

# Health Consultation

---

FIRST ENERGY CORPORATION, BRUCE MANSFIELD POWER PLANT  
SHIPPINGPORT, BEAVER COUNTY, PENNSYLVANIA

MARCH 31, 2009

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Agency for Toxic Substances and Disease Registry  
Division of Health Assessment and Consultation  
Atlanta, Georgia 30333

## **Health Consultation: A Note of Explanation**

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

You May Contact ATSDR Toll Free at  
1-800-CDC-INFO

or

Visit our Home Page at: <http://www.atsdr.cdc.gov>

HEALTH CONSULTATION

FIRST ENERGY CORPORATION, BRUCE MANSFIELD POWER PLANT  
SHIPPINGPORT, BEAVER COUNTY, PENNSYLVANIA

Prepared By:

Pennsylvania Department of Health  
Division of Environmental Health Epidemiology  
Under a Cooperative Agreement with the  
Agency for Toxic Substances and Disease Registry

---

## Table of Contents

|  |    |
|--|----|
| Executive Summary .....                    | ii |
| Background and Statement of Issues .....   | 1  |
| Site Description and History .....         | 1  |
| Site Visit .....                           | 2  |
| 2006 Sample Events.....                    | 2  |
| Wipe Sampling .....                        | 2  |
| 2007 Sample Events.....                    | 2  |
| Wipe and Soot Sampling .....               | 2  |
| Soil Sampling.....                         | 3  |
| Stack Effluent Sampling .....              | 3  |
| Dust Fall Sampling .....                   | 3  |
| Surface Water Sampling.....                | 3  |
| Air Sampling.....                          | 4  |
| Fish Sampling .....                        | 4  |
| Sample Results.....                        | 4  |
| Quality Assurance and Quality Control..... | 6  |
| Exposure Pathway Analysis.....             | 6  |
| Discussion.....                            | 7  |
| Contaminant Evaluation.....                | 10 |
| Coal byproducts .....                      | 10 |
| Arsenic .....                              | 10 |
| Mercury.....                               | 11 |
| Child Health Considerations .....          | 12 |
| Conclusions.....                           | 13 |
| Recommendations.....                       | 13 |
| Public Health Actions Planned .....        | 13 |
| References.....                            | 15 |
| Certification .....                        | 16 |
| Authors, Technical Advisors .....          | 17 |
| Figures.....                               | 18 |
| Tables.....                                | 19 |

---

## Executive Summary

At the request of the Pennsylvania Department of Environmental Protection (PADEP) and concerned community members, the Pennsylvania Department of Health (PADOH) prepared this health consultation (HC) to determine whether residents near the First Energy Generation Corporation, Bruce Mansfield Power Plant Site in Shippingport, PA (the site) were exposed to contaminants at levels that would harm their health. PADOH reviewed air, dust fall, wipes/soot, soil, and surface water sampling data. PADOH developed this health consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

ATSDR and PADOH cannot determine if a public health threat exists for the Shippingport area residents due to emissions from the Bruce Mansfield power plant because there is insufficient sampling data. Thus, the exposures to the detected contaminants currently *pose an indeterminate public health hazard* to residents in the surrounding communities. Some of the sampling results, and the fact that the plant has suffered two recent operational malfunctions, warrant additional monitoring. A comprehensive air sampling plan would quantify the current and on-going community exposure levels and address any data gaps. However, future sampling data will not be able to delineate any contamination from the past operational malfunctions or past sampling data gap issues. The interpretation, conclusions, and recommendations regarding the Bruce Mansfield Site for this health consultation are specific to this area and do not necessarily apply to any other site or location.

---

## Background and Statement of Issues

### Site Description and History

The Bruce Mansfield Power Plant site, First Energy Corporation, (the site) is approximately 473 acres in size and is located in the Borough of Shippingport, Beaver County, Pennsylvania, 25 miles northwest of Pittsburgh. The site is bordered by the Ohio River to the west to northwest and residential areas and Shippingport Community Park toward the east to northeast. A railroad track transverses the site on the western edge. Raccoon Township is located east of the site (Figure 1). The site contains three coal-fired generators; the first went on-line in 1976. The second and third units came on-line in 1977 and 1980. The plant produces 56-million kilowatt-hours per day, burning more than six million tons of coal annually. In addition, a joint project between First Energy and National Gypsum Company was developed to convert calcium sulfate from the plant's scrubber by-products into dry wall. The plant can produce 725 million square feet of wallboard per year. [1]

Units 1 and 2 share two stack effluent flues, consisting of Unit 1A, Unit 1B, Unit 2A and Unit 2B. The point of release was in Unit 1B [2]. In recent years, two 'black stack rain' fallout events occurred at the site, which were determined to be associated with a device added to remove flue gas. The device, called a mist eliminator, is part of the plant's flue-gas desulfurization, or scrubber system. The scrubber is designed to remove over 95 percent of sulfur dioxide (SO<sub>2</sub>) from the plants emissions by using a wet, lime-based process. In one of the final steps in the process, the mist eliminators remove excess moisture before the remaining flue gas is released via the plant stack. A buildup of deposits on these mist eliminators caused them to malfunction, allowing additional moisture mist with scrubber material to be released in the form of stack rain.

The first black stack rain event occurred on July 22, 2006, when a black oily substance rained over Shippingport and extended 2 miles into neighboring Raccoon Township (part of the city of Aliquippa), affecting nearly 300 residents. A second stack rain event occurred on June 10, 2007, where some 25 property owners in Shippingport and Raccoon Township reported this incident [3]. The distance from Unit 1 and Unit 2 Stacks (point of release) to the Shippingport Community Park and the nearest home is approximately 1100ft and 1200ft, respectively. First Energy reportedly responded to the stack rain incidents by cleaning up affected residents' homes and businesses. Contractors cut grass and disposed of clippings, mowed crop and hay fields, mulched the harvest, and power-washed houses, driveways, buildings and vehicles. The Shippingport Borough Community Park was also cleaned and re-opened by the Borough.

For this health consultation, PADOH and ATSDR, at the request of PADEP, evaluated and summarized the sampling results for various media (i.e., soil, water, air, etc.) at the site and in the surrounding communities. PADOH's objective throughout this health consultation is to determine whether exposures to contaminants were at levels that would be considered a public health hazard.

---

## Site Visit

In November 2007, representatives of the PADOH Bureau of Epidemiology, Division of Environmental Health, viewed the site with representatives of PADEP, Southwest Regional Office. During this visit, PADOH staff took notes, discussed site background information and community concerns.

## 2006 Sample Events

### Wipe Sampling

On July 25, 2006, First Energy Corporation, along with its contractors, sampled soot material associated with the 2006 fallout event. Soot material, from wipe sampling, was collected from tree leaves located at two parking lot locations, within the site boundary. The wipe samples were collected by wiping or scraping a set area, then analyzing the wipe. The samples were analyzed for metals, using Scanning Electron Microscope (SEM) at First Energy BETA laboratory. [4]

In response to this same fallout event, PADEP also collected wipe samples. PADEP sampled two residential locations on July 26, 2006. The first location, Residence A, is located in Shippingport, less than 2000 ft northeast from the point of release and adjacent to the Shippingport community park. Samples were collected from lawn furniture on the property. The second residence sampled was the Residence B, located in Aliquippa, approximately one mile from the release location. The samples were analyzed at the PADEP Bureau of Laboratories (BOL) for metals. [5]

## 2007 Sample Events

### Wipe and Soot Sampling

First Energy Corp. collected wipe samples in response to the 2007 fallout event. Samples were collected on June 12, 2007, from the tops of garbage cans located in the Shippingport community park, which is situated approximately 1100 feet south of the release site. Samples were also collected from picnic tables located on Residence A. The protocol involved using a sterile gauze wipe soaked with a solvent to remove the soot material. Nitric acid was the solvent used for metals sampling and deionized water for Polyaromatic Hydrocarbons (PAH's) sampling [2]. The samples were placed in jars and sent to Severn Trent Laboratories for analysis [6]. The concentrations of the samples, based on area ( $\text{ug}/\text{m}^2$ ) and weight (ppm), were derived using the following calculations:

$$\text{Concentration, based on area (ug/m}^2\text{)} = \text{Result (ug/wipe)} \div \text{Area sampled (m}^2\text{)}$$

$$\text{Concentration (ppm or ug/g)} = \text{Result (ug/wipe)} \div \text{Weight of sample (g)}$$

---

PADEP collected grab samples of the soot material on June 11, 2007, in the Shippingport community park, located approximately 1100 feet south of the release point. A sample was collected from various pieces of playground equipment and the sand box roof. The sample was aliquoted and independently tested at three laboratories; PADEP tested the samples at BOL, First Energy utilized Severn Trent Labs, and lastly a private citizen used Neumeyer Environmental Services [7].

A second grab sample was collected on July 8, 2007, in Hookstown, located approximately 2 miles south of the site. Fallout material was collected from a roof, truck and camper located on the residence. The samples were sent to PADEP BOL for metals analysis.

