Special Study for Amnicola/ Wisdom Street Area

September 2006- January 2007

On September 21, 2006, the Chattanooga-Hamilton County Air Pollution Control Bureau became aware of a paint damage complaint of rust spots on cars in the police impound lot on Wisdom Street. Similar spots were discovered on new cars being received by the City of Chattanooga parked in the Police Service Center lot on Wisdom Street and also parked at the City Garage on Belle Arbor Avenue a block away. The rust spots on horizontal surfaces of the vehicles were not easily removed by ordinary washing. An investigation revealed a wider sphere of rust spot influence on cars around the area. Daily inspection indicated that the problem was continuing.

Rust samples collected from affected cars by Bureau Investigator, John Schultz, were examined microscopically by Kathy Jones, Air Monitoring Manager. The collected samples appeared to be oxides of iron when compared against an example photomicrograph, 391 Iron Oxide, page 477, in *The Particle Atlas Edition Two* by Walter McCrone and John Delly. A confirming sample was taken of particulate debris that had accumulated on the ground in a parking lot across the street from Mueller Company. It was sent to Technical Laboratories, and the sample was found to be composed of 65.5% iron compounds, a combination of soluble and insoluble components. The particles on the cars were metallic in appearance and magnetic.

The investigation then focused on (1) the source of the particles, (2) whether moisture alone caused the rust, or (3) whether some other pollutant caused damage to the vehicle clear coats that catalyzed particles to rust more rapidly. It was theorized that a combination of metallic particles and an acid atmosphere had made the spots extremely difficult to remove. The purpose of this paper, therefore, is to evaluate the problem, present and interpret laboratory results of special monitoring, and provide some risk assessment.

Known Pollution Incident

A fire had occurred in Baghouse 28 at Mueller Company, a local foundry .58 miles from the impound lot, on August 24, 2006. Fire department records show that the fire department responded at 7:00 PM and the incident ended at 7:27 PM. When the fire department arrived, the fire was already extinguished. Baghouse 28 controls emissions from a shot blast machine. The contents of the baghouse would have been discharged to the atmosphere during the fire. Draft from the fire would release particulate material, including iron shot and material from cast parts that were being cleaned. Reported wind at the airport was from the east to east northeast. Local wind as reported by observers at the time may have been more from the north. The rust spot problem in the area has continued, however, for months after the baghouse was repaired.

Investigation

All acids and solvents in the emissions inventory database were reviewed. Emissions in the area were found, as expected, to be small except for that of INVISTA S.à r.l., located at 4501 North Access Road, with an emission rate of 16.4 lbs/hr of HCl. However AERMOD dispersion modeling for 2001 through 2005 had been submitted in accordance with "Appendix A to Subpart DDDDD-Methodology and Criteria for Demonstrating Eligibility for the Health-based Compliance Alternatives Specified for the Large Solid Fuel Subcategory" of the National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters. The modeling shows a Hazard Index at the Police Service Center from Cl_2 and HCl combined of less than 1.

Literature indicates that sources of iron particulate are railroad operations where steel is in contact with steel, automobile and truck operations from vehicle wear, and industrial fallout. Major railroad tracks are located 0.77 miles from the impound lot. Amnicola Highway is a high traffic area, and many vehicles are parked at the impound lot, the Police Service Center, and the City Garage. Industrial fallout is also possible since the area of complaint is in the heart of an industrial area. Mueller Company's foundry is located in the industrial area.

The foundry was thoroughly inspected after the complaint by Cynthia McDaniel, Bureau Engineer, and Mueller was found to be in compliance with their Air Pollution Control operating permit. This inspection did not find any indication of emissions greater than allowable.

Because iron is relatively inert, a significant time should elapse before permanent rust spots are observed on cars. In this complaint it appeared that rust was appearing within a short period of time. It was thought that iron should not stick to vehicles unless there is some catalytic mechanism.

Paint Characteristics

Travis Wileman, a painter at a local Ford dealer was contacted. He provided the name of the company that supplied paint for Ford. He also said the local dealer had repaired acid rain damage on automobiles in this area and that they had treated automobiles for the iron particulate damage. Mr. Victor Leal of DuPont (the paint supplier to Ford) was contacted. Mr. Leal said that the clearcoat could be damaged by iron particulate which he referred to as "railroad dust", acid rain, and bird droppings. Mr. Leal said that it was common to experience railroad dust at many locations in the United States. An internet search indicated that the problem is common in the United States and in Europe.

Inspection of automobiles upon delivery for iron damage appears to be common. For example the Jaguar & Land Rover Transport Quality Manual, Chapter 8 Survey Standards Issue 4 July 2004 requires "All parts must be checked for the following damages (damage classification) Typical damages during transport process.....

Shifting/flying rust is a corrosion caused by the diffusing of iron or steel particles in the paint surface which circulate in the atmosphere (frequently caused through rail wagon brake blocks/overhead cabling)."

Acid Rain

The acid rain EPA sites state that acid rain damages automobiles but does not state that acid rain causes the rust spots that were observed. Specifically the EPA site www.epa.gov/airmarkets/acidrain/effects/auto.html states "The results of laboratory experiments and at least one field study have demonstrated that acid rain can scar automotive coatings. Furthermore, chemical analysis of the damaged areas of some exposed test panels indicated elevated levels of sulfate, implicating acid rain."

The site goes on to say "Because evaporation of acidic moisture appears to be a key element in the damage, any steps taken to eliminate its occurrence on freshly painted vehicles may alleviate the problem. These steps include frequent washing followed by hand drying…."

The National Atmospheric Deposition Program/ National Trends Network, on an annual basis, show a Lab pH arithmetic mean of 4.45 for 2005. This indicates the presence of acid rain. Unpolluted rain has a pH of 5.8.

EPA explains that acid rain is produced by atmospheric reactions involving the emissions from power plants. Acid rain is formed from NO_x and SO_x. Our area is surrounded by power plants that are not in our jurisdiction. The nearest power plants emitted the following quantities of SO_2 in 2005.

