

CELRC-TS-HE

MEMORANDUM FOR CELRC-PM-PM (White)

**SUBJECT: Indiana Harbor and Canal Air Monitoring Program: Construction
Phase Annual Report 2004**

1. Enclosed is the 2004 Annual Report for the Ambient Air Monitoring Program (AAMP) at the Indiana Harbor CDF site. A one-page Executive Summary is included to summarize results and recommendations.
2. Particular attention should be addressed to the *Recommendations* section, on Page 21 of the document text, as it requests a response from PM regarding a potential modification of the AAMP.
3. If there are any questions regarding this document, please contact Dave Wethington at extension 5522.



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Indiana Harbor and Canal Air Monitoring Program: Construction Phase Annual Report 2004

Executive Summary

In November 2001, the U.S. Army Corps of Engineers (USACE) began the Background Phase of the Ambient Air Monitoring Program (AAMP) in the vicinity of the Indiana Harbor and Canal confined disposal facility (CDF), located in East Chicago, Indiana. The goals of the Background Phase of the AAMP were to characterize atmospheric conditions and obtain data on the occurrence of atmospheric contaminants of concern (COCs) before USACE activity in the area. Specifically, the Background Phase AAMP collected data on polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), particulate matter, and metals in background air samples. Twenty-four hour air samples were collected from four different stations surrounding the CDF site, and one adjacent to the East Chicago Central High School, once every six days. The results of the air monitoring were utilized to develop an ambient air quality database, which lists the background levels of these contaminants in the vicinity of the CDF site.

Two years later, in November 2003, USACE established sampling procedures for the Construction Phase of the AAMP, in order to coincide with the CDF construction activities occurring at the site. Implemented in May 2004, the Construction Phase AAMP is an evolution of the original Background Phase AAMP. The Construction Phase AAMP continues to collect data on the same six-day rotation, however the number of sampling sites and amount of COCs were modified to simplify the ongoing assessment of ambient air quality trends at the CDF. The objective of the Construction Phase AAMP is to continue to collect atmospheric data to support the ongoing evaluation of the ambient air quality database, and to assess the potential of construction activities at the CDF site to impact ambient concentrations of COCs in the vicinity of the site.

The results of the COC trend analysis presented in the 2004 Annual Report indicate that construction activities at the CDF do not significantly impact ambient concentrations of measured atmospheric COCs at either the CDF or High School sites. Several exceptions are noted and discussed further in the main text, however statistically elevated concentrations of the majority of the COCs do not directly correlate to construction activities at the CDF. Barium is the only analyte that exhibits statistically elevated concentrations at both the CDF and High School sites, during the same time period. Although this result could potentially be linked to CDF construction, the most likely sources of barium to the atmosphere are generated through the oil refining process, or through the combustion of coal or oil. Additionally, a comparison with published EPA inhalation risk-based guidelines show that the concentrations reported near the CDF site and High School are not expected to pose any health risk to surrounding populations.

As a result of the findings of the 2004 Annual Report, a recommendation is presented to modify the Construction Phase AAMP from a 6-day to a 12-day rotational schedule. This schedule would ensure that the program is continuing to adequately monitor ambient air quality at the CDF site in response to the ongoing development of the project.

Indiana Harbor and Canal
Ambient Air Monitoring Program:
Construction Phase Annual Report 2004

U.S. Army Corps of Engineers
Chicago District

Environmental Engineering Section
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PREFACE

In November 2003, the U.S. Army Corps of Engineers (USACE), Chicago District established atmospheric sampling procedures for Ambient Air Monitoring during the Construction Phase of the Indiana Harbor and Canal (IHC) Confined Disposal Facility (CDF). Implemented in May 2004, the Construction Phase of the Ambient Air Monitoring Program (Construction Phase AAMP, or CAAMP) is an evolution of the perimeter Background Phase Ambient Air Monitoring Program (Background Phase AAMP, or BAAMP), originally established in November 2001 (USACE, 2003a).

The development of the CAAMP was based on a technical, statistical analysis of atmospheric contaminants of concern (COCs) and meteorological data collected during the first two years of the Background Phase AAMP. The Background Phase of the AAMP was established to characterize the site for potential COCs prior to any USACE activity in the area. The CAAMP continues to collect data on a similar timeline, however the quantity of analytes and number of sampling sites were adapted to facilitate the ongoing assessment of ambient air quality trends at the CDF. The objective of the Construction Phase AAMP is to continue to collect atmospheric data to support the ongoing evaluation of the ambient air quality database. The information collected during the Construction Phase will be used to perform a trend-based analysis in order to assess the potential impacts of construction activity at the site.

It is important to note that the CAAMP is supplemented, as necessary, by a separate regimen of action-level based Emissions Air Monitoring activities, which are dependant upon the activities of individual construction contracts. These particular air monitoring activities are health-based and intended to protect of both site workers and off-site populations.

The objectives and methods of implementing ambient air monitoring at the CDF site will continue to be reevaluated throughout the Construction Phase, and into future stages. Through these assessments, the AAMP will be modified – as appropriate – to ensure that the program is continuing to adequately monitor ambient air quality at the CDF site in response to the ongoing development of the project.

The purpose of this document is to fulfill the annual reporting commitment set forth in the CAAMP, (USACE, 2003b). This report summarizes pertinent data collected by the Ambient Air Monitoring Program from its inception, through December 2004, and includes a trend-based analysis of reported COC concentrations.

INTRODUCTION

In May 2004, the U.S. Army Corps of Engineers (USACE) implemented the Construction Phase of the Ambient Air Monitoring Program (Construction Phase AAMP, or CAAMP) at the Confined Disposal Facility (CDF) site for the Indiana Harbor and Canal (IHC) Dredging Project. The objective of this sampling campaign is to continue to enhance the database of atmospheric contaminants of concern (COCs) originally established by the Background Phase Ambient Air Monitoring Program, in order to support the assessment and evaluation of these atmospheric compounds. Information from this database is utilized to perform a trend-based analysis of ambient concentrations of COCs at the CDF, and adjacent community, in order to assess potential impacts of construction activity at the site.

Two atmospheric sampling stations, shown in Figure 1, function to collect ambient air samples representative of on-site and nearby residential environments. One monitor (South Sampler) is located directly to the south of the CDF site, on the edge of the Lake



Figure 1: Location of Ambient Air Sampling Stations and major project features of the Indiana Harbor CDF site.

George Branch of the Indiana Harbor Canal, while the other (High School Sampler) is located adjacent to the East Chicago Central High School. A ten-meter high meteorological station is co-located with the South Sampler. Variables collected at the weather station include wind speed and direction, temperature, barometric pressure, rainfall, and solar radiation.

The air sampling stations operate in tandem, on a 6-day rotational schedule, to collect 24-hour samples and report the ambient concentrations of seven (7) individual polycyclic aromatic hydrocarbons (PAHs), five (5) different polychlorinated (PCB) congeners, two (2) volatile organic compounds (VOCs), twelve (12) trace metals, and total suspended particulates (TSP). This set of analytes represents the inventory of COCs that have been detected with statistical significance in atmospheric samples at the CDF and High School sites. Table 1 outlines the analytes reported by the CAAMP.

Table 1: Analytes Reported during the CAAMP

PAHs	Metals
Acenaphthene	Aluminum
Acenaphthylene	Arsenic
Fluoranthene	Barium
Fluorene	Chromium
Naphthalene	Cobalt
Phenanthrene	Copper
Pyrene	Iron
PCBs	Lead
Congener 8	Manganese
Congener 15	Nickel
Congener 18	Selenium
Congener 28	Zinc
Congener 31	TSP
VOCs	<i>(Total Suspended Particulates)</i>
Benzene	
Toluene	

PCB and PAH samples are obtained using a high-volume (Hi-Vol) vacuum pump air sampler. This apparatus draws air through a glass fiber filter (GFF), and a sandwich of polyurethane foam (PUF) and adsorbent resin (XAD-2) media. The combination of filter and adsorbent media allows for the evaluation of the collective gas and particulate phases of the PAHs and PCBs. Metals and suspended particulates (TSP) are collected using a separate Hi-Vol sampler, employing GFF media. Volatile organics (VOCs) are obtained using specially treated stainless steel canisters, which utilize a bellows-type pump to draw in ambient air. Modern analytical methods, detailed laboratory quality-assurance procedures, and state-of-the-art equipment are all employed to obtain atmospheric COC data from these environmental samples. Further details on sample media, collection schedule, analytical methods, and quality assurance methods can be found in the *Indiana Harbor and Canal Dredging and Disposal Project, Ambient Air Monitoring Plan: Volume 1* (USACE, 2003a).

A statistical analysis, presented in the documentation for the CAAMP (USACE, 2003b), demonstrated that the South Sampler effectively characterizes atmospheric conditions relevant to potential on-site sources of COCs at the CDF site. Additionally, the High School Sampler represents the nearest residential location where the potential exists to detect elevated levels of COCs possibly originating from the CDF construction site. Consequently, a comparison of COC signals observed at both sampling stations, in combination with on-site meteorological data, can yield predictions regarding the potential impacts of construction activities on the ambient concentrations of COCs, on- and off-site.

DATASET DESCRIPTION

Background Phase

Ambient air monitoring at the CDF site began in November 2001. During the ensuing two-year period – identified as the Background Phase – atmospheric samples were collected from four on-site stations. The monitors were positioned to surround the perimeter of the CDF site, each one corresponding to an ordinal direction (i.e. north, east, south, and west), and an off-site station was established at the High School. At that time, analysis was conducted for a greater number of analytes, for a combined total of 62 PAHs, PCB congeners, VOCs, and metals. This number of parameters was included in the initial investigation of ambient air because of their presence in environmental samples (water and sediment) obtained from the Indiana Harbor and Canal. However, evaluation of the two-year dataset demonstrated that more than one-half of the analytes (56%) were not detected consistently, or not observed with a statistically significant frequency of detection (USACE, 2003b). Therefore, those analytes that did not meet the appropriate criteria for continued monitoring during the Construction Phase, and were removed from further evaluations.

Investigation of Background Phase data also demonstrated a statistical similarity in reported concentrations among the four on-site monitoring stations. In over 85% of the cases, all four monitoring stations on the CDF site were shown to be, in effect, sampling and reporting chemical constituents of the same air mass. Additionally, the North and East sampling stations were shown to be biased toward off-site sources of COCs, and contribute to over 75% of the total disparity among the four monitors (USACE, 2003b). Since the intent of the ambient monitoring program is to enumerate potential COC contributions from the CDF site, quantification of off-site sources does not fall into the objectives of the campaign. As a result, the South Site was shown to most reliably and accurately represent atmospheric conditions on-site, and most readily characterize potential emissions from CDF construction activities.

Construction Phase

As a result of the information gained from analysis of the Background Phase data, the Construction Phase of the ambient monitoring program (CAAMP) adapted an appropriate list of environmentally relevant COCs (Table 1), and modified the technical sampling

program to incorporate monitoring at the South and High School sites. The Construction Phase officially began in May 2004, and is currently ongoing at the time of publication of this report. The CAAMP utilizes the same sampling, analytical, and quality assurance procedures as the Background Phase, which are described by the original Sampling and Analytical Plan (2003a). To date, quality checked and assured data exist through December 2004. Samples collected beyond this date are still in the process of laboratory extraction, analysis, quality assurance, and publication.

