Michigan DEQ: FY 2004 Community Monitoring Assessment Application
March 4, 2004

The Michigan Department of Environmental Quality (MDEQ) is seeking $94,231 in air toxics funding to implement a special community monitoring project in the Del Ray area of Detroit. This project will examine the impact of air toxics emissions from mobile and stationary sources on air quality. A complementary proposal requesting $95,195 was recently submitted under the reallocated PM2.5 103 grant program to address the particulate-related aspects of mobile source emissions. To complete the proposed study, both applications will need to be funded. The suites of measurements generated by each grant proposal will *complement* each other. By leveraging both funding sources, MDEQ's existing infrastructure, historical MDEQ air quality databases and speciated organic carbon data from the Wisconsin State Laboratory of Hygiene under the direction of Dr. Jamie Schauer, this project will create a unique data set representing BOTH types of state of the art measurements reflecting diesel impacts. Contemporary research[1] indicates that there are two ways to estimate the contributions of diesel to ambient air:

- the use of organic carbon tracer species, such as those generated by Dr. Schauer
- time resolved data sets such as carbon black and trace level carbon monoxide (CO)

The PM2.5 grant requesting reallocated 103 funds deals with the use of the organic tracer species. This Community Monitoring Assessment application is requesting funds that will be used to purchase a trace level CO monitor, a continuous formaldehyde sampler and to collect and analyze 24-hour carbonyl measurements at Del Ray, an area of Detroit heavily impacted by motor vehicle and rail traffic. The CO monitor will complement the data collected by a CO monitor secured with reallocated PM2.5 funds. The continuous formaldehyde measurements will complement continuous measurements made at Dearborn through the National Air Toxics Trends Sites (NATTS) program.

Assessing the precision of the duplicate samplers (trace CO and continuous formaldehyde) in the field is vital before deployment spatial variability across the network is assessed. For the formaldehyde samplers, these activities will be coupled with QA activities to assess accuracy of the method and comparability with TO-11A. By coupling these measurements with some particulate-related measurements and the creating two new sites, one downwind of the Del Ray area and one at the border crossing with Canada, this community monitoring project will:

- generate actual ambient measurements of the air quality in the area
- develop background levels in an area with expanding transportation activities
- assess impact from delays at the Ambassador bridge on air quality in the area
- complement the USEPA Detroit Exposure Aerosol Research Study (DEARs)
- complement the Canadian bridge crossing monitoring project conducted by Environment Canada, Ontario Ministry of the Environment and the University of Windsor
- investigate middle and micro variability in air toxics concentrations
- field test continuous formaldehyde monitors, and trace carbon monoxide monitors
- understand diurnal variations in CO and formaldehyde and how they relate to other mobile sources oriented pollutants such as carbon black, and continuous fine particulate
- generate data to support source apportionment estimates of the contributions of motor vehicle and diesel exhaust to air quality
- identify other possible tracer compounds for diesel by comparing speciated organic carbon measurements from Del Ray, an area heavily impacted by diesel with Allen Park, a population-oriented mobile source dominated site, with the St Louis super site and the Class 1 Seney Wildlife Refuge site

Description of Sources/Background Material

In previous monitoring projects, levels of formaldehyde as well as other mobile source signature compounds have been shown to be elevated in the Detroit area[2,3]. The observed concentrations are highly variable by site, suggesting that point sources are contributing to the levels at some of the stations.

[1] Personal communication from Dr. Jamie Schauer, University of Wisconsin to Dr. Mary Ann Heindorf, Michigan Department of Environmental Quality, February 20, 2004.

[2] "2001 Urban Air Toxics Monitoring Program (UATMP) Final Report" October 2002, Eastern Research Group

In order to transport commodities to market, trucks and trains are often used. Inter modal freight combines both methods of transportation by transferring large containers from truck to train, without unloading or repackaging. The international port status of Detroit and proximity to Canada, make the enhanced efficacy and improved profit margins of inter modal transport an attractive means of transportation.

Much activity from freight transportation occurs in Del Ray. Residents have expressed concerns about impacts from the increased freight on the air quality in their community and impacts on their health. In addition, the Ambassador Bridge crossing is heavily used by trucking traffic as an international border crossing. As a result of increased traffic due to the success of the North American Free Trade Agreement and because of enhanced security measures implemented by the US Customs Service, delays at the border crossing have occurred. Residents in the nearby community have also expressed concern about these activities on the air quality in their community.

Heavy duty diesel truck, container lifting equipment and train emissions consist of various toxic air contaminants including: benzene, 1,3-butadiene (and other VOCs), acetaldehyde, formaldehyde, acrolein and PAHs. These sources also emit components that could impact on the NAAQS, including nitrogen oxides, sulfur compounds and fine particulate.

