CBMP
Inhalation Risk Posed by Toxic Emissions From the Port of Tampa
Final Performance Report

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June 4, 2008

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1.0 Executive Summary

The Community Based Air Toxics Monitoring Work-Plan (CBMP) for the Environmental Protection Commission (EPC) of Hillsborough County conformed to all the objectives stated in EPA's "Request for Application." The Request specified that all projects clarify spatial concentrations within urban areas, characterize risk and air toxics reduction, compare monitor to model, and use advanced technology and other available resources. All requests were met by the CBMP project.

Specifically, the CBMP project objectives that were originally presented in the Request and completed in the project were to, measure air toxic emissions, with different methods of air toxic monitoring equipment in the Port of Tampa, and compare this data to other local sites also monitoring the same air toxics. Then to use this data to distinguish between highway and marine diesel PM emissions, compare the new air toxic monitoring methods with established fixed point analyzer methodologies, compare measurements during the study period with previous toxics monitoring, establish a baseline for future comparisons of concentrations of air toxics around the Port of Tampa, and perform sufficient quality assurance and quality control procedures to validate the data, define precision and accuracy of the data; and identify and characterize the air toxics of greatest potential public health threat.

1.1 Summary and Lessons Learned

Although most outcomes stated in the grant proposal were met, the evaluation of different methods of air toxic monitoring equipment was not as intercomparable as anticipated. Additionally, we were able to document large differences in the detection limits and reporting levels of toxic data from different laboratories used during our study. Based on our data and the toxic data analysis performed by Sonoma Technology on our national toxics database, there has been a Region 4 workgroup established to evaluate and establish minimum detectable limits for analytical methods of our ambient air monitoring toxic data.

The CBMP project was unable to distinguish a difference between highway PM and marine diesel PM measurements at our port location. After spending more time analyzing the advanced technologies and monitoring methodologies, we may be able to detect slight differences between formulations of highway and marine diesel PM but at this time this has not been established.

The information and data from this grant has already been utilized for additional projects by EPC in Hillsborough County. As an example, the Air Division performed a comparison risk assessment of an Ybor City community's air pollution concentrations, against the CBMP monitoring data to address citizens concerns over the addition of two new crematories within the city's residential neighborhood area. The risk assessment was able to demonstrate the probable risk of living in the Ybor area, and is attached in the appendix.

The crematory project was very useful in that it documented that the levels of six metals (arsenic, chromium, lead, manganese, nickel, antimony) and the gas benzene were above established EPA risk chronic cancer benchmarks, in the Ybor City area.

We were also able to establish that ambient levels of sulfur dioxide and ozone at the Port of Tampa had no statistical difference in concentration levels when compared to other air monitoring sites located within Hillsborough County, (sites used for comparison were Gandy and Sydney). Sulfur dioxide and ozone air pollutants are characteristic of motor vehicle emissions, thus allowing the inter comparison of vehicular traffic in the port area to the over-all motor vehicle emissions in Hillsborough County. This information is being used in our DRI review and long range planning

Finally, we were able to establish the inter-comparison of Fixed Point monitors to the Open Path Ultra-violet (U.V.) monitoring system. The data demonstrated that the open path system was able to quantify Ozone and Sulfur Dioxide for site evaluation purposes.

2.0 Introduction

The greater Tampa Bay metropolitan area is one of the fastest growing and environmentally diverse areas in the United States. The region has a subtropical climate with local meteorology particularly influenced by the recurring diurnal land and sea breeze dynamics typical of coastal regimes. The bay sits on the west-central coast of the Florida peninsula and is bounded by Pinellas County on the west and Hillsborough County to the east. Both Pinellas County and Hillsborough County have populations of over one million, with Hillsborough County's population centered primarily on the City of Tampa, which in turn is centered on the Port of Tampa.

In addition to the broad range of sources in the Tampa Bay area, there are a large number of air emission sources within the Port of Tampa. These include: a fuel-oil fired power plant, a large natural gas-fired power plant, seven bulk petroleum distribution terminals, three shipbuilding and repair facilities, three cruise ship terminals, four liquid sulfur terminals/tank complexes, four large ammonia storage tanks/terminals, one large propane storage tank/terminal, two liquid asphalt terminals/storage complexes, a large wastewater treatment plant, a waste incinerator, four phosphate fertilizer shipping terminals, several scrap metal grinding/melting and shipping facilities, as well as a number of other stationary air emission sources.

Figures 1 through 7 are aerial maps of the Port of Tampa and the air monitoring sites that were compared in the study. The Port of Tampa is primarily located on the Hookers Point peninsula and centered on the shipping channel which runs between Hookers Point, Davis Island, and Harbour Island, although there is a large contribution from the Port Sutton channel to the east of Hookers Point. In addition to large point sources, there are considerable mobile source emissions from vehicular traffic in to and out of the port, to downtown Tampa, and along the Interstate corridors that pass through the City of Tampa.

The 2000 Hillsborough County HAP Emission Inventory data show major source, area source and mobile source contributions are 31%, 24%, and 45%, respectively.

During 2001, 22 of the 33 National-scaled Air Toxics Assessment (NATA) toxics were monitored and the data collected was compared against 1996 NATA data. NATA modeling predicted that 12 compounds would exceed health benchmarks in the Tampa Bay area. Of the 12, Hillsborough County monitored for 10, and did not monitor 2 (acrolein and POM, although POM was monitored for at the Gandy site by the BRACE program (Bay Regional Atmospheric Chemistry Experiment)). Of the 22 compounds monitored for, 6 exceeded health benchmarks, which were not predicted to exceed by NATA modeling. Also, 2 other compounds did not exceed health benchmarks, although predicted to exceed by NATA results. Additional sampling, analysis and characterization of the HAPs identified in the 1996 NATA, 2001 monitoring study in-house analysis and local toxic monitoring efforts, justified more comprehensive monitoring and assessment in this region, and the reason why this study was funded.

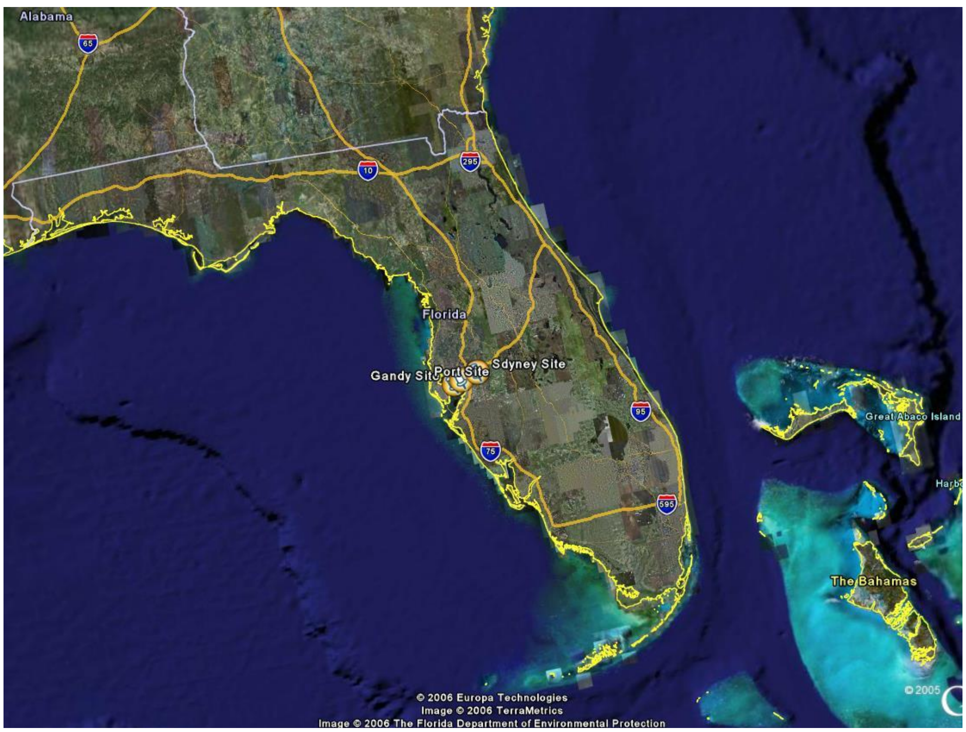

Figure 1. Aerial Map of Florida, Indicating Approximate Air Monitoring Site Locations.

