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**Interim Report: Phase 1 of the Air Quality Study of the Impact
of the Peace Bridge Plaza on the Surrounding Neighborhood**

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Executive Summary

The NYS Department of Environmental Conservation (DEC) undertook a six month air monitoring campaign beginning in late August 2012. The data collection was the first step in a two part program designed to assess changes in local air quality resulting from the redesign of the Peace Bridge Plaza. Once the Plaza reconstruction is complete, another six months of data collection will be undertaken. A final report will be prepared that provides an analysis of the air quality impact of the new Plaza configuration on the surrounding neighborhood. This report provides a summary of the data collected in phase one of the project. All of the data collected in this program are available on the NYSDEC website:

<http://www.dec.ny.gov/chemical/83984.html>

Two monitoring locations were utilized to assess the impact of the current configuration of the Peace Bridge Plaza on the surrounding neighborhood. One site was situated in the predominant downwind direction from the Plaza on a vacant lot on Busti Avenue at the intersection of Vermont Street. The other site was located in the Southwest corner of Front Park just downwind of I-190 and upwind of the Plaza.

The DEC installed filter based and continuous fine particulate matter (PM-2.5) monitoring devices as well as Black Carbon (BC) monitors at both sites, and meteorological equipment at the Busti Avenue site. The sites were used to collect data from late August 2012 through mid-March 2013. The data collected at the two sites were very similar and during most of the sampling period the PM-2.5 concentrations were slightly higher at the Front Park site while the BC concentrations on average were equal at the two sites. There were a few short periods when concentrations of both PM-2.5 and BC were higher at the Busti Avenue site. The only pollutant measured in this campaign with a National Ambient Air Quality Standard (NAAQS) was PM-2.5 and at no time did measured concentrations at either site exceed the NAAQS. The average PM-2.5 at Front Park was $8.3\mu\text{g}/\text{m}^3$ and $8.2\mu\text{g}/\text{m}^3$ at Busti Avenue. The average BC at both Front Park and Busti Avenue was $0.53\mu\text{g}/\text{m}^3$. The analysis of BC data originating from the direction of the Plaza showed that there was a small increase in the contribution of BC to local PM in the neighborhood downwind of the Plaza in the afternoons when truck activity is highest.

The data collected in phase one of the study indicate that the PM-2.5 collected at the two sites in this study correlate very well with the two monitors in Buffalo and Niagara Falls. This indicates that on average, there is no significant source of PM-2.5 impacting the neighborhood around the Peace Bridge that is not also impacting the sites in Niagara Falls and Buffalo. This result is not surprising due to the heavy influence of mobile sources in the region. Historically, the DEC has used the PM-2.5 monitoring site in Buffalo on Dingens Street to assess the air quality for the region. The average PM-2.5 in Buffalo for the same period as this study was $8.3\mu\text{g}/\text{m}^3$.

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Introduction

The NYS Department of Environmental Conservation (DEC) and the Buffalo and Fort Erie Public Bridge Authority (PBA) developed a monitoring plan to determine the air quality impact of vehicle traffic and plaza operations at the Peace Bridge in Buffalo, NY. Over the last nine years, the average number of daily vehicle crossings at the Peace Bridge was 17,920 vehicles and approximately 20 percent of these vehicles were heavy duty trucks. The Peace Bridge is the highest volume border crossing in Western New York and the second highest border crossing between the United States and Canada. Traffic approaching or leaving the Peace Bridge Plaza generally uses I-190 which has an average daily traffic count of approximately 77,000 vehicles.

The Peace Bridge monitoring project will assess air quality prior to prospective renovations at the plaza as well as after improvements to the plaza are completed. The objective of the plaza renovation is to reduce congestion. The first phase of air quality monitoring occurred from late summer 2012 to spring 2013.

Monitoring Network Design

The objective of the monitoring program is to measure the impact of the operations at the Peace Bridge Plaza on the air quality in the surrounding neighborhood. This type of source impact assessment requires, at a minimum, upwind and downwind monitoring sites. Careful selection of the monitoring sites is necessary to adequately determine the impact of bridge operations without including other nearby sources of air pollution. The DEC analyzed the local wind patterns and determined that the winds in the area are predominantly out of the southwest in the summer months and west-southwest in the winter months. The DEC installed a meteorological tower with an anemometer to provide hourly wind direction and wind speed data during the monitoring period. Hourly wind direction data are used to confirm when the installed monitors are actually upwind or downwind of plaza operations and not up or down wind from some other source.

A location was selected for the downwind monitoring site on the east side of Busti Avenue near the intersection of Vermont Street. The siting was based on the ability to measure emissions from the Peace Bridge Plaza and the location is within the neighborhood concerned about air quality. The data collected from this site will be classified as downwind or “in-sector” when the wind direction indicates that the wind is coming from the direction encompassing the extent of the Plaza. This range is from 224° to 313°. When the wind is coming from any other direction, the data will be classified as “out-sector” and that data will not be used to estimate the impact of the Plaza on the neighborhood.

The upwind site was established on the southern edge of Front Park. The site is south of the Plaza in a grassy area of the park. Ideally an upwind site would be located in the prevailing upwind direction from the Plaza which would be in the WSW direction. That was not possible in this situation because I-190 is located west of the Plaza. The selected site is suitable to be an upwind or background site for this project because it is impacted by the same upwind sources as the Busti Avenue site with the exception of the Plaza. Both study sites are impacted by I-190.

The comparisons between the two sites will only be made with data collected during identical time periods. This is necessary because the background concentrations of the pollutants vary but on average have a nearly equal impact on the two sites. The varying background concentrations will change the magnitude of the pollutants at each site but the difference in the concentration between the two sites

when the wind is within the in-sector range can be attributed to the plaza operation. Appendix A includes a map showing the in-sector wind category as well as the Peace Bridge Plaza and the two monitoring sites.

Each location had equipment to measure filter based 24-Hr average and 1-Hr fine particulate matter (PM-2.5) in addition to 1-Hr average Black Carbon (BC). Sulfur and elemental data were determined by analyzing the 24-Hr integrated PM-2.5 filters. The 1-Hr data were collected because they can be used to correlate with local wind direction as well as with parameters such as traffic counts on I-190 and bridge volume. The monitoring protocol was performed using equipment, methods and personnel that are comparable with what is done in other parts of the State. This ensures that the study results are comparable to the data collected anywhere else in the State.

Background and Trends in Air Quality

The Buffalo area is currently in attainment for all of the National Ambient Air Quality Standards (NAAQS) and the Department believes that the air quality around the Peace Bridge Plaza also meets all of the NAAQS. The Department has a permanent air monitoring station in Buffalo near I-90 and I-190 where data are collected for comparison to the NAAQS for this region. This site is predominantly downwind of the city of Buffalo as well as the congestion associated with the Peace Bridge Plaza activities. The Department's air quality monitoring network is designed to ensure that the concentrations measured are representative of the maximum impact from the combination of emissions from both stationary and mobile sources affecting residents in the region.

The air quality at the Peace Bridge Plaza will be more variable than the air quality at the Department's Buffalo monitor because the upwind concentrations at the Peace Bridge Plaza will vary depending on whether relatively clean air from Lake Erie or air with higher pollutant concentrations coming from the downtown Buffalo area is impacting the area. The predominantly westerly wind direction at the Peace Bridge Plaza generally favors lower background pollutant concentrations while the Buffalo air monitor is essentially surrounded by significant sources.

