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National Air Toxics Monitoring-Community Assessment Plan for Spokane, Washington

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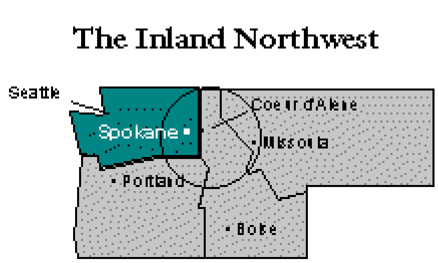
Introduction

This document summarizes the Washington State Department of Ecology Work Plan for conducting a National Air Toxics Monitoring Program-Community Assessment in Spokane Washington. The application is being made in part at the request of Spokane communities. See attached letters of request from community councils and municipalities.

Spokane is located on the east side of Washington State 18 miles west of the Idaho state line and 110 miles south of the Canadian border. With a county population of 428,000 Spokane is the largest city between Seattle and Minneapolis. Spokane is located in a semiarid eastern Washington valley. Due to geography, meteorology and emission sources, the Spokane valley is subject to frequent episodes of unhealthy air quality. In addition to the typical urban and industrial sources of air pollution the Spokane valley is also impacted by burning of agricultural field residue. Several of the proposed monitoring locations represent low income neighborhoods that have highly disproportional exposures to hazardous air pollutants. The Spokane area has a thriving high-tech sector with many large companies, such as Agilent Technologies, Alcatel, Getronics, Itron, Telect, World Wide Packets, Itronix, F5 Networks, and Honeywell. More than 10% of the county has been diagnosed with asthma.



The primary goals of the Spokane study are to (a) characterize ambient air toxics concentrations and their spatial and temporal patterns, (b) determine base-line air toxics concentrations, (c) estimate source apportionment for air toxics emissions, (d) evaluate NATA and local area (AIRPACT) modeling results, (e) determine health risks from exposure to air toxics, and (f) determine, implement and evaluate control strategies and their effectiveness. The proposed study is designed to address each of EPA's evaluation factors and project requirements.

The Plan

The study design is consistent with EPA's strategy for the National Air Toxics Monitoring-Community Assessments. The study will complement existing National, State and Local monitoring programs by integrating the State's toxics monitoring program with other existing and planned monitoring activities. The Plan includes coordinated monitoring with the National Air Toxics Trends Site (NATTS) located at Beacon Hill in the Seattle area and the Washington State PM2.5 Chemical Speciation monitoring network. This approach will make efficient use of related monitoring activities to the extent that existing monitoring platforms will be used and criteria pollutant monitors will be co-located with the air toxics samplers.

The study design is intended to complement Washington's NATTS by providing a regional spatial resolution beyond that represented by the Beacon Hill monitoring location.

In cooperation with EPA Region X, Spokane County Air Pollution Control Authority (SCAPCA), Washington State University and the University of Washington, the Washington State Department of Ecology will coordinate and manage an air toxics study in the Spokane valley. The study will consist of four air toxics monitoring sites. One site (Lincoln Park) will be located in such a way as to represent air quality conditions in a "typical" Spokane urban residential neighborhood. Two sites (Hillyard & Millwood) will be located in low income communities that are adversely impacted by industrial, commercial and mobile sources. In addition, the Hillyard neighborhood is in the vicinity of industrial activity where there has been at least one completed CERCLA cleanup action. The fourth site (Gonzaga University) will be located near downtown Spokane and sited to represent typical urban city core conditions, i.e. impacts from mobile sources. The Spokane County Air Pollution Control Authority (SCAPCA) will operate the samplers and update the emission inventory for the study.

Sampling will be conducted for volatile organic compounds (VOCs), carbonyls and PM2.5 metals. Integrated 24-hour samples will be collected every six days for 12 consecutive months.

In addition, several advanced air toxics monitoring technologies will be deployed at selected sites. These advanced technologies will be thoroughly evaluated and the results used to support source apportionment and risk assessment analysis. One site will be equipped with an <u>aethalometer</u> that will be used to assist with source apportionment. <u>Polycyclic Aromatic Hydrocarbon</u> (PAH) sampling will be conducted at one of the selected sites using two new instruments that measure real time total Particle Bound

Polycyclic Aromatic Hydrocarbon (PPAH) concentrations and the total active surface area of the PPAH. The results from these new instruments will be used to determine the PAH source apportionment. A Proton Transfer Reaction Mass Spectrometer (PTR-MS) will be used and evaluated for weeklong periods several times during the study. The PTR-MS is capable of measuring air toxics on a real-time basis. It is especially suited for BTEX species and has demonstrated potential for other difficult to measure species such as acrolein. A VOC Technologies real-time VOC analyzer utilizing Pneumatic Focusing Gas Chromatography will also be deployed at one of the selected sites and evaluated.