Idle & Active Datasets

For purposes of discussion and analysis, the ambient data collected at the CDF site are divided into two distinct categories; the *Idle* dataset and the *Active* dataset. The *Idle* dataset is defined as samples that were obtained when no earth-disturbing activities were taking place at the CDF. Conversely, samples included in the *Active* dataset were collected while on-site construction was taking place. Comparisons between the *Idle* and *Active* datasets can yield information related to the likelihood of construction activities to contribute to ambient concentrations of COCs. Assessments may also be made to evaluate whether an observed increase of a particular COC on-site can be directly correlated to a similar increase at an off-site location.

METHODS

With over three years of atmospheric and meteorological data collected at the CDF and High School sites, various assessments of COC concentrations can be performed. However, the difficulties inherent in assembling pertinent and significant information from a large atmospheric dataset are considerable. Confounding factors including seasonal variations and outside influence from industry (i.e. emissions from refineries, steel mills, foundries, or contaminated environmental sites) contribute the largest amount of uncertainty to this type of air sample dataset analysis. Additionally, the project area has historically been home to a myriad of heavy industrial tenants because of its strategic location as a major port city on Lake Michigan. Industries such as steel mills, foundries, refineries, and associated commerce have all had a strong lineage to this vicinity. The CDF site, itself, was formerly home to a petroleum refinery and pesticide manufacturing facility, and is listed under open Resource Conservation and Recovery Act (RCRA) status. As a result of the site location, the background concentrations of many atmospheric toxics, including PCBs, PAHs, VOCs, and metals are elevated, as compared to non-industrial areas. Accordingly, these details must be considered when comparing information obtained during comprehensive monitoring program of such a lengthy project timeline.

Analytical Approach

Various computational and statistical software packages have the capacity to break down and model a data series, taking into consideration disruptions and seasonal factors. It is theoretically possible to apply this type of modeling to the data collected by the ambient monitoring programs, in order to determine tendencies of contaminant levels at the CDF

site or High School. For example, the data gathered could be utilized to observe the effect of construction activity on the ambient data, or examine the temporal effects of seasonality on the concentrations of contaminants of concern.

However, the CDF site poses a substantial challenge to this type of analysis because of its inherently dynamic nature, and the seasonal, meteorological, and site-specific variables mentioned above. During the two-year Background Phase, the majority of the samples were collected during an absence of on-site construction (Idle conditions). Since the inception of the Construction Phase, as the name suggests, a greater frequency of on-site activity has occurred, however intermittent periods of inactivity are still common. At the time of publication of this document, it is anticipated that during the next three years, nearly continuous construction activity will be occurring, (except potentially during the winter months), as the CDF is completed and prepared to accept dredged material from the IHC.

In order to develop a trend-based model, a statistically robust dataset – one which entails approximately four years' worth of comparable atmospheric data (Kozik, Personal Communication) – should be compiled. Since the purpose of collecting “comparable atmospheric data” would be to identify and forecast trends for a given site condition – such as the impact of construction activities on ambient (background) atmospheric concentrations of COCs – it is virtually impossible to compile such a dataset given the ongoing site transformation associated with the completion schedule of the CDF. For example, intermittent periods of activity and inactivity make it increasingly more difficult to precisely distinguish between Idle and Active conditions, thus detracting from the uniformity of the sample sets. Therefore, the utilization of an exhaustive trend-based statistical package would not be practical for this application.

Instead, a more fundamental evaluation – but one similar in strength and capability to a commercially packaged trend-based analysis – will be performed on the data collected to date. This analysis will be utilized to evaluate existing information and, in turn, to assess the need to further adapt the CAAMP during construction of the CDF. This evaluation will examine:

- Meteorological trends
- Observed results at South (CDF) Site and High School locations
- Variation of samples during Idle and Active site conditions
- Seasonal trends of contaminant concentrations

Statistical Methods

Statistical tests provide an avenue to evaluate the degree to which the qualities of one group of data differ from those of another group. Any statistical test is based upon certain assumptions about the population from which the data are drawn. The two main types of statistical tests are known as parametric and nonparametric evaluations. Parametric tests are based upon a number of critical assumptions, all of which must be realized, in order to retain the robustness (i.e. strength, reliability, validity) of the

evaluation. If these assumptions are not met, the probability of incurring a Type I error – the detection of a significant difference when one does not exist – increases, and the robustness of the test decreases (Clark and Brandon, 1996).

Nonparametric tests are often utilized when the parametric test assumptions cannot be met, when very small numbers of data are used, and when no basis exists for assuming certain types (or shapes) of distributions. Nonparametric tests are performed on the data ranks, rather than the actual data values. Ranking the data avoids the assumption of a normal distribution, which is required by parametric statistics, and minimizes the effects of data outliers (Clark and Brandon, 1996).

A statistical test can never establish the truth of a hypothesis with 100% certainty. Typically, this hypothesis is specified in the form of a “null hypothesis,” i.e. the score characterizing one group of measurements does not differ (within an allowable margin of error) from the score characterizing another group. Therefore, performing a statistical test helps arrive at the decision that either the scores are not different (the hypothesis is confirmed) or the difference in scores is too large to be explained by chance (the hypothesis is rejected). For the statistical tests described in this report, a confidence level of 95% (significance level $\alpha = 0.05$) was used to test the null hypothesis.

To determine if a statistical difference exists among sample groups, a Mann-Whitney test (Ott and Longnecker, 2000) was performed. The Mann-Whitney test is a nonparametric independent two-group comparison, which compares the distribution of the medians of the sample sets and determines if a statistical difference is detected among the groups. The Mann-Whitney is analogous to the parametric Students t-Test, which tests the null hypothesis between two independent groups assuming a normal distribution. The statistical software plug-in for Microsoft Excel, *Analyse-It* (<http://www.analyse-it.com>), was utilized to facilitate this statistical analysis.

Data Organization

The discussion presented in this annual report incorporates data obtained throughout the lifetime of the ambient monitoring program. In order to identify and describe site-based COC trends, it is important to utilize the largest, most consistent, and most reliable dataset. Therefore, samples collected in both the Background and Construction Phase will be included. However, as described previously, the comprehensive analysis of data collected from the four on-site monitoring stations during the Background Phase demonstrated the South Site’s ability to accurately and reliably represent on-site conditions (2003b). For this reason, it is not appropriate to consider the data from the North, East, and West sampling stations, which are limited to the duration of the Background Phase (November 2001 – May 2004). Consequently, the evaluation of analytical data for this summary utilizes samples collected at the South and High School Sites obtained during the Background Phase, and combines this information with the analogous dataset currently being acquired during the Construction Phase. Figure 2

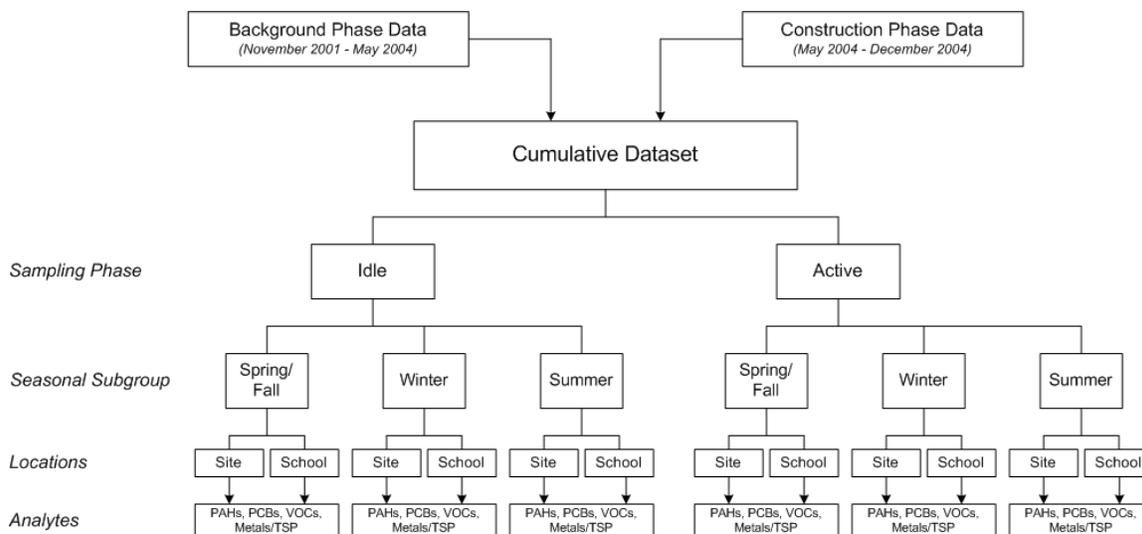


Figure 2: Schematic diagram of atmospheric dataset sample arrangement.

presents a schematic diagram of the sample set arrangement utilized for the comparison of COC trends.

For each particular PAH, PCB, VOC, or metal analyte, the reported concentrations for a certain period (Idle or Active) were compiled. Subsequently, the results from each sampling station were separated according to seasonal similarity. The average temperature record was obtained from the on-site meteorological station via calculating a monthly mean temperature during the lifetime of the sampling campaign. Subsequently, the samples were split into three temperature-dependant groups based upon the average temperature of the month of sample collection. Table 2 identifies the three sample subgroups (Winter, Spring/Fall, and Summer) and the respective monthly mean temperatures.

Table 2: Monthly Mean Temperatures of Sample Subgroups

Winter	Mean Temp (°F)	Spring/Fall	Mean Temp (°F)	Summer	Mean Temp (°F)
December	34	March	40	June	69
January	23	April	49	July	74
February	37	May	57	August	72
		October	52	September	68
		November	42		

The total number of samples obtained during Idle conditions significantly outnumbers the number of samples collected during Active periods, at a ratio of approximately 3:1. However, for direct comparison of cumulative Idle and Active phases, a sufficient distribution between Spring/Fall, Winter, and Summer months have been obtained during Active periods, such that the normalized allocation of samples between these climatic subgroups nearly mirrors that of the Idle sampling phase. Therefore, direct comparisons

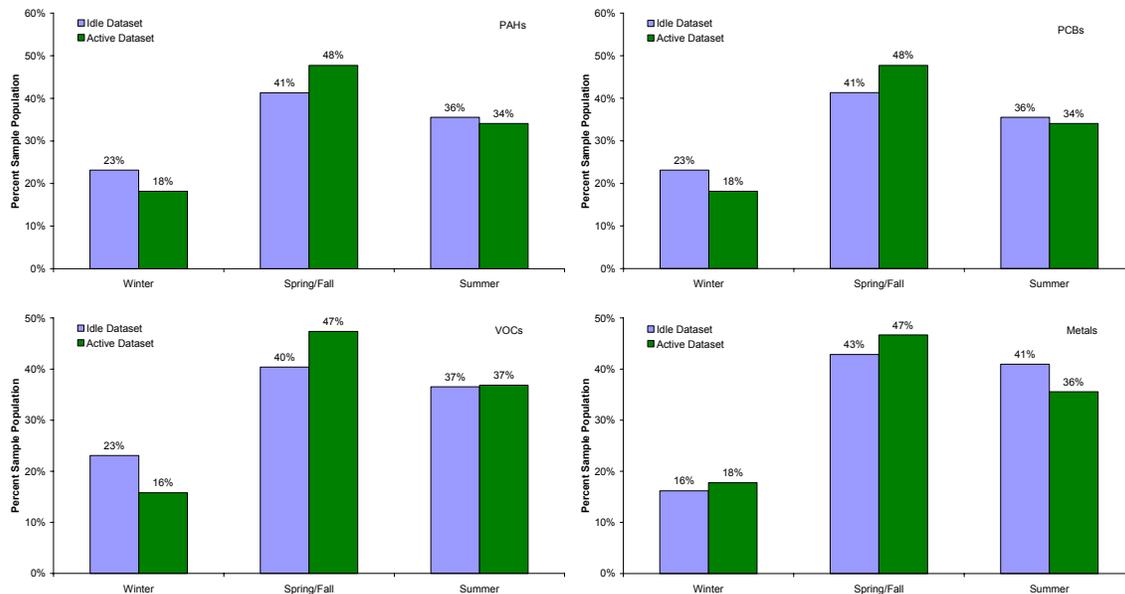


Figure 3: Normalized comparison of sample population between Idle (blue) and Active (green) Phases for each seasonal subset. Beginning in the upper left-hand quadrant, clockwise, are the distributions for PAHs, PCBs, Metals, and VOCs. PAH and PCB percentages are identical since they are obtained from the same sample media.

may be made between collective groupings of Idle and Active data, since it is assumed that the influence of temperature on these results is distributed equally among the two sets. Nonetheless, it should be noted that the probability of incurring a statistical error – either correctly or falsely identifying a statistically significant difference – is increased when comparing a dataset with substantially less data points than another. Figure 3 depicts the normalized distribution of samples between the Idle and Active phases among the three temperature regimes.

