

*Portland Air Toxics  
Assessment*

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## Executive Summary

- **Purpose**

The Portland Air Toxics Assessment was designed to provide more refined estimates of the most significant air toxics in the Portland area. This allows the Department to better characterize the risks from air toxics and better understand local patterns of air toxics exposure and locations with elevated risk. By producing more detailed information about the sources of air toxics emissions in Portland, PATA establishes a foundation from which the Department can develop emission reduction strategies and measure changes. PATA enables the Department to communicate about air toxics and promote voluntary reductions in Portland in advance of a more prescribed planning process.

- **Methods**

In partnership with EPA, ICF Consulting and Metro, the Department applied a dispersion model to detailed local emissions information, and local meteorological and topographical data to produce estimated emissions for 12 air toxics in the Portland area. These emission estimates were compared to monitoring results for the same time period to verify accuracy. By comparing these results to risk concentrations, the Department was able to estimate risk from the 12 air toxics for each census block within the modeling area.

- **Results**

The assessment credibly predicted ambient concentrations where there were measurements for comparison. The modeling results allow the Department to make correlations between source locations and pollution levels and observe how exposure varies within the Portland area. PATA shows the importance of diesel, motor vehicles and burning as sources of air toxics in Portland. It confirms national estimates that individuals are exposed to various air toxics above levels of concern. The assessment will guide emission reduction strategies well into the future.

# 1. Introduction

## 1.1 Background

The Portland Air Toxics Assessment (PATA) is a computer modeling project designed to estimate and assess the risk from 12 air toxics in the Portland area. PATA is the first local-scale air toxics modeling project conducted in Oregon as part of the developing state air toxics program. The U.S. Environmental Protection Agency (EPA) has conducted the National Air Toxics Assessment (NATA), which modeled pollutant levels on a larger scale. PATA refines the national model by using the Department of Environmental Quality's current pollution information, including emissions from motor vehicle traffic; and unique regional characteristics, like weather and topography. PATA is a collaborative effort between DEQ and EPA, with key contributions from Portland's metropolitan regional government (Metro).

## 1.2 Project Purpose and Context

In 1990, The Clean Air Act Amendments established EPA's current air toxics program. Between 1990 and 2000, the federal program to reduce air toxics, which was delegated to DEQ, focused on reducing emissions from large stationary sources through technology-based emission standards. However, because these standards do not fully protect public health, the Clean Air Act also requires reductions from smaller more numerous sources, motor vehicle controls, and a strategy to address public health risks from cumulative emissions in urban areas. This federal "Integrated Urban Air Toxics Strategy" outlines state program elements to advance the Clean Air Act goals of 75 percent reduction in cancer incidence associated with air toxics, and a substantial reduction in public health risks for effects other than cancer. Basic elements include local urban risk assessments, including problem chemicals, sources, and geographic "hot spots"; a process to develop, implement and measure risk reduction strategies, and stakeholder participation.

In October 2003, Oregon adopted state air toxics rules that contain a framework for the Department to work with communities to reduce unacceptably high risk from air toxics. This program closely tracks the elements of the federal Urban Air Toxics Strategy by using a risk-based approach to identify communities most exposed to air toxics, and working with local stakeholders to develop and implement emission reduction plans. Oregon's air toxics program also includes methods to reduce air toxics from categories of sources, and address unusual cases of high risk from stationary sources.

PATA is a community assessment that advances the goals of both the federal and state air toxics programs. It leads to a better understanding of air toxics in the Portland area by producing more accurate estimates of the most significant air toxics and characterizing their risks. While NATA estimates pollutants at the county level, PATA produces more detail with estimates for census tracts and census blocks, which can be grouped according to neighborhoods. PATA also shows how pollutants are distributed spatially, with distinct gradients related to highways and other areas of emission density. This will help DEQ understand exposure patterns and the locations of areas with elevated risk from air

toxics. Because PATA attributes air toxics to specific categories of sources, it gives the Department a credible starting point to develop risk reduction strategies. PATA will also serve as a baseline for tracking trends and progress in reducing air toxics.

Local scale modeling, along with additional monitoring and a continuously improving emission inventory will serve as the foundation for future emission reduction planning. This process will involve local stakeholders and community members. PATA enables the Department to communicate about air toxics and promote voluntary reductions in Portland in advance of a more formal planning process.

### **1.3 Study Design**

PATA includes the following components:

- 1999 emission inventories—calendar year
- 1999 air monitoring data—July 1999-July 2000
- Air dispersion modeling
- Population exposure assessment
- Risk characterization