The primary goal of this study is to provide air toxics data for the commercially and industrially impacted neighborhoods in the Spokane valley. The data will be used for the following:

1. Characterize the ambient air toxics concentrations and their spatial and temporal patterns.
2. Determine base-line air toxics concentrations for the community assessment.
3. Estimate source apportionment for the study areas.
4. Evaluate NATA and AIRPACT air toxics modeling results for Spokane.
5. Determine health risks to the community from exposure to air toxics.
6. Estimate source apportionment for air toxics emissions,
7. Determine and implement air toxics control strategies and evaluate their effectiveness

Spatial Determination – Four air toxics monitoring sites will be installed and operated for 12 consecutive months. One site (Lincoln Park) will represent air quality conditions in a "typical" Spokane urban residential neighborhood. Two sites (Hillyard & Millwood) will be located in low income communities that are adversely impacted by Spokane's industrial, commercial and mobile sources The fourth site (Gonzaga University) will be located near downtown Spokane and sited to represent the typical urban city core conditions. This location is impacted from a mix of urban source categories including mobile sources. Spatially diverse concentrations of the "CORE" air toxics will be monitored and evaluated. The neighborhood scale monitoring sites will be located to show impacts from mobile, area and large stationary sources. Station siting will meet the specifications in the Code of Federal Regulations Title 40, Part 58 (40 CFR 58), Appendix D, "Network Design for State and Local Air Monitoring Stations" (SLAMS); and Appendix E "Probe Siting Criteria for Ambient Air Quality Monitoring". Adherence to these criteria will provide for the uniform collection of comparable air quality data that will be used to evaluate air toxics concentration gradients across the study area. The monitoring data from these sites will provide spatial and temporal information concerning the dispersion of air toxics in the Spokane valley.

The Spokane study will also complement the State's Air Toxics and PM2.5 Chemical Speciation monitoring activities by providing additional statewide spatial resolution beyond that represented by the Beacon Hill NATTS location.

Community Initiated Assessment - The Spokane Air Toxics Monitoring Plan is supported by multiple community and city organizations. See attached letters. Clearly this Air Toxics Monitoring plan has strong community support, and the infrastructure is in place to evaluate health risks. The study results will be used to support the community's request to determine concentrations and assess health risks from air toxics. The monitoring project will be designed to characterize air toxics and provide baseline air toxics data that will be used to determine, implement and evaluate emission reduction strategies, i.e. Diesel Retrofit, wood stove burn bans, agricultural burning and industrial source reduction programs in the Spokane area. In addition, the results from this study will be used by scientists at the University of Washington and Washington State University to further their ongoing risk assessment evaluations in the Spokane valley.

Monitoring to Model Evaluation – Washington State University (WSU) in collaboration with the State of Washington developed an air quality forecasting system (AIRPACT). AIRPACT operates daily and uses MM5 forecasts from the University of Washington with the CALMET/CALGRID photochemical modeling suite to predict photochemical air pollutant concentrations with hourly time steps and four kilometer cell resolution. Forecast results along with the emissions that were used for the simulations are provided to the public daily on the project website at www.airpact.wsu.edu. The system has recently been expanded to encompass the I-5 corridor from Vancouver, British Columbia to Portland, Oregon. The model has also been enhanced to include air toxics compounds, including formaldehyde, acetaldehyde, 1,3-butadiene, benzene, perchloroethylene, diesel PM2.5, wood-smoke PM2.5 and a PAH tracer.

Though not funded through this grant, WSU plans to implement a second modeling domain for the Spokane area. This modeling effort should provide air toxics simulations similar to those that currently exist for the Seattle-Portland corridor. This expansion of AIRPACT to other parts of the Pacific Northwest supports the goals of the NW-AIRQUEST modeling consortium.

A key step in implementation of the AIRPACT modeling for Spokane is the completion of an air toxics emission inventory. See the Emission Inventory section of this document. The air toxics results from this study will be used to validate the AIRPACT and NATA modeling results. The air toxics monitoring data collected from this study will be transmitted to the modelers where it is planned to be used to modify the modeling results and potentially generate air toxics isopleths for the study area. The modeled data can then be averaged over annual time spans to yield population exposure estimates. The AIRPACT air toxics modeling project is funded independently through an EPA 103/105 grant.

