Indiana Harbor and Canal Ambient Air Monitoring Program: Construction Phase Annual Report 2006

U.S. Army Corps of Engineers
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Executive Summary

Ambient air monitoring data, including polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), volatile organic compounds (VOC), and metals, are currently being collected as part of the Indiana Harbor and Canal Confined Disposal Facility construction project. The construction project is located on the former Energy Cooperative, Inc. refinery site. Two monitoring locations are used: the south site (adjacent to the Indiana Harbor Canal just south of the ECI property), and the East Chicago High School.

This report presents as summary of the mean concentrations for both monitoring sites, for a number of compounds. Data are analyzed based on the location of the monitoring station, the season (corresponding to the average temperature), and whether construction activities are occurring on site.

Based on a statistical analysis of the data, there is no indication that construction activities at the ECI site are causing degradation of the ambient air at either the south monitoring site or at the high school. It is recommended that monitoring continue during construction activities at the ECI site, and that the data be re-evaluated on an annual basis.

Table of Contents

Tables

Figures

Introduction

In November 2001, the U.S. Army Corps of Engineers (USACE) implemented an ambient air monitoring program at the property known as the Energy Cooperative, Inc. (ECI) site, located in East Chicago, Indiana. The ECI site is the location of a confined disposal facility (CDF), which is currently being constructed to hold sediment dredged from the Indiana Harbor and Canal. In May 2004, the construction phase of the ambient air monitoring program was implemented. The ambient air monitoring program results, including the construction phase monitoring through 2005 are presented in three reports:

1. Indiana Harbor and Canal Air Monitoring: Background Phase Ambient Summary & Construction Phase Ambient Air Monitoring Program, USACE Chicago District, November 2003.

2. Indiana Harbor and Canal Ambient Air Monitoring Program: Construction Phase Annual Report 2004, USACE Chicago District, June 2005.

3. Indiana Harbor and Canal Ambient Air Monitoring Program: Construction Phase Annual Report 2005, USACE Chicago District, June 2006.

These reports include detailed information on the selection of the monitoring sites, the handling of non-detectable data, an evaluation of meteorological data, and statistical analyses of the previous air monitoring data. Because the monitoring locations, physical conditions, and data handling have not changed, that information will not be repeated in this report. Interested readers are referred to the above referenced documents for details.

The purpose of this report is to present an updated statistical analysis of the ambient air monitoring data. Air monitoring data will be compared by location, season, and parameter. The entire ambient air monitoring dataset is used for this analysis, including data from 2001 through 2006.

Air Monitoring Data

Locations and Parameters

The air monitoring data used for the statistical analysis were collected at two locations, referred to as the “south” site and as the “high school” site. These two locations are shown in Figure 1. The south site is located adjacent to the Lake George Branch of the Indiana Harbor Canal. The high school (HS) site is located approximately 1700 feet south of the south sampler, on the East Chicago High School property. The rational for these monitoring locations is discussed in previous reports.

The air sampling stations operate in tandem, on a 6-day rotational schedule. Each sample is a 24 hour sample. Parameters measured and used in the statistical analysis include the analytes listed in Table 1. The parameters fall into several chemical groups: polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), and metals.

Figure 1: Location of Ambient Air Sampling Stations and the ECI site in East Chicago, Indiana.