In addition to a plethora of mobile source emissions, there is a very diverse industrial base in Detroit, including automotive manufacturing, steel mills, coke batteries, oil refineries, chemical manufacturing plants and medical waste incinerators. Residential areas are well dispersed through the CMSA, with many neighborhoods and schools located close to these sources.

Related Studies

Based on EPA's 1996 National Air Toxics Assessment (NATA) the greater Detroit area including Wayne County ranks in the highest 5% of counties in the nation with regard to risks from air toxics. The concentration of diesel particulate in this area is also among the highest 5% of counties in the country.

MDEQ and the US EPA have invested significant resources to better understand the distribution of air toxics in the Detroit area. The Detroit Pilot Project was conducted from April 2001 through April 2002. At present, the pilot data set is being used to assess the health risks from air toxics in the Detroit area through MDEQ's Detroit Air Toxics Initiative, funded through the US EPA's Fiscal Year 2003 Community Assistance and Risk Reduction Initiative. This project will communicate the study's findings to the local community, and support risk reduction initiatives for the area. If funding were awarded for this community monitoring project, the data would complement the Detroit Air Toxics Initiative. Depending upon when monitoring begins, the data could be used in the Initiative to further characterize the risk prior to initiation of risk reduction activities, or after implementation of the risk reduction activities to evaluate their efficacy.

The US EPA's interest in the Detroit air shed is continuing with the initiation of two new projects through various branches of their Office of Research and Development (ORD), the Detroit Exposure Aerosol Research Project and the Children's Health Study, will begin in FY 04.

The US EPA's National Exposure Research Laboratory and the National Health and Environmental Effects Laboratory will be conducting DEARS from June 2004 through 2007. In this study, passive samples will be collected in and outside of about 120 homes, targeting PM2.5, VOCs and carbonyls. Personal monitoring will also be performed for the same parameters. Fine particulate will be analyzed for mass, elemental carbon, some elements and sulfate (as sulfur). The passive samplers will also be placed at one or more monitoring stations in the area. Comparisons of speciated particulate and air toxics collected by the study and by the ambient monitoring network are also planned. Access to hourly formaldehyde and trace level CO measurements from two sites would benefit this study, allowing comparisons to be made between the passive techniques, established methodology and the continuous instrumentation. In addition, the efficacy of DNPH and DNSH treated passive samplers will be compared by US EPA, providing a complete suite of formaldehyde measurements. Also, if MDEQ's community monitoring project and the grant proposal requesting reallocated of PM2.5 funds are approved, two additional aethelometers and a PM2.5 TEOM can be borrowed from US EPA/ORD to complement all studies.

---

[3] Detroit Pilot Project Data, April 2001 to April 2002, unpublished data, MDEQ February 2004.

A second study, the Detroit Children's Health Study, will be conducted by the National Exposure Research Laboratory to assess the effect of environmental exposures on the health of 4th and 5th grade children living in Detroit. This study was slated to begin in fall, 2003. It will also address elevated manganese levels in the area.

A similar exposure study is being planned in Windsor Ontario, Canada, through the US Canada Border Strategy that will be conducted by Environment Canada and Health Canada. Details are not known at this time. Initial contacts have been made for future data sharing activities. Follow-up will occur through meetings such as the February 26, 2004 Symposium on Windsor Air Quality.

Proposed Measurements

This project will investigate in more detail, the air quality in an area of Detroit containing a variety of industrial point sources as well as transportation–related activities. Transfer of products between rail and trucking operations (inter modal freight) is heavily concentrated in the Del Ray area and is expected to grow significantly in the future. Traffic backups and excessive idling that result from delays crossing the international border with Canada at the Ambassador Bridge impact air quality in this area. Previous ambient air monitoring activities that include the Detroit Air Toxics Pilot Project and the Region 5 Air Toxics Project have been conducted upwind of the location of the Del Ray area. The **upwind levels** of fine particulate and air toxics are the highest within the state, and dependent upon the parameter, are among some of the highest in the nation[4,5]

Another facet of this proposal includes various aspects of quality assurance. In this grant application, MDEQ is requesting a continuous formaldehyde monitor and a trace level carbon monoxide monitor for the Del Ray site. Another continuous formaldehyde monitor was funded through the FY04 NATTS program for Dearborn. A second trace level CO monitor was requested through the reprogrammed PM.25 grant funds. By leveraging these two different grant applications, it is MDEQ's intent to purchase two identical models of continuous formaldehyde and trace level CO samplers to investigate both precision of the techniques and the utility of the methodology to ambient monitoring applications. Two phases of the study are envisioned.