The DEC's air quality surveillance network is used to assess our regulatory progress as various federal and state air pollution control strategies are implemented over time. It also provides the public with information and is used by researchers to study the public health impacts of air pollution. The report "NYS Ambient Air Monitoring Program Assessment (May 2010)" includes plots which provide an indication of the improvement in air quality over time as the regulations to control air pollution from motor vehicles and other sources are implemented.¹ Overall, the concentrations of criteria pollutants (particulate matter, carbon monoxide, sulfur dioxide, nitrogen dioxide) have decreased statewide and more specifically in the Buffalo Metropolitan area. The Buffalo area is currently in attainment with the NAAQS. The concentrations of benzene, a motor vehicle air toxic of concern have also been decreasing over time as the new regulations developed to reduce motor vehicle pollutants are being phased in over time.

¹ New York State Department of Environmental Conservation. 2010. NYS Ambient Air Monitoring Program Assessment (May 2010). Available On-Line: <http://www.dec.ny.gov/chemical/65574.html>

Instrumentation

Each location had identical models of 1-Hr and 24-Hr PM-2.5 instruments as well as BC instruments. The Busti Avenue site also had a 10 m tower installed to provide 1-Hr wind direction and 1-Hr wind speed data.

PM_{2.5} Mass and Trace Elements (1 in 6 day samples)

The sampler used for 24-Hr integrated PM-2.5 mass and trace elements sample collection, once every 6th day, was the Thermo Scientific Partisol Plus 2025 Sequential Ambient Particle Sampler. This sampler is a designated Federal Reference Method for PM-2.5 mass. Air was sampled at 16.7 liters/minute (LPM) through a PM-10 separator with a rain collector, followed by a well impactor ninety-six (WINS) separator which provided a PM-2.5 cut-point. Particles were collected onto a Teflon filter. The Teflon filters were shipped to an independent laboratory from which gravimetric PM-2.5 mass and trace element concentrations using energy dispersive X-ray fluorescence (XRF) were obtained.

Hourly PM_{2.5} Mass

The TEOM (Tapered Element Oscillating Microbalance) used for hourly measurements of PM-2.5 mass was a Thermo Scientific model 1400ab. Air was sampled at 16.7 LPM through an inlet consisting of a PM-10 separator and rain collector followed by a PM-2.5 cyclone separator. Particles were continuously sampled onto a borosilicate Teflon coated filter mounted on the end of a hollow quartz glass tube. The quartz tube was set to oscillate and the frequency of oscillation was used to measure the change in mass as particles collected on the filter.

Black Carbon (BC)

A Magee Scientific, model AE-21, Aethalometer® was used to sample for BC. The instrument sampled PM-2.5 particles through a BGI model 1.828 sharp cut cyclone at 5 LPM onto a quartz fiber filter tape. The Aethalometer® calculates light attenuation due to particle deposition on the filter relative to a clean part of the filter. Since BC is the strongest light absorbing component, by measuring the rate of change in light attenuation the mass concentration was determined. A 5 minute time interval and an absorption coefficient of 16.6 m²/g at 880 nm were used in this study. Five minute Aethalometer® raw data were corrected for non-linear optical saturation and processed into hourly intervals using software developed by Jay Turner, Air Quality Laboratory at Washington University.

Meteorology (WS and WD)

A Vaisala WXT520 sonic anemometer was used to collect ambient 1-Hr wind direction and wind speed data at 10 meter elevation at the Busti Avenue site. The instrument uses three transducers set equidistant to each other in a level plane to simultaneously determine the speed of an ultrasonic wave in three directions. The ambient wind speed and direction are calculated by comparing transit time for the ultrasonic waves in both directions between each transducer.

24-Hr PM-2.5 Data Summary

The 24-Hr filter samples were collected every 6th day from 8/31/12 – 3/17/13. A complete set of the data is available on the Department's website at:

<http://www.dec.ny.gov/chemical/83984.html>.

Three samples out of thirty-four were invalidated at Front Park due to sampler malfunction. The dates for the invalid samples were: 10/18/12, 1/22/13 and 2/27/13. There were no invalid samples from the Busti Avenue site.

Table 1 presents a statistical summary of the 24-Hr PM-2.5 concentrations from the two Peace Bridge sites, as well as two nearby DEC sites (Buffalo and Niagara Falls). The data from the 3 days when samples were invalidated at Front Park were not included for any of the sites in Table 1. Figure 1a is a time series of 24-Hr PM-2.5 data from these four sites, while Figure 1b compares the two Peace Bridge sites. Table 1 and Figure 1 show that the 24-Hr PM-2.5 data from the Busti Avenue and the Front Park sites are very similar. This is not surprising since PM-2.5 is a mixture of primary, locally emitted particles, transported particles and particles that are formed through chemical processes in the atmosphere known as secondary particles. The regional background PM-2.5 dominates the data as evidenced by the similarity in the readings between the Peace Bridge sites and the DEC monitors in Buffalo and Niagara Falls.

The 24-Hr filter sample data can be directly compared to the daily PM-2.5 NAAQS since the data were collected in the same fashion as the data in the rest of the DEC compliance monitoring network. The 24-Hr standard is based on the 98th percentile of the data collected each Quarter and then averaged for a year. The 98th percentile is included in Table 1. A designation cannot be made one way or the other since it takes three years of data with satisfactory completeness for each calendar quarter to make a valid designation. The data, however, indicate that the 98th percentile 24-Hr value at both Front Park and Busti Avenue never exceeded 26 $\mu\text{g}/\text{m}^3$ which is well below 35 $\mu\text{g}/\text{m}^3$; the current 24-Hr NAAQS.

The Annual PM-2.5 NAAQS is now 12.0 $\mu\text{g}/\text{m}^3$ and the mean PM-2.5 concentrations for this monitoring campaign were 8.25 $\mu\text{g}/\text{m}^3$ at Front Park and 8.22 $\mu\text{g}/\text{m}^3$ at Busti Avenue. The similarity of the campaign data with data from the Regional site in Buffalo indicates that the long-term average PM-2.5 concentrations will not approach the level of the current Annual NAAQS.

Table 1: 24-Hr Filter Based PM-2.5 Data Summary ($\mu\text{g}/\text{m}^3$)

	10%	25%	median	mean	75%	90%	98%
Front Park	3.04	4.96	6.88	8.25	11.67	13.67	25.54
Busti Ave	3.25	4.75	6.62	8.22	11.79	14.04	25.71
Buffalo	3.46	4.25	7.63	8.34	11.75	14.04	26.71
Niagara Falls	3.21	5.7	7.58	8.79	12.04	14.92	25.33

Figure 1a: Time series of 24-Hr Filter Based PM-2.5 Data ($\mu\text{g}/\text{m}^3$);