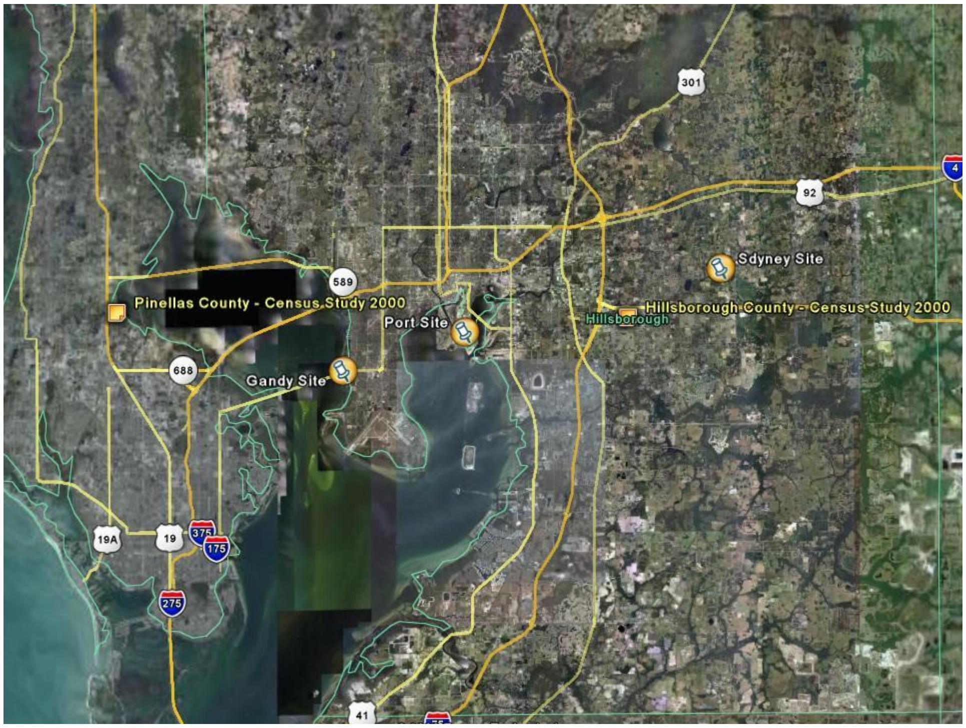

Figure 2. Close-up Air Monitoring Site Locations.

Figure 3. Gandy Air Monitoring Site.

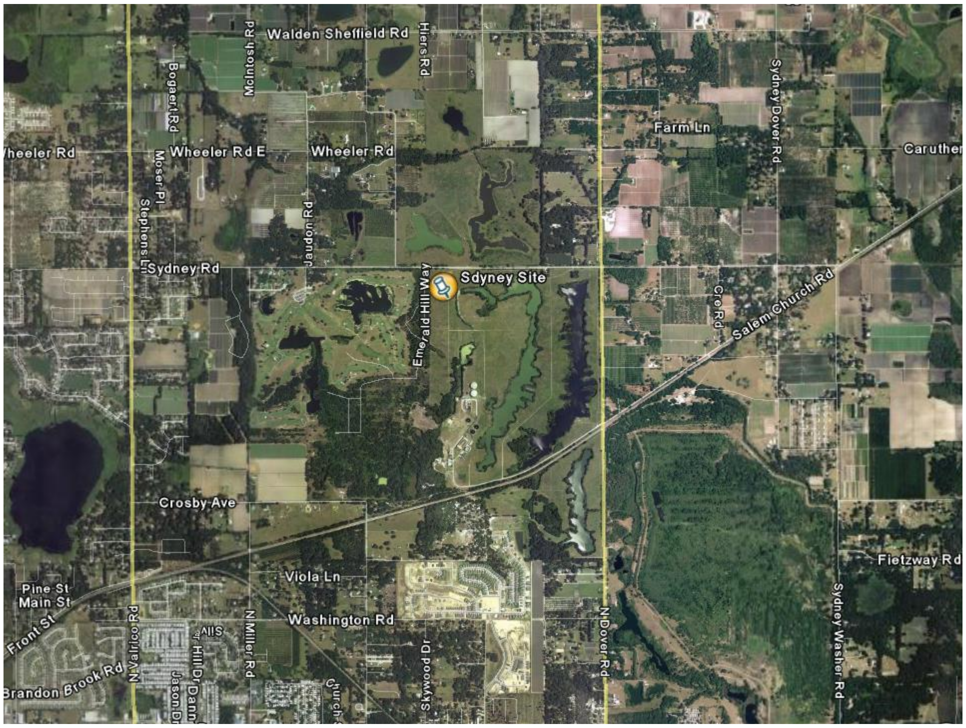

Figure 4. Sydney Air Monitoring Site.

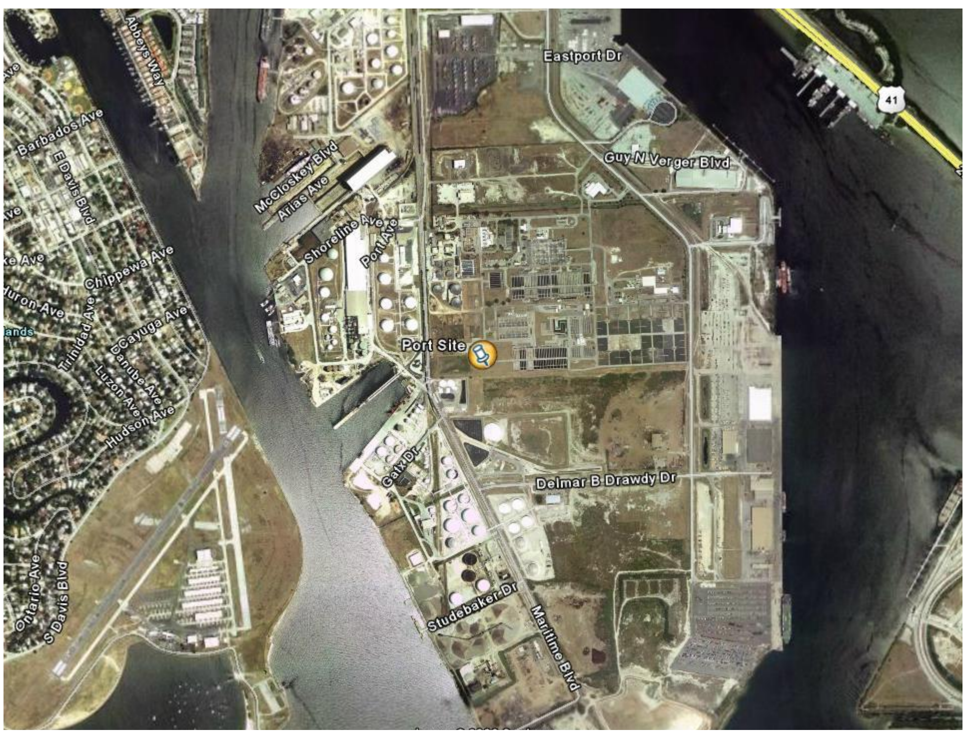

Figure 5. Port of Tampa Air Monitoring Site.

