Southwest Indianapolis Community-Scale Air Toxics Study
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Overview

The report below is a summary report to satisfy the Indiana Department of Environmental Management's (IDEM) grant obligation. Between October 2006 and October 2008, IDEM, the United States Environmental Protection Agency (U.S. EPA), the city of Indianapolis, and a diverse group of stakeholders conducted a study of Hazardous Air Pollutants and other air toxics in the southwestern quadrant of Indianapolis, Indiana. This report is intended solely for U.S. EPA and is not intended to be released to the public. The report that will be released to the public will focus on communicating the results that the public is interested in and will be released to the public following a schedule as determined by the Public Advisory Group. A detailed technical report will also be available mid 2010.

IDEM's refined analyses shows that air toxics concentrations and risks are significantly lower than predicted by the U.S. EPA's 1999 National Air Toxics Assessment (NATA) for the area. The air toxic concentrations measured in the area are similar to concentrations observed throughout Indiana and in other Midwestern cities. No pollutants were observed at concentrations that warrant immediate or emergency action.

The largest contributor to air toxics concentrations and estimated risks from within the study area are mobile sources (cars, trucks, etc.). IDEM is actively promoting the Voluntary Idling Reduction Program (VIP) as well as working on diesel retrofit opportunities to reduce mobile source impacts in the area. Industrial sources were evaluated in detail concerning their contribution to air toxics and risk. The risks contributed by industry in the area were small when compared to the risk from mobile sources. However, IDEM has identified a few industrial sources in the area that, while not significant sources of risk, could warrant further evaluation for potential pollution prevention opportunities and has initiated communication with these entities. The risks in this section of Indianapolis are comparable to the risks observed in other metropolitan areas and Indiana.

Report

The goal of the Southwest Indianapolis Community-Scale Air Toxics Study was to conduct a community scale analysis of air toxics in a 10 square mile area of southwestern Indianapolis, Indiana. Originally for purposes of the siting of air monitors, the study area was divided into a primary and a secondary study area. However, once monitor placement was determined, the labels of "primary" and "secondary" were dropped and the combined area was designated as the study area. In the 1999 NATA, U.S. EPA identified census tracts in this area as being of potential concern for exposure to air toxics. In addition, there was considerable concern by residents in this part of the city, as documented by articles in the *Indianapolis Star* (February 22-23, 2004). The study was comprised of three interconnected components:

- For the first component of the study, IDEM conducted ambient air monitoring in two residential neighborhoods. The monitored concentrations were evaluated and compared to toxicological information for each pollutant, other Indiana ToxWatch sites, other metropolitan areas, and the NATA.

- For the second component, IDEM worked with the local industries to develop a refined emissions inventory of sources and categories of sources likely to be contributing to the identified air toxic concentrations.

- For the third component, IDEM conducted detailed air dispersion modeling of sources over a large area in order to estimate air toxic concentrations in the area.

The results of the above analyses were used to characterize the potential (not actual) excess cancer risk and non-cancer hazard posed by air toxics in the study area. The resulting risk characterization can be used to inform citizens and other interested parties of the potential health risks from air toxic emissions and to identify areas where, in the future, IDEM can work with local sources and the community to reduce emissions and their potential health risks.

Fine particulate matter, also referred to as $PM_{2.5}$ and PM_{10}, was not evaluated as part of this study. The goal of the study was to gather more information about air toxics in an area where little information was available. The existing understanding and monitoring of particulate matter is more extensive and has clearly defined health protective concentrations and monitoring requirements by U.S. EPA. Currently, Marion County is designated as not meeting the federal health standard set by U.S. EPA for particulate matter. However, current monitoring results demonstrate that Marion County meets federal particulate matter health standards. IDEM has petitioned U.S. EPA to redesignate the area from nonattainment to attainment.

Ambient Air Monitoring

IDEM operated two monitoring sites in neighborhoods within southwest Indianapolis with one site having an additional chromium speciation monitor. One monitoring location was at 1321 South Harding Street. The other monitor was located at 1802 South Holt Road. Monitoring location selection conforms to U.S. EPA standards as detailed in the Quality Assurance Handbook for Air Pollution Measurement Systems - Ambient Air Quality Monitoring Program Quality System Development EPA-454/R-98-004. The monitoring sites were strategically located based on an evaluation of the U.S. EPA's 1996 and 1999 NATA reports, proximity to major sources for emissions, and in locations where the general public lives and congregates.

Both sites were operated consistent with procedures established for U.S. EPA's National Air Toxics Trends Station (NATTS) network. Specifically, the sites used U.S. EPA recommended sampling and analytical protocols to monitor for a list of air toxics considered by U.S. EPA to pose the greatest potential health risk. IDEM monitored volatile organic compounds (VOCs), carbonyls, and toxic metals. Additionally, the Harding Street site had a chromium speciation monitor. The sites followed U.S. EPA's standard one-in-six-day monitoring schedule and each sample was taken for a 24-hour period. All monitoring followed the project's Quality Assurance Project Plan (QAPP) approved by U.S. EPA.

Monitoring results were analyzed using U.S. EPA approved statistical methods. IDEM used a statistical analysis tool called Kaplan-Meier to evaluate the data. During sampling, it is not uncommon to have pollutant concentrations below the detection limits, even with the very low detection limits that IDEM is able to achieve (parts per billion). Instead of ignoring readings that were below the detection limit, assuming that the concentration is always zero, or assuming that the concentration is always at the detection limit for that chemical, IDEM applied a more complex and robust statistical analysis. U.S. EPA recommends that, if possible, the Kaplan-Meier Product Limit Estimate (Kaplan-Meier) method be used. Kaplan-Meier was used to evaluate the data so that a 95% upper confidence limit of the mean (UCL) could be determined. This is the standard methodology recommended by U.S. EPA for estimating the concentration to which people are exposed.

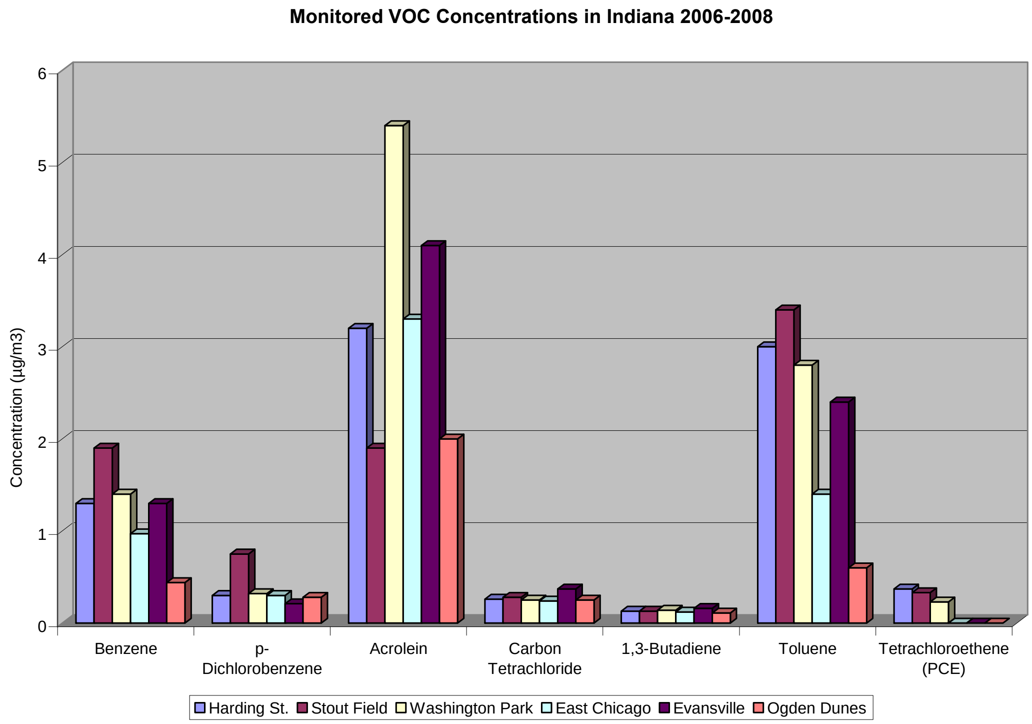
Kaplan-Meier is a non-parametric method that allows the calculation of a less-biased mean and standard error (and by extension, many other statistical values) from a dataset that contains non-detects. Kaplan-Meier has many advantages over other methods for dealing with non-detects: it is a non-parametric method, and as such does not require that the distribution of the data be known, it can be used with datasets that contain many non-detects, and is more accurate than substitution methods such as using ½ the detection limit.

There are at least two different variation of the Kaplan-Meier method. The main difference in these methods appears to be where censoring occurs in the dataset. The dataset can be censored either at the lowest detection in the dataset or at the lowest detection limit. Censoring at the lowest detection limit will introduce less bias into your results, where censoring at the lowest detection will provide results that are slightly more conservative. To be consistent with EPA's ProUCL software, this analysis chose to censor at the lowest detection, rather than the lowest detection limit.

IDEM monitored for a total of 95 air pollutants. A total of 78 pollutants were detected at least one time at the Harding Street location and 73 pollutants were detected at least one time at Stout Field. Table 3 summarizes the detection rates for all the pollutants at each site.

Concentrations of most pollutants in southwest Indianapolis were similar to concentrations observed in other areas of Indiana and other metropolitan areas. Graph 1 shows the concentrations of some pollutants throughout Indiana.

Graph 1



One pollutant, p-dichlorobenzene, was observed to be higher at the Stout Field location than other monitoring locations in the state. A majority of the time p-dichlorobenzene was monitored at low concentrations at both monitors. However, during a two month period p-dichlorobenzene concentrations were higher than normal at Stout Field. This episode of higher p-dichlorobenzene concentrations coincided with other pollutants also at levels not normally observed. Given that these readings were only observed at one monitoring location for a brief period of time, IDEM views this as a brief, localized event. IDEM investigated possible sources of the p-dichlorobenzene but was unable to identify the likely source. An event like this was not observed again during the two year monitoring period and concentrations during the event were not above acute health protective levels.

Inventory and Air Dispersion Modeling

IDEM used the Regional Air Impact Modeling Initiative (RAIMI) model for the Southwest Indianapolis study. RAIMI evaluates the potential for health impacts resulting from exposure to multiple pollutants emitted from multiple sources throughout a community. RAIMI uses different tools to focus on the risk characterization process. The Data Miner tool allows data from different sources to be combined to run the model. The Air Modeling Preprocessor can process meteorological and terrain data and automatically input them into the model. The processor also creates a receptor grid node for each source, which allows IDEM to estimate concentrations out to 10 kilometers from each source. The model prepared output files based on chronic (long term) and acute (short term) averaging periods.

