

**COMPARATIVE EVALUATION OF AMBIENT FINE  
PARTICULATE MATTER (PM<sub>2.5</sub>) DATA OBTAINED  
FROM URBAN AND RURAL MONITORING SITES  
ALONG THE UPPER OHIO RIVER VALLEY**

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**Semi-Annual Technical Progress Report**

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## ABSTRACT

Advanced Technology Systems, Inc. (*ATS*), with Desert Research Institute (DRI) and Ohio University as subcontractors, was contracted by the NETL in September 1998 to manage the *Upper Ohio River Valley Project* (UORVP), which included the establishment and operation of four ambient air monitoring sites located in the Upper Ohio River Valley (UORV). Two urban and two rural monitoring sites were included in the UORVP. The four sites selected for the UORVP were collocated at existing local and/or state air quality monitoring stations. The goal of the UORVP was to characterize the nature and composition of  $PM_{2.5}$  and its precursor gases. In the process, the objectives of the UORVP were to examine the ambient air concentrations of  $PM_{2.5}$  as compared with the promulgated  $PM_{2.5}$  standards, the geographical, seasonal and temporal variations of ambient air concentrations of  $PM_{2.5}$ , the primary chemical constituents of  $PM_{2.5}$ , and the correlations between ambient air concentrations of  $PM_{2.5}$  and its precursor gases, other gaseous pollutants and meteorological parameters. A variety of meteorological and pollutant measurement devices, including several different  $PM_{2.5}$  samplers that provided either real-time or integrated concentration data, were deployed at the monitoring sites. The frequency of integrated sampling varied throughout the UORVP study period and was as follows:

- “Intensive” sampling periods were defined as periods in which samples were collected on a relatively frequent basis (ranged from 6-hour integrated samples collected round-the-clock to one 24-hour integrated sample collected every third day).
- “Background” sampling periods were defined as periods in which 24-hour integrated samples were collected every third or sixth day.

Sampling activities for the UORVP were initiated in February 1999 and concluded in February 2003. This semi-annual Technical Progress Report summarizes the data analyses and interpretations conducted during the period from April 2004 through September 2004. This report was organized in accordance with the Guidelines for Organization of Technical Reports (September 2003).

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## 1.0 INTRODUCTION

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### 1.1 Background and Summary of the Scope of Work

In July 1997, the U.S. Environmental Protection Agency (U.S. EPA) promulgated updates to the National Ambient Air Quality Standards for particulate matter (please refer to the following reference link: <http://www.epa.gov/ttn/amtic/files/cfr/recent/pmnaaqs.pdf>). The updates included (i) revisions to the existing daily ambient air standard for PM<sub>10</sub> and (ii) establishing new daily and annual ambient air standards for PM<sub>2.5</sub> (herein after referred as fine particulate matter). Investigative studies conducted prior to July 1997 suggested that the U.S. EPA would eventually classify many areas of the U.S. as non-attainment areas with regards to the new PM<sub>2.5</sub> standards. The U.S. EPA mandates that state and local environmental regulatory agencies, in cooperation with industries located within non-attainment areas, develop state implementation plans (SIPs) for these areas. The SIPs include procedures and practices that will ultimately result with the non-attainment area demonstrating attainment with the pertinent ambient air standard. Historically, the SIPs often mandate reducing air emissions of the criteria pollutant and/or its precursor gases from stationary, mobile and area sources. In response to the new PM<sub>2.5</sub> ambient air standards, the U.S. Department of Energy's National Energy Technology Laboratory (NETL), in cooperation with key stakeholders including the U.S. EPA, local and state environmental regulatory agencies, industry and academia, elected to fund ambient air monitoring research programs located throughout the U.S. to investigate (i) the nature and composition of PM<sub>2.5</sub> and its precursor gases (e.g., sulfur dioxide [SO<sub>2</sub>], nitrogen oxides [NO<sub>x</sub>]) and (ii) the relationship between emissions from coal-fired electric utilities and ambient air quality. One of the research programs is the *Upper Ohio River Valley Project* (UOVRP), which included the establishment and operation of ambient air monitoring sites located in the Upper Ohio River Valley (UORV). The UORV was chosen for extensive fine particulate research since it is representative of areas in the eastern half of the continental United States that are not well characterized in terms of the ambient air concentrations and chemical composition of PM<sub>2.5</sub> but have a high density of coal-fired electric utility, heavy industry (e.g., coke and steel making), light industry and transportation emission sources. The UORV is also in the center of the ozone transport region, which provides a platform to study interstate pollution transport issues.

The location of the two urban and two rural ambient air monitoring sites included in the UOVRP along with neighboring coal-fired electric utility plants are presented in Figure 1. The four sites selected for the UOVRP were collocated at existing local and/or state air quality monitoring stations. The sites were as follows:

SITE NAME	LOCATION	SITE TYPE	COOPERATING REGULATORY AGENCY
Athens (AT)	Athens, OH	Rural	Ohio EPA (OH EPA)
Holbrook (HB)	Holbrook, PA	Rural	Pennsylvania Department of Environmental Protection (PA DEP)
Lawrenceville (LW)	Pittsburgh, PA	Urban	Allegheny County (PA) Health Department (ACHD)
Morgantown (MO)	Morgantown, WV	Urban	West Virginia Department of Environmental Protection (WV DEP)

Details regarding the location of these four sites as well as a summary of the ambient air parameters measured at each site are presented in Section 3 of this report. Sampling activities for the UORVP were initiated in February 1999 and concluded in February 2003.

## 1.2 Project Goal and Objectives

The goal of the UORVP was to characterize the nature and composition of PM<sub>2.5</sub> and its precursor gases. In the process, the objectives of the UORVP were to address the following at sites located in the UORV:

- What are the ambient air concentrations of PM<sub>2.5</sub>?
- How do the ambient air concentrations of PM<sub>2.5</sub> compare with the promulgated PM<sub>2.5</sub> standards?
- Are there geographical, seasonal or temporal variations of ambient air concentrations of PM<sub>2.5</sub>?
- Are there significant differences in ambient air concentrations of PM<sub>2.5</sub> at sites that deploy different types of PM<sub>2.5</sub> samplers?
- What are the primary chemical constituents of PM<sub>2.5</sub>?
- Are there any correlations between ambient air concentrations of PM<sub>2.5</sub> and its precursor gases?
- Are there any correlations between ambient air concentrations of PM<sub>2.5</sub> and other gaseous pollutants (e.g., ozone)?
- Are there any correlations between ambient air concentrations of PM<sub>2.5</sub> and meteorological parameters?

Advanced Technology Systems, Inc. (*ATS*) was contracted by the NETL in September 1998 to manage the UORVP. This semi-annual Technical Progress Report summarizes the data analyses

and interpretations conducted during the period from April 2004 through September 2004. The organizational format for this report is as follows (per the Guidelines for Organization of Technical Reports [September 2003]):

1. Introduction
2. Executive Summary
3. Experimental
4. Results and Discussion
5. Conclusions

### **1.3 Project Organization**

A list of the individuals with major responsibilities who participated in this project includes the following:

- NETL Program Manager for the UORVP
- *ATS* Program Manager for the UORVP
- *ATS* Coordinator for Sampling and Analytical Laboratory Activities
- Subcontract Analytical Laboratory Representatives
- Subcontract Site Operators
- Cooperating Regulatory Agency Representatives

An organization chart showing the relationships and the lines of communication among these individuals is presented in Figure 2. *ATS* contracted Desert Research Institute (DRI) to (i) provide many of the PM<sub>2.5</sub> and precursor gas samplers not already deployed at the sites by the cooperating regulatory agency or *ATS* and (ii) conduct the required analyses of the samples generated by DRI's samplers. Details regarding DRI's organizational structure for the UORVP were previously presented in the document prepared by DRI entitled "Quality Integrated Work Plan (QIWP) for the Upper Ohio River Valley Project" dated April 27, 1999.

## 2.0 EXECUTIVE SUMMARY

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Advanced Technology Systems, Inc. (*ATS*), with Desert Research Institute (DRI) and Ohio University as subcontractors, was contracted by the NETL in September 1998 to manage the *Upper Ohio River Valley Project* (UORVP), which included the establishment and operation of four ambient air monitoring sites located in the Upper Ohio River Valley (UORV). Two urban and two rural monitoring sites were included in the UORVP. The four sites selected for the UORVP were collocated at existing local and/or state air quality monitoring stations. The goal of the UORVP was to characterize the nature and composition of PM<sub>2.5</sub> and its precursor gases. In the process, the objectives of the UORVP were to examine the ambient air concentrations of PM<sub>2.5</sub> as compared with the promulgated PM<sub>2.5</sub> standards, the geographical, seasonal and temporal variations of ambient air concentrations of PM<sub>2.5</sub>, the primary chemical constituents of PM<sub>2.5</sub>, and the correlations between ambient air concentrations of PM<sub>2.5</sub> and its precursor gases, other gaseous pollutants and meteorological parameters. A variety of meteorological and pollutant measurement devices, including several different PM<sub>2.5</sub> samplers that provided either real-time or integrated concentration data, were deployed at the monitoring sites. The frequency of integrated sampling varied throughout the UORVP study period and was as follows:

- “Intensive” sampling periods were defined as periods in which samples were collected on a relatively frequent basis (ranged from 6-hour integrated samples collected round-the-clock to one 24-hour integrated sample collected every third day).
- “Background” sampling periods were defined as periods in which 24-hour integrated samples were collected every third or sixth day.

Sampling activities for the UORVP were initiated in February 1999 and concluded in February 2003. This semi-annual Technical Progress Report, which was organized in accordance with the Guidelines for Organization of Technical Reports (September 2003), summarizes the data analyses and interpretations conducted during the period from April 2004 through September 2004. The findings can be summarized as follows:

### **Samples Collected During the Background Sampling Periods**

- The data collected during the background sampling periods suggests that PM<sub>2.5</sub> mass concentrations are statistically the same at the LW, HB and MO sites.
- The data collected during the background sampling periods show that the overall average PM<sub>2.5</sub> mass concentrations measured at the HB, LW and MO sites are very nearly equal to the promulgated annual standard of 15 µg/m<sup>3</sup> but far less than the 24-hour standard of 65 µg/m<sup>3</sup>.
- The data collected during the background sampling periods suggests that LW PM<sub>10</sub> mass concentrations are statistically greater than the HB PM<sub>10</sub> mass concentrations.

- The data collected during the background sampling periods show that the overall average PM<sub>10</sub> mass concentrations measured at the HB and LW sites are far less than the promulgated annual standard of 50 µg/m<sup>3</sup> and the 24-hour standard of 150 µg/m<sup>3</sup>.

### **Samples Collected During the Intensive Sampling Periods**

- During the summer months, diurnal variations of LW PM<sub>2.5</sub> and PM<sub>10</sub> mass concentrations were observed. The changes in concentrations from one 6-hour measurement period to the following 6-hour measurement period were not statistically significant except for PM<sub>10</sub> (increase from 0000-0600 to 0600-1200, likely due to inputs from automotive sources during the morning hours).
- During the winter months, diurnal variations of LW PM<sub>2.5</sub> and PM<sub>10</sub> mass concentrations were observed. The changes in concentrations from one 6-hour measurement period to the following 6-hour measurement period were not statistically significant except for (i) PM<sub>2.5</sub> and PM<sub>10</sub> (increase from 0000-0600 to 0600-1200, likely due to inputs from automotive sources during the morning hours and decreases in the atmospheric mixing height during nighttime hours) and (ii) PM<sub>2.5</sub> and PM<sub>10</sub> (decrease from 0600-1200 to 1200-1800, likely due to increases in the atmospheric mixing height during daytime hours).
- At the LW site, the data suggests that PM<sub>2.5</sub> mass concentrations are usually higher during the summer season as compared with the winter season, although other factors (e.g., local sources and weather) apparently contribute in a manner sufficient to obfuscate the seasonal pattern. At the HB site, the data strongly suggests that PM<sub>2.5</sub> mass concentrations are higher during the summer season as compared with the winter season, which is likely due to the occurrence of photochemical activity. There is insufficient quantity of data from the MO site to deduce any seasonal variations in PM<sub>2.5</sub> mass concentrations at this site.
- At the LW site, the data suggests that there are no seasonal variations in PM<sub>10</sub> mass concentrations at this site. At the HB site, the data suggests that PM<sub>10</sub> mass concentrations may be higher during the summer season as compared with the winter season. However, the quantity of data from the HB site is not sufficient to strongly defend this conclusion.