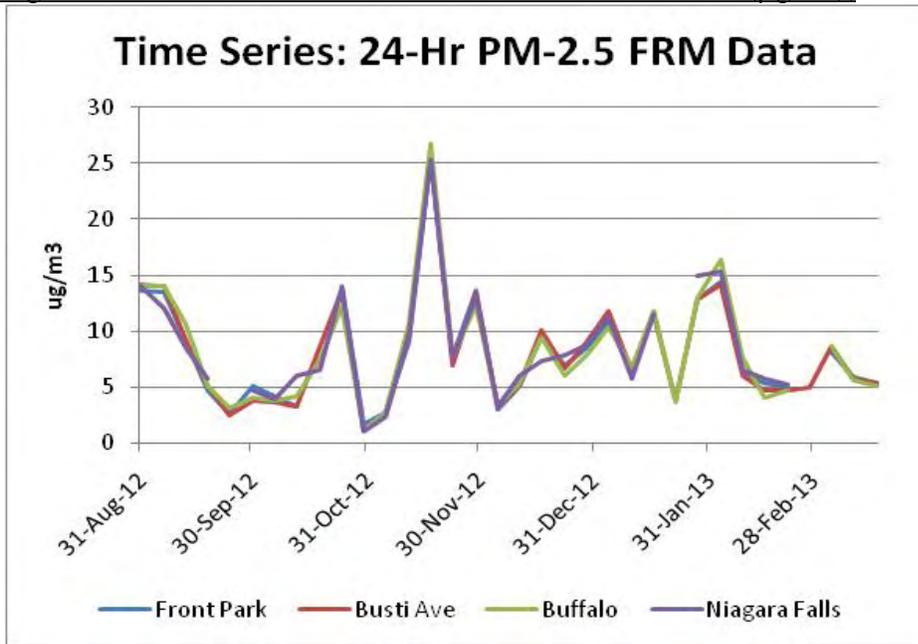
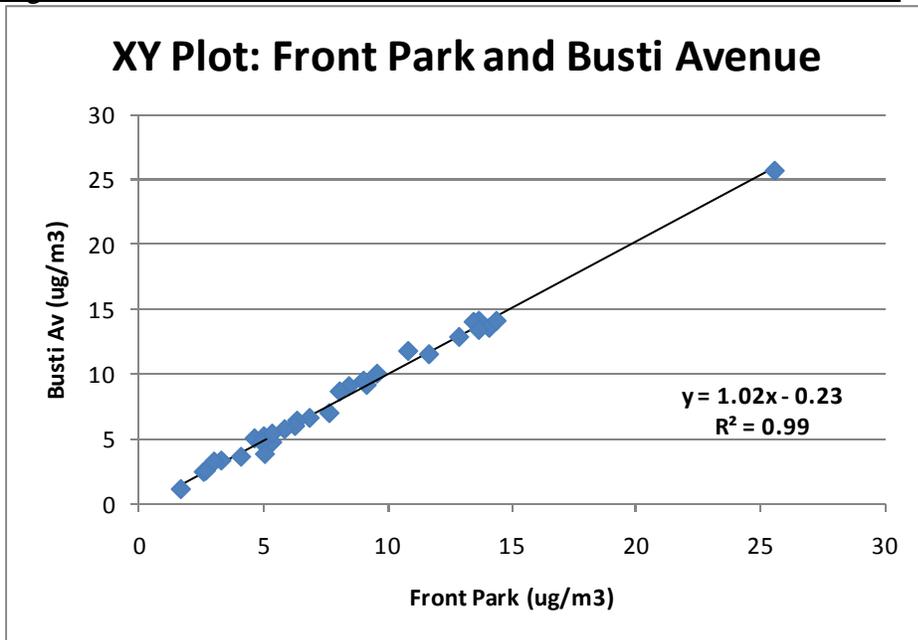


Figure 1b: XY: 24-Hr PM-2.5 Data from Front Park and Busti Avenue



1-Hr PM-2.5 Data Summary

The 1-Hr PM-2.5 and BC data were collected from 9/14/12 – 3/25/13. A complete set of the data is available on the Department’s website at: <http://www.dec.ny.gov/chemical/83984.html>. The data completeness for both sites exceeded 99%.

The 1-Hr data were collected because the high frequency data are necessary to correlate PM-2.5 with source emissions patterns and wind direction. These measurements are also used to provide near-real time data to the public and for DEC air pollution forecasters. The 1-Hr PM-2.5 and BC data were available during the monitoring campaign both graphically and via download from the DEC web site: <http://www.dec.ny.gov/airmon/index.php>

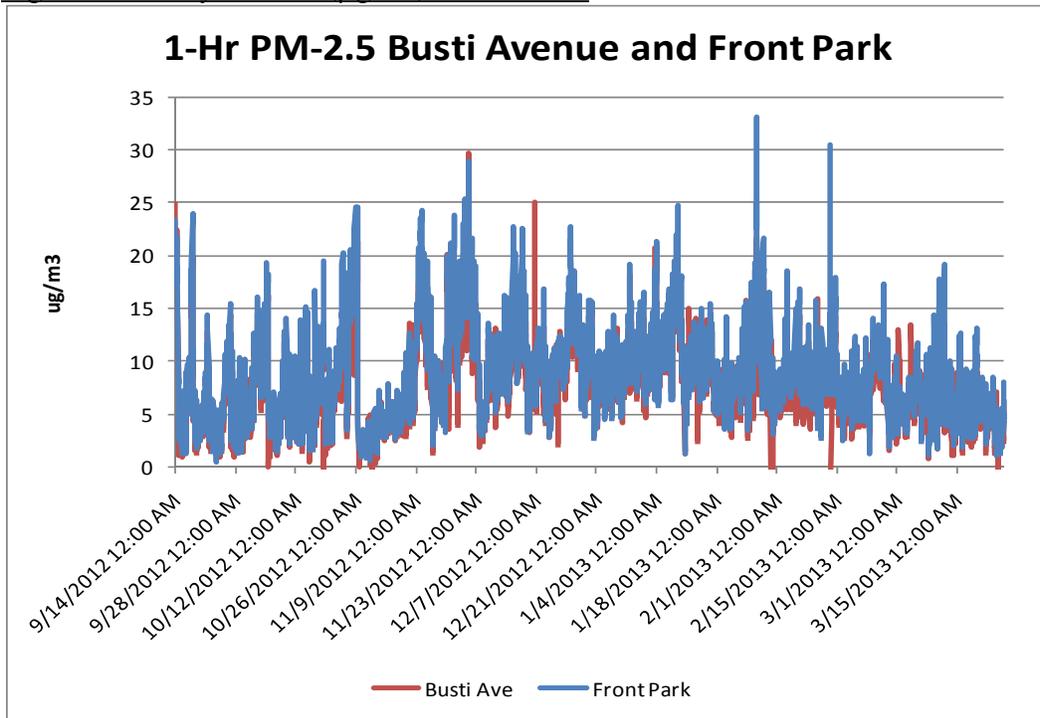
Table 2 presents a statistical data summary of 1-Hr PM-2.5 data at the Front Park (FP) and Busti Avenue (BA) sites for times when the wind directions were denoted as in-sector and out-sector. There were a few hours when the measured wind speed was zero (“calm” winds). The highlighting denotes those hours when the Busti meteorological tower indicated in-sector wind flow, that is, the times when the air quality is most likely to be impacted by the Plaza. In addition to examining the two sites individually, Table 2 also presents a summary of the differences in concentrations between the two sites ($\Delta = BA - FP$).

Table 2: 1-Hr PM-2.5 Data Summary ($\mu\text{g}/\text{m}^3$)

	10%	25%	median	75%	90%	N
In-sector FP	3.9	5.5	8	10.7	13.5	2100
Out-sector FP	3.5	5.6	8.4	11.5	15.9	2458
calm FP	8	11.1	13.9	18.5	25.1	18
In-sector BA	3.5	5	7.2	9.5	12.4	2111
Out-sector BA	3.2	5	7.5	10.2	13.6	2473
calm BA	6.7	8.4	11.2	16.5	20.7	18
In-sector Δ	-2.2	-1.4	-0.7	-0.2	0.3	2088
Out-sector Δ	-2.8	-1.7	-0.9	-0.3	0.3	2452
calm Δ	-5.6	-3.8	-2	-0.9	-0.4	18
Note: $\Delta = BA - FP$						

Figure 2 is a time series of 1-Hr PM-2.5 concentrations at the two Peace Bridge sites. There are a few hours in which the Busti Avenue site experiences higher PM-2.5, but for most hours the concentrations at Front Park exceed those at Busti Avenue.

Figure 2: Hourly PM-2.5 ($\mu\text{g}/\text{m}^3$) Time Series



1-Hr Black Carbon Data Summary

BC is a primary pollutant and originates from combustion sources including on and off road motor vehicles, residential and commercial space heating from both biomass and fuel oil, and other industrial processes. BC is one of many components of PM-2.5 and there are no air quality standards associated with BC. BC particles generally are small and can be transported significant distances. The long distance transport of BC particles is responsible for the strong regional nature of this pollutant. Locally generated BC can cause elevated near-source concentrations although these levels tend to disperse quickly. BC is likely to remain highest during meteorological stagnations when dispersion is limited.