To get the most up-to-date information for the model, IDEM sent emission related information requests to 319 businesses and industries in the area. IDEM held workshops and meetings with businesses and industry to build the most accurate emissions inventory possible. A total of 268 (84%) facilities that received requests responded with updates or confirmation of their emissions. It is estimated that these 268 facilities accounted for 98% of all estimated point and area source emissions in the area.

IDEM modeled a total of 464 sources of emissions within the study area. This included major industry sources, trucking companies, gas stations/truck stops, auto body shops, and dry cleaning facilities. Some industries had more than one source located on their property so those sources were modeled separately. Table 1 provides a breakdown of the different sources modeled. A total of 168 pollutants were modeled throughout the study area.

Table 1 – Modeled Sources

Source	Number
Major sources	315
Trucking companies	71
Gas stations/Truck stops	49
Auto body shops	19
Dry cleaning shops	10
Total	**464**

IDEM also modeled major and secondary roadways for emissions and impacts from cars and trucks. IDEM split the roads into segments and used traffic count data from the Indiana Department of Transportation to aid in the determination of the volume of emissions deriving from each segment.

Emissions Inventory Gathering

IDEM started the emissions information gathering by sending out letters to all the industries from which information would be requested in order to inform them about the Southwest Indianapolis Air Toxics project. The letter contained a few details about the project and the emissions inventory gathering process.

In the letter IDEM announced a date, time, and location of two informational sessions for industry to attend so that they could have questions answered by IDEM. This gave industry an opportunity to comment and ask questions of staff prior to the official request for information. The letter contained contact information for IDEM staff so that if they had questions they could ask prior to or outside of the information sessions.

At the information session, IDEM gave a brief presentation about the project as a whole and then went into detail about why the emissions inventory request is important, how it would be used, and what information was needed. IDEM provided an example of what information would be sent out to industry and went over how that information was derived. Following the walkthrough of the example emissions inventory request IDEM answered questions and addressed concerns from industry representatives.

The goal of the emission inventory gathering process was to collect the best available data from industries in the study area for the purpose of running a dispersion model. While this was an information gathering exercise, the purpose was not to simply gather any and all data available. The only information that IDEM was seeking was information that would be useful for the dispersion modeling effort.

IDEM has gathered emissions information in the past for other purposes. In this instance, IDEM was seeking emissions information from industry specifically for the use in a computer dispersion model. IDEM wanted industry to be fully aware of what the intended use of the information was and the importance of industry providing the best available information that they have. This emissions information exercise gave industry an opportunity to correct emission inventory issues prior to the running of the dispersion model.

IDEM sent to all the industries involved in the study a spreadsheet that contained the company's specific emissions information. The spreadsheet was designed to only display information that IDEM required to run the dispersion model. The file was formatted to clearly show where IDEM obtained the emissions information (i.e. Toxics Release Inventory, National Emissions Inventory etc.) and from what year the data was obtained. IDEM requested that industries verify the information that they sent and to update the information as appropriate. IDEM also requested that if there were gaps in the information that IDEM sent out that industry use the best available information to fill in those gaps. Industry was given 90 days to return the verified data to IDEM.

As part of the emissions inventory gathering process, IDEM sent out a "pollutant of interest" list to all the industries. This list contained pollutants that IDEM was examining in greater detail. It was not IDEM's intent that all industries verify the existence or absence of each pollutant on this list. The purpose of providing the list to industry was to make them aware of which pollutants were of potential concern. If an industry had additional information that they wanted to provide to IDEM about pollutants on the list, then they had that opportunity.

After the 90 days were finished, IDEM completed the inventory using the industry supplied information. IDEM filled in any information gaps that industry was unable to complete using health protective assumptions appropriate for the industry.

Emissions inventory request surveys were returned by 84% of the sources in the area. Some sources reported zero emissions or that the facility had been closed. For the other sources, inventories were developed based on National Emissions Inventory (NEI) data, TRI data or from the allowable emissions based on the sources most recently issued permit. Sources that did not have any available information were omitted from the input file.

Surveys were put into input files for modeling and all point sources were checked for accuracy and quality assured by the air toxic inventory specialist. The emissions were checked against the 2005 Regional Air Pollutant Inventory Development System (RAPIDS) inventory. Sources with a greater than 1000 pound change from the inventory to the modeling input file were noted. Sources that were not required to be included in the RAPIDS inventory were more difficult to determine the accuracy of the emissions. Four sources were flagged for having high risk pollutants at emission rates that did not seem likely for the source's permit type. Two of the sources were found to have lower emission rates and one source did not report and was modeled at its potential emission rate.

For gas stations, surveys requested the amount of gasoline sold per week. This amount was the throughput for the source and emissions were calculated based on Volatile Organic Compound (VOC), emission factors from AP-42. The emissions were speciated based on Hazardous Air Pollutant (HAP) profiles from "Bulk Gasoline MACT Background Information Document." Any gas station that did not return the survey was estimated based on the number of pumps and location of the station.

For auto body repair and refinishing, the surveys requested the number of employees working in the refinishing area of the facility and the amount of material used per week. The 1999 US Census Bureau Industry Code Summary was used to calculate the amount of VOC emissions per employee. A HAP speciation profile was used to determine the individual HAP emission rate for each source.

For trucking companies, surveys requested the number of trucks that go through the facility each week and if the source had an idling policy. If a source reported idling time, the number of trucks was multiplied by the amount of idling time to determine the idle hour throughput. Emissions were calculated based on emission factors taken from the Coordinating Research Council's "Diesel Exhaust Standard Phase Project", August 2003. If the source had a no idling policy, the start-up emissions were estimated based on emission factors from the same project. If the source did not respond to the survey, the emissions were estimated based on the number of trucks at a facility with a 10 minute idle time.

For dry cleaners, surveys requested the type and amount of chemical used. Emissions estimates were based on the response to the survey.

Emissions were also estimated for the mobile component of the project. Traffic count data was acquired for the main interstates and city streets in the study area. The data was estimated for each 100 meters of the roadway to determine the vehicle miles traveled (VMT) for each section. Estimates were for cars and trucks. For cars the VMT was multiplied by the AP-42 emission factors. For trucks, the VMT was multiplied by the Urban Daily Driving cycle emission factors from the Diesel Exhaust Study.

Airport emission factors for the Indianapolis International Airport were taken from the 2005 NEI.

Risk

The term "risk characterization" has many different meanings and can include projects of wide variability in depth and scope. The tools and resources available to IDEM limit the scale and scope of the risk characterization that IDEM can produce. This risk characterization is designed to answer questions about the types, amounts, and potential health risks posed by air toxics in the study area. This risk characterization focuses on two toxic endpoints for each pollutant, cancer and non-cancer health effects from inhalation exposure over a lifetime (70 years) and uses health protective assumptions and inputs. The primary function of the risk characterization is to put into context the concentration of each of the pollutants to which the public is exposed by taking into account the toxicity of the different pollutants.

The risk characterization, while a useful tool, is not a statement of "actual risk" that people face but rather a reasonable estimate of upper-bound potential risk. It is not IDEM's goal to identify the cause of any observed health effects in the area through this study. This characterization can be used to make decisions about whether additional resources should be dedicated to reduce emissions and risk. The "actual risk" that individuals face is a complex combination of many factors, including genetic predisposition, diet, lifestyle choices, and environmental contribution. It is outside the scope of this study to determine what this complex combination of factors is for every person who lives in the study area. IDEM has made certain health protective assumptions that result in an estimate of upper-bound potential risk posed by the pollutants in the ambient air (i.e., the air in and around the study area). Risk values shown should not be considered to represent actual predicted cases of cancer.

IDEM used risk characterization methodology based on U.S. EPA approved guidance. Specifically, U.S. EPA's Air Toxics Risk Assessment Reference Library Volumes 1, 2, and 3, were used. Methods were reviewed by a Technical Advisory Group during the course of the study.

IDEM evaluated the highest 24-hour air monitoring sample and compared that value to available toxicological values for acute (short-term) health effects. Table 2 summarizes the evaluation. 24-hour monitored concentrations were compared to 24-hour Minimal Risk Levels (MRLs) list in the Agency for Toxic Substances and Disease Registry (ATSDR) and Occupational Safety and Health Administration (OSHA) 1-hour Reference Exposure Levels (RELs). No pollutants were observed over the short-term health protective level for a 24-hour period.

Table 2 – Short Term Exposure Comparison

Pollutant	Harding St. Maximum µg/m³	Stout Field Maximum µg/m³	MRL 24-hr risk	REL 1-hr
Acrolein	5.6	6.3	6.9	2.5
Benzene	7.8	19	29	1300
Benzyl Chloride	-	-		240
Bromodichloromethane	-	-	2100	14000
Carbon Disulfide	0.44	3.3		6200
Carbon Tetrachloride	0.69	0.63		1900
Chloroform	0.88	0.30	490	150
p-Dichlorobenzene	1.5	5.4	12000	
1,4-Dioxane	2.5	1.4	7200	3000
Methyl Tert-Butyl Ether (MTBE)	0.32	-	7200	
Styrene	0.85	3.4		21000
Tetrachloroethene (PCE)	3.5	1.8	1400	20000
Toluene	25	38	3800	37000
1,1,1-Trichloroethane	-	-	11000	68000
Trichloroethene (TCE)	0.48	1.7	11000	
Vinyl Chloride	-	-	1300	180000
o-Xylene	4.1	4.3	8700	22000
m+p-Xylenes	12	13	8700	22000
Arsenic	0.0042	0.0064		0.19
Mercury	0.0029	0.0017		1.8
Nickel	0.0026	0.025		6
Formaldehyde	13	8.4	49	94

IDEM evaluated pollutants for the reasonable upper-bound probability of causing harm for non-cancer health effects when exposed to pollutants over a lifetime. IDEM assumes that individuals are exposed to the pollutant continuously for 70 years. IDEM also takes into consideration sensitive population (i.e., those with conditions making them more susceptible to the effects of pollution, like children or the elderly) when evaluating the observed concentrations.