Bowen	Chatsworth GA	186,476 tons per year
Kingston	Kingston TN	56,207 tons per year
Widows Creek	Stevenson AL	34,380 tons per year
Hammond	Rome GA	39,584 tons per year

The bureau had an automobile hood located at the city garage with half of the hood clear coated and the other half painted only. *No rust developed on the painted portion but the clear coated portion developed rust spots.* The magnitude of pH readings was recorded whenever moisture was sufficient to measure pH on the hood. The readings are attached. The local readings appear to be consistent with the National Atmospheric Deposition Program /National Trends Network. The pH readings are shown in the following chart:

pH Readings			
Date	**Area**	**pH**	**Tested**
11/21/06	Hood (City Garage)	4.0	Dew
11/28/06	Hood	4.0	Dew
11/29/06	Hood	4.5	Dew
	Police Impound Lot	4.5	Dew
	Hunt Nissan	4.0	Dew
11/30/06	Hood	5.5	Rain
12/1/06	Hood	6.0	Rain
12/5/06	Hood	5.5	Dew
12/6/06	Hood	6.5	Dew
12/12/06	Hood	5.5	Dew
12/13/06	Hood	5.5	Rain
12/14/06	Hood	5.5	Dew
12/15/06	Hood	5.5	Dew
12/18/06	Hood	6.0	Dew
12/19/06	Hood	5.5	Dew
12/20/06	Hood	5.5	Rain
12/22/06	Hood	5.5	Rain
12/26/06	Hood	6.0	Rain
1/2/07	Array	6.0	Rain
1/3/07	Hood	6.0	Dew
	7500 Standifer Gap	6.5	Dew
1/4/07	Hood	6.5	Dew
1/5/07	Hood	6.0	Rain
1/8/07	Hood	6.0	Rain
1/16/07	South Creek Road	6.0	Rain
1/18/07	Array (N. Hawthorne)	6.0	Rain

pH of Particles

Kathy Jones took the samples that John Schultz, Bureau Investigator, collected from accumulated metallic debris on the ground across the street from Mueller and shot blast material from the plant. A small amount of distilled water was added, and the liquid was tested with pH color indication test paper. The test paper strips used are designed for medical use and have a color indicator for every number on the pH scale up to 10 (pH is 0-14). The pH was in the neutral range at about 6 on the pH scale, no change from testing the distilled water, indicating that the particles had not acquired a low pH coating or acid contamination as dry material. Water was poured out of the two samples, and the samples rusted in the Petri dishes over a weekend.

PM_{10} Monitoring

For this special study two different monitoring methods were incorporated and three different types of analysis. A PM_{10} (particulate matter 10 microns or less) monitor was set up in the Police Service Center parking lot to compare particulate mass against a control of two PM_{10}s at WDEF at 3300 Broad Street. A comparison of mass will sometimes indicate a marked difference in the sites and signify a mass problem at one location. There is no National Ambient Air Quality Standard (NAAQS) for iron, therefore, the comparison for health risk purposes is against the National Standard for Particulate. The standards for PM_{10} are 50 micrograms per cubic meter for a yearly arithmetic average (revoked in new legislation in December 2006) and 150 for a daily standard. The local arithmetic average yearly in Hamilton County is about 22 and the highest daily observed value during the year is no more than 49. Background levels are usually in the 6-13 range. $PM_{2.5}$ averages in the area are about 15.7 for a three year average at the highest site at the Tennessee/Georgia border in East Ridge. The yearly arithmetic averages are averaged over 3 years to compare against the standard. The highest daily $PM_{2.5}$ data is about 44 for a daily high value. The yearly and the high daily numbers are over the yearly standard of 15 and the newly promulgated daily standard of 35. Currently, Hamilton County does not meet either of the $PM_{2.5}$ particulate standards.

Although the particulate standard has been changed to $PM_{2.5}$, PM_{10} monitoring is still used in comparison monitoring. PM_{10} monitoring is done with a less technical monitor, and the weighing of filters is done locally. Thus, the results are faster and much less expensive. The monitoring was done in accordance with method *40 CFR, Part 50 Appendix M: Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere*. Initial monitoring for PM_{10} in this study was done on a random schedule between required monitoring days at the control site. The monitoring, however, subsequently was put on the national 3-day schedule with alterations in the schedule for filter changing on weekends because of difficulty in accessing the Broad Street site. The method involves drying by desiccation a large quartz 8 by 10 inch filter, placing it on the monitor in a cassette, exposing it for 24 hours at about 40 cubic feet per minute (ambient air sucked through the filter), removing the cassette, removing the filter, redrying the filter, and reweighing it. Then a calculation is done to convert to micrograms per cubic meter. The monitor uses a vacuum cleaner motor and functions like a vacuum cleaner on a minute timer. These monitors are commonly referred to as high volume samplers or Hi-Vols.

Federal Reference $PM_{2.5}$ monitors, in contrast, are low volume samplers that operate at a flow of 16.7 liters per minute, are computer operated on a pneumatic system, have a 47 mm (roughly half dollar size) fragile Teflon filter, and require a contract laboratory to handle the filter weighing. Data must be downloaded from the monitor and sent to the contract laboratory. Filters must be mailed for the lab to reweigh the exposed filters.

EPA requires identical monitors (collocation) at the same site for precision purposes. PM_{10} monitors at Broad Street used as the controls in this study are identical and should have almost identical mass numbers from their exposed filters.