### **Implications**

- The data obtained as part of the UORVP suggests that many regions within the UORV may be designated as non-attainment with respect to the annual PM<sub>2.5</sub> standard. If this is realized, then the State Implementation Plans will likely mandate reducing air emissions of PM<sub>2.5</sub> and/or its precursor gases from a large number of stationary, mobile and area sources that are located within a large geographical area. It should be noted that the UORV states (OH, PA and WV) submitted to the U.S. EPA in February 2004 a list of areas (counties) recommended to be designated to be in non-attainment with the PM<sub>2.5</sub> standards. The U.S. EPA intends to rule upon the state recommendations later this year.

### 3.0 EXPERIMENTAL

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#### 3.1 Ambient Air Monitoring Site Locations

Details regarding the locations of the four sites included in the UORVP are presented below:

SITE	LATITUDE AND LONGITUDE	ELEVATION (ASL)	SITE DESCRIPTION
AT	To be provided	To be provided	To be provided
HB	N39° 48.969' W80° 17.077'	445 m	Site located on privately-owned land near Holbrook, PA; Terrain best described as rolling grassy hills; Land usage includes cow pasture; Sampling equipment located at ground level within a fenced area situated on a grassy knoll
LW	N40° 27.934' W79° 57.646'	267 m	Site located at the Allegheny County (PA) Health Department complex; The complex is situated within a joint residual and retail business district of Pittsburgh, PA; Sampling equipment located on the roof of Building No. 7 (~ 25 feet above ground)
MO	N39° 39.003' W79° 55.245'	463 m	Site located at the Morgantown, WV Municipal Airport; Sampling equipment located at ground level in a grassy field within the complex

The LW site is the most northern and second most eastern of the four UORVP sites while the AT site is the most southern and western of the four UORVP sites. Since the prevailing wind direction in the Pittsburgh, PA area is westerly, it is expected that the LW site would generally be impacted the most by air emissions sources located in the UORV and the AT site would generally be impacted the least by air emissions sources located in the UORV. Digital images of the four sites are presented in Appendix A.

### 3.2 Ambient Air Parameters and Sampling / Analytical Methodologies

The following ambient air parameters were quantified at one or more of the following UORVP sites:

- Mass concentrations of PM<sub>2.5</sub> and PM<sub>10</sub>
- Chemical composition of PM<sub>2.5</sub> and PM<sub>10</sub> – includes organic and elemental carbon, water soluble ions and selected elements (primarily metals)
- Particle size analysis of PM<sub>2.5</sub>
- Concentrations of photo-chemically produced reactive gases – nitric acid (HNO<sub>3</sub>)
- Concentrations of naturally occurring reactive gases – ammonia (NH<sub>3</sub>)
- Concentrations of gaseous criteria pollutants – ozone (O<sub>3</sub>), nitrogen oxides (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>) and carbon monoxide (CO)
- Meteorological parameters – wind speed and direction, temperature, relative humidity, solar radiation and precipitation depth

A summary of the ambient air parameters and the associated measurement techniques deployed at each of the four UORVP sites is presented in Table 1. Several different measurement techniques were utilized to measure integrated (over time) PM<sub>2.5</sub> and PM<sub>10</sub> ambient air concentrations. The instrumentation for the integrated measurement technique essentially includes an inlet particle size separator (impactor or cyclone), an optional denuder for removing selected gases (e.g., HNO<sub>3</sub>), a filter pack loaded with multiple filters, a vacuum pump and a device for measuring sample gas volume. For the purposes of the UORVP, all integrated PM<sub>2.5</sub> samplers were assumed to be equivalent. One measurement technique (TEOM) was utilized to measure real-time (continuous) PM<sub>2.5</sub> and PM<sub>10</sub> ambient air concentrations. The instrumentation for the real-time measurement technique essentially includes an inlet particle size separator (impactor or cyclone), an oscillating microbalance, a vacuum pump and a device for measuring sample gas volume. Details regarding the DRI samplers and their analytical laboratory procedures were previously presented in the DRI QIWP. All other samplers and measurement devices were operated in accordance with the manufacturer's instructions and each operating group's quality assurance project plan.

### 3.3 Sampling Schedule

The analyzers that provided real-time data were designed to operate on a continuous basis throughout the UORVP study period. The sampling and analysis logs for the analyzers that provided integrated data are presented in Tables 2 through 6. The frequency of integrated sampling varied throughout the UORVP study period and was as follows:

- “Intensive” sampling periods were defined as periods in which samples were collected on a relatively frequent basis (ranged from 6-hour integrated samples collected round-the-clock to one 24-hour integrated sample collected every third day).

- “Background” sampling periods were defined as periods in which 24-hour integrated samples were collected every third or sixth day.

For each sampling period, all appropriate samples were analyzed for PM<sub>2.5</sub> or PM<sub>10</sub> mass concentration. For each sampling period, a subset of selected samples was analyzed for targeted elements, ions or compounds. As outlined in Tables 2 through 6, there were very few samples collected during the background sampling periods that were analyzed for targeted elements, ions or compounds. As such, discussions regarding the chemical composition of the collected samples (Section 4 of this report) will be limited to samples collected during the intensive sampling periods.

## 4.0 RESULTS AND DISCUSSION

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### 4.1 Current Data Status for the UORVP Sites

Summaries of the current data statuses for the AT, HB, LW and MO sites are presented in Tables 7 through 10, respectively. All available data have been obtained by ATS except for the data collected by the OH EPA and WV DEP at the AT and MO sites, respectively – ATS intends to request these data soon. Groups external to ATS provided validated data – the validation procedures can be obtained by ATS upon request. No data collected by ATS alone (the TEOM data for HB and LW, the NO<sub>x</sub> data for HB, and the SO<sub>2</sub> and meteorological data for LW) have been validated to date. ATS submits that all validated data will require additional “filtering” in order to develop a final data set that will be utilized for the data analyses and interpretation. Such filtering step will include the following:

#### For Data Obtained Using Continuous Analyzers

- Eliminate voided and missing data (these values are often assigned the value of –99)
- Reassign values that are less than the accepted detection limit / threshold value of the continuous analyzer
- Eliminate other suspicious data as judged by ATS

#### For Data Obtained Using Integrated Samplers

- Eliminate voided and missing data (these values are often assigned the value of –99)
- Eliminate duplicate data entries that present different values (i.e., two data entries with the same identification but differing analytical values)
- “Blank correct” the results for minor contamination if not already performed by the group that submitted the data to ATS (DRI submitted blank-corrected data while Chester LabNet did not) – ATS intends to eliminate data for which the contamination was not considered minor
- For the data provided by DRI, eliminate samples (paired observations only) at the HB and LW sites that satisfied the following criteria:  
PM<sub>10</sub> mass concentration < PM<sub>2.5</sub> mass concentration; and  
The associated error bars did not overlap
- For the data provided by DRI, eliminate samples that satisfied the following criteria:  
PM<sub>2.5</sub> or PM<sub>10</sub> mass concentrations < Sum of the individual chemical concentrations for PM<sub>2.5</sub> or PM<sub>10</sub>; and  
The associated concentration error bars did not overlap
- For the data provided by DRI, eliminate samples that satisfied the following criteria:  
Total chlorine concentration < Water-soluble chloride concentration; and  
The associated concentration error bars did not overlap

- For the data provided by DRI, eliminate samples that satisfied the following criteria:  
Total potassium concentration < Water-soluble potassium concentration; and  
The associated concentration error bars did not overlap
- For the data provided by DRI, eliminate samples that satisfied the following criteria:  
Charge Balance Ratio < 0.80 or Charge Balance Ratio > 1.20  
where Charge Balance Ratio (equivalents basis) =  
Sum of the water-soluble cations / Sum of the water-soluble anions
- Eliminate other suspicious data as judged by ATS

It should be noted that DRI provided an extensive data summary. Per DRI’s standard operating procedures (SOPs), data entries were flagged (using a variety of descriptors) as appropriate if (i) nonstandard procedures were utilized in the field or in the laboratory or (ii) peculiar observations of the samples were noted. DRI voided some samples as appropriate (occurred primarily due to field equipment failures) and elected to report the remainder of the data either with or without data flags. DRI’s SOPs reserve the right for the end user of the data to accept or reject flagged data entries. ATS adopted a fairly conservative approach for filtering DRI’s data prior to conducting the analyses presented in this report (i.e., ATS excluded many, but not all, of the flagged data entries – depended on the nature of the flag).

The data analyses presented in the following sections summarizes the efforts from the integrated filter sampling at the HB, LW and MO sites. These analyses were previously presented in the most recent semi-annual technical report.

## 4.2 Data Collected During the Background Sampling Periods

### 4.2.1 PM<sub>2.5</sub> Mass Concentrations – Site Comparisons – DRI Sampling Equipment

For the LW, HB and MO sites, examine the 24-hour integrated PM<sub>2.5</sub> mass concentrations (samples were collected every sixth day) – composite data were generated that sorted the concentrations by the common sample date (not examining seasonal variations in PM<sub>2.5</sub> mass concentrations here) -

- Calculate the Spearman Rank Correlation Coefficient ( $r_s$ ) for each pairing (LW/HB, LW/MO and HB/MO) – the results are as follows:

Pairing (PM <sub>2.5</sub> DRI)	$r_s$ value	Conclusion
LW / HB	0.70	Reasonably good positive correlation between LW and HB
LW / MO	0.71	Reasonably good positive correlation between LW and MO
HB / MO	0.65	Reasonably good positive correlation between HB and MO

A scatter plot for each pairing also confirms the positive correlations.

- (ii) Calculate the differences for each pairing (LW/HB, LW/MO and HB/MO) – Run a statistical hypothesis test to determine if the average difference for each pairing is significantly different from zero at the 95 percent confidence level – the results are as follows:

Pairing (PM <sub>2.5</sub> DRI)	Conclusion
LW / HB	Insufficient data to conclude that the average difference is significantly different from zero
LW / MO	Ibid.
HB / MO	Ibid.

Essentially, the data collected during the background sampling periods suggests that PM<sub>2.5</sub> mass concentrations are statistically the same at the LW, HB and MO sites.