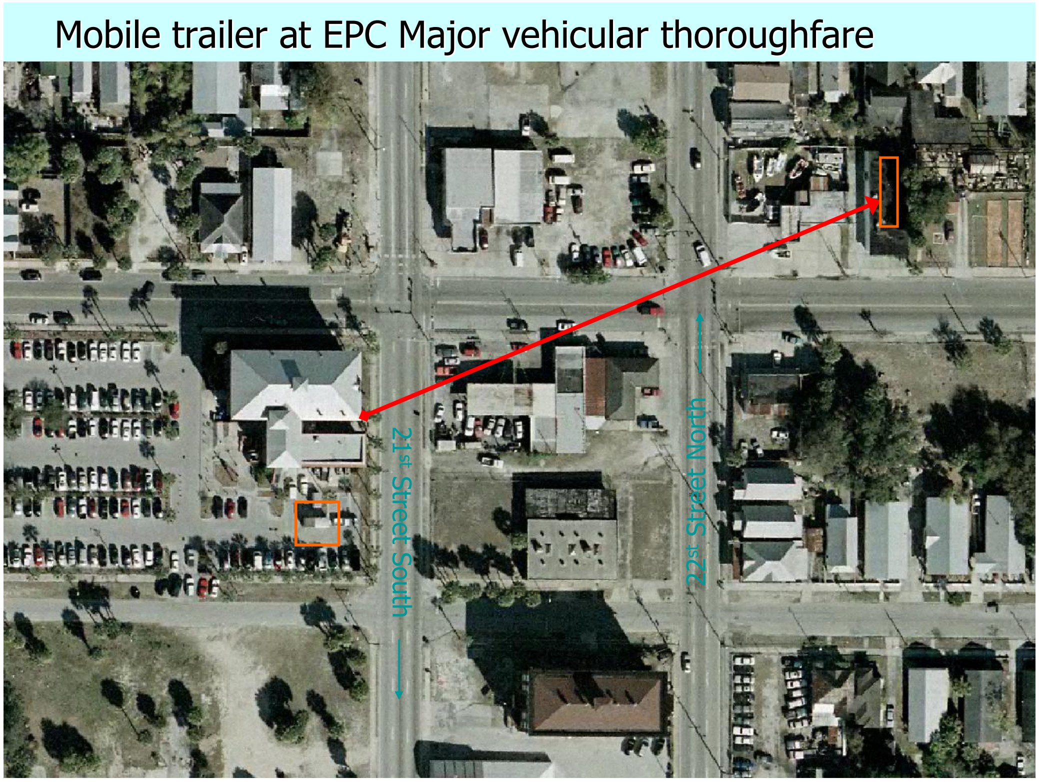

Figure 6. Ybor City Air Monitoring Site (red line is open path sampling area).


Figure 7. Close-up of Port of Tampa Air Monitoring Site.

3.0 Methodology:

3.1 Analytical Instruments Summary

The CEREX UV open path air monitoring system is a portable, tripod mounted open path system capable of simultaneously detecting multiple toxic gases such as benzene, ozone, sulfur dioxide, toluene, xylene, and formaldehyde. Quantitative reference spectra have been created for a number of these same compounds and can be easily inserted into the system as part of the monitoring routine. EPC has been using this system as well as an FTIR for several months to investigate gaseous emissions around a facility in Hillsborough County. This study compared CEREX UV and FTIR air monitoring systems to fixed point FRM monitors and provided the inter comparability with our other monitoring stations. (Figure 8 and Table 1).

Figure 8. Comparison of FTIR and CEREX (left and right, respectively).

Table 1. Site Comparisons to Equipment and Chemicals.

Site	Type area	Equipment	At site?	Fed approved ?	Chemicals Monitored ?
PORT	**Industrial**	**FTIR**	**yes**	**no**	**all**
		UV	**yes**	**no**	**all**
		SO2	**no**	**no**	**none**
		NO2	**no**	**no**	**none**
		Ozone	**yes**	**yes**	**Ozone**
		VOC's	**yes**	**yes**	**VOC's**
GANDY	**City Urban**	**FTIR**	**no**	**no**	
		UV	**no**	**no**	
		SO2	**yes**	**yes**	**SO2**
		NO2	**yes**	**yes**	**NO2**
		Ozone	**yes**	**yes**	**Ozone**
		VOC's	**yes**	**yes**	**VOC's**
SYDNEY	**Rural**	**FTIR**	**no**	**no**	
		UV	**yes**	**no**	**all**
		SO2	**yes**	**yes**	**SO2**
		NO2	**yes**	**yes**	**NO2**
		Ozone	**yes**	**yes**	**Ozone**
		VOC's	**yes**	**yes**	**VOC's**

There is also an OPSIS DOAS open path system at our Sydney station. This is an EPA approved open path analyzer for ozone and sulfur dioxide. When properly configured, it is capable of measuring a large number of toxic gases in approximately the same spectrum as the CEREX unit. One of the OPSIS systems is measuring oxides of nitrogen primarily, but the other has also been recording

BTEX gases. Both units are on loan by FDEP, but with their approval, EPC reconfigured one of them to measure as many toxic gases as possible at the Sydney NATTS site, including formaldehyde which is being used in the inter comparison of monitoring stations.

The EPC has been operating an FTIR on loan from EPA Region 4; in accordance with EPA's FTIR open path monitoring guidance (EPA/600 R-96-040). The FTIR is capable of detecting a large number of compounds in the infrared spectrum; as opposed to the ultraviolet spectrum of the CEREX UV open path analyzer and the OPSIS DOAS. While the operation of the FTIR equipment was not difficult, analyzing the data generated has been very difficult, especially with the interference of water vapor. As part of the CBMP, EPC also compared a fixed point monitoring unit with an open path mobile monitoring system (Figures 9-15). Figure 10 indicates a very close linear relationship between the fixed and open path methods (r2 = 0.9604). Figures 11-13 compares the fixed and open path methods on April 4 and April 18, 2005, comparing hourly, as well as minute ozone data.

FIXED Point Monitor Unit	OPEN Path Mobile Monitoring System
	
Requires Electrical	Battery operation
1&6 day sampling 24hr	Continuous operation
2 months for lab anal.	Instant / real time data
Enclosure required	No enclosures needed
Equip / analysis cost	35-45K onetime cost

Figure 9. Comparison of Fixed Point Monitoring with an Open Path System.

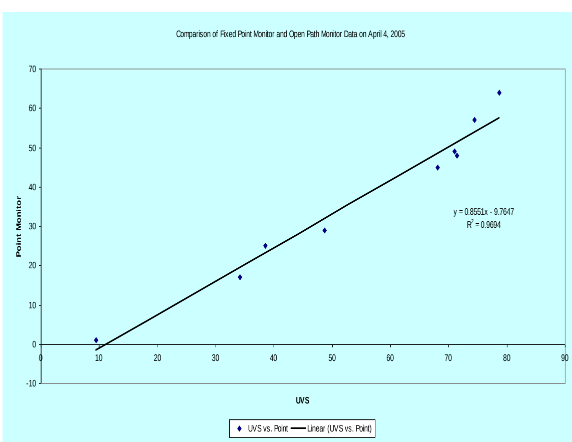

Figure 10. Comparison of Fixed Point Monitoring with an Open Path System.