IDEM used U.S. EPA methods and toxicological information from reliable sources when calculating cancer risk estimates. The resulting calculations give a number that is expressed using the term “cancer cases per number of people”. For example, a number could be four excess (additional) cancer cases per million people over 70 years. U.S. EPA uses a range between one in a million to one hundred in a million (1.0×10^{-6} to 1.0×10^{-4}) when evaluating whether the estimated risk is at a level where action should be taken. Generally, U.S. EPA considers risk estimates over one hundred in a million (1.0×10^{-4}) to be at levels where action or more investigation is required. Risks that fall between one in a million and 100 in a million (1.0×10^{-6} to 1.0×10^{-4}) level generate decisions and actions taking into account the assumptions used to determine the estimate. Risk estimates below one in a million (1.0×10^{-6}) are usually considered as not requiring further action.

Table 3 contains the chronic (lifetime) cancer risk estimates for all the pollutants monitored during the study for both monitoring locations.

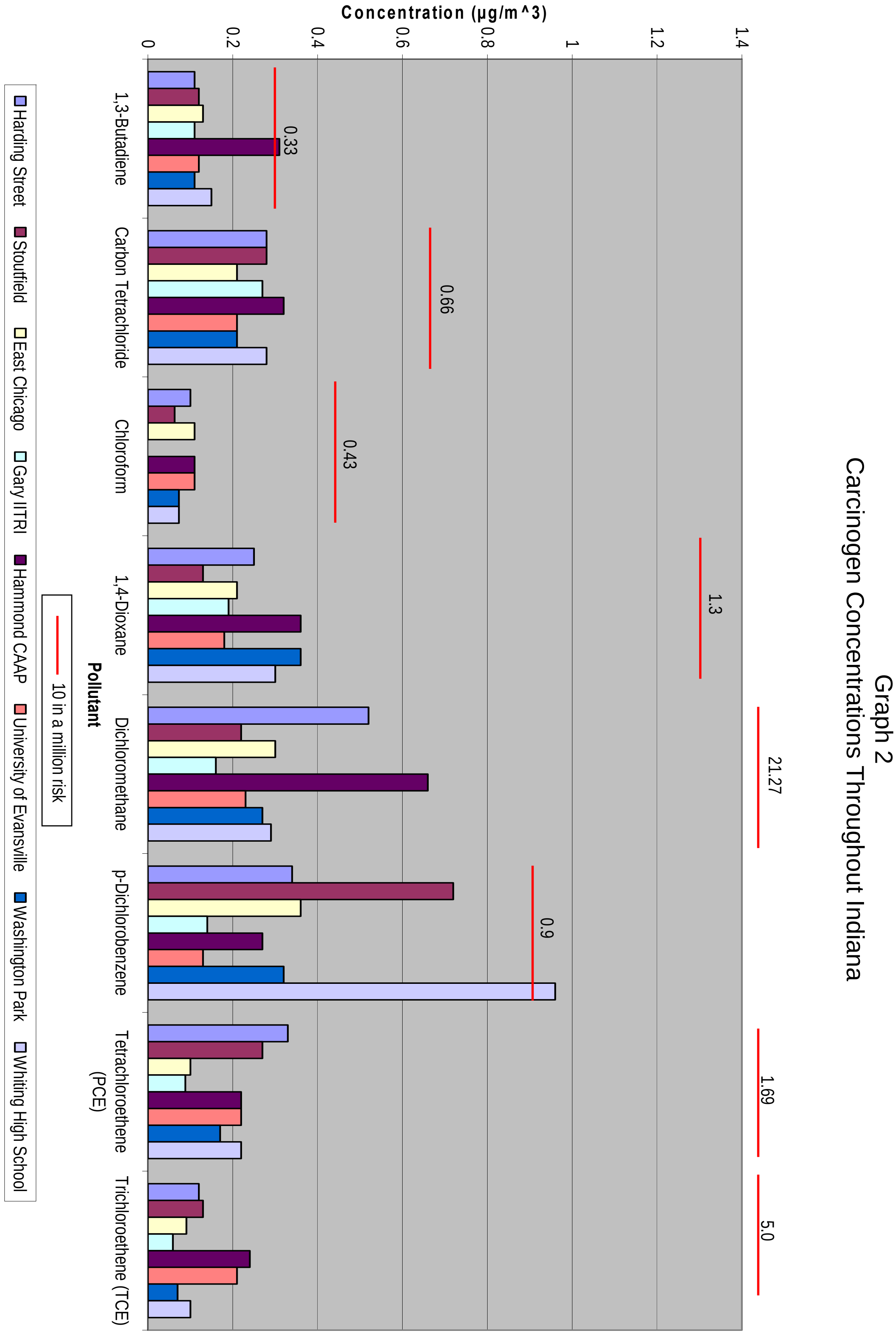
Table 3 – Pollutant Detection Rates and Lifetime Cancer Risk Estimates

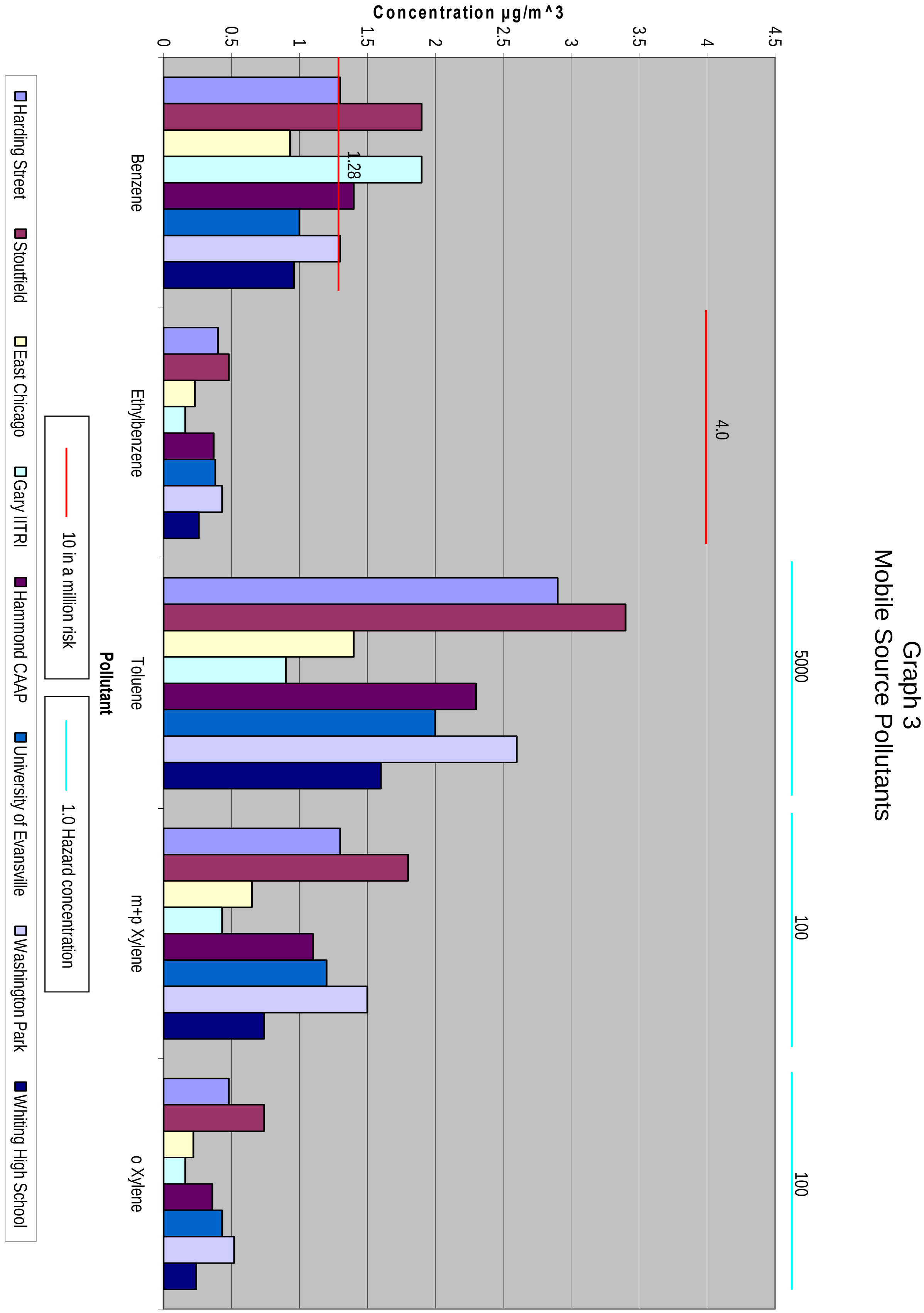
Pollutant	CAS #	Harding Street			Stout Field		
		Detection Rate percentage	Exposure Concentration (µg/m³)*	Lifetime Risk Estimate (per million)	Detection Rate percentage	Exposure Concentration (µg/m³)*	Lifetime Risk Estimate (per million)
Acetaldehyde	75-07-0	87.0%	0.67	1.5	86.8%	0.70	1.5
Arsenic	N/A	91.3%	0.0011	4.8	89.1%	0.0012	5.3
Benzene	71-43-2	100.0%	1.3	10	95.5%	1.9	15
Beryllium	N/A	97.4%	0.0000080	0.020	97.5%	0.0000090	0.020
1,3-Butadiene	106-99-0	22.9%	0.11	3.2	25.2%	0.12	3.5
Cadmium	N/A	92.2%	0.00030	0.50	84.9%	0.00030	0.50
Carbon Tetrachloride	56-23-5	35.6%	0.28	4.2	38.7%	0.28	4.2
Chloroform	67-66-3	24.6%	0.10	2.4	9.9%	0.063	1.5
p-Dichlorobenzene	106-46-7	45.8%	0.34	3.8	60.4%	0.72	8.0
Dichloromethane	75-09-2	73.7%	0.52	0.20	56.8%	0.22	0.10
1,4-Dioxane	123-91-1	13.6%	0.25	1.9	15.3%	0.13	1.0
Ethylbenzene	100-41-4	74.6%	0.40	1.0	70.3%	0.48	1.2
Formaldehyde	50-00-0	93.5%	3.5	0.020	89.3%	2.4	0.010
Lead	N/A	91.3%	0.0060	0.070	96.6%	0.0090	0.10
Nickel	N/A	87.0%	0.0010	0.20	88.2%	0.0020	0.40
Tetrachloroethene (PCE)	127-18-4	41.5%	0.33	1.9	37.8%	0.27	1.6
Trichloroethene (TCE)	79-01-6	8.5%	0.12	0.20	18.0%	0.13	0.30
Chromium VI	1854-02-99	77.0%	0.000041	0.50	-	-	-

*µg/m³ - micrograms per meter cubed

All pollutants were monitored at concentrations below the one hundred in a million (1.0×10^{-4}) risk level. Only benzene was monitored above the ten in a million (1.0×10^{-5}) risk level. Risk estimates for 1,3-Butadiene, Acetaldehyde, Arsenic, Carbon Tetrachloride, Chloroform, p-Dichlorobenzene, 1,4-Dioxane, Ethylbenzene, and Tetrachloroethene were over one in a million (1.0×10^{-6}) risk. Benzene can come from many sources, most commonly cars and trucks. The benzene concentrations observed at the southwest Indianapolis monitors are consistent with the concentrations observed at monitors in other cities around Indiana and the United States.