- (iii) Compare the PM<sub>2.5</sub> mass concentrations measured at the LW, HB and MO sites with the promulgated PM<sub>2.5</sub> mass concentration standards –

24-hour standard = 65 µg/m<sup>3</sup> measured as the 98<sup>th</sup> percentile of the 24-hour PM<sub>2.5</sub> mass concentrations in a year (averaged over three years)

Annual standard = 15 µg/m<sup>3</sup> measured as the three year average of the annual arithmetic mean

The results are as follows:

Site	Overall Average PM <sub>2.5</sub> Conc. (DRI)	50 <sup>th</sup> Percentile PM <sub>2.5</sub> Conc. (DRI)	98 <sup>th</sup> Percentile PM <sub>2.5</sub> Conc. (DRI)
LW	14.4 µg/m <sup>3</sup>	12.5 µg/m <sup>3</sup>	32.7 µg/m <sup>3</sup>
HB	13.0 µg/m <sup>3</sup>	10.4 µg/m <sup>3</sup>	35.0 µg/m <sup>3</sup>
MO	16.3 µg/m <sup>3</sup>	15.6 µg/m <sup>3</sup>	34.6 µg/m <sup>3</sup>

The results show that the overall average PM<sub>2.5</sub> mass concentrations measured at the HB, LW and MO sites are very nearly equal to the promulgated annual standard of 15 µg/m<sup>3</sup> but far less than the 24-hour standard of 65 µg/m<sup>3</sup>.

#### 4.2.2 PM<sub>10</sub> Mass Concentrations – Site Comparisons – DRI Sampling Equipment

For the LW and HB sites, examine the 24-hour integrated PM<sub>10</sub> mass concentrations (samples were collected every sixth day) – composite data were generated that sorted the concentrations by the common sample date (not examining seasonal variations in PM<sub>10</sub> mass concentrations here) -

- (i) Calculate the Spearman Rank Correlation Coefficient ( $r_s$ ) for the LW/HB pairing – the results are as follows:

Pairing (PM <sub>10</sub> DRI)	$r_s$ value	Conclusion
LW / HB	0.80	Good positive correlation between LW and HB

A scatter plot for the pairing also confirms the positive correlations.

- (ii) Calculate the differences for the LW/HB pairing – Run a statistical hypothesis test to determine if the average difference for the pairing is significantly different from zero at the 95 percent confidence level – the results are as follows:

Pairing (PM <sub>10</sub> DRI)	Conclusion
LW / HB	The average difference is significantly different from zero (LW > HB)

The data collected during the background sampling periods suggests that there is a larger number of PM<sub>10</sub> sources that impact the LW site as compared with the HB site.

- (iii) Compare the PM<sub>10</sub> mass concentrations measured at the LW and HB sites with the promulgated PM<sub>10</sub> mass concentration standards –

24-hour standard = 150 µg/m<sup>3</sup> measured as the 99<sup>th</sup> percentile of the 24-hour PM<sub>2.5</sub> mass concentrations in a year (averaged over three years)

Annual standard = 50 µg/m<sup>3</sup> measured as an annual arithmetic mean

The results are as follows:

Site	Overall Average PM <sub>10</sub> Conc. (DRI)	50 <sup>th</sup> Percentile PM <sub>10</sub> Conc. (DRI)	99 <sup>th</sup> Percentile PM <sub>10</sub> Conc. (DRI)
LW	22.3 µg/m <sup>3</sup>	20.4 µg/m <sup>3</sup>	52.6 µg/m <sup>3</sup>
HB	17.0 µg/m <sup>3</sup>	14.2 µg/m <sup>3</sup>	49.0 µg/m <sup>3</sup>

The results show that the overall average PM<sub>10</sub> mass concentrations measured at the HB and LW sites are far less than the promulgated annual standard of 50 µg/m<sup>3</sup> and the 24-hour standard of 150 µg/m<sup>3</sup>.

#### 4.2.3 Comparison of PM<sub>2.5</sub> with PM<sub>10</sub> Mass Concentrations – DRI Sampling Equipment

For the LW and HB sites, examine the 24-hour integrated PM<sub>2.5</sub> and PM<sub>10</sub> mass concentrations (samples were collected every sixth day) – composite data were generated that sorted the concentrations by the common sample date (not examining seasonal variations in PM<sub>2.5</sub> and PM<sub>10</sub> mass concentrations here) -

- (i) For the LW and HB sites, calculate the Spearman Rank Correlation Coefficient ( $r_s$ ) for each PM<sub>2.5</sub> / PM<sub>10</sub> pairing – the results are as follows:

Pairing (DRI)	$r_s$ value	Conclusion
LW PM <sub>2.5</sub> / PM <sub>10</sub>	0.85	Very good positive correlation at the LW site
HB PM <sub>2.5</sub> / PM <sub>10</sub>	0.84	Very good positive correlation at the HB site

A scatter plot for each pairing also confirms the positive correlation.

- (ii) For the LW and HB sites, calculate the differences for each PM<sub>2.5</sub> / PM<sub>10</sub> pairing – Run a statistical hypothesis test to determine if the average difference for each pairing is significantly different from zero at the 95 percent confidence level – the results are as follows:

Pairing (DRI)	Conclusion
LW PM <sub>2.5</sub> / PM <sub>10</sub>	The average difference is significantly different from zero at the LW site (PM <sub>10</sub> > PM <sub>2.5</sub> )
HB PM <sub>2.5</sub> / PM <sub>10</sub>	The average difference is significantly different from zero at the HB site (PM <sub>10</sub> > PM <sub>2.5</sub> )

If the sampling equipment is operating properly, then these are the expected results.

#### 4.2.4 Comparison of PM<sub>2.5</sub> Mass Concentrations – DRI Sampling Equipment with PM<sub>2.5</sub> Mass Concentrations – FRM Sampling Equipment

For the LW and HB sites, examine the 24-hour integrated PM<sub>2.5</sub> mass concentrations (samples were collected every sixth day) that were measured using the DRI and the FRM sampling equipment – composite data were generated that sorted the concentrations by the common sample date (not examining seasonal variations in PM<sub>2.5</sub> mass concentrations here) -

- (i) For the LW and HB sites, calculate the Spearman Rank Correlation Coefficient ( $r_s$ ) for each DRI / FRM pairing - the results are as follows:

Pairing (PM <sub>2.5</sub> )	$r_s$ value	Conclusion
LW DRI / FRM	0.92	Very good positive correlation at the LW site
HB DRI / FRM	0.90	Very good positive correlation at the HB site

A scatter plot for each pairing also confirms the positive correlation.

- (ii) For the LW and HB sites, calculate the differences for each DRI / FRM pairing - Run a statistical hypothesis test to determine if the average difference for each pairing is significantly different from zero at the 95 percent confidence level – the results are as follows:

Pairing (PM <sub>2.5</sub> )	Conclusion
LW DRI / FRM	Insufficient data to conclude that the average difference is significantly different from zero
HB DRI / FRM	The average difference is significantly different from zero at the HB site (DRI > FRM)

The results summarized above present different conclusions for identical tests performed at two separate sites. To further understand these conclusions, an additional statistical hypothesis test was run in a manner similar to the test described in Section 1.1(ii). Calculate the differences for the LW/HB FRM pairings - Run a statistical hypothesis test to determine if the average difference for the pairing is significantly different from zero at the 95 percent confidence level – the results are as follows:

Pairing (PM <sub>2.5</sub> )	Conclusion
FRM LW / HB	The average difference is significantly different from zero (LW > HB)

The result summarized above does not match the result summarized in Section 1.1 using the DRI sampling equipment (PM<sub>2.5</sub> DRI LW / HB). As such, we conclude that the PM<sub>2.5</sub> data generated with the FRM sampling equipment at the HB site may be suspect.

### 4.3 Data Collected During the Intensive Sampling Periods

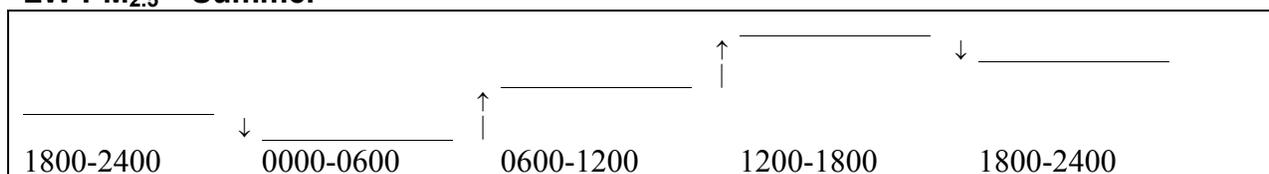
#### 4.3.1 Diurnal Variations of LW PM<sub>2.5</sub> and PM<sub>10</sub> Mass Concentrations – DRI Sampling Equipment

For the LW site, examine the 6-hour integrated PM<sub>2.5</sub> and PM<sub>10</sub> mass concentrations to determine the presence of diurnal variations of these concentrations – For PM<sub>2.5</sub> and PM<sub>10</sub>, calculate the difference in the concentrations for each consecutive 6-hour sampling period (i.e., concentration for [0600 to 1200] time period minus the concentration for the [0000 to 0600] time period) - composite data were generated that sorted the differences by the common sampling comparison period and the season of the year (summer or winter) – Run a statistical hypothesis test to determine if the average difference for each seasonal sampling comparison period is significantly different from zero at the 95 percent confidence level – the results are as follows:

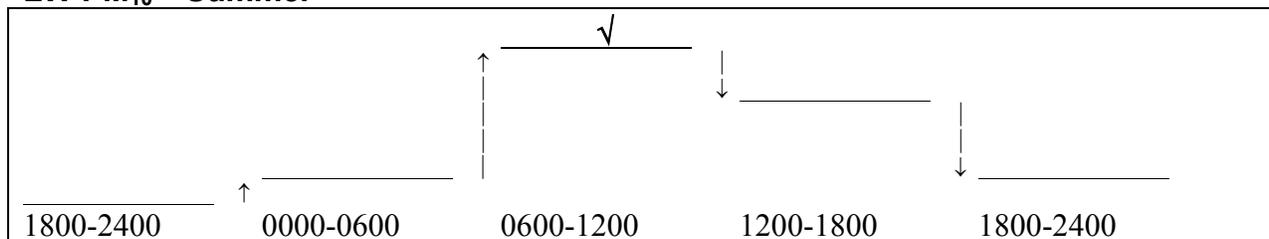
Legend

- ↑ Average difference in concentration for consecutive 6-hour sampling periods > 0
- ↓ Average difference in concentration for consecutive 6-hour sampling periods < 0 (size of ↑ and ↓ approximates the value of the average difference)
- √ Average difference is significantly different from zero

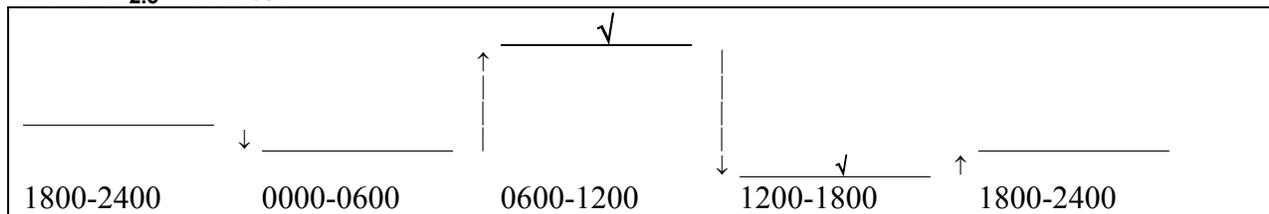
#### LW PM<sub>2.5</sub> – Summer



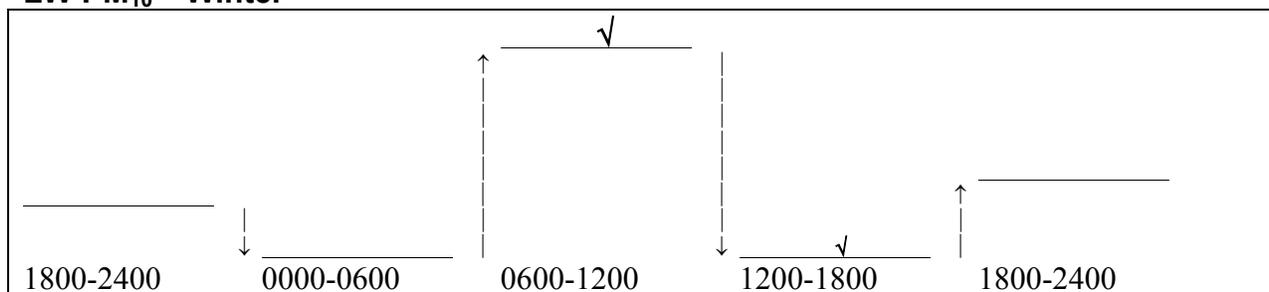
#### LW PM<sub>10</sub> – Summer



### LW PM<sub>2.5</sub> – Winter



### LW PM<sub>10</sub> – Winter



During the winter season, the changes in PM<sub>2.5</sub> and PM<sub>10</sub> mass concentrations are likely due to (i) inputs from automotive sources during the morning hours and (ii) increases and decreases in the atmospheric mixing height during daytime and nighttime hours, respectively. During the summer season, the changes in PM<sub>2.5</sub> and PM<sub>10</sub> mass concentrations are likely due to the factors outlined above and to the occurrence of atmospheric photochemical activity (especially for PM<sub>2.5</sub>).