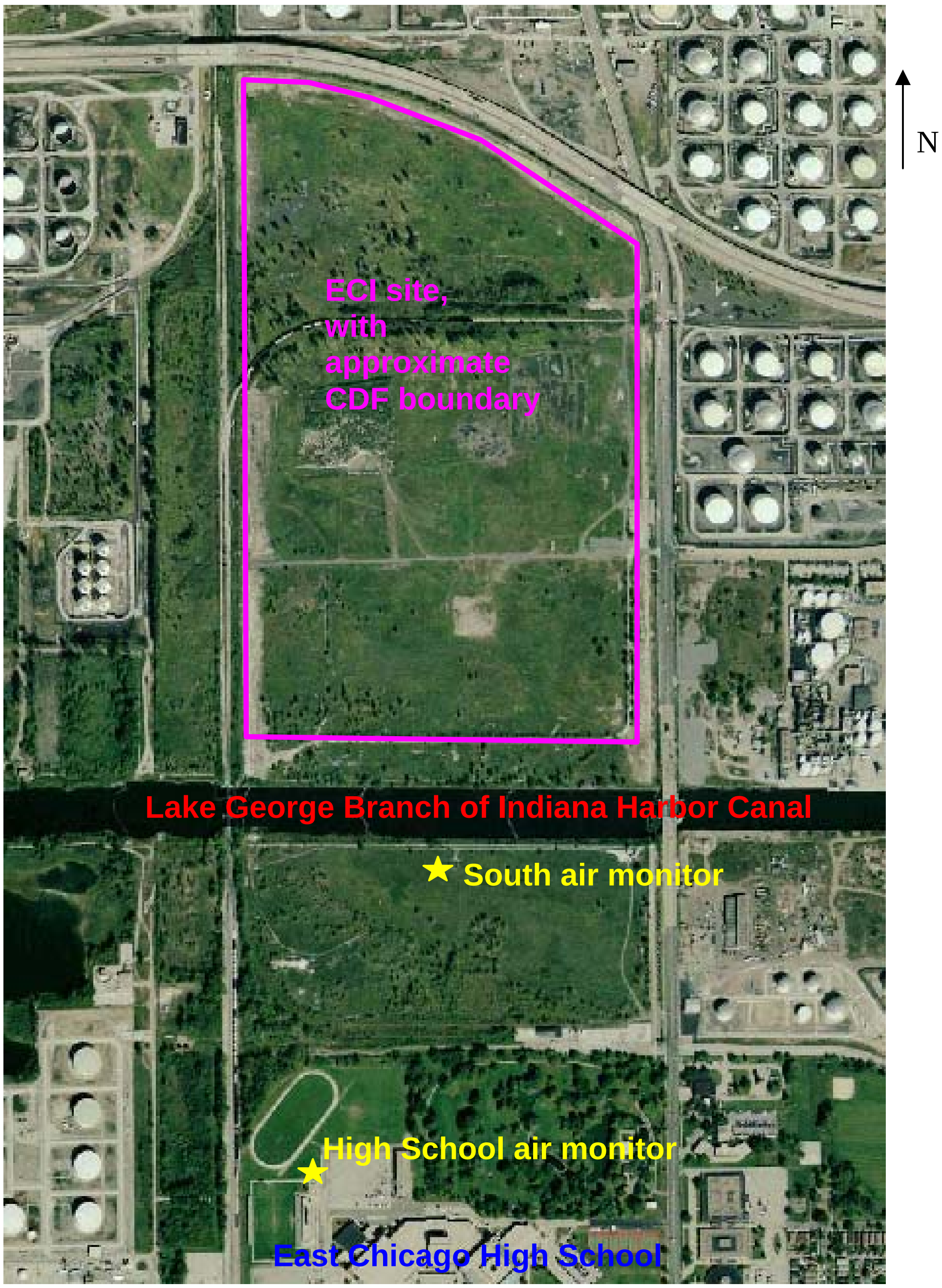

Table 1: Air Monitoring Analytes

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

The PAH and PCB samples are obtained using a high-volume vacuum pump air sampler, with a glass fiber filter, a polyurethane foam (PUF) and adsorbent resin (XAD-2) media. Total suspended particulates and metals are collected using a separate high-volume vacuum pump air sampler, with a glass fiber filter medium. VOCs are collected using specially treated stainless steel canisters, which utilize a bellows-type pump to draw in air.

Data Organization

For analyzing the ambient air monitoring data, the data are subdivided into two main groups: Active and Idle. Active refers to data collected while construction activities were occurring on the ECI site. Various types of construction have occurred and will continue during the next few years, including excavations, obstruction removal, grading, embankment (dike) construction, cut-off wall construction, well installation, construction of a treatment plant and various other structures. This construction work occurs at various times of the year. Idle refers to data collected while no construction activities are occurring. This includes the initial years of data collection, before construction started on the ECI site, as well as data from more recent years when construction activities were not occurring.

Air data, particularly for volatile compounds, show temperature related trends. For this reason, the data were broken down by season: spring/fall (March, April, May, October, November), summer (June, July, August, September), and winter (December, January, February). These groups correspond to mean monthly temperatures of $<40^{o}$F (winter), 40

– 60^{o}F (spring/fall), and >60^{o}F. Thus, based on seasonal subgroups and also the status of construction activities, there are a total of twelve data subsets for each parameter:

- South site, Active, spring/fall
- South site, Active, summer
- South site, Active, winter
- South site, Idle, spring/fall
- South site, Idle, summer
- South site, Idle, winter
- HS site, Active, spring/fall
- HS site, Active, summer
- HS site, Active, winter
- HS site, Idle, spring/fall
- HS site, Idle, summer
- HS site, Idle, winter

Statistical Analysis

The ambient air monitoring data were compared using a non-parametric comparison of means, the Mann-Whitney test. Non-parametric tests are used when a normal distribution of the data cannot be assumed or when there are small numbers of data points. The handling of non-detectable data and other details of the statistical analysis can be found in previous reports.

Results

Appendix A contains the results of comparisons of means. These tables give the updated means and the results of statistical comparisons of the data sets. The continued primary objective of this analysis is to evaluate the potential impacts of construction activities at the ECI site on the ambient air quality near the facility. To facilitate this evaluation, the data have been compared based on location and activity (or lack of activity). The data presentation follows the format used in previous Indiana Harbor and Canal ambient air monitoring reports. The results are discussed further, below.

South Site versus High School Site

The ambient concentrations of each analyte were compared between locations (south monitoring site versus the high school monitoring site) for both idle (no construction) and active (construction) periods. Data were broken down into seasonal groups for comparison, and the overall data group was also used for comparison. Tables A1 through A8 show the mean concentrations and also the statistical significance of each comparison.

For PAHs (shown in Tables A1 and A2), acenaphthene, acenaphthylene, and fluorene were significantly different between the south site and the high school for idle conditions, with the south site having a higher acenaphthene concentration than the high school in the winter, the south site having higher acenaphthylene concentration than the high school in the summer and overall, and the south site having higher fluorene concentration than the high school in the spring/fall, winter, and overall. The remaining data show no seasonal or overall differences. Previous years' report results had indicated only overall acenaphthylene concentrations as being higher at the south site than the high school site; the addition of new information has lead to the identification of new trends in the data. The higher concentrations of acenaphthene, acenaphthylene, and fluorene at the south site during idle conditions are attributed to the known concentrations of PAHs in the canal sediment and water column.

For PCBs (shown in Tables A3 and A4), there were differences between the south site and the high school for all seasons and overall, for both idle and active periods. Except for total PCB concentration in the summer for the active period (which were not statistically different between the south site and high school), Congeners 15, 18, 28, 31, and the total PCB concentration were statistically different, with concentrations at the south site being higher than the concentrations at the high school site in the spring/fall, summer, and overall. Congeners 18, 28, and 31 were also statistically higher at the south site for the winter, idle conditions than at the high school. Congener 8 did not show any statistically significant differences between the two monitoring locations for any season for both idle and active periods. The higher concentrations of PCBs at the south site are attributed to the known concentrations of PCBs in the canal sediment and water column. The PCB trends are consistent with previously reported results.

Except for benzene concentration being higher at the high school site than the south site during the spring/fall for the idle period, the concentrations of VOCs (benzene and toluene) were statistically similar for all seasons, for both idle and active conditions. Concentrations are very similar for all seasons, and do not appear to show strong seasonality. It is not known why the high school site has higher benzene concentration in the spring/fall idle period, however it is possible that there is a local source of benzene emissions nearer the high school than the south monitoring site. There was no statistical difference between benzene at the two monitoring sites in previous years' data; the addition of new information has lead to the identification of a new trend in the data. VOC data are summarized in Tables A5 and A6.