PM_{10} Results from 2006/07 Amnicola/Wisdom Street Study Rust Spots on Cars Micrograms per Cubic Meter			
Date	**Broad Street Collocated Monitor**	**Broad Street Primary Monitor**	**Police Service Center Special Monitor**
11/01/06	29	31	30
11/07/06	17	18	19
11/10/06	Void	31	Void
11/14/06	Void	28	37
11/21/06	9	10	11
11/25/06	34	35	30
11/28/06	43	42	36
12/01/06	Void	Void	10
12/07/06	13	13	16
12/10/06	33	32	35
12/13/06	22	21	32
12/16/06	31	29	31
12/19/06	30	30	Void
12/21/06	27	27	31
12/27/06	16	16	17
12/31/06	29	28	29
01/03/07	28	28	30
01/06/07	18	17	23
01/09/07	7	7	9
01/12/07	20	19	31

On five dates since PM_{10} monitoring began there have been noteworthy higher data at the site of interest: 11/14, 12/13, 12/21, 1/6/07, and 1/12/07. There have, however, been days that were higher at Broad Street: 11/25, and 11/28.

To understand how the PM_{10} compares to the $PM_{2.5}$ in Hamilton County, a chart is provided of the Broad Street Primary PM_{10} monitor and the Police Service Center PM_{10} monitor comparing them against the Siskin Drive $PM_{2.5}$ continuous monitor during the time period of the study. The continuous $PM_{2.5}$ monitor's data runs about 2.3 micrograms per cubic meter higher on average than the $PM_{2.5}$ Federal Reference Monitors that are used for attainment or nonattainment designations.

The $PM_{2.5}$ continuous monitor is a monitor that contains a tapered element oscillating microbalance that makes a direct measurement of the particle mass collected on a filter in

real time. The monitor measures the oscillations of the filter on the microbalance to determine the mass.

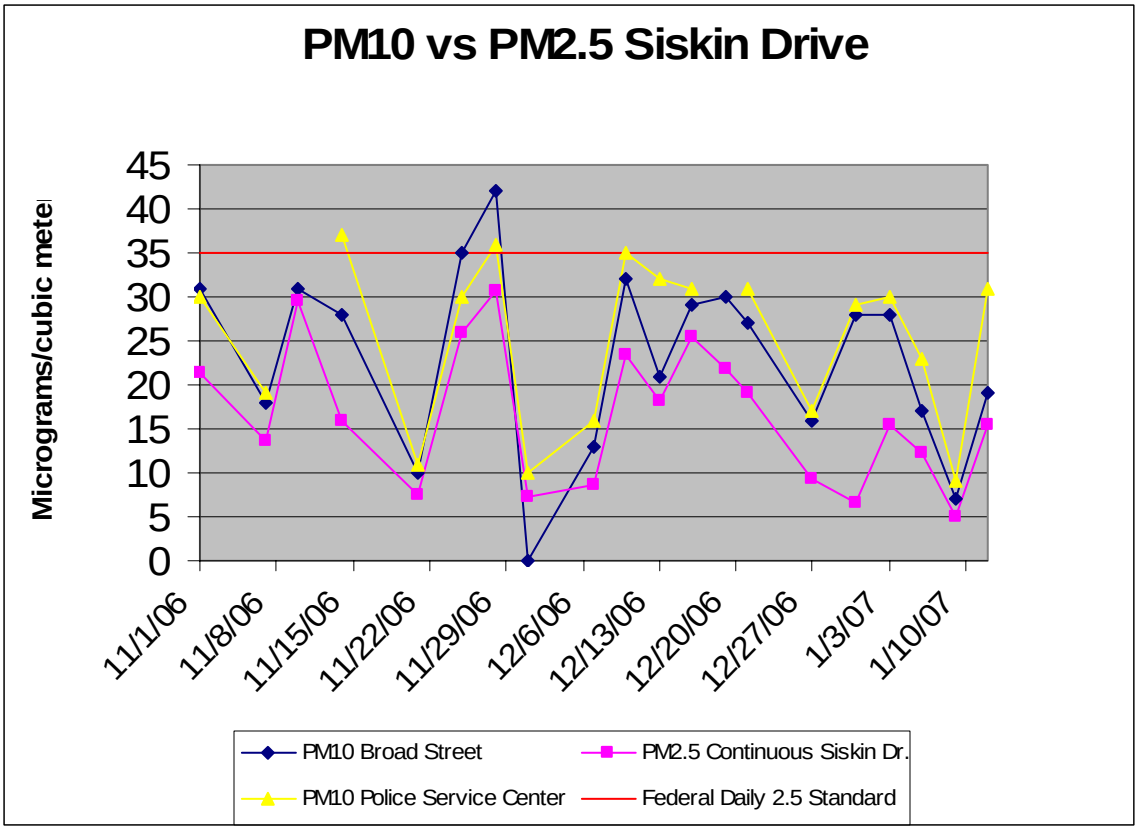
Thus, the $PM_{2.5}$ continuous monitor, the $PM_{2.5}$ Federal Reference Monitor, and PM_{10} Hi Vol monitors are all different types of monitors; therefore, the methods of collection are different. The continuous monitor is used for real-time observations, for reporting to a national mapping system, and day-to-day comparison purposes. The continuous data is ***not*** used for comparison against national standards.

The Siskin Drive continuous monitor is located behind the Chattanooga School of Arts and Sciences, 2.7 miles from the Police Service Center parking lot. It has been established with historical data from the $PM_{2.5}$ monitoring program that regional $PM_{2.5}$ mass levels tend to be very similar. EPA has concluded that the same monitoring areas can be covered with fewer representative monitors. If Siskin Drive is reflecting accurately the $PM_{2.5}$ in the area, then it would appear that the increased PM_{10} at the site of interest would be mostly due to size particles larger than $PM_{2.5}$. In other words, the difference in PM_{10} between the two sites appears to be more related to size particles that fall between $PM_{2.5}$ and PM_{10}.