Graph 2 shows how the monitored values in the study area compare to monitored values around Indiana. Graph 3 shows the monitored concentrations of pollutants that are commonly attributed to mobile sources, like cars and trucks. Both graphs contain reference bars that mark the concentration that represents ten in a million risk or a non-cancer hazard index of one (1.0) for each pollutant.


Graph 2
Carcinogen Concentrations Throughout Indiana
Concentration (µg/m^3)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Pollutant
1,3-Butadiene
Carbon Tetrachloride
Chloroform
1,4-Dioxane
Dichloromethane
p-Dichlorobenzene
Tetrachloroethene (PCE)
Trichloroethene (TCE)
0.33
0.66
0.43
1.3
21.27
0.9
1.69
5.0
10 in a million risk
Harding Street
Stoutfield
East Chicago
Gary IITRI
Hammond CAAP
University of Evansville
Washington Park
Whiting High School


Graph 3
Mobile Source Pollutants
Concentration µg/m^3
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
1.28
4.0
5000
100
100
Benzene
Ethylbenzene
Toluene
m+p Xylene
o Xylene
Pollutant
10 in a million risk
1.0 Hazard concentration
Harding Street
Stoutfield
East Chicago
Gary IITRI
Hammond CAAP
University of Evansville
Washington Park
Whiting High School

IDEM evaluates non-cancer hazard assuming a threshold for each pollutant under which no adverse effect is expected. That is, it assumes safe exposure to the pollutant up to a certain level before it is possible to experience a health effect from breathing the pollutant. IDEM uses health protective assumptions by taking into account people who might be more sensitive to the pollutants. A Hazard Quotient (HQ) is a ratio that divides an exposure concentration by a reference value. A HQ under 1.0 is commonly recognized to be below the health protective level. HQs over 1.0 indicate that further investigation may be necessary and does not mean that health effects are expected. Given the many health protective assumptions used in the evaluation, most HQs over 1.0 are still not at levels where health effects may be observed. However, for the purposes of this study, IDEM evaluated all pollutants where the HQ was over 1.0. Table 4 lists the detection rates and HQs of pollutants for which IDEM has toxicological information.

Table 4 – Pollutant Detection Rates and Hazard Estimate

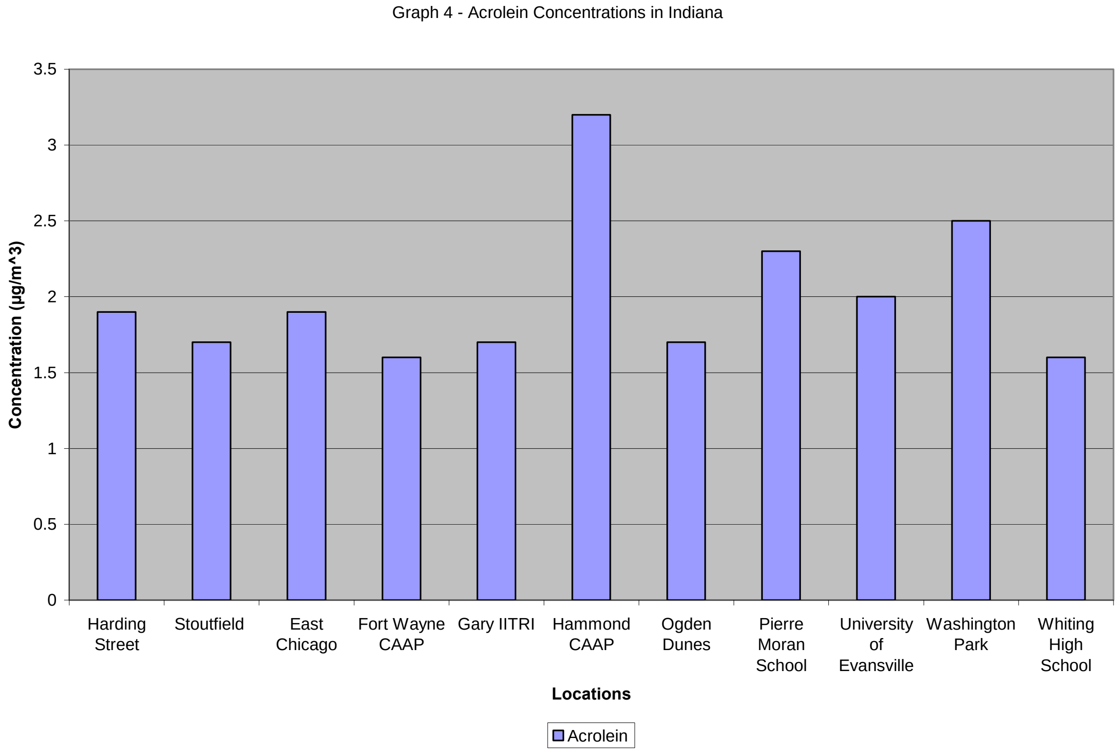
	Harding Street			Stout Field		
Pollutant	Detection Rate Percentage	Exposure Concentration (μg/m^3)*	Hazard Quotient	Detection Rate Percentage	Exposure Concentration (μg/m^3)*	Hazard Quotient
Acetaldehyde	87.0%	0.67	0.075	86.8%	0.70	0.078
Acetone	98.3%	11	0.00037	98.2%	290	0.0092
Acrolein	85.4%	1.9	96	82.2%	1.7	84
Arsenic	91.3%	0.0010	0.037	89.1%	0.0010	0.041
Benzene	100.0%	1.3	0.043	95.5%	1.9	0.064
Beryllium	97.4%	0.0000080	0.00040	97.5%	0.0000090	0.00040
Bromomethane	22.0%	0.32	0.064	27.0%	0.23	0.047
1,3-Butadiene	22.9%	0.11	0.053	25.2%	0.12	0.059
Cadmium	92.2%	0.00029	0.014	84.9%	0.00026	0.013
Carbon Disulfide	11.9%	0.17	0.00024	64.9%	0.53	0.00076
Carbon Tetrachloride	35.6%	0.28	0.0015	38.7%	0.28	0.0015
Chloroform	24.6%	0.10	0.0010	9.9%	0.063	0.00065
Chloromethane	98.3%	1.0	0.011	96.4%	0.93	0.010
Cobalt	99.1%	0.0016	0.016	80.7%	0.0014	0.014
Cyclohexane	49.2%	0.18	0.000029	46.8%	0.17	0.000029
p-Dichlorobenzene	45.8%	0.34	0.00043	60.4%	0.72	0.0009
Dichlorodifluoromethane (F-12)	99.2%	2.8	0.0018	96.4%	2.6	0.0017
Dichloromethane	73.7%	0.52	0.00052	56.8%	0.22	0.00022
1,4-Dioxane	13.6%	0.25	0.000069	15.3%	0.13	0.000036
Ethanol	82.2%	51.0	0.00051	83.8%	34	0.00034
Ethyl Acetate	69.5%	0.50	0.0014	63.1%	0.34	0.00091
Ethylbenzene	74.6%	0.40	0.00040	70.3%	0.48	0.00048
Formaldehyde	93.5%	3.52	0.36	89.3%	2.36	0.24
Heptane	91.5%	0.57	0.0013	87.4%	0.61	0.0014
Hexane	100.0%	0.92	0.0013	95.5%	0.74	0.0011
Isopropanol	78.8%	2.0	0.00029	76.6%	1.6	0.00023
Lead	91.3%	0.0062	0.0042	96.6%	0.0094	0.0063
Manganese	100.0%	0.0064	0.13	93.3%	0.0063	0.13
Mercury	93.9%	0.00021	0.00070	95.0%	0.00019	0.00060
Methyl Ethyl Ketone (MEK)	99.2%	2.5	0.0005	96.4%	3.8	0.00077
Methyl Isobutyl Ketone (MIBK)	57.6%	0.34	0.00011	62.2%	0.41	0.00014
Methyl n-Butyl Ketone (MBK)	68.6%	1.3	0.023	73.0%	0.74	0.013
Nickel	87.0%	0.0010	0.011	88.2%	0.0020	0.022
Propene	97.5%	1.0	0.00034	94.6%	1.1	0.00038
Propionaldehyde	78.9%	0.17	0.021	99.2%	0.077	0.0096

	Harding Street			Stout Field		
Pollutant	Detection Rate Percentage	Exposure Concentration (μg/m^3)*	Hazard Quotient	Detection Rate Percentage	Exposure Concentration (μg/m^3)*	Hazard Quotient
Selenium	93.0%	0.0016	0.000080	89.9%	0.0018	0.000090
Styrene	14.4%	0.17	0.00017	60.4%	0.47	0.00047
Tetrachloroethene (PCE)	41.5%	0.33	0.0012	37.8%	0.27	0.0010
Tetrahydrofuran (THF)	28.8%	0.18	0.0051	30.6%	0.19	0.0054
Toluene	100.0%	2.9	0.00058	96.4%	3.4	0.00069
Trichloroethene (TCE)	8.5%	0.12	0.00020	18.0%	0.13	0.00022
Trichlorofluoromethane (F-11)	100.0%	1.4	0.0020	97.3%	1.4	0.0020
1,3,5-Trimethylbenzene	13.6%	0.29	0.048	24.3%	0.16	0.026
1,2,4-Trimethylbenzene	86.4%	0.69	0.098	85.6%	0.89	0.13
Valeraldehyde	49.6%	0.016	0.00045	93.4%	0.014	0.00039
Vinyl Acetate	89.8%	5.3	0.026	88.3%	4.6	0.023
o-Xylene	82.2%	0.48	0.0048	76.6%	0.74	0.0074
m+p-Xylenes	93.2%	1.3	0.013	86.5%	1.8	0.018

The only pollutant with a monitored HQ over 1.0 is acrolein. Acrolein concentrations were well above the health protective benchmark at both monitoring locations. As such, IDEM has spent time investigating this pollutant.