In the initial phase of the study, both continuous formaldehyde and CO monitors will be setup at a single location, either at Dearborn (261630033), or at River Rouge (261630005) due to its higher historical formaldehyde levels. All samplers will be individually connected to outside air, bypassing any manifolds. Inter-sampler precision will be determined for both trace level CO and formaldehyde samplers, prior to the beginning of the formalized ambient air monitoring project to understand variability due to instrumentation.

For the continuous formaldehyde monitors, the existing infrastructure will support investigation into inter-method comparability and accuracy testing. In addition, inter-sampler differences between formaldehyde samplers will be magnified due to the elevated levels of formaldehyde previously measured in the area. Twenty-four hour averages will be calculated from the continuous data and compared to the 24-hour results generated using method TO-11A to provide an estimate of inter method precision. The final QA component of the first phase of the project will be to assess accuracy of the continuous formaldehyde monitors by performing a through the probe audit (TTP) using a known concentration of formaldehyde gas. The instrumentation and supplies have been purchased by MDEQ to augment its air toxics monitoring program.[6]

Once deployment to the field has occurred, MDEQ's infrastructure will support continued measurements at nearby sites further enhancing our knowledge of spatial variability. Measurements will continue to be collected by the Air Quality Division (AQD) at the Dearborn NATTS site, the PM2.5 speciation trend site at Allen Park (7 km to the south west) and the Michigan Toxics Air Monitoring Program (MITAMP) stations at Southwest High School and River Rouge. The locations of the existing monitoring sites and proposed locations are shown in **Figure 1**. The area in green shows the proposed location for the consolidated inter modal freight terminal. (To handle the anticipated increases in inter-modal freight, three options have been proposed: do nothing, expand

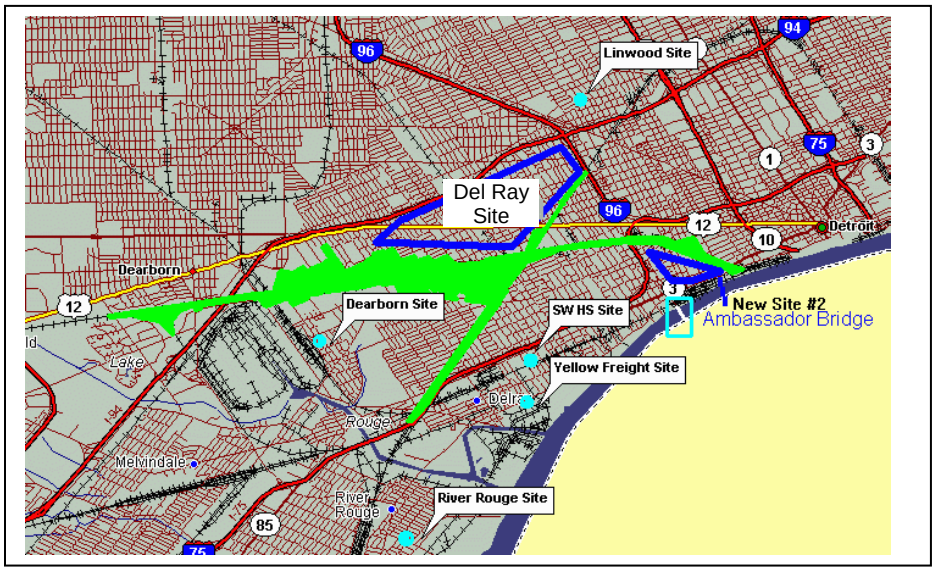
[4] "2001 Urban Air Toxics Monitoring Program (UATMP) Final report" October 2002, Eastern Research Group

[5] "Phase II Air Toxics Monitoring data: Analysis and Network Design Recommendations" July 3, 2003, Battelle Memorial Institute

[6] Similar TTP audits have been implemented by the California Air Resources Board (CARB) since 1989. MDEQ will reproduce these TTP audits for VOCs and acetaldehyde according to California's specifications. Acetaldehyde will used by MDEQ to allow comparisons with California's results and provide a more stable gas. Although formaldehyde is quite reactive and the cylinder will have a limited lifetime, it is important to attempt to estimate the overall accuracy of the TO-11A method for formaldehyde. These materials will also be used to test the accuracy of the continuous formaldehyde samplers. To assess accuracy of other carbonyl compounds, MDEQ will spike cartridges with known concentrations of prederivatized compounds, and through a technique similar to a method of standard additions, assess accuracy of TO-11A in ambient air.

four existing freight areas or consolidate all activity into one location shown by green). Two potential monitoring locations for this study are located in the areas outlined by dark blue.

Figure 1: Detailed Map of Monitoring Area



Although VOC and PAH measurements would provide more information about mobile source signatures in these areas, measurements for these analytes are not requested due to funding limitations. Detailed chemical characterization of organic carbon at Del Ray is preferred over VOC and PAH measurements because the former measurements are more useful for source apportionment activities. Speciated organic carbon measurements are also being collected at Allen Park, so small scale gradients can be identified. This is discussed at length in MDEQ's application for reprogrammed PM2.5 funds.