Date	Broad Street PM_{10} Control Site	Siskin Drive $PM_{2.5}$	$PM_{2.5}$ as Percent of PM_{10}	Police Service Center Site PM_{10}	$PM_{2.5}$ as Percent of PM_{10}
11/01/06	31	21.3	68.7	30	71.0
11/07/06	18	13.6	75.6	19	71.6
11/10/06	31	29.5	95.2	Void	Void
11/14/06	28	15.9	56.8	37	43.0
11/21/06	10	7.5	75.0	11	68.2
11/25/06	35	26	74.2	30	86.7
11/28/06	42	30.7	73.1	36	85.3
12/01/06	Void	7.2	N/A	10	72.0
12/07/06	13	8.6	66.2	16	53.8
12/10/06	32	23.5	73.4	35	67.1
12/13/06	21	18.1	86.2	32	56.6
12/16/06	29	25.5	87.9	31	82.3
12/19/06	30	21.9	73.0	Void	N/A
12/21/06	27	19.1	70.7	31	61.6
12/27/06	16	9.3	58.1	17	54.7
12/31/06	28	6.5	23.2	29	22.4
01/03/07	28	15.5	55.4	30	51.7
01/06/07	17	12.3	72.3	23	53.5
01/09/07	7	5	71.4	9	55.6
01/12/07	19	15.4	81.1	31	49.7

If one averages the percent difference from November 1 through January 12 (excluding the three dates that are less consistent during the holidays), the percent of PM_{10} that is $PM_{2.5}$ is about 75% comparing the Broad Street PM_{10} to the Siskin Drive $PM_{2.5}$. If one uses the same methodology to determine $PM_{2.5}$ percent of PM_{10} for the Police Service Center, the percent is actually lower because the PM_{10} data days have higher data on average.

Only two dates of 11/14 and 11/28/06 are above 35 micrograms per cubic meter for PM_{10}. The Siskin Drive $PM_{2.5}$ for those dates were 15.9 and 30.7. The PM_{10} data for 12/19 which was voided should have been also in the 30 range or above. The daily PM_{10} standard is 150 micrograms per cubic meter which is 4 times the highest PM_{10} at the test site in the study of 37 micrograms per cubic meter. But data is higher for 11/28 at Broad Street, most likely indicating high $PM_{2.5}$ regionally. The Siskin Drive continuous $PM_{2.5}$ data may itself be artificially elevated because of a construction project next to the site.



Therefore, the risk from exposure to the particulate in the area seems no greater than the risk at the Broad Street control site. Particulate that is visible and able to be collected from cars appears to be over 2.5 microns in size and may be over 10 microns. Material that is large enough to be seen with the naked eye is generally considered too large to be respirable.

Contract Data

Five sets of samples, test filters and matching date control samples, were sent to Research Triangle Institute at Research Triangle Park in North Carolina. RTI has a national reputation and is the contract lab that EPA uses for the EPA National $PM_{2.5}$ Speciation program. Iron; anions and cations; and lead and cadmium were selected for analysis. Anions and cations were selected to study the balance between the irons to determine if there is an indication of acid atmosphere. Total iron was selected for analysis to determine if there is more iron in the atmosphere in the study area. Cadmium and lead were selected to be spot checked because they are known emissions from foundries and because lead is a criteria pollutant for which there is a national standard.

Iron was analyzed by a Perkin-Elmer inductively coupled plasma atomic emission spectrometer (ICP-AES). Cadmium, and lead were analyzed by a Thermo X-Series II inductively coupled plasma mass spectrometer (ICP-MS). Both methods require acid washing a strip from each filter, heating the liquid in a ultrasonic water bath, vortex mixing, cooling the sample, diluting the sample, and vortex mixing again before analysis.

X ray florescence was considered for metals analysis, but it was thought that the limits of detection were not in the correct range to do XRF on PM_{10} filters. XRF is one of the methods the $PM_{2.5}$ speciation program is using.

Ions were analyzed using a Dionex DX600 ion chromatograph. The method requires extraction by dilution and using a reciprocating shaker and ultrasonic bath. The extracts were centrifuged just prior to analysis to settle quartz particles.

Table of Analytical Monitoring Results

Special Study: Car Rust in Amnicola/Wisdom Street Area 2006

Units: µg

	Fe	Cl	NO_2	NO_3	PO_4	SO_4	Na	NH_4	K	Mg	Ca	Cd	Pb	PM_{10} µg/m^3
11/01/06PS	1050	100	22.6	2590	330	4440	445	810	142	156	856	.534	20.8	30
Broad	1130	43.2	13.6	1910	307	4890	434	1750	116	93	636	.672	14.1	31
11/07/06PS	308	23.3	42	1190	329	3710	403	745	92.8	136	328			19
Broad	549	20.4	44.2	1220	316	3750	384	1410	80.4	52.6	277			18
11/14/06PS	1120	285	54.2	1490	259	4810	386	477	143	95.8	1830	.943	23.8	**37**
Broad	1030	36.0	19.3	874	250	4400	352	1150	141	73.6	1440	.306	10.5	**28**
11/21/06PS	269	16.8	28.1	607	268	3520	312	916	37.2	64.7	659			11
Broad	357	17.7	19.7	416	174	3620	270	1290	43.6	54.3	368			10
11/25/06PS	979	28.3	26.8	911	222	4710	279	1030	165	109	729	.830	12.9	30
Broad	956	27.9	102	709	247	4250	298	1180	258	66.9	980	.700	16.9	35