Similarly to Table 2, Table 3 presents a statistical data summary of 1-Hr BC data at the two Peace Bridge sites for times when the wind directions were denoted as in-sector and out-sector. As with Table 2, calm winds are treated separately from in- and out-sector; the highlighting denotes those hours when the Busti Avenue meteorological tower indicated in-sector wind flow; and a summary of the differences in concentrations between the two sites is also shown.

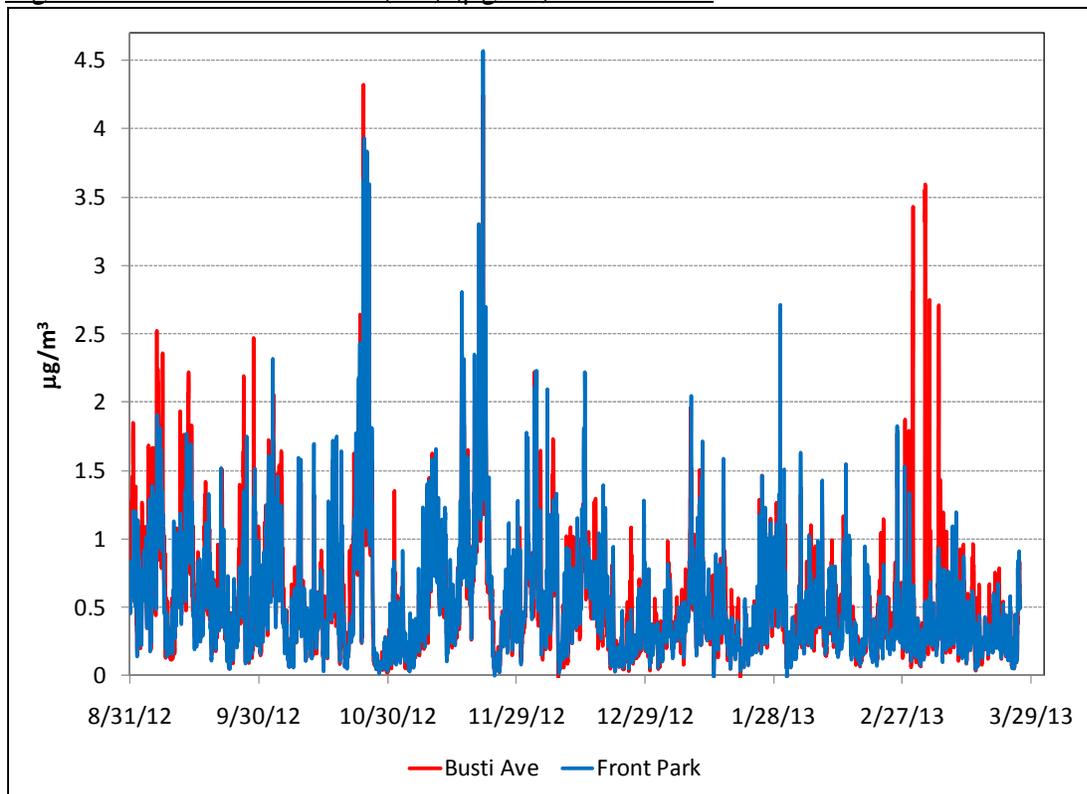
Table 3: 1-Hr Black Carbon (BC) Data Summary ($\mu\text{g}/\text{m}^3$)

	10%	25%	median	75%	90%	N
In-sector FP	0.143	0.218	0.336	0.528	0.772	2121
Out-sector FP	0.148	0.262	0.455	0.767	1.2	2489
calm FP	0.383	0.63	0.987	1.633	2.418	18
In-sector BA	0.159	0.247	0.397	0.625	0.931	2097
Out-sector BA	0.119	0.229	0.401	0.665	1.043	2480
calm BA	0.414	0.58	0.866	1.544	2.21	18
In-sector Δ	-0.078	-0.012	0.045	0.146	0.286	2096
Out-sector Δ	-0.25	-0.13	-0.048	-0.006	0.036	2476
calm Δ	-0.307	-0.238	-0.128	0.016	0.342	18

Note: $\Delta = \text{BA} - \text{FP}$

Figure 3 is a time series of 1-Hr BC concentrations at the two Peace Bridge sites. With few exceptions, there is good agreement between the two Peace Bridge monitors. One exception was the period in late February and early March when the data at Busti Avenue were elevated in comparison to Front Park. Several unoccupied residences were demolished and the debris removed. The work took place during the period from February 23 through March 8th. The elevated BC at Busti Avenue during this period can be seen in the Figure.

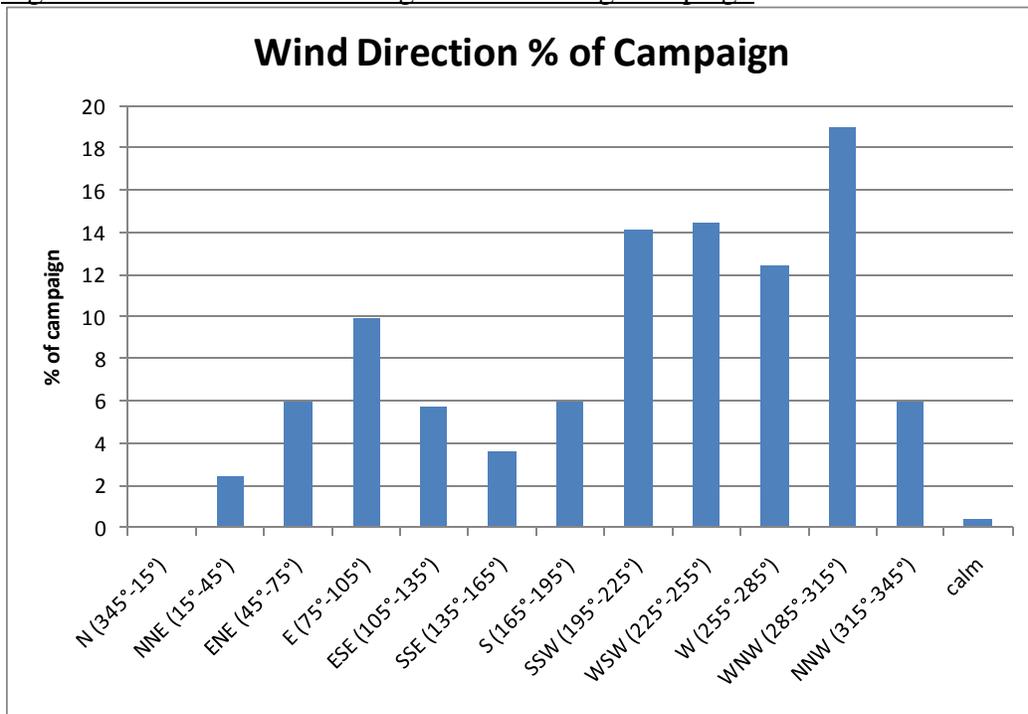
Figure 3: 1-Hr Black Carbon (BC) ($\mu\text{g}/\text{m}^3$) Time Series



1-Hr Meteorology Data Summary

The meteorological data were collected in order to provide an indication of the direction of transport of air pollution emanating from nearby sources as well as to indicate the significance of dispersion. Figure 4 shows the percentage time the wind emanated from a particular direction during the air monitoring period. Winds were predominantly from a westerly direction (SSW to WNW). The wind direction data were used to define the periods of time when the wind impacting the Busti Avenue site was passing over any portion of the Peace Bridge Plaza before arriving at the air monitoring location. This is necessary because even though Busti Avenue was established to be the downwind site, the data collected at this site can only be classified as downwind if the wind is coming from a direction that includes the aerial extent of the Peace Bridge Plaza. Appendix A shows the wind directions established as in-sector or impacted by the Plaza or out-sector not impacted by the Plaza. The data at Busti Avenue was classified as in-sector about 46% of the monitoring period, it was not impacted by the Plaza 54% of the time, and the winds were calm less than 1% of the time.