### **Soil Sampling**

On June 13, 2007, Shippingport Borough collected four soil samples in the Shippingport Community Park, located adjacent to the site. The samples were analyzed by Veolia Water for arsenic, cadmium, chromium, lead and mercury. [8] In addition, in the 1980's PADEP collected soil samples within a 10-mile radius of the site, for heavy metals. However, since most of the data was collected in the 1980s, it is not representative of current environmental conditions around the site and is, therefore, not relevant to the current HC. [9]

### **Stack Effluent Sampling**

On June 10, 2007, First Energy sampled the stack effluent in Unit 1-B, labeled U1B stack effluent and U1 paddle test sample, at the site. These samples were collected from a port in the stack at 377 feet. The samples were obtained by using a 2x4 piece of wood with a piece of office paper taped to the end. The paddle was left in the stack flue for five minutes for each test [2]. The samples were analyzed by Severn Trent Laboratories for metals and PAH's.

### **Dust Fall Sampling**

Dust fall samples were conducted, by PADEP, at three community locations from September to April 2008. Sample jars were left out for one month at a time. The locations sampled were: Residence A, located approximately 2000 feet northeast of the release; The Shippingport Borough Building, located approximately 2500 feet north; and one sample from the Ohioville Borough Building located approximately 5 miles north of the site which served as a background sample). Samples were sent to PADEP BOL for metals analysis. [10]

### **Surface Water Sampling**

PADEP, and its contractors, collected surface water samples from two locations. The first sample was collected at the Ambridge Water Authority, in Ambridge, PA on December 5, 2007 by Berr Herr Inspectors. The sample is a raw water sample taken from the tap before entering the turbines. An additional water sample was collected from an Aliquippa resident's pool, approximately 2 miles east of the release site, on November 16, 2007. The samples were sent to PADEP BOL for metals analysis. [11]



---

## **Air Sampling**

Due to complaints by local residents, ambient air sampling was performed by PADEP over a 6-month time frame, from September 2004 through February 2005. During that time, samples were collected during two to three day periods. In September, October, November, and December of 2004, samples were collected from three locations that included the Shippingport community park, Residence C in Aliquippa Township, situated less than 4.5 miles east of the site, and the Potter Township municipal building, located approximately 3.5 miles north to north-east of the site. In January and February of 2005, air samples were also collected from two locations in Masontown and another in Monaca Township, several miles from the Bruce Mansfield power plant. The air samples were analyzed for heavy metals and particulates [12] PADOH reviewed the air sampling results and summarized the data into average monthly concentration for each analyte (tables 15, 16).

## **Fish Sampling**

Fish tissue samples were also collected on the Ohio and Beaver Rivers by PADEP from the late 1980's through 2006. Tissue samples were analyzed for heavy metals, Polychlorinated Biphenyl's (PCB's), PAH's and other analytes. [13]

## **Sample Results**

### **Wipe Sample Results**

ATSDR and PADOH reviewed the wipe sampling data collected in 2006 and 2007 (tables 1-7). The 2006 wipe sampling event of the parking lot area represents the closest sampling point to the point of release. Depending on the prevailing winds and the resulting deposition pattern, this sampling location could possibly represent the 'worst case' scenario for exposure. The samples collected contained 60% calcium sulfate/sulfite, 30% carbon soot, and 10% fly ash [3]. The two parking lot samples contained concentrations of arsenic and chromium at 1950/1220 ppm and 590/390 ppm, respectively (Table 1).

In the 2007 wipe sampling performed by First Energy detected arsenic in the park picnic table-2 wipe sample (table 6) at 203.86 ppm (or 496.47 ug/m<sup>2</sup>). This level exceeded EPA's health-based benchmark standard for arsenic of 387 ug/m<sup>2</sup>. However, arsenic was also detected in the method blank, above the reporting level, in some of the wipe samples indicating a possible cross contamination issue. Mercury was detected at 251.8 ug/m<sup>2</sup> in the Park garbage can-1 sample, which is above the EPA benchmark standard of 157 ug/m<sup>2</sup>. Due to insufficient sample quantity only some of the samples were analyzed for the whole spectrum of metals and PAH's.

During the PADEP 2007 sampling of the Shippingport Borough Community Park, samples were split and analyzed at three separate laboratories, provided by PADEP, a private citizen at Residence C and First Energy. The lab results found 897, 767, and 270 ppm of arsenic, respectively. The variability in the lab results is most likely due to the sample being a heterogeneous material and possibly not being mixed before being split.

---

### **Soil Samples Results**

Following the 2007 fallout event, Shippingport Borough collected soil samples in the Shippingport Community Park, at four locations (table 8). The surface soil samples collected from the 0 to 3 inch soil horizon, were analyzed for five metals; arsenic, cadmium, chromium, lead and mercury. The maximum levels detected were 8.21, 0.67, 20.6, 16, and 0.5 ppm, respectively. PADEP also provided soil sample data collected in the 1980's. However, these results are not representative of current environmental conditions potentially associated with the site

### **Stack Effluent Results**

Samples taken from the stack effluent in 2007 displayed low or non-detect levels of metals and PAH's. Samples collected from the stack effluent in Unit 1-B, 2 days following the stack rain event, showed low levels of metals and low to non-detect levels of PAH's.

### **Dust-fall Sampling Results**

ATSDR and PADOH reviewed monthly dust-fall jar results collected near the Bruce Mansfield power plant from September 2007 through April 2008 [Table 11, 12, 13]. The overall trend of the data shows that the samples collected at Residence A and the Shippingport Borough Building, which are closer to the site, were slightly elevated compared to the background levels observed at the Ohioville Borough Building (i.e., cadmium, chromium, lead, nickel, zinc, copper, aluminum, manganese, iron, and silicon).

### **Surface Water Sample Results**

The two surface water samples collected at the Shippingport pool and the Ambridge reservoir did not show elevated metal levels (table 14), above ATSDR's comparison values or the Maximum Contaminant Levels (MCL) established by EPA. Additional surface water samples would assist in evaluating the extent, if any, of any potential on-going contamination associated with the site. However, future surface water samples would not provide additional information on the 2006 and 2007 fallout events.

### **Air Sample Results**

PADEP collected air samples in areas surrounding the site in 2004-2005. The highest level of arsenic was observed in Monaca Township in February 2005 sampling episode at 0.024752 ug/m<sup>3</sup>. Chromium and particulate matter levels were the highest in January 2005 in Monaca Township at 0.097616 and 148.4 ug/m<sup>3</sup>, respectively. The highest observed concentrations of Manganese (0.498950 ug/m<sup>3</sup>), Cadmium (0.018846 ug/m<sup>3</sup>), Lead (0.123590 ug/m<sup>3</sup>), and Zinc (3.451725 ug/m<sup>3</sup>), occurred in Potter Township in the September/October 2004 sampling.

### **Fish Sampling Results**

PADEP also provided PADOH and ATSDR with fish tissue sampling data. Sampling of the Ohio River, located adjacent to the site, in 2003 and 2006, showed levels of mercury in the fish tissue far

---

below the PADEP fish advisory levels of 0.13 to 0.25 ppm (based on 1 meal/week; 52 meals/year) and the FDA action level of 1 ppm. [14]

## **Quality Assurance and Quality Control**

ATSDR and PADOH are limited to the information provided in the referenced documents. It is expected that adequate quality assurance and quality control measures were adhered to regarding data gathering, chain of custody, laboratory procedures, and data reporting. In addition, during all aspects of sample collection, analyses, and reporting, extreme care is required to ensure high quality data and the best applicable science. ATSDR and PADOH expect that the laboratory only used certified, clean-sample collection devices. Once samples were collected, it is expected that they were stored according to the method protocol and were delivered to the analytical laboratory within the limits of method protocol. Finally, it is expected that laboratory standard operating procedures and other procedures and guidance for sample analysis, reporting, and chains of custody were followed. If ATSDR and PADOH believe the laboratory data were flawed in any way, further evaluation of the quality assurance and quality control procedures were conducted. Any analyses, conclusions, and recommendations in this health consultation are limited by the completeness and reliability of the referenced documents.

## **Exposure Pathway Analysis**

An exposure pathway is how a person comes in contact with chemicals originating from a source of contamination. Every exposure pathway consists of the following five elements: 1) a *source* of contamination; 2) a *media* such as air or soil through which the contaminant is transported; 3) a *point of exposure* where people can contact the contaminant; 4) a *route of exposure* by which the contaminant enters or contacts the body; and 5) a *receptor population*. A pathway is considered complete if all five elements are present and connected. A pathway is considered potential if the pathway elements are (or were) likely present, but insufficient information is available to confirm or characterize the pathway elements.

A pathway may also be considered potential if it is currently missing one or more of the pathway elements, but the element(s) could easily be present at some point in time. An incomplete pathway is missing one or more of the pathway elements and it is likely that the elements were never present and not likely to be present at a later point in time. An eliminated pathway was a potential or completed pathway in the past, but has had one or more of the pathway elements removed to prevent present and future exposures. The presence of a complete exposure pathway, does not, however, necessarily mean that adverse health effects will occur or have occurred in the past because of such exposure.