The existing infrastructure, the resources available through the DEARS program and the reprogrammed PM2.5 grant application will all be leveraged to create a suite of measurements characterizing levels of air toxics and fine particulate in the area. Twenty-four hour VOC and trace level metals as TSP measurements are being collected at Dearborn and Allen Park on a once every six day sampling schedule. Trace level metals as PM-10 are also collected at Dearborn. A summary of all proposed and leveraged measurements is shown in **Table 1.** The measurements covered by the funds requested in this proposal are shown in *blue italics*.

The data generated by the use of assorted continuous instruments will support detailed analysis of the variability of carbon black, PM2.5, CO EC/OC and formaldehyde by time of day, wind patterns and spatial homogeneity between sites. CO is from combustion sources, and is not intended to be a tracer for diesel PM. Rather, the CO, when combined with BC (and/or EC), will be helpful in assessing diesel impacts. In addition the high time resolution of the EC and CO will be very insightful considering weekend and weekday comparisons. Once this project is completed, the CO monitor purchased through this air toxics grant application will end up at the NATTS site at Dearborn. Its companion, purchased with the reprogrammed PM2.5 funds will be deployed at the PM2.5 trend site at Allen Park.

Due to the research quality of the instruments, their need for weekly maintenance, and likelihood of breakdown if the solutions run dry, the operation of the formaldehyde monitors will be over seen by an AQD staff member who has a completed all coursework and research for a PhD in analytical chemistry. Qualifications of other support staff are discussed in the one-page NATTS application for the continuous formaldehyde monitor. These staff have extensive air monitoring experience that will ensure the successful operation of the continuous formaldehyde monitor. The magnitude of the 24-hour readings previously recorded at various locations in Detroit suggests that 1-hour spikes will continue, providing a data set populated with detectable levels. This hourly data will be useful in a variety of exposure related studies that are planned in Detroit over the next few years. The Detroit Exposure Aerosol Research Study (DEARs), the Detroit Children's Health Study, the Detroit Air Toxics Initiative and the US Canada Border Strategy will all benefit from access to the data set.

Table 1: Measurements Made Near the Del Ray Area of Detroit

Site	PM2.5 TEOM	PM2.5 FRM	PM2.5 Spec.	Carbon Black	Continuous EC/OC	Formal-dehyde & carbonyls	Trace level CO	Speciated Organic Carbon	PM10 TEOM	PM10 24-hr
Del Ray (near Livernois)	Pro posed-Borrow monitor DEARS	Proposed 1 in 3 leverage infra structure	Proposed In reprog. PM2.5 applica-tion	Proposed-Borrow monitor DEARS	Proposed In reprogrammed PM2.5 application	*Proposed Continuous & 24-Hr TO-11A*	**Proposed** In reprogrammed PM2.5 application	**Proposed** In reprogrammed PM2.5 application	Proposed Leverage MDEQ	Proposed Leverage MDEQ
Near Ambass-ador Bridge		Proposed 1 in 3 leverage MDEQ		Proposed-Borrow monitor DEARS			*Proposed in this application*			
Dearborn	**E**	**E 1 in 3**	**E 1 in 6**	**E**		**Continuous NATTS, TO-11A 1 in 6**			**E**	**E 1 in 6**
SW HS		**E 1 in 3**				**TO-11A 1 in 12**				**E 1 in 6**
River Rouge						**TO-11A 1 in 6**				
Allen Park	**E**	**E 1 in 1**	**E 1 in 3**	**E**		**TO-11A 1 in 6, as regional site**	**E**	**E**		**E 1 in 6**

Key: E =Existing

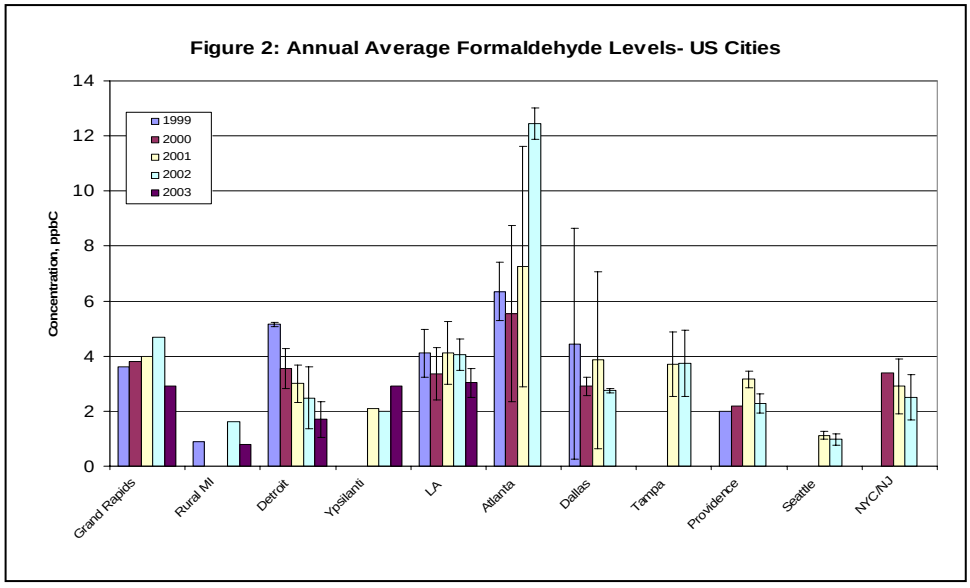
Historical Levels of Particulates and Toxic Air Contaminants in SE Michigan:

