Characterization of Air Toxics Concentrations Around a Kraft Pulp and Paper Mill Facility, Lewiston, Idaho

A Proposal
RFA# OAR-EMAD-03-08
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Work Plan Narrative

1. Introduction

The proposed study will be used to characterize air toxics concentrations in the Lewiston, Idaho urban area and in nearby areas of the Clearwater River valley including significant parts of the Nez Perce Reservation. The study would be designed with special reference to the characterization of emissions from the Potlatch pulp and paper mill facility located in east Lewiston with a determination of the spatial pattern and gradient in VOC (Volatile Organic Compound) air toxics concentrations. The Potlatch facility is the largest complex of pollutant point sources in the valley. There are approximately 15,312 residents and 6594 households within a 3-mile radius of the facility. Emissions from the Potlatch complex commonly adversely affect air quality (haze, odor) in the cities of Lewiston, Idaho and Clarkston, Washington, a combined population of about 49,300. Depending upon conditions, the outlying towns of Lapwai, Lenore, and Orofino in Idaho and Asotin in Washington can also be affected.

There have been some past studies on air toxics in the valley. The motivation for these studies was the finding that the Lewiston-Clarkston area had 12% more total cancers in the study period than expected relative to overall Idaho averages. This was based upon data compiled in the Cancer Data Registry of Idaho and the Washington State Cancer Registry.

The first of these studies was completed in 1990 and focused on chloroform concentrations around Potlatch (EPA 1991). Maximum downwind concentrations were found to be 2 to 8 ppb. A major modernization was completed after this in 1992 that reduced the use of chlorine dioxide.

A more general year-long HAPs study was conducted from July, 1994 through June, 1995 (IDEQ 1995). This was a more comprehensive study and included sampling for chloroform, benzene, toluene, ethylbenzene, and xylene on a once every six days schedule at 13 sites plus a background site. The highest annual average chloroform concentration was 0.111 ppb at a site directly across the river from Potlatch. The maximum 24-hour concentration observed was 0.46 ppb at the same site. The annual average chloroform concentration for all sites, excluding background, was 0.07 ppb. The background site concentration was 0.02 ppb. The annual averages for all sites for benzene, toluene, ethylbenzene, and xylene were 0.97, 1.53, 0.30, and 1.27, respectively. The background site concentrations for the same species were 0.19, 0.18, 0.03, and 0.24, respectively.

A third study was conducted in winter and spring of 2003 and, like the first study, focused on emissions from the Potlatch operation. Using the TO-15 method and GC/MS it identified 21 separate species in ambient samples that are listed in the EPA's Integrated Risk Information System (IRIS) database (internal report). Sampling during this study attempted to define differences in species present between samples taken in and out of the influence of Potlatch plume sources. There appeared to be some significant differences between ambient samples believed to be influenced by the Potlatch sources and those believed to have little or no Potlatch influence. Due to limitations on resources, however, it was not possible to fully characterize these differences or do any notable quantification of concentrations.

The proposed study would provide a rigorous quantification of a broad suite of air toxics species in the vicinity of a pulp and paper mill facility. Furthermore, it would enable a much more definitive evaluation of the relative contributions of Potlatch emissions to the ambient levels of air toxics in the valley by species, develop a picture of the spatial patterns of air toxics concentrations, and provide the means for predicting concentrations in areas without monitors and anticipating the effects of changes in operation.

2. Experimental Design

The experimental design will emphasize the characterization of emissions from the Potlatch pulp and paper facility and still satisfy all the basic requirements listed in RFA #OAR-EMAD-03-08. The monitoring component of the study will include sampling for VOCs (EPA TO-15 method), carbonyls (EPA TO-11A method), and metals (EPA IO-3.5 method) at 5 monitoring sites distributed through the central urban area and in nearby areas of the Clearwater valley. This sampling will be conducted on the standard schedule of once every six days. This will be supplemented by continuous long path DOAS (Differential Optical Absorption Spectroscopy) monitoring at one site and meteorological monitoring. The concentration and meteorological data will be used to support dispersion modeling. Details on each phase of work are given below.