PADOH and ATSDR consider inhalation to be the most significant route of exposure in the current evaluation. PADOH considers the air a potential pathway of exposure for this health consultation. In addition, PADOH and ATSDR evaluated the soil and water pathways. Soil samples collected in the Shippingport Park, for metals, contained levels well below ATSDR's CV's. Water samples collected in a residential pool and in the Ambridge Water Authority Reservoir were non-detect.

---

Based on the available sampling data and the likely exposure scenarios, PADOH and ATSDR do not consider the soil and water likely pathways of exposure, for this health consult and Site.

## **Discussion**

ATSDR and PADOH reviewed the wipe, dust fall, historical air, soil and surface water sampling data for the site. The highest levels of arsenic, in the 2006 fallout samples, were observed in the parking lot of the site at 1950 ppm and 1220 ppm. These samples were collected from the closest location to the release point and depending on the prevailing winds and the resulting deposition pattern; these samples could represent the ‘worst case’ scenario for potential exposure. A transient acute exposure to these levels is possible; however, it is unlikely a public health threat, since the locations are within the site property and it would be highly unlikely that anybody would be able to aggregate and ingest enough surface dust for this exposure scenario to occur. In response to the September 11<sup>th</sup> tragedy in 2001, EPA, along with ATSDR and the New York City Department of Health, established health-based benchmarks for wipe samples to aid in evaluating the effectiveness of indoor clean-up activities and not reflective of potential outdoor community exposure [15]. ATSDR and PADOH cannot reference these benchmarks, since the sampling area for this sampling event is not known. Neither can PADOH or ATSDR make a conclusion on the potential public health implications.

The maximum level of arsenic detected during the 2007 wipe sampling event was at the Shippingport Community Park and the neighboring residential yard. These samples are the closest off-site locations, and depending on the factors mentioned previously, represent the highest levels to which the general public could have potentially been exposed. The 2007 wipe sampling performed by First Energy contained concentrations of mercury and arsenic, at 251.8 ug/m<sup>2</sup> on the park garbage can-1 sample (Table 2) and 496.47 ug/m<sup>2</sup> on the picnic table-2 sample (Table 6), respectively. However, arsenic was also detected in the method blank in these samples, above the reporting level, indicating a possible cross contamination or method contamination problem. If these levels of contaminants were detected in surface soil, it would represent a possible acute exposure concern for young children through the ingestion route. However, it seems highly unlikely that anybody would be able to aggregate and ingest enough surface dust for this exposure scenario to occur. The levels of arsenic and mercury did exceed the EPA benchmark value for wipe samples, however these benchmarks were developed for indoor clean-up activities, and do not reflect potential community-level exposure. The residential indoor reference values were designed to be more conservative (i.e. more protective of health, due to the increased likely exposure frequency). Sample concentrations below the EPA benchmark values would not be a public health threat. As mentioned above, PADOH and ATSDR can not conclude on the public health implications related to these samples, due to a lack of an appropriate comparison value. In addition, PADOH and ATSDR consider the air pathway the greatest pathway of potential concern for this site.

During the PADEP 2007 sampling of the Shippingport Borough Community Park, samples were split and analyzed at three separate laboratories, provided by PADEP, a private citizen at Residence C and First Energy. This sample is the closest off-site location sampled, and it is possible that children playing in the park, immediately following the event, could have ingested some of the soot

---

material on the playground equipment. Since the sampling area for this sampling event is not known, ATSDR and PADOH cannot reference the EPA health-based benchmarks for wipe samples or make a conclusion on the potential public health implications.

Soil samples were also collected in Shippingport Community Park, following the 2007 fallout event, and analyzed for metals (table 8). The resulting concentrations are below ATSDR's soil Comparison Values (CV's) for chronic exposure in children and adults for arsenic, cadmium, lead, and mercury. Currently, ATSDR does not have a CV for chromium in soil. The highest concentration of chromium in the park (20.6 ppm) is below the average background levels of chromium found in U.S. soil of 37 ppm. The analytes were also below PADEP's regulatory standards for direct contact to soil. Since the concentrations are well below ATSDR's CV's, exposure to the soil levels observed are unlikely to be a public health hazard. In addition, ATSDR and PADOH currently consider the air pathway to be the pathway of the greatest concern for the site.

Samples taken from the stack effluent in 2007 displayed low or non-detect levels of metals and PAH's. These data provide some information on what contaminants are present in the effluent. However, this sampling method is not an approved method for public health assessments. In addition, the data do not provide information on actual community contaminant levels, and thus the most relevant to this health consultation. Therefore, PADOH and ATSDR can not make any public health conclusions on such data. In addition, stack effluent, and the resulting potential deposition in the community, can be influenced by the prevailing winds, topography, precipitation, etc. Thus, air samples collected in the community provides more accurate data on the potential community-level exposures.

ATSDR and PADOH reviewed monthly dust-fall jar results collected near the Bruce Mansfield Power plant from September 2007 through April 2008. Although dust fall jar results can be useful for determining the chemical composition of particulates that fall out of suspension, it does not offer the data required to evaluate human exposures to air contaminants. Dust fall jar results measure the fall out rate of coarse particulates (usually larger than PM 10), they do not evaluate exposures to smaller sized particles (PM 2.5 - PM10), which are smaller particles that are inhaled deeper into the lungs and present a bigger health concern to exposed individuals. Dust fall samples, at Residence A and Shippingport Borough Building showed contaminant levels that were slightly elevated compared to the background levels observed at the Ohioville Borough Building. The sample results for the month of September show higher concentrations of metals in the Shippingport results when compared to the background sample in Ohioville. The overall pattern indicates that the dust fall contamination would be more concentrated closer to the site. Even though there are no regulatory standards for the dust fall contaminants sampled, rates between 50 to 100 tons/sq mile/month are considered nuisances and indicative of areas with air pollution problems. All monthly dust fall results, including background, reviewed by PADOH and ATSDR had rates between 70-90 tons/sq mile/month. Currently, ATSDR does not utilize dust fall jar sampling data for public health exposure assessments, due to lack of reference standards. Therefore, PADOH and ATSDR cannot quantitatively evaluate dust fall jar data for public health exposure levels. A comprehensive ambient air sampling plan, with community-based locations, would address any on-going air quality issues potentially associated with the site.

---

Air sampling conducted in 2004-2005 showed the contaminants were at “ambient concentrations” and below levels of concern. The highest level of arsenic was observed in Monaca Township, located several miles from the site. However, PADOH and ATSDR are unable to draw public health conclusions from this data in regards to the 2006 and 2007 two fallout events or to the overall exposure. Due to the short sampling time frame, the use of an alternative air sampling method (i.e. not 24-hour ambient air sampling) and the lack of a sample location map, we can not reach a conclusion on the public health significance of the air data. Future air sampling events should consider additional contributing sources of air contaminants near the sampling locations and length of sampling event. A well-designed and continuous air monitoring plan that samples for additional contaminants associated with fossil fuel combustion, such as Sulfur Dioxide and Particulate matter (PM10 and PM 2.5), will better address any potential community exposure levels associated with the site.

Currently, the Borough of Shippingport and Raccoon Townships get their water from both public water systems and private wells. Half of the residents are on private wells. Public water supply for Shippingport is from Midland Municipal Authority. Midland’s intake is on the Ohio Rivers, downstream of the site 18 feet below the surface level. The Raccoon Township receives its public water supply from Aliquippa Municipal Authority, whose intake is also on the Ohio River. Public water suppliers are required to undergo Inorganic Chemicals Sampling (IOC), as part of the Safe Drinking Water Act, to determine if metals are below Maximum Contamination Levels (MCL). As detailed in the most recent monitoring data in 2002, metals in the Midland and Aliquippa water supplies were well below the MCL for metals. The municipalities are not required to test the water for metals again until 2011, with the exception of arsenic. The MCL and laboratory detection limit for arsenic were lowered, and systems must now prove they are below the MCL annually. Data on private well sampling is very limited. [16]

Surface water samples were collected at a residential pool located in Shippingport Borough and the Ambridge reservoir. The levels of analytes in the surface water were low or non-detect. Although the concentrations in the water samples were well below ATSDR’s comparison value for drinking water and EPA’s Maximum Contaminant Level (MCL) for metals, the water samples provide little data on the extent, if any, of the surface water contamination, since the samples were collected 6 months after fallout event. Additional surface water samples would address any on-going water quality issues, potentially associated with the site.

PADEP also provided ATSDR and PADOH with fish sampling data. Sampling of the Ohio River, located adjacent to the site, in 2003 and 2006 showed levels of mercury in the fish tissue far below the PADEP fish advisory levels of 0.13 to 0.25 ppm (based on 1 meal/week; 52 meals/year) and the FDA action level of 1 ppm. However, this sampling data does not provide information on the 2006 and 2007 fallout events. There is insufficient data to correlate contaminant levels to the Site.

In summary, the dust fall, dust wipe, soil and surface water sampling data provided some information on the contaminants present in the stack rain fallout. However, the sampling provided limited information on the extent of the dispersal of the stack rain or the potential community exposure levels, due to alternative sampling methods, limited sample events and locations, and the

---

lack of reference values. Historical air sampling data also provided some information of levels of contaminants, but not the exposure levels, due to an alternative air sampling method. A detailed and thorough air sampling plan will assist in addressing the current data gaps.