RESULTS

As mentioned in the introduction to this report, the atmospheric information collected by the CAAMP can be dissected into two generalized sets – meteorological data and analytical (chemical) data. The discussion presented in the following pages will first summarize meteorological trends, and then present a statistical analysis of the PAH, PCB, VOC, and metals data. Finally, any correlations that can be drawn between the two types of data will be presented.

Meteorological Data

Meteorological data was collected concurrently with the PAH, PCB, VOC, and TSP/metals data throughout the majority of the Ambient Air Monitoring Program. A ten-meter meteorological tower is positioned adjacent to the South site monitoring station to

record climactic conditions. Variables collected at the weather station included wind speed and direction, temperature, barometric pressure, rainfall, and solar radiation. Observation of meteorological conditions, coupled with pollutant monitoring, allows the potential to assess the correlation of contaminant behavior, such as volatility or transport, to site-specific conditions.

Wind direction is a principal factor that can provide insight into to the possible sources of atmospheric contaminants of concern. Wind direction data at the meteorological station is recorded continuously and reported as a 5-minute average. A compilation of the 5-minute averages was examined for the duration from May 2002 to December 2004, to determine if a prevalent wind direction existed at the CDF site. Direction is recorded in tenths of a degree, clockwise from due north, which is designated as 0-360 degrees. The wind direction is operationally defined as blowing **from** a particular cardinal direction (N, E, S, W) if it falls within $\pm 45^\circ$ of the respective degree designation (0° , 90° , 180° , 270°). Figure 4 identifies the degree coordinates and abbreviations utilized for describing the wind direction through the remainder of this document.

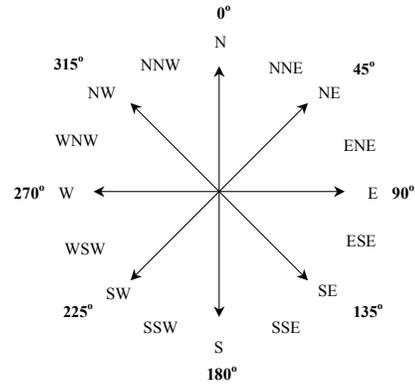


Figure 4: Directional designations

Figure 5 displays the normalized average wind direction compiled over a 32-month period of nearly continuous monitoring at the CDF site. This data does not indicate any

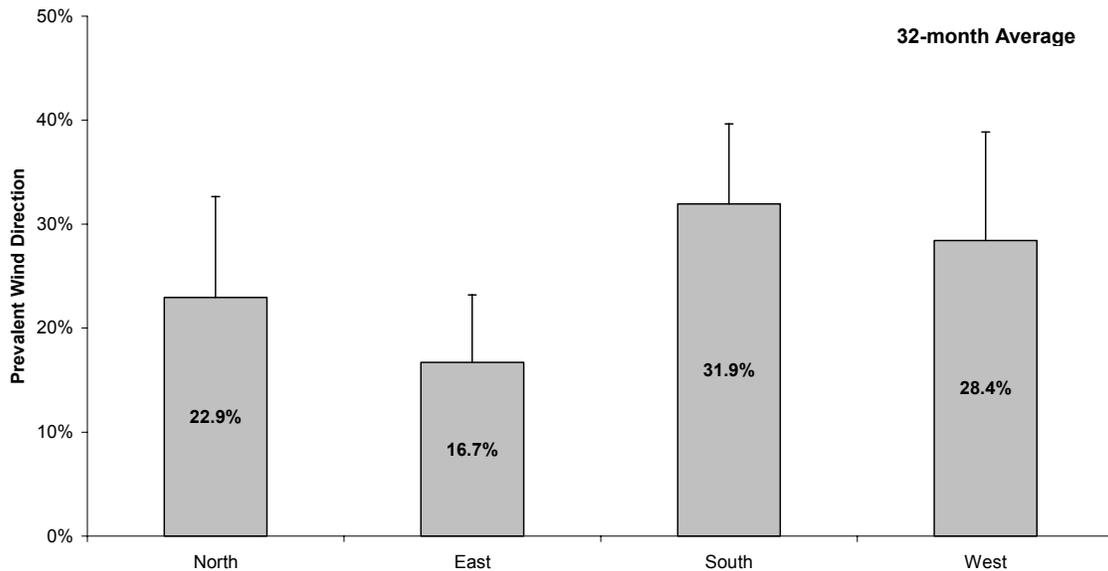


Figure 5: Cumulative wind direction distribution between ordinal directions, north, east, south, and west, during period from May 2002 to December 2004. Error bars represent one standard deviation.

singly dominant wind direction, rather it demonstrates a slightly higher incidence of wind from the south and west, with a marked lack of prevailing winds from the east. This highly variable wind pattern is likely to be partially attributed to the CDF Site's location less than two miles from the land-water interface of Lake Michigan. At this interface, the dissimilar heating and cooling properties of land and water tend to initiate the development of atmospheric pressure gradients on days that have high amounts of radiative heating (De Nevers, 2000). The resulting effect is a swirling air pattern that does not allow one particular direction to prevail.

Since no dominant pattern emerges from the overall dataset, the data was further refined to portray the average normalized wind direction on a monthly basis. Given that monthly weather patterns may vary from year to year, an average monthly wind direction distribution was acquired utilizing the full 32-month meteorological dataset. The resulting monthly distribution, displayed in Figure 6, is also differentiated by the seasonal subgroups (Winter, Spring/Fall, Summer) identical to those described for the analytes, above.

Several trends can be observed from the analysis shown in Figure 6. During the Winter months (blue), the wind prevails from the south and west, which is a pattern generally reflective of Midwestern winter meteorology. Throughout this time period, the water temperature near the shore of Lake Michigan is near freezing, or frozen, thus more closely mimics the temperature of the land. Additionally, the amount of radiative heating from the sun is significantly less than in summer months. The combination of these two

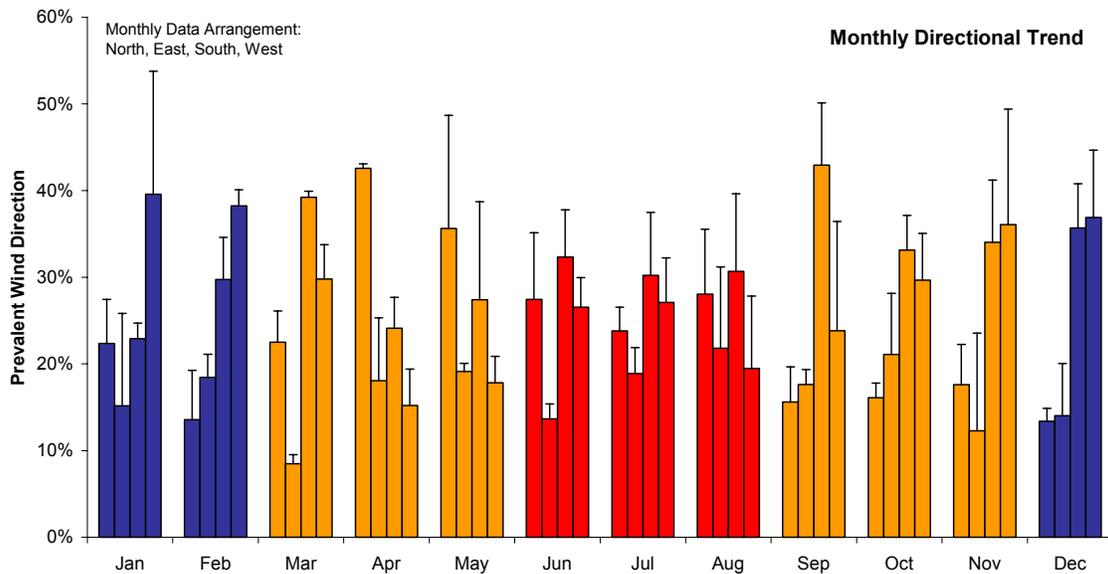


Figure 6: Monthly average wind direction data, obtained from May 2002 to December 2004, arranged monthly, from left to right, according to ordinal directions, north, east, south, and west. Winter, Spring/Fall, and Summer months – blue, orange, and red, respectively – are grouped according to mean temperatures. Error bars represent one standard deviation.

conditions virtually negate any influence by the atmospheric pressure gradients otherwise found at the land-water interface.

Conversely, the high variability in wind direction observed during the Summer (red) months, clearly demonstrates the effects of the land-water interface. During the daytime, land heats up much faster than water as it receives solar radiation from the sun. The warmer air over the land then begins to expand and rise, while the air over the lake stays cooler because of water's slower rate of heating. Air begins to flow as soon as there is a significant difference in air temperature and pressure across the land to water gradient. The development of this pressure gradient causes the heavier, cooler air over the lake to move toward the land and to replace the air that has risen. Likewise, at night, the land surface stops receiving radiation from the sun and begins losing heat energy at a much faster rate than the water surface. Eventually, similar air temperature and pressure contrasts can begin to develop between the land and lake surfaces, thus wind flow will tend to move from the land to the open water (De Nevers, 2000). This daily trend during the summer months will cause winds from both the north (toward the land) and south (toward the lake) to prevail slightly, as is observed in Figure 6.

During the remainder of the months (Spring/Fall), it is observed that winds prevail from the north during the “warming” months of April and May, and from the south during the “cooling” months of September and October. The warming and cooling pattern is very similar to the diurnal tendencies driven by solar radiation, described above, except on a much longer temporal scale. As the lake comes out of the winter months, a more substantial temperature gradient can be observed between land and water temperature. Since lake temperatures during this period are often significantly cooler than the land, the direction of wind is more prevalent from the lake to the land, which corresponds with a northerly wind. Similarly, as the lake comes out of the summer months, it will retain heat better than the land, consequently the warm air above the lake will rise and be replaced with the cooler air from the land, corresponding with a southerly wind. March and November lie somewhat outside of the expected season-based predictions, however this behavior can be attributed to the variability of the climate, and be described best that these months exhibit transitional trends from one season to the next.

