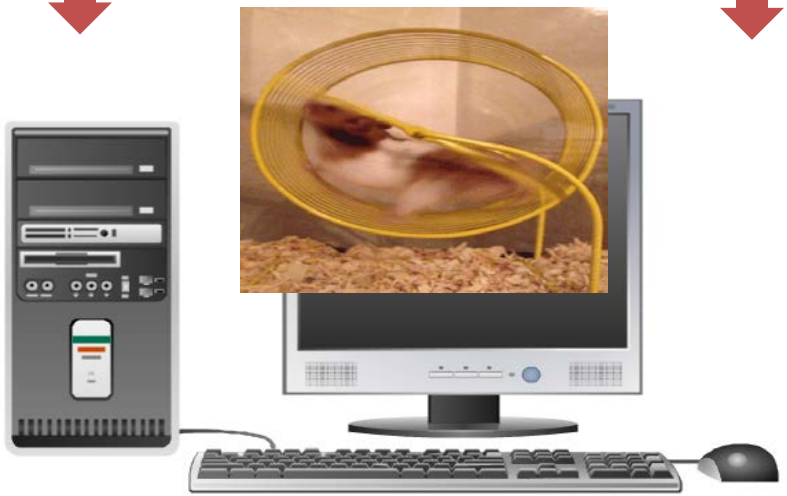
Vegetative Damage

Fogging and Icing

Odors

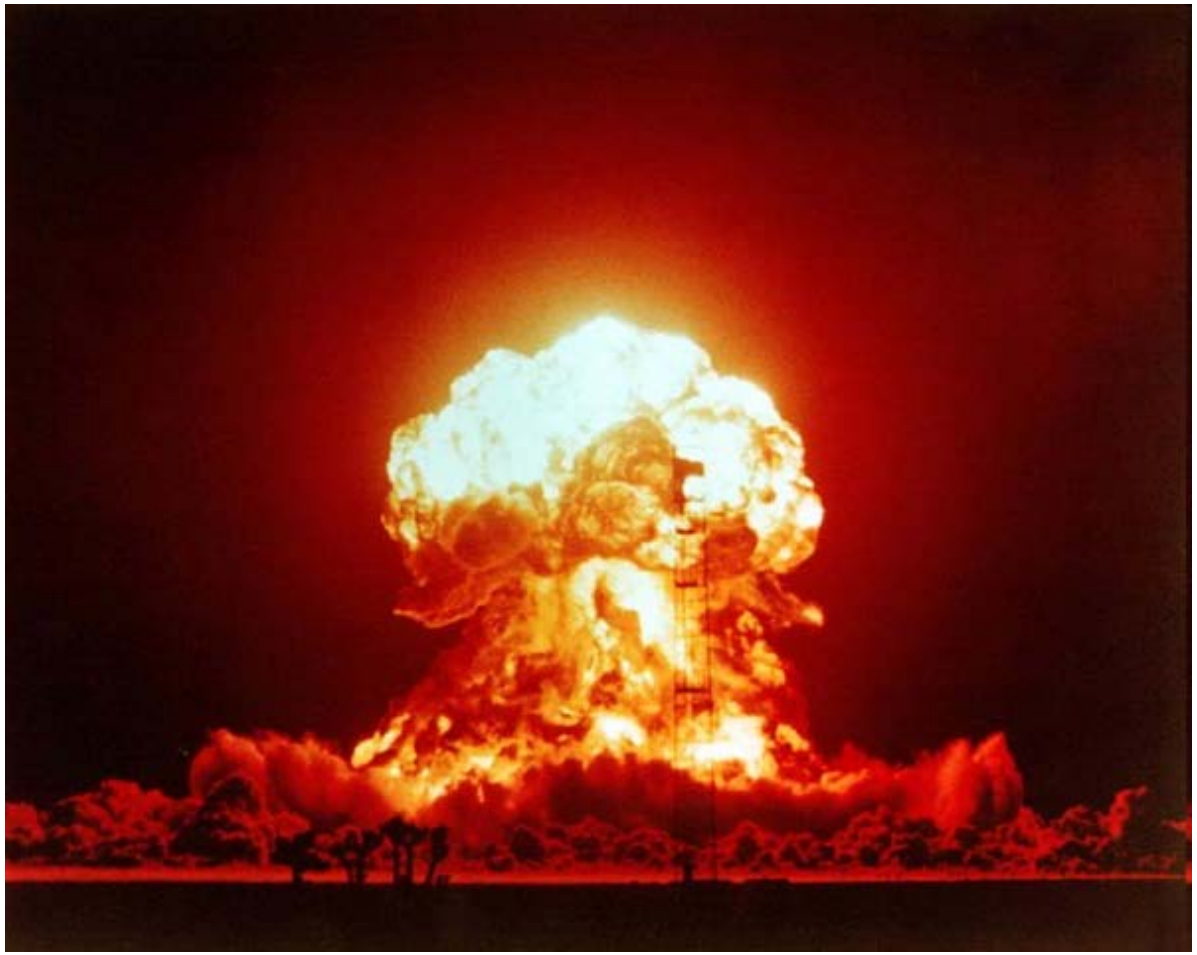
CREATE AN INPUT FILE FOR THE MODEL

RUN THE MODEL



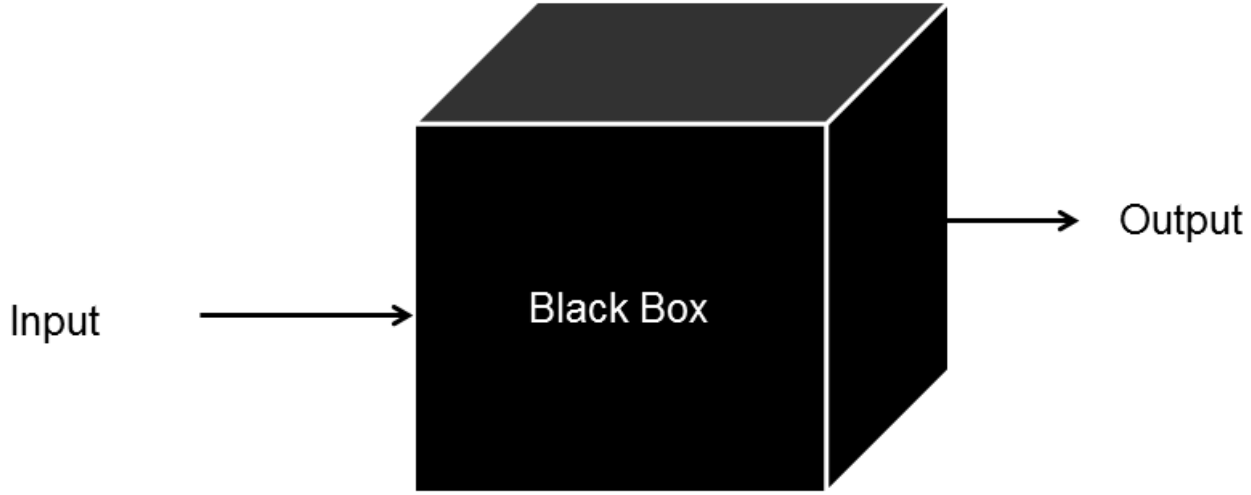
Model Predictions Pass: Permit Process Continues!

Model Predictions Fail: Then What?!?!?



Model Predictions Fail: Reduced Impact Strategies

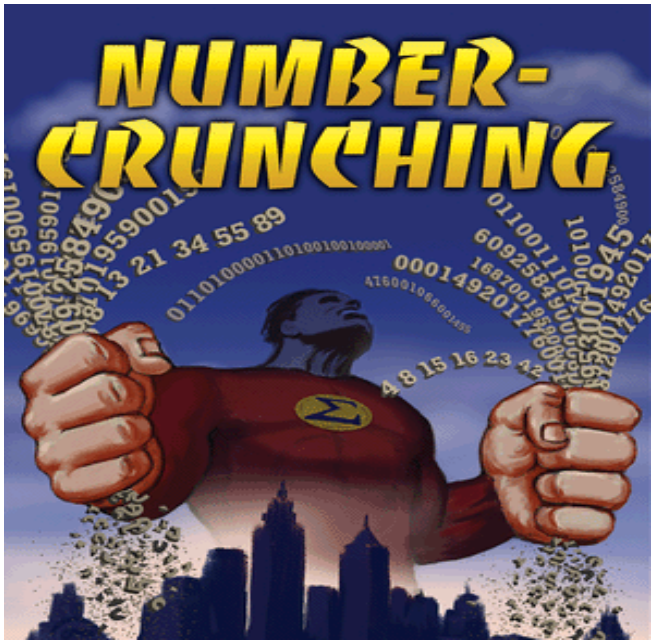
How Accurate are the Models?



Internal behavior of the code is unknown

AERMOD: EPA Preferred Model

- Steady state plume dispersion model for assessment of pollutant concentrations from a variety of sources;
- Simulates transport and dispersion from multiple points, area, and volume sources;
- Employs hourly sequential meteorological data to estimate concentrations for averaging times ranging from one hour to one year



AERMOD SOFTWARE

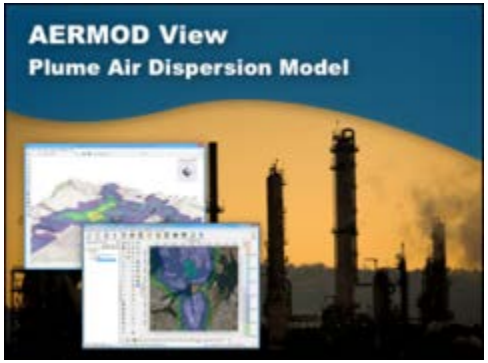
EPA

$Free

AERMOD SOFTWARE

BEE-LINE Software

$1,350



Lakes Environmental

$1,599

Breeze Software

$1,495