## **Contaminant Evaluation**

### **Coal byproducts**

The black rain fallout material associated with the site contained coal byproducts that are commonly associated with the combustion of fossil fuels. Coal combustion has a variety of byproducts. When these byproducts are released into the air as pollutants, their type and amount depend upon a combination of factors, including the composition of the coal, coal-combustion conditions, and the type and condition of air pollution control equipment. The major constituents of the gases emitted from coal-fired power plants are sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), and carbon dioxide (CO<sub>2</sub>). Other elements and compounds also are released, but at much lower concentrations. These include metals, such as mercury and selenium, and particulate matter.

Various PAH's also have been identified in the flue gas of power plants after coal combustion. The specific type and amount of PAH's emitted depends largely on the combustion conditions and slightly on the type of coal burned.

The major public health concern from coal combustion is from the amount of particulate matter released, in addition to other contaminants such as sulfur dioxide and nitrogen dioxide. Many particulates do not exhibit a specific toxic effect but may still inhibit the clearance mechanisms in the lungs or, at relatively low concentrations, cause sensitization or allergic reactions in sensitive individuals. The US Environmental Protection Agency (EPA) has developed the "National Ambient Air Quality Standards" (NAAQS) for particulate matter. This standard was established to protect the public from excessive, respirable, solid material in air. The standard specifies a mass concentration in air and not the chemical identity of the solid material. The standard today applies to particulate matter that has an aerodynamic diameter of 10 micrometers or less. This size of particulates describes "respirable" particles. Larger particles are exhaled or swallowed during the normal breathing process and are not considered to be health problems [17]. In an EPA study, the inhalation exposure risk to certain airborne contaminants (e.g., mercury and arsenic) to residents near a coal-fired plant was assessed. The study concluded that properly operating local coal-fired power plants do not represent a public health hazard to the surrounding community [18].

### **Arsenic**

People can be exposed to arsenic from the environment by eating food, drinking water, or breathing air. Young children may be exposed to arsenic from eating dirt because of their tendency to place their hands in their mouths. Dermal contact with soil or water that contains arsenic may be another exposure route, but absorption of arsenic through skin is so minimal that it is not considered a risk factor. The Department of Health and Human Services (DHHS) and The International Agency for

---

Research on Cancer (IARC) classify inorganic arsenic as a “known human carcinogen”. The EPA has also determined that inorganic arsenic is a human carcinogen and has assigned it the cancer classification, Group A. Long-term exposures to arsenic may increase the risk of liver, bladder, kidney, prostate, and lung cancers. [19]

Health-based studies show that doses as low as 0.050 mg/kg/day (equivalent to ppm for chemical concentrations in soil) of inorganic arsenic, which is below background soil levels, over a 2 to 3 week period, may cause edema of the face, and gastrointestinal and upper respiratory symptoms initially, followed in some patients by skin lesions and neuropathy. Other symptoms included insufficient blood cell production, which may cause fatigue, abnormal heart rhythm, blood vessel damage resulting in bruising, and impaired nerve function causing a “pins and needles” sensation in the hands and feet. Chronic exposure to levels as low as 0.014 mg/kg/day may lead to “Blackfoot Disease”, a condition in which blood circulation is lost and ultimately results in necrosis (cell death) in the hands and feet. The most characteristic effect of chronic oral exposure to arsenic is a pattern of skin changes. These include darkening of the skin and appearance of warts on the palms, soles, and upper-body. Some of the warts may also result in skin cancer. Arsenic was detected in the 2006 and 2007 wipe sampling event above these values. A transient acute exposure to these levels is possible; however, it is not likely a current public health threat since it is highly unlikely the general public would be able to aggregate and ingest enough surface dust for this exposure scenario to occur.

Arsenic in soil is more difficult to absorb than the soluble arsenic forms found in groundwater on some sites. Health studies demonstrated that the bioavailability of arsenic in soil might be quite small and is unlikely to be absorbed by the body. This is important for estimating human doses. Acute exposure to arsenic was observed in a case in upstate New York where gastrointestinal symptoms began almost immediately after being intermittently exposed to arsenic-contaminated drinking water at an estimated dose of 0.05 mg/kg/day. Gastrointestinal symptoms have been widely reported in other acute arsenic poisoning studies as well, although in some cases, the doses were higher and effects were more severe, and in other cases, the dose information was not available. [19]

The levels of arsenic detected in soil samples collected in the Shippingport Community Park, following the 2007 fallout event, were well below ATSDR’s Comparison Values for both child and adult chronic arsenic exposure of 20 and 200 ppm, respectively (ATSDR’s Environmental Media Evaluation Guide (EMEG)). In order to be conservative and protective of public health, ATSDR’s CVs are lower than levels at which no effects were observed in experimental animals or human epidemiologic studies. The current ATSDR Cancer Risk Evaluation Guide (CREG) for arsenic in surface soil is 0.5 ppm (or milligram per kilogram (mg/kg)), which is below soil background levels, and is used as a screening tool to identify contaminants of concern. The CREG is a theoretical calculation that assumes a consumption of 100 mg of soil per day by a 70 kg person over a lifetime without consideration of absorption rate or the bioavailability of arsenic from soil. This scenario is far more conservative and thus soil levels of arsenic are not likely a public health threat.

## **Mercury**

The EPA’s benchmark value for mercury (156 ug/m<sup>2</sup>) was exceeded in the park garbage can-1 wipe sample (251.8 ug/m<sup>2</sup>), during the 2007 sampling event and believe to be caused by the operational

---



---

malfunction of the Bruce Mansfield plant. Mercury is a naturally occurring metal found throughout the environment. However, approximately 80% of the mercury released from human activities is elemental mercury released to the air, primarily from fossil fuel combustion, mining, and smelting, and from solid waste incineration. A person can be exposed to mercury from breathing in contaminated air, swallowing or eating contaminated water or food, or from having skin contact with mercury. Between 10 and 20 nanograms of mercury per cubic meter ( $\text{ng}/\text{m}^3$ ) of air have been measured in urban outdoor air. These levels are hundreds of times lower than levels still considered to be "safe" to breathe. Background levels in nonurban settings are even lower, generally about  $6 \text{ ng}/\text{m}^3$  or less. Mercury levels in surface water are generally less than 5 parts of mercury per trillion parts of water (5 ppt, or 5 ng per liter of water), about a thousand times lower than "safe" drinking water standards. Normal soil levels range from 20 to 625 parts of mercury per billion parts of soil (20–625 ppb; or 20,000–625,000 ng per kilogram of soil).

Animals exposed orally to long-term, high levels of mercury in laboratory studies experienced damage to the kidneys, stomach, and large intestine; changes in blood pressure and heart rate; adverse effects on the developing fetus, sperm, and male reproductive organs; and increases in the number of spontaneous abortions and stillbirths. Adverse effects on the nervous system of animals occur at lower doses than do harmful effects to most other systems of the body. Exposure to mercury is more dangerous for young children than for adults, because more passes into the developing brain of young children and may interfere with the development process. [21]

Mercury can enter and bioaccumulate in the food chain. Bioaccumulation occurs when larger fish eat smaller fish or other organisms that contain mercury, most of the mercury originally present in the small fish will then be concentrated and stored in the larger fish. The FDA estimates that most people are exposed, on average, to about 50 ng of mercury per kilogram of body weight per day (50  $\text{ng}/\text{kg}/\text{day}$ ) in the food they eat. Commercial fish sold through interstate commerce that are found to have levels of mercury above an "action level" of 1 ppm (established by the FDA) cannot be sold to the public. This level itself is below a level associated with adverse effects. The PADEP has set mercury levels in fish tissue, based on consumption quantities, and the level for unrestricted consumption is 0 to 0.12 ppm mercury. Mercury levels between 0.13 to 0.25 ppm represent the first level of a fish consumption advisory, which typically warns the public to consume no more than one fish meal per week per year from that body of water. [15]

## **Child Health Considerations**

PADOH and ATSDR recognize that infants and children can be more vulnerable to chemical exposure than adults. PADOH and ATSDR are committed to evaluating children's special interests. In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors, which *might* increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage.

---

## Conclusions

Based on the current sampling data, exposures to the concentrations of contaminants in the air near the Bruce Mansfield site pose *an indeterminate public health hazard* to community residents. The current sampling results do not provide enough data on any potential community exposures; therefore, PADOH and ATSDR can not make a public health call, at this time. Some of the sampling results, and the fact that the plant has suffered two recent operational malfunctions, make ATSDR and PADOH conclude that additional air monitoring is merited. Numerous data gaps exist in the current sampling results. ATSDR and PADOH will comment upon, give suggestion to, and help PADEP in their development of a comprehensive ambient air plan to assist in characterizing the community exposure levels potentially related to the site.