Figure 4: Wind Direction during the Monitoring Campaign



24-Hr Elemental Data Summary

The elemental data were obtained by analyzing the 24-Hr filters for elemental mass. The data can be used to help identify sources of PM-2.5. The concentrations are low and the averages below are presented in ng/m³. Some of the sources that may be qualitatively identified by their elemental composition include road salting operations, windblown soils, metal smelting and finishing, and fuel oil and motor vehicle emissions. The data from the two Peace Bridge sites are very similar and no specific source is impacting one of the two sites more significantly than the other. The elemental concentrations for both sites on average are generally lower than those from the DEC sites in Buffalo and Rochester.

Table 5: 24-Hr Elemental Data Average Concentrations (ng/m³)

Element	Symbol	Busti Ave	Front Park	Buffalo	Rochester
Silver	Ag	0.39	0.29	0.39	0.90
Aluminum	Al	3.39	4.04	15.59	6.91
Arsenic	As	0.50	0.55	0.87	0.48
Barium	Ba	0.00	0.01	0.98	0.50
Bromine	Br	2.83	2.91	3.68	2.80
Calcium	Ca	23.28	24.11	80.53	21.86
Cadmium	Cd	1.03	1.72	1.31	1.35
Cerium	Ce	0.00	0.00	0.18	0.09
Chlorine	Cl	8.96	11.46	53.65	18.08
Cobalt	Co	0.09	0.07	0.41	0.35
Chromium	Cr	1.05	1.49	1.74	2.95
Cesium	Cs	0.10	0.18	1.06	0.52
Copper	Cu	1.39	1.84	2.22	2.56
Iron	Fe	37.57	51.85	69.57	52.09
Indium	In	0.23	1.17	0.80	1.84
Potassium	K	33.47	32.73	50.15	34.87
Magnesium	Mg	2.07	1.83	7.54	2.96
Manganese	Mn	1.33	1.44	1.52	0.79
Sodium	Na	34.86	38.90	94.56	40.16
Nickel	Ni	0.43	0.61	0.21	0.50
Phosphorus	P	0.25	0.21	0.39	0.00
Lead	Pb	3.01	2.55	4.63	0.88
Rubidium	Rb	0.06	0.03	0.22	0.15
Sulfur	S	559.46	552.08	642.74	525.01
Antimony	Sb	3.72	3.14	1.55	6.10
Selenium	Se	0.44	0.34	0.25	0.29
Silicon	Si	35.21	34.72	61.72	28.40
Tin	Sn	1.50	0.97	2.59	3.73
Strontium	Sr	0.12	0.15	0.21	0.16
Titanium	Ti	1.75	1.60	2.04	0.99
Vanadium	V	0.21	0.25	0.67	0.30
Zinc	Zn	9.09	8.74	22.36	7.09
Zirconium	Zr	0.03	0.12	0.45	1.17

Peace Bridge Traffic Pattern Summary

Figure 5 shows the average daily pattern of passenger and light duty automobile traffic counts by day of week. The traffic crossing the Peace Bridge in either direction does not have the same daily pattern as traffic normally found in urban areas impacted by work day commuting where weekday vehicle counts are higher than on weekends. The bridge traffic does not have an early morning rush hour; for automobiles, the traffic increases in the morning and does not reach a maximum until late afternoon. The overnight hours have a very low automobile count and the weekends have the highest vehicle count.

Figure 6 shows the average diurnal pattern of truck traffic counts by day of week. For trucks, the vehicle count is low on the weekends, starts gradually on Monday, is very consistent from Tuesday through Thursday and tails off early on Friday afternoons. The highest vehicle count for trucks always occurs mid-afternoon on weekdays. The truck vehicle count is not as low as the automobile count during the overnight hours on weekdays.

Figure 5: Diurnal pattern of Peace Bridge passenger and light duty automobile traffic by day of week.

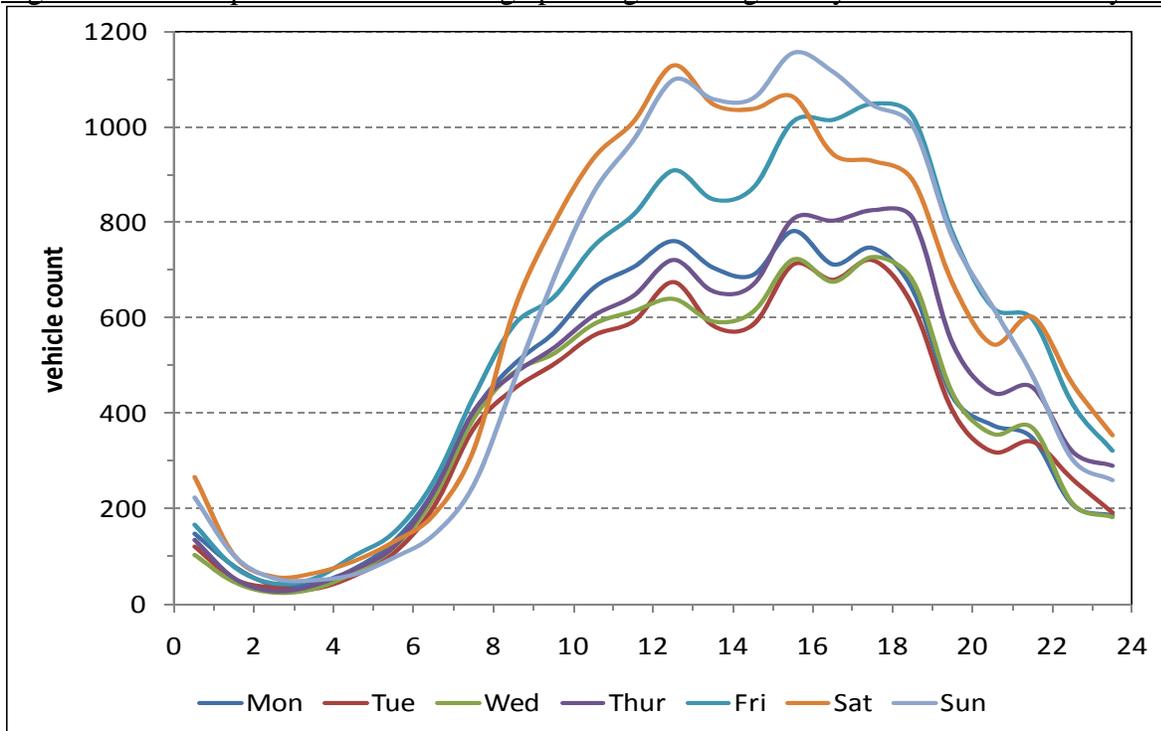
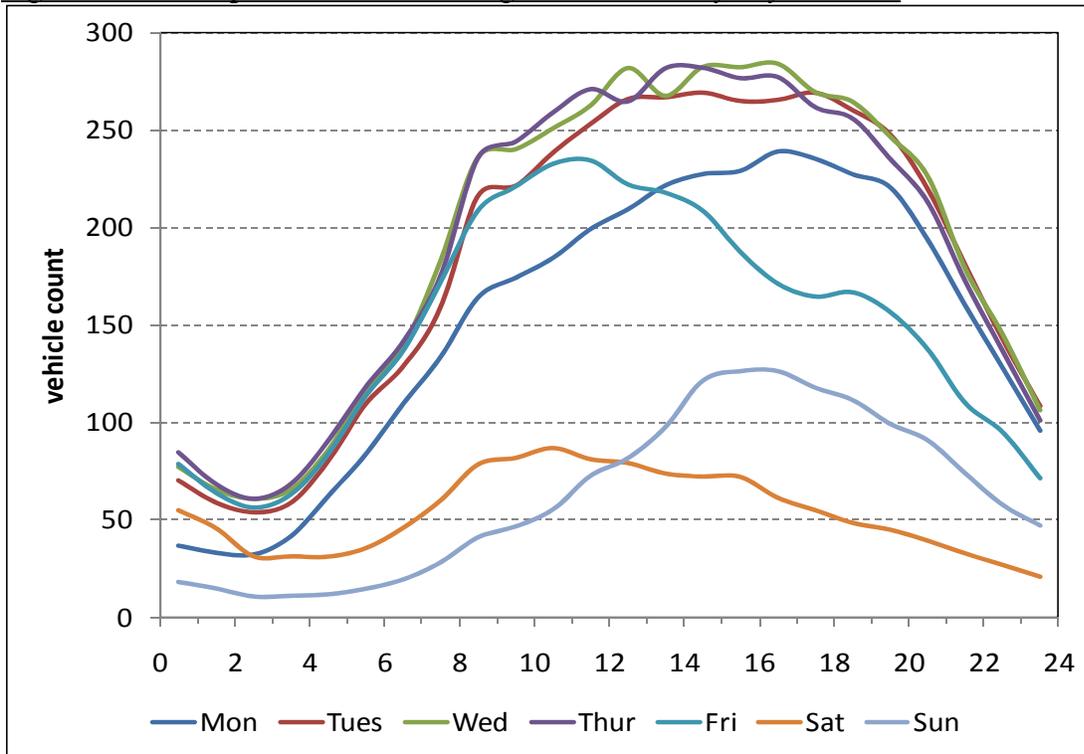