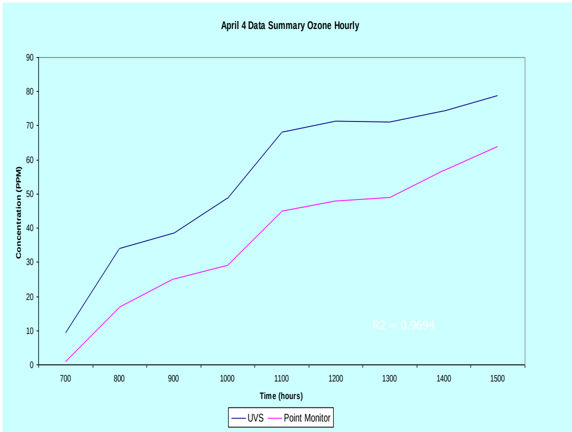

Figure 11. Comparison of Fixed Point Monitoring with an Open Path System, Hourly Summary April 4.

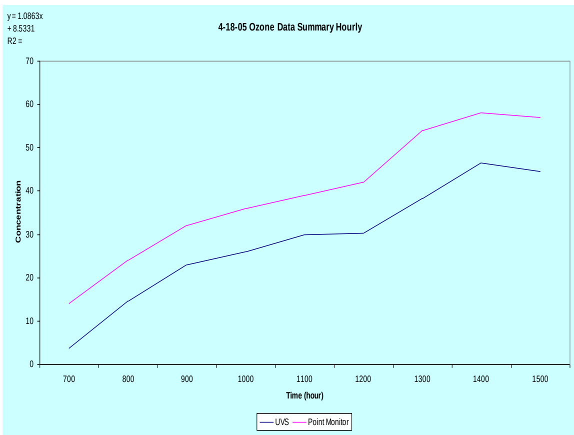

Figure 12. Comparison of Fixed Point Monitoring with an Open Path System, Hourly Summary April 18.

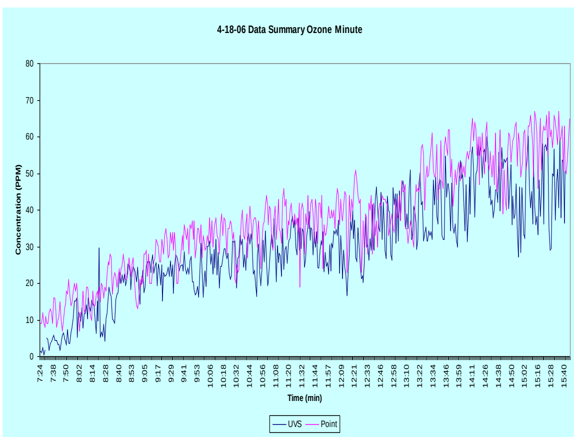

Figure 13. Comparison of Fixed Point Monitoring with an Open Path System Minute Summary April 18.

Figure 14. Inside of Trailer at Port Monitoring Site.

Figure 15. Port Monitoring Site Trailer.

3.2 Sampling Sites

To meet some of the objectives mentioned in 1.0 above, EPC compared available open path analyzers against traditional toxic monitors prior to the CBMP commencement. To determine spatial relationships, EPC conducted the same type of toxic monitoring at several sites around the City of Tampa for the full twelve month period, utilizing the NATTS site as one of the sites. Also, the EPC monitored for toxic emissions from highway mobile sources, including diesel PM, for four months. Then EPC monitored for toxic emissions from the Port of Tampa, including mobile sources emissions from marine vessels, including diesel PM, for the final eight months of the period. The final phase is the data analysis and report generation.

EPC already has possession of a CEREX UV open path analyzer and an FTIR on loan from EPA. In March of 2004, EPC placed our mobile trailer at the Sydney NATTS site and compared the data recorded on those open path monitors with that recorded by the NATTS air toxics monitoring equipment, and the OPSIS

DOAS operating at the Sydney site. The CBMP project included the following three phases:

Phase I: Mobile Trailer - EPC initially located our mobile monitoring trailer at EPC's office in Ybor City (Tampa), which happens to be on a major thoroughfare of truck and other vehicular traffic, for four months. The reason for this initial location was to measure highway vehicular and diesel emissions and to set the stage for a later determination of any difference between vehicular/diesel emissions from highway vehicles and marine vessels. The street immediately next to EPC, 21^{st} Street, is three lanes one-way southbound and one small block away is 22^{nd} Street, which is three lanes one-way northbound. Both streets feed traffic to and from Interstate 4. A lot of heavy truck traffic utilizes these routes going to and coming from the Port of Tampa. EPC measured the emissions at this site with the same suite of toxics monitors (VOC's, PM_{10} metals, carbonyls, wind and an aethalometer) as operating at the NATTS site and running on the same schedule as those at the NATTS site. Also operating from the mobile trailer was the CEREX UV open path analyzer and the FTIR. Because the open path instruments were set up each sampling day, they were operated at least eight hours on each sampling period.

Concurrent with Phase I and Phase II, and to meet the primary objective, EPC conducted toxics monitoring at the following other sites around Hillsborough County (Figures in Section 4.0):

Sydney – (VOC's, PM_{10} metals, carbonyls, aethalometer, $PM_{2.5}$ speciation, wind) EPC used the NATTS site at Sydney, paid for by the NATTS program, as one neighborhood point of comparison. With the cooperation of the State of Florida, and as part of the CBMP, EPC utilized the existing OPSIS DOAS equipment already at Sydney to conduct toxics monitoring at the NATTS site within the capabilities of the DOAS. Data collected via the DOAS was compared against that collected using the NATTS monitors.

Gandy – (VOC's, PM_{10} metals, carbonyls, wind) EPC has monitored for these same toxic VOC's, metals (TSP), and carbonyls at Gandy for the past three years, so there is a history of toxic concentrations available for temporal and spatial comparisons.

Simmons Park – (VOC's, PM_{10} metals, carbonyls, wind) EPC monitored for toxic VOC's, metals (TSP), and carbonyls at the Simmons Park site in CY2001, so there is some toxics data available for temporal and spatial comparisons.

Phase II: Mobile Trailer - At the completion of phase one, EPC moved the mobile trailer, to the Port of Tampa to conduct the same type of monitoring as conducted in phase one for the remaining eight months of the twelve month monitoring period. EPC already had an existing air monitoring site at Davis Islands, which is very close to the shipping channel and Hookers Point. Phase II monitoring consisted of the same suite of monitoring equipment outlined in phase one, operating on the same schedule as the NATTS equipment, and as outlined in Phase I. However, Phase II monitoring will be primarily focused on measuring toxic emissions originating from the marine environment and industrial sources around the Port of Tampa.

During Phase II, EPC continued to operate the Sydney NATTS site and the Gandy and Simmons Park sites on the same schedule addressed in Phase I.