Table 2 shows validated PM2.5 measurements through April 30, 2003, (primary monitors only). Samples are collected daily at Allen Park and Linwood, where as the other stations sample on a once every three day schedule. As shown in the table, the Del Ray and Ambassador Bridge areas will not likely meet the PM2.5 annual ambient air quality standard. Annual average concentrations at Dearborn are almost 20 ug/m^3, surpassing the level of the annual NAAQS of 15.0 ug/m^3. The annual form of the PM2.5 NAAQS is the controlling form, with all sites in Michigan currently meeting the 24-hour standard.

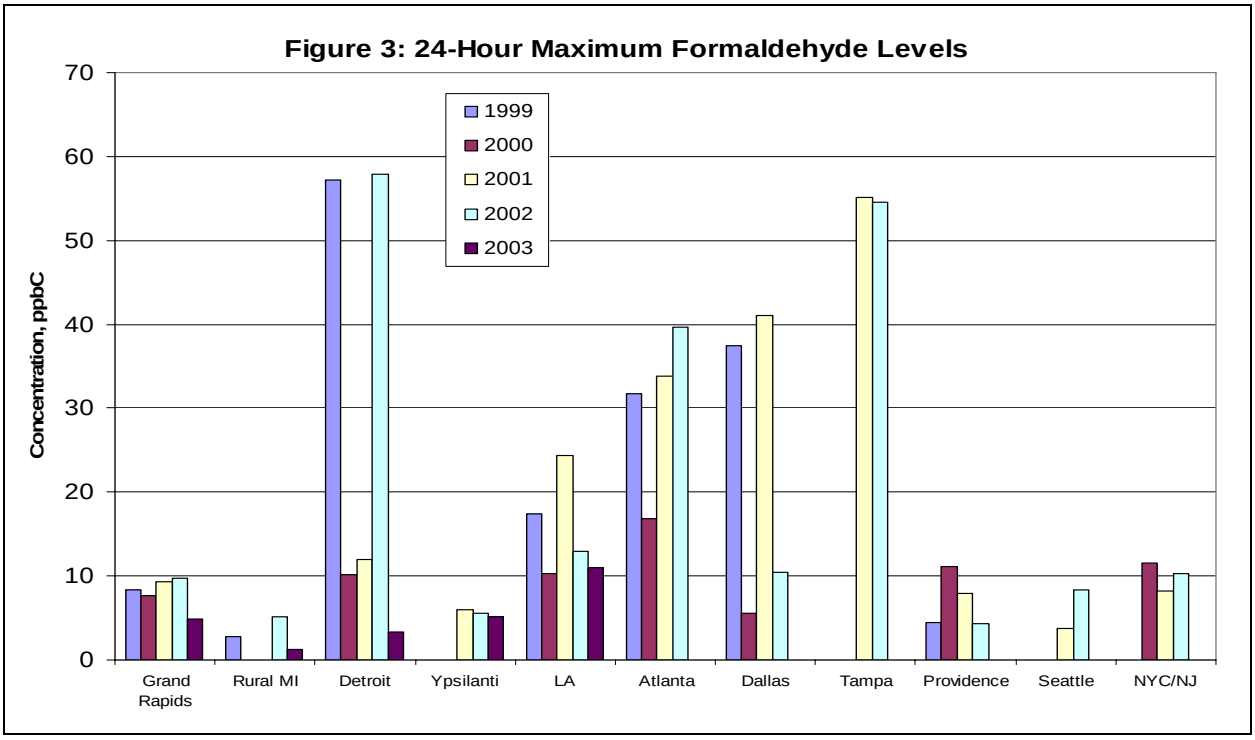
Formaldehyde and benzene data from all monitors in counties making up major metropolitan statistical areas was downloaded from AQS on August 27, 2003. Annual average concentrations for these pollutants were then calculated using 24-hour measurements. These averages, compared to those observed in Detroit are shown in **Figure 2**, with 90% confidence intervals indicated by the vertical bars. Some cities did not have multiple monitors so it wasn't possible to calculate the confidence intervals in all cases**.**