Advanced Technologies - The project will include the use of several non-routine advanced technologies that have a strong potential to become routine air toxics monitoring methods. At least one site will be equipped with an aethalometer that will be used in conjunction with the VOC, carbonyl, PM10 metals and PM2.5 Chemical Speciation data to evaluate source contributions (specifically wood smoke and diesel).

Polycyclic aromatic hydrocarbon (PAH) sampling will be conducted at one site and the resulting data analyzed to determine the PAH source apportionment. We plan to use two new advanced technologies that have been shown to provide real time total Particle Bound Polycyclic Aromatic Hydrocarbon (PPAH) concentrations and their total active surface area. The Photoelectric Aerosol Sensor-Photoelectric Charging (PAS-PC) and Photoelectric Aerosol Sensor-Diffusion Charging (PAS-DC) instruments are portable near real-time battery operated samplers that respectively measure the PPAH concentration and active surface area of the particles. The use of these two sensors in parallel will allow the physical and chemical characteristics of the particles to be qualitatively associated with major PAH emission sources. The ratio between the PPAH concentration and the total active surface area (PC/DC) has been described as a fingerprint for individual types of combustion particles (Bukowiecki *et al*., 2002; Matter *et al*., 1999; Siegmann *et al*., 1999). A plot of the photoelectric charge versus the diffusion charge has been found to yield a linear relationship for combustion sources. The amount of PAH from a combustion source varies widely depending on the fuel and the conditions of the combustion. Hence, ambient measurements can exhibit a characteristic PC/DC ratio according to the major emission source of each specific site with an associated variability due to the contribution of other sources.

The project will also include the use of a Proton Transfer Reaction Mass Spectrometer (PTR-MS) for several short -term, intensive sampling periods. The PTR-MS operates on the principle of ionization of the molecule by transfer of a proton from water. The soft ionization yields only the protonated molecular ion. Because each species generally yields only one ion, the fragmentation pattern is less complex and pre-separation of individual species with a GC or HPLC is not required. Specificity is good for many of the low molecular weight species present in ambient air. Compounds with a proton affinity greater than that of water will provide a good PTR-MS response. Formaldehyde, acetaldehyde and benzene can be monitored in real-time by this technique. The PTR-MS has proven very effective for ambient measurements of BTEX compounds in real-time. The ambient BTEX data will be used to verify mobile source emission factors for the BTEX species. The PTR-MS will also be evaluated for potential use to serve as a real-time monitor for acrolein. When operated in a real-time monitoring mode the PTR-MS will allow for an identification and assessment of short term peak concentration that might have potential for human health risks not apparent in the 24 hour integrated data. A carbon monoxide (CO) monitor will be operated side-by-side with the PTR-MS to establish a relationship between VOCs and CO in the study area.

In addition, we will evaluate a VOC Technologies real-time VOC analyzer utilizing Pneumatic Focusing Gas Chromatography (PFGC). The instrument will be deployed at one of the selected sites and evaluated. PFGC uses a novel sampling method that is integrated into a gas chromatograph. The instrument provides ultra-sensitive detection of trace gas pollutants at the parts per trillion (PPT) level. The instrument is fully automated and can be configured to provide hourly average data concentrations.

Leverage Other Resources - The State will provide the demonstrated expertise and overall management of the study. The State will provide co-locate carbon monoxide and PM2.5 Chemical Speciation samplers at one of the selected sites so that the study area will have sequential VOC and particulate speciation data that will be used in the modeling, source apportionment and risk evaluations. The State will provide the sampling shelters, and the carbon monoxide, PM2.5, meteorological, VOC and carbonyl sampling equipment.

The State will also leverage demonstrated expertise from their research partners. Examples include; (a) the Washington State University (WSU) AIRPACT modeling project, which is funded by a separate special project grant, will be expanded to include air toxics compounds. WSU will use the monitoring results to modify and validate the AIRPACT model. (b) The results from the study will be used by scientists at the University of Washington and Washington State University to further their ongoing risk assessment evaluations in the Spokane valley. (c) The University of Washington Environmental Health and Civil Engineering Departments will determine risk exposures and estimate source apportionment utilizing the results from the study.