PS - Police Service Center
Broad- Broad Street Monitors: Control Site

Analysis of Analytical Monitoring Results

Iron

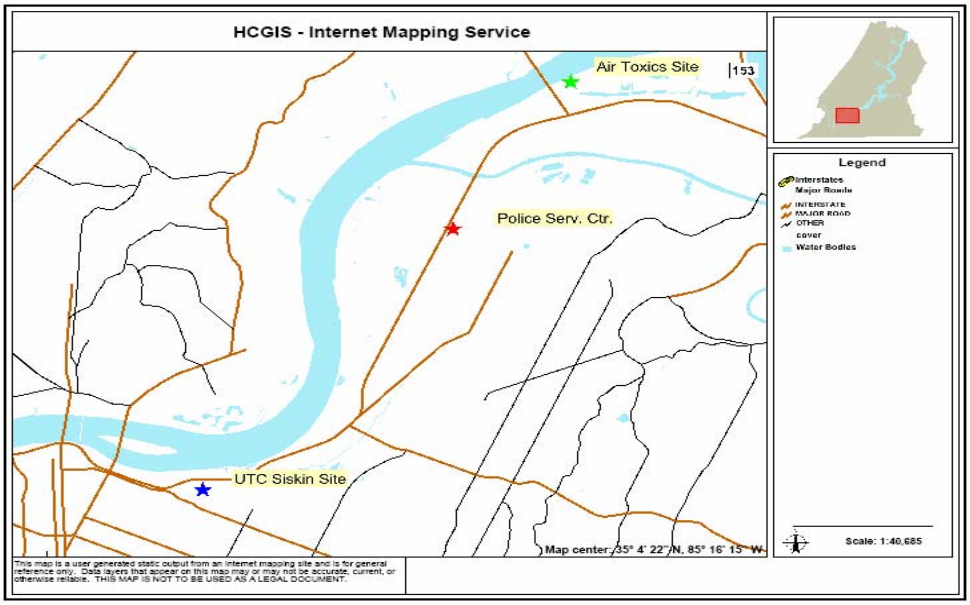
Iron levels were similar between the test site on Wisdom Street and the control site at Broad Street. In fact, levels were actually higher on Broad Street for 3 of the 5 sample sets. This is not surprising since former foundries in the Broad Street area would have left residual foundry dust in the area. But, it does indicate that *iron levels in the PM_{10} size range and below are not different at the test Wisdom Street site than the control site at Broad Street.*

A point of reference is the iron levels measured in the $PM_{2.5}$ speciated data since 2002. The iron annual averages in micrograms per cubic meter calculated by Errol Reksten are:

2002	2003	2004	2005	2006
.1058	.1559	.0884	.1078	.1239

The iron average levels by site as calculated by Errol Reksten from the 1998/1999 one year Toxics Study from Total Suspended Particulate in micrograms per cubic meter are:
**Note that the TN Riverpark site, marked Air Toxics Site on the map, is closest to the 2006 study area.*

Emma Wheeler Homes-Wilson Road/Rossville	Bethlehem Community Center-Alton Park/ 38th Street	Bethlehem Community Center	20th Street Fire Hall	Interstate I 75 Split behind Eastgate	East Brainerd Fire Hall-EB Rd.	Tennessee Riverpark-Amnicola Highway
.5726	.72	.8354	1.3393	.4748	.36	.5781



The magnitude of the TSP iron is different from that of the $PM_{2.5}$ because of the difference in size particle fractions. However, the numbers are useful for comparison against the PM_{10} data collected during the 2006 study.

The PM_{10} iron results from the 2006 study are converted from micrograms to micrograms per cubic meter in the following chart to make the numbers easier to compare against the previous studies' iron results.

Date	Location	Fe Micrograms	Fe Micrograms/m^3
11/01/06	Police Service	1050	.6572
	Broad	1130	.7073
11/07/06	Police Service	308	.1928
	Broad	549	.3436
11/14/06	Police Service	1120	.7010
	Broad	1030	.6447
11/21/06	Police Service	269	.1684
	Broad	357	.2234
11/25/06	Police Service	979	.6127
	Broad	956	.5983

The Toxics Study in 1998-99 used a Total Suspended Particulate (TSP) monitor to capture particulate for metals analysis. A TSP monitor captures 99.9% of the particulate that is suspended in the air. It does not cut down the captured particle size like a PM_{10} or $PM_{2.5}$ monitor. The comparison of the iron results from this PM_{10} Amnicola/Wisdom Street 2006 study to iron results of Total Suspended Particulate of the Toxics Study, indicate that the numbers are similar, an average of roughly .5 micrograms per cubic meter in both cases, except in the case of the 20th Street Fire Hall that was located near Foundry Row on Broad Street and the Bethlehem Community Center on 38th Street. The 20th Street site would be expected to reflect foundry emissions in 1998 since it was the closest site to the foundries. The Bethlehem Community Center was assumed to have elevated iron reflecting foundry influence. But, the average total influence from foundry iron in 1998-99 appeared to be no more than .98 micrograms per cubic meter at the highest foundry impacted site compared to the lowest nonfoundry site at East Brainerd Fire Hall. This difference reflects a concentrated foundry area along Broad Street and emissions in 1998-99 from a foundry five times larger than Mueller.

The PM_{10} yearly average in Hamilton County fell about 5 micrograms per cubic meter, a fairly significant drop, when Wheland Foundry closed and Signal Mountain Cement started up a new multimillion dollar plant in the same year. The $PM_{2.5}$, though, was not so dramatically affected.

The comparison of current data to past data indicates several possible interpretations. The data may indicate that iron city-wide is mostly in the PM_{10} fraction and existed in the same particle size distribution in 1998-99. The data is almost identical comparing the 2006 PM_{10} and the 1998-99 TSP. The $PM_{2.5}$ speciation data indicates that the $PM_{2.5}$ average is only .1 micrograms per cubic meter of iron compared to the .5 or so in the PM_{10} and TSP. Or, the fact that the TSP and PM_{10} data are close in magnitude except for the 20th Street Fire Hall could indicate that there is a larger fraction of iron in the PM_{10} range in 2006. If TSP were measured at the test site, more total iron mass than is in the PM_{10} might be discovered.

When the data was evaluated during the 1998-99 Toxics Study, no health risk was associated with the iron monitoring results. The data in that study was actually higher at some sites than has been found in the Amnicola/ Wisdom Street site; therefore, it is logical to assume that no health risk would be assigned in this study if a professional risk assessment were conducted

Cl

Two of the 5 sample sets had unusually high chloride compared with the control. The calculations for the 11/14 sample were rechecked and verified by the laboratory because the magnitude of difference was so great between the control and test sites. Industries in the area do emit hydrochloric acid so this chloride elevation may be indicative of the acid in the area.