The variability in wind direction found at the CDF site is also predicted to affect trends in chemical (COC) concentrations at the South and High School monitoring sites. Essentially, on a broad timescale, the region could be considered homogenous, since no general trend prevails. Likewise, if the overall (32-month) meteorological dataset is examined, transport of COCs from the CDF site would be predicted to be slightly greater toward the north and east, resulting from southerly and westerly winds, respectively. However, to achieve a more detailed description of potential trends, further examination of the monthly seasonal meteorological data, in parallel with corresponding chemical data, is necessary. A set of statistical analyses will be presented in the following section of this text describing the relationship between the South (CDF) and High School sites, and the variation of samples during Idle and Active site conditions. Following this analysis, the meteorological information presented above will be revisited, and related to the results of the chemical data trends.

Analytical Data

The primary objective of the Construction Phase of the AAMP is to continue building the sample database originated by the Background Phase, in order to support a behavioral assessment of atmospheric COCs. This data is utilized to perform trend-based (or similar) analyses, which will evaluate the potential impacts of construction activities at the CDF to ambient air. Atmospheric data collected during the Construction Phase is also intended to support revision of the AAMP, as appropriate, during future stages of the Indiana Harbor Dredging Project. The COC information collected to date during the lifetime of the AAMP (both Background and Construction Phases) can be utilized to make several comparisons of interest, involving the variability in concentrations between location (South Site vs. High School), activity on site (Idle vs. Active), and temperature (Spring/Fall vs. Summer vs. Winter).

South Site vs. High School

The first comparison outlined is between ambient concentrations of a particular analyte at the South (CDF) Site versus the High School. This evaluation will determine whether the concentrations of particular COC detected at the CDF Site are higher, lower, or statistically similar to the concentration of the same COC at the high school during the same time period. From this information, conclusions can be drawn as to whether the CDF Site may serve as a potential source of the COC in question. In order to reduce the number of confounding factors, such as variability in temperature and the possibility of construction activity contributing to ambient concentrations, the comparisons are segregated by season and construction phase.

Due to the large amount of data that has been compiled for this Annual Report, all data tables have been included at the conclusion of this text, in Attachment 1. The tables will be referred to by number (A1-A24), as necessary, throughout the remainder of this discussion. However, several examples will be provided in the text, to aid in the conceptualization of the comparison being discussed.

PAHs:

Table 3 (Table A1, Attachment) provides an example of the Site vs. School comparison for PAH analytes under Idle conditions. The average concentration is provided for the seasonal (Spring/Fall, Summer, Winter) datasets, along with the cumulative (Overall) dataset, which represents the analyte's average concentration throughout the entire Ambient Monitoring Program, during Idle conditions.

Additionally, a column to the right of each analyte's mean concentration is provided to indicate whether a statistical difference exists between the two given average concentrations. If the column to the right is blank, this indicates that the two sets of data from which the mean concentration is derived are statistically similar. For example, although the average concentration of acenaphthene at the South (CDF) Site during the Spring/Fall is numerically higher than that of the concentration found at the High School

Table 3: Comparison of Mean Concentrations between Locations (*CDF Site vs. High School*) of PAHs during IDLE Conditions

<i>Analyte & Location</i>		Spring/Fall		Summer		Winter		Overall	
		ng/m ³	S/D*	ng/m ³	S/D*	ng/m ³	S/D*	ng/m ³	S/D*
Acenaphthene	Site	9.76		15.37		3.19		10.31	
	School	7.36		15.80		2.37		9.42	
Acenaphthylene	Site	2.56		2.85		3.29		2.83	Yes
	School	2.07		1.97		2.90		2.21	
Fluoranthene	Site	3.54		5.89		1.91		4.02	
	School	3.01		6.57		1.96		4.11	
Fluorene	Site	9.07		14.72		4.80		10.14	
	School	7.02		14.60		4.14		9.22	
Naphthalene	Site	95.95		97.43		81.94		93.31	
	School	97.95		103.1		86.37		97.35	
Phenanthrene	Site	13.83		27.52		8.67		17.61	
	School	12.95		27.88		8.36		17.51	
Pyrene	Site	2.04		3.37		1.75		2.45	
	School	1.97		3.37		1.68		2.43	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

during the same phase (9.76 ng/m³ vs. 7.36 ng/m³), an analysis of the two groups of data from which these means are derived indicates that sample sets are statistically similar. On the other hand, the indicator “Yes” found next to the Overall concentration of acenaphthylene indicates that the ambient level of this COC at the site – over the cumulative duration of Idle conditions – is statistically higher than that found during the same period at the High School.

As can be seen from Table 3, the Overall concentration of acenaphthylene is the only PAH analyte that exhibited a statistically significant difference in concentration between levels measured at the South Site and the High School. Table A2 presents a similar comparison of concentrations of PAH analytes, during the Active Period. Again, only one COC, acenaphthylene, demonstrated a statistically significant difference in concentrations between the two sites. The average concentration of acenaphthylene during the Summer months at the South Site was found to be statistically higher than that recorded at the High School.

PCBs:

Tables A3 and A4 present the mean PCB concentrations and statistical comparison results. During Idle conditions, a consistent majority of the analyses from the Spring/Fall, Summer, and Overall datasets, show that concentrations at the South Site are statistically higher than recorded at the High School. This trend can be attributed to the presence of PCBs in the Canal sediments and water column. Due to the chemical properties of PCBs, they are more likely to volatilize during warmer ambient temperatures, correlating to the Spring/Fall and Summer months. Note that the concentrations measured during the Winter months are statistically similar in both locations. The South Sampler’s location directly adjacent to the Canal, which is the likely source of the PCB emissions, causes it to measure concentrations that are

statistically greater than those sampled at the High School during periods when warmer ambient temperatures are causing volatile losses of PCBs from the Canal. During the Winter timeframe, PCBs are volatilizing at a significantly lesser rate, thus the influence of the Canal is not apparent, and the samplers are reporting statistically similar concentrations of PCBs in the atmosphere.

Review of the Active conditions for PCBs does not reflect the same consistent statistically higher concentration of PCBs at South Site as compared to the High School. This is likely an artifact of the smaller dataset, and the increased probability of encountering a Type II Error – not detecting a statistical difference when one does, in fact, exist. Nevertheless, it can be asserted that construction activity does not contribute to ambient concentrations of PCBs. Specifically, if concentrations at site were higher – caused by construction activities – it would be *more likely* that a statistically significant difference would be detected. In addition, visual inspection of the Active dataset displays the same overall trends as the Idle dataset, so it can be assumed that a Type II statistical error is the cause of the discrepancy between Idle-Phase and Active-Phase trends. This issue will be revisited in the future, once additional data has been gathered to assemble a more robust dataset.

VOCs:

Tables A5 and A6 present the mean VOC concentrations and statistical comparison results. During both Idle and Active site conditions, all reported concentrations of VOCs between the South Site and the High School are statistically similar, with the exception of one instance. The Spring/Fall dataset demonstrated that the average concentration of benzene at the High School is statistically greater than the mean concentration recorded at the Site. It is likely that this result is an artifact of the sampler's location at the High School. The potential exists that the sampler – positioned adjacent to the High School's parking lot – could be reflecting higher ambient concentrations due to automobile or maintenance traffic (i.e. lawnmowers) during the Spring/Fall months.

Metals:

Tables A7 and A8 present the mean metals concentrations and statistical comparison results. Only one metal, copper, was found to exhibit statistically elevated concentrations during either Idle or Active site conditions. Ambient concentrations of copper were found to be statistically greater at the High School in the Spring/Fall, Summer, and Overall datasets during Idle site conditions. Concentrations of copper were also found to be statistically greater at the High School in the Summer dataset during Active site conditions. Industrial operations such as smelters, foundries, power stations, incinerators and other combustion sources emit copper into the atmosphere. It is possible that the High School sampler is closer to a potential source of copper in the atmosphere, such as an incinerator, than is the South Site monitoring station.

Idle vs. Active

An alternative comparison that can be constructed from the Ambient data is an assessment between average concentrations measured during Idle vs. Active site

conditions. This evaluation can determine whether the concentrations of a particular COC, at either the South Site or High School, are affected by construction activities at the CDF. From this information, conclusions can be drawn as to whether construction activities at the CDF may serve as a potential source of the COCs in the project vicinity. Additionally, this analysis can aid in determining whether construction activity at the CDF site is increasing ambient concentrations of a particular analyte at the High School. Specifically, if the Active phase concentration of a COC at the South Site is statistically higher than its Idle phase counterpart, the same comparison could be made – for the same dataset – at the High School. If the results of the High School site’s Active versus Idle analysis were statistically similar during the same time period, then it is not likely that the CDF is causing elevated concentrations of that COC in residential areas. Conversely, if a statistically greater concentration of an analyte was recorded during Active conditions at both the South and High School Sites, a positive correlation may exist between CDF construction activities and an increased ambient concentration of that analyte. Again, in order to reduce the number of confounding factors, the comparisons are segregated by seasonal subgroup (Spring/Fall, Summer, Winter) and location (South Site or High School).

PAHs:

Tables 4 and 5 (Tables A9 and A10, Attachment 1) provide an example of the Idle vs. Active comparison for PAH analytes at the CDF Site and High School, respectively. Similar to the previous Site vs. School analysis, the average concentration is provided for the seasonal (Spring/Fall, Summer, Winter) datasets, along with the combined (Overall) concentration, which represents the analyte’s average concentration throughout the entire Ambient Monitoring Program, at the designated station.

Table 4: Comparison of Mean Concentrations between Periods (*Idle vs. Active*) of PAHs at the CDF SITE.

<i>Analyte & Site Condition</i>		Spring/Fall		Summer		Winter		Overall	
		ng/m ³	S/D*	ng/m ³	S/D*	ng/m ³	S/D*	ng/m ³	S/D*
Acenaphthene	Idle	9.78		15.37		3.18		10.31	
	Active	6.26		12.17		5.84		8.13	
Acenaphthylene	Idle	2.56		2.85		3.39		2.83	
	Active	3.16		1.58		4.97		3.07	
Fluoranthene	Idle	3.54		5.89		1.96		4.02	
	Active	2.85		5.52		2.68		3.79	
Fluorene	Idle	9.07		14.72		4.77		10.14	
	Active	7.83		14.49		6.73		9.91	
Naphthalene	Idle	95.95		97.43		82.81		93.31	
	Active	83.91		75.32		88.28		82.19	
Phenanthrene	Idle	13.83		27.52		8.71		17.61	
	Active	13.25		30.69		10.97		18.83	
Pyrene	Idle	2.04		3.37		1.80		2.45	
	Active	2.32		3.08		2.62	Yes	2.69	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table 5: Comparison of Mean Concentrations between Periods (*Idle vs. Active*) of PAHs at the HIGH SCHOOL.

<i>Analyte & Site Condition</i>		Spring/Fall		Summer		Winter		Overall	
		ng/m ³	S/D*						
Acenaphthene	Idle	7.36		15.80		2.29		9.42	
	Active	5.75		13.95		3.31		7.85	
Acenaphthylene	Idle	2.07		1.97	Yes	3.00		2.21	
	Active	2.85		0.65		4.03		2.52	
Fluoranthene	Idle	3.01		6.57		2.02		4.11	
	Active	3.05		6.25		2.41		4.02	
Fluorene	Idle	7.02		14.60		4.10		9.22	
	Active	6.80		14.32		4.66		8.85	
Naphthalene	Idle	97.95		103.1		86.35		97.35	
	Active	95.75		97.34		86.73		95.19	
Phenanthrene	Idle	12.95		27.88		8.33		17.51	
	Active	12.92		32.93		8.78		18.62	
Pyrene	Idle	1.97		3.37		1.72		2.43	
	Active	2.22		3.14		2.07		2.56	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table 4 shows a statistically greater concentration of pyrene during Active conditions, for the Winter dataset. Pyrene can be found as a component of diesel emissions (Lev-On, *et al.*, 2002). Consequently, elevated concentrations at the CDF Site are likely to be attributed to the exhaust emissions from diesel-burning machinery. A comparison of the pyrene concentrations observed at the High School for the Winter dataset (Table 5), indicate that the concentrations between Idle and Active phases are statistically similar. Therefore, an increase in pyrene concentrations at the CDF cannot be correlated to increased ambient concentrations off-site.