The network of sites mentioned are preexisting and designed to distinguish spatial gradients over a wide range of population types around the City of Tampa. The site selection factors for inclusion in this study were:

- Availability of land;
- Existing sites in areas of differing population density;
- Proximity to traffic corridors;
- Proximity to the Port of Tampa
- Availability of on-site meteorological measurements;

The sites and their AIRS ID numbers are (Table 2):

Table 2. Air Monitoring Site AIRS ID numbers

Site Name	AIRS ID	Type
Gandy	12-057-1065	Commercial
Davis Islands	12-057-1035	Industrial (Port)
Sydney	12-057-3002	Neighborhood (NATTS)
Simmons Park	12-057-0081	Rural
EPC	TBD	Urban

Phase III: Data Analysis and Report Development (on-going).

3.3 Measured Pollutants

During the CBMP, samples were obtained for volatile organic compounds (VOCs), metals, and carbonyl compounds at the Gandy, Simmons Park, Sydney and mobile trailer sites, utilizing EPA methods TO-15, IO-3, and TO-11. Table 3 lists the air toxic compounds measured, analyzed, and reported.

Table 3. List of Target Compounds.

EPA Method	Core pollutants	Additional HAPS	Additional HAPS (cont)
TO-15	Benzene 1,3-butadiene Carbon tetrachloride Chloroform 1,2-dichloropropane methylene chloride Tetrachloroethene Trichloroethene vinyl chloride	methyl chloride methyl bromide ethyl chloride 1,1-dichloroethene 1,1-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane toluene chlorobenzene ethylbenzene m-xylene p-xylene	styrene o-xylene 1,4-dichlorobenzene 1,2,4-trichlorobenzene hexachloro-1,3-butadiene Acrylonitrile 1,2 dibromoethane cis-1,3-dichloropropene trans-1,3-dichloropropene 1,2-dichloroethane 1,1,2,2-tetrachloroethane
IO-3	Arsenic Beryllium Cadmium Chromium (total) Lead Manganese Nickel	antimony cobalt selenium	
TO-11	Acetaldehyde Formaldehyde	propionaldehyde	
	Acrolein		
	Hexavalent Chromium		

3.4 Sampling Frequencies and Duration

Samples for PM_{10} metals, carbonyls and VOCs at all monitoring sites under this study were collected on a 1/6-day frequency using the EPA air-monitoring schedule. CBMP sampling began 2004 and continued for twelve months. The protocol for site-specific sampling duration was one (1) continuous 24-hour sample at each monitor except as noted for the CEREX open path analyzer and the FTIR.

3.5 VOC Sampling & Analysis

The volatile organic compounds (VOCs) were sampled and analyzed using EPA Compendium Method TO-14A/15. Samplers were assembled using commercially available parts. They were collected in canisters and analyzed using gas chromatography/mass spectrometry (GC/MS) by the Pinellas County Department of Environmental Management, Air Quality Division laboratory. In addition, the EPC utilized the Florida Department of Environmental Protection (FDEP) laboratory in Tallahassee to conduct the same analysis on at least half of the VOC canisters. Method detection limits (MDL) were determined using 40 CFR Appendix B to part 135. All concentrations were submitted, as their actual numerical value with a system developed to flag measurements that are below MDL.

VOCs listed in Table 3 as additional HAPS were extracted from the TO-14A/15 method because there was no additional cost to sample or analyze these compounds. The TO-14A/15, TO-11A, and IO-3 analyses provide additional data for HAPs not included in the Urban HAP List with minimal expense for data management.

3.6 Carbonyl Sampling & Analysis

All carbonyl compounds sampled and analyzed for the project utilize the EPA Compendium Method TO-11A. Samples were collected on 2, 4-dinitrophenylhydrazine cartridges and analyzed using high performance liquid chromatography. The Eastern Research Group (ERG), an EPA UATMP contractor, provided technical and analytical support.

3.7 Metals Sampling & Analysis

The primary method for sampling HAP metals for the study was the collection of 10-micron particulates (PM_{10}) samples utilizing PM_{10} samplers. The PM_{10} federal reference method was used for the operation of these monitors. All nonvolatile compounds (metals) were sampled and analyzed using EPA Compendium Method IO-3, and are analyzed as “total” metals. Samples were collected on 8x10 inch, quartz fiber filters utilizing PM_{10} samplers. The EPC laboratory performed the chemical analysis, using an ICP.

3.8 Data Management

Handling the data generated by this study required a coordinated effort to include contracted laboratories, FDEP, Region 4, and the USEPA. Data management involved compiling measurements and analytical results, data quality and validation checks, and finally, formatting and submittal to the EPA AQS (AIRS) database. The roles and responsibilities are defined below. However, they were flexible to allow for improving data collection and transfer efficiencies.

For the carbonyl compounds, data management responsibilities were included in the contract with ERG, which included data formatting and input into AQS (AIRS). All work by ERG was under the Federal Urban Air Toxics Monitoring Program (UATMP) contract.

Data management for the VOCs included monthly data reduction and validation, which was formatted for electronic submittal into AQS (AIRS) by DEM. The processed data was electronically forwarded to the State of Florida for input to the EPA AIRS database.

Data management for the metals included monthly data reduction and validation, formatted for electronic submittal into AQS (AIRS) by EPC. The processed data was electronically forwarded to the State of Florida for input to the EPA AIRS database.

3.9 Quality Assurance Project Plan

In additional to the normal quality assurance programs associated with EPC's normal air monitoring efforts, specific quality assurance plans were developed and submitted for approval for the programs mentioned above, including: Deposition of Air Toxics to Tampa Bay (draft), and $PM_{2.5}$ Speciation Trends Network (draft). Pinellas County adheres to the QA requirements of EPA Method TO-15 (Jan 1997), meeting all technical acceptance criteria for BFB tune, initial and daily calibration, blank and sample analysis and replicate precision. Canister and sampler certification requirements are adhered to. Method detection limits (MDL) are preformed as described in 40 CFR 136 Appendix B. In addition, Pinellas County initiated intrastate agency audits and analyzed EPA Region 4 audit samples for TO-14 compounds. EPC participates in EPA's round robin interagency metals audits.

EPC submitted a QAPP in conjunction with the NATTS program. That plan included similar requirements that 10% of all sampling and total project expenditures would be associated with quality assurance activities. A project specific quality assurance plan that builds on the NATTS QAPP and adds the additional monitors to be employed in this project will be submitted to EPA Region 4.

4.0 Baseline Air Toxic Concentrations:

4.1 Sulfur Dioxide

Sulfur dioxide is a colorless gas with a pungent odor. It is a liquid when under pressure, and it dissolves in water easily. Sulfur dioxide in the air comes mainly from activities such as the burning of coal and oil at power plants or from copper smelting. In nature, sulfur dioxide can be released to the air from volcanic eruptions.

Exposure to high levels of sulfur dioxide can be life threatening. Exposure to 100 parts of sulfur dioxide per million (ppm) parts of air is considered immediately dangerous to life and health.

Long-term exposure to low levels of sulfur dioxide can also affect your health. Lung function changes were seen in some workers exposed to low levels of sulfur dioxide for 20 years or more. Asthmatics are known to be especially sensitive to low concentrations of sulfur dioxide. The EPA has set an air quality standard of 0.03 ppm for long-term, 1-year average concentrations of sulfur dioxide. Shortterm, 24-hour air concentrations should not exceed 0.14 ppm more than once a year. Figure 16 shows levels of sulfur dioxide one-hour averages at four different monitoring sites in Hillsborough County.