Only one metal, copper, showed any statistical differences between the two monitoring sites. During idle conditions, the copper concentration is higher at the high school during the summer. It is not known why the high school site has higher concentration in the summer idle period, however it is possible that there is a local source of copper emissions nearer the high school than the south monitoring site. The higher copper concentrations at the high school were also reported in previous studies. There were no statistical differences in any metal concentrations between the two monitoring sites during the active period. Metals data are summarized in Tables A7 and A8.

Idle versus Active

Data for each monitoring site, the south site and the high school, were compared between idle (no construction) and active (construction) periods. The intent of this comparison is to evaluate differences in ambient air conditions that may be attributed to construction activities. The data were analyzed as seasonal groups and also as an overall data group. The data are presented in Appendix A, Tables A9 through A16.

Several PAHs (Table A9 and A10) showed seasonal and overall differences between active and idle conditions. At the south site, acenaphthylene and naphthalene were statistically higher in the summer during idle conditions. Naphthalene was also higher overall during idle conditions. Phenanthrene was higher during summer active conditions and also over all during active conditions. Fluoranthene and pyrene were higher overall during active conditions. These trends are consistent with previously reported results, though it should be noted that the average concentrations of all PAHs have decreased since the previous report. Higher concentrations during idle conditions and summer months may indicate that these compounds are originating from other local sources, possibly seasonal sources such as warm weather maintenance or operations, rather than from the ECI site. Higher active overall concentrations of some PAHs (fluoranthene, phenanthrene, and pyrene) are attributed to the prevalence of summer data (when most PAH concentrations are highest – see Tables A17 and A18 and the Seasonal Dependence discussion below) in the active period data set, rather than actual impact from construction activities. This is confirmed by the fact the active vs. idle comparisons by season do not show statistical differences.

At the school, acenaphthylene was higher during active conditions in the spring/fall, while naphthalene was higher during idle conditions in the summer. Compounds which have higher concentrations during idle conditions may be emitted from industry or other local sources. Fluoranthene, phenanthrene, and pyrene were higher overall during the active conditions. Previous years' report results had not indicated any overall PAH concentrations as being higher during the active conditions than the idle conditions. However, as discussed in the previous paragraph, the higher active overall concentrations of these PAHs are attributed to the prevalence of summer data (when most PAH concentrations are highest – see Tables A17 and A18 and the Seasonal Dependence discussion below) in the active period data set, rather than actual impact from construction activities. This is confirmed by the fact the active vs. idle comparisons of these PAHs by season do not show statistical differences. It should also be noted that as with PAH concentrations at the south site, the average concentrations of all PAHs at the high school have decreased since the previous report.

For PCBs at the south site (Table A11), only the overall concentration of congener 15 was statistically higher during active conditions than idle conditions. Previous years' report results had indicated overall concentrations of several congeners (congener 15, 18, and 28) as well as total PCBs as being higher during the active conditions at the south site. At the school (Table A12), the overall concentrations of congeners 8, 15, 18, 28, 31, and total PCBs were all statistically higher during active periods. Previous years' report results had indicated only overall congener 18 concentrations as being higher during the active periods at the high school. However, as discussed in the previous paragraphs about PAHs, the higher active overall concentrations of these PCBs are attributed to the prevalence of summer data (when the PCB concentrations are highest – see Tables A19 and A20 and the Seasonal Dependence discussion below) in the active period data set, rather than actual impact from construction activities. This is confirmed by the fact the active vs. idle comparisons of PCBs by season do not show any statistical differences.

Also, it should be noted that although the PCB concentrations were found to be higher during active concentrations at the high school site, the mean total PCB concentrations are 0.000104 ug/m^3 during idle conditions and 0.000133 ug/m^3 during active conditions. These concentrations are more than 10 times *less* than the USEPA Region 3 risk based concentration for total PCBs in ambient air. The risk based concentration for total PCBs in ambient air is 0.0031 ug/m^3, which corresponds to a lifetime cancer risk of 1 x 10^{-6}. The PCB concentrations measured at the south site and high school represent an even lower risk. Furthermore, as with PAH concentrations, the average high school site PCB concentrations have decreased since the previous report.

There were no statistical differences between VOC (benzene and toluene) concentrations during idle and active periods for any season or overall at either the south or the high school sites. VOC data are summarized in Tables A13 and A14. Previous years' report results had indicated benzene concentrations as being higher at the school during the summer and also overall during idle conditions. Incorporation of the latest data did not confirm this trend.

Concentrations of some metals showed statistically significant differences between active and idle conditions (Tables A15 and A16). At the south site, winter aluminum, the barium concentrations (summer, winter, and overall), the overall cobalt concentration, and the overall lead concentration were statistically higher during active conditions than during idle conditions. The south site summer cobalt and summer copper concentrations were statistically higher during idle than active conditions. At the high school site, winter aluminum, the barium concentrations (summer, winter, and overall), spring/fall cobalt, summer copper, the overall iron concentration, and the lead concentrations (winter and overall) were statistically greater during active conditions. The barium, copper, and lead trends were identified previously and were discussed in previous reports. The aluminum, cobalt and iron trends are newly identified, and though winter south site and high school aluminum, and overall high school iron concentrations are higher during active conditions, cobalt is higher during the idle period at the south site in the summer, and higher during the active period at the south site overall and in the spring at the high school. The lack of consistent trends supports the conclusion that other emission sources may be impacting ambient air concentrations of metals.

Seasonal Dependence of Concentration

Many factors, including air temperature and wind direction, can impact the concentration of compounds in the ambient air. For this reason, the average concentrations for each compound during each period, and at each location were compared between seasons. The data are presented in Appendix A, Tables A17 through A24.

In general, the PAHs had the statistically greater concentrations during the summer period than during the spring/fall or winter (Tables A17 and A18). Most of the PAHs do not show a significant difference between the spring/fall concentration and the winter concentration. Although the concentrations may be different between location and period, the tendency for seasonally higher concentrations holds true for all the data except for naphthalene at the south site during active conditions. The winter naphthalene concentration is higher than the summer naphthalene concentration at the south site during the active period. This is not consistent with greater volatility of the compounds during warmer months and is difficult to explain. As this trend is newly identified; future data collection may help clarify this finding.