## Recommendations

1. PADOH recommends PADEP install several air monitoring stations in proximity to the plant (including up-wind) and in nearby residential areas. The monitoring should be performed for a minimum of four weeks, to account for fluctuations in air emissions due to changes in the plant's operations and for local air quality variations. Samples should be analyzed for metals (lead, mercury, cadmium, chromium, arsenic and beryllium), particulate matter smaller than 2.5 and 10 microns (PM2.5 and PM10), PAH's and other pollutants for which there are National Ambient Air Quality Standard (NAAQS).
2. ATSDR and PADOH consider inhalation to be the most significant route of exposure in the current evaluation. However, ATSDR and PADOH will evaluate any future surface water sampling results or other environmental samplings collected by PADEP, as needed and as appropriate, and prepare a health consultation or health evaluation document that addresses the public health significance of the data.

## Public Health Actions Planned

ATSDR and PADOH will make this health consultation available to the residents and will be available to answer the residents' health questions.

ATSDR and PADOH will evaluate future sampling results, as needed and as appropriate, and prepare a health consultation or other document that addresses the public health significance of the data

In light of the uncertainties related to the current sampling data, ATSDR and PADOH will coordinate, discuss and assist PADEP in their development of a comprehensive air sampling plan.

---

ATSDR and PADOH will continue working with the community to answer questions and address ongoing concerns.

ATSDR and PADOH will pursue site visits and meetings with the community, as well as state health, local health and other government agencies as appropriate.

---

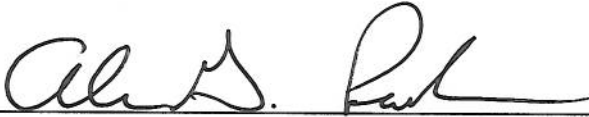
## References

1. First Energy Corporation, Fact sheet  
[http://www.firstenergycorp.com/environmental/files/Fact\\_Sheets/brucemansfield.pdf](http://www.firstenergycorp.com/environmental/files/Fact_Sheets/brucemansfield.pdf)
2. Letter from Bruce Warnaka, Bruce Mansfield Plant, to Mark Wayner, PADEP Southwest Regional Office; June 21, 2007
3. First Energy Corporation, Press release, June 18, 2007
4. Beta Laboratory, Laboratory Results Report 7/25/06
5. PADEP BOL, Analytical Report for Air Quality, 2006
6. Severn Trent Laboratory, Laboratory results report, June 2007
7. PADEP, Press release, August 27, 2007
8. Letter from Veolia Water, LLC to William Green, Borough of Shippingport Manager; June 20, 2007
9. PADEP Bureau of Waste Management, Soil sampling report,; September 1987
10. PADEP BOL, Analytical Report for Air Quality, 2007
11. PADEP BOL, Analytical Report for Water Supply Management, 2007
12. PADEP BOL Analytical Report for Air Quality, 2004-2005
13. PADEP, Fish sampling data
14. PADEP Fish tissue sampling and assessment protocol: 2008  
<http://www.depweb.state.pa.us/watersupply/lib/watersupply/PCtissue.pdf>
15. EPA Response to September 11, Wipe Sampling Program, Health-Based Benchmarks: 2005  
[http://www.epa.gov/wtc/wipe\\_samples/censuspdfs/wipe\\_benchmarks.htm](http://www.epa.gov/wtc/wipe_samples/censuspdfs/wipe_benchmarks.htm)
16. E-mail correspondence between Deborah McDonald (PADEP) and Ronald Schwartz (PADEP), November 30, 2007
17. ATSDR, Public Health Assessment, US DOE Mound Facility, Miamisburg, Montgomery County, Ohio; 1998. [http://www.atsdr.cdc.gov/HAC/pha/doemound/dmf\\_toc.html](http://www.atsdr.cdc.gov/HAC/pha/doemound/dmf_toc.html)
18. ATSDR, Public Health Assessment, Fort Wainwright, Fairbanks North Star, Alaska;  
[http://www.atsdr.cdc.gov/HAC/pha/fortwainwright/wai\\_toc.html](http://www.atsdr.cdc.gov/HAC/pha/fortwainwright/wai_toc.html)
19. ATSDR, Toxicological Profile for Arsenic, 2007.  
<http://www.atsdr.cdc.gov/toxprofiles/tp2.html>
20. ATSDR, Health Consultation, American Street Tannery, Philadelphia, Pennsylvania; 2007.  
<http://www.atsdr.cdc.gov/HAC/pha/AmericanStreetTannery/AmericanStreetTannerySite%20HC%209-20-07.pdf>
21. ATSDR, Toxicological Profile for Mercury; 1999  
<http://www.atsdr.cdc.gov/toxprofiles/tp46.html>

---

## Certification

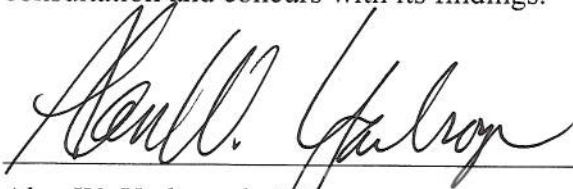
This health consultation for the Bruce Mansfield Power Plant was prepared by the PADOH under a cooperative agreement with the ATSDR. It is in accordance with approved methodology and procedures existing at the time the health consultation were initiated. Editorial review was completed by the cooperative agreement partner.



Alan G. Parham, MPH, REHS

Technical Project Officer, CAT, CAPEB, DHAC, ATSDR

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.



Alan W. Yarbrough, MS

Team Leader, CAT, CAPEB, DHAC, ATSDR

---

## **Authors, Technical Advisors**

Pennsylvania Department of Health  
Bureau of Epidemiology  
Division of Environmental Health Epidemiology  
Health Assessment Program

### **PADOH Author:**

Christine Lloyd, M.S.  
Epidemiology Program Specialist/Health Assessor

### **PADOH Co-Authors:**

Mark V. White, MD, MPH  
Program Director/Epidemiologist

Barbara Allerton, MPH, RN  
Epidemiology Research Associate

### **ATSDR Reviewers:**

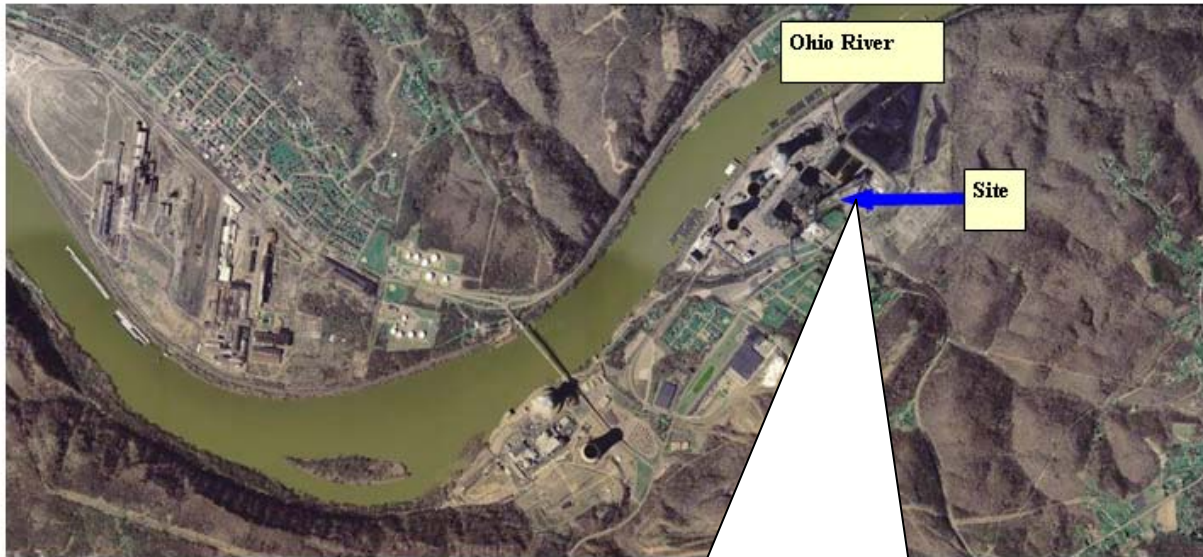
Ana Pomales, M.S.  
Regional Representative  
ATSDR, Region 3

Alan Parham, MPH, REHS  
Technical Project Officer  
Division of Health Assessment and Consultation  
ATSDR

---

## Figures

Figure 1 – Overview of the Site and Borough of Shippingport.