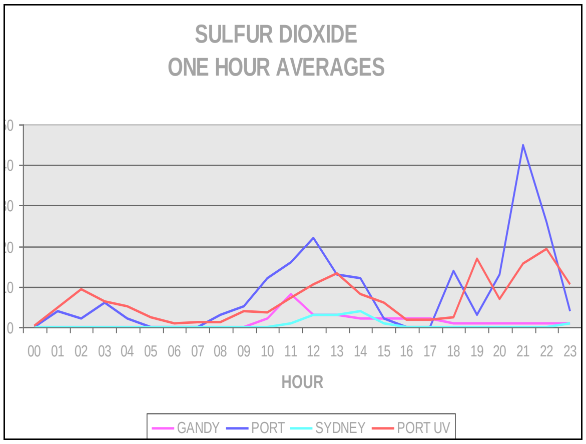

Figure 16. Sulfur Dioxide One-Hour Averages at Four Monitoring Sites.

4.2 Ozone

Ozone is a gas consisting of three oxygen atoms. Ground-level ozone is an air pollutant with harmful effects on the respiratory systems of animals. Ozone in the upper atmosphere filters potential damaging ultraviolet light from reaching the Earth's surface. It is present in low concentrations throughout the Earth's atmosphere.

Most people can detect 0.01 ppm ozone in air. Exposure of 0.1 to 1ppm produces headaches, burning eyes and irritation to the respiratory system. Figure 17 shows levels of ozone one-hour averages at four different monitoring sites in Hillsborough County. Figure 18 shows the association between ozone levels and sulfur dioxide at the Port of Tampa monitoring site.

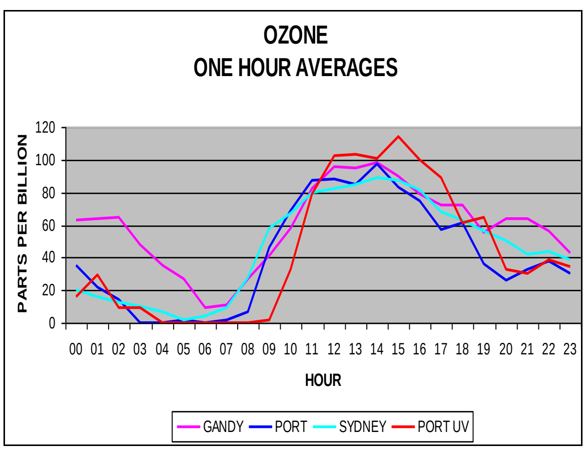

Figure 17. Ozone One-Hour Averages at Four Monitoring Sites.

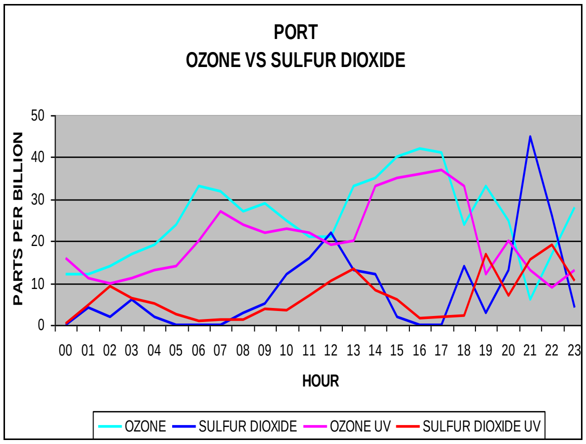

Figure 18. Ozone vs Sulfur Dioxide One-Hour Average Comparisons Between Methods of Measurement.

Another method of comparison for the CBMP study was to compare and contrast data concentrations at the monitoring sites during the project timeline and emission inventory (EI) concentrations. Table 4 shows the highest levels of "modeled" inventory concentrations of chemicals between the five years 2001 and 2005. Those levels were compared to EPA standards (column 4). All modeled chemical concentrations, from 2001-2005, were below the EPA 24-acute levels as well as the 24-hour EPA standards.

Table 4. 24-hour Emission Inventory Modeling Concentrations for 2001-2005 (ug/m3).

24-hour Modeling Concentrations

POLLUTANT	Max 2001-2005	24 hr acute MRL	NAAQS 24 hr
Nox	3.8602		
CO	0.8106		
SO2	0.0232		367
PM2.5	0.1469		35
PM10	19.1949		150
ACETALDEHYDE	0.0044	0	
ARSENIC	0.0017	0	
BENZENE	0.0021	160	
BERYLLIUM	0.0001	0	
CADMIUM	0.0005	0	
CHROMIUM, HEXAVALENT	0.0006	0	
COPPER	0.0012		
FORMALDEHYDE	0.0012	49	
HYDROGEN CHLORIDE	2.5396	0	
HYDROGEN FLUORIDE	0.0230	25	
LEAD	0.0029	0	
MERCURY	0.1417	0	
NICKEL	0.0017	0	
SELENIUM	0.0019	0	
TOLUENE	0.0292	3800	
XYLENES	0.0083	4300	

A main objective for the CBMP study was to clarify spatial concentrations within urban areas and characterize risk and air toxics reduction. Figures 19-21 show concentration levels of sulfur dioxide, volatile organic compounds, metals, particulates and ozone and how those levels compare to EPA standards. Figure 19 shows that during the five months in 2005, in the study, monitoring levels were considerably below EPA guidelines.

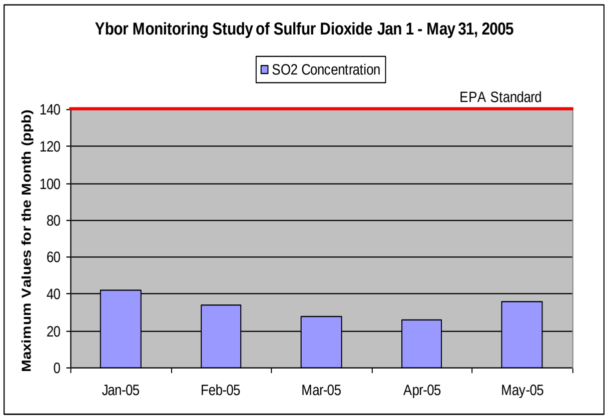

Figure 19. Ybor Monitoring Study Sulfur Dioxide Data from Jan 1- Mar 31, 2005.

Figures 20 and 21 compare air monitoring data with EPA cancer and non-cancer benchmarks. Figure 20 shows EPA cancer and non-cancer benchmarks for volatile organic compounds, comparing monitoring data to the benchmarks. Benzene was above the cancer benchmark. All three VOCs were below non-cancer benchmarks. Figure 21 shows EPA cancer and non-cancer benchmarks for metals, comparing monitoring data to the benchmarks. Arsenic, chromium, lead, manganese, nickel and antimony are all above cancer benchmarks.

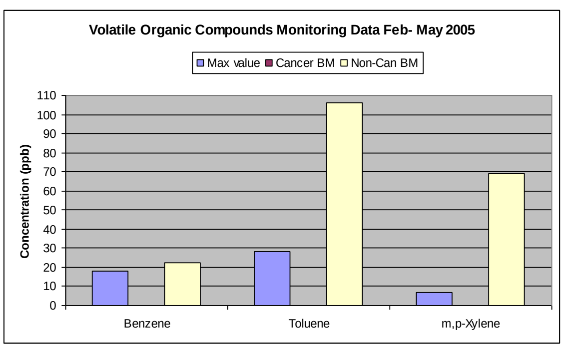

Figure 20. Ybor Monitoring Study VOCs from Feb- May 2006.