NO_2 and NO_3

Duplicate analyses indicated that the NO_2 analysis was the least reproducible of any of the analyses done. Therefore, attention will be focused more on the NO_3. There was a substantial difference in the NO_3 on November 1 and 14 in comparison with the control site. The elevated NO and NO_3 might be caused by traffic since Amnicola is a high traffic area. Or, high NO and NO_3 might be caused by a permitted or unpermitted source as yet undetermined. Elevated NO and NO_3 can contribute to the formation of an acid atmosphere by forming nitric acid.

The National Primary Ambient Air Quality Standard for nitrogen dioxide is .053 parts per million (100 micrograms per cubic meter) annual arithmetic mean concentration. The highest NO_2 measured in the study was .0638 micrograms per cubic meter of air compared against a standard of 100 micrograms per cubic meter. This is less than 1% of the standard. The secondary standard is exactly the same. NO_2 is measured against the standard by a gaseous monitor rather than through evaluation of particulate.

PO_4, Na, K, Ca

Phosphate data was similar except for 11/21. Sodium and potassium data were close in magnitude. Ammonia was dramatically higher at the control site. Calcium was almost double at the test site on November 21.

Cd and Pb

Cadmium was almost triple on 11/14 but the amounts present were barely trace amounts. For example, the highest cadmium data was .943 micrograms which translates to .0006 in micrograms per cubic meter. Lead levels were higher at the Amnicola/ Wisdom Street

site than at Broad site on two of the three days analyzed. A chart converting the micrograms to micrograms per cubic meter is provided to compare the data against the standard.

Pb in Micrograms per Cubic Meter		
	Police Service Center	Broad Street
11/01/06	.0130	.0088
11/14/06	.0149	.0066
11/25/06	.0081	.0106

When the amount of lead is calculated into micrograms per cubic meter, the amount present is considerably below the NAAQS for lead in ambient air: 1.5 micrograms per cubic meter maximum arithmetic mean averaged over a calendar quarter. The highest value is .0149 which is about 1% of the standard.

UV Hound Monitoring

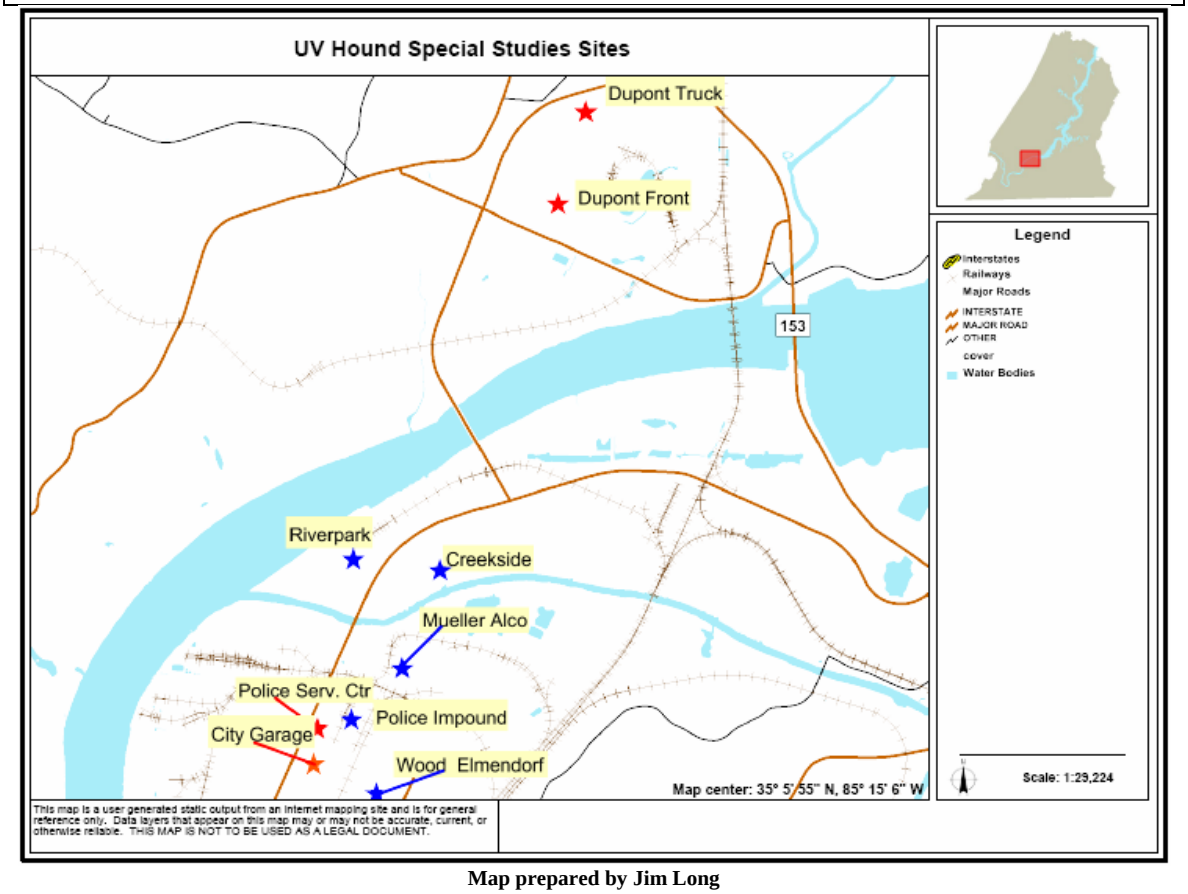
A UV Hound, a point and shoot real-time instrument, was borrowed from CEREX Scientific, Inc., to do real time monitoring at numerous locations for several days in the area. This monitoring was designed to investigate the hypothesis that there is an acid atmosphere in the area of the rusted cars. The monitor samples air and passes it through an optical analysis chamber. It analyzes using a UV absorbance method before it expels the air. Target gasses are detected and instantaneously reported (method information taken from lecture and website). Gasses absorb light at different wavelengths in the UV spectrum, and this instrument compares sample data with a library of gasses with previously identified absorption wavelengths. The monitor has a 17 foot internal path to the detector. Data was sent electronically daily to the parent company who ran software to evaluate the monitoring results against the wavelength library, and the data evaluation was sent back to the Bureau the following week.