Figure 6: Diurnal pattern of Peace Bridge truck traffic by day of week.



Data Analysis Summary

The first phase of the monitoring program is complete and the air quality impact of the Peace Bridge Plaza has been assessed for the current configuration of the Plaza. The PM-2.5 levels were found to be well below the level of the NAAQS and very similar to the DEC's air monitors in the region. None of the data collected indicates that the air quality in the neighborhood surrounding the Peace Bridge Plaza is more impacted by mobile source emissions than other urban areas in the State.

The PM-2.5 concentrations in general were slightly higher at Front Park than they were at Busti Avenue. The BC concentrations were higher at Front Park during the morning rush hour on I-190 and then typically slightly higher in the afternoon at Busti Avenue when the truck traffic was highest. This finding is not surprising because I-190 is a significant source of motor vehicle emissions and Front Park is closer to the highway than Busti Avenue. I-190 has a higher traffic count than the Peace Bridge. Busti Avenue is also impacted by I-190 but the site is further down gradient from the highway so the mobile source emissions are slightly more dispersed and diluted at Busti Avenue.

The in-sector wind direction analysis showed that the PM-2.5 (Table 2) was higher at Front Park and BC (Table 3) was higher at Busti Avenue when all of the in-sector data were taken into account. Plot 7 shows the differences in BC between Busti Avenue and Front Park as a function of wind direction segment. When narrower wind direction segments are considered, BC was found to be higher at Busti Avenue when the wind was from the WSW. (Figure 7) The higher BC at Busti Avenue on weekday afternoons (Figure 8) correlates with the highest truck traffic counts on the Peace Bridge which also occurs mid afternoon on weekdays.

BC at Busti Avenue was also impacted by the demolition of nearby unoccupied residences and subsequent debris removal. This work occurred from February 23rd through March 8th. Plot 8 shows that BC is still slightly elevated in comparison to Front Park on weekday afternoons even if the data during the period of demolition and debris removal is not considered.

The increase in BC at Busti Avenue when the winds are from the WSW and during weekday afternoons is between 0.1 and 0.2 $\mu\text{g}/\text{m}^3$. This small difference equates to an increase of about 2% of the PM-2.5 when the wind is coming from the WSW and about 1% on weekday afternoons. The BC data show that there is some evidence of mobile source related BC impacting the neighborhood surrounding the Peace Bridge Plaza but the change in the BC concentration is too small to impact the PM-2.5 measured at the same site.

Figure 7 BC Difference = Busti Avenue – Front Park ($\mu\text{g}/\text{m}^3$)

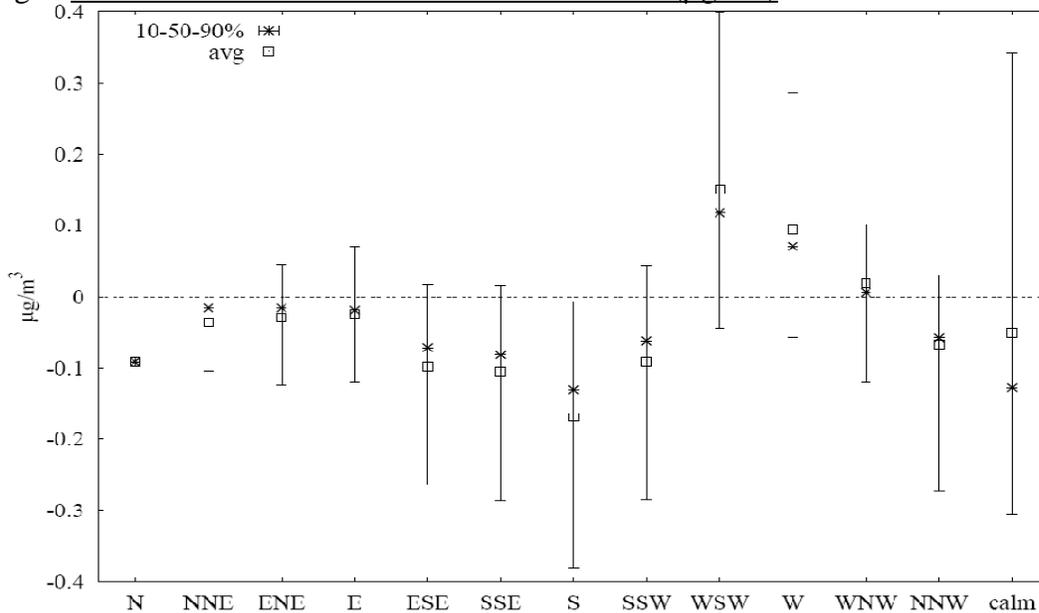
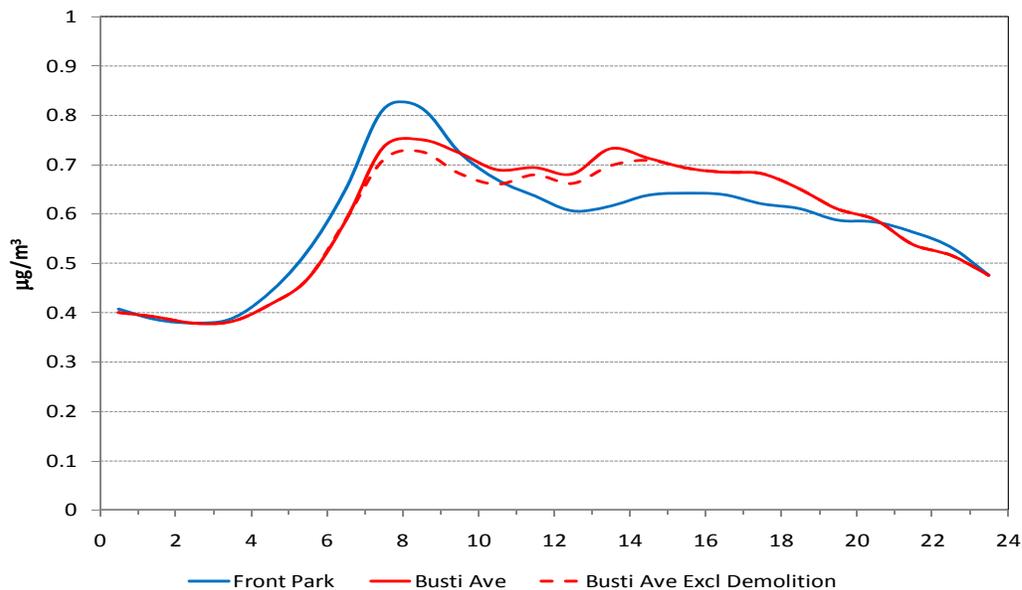