In addition, the particulate matter and metal data from our study will assist the historic the Spokane County Health Department's two-year study of child-use areas where lead and arsenic are considered the primary contaminates. The use of lead-arsenate pesticides on farms and orchard land potentially affects over 19,000 acres in the Spokane County. The results may be applicable to the other 79,000 acres of central Washington orchard lands where lead-arsenate pesticides were applied. Additional information on the statewide approach to resolving this challenge can be found at http://www.ecy.wa.gov/programs/tcp/area_wide/area_wide_hp.html

Information gathered from this study would also be useful to the Department of Ecology's Water Quality Program. The agency has established a Total Maximum Daily Load (TMDL) for the Spokane River for dissolved cadmium, lead, and zinc. These pollutants are caused by mining activities near the origin of the river in Idaho. Ecology could use the results from this study to assist with the assessment of dry deposition of chemicals to the exposed riverbank soils.

Risk Evaluation - Working with the Environmental Health and Civil Engineering Departments at the University of Washington the monitored and modeled results will be used to assess risk from exposure to air toxics in the study areas.

Source Apportionment – Working with the University of Washington Environmental Health and Civil Engineering Departments the resulting data will be used to estimate source apportionment. Positive Matrix Factorization (PMF) will be utilized in the source apportionment analysis. In addition to being highly impacted by mobile (including diesel), area and large industrial sources, the Spokane valley is also impacted by wood smoke in the winter and agricultural crop residue burning and wild fires in the summer.

Monitored Parameters - The following EPA "CORE" air toxics parameters will be measured at each site:

VOCs

1. Benzene
2. 1,3-butadiene
3. Carbon tetrachloride
4. Chloroform
5. 1,2-dichloropropane (propylene dichloride)
6. Ethylene dibromide*
7. Methylene chloride (dichloromethane)
8. Tetrachloroethylene (perchloroethylene, PCE)
9. Trichloroethylene, TCE
10. Vinyl chloride

Carbonyls

11. Acrolein**
12. Acetaldehyde
13. Formaldehyde

Metals

14. Arsenic
15. Beryllium
16. Cadmium
17. Chromium
18. Lead
19. Manganese
20. Nickel

*Ethylene dibromide was used as a fumigant to protect against insects, pests, and nematodes in crops and as a fumigant for turf grass. Though it was banned by EPA in 1984 for use as a soil and grain fumigant it is known to remain in the soil and groundwater for long periods of time. It has been suggested that ethylene dibromide may contribute to health risk in areas where it has been used in the past.

**Currently there are no reliable methods for the measurement of acrolein. We propose to evaluate the PTR-MS for potential use as a real-time monitor for acrolein.

Methods – EPA reference, equivalent or approved methods will be used for each air toxics parameter measured. EPA methods TO-15, TO-11A and IO-3 will be used to measure VOC's, carbonyls and PM10 metals, respectively.

Meteorological Monitoring – Meteorological monitoring for wind speed, wind direction and temperature will be conducted in the study area.

Quality Assurance – The State's existing and EPA approved Quality Assurance Project Plan (QAPP) for Air Toxics Monitoring will be used for this study. The QAPP addresses procedures for quantifying measurement precision and bias through collocated measurements and specific sampling methods. The results from the co-located sampling conducted at the Beacon Hill National Air Toxics Trends Site will be used to evaluate VOC, carbonyl and PM10 metal sampling and analytical precision.

Laboratory Analysis – To maintain continuity with previous and existing air toxics monitoring and to provide for uniform sampling results, Washington State University will perform the laboratory analysis for the VOCs, carbonyls and PM10 metals.

Data Management and Reporting – The resultant air toxics monitoring data and associated quality assurance information will be submitted to EPA's Air Quality System (AQS) no later than 120 days following the end of each calendar quarter.

Web Site – The resulting data and links to associated reports will be posted to Ecology's Web site https://fortress.wa.gov/ecy/aqp/Toxics/AnnualToxicsSummaries.shtml.

Emissions Inventory – The monitoring area is included in the present 1999 emission inventory and 2002 emission inventory update. The State of Washington in collaboration with SCAPCA will update and submit a improved 2002 national emission inventory including air toxics and criteria data for mobile, point and area source categories in the study area.

Final Report - A final report in the form of a Power Point presentation will summarize the results. The report will include the results from the Positive Matrix Factorization (PMF) analysis, source apportionment, AIRPACT modeling, method evaluation and risk assessment. The report will be presented at the EPA sponsored annual data analysis workshop and at the EPA Region 10 annual air toxics summit.