Table 5 compares Active vs. Idle concentrations of PAHs at the High School. Acenaphthylene demonstrates idiosyncratic behavior by exhibiting a greater average concentration at the High School during the Idle phase Summer dataset. Similar to pyrene, acenaphthylene can be found as a byproduct of diesel combustion (Lev-On, *et al.*, 2002). Oddly, this increased concentration occurs during the Summer months, which is not usually associated with school attendance. A potential explanation is that some type of maintenance (i.e. mowing) activity consistently takes place at the High School during the summer months, leading to higher ambient concentrations near the school. Another explanation could be that summer school attendance, under a compressed schedule, could contribute considerably to the amount of vehicle traffic adjacent to the High School sampler. Additionally, during the months of July and August 2004, a new tar roof was applied to the High School. During these two months, no construction activity was occurring at the CDF Site, therefore the data collected would be grouped into the Idle dataset, and could contribute to a statistically greater concentration of acenaphthylene at the High School during the Summer timeframe. As with pyrene, there is no direct correlation linking an increase in average ambient concentrations of acenaphthylene at the High School to construction at the CDF.

PCBs:

Tables A11 and A12 present ambient concentrations of PCBs, as well as the Idle vs. Active comparison at the CDF Site and High School, respectively. There were no instances at either the South Site or High School where the average concentrations between Idle and Active Phases were statistically different. This result demonstrates that construction activity at the CDF does not appear to increase the ambient concentrations of PCBs at the Site or High School. Referring back to the Site vs. School comparison of PCB concentration (presented in tables A3 and A4), this result demonstrates that the Canal is one of the likely sources of PCBs to the atmosphere, and volatilization is primarily driven by (warm weather) meteorological conditions.

VOCs:

Tables A13 and A14 present ambient concentrations of VOCs, as well as the Idle vs. Active comparison at the CDF Site and High School, respectively. Only one occasion of statistical significance occurred with VOCs. The average concentration of benzene during the Idle Phase for the Summer dataset, reported at the High School, was statistically higher than that reported during the Active Phase. If compared to the concentrations of benzene in the other datasets (Spring/Fall, Winter, and Overall), it appears that benzene concentrations remain fairly constant year-round. This being the case, the average concentration recorded during the Active Phase of the Summer dataset (where the statistical difference was reported) was slightly below the other values. It is possible that the statistical difference is due to an artifact in the data, such that a statistical difference was reported where one does not actually exist. Regardless, the higher concentration of benzene was demonstrated during Idle conditions, so activity at the CDF site cannot be linked to the increase of this analyte's concentration.

Metals:

Tables A15 and A16 present ambient concentrations of metals, as well as the Idle vs. Active comparison at the CDF Site and High School, respectively. Barium was shown to have an increased Active Phase concentration at the CDF site for the Spring/Fall, Summer, and Overall datasets. It also demonstrated statistically greater Active Phase concentrations at the High School for the Spring/Fall and Overall datasets. This is the only analyte that demonstrates a statistically greater concentration during the same period (Active) at both the CDF Site and the High School, which may positively link it to construction activities. However, it is also possible that this behavior is indicative of a larger-magnitude off-site source, which is observed both at the CDF and High School Sites. It is difficult to establish a direct link between increased concentrations of barium and construction activities because barium most commonly enters the atmosphere through oil refining processes and from the combustion of coal and oil (ATSDR, 2003). For this reason, it is unlikely that construction activities would contribute statistically elevated concentrations of barium to the ambient air. Given the industrial nature of the surroundings, a statistically increased concentration of barium at both the CDF and High School sites is more likely to be indicative of some off-site source, potentially originating from a combustion process (i.e. refining, power generation, or incineration), since no such combustion takes place at the CDF during construction. Further discussion in

regard to the potential implications of elevated barium concentrations is presented at the conclusion of this document.

The data show that concentrations of cobalt were greater during the Idle phase, as opposed to the Active phase, for the Spring/Fall and Overall samples. This attribute suggests that some intermittent atmospheric source of cobalt is likely to exist during the Idle period, which is not detected during the Active period. The chemical industry utilizes a large amount of cobalt in chemical and petroleum processing, therefore the vicinity surrounding the CDF is a likely source of this cobalt release.

Seasonal Dependence of Concentration

As mentioned previously, climactic conditions, such as temperature and wind direction can play a large role in the transport of contaminants in the atmosphere. Earlier analysis demonstrated that the directional trends of the wind changed notably between seasons (Winter, Spring/Fall, and Summer). Another driving factor, as mentioned briefly in the assessment of PCB trends between the Site and the High School is the temperature dependence of a number of the analytes. Semi-volatiles such as PAHs and PCBs are expected to have the greatest response to changes in temperature – for example between summer and winter. VOCs, by nature, are highly volatile at most ambient temperatures, and are not expected to volatilize more/less readily between seasons. On the other side of the spectrum, metals are not expected to have any relationship with temperature, since they are mainly found as larger atmospheric particulates.

The COC concentrations obtained from the South (CDF) and High School sites were revisited once more to determine the seasonal effects on ambient concentrations. Average concentrations at a particular location (either Site or High School) and specific site condition (Idle or Active) were compared among the Spring/Fall, Summer, and Winter datasets. The results are given in tables A17-A24, and the details for each analyte subgroup are discussed below.

PAHs:

Table 6 (Table A17, Attachment 1) demonstrates the seasonal trends for the PAH analytes during Idle conditions. As expected, a number of the PAHs demonstrate statistically higher concentrations in the warmer months, as compared to cooler months. Interestingly, acenaphthylene and naphthalene demonstrate statistically similar concentrations throughout all three seasons. This characteristic indicates a potential “steady-state” anthropogenic source of these two PAHs, since their concentrations remain virtually constant throughout the year. A similar response is observed with pyrene during Active site conditions. As mentioned previously, pyrene can be found as a byproduct of diesel combustion. Therefore, it is possible that when construction is ongoing, machinery, along with other ancillary vehicle traffic such as semis and school buses, may serve as a steady source of pyrene to the ambient air.

Another interesting response is exhibited by acenaphthylene during Active conditions. Statistical results from both the Site and High School indicate that average concentrations

Table 6: Comparison of Mean Seasonal Concentrations between Locations (*CDF Site vs. High School*) of PAHs during IDLE Conditions.

<i>Analyte & Location</i>		Concentration (ng/m³)			Statistical Significance*
		Spring/Fall	Summer	Winter	
Acenaphthene	Site	9.76	15.37	3.19	Summer > Spring/Fall > Winter
	School	7.36	15.80	2.37	Summer > Spring/Fall > Winter
Acenaphthylene	Site	2.56	2.85	3.29	
	School	2.07	1.97	2.90	
Fluoranthene	Site	3.54	5.89	1.91	Summer > Spring/Fall > Winter
	School	3.01	6.57	1.96	Summer > Spring/Fall > Winter
Fluorene	Site	9.07	14.72	4.80	Summer > Spring/Fall > Winter
	School	7.02	14.60	4.14	Summer > Spring/Fall > Winter
Naphthalene	Site	95.95	97.43	81.94	
	School	97.95	103.1	86.37	
Phenanthrene	Site	13.83	27.52	8.67	Summer > Spring/Fall > Winter
	School	12.95	27.88	8.36	Summer > Spring/Fall > Winter
Pyrene	Site	2.04	3.37	1.75	Summer > Spring/Fall; Summer > Winter
	School	1.97	3.37	1.68	Summer > Spring/Fall; Summer > Winter

* Indicates statistically significant difference between the values at a 95% confidence interval

are higher in the Winter, as opposed to the Spring/Fall or Summer. This trend indicates that the acenaphthylene being observed at the CDF and High School sites could likely be a byproduct of some type of heating oil combustion.

PCBs:

Results for the seasonal analysis of PCB trends is presented in Table A19 and A20. As an expected trait of its semi-volatile nature, PCBs exhibit an almost categorical response to increased temperature. Both the Idle and Active Phase comparisons of PCBs at the CDF Site or High School indicate that summer concentrations are always greater than those found in the Winter dataset.

VOCs:

Results for the seasonal analysis of VOC trends is presented in Tables A21 and A22. The VOC compounds also behave as expected, exhibiting statistically similar concentrations year-round. The exception was with Toluene, which exhibited a slightly higher concentration during the Summer months. Spring/Fall and Winter concentrations of Toluene were found to be similar.

Metals:

Results for the seasonal analysis of metals trends is presented in Tables A23 and A24. Intriguingly, many of the metals demonstrated some type of seasonal response, especially during the Idle phase. Investigating further into the trend presented by this data, it became apparent that increased metals concentrations during the Summer time periods were prevalent across a large number of the analytes. The most likely explanation of this trend is that metals, often in the form of small particles, have the greatest propensity to become airborne when the weather is dry and windy. This is often the case during the

summer months at the CDF site, where temperatures reach above 80°F, and the lake breeze effect, (described earlier) can sustain winds over extended periods of time.

CONCLUSION

The discussion provided within this report describes the continued monitoring of ambient atmospheric conditions at the Indiana Harbor CDF Site. The purpose of the Construction Phase AAMP is to add to the existing COC database, and evaluate contaminant trends at both the CDF and High School Sites. Ultimately, the goal of ambient monitoring during the Construction Phase is to provide an assessment as to whether construction activities at the CDF are affecting ambient concentrations of COCs in the vicinity of the Site.

Summary

Statistical analyses indicate that the general ambient concentrations of PAHs, VOCs, and Metals do not differ significantly between the CDF and the High School. Specific exceptions include acenaphthylene (a PAH), benzene (a VOC), and copper (a metal). Acenaphthylene demonstrated an occasional elevated concentration at the CDF Site, whereas benzene and copper exhibited statistically greater concentrations intermittently at the High School Site. In contrast, PCB concentrations are reported at consistently elevated levels at the CDF Site during both Idle and Active conditions. This finding indicates a likely source of PCBs adjacent to the CDF monitoring station, such as the Canal.

The results of the contaminant trend analysis presented in this summary offer a general indication that construction activities at the CDF do not significantly impact ambient concentrations of measured atmospheric COCs at the CDF or High School Sites. Specific exceptions include acenaphthylene and pyrene (PAHs), and barium, cobalt, and lead (metals). Acenaphthylene, cobalt, and lead exhibit occasional statistically elevated concentrations at the High School during Active conditions, but do not demonstrate a similar trend at the CDF Site. Since one would expect to record a statistically elevated concentration *closer* to the source, it stands to reason that construction activities at the CDF do not directly correlate to elevated concentrations of these COCs. Pyrene demonstrates a statistically higher concentration at the CDF Site during Winter conditions, but is not associated with a similar statistically elevated concentration at the High School. Therefore, elevated levels of pyrene off-site are not directly correlated to construction activities at the CDF.