Figure 8 Mean diurnal Black Carbon (BC) $\mu\text{g}/\text{m}^3$ during weekdays (Mon-Fri). Busti Ave is shown with all data (solid line) and excluding the building demolition period (dashed line)

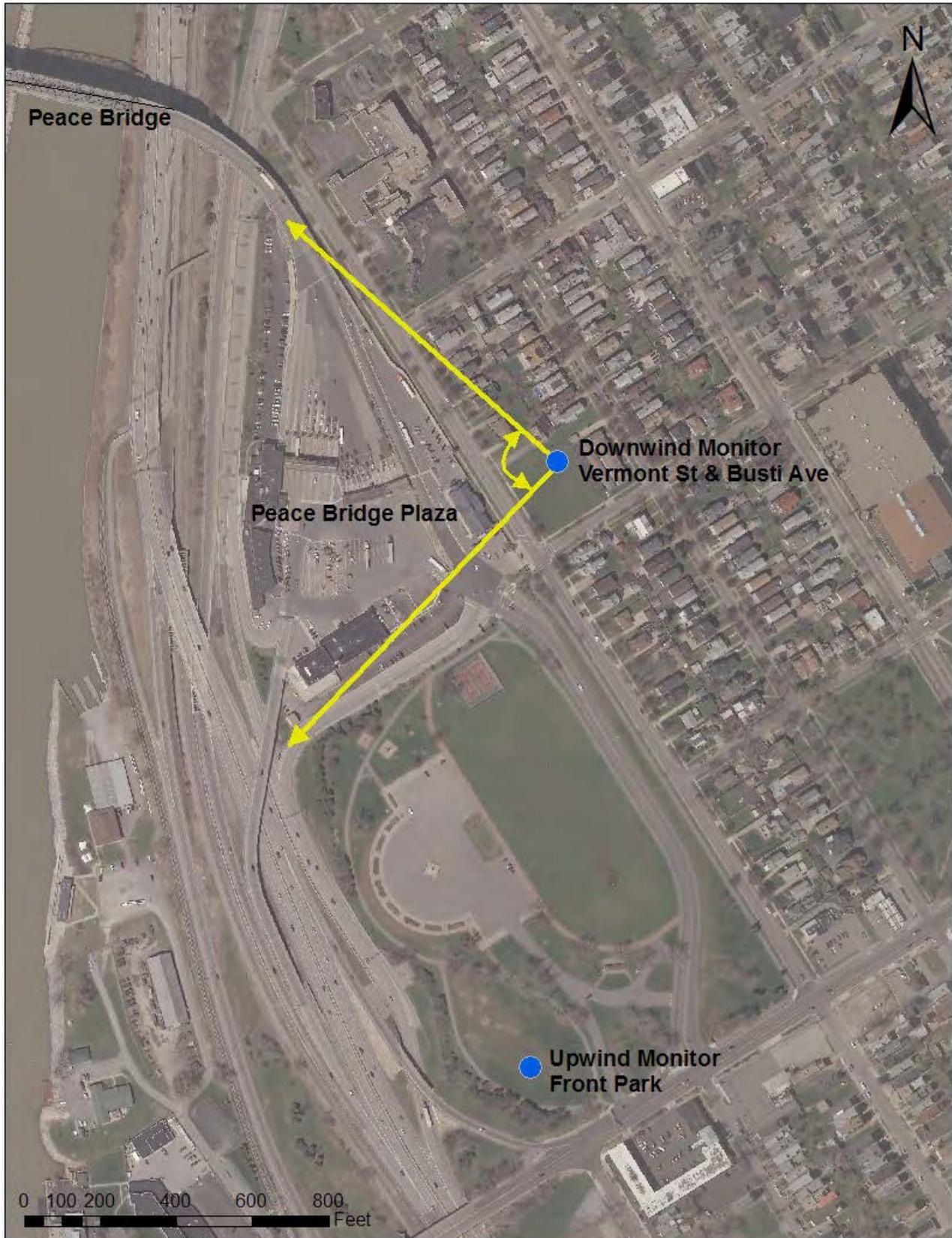


Conclusion

The monitoring program found acceptable air quality in the neighborhood downwind of the Peace Bridge Plaza for the parameters measured in this study. The results are consistent with air quality monitoring in the region. Slightly elevated BC was observed at the downwind site on weekday afternoons that is likely due to truck activity at the Plaza. The increase in BC concentration was too small to have a measureable impact on the PM-2.5 concentrations measured in the neighborhood.

The DEC chose pollutants for the study that included PM-2.5 which has an air quality standard and BC because it is a suitable tracer for local combustion sources. Other pollutants such as ultra fine particles and PAHs were not chosen for this study because they lack ambient air quality standards and because attributing their concentrations to specific source categories is not practical at this time. The DEC plans to utilize similar instrumentation and the same monitoring sites to perform the second phase of the monitoring campaign when the work at the Plaza is complete.

Appendix A: Layout of in-sector wind direction for Busti Avenue site



Appendix B: Previous Air Quality Monitoring Studies in the Peace Bridge Area

There have been two local or micro-scale air quality monitoring studies conducted in near proximity to the Peace Bridge Plaza on the U.S. side of the border. The basic study designs involved the operation of air monitoring sites in tandem with a local meteorological station to measure the incremental impact of motor vehicle emissions from the Peace Bridge and Peace Bridge Plaza on the nearby community known as Buffalo's lower Westside. This was accomplished by knowing the average or exact daily traffic counts crossing the bridge on the sampling days, which included an assessment of the hourly percentage of diesel trucks and gasoline powered vehicles in one of the studies.

The Buffalo and Fort Erie Public Bridge Authority (BFEPBA) together with the New York State Department of Transportation (NYSDOT) and the Federal Highway Administration (FHWA) commissioned short-term air quality monitoring studies in 2001 and 2002 for inclusion into the September 2007 draft environmental impact statement (DEIS) for the bridge expansion project.² The study was limited to monitoring particulate matter (PM-10 and PM-2.5) for 24 hours and conducting an elemental analysis of the PM filters to assess concentrations of metals, elemental carbon, organic carbon and elemental sulfur to determine the origin of the sources. These sampling campaigns were of a relatively short duration (14 to 16 days). The PM-10 measurements indicated there was a slight increase that was attributed to motor vehicle emissions from the U.S. Plaza. The PM-10 sampling event was disrupted by the September 11, 2001 World Trade Center (WTC) attack which caused a significant downturn of traffic traversing the bridge, but resulted in some very interesting observations. The PM-10 sampling prior to the WTC event indicated that the average incremental PM-10 impact from the U.S. Plaza on the lower Westside community was 2.2 $\mu\text{g}/\text{m}^3$. The PM-10 sampling during the post WTC event indicated the average incremental PM-10 impact from the U.S. Plaza on the lower Westside community was 8.8 $\mu\text{g}/\text{m}^3$. The investigators attributed the large increase in the average incremental PM-10 contribution from the U.S. Plaza was due to the long traffic back-ups, even though the average daily traffic count was down by 12,200 vehicles when the samples were collected. In March-April 2002, the air quality study was conducted again and the average incremental PM-10 impact from the U.S. Plaza on the lower Westside community was 8.9 $\mu\text{g}/\text{m}^3$. The average daily traffic count increased by 3,911 vehicles per day from the post WTC event sampling period. These average incremental PM-10 values were a small percentage of the total average PM-10 daily measurements which ranged from 31 to 33 $\mu\text{g}/\text{m}^3$ downwind from the U.S. Plaza.