There are limitations to performing this method and to snapshot real-time monitoring. Although the library of absorption wavelengths is large, there are still unidentified wavelengths that are found in ambient air sampling. Since the monitoring is only for short time periods gasses can be present but missed because the emissions did not occur in the time-frame of the monitoring. Thus, nondetects on snapshot monitoring do not indicate the gasses are not present. Some gasses cannot be measured by this method because their wavelengths are too low in the spectrum to be accurately determined. For example, sulfuric acid was an acid of interest, but the instrument cannot detect it properly because it has a low nanometer spectrum.

The monitor was transported by car to various predetermined locations and 6 minute samples were taken. The monitoring scheme was patterned after a current project in Hillsborough County, Florida, where daily grab samples are being taken at specific

locations. There were a total of 6 data sets taken December 5, 6, and 7 at these locations by Bureau Instrument Technician, Jim Long:

UV Hound Study Sites December 2006	
Set 1, 2, 3	Police Service Center Parking Lot-
(set 3- Dupont truck parking not sampled)	Police Impound Lot Gate- South side of lot
	Police Impound Lot Railroad Tracks- West side of lot
	City Garage on Belle Arbor Avenue
	Elmendorf and Woods
	Mueller/Alco cul-de-Sac
	River Park near BASF
	DuPont/INVISTA Main Parking Lot- South side of Plant
	Truck parking Lot, Dupont
Set 4, 5, 6 Added Creekside Drive	Creekside Drive cul-de-sac
Sets 1,2,3 Monitored 12/5/06	
Sets 4,5 Monitored 12/6/06 *Monitor was left on while traveling from DuPont to East Ridge*	
Set 6 Monitored 12/7/06	



Map prepared by Jim Long

UV Hound Monitoring Results

Bureau Instrument technician, Jim Long, detailed location, time of day of real-time samples, and length of grab samples in a bound log book. Monitoring results were compared against the detailed notes and the results are as follows:

12/05/2006	Unknown gas detected twice, both at Elmendorf and Wood
12/06/2006	Elevated Nitric Oxides (NO) in the Police Serve Parking lot on Wisdom Street two times(40-60 ppb) (27-68 ppb) and at the City Garage on Belle Arbor Avenue (40 to 119 ppb)
12/6/2006	Elevated SO_2 while driving through a residential neighborhood to 153 on Hamill Road (7-30 ppb)
12/6/2006	Unknown gas detected: similar to ammonia fingerprint
12/6/2006	Marked increase in NO while traveling 153 and 75 to East Ridge from Hamill Road behind Dupont (24-213 ppb)
12/7/2006	Elevated NO at Police Impound Railroad tracks (see next line)
12/7/2006	Elevated NO at City Garage and Elmendorf and Wood (25-51 ppb including 12/7 Railroad tracks sample)

Evaluation of UV Hound Monitoring

On December 5 an unknown gas was detected twice, both at the same location. The profile was not in the profile library and has not been identified. Elevated nitric oxides existed in the Police Service Center Parking lot and at the City Garage on Belle Arbor Avenue on December 6. Since the elevated NO was only detected in those two locations and not at other sites in the area on that day, it appears that motor vehicle emissions may have been the cause. In both locations there are many vehicles parked in close proximity. In the Police Service Center lot are located gasoline pumps where city employees fill their vehicles. The large nitrogen oxide amount detected, up to 213 ppb, during the drive to East Ridge from DuPont seems to reflect NO from traffic on 153 and I-75. NO is not indicated in large amounts until the freeway is accessed and appears to instantly diminish to normal levels when the freeway is exited. On 12/7 NO seems high at three sites accessed back to back, possibly indicating that NO was elevated in the test area during the time-period. SO_2 was elevated on Hamill Road.

Hydrochloric acid was not detected by the UV Hound. Sulfur Dioxide (SO_2) was only detected at elevated levels in the residential neighborhood on Hamill Road.

There is no National Standard for nitric oxide. The standard is for nitrogen dioxide. However, since NO was detected at elevated levels, nitric acid may be an acid of interest.

Health Risk Evaluations

Iron and Particulate

There is no monitoring evidence to support an increased health risk from iron since iron data at the Control site at Broad Street is virtually identical to the data at the test site on Wisdom Street**.** Iron was a very small fraction of the monitored PM_{10} in this 2006 study. ***The iron data is less in magnitude than data from the Toxics Study in 1998-99 where no risk was assigned to iron in a professional risk assessment.***

Since there is no National Ambient Standard for iron, risk assessment can be done by comparing particulate levels to the NAAQS for particulate. Particulate levels measured in PM_{10} at the test site were found to be below $PM_{2.5}$ daily standard levels on every test day except 11/14 and 11/28. The Siskin daily $PM_{2.5}$ continuous data on 11/14 and 11/28 were 15.9 and 30.7, both below the 35 micrograms per cubic meter $PM_{2.5}$ daily standard. The Broad Street control site was even higher than the test site for PM_{10} on 11/28.

Thus:

(1) if the $PM_{2.5}$ was actually more elevated at the test location than the Siskin Drive data 2.7 miles away

(2) if the 1 microgram per cubic meter iron foundry influence in the 1998-1999 Toxics Study is applied (logically less than 1 since the particle fraction is reduced to PM_{10} in this study) and

(3) if the 2.3 microgram per cubic meter reduction is applied due to using a different method of measurement than Federal Reference Monitor sample data required to compare against the standard,

then it is improbable that any of the daily samples monitored at the test site would be close in magnitude to the daily $PM_{2.5}$ standard if $PM_{2.5}$ had been monitored. The PM_{10} data is still 4 times lower than the PM_{10} standard of 150 micrograms per cubic meter. Therefore, there should be no greater risk from $PM_{2.5}$ at the test site than at Siskin Drive 2.7 miles away.