Barium is the only analyte that exhibits statistically elevated concentrations at *both* the CDF and High School Sites, during the same seasonal timeframe. Although this result could potentially be linked to CDF construction, previous discussion noted that the most likely sources of barium to the atmosphere are generated through the oil refining process, or through the combustion of coal or oil. Nonetheless, in an attempt to quantify this atmospheric concentration into some type of numerical perspective, a comparison to available risk-based concentration (RBC) values can be made. RBC charts are published by the U.S. Environmental Protection Agency, Region 3, located in Philadelphia,

Pennsylvania. These tables combine toxicity values for 400-500 chemicals with “standard” exposure scenarios to calculate RBCs. Although RBC values do not constitute regulation or guidance, they are regularly used for chemical screening during baseline risk assessments, and represent a hazard concentration based upon a lifetime of chronic exposure. A comparison of the average (0.0299 ug m^{-3}) and maximum (0.0631 ug m^{-3}) barium concentrations recorded during the AAMP show that ambient levels are approximately an order of magnitude *lower* than the RBC concentration of 0.51 ug m^{-3} . Consequently, ambient concentrations of barium, as measured during the Construction Phase AAMP, are not expected to pose any health risk to surrounding populations. The Construction Phase AAMP will continue to monitor and report the ambient levels of this analyte.

Recommendations

Through the analysis and discussion provided in this report, it can be observed that construction activities at the CDF Site are having little to no impact on ambient COC concentrations at the CDF or adjacent vicinity. Since the goals and objectives of the AAMP call for the periodic reevaluation of the program, this report is the appropriate venue in which to propose a modification of the remainder of the Construction Phase AAMP.

As stated previously, the primary goal of this program is to assess the potential impact of construction activities on ambient concentrations of COCs at the CDF and surrounding vicinity. This objective has been accomplished, and the results have been reported within this document. Consequently, the continuing goal of the Construction Phase AAMP should focus on confirming that concentrations of all COCs continue to fall within the boundaries observed since the inception of ambient monitoring at the CDF.

For these reasons, a recommendation is put forth to modify the Construction Phase AAMP from a 6-day to a 12-day rotational schedule. This would allow the sampling schedule to continue alternating days of the week, and would provide an ample number of samples on an annual basis (approximately 30 samples per year). This schedule would ensure that the program is continuing to adequately monitor ambient air quality at the CDF site in response to the ongoing development of the project.

This report shall serve as official documentation of this recommendation, and will be submitted to the Project Management chain for further review. When provided, official response will be appended to this report as Attachment 2.

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Attachment 1
Statistical Comparisons

Table A1: Comparison of Mean Concentrations between Locations (*CDF Site vs. High School*) of PAHs during IDLE Conditions

<i>Analyte & Location</i>		Spring/Fall ng/m ³ S/D*		Summer ng/m ³ S/D*		Winter ng/m ³ S/D*		Overall ng/m ³ S/D*	
Acenaphthene	Site	9.76		15.37		3.19		10.31	
	School	7.36		15.80		2.37		9.42	
Acenaphthylene	Site	2.56		2.85		3.29		2.83	Yes
	School	2.07		1.97		2.90		2.21	
Fluoranthene	Site	3.54		5.89		1.91		4.02	
	School	3.01		6.57		1.96		4.11	
Fluorene	Site	9.07		14.72		4.80		10.14	
	School	7.02		14.60		4.14		9.22	
Naphthalene	Site	95.95		97.43		81.94		93.31	
	School	97.95		103.1		86.37		97.35	
Phenanthrene	Site	13.83		27.52		8.67		17.61	
	School	12.95		27.88		8.36		17.51	
Pyrene	Site	2.04		3.37		1.75		2.45	
	School	1.97		3.37		1.68		2.43	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A2: Comparison of Mean Concentrations between Locations (*CDF Site vs. High School*) of PAHs during ACTIVE Conditions

<i>Analyte & Location</i>		Spring/Fall ng/m ³ S/D*		Summer ng/m ³ S/D*		Winter ng/m ³ S/D*		Overall ng/m ³ S/D*	
Acenaphthene	Site	6.26		12.17		5.71		8.13	
	School	5.75		13.95		3.48		7.85	
Acenaphthylene	Site	3.16		1.58	Yes	5.48		3.07	
	School	2.85		0.65		4.68		2.52	
Fluoranthene	Site	2.85		5.52		3.08		3.79	
	School	3.05		6.25		2.93		4.02	
Fluorene	Site	7.83		14.49		7.12		9.91	
	School	6.80		14.32		5.37		8.85	
Naphthalene	Site	83.91		75.32		89.91		82.19	
	School	95.75		97.34		90.19		95.19	
Phenanthrene	Site	13.25		30.69		12.03		18.83	
	School	12.92		32.93		10.34		18.62	
Pyrene	Site	2.32		3.08		2.92		2.69	
	School	2.22		3.14		2.53		2.56	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A3: Comparison of Mean Concentrations between Locations (*CDF Site vs. High School*) of PCBs during IDLE Conditions

<i>Analyte & Location</i>		Spring/Fall pg/m ³ S/D*		Summer pg/m ³ S/D*		Winter pg/m ³ S/D*		Overall pg/m ³ S/D*	
PCB 8	Site	36.92		77.57		21.00		48.00	
	School	34.03		73.06		17.22		44.91	
PCB 15	Site	6.47		13.80		2.36		8.18	
	School	4.51	Yes	10.80	Yes	1.91		6.29	Yes
PCB 18	Site	31.52		59.43		10.75		36.89	
	School	18.07	Yes	42.00	Yes	8.02		24.80	Yes
PCB 28	Site	21.65		45.07		7.18		26.83	
	School	13.21	Yes	30.52	Yes	5.62		18.01	Yes
PCB 31	Site	23.13		47.38		7.85		28.43	
	School	13.59	Yes	30.77	Yes	5.78		18.29	Yes
ΣPCBs	Site	107.1		243.2		45.18		142.3	
	School	71.08	Yes	187.1	Yes	35.32		106.5	Yes

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A4: Comparison of Mean Concentrations between Locations (*CDF Site vs. High School*) of PCBs during ACTIVE Conditions

<i>Analyte & Location</i>		Spring/Fall pg/m ³ S/D*		Summer pg/m ³ S/D*		Winter pg/m ³ S/D*		Overall pg/m ³ S/D*	
PCB 8	Site	40.55		104.6		17.27		57.48	
	School	37.02		102.1		16.20		53.19	
PCB 15	Site	6.61		17.07		3.28		9.46	
	School	4.69		14.35		2.40		7.24	
PCB 18	Site	34.34		76.29		21.74		45.92	
	School	22.27	Yes	52.70		12.28		29.79	Yes
PCB 28	Site	20.29		54.64		12.55		30.27	
	School	13.86		39.91		7.33		20.68	
PCB 31	Site	22.06		56.14		12.53		31.60	
	School	14.51	Yes	39.72		7.73		21.02	
ΣPCBs	Site	123.6		308.7		66.53		174.4	
	School	91.93		248.8		44.67		131.5	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A5: Comparison of Mean Concentrations between Locations (*CDF Site vs. High School*) of VOCs during IDLE Conditions

<i>Analyte & Location</i>		Spring/Fall		Summer		Winter		Overall	
		ug/m ³	S/D*	ug/m ³	S/D*	ug/m ³	S/D*	ug/m ³	S/D*
Benzene	Site	1.11		1.38		1.48		1.29	
	School	1.42	Yes	1.59		1.49		1.50	
Toluene	Site	1.83		3.04		2.15		2.41	
	School	2.05		3.30		2.22		2.57	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A6: Comparison of Mean Concentrations between Locations (*CDF Site vs. High School*) of VOCs during ACTIVE Conditions

<i>Analyte & Location</i>		Spring/Fall		Summer		Winter		Overall	
		ug/m ³	S/D*	ug/m ³	S/D*	ug/m ³	S/D*	ug/m ³	S/D*
Benzene	Site	1.20		1.33		1.25		1.26	
	School	1.43		1.18		1.38		1.33	
Toluene	Site	2.41		2.95		2.04		2.58	
	School	3.31		3.06		1.24		2.90	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A7: Comparison of Mean Concentrations between Locations (*CDF Site vs. High School*) of Metals during IDLE Conditions

<i>Analyte & Location</i>		Spring/Fall ug/m ³ S/D*		Summer ug/m ³ S/D*		Winter ug/m ³ S/D*		Overall ug/m ³ S/D*	
Aluminum	Site	0.3236		0.3758		0.2289		0.3298	
	School	0.3230		0.3861		0.2223		0.3325	
Arsenic	Site	0.0014		0.0016		0.0010		0.0014	
	School	0.0014		0.0016		0.0009		0.0014	
Barium	Site	0.0195		0.0253		0.0214		0.0222	
	School	0.0200		0.0271		0.0222		0.0233	
Chromium	Site	0.0056		0.0056		0.0041		0.0053	
	School	0.0051		0.0053		0.0039		0.0050	
Cobalt	Site	0.0006		0.0008		0.0006		0.0007	
	School	0.0006		0.0008		0.0004		0.0007	
Copper	Site	0.0767	Yes	0.1148	Yes	0.0795		0.0931	Yes
	School	0.1112		0.1678		0.0995		0.1325	
Iron	Site	0.9702		1.1157		0.7116		0.9883	
	School	0.9089		1.0565		0.7041		0.9362	
Lead	Site	0.0222		0.0216		0.0165		0.0210	
	School	0.0177		0.0189		0.0151		0.0177	
Manganese	Site	0.0946		0.1070		0.0708		0.0959	
	School	0.0875		0.1009		0.0699		0.0901	
Nickel	Site	0.0017		0.0019		0.0014		0.0017	
	School	0.0018		0.0018		0.0014		0.0017	
Selenium	Site	0.0011		0.0015		0.0014		0.0013	
	School	0.0010		0.0014		0.0014		0.0013	
Zinc	Site	0.1147		0.1051		0.0765		0.1044	
	School	0.1026		0.1012		0.0718		0.0971	
TSP	Site	4.89E-05		5.54E-05		4.61E-05		5.12E-05	
	School	4.71E-05		5.55E-05		4.57E-05		5.03E-05	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A8: Comparison of Mean Concentrations between Locations (*CDF Site vs. High School*) of Metals during ACTIVE Conditions

<i>Analyte & Location</i>		Spring/Fall ug/m ³ S/D*		Summer ug/m ³ S/D*		Winter ug/m ³ S/D*		Overall ug/m ³ S/D*	
Aluminum	Site	0.2550		0.3245		0.2392		0.2769	
	School	0.2518		0.3777		0.2402		0.2965	
Arsenic	Site	0.0014		0.0013		0.0009		0.0013	
	School	0.0014		0.0014		0.0015		0.0014	
Barium	Site	0.0269		0.0299		0.0291		0.0283	
	School	0.0280		0.0310		0.0308		0.0296	
Chromium	Site	0.0041		0.0045		0.0051		0.0044	
	School	0.0037		0.0047		0.0050		0.0043	
Cobalt	Site	0.0005		0.0005		0.0003		0.0005	
	School	0.0004		0.0005		0.0003		0.0004	
Copper	Site	0.0839		0.1050	Yes	0.0703		0.0890	
	School	0.0969		0.1682		0.0839	0.1199		
Iron	Site	0.7645		0.9440		0.7428		0.8244	
	School	0.7274		0.9750		0.7926		0.8317	
Lead	Site	0.0231		0.0232		0.0250		0.0235	
	School	0.0211		0.0285		0.0273		0.0250	
Manganese	Site	0.0727		0.0921		0.0762		0.0802	
	School	0.0672		0.0993		0.0698		0.0796	
Nickel	Site	0.0016		0.0020		0.0014		0.0017	
	School	0.0016		0.0021		0.0017		0.0018	
Selenium	Site	0.0011		0.0016		0.0010		0.0013	
	School	0.0008		0.0018		0.0011		0.0012	
Zinc	Site	0.0782		0.0898		0.0798		0.0826	
	School	0.0698		0.0910		0.0850		0.0805	
TSP	Site	4.24E-05		5.68E-05		3.85E-05		4.68E-05	
	School	4.04E-05		5.75E-05		3.75E-05		4.62E-05	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A9: Comparison of Mean Concentrations between Periods (*Idle vs. Active*) of PAHs at the CDF SITE.