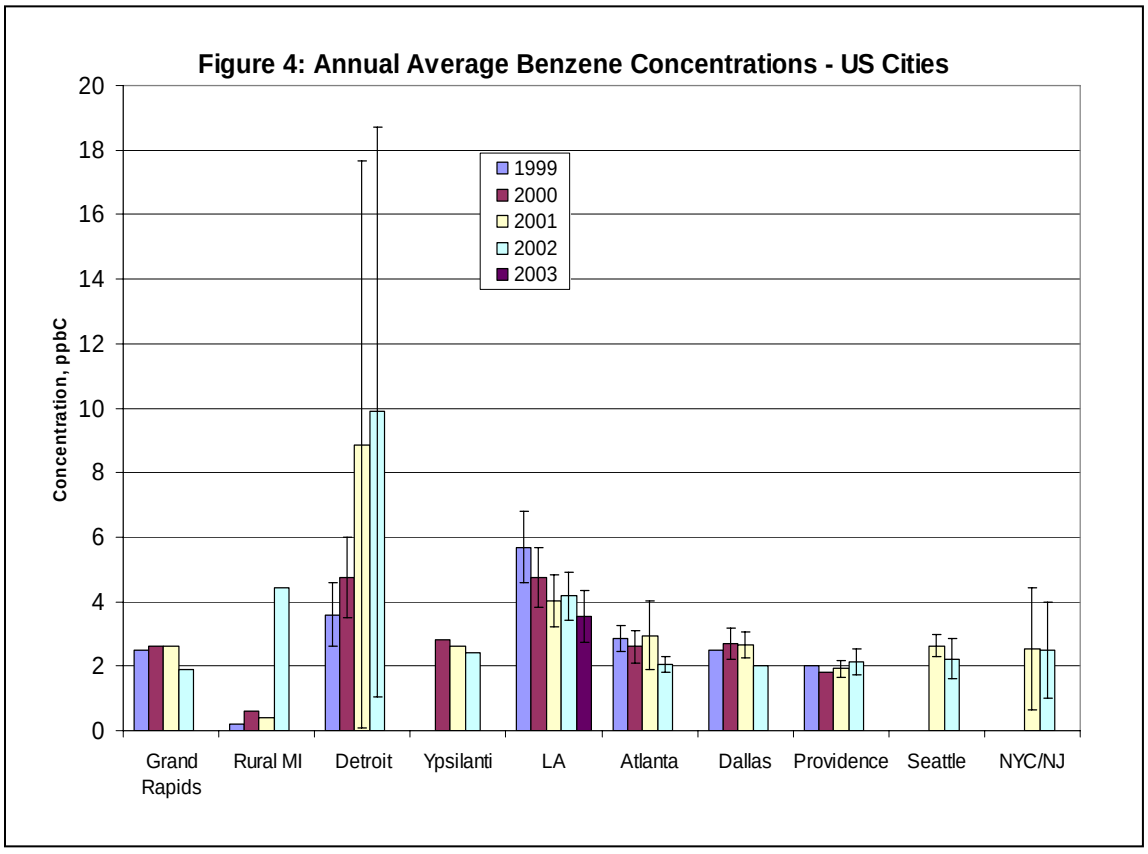
Table 2: Annual Average PM2.5 Concentrations for Sites Near Project Area