Iron is not listed in EPA Integrated Risk Information System database. There are no published Acute Dose-Response Values for Screening Risk Assessments nor are there Prioritized Chronic Dose-Response Values. There is an OSHA PEL and an AGIH TLV. The PEL and TLV are for fume which is very fine particulate. The PEL is 10 milligrams /cubic meter and the TLV is 5 milligrams per cubic meter (the magnitudes of iron monitored in the 2006 and 1998/99 study were in the microgram range). These limits are for use in an industrial setting.

Analytical Results

The more detailed monitoring detected Fe, Cl (chloride as the anion), NO_2, NO_3, PO_4, SO_4, Na, NH_4, K, Mg ,Ca, Cd, and Pb. All of the compounds that were monitored are components of speciated $PM_{2.5}$. These compounds have been monitored at the Siskin Drive site since 2002.

Of the analytical results, the biggest differences between the test site and the control site were in chloride, nitrites, nitrates, magnesium, and calcium. UV Hound results seem to indicate high nitric oxides from traffic, and the nitrites and nitrates may be elevated from the same source. It is unclear why magnesium and calcium are elevated at the test site. But, magnesium levels converted into micrograms per cubic meter are quite low and the differences are minimal.

Anions and cations were selected for monitoring for an anion/cation study. This will have to be addressed in another document because of the labor intensive requirements for data analysis.

The following metals that were in this 2006 study were evaluated in the 1998/1999 Toxics study: Cadmium, Sodium, Calcium, Lead, and Potassium. No risk was found in that study from any of the five. In 1998/99, the emissions in the Amnicola Highway area were considerably greater than at present. The particulate emissions from Mueller Company alone are now 23 percent of what they were at the time of the study.

Nitrates, Sulfates, and Ammonium are components of $PM_{2.5}$. Nitrates are formed from NO_x emitted from combustion sources. Sulfates are formed from atmospheric reactions with SO_2. The SO_2 is emitted from combustions that burn fuel containing sulfur. The primary source of these emissions is from the burning of coal. Mueller uses electric melt so they could not be emitting SO_2 except from vehicles.

Phosphorus was detected in the speciated $PM_{2.5}$ four times in 2006. This indicates that phosphates, if present were at very low concentrations.

No unusual findings, therefore, appeared in the monitoring analyses.

Lead and Summary NAAQS Chart

Lead levels in this study were determined to be about 1% of the National Ambient Air Quality Standards. A summary chart comparing the highest data points against the National Ambient Standards is prepared.

All data is in micrograms per cubic meter unless otherwise indicated.

Pollutant	Highest Data in 2006 Study: Wisdom Street	Daily NAAQS	Yearly NAAQS	Clarification Of yearly NAAQS
PM_{10}	37	150	50	Yearly standard revoked Dec. 2006
$PM_{2.5}$ (Siskin Dr)	30.7	35	15	3-yr average of yearly average
Lead	.0149	N/A	1.5	
Nitrogen Dioxide Grab sample only	54	N/A	100	
Sulfur Dioxide ppb Grab sample only	30 ppb	500 3-hr 140	30 ppb	

Acid Determination

There were some indications that acid might be present since there was a big difference in chloride on 11/14 between the test and control data. It cannot be concluded from that data alone that acid was present. But, John Schultz used the acid test strips to indicate pH in moisture on the cars (see chart on Page 4) and found several days in the 4 pH range. This gives credence to the possibility of an acid atmosphere in that area of town.

Nitric Oxide and SO_2

UV Hound monitoring detected one unidentifiable gas and indicated high Nitric Oxides and SO_2. Most of the high NO seems to be associated with vehicle emissions and traffic. The OSHA PEL (permissible exposure limit) for nitric oxide (NO) is 25 ppm or 2,500 ppb (averaged over an 8-hour workshift). The highest NO measured by the UV hound in a grab sample was 213 ppb.

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Conclusions

The monitoring investigation seemed to demonstrate that iron, fine particulate, and lead were not health risks in the test area any more than at the control site on Broad Street. The problem seemed to be with particles larger than $PM_{2.5,}$ possibly larger than $PM_{10,}$ and mostly cosmetic. The source of the particulate is still undetermined although John Schultz's report indicates that the rust spots have not occurred since Mueller Company added a high efficiency filter system.

Mueller hired Alley & Associates, Inc., an engineering and environmental firm, to do different types of monitoring in and near the foundry since the complaint. E. Roberts Alley of Alley & Associates made a recent technical presentation to Bureau personnel. Mueller had put in place a wind-activated monitoring system around the entire perimeter

of their plant. Their monitoring results indicated that the plant was receiving from other sources more particulate into the plant than what was monitored leaving the plant. Their consultant performed monitoring to try to determine if there was an acid atmosphere, and the monitoring did seem to indicate acidic conditions at times in the area. In response to this complaint, Mueller has made a very aggressive effort, including a substantial financial commitment, to adding pollution reduction equipment beyond what is required for a foundry.

Particles on the vehicles may be rusting from moisture alone. But, since the problem has not been so serious during the years the foundry has existed in that location, it would appear that some condition had changed that caused rusting. The fact that dew and moisture on the cars some days seemed to be in the pH 4 range indicates that acidic conditions or acid rain/dew might catalyze the formation of rust spots, damage the clear coat, and make the spots very difficult to remove. INVISTA S.à r.l. is a known source of hydrochloric acid as part of their allowable emissions. Acids are also formed from power plant emissions. There may be an undetermined source of acid emissions in the area or some emission that is contributing to secondary acid formation. A specific acid, however, was not identified in this 2006 study. Acid aerosol monitoring is extremely expensive and problematic. Therefore, it was not practical in this study to attempt to monitor for specific acids.

Thus, since the rust spots have appeared to have ended, no further investigation is recommended at this time. If the spots reappear, the investigation can be revisited.