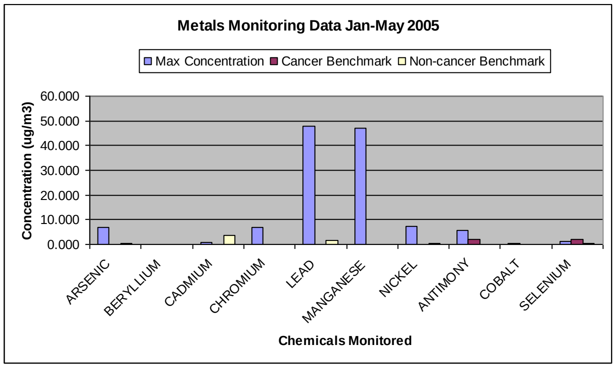

Figure 21. Ybor Monitoring Study Metals from Jan- May 2005.

4.3 Benzene

Benzene (Cyclohexatriene, *CAS # 71-43-2)*. Benzene is a clear liquid that is ubiquitous in the atmosphere; it is found naturally in the environment as well as from human activities[1]. It was first isolated from coal tar in the 1800s and is now ranked as one of the top twenty chemicals in production. Benzene is used in the manufacturing of plastics, resins, nylon, rubbers, lubricants, dyes, detergents, drugs and pesticides and gasoline. Natural sources include volcanoes and forest fires.

The EPA has classified benzene as a known carcinogen of the blood forming, and possibly the reproductive, organs[2]. Ethanol consumption can increase the severity of the damage[3], and chronic exposure has been shown to cause reduced birth weight of babies born to pregnant petrochemical industry workers[4]. The population at greatest risk from high exposure levels to benzene are those people who live or work near chemical manufacturing sites, cigarette smokers, gasoline inspectors or refuelers[5 & 6] and those who live near landfills and hazardous waste sites[7]. However, studies have shown that children can also be at risk due to their proximity to cigarette smokers and traffic[8].

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[1] Harbison, R.D. 1998. Hamilton & Hardy’s Industrial Toxicology. Mosby-Year Book, Inc. NY.
[2] U.S. EPA, 1993. Integrated Risk Information System (IRIS) on Benzene. Office of Research and Development, Cincinnati.
[3] Suh, H., et. al., 2000. Criteria air pollutants and toxic air pollutants. Environm Health Perspectives 108, 625-633.
[4] Chen, D. et. al., 2000. Exposure to benzene, occupational stress, and reduced birth weight. Occupational & Environmental Medicine 57, 661-667.
[5] Davenport, A. et. al., 2000. Coast Guard exposure to gasoline, MTBE and benzene vapors during inspection of tank barges. J for the Science of Occupational & Environmental Health & Safety 61, 865-872.
[6] Egeghy, P., et. al., 2000. Environmental and biological monitoring of benzene during self-servi automobile refueling. Environm health Perspectives 108, 1195-1202.
[7] Crebelli, R. et. al., 2001. Exposure to benzene in urban workers : environmental and biological monitoring of traffic police in Rome. Occupational & Environmental Medicine 58, 165-171.
[8] Amodio-Cocchieri, R., et. al., 2001. Evaluation of benzene exposure in children living in Campania (Italy) by urinary trans, trans-muconic acid assay. J of Toxicol. & Environmental Health, Part A 63, 79-87.

4.4 Arsenic

Arsenic (CAS # 7440-38-2). Arsenic is a brittle solid with a metallic coloring that ranges from silver to gray and is a naturally occurring element found in the earth's crust[9]. Arsenic combined with elements like oxygen, chlorine and sulfur is called inorganic arsenic, while arsenic combined with carbon and hydrogen is called organic arsenic. The organic forms are less harmful than the inorganic forms. Inorganic arsenic occurs naturally in many types of rock, and when heated enters the air as dust. Most of the arsenic produced (~90%) is used as a wood preservative (chromated copper arsenate, CCA) to resist decay and rotting[10].

Health effects from exposure to inorganic arsenic are well documented. In the past, several products contained arsenic as a poison: rat poison, weed killer and ant poison. A characteristic effect of chronic exposure to inorganic arsenic is a pattern of skin changes: darkening of the skin, as well as appearance of corns and warts on the palms, soles and torso[11]. Ingestion of inorganic arsenic has been reported to increase the risk of liver, bladder, kidney, prostate, and lung cancer[12]. The EPA has classified arsenic as a known human carcinogen[13].

4.5 Chromium

Chromium (CAS # 7440-47-3). Chromium is a naturally occurring element in the soil, plants, animals and gases. It is present in several oxidative states: metal or chromium (0), and in valence +2 through +6. Only two states, III and VI occur in nature. Chromium III (trivalent) is the typical form found in the environment because it is the most stable state. Also, it is an essential nutrient required by the human body. Chromium VI is produced through industrial processes, and is used for chrome plating, manufacture of dyes, leather tanning and wood preserving.

Chromium VI is considered the toxic form that can cause irritation to the nose, itching, ulcers and holes in the nasal septum. Chronic exposure to chromium VI can cause lung cancer[14], and the risk of chronic chromium exposure can be exacerbated by smoking cigarettes[15]. The EPA has classified chromium VI as a known human carcinogen[16]. The population at greatest risk from high exposure levels to chromium are those people who live or work near industries that use

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[9] Harbison, R.D. 1998. Hamilton & Hardy's Industrial Toxicology. Mosby-Year Book, Inc. NY.
[10] Davis, A., et. al., 2001. An Analysis of Soil Arsenic Records of Decision. Environmental Science & Technology 35, 2401-2406.
[11] Kaltreider, R., et. al., 2001. Arsenic Alters the Function of the Glucocorticoid Receptor as a Transcription Factor. Environmental Health Perspectives 109, 245-251.
[12] U.S. Dept. of Health & Human Services, 2000. Toxicological Profile for Arsenic. ATSDR.
[13] U.S. Dept. of Health & Human Services, 1998. 8th Report of Carcinogens.
[14] U.S. Dept. of Health & Human Services, 2000. Toxicological Profile for Chromium. ATSDR.
[15] Albert, R.E., 1991. Issues in the risk assessment of chromium. Environ. Health Perspectives 92, 91-92.
[16] U.S. Dept. of Health & Human Services, 1998. 8th Report of Carcinogens.

chromium, like stainless steel production and welding, chromium plating, ferrochrome alloys, tanning industries, and chrome pigment production[17].

4.6 Lead

Lead (CAS #7439-92-1). Lead is a heavy, soft, bluish-gray solid, found in small amounts in the earth's crust. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing. It is used in the production of batteries, ammunition, metal products and devices to shield x-rays.[18]

Possible health effects from chronic exposure to lead include almost every organ and system in the body. The main target for lead toxicity is the nervous system, both in adults and children. Long-term exposure of adults can result in decreased nervous system performance tests. Exposure to high lead levels can severely damage the brain and kidneys in adults or children or death. Small children are more vulnerable to lead poisoning than adults through eating lead-based paint. Harmful effects include premature births, smaller babies, decreased mental ability, learning difficulties and reduced growth in young children. The EPA has classified lead as a probable carcinogen.[19]

4.7 Manganese

Manganese (CAS # 7439-96-5). Manganese is a lustrous, brittle, silvery solid, found in many types of rocks, but does not occur naturally. It combines with other substances such as oxygen, sulfur or chlorine to make compounds. Manganese can enter the air from iron, steel and power plants, coke ovens and dust from mining operations.[20]