The PCB data during idle conditions (Table A19) showed a similar expected trend, with the summer concentrations being statistically greater than the spring/fall concentrations, which were in turn statistically greater than the winter concentrations. This is the expected behavior of the compounds based on air temperature data. During active conditions (Table A20), the summer concentrations were also statistically greater than the spring/fall and winter concentrations. However, unlike the idle conditions, during the active conditions there was not a statistical difference between the spring/fall and winter data. This is likely an artifact of the datasets; there are very few winter active data (most construction activities do not occur during the winter) so it is difficult to demonstrate the statistical significance of the numbers. It is expected that the data may follow the pattern shown by the idle data when more measurements are available.

The VOC data showed fewer trends based on temperature. The idle toluene data (Table A21) for both the south site and the high school were statistically greater during the summer than during the spring/fall, however the winter data were not statistically different from the other seasons. The benzene concentration at the school during idle conditions was greater during the winter than during the spring/fall, which is the opposite result one would anticipate based on temperature alone. The higher VOC concentrations at the school in the winter may be related to increased traffic at the school while classes are in session. During active conditions (Table A22), there were no significant statistical trends based on temperature. It is likely that the benzene and toluene data do not show as much seasonal trend for two reasons: first these compounds are quite volatile, even at lower temperatures and so are already in the air column regardless of the air temperature, and second, there are probably many local sources of these ubiquitous compounds and the multiple emissions may have a greater impact than temperature or other climactic factors.

The metals data (Tables A23 and A24) showed some seasonal trends, mostly for the idle datasets. It should be noted that metals are not expected to show temperature dependent trends, since the atmospheric transport of metals is driven by particulate concentration (except for mercury). There is some seasonal correlation to metal concentrations in the air, which may be attributed to other factors such as more anthropogenic activity during the warm seasons, or wind. In general, the summer concentrations were statistically higher than the winter concentrations for idle conditions. There was a statistical difference between the spring/fall and winter concentrations and also between summer and spring/fall concentrations for some metals, but not for all. Selenium concentration at the south site was greater during the spring/fall than during the summer for idle conditions. The south site selenium concentration may be attributable to a local emission source.

Conclusions

The air monitoring data presented were statistically analyzed based on location, season, and whether construction activities were occurring on the ECI site. The data and statistical significance are presented in tables. Based on a statistical analysis of the data, there is no indication that construction activities at the ECI site are causing degradation of the ambient air at either the south monitoring site or at the high school. It is recommended that monitoring continue for the purpose of expanding the dataset, and that the data and statistical analysis be revisited on an annual basis.

Appendix A Data Summary

Table A 1: Comparison of Mean Concentrations between Locations (South site vs. High School site) of PAHs during IDLE conditions

Analyte & Location		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	South	9.364		15.074		4.104	yes	9.629	
	HS	7.429		15.612		2.834		8.627	
Acenaphthylene	South	2.645		2.935	yes	3.675		3.003	yes
	HS	2.255		2.160		3.338		2.507	
Fluoranthene	South	3.476		5.802		2.219		3.819	
	HS	3.202		6.488		2.338		3.937	
Fluorene	South	9.474	yes	14.505		5.746	yes	9.948	yes
	HS	7.543		14.410		4.436		8.742	
Naphthalene	South	84.701		94.211		81.328		86.573	
	HS	89.187		100.803		90.795		92.987	
Phenanthrene	South	15.542		27.233		9.932		17.455	
	HS	14.427		27.664		9.375		16.979	
Pyrene	South	2.248		3.344		2.117		2.532	
	HS	2.210		3.325		2.099		2.506	

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

Table A 2: Comparison of Mean Concentrations between Locations (South site vs. High School site) of PAHs during ACTIVE conditions

Analyte & Location		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	South	6.621		11.271		4.408		8.295	
	HS	6.167		13.106		3.084		8.728	
Acenaphthylene	South	3.402		1.745		4.719		2.879	
	HS	2.879		1.503		4.298		2.480	
Fluoranthene	South	3.439		5.820		2.548		4.330	
	HS	3.208		6.460		2.525		4.510	
Fluorene	South	8.699		13.760		6.116		10.496	
	HS	7.263		14.257		4.841		9.936	
Naphthalene	South	76.328		55.491		86.286		68.836	
	HS	85.724		68.175		90.022		78.779	
Phenanthrene	South	16.421		31.888		10.363		22.167	
	HS	14.561		32.651		9.485		21.634	
Pyrene	South	2.806		3.446		2.409		3.024	
	HS	2.351		3.335		2.353		2.773	

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

Table A 3: Comparison of Mean Concentrations between Locations (South site vs. High School site) of PCBs during IDLE Conditions

Analyte & Location		**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*
Congener 8	South	38.393		75.375		20.970		44.529	
	HS	35.640		70.572		19.116		41.441	
Congener 15	South	6.770	yes	13.533	yes	2.772		7.676	yes
	HS	4.841		10.465		2.300		5.807	
Congener 18	South	35.827	yes	60.462	yes	13.678	yes	37.111	yes
	HS	20.745		41.569		9.016		23.706	
Congener 28	South	23.992	yes	45.141	yes	8.910	yes	26.140	yes
	HS	14.126		29.844		6.219		16.612	
Congener 31	South	25.480	yes	47.741	yes	9.598	yes	27.739	yes
	HS	14.554		30.058		6.335		16.894	
Sum PCBs	South	130.250	yes	242.223	yes	54.964		142.837	yes
	HS	88.543		172.920		41.874		103.870	

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

Table A 4: Comparison of Mean Concentrations between Locations (South site vs. High School site) of PCBs during ACTIVE Conditions