Acrolein is a common pollutant found in many urban areas. It is most commonly associated with the burning of organic materials and from motor vehicles. It can also be formed in the air when pollutants react with the sun and other chemicals. Animal studies have shown that breathing acrolein may cause irritation to the nasal cavity and can damage the lining of the lungs.

IDEM compared concentrations of acrolein and other pollutants to concentrations observed in other areas of Indianapolis and to other cities. The results indicate that acrolein concentrations in southwest Indianapolis are comparable to concentrations observed in other urban areas of the state. Graph 4 shows how concentrations compare for the time period of the study.



Initial analysis indicated that acrolein concentrations appeared to be much higher in the study area and throughout Indiana than other areas of the country. From 2006 through 2008 Indiana had eight of the top ten highest average monitoring locations throughout the country. As a result, IDEM decided to investigate acrolein further to determine why concentrations were elevated in Indiana. IDEM looked into possible sources of acrolein but found no obvious sources that were unique to Indiana that could account for the higher concentrations. After the source investigation, IDEM looked into the monitoring methods to determine if there were any differences between IDEM and other states. An evaluation of the standards used in the GC/MS calibration lead to a discovery that a faulty standard may be the most likely cause of the observed elevated values for acrolein.

The Air Toxics Monitoring Section suspected that the data from 2007 data might have been affected by a systematic error that caused all acrolein concentrations to be reported higher than the true concentration. Staff of the Air Toxics Monitoring Section reviewed all analytical methods associated with the measurement of acrolein in 2007 in order to find the source of the error. The staff members found that in the period of March-April 2007, the section had been using a TO-15 standard that contained acrolein in the standard mixture at concentrations lower than reported. The reported concentration of acrolein in the standard mixture was 100ppb; however, it appears that the actual acrolein concentration in this standard was much lower than reported. The continuing calibration abundance of 2.5ppb of acrolein on the GC/MS system used in 2007 for the analysis of TO-15 samples is shown below, as well as the approximate response factor (the abundance calculated for a 1 ppb amount of acrolein).

Table 5 – 2007 GC/MS Response Factors for Acrolein

Time Period	Response Abundance of 2.5 ppbv acrolein on GC/MS	Response Factor
Jan-Feb 2007	52,000 – 70,000 abundance	24,400
Mar-Apr 2007	1,200 – 2,250 abundance	750
May-Dec 2007	55,000 – 67,000 abundance	24,400

This table shows that during the period of March-April 2007, a standard was being used by IDEM's laboratory that contained far less acrolein than what was stated on the certificate of analysis for the standard. This systematic error caused the lab to over-report the concentration of acrolein in the affected samples by a factor of approximately 32.5.

Due to the uncertainties of how acrolein reacts with other compounds in a mixture, a separate standard is maintained for acrolein, and mixed with the TO-15 standard immediately before analysis to minimize the possibility of acrolein reacting with other compounds in the standard. This procedure is different from the process used in many other laboratories, but IDEM feels that it yields more accurate and cost-effective results for acrolein.

As a result of this investigation, acrolein data for all monitoring locations in March and April 2007 have been invalidated and removed from the analysis. This resulted in Hazard Quotients calculated for acrolein being reduced by approximately half.

IDEM has determined that acrolein concentrations are not unusually high in southwest Indianapolis compared to other metropolitan areas in the state.

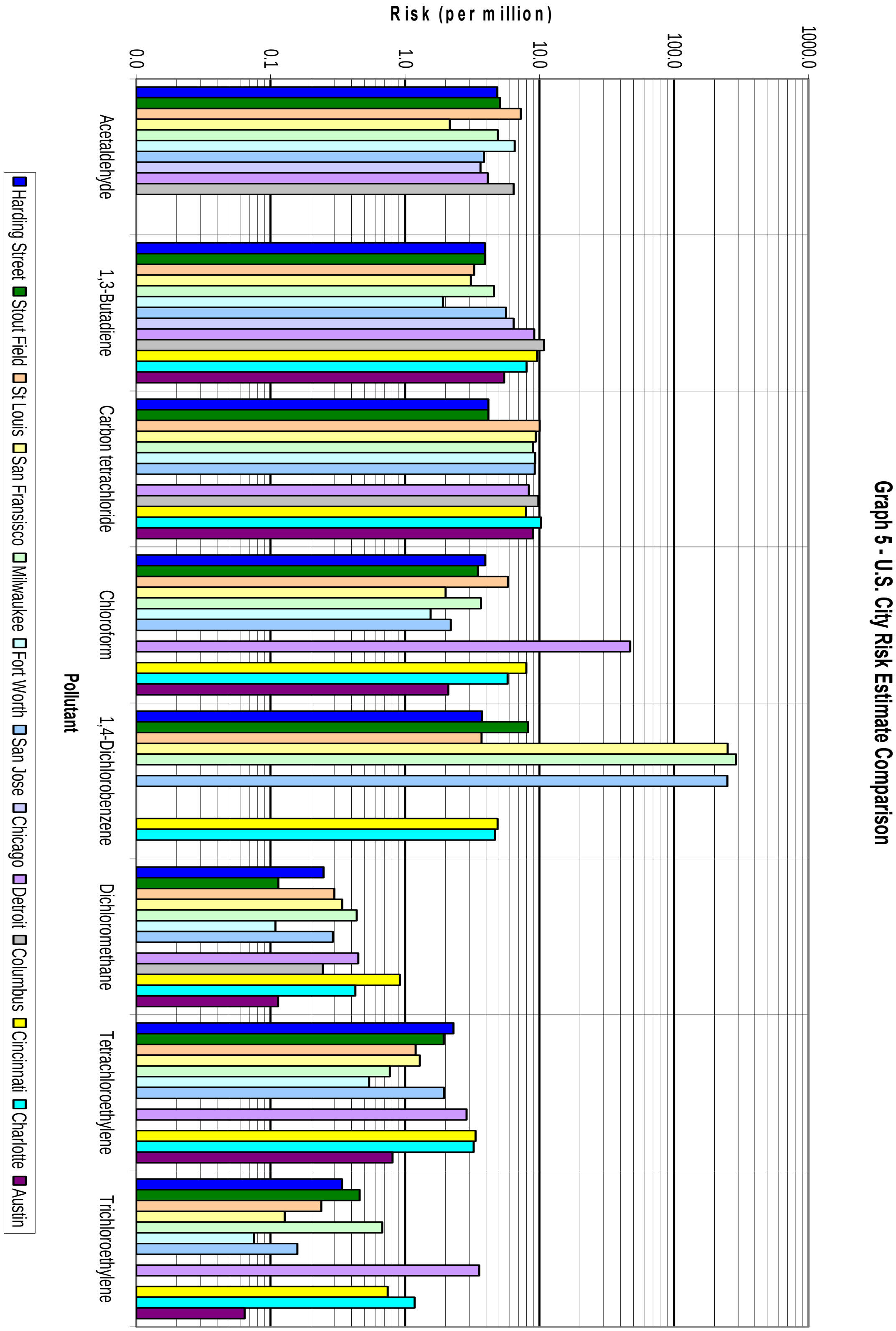
Air Monitoring Comparison

While risk evaluations are useful tools, comparing the monitoring results from the study area to monitoring results from other metropolitan areas around the United States is also helpful at putting the monitoring results into perspective. Graphs 5 through 7 compare readings from monitors which were placed using similar criteria and site descriptions as those used for the Southwest Indianapolis Air Toxics Study. It is important to note that while siting descriptions are similar, it does not mean that they were sited exactly the same. As such, the results should be used for general comparisons only.

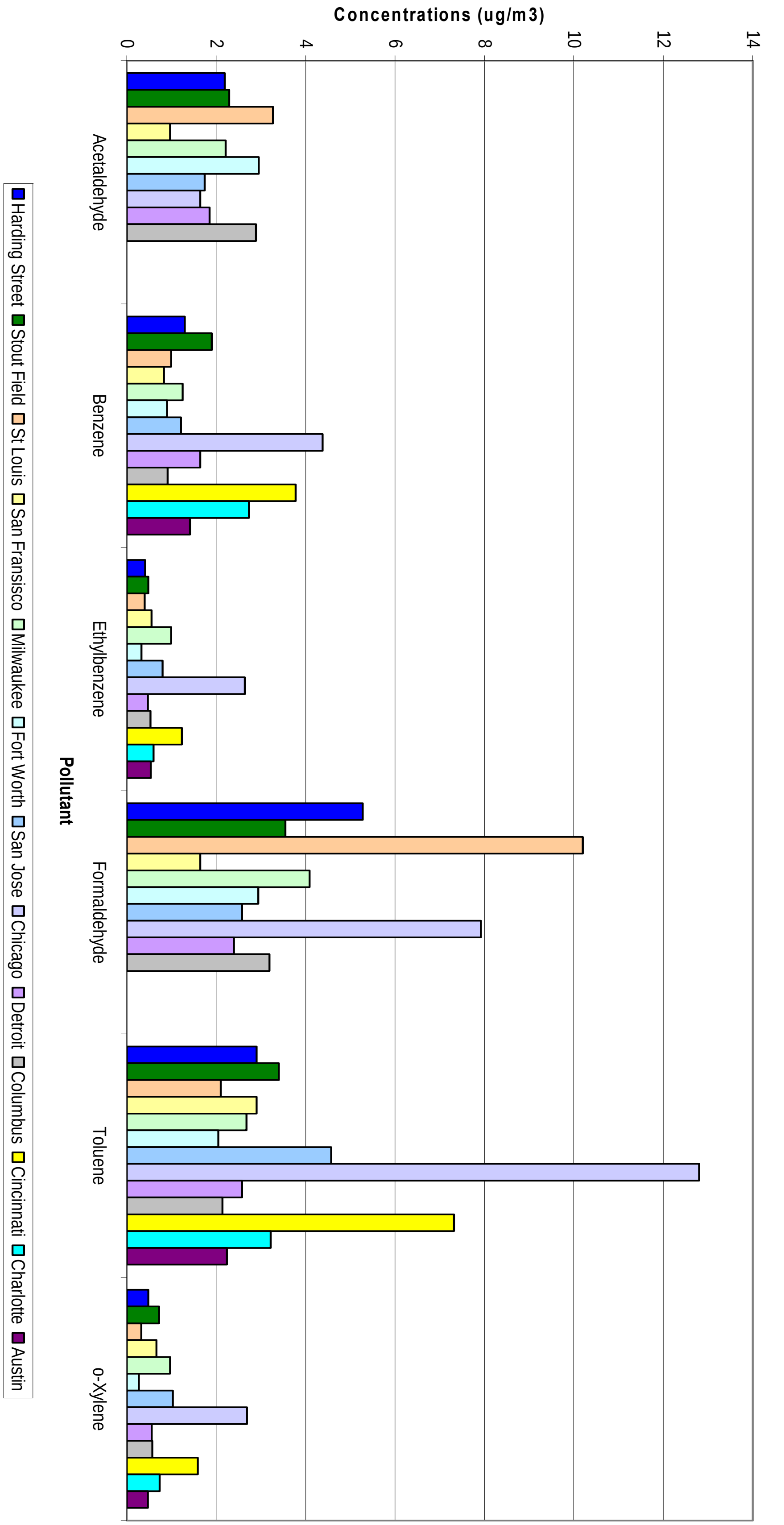
Graph 5 compares the risk estimates from pollutants classified as carcinogens monitored in several urban locations. The chart shows that concentrations observed in southwest Indianapolis are comparable to concentrations monitored in other cities.