<i>Analyte & Site Condition</i>		Spring/Fall		Summer		Winter		Overall	
		ng/m ³	S/D*	ng/m ³	S/D*	ng/m ³	S/D*	ng/m ³	S/D*
Acenaphthene	Idle	9.78		15.37		3.18		10.31	
	Active	6.26		12.17		5.84		8.13	
Acenaphthylene	Idle	2.56		2.85		3.39		2.83	
	Active	3.16		1.58		4.97		3.07	
Fluoranthene	Idle	3.54		5.89		1.96		4.02	
	Active	2.85		5.52		2.68		3.79	
Fluorene	Idle	9.07		14.72		4.77		10.14	
	Active	7.83		14.49		6.73		9.91	
Naphthalene	Idle	95.95		97.43		82.81		93.31	
	Active	83.91		75.32		88.28		82.19	
Phenanthrene	Idle	13.83		27.52		8.71		17.61	
	Active	13.25		30.69		10.97		18.83	
Pyrene	Idle	2.04		3.37		1.80	Yes	2.45	
	Active	2.32		3.08		2.62		2.69	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A10: Comparison of Mean Concentrations between Periods (*Idle vs. Active*) of PAHs at the HIGH SCHOOL.

<i>Analyte & Site Condition</i>		Spring/Fall		Summer		Winter		Overall	
		ng/m ³	S/D*	ng/m ³	S/D*	ng/m ³	S/D*	ng/m ³	S/D*
Acenaphthene	Idle	7.36		15.80		2.29		9.42	
	Active	5.75		13.95		3.31		7.85	
Acenaphthylene	Idle	2.07		1.97	Yes	3.00		2.21	
	Active	2.85		0.65		4.03		2.52	
Fluoranthene	Idle	3.01		6.57		2.02		4.11	
	Active	3.05		6.25		2.41		4.02	
Fluorene	Idle	7.02		14.60		4.10		9.22	
	Active	6.80		14.32		4.66		8.85	
Naphthalene	Idle	97.95		103.1		86.35		97.35	
	Active	95.75		97.34		86.73		95.19	
Phenanthrene	Idle	12.95		27.88		8.33		17.51	
	Active	12.92		32.93		8.78		18.62	
Pyrene	Idle	1.97		3.37		1.72		2.43	
	Active	2.22		3.14		2.07		2.56	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A11: Comparison of Mean Concentrations between Periods (*Idle vs. Active*) of PCBs at the CDF SITE

<i>Analyte & Site Condition</i>		Spring/Fall		Summer		Winter		Overall	
		pg/m ³	S/D*	pg/m ³	S/D*	pg/m ³	S/D*	pg/m ³	S/D*
PCB 8	Idle	36.92		77.57		21.00		48.00	
	Active	40.55		104.6		17.27		57.48	
PCB 15	Idle	6.47		13.80		2.36		8.19	
	Active	6.61		17.07		3.28		9.46	
PCB 18	Idle	31.52		59.43		10.75		36.89	
	Active	34.34		76.29		21.74		45.92	
PCB 28	Idle	21.65		45.07		7.18		26.83	
	Active	20.29		54.64		12.55		30.27	
PCB 31	Idle	23.13		47.38		7.85		28.43	
	Active	22.06		56.14		12.53		31.60	
ΣPCBs	Idle	107.1		243.2		45.18		142.3	
	Active	123.57		308.7		66.53		174.4	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A12: Comparison of Mean Concentrations between Periods (*Idle vs. Active*) of PCBs at the HIGH SCHOOL.

<i>Analyte & Site Condition</i>		Spring/Fall		Summer		Winter		Overall	
		pg/m ³	S/D*	pg/m ³	S/D*	pg/m ³	S/D*	pg/m ³	S/D*
PCB 8	Idle	34.03		73.06		17.22		44.91	
	Active	37.02		102.1		16.20		53.19	
PCB 15	Idle	4.51		10.80		1.91		6.29	
	Active	4.69		14.35		2.40		7.24	
PCB 18	Idle	18.07		42.00		8.02		24.80	
	Active	22.27		52.70		12.28		29.79	
PCB 28	Idle	13.21		30.52		5.62		18.01	
	Active	13.86		39.91		7.33		20.68	
PCB 31	Idle	13.59		30.77		5.78		18.29	
	Active	14.51		39.72		7.73		21.02	
ΣPCBs	Idle	71.08		187.1		35.32		106.5	
	Active	91.93		248.8		44.67		131.5	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A13: Comparison of Mean Concentrations between Periods (*Idle vs. Active*) of VOCs at the CDF SITE

<i>Analyte & Site Condition</i>		Spring/Fall		Summer		Winter		Overall	
		ug/m ³	S/D*	ug/m ³	S/D*	ug/m ³	S/D*	ug/m ³	S/D*
Benzene	Idle	1.11		1.38		1.48		1.24	
	Active	1.20		1.33		1.25		1.26	
Toluene	Idle	1.83		3.04		2.15		2.40	
	Active	2.41		2.95		2.04		2.58	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A14: Comparison of Mean Concentrations between Periods (*Idle vs. Active*) of VOCs at the HIGH SCHOOL.

<i>Analyte & Site Condition</i>		Spring/Fall		Summer		Winter		Overall	
		ug/m ³	S/D*	ug/m ³	S/D*	ug/m ³	S/D*	ug/m ³	S/D*
Benzene	Idle	1.42		1.59	Yes	1.49		1.50	
	Active	1.43		1.18		1.38		1.33	
Toluene	Idle	2.05		3.30		2.22		2.55	
	Active	3.31		3.06		1.24		2.90	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A15: Comparison of Mean Concentrations between Periods (*Idle vs. Active*) of Metals at the CDF SITE

<i>Analyte & Site Condition</i>		Spring/Fall ug/m ³ S/D*		Summer ug/m ³ S/D*		Winter ug/m ³ S/D*		Overall ug/m ³ S/D*	
Aluminum	Idle	0.3236		0.3758		0.2289		0.3450	
	Active	0.2550		0.3245		0.2392		0.2769	
Arsenic	Idle	0.0014		0.0016		0.0010		0.0014	
	Active	0.0014		0.0013		0.0009		0.0013	
Barium	Idle	0.0195	Yes	0.0253	Yes	0.0214		0.0229	Yes
	Active	0.0269		0.0299		0.0291		0.0283	
Chromium	Idle	0.0056		0.0056		0.0041		0.0055	
	Active	0.0041		0.0045		0.0051		0.0044	
Cobalt	Idle	0.0006		0.0008		0.0006		0.0007	
	Active	0.0005		0.0005		0.0003		0.0005	
Copper	Idle	0.0767		0.1148		0.0795		0.0941	
	Active	0.0839		0.1050		0.0703		0.0890	
Iron	Idle	0.9702		1.1157		0.7116		1.0225	
	Active	0.7645		0.9440		0.7428		0.8244	
Lead	Idle	0.0222		0.0216		0.0165		0.0208	
	Active	0.0231		0.0232		0.0250		0.0235	
Manganese	Idle	0.0946		0.1070		0.0708		0.1001	
	Active	0.0727		0.0921		0.0762		0.0802	
Nickel	Idle	0.0017		0.0019		0.0014		0.0018	
	Active	0.0016		0.0020		0.0014		0.0017	
Selenium	Idle	0.0011		0.0015		0.0014		0.0013	
	Active	0.0011		0.0016		0.0010		0.0013	
Zinc	Idle	0.1147		0.1051		0.0765		0.1032	
	Active	0.0782		0.0898		0.0798		0.0826	
TSP	Idle	4.89E-05		5.54E-05		4.61E-05		5.24E-05	
	Active	4.24E-05		5.67E-05		3.85E-05		4.68E-05	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A16: Comparison of Mean Concentrations between Periods (*Idle vs. Active*) of Metals at the HIGH SCHOOL.

<i>Analyte & Site Condition</i>		Spring/Fall ug/m ³ S/D*		Summer ug/m ³ S/D*		Winter ug/m ³ S/D*		Overall ug/m ³ S/D*	
Aluminum	Idle	0.3230		0.3861		0.2223		0.3479	
	Active	0.2518		0.3777		0.2402		0.2965	
Arsenic	Idle	0.0014		0.0016		0.0009		0.0014	
	Active	0.0014		0.0014		0.0015		0.0014	
Barium	Idle	0.0200	Yes	0.0271		0.0222		0.0239	Yes
	Active	0.0280		0.0310		0.0308		0.0296	
Chromium	Idle	0.0051		0.0053		0.0039		0.0052	
	Active	0.0037		0.0047		0.0050		0.0043	
Cobalt	Idle	0.0006	Yes	0.0008		0.0004		0.0007	Yes
	Active	0.0004		0.0005		0.0003		0.0004	
Copper	Idle	0.1112		0.1678		0.0995		0.1411	
	Active	0.0969		0.1682		0.0839		0.1199	
Iron	Idle	0.9089		1.0565		0.7041		0.9662	
	Active	0.7274		0.9750		0.7926		0.8317	
Lead	Idle	0.0177		0.0189		0.0151	Yes	0.0182	
	Active	0.0211		0.0285		0.0273		0.0250	
Manganese	Idle	0.0875		0.1009		0.0699		0.0934	
	Active	0.0672		0.0993		0.0698		0.0796	
Nickel	Idle	0.0018		0.0018		0.0014		0.0017	
	Active	0.0016		0.0021		0.0017		0.0018	
Selenium	Idle	0.0010		0.0014		0.0014		0.0013	
	Active	0.0008		0.0018		0.0011		0.0012	
Zinc	Idle	0.1026		0.1012		0.0718		0.0973	
	Active	0.0698		0.0910		0.0850		0.0805	
TSP	Idle	4.71E-05		5.55E-05		4.57E-05		5.16E-05	
	Active	4.05E-05		5.75E-05		3.75E-05		4.62E-05	

* S/D indicates a statistically significant difference between the two values at a 95% confidence interval

Table A17: Comparison of Mean Seasonal Concentrations between Locations (*CDF Site vs. High School*) of PAHs during IDLE Conditions.