2.1 Monitoring

A location map showing the Lewiston urban and nearby areas, Potlatch mill facility, and the proposed monitoring sites is shown in Figure 1. The monitoring sites were selected to provide a variety of land use types and spatial resolution. The 5 sites are:

- Idaho State Patrol Office – Proximal to the Potlatch industrial source.
- Idaho DEQ (State Office Building) – Representative of central Lewiston urban area with commercial and residential mix. Near downtown.
- Clearwater River Casino – Located at the western boundary of the Nez Perce Indian Reservation and frequently affected by plumes from Potlatch.
- IDEQ Sunset TEOM site – Residential site in southeast Lewiston out of central valley.
- Nez Perce Tribe Lapwai site – Background site

The continuous DOAS monitoring requires a site for the instrument itself as well as a mirror site. The DOAS instrument will be located atop the State Office Building at Idaho DEQ.

2.2 VOC and Carbonyl Monitoring and Analysis

Sampling for VOCs will be conducted using EPA method TO-15. The VOCs selected for analysis by TO-15 will include the standard set of species as designated in the RFA (benzene, carbon tetrachloride, chloroform, 1,3-butadiene, 1,2-dichloropropane, methylene chloride, tetrachloroethylene, trichloroethylene, and vinyl chloride). We are also interested in evaluating VOCs included in the IRIS database, but not listed above, that were identified in the earlier study. These include acetophenone, benzaldehyde, chlorobenzene, cyclohexanone, ethylbenzene, furfural, 1,4-dichlorobenzene, dichlorodifluoromethane, hexane, d-limonene, naphthalene, toluene, trichlorobenzene, 1,1,1-trichloroethane, and trichlorofluoromethane. Due to availability of certified standards we propose limiting the analytical quantification of these additional species to chlorobenzene, ethylbenzene, 1,4-dichlorobenzene, dichlorodifluoromethane, toluene, trichlorobenzene, 1,1,1-trichloroethane, and trichlorofluoromethane.

Carbonyl sampling for formaldehyde and acetaldehyde will be conducted using EPA method TO-11A.