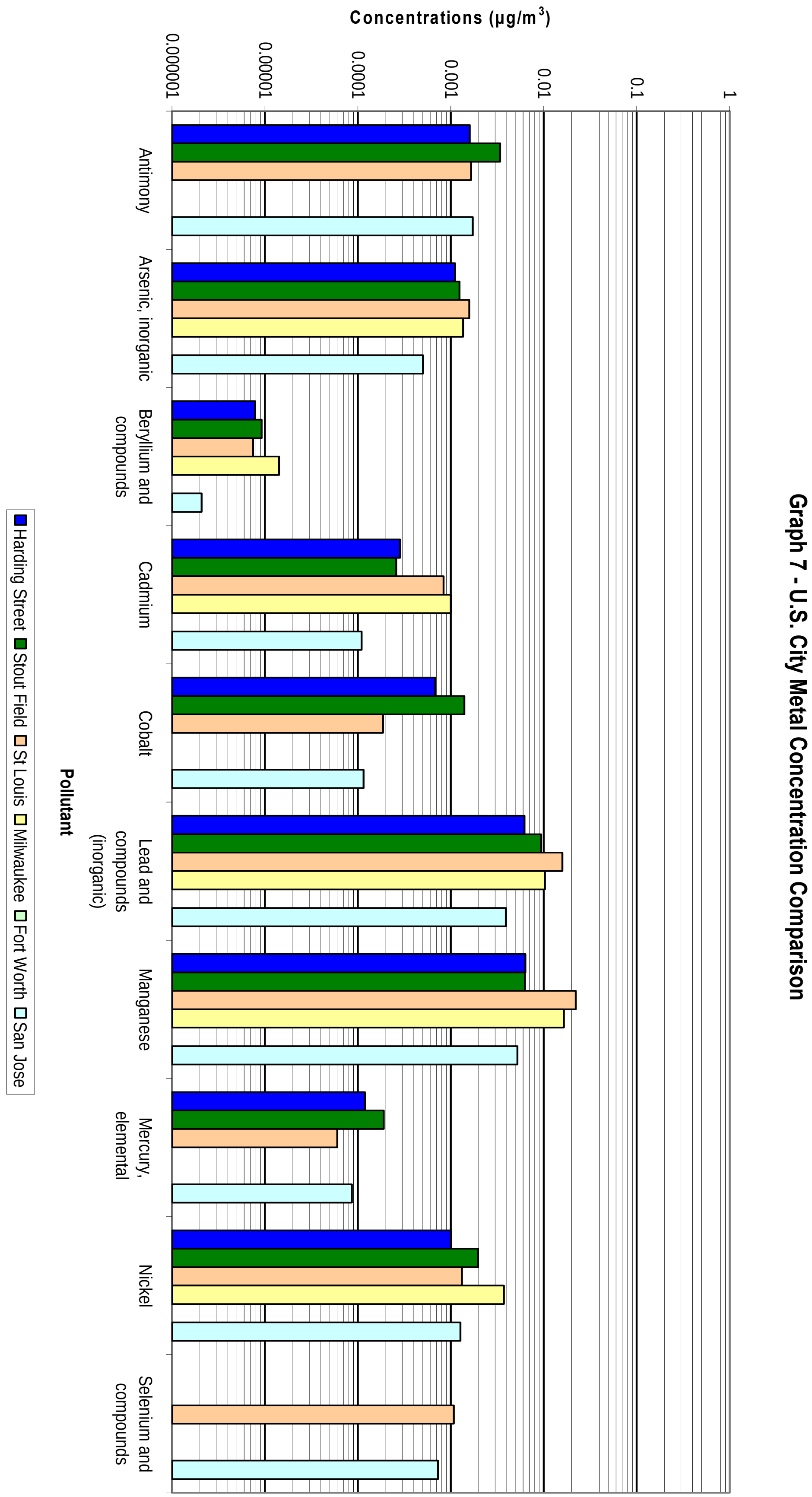
Graph 6 compares concentrations of pollutants monitored in several urban locations which are most commonly associated with mobile sources. Concentrations of mobile source pollutants in some urban locations appear to be slightly higher than in southwest Indianapolis and they appear to be lower in others. Based on monitored and modeled values, mobile source pollutants are some of the biggest contributors to potential risk in the area.

Metals were identified in past large scale modeling analyses as being one of the primary concerns in southwest Indianapolis. Based on monitoring results however it does not appear that metals pose a significant risk in southwest Indianapolis. Metal concentrations in other cities are displayed in graph 7. Concentrations in southwest Indianapolis do not significantly vary from concentrations observed in other cities.


Graph 5 - U.S. City Risk Estimate Comparison
Risk (per million)
0.0
0.1
1.0
10.0
100.0
1000.0
Acetaldehyde
1,3-Butadiene
Carbon tetrachloride
Chloroform
1,4-Dichlorobenzene
Dichloromethane
Tetrachloroethylene
Trichloroethylene
Pollutant
Harding Street
Stout Field
St Louis
San Fransisco
Milwaukee
Fort Worth
San Jose
Chicago
Detroit
Columbus
Cincinnati
Charlotte
Austin

Graph 6 - U.S. City Mobile Source Pollutant Comparison

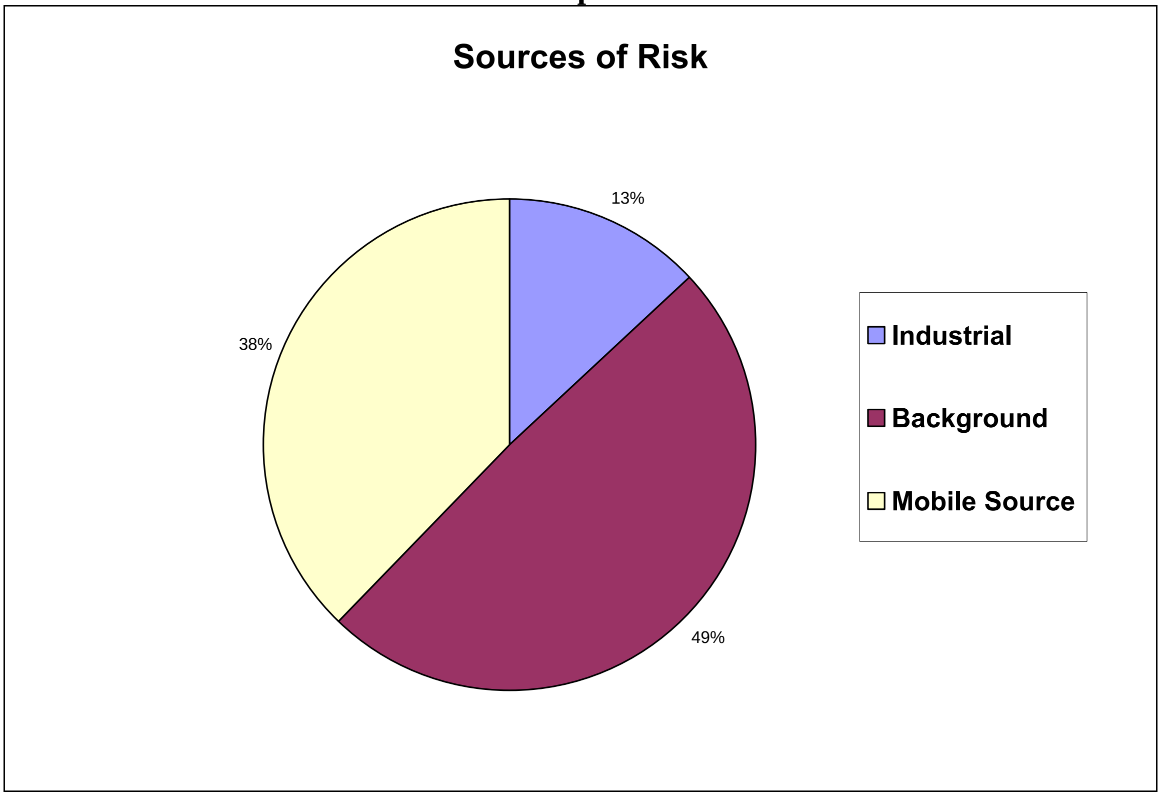



Graph 7 - U.S. City Metal Concentration Comparison
Concentrations (µg/m³)
0.000001
0.00001
0.0001
0.001
0.01
0.1
1
Antimony
Arsenic, inorganic
Beryllium and compounds
Cadmium
Cobalt
Lead and compounds (inorganic)
Manganese
Mercury, elemental
Nickel
Selenium and compounds
Pollutant
Harding Street
Stout Field
St Louis
Milwaukee
Fort Worth
San Jose

Risk Estimates Based on Air Dispersion Modeling

Modeling results indicate that mobile sources (cars, trucks) are the largest single contributor to the total risk posed by air toxics in the area, comprising approximately 38% of the total. Approximately half of the risk in the study area comes from background. Background includes sources such as lawn mowers, emissions from homes, and transport of pollutants from outside the study area. Background concentrations are uniform throughout the study area and are consistent throughout the Indianapolis metro area.

Graph 8



Modeling showed concentrations of certain pollutants associated with mobile sources to be very high close to major roadways. Concentrations declined rapidly farther away from the center of the roadways. While there is no monitoring data from this study taken in close proximity to the roads, the modeling results are consistent with other studies that examined the impact roadways have on air quality. Modeling results also indicate that concentrations decline rapidly away from the road and are 98% lower about 225 feet from the road than concentrations on the road. Other monitoring studies have shown that concentrations decline dramatically 30 feet from the roadway.