The PM-2.5 measurements indicated there was a slight increase that was attributable to motor vehicle emissions from the U.S. Plaza. The average incremental PM-2.5 impact from the U.S. Plaza on the lower Westside community was 4.8 $\mu\text{g}/\text{m}^3$. The average PM-2.5 daily downwind measurement was 15.2 $\mu\text{g}/\text{m}^3$. All of the sampling conducted for PM-10 and PM-2.5 at any of the monitoring locations were below their respective NAAQS.

The elemental analysis conducted on the particulate filters was largely inconclusive. However, the elemental carbon analysis indicated that the contribution of U.S. plaza emissions slightly increased PM-10 concentration at downwind locations in the Westside community and was likely vehicle related.

The Health Effects Institute (HEI) released a study in 2011 entitled "Air Toxics Exposure From Vehicle

²Buffalo and Fort Erie Public Bridge Authority (2007). Peace Bridge Expansion Project , Draft Design Report, Draft Environmental Impact Statement, Draft Section 4(f) Evaluation, Draft Section 6(f) Evaluation, Appendix A – Air Quality Analysis (US)

Emissions at a U.S. Border Crossing: Buffalo Peace Bridge.”³ This study was conducted over a couple of weeks in 2005 and 2006. The scope of this study was more comprehensive than the commissioned DEIS study described above. It involved air quality monitoring at fixed site locations in the Westside community around the Peace Bridge and U.S. Plaza. Monitoring was conducted for more than one hundred individual chemicals including particulate matter (ultrafine PM, PM-2.5 and PM-10), elemental composition of PM, volatile organic compounds (VOCs), nitrogen based polycyclic aromatic hydrocarbons (NPAHs) and polycyclic aromatic hydrocarbons (PAHs) over various time periods. The sampling campaigns were of short durations, one week in January of 2005, two weeks in July 2005 and two weeks in January 2006. In addition, backpacks equipped with samplers (mobile monitoring) to measure ultra-fine particles (UFP) and particle bound PAHs were worn by volunteers as they traversed the streets of the impacted Westside community.

The PM sampling at the fixed sites can be compared to the results from the DEIS study while accounting for some specific limitations, which include sampling time and sampling methods. The fixed site samplers were operated for 12 hours per day during the peak traffic count times (7:00 AM until 7:00 PM) during the weekdays. The pooled PM-10 samples indicated the average incremental PM-10 impact from the U.S. Plaza on the lower Westside community was $4.7 \mu\text{g}/\text{m}^3$. The pooled PM-2.5 sampling indicated the average incremental PM_{2.5} impact from the U.S. Plaza on the lower Westside community was $2.3 \mu\text{g}/\text{m}^3$. The incremental increase in PM-2.5 was attributed to the elemental carbon fraction from vehicle traffic. These values are 47% and 52% lower than the average PM-10 and PM-2.5 incremental contributions in the community measured during the DEIS study in 2001 and 2002. Sampling time (12 vs 24 hours) may account for some of these observed reductions or it could be related to improvements in traffic flow and the reduction of standing traffic at the U.S. Plaza since the toll booth was relocated to the Canadian side of the border in Spring of 2005. PM and elemental carbon were also measured in the evening hours during times of lower traffic counts and showed much lower levels.

The VOC analysis clearly showed that motor vehicles were the dominant source of air toxics at the fixed sampling sites in the Westside community. The ratios of benzene, toluene, xylenes and 1,3-butadiene exhibited a clear vehicle emission fingerprint. The elemental analysis of the PM-2.5 filters indicated that calcium, chromium, manganese, iron, copper and antimony were elevated at the fixed monitoring site closest to the U.S. Plaza. The emissions were attributed to road dust resuspension, tire and break wear and vehicle exhaust. The mobile monitoring effort identified elevated concentrations of UFPs in the area around the U.S. Plaza and community roadways. This finding is not inconsistent with other studies that have demonstrated elevated UFPs within 50 meters along roadways that are associated with vehicle emissions.

In summary, the HEI study provides good information that can serve as a baseline assessment of motor vehicle air toxics in the Westside community. This information can be used to assess air quality benefits that are predicted to occur as a result of improvements to the traffic flow over the bridge with the proposed traffic-pattern modifications, and the regulatory requirements that are gradually being phased in for gasoline and diesel powered vehicles overtime.

³ Spengler J, Lwebuga-Mukasa J, Vallarino J, Melly S, Chillrud S, Baker J, and T Minegishi (2011). Air Toxics Exposure From Vehicle Emissions at a U.S. Border Crossing: Buffalo Peace Bridge. Health Effects Institute Research Report Number 158. Boston, Massachusetts.

Appendix C: Regulations for the Reduction of Air Pollution from Mobile Sources

The control of air pollution from motor vehicles is extremely important in order to improve air quality and protect public health. This was recognized by Congress when they amended the 1990 Clean Air Act (CAA) and included provisions to reduce emissions of all air pollutants from motor vehicles. The 1990 CAA empowered the U.S. Environmental Protection Agency (EPA) to develop regulations that would require the development of fuels that would burn cleaner and would mandate new technology to reduce emissions of criteria air pollutants and hazardous air pollutants from all motor vehicles (cars, trucks and buses). This two-fold approach has significantly reduced air pollution from motor vehicles, even as the number of vehicles and vehicle miles traveled have increased over the past twenty-two years. The control of air pollution from motor vehicles has been an extremely important part of the EPA's and DEC's strategy to meet the health based national ambient air quality standards and to reduce ambient concentrations of hazardous air pollutants in urban areas. State and Federal air pollution officials are confident that these efforts will lead to improved air quality and the enhancement of public health for all Americans.

There are three general areas of regulatory focus in the national strategy to reduce air pollution from motor vehicles: clean cars and fuels, clean trucks and buses and diesel fuels, and the establishment of certification and compliance programs.⁴ The Tier 2 vehicle and gasoline sulfur program was phased in beginning in 2004 and was fully implemented by 2009. This program has made gasoline powered vehicles 77 to 95% cleaner than the 2003 model year. The heavy-duty engine and vehicle standards and highway diesel fuel sulfur control requirements were phased in beginning in 2007 and will be fully implemented in 2030. This program will result in each new truck and bus being more than 90 percent cleaner than pre-2007 models. This regulation will provide annual emission reductions equivalent to removing the pollution from more than 90 percent of today's trucks and buses, or about 13 million trucks and buses. The motor vehicle certification and compliance programs will ensure that all vehicles are designed to meet new emission standards and they will continue to meet those standards throughout their useful life.

All of these motor vehicle air pollution regulations are already being phased in and were specifically developed to improve air quality in urban areas that are heavily impacted by motor vehicles. We expect these regulations, in tandem with the overall vehicle congestion relief that will be achieved with the upgrade of the Peace Bridge Buffalo Plaza, will result in improved overall air quality in the local community.

⁴United States Environmental Protection Agency (USEPA). 2005. Toward a Cleaner Future: Office of Transportation and Air Quality Progress Report 2005. Available On-Line: <http://www.epa.gov/otaq/about/420r05011.pdf>