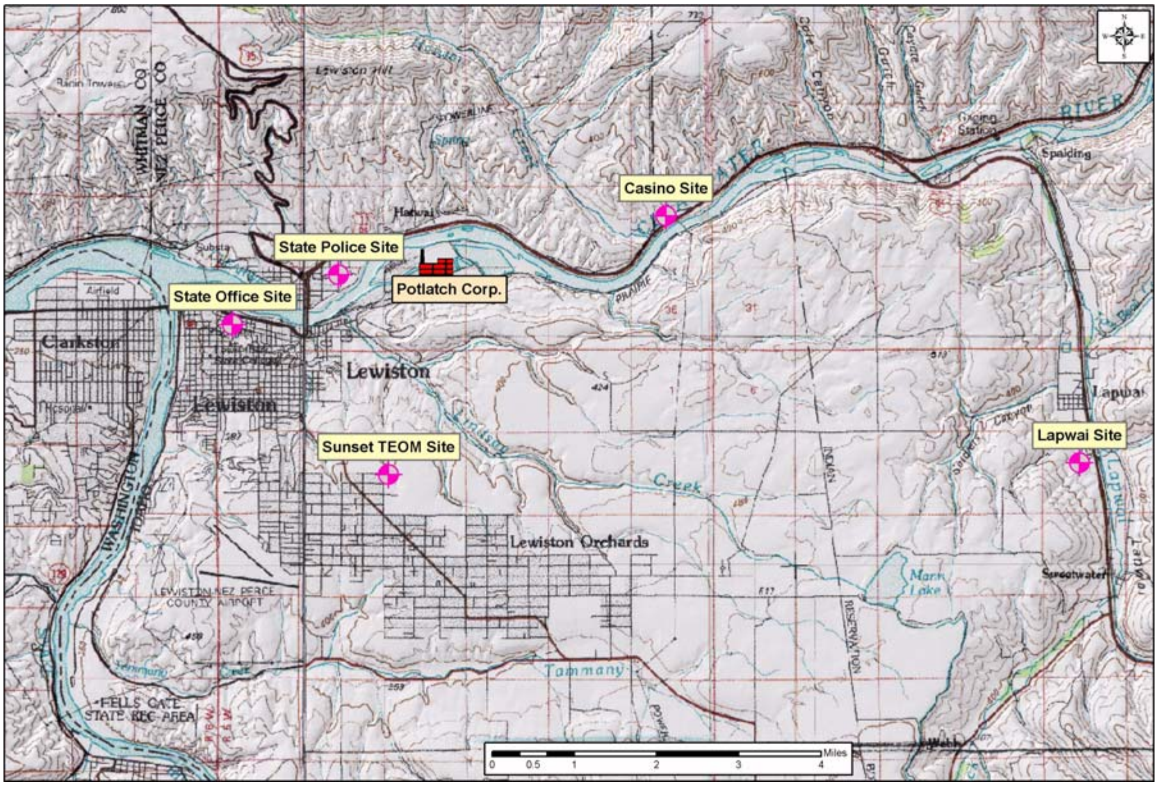

Figure 1. Proposed monitoring sites location map.

2.3 Metals

Sampling and analysis of metals will be conducted using the methods described in EPA method IO-3.5. Metals analysis will include the following:

- Arsenic compounds
- Beryllium compounds
- Cadmium compounds
- Chromium (total)
- Lead compounds
- Manganese compounds
- Nickel compounds

Aluminum will also be analyzed to serve as a tracer of crustal contributions.

2.4 Meteorological Stations

Permanent meteorological stations are located at the Lewiston airport, IDEQ $PM_{2.5}$ monitoring site in southeast Lewiston, the Nez Perce $PM_{2.5}$ tribal monitoring site in

Lapwai east of Lewiston, and at the Potlatch facility. These will be supplemented during the experiment by portable weather stations located at the State Office Building near downtown Lewiston and the State Police Office. Together with the concentration data generated by the monitoring network, the meteorological observations will provide the basis for conducting dispersion modeling.

2.5 Modeling Studies

The emphasis of the proposed work is monitoring of air toxics within the vicinity of the Potlatch pulp and paper mill. Dispersion modeling studies of emissions from Potlatch will also be conducted, however, to complement the monitoring data base. Optimum dispersion modeling calls for a well known emissions inventory and adequate meteorological data. We propose adding two portable meteorological stations to augment the meteorological data available from the existing network of stations. The emissions inventory for Potlatch, however, is not well known, especially on the temporal resolution basis (e.g. daily) best suited to dispersion modeling. Therefore the dispersion modeling will adopt a twin approach. First, the modeling will assess the accuracy of the model as much as possible using the available emissions inventory data together with the air toxics monitoring data. Second, the modeling can be used to help develop an emissions inventory.

The modeling itself will be based upon the use of CALPUFF and CALMET, with and without MM5, to generate daily predictions of the concentration fields. Meteorological observations will be used to fine tune CALMET.

Further discussion of the need for the proposed modeling effort is included in the criteria discussion, section 3.3.

2.6 Continuous Monitoring

Differential Optical Absorption Spectroscopy (DOAS) will be used for continuous monitoring. This optical-based measurement operates in the ultraviolet and can provide continuous measurements and a much better temporal resolution of concentrations for formaldehyde than that given by the time-averaged, once in six days schedule. Continuous measurements can be made of the following species: formaldehyde, ozone, NO_2, SO_2. The determination of concentrations for NO and NH_3 and additional air toxic VOCs are possible but will depend upon the experience with operating the DOAS in Lewiston. Detection limits are about 1 ppbv.