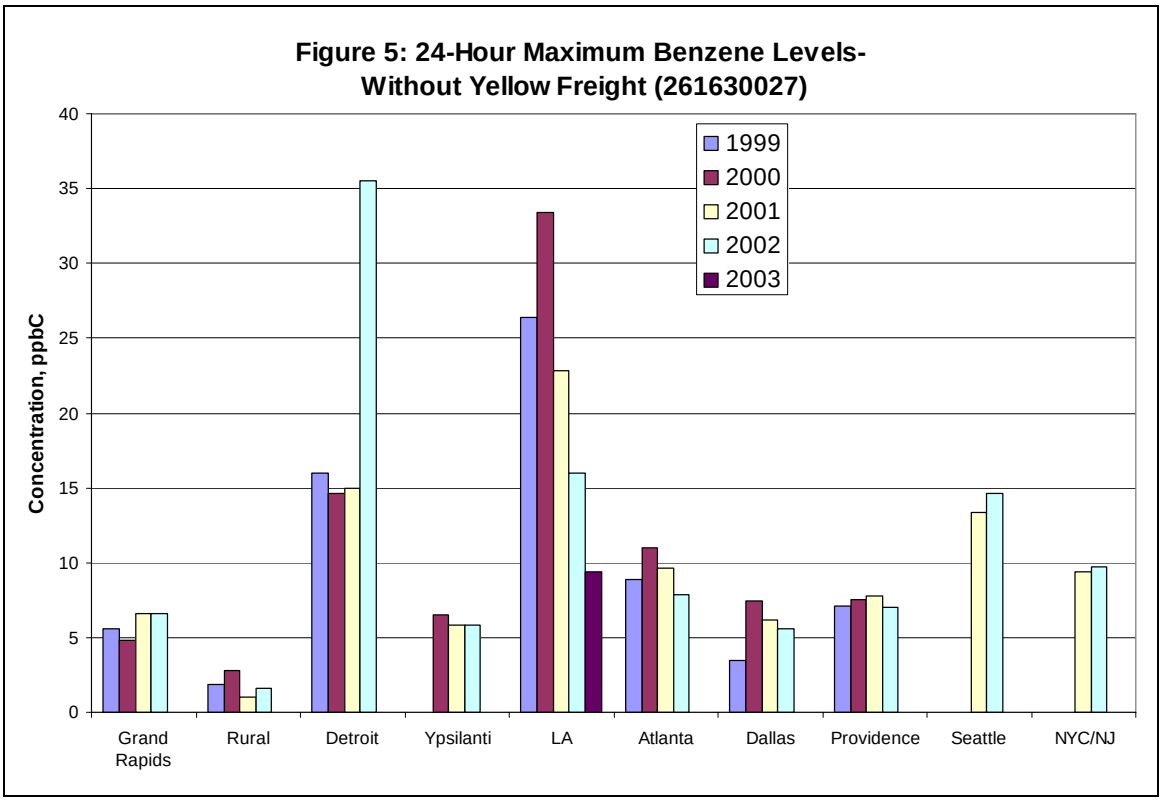
Site	AIRSID	Year	Annual Avg, ug/m^3	3-Year Avg ug/m^3
Allen Park	261630001	1999	16.66	
Allen Park	261630001	2000	15.56	
Allen Park	261630001	2001	17.34	16.5
Allen Park	261630001	2002	15.94	16.3
Allen Park	261630001	2003	16.43	16.6
SW HS	261630015	1999	17.68	
SW HS	261630015	2000	18.10	
SW HS	261630015	2001	18.28	18.0
SW HS	261630015	2002	17.43	17.9
SW HS	261630015	2003	16.29	17.3
Linwood	261630016	1999	17.08	
Linwood	261630016	2000	15.49	
Linwood	261630016	2001	15.79	16.1
Linwood	261630016	2002	15.59	15.6
Linwood	261630016	2003	16.63	16.0
Dearborn	261630033	1999	17.00	
Dearborn	261630033	2000	20.13	
Dearborn	261630033	2001	19.61	18.9
Dearborn	261630033	2002	19.84	19.9
Dearborn	261630033	2003	21.43	20.3



Figures 3 to **5** compare 24-hour maximum concentrations. The data from NYC/NJ reflects values from counties in NJ that are part of the New York CMSA, and not part of New York State (Manhattan) to avoid the introduction of any 9-11 data into the set. As shown by **Figures 2** through **5,** there is much spatial variability for benzene and formaldehyde in Detroit. In addition to this spatial variability, the magnitude of the concentrations of air toxics are elevated in comparison to other CMSAs.







Data Analysis:

The inter-sampler precision of the continuous formaldehyde and trace level CO monitors will be determined, if both of MDEQ's proposals are funded, by locating both instruments in a single location for one month. The spatial variability in the diurnal profiles of formaldehyde, carbon black, fine particulate and carbon monoxide will be compared according to the sites and monitor deployments shown in **Table 1**. Correlations between the hourly measurements will also be determined at each site.

Ultimately the data will be used to estimate the relative proportion of mobile source contributions to the fine particulate loading in the area using source apportionment techniques. It is anticipated that another grant will be necessary to cover the more detailed analysis and source apportionment work. However, cursory data analysis is possible and will be performed by MDEQ staff with assistance from Dr. Schauer.

The data with finer resolution will provide an independent check on the source apportionment results and allow detailed analysis of the variability of carbon black, PM2.5, CO, EC/OC and formaldehyde by time of day, wind patterns and spatial homogeneity between sites.

Model to Monitor Comparisons:

Over the past several years, much attention has been given to the quantification of toxic levels in the National Air Toxics Assessment (NATA). The quantification was done by inventorying toxics emissions in an area and running dispersion models. NATA results have not been thoroughly validated. In this study, NATA results will be compared to quality assured monitoring data to assess applicability of the NATA modeling techniques in a large urban area such as Detroit. Efforts will be made to assess the appropriateness of the NATA data, in both magnitude and its ability to reproduce spatial variability in the Detroit Air Toxics Initiative project, if time allows. Depending on the timing of when the monitoring began, the data could be used in the assessment to help further characterize the risk prior to initiation of risk reduction activities, or after implementation of the risk reduction activities to evaluate their success.