### 4.3.2 Seasonal Variations of PM<sub>2.5</sub> Mass Concentrations – Site Comparisons - DRI Sampling Equipment

Compare the PM<sub>2.5</sub> mass concentrations measured at the LW, HB and MO sites with the promulgated PM<sub>2.5</sub> mass concentration standards for each sampling period – the results are as follows:

24-hour standard = 65 µg/m<sup>3</sup> measured as the 98<sup>th</sup> percentile of the 24-hour PM<sub>2.5</sub> mass concentrations in a year (averaged over three years)

#### LW PM<sub>2.5</sub> (DRI)

Season	Sampling Dates	50 <sup>th</sup> Percentile PM <sub>2.5</sub> Conc. (DRI)	98 <sup>th</sup> Percentile PM <sub>2.5</sub> Conc. (DRI)
Winter	02/17/1999 – 02/28/1999 *	12.6 µg/m <sup>3</sup>	34.2 µg/m <sup>3</sup>
Summer	08/03/1999 – 09/11/1999 *	15.2 µg/m <sup>3</sup>	36.0 µg/m <sup>3</sup>

Season	Sampling Dates	50 <sup>th</sup> Percentile PM <sub>2.5</sub> Conc. (DRI)	98 <sup>th</sup> Percentile PM <sub>2.5</sub> Conc. (DRI)
Winter	01/12/2000 – 02/18/2000 *	13.7 µg/m <sup>3</sup>	32.5 µg/m <sup>3</sup>
Summer	07/17/2000 – 08/25/2000 *	15.0 µg/m <sup>3</sup>	38.8 µg/m <sup>3</sup>
Summer	06/30/2001 – 08/08/2001 *	18.8 µg/m <sup>3</sup>	52.8 µg/m <sup>3</sup>
Winter	01/02/2002 – 01/22/2002	15.8 µg/m <sup>3</sup>	20.5 µg/m <sup>3</sup>
Fall & Winter	10/01/2002 – 02/27/2003	9.9 µg/m <sup>3</sup>	27.1 µg/m <sup>3</sup>

\*: 6-hour integrated samples rather than 24-hour integrated samples

#### HB PM<sub>2.5</sub> (DRI)

Season	Sampling Dates	50 <sup>th</sup> Percentile PM <sub>2.5</sub> Conc. (DRI)	98 <sup>th</sup> Percentile PM <sub>2.5</sub> Conc. (DRI)
Winter	02/17/1999 – 02/28/1999	N/A – less than 20 samples available	N/A – less than 20 samples available
Summer	08/03/1999 – 09/11/1999	15.8 µg/m <sup>3</sup>	29.6 µg/m <sup>3</sup>
Winter	01/12/2000 – 02/17/2000	8.4 µg/m <sup>3</sup>	16.0 µg/m <sup>3</sup>
Summer	07/17/2000 – 08/25/2000	18.0 µg/m <sup>3</sup>	36.9 µg/m <sup>3</sup>
Summer	07/02/2001 – 08/08/2001	27.5 µg/m <sup>3</sup>	55.9 µg/m <sup>3</sup>
Winter	01/02/2002 – 01/22/2002	9.7 µg/m <sup>3</sup>	15.4 µg/m <sup>3</sup>

#### MO PM<sub>2.5</sub> (DRI)

Season	Sampling Dates	50 <sup>th</sup> Percentile PM <sub>2.5</sub> Conc. (DRI)	98 <sup>th</sup> Percentile PM <sub>2.5</sub> Conc. (DRI)
Winter	01/13/2000 – 02/18/2000	N/A – less than 20 samples available	N/A – less than 20 samples available
Summer	08/21/1999 – 08/05/2001	20.3 µg/m <sup>3</sup> (29 samples available)	38.3 µg/m <sup>3</sup> (29 samples available)

At the LW site, the data suggests that PM<sub>2.5</sub> mass concentrations are usually higher during the summer season as compared with the winter season, although other factors (e.g., local sources and weather) apparently contribute in a manner sufficient to obfuscate the seasonal pattern. At the HB site, the data strongly suggests that PM<sub>2.5</sub> mass concentrations are higher during the summer season as compared with the winter season, which is likely due to the occurrence of photochemical activity. There is insufficient quantity of data from the MO site to deduce any seasonal variations in PM<sub>2.5</sub> mass concentrations at this site.

#### 4.3.3 Seasonal Variations of PM<sub>10</sub> Mass Concentrations – Site Comparisons - DRI Sampling Equipment

Compare the PM<sub>10</sub> mass concentrations measured at the LW and HB sites with the promulgated PM<sub>10</sub> mass concentration standards for each sampling period – the results are as follows:

24-hour standard = 150 µg/m<sup>3</sup> measured as the 99<sup>th</sup> percentile of the 24-hour PM<sub>10</sub> mass concentrations in a year (averaged over three years)

##### LW PM<sub>10</sub> (DRI)

Season	Sampling Dates	50 <sup>th</sup> Percentile PM <sub>2.5</sub> Conc. (DRI)	99 <sup>th</sup> Percentile PM <sub>2.5</sub> Conc. (DRI)
Winter	02/17/1999 – 02/28/1999 *	16.6 µg/m <sup>3</sup>	48.9 µg/m <sup>3</sup>
Summer	08/03/1999 – 09/11/1999 *	22.9 µg/m <sup>3</sup>	53.7 µg/m <sup>3</sup>
Winter	01/12/2000 – 02/18/2000 *	19.4 µg/m <sup>3</sup>	56.5 µg/m <sup>3</sup>
Summer	07/17/2000 – 08/25/2000 *	20.5 µg/m <sup>3</sup>	48.8 µg/m <sup>3</sup>
Summer	07/02/2001 – 08/07/2001 *	25.8 µg/m <sup>3</sup>	70.3 µg/m <sup>3</sup>

\*: 6-hour integrated samples rather than 24-hour integrated samples

## HB PM<sub>10</sub> (DRI)

Season	Sampling Dates	50 <sup>th</sup> Percentile PM <sub>2.5</sub> Conc. (DRI)	99 <sup>th</sup> Percentile PM <sub>2.5</sub> Conc. (DRI)
Winter	02/17/1999 – 02/28/1999	N/A – less than 20 samples available	N/A – less than 20 samples available
Summer	08/03/1999 – 09/11/1999	20.0 µg/m <sup>3</sup>	45.8 µg/m <sup>3</sup>
Winter	01/13/2000 – 02/18/2000	12.7 µg/m <sup>3</sup>	23.6 µg/m <sup>3</sup>
Summer	07/17/2000 – 08/25/2000	19.9 µg/m <sup>3</sup>	42.5 µg/m <sup>3</sup>
Summer	06/30/2001 – 08/08/2001	24.0 µg/m <sup>3</sup>	57.5 µg/m <sup>3</sup>

At the LW site, the data suggests that there are no seasonal variations in PM<sub>10</sub> mass concentrations at this site. At the HB site, the data suggests that PM<sub>10</sub> mass concentrations may be higher during the summer season as compared with the winter season. However, the quantity of data from the HB site is not sufficient to strongly defend this conclusion.

### 4.3.4 Presence of Trace Elements in PM<sub>2.5</sub> and PM<sub>10</sub> Samples - DRI Sampling Equipment – Site and Particle Size Comparisons

For the PM<sub>2.5</sub> and PM<sub>10</sub> samples collected at the LW and HB sites with the DRI sampling equipment, calculate the “relative error” (defined as the ratio of the uncertainty value to the concentration) for each trace element – For comparison purposes, all HB PM<sub>2.5</sub>, HB PM<sub>10</sub> and LW PM<sub>10</sub> mass concentrations had a “relative error” of 0.2 or less; For comparison purposes, 99 percent of the LW PM<sub>2.5</sub> mass concentrations had a “relative error” of 0.2 or less

√ = At least 80 percent of the samples classified in a particular category (HB PM<sub>2.5</sub>, LW PM<sub>2.5</sub>, HB PM<sub>10</sub> or LW PM<sub>10</sub>) had a “relative error” (defined as the ratio of the uncertainty value to the concentration) of 0.2 or less –

Trace Element	HB PM <sub>2.5</sub> (58 samples)	LW PM <sub>2.5</sub> (387 samples)	HB PM <sub>10</sub> (8 samples)	LW PM <sub>10</sub> (34 samples)
Na				
Mg				
Al				
Si				
P				
S	√	√	√	√
Cl	√	√		
K	√	√		

Trace Element	HB PM <sub>2.5</sub> (58 samples)	LW PM <sub>2.5</sub> (387 samples)	HB PM <sub>10</sub> (8 samples)	LW PM <sub>10</sub> (34 samples)
Ca			√	√
Ti				
V				
Cr				
Mn				
Fe	√	√	√	√
Co				
Ni				
Cu				
Zn			√	√
Ga			√	
As				
Se				
Br				
Rb				
Sr				
Y				
Zr				
Mo				
Pd			√	
Ag				
Cd				
In				
Sn				
Sb				
Ba				
La				
Au			√	
Hg			√	
Tl				
Pb				
U				

## 5.0 CONCLUSIONS

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### 5.1 Summary of Findings

The following can be concluded from the findings presented above (this summary was previously presented in the most recent semi-annual technical report):

#### *Samples Collected During the Background Sampling Periods*

- The data collected during the background sampling periods suggests that PM<sub>2.5</sub> mass concentrations are statistically the same at the LW, HB and MO sites.
- The data collected during the background sampling periods show that the overall average PM<sub>2.5</sub> mass concentrations measured at the HB, LW and MO sites are very nearly equal to the promulgated annual standard of 15 µg/m<sup>3</sup> but far less than the 24-hour standard of 65 µg/m<sup>3</sup>.
- The data collected during the background sampling periods suggests that LW PM<sub>10</sub> mass concentrations are statistically greater than the HB PM<sub>10</sub> mass concentrations.
- The data collected during the background sampling periods show that the overall average PM<sub>10</sub> mass concentrations measured at the HB and LW sites are far less than the promulgated annual standard of 50 µg/m<sup>3</sup> and the 24-hour standard of 150 µg/m<sup>3</sup>.