Possible health effects from chronic exposure to very high levels of manganese include mental and emotional disturbances and slow and clumsy body movements, a disease called "manganism." Exposure to high levels of ambient manganese can affect motor skills such as holding one's hand steady, performing fast hand movements and maintaining balance. The EPA has determined that manganese is NOT classifiable as to human carcinogenicity.[21]

4.8 Nickel

Nickel (CAS # 7440-02-0). Nickel is a hard, silvery-white metal that is found naturally in the environment, in all soils and emitted from volcanoes. It is also combined with other metals to form alloys. It is usually alloyed with iron, copper, chromium, and zinc to make coins, jewelry and in industry for making valves and

[17] U.S. EPA, 1998. Integrated Risk Information System (IRIS) Report for Chromium.
[18] U.S. EPA, 2007. Integrated Risk Information System (IRIS) Report for Lead.
[19] Agency for Toxic Substances and Disease Registry. 2007. Toxicological profile for Lead.
[20] U.S. EPA. 2000. Integrated Risk Information System (IRIS) Report for Manganese.
[21] Agency for Toxic Substance and Disease Registry. 2000. Toxicological profile for Manganese.

heat exchangers. Most importantly, nickel is released into the atmosphere by oil-burning power plants, coal-burning power plants and trash incinerators[22].

Possible health effects from chronic exposure to nickel include allergic reactions, chronic bronchitis and reduced lung function. The populations at greatest risk from high exposure levels to nickel are those people who live or work near facilities that produce stainless steel, oil-fired power plants, coal-fired power plants, and waste incinerators. The EPA has classified nickel as reasonably anticipated to be a human carcinogen[23].

4.9 Antimony

Antimony (CAS # 7440-36-0). Antimony is a silver-white, lustrous, hard, brittle solid, found in the earth's crust. Antimony ores are mined and then mixed with other metals to form alloys. Alloys are used in lead storage batteries, solder, sheet and pipe metal, bearings, casting, and pewter.[24]

Possible health effects from breathing high levels of antimony for long periods of time are eye and lung irritation, health and lung problems, stomach pain, vomiting and stomach ulcers. The EPA has NOT classified antimony as to its human carcinogenicity. [25]

Figure 22 shows particulate monitoring data from February through May 28, 2005 at the Ybor monitoring site. All data was far below the EPA standard.

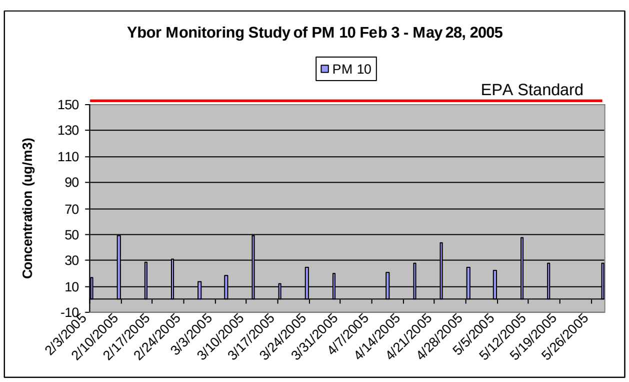

Figure 22. Ybor Monitoring Study Particulates from Feb- May 28, 2005.

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[22] U.S. EPA, 1996. Integrated Risk Information System (IRIS) Report for Nickel.
[23] U.S. Dept. of Health & Human Services, 1998. 8th Report of Carcinogens.
[24] U.S. EPA 1992. Integrated Risk Information System (IRIS) Report for Antimony.
[25] Agency for Toxic Substance and Disease Registry. 1992. Toxicological profile for Antimony.

Figure 23 shows ozone monitoring data from January 1 through May 31, 2005 at the Ybor monitoring site. All data was below the EPA standard.

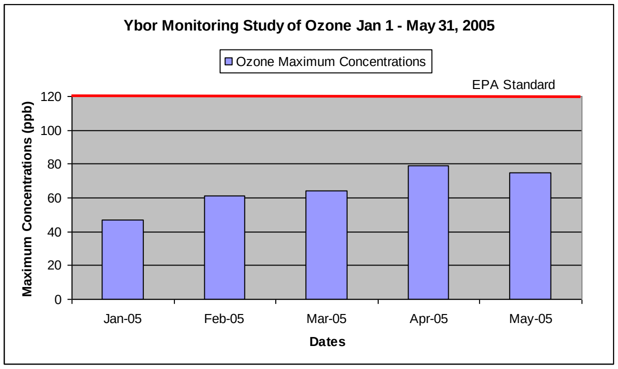

Figure 23. Ybor Monitoring Study Ozone from Jan- May 31, 2005.

5.0 Special Studies

In addition to the goals and objectives described in this final grant report, the EPC has conducted two special studies that incorporated the CBMP data.

5.1 Air "Hound" to measure VOC's around an air toxic source.

We initiated a "Mobile Monitoring" program at EPC where we can monitor neighborhoods for specific chemicals of concern. For instance, we had a new facility move into a neighborhood that was manufacturing Spas. The concern was whether Styrene, a carcinogen, was passing into the surrounding housing. We set up a research study with the citizens where we drove around their neighborhood for a month to monitor styrene.

This is one way to validate concerns that the citizens had about the spa manufacturing facility (Figure 24).

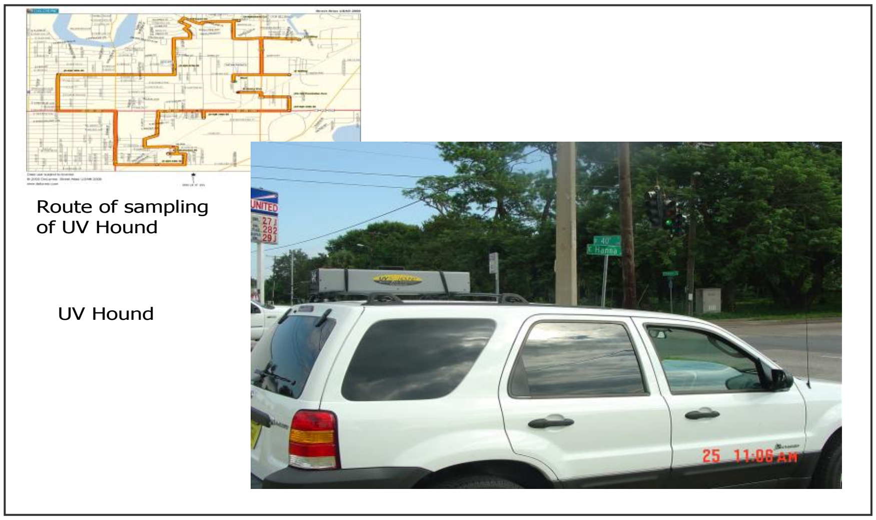

Figure 24. Route of Air Sampling Hound for Special Study.

5.2 Crematory Study Using Data from Community Based Air Toxics Study

Another study the EPC initiated was to investigate possible exposure of citizens in Ybor to crematory emissions. The study concluded that background levels of chemicals of concern, found in the CBMP study, were higher than what would occur if the new crematories were permitted (Appendix).

6.0 Conclusions

In summary, a very successful community assessment study was conducted in Ybor City, Florida that has provided significant air toxics information that has already been used in various studies of utmost importance to the people of Hillsborough County. The CBMP monitoring study, using air concentration data from the Ybor City monitoring site, concluded that most metals were above the EPA guidelines for non-cancer and cancer health effects guidelines. The study also found that benzene was above EPA cancer health effects guidelines.

APPENDIX