Modeling did identify a few isolated locations, or nodes, where an industrial source was the most significant contributor to air toxics concentrations. Many of these locations were actually still on the property of the industry, implying that the general public would not be exposed at these areas. While none of the concentrations predicted by the modeling are cause for alarm, IDEM is in contact with the industries to attempt to identify potential ways to reduce emissions.

Figures 1 through 3 are color coded maps that represent cumulative cancer risk estimates in and around the study area. These maps were derived using the RAIMI modeling results for each node.

Figure 1 represents incremental increased risk from major, point, and area sources located in and around the southwest Indianapolis study area. All industries and chemicals were added together to derive the cumulative risk estimates. No attempt has been made to alter the model estimates to exclude area where people are unable to live or congregate. For example, the point of maximum cancer risk impact is located in the middle of a landfill. While it is extremely unlikely that a person would live on the landfill for their entire life it was determined that altering the GIS derived maps to exclude areas could be viewed and not being transparent during results communication.

Figure 2 represents the cumulative impact from major and secondary roadways in the study area.

Figure 3 is a combination of the industrial and mobile source cancer risk impacts around the study area.

Figure 1

Southwest Indianapolis Air Toxics Study
Total Modeled Estimated Major Source Cancer Risk

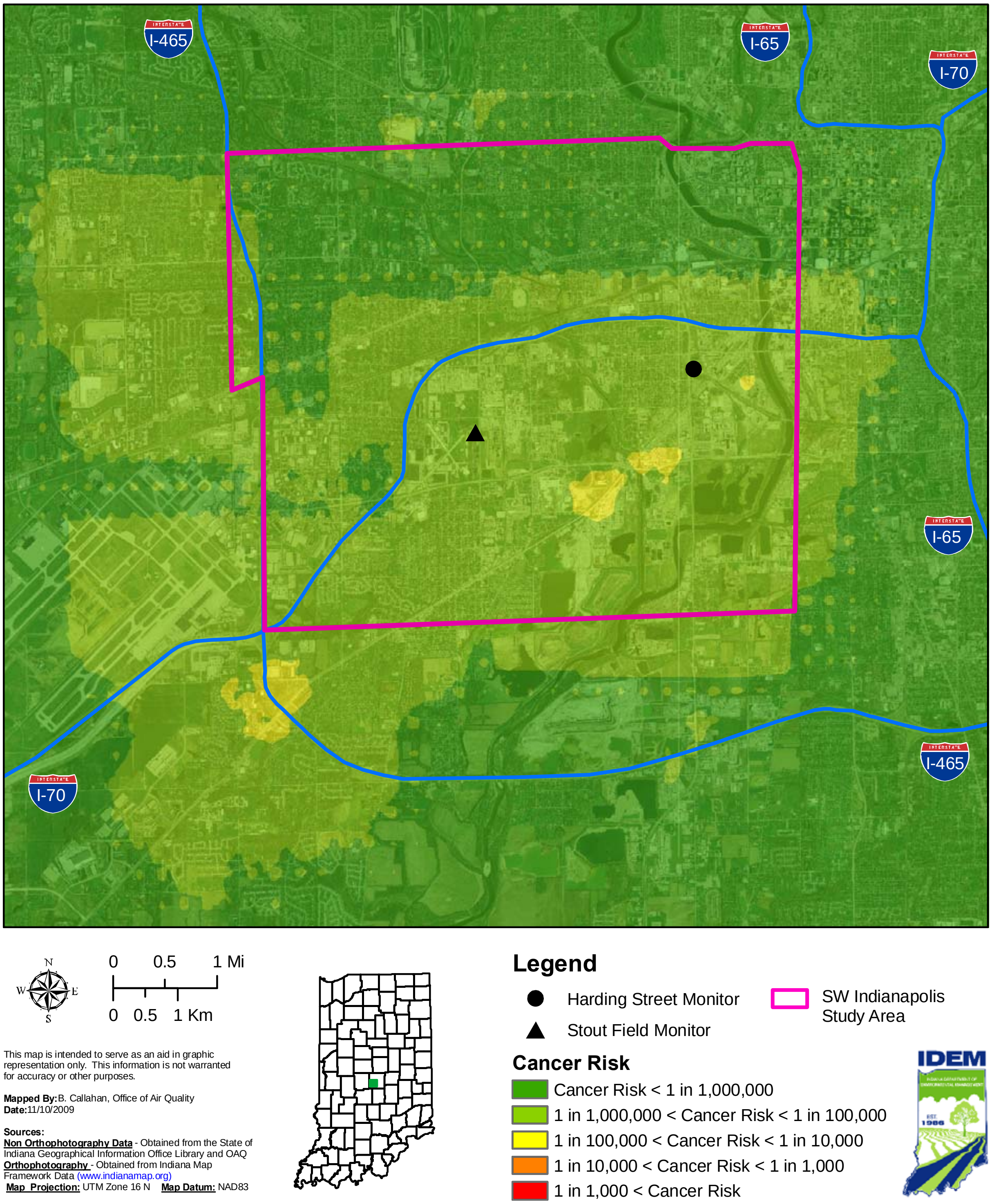


Figure 2

Southwest Indianapolis Air Toxics Study
Total Modeled Estimated Mobile Source Cancer Risk

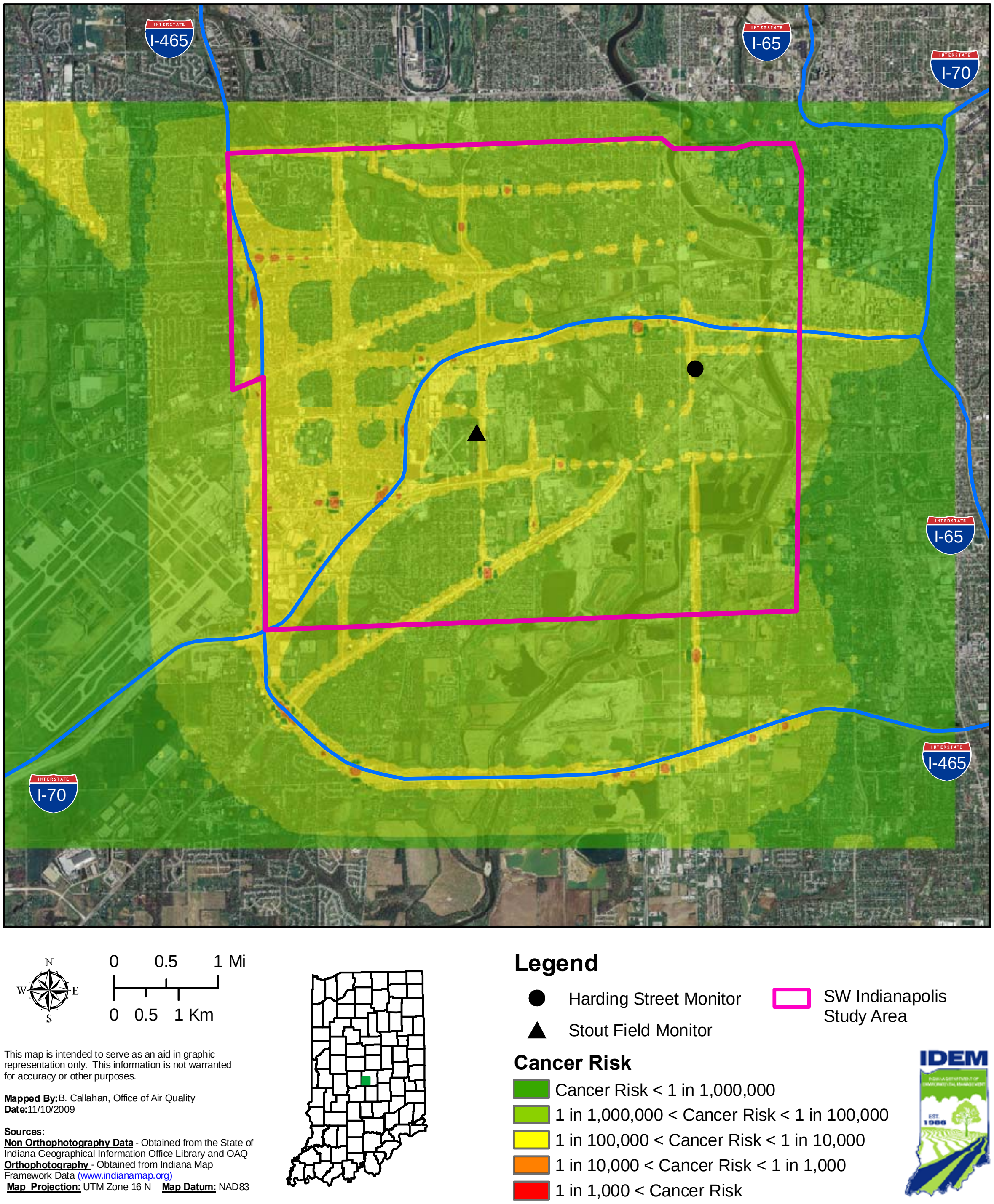
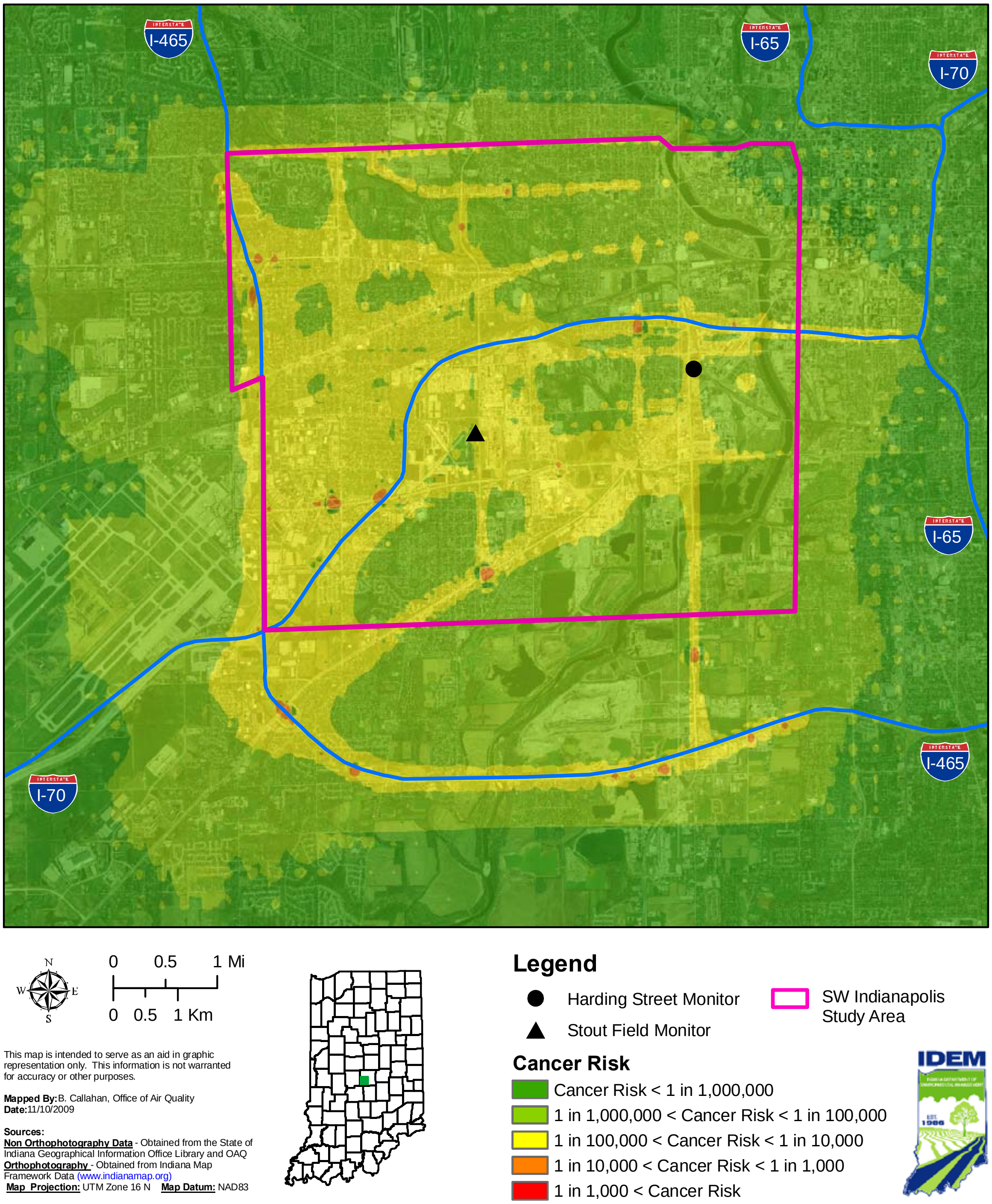