## Tables

**Table 1- 2006 Sampling wipe results, First Energy and PADEP \*\*\***

| First Energy leaf deposits samples † |                                  |                                  | PADEP wipe samples †          |                               |
|--------------------------------------|----------------------------------|----------------------------------|-------------------------------|-------------------------------|
| Analyte                              | Parking area #2<br>(ug/g or ppm) | Parking Area #3<br>(ug/g or ppm) | Residence A<br>(mg/kg or ppm) | Residence B<br>(mg/kg or ppm) |
| Arsenic                              | 1950                             | 1220                             | 339                           | <4.0                          |
| Beryllium                            | 3                                | 1                                | 1.74                          | <0.5                          |
| Cadmium                              | 3                                | 3                                | 0.64                          | <0.5                          |
| Chromium                             | 590                              | 390                              |                               | 2.05                          |
| Lead                                 | 230                              | 120                              | 43                            | <0.5                          |
| Mercury                              | 60                               | 60                               | 12.27                         | <0.2                          |
| Nickel                               | 110                              | 160                              |                               | <0.2                          |
| Zinc                                 | 80                               | 140                              | 55.8                          | 17.8                          |
| Selenium                             | 250                              | 100                              |                               |                               |

**Table 2- First Energy 2007 wipe sampling results of Shippingport Park - Garbage Can-1**

| Analyte | Result<br>(ug/wipe) | Area<br>sampled<br>(m2)* | Concentration<br>(ug/m2) | Weight of wipe<br>residue<br>(g)** | Concentration<br>(ug/g or ppm) | EPA<br>Benchmark<br>(ug/m2) |
|---------|---------------------|--------------------------|--------------------------|------------------------------------|--------------------------------|-----------------------------|
| Mercury | 61.7                | 0.245                    | 251.8                    | 1.60                               | 38.6                           | 157                         |

**Table 3- First Energy 2007 wipe sampling results of Shippingport Park – Garbage Can-2**

| Analyte                    | Result<br>(ug/wipe) | Area<br>sampled<br>(m2)* | Concentration<br>(ug/m2) | Weight of<br>wipe<br>residue<br>(g)** | Concentration<br>(ug/g or ppm) | EPA<br>Benchmark<br>(ug/m2) |
|----------------------------|---------------------|--------------------------|--------------------------|---------------------------------------|--------------------------------|-----------------------------|
| Napthalene                 | 0.6                 | 0.231                    | 2.597                    | 2.28                                  | 0.263                          | No Standard                 |
| Acenaphthylene             | 0.042               | 0.231                    | 0.182                    | 2.28                                  | 0.018                          | No Standard                 |
| Acenaphthene               | 0.049               | 0.231                    | 0.212                    | 2.28                                  | 0.021                          | No Standard                 |
| Fluorene                   | 0.095               | 0.231                    | 0.411                    | 2.28                                  | 0.042                          | No Standard                 |
| Phenanthrene               | 0.063               | 0.231                    | 0.273                    | 2.28                                  | 0.028                          | No Standard                 |
| Anthracene                 | 0.034               | 0.231                    | 0.147                    | 2.28                                  | 0.015                          | No Standard                 |
| Fluorathene                | 0.21                | 0.231                    | 0.909                    | 2.28                                  | 0.092                          | No Standard                 |
| Pyrene                     | 0.1                 | 0.231                    | 0.433                    | 2.28                                  | 0.044                          | No Standard                 |
| Benzo(a)anthracene         | 0.037               | 0.231                    | 0.160                    | 2.28                                  | 0.016                          | No Standard                 |
| Chrysene                   | 0.93                | 0.231                    | 4.026                    | 2.28                                  | 0.408                          | No Standard                 |
| Benzo(a)fluoranthene       | 0.09                | 0.231                    | 0.390                    | 2.28                                  | 0.039                          | No Standard                 |
| Benzo(a)fluoranthene       | ND                  | 0.231                    | ND                       | 2.28                                  | ND                             | No Standard                 |
| Benzo(a)pyrene             | ND                  | 0.231                    | ND                       | 2.28                                  | ND                             | No Standard                 |
| Ideno(1,2,3-dc)<br>pyrene  | ND                  | 0.231                    | ND                       | 2.28                                  | ND                             | No Standard                 |
| Dibenzo(a,h)<br>anthracene | ND                  | 0.231                    | ND                       | 2.28                                  | ND                             | No Standard                 |
| Benzo (ghi) perylene       | ND                  | 0.231                    | ND                       | 2.28                                  | ND                             | No Standard                 |



**Tables 4 - First Energy 2007 wipe sampling results of Shippingport Park- Garbage Can-3**

| Analyte                | Result<br>(ug/wipe) | Area sampled<br>(m2)* | Concentration<br>(ug/m2) | Weight of<br>wipe<br>residue<br>(g)** | Concentration<br>(ug/g or ppm) | EPA<br>Benchmark<br>(ug/m2) |
|------------------------|---------------------|-----------------------|--------------------------|---------------------------------------|--------------------------------|-----------------------------|
| Arsenic <sup>†</sup>   | 176                 | 0.756                 | 232.80                   | 0.261                                 | 674.33                         | 387                         |
| Beryllium <sup>†</sup> | 0.44                | 0.756                 | 0.58                     | 0.261                                 | 1.69                           | 3140                        |
| Boron <sup>†</sup>     | 12.1                | 0.756                 | 16.01                    | 0.261                                 | 46.36                          | No Standard                 |
| Cadmium                | 0.25                | 0.756                 | 0.33                     | 0.261                                 | 0.96                           | 1560                        |
| Chromium <sup>†</sup>  | 50.8                | 0.756                 | 67.20                    | 0.261                                 | 194.64                         | 4700                        |
| Nickel <sup>†</sup>    | 7.5                 | 0.756                 | 9.92                     | 0.261                                 | 28.74                          | 31400                       |
| Lead                   | 22.3                | 0.756                 | 29.50                    | 0.261                                 | 85.44                          | 270                         |
| Selenium <sup>†</sup>  | 10.5                | 0.756                 | 13.89                    | 0.261                                 | 40.23                          | 7840                        |
| Zinc                   | 42                  | 0.756                 | 55.56                    | 0.261                                 | 160.92                         | 470000                      |

**Table 5- First Energy 2007 wipe sampling results of Shippingport Park - Picnic Table-1**

| Analyte | Result<br>(ug/wipe) | Area<br>sampled<br>(m2)* | Concentration<br>(ug/m2) | Weight of<br>wipe residue<br>(g)** | Concentration<br>(ug/g or ppm) | EPA<br>Benchmark<br>(ug/m2) |
|---------|---------------------|--------------------------|--------------------------|------------------------------------|--------------------------------|-----------------------------|
| Mercury | 4.6                 | 0.085                    | 54.1                     | 0.19                               | 24.8                           | 157                         |

**Table 6- First Energy 2007 wipe sampling results of Shippingport Park - PicnicTable-2**

| Analyte                | Result<br>(ug/wipe) | Area<br>sampled<br>(m2)* | Concentration<br>(ug/m2) | Weight of<br>wipe<br>residue<br>(g)** | Concentration<br>(ug/g or ppm) | EPA<br>Benchmark<br>(ug/m2) |
|------------------------|---------------------|--------------------------|--------------------------|---------------------------------------|--------------------------------|-----------------------------|
| Arsenic <sup>†</sup>   | 42.2                | 0.085                    | 496.47                   | 0.207                                 | 203.86                         | 387                         |
| Beryllium <sup>†</sup> | 0.3                 | 0.085                    | 3.53                     | 0.207                                 | 1.45                           | 3140                        |
| Boron <sup>†</sup>     | 11.1                | 0.085                    | 130.59                   | 0.207                                 | 53.62                          | No Standard                 |
| Cadmium                | 0.53                | 0.085                    | 6.24                     | 0.207                                 | 2.56                           | 1560                        |
| Chromium <sup>†</sup>  | 19                  | 0.085                    | 223.53                   | 0.207                                 | 91.79                          | 4700                        |
| Nickel <sup>†</sup>    | 18.4                | 0.085                    | 216.47                   | 0.207                                 | 88.89                          | 31400                       |
| Lead                   | 12.2                | 0.085                    | 143.53                   | 0.207                                 | 58.94                          | 270                         |
| Selenium <sup>†</sup>  | 3.7                 | 0.085                    | 43.53                    | 0.207                                 | 17.87                          | 7840                        |
| Zinc                   | 67.6                | 0.085                    | 795.29                   | 0.207                                 | 326.57                         | 470000                      |

**Table 7 – First Energy 2007 wipe sample results for Shippingport Park - Picnic Table-3**

| Analyte                    | Result<br>(ug/wipe) | Area<br>sampled<br>(m2)* | Concentration<br>(ug/m2) | Weight<br>of wipe<br>residue<br>(g)** | Concentration<br>(ug/g or ppm) | EPA<br>Benchmark<br>(ug/m2) |
|----------------------------|---------------------|--------------------------|--------------------------|---------------------------------------|--------------------------------|-----------------------------|
| Napthalene                 | 0.058               | 0.231                    | 0.251                    | 0.085                                 | 0.682                          | No Standard                 |
| Acenapathylene             | ND                  | 0.231                    | ND                       | 0.085                                 | ND                             | No Standard                 |
| Acenapathene               | ND                  | 0.231                    | ND                       | 0.085                                 | ND                             | No Standard                 |
| Fluorene                   | ND                  | 0.231                    | ND                       | 0.085                                 | ND                             | No Standard                 |
| Phenanthrene               | 0.14                | 0.231                    | 0.606                    | 0.085                                 | 1.647                          | No Standard                 |
| Anthracene                 | ND                  | 0.231                    | ND                       | 0.085                                 | ND                             | No Standard                 |
| Fluorathene                | 0.038               | 0.231                    | 0.165                    | 0.085                                 | 0.447                          | No Standard                 |
| Pyrene                     | ND                  | 0.231                    | ND                       | 0.085                                 | ND                             | No Standard                 |
| Benzo(a)anthracene         | ND                  | 0.231                    | ND                       | 0.085                                 | ND                             | No Standard                 |
| Chrysene                   | 0.023               | 0.231                    | 0.100                    | 0.085                                 | 0.271                          | No Standard                 |
| Benzo(a)fluoranthene       | 0.026               | 0.231                    | 0.113                    | 0.085                                 | 0.306                          | No Standard                 |
| Benzo(a)fluoranthene       | ND                  | 0.231                    | ND                       | 0.085                                 | ND                             | No Standard                 |
| Benzo(a)pyrene             | ND                  | 0.231                    | ND                       | 0.085                                 | ND                             | No Standard                 |
| Ideno(1,2,3-dc)<br>pyrene  | ND                  | 0.231                    | ND                       | 0.085                                 | ND                             | No Standard                 |
| Dibenzo(a,h)<br>anthracene | ND                  | 0.231                    | ND                       | 0.085                                 | ND                             | No Standard                 |
| Benzo (ghi) perylene       | ND                  | 0.231                    | ND                       | 0.085                                 | ND                             | No Standard                 |