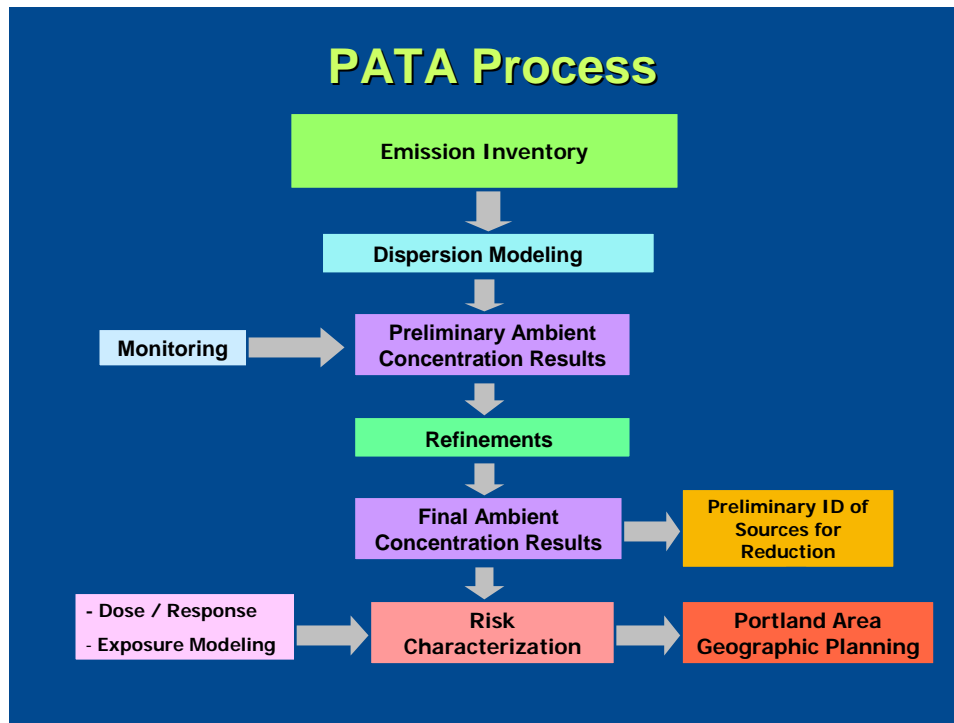
Twelve toxic air pollutants were selected for air dispersion modeling because they were above levels of concern in the 1996 NATA national-scale assessment for the Portland area. These are:

- 1,3-butadiene
- primary acetaldehyde
- primary acrolein
- arsenic
- benzene
- chloroform
- diesel particulate matter
- primary formaldehyde
- nickel
- polycyclic organic matter
- perchloroethylene (also called tetrachloroethylene)

The model selected for PATA is called CALPUFF. This model was chosen because of its ability to account for complex weather conditions, local terrain, such as mountains and rivers, and to handle various types of emission sources. Meteorological inputs were developed with the CALMET model. PATA contained meteorological data from nine sites in Portland, each containing nine vertical layers. Oregon's 1999 emission inventory, prepared by DEQ and METRO, served as the emissions input to CALPUFF.

Supplementary emissions data were also taken from the 1996 National Toxics Inventory (NTI) and the 1999 National Emissions Inventory (NEI) as described below. DEQ provided the results of 1999 air monitoring to evaluate the performance of the model. CALPUFF does not address atmospheric chemistry or secondary formation of pollutants. The Department performed exposure analysis and risk characterization by using HAPEM 5. Figure 1.1 illustrates the steps of the PATA process.

**Figure 1.1 Steps of the PATA Process**



#### **1.4 Data Requirements and Sources**

Two distinct, but complimentary, approaches are commonly used to assess air quality: ambient monitoring and air dispersion modeling. Ambient monitoring provides direct measurements of airborne pollutant concentrations. Uncertainties of these measurements arise because of measurement errors and limitations in the sampling technology. However, if these uncertainties and limitations are minimized and properly characterized, monitoring results can be considered to represent the best estimate of pollutant concentrations at the locations and during the time periods of sampling.

There may be other important limitations of ambient monitoring results for some uses. For example, because of the expense of monitoring, the number of sampling locations is generally small for most studies. Using monitoring results to characterize population exposure commonly involves simplifying assumptions about the uniformity of pollutant concentrations over large areas. This may be appropriate for some pollutants that typically display small concentration gradients (e.g., ozone); but it is more problematic for most air toxics, which can exhibit large spatial variations in concentrations.

Modeling studies can provide indirect evidence for exposures over broader geographic areas. These exposure estimates are calculated and rely on the quality of input data, the validity of modeling assumptions, and the model's formulation. Despite their uncertainties, modeling approaches have several advantages over monitoring.

- **Lower expense.** Modeling studies typically provide concentration estimates at a much larger number of locations for a lower budget, than do monitoring studies.
- **Temporal flexibility.** Modeling can be performed for any past, present, or future year, whereas measurements reflect only current conditions.
- **Source attribution.** Individual sources and/or source categories can be tracked throughout the modeling process to yield information on the importance of each source or source category to overall concentrations.
- **Consideration of hypothetical situations.** Modeling can address situations such as impacts of increased emissions, controls on emissions, or alternative meteorological conditions.
- **Inclusion of more chemical species.** Accurate monitoring techniques do not exist for all pollutants at the present time; and the concentrations of some pollutants may be below the minimum detection limits of the analysis methods.

Model performance evaluation is a key component to any modeling study. Comparison of model estimates to monitored values at model receptor locations can provide “ground-truthing” of the model’s ability to predict conditions in the real world.

Because of their complementary strengths and weaknesses, monitoring and modeling approaches can be integrated usefully in the design of an air quality study. This study focused on the 1999 – 2000 time period because DEQ had monitored an array of air toxics at five sites in the Portland metropolitan area during that time, and because DEQ had already completed a statewide emissions inventory of air toxics for 1999. This modeling and monitoring data became the starting point for the refined information required for a local modeling study.

Meteorological data, land use, and recent census data were also available as model inputs for this time period. Having all of these elements available made it possible to run the model, compare model estimates to monitored values, and to evaluate the performance of the model, estimating the uncertainty of the model predictions.

The sections below describe in detail the inventory, modeling, and monitoring data that was used in this assessment of air toxics impacts in the Portland metropolitan area.