Analyte & Location		**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*
Congener 8	South	41.501		87.925		20.777		58.396	
	HS	39.512		76.925		24.247		53.502	
Congener 15	South	6.710	yes	17.319	yes	3.841		10.830	yes
	HS	4.901		11.071		3.637		7.376	
Congener 18	South	35.419	yes	71.659	yes	19.890		48.698	yes
	HS	21.576		41.759		18.064		29.755	
Congener 28	South	21.319	yes	73.785	yes	13.115		42.526	yes
	HS	14.036		32.534		11.556		21.632	
Congener 31	South	21.834	yes	64.946	yes	13.249		39.004	yes
	HS	14.325		32.061		11.965		21.610	
Sum PCBs	South	143.302	yes	289.369		69.252		199.042	yes
	HS	93.772		194.323		67.401		133.333	

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

Table A 5: Comparison of Mean Concentrations between Locations (South site vs. High School site) of VOCs during IDLE Conditions

Analyte & Location		**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	South	1.205	yes	1.352		1.703		1.380	
	HS	1.441		1.524		1.744		1.545	
Toluene	South	1.780		2.892		2.668		2.358	
	HS	2.057		3.111		2.624		2.508	

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

Table A 6: Comparison of Mean Concentrations between Locations (South site vs. High School site) of VOCs during ACTIVE Conditions

Analyte & Location		**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	South	1.271		1.557		1.323		1.411	
	HS	1.324		1.583		1.882		1.514	
Toluene	South	2.430		2.727		1.913		2.515	
	HS	2.700		3.340		2.614		3.000	

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

Table A 7: Comparison of Mean Concentrations between Locations (South site vs. High School site) of Metals during IDLE Conditions

Analyte & Location		**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*
Aluminum	South	0.337		0.375		0.198		0.315	
	HS	0.338		0.383		0.192		0.317	
Arsenic	South	0.00164		0.00177		0.00134		0.00161	
	HS	0.00160		0.00175		0.00134		0.00158	
Barium	South	0.0179		0.0247		0.0174		0.0199	
	HS	0.0181		0.0263		0.0181		0.0205	
Chromium	South	0.00541		0.00566		0.00359		0.00505	
	HS	0.00510		0.00537		0.00346		0.00480	
Cobalt	South	0.00076		0.00092		0.00072		0.00080	
	HS	0.00075		0.00094		0.00066		0.00078	
Copper	South	0.0797		0.114	yes	0.0940		0.0938	
	HS	0.0962		0.162		0.0843		0.113	
Iron	South	1.016		1.141		0.665		0.969	
	HS	0.978		1.060		0.648		0.924	
Lead	South	0.0210		0.0224		0.0148		0.0199	
	HS	0.0176		0.0186		0.0133		0.0169	
Manganese	South	0.0948		0.1095		0.0620		0.0914	
	HS	0.0891		0.1018		0.0598		0.0859	
Nickel	South	0.00195		0.00197		0.00160		0.00187	
	HS	0.00190		0.00188		0.00157		0.00182	
Selenium	South	0.00240		0.00176		0.00175		0.00204	
	HS	0.00256		0.00169		0.00170		0.00210	
Zinc	South	0.117		0.113		0.0887		0.109	
	HS	0.106		0.101		0.0772		0.098	
TSP	South	4.84E-05		5.51E-05		3.89E-05		4.82E-05	
	HS	4.74E-05		5.57E-05		3.89E-05		4.79E-05	

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

Table A 8: Comparison of Mean Concentrations between Locations (South site vs. High School) of Metals during ACTIVE Conditions

Analyte & Location		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*
Aluminum	South	0.296		0.371		0.226		0.324	
	HS	0.281		0.375		0.231		0.322	
Arsenic	South	0.00296		0.00160		0.00127		0.00212	
	HS	0.00266		0.00160		0.00177		0.00203	
Barium	South	0.0239		0.0234		0.0252		0.0238	
	HS	0.0234		0.0294		0.0271		0.0269	
Chromium	South	0.00570		0.00520		0.00468		0.00535	
	HS	0.00511		0.00511		0.00466		0.00506	
Cobalt	South	0.00195		0.00070		0.00061		0.00120	
	HS	0.00166		0.00071		0.00067		0.00107	
Copper	South	0.0694		0.1013		0.0716		0.0848	
	HS	0.0815		0.166		0.0848		0.124	
Iron	South	0.920		1.361		0.867		1.124	
	HS	0.825		1.351		0.847		1.091	
Lead	South	0.0263		0.0236		0.0193		0.0242	
	HS	0.0204		0.0222		0.0212		0.0214	
Manganese	South	0.0804		0.111		0.0651		0.0935	
	HS	0.0726		0.107		0.0608		0.0883	
Nickel	South	0.00326		0.00204		0.00166		0.00250	
	HS	0.00286		0.00196		0.00182		0.00229	
Selenium	South	0.00299		0.00182		0.00150		0.00227	
	HS	0.00258		0.00191		0.00157		0.00213	
Zinc	South	0.0816		0.1007		0.0711		0.0895	
	HS	0.0707		0.1003		0.0766		0.0862	
TSP	South	4.68E-05		5.67E-05		3.66E-05		5.03E-05	
	HS	4.44E-05		5.59E-05		3.63E-05		4.92E-05	

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

Table A 9: Comparison of Mean Concentrations between Periods (Idle vs. Active) of PAHs at the South Site

Analyte & Location		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	9.364		15.074		4.104		9.629	
	Active	6.621		11.271		4.408		8.295	
Acenaphthylene	Idle	2.645		2.935	yes	3.675		3.003	
	Active	3.402		1.745		4.719		2.879	
Fluoranthene	Idle	3.476		5.802		2.219		3.819	yes
	Active	3.439		5.820		2.548		4.330	
Fluorene	Idle	9.474		14.505		5.746		9.948	
	Active	8.699		13.760		6.116		10.496	
Naphthalene	Idle	84.701		94.211	yes	81.328		86.573	yes
	Active	76.328		55.491		86.286		68.836	
Phenanthrene	Idle	15.542		27.233	yes	9.932		17.455	yes
	Active	16.421		31.888		10.363		22.167	
Pyrene	Idle	2.248		3.344		2.117		2.532	yes
	Active	2.806		3.446		2.409		3.024	

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

Table A 10: Comparison of Mean Concentrations between Periods (Idle vs. Active) of PAHs at the High School Site