**Table 8 – 2007 soil samples collected in Shippingport Borough Park**

| Analyte<br>(ppm) | Park-<br>North side | Park-<br>Westside | Park-<br>Eastside | Park -<br>Southside | ATSDR<br>CV<br>(ppm)               | PADEP Regulatory<br>Value<br>(ppm) |
|------------------|---------------------|-------------------|-------------------|---------------------|------------------------------------|------------------------------------|
| Arsenic          | 8.21                | 8.11              | 7.69              | 7.65                | 20 <sup>1</sup> , 200 <sup>2</sup> | 12                                 |
| Cadmium          | 0.55                | 0.55              | 0.65              | 0.67                | 10 <sup>1</sup> , 100 <sup>2</sup> | 47                                 |
| Chromium         | 17.9                | 14                | 20.6              | 14.2                | No value                           | 94                                 |
| Lead             | 13.5                | 14                | 16                | 15.7                | 400 <sup>3</sup>                   | 500                                |
| Mercury          | 0.11                | 0.12              | 0.5               | 0.07                | 20 <sup>1</sup> , 200 <sup>2</sup> | 66                                 |

<sup>1</sup> Chronic child Environmental Media Evaluation Guide (EMEG)

<sup>2</sup> Chronic adult Environmental Media Evaluation Guide (EMEG)

<sup>3</sup> Toxic Substance and Control Act (TSCA) soil hazard value and EPA's screening value in residential soils

---

**Table 9- PADEP 2007 samples from fallout, soot wipe**

| <b>Analyte</b> | <b>Shippingport playground***, soot<br/>6/11/2007<br/>(mg/kg or ppm)</b> | <b>Hookstown Township, soot<br/>7/8/2007<br/>(mg/kg or ppm)</b> |
|----------------|--|---|
| Arsenic        | 897  | 186   |
| Beryllium      | 6.3  | <4.16   |
| Cadmium        | 1.6  | <4.17   |
| Chromium       | 314  | 120   |
| Lead           | 75.9   | 37.1  |
| Mercury        | 50.2   | 23.71   |
| Nickel         | 96.4   | 158   |
| Zinc           | 137  | 92.9  |
| Selenium       | 67.9   | 40  |
| Cooper         | 65.8   | 28.3  |
| Aluminum       | 8061   | 3155  |
| Manganese      | 61.6   | 201   |
| Vanadium       | 262  | 92.9  |
| Barium         | 471  | 282   |
| Magnesium      | 20290  | 12892   |
| Iron           | 16190  | 5062  |

---

**Table 10 – First Energy 2007 stack effluent sampling**

| <b>Analyte</b>          | <b>U1B Stack Effluent<br/>(ug/g or ppm)</b> | <b>U1 Paddle Test<br/>(ug/g or ppm)</b> |
|-------------------------|---|---|
| Arsenic                 |   | 47.6                                    |
| Beryllium <sup>†</sup>  |   | 2.3                                     |
| Boron <sup>†</sup>      |   | 90.4                                    |
| Cadmium                 |   | 2                                       |
| Chromium <sup>†</sup>   |   | 135                                     |
| Nickel <sup>†</sup>     |   | 146                                     |
| Lead                    |   | 45.7                                    |
| Selenium <sup>†</sup>   |   | 37.7                                    |
| Zinc                    |   | 83.9                                    |
| Naphthalene             | 0.15  | 0.045                                   |
| Acenapathylene          | ND  | ND                                      |
| Acenapathene            | 0.042                                       | 0.0089                                  |
| Fluorene                | 0.07  | ND                                      |
| Phenanthrene            | 0.38  | 0.019                                   |
| Anthracene              | 0.054                                       | ND                                      |
| Fluorathene             | 0.036                                       | ND                                      |
| Pyrene                  | 0.15  | ND                                      |
| Benzo(a)anthracene      | 0.023                                       | ND                                      |
| Chrysene                | 0.031                                       | ND                                      |
| Benzo(a)fluoranthene    | ND  | ND                                      |
| Benzo(a)fluoranthene    | ND  | ND                                      |
| Benzo(a)pyrene          | ND  | ND                                      |
| Ideno(1,2,3-dc) pyrene  | ND  | ND                                      |
| Dibenzo(a,h) anthracene | ND  | ND                                      |
| Benzo (ghi) perylene    | ND  | ND                                      |

**Table 11- PADEP 2007- 2008 Dust fall sampling (mg/kg) at Residence A**

| Analyte   | Residence A     |                 |                 |                |               |               |
|-----------|-----------------|-----------------|-----------------|----------------|---------------|---------------|
|           | 09/07-<br>10/07 | 10/07-<br>11/07 | 11/07-<br>12/07 | 12/07-<br>1/08 | 2/08-<br>3/08 | 3/08-<br>4/08 |
| Arsenic   | <0.072          | --              | <0.032          | <0.032         | <0.016        | ----          |
| Cadmium   | <0.018          | <0.003          | <0.008          | <0.008         |               | <0.006        |
| Chromium  | <0.072          | 0.011           | 0.06            | 0.175          | 0.048         | 0.039         |
| Lead      | 0.156           | 0.015           | 0.101           | 0.266          | <0.004        | 0.042         |
| Mercury   | <0.004          | <0.001          | <0.002          | <0.002         | <0.001        | <0.001        |
| Nickel    | 0.083           | <0.001          | 0.076           | 0.117          | 0.027         | 0.027         |
| Zinc      | 0.627           | 0.212           | 0.785           | 0.669          | 0.14          | 0.213         |
| Cooper    |                 | 2.7             | 17.5            | 0.167          | 0.189         | 0.043         |
| Aluminum  | 2.44            | 0.471           | 1.24            | 4.21           | 1.76          | 2.69          |
| Manganese | 0.784           | 0.223           | 0               | 0.673          | 0.179         | 0.343         |
| Magnesium | <1.8            | 0.406           | 0.724           | 0.893          | 0.484         | 0.62          |
| Iron      | 10.8            | 0.824           | 1.79            | 14.8           | 3.86          | 4.82          |
| Silicon   | 158             | 23.7            | 66.4            | 68.78          | 41            | 57            |
| Thallium  | <0.36           | --              | <0.016          | <0.016         | <0.008        | ----          |

**Table 12- PADEP 2007- 2008 Dust fall sampling (mg/kg) at Shippingport Borough Building**

| Analyte   | Shippingport Borough Bldg |                 |                 |                |               |               |
|-----------|---------------------------|-----------------|-----------------|----------------|---------------|---------------|
|           | 09/07-<br>10/07           | 10/07-<br>11/07 | 11/07-<br>12/07 | 12/07-<br>1/08 | 2/08-<br>3/08 | 3/08-<br>4/08 |
| Arsenic   | <0.059                    | --              | <0.02           | <0.012         | <0.024        | ----          |
| Cadmium   | <0.015                    | 0.021           | <0.005          | <0.003         | <0.006        | <0.007        |
| Chromium  | 0.069                     | 0.07            | 0.06            | 0.03           | 0.092         | 0.144         |
| Lead      | 0.181                     | 0.237           | 0.141           | 0.047          | 0.139         | 0.19          |
| Mercury   | <0.003                    | <0.002          | <0.001          | <0.001         | <0.001        | <0.001        |
| Nickel    | 0.091                     | 0.036           | 0.044           | 0.021          | 0.051         | 0.093         |
| Zinc      | 0.599                     | 3.98            | 1.27            | 0.126          | 0.31          | 0.489         |
| Cooper    | 1545                      | 218             | 51.8            | 0.046          | 0.082         | 0.075         |
| Aluminum  | 2.73                      | 3.87            | 2.49            | 0.702          | 4.11          | 6.32          |
| Manganese | 0.83                      | 2.77            | 0.543           | 0.118          | 0.469         | 0.628         |
| Magnesium | 2.24                      | 4.41            | 1.99            | <0.345         | 1.13          | 1.44          |
| Iron      | 8.71                      | 7.64            | 4.21            | 1.7            | 9.24          | 12.568        |
| Silicon   | 129                       | 76.3            | 44.7            | 30.5           | 57.067        | 73.7          |
| Thallium  | <0.029                    | --              | <0.1            | <0.006         | <0.012        | ----          |