<i>Analyte & Location</i>		Concentration (ng/m³)			Statistical Significance*
		Spring/Fall	Summer	Winter	
Acenaphthene	Site	9.76	15.37	3.19	Summer > Spring/Fall > Winter
	School	7.36	15.80	2.37	Summer > Spring/Fall > Winter
Acenaphthylene	Site	2.56	2.85	3.29	
	School	2.07	1.97	2.90	
Fluoranthene	Site	3.54	5.89	1.91	Summer > Spring/Fall > Winter
	School	3.01	6.57	1.96	Summer > Spring/Fall > Winter
Fluorene	Site	9.07	14.72	4.80	Summer > Spring/Fall > Winter
	School	7.02	14.60	4.14	Summer > Spring/Fall > Winter
Naphthalene	Site	95.95	97.43	81.94	
	School	97.95	103.1	86.37	
Phenanthrene	Site	13.83	27.52	8.67	Summer > Spring/Fall > Winter
	School	12.95	27.88	8.36	Summer > Spring/Fall > Winter
Pyrene	Site	2.04	3.37	1.75	Summer > Spring/Fall; Summer > Winter
	School	1.97	3.37	1.68	Summer > Spring/Fall; Summer > Winter

* Indicates statistically significant difference between the values at a 95% confidence interval

Table A18: Comparison of Mean Seasonal Concentrations between Locations (*CDF Site vs. High School*) of PAHs during ACTIVE Conditions.

<i>Analyte & Location</i>		Concentration (ng/m³)			Statistical Significance*
		Spring/Fall	Summer	Winter	
Acenaphthene	Site	6.26	12.17	5.71	Summer > Spring/Fall; Summer > Winter
	School	5.75	13.95	3.48	Summer > Spring/Fall; Summer > Winter
Acenaphthylene	Site	3.16	1.58	5.48	Winter > Summer
	School	2.85	0.65	4.68	Winter > Spring/Fall > Summer
Fluoranthene	Site	2.85	5.52	3.08	Summer > Spring/Fall; Summer > Winter
	School	3.05	6.25	2.93	Summer > Spring/Fall; Summer > Winter
Fluorene	Site	7.83	14.49	7.12	Summer > Spring/Fall; Summer > Winter
	School	6.80	14.32	5.37	Summer > Spring/Fall; Summer > Winter
Naphthalene	Site	83.91	75.32	89.91	
	School	95.75	97.34	90.19	
Phenanthrene	Site	13.25	30.69	12.03	Summer > Spring/Fall; Summer > Winter
	School	12.92	32.93	10.34	Summer > Spring/Fall; Summer > Winter
Pyrene	Site	2.32	3.08	2.92	
	School	2.22	3.14	2.53	

* Indicates statistically significant difference between the values at a 95% confidence interval

Table A19: Comparison of Mean Seasonal Concentrations between Locations (*CDF Site vs. High School*) of PCBs during IDLE Conditions.

<i>Analyte & Location</i>		Concentration (pg/m³)			Statistical Significance*
		Spring/Fall	Summer	Winter	
PCB 8	Site	36.92	77.57	21.00	Summer > Spring/Fall > Winter
	School	34.03	73.06	17.22	Summer > Spring/Fall > Winter
PCB 15	Site	6.47	13.80	2.36	Summer > Spring/Fall > Winter
	School	4.51	10.80	1.91	Summer > Spring/Fall > Winter
PCB 18	Site	31.52	59.43	10.75	Summer > Spring/Fall > Winter
	School	18.07	42.00	8.02	Summer > Spring/Fall > Winter
PCB 28	Site	21.65	45.07	7.18	Summer > Spring/Fall > Winter
	School	13.21	30.52	5.62	Summer > Spring/Fall > Winter
PCB 31	Site	23.13	47.38	7.85	Summer > Spring/Fall > Winter
	School	13.59	30.77	5.78	Summer > Spring/Fall > Winter
ΣPCBs	Site	107.1	243.2	45.18	Summer > Spring/Fall > Winter
	School	71.08	187.1	35.32	Summer > Spring/Fall > Winter

* Indicates statistically significant difference between the values at a 95% confidence interval

Table A20: Comparison of Mean Seasonal Concentrations between Locations (*CDF Site vs. High School*) of PCBs during ACTIVE Conditions.

<i>Analyte & Location</i>		Concentration (pg/m³)			Statistical Significance*
		Spring/Fall	Summer	Winter	
PCB 8	Site	40.55	104.6	17.27	Summer > Spring/Fall > Winter
	School	37.02	102.1	16.20	Summer > Spring/Fall > Winter
PCB 15	Site	6.61	17.07	3.28	Summer > Spring/Fall > Winter
	School	4.69	14.35	2.40	Summer > Spring/Fall > Winter
PCB 18	Site	34.34	76.29	21.74	Summer > Spring/Fall; Summer > Winter
	School	22.27	52.70	12.28	Summer > Spring/Fall; Summer > Winter
PCB 28	Site	20.29	54.64	12.55	Summer > Spring/Fall; Summer > Winter
	School	13.86	39.91	7.33	Summer > Spring/Fall > Winter
PCB 31	Site	22.06	56.14	12.53	Summer > Spring/Fall > Winter
	School	14.51	39.72	7.73	Summer > Spring/Fall > Winter
ΣPCBs	Site	123.6	308.7	66.53	Summer > Spring/Fall > Winter
	School	91.93	248.8	44.67	Summer > Spring/Fall > Winter

* Indicates statistically significant difference between the values at a 95% confidence interval

Table A21: Comparison of Mean Seasonal Concentrations between Locations (*CDF Site vs. High School*) of VOCs during IDLE Conditions.

<i>Analyte & Location</i>		Concentration (ug/m³)			Statistical Significance*
		Spring/Fall	Summer	Winter	
Benzene	Site	1.11	1.38	1.48	
	School	1.42	1.59	1.49	
Toluene	Site	1.83	3.04	2.15	Summer > Spring/Fall; Summer > Winter
	School	2.05	3.30	2.22	Summer > Spring/Fall; Summer > Winter

* Indicates statistically significant difference between the values at a 95% confidence interval

Table A22: Comparison of Mean Seasonal Concentrations between Locations (*CDF Site vs. High School*) of VOCs during ACTIVE Conditions.

<i>Analyte & Location</i>		Concentration (ug/m³)			Statistical Significance*
		Spring/Fall	Summer	Winter	
Benzene	Site	1.20	1.33	1.25	
	School	1.43	1.18	1.38	
Toluene	Site	2.41	2.95	2.04	
	School	3.31	3.06	1.24	

* Indicates statistically significant difference between the values at a 95% confidence interval

Table A23: Comparison of Mean Seasonal Concentrations between Locations (*CDF Site vs. High School*) of Metals during IDLE Conditions.

<i>Analyte & Location</i>		Concentration (ug/m³)			Statistical Significance*
		Spring/Fall	Summer	Winter	
Aluminum	Site	0.3236	0.3758	0.2289	Spring/Fall > Winter; Summer > Winter
	School	0.3230	0.3861	0.2223	Spring/Fall > Winter; Summer > Winter
Arsenic	Site	0.0014	0.0016	0.0010	Summer > Winter
	School	0.0014	0.0016	0.0009	Summer > Winter
Barium	Site	0.0195	0.0253	0.0214	Summer > Spring/Fall
	School	0.0200	0.0271	0.0222	Summer > Spring/Fall
Chromium	Site	0.0056	0.0056	0.0041	Spring/Fall > Winter; Summer > Winter
	School	0.0051	0.0053	0.0039	Spring/Fall > Winter; Summer > Winter
Cobalt	Site	0.0006	0.0008	0.0006	
	School	0.0006	0.0008	0.0004	
Copper	Site	0.0767	0.1148	0.0795	Summer > Spring/Fall; Summer > Winter
	School	0.1112	0.1678	0.0995	Summer > Spring/Fall; Summer > Winter
Iron	Site	0.9702	1.1157	0.7116	Summer > Winter
	School	0.9089	1.0565	0.7041	Summer > Winter
Lead	Site	0.0222	0.0216	0.0165	Summer > Winter
	School	0.0177	0.0189	0.0151	Summer > Winter
Manganese	Site	0.0946	0.1070	0.0708	Summer > Winter
	School	0.0875	0.1009	0.0699	Summer > Winter
Nickel	Site	0.0017	0.0019	0.0014	
	School	0.0018	0.0018	0.0014	
Selenium	Site	0.0011	0.0015	0.0014	Summer > Spring/Fall
	School	0.0010	0.0014	0.0014	Summer > Spring/Fall
Zinc	Site	0.1147	0.1051	0.0765	
	School	0.1026	0.1012	0.0718	
TSP	Site	4.89E-05	5.54E-05	4.61E-05	
	School	4.71E-05	5.55E-05	4.57E-05	Summer > Spring/Fall

* Indicates statistically significant difference between the values at a 95% confidence interval

Table A24: Comparison of Mean Seasonal Concentrations between Locations (*CDF Site vs. High School*) of PAHs during ACTIVE Conditions.

<i>Analyte & Location</i>		Concentration (ug/m³)			Statistical Significance*
		Spring/Fall	Summer	Winter	
Aluminum	Site	0.2550	0.3245	0.2392	
	School	0.2518	0.3777	0.2402	
Arsenic	Site	0.0014	0.0013	0.0009	
	School	0.0014	0.0014	0.0015	
Barium	Site	0.0269	0.0299	0.0291	
	School	0.0280	0.0310	0.0308	
Chromium	Site	0.0041	0.0045	0.0051	
	School	0.0037	0.0047	0.0050	
Cobalt	Site	0.0005	0.0005	0.0003	
	School	0.0004	0.0005	0.0003	
Copper	Site	0.0839	0.1050	0.0703	
	School	0.0969	0.1682	0.0839	Summer > Spring/Fall; Summer > Winter
Iron	Site	0.7645	0.9440	0.7428	
	School	0.7274	0.9750	0.7926	
Lead	Site	0.0231	0.0232	0.0250	
	School	0.0211	0.0285	0.0273	
Manganese	Site	0.0727	0.0921	0.0762	
	School	0.0672	0.0993	0.0698	
Nickel	Site	0.0016	0.0020	0.0014	
	School	0.0016	0.0021	0.0017	
Selenium	Site	0.0011	0.0016	0.0010	
	School	0.0008	0.0018	0.0011	Summer > Spring/Fall
Zinc	Site	0.0782	0.0898	0.0798	
	School	0.0698	0.0910	0.0850	
TSP	Site	4.24E-05	5.68E-05	3.85E-05	
	School	4.04E-05	5.75E-05	3.75E-05	Summer > Spring/Fall; Summer > Winter

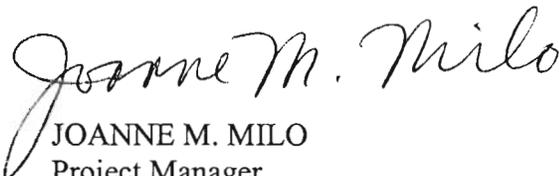
* Indicates statistically significant difference between the values at a 95% confidence interval

Attachment 2
Recommendation Response

MEMORANDUM FOR RECORD

SUBJECT: Ambient Air Monitoring Plan for the Indiana Harbor and Canal Project

1. The recommendation presented in the Indiana Harbor and Canal Ambient Air Monitoring Program: Construction Phase Annual Report 2004, published in June 2005, has been considered by USACE Project Management. The recommendation was to decrease the monitoring frequency from 6 days to 12 days, for ambient air monitoring that occurs at the ECI site and at the East Chicago Central High School. The recommendation was based on the finding that construction activities are having little to no impact on concentrations of ambient air contaminants of concern at the ECI site and high school. Ambient concentrations of contaminants of concern at the ECI site and surrounding vicinity have fallen within the boundaries observed since inception of the background ambient air monitoring program.
2. An adjustment to the current sampling frequency will not be implemented at this time.
3. This memo serves as the official documentation of the response to the recommendations made in the 2005 report. This memo is included in the report as attachment 2. Questions concerning this memorandum should be addressed to the Project Manager, at 312-846-5558.


JOANNE M. MILO
Project Manager