Analyte & Location		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	7.429		15.612		2.834		8.627	
	Active	6.167		13.106		3.084		8.728	
Acenaphthylene	Idle	2.255	yes	2.160		3.338		2.507	
	Active	2.879		1.503		4.298		2.480	
Fluoranthene	Idle	3.202		6.488		2.338		3.937	yes
	Active	3.208		6.460		2.525		4.510	
Fluorene	Idle	7.543		14.410		4.436		8.742	
	Active	7.263		14.257		4.841		9.936	
Naphthalene	Idle	89.187		100.803	yes	90.795		92.987	
	Active	85.724		68.175		90.022		78.779	
Phenanthrene	Idle	14.427		27.664		9.375		16.979	yes
	Active	14.561		32.651		9.485		21.634	
Pyrene	Idle	2.210		3.325		2.099		2.506	yes
	Active	2.351		3.335		2.353		2.773	

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

Table A 11: Comparison of Mean Concentrations between Periods (Idle vs. Active) of PCBs at the South Site

Analyte & Location		**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*
Congener 8	Idle	38.393		75.375		20.970		44.529	
	Active	41.501		87.925		20.777		58.396	
Congener 15	Idle	6.770		13.533		2.772		7.676	yes
	Active	6.710		17.319		3.841		10.830	
Congener 18	Idle	35.827		60.462		13.678		37.111	
	Active	35.419		71.659		19.890		48.698	
Congener 28	Idle	23.992		45.141		8.910		26.140	
	Active	21.319		73.785		13.115		42.526	
Congener 31	Idle	25.480		47.741		9.598		27.739	
	Active	21.834		64.946		13.249		39.004	
Sum PCBs	Idle	130.250		242.223		54.964		142.837	
	Active	143.302		289.369		69.252		199.042	

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

Table A 12: Comparison of Mean Concentrations between Periods (Idle vs. Active) of PCBs at the High School Site

Analyte & Location		**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*
Congener 8	Idle	35.640		70.572		19.116		41.441	yes
	Active	39.512		76.925		24.247		53.502	
Congener 15	Idle	4.841		10.465		2.300		5.807	yes
	Active	4.901		11.071		3.637		7.376	
Congener 18	Idle	20.745		41.569		9.016		23.706	yes
	Active	21.576		41.759		18.064		29.755	
Congener 28	Idle	14.126		29.844		6.219		16.612	yes
	Active	14.036		32.534		11.556		21.632	
Congener 31	Idle	14.554		30.058		6.335		16.894	yes
	Active	14.325		32.061		11.965		21.610	
Sum PCBs	Idle	88.543		172.920		41.874		103.870	yes
	Active	93.772		194.323		67.401		133.333	

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

Table A 13: Comparison of Mean Concentrations between Periods (Idle vs. Active) of VOCs at the South Site

Analyte & Location		**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	1.205		1.352		1.703		1.380	
	Active	1.271		1.557		1.323		1.411	
Toluene	Idle	1.780		2.892		2.668		2.358	
	Active	2.430		2.727		1.913		2.515	

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

Table A 14: Comparison of Mean Concentrations between Periods (Idle vs. Active) of VOCs at the High School Site

Analyte & Location		**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	1.441		1.524		1.744		1.545	
	Active	1.324		1.583		1.882		1.514	
Toluene	Idle	2.057		3.111		2.624		2.508	
	Active	2.700		3.340		2.614		3.000	

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

Table A 15: Comparison of Mean Concentrations between Periods (Idle vs. Active) of Metals at the South Site

Analyte & Location		**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*
Aluminum	Idle	0.337		0.375		0.198	yes	0.315	
	Active	0.296		0.371		0.226		0.324	
Arsenic	Idle	0.00164		0.00177		0.00134		0.00161	
	Active	0.00296		0.00160		0.00127		0.00212	
Barium	Idle	0.0179	yes	0.0247		0.0174	yes	0.0199	yes
	Active	0.0239		0.0234		0.0252		0.0238	
Chromium	Idle	0.00541		0.00566		0.00359		0.00505	
	Active	0.00570		0.00520		0.00468		0.00535	
Cobalt	Idle	0.00076		0.00092	yes	0.00072		0.00080	yes
	Active	0.00195		0.00070		0.00061		0.00120	
Copper	Idle	0.0797		0.114	yes	0.0940		0.0938	
	Active	0.0694		0.1013		0.0716		0.0848	
Iron	Idle	1.016		1.141		0.665		0.969	
	Active	0.920		1.361		0.867		1.124	
Lead	Idle	0.0210		0.0224		0.0148		0.0199	yes
	Active	0.0263		0.0236		0.0193		0.0242	
Manganese	Idle	0.0948		0.1095		0.0620		0.0914	
	Active	0.0804		0.111		0.0651		0.0935	
Nickel	Idle	0.00195		0.00197		0.00160		0.00187	
	Active	0.00326		0.00204		0.00166		0.00250	
Selenium	Idle	0.00240		0.00176		0.00175		0.00204	
	Active	0.00299		0.00182		0.00150		0.00227	
Zinc	Idle	0.117		0.113		0.0887		0.109	
	Active	0.0816		0.1007		0.0711		0.0895	
TSP	Idle	4.84E-05		5.51E-05		3.89E-05		4.82E-05	
	Active	4.68E-05		5.67E-05		3.66E-05		5.03E-05	

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

Table A 16: Comparison of Mean Concentrations between Periods (Idle vs. Active) of Metals at the High School Site