**Table 13- PADEP 2007- 2008 Dust fall sampling (mg/kg) at Ohioville Borough Building**

| Analyte   | Ohioville Borough Bldg. |                 |               |               |
|-----------|-------------------------|-----------------|---------------|---------------|
|           | 10/07-<br>11/07         | 11/07-<br>12/07 | 2/08-<br>3/08 | 3/08-<br>4/08 |
| Arsenic   | --                      | <0.008          | ----          | <0.003        |
| Cadmium   | <0.003                  | <0.002          | <0.006        | <0.001        |
| Chromium  | <0.013                  | <0.008          | 0.06          | 0.006         |
| Lead      | 0.02                    | 0.007           | 0.046         | 0.003         |
| Mercury   | <0.001                  | <0.0004         | <0.001        | <0.0001       |
| Nickel    | <0.013                  | 0.009           | <0.023        | 0.003         |
| Zinc      | 0.24                    | 0.53            | 0.198         | 0.014         |
| Cooper    | 34.46                   | 1.21            | 1.84          | 0.005         |
| Aluminum  | 0.724                   | 0.1             | 5.4           | 0.164         |
| Manganese | 0.05                    | 0.034           | 0.303         | 0.011         |
| Magnesium | 0.425                   | <0.2            | 2.16          | <0.068        |
| Iron      | 0.489                   | 0.228           | 2.16          | 0.31          |
| Silicon   | 28.1                    | 17.3            | 56.1          | 6.08          |
| Thallium  | --                      | <0.004          | ----          | <0.002        |

**Table 14 - PADEP 2007 sampling of pool water and reservoir**

| Analyte   | Shippingport,<br>Pool Water | Ambridge Water<br>Authority | ATSDR CV                                | ATSDR CV                   | EPA                       |
|-----------|-----------------------------|-----------------------------|---|----------------------------|---------------------------|
|           | 12/5/2007<br>(ppm)          | 12/10/2007<br>(ppm)         | EMEG<br>(ppm)                           | CREG <sup>3</sup><br>(ppm) | MCL <sup>4</sup><br>(ppm) |
| Arsenic   | <0.005                      | <0.01                       | 0.003 <sup>1</sup> , 0.01 <sup>2</sup>  | 0.00002                    | 0.01                      |
| Beryllium |                             | <0.001                      | 0.02 <sup>1</sup> , 0.07 <sup>2</sup>   |                            | 0.004                     |
| Barium    |                             | 0.28                        | 2 <sup>1</sup> , 7 <sup>2</sup>         |                            | 2                         |
| Cadmium   |                             | <0.001                      | 0.002 <sup>1</sup> , 0.007 <sup>2</sup> |                            | 0.005                     |
| Chromium  |                             | <0.04                       |   |                            | 0.1 (total)               |
| Lead      |                             | <0.005                      |   |                            | 0.015                     |
| Thallium  |                             | <0.02                       |   |                            | 0.002                     |
| Mercury   |                             | <0.0002                     | 0.003 <sup>1</sup> , 0.01 <sup>2</sup>  |                            | 0.002                     |
| Selenium  |                             | <0.02                       | 0.05 <sup>1</sup> , 0.2 <sup>2</sup>    |                            | 0.05                      |

1 Chronic child Environmental Media Evaluation Guide (EMEG)

2 Chronic adult Environmental Media Evaluation Guide (EMEG)

3 Cancer Risk Evaluation Guide (CREG) for 1x10<sup>-6</sup> excess cancer risk

4 Maximum Contaminant Level (MCL) established for drinking water

**Table 15 – 2004 monthly average ambient air sampling results (ug/m<sup>3</sup>)**

|             | September/October |           |             | November     |           |             | December     |           |             |
|-------------|-------------------|-----------|-------------|--------------|-----------|-------------|--------------|-----------|-------------|
|             | Shippingport      | Aliquippa | Potter Twp. | Shippingport | Aliquippa | Potter Twp. | Shippingport | Aliquippa | Potter Twp. |
| Chromium    | 0.006593          | 0.006456  | 0.006936    | 0.004411     | 0.002464  | 0.002830    | 0.003621     | 0.003846  | 0.003170    |
| Nickel      | 0.005733          | 0.004998  | 0.005421    | 0.002340     | 0.001210  | 0.001626    | 0.001780     | 0.002167  | 0.001633    |
| Beryllium   | <0.000096         | <0.000096 | <0.000098   | <0.000092    | <0.000093 | 0.000102    | <0.000089    | <0.000099 | <0.000098   |
| Mercury     | <0.000096         | 0.000096  | <0.000158   | <0.000092    | <0.000093 | 0.000102    | <0.000089    | <0.000099 | <0.000098   |
| Particulate | 30.47661          | 37.36357  | 34.84043    | 34.65795     | 21.00792  | 27.44422    | 20.47263     | 23.26313  | 16.08340    |
| Manganese   | 0.071887          | 0.060598  | 0.104808    | 0.076104     | 0.019155  | 0.021499    | 0.048225     | 0.015493  | 0.016214    |
| Cadmium     | 0.003969          | 0.005199  | 0.006247    | 0.002241     | 0.017626  | 0.024653    | 0.001627     | 0.001138  | 0.002179    |
| Lead        | 0.022592          | 0.026162  | 0.047404    | 0.013394     | 0.013093  | 0.031357    | 0.010529     | 0.009635  | 0.017940    |
| Zinc        | 0.401022          | 0.628955  | 1.214648    | 0.273365     | 0.100109  | 0.461616    | 0.107826     | 0.090131  | 0.124096    |
| Arsenic     | 0.002053          | 0.002348  | 0.002502    | 0.001267     | 0.001194  | 0.001389    | 0.001006     | 0.001332  | 0.002295    |

**Table 16 – 2005 monthly average ambient air sampling results (ug/m<sup>3</sup>)**

|             | January      |              |           | February     |              |          |
|-------------|--------------|--------------|-----------|--------------|--------------|----------|
|             | Masontown #1 | Masontown #2 | Monaca    | Masontown #1 | Masontown #2 | Monaca   |
| Chromium    | 0.002214     | 0.002262     | 0.027212  | 0.002353     | 0.0020435    | 0.00784  |
| Nickel      | 0.001097     | 0.001232     | 0.013474  | 0.002078     | 0.00173782   | 0.00434  |
| Beryllium   | <0.000089    | <0.000094    | <0.001284 | <0.000089    | <0.00009595  | <0.00033 |
| Mercury     | <0.000407    | <0.000094    |           | <0.000089    | <0.00009595  |          |
| Particulate | 19.50981     | 19.88630     | 50.06898  | 33.1905      | 29.05246118  | 38.5798  |
| Manganese   | 0.007692     | 0.008261     | 0.051416  | 0.012573     | 0.00955799   | 0.01871  |
| Cadmium     | 0.000402     | 0.000445     | 0.002270  | 0.000768     | 0.00060504   | 0.00103  |
| Lead        | 0.006032     | 0.006938     | 0.036317  | 0.011502     | 0.01036293   | 0.02088  |
| Zinc        | 0.024635     | 0.031370     | 0.240910  | 0.044138     | 0.03684598   | 0.08661  |
| Arsenic     | 0.001517     | 0.001513     | 0.008524  | 0.002709     | 0.00193772   | 0.00412  |

---

**Table 17 – Highest observed air sampling results during 2004-2005 sampling event**

|             | <b>Conc. (ug/m<sup>3</sup>)</b> | <b>Date</b> | <b>Location</b> |
|-------------|---------------------------------|-------------|-----------------|
| Chromium    | 0.097616                        | Jan-05      | Monaca          |
| Nickel      | <0.046057                       | Jan-05      | Monaca          |
| Beryllium   | <0.004605                       | Jan-05      | Monaca          |
| Mercury     | <0.0002065                      | Sept/Oct    | Potter          |
| Particulate | 148.4                           | Jan-05      | Monaca          |
| Manganese   | 0.498950                        | Sept/Oct-04 | Potter          |
| Cadmium     | 0.018846                        | Sept/Oct-04 | Potter          |
| Lead        | 0.123590                        | Sept/Oct-04 | Potter          |
| Zinc        | 3.451725                        | Sept/Oct-04 | Potter          |
| Arsenic     | 0.024752                        | Jan-05      | Monaca          |

ND = Non-detect

‡ First Energy, Beta Laboratory report, 7/28/06

+ DEP Bureau of Laboratories Analytical Report, 8/10/2006

† Analyte also detected in method blank

± Ohioville dustfall sampling - 09/07-10/07 not sampled, 12/08/ - 1/08 dustfall sampler destroyed by a wind storm, 1/08-2/08 windstorm blew a noticeable amount of road dust into sampling jar

\* Letter from Bruce Warnaka, Bruce Mansfield Plant, to Mark Wayer, PADEP SWRO, June 21, 2007

\*\* Severn Trent Laboratories, Analytical Report, June 18 2007

\*\*\* No sample area reported, can not reference EPA's benchmark standards for wipe samples (ug/m<sup>2</sup>).