#### *Samples Collected During the Intensive Sampling Periods*

- During the summer months, diurnal variations of LW PM<sub>2.5</sub> and PM<sub>10</sub> mass concentrations were observed. The changes in concentrations from one 6-hour measurement period to the following 6-hour measurement period were not statistically significant except for PM<sub>10</sub> (increase from 0000-0600 to 0600-1200, likely due to inputs from automotive sources during the morning hours).
- During the winter months, diurnal variations of LW PM<sub>2.5</sub> and PM<sub>10</sub> mass concentrations were observed. The changes in concentrations from one 6-hour measurement period to the following 6-hour measurement period were not statistically significant except for (i) PM<sub>2.5</sub> and PM<sub>10</sub> (increase from 0000-0600 to 0600-1200, likely due to inputs from automotive sources during the morning hours and decreases in the atmospheric mixing height during nighttime hours) and (ii) PM<sub>2.5</sub> and PM<sub>10</sub> (decrease from 0600-1200 to 1200-1800, likely due to increases in the atmospheric mixing height during daytime hours).
- At the LW site, the data suggests that PM<sub>2.5</sub> mass concentrations are usually higher during the summer season as compared with the winter season, although other factors (e.g., local sources and weather) apparently contribute in a manner sufficient to obfuscate the seasonal pattern. At the HB site, the data strongly suggests that PM<sub>2.5</sub> mass concentrations are higher during the summer season as compared with the winter season,

which is likely due to the occurrence of photochemical activity. There is insufficient quantity of data from the MO site to deduce any seasonal variations in PM<sub>2.5</sub> mass concentrations at this site.

- At the LW site, the data suggests that there are no seasonal variations in PM<sub>10</sub> mass concentrations at this site. At the HB site, the data suggests that PM<sub>10</sub> mass concentrations may be higher during the summer season as compared with the winter season. However, the quantity of data from the HB site is not sufficient to strongly defend this conclusion.

## 5.2 Implications

Historically, regions within the UORV that were initially designated to be in non-attainment with the PM<sub>10</sub> ambient air standards were primarily localized industrial areas (e.g., Clairton, PA). As such, the SIPs for these areas focused on controlling air emissions from selected industrial facilities in an attempt to obtain attainment status with respect to the 24-hour PM<sub>10</sub> standard (there were no regions within the UORV that were designated to be in non-attainment with respect to the annual PM<sub>10</sub> standard). By comparison, the data obtained as part of the UORVP suggests that many regions within the UORV may be designated as non-attainment with respect to the annual PM<sub>2.5</sub> standard. If this is realized, then the SIPs will likely mandate reducing air emissions of PM<sub>2.5</sub> and/or its precursor gases from a large number of stationary, mobile and area sources that are located within a large geographical area. It should be noted that the UORV states (OH, PA and WV) submitted to the U.S. EPA in February 2004 a list of areas (counties) recommended to be designated to be in non-attainment with the PM<sub>2.5</sub> standards (please refer to the following reference links: <http://www.epa.gov/pmdesignations/regions/region3.htm> and <http://www.epa.gov/pmdesignations/regions/region5.htm>). The U.S. EPA intends to rule upon the state recommendations later this year.

## **6.0 ACKNOWLEDGEMENTS**

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Figure 1

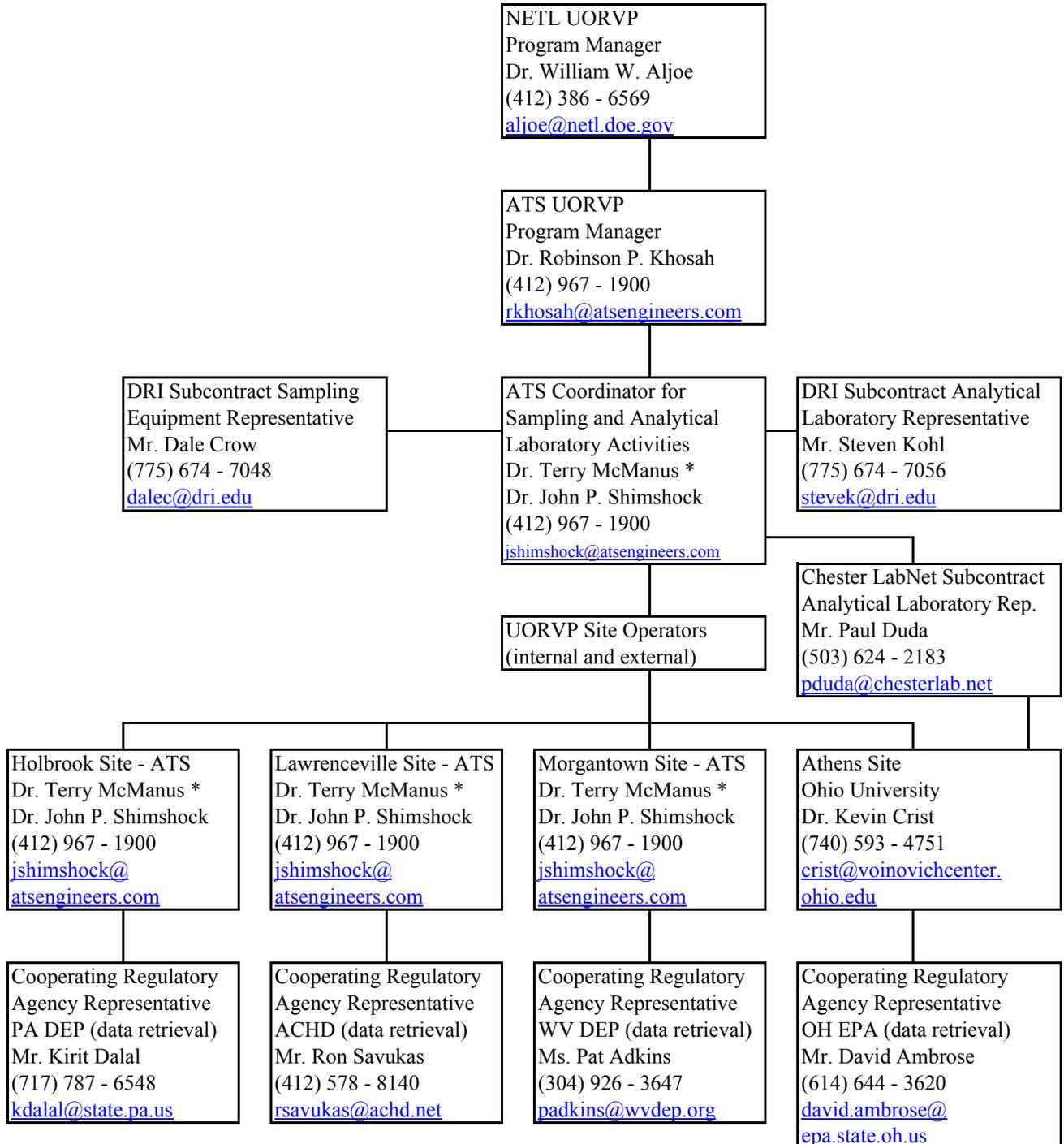
Location of the UORVP Air Monitoring Sites and Neighboring Coal-Fired Electric Utility Plants



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**FIGURE 2**

**UORVP ORGANIZATION CHART**



\*: Currently with West Virginia University - Morgantown, WV

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**TABLE 1**

**SUMMARY OF THE AMBIENT AIR PARAMETERS AND THE ASSOCIATED  
MEASUREMENT TECHNIQUES DEPLOYED AT EACH OF THE FOUR UORVP SITES**

Constituent of Concern	Measurement Technique	Data Type	AT Site		HB Site		LW Site		MO Site	
			Data Collected	Operating Group +						
PM <sub>2.5</sub>	DRI SFS	Integrated *	No	---	Yes	ATS / DRI	Yes	ATS / DRI	Yes	ATS / DRI
	R&P FRM	Integrated *	No	---	Yes	ATS / DRI	Yes	ATS / DRI	Yes	WV DEP
	R&P TEOM	Real-Time **	No	---	Yes	ATS	Yes	ATS	No	---
	Met One SASS	Integrated *	Yes	OU/LabNet	No	---	No	---	No	---
	Anderson SFS	Integrated *	Yes	OH EPA	No	---	No	---	No	---
PM <sub>10</sub>	DRI SFS	Integrated *	No	---	Yes	ATS / DRI	Yes	ATS / DRI	No	---
	R&P TEOM	Real-Time **	No	---	No	---	Yes	ATS	No	---
	Anderson Hi-Vol	Integrated *	Yes	OH EPA	No	---	No	---	Yes	WV DEP
HNO <sub>3</sub>	DRI SGS TP	Integrated *	No	---	Yes	ATS / DRI	Yes	ATS / DRI	No	---
NH <sub>3</sub>	DRI SGS PM <sub>2.5</sub>	Integrated *	No	---	Yes	ATS / DRI	Yes	ATS / DRI	No	---
Particle Size	DRI Portable	Integrated *	No	---	Yes	ATS / DRI	Yes	ATS / DRI	No	---
Ozone (O <sub>3</sub> )	Continuous Analyzer	Real-Time **	No	---	Yes	PA DEP	Yes	ACHD	Yes	WV DEP
Nitrogen Oxides (NO <sub>x</sub> )	Continuous Analyzer	Real-Time **	No	---	Yes	ATS	Yes	ACHD	No	---
Sulfur Dioxide (SO <sub>2</sub> )	Continuous Analyzer	Real-Time **	No	---	Yes	PA DEP	Yes	ATS	Yes	WV DEP
Carbon Monoxide (CO)	Continuous Analyzer	Real-Time **	No	---	Yes	PA DEP	No	---	No	---
Wind Speed / Direction	Continuous Analyzer	Real-Time **	No	---	Yes	PA DEP	Yes	ATS	No	---
Ambient Temperature	Continuous Analyzer	Real-Time **	No	---	Yes	PA DEP	Yes	ATS	No	---
Relative Humidity	Continuous Analyzer	Real-Time **	No	---	Yes	PA DEP	Yes	ATS	No	---
Solar Radiation	Continuous Analyzer	Real-Time **	No	---	No	---	Yes	ATS	No	---
Precipitation Depth	Continuous Analyzer	Real-Time **	No	---	No	---	Yes	ATS	No	---

**Legend**

DRI	Desert Research Institute	R&P	Rupprecht & Patashnick Co., Inc.
SFS	Sequential Filter Sampler	FRM	Federal Reference Method
SGS TP	Sequential Gas Sampler with Total Particulate Matter Inlet Particle Sizer	Hi-Vol	High volume air sampler
SGS PM <sub>2.5</sub>	Sequential Gas Sampler with PM <sub>2.5</sub> Inlet Particle Sizer	Met One	Met One Instruments, Inc.
Portable	Filter Sampler with PM <sub>2.5</sub> Inlet Particle Sizer	TEOM	Tapered Element Oscillating Microbalance - Series 1400a
Anderson	Sierra (Thermal) Anderson Instruments	SASS	Spiral Aerosol Speciation Sampler
OU	Ohio University	*	Over time
LabNet	Chester LabNet	**	Continuous
		+	If two groups are listed (e.g., ATS / DRI), the first group performed the field sampling while the second group performed the analytical laboratory analyses