Analyte & Location		**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*
Aluminum	Idle	0.338		0.383		0.192	yes	0.317	
	Active	0.281		0.375		0.231		0.322	
Arsenic	Idle	0.00160		0.00175		0.00134		0.00158	
	Active	0.00266		0.00160		0.00177		0.00203	
Barium	Idle	0.0181	yes	0.0263		0.0181	yes	0.0205	yes
	Active	0.0234		0.0294		0.0271		0.0269	
Chromium	Idle	0.00510		0.00537		0.00346		0.00480	
	Active	0.00511		0.00511		0.00466		0.00506	
Cobalt	Idle	0.00075	yes	0.00094		0.00066		0.00078	
	Active	0.00166		0.00071		0.00067		0.00107	
Copper	Idle	0.0962		0.162	yes	0.0843		0.113	
	Active	0.0815		0.166		0.0848		0.124	
Iron	Idle	0.978		1.060		0.648		0.924	yes
	Active	0.825		1.351		0.847		1.091	
Lead	Idle	0.0176		0.0186		0.0133	yes	0.0169	yes
	Active	0.0204		0.0222		0.0212		0.0214	
Manganese	Idle	0.0891		0.1018		0.0598		0.0859	
	Active	0.0726		0.107		0.0608		0.0883	
Nickel	Idle	0.00190		0.00188		0.00157		0.00182	
	Active	0.00286		0.00196		0.00182		0.00229	
Selenium	Idle	0.00256		0.00169		0.00170		0.00210	
	Active	0.00258		0.00191		0.00157		0.00213	
Zinc	Idle	0.106		0.101		0.0772		0.098	
	Active	0.0707		0.1003		0.0766		0.0862	
TSP	Idle	4.74E-05		5.57E-05		3.89E-05		4.79E-05	
	Active	4.44E-05		5.59E-05		3.63E-05		4.92E-05	

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

Table A 17: Comparison of Mean Seasonal Concentrations between Locations (South site vs. High School) of PAHs during IDLE Conditions

Analyte & Location		**Concentration (ng/m^3)**			**Statistical Significance***
		Spring/Fall	Summer	Winter	
Acenaphthene	South	9.364	15.074	4.104	Summer > Spring/Fall > Winter
	HS	7.429	15.612	2.834	Summer > Spring/Fall > Winter
Acenaphthylene	South	2.645	2.935	3.675	
	HS	2.255	2.160	3.338	
Fluoranthene	South	3.476	5.802	2.219	Summer > Spring/Fall; Summer > Winter
	HS	3.202	6.488	2.338	Summer > Spring/Fall; Summer > Winter
Fluorene	South	9.474	14.505	5.746	Summer > Spring/Fall > Winter
	HS	7.543	14.410	4.436	Summer > Spring/Fall > Winter
Naphthalene	South	84.701	94.211	81.328	
	HS	89.187	100.803	90.795	
Phenanthrene	South	15.542	27.233	9.932	Summer > Spring/Fall > Winter
	HS	14.427	27.664	9.375	Summer > Spring/Fall > Winter
Pyrene	South	2.248	3.344	2.117	Summer > Spring/Fall; Summer > Winter
	HS	2.210	3.325	2.099	Summer > Spring/Fall; Summer > Winter

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

Table A 18: Comparison of Mean Seasonal Concentrations between Locations (South site vs. High School) of PAHs during ACTIVE Conditions

Analyte & Location		**Concentration (ng/m^3)**			**Statistical Significance***
		Spring/Fall	Summer	Winter	
Acenaphthene	South	6.621	11.271	4.408	Summer > Spring/Fall; Summer > Winter
	HS	6.167	13.106	3.084	Summer > Spring/Fall; Summer > Winter
Acenaphthylene	South	3.402	1.745	4.719	Summer > Spring/Fall; Summer > Winter
	HS	2.879	1.503	4.298	Summer > Spring/Fall; Summer > Winter
Fluoranthene	South	3.439	5.820	2.548	Summer > Spring/Fall; Summer > Winter
	HS	3.208	6.460	2.525	Summer > Spring/Fall; Summer > Winter
Fluorene	South	8.699	13.760	6.116	Summer > Spring/Fall; Summer > Winter
	HS	7.263	14.257	4.841	Summer > Spring/Fall; Summer > Winter
Naphthalene	South	76.328	55.491	86.286	Winter > Summer
	HS	85.724	68.175	90.022	
Phenanthrene	South	16.421	31.888	10.363	Summer > Spring/Fall; Summer > Winter
	HS	14.561	32.651	9.485	Summer > Spring/Fall; Summer > Winter
Pyrene	South	2.806	3.446	2.409	Summer > Spring/Fall; Summer > Winter
	HS	2.351	3.335	2.353	Summer > Spring/Fall; Summer > Winter

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

Table A 19: Comparison of Mean Seasonal Concentrations between Locations (South site vs. High School) of PCBs during IDLE Conditions

Analyte & Location		**Concentration (pg/m^3)**			**Statistical Significance***
		Spring/Fall	Summer	Winter	
Congener 8	South	38.393	75.375	20.970	Summer > Spring/Fall > Winter
	HS	35.640	70.572	19.116	Summer > Spring/Fall > Winter
Congener 15	South	6.770	13.533	2.772	Summer > Spring/Fall > Winter
	HS	4.841	10.465	2.300	Summer > Spring/Fall > Winter
Congener 18	South	35.827	60.462	13.678	Summer > Spring/Fall > Winter
	HS	20.745	41.569	9.016	Summer > Spring/Fall > Winter
Congener 28	South	23.992	45.141	8.910	Summer > Spring/Fall > Winter
	HS	14.126	29.844	6.219	Summer > Spring/Fall > Winter
Congener 31	South	25.480	47.741	9.598	Summer > Spring/Fall > Winter
	HS	14.554	30.058	6.335	Summer > Spring/Fall > Winter
Sum PCBs	South	130.250	242.223	54.964	Summer > Spring/Fall > Winter
	HS	88.543	172.920	41.874	Summer > Spring/Fall > Winter

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

Table A 20: Comparison of Mean Seasonal Concentrations between Locations (South site vs. High School) of PCBs during ACTIVE Conditions