Figure 3

Southwest Indianapolis Air Toxics Study
Total Modeled Estimated Cancer Risk



Model to Monitor Comparison

IDEM compared the concentrations predicted by the RAIMI computer model to measured concentrations at the two monitoring locations. While a direct comparison relies on a variety of assumptions, a comparison does provide a general sense whether the model results are realistic. It is important to note that the number of pollutants modeled differs from the number of pollutants monitored. The results of the comparison are in Table 6.

Table 6 – RAIMI Modeling Risk Results Compared to Monitored Data

Source	Harding Street Lifetime Risk per Million	Stout Field Lifetime Risk per Million
Industrial Sources	5.0	4.0
Interstates	4.2	6.4
City Thoroughfares	8.0	11.0
Total RAIMI Risk	**17.5**	**21.4**
2002 NATA Background	21	21
Total Modeled Risk	**38.5**	**42.4**
Monitored Risk	**38**	**48**

The modeled locations are not at the exact locations of the monitor but represent a location in close proximity. The background used in this comparison was taken from the 2002 NATA conducted by U.S. EPA, and is specific to the census tract where the monitor is located.

Public Outreach

IDEM has attended numerous meetings with various community groups and associations during the study. A summary of these community groups is listed below:

- Community Advisory Panel (CAP): CAP meetings are sponsored and hosted by industry, such as National Starch, Eli Lilly, and Indianapolis Power & Light (IPL). CAP meetings provide a forum for industry, individuals and public service groups to discuss community issues. Attendees have included local school representatives, neighborhood groups, residents, police department, fire department, environmental consultants, Eli Lilly, National Starch, and IPL. IDEM attended on a regular basis.
- West Indianapolis Neighborhood Congress (WINC): WINC meetings take place at the Mary Rigg Center, a well-known community center on the southwest side of Indianapolis. Attendees have included economic development representatives, community leaders, local school representatives, and residents. WINC requested IDEM attend meetings every six months to give project updates.

- Neighborhood Involvement Council (NIC): NIC is sponsored and hosted by Rolls Royce and Vertellus. Attendees have been Rolls Royce, Vertellus, local school representatives, and residents. IDEM attended on a regular basis.
- Neighborhoods and the Environment (NATE): NATE meetings take place in the Indianapolis Neighborhood Resource Center in downtown Indianapolis. These meetings are generally small and cover a variety of neighborhood environmental concerns. Attendees have included the Sierra Club, Indiana Environmental Institute, various other environmental groups, and residents. IDEM attended upon request.
- Environmental Managers: The Environmental Managers meeting is a forum for specialists from industry to discuss local environmental issues. Attendees have included representatives from the largest industries located within the study area, including power plants, chemical plants, pharmaceutical plants, incinerators, etc. IDEM attended upon request on a regular basis.

At each meeting, IDEM presented updates on the Southwest Indianapolis Air Toxics Study and answered questions. The public displayed continued interest in and support of the study.

IDEM met routinely with a Public Advisory Group (PAG) to review study results, and listen to the communities' concerns. The Public Advisory Group (PAG) is comprised of Southwest Indianapolis residents and community leaders who work toward increasing livability for area residents through community improvements. This make-up allowed IDEM to hear what the community's perspectives were on issues directly from the public.

The goals for the PAG were to:

- To ensure study results reach Southwest Indianapolis residents before media outlets distribute information citywide;
- To ensure study results are communicated in a clear and understandable manner to the general public in the area;
- To give residents of Southwest Indianapolis a forum for obtaining information and voicing questions and concerns regarding the study; and,
- To help IDEM gain community input concerning any necessary follow-up actions once the study is complete.

The PAG assisted IDEM in developing outreach materials, including reviewing, editing and revising documents as provided. They also provided IDEM information regarding events that were taking place in the community which allowed IDEM to attend more community functions and get more information out to the public. The group served as a source of information about the study to interested community members. The communication between the PAG members and the public coupled with the communication of the PAG with IDEM helped IDEM better address the communities' needs and interest throughout the study.

The PAG worked with IDEM to develop a resource list. This list was comprised of small businesses, community leaders, and organizations that IDEM could contact to help distribute information.

Following the public release of the report, it is anticipated that the PAG members will be the community representatives that the media has the most interest in talking too. This will provide a well informed person to serve as the face for the community to the media. Since the PAG is comprised mainly of community leaders, the PAG has also taken it upon themselves to serve as the leads on any follow-up action that may take place, including pursuing grant opportunities for air toxic emission reduction projects.

Technical Advisory Group

IDEM's goal in the formation of this technical advisory group was to provide the State with an opportunity to get expert input on complex technical issues. The diverse technical expertise available at the meetings allowed IDEM to receive very specific technical input on a variety of issues. The technical advisory group met at the beginning of the study to thoroughly review the scope of the project and make suggestions.

External technical expertise provided a useful review of the assumptions and calculations used to support the study; a source of new ideas and different perspectives; and independent verification of the study's conclusions to alleviate any concerns from the public or from industry about government bias or competence.

The advisory group provided recommendations and reviewed technical aspects of the study for IDEM. Consensus from the group on specific methodology or technical ideas was not necessary. IDEM used the input and the technical expertise of the group to help in its decision-making process.

Technical advisory group meetings were open to the public. Laura Steadham, IDEM OLQ, served as the facilitator of the group and facilitated each meeting following a predetermined agenda. During the meeting, members of the technical advisory group discussed technical issues associated with the project and made recommendations to IDEM on the issues discussed. The last agenda item for every meeting provided an opportunity for members of the public to comment on topics discussed by the advisory group.

Technical Advisory Group Participants:

- Dr. Jim Klaunig - Professor of Toxicology - Indiana University School of Medicine/IUPUI
- Rad Scott - Chemical Engineer - Eli Lilly
- Dr. Bill Beranek - Indiana Environmental Institute – chemist and community facilitator
- Dr. Phil Stevens - Professor of Chemistry, Indiana University General Public Representative-Air Pollution Control Board
- Dick Van Frank - Improving Kids' Environment

- Rod Thompson, -Environmental Toxicologist
- Dr. George Bollweg - U.S. Environmental Protection Agency - Region 5
- Motria Caudill - U.S. Environmental Protection Agency - Region 5
- LaNetta Alexander – Environmental Epidemiologist – Indiana State Department of Health
- Jason Ravencroft – Marion County Health Department
- Dr. Syed Ghiassudin – Indiana Department of Environmental Management - Water

Grant Spending and Publication

No publications have come about from this project to date. Any future reports or publications that are generated as a result of this project will be submitted to the U.S. EPA. Additionally, no copyright materials or software was developed as a result of the project or spending of grant monies.

All the grant money for this project was spent. There were no major issues in the spending of the grant money. No income was generated as a result of this study.

Table 7
Southwest Indianapolis Air Toxics Grant Spending Breakdown

Item	Cost
Personnel	$14,890.00
Fringe Benefits	$6,818.00
Travel	$0.00
Supplies	$6,808.00
Other	$0.00
Contractual	$10,377.00
Equipment	$83,788.00
Indirect Costs	$3,126.00
Total	**$125,807.00**

Summary

The study results indicate that inhalation risk from potential air toxics exposure in the southwest Indianapolis area is comparable to other cities around Indiana and the United States.

The largest contributors to air toxics in the study area are background and mobile sources (i.e., cars, trucks, etc.). Industrial source contributions to air toxics and risk were small when compared to the risk from background and mobile sources. However, IDEM has identified a few industrial sources in the area that, while not significant sources of risk, could warrant further evaluation for potential pollution prevention opportunities.

IDEM is actively promoting the Voluntary Idling Reduction Program (VIP) as well as working on diesel retrofit opportunities to reduce mobile source impacts in the area and working with industry in the area to find ways to reduce emissions of air toxics. A new mobile source air toxics rule along new emission regulations on new cars and trucks are expected to reduce mobile source impacts. These new federal standards combined with the replacement of older, less efficient cars with new cleaner, more efficient cars is expected to reduce mobile source air toxics emissions by up to 45% over the next fifteen years.