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**TABLE 2**

**INTEGRATED PM<sub>2.5</sub> SAMPLERS -  
SAMPLING AND ANALYSIS LOG**

Sampling Period Type	Site ID	Measurement Technique	Start Date	Stop Date	Sampling Frequency	Nominal Sampling Duration (hrs)	No. of Samples Collected *	No. Samples Analyzed **	
								Mass	Chemical Constituents
Intensive (winter)	AT	Anderson SFS			Every 3rd Day	24			
	AT	Met One SASS							
	HB	DRI SFS	2/17/1999	2/28/1999	Once per day	24	12	11	10
	HB	R&P FRM	2/17/1999	2/28/1999	Every 6th Day	24			2
	LW	DRI SFS	2/17/1999	2/28/1999	4 times per day	6	48	46	37
	LW	R&P FRM	2/17/1999	2/28/1999	Every 6th Day	24			2
	MO	DRI SFS	2/17/1999	2/28/1999	Every 3rd Day	24	0	0	0
	MO	R&P FRM			Every 3rd Day	24			
Background	AT	Anderson SFS			Every 3rd Day	24			
	AT	Met One SASS							
	HB	DRI SFS	3/1/1999	7/29/1999	Every 6th Day	24	26	26	7
	HB	R&P FRM	3/1/1999	7/29/1999	Every 6th Day	24			7
	LW	DRI SFS	3/1/1999	7/29/1999	Every 6th Day	24	26	26	7
	LW	R&P FRM	3/1/1999	7/29/1999	Every 6th Day	24			7
	MO	DRI SFS	3/1/1999	7/29/1999	Every 6th Day	24	0	0	0
	MO	R&P FRM			Every 3rd Day	24			
Intensive (summer)	AT	Anderson SFS			Every 3rd Day	24			
	AT	Met One SASS							
	HB	DRI SFS	8/3/1999	9/11/1999	Once per day	24	40	39	11
	HB	R&P FRM	8/3/1999	9/11/1999	Every 6th Day	24			7
	LW	DRI SFS	8/3/1999	9/11/1999	4 times per day	6	160	154	40
	LW	R&P FRM	8/3/1999	9/11/1999	Every 6th Day	24			2
	MO	DRI SFS	8/21/1999	9/11/1999	Every 3rd Day	24	8	5	0
	MO	R&P FRM			Every 3rd Day	24			
Background	AT	Anderson SFS			Every 3rd Day	24			
	AT	Met One SASS							
	HB	DRI SFS	9/15/1999	1/7/2000	Every 6th Day	24	20	17	0
	HB	R&P FRM	9/15/1999	1/7/2000	Every 6th Day	24			
	LW	DRI SFS	9/15/1999	1/7/2000	Every 6th Day	24	20	20	0
	LW	R&P FRM	9/15/1999	1/7/2000	Every 6th Day	24			
	MO	DRI SFS	9/15/1999	1/7/2000	Every 6th Day	24	21	20	0
	MO	R&P FRM			Every 3rd Day	24			

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**TABLE 2**

**INTEGRATED PM<sub>2.5</sub> SAMPLERS -  
SAMPLING AND ANALYSIS LOG**

Sampling Period Type	Site ID	Measurement Technique	Start Date	Stop Date	Sampling Frequency	Nominal Sampling Duration (hrs)	No. of Samples Collected *	No. Samples Analyzed **	
								Mass	Chemical Constituents
Intensive (winter)	AT	Anderson SFS			Every 3rd Day	24			
	AT	Met One SASS							
	HB	DRI SFS	1/12/2000	2/18/2000	Once per day	24	38	35	11
	HB	R&P FRM	1/12/2000	2/18/2000	Every 6th Day	24			6
	LW	DRI SFS	1/12/2000	2/18/2000	4 times per day	6	152	140	38
	LW	R&P FRM	1/12/2000	2/18/2000	Every 6th Day	24			6
	MO	DRI SFS	1/13/2000	2/18/2000	Every 3rd Day	24	13	8	0
	MO	R&P FRM			Every 3rd Day	24			
Background	AT	Anderson SFS			Every 3rd Day	24			
	AT	Met One SASS							
	HB	DRI SFS	2/24/2000	7/11/2000	Every 6th Day	24	23	16	1
	HB	R&P FRM	2/24/2000	7/11/2000	Every 6th Day	24			
	LW	DRI SFS	2/24/2000	7/11/2000	Every 6th Day	24	23	22	2
	LW	R&P FRM	2/24/2000	7/11/2000	Every 6th Day	24			
	MO	DRI SFS	2/24/2000	7/11/2000	Every 6th Day	24	21	19	0
	MO	R&P FRM			Every 3rd Day	24			
Intensive (summer)	AT	Anderson SFS			Every 3rd Day	24			
	AT	Met One SASS							
	HB	DRI SFS	7/17/2000	8/25/2000	Once per day	24	40	39	16
	HB	R&P FRM	7/17/2000	8/25/2000	Every 6th Day	24			7
	LW	DRI SFS	7/17/2000	8/25/2000	4 times per day	6	160	149	60
	LW	R&P FRM	7/17/2000	8/25/2000	Every 6th Day	24			7
	MO	DRI SFS	7/17/2000	8/25/2000	Every 3rd Day	24	14	12	0
	MO	R&P FRM			Every 3rd Day	24			
Background	AT	Anderson SFS			Every 3rd Day	24			
	AT	Met One SASS							
	HB	DRI SFS	8/28/2000	6/24/2001	Every 6th Day	24	51	38	2
	HB	R&P FRM	8/28/2000	6/24/2001	Every 6th Day	24			22
	LW	DRI SFS	8/28/2000	6/24/2001	Every 6th Day	24	51	50	2
	LW	R&P FRM	8/28/2000	6/24/2001	Every 6th Day	24			21
	MO	DRI SFS	8/28/2000	6/24/2001	Every 6th Day	24	50	43	0
	MO	R&P FRM			Every 3rd Day	24			

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**TABLE 2**

**INTEGRATED PM<sub>2.5</sub> SAMPLERS -  
SAMPLING AND ANALYSIS LOG**

Sampling Period Type	Site ID	Measurement Technique	Start Date	Stop Date	Sampling Frequency	Nominal Sampling Duration (hrs)	No. of Samples Collected *	No. Samples Analyzed **	
								Mass	Chemical Constituents
Intensive (summer)	AT	Anderson SFS			Every 3rd Day	24			
	AT	Met One SASS							
	HB	DRI SFS	6/30/2001	8/8/2001	Once per day	24	40	36	21
	HB	R&P FRM	6/30/2001	8/8/2001	Every 6th Day	24			9
	LW	DRI SFS	6/30/2001	8/8/2001	4 times per day	6	160	156	83
	LW	R&P FRM	6/30/2001	8/8/2001	Every 6th Day	24			9
	MO	DRI SFS	6/30/2001	8/5/2001	Every 3rd Day	24	14	12	0
	MO	R&P FRM			Every 3rd Day	24			
Intensive (winter)	AT	Anderson SFS			Every 3rd Day	24			
	AT	Met One SASS							
	HB	DRI SFS	1/2/2002	1/22/2002	Once per day	24	21	21	0
	HB	R&P FRM	1/2/2002	1/22/2002	Every 6th Day	24			
	LW	DRI SFS	1/2/2002	1/22/2002	Once per day	24	21	21	0
	LW	R&P FRM	1/2/2002	1/22/2002	Every 6th Day	24			
	MO	DRI SFS	1/2/2002	1/22/2002	Every 3rd Day	24	0	0	0
	MO	R&P FRM			Every 3rd Day	24			
Intensive (fall & winter)	AT	Anderson SFS			Every 3rd Day	24			
	AT	Met One SASS							
	HB	DRI SFS	10/1/2002	2/28/2003	Once per day	24	0	0	0
	HB	R&P FRM	10/1/2002	2/28/2003	Every 6th Day	24			
	LW	DRI SFS	10/1/2002	2/28/2003	Once per day	24	164	164	164
	LW	R&P FRM	10/1/2002	2/28/2003	Every 6th Day	24			
	MO	DRI SFS	10/1/2002	2/28/2003	Every 3rd Day	24	0	0	0
	MO	R&P FRM			Every 3rd Day	24			

\*: Excludes Field Blanks and Missing Data  
Blank entries denotes that the data were unavailable for this report

\*\*: Excludes Field and Laboratory Blanks  
Chemical constituents include 38 elements (primarily metals), organic and elemental carbon, inorganic ions, artifact organic carbon and volatilized nitrate

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**TABLE 3**

**INTEGRATED PM<sub>10</sub> SAMPLERS -  
SAMPLING AND ANALYSIS LOG**

Sampling Period Type	Site ID	Measurement Technique	Start Date	Stop Date	Sampling Frequency	Nominal Sampling Duration (hrs)	No. of Samples Collected *	No. Samples Analyzed **	
								Mass	Chemical Constituents
Intensive (winter)	AT	Anderson Hi-Vol			Every 6th Day	24			
	HB	DRI SFS	2/17/1999	2/28/1999	Once per day	24	12	11	10
	LW	DRI SFS	2/17/1999	2/28/1999	4 times per day	6	48	45	38
	MO	Anderson Hi-Vol			Every 6th Day	24			
Background	AT	Anderson Hi-Vol			Every 6th Day	24			
	HB	DRI SFS	3/1/1999	7/29/1999	Every 6th Day	24	26	26	7
	LW	DRI SFS	3/1/1999	7/29/1999	Every 6th Day	24	26	25	7
	MO	Anderson Hi-Vol			Every 6th Day	24			
Intensive (summer)	AT	Anderson Hi-Vol			Every 6th Day	24			
	HB	DRI SFS	8/3/1999	9/11/1999	Once per day	24	40	40	0
	LW	DRI SFS	8/3/1999	9/11/1999	4 times per day	6	160	155	0
	MO	Anderson Hi-Vol			Every 6th Day	24			
Background	AT	Anderson Hi-Vol			Every 6th Day	24			
	HB	DRI SFS	9/15/1999	1/7/2000	Every 6th Day	24	19	19	0
	LW	DRI SFS	9/15/1999	1/7/2000	Every 6th Day	24	20	20	0
	MO	Anderson Hi-Vol			Every 6th Day	24			
Intensive (winter)	AT	Anderson Hi-Vol			Every 6th Day	24			
	HB	DRI SFS	1/12/2000	2/18/2000	Once per day	24	38	35	0
	LW	DRI SFS	1/12/2000	2/18/2000	4 times per day	6	147	132	0
	MO	Anderson Hi-Vol			Every 6th Day	24			
Background	AT	Anderson Hi-Vol			Every 6th Day	24			
	HB	DRI SFS	2/24/2000	7/11/2000	Every 6th Day	24	22	20	0
	LW	DRI SFS	2/24/2000	7/11/2000	Every 6th Day	24	23	21	0
	MO	Anderson Hi-Vol			Every 6th Day	24			
Intensive (summer)	AT	Anderson Hi-Vol			Every 6th Day	24			
	HB	DRI SFS	7/17/2000	8/25/2000	Once per day	24	40	39	0
	LW	DRI SFS	7/17/2000	8/25/2000	4 times per day	6	160	153	0
	MO	Anderson Hi-Vol			Every 6th Day	24			

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TABLE 3

INTEGRATED PM<sub>10</sub> SAMPLERS -  
 SAMPLING AND ANALYSIS LOG

Sampling Period Type	Site ID	Measurement Technique	Start Date	Stop Date	Sampling Frequency	Nominal Sampling Duration (hrs)	No. of Samples Collected *	No. Samples Analyzed **	
								Mass	Chemical Constituents
Background	AT	Anderson Hi-Vol			Every 6th Day	24			
	HB	DRI SFS	8/28/2000	6/24/2001	Every 6th Day	24	51	51	0
	LW	DRI SFS	8/28/2000	6/24/2001	Every 6th Day	24	51	46	0
	MO	Anderson Hi-Vol			Every 6th Day	24			
Intensive (summer)	AT	Anderson Hi-Vol			Every 6th Day	24			
	HB	DRI SFS	6/30/2001	8/8/2001	Once per day	24	40	40	0
	LW	DRI SFS	6/30/2001	8/8/2001	4 times per day	6	160	145	0
	MO	Anderson Hi-Vol			Every 6th Day	24			
Intensive (winter)	AT	Anderson Hi-Vol			Every 6th Day	24			
	HB	DRI SFS	1/2/2002	1/22/2002	Once per day	24	0	0	0
	LW	DRI SFS	1/2/2002	1/22/2002	Once per day	24	0	0	0
	MO	Anderson Hi-Vol			Every 6th Day	24			
Intensive (fall & winter)	AT	Anderson Hi-Vol			Every 6th Day	24			
	LW	DRI SFS	10/1/2002	2/28/2003	Once per day	24	0	0	0
	HB	DRI SFS	10/1/2002	2/28/2003	Once per day	24	0	0	0
	MO	Anderson Hi-Vol			Every 6th Day	24			