Analyte & Location		**Concentration (pg/m^3)**			**Statistical Significance***
		Spring/Fall	Summer	Winter	
Congener 8	South	41.501	87.925	20.777	Summer > Spring/Fall; Summer > Winter
	HS	39.512	76.925	24.247	Summer > Spring/Fall; Summer > Winter
Congener 15	South	6.710	17.319	3.841	Summer > Spring/Fall; Summer > Winter
	HS	4.901	11.071	3.637	Summer > Spring/Fall; Summer > Winter
Congener 18	South	35.419	71.659	19.890	Summer > Spring/Fall; Summer > Winter
	HS	21.576	41.759	18.064	Summer > Spring/Fall; Summer > Winter
Congener 28	South	21.319	73.785	13.115	Summer > Spring/Fall; Summer > Winter
	HS	14.036	32.534	11.556	Summer > Spring/Fall; Summer > Winter
Congener 31	South	21.834	64.946	13.249	Summer > Spring/Fall; Summer > Winter
	HS	14.325	32.061	11.965	Summer > Spring/Fall; Summer > Winter
Sum PCBs	South	143.302	289.369	69.252	Summer > Winter; Spring/Fall > Winter
	HS	93.772	194.323	67.401	Summer > Spring/Fall; Summer > Winter

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

Table A 21: Comparison of Mean Seasonal Concentrations between Locations (South site vs. High School) of VOCs during IDLE Conditions

Analyte & Location		**Concentration (ug/m^3)**			**Statistical Significance***
		Spring/Fall	Summer	Winter	
Benzene	South	1.205	1.352	1.703	Winter > Spring/Fall
	HS	1.441	1.524	1.744	
Toluene	South	1.780	2.892	2.668	Summer > Spring/Fall
	HS	2.057	3.111	2.624	Summer > Spring/Fall

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

Table A 22: Comparison of Mean Seasonal Concentrations between Locations (South site vs. High School) of VOCs during ACTIVE Conditions

Analyte & Location		**Concentration (ug/m^3)**			**Statistical Significance***
		Spring/Fall	Summer	Winter	
Benzene	South	1.271	1.557	1.323	
	HS	1.324	1.583	1.882	
Toluene	South	2.430	2.727	1.913	
	HS	2.700	3.340	2.614	

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

Table A 23: Comparison of Mean Seasonal Concentrations between Locations (South site vs. High School) of Metals during IDLE Conditions

Analyte & Location		Concentration (ug/m^3)			Statistical Significance*
		Spring/Fall	Summer	Winter	
Aluminum	South	0.337	0.375	0.198	Spring/Fall > Winter; Summer > Winter
	HS	0.338	0.383	0.192	Spring/Fall > Winter; Summer > Winter
Arsenic	South	0.00164	0.00177	0.00134	Summer > Winter
	HS	0.00160	0.00175	0.00134	Summer > Winter
Barium	South	0.0179	0.0247	0.0174	Summer > Spring/Fall; Summer > Winter
	HS	0.0181	0.0263	0.0181	Summer > Spring/Fall; Summer > Winter
Chromium	South	0.00541	0.00566	0.00359	Spring/Fall > Winter; Summer > Winter
	HS	0.00510	0.00537	0.00346	Spring/Fall > Winter; Summer > Winter
Cobalt	South	0.00076	0.00092	0.00072	Summer > Winter
	HS	0.00075	0.00094	0.00066	
Copper	South	0.0797	0.114	0.0940	Summer > Spring/Fall; Summer > Winter
	HS	0.0962	0.162	0.0843	Summer > Spring/Fall; Summer > Winter
Iron	South	1.016	1.141	0.665	Spring/Fall > Winter; Summer > Winter
	HS	0.978	1.060	0.648	Spring/Fall > Winter; Summer > Winter
Lead	South	0.0210	0.0224	0.0148	Summer > Winter
	HS	0.0176	0.0186	0.0133	Summer > Winter
Manganese	South	0.0948	0.1095	0.0620	Spring/Fall > Winter; Summer > Winter
	HS	0.0891	0.1018	0.0598	Spring/Fall > Winter; Summer > Winter
Nickel	South	0.00195	0.00197	0.00160	Summer > Winter
	HS	0.00190	0.00188	0.00157	Summer > Winter
Selenium	South	0.00240	0.00176	0.00175	Spring/Fall > Summer
	HS	0.00256	0.00169	0.00170	
Zinc	South	0.117	0.113	0.0887	
	HS	0.106	0.101	0.0772	
TSP	South	4.84E-05	5.51E-05	3.89E-05	Summer > Winter
	HS	4.74E-05	5.57E-05	3.89E-05	Summer > Spring/Fall; Summer > Winter

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

Table A 24: Comparison of Mean Seasonal Concentrations between Locations (South site vs. High School) of Metals during ACTIVE Conditions

Analyte & Location		Concentration (ug/m^3)			Statistical Significance*
		Spring/Fall	Summer	Winter	
Aluminum	South	0.296	0.371	0.226	
	HS	0.281	0.375	0.231	Summer > Winter
Arsenic	South	0.00296	0.00160	0.00127	Spring/Fall > Winter
	HS	0.00266	0.00160	0.00177	
Barium	South	0.0239	0.0234	0.0252	
	HS	0.0234	0.0294	0.0271	
Chromium	South	0.00570	0.00520	0.00468	
	HS	0.00511	0.00511	0.00466	
Cobalt	South	0.00195	0.00070	0.00061	
	HS	0.00166	0.00071	0.00067	
Copper	South	0.0694	0.1013	0.0716	Summer > Spring/Fall
	HS	0.0815	0.166	0.0848	Summer > Spring/Fall
Iron	South	0.920	1.361	0.867	
	HS	0.825	1.351	0.847	Summer > Spring/Fall
Lead	South	0.0263	0.0236	0.0193	
	HS	0.0204	0.0222	0.0212	
Manganese	South	0.0804	0.111	0.0651	
	HS	0.0726	0.107	0.0608	Summer > Spring/Fall
Nickel	South	0.00326	0.00204	0.00166	
	HS	0.00286	0.00196	0.00182	
Selenium	South	0.00299	0.00182	0.00150	
	HS	0.00258	0.00191	0.00157	
Zinc	South	0.0816	0.1007	0.0711	
	HS	0.0707	0.1003	0.0766	Summer > Spring/Fall
TSP	South	4.68E-05	5.67E-05	3.66E-05	Summer > Winter
	HS	4.44E-05	5.59E-05	3.63E-05	Summer > Spring/Fall; Summer > Winter

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