Community Partners:

Local community groups are very concerned about the air quality in the Del Ray area. Results of this project as well as the analysis of risk that is being assessed through the "Detroit Air Toxics Initiative" will be communicated to these groups and to a community advisory board, which is currently being formed as part of the Initiative grant. As part of the aforementioned grant, the community partners and MDEQ will then formulate risk reduction initiatives for the area. Potential community partners include: Community Action Against Asthma (CAAA), ACCESS (Arab Community Center for Economic and Social Services), Southwest Detroit Environ-mental Vision, East Michigan Environmental Action Council, Transportation Riders United and Good Neighbors United.

Quality Assurance:

All the quality assurance and data reporting conventions described in the national air toxics pilot program and the PM2.5 speciation Quality Assurance Project Plan (QAPP) as well as MDEQ's PM2.5 FRM QAPP, will continue to be followed. The measurements at the new stations will conform to these programs and follow all MDEQ Standard Operating Procedures (SOPs). The 24-hour carbonyl samples will be sent to the National Contact Laboratory.

To provide an added level of quality assurance, 10% of all carbonyl samples will be duplicate samples, which will be collected by filling two cartridges from a single sampler over a 24-hour period at Del Ray.

Co-located PM2.5 FRM measurements will continue to be collected at the Allen Park (261630001) site.

Any SOPs and QAPPs supplied by the US EPA for the operation of the continuous formaldehyde sampler and trace level CO monitor will be adopted from the NATTS program. Because these instruments are undergoing field testing through the NATTS program, and are still in the development phase, it is likely many revisions will be made to these documents during the testing phase. MDEQ will participate in all NATTS QA conference calls to keep informed of revisions proposed by other cities also conducting testing.

Meteorological Monitoring:

Wind speed, wind direction, temperature and sigma-theta will continue to be measured and reported to AQS by the existing stations. Wind speed and wind direction as well as temperature will be added to new Del Ray and at the bridge, if siting allows.

Monitor Siting:

The two new sites proposed in this study will meet siting criteria. They will be located away from the influence of large buildings, trees, vents, etc., and conform to minimum probe separation criteria.

Data Output:

All collected data will be submitted to the AQS by MDEQ.

Projected Budget:

Table 3 summarizes the budget of $94,231 for the Community Monitoring grant application. Travel costs are essential to support weekly site visits to the continuous formaldehyde monitor. If the solutions are allowed to run dry, the monitor may become irreparably damaged.

Table 3: Budget Community Monitoring Study DelRay Michigan for Monitoring May 1, 2004 through April 31, 2005.

updated 03/05/04

Item	Description	Number	Est. Unit Cost	SubTotal	Overall Running Total
1. Instrumentation					
	A. Continuous Formaldehyde				
	Continuous formaldehyde monitor MA-100 Alpha _Omega*	1	$32,500.00	$32,500.00	
	1 year of supplies	1	$539.03	$539.03	
	Shipping & handeling	1	$250	$250	
	Continuous formaldehyde total			$33,289.03	$33,289.03
	B. Trace Level Carbon Monoxide				
	API/Teledyne API 300-EU, with autozero solenoid, heated	1	$14,728.00	$14,728.00	$48,017.03
	Palladium zero scrubber option, nafion dryer, rack mount				
	Expendables kit, warranty				
2. 24-Hour Sampling					
Carbonyls	Carbonyl Samples, 1 in 6 day, 1 sites	62	$126.00		
	Carbs. Replicate Samples, 10% (ERG)**	6	$126.00		
	Carbs Blank Samples, 10%**	6	$126.00		
	Total Carb. Samples /year	74	$126.00		
	Carbs to Contract Lab**	74	$126.00	$9,324.00	$57,341.03
3. Travel & Utilities for site Operation					
	Travel, site set up, operation & audits			$7,540	
	Staff Time, annual	650	$35	$22,750	
	Electric 1 Site in Detroit / year		$5,500	$5,500	
	Total Site Operation Costs			$35,790	$93,131
4. Indirect Costs, 19.56%					
	Personnel Subtotal, wages, fringes & benefits from above	0.20	$5,500	$1,100.00	$94,231

NOTES:

* Permeation device and other peripherals will be purchased through the Dearborn NATTS 103 grant for the continuous formaldehyde monitor.

** 0020B Category II HAPs only - no site support - estimated analysis & shipping cost

*** 0020A Category I HAP's only - no site support - estimated analysis & shipping cost

**** 0020D Semi-vols-Catergory IV HAPs Only ? - no site support - estimated analysis & shipping costs