\*: Excludes Field Blanks and Missing Data  
 Blank entries denotes that the data were unavailable for this report

\*\*: Excludes Field and Laboratory Blanks  
 Chemical constituents include 38 elements (primarily metals), organic and elemental carbon, inorganic ions, artifact organic carbon and volatilized nitrate

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**TABLE 4**

**INTEGRATED NITRIC ACID (HNO<sub>3</sub>) GAS SAMPLER -  
SAMPLING AND ANALYSIS LOG**

Sampling Period Type	Site ID	Measurement Technique	Start Date	Stop Date	Sampling Frequency	Nominal Sampling Duration (hrs)	No. of Samples Collected *	No. of Samples Analyzed **
Intensive (winter)	HB	DRI SGS TP	2/17/1999	2/28/1999	Once per day	24	12	10
	LW	DRI SGS TP	2/17/1999	2/28/1999	4 times per day	6	48	38
Background	HB	DRI SGS TP	3/1/1999	7/29/1999	Every 6th Day	24	26	7
	LW	DRI SGS TP	3/1/1999	7/29/1999	Every 6th Day	24	26	7
Intensive (summer)	HB	DRI SGS TP	8/3/1999	9/11/1999	Once per day	24	40	11
	LW	DRI SGS TP	8/3/1999	9/11/1999	4 times per day	6	160	41
Background	HB	DRI SGS TP	9/15/1999	1/7/2000	Every 6th Day	24	20	0
	LW	DRI SGS TP	9/15/1999	1/7/2000	Every 6th Day	24	20	0
Intensive (winter)	HB	DRI SGS TP	1/12/2000	2/18/2000	Once per day	24	38	12
	LW	DRI SGS TP	1/12/2000	2/18/2000	4 times per day	6	152	46
Background	HB	DRI SGS TP	2/24/2000	7/11/2000	Every 6th Day	24	24	2
	LW	DRI SGS TP	2/24/2000	7/11/2000	Every 6th Day	24	24	2
Intensive (summer)	HB	DRI SGS TP	7/17/2000	8/25/2000	Once per day	24	40	19
	LW	DRI SGS TP	7/17/2000	8/25/2000	4 times per day	6	160	66
Background	HB	DRI SGS TP	8/28/2000	6/24/2001	Every 6th Day	24	51	3
	LW	DRI SGS TP	8/28/2000	6/24/2001	Every 6th Day	24	51	5
Intensive (summer)	HB	DRI SGS TP	6/30/2001	8/8/2001	Once per day	24	40	20
	LW	DRI SGS TP	6/30/2001	8/8/2001	4 times per day	6	160	80
Intensive (winter)	HB	DRI SGS TP	1/2/2002	1/22/2002	Once per day	24	21	0
	LW	DRI SGS TP	1/2/2002	1/22/2002	Once per day	24	21	0
Intensive (fall & winter)	HB	DRI SGS TP	10/1/2002	2/28/2003	Once per day	24	0	0
	LW	DRI SGS TP	10/1/2002	2/28/2003	Once per day	24	0	0

\*: Excludes Field Blanks

\*\* : Excludes Field and Laboratory Blanks

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**TABLE 5**

**INTEGRATED AMMONIA (NH<sub>3</sub>) GAS SAMPLER -  
SAMPLING AND ANALYSIS LOG**

Sampling Period Type	Site ID	Measurement Technique	Start Date	Stop Date	Sampling Frequency	Nominal Sampling Duration (hrs)	No. of Samples Collected *	No. of Samples Analyzed **
Intensive (winter)	HB	DRI SGS PM <sub>2.5</sub>	2/17/1999	2/28/1999	Once per day	24	12	4
	LW	DRI SGS PM <sub>2.5</sub>	2/17/1999	2/28/1999	4 times per day	6	48	34
Background	HB	DRI SGS PM <sub>2.5</sub>	3/1/1999	7/29/1999	Every 6th Day	24	26	5
	LW	DRI SGS PM <sub>2.5</sub>	3/1/1999	7/29/1999	Every 6th Day	24	26	5
Intensive (summer)	HB	DRI SGS PM <sub>2.5</sub>	8/3/1999	9/11/1999	Once per day	24	40	6
	LW	DRI SGS PM <sub>2.5</sub>	8/3/1999	9/11/1999	4 times per day	6	160	39
Background	HB	DRI SGS PM <sub>2.5</sub>	9/15/1999	1/7/2000	Every 6th Day	24	20	0
	LW	DRI SGS PM <sub>2.5</sub>	9/15/1999	1/7/2000	Every 6th Day	24	20	0
Intensive (winter)	HB	DRI SGS PM <sub>2.5</sub>	1/12/2000	2/18/2000	Once per day	24	38	11
	LW	DRI SGS PM <sub>2.5</sub>	1/12/2000	2/18/2000	4 times per day	6	152	42
Background	HB	DRI SGS PM <sub>2.5</sub>	2/24/2000	7/11/2000	Every 6th Day	24	24	1
	LW	DRI SGS PM <sub>2.5</sub>	2/24/2000	7/11/2000	Every 6th Day	24	24	2
Intensive (summer)	HB	DRI SGS PM <sub>2.5</sub>	7/17/2000	8/25/2000	Once per day	24	40	16
	LW	DRI SGS PM <sub>2.5</sub>	7/17/2000	8/25/2000	4 times per day	6	160	57
Background	HB	DRI SGS PM <sub>2.5</sub>	8/28/2000	6/24/2001	Every 6th Day	24	51	3
	LW	DRI SGS PM <sub>2.5</sub>	8/28/2000	6/24/2001	Every 6th Day	24	51	2
Intensive (summer)	HB	DRI SGS PM <sub>2.5</sub>	6/30/2001	8/8/2001	Once per day	24	40	16
	LW	DRI SGS PM <sub>2.5</sub>	6/30/2001	8/8/2001	4 times per day	6	160	72
Intensive (winter)	HB	DRI SGS PM <sub>2.5</sub>	1/2/2002	1/22/2002	Once per day	24	0	0
	LW	DRI SGS PM <sub>2.5</sub>	1/2/2002	1/22/2002	Once per day	24	0	0
Intensive (fall & winter)	HB	DRI SGS PM <sub>2.5</sub>	10/1/2002	2/28/2003	Once per day	24	0	0
	LW	DRI SGS PM <sub>2.5</sub>	10/1/2002	2/28/2003	Once per day	24	0	0

\*: Excludes Field Blanks

\*\*: Excludes Field and Laboratory Blanks

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**TABLE 6**

**INTEGRATED PM<sub>2.5</sub> PARTICLE SIZE SAMPLER -  
SAMPLING AND ANALYSIS LOG**

Sampling Period Type	Site ID	Measurement Technique	Start Date	Stop Date	Sampling Frequency	Nominal Sampling Duration (hrs)	No. of Samples Collected *	No. of Samples Analyzed **
Intensive (winter)	HB	DRI Portable	2/17/1999	2/28/1999	Once per day	24	12	0
	LW	DRI Portable	2/17/1999	2/28/1999	4 times per day	6	48	0
Background	HB	DRI Portable	3/1/1999	7/29/1999	Every 6th Day	24	26	0
	LW	DRI Portable	3/1/1999	7/29/1999	Every 6th Day	24	26	0
Intensive (summer)	HB	DRI Portable	8/3/1999	9/11/1999	Once per day	24	40	0
	LW	DRI Portable	8/3/1999	9/11/1999	4 times per day	6	160	0
Background	HB	DRI Portable	9/15/1999	1/7/2000	Every 6th Day	24	20	0
	LW	DRI Portable	9/15/1999	1/7/2000	Every 6th Day	24	20	0
Intensive (winter)	HB	DRI Portable	1/12/2000	2/18/2000	Once per day	24	38	0
	LW	DRI Portable	1/12/2000	2/18/2000	4 times per day	6	152	0
Background	HB	DRI Portable	2/24/2000	7/11/2000	Every 6th Day	24	24	0
	LW	DRI Portable	2/24/2000	7/11/2000	Every 6th Day	24	24	0
Intensive (summer)	HB	DRI Portable	7/17/2000	8/24/2000	Once per day	24	39	0
	LW	DRI Portable	7/17/2000	8/25/2000	4 times per day	6	160	0
Background	HB	DRI Portable	8/28/2000	6/24/2001	Every 6th Day	24	51	0
	LW	DRI Portable	8/28/2000	6/24/2001	Every 6th Day	24	51	0
Intensive (summer)	HB	DRI Portable	6/30/2001	8/8/2001	Once per day	24	40	0
	LW	DRI Portable	6/30/2001	8/8/2001	4 times per day	6	160	0
Intensive (winter)	HB	DRI Portable	1/2/2002	1/22/2002	Once per day	24	21	0
	LW	DRI Portable	1/2/2002	1/22/2002	Once per day	24	21	0
Intensive (fall & winter)	HB	DRI Portable	10/1/2002	2/28/2003	Once per day	24	0	0
	LW	DRI Portable	10/1/2002	2/28/2003	Once per day	24	0	0

\*: Excludes Field Blanks

\*\* : Excludes Field and Laboratory Blanks

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TABLE 7

CURRENT DATA STATUS SUMMARY FOR THE ATHENS (AT) SITE

Constituent of Concern	Measurement Technique	Data Type	Data Collected	Data Provider	Data Obtained by ATS	Data Validated by Provider	Data Filtering Status #	Notes
PM <sub>2.5</sub>	DRI SFS	Integrated *	No	---	---	---	---	---
	R&P FRM	Integrated *	No	---	---	---	---	---
	R&P TEOM	Real-Time **	No	---	---	---	---	---
	Met One SASS	Integrated *	Yes	LabNet	Yes	Yes	In Progress	Action item
	Anderson SFS	Integrated *	Yes	OH EPA	No	---	---	ATS to request data
PM <sub>10</sub>	DRI SFS	Integrated *	No	---	---	---	---	---
	R&P TEOM	Real-Time **	No	---	---	---	---	---
	Anderson Hi-Vol	Integrated *	Yes	OH EPA	No	---	---	ATS to request data
HNO <sub>3</sub>	DRI SGS TP	Integrated *	No	---	---	---	---	---
NH <sub>3</sub>	DRI SGS PM <sub>2.5</sub>	Integrated *	No	---	---	---	---	---
Particle Size	DRI Portable	Integrated *	No	---	---	---	---	---
Ozone (O <sub>3</sub> )	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Nitrogen Oxides (NO <sub>x</sub> )	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Sulfur Dioxide (SO <sub>2</sub> )	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Carbon Monoxide (CO)	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Wind Speed / Direction	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Ambient Temperature	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Relative Humidity	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Solar Radiation	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Precipitation Depth	Continuous Analyzer	Real-Time **	No	---	---	---	---	---