The DOAS will allow for an assessment of what is being missed on non-sampling days for formaldehyde and possibly other air toxic VOCs and enable an identification of short-term peak concentrations that might have potential for human health risks not apparent in 24-hour integrated results. The temporal resolution of the dispersion modeling can also be evaluated against the continuous data. In combination with the VOC monitoring data and modeling results it should also be possible to estimate concentrations of formaldehyde and other VOC air toxics susceptible to DOAS detection on non-sampling days.

2.7 Quality Assurance/Quality Control

Standard QA/QC procedures will be followed as described in EPA's National Air Toxics Trends and Assessment Program (NATTS). A QAPP will be submitted prior to monitoring if the application is accepted.

3. Criteria Discussion

The work program described above satisfies the criteria listed in RFA #OAR-EMAD-03-08. Specific responses for each criterion are listed below.

3.1 Clarification of Spatial Gradients

Empirical observations of typical Potlatch plume behavior and associated haze development indicates that the most affected areas lie along the east-west axis of the Clearwater Valley. Depending on meteorological conditions, this can include the area immediately around Potlatch, localities to the west (North Lewiston, downtown Lewiston and surrounding residential areas, and Clarkston), and/or areas to the east (western portions of the Nez Perce Reservation). Areas further to the south in Lewiston and along the axis of the Snake River (e.g. Asotin) are usually much less affected. This suggests that in order to obtain spatial gradients in air toxics concentrations with respect to the Potlatch facility it will be necessary to locate most monitoring activities along the axis of the Clearwater Valley. That is the basis for the location of the proposed monitoring sites shown in Figure 1. The proposed monitoring has sites representing different land use types and topographic settings. These include a site near the featured source, a site representing the commercial/residential mix near downtown Lewiston, a site on the Nez Perce Reservation, and a residential site in the Lewiston urban area above the valley floor that is less influenced by Potlatch emissions.

3.2 Characterization of Air Toxic Risks

It was noted in the introduction that there have been some previous studies on air toxics in the Lewiston area. One of these was limited in scope (chloroform only) and was prior to the plant modernization. A second study, conducted after the modernization, demonstrated that chloroform levels had been significantly reduced but it was otherwise limited to evaluating only four other HAPs. A more recent study indicated the presence of many other air toxics, several which appeared to be related to Potlatch sources, but limited resources prevented a more rigorous evaluation of any risks posed. Thus there has been no adequate comprehensive characterization of the current levels of air toxics risks posed by the present Potlatch operation.

Idaho DEQ has been attempting to obtain funding for the purpose of a comprehensive study of air toxics in the Lewiston area for several years now but budgetary constraints have been prohibitive. The Nez Perce Tribe is also very interested in this proposal since emissions from the Potlatch facility affect tribal members living both in Lewiston and in portions of the reservation.

3.3 Modeling

The monitoring network will provide an overall spatial characterization of air toxics concentrations in the study area. However, due to the complications of wind patterns and topography in the valley, it is possible that locally heavier concentrations of air toxics would not be observed by the network. This issue can be addressed with dispersion modeling. Concentration data obtained from the monitoring sites and the available meteorological information will provide the basis for this modeling. If the dispersion modeling can be validated by accurately matching the observed distribution of concentrations in the monitoring network, then it can be used to assess if there are areas of higher concentrations that are being missed elsewhere. The modeling could then also be used to make predictions of concentrations assuming some future changes in Potlatch operation.

Peculiar meteorological conditions are often observed in the Clearwater Valley as a result of the complex terrain. In addition to the frequent development of trapping inversions in the valley, especially during the colder months, it is not uncommon to observe wind and pollutant dispersion patterns contrary to the overall mesoscale flow. Therefore it is sometimes difficult to anticipate where the maximum concentrations originating from the Potlatch sources are likely to be observed under a given set of meteorological conditions. The ability to accurately model and predict the air toxics concentration field will be dependent upon a sufficient base of quality meteorological observations.

3.4 Continuous Monitoring

A long path DOAS instrument will be deployed. This is an advanced optical measurement technology that can analyze for formaldehyde. It might also be able to detect other VOC air toxics depending upon what is learned during instrument operation and analysis of the data generated.

3.5 Leverage of Other Resources

Data from the existing $PM_{2.5}$ Nez Perce Tribe (Lapwai) and IDEQ (Sunset) TEOM monitoring sites and their collocated meteorological stations will be incorporated into the database, modeling efforts, and data analysis. High volume samplers for metals analysis will be obtained from available sources. A portion of the equipment required for the project will be supplied by a nearby university helping to minimize costs. This includes VOC sample cans. The resources and expertise available at nearby universities will contribute to the DOAS deployment, data reduction and analysis, some of the monitoring field work, and other services. Drawing upon these additional resources will enable the project to include elements in the proposal that would otherwise be prohibitive.

4. Workplan Overview

The two-year study workplan will have the following schedule:

Time Period	Activity
July 1, 2004 – August 31, 2004	Study team is formed and begins meeting. Detailed workplan developed. Contracts in place. QAPPs developed.
September 1, 2004 – December 31, 2004	Monitoring sites installed and operational. QAPPs approved.
By October 31, 2004	Quarterly Report to EPA
January 1, 2005 – December 31, 2005	Toxics monitoring and modeling year.
By January 31, April 30, July 31, and October 31, 2005	Quarterly Reports to EPA
January 1, 2006 – September 30, 2006	Data analysis, modeling, and reporting.
By January 31, April 30, and July 31, 2006	Quarterly Reports to EPA
By December 31, 2006	Final Report to EPA

5. Biographical Sketches for Project Personnel

Name	Degrees, Registrations and Certifications	Current Job Title/Description and Past Experience	Areas of Specialty
Julie Simpson	M.S. Environmental Science, Washington State University, 1994 B.S. French, International Business, University of Wisconsin – Madison, 1988	Nez Perce Tribe, Environmental Specialist 1995-Present; Air Project Coordinator 1998-Present	Administrates grants and contracts on 103 Air Grant & Smoke Management DITCA (currently full-time) Develops and implements project plans.

Dennis Finn	Ph.D. Civil & Environmental Engineering, Washington State University, 1996 M.S. Geology, Eastern Washington University, 1979 B.S. Geology, Eastern Washington University, 1976	Nez Perce Tribe, Environmental Specialist, 2002-Present Maintain/operate $PM_{2.5}$ monitoring network. <u>Past Experience</u> Aerosol Research Scientist – 6 years (Washington State U.) Research Assistant – 4 years (Washington State U.) Asbestos Analyst – 1 year Geologist/Exploration Project Manager – 10 years	Aerosol measurement and speciation Air pollution measurement, modeling, and control Boundary layer meteorology and atmospheric turbulence Flux footprint Multifractal modeling Biogeochemical cycles
Hudson Mann	B.S. Natural Science, LCSC 1984	IDEQ, 1987-Present Air Quality Regional Manager	Lewiston Region analyst for air, remediation, ground water, solid waste, and emergency response.
Eric Kopcynski	B.S. Microbiology, Montana State University, 1992	IDEQ, 2000-Present Air Quality Analyst <u>Past Experience:</u> Montana DEQ, (1993-2000)	Maintenance and Operation of Regional Air Quality Equipment AQ specialist for air quality compliance, source testing, permit issues and inspections. Industrial expertise include Pulp & Paper, Acid Rain, NSPS, MACT, PSD, sugar beet plants, heavy-metal smelters, oil refineries, gas compressor turbines/IC engines.
Clayton Steele	B.S. Environmental Science, University of Idaho, 2001 CPR/First Aid Certified Visible Emissions Evaluator	IDEQ, 2001-Present Air Quality Analyst	Maintenance and Operation of Regional Air Quality Equipment Maintains the regional air quality network PM2.5 monitors and oversees regional advisory and AQI index efforts.