Legend

DRI	Desert Research Institute	R&P	Rupprecht & Patashnick Co., Inc.
SFS	Sequential Filter Sampler	FRM	Federal Reference Method
SGS TP	Sequential Gas Sampler with Total Particulate Matter Inlet Particle Sizer	Hi-Vol	High volume air sampler
SGS PM <sub>2.5</sub>	Sequential Gas Sampler with PM <sub>2.5</sub> Inlet Particle Sizer	Met One	Met One Instruments, Inc.
Portable	Filter Sampler with PM <sub>2.5</sub> Inlet Particle Sizer	TEOM	Tapered Element Oscillating Microbalance - Series 1400a
Anderson	Sierra (Thermal) Anderson Instruments	SASS	Spiral Aerosol Speciation Sampler
OU	Ohio University	*	Over time
LabNet	Chester LabNet	**	Continuous
		#	Performed by ATS - Goal is to develop a final data set that will be utilized for the data analyses and interpretation

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TABLE 8

CURRENT DATA STATUS SUMMARY FOR THE HOLBROOK (HB) SITE

Constituent of Concern	Measurement Technique	Data Type	Data Collected	Data Provider	Data Obtained by ATS	Data Validated by Provider	Data Filtering Status #	Notes
PM <sub>2.5</sub>	DRI SFS	Integrated *	Yes	DRI	Yes	Yes	Partially complete	Action item
	R&P FRM	Integrated *	Yes	DRI	Yes	Yes	Partially complete	Action item
	R&P TEOM	Real-Time **	Yes	ATS	Yes	No	In Progress	Action item
	Met One SASS	Integrated *	No	---	---	---	---	---
	Anderson SFS	Integrated *	No	---	---	---	---	---
PM <sub>10</sub>	DRI SFS	Integrated *	Yes	DRI	Yes	Yes	Partially complete	Action item
	R&P TEOM	Real-Time **	No	ATS	Yes	No	Not initiated	Action item
	Anderson Hi-Vol	Integrated *	No	---	---	---	---	---
HNO <sub>3</sub>	DRI SGS TP	Integrated *	Yes	DRI	Yes	Yes	In Progress	Action item
NH <sub>3</sub>	DRI SGS PM <sub>2.5</sub>	Integrated *	Yes	DRI	Yes	Yes	In Progress	Action item
Particle Size	DRI Portable	Integrated *	Yes	DRI	No	---	---	No samples analyzed
Ozone (O <sub>3</sub> )	Continuous Analyzer	Real-Time **	Yes	PA DEP	Yes	Yes	In Progress	Action item
Nitrogen Oxides (NO <sub>x</sub> )	Continuous Analyzer	Real-Time **	Yes	PA DEP	Yes	No	In Progress	ATS to validate data
Sulfur Dioxide (SO <sub>2</sub> )	Continuous Analyzer	Real-Time **	Yes	PA DEP	Yes	Yes	In Progress	Action item
Carbon Monoxide (CO)	Continuous Analyzer	Real-Time **	Yes	PA DEP	Yes	Yes	In Progress	Action item
Wind Speed / Direction	Continuous Analyzer	Real-Time **	Yes	PA DEP	Yes	Yes	In Progress	Action item
Ambient Temperature	Continuous Analyzer	Real-Time **	Yes	PA DEP	Yes	Yes	In Progress	Action item
Relative Humidity	Continuous Analyzer	Real-Time **	Yes	PA DEP	Yes	Yes	In Progress	Action item
Solar Radiation	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Precipitation Depth	Continuous Analyzer	Real-Time **	No	---	---	---	---	---

Legend

DRI	Desert Research Institute	R&P	Rupprecht & Patashnick Co., Inc.
SFS	Sequential Filter Sampler	FRM	Federal Reference Method
SGS TP	Sequential Gas Sampler with Total Particulate Matter Inlet Particle Sizer	Hi-Vol	High volume air sampler
SGS PM2.5	Sequential Gas Sampler with PM2.5 Inlet Particle Sizer	Met One	Met One Instruments, Inc.
Portable	Filter Sampler with PM2.5 Inlet Particle Sizer	TEOM	Tapered Element Oscillating Microbalance - Series 1400a
Anderson	Sierra (Thermal) Anderson Instruments	SASS	Spiral Aerosol Speciation Sampler
OU	Ohio University	*	Over time
LabNet	Chester LabNet	**	Continuous
		#	Performed by ATS - Goal is to develop a final data set that will be utilized for the data analyses and interpretation

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TABLE 9

CURRENT DATA STATUS SUMMARY FOR THE LAWRENCEVILLE (LW) SITE

Constituent of Concern	Measurement Technique	Data Type	Data Collected	Data Provider	Data Obtained by <i>ATS</i>	Data Validated by Provider	Data Filtering Status #	Notes
PM <sub>2.5</sub>	DRI SFS	Integrated *	Yes	DRI	Yes	Yes	Partially complete	Action item
	R&P FRM	Integrated *	Yes	DRI	Yes	Yes	Partially complete	Action item
	R&P TEOM	Real-Time **	Yes	ATS	Yes	No	In Progress	Action item
	Met One SASS	Integrated *	No	---	---	---	---	---
	Anderson SFS	Integrated *	No	---	---	---	---	---
PM <sub>10</sub>	DRI SFS	Integrated *	Yes	DRI	Yes	Yes	Partially complete	Action item
	R&P TEOM	Real-Time **	Yes	ATS	Yes	No	In Progress	Action item
	Anderson Hi-Vol	Integrated *	No	---	---	---	---	---
HNO <sub>3</sub>	DRI SGS TP	Integrated *	Yes	DRI	Yes	Yes	In Progress	Action item
NH <sub>3</sub>	DRI SGS PM <sub>2.5</sub>	Integrated *	Yes	DRI	Yes	Yes	In Progress	Action item
Particle Size	DRI Portable	Integrated *	Yes	DRI	No	---	---	No samples analyzed
Ozone (O <sub>3</sub> )	Continuous Analyzer	Real-Time **	Yes	ACHD	Yes	Yes	In Progress	Action item
Nitrogen Oxides (NO <sub>x</sub> )	Continuous Analyzer	Real-Time **	Yes	ACHD	Yes	No	In Progress	Action item
Sulfur Dioxide (SO <sub>2</sub> )	Continuous Analyzer	Real-Time **	Yes	ATS	Yes	No	In Progress	<i>ATS</i> to validate data
Carbon Monoxide (CO)	Continuous Analyzer	Real-Time **	No	ACHD	Yes	Yes	In Progress	Action item
Wind Speed / Direction	Continuous Analyzer	Real-Time **	Yes	ATS	Yes	Yes	In Progress	<i>ATS</i> to validate data
Ambient Temperature	Continuous Analyzer	Real-Time **	Yes	ATS	Yes	Yes	In Progress	<i>ATS</i> to validate data
Relative Humidity	Continuous Analyzer	Real-Time **	Yes	ATS	Yes	Yes	In Progress	<i>ATS</i> to validate data
Solar Radiation	Continuous Analyzer	Real-Time **	Yes	ATS	Yes	Yes	In Progress	<i>ATS</i> to validate data
Precipitation Depth	Continuous Analyzer	Real-Time **	Yes	ATS	Yes	Yes	In Progress	<i>ATS</i> to validate data

Legend

DRI	Desert Research Institute	R&P	Rupprecht & Patashnick Co., Inc.
SFS	Sequential Filter Sampler	FRM	Federal Reference Method
SGS TP	Sequential Gas Sampler with Total Particulate Matter Inlet Particle Sizer	Hi-Vol	High volume air sampler
SGS PM <sub>2.5</sub>	Sequential Gas Sampler with PM <sub>2.5</sub> Inlet Particle Sizer	Met One	Met One Instruments, Inc.
Portable	Filter Sampler with PM <sub>2.5</sub> Inlet Particle Sizer	TEOM	Tapered Element Oscillating Microbalance - Series 1400a
Anderson	Sierra (Thermal) Anderson Instruments	SASS	Spiral Aerosol Speciation Sampler
OU	Ohio University	*	Over time
LabNet	Chester LabNet	**	Continuous
		#	Performed by <i>ATS</i> - Goal is to develop a final data set that will be utilized for the data analyses and interpretation

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TABLE 10

CURRENT DATA STATUS SUMMARY FOR THE MORGANTOWN (MO) SITE

Constituent of Concern	Measurement Technique	Data Type	Data Collected	Data Provider	Data Obtained by ATS	Data Validated by Provider	Data Filtering Status #	Notes
PM <sub>2.5</sub>	DRI SFS	Integrated *	Yes	DRI	Yes	Yes	Partially complete	Action item
	R&P FRM	Integrated *	Yes	WV DEP	No	---	---	ATS to request data
	R&P TEOM	Real-Time **	No	---	---	---	---	---
	Met One SASS	Integrated *	No	---	---	---	---	---
	Anderson SFS	Integrated *	No	---	---	---	---	---
PM <sub>10</sub>	DRI SFS	Integrated *	No	---	---	---	---	---
	R&P TEOM	Real-Time **	No	---	---	---	---	---
	Anderson Hi-Vol	Integrated *	Yes	WV DEP	No	---	---	ATS to request data
HNO <sub>3</sub>	DRI SGS TP	Integrated *	No	---	---	---	---	---
NH <sub>3</sub>	DRI SGS PM <sub>2.5</sub>	Integrated *	No	---	---	---	---	---
Particle Size	DRI Portable	Integrated *	No	---	---	---	---	---
Ozone (O <sub>3</sub> )	Continuous Analyzer	Real-Time **	Yes	WV DEP	No	---	---	ATS to request data
Nitrogen Oxides (NO <sub>x</sub> )	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Sulfur Dioxide (SO <sub>2</sub> )	Continuous Analyzer	Real-Time **	Yes	WV DEP	No	---	---	ATS to request data
Carbon Monoxide (CO)	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Wind Speed / Direction	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Ambient Temperature	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Relative Humidity	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Solar Radiation	Continuous Analyzer	Real-Time **	No	---	---	---	---	---
Precipitation Depth	Continuous Analyzer	Real-Time **	No	---	---	---	---	---

Legend

DRI	Desert Research Institute	R&P	Rupprecht & Patashnick Co., Inc.
SFS	Sequential Filter Sampler	FRM	Federal Reference Method
SGS TP	Sequential Gas Sampler with Total Particulate Matter Inlet Particle Sizer	Hi-Vol	High volume air sampler
SGS PM <sub>2.5</sub>	Sequential Gas Sampler with PM <sub>2.5</sub> Inlet Particle Sizer	Met One	Met One Instruments, Inc.
Portable	Filter Sampler with PM <sub>2.5</sub> Inlet Particle Sizer	TEOM	Tapered Element Oscillating Microbalance - Series 1400a
Anderson	Sierra (Thermal) Anderson Instruments	SASS	Spiral Aerosol Speciation Sampler
OU	Ohio University	*	Over time
LabNet	Chester LabNet	**	Continuous
		#	Performed by ATS - Goal is to develop a final data set that will be utilized for the data analyses and interpretation

**COMPARATIVE EVALUATION OF AMBIENT FINE  
PARTICULATE MATTER (PM<sub>2.5</sub>) DATA OBTAINED  
FROM URBAN AND RURAL MONITORING SITES  
ALONG THE UPPER OHIO RIVER VALLEY  
SEMI-ANNUAL  
TECHNICAL PROGRESS REPORT  
APRIL 1, 2004 THROUGH SEPTEMBER 30, 2004**

**Submitted to:**



U. S. Department of Energy  
National Energy Technology Laboratory  
Pittsburgh, PA 15236

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**APPENDIX A**

Digital Images of the UORVP Air Monitoring Sites  
(To be provided)